6.0 BASIN PROBLEM ANALYSIS

The investigation of the Percival Creek basin has identified numerous flooding, habitat, and water quality problems and the potential for increased problems in the future. These problems are discussed briefly below and illustrated on Map 9 in Appendix 1. Preceding chapters have described the existing characteristics of the basin; subsequent chapters evaluate potential management approaches for addressing the problems.

6.1 Flooding

Flooding results when urbanization proceeds without adequate stormwater management infrastructure to manage the associated runoff. Flooding has been identified by staff and citizen advisory committee members as the primary surface water management problem in the basin.

6.1.1 Existing Flooding Problems

In recent years, high urban growth rates combined with inadequate regulation, capital improvements, and maintenance have stressed several of the stormwater storage and conveyance systems in the basin. Necessary improvements to the systems range from minor tasks such as removing sediments from catch basins to extensive and costly system upgrades.

More problematically, the Percival Creek system is expected to receive and convey unnaturally high flood flows. Field investigations conducted as part of this study and past studies indicate that increased flood flows throughout the basin have accelerated the erosion of the streambanks, promoted mass wasting of the canyon walls, and impaired aquatic habitat. In a study of numerous creek systems, Klein (1979) observed that when impervious surfaces within a basin exceed 12 percent, stream hydrology and water quality can be noticeably affected. Total impervious surfaces within the Percival Creek basin are currently approximately 18 percent of the basin area.

Flooding problems have been segregated as follows:

- Creek flooding:
  This type of flooding results in damaged creek conditions and/or property damage to streamside developments. The highly erosive streambanks within the Percival Creek canyon are evidence of this flooding type.

- Upland flooding:
  These flooding problems result from the lack of properly designed stormwater systems. The flooding of Cooper Point Road is an example of this category.

Creek Flooding

Flood flows in the Percival creek system has been evaluated using the HSPF computer model (HSPF, 1991). One aspect of the analysis sought to estimate the change in flood flows between historical forested conditions and existing conditions. In this analysis, existing channel configurations were used instead of suspected, but unknown, historical configurations.

This analytical inaccuracy is important for the following reasons:

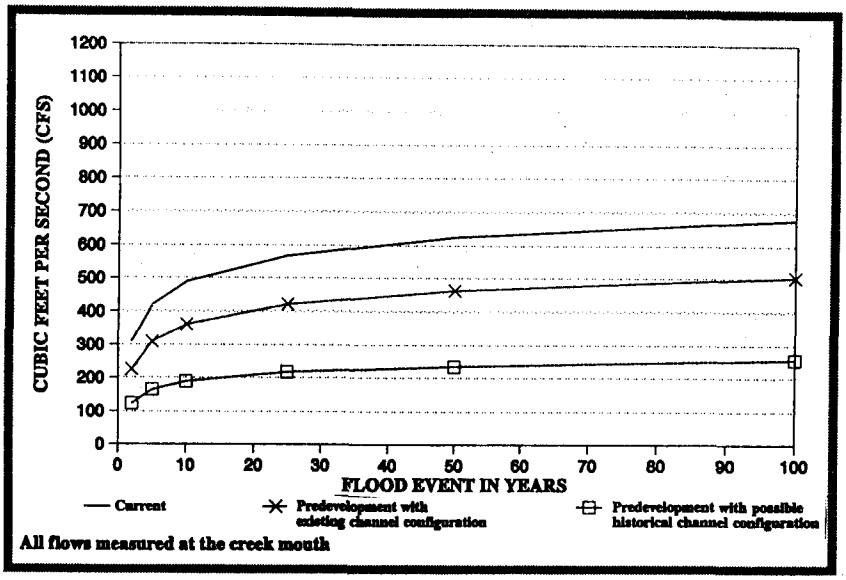
- The Black Lake drainage ditch carries considerable flows from Black Lake and the associated 400 acre wetland to Percival Creek. In all likelihood, the lake and wetland would have historically stored flood waters.

- The area from Yauger Park to the Black Lake drainage ditch along what is now Cooper Point Road and Black Lake Boulevard was historically an extensive wetland. Flood waters are no longer stored in this area.

Because of this approach, the computer analysis generated appreciably higher historical flows than are expected to have occurred.

Given this scenario, flood flows generated by historical channel configurations have also been estimated subjectively. The following graph (Figure 1) illustrates the two predevelopment flood flow scenarios with a comparison to existing flows. The high predevelopment flow scenario utilizes existing channel configurations with forested basin conditions; the lower flow scenario subjectively reduces flow contributions from the Black Lake Drainage Ditch and the Cooper Point Road conveyance system by approximately 80 percent. Regardless of the accuracy of historical flood flow estimates, flows have increased appreciably with urbanization. Results of the computer analysis are presented in Table A-11 of Appendix 2.

Figure 1: Predevelopment Flood Flow Scenarios



High creek flows have resulted in the following known physical problems in Percival Creek:

- Mass wasting of hill slopes and streambanks in the canyon reach of the creek.
- Increased sediment transport to Percival Cove.
- Excessive channel width in the downstream 1000 feet of the creek.
- Reduced frequency of creek meanders.
- Irregular pool spacing.
- Large organic debris (LOD) levels are 20 to 50 percent of natural levels.

The increased creek flows are the result of inadequate stormwater management. The problems are as follows:

- Approximately 28 percent of the development in the basin provides no stormwater management.
- The remaining 72 percent of the development provides varying, but commonly inadequate, levels of management.
- Flood flows discharged from any given developed site are higher than predevelopment flood flows.

In addition to impacting the physical; and therefore, biological integrity of the creek system, creek flooding has the potential to threaten or damage development. Fortunately, development adjacent to Percival Creek is not subject to flooding. The creek is bounded by steep and undevelopable canyon walls in the downstream stream segments, and extensive wetlands in the upstream segments. These environmental traits have, in most cases, deterred streamside development.

Upland flooding

Inadequate management of stormwater has also resulted in flooding of development and roads distant from the creek system. Upland flooding can occur in varying degrees, some of which may be minor inconveniences and therefore considered acceptable to community members. Other instances of flooding can involve the impairment of private property and closures of vital emergency travel routes. Existing major problem areas within the basin include the following:

- Cooper Point Road/Black Lake Boulevard intersection.
- Mottman Industrial Park.

Relatively minor problems are located throughout the basin and could be corrected by small-scale maintenance and system upgrade projects. Additional flooding problems occurring within the basin are identified on Map 9 in Appendix 1.

