CHAPTER 6: PROBLEM IDENTIFICATION AND PRIORITIZATION

The hydrology, water quality and habitat studies summarized in chapters 3 through 5 form the basis of the problems identified in this chapter. Field work by city and county staff and complaints from basin residents identified additional problem sites. This chapter presents a general overview of stormwater-related problems, and describes the specific existing and future problems in the basin. Preceding chapters described the existing characteristics of the basin; subsequent chapters recommend problem solutions.

6.1 OVERVIEW OF STORMWATER-RELATED PROBLEMS

Stormwater-related problems in the basin include flooding of roads and residential areas, water-quality degradation, and fish habitat degradation.

6.1.1 FLOODING OVERVIEW

The extent and impact of flooding varies widely around the basin. The flooding analysis included two parts: modeling the effects of future development on Green Cove Creek and associated wetlands; and identifying flooded homes and roads. The modeling results are reported in the habitat problems section. The flooding problems described here threaten homes, roads, or public health and safety.

Flooding occurs naturally when storms cause waterways to overflow their banks. Forests intercept and absorb rainfall, which reduces flooding of streams and property. Repeated flooding creates floodplain areas around streams, which absorb overflow waters and slow down the flows, reducing damage.

Flooding in developed areas results from several factors, including:

Increased Impervious Area. Buildings and pavement cover the land with impervious surfaces that prevent the soil from absorbing rainfall, so flooding usually increases with development. When impervious coverage within a basin exceeds 10% to 15%, stream hydrology, water quality and habitat quality decline (Klein 1979; Schueler 1994). Impervious surfaces currently (1989) cover about 8% of the Green Cove basin.

Clogged Stormwater Facilities. Dry wells and retention ponds, which drain runoff into the ground, fail when they become clogged with fine sediments from road and construction site runoff. The natural infiltration capacity of most soils in the basin is low, and additional compaction and sedimentation during construction can make the soils almost impervious. Clogged facilities cause localized flooding, often in residential neighborhoods.

Inadequate Stormwater Facility Design. Many older system designs relied on less sophisticated methods to determine volumes of runoff than the methods available now. Frequently, those older systems were designed with inadequate capacity, causing stormwater runoff to back up and overflow onto roads and property.

Perched Water Tables. Layers of impermeable, clay-cemented till that occur below the soil surface in some areas of the basin create "perched" high water tables when the soil becomes saturated. They can flood stormwater facilities and lowlands.

6.1.2 Water Quality Problem Overview

The water quality assessment performed for this basin plan identified several specific water quality problems. Chapter 4 summarized the overall water quality conditions in the basin.

Non-point Pollution. Pollutants accumulate on the landscape during the dry season when there are few storms to carry them away. Stormwater washes pollutants from the landscape into streams, lakes and wetlands. Stormwater runoff pollution is called "nonpoint pollution," because it originates from many dispersed sources rather than a single point such as a sewage plant discharge pipe. The initial storms of autumn carry the highest levels of contamination as the first flush of runoff scours catch basins, lawns, fields and streets.

Sediment. Stormwater runoff collects sediments from pavement, construction sites, and eroding slopes and ditches. Clearing and grading can increase sediments in runoff, if effective erosion controls are not applied. Dirty stormwater facilities can also add sediment to runoff. Sediment often contains fecal coliform, heavy metals and other pollutants.

Fecal Coliform. Runoff can pick up fecal coliform bacteria from human and animal feces. Pet waste and failing septic systems are common sources of fecal coliform in urbanizing areas.

Properly functioning septic systems require at least 2-4' of unsaturated, relatively fine soil. Stormwater can saturate fine soils, flooding septic systems and allowing untreated effluent with fecal coliform contamination to flow directly into surface and ground water. Drainage systems that drain runoff into the ground can worsen the problem. The same thing can occur wherever ground water rises near the surface during the rainy season.

6.1.3 Fish Habitat Problem Overview

Declining fish runs result from several factors that are too complex to trace back to individual causes (Reinelt 1990). However, biologists have noted for more than 100 years that habitat loss causes fish runs to decline (Van Cleef 1885), and several biologists agree that habitat loss is the biggest single cause of decreased salmon runs in Puget Sound streams (Bisson 1992; Shuller 1992). This plan only deals with the fish habitat problems associated with stormwater, not other fish management issues such as fishing quotas or fish stocking rates.

Chapter 5 summarizes the elements of good fish habitat, including food, shelter and other environmental needs for fish survival. Each fish species has unique habitat requirements, but the plan focuses on the needs of coho (the Washington Department of Fish and Wildlife uses Green

Cove Creek as an "index" creek for coho). Chum and coho are the primary anadromous fish species found in Green Cove Creek (Jim Fraser, personal communication, 1996).

The loss of fish habitat in Green Cove basin has resulted from several factors:

Vegetation Clearing. Vegetation is often cleared to develop land. Removing streamside vegetation can reduce fish populations because it reduces cover and food sources for fish, raises stream temperatures, degrades water quality, increases erosion and sedimentation, and reduces the large woody debris that forms pools (Shlosser 1991; Gregory et al 1991; Sedell and Beschta 1991). Forest clearing increases flood frequency in creeks (Nelson 1992), so the riparian vegetation never gets a chance to recover.

Fish Barriers. Artificial fish migration barriers include culverts that create flow velocities too high for fish to swim against, and raised culvert outfalls that create cascades too high for fish to jump. Culverts also tend to block the natural movement of gravel in a stream. Fish barriers reduce a stream's capacity to sustain fish production.

Altered Hydrology. Urbanization increases stream peak flows and lowers summer base flows, which can limit available fish habitat (Nelson 1992). High peak flows degrade fish habitat by reducing in-stream pools and eddies and washing away streamside vegetation, woody debris and spawning gravels (Booth 1992). Reduced habitat complexity caused by urbanization decreases the fish population and diversity (Lucchetti 1992). High peak flows can also flood road crossings and block fish passage. Fish and overall stream health often suffer more damage from changes to stream hydrology than from water quality degradation (Scott 1982; Steward 1983; Bissonnette 1985).

Water Quality Degradation. Pollutants that affect fish habitat include nutrients that cause algae blooms and deplete dissolved oxygen; soap products; extremely acid or alkaline substances; and sediments.

6.2 EXISTING PROBLEMS

Stormwater runoff causes several existing problems in the basin that result in flooding and degraded water quality and fish habitat (see figure 6-1).

PROBLEM #1: FLOODING FROM STORMWATER RUNOFF

All the precipitation that falls on southern Green Cove basin either evaporates, infiltrates into the ground or drains to Grass Lake wetlands. The sub-basins that drain to Grass Lake wetlands include GC10 through GC40, which comprise 938 acres, or 36% of the entire basin. Ultimately, this entire area drains into Lake Louise and through a culvert under Kaiser Road to feed Green Cove Creek. This concentration of runoff triggers flooding at Kaiser Road.

Figure 6-1 Grass Lake wetland drainage area and Kaiser Road flooding location

FL1: KAISER ROAD FLOODING

Kaiser Road floods at the Green Cove Creek culvert near the outlet to Lake Louise during major rainfalls. When the water flows across the road, it creates a public safety hazard. Flooding occurs when rainfall in the winter fills Lake Louise faster than the culvert can discharge. At these times, the road becomes, in effect, the overflow outlet for the adjacent wetlands.

PROBLEM #2: FLOODING FROM SEASONAL HIGH WATER TABLES

Seasonal high water tables occur in areas where poorly drained till layers underlie the topsoil, which includes much of northern Green Cove basin. Till layers vary in depth from the surface, thickness, permeability and extent. Highly impermeable till layers may occur close to the surface at one location and be entirely absent just a short distance away. Many of the northern basin's wetlands have developed where shallow till layers trap water close to the surface. Some of these "perched" water tables reach the surface only during the rainy season in years with heavy rainfall. Seasonal high water triggers the following flooding problems in the basin (see map 14).

