MEMORANDUM

From: Fred Towne, Planning Division Manager

To: Mayor and City Council

Date: January 28, 2009

Subject: Written Testimony - Brooklane Heights, LUBA Remand (PLD06-00018, SUB06-00006)

On January 21, 2009, City Council closed the Brooklane Heights public hearing, and held the written record open for seven days to provide opportunity for citizens to submit additional written testimony. The applicants waived their right to respond to the additional written testimony. This memorandum includes written testimony received between the close of the public hearing on January 20, 2009, and January 27, 2009, at 5:00 PM, when the written record was closed. A hard copy of this memorandum and enclosed testimony is available in the reference section of the Corvallis-Benton County Public Library, which is located at 645 NW Monroe Avenue, Corvallis. This memorandum and enclosures is also available online as part of the February 2, 2009, City Council packet, at:
http://www.ci.corvallis.or.us/index.php?option=com_content&task=view&id=2133&Itemid=2858

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Tuesday, January 20, 2009 6:47 PM
To: Richardson, Robert
Cc: Extrom, Joan
Subject: Brooklane Heights Testimony

Attachments: Testimony on Remand.pdf; Appendix_1.pdf; Appendix_2.pdf; Appendix_3.pdf; Appendix_4.pdf

Testimony on Remand.pdf (318 K.. | Appendix_1.pdf (362 KB) | Appendix_2.pdf (846 KB) | Appendix_3.pdf (5 MB) | Appendix_4.pdf (182 KB)

Hi Bob,

Please add my testimony with attachments to the record for Brooklane Heights.

If at all possible, I would like the files to be added directly to the PDF file generated for the case -- rather than printed and scanned -- because that process decreases the resolution of the documents. I would also like the appendices to appear in order after my testimony.

Thank you.

Mark

Date: January 20, 2009
From: Mark Knapp
To: Corvallis City Council
Subject: Brooklane Heights (PLD06-00018, SUB06-00006)

I urge you to deny the development application and uphold the appeal by the LUBA petitioners and South Hill neighbors. This testimony discusses several ways in which the proposed development fails to comply with the Comprehensive Plan and applicable sections of the Land Development Code.

> "When natural systems are altered, they may not recover or return to their original state and ecological function. We do not yet understand the complex interactions between natural systems, or the cumulative impacts of changes on such systems."
>
> – Corvallis Comprehensive Plan, *Finding 4.2.c*

1. Water Quality

The proposed land development application fails to comply with Comprehensive Plan Policy 4.11.12 – because it fails to ensure that pre-development water quality would be preserved after drastic changes are made to the hydrology of the hillside.

A. Detention Ponds

Peer-reviewed research by Derek Booth and Rhett Jackson demonstrates that detention ponds often fail to provide adequate mitigation to protect water quality.[1] Their article in the Journal of the American Water Resources Association explains in detail the inadequacy of detention ponds that attempt to mitigate the runoff from post-development constructed and compacted impervious surfaces.

> "Stormwater detention is a particularly widespread application that promises substantive improvements, but all-too-often it fails to achieve even the most limited of objectives.
>
> Modifications of the land surface during urbanization produce changes in both the type and the magnitude of runoff processes. These changes result from vegetation clearing, soil compaction, ditching and draining, and finally covering the land surface with impervious roofs and roads. The infiltration capacity of these covered areas is lowered to zero, **and much of the remaining soil-covered area is trampled to a near-impervious state.** Compacted, stripped,

[1] Booth, Derek B. and Jackson, Rhett, *Urbanization of Aquatic Systems: Degradation Thresholds, Stormwater Detection, and the Limits of Mitigation,* **Journal of the American Water Resources Association,** Vol. 33, No. 5, October 1997, pp. 1077-1090.

> or paved-over soil also has lower storage volumes, and so even if precipitation can infiltrate, the soil reaches surface saturation more rapidly and more frequently. Thus *Horton overland flow* or *saturation overland flow* (Dunne and Leopold, 1978) is introduced into areas that formerly may have generated runoff only by subsurface flow processes, particularly in humid areas of generally low-intensity rainfall such as the Pacific Northwest."
>
> – Booth and Jackson, pp. 1077-1078

The geotechnical investigation by Foundation Engineering (May 20, 2008) identified the same subsurface flow on page 6 of their report:

> "The observed iron-staining of the surficial soils suggests that rainfall perches within a few feet of the ground surface during the wet portion of the year. It is difficult to predict where seepage may be encountered during construction. However, ground water infiltration should be anticipated in deep cuts and excavations."

When topsoil is bulldozed and replaced by concrete, asphalt, and compacted clay, the ***surficial aquifer*** is eliminated from the hillside. This subsurface water storage is critical for the healthy hydration of downhill vegetation during the dry season in Corvallis.

Furthermore, the replacement of *subsurface* flow with *overland* flow greatly increases the sediment loading of hillside runoff – thereby creating negative impacts to the wetland and the Marys River.

> "Changes in upland runoff processes, particularly from a predominantly *subsurface* flow regime to a predominantly *surface* flow regime, alter not only the magnitude of discharges but also the delivery of sediment to the stream network. With overland flow, fine sediment is moved into channels throughout the year; when coupled with land-cover changes, the sediment load can increase by many orders of magnitude (Wolman and Schick, 1967) and **the predominant grain-size distribution can shift to much finer fractions.** Such increases in the delivery of fine sediments significantly alters the sediment size distribution of gravel bed streams (e.g., Caning, 1984; Jobson and Carey, 1989), **with attendant changes in stream ecology** (recognized as early as Ellis, 1936; also Hawkins et al., 1982; Culp et al., 1986; Chapman, 1988; Naiman et al., 1992; Weaver and Garman, 1994)."
>
> – Booth and Jackson, pp. 1078-1080

Fine sediments are more likely than coarse sediments to remain suspended in flowing water, thereby increasing the ***turbidity*** in pools, ponds, streams and rivers. Fine sediments clog the gills of fish and amphibians, increasing mortality and decreasing reproductive capacity. Fine sediment loading is a major impediment to the restoration of wetland and stream ecology. But such restoration is exactly what the City of Corvallis and many of its citizens are trying to do in the Marys River Natural Area (as noted below). So the proposed development would be a significant detriment to the public interest.

> "At the end of this causal chain of upland, riparian, and channel changes lies the degradation of in-stream biological function that so often motivates rehabilitation efforts (Karr, 1996). In the Pacific Northwest, many of these efforts are focused on enhancing populations of anadromous salmon in lowland streams. These fish depend on a particular combination of water and sediment fluxes to maintain favorable channel conditions. Because land-use change in a watershed alters those fluxes, the resulting flow regime and channel configuration no longer tend to favor salmonids (Booth and Fuerstenberg, 1994), and thus most rehabilitation efforts that address only the in-stream symptoms of these watershed changes are unlikely to succeed (Roper et al., 1997)."
>
> – Booth and Jackson, p. 1080

The primary problem with detention ponds – including those proposed by the Applicant – is that they typically only mitigate peaks flows, while not mitigating the ***volume*** of post-development. This distinction is critical, as Booth and Jackson explained:

> "R/D ponds can achieve either of two levels of design performance, depending on the desired balance between achieving downstream protection and the cost of that protection. A ***peak standard***, the classic (and least costly) goal of R/D facilities, seeks to maintain post-development peak discharges at their pre-development levels. Even if this goal is achieved successfully, however, the aggregate duration that such flows occupy the channel must increase because the overall volume of runoff is greater.
>
> In contrast, a ***duration standard*** seeks to maintain the post-development duration of all sediment-transporting discharges at pre-development levels. Duration standards are motivated by a desire to avoid potential disruption to the conveying channel itself by not allowing increased sediment transport. Without infiltration of runoff, however, the total volume of runoff increases in the post-development condition, and so durations cannot be matched for all discharges; at some level the 'excess' water must be released. This is accomplished by determining a **threshold discharge below which sediment transport in the receiving channel does not occur.** This determination can be made by site-specific, but rather expensive, analysis based on stream hydraulics and sediment size (Buffington and Montgomery, 1997) or can be applied as a 'generic' standard based on pre-development discharges."
>
> – Booth and Jackson, pp. 1084-1085

Another critical issue with stormwater detention is the size of the detention pond itself.

> "The volume of a detention pond is its single most important design characteristic. From a hydrologic perspective, that volume determines the time-integrated difference between inflow and outflow and so imposes an absolute limit on net hydrologic performance. It is also the single most expensive element of pond design and construction, because pond volume is directly related to pond area and thus cost, incurred in both construction and lost developable land."
>
> – Booth and Jackson, p. 1085

But none of the geotechnical investigations performed by Foundation Engineering and submitted by the Applicant even ***mentions*** the size of the proposed detention ponds. Neither does the Applicant's original narrative nor the memo from Metolius Consulting (November 24, 2008) discuss the hydrologic performance of the proposed detention ponds in any significant detail, other than the Applicant's statement, "Water quality will be designed in accordance with the King County Surface Water Design Manual." Fortunately, we do at least know that the "approximate" storage volume of the detention ponds would be 36,000 cubic feet. Rec. 587.

The evidence in the record also fails to mention the ***area*** that would be drained into the proposed detention ponds in the center of the site. A conservative estimate would be at least one-third of the site, or 8.6 acres, which equals 376,000 square feet.

> "To facilitate comparison, all detention-pond designs here are expressed in terms of a live-storage volume per unit area of developed land draining to the facility. This normalized measure of volume is thus, paradoxically, in units of ***depth*** and is equal to the volume of the pond as though it were evenly spread out over the area of the development. Typical unit-area volumes are expressed in cm-hectares per hectare (metric) or inch-acres per acre (English), and so the simplified units are simply 'centimeters' or 'inches' of net pond volume."
>
> – Booth and Jackson, p. 1085

So the proposed detention ponds would have a functional "depth" of no more than 1.15 inches, which is ***2.9 centimeters***. Research using the King County Runoff Time Series program puts that estimated depth in perspective.

> "Effective runoff mitigation in the Pacific Northwest appears to require pond volumes from ***3 to as much as 14 centimeters*** (Figure 6). With associated berms, control structures, and maintenance access roads such a facility may occupy more than 10 percent of the gross area of a development."
>
> – Booth and Jackson, p. 1087

Therefore, it seems unlikely that the proposed detention ponds would be large enough to mitigate stormwater runoff from increased impervious surfaces, and thereby comply with the Corvallis Comprehensive Plan. Given the steep slopes and shallow soils on the hillside of the proposed development site, the size of a successful detention pond would be at least in the middle of the range indicated by hydrologic research, not just below the bottom of the range – or even less.

For the proposed development, much of the post-development runoff would be conveyed through a natural drainage in the center of the property. The Applicant has provided no evidence that would lead a reasonable person to conclude that the very two small detention ponds proposed for only one of the two identified drainages could ***ever*** maintain sediment transport at the same level as before development. The Applicant has provided no site-specific data about the critical ***threshold discharge rate*** for sediment transport from the hillside of Brooklane Heights into the downstream wetland.

One can reasonably expect significant increases in sediment transport, because the Applicant has proposed to only mitigate the peak of stormwater discharges, and not the volume.

Another problem with the use of detention ponds in the proposed development is that the steep slope of the hillside impairs their function. On page 18 of the Metolius Memo, the Applicant concedes that detention ponds are inadequate to meet the applicable land use criteria on steep slopes:

> "For fairly flat sites that have less than 5% slopes, at-grade bioswales and similar water quality treatment facilities are appropriate. In contrast, steep sites with slopes greater than 5% are not conducive to typical 'open-swale' type water quality facilities because the runoff moves too rapidly and suspended solids are not able to settle out of the flow."

The City Memo from the Community Development Director (December 24, 2008) acknowledges the same on page 34:

> "However, the slopes associated with this site are too steep to feasibly implement the King County Facilities."

Furthermore, the proposed development would provide ***no detention*** for the remaining hillside runoff – including the West Drainage and runoff from the eastern side of the site, where concerns about unrestricted sheet flow were raised in previous testimony.

As indicated on page 17 of the Metolius Memo, the Applicant's position seems to be that compliance with recommendations of the City's Stormwater Master Plan – which are unexplained or even submitted as evidence for public review – is somehow a guarantee of compliance with all land use requirements related to hydrology.

The City's Stormwater Master Plan is based on standards developed in King County, Washington. But the University of Washington research (shown above) refuting the Applicant's assurances is ***also*** based on standards developed in King County. Compliance with the applicable criteria requires site-specific evidence and a reasoned argument, but the Applicant has provided neither.

B. Filtration Devices

The Metolius Memo introduces a Major Modification to the development proposal (as defined by LDC 2.5.60.02.a.14). The Applicant's shifting position with regard to natural features protection has now settled upon a device from BaySaver Technologies Inc. to achieve compliance with the Corvallis Comprehensive Plan. But the device is largely experimental, and the Applicant fails to provide sufficient evidence that it will ensure compliance.

The City and the Applicant take the position that adherence to a ***recommendation*** from an obscure 1999 Technical Memorandum tucked away in Appendix F to the Stormwater

Master Plan qualifies as compliance with Comprehensive Plan Policy 4.11.12. Most of the memorandum (including the portion cited on pages 22-23 of the December 24, 2008 Report to the City Council) offers proposed changes to the *Design Criteria Manual for Public Improvements* – a document that appears to ***no longer exist*** or to be at least no longer used.

Even if a recommendation for the removal of total suspended solids ***were*** an applicable criterion for a land use application, the Applicant fails to explain how such a theoretical achievement would ***also*** create compliance with the criteria identified in the LUBA Remand. The recommendation may be clear and objective on its face, but it is also somewhat random, because the Applicant has failed to establish a baseline to which the reduction of suspended solids would apply, thereby establishing the significance of the achievement.

A hypothetical example illustrates the point. If increased impervious surfaces were to create 4 times more suspended sediment, and even if the BaySeparator removed 70% of that sediment, then the post-development wetland would ***still*** receive more sediment loading than it did before development. In such a scenario, it is clear that one could not reasonably (or objectively) claim that upslope development had "minimized detrimental changes in water quality for waters discharging to wetlands" – regardless of whether the "TSS standard" had been met.

The Applicant still has no actual data to support claims of compliance with the Corvallis Comprehensive Plan.

Furthermore, the performance of the device in question has not been sufficiently proven for regulatory compliance. The experimental nature of "hydrodynamic separation" is confirmed by its exclusion from the *King County Surface Water Design Manual* (KCSWDM), as acknowledged on page 34 of the City Memo:

> "The use of manhole based water quality facilities is typically not allowed through the King County standards."

So on one hand, the City points to the King County standards to validate its stormwater regulations and land use decisions, but then it grants a waiver to those standards without site-specific evidence or a reasoned argument for ***why*** such an exception is justified.

Section 6.5.1 of the KCSWDM contains design criteria for media filtration facilities:

> "Filtration facilities are particularly susceptible to clogging. Presettling must therefore be provided before stormwater enters a filtration facility. The presettling treatment goal is to remove 50 percent of the total suspended solids (TSS)."

Given the problems with the proposed detention ponds (discussed above), and given the absence of runoff detention on the remainder of the site, the Applicant has failed to

provide evidence that the BaySeparator would be accompanied by adequate presettling treatment.

Another problem with the BaySeparator system is stated on page 68 of the product description:

> "As expected, the function indicates that the BaySeparator system's sediment removal efficiency increases as the flow rate through the system decreases."

In other words, as stormwater events increase in magnitude and increase the rate of sediment transport, the efficiency of the Applicant's proposed mitigation would decrease.

C. Major Modification

The Applicant's addition of hydrodynamic separators to his development proposal constitutes a Major Modification. Therefore, the citizens of Corvallis are entitled to a *de novo* hearing, rather than a hearing limited to issues remanded by the Land Use Board of Appeals.

The City has clear and objective standards in its 2006 Land Development Code that identify the "Thresholds that Separate a Minor Planned Development Modification from a Major Planned Development Modification." Among those thresholds is the following:

> **LDC 2.5.60.02.a.14**
>
> "Change to any aspects of the Plan involving Natural Resources and/or Natural Hazards governed by Chapter 4.5 - Natural Hazards and Hillsides ..."

The City might argue that LDC 2.5.60.02 (2006) is not an applicable criterion for the Brooklane Heights development proposal. As a general proposition, it is true that the 2006 LDC is inapplicable. But the placement of Condition 27 on the application made LDC 4.5 (2006) an applicable criterion in particular, and therefore, LDC 2.5.60.02.a.14 (2006) becomes applicable by extension.

In other words, if the City allows the Applicant to achieve compliance with the Comprehensive Plan by applying its new Natural Resources codes, then it would defy reason to allow a major change to the development proposal ***with regard to natural resources*** without truthfully identifying the change as what it is – a Major Modification.

2. Wildlife Habitat

Increased sediment transport by stormwater runoff threatens the downstream wetland to the south of Brooklane Drive. This wetland is part of the Marys River Natural Area, which has been the site of restoration activity by multiple organizations and volunteers.

Excessive sediment transport is a common means by which wetlands become degraded and lose some of their ecological function. One of those primary functions is water quality maintenance for rivers and streams. When the wetland filter becomes essentially clogged, sediment becomes free to bypass the filter – carried through erosion channels or carried across the wetland by overland flow.

This cascading scenario, therefore, threatens to increase the sediment loading of the Marys River, which is also the target of restoration efforts.

A. Salmon

The City of Corvallis launched a program in the summer of 2000 to restore salmon habitat, as part of its effort to comply with federal requirements for conservation of species listed under the Endangered Species Act. The program culminated with the publication of the ***City of Corvallis Salmon Response Plan*** on August 20, 2004.

> "The plan was to comply with the protection regulations surrounding the listing of Upper Willamette River Spring-run chinook salmon as a threatened species under the Endangered Species Act (ESA) in March 1999 (Federal Register, Vol. 64, No. 56, page 14308-14328, March 24, 1999).... The purpose of the Salmon Response Plan project as to identify activities (both City of Corvallis sponsored as well as Corvallis citizen behaviors) that negatively impact chinook salmon habitat in Corvallis and develop a plan to, at a minimum, prevent further degradation."
>
> – Corvallis Salmon Response Plan, Executive Summary, p. 1

As shown in Figure 3 of the Plan, portions of the Marys River directly downstream from the proposed Brooklane Heights development were part of the evaluated area for the restoration of chinook salmon habitat. The rationale for the restoration was clearly stated:

> "The City has embarked upon this effort for two reasons. First, the City administration (elected officials) and its residents believe they have a responsibility to help maintain the natural environment processes critical to the environmental health and quality of life in the Willamette River Valley and state of Oregon.... Participation in the preservation of chinook salmon habitat is consistent with the City's position and ethic to take actions that contributed to overall environmental and community health.
>
> Second, the City administration has a **fiduciary responsibility to its residents** to protect their interests through responsible decision-making and actions. Such

> decisions apply to the ESA listing of chinook salmon where the City has compared the costs and benefits of complying with federal rules and the protections that compliance offers to the potential risks, liabilities and costs of non-compliance. The City has determined that compliance with the federal rules governing chinook salmon habitat, specifically the ESA Section 4(d) Rules, to be [sic] more beneficial than potentially costly third-party law suits challenging the City to demonstrate compliance with these federal rules."
>
> – Corvallis Salmon Response Plan, p. 4

The Salmon Response Plan found that the greatest impacts to salmon habitat come from impervious surfaces, primarily from the construction of buildings, streets and parking lots. The implementation of revised land use development standards was a principal solution offered by the plan. The City cited most of the natural features protections of its Comprehensive Plan as positive factors for the achievement of habitat restoration. (See attached.)

B. Trees

According to the Metolius Memo, the proposed development would preserve 420 of the "454 significant trees currently on the property, of which 98% are white oaks." The memo by Ken Gibb to the City Council on August 10, 2007 stated (on page 2) that the number of preserved significant trees would be 396, which are 24 fewer.

The Applicant's argument is that not cutting down trees is synonymous with preserving them. The premise of that argument is that the Applicant's other activities on the site will not lead to the destruction of many oak trees. But as shown above, there is insufficient evidence to support the premise, because the Applicant's project threatens to severely disrupt the hydrology of the hillside, upon which the oak trees are dependent for survival. Neither the Metolius Memo nor the City Memo (December 24, 2008) addresses the damage to trees by changes in hillside hydrology.

LDC 4.5.60.01.b requires the protection of environmental resources "by ensuring that development does not create soil erosion, sedimentation of lower slopes ... [or] severe cutting or scarring." But the Applicant's housing project would cause those outcomes.

3. Hillside Stability

A. Geotechnical Investigation

LDC 4.5.60.04.b requires a professional evaluation of slope stability that "shall be complete and stamped by either a Certified Engineer Geologist or by a Licensed Civil Engineer, licensed in the Specialty of Geotechnical Engineering."

The Applicant provided a ***draft*** geotechnical investigation (dated May 20, 2008) that is ***not*** complete and stamped in accordance with the code requirement.

The Metolius Response (on page 13) states that a site assessment "shall be completed" in the future, but this promise would not provide the public with an ability to comment on the version of the site assessment that is actually complete and stamped. The Applicant's deferral of the certification would be a violation of the due process ensured by Goal 1.

LDC 4.5.70.03.a requires the same complete and stamped geotechnical report, by extension.

LDC 4.5.70.03.a also requires a geotechnical report that "shall specifically address the presence, characteristic, and ***precise location*** of the identified hazard(s) on the subject property which is/are depicted on the Natural Hazards Map."

However, the draft geotechnical investigation provided by the Applicant only discusses the landslide risk areas in general terms (on page 5), without identifying their precise location. It is, therefore, not clear that the engineer correctly identified the hazards on the subject property, as required by code.

No compensating public benefit was offered for the failure to comply with these geotechnical code requirements.

B. Pedestrian Oriented Design

Condition 27 requires the application to comply with LDC Chapter 4.10 – Pedestrian Oriented Design Standards. But the City still proposes to defer compliance with LDC 4.10 to a future lot-by-lot review process by the Planning Division. As LUBA already noted in its ruling (on page 11), "the city cannot defer such a demonstration of compliance with CCP 4.6.7 to a future review process that does not provide notice or opportunity for public participation."

Furthermore, the Planned Development process is not one that can consider most issues, while excluding others. A consideration of the ***whole*** package is essential to the process.

The memo by Ken Gibb to the City Council on August 10, 2007 is also instructive with regard to public participation. Theoretically, the Planning Division could treat every lot approval as a Major Modification, thereby requiring public notice and input. But on page 20 of his remarks, in reference to compliance with CCP 4.6.7, the Community Development Director wrote:

> "In addition, staff do not believe it is appropriate to condition a project in a manner that would result in a need to obtain a Planned Development Modification for the condition to be met."

C. Mass Grading

LDC 4.5.80.04.c.3 limits mass grading area to protect steep hillsides. For low-density residential development zones with slopes equal to or great than 10 percent, ***no mass grading is allowed*** on lots greater than 10,000 square feet. On smaller lots, mass grading is allowed up to 6,500 square feet.

But only 13 of the 45 proposed lots are less than 10,000 square feet, and some of the smaller lots would be entirely graded. Furthermore, most of the lots are on a slope greater than 10 percent. Therefore, noncompliance with the mass grading limitations is widespread. No compensating public benefit has been offered.

JOURNAL OF THE AMERICAN WATER RESOURCES ASSOCIATION
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URBANIZATION OF AQUATIC SYSTEMS: DEGRADATION THRESHOLDS, STORMWATER DETECTION, AND THE LIMITS OF MITIGATION[1]

Derek B. Booth and C. Rhett Jackson[2]

ABSTRACT: Urbanization of a watershed degrades both the form and the function of the downstream aquatic system, causing changes that can occur rapidly and are very difficult to avoid or correct. A variety of physical data from lowland streams in western Washington displays the onset of readily observable aquatic-system degradation at a remarkably consistent level of development, typically about ten percent effective impervious area in a watershed. Even lower levels of urban development cause significant degradation in sensitive water bodies and a reduced, but less well quantified, level of function throughout the system as a whole. Unfortunately, established methods of mitigating the downstream impacts of urban development may have only limited effectiveness. Using continuous hydrologic modeling we have evaluated detention ponds designed by conventional event methodologies, and our findings demonstrate serious deficiencies in actual pond performance when compared to their design goals. Even with best efforts at mitigation, the sheer magnitude of development activities falling below a level of regulatory concern suggests that increased resource loss will invariably accompany development of a watershed. Without a better understanding of the critical processes that lead to degradation, some downstream aquatic-system damage is probably inevitable without limiting the extent of watershed development itself.
(KEY TERMS: stormwater management; urban hydrology; hydrograph analysis and modeling.)

INTRODUCTION

Urban development imposes a variety of watershed changes that profoundly affect runoff processes and the downstream surface-water aquatic system. Attention is generally given to channel changes: the stream channel itself is the object of interest and also, typically, the focus of any subsequent restoration or rehabilitation efforts. Yet that stream channel, commonly draining up to many square kilometers, is largely a product of its upland watershed. The net effect of upland changes, occurring across the land surface of the contributing headwater catchments, is at least as important in determining overall stream function, degradation, and rehabilitation potential (National Research Council, 1992). To understand the potentially degrading effects of urban development and the potential for mitigation, both areas – upland and riparian – must be considered in turn.

Our approach to this problem draws on both field data and hydrologic simulation results from a variety of lowland watersheds in King County, Washington (Figure 1, Table 1). We have relied on field data to display overall trends in stream-channel changes; hydrologic simulations have been no less invaluable to improve our understanding of the likely physical processes that underlie those observed changes. Although an analysis of urban-induced channel changes would be complete without any discussion of mitigation, we have elected to include here an investigation into the most common of mitigation efforts, stormwater detention. Stormwater detention is a particularly widespread application that promises substantive improvements, but all-too-often it fails to achieve even the most limited of objectives.

Development-Induced Upland Changes – Runoff and Sediment Processes

Modifications of the land surface during urbanization produce changes in both the type and the magnitude of runoff processes. These changes result from vegetation clearing, soil compaction, ditching and

[1]Paper No. 96163 of the *Journal of the American Water Resources Association* (formerly *Water Resources Bulletin*). **Discussions are open until June 1, 1998.**
[2]Respectively, Professor and Director, Center for Urban Water Resources Management, Department of Civil Engineering, Box 352700, University of Washington, Seattle, Washington 98195; and Senior Hydrologist, Pentec Environmental, Inc., 120 Third Avenue S., Suite 110, Edmonds, Washington 98020.

draining, and finally covering the land surface with impervious roofs and roads. The infiltration capacity of these covered areas is lowered to zero, and much of the remaining soil-covered area is trampled to a near-impervious state. Compacted, stripped, or paved-over soil also has lower storage volumes, and so even if precipitation can infiltrate, the soil reaches surface saturation more rapidly and more frequently. Thus *Horton overland flow* or *saturation overland flow* (Dunne and Leopold, 1978) is introduced into areas that formerly may have generated runoff only by subsurface flow processes, particularly in humid areas of generally low-intensity rainfall such as the Pacific Northwest.

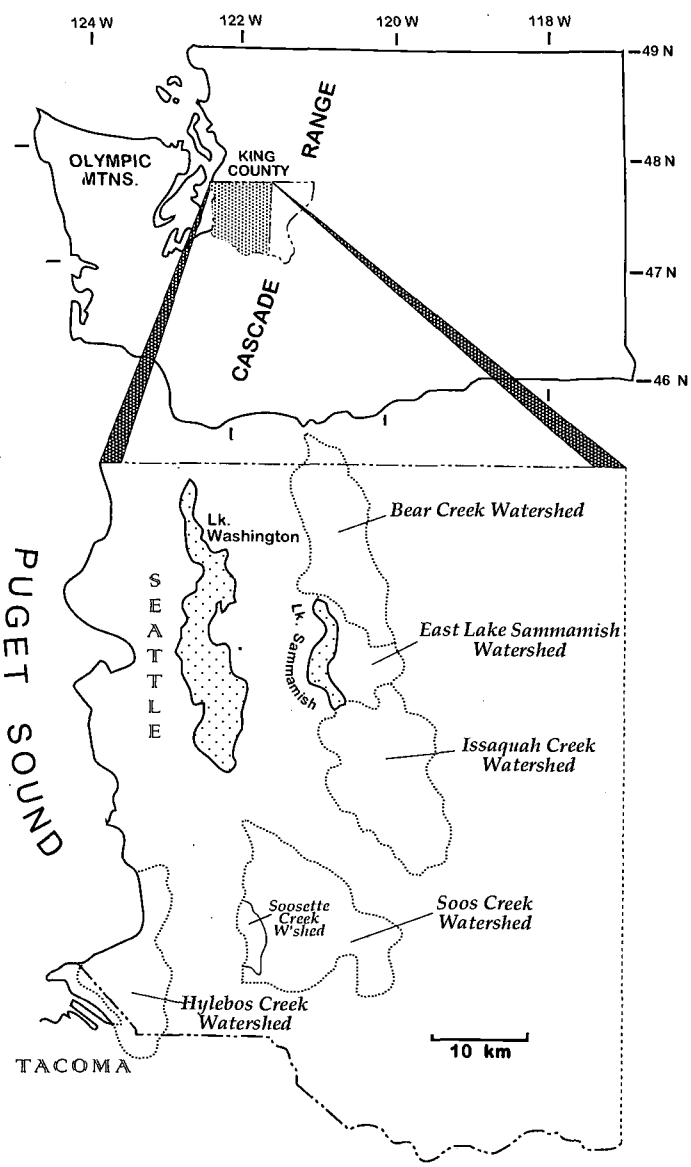

Figure 1. Map of watersheds used as sources of field data and in analyses. Physical and simulation characteristics are summarized in Table 1.

Besides changing the hydrologic flow regime, urbanization affects other elements of the drainage system. Gutters, drains, and storm sewers are laid in the urbanized area to convey runoff rapidly to stream channels. Natural channels are often straightened, deepened, or lined with concrete to make them hydraulically smoother. Each of these changes increases the efficiency of the channel, transmitting the flood wave downstream faster and with less retardation by the channel. In total, direct measurements and hydrologic simulation models demonstrate several related consequences: for any given intensity and duration of rainfall the peak discharge is greater (by factors of 2 to 5; Hollis, 1975), the duration of any given flow magnitude is longer (by factors of 5 to 10; Barker *et al.*, 1991), and the frequency with which sediment-transporting and habitat-disturbing flows move down the channel network is increased dramatically (by factors of 10 or more; Booth, 1991; Booth and Fuerstenberg, 1994) (Figure 2).

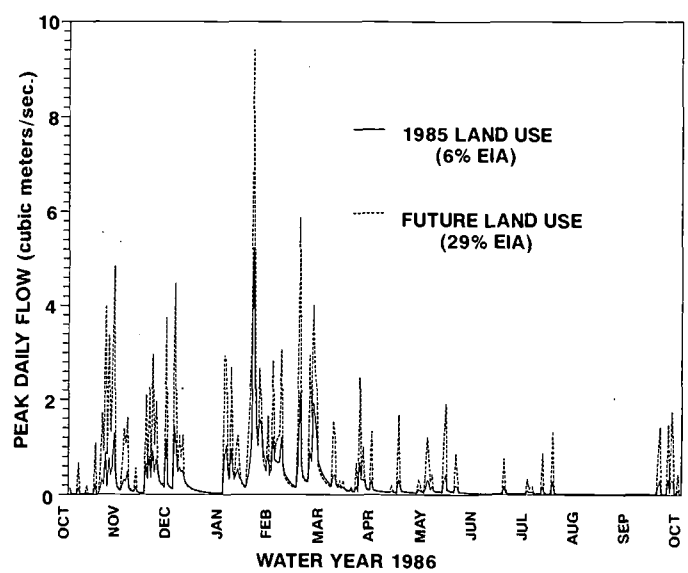

Figure 2. One year of simulated streamflow from a 14.2-km^2 watershed (Soosette Creek), under identical rainfall but differing land uses, using the continuous numerical model HSPF (USEPA, 1984). Parameters characterize the present-day (1985) land cover [6 percent effective impervious area (EIA), the impervious surfaces with direct hydraulic connection to the stream system] and projected future land cover (29 percent EIA).

Changes in upland runoff processes, particularly from a predominantly *subsurface* flow regime to a predominantly *surface* flow regime, alter not only the magnitude of discharges but also the delivery of sediment to the stream network. With overland flow, fine sediment is moved into channels throughout the year; when coupled with land-cover changes, the sediment

TABLE 1. Physical Characteristics of Watersheds Used as Data Sources and in Analyses.

Watershed Name	Soos	Bear	Hylebos	East Lake Sammamish	Issaquah
Reference	King County, 1990a	King County, 1989	King County, 1990b	King County, 1990c	King County, 1991
Size	181 km^2	132 km^2	93 km^2	38 km^2	158 km^2
Range of Watershed Elevations	305 m - 25 m	185 m - 9 m	158 m - 0 m	168 m - 10 m	905 m - 10 m
Average Annual Rainfall	1190 mm	1100 mm	1040 mm	1220 mm	1450 mm
Number of HSPF-Modeled Subcatchments	57	66	61	22	65
Subcatchment Size – Average and Range	3.18 km^2 (avg.) 1.53-10.62 km^2 (range)	2.00 km^2 (avg.) 0.56-8.65 km^2 (range)	1.52 km^2 (avg.) 0.21-2.36 km^2 (range)	1.73 km^2 (avg.) 0.33-4.86 km^2 (range)	2.43 km^2 (avg.) 0.31-6.97 km^2 (range)
Watershed Impervious Area (EIA)	49%	3.0%	20.0% (median of 8 independent subwatersheds)	5.0% (median of 3 independent subwatersheds)	1.4%
Impervious Areas (EIA) – Range by Subcatchments	0.7-23.1%	0.0-12%	0.2-54%	0.0-13.1%	0.0-18.3%
Forest Cover	69%	76%	27% (median of 8 subwatersheds	60% (median of 3 subwatersheds	78%
Forest Cover – Range by Subcatchments	35.3-88.8%	41-100%	0.1-100%	29.0-68.4%	25.6-100%
Unit-Area Discharges (2-year) – at Watershed Outlet, and Range Within Subcatchments	0.13 $m^3/sec/km^2$ (at outlet; = 12.1 cfs/mi^2) 0.08-0.41 $m^3/sec/km^2$ (range)	0.14 $m^3/sec/km^2$ (at outlet; = 12.4 cfs/mi^2) 0.09-0.42 $m^3/sec/km^2$ (range)	0.60 $m^3/sec/km^2$ (median of 8 independent subwatersheds at outlets; = 55.0 cfs/mi^2) 0.01-0.98 $m^3/sec/km^2$ (range)	0.19 $m^3/sec/km^2$ (median of 3 independent subwatersheds at outlets; = 51.2 cfs/mi^2) 0.02-0.56 $m^3/sec/km^2$ (range)	0.32 $m^3/sec/km^2$ (at outlet; = 28.9 cfs/mi^2) 0.10-0.66 $m^3/sec/km^2$ (range)
Unit-Area Discharges (100-year) – Outlet, and Range	0.28 $m^3/sec/km^2$ (at outlet; = 25.9 cfs/mi^2) 0.13-0.97 $m^3/sec/km^2$ (range)	0.31 $m^3/sec/km^2$ (at outlet; = 15.2 cfs/mi^2) 0.17-0.80 $m^3/sec/km^2$ (range)	1.20 $m^3/sec/km^2$ (median, at outlets; = 110 cfs/mi^2) 0.03-1.94 $m^3/sec/km^2$ (range)	0.41 $m^3/sec/km^2$ (median, at outlets; =37.2 cfs/mi^2 0.06-1.20 $m^3/sec/km^2$ (range)	0.79 $m^3/sec/km^2$ (at outlet; = 72.5 cfs/mi^2) [range data not available]

load can increase by many orders of magnitude (Wolman and Schick, 1967) and the predominant grain-size distribution can shift to much finer fractions. Such increases in the delivery of fine sediments significantly alters the sediment size distribution of gravel bed streams (e.g., Carling, 1984; Jobson and Carey, 1989), with attendant changes in stream ecology (recognized as early as Ellis, 1936; also Hawkins *et al.*, 1982; Culp *et al.*, 1986; Chapman, 1988; Naiman *et al.*, 1992; Weaver and Garman, 1994).

Development-Induced Riparian Changes

Urban development not only increases rates of water and sediment delivery but also encroaches on the riparian corridor. From clearing of streamside vegetation, less wood enters the channel, depriving the stream of stabilizing elements that help dissipate flow energy and usually (although not always) help protect the bed and banks from erosion (Booth *et al.*, 1996). Deep-rooted bank vegetation is replaced, if at all, by shallow-rooted grasses or ornamental plants that provide little resistance to channel widening (Booth and Jackson, 1994). Furthermore, the overhead canopy of a stream is lost, eliminating the shade that controls temperature and supplies leaf litter that enters the aquatic food chain.

Channel Response to Development-Induced Watershed Changes

As a result of these factors, channel widths and depths increase throughout urban areas (Hammer, 1972; Leopold, 1973) and heterogeneous channel morphology becomes more simplified and uniform. Most commonly, channels expand gradually in response to progressive increases in the flow regime (Figure 3). However, they can also experience rapid and nearly uncontrolled incision of the stream bed, usually in response to an increase in the flow rate combined with specific combinations of gradient, substrate, and reduced in-channel vegetation (Heede, 1985; Booth, 1990).

At the end of this causal chain of upland, riparian, and channel changes lies the degradation of in-stream biological function that so often motivates rehabilitation efforts (Karr, 1996). In the Pacific Northwest, many of these efforts are focused on enhancing populations of anadromous salmon in lowland streams. These fish depend on a particular combination of water and sediment fluxes to maintain favorable channel conditions. Because land-use change in a watershed alters those fluxes, the resulting flow regime and channel configuration no longer tend to favor salmonids (Booth and Fuerstenberg, 1994), and thus most rehabilitation efforts that address only the in-stream symptoms of these watershed changes are unlikely to succeed (Roper *et al.*, 1997). This study addresses only the flow-related consequences of upland watershed changes, and so it does not offer a comprehensive analysis of, or solution to, the loss of salmonids in urban streams of the Pacific Northwest. However, the work has been motivated in large measure by these concerns, and it demonstrates the tremendous ecological significance of those upland changes occurring in the urban environment.

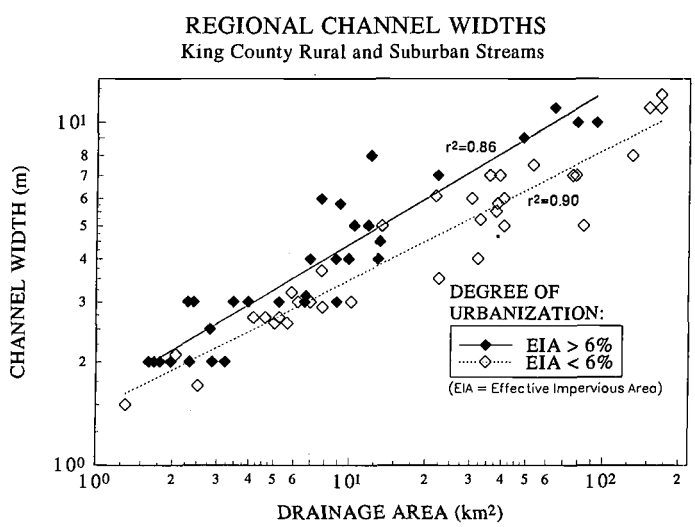

Figure 3. Channel widths as a function of contributing drainage area, measured by the senior author using the methods for bankfull channel identification in Williams (1978). Regression lines plotted for each data set independently.

THE RELATIONSHIP BETWEEN URBANIZATION AND AQUATIC-SYSTEM DEGRADATION

Study Approach

With this conceptual model of altered watershed processes as our context, we wish to better characterize the magnitude of urban development and to identify any consistent trends or thresholds of aquatic-system degradation associated with that development. Our approach has been to collect data rapidly from a large number and wide variety of urbanizing watersheds, acknowledging the extreme variability in our sample population but anticipating that the overriding influence of urban development will impose consistent trends in our measurements. Two types of

data are required: those that characterize the *magnitude* of urban development, and those that characterize the *effects* of urban development.

Characterizing the Magnitude of Urban Development

Rationale. There is great appeal to identifying a single "index" variable that characterizes the magnitude of urban development in a watershed. Patterns can be readily displayed, correlations are simplified, and communication between scientists and planners is enhanced. Yet urban development comes in many styles, occurs on many different types of landscapes, and is accompanied by a variety of mitigation measures designed to reduce its negative consequences on downstream watercourses. So any simple correlation between urbanization and aquatic-system condition appears unlikely, and it is with this expectation that many of the data reported below were first collected.

TIA and EIA. Past efforts to quantify the degree of urban development have not been consistent. Recent and historical use of the most widely accepted parameter, percent impervious area in the contributing watershed, has been carefully documented in a recent review article (Schueler, 1995) but several issues remain ambiguous. Most significant of these is the distinction between ***total*** impervious area (TIA) and ***effective*** impervious area (EIA). TIA is the "intuitive" definition of imperviousness: that fraction of the watershed covered by constructed, non-infiltrating surfaces such as concrete, asphalt, and buildings. Hydrologically this definition is incomplete for two reasons. First, it ignores nominally "pervious" surfaces that are sufficiently compacted or otherwise so low in permeability that the rate of runoff from them are similar or indistinguishable from pavement. For example, Wigmosta *et al.* (1994) found that the impervious unit-area runoff was only 20 percent greater than that from pervious areas, primarily thin sodded lawns over glacial till, in a western Washington residential subdivision. Clearly, this hydrologic contribution cannot be ignored entirely.

The second limitation of TIA is that it includes some paved surfaces that may contribute nothing to the storm-runoff response of the downstream channel. A gazebo in the middle of parkland, for example, probably will impose no hydrologic changes into the catchment except a very localized elevation of soil moisture at the edge of its roof. Less obvious, but still relevant, will be the different downstream consequences of rooftops that drain alternatively into a piped storm-drain system with direct discharge into a natural stream or onto splashblocks that disperse the runoff onto the garden or lawn at each corner of the building.

The first of these TIA limitations, the production of significant runoff from nominally pervious surfaces, is typically ignored in the characterization of urban development. The reason for such an approach lies in the difficulty in identifying such areas and estimating their contribution, although site-specific studies demonstrate that these tasks can be accomplished with simple field methods and the resulting hydrologic insights are often valuable (Burges *et al.*, 1989). Furthermore, the degree to which pervious areas shed water as overland flow should be related, albeit imperfectly, with the amount of *impervious* area: where construction and development is more intense and covers progressively greater fractions of the watershed, the more likely that the intervening green spaces have been stripped and compacted during construction and only imperfectly rehabilitated for their hydrologic functions during subsequent "landscaping."

The second of these TIA limitations, inclusion of non-contributing impervious areas, is formally addressed through the concept of *effective impervious areas* (EIA), defined as the impervious surfaces with direct hydraulic connection to the downstream drainage (or stream) system. Thus any part of the TIA that drains onto pervious (i.e., "green") ground is excluded from the measurement of EIA. This parameter, at least conceptually, captures the hydrologic significance of imperviousness. EIA is the parameter normally used to characterize urban development in hydrologic models.

Yet the direct measurement of EIA is complicated. Studies designed specifically to quantify this parameter must make direct, independent measurements of both TIA and EIA (Alley and Veenhuis, 1983; Laenen, 1983; Prysch and Ebbert, 1986). The results can then be generalized either as either a correlation between the two parameters or as a "typical" value for a given land use. For example, Alley and Veenhuis (1983) found that $[EIA] = 0.15\ [TIA]^{1.41}$ in their highly urbanized watersheds in Denver, Colorado ($r^2 = 0.98$). Using the alternative approach, Dinicola (1989) compiled the findings of these earlier studies to recommend a single set of impervious-area values based on five land-use categories for use in studies of western Washington watersheds (Table 2). These values are the basis for the impervious-area assignments for our present study as well.

Characterizing the Effects of Urban Development

Previous Studies. Correlations between development and aquatic-system conditions have been

TABLE 2. Presumed Relationship Between Imperviousness and Land Use (from Dinicola, 1989).

Land Use	TIA (percent)	EIA (percent)
Low Density Residential (1 unit per 2-5 acres)	10	4
Medium Density Residential (1 unit per acre)	20	10
"Suburban" Density (4 units per acre)	35	24
High Density (multi-family or 8+ units per acre)	60	48
Commercial and Industrial	90	86

investigated for nearly two decades with remarkably consistent results. Klein (1979) published the first such study, where he reported a rapid decline in biotic diversity where watershed imperviousness much exceeded 10 percent. A variety of more recent studies, mainly unpublished but covering a large number of study methods and researchers, has been compiled by Schueler (1995). Two aspects of his exhaustive compendium, however, limit the ability to draw overly precise conclusions:

1. The geographic scope of this body of work is largely restricted to streams of the mid-Atlantic seaboard and Pacific Northwest. A few reports from other humid regions are included, and they do not suggest radical differences. However, arid and semi-arid regions are entirely unrepresented by this set of studies

2. The definition and determination of "imperviousness," by far the most common characterization of urban development in use, is not well described in most of the studies (including the preliminary report of this study – Booth and Jackson, 1994). Commonly, not even the use of TIA or EIA is specified, nor is the measurement method used (e.g., direct measurement from aerial photographs, interpretation of LANDSAT imagery, or characteristic values assigned to different land uses). In the typical range of imperviousness for which "degradation thresholds" have been investigated, this uncertainty in the choice of imperviousness measure introduces a potential factor-of-two error (Table 2) in comparing the results of one study with another.

Flow Increases. The data sets in our current investigation focus on measures of flow quantity, channel size, and condition of the riparian corridor. They were collected during a series of watershed assessments in the east-central Puget Lowland and are compiled in a series of associated planning documents (see Table 1). The absence of chemical measurements reflects our judgment of the voluminous, but inconclusive, body of water-quality data that shows only poor correlation between development intensity and water quality across the range of (mainly suburban) land uses that we are investigating (Horner *et al.*, 1996). In contrast, the dramatic evidence of physical degradation that is so readily seen in these watersheds (Booth, 1991) suggests the overriding significance of urban-induced flow increases, characterized by both peak discharges and the aggregate duration of sediment-transporting events.

To identify rapidly the potential effects of flow increases in field observations, we discriminate between ***stable*** channels, with little or no erosion of their bed and banks, and ***unstable*** channels, which display long continuous reaches with bare and destabilized banks indicative of severe downcutting and widening (Galli, 1996). To quantify the increase in flows imposed by urbanization, we have used the output of a continuous hydrologic model (Hydrologic Simulation Program-FORTRAN [HSPF]; USEPA, 1984) to simulate discharges in a variety of local watersheds under identical rainfall regimes but differing land uses. We have indexed the magnitude of modeled flow changes in terms of the *post*development frequency of the discharge that had a *pre*development (i.e., forested) recurrence of 10 years ($Q_{10\text{-for}}$). Note, however, that other measures of hydrologic change would produce a similar result; there is nothing unique about this particular index discharge.

Model simulations on the watersheds of Figure 1, matched with corresponding field observations, are summarized by Figure 4. This plot discriminates the degree of observed channel stability at each station (indicated by the "X"s and "O"s of Figure 4), and it positions each observation with respect to the contributing watershed's EIA (horizontal axis) and the now-increased frequency of $Q_{10\text{-for}}$ under current urbanized conditions (vertical axis). The simulations assumed no on-site detention of stormwater runoff under current conditions, because almost no development in this region had yet been constructed with hydrologically significant detention volumes when these observations were made (1988-1992). The forested land-use simulations assumed a rainfall regime and channel network identical to the present, focusing solely on the land-use changes from pre- to post-development conditions.

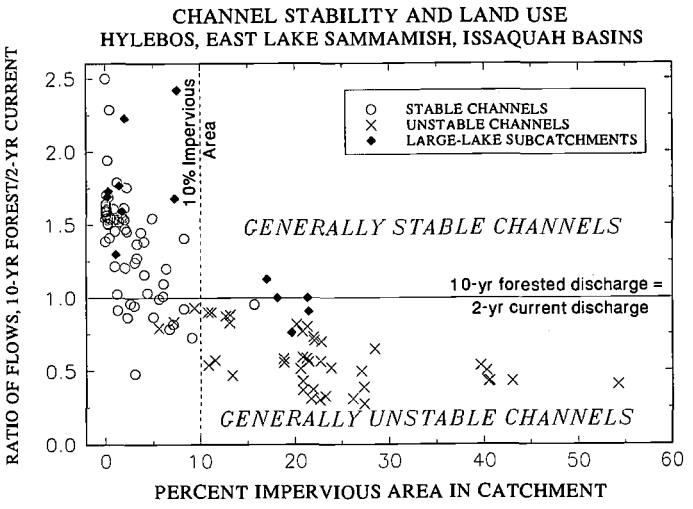

Figure 4. Observed stable ("O") and unstable ("X") channels, plotted by percent effective impervious area (EIA) in the upstream watershed (horizontal scale) and ratio of modeled 10-year forested and two-year current (i.e. urbanized) discharges (vertical scale). Apparent thresholds relating channel stability with either 10 percent EIA or $Q_{2\text{-cur}} = Q_{10\text{-for}}$ are consistently met except for the few catchments containing large lakes.

A surprisingly good correlation emerges between observed channel stability and watershed urbanization, be it characterized by percent effective impervious area or by the magnitude of simulated flow increases. The observations here show that observed instability is all-but ubiquitous where the contributing effective impervious area percentage exceeds a rather low level: a value of about 10 percent (dashed vertical line in Figure 4) discriminates between observed stable and unstable reaches almost perfectly. The magnitude of simulated hydrologic change also discriminates between these observations: in any basin where the discharge equal to $Q_{10\text{-for}}$ now has a recurrence of two years or less (shown by the solid horizontal line in Figure 4), instability is assured. We see anomalously low flow increases with increasing EIA only where large lakes (surface area equals or exceeds 10 percent of the watershed area) are present upstream of the observation point. We emphasize that the good relationship between "instability" and "imperviousness" is not a simple causal relationship, because we recognize that EIA is but an *index* of the variety of hydrologic changes imposed by urban development. However, it is clearly a robust and easily estimated relationship.

Integrated Effects of Urban Development. Urbanization yields not only measurable changes in specific elements of aquatic systems but also a decline in the overall function of those systems. This fact is evident to any resident of such a watershed; similarly intuitive is the observation that degradation increases as development progresses. To understand the range of such effects we have made more complete surveys of the physical habitat along 140 km of stream channel in two of the King County watersheds (Figure 1), classifying each reach as excellent, fair, or poor, defined on the basis of not only channel stability but also pool:riffle ratio, channel roughness and diversity, and observed fish use. The effective impervious-area percentage of the watershed above each channel reach was measured, with EIAs ranging from 2 to 50 percent in watersheds ranging from 2 to 110 km^2. As with all of our data, significant on-site detention is absent in these watersheds. The level of degradation changes markedly at about 8-10 percent EIA (Figure 5), except a few sites with areas of significant upstream impoundments. A similar relations between habitat quality and effective impervious area has also been seen in wetlands of this region (Booth and Reinelt, 1993).

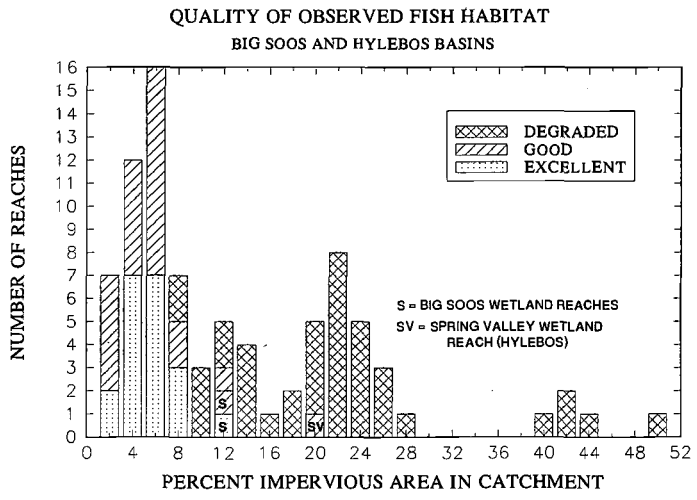

Figure 5. Observed fish-habitat quality as a function of effective impervious area in the contributing watershed, based on more than 80 individually inventoried channel segments in south King County (Figure 1). "EXCELLENT" reaches show little or no habitat degradation; "GOOD" reaches show some damage to habitat but still maintain good biological function; and "DEGRADED" reaches contain aquatic habitat that has been clearly and extensively damaged, typically from bank erosion, channel incision, and sedimentation. Three identified reaches with large wetland-to-watershed-area ratios disturb an otherwise consistent pattern of degradation across the gradient of urban development.

At very low levels of watershed urbanization, individual differences between watersheds produce greater variability in relative habitat quality. Patterns become evident only through more detailed evaluations of stream reaches, using not only physical but also biological criteria, which have been

conducted through the watershed plans that now cover over 750 km^2 in the lightly (but rapidly) urbanizing areas of the region (Figure 1; e.g., King County, 1990a, 1992, 1993). Each such plan has identified "Regionally Significant Resource Areas" (RSRAs), where the aquatic system is observed to function at a very high level "by virtue of exceptional species and habitat diversity and abundance, when compared to aquatic and terrestrial systems of similar size and structure elsewhere in the region" (King County, 1993). Across the region, 12 such RSRA stream reaches or subbasins have been identified out of a potential population of several hundred. With one exception, located in a uniquely infiltrative subbasin with extremely permeable soils, none are found where the contributing EIA exceeds 3.6 percent. Indeed, the three RSRAs with the greatest contributing impervious area are in basins with unusually widespread and rapid infiltration. *Every other* RSRA has 3 percent or less EIA in its watershed.

Conclusions: Urbanization and Aquatic-System Degradation

These results show remarkably clear and consistent trends in aquatic-system degradation. In western Washington, and likely in other humid regions as well, approximately 10 percent effective impervious area in a watershed typically yields demonstrable, and probably irreversible, loss of aquatic-system function. Even lower levels of urban development cause significant degradation in sensitive water bodies and a reduced, but less well quantified, degree of loss throughout the system as a whole. These results do not indicate a "threshold" per se: degradation begins at very low levels of urban development and continues well beyond the range of imperviousness emphasized in this study. But we find a noteworthy accumulation of physical and biological effects, particularly those that can be consistently observed and measured by even rather crude (but also rapid and so inexpensive) methods, once EIAs reach about 10 percent. The *changes* imposed on the natural system are a continuum, and so defining a strict "threshold" in this context would be naive; but our *perception of* and our *tolerance for* those changes appears to undergo a far more abrupt transition, one which suggests a basis for discrete levels of both impact evaluation and management response.

ON-SITE DETENTION AS MITIGATION FOR URBAN DEVELOPMENT

Design Issues

The value of storing stormwater runoff in large water bodies has been recognized for decades (Dunne and Leopold, 1978; Whipple, 1979) and is in widespread practice nationwide. In general, all such impoundments function similarly: water is collected from developed areas and is released by infiltration (retention facilities) or surface discharge (detention facilities) at a slower rate than it enters; the excess of inflow over outflow is temporarily stored in a pond or vault. In principle, adequate performance of these "R/D ponds" might change the level of or even eliminate the impervious-area thresholds that produce recognizable aquatic-system degradation.

The *actual* performance of R/D ponds, however, depends on the answer to two questions. The first is one of design ***policy***: how completely do we want the facility to mimic predevelopment runoff conditions? The second is one of design ***analysis***: how accurately does our hydrologic model predict true performance, so that the constructed facility actually achieves the intended management policy?

Policy: Design Performance. R/D ponds can achieve either of two levels of design performance, depending on the desired balance between achieving downstream protection and the cost of that protection. A ***peak standard***, the classic (and least costly) goal of R/D facilities, seeks to maintain postdevelopment *peak* discharges at their predevelopment levels. Even if this goal is achieved successfully, however, the aggregate duration that such flows occupy the channel must increase because the overall volume of runoff is greater.

In contrast, a ***duration standard*** seeks to maintain the postdevelopment duration of all sediment-transporting discharges at predevelopment levels. Duration standards are motivated by a desire to avoid potential disruption to the conveying channel itself by not allowing increased sediment transport. Without infiltration of runoff, however, the total volume of runoff increases in the postdevelopment condition, and so durations cannot be matched for all dischargesóat some level the "excess" water must be released. This is accomplished by determining a threshold discharge below which sediment transport in the receiving channel does not occur. This determination can be made by site-specific, but rather expensive, analysis based on stream hydraulics and sediment size (Buffington and Montgomery, 1997) or can be applied as a "generic" standard based on pre-

development discharges. Differences between stream channels ensure that no single threshold can possibly work equally well on all channels; nevertheless, a single criterion has substantial advantages in ease of analysis and implementation. A presumed threshold discharge of about one-half of the 2-year flow ($Q_{pre\text{-}2}/2$), at least for gravel-bed streams, appears to have reasonable substantiation in the scientific literature (e.g., Pickup and Warner, 1976; Andrews, 1984; Carling, 1988; Sidle, 1988).

Faced with determining the threshold discharge for sediment transport by using either (1) a site-specific method that will likely prove somewhat ambiguous and cumbersome to use; or (2) a rapid, universally applicable method that almost certainly generates incorrect results in a fraction of circumstances, the choice of method may not appear obvious. However, public regulations are replete with examples of uniform (and predictable) standards that may be inappropriate in a minority of cases, because the benefits of such a uniform approach are judged to outweigh the disadvantages. That approach is recommended for this issue as well.

Analysis: Choice of Model. Having determined a design standard, a particular hydrologic model must be used during the design analysis. The choice is critical, because model predictions of pre- and post-development runoff determine the size and configuration of the detention facility. Use of a 24-hour Soil Conservation Service (SCS) Curve-Number method, typically the Santa Barbara Urban Hydrograph method, or SBUH, has been standard practice across much of the Pacific Northwest since 1990 despite its poor correlation between assigned and calibrated curve numbers (Hawkins, 1984) and the inability of any event-based model to predict accurately a continuous process such as runoff (Barker *et al.*, 1991). Alternatives to the SCS method have produced promising results, particularly the King County Runoff Time Series program (KCRTS; King County, 1995). It is a relatively simple hydrologic analysis tool with nearly all of the accuracy and versatility of the continuous rainfall/runoff model, Hydrologic Simulation Program-FORTRAN (HSPF), on which it is based. KCRTS provides the user with a database (the runoff files) of unit-area runoff rates pre-simulated using HSPF for a range of land cover and soil conditions, and for different precipitation regions. Hydrograph analysis and design of detention facilities is then accomplished by directly manipulating the runoff-file and land-cover data with the supporting interface software.

Characterizing Pond Volumes. The volume of a detention pond is its single most important design characteristic. From a hydrologic perspective, that volume determines the time-integrated difference between inflow and outflow and so imposes an absolute limit on net hydrologic performance. It is also the single most expensive element of pond design and construction, because pond volume is directly related to pond area and thus cost, incurred in both construction and lost developable land. Once a development is complete, pond volume is also the most inflexible parameter. Orifices may be resized with only trivial effort, but the total pond area or the maximum depth of live storage generally cannot be changed without tremendous expense.

To facilitate comparisons, all detention-pond designs here are expressed in terms of a live-storage volume per unit area of developed land draining to the facility. This normalized measure of volume is thus, paradoxically, in units of *depth* and is equal to the volume of the pond as though it were evenly spread out over the area of the development. Typical unit-area volumes are expressed in cm-hectares per hectare (metric) or inch-acres per acre (English), and so the simplified units are simply "centimeters" or "inches" of net pond volume.

Performance of Ponds

Peak Standards. HSPF simulation of runoff originating from an SCS-designed detention pond was analyzed by Barker *et al.* (1991). Ponds were initially designed using SBUH to match pre- and post-development two- and ten-year peak discharges (a "2-10 standard"). Where the simulated land-use conversion was from forest land cover to urban land use, performance within the design range (i.e., up to the ten-year event) was near-perfect: in other words, pre- and post-development peak discharges for any given recurrence within this frequency range were equivalent. The volume of these ponds, a rough surrogate for facility cost, can be as much as 4 cm (i.e., 4 cm-hectares of volume per hectare of developed land). Where the land-use conversion was from *grassland* to urban uses, however, even ten-year flows discharged from the SCS ponds increased up to three-fold. Beyond the design range of discharges both land-cover conversions result in more extreme postdevelopment flooding; in particular, the predevelopment $Q_{100\text{-}yr}$ discharge for a grass-to-urban conversion recurs about 10 times as often. Even this relatively poor performance is an historic improvement; ponds constructed prior to 1990 using a design based on the rational method (Yrjanainen and Warren, 1973) typically provided one-quarter or less of this volume.

Using KCRTS for pond design, performance is uniform and successful across all types of land conversion following development. Indeed, because of a 20

percent safety factor added to the volume of all pond designs by this program, KCRTS ponds designed under the "2-10 standard" actually match postdevelopment and predevelopment peak discharges up to the *100*-year events. To achieve this performance, however, requires pond volumes as much as 50 percent greater than under the SCS design.

Duration Standards. Matching pre- and postdevelopment flow durations is a far more challenging task than simply matching flow peaks, because the total *volume* of runoff arising from a given storm is greater and so must be released or disposed of in some fashion. We have considered two modeling approaches for attaining this enhanced performance in the absence of infiltration: using an apparent "overperformance" of the SCS 24-hour method (Table 3), or using KCRTS with this performance as an explicit goal. In either case, any R/D design that meets a flow-duration standard will easily meet a peak standard as well.

TABLE 3. Design Standard for Use with SCS Curve Number Method to Control Postdevelopment Runoff Durations ("Overperformance").

Postdevelopment Recurrence	Target Postdevelopment Discharge
2 year	0.5 x $Q_{predevelopment\ 2\text{-}yr}$
10 year	$Q_{predevelopment\ 2\text{-}year}$
100 year	$Q_{predevelopment\ 10\text{-}year}$

A detailed comparison of duration-control ponds designed with these two models is instructive, using the 14.2-km^2 Soosette Creek watershed (Figure 1). The watershed's land use, currently 25 percent suburban, 25 percent grassland, and 50 percent forest, is typical of conditions across the region. About 6 percent of the basin is covered by effective impervious area. HSPF simulations, which provide the "truest" picture of detention-pond performance, were generated by a model calibrated to this basin using two years of gauged rainfall-runoff data (King County, 1990a; see Figure 2 for sample simulation outputs from this watershed).

Pond performance depends strongly on the predevelopment vegetation cover. Conversion of the 50 percent forested land in the watershed results in little dependence on modeling method; ponds associated with such development meet their stated goals (i.e., matching of flow durations) regardless of which model is used for design. Pond volumes may be as much as 14 cm, depending on the details of the local soil and topography. Conversion of the 25 percent grassed areas, however, results in substantial differences between design methods. The "overperformance" SCS ponds result in extended postdevelopment flow durations, with discharges greater than $Q_{pre\text{-}2}$ occurring 15 to 40 percent more often than they did prior to this (limited) development. In contrast, the KCRTS ponds achieve durations that are less than or equal to the predevelopment durations for all discharges above one-half of the 2 year flow ($Q_{pre\text{-}2}/2$).

Describing the physical *consequences* of flow-duration changes is a vexing, but critical, task. Management decisions involving high-cost facilities will not be made on the basis of fractional flow-duration increases but on anticipated, tangible changes in downstream channels. We have estimated these consequences by comparison to other actual basins in the region where stream-channel conditions can be readily observed. The magnitude of flow-duration increase seen in the SCS-pond grassland simulation, i.e., 25 percent of the watershed area converted with a resultant 15-40 percent increase in flow durations, is of a magnitude seen once development achieves 1.7 to 4.6 percent effective impervious area in a watershed, based on calibrated HSPF simulation of such land-use conversions region-wide. Thus for a watershed that began as half forested and half grassland, for example, total urban development under an SCS-based "duration-control" standard would *in fact* allow duration increases about double to those seen in the Soosette example, and so similar to those already experienced by a watershed that now has approximately three to nine percent *undetained* EIA. Referring to our previous discussion, this level of equivalent watershed imperviousness is associated, at minimum, with loss of the highest degree of resource value and aquatic-system function in virtually any catchment in which it is applied. If yet more than 50 percent of the watershed is in grass cover prior to development the equivalent impervious-area increase will likely exceed 10 percent, ensuring substantial channel instability and the near-complete loss of significant aquatic resources despite a highly restrictive detention design.

CONCLUSION: MITIGATION USING ON-SITE DETENTION

These results demonstrate fundamental elements of urban runoff mitigation. From the standpoint of *peak discharge*, even relatively modest detention volumes can achieve notable (though commonly imperfect) flow reductions, reducing the consequences of a given impervious-area increase on flow maxima by

two-thirds or more. Reducing *flow durations*, in contrast, not only reduces or entirely solves downstream conveyance problems but also helps control development-induced channel erosion (Figure 6). This improved performance, however, comes with a cost, because the necessary detention volumes are dramatically larger. It also requires the use of an adequate hydrologic model, or the anticipated performance may never be achieved.

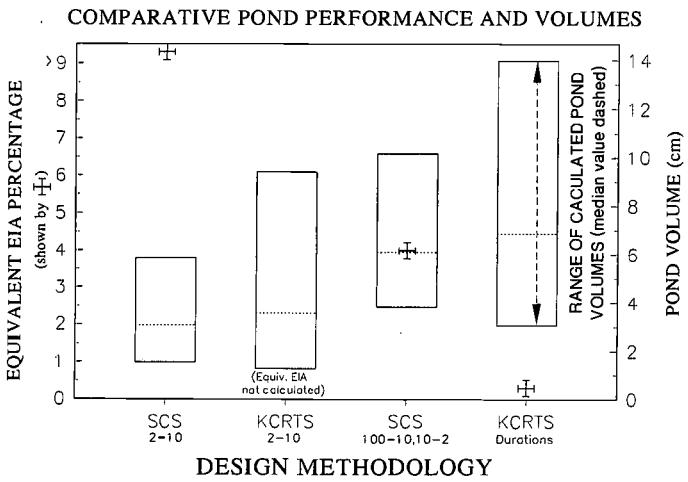

Figure 6. Comparative pond performance using different design methodologies – SCS and KCRTS hydrologic models, each under peak (labeled "2-10") and duration (labeled "100-10,10-2" or "Durations") standards. Evaluations are based on HSPF simulations of different developments within the fully built-out Soosette Creek watershed (29 percent impervious; see Figure 1). Overall performance (crosses) is represented by the equivalent flow increases allowed by a watershed having the indicated impervious-area percentage (as EIA) *without* detention; only KCRTS with a duration standard achieves "full" mitigation. The range of pond sizes (boxes) is expressed in cm-ha of volume per developed ha, with the range imposed by variability of soils and pre-development vegetation and the median value for all simulations shown by the dotted line.

The Limits of Mitigation

Despite the promise of successfully mitigating the effects of urban development through detention ponds, hydrologic modeling and empirical data suggest the elusivity of this goal. Along with the use of imperfect hydrologic models, several additional factors, both social and physical, are responsible for this shortcoming.

Regulatory Thresholds. There are practical limits to applying drainage regulations to individual small-scale land developments. Jurisdictions typically set a minimum "threshold of concern" to nearly all development activities: above this threshold the drainage regulations apply, but below this level regulations are minimal or absent [e.g., local King County regulations stipulate a minimum 0.50-cfs (0.014-m^3/sec) increase in runoff, equivalent to about 0.5 acre (0.2 ha) impervious surface, before mitigation is required]. Based on six years of King County permit activity (1987-1992), about one quarter of the impervious area added to the local watersheds there fell below this threshold and so are constructed without any detention facilities at all. Thus at full build-out (25-50 percent EIA, depending on zoning), a watershed will contain six to more than ten percent EIA that lacks any drainage control whatever. So under current regulatory thresholds, debates over the relative merits of alternative R/D design standards are largely moot – even the most restrictive design standard is unlikely to maintain future aquatic-system function at any but a recognizably degraded level.

Cost of Mitigation. Effective runoff mitigation in the Pacific Northwest appears to require pond volumes from 3 to as much as 14 centimeters (Figure 6). With associated berms, control structures, and maintenance access roads such a facility may occupy more than 10 percent of the gross area of a development (Figure 7). These are "lakes," not stormwater ponds, and although fully justifiable from a hydrologic standpoint they are unlikely to be built except in the most unusual of economic and social climates.

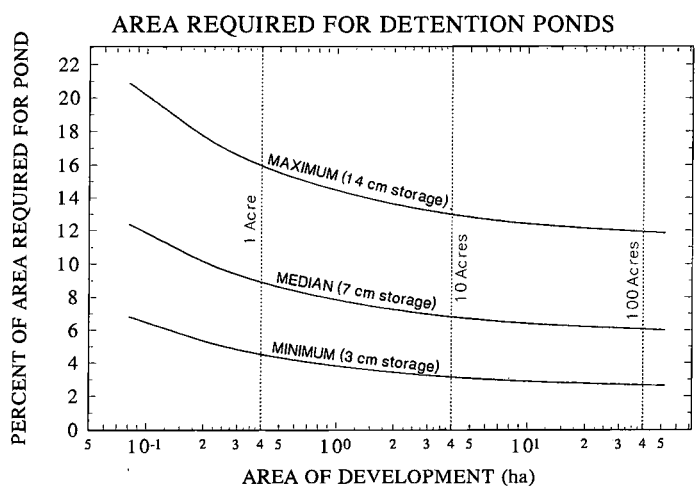

Figure 7. Relative gross area required for detention ponds, depending on the development area and the desired volume of stored runoff (expressed as cm-ha per ha of developed land). Pond layout and design is in accord with local regulations and assumes a 1.3-m (4-ft) maximum water depth and 3:1 sideslopes on all confining berms. Range of pond volumes correspond to the likely values determined with a "KCRTS duration" standard (Figure 6).

Thresholds of Sediment Movement. The concept of a "duration standard" implies the existence of a discharge below which no sediment transport occurs, allowing non-erosive release of urban-increased runoff volumes. For gravel-bed stream channels, this threshold discharge is real and can be determined on a site-specific or generic basis. In sand-bedded channels, however, the threshold of sediment motion occurs at impracticably low discharges, and so increases in the net transport of bed material is virtually unavoidable is such systems. We have not investigated the consequences of such a condition in small sand-bedded urban streams but speculate that they may be locally severe.

Point Discharges. Hydrologic models make the near-universal presumption that surface water exits a watershed at a point discharge. In the postdevelopment case this is invariably true: a constructed channel or a culvert outfall is generally quite identifiable. In the predeveloped case, however, watersheds up to several tens of hectares in size may have no discrete surface-water discharge point at all. Even if flow durations are matched precisely in pre- and post-developed cases, the change from a subsurface to a surface flow regime renders the entire design analysis irrelevant and can lead to severe, but entirely unanticipated, channel incision (Booth, 1990).

CONCLUSIONS: URBANIZATION, DEGRADATION, AND THE LIMITS OF MITIGATION

In western Washington, and likely in other humid regions as well, approximately 10 percent effective impervious area in a watershed typically yields demonstrable, and probably irreversible, loss of aquatic-system function. The data do not require a discrete "threshold" of effects, but they do display a noteworthy accumulation of physical and biological effects once this fraction of a watershed is covered by EIA. On-site detention is an appealing and widespread strategy for mitigating these effects, but very restrictive and so costly standards may need to be met to protect aquatic systems in urbanizing areas. Even though this study has considered only this one mitigation strategy, substantial difficulties are revealed. The common hydrologic methods used to size detention facilities give a false sense of accomplishment, and regulatory thresholds designed to avoid economic hardship for small projects may nevertheless allow substantial cumulative impacts to accrue. Many of the changes to the landscape imposed by urbanization are probably beyond our best efforts to fully correct them, and so some downstream loss of aquatic-system function is probably inevitable at our present level of understanding. Unless we can develop a more precise, process-based understanding of how altered landscapes produced degraded stream channels we probably will not achieve genuine protection without limiting the extent of development itself, a strategy that is being used with increasing frequency in this region's remaining resource-rich watersheds.

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City of Corvallis
Salmon Response Plan

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DISCLAIMER

The authors have attempted to replace all references to Squaw Creek with the creek's new name, Dunawi Creek. This includes replacing the creek's full name as well as changing Squaw Creek Reach reference labels to indicate Dunawi Creek.

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EXECUTIVE SUMMARY

INTRODUCTION

The City initiated the Salmon Response Plan project during the summer of 2000. The plan was to comply with protection regulations surrounding the listing of Upper Willamette River Spring-run chinook salmon as a threatened species under the Endangered Species Act (ESA) in March 1999 (Federal Register**,** Vol. 64, No. 56, page 14308-14328, March 24, 1999). At that time, the National Marine Fisheries Service (NOAA Fisheries) identified the range or geographic distribution for the Upper Willamette River Spring-run chinook salmon evolutionarily significant unit (ESU; Figure ES1 for a map of the ESU). Jurisdictions located within the ESU, which included the City of Corvallis, would from that date forward be held responsible for preventing any further degradation of chinook salmon habitat.

The purpose of the Salmon Response Plan project was to identify activities (both City of Corvallis sponsored as well as Corvallis citizen behaviors) that negatively impact chinook salmon habitat in Corvallis and develop a plan to, at a minimum, prevent further degradation. Additionally, where chinook salmon habitat existed in city creeks and rivers the City also identified long-term activities that lead toward restoration of properly functioning conditions (PFC) to support chinook salmon.

Controlling Federal Regulation

The federal government since 1973, the year that the ESA was passed, had the authority to identify and impose protections for specific species (wildlife, fish, and plants) in order to prevent these species from becoming extinction. The ESA set out guidelines for listing species, levels of protection depending on whether a species was listed as endangered of or threatened with becoming extinct, any special exceptions to the protections, penalties for violating the protection guidelines, and guidelines for de-listing a species should it no longer be endangered or threatened with extinction.

In July 2000, NOAA Fisheries, the federal agency with regulatory authority for marine species including anadromous fish, published final ESA Section 4(d) Rules for protection of listed salmonids in the northwestern United States (including Upper Willamette Spring Chinook Salmon). Importantly, the ESA Section 4(d) Rules allowed incidental take of listed anadromous fish as long as the jurisdiction could ensure that, overall, it did not jeopardize the listed species from becoming either endangered or extinct. These rules, developed specifically for listed northwestern salmonids, provided options for jurisdictions to obtain an incidental take permit from NOAA Fisheries for its activities. This permit ensured compliance with the ESA and provided protection in the event of legal challenges by the federal government and/or other parties.

Figure ES1. Chinook Salmon Evolutionarily Significant Unit (ESU) Map

See separate file

Project Rationale

The City embarked upon this effort for two reasons. First, the City administration (elected officials) and its residents believed they had a responsibility to help maintain the natural environmental processes critical to the environmental health and quality of life in the Willamette River Valley and state of Oregon. This responsibility had been reflected in many of the City's previous and ongoing activities; from the preservation of open space and natural resources, reduction of stormwater run-off and contamination of local streams, preservation of the Willamette River waterfront, participation in other environmental planning efforts (e.g., State-wide Goal 5 Significant and Natural Features Inventory projects), to the high degree of citizen participation in the city's recycling programs. Participation in the preservation of chinook salmon habitat was consistent with the City's position and ethic to take actions that contributed to overall environmental and community health.

Second, the City administration had a fiduciary responsibility to its residents to protect their interests through responsible decision-making and actions. Such decisions applied to the ESA listing of chinook salmon where the City had compared the costs and benefits of complying with federal rules and the protections that compliance offered to the potential risks, liabilities and costs of non-compliance. The City determined that compliance with the federal rules governing chinook salmon habitat, specifically the ESA Section 4(d) Rules, to be more beneficial than potentially costly third-party law suits challenging the City to demonstrate compliance with these federal rules.

PROJECT STRUCTURE

The City budgeted a multi-year project to develop a Salmon Response Plan. The Plan would assess chinook salmon habitat in streams within the City limits and the area within the unincorporated urban growth boundary (UGB), and develop a response plan based on sound science that would 1) prevent further chinook salmon habitat degradation and 2) eventually put the habitat on a trajectory toward PFC (see project area map in Figure ES2). The City hired a team of consultants with expertise in the ESA, chinook salmon biology and ecology, and the recently implemented ESA Section 4(d) Rules.

While the project was unique in its methodology by using a scientific approach to define, identify, evaluate and protect chinook salmon habitat, it incorporated previous City, regional, and statewide efforts to protect natural resources, water quality, and salmon. Such an approach helped to keep project costs down and provided the project team with useful data, reports, and programs that could be integrated and expanded in the Salmon Response Plan. Among the relevant activities that were incorporated into the Salmon Response Plan was the City's comprehensive stormwater master planning effort and the Goal 5 (Significant Natural Features) planning. Region and statewide programs such as the "Oregon Plan for Salmon and Watersheds" and the Willamette Restoration Initiative (WRI) were also helpful.

Figure ES2. Corvallis Salmon Response Plan Project Area

See separate file

Project Team

The Project Team was made up of three levels – City project management, technical advisory committee, and the technical consultants. Tom Penpraze was the City's overall project manager. Greg Gescher, P.E., supported him. A technical advisory committee (TAC) made up of City staff representatives from across City departments (utilities, transportation, community planning, parks and recreation) and a Benton County planning department representative was appointed to help guide and consulting team and review and comment on the project materials that were prepared by the project team. Professional consultants with expertise in biology, watershed ecology, fisheries science, planning, regulatory compliance, economics, geographic information systems and mapping, and public involvement were hired to manage the day-to-day project activities. Drs. Robert Dillinger and Bill Jones managed the project team from the project's inception to completion.

Two other groups played a significant role in the project and helped guide the final project results. The public (direct stakeholders and public at large) played an important role in the project. Project team communication with the public to inform, educate, and take comment on the type of program that they would support was initiated early and continued throughout the project. Meetings, workshops, news articles, fact sheets, direct contact, questionnaires/comment sheets, and web site communication were the methods the project team used to keep the public involved.

A second important group was NOAA Fisheries, the responsible federal regulating agency. Communication began during the project's early stages to ensure that the City received the benefit of guidance from the Agency that would ultimately receive the City's report and certify compliance under ESA Section 4 (d). Frequent communication continued throughout the entire project.

Two-Phase Study and Key Tasks

The project had two phases. Phase One of the project developed a comprehensive environmental baseline documenting the existing conditions of city streams for chinook salmon habitat. A pathways/effects analysis assessed the impact of City activities and citizen behavior on chinook salmon habitat.

Phase Two used the pathways/effects analysis to determine the degree and geographic distribution of City activities and citizen behavior that negatively impacted habitat. Activities were weighted and ranked according to their impact in order to identify solution options to prevent further habitat degradation and eventually restore PFC. The solution options included activities and programs that were currently implemented or being initiated under different programs as well as new activities. Importantly, the options identified were from across nearly all City departments.

This project would support the final preparation and submission of an ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial, and Industrial Development Program) application to NOAA Fisheries. The application would document the City's understanding of chinook salmon habitat, City activity and citizen behavior impacts, and solutions that would be implemented to meet ESA requirements.

To accomplish this project the following key tasks were completed:

- Development of an existing conditions database (existing sources and field data collection).
- Production of a geographic information systems (GIS) map of city streams with a 400-foot riparian corridor evaluation area (200 feet on each side of the top of bank).
- Creation of a pathways/effects evaluation of City activities (e.g., public infrastructure and services, transportation, operations and maintenance activities, parks and recreation, land use planning etc.) and citizen behavior (e.g., household activities, yard maintenance, home auto repairs, etc.).
- Preparation and submittal of the Phase One report "Baseline Habitat Evaluation and Evaluation of Impacts of City Activities" to NOAA Fisheries (approved by NOAA Fisheries in January 2002).
- Development of a database of weighted data that compared the pathways/effects analysis of City activities and citizen behavior against the baseline conditions database to determine the degree of chinook salmon habitat impact and its distribution.
- Development of solution options to prevent further degradation of chinook salmon habitat.
- Development of solution options to put the City on a trajectory toward achieving PFC in its streams and rivers.
- Development of a monitoring program.
- Preparation of a final report combining both phases of the project into a single report in partial fulfillment of the requirements for submission to NOAA Fisheries.
- Provide extensive public involvement activities throughout the project (stakeholder and open house meetings, press releases, comment forms, project website, etc.) to ensure public understanding of the project and to provide the general public with an opportunity for input.

ACCOMPLISHMENTS

This project took steps to identify and document baseline habitat conditions for chinook salmon and the options available to prevent chinook salmon habitat degradation as well as options that could actually improve such habitat and overall water quality in Corvallis streams. Many of these options have, in fact, been initiated. Through this process the City has also made a substantial effort to meet federal compliance requirements under the ESA, specifically with respect to the ESA Section 4(d) Rule. The results of this effort are briefly described below.

- Scientific understanding of existing conditions: a scientifically based evaluation has been conducted that provides the City with detailed and comprehensive picture of chinook salmon habitat and water quality in the city as well as the unincorporated UGB. The scientific approach was approved and, in fact, lauded by NOAA Fisheries, the federal agency responsible for reviewing all compliance plans for the ESA Section 4(d) Rule. An extensive database was prepared on the existing habitat conditions based upon field data collection and evaluation of existing documentation (sources included the Corvallis, Oregon State University [OSU], and state and federal natural resource agencies). The database provided information on a reach-by-reach basis for all streams that could support chinook salmon habitat in the project area (see Figure ES3 for a map of all the stream reaches evaluated).

- Pathways database: The potential relationship between City activities, citizen behavior and their impact on chinook salmon habitat were analyzed. Public services provided by the City (e.g., public utilities, community planning, land development, transportation, parks and recreation, etc.) and citizen behaviors (e.g., yard maintenance, vegetation, vehicle maintenance, etc.) were evaluated as to their impact on the habitat. A database identifying specific City activities and their relationship to chinook salmon habitat (negative, neutral, or beneficial relationship) was prepared. Similarly, a list of citizen behaviors was prepared that noted whether such activity had a potential negative, neutral, or beneficial relationship on the habitat.

- Phase I Report: The first phase of the project ended with preparation of a report on the City's existing or baseline habitat conditions and the pathways analysis (see Appendix 6). This was submitted to NOAA Fisheries after public input from stakeholders and city residents in special stakeholder meetings and a public workshop. NOAA Fisheries review and response was positive. In a letter to the City (January 7, 2002) they approved the baseline conditions evaluation and pathways analysis and considered it a "thorough compilation of existing and new data" and the pathways analysis showing "the list of activities and potential for impact to fish and habitat appears thorough and thoughtful." Most importantly, the letter stated that "the approach and the baseline data collected will be sufficient for us to determine the technical adequacy of the final 4(d) submittal" (see Appendix 7 for copy of letter).

Figure ES3. Stream Reaches with 400-foot Stream Corridor Evaluation Area Identified

See separate file

- Pathways Weighted Database: A comprehensive database that combined the existing/baseline conditions data with the pathways evaluation data was prepared in the second phase of the project. This was a significant development and important tool for the project because it identified the potential impacts (negative, neutral, or positive) that City activities and citizen behaviors had on chinook salmon habitat on a stream reach by reach basis. That is, it was possible to determine specifically where (i.e., what stream reach or reaches) and to what extent (negative, neutral, positive) a particular activity had on chinook salmon habitat and water quality in the stream reach(es) (see Appendix 5 for a CD of the database). In addition, the analysis incorporated a weighting factor that accounted for an activity's geographic location within or outside of the 400-foot stream corridor evaluation area (200 feet upland each side of the stream bank). Activities or citizen behaviors occurring within the corridor were considered to have a greater impact on chinook salmon habitat than those same activities or citizen behaviors occurring outside the corridor. Due to the number of City activity/stream reach combinations the size of the Pathways Weighted Database included over 3,500 records.

- Potential 4(d) Rule Options: By using the Pathways Weighted Database as an analytic tool it was possible to determine the geographic distribution and impact of City activities. From this database it was possible to determine which activities had the greatest negative impact and therefore potentially the greatest need to address through public policies. The project team evaluated the activities and identified an initial set of potential 4(d) Rule Limit 12 options that could help prevent chinook salmon habitat degradation and improve water quality in Corvallis streams. The options were categorized by City activity (e.g., stormwater, parks and recreation, transportation, etc.). Some of the options identified had already or were about to be implemented by City agencies (e.g., stormwater master plan activities, Taylor pump station fish screen installation, etc.). They were included in the list of options because they would help meet the City's ESA goals and ESA 4(d) Rule objectives. The options were presented to the public twice in public workshops to obtain public comment to help refine the options and set priorities. In addition, comment forms were distributed and posted on the City's ESA web site to gain as wide a set of comments as possible (see Appendices 14 and 15 for copies of the comment forms). A final set of options was developed based on public input and project team review (see Table ES1 at the end of this section for a list of the options that were selected).

- Monitoring Plan: In order to assess progress toward reducing chinook salmon habitat degradation and to meet requirements under the ESA Section 4(d) Rule, the project team prepared a comprehensive monitoring plan. The monitoring program closely followed the requirements outlined in the ESA 4(d) Rule. The monitoring plan would allow the City to assess progress toward meeting its habitat goals and compliance requirements. The plan had scientific and programmatic components. The programmatic component would evaluate the programs and program implementation outlined in the ESA 4(d) Rule Plan. It would focus on overall

program development and implementation that will take place during the life of the plan. The scientific component addressed specific protocols for collecting field data comparing the data against a standard or metric to determine progress. Combined, the monitoring plan would provide the City and NOAA Fisheries a method to track plan progress and effectiveness.

- Final Project Report: A final Salmon Response Plan Report was prepared that incorporated all the project team's work and products. This report outlined what had been accomplished and provided a strong base on which to move forward toward implementing the proposed options and preparing the ESA Section 4(d) Rule report to be submitted to NOAA Fisheries for compliance approval.

FUTURE STEPS

Before the City can submit its formal ESA 4(d) Rule plan to NOAA Fisheries the report identified key activities that need to be addressed. The following are a list of these key activities.

- Select and Implement ESA Options: the City Council will need to formally adopt the proposed ESA 4(d) Rule options identified in this report. NOAA Fisheries requires that the ESA program be implemented to demonstrate that it is complying with the ESA 4(d) Rule. A number of the options are already being implemented as part of other programs, but there are options that cannot be implemented until they are adopted by the City Council. Once formally adopted, the City will need to outline an implementation schedule and initiate implementation for those options that are note already underway.

- Initiate the Monitoring Program: the monitoring program will need to be activated to provide the feedback support necessary to assess program effectiveness.

- Land Development Code Update: the City is in the process of updating its land development code (LDC) to incorporate a number of environmentally sound programs and policies into its development standards. The Stormwater Master Plan, results of the Significant Natural Features (Goal 5) Project and the ESA Salmon Response Plan need to be incorporated into the LDC. By doing so the City can certify that relevant options have been incorporated into the land development standards.

- Comprehensive Plan Update: it will be important for the City to incorporate relevant elements into the City's comprehensive plan. A number of the identified options are related to City planning policies and zoning. While comprehensive planning revisions do not have to be completed, a process should be outlined or underway that the 4(d) Rule report can identify.

- Integration of ESA Plan and data, Stormwater Master Plan, and Significant Natural Features (Goal 5) data: there are two other related projects that should be integrated with the ESA Salmon Response Plan. While they may have been initiated under different authorities, they are related because they address water quality and natural resource features that the ESA program identifies as important for preserving and improving chinook salmon habitat. While there are a number of good reasons why they should be integrated, from the ESA 4(d) Rule program standpoint integration will demonstrate to NOAA Fisheries that the City is taking a comprehensive approach, which will increase the likelihood of success.

- National Environmental Policy Act (NEPA): according to NOAA Fisheries an environmental impact analysis will need to be prepared to accompany the ESA 4(d) Rule Plan submission. It is unclear at this point whether the environmental impact analysis will have to be prepared by the submitting jurisdiction (Corvallis) or by the federal agency. City staff and consultants met with NOAA Fisheries officials in late Fall 2002 and Spring 2003 to discuss the environmental documentation requirement. At that time NOAA Fisheries was considering the preparation of a programmatic environmental impact statement (EIS) that would address the ESA 4(d) Rule Limit 12 that Corvallis was to submit. NOAA Fisheries could not provide a completion date because they had not yet scheduled the EIS work. One option that NOAA Fisheries suggested was that the City could prepare the EIS on its own and submit it with the ESA 4(d) Rule. The environmental documentation would take the City some time and expense to prepare. As of the date of this report, the City has not decided whether they will prepare it.

- Prepare ESA 4(d) Report: Once the above key steps are completed the City will need to submit the ESA 4(d) Rule Report to NOAA Fisheries. The report must address how the City's program will meet each of the 12 limits outlined in the ESA 4(d) Rule Limit 12 (Municipal Commercial Residential Industrial or MRCI) development program. It will be important to demonstrate that all the programs combined satisfy all 12 limits.

These are the key future steps that will need to be taken to meet the City's goals and comply with the ESA 4(d) Rule. They will build on the foundation that has been prepared up to this point.

Table ES1. Considerations and Solution Options Matrix

Solution Option	LIMIT 12 CONSIDERATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Land Use												
Zoning	X	X	X	X	X	X	X	X	X	X	X	X
Development Standards	X	X	X	X	X	X	X	X	X	X	X	X
Park & Recreation												
Neighborhood Park Planning	X	X	X	X	X	X	X	X	X	X	X	X
Open Space & Recreation Service Plan	X	X	X	X	X	X	X	X	X	X	X	X

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Capital Improvement Plan	X	X	X	X	X	X	X	X	X	X	X	X
Park O&M Manual		X	X			X		X	X		X	X
Park Inventory	X	X	X	X	X	X	X	X	X	X	X	X
Existing Parks		X	X			X		X			X	X
Park Construction Retrofit	X	X	X	X				X	X	X	X	X
Mini Parks	X	X	X	X	X	X	X	X	X	X	X	X

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Specific Parks	X	X	X			X		X	X	X		X
Equipment Maintenance		X										X
Organic Debris Disposal		X				X			X		X	X
Construction Specifications								X				
On-site Construction Activities		X	X			X			X		X	X

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Construction Site Enforcement			X			X			X		X	X
Hazardous Materials		X							X			X
Pipe Commissioning		X							X			X
Erosion Control Ordinance		X	X		X	X	X		X		X	X
Sustainability	X	X	X	X	X	X	X	X	X	X	X	X

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Transportation												
Planning Elements	X	X	X	X	X	X	X	X	X	X	X	X
TDM			X	X		X					X	X
Transportation System Plan	X	X	X	X	X	X	X	X	X	X	X	X
CIP	X	X	X	X	X	X	X	X	X			X
Design Specifications		X				X		X	X			X

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Routine Rd. Maintenance - ESA Limit 10		X		X		X			X		X	X
Stormwater Planning & CIP	X	X	X	X	X	X	X	X	X	X	X	X
Erosion Control Ordinance		X	X		X	X	X		X		X	X
O&M		X	X			X		X	X			X
Monitoring											X	X

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Wastewater												
Wastewater Treatment											X	X
Facility Oils & Grease Program											X	X
Wastewater Collection,	X			X		X			X		X	X
O&M						X			X		X	X
Master Plan and CIP	X	X	X	X	X	X	X	X	X	X	X	X

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Discharge						X					X	X
Water												
Water Supply Conservation								X		X	X	X
Water Intake										X	X	X
Distribution	X			X		X			X	X	X	X
O&M						X			X		X	X

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Citizen Behavior Public Education Involvement	X	X	X	X	X	X	X	X	X	X		
Incentives		X	X			X		X		X		
Pollution Prevention	X	X	X		X	X	X	X	X	X	X	X
Landscaping			X		X	X	X	X		X		

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Household		X	X					X	X	X		X
Vehicle Maintenance		X	X									X
Riparian Areas		X	X		X	X	X	X	X	X		X

CHAPTER 1. INTRODUCTION

REPORT ORGANIZATION

This report outlines the regulatory compliance requirements, project history, and technical, policy, and public involvement work that the City of Corvallis, Oregon has undertaken to craft a response to the Endangered Species Act (ESA) listing of chinook salmon as threatened in the Upper Willamette River. Each chapter addresses a specific topic in the development of the City's ESA Salmon Listing Response Plan (Salmon Response Plan).

Brief Chapter Descriptions

Chapter I (Introduction) is a project overview. It briefly covers the project purpose, the ESA listed species, federal compliance requirements, the City's rationale for pursuing the ESA 4(d) Rule, project development history, and key tasks undertaken to develop the Salmon Response Plan.

Chapter II (ESA and Section 4(d) Rule Requirements) addresses the ESA. It provides a brief history of the ESA, the listing process, enforcement, and compliance options available to local agencies that have listed species within their jurisdiction. Chapter II also contains a detailed discussion of the 4(d) Rule and the guidance it provides for listed salmonids such as chinook salmon.

Chapter III (Project Structure) provides background information on the project. It outlines the City's demographics, project area, other related projects, and a brief history of the City's effort to prepare the Salmon Response Plan. Chapter III also describes the project structure used to prepare the Salmon Response Plan (e.g., two-phased approach, federal oversight, partnership with Benton County, the consultant team, local technical oversight and role of the public).

Chapter IV (Methodology) focuses on the methodology used to prepare the City's baseline salmon habitat conditions including the literature review, fieldwork and data collection process and analysis. It emphasizes the scientific rigor for determining existing conditions on which the Salmon Response Plan is based.

Chapter V (Baseline Conditions) addresses the baseline conditions and findings. It describes the development of the baseline conditions database that covers all streams and rivers in the project area. General descriptions of the existing conditions are provided for the reaches within the project area. The key findings focus on the historic and existing chinook salmon habitat in the project area.

Chapter VI (Pathways/Effects Analysis) focuses on the analysis of City activities and citizen behavior and how they influence chinook habitat. This chapter describes how existing City activities (planning, land development code, public infrastructure, transportation, parks and recreation, maintenance and operation, etc.) and citizen behavior (yard maintenance, recycling, etc.) impact the existing chinook salmon habitat conditions. This is the most

critical step in the project because it allows the City to identify activities that impact (positively and negatively) existing habitat as well as the degree and spatial distribution of the impact. The City has created a unique weighted pathways database to perform this work and analysis. The results of this analysis give the City the ability to rank activities according to their impact, setting the stage for developing solution options for those activities that have the greatest negative impact.

Chapter VII (Proposed Limit 12 Program Solutions) presents the proposed solution options based on the analysis in Chapter VI. Chapter VII contains extensive discussion on the development of the solution options as a product of the pathways/effects analysis and input from the Technical Advisory Committee (TAC), stakeholders, and general public (public meetings, surveys, comment forms). The solution options are identified and described.

Chapter VIII (Monitoring/Reporting) focuses on the proposed monitoring that will be performed to assess progress toward meeting the project goals of achieving properly functioning conditions (PFC). The monitoring will cover both the technical/scientific monitoring (field data collection, testing and analysis) and programmatic monitoring (how well the proposed options and programs are accomplishing the project goals).

Chapter IX (Public Involvement) describes the extensive public involvement used throughout the project. The project has relied on a multi-media approach including stakeholder and citizen meetings, news releases, e-mail announcements, fact-sheets, comment forms, and a special website devoted to the project.

Chapter X (Conclusion: Next Steps and Future Directions) contains a discussion of what the City will do to prepare a formal application for the ESA Section 4(d) Rule submission to the National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries). This discussion includes a schedule of other City activities that must be accomplished before the NOAA Fisheries application can be submitted.

Supporting materials are included. A Glossary and Bibliography are provided to define terms and identify source materials used throughout the project. An appendix of key reports, technical memoranda, and public education documents also is included. Finally, an electronic copy (compact disk) of the pathways database is provided. The database contains the weighting scores used to determine the relative impact City activities have on chinook salmon habitat in Corvallis.

PROJECT PURPOSE

The City initiated the Salmon Response Plan project during the summer of 2000. The plan was to comply with protection regulations surrounding the listing of chinook salmon as a threatened species under the ESA (March 1999). At that time, the range for the Upper Willamette River Spring Chinook Salmon evolutionary significant unit (ESU) was identified by NOAA Fisheries. The City is located within the range of the ESU (Figure 1). From that date forward local jurisdictions were held responsible for preventing further degradation of chinook salmon habitat.

Figure 1. Chinook Salmon Evolutionarily Significant Unit (ESU) Map

See separate file

The purpose of the project is to identify activities (both City and citizen) that have negative impacts on chinook salmon habitat and develop a plan to, at a minimum, prevent further degradation. The long-term goal of the project is to implement activities that put fish habitat in city creeks and rivers on a trajectory toward PFC.

Project Rationale

The City has embarked upon this effort for two reasons. First, the City administration (elected officials) and its residents believe they have a responsibility to help maintain the natural environmental processes critical to the environmental health and quality of life in the Willamette River Valley and state of Oregon. This responsibility is reflected in many of the City's previous and ongoing activities; from the preservation of open space and natural resources, reduction of stormwater run-off and contamination of local streams, preservation of the Willamette River waterfront, participation in other environmental planning efforts (e.g., State-wide Goal 5 Significant and Natural Features Inventory projects), to the high degree of citizen participation in the city's recycling programs. Participation in the preservation of chinook salmon habitat is consistent with the City's position to take actions that contribute to overall environmental and community health.

Second, the City administration has a fiduciary responsibility to its residents to protect their interests through responsible decision-making and actions. Such decisions apply to the ESA listing of chinook salmon where the City has compared the costs and benefits of complying with federal rules and the protections that compliance offers to the potential risks, liabilities and costs of non-compliance. The City has determined that compliance with the federal rules governing chinook salmon habitat, specifically the ESA Section 4(d) Rules, to be more beneficial than potentially costly third-party law suits challenging the City to demonstrate compliance with these federal rules.

ENDANGERED SPECIES ACT: THE SECTION 4(D) RULE AND REGULATING AGENCY

The controlling federal legislation is the ESA, which was passed in 1973 (see Chapter II). Species listed under the ESA are subject to special regulations designed to protect them from extinction. A jurisdiction that fails to provide adequate protection may be subject to federal intervention or third-party legal challenge to demonstrate that the jurisdiction is providing sufficient protections to meet the requirements of the ESA. Should a jurisdiction fail to demonstrate that it is protecting the listed species, that jurisdiction could be subject to civil and criminal penalties (ESA Section 9).

There are specific ESA sections that provide guidance for complying with the ESA (i.e., Sections 10, 7, and 4). Concerning listed salmonids in streams and rivers in the northwestern United States, the federal government has developed a set of guidelines under ESA Section 4(d), which jurisdictions can follow to ensure compliance.

In July 2000, NOAA Fisheries, the federal agency with regulatory authority for marine species including anadromous fish, published the final ESA Section 4(d) Rules for protection of listed salmonids in the northwestern United States (including Upper Willamette Spring Chinook Salmon). Importantly, the ESA Section 4(d) Rules allow incidental take as long as the local jurisdiction can ensure that, overall, it will not create any "jeopardy" to a listed species of becoming either endangered or extinct. These rules, developed specifically for listed northwestern salmonids, provide options for jurisdictions to obtain an incidental take permit from NOAA Fisheries for its activities. This permit ensures compliance with the ESA and provides protection in the event of legal challenges by the federal government and/or other parties.

CORVALLIS ESA RESPONSE PLAN HISTORY

The City initiated a formal response to the listing of chinook salmon in the Summer of 2000 when it began the project to identify chinook habitat, City and citizen activities that could degrade habitat, and solution options to protect chinook habitat from further degradation. In the years leading up to the project, the City had become aware of the potential for chinook to be listed as threatened under the ESA and the requirements to comply with ESA.

City officials supported state and region-wide efforts to protect salmon. They participated in the "Oregon Plan for Salmon and Watersheds", which was a state-lead effort to address declining populations of salmon with a pro-active, coordinated effort for restoration of the state's salmon habitat that included federal and state agencies, local jurisdictions, and community-based groups in the process. The City became a member of the Willamette Restoration Initiative (WRI), whose goal was to coordinate efforts to protect and restore the health of the Willamette River watershed.

Locally, the City had initiated several efforts that both highlighted potential fish habitat problems and proposed a number of rehabilitation measures. The City's comprehensive stormwater management planning effort identified potential water quality problems from untreated stormwater run-off to streams. While the City funded an extensive combined sewer overflow (CSO) project to capture and treat wastewater and stormwater run-off from the older areas of the community that previously discharged untreated stormwater to the Willamette River, it also recognized that other unprotected streams would continue to be contaminated without additional policy and development changes. In addition, the City was beginning to prepare for the periodic review of the its Comprehensive Plan, which required extensive inventories of its environmental resources, including fish habitat in city streams.

City residents were also aware of the declines of salmonid populations in the northwest and generally were supportive of efforts to seek solutions to restore fish habitat. Among the evidence of such support was an annual random survey of residents that the City conducted to measure service effectiveness. While residents traditionally favored the City's environmental programs, in 1999 specific questions were included in the survey regarding

the recently ESA-listed chinook salmon. Though no specific actions were identified, residents responded overwhelmingly positively to the need to support City activities that address chinook salmon habitat, even if it required modification of city services (wastewater treatment, water supply, stormwater management, etc.) and land development regulations.

The City budgeted for a multi-year project to develop an Salmon Response Plan. The Plan would assess chinook salmon habitat in streams within the its urban growth boundary (UGB), and develop a response plan based on sound science that would 1) prevent further chinook salmon habitat degradation and 2) eventually put the habitat on a trajectory toward PFC. The City hired a team of consultants with expertise in the ESA, chinook salmon biology and ecology, and the recently implemented ESA Section 4(d) Rules. The project was initiated in the Fall of 2000 (see project area map in Figure 2).

KEY PROJECT TASKS

The project's scope of work outlined a two-phased approach that coordinated the efforts of the City's TAC, the public (both stakeholders and general public), and the consulting team. The City recognized that project success hinged on significant communication between the City and NOAA Fisheries. Communication began in the project's early stages to ensure that the City received the benefit of guidance from the agency which would receive the City's report and provide the incidental take permit under ESA Section 4 (d). Frequent communication continued throughout the entire project.

Phase One of the project developed a comprehensive environmental baseline documenting the existing conditions of city streams for chinook salmon habitat. A pathways/effects analysis assessed the impact of City activities and citizen behavior on chinook salmon habitat.

Phase Two used the pathways/effects analysis to determine the degree and geographic distribution of City activities and citizen behavior that negatively impacted habitat. Activities were weighted and ranked according to their impact in order to identify solution options to prevent further habitat degradation and eventually restore PFC.

The combined effort of the two-phased approach would be the preparation and submission of an ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial, and Industrial Development Program) application to NOAA Fisheries. The application would document the City's understanding of chinook salmon habitat, City activity and citizen behavior impacts, and solutions that would be implemented to meet ESA requirements.

Figure 2. Corvallis Salmon Response Plan Project Area

See separate file

To accomplish this project the following key tasks were completed:

- Development of an existing conditions database (existing sources and field data collection).
- Production of a geographic information systems (GIS) map of city streams with a 400-foot riparian corridor evaluation area (200 feet on each side of the top of bank).
- Creation of a pathways/effects evaluation of City activities (e.g., public infrastructure and services, transportation, operations and maintenance activities, parks and recreation, land use planning etc.) and citizen behavior (e.g., household activities, yard maintenance, home auto repairs, etc.).
- Preparation and submittal of the Phase One report "Baseline Habitat Evaluation and Evaluation of Impacts of City Activities" to NOAA Fisheries (approved by NOAA Fisheries in January 2002).
- Development of a database of weighted data that compared the pathways/effects analysis of City activities and citizen behavior against the baseline conditions database to determine the degree of chinook salmon habitat impact and its distribution.
- Development of solution options to prevent further degradation of chinook salmon habitat.
- Development of solution options to put the City on a trajectory toward achieving PFC in its streams.
- Development of a monitoring program.
- Preparation of a final report combining both phases of the project into a single report for submission to NOAA Fisheries.
- Provide extensive public involvement activities throughout the project (stakeholder and open house meetings, press releases, comment forms, project website, etc.) to ensure public understanding of the project and to provide the general public with an opportunity for input.

CHAPTER 2. ESA AND THE 4(D) RULE

INTRODUCTION

Since the project is driven by the ESA, it is important that the reader have a basic understanding of the ESA and how it applies to the Salmon Response Plan. The following sections briefly describe the ESA including its purpose, the listing process, enforcement, and the compliance options available to local agencies, which can impact listed species within their jurisdictions. This chapter concludes with a more detailed discussion of the 4(d) Rule and the guidance it provides for listed salmonids.

A BRIEF HISTORY OF THE ESA

Since its passage in 1973, the ESA has become the most important environmental legislation for the protection and conservation of plant and animal species. The ESA is a federal action that is designed to prevent the extinction of wildlife, fish and plants. The ESA covers the listing and delisting process, prohibited activities; enforcement and penalties for violators, exceptions to the ESA, and importantly for Corvallis, guidelines for protecting and conserving threatened species.

The primary motivation for the Act's passage was the recognition that economic growth and development was responsible, in part, for species extinction. The Act's findings stated that previous species extinction was the "consequence of economic growth and development untempered by adequate concern and conservation." The Act's findings further stated that fish, wildlife, and plants were of "esthetic, ecological, educational, historical, recreational, and scientific value to the Nation [and international community] and its people." To conserve species and prevent future extinctions, the United States Congress passed the ESA with sweeping powers to, "provide a program for the conservation of such endangered species and threatened species…" and that <u>all</u> "…Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act."

Threatened and Endangered: Important Distinctions

There are two important designations under the ESA, endangered and threatened, each having different prohibitions and restrictions. An endangered species is defined as, "any species which is in danger of extinction throughout all or a significant portion of its range other than a species of the Class Insecta determined by the Secretary [of Commerce] to constitute a pest whose protection under the provisions of this Act would present an overwhelming and overriding risk to man." A species that is listed as threatened, on the other hand, is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

The two designations differ significantly with respect to the prohibited activities. While both are subject to the "take"[1] prohibitions (Section 9 Prohibited Acts), those for endangered species are significantly more restrictive because of the potential for extinction. Essentially, any human-related activity that could result in extinction of the species outside of self-protection (an act of self-defense by humans) from an endangered species is considered unlawful. Included in these prohibitions are the sale and trafficking (importing, exporting), possessing, and violation of any regulation pertaining to the endangered species.

There are exceptions to these prohibitions. Incidental take of an endangered species may be permitted as long as it does not create jeopardy. That is, the take of the endangered species does not result in the species' extinction. Therefore, ESA Sections 7 (Interagency Cooperation) and 10 (Exceptions) allow the "take" of species listed as threatened or endangered, as long as there is no possibility that it will become extinct.

Prohibited activities under the threatened species designation are subject to the same ESA sections, though they are somewhat less restrictive. Like endangered species, there are incidental take prohibitions, but there are also exceptions. The exceptions are significantly more flexible than those for endangered species. Incidental take can happen only if it does not result in jeopardy. That is, that the take will not result in a threatened species becoming endangered.

What differs between the two designations is the application of Section 4(d) Protective Regulations. Section 4(d) only applies to threatened species. It gives the Secretary of Commerce sweeping authority to prepare any regulations necessary to conserve (save) a listed threatened species including, under certain circumstances, allowing exemptions from prohibited activities in other sections of the ESA such as Section 9(a)(1). Section 9(a)(1) lists prohibited activities for listed threatened species including importing/exporting, transporting, selling, damaging/destroying, or violating any regulation related to a threatened species promulgated by the Secretary of Commerce.

ESA Listing Process

Listing of species under the ESA is a three-step process (ESA Section 4). In the first step, a species review is triggered by a petition to the Secretary of Commerce claiming other laws and regulations have not sufficiently protected the species, and ESA protection is warranted. The petition must present the scientific evidence leading to that conclusion. A biological review team (BRT) is formed and a "status review" conducted. This review has at least five possible outcomes. The BRT may conclude that there is insufficient cause for listing and reject the petition, that the petition has presented insufficient evidence for listing and reject the petition, or that the evidence is insufficient for listing but the species should

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[1] The term ''take'' in the ESA means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."

be designated as "candidate" and re-examined in five years. Should the BRT find that listing is warranted, it may either decide that, while listing is warranted, other species have greater urgency and so the species in question will not be listed at this time, or that listing is necessary.

In the second step, there is additional scientific review and public comment for the proposed listing of the species. At this time other governmental agencies are "obligated" by Section 7 of the ESA to consult with the regulatory agency (e.g., NOAA Fisheries, U.S. Fish and Wildlife Service) on any projects involving federal actions (including funding) to protect the proposed species and its habitat. Federal regulations, however, do not yet apply to state and local authorities because the species has not been formerly listed.

In the third step, the ESA lists the species when scientific review and public comment in the second step warrant further protections. At this point state, local and private citizens along with federal government agencies are all required by Section 7 of the ESA to consult with the federal regulatory agencies on any federal actions that may impact the listed species. The Section 7 consultation process ensures, for a specific project, that the listed threatened species is not in jeopardy of becoming endangered and the listed endangered species is not in jeopardy of becoming extinct. Through the consultation process a proposed project may be modified, altered, or even prevented depending on the federal agency's determination of impact on the listed species.

Chinook Salmon Listing History

The ESU for Upper Willamette Spring Chinook Salmon was listed as threatened on March 24, 1999. The final determination to list these salmon as threatened came after a year of scientific analysis and public comment. During that time NOAA Fisheries reviewed the potential listing of eight chinook salmon stocks along the west coast of the United States. In March 1999, three other chinook stocks also were listed under the ESA, two as threatened and one as endangered (Federal Register March 24, 1999). Decisions on the remaining chinook stocks were postponed for six months in order to extend the review period.

At the time of the listing NOAA Fisheries also was required to designate critical habitat for Upper Willamette Spring Chinook Salmon (ESA Section 4(a)(3)(A)). Critical habitat as defined in the ESA is ''(i) the specific areas within the geographical area occupied by the species...on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species...upon a determination by the Secretary [of Commerce] that such areas are essential for the conservation of the species.'' (ESA Section 3(5)(A)).

NOAA Fisheries postponed designation of critical habitat in March 1999 because of the number of comments received regarding critical habitat area. Critical habitat was finally designated on February 16, 2000 (Federal Register Vol. 65, No. 32). The critical habitat designation for Upper Willamette Spring Chinook Salmon, as well as for 18 other salmon stocks, were then voluntarily vacated April 30, 2002 in response to litigation challenging the process by which critical habitat was established.

To date, the critical habitat designation is still vacated pending the review of the critical habitat designation process by NOAA Fisheries. Upper Willamette Spring Chinook Salmon remains listed as threatened under the ESA and jurisdictions must still demonstrate that they are conserving habitat under other federal legislative mandates (i.e., Magnuson-Stevens Act of 1996).

Section 4(d) Rules

As was noted in a previous section of this chapter, the federal government has flexibility to issue regulations that allow exceptions to the take prohibition. There are three Sections of the ESA that guide the type of exceptions that may be allowed for a listed threatened species designation. Section 4(d) is one of the ESA sections that provides regulatory flexibility when the Secretary of Commerce deems it is "necessary and advisable to provide for the conservation of such [as listed threatened] species." NOAA Fisheries has used this section to develop specific rules for listed anadromous fish, including Upper Willamette Spring Chinook Salmon, to provide guidance to jurisdictions on how to demonstrate conservation of these listed species' habitat.

NOAA Fisheries formally adopted the Section 4(d) Rules on July 10, 2000 (Federal Register Vol. 65, No. 132). The Rules identified activities that NOAA Fisheries believed might constitute a "take" of listed species. The Rules also identified activities that "conserve" listed species; that is, activities conducted pursuant to NOAA Fisheries-approved land use regulations. The Rules identified 13 activities or programs that NOAA Fisheries believed limited impacts on salmonid species, so that additional protection through application of ESA Section 9 would be unnecessary.

NOAA Fisheries intended to use the 4(d) Rule process as a way to encourage governments to review their regulations and make changes to ensure activities conducted pursuant to such regulations did not cause a "take." NOAA Fisheries actively encouraged and was "interested in working with local jurisdictions to develop programs that protect endangered and threatened species and their habitats and to recognize such programs through 4(d) Rules exceptions or other mechanisms." (*ESA and Local Governments: Information on 4(d) Rules*, NOAA Fisheries, 2000).

The 4(d) Rules set forth an administrative process whereby governmental entities could except their land use and water quality regulations from ESA restrictions. In practical language, NOAA Fisheries recognized that implications of the listed species were for the first time mainly on urban rather than rural areas. Therefore, certain activities such as

urban development, the delivery of urban services (e.g., public infrastructure, operations and maintenance, etc.) and citizen behavior as well as the history of urban development and activities were very complex and would likely violate Section 9 take prohibitions. In order to both comply with the ESA, but still allow for the continued activities that were primarily urban in nature, there had to be some guidance for local jurisdictions to demonstrate compliance. The Section 4(d) Rules provided that guidance.

Further, NOAA Fisheries recognized that the 4(d) Rules "did not require states, local governments, or private parties to change their practices to conform to any of the take limits described in the final rule. However, the limits provided one way to be sure an activity or program did not risk violating the take prohibitions. Simply because a program was not within a limit *does not* mean that it automatically violated the ESA, but that a program or jurisdiction would risk ESA penalties if the activity in question took a listed fish. By qualifying for a limit, governments and individuals received assurance that their activities, when implemented in accordance with the criteria in the 4(d) Rules, did not violate the take prohibitions and would not be subject to enforcement actions." In other words, NOAA Fisheries could not charge a jurisdiction or individual with violating the take prohibitions if they were complying with an approved 4(d) Rule plan.

Description of the 13 Limits

The 13 limits cover a broad number of categories where take may occur, including:

- Scientific research conducted or supervised by, or coordinated with, state fishery agencies
- Fish harvest activities
- Artificial propagation programs
- Habitat restoration based on watershed plans
- Properly screened water diversions
- Routine road maintenance
- Municipal, residential, commercial, and industrial development and redevelopment
- Forest management practices in the State of Washington

To help guide local jurisdictions through the 4(d) Rule compliance process, NOAA Fisheries has also issued the *Implementation Binder for Threatened Salmon and Steelhead on the West Coast* (September 22, 2000). The Binder outlines the steps for evaluating the need for a limit, the limit to be submitted, the contents of the limit documentation and the submittal process (See Appendix 1 for a copy of the revised Binder)

The following briefly addresses each of the 13 limits under the ESA Section 4(d) Rules (descriptions are from the *4(d) Rule Implementation Binder for Threatened Salmon and Steelhead on the West Coast*, September 22, 2000). Not all apply to the City of Corvallis

and their ESA program. The City is in the process of submitting an application for Limit 9 (Water Diversion Screen for the Taylor Water Treatment Plant Intake Pump Station), will submit an application for Limit 12 (Municipal, Residential, Commercial, and Industrial Development Program) following the Land Development Code Phase III Update process, and is considering an application for a Limit 10 (Routine Road Maintenance).

Limit 1 – ESA Permits

This limit recognizes that those holding permits under Section 10 of the ESA (or receiving other exemptions under the ESA) are not prohibited from take that is in accordance with the permit or applicable law. A Section 10 permit (e.g., Habitat Conservation Plan) allows a jurisdiction to take listed fish based on the plan and not be in violation of the ESA.

Limit 2 – Ongoing Scientific Research

NOAA Fisheries allowed a temporary, one-time limit on the ESA take prohibitions to allow scientific activities to continue until March 7, 2001. Authorization under this limit did not remove a researcher's obligation to obtain any additional state, tribal, or federal permits. Nor did this limit remove the need for federal researchers to consult with NOAA Fisheries under Section 7 of the ESA.

Limit 3 – Rescue and Salvage Actions

This limit relieves certain agency and official personnel (or their designees) from the take prohibitions when they are acting to aid an injured or stranded fish or salvage a dead fish for scientific study.

Limit 4 – Fishery Management

Allows the take of listed fish in fisheries if a fishery management agency develops a Fisheries Management and Evaluation Plan (FMEP) and NOAA Fisheries approves it. Some benefits of the FMEP approach are long-term management planning, more public involvement, less government paperwork, and more certainty that there will be fishing opportunities in the future.

Limit 5 – Artificial Propagation

Hatcheries can be managed in a manner that conserves and recovers listed salmon and steelhead. The 4(d) Rules do not prohibit the take of listed fish for a variety of hatchery purposes if a state or federal hatchery management agency develops a Hatchery and Genetics Management Plan (HGMP) and NOAA Fisheries approves it.

Limit 6 – Limits on the Take Prohibitions for Joint Tribal/State Plans Developed under the United States v. Washington or United States v. Oregon Settlement Processes

NOAA Fisheries includes this limit on the take prohibitions to accommodate any resource management plan developed jointly by the states and the tribes (joint plan) under the jurisdiction of *United States v. Washington* or *United States v. Oregon*. Such a plan would be developed and reviewed under the government-to-government processes outlined in the final 4(d) Rule for Tribal Resource Management Plans.

Limit 7 – Scientific Research Activities Permitted or Conducted by The States

The 4(d) Rule allows take for specific scientific research activities undertaken by states. Coverage under the limit requires that the state fishery agencies either conduct or oversee research/monitoring efforts, or become involved in coordinating those efforts. In addition, compliance with the limit will require that the state fishery agencies submit annual reports describing research-related take for each of the affected ESUs.

Limit 8 – Habitat Restoration

The final 4(d) Rule provides that take prohibitions will not apply to habitat restoration activities that are part of a watershed conservation plan that the state of Washington, Oregon, Idaho, or California has certified to be consistent with the state's watershed conservation plan guidelines.

Limit 9 – Water Diversion Screening

Water diversions that operate without adequate screens to block fish access are widely known to kill salmon and steelhead. Juveniles may be sucked or attracted into diversion ditches or pipes where they later die from a variety of causes (e.g., stranding, hydropower production, drinking water treatment, etc.). In addition, juveniles are often injured or killed when caught in pumping facilities or forced against screens. Adult and juvenile salmonid migration may also be impaired by diversion structures such as push-up dams.

The 4(d) Rule does not apply take prohibitions provided that NOAA Fisheries engineering staff, or any resource agency or tribal representative NOAA Fisheries designates as an authorized officer, has agreed in writing that the diversion facility is screened, maintained, and operated in compliance with NOAA Fisheries' Juvenile Fish Screening Criteria or, in California, in compliance with NOAA Fisheries' Southwest Region Fish Screening Criteria for Anadromous Salmonids. If a diversion is screened, operated, and maintained in a manner consistent with those criteria, adequate safeguards will be in place and no additional federal protection is necessary or advisable for conserving listed fish.

The City of Corvallis prepared a Limit 9 application for replacement of its Taylor water intake diversion screen on the Willamette River. The water diversion screen was replaced during the summer and fall of 2004.

Limit 10 – Routine Road Maintenance

NOAA Fisheries does not find it necessary or advisable to apply take prohibitions to routine road maintenance activities provided that: (1) the activity constitutes routine road maintenance conducted by Oregon Department of Transportation (ODOT) employees (or their agents) that complies with ODOT's *Transportation Maintenance Management System Water Quality and Habitat Guide* (ODOT Guide, July 1999); (2) it is conducted by the employees or agents of a state, county, city, or port under a program that complies substantially with the ODOT Guide and has been determined to meet or exceed the protections provided by the ODOT Guide; or (3) it is conducted by the employees or agents of a state, county, city, or port in a manner that has been found to contribute to PFC.

For a state, city, county, or port program that is equivalent to the ODOT program (or any of its amendments) to qualify under Limit 10, it must be approved in writing by the NOAA Fisheries Northwest or Southwest Regional Administrator, whichever is appropriate. Any jurisdiction desiring its routine road maintenance activities to qualify under this limit must have adopted road maintenance guidelines equivalent to or better than the ODOT program and commit in writing to apply these management practices.

The City of Corvallis is considering a submission of a Limit 10 application. The City considers its routine road maintenance program equal to the ODOT Guide and in many cases exceeds ODOT practices. In addition, NOAA Fisheries has encouraged the City to submit a Limit 10 based on the Salmon Response Plan Phase One report, *Baseline Habitat Evaluation and Evaluation of the Impacts of City Activities* (February 2002).

