

## CHAPTER 8

### WATERSHED PLANNING AND ANALYSIS: JACKSON/FRAZIER/VILLAGE GREEN CREEKS

#### 8.1 INTRODUCTION

This watershed consists of the Jackson, Frazier, and Village Green Creeks, which form a complex network of streams and wetlands to the north of the Corvallis city limits. Jackson and Frazier Creeks both originate in McDonald State Forest. The headwaters of Jackson Creek are located near Dimple Hill. Frazier Creek originates farther north near the 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 Wetland, an important habitat area. The flow leaving the wetland 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 wetland 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 with about 700 acres. Over 400 acres is currently undeveloped. In the future, the forest land will still be present, but the undeveloped land may be largely 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 (almost 600 acres). In the future, the undeveloped land may become part of almost 900 acres of new low-density residential. Two-thirds of the 380 acres draining to Village Green Creek are residential. The mix of low-, medium-, and high-density residential will remain the same in the future. The area designated as open space will increase slightly, from 28 percent at present to 33 percent in the future.

#### 8.2 WATERSHED FINDINGS

Information on watershed conditions was obtained by collecting public comments at open houses, working with City staff to identify maintenance and operation problems, conducting a technical stream evaluation of selected reaches, and by modeling the conveyance system for the existing and build-out scenarios. This information was compiled by stream reach and is summarized in Section 8.2.5. A map of the Jackson/Frazier/Village Green Creeks watershed, presented as Figure 8-1, shows the location of the streams and identifies some of the major observations made during the watershed study.

Village Green Creek is typical of many urbanized streams. It is highly channelized and in many locations has little or no available shade. However, unlike many other Corvallis streams, Village Green Creek has few structures encroaching on its bank. The open stream banks, such as at Village Green Park (Figure 8-2, Photo 1), 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.

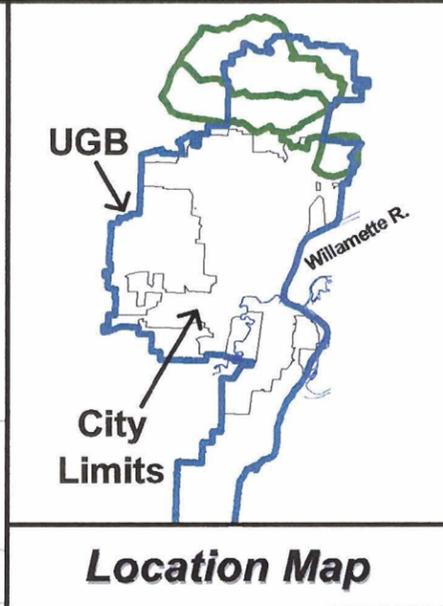
The Jackson-Frazier Wetland is a key component of this watershed. The wetland lies just downstream of Highway 99 and receives the combined flows of Jackson and Frazier Creeks. The natural drainage through the wetland has been modified over the years, affecting the flows through the system. A berm along the southern perimeter of the wetland is one of the more obvious signs of the modifications. At present, flows leave the wetland via a drainage ditch to the northeast and Village Green Creek to the south. A number of studies have been conducted on the wetland's vegetation and wildlife. Most of the studies have been coordinated through Oregon State University. However, only limited information exists on the hydraulics of the wetland. Additional information and analyses are needed to better determine how the wetland reacts to large storm flows. The wetland is part of Benton County's park system. It currently contains a raised boardwalk used for an interpretive trail.

Above the wetland, Jackson and Frazier Creeks flow through mainly agricultural lands with low-density residential development concentrated along the streams. In this area, many stream reaches are in relatively good shape, with a fair amount of canopy cover and few erosion problems, as shown in Figure 8-2, Photo 2, taken just upstream of the Jackson-Frazier Wetland. Other reaches have had more development, resulting in constrained channels and bank erosion (Figure 8-2, Photo 3). The large amount of undeveloped space presents opportunities for restoring and enhancing floodplain habitat in a number of locations, such as that shown in Figure 8-2, Photo 4. Other opportunities for floodplain improvements exist on the campus of Crescent Valley High School where six different bridges and box culverts cross the stream (Figure 8-2, Photo 5). Farther upstream, in the headwaters of Jackson Creek, coordination efforts with property owners adjacent to the stream will be the key to maximizing the habitat potential of the area (Figure 8-2, Photo 6).

### 8.2.1 Public Comments

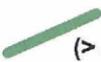
Public input into the watershed planning process has been encouraged and facilitated through a number of public meetings held at Cheldelin Middle School. Residents were encouraged to share their knowledge of problem areas and to identify opportunities for improving the health of the Jackson/Frazier/Village Green watershed. Most of the comments heard at the meetings were general in nature. The comments are shown below, as they were recorded at the meeting (with explanatory language added in parentheses when needed):

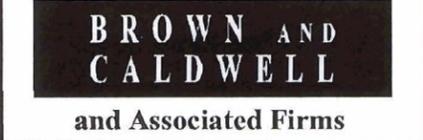
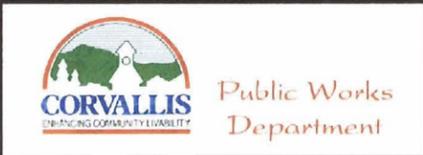
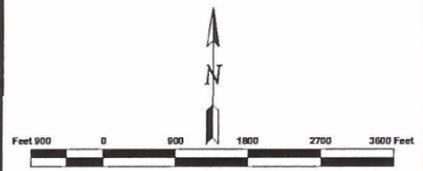
- “City should require on-site impoundment to reduce the flooding.”
- “Other communities and neighborhoods have ‘adopt a stream’ – would be cost effective and works in other cities – have to ‘pass plans’ by City first to make sure meets community objectives.”
- “Has seen changes to downstream flows, etc. Over the past years – the flashiness of it (downstream of Corvallis) at Stewart Slough.”
- “Master Plan should acknowledge and have an overview regarding fish and habitat in the basin.”