FL2: RESIDENTIAL FLOODING FROM SEASONAL HIGH WATER

The following residences experience flooded basements, garages, or driveways:

3404 Country Club Drive NW
4037 Green Cove Street NW
3349 36th Avenue NW
3619 36th Avenue NW
3718 Wesley Loop NW
3604 Wesley Drive NW
3644 Wesley Drive NW
3409 Cooper Point Road NW

Several factors contribute to the problem of homes sited in areas with seasonal high water, including:

1) Soil drainage tests are not required for permits to build single family homes, duplexes, buildings with less than 5000 square feet of impervious surface, and buildings on approved plats.
2) Soil drainage tests are not required to add less than 5000 square feet of impervious surface to an existing building.
3) Many older homes were built before any drainage tests were required.
4) The extent of subsurface till layers is difficult to determine.
5) Visual evidence of seasonal high water often appears only during unusually wet winters.
6) County and city floodplain maps do not indicate flood areas caused by high water tables.
7) Poorly drained soils often produce no runoff when the land is forested; drainage problems do not occur until after the land has been cleared for construction.

8) Construction practices further reduce the soil's ability to infiltrate rainfall.
9) Development exacerbates seasonal high water by consolidating runoff from a large area into relatively small infiltration areas.
10) Groundwater protection regulations make it impractical to discharge runoff into the deeper soils underlying till layers.

PROBLEM #3: FLOODING FROM UNMAINTAINED STORMWATER FACILITIES

All stormwater facilities require maintenance in order to function properly. Needed maintenance includes mowing swales, removing blockages from culverts and outfalls, and cleaning sediment from catch basins, dry wells and ponds. Most subdivisions built before 1991 have no drainage maintenance plan and no organization with legal responsibility to maintain the facilities. These locations in the basin experience flooding from unmaintained drainage systems (see map 14).

FL3: RESIDENTIAL FLOODING FROM UNMAINTAINED DRAINAGE FACILITIES

The following locations experience residential flooding due to unmaintained drainage facilities:

2903 29th Avenue NW
3927 Hillview Court NW
1517 Briarwood Court NW
3818 Hillview Court NW
3825 Hillview Court NW

PROBLEM #4: POLLUTED STORMWATER

Stormwater runoff conveys fecal coliform bacteria and sediment into receiving waters, including Grass Lake wetlands, Green Cove Creek, and Eld Inlet. Stormwater runoff can cause streams to exceed state water quality standards for fecal coliform, resulting in public health hazards. Fecal coliform in runoff can also trigger commercial shellfish harvesting restrictions or closures, because the shellfish become unsafe for human consumption. Possible sources of fecal coliform include septic systems, sewer lines, pet waste, and wildlife. The following sites in Green Cove basin have fecal coliform contamination problems.

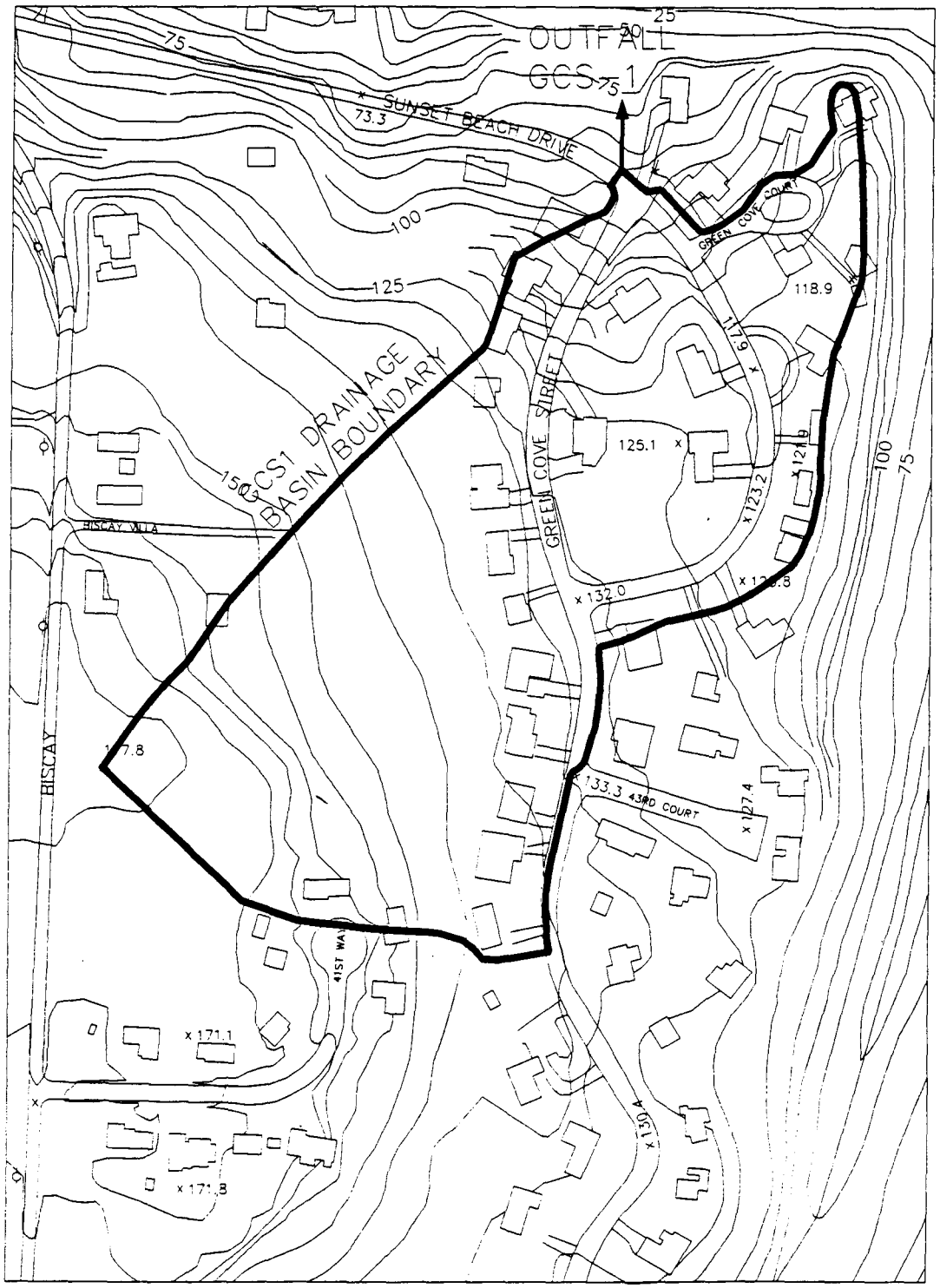
WQ1: HIGH FECAL COLIFORM LOADING IN STORMWATER ON SUNSET BEACH DRIVE

Stormwater runoff from a residential neighborhood on Sunset Beach Drive contributes high loads of fecal coliform bacteria and sediment to Green Cove shellfish areas (see figure 6-2). The likeliest source at this site is failing septic systems.

WQ2: HIGH FECAL COLIFORM LOADING IN STORMWATER ON EVERGREEN PARKWAY

High fecal coliform loads in stormwater runoff from a residential neighborhood on Evergreen Parkway increase the bacteria loading in Green Cove Creek, which threatens downstream

Figure 6-2 Outfall GCS1 contributing drainage basin area



shellfish resources (see Outfall GCS5 on Map 10). The likeliest source at this site is failing septic systems.

WQ3: HIGH FECAL COLIFORM LOADING IN GREEN COVE CREEK BETWEEN KAISER ROAD AND EVERGREEN PARKWAY

Fecal coliform bacteria from unknown sources significantly increases the loading levels in Green Cove Creek between Kaiser Road and Evergreen Parkway, which threatens downstream shellfish resources (see Segment #3 between Kaiser Road and Evergreen Parkway on Map 2). Sources at this site could include leaking sewage at the lift station, failing septic systems, or wildlife in the adjacent wetlands.

WQ4: INFREQUENT HIGH FECAL COLIFORM AND SEDIMENT LOADS ON 14TH AVENUE NW

Stormwater runoff from a residential neighborhood on 14th Avenue NW occasionally deposits high sediment and fecal coliform concentrations into the Grass Lake wetland, potentially degrading Olympic mud minnow habitat and altering wetland aquatic communities (see outfall GCS7 on Map 10B). School construction upstream of the outfall probably caused the initial high levels of sediment. Later, sediment could have come from street dust or residual sediment within the stormwater system. Fecal coliform sources may include leaking sewer lines, pet waste and wildlife.