Limit 11 – Portland Parks Integrated Pest Management

After carefully analyzing the City of Portland's Parks and Recreation (PP&R) integrated program for pest management, NOAA Fisheries concludes that it addresses potential impacts and provides adequate protection for listed fish. NOAA Fisheries does not find it necessary or advisable to apply additional federal protections in the form of take prohibitions to PP&R activities conducted under the Pest Management Program.

This limit only covers the City of Portland. The City has worked closely with NOAA Fisheries to develop a program that covers their activities. NOAA Fisheries has not expanded it to allow other jurisdictions adopt their program as they have for Limit 10.

Limit 12 – Municipal, Residential, Commercial and Industrial Development and Redevelopment

The City will submit an application under Limit 12. The Municipal, Residential, Commercial and Industrial (MRCI) limit application is complicated because it covers many of the diverse activities that a city provides. Through the 4(d) Rule, NOAA Fisheries identifies a mechanism whereby cities, counties, and regional governments can ensure that MRCI development and redevelopment authorized within those areas is consistent with ESA requirements. The challenge is to be able to provide adequate protections to prevent

Upper Willamette Spring Chinook Salmon from becoming endangered, which at the same time allows local jurisdictions enough flexibility to continue to conduct their business. The 4 (d) Rules allow this as the take prohibitions do not apply to MRCI development or redevelopment governed by and conducted in accordance with city, county, or regional government ordinances or plans that NOAA Fisheries has found to adequately protect listed species.

NOAA Fisheries has developed 12 criteria by which a Limit 12 application will be evaluated. The following criteria will be applied by NOAA Fisheries when evaluating the MRCI program plans and ordinances:

- Avoid development in inappropriate areas (e.g., steep lopes, wetlands, riparian areas)
- Avoid stormwater discharge impacts to water quality, quantity and the watershed hydrograph
- Provide riparian area management that adequately maintains properly functioning conditions and mitigates unavoidable damage
- Avoid stream crossings by roads, utilities, etc., when possible, and minimize impacts where crossings are unavoidable through choice of mode, sizing, and placement
- Protect historical stream geomorphology and avoid hardening of banks and shorelines
- Protect wetlands and wetland functions
- Preserve hydrologic capacity of all streams, permanent and intermittent, to pass peak flows
- Provide for and encourage use of native vegetation for landscaping to reduce water, pesticide and herbicide use
- Ensure water supply demands can be met without having a negative impact on flows, directly or through influences on groundwater. Any new diversions should be placed and screened in such a way as to prevent injury to and/or death of salmonids
- Provide necessary enforcement, funding, reporting, and implementation mechanisms and formal plan evaluations at no greater than 5 year intervals
- Comply with all other state and federal environmental and natural resource laws
- Provide NOAA Fisheries with annual reports regarding implementation and effectiveness

Limit 13 – Forest Management in Washington

NOAA Fisheries has determined that it is not necessary to apply take prohibitions to non-federal forest management activities conducted in the State of Washington provided that: (1) the action complies with adopted forest practice regulations that NOAA Fisheries has found to protect habitat functions at least as well as the regulatory elements of the Forests and Fish Report (FFR); and (2) the activity also implements all non-regulatory elements of the FFR.

CHAPTER 3. PROJECT STRUCTURE

INTRODUCTION

When the City of Corvallis decided to undertake a project to address the ESA and prepare an application using the Section 4 (d) Rules as guidance, the City involved itself with a process not previously accomplished. Few other local jurisdictions had evaluated the impact of their activities on listed salmonids in the Pacific Northwest. In jurisdictions that attempted to do so (e.g., Clark County, Washington; Clackamas County, Oregon; and the City of Sandy, Oregon) such attempts were considered inadequate by NOAA Fisheries. Without a template or road map to follow, the City had to develop a new and innovative approach if it wanted to meet the compliance requirements.

This chapter addresses the innovative project structure that the City developed to assess the baseline fish habitat conditions, evaluate city and citizen impacts on fish habitat, and identify and implement solutions that protect habitat and actually put habitat on a trajectory toward achieving PFC. The following project elements are addressed:

- Project area
- Data collection area and reach definition;
- Task structure of the two-phased project;
- Project team, coordination and oversight, project team management, Urban Services Committee (USC), Technical Advisory Committee (TAC), professional consultant,
- Agency/jurisdiction coordination (NOAA Fisheries and other regulating agencies), local jurisdiction coordination (i.e., Benton County, Oregon State University, other jurisdictions); and
- Public involvement (e.g., residents, interested public, conservation groups, business groups, etc.).

PROJECT AREA

When Corvallis was identifying the project boundary, it considered the area within the City limits and immediately outside the city limits within the urban growth boundary (UGB) as important to the project. While UGB land was in Benton County, because of the influence the City exerted on the surrounding county land and development activities, the City felt that the entire UGB should be included as part of the project area (see Figure 2 in Chapter 1).

This expanded City project area had advantages. First, the larger area allowed the City to address a much larger part of the watershed. Including the UGB doubled the project area to approximately 17,900 acres (8,962 for the UGB, 8,942 for the City). Second, the project would extend cooperation between the two jurisdictions to include environmental activities. Third, solution options and programs requiring joint implementation would

more likely be successful if both jurisdictions participated in the project. Finally, cooperation between jurisdictions would meet one of NOAA Fisheries main goals, which was to encourage collaborative efforts to address salmon habitat protection.

DATA COLLECTION AREA AND REACH IDENTIFICATION

One of the main tasks of the project was to create an environmental baseline or existing conditions database that accurately described the chinook salmon habitat in the project area. Accomplishing this task required a review of existing data and information, identification of data gaps and fieldwork to fill the data gaps.

A critical concern for developing the environmental baseline was related to the areas that were to be surveyed. What steams would be included, how would the data be organized and, for efficiency purposes, could the project rely on previous or on-going City environmental projects to minimize duplication of effort?

Stream Corridor Width and Basin Organization

One of the first steps was to determine the research area to be studied. While the project would obviously review and collect data on all water-courses (streams and rivers) within the project area, how far back from the top-of-bank would be reasonable to conduct research and collect data? Guidance on the width of the investigation area came from a NOAA Fisheries discussion on salmonid critical habitat (Federal Register February 16, 2000).

Salmonid research suggested that the most significant area of habitat influence on salmon habitat was the riparian area as it provides shade, sediment transport, nutrient or chemical regulation, stream bank stability, and input of large woody debris or organic matter. While the literature varied on how wide the riparian area should be (varying from 300 feet to formula based on the length of one "site potential" tree), there was agreement that widths should be wide enough to capture these important habitat-sustaining functions. NOAA Fisheries also recognized that different land uses and activities (e.g., urban land types, development, agriculture, etc.) could severely diminish the riparian area's habitat sustaining functions.

The project team decided that although much of the project area was impacted by urban land uses, which reduced the width of a riparian area's habitat-sustaining function, they were concerned about evaluating as much of the potential riparian area as reasonable, even if it did not currently provide chinook habitat-sustaining functions. Therefore, a 400-foot-wide corridor (200 feet from top of bank on both sides of the watercourse) was selected as the area of research. The project team considered this a reasonable corridor width because it would ensure developing a database covering any future buffer width restrictions that NOAA Fisheries could require for ESA compliance. Data collected from within this 400-foot width also would be useful in meeting the Oregon statewide Goal 5 (Open Spaces, Scenic and Historic Areas and Natural Resources Goal) significant natural features identification project objectives.

The project team also decided to organize the project and existing conditions database around the stormwater basins used for the Stormwater Master Plan (SMP). The SMP had divided the City into a series of stormwater basins. All work on the SMP from data collection to project improvement identification was categorized into these stormwater basins. By using the same format the ESA project had a ready-made template for data collection and analysis, as well as the ability to tie any future ESA solution options that were stormwater-related directly into the SMP to satisfy multiple objectives.

Reach Identification

In order to be able to accurately describe chinook salmon habitat, the project area was divided into discrete sections. This allowed for the collection and assembly of the data, and assessment of the varying conditions across the area. The major watercourses (Mary's and Willamette Rivers, and Dunawi [formerly known as Squaw Creek], Oak, and Dixon Creeks) were divided into 27 reaches. For study purposes, stormwater basins that either did not have one of the listed watercourses or had a watercourse above the Jackson Frazer Wetland, which acted as a natural barrier to fish passage, were each categorized as a reach. A total of 42 reaches were identified.

Reach boundaries along the watercourse were determined by break in riparian community structure (e.g., development features such as roadway intersections and bridge crossings, changes in land use, changes in riparian vegetation from native to non-native, and natural features such as creek confluences). Preliminary reach boundaries were identified by aerial photography. These were then "ground-truthed" and refined during fieldwork data collection. The SMP stormwater basin boundaries were used for the stormwater basin reaches. Table 1 defines the reaches and boundaries for the watercourses and Figure 3 displays the reaches that were used in this evaluation.

Table 1. Reach/Stormwater Basin Approximate Boundaries

Reach	Description	Approx. Beginning	Approx. End
DCR1	Dixon Creek Reach 1	Willamette River	SW 9th Ave
DCR2	Dixon Creek Reach 2	SW 9th Ave	NW Garfield
DCR3	Dixon Creek Reach 3	NW Garfield	NW Circle Blvd
DCR4	Dixon Creek Reach 4	NW Circle Blvd	Walnut Blvd
DCWF	Dixon Creek West Fork	Walnut Blvd	UGB
DCEF	Dixon Creek East Fork	Walnut Blvd	Headwaters
DCMF	Dixon Creek Middle Fork	Walnut Blvd.	UGB boundary

Table 1. Reach/Stormwater Basin Approximate Boundaries

Reach	Description	Approx. Beginning	Approx. End
OCR1	Oak Creek Reach 1	Mary's River	Hwy. 20
OCR2	Oak Creek Reach 2	Hwy. 20	SW Jefferson Ave
OCR3	Oak Creek Reach 3	SW Jefferson	Walnut Blvd
OCR4	Oak Creek Reach 4	Walnut Blvd	UGB
OCNTR1	Oak Creek North Tributary Reach 1	Walnut Blvd	0.75 mile upstream
OCNTR2	Oak Creek North Tributary Reach 2	0.75 mile upstream	Walnut Blvd
OCNTR3	Oak Creek North Tributary Reach 3	Walnut Blvd	UGB
OCNTWF	Oak Creek North Tributary West Fork	Walnut Blvd	UGB
DuCR1	Dunawi Creek Reach 1	Mary's River	Brooklane Dr/ Stratton Way
DuCR2	Dunawi Creek Reach 2	Brooklane Dr/ Stratton Way	0.25 mile upstream
DuCR3	Dunawi Creek Reach 3	0.25 mile upstream	SW 35th Ave
DuCR4	Dunawi Creek Reach 4	SW 35th Ave	Confluence S & N Fork Dunawi Creek
DuCNFR1	Dunawi Creek North Fork Reach 1	Confluence S & N Fork Dunawi Creek	Hwy 20
DuCNFR2	Dunawi Creek North Fork Reach 2	Hwy 20	NW 63rd St
DuCNFR3	Dunawi Creek North Fork Reach 3	NW 63rd St	UGB
DuCSFR1	Dunawi Creek South Fork Reach 1	Confluence S & N Fork Dunawi Creek	Sunset Park

Table 1. Reach/Stormwater Basin Approximate Boundaries

Reach	Description	Approx. Beginning	Approx. End
DuCSFR2	Dunawi Creek South Fork Reach 2	Sunset Park	Walnut Blvd
DuCSFR3	Dunawi Creek South Fork Reach 3	Walnut Blvd	UGB
MRR	Mary's River Reach	Willamette River	UGB
WRR	Willamette River Reach	Entire east project boundary	
Adams Jefferson	Adams Jefferson	Stormwater MasterPlan (SMP)	SMP
Dry Creek	Dry Creek	SMP	SMP
Fillmore	Fillmore	SMP	SMP
FRAZIER	Frazier Creek	SMP	SMP
Garfield	Garfield	SMP	SMP
Goodnight	Goodnight	SMP	SMP
JACKSON	Jackson Creek	SMP	SMP
LEWISBURG	Lewisburg	SMP	SMP
Madison	Madison	SMP	SMP
Mill Race	Mill Race	SMP	SMP
North East Corvallis	North East Corvallis	SMP	SMP
Ryan Creek	Ryan Creek	SMP	SMP
SEQUOIA	Sequoia Creek	SMP	SMP
Village Green	Village Green	SMP	SMP
Western	Western	SMP	SMP

Figure 3. Stream Reaches with 400-foot Stream Corridor Evaluation Area Identified

See separate file

TWO PHASED PROJECT STRUCTURE

The project was divided into two phases. The phases can generally be categorized into baseline conditions/problem identification (Phase One), and solutions identification/plan preparation (Phase Two).

Phase One

Phase One was primarily data collection and analysis. The major effort was to develop a scientifically based dataset that would accurately describe the existing chinook salmon habitat conditions within the project area and to develop a pathways analysis that identified existing city activities and citizen behavior that could impact chinook habitat.

Project tasks were structured to focus on the scientific methodology that would be developed to collect and analyze the data, and the databases that would be prepared to conduct the analysis. While the following chapter (Chapter 4) describes the scientific methodology used, six distinct tasks were used to develop the baseline conditions. These tasks covered the following activities:

- Project initiation
  - Develop project goals and objectives
  - Identify problem set
  - Develop public involvement plan and outreach/education approach
  - Conduct initial public involvement (stakeholders meetings)
  - Conduct initial federal regulating agency contact (NOAA Fisheries)
- Methodology development and data collection
  - Develop the methodology for data collection and analysis, including approval of the methodology by NOAA Fisheries
  - Prepare the database structure for baseline data and pathways analysis
  - Identify project area and data collection area
  - Collect existing data and determine data gaps
  - Collect field data and enter into database
- Evaluate data
  - Conduct initial baseline conditions data analysis
  - Present findings to the TAC
  - Revise findings based on comments
- Risk assessment
  - Assess the City's risk for chinook salmon habitat degradation

- Pathways/Effects Analysis
  - Review and document city activities (reports, interviews, field investigation)
  - Review and document citizen activities (interviews and field investigation)
  - Develop preliminary pathways/effects database
- Preliminary reporting
  - Develop preliminary findings based on existing habitat conditions and pathways/effects analysis
  - Meet with NOAA Fisheries to review preliminary findings
  - Facilitate open house/public meeting to provide information and obtain public comment
  - Prepare initial report on baseline conditions and pathways analysis
  - Submit report to NOAA Fisheries for review and approval
  - Obtain NOAA Fisheries approval of baseline conditions and pathways/effects report (approved January 2002)
  - Facilitate open house/public meeting to present results of Phase One

Phase Two

Phase Two focused on identifying and developing solution options that would prevent chinook salmon habitat degradation and maintain water quality. The tasks were structured to take the results of the Phase One baseline conditions and pathways/effects analysis and craft a set of reasonable and cost effective solutions to meet the requirements of the ESA Section 4(d) Rule Limit 12 and that could be implemented by the City.

The following five tasks were developed to accomplish Phase Two:

- Integrate the baseline conditions and pathways/effects databases
  - Develop a database of weighted factor scores to determine the relative impact of city activities and citizen behavior on chinook salmon habitat
  - Identify geographic distribution of city activities (by reach) that impact chinook salmon habitat
  - Rank city activities and citizen behavior based on score
  - Present preliminary findings to NOAA Fisheries for review and comment

- Identify initial program options
  - Develop preliminary set of solution options based on categories of city activity (public infrastructure, transportation, planning, parks and recreation, city operation and maintenance activities, etc.)
  - Match program options to ESA Section 4(d) Limit 12 evaluation criteria to ensure that the options meet the requirements of Limit 12
  - Seek public input on solution options (stakeholder and public meetings)
  - Refine options based on public input
  - Present solution options to NOAA Fisheries for review and comment
- Develop program strategy
  - Refine solution options and develop an implementation program
  - Assign approximate costs to the refined solution options
  - Seek second round of input from public
  - Develop final solution options
  - Develop preliminary compliance program based on input from NOAA Fisheries and the public
- Develop implementation plan and report
  - Prepare implementation plan for ESA compliance
  - Prepare report that integrates the options, rationale for option selection, implementation plan, and monitoring plan to ensure compliance
  - Present implementation plan to NOAA Fisheries for review and comment
  - Refine implementation plan and present to City Council and public

PROJECT TEAM

The project team consisted of City project management/oversight, City and County technical advisory members, and the professional consulting team. In addition, there was elected official oversight provided by the Urban Services Committee (USC).

The project was managed through the City Public Works Department. City project management and oversight were the responsibility of the department's Utilities Division Manager and the Capital Planning and Projects Supervisor.

Since the ESA listing has an impact on City service delivery provided by several departments, the TAC was created to provide technical oversight. The TAC consisted of members from the following departments and divisions:

- Public Works Department
    - Transportation Division
    - Utilities Division
    - Engineering Division
- Parks and Recreation Department
- Community Development Department (planning division)

In addition, a representative from the Benton County Community Development Department was also a member of the TAC.

The TAC was responsible for helping set the project goals/objectives, approving the scope of work, and reviewing and approving all products and deliverables. The TAC met with the entire project team on a monthly basis. TAC members also attended and participated in all public meetings.

The professional consulting team included experts in a number of disciplines. The lead consulting firm managed the project tasks, scope of work and budget. The firm specialized in fish, wildlife, and plant biology, environmental compliance, land use planning, and economics.

The lead firm was supported by four sub-consultants: a civil engineering firm that focused on the public infrastructure issues and programs that could impact the chinook salmon habitat; a geographic information services (GIS) firm that provided GIS support to integrate the databases with GIS maps; a public involvement firm that guided the public education and outreach program; and an Oregon State University (OSU) professor who specializes in fish biology to provide additional science expertise and oversight.

AGENCY COORDINATION

There were a number of agencies that were important to the project. The most critical, of course, was NOAA Fisheries. As the federal regulatory agency for listed salmonids, approval by NOAA Fisheries of the Salmon Response Plan was needed. The City began contacting NOAA Fisheries early in the project. Frequent meetings (face-to-face and telephone conferences) were held between NOAA Fisheries, City representatives and the consultant team. In addition, technical memoranda related to project methodology and analysis, and project reports were forwarded to NOAA Fisheries for review and comment.

There were other public agencies that were critical to the project. The project team at various times contacted the following agencies for information, data, or reports:

- Oregon Department of Fish and Wildlife (ODFW)
- Oregon Department of State Lands (DSL)
- Oregon Department of Environmental Quality (DEQ)
- Oregon Department of Transportation (ODOT)
- U.S. Fish and Wildlife Service (USFWS)
- U.S. Army Corps of Engineers (Corps)
- U.S. Environmental Protection Agency (EPA)
- Benton County
- Oregon State University (OSU)
- Corvallis School District
- Mary's River Watershed Council

PUBLIC INVOLVEMENT/EDUCATION

A critical component in the project was input from the public. Not only is public involvement an expressed goal of the ESA and the Section 4(d) Rules, but, strategically, it also was important to have citizen support for the Salmon Response Plan to be successful.

While Chapter 9 of this report details the public involvement activities, the following is a list of the public involvement elements that occurred throughout the project:

- Stakeholder meetings – stakeholders were identified and contacted to participate in special meetings to identify key issues of concern. These meetings were held during both phases of the project.
- Open house/public meetings – four open house/public meetings were held to present project information and to seek public input and comment. The meetings were structured to maximize public participation. Comment forms were provided to the participants and distributed throughout the community.
- An email mailing list was used to periodically inform Corvallis residents of ESA project activities and upcoming events.
- Press releases were sent to local media regarding project status.
- Fact sheet – an ESA fact sheet was prepared and distributed to the public.
- City event participation – City representatives provided information on the ESA project at events such as the County Fair and the Da Vinci Days Festival.

- Project website – a project website was developed to provided general and specific information about the project, including meeting summaries, reports, and technical memoranda that were prepared. In addition, there was a calendar included that listed upcoming public meetings and relevant deliverable dates. The website also included an online comment form for the public to use to comment on the solution options.

CHAPTER 4. METHODOLOGY

INTRODUCTION

The purpose of this chapter is to describe the project's scientific methodology. The following elements are addressed in the chapter:

- Description of the evaluation methodology;
- Process/steps to determine the baseline conditions (e.g., existing data collection, field research, interviews, geographic information systems, etc.); and
- Quantification/calculation factors and the rationale that justifies each numerical score so reviewers understand how a particular score is calculated and can be replicated.

SCIENTIFIC BASIS FOR STUDY

As identified in Chapter 2, the ESA requires a strong scientific basis for methodology used in the evaluation process. It was critical that the data collection and analysis carefully follow scientific principles.

The methodology used in the analysis was developed in collaboration with the NOAA Fisheries. A series of meetings were held between the City of Corvallis, their project consultants and NOAA Fisheries in the Spring of 2001. The purpose of the meetings was to develop a methodology that would be acceptable to NOAA Fisheries. The methodology included the data elements that were to be collected, the data collection procedures, the categorization of the data, the evaluation/interpretation of the data collected and the City's proposed scoring for ranking City activities and citizen behavior in the pathways/effects analysis.

There was some concern on the part of NOAA Fisheries that any quantitative metric, no matter how carefully it was calculated, runs the risk of "hiding" or "masking" the rationale for a particular score. NOAA Fisheries recommended that any scoring methodology had to be fully explained in the report. The City agreed that all scoring methods would be carefully outlined so the reader would understand the scoring rationale and methodology.

Based on these meetings, the Corvallis project team prepared and submitted a technical memorandum (April 18, 2001) that outlined in detail the scientific approach to the methodology. The methodology incorporated the Oregon Department of Fish and Wildlife (ODFW) *Aquatic Inventories Project, Stream Survey Methods* and methods that were developed in discussions with NOAA Fisheries, as well as an approach to assessing pathways/effects for City services and citizen behavior. The technical memorandum was reviewed and approved by NOAA Fisheries (Appendix 2).

METHODOLOGY DESCRIPTION

The following is a brief overview of the methodology developed for the data collection, analysis, and pathways/effects analysis and scoring.

Baseline Conditions Habitat Assessment

The stream habitat inventory assessed the aquatic habitat of streams and gathered baseline data for the purpose of future monitoring activities. The data were collected according to protocols set forth in the ODFW *Aquatic Inventories Project, Stream Survey Methods*.

The inventory protocol had two phases. Phase one consisted of surveying existing fish habitat at selected reaches by estimating and measuring the physical dimensions of individual habitat units (pools, riffles, etc.) and characterizing important features (i.e., substrate, fish cover, and large wood) within each unit. Phase two involved taking detailed, site-specific data of channel morphology and substrate composition to establish a baseline for future monitoring activities. Field visits were also made to assess any barriers to fish movement in any of the streams.

Sequoia, Dixon, Oak, Dunawi, and Stewart Creeks were assessed for barriers to anadromous fish movement. Dry Creek, Ryan Creek, and the Mill Race were investigated but not selected for the barrier assessment because they were determined not to have the necessary hydraulic connection to support chinook salmon habitat. No barriers were found on the Mary's River or Stewart Slough. Oak Creek had a box culvert that forms a barrier just above its confluence with the Mary's River, and two dams on the Oregon State University (OSU) Campus at the Entomology Farm (between 30th and 35th Streets) and a pop-up dam used for summer irrigation (between 53rd and Harrison Streets). Dunawi Creek had a retaining wall constituting an impassable channel barrier at Brooklane Drive, and two box culverts at its 35th Street and West Hills Road crossings, likely impassable except to adult anadromous fish at high flows. Dixon Creek had a baffled cement box culvert at its Highway 20 crossing (6 meters upstream from the confluence with the Willamette). Higher water levels in the Willamette or removal of the boulders would make the culvert passable. It also had double box concrete culverts at its 3rd and 4th Street crossings and its Buchanan Avenue crossing. The very shallow water at low flows and high velocities at moderate and high flows create severe passage problems.

The riparian condition analysis (RCA) process was developed to inventory riparian area conditions for the ESA stream habitat assessment. The RCA process uses an assessment system that results in a score indicting how well the riparian unit functions as fish habitat. The process documents habitat characteristics such as stream size, vegetation type, and the degree of habitat modification by development. It provides scores for a set of condition modifiers, or factors, that influence fish habitat. The initial assessment was made using aerial photograph interpretation and ground-truthed with observations made during stream habitat surveys.

The process was hierarchical, with the first division made as to the nature of the riparian system; lotic (flowing) or lentic (standing). The second level (class) concerned dominant ground cover and had the following categories: forested, shrub-sapling, herbaceous, and developed. The next level (subclass) further subdivided the previous one, and described in more detail the various subclasses.

Table 2 outlines the classification system used to label the GIS riparian polygons. The information encoded in each polygon classification can be analyzed to produce a range of possible scores that can be assigned for the individual fish habitat functions. The scores are derived by GIS analysis of the mapped and classified polygons.

Table 2. Riparian Classification System

Riparian System	Class	Subclass
Lotic (Lt)[1] riparian area adjacent to stream or river or Lentic (Ln) riparian area adjacent to lake or pond	Forested (FO) (at least 30% forest canopy)	evergreen (eg)
		deciduous (de)
		mixed (mx) (at least 30% each eg and de)
	Shrub-sapling (SS) (at least 30% shrub or sapling cover, less than 20 feet high)	evergreen (eg)
		deciduous (de)
		mixed (mx) (at least 30% each eg and de)
	Herbaceous (HE)	agricultural (ag) (crops, pasture)
		turf(tf)
	Developed (DV)	residential (res)
		commercial/industrial (c/i)
		infrastructure (inf)
		mixed (mx)

1 - Modifiers may be used with Lotic to designate approximate stream size and channel condition

A simple example of a polygon classification is LtFOde. This denotes a deciduous (de) forested (FO) riparian area adjacent to a stream (Lt). Modifiers may be added to increase the density of information as necessary. Canopy cover, cover of shrubs or saplings, or amount of the polygon covered with developed areas were similarly quantified and documented as modifiers to the subclass category.

CORVALLIS PATHWAYS ANALYSIS

Pathways Descriptions

The pathways used in this report combine the concept of take with the assessment of properly functioning condition, and use it to evaluate City activities. Pathways are the links or connections between an activity and the chinook salmon habitat. It is through the pathway that an activity may impact the habitat.

There are five pathways that tie an activity and that habitat together. They are the following:

- Channelization/Instream Habitat
- Impervious Surface
- Riparian Areas
- Barriers
- Contaminants

A brief description of each pathway, as it is used in the analysis follows. How the methodology is applied to evaluate the pathways is provided in the next section.

Channelization/Instream Habitat

As encroachment occurs in floodplains, streams become stormwater conduits. When encroachment is combined with the removal of large woody debris (LWD) from the channel, down-cutting increases (incision), stream bottom gradient increases, lateral erosion decreases, and the stream resembles a straight channel. Loss of floodplain and restriction of channel cause loss of off-channel habitat. Channelization itself causes increased velocity and increased down-cutting erosions. It severs connections between streamflow and groundwater, causes problems in the hyporheic zone, and increases difficulty of fish spawning and rearing by depriving them of oxygenated upwelling water. Channelization also degrades instream cover, off-channel and other refugial habitat, riparian conditions, hydrologic connectivity, food resources, substrate, and instream habitat quantity, diversity, and quality.

Impervious Surface

Properly functioning condition consists of flows governed by infiltrated groundwater, overland flows, and source flows (e.g., springs, lakes, etc). This condition means that system hydrographs have fewer peaks over a longer period of time (i.e., bankfull flows occur on the order of two per five-year interval). Systems with heavy impacts can have these events several times in a year.

An increase in impervious surface can upset a stream's equilibrium as it leads to greater amounts of overland flow, as opposed to infiltrated groundwater, as one of the sources of water in the stream. Overland flows create larger water volumes in the stream in a shorter period of time. Runoff from impervious surfaces can also increase instream erosion as the stream moves toward a new equilibrium based on the new flow regime.

The results of impervious surface can lead to loss of instream habitat features (e.g., under-bank cover) through erosion and transport of LWD downstream. Initially, it also increases the amount of fine sediment that is transported downstream.

If left uninterrupted by other flow regime changes, it is possible that a stream will attain a new equilibrium within approximately 20 years even with the initial increase in impervious surface. As it nears its new equilibrium, the percentage of fine sediments in the substrate decreases.

The principal effect of the increased flows is to widen the channel. This occurs because the stream must accommodate these greater flows. Bankfull width increases and pools fill in. Streamflow slows and temperature increases, due to the slower passage, loss of riparian shading, and greater surface area to be heated. Continued erosion causes the loss of overhanging cover in the pool areas. Increased sedimentation and the subsequent slowing of flows and filling of pools by finer sediments causes a loss of spawning and rearing habitat. As the channel reaches equilibrium, the higher flows flush the finer sediments away leaving coarser sediments, which may be better for spawning activities. However, spawning activity would likely be diminished if the connection between the groundwater flows and surface flows is severed as the result of changes in the hyporheic zone due to the increase in impervious surface. The higher flows may also wash fish away and the lower flows may strand them in summer when rearing is important.

The chief pathway for this change is increased impervious surface contributing to greater surface runoff and less infiltration. This leads to higher flows and a "flashier" hydrograph. Secondary pathways could be the loss of riparian habitat and decreased groundwater flows; the latter as at least the partial result of reduced infiltration of stormwater. Increased impervious surface is the direct result of increased development of all types. The more concentrated the development, the greater the amount of impervious surface. When impervious surface cover becomes approximately 10% of the total land surface, stream habitat begins to suffer. If a stream's flow reaches a new equilibrium given the increased impervious surface coverage, riparian issues become more critical to the preservation of chinook salmon habitat.

Riparian Areas (Buffers)

Properly functioning condition consists of buffer widths, continuity, and structure sufficient to provide streambank erosion protection, LWD, filtration of overland flow, and shading. Densely vegetated riparian areas act as filters for contaminants and nutrients, as well as infiltration areas to regulate flows. Riparian areas provide LWD, an important contributor to

instream habitat structure and formation. They also provide shade for the adjacent stream, reduce bank failure, and create instream bank cover for fish.

Riparian areas function to preserve or enhance water quality by regulating temperature and by filtering contaminants, sediments, and nutrients. Temperature plays a critical role in the regulation of fish physiological function. The Clean Water Act sets temperature limits for cold-water fish species (e.g., salmonids) through the Beneficial Use portion of the Act that authorizes and justifies the Section 303(d) listings and total maximum daily load (TMDL) limits. The presence of vegetation serves to create cool-water refugia microclimate areas for fish to escape generally warmer temperatures in other portions of the stream. Riparian areas regulate temperature by shading the stream. Tall conifers perform this function best, but any woody or even tall herbaceous vegetation along the streambank or on a south slope will also do this, depending on the size of the stream. Elements important to this function include vegetation type and height, stream width, stream orientation and stream flow.

Contaminants not only include pollutants, but also sediments, nutrients, and streambank erosion. Recent research suggests that grassy buffer strips may filter out contaminants better than woody vegetation, but any vegetation will do this at some level. Aside from acting as a filter, vegetation also binds the streambank, reducing erosion. Important elements for this function are vegetation type, buffer width, riparian continuity, and slope.

Riparian areas influence fish habitat through many other significant elements, including the temperature, the contaminants, and vegetation type. Temperature and filtration effects are mentioned above, as is the securing of the streambanks. This reduces the collapsing of the banks, allowing the stream to undercut them and thereby creating fish habitat. This undercut bank habitat also may serve as a cool-water refuge. The securing of banks is an under-appreciated feature of grassy riparian zones. The prevention of instream erosion and the filtration of sediments keep important habitat features, such as spawning gravels and rearing pools, from silting in. This prevents mortality of the eggs from anoxia. It also maintains pool depth, which prevents summer mortality. Large wood serves an important role in stream habitat modification by creating pools and other instream habitat features, as well as substrate for invertebrates, which are potential food sources.

Changes in the riparian condition cause an increase in instream erosion and an eventual loss of habitat structure and diversity. The increased Horton (overland) flow of water also contributes more sediment and contaminants. Other riparian condition pathways are insufficient buffer size and structure, which diminish the functions of infiltration and filtration. If the riparian zone consists of lawns or manicured grasses, it can act as impervious surface. The presence of large wood is diminished by lowered riparian connectivity, as is the structure of the riparian zone. A zone with no large trees will contribute no LWD to the stream channel. Riparian areas with shrubs or young trees provide less shade function to a stream. Grasses shade even less and manicured grasses provide no shade function. Any vegetation on the bank will provide protection against erosion, although quality varies.

Barriers

Barriers to fish movement include such structures as culverts and pop-up dams. Culverts create an environment where flows become considerably more powerful, but also may serve as low-flow barriers to movement. Dams without fish passage serve as blockage to movement during all flow regimes. Barriers are critical as they do not allow adult fish upstream access to spawning habitat, they do not allow juveniles access to rearing and refugia, and they do not allow juveniles downstream passage.

Contaminants

Contaminants in the water may have a direct effect, through toxicity to one or more life stages of the fish or other elements of the food web (as measured by field discovery and/or lab testing), or indirect effects, such as sublethal impacts on growth and vitality. These effects are difficult to separate from background individual variation within a population, as well as from seasonal changes. They can, however, be highly important in the long-term survivability of the population, as their impact tends to be on lifetime reproductive output, usually through effects on growth, reproduction, sensory or motor functions, or food supply.

As can be seen by the complexity of the various pathways, channelization, impervious surface, and riparian buffers have the most diverse potential for impacts leading to take. In order to determine the impact of the City and set the habitat baseline for these impacts, the stream condition in the project area must be assessed and the nature and extent of current and future City regulatory and infrastructure activities must be measured.

GUIDELINES FOR USING THE PATHWAY ANALYSIS WORKSHEET

Purpose

The protocols describe and provide guidance and consistency in evaluating Corvallis Land Development Code, Comprehensive Plan and other plans and policies using the Pathway Analysis Worksheet (See Appendix 3 for example worksheets from the Baseline Database and the Weighted Pathways Database). The Pathway Analysis Worksheets have been created to systematically analyze and evaluate City documents and activities.

Process

The process requires:

1. Screening the code, plan or policy text for sections that may impact stream habitat.
2. Citing and documenting the language and relevant information.
3. Characterizing the pathway (means by which an impact occurs).
4. Analyzing the text.
5. Scoring and documenting the results.

What follows is a step-by-step description of the process for performing regulatory analysis using the Pathway Analysis Worksheet.

Step 1: Screening

The first step involves screening the document (e.g., Land Development Code, Comprehensive Plan, etc.) for sections that may have positive or negative effects on stream habitat, or where a clear connection or pathway may exist but the effects are deemed neutral. When screening the key question that should be considered is:

> Key Question: Could the subject of the section (actions, uses, activities, behaviors, or authorities, etc.) have an impact on protected fish or stream habitat?

If a nexus can be discerned, then a record for the section should be entered in the worksheet.

Step 2: Citation and Documentation

If a record is warranted, the second step is to fill out Columns 5 through 8 in the worksheet. These items must provide a clear reference from the document item to the line item in the worksheet. The "Description" column includes either a synopsis of the language within the section, a paraphrase, or an excerpt. If more than one document will be included in the worksheet also add a document identification code in Column 1.

Step 3: Characterize the Pathway

The third step is to characterize the pathway by filling out Columns 2, 3 and 4 in the worksheet. This involves:

1. Identifying the pathway or conveyance as either:
    a. Channelization,
    b. Barrier,
    c. Buffer,
    d. Contaminants, or
    e. Impervious Surfaces;
2. Identifying the type of impact as either Direct or Indirect; and
3. Ascribing a positive negative or neutral influence to the pathway.

Step 4: Analyze the Code Section, Plan, or Policy

Step four, Analysis of the Land Development Code (LDC) Section, involves clarifying and isolating the relevant connection between the substance of the code documented in the Description, the Pathway/Conveyance, and the effect on stream habitat.

If necessary, notes, calculations, diagrams, and detailed rationale can be documented.

Step 5: Scoring, Discussion, and Justification

Having clarified and isolated the pathway identified in the LDC section, it can now be scored based on the following columns in the worksheet:

> Filter: This column provides a useful way to categorize the language used in the code section (Definite or Conditional, Quantifiable or Non- Quantifiable).
>
> Magnitude: This is used to describe the geographic area or extent to which the language applies.
>
> Duration: A measure used to describe how long lasting the impacts of the pathway are to habitat.
>
> Intensity: This is a relative measure of the level of impact of benefit or harm to habitat not associated with geographic extent (magnitude), duration, or proximity to habitat.

General Working Rules

- Review each document by major paragraph or section. No more than one line item should be created in the worksheet for each major paragraph or section number. If necessary, analyze subsections collectively.
- Analyze, evaluate and document only what appears within the major paragraph or section (ignore references to other sections; they will have their own line item).
- When reviewing purpose statements, vision statements, policy goals, or research that can be considered directed at water quality or stream habitat but which does not establish a conveyance or pathway, a line item may be entered without scoring the item. Also, enter an item in the worksheet when a connection to water quality or stream habitat exists and a pertinent statement or goal is noticeably absent.
- When analyzing regulatory language, screen the statements carefully to identify any causal relationship between the statement and a pathway or conveyance.
- When screening policies, goals, or vision statements only include those that seem clearly directed at habitat, water quality, or specific pathways or conveyances,or statements that might unintentionally result in tangible impacts to water quality, habitat, or a pathway or conveyance.
- Generally, introductory statements, background information, and findings of fact should not be included in the worksheet, but relevant policies that result should be included.

- Make sure the pathway is analyzed in isolation; evaluate only the impact of one section at a time. For example, if impervious surface area must be reduced as a requirement for a landscape buffer, address only the reduction of impervious surfaces; do not address to the impacts that the landscape buffer might produce (e.g. application of horticultural chemicals, or other landscape management practices). Landscape management and maintenance requirements will be analyzed elsewhere.

- Use the hardcopy of the document as work record of notes, sketches and calculations. Record detailed rationale for analysis and scoring for future reference.

- When reviewing documents the following notations are suggested when screening statements:

  NA: Not applicable; this indicates that the section does not have a tangible connection to stream habitat.

  (i): This indicates that the section may have some relationship to habitat or water quality, but the connection is not tangible, or is inconsequential. For example, a policy statement to perform environmental plans or studies has no tangible benefit or impacts upon habitat, although there is an obvious relationship.

  CD: This indicates that the policy statement is a "Code Direction." If the Code has been reviewed, no entry should be made in the worksheet to avoid redundancy.

  REF: This indicates that the statement refers, authorizes, or directs another document. If the document is to be reviewed, do not make an entry in the worksheet. If not, research the reference and make an entry.

  Fringe: Indicates that the section pertains to areas outside the study area.

- Weight the impacts of overlay zones, conditional uses, and mixed-use zones that replace base zoning against the activities and uses it is likely to replace (e.g. commercial). Replacing commercial zoning with mixed-use zoning may eliminate the possibility of more intensive commercial uses.

Column Definitions

Line Reference Number: This column is used to record a sequential number for each section of code analyzed in the worksheet for cell reference purposes.

Document ID: This column is used to indicate the document being analyzed. A three-letter abbreviation is used (e.g. Corvallis Comprehensive Plan – CCP).

Impact Type: This column documents whether the impact pathway is **direct** or **indirect**. Direct impacts are those that directly impact stream habitat; for example, contaminants released directly into the waters of a salmon-bearing stream. Contaminants released on land, or those that enter stormwater systems would be indirect impacts.

Pathway/Conveyance: This column indicates the pathway or conveyance of the impact. Pathways should be classified as one of the following:

1. Channelization,
2. Impervious Surfaces,
3. Contaminants,
4. Barriers, or
5. Buffers.

Statements can be included in the worksheet that do not correspond to a specific pathway or conveyance. Either multiple pathways or conveyances may apply, or the statement may be too general to tie to a specific pathway or conveyance. In such cases the column should be used to indicate either "Multiple", or "Not Applicable" (NA).

+/-/0: This column is used to qualify the impact of the code section on habitat as, positive, negative, or neutral. For example, a code section with a positive impact might limit the amount of impervious surface allowed on sites within a zoning district.

Chapter Name: This column records the chapter name of the code in question.

Section Number: This column lists the specific code reference number being analyzed. When section numbers are not used, this column can be used to indicate a page number.

Section Name: This column lists the specific code name being analyzed.

Description: This is used to summarize the relevant content of the code section as follows:

First paragraph - code summary,

Second paragraph - conditions or exceptions, and

Third paragraph - list specific indicators or standards.

The "Description" column can include either a synopsis of the language within the section, a paraphrase, or a quotation.

Discussion/Justification: Enter in this column a formatted response to two key questions: 1) what is the relationship between the source use or activity, the pathway, and the habitat? and, 2) what is the rationale for scoring this specific pathway for the following parameters: +/-/0, Magnitude, Duration, and Intensity?

Filter: This column provides a useful way to categorize the language used in the code section (Definite or Conditional, Quantifiable or Non- Quantifiable): *Definite* - an absolute and universal requirement, or *Conditional* - a requirement that applies only under certain circumstances or when certain conditions have been met; and either as, *Quantifiable* - a statement or regulation with a clearly measurable effect, or *Non-quantifiable* - a statement that would not result in a measurable effect.

Magnitude: This column documents the geographic extent or scope of the code section. Magnitude is classified as Citywide (Score = 3), Reach (Score = 2), or Point (Score = 1). "Point" means in only one location or on a site-by-site basis. "Reach" means the extent is less than citywide but in more than one place.

Duration: Duration is a temporal measure of how often or how frequently the pathway occurs or how often a pathway persists. Duration is classified as "Chronic" (Score = 3), "Episodic" (Score = 2), or a single event occurring only "Once" (Score = 1).

Intensity: Intensity is an estimate of the level of impact to stream habitat. Estimates of intensity are High (Score = 3), Medium (Score = 2), or Low (Score = 1). "Low" means little long-term harm to habitat. "High" means certain long-term harm to habitat. "Medium" means moderate impacts to habitat are likely to result.

Area: This column is reserved for later use, when some of the pathways can be quantified.

Subtotal: This column is a subtotal of scoring for Magnitude, Duration, and Intensity.

Total: This column indicates the total score based on subtotal and Weight.

CORVALLIS PATHWAYS AND REHABILITATION EVALUATION

This methodology has two parts. Part I sets the stage for the evaluation of impacts and the appropriate rehabilitation methods by using a more detailed assessment of the stream systems from a geographic and geomorphic standpoint. It uses an understanding of the urban setting of the stream basins, their function within the human-based infrastructure of the city, and the current habitat-forming processes to set the baseline for the last part.

Part II builds upon the scoring methodology developed in Phase 1 Pathways Analysis to provide the City with a tool for assessing the various options available for protecting, rehabilitating, and/or enhancing the current stream environment. This tool functions at the reach, stream, and watershed scales. This will eventually lead to the establishment of a trajectory of change toward achieving properly functioning condition within an urban stream network.

Quantification/Calculation Factors

The following stepped approach was used for the quantification/calculation for evaluating each reach for chinook salmon habitat.

1. Determine the stormwater basin for each area of interest. Using the basins listed below to organize the classification makes sense, in that the inputs to the streams fit into this model better than a strictly watershed-based system. This approach recognizes the urban reality of Corvallis' stream systems, and allows the classification to link the elements of the Stormwater Master Plan with the ESA baseline analysis conducted in Phase 1.

    a. Dixon Creek
    b. Dunawi Creek
    c. Jackson-Frazier-Village Green
    d. Sequoia
    e. Oak Creek
    f. Garfield
    g. Mary's River
    h. Willamette River

2. Select an appropriate reach (one of the three or more major subdivisions of the stream) and classify it using the geomorphic methodologies listed below. For the purposes of this analysis, the most important reach characteristic becomes simply the ability to define an area where processes appear to be acting in a similar fashion. Reaches are those used by the Salmon Response Plan to assess habitat. These reaches are based on geomorphologic changes such as the presence of tributaries entering the main stem and gradient

3. Determine the related land use/zoning for the area in question. This characteristic will guide the assessment of the impacts of the various pathways, and accentuate those that may have the most impact and eliminate those that may not have an effect. This also provides a structure for both restoration and for the use of best management practices (BMP). Zoning, for the purposes of the Salmon Response Plan, may be kept at a more coarse scale. A great many of the effects detected in the analysis conducted in Phase 1 are citywide in their scope, and so may be dealt with, for the purposes of this Plan, at this greater scale. The NOAA Fisheries is unlikely to want to evaluate City activities at a scale smaller than the reach level, with the exception of easily identified point sources. The tool being developed will provide the City with the framework for assessing impacts at the point source level, if desired.

    a. Residential
    b. Agricultural
    c. Commercial
    d. Municipal
    e. Industrial

4. Determine listed fish use. This establishes the baseline for evaluation of the impacts of pathways on listed populations, and also provides input into the rehabilitation decision tree elements of the plan. Habitat types of interest include spawning habitat, rearing habitat, refugia, and movement corridors. Spawning habitats generally consist of riffle or pool tail-out areas with a high percentage of gravel substrate. Rearing habitat consists of moderate-sized pools with overhead cover. Barriers include impassable culverts, pop-up or other dams, and de-watered areas. Other elements of habitat directly influenced by city activities include temperature, turbidity, and food supply.

    a. Spawning. Depth, velocity, and size of redd area are highly variable. The key requirement is large gravel. Chinook have been known to clean and spawn in areas containing as much as 25% fine sand/silt/clay substrates.

    b. Rearing. Rearing generally occurs in smaller tributaries, using well-developed riffle-pool systems with rubble type habitat. Chinook tend to avoid rearing in beaver ponds or off-channel sloughs.

    c. Movement. The key element in movement is to ensure passage at times when listed species may be using a stream. Blockage factors include direct blockages such as pop-up dams and compromised or poorly designed culverts.

    d. Refuge from high-water winter flows. Access and water quality comprise the critical issues here.

5. Identify any habitat-forming processes in stream.

    a. Floodplain/groundwater connectivity (level of incision and overland flow). Does the stream still overflow its banks? Are there streamside wetlands present? Is there still a connection with the groundwater system, both laterally and vertically?

    b. Hydrograph. Do 2-year floods occur with a 1.5- to 3-year periodicity? Is the major contributor to year-round flows groundwater-based, such that the rising limb of the hydrograph is smaller than would be the case if the major contribution came from directed flow or overland flow? What level of floodplain water storage is available?

    c. Riparian community structure, width, and connectivity. Communities should be dominated by native species and should be a mosaic of the various seral stages and sizes appropriate for that area. Indications of non-functioning or impaired functioning include: riparian areas missing entirely or broken up by large areas of infrastructure impingement; communities heavily dominated by non-native vegetation and climax or early seral stages (should be a mosaic which would adequately represent levels of disturbance necessary to maintain the stream in a dynamic equilibrium); reduced or no capability for large wood supply to the stream, and leafy debris in the upper reaches.

d. Pool-riffle ratios, reach-specific. Existing pools should be deep and broken up by riffle areas, rather than taking on the form of glides. The presence of glides suggests a system that is on a trajectory away from properly functioning condition.

e. Substrate type. This depends upon the soils and bedrock present. Some reaches degrade more rapidly than others (i.e., reaches higher up in the system with greater gradients), and so contain larger substrates. Fines should dominate aggrading reaches, lower down in the system with little or no gradient. Fines dominate not properly functioning systems. When gravels are present, they are heavily imbedded or low in the system, indicating high flows sufficient to transport bedload.

f. Instream cover. –The presence of undercut banks, instream boulders, and woody debris.

SCORING AND RANKING METHODOLOGY

The following is the description of the pathway/effects analysis used to determine the impact of city services and citizen behavior on chinook salmon habitat. The first part is the development of the pathways/effects database in the first phase of the project. The second part is the combining of the baseline conditions data and pathways/effects database in the second phase of the project into a powerful tool that allows the City to identify the geographic distribution and the degree of impact that City services and citizen behavior have on chinook salmon habitat. This weighted database was developed using relational database software, which can access, query and analyze large data sets (the weighted dataset has approximately 4,300 records). From this weighted database the City is able to rank impacts to chinook salmon habitat and develop a list of priority remedial actions.

Pathways/effects weighted database covers the following activities and citizen behavior:

- Public infrastructure activities and operations and maintenance
  - Wastewater treatment
  - Water supply
  - Stormwater management
- Transportation activities and routine road maintenance
- Planning activities
  - Comprehensive Plan
  - Zoning
  - Land Development Code
- Parks and recreation activities and operations and maintenance
- Fire Department training and vehicle/equipment maintenance

- Public construction specifications
- Citizen behavior (household and yard maintenance activities, landscaping, home auto repair, etc.)

Scoring process

Priority ranking of City programs and activities was based on the scores as discussed above. Using the stormwater basin for each area of interest recognized the urban reality of Corvallis' stream systems. Using reaches as defined by the riparian analysis recognized the changes in streams resulting from urbanization and solves the problem of reach definition characteristics. For the purposes of this analysis, the most important reach characteristic becomes simply the ability to define an area where processes appear to be acting in a similar fashion.

The use of a methodology for scoring impacts and evaluating projects allowed the City to make determinations as to the most important elements to fulfill its various mandates (e.g., ESA, Clean Water Act, Statewide Planning Goals). This methodology assumed that funds for rehabilitation are not limitless, and there is a desire to accomplish the necessary ordinance changes in as few steps as possible. The approach provided a mechanism for evaluating effects on any level desired by the City, as well as erecting a framework for fiscal analysis.

Pathways/Effects Analytic Approach

1. Determine the pathway(s) of interest and operating in the selected area. For the City of Corvallis, Contaminants and Buffers are the major pathways for habitat degradation in all reaches and all systems for the purpose of ESA compliance. The following are the pathways (see detailed discussion in earlier part of this chapter).

    a. Channelization/Instream Habitat

    b. Impervious Surface

    c. Riparian Areas/Buffers

    d. Barriers

    e. Contaminants

2. Determine the latitudinal/longitudinal extent of the pathway.

    a. Within the riparian buffer/floodplain (3). Activities occurring within this zone have the capability of influencing the listed fish and their habitat with less need for a transport mechanism such as the stormwater system. Activities within this area also directly affect the riparian buffer characteristics.

b. Outside the buffer/floodplain (1). This is scored lower simply because activities occurring outside the buffer require the intervention of a transport mechanism (such as the stormwater system).

3. Rank the location of the pathway or event (by reach and stormwater basin). Each system should be weighted according to the pathway of interest. The Contaminant pathway should be the same for all streams, regardless of their position in the system, as should the riparian buffer (for purposes of water quality). Impervious surface and instream habitat should use the ranking system listed below. The importance of the Buffer pathway varies with the desired function. The most important functions of the buffer are to maintain water quality. Buffer width should increase in a downstream direction, as the amount of flow increases and the gradient decreases to the point that the stream can easily overflow its banks. Barriers should be addressed going upstream, with the greatest emphasis on those lower in the system.

    a. Upland tributaries: urbanized (4), non-urbanized (5)

        i. Intermittent stream area (2)

        ii. Perennial stream area (4)

    b. Non-urbanized lowlands (2)

    c. Urbanized lowlands (1)

4. Determine the spatial extent (magnitude) of the pathway's influence. Spatial extent plays an important role not only in the assessment of the level of influence, but also on the nature of the restorative or rehabilitative activity. The greater the magnitude, the more likely that fixes will require some change in ordinances or the creation of new ones. This does not preclude the use of individual or point-related BMP.

    a. Point. Occurring at a single location or site (1).

    b. Reach. Occurring at multiple locations throughout the designated stormwater reach (2).

    c. Reach. Occurring at multiple locations throughout the designated ESA survey reach (3)

    d. Basin/Watershed. Occurring throughout the basin as a whole (4).

5. Determine the timing (Duration) of the pathway. Timing has considerable influence upon the resilience of the system. Historic habitat-forming processes tended to be single-event or episodic in nature. The chronic nature of a great many anthropogenic changes in inputs to these processes is considered to apply more stress to the ability of the system to rebound.

    a. Single event (1) - occurs as the result of failure to implement BMPs or failure of BMPs.

b. Episodic (2) - intervals are regular but occurs more than once

c. Chronic (4) - occurs as the result of long-term action (e.g. stormwater runoff

d. Periodic (3) - occurs at regular intervals

6. Determine intensity of the pathway or event. Intensity of an activity is related, to some degree, to the previous two categories (magnitude and duration) and has the least clear-cut predictive capability.

   a. Low (1) - little or no mortality or habitat change expected

   b. Medium (2) - some mortality; habitat changes occur but are within the resilience capability of the stream and within expectations for that particular time period in the evolution of the stream

   c. High (4) - dramatic changes beyond the capability of the reach or stream to accommodate, forcing a change in steam geomorphology beyond that which could be expected from typical stream evolution; sufficient mortality to put populations in that area in jeopardy

The scoring methodology determines the pathway(s) of interest and operating in that area and the latitudinal/longitudinal extent of the pathway. It is then assessed as to its position within or outside the riparian buffer/floodplain, and ranked by the location of the pathway or event (by reach and basin). Next, it evaluates instream habitat and presence of impervious surface by reach longitudinal position and physiographic characteristics. Finally, it evaluates the spatial extent (magnitude, duration, and intensity) of the pathway's influence.

CHAPTER 5. BASELINE CONDITIONS

INTRODUCTION

The purpose of this chapter is to present an overview of the baseline conditions for Chinook salmon habitat. This covers the data collected and evaluated in Phase One of the project (see *Baseline Habitat Evaluation and Evaluation of the Impacts of City Activities*, February 2002) and the technical memorandum titled *Description of Habitat for Upper Willamette River Spring Chinook ESU* (March 3, 2003). The stream and river reaches identified in the baseline descriptions are displayed in Figure 3 (Chapter 3).

Dixon Creek (From Corvallis Stormwater Master Plan, 2000)

Dixon Creek originates in the hills to the northwest of Corvallis. Most of its length lies within the City, where it is an important feature of many residential backyards. It also runs through several school properties and parks before reaching commercial property at 9th Street and Reiman Avenue and shortly thereafter, the Willamette River. The Dixon Creek watershed contains 2,712 acres. The largest land use is low-density residential, which covers more than one-third of the watershed. In addition, medium density residential, OSU forest (McDonald-Dunn Forest) land, and vacant parcels each cover approximately 400 acres. Estimated current impervious surface coverage is 897 acres, which is approximately 33% of total watershed acreage

If the watershed is developed to full build-out according to the City of Corvallis' Comprehensive Plan (1998), the current vacant land may be largely converted into low- and high-density residential use. Other changes may also include a decrease in medium-density residential and an increase in commercial land use. Overall, the number of impervious acres is estimated to increase by 13%, from the current 897 acres to 1,017 acres, or nearly 38% of the watershed acreage.

The following habitat evaluations summarize the information from the Streamwalks conducted by Watershed Applications and field analyses conducted by the ESA project team.

Temperature

The City is evaluating temperature at four permanent monitoring sites in Dixon Creek. Thermistors at the sites record the water temperature hourly.

Sediment/Turbidity

The high levels of fine sediment found throughout the Dixon Creek watershed are likely a function of the local geology and urbanization. In the vicinity of Dixon Creek, the Willamette valley floor is composed nearly entirely of silty-loam soils. Therefore, high levels of fine and suspended sediments are likely natural features of the stream. Stream incision and bank erosion likely have added to the natural loads of fine and suspended

sediments. Nutrient inputs from urban landscaping and fertilizing likely have increased the amount of algae in the stream and contributed to higher turbidity levels.

Chemical and Nutrient Contamination

The U.S. Geological Survey (USGS) assessed Dixon Creek during its sampling in the mid-1990s. The chemicals found in it placed it in the non-agricultural chemical source category. These included Carbaryl (Sevin), used for both home and landscape applications; Dichlobenil (Casoron) and Tebuthiuron, used to control broadleaf weeds and applied under asphalt and on railway rights-of-way (ROW); Diazinon, whose use is similar to Carbaryl; and Prometon, which is used in urban landscaping, ROW, and industrial applications, and by homeowners. Dixon Creek also exceeded standards for temperature, fecal coliform, and *E. coli* bacteria. It appeared to have no excessive nutrients. This stream likely carries the "usual" urban runoff components of metals and petroleum products.

Physical Barriers

A partial barrier exists at the confluence of Dixon Creek and the Willamette River. The box culvert under Highway 20 has been modified to promote fish passage by creating deeper, slower flows through a portion of the culvert. However, because the culvert is perched and falls onto riprap, access to the culvert's fishway is restricted to times when the water level in the Willamette reaches the culvert outfall (mainly during winter and spring flows).

Flat-bottomed box culverts located at 3rd Street, 4th Street, Buchanan Avenue, Kings Boulevard, 29th Street, and Walnut Boulevard may pose additional passage problems during high and low flows. Dace were observed in the stream up to 29th Street, indicating that all of these box culverts are likely passable during some flow conditions.

Substrate

Exposed clay layers, silt, and riprap are the most common substrates in Dixon Creek. The high levels of silt and lack of gravel are likely a function of the local geology. No rock outcroppings or colluvial debris slides occur in the watershed to serve as a source of coarse stream sediments. Moreover, the silt loam soils that dominate this area of the Willamette valley (USDA 1975) are likely the dominant streambed material in the small wetland channels that historically occurred in the Corvallis area. The exposed clay substrate likely results from urbanization along Dixon Creek. Channelization and changes to the creek's hydrograph have led to increased downcutting of the streambed and the exposure of clay layers formerly covered by the more erodible silt soils. The large quantities of riprap in the channel result from the frequent bank stabilization efforts needed to protect the highly erodible streambanks.

Large Wood (LW)

The small amount of LW in Dixon Creek does not contribute significantly to stream complexity or aquatic refuge and represents a distinct change from the high amounts expected, historically. Most of the wood in the creek consists of small-diameter deciduous logs that decay rapidly and have little potential to create significant instream cover. The highest concentrations of LW are in the small headwater streams of Dixon Creek where fish presence is unlikely, as is downstream transport of the LW. Future LW recruitment potential is limited by the reduced size of the riparian zones and channel incision.

Pool Frequency

Trench scour pools, with long glide-like tail-outs, were the dominant habitat types in reaches of Dixon Creek that could potentially support salmonids. However, pool frequency does not meet the standard established by NOAA Fisheries. The long pool lengths precluded sufficient numbers of pools from occurring in any 1.6 km length of stream.

Pool Quality

Pool quality in Dixon Creek is poor. Deep scour or trench pools are abundant in Dixon Creek; however, they lack structure such as LW and undercut banks that provide cover for fish. Reduction of pool depth because of sediment deposition is not a concern in Dixon Creek. The channelized nature of the stream ensures that all deposited sediments are washed out of the system during high flow events.

Off-Channel Habitat

Channel entrenchment in the lower reaches of Dixon Creek precludes the formation of off-channel habitat. No off-channel habitat exists in stream reaches along the mainstem of Dixon Creek or the lower portions of the tributary streams.

Refugia

Dixon Creek was likely bordered by upland gallery forests and lowland prairies before settlement by Euro-Americans. Land conversion and urbanization have dramatically changed the nature of the stream and its riparian areas. While a small amount of remnant aquatic refugia may exist in the headwater streams, none was observed during the survey. The natural wetland channels have been converted to a single entrenched channel. Gallery forests and riparian wetlands have been replaced with residential developments. Riparian buffers are narrow and have been overrun by invasive species such as Himalayan blackberry (*Rubus discolor*) and bedstraw (*Galium* sp.).

Width-to-depth Ratio

Width-to-depth ratio is estimated to be approximately 8, and meets the NOAA Fisheries criteria for PFC. However, because the channel is entrenched and revetments often prevent the stream from widening, this indicator may not be appropriate for use in evaluating stream health. This relatively low width-to-depth ratio likely results from urbanization than preservation of natural habitat conditions. Habitat features usually associated with low width-to-depth ratios, such as lower stream temperatures and instream cover, are not characteristic of the current conditions in Dixon Creek.

Streambank Condition

The conditions of streambanks in Dixon Creek are variable. Root masses of living trees are being undercut by the stream and bank erosion is common in the upper watershed. In areas where root masses are being undercut, future bank erosion is likely as the trees fall and expose unstabilized soils. Large portions of the streambanks have been armored with riprap, gabions, and log bulkheads. As more impervious surface is added to the watershed, bank erosion and undercutting will likely increase.

Floodplain Connectivity

Channel incision has severed much of the natural hydrologic link between the floodplain and the stream channel. Incision depth in the mainstem of Dixon Creek averages approximately 2.5 m. Any flows that once may have regularly exceeded the streambanks and inundated the floodplain are now confined to the entrenched channel. Overbank flooding now occurs only during extreme runoff events. Wetland riparian areas that once bordered the creek have become perched and drained as the water table has deepened.

Peak and Base Flows

Peak and base flows undoubtedly have been altered by the loss of riparian wetlands, channel incision, land conversion, and the addition of large amounts of impervious surface to the watershed. The loss of floodplain wetlands caused by historic and present-day channel incision decrease the watershed's capacity to store water and likely has resulted in decreased base flows. Channel incision has increased the conveyance capability in the watershed and contributed to sharper peaks in the stream hydrograph. The addition of large amounts of impervious surface, coupled with stormwater conveyance systems, creates a pathway by which precipitation is collected and quickly piped to the stream rather than percolating into the groundwater or slowly trickling into the stream. This rapid transformation of precipitation to runoff creates unnaturally high and sharp spikes in the hydrograph of Dixon Creek.

Road Density and Location

Road density in the urban environment of Dixon Creek is very high. A significant portion of the watershed is covered with impervious surface. Roads closely parallel the stream in many places and numerous road crossings fragment the aquatic and riparian habitat.

Disturbance History

More than 60% of the Dixon Creek watershed has been developed for commercial or residential purposes. Very little late successional or old growth forest remains in the area. Because of the permanent nature of urban development, no significant improvements to this indicator are expected.

Riparian Reserves

Approximately 80% of the riparian area in the watershed is developed. Riparian vegetation in the developed areas is confined to the land at or below the top of bank. At least 33 road crossings occur on Dixon Creek. These crossings reduce the connectivity and create a discontinuous series of isolated riparian areas.

Dunawi Creek (From Corvallis Stormwater Master Plan, 2000)

Dunawi Creek runs from Bald Hill Park west of Corvallis eastward to its conjunction with the Mary's River at Brooklane Drive. The Dunawi Creek watershed contains 2,363 acres. The largest land uses in the watershed are low-density residential (766 acres) and vacant land (609 acres). Some land in the watershed is used for industry and commerce, although this is mostly limited to the Sunset Research Park and along Philomath Boulevard (Highway 20/34). If the watershed is developed according to the City of Corvallis' Comprehensive Plan (1998), all of the vacant land may be developed, with most of it converted to residential use. In addition, medium- and high-density dwellings will make up an increasingly larger portion of the residential land use. As a result of these changes, the amount of impervious surface could increase from 762 to 968 acres, an increase of 27%.

Temperature

Temperature was not assessed because the survey period did not overlap with the summer months when stream temperatures are of greatest concern. The City of Corvallis currently is conducting a temperature assessment.

Sediment/Turbidity

Dunawi Creek contains high levels of fine sediment. Silt, sand, and organic matter are the most common substrates. The water in the creek had low visibility at the time of survey. The high level of fine sediment and turbid nature of the water likely are caused by the wetlands in the watershed and the presence of the predominant substrates (clays and other fine sediments). The slow, flat nature of the watershed allows for accumulation and

decomposition of organic material, as well as benthic algae blooms. The high color of the creek is likely caused by tannic acid or other solutes produced by decomposing organic material.

Chemical Contamination

The urban chemicals that may be present in this basin are the same as those potentially present in Dixon Creek.

Physical Barriers

A retaining wall just upstream from the confluence of Dunawi Creek and the Mary's River creates a 1-meter drop that creates a barrier to Chinook salmon fish passage. The height of the falls and the lack of a plunge pool below it eliminates fish migration from the Mary's River into the Dunawi Creek watershed. Reconstructing the retaining wall to make it passable to Chinook salmon would have limited benefits because of the poor quality of upstream salmonid habitat.

Substrate

Clay, silt, sand, and organic materials dominate the substrate in Dunawi Creek. The natural geology of the watershed, as opposed to the human disturbance, likely is the cause of the high level of fine sediment. Coarse substrates other than riprap were not found in significant quantities in any portion of the watershed and appear to be absent from all alluvial layers exposed by the stream. Moreover, the flat topography of the watershed does not create enough stream energy to produce the downcutting needed to expose sources of coarse sediment or transport such sediment once it has been exposed. Without a source of gravel and cobble substrates, Dunawi Creek appears always to have been devoid of coarse substrates.

Large Wood

LW is scarce in the Dunawi Creek drainage. No pieces that match the NOAA Fisheries definition of 24-inch diameter and 5-foot length were observed in the stream channel. Small accumulations of woody debris are common in many reaches. Because of the small size of Dunawi Creek and the low energy of the flows, these accumulations are able to persist within the active channel, functioning similarly to pieces of LW. These accumulations create small pockets of scour and could provide cover to any fish that potentially inhabit the creek.

Pool Frequency and Pool Quality

Pool frequency and pool quality are very poor. Aquatic habitat is largely composed of slowly moving, slack-water glides. Riffles are short and infrequent. Pools with significant scour are even more infrequent. The one wide pool is present in Reach 2, which results from a relatively large debris jam.

Off-Channel Habitat

The pond near the top of the south fork and the millpond on the north fork (both artificial situations) are the only two significant areas of off-channel habitat.

Refugia

Intact, well-buffered riparian areas exist in few areas of the Dunawi Creek watershed. Residential and commercial developments, city parks, and agricultural fields all encroach into Dunawi Creek riparian areas. This disturbance to riparian habitat has aided the invasion of species such as reed canarygrass (*Phalaris arundinacea*) and Himalayan blackberry. Approximately 33% of the total stream habitat has been straightened and channelized. In other areas, the channel appears to have been excavated for the purpose of enhancing stream conveyance. Encroachments into the riparian areas and channel modification limit the amount of suitable habitat available to sensitive aquatic species.

Width-to-depth Ratio

The width-to-depth ratio in Dunawi Creek is less than 10. The glide-like streambed common in the creek averages approximately 0.15 to 0.2 m in depth. The channel width averages about 1.5 m across.

Streambank Condition

Bank erosion in Dunawi Creek is uncommon. Eroding banks are present in small areas of Reach 2 and the upper portion of Reach 3. The erosion in Reach 3 is just below the stormwater outfalls and box culverts located at 35th Street, where large sections of the bank are collapsing into the creek. In other portions of the creek, low stream gradients do not appear to generate enough energy to undermine rooted vegetation and erode bank substrates. Streambank conditions in the Dunawi Creek watershed appear stable, with little evidence of erosion.

Floodplain Connectivity

With the exception of the channelized portions of Dunawi Creek (approximately one-third of the watershed) most of the stream regularly exceeds its banks and inundates the local floodplains. Evidence of ephemeral side channels is apparent in many wetland riparian areas.

Changes in Peak and Base Flow

Some changes in peak and base flow likely have occurred as a result of channelizing and increasing impervious surface. Approximately 33% of the channel has been straightened or confined within artificial banks. These channelized stream segments have a reduced capacity to detain flows during peak runoff events, and have little water storage potential. The increase in impervious surface creates quicker, higher spikes in runoff after rainfall

events. The magnitude of the changes has not been quantified; however, based on instream indicators such as increased frequency of erosion and channel downcutting, the hydrologic changes associated with development have not been great enough to produce large changes in the channel morphology. The extent to which summertime flows have been altered because of decreased storage capacity has not been evaluated.

Disturbance History

Dunawi Creek is an urbanized stream. Nearby forest clearing, development, and agriculture have disturbed the entire watershed. Very little mature forest exists in the watershed.

Riparian Reserves

Riparian corridors and setbacks have been established along much of Dunawi Creek. These vary in width from a few meters to nearly 100 meters. In corridor areas, near Technology Loop for example, reestablishment of native riparian vegetation appears to be impaired by invasive species. Overstory trees do not appear to be recolonizing these areas, and riparian shading and function have been lost. Many of the undisturbed riparian areas are functioning in a limited capacity. The overstory in these areas provides good canopy closure and shade to the channel. However, invasive species such as Himalayan blackberry and reed canarygrass are colonizing many areas.

Oak Creek (From Corvallis Stormwater Master Plan, 2000)

The Oak Creek Watershed is the largest watershed within the study area of this plan. The upper reaches of Oak Creek lie outside the city limits and the UGB. The stream's headwaters are located northwest of Corvallis in McDonald State Forest, on the southern slopes of Cardwell Hill at about 747 meters in elevation. Oak Creek follows logging roads southward past Dimple Hill and the OSU Experimental Station. The creek follows Oak Creek Drive, where it is joined by Alder Creek downstream from Skillings Drive. Mulkey Creek joins Oak Creek from the west, downstream from Bald Hill Park. Oak Creek flows under 53rd Street just north of Harrison Boulevard.

The lower reaches begin just outside the UGB beginning where Oak Creek crosses Harrison Boulevard to the south and then crosses into the city limits. The stream then flows southeast toward OSU. It flows through pastures, farm buildings, and research facilities before reaching the main body of the campus. On the south side of the OSU campus, the creek is bounded by the Reser Stadium parking lot to the northeast and mixed residential use to the southwest. As Oak Creek leaves OSU, it flows through a short residential section before flowing under Highway 20/34 and entering Mary's River.

The Oak Creek watershed contains 8,300 acres. The largest land use type is McDonald-Dunn state forest (managed by Oregon State University), which covers almost 5,900 acres, representing more than 70% of the watershed. Approximately 12% of the watershed (1,030 acres) is used for agricultural purposes. OSU manages both the forestland and most of the

agricultural land. With the addition of the campus itself, OSU manages almost 90% of the land in the watershed. More than 500 acres are listed as undeveloped.

Under future development, the undeveloped land may be built out as residential and some of the OSU agricultural land may be developed for university non-agricultural purposes. The amount of impervious surface in the watershed will increase only slightly under these conditions.

Temperature

The City is assessing temperature regimes in the stream.

Sediment/Turbidity

High, fine sediment loads and turbidity are likely natural features of the Oak Creek drainage. The banks of the creek are composed of alluvial soils that are easily eroded and suspended in the water column. Because of its low gradient (less than 1% slope), the stream often lacks the velocity to transport eroded fine sediment out of the drainage. Instead, it settles out in areas with lower velocities. The naturally occurring high level of turbidity and fine sediment in Oak Creek have likely been augmented with fine sediment loads brought about by human activity. Many portions of the upper watershed have been logged, with historic practices likely contributing fine sediment to the stream. Agricultural fertilizers and manure undoubtedly have leached into the stream, increasing the amount of algae in the water and leading to high turbidity.

Chemical Nutrient Bacteria Contamination

Data collected by the City indicates that concentrations of *E. coli* bacteria in Oak Creek exceed the Oregon Department of Environmental Quality's (DEQ) standard of 126 organisms per 100 milliliters of water. The urban chemicals that may be present in this basin are the same as those potentially present in Dixon Creek. Some agricultural chemicals such as atrazine and related compounds may also be found in Oak Creek.

Physical Barriers

The concrete exit skirt of the twin box culverts at the Highway 20 creek crossing creates a barrier falls. The incision downstream has deepened since construction of the culverts and left the exit apron perched approximately 1 meter. No adequate jumping pools exist immediately below the perched apron. Although the falls created by the culverts appears impassable at all times of the year, juvenile Chinook salmon have been observed upstream from the barrier as recently as 1994. The pop-up dam near the top of Reach 3 creates a second fish passage barrier. The dam is used by OSU to create a pool for irrigation withdrawals and is therefore only in place during the dry season (May through October).

Substrate

Gravel dominates the substrate in the mainstem of Oak Creek; however, silt, sand, bedrock, and native clay layers are also common substrate components. Observed gravel substrates were almost always embedded in sand and silt that clogged interstitial spaces and restricted flows through the substrate. Estimates of embeddedness in mainstem reaches decreased from 50% in the lower two reaches to between 20% and 30% in Reach 3.

Silts and other fine sediments dominated substrates in the tributary streams. These small streams appear to lack a source of coarse substrate and have insufficient energy to transport and distribute such substrates. The high level of fine sediment in these streams is more a function of the surrounding geology and hydrologic state of the streams than any human habitat alterations.

Large Wood

The concentration of LW in the watershed is estimated to be approximately 87 pieces per kilometer. The NOAA Fisheries standard for PFC is 80 pieces of LW per 1.6 km; defined as 60 cm in diameter and at least 15 m long. In the survey, woody debris was counted as LW if it was 10 cm in diameter and 3 meters long. Because very few pieces of woody debris counted in Oak Creek would meet the NOAA Fisheries criteria, concentrations of LW do not meet the NOAA Fisheries standard for PFC.

Downed trees contribute little habitat in the lower reaches of the creek. While concentrations of LW are more substantial in Reaches 2 and 3, they do not approach the amount of LW that historically occurred in the creek. At current levels, LW does not contribute significantly to habitat complexity and only rarely creates deep sheltering pools important for salmonid rearing.

Pool Frequency

Pool frequency may not be an appropriate indicator for evaluating the aquatic habitat in Oak Creek. Because of its low gradient, the creek contains an abundance of pool habitat. These pools are often extensive (one measured 64 meters in length) and contain long glide-like tail-outs. The length of many pools limits the frequency with which they occur.

Pool Quality

Pool quality in lower Oak Creek tends to be poor. Most pools are less than 1 meter deep and frequently lack objects such as LW or boulders that provide instream cover and shelter from high stream flows. The most common form of cover in the creek is undercut living root wads. These provide fish with hiding places for predator avoidance but may not be suitable for shelter from fast current during high flow events. With the exception of the one large debris jam in Reach 3, LW in the creek at the time of the survey did not provide significant sheltering areas that juvenile salmonids would use to avoid high wintertime flows.

Off-Channel Habitat

The deep and narrow incision of the creek offers little opportunity for development of off-channel habitat. Important slack-water features such as side channels, oxbows, and large root wads are absent or rare in Oak Creek. With few structures to deflect the current and no floodplain to disperse the energy of the stream, fish have few places to take refuge from the high flows that fill the incised channel. Many are likely washed out of the drainage during high flow events.

Refugia

Historically Oak Creek was a sinuous stream likely bordered by floodplain wetlands, prairies, and gallery woodlands. Euro-American settlement of the area has resulted in stream channelization, riparian forest clearing, and wetland conversion (OSU 2001), although the lower reaches of Oak Creek now contain more riparian forest than historically. As a result of these activities, very little aquatic refugia still exists on Oak Creek. The deeply incised channel precludes formation of off-channel habitat and floodplain wetlands that are usually associated with refugia. The riparian corridor is narrow, often ending at or near the top of the streambank, and is insufficient to buffer any areas of refugia that may exist. Invasive species such as Himalayan blackberry and reed canarygrass are prominent species along many portions of the creek. As a result, very little remnant habitat for sensitive aquatic species exists in the watershed.

Width-to-depth Ratio

The width-to-depth ratio of Oak Creek was estimated to be less than 10. Channel incision prevents the channel from spreading out into shallow riffles or glides. The high proportion of pool habitat, especially in Reach 2, gives the stream consistently deep residual depths. Due to its low width-to-depth ratio the creek is less prone to temperature fluctuation. The relatively large volume of water in the channel may buffer the stream against rapid temperature increases during periods of high temperature in summer heat waves.

Streambank Condition

The surveyed portion of Reach 2 was the only surveyed area in Oak Creek in which more than 10% of the streambanks were eroding. Approximately 14% of the banks in the surveyed stretch of Reach 2 were eroding, whereas only 9% of the streambank in Reach 1 was eroding. Reach 3 had the lowest proportion of eroding bank with only 3% of the bank showing signs of active erosion. Bank erosion in the tributary streams was uncommon and was estimated to be well below the 10% threshold established by NOAA Fisheries as properly functioning.

The relatively low amount of bank erosion in such a highly disturbed watershed may be attributed to two factors. First, the bulk of channel incision probably occurred in the early part of the century as wetlands were drained and channels modified to create agricultural lands and development of the City of Corvallis. The channel may now be approaching a

stage of equilibrium. The channel likely has carved away enough width and depth to accommodate its bankfull flows without eroding its banks. Second, the lower streambank in many portions of the creek is composed of clay layers and cemented alluvial materials that are only slightly erodible. These slightly erodible bank substrates likely slow the rate of erosion in many parts of the creek.

Floodplain Connectivity

Floodplain connectivity along Oak Creek may have degraded dramatically since the 1940s. Benner (1984) describes the Oak Creek channel near the current location of Reser Stadium as being braided as recently as 1936. The land near Oak Creek was described as "low, wet, and especially prone to flooding." By 1956 the channel continued its historic incising, further isolating the forest/prairie from the creek (Benner 1984). The increased channel incision also perched the riparian wetland above the streambed. Floodwaters inundated and recharged the riparian areas less frequently, the water table deepened, and the wetlands were converted to agricultural uses. Hyporheic connections between the stream and floodplain were severed as the channel began to erode into non-permeable clay layers and cemented alluvium.

In its current entrenched condition, the creek has little or no connectivity with its historical floodplain. The low terraces present in Reach 3 have created a new, narrow floodplain below the high terraces of the creek bed.

Changes in Peak and Base Flow

Changes in the peak and base flows of Oak Creek undoubtedly have resulted from channelization, deforestation, and wetland conversion. Channelization of Oak Creek has reduced the capacity of the stream to detain and store water during periods of high runoff. Spikes in discharge are generally greater in magnitude and shorter in duration than historically occurred. Loss of riparian wetlands has likewise reduced the watershed's capacity to store water and likely results in higher peak flows and lower base flows. Deforestation in the Oak Creek drainage also likely resulted in changes to the stream's hydrologic regime. Removal of vegetation from a watershed or changes in vegetated communities from communities with high rates of transpiration to communities with low rates of transpiration may result in higher magnitude peak flows (Brooks et al. 1991).

The precise nature of the changes to the hydrograph of Oak Creek is unknown. It is likely that current peak flows are greater than historical magnitudes because of channel incision, wetland conversion, urban development, and deforestation. Changes in base flow levels are difficult to evaluate because of the opposite and competing effects of deforestation and wetland conversion.

Disturbance History

Timber harvest and the conversion of land for agricultural and municipal purposes have disturbed much of the Oak Creek watershed. The headwaters of Oak Creek are in McDonald Experimental Forest, which has been extensively harvested. The Oak Creek valley between the experimental forest and the Willamette valley is a mosaic of private properties, with high levels of disturbance. Where the Oak Creek channel meets the Willamette valley, commercial, residential, and agricultural land uses have resulted in riparian degradation and loss of wetlands.

Riparian Reserves

The riparian areas along Oak Creek are highly fragmented, narrow bands of vegetation that often inadequately shade the stream channel. The riparian vegetation along much of the creek is restricted to the area between the edge of the stream and the top of the bank. Although stream shading in these areas is sometimes adequate, gaps in the canopy occur in many places, leaving the channel exposed to solar heating. The lack of a riparian buffer in these areas also decreases the potential for LW recruitment into Oak Creek.

In areas where the riparian vegetation extends beyond the top of bank, it is often limited to 10 or 15 meters beyond the top of bank. Stream shading in these areas is generally better than in stream segments with narrower riparian zones, but the lack of a floodplain and riparian wetlands limit riparian functioning. Few large tracts of wide riparian areas exist in the watershed. Large tracts of native riparian forest occur near the covered bridge and bike path crossing in Reach 3, and along the Bald Hill tributary. These areas contain remnants of the gallery forests and riparian wetlands that were once common along the stream.

Sequoia Creek (From Corvallis Stormwater Master Plan, 2000)

The Sequoia Creek headwaters originate near Chip Ross Park. The creek runs generally southeast through residential development then turns eastward near Sycamore Avenue. The creek crosses beneath Highway 99W and the Willamette and Pacific Railroad trestle before turning to the northwest at its junction with Village Green Creek. After being joined by Village Green Creek, Sequoia Creek turns eastward, where it is known as Stewart Slough. The creek crosses beneath Highway 20 and ultimately discharges into the Willamette River.

The Sequoia Creek Watershed contains 1,357 acres. The largest land use at present is low-density residential, which covers approximately 34% of the watershed. Fourteen percent of current use is for medium- and high-density residential. City streets and rights-of-way take up approximately 14% of the available area. Approximately 12% of the land use is industrial, primarily located downstream of Highway 99W. Open spaces make up about 11% of the watershed. Land use in the remaining areas of the watershed includes a mixture of commercial properties, OSU, and vacant land.

As future development occurs, the vacant land may be converted to low-, medium- and high-density residential areas. Other changes may include a decrease in industrial land-use and an increase in commercial use. The number of acres of impervious land will increase from 543 acres to 650 acres (29% increase in impervious surface), thus affecting the quantity and quality of stormwater runoff in the watershed.

Watershed Findings (From Corvallis Stormwater Master Plan, 2000)

The condition of the watershed was evaluated using information from a number of sources, including public comments collected at open houses, City of Corvallis (City) staff input on maintenance and operation issues, a technical stream evaluation of selected reaches, and modeling the stormwater conveyance system for existing and future build-out scenarios.

The elevation of the channel drops quickly relative to the horizontal distance, thus defining a steep gradient upstream of Walnut Boulevard. The gradient flattens out below that point, creating the potential for flooding in the transitional area between the hills and the flat area near the mouth of the creek. The gradient is very flat downstream of 9th Street, thereby increasing the potential for flooding during large storm events.

Riparian conditions vary along the length of the stream. Unlike those of other Corvallis streams, the riparian corridors of Sequoia Creek have more shrub area toward the downstream end. Industrial land-use encroaches on the creek near Jack London Street. Also, a large number of natural debris dams in the creek downstream of Jack London Street obstruct flows. An example of industrial land-use encroaching on the stream occurs at the recycling facility (Corvallis Disposal) located along the north bank of the creek downstream of Highway 99W. Sediment accumulation at the culverts under 9th Street may restrict higher flows.

Mary's River (From Corvallis Stormwater Master Plan, 2000)

The Mary's River watershed portion of this planning effort contains three small drainages that lie south of the Corvallis Country Club. The drainages lie outside the city limits, but inside the UGB. Flows from the drainages run southward underneath Brooklane Drive before entering the Mary's River floodplain. The 78 acres of drainages were modeled from the culverts underneath Brooklane Drive to the top of their drainages at the crest of the hill. The existing land use is split between low-density residential and open space, but the area is undergoing significant development. In the future, low-density residential will cover 69 acres, with the rest preserved with an open space conservation designation. Another subdivision, Brooklane Estates, also is being constructed further to the east in the Mary's River watershed. Brooklane Estates is located south of the Oak Lawn Memorial Park and has its own piped drainage system. This subdivision was not examined in detail or modeled, but is included for the sake of completeness.

Temperature

The Mary's River is listed on the DEQ's 303(d) list for temperature exceeding the 64°F (17.8° C) standard for rearing salmonids. Temperatures exceed the standard on a yearly basis and have been recorded as high as 82.4° F (DEQ 2001).

Chemical/Nutrient Contamination

The Mary's River is listed on the DEQ's 303 (d) list of water-quality limited bodies for bacterial contamination. Fecal coliform levels exceeded state standards in 24% of the samples taken. The Mary's River also contains some levels of atrazine compounds according to the USGS.

Sediment/Turbidity

The Mary's River is turbid and has a high level of fine sediments. Visibility at moderate to low flows was approximately 0.6 m. (2 ft.). Fine sediments are the dominant substrate types. The turbidity and high level of fine sediments is a function of the local geology and land usage. The soft, loamy soils that dominate the banks of the river are easily eroded and suspended in the water column. Deforestation of riparian areas and headwater streams also likely contribute to high levels of suspended sediment. Turbidity also may be affected by increases in nutrient levels from agricultural fertilizers. Increased phosphorous and nitrogen levels will lead to increased concentrations of free-floating algae.

Physical Barriers

No potential barriers to fish passage occur in the surveyed reach of the Mary's River.

Substrate

In areas where the river was shallow enough to assess the substrate, sand and fine sediments or gravel were dominant. However, a layer of non-erodible, cement-like alluvium is also common on the channel bottom.

Large Wood

Fifty-four individual pieces of LW, 16 accumulations, and 10 jams were present in the portion of Mary's River within the UGB. Many of these create small back eddies that would provide refuge during high flows.

Pool Frequency

Pool or pool-like run habitat comprises more than 95% of the habitat in the Mary's River. The scarcity of riffle habitat and abundance of slack water habitat may limit salmonid use of the river. Riffles are important in creating foraging opportunities for salmonids, and the lack of such habitat may decrease its suitability as habitat for these species. Therefore, the

high amount of pool and slack water habitat in the Mary's River indicates degraded habitat quality.

Off-Channel Habitat

Only three small areas of off-channel habitat were observed on the Mary's River. The incised nature of the channel limits the formation of off-channel habitat.

Refugia

No significant aquatic refugia occur on the Mary's River within the UGB. Water withdrawals outside of the City, riparian degradation, and alteration of the historic floodplain and hydrograph have led to systemic changes in the aquatic habitat. Remnant areas of pristine habitat or refuges for sensitive aquatic species do not occur on the Mary's River within the UGB.

Streambank Condition

Approximately 570 meters of eroding stream bank was present in the 6,100 meters of surveyed reach of the Mary's River. The large amount of erosion is likely the result of historic human activities, as well local geology and the sinuous nature of the river. Most of the erosion occurs on the outside edge of channel meanders or is associated with LW accumulation and jams. Bank erosion appears to be just as common in areas with extensive riparian buffers as in those developed for agriculture or residential purposes. A variety of bank stabilization strategies such as planting, concrete retaining walls, and riprap revetment are employed in the lower portion of the reach.

Floodplain Connectivity

Floodplain connectivity of the Mary's River is low. The channel is incised 4 to 5 m, making over-bank flows uncommon. Potential riparian wetlands are perched; hyporheic nutrient and water exchanges have been severed or substantially altered.

Change in Peak/Base Flows

Water rights in the Mary's River (outside of the city) have been over-allocated. Instream withdrawal rights exceed flows during the months of September, October and November. Instream withdrawal rights plus allocated rights exceed flows from June through November. The over-allocation of water has been implicated as a likely cause of the decline in the Mary's River cutthroat trout population (Ecosystems Northwest 1999).

Disturbance History

The Mary's River watershed is highly disturbed. Private and public timberlands in the upper reaches of the watershed have been heavily logged in the last century. Very little late successional stage old-growth stands exist in the timberlands of this region of the coast

range. Many stands are young second- or third-growth forests. The Willamette Valley portion of the watershed has also been heavily altered. Once covered in native wetland and upland prairies and gallery forests, the valley bottom portion of the watershed has been largely converted to agricultural lands.

Riparian Reserves

Riparian reserves have been significantly depleted along most of the Mary's River within the UGB. Agricultural fields, residential developments, roads, parks and a golf course are all located adjacent to the river. Riparian vegetation is often restricted to a narrow strip of streambank between the top of bank and the wetted channel. Invasive species have colonized much of the riparian area. Himalayan blackberry commonly grows on the stream banks and reed canary grass is the dominant species along the margins of the channel.

Willamette River (From Corvallis Stormwater Master Plan, 2000)

Habitat Features

The Willamette River forms the eastern edge of Corvallis' UGB. Project team biologists walked the western shoreline to identify important habitat features and problem spots.

The western shoreline can be divided into three distinct and approximately equal reaches: a side channel reach, a mainstem reach, and a mainstem reach with revetted banks (see map).

Near its southern end, the UGB is bordered by a series of side channels of the Willamette River. These side channels are deeply incised, and contain very little off-channel habitat. Narrow, low terraces are present on both banks. The low terraces increase in width near their confluence with the Willamette River. Substrate in the side channels was an even mix of fine sediments and gravel. Riffle habitat was uncommon. LW concentrations were low, probably the result of channel incision and width as well as lack of upstream recruitment. The channels are separated from agricultural fields by narrow strips of riparian vegetation. The widths of these riparian areas average approximately 50 feet and are often limited to the area below the top of bank. Riparian vegetation was composed of cottonwood, Oregon ash, and Douglas fir. Reed canary grass was the dominant species near the water's edge.

Between the south UGB boundary and the mouth of the Mary's River, the mainstem Willamette River is only partially incised. In Willamette Park, despite the revetted areas, much of the west bank slopes gently and has been contoured into several overflow channels. These overflow channels create alcoves of off-channel habitat. The substrate of the mainstem appears to be dominated by cobble and gravel substrates. Fine sediment and gravel are the dominant and subdominant substrates in the overflow channels. The riparian overstory is dominated by cottonwood and Oregon ash. Himalayan blackberry is the dominant understory shrub.

Downstream from the confluence with the Mary's River, the mainstem channel becomes confined between riprap lined banks. No off-channel habitat or refuge occurs in this reach. The riparian area is very narrow and is largely composed of willow and blackberry bushes. The instream habitat is composed of a single continuous run. The downtown area and Highway 20 closely parallel much of this reach and limits the potential for any rehabilitation activities.

The Willamette River receives all the agricultural and urban chemicals listed for the previous streams. It also receives treated effluent from the City's Wastewater Treatment Plant. These wastewater discharges are monitored by the City and form part of the baseline

Temperature

The Willamette River is currently listed on the DEQ's 303 (d) list for temperature during the summer months. The City of Corvallis currently conducts temperature monitoring in association with its facilities, which forms part of the baseline dataset.

Sediment/Turbidity

The river is currently considered to be properly functioning in this category.

Chemical Contamination

See Dixon Creek for a list of urban chemicals that may occur in this basin. The river also may have some agricultural chemicals, such as atrazine and related compounds. Nutrient levels are considered to be properly functioning. The Willamette River has a mercury advisory in this area and also is listed for fecal coliforms (e. coli).

Physical Barriers

There are no physical barriers to fish movement in the Willamette River in this area.

Substrate

NOAA Fisheries likely considers the Willamette River as "not properly functioning" in this category, due to the perception of increased fine sediment inputs upstream.

Large Wood

Habitat surveys have indicated that there is little large wood in the system, due to changes in the riparian forests, natural river geomorphology, and river maintenance activities.

Pool Frequency and Pool Quality

This is considered to be properly functioning in this section of the river, but there are areas at risk. The construction of revetments in the area has changed the way the river responds, but as these generally occur on one side only, they shift the stream activities to the other side.

Off Channel Habitat

This is considered to be properly functioning in this section of the river, as there exists off-channel habitat upstream on the east bank.

Refugia

Intact, well-buffered riparian areas exist in very few areas. Residential and commercial developments, city parks, and agricultural fields all encroach on Willamette River riparian areas. This disturbance to riparian habitat has facilitated the introduction of invasive species such as reed canary grass and Himalayan blackberry. Encroachments into the riparian areas and channel modification limit the amount of suitable habitat available to sensitive aquatic species.

Width-to-depth Ratio

The width-to-depth ratio is greater than 12 in most of the mid and upper reaches of the mainstem Willamette River. This resembles the historic condition, which was likely heavy braiding on a broad alluvial flood plain.

Streambank Condition

It would be difficult to classify this indicator as properly functioning, as there is riprap present in some areas. Portions of the stream still have streambanks more similar to the historic condition (see above).

Floodplain Connectivity

This feature is likely to be at risk or not properly functioning. Connectivity with the floodplain has been removed on the west side of the river to control flooding..

Changes in Peak/Base Flow

Some very small changes in peak and base flows probably occurred as a result of channelizing and increased impervious surface, but these are dwarfed by the changes resulting from upstream dam construction, and the high amount of flow in the river itself. These channelized stream segments have a reduced capacity to detain flows during peak runoff events, and have little water storage potential. The increase in impervious surface creates quicker, higher spikes in runoff after rainfall events. The hydrologic changes associated with development have likely produced little change in the channel

morphology, despite the presence of revetments, given the geology of the area and the geomorphology of the river in the Corvallis area.

Disturbance History

The Willamette River in the study area is an urbanized system. Increased impervious surface, riparian forest clearing, development along the tributaries and the mainstem, and agriculture practices have disturbed the river. Very little mature forest exists in the area.

Riparian Reserves

Some riparian areas still exist, especially in the Willamette Park area, but riparian systems have been heavily altered.

Jackson, Frazier, Village Green Creeks (From Corvallis Stormwater Master Plan, 2000)

This watershed consists of the Jackson, Frazier, and Village Green Creeks that form a complex network of streams and wetlands to the north of the Corvallis city limits. Jackson and Frazier Creeks both originate in McDonald-Dunn State Forest. The headwaters of Jackson Creek are located near Dimple Peak while Frazier Creek originates further north near Lewisburg Saddle. The two creeks flow eastward through the state forest and into low-density residential developments prior to merging at Highway 99. East of Highway 99 their combined flow enters the Jackson-Frazier Wetlands, an important habitat area. The flow leaving the wetlands is split. Part of the flow heads northeast across farmland to connect with the Willamette River at Bowers Slough, downstream of Lower Kiger Island. The remaining flow runs south from the wetlands as Village Green Creek. Village Green Creek turns to the southeast, flows through largely residential neighborhoods, and eventually joins Sequoia Creek to the east of Conser Street.

The Jackson Creek portion of the watershed contains over 1,500 acres, of which forest land is currently the largest land use (approximately 700 acres). Over 400 acres is currently undeveloped. In the future, the forest land will still be present, but the undeveloped land may largely be replaced by low-density residential development. The Frazier Creek drainage area is larger, with over 2,200 acres within its drainage boundary. Like the Jackson Creek area, the largest land uses are forest (1,000 acres) and undeveloped land (approximately 600 acres). In the future, the undeveloped land may become part of almost 900 acres of new low-density residential development. Currently two-thirds of the 380 acres draining to Village Green Creek are residential. This mix of low-, medium-, and high-density residential will remain the same in the future according to the City's comprehensive plan. The area designated as open space will increase slightly, from 28% at present to 33% in the future.

Village Green Creek is typical of many urbanized streams. It is highly channelized and in many locations has little or no available shade. However, there are few structures encroaching on the stream bank unlike many other Corvallis streams. The open stream banks, such as at Village Green Park are potential sites for projects to enhance stream and riparian health. For instance, in many areas of this watershed the floodplain can be reconnected to the stream, thereby enhancing habitat as well as alleviating downstream flooding potential.

Other stream systems (Jackson and Frazier Creeks above the wetlands, Dry Creek, Ryan Creek, the Millrace) were not evaluated as they contained no potential for being utilized as salmonid habitat. The influence of these systems on overall stream water quality was evaluated in the pathways evaluation section of the report.

Corvallis Area ESA Riparian Area Mapping Summary

All comments apply only to the area within the 400-foot-wide riparian corridor evaluation area.

Dixon Creek

- The mainstem (south of Walnut Avenue) is almost completely residential.
- The majority of the mainstem, although residential, includes a narrow strip of deciduous forest canopy that shades the channel.
- Street crossings that dissect the riparian zone are common on the mainstem.
- Tributaries (north of Walnut Avenue) generally are either in strips of deciduous forest bordered by unmaintained herbaceous vegetation or in continuous deciduous forest.
- Street crossings north of Walnut Avenue are uncommon or non-existent.
- Some first-order tributaries are in herbaceous vegetation.

Oak Creek

- Nearly all of the stream is bordered by a narrow strip of forest canopy.
- The lower 0.9 km (downstream from 35th Street) includes commercial/industrial and residential development; road crossings are common.
- Upstream from 35th Street, the forested area varies from very narrow to the full width of the riparian area, averaging 1/3 to 1/2 of the corridor width.
- Agricultural lands make up most of the remainder of the corridor above 35th Street.

- Above 35th Street, road crossings occur every 0.4 to 0.8 km.

Mary's River

- The riparian buffer along the Mary's River consists mostly of contiguous deciduous forest that extends the full 200 feet on each side of the stream.
- The forest strip is contiguous on both sides of the stream, for the full length of the stream within the UGB.
- A small amount of agricultural lands are located on the outer edges of the corridor just downstream from the point where the Mary's River enters the UGB.

Dunawi Creek

- Six major or complex road crossings fragment the system.
- Scattered but generally small pockets of commercial/industrial and residential development impinge on the corridor in several places.
- A forested strip is adjacent to nearly all of the stream, both mainstem, north fork and south fork; it averages about 1/3 the total width of the corridor.
- South of Philomath Boulevard, the remainder includes residential, commercial/industrial, and infrastructure developments
- North of Philomath Avenue, the remainder mostly consists of agricultural lands.

Sequoia Creek

- Riparian conditions vary along the length of the stream.
- More natural (shrubby) toward the downstream end of Sequoia Creek
- Large number of debris dams in the creek downstream of Jack London Street obstruct flows.

BASELINE CONDITIONS – SUMMARY OF RESULTS

The available data from the streams in the Corvallis area, including the Willamette River, show that all have suffered considerable degradation from likely conditions prior to human settlement. They comprise typical urban streams with incised and straightened channels and riparian buffers reduced in size, continuity, and complexity. Off-channel habitat in the Willamette River has become considerably reduced, or disappeared altogether. While this plays a lesser role in the establishment of the baseline condition, the distinction becomes more important when a trajectory for recovery is considered.

The streams in the Corvallis area, with the exception of the Willamette River, likely contain no listed chinook salmon, except as occasional visitors to the systems during some portion of the winter high flow period. A cursory review of those characteristics required for successful spawning and rearing demonstrate why.

Chinook salmon selectively spawn in the tributaries to major rivers, in third- to fifth-order streams. In order for any of the Corvallis streams to be considered this complex, it would be necessary to include the uppermost tributaries of Dixon and Oak Creek, which have low or no year-round flow, and are unsuitable for spawning or rearing. Chinook spawn in streams classified as Rosgen-type C-3. This describes a stream with moderate sinuosity, a gradient less than 2%, and a high width-to-depth ratio, with numerous gravel pool-riffle complexes and side channels. No Corvallis stream resembles this description except in gradient. They more closely resemble Rosgen-type G-6 streams; low to no sinuosity and low width-to-depth ratio, and containing mainly silt-clay substrates.

Chinook salmon require gravel to cobble substrates in riffle areas for spawning (approximately 16 m^2 area per redd or spawning site), with high amounts of groundwater flow to irrigate the eggs, and low (less than 25%) amount of fine substrate materials that tend to clog intra-gravel spaces (Healey 1991). Preferred spawning areas consist of the transitional areas between pools and riffles found at the nickpoints between bounded and unbounded valley segments (Bjornn and Reiser 1991). This provides downwelling of streamflow into the gravels and upwelling of groundwater. The upwelling appears the most critical of the hyporheic functions for chinook spawning at the reach-level scale of habitat characteristics. Surveys in the Corvallis streams found none of this habitat present.

Throughout their range Chinook salmon spawn at different water depths. Water velocities vary as well. The lack of gravel, high degree of incision, and low flow rates in Corvallis streams make them unsuitable for chinook salmon spawning. While adult Chinook salmon can venture up Corvallis streams, and indeed one was caught in Dixon Creek in the 1950s, spawning adults actively select habitat, and show a preference for the above-mentioned habitat features. Clearly, no successful spawning could occur in these streams, as they contain no habitat.

After hatching, spring chinook salmon spend a more extended portion of their life cycle in fresh water, unlike fall chinook, which migrate to the estuaries after a few weeks. Rearing areas consist generally of side channel areas with deep pool-riffle complexes with an abundance of overhead cover, cool temperatures, and drifting stream insects. These pool-riffle complexes play an important role in salmonid growth and survival (Healey 1991). As salmon are visual predators, water clarity is highly important.

None of the surveyed streams contain any of these elements. Flows are often intermittent, even in the mainstem of some of the streams (e.g. Dunawi Creek), temperatures are high, when flows are high the water is quite turbid, pool-riffle complexes are generally absent, and existing pools are quite shallow. Existing gravels were quite embedded (filled in by sand or silt). This armoring makes them quite difficult to use effectively, whether by

juvenile salmon as cover, or as habitat for macroinvertebrate prey species. The lack of these necessary elements of chinook rearing habitat makes Corvallis streams unsuitable for this life history stage, as any rearing habitat in Corvallis streams would be of extremely low quality. Habitat existing in this area would likely only comprise of winter refuge habitat, occupied when flows in the Willamette River become too strong.

When juvenile chinook salmon move from one habitat to another upon hatching, this movement initially goes downstream, not up, essentially a drift. The fact that juvenile chinook salmon barely swim fast enough to stay ahead of the river current strongly suggests that they can spend little time or effort searching out tributary habitat upstream of where they end up, and indeed, likely often find themselves transported by flood flows into areas not suitable for rearing (Healey 1991). Juveniles generally don't drift for long before finding suitable habitat within their natal stream. Juvenile salmon will move as much as 6 km from their natal stream in search of suitable cold, clear pool-riffle complexes to overwinter and rear (Murray and Rosenau 1989). Therefore, juvenile chinook salmon from the Mollala and Santiam Rivers are not likely to seek habitat upstream in the Willamette River, particularly as this necessitates swimming against the current. Following establishment of residence, movements become relatively restricted (Richards and Cernera 1989).

The vast majority of fish moving downstream from the tributaries of the McKenzie and Coast Fork-Willamette likely find sufficient suitable habitat associated with those streams. Studies done as part of the McKenzie Confluence Study and the McKenzie Subbasin Assessment confirm this. Very few fish were found in the Willamette River and the lower McKenzie River during the studies, despite the presence of "above-average" habitat in this area.

There exists no historical record of spawning or productive rearing in any of the streams in and around Corvallis, excepting the Willamette River. It is likely, given their size, hydrology, and geomorphology, that they have never been "chinook" streams. Therefore, impacts to spawning and rearing areas are not critical elements in determining the potential for take resulting from actions by the City.

Despite this, Corvallis streams play a role in the baseline water quality of the Willamette River, and may provide high-water refuge habitat to a small percentage of the total population. As a result, barriers at the mouths of some of the streams could impede use of these areas as refuge habitat. However, during the winter months, flows in Corvallis streams, though quite flashy, may ensure no barriers to access to the lower ends of Oak and Dixon Creeks, the two urban streams likely to serve as refuges.

Riparian areas also play a critical role as shade sources to decrease temperatures, as filters for removing contaminants, and in preventing instream and bank erosion. Especially in the lower reaches of the streams, riparian areas have been severely diminished through development activities.

Channelization results from increased development in the floodplain of the stream, and causes degradation of instream habitat through erosion and simplification, or lack of structures and elements that are necessary to create habitat. The use of streams as stormwater conduits in urban areas further contributes to incision, and diminishes and eventually removes altogether the floodplain connectivity of the system.

Therefore, despite the lack of any focused use of the systems by Chinook salmon, the impacts from contaminants, impervious surface, riparian buffers, and instream habitat conditions (erosion and excessive sedimentation) all play a critical role in the determination of water quality. The result of all this activity, along with the basic human activities associated with living, be they urban, suburban or rural, leads to diminished water quality in these streams. Eventually, this makes its way to the Willamette River, where it may result in a "take."

The Willamette River differs from the other streams, however, as both immigrating adults and emigrating juveniles use the area fronting Corvallis. Adults move upstream from April through June and juveniles move downstream from February through May. Some additional movement occurs in October and November. Conditions in the mainstem Willamette in this area appear mainly unsuitable for any extended rearing or successful spawning, despite the presence of fish in these areas, and so these habitat types are not affected by City activities. It may be that some use the off-channel habitat on the east side of the river, and the presence of structures on the west side as resting areas. This makes activities both in and ultimately affecting the Willamette more critical in terms of take of listed species.

CHAPTER 6. PATHWAYS/EFFECTS ANALYSIS

INTRODUTION

This chapter describes the combined baseline conditions and pathways/effects data for identifying the geographic distribution and the degree of impact that City services and citizen behavior have on Chinook salmon habitat. It discusses these activities and their effects in terms of their spatial (geographic distribution), temporal (time) and intensity (concentration) scales.

The chapter relies on three sources to identify impacts. First, it relies on an approved methodology for evaluating city activities and their impact on chinook salmon habitat in the project area (see Appendix 4 for a copy of the Technical Memorandum, *Methodology for Pathway Evaluation*). Second, it draws on a weighted database that has been created to analyze city activities and their impacts on Chinook salmon habitat and water quality. The weighted database contains approximately 4,300 records that cover the range of city activities that can impact habitat (see Appendix 5 for a CD with the entire database). Finally, it relies on information and baseline conditions work from Phase I of the ESA study (see *Baseline Habitat Evaluation and Evaluation of the City Activities*, February 2002, in Appendix 6 and NOAA Fisheries letter response in Appendix 7).

The methodology for this analysis compares and ranks activities as to their relative impact on Chinook salmon habitat and water quality. This approach provides a mechanism for evaluating the effects of City activities and events and citizen behavior at any geographic level desired by the City (e.g., reach, stormwater basin, citywide, and UGB). It allows for a comparative ranking of the effects to identify different degrees of impact, and it provides a framework for fiscal analysis. This analytic framework can help the City allocate its limited financial resources for habitat rehabilitation and recovery, and water quality improvements.

Given the number of records and the many ways of organizing and analyzing the data, this discussion confines itself to broader spatial and time scales rather than to specific impacts. It summarizes the results of the analysis and identifies some of the major impacts to Chinook salmon habitat identified in the database and the Phase I analysis. Using this approach it is possible to draw a number of more generalized conclusions about City activities and their impact on Chinook salmon habitat.

WEIGHTED DATABASE KEY ELEMENT DESCRIPTION

Database Set Up

The database is set up to evaluate impacts that City activities and citizen behavior have on Chinook salmon habitat and water quality. The structure of the database and the weightings is based on actual, not hypothetical, use of the streams by Chinook salmon. Since Chinook salmon use of Corvallis streams is very limited, it bears repeating that the findings of Phase I of this project provide the setting for the database structure and impact analysis.

The baseline analysis in Phase I indicates that streams in Corvallis do not now, or in the past, contain the elements Chinook salmon require for spawning and rearing (see Appendix 6 for the *Baseline Habitat Evaluation and Evaluation of the Impacts of the City Activities* February 2002, and Appendix 8 for the *Technical Memorandum on Chinook Salmon Habitat in the Upper Willamette River ESU* 3/3/03). Chinook salmon potentially gain access to and may use the lower reaches of some of the streams for refuge during high water flows in the Willamette River. Juvenile Chinook use the Willamette River for rearing and movement. Adult Upper Willamette River Spring Chinook salmon use the river as a migration corridor. Neither juveniles nor adults use the upper reaches of Corvallis streams.

Therefore, while Chinook salmon may gain temporary access to Corvallis streams, the streams provide none of the elements necessary for spawning and rearing. Consequently, the results of the weightings analysis focus mainly on impacts to water quality, which can realistically influence Chinook salmon habitat downstream, outside of the project area.

The analysis in this report focuses on the predetermined stormwater basins the City uses for its stormwater management program. By doing so the City can link activities and their weighted impacts in this study to other important City programs, such as control of stormwater runoff impacts to water quality. The advantage of piggybacking onto the stormwater basins and the reaches within them makes it possible to define areas where natural processes act in a similar fashion and City activities have similar impacts. Such organization also allows for the identification of "fixes" that can, where possible, be integrated with other ongoing City activities to improve watershed health.

Another advantage of the weighted database analysis is the incorporation of land use/zoning designations by reach. Land use can significantly impact Chinook salmon habitat. Fortunately, zoning characteristics determined to have negative impacts on habitat may be modified or changed to incorporate land use or development activities, mitigations, or even best management practices (BMPs) to help preserve or restore riparian function and water quality in the Willamette River and its Corvallis tributaries.

Pathway Scoring and Weight Score Assignment

Weight scores are based on five factors. They are the four pathways as defined by NOAA Fisheries and a fifth factor that accounts for proximity of a City activity to a city stream. Citizen behavior can also impact Chinook salmon habitat and water quality, but it is evaluated as a separate category. The database evaluates each activity or event for the above pathways, contaminants, impervious surface, buffers and barriers, and weights City activities according to its location inside or outside a 200-foot stream corridor.

The following sub-sections describe the pathways and score values assigned to each pathway. Values vary depending on the pathway. Some pathways exhibit little or no variation while others have significant variation.

Contaminant Pathway

Weighting factors for the contaminant pathway do not vary by stream location. Contaminants are considered to have relatively the same impact on water quality regardless of the location at which the contaminant enters the stream. Contaminants in the water produce direct effects, through toxicity to one or more life stages of the fish or other elements of the food web, or indirect sub-lethal effects on growth and vitality.

The difficulty comes in separating these sub-lethal effects from normal Chinook salmon population variation, as well as normal variation that occurs within and between seasons. NOAA Fisheries regards sub-lethal effects as highly important to the long-term survivability of the Chinook salmon population, as they diminish lifetime reproductive output, usually through effects on growth, reproduction, sensory or motor functions, or food supply. Though Chinook salmon rarely inhabit Corvallis streams (except the Willamette River), if at all, and only during peak flow times, the impacts resulting from City actions are considered indirect and citywide in their spatial distribution. Because of the above-mentioned difficulty in separating sub-lethal effects from normal variation, sub-lethal effects are included in the overall contaminant score.

Impervious Surface Pathway

The impervious surface pathway weighting values vary widely because of the variability of existing impervious surface in Corvallis. The lower reaches of Corvallis streams, those closest to their confluence, where there already exists a high percentage of impervious surface are assigned lower negative weight values for City activities than upstream reaches, where there is a much lower percentage of impervious surface. This is due to the fact that additional impervious surface in a lower reach would not impact Chinook salmon habitat as much as in a reach with little or no impervious surface (i.e., areas with little development).

Buffer Pathway

The weightings for the buffer pathway follow a similar rationale as that for the impervious surface pathway. Reaches where buffers are already narrow tend to have lower weightings than reaches with existing wide buffers.

The importance of the buffer or stream corridor characteristics pathway varies. Changes in the riparian condition (e.g., shade, LWD, impervious surface, bank stability, etc.) can result in an increase in instream erosion and an eventual loss of habitat structure and diversity. The increased hortonian (overland) water flow that can happen with a reduced buffer can contribute more sediment and contaminants to streams. Other riparian conditions such as infiltration can be impacted with diminishing buffer size.

The presence of LWD diminishes with lowered riparian connectivity. A buffer zone with no large trees contributes no LWD to the stream channel. Buffer values generally increase with decreasing stream gradient, as do vegetation mosaics.

In the case of Corvallis, the most important buffer functions are to maintain water quality. Buffer community structure has less importance. Recent information suggests that the historic riparian buffers in the lower reaches of Dixon, Dunawi, Oak, and Sequoia Creeks consisted of prairies, with the upper, higher elevation areas containing the more dense oak and conifer forests. Width typically increases in a downstream direction, as floodplain size increases. Research suggests that the riparian buffer width in these areas has actually increased over what existed historically, at least in terms of trees and shrubs (S. Gregory, personal communication [pers. comm.] 2003).

The lower reaches of Dixon, Oak, and Sequoia Creeks contain the highest negative riparian buffer scores, as they contain the highest concentration of urban development and activities. The large concentration of urban activities has converted the natural buffer to impervious surface, which has narrowed the natural buffer corridor width.

Urban development and road crossings also cut the continuity of the riparian buffers, negatively influencing their function, and potentially restricting free movement of water along the corridor and decreasing vegetation diversity. Dunawi and Dixon Creeks provide good examples of the importance of continuity. Both creeks have similar types of development activities occurring in the upland areas. Despite this, on Dixon Creek Reaches 1, 2, and 3 the riparian buffer consists of a single row of trees for most of its length, as opposed to the more extensive riparian buffer on Dunawi Creek. The change from prairie and gallery forests to treed areas increases the shading of the area, but decreases the mosaic or buffer community structure, simplifying its composition and changing it from native to predominantly non-native species.

The presence of urban development within the stream corridor and buffer area generally decrease shade in the riparian zone, which can result in higher stream temperatures. Buffer areas with shrubs or young trees provide little shade, grasses even less, with lawns providing none. While the thin riparian buffers may provide some shade, all reaches suffer from high temperatures by August. These temperatures likely resemble historic trends as the increased riparian tree cover in the lower reaches of creeks like Oak and Dixon, which are not believed to have existed prior to urban development, balances the loss of historic, low temperature groundwater inputs.

This potential for temperature increase is less important in upper stream reaches as higher gradients move water more rapidly through the system decreasing residence time and exposure to the sun. In the lowland reaches, water remains in the stream longer, and may reach temperatures too high for salmonids.

While almost any bank vegetation provides a buffer and protection against erosion, the quality of this protection can vary. In the incised lowland reaches of the streams, the presence of trees in the riparian corridor provides little bank protection, despite their extensive root systems. Grasses play an even smaller role for bank protection, although both do provide some protection against erosion from overland flows. The critical reaches to protect remain those highest up in the systems, as these have not yet incised to the

degree of the lower ones. Reducing the intensity and magnitude of flows resulting from stormwater inputs in the higher reaches of the system will serve to slow the process of incision in the lower reaches. Historical analysis, and the nature of the Corvallis area soils and topography, all suggest the inevitability of incision by most streams. Despite this, the lack of incision on Dunawi Creek has produced a viable riparian corridor and buffer width in the non-urbanized reaches, with some streamside wetlands remaining in the upper areas.

Barrier Pathway

Barriers can prevent fish passage and access as well as block the development and/or maintenance of salmonid habitat. Natural processes and human activities can both create barriers. Debris jams, waterfalls and seasonal downwelling (a stream that goes underground) are examples of natural barriers. Dams and culverts are examples of barriers created by human activity. Depending on the barrier, fish passage access may be restricted seasonally or permanently. The concern for the City of Corvallis is the degree to which human-made barriers in the streams negatively impact Chinook salmon passage and habitat.

The evaluation and scoring of barriers depends on their location and the degree to which they prevent passage or access. The barrier pathway is scored by the following process. Barriers that are located in lower reaches or at a stream's confluence are considered to have a greater negative impact because they prevent access or passage to a larger part of the stream's habitat than those in higher reaches. Therefore, lower stream barriers are assigned a higher number. Secondly, barriers that permanently prevent passage and access are considered to have a greater negative impact and are scored higher than seasonal barriers (e.g., barriers to passage and access during low flow). This is important where Chinook salmon have been known to seek off-channel refuge in Dixon Creek during high water flow in the Willamette River.

Stream Corridor Distance Factor

A fifth factor is included in the weight scores to account for differential impacts of City activities and events and citizen behavior on Chinook salmon habitat related to distance from a stream. Activities and behaviors occurring within the study area (200-foot corridor extending upland from the top of the bank on each side of the stream) as opposed to the same activities and behaviors occurring outside the corridor are considered to have a higher potential habitat impact.

There are three reasons for this difference. First, activities and behaviors occurring within the stream corridor influence listed fish and their habitat directly without the need of a transport mechanism or pathway to convey the impact to the stream. Activities and behaviors occurring outside the corridor often require intervention of a transport mechanism or pathway such as the stormwater system to convey the impact to the stream.

Second, activities and behaviors within the stream corridor can directly affect riparian buffer characteristics, which are critical to maintaining the health of Chinook salmon habitat. The further the activity or behavior is from the stream, the less likely it can impact the riparian buffer characteristics.

Third, NOAA Fisheries recognizes that there is a spatial relationship between urban oriented activities and impact to salmonid habitat. NOAA Fisheries cited in their preamble to the proposed 4(d) Rule a 200-foot corridor or buffer from streamside within which urban activities could potentially have a greater impact on salmonid habitat. NOAA Fisheries has gone on to state that the most "effective way to ensure PFC [Properly Functioning Condition] is to manage MRCI [Municipal, Residential, Commercial, Industrial] development activities in riparian areas so that their impacts on habitat functions are minimal at the streamside, but may gradually increase with distance from the stream." (Federal Register/Vol. 65, No. 132, pg. 42462).

The City used the 200-foot corridor width proposed by NOAA Fisheries as the riparian study area boundary, simply to provide consistency with the guidance. The presence of this area precludes no activities, but simply defines an area that NOAA Fisheries will scrutinize heavily in their analysis of any plan seeking ESA 4(d) Rule compliance. Consequently, weight scores are adjusted to increase the impact that an activity or behavior can have if it is located within the corridor. The weighting factor within the corridor increases the numerical score by a multiple of three.

Urban Activities and Impacts

The four pathways and the location factor are important in determining an activity's impact on water quality, but they do not describe the activity itself. They are external factors acting as a pathway to or a location relative to the stream. When considering the activity itself three additional factors are used to determine an activity's impact and the degree of impact it has relative to another activity. The three factors are magnitude, periodicity and intensity.

Magnitude

Magnitude refers to size or spatial extent of an urban activity. Size plays an important role in the level of impact on water quality; the larger the area the activity covers, the greater potential for impact. For example, discharge from a single stormwater outfall located in an upper reach of a Corvallis stream would not have the same impact on Chinook salmon habitat and water quality as the combined impact from all stormwater discharges.

Magnitude of an activity is rated or scored according to the area of its spatial distribution. The smaller its distribution, the smaller its impact on Corvallis streams and therefore the smaller the score. The smallest magnitude is an activity with a single or point location. This is scored a One. Activities with the biggest spatial distribution are considered to have an impact basin-wide and are scored a Four.

Among City activities that may have the greatest impact on Chinook salmon habitat due to magnitude are those related to land use and development. The wide spatial distribution associated with different types of development and the requirements set forth in the land development code (LDC) affects large areas of the City.

For example, the urbanizing upland areas in Oak Creek, Dunawi Creek South Fork, and Dixon Creek Middle and West Fork are beginning to display similar impacts as their lowland reaches – incising due to increasing water volume and velocity, removal of buffer vegetation, and sediment transfer. Widespread residential development has added and is adding significantly to the amount of impervious surface in these upper reaches. The magnitude of this development has a significant impact on the potential Chinook salmon habitat and water quality. Activities in this area receive higher negative scores due to the presence of increased residential development and associated increases in impervious surface. The higher slope of the areas in question also exacerbates the negative contributions to flow from impervious surface and stormwater runoff. Further removal of the buffer in these areas increases the potential for erosion.

The magnitude of impervious surface from urban development and subsequent stream channel alteration in the lower reaches has significantly influenced water quality. The lower reaches of all streams contain high levels of impervious surface and associated runoff. The percentage of impervious surface in the lower reaches of both Dixon and Oak Creeks exceeds 70 percent.

Periodicity

The frequency and duration of an event or activity can exert considerable influence upon the ability of the stream system to rebound from disturbance and remain in properly functioning condition for Chinook salmon habitat. Historic habitat-forming processes typically consisted of single-event or episodic occurrences. For instance, a tree falling into a creek is a single event, while flooding (e.g., 2-year 10-year, 100-year, etc.) and seasonal flows are considered episodic events. The periodicity of their occurrence allows the stream time to react and rebound.

Activities are rated according to their periodicity using a One to Four scale. Single event activities are those with the shortest period and are rated One. At the other end of the spectrum are chronic events or events that have a continual impact on the stream system. Chronic events are rated a Four. In between are episodic (occur with no predictability) and periodic events (occur at predictable intervals, separated in time) that reflect increasing impact to water quality. They are rated Two and Three respectively.

Many City activities and citizen actions, however, are not single or periodic events. They fall into the chronic category of events that occur on a continual basis, such as regularly scheduled City maintenance activities for transportation, utilities, and parks. The chronic nature of these activities may actually apply more stress on the ability of the system to react and rebound. Instead of the system reacting to single or episodic events, the watershed is

constantly receiving inputs. The reaction to chronic inputs can have a very different impact on a watershed than single, episodic or even periodic events.

Intensity

Intensity refers to the strength or concentration of the activity's or event's contribution to the impact. The higher the intensity or contribution that the activity or event has on the water quality, the greater the intensity score. For example chemicals in herbicides, pesticides or fertilizers can vary in concentration. If they enter the stream their impact will depend on their strength (in this case toxicity to Chinook salmon) and concentration. Stormwater discharge can also vary in intensity. A stormwater outfall along a creek could have a low, medium, or high intensity impact depending on the volume of water and the contents in the runoff.

A rating of One to Three is used to score the intensity factor. Events or activities that are considered to be of low intensity would be scored a One, while events or activities of high intensity would be scored a Three. An event or activity of medium intensity would be scored a Two.