6.1.2 Potential Flooding Problems

Without adequate stormwater conveyance and storage systems, the flooding problems in the creek system and upland areas can be expected to intensify as development continues. Unnatural flooding results from impervious surfaces. The potential increase in these surfaces with full development of the basin are presented in the following table:

Table 4: Current and Potential Effective Impervious Surfaces[1] by Soil Type Percival Creek Basin
(Thurston Geographic Information Facility, 1990)

	Till[2], acres		Outwash[3], acres	
	Current	Build-Out	Current	Build-Out
P-1	0	0	44	90
P-2	4	100	35	89
P-3	4	44	32	97
P-4	30	164	67	117
P-5	109	186	5	8
P-6	4	10	23	46
P-7	53	204	3	10
P-8	65	92	0	0
P-9	66	66	2	2
P-10	N/A	N/A	N/A	N/A
P-11	63	112	23	49
P-12	33	83	5	11
P-13	29	108	33	60
	460	1,169	272	579

1 - Impervious surfaces that can be expected to generate runoff to creeks, rather than sheet flow to pervious surfaces
2 - Relatively impervious soil types
3 - Relatively pervious soil types

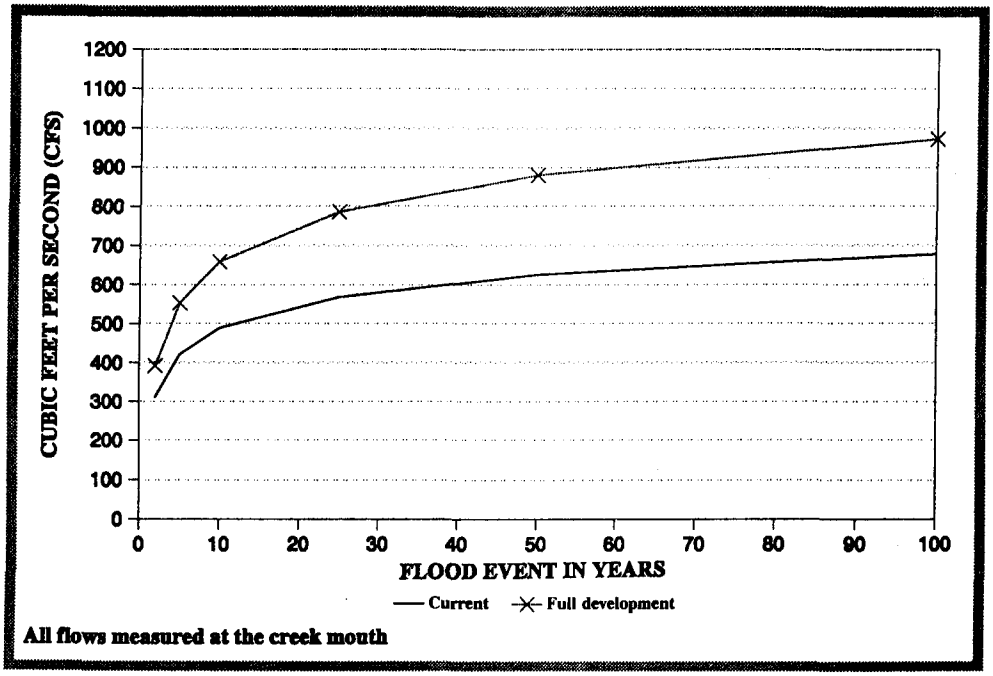
Creek Flooding

Given current drainage requirements for new development, destructive flood flows in the creek system can be expected to increase as development continues. Flood flows will further reduce the creek system's physical stability and biological viability.

HSPF computer analysis has been used to estimate potential flood flows in the creek system under full development conditions in the basin (HSPF, 1991). This future scenario assumes that wetlands and shoreline management areas will be preserved using current levels of regulation. Existing zoning classifications for currently undeveloped areas have been used in the model. Additionally, the scenario assumes full implementation of the *Drainage Design and Erosion Control Manual for Thurston Region, Washington.*

The following graph (Figure 2) illustrates expected future flood flows in the creek system as compared to existing flows.

Figure 2: Potential Full Development Flood Flows



Observations resulting from the computer modeling of potential future conditions include the following:

- Flood flows at the mouth of the creek would be approximately 390 and 970 cfs for the 2- and 100-year storm events, respectively. These flows represent increases of 24 and 46 percent compared to current 2- and 100-year flood flows.

- Creek velocities would increase approximately 14 percent during major storm events. The erosive energy of water increases exponentially with increasing velocity.

- The primary sources of potential flow increases are found primarily in the central and southern portions of the basin.

Potential impacts to the physical traits of creek system from these potential flows include the following:

- Accelerated mass wasting of the canyon hill slopes and streambanks.
- Continued filling of Percival Cove with sediments.

Numerous biological impacts from these potential flows can be expected. These impacts are discussed in Section 6.2. Computer results under full development are provided in Table A-12 of Appendix 2.

Creek widths under flood conditions have been evaluated by HSPF and HEC-2 computer modeling (HSPF, 1991). The threat of streamside development flooding will continue to be minimal as illustrated by the data presented in Table A-13 of Appendix 2.

Upland flooding

Many of the developable areas within the basin are located in close proximity to either Percival Creek or the Black Lake drainage ditch. Stormwater flows from potential developments in these areas can, after storage and treatment, be conveyed to these receiving waters without elaborate interconnected systems. Other areas more distant from the creek will require system upgrades.

The major conveyance systems in the basin have been evaluated using the HYDRA computer model. The analysis indicates the potential for several future system deficiencies as follow:

- North basin conveyance system to Grass Lake wetland.
- Capital Mall Drive west of Cooper Point Drive.
- Yauger Park

- Cooper Point Road/Black Lake Boulevard/SR #101 area.
- Lakemoor Subdivision.
- Cooper Point Bridge/Decatur Street Area.

6.2 Habitat Problems

The deterioration of habitat within the basin includes disturbance and destruction by development, unnaturally high flood flows, and water quality contamination. High flood flows have been identified as the primary threat to creek habitat. The following evaluation of habitat concerns addresses instream, wetland, and riparian areas.

6.2.1 Existing Habitat Problems

Over the last 30 years the basin has evolved from a largely undeveloped wooded and wetland area to one of the Olympia area's most highly urbanized areas. Although various development regulations implemented over the last 20 years have helped preserve the natural amenities of the creek system, deterioration has occurred.

Instream Habitat

The ability of creeks to support anadromous and resident fish is directly related to the amount and complexity of habitat they offer. Percival Creek has some good quality salmon habitat areas remaining, but instream habitat has been degraded by unnatural flood flows which:

- Destabilize and erode streambanks.
- Deposit sediment in salmon spawning beds.
- Straighten beneficial creek meanders.
- Transport large organic debris (LOD) downstream.
- Reduce fish refuge cover.
- Reduce natural riparian zone vegetation.
- Decrease biological diversity.
- Reduce drought flows.

