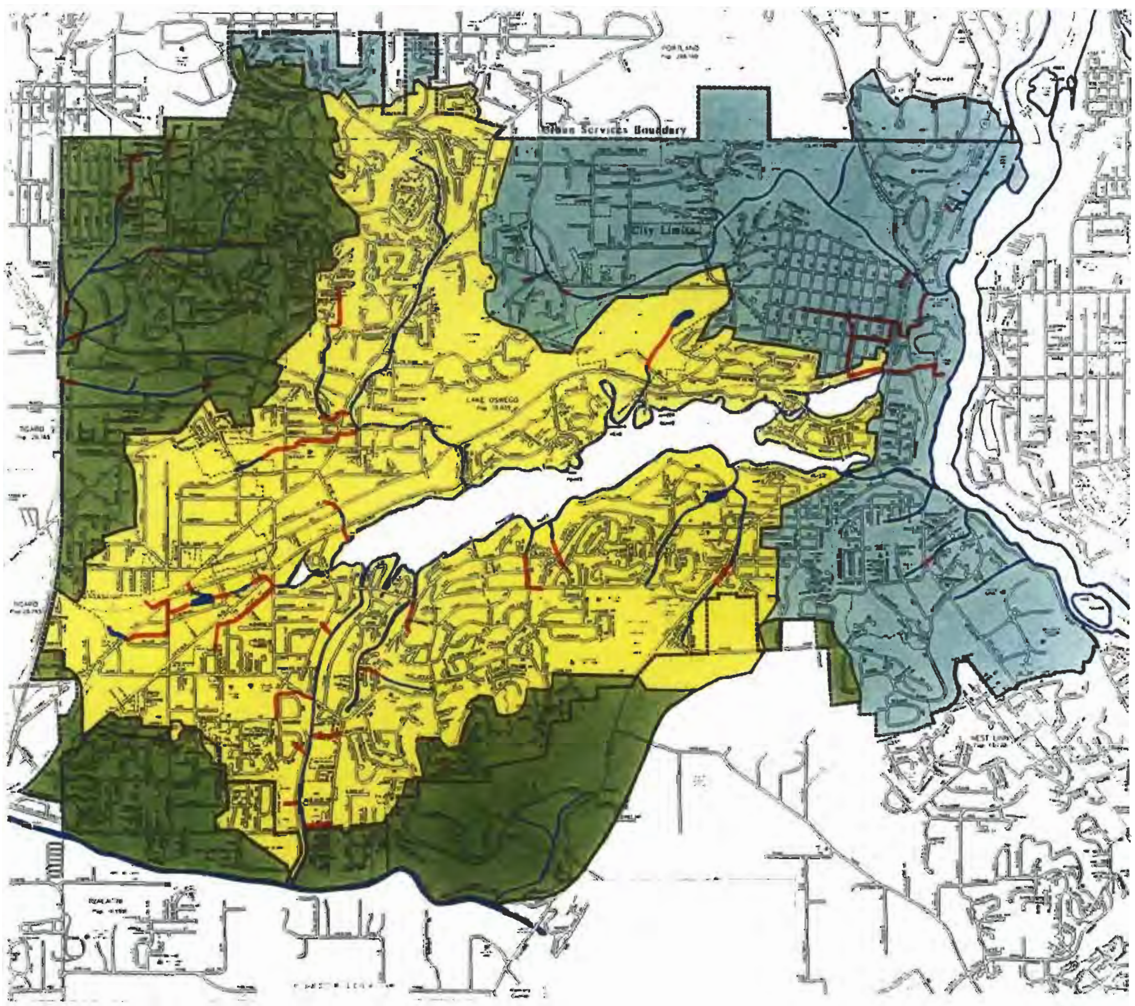
Lake Oswego
Surface Water Management

Volume I - Recommended Plan



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JULY 1992

LAKE OSWEGO
SURFACE WATER MANAGEMENT
MASTER PLAN
EXECUTIVE SUMMARY

In March 1991 the City of Lake Oswego contracted with OTAK to prepare a Surface Water Management (SWM) Master Plan for major drainages within the City's Urban Services Boundary (USB). In addition to areas incorporated within the City, the study area includes portions of Rivergrove and unincorporated Clackamas County. Clackamas County participated in the funding for the SWM planning effort. The SWM Master Plan consists of four elements:

- **Public Awareness and Involvement Plan** recommends programs to increase public awareness of water quality and drainage needs and promote volunteer involvement in programs such as streamwalks and stream corridor restoration.

- **Flood Control Management Plan** recommends increased maintenance and cost-effective improvements to undersized major culverts and pipe systems over the next twenty years.

- **Water Quality Management Plan** recommends cost effective levels of street sweeping, storm sewer and catchbasin cleaning, and new development controls, revised phosphorus load allocations for study area basins draining to the Tualatin River or Oswego Lake, and construction of eight major pollution reduction facilities over the next twenty years.