Ratings

Three ratings were applied to City activities and events, depending on their magnitude, timing, and intensity. A few examples should illustrate how the rating process was conducted.

One example that demonstrates the rating process is park maintenance and herbicide use. The City has a small program that uses primarily backpack sprayers but also uses aerosols and granular products. Non-selective post emergent and non-selective pre-emergent herbicides are used periodically on developed landscape areas or on invasive plants, such as blackberries, along stream corridors. Application techniques and practices vary by site. Insecticides are predominantly used in treatment of structural and nuisance insects (e.g., sugar ants). While the Parks and Recreation Department goes to great lengths to minimize the environmental impact when maintaining their parks, they do still have a potential impact on Chinook salmon habitat and water quality. The following is the analysis used to rate maintenance activities and herbicide use.

- Magnitude: There are a number of parks located adjacent to Corvallis streams. While they are at specific or discrete locations along creeks, they are not a point location, but more likely cover several reaches. Therefore, the Magnitude is a reach (rate 3).

- Timing: Maintenance is conducted year-round, though different types of pesticides are used at different times of the year. Therefore the timing is chronic (rate 4).

- Intensity: Herbicides contain chemicals that may harm water quality and impact stream habitat. Therefore there is a potential for herbicides, should they enter the stream, to have a negative impact. Since herbicides are not used extensively and application techniques are adapted to site conditions, the intensity of the impact may vary, but generally it is considered low (rate 1).

A second example is stormwater runoff. In the LDC there are street standards that outline how development must handle stormwater runoff. Section 4.0.70 of the LDC defines minimum street standards for development. Stormwater drainage is required on temporary dead-ends. Alleys are required "in commercial and industrial districts to serve abutting properties unless other permanent provisions are approved by the Planning Commission or Director." New development and roadways increase impervious surface. The stormwater collection requirements, while important for keeping water off the roadway and other property, can increase the rate of runoff, concentrate pollutants, and interfere with groundwater recharge. If development is outside of the downtown area that is currently served by the City's combined stormwater and wastewater collection and treatment system, stormwater will likely end up being discharged directly to streams, which can have a negative impact on Chinook salmon habitat/water quality.

- Magnitude: The requirements apply throughout the City; therefore the magnitude is basin-wide (rate 4).

- Timing: The impervious surfaces will continue to exist for a long period. The timing is considered chronic (rate 4).

- Intensity: the intensity could be low or high depending on the location of the development and whether it is within the City's combined stormwater and wastewater collection and treatment system. If it is within the City's combined collection system the intensity is low (rating 1). If it is outside the collection system, it could be medium or high (rate 2 or 3).

SUMMARY OF IMPACTS – CITY ACTIVITY AND CITIZEN BEHAVIOR

The following summarizes the assessment of City activities and citizen behavior on Chinook salmon habitat and water quality in Corvallis streams. The assessment methodology is described in detail in Chapter 5 and the pathway data from which this summary is taken is provided on a Compact Disk (CD) in Appendix 5 and in the Phase I report (*Baseline Habitat Evaluation and the Evaluation of Impacts of City Activities, February 2002,* Appendix 6).

Since there are 4,375 records in the database it is not possible to provide specific details for all activities. This summary highlights the range and degree of impacts that City activities and citizen behavior have on Chinook salmon habitat and water quality and their geographic distribution. The activities examined include construction, operation, and maintenance of public infrastructure (e.g., utilities and transportation); parks and

recreational facilities; land development; planning and policy development to provide infrastructure, transportation and park facilities; and citizen behavior.

Not all City activities negatively influence habitat and water quality. The City has made progress, through its LDC, toward requiring development to minimize the impact on surrounding natural resources. The City is also making progress toward preserving significant natural features identified by its Statewide Goal 5 work. Similarly, park facilities design for trails and pathways must minimize their impact on sensitive areas. This section focuses primarily on City activities that have negative outcomes, as these are the ones the City is developing proactive measures to avoid, minimize or improve in the future.

Stormwater

The stormwater collection and conveyance system has, perhaps, some of the greatest impacts on streams. Chief among these is the impact upon the streams by changing the hydrograph. The number of outfalls in the system and the relatively little on-site detention means that the greatest amount of stormwater acts as channelized flow into the streams, rather than percolating and entering the stream gradually through the groundwater system. Stormwater also serves as the conveyance or pathway for a number of other activities that can negatively impact habitat and water quality.

In Corvallis streams, some of the greatest negative impacts result from both increased erosion (in the upper reaches) and increased sedimentation rates in the lower. . Other pathway impacts include temperature changes, either through the warming of pooled water in detention facilities, or when stream flows are low during the dry season.

Other negative impacts from the stormwater system include the presence of barriers to fish movement caused by culverts (also a transportation impact) and the use of fertilizers, herbicides, and pesticides for vegetation control and maintenance along watercourses and in streams. Other contaminants, as well as sediments, get introduced into the system through the flushing process. Ditch maintenance also contributes to runoff and the introduction of contaminants.

The City has made progress in the reduction of some of these negative impacts. In the urban core, the City collects and treats most stormwater runoff. Stormwater is conveyed to the City's wastewater treatment facility where it is treated and discharged to the Willamette River. Outside of the urban core, stormwater continues to have a negative impact on the habitat and water quality in City streams.

Wastewater

Wastewater impacts include the introduction of contaminants and alteration of temperature. There are scenarios that could involve spills of wastewater and discharges that could introduce raw pollutants or treatment chemicals directly into the system (spills, overflows, leaking pipes, and pumping system failures). Effects of these discharges can have both direct toxic and sub-lethal effects on the fish themselves, though habitat impacts

in these cases are likely to be negligible. New construction, such as the pipelines the City is planning along stream systems would have impacts related to the construction (increased erosion and sedimentation) and removal of riparian vegetation (the buffer) leading to increased temperatures from shading loss or increased sedimentation from bank erosion.

Drinking Water

The potable water system impacts occur as the result of raw water withdrawal from the Willamette River (instream habitat pathway) and its return to the system through the wastewater and stormwater systems, causing flow alterations and hydrograph changes. The introduction of contaminants through the effluent from backwashing of water filters, and flushing of pipes may prove critical, as does scheduling of any maintenance activities, as actions done during low water conditions do not benefit from dilution effects.

Transportation

Impacts from the transportation activities (e.g., improvements, new construction, the existing transportation network, and operation and maintenance) can have a significant negative impact on Chinook salmon habitat/water quality. Impacts may come from transportation improvements (e.g. the road design), their location in relation to city streams, increased traffic, increased maintenance and operation requirements, and from the construction activities themselves. Construction within the 200-foot study corridor has immediate impacts from increased erosion and sediment transfer to streams, increased impervious surface and resultant stormwater runoff-related changes to the hydrograph, and inputs of contaminants from the road surface. There can also be impacts to the riparian vegetation buffer continuity, composition, and width.

Construction outside the stream corridor may also have negative stream impacts resulting from the impervious surface and contaminant conveyance. Increasing stormwater runoff into the conveyance system will negatively impact instream habitat by altering the stream's hydrograph and introducing contaminants from the roadway surface (primarily petroleum based oils and grease). Greater impervious surface from roadway construction or widening will also reduce infiltration and increase runoff volumes and velocities. Similar impacts to the water quality result from the existing roadway network.

Operation and maintenance associated with de-icing roads, though rare in winter, introduces contaminants either directly into the stream system or into the stormwater system, with the same eventual destination. Roadside mowing decreases the ability of the vegetation to slow overland flow, by decreasing the surface roughness and to allow the stormwater to percolate. Bridge washing, maintenance, repairs, and painting can result in toxic or sub-lethal effects on fish or their food organisms.

Culvert cleaning and repair may introduce sediments into the stormwater or stream systems, causing an increase in total suspended solids. Overall operations and maintenance activities can have negative water quality impacts to Chinook habitat, though these activities are likely to be sub-lethal in nature.

Parks and Recreation

An examination of parks planning, design, construction and maintenance indicates two major pathways for impacts upon fish habitat – impervious surfaces and contaminants. Existing parks have an impact on habitat through design and maintenance. Design elements include trails, parking lots, park structures, landscaped areas, and playing fields. All of these can modify the existing conditions by increasing impervious surface and surface water runoff, with effects like those outlined for stormwater and wastewater. This can be a significant problem since the City has a number of park facilities adjacent to streams and rivers.

Since parks do not have stormwater collection, treatment and discharge facilities to handle runoff, the impervious surfaces, which can include turf fields, tend to produce hortonian flow into the streams. While sod areas may allow some stormwater infiltration, asphalt and heavily compacted soil, gravel and grassy surfaces still increase hortonian flow into the streams.

While the City Parks and Recreation Department has had some success in reducing the use of pesticides and fertilizers, effective substitutes have been difficult to find. The application of these chemicals can result in soil contamination, and eventually stream contamination through stormwater runoff. Maintenance actions utilizing these chemicals along the streams can have a direct negative effect, despite localized dispersal methods. Indirect effects occur as the result of sheet flow runoff from parts of the park system outside the stream corridor.

New parks may impact Chinook salmon and water quality through the same two pathways – impervious surfaces and contaminants. New construction also may commit a direct take on critical habitat (if NOAA Fisheries lists these streams as critical habitat) through placement in the riparian zones of the streams or by usurping other hydrologic features (e.g. wetlands).

Land Use

The greatest impacts on Chinook salmon/water quality occur with land development. Development (both private and public) often increases impervious surface. The degree of impact depends upon location, type and size of the development, construction methods and materials, and level of stormwater treatment.

Locations with potentially greater negative impacts include those adjacent to stream courses and in riparian buffer areas – essentially within the 200-foot stream corridor. Development resulting in stream crossings and structural encroachments can break riparian and buffer continuity and can also have negative impacts on streams. When this happens, species composition usually changes, sometimes quite radically. Similarly, removing trees and replacing native oak gallery forest with maintained lawns and non-native vegetation decrease a great many of the functions of a riparian system, especially those associated with water quality (temperature and filtering). Even a lawn, if compacted sufficiently, can

act as an impervious surface, and the length of the grass may be too short to be effective as a filter strip, or as shade.

Development often causes the separation of streams from their floodplains, through methods to reduce property damage by flooding. As a result, runoff volume and velocity will increase, which can result in incising, sedimentation, and stream contamination. Streams are also constrained by infrastructure development such as streets and culverts. These barriers may increase the negative impact to Chinook salmon/water quality by restricting access, although this likely doesn't occur in Corvallis.

Impacts to Chinook habitat and water quality vary among different land uses, such as residential, industrial, commercial. Residential low-density housing can impact Chinook habitat through yard-maintenance activities, whereas higher residential density may have greater impervious surface runoff. Industrial land use whether heavy or light can impact Chinook salmon habitat. There may be greater potential for chemical contamination from these activities. The degree of impact from commercial land use depends in part on the size of the development and mitigation steps taken (either required or voluntary) to avoid, minimize or reduce these impacts.

Land Use Planning and Development Code

The Comprehensive Plan for the City of Corvallis serves to organize city development activities. It contains a vision of the future for its jurisdiction. Among the plan elements are goals and policies that guide future land development, development intensity and spatial distribution of activities, and the preservation and protection of resources such as waterways, riparian zones, forest, and significant wetlands.

The LDC helps to implement the Comprehensive Plan. At this time the LDC does not sufficiently addresses protection and preservation of habitat, riparian corridors, open spaces, and significant natural features that the Comprehensive Plan addresses. The Comprehensive Plan and LDC are currently out of sync. That is, the Plan identifies goals and policies that outline an approach, which could improve Chinook salmon habitat/water quality, but the LDC does not yet provide the specific language to implement the Plan. The LDC does address, though inadequately, some of the relevant habitat issues. The LDC will be updated after both the City's Statewide Goal 5 project effort and this ESA Salmon Response Plan are completed.

Citizen Behavior

There are citizen behaviors and activities that are identified and associated with water quality. Not all the activities have the same degree of impact, but they can result in stream contamination and further contribute to Chinook salmon habitat degradation. The following list represents some of these activities:

- Upkeep and maintenance of landscapes and yards. Activities such as mowing, pruning and improper disposal of yard debris can impact streams;

- Application of chemical insecticides, herbicides and fertilizers to landscape vegetation;
- Auto maintenance in driveways where oil, fluids and grease spills or improper disposal of these liquids can enter the streams;
- Excessive irrigation can wash contaminants into streams;
- Wash down of impervious surfaces; and
- Replacement of native with non-native vegetation.

CONCLUSION

It is clear from this examination that City activities, through any of the identified pathways, can have a negative impact on the streams in the project area. The greatest impacts come from impervious surface, followed by riparian buffer changes and stream channelization. Impervious surface results not from just the construction of buildings, streets, and parking areas, but also from such seemingly benign activities as trails, lawns, and parks. Stormwater runoff from urban development in the upper reaches of Corvallis streams (Dixon, Oak, and Dunawi) is likely to have the greatest negative impact on water quality. The lower reaches of these streams are already incised while the upper reaches still retain a great deal of function and hydrologic connectivity. This may change as these areas experience development and increases in impervious surface that will accelerate stream incision, diminish buffer and riparian connectivity, and channel larger volumes of water at higher velocities downstream.

The City has examined and identified City activities and citizen behaviors that negatively affect Chinook salmon habitat/water quality. They understand their impacts and spatial distribution. In the next chapter pro-active steps are identified that the City proposes to take to avoid, minimize or reduce the negative impacts and where possible reverse or improve Chinook salmon habitat and water quality.

CHAPTER 7. PROPOSED LIMIT 12 PROGRAM SOLUTIONS

INTRODUCTION

Based on the analysis of impacts to Chinook salmon habitat and water quality from City of Corvallis activities and citizen behaviors, which is described in the previous chapter, the City has proposed solutions that prevent future habitat degradation and initiate restoration of PFC. When combined into a single program the proposed solutions meet the intent of the ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial, and Industrial Development and Redevelopment) objectives.

This chapter identifies the proposed solution options. It describes the process used to identify solution options, the justification for the solutions, the solution option refinement process, and the list of solution options. It details each solution and the impacts they are designed to address. It also identifies which Limit 12 criterion the selected solution will meet since most individual solutions do not meet all 12 considerations listed under Limit 12 of the 4(d) Rules (see Appendix 1 for the NOAA Fisheries guidance binder on 4(d) Rules compliance).

It is important to emphasize, however, that the program solutions have not been finalized. Other City environmental, planning and program activities identified in previous chapters are still under development (e.g., Goal 5 process Natural Features Inventory, stormwater management implementation program, Comprehensive Plan and LDC updates). It is the City's intention to integrate the ESA Salmon Response Plan program solutions into the City's practices, policies and codes as they are modified through these processes.

SOLUTION OPTION IDENTIFICATION PROCESS OVERVIEW

The following is an overview of the process used to identify the solution options. It begins with an evaluation of the impacts from City activities and citizen behavior on Chinook salmon habitat/water quality. This involves the determination of the relative impact and ranking of the activities and behaviors on habitat done with the weighted database. It is followed by solution option identification where the project team and the community developed solution options that prevent future habitat degradation and initiate restoration of PFC. An important part of the options development process is the extensive refinement that involved stakeholders and the public. The process overview concludes with a brief discussion of how the final set of solution options was selected.

Identifying and Ranking City Activity and Citizen Behavior Impacts

The identified solution options resulted from the integration of the baseline conditions database and pathways database developed in Phase I into a single relational database in Phase II. Weighting factors were developed because different City activities and behaviors have relatively different impacts on Chinook salmon habitat. These weighting factors, when applied to City activities and citizen behaviors, allowed the project team to analyze the spatial distribution and relative differences of impact that City activities and citizen

behaviors have on Chinook salmon habitat/water quality. The project team found that the impacts ranged from positive (decreased or prevented habitat degradation) to negative (increased habitat degradation).

Since the purpose of the project is to prevent habitat degradation, attention was focused on those activities and behaviors that negatively impact Chinook salmon habitat and water quality. Using the database it is then possible to identify not only which activity and behavior negatively impacts Chinook salmon habitat and its distribution (reach, stormwater basin, creek, citywide, and UGB), but it is also possible to determine the relative negative impact of the activity as well.

A rank-ordered list was developed that grouped together activities and behaviors with similar weighted scores. Those with higher negative scores were considered to have a greater negative impact on Chinook salmon habitat and from a policy standpoint were presumably of higher priority to correct than other activities and behaviors with lower negative scores.

An extensive review process was used to ensure the accuracy of the list and ranking. The review process included an internal project team review as well as a peer review process with the Technical Advisory Committee (TAC). Where necessary, refinements, modifications and corrections were made to the database to better reflect the impact of the City activity and citizen behavior.

Finally, the activities and behaviors were compared to a set of criteria to determine their relative impact to Chinook salmon habitat and water quality based on their magnitude, timing and intensity. A number that best represented the activity's magnitude, timing and intensity was assigned to the activity and behavior. These numbers were summed and then multiplied by a number that represented their location inside or outside the 200-foot study corridor. Activities were then ranked according to their final score, which represented the activity's impact to Chinook salmon habitat and water quality (see previous chapter for detailed discussion of this evaluation process).

Solution Options Identification Process

After review of the ranked order of activities and citizen behaviors, the project team began the solution option identification process. This process was completed in three steps – 1) selecting activities with the greatest negative values, 2) evaluating potential adjustments or changes to selected activities, and 3) developing solution options.

Select Activities

The City activities that contribute to Chinook habitat and water quality degradation come primarily from City Departments responsible for parks and recreation, transportation, utilities, and land use planning. They cover land development, roads, buildings, pipeline construction and utility service facilities, as well as the operation and maintenance activities to service and maintain them. Planning policies, along with the supporting LDC,

are the guidelines and directions for the City's growth and development and the public services that are needed to support it.

The first stage in the selection process was to identify those activities with the greatest negative score. The team reviewed all activities with negative scores. There were 1,710 records with negative scores ranging from -1 (least negative impact on Chinook salmon habitat and water quality) to -60 (highest negative impact on habitat and water quality). The initial determination was to include all activities with negative scores. The rationale to do so was based on the idea that in the initial screening it would be important to recognize that all negative scores indicated that the activity had a negative impact on habitat and water quality. In later stages of the screening process, there would be an opportunity to screen out activities with a lesser negative impact and focus on those that had a greater impact on habitat and water quality.

The second stage was to organize the records in a way that would be useful for developing solution options. Since there were so many records it was necessary to create practical categories for solution development. One way was to group them by similarity (e.g., purpose, function, department, etc.) since many of the records in the database covered a specific detail or single aspect of the same activity. The following categories were used to group the activities:

- Land use
  - Zoning
  - Land Development Code
- Parks and recreation
  - Planning and design
  - Capital improvements
  - Operation and maintenance
- Stormwater
  - Operation and maintenance
  - Run-off collection, treatment, and discharge
  - Capital improvements
- Construction of public projects
  - On-site construction requirements
- Transportation
  - Operation and maintenance
  - Capital improvements

- Water supply
  - Operation and maintenance
  - Capital improvements
- Wastewater treatment
  - Operation and maintenance
  - Capital improvements

The citizen behavior activities were organized differently. Similar activities were categorized based on whether they were indoor or outdoor, landscape or other maintenance. The citizen behavior activities were grouped in the following manner:

- Household
  - Indoor cleaning and upkeep
- Outside
  - Yard maintenance
  - Landscaping
  - Other outdoor maintenance other than yard.

Develop Solution Options

Once the records were organized according to the categories, a third stage was initiated to identify solution options. The initial screen involved examining each category to determine whether there were already other programs underway or planned that could also address the project's Chinook salmon habitat and water quality issues. If so, the project would avoid any overlapping and duplication of effort by simply contributing to these ongoing or planned programs.

The screening discovered several programs currently in various stages of development and implementation that did have some overlap with the existing ESA categories. They included the following:

- Statewide Goal 5 Inventory (Natural Resource, Scenic and Historic Areas and Open Space Goal – OAR 660-015-0000(5))
- Land Development Code update (Phase II)
- Stormwater Master Plan implementation

Where ESA categories matched other programs, the project team reviewed them to identify how well they considered ESA issues and to identify where additional ESA recommendations could be made to the existing program. ESA categories that did not

match ongoing efforts were considered wide open to begin to develop options targeted to specifically address Chinook salmon habitat and water quality.

First Solution Option Identification

The first cut at solution options identification was unconstrained by cost or other parameters. This allowed for the most creative and far-reaching possibilities to be explored. In a number of instances elements of an option that would otherwise not have been identified were selected and incorporated into the viable options.

The following is a summary of the options identified in this first screening.

- Land Use.
  - Create new zoning categories (e.g., stream corridor, conservation open space).
  - Fully protect portions of the stream corridor that are deemed Significant Natural Features.
  - Support LDC updates to incorporate Chinook salmon habitat protection design standards.
  - Prevent any future development within the 100-year flood plain and provide incentives to remove existing development within the 100-year flood plain.
  - Contribute to the City's effort to meet Statewide Goal 5 planning requirements with Chinook salmon habitat data and protection options.
  - Ensure consistency with other planning efforts (e.g., parks and recreation planning, utility master planning, transportation planning).
  - Incorporate planning concepts that reduce transportation trip generation and need for more roads (e.g., mixed use, higher residential density, alternative transportation modes, etc.).
- Parks and Recreation.
  - Design future parks and open space facilities to consider site location and incorporate "fish-friendly" elements (stream corridors, riparian areas, connectivity, vegetation, etc.).
  - Inventory parks facilities to assess how they currently fit ESA goals and identify and design modifications to meet these goals where they do not.
  - Partner with non-profit organizations to purchase and set aside land to meet ESA goals.
  - Prepare an Operations and Maintenance Manual outlining operations and maintenance for each park.
  - Site wood chip pile elsewhere with appropriate run-off controls in place and do not accept third party organic debris.

- Stormwater.
  - Incorporate stormwater protection criteria into the LDC and Design Criteria Manual.
  - Incorporate erosion control requirements into the LDC for public and private projects.
  - Implement applicable master plan recommendations to meet ESA goals.
  - Develop operations and maintenance manual that incorporates ESA goals.
- Public Construction.
  - Require waste materials disposal plan for approval by City construction engineer.
  - Require City to monitor construction site for construction activities that can degrade Chinook salmon habitat and water quality.
  - Memorialize changes in site construction requirements through city ordinance.
  - Add requirements in the Standard Construction Specifications (SCS) for construction site activities including the recycling of construction site materials, prohibiting clean-up activities (e.g., concrete wash down and disposal, asphalt clean up, etc.), de-chlorination, dewatering, erosion control, eco-friendly construction materials, etc.).
  - Strive to meet Leadership in Energy & Environmental Design (LEED) standard specifications for City buildings (City is currently reviewing specs for compatibility and practical use).
- Transportation.
  - Incorporate ESA goals into future transportation planning activities (e.g., adapt "green streets" concepts, transportation demand management, non-motorized transportation alternatives, minimize stream crossings, consider sensitivity to stream corridors and placement of transportation facilities).
  - Integrate transportation planning with land use planning to ensure that there is consistency in the application of ESA goals.
  - Revise transportation system plan to incorporate ESA goals.
  - Incorporate ESA goals into future transportation design activities (e.g., minimize proximity of streets, pedestrian and bike paths, bike and car parking areas to stream corridors; design "fish-friendly" bridge crossings; use "fish-friendly" construction materials).
  - Encourage businesses to provide employee bus-passes, provide bike parking, and encourage car/van pooling, off-peak hours and telecommuting.

    - Modify operations and maintenance activities to reduce impact on Chinook salmon habitat and water quality (e.g., airport maintenance, grading/sweeping, vegetation maintenance, chemical application, vehicle maintenance).
- Water Supply.
    - Add fish screens at water supply intakes.
    - Promote water conservation measures (public, private businesses and residents).
    - Adjust rates to regulate water consumption.
- Wastewater Treatment.
    - Promote planning activities that will reduce impact to Chinook salmon habitat (e.g., increase capacity of pump stations to reduce likelihood of overflows).
    - Develop a spill prevention program.
    - Require discharges from certain businesses to be pre-treated before discharge.
    - Investigate use of pump stations instead of gravity systems near waterways and high groundwater areas.
    - Incorporate operations and maintenance activities that minimize impacts to streams.
    - Consider grey water separation to decrease flow to wastewater treatment plant and to conserve water.

Similarly, for citizen behavior the following options were identified.

- Encourage appropriate vehicle maintenance activities (spill prevention, clean-up and disposal, etc.).
- Promote proper landscaping, yard care and pollution prevention techniques (disposal of yard waste, recycling, application of fertilizers, herbicides and pesticides, etc.).
- Encourage vehicle trip reduction through employee transportation coordination and use of alternative transportation modes.
- Promote water conservation activities to reduce water consumption (e.g., recycling, appliance purchase rebates).
- Develop program to educate citizens about salmon habitat protection and how they can contribute (schools, media, etc.).

Public Review

Once the initial options list was developed in the Fall of 2002, the City began a series of public reviews that culminated with a public open house/workshop on November 19, 2002 and a website-based questionnaire. The purpose of these actions was three-fold. First, they were designed so the public could review and comment on the solution options

that were identified. Second, they were designed to solicit additional options from the public. Third, they were used to gauge public acceptability and support for the solution options.

Two stakeholder meetings (October 2 and 9, 2002) were held prior to the second public open house/workshop. The stakeholders were identified from contacting environmental organizations (The Environmental Center, Mary's River Watershed Council) business organizations (Corvallis Chamber of Commerce), institutions (Oregon State University) and interested people who had registered for future contact at previous public meetings.

After a project update and overview, stakeholders were presented with the draft options and then encouraged to ask questions and comment on them, as well as identify other options or variations on the solution options. The stakeholders identified variations to the solutions options and suggested specific ways to apply the options.

The second public event (the first was held May 2001) was an open house/work shop (November 19, 2002). Attendees were presented with the options and then divided into groups to carefully review, comment on and add/modify the solution options (e.g., land use, parks and recreation, utilities, construction specifications, transportation, citizen behavior). The options were ranked in order of effectiveness to prevent Chinook salmon habitat degradation. At the end of the meeting participants were also asked to rank the options themselves based on how they perceived the City should prioritize its ESA planning efforts. A questionnaire was distributed to the attendees for that purpose.

This questionnaire was also posted for three weeks on the City's ESA project website so that persons who did not attend the public meeting could submit rankings (See Appendix 14 for copy of 11/19/03 website questionnaire). The questionnaire also included space to add comments on the options.

The first phase of review closed with the project team collecting all comments, questionnaires, and proposed new options and option modifications. Based on these inputs and those from City staff and the TAC, the project team began refining the options.

Option Refinement and Public Review

A revised set of options was prepared that incorporated the comments from the public, City staff and the TAC. Three new elements were included in the revisions. First, each solution option was screened to identify which of the 12 considerations under ESA Section 4(d) Rule Limit 12 (Municipal, Residential, Commercial and Industrial development activities) the solution met. Second, timing for implementation of the option was identified to give an idea of the lead-time and staging that might be necessary to put the option into action. Third, where possible, implementation costs were calculated.

The TAC was given several additional opportunities to review and comment on the revised options. Only minor modifications were necessary to prepare them for a final round of public comment.

The final draft set of options with revisions was presented to the public at an open house/workshop meeting on June 4, 2003. This event was similar in format to the one held on November 19, 2002. After review of the options and the modifications made based on the previous comments, the public divided into groups to carefully review the options and provide further comments and modifications. The options were listed in order of effectiveness toward preventing Chinook salmon habitat degradation. Meeting participants were again asked to fill out a survey questionnaire and provide comments based on the revised options and to change the ranking if they disagreed with the order.

The same questionnaire and comment form was posted on the City's ESA project website for four weeks to allow persons who did not attend the public meeting an opportunity to comment on the options (See Appendix 15 for copy of web-site questionnaire). Once the website questionnaire and comment form was closed, the project team assessed the public review comments and began developing the final draft solution options.

Recommended Solution Options

The following are the recommended solution options. They are presented by category and represent solutions that should prevent Chinook salmon habitat degradation and in many instances begin the process of restoring PFC. The solution options should also improve water quality, which is the most important factor in fish habitat in the Corvallis watershed. See also Appendix 9 for detailed tables of the solution options including cost estimates where it has been feasible to identify them.

Accompanying the solution options is Table 3. The table lists the solution options and indicates which of the 12 considerations under ESA Section 4(d) Rule Limit 12 the solution option meets. In some cases the solution option meets all considerations. In others the solution options meet only a few. The importance of the table is to demonstrate that the solution options when taken altogether meet all 12 considerations that are required of ESA Section 4(d) Limit 12. Not only will a program that includes these solution options comply with Limit 12, they will be effective in preventing habitat degradation and restoring PFC.

Land Use Solution Options

<u>Zoning</u>

Several options address changes in zoning designations that affect future land use and result in protecting Chinook salmon habitat. Some of the proposed zoning solution options are being considered under the Phase III planning effort currently underway at the City's Community Development Department. Timing for Phase III implementation is scheduled for the end of 2004.

The major components of the zoning solution options are the following.

- Protect portions of stream corridor(s) that are deemed critical to preserve Chinook salmon habitat and water quality from development through zoning. The following are examples:
  - Create protection zones and apply them at specific locations to protect habitat and water quality.
  - Create an overlay zone designed to protect Chinook salmon and water quality.
- Zoning and Open Space
  - Increase open space requirements for all zones.
- Density transfers for development:
  - Allow density transfers to increase open space.
  - Allow density transfers on-site to protect selected resource areas.
- Use resource information from Corvallis' Statewide Goals 5 (Open Spaces, Scenic and Historic Areas and Natural Resources), 6 (Air, Water and Land Resources Quality) and 7 (areas subject to Natural Disasters and Hazards) compliance projects to craft ESA protection policies and actions.
- Limit uses within zones:
  - Uses within stream corridors or on specific reaches or watersheds would have limited use depending on location.

Land Use Development Standards

Solution options are also proposed for development standards. Development standards are part of the City's LDC, which is currently being updated as part of the Phase III planning effort. Like the timing for zoning, the City intends to complete update of the LDC by the end of 2004.

The following lists the major components of proposed development standard solution options.

- Standards to decrease impervious surface. One of the biggest contributors to Chinook salmon habitat degradation is stormwater run-off from impervious surface. One method to reduce the volume of run-off is to consider reductions in the amount of impervious surface allowed in land development. The following are a few examples:
  - Reduce parking maximums where transit is available.
  - Require an increase in bicycle parking to encourage riding and reduce vehicle trips.
  - Encourage pervious pavement.

  - Reduce base ratios for auto parking.
- Modify street design standards.
  - Reduce street widths (not below emergency access widths).
  - Require bike lanes.
  - Allow one-sided street parking.
  - Incorporate "green street" design standards (e.g., use planting strips/swales for stormwater treatment).
- Require and provide incentives for vegetation protection.
  - Vegetation can be used as an effective buffer (see below) between stream corridors and development.
  - Landscaping with native species will also help reduce the impact to habitat.
- Buffer areas.
  - Adjust buffer requirements depending on the habitat quality of a specific reach. High quality reaches would have more restrictive development standards than low quality reaches in order to protect and prevent them from becoming degraded.
  - Apply greater mitigation requirements in lower quality reaches in order to prevent further degradation.
- Dedications and easements to protect riparian function.
  - Develop a formula-based approach to determine the size/width of an easement.
- Develop specific design standards for stream crossings.
  - Identify appropriate locations for stream crossings to minimize impact to water quality and fish habitat.
- Provide incentives (e.g., density transfers) to remove development within the 100-year flood plain.
- Require development standards that address wetland and other sensitive areas/lands.
- Create specific land use standards that address Chinook salmon refuge areas, if necessary.
- Prepare land development standards that are specific to the Mary's River area to take account of the unique habitat features of the river.

Parks and Recreation Solution Options

The City has a significant amount of land devoted to park and recreational facilities. Park acreage is approximately 1,439 acres of which 1,100 acres are designated open space lands. Many of these park facilities are adjacent to or along streams where park development and operation and maintenance activities can impact the quality of Chinook salmon habitat and water quality. Even park facilities that are not along streams have some potential to impact fish habitat and water quality.

The proposed solution options cover a wide range of parks and recreation activities. The activities include future park, open space, and recreational planning; specific park and recreation facility improvements; and park and recreation facility operations and maintenance. Timing for implementing the solution options varies depending on the activity and the Department's ability to fund the solutions.

Neighborhood Park Planning

A number of recommended solution options were suggested for neighborhood park facility planning. The following specific options are proposed:

- Develop new park siting, planning, and design criteria that address Chinook salmon habitat and water quality. Some examples follow:
  - Incorporate water quality sensitive design.
  - Use eco-friendly design materials (e.g., pervious pavement for trails and parking lots).
  - Site park facilities where impacts are lower.
  - Maintain surface and sub-surface flows by decreasing the amount of impervious surface, compaction and contaminants.
  - Site active recreation parks outside stream corridors.
  - Limit corridor crossings with culverts.
  - Develop park programs that balance recreation and environmental stewardship.
  - Have goals that reflect sensitivity towards ESA, fish and wildlife needs, and water quality.
  - Maintain composition and overstory cover (tree cover).
  - Maintain composition and understory cover (shrub/herbaceous layer).
  - Maintain historic water flow and hydrology where parks are adjacent to streams.
  - Minimize the need for additional stormwater treatment with proper facility design.
  - Plant native species where appropriate for mitigation and park plant community.

- Continue park policy of "right plant, right location."
- Place parks on one-side of the creek or use bridges that span the entire creek (no in water bents) to minimize impacts.
- Maintain stream corridors by designing to minimize their impact.
- Develop partnerships to acquire land or conservation easements that can be preserved as open space.

Open Space and Recreation Service Planning

Since the City is responsible for over 1,000 acres of park lands designated as open space, there is a need to address how to manage the open space as it pertains to Chinook salmon habitat and water quality. The City recognizes its role as steward for this open space and has begun developing an Open Space and Recreation Service Plan that addresses among other issues impacts on habitat and water quality. Plan development is currently underway with the Owens Farm property (located adjacent to the Jackson-Frazer Wetland) and will be expanded to other open space lands once a methodology for developing an open space plan is worked out.

Operations and Maintenance

Operations and maintenance activities can have some of the most direct impacts on fish habitat. Maintenance for parks along City streams and rivers (Willamette Park, Crystal Lakes Sports Fields/Kendall Natural Area, MLK/Berg Park, Riverfront Commemorative Park, Avery Park, etc.) have the potential to degrade habitat if not conducted properly. The following options have been identified to help reduce habitat degradation. The timing for implementing these solutions will vary depending on the availability of the budget.

- Prepare an Operations and Maintenance Manual to provide guidance for the entire parks system.
  - The Operations and Maintenance Manual would be site- and season-specific and provide guidance for all site operations and maintenance activities (e.g., vegetation maintenance, mowing, fertilizer and herbicide/pesticide applications, etc.).
  - Map parks and identify locations where specific activities may and may not take place.
- Maintenance for nearly all park and recreation equipment is performed at Avery Park. Since this park is located adjacent to the Mary's River, maintenance activities, if proper precautions are not taken, could potentially impact the river.
  - Provide guidance for the Avery Park maintenance facility, which includes containment and treatment of equipment wash-down and run-off liquids.
  - Develop a spill prevention program.

- Properly dispose of liquids and materials used for maintenance.
- Provide an appropriate facility for storing chemicals and liquids.

Existing Park and Recreational Facilities

While planning can address future park and recreational facility development, existing parks have the potential to impact Chinook salmon habitat and water quality. The following solution options are directed toward addressing the City's existing park and recreation facilities.

- Inventory existing park and recreational facilities (e.g., activities, programs, structures, locations, and operations and maintenance practices) and assess how they fit with ESA goals.
  - Determine what modifications are needed to minimize impact to fish habitat and water quality.
- Existing park and recreation solution options.
  - Mitigate activities on-site by removing/replacing structures and impervious surfaces with low environmental impact materials.
  - Retro fit and mitigate impacts with low impact design and materials.
  - Identify parks located in sensitive and riparian areas and determine mitigation needs.
  - Implement agriculture conservation plans where agriculture leases and service agreements exist.
  - Time construction to minimize erosion and sediment transfer, soil compaction, and impact to Chinook salmon habitat.
  - Use Best Management Practices (BMPs) to maintain low impact.
- BMX Track (bike park).
  - Retro fit and mitigate BMX park or move it to reduce impact on stream water quality and fish habitat.
  - Remove creosote posts.
  - Remove paved access ramp and boat structures.
- Timberhill School Park.
  - Restore wetland and mitigate drainage impacts.

- Mary's River Natural Park.
  - Install floating dock to minimize impacts.
  - Use low impact materials for facilities and structures.
- Bruce Starker Park.
  - Implement management strategy to minimize impact of ornamental pond on adjacent streams (chemicals in water have been discharged).
  - Treat discharge of stormwater (install oil separator).
  - Redesign and relocate parking lot so as not to be so close to stream.
- Wood chip pile run-off and containment (located at Avery Park) – several options.
  - #1: Develop methods to capture, treat, and discharge run-off from organic debris at existing location.
  - #2: Move the pile elsewhere to prevent discharge to Mary's River (e.g., move to Process Recovery Center).
  - #3: Reduce, restrict, or eliminate third-party organic debris to reduce potential liquid run-off.

Stormwater Run-off Solution Options

It has been determined that one of the main pathways contributing to Chinook salmon habitat and water quality degradation is stormwater run-off. The City recognizes that stormwater run-off can be a problem and has taken a number of steps recently to help reduce its impact through planning efforts and projects such as the City's successful stormwater collection, treatment and discharge project in its urban core (combined sewer overflow project). The ESA project team has carefully reviewed these efforts and has proposed solution options that capitalize on ongoing stormwater management efforts as well as proposed additional solutions that will further reduce negative impacts to Chinook salmon habitat and water quality. Some of the options are incorporated into ongoing stormwater projects, while other options will be included in future planning and capital improvement efforts.

<u>Stormwater Planning</u>

Control of stormwater begins with planning where it is possible to assess current conditions and forecast future conditions that incorporate such factors as population growth and the spatial distribution of land use development. From these planning efforts the City can assess ways to manage future stormwater run-off. The City has undertaken just such an effort over the past six years with development of its Stormwater Master Plan (SWMP). They have crafted major policies and identified projects that will address the City's stormwater.

The ESA project was initiated after the SWMP was well underway, but the City was extremely interested in integrating the SWMP with the ESA. The ESA project team carefully reviewed the working documents for the SWMP and provided information, as it was available, to members of the SWMP committee. From these interactions the following proposed solutions options were crafted.

- Integrate SWMP into ESA program.
  - General policies to integrate into the ESA program are in Chapter 5 of the SWMP. The policies include maintaining natural hydrologic processes, protecting and restoring natural resources and ecosystem functions; protecting and improving water quality; addressing maintenance requirements and allowing for maintenance access; incorporating community awareness and information exchange.
  - SWMP recognizes the need to integrate the SWMP policies with the ESA program through application of SWMP policies to Municipal, Residential, Commercial, and Industrial (MRCI) development, which is ESA Section 4(d) Rule Limit 12.
- Integrate specific SWMP actions into ESA program that do the following:
  - Provide sediment and erosion control requirements to reduce erosion and sediment transfer.
  - Reduce contaminant transfer to surface and groundwater.
  - Enhance native vegetation along riparian areas to maintain connectivity, filtering pollutants, provide shade, and maintain buffer.
  - Protect and enhance stream channels.
  - Protect uplands and wetlands.
  - Manage floodplains to protect development but also to maintain fish habitat.
  - Restore streams to properly functioning condition.
- Erosion Control Ordinance
  - Pass and implement Erosion Control Ordinance
- Operations and Maintenance
  - Develop stormwater operations and maintenance management plan (this is Phase II of the U.S. Environmental Protection Agency's stormwater discharge permit requirement).
- Monitoring stormwater
  - Develop stormwater monitoring plan to measure improvement in water quality in streams and creeks over time and incorporate ESA goals for preventing Chinook salmon habitat degradation.

- Focus on two elements in the monitoring program: on-site monitoring and programmatic monitoring. On-site monitoring will require taking actual site (field) measurements to determine effectiveness of program goals. Programmatic monitoring will assess how the implemented activities meet ESA goals.
- Incorporate steps and procedures for corrective actions where program does not meet improvement criteria.
- Develop community awareness and recognition that ESA salmon recovery is a long-term commitment. Changes in the landscape and water quality will take considerable time to accomplish.

Public Construction Specifications Solution Options

It is considered important that the City take the lead in demonstrating how to meet the ESA project goals of preventing further Chinook salmon habitat degradation and initiation of PFC restoration. All public construction must comply with the City's construction specifications. The project team reviewed the existing public construction specifications to identify solution options that could meet the ESA goals. In addition to actual construction, the project team has reviewed the City's commitment to sustainable development practices. The following solution options that were identified to meet the ESA goals range from job site activities and enforcement to long-term sustainability practices.

<u>Onsite Construction Activities</u>

The concerns with the job site are construction activities that may have off-site impacts. Not only do equipment clean up and materials disposal practices have the potential to impact nearby streams and riparian areas, but also the construction materials themselves can have long-term impacts. The following are on-site solution options that primarily address clean up and construction practices. The next section on sustainability addresses construction materials.

- Require contractor to prepare a construction site plan that addresses:
  - Appropriate disposal of construction materials (concrete, soil, construction materials).
  - Mitigation of impacts should plan fail and damage occurs off-site.
  - Appropriate disposal of demolition materials.
  - Monitoring plan to assure compliance.
  - Proper pipe flushing activities.
- On-site hazardous materials.
  - Proper use and disposal of construction related hazardous materials. Dispose of hazardous materials in a manner that does not impact water quality and salmonid habitat.

    - Require specific clean up practices for solvent materials that are used at the construction site.
- Erosion control.
    - Specify appropriate erosion control practices (see erosion control option in stormwater solution options).
    - Containment of pollution run-off (e.g., stormwater, wash-down, etc.).
    - Minimize contaminates at job site from entering streams and groundwater.
- Monitoring and enforcement of construction site plan: two methods.
    - Contractor or materials supplier performs monitoring and self-enforcement.
    - City performs monitoring and enforcement.

Sustainability

Sustainability has become an increasingly important element in development. Both public agencies and private developers are recognizing the benefits of developing projects that support environmentally sustainable concepts. One way to encourage the adoption of sustainable development practices by the private sector is for the City to use the concepts in its own construction. Another way to encourage private business to adopt sustainability in private development is to create incentives for the private sector to support sustainable development.

Sustainability with respect to protection of Chinook salmon habitat and water quality ranges from siting of facilities and use of construction materials to the actual design of a facility. The following solution options identify sustainability practices that can positively impact Chinook salmon habitat and water quality.

- Encourage construction in the City to meet LEED standards (Leadership in Energy and Environmental Design). Corvallis is currently using LEED for some of its own building practices, but these practices should be expanded to encourage incorporation of LEED in private land development and construction.
- Require "eco-friendly", low impact materials and recycling practices.
- Encourage use of materials that would reduce impact on environment, including paints, construction materials, etc.
- Consider providing a list of products that are accepted/prohibited or, alternatively, the City should define "fish friendly" criteria that contractors/suppliers can use to determine what construction materials qualify.
- Incorporate construction-siting criteria that reduce negative impacts on water quality and fish habitat (e.g., building placement, buffer areas, utility location, drainage way location, etc.).

Transportation Solution Options

Transportation (e.g., roadway network, bridges, bike and pedestrian pathways, transit, etc.) plays a critical role in almost all City activities. It is principally through the transportation network that residents and businesses connect and interact. Freight is transported, residents commute to work, to shop, and to recreate.

The transportation network is both large and pervasive. The facilities that are needed to support the network can have negative impacts on the environment including Chinook salmon habitat and water quality in streams. The purpose for identifying transportation solution options is to help minimize their negative impact through planning, project construction, and maintenance and operation activities. By incorporating the proposed solutions it will be possible to prevent further Chinook salmon habitat degradation and water quality impacts to city streams.

The solution options are divided in to three main categories — planning, design, and operations and maintenance. Transportation planning covers solutions that will help future transportation network development. Design will address projects to be constructed. Operations and maintenance addresses current and future impacts to Chinook salmon habitat and water quality.

Transportation Planning

While planning for transportation facilities is closely tied to the City's comprehensive planning efforts, determining exactly what type of transportation facilities will be needed is in part the role of the Transportation System Plan (TSP). In that capacity the TSP can address not only the types of transportation facilities to provide, but also the way they are delivered. Issues such as timing, location, design and even materials that are used can be addressed in transportation planning policies. Therefore, transportation planning is an important method of preventing future Chinook salmon habitat degradation as policies can be identified to meet ESA goals.

What follows are solution options that cover future transportation facilities. The options range from proposed policy changes to more specific design related planning.

- Incorporate ESA goals into the Transportation System Plan (TSP).
  - Review the TSP to make sure specifications incorporate habitat and water quality considerations.
  - Revise proposed projects to meet habitat and water quality requirements.
- TSP policy planning should address the following:
  - Minimize proximity of streets, pedestrian and bike paths, and parking areas to streams, creeks, water bodies and wetlands.

- Minimize impacts caused by proximity of transportation facilities to streams and water bodies through design and materials used.
- Minimize stream crossings. Where bridges are needed use open bottom structures instead of culverts and span entire streams to reduce the number of structures in streams.

- Transportation Demand Management (TDM) Strategies.
  - Identify and implement strategies in the 1995 Transportation Alternatives Study to help improve water quality, reduce stormwater run-off, and reduce impervious surface cover.
  - Reduce private vehicle trip generation by encouraging alternative transportation methods (bike, bus, carpooling, pedestrian, walking).
  - Encourage telecommuting.
  - Recommend reduction in vehicle miles traveled (VMT). As a member of the Corvallis Area Metropolitan Planning Organization (CAMPO) The City can now implement programs that encourage VMT reduction.

Transportation Design

The project team proposed solution options that can be incorporated into project design. The following solution options address specific design elements that will help prevent Chinook salmon habitat degradation. Many of these options come from the so-called Green Street design elements that address methods to meet important transportation network goals through low impact transportation improvement designs.

- Capital Improvement Plan (CIP).
  - Incorporate low impact design into CIP transportation projects.
  - Incorporate SWMP policies as part of the evaluation criteria to determine applicable low impact design elements.
- Consider incorporating the following design elements into future transportation projects. These design elements could become part of the updated TSP.
  - Modify existing street widths based on street classifications (e.g., one-side parking, one-side sidewalks).
  - Consider bio-swales and other vegetative buffers to prevent run-off to streams along streets and in parking lots.
  - Consider alternative materials (e.g., pervious materials, vegetation, etc.) in project designs.
  - Consider vegetation planting wherever possible to reduce temperature and evaporation.

- Incorporate capture and treatment techniques to reduce the impact of stormwater run-off.
- Reduce the City's current off-street parking space ratio from 1:400 square feet of floor space to 1:1,000 square feet of floor space.
- Use concrete instead of asphalt to reduce run-off temperature.

Street Operation and Maintenance

The City's transportation operation and maintenance activities are quite advanced. Many operation and maintenance activities already minimize impacts to streams. The City is considering a similar application to NOAA Fisheries for an ESA Section 4(d) Rule Limit specifically for its transportation operation and maintenance practices. Limit 10 of the Section 4(d) Rule covers Routine Road Maintenance Activities. Like Limit 12, if approved by NOAA Fisheries, the operation and maintenance activities performed by the City's transportation division will be certified as protecting Chinook salmon habitat.

A letter from NOAA Fisheries dated January 7, 2002, which addressed Phase I of Corvallis' ESA project, encouraged the City to consider submitting a Limit 10 application. In part the letter noted "we [NOAA Fisheries] recommend the city consider submitting an application under the 4(d) limit for your road maintenance program (Limit 10)."

Further, the letter from NOAA Fisheries acknowledged that the level of effort to obtain approval for a Limit 10 is less arduous than for a Limit 12. While the Limit 12 may cover a broader number of activities, the Limit 10 is a good start to meeting the ESA requirements for Chinook salmon habitat preservation.

Water Supply Solution Options

Water supply impacts on Chinook salmon habitat typically occur in three ways. First, there is the raw water intake where water is pumped from the Willamette River to eventually be delivered to the user. Second, there is the consumption of the water by the user. Third there are the activities that the City must perform to maintain the water supply system.

In the first instance, water withdraw from the river has the potential to result in a direct take of Chinook salmon should they be sucked into the raw water intake. In the second instance, there is a potential of indirect take if water applied to land acts as a pathway for contaminants such as lawn fertilizer, to enter a stream and degrade Chinook salmon habitat. Finally, in the third instance there are maintenance activities such as waterline flushing that can result in habitat impacts. All three can violate the ESA for listed Chinook salmon.

Fortunately, the City has already undertaken efforts to eliminate take at the City's raw water intake. The City installed a NOAA Fisheries approved water diversion fish screen to reduce the possibility that Chinook salmon will enter the water intake. An approved water diversion screen by NOAA Fisheries complies with ESA Section 4(d) Rule Limit 9. Limit 9

specifically addresses water intakes and appropriate screening to prevent the take of listed fish.

With respect to the second and third areas of potential impact there are a number of potential solution options that can help reduce habitat degradation. The following options have been proposed to address water consumption and system maintenance.

Water Consumption

Reducing water consumption can be a way to lower the potential impact on Chinook salmon habitat. A reduction in water demand will lower water needs for the Corvallis system, which in turn will reduce the risk of a take at the City's water intake and leave more water in the Willamette River. Water conservation may also result in a reduction of the need for water to be applied to landscaping and other land features, which can lead to Chinook salmon habitat impacts. The following proposed options address ways to encourage water conservation.

- Conservation measures.
  - Encourage public and private business conservation measures to reduce water consumption through education programs.
  - Use inclining rates to reduce water consumption.
  - Investigate the use of appliance rebates to encourage conservation.
  - Encourage use of native vegetation to reduce irrigation needs.

Operation and Maintenance

The City must maintain its water supply system. Most operations and maintenance activities already prevent impacts to streams. A few additional solution options have been proposed that will further reduce impacts.

- Consider reducing the amount of water needed for flushing the distribution system and blow-off to reduce water supply demand.
- Quickly replace or repair broken or damaged pipelines.
- Provide secondary containment for spills that could contaminant streams.
- De-chlorinate backwash water.

Wastewater Treatment Solution Options

There are a number of areas where wastewater has the potential of impacting Chinook salmon habitat. Upsets can occur and untreated wastewater can be discharged directly into the Willamette River when combined sewer and stormwater flows overwhelm the collection system and treatment facility's ability to treat the volume (fortunately, recent projects have substantially reduced the frequency of this occurrence). Gravity collection

systems are often located along side streams where they can impact stream surface and underground water flows. Treated wastewater discharges have the potential to elevate receiving water temperatures. In addition, as city growth occurs there are increasing collection, treatment and discharge capacity needs to handle the growth creating potential future impacts on habitat and water quality.

The project team has identified a number of solution options that can reduce Chinook salmon habitat impacts. Like water supply, some of the solution options are related to activities that can reduce demand or the need for treatment capacity through planning and other reductions in capacity needs. Other options address maintaining the existing system so there is a lower probability of upsets or overflows.

Wastewater Collection

The following are proposed options to help reduce the potential for system upsets. They address both maintenance as well as conservation techniques.

- Increase capacity of pump stations to reduce likelihood of overflows. Install auxiliary power source.
- Disconnect stormwater drains on private and public facilities from the sanitary sewer system.
- Regular inspection of pipes to verify integrity.
- Repair or replace damaged and broken pipes.
- Flush and clean pipes to maximize capacity.
- Enforce the fats, oils, and grease (FOG) program to reduce grease build-up in pipelines, which reduce their capacity to convey wastewater.

Conservation

Conservation can help reduce wastewater treatment capacity demand. Like water supply conservation, reductions in demand can have a number of benefits to Chinook salmon habitat including lower discharge, fewer new facilities and reduced risk of system upsets. The following solution options address methods that can lead to reduced treatment capacity demand.

- Investigate use of grey water separation to decrease flow to wastewater treatment plant and to conserve water.
- Investigate wastewater reuse.
- Encourage citizen and business conservation measures to reduce wastewater discharge.

Discharge

The City has a National Pollution Discharge Elimination System (NPDES) permit that allows it to discharge treated wastewater into the Willamette River. The permit specifies the requirements for discharge including volumes, temperature, quality and allowable mass load limits. The City is seeking a renewal for the NPDES permit in 2004. During renewal the following proposed solution options should be considered for the new permit.

- Incorporate temperature requirements for Chinook salmon in upcoming NPDES permit.

Citizen Behavior Solution Options

Citizens should be considered partners in any ESA plan that is developed. Corvallis residents and businesses are known for their support of civic activities and environmental preservation. In many instances citizens and businesses are already incorporating behaviors that support Chinook salmon habitat and water quality. These activities include recycling, use of alternative transportation modes, telecommuting, water conservation, planting native vegetation and other low water use plants, and supporting other pollution prevention activities.

The following proposed solution options capitalize on the predisposition of citizen and local business behavior. In addition, with some strategic support by the City (using staff time to help implement some of these activities) the activities could have a noticeable impact on protecting Chinook salmon habitat.

Public Education

Informing and educating the public on the purpose and goal of protecting Chinook salmon habitat is an important step in changing citizen behavior. To be successful, though, it needs to be a coordinated program with sufficient resources to promote the educational effort. The following proposed solution options address public education outreach efforts.

- Develop a formal Public Education Plan and include the following elements:
  - Outline program and activities/elements to be used to encourage changes in public behavior.
  - Provide overall guidance and direction on public education.
  - Include program elements, milestones and evaluation criteria to measure effectiveness.
- Coordinate with other ongoing programs.
  - Use Public Works Department Water Resources Specialist to organize public education plan in coordination with other water quality initiatives.

- Use other existing programs to educate public on what they can do to contribute to preserving Chinook salmon habitat and maintaining water quality. Existing programs would include the Parks and Recreation Department's Urban Forestry program and Public Works Department's water conservation programs.
- Prepare, print and distribute brochures on recycling and conservation.
- Enlist other non-city organizations and programs to help educate the public (e.g., Master Gardener Program, Chamber of Commerce, Environmental Center, neighborhood associations, Mary's River Watershed Council, etc.).

- Pollution prevention program (PPP). This program has similar goals and can be a useful tool for the ESA education program.
  - Public Education Plan would reference the PPP as part of the City's overall effort.
  - Encourage both citizens and businesses to participate.
  - Existing PPP is currently being updated and expanded to meet Clean Water Act (CWA) requirements.

Incentives

Incentives can encourage voluntary participation. The following address goals that can help achieve the ESA goal.

- Support incentives to change citizen behavior. Incentive programs could be an element in the Public Education Plan. The following programs will help to reduce water demand and water quality degradation:
  - Low water use appliance rebates.
  - Recycling programs including yard waste.
  - Water conservation programs.

Landscaping and Yard Maintenance

Appropriate landscaping can help conserve water, shield and buffer riparian areas, and reduce stream contamination. Similarly, appropriate yard maintenance techniques can reduce stream pollution and contamination. The following proposed solution options address some of the major landscaping and maintenance elements.

- Encourage appropriate landscaping activities.
  - Develop landscaping education programs as an element of the Public Education Plan.
  - Use native species and low water use plants.
  - Reduce chemical application.
  - Recycle yard debris.

    - Increase use of pervious materials on residential lots.
- Encourage citizen protection of riparian areas.
    - Riparian area preservation education would be an element in the Public Education Plan.
    - Encourage volunteering to help clean up riparian areas and planting native vegetation.
    - Encourage stewardship programs.

Vehicle Maintenance

Encouraging proper maintenance techniques will reduce the possibility of contamination entering local streams.

- Include a Vehicle Maintenance Program as part of the Public Education Plan.
    - Encourage households and businesses to use appropriate disposal/recycling of vehicle maintenance fluids and equipment.
    - Encourage use of spill containment for home and business auto repairs.

Household

While there is a lower risk that household cleaning and maintenance activities can impact local streams, encouraging the use of low impact household chemicals can further reduce that risk. The following proposed solution option can become a part of the Public Education Plan.

- Encourage use of "fish friendly" or low impact non-toxic household cleaners/chemicals. Many household chemicals dumped down sewers cannot be effectively treated and are discharged to the Willamette River.

CONCLUSION

This chapter addresses the process used to develop the proposed solution options. The solution options are the culmination of Phase I, development of the baseline conditions, and Phase II, assessment of city activities and citizen behavior on the existing conditions.

Actual and potential impacts to the existing habitat and water quality conditions have been quantified and ranked. From this process solution options unfettered by any conditions or restrictions have been identified in order to obtain the widest possible number of solutions that could meet the ESA compliance requirements.

Through a rigorous process of review by City staff, the TAC, and the public, the initial solution options were screened and reduced. The final draft set of solution options cover a wide range of activities that meet the ESA Section 4(d) Rule Limit 12 compliance requirements.

Table 3. Considerations and Solution Options Matrix

Solution Option	LIMIT 12 CONSIDERATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Land Use												
Zoning	X	X	X	X	X	X	X	X	X	X	X	X
Development Standards	X	X	X	X	X	X	X	X	X	X	X	X
Park & Recreation												
Neighborhood Park Planning	X	X	X	X	X	X	X	X	X	X	X	X
Open Space & Recreation Service Plan	X	X	X	X	X	X	X	X	X	X	X	X
Capital Improvement Plan	X	X	X	X	X	X	X	X	X	X	X	X

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Park O&M Manual		X	X			X		X	X		X	X
Park Inventory	X	X	X	X	X	X	X	X	X	X	X	X
Existing Parks		X	X			X		X			X	X
Park Construction Retrofit	X	X	X	X				X	X	X	X	X
Mini Parks	X	X	X	X	X	X	X	X	X	X	X	X
Specific Parks	X	X	X			X		X	X	X		X
Equipment Maintenance		X										X
Organic Debris Disposal		X				X			X		X	X

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Construction Specifications On-site Construction Activities		X	X			X		X	X		X	X
Construction Site Enforcement			X			X			X		X	X
Hazardous Materials		X							X			X
Pipe Commissioning		X							X			X
Erosion Control Ordinance		X	X		X	X	X		X		X	X
Sustainability	X	X	X	X	X	X	X	X	X	X	X	X

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	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Transportation												
Planning Elements	X	X	X	X	X	X	X	X	X	X	X	X
TDM			X	X		X					X	X
Transportation System Plan	X	X	X	X	X	X	X	X	X	X	X	X
CIP	X	X	X	X	X	X	X	X	X			X
Design Specifications		X				X		X	X			X
Routine Rd. Maintenance - ESA Limit 10		X		X		X			X		X	X

Table 3. Considerations and Solution Options Matrix

Solution Option	LIMIT 12 CONSIDERATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Stormwater												
Planning & CIP	X	X	X	X	X	X	X	X	X	X	X	X
Erosion Control Ordinance		X	X		X	X	X		X		X	X
O&M		X	X			X		X	X			X
Monitoring											X	X
Wastewater												
Wastewater Treatment											X	X
Facility Oils & Grease Program											X	X

Table 3. Considerations and Solution Options Matrix

Solution Option	LIMIT 12 CONSIDERATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Wastewater Collection,	X			X		X			X		X	X
O&M						X			X		X	X
Master Plan and CIP	X	X	X	X	X	X	X	X	X	X	X	X
Discharge						X					X	X
Water												
Water Supply Conservation								X		X	X	X

Table 3. Considerations and Solution Options Matrix

Solution Option	LIMIT 12 CONSIDERATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Water Intake										X	X	X
Distribution	X			X		X			X	X	X	X
O&M						X			X		X	X
Citizen Behavior												
Public Education Involvement	X	X	X	X	X	X	X	X	X	X		
Incentives		X	X			X		X		X		

Table 3. Considerations and Solution Options Matrix

Solution Option	LIMIT 12 CONSIDERATIONS											
	1	2	3	4	5	6	7	8	9	10	11	12
	Avoid inappropriate Areas (e.g., slopes, wetlands, high habitat value)	Prevents stormwater discharge impacts on water quality & quantity & stream flow patterns in watershed.	Protects riparian areas well enough to attain or maintain PFC	Avoids or minimizes impact of stream crossings (e.g., roads, utilities, linear development) wherever possible.	Adequately protects historic stream meander patterns & channel migration zones & avoids hardening stream banks/shorelines	Adequately protects wetlands, wetland buffers & wetland function – including isolated wetlands.	Adequately preserves permanent & intermittent streams' ability to pass peak flows.	Stress landscaping with native vegetation to reduce the need to water & apply herbicides, pesticides, & fertilizer.	Provisions to prevent erosion & sediment run-off during (& after) construction, prevents sediment & pollutant discharge to streams, wetlands, & other water bodies.	Ensures demands on water supply can be met without affecting the flows that threatened salmonids need.	Provides mechanisms for monitoring, enforcing, funding, reporting, and implementing its program. Formal evaluations to take place every 5 yrs.	Complies with all other state & Federal environmental & natural resource laws & permits.
Pollution Prevention	X	X	X		X	X	X	X	X	X	X	X
Landscaping			X		X	X	X	X		X		
Household		X	X					X	X	X		X
Vehicle Maintenance		X	X									X
Riparian Areas		X	X		X	X	X	X	X	X		X

CHAPTER 8. MONITORING/REPORTING

INTRODUCTION

The ESA Section 4(d) Rules require that any application for certification under this section must include a mechanism for monitoring the effectiveness of the program. NOAA Fisheries is explicit in its publication of the ESA Section 4(d) Rules:

''NMFS [NOAA Fisheries] will evaluate on a regular basis the effectiveness of the program in protecting and achieving a level of salmonid productivity and/or habitat function consistent with the conservation of the listed salmonids. If a program does not meet its objectives, NMFS [NOAA Fisheries] will work with the relevant jurisdiction to adjust the program accordingly. If the responsible entity chooses not to adjust the program accordingly, NMFS [NOAA Fisheries] will publish notification in the **Federal Register** and announce that the program will no longer be free from ESA take prohibitions because it does not sufficiently conserve listed salmonids." (Federal Register, July 10, 2000, page 42426)

The monitoring program that is developed for the Salmon Response Plan does the following:

- Measures progress of the implemented activities under the Salmon Response Plan.
- Compares progress to stated goals in the Salmon Response Plan to quantify progress, and depending on degree of progress either,
    - Determines that the implementation activities are meeting goals, or
    - Determines that the implementation activities are not meeting goals.
- Reports implementation activities to NOAA Fisheries.

If monitoring determines that implementation activities are not meeting the Salmon Response Plan goals of protecting Chinook salmon habitat, the monitoring report to NOAA Fisheries must outline the pro-active steps to be taken to modify implementation activities that will bring the plan into alignment with the goals.

Corrections to the implementation activities will incorporate an "adaptive management" approach, which requires the City to modify its Salmon Response Plan as it becomes more knowledgeable of those activities that may or may not meet the plan goals. Directions are provided in the ESA Section 4(d) Rules Guidance Manual, which states that where monitoring indicates the need for program modification the plan should include "a method for using monitoring information to change actions when needed [through an] adaptive management" approach (National Marine Fisheries Service Northwest and Southwest Regions September 22, 2000, page 8).

In addition to the mandatory requirement that the monitoring plan has to fulfill the certification process, it will also function as a practical document that the City will use internally to measure progress. Importantly it will be used by to document for City officials and the public progress toward meeting the plan's goals. In that capacity it will become the official statement on the program's ability to further prevent habitat degradation and to restore PFC. Where plan deviations are identified, it will be used as a tool to outline the pro-active steps to be taken to correct plan deviations in order to keep the plan on track.

Monitoring Plan Format, Frequency and Content

NOAA Fisheries does not state monitoring frequency or the report format to be submitted. The ESA Section 4(d) Rule Guidance only requires that the jurisdiction have a plan and "a schedule for conducting monitoring and submitting reports."

The monitoring plan submission should be a formal report to NOAA Fisheries. It should contain only the information necessary to demonstrate how the plan is meeting the main and legal objective of preventing further habitat degradation. It should also demonstrate, as the plan becomes capable of doing so, that it is meeting the secondary objective of putting the City on a trajectory of restoring PFC.

Given the nature of what is to be monitored and the cycle of assessment that will need to be developed, the monitoring program should be conducted on an annual basis for the following reasons:

- Programmatic Monitoring activities
  - Many activities rely on an annual funding and budgeting cycle.
  - Other related activities and programs have annual reporting requirements that can be incorporated into this monitoring plan.
  - Annual monitoring is a useful time period to develop trend lines for annual comparisons.
- Scientific monitoring
  - Much of the scientific monitoring will need to be conducted on an annual basis and some of it even more frequently in order for there to be data collection and measurement consistency.
  - Other related activities have annual data collection and evaluation requirements that can be incorporated into this monitoring plan.
  - Annual monitoring is a useful time period to develop trend lines for annual comparisons.

The monitoring plan described in this chapter has two elements. The first is the programmatic element. Monitoring will evaluate the programs and program implementation outlined in the plan. It will focus on overall program development and implementation that will take place during the life of the plan. Since the plan is a

comprehensive, cross departmental effort to prevent further Chinook salmon habitat degradation and restore PFC, there are a complex series of activities to be implemented over the plan's life. The programmatic element will assess both the implementation progress and the efficacy of the programs toward meeting the plan goals.

The second element is the actual scientific monitoring that will rely on the collection and assessment of data from project area streams. These data will address the physical aspects of the Chinook salmon habitat and the changes in habitat conditions over the life of the plan. Like the first element, where data assessment indicates that program activities do not meet the plan goals, the City will need to modify its programs or else risk losing federal government protections.

Though the two elements are somewhat separate, the programmatic and scientific monitoring will be combined into a single report to submit to NOAA Fisheries. The last section of this chapter outlines how results from the programmatic and scientific monitoring will be integrated and presented to NOAA Fisheries. The monitoring plan to be submitted will include the declaration of compliance with ESA Section 4 (d) Rule requirements for continued certification, the monitoring data that demonstrates compliance, and, for those activities that may not be contributing toward the Section 4(d) Rule objectives, corrective steps to be taken.

PROGRAMMATIC MONITORING

Programmatic monitoring covers all the programs to be implemented to prevent habitat degradation and initiate restoration of PFC. As described in detail in Chapter Seven, the actual suite of program solutions to be implemented across three city departments and several divisions within each department is very complex and requires a well organized monitoring plan. In addition, there are citizen behavior activities to be implemented, which will likely impact in one way or another all the City program activities.

Not all program activities will be implemented simultaneously, nor will each activity be fully mature when initiated. The activities will be implemented over a multi-year period and develop and mature over time.

Activity implementation will be based on several factors including the type of activity to be initiated, funding necessary to finance the activity, ancillary activities that may be necessary to support an activity, and the logistical mechanisms (departmental and political support, staffing, supplies, etc.) that will need to be in place before the activity can be implemented. Consequently the following steps will be taken to monitor these programs.

- Development of a timeline and implementation schedule,
- Identification of activity initiation and subsequent milestone steps to meet the implementation schedule, and
- Identification of goal achievement – ultimate goal(s) and interim goal(s).

Implementation Timeline and Milestones

There are approximately 43 activities that the City will implement as part of the plan. Many of them are made up of multiple elements or "sub-activities" that will need to be implemented before the activity is fully effective. With such a large number of activities, the timing of their implementation will be critical. Therefore, the plan will need to include a master schedule that can be used as an activity-initiation checklist.

As mentioned, not all activities will be initiated at once. Activities related to changes or modifications to the City's zoning and land use development code are dependent on other ongoing projects (e.g., Goal 5 project, periodic review, etc.). Similarly, some activities that are related to the implementation of the City's Stormwater Master Plan are scheduled for implementation over several years, and need to be included in a comprehensive timeline.

In other instances, some activities cannot be implemented until another activity is implemented or even completed. For example, the retrofitting of existing City parks to reduce negative impacts to Chinook salmon habitat, if any, cannot take place until the Parks and Recreation Department completes its park inventory.

The timeline elements will include the following:

- 10 year time horizon divided into quarters,
- List of activities to be implemented categorized by department,
- Each activity will list an initiation date and the exact activities or "sub-activities" to be initiated. In many instances there is expected to be multiple dates as a program is initiated or expanded as it matures.
- Ongoing programs will be listed as such and will identify any additional activities to be included in the implementation period, and
- Activities with end dates or sunset dates will be noted.

Associated with the timeline and initiation dates will be a list of expected milestones. Milestones will be defined as those specific achievements that are related to the plan. Only those milestones that are specifically related to the plan will be included. The milestones will be itemized by activity and date they are expected to be met.

Identified Goals

A set of specific, measurable goals will be identified for each of the activities. These goals are critical because they will be compared to the progress that is documented in the monitoring assessment to determine overall plan progress. While the plan's ultimate goal is to prevent further degradation to Chinook salmon habitat and to secondarily initiate restoration of PFC, it is impossible for an individual activity to achieve that goal alone. It is the sum of the individual activities' goals that will result in the ultimate achievement of the plan. Consequently, it is expected that goals for individual activities will be very specific and likely differ depending on where the activity is in its implementation timeline.

It is important that the goals be measurable. While goals need not be quantitative, they should identify a specific achievement to be reached. For example, the parks inventory and assessment activity has the goal of identifying park design or structures that may have negative impacts on Chinook salmon habitat. Therefore, the measurable goal could be that the inventory will be conducted in phases with a certain number completed by each phase. The goals are specific and easily measurable.

Other goals may be more difficult to measure. Construction site enforcement is a good example of this type of goal. While it may be easy to quantify on-site visits by enforcement officials and the actions that they may take, a goal based on number of site visits and enforcement actions may not be a reasonable measure for compliance. Goals will need to be carefully considered in order to identify measurable goals for use in the monitoring plan.

Timelines and Goals Matrix

The activity timelines/schedules and goals will be combined to create a master matrix that outlines not only the schedule for implementation and the milestones expected by specific date, but also the goals to be achieved. This master matrix will become the basic tool used to evaluate programmatic progress.

The following steps will be taken annually to monitor programmatic progress:

- Collection of information on the programs that are initiated and the specific activities performed over the previous 12 months,
- Comparison of the activities initiated, and related milestones, to activities expected to be initiated in the master matrix,
- Determination as to whether the goals have been met and, if not, a determination of the degree of progress.

Once the initial monitoring assessment is completed and a determination is made for each program activity there will need to be an overall assessment that addresses what this means. This is important as it can help the City make choices, if needed, regarding how to move forward should program activities not meet their goals.

It could be that the City finds some activity goals are unrealistic or that some activities are more important that others. Again, the ultimate goal is to not further degrade Chinook salmon habitat and that meeting this goal is the sum of all the activities. Therefore, the failure or success of a single activity would not necessarily translate to failure or success of the plan itself. Since it will be the actual scientific measurements (see the next section on the Chinook salmon habitat monitoring program) that will determine whether the plan is successful, it is presumed that implementation of programmatic activities will result in the scientific information showing that the plan's ultimate goals are met. Whether all activities must all be meeting their goals at all times is open to interpretation.

From a literal interpretation, a program that does not meet its goals is technically in need of corrective action. Steps to be taken to correct the activity direction would need to be identified and a timeline developed that would put the activity back on schedule. This should be done for the monitoring report.

From the practical standpoint, it may be that certain programs are more important than others and that if these do not meet their goals, the City, with limited resources, may decide to focus on the most important activities first. The approach to activities and their differential impact will be addressed in the last section of this chapter.

Programmatic Reporting

From the standpoint of the monitoring program and reporting, all activities will need to be evaluated equally in order to assess the progress of an activity from year to year. Once the activities are assessed and a determination is made as to whether an activity has met its goals, the programmatic portion of the monitoring report can be prepared.

The programmatic report will include the following sections:

- Matrix showing, for the year in question, the schedule of activities to be initiated or performed, their milestones and expected goals,
- The actual assessment of what each program has accomplished,
- The comparison between goals and actual accomplishment, and
- Corrective steps and a schedule to bring activities that do not meet their goals back into line.

CHINOOK SALMON HABITAT MONITORING PROGRAM

Objectives

Stream monitoring generally results from questions concerning the impact of land cover and land use activities on water quality and system health, and the desire to predict outcomes from any changes. These may involve increases in runoff through changes in vegetation cover type, or increases in impervious surfaces altering sedimentation patterns, sediment fluxes, and chemical inputs to the streams. Other human activities causing

changes in stream health include flow removal and alteration for drinking water, irrigation, and hydroelectric power generation. The monitoring objective, type of problem (for example, nutrients versus toxic metals), and use of information (for example, a local management question versus legal litigation) determines the necessary stage of analysis. As part of its Salmon Response Plan, the City must develop a monitoring plan to assess the impact of any activities by the City to ensure compliance with the ESA, as well as the outcomes of any rehabilitative projects undertaken.

The stream habitat baseline assessment completed as part of Phase 1 of the ESA 4(d) Program forms a critical element of the monitoring effort for the City. The stream reaches identified in the Corvallis ESA 4(d) Assessment Phase 1 Report contain the monitoring points. This project identified representative sampling transects and collected baseline data using the methodologies described by United States Forest Service (USFS) Level 2 Stream Habitat Analysis, USFS Guidelines for Establishing Stream Reaches, and the Oregon Department of Fish and Wildlife (ODFW) Stream Habitat criteria.

The ESA habitat assessment sampling established GPS-monumented transects with the reaches to facilitate return to the same locations for monitoring. The study measured five cross sections, using channel width and depth at 0.5 m intervals, for each reach. In addition, the study identified existing instream habitat types within each reach, measured erosion, substrate type, percent cover, amount of overhang, and shading. As well, the City placed 12 thermistors (temperature gauges) in selected locations in each of the urban stream systems in the summer of 2001. These gauges provide an hourly record of temperatures at each location (see Figure 4 and Tables 4 and 5 for map and locations of GPS transects and thermistosr).

This initial baseline assessment, in combination with the City's current temperature and water quality sampling, measures most of the necessary parameters, paying close attention in the study design to the seasonality and natural variability inherent in each variable. The pathways analysis established the parameters of interest for monitoring purposes. These consist of channelization, instream habitat, impervious surface, riparian areas (buffers), and barriers to fish movement.

Figure 4. GPS Transects and Thermistor Locations

See separate file

Table 4. GPS Transect Locations

Identification Label	Down Steam Point		Up Stream Point	
	Latitude	Longitude	Latitude	Longitude
DuCSFR1 T1	44.54818	123.29968	44.54794	123.30085
DuCSFR2 T1	44.55043	123.30997	44.55100	123.31099
DuCSFR3 T1	44.55142	123.31224	44.55136	123.31364
DuCR1 T1	44.55280	123.27928	44.55222	123.27976
DuCR2 T1	44.55038	123.28030	44.54988	123.28134
DuCR3 T1	44.54925	123.28489	44.54898	123.28510
DuCR4 T1	44.54974	123.28983	44.55005	123.29097
DuCNFR1 T1	44.55395	123.29337	44.55405	123.29468
DuCNFR2 T1	44.55692	123.30031	44.55751	123.30089
OCR1 T1	44.55492	123.27821	44.55498	123.27925
OCR2 T1	44.55646	123.28096	44.55688	123.28194
OCR2 T2-	44.55927	123.289457	44.560187	123.289517
OCR3 T1	44.56591	123.299571	44.566511	123.30062
OCR3 T2-	44.57072	123.30914	44.57104	123.31030
OCR4 T1	44.57135	123.31230	44.57137	123.31349
OCR4 T2	44.57612	123.32648	44.57682	123.32731
OCNTR1 T1	44.57192	123.31089	44.572809	123.31066
OCNTR2 T1	44.58653	123.30796	44.58730	123.30815
OCNTWF T1	44.58100	123.30867	44.58936	123.30940
OCNTR3 T1	44.59001	123.308309	44.59078	123.30914
DCR1 T1	44.57472	123.25347	44.57471	123.25452
DCR2 T1	44.57346	123.26357	44.57424	123.26379
DCR2 T2	44.57662	123.26826	44.577255	123.26912
DCR3 T1	44.58522	123.27454	44.58532	123.27580
DCR4 T1	44.58957	123.28201	44.59021	123.282641
DCWF T1	44.59188	123.29665	44.59236	123.29767
DCWF T2	44.59597	123.30370	44.59656	123.30409`
DCMF T1	44.59340	123.28559	44.59359	123.28667
DCMF T2	44.59613	123.29050	44.59685	123.29097

Table 4. GPS Transect Locations

Identification Label	Down Steam Point		Up Stream Point	
	Latitude	Longitude	Latitude	Longitude
DCEF T1	44.59328	123.28406	44.59398	123.28463
DCEF T2	44.59481	123.28507	44.59566	123.28526

Table 5. Thermistor Locations

Identification Label	Thermistor #	Latitude	Longitude
SQC13	5508	44.54796	123.30050
SQC14	5507	44.55282	132.27977
OC7	5506	44.57646	123.32702
OC8	5504	44.57141	123.31193
OC9	5503	44.57141	123.31193
OC10	5505	44.57137	123.31071
OC11	5502	44.55664	123.28180
OC12	5501	44.55495	123.27918
DC3	5500	44.59191	123.29693
DC4	5498	44.59350	123.28587
DC5	5499	44.57806	123.26986
DC6	5497	44.57472	123.25335
SEC1	4296	44.60041	123.26248
SEC2	4292	44.59020	123.24506

Monitoring of changes in the riparian buffer will use both the existing ESA project data and the NFI riparian species identifications. Unfortunately, the lack of any quantitative survey work precludes use of most of the NFI database. The baseline analysis, when combined with those elements of the NFI project, allows the prediction of the trajectory of current habitat effects succession as changes occur. Determination of succession uses analysis of historic changes and current conditions to predict the future. This facilitates determining the fate of the various habitat elements, as well as developing correlations between natural and anthropogenic conditions and habitat effects.

Monitoring variables of interest include flow, stream geomorphology, high flow turbidity, nutrients (nitrogen, phosphorous), pesticides (including insecticides and herbicides), industrial chemicals, and heavy metals. This focuses chiefly on the contamination and

habitat pathways. There exists sufficient background knowledge of these parameters to formulate correlations with existing land cover/land use (LC/LU) patterns, and to predict the expected direction and magnitude of changes. The plan need not measure dissolved oxygen or any biotic parameters, unless nutrient measurements increase during the low flow season, indicating potential for anoxic conditions. The plan should have a structured sampling periodicity to fit both the proposed changes in LC/LU activities and the periodicity expected from each of the water quality variables.

The overall goal for monitoring consists of shifting the above-mentioned parameters toward PFC when possible, or allowing no further degradation. PFC refers to the retention of the underlying habitat-forming processes while changing the inputs to achieve a system functioning in a manner beneficial to fish. Urban systems present the greatest challenge to obtaining PFC, as they contain a great deal more "constraints", which restrict rehabilitative actions.

Monitoring Study Design and Approach

Monitoring of stream ecosystems to determine if some impact has significantly altered the integrity of the stream or site in question requires the determination of the appropriate scale of inference. For example, to describe the physical and biotic components within the ecoregion, sample sites should represent the types of streams occurring within that spatial scale. Selecting sampling locations involves two different processes. First, is the selection of sampling reaches. This involves selecting reaches that are representative of the spatial scale of inference and that conform to the statistical design. Second, is the choice of sample site locations within the reach. Sample locations depend on the statistical design and the particular factor to be measured.

The balance of this chapter is divided into two sections. The first section addresses the important scientific concepts that form the basis of the ESA Section 4(d) Rules monitoring study. It covers the methodological underpinnings of monitoring, sampling procedures, periodicity, time series and multiple sites, and water quality analysis. The section concludes with a brief discussion of monitoring design and interpretation of monitoring data that are collected. Without a properly designed monitoring plan, it is possible to introduce interpretation error.

The second section describes the monitoring plan to be implemented. It identifies the data to be collected, the evaluation procedures to be performed and the comparative process that is designed to determine effectiveness of the ESA Section 4(d) Rule plan.

Classification Methodology and Background

Stream classification provides a means of stratifying streams and identifying sampling locations that addresses the spatial scale of inference and objectives of the monitoring program. A spatially nested hierarchical framework for classifying stream systems allows managers to identify the spatial scale of inference (Frissell et al. 1986; Hawkins and others 1993; Maxwell et al.1994). In a hierarchical system, lower levels are modified and

constrained by factors operating at higher levels. Therefore, an attempt to focus on factors influencing stream ecosystems on a small scale requires awareness of factors operating at larger scales. One cannot evaluate and manage to alleviate the effects of riparian removal when similar or other impacts occur throughout the watershed. The methodologies below provide both the theoretical and technical underpinnings for this understanding.

Watershed Scale

The ecoregion exists as the upper level of the hierarchy. Successively lower levels consist of streams, stream segments, reaches, pool/riffle complexes, and microhabitats. Each hierarchical level permits refinement for more precise classification. Inclusion of flow regime further refines the biogeoclimatic aspects and relates to flow, a major environmental driver of stream/riparian ecosystems. Corvallis lies within the Willamette Valley ecoregion, characterized by generally mild climatic conditions, with streams having seasonal flows consisting primarily of rainfall runoff.

Classification requires distinguishing between "regional" versus "local" for climate, geology, and terrestrial vegetation. Proper classification at the watershed level uses the availability of long-term records of atmospheric temperature, precipitation, and stream discharge to develop the information base for these contrasts. Incorporation of thermal regime permits stratification by catchment-level differences. Catchments similar in external or regional biogeoclimatic controls often differ in their thermal environments because of different make-up combinations of ground and surface water or different aspect of orientation to the sun.

The following discussions place the Corvallis area in its appropriate regional context. Foothills dominate the northern and western parts of the city separated by smaller stream corridors and valleys, flowing east to the Willamette and Mary's Rivers. The hills have moderate to steep side slopes (10 to 25 percent). Floodplains and terraces rise stepwise from the Willamette and Mary's Rivers towards the Corvallis foothills.

The Willamette and Mary's Rivers create the two major hydrologic basins within the study area. Dunawi and Oak Creek, both tributaries of the Mary's River, drain the western part of the city. Other small, perennial streams discharge to the Willamette River, (Dixon Creek, Jackson Creek, Frazier Creek, Lower Booneville Channel, Sequoia Creek, Stewart Slough and their tributaries).

Upland soils mainly comprise moderately deep, well-drained silty clay loams and shallow, well-drained silty clays, with minor amounts of clay loam, clay, and silty-clay. Association on the slopes and upper terraces developed on mixed alluvium from glacial outbreak floods in well-drained locations and contain moderately well-drained and well-drained silt loams. A series of poorly drained clays dominate in the lowland areas, preventing significant infiltration of rainwater.

Stream Classification

The lower spatial scales depend upon analyses performed at the reach- and point-scales, and require classification of the segments in order to establish correlations suitable for statistical evaluation. As well, the classification methodologies, particularly Rosgen's approach, provide an excellent diagnostic basis for assessing stream changes, or in combination with other techniques (Montgomery-Buffington 1993) provide a quantitative approach for assessing the likelihood of rehabilitation project success.

Classification of stream segments uses conventional geomorphology practices based on either tributary junctions, or major geologic discontinuities or both. Rosgen (1996) provides criteria for distinguishing stream reach classes. Important habitat-forming processes at the stream reach level include sediment budgets (substrate type) and large woody debris (LWD).

Valley and channel features (Rosgen 1996) further characterize the physical environment. Channel slope (gradient) influences current velocity, turbulence, and substratum composition. Valley form uses the degree of entrenchment; the ratio of flood prone width divided by bankfull width. Bed form indicates whether the channel is straight, braided, or meandering. Sinuosity, the ratio of channel length to valley length, indicates the extent of meandering by the stream. Width/depth ratio, width at bankfull stage divided by bankfull depth, measures the distribution of energy within channels. The use of valley form (Rosgen 1996) in place of side-slope gradient better characterizes features important to riparian as well as stream dynamics at this classification level. Classification of pool/riffle systems provides important descriptions of the desired fish habitat features.

Sampling Design

Effective outcome-based monitoring of a project or process requires the establishment of cause-effect correlations between actions and results. This makes the use of statistics to establish a quantitative basis critical. The use of "best professional judgment" especially needs the support of a quantitative sampling program and the resulting correlations, even if it fulfills the regulatory agency requirements. Developing this sampling program requires knowledge of sampling frequency at different temporal scales. For instance, larger scales deal with the scale of inference determined by the sampling objectives and the spatial level of disturbance or interest. The smaller temporal scales address the sampling frequency necessary to adequately characterize the factor measured. This depends on the factor and stage of analysis.

Natural landscape disturbances of a given frequency generally occur at a particular spatial scale; the longer the recurrence interval of a disturbance, the larger the spatial scale, and the higher the system organizational level of the system (O'Neill et al. 1986). For example, in the Pacific Northwest small forest fires occur frequently but over small areas. Fires occurring over larger areas have much longer recurrence intervals. The relationship

between natural spatial and temporal scales of disturbance helps determine sampling frequency.

Corvallis Stream Habitat Sampling

Sampling to obtain background or reference data uses the scale of inference (spatial scale) to establish sampling frequency. For example, at the ecoregion scale of inference with sites stratified by stream order, sampling should occur annually at first-order sites, every other year at third-order sites, and every five years at sites greater than fifth order. Small order sites drain a smaller area than large-order sites. Therefore, stream conditions likely will vary on a shorter temporal scale and require more frequent sampling to document natural variability.

The temporal scale of the Corvallis ESA monitoring effort should continue to measure and replicate stream physical habitat and cross sections yearly to determine the changes associated with conditions in the stream. The interpretation of these data requires caution, however, as even in a system not influenced by human activities, these parameters change through time. The cross-sections should change gradually, as part of the stream's evolution. Any dramatic changes in the lower reaches over a 5-year time span indicates both a lack of stream equilibrium and the continued presence of inputs that caused the shift away from "typical" stream evolution. These include inputs of stormwater runoff such that the streams continue to downcut. If these inputs decrease, the City should expect a gradual decrease in depth as the stream adjusts its sediment deposition accordingly.

The reaches high in the system will likely show changes in stream cross-section, as the incision progresses more quickly initially as the result of continued increases in overland transport of stormwater runoff and the presence of relatively easily-eroded soils in proximity to and within the stream channels. The baseline study considered this when planning the sampling design and placed cross-sections in areas expected to show changes quickly in respect to changes in corresponding land use. The rate of change, rather than the amount of change, will provide more information on the effects of any City-initiated changes in land use or operations.

Site Selection for Evaluation of Point and Non-Point Actions

Monitoring to determine possible impacts usually involves comparing impacted sites with reference sites. Reference sites replace the more rigorously defined "controls" of a laboratory experiment and create many problems associated with the validity of comparisons. Reference sites generally consist of either a similar location upstream of the disturbance (for small-scale impacts), the same location prior to disturbance, or a similar site or sites located on a different stream or streams (either historic or contemporary data). The selection of impact and control sites varies with the spatial scale of the disturbance. If the disturbance affects an entire basin, comparisons would use historic data (same location or different location within the ecoregion) or data from other streams in similar basins.

Effective management of local ecosystems (for example, stream reaches or watersheds) requires attention to the landscape in which they occur. In general, the City should confine any reach comparisons to within-watershed. Should cross-watershed comparisons prove necessary, the City should restrict them to reaches with similar gradient and longitudinal stream position. The City should use similar criteria for establishing monitoring of changes in instream habitat type as it, too, evolves with the stream geomorphology.

The following example outlines the dangers inherent in sample site selection and spatial scales. The same cautions hold true for temporal scales. Assume the random selection of sample sites from any sized stream (first to fourth order), and any segment of these streams (confined high slope to unconfined shallow slope). Despite the high degree of variability in these data, this sampling design provides a means to distinguish differences among ecoregions, while not allowing the comparison of differences among locations within the ecoregion. Sample sites located on steep-sloped first order streams cannot provide data representative of all streams within the ecoregion nor does it allow comparisons of stream reaches contained within different kinds of stream segments, systems, or ecoregions. One would not compare physical data obtained from a large river with similar data from a small headwater stream.

No matter what spatial scale of disturbance, reference sites should have as similar a classification to impacted sites as possible, not necessarily proximity to impacted sites. Proper and similar classification of impact and reference reaches ensures viable comparisons. Decisions concerning sample site location depend on the study design and the nature of any statistical comparisons. Comparative data require the selection of a sampling location that provides the best measurement of the parameter. For statistical comparisons all suitable locations within the reach should have an equal probability for being selected as sampling sites.

The relationship between spatial and temporal scales also facilitates impact evaluation. For example, climate operates at the spatial scale of a watershed or ecoregion. Impacts at this spatial scale (depending on intensity) influencing stream systems at a temporal scale from 10 to 100 years necessitate monitoring every few years rather than monthly. However, citywide operations warrant an annual monitoring regime with monthly sampling during the summer months to evaluate such outcomes as influence of facility practices on water quality.

Selection of the appropriate temporal scale of operation facilitates the selection of the optimal sampling frequency to characterize the variability in stream structure and function. Any differences observed between treatment and control sites may suggest the presence of suspected problems, but only sampling for multiple years or comparison to long-term sampling locations can confirm that the differences represent changes outside the normal condition.

The frequency of sampling depends on the parameter and the stage of analysis. The characterization of the variability of same parameters of interest requires only annual sampling (e.g. large woody debris and substratum size distribution) as they result from processes occurring at a longer time scale (bankfull or 2-year flooding). As bankfull flows generally occur during annual rainfall periods for Corvallis streams, more frequent measurements of these parameters prove unnecessary. Most of the parameters measured vary throughout the year and sampling frequency increases with the stage of analysis to better characterize these changes.

Statistical Design

A monitoring program usually attempts to determine differences between treatment and reference sites, or correlations (cause-effect) between variables of interest and activities. Determining this successfully depends on the action under investigation and often requires statistical comparisons. All the variables of interest rarely get collected, making the taking of a sample necessary. Sampling obtains a portion of the total population to use to make inferences about the total. Statisticians refer to the characteristics of the total populations as parameters, and an estimate of a parameter obtained from a sample as a statistic. For example, a statistic will include such calculations as the arithmetic mean obtained from the samples used to estimate the population mean. The more samples obtained, the more resemblance of the sample statistics to the population parameters.

If no need to sample existed (i.e., the observer has access to the entire population) simple parameter comparisons could determine any differences. However, as the analysis compares samples of the population, statistical analyses determine the probability of the samples from the reference and impacted sites representing the same population. The observer formally states this as a null hypothesis: no difference exists between impacted and reference sites. This statistical inference contains within it the possibility of committing two types of error. First, one could conclude that the samples come from different populations when in fact they do not. This represents a Type I error. Second, one could conclude that the samples come from the same population when they do not. This represents a Type II error. The problem lies in that by attempting to reduce one type of error, the other type increases. Since increasing the number of samples causes sample statistics to approach population parameters, increasing sample size helps reduce the probability of committing Type II errors.

Increasing the number of samples increases sampling and processing time and associated costs. Therefore, in selecting the number of samples taken, one attempts to increase confidence in statistical analysis while reducing time and costs. The exact number of samples required to obtain a certain level of confidence in the statistical analysis depends upon on the magnitude of difference in populations determined as significant by the observer, and the variability among samples. Bio-ethicists suggest that observers prefer the potential of a Type I error in cases involving only expense, and a Type II error in those cases containing risk to humans or animals of interest.

Statistical analytical procedures use parametric or nonparametric methods, each depending upon different assumptions and the underlying distributions of the variables in question. Parametric tests require meeting the following assumptions: random sampling from a normal population and equal variances. Data transformation can resolve problems associated with non-normal distribution and inequality of variance, but failure to meet these assumptions requires the use of nonparametric alternatives.

Sampling programs should measure chosen parameters at intervals of time and space reflecting the variability inherent in the system. The value in choosing somewhat conservative parameters lies in the ability to effectively capture their variability within the sampling program without prohibitive expenditures. However, the analytical process should effectively remove the background "noise" (e.g. natural variability associated with ecoregion-level processes) from the data through use of the existing background data sets. This allows the assessing and correlating of the "residuals" with associated watershed controls and processes, and the establishing of cause-effect relationships.

Single Site or Time Period Analyses

Assessing the difference between reference and impacted sites compares only two statistical populations: factors at reference sites and those at the treatment sites. Appropriate statistical tests for these comparisons include parametric t-tests or analysis of variance (ANOVA). Nonparametric tests include alternatives for continuous data, and chi-square tests for discrete data. The nature of some of the parameters of interest in monitoring allows for only qualitative comparisons. Data variation problems arise when comparing single- and two-sample sites. The variation determined by these small samples renders any inference concerning differences essentially impossible. Observers should conduct replicated sampling at each site to allow meaningful comparisons.

Multiple reference and treatment sites still represent only two populations: impacted and reference. However, variance in this case comes from a number of different replicate streams (or reaches) and should be treated with extreme skepticism despite similar classifications. Many of the factors measured vary considerably among differently classified stream reaches. For example small upland confined streams contain larger particles than larger floodplain streams. This inherent variability masks impact effects, increasing the chance of committing Type II errors.

Impacts occurring at discrete locations allow the use of a paired t-test as the statistical design (assuming assumptions are met). For example, multiple sites may potentially face impacts resulting from the presence of road crossings. Impacted sites below the crossing and reference sites above get paired, with the sampling statistic as the difference in factors between these two sites at multiple locations. This reduces the stream variability and reduces the probability of committing a Type II error.

Any monitoring of reach-scale restoration activities designed to improve contaminant levels will likely involve the following study design: an "upstream-downstream" model testing the hypothesis that any detected changes in the baseline result from a specific action or activity and attempts to obtain statistical correlations between or among actions and observed outcomes. Many point- and non-point-source monitoring programs use approaches that statistically evaluate change by examining differences in parameter means. These generally consist of data time-series analyzed using moving averages calculated over some time (typically seven days) of maximum or mean temperatures, measured upstream and downstream of a designated point-source or area of concern.

This upstream-downstream design presents severe statistical problems, especially in the assumptions used in the comparison of sites and determining the presence of significant changes in parameters as the result of some action. A more appropriate design than the simple paired before-after analysis uses Before-After-Control-Impact Paired Studies, which has a similar design, but rather than compare means from each data set, instead compares the variability in a time-series from each site. This allows the use of the same parametric or non-parametric statistical analysis procedures, but more appropriately reflects differences as the result of the "treatment" rather than pre-existing differences in variable concentrations.

Multiple Site or Time Series Data

Multiple years of data from both locations creates a study design analogous to multiple reference and impacted sites. In this case data variability comes from the same stream over time. Sampling during the same time interval, allows comparison of each year individually; beneficial for short-duration impacts or monitoring of management.

The presence of the time series of temperature data provides a useful baseline for the analysis of the influence of future land use changes on watershed health. Time series analysis applies a basic regression model to data collected between discrete times. This methodology uses the order of the observations to assess the past and future behavior of the variable(s). This provides some degree of both prediction of future behavior, and correlation with past events, occurring within the time series. Taking advantage of this predictive capability requires understanding the processes within the system, and estimating its parameters.

Time series regression allows the observer to use the data collection series to directly correlate the endogenous (dependent) variable, with the associated exogenous (independent) variables, or to "lag" the endogenous with the exogenous. The latter methodology uses dependence upon the past values of the latter to predict the current values of the former. For example, it may prove desirable to examine the influence of various factors on temperature. Exogenous variables include shade, groundwater, and the temperature of the upstream flows past a designated point. The upstream temperatures represent an exogenous variable that requires "lagging" to fully develop the correlation.

Further time series analysis models include "unreplicated" (before-after with a single intervention), paired designs (following the BACIPS model), and ARIMA models. ARIMA stands for auto-regressive integrated moving average. These represent the great majority of time series models found in the literature, especially intervention models. Intervention models examine the time series for responses to events. Detailed explanations of these methodologies go beyond the scope of this report, however, the statistical analytical procedures exist on most "canned" packages, and most advanced statistics texts contain detailed descriptions of the available models.

As an example, the nonparametric analytical procedure, the Seasonal-Kendall trend analysis available in the WQHydro statistical software package, requires a minimum of thirty data points to detect the presence of statistically significant trends at any given monitoring site. For each site, the data set gets divided into twelve subsets, one for each month, with the analysis of each of these subsets for the direction, magnitude, and significance of trends. The test compares these subsets and generates an annualized result, indicating the existence of any significant trend, and its magnitude and significance. This procedure also ensures the consistency of increasing or decreasing trends through time, and the separation of actual trends from normal seasonal variation.

Another non-parametric methodology, superposed epoch analysis, provides a useful methodology for examining the behavior of selected variables under changing controls, such as climate or geologic phenomena. The methodology requires simultaneous collection of biotic or physical parameter data and simultaneous information on the control variable(s) of choice. The analytical procedure uses a non-parametric ranking methodology, such as Spearman's rank, to organize the data of interest. This methodology provides a suitable approach to data analysis at the landscape or similar such hierarchical level. This provides, perhaps, more statistical power than necessary for the project, although some utility may lie in analyzing the outcomes of larger time scales.

Multivariate analyses also apply in some situations. Treatment sites often vary in intensity and treatments vary directly or over time. Parametric analysis of variance (ANOVA) or a nonparametric alternative (Kruskal-Wallis) could determine the effectiveness of a management action, with each year representing a separate factor. Likewise, correlation between stream condition and years since the action could also evaluate management actions. In this case, treatment intensity changes with time.

Corvallis Water Quality Monitoring

Water quality sampling for the monitoring program should begin with the first significant rainfall and continue during the next several storms, in order to assess the timing and amount of inputs to the stream systems. Sampling should also include the summer low-water period to assess residence time of various compounds.

The United States Geological Survey (USGS) North American Water Quality Assessment (NAWQA) program used Dixon Creek as one of its study streams. The chemicals found in it placed it in the non-agricultural category. These included Carbaryl (Sevin), used for both home and landscape applications; Dichlobenil (Casoron) and Tebuthiuron, used to control broadleaf weeds, and under asphalt and railway rights-of-way (ROW); Diazinon, uses similar to Carbaryl; and Prometon, used in urban landscaping, ROW, and industrial applications, and by homeowners. Dixon Creek also exceeded standards for temperature, fecal coliform, and *E. coli* bacteria. It appeared to have no excessive nutrients.

Dixon Creek likely carries the "usual" urban runoff components of metals, other organic compounds, and petroleum products. Indeed, a study done for the City of Salem by the USGS found excessive levels of lead, zinc, DDD, DDE, DDT, and several polycyclic hydrocarbons. This data set should provide Corvallis with guidance as to what to expect in its urban streams. As a result, good data on most of the water quality parameters already exists and should function extremely well as the baseline for assessing the impact of City actions and its citizen's behaviors on the streams of the area.

Oak Creek, as the result of the agricultural land uses on the middle reaches, may require a baseline more skewed toward nutrient levels. Dr. Stan Gregory of Oregon State University (OSU) has initiated a N^{15} study in Oak Creek that should prove very useful. Despite a long-term focus on the problem of herbicide transport in surface runoff from agricultural application, until recently little detailed investigation of the transport of herbicides in surface runoff from roadside applications exists in the literature. Because of the NAWQA program, the USGS measured the concentrations of urban, rural, and forest chemicals in select water bodies across the country.

The water quality variables measured by the NAWQA program, and the others mentioned earlier should comprise the extent of the City's water quality assessment. See Appendix 10 for a discussion of the nature of these parameters and their expected spatial and temporal variability.

Models for Sample Design and Data Interpretation – Contamination Transport

Most of the basic theory of herbicide entrainment and transport in runoff information and models apply directly to the other applications, despite its major development in an agricultural context, particularly those related to the time periods following application (rainfall timing, intensity, and duration, and total runoff volume/pounds). The first significant runoff nearly always removes the greatest amount of compound. An often almost exponential decline in the total amount of the compound removed, as well as the runoff concentration with subsequent events, follows this initial rainfall event.

The availability of a compound for transport usually declines with time, even in the absence of precipitation, through

1. A decrease in the total amount of compound stored in the surface layer of the soil (degradation),

2. A decrease in the readily mobilized fraction through slow, progressive adsorption onto the soil matrix, and/or

3. A migration to more strongly binding adsorption sites. A longer lag time between compound application and the first runoff event decreases the amount of the compound removed by that event.

Cautions – Temperature Data

The City should also take care in the analysis of temperature data, as the recent literature on stream temperature demonstrates that measurements taken in a reach represent the outcomes from actions or conditions just upstream. Any monitoring of reach-scale restoration activities designed to reduce temperatures should first have the analysis of the baseline completed so as to characterize the parameter's variability, then monitor downstream of the activity. Any comparisons made among and between months at any or all sites should consider this.

Conclusion

In conclusion, a plan for ESA outcomes should establish the spatial and temporal scale(s) of interest for monitoring using the approaches described above. The study design should specifically establish sampling sites for the collection of nutrient and other water chemistry data on a temporal scale that would allow correlations with point and non-point sources at each level of interest, similar to the suggestions discussed in the chapters on each and the information on variability of each potential parameter in Appendix 10. The City's sampling program for water quality should allow the development of statistically defensible correlations between LC/LU changes and variations in the parameters of interest using the statistical approaches described above. Numbers of samples taken should reflect the hypothesized variability of the parameter in question, to establish background variability. This permits the testing of the hypothesized cause-effect relationships and a determination of their strength.

COMBINING PROGRAMMATIC AND SCIENTIFIC MONITORING

Both the programmatic and scientific reports will be integrated before forwarding to NOAA Fisheries. While the monitoring activities will be done separately, they will needed to be combined in order to make a declaration to NOAA Fisheries as to whether the plan is meeting the ultimate goal of no further degradation and restoration of PFC.

As noted earlier, the final determination as to the success of the plan will be based on the scientific information that is collected. If for some reason all the programmatic activities are failing to meet their goals yet the scientific monitoring indicates that there is no further degradation, the City could conceivably declare they are in compliance with the 4(d) Rules. The contrary, however, cannot happen. Scientific monitoring that shows further habitat degradation no matter the programmatic activity success will result in a declaration of non-compliance.

It is doubtful that either scenario could happen, though, because programs have been put into place that, when implemented, will meet the ultimate plan goals as reflected in the scientific monitoring. So, the monitoring plan must be integrated to demonstrate that the City is making progress toward the ultimate goal as reflected by the scientific monitoring and that the activities implemented meet the considerations listed under the ESA Section 4(d) Rules Limit 12 (Municipal, Residential, Commercial and Industrial Program development).

The final report will have the following contents:

- Programmatic monitoring section with the schedule and milestones for the monitoring year, measurement of actual progress for each activity, comparison between the expected and actual progress, determination of corrective actions, if any, and actual corrective action plan.
- Scientific monitoring will outline the factors and the measurements that will be necessary to be maintained for compliance, the actual data collected for each of the factors, the comparison between actual and expected, determination of corrective actions, if necessary, and actual corrective action plan.
- Declaration of whether the plan is meeting the ultimate and secondary plan goals.

The declaration is the most important section in the monitoring report because it is an overall statement of the ability of the City to meet the plan goals. Does failure to show that all scientific factors meet the required measurements mean that the program is out of compliance? How many factors must fail before the program is out of compliance? What about temporal changes, where some factors maybe out of compliance one year and another set the next? The point of these questions is to raise the issue that the monitoring program will have an interpretive component. That some scientific factors do not meet standards that prevent further habitat degradation might be acceptable in the short run if the program activities that influence the scientific factors do prevent habitat degradation in the long run.

It will be critical in the monitoring report to explain why project activities or scientific factors do not comply with the monitoring goals. That failure of a program to meet the goals is not a failure of the program itself. For instance, it could be that a program activity, such as a stream restoration, may have a long-run benefit to salmon habitat, but that it will

take some time for those benefits to be seen in the monitoring plan. While the program activity is maturing, there may be a period when scientific factors do not meet the goals.

Therefore, the declaration section will carefully explain those programs that may have interim goals that could violate the monitoring goals, but in the long run will meet those goals. There will, of course, be programs that may not meet their goals and will need corrective action. For these activities the monitoring plan will describe the steps to be taken to put them back on schedule.

CHAPTER 9. PUBLIC INVOLVEMENT

INTRODUCTION

Public involvement, participation and information have been an important element throughout the Corvallis ESA Salmon Response Plan project. Not only is it required under the ESA, but the City also has a strong commitment to and history of encouraging public involvement and education. This is reflected in Corvallis residents' and business owners' active participation in the many public opportunities (e.g., public meeting attendance, volunteering on various organization boards and committees, participating on advisory boards, etc.) to provide input on important City projects such as the ESA Salmon Response Plan project. The result is a City whose residents and business owners care about their community and its future, and demonstrate their commitment through active support.

The structure of the public involvement program for this project follows ESA requirements. Public input has been recognized as critical to the plan's success since the public will need to support or "buy-in" to the plan's implementation programs. As a consequence the professional consulting team included a public involvement/education specialist to craft the public involvement plan (PIP) and guide and facilitate the public involvement activities in order to maximize the input opportunities that the public would have.

What follows is a description of the public involvement/education program developed for the ESA Salmon Response Plan project. It describes the various techniques and activities implemented throughout the project.

PUBLIC INVOLVMENT PLAN

Plan Structure and Objectives

A professional consulting firm, Cogan Owens Cogan, LLC, was hired to develop and guide the public involvement program (PIP). One of their first activities was to develop a PIP that outlined the overall public involvement objectives, strategies, and specific activities that would be implemented during the project. The PIP recognized Corvallis' unique qualities and stated that the public involvement strategy would have to be multi-faceted since "no single public involvement strategy will be effective in helping the City achieve its desired result", which was broad public support for the response plan effort.

The PIP recognized that public involvement and education would be a key element in the success of the project. The PIP stated, "Not only must the plan have a sound scientific basis for decision making, but the public also must be supportive of the programs to prevent salmon habitat degradation in Corvallis." Building on the requirements of the ESA and the City's historical support for public input, the public involvement strategy provided an outline of activities to educate, involve, inform, and seek contribution from the public throughout the project.

The PIP outlined a program with a variety of techniques to accomplish the City's objectives (see overall PIP and Second Phase PIP in Appendices 11 and 12). The PIP elements included educational activities such as fact sheets (see Appendix 13) and a project-related website. There was a two-way communication structure that included a series of public meetings/open houses, distribution of questionnaires and comment forms (see Appendices 14 and 15), and an e-mailing list. There also was a concerted effort to identify "hot button" issues early in the project through a series of stakeholders meetings and presentations to community groups such as the Corvallis Chamber of Commerce, large land owners (agricultural land owners, Corvallis School District), Mary's River Watershed Council and Oregon State University.

PIP Elements

The following is a description of the major PIP elements:

- **Designate an ESA contact for the City.** Greg Gescher, Corvallis Public Works Department Capital Planning and Projects Supervisor, was designated as the primary contact for citizen inquiries and involvement for the project. Mr. Gescher acted as the single contact person for questions regarding project progress. When needed he would contact other project team members to answer questions. His name and contact information (telephone and e-mail address) was included on all media releases, fact sheets and newsletters, and on the project website.

- **Establish an ESA response plan website.** A dedicated website was developed to provide Internet access to project information. The website was accessible directly or through a link from the City's own website. Information posted on the website included project background, schedules of public meetings and events, public meeting and activity results (summaries), project reports and technical memoranda. The website also included background information on the ESA, Section 4(d) Rules, listed Chinook salmon, and other relevant information. In addition, two public comment forms were posted on the website in order to collect public input from community members who were unable to attend the public meetings. The website was updated regularly to incorporate new information.

- **Publish articles in *The City* newsletter and other organizations' newsletters.** Articles were published in *The City* newsletter and other local publications on a regular basis to inform Corvallis citizens of the City's plans to prepare a response strategy, as well as to announce updates about the process. The newsletter was perhaps the most effective element in the media effort because it was sent to all residential households and businesses (more than 29,000 households in Corvallis). The first informational article was printed in the January 2001 newsletter. Updates were published at least quarterly and sometimes more frequently.

- **Involve other media.** Regular updates and advisories were sent to other media including the Corvallis *Gazette-Times*, Oregon State University student newspaper (The Barometer), Mary's River Watershed Council newsletter, and Corvallis Chamber of Commerce newsletter.

- **Stakeholder involvement.** Stakeholders with specific issues regarding the ESA project were identified and contacted at the beginning of the project and periodically during the project. Early involvement of informed constituent groups through a series of meetings helped to advise and refine the project, and the approach to public involvement. Hot button issues were identified early in the project, which helped the project team structure its response. Both the land use/environmental and business groups recommended strong, early, and frequent public education and involvement in the process to obtain citizen input and avoid "surprises". Both groups offered to co-sponsor events, help distribute information about the process, and encourage the active involvement of their members. Stakeholders were again contacted early in Phase II of the project, and a series of meetings were held to provide them with an update on the Phase I findings and to identify any additional project issues or concerns.

- **Public meetings and events.** Four public meetings/open houses were held over the life of the project; on May 29, 2001; February 21, 2002; November 19, 2002; and June 4, 2003. The structure of these events allowed the public to view progress and talk with the project team members in an informal format. Maps, graphs and photographs were displayed. Project team members were available to explain the work and answer questions. Handouts that attendees could take with them also were available. These events included formal presentations, question and answer periods, and "table discussions" where those attending were able to address specific topics and the project team obtained public response and input. Comment forms were always available for the public to provide additional written information. Summaries of all public meetings/open houses, along with photographs and handouts, were posted on the project website.

- **Exhibits at summer affairs and events.** In order to disseminate information about the project and to provide general information on the ESA and how citizens can be involved, the project team attended City summer affairs and events, provided information tables, distributed fact sheets and answered questions. The events attended by the project team included DaVinci Days and the County Fair.

Phase II Pubic Involvement Plan Modifications

Prior to initiation of Phase II of the project (preparation of the solution program and report preparation), the project team reviewed the PIP and accomplishments to date with the purpose of identifying any modifications or changes in the program to make the PIP more effective. Several changes were identified and are described below.

- **Comment forms.** While comment forms had been used extensively at the public meetings/open houses, and distributed to the Chamber of Commerce and Environmental Center for distribution to the public, there was a concern that this distribution was not broad enough. It was decided that comments forms should be posted on the project website as another source for public input. Comment forms were posted to the website twice: immediately after the November 19, 2002 and June 4, 2003 public meetings/open houses.

- **Solution Options.** The project team recognized that the solution options to be developed in Phase II would be complex and not easily understood by the public, especially in their technical form. Since public input on the solution options would be very important, it was decided that non-technical versions would be prepared for public review. These versions would incorporate all the information about the solution options, but would limit the amount of technical language so the public would be more likely to understand the options.

- **PowerPoint Presentations.** Presentations at the public meetings during Phase II usually made heavy use of flip charts. The flip charts could not easily be posted on the website. It was decided that presentations at public meetings would be prepared and presented using Microsoft PowerPoint software. Such presentations could then easily be posted on the website as part of the meeting summary materials.

Public Involvement Activities

The following is a table (Table 6) of key public involvement activities during the project.

Table 6. Key Public Involvement Dates and Activities

Date	Activity Type	Description
October 2000	Stakeholder Meetings	Two meetings held over two days to elicit project "hot button" issues and concern. Recorded comments, which were used to help modify the public involvement strategy.
January 2001	*The City* Newsletter Article	Article describing ESA project and project schedule
January 2001	Launch Website	A project-related website was developed to provide 24-hour access to project information and related topics.
May 29, 2001	Open House/Public Meeting	First public meeting to present information on the project, work done to date, schedule, and related ESA information. Recorded public meeting comments
June 2001	*The City* Newsletter Article	Article updating the public on the ESA project.
Summer 2001	Displays at Local Public Events	Distributed information about the project at DaVinci Days and the County Fair.
February 21, 2002	Open House/Public Meeting	Second public meeting. Provided update on project. Displayed maps and provided information handouts. Discussed completion of Phase I of the project. Recorded public comments about the Phase I report and initial public input on solution options to be developed in Phase II.
Summer 2002	Displays at Local Public Events	Distributed information about the project at DaVinci Days and the County Fair.
September 2002	*The City* Newsletter Article	Article describing ESA Phase II project status and project schedule.

Table 6. Key Public Involvement Dates and Activities

Date	Activity Type	Description
October 2002	Stakeholder Meetings	Update stakeholders on project progress. Presented solution options and recorded their comments. Revised solution options based on comments.
October 2002	Project Fact Sheet	Prepared project Fact Sheet for distribution at public events and public meetings.
November 19, 2002	Open House/Public Meeting	Third public meeting. Provided update on project. Displayed maps, provided information handouts, and answered public questions. Presented solution options. Conducted table discussions to listen to public opinions and comments about the range of solution options to prevent further degradation of Chinook salmon habitat.
November 19 to December 9, 2002	Website Comment Form	Posted online interactive comment form on project website so public could submit comments and opinions on the range of solution options.
January 2003	*The City* Newsletter Article	Article on project status and synopsis of November 19, 2002, public meeting.
May 2003	Media Release	News release announcing public meeting June 4, 2003. Sent release to local news media (Gazette-Times, OSU Barometer) and community and business organizations (e.g., Mary's River Watershed Council, Chamber of Commerce). Printed announcement in *The City* Newsletter.
June 4, 2003	Open House/Public Meeting	Fourth public meeting. Provided update on project. Displayed maps, provided information handouts, and answered public questions. Presented revised solution options along with costs. Conducted table discussions to gather opinions and comments about the revised solution options to prevent further degradation of Chinook salmon habitat.

Table 6. Key Public Involvement Dates and Activities

Date	Activity Type	Description
June 9 to July 9, 2003	Website Comment Form	Posted online, interactive comment form on project website so public could submit comments and opinions on the revised solution options.
June 26, 2003	Comment Form Announcement	Sent announcement to e-mail mailing list regarding availability of the website comment form. Encouraged recipients to fill out comment form and to forward announcement to other City residents. Forwarded copy of comment form to Mary's River Watershed Council so Council could e-mail copy of comment form to their membership.

CHAPTER I0. CONCLUSION

INTRODUCTION

This project has taken steps to identify and document baseline habitat conditions for chinook salmon and the options available to prevent chinook salmon habitat degradation as well as options that could actually improve such habitat and overall water quality in Corvallis streams. Many of these options have, in fact, been initiated. Through this process the City has also made a substantial effort to meet Federal compliance requirements under the Endangered Species Act (ESA), specifically with respect to the ESA Section 4(d) Rule.

These accomplishments are part of an overall process that the City has initiated to meet its goals and comply with federal requirements. What are the next steps that the City should take to continue this process and ensure success? To outline these next steps it is important to first briefly review of what has been accomplished. Based on these accomplishments a number of key steps can be identified that will ensure Corvallis will meet its goals.

ACCOMPLISHEMENTS

The City of Corvallis initiated the Salmon Response Plan project soon after the federal government designated chinook salmon as a threatened species under the ESA (March 1999). At that time, the range for the Upper Willamette River Spring Chinook Salmon evolutionary significant unit (ESU) was identified by NOAA Fisheries (see Figure 1 in Chapter 1). Corvallis was within the ESU and therefore subject to the ESA and potential federal actions should they be accused of activities that resulted in a take of chinook salmon within their jurisdiction.

In keeping with the City's progressive attitude toward maintaining a high quality of life, which included support and protection of its natural resource base, as well as its fiduciary responsibility to protect its residents through responsible decision-making and actions, the City initiated in Fall 2000 its Salmon Response Plan Project. This was a multi-faceted approach to comply with the federal requirements. It incorporated the best scientific methodologies available to understand chinook salmon habitat with public policy development that relied on the science to ensure that activities the city would initiate had the greatest probability of success.

Through the past three and one-half years much was accomplished that sets the stage to meet its goals. The Project Team included project management from the Public Works Department Staff, a Technical Advisory Committee of City and Benton County staff, and a consultant team to provide needed expertise in biology, planning and policy, civil engineering, geographic information systems, and public involvement. In addition, the Project Team initiated a public involvement effort to provide information and seek guidance and take comment from the public (stakeholders as well as the public at large).

The results of this effort are briefly described in the following bullets.

- Scientific understanding of existing conditions: a scientifically based evaluation has been conducted that provides the City with detailed and comprehensive picture of chinook salmon habitat and water quality in the city as well as the unincorporated urban growth boundary. The scientific approach was approved and, in fact, lauded by NOAA Fisheries, the federal agency responsible for reviewing all compliance plans for the ESA Section 4(d) Rule. An extensive database was prepared on the existing habitat conditions based upon field data collection and evaluation of existing documentation (sources included the Corvallis, OSU, state and federal natural resource agencies). The database provided information on a reach-by-reach basis for all streams that could support chinook salmon habitat in the project area.

- Pathways database: The potential relationship between city activities, citizen behavior and their impact on chinook salmon habitat were analyzed. Public services provided by the city the Corvallis (e.g., public utilities, community planning, land development, transportation, parks and recreation, etc.) and citizen behaviors (e.g., yard maintenance, vegetation, vehicle maintenance, etc.) were evaluated as to their impact on the habitat. A database identifying specific city activities and their relationship to chinook salmon habitat (negative, neutral, or beneficial relationship) was prepared. Similarly, a list of citizen behaviors was prepared that noted whether such activity had a potential negative, neutral, or beneficial relationship on the habitat.

- Phase I Report: The first phase of the project ended with preparation of a report on the City's existing or baseline habitat conditions and the pathways analysis (see Appendix 6). This was submitted to NOAA Fisheries after public input from stakeholders and city residents in special stakeholder meetings and a public workshop. NOAA Fisheries review and response was positive. In a letter to the City (January 7, 2002) they approved the baseline conditions evaluation and pathways analysis and considered it a "thorough compilation of existing and new data" and the pathways analysis showing "the list of activities and potential for impact to fish and habitat appears thorough and thoughtful." Most importantly, the letter stated that "the approach and the baseline data collected will be sufficient for us to determine the technical adequacy of the final 4(d) submittal" (see Appendix 7 for copy of letter).

- Pathways Weighted Database: A comprehensive database that combined the existing/baseline conditions data with the pathways evaluation data was prepared in the second phase of the project. This was a significant development and important tool for the project because it identified the potential impacts (negative, neutral, or positive) that City activities and citizen behaviors had on chinook salmon habitat on a stream reach by reach basis. That is, it was possible to determine specifically where (i.e., what stream reach or reaches) and to what extent (negative, neutral, positive) a particular activity had on chinook salmon habitat and water quality in the

stream reach(es) (see Appendix 5 for a CD of the database). In addition, the analysis incorporated a weighting factor that accounted for an activity's geographic location within or outside of the 400' stream corridor evaluation area (200-feet upland each side of the stream bank). Activities or citizen behaviors occurring within the corridor were considered to have a greater impact on chinook salmon habitat than those same activities or citizen behaviors occurring outside the corridor. Due to the number of City activity/stream reach combinations the size of the Pathways Weighted Database included over 3,500 records.

- Potential 4(d) Rule Options: By using the Pathways Weighted Database as an analytic tool it was possible to determine the geographic distribution and impact of city activities. By studying this database it was possible to determine which activities had the greatest negative impact and therefore potentially the greatest need to address through public policies. The project team evaluated the activities and identified an initial set of potential 4(d) Rule Options that could help prevent chinook salmon habitat degradation and improve water quality in Corvallis streams. The options were categorized by city activity (e.g., stormwater, parks and recreation, transportation, etc.). Some of the options identified had already or were about to be implemented by City agencies (e.g., stormwater master plan activities, Taylor pump station fish screen installation, etc.). They were still included in the list of options because they would help meet the City's ESA goals and ESA 4(d)Rule objectives. The options were presented to the public twice in public workshops to obtain public comment that would help the City refine the options and help set option priorities. In addition, comment forms were distributed and posted on the City's ESA web site to gain as wide a set of comments as possible (see Appendices 14 and 15 for copies of the comment forms). A final set of options was developed based on public input and project team review

- Monitoring Plan: In order to assess progress toward reducing chinook salmon habitat degradation and to meet requirements under the ESA Section 4(d) Rule, the project team prepared a comprehensive monitoring plan. The monitoring program closely followed the requirements outlined in the ESA 4(d) Rule. The monitoring plan would allow the city to assess progress toward meeting its habitat goals and compliance requirements. The plan had two components, scientific and programmatic. The programmatic component would evaluate the programs and program implementation outlined in the ESA 4(d) Rule Plan. It would focus on overall program development and implementation that will take place during the life of the plan. The scientific component addressed specific protocols for collecting field data comparing the data against a standard or metric to determine progress. Combined the monitoring plan would provide the City and NOAA Fisheries a method to track plan progress and effectiveness.