These problems are directly associated with unnaturally high flood flows in the creek system. Further discussion of instream habitat is provided in Sections 5.4 and 5.6.

Four poorly designed culverts have created fish passage barriers to major portions of the creek system. These culverts are discussed in detail in Section 5.6, and technical information presented in Tables A-3 and A-14 of Appendix 2.

Water quality contamination also impacts instream habitat. These concerns are addressed in Section 6.3.

Wetlands

Wetlands are important components of a healthy creek system. Unfortunately, several areas in the basin including the historical wetland which encompassed the Cooper Point Road/Black Lake Boulevard area have been filled. Degradation of wetlands has occurred through many processes including:

- Draining, filling, and sedimentation.
- Contamination.
- Invasion of exotic plant species.
- Fragmentation of hydrologic systems.

The few high quality wetlands remain in the basin.

Riparian habitat

The wooded habitat in the Percival Creek canyon provides beneficial habitat. Additionally, the creek system provides an effective wildlife corridor from Percival Cove at the mouth of Percival Creek to Trosper Lake and Black Lake. Several relatively minor road crossing deter from the quality of the wildlife corridor.

6.2.2 Potential Habitat Problems

Continued development and increased flood flows can be expected to produce additional habitat losses in the creek system.

Instream Habitat

Research indicates that:

- Impacts to the hydrology of a creek often have more profound effects on fish and overall stream health than does water quality degradation (Ragan and Dieteman, 1975; Scott, 1982; Steward, 1983; Bissonnette, 1985; Pederson, 1981, and Richey, 1982).

- With urbanization, creeks move towards less diversity and experience subsequent decreases in the number and kinds of fish (Klein, 1979).

- Studies conducted with salmon embryo yielded greater mortality in urban stream environments than in rural environments (Scott, 1982; Steward, 1983).

- Aquatic invertebrates also show a decrease in diversity in urban creeks (Pederson, 1981; Richey, 1982). These insects can be stressed as a result of streambed scouring, high levels of suspended solids, the lack of riparian vegetation, and the rapid transport of detritus. High sediment levels limit food gathering ability and can smother the insects.

- Decreases in riparian cover associated with urbanization have been shown to decrease fish production (Steward, 1983). The study indicates that the optimal amount of vegetative cover along a stream is approximately 80 percent.

Potential impacts from further increases in flood flows in Percival Creek include:

- Increased number of culverts posing fish barriers due to increased water velocities.
- Increased creek velocities and volume prompting accelerated streambank erosion.
- Loss of spawning beds.
- Loss of high quality aquatic insect populations.
- Loss of sheltered areas for salmon rearing and refuge.
- Loss of salmon populations.
- Loss of natural biological diversity.

Wetlands

The majority of the remaining wetlands in the basin currently have largely undeveloped buffer areas. The integrity of these wetlands is highly dependent upon the activities of future development. Potential impacts to the wetlands include the following:

- Physical degradation by development encroachment.
- Introduction of nonpoint source contaminants.
- Sedimentation.
- Alteration of the hydrologic regime.
- Fragmentation of extensive wetland systems.
- Introduction of highly competitive exotic plant species.

Riparian Habitat

Approximately 86 percent of the wildlife species native to the Puget Sound area reside in riparian zones. Many species of migratory wildlife require a contiguous riparian zone, rather than the patchwork of natural and impacted stream reaches typical of urban streams.

The riparian habitat could be impaired by the following:

- Fragmentation of the corridor by streamside development, roads, and utilities.
- Mass wasting and subsequent replacement of coniferous tree species with lesser quality vegetation such as alders.
- Alteration of the hydrologic regime of the riparian area.

The quality of instream habitat is highly dependent upon the integrity of the riparian zone.

6.3 Water Quality Problems

Nonpoint source pollution inputs are typically intermittent. Therefore they present periodic, but potentially chronic, stress factors to the biological community supported by the creek. As opposed to point pollution sources that arise from a specific source, nonpoint pollutants are contributed in small quantities from numerous sources. Because nonpoint pollution has a number of sources, it is difficult to manage or eliminate.

6.3.1 Existing Water Quality Problems

Although water quality within the Percival Creek system is generally acceptable, several known nonpoint contaminant sources exist. The Cooper Point Road/Black Lake Boulevard area is the primary source of water quality contaminants in the basin.

Common pollutants in Percival Creek include:

- Nonpoint pollutants. One major source of contaminants is the flushing of accumulated pollutants from impervious surfaces to the creek system during the initial phases of storms.

- Fecal coliform bacteria. Concentrations modestly exceeded Washington State Class A water quality standards at several locations in the creek during high flow conditions. Bacteriological contamination such as fecal coliform is often associated with faulty septic and/or sanitary sewer systems and animal wastes.

- Priority pollutants. Analysis of creek sediments showed potentially high levels of trace organic compounds and metals at several locations.

Current contaminant sources include:

- Contamination associated with high density land uses and vehicular traffic.
- Erosion.
- Hillslope failures.
- Possible septic system failures.

6.3.2 Potential Water Quality Problems

Given current zoning classifications, Percival Creek basin is expected to experience substantial urban development in the future. With full development, high density land use in the basin is expected to increase two-fold compared to current levels (Thurston Geographic Information Facility, 1990).

Research indicates that:

- Urbanization increases the input of contaminants by at least an order of magnitude (Schueler, 1987).
- The presence of pollutants in a creek have been shown to increase in response to increased urban concentration (Jones and Smart, 1980).
- The annual export of sediment in the Puget Sound region is approximately three times greater in an urbanized creek than in a rural stream (Richey, 1982).
- Phosphate and inorganic nitrogen levels were found to be three and eight times higher, respectively, in urban creek basins compared to forested creek basins (Omerick, 1977). The concentration of inorganic phosphorus and nitrogen in stormwater can exceed concentrations found in wastewater treatment plant effluent (Pitt and Bozeman, 1980). High phosphorous levels encourage algal growth.
- Development in the rural areas of the basin may rely upon septic systems in inappropriate soils and thereby present long-term threats to water quality.

Potential water quality problems include the following:

- The majority of the development potential is located in the upstream portions of the creek system. Contaminants introduced in these portions would impact the entire downstream system.
- The level of vehicular traffic associated with the potential land use in the basin could generate appreciable quantities of priority pollutants.
- Increased usage of septic systems could generate bacterial contamination.
- Lake and creek water quality could be impaired by inputs of fertilizers, herbicides, and pesticides.

- Groundwater quality could be contaminated by the infiltration of untreated stormwater in highly developed areas of the basin, and accidental or illicit discharge of hazardous materials to stormwater infiltration systems.

- Continued high erosional rates with the creek canyon could reduce water quality as well as habitat in the creek and Percival Cove.