- **Implementation Plan** recommends formation of a Surface Water Utility to implement capital improvements and operations and maintenance functions of the SWM program, including recommendations of these other three plans. Utility rates would be supplemented by a system development charge for new development.

PUBLIC AWARENESS AND INVOLVEMENT

This plan recommends programs needed to focus the public's attention on problems facing area waters, and how citizens can help. It supports continued efforts to maintain media exposure, cooperate fully with other area governments and agencies, and involve citizens in preventing pollution, maintaining healthy stream corridors, and funding community efforts to mitigate drainage and water quality problems.

Background

Throughout the SWM master planning effort, public involvement played a key role, beginning with the SWM Policy Committee, a broad-spectrum group which monitored the SWM master planning effort and led the public involvement process. This committee recommended the following **community objectives** to achieve the goals of public safety, minimal property damage, and better water quality and fish and wildlife habitat in a cost effective manner:

- Create opportunities for citizen participation and awareness
- Promote using natural systems, rather than closed pipe, to convey runoff
- Prevent pollution from getting into runoff
- Allocate costs in an equitable manner to all who would benefit from improvements
- Cooperate with other affected communities and agencies

The following accomplishments publicized area drainage and water quality problems and involved citizens in seeking constructive solutions:

- A field trip to Bellevue, Washington exposed how that community's successful SWM program could be adapted to suit Lake Oswego.

- Streamwalks coordinated volunteers who identified areas of erosion, siltation, and debris in area stream corridors.

- Lake Oswego School District students monitored water quality and learned the importance of healthy stream systems.

- Newspaper articles publicized the SWM planning effort and public involvement programs.

- Four stand-alone brochures on various aspects of surface water management provide information and helpful tips to the public.

- A project bulletin, "WaterWays", was prepared and distributed to all residents and businesses in the City's USB. The bulletin provided background information and articles about the SWM planning process.

- Volunteers stenciled catchbasins, warning that they drain to streams. A doorhanger was prepared and used as part of this program.

- A slide show used to describe the SWM program was prepared and presented at several public meetings.

<u>Recommendations</u>

The SWM Master Plan recommends implementing a Public Awareness and Action Plan supporting programs to raise the public's awareness and encourage their involvement in programs such as streamwalk, catchbasin stenciling, stream corridor cleanup, and public meetings. Actions could include:

- Produce periodic SWM bulletins and brochures to:
  — Promote stewardship role among streamside residents
  — Publicize how residents can prevent or minimize pollution
  — Present need for the SWM master plan and continued community support

- Publish a "stream team" booklet, similar to that of Bellevue, introducing the surface water system and how citizens and the recommended utility can help.

- Continue to coordinate volunteer streamwalks.

- Provide materials and coordinate volunteer efforts to restore and maintain stream corridors.

- Continue to coordinate volunteer catchbasin stenciling efforts.

- Continue public meetings to publicize the need to implement the SWM Master Plan recommendations.

- Cooperate with the Lake Oswego Corporation (LOC) in promoting SWM awareness among shareholders and existing and eligible easement members.

FLOOD CONTROL MANAGEMENT PLAN

The Flood Control Management Plan (FCMP) recommends increased maintenance and cost-effective improvements to undersized major culverts and pipe systems over the next twenty years. To do this, estimated peak flows throughout the major drainage system are compared with major pipe and culvert capacities. This plan is the drainage element of the Public Facilities Plan required by the Land Conservation and Development Commission for incorporated areas with more than 2,500 people (OAR 660-11-010).

Background

Urbanization has profound impacts on the land's response to rainfall by reducing infiltration and base flow and increasing runoff volumes and flows; and these higher flows reach stream systems faster. Undersized or blocked culverts only worsen the problem. They can flood road crossings and pose unacceptable risks to lives or property even for a short time.

In 1968, CH2M studied area drainage problems in great detail using topographic maps showing nearly all structures, and considering nearly every pipe and culvert in the public system. They used a simple drainage analysis method and dissected the study area into drainage areas of only a few acres each. However, methods and community values have changed since 1968. Although CH2M identified many undersized culverts at existing crossings and many areas where pipes should be added if development were to occur, their recommendations included:

- Channelize the lower 2 miles of Springbrook Creek
- Channelize the north side of the Hunt Club field and drain the 3-acre wetland to the east
- Channelize the tributary through Waluga Park and drain the large wetlands present
- Drain the wetlands near the railroad tracks and Lower Boones Ferry

In general, wetlands were to be drained, piped systems were encouraged wherever possible, and detention was avoided. However, the maps proved valuable in the current SWM planning process.