**Figure 8-1 Jackson/Frazier and Village Green Problem Areas**

**LEGEND**

 Pipes/Bridges	 Channels	 Basin Boundary
 Reported Problems (recorded at open house)	 Surcharged Manholes (10-year future storm)	 Flooded Manholes (10-year future storm)
 High Velocity Areas (> 4 fps, 2-year future storm)	 Undersized Conduits (10-year future storm)	 Undersized Channels (10-year future storm)



report/figures/final/fig8-1.wor, October 27, 2000, base data from City of Corvallis GIS Department

## Figure 8-2. Watershed Photos

Photo 1. Pedestrian bridge at Village Green Park



Photo 2. Jackson Creek upstream of Highway 99



Photo 3. Jackson Creek downstream of Crescent Valley HS and Highland Drive



Photo 4. Jackson Creek at Highland Drive



Photo 5. Jackson Creek at courtyard area at CVHS



Photo 6. Jackson Creek headwaters structures



- “Where areas are logged first, then first fall storm there is an initial increase in flow (has been his experience) and higher turbidity in reaches – and this can take a while to recover. Need better best management practices to handle increases in flow and sediment. Not the case now, especially in county/urban areas. Aren’t implementing land use practices that minimize flow changes and pollution problems.”
- “Lives in Garryanna area - City plan includes UGB (Urban Growth Boundary) and need to coordinate better with County, including water quality issues for planning and enforcement – especially with Jackson-Frazier.”
- “Problem is jurisdiction –Corps (Army Corps of Engineers) or DSL (Division of State Lands), County or City, State planning laws. First step – find out who has jurisdiction.”
- “Is there any way after the SWMP (Stormwater Master Plan) is adopted to, along the way, at different times, check in to see how it is working out? Evaluate SWMP in the interim (at critical points). How is the plan held accountable?”
- “Should detention even out flows so that urbanization doesn’t increase peaks and reduce low flows?”

Comments from the meetings regarding problem areas or specific enhancement opportunities are in Section 8.2.5.

### 8.2.2 City Staff Reports

City Engineering and Utilities Operations staff is familiar with portions of the Jackson/Frazier/Village Green watershed through their day-to-day activities. Other sections of the watershed are outside of the City’s jurisdiction. City staff provided input into the planning process by identifying known problem areas, recommending areas for stream enhancement activities, and recounting the extent and duration of flooding during major storm events. For example, the extent of flooding from the February 1996 storm was well documented. During that storm, road closures were reported in the Village Green portion of the watershed, along sections of Conifer Boulevard from Highway 99 east to Cheldelin Middle School. High water was also reported along Plymouth Circle and Lancaster Street.

### 8.2.3 Field Study Observations

Watershed Applications, a stream rehabilitation specialty firm, conducted a series of field investigations beginning in November 1997. Field personnel evaluated selected lengths of Village Green Creek during stream walks. Jackson and Frazier Creeks were not investigated by Watershed Applications. Instead, a limited field survey was taken by Brown and Caldwell in July 2000 to report on general conditions in the Jackson and Frazier Creek basins. Information from all of the field observations is in Section 8.2.5.

### 8.2.4 Modeling Results

A computer model for the Jackson/Frazier/Village Green watershed identified the hydraulic capacity and projected flows in the pipes, culverts, and channels of the conveyance system for existing and build-out scenarios. Existing conditions were modeled based on the level of development at the time of modeling, including the new culvert added at Conifer Boulevard in 1999. Build-out conditions were modeled based on the future full development of the watershed as identified in the City's Comprehensive Plan. A full range of storm events was modeled for the existing and future scenarios, including the 2-, 10-, 25-, and 100-year storm events. A complete summary of all modeled segments is in Appendix C.

Table 8-1 shows the hydraulic structures (pipes, culverts, bridge crossings, etc.) that are undersized for the City's 10-year design storm. Specifically, two stream crossings are undersized according to the model. This agrees with the public reporting of flooding along Lancaster Street at or near both of the crossings. The model also showed overflows out of the Frazier Creek base channel just below the junction with the Sulphur Springs branch. This coincides with a wetland designation for this section of the stream.

The hydrologic/hydraulic model also estimated velocities occurring in channel segments to determine areas at risk for channel or streambank erosion. Instream high velocity criteria are described in Chapter 3. In general, velocities in excess of 4 feet per second (fps) may cause erosion of the streambank or streambed. The velocities during the 2-year storm event—the storm size most responsible for determining the channel configuration—were compared to the 4 feet-per-second criteria.

**Table 8-1. Modeled Flow for Undersized Hydraulic Structures within the Jackson/Frazier/Village Green Watershed, cubic feet per second**

Reach/Location/Model segment	Full pipe or channel capacity <sup>1</sup>	10-year storm flows		Flooding predicted by model	Flooding reported by staff or public
		Existing	Future		
Conifer Boulevard to Jackson-Frazier Wetland/Conifer Boulevard	271	236	236	Yes	Yes
Conifer Boulevard to Jackson-Frazier Wetland/Oxford Circle	225	251	253	Yes	Yes
Highway 99 to Highland Drive (Frazier Creek)/Downstream of Sulphur Springs Branch	404	427	429	Yes	No

<sup>1</sup> The full pipe or channel capacity is based on Manning's equation. It does not account for hydraulic effects from downstream backwater effects.

As Table 8-2 indicates, a number of the modeled stream reaches within the Jackson/Frazier/Village Green watershed exceed velocity criteria. The channels with high velocities are either located on steep slopes in the headwater areas or just upstream of Highway 99. Also, the table indicates if erosion of the channel or stream bank has been observed or if stream bank stabilization projects have been implemented. Several of the stream reaches did not undergo field inspection and therefore lack erosion observations.