- Final Project Report: A final Salmon Response Plan Report was prepared that incorporated all the project team's work and products. This report outlined what had been accomplished and provided a strong base on which to move forward toward implementing the proposed options and preparing the ESA Section 4(d) Rule report to be submitted to NOAA Fisheries for compliance approval.

FUTURE STEPS

Before the City can submit its ESA 4(d) Rule plan to NOAA Fisheries there are a number of key activities that need to be addressed. The following are a list of these key activities.

- Select and Implement ESA Options: the City Council will need to formally adopt the proposed ESA 4(d) Rule options identified in this report. NOAA Fisheries requires that the ESA program be implemented to demonstrate that it is complying with the ESA 4(d) Rule. A number of the options are already being implemented as part of other programs, but there are options that cannot be implemented until they are adopted by the City Council. Once formally adopted the City will need to outline an implementation schedule and initiate implementation for those options that are note already underway.

- Initiate the Monitoring Program: The monitoring program will need to be activated to provide the feedback support necessary to assess program effectiveness.

- Land Development Code Update: the City is in the process of updating its land development code (LDC) to incorporate a number of environmentally sound programs and policies into its development standards. The Stormwater Master Plan, results of the Significant Natural Features (Goal 5) Project and the ESA Salmon Response Plan need to be incorporated into the LDC. By doing so the City can certify that relevant options have been incorporated into the land development standards.

- Comprehensive Plan Update: It will be important for the City to incorporate relevant elements into the City's comprehensive plan. A number of the identified options are related to city planning policies and zoning. While comprehensive planning revisions do not have to be completed, a process should be outlined or underway that the 4(d) Rule report can identify.

- Integration of ESA Plan and data, Stormwater Master Plan, and Significant Natural Features (Goal 5) data: There are two other related projects that should be integrated with the ESA Salmon Response Plan. While they may have been initiated under different authorities, they are related because they address water quality and natural resource features that the ESA program identifies as important for preserving and improving chinook salmon habitat. While there are a number of good reasons why they should be integrated, from the ESA 4(d) Rule program standpoint integration

will demonstrate to NOAA Fisheries that the City is taking a comprehensive approach, which will increase the likelihood of success.

- National Environmental Policy Act (NEPA): According to NOAA Fisheries an environmental impact analysis will need to be prepared to accompany the ESA 4(d) Rule Plan submission. It is unclear at this point whether the environmental impact analysis will have to be prepared by the submitting jurisdiction (Corvallis) or by the Federal Agency. Corvallis staff and the consultants met with NOAA Fisheries officials in late Fall 2002 and Spring 2003 to discuss the environmental documentation requirement. At that time NOAA Fisheries was considering the preparation of a programmatic environmental impact statement (EIS) that would address the ESA 4(d) Rule Limit 12 that Corvallis was to submit. NOAA Fisheries could not provide a completion date because they had not yet scheduled the EIS work. One option that NOAA Fisheries suggested was that the City could prepare the EIS on its own and submit it with the ESA 4(d) Rule. The environmental documentation would take the City some time and expense to prepare. As of the date of this report, the City has not decided whether they will prepare it.

- Prepare ESA 4(d) Report: Once the above key steps are completed the City will need to submit the ESA 4(d) Rule Report to NOAA Fisheries. The report must address how the City's program will meet each of the 12 limits outlined in the ESA 4(d) Rule Limit 12 (Municipal Commercial Residential Industrial or MRCI) development program. It will be important to demonstrate that all the programs combined satisfy all the Limit 12 limits.

These are the key future steps that will need to be taken to meet the City's goals and comply with the ESA 4(d) Rule. They will build on the foundation that has been prepared up to this point.

LIST OF ABBREVIATIONS AND DEFINITIONS

Adaptive Management: a type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies and practices.

Anoxia: Lack of oxygen

DSL: Oregon Department of State Lands

Ecoregion: An area over which the climate is sufficiently uniform to permit development of similar ecosystems on sites that have similar properties. Ecoregions contain many landscapes with different spatial patterns of ecosystems.

EFH: Essential Fish Habitat. Congress defines EFH as "those waters and substrate necessary to [all Federally Managed] fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802(10)). In Section 303(a)(7) of the amended Magnuson-Stevens Act, Congress directs the National Marine Fisheries Service (NMFS) and the eight regional Fishery Management Councils, under the authority of the Secretary of Commerce, to 1) Describe EFH and identify EFH in each fishery management plan, 2) Minimize to the extent practicable the adverse effects of fishing on EFH, and, 3) Identify other actions to encourage the conservation and enhancement of EFH. The mandate also includes the development of conservation and enhancement activities for non-fishing related adverse impacts to designated EFH areas. Review of impacts and recommendation for conservation and enhancement of EFH is typically integrated into the existing environmental review procedures in accordance with the National Environmental Policy Act, Endangered Species Act, or Fish and Wildlife Coordination Act. While state and local actions that may adversely affect EFH do not require consultation under the Magnuson-Stevens Act, NMFS must provide Conservation Recommendations for these actions that would adversely affect EFH, if NMFS becomes aware of such actions. However, where proposed state and local actions have an impact on ESA listed anadromous fish such as Upper Willamette River Spring Chinook, NMFS has regulatory authority and therefore must review and provide conservation recommendations, unless the jurisdiction has an approved ESA Section 4(d) Rule Plan.

Endangered Species Act: See ESA

ESA: Endangered Species Act. A 1973 Federal law, amended in 1978 and 1982, to protect troubled species from extinction. The NOAA Fisheries and U.S. Fish and Wildlife Service (USFWS) decide whether to list species as threatened or endangered. Federal agencies must avoid jeopardy to and aid the recovery of listed species.

Essential Fish Habitat: See EFH

ESU: Evolutionarily Significant Unit. ESU is defined as a population that 1) is substantially and reproductively isolated from specific populations and 2) represents an important component in the evolutionary legacy of the species. Information that can be useful in determining the degree of reproductive isolation includes incidence of straying, rates of recolonization, degree of genetic differentiation, and physical or ecological barriers to migration. Insight into evolutionary significance can be provided by data on genetic and life-history characteristics, habitat differences, and the effects of stock transfers or supplementation efforts

Eutrophication: A process whereby a water body is becoming rich in nutrients, organic materials, and productivity.

Evolutionarily Significant Unit: See ESU

Hortonian: Overland flow of water.

Hydrograph: A graph that illustrates the relation of discharge, stage velocity or other water component with time, for a given point on a stream.

Mosaic: A pattern of vegetation across a landscape.

National Marine Fisheries Service: See NOAA Fisheries

National Oceanic and Atmospheric Administration National Marine Fisheries Service: See NOAA Fisheries

NMFS: see NOAA Fisheries

NOAA Fisheries: National Oceanic and Atmospheric Administration National Marine Fisheries Service, part of the U.S. Department of Commerce. The Administration is dedicated to protecting and preserving our nation's living marine resources through scientific research, fisheries management, enforcement, and habitat conservation, including anadromous fish. Anadromous fish are born in fresh water, migrate to the ocean to grow into adults, and then return to fresh water to spawn. Among NOAA Fisheries' duties is responsibility for enforcing the Endangered Species Act (ESA) for listed marine and anadromous species including the Upper Willamette River Spring Chinook, which are listed as threatened under the ESA.

Oregon Department of State Lands: See DSL

PFC: Properly Functioning Condition. Refers to an optimum state of aquatic habitat health as defined by the National Marine Fisheries Service. Presence of properly functioning conditions can enhance the long-term survival of anadromous salmonids. This optimum state of stream health is identified by key variables that provide the best possible environment for fish (e.g., Water temperature, Canopy cover, Sediment, Instream large wood, Large wood recruitment, Pool frequency, Pool quality).

Properly Functioning Condition: See PFC

Take: As defined in the definitions of the ESA (Section 3 (19)) means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect; or to attempt to engage in any such conduct.

Top-of-bank: Pont on a stream bank that corresponds to the high water mark for normal streamflows.

U.S. Fish and Wildlife Service: See USFWS

USFWS: U.S. Fish and Wildlife Service. The USFWS is an agency in the Department of the Interior that conserves and protects fish and wildlife and their habitats. With respect to the Endangered Species Act (ESA) the Agency along with NOAA Fisheries shares responsibility for administration of ESA. Whereas, though, NOAA Fisheries is responsible for ESA listed marine and anadromous species, USFWS is responsible for non-anadromous fish species, plants, and terrestrial wildlife.

Weighting: a method of rating the degree of importance of a factor or variable.

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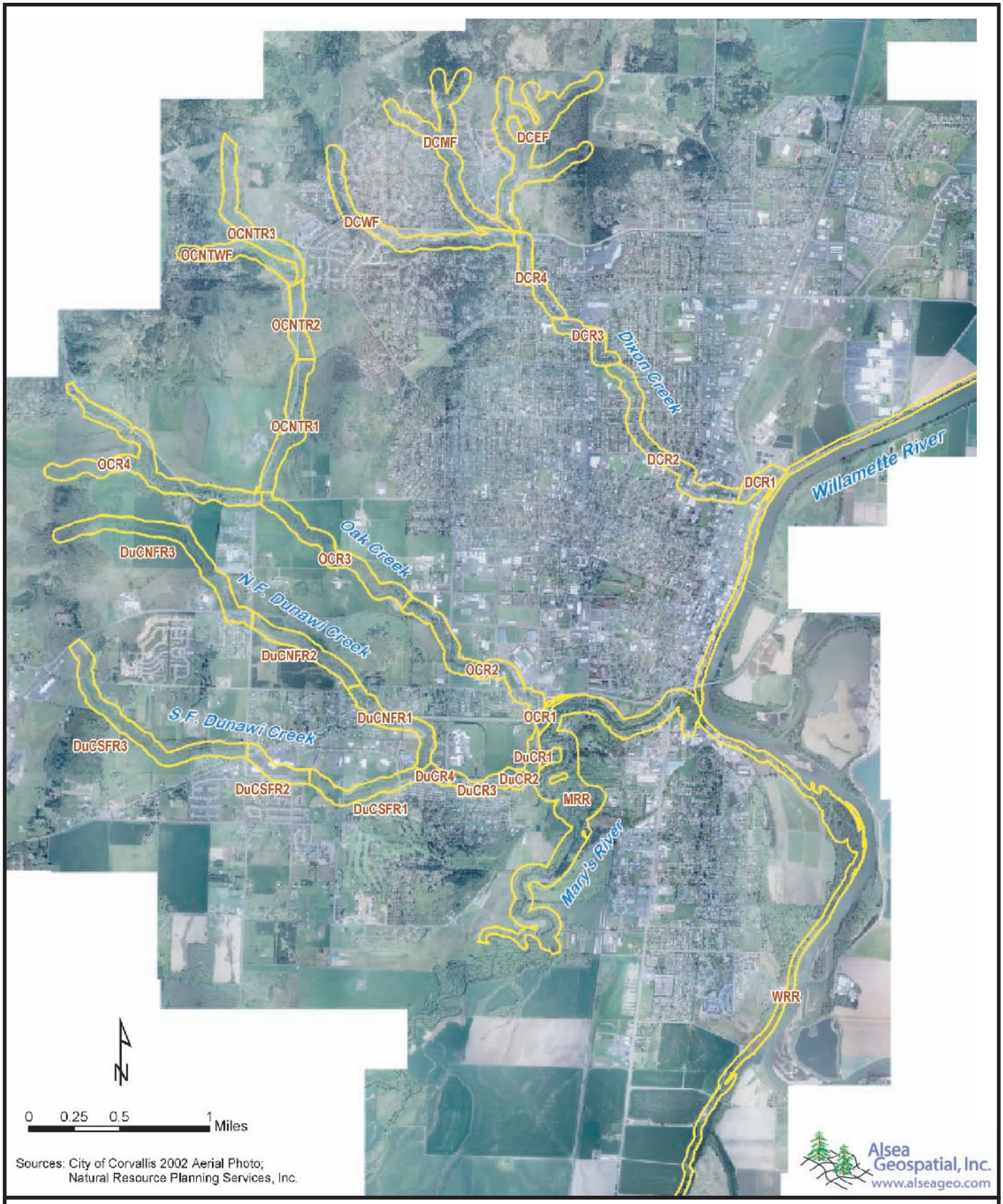

NRPS

Stream Reaches with 400-foot Stream Corridor Evaluation Area Identified

Figure 3

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

Line Item Reference Number	Document ID	Enter relevant data directly from development code			Summary and description of relevant indicators (uses, activity, or standards) impacting habitat	Formatted Response to two key questions: 1) What is the relationship between the source use or activity, the pathway, and the habitat? 2) What is the rationale for scoring this specific pathway for the following parameters; +/-/0 (Col.10 a), Mag.(Col.11 b), Dur. (Col.12 c), Intensity (Col.13 d)?	Def./Quant. Def./NonQ Cond/Q. Cond/NQ	Direct Direct Direct Indirect Indirect	Channelization Barriers Buffers Contaminants Impervious Surfaces	Impact on PFC POS - Positive NEG - Negative NTRL - Neutral	Magnitude City=3 Reach=2 Point=1	Duration Chronic=3 Episodic=2 Once =1	Intensity (impact on Habitat) High=3 Medium=2 Low=1	Subtotal	Total Score
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
1	CCP	Art. 3 - Land Use Guidelines	3.2.1	General Land Use	3.2.1 The desired land use pattern within the Corvallis Urban Growth Boundary will emphasize preservation of significant open space and natural features.	1 - Natural features include surface waters, riparian areas, wetlands and drainageways. Open space and natural features act as buffers that filter contaminants and reduce streambank erosion. Preservation of open space and natural features also will reduce sources of contaminants and impervious surfaces within the watershed. 10(a) - Positive: Preserving vegetation helps maintain the water cycle in an urbanized setting. 11(b) - City: The policy applies to all land division. 12(c) - Chronic: Preservation of natural features will persist for years. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Direct	Contaminants	POS	3	3	1	7	7
2	CCP	Art. 3 - Land Use Guidelines	3.2.7	General Land Use	All special developments, lot development options, intensifications, changes or modifications of nonconforming uses, Comprehensive Plan changes, and district changes shall be reviewed to assure compatibility with less intensive uses and potential uses on surrounding lands. Impacts of the following factors shall be considered: A. basic site design (i.e., the organization of uses on a site and its relationship to neighboring properties); B. visual elements (i.e., scale, structural design and form, materials, etc.); C. noise attenuation; D. odors and emissions; E. lighting; F. signage; G. landscaping for buffering and screening; H. transportation facilities; and I. traffic and offsite parking impacts.	1 - No mention of impact on water quality or stream habitat. 10(a) - Neutral: No mention of impact on water quatliy or stream habitat. 11(b) - City: The policy applies throughout the City. 12(c) - NA 13(d) - NA	D/N	Indirect	NA	NTRL	0	0	0	0	0
3	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.2.2	General Natural Features, Land, and Water Resources	Natural features and areas determined to be significant shall be preserved, or have their losses mitigated, and/or be reclaimed. The City may use conditions placed upon development of such lands, private nonprofit efforts, and City, state, and federal government programs to achieve this objective.	1 - This policy statement signifies the City's intent to protect or mitigate loss of natural features that contribute to PFC. 10(a) - Positive: Policy's purpose is to protect or maintain natural features. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: The policy statement is a long-term goal. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	NA	POS	3	3	1	7	7

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

Line Item Reference Number	Document ID	Enter relevant data directly from development code			Summary and description of relevant indicators (uses, activity, or standards) impacting habitat	Formatted Response to two key questions: 1) What is the relationship between the source use or activity, the pathway, and the habitat? 2) What is the rationale for scoring this specific pathway for the following parameters; +/-/0 (Col.10 a), Mag.(Col.11 b), Dur. (Col.12 c), Intensity (Col.13 d)?	Def./Quant. Def./NonQ Cond/Q. Cond/NQ	Direct Direct Direct Indirect Indirect	Channelization Barriers Buffers Contaminants Impervious Surfaces	Impact on PFC POS - Positive NEG - Negative NTRL - Neutral	Magnitude City=3 Reach=2 Point=1	Duration Chronic=3 Episodic=2 Once =1	Intensity (impact on Habitat) High=3 Medium=2 Low=1	Subtotal	Total Score
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
4	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.3.1	Agricultural and Forestry Resource Lands	Preserves high-quality agricultural and forest land near the City and outside the Urban Growth Boundary.	1 - No mention is made of impact on water quality or stream habitat. 10(a) - Neutral: No mention is made of impact on water quality or stream habitat. 11(b) - City: The policy applies to throughout the City. 12(c) - NA 13(d) - NA	D/N	Indirect	NA	NTRL	0	0	0	0	0
5	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.3.2	Agricultural and Forestry Resource Lands	Protects agricultural land abutting the Urban Growth Boundary until need for urban land arises.	FRINGE	NA	Indirect	NA	POS	0	0	0	0	0
6	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.3.3	Agricultural and Forestry Resource Lands	Protects forestlands abutting the Urban Growth Boundary until need for urban land arises.	FRINGE	NA	Indirect	NA	POS	0	0	0	0	0
7	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.3.4	Agricultural and Forestry Resource Lands	The ecosystems services and open space values of agricultural and forest lands shall be a strong consideration before approving a change in land use designation.	FRINGE	NA	Indirect	NA	POS	0	0	0	0	0
8	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.3.5	Agricultural and Forestry Resource Lands	A buffer between urban development and resource land shall be provided to protect Open Space - Agriculture and Open Space - Conservation lands. For forest and agricultural uses that currently exist on non-open-space designated lands, transitional buffering shall be provided to address compatibility concerns.	FRINGE	NA	Indirect	Impervious Surfaces	POS	0	0	0	0	0
9	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.4.1	Aggregate, Gas, and Oil Resources	The City...supports reasonable efforts of Benton and Linn counties in ensuring the availability of rock mineral resources. The relationship between the demand for the resource and the amount of land planned and zoned for sand and gravel extraction and processing should be closely monitored.	1 - Policy states an intent to monitor demand for mineral resources. 10(a) - Neutral: No mention is made of impact on water quality or stream habitat. 11(b) - NA 12(c) - NA 13(d) - NA	C/N	Indirect	Contaminants	NTRL	0	0	0	0	0

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

Line Item Reference Number	Document ID	Enter relevant data directly from development code			Summary and description of relevant indicators (uses, activity, or standards) impacting habitat	Formatted Response to two key questions: 1) What is the relationship between the source use or activity, the pathway, and the habitat? 2) What is the rationale for scoring this specific pathway for the following parameters; +/-/0 (Col.10 a), Mag.(Col.11 b), Dur. (Col.12 c), Intensity (Col.13 d)?	Def./Quant. Def./NonQ Cond/Q. Cond/NQ	Direct Direct Direct Indirect Indirect	Channelization Barriers Buffers Contaminants Impervious Surfaces	Impact on PFC POS - Positive NEG - Negative NTRL - Neutral	Magnitude City=3 Reach=2 Point=1	Duration Chronic=3 Episodic=2 Once =1	Intensity (impact on Habitat) High=3 Medium=2 Low=1	Subtotal	Total Score
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
10	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.4.2	Aggregate, Gas, and Oil Resources	Except for existing mining operations, mineral extraction within the Urban Growth Boundary shall be prohibited.	1 - This policy statement prohibits new mining within the City. Mining activity results in contamination of surface waters and/or runoff that comes in contact with mine tailings and other mining byproducts. Contaminated waters affect stream habitat. 10(a) - Positive: The policy prohibits new mining. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: The policy is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	D/Q	Indirect	Contaminants	POS	3	3	1	7	7
11	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.4.3	Aggregate, Gas, and Oil Resources	For land in the Urban Growth Boundary but under County jurisdiction, the City shall review any application for mining operations to ensure that negative environmental impacts are minimized.	FRINGE	NA	Direct	Contaminants	POS	0	0	0	0	0
12	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.4.4	Aggregate, Gas, and Oil Resources	Natural gas extraction should not be a permitted use within the Urban Growth Boundary.	1 - This policy statement prohibits natural gas extraction within the City. Such activity may result in contamination of runoff and surface waters from equipment used to drill for natural gas. Contaminated water affects stream habitat. 10(a) - Positive: The policy prohibits natural gas extraction. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: The policy is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	D/Q	Indirect	Contaminants	POS	3	3	1	7	7
13	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.5.1	Density Transfer and Transfer of Development Rights	The City shall encourage the use of density transfers as a means of preventing the development of significant resource sites and potentially hazardous locations, of mitigating the potential negative effects of hillside development, and/or of maximizing the availability of open space.	1 - This statement helps protect sensitive natural areas by allowing development rights to be transferred. Protecting sensitive lands from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects sensitive lands. 11(b) - Reach: The policy applies to significant resource sites. 12(c) - Chronic: The transfer of development rights is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
14	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.2	Hillsides	Development on hillsides shall not endanger life and property nor land and aquatic resources determined to be environmentally significant.	1 - This policy restricts hillside development to protect natural resources. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides **also** is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

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LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
15	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.3	Hillsides	Tree-covered hillsides within the City Limits shall retain a tree-covered appearance prior to development review. Selective logging could be permitted with a City-approved plan that assures hillsides within the City Limits retain a tree-covered appearance. On these hillsides, clear-cuts and other significant tree removal should not be permitted prior to development.	1 - This policy restricts tree removal on hillsides. Protecting hillsides from tree removal reduces erosion and sedimentation of surface water and stream habitat caused by tree removal. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from excessive tree removal. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
16	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.5	Hillsides	On tree-covered hillsides, development shall be designed to preserve as many trees as possible; tree removal shall be consistent with the approved development plan.	1 - This policy restricts hillside development in order to protect natural resources. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
17	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.6	Hillsides	On tree-covered hills, the design of dwellings and their placement shall be planned to retain a sufficient number of trees to preserve a green, tree-covered hillside appearance. If a proposed development pattern would result in the loss of a tree-covered hillside appearance, assuming the development plan has been designed to minimize the loss of existing trees to the extent that it is safe and practicable, the development may proceed, provided the following provisions are met: (1) the loss of trees is further minimized by development techniques such as clustering; and (2) a sufficient number of new trees are planted to recreate (at maturity) a green, tree-covered hillside appearance.	1 - This policy restricts hillside development to protect natural resources. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6

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LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
18	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.9	Hillsides	Where development of hillsides occurs, removal of vegetation will be minimized to control erosion. Vegetation disturbed during development shall be replaced or enhanced through landscaping.	1 - This policy minimizes the removal of vegetation on hillsides and require developers to reestablish vegetation on disturbed lands. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
19	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.13	Hillsides	The City shall encourage the use of density transfer to retain the open space character of that part of Locke Cemetery Hill that has been determined to be significant. If density transfer is not used, development shall retain sufficient vegetation to maintain tree canopy on the hillside.	1 - This policy identifies significant hillside areas and restricts removal of the tree canopy. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
20	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.14	Hillsides	The maximum residential density for the area between Chip Ross Park and Jackson Creek shall be two units per acre. The City shall encourage density transfer on existing large lots on the east and south slopes of IV Hill that have been designated for residential development to areas below the identified hillside open space resource area.	1 - This policy establishes a maximum development density within a specific area to protect open space resources. Protecting open space from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. 10(a) - Positive: The policy protects open space from development. 11(b) - Reach: The policy applies to a specific area. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	D/N	Indirect	Contaminants	POS	2	3	1	6	6
21	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.15	Hillsides	Tree canopy sufficient to maintain the visual appearance of a tree-covered hill shall be preserved on Timberhill Ridge.	1 - This policy identifies significant hillside areas and restricts removal of the tree canopy. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
22	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.16	Hillsides	Areas with slopes greater than 20% on the west side of Witham Hill, as identified in the Open Space - Hillside Report (November 1983), shall be retained in Open Space - Conservation uses.	1 - This policy identifies significant hillside areas for protection. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	D/Q	Indirect	Contaminants	POS	2	3	1	6	6

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
23	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.18	Hillsides	Development on Double Hill shall maintain a sufficient number of trees to preserve the existing tree canopy.	1 - This policy identifies significant hillside areas and restricts removal of the tree canopy. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
24	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.6.19	Hillsides	While development of the Philomath - Corvallis Hill is permitted, development shall maintain a sufficient number of trees to preserve the existing tree canopy.	1 - This policy identifies significant hillside areas and restricts removal of the tree canopy. Protecting hillsides from development can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. By protecting hillsides, the potential for landslides also is diminished. 10(a) - Positive: The policy protects hillsides from development. 11(b) - Reach: The policy applies to hillsides. 12(c) - Chronic: Protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
25	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.7.3	Natural Hazards	When natural hazards are identified, the City shall require that special design considerations and construction measures be taken to offset the soil and geologic constraints present to protect life and property, and to protect environmentally hazardous areas.	1 - This policy requires special design and construction techniques to offset soil and geologic constraints. Design and development techniques can reduce erosion and sedimentation of surface water and stream habitat caused by clearing and construction. These techniques also help reduce the potential for landslides. 10(a) - Positive: The policy reduces erosion, sedimentation, and landslide potential. 11(b) - Reach: The policy applies to constrained soils and geology. 12(c) - Chronic: The techniques are long-term. 13(d) - Low: Construction techniques are costly and are implemented as a last resort.	C/N	Indirect	Contaminants	POS	2	3	1	6	6
26	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.7.6	Natural Hazards	Benton County, the Oregon Department of Forestry, and the City of Corvallis shall work to identify Wildfire Hazard Zones within the Urban Growth Boundary and implement appropriate development standards.	1 - This policy establishes a mechanism to implement development standards to mitigate wildfire hazards. Development standards are not identified, so the impacts on stream habitat are unknown. 10(a) - Neutral: The impacts on stream habitat are unknown. 11(b) - NA 12(c) - NA 13(d) - NA	C/N	Indirect	Contaminants	NTRL	0	0	0	0	0

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LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
27	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.8.1	Floodplains and Flood Hazards	Development in the floodway fringe shall be controlled by local regulations to minimize potential damage (onsite, upstream, and downstream) to life and property; to allow for transport of flood waters; and to protect the economic, environmental, and open space qualities of the land and adjacent water bodies.	1 - This policy minimizes damage to the environmental qualities of the land and waters of the floodway fringe. Such protection minimizes direct impacts on stream habitat and water quality by essentially acting as a protective buffer. Contaminants, channelization, barriers, and impervious surfaces might all be reduced by this section. Minimizing development impact on the floodway fringe also may help protect fish habitat by maintaining shade along fish-bearing waters, which helps maintain suitable water temperatures. 10(a) - Positive: The policy minimizes direct impacts of development within the floodway. 11(b) - Reach: The policy applies to only to the floodway fringe. 12(c) - Chronic: The policy is long-term. 13(d) - High: Without such restrictions, impact on habitat might be severe.	C/N	Direct	Multiple	POS	2	3	3	8	8
28	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.8.3	Floodplains and Flood Hazards	Development shall be prohibited within the floodway, except bridges, public utilities, and seasonal and other temporary water-related uses that do not significantly alter the patterns of floodwater flows.	1 - This policy prohibits most development within the floodway. Such protection minimizes direct impacts on stream habitat and water quality by essentially acting as a protective buffer. Contaminants, channelization, barriers, and impervious surfaces might all be reduced by this section. Minimizing development impact on the floodway fringe also may help protect fish habitat by maintaining shade along fish-bearing waters, which helps maintain suitable water temperatures. 10(a) - Positive: The policy minimizes direct impacts of development within the floodway. 11(b) - Reach: The policy applies only to the floodway. 12(c) - Chronic: The policy is long-term. 13(d) - High: Without such restrictions, impact on habitat might be severe.	C/N	Direct	Multiple	POS	2	3	3	8	8
29	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.9.1	Water Resources	Significant watercourses, lakes, and wetlands shall be preserved or have their losses mitigated in order to maintain clean water, support natural vegetation, protect the aquatic habitat, retain existing significant public vistas, and provide wildlife habitat and recreation sites. Site-specific buffering and setback requirements may be required, as necessary, to achieve protection.	1 - This policy requires preservation or mitigation of watercourses, lakes, and wetlands and provides for the use of buffers or setbacks to achieve water resource protection. Such protection minimizes direct impacts on stream habitat and water quality. Contaminants, channelization, barriers, and impervious surfaces might all be reduced or avoided by this section. Minimizing development impact on such water resources also may help shade fish-bearing waters, which helps maintain water temperatures suitable for fish habitat. 10(a) - Positive: The policy minimizes direct impacts of development on water resources. 11(b) - Reach: The policy applies only to watercourses, lakes, and wetlands. 12(c) - Chronic: The policy is long-term. 13(d) - High: Without such restrictions, impact on habitat might be severe.	C/N	Direct	Buffers	POS	2	3	3	8	8
30	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.3	Urban Streams and Other Drainageways	Significant drainageways shall be kept in a natural state to protect tree lines, maintain their natural functions, and enhance native plant species to the maximum extent practicable.	1 - This policy protects drainageways to maintain their natural functions. Such protection minimizes impacts on surface waters and water quality. Minimizing impact on such water resources also may help maintain water temperatures suitable for fish habitat. 10(a) - Positive: The policy minimizes the impact of development on water resources. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Without such restrictions, habitat would be affected.	C/N	Direct	Buffers	POS	2	3	2	7	7

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
31	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.4	Urban Streams and Other Drainageways	Within the Urban Growth Boundary, drainageway dedications adequate for flood protection, conveyance of stormwater, channel access, maintenance protection of riparian environment, and channel migration shall be secured along all open drainageways needed for public conveyance of stormwater prior to or at the time of development. In already developed areas where dedications may not be possible, an easement may be pursued in lieu of a dedication.	1 - This policy protects drainageways to maintain their natural functions. Such protection minimizes impacts on surface waters and water quality. Minimizing impact on such water resources also may help maintain water temperatures suitable for fish habitat. 10(a) - Positive: The policy minimizes impact of development on water resources. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Without such restrictions, habitat would be affected.	C/N	Direct	Buffers	POS	2	3	2	7	7
32	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.5	Urban Streams and Other Drainageways	To minimize the negative impacts of development, stormwater runoff after development should be managed to produce no significantly greater peak flow rates than prior to development unless more appropriate provisions are identified in adopted comprehensive stormwater management plans.	1 - This policy sets a "no greater impact" development standard for stormwater quantity. Such a policy will help limit "flash" effects such as channel and streambank erosion and sedimentation often caused by impervious surfaces. 10(a) - Positive: The policy minimizes impact of development on water resources. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Without such restrictions, habitat would be affected.	C/N	Direct	Impervious Surfaces	POS	2	3	2	7	7
33	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.6	Urban Streams and Other Drainageways	To minimize the negative impacts of development, stormwater runoff after development should be managed to produce no significant reduction of water quality than prior to development unless more appropriate provisions are identified in adopted comprehensive stormwater management plans.	1 - This policy sets a "no greater impact" development standard for stormwater quality. Such a policy will help limit contamination of surface water caused by land uses and activities, and erosion and sedimentation caused by construction and development. 10(a) - Positive: The policy minimizes the impact of development on water resources. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Without such restrictions, habitat would be affected.	C/N	Direct	Contaminants	POS	2	3	2	7	7
34	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.7	Urban Streams and Other Drainageways	Grading and filling in drainageways shall be regulated to prevent negative impact on the channel, floodway and floodplain, riparian habitat, wetlands, and other properties. Where drainageways are disturbed through development, the developer shall return the drainageway to its natural state, to the extent practicable.	1 - This policy restricts drainageways from grading and filling. The policy will help limit contamination of surface water caused by development and related activities. The policy should prevent sedimentation from harming stream habitat. 10(a) - Positive: The policy protects riparian habitat from grading and filling. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Without such restrictions, habitat would be affected.	C/N	Direct	Multiple	POS	2	3	2	7	7

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35	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.8	Urban Streams and Other Drainageways	Negative impacts on habitat and migration corridors for birds, wildlife, aquatic life, and on open space and the recreation qualities of significant drainageways shall be minimized.	1 - This policy protects drainageways from grading and filling. The policy will help limit contamination of surface water caused by development and related activities. The policy should prevent sedimentation from harming stream habitat. 10(a) - Positive: Protects riparian habitat from grading and filling. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Without such restrictions, habitat would be affected.	C/N	Direct	Buffers	POS	2	3	2	7	7
36	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.9	Urban Streams and Other Drainageways	Drainageways can be used as trail corridors but trails must be designed and constructed to minimize impacts on the natural drainageway, to the maximum extent practicable.	1 - This policy permits trial corridors to be constructed along drainageways, if impacts are minimized. The policy allows impacts of a use, trail corridors, along drainageways. 10(a) - Negative: Permits negative impacts of trail corridors. 11(b) - Reach: The policy applies only to drainageways and trail corridors. 12(c) - Chronic: The policy is long-term. 13(d) - Low: The policy allows only minimal impacts from trail corridors.	C/N	Direct	Buffers	NEG	2	3	1	6	6
37	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.10	Urban Streams and Other Drainageways	The City shall work with Benton County to adopt a cooperative program that implements standards for management of vegetation, such as removal of detrimental vegetation and preservation of beneficial vegetation along significant drainageways within the City Limits and Urban Growth Boundary.	1 - The policy allows management of beneficial and detrimental vegetation along drainageways, which protects them from erosion. It allows direct habitat management to provide instream structures that provide fish refuge. Vegetation management can potentially provide shade to surface water that helps maintain suitable water temperatures. 10(a) - Positive: The policy permits vegetation management. 11(b) - Reach: The policy applies only to drainageways. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: Vegetation management can yield habitat benefits.	C/N	Direct	Buffers	POS	2	3	2	7	7
38	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.11	Urban Streams and Other Drainageways	If streams within the Urban Growth Boundary are declared water-quality limited by the Oregon Department of Environmental Quality, appropriate mitigation measures will be adopted.	1 - The policy commits the City to water-quality mitigation. Improved water quality results in better fish habitat. 10(a) - Positive: The policy effectively establishes a low limit on water quality. 11(b) - Reach: Water-quality standards and mitigation are applied by reach. 12(c) - Chronic: The policy is long-term. 13(d) - Low: If waters are declared "water-quality limited," mitigation efforts may improve water quality but are not likely to result in suitable fish habitat.	D/N	Direct	Contaminants	POS	2	3	1	6	6
39	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.10.12	Urban Streams and Other Drainageways	The City shall develop a program to minimize the conveyance of detrimental sediments and pollutants from public streets into streams and drainageways.	1 - The policy commits the City to minimize the negative impacts of City streets on water-quality mitigation. Improved water quality results in better fish habitat. 10(a) - Positive: The policy may result in significant improvements to water quality. 11(b) - City: Street system is City-wide. 12(c) - Chronic: The policy is long-term. 13(d) - High: The policy should result in a major reduction in contaminants that reach riparian habitat.	C/N	Direct	Contaminants	POS	3	3	3	9	9

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
40	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.1	Wetlands	Consistent with state and federal policy, the City adopts the goal of no net loss of significant wetlands in terms of both acreage and function. The City shall comply with at least the minimum protection requirements of applicable state and federal wetland laws as interpreted by the state and federal agencies charged with enforcing those laws.	1 - The policy commits the City to comply with federal and state wetland regulations. Protecting wetlands improves water quality, resulting in better fish habitat. 10(a) - Positive: The policy will lead to improvements in water quality. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: The policy should result in improvements to water quality.	C/N	Direct	Buffers	POS	2	3	2	7	7
41	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.2	Wetlands	During the City's inventory process of evaluating Statewide Planning Goal 5 wetland resources, the City may wish to adopt additional standards for wetland protection such as, but not limited to, protection of fish and wildlife habitat; maintenance of water quality; hydrological control; contribution to open space; connectivity of hydrologic systems; and protection of significant plant and animal species (e.g., state laws regulate cuts and fills but not vegetation removal).	1 - This section enables the City to adopt standards in addition to Wetland Goal 5 standards, for example standards to protect water quality and fish and wildlife habitat. No tangible connection to fish habitat is made, but this section establishes authority to act and demonstrates intent to protect habitat resources. 10(a) - Neutral: The policy makes no tangible connection to fish habitat. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: The policy is long-term. 13(d) - Medium: The policy should result in improvements to water quality.	C/N	Direct	Buffers	NTRL	0	0	0	0	0
42	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.8	Wetlands	City wetland management plans for significant wetlands, as defined by the state through the statewide Planning Goal 5 process or by a formally adopted plan, shall require protection of those lands consistent with state provisions.	1 - The policy commits the City to enforce Goal 5 wetland protection by implementing the City wetlands management plans. Protected wetlands improve water quality and results in better fish habitat. 10(a) - Positive: The policy may result in significant improvements to water quality. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	D/N	Direct	Buffers	POS	2	3	2	7	7

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
43	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.9	Wetlands	To determine which wetland sites are significant, the City maintains the option to use either the statewide Planning Goal 5 "ESEE" methodology or the state's “safe harbor” methodology or a combination of both. The safe harbor approach utilizes criteria in the Oregon Freshwater Wetland Assessment Methodology Handbook to determine which wetlands are significant. Upon completion of this analysis and acceptance by the state, the City shall then protect those lands consistent with State Administrative Rules.	1 - The policy commits the City to protect significant wetlands consistent with State Administrative Rules. Protected wetlands improve water quality and result in better fish habitat. 10(a) - Positive: The policy may result in significant improvements to water quality. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	C/N	Direct	Buffers	POS	2	3	2	7	7
44	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.10	Wetlands	City wetland management plans shall identify areas suitable for wetland restoration and possible use for offsite mitigation. The geographic area for mitigation may extend beyond the Urban Growth Boundary within the same drainage basin.	1 - Allows wetland mitigation outside the Urban Growth Boundary. The statement implies that wetlands lost within the City can be mitigated outside the Urban Growth Boundary. No tangible connection to riparian habitat can be inferred. 10(a) - Neutral: The affects of the policy are unknown. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	C/N	Direct	Buffers	NTRL	0	0	0	0	0
45	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.11	Wetlands	Regarding significant wetlands downstream of development sites, the cumulative unavoidable losses of significant wetland acreage and function attributable to upstream development should be mitigated by the City. Such mitigation can be achieved, in part, through dedication of open space, drainageways, and related natural infrastructure.	1 - The policy protects wetlands from upstream development by mitigation. Protected wetlands improve water quality and result in better fish habitat. 10(a) - Neutral: The affects of the policy are unknown. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	C/N	Direct	Buffers	POS	0	0	0	0	0
46	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.12	Wetlands	Development upslope of wetlands shall minimize interference with water patterns discharging to wetlands and shall minimize detrimental changes in water quality for waters discharging to wetlands.	1 - Protects natural functions of wetlands. Protected wetlands improve water quality and result in better fish habitat. 10(a) - Positive: The policy maintains natural functions of wetlands. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	C/N	Direct	Buffers	POS	2	3	2	7	7

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
47	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.13	Wetlands	Consistent with state and federal law, the City shall provide builders and developers notice of possible state and federal permit requirements when development review indicates that their site may have hydric soils or the site appears to be land identified on a state or federal wetland inventory.	1 - The policy protects wetlands from inadvertent destruction. Protected wetlands improve water quality and result in better fish habitat. 10(a) - Positive: The policy protects wetlands. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	D/N	Direct	Buffers	POS	2	3	2	7	7
48	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.11.14	Wetlands	To resolve wetland issues as early as possible in the development application process on land with hydric soils, land with wetland vegetation, and/or land identified on a state or national wetland inventory, the City shall require a developer to submit, at the time of application, a wetland determination or delineation from a qualified consultant. This professional analysis shall be submitted concurrently to the City and to the Division of State Lands. The City shall request comment from the Division of State Lands on land development applications requiring a public hearing.	1 - This policy protects wetlands from inadvertent destruction. Protected wetlands improve water quality and result in better fish habitat. 10(a) - Positive: The policy protects wetlands. 11(b) - Reach: The policy applies to wetlands. 12(c) - Chronic: Wetland protection is long-term. 13(d) - Medium: The policy should result in a reduction in contaminants that reach riparian habitat.	D/N	Direct	Buffers	POS	2	3	2	7	7
49	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.12.1	Groundwater	The City shall attempt to protect groundwater resources from pollution and damage through education, regulation, and example.	1 - This is a statement of intent to protect groundwater. It has no tangible connection to protection of habitat. 10(a) - Neutral: This statement of intent has no tangible connection to habitat. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: Groundwater protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	NA	NTRL	0	0	0	0	0
50	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.12.6	Groundwater	The City and County shall work together to minimize adverse impacts on the quality and quantity of the area's groundwater.	1 - This is a statement of intent to protect groundwater. It has no tangible connection to protection of habitat. 10(a) - Neutral: The statement of intent has no tangible connection to habitat. 11(b) - City: The statement of intent applies City-wide. 12(c) - Chronic: Groundwater protection is long-term. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	NA	NTRL	0	0	0	0	0
51	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.13.2	Plant, Wildlife, and Fishery Resources	Development on land identified with significant plant communities, or significant fish and wildlife habitats, shall be planned to minimize the impact on the significant resources.	1 - Statement of intent to minimize impacts from development on significant natural plant communities and fish and wildlife habitat. This policy includes stream habitat. 10(a) - Positive: The statement of intent is to protect stream habitat. 11(b) - Reach: The statement of intent applies to significant habitat. 12(c) - Chronic: The policy will persist until it is amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Direct	Multiple	POS	2	3	1	6	6

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
52	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.13.3	Plant, Wildlife, and Fishery Resources	During the evaluation of City requirements for a drainageway dedication, the City shall pursue inclusion of an adequate amount of land adjacent to riparian zones to allow the area to continue to support a diversity of habitat.	1 - City intends to pursue drainageway dedications wide enough to support diverse habitat. Such dedications effectively buffer impacts on surface waters and water quality. Riparian buffers also help maintain water temperatures suitable for fish habitat. 10(a) - Positive: The policy protects stream habitat. 11(b) - Reach: The policy applies to significant habitat. 12(c) - Chronic: The policy will persist until it is amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Direct	Buffers	POS	2	3	1	6	6
53	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.13.4	Plant, Wildlife, and Fishery Resources	The City shall encourage the retention of large, varied habitat areas on private and public lands including inventoried plant communities.	1 - By encouraging the protection of large, varied habitat, the City protects naturally functioning systems. Naturally functioning systems help improve water quality and protect stream habitat. 10(a) - Positive: The City encourages the protection of significant habitat. 11(b) - Reach: The policy applies to significant habitat. 12(c) - Chronic: The policy will persist until it is amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Buffers	POS	2	3	1	6	6
54	CCP	Art. 4 - Natural Features, Land, and Water Resources	4.13.6	Plant, Wildlife, and Fishery Resources	The City shall consider mechanisms such as density transfer and reduced densities as a means to protect significant plant, wildlife, and fish resources.	1 - The City encourages the transfer of development rights to minimize impacts from development to significant natural plant communities and fish and wildlife habitat. This policy includes stream habitat. 10(a) - Positive: The transfer of development rights can be used to protect stream habitat. 11(b) - Reach: The policy applies to significant habitat. 12(c) - Chronic: The policy will persist until it is amended. 13(d) - Medium: Transfer of development rights can be used to protect significant habitat.	C/N	Indirect	Contaminants	POS	2	3	2	7	7
55	CCP	Urban Amenities	5.2	Community Character	Both public and private properties located along entrance corridors to the City of Corvallis shall be attractively landscaped, left as open space, or maintained as active agricultural or forest lands.	1 - Property along entry corridors is to be left as open land. This policy reduces the amount of impervious surface allowed along entry corridors. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Positive: The policy reduces impervious surfaces. 11(b) - Reach: The policy applies only to entry corridors. 12(c) - Chronic: The policy will persist until it is amended. 13(d) - Low: Overall reduction of impervious surfaces based on policy is slight.	C/N	Indirect	Impervious Surfaces	POS	2	3	1	6	6
56	CCP	Urban Amenities	5.3.2	Urban Trees	The community shall establish and maintain a tree planting program, particularly along street rights-of-way, parks, and parkways, in the downtown and other areas where buffers, separation, and beautification are appropriate and desirable. This program should provide for the planning, planting, and maintenance of trees.	1 - This tree planting policy will help prevent soil erosion and allow for aquifer recharge. Soil and vegetation filter some contaminants from surface water and groundwater, improving water quality and stream habitat. 10(a) - Positive: Tree plantings reduce harmful impacts on stream habitat. 11(b) - City: Tree plantings apply throughout the City. 12(c) - Chronic: Trees and shrubs persist for years to come. 13(d) - Medium: Protecting vegetative cover and landscaped areas helps protect stream habitat.	C/N	Indirect	Impervious Surfaces	POS	3	3	2	8	8

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
57	CCP	Urban Amenities	5.5.4	Open Space	Appropriate trails, creeks, drainageways, and other natural constraints shall have an Open Space - Conservation designation to ensure their protection and utilization for multiple uses.	1 - This open space conservation policy conserves porous surfaces, helps prevent soil erosion and sedimentation, and allows for aquifer recharge. Soil and vegetation filter some contaminants from surface and groundwater, improving water quality and stream habitat. 10(a) - Positive: The open space designation protects habitat. 11(b) - Reach: The policy applies only to designated areas. 12(c) - Chronic: The open space designation should persist for years. 13(d) - Medium: Open space conservation helps protect stream habitat.	C/N	Indirect	Impervious Surfaces	POS	2	3	2	7	7
58	CCP	Urban Amenities	5.5.15	Open Space	The City shall establish vegetation management practices for open space that mitigate the uncontrolled spread of wildfire yet minimize the impacts on the natural habitat.	1 - Impact on habitat is minimized. Vegetation practices are not specified, so no tangible connection to riparian habitat can be established. 10(a) - Neutral: No tangible connection to riparian habitat is established. 11(b) - NA 12(c) - NA 13(d) - NA	C/N	Indirect	Contaminants	NTRL	0	0	0	0	0
59	CCP	Urban Amenities	5.6.12	Parks and Recreation	The Willamette riverfront is an important community asset and should be developed to protect its significant environmental features, allow for public access, park amenities, and places for recreational activities and events.	1 - This policy encourages the development of the Willamette riverfront as a significant environmental feature for public uses. Impact of this policy on habitat is unclear or ambiguous. 10(a) - Neutral: The impact on habitat is unclear. 11(b) - Reach: The policy applies only to Willamette riverfront. 12(c) - Chronic: The policy will persist until amended. 13(d) - Unknown: The impact of the policy is unknown.	C/N	Direct	Buffers	NTRL	0	0	0	0	0
60	CCP	Urban Amenities	5.6.14	Parks and Recreation	When developing plans for parks, the City's goal is to design plans that meet the recreational needs of the community and protect the significant natural features of the park.	1 - This policy protects significant natural features of park land. Protecting natural features generally reduces impervious surfaces and maintains the functions of natural systems. Natural systems generally enhance stream habitat. 10(a) - Positive: Natural features help protect stream habitat. 11(b) - Reach: The policy applies only to significant natural features on park land. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The impact of the policy is limited in scope.	C/N	Indirect	Impervious Surfaces	POS	2	3	1	6	6
61	CCP	Willamette River Greenway	6.2.1	Willamette River Greenway	The City and County shall balance the diverse and potentially conflicting uses of the Greenway by protecting, enhancing, and maintaining the natural, hydrological, scenic, historical, archaeological, agricultural, economic, and recreational qualities of lands along the river.	1 - The impact of this policy is unclear or ambiguous. 10(a) - Neutral: The impact of the policy on habitat is unclear. 11(b) - Reach: The policy applies only to areas in the Greenway. 12(c) - Chronic: The policy will persist until amended. 13(d) - Unknown: The impact of the policy is unknown.	D/N	Direct	NA	NTRL	0	0	0	0	0

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
62	CCP	Willamette River Greenway	6.2.7	Willamette River Greenway	The City shall identify hazardous bank areas and suitable, environmentally sensitive mechanisms for riverbank stabilization.	1 - This policy minimizes impacts from bank stabilization. Bank stabilization minimizes soil erosion and helps protect water quality. 10(a) - Positive: The policy stabilizes streambanks and protects water quality and habitat. 11(b) - Reach: The policy only applies to the Greenway. 12(c) - Chronic: The policy will persist until amended. 13(d) - Medium: Stream stabilization protects habitat.	D/N	Direct	Channelization	POS	2	3	2	7	7
63	CCP	Willamette River Greenway	6.2.8	Willamette River Greenway	The City shall protect and enhance the natural features and floodplain functions of City lands within the Willamette River Greenway on the east side of the river.	1 - This policy protects significant natural features of the Greenway. Protecting natural features generally reduces impervious surfaces and maintains the functions of natural systems. Maintaining natural systems generally protects stream habitat. 10(a) - Positive: Natural features help protect stream habitat. 11(b) - Reach: The policy applies only to significant natural features of the Greenway. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The impact of the policy is limited in scope.	D/N	Direct	Impervious Surfaces	POS	2	3	1	6	6
64	CCP	Environmental Quality	7.2.5	Environmental Quality Policies	The City shall encourage the use of the most appropriate technology in all new developments and existing businesses and industries to comply with or exceed state and federal environmental standards.	1 - This policy encourages the use of new technologies to meet federal and state standards. Federal and state standards include stream habitat and water quality. 10(a) - Positive: Environmental standards help protect stream habitat. 11(b) - City: Policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The impact of the policy is limited in scope.	C/N	Indirect	None	POS	3	3	1	7	7
65	CCP	Environmental Quality	7.2.6	Environmental Quality Policies	The City will encourage new development to be sensitive to the environment by having the development avoid significant negative impacts on air and water quality, noise or light pollution, and the hazards related to some types of waste materials.	1 - This policy encourages development to avoid significant impact on water quality and hazards related to waste material. It has the potential to reduce impacts from construction, such as soil erosion and sedimentation, and from contaminants such as hazardous waste. 10(a) - Positive: The policy helps protect stream habitat. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The impact of the policy is limited in scope.	C/N	Indirect	None	POS	3	3	1	7	7

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

Line Item Reference Number	Document ID	Enter relevant data directly from development code			Summary and description of relevant indicators (uses, activity, or standards) impacting habitat	Formatted Response to two key questions: 1) What is the relationship between the source use or activity, the pathway, and the habitat? 2) What is the rationale for scoring this specific pathway for the following parameters; +/-/0 (Col.10 a), Mag.(Col.11 b), Dur. (Col.12 c), Intensity (Col.13 d)?	Def./Quant. Def./NonQ Cond/Q. Cond/NQ	Direct Direct Direct Indirect Indirect	Channelization Barriers Buffers Contaminants Impervious Surfaces	Impact on PFC POS - Positive NEG - Negative NTRL - Neutral	Magnitude City=3 Reach=2 Point=1	Duration Chronic=3 Episodic=2 Once =1	Intensity (impact on Habitat) High=3 Medium=2 Low=1	Subtotal	Total Score
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
66	CCP	Environmental Quality	7.5.3	Environmental Quality Policies	To improve water quality and quantity in the Corvallis area, the City will continue to develop regulations or programs to manage both point and non-point pollutants by increasing public awareness of techniques and practices private individuals can employ to help correct water quality and quantity problems; improving management of industrial, commercial, and agricultural operations to reduce negative water quality and quantity impacts; regulating site planning for new development and construction to better control drainage and erosion and to manage storm runoff; increasing storage and retention of storm runoff to lower and delay peak storm flows as appropriate; reducing street-related water quality and quantity problems; and increasing public awareness, minimizing the use and encouraging the appropriate disposal of polluting substances that affect surface and groundwater resources.	1 - This policy states that the City will develop broad-based efforts to prevent point and non-point pollution. Pollution prevention will improve water quality and, in so doing, improve stream habitat. 10(a) - Positive: The policy will improve water quality and habitat. 11(b) - City: The policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Medium: The policy is broad in scope.	C/N	Indirect	Multiple	POS	3	3	2	8	8
67	CCP	Environmental Quality	7.5.5	Environmental Quality Policies	The City shall attempt to limit unnecessary increases in the percentage of Corvallis' impervious surfaces.	1 - This policy states the City's intent to limit unnecessary increases in impervious surfaces. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. As worded, this policy is likely to yield little benefit to stream habitat. 10(a) - Neutral: This policy, though an affirmative statement, has no tangible effect. 11(b) - City: The policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Impervious Surfaces	NTRL	0	0	0	0	0
68	CCP	Environmental Quality	7.6.3	Environmental Quality - Solid and Hazardous Waste	The City shall promote the appropriate forms of agricultural reuse of sludge produced by the City's wastewater treatment program.	1 - Appropriate forms of agricultural use of sludge include land application as fertilizer. Runoff from sludge and other agricultural fertilizers adds excessive amounts of nutrients to surface waters and is harmful to water quality and fish habitat of streams. 10(a) - Negative: Agricultural runoff is harmful to water quality. 11(b) - City: The policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Medium: Water quality is directly related to habitat quality.	C/N	Indirect	Contaminants	NEG	3	3	2	8	8

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
69	CCP	Environmental Quality	7.6.4	Environmental Quality - Solid and Hazardous Waste	The City shall ensure that special precautions or limitations are taken for the storage of hazardous substances, particularly in the 100-year floodplain.	1 - Hazardous substances can cause catastrophic damage to stream habitat if they are released on land or into surface waters, or if they contaminate groundwater. This policy is intended to prevent such releases. 10(a) - Positive: This policy is intended to prevent contamination. 11(b) - City: The policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	D/N	Direct	Contaminants	POS	3	3	1	7	7
70	CCP	Economy	8.10.3	Economy - Policies	All areas with commercial Comprehensive Plan Map designations other than Central Business District and Professional Office shall be redesignated as Mixed Use Commercial. (See Policy 8.10.7 for direction on Land Development Code standards to be developed to address the community's commercial needs.)	1 - This policy permits mixed use commercial development within all commercial designations on the Comprehensive Plan. This policy typically will result in greater density or a more intensive development pattern than the underlying base commercial zone. However, the policy is unlikely to result in greater contaminants resulting from land use. 10(a) - Neutral: The impact of the policy is unclear. 11(b) - Reach: The policy applies to all commercial zones. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Indirect	Contaminants	NTRL	0	0	0	0	0
71	CCP	Housing	9.6.3	Downtown Residential Neighborhood	The City shall amend the Land Development Code to encourage the following in the Downtown Residential Neighborhood: a. building to the higher end of the allowed density range through intensive site utilization; b. reducing onsite parking requirements; and c. maintaining historic character. (CODE DIRECTION)	1 - This policy allows more intensive site utilization and a reduction of onsite parking requirements for downtown residential. More intensive site utilization will increase the amount of impervious surfaces for downtown residential projects. Reduction of onsite parking will decrease impervious parking areas. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. Little or no change can be expected in the amount of impervious surfaces generated by downtown residential projects. 10(a) - Neutral: This policy has offsetting effects on impervious surfaces. 11(b) - Reach: The policy applies to downtown residential zones. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	D/N	Indirect	Impervious Surfaces	NTRL	0	0	0	0	0
72	CCP	Public Utilities, Facilities, and Services	10.3.5	Water, Wastewater, and Stormwater	The City shall increase its efforts to improve the drainage system through stormwater master plan efforts, the Capital Improvement Program, and the development process, consistent with EPA and DEQ directives.	1 - This policy states that the City will improve the drainage system consistent with EPA and DEQ directives. The policy is likely to result in improved water quality and stormwater management. These results will benefit stream habitat. 10(a) - Positive: The policy will improve water quality and habitat. 11(b) - City: The policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Direct	NA	POS	3	3	1	7	7

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
73	CCP	Public Utilities, Facilities and Services	10.3.6	Water, Wastewater, and Stormwater	The City shall take steps to minimize the effects of development on downstream drainage systems through the use of appropriate strategies as identified in the Stormwater Master Plan.	1 - This policy states that the City will minimize effects of development on downstream drainage systems. The policy is likely to result in improved water quality and stormwater management. These results will benefit stream habitat. 10(a) - Positive: The policy will improve water quality and habitat. 11(b) - City: The policy applies City-wide 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: Policy alone is a weak tool to achieve results.	C/N	Direct	NA	POS	3	3	1	7	7
74	CCP	Public Utilities, Facilities, and Services	10.4.3	Franchise Utilities	Private-franchise utility distribution facilities shall be located underground in newly-developed areas. To the extent practicable, the City shall encourage the underground relocation of existing above-ground private utility distribution facilities as part of modifications to existing systems.	1 - This policy states that utilities will be located underground. Trenching can contribute to soil erosion and interrupt the flow of surface water. Excessive sedimentation caused by trenching can damage stream habitat. Trenching may impact stream habitat by altering or diverting surface hydrology. 10(a) - Negative: Trenching disturbs soil and surface water flow. 11(b) - City: The requirements apply throughout the City. 12(c) - Episodic: Duration may vary on a case-by-case basis according to site conditions. 13(d) - Low: Impact on habitat is mitigated by erosion control and properly compacting backfill.	C/N	Indirect	Contaminants	NEG	3	2	1	6	6
75	CCP	Public Utilities, Facilities, and Services	10.7.6	Fire and Emergency Public Services - - Policies	The Fire Department shall procure equipment over time, compatible with narrow streets and pedestrian friendly environments.	1 - This policy will allow the City to reduce right-of-way and pavement widths of City and private streets. It will help minimize impervious surfaces. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Positive: Minimizing impervious surfaces benefits stream habitat. 11(b) - City: The policy applies to all Fire Department equipment. 12(c) - Chronic: This is a long-term policy with long-term benefits. 13(d) - Low: The policy will allow narrower pavement widths only for new or redeveloped roadways.	D/N	Indirect	Impervious Surfaces	POS	3	3	1	7	7
76	CCP	Transportation	11.4.3	Auto Parking	All traffic generators shall provide adequate parking.	1 - Parking requirements increase impervious surfaces. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Negative: Increasing impervious surfaces will be harmful to stream habitat. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The policy will require pavement for parking.	D/N	Indirect	Impervious Surfaces	NEG	3	3	1	7	7
77	CCP	Transportation	11.4.4	Auto Parking	Multiple-level parking facilities near major traffic generators should be encouraged where practical.	1 - Structured or multi-level parking limits the amount of impervious surfaces needed to provide parking. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Positive: Reducing impervious surfaces will benefit stream habitat. 11(b) - Reach: The policy applies to traffic generators. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The policy will require less pavement for parking.	C/N	Indirect	Impervious Surfaces	POS	2	3	1	6	6

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

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0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
78	CCP	Transportation	11.5.7	Auto Parking - policies	All new collector and arterial streets shall be designed to accommodate bicycle facilities.	1 - Designing streets to accommodate bicycles and pedestrians will increase impervious surfaces. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Negative: Increasing impervious surfaces will be harmful to stream habitat. 11(b) - City: The policy applies city-wide. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The policy will require marginal increases in pavement widths.	D/N	Indirect	Impervious Surfaces	NEG	3	3	1	7	7
79	CCP	Transportation	11.5.11	Auto Parking - policies	Where bicycle and pedestrian facilities are combined, adequate width for the combined uses shall be provided.	1 - Designing streets to accommodate bicycles and pedestrians will increase impervious surfaces. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Negative: Increasing impervious surfaces will be harmful to stream habitat. 11(b) - City: The policy applies City-wide. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The policy will require marginal increases in pavement widths.	C/N	Indirect	Impervious Surfaces	NEG	3	3	1	7	7
80	CCP	Transportation	11.10.1	Water - Policies	The Mary's and Willamette rivers should be considered as potential resources in future transportation planning.	1 - This policy considers future use of rivers as transportation resources. Increasing marine traffic on rivers will directly impact fish habitat by introducing contaminants associated with watercraft such as oils and fuels. 10(a) - Negative: Increase contaminants to river habitat. 11(b) - Reach: The policy applies to Mary's and Willamette rivers. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The policy would probably result in marginal increases in contaminants.	C/N	Direct	Contaminants	NEG	2	3	1	6	6
81	CCP	Special Areas of Concern	13.4.5	Oregon State University Open Space and Resource Lands - Policies	The City shall adopt land use policies, such as maintaining adequate buffers, to protect University agricultural and forest land from the negative impacts of urban development and protect urban development from the negative impacts of agricultural practices and forest uses.	1 - The policy adopts land use policies that will buffer incompatible uses. It is uncertain if these buffers consist of open land or other uses. Therefore, the impact on stream habitat is unclear. 10(a) - Neutral: The impact on habitat is unknown. 11(b) - Reach: The policy applies to University open lands. 12(c) - Chronic: The policy is long-term. 13(d) - Low: The impact of the policy is unknown.	C/N	Indirect	Buffers	NTRL	0	0	0	0	0
82	CCP	Special Areas of Concern	13.4.6	Oregon State University Open Space and Resource Lands - Policies	OSU shall continue to prevent harmful agricultural runoff from entering local streams and avoid agricultural activities that ecologically impair the Oak Creek and Squaw Creek systems.	1 - Runoff from agricultural lands can carry fertilizers, pesticides, and herbicides into surface waters and harm stream habitat. 10(a) - Positive: This policy is beneficial to water quality. 11(b) - Reach: The policy applies only to Oak and Squaw creeks. 12(c) - Chronic: The policy will persist until amended. 13(d) - Medium: Water quality is directly related to habitat quality.	D/N	Direct	Contaminants	POS	2	3	2	7	7

PATHWAY ANALYSIS - COMPREHENSIVE PLAN

Line Item Reference Number	Document ID	Enter relevant data directly from development code			Summary and description of relevant indicators (uses, activity, or standards) impacting habitat	Formatted Response to two key questions: 1) What is the relationship between the source use or activity, the pathway, and the habitat? 2) What is the rationale for scoring this specific pathway for the following parameters; +/-/0 (Col.10 a), Mag.(Col.11 b), Dur. (Col.12 c), Intensity (Col.13 d)?	Def./Quant. Def./NonQ Cond/Q. Cond/NQ	Direct Direct Direct Indirect Indirect	Channelization Barriers Buffers Contaminants Impervious Surfaces	Impact on PFC POS - Positive NEG - Negative NTRL - Neutral	Magnitude City=3 Reach=2 Point=1	Duration Chronic=3 Episodic=2 Once =1	Intensity (impact on Habitat) High=3 Medium=2 Low=1	Subtotal	Total Score
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
LI	DOC	Chapter Name	Sect #	Sect. Name	Description	Discussion/Justification	Filter	Impact	Pathway/Conveyance	+/-/0 (a)	Mag. (b)	Dur. (c)	Int. (d)	ST	Tot.
83	CCP	Special Areas of Concern	13.12.7	West Corvallis Area	Medium density residential uses are an essential feature of neighborhood villages. To meet the demand for single family housing while reducing land costs, the City shall review the Land Development Code to do the following: a. require a minimum average residential density of nine dwellings per net residential acre, including pocket parks but excluding areas set aside for commercial and employment uses, public facilities, and neighborhood parks greater than four acres; b. require at least one-third of a neighborhood village's dwelling units to be either multi-family or attached single family; and c. require that the majority of a neighborhood village's residential land be set aside for medium-density single family housing, either detached or attached.	1 - The requirements effectively increase the density of residential development within the specified area. This will result in an increase in impervious surfaces. Impervious surfaces increase the rate of runoff, increase the temperature of stream waters, concentrate pollutants, and interfere with groundwater recharge. 10(a) - Negative: Increasing impervious surfaces will be harmful to stream habitat. 11(b) - Reach: The policy applies to the West Corvallis area. 12(c) - Chronic: The policy will persist until amended. 13(d) - Low: The policy will require marginal increases in pavements.	C/N	Indirect	Contaminants	NEG	2	3	1	6	6

Richardson, Robert

From: Courtney Childs [courtneyc@peak.org]
Sent: Thursday, January 22, 2009 8:19 AM
To: Richardson, Robert
Subject: Brooklane Heights

Hello Bob,

I am very concerned about the proposed Brooklane Heights development. I consider that area a precious jewel to all of Corvallis and am horrified that it would be subject to deep cuts, tall building development and habitat disruption and that the development would threaten the quality of the wetlands it overlooks.

Please do your best to protect this treasure for us all. Thank you.

Courtney Childs
2620 SE Crystal Lake Drive
Corvallis, OR 97333

Dear Mayor and City Council Members,

I'd like to express my support for Tessa Hanover's position and ask that this development be denied.

Best Regards,
Ken Boorom,
2685 SW Dearmond Drive
Corvallis, OR

From: Tessa Hanover [mailto:tmhanover@comcast.net]
Sent: Tuesday, January 20, 2009 5:33 PM
To: 'mayor@council.ci.corvallis.or.us'; 'ward1@council.ci.corvallis.or.us'; 'ward2@council.ci.corvallis.or.us'; 'Ward3@council.ci.corvallis.or.us'; 'Ward4@council.ci.corvallis.or.us'; 'Ward5@council.ci.corvallis.or.us'; 'Ward6@council.ci.corvallis.or.us'; 'Ward7@council.ci.corvallis.or.us'; 'Ward8@council.ci.corvallis.or.us'; 'Ward9@council.ci.corvallis.or.us'; 'Robert.Richardson@corvallis.ci.or.us'
Subject:

RECEIVED
JAN 26 2009
Community Development
Planning Division

January 20, 2009

Dear Mayor and City Council Members,

Please deny the proposed Brooklane Heights Planned Development and uphold the Land Use Board of Appeals (LUBA) remand to the City of Corvallis regarding its decision to overturn the Planning Commissions 2008 denial of this project. The environmentally sensitive nature of this site with it's proximity to a wetland area and its significant oak grove deserves to be protected. As a former Archaeological Technician for the Oregon Museum of Anthropology Highway Department I worked on many sensitive sites in Oregon and Idaho in the 1990's and many would consider this hillside to be of significance for future excavation of cultural remains. Once development takes place there is so much disturbance of a site that the information it could hold for science is lost forever.

I also ask that you please consider the beautiful nature of this hillside as one feature of Corvallis worth saving. Your vote to deny this project will foster community support due to the fact that the City Council of 2009 understands that not every development plan is good for a community when it may damage significant habitats.

I live on De Armond Drive which runs parallel to SW Fairmont and have seen first hand what largess past developments below us have been built. A recent home there was listed for $800,000 dollars and I don't forsee anything different at Brooklane Heights. At this time of global financial uncertainty I ask you all to consider if this project is good for the environment and for the whole of Corvallis.

Thank you for your consideration.

Theresa Hanover
2685 SW De Armond Dr
Corvallis OR 97333

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Monday, January 26, 2009 9:07 PM
To: Richardson, Robert
Cc: Extrom, Joan
Subject: Brooklane Heights Q&A

Attachments: Brooklane_Q&A.pdf

Brooklane_Q&A.pdf
(121 KB)

Bob,

Here's more testimony for the record. Please add the PDF in full color, so that the highlights are retained. Thanks.

Mark

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Monday, January 26, 2009 9:12 PM
To: Mayor and City Council
Cc: Richardson, Robert
Subject: Brooklane Heights Q&A

Members of the Corvallis City Council:

You might share the confusion about applicable criteria that I had after the last hearing. So I offer you the results of research I did about the matter.

I already sent this file to Bob Richardson as an attachment:
http://www.knappster.org/Brooklane_Q&A.pdf

I found that the LUBA Remand requires the applicant to comply with the Comprehensive Plan, not just the 1993 Land Development Code. Statements to the contrary in the December 24, 2008 memo from the Community Development Director are directly refuted by state law and LUBA itself.

Mark Knapp

Date: January 26, 2009
From: Mark Knapp
To: Corvallis City Council
Subject: Brooklane Heights (PLD06-00018, SUB06-00006)

The enclosed questions and answers will hopefully clarify any confusion you may have about the applicable criteria for the Brooklane Heights development application.

Summary:

The LUBA Remand requires the applicant to comply with the Comprehensive Plan, not just the 1993 Land Development Code. Statements to the contrary in the December 24, 2008 memo from the Community Development Director are ***directly refuted*** by state law and LUBA itself.

Noncompliance with the Comprehensive Plan was the primary overall reason for the remand. The additional evidence and statements by the Applicant and the Planning Division fail to remedy those errors.

The development application still fails to comply with all of the applicable criteria.

Q: What are the applicable criteria for the land use decision?

A: State law determines the applicable criteria as follows:

> **227.173 Basis for decision on permit application or expedited land division; statement of reasons for approval or denial.**
> (1) Approval or denial of a discretionary permit application shall be based on standards and criteria, which shall be set forth in the development ordinance and which shall relate approval or denial of a discretionary permit application to the development ordinance and to the comprehensive plan for the area in which the development would occur and to the development ordinance and comprehensive plan for the city as a whole.
>
> (3) Approval or denial of a permit application or expedited land division shall be based upon and accompanied by a brief statement that explains the criteria and standards considered relevant to the decision, states the facts relied upon in rendering the decision and explains the justification for the decision based on the criteria, standards and facts set forth.

> **227.175 Application for permit or zone change; fees; consolidated procedure; hearing; approval criteria; decision without hearing.**
> (4) The application shall not be approved unless the proposed development of land would be in compliance with the comprehensive plan for the city and other applicable land use regulation or ordinance provisions. The approval may include such conditions as are authorized by ORS 227.215 or any city legislation.
>
> **227.178 Final action on certain applications required within 120 days; procedure; exceptions; refund of fees.**
> (3)(a) If the application was complete when first submitted or the applicant submits the requested additional information within 180 days of the date the application was first submitted and the city has a comprehensive plan and land use regulations acknowledged under ORS 197.251, approval or denial of the application shall be based upon the standards and criteria that were applicable at the time the application was first submitted.

Stephen Schaberg submitted the original application on October 13, 2006. He submitted a revised application on February 26, 2007 and a third application on April 10, 2007 – which was 179 days after the first application.

The applicable City documents on October 13, 2006 were the 1998 Comprehensive Plan and the 1993 Land Development Code.

Under ideal circumstances, the Land Development Code would contain all development ordinances related to the Comprehensive Plan. In this case, however, the 1998 Comprehensive Plan obviously contains new policies – reflecting a new citizen vision for Corvallis – that are not codified in the 1993 Land Development Code.

Therefore, the statutory requirement of ORS 227.173 (1) **includes the 1998 Comprehensive Plan as a direct standard.**

Q: What support do you have for that legal interpretation?

A: The remand from the Land Use Board of Appeals clearly indicates in several places that the policies of the 1998 Corvallis Comprehensive Plan are applicable criteria.

On page 6 of its ruling, for example, the Board noted that **LDC 2.5.40.04** includes the following:

> "Requests for approval of a Conceptual Development Plan shall be reviewed to assure consistency with the purposes of this chapter, policies and density requirements of the Comprehensive Plan, and any other applicable policies and standards adopted by the City Council."

On page 12 of its ruling, the Board wrote:

> "Second, even if the city had addressed the 2006 hillside development standards in this proceeding or required that those standards be addressed as part of a review process that provides notice and opportunity for public participation [both of which it failed to do], **it is not clear why the city believes that compliance with the 2006 LDC will suffice to demonstrate compliance with CCP 4.6.7.**"

In a footnote on page 10 of its ruling, the Board wrote:

> "The city explains that the 1998 CCP is applicable to the challenged decision, and the CCP anticipated that there would be a period of time between the effective date of the CCP and the effective date of the 2006 LDC where the CCP policies to be implemented by the 2006 LDC would be directly applicable."

Q: Wait a minute. The City itself acknowledged that the Comprehensive Plan is directly applicable?

A: Yes. On several pages in the record, the Planning Division discussed both the need for the application to comply with the Comprehensive Plan, and its failure to do so. That's why the Planning Division recommended denial of the application in its August 10, 2007 report to the City Council.

The conclusion on pages 21-22 of the August 10 report (pages 273-274 in the record) included the following excerpts:

> "The May 25, 2007, Staff Report provides a detailed evaluation of the proposal's ability to comply with applicable LDC Standards and Comprehensive Plan policies....
>
> Staff does not believe the proposed Conditions of Approval as reflected in the revised grading plan satisfy the hillside development criteria in Comprehensive Plan Policy 4.6.7. Further, insufficient detail regarding the extent of grading that will be necessary on the non-mass graded lots, and insufficient detail regarding building design on all lots, lead Staff to believe the Conceptual and Detailed Development Plan proposal does not comply with applicable hillside development standards. This also results in uncertainty regarding the compatibility of future development, including impacts to surrounding properties' views. For these reasons, Staff recommend that the City Council deny the appeal and the proposed Conceptual and Detailed Development Plans."

Q: But weren't the applicable criteria simply listed on the public notice for the 2007 land use appeal hearing?

A: Yes, and 60 policies from the Comprehensive Plan were included. (See page 882 in the record.)

Furthermore, as required by ORS 227.173 (3), the Planning Division provided a list of applicable criteria and referred to them throughout its narrative. That list included the same 60 policies from the Comprehensive Plan. (See pages 551-558 in the record.)

Q: Isn't the Planning Division now saying that policies in the Comprehensive Plan don't necessarily apply?

A: Yes, the December 24, 2008 memo from the Community Development Director argued in several places that the Comprehensive Plan is only advisory. Page 13 of the memo offered the following:

> "Policy 4.6.7.g directs the LDC to provide standards that address visual impacts of development on hillsides. CCP 4.6.7 is not a review criterion and development is not required to comply with it."

Similar reasoning was offered on page 25:

> "Because Comprehensive Plan policies are not standards, the Council is not required to find that CCP 4.2.2 and 4.10.9 have been 'met'."

Q: So the City has radically changed its stance and is now willing to challenge state law and the Land Use Board of Appeals, in order to develop a sensitive ecological area on a steep hillside on the edge of town?

A: That's about the size of it.

Q: What happened to the public interest?

A: There's a great 1974 movie with Jack Nicholson that I recommend.

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Tuesday, January 27, 2009 3:43 PM
To: Richardson, Robert
Cc: Extrom, Joan; Susan Morre
Subject: Brooklane Heights Wetland

Attachments: Brooklane Heights Wetland.pdf

Brooklane Heights Wetland.pdf ...

Bob,

Here's more testimony for the record.

Mark

Date: January 27, 2009
From: Mark Knapp
To: Corvallis City Council
Subject: Brooklane Heights (PLD06-00018, SUB06-00006)

It has come to my attention that the Brooklane Heights development proposal is in flagrant non-compliance with applicable land use standards for the protection of **wetlands.**

In the course of failing to comply with wetland provisions, the application also fails to comply with provisions to ensure public participation in the land use decision-making process.

I am submitting new evidence with this letter.

On September 26, 2008 the Oregon Department of State Lands received a wetland determination report from Scott Sanders for the Brooklane Heights property. The wetland determination was done by Zion Natural Resources Consulting on May 20, 2008. A copy of their draft report is attached.

None of this information was included in any of the materials submitted to the City Council (or made publicly available) for the land use hearings on January 5 or January 20, 2009.

Technical Details

The wetland consultant dug 13 sample plots and ultimately determined that there were 0.12 acres of palustrine emergent wetland on the property. (See page 10 of the determination report.)

One key issue for the development proposal is that detention ponds would be located within the area identified as wetland – because both are located in the natural drainage that runs through the center of the site.

The Applicant is proposing to build these ponds with a total storage volume of 36,000 cubic feet. Rec. 587.

OAR 141-085-0018 requires authorization from the DSL for any activity involving removal or fill of more than 50 cubic yards of material in a wetland. In constructing detention ponds designed to hold 36,000 cubic feet, it is quite probable that the Applicant would need to excavate more than 450 cubic feet. Therefore, the Applicant would need to receive a removal-fill permit from the DSL.

Furthermore, the Applicant's proposed grading map clearly shows that a street would be build across the wetland, between two detention ponds and perpendicular to the flow of water through the wetland.

Applicable Land Use Criteria

Numerous standards in the 1993 Land Development Code involve the protection of wetlands.

LDC 4.5.50

"Applications for building permits or other permits for structures and other development activities on sites containing ... wetland areas shall be submitted and reviewed to assure ... that ... wetland areas are appropriately protected before any permits are issued or improvements, construction, or development begin."

LDC 4.5.50.01

"Development applications for all properties containing or abutting a floodplain, riparian, or wetland area shall accurately indicate the locations of these features and the location of any proposed development. The applications shall contain a description of the extent to which any floodplain, water course, or wetland is proposed to be altered or affected as a result of proposed development ..."

LDC 4.5.50.01.c

The application shall include ... "a wetland delineation (with an accompanying site map) that has been accepted and approved by the Division of State Lands; or a wetland determination completed by a licensed wetland specialist ..."

LDC 4.5.100.b.2

"For properties with no approved Wetland Delineation, a Wetland Determination prepared by a licensed wetland specialist following the Oregon Freshwater Wetland Assessment Methodology (OFWAM), shall be completed and submitted with the development proposal."

LDC 4.5.100.b.3

"In accordance with ORS 227.350, the applicant shall be responsible for notifying DSL whenever any portion of any wetland is proposed for development. No application for development will be accepted as complete until documentation of such notification is provided, and no development shall be permitted until the City has received verification of DSL approval for development on the subject site."

Despite these clear and objective criteria about wetlands, the application fails to mention any wetland on the development site itself. The memo from Metolius Consulting (November 24, 2008) also fails to mention anything about wetlands on the site – even though it was written two months after the Applicant submitted a wetland determination to the DSL.

Meanwhile, the Report to the Planning Commission (May 25, 2007) stated the following on page 42:

> "No portion of the subject site is within the 100 or 500 year flood plain, and no wetlands or riparian corridors are present on the site." Rec. 430.

State law requires the City to include a discussion of all applicable criteria in its decision-making process:

> **ORS 227.173 Basis for decision on permit application or expedited land division; statement of reasons for approval or denial.**
> (3) Approval or denial of a permit application or expedited land division shall be based upon and accompanied by a brief statement that explains the criteria and standards considered relevant to the decision, states the facts relied upon in rendering the decision and explains the justification for the decision based on the criteria, standards and facts set forth.

Neither LDC 4.5.50 nor LDC 4.5.100 were included in any report by the City that was relied upon in rendering its decision to approve the development application for Brooklane Heights. These two sections of the LDC were also missing from the list of applicable criteria provided in the Notice of Land Use Public Hearing. Rec. 882.

Knowing that the entire issue of wetland protection is missing from the land use application, the City Council can now be assured that the application is grossly incomplete.

Furthermore, the failure of the Applicant to address the issue of wetlands until this very late date raises the troubling question of why this application is still allowed to be judged according to the 1993 Land Development Code, rather than the 2006 standards. As you probably recall, this application already required two revisions in 2007 – after the new LDC went into effect on December 31, 2006.

It is now clear that the Planning Division erred when it ruled that the application was complete in April 2007, thereby assuring that the 1993 LDC would be an applicable standard, rather than the revised LDC. The source of the error was the Applicant's failure to notify the City that there was wetland on the property.

The application now seems ripe for a Reversal by the Land Use Board of Appeals. The new City Council can avoid such a scenario by reversing the original City Council decision and denying the application.

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Tuesday, January 27, 2009 3:52 PM
To: Richardson, Robert
Cc: Extrom, Joan; Susan Morre
Subject: Brooklane Heights Wetland

Attachments: Brooklane Heights Wetland.pdf; Wetland-A.pdf; Wetland-B.pdf

Brooklane Heights Wetland.pdf ... | Wetland-A.pdf (280 KB) | Wetland-B.pdf (9 MB)

Bob,

I failed to attach everything in the first message. Here is my three-page letter, along with attachments A and B.

Mark

RECEIVED
SEP 26 2008
DEPARTMENT OF STATE LANDS

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

This form must be included with any wetland delineation report submitted to the Department of State Lands for review and approval. A wetland delineation report submittal is not "complete" unless the fully completed and signed report cover form and the required fee are submitted. Attach the form to the front of an unbound report and submit to: **Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279**

Mail a copy of the completed form with payment of the required report review fee to: **Oregon Department of State Lands, P.O. Box 4395, Unit 18, Portland, OR 97208-4395.**

For new credit card payment option, see DSL web site.

☒ Applicant ☒ Owner Name, Firm and Address: **TC2 Investments, LLC - C/O Scott Sanders** **4411 Sw Golf View Ave** **Corvallis, OR 97333**	Business phone # Mobile phone # (optional) FAX # E-mail: **tc2sanders@comcast.net**
☒ Authorized Legal Agent, Name and Address: **Same as above**	Business phone # FAX # Mobile phone # E-mail:

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: _____ Signature: _____

Date: Special instructions regarding site access:

Project and Site Information (for latitude & longitude, use centroid of site or start & end points of linear project)

Project Name: **Brooklane Heights**	Latitude: **N 44.541833**	Longitude: **W 123.287417**	
Proposed Use: **Residential subdivision**	Tax Map # **12.5.10 C**		
Project Street Address (or other descriptive location): **Northwest of Brroklane Drive and Agate Ave, east of Fairmont Dr. and south of Whiteside Drive**	Township **12S**	Range **5W**	Section **10** QQ **C**
	Tax Lot (s) **1000**		
City: **Corvallis** County: **Benton**	Waterway: **NA**	River Mile: **NA**	
	NWI Quad(s): **Corvallis**		

Wetland Delineation Information

Wetland Consultant Name, Firm and Address: **Zion Natural Resources Consulting** **P.O. Box 545** **Monmouth, OR 97361**	Phone # **503-838-0103** Mobile phone # **503-881-4171** FAX # **503-623-7425** E-mail: **eric@zionconsulting.org**

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.

Consultant Signature: _____ Date: 9/25/2008

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No | Study Area size: **25.88** Total Wetland Acreage: **0.12**

Check Box Below if Applicable:	**Fees:**
☐ R-F permit application submitted	☒ Fee payment submitted $ 350
☐ Mitigation bank site	☐ Fee ($100) for resubmittal of rejected report
☐ Wetland restoration/enhancement project (not mitigation)	Name of Payor:
☐ Industrial Land Certification Program Site	

Other Information:	Y	N	
Has previous delineation/application been made on parcel?	☐	☒	If known, previous DSL #
Does LWI, if any, show wetland or waters on parcel?	☐	☒	

For Office Use Only JM

DSL Reviewer: LM	Fee Paid Date: ___/___/___	DSL WD # 2008-0494
Date Delineation Received: 9/26/08	DSL Project # _____	DSL Site # _____
Scanned: ☐ Final Scan: ☐	DSL WN # _____	DSL App. # _____

WD#2008-0494

NOTICE: REPORTS ARE CONSIDERED DRAFT DOCUMENTS UNTIL REVIEW IS COMPLETED BY DSL. WETLAND MAPS MAY CHANGE AS A RESULT OF DSL REVIEW.

A. Landscape Setting and Land Use

At the request of TC2 Investments, LLC.; Zion Natural Resources Consulting performed a wetland delineation on a 25.88 acre parcel on Tax Lot 1000 located northwest of Brooklane Drive and Agate Avenue, east of Fairmont Drive and south of Whiteside Drive in Corvallis, OR (T12S, R5W, Sec. 10 C). The site is currently vacant and undeveloped. The subject property is slopes from the north to the south with an approximate slope of 30% throughout most of the site consisting of hills and natural valleys. Residential subdivisions are located to the north, west, and south of the study area. The landscape consists of open grassland, some rock outcroppings, and Oregon Whit Oak savannahs. Previous land uses appeared to be agricultural including hay and pasture.

B. Possible Site Alterations

There appears to be no significant site alteration except for some mowing within the northwest portion of the site. This alteration does not appear to affect the presence, location, or geographic boundaries of any waters of the state on the site.

C. Precipitation Data and Analysis

The month to date (May 20th, 2008) rainfall at this location was 0.22 inches according to the Oregon Climate Service at the Hyslop Experimental Station in Corvallis, OR. For the month of March the precipitation was 0.38 inches which is below the average of 2.30 inches according to the WETS table of Corvallis, OR listed below. (see Appendix E).

Below is the WETS table for Corvallis, Oregon with the past three months data highlighted.

WETS Station : CORVALLIS STATE UNIV, OR1862 Creation Date: 09/09/2002
Latitude: 4438 Longitude: 12312 Elevation: 00230
State FIPS/County(FIPS): 41003 County Name: Benton
Start yr. - 1971 End yr. - 2000

Month	Temperature (Degrees F.) avg daily max	avg daily min	avg	Precipitation (Inches) avg	30% chance will have less than	more than	avg # of days w/.1 or more	avg total snow fall
January	46.2	33.6	39.9	6.46	3.95	7.82	12	1.1
February	50.4	35.4	42.9	5.71	3.91	6.80	12	2.1
March	55.6	37.6	46.6	4.59	3.46	5.35	12	0.1
April	60.2	39.9	50.0	2.98	2.09	3.53	8	0.0
May	66.6	44.0	55.3	2.30	1.52	2.81	6	0.0
June	72.9	48.5	60.7	1.46	0.93	1.76	4	0.0
July	80.6	51.8	66.2	0.57	0.17	0.68	1	0.0
August	81.7	51.5	66.6	0.73	0.08	0.86	2	0.0
September	76.4	48.2	62.3	1.47	0.52	1.80	3	0.0
October	64.8	41.8	53.3	3.02	1.70	3.68	7	0.0
November	52.3	38.0	45.2	6.94	4.55	8.34	13	0.2
December	45.7	33.8	39.8	7.43	5.03	8.88	12	1.3

D. Site-Specific / Field Methodology

A total of 13 sample plots were established on May 20, 2008 to document wetland and upland conditions within the project area. Plot locations were placed on all sides of the contiguous wetland areas. The number of sample plots documented is believed to be representative of the change in plant communities, soil features, or level of groundwater hydrology found within the study area.

E. Wetland / Waters of the State Description

The wetland appears to only be within two naturally formed drainages. The hydrology source appears to mainly be from springs at the beginning of each drainage. The western most drainage continues offsite to the south, while the eastern drainage appears to dissipate as it follows the topography to the south. The wetland boundaries of the drainages were defined by the topography as well as through the dominance of hydrophytic vegetation.

F. Deviation From National and/or Local Wetlands Inventory

There are no wetland/waters of the state associated with this site as depicted on the National Wetland Inventory (NWI) Map (Figure 3a). The Local Wetland Inventory for this area also did not show any wetland or water of the state (Figure 3b).

G. Mapping Method and Estimated Accuracy

Wetland areas were established and flagged by Zion Natural Resources Consulting and were field surveyed to an accuracy of one meter.

H. Additional Information to Help Establish State Jurisdiction

Hydrology is the study area is driven primarily by two springs along with surface flows during storm events. The hydrology then follows the microtopography of the subject property. The western drainage exits the property to the south into a stormwater grate along SW Brooklane Drive (Private Drive). The wetlands within the study area do not contain a fish presence due to the lack of aquatic features. The wetland boundaries were established based on topography and vegetation were in obvious visual contrast to the upland areas.

I. Results and Conclusions

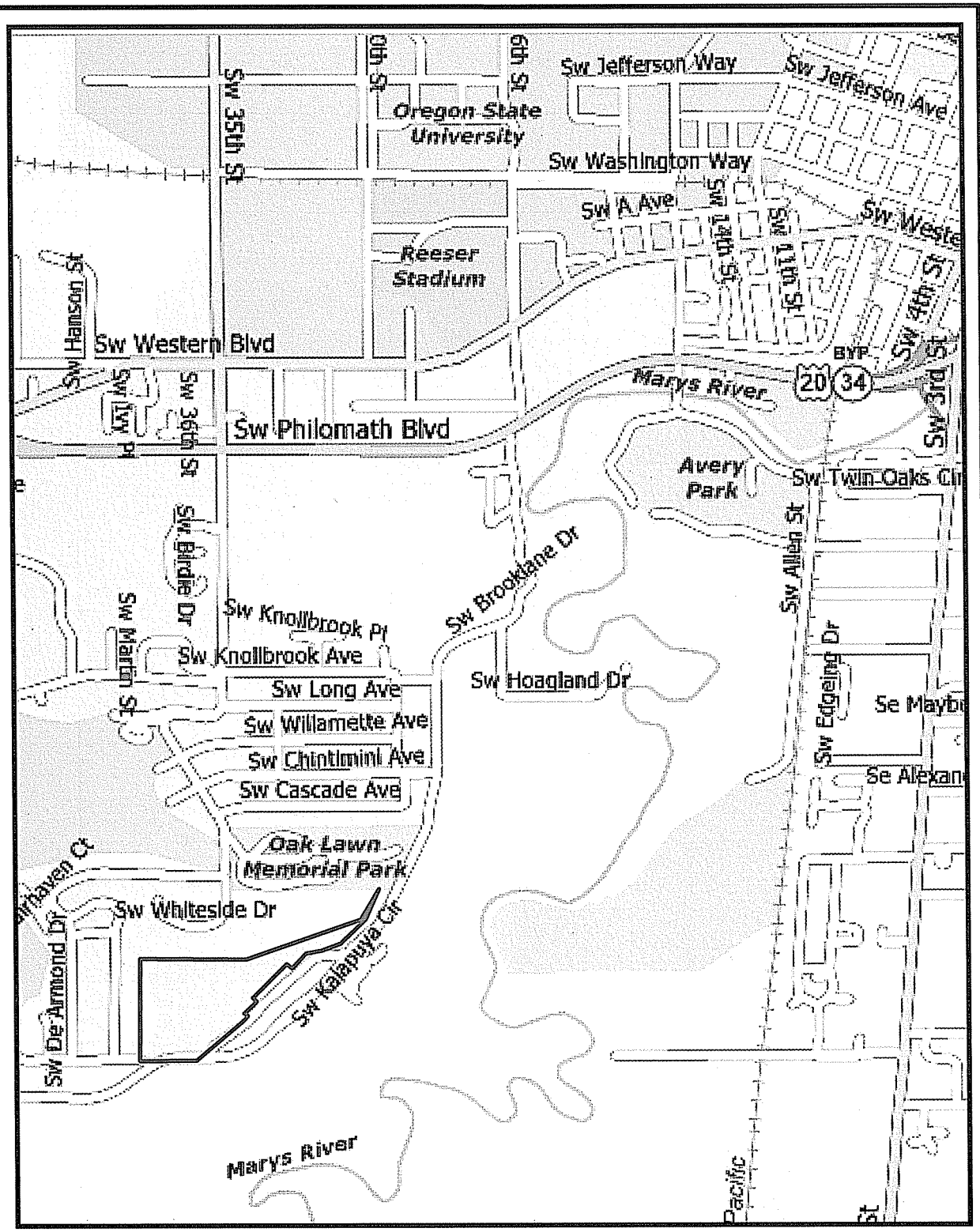
Based upon our site reconnaissance and sampling of the three required wetland criteria (wetland hydrology, hydric soils, and hydrophytic vegetation), ZNR has identified approximately 0.12 acres of potentially jurisdictional wetlands classified as palustrine

emergent wetlands. Figure 6 depicts the location of the potentially jurisdictional wetlands and sample sites. Upland in most instances is quite apparent and somewhat topographically defined (Photos 1-4).

J. LIMITATIONS AND REQUIRED DISCLAIMER

This report was prepared for the use of the client, its affiliates, lenders and assigns, their consultants and various governmental agencies. Any results and conclusions within this report represent our professional judgment based on the most recent information provided from publications, maps aerial photos, and field investigations as defined within the scope of services.

This report documents the investigation, best professional judgment and conclusions of the investigator. It should be considered a Preliminary Jurisdictional Determination of wetlands and other waters and used at your own risk unless it has been reviewed and approved in writing by the Oregon Department of State Lands in accordance with OAR 141-090-0005 through 141-09-0055. The review process must be completed and the boundary concurred with, prior to any detailed site planning or construction activities take place.

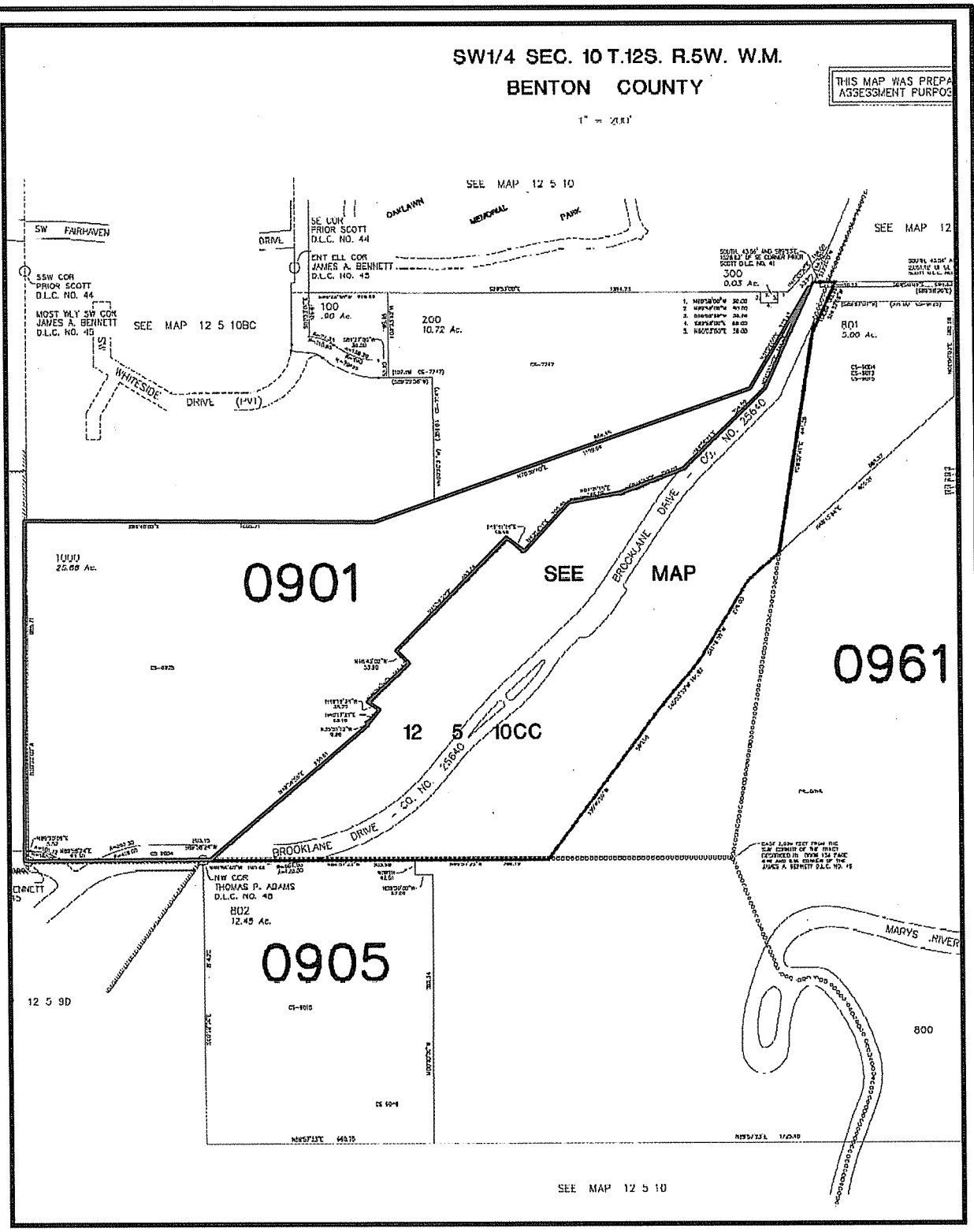


ZION
Natural Resources Consulting

FIGURE 1
Vicinity Map

Project: Brooklane Heights

N
W E
S



ZION
Natural Resources Consulting

FIGURE 2
Tax Lot Map

Project: Brooklane Heights

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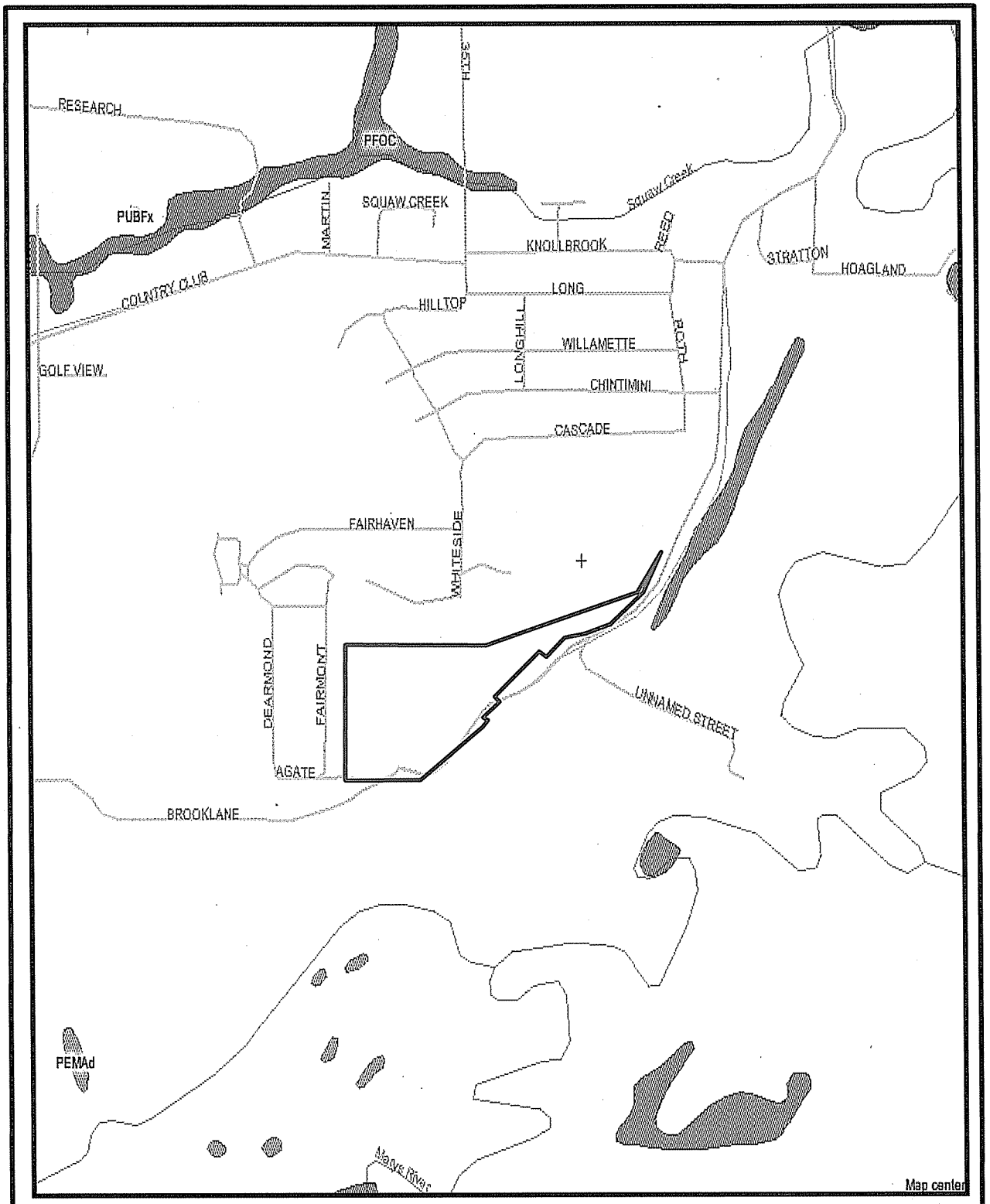

ZION
Natural Resources Consulting

FIGURE 3a
National Wetlands Inventory Map

Project: Brooklane Heights

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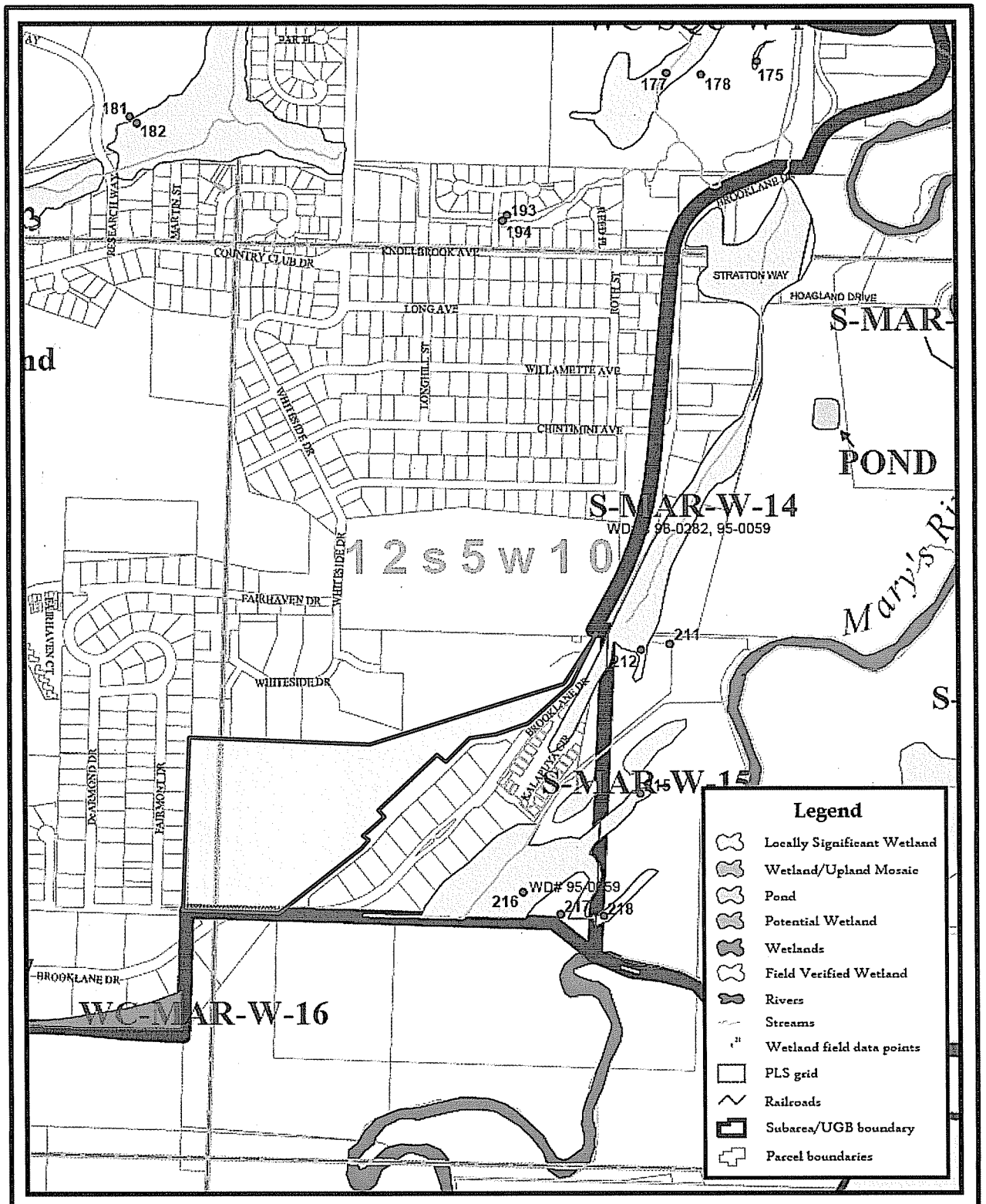


ZION
Natural Resources Consulting

FIGURE 3b
Local Wetlands Inventory Map

Project: Brooklane Heights

N
W E
S

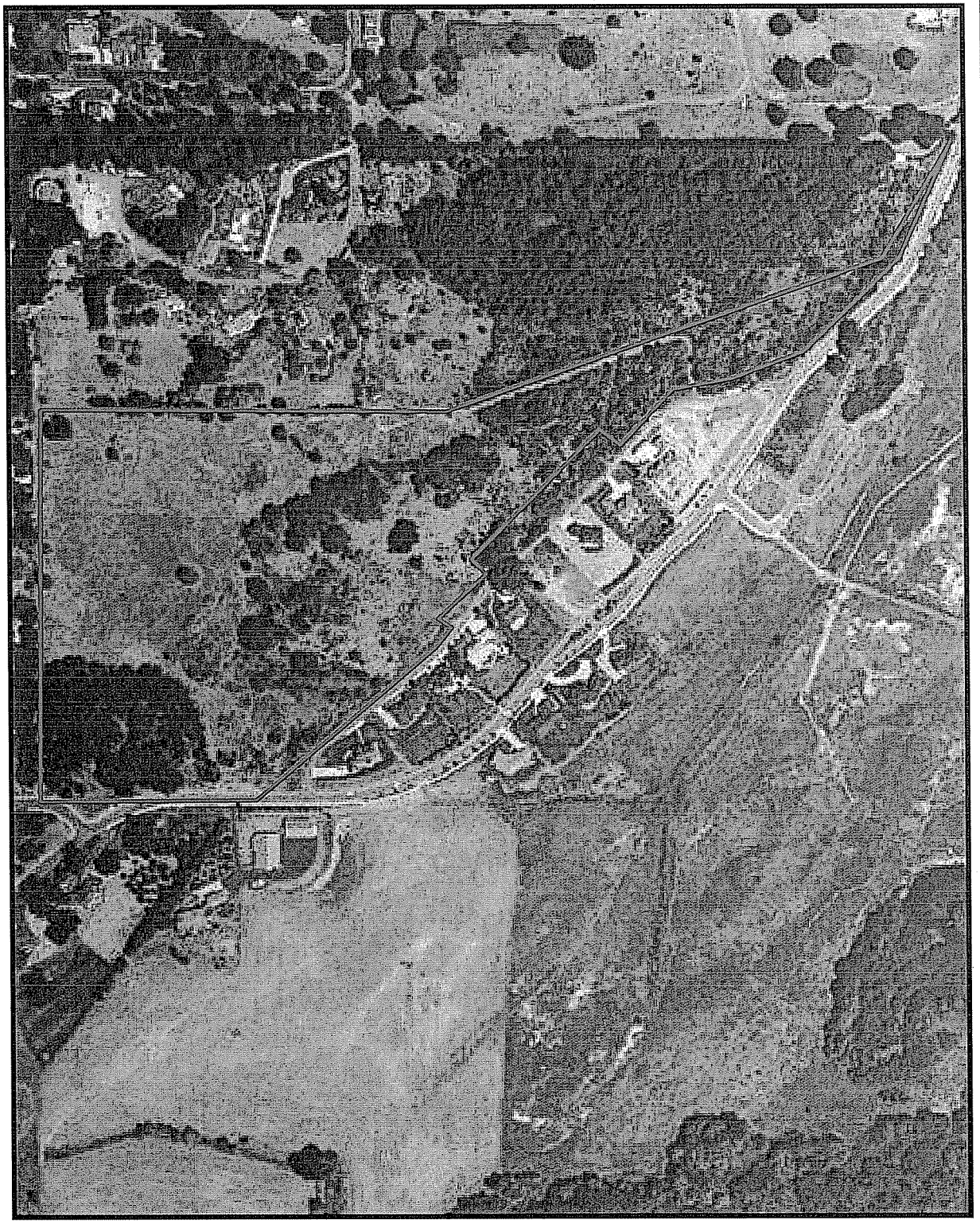
Benton County Soils Series
165 – Willakenzie loam, 20-30% slopes
167 – Willakenzie-Wellsdale complex, 12-20% slopes

ZION
Natural Resources Consulting

FIGURE 4
County Soils Survey Map - NRCS

Project: Brooklane Heights

N
W E
S



ZION
Natural Resources Consulting

FIGURE 5

Aerial Photo – MapQuest 2008

Project: Brooklane Heights

N
W E
S

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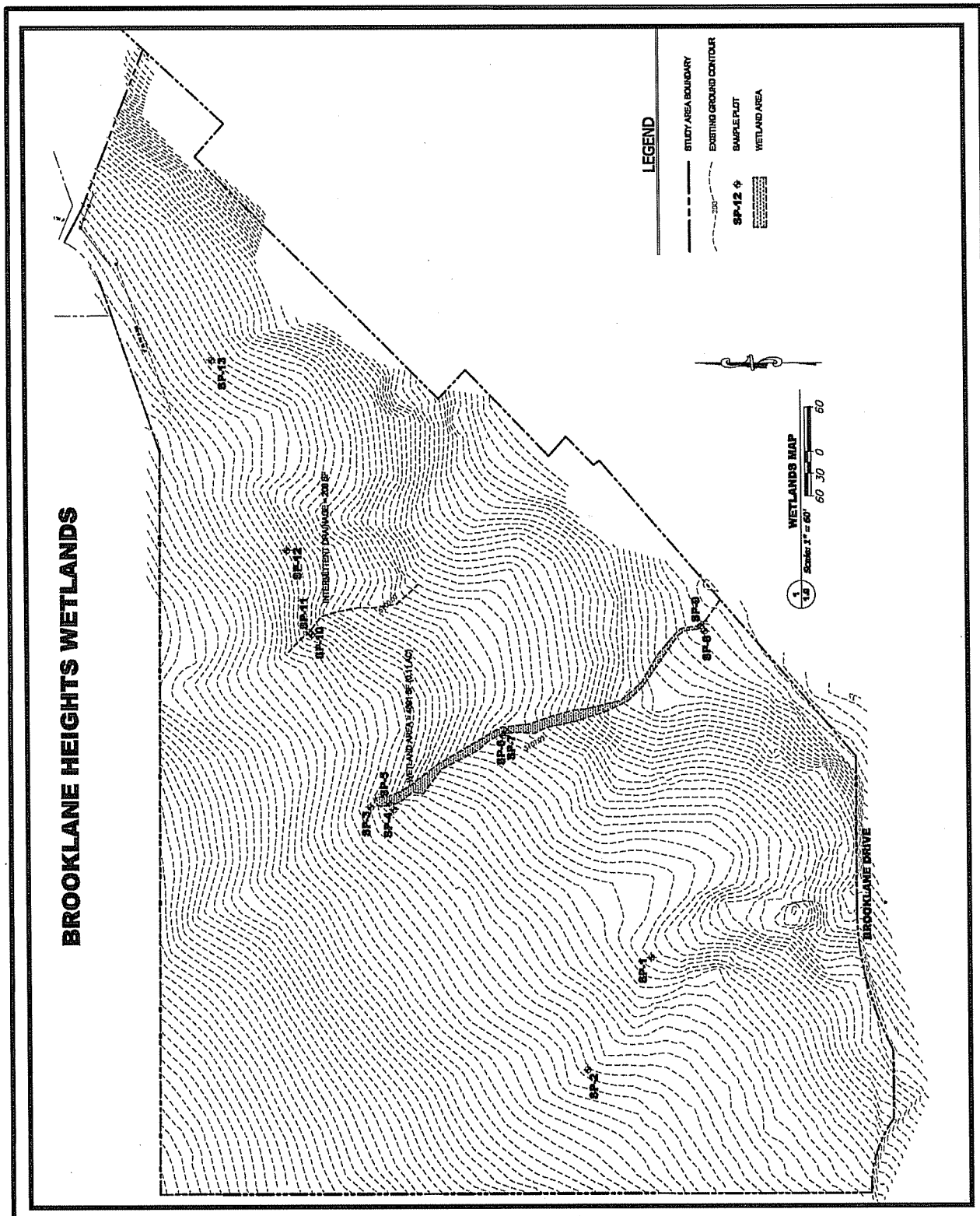


ZION
Natural Resources Consulting

FIGURE 6
Wetland Site Location Map

Project: Brooklane Heights

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-1
Plot location: South central portion of the site - main drain - reference point
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 40% 50% % 20% %

1. *Rubus discolor FACU 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1. *Festuca arundinacea FAC- 100%
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 0/2 or 0%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/4	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:

- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):

- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Plot #: SP-2
Plot location: Southwest poirtion of the site - second drain - reference point
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1.	*Agrostis spp.	FAC	30%
2.	*Festuca arundinacea	FAC-	70%
3.			%
4.			%
5.			%
6.			%
7.			%
8.			%
9.			%
10.			%
11.			%
12.			%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/2 or 50%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/4	none		Loam

* abund./size/contrast/color/location (matrix or pores/peds)

Hydric Soil Indicators:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:

- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):

- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-3
Plot location: Central portion of the site - above drainage
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 30% 50% % 20% %

1. *Rubus discolor FACU 90%
2. Quercus garryana NOL 10%
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1. *Festuca arundinacea FAC- 80%
2. *Agrostis spp. FAC 20%
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/3 or 33%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/3	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-4
Plot location: Central portion of the site
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 40% 50% % 20% %

1. *Rubus discolor FACU 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1.	*Festuca arundinacea	FAC-	80%
2.	Vicia americana	FAC	10%
3.	Cirsium vulgare	FACU	10%
4.			%
5.			%
6.			%
7.			%
8.			%
9.			%
10.			%
11.			%
12.			%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 0/2 or 0%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/3	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Plot #: SP-5
Plot location: Central portion of the site - within channel/drainage
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1. *Juncus patens FACW 100%
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/1 or 100%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☒ NO ☐ Comments: Him blackberry and white oak rooted outside

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-16"	2.5Y 4/1	7.5YR 4/6	Many, Medium, Prominent		Loam

Hydric Soil Indicators:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

* abund./size/contrast/color/location (matrix or pores/peds)

Criteria Met? YES ☒ NO ☐ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: Surface Depth to free water: 3"

Primary Hydrology Indicators:

- ☐ Inundated
- ☒ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☒ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):

- ☒ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ *Comments:*

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-6
Plot location: South central portion of the site
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 50% 50% % 20% %

1.	Rubus laciniatus	FACU+	10%
2.	*Rubus discolor	FACU	20%
3.	*Cytisus scoparius	NOL	40%
4.	*Crataegus monogyna	FACU+	20%
5.	Rhus diversiloba	NOL	10%

Herb Stratum
Total Cover: 80% 50% % 20% %

1.	*Festuca arundinacea	FAC-	80%
2.	Vicia americana	FAC	10%
3.	Galium aparine	FACU	10%
4.			%
5.			%
6.			%
7.			%
8.			%
9.			%
10.			%
11.			%
12.	Bare ground		20%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 0/4 or 0%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/3	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-7
Plot location: South central portion of the site - channel
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 10% 50% % 20% %

1. *Fraxinus latifolia FACW 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 70% 50% % 20% %

1. *Juncus patens FACW 40%
2. *Festuca arundinacea FAC- 50%
3. Galium aparine FACU 10%
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. Bare ground 30%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 2/3 or 67%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☒ NO ☐ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-12"	10YR 3/3	7.5YR 4/6	Many, Medium, Distinct		Loam
12-16"	10YR 3/3+2.5Y 4/1	7.5YR 4/6	Many, Medium, Prominent		Loam

* abund./size/contrast/color/location (matrix or pores/peds)

Hydric Soil Indicators:

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☒ NO ☐ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: Surface Depth to free water: 3"

Primary Hydrology Indicators:

- ☐ Inundated
- ☒ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☒ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):

- ☒ Oxidized Root Channels (upper 12")
- ☒ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Tree, Plot #: SP-8
Plot location: South central portion of the site
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: 70% 50% % 20% %

1. *Quercus garryana NOL 50%
2. *Fraxinus latifolia FACW 50%
3. %

Sapling/Shrub Stratum
Total Cover: 70% 50% % 20% %

1. *Rhus diversiloba NOL 20%
2. *Crataegus monogyna FACU+ 60%
3. *Rubus discolor FACU 20%

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 80% 50% % 20% %

1. *Festuca arundinacea FAC- 100%
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. Bare ground 20%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/6 or 17%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/2	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Tree, Plot #: SP-9
Plot location: South central portion of the site
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: 30% 50% % 20% %

1. *Quercus garryana NOL 40%
2. *Fraxinus latifolia FACW 60%
3. %

Sapling/Shrub Stratum
Total Cover: 30% 50% % 20% %

1. *Crataegus douglasii FAC 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 0% 50% % 20% %

1. %
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. Bare ground 100%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 2/3 or 67%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☒ NO ☐ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-16"	10YR 3/2	7.5YR 4/6	Few, Medium, Distinct		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☒ NO ☐ Comments: Very few mottles in the plot

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☒ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☒ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☒ Other: Topography

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Tree, Plot #: SP-10
Plot location: North central portion of the site - spring
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: 70% 50% % 20% %

1. *Quercus garryana NOL 100%
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 60% 50% % 20% %

1. *Rubus discolor FACU 40%
2. *Crataegus monogyna FACU+ 30%
3. *Rhus diversiloba NOL 30%

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 40% 50% % 20% %

1. *Festuca arundinacea FAC- 80%
2. *Vicia americana FAC 20%
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/6 or 17%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/3	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Plot #: SP-11
Plot location: North central portion of the site - within channel
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 0% 50% % 20% %

1. void of vegetation %
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. bare ground 100%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): %
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-16"	10YR 3/2+2.5Y 4/1	7.5YR 4/6	Many, Medium, Prominent		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☒ NO ☐ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: Surface Depth to free water: 3"

Primary Hydrology Indicators:

- ☐ Inundated
- ☒ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):

- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-12
Plot location: Northeast portion of the site - low point
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 50% 50% % 20% %

1. *Cytisus scoparius NOL 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1. *Festuca arundinacea FAC- 100%
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 0/2 or 0%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/3	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:

- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):

- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:

DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Tree, Plot #: SP-13
Plot location: Northeast portion of the site - low point
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: 50% 50% % 20% %

1. *Quercus garryana NOL 100%
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 40% 50% % 20% %

1. *Cytisus scoparius NOL 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1. *Festuca arundinacea FAC- 70%
2. *Agrostis spp. FAC 30%
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/4 or 25%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/3	none		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☐ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☐ NO ☒ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:

- ☐ Inundated
- ☐ *Saturated in upper 12 inches*
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☐ Drainage Patterns

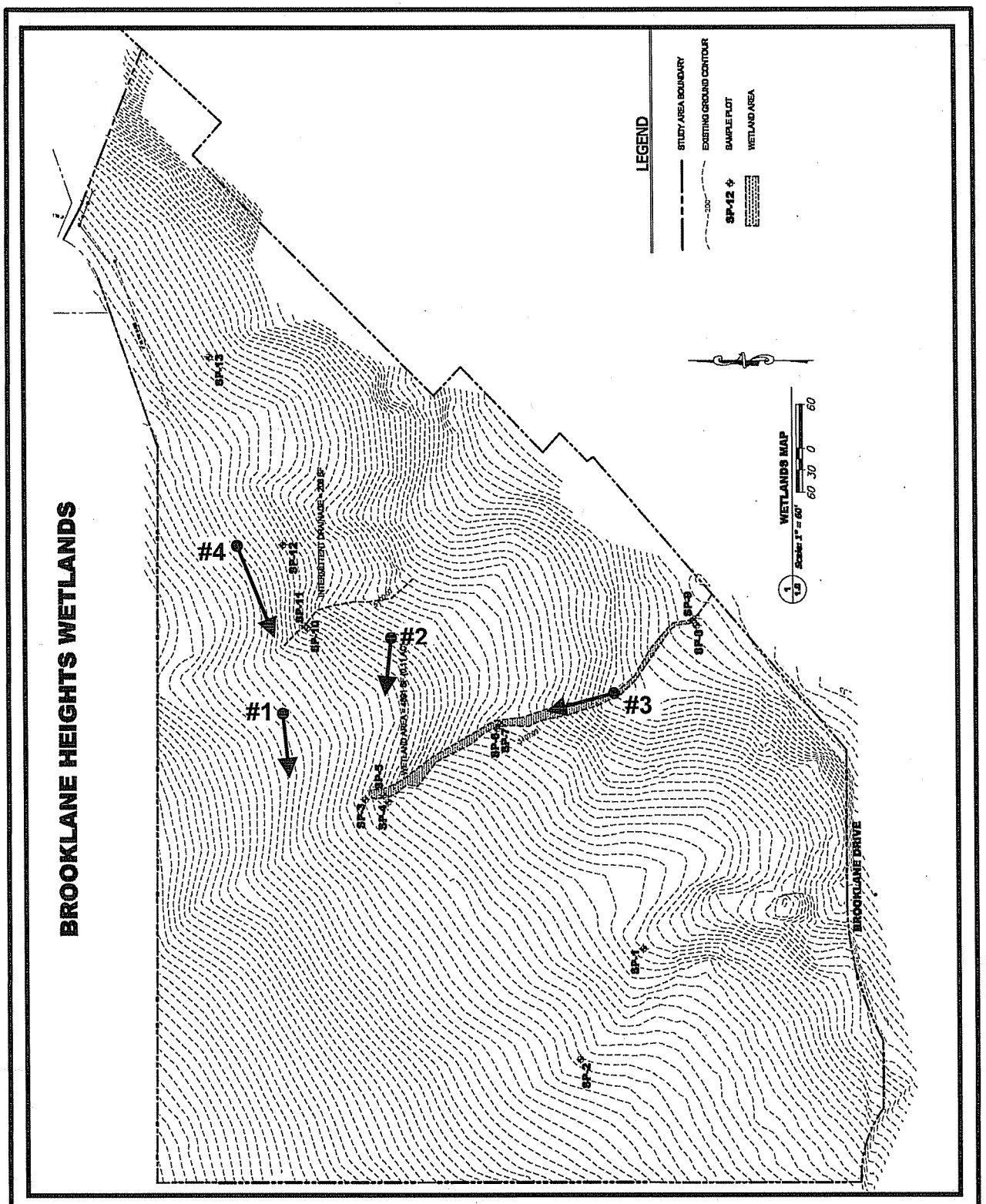
Secondary Hydrology Indicators (2 or more required):

- ☐ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☐ NO ☒ Comments:

DETERMINATION

WETLAND? YES ☐ NO ☒ Comments:



ZION
Natural Resources Consulting

FIGURE 7
Photo Point Location Map

Project: Brooklane Heights

Photo Point #1 – Located in the north central portion of the site looking west across the study area.