- The removal of streamside vegetation could increase creek water temperatures and impair instream habitat.

7.0 MANAGEMENT ALTERNATIVES

Historically, surface water management in the Olympia area sought to control flooding and the associated threats to property. As described in Chapter 6, the current level of urbanization occurring in the Percival Creek basin has resulted in habitat and water quality problems as well as flooding. To be effective, management emphasis must shift from response to problems to the prevention of problems. Furthermore, the problem solving approach must take place within the context of long-term ecological and social sustainability and within the constraints of costs and feasibility.

The effective correction of existing problems and the prevention of potential problems within the basin necessitates a comprehensive management strategy. Elements of water resource management range from the construction of stormwater facilities to public education. The elements of a successful basin management program are as follows:

- Stormwater facilities.
- Habitat enhancement/sensitive area protection.
- Regulations/development controls.
- Enforcement/complaint response.
- Pollution source control programs.
- System monitoring.
- Public involvement and education.
- Cooperative program management.

Implementing adequate action plans for these management elements would ensure successful long-term management of the basin. Effective basin management would provide the following benefits:

- Protection of Percival Creek.
- Reduction of flooding and other hazards.
- Preservation of sensitive areas and wildlife resources.
- Preservation of cultural amenities.

Problems associated with surface water in the Percival Creek basin can be managed at various levels with different levels of success. Current levels of service within the basin, which are largely reactive in nature, can be continued or increased to a more intensive and proactive degree of management.

Numerous problems identified during the early phases of the Percival Creek basin plan are also apparent in the other basins of the Urban Growth Management Area. These management inadequacies range from stormwater system maintenance to regulatory shortcomings. The regional nature of these problems has prompted the development of a proposed regional management program separate from the following basin-specific management alternatives. The regional program, as presented in Chapter 11, will also be included in the upcoming Indian/Moxlie Creek and Woodard/Woodland Creek basin plans.

The recommendations of the regional program address the individual management needs of Olympia, Tumwater, Thurston County, and Lacey while providing for more consistent management of the Urban Growth Management Area.

7.1 Alternative Management Plans

Three alternative management plans have been developed for the Percival Creek Basin Plan. The three management alternatives address the flooding, habitat, and water quality problems identified in Chapter 6. These alternatives have been analyzed for their shortcomings and benefits during the planning process. Generally:

- Alternative I presents the existing level of service within the Percival Creek basin. This level of service encompasses current management activities and project funding levels.

- Alternative II represents an enhanced level of service that would correct flooding problems, protect Percival Creek's resources, and provide greater problem-solving capabilities.

- Alternative III is the optimum level of service considered appropriate for the basin.

Alternative I approximates the existing level of surface water management within the basin by the three jurisdictions. Some services would be reduced in the future under this alternative. For example, temporary grant funding supports many of the current resource evaluation and public education activities underway in the basin. A limited capital improvements budget would be available to construct small projects in the Percival Creek basin. As emergencies arise or funding becomes available, capital projects would be undertaken.

Alternative II presents a management approach that controls current and potential flooding problems in the basin and protects the integrity of the creek corridor and water quality. It would require funding above current levels. New projects and regulations would be proposed to moderate flood flows, better manage habitat areas, and encourage the preservation of naturally pervious surfaces.

Alternative III incorporates the overall level of management proposed for Alternative II with additional zoning changes and natural resource improvements. These measures would result in a further decrease in future flood flows and increased preservation of the creek corridor. Public and private costs associated with Alternative III are higher than Alternative II costs.

An evaluation of these alternatives based on the criteria of effectiveness, environmental sustainability, cost, feasibility, and compliance with the goals of the basin planning effort is contained in Chapter 8. The specific components of Alternatives II and III are presented in Chapters 9 and 10, respectively. An evaluation of costs and funding options is presented in Chapters 12 and 13 respectively.

The level of service provided by each management alternative is discussed below under each of the eight basin management elements mentioned above. This comparison of the alternatives are preceded by the goal and description of a successful basin management program.

7.2 Stormwater Facilities

Stormwater facilities convey, treat, and store runoff in order to avoid urban flooding and natural resource degradation. A wide variety of facilities are commonly used for drainage and treatment of stormwater runoff. Low maintenance, passive facilities are generally appropriate for the management of stormwater runoff. More elaborate structural systems may be necessary in highly developed areas where available land is scarce and contaminant levels are high.

With the recent increase in stormwater utility rates of the local jurisdictions, additional funding for municipal capital improvements and maintenance has become available. However, given the backlog of surface water problems throughout the Olympia area, this revenue base remains inadequate to expediently correct problems within the basin. Municipalities have limited financial ability to undertake major stormwater capital improvements designed to prevent foreseeable problems. These funding shortages create an atmosphere of uncertain project scheduling, lack of infrastructure integration, and to some extent, community hardships and inequities.

7.2.1 Conveyance Facilities

GOAL: Conveyance facilities should transport stormwater runoff from its point of origin to its point of release without flooding. The use of open channel surface drainage facilities is the preferred method of stormwater conveyance. Open channels provide a greater range of options for the treatment and storage of stormwater than do underground pipe systems. Grass-lined swales offer excellent water quality treatment. Rock-lined or paved channels are preferred where swales cannot be used.

The Percival Creek system is a natural component of the basin's conveyance system and should be protected from degradation.

Conveyance Facilities: Alternative I

The *Drainage Design and Erosion Control Manual for the Thurston Region, Washington* (Regional Drainage Manual) requires that, at a minimum, conveyance systems be constructed to carry the 10-year, 24-hour storm event. For culverts passing under public roads, the minimum is the 25-year, 24-hour storm event. The drainage regulations require the use of vegetated open channels for the conveyance of stormwater. Where these are not possible other channels are acceptable. Only as a last resort are piped systems allowed for the conveyance of stormwater.

Proponents of new development must also evaluate the potential upstream and downstream impacts of the development. Conveyance system inadequacies that would result from new development would have to be corrected.

Older conveyance systems in the basin are comprised largely of pipe networks. As development continues, the ability of existing systems to carry increasing quantities of runoff can become limited. Alternative I would ensure adequate new private systems, but would not provide funds for the correction of existing conveyance system problems.

Additionally, the staff compliment to implement the regulations of the drainage manual is, in some cases, inadequate.

Conveyance Facilities: Alternative II

Alternative II proposes a long-term commitment to improve the conveyance system within the Percival Creek basin. A focus of these efforts would be on the central portion of the basin where current and anticipated development exceeds the conveyance capabilities of artificial and natural systems. Flooding of property and roads would be minimized and flood flows in Percival Creek would be managed.

The need to ensure the long-term integrity of Percival Creek is addressed by Alternative II.

Conveyance Facilities: Alternative III

Additional improvements to develop conveyance systems would not be undertaken. However, flood flows in Percival Creek would be further reduced.