SWM Study Approach

1. The study area was divided into 28 major drainage basins, and these were subdivided into 219 subbasins, for the purpose of modeling. These subbasins ranged in size from 23 to 194 acres and averaged about 80 acres. The major system was defined to include those stream and pipe reaches downstream of one or more subbasins, and the culverts they may flow through. In some cases, major culverts or detention facilities were included since they were near the outlet of a designated subbasin.

2. Design storms which would occur, on average, only once every 10, 25, 50, and 100 years were determined. A year's largest storm would, on average, exceed these design storms only 10%, 4%, 2%, and 1% of the years, respectively. Rainfall data from a gage located in the Fanno Creek basin was used to establish the following design storms:

Recurrence Interval	24-Hour Rainfall Depth
10 Years	3.3 Inches
25 Years	3.8 Inches
50 Years	4.3 Inches
100 Years	4.8 Inches

3. The hydrologic model HEC-1 was used to translate these storms into runoff events under both existing (1991) and built-out (2012) conditions for each of the 219 delineated subbasins. First, these total depths are distributed over a 24-hour period using the Type I-A design storm established by the Soil Conservation Service (SCS). The rainfall rate is then translated into runoff using a 3 minute simulation timestep and the following information to model infiltration and other losses:

- Soils were grouped into four hydrologic soil classes by the infiltration rate at which water can soak into the ground. Less porous soils generate greater runoff volumes. SCS curves relating rainfall to runoff were used to model the runoff contributed by pervious surfaces. Large areas west of Oswego Canal, including Rivergrove, and northwest of West Bay have porous soils and frequently drain into sumps or drywells, many of which may work well. In any case, however, they would only slightly affect peak flows from the large design storms, and their effect on smaller ones is not clear. They were not considered during either the flood control or water quality planning processes, as little is known about their exact locations or characteristics.

- Land uses were grouped by fraction of impervious surface, as determined from 1990 aerial photos. Impervious surfaces have very little loss during large storms. Five general land use groups were used: Single Family, Multi-Family, Institutional, Commercial and Industrial, and, Undeveloped Land. Streets were included with the land uses.

- Subbasin travel time for water to flow from the furthest point to the outlet was computed using estimates of impervious area, elevation difference, and travel distance. The longer the travel time, the more "spread out" and reduced are the resulting flows.

4. HEC-1 was then used to route the eight sets of subbasin flows through the 29 major drainage systems. Travel time was estimated using slope and field-estimates of channel dimensions and roughness. Flows were delayed by travel through channels or long pipes, but were not found to decrease. Also, culverts and smaller detention or sedimentation ponds were not found to affect the peak flows. While flood water surface elevation might increase, the additional runoff storage volume is a small fraction of the total storm volume. Only the larger wetlands were found to significantly reduce flows.

5. The design event used to evaluate the major pipes and culverts was based on the risk of potential damage. Culverts and stream channels serving larger areas are more expensive to repair or replace, and usually cause damage for longer periods if they overflow. Also, the significance of the crossings ranged from paths to roads to major arterials, with the latter causing the greatest threat if flooded. Finally, long pipe reaches can exceed their gravity flow capacity by forcing more water through under pressure flow. These issues are reflected in the following design criteria:

Drainage Area:	Design Storm Recurrence Interval (Years)			
	Open Channel Reach	Long Pipe Reach	Street Culvert	Major Arterial Culvert
< 40 Acres	25	10	10	25
< 640 Acres	50	25	50	50
> 640 Acres	50	Don't Use	50	50

Note: Improvements require a 100 year design on waterways with 100-year flood plains designated by the Federal Emergency Management Agency (FEMA).

6. The capacity of each major culvert and pipe reach is compared against the appropriate design flow under both existing and future conditions. Culverts were usually inlet controlled, but a few were so flat that their outlets limited the capacity even more. Long pipe runs were modeled as flowing full with slope balancing friction losses.

7. Identified undersized pipes were arranged into the following groups depending upon their location, relative deficiency and their estimated replacement or improvement cost:

- Some were below paths where flood risk was low, or were private crossings. These were not recommended for improvement. For some (e.g. at detention facilities whose problems could be relieved by removing flash boards) information was provided to the City. None of these were recommended as capital improvements.

- Others were undersized for the design storm but not for the next smaller event. Those pipes and culverts that could pass the next-smaller design event under future built-out conditions were not recommended for improvement within the 20-year Capital Improvement Program (CIP) timeframe.

- The remaining capital improvements would require some capital expenditure to replace or improve the existing structure, although twelve employ solutions that fall short of replacement by either providing a safe spillway for overflows, removing the structure, or enlarging the inlet to allow more water to enter the structure. These low-cost solutions are preferable to replacement whenever feasible.

Recommended Plan

Forty-four capital improvements are recommended for construction within existing Lake Oswego corporate limits by 2012 at a total project cost of $2.6 million in 1992 dollars. Nine others are recommended for the remaining study area, at an additional $285,000. In scheduling improvements, the following criteria for prioritization are recommended:

- Complete projects within Lake Oswego jurisdiction. Others can be completed later by the City as they are annexed, or by Clackamas County.