**Table 8-2. Modeled Velocities for Jackson/Frazier/Village Green Channel Segments Exceeding 4 Feet per Second**

Reach/Model segment	2-year storm		Erosion observed	Existing bank stabilization
	Existing velocities	Future velocities		
Village Green Creek				
No excessive velocities in these reaches	--	--	--	--
Jackson Creek				
Jackson-Frazier Wetland to Highland Drive/3300 feet upstream of Highway 99	5.1	5.1	Yes	No
Crescent Valley Drive to McDonald State Forest/Jackson Creek Road to Crescent Valley Drive	4.4	4.4	Yes	No
Crescent Valley Drive to McDonald State Forest/Along Jackson Creek Road	9.0	9.0	Yes	No
Frazier Creek				
Highway 99 to Highland Drive/Highway 99 to Sulfur Springs tributary	5.5	5.5	No	No
Sulfur Springs Branch/Along Lewisburg Road	5.8	5.7	No	No
Sulfur Springs Branch/Along Sulfur Springs Road	5.3	5.3	No	Yes
Frazier Creek Headwaters/Along Frazier Creek Road	6.6	6.6	Yes	No

### 8.2.5 Stream Reach Summaries

For study purposes, Jackson, Frazier, and Village Green Creeks have been divided into a number of reaches based on the physical characteristics of the stream, property ownership, and any other unique characteristics that might distinguish one section of the stream from the rest. Public comments, City staff reports, field observations, and modeling results for each reach are summarized in the following sections. Problems described by the public are noted as they were recorded at public meetings. Parentheses are used to identify any clarifications.

#### **Sequoia Confluence to Conifer Boulevard**

**Public Comments:** “Stream is eroding toward his fence.” (Village Green stretch near footbridge – upstream.)

“This isn’t a stream, it’s a manmade ditch.”

“Concern of continued degradation of Village Green channel that will eventually destroy his property.”

“Nutria is a problem – annual – burrow into banks that are already steep and when floods, the tunneled banks collapse.”

“City took seven nutria from Village Green last summer (1998).”

“Does City inspect storm drains after larger events? Example, drainage entry just downstream of foot bridge was plugged for several weeks (grate at culvert). He has called City several times on problems and City came right away.”

City Staff Reports: The channel downstream of Village Green is flat and prone to vegetation blockages. Over the last 5 years, City staff has responded to a variety of complaints about erosion, vegetation blockage, and flooding in the manmade channel section of Village Green Creek. An additional high-flow culvert was installed at Conifer Boulevard in 1999 to help reduce the potential for flooding. A detailed comprehensive analysis is required for the entire Jackson and Frazier basin that addresses peak flows, wetlands, floodplain, and stream corridor issues.

Field Observations: The channel downstream of Conser Street has a dense growth of trees. The trees provide a good canopy, but have a tendency to cause debris to collect. The large metal culvert under Conser Street has very shallow flows during summer, barely deeper than the corrugations. A large number of stormwater pipes discharge into the creek from Conser Street up to the railroad bridge. Vegetative buffers and canopy coverage are in generally poor condition along this section of channel. Above the railroad bridge, Village Green Park has a closely mowed lawn and few trees on the park side of the creek. The footbridge connecting the park with Sherwood Way to the south has a relatively small clearance space above the low-flow water surface. The overbank area of the park is a potential location for a facility to improve habitat and store larger flows. Upstream of the park the channel is more constricted. The banks are steep and some erosion is occurring. Plywood sheeting along the south bank of the bend appears to be a homemade attempt at bank stabilization. A couple of large stormwater pipes discharge to the creek on the south bank. Based on backyard fence placement, there appears to be some space along the south bank available for an enhancement project.

Modeling Results: The model showed no capacity problems with the reach’s existing channel, culverts, and bridges. Velocities were not predicted to exceed the 4 feet-per-second criteria for erosion during the 2-year storm event.

### **Conifer Boulevard to Jackson-Frazier Wetland**

Public Comments: No comments were received for this reach at the public meetings. However, during field investigations the consultant staff received comments from local residents who expressed concern about flooding of roadways. The residents were especially concerned with the flooding of the roads leading to the daycare center located on the east side of the stream at Oxford Circle.

City Staff Reports: This reach will flood during a 5-year storm event. An additional high-flow culvert recently installed at Conifer Boulevard helps reduce the flooding at this location. Following recent development in the area, heavy public use has impacted the revegetation of this reach.

Field Observations: In this reach, the creek flows through a highly constrained trapezoidal channel. No shrubs or trees provide shade. The vegetation on both banks is grass mowed almost to the water’s edge. The land use immediately surrounding the channel is mostly apartments and townhomes with associated parking lots.

Modeling Results: Village Green and the culverts at Conifer Boulevard were modeled as part of the City's Flood Mitigation Program in 1998. Modeling at that time showed that the culverts are undersized and water is backing up onto Lancaster Street near Oxford Circle. This confirmed reports of flooding by City staff and the public. The City installed an overflow culvert at Conifer Boulevard in 1999 to help reduce flooding in the area.

Remodeling of Village Green with the new culvert showed that water still backs up behind the culverts at Conifer Boulevard, but with a reduced potential for flooding along Lancaster Street. In addition, the model showed high water levels likely at Oxford Circle and Lancaster Street due to the undersized culverts at Oxford Circle. Velocities along the channel did not exceed the 4 feet-per-second criteria for erosion.

### **Jackson-Frazier Wetland**

Public Comments: "Jackson-Frazier wetlands are beautiful with lots of voluntary support and effort (provided by the public). (The wetland) Cleans (the) water then water comes out and mixes with other water coming in and gets degraded. All of that work should be protected and other volunteer work help other reaches."

City Staff Reports: A detailed comprehensive analysis is required for the entire Jackson and Frazier basin that addresses peak flows, wetlands, floodplain, and stream corridor issues. Hydraulics, aesthetics, and habitat values are not coordinated in a comprehensive plan. The northeast discharge from the wetlands is ditched through farmland to the Willamette River. The City may have future stormwater regulatory responsibility for flows into this ditch as the City expands within the northern portion of the UGB.

Field Observations: The Jackson-Frazier Wetland, which lies east of Highway 99, receives the flows from the now joined Jackson and Frazier Creeks. During lower flows, most of the water follows a small, apparently manmade channel that leads south to form Village Green Creek. The remainder of the flow enters a drainage ditch, leading across farm fields to the northeast. During high flows, the water spreads out in a broad sheet across the wetland before leaving the wetland to the south or northeast.

Modeling Results: No capacity or velocity problems were noted. Further work is needed to confirm the hydraulics of the wetland, such as the elevations at which overflows occur, the proportion of flows leaving via the northeast drainage ditch, and the influence of groundwater. The wetland covers approximately 200 acres; consequently, the wetland has a large impact on the hydraulics of the downstream conveyance system. A detailed topographic survey of the entire wetland area and flow monitoring information would be required to accurately model the response of the wetland and discharging streams to storm events.