7.2.2 Storage Facilities

GOAL: Stormwater that is not promptly infiltrated should be stored in order to prevent flooding. Storage facilities include a range of structures designed to store and/or infiltrate stormwater.

One of the most common types of storage facilities is the detention pond. Detention ponds can be either dry or wet. Dry ponds are designed to hold water only during storm events; during dry weather they are empty and can be used for other purposes such as parks. Yauger Park, in the Percival Creek basin, is a dry pond facility. Wet ponds are designed to receive runoff during storm events, provide treatment, and slowly release it. These ponds can be aesthetically pleasing because they can be designed to function as a natural pond or wetland.

Infiltration facilities are also considered storage facilities since they are designed to store runoff and discharge it to groundwater. Wetlands naturally hold and slowly release appreciable quantities of water to the creek system.

Storage Facilities: Alternative 1

New facilities constructed to store stormwater are currently designed according to the requirements outlined in the Regional Drainage Manual. Under Alternative I, new construction would continue to be required to provide a minimum live storage of 6,000 cubic feet per acre of impervious surface, and 2000 cubic feet per pervious "disturbed acre."

In the past, appreciably smaller storage facilities were allowed. Given the current expectations for storage capacity, many of these facilities are inadequate. The existing management program does provide for the correction of current storage inadequacies.

The storage requirement provided by the Regional Drainage Manual is not sufficient to minimize continued degradation of Percival Creek. Future development will compound the existing problem throughout the creek system.

Storage Facilities: Alternative II

Municipally funded stormwater storage facilities would be constructed as necessary and feasible to manage the runoff from existing development. Depending upon technical and financial considerations, these facilities would range in size and complexity from large regional projects to simple upgrades of smaller neighborhood systems. Existing private systems currently operating under design capacity would be maintained to increase their effectiveness.

New development would be required to provide more stormwater storage and a lower release rate than is currently required. Development designs aimed at reducing the quantity of runoff generated by the site would be strongly encouraged. Such designs would reduce the minimum storage requirement. The local jurisdictions would provide technical assistance addressing methods to reduce runoff. Sections 7.4 and 11.4 provide additional discussion of proposed drainage requirements.

Storage Facilities: Alternative III

No change from Alternative II. Retrofitting of existing system deficiencies would be accomplished under Alternative II. Although future development would continue to generate and release runoff in excess of predevelopment levels under Alternative II and the regional management program, the impacts to the creek system would be minimal.

7.2.3 Treatment Facilities

GOAL: Stormwater management should include the treatment of runoff for contaminants.

Pollutants carried in stormwater can be partially removed by holding the water in detention/retention systems and allowing suspended particulates to settle out before the water is discharged. Better treatment methods include utilizing grassy swales and constructed wetlands, infiltrating stormwater and trapping pollutants in the soil, and installing oil/water separators.

The preferred methods of stormwater treatment, both regulatory and structural, are classified as best management practices (BMPs). BMPs are those techniques that are currently believed to provide the most effective and practical means to minimize or control the quantity of pollutants carried by stormwater. Where soil conditions allow, infiltrating treated runoff to groundwater is the preferred management alternative.

Although natural wetlands are highly effective at treating contaminated waters, wetlands can become degraded by the accumulation of contaminants.

Treatment Facilities: Alternative 1

Until 1991, stormwater facilities did little to reduce the amount of contaminants in runoff. New requirements for the treatment of stormwater have been adopted by all local jurisdictions through the Regional Drainage Manual. Under Alternative I, all new construction would continue to be required to build stormwater treatment facilities capable of treating the runoff generated from the six month, 24-hour storm. Innovative and cost effective means to treat stormwater would continue to be pursued.

Efforts to construct the necessary facilities for correcting existing water quality problems would not be undertaken under Alternative I.

Treatment Facilities: Alternative II

Regional facilities would be constructed to adequately treat existing problems. Regional Drainage Manual requirements for new development would not be changed.

Treatment Facilities: Alternative III

No change from Alternative II.

7.2.4 Facility Operations and Maintenance

GOAL: The efficient operation of a stormwater management program requires adequate maintenance of private and public stormwater systems. Scheduled maintenance includes vegetation management, the dredging of ponds and ditches, and the cleaning of pipes, culverts, and catch basins.

In addition to providing conveyance and storage capacity, the maintenance program directly benefits water quality. Much of the suspended solids and priority pollutants found in stormwater are associated with street and parking lot surfaces. Street sweeping and removing sediments from catch basins are effective means of controlling water quality contaminants.

Operations and Maintenance: Alternative I

Adequate maintenance of private systems is currently a problem. To ensure proper maintenance in new development, Olympia now requires maintenance agreements between the City and the party responsible for the stormwater facility. Maintenance schedules for older facilities will also be pursued. Thurston County and Tumwater require limited maintenance of private systems.

The City of Olympia supports adequate staff to maintain public systems. The other local jurisdictions are aware of the need to better maintain systems.

These maintenance programs would continue under Alternative I.

Operations and Maintenance: Alternative II

Existing levels of maintenance of the municipal stormwater system within the jurisdictions of Tumwater and Thurston County would be increased under Alternative II. The systems would be managed in a scheduled, proactive manner. Research during the planning process indicates that Olympia's maintenance program is currently adequate.

The private stormwater management facilities in all the jurisdictions would be maintained on a regular basis.

Operations and Maintenance: Alternative III

No change from Alternative II. Although not providing an optimal level of service, the maintenance program supported by Alternative II represents an appreciable improvement in the operation of both private and public systems.

7.3 Habitat Enhancement/Sensitive Area Protection

Since urbanization impacts the hydrologic and biological functions of drainage basins, the resource base must be managed in order to minimize degradation. While flood management is critical to natural resource management, additional protection measures are often necessary.

Natural habitat areas are critical to the well being of fish and wildlife. Besides providing food, shelter, and water to fish and wildlife, these areas are aesthetically pleasing open space. By protecting the natural resource base the sustainability of an area is enhanced and the quality of life for future generations is preserved.

7.3.1 Revegetation

GOAL: Revegetation projects should be undertaken to enhance streambanks that are currently lacking vegetation. Streamside vegetation is critical to high quality riparian and aquatic habitat.

Riparian vegetation serves a number of important purposes in the stream system. The roots of streamside vegetation protect the integrity of the streambanks, reduce erosion, and assist in forming pools in the stream channel and undercut banks along the side. By shading the creek, vegetation maintains cool water temperatures necessary for salmonids. Overhanging branches provide cover for juvenile fish and organic matter for aquatic insects.

Revegetation: Alternative I

Revegetation projects are currently limited to small scale volunteer efforts through the Stream Team program. The projects are limited by availability of volunteers and the accessibility of the site.