PROBLEM #5: STORMWATER DISCHARGES TO THE GREEN COVE CREEK RAVINE

Stormwater runoff from roads and homes around Green Cove Creek in the northern basin discharges to the Green Cove Creek ravine. In a few locations, runoff discharges directly onto the slopes of the ravine from ditches and culverts. In other locations, stormwater infiltration facilities drain runoff into the soil. When the infiltrated runoff hits a dense till layer, it migrates laterally through the soil, over the till layer, toward the ravine and discharges as seeps on the ravine slopes. It is impossible to gauge how much seepage is caused by drainage facilities versus natural subsurface flow. The stream ravine contains the following sites where stormwater discharges have caused slides that deposited fine sediment in the stream, degrading fish habitat.

HAB1: OUTFALL-TRIGGERED SLIDE ON GREEN COVE STREET

Stormwater from Green Cove Street discharges through an outfall onto a steep, unstable slope on the west side of the creek (see Segment 2C, left bank, sta. 4+30 on Map 12). The outfall has since been extended down to a stable point lower in the ravine, and the existing slide is slowly revegetating, but the surface continues to erode slowly into the creek. The sediment degrades salmon spawning habitat in the creek.

HAB2: SEEP-TRIGGERED SLIDES ON THE WEST SLOPE OF GREEN COVE CREEK

Seeps have triggered several slides on the west slope of the Green Cove Creek ravine, below the most developed area near the ravine. A few of the seep-triggered slides have delivered fine sediment to the creek (see segment 2 on Map 12). Fine sediment delivered to the creek degrades the salmon spawning habitat in the creek.

PROBLEM #6: DUMPING IN GREEN COVE CREEK

People have dumped trash and garbage into Green Cove Creek and used waste material such as old tires to attempt to armor the banks of the creek.

HAB3: GARBAGE DUMPS IN GREEN COVE CREEK

During the stream habitat survey of Green Cove Creek, a significant garbage dump was located in Segment 2B, a few hundred meters downstream of 36th Avenue (see Map 12). Garbage included old metal 55 gallon drums and various lumber that had been placed along the right bank of the creek, to shore it up near a footbridge.

6.3 FUTURE PROBLEMS

The problems described above are likely to worsen in the future as new development continues to alter the basin runoff patterns. Existing drainage design and construction standards cannot completely prevent future stormwater-related problems. The basin is currently on the threshold of more significant environmental degradation. The channel of Green Cove Creek is especially vulnerable to increased peak flows.

PROBLEM #7: INCREASED FUTURE FLOODING IN GREEN COVE CREEK

The Kaiser Road flooding and habitat degradation resulting from stormwater runoff, described above, will increase in the future as more development occurs. The landslides in the Green Cove Creek ravine, described above, will also increase. In addition, habitat in other areas of the Green Cove Creek may begin to degrade. Increased runoff will also increase peak flows downstream in Green Cove Creek.

HAB4: EROSION AND DESTABILIZATION OF GREEN COVE CREEK CHANNEL

Future development will add to stormwater runoff to Green Cove Creek, increasing the peak flows in the creek, especially below 36th Avenue. Runoff from all areas of the basin will add to the peak flows, but the greatest contribution will come from the areas near the creek in sub-basins GC70 and GC80. The creek channel is relatively stable now, able to withstand the current level of active bank erosion. However, the creek is now at capacity and increased peak flows are likely to cause future erosion and destabilization of the channel.

Increased peak flows cause the creek to overflow its banks more frequently, eroding away the toes of the steep slopes at the edges of the floodplain. When this occurs, large amounts of sediment are deposited in the lower gradient areas, which increases the steepness of the higher

gradient areas. The creek enters a cycle of bank erosion, deposition, downcutting, and more bank erosion. The result is significantly degraded fish habitat due to loss of pools, cover and spawning gravel.

HAB5: INCREASED SLIDES IN GREEN COVE CREEK RAVINE

Future development will increase the number of direct discharges to the Green Cove Creek ravine, and the number of stormwater infiltration facilities in areas above the ravine. Direct discharges to the ravine will probably cause additional slope failures in the future, similar to the slide that occurred where the Green Cove Street outfall discharged to the slope (problem HAB1). New infiltration facilities upslope of the ravine will concentrate subsurface flows and will probably lead to more seep-triggered slides in the future, similar to the existing slides west of Green Cove Creek (problem HAB2).

PROBLEM #8: INCREASED FLOODING FROM SEASONAL HIGH WATER TABLES

Future development will eliminate more forest cover and drain more runoff into the ground through infiltration facilities. This will make the seasonal high water tables rise faster and more frequently, and standing water is likely to occur in areas that currently remain unflooded.

FL4: INCREASED FUTURE RESIDENTIAL FLOODING

Existing homes that do not currently experience flooding problems, and new homes, are likely to have flooding in the future. Mapping has not yet been done to indicates the areas most likely to experience flooding problems, based on soil type, well-log information and aerial photographs taken during flooding in 1996.

6.4 SIGNIFICANT ISSUES

Analysis of the basin's water resources and discussions with the citizen task force identified key issues. The primary beneficial uses of the basin's surface waters determined by staff and the citizen committee were: healthy, complex ecosystem functions in Grass Lake wetlands; healthy salmon habitat in Green Cove Creek; and, shellfish fit for human consumption in Green Cove.

6.4.1 MANAGING FUTURE FLOWS IN GREEN COVE CREEK

The single biggest threat to the basin's beneficial surface water uses is posed by future excess stormwater runoff to Green Cove Creek. Increased stormwater runoff in the future could cause several impacts of concern. First, increased runoff would trigger high peak flows in Green Cove Creek that could destabilize the stream channel and threaten the salmon habitat. Second, increased future runoff could carry more pollutants into Green Cove, endangering the shellfish resources there. Third, increased future runoff could cause flooding problems for some of the property owners around the creek and wetlands.

Consequently, the top priority that emerged during the planning process was reducing future stormwater runoff to Green Cove Creek. The planning process considered both engineered solutions and land use changes. The next chapter summarizes this analysis.

6.4.2 Reducing Flooding From Seasonal High Water Tables

The other major issue to emerge during the planning process was the problem of residential flooding from shallow groundwater. Two consecutive years of high rainfall and extreme flooding occurred during the planning process. Local governments were inundated with requests for assistance from landowners all over the county who experienced flooding in places where flooding had not occurred within the last twenty years.

Staff investigated each flooding complaint, and identified several contributing factors. One of the biggest problems was that local agencies that regulate development had no previous documentation of flood-prone areas. Federal flood plain maps, which form the basis of most local flood-related development regulations, turned out to be inaccurate. Flood plain maps were limited to flooding alongside streams and rivers; they did not show shallow water table areas.

Another major problem was lack of detailed soils information about the actual building sites. Large developments provide soil drainage studies before the streets and sidewalks are laid out. However, the individual houses in those developments are required to provide drainage on-site for their individual stormwater systems. These houses are not required to conduct additional soil drainage studies prior to building.

In rural areas, the best-drained soils are frequently used for siting septic systems, because these systems require a certain depth of dry soil to function correctly. Unfortunately, this leaves the worse-draining areas for building sites. Again, many proposed single-family residences in rural areas are not required to provide detailed soil drainage studies prior to building.

The residential sites where high groundwater causes flooding cannot usually be repaired by building stormwater drainage systems, because it is not feasible to dry out all the water seeping through the ground from hundreds of surrounding acres. As staff and the citizen committee examined these flooding problems, the focus turned toward preventing additional flooding problems in the future. Developing better information on flood-prone areas, and requiring more detailed soil drainage studies before siting a house, emerged as the top priorities. The analysis of alternatives and the recommendations that follow reflect these priorities, while attempting to balance the trade-offs.

CHAPTER 7: ANALYSIS OF ALTERNATIVES TO REDUCE FUTURE PEAK FLOWS IN GREEN COVE CREEK

To evaluate various alternatives aimed at limiting future peak flows to Green Cove Creek, a hydrologic model was developed and calibrated against four years of rainfall and streamflow data. Numerous structural (construction) projects were evaluated along with the impact of imposing existing county stormwater development standards. Lastly, the impact of retaining a defined amount of forest canopy coverage, at basin "build out", was evaluated to assess its expected impact to reduce increases in future peak flows within Green Cove Creek.