### **Jackson-Frazier Wetland to Highland Drive (Jackson Creek)**

Public Comments: No public comments on this reach.

City Staff Reports: Property owners have reported to the City that changes from past flooding patterns have occurred as a result of channel meandering during the past five years of high rainfall events. Privately owned creek crossings in this reach have not been permitted by the Oregon Division of State Lands or the Oregon Department of Fish and Wildlife. A private low-elevation dam was reported, but has not been located. Irrigation uses and their impacts on stream flows are not clearly documented or understood.

Field Observations: The combined creeks downstream of Highway 99 create a quiescent pool under the railroad trestle. Upstream of Highway 99, Jackson Creek has a good canopy cover with a large proportion of willows. An approximate 50-foot buffer runs along the main channel, with narrower buffers along tributary ditches and channels. Blackberry thickets are present along the edge of the buffer. Jackson Creek is quiescent immediately upstream of Highway 99 with no apparent channel incision. The surrounding land use is hay fields. At the upstream end of this reach, Jackson Creek flows through a corrugated metal culvert under Highland Drive and then down a slight drop over rocks. The culvert is clean with no noticeable debris or sediment deposits. The channel is in poor condition downstream of the culvert with downcutting, bottom scouring, and a number of woody debris dams. Ivy covers much of the bank under the trees with blackberry brambles between the stream and the hay fields to the north and south of the channel. The narrow vegetative buffer shows evidence of heavy use by deer. The hay field to the south of the main channel is small and sandwiched between the main channel and a tributary ditch. This area may be a potential candidate for habitat enhancement or a detention pond project; however, part of the meadow to the south of the ditch is lower in elevation and may be a better location for a pond or wetland.

Modeling Results: The model showed that the reach has no capacity problems. Velocities exceeded the 4 feet-per-second criteria for erosion in the lower section of the reach. Modeled velocities in the upper section (near Highland Drive) did not exceed criteria, but the lack of surveyed cross-sections prevented good definition of the low-flow channel, possibly resulting in underestimated velocities.

### **Crescent Valley High School, Highland Drive to Crescent Valley Drive (Jackson Creek)**

Public Comments: No public comments on this reach.

City Staff Reports: School facilities need to be upgraded to provide water quality protection from stormwater runoff from parking lots and other paved areas. During power failures, reported spills have occurred from the wastewater system pressure pump station at the school into a ditch leading to Jackson Creek. Under the existing emergency response plan, a temporary power generator placed at the pump runs the station until power is restored. The City plans to install a permanent backup generator in 2003.

Field Observations: Immediately upstream of Highland Drive, a 12-inch water pipe crosses Jackson Creek at the water's surface. The channel is somewhat downcut, but has a good canopy until reaching the Crescent Valley High School (CVHS) buildings. The CVHS campus has six separate stream crossings, including a concrete box culvert under the concrete apron of the main courtyard area, concrete footbridges upstream and downstream of the courtyard, a ramp leading across the stream

to what appears to be a second floor garage, and two wooden footbridges upstream of the campus buildings that connect the sports fields. The box culvert under the courtyard appears to be the most restrictive to stream flows. Although the stream has a natural bottom through most of the campus, it is heavily incised in places and has been armored with riprap.

Modeling Results: The model showed that the natural channel and the roadway culverts in this reach can accommodate 10-year storm events. Velocities were below the 4 feet-per-second criteria for erosion. Physical information on the hydraulic structures at CVHS was not available and thus these structures were not included in the modeling effort. A field survey of these structures would be required to obtain the detailed physical information required for modeling.

### **Crescent Valley Drive to McDonald State Forest (Jackson Creek)**

Public Comments: “How about help if we are outside the City and our property is flooding. She (the speaker) has water at back door and when she was out of country their land was declared a wetland. She is upstream of Crescent Valley High School and has had Jackson Creek rushing 3 feet deep across their property. There has also been deposition of sediment – lots of silt coming from upstream and the channel is moving. The creek has made a new creek bed. Feels that County improvements at the bridge have contributed to the flooding problem.”

City Staff Reports: Property owners have reported erosion and deposition problems that have changed the flood response of the creek in this area. Several owners feel that management of forest lands owned by Oregon State University has resulted in an increase in peak runoff that has caused incision of the stream and erosion problems. There is no established buffer between the creek and agricultural activities in this reach.

Field Observations: The stream gradient becomes markedly steeper upstream of Crescent Valley Drive. The drainage is from mostly agricultural or undeveloped land, except along the creek. Single-family homes on large lots are sited next to the creek. The homes have numerous frontage culverts and bridges, mostly to accommodate driveways over the creek. A few of the homes have footbridges. The creek flows through a series of manmade ponds and waterfalls at one residence. The canopy coverage is generally good in this reach, except where the large transmission lines cross the creek.

Modeling Results: The model showed that the reach has no capacity problems for the 10-year storm event. Velocities for this reach are predicted to exceed the 4 feet-per-second criteria for erosion due to the steep channel gradient.

### **Jackson Creek Headwaters (McDonald State Forest)**

Public Comments: No public comments on this reach.

City Staff Reports: No input was received from City staff on this reach.

Field Observations: No observations made.

Modeling Results: Runoff from this reach was included in the overall hydrologic model, but this reach was not specifically included in the hydraulic model.

#### **Highway 99 to Highland Drive (Frazier Creek)**

Public Comments: No public comments on this reach.

City Staff Reports: This reach has no established buffer between the creek and agricultural activities.

Field Observations: Frazier Creek joins Jackson Creek from the north at Highway 99. Most of the tributaries to Frazier Creek appear to be agricultural ditches with little vegetative cover. The buffer width and canopy coverage for Frazier Creek decrease upstream near Harman Drive. A number of houses with large yards are located on the south side of the creek. The Crescent Valley Evangelical Church at the corner of Harman Lane and Highland Drive has a large gravel parking lot with runoff passing across a grassy strip before reaching the creek.