Limited activity would continue to occur under Alternative I.

Revegetation: Alternative II

Selected erosive streambanks along Percival Creek would be targeted for volunteer revegetation projects. The revegetation of severely erosive and dangerous sites would not be undertaken. Streamside property owners would be encouraged to participate in the revegetation efforts.

Revegetation: Alternative III

Professional efforts to stabilize and revegetate a major landslide within the Percival Creek corridor would be pursued.

7.3.2 Removal of Fish Barriers and Other Habitat Improvements

GOAL: Replace poorly designed culverts that create barriers to fish passage. Improperly installed culverts can create excessively high water velocities or may be placed too high above the creek channel. Habitat improvements should be undertaken to correct historical problems.

Structural changes within a stream channel can potentially improve fish habitat. Most often these projects are limited to the installation of large woody debris within the channel, importation of spawning gravels, creation of structures that replicate overhanging banks, and structures that create more diversity in creek flow velocity.

Improvement of wildlife habitat is also possible. Construction and placement of cavity nest boxes for birds is a common structural habitat improvement. Large buffer areas adjacent to creeks and wetlands also create additional habitat areas. The incorporation of wildlife corridors into the landscape of new developments also helps maintain viable habitat areas.

Habitat Improvements: Alternative I

Under Alternative I, municipal funds for the removal of fish barrier culverts and habitat improvements are not available.

Habitat Improvements: Alternative II

Culverts presenting barriers to fish migration would be removed in order to open up additional habitat areas in the system. Several impassable culverts are located in the basin including the major culvert carrying Percival Creek under Mottman Road. When possible, these projects would be planned to coincide with road upgrades.

Many instream habitat improvement projects have been completed in the Pacific Northwest, but it is uncertain how much actual improvement has been created and what the impacts to the natural system have been. Given the high level of uncertainty associated with instream habitat improvement projects, Alternative II does not propose such projects in the foreseeable future.

Habitat Improvements: Alternative III

No change from Alternative II.

7.3.3 Sensitive Area Acquisition

GOAL: When feasible, wetlands and streamside habitat areas should be protected by the donation of these areas to land trusts, or the placement of sensitive areas in conservation easements. Sometimes areas of unique resource values can be acquired by fee simple purchase. For example, the City of Olympia recently purchased 160 acres of the Grass Lake wetland. The area will be preserved in its natural state and used for low impact recreation and education.

Numerous sensitive areas have been impaired or lost to urbanization; others may be threatened by continued development.

Sensitive Area Acquisition: Alternative I

Acquisition funds would not be provided under Alternative I. Local assistance to private parties pursuing donations or conservation easement is limited.

Sensitive Area Acquisition: Alternative II

Technical assistance would be provided to private parties interested in donations and conservation easements. Land purchases for preservation and education would be supported, but not funded, under Alternative II. Efforts to purchase and preserve sensitive areas in conjunction with the management of stormwater would be undertaken.

In general, regulatory means of habitat protection would be sought instead of public purchase of critical areas.

Sensitive Area Acquisition: Alternative III

Long-term efforts to purchase the high quality sensitive areas and wildlife habitat in the Percival Creek corridor would be pursued. The location of these areas is currently not known. Potential costs of this option have not been evaluated in the basin plan.

7.4 Regulations/Development Controls

Jurisdictions within the Percival Creek basin protect natural resources with a variety of regulations and development controls. These protection measures include stormwater management requirements and numerous zoning/development regulations.

Although Washington has given local jurisdictions the authority to manage water resources, specific regulations addressing management problems have not, in many cases, been developed. For instance, the Washington State Growth Management Act requires the adoption of development regulations to protect critical areas including wetlands, flood areas, fish and wildlife habitat, and conservation areas. However, the specific tools to accomplish this goal are not outlined.

As an alternative to strict regulations, many state agencies have developed management guidelines that local jurisdictions can choose to uphold strictly or follow on a more informal level. The Puget Sound Water Quality Authority (PSWQA), Washington Department of Ecology (WDOE), and Washington Department of Fisheries (WDF) have all developed guidelines for stormwater, water resource, and/or habitat management. These guidelines are in some cases limited, and from a resource protection standpoint, may be inadequate.

Local regulations and guidelines relevant to water resources and habitat management include site plan review, sensitive areas regulations, and clearing and grading regulations. Of primary importance is the *Drainage Design and Erosion Control Manual for Thurston Region, Washington* which has been adopted by Olympia, Lacey, Tumwater, and Thurston County.

A detailed discussion of federal, state, and local regulations concerning water resources and habitat management is presented in Appendix 9.

7.4.1 Drainage Regulations

GOAL: In urban areas, impervious surfaces create stormwater runoff. The runoff can flood developments and damage creeks. Discharge requirements should adequately regulate the amount and quality of stormwater releases in order to prevent property and environmental damage.

Drainage Regulations: Alternative I

The *Drainage Design and Erosion Control Manual for Thurston Region, Washington* (Regional Drainage Manual) would continue as the primary regulatory tool providing stormwater and erosion management requirements for private and public projects. The release rates required by the Regional Drainage Manual would continue to be implemented at the current level of 0.08 cubic feet/second (cfs)/disturbed acre for a 2-year storm event and 0.70 cfs/disturbed acre for a 100-year storm event. Water quality treatment methods, as addressed in the Regional Drainage Manual, would continue to be required.

Computer modeling indicates that the regulations addressing stormwater discharge rates would not protect Percival Creek from continued deterioration.

Drainage Regulations: Alternative II

New developments within the basin would be required to more effectively manage stormwater. The stormwater storage requirement as presented in the Regional Drainage Manual would be approximately doubled for new developments on relatively impervious soils. The increased storage requirement would serve as a incentive for developments to minimize runoff and thereby reduce their storage needs. The proposed requirement is evaluated in Section 11.4.

Drainage Regulations: Alternative III

No change from Alternative II. However, research indicates that in order to manage runoff at predevelopment level, facilities should be sized approximately three times larger than is currently required.

7.4.2 Fish and Wildlife Protection Regulations

GOAL: Provide specific regulations to protect existing natural resources and habitat areas. Methods of habitat protection focus on regulations pertaining to permitted activities in and around streams and wetlands. Regulated buffer zones and prohibitions on disturbance of sensitive areas have been established by the local jurisdictions.

Fish and Wildlife Regulations: Alternative I

Fish and wildlife are currently protected through a variety of state and local regulatory mechanisms.