7.1 Hydrologic Model:

Hydrological Simulation Program Fortran (HSPF), originally developed for the United States Environmental Protection Agency in the early 1980's, remains the single best tool for watershed evaluations today. Models are created using area specific parameters such as: land cover type, slope, soil type and percent impervious coverage. The model is then fed continuous rainfall records to determine watershed percolation, runoff, evaporation, discharge to deep groundwater and base flows to area streams. Following model creation, the model is calibrated against actual recorded watershed rainfall and stream flows. In the case of Green Cove Creek, four years of precipitation data from 36th Avenue NW and associated stream flow data were used to initially calibrate the model. Lastly, the model was verified by using 39 years of continuous rainfall data from the Olympia Airport. Once calibration and verification are complete, various proposed changes (alternatives) are "run" through the model to examine their relative value at reducing future peak flows within Green Cove Creek.

7.2 Results of the Model Calibration and Verification:

The model compares favorably with measured stream flows at 36th Avenue NW. Simulated volumes matched actual volumes within 15%. Longer duration flooding events appear to more closely match actual recorded data than instantaneous events. On average, the model simulations reasonably predicted the flow patterns found in the Green Cove Creek watershed.

7.3 Alternatives Evaluated:

A. Increase the detention capacity of Louise Lake
B. Evaluate the impact to future peak flows given current zoning at "build out" conditions
C. Evaluate the impact to future peak flows given current zoning at "build out" conditions with the existing county drainage manual in place basin wide
D. Evaluate the impact of doubling existing county drainage manual standards within the basin
E. Construct new detention facilities upstream of Louise Lake
F. Divert runoff from grass lake wetlands out of the basin
H. Retain or restore 60% and 70% forest canopy coverage within the basin

7.4 Discussion of Alternatives:

A. Increase the detention capacity of Louise Lake: Several ways to increase the storage capacity of Louise Lake were considered, these, included: 1) Excavating the shoreline; 2) Constructing a berm around the lake; and 3) Lowering the lake level between storms. Of the various alternatives evaluated, increasing the detention capacity of Louise Lake was the only alternative that was not modeled. This was due to the environmental constraints of the various options.

> **Considerations used to eliminate the alternative from recommendations within the plan:** None of the Louise Lake alternatives appear to be consistent with federal, state and local requirements relative to wetland and stream corridor protection. Additionally, potential adverse impacts to fish and wildlife habitat further precluded these options from further consideration.

B. Evaluate the impact to future peak flows given current zoning at "build out" conditions: Having completed the calibration and verification of the Green Cove Creek model, basin parameters were changed to reflect future zoning and associated "build out" conditions. Using the simulated 100 year, 24 hour storm event, a future peak flow increase of 36% is predicted at 36th Avenue NW. The significance of this increase is expected owing to the fact that this location is below associated wetlands and not likely to benefit from the wetlands' ability to attenuate peak flows. The predicted ability of the wetlands' ability to buffer peak flows in the upper reaches of the watershed is verified with a predicted increase of 14% at Kaiser Road. This data suggests that the risk to the creek section below the wetlands is increased owing to predicted future development within the basin (A complete description of future predicted peak flows is available from Thurston County upon request).

C. Evaluate the impact to future peak flows given current zoning at "build out" conditions with the existing county drainage manual in place basin wide: Evaluating the benefit of the 1994 drainage manual upon future peak flows, the model predicts an increase of 34% at 36th Avenue NW (100 year, 24 hour storm). At first glance, this would seem odd given today's storage and release requirements for new development. Upon closer examination, staff determined that this prediction is consistent with hydrologic expectations owing to cover, slope and soil conditions specific to Green Cove Creek. The nature of area soils is such that a relatively shallow aquifer moves percolated water fairly rapidly to Green Cove Creek. Associated with "build out" conditions is the loss of forest canopy cover. The post-developed storage and discharge strategies currently used in Thurston County may not adequately replicate the natural hydrologic cycle that currently exists within the basin.

> **Considerations used to eliminate the alternative from recommendations within the plan:** Predicted increases in future peak flows of 34% (100 year, 24 hour storm) are not acceptable if the creek is likely to maintain its current biologic diversity. Existing standards for development drainage design are predicted to fall far short of that needed to reduce future predicted peak flows.

D. Evaluate the impact of doubling existing county drainage manual standards within the basin: To confirm the watershed's response to infiltrating stormwater from future development, the model was run with a doubling of the 1994 standards relative to storage and allowable release rates. A future peak flows increase of 16% at 36th Avenue NW (100 year, 24 hour storm) is predicted by the model. The significant indicator here is that by doubling the hydrologic delay from current standards, the watershed responds by reduced peak flows at 36th Avenue NW. This results confirms expected hydrologic system response given watershed characteristics.

E. Construct new detention facilities upstream of Louise Lake: Constructing a detention pond below the culvert at 14th Avenue appears to provide improved water quality and some peak flow attenuation to the wetland. However. this proposed pond appears to have no beneficial impact to reducing peak flows to Green Cove Creek below Kaiser Road.

F. Divert runoff from Grass Lake wetlands out of the basin: Two key diversion scenarios held some initial promise: 1) Divert flows to Mud Bay; and 2) Divert flows to the Percival Basin. The City of Olympia separately funded an alternative analysis investigating these scenarios. Diversion of flows to Mud Bay were analyzed by investigating several configuration options for an existing culvert under Mud Bay Road south of the Grass Lake wetland. Each of the culvert scenarios was examined for wetland impact by Sarah Cooke of Cooke Scientific Services. The four culvert proposals appear to reduce peak flows at Kaiser Road (18-23%) but, afford little reduction in peak flows to the remainder of Green Cove Creek. Increasing flows to Percival Basin are likely to result in adverse impacts to stream channel integrity and habitat in Percival Creek. Diverting flows to Mud Bay may afford a reduction of peak flows at Kaiser Road (8-20%) but are not likely to significantly reduce flows to the remainder of Green Cove Creek. The analysis performed by Cooke Scientific Services determined that future alterations in flow regimes from "build-out" conditions would not adversely impact biologic integrity in the Grass Lake wetlands (A complete description of the alternative analysis is available from the City of Olympia upon request).

H. Retain or restore 60% and 70% of 1989 forest canopy coverage within the basin: Having evaluated and eliminated from further consideration diverting flows from the basin, staff reviewed the predicted impacts from doubling the drainage manual requirements. Careful review of the model and the various alternative results prompted staff to request additional model runs with two separate canopy coverage conditions: 60% and 70% of 1989 forest canopy levels. These scenarios were modeled assuming a future unmitigated condition, as the costs to model the canopy retainage scenarios with a future mitigated condition would have been prohibitively expensive.

Both canopy scenarios significantly reduce future peak flows to Green Cove Creek. For the 70% alternative, future peak flows at 36th Avenue are expected to increase only 6% over current conditions, while the 60% alternative predicts a future increase of only 9% over current conditions (100 year, 24 hour storm). Most significant in the analysis is the slight increase in peak flows during the 2 year 24 hour storm of just 3%. Increasing evidence supports the theory that the smaller storm events provide the greatest harm to fish habitat by increasing the frequency of "bankfull" flow events. These "bankfull" events appear to strip the stream of sensitive habitat;

hence, the minimum number of "bankfull" events in any given year, the better for Green Cove Creek. The model predicts significant benefits to peak flow reductions when examined against all storm events.

7.5 Conclusion:

Multiple structural alternatives have been evaluated to reduce future peak flows to Green Cove Creek. The predictive model indicates retaining or restoring forest canopy coverage in the proximity of 60-70% of 1989 levels, combined with increased drainage manual requirements, are likely to provide the best approach to limiting future peak flows to Green Cove Creek. Though the predictive effects of both are not directly additive, combining a 20% peak flow reduction for canopy retainage and 20% peak flow reduction for increased manual standards will likely substantially reduce future peak flows at "build out" conditions. Essentially, by taking the action of doubling current development drainage standards and by retaining or restoring forest canopy to 60% of 1989 levels, future peak flow impacts to Green Cove Creek will be minimized to closely match peak flows currently recorded in the creek.

Complete alternatives analysis data is available from Thurston County, Department of Water and Waste Management, Storm and Surface Water Program, 921 Lakeridge Drive SW, Room 100, Olympia, WA 98503, 360-754-4681.