Photo Point #2 – Located just east of the western most drainage area. The beginning of the wetland area is located in the center of the frame.

Photo Point #3 – Located in the western most drainage looking north (uphill) at the wetland area.

Photo Point #4 – Located to the east of the eastern drainage looking west.

May 2008 Daily Observations at Hyslop Exp. Stn., Corvallis

Day	Max Temp (F)	Min Temp (F)	Precip (in)	Snow (in)	2 in soil Max	2 in soil Min	4 in soil Max	4 in soil Min	Heating Deg. Days	Cooling Deg. Days	Growing Deg. Days	Evaporation (in.)
1	50	33	.06	0	65	44	58	47	23	0	0	.117
2	60	38	0	0	67	43	60	45	16	0	0	.120
3	68	40	0	0	73	51	65	53	11	0	4	.109
4	62	35	0	0	68	46	61	51	16	0	0	.135
5	68	41	0	0	72	48	67	49	10	0	5	.108
6	73	40	0	0	79	51	72	52	8	0	7	.289
7	62	44	0	0	71	53	64	55	12	0	3	.109
8	56	40	0	0	62	50	58	53	17	0	0	.063
9	55	38	0	0	62	48	58	50	18	0	0	.084
10	63	43	T	0	78	48	70	49	12	0	3	.174
11	61	43	T	0	66	51	61	50	13	0	2	.079
12	59	34	0	0	75	42	68	52	18	0	0	.225
13	61	46	.01	0	78	50	70	50	11	0	4	.053
14	63	51	0	0	64	57	61	57	8	0	7	.180
15	75	55	0	0	85	59	74	57	0	0	15	.188
16	85	58	0	0	88	61	80	60	0	7	22	.346
17	94	56	0	0	99	64	88	64	0	10	25	.276.
18	92	48	0	0	101	64	91	68	0	5	20	.334
19	85	47	0	0	97	63	88	66	0	1	16	.162
20	85	48	.22	0	97	65	85	66	0	2	17	.238
21	61	48	t	0	74	57	70	60	10	0	5	.182
22	60	45	0	0	76	55	71	58	12	0	3	.211
23	58	45	0	0	70	56	66	57	13	0	2	.234
24	55	46	.05	0	64	56	61	57	14	0	1	.026
25	73	50	T	0	84	56	74	55	3	0	12	.160
26	62	52	.03	0	73	60	67	58	8	0	7	.008
27	63	51	T	0	70	56	65	59	8	0	7	.105
28	68	53	.01	0	83	60	75	58	4	0	11	.186
29	61	51	T	0	72	59	67	61	9	0	6	.164
30	64	48	0	0	75	59	69	59	9	0	6	.123
31	69	42	0	0	90	59	80	59	9	0	6	.134
Average/Total	66.8	45.5	0.38	0.00	76.7	54.5	69.8	56.0	292	25	216	4.922
Departure	0.7	2.4	-1.57									

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Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Tuesday, January 27, 2009 4:27 PM
To: Richardson, Robert
Subject: Empty Lots

Attachments: Empty_Lots.jpg; Kalapuya.jpg

Empty_Lots.jpg (344 KB) Kalapuya.jpg (119 KB)

Hi Bob,

I have attached two more files for the record. I request that they be included in color.

The first is a satellite photograph of the development site and surrounding areas. I believe the photo was taken in 2005.
The photo shows empty lots on both sides of Brooklane Drive and on Kalapuya Drive, even though Kalapuya Drive was approved for development several years ago.

The second attachment is a photograph of Kalapuya Drive, looking east, that was taken this afternoon. There are still no houses on Kalapuya Drive.

Mark

SW Fairmont Dr
SW Fairmont Dr
SW
haven Dr
SW Whiteside Dr
SW Whiteside Dr
SW Brooklane Dr
SW Brooklane Dr
SW Brooklane Dr
SW Brooklane Dr
Gate (Keyed Access)
SW Kalapuya Cir
SW Brooklane Dr
Imagery ©2008 i-cubed, GeoEye
Map

POSTED

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Tuesday, January 27, 2009 4:36 PM
To: Richardson, Robert
Subject: Re: Empty Lots

Attachments: Kalapuya2.jpg

Kalapuya2.jpg (73 KB)

Bob,

Here's one more photograph to be added to the other two.
This one was also taken this afternoon, facing south from the intersection of Brooklane and Kalapuya.

Thanks.

Mark

Date: January 27, 2009
From: Mark Knapp
To: Corvallis City Council
Subject: Brooklane Heights (PLD06-00018, SUB06-00006)

Page 38 of the City Memo from the Community Development Director (December 24, 2008) clarifies that Condition 27 would allow significant mass grading in the development.

> **Revised Condition 27**
> "Mass grading shall be limited to the areas shown on the grading plan identified as Attachments 1.7 and 1.8 of the August 10, 2007, Staff Memorandum to the City Council.... All mass graded areas, as shown in Attachment 1.8, shall be engineered and constructed such that retaining walls are neither required nor used."

The City Memo argues that compliance with Chapter 4.5 of the 2006 Land Development Code implements CCP 4.6.7 by virtue of the fact that Article 50 of the Comprehensive Plan defines the LDC as "a set of ordinances and regulations that implements the policies contained in the Comprehensive Plan."

The key word in that definition is "set" – because it identifies the LDC as a collection of interdependent standards ***to be applied as a whole.*** Compliance with the hillside policies of the Comprehensive Plan is implemented by the application of ***all*** of the relevant standards in the LDC. The City cannot pick and choose standards from the set and then reasonably argue that the effect of compliance with the subset is the same as compliance with all of the standards.

In the case of Condition 27, the City removes a critical piece of the puzzle when it allows mass grading – because mass grading increases the risk of slope instability, and it increases sediment transport from storm water runoff.

LDC 4.5.80.04.c.3 limits mass grading area to protect steep hillsides. For low-density residential development zones with slopes equal to or great than 10 percent, ***no mass grading is allowed*** on lots greater than 10,000 square feet. On smaller lots, mass grading is allowed up to 6,500 square feet.

But only 13 of the 45 proposed lots are less than 10,000 square feet, and some of the smaller lots would be entirely graded. Furthermore, most of the lots are on a slope greater than 10 percent. Therefore, noncompliance with the mass grading limitations is widespread. No compensating public benefit has been offered.

The failure of the City to require the Applicant to comply with the prohibition on mass grading would further ensure that the application does ***not*** comply with CCP 4.11.12 – because mass grading would greatly increase the transport of suspended sediment into the wetland. The proposed development would create large areas of construction fill that are exposed to hillside runoff until houses are constructed and landscaping is added.

A new study by the National Research Council notes the significant erosion problems caused by mass grading.[1]

"Numerous researchers have documented the impact of mass grading, clearing, and the passage of construction equipment on the compaction of soils, as measured by increase in bulk density, declines in soil permeability, and increases in the runoff coefficient (Lichter and Lindsey, 1994; Legg et al., 1996; Schueler, 2001a,b; Gregory et al., 2006)." – page 302

The situation would be exacerbated by the current depressed economy, which would increase the probability that the graded lots would remain vacant for an extended period of time. Empty lots already exist adjacent to the proposed development. These empty lots were mass graded, just as the Applicant proposes for Brooklane Heights. The Furtick property along Kalapuya Circle was annexed in November 2000 and approved for development shortly thereafter. Some seven years after mass grading, however, the lots still sit empty.

Furthermore, a study by Abramson in 2001 (attached) showed that exposed clay surfaces lose their cohesiveness, thereby increasing erosion and sediment transport.

[1] Urban Stormwater Management in the United States. National Academies Press (in printing).

CHAPTER 1

GENERAL SLOPE STABILITY CONCEPTS

1.1 INTRODUCTION

The evolution of slope stability analyses in geotechnical engineering has followed closely the developments in soil and rock mechanics as a whole. Slopes either occur naturally or are engineered by humans. Slope stability problems have been faced throughout history when men and women or nature has disrupted the delicate balance of natural soil slopes. Furthermore, the increasing demand for engineered cut and fill slopes on construction projects has only increased the need to understand analytical methods, investigative tools, and stabilization methods to solve slope stability problems. Slope stabilization methods involve specialty construction techniques that must be understood and modeled in realistic ways.

An understanding of geology, hydrology, and soil properties is central to applying slope stability principles properly. Analyses must be based upon a model that accurately represents site subsurface conditions, ground behavior, and applied loads. Judgments regarding acceptable risk or safety factors must be made to assess the results of analyses.

The authors have recognized a need for consistent understanding and application of slope stability analyses for construction and remediation projects across the United States and abroad. These analyses are generally carried out at the beginning, and sometimes throughout the life, of projects during planning, design, construction, improvement, rehabilitation, and maintenance. Planners, engineers, geologists, contractors, technicians, and maintenance workers become involved in this process.

This book provides the general background information required for slope stability analyses, suitable methods of analysis with and without the use of computers, and examples of common stability problems and stabilization methods for cuts and

Richardson, Robert

From: Mark Knapp [geocogent@yahoo.com]
Sent: Tuesday, January 27, 2009 5:00 PM
To: Richardson, Robert
Subject: Mass Grading

Attachments: Mass Grading.pdf; Slope Stability.pdf

Mass Grading.pdf (117 KB)
Slope Stability.pdf (1 MB)

Last one.

Mark

Richardson, Robert

From: Will Koenitzer [shonto88tc@comcast.net]
Sent: Tuesday, January 27, 2009 4:54 PM
To: Richardson, Robert
Subject: Brooklane testimony
Attachments: GENERAL SLOPE STABILITY CONCEPTS.pdf

Date: 27 January 2009
To: Corvallis Mayor and City Council
From; Will Koenitzer, 4240 SW Fairhaven Drive, 97333
Subject: Brooklane Heights (PLD06-00018, SUB06-00006)

The applicant's engineer stated that retaining devises (or retaining structures) were not necessary following excavation (in so many words) when asked if such devices would be installed by a city council member. This statement caused me to be curious in that clay soils are known to be very unstable, that is, perhaps that any form of land form change such as cut/fill or mass grading can be conducted one day and remain stable, but at any time in the future become disastrously unstable. I have witnessed such slope stability failures during my 30 years of forestry work.

I have attached the first chapter, "General Slope Stability Concepts, from Lee Abramson, et al, "Slope Stability and Stabilization Methods," to provide the reader with information that there are strong requirements to deal with clay soils to prevent slope instability and catastrophic failures.

I have included below, two paragraphs from the attached PDF file, that highlight the issues of cut/fill in clay, which appears to me to be of some concern that retaining walls would be required during any form of excavation of the subject hill.

Steep cuts often are necessary because of right-of-way and property line constraints. The design must consider measures that will prevent immediate and sudden failure as well as protect the slope over the long term, unless the slope is cut for temporary reasons only. In some situations, cut stability at the end of construction may be a critical design consideration. Conversely, cut slopes, although stable in the short term, can fail many years later without much warning. (PAGE 16)

Long-term cut slope stability is also dependent on seepage forces and, therefore, on the ultimate groundwater level in the slope. After excavation, the free-water surface will usually drop slowly to a stable zone at a variable depth below the new cut surface. This drawdown usually occurs rapidly in cut slopes made in sand but is usually much slower in clay cut slopes. Although typical rates and shapes of groundwater drawdown curves have been proposed for cut slopes, none has proved useful for correctly predicting the time or rate of drawdown of preconsolidated clays. The main obstacle to such prediction comes from the difficulty in correctly modeling the recharge of the area in the vicinity of the cut slope. (PAGE 17)

--

Will Koenitzer
4240 SW Fairhaven Drive
Corvallis, OR 97333

541.754.0656

Please Note New Email Address: shonto88tc@comcast.net

CHAPTER 1

GENERAL SLOPE STABILITY CONCEPTS

1.1 INTRODUCTION

The evolution of slope stability analyses in geotechnical engineering has followed closely the developments in soil and rock mechanics as a whole. Slopes either occur naturally or are engineered by humans. Slope stability problems have been faced throughout history when men and women or nature has disrupted the delicate balance of natural soil slopes. Furthermore, the increasing demand for engineered cut and fill slopes on construction projects has only increased the need to understand analytical methods, investigative tools, and stabilization methods to solve slope stability problems. Slope stabilization methods involve specialty construction techniques that must be understood and modeled in realistic ways.

An understanding of geology, hydrology, and soil properties is central to applying slope stability principles properly. Analyses must be based upon a model that accurately represents site subsurface conditions, ground behavior, and applied loads. Judgments regarding acceptable risk or safety factors must be made to assess the results of analyses.

The authors have recognized a need for consistent understanding and application of slope stability analyses for construction and remediation projects across the United States and abroad. These analyses are generally carried out at the beginning, and sometimes throughout the life, of projects during planning, design, construction, improvement, rehabilitation, and maintenance. Planners, engineers, geologists, contractors, technicians, and maintenance workers become involved in this process.

This book provides the general background information required for slope stability analyses, suitable methods of analysis with and without the use of computers, and examples of common stability problems and stabilization methods for cuts and

fills. This body of information encompasses general slope stability concepts, engineering geology principles, groundwater conditions, geologic site explorations, soil and rock testing and interpretation, slope stability concepts, stabilization methods, instrumentation and monitoring, design documents, and construction inspection.

Detailed discussions about methods used in slope stability analyses are given, including the ordinary method of slices, simplified Janbu method, simplified Bishop method, Spencer's method, other limit equilibrium methods, numerical methods, total stress analysis, effective stress analysis, and the use of computer programs to solve problems. This book is intended for individuals who deal with slope stability problems, including most geotechnical engineers and geologists who have an understanding of geotechnical engineering principles and practice.

1.2 AIMS OF SLOPE STABILITY ANALYSIS

In most applications, the primary purpose of slope stability analysis is to contribute to the safe and economic design of excavations, embankments, earth dams, landfills, and spoil heaps. Slope stability evaluations are concerned with identifying critical geological, material, environmental, and economic parameters that will affect the project, as well as understanding the nature, magnitude, and frequency of potential slope problems. When dealing with slopes in general and slope stability analysis in particular, previous geological and geotechnical experience in an area is valuable.

The aims of slope stability analyses are

(1) To understand the development and form of natural slopes and the processes responsible for different natural features.
(2) To assess the stability of slopes under short-term (often during construction) and long-term conditions.
(3) To assess the possibility of landslides involving natural or existing engineered slopes.
(4) To analyze landslides and to understand failure mechanisms and the influence of environmental factors.
(5) To enable the redesign of failed slopes and the planning and design of preventive and remedial measures, where necessary.
(6) To study the effect of seismic loadings on slopes and embankments.

The analysis of slopes takes into account a variety of factors relating to topography, geology, and material properties, often relating to whether the slope was naturally formed or engineered.

1.3 NATURAL SLOPES

Many projects intersect ridges and valleys, and these landscape features can be prone to slope stability problems. Natural slopes that have been stable for many years

may suddenly fail because of changes in topography, seismicity, groundwater flows, loss of strength, stress changes, and weathering. Generally, these failures are not understood well because little study is made until the failure makes it necessary. In many instances, significant uncertainty exists about the stability of a natural slope. This has been emphasized by Peck (1967), who said:

> Our chances for prediction of the stability of a natural slope are perhaps best if the area under study is an old slide zone which has been studied previously and may be reactivated by some human operations such as excavating into the toe of the slope. On the other hand, our chances are perhaps worst if the mechanism triggering the landslide is (1) at a random not previously studied location and (2) a matter of probability such as the occurrence of an earthquake.

Knowing that old slip surfaces exist in a natural slope makes it easier to understand and predict the slope's behavior. Such slip surfaces often result from previous landslides or tectonic activities. The slip surfaces may also be caused by other processes, including valley rebound, glacial shove, and glacial phenomena such as solifluction and nonuniform swelling of clays and clay–shales. The shearing strength along these slip surfaces is often very low because prior movement has caused slide resistance to peak and gradually reduce to residual values. It is not always easy to recognize landslide areas (while postglacial slides are readily identified, preglacial surfaces may lie buried beneath glacial sediments). However, once presheared strata have been located, evaluation of stability can be made with confidence.

The role of progressive failure in problems associated with natural slopes has been recognized more and more as time goes on. The materials most likely to exhibit progressive failure are clays and shales possessing chemical bonds that have been gradually disintegrated by weathering. Weathering releases much of the energy stored in these bonds (Bjerrum, 1966). Our understanding of landslides involving clay and shale slopes and seams has increased largely due to the original work by Bishop (1966), Bjerrum (1966), and Skempton (1964).

1.4 ENGINEERED SLOPES

Engineered slopes may be considered in three main categories: embankments, cut slopes, and retaining walls.

1.4.1 Embankments and Fills

Fill slopes involving compacted soils include highway and railway embankments, landfills, earth dams, and levees. The engineering properties of materials used in these structures are controlled by the borrow source grain size distribution, the methods of construction, and the degree of compaction. In general, embankment slopes are designed using shear strength parameters obtained from tests on samples of the proposed material compacted to the design density. The stability analyses of embankments and fills do not usually involve the same difficulties and uncertainties as natural slopes and cuts because borrow materials are preselected and processed. Because fills

are generally built up in layers, analyses are required for all steps in the life of the project including:

(1) All phases of construction
(2) The end of construction
(3) The long-term condition
(4) Natural disturbances such as flooding and earthquakes
(5) Rapid drawdown (for water-retaining structures like earth dams)

Debris and waste landfills differ from other engineering slopes in that they typically have an extreme variety of material types, sizes, and characteristics. These materials are extremely difficult to characterize and analyze.

Constructed fills have been used since antiquity with varying degrees of success and failure. In ancient times, they were used to construct earth fill dams for storing irrigation water. One of the oldest recorded earth fill dams is the dam completed in Ceylon in the year 504 BC, which was 11 miles long, 70 feet high, and contained about 17 million cubic yards of embankment (Schuyler, 1905).

It is well known and documented that compaction of soils increases their strength. Tools and methods for compacting soils were developed long before the principles of compaction were discovered in the 1930s. For a long period of time, before the building of the first road compaction roller in the 1860s, cattle, sheep, and goats were used to compact soils. For example, in the United States, the 85-foot high Santa Fe water supply dam of New Mexico was compacted by 115 goats in 1893 (Highway Research Board, 1960).

Although mechanical equipment has been used to compact soil since the late 1860s, the engineering literature prior to the 1930s gave no evidence that anyone had established the relationships between moisture content, unit weight, and the compaction effort, relationships that are now documented as the fundamental principles of soil compaction. Between the 1930s and 1940s, the principles of compaction were widely known and discussed among engineers. The "Proctor curve" was a result of these studies. Following the work by Proctor, numerous investigations and reports were prepared to increase knowledge of compaction principles, which, through modifications and upgrading, resulted in widely used compaction testing standards.

Today, as in the past, earth materials continue to be used for embankment fills and backfill behind retaining structures because of their widespread availability and relative economy. Backfill is compacted in lifts that vary from 6 inches to 3 feet, depending on the types of soils and proposed use. Different types of compactors, ranging from large sheep's foot and vibratory rollers to small hand-operated tampers, have been developed and used to compact soils.

Embankment fills generally consist of:

(1) Cohesionless soils (sands and gravels)
(2) Cohesive soils (silts and clays)
(3) A mixture of cohesionless and cohesive soils, gravels, and cobbles (herein called earth–rock mixtures).

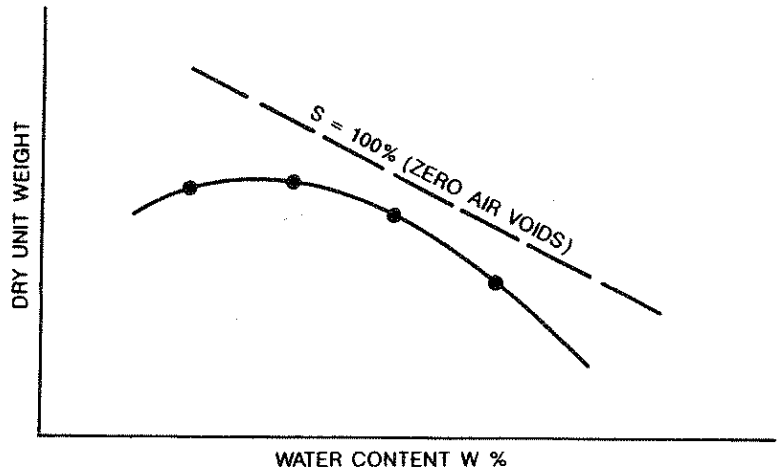

Figure 1.1 The moisture–density relationship (Proctor curve).

Organic soils, soft clays, and silts are usually avoided. The range of particle sizes of embankment fills is governed, for economic purposes, by the availability of the materials from nearby borrow areas.

The density of the materials after being excavated from borrow areas is usually very low and can be increased by compaction with mechanical equipment. In general, when the moisture content of the compacted soil is increased, the density will increase under a given compaction effort, until a peak or maximum density is achieved at a particular optimum moisture content. Thereafter, the density decreases as the moisture content is increased. The variations of moisture contents with density of the compacted soil is generally plotted in curves (Proctor curves) similar to Figure 1.1. The point of 100 percent saturation is called the saturation line, which is never reached since some air (pore space) always remains trapped in the soil material.

Cohesionless and cohesive soils behave differently when being compacted and have different compaction curves under the same compaction effort. Engineering characteristics of fills are discussed in the following sections. Typical engineering properties for compacted soils include maximum dry unit weight (standard compaction), optimum moisture content, typical strength, and permeability characteristics.

In general, soil shear strength varies with soil type and compaction conditions. Samples compacted dry of optimum moisture content appear stronger and more stable than those compacted wet of optimum moisture content. Increasing the compaction effort on soil reduces the permeability by reducing the amount of void space between the soil particles. When soil is compacted dry of optimum moisture content, the permeability is increased with an increase in water content. There is a slight decrease in permeability if the water content exceeds the optimum value.

Cohesionless Fills Cohesionless soils generally consist of relatively clean sands and gravels that remain pervious when compacted. These soils are represented by

Unified Classification System soil groups SW, SP, GW, GP, and boundary groups of any of these.

During the compaction process, compacted cohesionless soils are not affected significantly by water content because they are relatively pervious. The Proctor curve, as depicted in the dry density versus optimum moisture content graph, is usually round. Hence, their compactness is usually evaluated based on their relative density, as introduced by Terzaghi (1925) and defined as

$$D_r = \frac{e_{\max} - e}{e_{\max} - e_{\min}} \qquad \text{(Eq. 1-1)}$$

where D_r = relative density expressed as a percentage
$e_{\max}$ = void ratio of the soil in its loosest state
e = void ratio of the soil being tested
$e_{\min}$ = void ratio of the soil in its densest state

Since void ratio is related to dry density for a given specific gravity, Equation 1-1 can be written as

$$D_r = \frac{\gamma_{d\max}(\gamma_d - \gamma_{d\min})}{\gamma_d(\gamma_{d\max} - \gamma_{d\min})} \qquad \text{(Eq. 1-2)}$$

where $\gamma_{d\max}$ = dry density of the soil in its densest state
$\gamma_{d\min}$ = dry density of the soil in its loosest state
γ_d = dry density of the soil being tested

The loose or dense state of cohesionless soils is usually judged by relative density as defined by Terzaghi. Typical ranges of relative density of sand are

$0 < D_r < \frac{1}{3}$	Loose sand
$\frac{1}{3} < D_r < \frac{2}{3}$	Medium dense sand
$\frac{2}{3} < D_r < 1$	Dense sand

Terzaghi further defined compactibility as

$$F = \frac{e_{\max} - e_{\min}}{e_{\min}} \qquad \text{(Eq. 1-3)}$$

where F is very large for well-graded cohesionless soil such as SW and GW soils. Table 1.1 presents a list of compactibility values (F) for cohesionless soils.

Cohesive Fills Cohesive soils consist of those that contain sufficient quantities of silt and clay to render the soil mass relatively impermeable when properly compacted. Unlike compacted cohesionless soils, whose physical properties are generally improved by compaction to the maximum dry unit density, the physical properties of cohesive soils are not necessarily improved by compaction to a maximum unit

TABLE 1.1 List of Compactibility Factor F

Classification	γ_{min}	γ_{max}	e_{min}	e_{max}	Maximum Size	D_{10}	C_u	C_c	F
SP-SM	90	108	0.54	0.84	#16	0.058	6.1	2.2	0.555
SM	75	97	0.83	1.36	$\frac{3}{4}''$	0.0065	31.0	5.5	0.638
SP	92	112	0.48	0.80	#4	0.15	3.0	0.93	0.667
SP	93	113	0.46	0.77	$1\frac{1}{2}''$	0.16	2.4	0.92	0.674
SP	95	116	0.43	0.74	#4	0.30	3.7	1.0	0.721
SP-SM	92	113	0.46	0.80	$\frac{3}{4}''$	0.08	3.0	0.88	0.739
SP	85	107	0.54	0.94	#30	0.10	2.3	1.3	0.740
SP	97	118	0.40	0.70	$1\frac{1}{2}''$	0.11	3.2	1.2	0.750
SP	99	120	0.38	0.67	$1\frac{1}{2}''$	1.8	4.4	0.76	0.763
SM-ML	83	108	0.62	1.11	#4	0.012	8.3	1.5	0.790
SP-SM	79	103	0.60	1.08	#30	0.09	2.4	1.5	0.800
SP	103	124	0.33	0.60	$\frac{3}{8}''$	0.17	5.0	0.75	0.818
SM	105	126	0.31	0.57	$5''$	0.02	350.0	0.30	0.838
SP-SM	87	112	0.48	0.90	#4	0.08	3.0	1.3	0.875
SM	82	108	0.54	1.02	#16	0.023	6.5	1.4	0.889
SW-SM	95	119	0.39	0.74	$3''$	0.05	10.0	1.4	0.897
SP	98	122	0.36	0.69	#4	0.37	5.1	1.2	0.917
SW-SM	98	125	0.34	0.71	$3''$	0.07	6.8	1.0	1.088
SP-SM	97	124	0.33	0.70	$\frac{3}{4}''$	0.10	5.0	1.4	1.121
SP-SM	84	115	0.44	0.97	$1\frac{1}{2}''$	0.085	4.7	1.4	1.205
SP-SM	94	123	0.34	0.76	$1\frac{1}{2}''$	0.12	4.4	1.3	1.235
SM	99	128	0.31	0.70	$3''$	0.02	240.0	1.8	1.258
SP-SM	80	114	0.44	1.06	#16	0.07	3.7	1.6	1.409
SW-SM	80	116	0.42	1.07	$1\frac{1}{2}''$	0.074	6.6	2.4	1.547
SM	83	120	0.38	0.99	#4	0.015	26.0	6.1	1.605
SM	102	134	0.23	0.62	$\frac{3}{4}''$	0.01	120.0	1.9	1.695
GN-GM	113	127	0.31	0.47	$3''$	0.14	86.0	1.2	0.517
GP-GM	112	129	0.32	0.52	$3''$	0.03	200.0	0.50	0.625
GW-GM	116	133	0.26	0.44	$5''$	0.17	171.0	2.2	0.692
GP-GM	110	128	0.30	0.51	$3''$	0.11	191.0	15.0	0.700
GP-GM	117	133	0.24	0.41	$5''$	0.125	160.0	4.0	0.708
GW-GP	111	130	0.27	0.49	$3''$	0.20	105.0	7.5	0.815
GP	116	134	0.23	0.43	$5''$	0.27	111.0	6.2	0.870
GW	119	139	0.24	0.45	$3''$	0.51	45.0	2.2	0.875
GW	120	139	0.20	0.39	$3''$	0.45	51.0	1.6	0.950
GW	119	139	0.21	0.41	$3''$	0.18	94.0	1.1	0.952
GW	111	132	0.25	0.49	$3''$	2.9	9.7	1.8	0.960
GP	115	136	0.22	0.44	$5''$	0.38	29.0	0.61	1.000
GP	114	135	0.22	0.45	$3''$	2.0	11.0	0.77	1.045
GW-GM	121	141	0.19	0.39	$3''$	0.30	77.0	2.3	1.052
GM	122	141	0.17	0.36	$1\frac{1}{2}''$	0.025	381.0	3.0	1.118
GW-GM	114	137	0.21	0.45	$3''$	0.60	16.0	1.2	1.143
GW	112	138	0.20	0.48	$3''$	2.0	12.0	1.3	1.400
GW	109	137	0.21	0.52	$3''$	2.0	14.0	2.6	1.476

(Continued)

TABLE 1.1 *(Continued)*

Classification	γ_{min}	γ_{max}	e_{min}	e_{max}	Maximum Size	D_{10}	C_u	C_c	F
GP	114	140	0.18	0.45	3″	1.7	10.0	0.76	1.500
GM	101	132	0.25	0.64	$1\frac{1}{2}$″	0.03	260.0	12.0	1.560
GW-GM	111	139	0.19	0.49	3″	1.8	13.0	2.3	1.578
GP	115	142	0.17	0.44	3″	0.31	87.0	8.2	1.588
GW	123	146	0.13	0.34	3″	0.21	124.0	1.1	1.615
GW-GM	110	139	0.19	0.50	5″	0.42	43.0	2.1	1.631
GW-GM	115	142	0.17	0.45	3″	0.15	133.0	1.1	1.647
GP-GM	112	140	0.18	0.48	3″	0.42	26.0	4.2	1.667
GW-GM	112	140	0.18	0.48	5″	0.25	56.0	1.0	1.667
GW-GM	114	142	0.16	0.45	3″	1.2	15.0	1.7	1.812
GP	112	141	0.17	0.48	3″	1.4	7.1	0.73	1.823
GW-GM	118	147	0.12	0.40	3″	1.3	19.0	1.1	2.333

Source: Hilf (1991).

density. For example, Figure 1.2 indicates that the strength of compacted silty clay decreases with increasing molding water content (Seed and Chan, 1959).

Whether compacted cohesive soils should be placed dry or wet of optimum for the same density depends on the type of construction. During construction of a fill slope, data (Lee and Haley, 1968) indicate that it is better to place cohesive soils dry of optimum. Such data are presented in Figures 1.3 and 1.4. Nevertheless, for earth dam construction, there is an increasing tendency to compact the cores of earth dams on wet of the optimum moisture content to minimize crack development and subsequent formation of seepage channels. A balance must be struck between the resultant lower strength and potential pore pressure problems caused by using a higher initial water content.

By changing the moisture content of compacted clays, a pronounced change in their engineering properties results. The effects of compaction dry and wet of optimum on the shear strength, permeability, compressibility, and structure of cohesive soils are shown in Table 1.2.

Earth–Rock Mixtures There has been a considerable increase in the usage of earth–rock mixtures in the fills of high embankments over the last 40 years. Such soils are heterogeneous mixtures of particles that may range in size from large boulders to clay. The mixing of the larger size particles enhances the workability of the soil in the field and increases the overall strength of the soil.

Past research studies by the Bureau of Reclamation (Holtz and Gibbs, 1956) suggested that the strength of earth–rock mix fill depends on the amount of rock to be mixed with the in situ soils. The strength will increase with the amount of rock until some threshold percentage, for instance about 50 to 68 percent for sand–gravel mixtures, is reached. Further increase in gravel contents produces little to no increase in strength. Variations in friction angle with gravel contents of earth–rock mixtures for coarse-grained soils are shown in Figure 1.5.

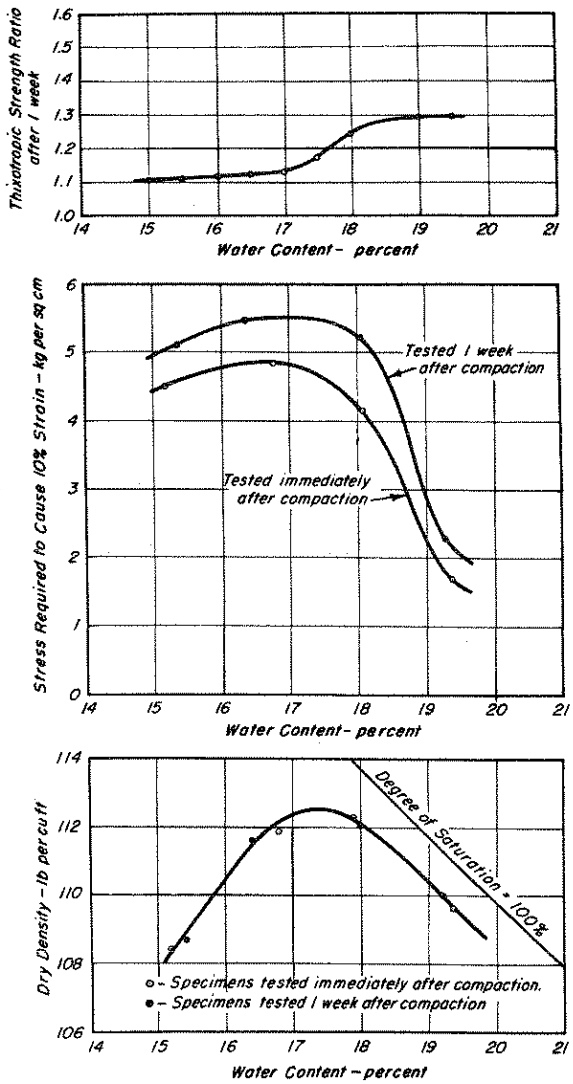

Figure 1.2 Strength of compacted clay versus moisture content. (From Seed and Chan, 1959, reproduced by permission of ASCE.)

Embankments on Weak Foundations Embankments are sometimes built on weak foundation materials. Sinking, spreading, and piping failures may occur irrespective of the stability of the new overlying embankment material. Consideration of the internal stability of an embankment-foundation system, rather than just the embankment, may be necessary. A simple rule of thumb based on bearing capacity theory can be used to make a preliminary estimate of the factor of safety against

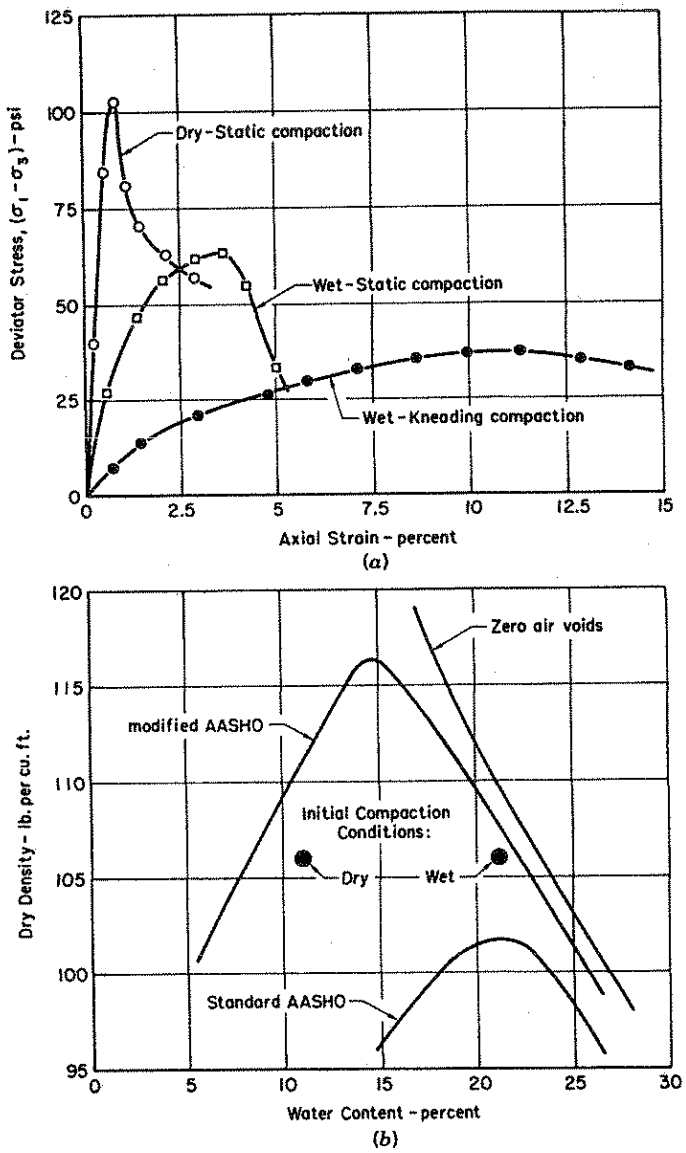

Figure 1.3 Compaction and unconfined compression characteristics of Higgins clay. (*a*) Unconfirmed compression tests. (*b*) Compaction curves. (From Lee and Haley, 1968, reproduced by permission of ASCE.)

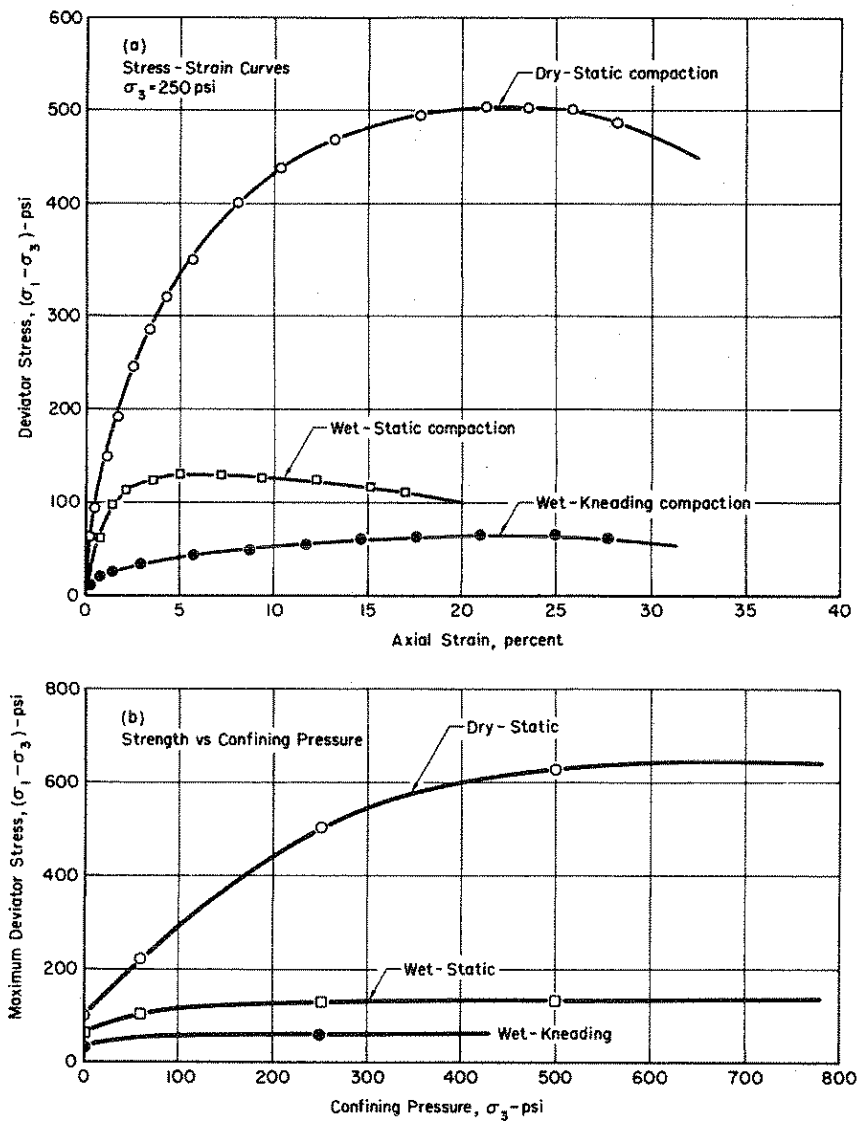

Figure 1.4 Unconsolidated-undrained tests on compacted Higgins clay. (*a*) Stress–strain curves = 250 psi. (*b*) Strength versus confining pressure. (From Lee and Haley, 1968, reproduced by permission of ASCE.)

TABLE 1.2 Comparison between Dry of Optimum and Wet of Optimum Compaction of Cohesive Soils

Physical Properties	Effects of Compaction
	Shear Strength
As molded	
Undrained	Dry side much higher
Drained	Dry side somewhat higher
After saturation	
Undrained	Dry side somewhat higher if swelling prevented; wet side can be higher if swelling permitted
Drained	Dry side about the same or slightly higher
Pore-water pressure at failure	Wet side higher
Stress–strain modulus	Dry side much greater
Sensitivity	Dry side more apt to be sensitive
	Permeability
Magnitude	Dry side more permeable
Permanence	Dry side permeability reduced much more by permeation
	Compressibility
Magnitude	Wet side more compressible in low stress range, dry side in high stress range
Rate	Dry side consolidates more rapidly
	Structure
Particle arrangement	Dry side more random
Water deficiency	Dry side more deficient, therefore more water imbibed, more swell, lower pore pressure
Permanence	Dry-side structure more sensitive to change

Source: Table extracted from *Soil Mechanics*, by Lambe and Whitman (1969).

circular arc failure for an embankment built over a clay foundation. The rule is (Cheney and Chassie, 1982)

$$\text{FOS} = \frac{6c}{\gamma_{\text{fill}} \times H_{\text{fill}}} \qquad \text{(Eq. 1-4)}$$

where FOS = factor of safety
c = cohesion of foundation clay (pounds per square foot)
γ_{fill} = unit weight of embankment fill (pounds per square foot)
H_{fill} = height of embankment fill (feet)

The factor of safety computed using this rule serves only as a rough preliminary estimate of the stability of an embankment over a clay foundation and should *not* be

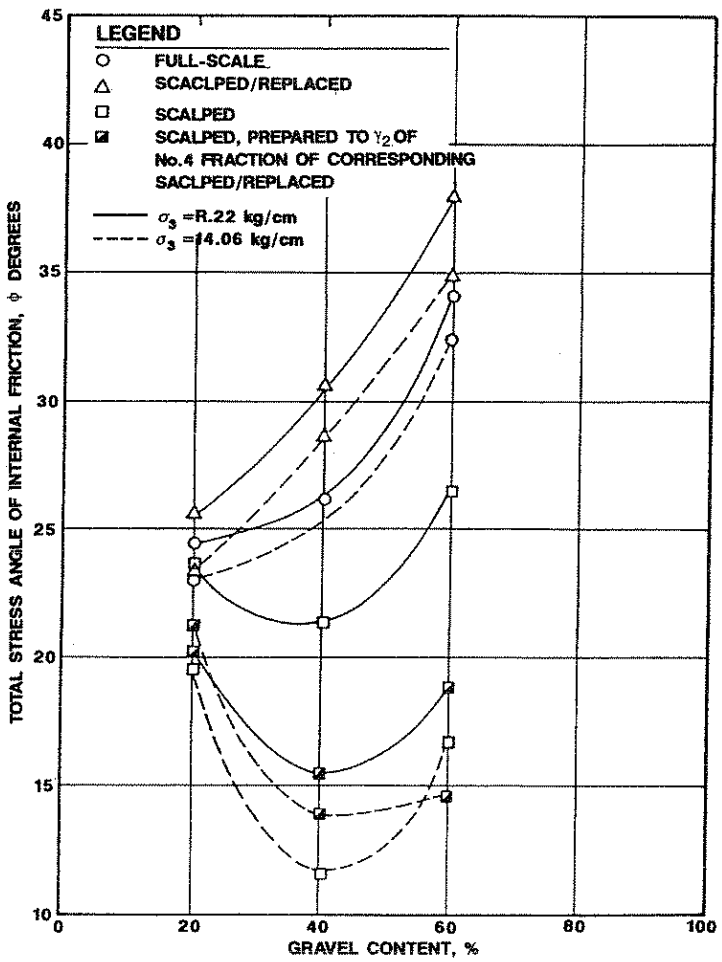

Figure 1.5 Total stress angle of internal friction versus gravel contents. (Donaghe and Torrey, 1985.)

used for final design. The simple equation does not take into consideration factors such as fill strength, strain incompatibility between embankment fill and the underlying foundation soils, and fill slope angle. In addition, it does not identify the location of a critical failure surface. If the factor of safety using the rule-of-thumb equation is less than 2.5, a more sophisticated stability analysis is required (Cheney and Chassie, 1982).

Figure 1.6 shows the variations in safety factor, strength, pore pressures, load, and shear stresses with time for an embankment constructed over a clay deposit. Over time, the excess pore pressure in the clay foundation diminishes, the shear strength of the clay increases, and the factor of safety for slope failure increases.

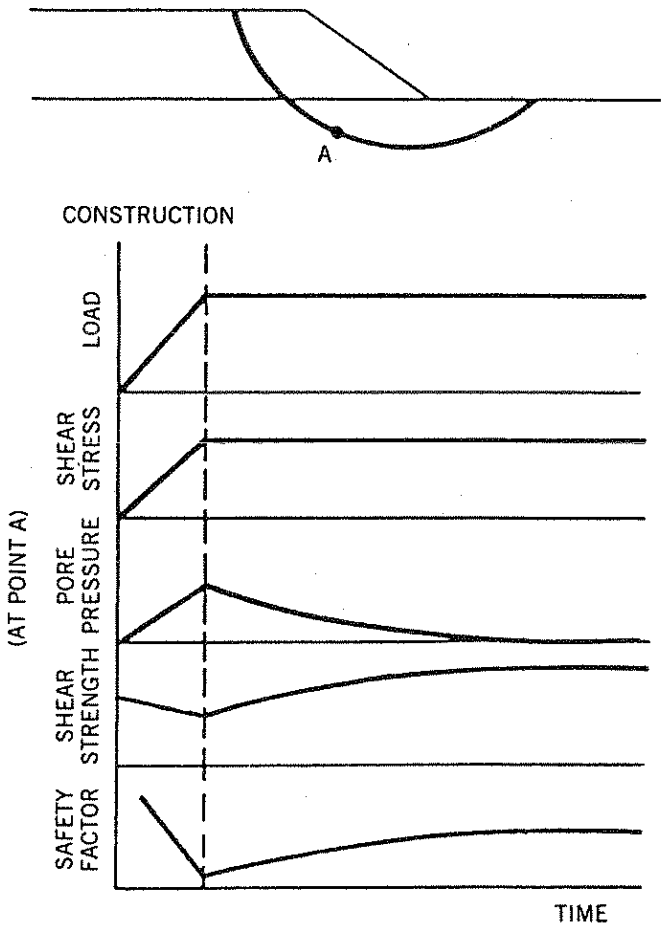

Figure 1.6 Stability conditions for an embankment slope over a clay foundation. (From Bishop and Bjerrum, 1960, reproduced by permission of ASCE.)

Embankment fills over soft clay foundations are frequently stronger and stiffer than their foundations. This leads to the possibility that the embankment will crack as the foundation deforms and settles under its own weight and to the possibility of progressive failure because of stress–strain incompatibility between the embankment and its foundation. Design charts developed by Chirapuntu and Duncan (1977), using finite element method analyses, depict the effects of cracking and progressive failure on the stability of embankments on soft foundations. These charts may be used as a supplement to conventional stability analyses. The use of geosynthetic reinforcement in the fill may prevent the initiation of cracking and subsequent failure in these cases. Alternatively, it may be necessary to remove the soft foundation materials or locate the fill at another site.

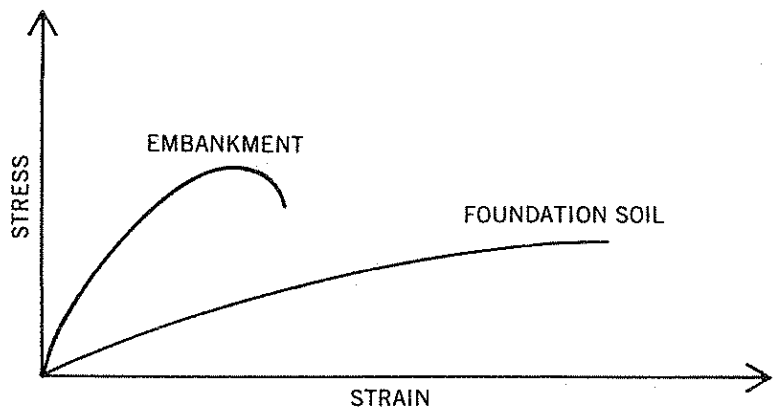

Figure 1.7 Example of stress–strain incompatibility.

Peak strengths of the embankment and the foundation soils cannot be mobilized simultaneously because of stress–strain incompatibility (Figure 1.7). Hence, a stability analysis performed using peak strengths of soils would overestimate the factor of safety. Many engineers perform stability analyses using soil strengths that are smaller than the peak values to allow for possible progressive failure.

Shale Embankments Embankments constructed of shale materials often have slope stability and settlement problems. According to DiMillio and Strohm (1981), the underlying causes of shale fill slope failures and excessive settlement frequently appear to be:

(1) Deterioration or softening of certain shales over time after construction
(2) Inadequate compaction of the shale fill
(3) Saturation of the shale fill

These types of failures have been found to be typical in many areas from the Appalachian region to the Pacific coast. In general, severe problems with shales in embankments are found in states east of the Mississippi River rather than west of the river (DiMillio and Strohm, 1981). Embankments can use fill originating from shale formations successfully if the borrow source is not particularly prone to long-term decomposition and if adequate compaction and drainage are required. In addition, shale embankments should be keyed into any sloping surfaces by using benches and installing drainage measures to intercept subsurface water that may enter the foundation area. Guidelines for design and construction of shale embankments have been established by Strohm et al. (1978).

1.4.2 Cut Slopes

Shallow and deep cuts are important features in any civil engineering project. The aim in a slope design is to determine a height and inclination that is economical

and that will remain stable for a reasonable life span. The design is influenced by the purposes of the cut, geological conditions, in situ material properties, seepage pressures, construction methods, and the potential occurrence of natural phenomena such as heavy precipitation, flooding, erosion, freezing, and earthquakes.

Steep cuts often are necessary because of right-of-way and property line constraints. The design must consider measures that will prevent immediate and sudden failure as well as protect the slope over the long term, unless the slope is cut for temporary reasons only. In some situations, cut stability at the end of construction may be a critical design consideration. Conversely, cut slopes, although stable in the short term, can fail many years later without much warning.

To a certain degree, the steepness of a cut slope is a matter of judgment not related to technical factors. Flat cut slopes, which may be stable for an indefinite period, are often uneconomical and impractical. Slopes that are too steep may remain stable only for a short period of time. A failure may pose a danger to life and property at a later date. Failures could involve tremendous inconvenience and the expense of repairs, maintenance, and stabilization measures.

Figure 1.8 shows the general variations of factor of safety, strength, excess pore pressure, load, and shear stresses over time for a clay cut slope. The initial shear strength is equal to the undrained shear strength on the assumption that no drainage occurs during construction. In contrast to embankment slopes, the pore pressure within the cut increases over time. This increase is accompanied by a swelling of the clay, which results in reduced shear strength. Thus the factor of safety decreases over time until an unstable condition is reached. This, for the most part, explains why clayey cut slopes sometimes fail a long time after initial excavation.

For cuts in overconsolidated clays, the in situ shear strength is a direct function of the maximum past overburden pressure. The higher the maximum past overburden pressure, the greater the shear strength. However, if the clay is subjected to long-term unloading conditions (permanent cuts), the strength of the clay no longer depends on the prior loading. The strength of a cut slope will decrease with time. The loss in strength is attributed to reduction of negative pore pressure after excavation. This loss in strength has been observed to be a time-dependent function related to the rate of dissipation of negative pore pressure.

In practice, the loss in strength after cuts are made is not easily determined. According to McGuffey (1982), the time dependency of clay cut slope failures can be hypothesized to be a function of the Terzaghi hydrodynamic lag model. The estimated time to failure can be expressed as (McGuffey, 1982)

$$t = \frac{h^2 T_{90}}{C_v} \qquad \text{(Eq. 1-5)}$$

where t = time to failure
h = average distance from the slope face to the depth of the maximum negative pore pressure
T_{90} = time factor for 90% consolidation = 0.848
C_v = coefficient of consolidation (square feet per day)

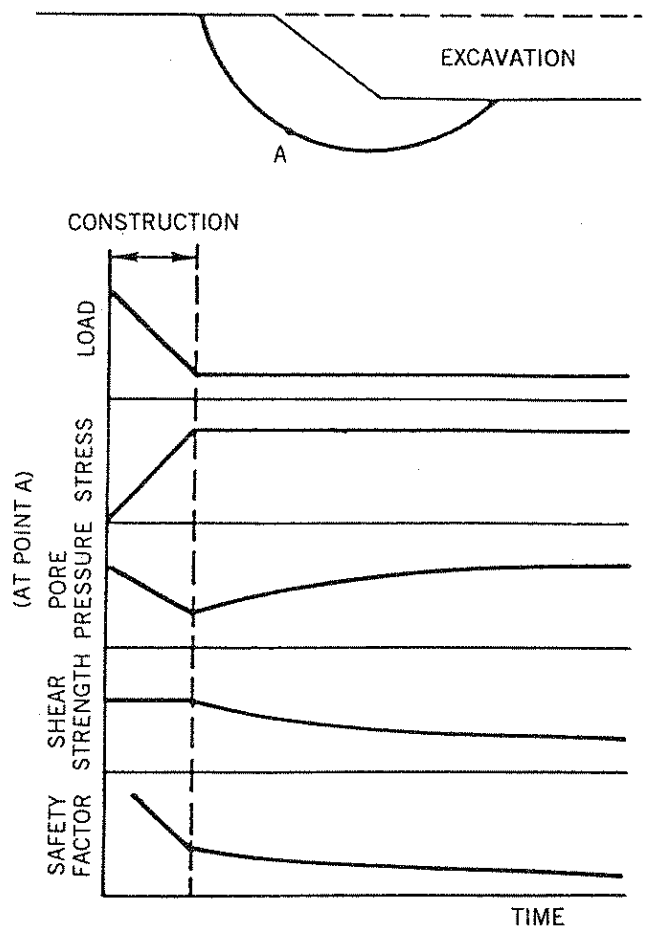

Figure 1.8 Stability conditions for a cut slope. (From Bishop and Bjerrum, 1960, reproduced by permission of ASCE.)

This model was used with some success by McGuffey (1982) to determine and back-analyze the time for stress release leading to slope failures in clay cuts in New York.

Long-term cut slope stability is also dependent on seepage forces and, therefore, on the ultimate groundwater level in the slope. After excavation, the free-water surface will usually drop slowly to a stable zone at a variable depth below the new cut surface. This drawdown usually occurs rapidly in cut slopes made in sand but is usually much slower in clay cut slopes. Although typical rates and shapes of groundwater drawdown curves have been proposed for cut slopes, none has proved useful for correctly predicting the time or rate of drawdown of preconsolidated clays. The main obstacle to such prediction comes from the difficulty in correctly modeling the recharge of the area in the vicinity of the cut slope.

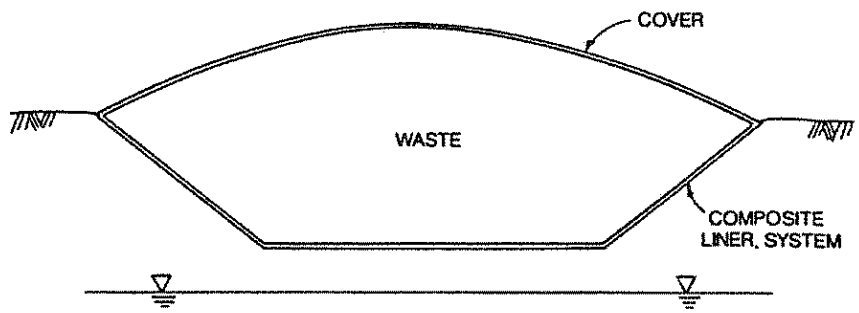

Figure 1.9 Cut and fill slopes used for landfills. (From Mitchell and Mitchell, 1992, reproduced by permission of ASCE.)

1.4.3 Landfills

Landfills are a special case where both cut and fill slopes are involved (Figure 1.9) and where the fill materials are much less than optimum. To make matters worse, except for very old landfills, zones of clay barriers and, more recently, geosynthetic barriers (Figure 1.10) are placed between the fill materials and the natural ground, creating an extra zone that must be characterized and analyzed with respect to short-term and long-term stability. Also, the plethora of environmental regulations that are imposed on existing and new landfills places an extremely heavy burden on the engineers and geologists to accurately characterize and analyze the short-term and long-term behavior of landfills for the life of the project and beyond.

Landfills may contain organic materials, tree limbs, refuse, and a variety of debris that are commonly dumped, pushed, and spread by bulldozers, and then compacted by refuse compactors. Compaction of landfills is somewhat different from the compaction of soils, particularly with respect to crushing. Compaction crushes (collapses) hollow particles, such as drums, cartons, pipes, and appliances, and brings the crushed particles closer together. It may be expected that landfills, compacted at the top only, will be relatively loose. Landfill materials are commonly soft, and large voids can be encountered.

The evaluation of landfill slope stability is similar to the analysis of other types of slope stability problems. Selection of proper values for the strengths of the waste and foundation materials, and of proper shearing resistances along the interfaces within the liner and cover systems, is the most critical part of any stability study. The greatest difficulties and uncertainties are associated with evaluation of the strength and stress–strain properties of the liner system materials and interfaces, and of the waste fill.

Very little is known about the geotechnical engineering properties of landfills. The paucity of data results in part from the difficulties in credible sampling and testing of refuse. This difficulty is further compounded by the fact that refuse composition and properties are likely to change erratically within a landfill and are also likely to decompose with time.

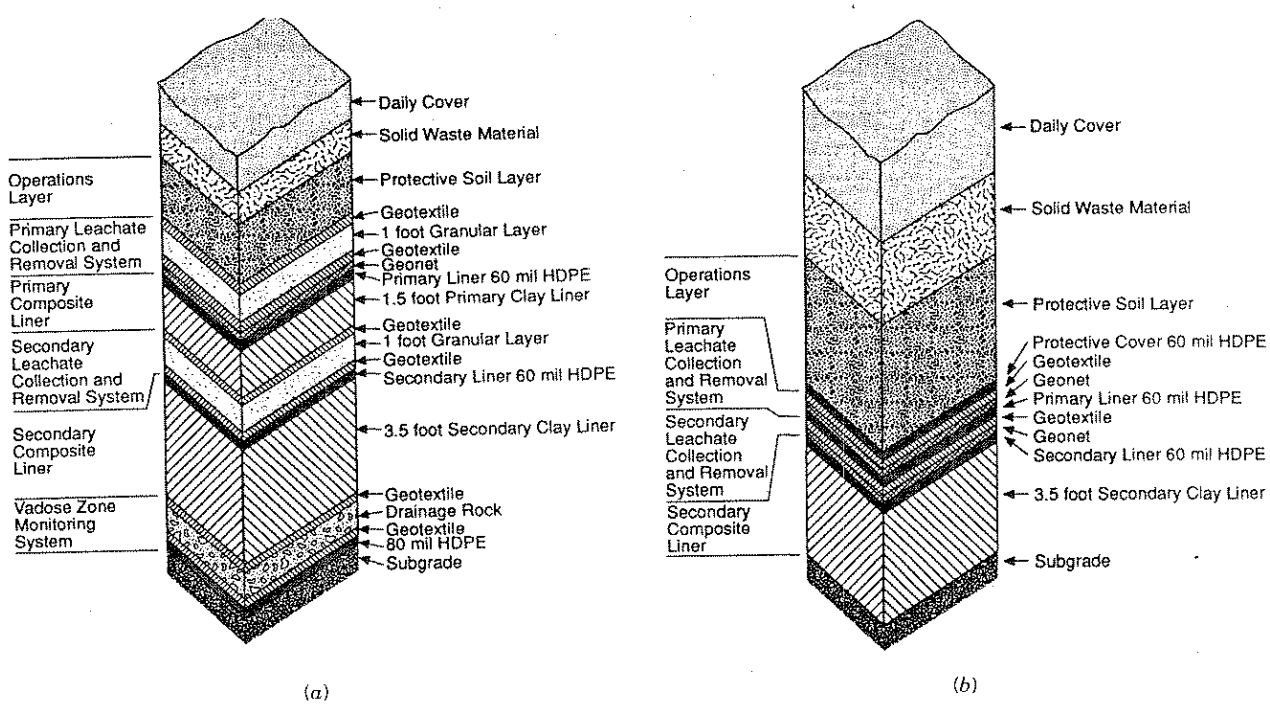

Figure 1.10 Geosynthetic barriers used for landfills. (*a*) Base liner. (*b*) Side slope liner. (From Byrne et al., 1992, reproduced by permission of ASCE.)

The unit weight of landfill is highly dependent on a number of factors, including initial composition, compactive effort, decomposition, settlement, and moisture content. Although the density of the landfill will typically increase with depth, considerable variability should be expected within relatively short distances (Landva and Clark, 1987).

The moisture content of landfill materials is also dependent on a number of interrelated factors, such as the initial composition, landfill operating procedures, the effectiveness of any leachate collection and removal systems, the amount of moisture generated by biological processes within the landfill, and the amount of moisture removed with landfill gas (Mitchell and Mitchell, 1992). The water content of the landfills in the United States ranges from 10 to 50 percent.

Shear strengths of the landfills may be estimated by means of:

(1) Laboratory testing
(2) Back-calculation from field tests and operational records
(3) In situ testing

Laboratory samples are usually reconstituted from landfills before they are tested. Direct shear tests have been commonly used to determine shear strength parameters of the landfill materials. Back-calculation of an existing landfill based on field load tests also can be made to estimate the shear strengths of the landfill (Converse et al., 1975). However, the back-calculated strengths are usually conservative by an unknown amount because the back-calculation assumes failure of the slope (that is, a factor of safety equal to 1). Vane shear and standard penetration tests have been used to estimate the shear strength of refuse in a landfill near Los Angeles, California (Earth Technology Corporation, 1988). The shear strength data obtained by these in situ testings may not be representative of the actual conditions because both the vane shear device and the standard penetration sampler are small compared with the inclusions (for example, tires, wood, carpet) that make up the landfill.

True cohesion or bonding between particles is unlikely in landfills. However, there may be a significant cohesion intercept that results from interlocking and overlapping of the landfill constituents. This interpretation is supported by some laboratory test results and the common observation that vertical cuts in landfills can stand, unsupported, to considerable heights (Mitchell and Mitchell, 1992).

Alshunnar (1992) proposed the following design considerations for landfill slopes:

(1) Groundwater conditions before and after construction of the landfill
(2) Subsurface conditions
(3) Construction sequence
(4) Adjacent site conditions and history
(5) Site topography
(6) External loads such as from construction equipment, stockpiles, earthquakes, and so on
(7) Liner geometry and configuration
(8) Filling sequence

It is extremely difficult to reconcile the uncertainties implicit in landfill site characterizations (e.g., landfill material types and characteristics, future land use at and around the site, the probability of severe natural phenomena like earthquakes, tsunamis, sinkholes, etc.) with the guarantees that regulatory agencies require of operators and owners related to siting, operations, and closure. Seed and Bonaparte (1992) stated:

> There are some considerable uncertainties with respect to material properties and dynamic response characteristics associated with both: (a) waste fill masses, and (b) base liner systems and final cover systems. As a result, current analysis and design methods are generally based on a sequence of conservative assumptions at various stages of the analyses, with the resulting cumulative level of conservatism generally selected so as to offset the possible impact(s) of uncertainties at each stage of analysis and design. In the opinion of the authors, the compounding of conservative assumptions, both in terms of property/parameter selection and analysis/evaluation methodology, at multiple stages during the overall analysis and design process should provide a conservative final result when carefully implemented.

An example of how modern regulations and construction methods of landfills surpassed analytical characterization and design methods is the case of the Kettleman Hills Landfill B-19 Phase IA failure. On March 19, 1988, there was a failure in Landfill B-19, Phase IA at the Kettleman Hills Class I hazardous waste treatment, storage, disposal facility (Byrne et al., 1992). Approximately 580,000 cubic yards of waste and other material had been placed to a height of 90 feet above the base at the time of the failure (Figure 1.11). The entire mass slid a horizontal distance of about 35 feet toward the southeast, and vertical slumps of up to 14 feet along the sideslopes of the landfill were observed after the failure (Figure 1.12). Initial study of the failure indicated that it had most likely occurred within the liner system and identified both geomembrane/clay and various synthetic/synthetic interfaces as candidate sliding surfaces. The characteristics of the landfill base and sideslope liners are shown in Figure 1.13. Further study, testing, and two- and three-dimensional slope stability analyses after the failed waste and liner materials were excavated concluded that

(1) The mechanism of failure consisted of slip along multiple interfaces within the landfill liner system.
(2) Low liner interface strengths (residual friction angles as low as 8 degrees) relative to the constructed geometry of the landfill were clearly the underlying cause of the failure.
(3) The predominant surface of sliding during the failure appeared to be the geomembrane/clay interface of the secondary liner system that apparently behaved in an essentially undrained mode during the approximately one year of waste loading prior to failure.
(4) Undrained shear strength testing of the clay/geomembrane interface indicated that the shear strength was sensitive to the as-placed moisture and density conditions of the clay.

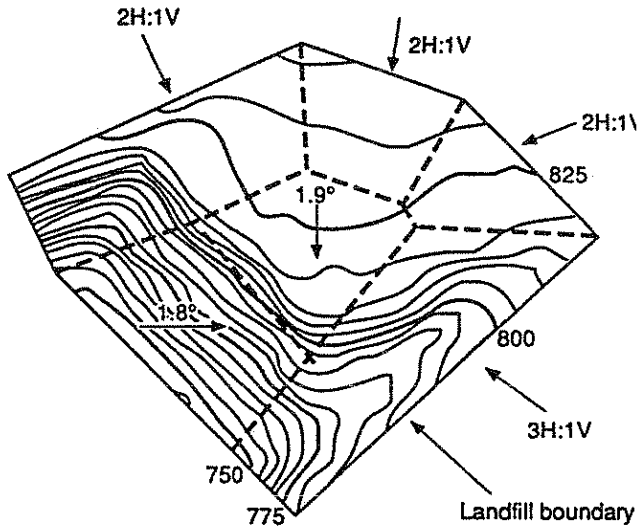

Figure 1.11 Kettleman Hills landfill layout. (From Byrne et al., 1992, reproduced by permission of ASCE.)

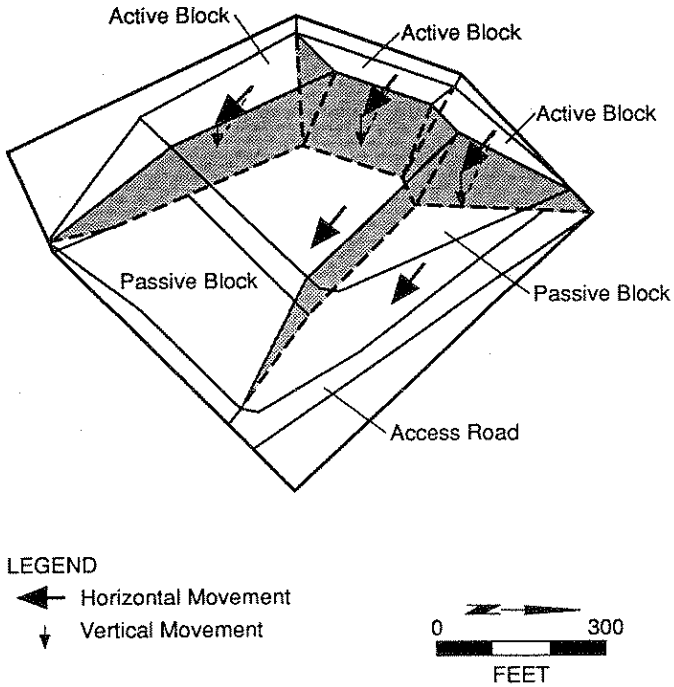

Figure 1.12 Slope failure at Kettleman Hills Landfill. (From Byrne et al., 1992, reproduced by permission of ASCE.)

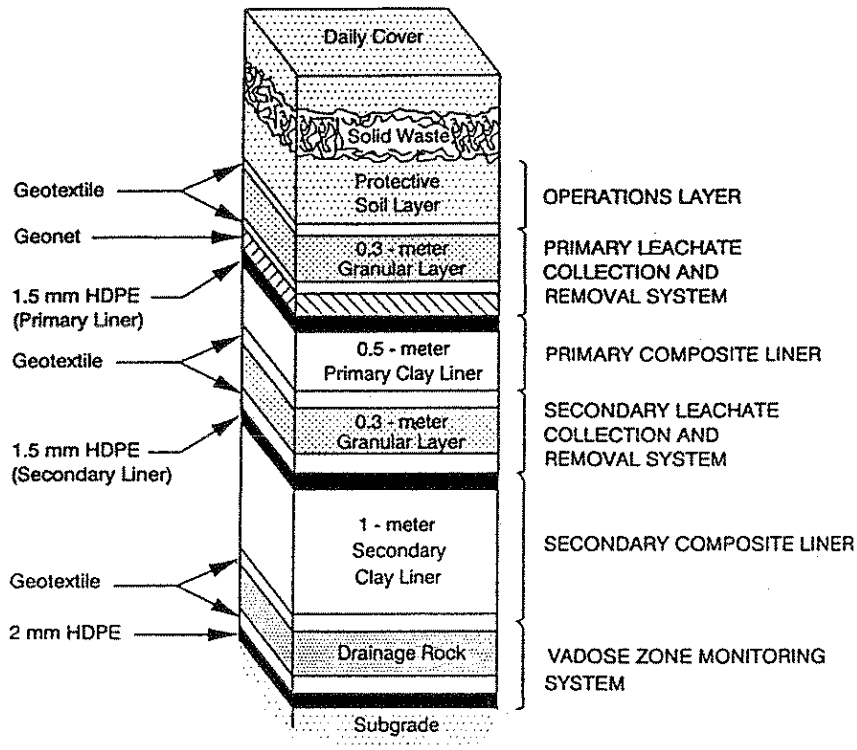

Figure 1.13 Kettleman Hills landfill liner characteristics. (From Byrne et al., 1992, reproduced by permission of ASCE.)

(5) The calculated factor of safety using a three-dimensional model and residual shear strengths was 0.85. This was consistent with the observed occurrence of large displacements following failure initiation and the attainment of residual strength conditions over the entire slip surface.

(6) The failure demonstrated that specifications for the placement of liner clay must focus not only on achieving specific permeability requirements, but also on developing liner shear strengths that are adequate to support both the interim and final geometric configurations of the landfill.

It should be noted here that three-dimensional analysis was required for this case because of the complex geometry and difficulty in selecting a typical two-dimensional section to analyze. However, as Duncan (1992) states, "The factor of safety calculated using 3D analyses will always be greater than, or equal to, the factor of safety calculated using 2D analyses." This is true for all cuts and fills, not just landfills.

1.4.4 Retaining Structures

Retaining structures are frequently used to support stable or unstable earth masses. The different types of retaining structures, as shown in Figure 1.14, are:

(1) Gravity walls (e.g., masonry, concrete, cantilever, or crib walls)
(2) Tieback or soil-nailed walls
(3) Soldier pile and wooden lagging or sheet pile walls
(4) Mechanically stabilized embankments including geosynthetic and geogrid reinforced walls

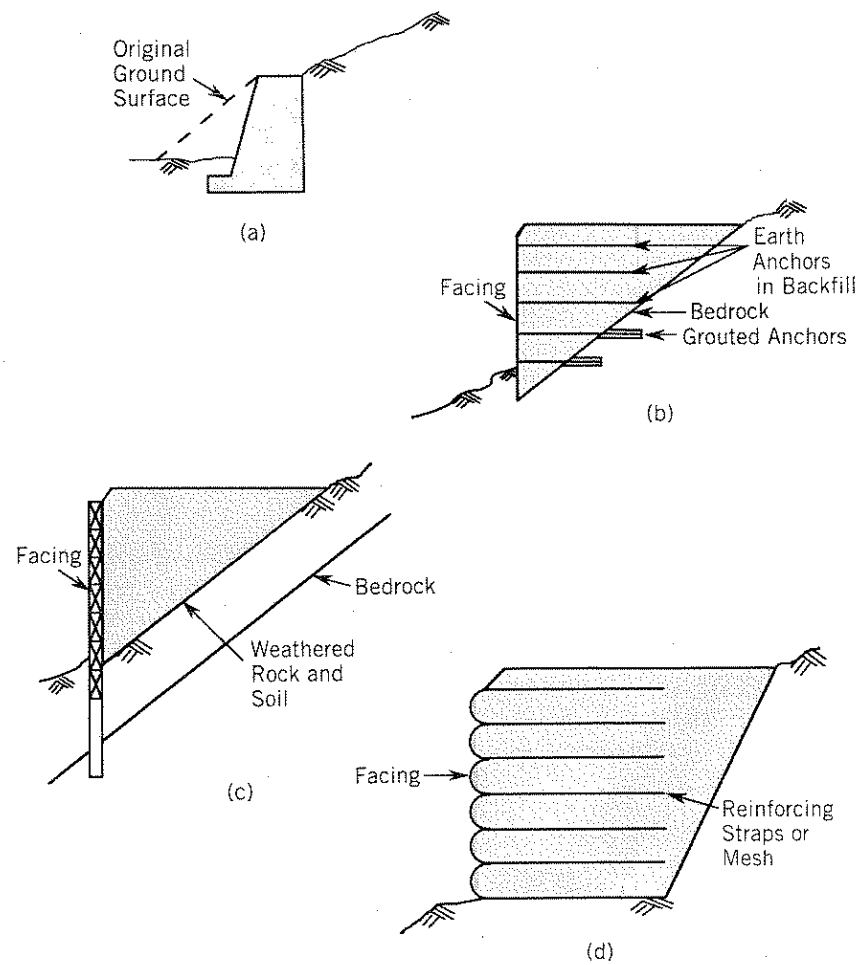

Figure 1.14 Types of retaining structures. (*a*) Gravity retaining wall. (*b*) Tieback retaining wall. (*c*) Sheet pile cantilever wall or soldier pile. (*d*) Mechanically stabilized embankment.

Retaining structures are used in seven principal ways, as shown in Figure 1.15. The design of retaining structures requires three primary considerations:

(1) External stability of the soil behind and below the structure
(2) Internal stability of the retained backfill
(3) Structural strength of retaining wall members

1.5 LANDSLIDES

When a slope fails, it is often called a landslide or a slope failure. Several classification methods and systems have been proposed for landslides. The one adopted in this book and most consistently around the world is the one proposed by the International Association of Engineering Geologists (IAEG) Commission on Landslides.

1.5.1 Features and Dimensions of Landslides

Typical features of a landslide are shown schematically in Figure 1.16. The observable features of a landslide are

(1) *Crown* The practically undisclosed material above the main scarp
(2) *Main Scarp* A steep surface on the undisturbed ground at the upper edge of the landslide
(3) *Top* The highest point of contact between the displaced material and main scarp
(4) *Head* The upper parts of the landslide between the displaced material and main scarp
(5) *Minor Scarp* A steep surface on the displaced material produced by differential movements
(6) *Main Body* The part of the displaced material that overlies the surface of rupture
(7) *Foot* The portion of the landslide that has moved beyond the toe
(8) *Tip* The point on the toe farthest from the top
(9) *Toe* The lower margin of the displaced material
(10) *Surface of Rupture* The surface that forms the lower boundary of the displaced material
(11) *Toe of Surface of Rupture* The intersection between the lower part of the surface of rupture and the original ground surface
(12) *Surface of Separation* The original ground surface now overlain by the foot of the landslide
(13) *Displaced Material* Material displaced from its original position by landslide movement

Date: 27 January 2009
To: Corvallis Mayor and City Council
From; Marilyn Koenitzer, 4240 SW Fairhaven Drive, 97333
Subject: Brooklane Heights (PLD06-00018, SUB06-00006)

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JAN 27 2009

Community Development
Planning Division

During the January 20 hearing, I was confused by conflicting staff statements on which documents apply in this case. Because it appears that some of you also were not clear on the subject, I listened to the meeting on Public TV, reread the staff report, and the LUBA opinion.

I concur with Mark Knapp's testimony "Brooklane Heights Q and A" regarding the applicable documents. You have a very difficult case before you in the Brooklane Heights subdivision and Planned Development.

It appears from reading the Public Notice for the Brooklane Heights Remand, state law (ORS 227.173, 175, 178) and the Land use Board of Appeals (LUBA) remand, that only the Corvallis Comprehensive Plan (CCP) and the 1993 Land Development Code (LDC) apply. Condition 27 does not apply, according to LUBA, even though it attempts to. The evidence submitted for this hearing does not change any of the Assignments of Error enough to justify approval. The Applicant has opened a can of worms for himself, you, and the public by not filing under the 2006 LDC. It appears your only action is to deny the remand application. If the Applicant wishes to go forward later, he can apply under the new code. Perhaps by that time hillside regulations that satisfy areas such as Country Club Hill can be adopted.

In my reading of the **CCP 4.6.7** and **2006 LDC**, I agree with LUBA and Attorney Anne Davies that the Applicant has not satisfied the requirements of the LUBA remand, especially with respect to the Fourth and Fifth Assignments of Error, and Condition 27.

The staff report says in several places, and this statement was corroborated by City Atty. Jim Brewer, during the Q and A session after the public hearing was closed, "all development on the subject site will be required to comply with standards in the 2006 LDC." These statements appear to conflict with State law and the LUBA opinion. The LUBA Remand says that future development issues have to be resolved at the time of the hearing, and Condition 27, as proposed, does not meet CCP 4.6.7. Therefore, unless Condition 27 is substantially amended to meet the intent of CCP 4.6.7, it will not be satisfactory. It has not been amended by the developer.

I am addressing the LUBA Fourth and Fifth Assignments of Error in the following presentation.

I originally testified about neighborhood compatibility. What follows is a minor history.

My neighborhood, the "Country Club Hill," initially had design covenants which limited heights of the homes to 4:12 roofs and one story above ground level in order to maintain views from the hill for all who live here. Many of the homes have daylight basements

which provide additional comfortable living space. Those covenants expired in the late 1970's. After that, people began building homes which do not meet the expired covenants. In 1973, sewer and water was brought to this area, causing a gradual increase in building on vacant lots that had not been used due to health hazard.

For many years, (until we questioned the Assessor's office about our tax assessments) houses in the upper block on Fairhaven Drive were assessed a premium for having view lots. This would lead us to believe we owned the view for which we paid. This has worked for our view over houses, but it has not worked to preserve our view from growing oaks and fir trees. (This may partially answer Mr. O'Brien's question.)

At the 20 January 2009 hearing, the Applicant initially provided two photographs of homes on Fairmont Drive which he said show compatibility with his prospective homes. In surrebuttal, he provided a few others.

Most of these homes have second storys, and one of them could conceivably house a third floor. The Ball house was objected to by a neighbor at the time of it remodel for its view-limiting height. Will Koenitzer showed 63 slides of the area, with the majority of them being homes in this neighborhood. As you saw, the majority of them are ranch-type daylight basements.

By showing homes with high roofs, the Applicant infers that his homes will be the type with high roof pitches, and what I call "turret" projections, the type espoused in the "Smart Development" neighborhood trend that we have incorporated into our 2006 LDC. These homes are not compatible with our neighborhood. Most of our houses attempt to "fit into" the hillside, not stick out from it.

Furthermore, the Applicant cannot just "infer." He has to substantiate the style of housing, with details, or he has to show elevation drawings, and they have to be conditioned into the development, so that the public knows if the new neighborhood will be compatible. Because the Applicant has not done this, you should deny his application.

How do Chapters LDC 4.1 and 4.5 relate to CCP 4.6.7, Hillside Development?
I read LDC Chapters 4.1 and 4.5 and 9.2 to see if Condition 27 satisfies CCP 4.6.7. The purposes of 2006 LDC Chapter 4.5 do align with CCP 4.6.7, but I found <u>no code</u> in this section which implements the purposes. The following paragraphs give examples of what is in those chapters and how they do not apply. Also, the staff report recognizes, in several instances, that our neighborhoods on hillsides do not have, and are unlikely ever to have, the characteristics that are meant to be achieved in our LDC Chapter 4.10 and 4.50, specifically, 4.10.50.03; 4.5.8; and CP 9.2.1 and 9.5.1. Therefore, the developer has to give you other information that will satisfy CCP 4.6.7.

The reason these chapters cannot meet the CCP is that they are devoted for the most part to "Smart Development", and our hillside neighborhood is not designed that way, and is not likely to be in my lifetime.

Examples of types of development covered in LDC 4.10:
I could find no code to implement road installation following the contours of slope, or code to implement siting of houses on slopes, except that 2' elevation contour maps should be provided.

Many of the 2006 LDC Pedestrian Oriented Design standards (LCD 4.10) are not compatible with our neighborhood. The PODS require a variety of design elements that are oriented to dense living environments. Many of them are difficult to place on sloping land with drainage issues. Alleyways for garages is one example for small lot sizes. An example of incompatibility is LDC 4.10.50.03, which requires roof pitches to be 4:12 and higher. Higher roof pitches can impede or block the views from the houses on Fairmont, and the views of those in the new development.

The higher roof pitches also make it more expensive to provided necessary minimum 18" eaves. The eaves partially protect windows from the elements, in this case blowing rain. In this rainy climate, eaves should be wider than 18", so that window areas are protected from the elements. The only way to get a reasonable eave size without curving it out (expensive to build) is to have a low roof pitch.

The Chapter provides extenuating circumstances for exceptions to cut and fill for the purposes of placing streets and infrastructure, and pedestrian alignment. These extenuating circumstances allow more cut/fill allowances. Fortunately, the Chapter does provide allowances for additional cut/fill to protect a significant natural feature and/or significant tree.

The majority of **Section 4.5.80 Hillside Development Standards** contains regulations for mass and single-lot grading, and regulations for 8, 10, and 12 feet cut and fill procedures. These regulations are based on lot size, rather than contour. They do not establish the care to be given to sensitive areas, including soil and vegetation other than trees. They do not cover erosion from mass grading which is left undeveloped for lengthy period of time.

2006 LDC 4.5.80 Hillside Development Standards also contains this: "A necessary street or pedestrian connection is one which is needed to create a block perimeter of approximately 1,600 ft., or which is identified in an adopted City Master Plan document." This regulation was adopted to accomplish the "Smart Development" block grid pattern, which is not easily applied in low-density hillside development with significant tree groves and drainage problems.
These chapters were adopted with the new designs of "Smart Development" and do not specifically address the problems of low-density hillside development. Chapter 9.2.5 explains that buildings should be oriented to public areas so that people will be present at night. This Chapter refers to highly developed commercial/residential areas, not quiet areas like our neighborhood on the Country Club Hill! This new development has no connectivity by road or pathway to any of its neighboring existing developments. It will only connect to the future Oakmont neighborhood which is also not connected to the existing older neighborhoods. The City chose to ignore connectivity through Oakmont to

Whiteside Drive with an existing unused city right of way. The Brooklane Heights area has no neighborhood center, and one is unlikely to develop since no land is zoned for one. The closest neighborhood center is at 53rd St. and Highway 20, approximately 1.5 to 2 miles distant. It has never been served by a city bus. The closest bus is approximately a mile away.

Beyond the above categories, I agree with LUBA that **2006 LDC 4.5.80** does nothing to assure compatibility with the hillside let alone compatibility with the adjacent neighborhoods. Staff argues that the matter of hillside development and neighborhood compatibility are satisfied in other chapters of the **2006 LDC,** and **1998 CP**, specifically, **LDC 4.10** Pedestrian Oriented Design, **CP 9.2.1** and portions of 9.2.5 Neighborhood Development, but I find that these chapters are better suited to flatter land developed to higher densities. I believe it would be good to have more qualities of CP **9.2.5**, but it is impossible without total redevelopment, which is unrealistic. Our neighborhood had a "little store," like mini 7-11 at the corner of 35th St. and Country Club Drive years ago, but it was converted to a duplex. Its time had not yet come.

In your post-hearing discussion, some of you mentioned adding a condition for lower roof pitch. This might be acceptable to the neighborhood, but more conditions will be necessary if you do not outright deny this application.

In general, I do not like to have to create Homeowners Associations (HOA) to deal with issues you cannot control, such as pesticides. If a site should not have pesticides, it should not be allowed to develop. HOA's add expenses to the owners, with little return.

Thank you for your hard work on this complicated issue.

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JAN 27 2009

Community Development
Planning Division

Date: January 27, 2009

To: Corvallis Mayor and City Council
From: Dianne Safford
Subject: Brooklane Heights

This is submitted as additional testimony regarding drainage concerns emanating from the proposed Brooklane Heights development.

On January 26, 2009, Mr. Ted Reese and Mr. Jeff McConnell from the Corvallis Public Works Department met with five homeowners representing all four existing homes on the south side of Brooklane Dr. Our meeting consisted of walking through portions of the wetland and discussing the concerns that these homeowners share. It should be noted that our concerns were brought up before the Planning Commission and City Council in June and August of 2007, and again on January 20, 2009.

Although the drainage concerns regarding Brooklane Park Estates are more broad than will be addressed here (as explained in previous documents mentioned above), this meeting was limited to drainage and flooding problems that homeowners on the south side of Brooklane Dr. fear may be experienced and/or exacerbated due to increased storm water runoff if the Brooklane Heights development were approved. Specifically, water from the culverts that drain into the Marys River Natural Area wetland is intended to enter a ditch that borders the end lot on the southwest, and then turns to jut northeast. This ditch is adjacent to our property, but not on it. The problem is that a significant amount of the water draining from the culvert winds up on our private property.

Additional water pooling in our private property only a few feet from the fill dirt upon which are homes are built is problematic to us for these reasons:

- We are concerned that this water will contain toxins (as storm water runoff always does) and that it will pollute our property and be unsafe for us and our pets.
- We do not want additional water pooling on our private property because it can be expected to attract more insects.
- We are concerned about flooding problems, including the erosion of the fill dirt embankments. Because the water pools up and stagnates directly behind our homes, we are concerned about localized flooding in the event of heavy rains even when the entire Marys River Natural Area is not flooded and the Marys River does not overflow.
- We are concerned about damage to landscaping.
- We are respectful of the wetlands in that we do not use chemicals (herbicides, insecticides, pesticides) that might contaminate the wetlands. We are concerned that in approving the development application, the City would sanction polluting

the wetlands (much of which is privately owned) with storm water runoff that is known to contain the very same pollutants that we are so careful to not use.

- We contend that if the City were to use our property to dump polluted storm water runoff, that action would constitute a taking, for which we would be constitutionally entitled to compensation from the City.

We asked Mr. Reese and Mr. McConnell if the City or the developer could commit to fixing the situation. (For example, the ditch intended to carry the storm water drainage from the culvert could be repaired and deepened.) They said they could not make this commitment because of restrictions to what can be done in the wetlands. It was also noted that regrading the ditch would require that it be entirely drained beforehand.

As we explained to Mr. Reese and Mr. McConnell, our concerns do not relate to a rare, widespread flooding situation – because flooding of the entire Marys River Natural Area would cause any water exiting the culvert to intermingle with all other water in the flooded wetland plain, thereby significantly diluting the pollutants in the storm water runoff.

I am requesting that they City Council deny the Brooklane Heights' application unless it first determines that the residents of Brooklane Park Estates will not suffer any damages from polluted storm water runoff.

Dianne Safford
2621 SW Brooklane Dr.
Corvallis, OR 97333
(541) 207-3070

Anne C. Davies
Attorney at Law

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JAN 27 2009
Community Development
Planning Division

January 27, 2009

Corvallis City Council
501 SW Madison Ave.
PO Box 1083
Corvallis, OR 97339-1083

Re: Brooklane Heights Remand Hearing—PLD06-00018; SUB06-00006

Following the city council's remand hearing last Tuesday evening, January 20, 2009, the record was left open for seven days. Please accept this final submittal on behalf of my clients, the individuals who appealed the city council's original decision to the Land Use Board of Appeals (LUBA).

Cut and Fill/ Hillside Development Standards / CCP 4.6.7

As I explained in my written testimony of last week, the comprehensive plan provisions are mandatory approval criteria; the city has treated them as such throughout this process, and the law of the case requires that they be treated as such. The comprehensive plan provisions require that cuts and fills on the property be minimized to the greatest extent practicable.

Policy 4.6 of the Corvallis Comprehensive Plan is entitled "Hillsides." Policy 4.6.7 provides:

> "In areas where development is permitted, standards in the Land Development Code for hillside areas will achieve the following:
>
> "A. Plan development to fit the topography, soil, geology, and hydrology of hillsides and to ensure hillside stability both during and after development.
>
> B. Preserve the most visually significant slopes and ridgelines in their natural state by utilizing techniques such as cluster development and reduced densities.
>
> C. Preserve significant natural features such as tree groves, woodlands, the tree-meadow interface, and specimen trees.
>
> D. Align the built surface infrastructure, such as roads and waterways, with the natural contours of terrain and minimize cutting and filling in developments.

433 W. 10th Ave. ‡ Eugene, Oregon 97401 ‡ Phone: 541 953-2119 ‡ Fax: 541 344-6266 ‡ Email: acdavies@qwest.net

E. Minimize soil disturbances and the removal of native vegetation and avoid these activities during winter months unless impacts can be mitigated.

F. Design developments and utilize construction techniques that minimize erosion and surface water runoff.

G. Demonstrate a concern for the view of the hills as well as the view from the hills.

H. Provide landscaping that enhances the identified open space resources.

I. Design developments that consider landscaping management that will minimize the threat of fire on improved property spreading to wildland habitat."

Before the city adopted the 2006 Hillside Development Standards, the city council had interpreted Policy 4.6.7 to allow up to 8-foot cuts and fills on proposed hillside developments. As you are aware, in 2006, the city adopted a code provision to implement Policy 4.6.7. The provisions are currently located in Chapter 4.5 of the land development code. Because this application was submitted prior to the adoption of Chapter 4.5, those provisions do not apply directly to the application. Rather, CCP Policy 4.6.7 applies directly.

In its original decision, the city council adopted Condition 27 to insure compliance with Policy 4.6.7. Condition 27 provided:

> "All cuts and fills shown on the grading plan identified as Attachments I.7 and I.8 of the August 10, 2007, Staff Memorandum to the City Councils shall be engineered and constructed such that retaining walls are not required. All lots shall be developed in accordance with Chapter 4.5 – Natural Hazards and Hillside Development Provisions and Chapter 4.10 – Pedestrian Oriented Design Standards from the December 31, 2006 Land Development Code."

Before LUBA, the opponents argued that the city could not demonstrate compliance with Policy 4.6.7 merely by requiring that, at some point in the future, the applicant would be required to comply with Chapter 4.5, the hillside development standards. LUBA agreed that the condition that required compliance in the future was not sufficient to demonstrate compliance with Policy 4.6.7 now.

On remand, the applicant chose to rely on the same cut and fill analysis that it had used in the initial application. A revised condition was imposed that does nothing different than the original condition did. The condition still provides that the mass grading shall be consistent with the cut and fill analysis, and it provides that grading on individual lots, when they occur, will have to comply with Chapter 4.5. This is no different than the original Condition 27. The city is still not requiring an opportunity for public comment at the time in the future when individual lot grading will occur.

In adopting the 2006, Hillside Development Standards, the city council concluded that those standards were sufficient to implement Policy 4.6.7. The standards provide very detailed limits on cutting and filling on development proposed on steep hillsides. It is true that the city is not required, in this application, to demonstrate compliance with those standards, because the application was filed prior to their adoption. However, the city is still free to rely on those standards as a means of demonstrating compliance with Policy 4.6.7. Indeed, it should do so. The city council has already determined, in adopting the hillside standards, that those standards implement Policy 4.6.7. The city therefore has a high burden to demonstrate that allowing anything less restrictive than those standards is sufficient to show compliance with Policy 4.6.7. The geotechnical reports that assert that a development can safely be constructed using extreme cuts and fills (an assertion which opponents question) is not adequate to demonstrate that the proposal minimizes cuts and fills to the greatest extent practicable.

Drainage

The applicant has not submitted a drainage plan. Rather, it has submitted general information showing the approximate directions of water flowing on and from the property. The applicant must submit a drainage plan before the city council can make a determination that applicable criteria are complied with.

Compatibility/Views

LUBA's decision was not merely a direction to the city to "clarify" its decision, as the applicant asserted at last week's hearing. With regard to compatibility and views, LUBA agreed with the petitioners that the city's finding of compliance with criteria related to compatibility and views was not supported by any evidence because the applicant had failed to submit "typical building elevations." LUBA did not call for clarification on this point. It required either the submittal of typical building elevations or other evidence that was sufficient to demonstrate compliance with the applicable criteria. On remand, the applicant has failed to submit either typical building elevations or any other evidence that would allow the city to provide the necessary findings of compliance.

Opponents understand that the applicant does not intend to build the homes, and therefore is reluctant to provide the typical elevations. However, it is not adequate for the applicant to ignore this criterion based on its plans to sell the lots undeveloped. At the very least, the city must impose conditions of approval that are adequate to insure that the future development of the hillside will comply with the applicable approval criteria for preservation of views and compatibility.

Sincerely,

Anne C. Davies

RECEIVED

JAN 27 2009

Community Development
Planning Division

January 24, 2009

To: Corvallis Mayor, City Council, and Planning Staff
From: Susan Morré , 2775 SW Fairmont Drive, Corvallis, Oregon 97333
RE: Brooklane Heights Planned Development (PLD06-00018, SUB06-00006)

Applicants for the Brooklane Heights Planned Development have submitted new information in the Metolius Consulting Report (November 28, 2008) which was not previously offered: "typical building elevations" and a new drainage facility proposal . Required by code but still missing are a detailed drainage plan , a grading plan with 2 ft/5ft topographic intervals, a final geotechnical report, and a site assessment. The new archaeological survey report is not available yet , and a September 25, 2006 wetland delineation is not in the record but available from the Department of State Lands (see attached). This new information allows you to apply relevant review criteria to determine if the proposed development complies with all applicable Comprehensive Plan Policies and 1993 Land Development Code provisions, and if lots can be developed under the 2006 LDC standards. The August 10, 2007 Staff Report recommended denial because too many aspects of this development fail to comply, especially those related to neighborhood compatibility, views of and from the hill, hillside development standards, drainage issues and protection of numerous environmental features deemed to be significant by pre-2006 inventories and protected by Comprehensive Plan policies and purposes.

I urge you to deny the application because it fails to comply with too many fundamental parts of the Comprehensive Plan and 1993 Land Development Code, and the 2006 LDC under which lots would be developed. Most importantly:

1) Lack of neighborhood compatibility or buffering from existing properties who will be most impacted by the development. "Typical elevations" and stated intention to reflect the high-profile characteristics of Fairway View Estates in proposed building styles, mass and placement on lots, is a clear demonstration of lack of compatibility and no attempt to provide transitional elements. In response, the photos of the Fairhaven Heights neighborhood to the north and west of Brooklane Heights reveal predominantly low-profile characteristics that preserve views of and from the hills. and the new information the neighbors provided about existing neighborhood characteristics, clearly demonstrate this development does not reflect or protect existing and desirable neighborhood characteristics;
2) Newly proposed BaySeparator drainage facilities in manholes on slopes do not comply with King County facilities standards which our Stormwater Management Plan implements (Appendix F); a drainage plan has still not been provided; there is no assurance that relevant environmental and public safety standards will be met; DSL WD#2008-0494 wetland delineation September 2008 shows pool, springs and stream in east drainage are wetland ; putting surface detention ponds, berms and a road here are prohitibed by code.

3) The same grading plan that Planning Staff recommended you deny is still before you , and still does not comply with all applicable review criteria for hillside development standards and drainage standards. Two engineers offer expert testimony that repeats our concerns about damage to existing homes, property, and plants if these excessive cuts and fills are allowed (see evidentiary photos of this hillside's nearby slope failure).
4) The development to protect numerous environmentally significant features that are all present on this significant hillside, and whose protection is provided by the Comprehensive Plan (not dependent on the new Land Development Code to be applicable review criteria): Significant Hillside (1983, 1999, 2003), Significant Wildlife Habitat over the entire southeast quadrant of the hillside, Significant Vegetation (upland prairie and oak woodland), and it drains to a Locally Significant Wetland, Significant Views, and Natural Hazard due to steep slopes (12 – over 35% slope). The 2003 Wildlife habitat assessment concludes "Outstanding restoration site due to close proximity to Marys River riparian area." Nothing in the code says choose one item to protect, when there is a whole suite of significant features on the site that are rare and important parts of a healthy ecosystem and contribute to our community's quality of life. Natural Features protection calls for an integrated hillside approach, not staff's current claim that the trees are most important.
5) The Oakmont Subdivision is not dependent on this one. It has a secondary road access at the top of the hill on Whiteside Drive, as shown on the plat submitted with it.
6) Some misinformation has been put forth by the applicant and his partners, and numerous actions to date on the property have failed to comply with existing regulations. That makes it hard to have faith that conditions placed on the property will be respected. Failure to follow applicable permitting policies does not warrant 27 or more waivers from our land development code. It is a little unclear who owns which property and who the partners are because development applications, property tax information, and wetland delineation forms have different information on them. Are there two partners in each development, or just one? This property used to have a 10 acre Douglas-fir forest on it, but it was clearcut by the Oakmont applicant a couple of years ago without having the required development application on file first. The Wetland Delineation says Scott Sanders and TC2 Investments owns the Brooklane Heights property. Mr. Evashevski testified in favor of this application without identifying himself as a partner in the development. Mr. Sanders cut down 24 significant oak trees, two large pine trees, graded and put in a gravel access road before a development application was filed, resulting in a stop work order. After learning about the known archaeological sites on the property, Bob Richardson sent the applicant a letter with the State Historic Preservation Office request to not do any other ground disturbing activities on the site until after an archaeological survey was completed. Disregarding the directive, they dug numerous test pits up to 16 feet deep in some places on the site, until three

city permit inspectors came out and escorted the excavator off the property. The applicant has requested to remove the artifacts, grade and build over the site. Now Mr. Wright is showing misleading photos of a couple of out-of-character houses on our street, trying to make you think that whatever they build on the hill will be compatible because all the homes are different. Our neighborhood has a very distinctly different character than that of Fairway View Estates, and we would like to maintain its very special qualities if any new development that meets the code is allowed. This one does not, and the previous actions of the owners does not warrant numerous waivers. Please enforce the existing Comprehensive Plan and Land Development Codes fairly, and deny this noncompliant application. If they want to present a different application that complies with codes, then they have every right to a fair review, and to develop their property in a manner that meets existing codes and respects the existing neighborhood..

In summary, this proposed development, even with changes made after Planning Commission and LUBA hearings, still fails to comply with numerous applicable hillside development standards, neighborhood compatibility requirements, and significant environmental features protection review standards found in LDC 2.4.20.b, 2.4.30.04,2.5.20.c and h, 2.5.40.04, 4.0.70, 4.5.80, 4.5.110, and CCP 3.2.1.a, b, c, and e, 3.2.3, 3.2.4, 3.2.7, 4.2.2, 4.6.1, 4.6.2, 4.6.7, 4.6.9, 4.7.1, 4.7.3, 4.10.7, 4.10.8, 4.10.9, 4.11.11, 4.11.12, 9.2.2, 9.2.5.a, c, d, f, g, and I, 9.5.2, 9.5.13, and 11.2.1.

List of supporting documents (found at the end of the expanded testimony or already in record):

Jim Howland letter August 10, 2007 – if a founder of the internationally renowned engineering firm CH2M Hill says "It is our opinion that allowing such a cut could destabilize the hillside and cause extensive damage to our and other property."
Email from Dr. Wayne Huber, OSU professor of Civil, Structural and Landscape Engineering – expresses concern about extreme cuts and fills that will likely dewater slopes, dry up wildlife water source, and pose threat of damage to existing home foundations along the upper 2/3 of Fairmont Drive and to native trees and understory plants
Photo of slope failure at same elevation on this hill – why we don't have confidence in the draft Foundation Engineering report – we've seen what actually happens on this slope.
Aerial photo with Brooklane/Oakmont outlined in yellow – demonstrates it is not infill development in a fully developed area (false claim by Metolius report); it is on the edge of the Urban Growth Boundary
EPA Fact Sheet "Protecting Water Quality from Urban Runoff" - clear explanation of changes in runoff patterns, quality, and other characteristics due to impervious cover and urban pollutants
http://www.statelandsonline.com/pdfs/WD2008-0494.pdf
Wetland Delineation/Determination Report Cover Form (shows Scott Sanders as owner)
Wetland Delineation Report from Zion Natural Resources Consulting
Photos of existing homes adjacent to property
Photos of homes at Fairway View Estates

Photos of three failed development in this Southwest Corvallis area
Open Space Advisory Commission May 8, 2007 minutes – expert testimony from Steve Smith, US Fish and Wildlife Service; commission finds that the Brooklane Heights property has numerous significant features, unanimous recommendation to negotiate to conserve it
Corvallis Comprehensive Plan Urban Growth Boundary Advisory Constraints Map 1999 – identifies Country Club Hill as a Significant Hillside
Corvallis Official Zoning Map October 16, 2006 – identifies the adjacent properties as less intensive uses than Brooklane Heights, so buffering is required but not included in the plan.
Significant Vegetation Map 2004 – identifies as significant upland prairie and oak woodland
Significant Wildlife Habitat Map and data sheets 2003 – identifies this section of the hillside as all Significant Wildlife Habitat and notes observations of several species of concern
Riparian Corridors and Wetlands map 2004
Natural Hazards Map
City of Corvallis Landslide Hazards Map
Exerpts from Natural Features Scoping Project – identifies numerous significant features of hillsides, includes Country Club Hill as significant (1983 Hillsides report)
Natural Features Inventory report/NRA map shows synthesis of significant natural features
Natural Features Goal 5 Significance and Impact Area Determinations
Archaeological Report – 1996 report in record already shows at least two known archaeological sites with Smithsonian record numbers; 2008 survey report not ready yet .
Botanical survey (Species List from Brooklane Development, 5/2/07)
Biologist letter Ann Kreager (already in record but misquoted and incorrect inferences drawn by Dec. 24 staff report
Urbanization of Aquatic Systems (Booth and Jackson)
Actinemys marmorata Western Pond Turtle paper (Bruce Bury and David Germano) – notes that water quality degradation and habitat loss are prime threats to pond turtles
March 15, 2007 Bob Richardson letter to David Dodson saying application was incomplete because it did not include the required typical building elevations or design menus, did not show "compliance with Comprehensive Plan Policies that require minimization of disturbances to hillside soil, topography, geology, and hydrology;" concern about locating detention ponds in steep drainageways; area drain impacts, compatibility issues, and applicant's desire to grade and build on top of the known archaeological site)
Property Tax Statement for Oakmont Subdivision (clearcut two years ago but is still in forest deferment, paid about $40 in property tax last year)
Property Tax Statement for Brooklane Heights (Schaberg owner, lives in Arizona now, tax in arrears)

Susan Morse 2775 SW Fairmont Corvallis

<u>Additional details (just for the record)</u>

These new elevations show a total lack of regard for our existing neighborhood characteristics, and no design standards are employed to provide any buffering between our neighborhood and theirs. In fact, the small lots along the western border are over two utility easements and are smaller than our lots to begin with.and for the additional reasons cited by LUBA which still do not enforce the codes and ordinances that are for our broader community benefit. Things have changed over the past few years. We have a housing downturn that is driving down the value of existing homes. Several businesses have closed their doors. We have an uncertain future at Witham Oaks with a builder in Chapter 11 bankruptcy. It is ill-advised to allow such massive soil disturbance and mass grading on a steep slope with no retaining walls. With global warming concerns, we need to protect our carbon-sequestering meadows and woodlands, and build less energy-intensive developments. It is not necessary to waive so many codes to allow development on such an environmentally sensitive site. We already have three other failed developments in Southwest Corvallis that we seen daily on Brooklane, Fairhaven, and 35th. at Philomath Blvd. This has the potential to be a severely disturbed site for years if HP continues to contract town and state budgets remain constricted. We don't have a demonstrated need for housing that would warrant such loose interpretation of our codes, and the potential negative impacts far outweigh the benefit the applicant will derive. The existing neighborhood will get no benefits. All three of these developments are being presented to the City in a piecemeal fashion with no provisions for neighborhood centers or connectivity. The developer has refused all opportunities to provide any pathway from existing homes to the bikepath, or to provide any setback from our back windows as a courtesy. He has provided no pedestrian or bicycle connectivity, and no open space that existing neighbors can enjoy.

Fourth assignment of error has not been addressed adequately. The development application, with lots to be built under 2006 LDC RS-5 zoning, does not comply with the numerous review criteria it is required to satisfy in regard to neighborhood compatibility, reflecting and protecting existing neighborhood characteristics, and buffering from less intensive uses on surrounding lands, especially the existing RS 3.5 homes along Fairmont Drive. The LUBA opinion page 6-7: "LDC 2.5.40.04 requires that a Conceptual Development Plan must be consistent with the city's Comprehensive Plan. Corvallis Comprehensive Plan (CCP) 4.6.7(G) requires in relevant part that development "demonstrate a concern" for views from and to the hillside. CCP 9.2.5 requires development to "reflect neighborhood characteristics." CCP 9.2.5 provides that "development shall reflect neighborhood characteristics appropriate to the site and area," and CCP 9.2.1 requires that land use decisions "protect and maintain" these neighborhood characteristics." Land Development Code 2.5.40.04 states: "Requests for approval of a Conceptual Development Plan shall be reviewed to assure consistency with the purposes of this chapter, policies and density requirements of the Comprehensive Plan, and any other applicable policies and standards adopted by the City Council. In addition, CCP 3.2.2 through 3.2.7 says the application ***shall be reviewed to assure compatibility with less intensive uses*** and potential uses on surrounding lands. Impacts of the following compatibility factors shall be considered: Basic site design, visual elements (scale, structural design and form, materials, and so

forth), noise attenuation, noxious odors, lighting, signage, landscaping for buffering and screening, traffic, effects on off-site parking, and effects on air and water quality." LDC 2.5.20 parts c and h. On May 30, 2008, the Land Use Board of Appeals (LUBA) issued their final opinion and ruling on the Brooklane Heights appeal. It included several relevant rulings on applicable review criteria for compatibility with less intensive uses on surrounding properties, including reflecting existing neighborhood characteristics and consideration of impacts on views of and from the hill. Quoting LUBA:

Page 8: "The city's reliance on the applicant's agreement to comply in the future with inapplicable 2006 LDC design standards is insufficient to show that the development currently meets the applicable code and comprehensive plan requirements regarding compatibility with neighborhood characteristics." (1993 LDC and 2000 CCP, RS-3.5 zoning).

The proposed building styles do not reflect existing neighborhood characteristics, as required by code and by LUBA (CCP 9.2.5, page 6-7 LUBA opinion). They do not assure compatibility with less intensive uses on surrounding lands (CCP 3.2.7, especially A, B, C and G). and they fail to provide any buffering for those existing homes that will be most affected. They have very high rooflines that are out of character with all but two of the homes bordering the west and north sides of the site. The one out-of-character home is one of two existing homes shown in the Metolius report, in a misleading attempt to make it appear that the very high-pitched roofs shown in their "typical building elevations" were somehow compatible and would reflect existing neighborhood characteristics as required by code. Most of the existing homes around the west and north borders above this property have low profile rooflines that are much less intrusive when viewed from below and do not block the views of neighboring homes above them. When the existing neighborhood (Fairhaven Heights) was approved in the late 1950s, covenants restricting the height of buildings on the downhill side of the street were used to protect the view of neighbors above them. Construction of the proposed high-pitched structures would significantly block the view from existing homes and would dramatically change the view of this hillside when viewed from the southern gateway to the community. (See photos included with supporting documents.)

Fifth and Sixth Assignments of Error: **The proposal and the newly worded staff report fail to demonstrate compliance with CCP 4.6.7 hillside standards, and the application cannot simply be conditioned to comply. Excessive 20 ft. cuts and fills, mass grading, and building detention ponds in a delineated wetland in the east drainageway (which was not included in the materials provided to Council) does not comply with numerous hillside development standards, particularly those related to minimizing negative impact on existing topography and hydrology.** Failure to minimize these impacts threatens the integrity of the hillside, may damage trees and foundations of existing homes above it, may cause flooding to properties below, and will significantly degrade the view of the hill as you enter Corvallis from the south. Numerous attached documents support the preservation of this hillside and its numerous special qualities, and the wetland below.

From Metolius Report: (Pages 16 – 19 response to Sixth Assignment of Error, and pages 28 – 37 are six pages from the BaySaver manufacturer and four pages from Washington Department of Ecology conditional use designation for the BaySaver for pretreatment of runoff, to be installed ahead of infiltration treatment or other enhanced treatment device such as a sand or media filter. The applicant proposed to install these BaySaver separator facilities in two manholes in a drainageway that is over 15% slope, perhaps greater. It is hard to tell because the applicant has still failed to provide a topographic map with 2 foot contour lines. However, King County standards do not allow use of this type of facility on slopes over 5%. Therefore, this drainage plan does not comply with the King County Standards, or with the Stormwater Master Plan that is based on those standards.

Page 16 Metolius report says "The existing drainage patterns for the project site are illustrated in Drawing 1.9. This drawing shows the predominant overland drainage pattern is downhill into an existing public storm drainage system along the north side of an existing private road. From this public storm drainage system the water is routed under Brooklane Drive and has several outfalls into a historic drainage ditch along the Marys River Natural Park. The historic drainage ditch has been documented as a wetland and restoration around the drainage ditch has focused on creating wet prairie that is most sensitive to water levels and not water quality." (NOT TRUE. On January 16, 2009, I spoke with Dr. Tom Kaye whose Institute for Applied Ecology is conducting the restoration of this locally significant wetland in conjunction with US Fish and Wildlife's Natural Resource Conservation Service and Benton County, and he said "tell that to the pond turtles" and birds, salamanders, frogs....)

Page 17 Metolius unsubstantiated claim: "The proposed project does not interfere with the existing drainage patterns." Justification: "The proposed development utilizes the existing public storm drain system and maintains existing storm drain outfalls to the wetland area."

This unsubstantiated claim fails to account for the dramatic changes in slope hydrology that will be caused by the increase in impervious cover on steep slopes, large amounts of cuts and fills (up to 23 feet in some parts, up to eight feet on all lots) and the diversion of runoff through storm drains and over impervious surfaces to two detention ponds in the middle City-documented drainageway (to be constructed over the site of the existing springs, pond, and year-round small stream) and to a proposed new drainage swale in the easternmost drainage. In addition, the applicant did not include recent documentation from a wetland delineation study done by Zion Natural Resources that identifies the eastern drainageway springs, pool and stream as "potentially jurisdictional wetlands" totaling 0.12 acres (See DSL WD#2008-0494 in Appendix).

The hill is too steep, the plan they submitted does not fit the topography or hydrology or geology, and it fails to preserve this visually significant slope that can be seen from the southern gateway. Quote LUBA: Concerning Page 10: The 2006 LDC hillside development standards are not applicable to the challenged decision. Rather, CCP 4.6.7 is applicable." Page 14: **the city will need to adopt new findings on remand that either explain how the 2006 LDC hillside grading standards implement each of the CCP 4.6.7 provisions or find compliance with each of the provisions of CCP 4.6.7."** The revised grading plan that was approved by the City Council uses 10 foot contour lines instead of 2

foot lines, and it shows grading up to 20 feet deep. The accompanying narrative in the application mentions up to 23 feet in some spots. While both the Metolius report and the new City Staff Report list each of the provisions of CCP 4.6.7, a careful reading of the accompanying claims reveals that the proposal still fails to implement or comply with eight of its nine provisions:

- *CCP 4.6.7.A. Plan development to fit the topography, soil, geology, and hydrology of hillsides and to ensure hillside stability both during and after development.* (The massive cuts and fills proposed do not fit and do not ensure hillside stability.)
- *CCP 4.6.7.B. Preserve the most visually significant slopes and ridgelines in their natural state by utilizing techniques such as cluster development and reduced densities.* (This visually significant slope is not preserved in its natural state.)
- *CCP 4.6.7.C Preserve significant natural features such as tree groves, woodlands, the tree-meadow interface, and specimen trees.* (Other examples of significant natural features on this site, acknowledged by the City in previous documents, include upland prairie, significant wildlife habitat and significant slope, none of which are preserved.)
- *CCP 4.6.7.D Align the built surface infrastructure, such as roads and waterways, with the natural contours of terrain and minimize cutting and filling in developments.* (Cutting and filling are not minimized but instead are up to two and a half times what is allowed, because the main proposed road does not align with the natural contours for over half of its length.)
- *CCP 4.6.7.E Minimize soil disturbances and the removal of native vegetation and avoid these activities during winter months unless impacts can be mitigated.* (Major soil disturbances are proposed, including mass grading and deep cuts into the steep slope.)
- *CCP 4.6.7.F Design developments and utilize construction techniques that minimize erosion and surface water runoff.* (Mass grading construction techniques do not minimize erosion and surface water runoff.)
- *CCP 4.6.7.G Demonstrate a concern for the view of the hills as well as the view from the hills.* (Views of and from the hills are both degraded and obstructed by the number, scale, mass and design of the "typical building elevations" recently provided by the applicant, and the proposed new street trees that would further block views across the upland prairie , oak woodland wetland and river.)
- *CCP 4.6.7.H Provide landscaping that enhances the identified open space resources.* (The proposed tree-lined streets do not enhance the open space resource of significant upland prairie, significant Oregon white oak woodland, and the significant wildlife habitat they provide.)

Seventh Assignment of Error: The applicant and staff are trying to say that by protecting the Significant Tree Groves, they are complying with required protection of environmentally significant features and that the City has prioritized protection of trees over other features. Numerous other

environmentally significant features will be removed or degraded, but no mitigation is proposed, and they have failed to demonstrate that there is any greater benefit to the broader community. The Comprehensive Plan required ongoing updates of significant hillsides, following the 1983 Hillsides Report; the 1999 Corvallis Urban Growth Boundary Advisory Constraints Map is a companion to the Comprehensive Plan, and updates the 1983 report. It shows this whole hillside to be significant, with diverse types of wildlife habitat including upland, riparian areas, and woodland. There is nothing in the code that supports the interpretation that to preserve one significant feature to the exclusion of numerous other meet required codes, policies and standards.

Photos included with my testimony show the vast majority of homes along the downhill sides of our Fairhaven Heights neighborhood (Fairmont to Fairhaven) and south side of Whiteside have low profile rooflines that don't block uphill neighbor's views. Mr. Wright showed you the only two that were not compatible, and disingenuously stated that 50% of the houses were like that. Those two high-pitched roofs are at or near the bottom of the hill. One of them was expanded when the neighborhood covenants lapsed. The low-profile homes along the western and northern borders of the property (above it). Only three of them don't demonstrate the unifying theme of this neighborhood: across the meadow, oak woodland, wetland, Marys River, and across the valley to the Cascades. The "typical building elevations shown in the Metolius plan emonstrates elevations provided aren't compatible, newly submitted "typical building elevations" clearly don't reflect existing neighborhood characteristics, not compatible with less intensive uses on adjacent lands, negative impact on views of and from the hills

This development application as proposed does not meet the standards for neighborhood compatibility, and fails to provide any buffering from its more intensive development, which is required by the Comprehensive Plan. This lack of consideration for existing homeowners violates several Comprehensive Plan and Land Development Code policies.

Oregon State Law requires that City Land Use Planning decisions be based on factual information. The Metolius Consulting Report submitted to you on November 24, 2008 and oral testimony of the applicant's agent Scott Wright on January 5 and 20, 2008 contain inaccurate and misleading information regarding neighborhood characteristics of the area immediately adjoining this property. Therefore, the staff report is making some unfounded conclusions based on this misleading information supplied to them by the applicant. In addition, the latest staff report claims certain review criteria, policies, and standards do not apply (the city must apply the 1993 Land Development Code and 2000 Comprehensive Plan policies on compatibility, hillside development standards, and protection of environmentally significant features) when LUBA has ruled that they do (page 8 LUBA opinion). Please check the actual language in the LUBA appeal, and look at the attached supporting documents that follow this very short summary of reasons that support your denial of the Brooklane Heights Planned Development in its current state. More extensive narrative supporting my summary statements follows at the end of this packet of testimony, in case you want detailed supporting arguments.

State law determines the applicable criteria as follows:
227.173 Basis for decision on permit application or expedited land division; statement of reasons for approval or denial.
(1) Approval or denial of a discretionary permit application shall be based on standards and criteria, which shall be set forth in the development ordinance and which shall relate approval or denial of a discretionary permit application to the development ordinance and to the comprehensive plan for the area in which the development would occur and to the development ordinance and comprehensive plan for the city as a whole.
(3) Approval or denial of a permit application or expedited land division shall be based upon and accompanied by a brief statement that explains the criteria and standards considered relevant to the decision, states the facts relied upon in rendering the decision and explains the justification for the decision based on the criteria, standards and facts set forth.
227.175 Application for permit or zone change; fees; consolidated procedure; hearing; approval criteria; decision without hearing.
(4) The application shall not be approved unless the proposed development of land would be in compliance with the comprehensive plan for the city and other applicable land use regulation or ordinance provisions. The approval may include such conditions as are authorized by ORS 227.215 or any city legislation.

Response to Dec. 24, 2008 Staff Report unsubstantiated claims:

P. 25 Staff Report inaccurately states "Comprehensive Plan Policies are not standards that must be adhered with, they are decision-making guidelines."

This is a misreading of Comprehensive Plan 1.2. Statewide Planning Goals and the Corvallis 2020 Vision Statement are the basis of the Comprehensive Plan, which has criteria for development review that are the basis of the Land Development Code standards. The Land Development Code is supposed to implement the Comprehensive Plan policies. In relevant part:

Policies:
1.2.1 The City of Corvallis shall develop and adopt appropriate implementation mechanisms to carry out the policies of the Comprehensive Plan.
1.2.9 The applicable criteria in all land use decisions shall be derived from the Comprehensive Plan and other regulatory tools that implement the Plan.