Modeling Results: Where the Sulfur Springs Branch joins the main stem of Frazier Creek, channel capacity is undersized for the 10-year storm event. Velocities downstream of this point exceeded the 4 feet-per-second criteria for erosion.

#### **Highland Drive to Crescent Valley Drive (Frazier Creek)**

Public Comments: No public comments on this reach.

City Staff Reports: This reach has no established buffer between the creek and agricultural activities.

Field Observations: The main land use in this reach is agricultural. The buffer width is limited throughout the reach. At the upstream end near Crescent Valley Drive, the hayfields and pasture extend essentially to the streambank. Little channel incision was observed.

Modeling Results: Modeling showed that the reach has no culvert or capacity problems for the 10-year storm event. Velocities in the reach did not exceed the 4 feet-per-second erosion criteria.

#### **Frazier Creek Headwaters (Upstream of Crescent Valley Drive)**

Public Comments: No public comments on this reach.

City Staff Reports: No specific input was received from City staff on this reach.

Field Observations: Good canopy coverage exists at Crescent Valley Drive, but the understory is a large expanse of blackberry brambles. The creek angles sharply to flow through a corrugated metal culvert under Frazier Creek Road. Vegetative buffers and canopy cover are lacking upstream of this crossing and the stream banks are mostly exposed soils with signs of erosion. The vegetation along the Frazier Creek branch that flows underneath Winter Creek Road alternates between landscaping down to its banks or blackberry brambles. The creek in this area doesn't appear to be experiencing downcutting problems.

Modeling Results: Modeling showed that the reach has no capacity problems for the 10-year storm event. The modeling indicated that velocities exceeded the 4 feet-per-second criteria for erosion at the upstream end of this reach.

### **Sulfur Springs Branch (Frazier Creek)**

Public Comments: No public comments on this reach.

City Staff Reports: No input was received from City staff on this reach.

Field Observations: Topographic analysis based on U.S. Geological Survey topographic maps and the City's GIS coverage show the main drainage runs east of Sulfur Springs Road and then crosses under Lewisburg Road near Highland Drive. During fieldwork, a ditch to the west of Sulfur Springs Road was observed. This ditch is a steep, riprapped channel containing several concrete check dams. It crosses under Lewisburg Road close to Crescent Valley Drive. Downstream of the crossing, trees line a small channel leading southward. The channel was dry at the time of the observation.

Modeling Results: Modeling showed that the reach has no capacity problems for the 10-year storm event. Velocities exceeded the 4 feet-per-second criteria for erosion along Lewisburg and Sulfur Springs Roads due to the steep slope of these stream segments.

## **8.2.6 Watershed Summary**

Stream conditions along the Jackson/Frazier/Village Green Creeks reflect the variety of land uses through which the creeks pass. At the downstream end of the watershed, Village Green Creek is highly channelized and lacks good vegetative cover at many locations as it flows through low- to high-density residential areas. Upstream of the developed urban area, the Jackson-Frazier Wetland provides good habitat with little or no erosion and channel downcutting. The hydraulics of the Jackson-Frazier Wetland are not well understood. This area could be modeled given a detailed topographic survey of the area and flow monitoring of the input and exit flows.

Upstream of Highway 99, agricultural land use predominates, with the stream buffer ranging from good to nonexistent. Some erosion of the channel was observed, particularly in the steep, upper reaches where much of the land along the stream has been developed as single-family residences. Although the canopy cover is good in many of the residential areas, landscaping down to the streambank is also common, with a resultant loss of habitat. The headwater reaches within McDonald State Forest were not investigated. Although the headwater areas are not likely to be developed, the impact of forestry practices on the overall health of the stream needs to be considered.

### 8.3 WATERSHED MANAGEMENT OPTIONS

Recommendations for the Jackson/Frazier/Village Green Creeks watershed are shown in Table 8-3. The short-term options identified in Table 8-4 focus on involving the community in activities to protect or enhance the streams and riparian areas. Vegetation management is recommended at various locations to either remove non-native invasive species or to enhance the riparian canopy. Educational activities are recommended to inform the public about water quality and habitat issues and to explain how their activities may impact the health of the streams. In addition, the short-term options include the development of conservation easements along the streams in order to widen and protect vegetative buffers and to provide City access to the stream.

The long-term options shown in Table 8-5 include several capital improvement projects to enhance the channel and provide for greater flood protection by reconnecting the channel with the floodplain and existing wetlands. Other recommended options include increasing the buffer widths and providing better canopy coverage. These actions will help filter pollutants out of the runoff before it enters the stream, keep the stream cooler, and provide increased habitat value. The last type of recommended solution requires structural work at locations where culverts or other structures are poorly aligned or present a barrier to fish passage.

Several elements of both the short-term and long-term programs are intended to decrease downstream flooding through preservation of natural wetland and floodplain areas. Flooding along Village Green, especially along Lancaster Street, has been a longtime concern of the City. Information gathered during a flood mitigation study in 1999 was incorporated into the current work. In 1999, an additional culvert at Conifer Boulevard was added that reduces flood water levels along Lancaster Street. However, high water still persists at the corner of Oxford Circle and Lancaster Street due to the undersized culverts at Oxford Circle.

Options for alleviating the flooding along Lancaster Street are limited. Replacing the bridges at Conifer Boulevard and Oxford Circle would eliminate the flooding in this area, but could increase the flooding downstream of Conifer Boulevard, particularly during larger storm events that are coupled with high water levels in Stewart Slough. Increasing the size of the channel directly upstream of Conifer Boulevard provides very limited improvement. A 24-acre-foot detention facility located upstream of Highway 99 would reduce flows by approximately 100 cfs and would reduce the potential for flooding along Lancaster Street. However, the construction cost for the facility is estimated at nearly \$500,000. A detention facility's impacts on the groundwater hydrology and hydraulics of the Jackson-Frazier Wetland would have to be evaluated. The proposed location of a detention facility is a designated wetland area that would present construction-permitting challenges. Expanding the detention capabilities of the Jackson-Frazier Wetland and re-establishing the discharge point from the northeast corner of the wetlands appear to have the greatest potential for removing the persistent Village Green Creek flooding.