CHAPTER 8: RECOMMENDED PLAN

The recommended plan contains a package of measures designed to address the problems in Green Cove basin as effectively and efficiently as possible. The recommendations were developed from the analysis of alternatives presented in the previous chapter. Each recommendation includes: problems addressed (according to the problem number assigned in Chapter 6); description of the proposed solution; benefit of the proposal; cost estimate; and participants. Most of the estimated costs would require new funding sources, but those costs that could be borne within existing budgets have been identified. The participants listed include only funding and/or staffing participants, but many others would participate in implementing several of the recommendations. The recommendations are not listed in prioritized order.

Recommendation 8.1: Build a detention and treatment facility on upland properties adjacent, or directly tributary to the Grass Lake refuge.

Problems Addressed: Kaiser Rd. flooding (FL1)

Description: A stormwater detention and treatment pond would be constructed on upland properties near where sub-basin GC10 discharges into GC-35. Potential pond sites could include public and/or private undeveloped land along 14th Avenue NW. Upgrading existing onsite stormwater facilities that discharge to the refuge from the east would also be evaluated to achieve the detention and improved water quality goal.

Benefit: The project would reduce flooding of Kaiser Road . Resulting benefits include reduced public property damage and improved public safety.

Estimated Cost: $300,000 (planning level estimate)

Participants: Olympia, Thurston County

Recommendation 8.2: Thurston County and the City of Olympia should encourage landowner incentives such as conservation easements to preserve natural areas and sensitive habitats in the Green Cove Creek basin. Thurston County and the City of Olympia should also consider incentives to encourage landowners to retain natural forest cover and/or re-forest disturbed or developed properties basin wide. Additionally, Thurston County and Thurston Conservation District should actively seek out funding opportunities to purchase/lease private property for the purposes of preserving/restoring forest canopy.

Problems Addressed: Green Cove Creek future flows (HAB4), Future residential flooding (FL4)

Description: Preventing deforestation in the Green Cove Creek basin is probably the most cost effective mitigation for reducing future stormwater impacts to the creek. Tax incentive programs, such as conservation easements and the Open Space program, as well as outright public purchase of private property, will assist in maintaining and increasing forest canopy throughout the basin.

Thurston County will be working with the Capital Land Trust to hold public education events which will illustrate the conservation easement program and how basin residents can become enrolled. Thurston County and Olympia should also consider adding a new category to the Public Benefit Rating System and the Open Space program for the Green Cove Creek basin. This new category should allow small parcel owners entrance into the Open Space Program if they commit to retaining or restoring their property to long term forest management (approved management plan required). This new category should receive a high resource rating in the Public Benefit Rating System so that participants could receive the maximum property tax reduction.

Restoration programs, that purchase and/or lease private property in riparian areas for the purposes of restoring forest canopy and ecologic potential, should be investigated. Thurston County and Thurston Conservation District should actively seek out funding through these types of programs in order to preserve and/or restore forest cover and sensitive habitat.

Benefit: Habitat would be preserved and future, adverse stormwater impacts would be prevented.

Estimated Cost: Not completely identified at this time. The 1999 Thurston County Stormwater budget includes $15,000 of staff time to further develop and begin implementation of regulatory and voluntary/incentive strategies.

Participants: Thurston County, Olympia, Capital Land Trust, Thurston Conservation District

Recommendation 8.3: Raise Kaiser Road.

Problems Addressed: Kaiser Rd flooding (FL1)

Description: Kaiser Road would be raised to reduce the dip in the road where the Green Cove Creek crosses under it south of the intersection with 14th Avenue NW. An overflow culvert would be installed under the raised roadbed at the elevation of the existing road surface. The road footprint would not change.

Benefit: Kaiser Road flooding would be eliminated under most storm conditions, reducing property damage and improving public safety.

Estimated Cost: $40,000

Participants: Thurston County

Recommendation 8.4: Revise building regulations to discourage building in seasonal high water areas.

Problems Addressed: Increased future residential flooding (FL4)

Description: Building regulations would be revised to reduce residential flooding. Revisions would include:
1) Identify and map areas of seasonal high water. Aerial photographs of the County taken during the flooding in February, 1996, would be used to identify flood-prone areas and set flood elevations. Existing well logs, soil drainage reports and wetland reports would be researched to identify areas with shallow till layers and/or shallow groundwater. These sources could be used to identify sites where further drainage analysis or additional building safeguards would be needed before permitting construction.

2) Require soil tests for all new homes and commercial buildings. Existing County and City drainage regulations would be revised to require soil drainage studies for all proposed single family homes, duplexes and commercial projects within flood-prone areas. Many of these projects are currently exempt from this requirement. The requirement would include proposed buildings on individual lots within existing, approved subdivisions, if they are identified as flood-prone.

3) Change permit requirements to protect buildings from flood damage. Building permit requirements for flood-prone areas of the basin would be changed to apply the standards for building in floodplains. Basements would be prohibited, and building sites would be elevated to at least 1' above the 100-year flood elevation.

Benefit: Future property damage and health and safety hazards due to flooding would be reduced.

Estimated Cost: $20,000

Participants: Thurston County, Olympia

Recommendation 8.5: Thurston County and the City of Olympia should review and revise development regulations as appropriate, that will prevent further degradation of Green Cove Creek from stormwater impacts. Strategies that preserve and restore forest canopy should receive high priority for implementation.

Problems Addressed: Green Cove Creek future flows (HAB4), Future residential flooding (FL4)

Description: Computer modeling predicted that a minimum of 60% undisturbed forest cover retained throughout the basin would be the most effective mechanism to mitigate future stormwater impacts as the basin develops. Considering that approximately 50% of the Green

Cove Creek basin lies within Olympia and the Urban Growth Area (UGA), achieving a minimum of 60% undisturbed forest cover would be difficult given the mandated minimum densities in the City and the UGA. Sixty percent undisturbed forest cover translates to approximately 900 acres. Critical Area buffers constitute approximately 200 acres of the basin. These buffers are protected from development and could, if necessary, be restored to forest. Consequently, another 700 - 750 acres of forest need to be preserved or restored within the basin in order to meet the goal of minimizing future adverse impacts to the creek. Regulatory measures in combination with voluntary and incentive programs may be needed in order to reach this goal.

Therefore, Thurston County and Olympia should utilize a combination of regulatory measures combined with voluntary/incentive measures in order to prevent any future adverse impacts to the creek. Review and revision of development regulations may include but are not limited to:

- *Strongly encouraging development clustering where compatible with density requirements. Resource parcels should be maintained in, or restored to, forest cover.*
- *Expanding buffer widths for critical areas within the Green Cove Creek basin*
- *Increasing drainage manual standards for release rates and storage requirements within the Green Cove Creek basin*
- *Adopting seasonal grading restrictions within the Green Cove Creek basin*
- *Adopting clearing restrictions compatible with density requirements for new development within the Green Cove Creek basin.*
- *Revising construction practices as appropriate, to protect existing soil infiltration capacity.*
- *Revising building standards as appropriate, to reduce future impervious coverage.*
- *Consider re-zoning the portion of the basin within the UGA to a lower density requirement. This would allow for greater forest canopy protection. This would require amendments to the Thurston County Comprehensive Plan and the Olympia/Thurston County Joint Plan.*

Benefit: Adverse stormwater impacts from future development would be prevented to the greatest extent practicable.

Estimated Costs: Not completely identified at this time. The 1999 Thurston County Stormwater Program budget includes $15,000 of staff time to further develop and begin implementation of regulatory and voluntary/incentive strategies.

Participants: Thurston County, Olympia

Recommendation 8.6: Perform remedial maintenance at sites listed in problem statements.

Problems Addressed: Residential flooding (FL3)

Description: The stormwater systems that cause flooding at several sites in the Goldcrest subdivision would be repaired. The stormwater swale that runs along the south edge of the Marshall Middle School playfield, behind the houses on the north side of Hillview Court, would be regraded and extended to the northeast. The berm that contains runoff from the school above would also be repaired. Simultaneously, the new stormwater pond serving the school would be inspected and additional repairs would be performed, if needed.

Benefit: Residential flooding in Goldcrest would be reduced or eliminated, and stormwater that currently runs directly into the Road 65 collection system would be rerouted through the treatment pond, improving water quality.