P. 25 Staff Report states: "the term "upland prairie" does not appear anywhere in the Comprehensive Plan."

Upland prairies in the past have been referred to as grasslands or meadows. Several portions of the Comprehensive Plan refer to them:
4.2.1 Significant natural features within the Urban Growth Boundary shall be identified and inventoried by the City or through the development process. These shall include:

A. Seasonal and perennial streams and other natural drainageways, wetlands, and flood plains;
B. Lands abutting the Willamette and Marys Rivers;
C. Land with significant native vegetation as defined in the Oregon Natural Heritage Plan (1998), which may include certain woodlands, ***grasslands,*** wetlands, riparian vegetation, and plant species.
The Oregon Natural Heritage Plan notes that
CCP 4.6 Hillside Findings states in 4.6.g; " Corvallis residents value the views of and from the City's tree and ***meadow-covered hills.*** *These natural features are a dominant visual characteristic of the community."*
4.13.c Important plant communities and animal habitat areas include riparian vegetation, ***hillside meadows, wetland prairies,*** *tree groves and the urban forests. The City has not inventoried and reviewed significant plant and wildlife areas that warrant protection.*

There are several discrepancies between the applicant's testimony at the remand hearings, and the details found in the latest Foundation Engineering report dated May 20, 2008. The applicant submitted this May 20, 2008 "Draft Geotechnical Investigation" on October 3, 2008 with their request for a remand hearing. There is new information provided in this new report that calls into question the reliability of the applicant's testimony about slope stability and drainage concerns. It also provides new traffic estimates that are more than double the estimated trips per day previously provided by the applicant from PTV America. While traffic concerns per se were not a remanded issue, they are one of the compatibility review criteria in Corvallis Comprehensive Plan (CCP)3.2.7.I and are therefore relevant to the remand deliberations. The applicant has provided new traffic estimates associated with the development that contradicts their previously submitted information, and is therefore one more item that deserves your consideration as you review the facts of this remanded application. You are charged by state law and local codes to make your decision on the basis of facts, but there are numerous inconsistencies in the applicant's information that make it difficult to know which information is accurate.

<u>On traffic and neighborhood compatibility:</u>

The new Foundation Engineering report mentions that a traffic impact study had not yet been completed, so they did their own estimation of numbers of concrete and materials trucks and personal auto trips. However, a traffic impact analysis (TIA) from PTV America was submitted by the applicant in February 2007 (dated January 2007, based on data collected in mid-December). A second TIA report was later submitted to correct some calculation errors in the first report. The January 2007 TIA report, page 8, estimated a total of 145 trips per day for the Brooklane and Oakmont subdivisions combined (66 houses at that time, now 69). (We questioned the accuracy of that estimate at previous hearings because they did not appear realistic.)

This May 2008 Foundation Engineering report, page 9, estimates 360 cars and light trucks per day plus one heavy truck – that is two and a half times what the previous TIA report estimated, so the original TIA intersection failure calculations are called into question. The May 2008 Foundation Engineering report on page 9 also estimates "construction traffic at the beginning of the development including 5 concrete trucks, 10 dump trucks, and 10 material delivery trucks per lot." That totals 1675 heavy trucks on Brooklane Road or on 45th street. It is not clear if these estimates also included dump trucks hauling soil away from the site. (The geotechnical report says the subsoil is of variable plasticity and is too soft to be used as fill and should be excavated and replaced with new material.)

This raises greater concerns about the reliability of information being submitted to you, safety of pedestrians and bicyclists on Brooklane, the ability of this roadway to bear this amount of traffic, and road repair costs the City will incur. Traffic impacts to less intensive uses on surrounding lands (which include the wetland and the RS 3.5 older established neighborhood to the north and west of the site) is one of the review criteria of Comprehensive Plan 3.2.7 under which this development application "shall be reviewed to assure compatibility with less intensive uses and potential uses on surrounding lands" (CCP 3.2.7.I).

<u>On cuts and fills, slope stability and drainage:</u>

The May 2008 FE report says on page 6: "Deep cuts and utility excavations made in very weak to weak shallow sandstone will either require heavier equipment than the excavators used for our explorations, pre-drilling, and splitting or use of a hydraulic ram. We anticipate blasting is not a feasible option due to nearby residences. Contractors bidding on the work should be provided a copy of this report to qualitatively evaluate the difficulty of the excavations...." As owner of an adjacent residence, I am relieved that they don't propose to do blasting but I am concerned about the potential impacts to adjacent property from use of a hydraulic ram within a few feet of the lot lines of neighboring homes.

Comprehensive Plan policies prohibit excavating so close to the property line. The applicant cited previously approved development at Timberhill as justification for allowing greater than 8 ft. cuts and fills on this property. However, the record shows that the City required a minimum of 30 feet of natural topography be preserved between adjacent existing backyards and any cuts and fills on the new development. (See previous documents submitted to City Council, part of the LUBA record.) However, this Brooklane Heights development proposes to excavate within a few feet of existing back yards, up to 20 feet deep, with no retaining walls.

This proposal should be denied, and allow the applicant the opportunity to come up with one that meets the relevant parts of the code. If you approve it, I am very concerned about the impacts on slope stability and hydrology that will be created by the extensive cuts and fills and the disruption of the natural water patterns on this hillside that is hydrologically connected to the wetland below. I have

attached an email from Dr. Wayne Huber, OSU professor of civil, structural and environmental engineering, expressing concerns about dewatering the slope by this disruption of the surficial aquifer. He mentions the red flag it raised for him about negative impacts on homes above the slope and on existing vegetation that relies on the slow release of winter rainfall stored in the hillside soils over the dry summer months. The attached EPA report "Protecting Water Quality from Urban Runoff" offers more information on this issue.

More from FE report page 6: "The proposed grading will require building an embankment across the East Drainage." This is technically a drainageway with a year-round spring, pool and stream lined with riparian vegetation, so it is subject to numerous provisions of the Comp Plan and LDC that would prohibit construction of a road and embankment or disruption of the existing water feature. "It is possible that concentrated seepage or springs may develop in cut slopes at isolated locations....The observed iron-staining of the surficial soils suggests that rainfall perches within a few feet of the ground surface during the wet portion of the year. It is difficult to predict where seepage may be encountered during construction. However, ground water infiltration should be anticipated in deep cuts and excavations. Permanent mitigation of seeps and springs, which daylight along the face of cut slopes may be required as they are encountered during construction to reduce the risk of localized slope instability....Shallow ground water can accumulate in granular trench backfill. In long segments of trenches extending down sloping terrain, the water can develop significant pressure that can be detrimental to pavements....The plasticity of the residual soil varies with location and depth....Medium to high plasticity soils may also be encountered at some locations. Such soils typically have moderate to high potential to shrink and swell with seasonal changes in moisture content. Shrinkage or swelling of the subgrade could cause cracking and distress in slabs, foundations and structures if not properly mitigated...." They caution that if expansive soils are present there will be "required overexcavation." This is not consistent with our codes that are designed to minimize cuts and fills and to follow the natural topography.

Page 10 states "The subgrade soils are sensitive to moisture, will soften when wet, and pump under construction traffic." Additional cautions are expressed about costs to install utilities and roads to serve this subdivision on a too-steep slope with shallow surficial aquifers, some areas with just a few inches of soil over rock where excavation up to ten feet is proposed. At one point the application talks about using cut materials for fill, but the earlier FE report said the soils were of variable plasticity (some low to medium and some medium to high) subject to shrink and swell with rainfall, and would need to be replaced with other fill material that would compact and stay compacted. Page 4 of the May 2008 report says that on December 6, 2005 "We observed an active spring, wet conditions, and/or standing water at various locations in the East Drainage." (That includes the spring-fed pool and year round stream. However, the applicant failed to identify this spring, pool and stream on any of the documents submitted to you, and David Dodson told the Planning Commission he was not aware of any such spring or small stream on the property.)

This casts doubt on the accuracy of Scott Wright's January 20 assertion that Foundation Engineering assured them they could go far deeper on cuts and fills but they chose to "pull back to just 20 ft." In response to a question from Councilor Richard Hervey, Mr. Wright said that they do not plan to build retaining walls. However, the May 2008 FE report says on page 8: "We understand rockery walls may be constructed associated with the site grading work. The actual heights and locations were not established at the time this report was prepared. Therefore, we have limited our work to providing general recommendations. We assume the actual design of rockery walls will be by others." Appendix A, figure 7A shows "typical rockery wall detail" in front of an excavated slope, with large boulders. Yet Scott Wright says they are not proposing to construct any retaining walls, and that Foundation Engineering had assured them they could excavate far deeper than 20 feet. Just as in the previous lack of consistency between what the earlier Foundation Engineering reports recommended for detention ponds and those proposed by the applicant, there are further discrepancies between what FE recommends for stabilizing the cut and fill slopes and what the applicant is proposing to do. This proposed project fails to meet hillside development standards and if approved, it poses a very real risk to existing properties adjacent to it, above and below the site, as noted in the Planning Staff Report dated August 10, 2007. According to Dr. Wayne Huber, OSU professor of civil, structural, and environmental engineering, damage may result to existing homes, soils and trees above the site due to the excessive cuts and diversion of groundwater that will result in dewatering the slope. This is likely to cause greater drying out of soils in summer and may cause foundations to crack and landscape plants and native trees to die. When the water that now infiltrates into the slope is instead running down asphalt, diverted to storm drains, and dumped out in the wetland, it will not approximate the pre-development water discharge patterns or water quality as the applicant claims.

<u>On neighborhood compatibility:</u>

There is a discrepancy between information submitted by the applicant in testimony and in the Metolius Consulting report, and facts about existing neighborhood characteristics. Numerous Land Development Code and Comprehensive Plan policies address compatibility review criteria which are ignored in this development proposal.

This close excavation on several lots in the northwest corner, lots which are smaller than those of the adjacent RS 3.5 neighborhood, and the lack of any separation from existing homes along Fairmont Drive is a violation of Corvallis Comprehensive Plan (CCP) policies CCP 3.2.3, 3.2.4.B, and 3.2.7. This basic respect for existing residents' quality of life is one reason that our Comprehensive Plan requires that compatibility conflicts **"shall** be addressed through greater building separation and buffering elements, and states the new development **shall** provide these transitional elements because they are proposing to build at RS-5, which is more intensive than our existing less-intensive RS-3.5. The code language says "**shall be reviewed to assure compatibility** with less intensive uses." "Impacts of the following factors **shall** be considered" including 3.2.7.a Basic site design (i.e. the organization of uses on a site and its relationship to neighboring properties).

The planning staff is trying to assert that you only need to be concerned about blocking the views and providing buffering setbacks for the minority of those affected by this development, rather than for the majority of them, by claiming they've considered the impact on the folks who live on Whiteside (the owner's former home) by simply cramming all the houses as close as possible to the folks who live on Fairmont. This does not fairly implement the code.

In addition:

1.1 Local Planning Context

Background

The Corvallis Comprehensive Plan is the document through which the citizens of Corvallis have made the basic choices on how land development and redevelopment should occur and how it will be managed. Consistent with Statewide Planning Goals and Guidelines, and the Corvallis 2020 Vision Statement, the Plan is intended to maintain and improve the existing quality of life for all residents within the Urban Growth Boundary. The following specific objectives, with minor modifications, have been in the Comprehensive Plan since 1980:

C Encourage only development that maintains and/or improves the existing quality of life of residents.

C Identify and protect resource lands from encroachment by urban development.

C Protect individuals from the negative impact of developing lands that have natural hazards or which are subject to natural disasters.

C Provide for the retention of natural and cultural resources that contribute to the livability of the community.

1.1.8 City adopted indicators of livability shall be considered in making land use decisions.

1.2 Local Planning Process

The policies and land use designations of the Comprehensive Plan establish the limits within which land development and public investment that affect the physical character of the community will occur. They provide the framework for more detailed plans and other implementation tools that also will guide and direct public and private investments (see Figure 1.1).

Implementation Tools include Plans, Regulations (including the Land Development Code, which "ensures that development is in all respects consistent with the goals and policies of the Corvallis Comprehensive Plan"**and other ordinances), the City Charter, and other initiatives (including** "The LDC also "Resource inventories, such asinventories of wetlands, buildable lands, and historic resources, are toolsfor ensuring that development within the City is consistent with thepolicies of the Comprehensive Plan.")

Findings:
1.2.a All Comprehensive Plan policies must comply with current State land use laws, Statewide Planning Goals and Guidelines, and State policies.
1.2.c The policies of the Comprehensive Plan are influenced by many factors, including economics, social need, and the community's vision.
1.2.i Specific area plans have been used to develop concepts for future development patterns. [NOTE: Citizens submitted a formal request for the development of an Area Plan for Southwest Corvallis in 2006 before any more subdivisions or planned developments were approved. The City added this to their work plan for the past biennium, but has not yet acted on this task. In the meantime, three more development proposals, including Brooklane Heights, have been proposed for this significant hillside, totaling 39 acres.]
1.2.j According to State law, the City is to specify applicable ordinances and plans in all land use decisions.
2.1 Relevant Vision Statement Elements
"Corvallis in 2020 fosters citizen participation in all aspects of community decisions. Neighborhood organizations are vigorous, and their meetings and ward meetings provide opportunities for formal and informal discussions of community issues. Most citizens vote and regularly discuss issues with their neighbors, Councilors, and the mayor. Citizens are confident that their elected representatives will carefully consider their ideas and opinions."
2.2.9 The City shall seek participation from citizens within the entire Urban Growth Boundary in all land use planning.

The Dec. 24, 2008 Staff Report doesn't mention the existence of the 1999 Comprehensive Plan Urban Growth Boundary Advisory Constraints Map, which was submitted as part of the record in the previous City Council Brooklane Heights hearing appealing the Planning Commission denial of the application. Quoting the City of Corvallis Community Development Department website :

"The Advisory Constraints Map is intended to accompany the Comprehensive Plan Map. This map shows natural resource constraints that may impact future development in the Urban Growth Boundary, including probable wetlands and the 100-year flood plain. The map is to be used for informational purposes only. It is expected that additional field verification or study will be needed to confirm actual development constraints."
Policies
3.2.1 The desired land use pattern within the Corvallis Urban Growth Boundary will emphasize:
A. Preservation of significant open space and natural features;
B. Efficient use of land;
C. Efficient use of energy and other resources;
D. Compact urban form;

E. Efficient provision of transportation and other public services; and
F. Neighborhoods with a mix of uses, diversity of housing types, pedestrian scale, a defined center, and shared public areas.

3.2.3 The City shall address compatibility conflicts through design and other transitional elements, as well as landscaping, building separation, and buffering.

3.2.4 In the case of compatibility conflicts, requirements will be imposed on both sides of a given property line, in the following manner:

A. Where both lots are undeveloped, each will be required to provide transitional elements when it develops.

B. The development in the more intensive development district shall provide the bulk of the transitional elements but shall not be required to provide the full amount unless the property in the less intensive district is already developed.

3.2.7 All special developments, lot development options, intensifications, changes or modifications of nonconforming uses, Comprehensive Plan changes, and district changes shall be reviewed to assure compatibility with less intensive uses and potential uses on surrounding lands. Impacts of the following factors shall be considered:

A. Basic site design (i.e., the organization of uses on a site and its relationship to neighboring properties);
B. Visual elements (i.e., scale, structural design and form, materials, etc.);
C. Noise attenuation;
D. Odors and emissions;
E. Lighting;
F. Signage;
G. Landscaping for buffering and screening;
H. Transportation facilities; and
I. Traffic and off-site parking impacts.

Comprehensive Plan Article 4. Natural Features, Land, and Water Resources:

Article 4. Natural Features, Land, and Water Resources

Article 4 Amended April 18, 2002 and November 28, 2002

4.0 Background

This Article, as well as the following two Articles, Urban Amenities and Willamette River Greenway, address a broad range of topics, all having to do with the resources within and adjacent to the Corvallis Urban Growth Boundary. These Articles reflect the concerns expressed in several of the Statewide Planning Goals including: Goal 3 - Agricultural Lands; Goal 4 - Forest Lands; Goal 5 - Open Spaces; Goal 7 - Natural Hazards; Goal 8 - Recreational Needs; and Goal 15 - Willamette Greenway.

The Corvallis Urban Growth Boundary includes a number of diverse environmental communities, ranging from the Willamette River corridor to the forested foothills of the Coast Range; from urbanized valley flatlands to large tracts of land used for agricultural and commercial forestry purposes. Each diverse environmental community offers opportunities and limitations for future urban expansion and redevelopment.

The natural environments included within the Urban Growth Boundary all have their own respective limitations with regard to urbanization. Development pressure upon lands with such limitations can have profound effects on a given ecosystem. Erosion of steep slopes caused by inappropriate development, for instance, does not occur as an isolated incident. Soil type, permeability, vegetation, and drainage all play major roles in and are affected by such occurrences. Likewise, the effects of inappropriate development located within prime agricultural resource lands do not stop at the edge of such development. The social, cultural, and economic values of such resource lands could be reduced by the effects of urban development nearby. The limitations of the various environments should be considered in reviewing new development within the Urban Growth Boundary.

The natural environments within the Urban Growth Boundary offer many opportunities for unique and healthy urban development. Those environments, when viewed as a series of systems rather than isolated features, will provide Corvallis with those things necessary for a healthy place in which to live, work, and play. Urban streams and other drainageways, for example, can provide the community with an excellent system of open space links between neighborhoods and services, in addition to providing a system for storm water runoff.

It is to the community's benefit that consideration be given to both the opportunities and the limitations of the various environments within the Urban Growth Boundary.

The recognition of the natural environment in the Corvallis Urban Growth Boundary and the development of findings and policies which address the characteristics of the environment are extremely important elements in the Comprehensive Plan. The purpose of this Article is to define the parameters of the various natural environments in the Urban Growth Boundary and to identify the limitations and opportunities inherent in those environments. The purpose of this Article is also to outline the community's role in ensuring that future development is harmonious with its natural environment.

4.1 Relevant Vision Statement Elements

"Corvallis in 2020 has successfully integrated its economic and population growth with the preservation of its scenic natural environment, open spaces, clean air and water, wildlife habitat areas, and recreational opportunities."

"We value the beauty of our surroundings: the hills, valleys, forests, streams, rivers, and clean air. We value living in a City that is in harmony with these natural beauties, and seek to build for the future with this in mind. Corvallis recognizes the connection between development patterns and impacts on the environment. More efficient land-use through higher densities and compact development reduces the amount of land required for development and the negative impacts of an extended infrastructure. Careful design ensures that development minimizes impacts on plant

communities, wildlife habitat, and scenic areas, as well as enhances the sense of place and community character. In order to protect the environment, our growth rate has not exceeded necessary infrastructure."

4.2 General Natural Features, Land, and Water Resources

Findings

4.2.a Natural features are an important asset to the visual and environmental characteristics of the community.

4.2.b The Willamette and Marys Rivers are vital open space and recreation features.

4.2.c When natural systems are altered, they may not recover or return to their original state and ecological function. We do not yet fully understand the complex interactions between natural systems, or the cumulative impacts of changes on such systems.

4.2.d Planning for specific areas of the community is being used to supplement and coordinate efforts to maintain and enhance natural features within the community and between communities.

4.2.e The Land Conservation and Development Commission Periodic Review Order No. 001-223 directs the City to adopt a Comprehensive Plan policy "for completing inventories for riparian corridors and wetland resources, including schedules, budgets and enforceable provisions."

Policies

4.2.1 Significant natural features within the Urban Growth Boundary shall be identified and inventoried by the City or through the development process. These shall include:

A. Seasonal and perennial streams and other natural drainageways, wetlands, and flood plains;

B. Lands abutting the Willamette and Marys Rivers;

C. Land with significant native vegetation as defined in the Oregon Natural Heritage Plan (1998), which may include certain woodlands, grasslands, wetlands, riparian vegetation, and plant species;

D. Ecologically and scientifically significant natural areas;

E. Significant hillsides;

F. Outstanding scenic views and sites; and

G. Lands that provide community identity and act as gateways and buffers.

4.2.2 Natural features and areas determined to be significant shall be preserved, or have their losses mitigated, and/or reclaimed. The City may use conditions placed upon development of such lands, private nonprofit efforts, and City, State, and Federal government programs to achieve this objective.

4.2.3 The City shall maintain an advisory constraints map that identifies potential development constraints. This map shall be updated periodically as new information becomes available.

4.2.4 The City shall develop methods to track information indicating biological or archeologically sensitive sites for use in directing future inventory activities on those sites.

4.2.5 The City shall complete inventories of and develop protection standards for riparian corridors and wetland resources

Upon completion of the inventories (June 2003), the City Shall initiate a process for identifying from within these inventories the natural features to be considered "significant." This effort will be completed consistent with the requirements of Goal 5 and will also include a process to balance the impacts of protecting such features against the requirements of other Statewide Planning Goals and Rules [e.g., economic development (Goal 9) and needed housing(Goal 10)].

4.5.5 The City shall conduct further studies on methods to protect natural resources from the negative effects of development such as transfer of development rights, Open Space - Conservation districts or other useful measures.

4.6 Hillsides

Findings

4.6.a Fifteen hills and ridges, eleven within the City Limits, and four within the Urban Growth Boundary, were identified in the Open Space - Hillside Report (1983) as enhancing the attractiveness of the Corvallis skyline. Recent community input indicates there may be more significant hillside sites than previously identified.

4.6.b Due to the visual and environmental character of the hills and ridges, development must be sensitive to natural features, tree canopy, and community aesthetic values.

4.6.c Hillside development changes the landscape and results in increased runoff and increased downstream peak flows. Changes generally include the loss of trees and shrubs that intercept and re-evaporate rainfall plus hillside cuts that prematurely bring ground water to the surface. Poor development practices on hillsides can require increased public expenditures for flood and erosion control and storm water management.

4.6.d There are hillside areas within the Urban Growth Boundary that are prone to landslides. These areas are also associated with poor drainage, shallow subsurface flow of ground water and springs, and high susceptibility to erosion. Landslides can destroy roads and buildings and wildlife habitat, and adversely affect water quality and fishery potential within and downstream of the Urban Growth Boundary. Mass movement has not resulted in any major loss of life or property thus far, because there has not been significant development in hillside areas susceptible to problems.

4.6.e The City of Corvallis has adopted by ordinance the excavation and grading regulations as set forth in the Uniform Building Code.

4.6.f The City of Corvallis requires certain new construction to have an erosion control plan to ensure against adverse effects such as erosion and sedimentation.

4.6.g Corvallis residents value the views of and from the City's tree and meadow-covered hills. These natural features are a dominant visual characteristic of the community.
4.6.h Residential development using alternative methods such as clustering or reduced densities on hillside locations can minimize erosion and other environmental impacts, and preserve the views of and from the tree covered hills in the community. In addition, clustering can reduce the cost of public facilities and services.
4.6.i Slide scars are hazardous areas on which to build and with geological investigation, can be identified.

Policies
4.6.1 The City shall update the current hillside inventory. Until that time the City shall utilize the Open Space - Hillside Report (1983) and the Open Space Plan - Corvallis Planning Area (1979) to identify areas of significance during the review of annexations and developments.
4.6.2 Development on hillsides shall not endanger life and property nor land and aquatic resources determined to be environmentally significant.
4.6.3 Tree-covered hillsides within the City Limits shall retain a tree-covered appearance prior to development review. Selective logging could be permitted with a Cityapproved plan that assures hillsides within the City Limits retain a tree-covered appearance. On these hillsides, clear-cuts and other significant tree removal should not be permitted prior to development.
4.6.7 In areas where development is permitted, standards in the Land Development Code for hillside areas will achieve the following:
A. Plan development to fit the topography, soil, geology, and hydrology of hillsides and to ensure hillside stability both during and after development.
B. Preserve the most visually significant slopes and ridgelines in their natural state by utilizing techniques such as cluster development and reduced densities.
C. Preserve significant natural features such as tree groves, woodlands, the tree meadow interface, and specimen trees.
D. Align the built surface infrastructure, such as roads and waterways, with the natural contours of terrain and minimize cutting and filling in developments.
E. Minimize soil disturbances and the removal of native vegetation and avoid these activities during winter months unless impacts can be mitigated.
F. Design developments and utilize construction techniques that minimize erosion and surface water runoff.
G. Demonstrate a concern for the view of the hills as well as the view from the hills.
H. Provide landscaping that enhances the identified open space resources.

4.6.9 Where development of hillsides occurs, removal of vegetation will be minimized to control erosion. Vegetation disturbed during development shall be replaced or

enhanced through landscaping.

Policies

4.7.1 Developments shall not be planned or located in known areas of natural hazards without appropriate safeguards.

4.7.3 Prior to development, the City of Corvallis may require site-specific soil surveys and geologic studies where potential hazards are identified based upon available geologic and soils evidence. When natural hazards are identified, the City shall require that special design considerations and construction measures be taken to offset the soil and geologic constraints present in order to protect life and property, and to protect environmentally hazardous areas.

4.7.4 The City shall provide mechanisms such as density transfer and Open Space - Conservation districts (or other reduced density provisions) to reduce the risks of natural hazards and provide protection for significant natural features.

4.9 Water Resources

Findings

4.9.a The water resources in the Urban Growth Boundary include streams, rivers, drainageways, lakes, wetlands, and flood plains.

4.9.b The water resources and associated riparian vegetation in the Urban Growth Boundary contribute to the health, safety, and general welfare of the area. The stability of natural systems and vitality of the community depend on the high quality of water provided by these resources.

4.9.c Water resources contribute to the general aesthetic quality and attractiveness of the area inside the Urban Growth Boundary.

Policies

4.9.1 Significant watercourses, lakes, and wetlands shall be preserved, or have their losses mitigated, in order to: maintain clean water, support natural vegetation, protect the aquatic habitat, retain existing significant public vistas, and provide wildlife habitat and recreation sites. Site-specific buffering and setback requirements may be required, as necessary, to achieve protection.

4.9.2 The City shall explore opportunities to acquire lands to preserve stormwater functions through outright purchase, conservation easements, and partnerships. (UP-6)

4.10 Urban Streams and Other Drainageways

(See Section 4.8 - Flood Plains and Flood Hazards for closely related findings and policies.)

Findings

4.10.e Upstream development has downstream impacts on stream channels, amount of water, water quality, and downstream lands.

4.10.f Urbanization increases the amount and rate of surface runoff. Unless properly

managed, this runoff increases flooding hazards and erosion in the drainage basins of the community including, but not limited to, the Frazier Creek, Jackson Creek, Oak Creek, Dixon Creek, Ryan Creek, Sequoia Creek, Squaw Creek, and Millrace Basins, and their tributaries.

4.10.g Other impacts of improperly managed urban drainageways include reduced water quality and loss of recreation opportunity, wildlife habitat, and fishery potential.

4.10.h Filling and removal along and within drainageways can negatively affect their functions by altering the stream channel and reducing water storage and transport capacity.

4.10.i Adequate setbacks along natural drainageways are necessary to protect the stream channel, riparian areas and water quality. Such setbacks also provide smooth transitions between urban development and the drainageway water course.

4.10.j Inadequate dedication of land along urban streams and drainageways has permitted construction immediately adjacent to streams and has resulted in property damage to adjacent structures, increased siltation, destruction of natural vegetation, reduced fishery potential, precluded recreation use, decreased open space, and increased maintenance cost and effort.

4.10.l Natural vegetation along drainageways can provide channel stability and wildlife habitat, and moderate flood flows. However, where the stream channel or its corridor has been altered or structures have been built close to the stream, invasive or native vegetation can interfere with water flow, diminish recreation and open space potential, and decrease maintenance opportunities. This maintenance of stream system vegetation can sometimes adversely affect the ecological functions of urban streams and drainageway.

4.10.n There are a number of significant streams in the Urban Growth Boundary that are intermittent.

4.10.o Automobiles are a leading source of surface water pollutants in urban areas. Automotive pavement areas occupy more than half of the impervious surface in residential developments; in most commercial areas they occupy more than 80% of the land.

4.10.3 Significant drainageways shall be kept in a natural state to protect tree lines, maintain their natural functions, and enhance native plant species, to the maximum extent practicable.

4.10.4 Within the Urban Growth Boundary, appropriate drainageway dedications and easements adequate for flood protection, conveyance of stormwater, channel access and maintenance protection of riparian environment, and channel migration shall be secured along all open drainageways needed for public conveyance of stormwater, prior to or at the time of development.

4.10.5 The City shall develop stream corridor width and other standards and programs that preserve the properly functioning condition of streams. These standards can be varied

by reach or basin and shall be determined based on functional objectives such as:
A. Preservation of the hydrologic conveyance and storage capacity;
K. Preservation or enhancement of habitat.
H. Pursue the use of retention and infiltration facilities where the soils are suitable to control runoff volume, peak flow and promote dry season base flows in streams.
I. Develop sub-surface storage as well as surface detention facilities.
J. Evaluate additional restrictions on cuts in hillsides, especially in areas with nearsurface groundwater.

(Foundation Engineering report and Zion Natural Resources report identify nearsurface groundwater on this slope. The upper slope areas have a perched surficial aquifer about three feet deep, and the wetland areas identified in the eastern drainageway has groundwater at 3 inches deep.

4.10.7 To minimize the negative impacts of development, stormwater runoff after development should be managed to produce no significant reduction of water quality than prior to development unless more appropriate provisions are identified in adopted comprehensive storm water management plans.
4.10.8 Grading and filling in drainageways shall be regulated to prevent negative impact on the channel, floodway and flood plain, riparian habitat, wetlands, and other properties. Where drainageways are disturbed through development, the developer shall return the drainageway to its natural state, to the extent practicable.
4.10.9 Negative impacts on habitat and migration corridors for birds, wildlife, aquatic life, and on open space and the recreation qualities of significant drainageways shall be minimized.
4.10.13 The City shall develop a program to minimize the conveyance of detrimental sediments and pollutants from public streets into streams and drainageways.
4.10.18 The City shall inventory and identify natural intermittent streams within the Corvallis Urban Growth Boundary that provide important hydrological, water quality and aquatic habitat functions. Those that are used for stormwater functions shall be protected using mechanisms such as drainageway dedications and easements. (SS-1)
4.10.19 The Corvallis stormwater utility shall incorporate existing natural features such as streams and wetlands as a means of managing urban run-off. When using these natural features for urban stormwater needs, stormwater management shall follow the guiding principle of minimizing harm to these natural systems, maintaining the natural functions, and over time, repair any damage associated with past practices. (GP-1)

4.11 Wetlands

Findings

4.11.a Wetlands serve several purposes. They help recharge ground water and reduce flood damage by detaining and absorbing storm water. They improve water quality by serving as settling basins and digesters for biodegradable substances in waste water and by extracting soluble nutrients and holding organics and metals from waste water.

Wetlands support many plant and animal species; some species cannot survive without wetland habitat. Wetlands also provide valuable open spaces.
4.11.b Wetlands are part of larger interconnected hydrologic systems within a watershed; alteration of any part of the system will affect the function of the system as a whole. Wetlands are usually the lowlands in these systems and are impacted by upland development.
4.11.c Lands with hydric soils are suspect of being wetlands. Large areas within the developed portion of the City have hydric soils. If these developed lands had not been urbanized and the hydrology not changed, then some of these lands would be considered jurisdictional wetlands given current State and Federal regulations. Large areas outside the developed portion of the City, but within the Corvallis Urban Growth Boundary, also have hydric soils and are potential wetlands.
4.11.h Numerous violations of State and Federal wetland laws have occurred in the past, sometimes deliberately and sometimes because people were not aware that their properties are classified as wetlands.
4.11.i Oregon Revised Statutes (ORS 227.350) requires the City to notify builders or developers that their projects may require wetland permits from the Division of State Lands. To reduce the community's liability, the City has been notifying developers of potential wetland issues whenever hydric soils are present. In addition, prior to issuing building permits, the City requires confirmation of wetland or upland status from the State when development is near a National Wetland Inventory site, a State approved Wetland Inventory site, or is otherwise suspected to impact a jurisdictional wetland as defined by State and Federal governments.
4.11.j Working with the City and the Division of State Lands prior to a development application can resolve wetland issues and result in development plans that better accommodate existing wetlands.

Policies

4.11.2 During the City's inventory process of evaluating Statewide Planning Goal 5 wetland resources, the City may wish to adopt additional standards for wetland protection such as, but not limited to: protection of fish and wildlife habitat; maintenance of water quality; hydrological control; contribution to open space; connectivity of hydrologic systems; and protection of significant plant and animal species (e.g., State laws regulate cuts and fills but not vegetation removal).

4.11.3 Lakes, wetlands, floodway, drainageways and other urban streams are part of the hydrological system and should be managed comprehensively.

4.11.11 Regarding significant wetlands downstream of development sites, the cumulative unavoidable losses of significant wetland acreage and function attributable to upstream development should be mitigated by the City. Such mitigation can be achieved, in part, through dedication of open space, drainageways, and related natural infrastructure.

4.11.12 Development upslope of wetlands shall minimize interference with water patterns

discharging to wetlands, and shall minimize detrimental changes in water quality for waters discharging to wetlands.

4.11.17 The City shall continue to maximize preservation and restoration of existing upland natural resource areas and wetlands by use of development standards in the Land Development Code (UP-12).

4.11.18 The City shall develop and implement incentives for developers and property owners to protect, enhance, and re-establish wetlands, natural swales, vegetation, and groundwater for stormwater functions. (UP-5)

4.12.7 The City shall consider the amount of impervious surface when evaluating detention requirements and develop a policy to encourage groundwater recharge opportunities. (QN-4)

4.12.8 The City shall promote the protection of key areas of exchange between ground and surface waters, such as springs, unconstrained reaches of streams and drainages upstream. (QL-12)

4.12.9 The City shall encourage practices that enhance groundwater recharge to maintain or increase stream flow during dry periods. (QN-10)

4.13 Plant, Wildlife, and Fishery Resources

Findings

4.13.a There are a variety of plants and animals in terrestrial and aquatic habitats within the urban area that greatly add to the quality of life within the community.

4.13.b Wildlife species require a complex and often narrowly-specific set of conditions with respect to food, water, and vegetative cover (or other natural features) necessary for travel, protection, feeding, and reproduction.

4.13.c Important plant communities and animal habitat areas include riparian vegetation, hillside meadows, wetland prairies, tree groves and the urban forests. The City has not inventoried and reviewed significant plant and wildlife areas that warrant protection.

4.13.d Development can affect water quality in adjacent drainageways and streams and may impact the fishery within and downstream of the Urban Growth Boundary.

4.13.e Vegetation contributes to the quality of the community through control of erosion, absorbing sound, moderating temperature, enhancing flow and moisture content of the air, providing for urban wildlife habitats, reducing air pollution and glare, and softening the impact of the urban environment (see Section 5.3 - Urban Trees).

Policies

4.13.1 Significant natural plant communities and significant habitats for fish and wildlife within the Urban Growth Boundary shall be identified and inventoried by the City or through the development process.

4.13.2 Development on land identified with significant plant communities, or significant fish and wildlife habitats, shall be planned to minimize the impact on the significant resources.

4.13.4 The City shall encourage the retention of large, varied habitat areas on private and

public lands including inventoried plant communities.
4.13.5 Development occurring in significant wildlife areas will set forth a plan of action to reduce impact to significant identified areas.
4.13.6 The City shall consider mechanisms such as density transfer and reduced densities as a means to protect significant plant, wildlife, and fish resources.
4.13.7 The City shall work to protect hydrological processes associated with the 100-year floodplain to support self-sustaining levels of native fish, aquatic species, and wildlife populations. (FP-7)

4.14 Supporting Documents

Oregon Natural Heritage Plan 1998

4.15 Advisory Boards

Open Space Commission

4.16 Mandated Reports / Plans / Inventories

Inventories (by the City or through the development process):
Drainageways, wetlands, flood plains
Significant native vegetation (certain woodlands, grasslands, wetlands, riparian vegetation, and plant species)
Scientifically significant natural areas
Significant hillsides (expand and update existing Hillside Report)
Outstanding scenic views, sites, gateways, and buffers
Significant natural plant communities & habitats for fish & wildlife
Significant sensitive aquifers & potential sources of pollution
Landslide (slide scars)
Develop a density transfer mechanism in the Land Development Code
Conduct a study of additional protection methods such a Open Space - Conservation districts and transfer of development rights
Develop a program to manage removal of detrimental riparian vegetation
Develop a program to minimize pollutant runoff from streets
Develop solutions to flooding problems in neighborhoods
Prepare and adopt wetland management plans
Work with Benton County to develop a community-approved tree management program for hillsides
Develop and maintain an Advisory Constraints Map

5.1 Relevant Vision Statement Elements

"Our natural features: hillsides, flood plains, streams, wetlands, and other natural areas are protected and treasured. Wildlife habitat areas, scenic areas, and other natural areas help shape development patterns as we grow. Our natural open space helps buffer flood events, purify our air and water, provide recreational and educational opportunities, and reinforce the community's distinctive character. Corvallis has identified its open space resources, and has established criteria and priorities for open space protection."

"Corvallis is encircled by an emerald necklace of parks, scenic vistas, natural habitats, and farm and forest lands that define the City's boundaries. . . . Our parks are among our most attractive assets. Scattered throughout the community, the parks vary in size, design, and function to meet the need of neighboring areas. Parks accommodate a wide range of recreation activities for all ages. This range includes provision of more passive activities such as bird watching all the way to active sports."

5.2 Community Character

Findings

5.2.a Individual natural features can be combined to create a community open space system.

5.2.5 The City shall retain portions of some parks within the parks system in undeveloped or natural states for recreational use and shall focus its acquisition efforts on securing hilltops around the community to develop a greenbelt system.

5.5 Open Space

Findings

5.5.a A properly planned and managed system of open space and recreation lands reduces the impact of urbanization and serves the leisure and aesthetic needs of all residents. The system needs to recognize the relationship between urban uses and the natural character of the land and drainageways.

5.5.b The community has expressed a desire to have parks and open space serve to shape and guide urban development.

5.5.c The community places a high value on acquiring, maintaining, and developing an adequate system of open space, recreation lands, and facilities to retain and improve livability.

5.5.d There is a relationship between population increase and increased demand for parks and open space. Additional development increases the demand for parks and open space.

5.5.g Open space includes the following kinds of lands: parks, wetlands, rivers and drainageways; farms and forest lands; protected lands for significant plant and animal habitats; scenic lands such as hilltops, ridgelines, meadows, and community gateways; trail and animal corridors; golf courses, cemeteries and undeveloped archeological sites.

5.5.h Open spaces serve many functions in and near the community: they provide landscape buffers and scenic views; accommodate flood waters; protect water quality, plant communities and fish and wildlife habitat; provide essential ecosystem services; protect productive farm and forest lands; offer opportunities for recreation, scientific research and education; preserve historic and cultural sites; and define community boundaries and gateways.

5.5.i Large undeveloped areas near major highways are entrance corridors to the City and help define the community's character as an urban center within a farm and forest setting.

5.5.j The community has indicated a desire to have a coordinated system of open spaces linked as a greenbelt around the Urban Growth Boundary. A greenbelt system would link park and natural features and provide recreation corridors.
5.5.k The community has indicated a desire for open space linkages which follow scenic routes and connect parks, schools, playgrounds, other public sites, and residential areas.
5.5.l There is community interest in the preservation of significant hillside areas as open space.
5.5.9 The City shall take a proactive role in acquiring and protecting the open space needed to complete a linked greenbelt around the Urban Growth Boundary.
5.5.11 The significant entry corridors that should be preserved or enhanced are the following: Highway 99W, both north and south of the City Center; Highway 34, between Tangent and the City Center; Highway 20/34, between the City Center and Philomath; and Highway 20, between north Albany and the City Center.
5.6.o Ongoing acquisition and development of park lands is an important indicator of community livability. Generally, it is more cost effective to develop larger parks within the Urban Growth Boundary, but all park lands, large or small, and in or out of the Urban Growth Boundary, are important assets to the community.
5.6.u Corvallis is a community that places a high value on protecting its environment and natural parks or natural areas in parks.
5.6.15 The City shall continue to make public investments to meet the open space and recreational needs of different areas of the community.
5.7 Supporting Documents
Criteria & Process to Acquire and/or Protect
Open Space
1998
Open Space - Hillsides Report
(Comprehensive Plan Amendments)
1983
Corvallis Parks and Recreation Master Plan 1980
7.2.6 The City will encourage new development to be sensitive to the environment by having the development avoid significant negative impacts on:
A. Air and water quality;
B. Noise or light pollution; and
C. The hazards related to some types of waste materials.
7.5.f Reduction of open space, removal of vegetative cover, terracing into hillsides, and development that increases the amount of impervious surfaces (for example, paved streets, roofs, parking lots) will, unless mitigated, contribute significantly to increases in the peak flows of urban storm runoff entering storm sewers and natural drainageways.

9.1 Relevant Vision Statement Elements

"Development standards have been created based on the characteristics of traditional Corvallis neighborhoods. These standards ensure that development and redevelopment create, protect, and enhance neighborhood form while facilitating the community-wide needs to improve transportation choices, provide housing for a diverse population within safe attractive neighborhoods, and maintain resource lands, natural areas, and recreational open spaces."

9.2 Neighborhood-Oriented Development

9.2.x Corvallis residents value the neighborhood characteristics of traditional residential areas and desire those characteristics in new development.

Policies

9.2.1 City land use decisions shall protect and maintain neighborhood characteristics (as defined in 9.2.5) in existing residential areas.

9.2.2 In new development, City land use actions shall promote neighborhood characteristics (as defined in 9.2.5) that are appropriate to the site and area.

9.2.5 Development shall reflect neighborhood characteristics appropriate to the site and area. New and existing residential, commercial, and employment areas may not have all of these neighborhood characteristics, but these characteristics shall be used to plan the development, redevelopment, or infill that may occur in these areas. These neighborhood characteristics are as follows:

A. Comprehensive neighborhoods have a neighborhood center to provide services within walking distance of homes. Locations of comprehensive neighborhood centers are determined by proximity to major streets, transit corridors, and higher density housing. Comprehensive neighborhoods use topography, open space, or major streets to form their edges.

B. Comprehensive neighborhoods support effective transit and neighborhood services and have a wide range of densities. Higher densities generally are located close to the focus of essential services and transit.

C. Comprehensive neighborhoods have a variety of types and sizes of public parks and open spaces to give structure and form to the neighborhood and compensate for smaller lot sizes and increased densities.

D. Neighborhood development provides for compatible building transitions in terms of scale, mass, and orientation.

F. Neighborhoods have an interconnecting street network with small blocks to help disperse traffic and provide convenient and direct routes for pedestrians and cyclists. In neighborhoods where full street connections cannot be made, access and connectivity are provided with pedestrian and bicycle ways. These pedestrian

and bicycle ways have the same considerations as public streets, including building orientation, security-enhancing design, enclosure, and street trees.
G. Neighborhoods have a layout that makes it easy for people to understand where they are and how to get to where they want to go. Public, civic, and cultural buildings are prominently sited. The street pattern is roughly rectilinear. **The use and enhancement of views and natural features reinforces the neighborhood connection to the immediate and larger landscape.**

9.3.i Excessive glare from outdoor lighting, noise, and direct lines of sight into homes from adjoining uses in residential areas can cause a decline in quality of life that may translate into reduced property values and neighborhood disagreements. Predictability of glare and noise, regular intervals when neighbors can depend on respites from the glare and noise, and methods to adjust lines of sight to minimize loss of privacy can mitigate some of the negative effects. These mitigating factors, to be effective, must be institutionalized and continue indefinitely in their implementation.
9.5.13 New subdivisions and planned developments of more than 5 acres in low density districts shall incorporate two or more of the following elements in at least 10% of the total acreage:
A. Zero lot line or attached dwellings (where allowed);
B. Minimum allowed lot area; or
C. Dwelling size less than 1,200 square feet.
10.1 Relevant Vision Statement Elements
Careful design ensures that development minimizes impacts on plant communities, wildlife habitat, and scenic areas, as well as enhances the sense of place and community character.
10.2.6 The type, location, and phasing of public facilities and utilities shall be based on actual needs, desired levels of service, cost-effectiveness, and/or property owner willingness to pay for infrastructure.

Transportation
Policies
11.2.1 The transportation system shall be planned and developed in a manner which contributes to community livability, recognizes and respects the characteristics of natural features, and minimizes the negative effects on abutting land uses.
11.6.6 Safe and convenient pedestrian facilities that minimize travel distance shall be provided by new development within and between new subdivisions, planned developments, shopping centers, industrial parks, residential areas, transit stops, and neighborhood activity centers such as schools, parks, and shopping.
11.6.7 Where minimizing travel distance has the potential for increasing pedestrian use, direct

and dedicated pedestrian paths shall be provided by new development.

Definitions

Buffer, Urban - An area designed to provide attractive space or distance, obstruct undesirable views, serve as an acoustic barrier, or generally reduce the impact of adjacent development.

Compatible - The ability of different uses to exist in harmony with each other. "Making uses compatible with each other" implies site development standards which regulate the impact of one use on another.

Hillside - Areas where slopes equal or exceed 10% and/or areas identified in the 1983 Open Space - Hillside Report, or its successor.

Land Development Code - A set of ordinances and regulations that implement the policies contained in the Comprehensive Plan.

Nuisance - That which is annoying, unpleasant, or obnoxious.

Open Space - Any undeveloped or predominantly undeveloped land, including waterways, in and around an urban area. (Source: 1998 Criteria and Process to Acquire and/or Protect Open Space plan)

Shall - Expressing what is mandatory.

Should - Expressing what is desired, but not mandatory.

Significant - A description of a feature which has been specifically identified in the Comprehensive Plan as worthy of special recognition or protection (e.g., a "significant" wetland, etc.), or a resource that has been formally adopted by the City.

Transition Area - The area between significantly different intensities of land use which is intended to protect both land uses from the negative impact of the other.

Unacceptable - That which does not meet applicable standards or requirements. As used in the Comprehensive Plan, this term describes such things as high levels of risk because of natural hazards or levels of pollution which exceed State, Federal, or local standards.

Unbuildable - Land which because of its natural character or location is unsuitable for urban development.

Urban Form - The shape of the urban community of which Corvallis is a part. It specifically deals with the image of the City which is projected and perceived.

Viewshed - The area visible from a given point on the ground, to encompass the visual image from that vantage point.

Howland
2575 S.W. Whiteside Drive
Corvallis, OR 97333

RECEIVED
AUG 14 2007
Community Development
Planning Division

August 10, 2007

Mr. Bob Richardson, Associate Planner
City of Corvallis, Planning Division
P.O. Box 1083
Corvallis, OR 97339

Brooklane Heights Subdivision

Dear Mr. Richardson:

We own the two lots just north of the northwest corner of the proposed Brooklane Heights Subdivision. From the map of the currently proposed grading plan, furnished to us by Steve Schaberg, it appears that a 20 foot cut within 30 feet of our south property line would be allowed. It is our opinion that allowing such a cut could destabilize the hillside and cause extensive damage to our and other property.

Therefore, we ask that any cut in this area be eliminated or limited to the more usual 10 feet or less.

This is sent by both e-mail and US mail in an effort to meet your deadline for distribution. Thank you for your consideration of this request.

Jim Howland

Jim Howland
2575 SW Whiteside Dr.
Corvallis, OR 97333
753- 3691

503/753-3691

Susan Morre

From: Wayne Huber [wayne.huber@orst.edu]
Sent: Tuesday, January 20, 2009 4:33 PM
To: 'Susan Morre'
Subject: RE: accurate understanding of your comments on Brooklane Heights runoff concerns

Susan, I've tweaked the language below, even though what you have is basically Ok with me. And I appreciate that you indicate that a geotechnical engineering or other CE specialist is needed to more accurately guess the impact of the cuts.

Wayne

From: Susan Morre [mailto:susanmorre@comcast.net]
Sent: Tuesday, January 20, 2009 12:39 PM
To: wayne.huber@orst.edu
Subject: accurate understanding of your comments on Brooklane Heights runoff concerns

Hello, Dr. Huber,

Thanks for taking the time to meet with us last week and take a brief look at the Brooklane Heights cut and fill plan and geotechnical report. I know you are very busy, so we appreciate your review of the documents with us. I wish we had more time to use the SWMM5 model and plug in some data, but we would need the area and rainfall statistics to do it, I assume. I didn't find that information in the report.

Would you say this is an accurate summary of your initial response to the information? I want to make sure I didn't misinterpret anything, and I realize this is just a cursory review.

There will be a change in runoff: faster flow, higher volume and change in timing and duration (faster response and shorter duration, post-development compared to pre-development). It is likely to increase erosion on this slope, especially combined with surface vegetation removal. The detention ponds will likely mitigate the downstream impact of a higher post-development peak flow, but will not mitigate the effect of a higher post-development runoff volume.

It is not clear where the runoff of much of the site would go, because it didn't appear that the upper and lower detention ponds in one drainageway would handle the flow off the whole site, based on the topography. It appeared that the runoff from the western portion of the hill would likely run down Wolverine Drive and perhaps across Brooklane Drive. The report doesn't show what the flows would be (there are no calculations of contributing area and volumes).

The spring and perennial stream will likely dry up and that will negatively impact wildlife. There will be some impacts on the wetland below, and they must expect some negative impacts on water quality or they wouldn't propose using the BaySaver devices. However, there is less concern about the negative impacts on the wetland below than on impacts on the hydrology of the whole hillside and the stability of the slope if this amount of cutting and filling is done.

A bigger concern which raises a red flag is the depth of cuts and fills , large area and amount of mass grading on many of the lots, and remaining individual lots proposed to be graded up to eight feet. Cutting this deeply into the slope will take away the surficial aquifer and dewater the slope above the cuts. If the seepage out of the cuts is diverted into storm drains or detention ponds, it will also dewater large portions of the slope, meaning less water in the dry season over much of the slope. This drying out and loss of groundwater may lead to death of trees and other plants , OR the need for more extensive irrigation to make up the loss. There is valid concern about the impacts on the existing houses

along Fairmont Drive, particularly those along the upper two thirds of the street, with possible damage to foundations resulting from changes in the soil's behavior incident to ground water loss.

Another geotechnical soil specialist could offer more expert advice on soil stability concerns on these specific types of soils.

Thanks for making any corrections needed to my understanding of your comments.

Sincerely,

Susan Morre

EPA
United States Environmental Protection Agency
EPA 841-F-03-003

Protecting Water Quality *from* URBAN RUNOFF

Clean Water Is Everybody's Business

In urban and suburban areas, much of the land surface is covered by buildings and pavement, which do not allow rain and snowmelt to soak into the ground. Instead, most developed areas rely on storm drains to carry large amounts of runoff from roofs and paved areas to nearby waterways. The stormwater runoff carries pollutants such as oil, dirt, chemicals, and lawn fertilizers directly to streams and rivers, where they seriously harm water quality. To protect surface water quality and groundwater resources, development should be designed and built to minimize increases in runoff.

The most recent National Water Quality Inventory reports that runoff from urbanized areas is the leading source of water quality impairments to surveyed estuaries and the third-largest source of impairments to surveyed lakes.

Did you know that because of impervious surfaces like pavement and rooftops, a typical city block generates more than 5 times more runoff than a woodland area of the same size?

How Urbanized Areas Affect Water Quality

Increased Runoff

The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands traps rainwater and snowmelt and allows them to filter slowly into the ground. In contrast, impervious (nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking, into the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly in unnaturally large amounts.

Storm sewer systems concentrate runoff into smooth, straight conduits. This runoff gathers speed and erosional power as it travels underground. When this runoff leaves the storm drains and empties into a stream, its excessive volume and power blast out streambanks, damaging streamside vegetation and wiping out aquatic habitat. These increased storm flows carry sediment loads from construction sites and other denuded surfaces and eroded streambanks. They often carry higher water temperatures from streets, roof tops, and parking lots, which are harmful to the health and reproduction of aquatic life.

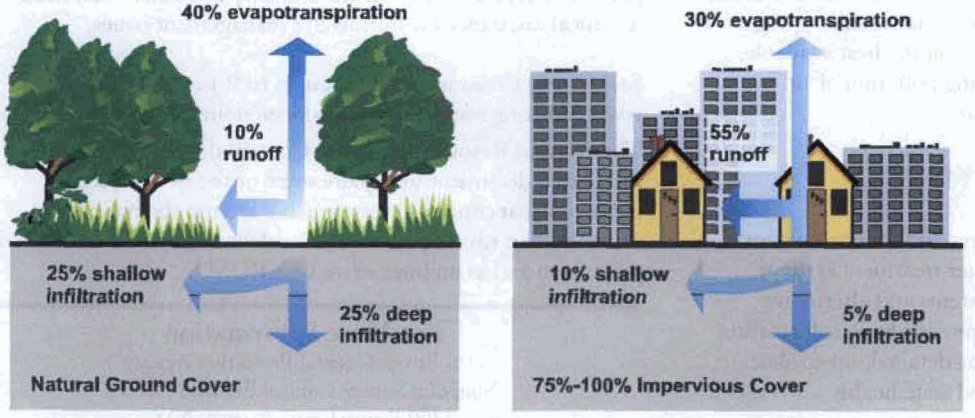
The loss of infiltration from urbanization may also cause profound groundwater changes. Although urbanization leads to great increases in flooding during and immediately after wet weather, in many instances it results in lower stream flows during dry weather. Many native fish and other aquatic life cannot survive when these conditions prevail.

Increased Pollutant Loads

Urbanization increases the variety and amount of pollutants carried into streams, rivers, and lakes. The pollutants include:

- Sediment
- Oil, grease, and toxic chemicals from motor vehicles
- Pesticides and nutrients from lawns and gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Road salts
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets and rooftops

These pollutants can harm fish and wildlife populations, kill native vegetation, foul drinking water supplies, and make recreational areas unsafe and unpleasant.



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

Managing Urban Runoff

What Homeowners Can Do

To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose. Instead of disposing of yard waste, they can use the materials to start a compost pile. And homeowners can learn to use Integrated Pest Management (IPM) to reduce dependence on harmful pesticides.

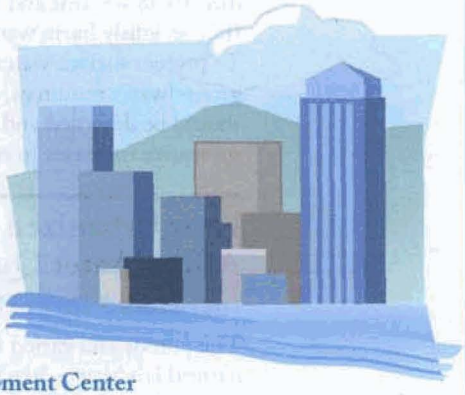
In addition, households can prevent polluted runoff by picking up after pets and using, storing, and disposing of chemicals properly. Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed. Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff. Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.

Controlling Impacts from New Development

Developers and city planners should attempt to control the volume of runoff from new development by using low impact development, structural controls, and pollution prevention strategies. Low impact development includes measures that conserve natural areas (particularly sensitive hydrologic areas like riparian buffers and infiltrable soils); reduce development impacts; and reduce site runoff rates by maximizing surface roughness, infiltration opportunities, and flow paths.

Controlling Impacts from Existing Development

Controlling runoff from existing urban areas is often more costly than controlling runoff from new developments. Economic efficiencies are often realized through approaches that target "hot spots" of runoff pollution or have multiple benefits, such as high-efficiency street sweeping (which addresses aesthetics, road safety, and water quality). Urban planners and others responsible for managing urban and suburban areas can first identify and implement pollution prevention strategies and examine source control opportunities. They should seek out priority pollutant reduction opportunities, then protect natural areas that help control runoff, and finally begin ecological restoration and retrofit activities to clean up degraded water bodies. Local governments are encouraged to take lead roles in public education efforts through public signage, storm drain marking, pollution prevention outreach campaigns, and partnerships with citizen groups and businesses. Citizens can help prioritize the clean-up strategies, volunteer to become involved in restoration efforts, and mark storm drains with approved "don't dump" messages.



Related Publications

Turn Your Home into a Stormwater Pollution Solution!
www.epa.gov/nps

This web site links to an EPA homeowner's guide to healthy habits for clean water that provides tips for better vehicle and garage care, lawn and garden techniques, home improvement, pet care, and more.

National Management Measures to Control Nonpoint Source Pollution from Urban Areas
www.epa.gov/owow/nps/urbanmm

This technical guidance and reference document is useful to local, state, and tribal managers in implementing management programs for polluted runoff. Contains information on the best available, economically achievable means of reducing pollution of surface waters and groundwater from urban areas.

Onsite Wastewater Treatment System Resources
www.epa.gov/owm/onsite

This web site contains the latest brochures and other resources from EPA for managing onsite wastewater treatment systems (OWTS) such as conventional septic systems and alternative decentralized systems. These resources provide basic information to help individual homeowners, as well as detailed, up-to-date technical guidance of interest to local and state health departments.

Low Impact Development Center
www.lowimpactdevelopment.org

This center provides information on protecting the environment and water resources through integrated site design techniques that are intended to replicate preexisting hydrologic site conditions.

Stormwater Manager's Resource Center (SMRC)
www.stormwatercenter.net

Created and maintained by the Center for Watershed Protection, this resource center is designed specifically for stormwater practitioners, local government officials, and others that need technical assistance on stormwater management issues.

Strategies: Community Responses to Runoff Pollution
www.nrdc.org/water/pollution/storm/stoinx.asp

The Natural Resources Defense Council developed this interactive web document to explore some of the most effective strategies that communities are using around the nation to control urban runoff pollution. The document is also available in print form and as an interactive CD-ROM.

For More Information

U.S. Environmental Protection Agency
Nonpoint Source Control Branch (4503T)
1200 Pennsylvania Avenue, NW
Washington, DC 20460
www.epa.gov/nps

February 2003

RECEIVED
SEP 26 2008
DEPARTMENT OF STATE LANDS

WETLAND DELINEATION / DETERMINATION REPORT COVER FORM

This form must be included with any wetland delineation report submitted to the Department of State Lands for review and approval. A wetland delineation report submittal is not "complete" unless the fully completed and signed report cover form and the required fee are submitted. Attach the form to the front of an unbound report and submit to: **Oregon Department of State Lands, 775 Summer Street NE, Suite 100, Salem, OR 97301-1279**

Mail a copy of the completed form with payment of the required report review fee to: **Oregon Department of State Lands, P.O. Box 4395, Unit 18, Portland, OR 97208-4395.**

For new credit card payment option, see DSL web site.

☒ Applicant ☒ Owner Name, Firm and Address: **TC2 Investments, LLC - C/O Scott Sanders** **4411 Sw Golf View Ave** **Corvallis, OR 97333**	Business phone # Mobile phone # (optional) FAX # E-mail: **tc2sanders@comcast.net**
☒ Authorized Legal Agent, Name and Address: **Same as above**	Business phone # FAX # Mobile phone # E-mail:

I either own the property described below or I have legal authority to allow access to the property. I authorize the Department to access the property for the purpose of confirming the information in the report, after prior notification to the primary contact.

Typed/Printed Name: _____ Signature: _____

Date: Special instructions regarding site access:

Project and Site Information (for latitude & longitude, use centroid of site or start & end points of linear project)

Project Name: **Brooklane Heights**	Latitude: **N 44.541833**	Longitude: **W 123.287417**	
Proposed Use: **Residential subdivision**	Tax Map # **12.5.10 C**		
Project Street Address (or other descriptive location): **Northwest of Brooklane Drive and Agate Ave, east of Fairmont Dr. and south of Whiteside Drive**	Township **12S**	Range **5W**	Section **10** QQ **C**
	Tax Lot (s) **1000**		
City: **Corvallis** County: **Benton**	Waterway: **NA**	River Mile: **NA**	
	NWI Quad(s): **Corvallis**		

Wetland Delineation Information

Wetland Consultant Name, Firm and Address: **Zion Natural Resources Consulting** **P.O. Box 545** **Monmouth, OR 97361**	Phone # **503-838-0103** Mobile phone # **503-881-4171** FAX # **503-623-7425** E-mail: **eric@zionconsulting.org**

The information and conclusions on this form and in the attached report are true and correct to the best of my knowledge.

Consultant Signature: Date: 9/25/2008

Primary Contact for report review and site access is ☒ Consultant ☐ Applicant/Owner ☐ Authorized Agent

Wetland/Waters Present? ☒ Yes ☐ No | Study Area size: **25.88** Total Wetland Acreage: **0.12**

Check Box Below if Applicable:	**Fees:**
☐ R-F permit application submitted	☒ Fee payment submitted $ 350
☐ Mitigation bank site	☐ Fee ($100) for resubmittal of rejected report
☐ Wetland restoration/enhancement project (not mitigation)	Name of Payor:
☐ Industrial Land Certification Program Site	

Other Information:	Y	N	
Has previous delineation/application been made on parcel?	☐	☒	If known, previous DSL #
Does LWI, if any, show wetland or waters on parcel?	☐	☒	

For Office Use Only JM

DSL Reviewer: LM	Fee Paid Date: ___/___/___	DSL WD # 2008-0494
Date Delineation Received: 9/26/08	DSL Project # _____	DSL Site # _____
Scanned: ☐ Final Scan: ☐	DSL WN # _____	DSL App. # _____

SPS

Pending Wetland Delineations / Determinations
Benton County

Application files are PDFs Need Help? [More info...]

Applicant (Click for Full Report)	Number (Click for Cover Form)	Status	Priority *	Type
Caldwell South Farm LLC	WD2003-0047	Rejected		Wetland Delineation
Zaback Chuck	WD2003-0468	Rejected		Wetland Determination
Corvallis City of	WD2004-0249	Information Requested		Wetland Delineation
Corvallis Industrial Park LLC	WD2004-0554	Information Requested	Tier 1	Wetland Delineation
Pacific Reserve Services	WD2005-0224	Rejected	Tier 1	Wetland Delineation
Gilmour Marvin	WD2006-0151	Information Requested	Tier 1	Wetland Delineation
Reams Jeffrey	WD2006-0330	Review Pending	Tier 1	Wetland Delineation
Billman Isabel	WD2006-0568	Rejected	Tier 2	Wetland Delineation
Rodgers Gary	WD2008-0489	Information Requested		Wetland Delineation
TC2 Investments LLC	WD2008-0494	Information Requested		Wetland Delineation

* *Tier 1* means DSL will attempt to review within 120 days. *Tier 2* means DSL will review when possible. Due to the current workload of DSL staff, *Tier 3* means that review is unlikely to occur.

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Wetland Delineation Detail

Wetland Delineation files are PDFs

Applicant	**TC2 Investments LLC**
Wetland Delineation Number	**WD2008-0494** View Scanned Wetland Delineation (File size: 6.57 MB) *(download of large files may be slow on some connections - please be patient)*
Type	Wetland Delineation
County	**Benton**
Location	**12S05W10C**
Date Received	**September 26, 2008**
Current Status	Information Requested
Priority *	
DSL Coordinator Phone Fax	**Lynne McAllister** **503-378-4844**

* *Tier 1* means DSL will attempt to review within 120 days. *Tier 2* means DSL will review when possible. Due to the current workload of DSL staff, *Tier 3* means that review is unlikely to occur.

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WD#2008-0494

A. Landscape Setting and Land Use

At the request of TC2 Investments, LLC.; Zion Natural Resources Consulting performed a wetland delineation on a 25.88 acre parcel on Tax Lot 1000 located northwest of Brooklane Drive and Agate Avenue, east of Fairmont Drive and south of Whiteside Drive in Corvallis, OR (T12S, R5W, Sec. 10 C). The site is currently vacant and undeveloped. The subject property is slopes from the north to the south with an approximate slope of 30% throughout most of the site consisting of hills and natural valleys. Residential subdivisions are located to the north, west, and south of the study area. The landscape consists of open grassland, some rock outcroppings, and Oregon Whit Oak savannahs. Previous land uses appeared to be agricultural including hay and pasture.

B. Possible Site Alterations

There appears to be no significant site alteration except for some mowing within the northwest portion of the site. This alteration does not appear to affect the presence, location, or geographic boundaries of any waters of the state on the site.

C. Precipitation Data and Analysis

The month to date (May 20th, 2008) rainfall at this location was 0.22 inches according to the Oregon Climate Service at the Hyslop Experimental Station in Corvallis, OR. For the month of March the precipitation was 0.38 inches which is below the average of 2.30 inches according to the WETS table of Corvallis, OR listed below. (see Appendix E).

Below is the WETS table for Corvallis, Oregon with the past three months data highlighted.

WETS Station : CORVALLIS STATE UNIV, OR1862 Creation Date: 09/09/2002
Latitude: 4438 Longitude: 12312 Elevation: 00230
State FIPS/County(FIPS): 41003 County Name: Benton
Start yr. - 1971 End yr. - 2000

Month	Temperature (Degrees F.) avg daily max	avg daily min	avg	Precipitation (Inches) avg	30% chance will have less than	more than	avg # of days w/.1 or more	avg total snow fall
January	46.2	33.6	39.9	6.46	3.95	7.82	12	1.1
February	50.4	35.4	42.9	5.71	3.91	6.80	12	2.1
March	55.6	37.6	46.6	4.59	3.46	5.35	12	0.1
April	60.2	39.9	50.0	2.95	2.09	3.53	8	0.0
May	66.6	44.0	55.3	2.30	1.52	2.81	6	0.0
June	72.9	48.5	60.7	1.46	0.93	1.76	4	0.0
July	80.6	51.8	66.2	0.57	0.17	0.68	1	0.0
August	81.7	51.5	66.6	0.73	0.08	0.86	2	0.0
September	76.4	48.2	62.3	1.47	0.52	1.80	3	0.0
October	64.8	41.8	53.3	3.02	1.70	3.68	7	0.0
November	52.3	38.0	45.2	6.94	4.55	8.34	13	0.2
December	45.7	33.8	39.8	7.43	5.03	8.88	12	1.3

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D. Site-Specific / Field Methodology

A total of 13 sample plots were established on May 20, 2008 to document wetland and upland conditions within the project area. Plot locations were placed on all sides of the contiguous wetland areas. The number of sample plots documented is believed to be representative of the change in plant communities, soil features, or level of groundwater hydrology found within the study area.

E. Wetland / Waters of the State Description

The wetland appears to only be within two naturally formed drainages. The hydrology source appears to mainly be from springs at the beginning of each drainage. The western most drainage continues offsite to the south, while the eastern drainage appears to dissipate as it follows the topography to the south. The wetland boundaries of the drainages were defined by the topography as well as through the dominance of hydrophytic vegetation.

F. Deviation From National and/or Local Wetlands Inventory

There are no wetland/waters of the state associated with this site as depicted on the National Wetland Inventory (NWI) Map (Figure 3a). The Local Wetland Inventory for this area also did not show any wetland or water of the state (Figure 3b).

G. Mapping Method and Estimated Accuracy

Wetland areas were established and flagged by Zion Natural Resources Consulting and were field surveyed to an accuracy of one meter.

H. Additional Information to Help Establish State Jurisdiction

Hydrology is the study area is driven primarily by two springs along with surface flows during storm events. The hydrology then follows the microtopography of the subject property. The western drainage exits the property to the south into a stormwater grate along SW Brooklane Drive (Private Drive). The wetlands within the study area do not contain a fish presence due to the lack of aquatic features. The wetland boundaries were established based on topography and vegetation were in obvious visual contrast to the upland areas.

I. Results and Conclusions

Based upon our site reconnaissance and sampling of the three required wetland criteria (wetland hydrology, hydric soils, and hydrophytic vegetation), ZNR has identified approximately 0.12 acres of potentially jurisdictional wetlands classified as palustrine

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pg 2

emergent wetlands. Figure 6 depicts the location of the potentially jurisdictional wetlands and sample sites. Upland in most instances is quite apparent and somewhat topographically defined (Photos 1-4).

ZION
Natural Resources Consulting

FIGURE 4
County Soils Survey Map - NRCS

Project: Brooklane Heights

N
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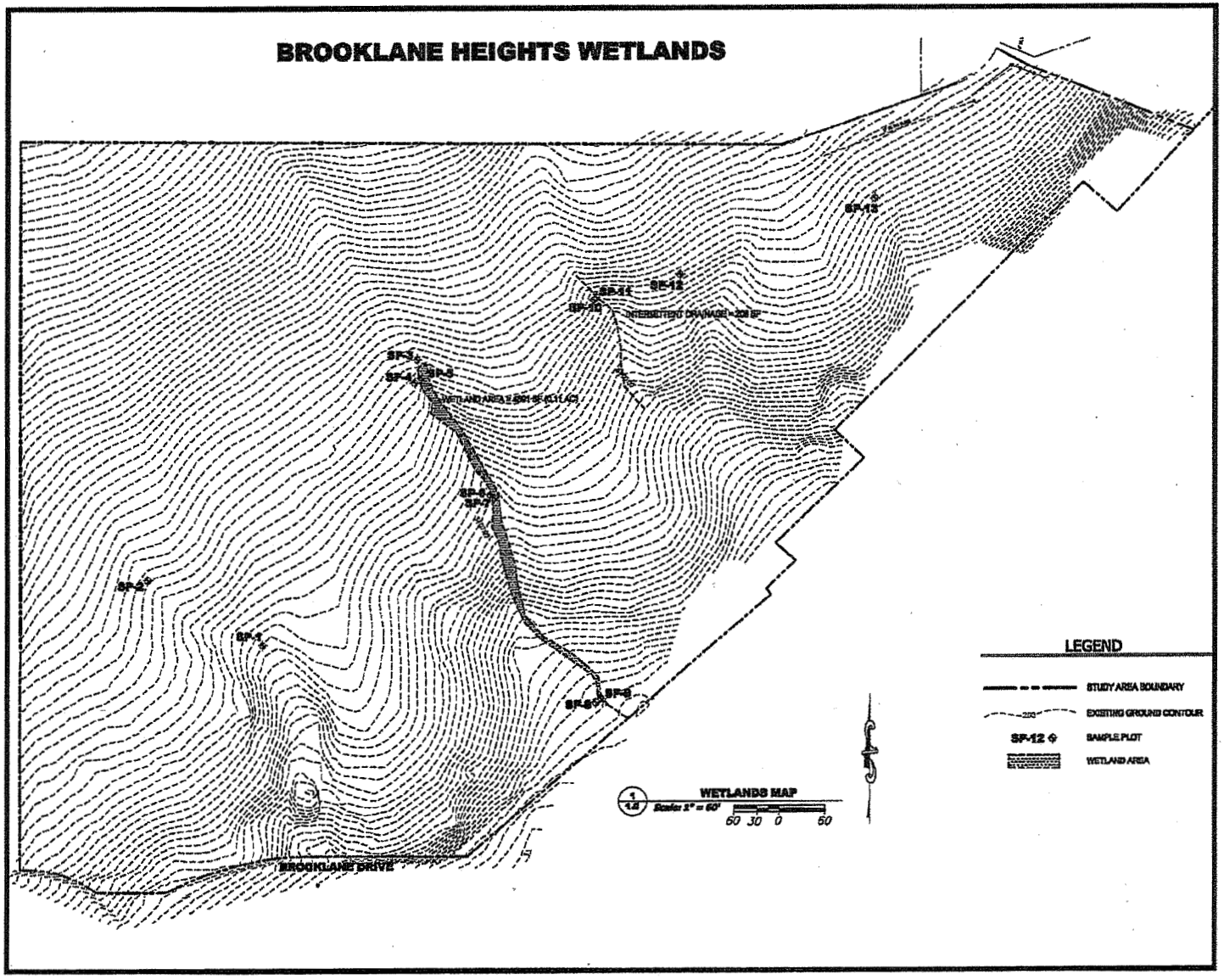
S

DSL WD#2008-0494 pg. 8



ZION
Natural Resources Consulting

FIGURE 6
Wetland Site Location Map
Project: Brooklane Heights

Zion Natural Resources Consulting

PSL WD# 2008-0491

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DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Plot #: SP-5
Plot location: Central portion of the site - within channel/drainage
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 100% 50% % 20% %

1. *Juncus patens FACW 100%
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. %

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 1/1 or 100%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☒ NO ☐ Comments: Him blackberry and white oak rooted outside

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-16"	2.5Y 4/1	7.5YR 4/6	Many, Medium, Prominent		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☒ NO ☐ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: Surface Depth to free water: 3"

Primary Hydrology Indicators:
- ☐ Inundated
- ☒ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☒ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☒ Oxidized Root Channels (upper 12")
- ☐ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

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DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Plot #: SP-7
Plot location: South central portion of the site - channel
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: 10% 50% % 20% %

1. *Fraxinus latifolia FACW 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 70% 50% % 20% %

1. *Juncus patens FACW 40%
2. *Festuca arundinacea FAC- 50%
3. Galium aparine FACU 10%
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. Bare ground 30%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 2/3 or 67%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☒ NO ☐ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-12"	10YR 3/3	7.5YR 4/6	Many, Medium, Distinct		Loam
12-16"	10YR 3/3+2.5Y 4/1	7.5YR 4/6	Many, Medium, Prominent		Loam

Hydric Soil Indicators:
* abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☒ NO ☐ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: Surface Depth to free water: 3"

Primary Hydrology Indicators:
- ☐ Inundated
- ☒ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☒ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☒ Oxidized Root Channels (upper 12")
- ☒ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☒ FAC-Neutral Test
- ☐ Other:

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

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DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Herbaceous, Sapling/Shrub, Tree, Plot #: SP-9
Plot location: South central portion of the site
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: 30% 50% % 20% %

1. *Quercus garryana NOL 40%
2. *Fraxinus latifolia FACW 60%
3. %

Sapling/Shrub Stratum
Total Cover: 30% 50% % 20% %

1. *Crataegus douglasii FAC 100%
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 0% 50% % 20% %

1. %
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. Bare ground 100%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): 2/3 or 67%
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☒ NO ☐ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*	Redox Depletions*	Texture
0-16"	10YR 3/2	7.5YR 4/6 Few, Medium, Distinct		Loam

Hydric Soil Indicators: * abund./size/contrast/color/location (matrix or pores/peds)

- ☐ Histosol
- ☐ Histic Epipedon
- ☐ Sulfidic Odor
- ☐ Reducing Conditions (tests positive)
- ☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
- ☐ Concretions/Nodules (w/in 3"; > 2mm)
- ☐ High organic content in surface (in Sandy Soils)
- ☐ Organic streaking (in Sandy Soils)
- ☐ Organic pan (in Sandy Soils)
- ☐ Listed on Hydric Soils List (and soil profile matches)
- ☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
- ☐ Supplemental indicator (e.g. NRCS field indicator):

Criteria Met? YES ☒ NO ☐ Comments: Very few mottles in the plot

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: None Depth to free water: None

Primary Hydrology Indicators:
- ☐ Inundated
- ☐ Saturated in upper 12 inches
- ☐ Water Marks
- ☐ Drift Lines
- ☐ Sediment Deposits
- ☒ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
- ☐ Oxidized Root Channels (upper 12")
- ☒ Water-stained Leaves
- ☐ Local Soil Survey Data
- ☐ FAC-Neutral Test
- ☒ Other: Topography

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

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DEPARTMENT OF STATE LANDS — WETLAND DETERMINATION DATA FORM

County: Benton City: Corvallis Date: 5-20-08 File #
Project/Contact: Brooklane Heights / TC2 Investments Det. by: Eric Henning
Plant Community: Plot #: SP-11
Plot location: North central portion of the site - within channel
Recent Weather: Sunny past 48 hours
Do normal environ. conditions exist? Y ☒ N ☐ If No, explain:
Has Veg. ☐ Soil ☐ Hydrology ☐ been significantly disturbed? No
Explain:

VEGETATION

Tree Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Sapling/Shrub Stratum
Total Cover: % 50% % 20% %

1. %
2. %
3. %

Woody/Vine Stratum
Total Cover: % 50% % 20% %

1. %
2. %

Herb Stratum
Total Cover: 0% 50% % 20% %

1. void of vegetation %
2. %
3. %
4. %
5. %
6. %
7. %
8. %
9. %
10. %
11. %
12. bare ground 100%

Percent of Dominant Species that are OBL, FACW, FAC (not FAC-): %
Other Hydrophytic Vegetation Indictors:

Criteria Met? YES ☐ NO ☒ Comments:

SOILS

Map Unit Name: Willakenzie-Wellsdale Complex Drainage Class: Well drained
On Hydric Soils List? Y ☐ N ☒ Has hydric inclusions? Y ☒ N ☐

Depth	Matrix Color	Redox Concentrations*		Redox Depletions*	Texture
0-16"	10YR 3/2+2.5Y 4/1	7.5YR 4/6	Many, Medium, Prominent		Loam

Hydric Soil Indicators:
☐ Histosol
☐ Histic Epipedon
☐ Sulfidic Odor
☐ Reducing Conditions (tests positive)
☒ Gleyed or low chroma colors and/or redox. Features within 10" surface
☐ Concretions/Nodules (w/in 3"; > 2mm)
☐ High organic content in surface (in Sandy Soils)
☐ Organic streaking (in Sandy Soils)
☐ Organic pan (in Sandy Soils)
☐ Listed on Hydric Soils List (and soil profile matches)
☐ Meets hydric soil criteria 3 or 4 (ponded or flooded for long duration)
☐ Supplemental indicator (e.g. NRCS field indicator):

* abund./size/contrast/color/location (matrix or pores/peds)

Criteria Met? YES ☒ NO ☐ Comments:

HYDROLOGY

Recorded Data
☐ Recorded Data Available ☐ Aerial Photos ☐ Stream gauge ☐ Other ☒ No Recorded Data Available

Field Data
Depth of inundation: Depth to Saturation: Surface Depth to free water: 3"

Primary Hydrology Indicators:
☐ Inundated
☒ Saturated in upper 12 inches
☐ Water Marks
☐ Drift Lines
☐ Sediment Deposits
☐ Drainage Patterns

Secondary Hydrology Indicators (2 or more required):
☐ Oxidized Root Channels (upper 12")
☐ Water-stained Leaves
☐ Local Soil Survey Data
☐ FAC-Neutral Test
☐ Other:

Criteria Met? YES ☒ NO ☐ Comments:

DETERMINATION

WETLAND? YES ☒ NO ☐ Comments:

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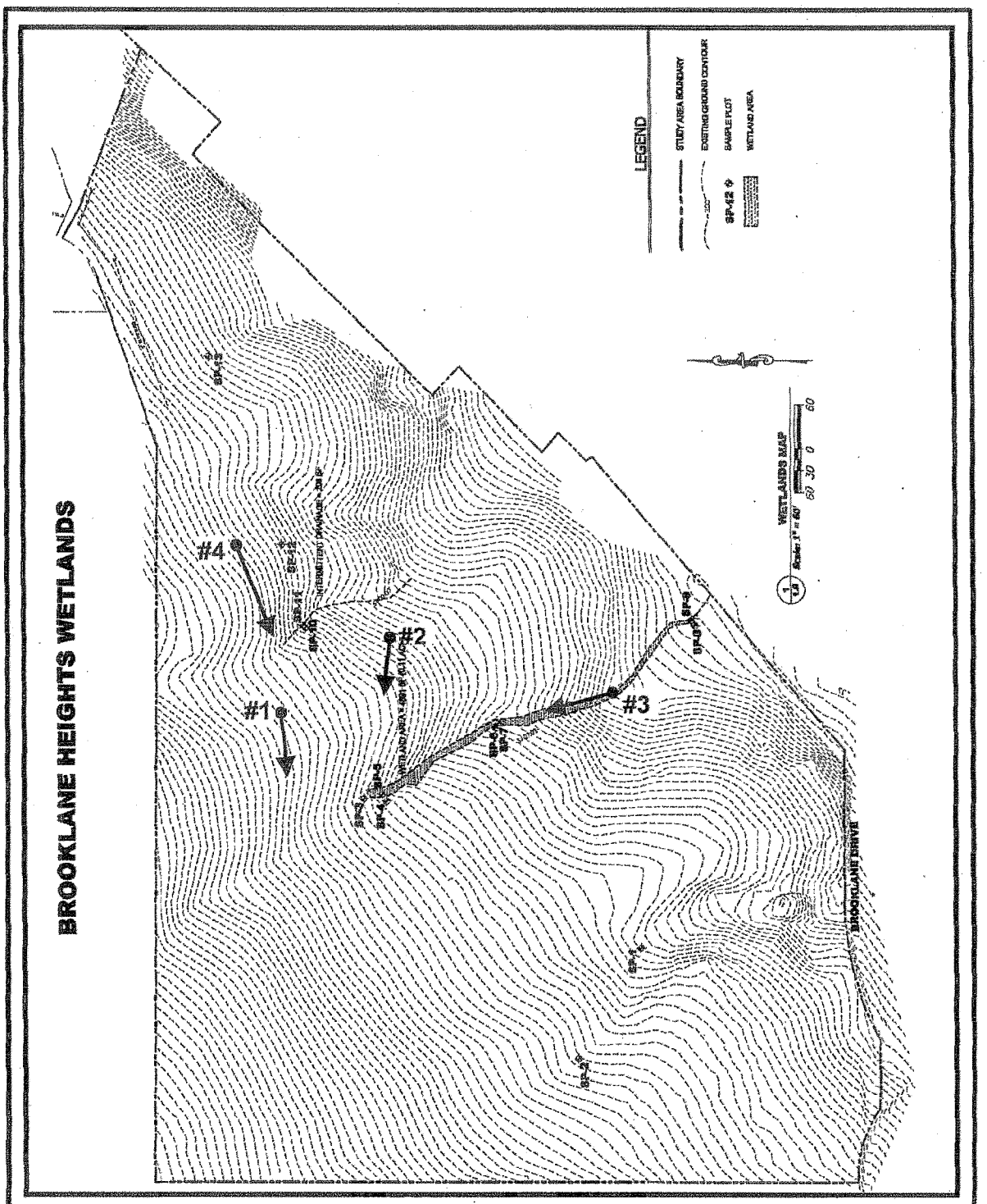

ZION
Natural Resources Consulting

FIGURE 7
Photo Point Location Map

Project: Brooklane Heights

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Photo Point #1 – Located in the north central portion of the site looking west across the study area.

Photo Point #2 – Located just east of the western most drainage area. The beginning of the wetland area is located in the center of the frame.

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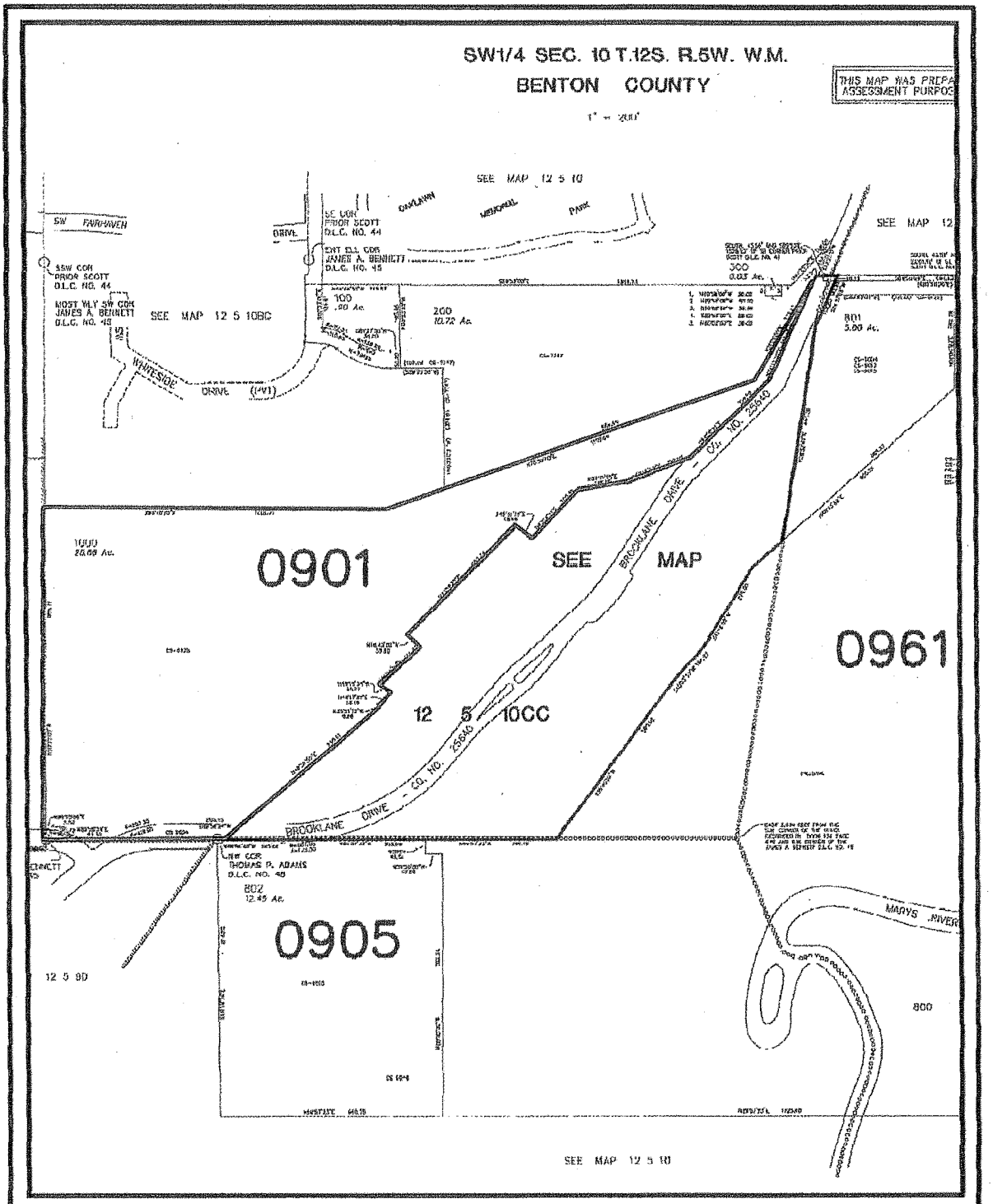
Photo Point #3 – Located in the western most drainage looking north (uphill) at the wetland area.

Photo Point #4 – Located to the east of the eastern drainage looking west.



ZION
Natural Resources Consulting

FIGURE 2
Tax Lot Map

Project: Brooklane Heights

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S

DSL WD# 2008-0494 Pg 5

Figures 1 and 2.

ABOVE: Demonstration of slope failure caused by 10 foot cuts at the same elevation of the same hill, just on the other side of the crest from the proposed 20 foot cuts with no retaining walls for Brooklane Heights. Ten foot cuts with no retaining walls continue to erode, resulting in periodic debris flows and trees falling off the upper slope. This is one of three failed developments in the area. (Corner of Fairhaven and Whiteside Drives)

RIGHT: Close-up of cut face twenty feet to the east. The development permit has expired, and the retaining wall has never been completed.

Figures 3 and 4. Additional examples of the variable soil structure of this hillside. Example of degraded sandstone on cut slope just north of Oakmont Subdivision and cemetery (same hillside). The City had a retaining wall installed to stop the ongoing erosion from falling onto Brooklane Drive.

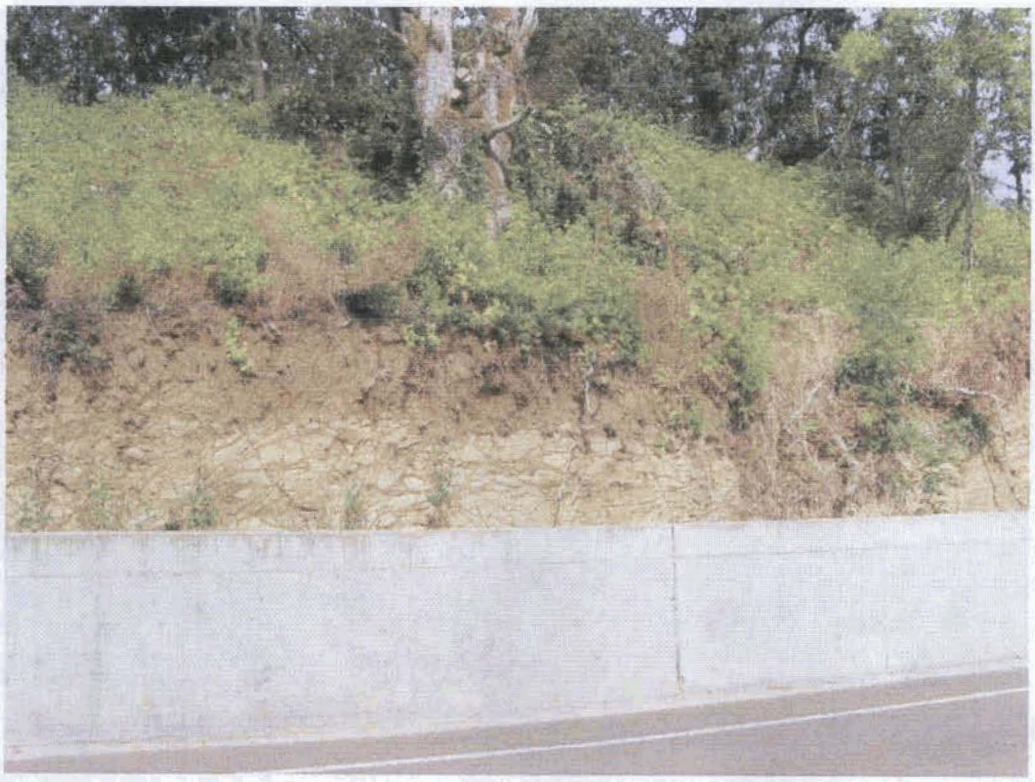


Figure 5. Another example of the variety of soil depths and sandstone bedrock.

Figure 6. Rock outcropping on Brooklane Drive at near proposed Wolverine Drive (southern end of site).

Figure 7. Example of steep slopes on southern end of proposed hillside development. This drainageway is shown on the Corvallis Natural Hazard map as high landslide risk and over 25% slope. Proposed Wolverine Drive through western drainageway. White sign on post is stop work order from City in response to developer's non-permitted removal of twenty four Oregon white oak trees from this "Significant Tree Grove," excavation in drainageway, and installation of gravel access road.

View from existing back yard on Fairmont Drive.

Same photo point, close-up view from the hillside toward Marys River Natural Area Locally Significant Wetland, hardwood forest along the Marys River, and Herbert Open Space beyond. This hillside is the only Significant Hillside (the ONLY hillside) in South Corvallis, and it is adjacent to wetland and riparian forest open space. This upland prairie is more significant due to its proximity to these other preserved habitat types.

View of the area where the eastern drainageway spring comes out of the ground in the middle of the Brooklane Heights property.

VIEW FROM THE HILL looking east across the meadow, through the Oregon white oak grove, across the Marys River Natural Area and to the Cascade Mountains in the distance.

ABOVE: View of the upper northwest portion of the proposed development. BELOW: Evidence of deer in this northwest corner under the oak trees (slated for removal in order to excavate 20 feet into the hill in this upper corner.

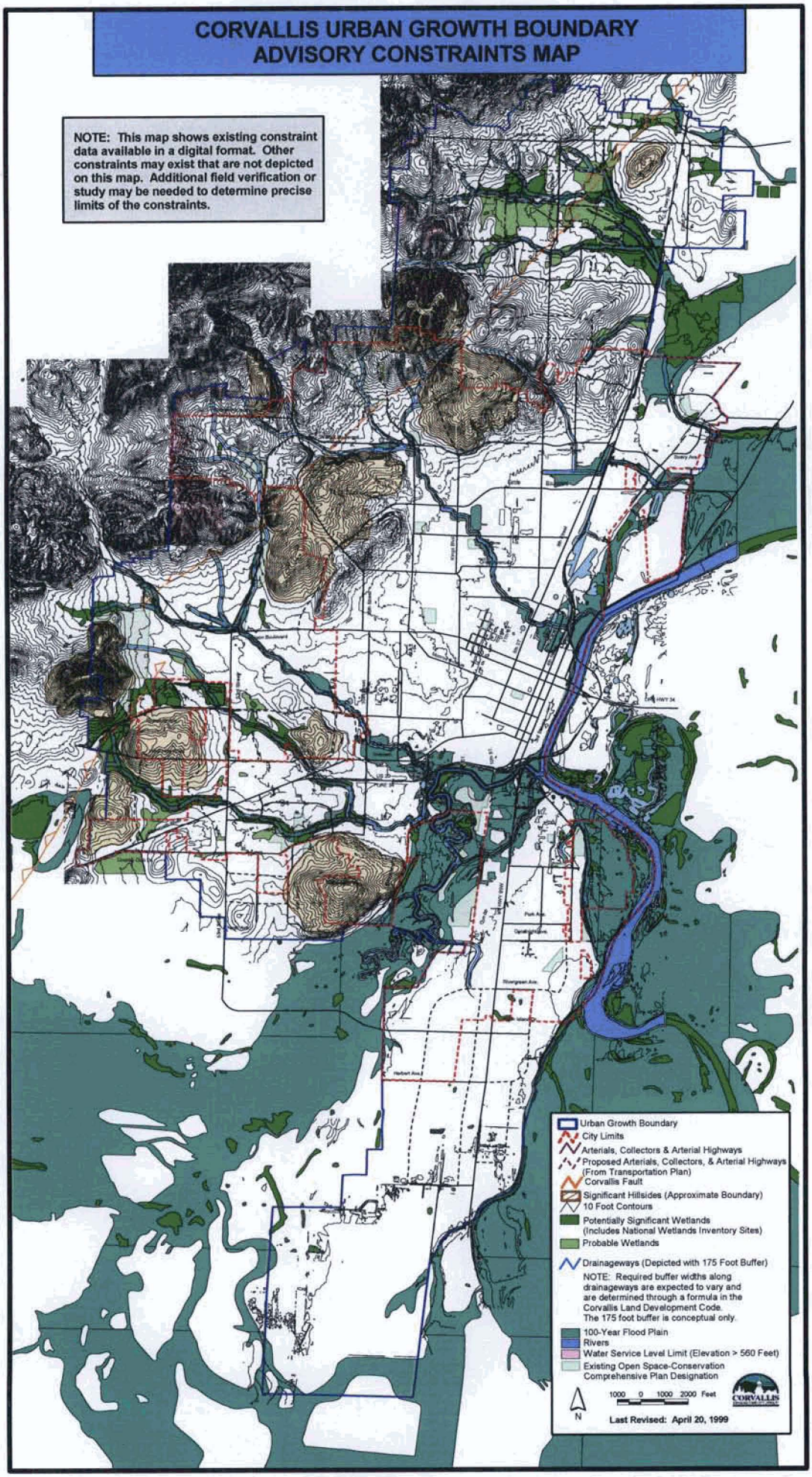
View of the wetland and floodplain looking west toward Marys Peak, with the hillside beyond.

Change in water quality of one of two ponds below the hill after the Douglas-fir forest was clearcut on the adjacent Oakmont Subdivision. These ponds are home to the Oregon sensitive species western pond turtle

SPEED
25

N
2795 SW Fairmont Dr, Corvallis, OR 97333
Google
Pointer 44°32'22.84" N 123°17'28.97" W elev 343 ft Streaming 100%
Eye alt 3775 ft

CORVALLIS URBAN GROWTH BOUNDARY ADVISORY CONSTRAINTS MAP



CITY OF CORVALLIS
PARTIAL MINUTES OF THE OPEN SPACE ADVISORY COMMISSION
MAY 8, 2007

Attendance
Mary Buckman
Paul A. Hohenlohe
Margie Powell
Janine Salwasser, Chair
Cary B. Stephens, Vice Chair
Terri Valiant

Absent/Excused
Stewart Wershow, Council Liaison

Staff
Julee Conway, Director
Mark Lindgren, Recorder
Jackie Rochefort, Park Planner

Visitors
Kent Daniels
David Eckert, 2311 NW Van Buren St. #6
Will Koenitzer, 4240 SW Fairhaven Dr.
Annette Mills, 2311 NW Van Buren St #6
Liz Schwartz, 3930 NW Witham Hill Dr. #64
Steve Smith, U.S. Fish and Wildlife
Susan Morre, 2775 SW Fairmont

SUMMARY OF DISCUSSION

Agenda Item	Information Only	Held for Further Review	Recommendations
II. Visitors' Propositions	X		
III. Approval of Minutes	X		
IV. Staff Reports	X		
V. Member Updates	X		
VI. Brooklane Heights Property Discussion			Motion passed unanimously that the OSAC recommend that the City Council investigate acquisition of this 26-acre open space property.
VII. Sunset Review / Board Consolidation Charter Review			Motion passed to recommend consolidation of the Open Space Advisory Commission with the Parks and Recreation Advisory Board. Motion passed to recommend that the Open Space Advisory Commission sunset.
VIII. Habitat Goal Discussion	X		
IX. Adjourn	X		The next Open Space Advisory Commission meeting will be on June 12, 2007, 4:00 p.m. at the Admin Conference Room.

CONTENT OF DISCUSSION

I. **CALL TO ORDER:** Chair Janine Salwasser called the meeting to order at 4:01 p.m.

II. **VISITORS' PROPOSITIONS.** None.

III. **APPROVAL OF MINUTES**. Approval of April 10, 2007 minutes was postponed until more members have time to review the minutes.

IV. **STAFF REPORTS.** Director Conway related she will make a departmental presentation to the Core Services Committee on May 10. She highlighted a national Urban Wildlife Management conference to be held June 18-20 in Portland.

Planner Jackie Rochefort related the Park and Recreation Advisory Board reviewed the conceptual plan for Willamette Park last week and approved the same plan that had been endorsed by the Willamette Park stakeholder committee; the plan will next be forwarded to the City Council for its endorsement. In July, work will go forward of preparing an application for a Willamette River Greenway permit. The North Riverfront stakeholder committee endorsed a plan for the North Riverfront site along with additional design refinements; the group is tentatively scheduled to meet May 30.

Phase II improvements at Sunset Park will begin after July 1; they will include wetland restoration, a boardwalk path, interpretive signs, improvements to Country Club Drive and an eco-parking lot. While adult softball will continue there as normal (though without Fall Ball) improvements to the parking lot will require that cars temporarily park in the adjacent Starker Arts Park. A contractor has been hired to install new ball field lights at Pioneer Park, replacing unreliable, inefficient existing lights.

V. **MEMBER UPDATES.** Salwasser stated she just attended the GeoSpatial 2007 conference in Portland. She related the US Forest Service regional forester stated that open space was one of the goals the USFS was working on.

Terri Valiant related that several students of Paul Dozier (who teaches an upper level ecology class at OSU) contacted her, expressing interest in doing research and creating a restoration plan for the oak hillside at the Witham Oaks site. She will try to schedule a meeting soon, though since the end of the term is rapidly approaching, it may be a project for future students.

VI. **BROOKLANE HEIGHTS PROPERTY DISCUSSION.** Chair Janine Salwasser reported that following Susan Morre's request discussed at the last meeting regarding whether the city should acquire the Brooklane Heights property as potential open space, some commission members toured the site last week. She noted that commission members have considered a number of documents describing the site, how it relates to other open space areas and including open space guiding documents and codes.

Salwasser summarized that the site was located in southwest Corvallis, on a hill and features both oak woodland and upland prairie habitat. She declared the oak woodland was wonderful but the upland prairie represents the real value of the site. She noted the site cannot be seen from the road.

Planner Rochefort related that the owner and developer have submitted an application to develop the property as a planned development. They are proposing to preserve the area of oak woodland; the rest of it would be developed with single-family houses. The full, active application is scheduled to go before the planning Commission on June 6. Staff has contacted the developer, who indicated that the property is not available for sale. Rochefort related that Susan Morre said she contacted the owner, who told her that the property may be for sale; however, staff has been unable to reach the owner, so the availability of the property is questionable at this time. The application for the planned development came in under the old code, under which the new natural features protections for wildlife, vegetation and drainageways do not

apply. The comp plan policy regarding protections of hillsides does apply to this application. The staff report should be out one week before the scheduled June 6 Planning Commission hearing.

Paul Hohenlohe asked about the configuration of the development. Rochefort replied that there are three development applications that are contingent upon one another, in regard to the street and utility systems. This discussion is centered on the Brooklane Heights project. She said that about 10% of the existing trees have been or are slated for removal; the rest are scheduled to remain; however, the upland prairie would not be preserved.

Margie Powell related that there is a nice view from the site unavailable from anywhere else; it overlooks the Herbert, Caldwell and Mary's River Natural Park open spaces below; it is a great piece of property. Salwasser stated that Steve Smith of the US Fish and Wildlife Service had been invited to provide his perspective on the value of the property.

Steve Smith stated he had toured the property and agreed it had a unique view. From a biological perspective, it is very important due to the oak savannah on the site. Oak savannah habitat was recently listed by world conservation organizations as one of the ten most imperiled ecosystems in the world. The site is also extremely unique for the presence of legacy grand oaks as the primary canopy. Because of that, it is an invaluable asset from a wildlife perspective, offering habitat to Silverberry Squirrels, Tree Mice, neo-tropical migrant songbirds, etc.

Smith stated he has seen better and worse quality upland prairie; there are scattered remnants of the native prairie community; however, the site recently had some mowing and other mechanical treatment preparatory to construction at the site. He cautioned that if mowing stopped at the site, poison oak and other species would take off, so restoration would be needed to maintain remnants there.

It is the kind of site that the USFS has discussed with the city and county about in having Section 6 recovery dollars available for acquisition, protection and restoration within the Benton County Habitat Conservation Plan. He related that in a discussion today, his state office concurred that it looked to local representatives to evaluate the value of such sites for funding.

Smith stated the site has the potential to be a valuable stepping stone habitat for species such as Fender's Blue Butterfly. There is a goal to establish that population at Finely Wildlife Refuge, and tie it into a corridor through the Muddy Creek drainage further north into the valley. He clarified that Section 6 funding typically passes from the USFW to the state agency with the primary jurisdiction for the species in question, which could be the Dept. of Agriculture or Dept. of State Lands, depending on whether plants or butterflies were being targeted. The state agency would pass the money to the county, the city or the Greenbelt Land Trust to hold the title for the parcel. The application would be linked to supporting the goals and objectives of the habitat conservation plan. The application deadline for 2007 would be in late June, with the allocation made in August. He has been talking with Benton County about several parcels in the Wren area for butterfly habitat. About $4-6 million are available annually for the State of Oregon, though the state hasn't applied for those funds for the last ten years.

Mary Buckman asked whether Section 6 funds could be used for developing the site, such as for parking and making it more accessible to people. Smith replied that funding would focus on restoration; funding for hiking trails and parking would have to come from other sources.

Smith stated that the Brooklane Heights site and Herbert and Mary's River Natural Park are close enough that they could be considered to be one unit. Because of the size and the presence of water and riparian areas and habitat components, the species diversity rating of that kind of habitat grouping is very high.

One challenge with the site is that the presence of the road makes it not as closely connected as one might prefer. While it is not a problem for birds, there could be challenges for mammals and turtles to get from the water and wetlands to the site. He stated that turtles probably nested on the hill and could be encouraged to do so again on the southwest exposure of the hill.

In response to Stephen's query, he compared the site to another west of Philomath, noting the other site had prairie of significantly better quality, with the Brooklane Heights property missing some of the other's herbaceous diversity.

Hohenlohe asked whether Section 6 funding came with any commitments for restoration dollars in the future; Smith replied that they did not. Smith clarified that initial Section 6 funds were for acquisition, though future funding could be requested for restoration; one does not preclude the other; they build on one another. He emphasized the importance of the Benton County Habitat Conservation Plan identifying the site as a potential supporting parcel for that effort. He said the Willamette Valley in this portion of Benton County is recognized by the USFW as still containing some of the best remaining habitat and there is real support for its preservation through the Department of the Interior.

Annette Mills, 2311 NW Van Buren St #6 encouraged the commission to recommend to the City Council that it consider acquisition of the land. The federal funding presents an incredible opportunity to protect habitat that would otherwise be destroyed.

David Eckert, 2311 NW Van Buren St. #6 stated he was present representing the Mary's Peak Chapter of the Sierra Club. The chapter's new conservation team has toured the site and was unanimous in wanting to participate in the process of promoting protection of the site. He emphasized the chapter's members had the highest respect for Steve Smith's opinions and had offered to assist in the fundraising effort and negotiating with the owner. The group assumes the acquisition will require a combination of public and private funds and would be willing to go to bat with the private sector.

Will Koenitzer, 4240 SW Fairhaven Dr., stated he concurred with previous comments and stated the need for protecting the site, especially given the diminution of the amount of vegetation generally.

Liz Schwartz, 3930 NW Witham Hill Dr. #64 agreed with previous comments and stated that open space was one of the best things about Corvallis. She urged the commission to recommend preservation of the site.

Hohenlohe asked what the Greenbelt land Trust has indicated regarding the site. Salwasser noted that GLT Director Karleen McCabe had commented on the site during the previous months' discussion. Cary Stephens related the GLT had looked at the site and saw the value of the property but was bound to balance the high cost of the property against lower-cost lands it sought to acquire and protect elsewhere. It identified the site as being more appropriate to be held by the city, though the GLT could be involved in a public-private partnership, perhaps with the Sierra Club. He added that the GLT also tends to focus on sites that involve less public access issues. He noted related the site was on the old GLT open space plan in a general sense; though it is not specifically identified. The GLT is currently updating its open space plan now; he guessed the parcel would probably make the cut. His main concern is whether a lot of time and energy would be spent on restoring prairie habitat there.

Terri Valiant asked how big the site was. Susan Morre, 2775 SW Fairmont, replied the site was 26 acres; there is a tongue along the road to provide access from Mary's River Natural Park. Morre stated there is potential for a loop trail and parking. She added that there is access to the site from the bike trail on Brook Lane.

Morre emphasized that cultural resources are an important part of the property, noting that three people have surveyed the site. She said the promontory overlooking Mary's River Natural Park was a prime settlement area. Smith added that the State Historic Preservation Office and the USFS Cultural Resource staff consider the area to be one of the most significant cultural sites in the Willamette Valley, in terms of the amount of surface material that has been observed. In fact, this has delayed habitat restoration activities in Mary's River Natural Area. Items have been located on the Brooklane Heights site.

Salwasser stated that given the urgency of the upcoming Planning Commission hearing, it is the role of the OSAC to advise on the value of a parcel. Stephens added that the commission has evaluation criteria and must use that in making a recommendation to the City Council. He observed that previously, the commission had a list of properties to compare the merits of and then reached consensus on ranking them. Salwasser noted the commission cannot wait until June in making a recommendation; that would be too late. Hohenlohe stated the commission could consider the results of the tour, the information from the discussion and then go through the criteria and try to reach consensus.

Director Conway advised that given that the commission has considered the matter the last four months or so, it would be best to come up with a recommendation either way today to go to the City Council, which could consider potential acquisition during executive session. She will consult with the City Attorney and City Manager on the most appropriate process. She noted that there is an active land development application. She distributed copies of the acquisition evaluation criteria matrix.

Buckman noted the value of the land would be very different if the land use application fails. Director Conway cautioned that it is very difficult to know the value of a property and that the commission should not consider that; the Council will do so in deciding to move forward. She observed that the property has not yet been approved for development. Rochefort added that when the city has gone forward with land acquisition in the past, generally the value of the land has not been known. Stephens added that when the commission evaluated properties for the 2000 bond measure, the value was simply characterized for its general bang for the buck.

Smith clarified that an escrow or purchase offer doesn't need to be part of a Section 6 application; however, there does need to be a willing seller.

Stephens related that in general, compared to the other properties that he reviewed in 2000, this property is equal or greater than some or all of them, though they are all different, with different components. The property would be relatively expensive, but has the additional benefit of being close to several other open space properties. He estimated the cost of stewardship would be rated as Medium; Education: Medium to High; Urgency as High; Water Quality rated as Medium to High; Viability of Long-Term Ownership is probably similar to other sites (it is smaller and perhaps could be added to management of the adjacent MRNP); Community Support: Medium-High; Extent of Benefit: Medium (as it is on the back side of a hill, it is less visible); Leveraging other Dollars: Medium-High (due to available Section 6 funds and possibly some private money).

Salwasser stated that she was impressed by the site's species diversity, the connectivity with other natural areas and the available federal funding. She stated that there are few opportunities to acquire this upland habitat type adjacent to river and wetlands. Smith agreed, saying this proximity was very rare. Salwasser stated that while the site is relatively small, it would be part of a larger unit. She advocated recommending acquisition, though it is predicated on having a willing seller.

Buckman stated she concurred with Salwasser and Stephens, though she is concerned with accessibility, though that is probably doable. Also, the parcel is relative small and there are some houses between the

site and the open space areas below. She noted that it is a really pretty property that would be nice to have. She added that this could be a good property to urbanize, as there are already roads and other infrastructure present. Powell replied that the city doesn't need this parcel to develop on.

Hohenlohe concurred with previous assessments, and would rank the property High on a number of criteria, though perhaps lower on Cost or Cost of Stewardship.

Mary Buckman moved and Terri Valiant seconded that the OSAC recommend that the City Council investigate acquisition of this 26-acre open space property; motion passed unanimously.

VII. **SUNSET REVIEW / BOARD CONSOLIDATION CHARTER REVIEW.** Paul Hohenlohe suggested an addition to the draft Board Consolidation Charter, similar to the Corvallis Open Space Commission Vision Statement: "Develop a comprehensive vision for the city's network of parks and natural areas and their role in the regional environment". The group agreed to add it to the draft charter as item (j).

Powell expressed mixed feelings, saying it was hard to envision how all the open space business could be accomplished. Director Conway related that leadership of both groups met and proposed adding an ongoing agenda item in the agenda template to include natural area activities, in order to give it a focus and a priority. A subcommittee could be formed where members would be responsible for working on the issue outside the general meetings and reporting back to the entire board. The restructuring will benefit from outside committees to work on open space issues. She noted the PRAB currently does not have a committee structure, though the Citizen Advisory Commission on Civic Beautification and Urban Forestry has two committees. The PRAB used to have 2 subcommittees but discontinues them in early 2000's. A natural area subcommittee would work on tasks such as management plans, brochure development, etc.

Director Conway added that specific projects now have short term stakeholder committees assembled to accomplish tasks. Member representation is established by the City Council. Planner Rochefort related that CIP used to dominate general PRAB meetings until it was assigned to a CIP subcommittee, which reviews and prioritizes the proposals to be reviewed by the entire board. She added that citizen-driven open space issues could also be brought before the board during Visitors' Propositions.

Cary Stephens stated that an issue like the Brooklane Heights discussion could dominate a meeting. Director Conway agreed it could, highlighting several meetings devoted to dogs off-leash with the Parks and Recreation Advisory Board.

The group agreed to modify item #2 with "The board shall recommend policies regarding department services for approval by the City Council".

Powell asked if the named for a merged group had been proposed; Director Conway responded that it had not. Stephens stated the group should recommend a name change be considered for the new group. Director Conway replied that that could be feedback on item #3.

Director Conway recommended adding language referring to having subcommittees; the commission agreed such language should be added. Hohenlohe advocated suggested language such as, "Many goals may be met by use of subcommittees".

Director Conway stated she was committed to creating a new draft agenda template to meet the goals of the consolidation. The PRAB will consider the matter at its May meeting. Responding to a question, she noted that the lack of specificity (in item #1) regarding backgrounds of members of the new board was

intentional, in order to avoid tying the hands of the City Council in appointing them based on a strict guideline. Current discussion is to have nine to eleven members on the new board.

Stephens expressed concern that the change could simply be re-labeling existing operational activities, requiring a similar amount of staff support. Director Conway replied that with the Civic Beautification and Urban Forestry Commission, staff sometimes does attend subcommittee meetings; it depends upon the needs of the subcommittees. Powell stated that if the change helps get more money to open space, she would support it.

Paul Hohenlohe moved and Mary Buckman seconded to recommend consolidation of the Open Space Advisory Commission with the Parks and Recreation Advisory Board; motion passed unanimously.

Mary Buckman moved and Paul Hohenlohe seconded to recommend that the Open Space Advisory Commission sunset; motion passed unanimously.

VIII. HABITAT GOAL DISCUSSION. Salwasser related the effort to develop habitat management guidelines is intended to have interim operational measures prior to having management plans for all the individual open space properties; the lack of those plans is holding up progress on enhancing and developing them. The commission had decided to look at oak woodland and oak savannah habitats first. She said the commission should focus on tactics for achieving goals for different habitat values. Director Conway added that it is a work in progress; this will not be the last time that this group or a similar PRAB subcommittee moves forward on this; this discussion should try to capture broad goals and values; e.g., protect queen White Oak trees.

In discussion on **Oak Woodland**, Cary Stephens asked whether there was a reason to be promoting larger canopied trees versus spindly trees. Steve Smith replied that it depends on what you have where you're starting from; if you already have a spindly, closed, high-density stand, it may not make management sense to try to create large open-grown trees, because the science does not support that it will be successful. Stephens noted that there seems to be an underlying goal that broad-canopied "queen oaks" are a priority goal; however, they may not be obtainable when a forest is already too dense and too far along. Smith responded that you may be able to save individual trees under a management prescription, rather than trying to treat an entire stand. Also, where there is an overgrown canopy, you will probably be less concerned about what the understory composition is, beyond trying to control non-native invasive species.

Smith also recommended identifying replacement trees for "queen" trees at a relatively young age, in order for them to develop appropriate crown structures to take the queens' place in 50-100 years. Director Conway suggested phrasing the goal as "protect and enhance, including objectives such as nurturing young oaks".

Salwasser suggested considering trying to maintain relative distribution and species diversity similar to previous times. Smith recommended looking at the inventory of what you have and then making decisions on what you want the different parcels to provide for the community. For example, some parcels could be open space managed for educational purposes for prairie savannah or wet prairie for high diversity and threatened and endangered species; there is a huge effort in the local community to engage kids in those activities; that would be a good partnership. He advised against trying to replicate percentages based on historic distributions, as opposed to trying to identify what you want to get out of your open space. Director Conway phrased goals as "protect queen oaks", "maintain distribution of

habitat to support species diversity" and "consider opportunities for education". Smith added that the educational component applies to adults as much as to kids.

Mary Buckman noted that since many parcels are urban oak woodlands, consideration should be given to public access for education and enjoyment; the commission concurred. Smith added that his system's highest trail use is at Basket Butte, an area of rare and endangered species. Stephens stated that in cases where oaks have been too far outgrown by the fir, the management goal may be to choose management for Douglas fir. Paul Hohenlohe suggested phrasing the goal as "Habitat goals for each site should be driven by what types of habitat the site can best support"; Director Conway suggested phrasing it as, "Habitat goals should be tailored for best management practices for the site".

Powell related that an area in her research where the management is less clear-cut is in parcels that are well into forest succession, where there are now oaks, fir, maples, etc, so that management can no longer be for oak savannah or oak woodland; in such cases, the question is what you value. Smith replied that one way to think about it is to consider whether you can manage for specific trees; mixed forest woodland actually has the highest species diversity; there's nothing wrong with such stands. You could manage by individual tree selection in management prescription in such areas. You could choose to protect the canopies of any remaining threatened queen oaks' canopies by ensuring they receive light and remove competition. Hohenlohe suggested the overarching idea could be that existing high quality habitat should be maintained; Director Conway suggested, "Existing high quality habitat should be considered before modifications to insert a different habitat".

In discussions on **Oak Savannah**, Smith observed that you have the opportunity to evaluate whether to consider the move to the native plant community or whether it's OK to be herbaceous oak savannah character for those values; however, there is a big leap between having the oak herbaceous layer and having an oak prairie layer, with introduction of native species. While they're visually similar, they are very ecologically different and you might use them very differently to complement other goals of the city. In some cases, it might cost too much to restore and then maintain a degraded site.

Stephens noted that beyond controlling invasive species, in some cases you might be simply preventing succession. Smith defined "invasives" as any species that detracts from the primary habitat goal that you are trying to achieve on that parcel. For example, Douglas fir would be an invasive in oak woodland and poison oak and English Hawthorn invasives in oak savannah.

Smith clarified that oak savannah is often defined as park-like, with big open canopies with an herbaceous understory (which is different from a closed canopy with a shrub understory, which is closer to woodland). Rochefort added savannah is also defined as having less than 10-15% canopy cover. Smith stated that poison oak was kept in check historically by fire; also, eventually native grasses would outcompete it. Grazing usually eliminated those grasses. Director Conway suggested the goal, "Manage site to encourage prairie species and open canopies where possible". Stephens suggested "Re-introduce native species, where possible".

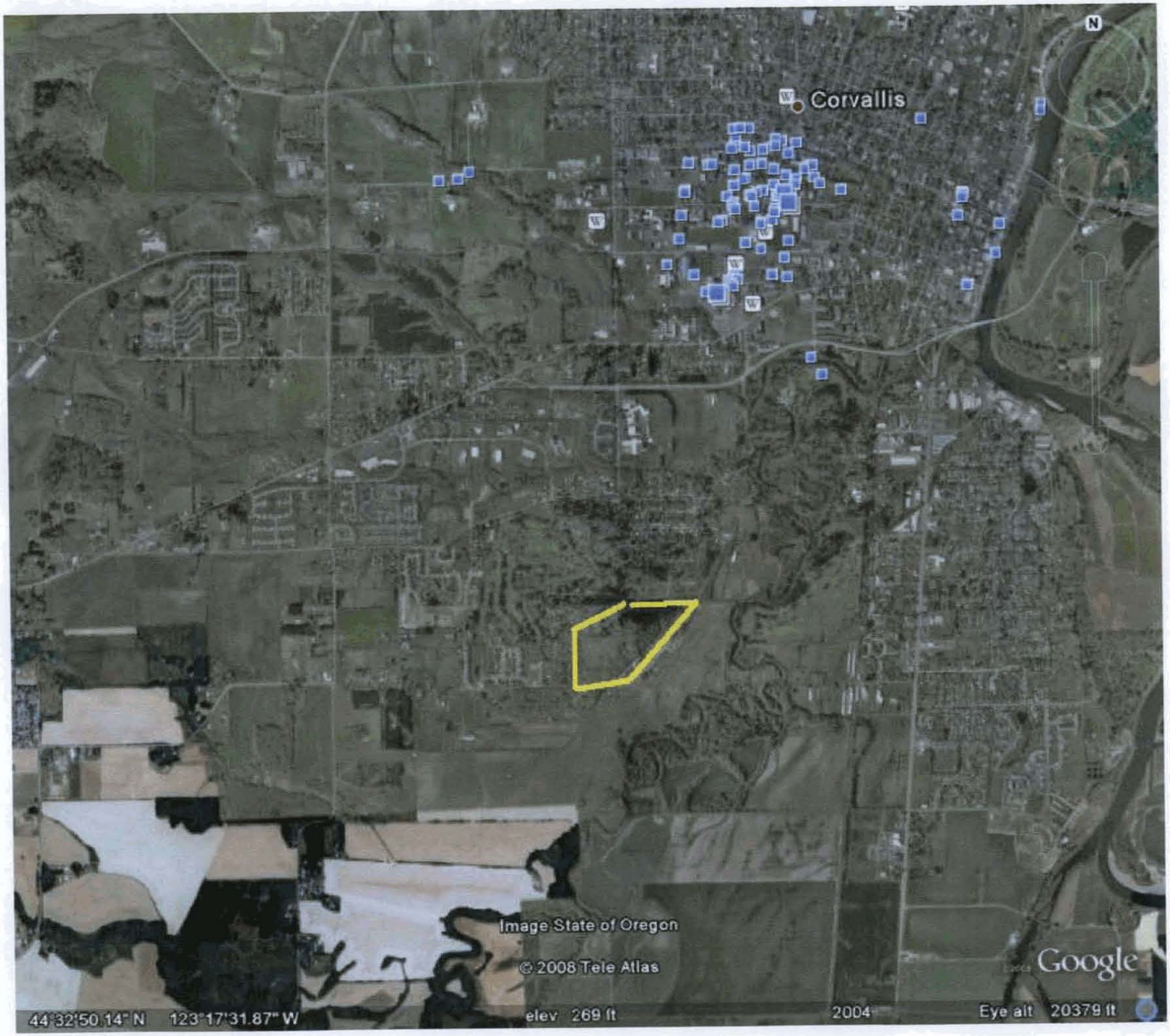
Terri Valiant noted that a number of goals were similar with both oak woodland and oak savannah. The group agreed that most goals applied to both. Smith clarified that oak savannah is different from prairie, which has less that 5% tree cover; though he cautioned that that was a landscape term, which can't be applied to management of an individual parcel.

Buckman said that when the phrase species diversity is used, it should include both animal and plant species that need a particular habitat; the group agreed. Director Conway suggested, "Provide habitat that

supports animal species, where appropriate"; the group agreed to add it to both systems. Hohenlohe noted the goal should be to provide a complete, functioning system.

Stephens emphasized the importance of protecting "queen" oaks and removing invasive plants while they are still small.