A number of studies and planning efforts are currently underway for the Jackson-Frazier Wetland. The wetland is part of the Benton County park system. The Jackson-Frazier Wetland Advisory Committee, which is appointed by the Benton County Board of Commissioners, is expecting a revised master plan for the County park containing the wetland. An Oregon State University engineering class is conducting a hydrologic study of the wetland. The study includes monitoring of

inflows and outflows to determine the water balance of the wetland. The City is also removing portions of the earthen berm that separate the wetland from several formerly connected wetland acres to the southwest.

Coordination with the ongoing studies and planning efforts is required to better define the hydrology and hydraulics of the Jackson-Frazier Wetland. The outcome of these studies will help determine whether additional storage or diversion is available as a valid alternative for reducing the potential for flooding along Lancaster Street.

**Table 8-3. Jackson/Frazier/Village Green Options**

Reach	Abridged observations	Recommended activity	Priority
Sequoia Confluence to Conifer Boulevard	1) Lack of habitat and constricted channel.	a. Reconnect floodplain and provide for stream meander at Village Green Park and plant native vegetation.	Long-term
		b. Plant trees at top of bank for shade.	Short-term
	2) Constricted channel upstream of park.	a. Widen channel upstream of park where space permits.	Long-term
	3) Opportunity for water quality or detention facility at Village Green Park.	a. Begin talks with Parks Department about concept. Conduct detailed survey work to determine potential volume of treatment.	Long-term
	4) Flat channel downstream of Village Green is prone to vegetation blockages.	a. As part of a comprehensive analysis of stream corridor issues, including Jackson-Frazier Wetland hydraulics, determine extent of flooding and ways to deal with source of blockages.	Short-term
Conifer Boulevard to Jackson-Frazier Wetland	1) Local concerns about flooding during large storms.	a. Address with storage/diversion at Jackson-Frazier Wetland. (See appropriate reach below).	Long-term
	2) Lack of shade along stream.	a. Plant trees/shrubs as part of community involvement program. Use dense or thorny shrubs or other ground cover to limit heavy foot traffic in eroded areas.	Short-term
Jackson-Frazier Wetland	1) The hydrologic response of the wetlands is poorly understood. City may have future responsibility for stormwater flows through ditch to the northeast.	a. Coordinate with County and Oregon State University studies to determine flow regime and storage potential of wetland, especially flow split between Village Green and drainage ditch to northeast. Coordinate with Jackson-Frazier Friends group.	Short-term

**Table 8-3. Jackson/Frazier/Village Green Options (continued)**

Reach	Abridged observations	Recommended activity	Priority
Jackson-Frazier Wetland to Highland Drive (Jackson Creek)	1) Limited buffer width along some sections of the stream.	a. Work with agricultural interests to increase vegetative buffer width along stream.	Long-term
		b. Establish conservation easements with willing property owners.	Short-term
	2) Channel erosion, concrete debris, and invasive vegetation adversely impact channel downstream of Highland Drive.	a. Remove non-native vegetation, widen streambanks and stabilize with willow plantings. Work in conjunction with #4, below.	Short-term
	3) Potential wetland restoration opportunity downstream of Highland Drive and Crescent Valley High School.	a. Investigate property ownership and willingness of owner to sell wet meadow. Work in conjunction with #1, above.	Long-term
	4) Unpermitted private creek crossings and reported dam.	a. Provide information to property owners about permitting requirements.	Ongoing
Crescent Valley High School (Highland Drive to Crescent Valley Drive-Jackson Creek)	1) PVC pipe crossing creek (16-inch water main).	a. Re-route pipe along roadway.	Short-term
	2) Channel erosion and invasive vegetation through Crescent Valley High School grounds.	a. Community stewardship opportunity to work with school to remove non-native invasive species like blackberry and ivy.	Short-term
	3) Potential capacity problems with Crescent Valley High School bridges and culverts.	a. Call problem to school district's attention.	Short-term
		b. Widen channel upstream of school and provide for stream meander.	Long-term
4) Pollution potential from Crescent Valley High School parking lots and athletic fields runoff. Spills reported from wastewater pump station at school into creek.	a. Coordinate with school district to install end-of-pipe treatment before discharge to stream from parking lots. Cut back pipe to allow vegetative treatment for playing field underdrains. Follow up on City plans for backup generator in 2003.	Short-term	

**Table 8-3. Jackson/Frazier/Village Green Options (continued)**

Reach	Abridged observations	Recommended activity	Priority
Crescent Valley Drive to McDonald State Forest (Jackson Creek)	1) Excessive velocities indicate risk of erosion.	a. Anchor large, woody debris to slow flows and provide more varied habitat.	Long-term
		b. Develop conservation easements and stewardship programs in conjunction with property owners and County.	Short-term
	2) Flooding reported upstream of Crescent Valley High School.	a. Work with County to confirm hydraulic analysis of replacement bridge at Crescent Valley Drive.	Short-term
	3) Residences with landscaping to edge of stream and constructed dams, waterfalls, and stream crossings impinging on creek.	a. Educational efforts with residents to avoid water quality and fish passage problems.	Ongoing
Jackson Creek Headwaters (McDonald State Forest)	1) Logging practices and road construction in McDonald State Forest affect peak flows and erosion downstream.	a. Coordinate with Oregon State University Forestry Department and other property owners.	Short-term
Highway 99 to Highland Drive (Frazier Creek)	1) Many Frazier Creek tributaries are agricultural ditches with little or no trees for shading.	a. Increase buffer width and plant trees for shade along ditches.	Long-term
		b. Develop conservation easements and stewardship programs in conjunction with property owners and County.	Short-term
	2) Creek velocities may contribute to erosion.	a. Plant vegetation, such as willows or alders, to stabilize trouble spots.	Short-term