Critical Area Ordinances have been adopted by the local jurisdictions. These ordinances place limitations on the types of activities that can take place in the vicinity of critical areas such as streams, wetlands, and steep slopes. They also establish setbacks from streams and wetlands. In general, buffers and setbacks established by the local jurisdictions range from 25 to 300 feet depending upon the characteristics of the area. Chapter 16.48 of the Olympia Code also protects fish and wildlife by placing limitations on land clearing in order to reduce siltation in the city's streams, lakes, and storm sewer systems. Thurston Regional Planning Council has received funding to further study the location and boundaries of the north Thurston County wetlands. The project is anticipated to be completed in 1992.

A discussion of existing regulations is presented in Appendix 9.

Fish and Wildlife Regulations: Alternative II

Current buffer and setback requirements adequately protect the basin's wetlands and sensitive areas. Under Alternative II, high quality critical areas (especially wetlands) would be recognized and protected as needed. This approach provides for relatively large buffers adjacent to several wetlands within the basin. Stormwater releases to these wetlands could be subject to increased regulations.

Fish and Wildlife Regulations: Alternative III

No change from Alternative II.

7.4.3. Zoning

GOAL: The location and design of future development should address water resource concerns through zoning designations. Additional regulatory changes can include decreases in allowable percentages of impervious surfaces on a developable lot and mandatory open space aimed at increasing the amount of natural infiltration. The Shoreline Management Act also established land use regulations for the majority of the Percival Creek system and associated lakes.

Zoning: Alternative I

No zoning changes would be recommended under Alternative I. Development would continue to be required to comply with current zoning regulations.

Zoning: Alternative II

In general, the zoning within the watershed would not be changed under Alternative II. The exception would be the requirement for open space/cluster development on approximately 230 acres of land currently zoned for residential development. The land use density of these sites would not be changed by this requirement. Open space/cluster development is further explained in Appendix 6.

Narrower street widths, porous pavement, reduced parking areas, and improved landscaping requirements would also be encouraged under this alternative, and evaluated for their effectiveness and feasibility in reducing flood flows and increasing groundwater recharge.

Zoning: Alternative III

Alternative III would require open space/cluster development for approximately 1200 acres of undeveloped parcels. Approximately 50 percent of these acres are zoned for high density residential and commercial/industrial development. Infiltration and flood flow reductions improve considerably from open space/cluster development.

7.5 Enforcement/Complaint Response

GOAL: Regulations should be enforced and complaints responded to in a timely manner. Regulations are often ineffective due to poor implementation. Enforcement of regulations designed to protect the integrity of water resources and important habitat areas is a critical part of any management program.

The local jurisdictions maintain small enforcement staffs. Unfortunately, these people are often responsible for large areas and may not be unable to enforce at an effective level. State agencies have enforcement staff, but they are commonly not available for enforcement at the local level.

Enforcement/Complaint Response: Alternative I

The existing level of enforcement and complaint response varies among the local jurisdictions. Olympia has a staff person responsible for the review of proposed stormwater facilities associated with new development and has hired a code enforcement officer for the enforcement of City codes pertaining to natural resource issues.

Thurston County has one environmental code enforcement officer responsible for the entire county. Tumwater has limited staff available for enforcement and complaint response.

This level of enforcement and complaint response would continue under Alternative I.

Enforcement/Complaint Response: Alternative II

Alternative II would establish adequate enforcement programs to implement natural resource regulations throughout the multijurisdictional region. Achieving adequate enforcement and complaint response would require the employment of additional staff in all jurisdictions.

Enforcement/Complaint Response: Alternative III

No change from Alternative II.

7.6 Pollution Source Control Programs

GOAL: Contaminants should be managed at the source. Once pollutants are released to the environment, corrective measures are difficult and costly. Source control programs focus on preventing the release of pollutants into the environment.

Pollution source control programs vary greatly in scope. They include nation-wide regulatory programs such as the EPA's NPDES program, and local programs such as stencilling storm drains, monitoring creeks, revegetating streambanks, and educating consumers on the disposal of hazardous household waste.

Pollution Source Control Programs: Alternative I

Currently, a grant funded business education program (Operation: Water Works) is being conducted for a targeted group of businesses in Olympia, Lacey, and north Thurston County. The program is limited in scope and funding, and will conclude in 1992. An ongoing program with a similar scope is not foreseeable.

Thurston County has developed a moderate risk waste plan to work with small generators of hazardous waste. The plan includes a consumer education component in the form of a household hazardous waste management program. The program is funded primarily from solid waste utility revenue and would continue under Alternative I.

State and federal regulations that address contaminants are or will be applicable within the local jurisdictions. These regulations establish management procedures as well as water quality standards. The local jurisdictions' financial ability to comply with these regulations is uncertain.

Programs aimed at source control would continue to be limited and carried out as funding sources become available.

Pollution Source Control Programs: Alternative II

The pollution source control program under Alternative II would encompass existing programs as well as additional public involvement and education (PIE) activities. PIE programs are discussed in Section 7.8.

Pollution Source Control Programs: Alternative III

Source control programs in Alternative III focus on increased levels of public involvement and education.

7.7 System Monitoring

Monitoring is an important tool for tracking the integrity of natural systems. Data collection allows for the early identification of problems.

7.7.1 Creek Monitoring

GOAL: Conduct long-term monitoring of water quality and flood flows, and respond to potential problems. Measurements of water quality parameters can be used to analyze trends and compare Percival Creek to other local creeks.

Creek Monitoring: Alternative I

In the past, water quality monitoring of the creek system has relied upon infrequent grant funding. Currently, intermittent monitoring projects can be conducted on a very limited basis within Olympia's jurisdiction. Occasional monitoring in response to known problems

would continue under Alternative I. Flows will be monitored in 1992 by means of an interlocal agreement between Olympia, Tumwater, and Thurston County.

Creek Monitoring: Alternative II

A long-term water quality and sediment monitoring program would be initiated for the creek system as well as limited monitoring efforts for Ken and Trosper Lakes. The proposed monitoring plan is presented in Appendix 8.

Flow monitoring would continue in the long term.

Creek Monitoring: Alternative III

Alternative III includes more extensive and frequent monitoring of water quality.

7.7.2 Instream Habitat Monitoring

GOAL: Monitor instream habitat conditions and respond to potential problems. Habitat conditions in urban settings can change quickly due to flood flow impacts or slowly from continued exposure to low level contaminants. Instream monitoring is important because many urban habitat areas are sensitive and under constant pressure from development.

Instream Habitat Monitoring: Alternative I

A recent training session was held to train volunteers to use the EPA's Streamwalk survey for habitat and stream monitoring. Similar types of cursory monitoring by volunteers would continue through the public involvement and education program.

Instream Habitat Monitoring: Alternative II

Alternative II would include a long-term geomorphic/habitat monitoring program for the Percival Creek system. Volunteer monitoring efforts would be augmented by professional investigations conducted every three years. The monitoring program would evaluate instream spawning and rearing habitat, geomorphology, streambank and hillslope erosion, and water quality problems.