IX. ADJOURN. The meeting adjourned at 6:25 P.M.


Corvallis
Image State of Oregon
© 2008 Tele Atlas
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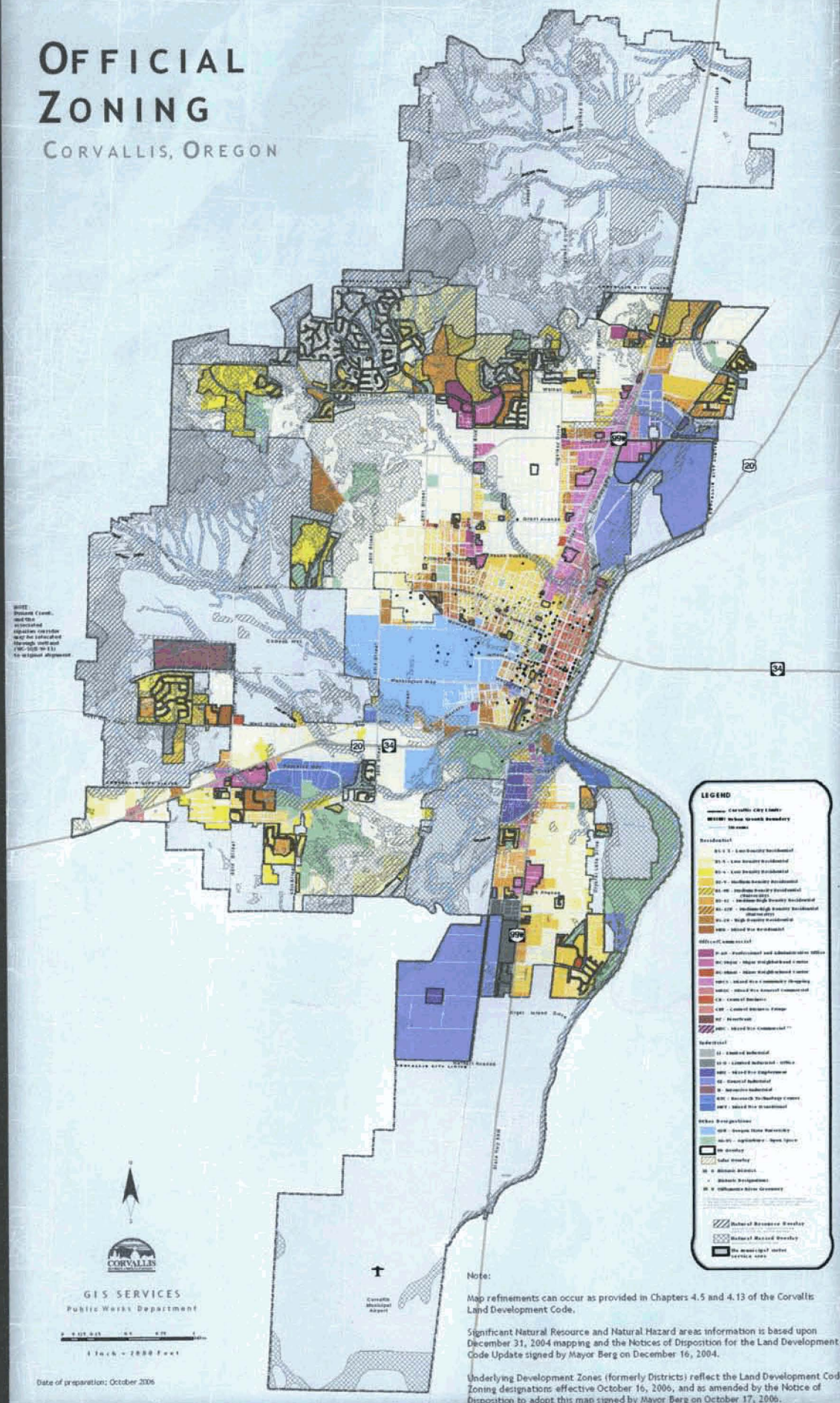
Eye alt 20379 ft

OFFICIAL ZONING

CORVALLIS, OREGON



GIS SERVICES
Public Works Department

1 Inch = 2000 Feet

Date of preparation: October 2006

Note:

Map refinements can occur as provided in Chapters 4.5 and 4.13 of the Corvallis Land Development Code.

Significant Natural Resource and Natural Hazard areas information is based upon December 31, 2004 mapping and the Notices of Disposition for the Land Development Code Update signed by Mayor Berg on December 16, 2004.

Underlying Development Zones (formerly Districts) reflect the Land Development Code Zoning designations effective October 16, 2006, and as amended by the Notice of Disposition to adopt this map signed by Mayor Berg on October 17, 2006.

Exerpts from Natural Features Scoping Project Report January 16, 2002
prepared for the City of Corvallis Department of Community Development
(Note: Natural Features Technical Advisory Committee included Trish Daniels, Hal Brauner, Scott Wright and Fred Towne)

P. 3 WATER RELATED RESOURCES
A. Introduction
The City of Corvallis (City) is required to address its water related resources under its periodic review work program. A schedule and approach for conducting the inventories was provided to the Department of Land Conservation and Development on September 30, 2001. The approach described in this report is consistent with that submittal.
The resources addressed in Water Related Resources section of the report include:
- streams and natural drainageways,
- riparian areas,
- lands abutting the Willamette and Marys rivers,
- wetlands,
- floodplains, and
- groundwater and aquifer recharge.

B. Streams and Natural Drainageways
1. Planning Strategy
Streams and drainageways provide a range of important functions within the Corvallis UGB. In addition to valuable stormwater drainage functions, they provide groundwater recharge and habitat for fish and a variety of wildlife. As a general rule, streams and rivers are considered significant resources because of the important functions they provide.
The overall planning strategy for significant natural features within the City is to provide an integrated approach that links resources and combines protection methodologies. The strategy for streams and drainageways needs to be closely related to riparian corridors, wetlands, and floodplains. The key linkage is the riparian corridor along both perennial and intermittent streams. Programs that are developed for the riparian corridors will include protection and/or enhancement of the streams. Depending on community needs, a protection program may be accomplished following the riparian safe harbor process or the standard Goal 5 process (Economic, Social, Environmental and Energy – ESEE analysis).

P. 4
Natural Drainageway. The topographic point after which sheet-drainage flows become channelized. When mapping natural drainageways using DEM, the threshold for mapping a natural drainageway occurs at the point of transition between the convex profile of a hillslope (sheet-flow dominated) and the concave profile of a channel slope.
P. 5
Perennial Stream: A perennial stream has flowing water year-round during a typical year. The water table is located above the streambed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow.

P. 6

Riparian Inventory Corridor. The Riparian Inventory Corridor identifies those properties that are to be inventoried by the City. The areas to be inventoried include:

- Along ESA streams and other perennial streams, the Riparian Inventory Corridor is the area within 200 feet of the centerline of the streams.
- Along the Willamette River and Marys River, where streams are associated with locally significant wetlands (LSW), and/or where the stream channel is braided, the Riparian Inventory Corridor is the area within 200 feet of the topof-bank of the river or stream or outer edge of the wetland or the braided channel (whichever is wider).
- Along Intermittent Streams, the Riparian Inventory Corridor is defined as follows:

Drainage Basin Inventory Corridor
(from centerline)
160 acres and greater 200 feet
80+ - 160 acres 150 feet
20 - 80 acres 100 feet
less than 20 acres 50 feet

P. 7

3. Significance Ranking Criteria

Generally all riparian areas are to be ranked to determine their level of significance based upon the functions they currently provide or could provide if restored to a natural state. The significance criteria for riparian areas are ranked from highest to lowest:

a. Stream within top-of-bank or edge of associated wetland
b. Locally Significant Wetlands
c. Area within 50 feet of the top-of-bank or edge of the associated wetland (this is necessary to maintain stream function)
d. Stream confluence areas
e. Undeveloped, vegetated riparian areas
f. Undeveloped, non-vegetated riparian areas
g. Undeveloped or developed riparian areas including wetlands or slopes 25% or greater
h. Developed riparian areas in public ownership

P. 8

Notes:

- Residential lots less than 10,000 square feet in size and occupied by a dwelling should be considered fully developed with no restoration potential.
- Residential lots 10,000 square feet and greater in size and occupied by a dwelling should be considered to have restoration potential.

Lands Abutting the Willamette and Marys Rivers

1. Planning Strategy

Lands abutting the Willamette and Marys rivers will be inventoried and assessed as riparian areas and in many instances they also will be inventoried as floodplain

areas. Protection and assessment strategies should occur under these other resource categories. These lands also may be considered scenic by their association with the rivers.

Significance Criteria

The rivers are considered significant resources. The lands abutting the rivers can be considered significant as a riparian, floodplain, or scenic resource. In general, the riparian significance will provide the guidance for determining the significance of these properties.

P. 9

The planning strategy for wetlands is governed by State of Oregon administrative rules (OARs). OAR 660-23 requires that local governments complete a local wetland inventory (LWI) to satisfy statewide planning Goal 5 OAR 141-86 sets forth the procedure to complete the LWI and the related significance evaluation. As part of the standard Goal 5 process, impact areas need to be defined. Wetland impact areas are defined as those properties that have a direct impact on the wetland or can be directly impacted by the wetland.... The OAR rules for identifying significant wetlands adopted by DSL will be used
to determine which wetlands qualify as locally significant wetlands.

Floodplains are natural features that are usually addressed under statewide planning Goal 7 as a natural hazard. In its Comprehensive Plan and Storm Water Master Plan, the City has both planned for the hazard aspect of floodplains, and recognized that floodplains should also be addressed as a natural resource. This is due to the important water quality, and fish and wildlife habitat functions floodplains provide. As with other resources, the overall planning strategy for floodplains is to link floodplain protection with the protection of other natural resources.

P. 10

The mapped floodplain is based on hydrological calculations and topography, but not actual flooding. By contrast, aerial photography of the February 1996 flood shows areas that are unquestionably subject to flooding in a less-than-100-year event. These areas should, therefore, have higher ranking than the mapped 100-year floodplain.

Existing sources of relevant information include:

- Stormwater Master Plan basin model calculations;
- Estimated location of the 0.2-foot floodway boundary (Willamette and Marys rivers);
- FEMA 100-year and 500-year floodplain boundaries, flood elevations, and topographical elevations for the Willamette and Marys rivers and portions of Dixon Creek, Oak Creek, Squaw Creek, Sequoia Ditch, and Stewart Slough;
- Drainageway calculations based on Section 4.5.80 of the Land Development Code;
- Aerial photographs of the 1996 flood; and
- Maps and aerial photographs of existing development patterns.

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Significance Ranking Criteria

The significance of floodplain areas is based on the following ranking from highest to lowest:
a. 0.2-foot floodway
b. Land Development Code Section 4.5.80 C.1., C.2. and C.4. (Section 4.5.80 defines the area along a stream or drainageway that is to be dedicated for stormwater conveyance)
c. Stream confluence areas
d. Documented 1996 flood areas that include another resource category (such as locally significant wetlands [LSW], wildlife habitat, riparian area, etc.)
e. 100-year floodplain that includes another resource category (such as locally significant wetlands (LSW), wildlife habitat, riparian area, etc.)
f. Documented 1996 flood areas that includes non-significant wetlands
g. 100-year floodplain that includes non-significant wetlands
h. Other undeveloped areas within the documented 1996 flood
i. Other undeveloped areas within the 100-year floodplain
j. Developed areas within the documented 1996 flood areas
k. Developed areas within the 100-year floodplain

G. Aquifer Recharge and Groundwater

1. Planning Strategy

Corvallis is situated over the Willamette aquifer, a permeable deposit of sand and gravel that provides relatively good quantities of groundwater. To the west, closer to the Coast Range, the deposit thins and water yields are much lower. Aquifer recharge occurs throughout the basin and impacts tend to be localized.

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HILLSIDES

A. Background/Introduction

Corvallis's "Emerald Necklace" refers to the ring of hillsides that generally defines the city's western urban growth boundary. In February of 1983, Corvallis mapped and described the resource values of significant hillsides at the urban fringe, including:

- Locke Cemetery Hill (north)
- Deer Run Ridge (northwest)
- IV Hill (northwest)
- Timberhill Ridge (north central)
- Forest Acres Hill (central)
- Witham Hill (central)
- Bald Hill (west)
- Double Hill (west)
- Philomath-Corvallis Hill (west)
- West Corvallis Skyline Hill (south central)
- Country Club Hill (south central)

Corvallis also adopted specific comprehensive plan policies for each of these hillside areas. Conflicts between urban development and resource values typically are resolved through the planned development review process. Open Space designations

were added to the Corvallis Comprehensive Plan.
In addition to the "Emerald Necklace", the Corvallis 2020 Vision statement recognizes the importance of the network of "green fingers" or riparian corridors.

B. Integrated Hillside Concept

NFTAC recognizes that Corvallis' riparian areas contain a series of inter-related resource types, including wetlands, vegetation, fish and wildlife habitat, flood plains, groundwater recharge areas and the like. Most of Corvallis' perennial streams and wetlands are found in the valley floor - generally below 290 feet above mean sea level. Similar to valley riparian areas, Corvallis' significant hillsides contain clusters of natural features identified in the Corvallis Comprehensive Plan, including the following:

- Streams
- Perennial streams
- Seasonal streams and natural drainageways
- Wetlands (usually, but not necessarily, associated with streams)
- Floodplains
- Significant Vegetation
- Non-riparian vegetation described in Lists 1, 2, 3, and 4 of the Oregon Natural Heritage Plan prepared by the Oregon Natural Heritage Advisory Council (ONHP, 1998) or the Rare, Threatened and Endangered Species of Oregon prepared by the Oregon Natural Heritage Program (R,T&ES, 2001)
- Natural plant communities and wildlife habitats in non-riparian areas
- Ecologically and scientifically significant natural areas as defined in the Oregon Natural Heritage Plan, including Bald Hill
- Hazard areas, including
- Landslide areas and alluvial fans
- Geologic hazards (e.g. fault lines, liquefaction soils, and landslide hazards
- Wildfire hazard areas
- Floodplains
- Undeveloped or partially developed drainage basins (e.g., upland meadows)
- Sensitive aquifers and aquifer recharge areas
- Scenic areas, including
- Vistas
- Viewpoints
- Gateways
- Buffers

Rather than isolate "hillsides" as a separate resource category, the project proposes an integrated hillside approach that considers Goal 5, 6 and 7 resource areas as follows:

- **Goal 5 scenic, open space, water and wildlife habitat areas**
- Scenic (viewpoints, vistas, gateways and buffers)
- Open space (vegetation, hilltops, higher elevation valleys)
- Water areas (stream corridors and wetlands)
- Wildlife habitat (wildlife habitat areas, including hillsides, stream corridors, wetlands, floodplains, and upland valleys)
- **Goal 6 water quality areas** (aquifer recharge areas, floodplains, wetlands,

seasonal and perennial streams)

- **Goal 7 hazard areas** (floodplains, and steep slopes, landslide, earthquake and wildfire hazard areas)

The intent is to digitally map each of these resource areas in a series of overlapping polygons. The comparative value of polygons (i.e., mapped clusters of resource values) then would be determined based upon an agreed-upon ranking system.

P. 15-16

In 1983, Corvallis inventoried specific sandstone and volcanic hills and found them to be "significant". However, the 1983 inventory did not address all of the natural features that typically are found outside the Corvallis valley floor.

For hillsides, the project team suggests using a contour elevation level to separate valley resources from hillside resources. The "Hillside Elevations" map shows water service levels within the Corvallis UGB. The 290-foot elevation level corresponds with the beginning of the second water service level and represents the dividing line between the valley and the surrounding hills. Therefore, the integrated hillside inventory area should include all land above the 290-foot elevation level.

E. What to Inventory

It is recommended that the following natural features be inventoried and mapped for hillside areas above the 290-foot elevation level:

1. Stream systems, including:

a. Perennial streams and riparian areas
b. Intermittent streams, natural drainageways and riparian areas
c. Wetlands
d. Aquifer recharge areas
e. Floodplains

2. Significant vegetation and wildlife habitat, including:

a. Non-riparian vegetation and wildlife defined in Lists 1-4 of the Oregon Natural Heritage Plan prepared by the Oregon Natural Heritage Advisory Council (ONHP, 1998) or the Rare, Threatened and Endangered Species of Oregon prepared by the Oregon Natural Heritage Program (R,T&ES, 2001) Heritage Plan (2001)
b. Plant communities and wildlife habitats in non-riparian areas
c. Ecologically and scientifically significant natural areas (e.g., Bald Hill)
d. Undeveloped or partially developed drainage basins (e.g., upland meadows)
e. Developed areas

3. Hazard areas, including:

a. Landslide/Slope hazard areas including the depositional areas
b. Geologic fault lines
c. Soil liquefaction areas d. Wildfire hazard areas
e. Floodplains

4. Scenic areas, including

a. Vistas
b. Viewpoints
c. Gateways
d. Buffers
e. Corridors
f. Open Space

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Significance Ranking Criteria and Methods

Four categories of natural and scenic resources were developed for discussion purposes. As noted above, the ranking system will be applied to polygons representing clusters of resource values for specific geographic areas. The categories follow:

Category A: Higher Elevation Stream Corridor System

The higher elevation stream systems in Corvallis are composed mostly of intermittent streams that feed into perennial streams. In contrast, perennial streams are more common than intermittent streams on the valley floor. For riparian areas above the 290-foot elevation level, the inventory corridor for perennial streams was determined to be 200 feet.

Category B: Slope Hazard, Wildfire Hazard and High Elevation Areas

Management of natural hazards falls under Statewide Planning Goal 7, Natural Hazards, rather than Goal 5, Natural Resources. A major factor in determining slope stability is the percent of slope. The following ranking system is proposed: 1

1 It is important to distinguish between slope measured in percentage points and slope measured in degrees. A 45° slope is the same as a 100% or 1:1 slope. Like a 45° slope, a 100% slope rises one foot in elevation for each horizontal foot at the base.

a. **Land above the 560' elevation level.**

b. **Areas with potential for landslides (including slopes of > 25%) or earth failures due to earthquakes, including fault movements, or water.**

c. **Undeveloped slopes of greater than 20%.** OAR Chapter 660-008-0005 defines slopes of 25% or greater as "unbuildable" for purposes of determining density within UGBs. The 1983 *Open Space – Hillsides* report defined steep slopes as 20% and greater. The *Soil Survey of Benton County* (USDA SCS 1972) often associates slopes of 20% or greater with "severe" limitations for building construction. With this background, the NFTAC recommends that all slopes of >20% be delineated with further breaks at 25% and 50%.2

d. Areas with high wildfire potential.

f. Undeveloped Slopes of 10-19%.

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Category C: Higher Elevation Vegetation & Wildlife Habitat

It is recommended that vegetation and wildlife habitat be considered together, because the presence of vegetative cover is a primary determinant of wildlife habitat. Six basic types of vegetation regimes have been identified in high elevation areas within the Corvallis UGB:

- Prairies (both wetland and upland meadow)
- Oak forests and savannas
- Coniferous forests (ponderosa pine, Douglas-fir etc.)
- Other Deciduous forests
- Mixed Deciduous-Coniferous forests
- Riparian (see riparian resources discussion paper)

1. Wildlife Habitat Assessment (WHA) Method

The first step in the inventory process would be to describe undeveloped areas according to habitat type based on distinct vegetation assemblages. Wildlife habitat values associated with these habitat types will then be evaluated using the WHA Method. The WHA Method documents the presence and availability of

water, food and cover for wildlife; connection with other habitat areas; unique or rare occurrences of plant and animal species; and disturbance impacts. The WHA survey will also document species occurrence by strata (e.g., tree, shrub, ground cover), plant community composition and seral stage, species dominance and cover values, presence and size of snags and similar vegetative characteristics. The sample WHA field sheets may be modified to reflect vegetation or habitat conditions specific to Corvallis, or the importance of upland habitats in the hillside areas where access to water is more limited (Please see Appendix E). Sources of additional information to be consulted include Oregon Natural Heritage Program records of sensitive and listed plant and animal species, and local, regional and state vegetation and wildlife surveys.

P. 19

Proposed Ranking Structure

a. WHA Score of 80 or greater. Areas with Wildlife Habitat Assessment score of 80 or greater represent intact vegetative regimes that are connected to other habitat areas, have a nearby source of water, and provide high quality food and cover for wildlife, including rare species.

b. Areas with known occurrences of rare plant, animal species, or habitats. Rare plant and animal species (including federally and state listed threatened and endangered species) are listed in Rare, Threatened and Endangered Plants and Animals of Oregon (Oregon Natural Heritage Program, February 2001). These species include the following:

- ONHP List 1 - species that are threatened with extinction or presumed to be extinct throughout their entire range
- ONHP List 2 - species that are threatened, endangered or extirpated in Oregon, but secure elsewhere. Such species are of concern when considering species diversity in Oregon.
- ONHP List 3 - species for which more information is needed before status can be determined but which may be threatened or endangered in Oregon or their range.
- ONHP List 4 - contains taxa that may be of conservation concern but are not presently threatened or endangered.

c. Locally rare species or habitats. Areas that are determined to be highly valued or rare by the CAC as a result of peer review or public input. Examples include remnant Oak Savanna and Prairie habitats. The inventory and assessment process shall document restoration potential.

d. WHA Score of 45-79. Several Oregon communities have established WHA scores of 45 and greater as a baseline threshold for significance. At this point, the project team recommends that sites with scores in this range be identified as in the fourth tier. Typically, sites with WHA scores ranging from 45-79 represent partially disturbed vegetative regimes that may be connected to other habitat areas and have a nearby source of water. Such sites may also provide potential food and cover for rare species of plants and wildlife. These sites usually have moderate to high potential for restoration or enhancement.

e. WHA Scores below 45. Sites with a WHA ranking below 45 typically exhibit a high level of vegetative disturbance, have limited or no access to water and are isolated from other resource sites. However, such sites may

have high potential for restoration or enhancement.
Note: WHA scores are ordinal and scoring thresholds can be adjusted at a later date after data has been collected, the scores are determined, and the competing land uses have been considered.

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Category D: Scenic Areas

In this section, we begin with a series of general definitions, and then move on to discuss a proposed inventory approach for Corvallis' higher elevation natural resources. NFTAC agreed to forward this approach to another Citizen Advisory Committee (CAC) (e.g. the Open Space Advisory Committee (OSAC) or another specially appointed committee) for further consideration. The appropriate CAC would be free to adapt this approach as it sees fit, and forward its recommendations to the City Council.

1. Scenic Vista. A scenic vista is a view of a natural and/or manmade feature that is valued locally for its aesthetic qualities. A scenic vista may be to a far away object, such as Marys Peak, a local panorama such as the forested hillsides or ridgelines (Emerald Necklace), or a nearby object such as a city bridge or county courthouse. A scenic vista may be observed from a public stationary location (scenic viewpoint) or be seen as one travels along a roadway, waterway, or path (scenic corridor).

2. Scenic Viewpoint. A scenic viewpoint is a publicly accessible location from which to enjoy a scenic vista. Scenic viewpoints must be publicly owned or accessible. A viewpoint may be a generalized location, such as a hillside or ridgeline, and include several vantage points where the vista may be seen to best advantage, or a single observation point. The inventory may include potential viewpoints on private land when it is anticipated that public access will become available at the time of development.

3. Buffer Areas. A buffer area is typically an area of vegetation, topographic variation, and/or open water that provides a visual transition between natural and urbanized environments or between neighborhoods, or creates a visual screen between certain types of incompatible or visually discordant land uses. Buffer areas may be linear, such as a ridgeline or stream corridor, or may be non-linear or fragmented, such as a series of small parks and open spaces.

4. Gateway Areas. Gateway areas consist of a combination of vistas and viewpoints that help to define the City of Corvallis or entryways to the community. Gateways typically are at the edge of the city or a specific area such as Downtown Corvallis. Corvallis, in Comprehensive Plan Policy 5.5.11, has already identified Highway 99, both north and south of the City Center; Highway 34, between Tangent and the City Center; Highway 20/34, between the City Center and Philomath; and Highway 20, between Albany and the City Center as significant gateways corridors. The gateway vista may be of the city's hillsides, downtown, university, rivers or other areas, and often offer a signature or "postcard" view of the city.

5. Scenic Corridor. A scenic corridor is a linear scenic resource. It may include streets, bikeways, trails, or waterways through parks, natural areas, or urban areas. The corridor may include scenic vistas along it, or may be valued for its intrinsic scenic qualities. Examples include a winding road through the Corvallis hillsides
or the Willamette River.

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CITY-WIDE NATURAL FEATURES

A. City-wide Natural Features Introduction

Certain natural features may occur anywhere in the community -- within the riparian corridors, at higher elevations, or on the middle ground. These features include trees and shrubs (including landmark trees, street trees, significant groves of trees, significant established individual trees and shrubs), archaeological resources, the Corvallis Fault, and soils subject to liquefaction. Each of these resource categories is addressed in this section.

B. Trees, Shrubs and Tree Clusters

Trees and shrubs are often considered to be significant natural features due to their riparian and wildlife habitat functions. Those functions are addressed through the specific inventories previously outlined. In addition, trees and shrubs provide scenic, architectural, aesthetic, engineering, storm water management, and energy benefits.

3 Prairies are typically dominated by native bunchgrasses such as Roemer's fescue. Remnant prairie habitats, such as those in the Corvallis area, often contain a mix of native and exotic species. Among the rare species associated with prairies are Fender's blue butterfly and Bradshaw's lomatium, which are found only in the Willamette Valley. It is estimated that less than one percent of upland and wetland prairie habitat remains in Oregon's Willamette Valley.

P. 27

Landmark Trees

Selection and Ranking Criteria--Proposed criteria for designating landmark trees include:

Historic trees (property owner consent is required for trees to be designated as landmark trees based upon the historic tree criteria)

- Association with a historic figure, property, or general growth and development of the City
- Historic survey marker

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Archaeological Areas

Archaeological resources are, in a real sense, recent geological features, as well as, cultural heritage. The oldest ones usually lie the most deeply buried while the youngest ones are nearest the surface. Archaeological features on their original surface are of much higher scientific value than ones that have been re-deposited by erosion. Corvallis potentially has three different types of archaeological sites:

(1) Historic Euro-American and Native American

(2) Earlier Native American

(3) Ice Age Paleontology with a potential for human association.

Archaeological areas are often identified through discovery rather than through an extensive citywide inventory in advance of development. Rather than survey the community, it may be possible to map locations where artifacts are more likely to be discovered. Use of such a map can provide notice to developers and contractors that an archaeological site may be present. In addition, any known sites on record at the State Historic Preservation Office (SHPO) will be documented.

The archaeological map can be developed based on factors that influence settlement patterns and can be focused on particular time periods such as pre-Euro-American

settlement or post-Euro-American settlement. Often these settlement patterns are similar because both Euro-American settlers and Native Americans required access to
water and relatively level ground that was free from flood hazards.

P. 31-32

SYNTHESIS OF MAPPED NATURAL FEATURES

As natural features are mapped and inventoried, maps will be digitized and information will be recorded in the Corvallis geographic information system (GIS). Inclusion in the GIS will allow the City to conduct complex analytical studies that overlay different resource categories to compare and contrast the significance of two or more areas. Because the natural features inventories will be developed over time, it will be important that this system be dynamic and developed in such a way that new information can be added.

Under the proposed concept, a significance map will be developed for each of the resource or natural feature categories identified. For example, in the broad category of Water-Related Resources, separate maps will be developed for each resource type: wetlands, riparian resources, floodplains, etc. Each separate resource map will include mapped information ranked according to the significance ranking criteria that was defined for the resource or feature. For example, the ranking of significance for riparian areas included stream within the top-of-bank or edge of associated wetland, locally significant wetlands, area within 50 feet of the top-of-bank or edge of associated wetland, stream confluence areas, and so on (see Section E. Riparian Areas starting on page 5). The significance ranking criteria will be given values assigned in rank order. Another option is to group the criteria as having high, medium, or low values. A map will be produced for each resource and will visually depict the significance by using shading for each value. Combining resource maps and allowing the shaded areas to overlap will provide a synthesized overall significance map for the City.

The overall significance map will be produced by combining the individual resource layer maps. As part of this process, it is possible to adjust the importance (weighting) given to any resource category. This will allow some resource categories to be considered more important than others. For example, the City may want to place a very high value on streams, so all stream resources are given a relative weight of "2." The vegetation and wildlife habitat areas of the higher elevation may be considered important and given a weight of "1." The middle ground areas may have lower relative weights since development is generally expected and encouraged in the middle ground areas. In our example, middle ground vegetation and wildlife may be given a weight of "0.5." The weighting provides a variable that can be useful to better reflect community values in the final results.

The overall significance map results from a compilation of all resource maps and values. The map will highlight areas where resource values overlap. The areas with the most overlap will generally be considered the most important areas to be protected. Those areas without a high degree of overlapping values may still be important, but it is likely that they will not be as important as those areas where multiple resources exist.

P. 45

Impact area: A geographic area within which conflicting uses could adversely affect a significant Goal 5 resource.6

Impervious surface: A surface that cannot be penetrated by water, such as pavement,

rock, or a rooftop, and thereby prevents infiltration and generates runoff.

P. 47

Significant Habitat Areas: A land or water area where sustaining the natural resource characteristics is important or essential to the production and maintenance of aquatic life or wildlife populations.[6]

Social consequences: The tangible and intangible effects upon people and their relationships with the community in which they live resulting from a particular action or decision.[6]

Sources:

1. Department of Land Conservation and Development; Department of Environmental Quality. 2000. Water quality model code and guidebook.
2. Oregon Administrative Rules 141-086-0200 from Oregon Division of State Lands web site
3. Oregon Administrative Rules 629-035-0000 from Oregon Department of Forestry web site
4. Oregon Administrative Rules 629-600-0100 from Oregon Department of Forestry web site
5. Oregon Administrative Rules 660-023-0000 from Oregon Department of Land Conservation and Development web site
6. Oregon Statewide Planning Goals
7. Oregon Division of State Lands, 1998. Urban riparian inventory and assessment guide

P. 51

Riparian areas provide a range of functions, including fish habitat, stream bank stability, flood management, water quality, microclimate moderation, and wildlife habitat. Each function contributes to the overall value of a riparian area, therefore all of the functions should be considered when evaluating community benefit of riparian areas.

P. 55-57 (B-5 to B-7)

Water Quality

Contaminants not only include pollutants, but also sediments, nutrients, and streambank erosion. Recent research suggests that a grassy buffer strip may filter out contaminants better than woody vegetation, but any vegetation will do this at some level. Aside from acting as a filter, vegetation also binds the streambank, which reduces erosion. Important elements for this function are vegetation type, buffer width, riparian continuity, and slope.

Wildlife Habitat

Wildlife habitat is perhaps the best known of riparian functions. Proximity to water, nesting and denning habitat, abundant food sources, and large woody debris on the ground for smaller forms, all serve to benefit wildlife species. Studies have shown that deciduous forest areas undergoing intermediate levels of disturbance, such as occasional tree falls, contain patchy habitat that creates species diversity. An open-canopy forest allows a patchy landscape to develop providing both arboreal and ground habitat. Size of the habitat plays a critical role in this function, but depends on the home range and general population structure of the species of interest. Habitat fragmentation serves to limit movements, and,

by dividing populations into smaller units, to increase the possibility of extinction. Species agility, the ability to move, plays an important role in determination of patch size. The preservation of movement corridors helps those species that tend to disperse over longer distances by maintaining continuity of habitat. Birds and insects are less impeded by broken movement corridors, depending upon the size and nature of the break. Elements of importance for this function include vegetation type (which provides a greater diversity of potential habitat types, food sources, and landscapes), riparian buffer width (patch size), riparian continuity (corridors), and land-use type.

Flood Management
Riparian areas serve as zones to reduce the impact of flooding. Wetland areas, in particular, perform a critical function by absorbing flood flow. Woody vegetation breaks flow, causing floodwaters to slow. This allows infiltration, which in turn raises the groundwater table and extends the critical connection between surface and ground waters. Grassy and herbaceous vegetation tend to act as baffles, slowing water and causing deposition of sediments and some infiltration into the soil. Stream size, riparian buffer size, vegetation type, land use, channel alteration, and incision of the channel all serve to determine the capability of a riparian area to perform this function.

Riparian Function Classification by Vegetation Types
Using the tables below, the functional performance of a riparian reach may be evaluated by vegetation type. Vegetation type for each function is listed in order of decreasing capability. These lists are approximate rankings. Riparian function is influenced by many factors in addition to vegetation type.

Table 1. Riparian Function by Vegetation Type

Water Quality	Aesthetic Values	Fish Habitat	Wildlife Habitat	Flood Management
Meadow	Mixed	Conifers	Hardwood	Mixed
Brush	Hardwood	Mixed	Mixed	Hardwood
Hardwood	Conifer	Hardwood	Conifer	Brush
Mixed	Meadow	Brush	Brush	Conifers
Conifer	Brush	Meadow	Meadow	Meadow
Yard	Pasture	Pasture	Yard	Pasture
Pasture	Yard	Ag Field	Pasture	Ag Field
Ag Field	Ag Field	Yard	Ag Field	Yard
No Veg	No Veg	No Veg	No Veg	No Veg

P. 62 (B-12)
Areas with High Restoration Potential
Areas with high restoration potential include:
- Slopes of 15% or greater,
- Land within 50 feet of the top of stream bank as defined by the Goal 5 rule,

– Floodplains, and
– Hydric soils including lower quality wetlands (i.e., wetlands that do not meet LSW criteria for local significance but lie within the riparian inventory area.

P. 66 - 67 (C-3 to C-4)
Locally Significant Wetland Analysis
The term "A significant wetland" has meaning in the context of Statewide Planning Goal 5. Under this goal, local governments must identify their significant resources, including wetlands, so that those resources serving significant functions in the local community are given proper consideration in planning decisions. The DSL established a technical advisory committee to develop the LSW criteria. The DSL adopted the OAR rules for identifying significant wetlands in January 1997 (141-86-300 through 141-86-350). The criteria rely heavily on the results of OFWAM. Under Goal 5, cities prepare local wetland protection ordinances to apply to locally significant wetlands. Any wetlands not protected by local ordinances may still be under the jurisdiction of the DSL and the U.S. Army Corps of Engineers (Corps).

A wetland is considered significant if it meets one or more of the following criteria:
- It has the highest OFWAM rank for any of the four ecological functions (wildlife habitat, fish habitat, water quality, or hydrologic control).
- It is (1) rated in the highest OFWAM category for water quality or (2) rated in the second highest category for water quality and is within 0.25 mile of a waterquality limited stream, as listed by the DEQ.
- It contains one or more rare wetland plant communities, including those listed in the Oregon Natural Heritage Program's (ONHP) Classification and Catalog of Native Wetland Plant Communities in Oregon (Christy 1993) as G1-G3 and S1-S3.
- It is inhabited by any species listed by the federal or state government as threatened or endangered in Oregon (unless consultation with an appropriate agency, e.g. USFWS, ODA or ODFW, deems the site not important for the maintenance of the species).
- It has a direct surface water connection to a stream segment mapped by the Oregon Department of Fish and Wildlife as habitat for indigenous anadromous salmonids, and Aintact@ or Aimpacted or degraded@ fish habitat function using OFWAM.

The final two criteria are at the discretion of the local government.

City of Corvallis

Natural Features Inventory
City Council Acceptance

September 2, 2003

Prepared by

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With

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I. Executive Summary

Purpose

The purpose of the Natural Features Project is to provide comprehensive information about the location and condition of natural resources and hazards within the Corvallis urban growth boundary (UGB). This information is needed by the City of Corvallis, Benton County, property owners, and the general public to make decisions about land use planning. The Natural Features Project and the associated inventories respond to the requirements of the Oregon statewide planning goals, primarily Goals 5, 6, and 7, and associated administrative rules. The Natural Features Project information will be used, in conjunction with other information and with substantial public input, to implement the Corvallis 2020 Vision Statement and the Corvallis Comprehensive Plan (1998). Both the Statewide Planning Goals and the Corvallis Comprehensive Plan direct the City to achieve a balance between providing a sufficient supply of buildable lands to meet the City's needs for housing and economic development while protecting significant natural features and reducing risks from natural hazards. The Oregon Department of Land Conservation and Development (DLCD) has directed the City of Corvallis to complete this work within the next several years.

Natural Features Project Planning Process

The Natural Features Project is a multi-year community project to inventory (systematically map and describe) and prioritize (determine the relative "significance" of) the natural features within the Corvallis UGB. The inventories are used to balance the community's need for buildable land for housing and economic development with natural resource protection and reducing risks from natural hazards. The steps necessary to achieve this work are discussed in more detail in the Introduction of the Inventory report. Briefly, the Natural Features Project has four major phases, consistent with State requirements:

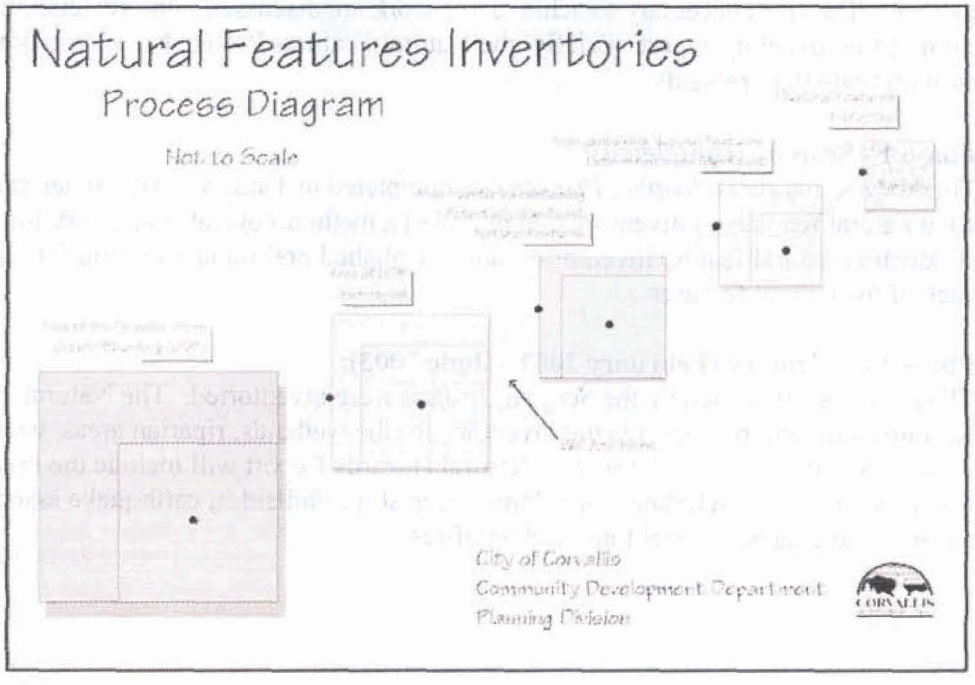
- **Phase 1 - Scoping (completed):**
  The *Natural Features Scoping Project* was completed in January 2002. It determined what natural features to inventory and provided a methodological framework for conducting natural feature inventories, and established preliminary criteria for ranking each of the natural features.

- **Phase 2 - Inventory (February 2002 – June 2003):**
  The resources identified by the *Scoping Project* were inventoried. The Natural Resources Inventory Report is the inventory for the wetlands, riparian areas, wildlife habitats and tree groves. A separate Natural Hazards Report will include the inventories for natural hazards including floodplains, steep slopes/hillsides, earthquake associated hazards, landslides, alluvial fans, and wildfires.

- **Phase 3 - Establish Priorities and Balance Needs (June 2003 – April 2004):**
  Not all natural features identified in the inventories will be significant and warrant protection. During this stage, the community will review the inventory information and will make decisions regarding the significance of each resource site. The community will also consider the consequences of various protection programs to ensure that a balance is achieved between resource and hazard protection, and providing sufficient buildable land to meet the community's needs.

- **Phase 4 - Developing Implementation Program (January - July 2004):**
  The final stage of the project will be to develop a combination of incentives, education materials, and regulations to protect the significant natural features and reduce the risks associated with natural hazards. Resource protection programs will include clear and objective standards in the Land Development Code and provide more certainty to property owners and the broader community regarding where development can occur, and where it will be limited.

It is important to understand that the inventory does not, by itself, establish which lands will be available for development or which natural features will be protected. Not all of the natural features included in the inventory will be considered "significant", not all of the significant natural features will be protected, and limited development may be allowed on protected resources. Each phase of the Natural Features Project will include decisions to balance conflicting or competing goals, which will reduce the number of natural feature areas under consideration (see figure below). These decisions will be made in future phases through a collaborative process with significant input from property owners and the general public.



The Natural Resources Inventory Report

This report is part of the inventory step in the Natural Features Project and includes the following resources:

- Wetlands
- Streams and Riparian Areas
- Wildlife Habitat (including Significant Vegetation)
- Tree Groves

In addition, the City of Corvallis is preparing separate inventories for the following natural hazards:

- Floodplains
- Steep Slopes/Hillsides
- Earthquake Associated Hazards
- Landslides
- Alluvial Fans
- Wildfire Potential

How To Use This Inventory

The Natural Features Inventory is divided into four resource types: wetlands, riparian areas, wildlife habitat and tree groves. Each resource has a **technical report** that describes the detailed methodology with summary tables and analysis. Detailed **data sheets** can be found for each resource site. The maps are divided into two categories: water-related resources (wetlands and riparian areas) and upland resources (wildlife habitat and tree groves). Each resource category has three types of maps with increasing detail. A **summary map** identifies the resource location within the Corvallis UGB. The **locator maps** are divided by study area (north, west-central, south) and provide a map index to the detailed **map sheets**, using 2002 aerial photos as their base.

Inventory Methodology

Specific methods are used for each of the natural features in this inventory. The inventory and assessment methods described in this report are based on the *Natural Features Scoping Project Report* (2002) prepared by the Corvallis Natural Features Technical Advisory Committee (NFTAC). The scoping report provides clear direction regarding what natural features to inventory further and provides the methodological foundation for determining how to inventory the natural features. The functional values of each natural resource area are evaluated using ranking/point systems to allow comparisons among all areas with the same type of resources. Detailed descriptions of the methods are found in each of the technical reports. Briefly:

- **Local Wetlands Inventory (LWI)** – the LWI includes all wetlands at least 0.5 acres is size, either isolated or within riparian assessment areas or wildlife habitat assessment areas. The methods are determined by Oregon Division of State Lands (DSL) administrative rules.[1] The LWI is unique in that it is the only resource in which "significance" of a local wetland is determined by state administrative rules. The *Oregon Freshwater Assessment Methodology* (OFWAM) is used to assess whether or not a wetland meets the criteria for a Local Significant Wetland (LSW).

- **Riparian Assessment** – the riparian assessment is conducted within riparian assessment areas (RAA), which vary in width depending on stream type (perennial or intermittent) and the presence of locally significant wetlands and/or continuous riparian vegetation. The width of the RAA extends beyond the width of the riparian vegetation to identify potential offsite impacts. Each RAA is mapped with subareas or "subpolygons" that indicate different vegetative cover types (i.e. trees, shrubs, grasses, developed). The methodology is based on the *Urban Riparian Inventory and Assessment Guide* (URIAG) and a supplemental Riparian Corridor Survey to provide additional information on vegetation cover and stream conditions consistent with the *NFTAC Scoping Report*.

- **Wildlife Habitat Assessment (WHA)** – the wildlife habitat assessment includes all areas of at least five acres with natural vegetation, except for areas within riparian assessment areas. The WHA inventories and assess six general categories of habitat features or conditions: water, food, cover, human disturbance, patch size and connectivity, and unique features. Vegetation subpolygons are defined within each WHA area based on vegetative cover types. Each vegetation subpolygon includes a description and characterization of the vegetation and identification of any rare, threatened or endangered species associations.

- **Tree Grove Assessment (TGA)** – tree grove assessments are conducted for all areas with trees that are predominantly 25 feet or more in height with a continuous canopy cover of 0.5 acres or more. The TGA distinguishes between isolated tree groves (less than five acres in size) and vegetative subpolygons within WHA areas (greater than five acres), but does not include tree cover within developed areas or riparian assessment areas. The TGA evaluates tree groves for scenic, aesthetic, and other functional values.

Aerial photo interpretation is used to identify potential resource sites, which are then confirmed by field surveys. The fieldwork is conducted on-site where access permission is granted. Where access is not obtained, off-site assessments are conducted using aerial photographs, existing data sources, and observation from public lands and adjacent rights-of-way.

In many cases, resource boundaries overlap. For example, tree groves may be isolated or part of a wildlife habitat assessment area; or, a riparian corridor may be located within a wildlife habitat assessment area. Similarly, wetlands may be part of either a wildlife habitat assessment area or a riparian assessment area. The methodology ensures comprehensive coverage and consideration

1 OAR 141-86-110 through 141-86-240

of multiple functional values for each type of resource (i.e. riparian areas serve as wildlife habitat), while avoiding "double counting" resources.

Natural Resources Inventory Results

The inventory area is the Corvallis UGB, which includes 17,965 acres or approximately 28 square miles. Just under half of this land is within the Corvallis city limits (approximately 8,934 acres), and the remainder is within unincorporated, but urbanizable, Benton County. Both Corvallis and Benton County have responsibility to plan for unincorporated land within the Corvallis UGB. The inventory area is divided into three study areas based on watershed basin boundaries (see Figures 1 and 2):

- North Corvallis Study Area (4,966 acres);
- West-Central Corvallis Study Area (8,467 acres); and
- South Corvallis Study Area (4,532 acres).

The total acres included in the inventories for all four resource categories cover approximately 44% of the Corvallis UGB. Approximately 2,157 acres or 27% of the resource areas are inside the Corvallis city limits. Approximately 5,757 acres or 73% % of the resource areas are outside the city limits in unincorporated Benton County. This imbalance is not unexpected given most of the vacant, undeveloped land is outside the city limits. Table 1 provides a breakdown of the total acreage in the inventory study area.

Table 1. Total Acres Inventoried by Area

	Total Area (Acres)	Resource Inventory (Acres)	% Area Inventoried
Corvallis UGB	17,965	7,921	44%
North Study Area	4,966	2,288	46%
West-Central Study Area	8,467	3,720	44%
South Study Area	4,532	1,913	42%
City of Corvallis	8,934	2,157	24%
Unincorporated Benton County	9,031	5,764	64%

Figure 1. Study Areas within Corvallis Urban Growth Boundary

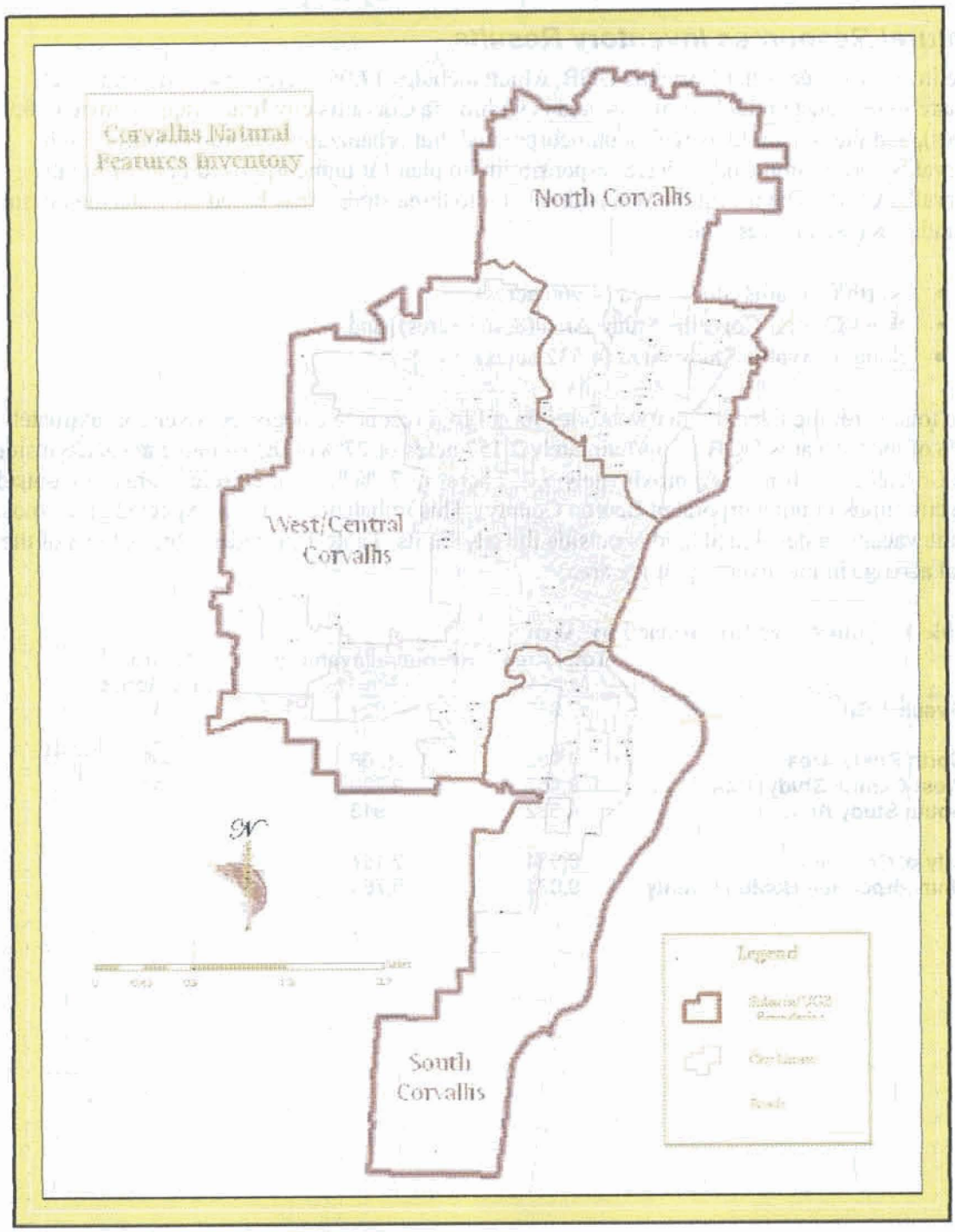
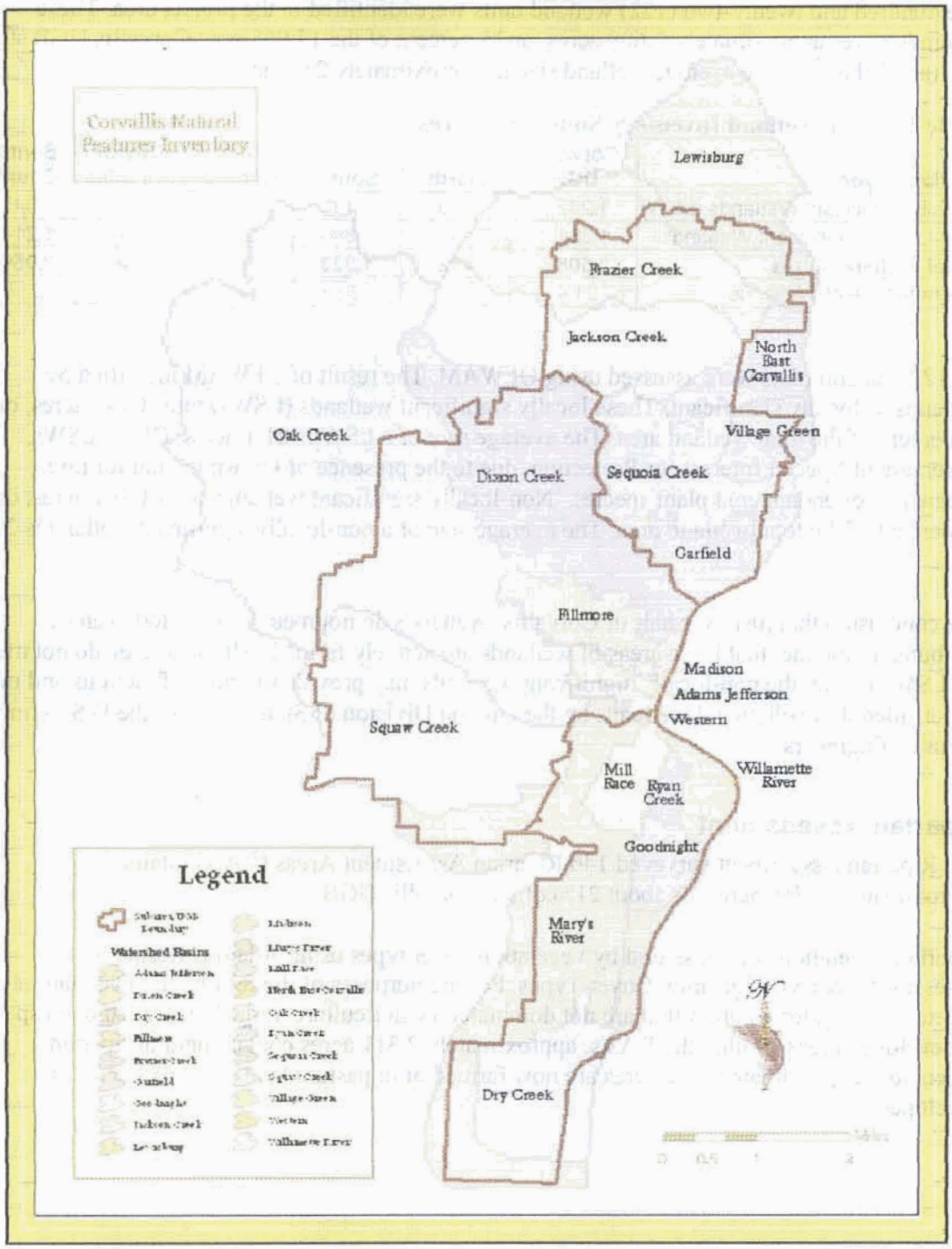


Figure 2. Watershed Basins within Corvallis Urban Growth Boundary



Local Wetland Inventory (LWI)

One hundred and twenty-two (122) wetland units were identified in the project area. These wetlands cover approximately 2,608 acres, or 15 percent of the 17,965-acre Corvallis UGB study area (see Table 2). The average wetland size is approximately 21.6 acres.

Table 2. Local Wetland Inventory Summary (acres)

Wetland Type	Corvallis UGB	North	South	West Central	City of Corvallis	Benton County
Locally Significant Wetlands (LSW)	1,247	299	433	515	402	845
Non-Locally Significant Wetlands	1,361	183	890	288	146	1,214
Total Wetland Acres	**2,608**	**482**	**1,323**	**803**	**548**	**2,059**
Average Size of Wetlands	21.4	21.1	32.3	14.1	15.7	23.9

All 122 wetland units were assessed using OFWAM. The result of OFWAM identified 59 wetlands as locally significant. These locally significant wetlands (LSWs) total 1,247 acres, or 48 percent of the total wetland area. The average size of a LSW is 21.1 acres. Of the LSWs, eleven are of Special Interest for Protection, due to the presence of known habitat for rare, threatened, or endangered plant species. Non-locally significant wetlands total 1,361 acres, or 52 percent of the total wetland area. The average size of a non-locally significant wetland is 21.6 acres.

The conclusion that just over half of Corvallis' wetlands do not meet LSW criteria can be attributed to the fact that large areas of wetlands are actively farmed. Although they do not meet the LSW criteria, the non-locally significant wetlands may provide important functions and may be considered jurisdictional wetlands by the Oregon Division of State Lands or the U.S. Army Corps of Engineers.

Riparian Assessment

The Riparian Assessment surveyed 140 Riparian Assessment Areas (RAA) totaling approximately 3,750 acres, or about 21% of the Corvallis UGB.

Riparian vegetation was classified by vegetation cover types using Adamus Resource Assessment (ARA) Vegetation Cover Types. For the purposes of the following table, natural vegetation includes all areas that are not dominated by agriculture, large landscaped open spaces, or developed areas. Within the RAAs, approximately 2,311 acres contain natural riparian vegetation, approximately 752 acres are now farmed or in pasture lands, and 688 acres are developed.

Table 3. Riparian Assessment Summary

Vegetation Cover Type	Corvallis UGB	North	South	West Central	City of Corvallis	Benton County
Natural Vegetation	1,420	373	298	748	429	991
Wetlands (LWI)	891	220	132	539	161	730
Agricultural/Pasture	752	303	96	353	155	597
Developed	688	172	86	430	480	208
Total Riparian Assessment Areas	**3,750**	**1,068**	**612**	**2,070**	**1,224**	**2,526**

In general, the RAAs of Corvallis are in relatively good condition, with the exception of reaches through agricultural fields, pasture areas and developed areas where there is a lack of woody vegetation. For many stream reaches, the dominant vegetation at the edge of the stream has generally greater structure than the vegetation within the entire RAA.

In the Riparian Condition Assessment, 50 (36 percent) RAAs were rated as Fully Functional, 67 (49 percent) were rated as Nearly Fully Functional, 22 (15 percent) were rated as Partially Functional, and only one (WC-DIX-R-1) was rated as Non-Functional. The Partially Functional and Non-Functional ratings are closely associated with adjacent land uses. Of the 22 RAAs, only one reach had undeveloped land adjacent to it. The other reaches were as follows: residential - 7 reaches; commercial/industrial - 6 reaches; agricultural - 9 reaches.

The URIAG results show that many reaches retain functions that are essential to a healthy stream system. For example, 111 (79 percent) of the RAAs provide high water quality functions, with only one RAAs (WC-DIX-R-16L) providing low water quality functions. One hundred and thirty-one (93 percent) RAAs provide high or medium flood management functions. The prevalence of woody vegetation within the RAAs accounts for the fact that 124 (89 percent) of the RAAs provide high or medium thermal regulation function. One hundred and thirty-two (94 percent) of the RAAs provide high or medium wildlife habitat functions.

Wildlife Habitat Assessment (WHA)

Thirty-two (32) habitat sites ranging in size from 6.8 to 260 acres were evaluated within the Corvallis planning area. WHA sites throughout the UGB totaled 2,595 acres, with a mean site size of 82 acres. Twelve sites were located in North Corvallis (952 acres), eighteen in West/Central Corvallis (1,506 acres) and two in South Corvallis (138 acres).[2] Most (27) of the WHA sites are located outside the city limits in unincorporated Benton County, which is to be expected given that is where most of the undeveloped land is located. Six (6) of the WHA sites are publicly-owned parkland, which account for approximately 650 acres or 25 percent of WHA acreage.

WHA scores ranged from a high of 102 (Site N-9a, Jackson Creek/Chip Ross Park) to a low of 31 (Site N-2a, Lewisburg Ave North). The mean score for all sites in their existing condition was 64.8. Some sites have the potential to be enhanced. With enhancements, the mean score could be raised to 69.8.

2 Acreage figures include approximately 285 acres of wetlands, but do not include adjacent riparian areas.

Table 4. Wildlife Habitat Assessment Summary

	Corvallis UGB	North	South	West Central	City of Corvallis	Benton County
Total Acres	2,595	952	138	1,506	517	2,079
Average WHA Site Size (acres)	81	86	69	84	106	77
Average WHA Score (points)	64.8	60.0	81	62.8	66.2	64.3

Tree Grove Assessment

Tree Grove Assessments were conducted for all areas with trees that are predominantly 25 feet or more in height with continuous canopy cover of one-half acre or more that are located outside developed areas. Trees inside riparian areas were not included in this assessment. One hundred eighty-three (183) tree groves ranging in size from 0.4 to 136 acres were identified within the Corvallis UGB. Tree groves sites throughout the UGB totaled 1,963 acres, with an average site size of 10.72 acres. Seventy-three (73) sites were located in North Corvallis (885 acres), 100 sites in West/Central Corvallis (941 acres) and 10 in South Corvallis (137 acres). One hundred fifteen (115), or 63 percent, of the tree groves were located within wildlife habitat sites with the balance classified as isolated groves. Sixty-nine (69), or 62 percent, of the tree groves are located inside the Corvallis city limits, but these groves represent only 23 percent of the acreage because most of them are smaller-sized isolated tree groves.

Each tree grove was rated in terms of scenic, aesthetic, and other functional values that trees provide to the community. Overall TGA scores ranged from a high of 30 (Site WC-5a-E) to a low of 12 (Site N-TG-31). The average score for all groves was 18.7. Dominant tree species varied widely with 44 different species or species mixes noted. Although rare within the Willamette Valley, Oregon white oak was the predominant species, with 81 groves surveyed. Douglas fir was the second most common species noted, with 66 fir groves surveyed.

Table 5. Tree Grove Assessment Summary

	Corvallis UGB	North	South	West Central	City of Corvallis	Benton County
Within WHA site	1,823	842	137	845	370	1,453
Isolated Grove	140	43	1	96	90	49
Total Tree Groves	**1,963**	**885**	**137**	**941**	**460**	**1,502**
Average Size Within WHA site	15.80	16.19	16.25	15.65	16.09	16.00
Average Score Within WHA site	18.8	17.3	23.9	19.2	19.8	18.6
Average Size of Isolated Groves	2.05	2.06	1	2.03	1.96	2.34
Average Score of Isolated Groves	18.4	16.2	21	19.0	18.8	17.6

Access for Field Surveys

The goal was to survey all sites or at least a portion of the site that appeared to be representative or typical of the conditions in that resource site. Field surveys were conducted on-site where access permission was obtained. Where access was not obtained, assessments were "field verified" with observations from adjacent roads, public lands, or properties that had granted access. For difficult to observe sites, an off-site assessment was conducted using aerial photographs and existing data sources. Table 6 provides a breakdown between the on-site, field verified and off-site surveys for each resource.

Table 6. Field Survey Methods

	On-Site		Field Verified		Off-Site	
Resource	No. of Sites	%	No. of Sites	%	No. of Sites	%
Wetlands	59	49%	43	36%	19	15%
Riparian Areas	104	74%	25	18%	11	8%
Wildlife Habitat	16	50%	15	47%	1	3%
Veg Subareas	62	37%	74	44%	32	19%
Tree Groves						
Inside WHA	45	39%	48	42%	22	19%
Isolated	-	-	67	100%	-	-

Quality Control and Quality Assurance

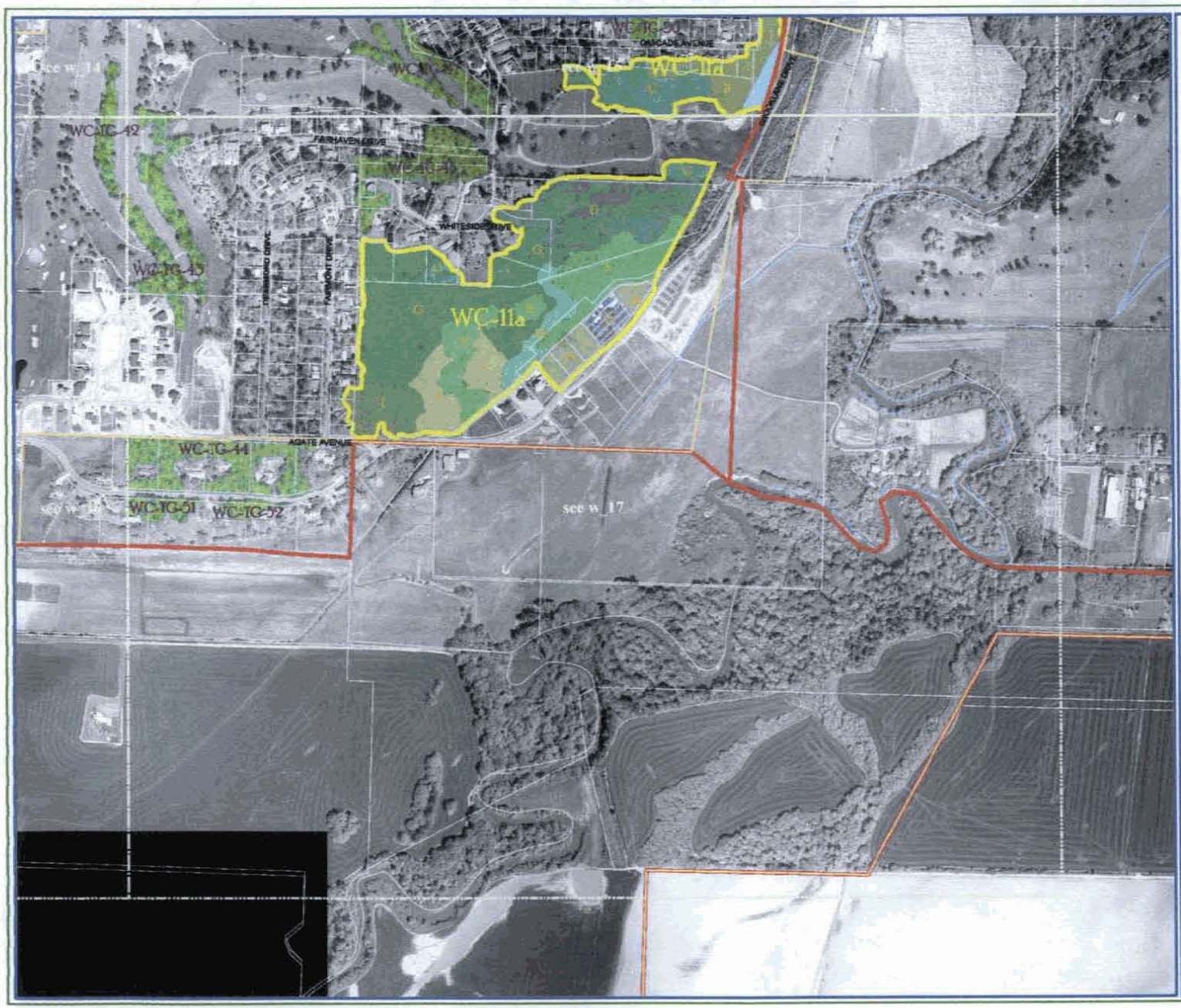
Quality Control and Quality Assurance are important to establish the reliability or integrity of the inventories. Careful attention was paid to ensure consistent application of the inventory methodologies throughout the Corvallis UGB. In addition, experienced scientists, who have conducted similar inventories for other jurisdictions, completed the field surveys.

At the start of each resource inventory, all participating field staff visited selected calibration sites (e.g., individual wetlands) that represented the likely range of conditions for each type of resource found in the Corvallis UGB. The purpose of visiting calibration sites as a group was to ensure that all personnel were interpreting the assessment methodology and data elements in the same manner. To determine if this was the case, each person assessed each site independently, then the results were immediately compared and discussed to identify possible reasons for any differences. This calibration process resulted in written clarification to the methodologies. Throughout the inventory process, lead scientists reviewed the work of the other team members to continue to assure consistency in the methodology and findings of the team members.

A Public Review Draft of the inventory reports, maps, and data sheets was released in January, 2003. Notices were mailed to property owners and other interested parties to inform them about the draft inventory report and opportunities to provide comments and corrections. Copies of the January Public Review Draft were available at the Corvallis – Benton County Library, at City Hall, and on the project website. A series of open houses were held to give property owners and others an opportunity to review the inventory maps and data sheets and discuss the findings with

the field survey scientists. A committee of local peer reviewers with expertise in each inventory specialty provided review comments and corrections.

In addition to responding to public and peer review comments on the January 2003 Public Review Draft, each resource site map was reviewed to make further adjustments and refinements to the site boundaries. The Local Wetland Inventory and Riparian Assessment databases were re-checked and revised to update the inventories. This revised information was used to prepare the May 2003 draft that went through an additional review by City staff, property owners, the general public, and the peer review team to form the basis of the June 2003 final inventory report.



Corvallis Natural Features Inventory

WHA, Vegetation Sub-polygons and Tree Groves

map sheet w_17

Legend

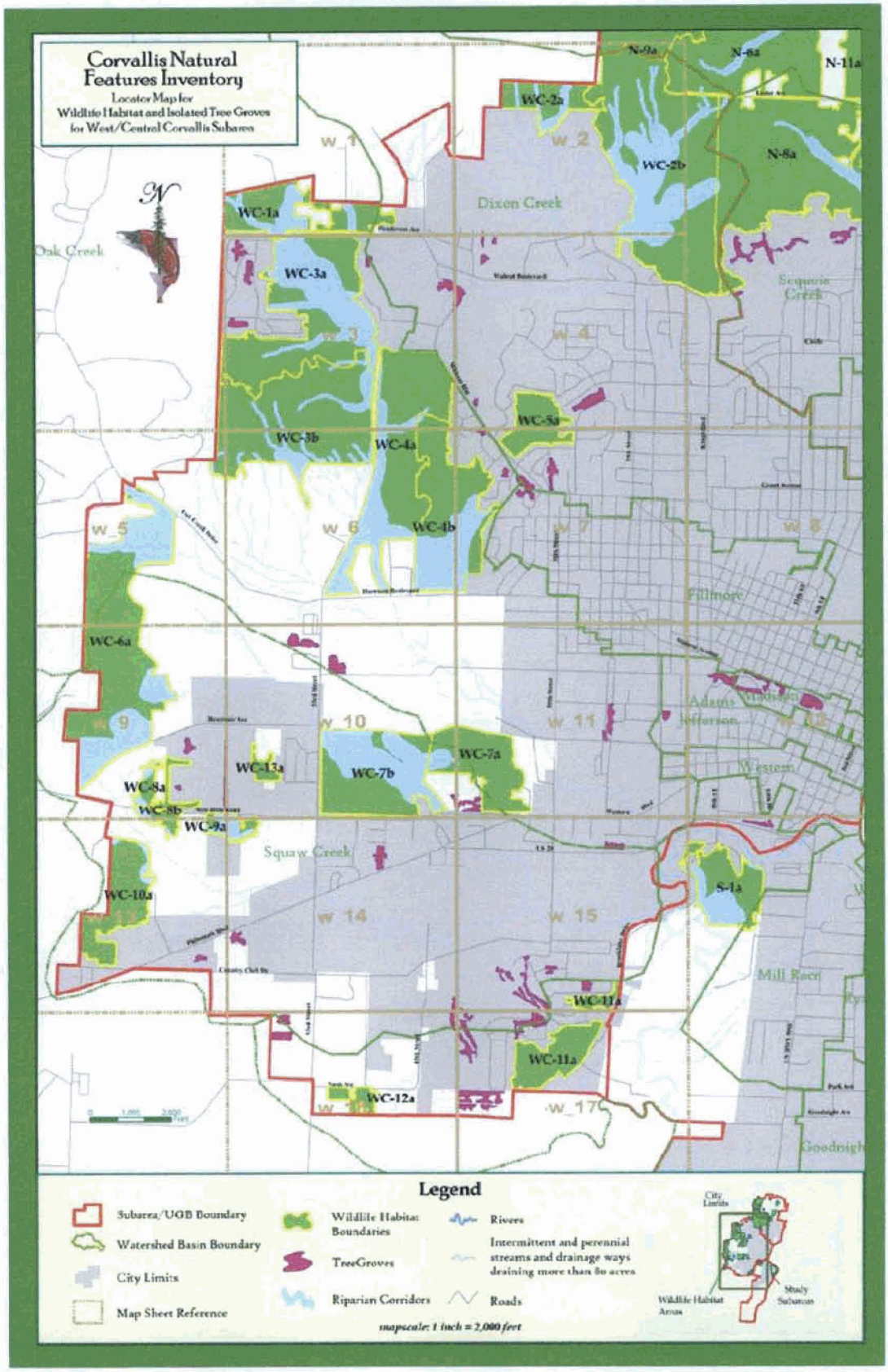
- Wildlife habitat boundaries
- Vegetation sub-polygons
- Isolated tree groves
- Streams
- Subarea/UGB Boundary
- City Limits
- Parcel boundaries

WHA site number referenced in yellow. Vegetation sub-polygons referenced in orange. To determine vegetation sub-polygons, first find the associated WHA data sheet and match their appropiate sub-polygon letter. The capital letter "O" represents developed areas inside WHA's (not part of WHA). Tree Grove site numbers are referenced in maroon.

600 300 0 600 Feet

Map scale: 1 inch = 600 feet
Projection:
State Plane Oregon Zone North, FIPS zone 3601
North American Datum 1983

Sources:
Field inventory conducted by Salix Associates.
All base data provided by the City of Corvallis.
Data compilation and map production by Ecotrust, 2002.



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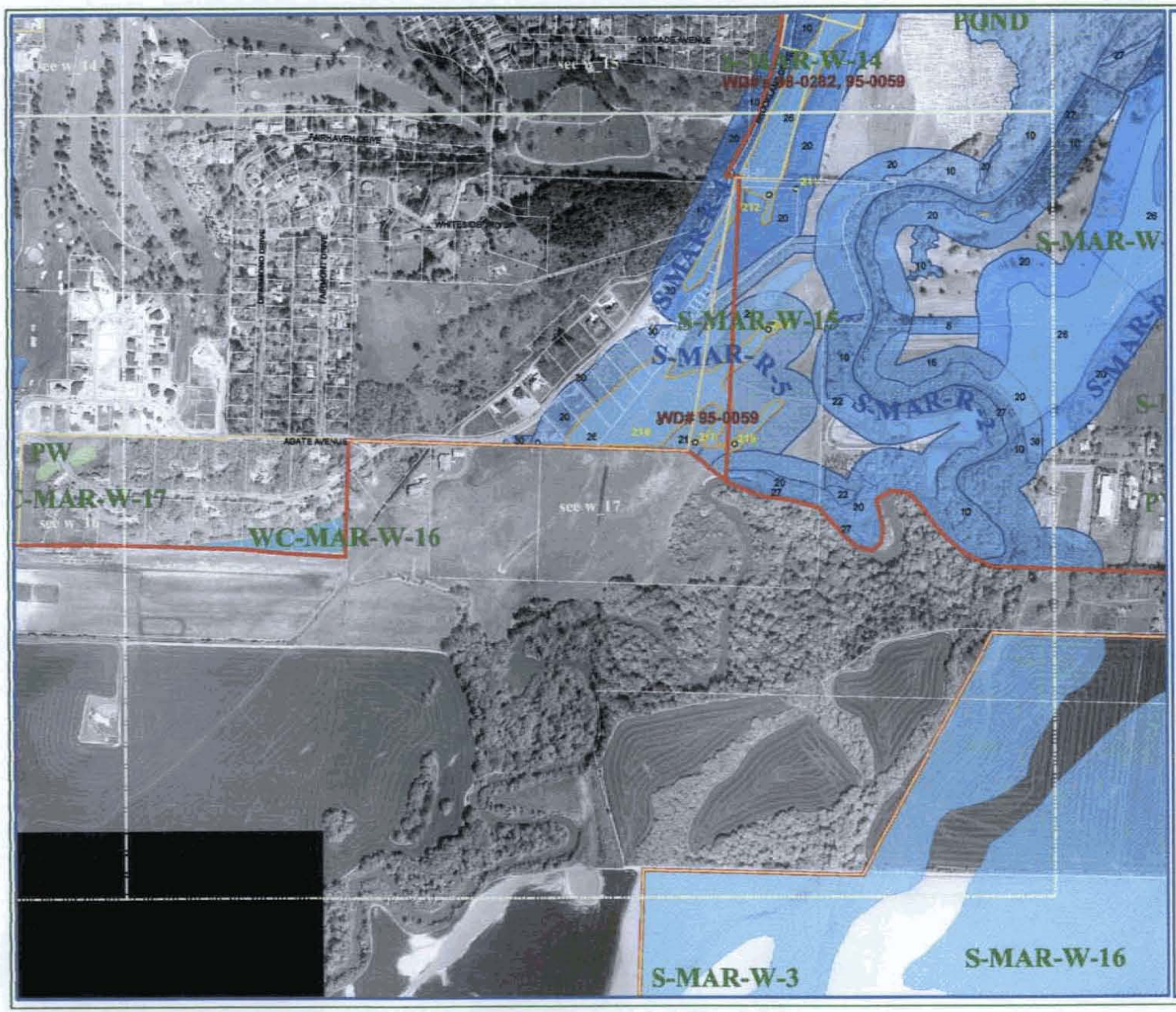


Corvallis Natural Features Inventory

Wetland and Riparian Inventory

map sheet w_17

Legend

- Riparian assessment areas
- Natural vegetation within riparian assessment area
- Streams
- Field verified wetland
- Locally significant wetland
- non-Locally significant wetland
- Mosaic wetland
- Prior converted cropland
- Farmed wetland
- Potential wetland
- Pond
- Subarea/UGB Boundary
- City Limits
- Parcel boundaries
- Riparian field data points
- Wetland field data points
- ARA vegetation cover types

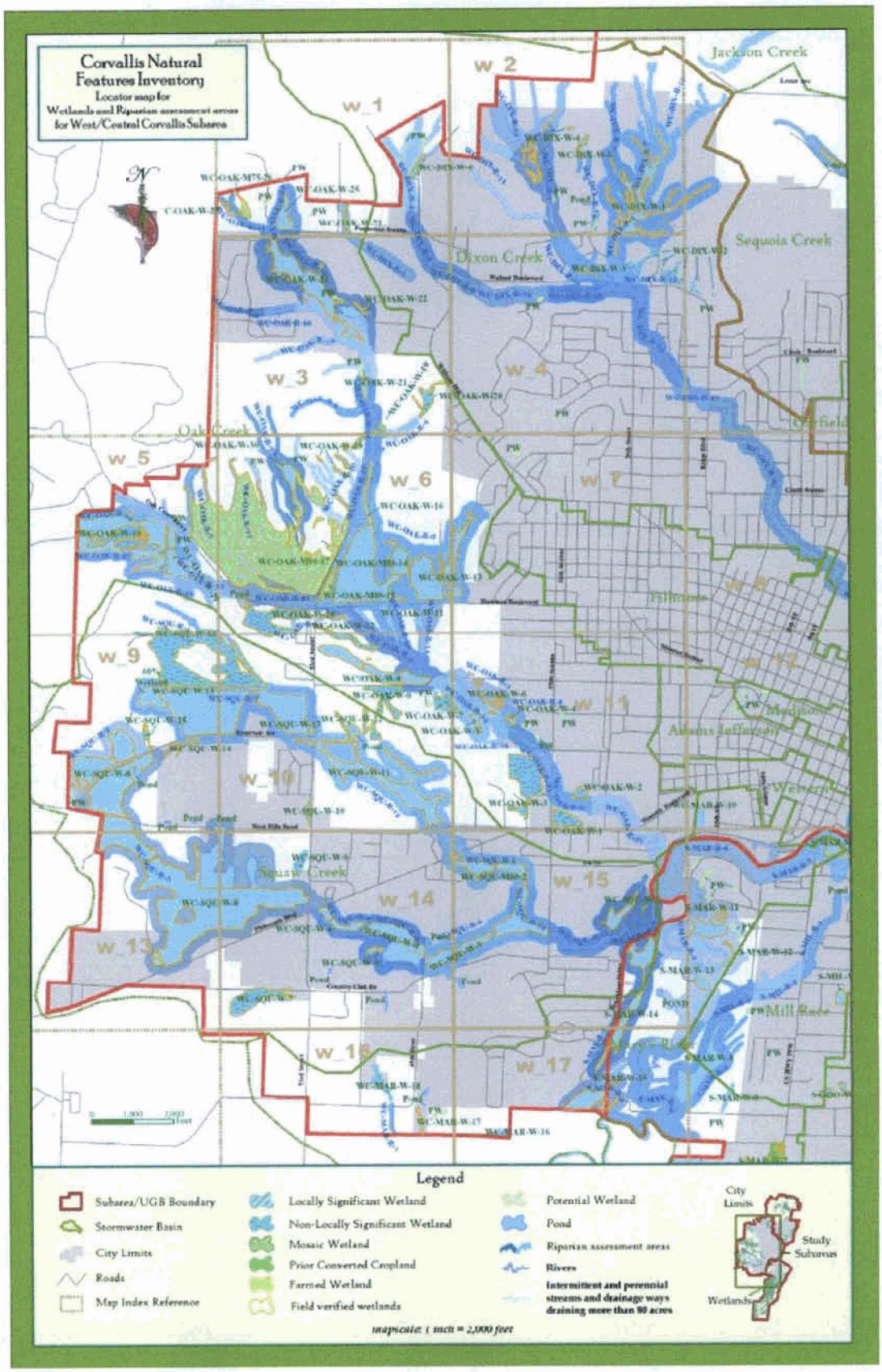
Wetland site number referenced in fir green.
Riparian reach codes referenced in deep blue.
Map sheet index number referenced in beige.
DSL numbers are referenced in deep red.
Permit numbers are referenced in purple.

600 300 0 600 Feet

Map scale: 1 inch = 600 feet
Projection:
State Plane Oregon Zone North,
FIPS zone 3601
North American Datum 1983

Riparian Assessment Area widths determined by size of drainage area (see Riparian Technical Report).

Sources:
Field inventory conducted by Pacific Habitat Services.
All base data provided by the City of Corvallis.
Data compilation and map production by Ecotrust, 2002.



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Squaw Creek Southwest (WC-10a)

67 acres, Score: 77, Enhanced Score: 79

Offsite, from West Hills Road / Winding Way.

Current Habitat Conditions

Site WC-10a is located in west Corvallis between West Hills Road and Highway 20/34. Most of the polygon is undeveloped but rural residential development has occurred at the south end and along the east side. The polygon is occupied by mixed forest of Douglas fir and Oregon white oak and by shrublands. The forest understory has a good native component, but Himalayan blackberry and sweet cherry are established and likely will spread without control. Oaks are being overtopped by Douglas firs and will eventually decline and die out of the stand. A shrubland area at the southern end of the polygon is very weedy. The forested area is connected to the Squaw Creek riparian corridor to the northeast and is adjacent to wetland prairie to the north.

Potential Wildlife Present

Western gray squirrels were observed in the forest, and potential habitat exists for oak forest, mixed forest, and forest edge species.

Restoration Recommendations

Potential restoration activities include selective removal of Douglas fir to benefit the oaks, controlling invasives, planting native food and cover species in the shrubland area, and maintaining and enhancing connections to riparian and wetland habitats to the northeast and north.

Vegetation Subpolygons

Site #	Size	Cover Type	Unique Features
WC-10a-A	53.60	Mixed Forest >70% closed canopy	Scattered large oaks and firs.
WC-10a-B	13.26	Shrubland	None noted.

Brooklane Drive (WC-11a)

55 acres, Score: 66, Enhanced Score: 68

Mostly offsite from adjacent roads.

Current Habitat Conditions

This site lies on both sides of Brooklane Drive about one mile south of OSU and just west of the Marys River. The portion of the polygon above Brooklane to the northwest is divided by a manicured cemetery. Portions are fairly densely forested with Douglas fir and Oregon white oak, and the north portion contains an oak woodland with a mostly native understory. A western gray squirrel and acorn woodpecker both were sighted there.

Most of the southern portions are prairie-savanna-shrubland complexes, and their composition was difficult to determine without an on-site visit. Indications from off-site glimpses and the aerial photo indicated that the area is probably disturbed rather than native habitat. Significant populations of Scot's broom and Armenian blackberry appear to be invading this site.

The portion of the polygon to the southeast of Brooklane is primarily flat, and is a complex of wetland and upland prairie habitats. They are overwhelmingly dominated by non-native species, indicating probable cultivation and/or heavy grazing in the past. Small populations of native plant species persist, such as tufted hairgrass. Tricolored monkeyflower (*Mimulus tricolor*) was present here approximately two years ago.

Potential Wildlife Present
Western meadowlarks and other grassland wildlife species could be expected here.

Restoration Recommendations
This may be the largest, flat, wetland-upland complex left within the Corvallis UGB, and restoration to a higher native plant component to improve habitat values could occur in conjunction with adjacent, similar lands outside the UGB. This potential restoration project could be important as it lies adjacent to the Marys River riparian corridor.

Vegetation Subpolygons

Site #	Size	Cover Type	Unique Features
WC-11a-A	2.75	Emergent herb/wetland	Large grassland-dominated habitat.
WC-11a-B	4.77	Hardwood Forest >70% closed canopy	Oak woodland with mostly native understory.
WC-11a-C	5.80	Mixed Woodland 30-70% closed canopy	Unknown (Offsite).
WC-11a-D	9.04	Mixed Forest >70% closed canopy	Unknown (Offsite).
WC-11a-E	8.68	Conifer Woodland 30-70% closed canopy	Unknown (Offsite).
WC-11a-F	4.07	Oak Savanna (<30% canopy)	Unknown (Offsite).
WC-11a-G	14.20	Herbaceous	Unknown (Offsite).
WC-11a-H	2.17	Shrubland	Unknown (Offsite).
WC-11a-I	3.12	Hardwood Forest >70% closed canopy	None noted.

Nash Avenue Plantation (WC-12a)

13 acres, Score: 46, Enhanced Score: 50
Offsite assessment from perimeter streets.
Current Habitat Conditions
WC-12a is located south of Nash Avenue and East of 53rd Street. Most of the polygon is occupied by a young conifer plantation. Small openings and a few homesites are also scattered within the site. Both native and non-native tree species have been planted including Douglas fir, giant sequoia, and Scot's pine. Forest cover is very dense resulting in little development of understory vegetation. Some trees appear to be in poor health, probably because they are non-

Corvallis Natural Features Inventory
Wildlife Habitat Assessment

Why so low?

Habitat Site Brooklane Drive **Site #:** WC-11a **Score:** 66 **Enhanced Score:** 68

Size(acres): 54.61 **Map:** W-17 **Date:** 11/27/02 **Observers:** BN

GPS Location: **Method:** ONSITE

GENERAL CONDITIONS

Site: Both sides of Brooklane Drive, north and south of cemetery.

Weather: Sunny, cool.

Topography: Flat to moderate slopes.

Land Use: Residential and open space.

Habitat Alteration: Invasive species in open and forested habitat. Past cultivation of flat areas.

ASSESSMENT

Component	Degree			Score	Enhanced	Basis/Description
Water						
Quantity and Seasonality	None 0	Seasonal 4	Perennial 8	6	+1	One tiny ephemeral creek, perennial ponds in NE.
Quality	Low 0	Medium 4	High 8	3		Road runoff into ponds.
Proximity To Cover	Low 0	Nearby 4	Adjacent 8	2		Road between forest and ponds.
Diversity (Types)	None 0	One 2 / Two 4	Three+ 6	4	+1	Seasonal streams and ponds. Perennial
Food						
Quantity and Seasonality	Low 0	Limited 4	Year Round 8	4	+1	Douglas-fir cones, acorns, non-naitve fruits, grasses and forbs.
Variety	Low 0	Medium 4	High 8	4	+1	
Proximity To Cover	None 0	Nearby 4	Adjacent 8	4		50% in cover, 50% in open.
Cover						
Structural Diversity	Low 0	Medium 4	High 8	4		Difficult to view, assumed OK.
Variety and Seasonality	Low 0	Medium 4	High 8	4		
Nesting and Denning	Low 0	Limited 2	Year Round 4	~~2~~ 4		
Human Disturbance						
Physical Alteration	High 0	Medium 2	Low 4	2		Himalayan blackberry, road divides site.
Activity	Low 0	Medium 2	High 4	2		Some dumping, increasing development
Patch Size and Connectivity						
Patch Size	Small 0	Medium 4	Large 8	3		Mostly fragmented.
Connectivity (Landscape)	Low 0	Medium 4	High 8	3		Open prairie and Marys River to east.
Connectivity (Internal)	Low 0	Medium 2	High 4	1		Divided by road and cemetery
Unique Features						
Habitat Type	None 0	Rare 4	Unique 8	4		Large wetland/prairie continues outside UGB.
Wildlife	None 0	Rare 4	Unique 8	4		W. Gray Squirrel, Acorn Woodpecker

Spring perennial stream

?

Corvallis Natural Features Inventory
Wildlife Habitat Assessment

Basin-Site# WC-11a **Score:** 66 **Enhanced Score** 68 **Size(ac):** 54.61 **Map:** W-17

WILDLIFE OBSERVE

Birds	Western scrub-jay, northern harrier, Lincoln's sparrow, golden-crowned sparrow, spotted towhee, acorn woodpecker, house finch, American robin, yellow-rumped warbler, black-capped chickadee, American kestrel.
Mammals	W. Gray Squirrel
Reptiles	
Invertebrates	

UNIQUE FEATURES

Oak-snowberry community may be present in north, near riparian area.

Large upland/wetland prairie, but dominated by non-natives.

LARGE WOOD FEATURES

Few.

OTHER HABITAT FEATURES

granary (acorn woodpkr)

HABITAT STRESSES

Invasives. English hawthorn and Himalayan blackberry.

RESTORATION OPPORTUNITIES

Native shrubs could be planted on prairie edges and in forest understories to improve food for wildlife. Consider restoration of native species to upland/wetland prairie in 11a and adjacent, similar habitats. Because of connection to Mary's River riparian corridor, this could be an outstanding restoration site.

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 2.75

Site #: WC-11a **Subpolygon** A **Date:** 11/27/2002 **Observers:** BN

GPS Location: ONSITE **Method:** ONSITE

Dominant Cover Type: Herbaceous

ARA Type: 26 Emergent herb/wetland

Other ARA Types: Grass natural/dry prairie

% of Total Cover Trees: 0 **Shrubs:** 1 **Herbs/Vines:** 99 **Bare:** 0

Trees:

Type: None

Dominant Species:

Secondary Species:

Comments:

% Total Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

% Invasive Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

% Native Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

Shrubs/Sapling:

Type: Deciduous

Dominant Species:

Secondary Species: Willow species

Comments:

% Total Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

% Invasive Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

% Native Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

Herbaceous:

Dominant Species: Tall annual willowherb, Queen Anne's lace, tufted hairgrass

Secondary Species: Reed canarygrass, many others

Comments:

% Total Cover: ( ) <10% ( ) 10%-50% ( ) 50%-90 (•) >90%

% Invasive Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

% Native Cover: (•) <10% ( ) 10%-50% ( ) 50%-90 ( ) >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road	**Size:** 2.75
Site #: WC-11a **Subpolygon** A	**Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 1a, 1b, 1e

RTE Species Comment: Tricolored monkeyflower observed in 1999-2000.

Other Factors

General Health/Condition: Appears to be overwhelmingly dominated by non-native species. Probable farming/grazing history. Some areas have trace natives remaining.

Unique Features: Large grassland-dominated habitat.

Restoration Potential

Recommended Actions: Control invasives. Prescribed burning and restoration with native species could be done for the larger prairie habitat area, which includes additional lands outside the UGB. The proximity to the Mary's River gives it high potential restoration value.

Current Efforts: None noted.

COMMENTS The weediest and most disturbed portions are closest to road.

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 4.77

Site #: WC-11a **Subpolygon** B **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 8 Hardwood >70% closed canopy

Other ARA Types: None

% of Total Cover Trees: 95 **Shrubs:** 5 **Herbs/Vines:** 0 **Bare:** 0

Trees:

Type: Deciduous

Dominant Species: Oregon white oak

Secondary Species:

Comments:

% Total Cover: ○<10% ○ 10%-50% ○ 50%-90 ◉ >90%

% Invasive Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ○ 10%-50% ○ 50%-90 ◉ >90%

Shrubs/Sapling:

Type: Deciduous

Dominant Species: Common snowberry

Secondary Species: Pacific dewberry, Himalayan blackberry

Comments:

% Total Cover: ○<10% ○ 10%-50% ◉ 50%-90 ○ >90%

% Invasive Cover: ○<10% ◉ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ◉ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: English ivy

Secondary Species: California brome (along road)

Comments:

% Total Cover: ○<10% ○ 10%-50% ○ 50%-90 ◉ >90%

% Invasive Cover: ○<10% ◉ 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 4.77

Site #: WC-11a **Subpolygon** B **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ○ None Noted ◉ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: Acorn Woodpecker, W.Gray Sq RTE Potential Habitat: 4a, 5c

RTE Species Comment: Oak-snowberry likely. Re-check in spring/summer.

Other Factors

General Health/Condition: Trees appear OK from offsite evaluation. Understory probably compromised by invasives.

Unique Features: Oak woodland with mostly native understory.

Restoration Potential

Recommended Actions: Control invasives - Himalayan blackberry and English ivy.

Current Efforts: None noted.

COMMENTS

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 5.80

Site #: WC-11a **Subpolygon** C **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 10 Mixed Woodland 30-70% closed canopy

Other ARA Types: None

% of Total Cover Trees: 60 **Shrubs:** 5 **Herbs/Vines:** 35 **Bare:** 0

Trees:

Type: Mixed

Dominant Species: Douglas-fir, Oregon white oak

Secondary Species:

Comments:

% Total Cover: ○ <10% ○ 10%-50% ◉ 50%-90 ○ >90%

% Invasive Cover: ◉ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ◉ 10%-50% ○ 50%-90 ○ >90%

Shrubs/Sapling:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Unknown

Secondary Species:

Comments:

% Total Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 5.80

Site #: WC-11a **Subpolygon** C **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 5b

RTE Species Comment:

Other Factors

General Health/Condition: Unknown

Unique Features: Unknown

Restoration Potential

Recommended Actions: Unknown

Current Efforts: Unknown

COMMENTS

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 9.04

Site #: WC-11a **Subpolygon** D **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 7 Mixed Forest >70% closed canopy

Other ARA Types: None

% of Total Cover Trees: 95 **Shrubs:** 5 **Herbs/Vines:** 0 **Bare:** 0

Trees:

Type: Mixed

Dominant Species: Douglas-fir, Oregon white oak

Secondary Species: Bigleaf maple

Comments:

% Total Cover: ○ <10% ○ 10%-50% ○ 50%-90 ◉ >90%

% Invasive Cover: ◉ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ○ 50%-90 ◉ >90%

Shrubs/Sapling:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Unknown

Secondary Species:

Comments:

% Total Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 9.04
Site #: WC-11a **Subpolygon** D **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 5b

RTE Species Comment:

Other Factors

General Health/Condition: Unknown

Unique Features: Unknown

Restoration Potential

Recommended Actions: Unknown

Current Efforts: Unknown

COMMENTS

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 8.68

Site #: WC-11a **Subpolygon** E **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 9 Conifer Woodland 30-70% closed canopy

Other ARA Types: None

% of Total Cover Trees: 70 **Shrubs:** 20 **Herbs/Vines:** 10 **Bare:** 0

Trees:

Type: Mixed

Dominant Species: Oregon white oak

Secondary Species: Douglas-fir, bigleaf maple, Oregon ash

Comments:

% Total Cover: ○ <10% ○ 10%-50% ◉ 50%-90 ○ >90%

% Invasive Cover: ◉ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ◉ 50%-90 ○ >90%

Shrubs/Sapling:

Type: Deciduous

Dominant Species: Himalayan blackberry

Secondary Species: Common snowberry, Scot's broom, English hawthorn

Comments:

% Total Cover: ○ <10% ◉ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○ <10% ◉ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ◉ <10% ○ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Tall fescue, many others

Secondary Species:

Comments:

% Total Cover: ○ <10% ○ 10%-50% ○ 50%-90 ◉ >90%

% Invasive Cover: ○ <10% ◉ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ◉ <10% ○ 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 8.68

Site #: WC-11a **Subpolygon** E **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 2a, 2b, 3b, 4a

RTE Species Comment:

Other Factors

General Health/Condition: Unknown

Unique Features: Unknown

Restoration Potential

Recommended Actions: Unknown

Current Efforts: Unknown

COMMENTS Roadside edge is weedy with invasive shrubs.

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 4.07

Site #: WC-11a **Subpolygon** F **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 13 Oak Savanna (<30% canopy)

Other ARA Types: None

% of Total Cover Trees: 15 **Shrubs:** 70 **Herbs/Vines:** 15 **Bare:** 0

Trees:

Type: Deciduous

Dominant Species: Oregon white oak

Secondary Species:

Comments:

% Total Cover: ○<10% ◉ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ◉ 10%-50% ○ 50%-90 ○ >90%

Shrubs/Sapling:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Unknown

Secondary Species:

Comments:

% Total Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 4.07
Site #: WC-11a **Subpolygon** F **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 5b

RTE Species Comment:

Other Factors

General Health/Condition: Unknown

Unique Features: Unknown

Restoration Potential

Recommended Actions: Unknown

Current Efforts: Unknown

COMMENTS

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 14.20

Site #: WC-11a **Subpolygon** G **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Herbaceous

ARA Type: Unknown

Other ARA Types: None

% of Total Cover Trees: 2 **Shrubs:** 2 **Herbs/Vines:** 96 **Bare:** 0

Trees:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ○<10% ● 10%-50% ● 50%-90 ● >90%

% Invasive Cover: ○<10% ○ 10%-50% ○ 50%-90 ● >90%

% Native Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

Shrubs/Sapling:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ●<10% ○ 10%-50% ○ 50%-90 ● >90%

% Invasive Cover: ○<10% ● 10%-50% ○ 50%-90 ● >90%

% Native Cover: ●<10% ● 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Unknown

Secondary Species:

Comments:

% Total Cover: ●<10% ● 10%-50% ● 50%-90 ● >90%

% Invasive Cover: ○<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ● 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 14.20
Site #: WC-11a **Subpolygon** G **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 1a

RTE Species Comment:

Other Factors

General Health/Condition: Unknown

Unique Features: Unknown

Restoration Potential

Recommended Actions: Unknown

Current Efforts: Unknown

COMMENTS

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 2.17

Site #: WC-11a **Subpolygon** H **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 14 Shrubland

Other ARA Types: None

% of Total Cover Trees: 5 **Shrubs:** 85 **Herbs/Vines:** 10 **Bare:** 0

Trees:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ○ <10% ● 10%-50% ○ 50%-90 ● >90%

% Invasive Cover: ○ <10% ○ 10%-50% ○ 50%-90 ● >90%

% Native Cover: ○ <10% ● 10%-50% ○ 50%-90 ○ >90%

Shrubs/Sapling:

Type: Unknown

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ● <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ● <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ● <10% ○ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Unknown

Secondary Species:

Comments:

% Total Cover: ● <10% ● 10%-50% ● 50%-90 ● >90%

% Invasive Cover: ○ <10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○ <10% ○ 10%-50% ○ 50%-90 ● >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 2.17

Site #: WC-11a **Subpolygon** H **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 2a, 2b

RTE Species Comment:

Other Factors

General Health/Condition: Unknown

Unique Features: Unknown

Restoration Potential

Recommended Actions: Unknown

Current Efforts: Unknown

COMMENTS

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Map:** W-17 **Size:** 3.12

Site #: WC-11a **Subpolygon** I **Date:** 11/27/2002 **Observers:** BN

GPS Location: OFFSITE **Method:** OFFSITE

Dominant Cover Type: Woody

ARA Type: 8 Hardwood >70% closed canopy

Other ARA Types: None

% of Total Cover Trees: 90 **Shrubs:** 4 **Herbs/Vines:** 1 **Bare:** 0

Trees:

Type: Deciduous

Dominant Species: Oregon white oak

Secondary Species:

Comments:

% Total Cover: ○<10% ○ 10%-50% ◉ 50%-90 ○ >90%

% Invasive Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ○<10% ○ 10%-50% ◉ 50%-90 ○ >90%

Shrubs/Sapling:

Type: Deciduous

Dominant Species:

Secondary Species:

Comments:

% Total Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Invasive Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

Herbaceous:

Dominant Species: Tall fescue, othe common non-natives

Secondary Species:

Comments:

% Total Cover: ○<10% ○ 10%-50% ○ 50%-90 ◉ >90%

% Invasive Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

% Native Cover: ◉<10% ○ 10%-50% ○ 50%-90 ○ >90%

Corvallis Natural Features Inventory
Vegetation Subpolygon

Habitat Site: Brooklane Road **Size:** 3.12

Site #: WC-11a **Subpolygon** I **Map:** W-17

Rare, Threatened, or Endangered (RTE) Species

ORNHIC Plant Community: ◉ None Noted ○ Listed Community Noted

ORNHIC Database: ◉ No Record ○ Documented Record

RTE Species Observed: RTE Potential Habitat: 4a

RTE Species Comment:

Other Factors

General Health/Condition: Tree health good. Understory probably peridocally grazed or mowed. No recruitment noted. Himalayan blackberry present in patches.

Unique Features: None noted.

Restoration Potential

Recommended Actions: Control invasives and restore understory.

Current Efforts: None noted.

COMMENTS

Site Code	Habitat Site	Observations and Comments
		West Central Corvallis
WC-10a	Squaw Creek Southwest	W. Gray Squirrel observed.
WC-11a	Brooklane Road	Acorn Woodpecker, W.Gray Squirrel, and showy milkweed observed. Tricolored monkeyflower observed in 1999-2000. Possible Oak-snowberry habitat (ORNHIC plant community).
WC-1a	Ponderosa Avenue Northwest	Acorn Woodpecker, tufted hairgrass, showy milkweed observed in riparian areas. Low potential for rare prairie species.
WC-2a	Timberhill West	W. Gray Squirrel and Pileated Woodpecker observed. W. Bluebird documented in property owner report. Possible native bunchgrass community remnant.
WC-2b	Timberhill East	Possible ORNHIC grassland communities, W. Meadowlark, Willow flycatcher, W. Bluebird, Pileated woodpecker, and W. Gray Squirrel documented in property owner report.
WC-3a	Walnut Park Northwest	Nelson's checkermallow (ORNHIC reference).
WC-3a	Walnut Park Northwest	Nelson's checkermallow (ORNHIC reference).
WC-3b	Walnut Park South	Meadow sidalcea and Nelson's checkermallow observed.
WC-4a	Witham Hill West	Nelson's checkermallow (ORNHIC reference). Possible Oak-snowberry habitat (ORNHIC plant community).
WC-5a	Woodland Meadows Park	W. Gray Squirrel and Acorn Woodpeckers observed. Limited area of California oatgrass present but not as a dominant community.
WC-6a	Bald Hill Park	Nelson's checkermallow, Willamette daisy and Taylor's Checkerspot (ORNHIC reference). W. Gray Squirrel observed. Possible Oak-snowberry habitat (ORNHIC plant community).
WC-7a	Squaw Creek East	Possible Oak-snowberry habitat (ORNHIC plant community).
WC-8a	West Hills Road/Reservoir Road	Acorn Woodpeckers and W. Gray Squirrel observed.
WC-8b	West Hills Road West	Acorn Woodpecker and W. Bluebird observed.
WC-9a	West Hills Road East	Acorn Woodpecker and W. Gray Squirrel observed.

Table 6 summarizes the RTE species findings. Potential habitat for a range of sensitive species are noted in different types of forest and non-forest habitats. Tall cottonwood forests, for example, located near the Willamette River provide potential nesting habitat for wintering bald eagles. Forest edge habitats are potential habitat for edge species such as western bluebird, mountain quail and thin-leaved peavine. Native upland grasslands provide potential habitat for rare upland prairie wildlife species and other species such as Kincaid's lupine, western meadowlark and Fender's blue butterfly. Tufted hairgrass prairies found within certain sites provide potential habitat for rare wetland prairie species.

Table 6. RTE Species Findings

Site Code	Habitat Site	Observations and Comments
		North Corvallis
N-1a	Crescent Valley Northwest	Pileated Woodpecker excavations observed.
N-2a	Lewisburg Ave North	W. Gray Squirrel observed
N-4a	Crescent Valley West	Pileated Woodpecker observed. Potential habitat for Acorn Woodpecker, W. Gray Squirrel, W. Bluebird, thin-leaved pearine, Lewis' Woodpecker, and tall bugbane.
N-5a	Owens Farm	Acorn Woodpecker observed
N-7b	Higland Drive/Crescent Valley Drive North	Potential habitat for W. Gray Squirrel, Acorn Woodpecker, Mountain Quail, and W. Bluebird
N-8a	Highland Dell	W. Gray Squirrel and Pileated Woodpecker observed. Potential habitat for Mountain Quail.
N-9a	Jackson Creek/Chip Ross Park	W. Gray Squirrel and Pileated Woodpecker observed. Potential habitat for tall bugbane.
		South Corvallis
S-1a	Avery Park	W. Gray Squirrel observed. Liverwort (ORNHIC reference).
S-2a	Willamette Park	Thin leaved peavine and Howell's montia observed. Wolffia columbiana (ORNHIC reference). Potential habitat for thin leaved peavine, Enemion. .Howell's montia documented in Willamette Park Wetland Determination and Habitat Study (2002).

Appendix A

CORVALLIS
Tree Grove Assessment Form

BASIN-SITE#: (WHA code)	**SIZE: (GIS)**		**SCORE:**
SUBPOLYGON#:	**MAP:**	**DATE:**	**OBSERVERS:**
GPS LOCATION:			**PHOTOS? ___ Roll/exp# ____**

TREES
❑ Decid. ❑ Evergreen ❑ Mixed Dominant Species:
Secondary Species:

FUNCTION/CHARACTERISTIC		HIGH		MEDIUM		LOW
Tree size/Grove maturity Scenic values tend to grow with age and mature trees are difficult to replace		>50% of trees have dbh of 18" or more		25-50% of trees have dbh of 18" or more		<25% of trees have dbh of 18" or more
Health General condition and signs of dieback, threats, disturbance or poor health		Appears healthy with no visible threats or low disturbance		Some dieback or potential threats		Extensive dieback or high disturbance
Visibility Groves that are clearly visible from larger streets or public lands have greater value		Visible from arterial street or public park/open space		Visible from local street or private common open space		Not visible from street or open space
Accessibility Greater access provides more opportunity for public use and enjoyment		Unrestricted public access (park, school)		Some physical or legal limits on access		Privately owned or inaccessible
Screening/Buffering Groves may serve as land use buffers, depending on size, location, nearby uses		Btwn industrial/commercial and residential/open space land uses or Corvallis and Philomath communities		Between similar land uses		No buffer function
Rarity Unusual features (e.g., large size or rare species) or historical value		Unique natural or cultural features		Rare or uncommon features		No uncommon features
Recreational Potential Groves with public access and trail networks offer passive recreational values		Publicly owned		Privately owned with public access		Privately owned with no public access
Educational Potential Groves with public access and note-worthy features offer educational values		High accessibility and unique features		Some accessibility and rare features		Inaccessible or common features
Existing Development Groves with development		Undeveloped (<.5 units per acre)		Partially developed		Developed (surrounded/enclosed)
Potential Development Comprehensive Plan designation		Public Institutional and Open Space		Low and Medium Density Residential		Industrial, Commercial, Mixed Use, HDR
SUB-TOTALS		X 3		X 2		X 1
SCORE						**TOTAL**

COMMENTS:

City of Corvallis
Natural Features
Scoping Project Report

Prepared for:

The City of Corvallis
Department of Community Development

Prepared by:

SHAPIRO & ASSOCIATES, INC.

and

WINTER BROOK
COMMUNITY RESOURCE PLANNING

January 16, 2002

ACKNOWLEDGMENT

Shapiro and Associates, Inc. and Winterbrook Planning would like to recognize the time and effort the Natural Features Technical Advisory Committee (NFTAC), the City of Corvallis staff and the Benton County staff spent on this report. The NFTAC, which represented various interests throughout the community, has spent many hours discussing issues and reviewing background material. Its work was of major importance and contributed directly to the completion of the report.

In addition, Shapiro and Associates and Winterbrook Planning would like to thank the many citizens who provided comments throughout the process and participated in the field studies. Finally, we would like to thank the scientists with expertise in the various resources for providing peer-review comments.

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New floodplain inventories are proposed as follows:

- Estimated 100-year flood boundaries along all perennial streams. These estimates will be determined by comparing 100-year flow information with topographical maps to generate estimated floodplain maps.
- Place the estimated location of the 0.2-foot floodway boundary along streams where streams converge or join the Willamette and Marys rivers into the City's GIS.

It is proposed that new floodplain data be placed into the City's GIS by the City Public Works Department using flow information developed for the stormwater master plan. Floodplain information can be refined over time as land is being planned for and developed. Detailed or refined floodplain calculations and estimated boundaries can be established when land-use applications are filed.

3. Significance Ranking Criteria

The significance of floodplain areas is based on the following ranking from highest to lowest:

a. 0.2-foot floodway
b. Land Development Code Section 4.5.80 C.1., C.2. and C.4. (Section 4.5.80 defines the area along a stream or drainageway that is to be dedicated for stormwater conveyance)
c. Stream confluence areas
d. Documented 1996 flood areas that include another resource category (such as locally significant wetlands [LSW], wildlife habitat, riparian area, etc.)
e. 100-year floodplain that includes another resource category (such as locally significant wetlands (LSW), wildlife habitat, riparian area, etc.)
f. Documented 1996 flood areas that includes non-significant wetlands
g. 100-year floodplain that includes non-significant wetlands
h. Other undeveloped areas within the documented 1996 flood
i. Other undeveloped areas within the 100-year floodplain
j. Developed areas within the documented 1996 flood areas
k. Developed areas within the 100-year floodplain

G. Aquifer Recharge and Groundwater

1. Planning Strategy

Corvallis is situated over the Willamette aquifer, a permeable deposit of sand and gravel that provides relatively good quantities of groundwater. To the west, closer to the Coast Range, the deposit thins and water yields are much lower. Aquifer recharge occurs throughout the basin and impacts tend to be localized. Wellhead and aquifer protection programs require an analysis that examines the quantity, quality, and direction of the subsurface flows. The planning strategy for the City

of Corvallis should be to collect and evaluate existing reports. It is likely that protection programs designed for improving water quality for salmon will also benefit the groundwater system.

2. Inventory Approach

The following documents shall be reviewed and evaluated:

- Groundwater Report #17 – Groundwater Data in the Corvallis and Albany Area – Oregon Department of Water Resources (ODWR), 1972
- Professional Paper #1424A – Geologic Formation of the Willamette Lowland Aquifer System – United States Geological Survey (USGS)
- Professional Paper #1424B – Hydro-geologic Formation of the Willamette Lowland Aquifer System – USGS
- Report #99-4036 – Groundwater and Water Chemistry for the Willamette Basin – USGS and ODWR

Digital map files are available for all of the reports except the 1972 study.

Developing a local groundwater model is not proposed at this time.

3. Significance Criteria

Areas identified in the reports as critical or sensitive aquifer recharge areas should be considered significant.

IV. HILLSIDES

A. Background/Introduction

Corvallis's "Emerald Necklace" refers to the ring of hillsides that generally defines the city's western urban growth boundary. In February of 1983, Corvallis mapped and described the resource values of significant hillsides at the urban fringe, including:

- Locke Cemetery Hill (north)
- Deer Run Ridge (northwest)
- IV Hill (northwest)
- Timberhill Ridge (north central)
- Forest Acres Hill (central)
- Witham Hill (central)
- Bald Hill (west)
- Double Hill (west)
- Philomath-Corvallis Hill (west)
- West Corvallis Skyline Hill (south central)
- Country Club Hill (south central)

Corvallis also adopted specific comprehensive plan policies for each of these hillside areas. Conflicts between urban development and resource values typically are resolved through the planned development review process. Open Space designations were added to the Corvallis Comprehensive Plan.

In addition to the "Emerald Necklace", the Corvallis 2020 Vision statement recognizes the importance of the network of "green fingers" or riparian corridors. The NMFS 4(d) rule compliance project is studying each of the following perennial stream systems that emanate from Corvallis' higher elevation areas:

- Willamette River
- Marys River
- Dixon Creek
- Sequoia Creek
- Squaw Creek
- Oak Creek

B. Integrated Hillside Concept

NFTAC recognizes that Corvallis' riparian areas contain a series of inter-related resource types, including wetlands, vegetation, fish and wildlife habitat, flood plains, groundwater recharge areas and the like. Most of Corvallis' perennial streams and wetlands are found in the valley floor - generally below 290 feet above mean sea level. Similar to valley riparian areas, Corvallis' significant hillsides contain clusters of natural features identified in the Corvallis Comprehensive Plan, including the following:

- Streams
  - Perennial streams
  - Seasonal streams and natural drainageways
  - Wetlands (usually, but not necessarily, associated with streams)
  - Floodplains
- Significant Vegetation
  - Non-riparian vegetation described in Lists 1, 2, 3, and 4 of the Oregon Natural Heritage Plan prepared by the Oregon Natural Heritage Advisory Council (ONHP, 1998) or the Rare, Threatened and Endangered Species of Oregon prepared by the Oregon Natural Heritage Program (R,T&ES, 2001)
  - Natural plant communities and wildlife habitats in non-riparian areas
- Ecologically and scientifically significant natural areas as defined in the Oregon Natural Heritage Plan, including Bald Hill
- Hazard areas, including
  - Landslide areas and alluvial fans
  - Geologic hazards (e.g. fault lines, liquefaction soils, and landslide hazards
  - Wildfire hazard areas
  - Floodplains

- Undeveloped or partially developed drainage basins (e.g., upland meadows)
- Sensitive aquifers and aquifer recharge areas
- Scenic areas, including
  - Vistas
  - Viewpoints
  - Gateways
  - Buffers

Rather than isolate "hillsides" as a separate resource category, the project proposes an integrated hillside approach that considers Goal 5, 6 and 7 resource areas as follows:

- **Goal 5 scenic, open space, water and wildlife habitat areas**
  - Scenic (viewpoints, vistas, gateways and buffers)
  - Open space (vegetation, hilltops, higher elevation valleys)
  - Water areas (stream corridors and wetlands)
  - Wildlife habitat (wildlife habitat areas, including hillsides, stream corridors, wetlands, floodplains, and upland valleys)
- **Goal 6 water quality areas** (aquifer recharge areas, floodplains, wetlands, seasonal and perennial streams)
- **Goal 7 hazard areas** (floodplains, and steep slopes, landslide, earthquake and wildfire hazard areas)

The intent is to digitally map each of these resource areas in a series of overlapping polygons. The comparative value of polygons (i.e., mapped clusters of resource values) then would be determined based upon an agreed-upon ranking system. The project team's proposed ranking system is described below.

C. Limitations of Integrated Hillside Approach

NFTAC noted that several of these resource and/or hazard areas are found below the 290-foot elevation level. Most of the hazards and resource areas discussed above are found primarily - but not exclusively - in hillside areas. Generally, lowlands that are not associated with riparian areas, wetlands and floodplains are considered buildable. Thus, we would not expect to find many significant Goal 5, 6 or 7 lowland resources that are not associated with water resources. Possible exceptions include the following:

- **Goal 5 scenic, open space and wildlife habitat areas in lowland areas**
  - Scenic (public viewpoints, vistas (e.g., the Willamette and Marys Rivers), gateways and buffers)
  - Open space (public parks, cemeteries, golf courses, etc.)
  - Wildlife habitat (Non-riparian vegetation and wildlife defined in Lists 1, 2, 3, and 4 of the Oregon Natural Heritage Plan prepared by the Oregon Natural Heritage Advisory Council (ONHP, 1998) or the Rare, Threatened and

Endangered Species of Oregon prepared by the Oregon Natural Heritage Program (R,T&ES, 2001)Oregon Natural Heritage Plan (1998) and locally significant habitats such as Oak Savanna and Prairies habitats)
  - Ecologically and scientifically significant natural areas
- **Goal 7 hazard areas** (earthquake hazard areas; limited wildfire hazard)

D. Where to Inventory

In 1983, Corvallis inventoried specific sandstone and volcanic hills and found them to be "significant". However, the 1983 inventory did not address all of the natural features that typically are found outside the Corvallis valley floor.

For hillsides, the project team suggests using a contour elevation level to separate valley resources from hillside resources. The "Hillside Elevations" map shows water service levels within the Corvallis UGB. The 290-foot elevation level corresponds with the beginning of the second water service level and represents the dividing line between the valley and the surrounding hills. Therefore, the integrated hillside inventory area should include all land above the 290-foot elevation level.

E. What to Inventory

It is recommended that the following natural features be inventoried and mapped for hillside areas above the 290-foot elevation level:

1. **Stream systems, including:**
   a. Perennial streams and riparian areas
   b. Intermittent streams, natural drainageways and riparian areas
   c. Wetlands
   d. Aquifer recharge areas
   e. Floodplains

2. **Significant vegetation and wildlife habitat, including:**
   a. Non-riparian vegetation and wildlife defined in Lists 1-4 of the Oregon Natural Heritage Plan prepared by the Oregon Natural Heritage Advisory Council (ONHP, 1998) or the Rare, Threatened and Endangered Species of Oregon prepared by the Oregon Natural Heritage Program (R,T&ES, 2001) Heritage Plan (2001)
   b. Plant communities and wildlife habitats in non-riparian areas
   c. Ecologically and scientifically significant natural areas (e.g., Bald Hill)
   d. Undeveloped or partially developed drainage basins (e.g., upland meadows)
   e. Developed areas

3. **Hazard areas, including:**
   a. Landslide/Slope hazard areas including the depositional areas
   b. Geologic fault lines
   c. Soil liquefaction areas

d. Wildfire hazard areas
e. Floodplains

4. **Scenic areas, including**
   a. Vistas
   b. Viewpoints
   c. Gateways
   d. Buffers
   e. Corridors
   f. Open Space

F. Significance Ranking Criteria and Methods

Four categories of natural and scenic resources were developed for discussion purposes. As noted above, the ranking system will be applied to polygons representing clusters of resource values for specific geographic areas. The categories follow:

Category A: Higher Elevation Stream Corridor System

The higher elevation stream systems in Corvallis are composed mostly of intermittent streams that feed into perennial streams. In contrast, perennial streams are more common than intermittent streams on the valley floor. For riparian areas above the 290-foot elevation level, the inventory corridor for perennial streams was determined to be 200 feet. For intermittent streams, the inventory corridor is as follows:

Drainage Basin	Inventory Corridor (from centerline)
160 acres and greater	200 feet
80+ - 160 acres	150 feet
20 - 80 acres	100 feet
less than 20 acres	50 feet

These inventory corridor standards are the same as the standards established for the water-related resources (see section III. B.2).

Category B: Slope Hazard, Wildfire Hazard and High Elevation Areas

Management of natural hazards falls under Statewide Planning Goal 7, Natural Hazards, rather than Goal 5, Natural Resources. A major factor in determining slope stability is the percent of slope. The following ranking system is proposed: [1]

[1] It is important to distinguish between slope measured in percentage points and slope measured in degrees. A 45° slope is the same as a 100% or 1:1 slope. Like a 45° slope, a 100% slope rises one foot in elevation for each horizontal foot at the base.

a. **Land above the 560' elevation level.** Sites above 560' in elevation lack adequate water pressure for fire suppression purposes. The City has no plans to extend urban water service above this elevation. The Hillside Elevations map shows several hilltops or ridgelines with areas above the 560' elevation level (e.g., IV Hill and hilltops to north, Deer Run Ridge and Bald Hill). Because of the lack of water service, it would be imprudent to allow urban level development above the 560' elevation level. Many of Corvallis' hilltops and ridgelines are also recognized in the Open Space - Hillsides report (1983) as scenic vistas. These high elevation areas also have value as wildlife habitat. The Hillsides Report and Hillside Elevations Map are available at the Corvallis Community Development Department.

b. **Areas with potential for landslides (including slopes of > 25%) or earth failures due to earthquakes, including fault movements, or water.** Data from state produced maps will be used to show all known geologic hazards related to landslides or related to earth failures due to an earthquakes, including movement near the Corvallis fault. The data used will be the 2001 GIS layers given to Benton County by the Oregon Department of Geology and Mineral Industries as part of the unpublished report dated June, 2001 and titled: Earthquake Hazard and Risk Assessment And Water-Induced Landslide Hazard in Benton County, Oregon by Zhenming Wang, Gregory B. Graham and Ian P. Madin. The results of mapping by DOGAMI and the Oregon Department of Forestry identifying source areas for landslides will be incorporated when they become available. Landslide depositional areas should also be inventoried and considered to be potentially hazardous.

   Each area with a potential to produce landslides shall be mapped by a qualified geologist to determine the most likely path and extent of any landslides generated from the identified sites.

   It is recommended that the City adopt the severity rating used in the DOGAMI report (none, low, medium and high.) The areas shown on the map with identifiable landslides shall be included in the high-risk category.

c. **Undeveloped slopes of greater than 20%.** OAR Chapter 660-008-0005 defines slopes of 25% or greater as "unbuildable" for purposes of determining density within UGBs. The 1983 *Open Space – Hillsides* report defined steep slopes as 20% and greater. The *Soil Survey of Benton County* (USDA SCS 1972) often associates slopes of 20% or greater with "severe" limitations for building construction. With this background, the NFTAC recommends that all slopes of >20% be delineated with further breaks at 25% and 50%.[2]

d. **Areas with high wildfire potential.** See Appendix D, Winterbrook Memorandum dated September 18, 2001, entitled Corvallis / Urban Wildfire Risk Factors.

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[2] Slope breaks should be mapped at 20%, 25%, and 50%.

e. **Areas with medium wildfire potential.** See Appendix D, Winterbrook Memorandum dated September 18, 2001, entitled *Corvallis / Urban Wildfire Risk Factors*.

f. **Undeveloped Slopes of 10-19%.** Although slopes in this category typically are not hazardous to build upon, urban design issues such as sidewalk and driveway gradients become important when developing land in this slope category.