**Table 8-3. Jackson/Frazier/Village Green Options (continued)**

Reach	Abridged observations	Recommended activity	Priority
Highland Drive to Crescent Valley Drive (Frazier Creek)	1) Vegetative buffer width limited throughout this reach.	a. Increase buffer width and plant trees for shade along ditches.	Long-term
		b. Develop conservation easements and stewardship programs in conjunction with property owners and County.	Short-term
	2) Modeling predicts flooding of Highland Drive stream crossing from backwater during 10-year storm.	a. Reconnect stream with floodplain and provide for stream meander upstream of Highland Drive, allowing for more storage.	Short-term
Frazier Creek Headwaters	1) Angled culvert under Frazier Creek Road may cause capacity, erosion problems.	a. Coordinate with County to confirm history of flooding with local residents. If flooding is not an issue, armor culvert entrance and exit to minimize erosion. If flooding is an issue, use longer culvert to straighten flow path.	Long-term
	2) High velocities contributing to erosion problems observed in field.	a. Stabilize streambanks through vegetative plantings.	Short-term
	3) Poor habitat, either blackberries or residential lawns.	a. Replace invasive species with native species.	Long-term
b. Develop conservation easements and stewardship programs in conjunction with property owners and County.		Short-term	
Sulphur Springs Branch (Frazier Creek)	1) County has responded to the high velocities with a riprapped channel and concrete check dams.	a. Coordinate with County to inspect regularly for signs of erosion.	Short-term

**Table 8-4. Jackson/Frazier/Village Green Creeks Short-Term Program**

Reach	Recommended activity	Capital cost (\$)	Annual O&M (\$)	Project type <sup>1</sup>
Sequoia Confluence to Conifer Boulevard	1) Plant trees at top of bank for shade.	22,000	NA	Green line
	2) As part of a comprehensive analysis of stream corridor issues, including Jackson-Frazier Wetland hydraulics, determine extent of flooding and ways to deal with source of blockages.	30,000	NA	
Conifer Boulevard to Jackson-Frazier Wetland	1) Plant trees/shrubs as part of community involvement program. Use dense or thorny shrubs or other ground cover to limit heavy foot traffic in eroded areas.	2,100	100	Green line
Jackson-Frazier Wetland	1) Coordinate with County and OSU studies to determine storage potential and flow regime of wetland, especially flow split between Village Green and drainage ditch to northeast. Coordinate with Jackson-Frazier Friends group.	19,200	NA	
Jackson-Frazier Wetland to Highland Drive (Jackson Creek)	1) Establish conservation easements with willing property owners.	4,000	NA	
	2) Remove non-native vegetation, widen stream and stabilize with willow plantings. Work in conjunction with long-term projects.	60,000	3,000	
Crescent Valley High School (Highland Drive to Crescent Valley Drive-Jackson Creek)	1) Reroute water pipe along roadway.	28,000	NA	
	2) Community stewardship opportunity to work with school to remove non-native invasive species like blackberry and ivy.	400	NA	
	3) Call potential flooding problem to school's attention.	200	NA	
	4) Coordinate with school district to install end-of-pipe treatment before discharge to stream from parking lots and cut back pipe to allow vegetative treatment for playing field under-drains.	800	NA	
Crescent Valley Drive to McDonald State Forest (Jackson Creek)	1) Develop conservation easements/ stewardship programs in conjunction with property owners and County.	4,000	NA	
	2) Work with County to confirm hydraulic analysis of the replacement bridge at Crescent Valley Drive.	800	NA	

**Table 8-4. Jackson/Frazier/Village Green Creeks Short-Term Program (continued)**

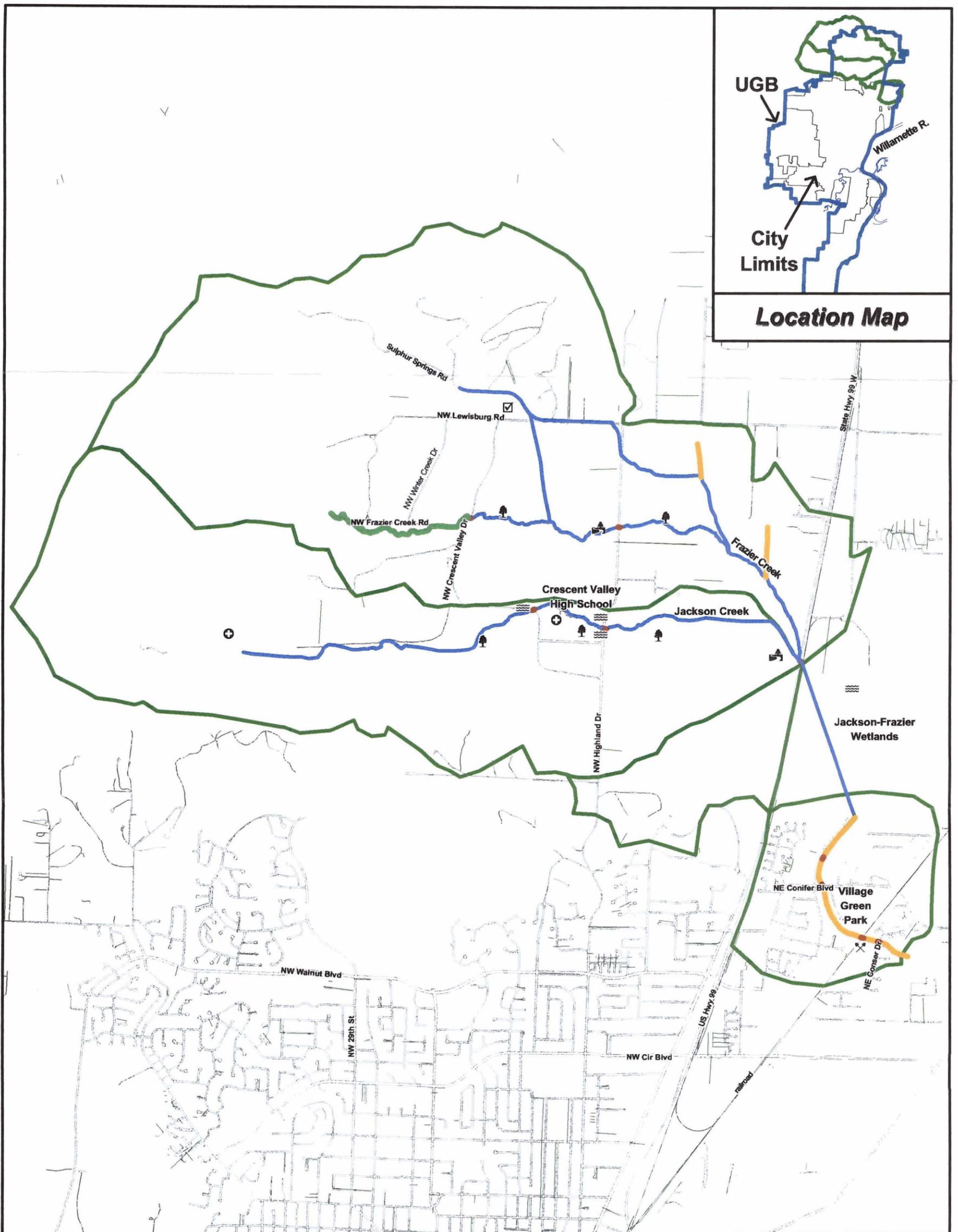
Reach	Recommended activity	Capital cost (\$)	Annual O&M (\$)	Project type <sup>1</sup>
Jackson Creek Headwaters (McDonald State Forest)	1) Coordinate with Oregon State University Forestry Department and other property owners.	800	NA	+
Highway 99 to Highland Drive (Frazier Creek)	1) Develop conservation easements/stewardship programs in conjunction with property owners and County.	4,000	NA	🌲
	2) Plant vegetation, such as willows or alders to stabilize trouble spots.	6,000	300	Green line
Highland Drive to Crescent Valley Drive (Frazier Creek)	1) Develop conservation easements/ stewardship programs in conjunction with property owners and County.	4,000	NA	🌲
	2) Coordinate with County to reconnect stream with floodplain and provide for stream meander upstream of Highland Drive, allowing more storage.	800	NA	🌲
Frazier Creek Headwaters	1) Stabilize streambanks through vegetative plantings.	800	NA	Orange line
	2) Develop conservation easements/ stewardship programs in conjunction with property owners and County.	4,000	NA	🌲
Sulphur Springs Branch (Frazier Creek)	1) Coordinate with County to inspect regularly for signs of erosion.	NA	400	☑
<b>Total</b>		<b>191,900</b>	<b>3,800</b>	