Estimated Cost: $20,000 (funded by existing maintenance budget)

Participants: Olympia

Recommendation 8.7: Perform water quality monitoring recommended in water quality study.

Problems Addressed: Fecal coliform at three sites (WQ2, WQ3, WQ4)

Description: The water quality monitoring recommended by the Green Cove Basin Water Quality Study would be implemented, including:

1) Segmentation and water quality monitoring of Green Cove Creek. The creek would be divided into segments between Kaiser Road and Evergreen Parkway, and between Evergreen Parkway and 36th Avenue, and each segment would be sampled separately to narrow the search for sources of fecal coliform contamination. The results of the segmentation and monitoring would help direct septic survey and repair efforts, described in Recommendation 8.9, below.

2) Follow-up monitoring of Evergreen Parkway west site. The site of a recently abandoned septic system on Evergreen Parkway would be monitored to determine if the abandonment reduced the fecal coliform contamination detected at the site. At the same time, the runoff from Evergreen Parkway east would be checked for TSS levels.

3) Monitoring stormwater discharges to Grass Lake wetlands. All major stormwater outfalls to the Grass Lakes wetland system would be monitored one complete year, with the same protocol used in the basin water quality study (four wet season and two dry season samples).

Benefit: The sources of existing contamination would be narrowed and the runoff to Grass lake wetlands would be characterized, ultimately leading to measures to improve water quality.

Estimated Cost: $10,000

Participants: Olympia, Thurston County

Recommendation 8.8: Maintain and repair septic systems.

Problems Addressed: Fecal coliform contamination of Green Cove Creek and Eld Inlet (WQ1, WQ2, WQ3)

Description: The creek segmentation study described above would identify the neighborhoods likeliest to have failing septic systems. A house-to-house septic system survey would be performed to identify failing septic systems in those areas, beginning with the houses closest to affected waterways. Neighborhoods would first be investigated visually for signs of failing systems. Homes with septic systems likeliest to cause contamination would be further investigated using a dye-tracing technique.

The Health Department would follow-up on repairing the failing systems. Currently, some homes with failing septic systems are eligible for low-interest loans from the county to repair their systems. This program would be offered to eligible homeowners.

Benefit: Water quality of Green Cove Creek and Eld Inlet would improve and public health risks would be reduced.

Estimated Cost: Varies depending on results of septic survey (Recommendation 8.8)

Participants: Thurston County

Recommendation 8.9: Provide homeowner education on maintaining septic systems.

Problems Addressed: Fecal coliform contamination of Green Cove Creek and Eld Inlet (WQ1, WQ2, WQ3)

Description: Thurston County's existing programs on septic system maintenance would be offered to homeowners in the Green Cove basin, through a series of small neighborhood meetings to provide hands-on training. Homeowner education would help prevent additional system failures in the future. Educating homeowners could also encourage owners of currently failing septic systems to repair them.

Benefit: Improved water quality in Green Cove Creek and Eld Inlet.

Estimated Cost: $8,000

Participants: Thurston County, Olympia

Recommendation 8.10: Inspect the sewer lift station on Kaiser Road regularly for leaks.

Problems Addressed: Fecal coliform in Green Cove Creek (WQ3)

Description: The sewer lift station on Kaiser Road near Green Cove Creek would be inspected periodically for leaks, and repaired if necessary.

Benefit: Improved water quality in Green Cove Creek

Estimated Cost: In existing budget

Participants: Olympia

Recommendation 8.11: Revise drainage and critical area regulations so the marine bluff standards for setbacks and runoff discharges apply to Green Cove Creek ravine.

Problems Addressed: Future slides in Green Cove Creek (HAB5)

Description: The basin plan would set new drainage standards for discharges to Green Cove Creek in the steep ravine north of Evergreen Parkway. The existing standards for marine bluffs would be applied to the ravine area, so that drains would have to be directed away from the slope or tightlined to the toe of the slope. Revisions to the critical areas ordinance would be developed, so that the same setbacks required for marine bluffs would also be required for ravines. The new setback distance would be measured from the creek's ordinary high water mark at a 2:1 angle back to the top of the existing slope.

Benefit: The salmon habitat in Green Cove Creek would be protected from additional landslides.

Estimated Cost: $1,000 (Funded by existing budget)

Participants: Thurston County

Recommendation 8.12: Monitor habitat of Green Cove Creek and Grass Lake wetlands.

Problems Addressed: Green Cove Creek habitat problems (HAB 1, HAB2, HAB3, HAB4, HAB5)

Description: The Green Cove Creek and Grass Lake wetlands habitat monitoring activities would be continued and expanded. Monitoring would involve volunteers and agency staff.

Green Cove Creek monitoring would use volunteers to provide annual habitat map updates. Stream Team volunteers from the basin would be trained to update the habitat base map produced by Thurston County, included in the basin plan (maps 11-13). The volunteers would walk the creek, update the map and report back to the county once every two years. The county staff would perform a complete, updated habitat survey of the creek once every ten years.

Grass Lake wetlands would be monitored according to the monitoring plan in the *Grass Lake Refuge Final Master Plan* (City of Olympia 1997). Wetland monitoring would include monitoring flows, vegetation, amphibians, birds and mammals.

Benefit: New problems would be identified and addressed quickly, and the effectiveness of other basin plan measures would determined. The information would provide the basis for improved management of the creek in the future.

Estimated Cost: $500 every 2 years; $7,000 every 10 years (Partially funded by existing budget)

Participants: Olympia, Thurston County

Recommendation 8.13: Provide education and information to residents throughout Green Cove basin on landscaping ideas for preventing run-off and non-point pollution and on the benefits of reforestation. Provide education and information to streamside property owners specifically on best management practices for preventing pollution and preserving/enhancing riparian habitat.

Problems Addressed: Garbage in Green Cove Creek (HAB3), Green Cove Creek future flows (HAB4)

Description: The existing surface water public education program would provide basin residents with education regarding landscaping techniques to limit runoff and reduce pollution. Streamside homeowners would be provided with educational materials and activities designed to promote stewardship of the creek, reduce illegal dumping and increase awareness of the creek's unique values. General educational materials would be provided to all basin residents regarding the value and need for re-forestation within the basin.

Estimated Cost: The 1999 Thurston County Stormwater Program budget includes $29,000 for Green Cove PIE.

Participants: Thurston County, Olympia, Thurston Conservation District, Native Plant Salvage Project, Department of Natural Resources

Recommendation 8.14: Retro-fit existing stormwater outfalls to Green Cove Creek where it is feasible to reduce erosion, improve water quality or both.

Problems Addressed: Outfall triggered slide on Green Cove Street (HAB1), Erosion and destabilization of Green Cove Creek Channel (HAB4).

Description: Existing stormwater outfalls at the following locations will be retro-fitted for either erosion control, water quality improvement or both:

1. Kaiser Road and Evergreen Parkway (water quality)
2. 36th Avenue NW (erosion)
3. Wesley Loop (conveyance, erosion and water quality)
4. Green Cove Street (conveyance and erosion)
5. 43rd Court (conveyance, erosion and water quality)
6. Sunset Beach Drive (conveyance, erosion and water quality)

Benefit: Improved habitat and water quality in Green Cove Creek.

Estimated Cost: $1,200,000 (Funded by utility rates)

Participants: **Thurston County**

CHAPTER 9: RECOMMENDED PLAN IMPLEMENTATION

9.1 PLAN ADOPTION AND REVISION

The basin plan must be adopted by Thurston County and Olympia in order to work effectively, because the plan recommendations span both jurisdictions. The county commissioners and city council will take public testimony on the plan at public hearings publicized through the media. Each jurisdiction may adopt the plan as written or direct the staff to prepare changes. Any revisions proposed by one jurisdiction must gain the support of the other jurisdiction so that both jurisdictions adopt the same version of the plan. The basin plan may also be adopted by reference in the jurisdictions' Comprehensive Plans, which would give the plan additional authority. Comprehensive Plan revisions are reviewed by the appropriate Planning Commission, then forwarded to the commissioners or city council with a recommendation.

The plan will also be submitted to the Department of Ecology for approval. The Department may also approve or request revisions. Approval by the Department of Ecology will make the recommendations eligible for a variety of state grant and loan programs.