Category C: Higher Elevation Vegetation & Wildlife Habitat

It is recommended that vegetation and wildlife habitat be considered together, because the presence of vegetative cover is a primary determinant of wildlife habitat. Six basic types of vegetation regimes have been identified in high elevation areas within the Corvallis UGB:

- Prairies (both wetland and upland meadow)
- Oak forests and savannas
- Coniferous forests (ponderosa pine, Douglas-fir etc.)
- Other Deciduous forests
- Mixed Deciduous-Coniferous forests
- Riparian (see riparian resources discussion paper)

1. Wildlife Habitat Assessment (WHA) Method

The first step in the inventory process would be to describe undeveloped areas according to habitat type based on distinct vegetation assemblages. Wildlife habitat values associated with these habitat types will then be evaluated using the WHA Method. The WHA Method documents the presence and availability of water, food and cover for wildlife; connection with other habitat areas; unique or rare occurrences of plant and animal species; and disturbance impacts. The WHA survey will also document species occurrence by strata (e.g., tree, shrub, ground cover), plant community composition and seral stage, species dominance and cover values, presence and size of snags and similar vegetative characteristics. The sample WHA field sheets may be modified to reflect vegetation or habitat conditions specific to Corvallis, or the importance of upland habitats in the hillside areas where access to water is more limited (Please see Appendix E). Sources of additional information to be consulted include Oregon Natural Heritage Program records of sensitive and listed plant and animal species, and local, regional and state vegetation and wildlife surveys.

One factor that is not directly measured in the WHA method is the "edge effect" that occurs when two or more types of vegetative cover intersect. This issue may require additional investigation.

2. Proposed Ranking Structure

a. **WHA Score of 80 or greater.** Areas with Wildlife Habitat Assessment score of 80 or greater represent intact vegetative regimes that are connected to other habitat areas, have a nearby source of water, and provide high quality food and cover for wildlife, including rare species.

b. **Areas with known occurrences of rare plant, animal species, or habitats.** Rare plant and animal species (including federally and state listed threatened and endangered species) are listed in Rare, Threatened and Endangered Plants and Animals of Oregon (Oregon Natural Heritage Program, February 2001). These species include the following:

- ONHP List 1 - species that are threatened with extinction or presumed to be extinct throughout their entire range
- ONHP List 2 - species that are threatened, endangered or extirpated in Oregon, but secure elsewhere. Such species are of concern when considering species diversity in Oregon.
- ONHP List 3 - species for which more information is needed before status can be determined but which may be threatened or endangered in Oregon or their range.
- ONHP List 4 - contains taxa that may be of conservation concern but are not presently threatened or endangered.

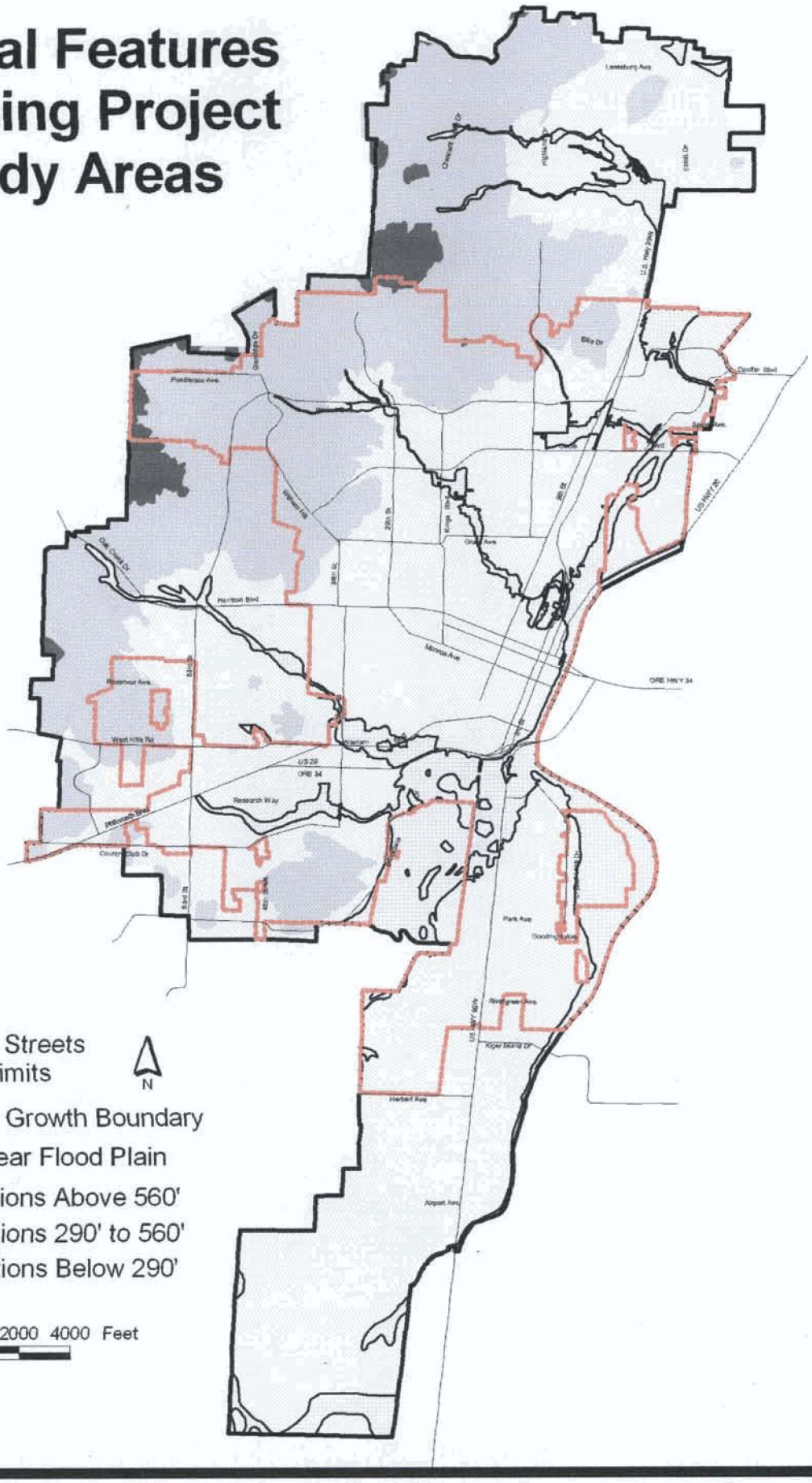
c. **Locally rare species or habitats.** Areas that are determined to be highly valued or rare by the CAC as a result of peer review or public input. Examples include remnant Oak Savanna and Prairie habitats. The inventory and assessment process shall document restoration potential.

d. **WHA Score of 45-79.** Several Oregon communities have established WHA scores of 45 and greater as a baseline threshold for significance. At this point, the project team recommends that sites with scores in this range be identified as in the fourth tier. Typically, sites with WHA scores ranging from 45-79 represent partially disturbed vegetative regimes that may be connected to other habitat areas and have a nearby source of water. Such sites may also provide potential food and cover for rare species of plants and wildlife. These sites usually have moderate to high potential for restoration or enhancement.

e. **WHA Scores below 45.** Sites with a WHA ranking below 45 typically exhibit a high level of vegetative disturbance, have limited or no access to water and are isolated from other resource sites. However, such sites may have high potential for restoration or enhancement.

Note: WHA scores are ordinal and scoring thresholds can be adjusted at a later date after data has been collected, the scores are determined, and the competing land uses have been considered.

Natural Features Scoping Project Study Areas



Chapter 2
Goal 5 Significance and Impact Area Determinations

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Introduction

Under the Goal 5 Rule (OAR Chapter 660, Division 23), local governments must inventory *potential* Goal 5 resources and then apply criteria to determine which resource sites are *significant* and which are not. Resource sites that do not qualify as "significant" are not subject to the ESEE decision-making process, and are not subject to local Goal 5 regulatory programs.

Uses that conflict with Goal 5 resource preservation often have *impacts* that extend beyond the resource site itself. For example, significant streams may be adversely affected by development within the riparian area adjacent to but outside the banks of the stream. The Goal 5 Rule requires that *impact areas* be defined and that the ESEE analysis consider the consequences of allowing conflicting development within the impact area as well as the resource site itself.

This chapter describes how Corvallis and Benton County decision-makers applied the Goal 5 Rule (OAR) to determine both significant resource sites and their respective impact areas. As discussed below, there are three types of significant natural resources:

1. Locally Significant Wetlands (including impact areas)
2. Riparian Corridors (including associated wetlands, riparian areas and floodplains)
3. Significant Vegetation (including tree groves and wildlife habitat vegetative subpolygons)

Natural resource polygons form the mosaics that comprise each of the 16 significant Natural Resource Analysis Areas (NRAs or resource sites). Corvallis and Benton County decision-makers decided *not* to protect portions each NRA as a result of the ESEE Analysis. (See Chapter 6 for a discussion of *why* certain significant Goal 5 polygons or resource sub-sites were removed from the Goal 5 Inventory.) Significant Natural Resource polygons that remained after the ESEE Analysis are shown on the *Protected Goal 5 Natural Resources Map.* Protected portions of each NRA appear on Corvallis Comprehensive Plan Map and Land Development Code District Map.

Significance and Impact Area Determinations

The Goal 5 Rule allows local governments to determine and apply local significance criteria for riparian corridors and significant vegetation, but prescribes significance criteria for wetlands. This section begins with a discussion of wetlands, and moves on to riparian corridors and significant vegetation.

The Goal 5 Rule and common sense require the determination of "impact areas" – or the area outside of significant resource sites where additional zoning regulation may be

appropriate, in order to reduce impacts from development. The rule offers the following direction (OAR 660-023-040):

> *(3) Determine the impact area. Local governments shall determine an impact area for each significant resource site. The impact area shall be drawn to include only the area in which allowed uses could adversely affect the identified resource. The impact area defines the geographic limits within which to conduct an ESEE analysis for the identified significant resource site.*

The location and extent of the impact areas for the Natural Resource Analysis Areas (NRA) are informed by the *Natural Features Scoping Report,* but were determined ultimately by Corvallis and Benton County decision-makers. The impact area for the boundaries of each NRA depends upon the specific type of polygon located at the NRA boundary, as described below.

1. Locally Significant Wetlands (LSW)

Wetland "significance" is determined using applicable Division of State Lands administrative rules. As noted in the Goal 5 Rule (OAR 660-023-100), both a Local Wetlands Inventory (LWI) and a Locally Significant Wetlands (LSW) inventory must be prepared by local governments and approved by the Division of State Lands:

> *(3) For areas inside urban growth boundaries (UGBs) * * *, local governments shall:*
> *(a) Conduct a local wetlands inventory (LWI) using the standards and procedures of OAR141-086-0110 through 141-086-0240 and adopt the LWI as part of the comprehensive plan or as a land use regulation; and*
> *(b) Determine which wetlands on the LWI are "significant wetlands" using the criteria adopted by the Division of State Lands (DSL) pursuant to ORS 197.279(3)(b) and adopt the list of significant wetlands as part of the comprehensive plan or as a land use regulation.*

Winterbrook followed these processes in preparing the Locally Significant Wetland Inventory and in identifying locally significant wetlands (LSWs). All LSWs are, by definition, are significant.

The impact area for an LSW includes the 25-foot transition area that surrounds each locally significant wetland. This transition area is consistent with the margin of error built into the Locally Significant Wetland Inventory process prescribed by the Division of State Lands (DSL).[1] Since the LSW Inventory is deemed accurate to within 25 feet of the mapped boundary of the locally significant wetland, the impact area is large enough to include the wetland itself plus the 25-foot margin of error.

Wetlands that appear on the Local Wetlands Inventory (LWI) and do not meet LSW criteria, but which are located within a Riparian Analysis Area (RAA), are considered significant. Because of the relatively low quality of non-LSW wetlands, and the fact that such wetlands are only deemed significant when they are located within a Riparian Assessment Area (RAA), no impact area has been assigned (See discussion below).

2. Riparian Corridor Polygons

The methodological foundation for the riparian inventory is found in *The Natural Features Scoping Project Report*. As discussed above, the inventory was conducted within Riparian Assessment Areas (RAA), which are defined as follows:

- **The Willamette and Mary's River and Streams with Braided Channels:** 200' measured horizontally from the top-of-bank of the outermost braided channel. If a locally significant wetland is located within 50 feet of the top-of-bank, the Riparian Assessment Area is measured horizontally outwards from the wetland edge.

- **Non-Braided Perennial Streams and Intermittent Streams Draining 160 Acres or more:** 200 feet measured horizontally from the top-of-bank. If a locally significant wetland is located within 50 feet of the top-of-bank, the Riparian Assessment Area is measured horizontally outwards from the wetland edge.

- **Intermittent Streams Draining from 80-160 Acres:** 150 feet from the top-of-bank.

- **Intermittent Streams Draining from 20-80 Acres:** 100 feet from the top-of-bank.

- **Intermittent Streams Draining Less than 20 Acres:** 50 feet from the top-of-bank if a discernable channel exists based on field observations.

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1 The *Oregon Freshwater Wetland Assessment Methodology* (OFWAM) was developed for the Division of State Lands (DSL) and is used to assess whether or not a wetland meets the criteria for a Locally Significant Wetland (LSW). The maps and documents produced for the LWI are intended for planning purposes and are considered by DSL to be accurate to within 25 feet. However, wetland boundaries may be adjusted based on a DSL-approved delineation at any time.

Corvallis and Benton County have determined that all streams mapped on the Natural Features Inventory (2003) are significant. Each stream (whether intermittent or perennial) has a numerically defined riparian area that is wide enough to address potential impacts from conflicting uses on significant streams. However, Corvallis and Benton County also determined that the riparian area beyond the stream's banks were themselves significant Goal 5 resources, and defines this integrated resource site as a *riparian corridor.*

Riparian Assessment Areas are usually much larger than the significant riparian corridor. Table 2.1 shows the widths of significant riparian corridors based on the drainage area of the stream. In most cases, potential impacts to the base riparian corridor are adequately addressed by Goal 6 (water quality) and 7 (natural hazard) regulations. However, where floodplain areas, wetlands, or connecting riparian vegetation are present, the riparian corridor extends beyond the base corridor distance to allow protection of these features. Thus, the riparian corridor functions as its own impact area. Because the base riparian corridor is extended to incorporate impacted areas (i.e., the base riparian corridor expands to include connecting riparian vegetation and associated floodplain and wetland areas), no purpose is served by defining a riparian corridor impact area beyond the significant riparian corridor resource area as defined in Table 2.1.

Table 2.1 summarizes criteria used by Corvallis and Benton County decision-makers to define riparian corridors. As noted above, the Significant Riparian Corridor boundary is drawn widely to include the required impact areas.

Table 2.1 Significant Riparian Corridors

Riparian Corridor Category	Base Riparian Area Width from Top-of-Bank	Plus Abutting Floodplain	Plus Riparian Vegetation within RAA[1] that Abuts Significant Upland Vegetation Polygon	Plus Non LSW and Non-LSW Wetlands within RAA[2]
Streams Draining				
Less than 20 acres	50 feet	Yes	Yes	Yes
20-160 acres	75 feet	Yes	Yes	Yes
More than 160 acres	100 feet	Yes	Yes	Yes
Rivers				
Willamette and Mary's River (Mostly Undeveloped Urban Fringe)	120 feet	Yes	Yes	Yes
Willamette and Mary's River (Mostly Developed City Limits)	120 feet	Yes	Yes	Yes

[1] The Riparian Analysis Area (RAA) is 50-200 feet from the top-of-bank. Continuous riparian vegetation that is connected to a significant vegetation polygon is also considered significant.

[2] Wetlands that appear on the Local Wetlands Inventory that are not Locally Significant Wetlands (LSW), but which are located within the RAA, are considered significant elements of the riparian corridor.

For most streams, the base riparian corridor shown in Table 2.1 includes the local stream floodplain, abutting riparian vegetation and associated wetlands. Where continuous riparian vegetation extends outside the base riparian corridor and abuts a significant vegetation polygon, it is considered part of the significant riparian corridor. Similarly, any wetland that appears on the LWI and is within the RAA is considered part of the significant riparian corridor. Finally, in cases where the floodplain extends beyond the base riparian corridor, the floodplain boundary becomes the boundary of the significant riparian corridor.

For the Willamette and Mary's Rivers, the floodplain extends beyond the base riparian corridor in several areas – most notably at the confluence of the two rivers. However, riparian vegetation is less likely to extend to abutting significant vegetation along these rivers, and wetlands are more likely to be included within the base riparian corridor or river floodplain.

3. Significant Vegetation Polygons

Significant Vegetation, by definition, occurs outside of Significant Riparian Corridors and Locally Significant Wetlands.

The Natural Features Inventory analyzes and maps two types of vegetation outside of Riparian Corridors:

1. vegetative cover within larger Wildlife Habitat Analysis Areas (WHAs); and
2. vegetative cover within Tree Groves. Tree Groves may be located within a WHA or may be isolated from a WHA.

Wildlife Habitat Areas are composed of mosaic of vegetative cover types, called "sub-polygons". Although tree groves are the dominant cover type in most cases, other cover types (shrub or meadow) are also found in WHAs. The WHA assessment focuses on the vegetative cover types that contribute to the overall value of the whole wildlife habitat mosaic. Each Tree Grove (vegetative cover sub-polygon) within a WHA is also assessed for its scenic and social value. *In contrast*, the Tree Grove inventory focuses primarily on the scenic and social value of each tree grove, both within and outside WHAs. Wildlife habitat value was not specifically inventoried for isolated Tree Groves (i.e., Tree Groves of one-half acre or greater located outside of WHAs.)

In most cases, the impact area for Significant Vegetation Polygons extends to the outer boundaries of the polygon, which includes the driplines of trees within Tree Groves.

Impacts to wildlife habitat functions and values are considered by creating two levels of significance: the "somewhat significant vegetation" category includes two types of Significant Vegetation Polygons that are valuable only in relation to Highly Significant Vegetation Polygons:

1. WHA Polygons contiguous to highly significant WHA Polygons; and
2. WHA Polygons connecting highly significant WHA Polygons.

Potential impacts to abutting Significant Riparian Corridors are considered by expanding the corridor to include riparian vegetation that abuts a highly significant Vegetation Polygon.

Table 2.2 summarizes criteria used by Corvallis and Benton County decision-makers to define highly and somewhat significant vegetation polygons.

Table 2.2 Criteria for Determining Significant Vegetation Polygons

Vegetation Polygon Category	WHA Reference
Somewhat Significant Isolated Tree Groves Outside WHA	
Isolated Groves– All Cover Types	Not Applicable
Highly Significant Vegetative Polygons Within WHA	
Mixed Forest >70% Canopy Cover	
Hardwood Forest >70% Canopy Cover	
Mixed Hardwood Woodland 30-70% Canopy Cover	
Oak Savannas <30% Canopy Cover	
"Top Upland Prairies" (Salix)	
"Top Oak Savannahs" (Salix)	
Old Growth Douglas Fir	
Somewhat Significant Vegetation Polygons Within WHA	
Top 25% "Current Condition" Score	
Tree Groves within WHA Scoring in Top 33%	
WHA Polygons contiguous to highly significant WHA Polygons	
WHA Polygons connecting highly significant WHA Polygons	
Grass lands - natural dry prairie	
Grass lands – tall grasses and meadow	
Emergent/herb wetland or pond	

Natural Resource Analysis Areas (NRA)

The *Natural Features Scoping Report* (2001) recognized the *inter-relationships* that existing among different types of Goal 5 and 6 resources. For example, riparian areas and wetlands often overlap with floodplain areas, and wildlife habitat areas are often associated with Corvallis' steeply-sloped and landslide-prone forested hillsides.

The NFTAC *Scoping Report* also recognized the importance of integrated management of the City's three types of Goal 5 resources: locally significant wetlands, riparian corridors, and significant vegetation. This integration is reflected in the City's inventory methods. For example, the importance of water to wildlife habitat is recognized by assigning higher scores to WHAs with wetlands and streams. Tree groves within WHAs are ranked for both aesthetic and wildlife habitat value, whereas tree groves outside WHAs (isolated groves) are ranked primarily for their scenic value.

Because these and many other functional inter-relationships exist and are documented in the *Natural Features Inventory*, individual resource subpolygons are grouped into 16 integrated Goal 5 Natural Resource Analysis Areas (NRA). Only those subpolygons that

have been determined to be *significant* are included in an NRA. For example, a vegetative cover type that does meet significance criteria will not be incorporated into an NRA and will not be further reviewed through the Goal 5 ESEE process.

Each NRA includes a complex of natural features that will be considered as a "contiguous resource site" or "isolated resource site" in the Goal 5 ESEE Analysis. To determine the NRA boundaries, we generally applied the following criteria:

1. The Urban Growth Area has been divided into three geographic subareas: North, Central and South. The North Subarea includes NRAs 1-3 and is generally north of Chip Ross Park. The Central Subarea includes 11 NRAs. The South Subarea, which includes two NRAs, is separated by Mary's River from the Central Subarea. The prefaces N, C or S denote the subarea where the NRA is located.

2. Wildlife Habitat Assessment Areas (WHAs) are most common in higher elevation, forested hillsides at the outer edges of the Urban Fringe. The 1983 Corvallis Comprehensive Plan refers to this ring of hills and uplands as the "Emerald Necklace." The size of several significant WHAs has been reduced through the initial ESEE Analysis process leading to acceptance of the Draft Preferred Scenario. Therefore, WHAs helped to determine NRA boundaries in North and West Central Corvallis.

3. Primary Roads were used to define and separate NRAs in several instances at the mid- to lower elevations. Roads are often located at the base of hills and/or create a recognized landmark to aid citizens in locating NRAs.

4. Rivers were used at lower elevation to separate several NRAs. The Willamette River actually forms most of the eastern UGB, and Mary's River separates the two southern NRAs from Central Corvallis NRAs.

5. Drainage basins were used to determine NRAs at mid- and lower elevations; streams and wetlands that drain to them are the most significant natural features. WHAs are less numerous and smaller at mid- to low-elevations and are less useful in determining NRA boundaries.

The NRAs are divided into three categories based on their proximity to the City Limits.

- Five NRAs are located entirely or mostly outside the City Limits (Chip Ross - Vineyard Mountain, Jackson Frazier, Lewisburg, Bald Hill, and Airport).

- Seven NRAs are split more or less evenly by the City Limits (Walnut Park, Sequoia Creek, Oak Creek, West Hills, Dunawi Creek, County Club, and Confluence). However, most of the natural features in these NRAs are located within the Urban Fringe.

- Only four NRAs are within or mostly within the Corvallis City Limits (Timberhill, Dixon Creek, Village Green, and Riverfront Central).

These figures support what is evident from reviewing the Natural Features Inventory Maps: most of the natural features are located outside the City Limits, where urban development has not yet occurred.

Urbanization of Aquatic Systems

by Derek B. Booth and C. Rhett Jackson

October 1997

ABSTRACT

Using continuous hydrologic modeling we have evaluated detention ponds designed by conventional event methodologies, and our findings demonstrate serious deficiencies in actual pond performance when compared to their design goals. Even with best efforts at mitigation, the sheer magnitude of development activities falling below a level of regulatory concern suggests that increased resource loss will invariably accompany development of a watershed. Without a better understanding of the critical processes that lead to degradation, some downstream aquatic-system damage is probably inevitable without limiting the extent of watershed development itself.

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INTRODUCTION

To understand the potentially degrading effects of urban development and the potential for mitigation, both areas – upland and riparian – must be considered in turn.

– p. 1077

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Stormwater detention is a particularly widespread application that promises substantive improvements, but all-too-often it fails to achieve even the most limited of objectives.

Modifications of the land surface during urbanization produce changes in both the type and the magnitude of runoff processes. These changes result from vegetation clearing, soil compaction, ditching and draining, and finally covering the land surface with impervious roofs and roads. The infiltration capacity of these covered areas is lowered to zero, and much of the remaining soil-covered area is trampled to a near-impervious state. Compacted, stripped, or paved-over soil also has lower storage volumes, and so even if precipitation can infiltrate, the soil reaches surface saturation more rapidly and more frequently. Thus *Horton overland flow* or *saturation overland flow* (Dunne and Leopold, 1978) is introduced into areas that formerly may have generated runoff only by subsurface flow processes, particularly in humid areas of generally low-intensity rainfall such as the Pacific Northwest.

– pp. 1077-1078

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Changes in upland runoff processes, particularly from a predominantly *subsurface* flow regime to a predominantly *surface* flow regime, alter not only the magnitude of discharges but also the delivery of sediment to the stream network. With overland flow, fine sediment is moved into channels throughout the year; when coupled with land-cover changes, the sediment load can increase by many orders of magnitude (Wolman and Schick, 1967) and the predominant grain-size distribution can shift to much finer fractions. Such increases in the delivery of fine sediments significantly alters the sediment size distribution of gravel bed streams (e.g., Caning, 1984; Jobson and Carey, 1989), with attendant changes in stream ecology (recognized as early as Ellis, 1936; also Hawkins *et al.*, 1982; Culp *et al.*, 1986; Chapman, 1988; Naiman *et al.*, 1992; Weaver and Garman, 1994).

– pp. 1078, 1080

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At the end of this causal chain of upland, riparian, and channel changes lies the degradation of in-stream biological function that so often motivates rehabilitation efforts (Karr, 1996). In the Pacific Northwest, many of these

efforts are focused on enhancing populations of anadromous salmon in lowland streams. These fish depend on a particular combination of water and sediment fluxes to maintain favorable channel conditions. Because land-use change in a watershed alters those fluxes, the resulting flow regime and channel configuration no longer tend to favor salmonids (Booth and Fuerstenberg, 1994), and thus most rehabilitation efforts that address only the in-stream symptoms of these watershed changes are unlikely to succeed (Roper *et al.*, 1997).

– p. 1080

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THE RELATIONSHIP BETWEEN URBANIZATION AND AQUATIC-SYSTEM DEGRADATION

The simulations assumed no on-site detention of stormwater runoff under current conditions, because almost no development in this region had yet been constructed with hydrologically significant detention volumes when these observations were made (1988-1992).

– p. 1082

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A surprisingly good correlation emerges between observed channel stability and watershed urbanization, be it characterized by percent effective impervious area or by the magnitude of simulated flow increases. The observations here show that observed instability is all-but ubiquitous where the contributing effective impervious area percentage exceeds a rather low level: a value of about 10 percent (dashed vertical line in Figure 4) discriminates between observed stable and unstable reaches almost perfectly.

– p. 1083

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The level of degradation changes markedly at about 8-10 percent EIA (Figure 5), except a few sites with areas of significant upstream impoundments. A similar relation between habitat quality and effective impervious area has also been seen in wetlands of this region (Booth and Reinelt, 1993).

– p. 1083

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These results show remarkably clear and consistent trends in aquatic-system degradation. In western Washington, and likely in other humid regions as well, approximately 10 percent effective impervious area in a watershed typically yields demonstrable, and probably irreversible, loss of aquatic-system function. Even lower levels of urban development cause significant degradation in sensitive water bodies and a reduced, but less well quantified, degree of loss throughout the system as a whole.

– p. 1084

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ON-SITE DETENTION AS MITIGATION FOR URBAN DEVELOPMENT

The *actual* performance of R/D ponds, however, depends on the answer to two questions. The first is one of design ***policy***: how completely do we want the facility to mimic predevelopment runoff conditions? The second is one of design ***analysis***: how accurately does our hydrologic model predict true performance, so that the constructed facility actually achieves the intended management policy?

Policy: Design Performance. R/D ponds can achieve either of two levels of design performance, depending on the desired balance between achieving downstream protection and the cost of that protection. A ***peak standard***, the classic (and least costly) goal of RID facilities, seeks to maintain postdevelopment *peak* discharges at their predevelopment levels. Even if this goal is achieved successfully, however, the aggregate duration that such flows occupy the channel must increase because the overall volume of runoff is greater.

In contrast, a ***duration standard*** seeks to maintain the postdevelopment duration of all sediment-transporting discharges at predevelopment levels. Duration standards are motivated by a desire to avoid potential disruption to the conveying channel itself by not allowing increased sediment transport. Without infiltration of runoff, however, the total volume of runoff increases in the postdevelopment condition, and so durations cannot be matched for all discharges; at some level the "excess" water must be released. This is accomplished by determining a threshold discharge below which sediment transport in the receiving channel does not occur. This determination can be made by site-specific, but rather expensive, analysis based on stream hydraulics and sediment size (Buffington and Montgomery, 1997) or can be applied as a "generic" standard based on pre-development discharges.

– pp. 1084-1085

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Analysis: Choice of Model. Having determined a design standard, a particular hydrologic model must be used during the design analysis. The choice is critical, because model predictions of pre- and post-development runoff determine the size and configuration of the detention facility. Use of a 24-hour Soil Conservation Service (SCS) Curve-Number method, typically the Santa Barbara Urban Hydrograph method, or SBUH, has been standard practice across much of the Pacific Northwest since 1990 despite its poor correlation between assigned and calibrated curve numbers (Hawkins, 1984) and the inability of any event-based model to predict accurately a continuous process such as runoff (Barker *et al.*, 1991). Alternatives to the SCS method have produced promising results, particularly the King County Runoff Time Series program (KCRTS; King County, 1995). It is a relatively simple hydrologic analysis tool with nearly all of the accuracy and versatility of the continuous rainfall/runoff model, Hydrologic Simulation Program-FORTRAN (HSPF), on which it is based.

– p. 1085

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Duration Standards. Matching pre- and post-development flow durations is a far more challenging task than simply matching flow peaks, because the total *volume* of runoff arising from a given storm is greater and so must be released or disposed of in some fashion. We have considered two modeling approaches for attaining this enhanced performance in the absence of infiltration: using an apparent "over-performance" of the SCS 24-hour method (Table 3), or using KCRTS with this performance as an explicit goal. In either case, any R/D design that meets a flow-duration standard will easily meet a peak standard as well.

– p. 1086

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CONCLUSION: MITIGATION USING ON-SITE DETENTION

Cost of Mitigation. Effective runoff mitigation in the Pacific Northwest appears to require pond volumes from 3 to as much as 14 centimeters (Figure 6). With associated berms, control structures, and maintenance access roads such a facility may occupy more than 10 percent of the gross area of a development (Figure 7). These are "lakes," not stormwater ponds, and although fully justifiable from a hydrologic standpoint they are unlikely to be built except in the most unusual of economic and social climates.

Thresholds of Sediment Movement. The concept of a "duration standard" implies the existence of a discharge below which no sediment transport occurs, allowing non-erosive release of urban-increased runoff volumes. For gravel-bed stream channels, this threshold discharge is real and can be determined on a site-specific or generic basis. In sand-bedded channels, however, the threshold of sediment motion occurs at impracticably low discharges, and so increases in the net transport of bed material is virtually unavoidable is such

systems. We have not investigated the consequences of such a condition in small sand-bedded urban streams but speculate that they may be locally severe.

– pp. 1087-1088

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CONCLUSIONS

In western Washington, and likely in other humid regions as well, approximately 10 percent effective impervious area in a watershed typically yields demonstrable, and probably irreversible, loss of aquatic-system function. The data do not require a discrete "threshold" of effects, but they do display a noteworthy accumulation of physical and biological effects once this fraction of a watershed is covered by EIA. On-site detention is an appealing and widespread strategy for mitigating these effects, but very restrictive and so costly standards may need to be met to protect aquatic systems in urbanizing areas. Even though this study has considered only this one mitigation strategy, substantial difficulties are revealed. The common hydrologic methods used to size detention facilities give a false sense of accomplishment, and regulatory thresholds designed to avoid economic hardship for small projects may nevertheless allow substantial cumulative impacts to accrue. Many of the changes to the landscape imposed by urbanization are probably beyond our best efforts to fully correct them, and so some downstream loss of aquatic-system function is probably inevitable at our present level of understanding. Unless we can develop a more precise, process-based understanding of how altered landscapes produced degraded stream channels we probably will not achieve genuine protection without limiting the extent of development itself, a strategy that is being used with increasing frequency in this region's remaining resource-rich watersheds.

– p. 1088

Benton County Assessor's Office

REAL PROPERTY

Account Information

		LAST CERTIFIED VALUES:	
Account #:	153373		
Map/Tax Lot:	12510C000200	Market Land:	$ 277,324
Acreage:	10.72	Market Structure:	$ 0
Property Class:	640	Specially Assessed Land:	$ 2,099
Tax Code Area:	0901	Total Real Market Value:	$ 277,324
		Assessed:	$ 2,099
Situs Address:	UNASSIGNED CORVALLIS, OR	Exemption:	$ 0
		Net Taxable:	$ 2,099

Owner Information

Owner	EVASHEVSKI FOREST JR P O BOX 781 CORVALLIS, OR 97339 USA
Owner	SCHABERG JOHN STEPHEN P O BOX 781 CORVALLIS, OR 97339 USA
Taxpayer	EVASHEVSKI FOREST JR P O BOX 781 CORVALLIS, OR 97339 USA

Improvement Information

No Improvement Information Located

Sales Information

Deed Ref Number	Sales Date	Sale Price	Grantor
126615-90	08/24/1990	$ 100,000	OSU FOUNDATION

Benton County Assessor's Office • 205 NW 5th St. • Corvallis, OR 97300 • 541.766.6855

07/01/2003 to 06/30/2004 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153373
SITUS ADDRESS: UNKNOWN SITUS

PROP CLASS: 640
PROP TCA: 0901
PROP MAP: 12510C000200 ACRES: 10.72

EVASHEVSKI FOREST JR ETAL
P O BOX 781
CORVALLIS, OR 97339

VALUES	LAST YEAR	THIS YEAR
RMV LAND	141,099.00	146,100.00
RMV STRUCT	0.00	0.00
RMV TOTAL	141,099.00	146,100.00
SAV TOTAL	418.00	425.00
AVR TOTAL	417.00	425.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**418.00**	**425.00**

LAST YEARS TAX	6.22
Corvallis SD 509J	1.90
LinnBenton CC	0.21
LinnBentonLincoln ESD	0.13
Local Option 2000-Corvallis SD 509J	0.02
Education Totals	**2.26**
Benton County	0.93
Benton County Library	0.17
City of Corvallis	2.17
Local Option 1999-Benton County	0.15
Local Option 2001-Benton County	0.13
General Government Totals	**3.55**
Bonds City of Corvallis	0.24
Bonds Corvallis SD 2003	0.73
Bonds Corvallis SD 509J	0.09
Bonds LinnBenton CC	0.07
Bonds - Other Totals	**1.13**

TAX COLLECTOR	(541)766-6808
ASSESSOR	(541)766-6855

WEB SITE: http://www.co.benton.or.us/assess/

Potential Tax Liability: POTENTIAL TAX LIABILITY

If a mortgage company pays your taxes, this statement is for your records only.

2003 - 2004 TAXES	6.94
TOTAL TAXES OUTSTANDING	6.94
TOTAL TAX (After Discount)	6.73

Full Payment with 3% Discount	**2/3 Payment with 2% Discount**	**1/3 Payment with No Discount**
6.73	4.54	2.32

Cut Here **PLEASE RETURN THIS PORTION WITH YOUR PAYMENT** Cut Here

ACCOUNT NUMBER: 153373
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2003	6.73
or 2/3 Payment Enclosed.....Due:	11/15/2003	4.54
or 1/3 Payment Enclosed.....Due:	11/15/2003	2.32

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

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Enter Payment Amount
$

EVASHEVSKI FOREST JR ETAL
P O BOX 781
CORVALLIS, OR 97339

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

07/01/2008 to 06/30/2009 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153373
SITUS ADDRESS: UNASSIGNED CORVALLIS, OR

PROP CLASS: 640
PROP TCA: 0901
PROP MAP: 12510C000200 ACRES: 10.72

EVASHEVSKI FOREST JR
P O BOX 781
CORVALLIS, OR 97339

VALUES	LAST YEAR	THIS YEAR
RMV LAND	208,050.00	277,324.00
RMV STRUCT	0.00	0.00
RMV TOTAL	208,050.00	277,324.00
SAV TOTAL	2,038.00	2,099.00
AVR TOTAL	2,038.00	2,099.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**2,038.00**	**2,099.00**

LAST YEARS TAX	**34.16**
Corvallis SD 509J	9.37
Corvallis SD 509J Local Option	2.52
LinnBenton CC	1.05
LinnBentonLincoln ESD	0.64
Education Totals	**13.58**
Benton County	4.63
Benton County Library	0.83
Benton County Soil & Water Dist	0.10
City of Corvallis	10.72
Local Option 2008 Benton County	1.89
General Government Totals	***18.17***
Bonds City of Corvallis	1.13
Bonds Corvallis SD 2003	2.93
Bonds Corvallis SD 509J	0.33
Bonds LinnBenton CC	0.37
Bonds - Other Totals	**4.76**

TAX COLLECTOR (541)766-6808
ASSESSOR (541)766-6855
WEB SITE: http://www.co.benton.or.us/assess/

Potential Tax Liability: POTENTIAL TAX LIABILITY

If a mortgage company pays your taxes,
this statement is for your records only.

2008 - 2009 TAXES	36.51
TOTAL TAXES OUTSTANDING	36.51
TOTAL TAX (After Discount)	35.41

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
35.41	23.85	12.17

Cut Here **PLEASE RETURN THIS PORTION WITH YOUR PAYMENT** Cut Here

ACCOUNT NUMBER: 153373
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2008	35.41
or 2/3 Payment Enclosed.....Due:	11/15/2008	23.85
or 1/3 Payment Enclosed.....Due:	11/15/2008	12.17

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

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Enter Payment Amount
$

EVASHEVSKI FOREST JR
P O BOX 781
CORVALLIS, OR 97339

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

Benton County Assessor's Office

REAL PROPERTY

Account Information

		LAST CERTIFIED VALUES:	
Account #:	153407		
Map/Tax Lot:	12510C001000	Market Land:	$ 1,708,080
Acreage:	25.88	Market Structure:	$ 0
Property Class:	100	Specially Assessed Land:	$ 0
Tax Code Area:	0901	Total Real Market Value:	$ 1,708,080
		Assessed:	$ 528,797
Situs Address:	UNASSIGNED CORVALLIS, OR	Exemption:	$ 0
		Net Taxable:	$ 528,797

Owner Information

Owner	SCHABERG J STEPHEN,TR 4751 LONG RIDGE PL MARANA, AZ 85653 USA
Taxpayer	SCHABERG J STEPHEN,TR 4751 LONG RIDGE PL MARANA, AZ 85653 USA

Improvement Information

No Improvement Information Located

Sales Information

Deed Ref Number	Sales Date	Sale Price	Grantor
258408-98	12/17/1998	$ 1,000,000	SOULE B LINN & DONNA F
258409-98	12/17/1998	$ 1,200,000	BREADNER PARKER & ASSOCIATES

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07/01/2008 to 06/30/2009 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153407
SITUS ADDRESS: UNASSIGNED CORVALLIS, OR

PROP CLASS:	100	
PROP TCA:	0901	
PROP MAP:	12510C001000	ACRES: 25.88

SCHABERG J STEPHEN,TR
4751 LONG RIDGE PL
MARANA, AZ 85653

VALUES	LAST YEAR	THIS YEAR
RMV LAND	2,029,199.00	1,708,080.00
RMV STRUCT	0.00	0.00
RMV TOTAL	2,029,199.00	1,708,080.00
SAV TOTAL	0.00	0.00
AVR TOTAL	513,395.00	528,797.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**513,395.00**	**528,797.00**

LAST YEARS TAX	**8,604.19**
Corvallis SD 509J	2,359.17
Corvallis SD 509J Local Option	634.56
LinnBenton CC	265.40
LinnBentonLincoln ESD	161.23
Education Totals	**3,420.36**
Benton County	1,166.10
Benton County Library	208.72
Benton County Soil & Water Dist	26.44
City of Corvallis	2,700.40
Local Option 2008 Benton County	475.92
General Government Totals	**4,577.58**
Bonds City of Corvallis	284.55
Bonds Corvallis SD 2003	741.06
Bonds Corvallis SD 509J	82.23
Bonds LinnBenton CC	92.43
Bonds - Other Totals	**1,200.27**

TAX COLLECTOR	(541)766-6808
ASSESSOR	(541)766-6855

WEB SITE: http://www.co.benton.or.us/assess/

If a mortgage company pays your taxes, *this statement is for your records only.*

2008 - 2009 TAXES	9,198.21
2007 - 2008 DELINQUENT TAXES	3,998.19
TOTAL TAXES OUTSTANDING	13,196.40
TOTAL TAX (After Discount)	12,920.45

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
12,920.45	10,007.69	7,064.26

Cut Here **PLEASE RETURN THIS PORTION WITH YOUR PAYMENT** Cut Here

ACCOUNT NUMBER: 153407
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2008	12,920.45
or 2/3 Payment Enclosed.....Due:	11/15/2008	10,007.69
or 1/3 Payment Enclosed.....Due:	11/15/2008	7,064.26

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

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Enter Payment Amount
$

SCHABERG J STEPHEN,TR
4751 LONG RIDGE PL
MARANA, AZ 85653

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

07/01/2003 to 06/30/2004 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153407
SITUS ADDRESS: UNKNOWN SITUS

PROP CLASS: 100
PROP TCA: 0901
PROP MAP: 12510C001000 ACRES: 25.88

SCHABERG J STEPHEN,TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

VALUES	LAST YEAR	THIS YEAR
RMV LAND	1,294,000.00	1,294,000.00
RMV STRUCT	0.00	0.00
RMV TOTAL	1,294,000.00	1,294,000.00
SAV TOTAL	0.00	0.00
AVR TOTAL	442,859.00	456,145.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**442,859.00**	**456,145.00**

LAST YEARS TAX	**6,835.26**
Corvallis SD 509J	2,035.05
LinnBenton CC	228.94
LinnBentonLincoln ESD	139.08
Local Option 2000-Corvallis SD 509J	347.17
Education Totals	**2,750.24**
Benton County	1,002.20
Benton County Library	180.04
City of Corvallis	2,329.40
Local Option 1999-Benton County	159.65
Local Option 2001-Benton County	141.40
General Government Totals	**3,812.69**
Bonds City of Corvallis	262.06
Bonds Corvallis SD 2003	773.20
Bonds Corvallis SD 509J	95.43
Bonds LinnBenton CC	80.19
Bonds - Other Totals	**1,210.88**

TAX COLLECTOR (541)766-6808
ASSESSOR (541)766-6855
WEB SITE: http://www.co.benton.or.us/assess/

If a mortgage company pays your taxes, this statement is for your records only.

2003 - 2004 TAXES	7,773.81
TOTAL TAXES OUTSTANDING	7,773.81
TOTAL TAX (After Discount)	7,540.60

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
7,540.60	5,078.89	2,591.27

Cut Here **PLEASE RETURN THIS PORTION WITH YOUR PAYMENT** Cut Here

ACCOUNT NUMBER: 153407
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2003	7,540.60
or 2/3 Payment Enclosed.....Due:	11/15/2003	5,078.89
or 1/3 Payment Enclosed.....Due:	11/15/2003	2,591.27

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

☐ Mailing address change on back

Enter Payment Amount
$

SCHABERG J STEPHEN,TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

07/01/2004 to 06/30/2005 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153407
SITUS ADDRESS: UNKNOWN SITUS

PROP CLASS:	100	
PROP TCA:	0901	
PROP MAP:	12510C001000	ACRES: 25.88

SCHABERG J STEPHEN.TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

VALUES	LAST YEAR	THIS YEAR
RMV LAND	1,294,000.00	999,999.00
RMV STRUCT	0.00	0.00
RMV TOTAL	1,294,000.00	999,999.00
SAV TOTAL	0.00	0.00
AVR TOTAL	456,145.00	469,829.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**456,145.00**	**469,829.00**

LAST YEARS TAX	**7,773.81**
Corvallis SD 509J	2,096.10
LinnBenton CC	235.81
LinnBentonLincoln ESD	143.25
Local Option 2000-Corvallis SD509J	339.40
Education Totals	**2,814.56**
Benton County	1,034.99
Benton County Library	185.44
City of Corvallis	2,399.27
Local Option 2004 Benton County	136.25
General Government Totals	**3,755.95**
Bonds City of Corvallis	231.20
Bonds Corvallis SD 2003	779.60
Bonds Corvallis SD 509J	94.01
Bonds LinnBenton CC	83.91
Bonds - Other Totals	**1,188.72**

TAX COLLECTOR	(541)766-6808
ASSESSOR	(541)766-6855
WEB SITE: http://www.co.benton.or.us/assess/	

If a mortgage company pays your taxes, this statement is for your records only.

2004 - 2005 TAXES	7,759.23
TOTAL TAXES OUTSTANDING	7,759.23
TOTAL TAX (After Discount)	7,526.45

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
7,526.45	5,069.36	2,586.41

Cut Here — **PLEASE RETURN THIS PORTION WITH YOUR PAYMENT** — Cut Here

ACCOUNT NUMBER: 153407
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2004	7,526.45
or 2/3 Payment Enclosed.....Due:	11/15/2004	5,069.36
or 1/3 Payment Enclosed.....Due:	11/15/2004	2,586.41

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

☐ Mailing address change on back

Enter Payment Amount
$

SCHABERG J STEPHEN.TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

07/01/2005 to 06/30/2006 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153407
SITUS ADDRESS: UNKNOWN SITUS

PROP CLASS:	100	
PROP TCA:	0901	
PROP MAP:	12510C001000	ACRES: 25.88

SCHABERG J STEPHEN,TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

VALUES	LAST YEAR	THIS YEAR
RMV LAND	999,999.00	999,999.00
RMV STRUCT	0.00	0.00
RMV TOTAL	999,999.00	999,999.00
SAV TOTAL	0.00	0.00
AVR TOTAL	469,829.00	483,924.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**469,829.00**	**483,924.00**

LAST YEARS TAX	**7,759.23**
Corvallis SD 509J	2,158.98
LinnBenton CC	242.88
LinnBentonLincoln ESD	147.55
Education Totals	**2,549.41**
Benton County	1,066.28
Benton County Library	191.00
Benton County Soil & Water Dist	24.20
City of Corvallis	2,471.25
Local Option 2004 Benton County	140.34
General Government Totals	**3,893.07**
Bonds City of Corvallis	262.19
Bonds Corvallis SD 2003	767.31
Bonds Corvallis SD 509J	92.19
Bonds LinnBenton CC	88.99
Bonds - Other Totals	**1,210.68**

TAX COLLECTOR	(541)766-6808
ASSESSOR	(541)766-6855

WEB SITE: http://www.co.benton.or.us/assess/

If a mortgage company pays your taxes, this statement is for your records only.

2005 - 2006 TAXES	7,653.16
TOTAL TAXES OUTSTANDING	7,653.16
TOTAL TAX (After Discount)	7,423.57

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
7,423.57	5,000.07	2,551.06

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ACCOUNT NUMBER: 153407
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2005	7,423.57
or 2/3 Payment Enclosed.....Due:	11/15/2005	5,000.07
or 1/3 Payment Enclosed.....Due:	11/15/2005	2,551.06

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

☐ Mailing address change on back

Enter Payment Amount
$

SCHABERG J STEPHEN,TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

07/01/2006 to 06/30/2007 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153407
SITUS ADDRESS: UNASSIGNED CORVALLIS, OR

PROP CLASS:	100	
PROP TCA:	0901	
PROP MAP:	12510C001000	ACRES: 25.88

SCHABERG J STEPHEN,TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

VALUES	LAST YEAR	THIS YEAR
RMV LAND	999,999.00	999,999.00
RMV STRUCT	0.00	0.00
RMV TOTAL	999,999.00	999,999.00
SAV TOTAL	0.00	0.00
AVR TOTAL	483,924.00	498,442.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**483,924.00**	**498,442.00**

LAST YEARS TAX	**7,653.16**
Corvallis SD 509J	2,223.75
LinnBenton CC	250.17
LinnBentonLincoln ESD	151.97
Education Totals	**2,625.89**
Benton County	1,098.62
Benton County Library	196.74
Benton County Soil & Water Dist	24.92
City of Corvallis	2,545.39
Local Option 2004 Benton County	129.59
General Government Totals	**3,995.26**
Bonds City of Corvallis	266.12
Bonds Corvallis SD 2003	758.23
Bonds Corvallis SD 509J	90.62
Bonds LinnBenton CC	89.02
Bonds - Other Totals	**1,203.99**

TAX COLLECTOR	(541)766-6808
ASSESSOR	(541)766-6855
WEB SITE: http://www.co.benton.or.us/assess/	

If a mortgage company pays your taxes, this statement is for your records only.

2006 - 2007 TAXES	7,825.14
TOTAL TAXES OUTSTANDING	7,825.14
TOTAL TAX (After Discount)	7,590.39

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
7,590.39	5,112.42	2,608.38

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ACCOUNT NUMBER: 153407
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2006	7,590.39
or 2/3 Payment Enclosed.....Due:	11/15/2006	5,112.42
or 1/3 Payment Enclosed.....Due:	11/15/2006	2,608.38

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

☐ Mailing address change on back

Enter Payment Amount
$

SCHABERG J STEPHEN,TR
2535 SW WHITESIDE DR
CORVALLIS, OR 97333

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

07/01/2007 to 06/30/2008 BENTON COUNTY PROPERTY TAX STATEMENT
110 SW 4TH STREET CORVALLIS, OR 97333

ACCOUNT NUMBER: 153407
SITUS ADDRESS: "UNASSIGNED CORVALLIS, OR"

PROP CLASS:	100	
PROP TCA:	0901	
PROP MAP:	12510C001000	ACRES: 25.88

"SCHABERG J STEPHEN.TR"
4751 LONG RIDGE PL
MARANA, AZ 85653

VALUES	LAST YEAR	THIS YEAR
RMV LAND	999,999.00	2,029,199.00
RMV STRUCT	0.00	0.00
RMV TOTAL	999,999.00	2,029,199.00
SAV TOTAL	0.00	0.00
AVR TOTAL	498,442.00	513,395.00
EXEMPTIONS	0.00	0.00
NET TAXABLE	**498,442.00**	**513,395.00**

LAST YEARS TAX	**7,825.14**
Corvallis SD 509J	2,290.47
Corvallis SD 509J Local Option	564.73
LinnBenton CC	257.67
LinnBentonLincoln ESD	156.53
Education Totals	**3,269.40**
Benton County	1,132.14
Benton County Library	202.64
Benton County Soil & Water Dist	25.67
City of Corvallis	2,621.75
Local Option 2004 Benton County	133.48
General Government Totals	**4,115.68**
Bonds City of Corvallis	264.50
Bonds Corvallis SD 2003	775.28
Bonds Corvallis SD 509J	91.33
Bonds LinnBenton CC	88.00
Bonds - Other Totals	**1,219.11**

TAX COLLECTOR	(541)766-6808
ASSESSOR	(541)766-6855
WEB SITE: http://www.co.benton.or.us/assess/	

If a mortgage company pays your taxes, this statement is for your records only.

2007 - 2008 TAXES	8,604.19
TOTAL TAXES OUTSTANDING	8,604.19
TOTAL TAX (After Discount)	8,346.06

Full Payment with 3% Discount	2/3 Payment with 2% Discount	1/3 Payment with No Discount
8,346.06	5,621.41	2,868.07

Cut Here **PLEASE RETURN THIS PORTION WITH YOUR PAYMENT** Cut Here

ACCOUNT NUMBER: 153407
INCLUDES DELINQUENT TAXES OWING, IF ANY

Full Payment Enclosed.....Due:	11/15/2007	8,346.06
or 2/3 Payment Enclosed.....Due:	11/15/2007	5,621.41
or 1/3 Payment Enclosed.....Due:	11/15/2007	2,868.07

DISCOUNT IS LOST & INTEREST APPLIES AFTER DUE DATE

☐ Mailing address change on back

Enter Payment Amount
$

"SCHABERG J STEPHEN.TR"
4751 LONG RIDGE PL
MARANA, AZ 85653

Please make checks payable to:
Benton County Tax Collector
110 SW 4th Street
Corvallis, OR 97333

CORVALLIS
ENHANCING COMMUNITY LIVABILITY

Community Development
Planning Division
501 SW Madison Avenue
P.O. Box 1083
Corvallis, OR 97339-1083
(541) 766-6908
FAX (541) 754-1792

March 15, 2007

David Dodson
Willamette Valley Planning
350 NW Polk Avenue
Corvallis, Oregon 97330

Mr. Dodson:

Thank you for submitting a Conceptual and Detailed Development Plan and Tentative Subdivision Plat application on behalf of Stephen Schaberg for Brooklane Heights. The submitted materials provide much of the information needed for staff to complete review of the application; however, at this time the application is considered incomplete. This letter outlines items necessary to complete the application. Many of the items are the same or similar to those presented in the completeness review letter to you dated November 9, 2006.

Staff will review revised application materials to determine completeness. If staff finds the application incomplete at that point, a third letter outlining missing or incomplete items will be mailed to you. Staff is willing to meet with the development team at that time to discuss any outstanding issues.

Please note that the application was received by Planning Division staff on October 13, 2006. Per state law, applications that are not complete within 180 days of receipt are deemed null and void unless the applicant states in writing that no further application materials will be submitted, in which case the application will be considered complete. April 11, 2007, is 180 days from the date the application was submitted.

This application is tentatively scheduled to he heard by the Planning Commission on May 16, 2007. To maintain this time line, and provide an opportunity for final application revisions, please provide the materials and information requested below by March 30, 2007. If additional time is needed, it will be necessary to provide an extension request letter, however, as discussed above no revisions can be accepted later than April 11, 2007.

"A Community that Honors Diversity"

Geotechnical / Hydrologic Report

1. A report analyzing the feasibility of the proposed development relative to geology and hydrology was requested in the completeness review letter dated November 9, 2006. This report has not yet been received. Once submitted, staff will review the report and evaluate its findings relative to the current proposal or other submitted revisions. Evaluation of this report may lead staff to request additional information or modifications to the application.

2. City GIS maps and Benton County soil maps indicate that the east portion of the site contains soils with a Moderate to High shrink/swell potential and high vulnerability to erosion. These areas are identified in the application as having slopes of 15% to 35% and one area is identified as a high risk landslide area. Approximately 14 lots, two storm water detention ponds, and a street are proposed for these areas. Given the above information, these soils and slopes present challenges to development. These challenges and methods for addressing the challenges should be explained in the geotech report and the viability of development in these areas should be addressed.

Archeological Survey

3. As requested, the known archeological site was identified on the site plans. The revised application has been forwarded to SHPO for further review regarding the proposal to grade and build on the identified site.

Grading and Excavation

Comprehensive Plan Policy 4.6.1 - 4.6.12 addresses Hillside development. The current application addresses some of these policies with an emphasis on tree preservation. These policies also focus on tree covered hillside appearance and minimization of soil disturbance through development that is designed to "fit topography, soil, geology, and hydrology of hillsides". At this point planning staff cannot make positive findings regarding the proposal's compliance with Comprehensive Plan policies that require minimization of disturbances to hillside soil, topography, geology, and hydrology. This is primarily because all lots are proposed to be mass graded while it is possible to grade on a lot by lot basis and minimize impacts to the hillside, and because of disturbances to the natural drainageway.

In consideration of all applicable Comprehensive Plan policies and LDC standards it may be appropriate to mass grade certain areas or lots, while individually grading other lots. If this type of scenario is proposed, the application narrative and graphics should clearly indicate the grading method for each lot and should explain how applicable policies and standards are balanced and the overall goal of minimizing impacts to hillsides is achieved. With this in mind, please provide the following information in the revised application.

4. The grading and excavation plan should include information per LDC Section 2.4.30.1.a.4.k.

5. Cuts and fills of 8 feet have been accepted as one way to comply with hillside development Comprehensive Plan policies. Grading and excavation plans should comply with the accepted 8-ft cut and 8-ft fill standard, or an alternative that similarly limits cuts and fills should be proposed. The application drawings and narrative should explain where and why it is not possible to comply with the standard, if it is proposed to vary from the "8 and 8" practice. The application should also explain how the proposed solution best creates a balance of applicable Comprehensive Plan policies and LDC standards.

6. The preliminary geotech report states that "as an alternative to cut/fill construction, basement construction and/or stepped foundations may be feasible. Where possible, structures and pavements should be located to avoid the steeply sloped areas." The current applicant preferred proposal is for mass grading, and does not incorporate basement construction or stepped foundations as a method to minimize cuts and fill as suggested by the draft geotech report. Revised application materials should identify where alternative methods to benching and trenching will occur. The narrative should explain why the chosen method of land preparation is proposed and how it complies with applicable Comprehensive Plan policies and LDC standards.

7. Please provide the following additional cross sections:
   a. Roughly northeast to southwest through detention ponds and Badger Place;
   b. The Brooklane drive alley through lots 34, 37 14, and 12, including streets.
   c. The trail connecting Badger Place with Wolverine Drive.

8. Private sewer pumps (grinders) may be used as necessary in the Brooklane Heights development to achieve Comprehensive Plan policies to protect trees and minimize cuts and fills. The grading and excavation and utility plans should reflect the possibility of using private pumps, and the site should be designed in a manner that protects trees on lots, and minimizes cuts and fills.

Drainage / Hydrology

9. The application should include reports, stamped by an engineer, that address hydrology, construction of detention ponds, risks of locating ponds in drainageways on steep slopes with minimal soil depth.

10. An area drain was incorporated in the northeast portion of the site. Please explain how this feature will function and what impacts its installation and operation will have to surrounding significant trees.

Tree Protection

11. Based on the submitted drawings it appears that approximately 45 trees have been identified for removal, while the application states that 29 are proposed to be removed. Please address this discrepancy and update drawings per the arborist's report.

12. Revise grading and tree preservation plan per arborist recommendations.
    a. Provide further explanation regarding need to remove trees 18-20 to protect grove to the east.
    b. Revise legend to more clearly distinguish tree protective zones and tree protective fencing.
    c. Report header should refer to Brooklane Heights rather than Cascade Crest.
    d. The recommendation for tree number one refers to Eagle Street. Please correct.

13. It appears that a number of trees on individual lots slated for removal could be protected as a result of the suggested revisions to the grading plan (e.g. Pine and maple on lots 4 and 5, Oak on lot 13, Oaks on lots 33, 34, Oaks on lot 1). Please address the ability to protect these trees in the revised application materials. It also appears that the three significant oak trees located on lot 32 could be preserved if the street were narrowed in this location. Please pursue this alternative or explain why it is not viable.

14. It appears that some trees identified for preservation, such as those near detention ponds, may be negatively impacted. Additionally, impacts to trees caused by increased or non-seasonal water run-off and trail and pond construction should be addressed, as well as methods for minimizing or mitigating impacts.

Street Improvements & Access

15. Approval of the Oakmont Addition proposal will be contingent on approval of the north street stub-out to the Oakmont Addition site. Construction of this street stub-out may be proposed as a phase of the Brooklane Heights development plan.

16. The entire site should be represented in the tentative subdivision plat, including the north street stub-out.

17. The proposed trail is narrower than the minimum eight feet required per LDC Section 4.0.50.c. As noted in the application, you may vary from this standard but it is important to explain why the variation is needed and expected off-setting benefits of the variation.

18. The 42 lot proposal is dependent on achieving secondary access via the proposed Oakmont Addition subdivision. If Oakmont Addition is not approved, or secondary access to city street standards is not possible, development on Brooklane Heights will be limited to a maximum of 18 lots that could be served by a single street that may not exceed 600-feet. If the Brooklane Heights development is expected to occur independent of approval for Oakmont Addition the application should propose a plan that complies with LDC standards for development absent secondary access through Oakmont.

Fire Department Concerns

19. Per OFC Section 508 fire hydrants must be in-service prior to construction above the level of the buildings' foundations. Minimum flow of 1,000 GPM @ not less than 20 psi residual will be required.

20. The edges of street segments that are 20 feet wide will be required to be painted / signed to prevent illegal parking on either side - within the reduced width section. Ref: OFC Section 503.3

Comprehensive Plan Policies and Application Requirements

21. The following are Comprehensive Plan Policies staff have identified in their preliminary review that should be addressed or addressed in more detail. This list is not an exhaustive list of applicable Comprehensive Plan Policies, and all relevant policies should be addressed in the application narrative, and reflected in drawings and site plans as appropriate.

    a. 3.2.1 (Desired Land Use Pattern)
    b. 4.10.3, 4.10.8 & 4.11.12 (Drainageways and Wetlands)
    c. 9.2.4, 9.2.5, 9.5.13 (Neighborhood Oriented Development and Residential Land Development)
    d. 11.7.4 (Transit Stops)

Land Development Code section 2.5.50.a.3) requires the following:

> *Typical elevations of buildings and structures (which may be submitted on additional sheets) sufficient to indicate the architectural intent and character of the proposed development;*

The applicant is not proposing to construct homes as part of this development. Therefore, it is not necessary to provide building elevations. However, the application should provide a design menu that will guide future development. This menu should be consistent with Comprehensive Plan policy 9.2.5 and other development standards. In previous conversations you suggested applying the Pedestrian Oriented Design Standards in the 2006 LDC as a way to demonstrate architectural intent and

compliance with Policy 9.2.5. Proposing to apply these standards would satisfy application requirement 2.5.50.a.3, and would help demonstrate compliance with Policy 9.2.5.

22. Comprehensive Plan Policy 9.5.13 states:

> **9.5.13** New subdivisions and planned developments of more than 5 acres in low density districts shall incorporate two or more of the following elements in at least 10% of the total acreage:
>
> A. Zero lot line or attached dwellings (where allowed);
>
> B. Minimum allowed lot area; or
>
> C. Dwelling size less than 1,200 square feet.

As noted in the application, the current proposal does not comply with Policy 9.5.13, and should be revised to comply with it. The 10% of the total acreage referred to in Policy 9.5.13 may be calculated based on the areas proposed for development (the open space tracts may be subtracted from the site total). Zero lot line or attached dwellings are not outright permitted structures in the RS-3.5 zone, therefore, the 10% area of the site should be designed to incorporate minimum allowed lot sizes and dwelling units less than 1,200 square feet.

23. The application should identify an area for a future transit stop. Please contact Bruce Moser at 766-1779 to discuss this in more detail.

Plan Certification

24. The following items should be prepared and stamped by a certified professional in the relevant field:
    a. Tentative Subdivision Plat - LDC Section 2.4.30.01.a.4)a, ORS 672 (The referenced LDC section requires the name and address of the registered land surveyor who prepared the plat)
    b. Grading Plans - ORS 672
    c. Utility Plans - ORS 672

Public Works Memo

25. The November 9, 2006, Public Works memo regarding application completeness for the Brooklane Heights proposal is attached. Requested revisions that have not yet been submitted are highlighted. Please provide the requested information and materials in the revised application.

Please contact me if you have any questions with regarding the requested application revisions or application review process. I can be reached at (541) 766-6908.

Respectfully,

Robert Richardson

Bob Richardson,
Associate Planner

encl.: Memo from Ted Reese, Public Works

cc: Fred Towne, Planning Division Manager
Kevin Young, Senior Planner
Keith Turner, Engineering Supervisor
Ted Reese, Public Works Engineer

MEMORANDUM

TO: Bob Richardson, Community Development Planning

FROM: Ted Reese, Public Works Engineering

DATE: November 9, 2006

SUBJECT: Brooklane Heights Subdivision(PLD06-00018, SUB06-00006)

Development Engineering staff has completed a review of the above-referenced application. Our comments and concerns are noted below.

TRAFFIC/CIRCULATION/BICYCLE/PEDESTRIAN/TRANSIT

1. B-1 Place cul-de-sac is stated to be 630 ft long. The maximum length for a cul-de-sac is 600 ft long. It is not clear why 30 ft additional length is going to benefit the development due to the topography and significant trees. The applicant should either shorten the cul-de-sac to 600 ft or less, or make a compelling case to exceed the maximum length.

2. The maximum allowable grade for local streets is 15%. The applicant states a maximum grade of 15% but scaling of the grading plans indicates a maximum grade of 19%. The applicant should verify that the existing configuration can be built to a 15% grade or less and make revisions to the grading plan accordingly.

3. Vision clearance should be checked in accordance with the City of Corvallis Off-Street Parking and Access Standards for all intersections. This is especially important with the intersection of A-1 Drive and Brooklane Dr due to significant grade changes.

4. The applicant states the development of Brooklane Heights will generate 42 additional trips during the peak PM hour. The City typically defines traffic impact as 30 peak hour trips or more to one single intersection. Two other developments are occurring concurrent with Brooklane Heights. Oakmont Addition and Cascade Crest, both with frontage on Brooklane Dr, are applying for development and should be considered in addition to Brooklane Heights. The applicant should combine the peak PM trips generated for the three subdivisions and produce a Traffic Impact Analysis for all developments.

5. Brooklane Dr has been the focus of traffic and pedestrian concerns for many years. It is not improved to City structural standards, is relatively narrow and winding, and sees a relatively high degree of bicycle and pedestrian traffic. The City is in the final stages of adding bike lanes and installing a new wearing surface between Chintimini Ave and Hwy 20/34. For the purposes of this project and other construction projects in the area, the City expects to apply a 5 ton weight limit for all construction vehicle access on Brooklane Dr. The applicant shall address how they will minimize impacts to the surrounding neighborhoods. Such measures may include but are not limited to a balanced cut and fill on the project site, distributing trips between different haul routes, and minimizing the

hours in haul and out haul of equipment and materials may occur.

6. The applicant proposes to construct a new sidewalk along Agate Ave. A sidewalk already exists in this location, please clarify.

7. A pedestrian crossing is desirable to the east of the intersection of A1-Drive and Brooklane Dr due to limited sight distance. The applicant should build sidewalk from A-1 Drive to the north west corner of the intersection of Brooklane Dr and the private drive outlet for Brooklane Park Estates. The applicant should verify if the existing right-of-way is suitable or if an easement would be required to build the above off site sidewalk. ADA curb cuts on both sides of Brooklane Dr at the above intersection should be provided.

8. With 3 concurrent proposed developments fronting Brooklane Dr it is desirable to complete the urban roadway infrastructure along Brooklane Dr between Chintimini Ave and Agate Ave. It is up to the three proposed developments to complete what has not already been done. Each development will complete their frontage but a gap will be created north of Oakmont Addition and south of Cascade Crest. Please address how the combined developments will work together to complete the street improvements pedestrian connection.

9. The professional credentials associated with the preparers of the tentative subdivision plat, grading plans and composite utility plans are unclear. The practice of engineering and land surveying without registration is prohibited. Please refer to ORS 672 for official requirements. The LDC requires that tentative subdivision plats be prepared by a registered land surveyor.

PUBLIC FACILITIES AND SERVICES

1. The proposed 10 ft easement for the multi-use path and water line between B-1 Place and A-1 Drive is not to City standard. The applicant should provide a 15 ft easement for a single utility or a 20 ft easement if two utilities are installed as required by Section 4.0.110.a.2. The applicant should also design the path to accommodate all-weather maintenance of the water line or any other utilities installed in the easement.

2. The applicant stated that no waterlines exist adjacent to the site. The applicant proposes to provide water by connecting to the 2nd level waterline proposed with the Oakmont Subdivision. The proposed waterline layout does not service Lot 1. Please address the lack of water supply to Lot 1.

3. The applicant has proposed a preferred grading plan. In this plan the maximum fill is 24 ft and the maximum cut is 12 ft. This is beyond the intent of the PD that overlays this parcel. The alternative plan with 16 ft of fill and 5 ft of cut is better but still may not adhere to the intent as outlined in Section 2.5.20 of the LDC. The alternative plan also places easements between and the back of lots to handle storm and sewer drainage. The City would prefer to minimize the cut and fill generated by the development of this land but also proposes alternate means to handle the sanitary sewer such as the installation and use of grinder pumps to push the sanitary sewage to the sewers under the street.

4. As per City LDC code, franchise utilities must be included as part of the application, and must be installed along with public utilities, prior to final plat. In addition, the applicant will need to provide confirmation that the franchise utilities have reviewed the Detailed Development Plans prior to review by the City.

DRAINAGE

1. The applicant states there are no water courses or drainageways that traverse the property. However the topography indicate that drainageways may be present. According to the Preliminary Geotechnical Investigation dated January 25, 2006, flowing water, wet conditions, and/or standing water was observed in the east drainage at various locations on December 6th. According to the definitions provided in the LDC a Drainageway is a natural or artificial watercourse, including adjacent riparian vegetation, that transmits natural stream or storm water runoff from a higher elevation to a lower elevation. With the observation of flowing water in a drainage this would then require the applicant to develop in accordance with the Corvallis Drainage Master Plan and Chapter 4.5 of the LDC. The application should contain but is not limited to information as outlined in 4.5.50.01.b

2. With the presence of drainageways on the site, dedications or easements will also be required according to 4.5.80. Access will also need to be provided for City maintenance activities.

3. The applicant states water quality will be achieved by discharging storm water into the existing natural drainage ravines. The applicant should specify how the existing drainage ravines meet the current King County Surface Water Design manuals criteria for this application.

4. The applicant is proposing to direct storm water drainage into the drainage system located in Brooklane Park Estates. Please confirm the system is public, or acquire drainage easements from Brooklane Park Estates, or direct the water to the public storm drainage system located in Brooklane Dr.

5. The applicant is proposing to locate water detention facilities in the existing drainageways that are listed by the City as high landslide risks. A detailed geotechnical report should be provided outlining this specific usage as acceptable.

6. The proposed water detention and water quality facilities are located in probable drainageways. The application should address conformance with with LDC 4.5.110, Comprehensive Plan policies 4.10.4, 4.10.8, and 4.10.10 and Stormwater Master Plan policy QN-3.

7. The grading and utility plans are not clear in reference to the proposed storm drain line located in A-1 Drive between the two developments, Brooklane Heights and Oakmont Addition. The contour lines would indicate water should be flowing to the east from Brooklane Heights into Oakmont Addition but the utility plans show an outlet to the system in Brooklane heights approximately 270 ft west of the storm line crossing from one development to the other. In either circumstance the pre-development flow rates need to be maintained before the

water is discharged from the Brooklane heights development. Additional water detention facilities may be required. Please clarify.

8. Summer irrigation may damage the stands of White Oak located throughout the development. Measures shall be taken to keep summer irrigation water away from the existing Oak trees

If you have any questions or need to discuss this information in greater detail, please call me at 766-6729 ext 5198.

Conservation Biology of Freshwater Turtles and Tortoises:
A Compilation Project of the IUCN/SSC Tortoise and Freshwater Turtle Specialist Group
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Actinemys marmorata (Baird and Girard 1852) – Western Pond Turtle, Pacific Pond Turtle

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Summary. – *Actinemys marmorata* (Family Emydidae) occurs in the Pacific States of North America from Baja California Norte north through Washington and, possibly, into southernmost British Columbia, Canada. Recent genetic studies indicate the presence of four groups or clades within the species, although historically there were two recognized subspecies. The species appears to be declining in abundance in the northernmost and southernmost portion of its range, but not in the core of its range from central California to southern Oregon. The primary threats are loss and alteration of both aquatic and terrestrial habitats. These losses fragment remaining populations and, perhaps, magnify the effects of introduced species through predation, competition, and epidemic disease(s). Historically, *A. marmorata* was collected for the food and pet trades. Most states now protect the species and, in Washington, it is listed as Endangered. Research is ongoing on many aspects of the species' ecology, but not all of the studies are published. Greater effort is needed to protect and manage aquatic habitats as well as nesting and overwintering sites in adjacent uplands.

Distribution. – Canada (?); Mexico; USA. Pacific States of North America from Baja California Norte, Mexico, north through Washington and, possibly, into southernmost British Columbia, Canada.

Synonymy. – *Emys marmorata* Baird and Girard 1852; *Actinemys marmorata*; *Clemmys marmorata*; *Geoclemmys marmorata*; *Chelopus marmoratus*; *Melanemys marmorata*; *Clemmys marmorata marmorata*; *Actinemys marmorata marmorata*; *Emys marmorata marmorata*; *Emys nigra* Hallowell 1854; *Clemmys wosnessenskyi* Strauch 1862; *Geoclemmys wosnessenskyi*; *Clemmys hesperia* Hay 1903; *Clemmys marmorata pallida* Seeliger 1945; *Actinemys marmorata pallida*; *Emys marmorata pallida*.

Subspecies. – None currently recognized, previously two: *A. m. marmorata* (Northern Pacific Pond Turtle) and *A. m. pallida* (Southern Pacific Pond Turtle). Genetic data suggest four phylogenetic clades.

Status. – IUCN 2007 Red List: Vulnerable (VU A1cd) (assessed 1996, needs updating); CITES: Not Listed; US ESA: Not Listed.

Figure 1. Adult female *Actinemys marmorata* from San Mateo Creek, Camp Pendleton, San Diego Co., California, USA. Photo by Dan C. Holland.

Figure 2. Adult male *Actinemys marmorata* from Fresno, San Joaquin Valley, California, USA. Photo by David J. Germano.

Taxonomy. — The phylogenetic relationships of the western pond turtle, *Actinemys marmorata*, are in a state of flux. Recent evidence suggests that the species is distinct from the other three species of the former group *Clemmys* in eastern North America (Bickham et al. 1996; Feldman and Parham 2001; Holman and Fritz 2001). Feldman and Parham (2002) and Parham and Feldman (2002) presented evidence that the western pond turtle should be placed in the genus *Emys*, along with the European pond turtle (*Emys orbicularis*) and the Blanding's turtle (*Emys* [= *Emydoidea*] *blandingii*), and this view has been adopted by others (Spinks et al. 2003; Spinks and Shaffer 2005). In contrast, Holman and Fritz (2001) and Stephens and Wiens (2003) believed that the western pond turtle is not closely related to any extant species and should be placed in its own genus, *Actinemys*. The Turtle Taxonomy Working Group (2007) recorded it as "*Emys* or *Actinemys marmorata* Baird and Girard 1852 [formerly in *Clemmys*]."

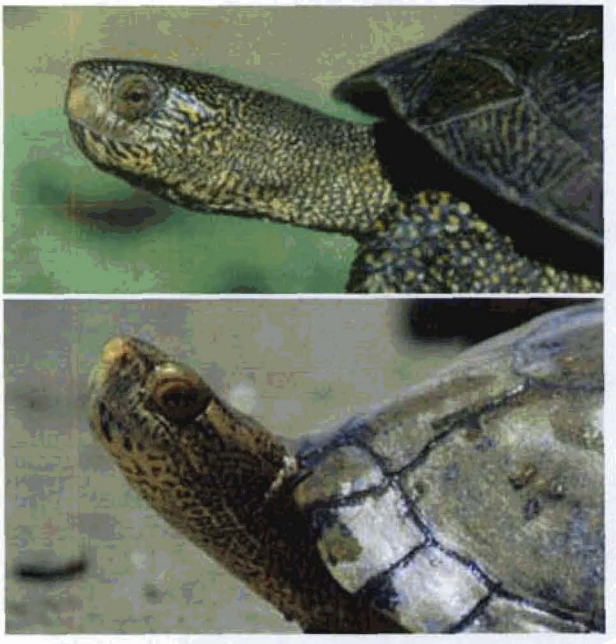

Figure 3. Top: Adult female *Actinemys marmorata* from Whiskeytown National Recreation Area, Shasta Co., California, USA. Photo by R. Bruce Bury. **Bottom:** Adult female *A. marmorata* from Fresno, San Joaquin Valley, California, USA. Photo by David J. Germano.

The genus *Actinemys* is used in both of the most recent standarized names of North American herpetofauna (Collins and Taggart 2002; Iverson et al. 2008) and globally (Fritz and Havas 2007), which we follow here.

The first specimens of *A. marmorata* were collected in 1841 in the vicinity of Puget Sound (Washington) and described by Baird and Girard (1852) as *Emys marmorata*. *Emys nigra* was described by Hallowell (1854) from "Posa (Poso) Creek, Lower California," which is in Kern County in the Central Valley of California (Bury, 1970), but this taxon has not been recognized recently. Seeliger (1945) described two subspecies: the northern Pacific pond turtle (*Clemmys* [= *Actinemys*] *marmorata marmorata*) and the southern Pacific pond turtle (*Clemmys* [= *Actinemys*] *m. pallida*). The northern subspecies has a relatively large inguinal scute compared to a smaller or no inguinal scute in the southern subspecies. In *A. m. marmorata*, the throat is light and contrasts with the darker sides of the head and neck; whereas *A. m. pallida* has a more uniform coloration of the throat and neck, often with dark vermiculations (Fig. 1). A broad range of intergradation occurs from the American River south through the San Joaquin Valley, California (Seeliger 1945; Stebbins 2003).

Based on morphology, Holland (1992) found three groups in the taxon: a Columbia River form; a northern form occurring from Puget Sound to central California; and a southern form along the central coast of California south to Baja California. However, there are no published descriptions of these taxa. Using DNA fingerprinting, Gray (1995) reported low levels of genetic variation within and among several populations throughout the range, although significant differences were present between northern and southern populations.

Recently, Spinks and Shaffer (2005) reported genetic differences indicating four un-named clades within *A. marmorata*, with the following distributions: 1) from the

Traverse Mountains of southern California south into Baja California Norte; 2) the San Joaquan Valley and adjacent foothills; 3) Ventura and Santa Barabara counties in central coastal California; and 4) all the remaining populations to the north. These data suggest considerable genetic fragmentation within the species, especially in the southern half of the range. The new groupings do not follow the pattern of the earlier described subspecies, and we suggest waiting for additional data before these new groups are recognized as taxonomic units.

Description. — Male *A. marmorata* can be distinguished from females usually by a size of 120 mm carapace length (in some populations by 110 mm), when individuals are considered adults. Generally, adults range in size from 140–190 mm CL (Bury 1995; Lubcke and Wilson 2007). Hatchlings are 20–30 mm CL (Storer 1930; Feldman 1982; Lovich and Meyer 2002). Shell metrics appear to be related to geographic location, water temperatures and, perhaps, diet (Lubcke and Wilson 2007). The shell is low and broad, generally widest posterior to the middle (across the 8th marginal). Turtles in cool flowing waters, such as streams, may be more elongate than those living in standing waters, such as ponds and lakes (Lubcke and Wilson 2007). The carapace in adults is smooth and lacks a keel or serrations. Vertebral scutes are broader than long, and the first touches four marginals and the nuchal (Carr 1952; Ernst et al. 1994). The hind foot is webbed to the base of the claws (Ernst et al. 1994). The carapace coloration is usually dark brown or dull yellow-olive, with or without darker streaks or vermiculations. Many males in the Central Valley of California develop distinct yellow coloring on all or part of each marginal and costal scutes of the carapace (Fig. 2). The plastron is cream or light-yellow in color, sometimes with dark areas on parts of the scutes.

Figure 4. Juvenile *Actinemys marmorata* showing growth rings; from Klamath Lake region, southern Oregon, USA. Photo by R. Bruce Bury.

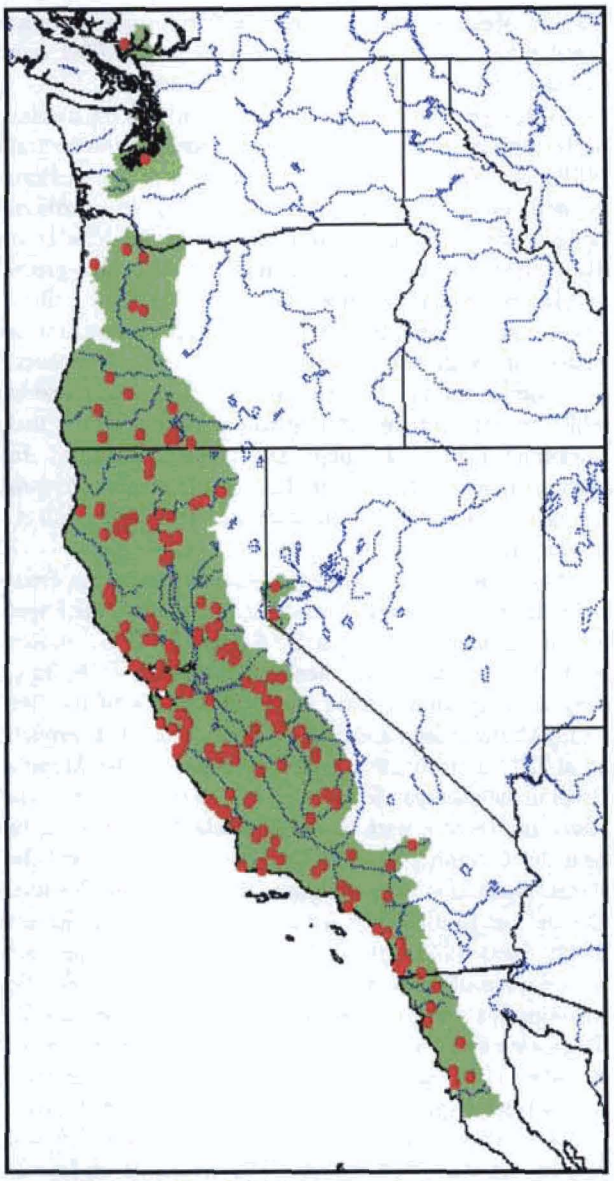

Figure 5. Distribution of *Actinemys marmorata* in western North America. Red points = museum and literature occurrence records based on Iverson (1992) plus more recent and authors' data; green shading = projected distribution based on GIS-defined hydrologic unit compartments (HUCs) constructed around verified localities and then adding HUCs that connect known point localities in the same watershed or physiographic region, and similar habitats and elevations as verified HUCs (Buhlmann et al., unpubl. data), and adjusted based on authors' data.

Males differ from females in size, shell, and other features. Males have a concave plastron in the femoral region, while the plastron in females tends to be flat. When the tail is extended, the cloaca is usually posterior to the edge of the carapace in males, but usually at or anterior to the margin in females. In males, the tail is thicker, the head slightly larger, and the snout more angular than in females. Males usually have light-colored throats that become lighter with age (Fig. 2). Most females (Fig. 3) have a brown or yellow-brown throat with moderate to extensive flecking, essentially keeping the pattern and coloration of juveniles

(Fig. 4). Males average a larger size than females in most populations, and reach a larger maximum size (241 mm CL) than females (192 mm CL; Lubcke 2006).

Although *A. marmorata* is the only native freshwater turtle from northern Baja California Norte to the central Willamette Valley in Oregon, it occurs with the western painted turtle (*Chrysemys picta bellii*) in northern Oregon and western Washington. The painted turtle is distinctively marked with a reddish plastron, olive-green or blackish-green carapace, and bright red and yellow stripes on the neck and legs. *Actinemys marmorata* is easily differentiated from the painted turtle; however, field identification of turtles is becoming complicated with the introduction of non-native turtles (Bury and Luckenbach 1977; Jennings 1987; Bury, in press). In particular, melanistic red-eared sliders (*Trachemys scripta elegans*) viewed from a distance may resemble adult *A. marmorata*.

Distribution. — *Actinemys marmorata* occurs from northern Baja California Norte, Mexico, north to the Puget Sound region of Washington, USA (Bury 1970; Nussbaum et al. 1983; Iverson 1986; Stebbins 2003) (Fig. 5). In Baja, they are only known from the Pacific slopes of the San Pedro Martir (Smith and Smith 1979; Welsh 1988; Lovich et al. 2007). Isolated populations occur in the Mojave River in the western Mojave Desert, California; the Carson River in Nevada; east of the Cascade Mountains in or near the Columbia River in Oregon-Washington; and the Puget Sound area in Washington. Records in the Truckee, Carson, and Humboldt rivers in western Nevada (LaRivers 1942; Banta 1963) are likely turtles originally imported as a source of human food (Cary 1889). Their genetic relationships are under study (Spinks and Shaffer 2005). There are other outlying locality reports that may represent introduced individuals or populations, or are mis-identified or mis-labeled specimens: one male collected along Canyon Creek, Grant County, Oregon (Black and Storm 1970); one juvenile taken in 1894 from along the Snake River, Jerome County, Idaho (Slater 1962); and two turtles collected in coastal British Columbia, Canada (Gregory and Campbell 1984; Matsuda et al. 2006).

Habitat and Ecology. — *Actinemys marmorata* occurs in a variety of permanent and intermittent aquatic habitats, including rivers, streams, lakes, ponds, marshes, vernal pools, and human-constructed environments such as ponds associated with waste-water, stock, and logging operations (Storer 1930; Germano and Bury 2001; Buskirk 2002). Prior to human settlement, there were few natural ponds or lakes within the range of the species, but some notable exceptions include the Klamath Lakes in Oregon and California, Clear Lake in northern California, the Tulare-Buena Vista-Kern Lake complex in the southern San Joaquin Valley of California, and back-dune ponds in coastal sand-dune complexes in central California. Streams, rivers, and artificial small ponds are the most common habitats for this species. Because much of the range of *A. marmorata* has a Mediterranean climate (mild, wet winters; dry, hot summers), many natural watercourses and ponds are intermittent or exhibit greatly reduced flows in summer. Although considered an aquatic form, this turtle may spend considerable time on land every year. Based on radio-tracking studies, some turtles occur on land up to seven months out of each year (Reese and Welsh 1997; Rathbun et al. 2002). Turtles may aestivate in upland areas, but physiological studies are needed to confirm this. Turtles may also travel across terrestrial habitats at distances in excess of 1 km from water.

Habitats with abundant basking sites, underwater refugia, and standing or slow-moving waters are preferred conditions for this species. Along a stream in northern California, there was a high correlation between turtle abundance and the number of available basking sites such as logs or boulders (Bury 1972). Turtles in streams often take refuge in plunge pools, perhaps because these pools provide deep water for escape and lack swift currents. Turtles aggregate in these microhabitats at densities often several times that observed in swifter moving sections of creeks. In rivers, the species is most abundant in slower waters (e.g., pools) that are deep and have basking sites (Reese and Welsh 1998a). Emergent basking sites may include mats of vegetation, floating logs, or mud banks just above the water line. *Actinemys marmorata* in all habitats also engages in aquatic basking by moving into the warm thermal environment on top of submerged mats of vegetation or in shallow water. Basking sites can become crowded with turtles and, at these times, turtles may display frequent aggressive interactions (pushing, open-mouth gestures, biting) among all size and sex classes (Bury and Wolfheim 1979; Holland 1985a).

The species is omnivorous and a dietary generalist (Evenden 1948; Holland 1985a, b; Bury 1986; Goodman and Stewart 1998), feeding on the larvae of dragonflies, mayflies, stoneflies, caddisflies, midges, beetles, and other insects, as well as crayfish and other aquatic invertebrates (Holland 1985a; Bury 1986). Native fishes and anurans also are eaten, but these are minor items (< 10%) in the diet and may represent animals scavenged when dead or weakened (Holland 1985a; Bury 1986). Further, they may eat small to large amounts of vegetation, including filamentous green algae, tule and cattail roots, water lily pods, and alder catkins (Holland 1985a; Bury 1986). *Actinemys marmorata* can employ neustophagia (modified gape-and-suck feeding) to obtain small prey items (such as *Daphnia*) off the water surface or in the water column (Holland 1985b; Bury 1986).

Actinemys marmorata occupies relatively small home ranges in stream habitats and moves over large areas in other habitats (Bury 1979; Goodman and Stewart 2000). In a California stream during one summer, males had a home range that averaged 1 ha of water surface, while the home range size over the yearly activity period (mostly summer) of females averaged only 0.3 ha and juveniles 0.4 ha (Bury 1972, 1979). Movements up and down this stream (based on mark-recapture from one summer to the next) differed

between adult sexes (mean values): males, 367 m; females 149 m; juveniles 145 m. *Actinemys marmorata* occasionally moves long distances within or among watercourses; a few turtles moved over 1 km in a three-year period, and one marked turtle moved more than 1.5 km in a two-week period (Bury 1972).

In the wild, *A. marmorata* are usually wary and secretive. Most individuals rapidly depart basking sites when disturbed by either visual or auditory stimuli of people (e.g., waving an arm, shouting) at distances of over 100 m. When resting or hiding, turtles often seek underwater refugia such as under rocks, boulders, root masses, in undercut banks, or under other debris, where they wedge themselves into the most inaccessible crevices available. Turtles disturbed in shallow water often remain motionless, or attempt to hide in or under floating vegetation or occasionally dig into the substrate.

Individuals appear to grow more slowly in the northern half of their range than towards the south. In northern California, males display secondary sexual characteristics at 110–120 mm CL (Bury 1972) and are 5–9 yrs old, and females are reproductive at 7–10 yrs old (Germano and Bury 2001). Females in the southern part of the range may reproduce at 4–8 yrs of age (Germano and Rathbun, in press; D. Germano, unpubl. data).

Like most turtle species, ages of young *A. marmorata* can be determined using scute annuli (Bury and Germano 1998; Germano and Bury 1998) (Fig. 4). At warmer sites, scute annuli are discernible for 6–10 yrs; whereas, at colder sites annuli form up to 16 yrs (Bury and Germano 1998). However, mark-recapture is the only way to age older individuals. Adult turtles may reach an age of more than 40 yrs in the wild. For example, we have recaptured adult turtles 30 yrs after they were first marked (Bury 1972, unpubl. data). One turtle marked as an adult in central Oregon in 1958 was recaptured in 1993 (D. Holland, unpubl. report). However, the relative proportion of "old" turtles in most populations appears low (Germano and Bury 2001). Most *A. marmorata* populations that we have studied consist of equal numbers of males and females and a large proportion of adult turtles (> 120 mm CL). However, most of these populations have a large proportion of turtles < 12 yrs of age, often with a number of turtles in the 1–4 yr age group (Germano and Bury 2001; Germano and Rathbun, in press; D. Germano and B. Bury, unpubl. data).

Parasites include external leeches and internal nematodes (Ingles 1930; Thatcher 1954; Bury 1986), although external parasites are rare. Hundreds of nematodes may occur in the intestine of a single individual (Bury 1986). Colonial protozoans may attach to some turtles in warm waters (Germano 2000). Predators include many carnivorous mammals (Bury 1972; Manning 1990): river otter, mink, raccoon, gray fox, coyote, and black bear. Avian predators may include bald eagle, osprey, great blue heron, and gulls (Holland 1994). Introduced bullfrogs (*Lithobates [= Rana] catesbeiana*) and fishes such as largemouth bass (*Micropterus salmoides*) are predators (Moyle 1973; Nussbaum et al. 1983) on young turtles, but their effect on populations, if any, is unknown, and the two species often co-exist (Germano and Bury, pers. obs.).

The activity cycle of *A. marmorata* is largely determined by temperature (Bury 1972; Reese and Welsh 1998b; Rathbun et al. 2002). The species becomes most active when water temperatures are above 15°C. Turtles may be active year-round in warmer areas, but on a reduced level in the late fall and winter. Courtship and mating behavior has been observed from February–November (Holland 1988). Turtles have been observed emergent-basking on warm days in February, and have even been observed and radio-tracked moving under the ice in frozen montane lakes in central Oregon when water temperatures were approximately 1–2°C (D. Holland, unpubl. report). Turtle activity is usually observed throughout the day, but nocturnal activity may occur during the summer (S. Cross, pers. comm.).

During atmospheric basking, adult turtles elevate and maintain body temperatures near 32°C through a repertoire of thermoregulatory behaviors (Bury 1972, 1979; Holland 1985a). They expose the shell to direct sun (heating) and then may dunk the head, limbs, or entire body in water for cooling. Turtles often rotate the body axis, extend or retract the head and/or limbs, and change diurnal patterns (time of emergence). In northern California, most atmospheric basking occurs early in the day (0900–1100 hrs) when water temperatures are low; many turtles hide or rest during warmer parts of the day (Bury 1972). *Actinemys marmorata* also may raise their body temperature by burying themselves in warm sand (Rathbun et al. 2002) and under algal mats that are much warmer than the surrounding water (Bury and Germano, pers. obs.; G. Rathbun, pers. comm.).

Actinemys marmorata display a "mixed-mode" strategy when overwintering. Although some animals may be active on a year-round basis, other animals may enter overwintering sites in October–November and reemerge in March–April. In most slack-water habitats, many turtles appear to overwinter in the substrate or in undercut areas along the bank (D. Holland, unpubl. report). Turtles may aggregate in a small area; 43 animals were found in an area of approximately 1 m^2 in a pond in western Oregon (D. Holland, unpubl. report). Turtles from flowing-water habitats often leave the watercourse in late fall and move up to 480 m into upland habitats, where they burrow into leaf litter, usually under trees or shrubs (Rathbun et al. 1992; Reese and Welsh 1997). Further, they may emerge from these sites to bask on warm days, and may move among several overwintering sites over the course of several months. Turtles will move to upland sites when waters disappear in streams (G. Rathbun, pers. comm.).

The temperature of egg development affects sex determination in many species of chelonians (Vogt and Bull 1982), and *A. marmorata* eggs exposed to high temperatures (> 27°C) result in a higher proportion of female hatchlings (Ewert et al. 1994). Some females in this species display some nesting-area fidelity (Goodman

1997a; K. Beal, unpubl. data). Females are noted for long overland treks to deposit eggs, moving as much as 402 m away from water and up to 90 m in elevation above it (Storer 1930; Rathbun et al. 1992). However, most nests are within 50 m of the edge of water (Holland 1994).

Clutch size varies from 2–13 eggs, and mean clutch size is from 4.5 to 7.3 eggs, depending on location (Feldman 1982; Rathbun et al. 1992; Goodman 1997a; Pires 2001; Lovich and Meyer 2002; Germano and Rathbun, in press). Females can produce two clutches in one season (Goodman 1997b; Pires 2001; Lovich and Meyer 2002; Germano and Rathbun, in press), and some may produce three clutches in the Central Valley of California (Germano, unpubl. data). Eggs of *A. marmorata* are off-white in color, elliptical-oval in shape, and range from 32–42 mm long and 18–25 mm diameter. Mass of eggs range from 7–11 g. The egg shell is hard or shelled with a "bone-china" texture. The time from ovulation of eggs to deposition in a nest is unknown. Incubation time ranges from 73–132 days under artificial conditions (Lardie 1975; Feldman 1982) and from 94–122+ days in the wild (D. Holland, unpubl. report; Goodman 1997a). Hatchlings from northern and central California northward overwinter in the nest (Reese and Welsh 1997; Rathbun et al. 2002).

Populations can reach high densities. Bury (1979) reported densities of approximately 400 turtles/ha in a stream population. Some small ponds may have high densities of turtles equal to or exceeding this level (Holland 1994), but turtles tend to aggregate in shrinking bodies of water during late summer and droughts (Storer 1930; R. Bury, pers. obs.). The largest populations of *A. marmorata* occur in Mediterranean-climate areas where there are warm to hot summers, but the same conditions often result in scarce surface water due to increased evaporation rates and lack of precipitation in a relatively long dry season. In most areas, the turtle occurs in disjunct populations over large areas (e.g., aggregations of turtles along long segments of rivers and streams or in isolated ponds or lakes).

Population Status. — The species occurs in many areas and often is abundant in hill and mountain habitats in many parts of their range where turtles have invaded stock tanks, logging ponds, and other standing waters created by humans over the last century. Three areas, however, that show marked declines in populations are southern California from Baja up to Ventura; the Central Valley of California; and the northernmost populations in Washington State and, perhaps, in northern Oregon. Today, only isolated clusters of turtles remain in most of southern California (Brattstrom 1988), which now are separated by inhospitable areas of cities and roads. Also, these isolated populations occur in aquatic habitats that humans are drawn to, especially in the summer. Much of the natural habitat for the species in the Central Valley of California, especially the southern portion (San Joaquin Valley), has been eliminated. The original complex of lakes, rivers, streams, wetlands, and sloughs was estimated to cover at least 787,000 ha in the Central Valley (Harding 1960). Most of this habitat has been drained or channelized to support a massive agricultural system and urban centers; however, the species has not been extirpated from the San Joaquin Valley. There remain a number of areas in the valley that support relatively large populations of turtles with population structures that indicate successful reproduction and long-term stability (Germano and Bury 2001). Besides these areas, *A. marmorata* also appears to be uncommon in northernmost Oregon and into Washington State (Bury 1995; Hays et al. 1999).

Threats to Survival. — In the 19th and early 20th centuries, *A. marmorata* was exploited for food (Storer 1930; Buskirk 1990; Bettelheim 2005). This began as early as the 1860s (Lockington 1879) and commercial exploitation peaked in the 1890s. Smith (1895) noted that at least 18,000 turtles/year were sold in the markets in San Francisco. Records of the U.S. Bureau of Fisheries indicate that the catch peaked in 1897 at 48,534 kg (107,000 pounds). In 1895 the catch was 42,638 kg, consisting of approximately 63,000 animals. Collecting efforts in the 1880s included the use of a small schooner operated on Tulare Lake (now a groundwater recharge facility and cropland) in the San Joaquin Valley, California. The commercial trade continued until at least the 1930s, and this activity exacerbated population declines caused by habitat losses and other factors.

Commercial overharvest of this species followed closely the pattern noted for the California red-legged frog, *Rana draytonii* (Jennings and Hayes 1985). Although there are no reliable estimates of the total take for pets, in the early 1960s, one of us (RBB) was asked by a reptile dealer in southern California to help collect this species. When asked for an approximate number to collect, the dealer replied that they had just exported 500 of this species to Europe, and needed that many additional turtles to fill orders. Collecting is now greatly reduced due to protective regulations.

Now and in the future, habitat destruction and alteration are the primary threats to the continued existence of this species. This is a problem that besets most species around the world. Massive water development projects have changed the location, flow, and use of water across much of the range of *A. marmorata*, particularly in the Central Valley of California. Construction of dams on many rivers results in cooler water temperatures and faster flowing water below dams, which may be detrimental to turtle populations (Reese and Welsh 1998a, b). Also, the reservoirs behind these dams may not be especially suitable habitat because recreational activities such as fishing, skiing, or swimming likely disturb normal behavioral routines of the turtles. Further, some of these reservoirs have large draw downs seasonally, which inhibits growth of aquatic vegetation and associated invertebrate populations that are prey for turtles. However, we have studied a population of *A. marmorata* in one large reservoir (Whiskeytown National Recreation Area in northern California) where we found turtles to be relatively abundant and the population was composed of a

stable age distribution (R. Bury and D. Germano, unpubl. data). Elimination of water bodies of any kind reduces habitat for this species. Still, small impoundments with permanent or intermittent water are inhabited by turtles, and numbers can be quite high, particularly if vegetation (e.g., trees, tules, cattails) and basking sites are allowed to become established along shorelines (Cook and Martini-Lamb 2004).

Other impacts can have local effects on *A. marmorata*, but are not expected to have significant population consequences. Fire can cause mortality in turtles overwintering in terrestrial habitats, turtles are sometimes deliberately shot while basking, or are inadvertently caught while fishing. They also have to contend with predators and competitors in some situations, especially urban waters (Bury, in press). The native raccoon (*Procyon lotor*) can be a problem in situations where turtle habitat occurs in urban environments because of artificially high raccoon populations associated with supplemental food from human habitations (G. Rathbun, pers. comm.). The introduction and spread of the red-eared slider, a potential competitor, is occurring in California (Spinks et al. 2003; Patterson 2006) and the Pacific Northwest (Bury 1995, in press).

Conservation Measures Taken. — *Actinemys marmorata* is protected by state law within its entire native range: it is listed as State Endangered in Washington; Sensitive - Critical in Oregon, and a Species of Special Concern in California. However, none of these laws confer effective protection of the habitat. Some habitat is partly to fully protected in waters designated as Wild and Scenic Rivers, but these are relatively few. The turtle occurs in some state and federal parks at low elevations, including Humboldt Redwoods State Park (northern California), Point Reyes National Seashore (north of San Francisco) and Pinnacles National Monument (south of San Francisco). Some limited habitat occurs in wilderness areas, but many of these are located in montane or high-elevation localities (e.g., Yosemite National Park, California), and turtles are generally uncommon above 1200 m. A small series of ponds at one site in southwestern Washington State are protected specifically for the turtle. The species was proposed for Federal listing as a threatened species, but it was found not warranted (U.S. Fish and Wildlife Service 1993).

Conservation Measures Proposed. — We believe that conservation efforts need to focus on protection of turtles in their native habitats. There have been attempts to translocate the species away from construction projects in California and Oregon, but none of the results have been published. This practice needs serious scrutiny. It is imperative to rigorously monitor the results of these efforts to evaluate the potential effectiveness of this mitigation strategy. Translocated turtles are known to return to the original site (L. Hunt, unpubl. data), which subjects them to increased stress and the likelihood of mortality. Additionally, this practice may mix stocks of genetically differentiated forms. Most attempts to translocate amphibians and reptiles have been ineffective as conservation strategies (Dodd and Seigel 1991).

Captive Husbandry. — There are successful efforts to captively breed this species in Washington, and to head-start young individuals for reintroduction into the wild in California, Oregon, and Washington. Except for rare instances, we question the expense of captive breeding of this species and point out that there are potential adverse effects (e.g., mixing gene pools) that need to be carefully considered before this is tried on other than an experimental basis. The long-term plight of the species must be considered in that these actions, if applied incorrectly, may dilute efforts to effectively protect and manage wild populations and their habitat.

Current Research. — Several meetings have been organized to discuss the status and needs of the species. For example, a workshop with 110 attendees on the biology and status of the turtle sponsored by the Western Section of The Wildlife Society was held in 2004 in northern California. A Western Pond Turtle Group was established in 1991 to foster communication and coordinate research on the species. Interested parties included representatives from federal and state agencies, several universities, zoos, industry, and private citizens. A primary goal of the Western Pond Turtle Group is to develop a strategic plan for the conservation of the turtle. Many members of this group are preparing a handbook on the species, including sampling protocol, summary of ecology, and management considerations. Recently, the California Department of Fish and Game commisioned a "Conservation Strategy" to summarize known information, identify threats, hold regional workshops, and other efforts for this turtle statewide.

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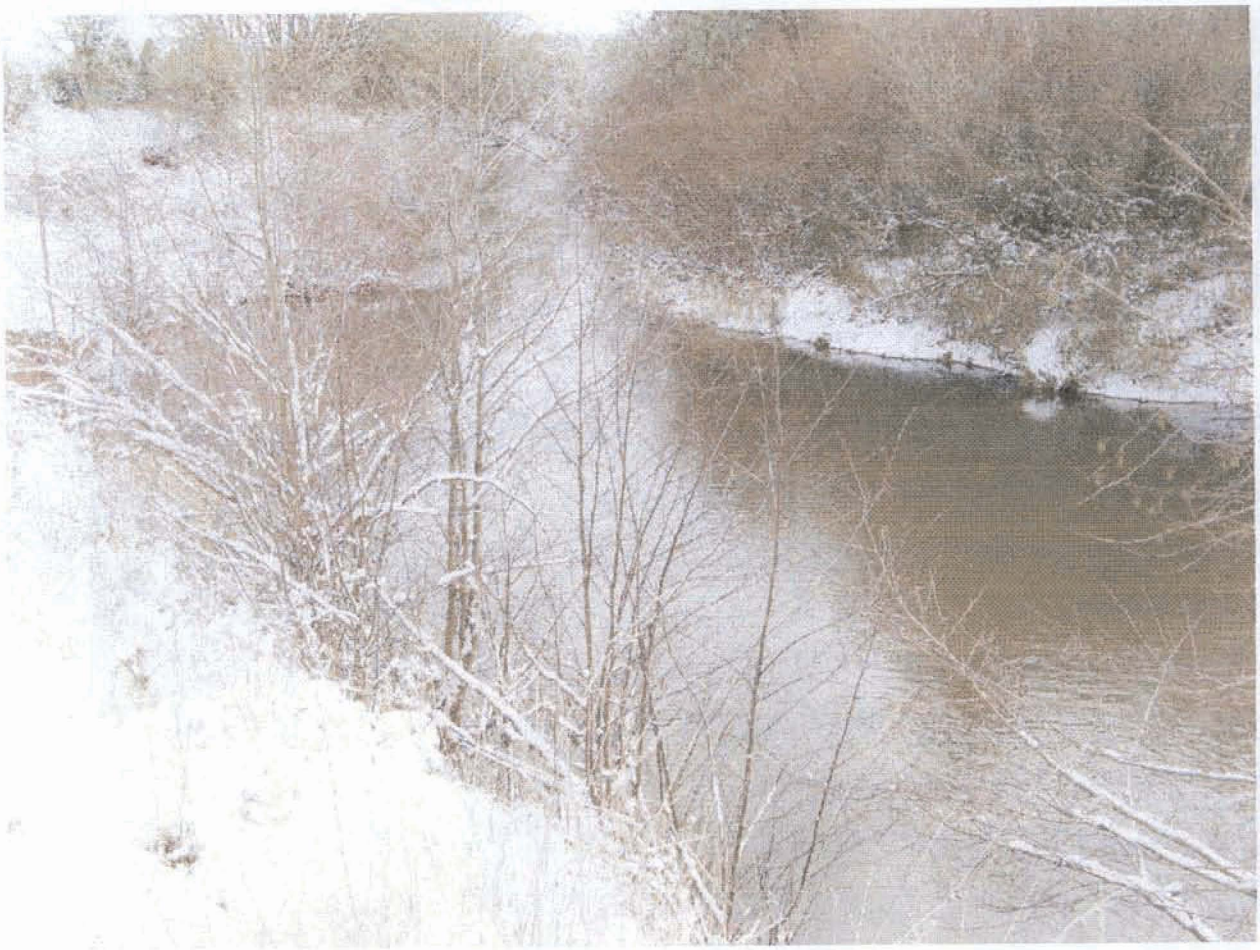
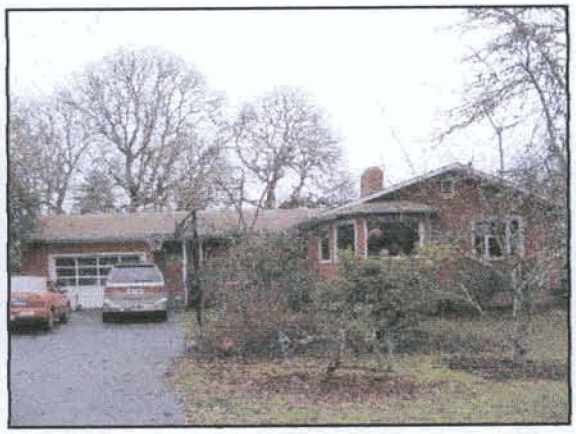
Species list from Brooklane Development 5/2/07

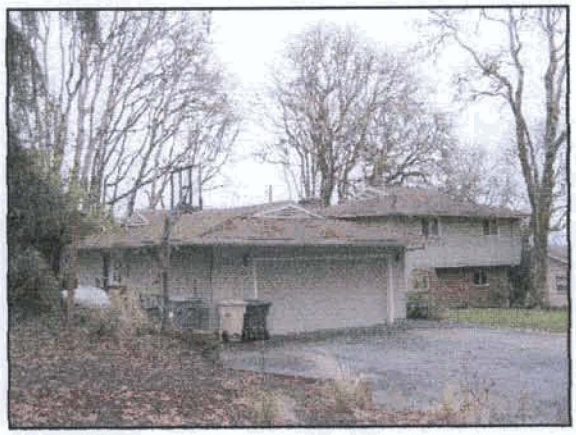
Growth Form	Scientific Name	Common Name	US Nativity?	Life Span
Forb	Allium vineale	wild garlic	Introduced	Perennial
Forb	Anthriscus caucalis	burr chervil	Introduced	Annual
Forb	Brodiaea	brodiaea	Native	Perennial
Forb	Calystegia atriplicifolia	nightblooming false bindweed	Native	Perennial
Forb	Cerastium glomeratum	sticky chickweed	Introduced	Annual
Forb	Cirsium arvense	Canada thistle	Introduced	Perennial
Forb	Cirsium vulgare	bull thistle	Introduced	Biennial
Forb	Claytonia perfoliata	miner's lettuce	Native	Annual, Perennial
Forb	Daucus carota	Queen Anne's lace	Introduced	Biennial
Forb	Daucus pusillus	American wild carrot	Native	Annual
Forb	Dipsacus fullonum	Fuller's teasel	Introduced	Biennial
Forb	Fragaria virginiana	Virginia strawberry	Native	Perennial
Forb	Galium aparine	stickywilly	Native	Annual
Forb	Geranium dissectum	cutleaf geranium	Introduced	Annual, Biennial
Forb	Hypericum perforatum	St. Johnswort	Introduced	Perennial
Forb	Hypochaeris radicata	hairy catsear	Introduced	Perennial
Forb	Iris tenax	toughleaf iris	Native	Perennial
Forb	Lamium purpureum	purple deadnettle	Introduced	Annual
Forb	Lathyrus angulatus	angled pea	Introduced	Annual
Forb	Lathyrus latifolius	perennial pea	Introduced	Perennial
Forb	Leucanthemum vulgare	oxeye daisy	Introduced	Perennial
Forb	Linum bienne	pale flax	Introduced	Annual, Biennial, Perennial
Forb	Marah oreganus	coastal manroot	Native	Perennial
Forb	Myosotis discolor	changing forget-me-not	Introduced	Annual, Perennial
Forb	Narcissus pseudonarcissus	daffodil	Introduced	Perennial
Forb	Nemophila parviflora	smallflower nemophila	Native	Annual
Forb	Osmorhiza berteroi	sweetcicely	Native	Perennial
Forb	Plantago lanceolata	narrowleaf plantain	Introduced	Annual, Biennial, Perennial
Forb	Potentilla gracilis	slender cinquefoil	Native	Perennial
Forb	Ranunculus occidentalis	western buttercup	Native	Perennial
Forb	Rumex acetosella	sheep sorrel	Introduced	Perennial
Forb	Rumex crispus	curly dock	Introduced	Perennial
Forb	Sanicula crassicaulis	Pacific blacksnakeroot	Native	Perennial
Forb	Senecio jacobaea	stinking willie	Introduced	Perennial
Forb	Sherardia arvensis	blue fieldmadder	Introduced	Annual
Forb	Sidalcea malviflora ssp. virgata	dwarf checkerbloom	Native	Perennial
Forb	Sisyrinchium	blue-eyed grass	Introduced	Perennial
Forb	Sonchus asper	spiny sowthistle	Introduced	Annual
Forb	Taraxacum officinale	dandelion	Introduced	Perennial
Forb	Torilis arvensis	spreading hedgeparsley	Introduced	Annual
Forb	Trifolium dubium	suckling clover	Introduced	Annual
Forb	Vicia americana	American vetch	Native	Perennial
Forb	Vicia cracca	bird vetch	Introduced	Perennial
Forb	Vicia sativa	garden vetch	Introduced	Annual
Forb	Vicia tetrasperma	lentil vetch	Introduced	Annual
Forb	Vinca minor	periwinkle	Introduced	Perennial
Graminoid	Alopecurus pratensis	meadow foxtail	Introduced	Perennial
Graminoid	Anthoxanthum odoratum	sweet vernalgrass	Introduced	Perennial
Graminoid	Arrhenatherum elatius	tall oatgrass	Introduced	Perennial
Graminoid	Bromus diandrus	ripgut brome	Introduced	Annual, Perennial

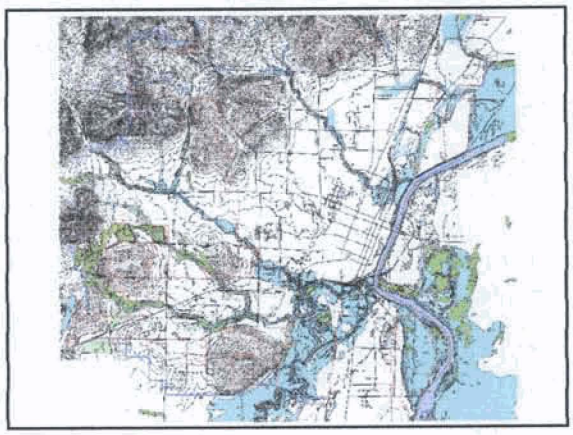
Growth Form	Scientific Name	Common Name	US Nativity?	Life Span
Graminoid	Bromus sterilis	poverty brome	Introduced	Annual
Graminoid	Carex tumulicola	splitawn sedge	Native	Perennial
Graminoid	Cynosurus echinatus	bristly dogstail grass	Introduced	Annual
Graminoid	Dactylis glomerata	orchardgrass	Introduced	Perennial
Graminoid	Danthonia californica	California oatgrass	Native	Perennial
Graminoid	Festuca arundinacea	tall fescue	Introduced	Perennial
Graminoid	Festuca idahoensis ssp. roemeri	Roemer's fescue	Native	Perennial
Graminoid	Festuca rubra	red fescue	Introduced	Perennial
Graminoid	Holcus lanatus	velvetgrass	Introduced	Perennial
Graminoid	Juncus tenuis	poverty rush	Native	Perennial
Graminoid	Luzula campestris	field woodrush	Native	Perennial
Graminoid	Poa pratensis	Kentucky bluegrass	Introduced	Perennial
Shrub	Cytisus scoparius	Scotch broom	Introduced	Perennial
Shrub	Symphoricarpos albus	snowberry	Native	Perennial
Shrub	Syringa	lilac	Introduced	Perennial
Shrub	Toxicodendron diversilobum	Pacific poison oak	Native	Perennial
Shrub/Tree	Crataegus douglasii	black hawthorn	Native	Perennial
Shrub/Tree	Crataegus monogyna	oneseed hawthorn	Introduced	Perennial
Shrub/Tree	Oemleria cerasiformis	Indian plum	Native	Perennial
Subshrub	Mahonia nervosa	Cascade barberry	Native	Perennial
Subshrub	Rosa eglanteria	sweetbriar rose	Introduced	Perennial
Subshrub	Rubus armeniacus	Himalayan blackberry	Introduced	Perennial
Tree	Acer macrophyllum	bigleaf maple	Native	Perennial
Tree	Arbutus menziesii	Pacific madrone	Native	Perennial
Tree	Populus balsamifera	balsam poplar	Native	Perennial
Tree	Pseudotsuga menziesii	Douglas-fir	Native	Perennial
Tree	Quercus garryana	Oregon white oak	Native	Perennial

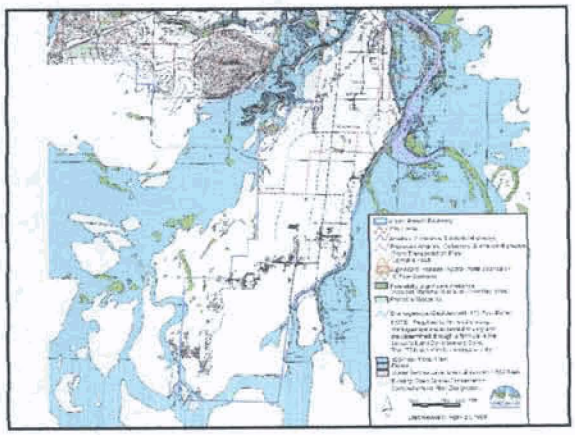
Western Pond turtle ponds at edge of Marys River Natural Area.

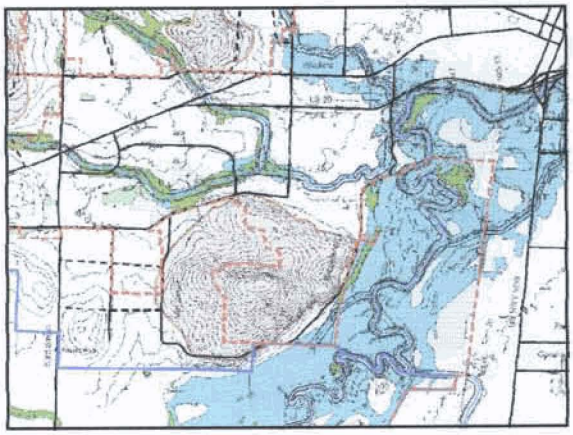




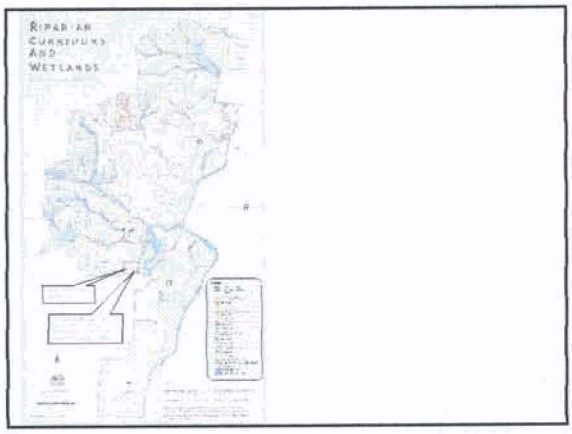


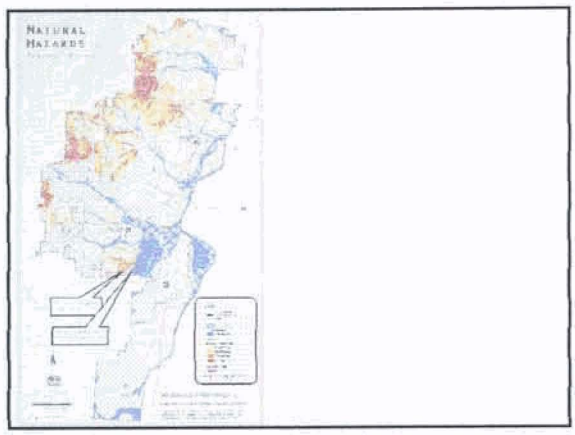


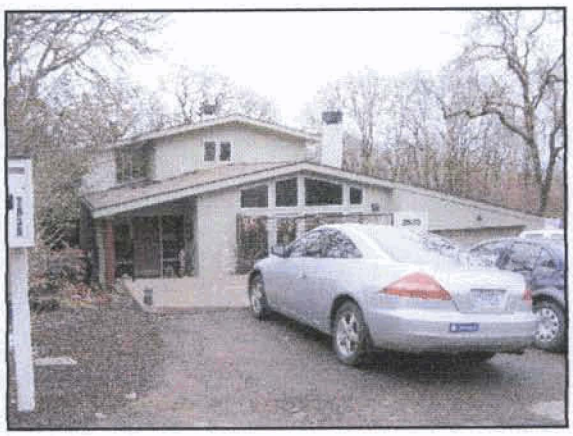




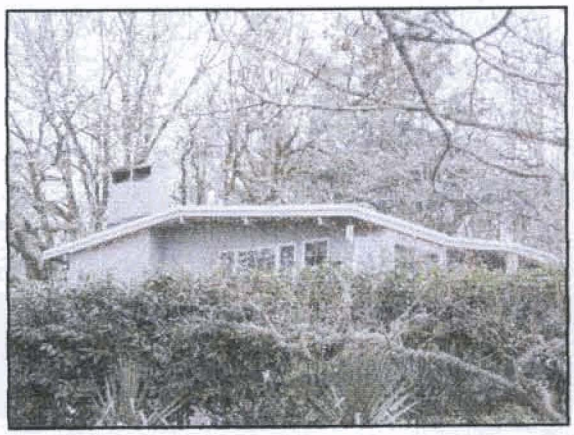
Significant
Vegetation
Areas

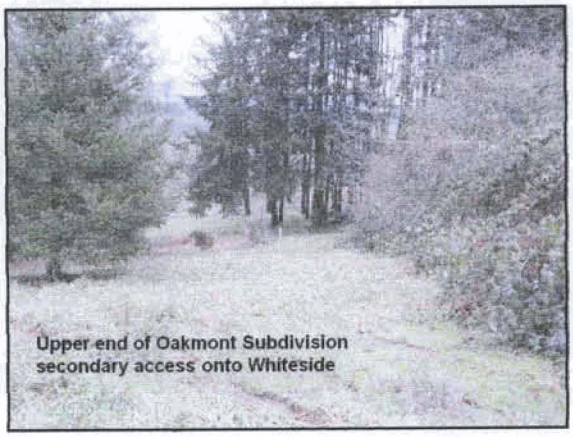

Riparian
Corridors
And
Wetlands


Natural
Hazards



NON CHARACTERISTIC




Upper end of Oakmont Subdivision
secondary access onto Whiteside