<sup>1</sup>Project types are in the Figure 8-3 map legend.

**Table 8-5. Jackson/Frazier/Village Green Creeks Long-Term Program**

Reach	Recommended activity	Capital cost (\$)	Annual O&M (\$)	Project type <sup>1</sup>
Sequoia Confluence to Conifer Boulevard	1) Reconnect floodplain and provide for stream meander at Village Green Park and planting trees	100,000	5,000	
	2) Widen channel upstream of park where space permits	60,000	3,000	
	3) Begin talks with Parks Department on concept of detention at Village Green Park. Conduct detailed survey work to determine potential volume of treatment.	1,400	NA	
Jackson-Frazier Wetland to Highland Drive (Jackson Creek)	1) Work with agricultural interests and local conservation district to increase vegetative buffer width along stream.	2,000	NA	
	2) Investigate property ownership and willingness of owner to sell wet meadow. Work in conjunction with short-term projects.	4,000	NA	
Crescent Valley School (Highland Drive to Crescent Valley Drive-Jackson Creek)	3) Coordinate with County to widen channel and provide for stream meander upstream of school.	2,000	NA	
Crescent Valley Drive to McDonald State Forest (Jackson Creek)	1) Anchor large, woody debris to slow flows and provide more varied habitat.	20,000	1000	
Highway 99 to Highland Drive (Frazier Creek)	1) Increase buffer width and plant trees for shade along ditches.	12,000	NA	Green line
Highland Drive to Crescent Valley Drive (Frazier Creek)	1) Increase buffer width and plant trees for shade along ditches.	4,000	NA	Green line
Frazier Creek Headwaters	1) Coordinate with County to confirm history of flooding with local residents. If flooding is not big issue, armor culvert entrance and exit to minimize erosion. If flooding is issue, use longer culvert to straighten flowpath.	1,400	NA	
	2) Coordinate with County and landowners to replace invasive species with native species.	1,400	NA	
<b>Total</b>		<b>208,200</b>	<b>9,000</b>	

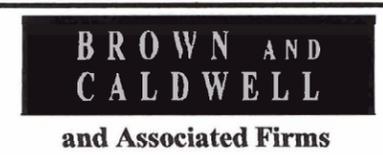
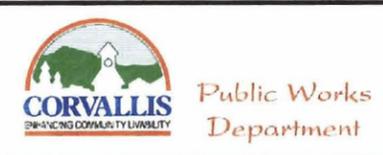
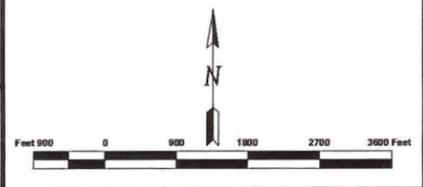
<sup>1</sup>Project types are in the Figure 8-4 map legend.



**Figure 8-3 Short Term Project Locations**

**LEGEND**

- |  |                         |  |                     |  |                         |
|--|-------------------------|--|---------------------|--|-------------------------|
|  | Pipes/Bridges           |  | Channels            |  | Basin Boundary          |
|  | Bank Stabilization      |  | Canopy Revegetation |  | Channel Improvement     |
|  | Replace Pipe/Bridge     |  | Fish Passage        |  | Buffer/Riparian Habitat |
|  | Floodplain Reconnection |  | Water Quality BMP   |  | Flood BMP               |
|  | Maintenance             |  | Monitor             |  | Multi-Use Facility      |



report/figures/final/fig8-3.wor, October 27, 2000, base data from City of Corvallis GIS Department



**Figure 8-4 Long Term Project Locations**

**LEGEND**

- |  |                         |  |                     |  |                         |
|--|-------------------------|--|---------------------|--|-------------------------|
|  | Pipes/Bridges           |  | Channels            |  | Basin Boundary          |
|  | Bank Stabilization      |  | Canopy Revegetation |  | Channel Improvement     |
|  | Replace Pipe/Bridge     |  | Fish Passage        |  | Buffer/Riparian Habitat |
|  | Floodplain Reconnection |  | Water Quality BMP   |  | Flood BMP               |
|  | Maintenance             |  | Monitor             |  | Multi-Use Facility      |