Adoption by the county and city does not commit actual dollars to specific recommendations. Each recommendation must then go through a separate implementation process, depending on the nature of the recommendation. The cost estimates will be refined and the details of each recommendation will be fleshed out at that time. Each recommendation will be subject to further public review through the implementation processes.

Some recommendations will require revising local ordinances or regulations. For instance, the basin plan recommends new regulations for development in flood-prone areas with seasonal high water. Once the basin plan is adopted, the county and city building regulations must still be revised to be consistent with the basin plan and fully implement the recommendation. Revising the building regulations would require additional actions by the county commissioners and city councils, with more opportunities for public comment. However, recommendations to revise drainage design standards would become effective upon adoption of the basin plan, and supercede requirements of the drainage manual.

All city and county capital facilities must be included in the jurisdictions' capital facilities plans (CFP), which are adopted as part of the Comprehensive Plans. The CFPs must support projected population growth for 20 years, and identify sources of funding for 6 years. The CFPs cover all capital projects such as sewer, roads, and parks. Depending on the funding source, the CFPs may need to balance the stormwater projects against other public needs, which could result in some stormwater projects receiving lower priority (Olympia stormwater projects are funded exclusively from stormwater utility funds, so they do not compete with other capital needs). The CFPs may be updated only once a year. The capital recommendations must also be coordinated between jurisdiction so that the correct project share is budgeted in the appropriate year for joint projects.

The county and city currently have a general interlocal agreement on stormwater projects, which provides the basis for shared participation on projects. Specific agreements attached to the general agreement detail the actual cost shares for various projects. For instance, the ambient monitoring agreement details the annual water quality monitoring budget and specifies the financial contribution of each jurisdiction. Some of the basin plan recommendations would require development of new interlocal agreements and/or revision of existing ones. These agreements must be approved by the county commissioners and city council.

Each recommendation must be incorporated into the appropriate agencies' annual work plans and budgets. The annual planning process usually begins in late spring or early summer for the local jurisdictions, leading eventually to budget approval by the end of the year. Coordination between jurisdictions begins early in the planning process, which insures that each jurisdiction's budget allocation reflects their correct share for joint projects.

The commissioners and city council review and approve the annual plans and budgets, with opportunities for public comment. No actual funds are committed to any project or program until this time. Each jurisdiction has its own specific process for adopting the annual budget. Olympia does most of its initial review and revision in subcommittees. The county commission requests input from the Storm and Surface Water Advisory Board, prior to approving the stormwater budget.

The "lead agency" for capital projects is usually the jurisdiction where the project will be constructed. The lead agency is responsible for making sure that interjurisdictional coordination occurs. The lead agency for capital projects and some nonstructural projects usually does the work, pays for the project, and bills the other participating jurisdictions. Some recommendations would be implemented separately by each jurisdiction, but planned cooperatively. The Stream Team program is an example of how the local jurisdictions plan and coordinate a program together, even though it is funded separately. Most basin plan recommendations require close coordination because the basins cross city and county boundaries.

The basin plan should be revised and updated in the future, as the basin changes and additional information becomes available. Monitoring will be critical to revising the basin plan.

Ambient monitoring would indicate the overall trends in the condition of the watershed. If monitoring detects continued declines in water quality or habitat, additional measures may be needed to protect the basin's resources. Project-specific monitoring would provide essential information for determining the most effective actions.

Project-specific monitoring would be incorporated in the funding and operation of each capital project and would include pre-construction (baseline) and post-construction data collection. Project-specific monitoring plans must be designed to portray as accurately as possible the

effectiveness of each management measure under a range of environmental conditions, which would take several years.

The results of monitoring would be interpreted for management implications and fed back into the basin planning process. As the basin develops, the conditions will change and the basin model would need to be updated to reflect the changes. The model would be revised and the original predictions would be checked periodically. Sufficient time must elapse between model runs to implement and monitor plan measures and land use changes.

Between model runs, the jurisdictions would continue to monitor and report on the basin's water resources through ambient water quality monitoring, stream flow and precipitation monitoring, habitat surveys and citizen reports. The plan would be revised to reflect the additional knowledge, and the revisions would go through an adoption process similar to the original adoption. In this way, the basin plan would be a dynamic document that evolves in response to changing conditions.

9.2 PROJECT PRIORITIZATION

The plan recommendations were originally prioritized based on criteria developed by the Thurston County Storm and Surface Water Advisory Board (SSWAB), a citizen board that advises the Board of County Commissioners, and revised in the Chambers Basin Plan. The initial criteria included: ability to implement; environmental sustainability; effectiveness; property damage; public health and safety; vision statement compliance (the "vision statement" is a plan for comprehensive, coordinated water resources in Thurston County, developed by the SSWAB); staging prerequisite; problem priority; cost; and source reduction. The ranking system was developed to use in prioritizing capital projects, and the Green Cove Citizen Advisory Task Force found that they did not apply well to the non-structural measures that form the majority of this plan's recommendations. The task force reviewed the plan and developed the priorities for the non-structural recommendations, shown in Table 9-1.

The plan contains only two structural recommendations: construct a pond at 14th Avenue or another site; and raise Kaiser Road. These recommendations will be prioritized as part of the annual city- and county-wide capital facilities planning process mandated by the state Growth Management Act. The process will include review by the Thurston County SSWAB to balance the projects with other stormwater capital needs, and review and approval bythe county commission and city council to balance the stormwater capital needs all the other capital construction needs.

9.3 IMPLEMENTATION PHASES

The basin plan implementation would address the top priority problems first, and make the best use of existing programs and scarce funds. The plan would be implemented in stages to insure

Table 9-1: Nonstructural recommendation priorities

Priority	Project Description
1	8.5 Review and revise development regulations to mitigate stormwater impacts
2	8.13 Retro-fit existing stormwater outfalls to Green Cove Creek
3	8.7 Water quality monitoring
4	8.12 Habitat monitoring
5	8.2 Landowner incentives to retain/restore forest cover
6	8.8 Septic system repairs
7	8.14 Education/information to basin residents on stream stewardship/reforestation/nonpoint pollution
8	8.11 New ravine discharge standards
9	8.4 Building regulations for high water areas
10	8.9 Septic system public education
11	8.6 Remedial stormwater maintenance
12	8.10 Sewer lift station inspections

that the plan responds to community needs as efficiently as possible. The plan implementation would be staged based on the following criteria:

1. The top priority problems should be addressed first.
2. Initial water quality improvement actions should reduce known contamination at the sources, rather than building treatment facilities at outfalls.
3. An educational approach to solving water quality problems should be emphasized, rather than a regulatory approach.
4. Existing water resource programs should be improved instead of starting new programs.
5. Problem sites should be monitored for water quality improvements following implementation of the initial remedial actions.
6. Contamination sources should be clearly identified for sites that continue to show problems.
7. Constructing water quality treatment facilities should be a last resort after all identified sources of contamination have been reduced as much as possible.

The first phase of implementing the recommended plan would address the worst problem in the basin: flooding in seasonal high water areas and future flow increases in Green Cove Creek. Phase 1 would also address the fecal coliform contamination uncovered by the water quality study. Examples of phase 1 actions include measures to retain forest vegetation, identify flood-prone areas, and conduct water quality and habitat monitoring.

The second phase of implementing the recommended plan would follow-up on phase 1 improvements and would address regulatory changes for new development, and public education. Some steps taken in the second phase would depend on the results of phase 1 measures. For example, septic system repairs would depend on the results of the sanitary surveys conducted in phase 1. Other measures, such as new building regulations for flood-prone sites

and critical area revisions for ravine discharges, would require additional actions by city and county governments.

9.4 FUNDING

Revenues for financing the basin plan recommendations can be grouped into two categories: local sources and grants. Existing local sources include stormwater utility fees, road funds, city and county general funds, various building fees, and development charges. Each local source generates money from a different mix of residents. Other potential mechanisms for generating local revenues include shellfish districts, aquifer protection areas and local improvement districts. Grants include a variety of federal and state programs. Historically, stormwater needs have been funded by a mix of utility fees, road funds and grants.