Instream Habitat Monitoring: Alternative III

No change from Alternative II.

7.7.3 Wetland Monitoring

GOAL: Monitor wetland conditions and respond to potential degradation. Wetland inventories provide an opportunity to understand the status and quality of wetlands in an area. They are especially valuable when a limited number of wetlands remain and their quality and functions are not well understood. By regular monitoring of wetlands, changes in water quality and/or habitat can be spotted early before problems arise.

Wetland Monitoring: Alternative I

Volunteer Stream Team members are capable of monitoring and keeping track of water levels in wetlands and identifying wetland wildlife. Limited volunteer activities may occur under Alternative I.

Wetland Monitoring: Alternative II

A monitoring program for the basin's relatively high quality wetlands would be established under Alternative II. Monitoring would be conducted by volunteers and would track vegetative species as an indication of the health of the wetlands.

Wetland Monitoring: Alternative III

No change from Alternative II.

7.8 Public Involvement and Education

GOAL: Public involvement and education (PIE) programs should provide opportunities for interested residents to learn more about the natural resources of the area. Through education, many potential natural resource problems can be avoided.

Mandates and guidelines for public involvement and education come in many different forms. Comprehensive plans of local jurisdictions, PSWQA, WDOE, and the Washington State Legislature have all recommended more extensive education programs focusing on the environment, growth, Puget Sound, and water resource related issues. The local jurisdictions have established a process for public involvement in decision making.

Public involvement is defined in the Puget Sound Water Quality Management Plan as an ongoing dialogue between interested and affected parties and decision makers in all steps of the decision-making process. Education is more broadly defined, involving more diverse audiences, materials and activities.

As part of the basin planning effort, PIE activities have been divided into categories which define the variety of approaches used to involve and educate the public. These categories are as follows:

- Community Grants: Providing schools, community groups and business organizations with funds to support small scale PIE and habitat restoration projects.

- Education and Training: Providing targeted audiences with practical training and education, and reaching potential audiences through lectures, field training, and neighborhood meetings.

- Outreach: Providing water resource management information through brochures, videos, television, newspapers, and newsletters.

- Coordination/Evaluation: Providing regional coordination and evaluation of PIE projects and strategies.

- Technical Support: Providing citizens and Stream Teams with technical information on PIE and jurisdictional activities.

- Data Management: Providing a comprehensive method of tracking volunteers, projects, skills, and complaints relating to water resources.

- Policy and Program Development: Facilitating citizen involvement in policy and program decisions through advisory committees and workshops.

- Special projects: Provides short-term campaigns, utility mailings, and interpretive signs as enhancements to an ongoing PIE program.

Additional information on the current and proposed PIE programs is presented in Appendix 7.

Public Involvement and Education: Alternative I

During 1990 and 1991, local PIE activities were funded almost entirely by grants from WDOE. These grants have supported substantial levels of PIE activities.

In the near future, the PIE program would be dramatically reduced due to the lack of local funding. The reduced level of service under Alternative I is detailed below:

- Community Grants: None.
- Education and Training: Stream Team activities would continue at a reduced level in Olympia, and would not occur in the Thurston County or Tumwater. Ongoing household and moderate risk waste activities would continue regionally.
- Outreach: Although outreach would continue in Olympia, outreach efforts would not target the Percival Creek basin.
- Coordination/Evaluation: PIE staff from the local jurisdictions would continue to coordinate activities.
- Technical Support: Technical assistance would rely on limited jurisdictional, state, tribal, and volunteer support.
- Data Management: City of Olympia Stream Team register revisions and limited analysis of volunteer projects/monitoring would be provided.
- Policy and Program Development: Public workshops and briefings would occur only during plan development and adoption.

Under Alternative 1 there would be no stable funding source to support an adequate level of PIE in the region.

Public Involvement and Education: Alternative II

Alternative II would provide ongoing opportunities for public involvement and education.

Alternative II supports a regional PIE proposal developed by the Thurston Regional Educational Technical Advisory Committee (ETAC). The staff committee was appointed by the Storm and Surface Water Technical Advisory Committee (TAC) to provide assistance in the development of long-range public involvement and education programs. The proposal is based on guidelines and policies provided by PSWQA in the 1991 Puget Sound Water Quality Management Plan.

The PIE recommendations in Alternative II provide a regional approach as discussed in Chapter 11. Regional elements establish a basic framework and budget to support ongoing PIE activities that would be common to all basin plans. This framework would support PIE activities within the basin.

Public Involvement and Education: Alternative III

With the exception of the public outreach and data management components, the recommendations for Alternative III are the same as Alternative II.

Alternative III would expand the complaint response system regionally. Telephone numbers would be advertised to encourage public use. Accurate records of all calls would be kept and entered into the data base.

Alternative III would create a well-organized system of analyzing and evaluating Stream Team data. The information base would be regional in scope.

7.9 Cooperative Program Management

GOAL: The jurisdictions would coordinate activities in order to successfully manage a basin. The Percival Creek basin as well as other basins in the area encompass portions of several jurisdictions. Improvements in the management of a basin can not be expected to come from the efforts of any single jurisdiction, but rather from the combined and cooperative efforts of all involved jurisdictions.

In addition to the need for coordination among the four jurisdictions, coordination with state agencies such as WDOE, WDW, and WDF is important for the effective management of resources.

Cooperative Program Management: Alternative I

Current program management activities would continue under Alternative I. These include several groups representing the four local jurisdictions:

- Storm and Surface Water Technical Advisory Committee (TAC) responsible for assisting in the review of information and management of individual projects and policies.
- Public Works Directors steering committee.
- Thurston County Storm and Surface Water Advisory Board (SSWAB), the Henderson Inlet Advisory Committee, and the Budd Inlet Urban Bay Action Committee.

The four jurisdictions have signed a general Interlocal Cooperation Agreement for joint storm/surface water management (April 26, 1990). For particular projects such as planning, construction, facility operation, or program management, separate project agreements among two or more jurisdictions are signed. About 12 such project agreements are now in effect. This process of formalizing the roles and responsibilities of each jurisdiction for particular projects would continue as the basis for implementation of the Percival Creek basin plan under Alternative I.

Cooperative Program Management: Alternative II

Alternative II proposes improvements in the cooperative management of water resources. Efforts to provide more consistent and effective management of basin issues would be pursued.

Nonstructural recommendations to be implemented as part of the basin plan are presented in Chapter 11.

Cooperative Program Management: Alternative III

Alternative III supports the investigation and implementation of a comprehensive regionalized program for water resource management. While the effectiveness and efficiency of a regional program are perceivable, the overall needs and implications of a regional program have not been investigated as part of the basin planning effort.