9.4.1 LOCAL REVENUE SOURCES

Stormwater Utility Fees

Thurston County, Olympia, Lacey and Tumwater all have stormwater utilities that collect fees from property owners within their boundaries (Thurston County only collects fees in the northern county). The charges are based primarily on the amount of impervious area (as measured, estimated or averaged) and the type of property use. Each jurisdiction's utility has a unique rate structure. Table 9-2 compares the local jurisdictions' utility rates.

Some of the local stormwater utilities' current rate revenues may not be sufficient to finance the basin plan recommendations. One possible source of revenues for basin plan recommendations would be increasing the stormwater utility rates.

Road Funds

Funding for drainage improvement and maintenance in Thurston County is largely the responsibility of the Roads and Transportation Services Department. Road drainage improvements such as culverts and ditches are constructed as a part of road projects because they are necessary to accommodate transportation needs. Road funds currently support only minor capital improvements. Thurston County's stormwater system is largely comprised of ditches and culverts. Minimal additional funds can be expected from this source. Olympia uses a variety of sources for street repairs and construction, including grants and general funds.

Other Local Revenue Sources

Other existing local revenue sources that could be used for stormwater programs include:

- General Funds
- Plan Review and Inspection Fees
- Connection Fees (General Facilities Charges)
- Latecomer Fees

Table 9-2 Local Stormwater Utility Rates (Annualized)[1]

Land Use	Olympia	Tumwater	Lacey	Thurston County
Single-Family Residential	$72.00/60.00[2]	$54.00	$63.00	$20.00 + 1.00 per acre[4]
Duplex	$144.00/120.00[2]	$108.00	$126.00	$13.00 per unit + 1.00 per acre[4]
Multi-Family Residential	$102 + (28.80/53.28/79.20 per gross impervious area ,2528 sq. ft.)[2]	9.00 + (45.00 per gross impervious area , 3250 sq.ft.)	$26.64 to $618.12 per gross acre[3]	$6.00 per unit
Commercial, Industrial, and Schools	Same as multi-family	Same as multi-family	Same as multi-family	$5.56 per 1,000 sq ft impervious area
Streets, Roads, and State Government	30% of commercial charge	30% of commercial charge	30% of commercial charge (no charge to WDOT)	30% of commercial charge

Notes:

[1]Olympia, Lacey and Tumwater charge monthly rates and offer various incentives for improved facilities. Contact the local Public Works Department for complete details. Lacey rates effective 4/1/95.

[2]Olympia's rates vary according to the date of development, in order to reduce rates for developments which meet higher standards. The higher rate is the base rate which most parcels pay.

[3]Lacey sets 7 nonresidential rates on a scale according to the % of impervious area. Parcels which mitigate their stormwater impacts receive a one-step rate reduction.

[4]Thurston County surcharges residential parcels $1.00/acre for each additional acre over one-half acre. The duplex rate also applies to triplex and fourplex.

State law permits local governments to create a variety of districts and jurisdictions to fund specific types of projects. None of these mechanisms have been created in Thurston County, or Olympia, but they could theoretically be used to fund stormwater projects. Potential mechanisms for generating local revenues include:

- Shellfish Protection Districts
- Aquifer Protection Areas
- Impact Fees
- Street Utility Fees
- Fee-in-Lieu of Construction
- Local Improvement Districts (LIDs)
- Flood Control Zone Districts

9.4.2 GRANTS

Adopting the basin plan will improve the local jurisdictions' ability to compete for increasingly limited grants. Local governments have been highly successful in obtaining state and federal grants in the past. Most state-administered grants target either existing water quality or flooding problems, but not both, which sometimes causes problems for combined facilities. Problems which cause property damage or present public health or safety hazards usually rate highly for grant eligibility. Public involvement and education programs are also eligible for limited grant funding. Funds targeted at historical problems may also address potential future problems, or they may free up other funds for the prevention of potential problems.

Most grants require some amount of local matching funds, which may sometimes take the form of services-in-kind. Grant sources have dried up in recent years as government has reduced spending at all levels. Grants help bolster finite local funds, but they are highly uncertain and cannot be relied on for long-term planning. Grant sources for stormwater projects include:

- Centennial Clean Water Fund Grant Program
- Flood Control Assistance Account Program
- Puget Sound Water Quality Action Team Public Involvement and Education Fund
- Washington State Ecosystems Conservation Project
- EPA Clean Water Act Section 319 Grants

9.4.3 DEBT FINANCING MECHANISMS

Local government's ability to pay for the basin plan recommendations is limited by the existing revenues described above. These revenue sources might be able to pay for gradual implementation of basin plan recommendations with available funds over several decades. This "pay-as-you-go" approach could not implement the basin plan recommendations in time to prevent or repair the damage they are intended to address. Local governments have two basic debt financing mechanisms for obtaining additional, up-front funds in excess of current revenues: loans and bond sales.

Local jurisdictions have historically used loans for smaller capital projects and sold bonds to finance major improvements such as new schools or bridges. Thurston County and Olympia have never sold bonds to finance stormwater projects because past projects have been small enough to fund from existing revenues. However, as local governments proceed with comprehensive facilities planning for stormwater and other infrastructure projects, bonds have become a more realistic approach.

Major capital improvement projects often require large sums of capital for construction, but they have low operating costs and long life spans. Debt financing offers a method for spreading out the impact of high-cost construction over a long period of time. Mechanisms such as bonds and low-interest loans have long been used to ease the immediate burden of financing capital construction, but they add financing charges to the total cost of the projects.

The basin plan recommends a combination of ongoing and one-time activities. The ongoing activities such as monitoring, maintenance and education constitute the base work programs of the stormwater utilities or other local agencies. The capital facilities would be one-time expenditures for facilities with finite life spans. Existing or projected revenues must be sufficient to fund ongoing activities because debt-financing of basic work programs would be financially risky.

Capital facilities are good candidates for debt-financing, because they require a one-time expenditure. The cost of capital facilities can be spread across the lifespan of the facilities, or some shorter period. Spreading the cost over several years reduces the financial burden of any particular year, but the longer that financing is extended, the greater the additional financing charges. Debt-financing would probably delay implementation of lower-priority projects, because they could not be funded until the debt from the high-priority projects was retired. Sources of debt-financing include:

- Washington Public Works Trust Fund
- Department of Ecology Centennial Clean Water Fund Loan Program
- Washington State Revolving Fund for Water Pollution Control
- Revenue Bonds

9.4.4 Cost Sharing

Table 9-3 shows the proposed cost distribution between participating jurisdictions. Capital facility costs are distributed according to the proportion of contributing area in each jurisdiction. Nonstructural costs are split evenly between jurisdictions. Maintenance costs are allocated according to the jurisdiction where each facility is located. Amount shown in bold face are available from existing budgets, and do not represent new costs.

9.4.5 Ongoing Maintenance

As capital facilities are constructed and placed into operation, funding to support short- and long-term maintenance needs will be required. Replacement of capital facility components may also be required. Funding to provide this needed maintenance could come from two sources: existing program budget; or, from a dedicated maintenance rate collected through the stormwater fees. If funding is to come from the existing program budget, the existing work program will need to be reduced in scope or eliminated altogether. A dedicated maintenance rate would provide a financial resource that will meet the ongoing maintenance needs resulting from capital construction.

Table 9-3 Implementation Costs

Recommendation	Olympia share	Thurston County share	Total cost
8.5 Review and revise development regulations	5000	5000	10000
8.14 Retro-fit existing stormwater outfalls	0	1,200,000	1,200,000
8.7 Water quality monitoring	5000	5000	10000
8.12 Habitat monitoring*	500	500	1000
8.2 Landowner incentives to retain/restore forest cover	5000	8200	13500
8.8 Septic system repairs**			***
8.13 Basin resident education on stream stewardship/ reforestation/ nonpoint pollution prevention	2000	31000	33000
8.11 New ravine stormwater discharge standards	500	500	1000
8.3 Building regulations for seasonal high water areas	10000	10000	20000
8.9 Septic system public education	4000	4000	8000
8.6 Remedial stormwater maintenance	20000		20000
8.10 Sewer lift station inspections			0
8.1 14th Avenue detention pond	300000		300000
8.3 Raise Kaiser Road		40000	40000
TOTAL	$352,000	$1,304,500	$1,656,500

*These costs are the annualized portion of the 10-year monitoring cycle

** The cost of septic system repairs would depend on the extent of needed repairs as determined by the proposed monitoring

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