- Complete projects which cost less than $10,000 over a shorter term. Many of these less expensive projects can be completed for the cost of one of the larger ones, allowing more areas to see benefits from the SWM plan at an earlier time.

- Prioritize these lower-cost projects by estimated improvement cost.

- Complete projects which cost more than $10,000 by 2012. These larger projects can be spread out over twenty years.

- Prioritize these higher-cost projects by their ratio of improvement cost to relative deficiency. This relative deficiency is the fraction of design flow which can not be conveyed through the existing pipe or culvert, and reflects the flood risk which would be relieved by the project.

The City should continue to regularly maintain and clean its storm water system consisting of an estimated: 150 miles of pipe and open channels, 2880 storm water inlets and catchbasins, and 170 miles of publicly owned streets. In addition, existing drainage sumps and drywells in both the

City and the County should be inventoried, regularly inspected to identify clogging, and periodically cleaned. Finally, any new drywells should include sediment-trapping inlets to reduce drywell clogging.

Increasing regional detention for large (i.e. 10 to 100 year) design storms is not recommended for drainage basins within the study area. Extreme runoff storage volumes are required for any significant reduction in flow, and in order to be effective, these facilities would only begin to fill at very high flows, and could not provide any water quality benefits during more frequent storms.

WATER QUALITY MANAGEMENT PLAN

This Water Quality Management Plan (WQMP) recommends total phosphorus load allocations for the study area and specific maintenance practices and capital improvements that can significantly reduce sediment and sediment-borne phosphorus and other pollutants from all of the City's major drainage basins. It recommends increased levels of street sweeping, storm sewer and catchbasin cleaning, new development controls, and construction of eight major pollution reduction facilities over the next twenty years. It also recommends continued water quality monitoring to confirm that estimated pollutant reductions are achieved.

This plan is required by DEQ to address specific upland management practices and capital improvements needed to improve water quality and bring the following "water quality limited" (WQL) waters into compliance with DEQ standards for water contact, aquatic life exposure, or aesthetics (OAR 340-41-470):

Stream or Water Body	Season(s)	Problem(s)
Springbrook Creek	All	Bacteria
Fanno Creek	All	Bacteria
Fanno Creek	Summer	Algae (chlorophyll-a)
Oswego Lake	Summer	Dissolved Oxygen, pH, Algae
Tualatin River	Summer	Dissolved Oxygen, pH, Algae
	Fall, Spring	Bacteria

[From the 1990 Section 305(b) DEQ Clean Water Act status report to EPA]

Lake Oswego Corporation (LOC) has prepared annual Water Quality Management Plans for the lake itself since the Scientific Resources, Inc. (SRI) 1988 study. This plan, for the City and County, addresses pollution sources and specific capital improvements upland. Except for bacteria, for which the new enterococci standard needs new data to assess WQL status, the remaining problems all relate to algae blooms (specifically to levels of chlorophyll-a, the "green" pigment used to quantify algae levels). DEQ has determined that phosphorus is the limiting nutrient and that reducing it is the best way to reduce algae. A maximum total phosphorus concentration of 0.07 mg/l has been set for the lower Tualatin River. Even lower concentrations were required further upstream in order to dilute the large discharges from sewage treatment plants. Total phosphorus must be reduced to 0.025 mg/l in the lake in order to prevent algae growth without chemical treatments.

Actual phosphorus pollutant loads, obtained by multiplying the allowable concentrations times the river or stream flow, have become a serious concern in the study area following a successful 1986 lawsuit by the Northwest Environmental Defense Center over the water quality in the Tualatin River and Oswego Lake. As a result, DEQ has established total maximum daily loads (TMDL's) for total phosphorus (TP) entering these waterways, which must be achieved by June, 1993. Only 1500 pounds of total phosphorus per year would be allowed to enter the lake from ALL sources, including bottom sediment interaction and flow diverted from the Tualatin River. The load allocation (LA) for annual TP entering the lake from its drainage area is now set at 850 pounds. In an apparent oversight by DEQ, no phosphorus LA was established for runoff from the study area draining into the Tualatin River.

The City must also plan to characterize storm water runoff quality as part of the National Pollutant Discharge Elimination System (NPDES) municipal storm water permitting process. Lake Oswego, and Rivergrove have joined the Clackamas County permitting effort. The NPDES effort will include all of the City's drainage basins, including those draining to the Willamette.

Background

The major water quality issue for Oswego Lake, is the struggle to maintain algae within limits for aesthetics and swimming safety, while continuing to use Tualatin River water to generate electricity, without adding so much copper that conditions become toxic to aquatic life. This concern over lake quality and the need for better influent water quality from both area streams and the Tualatin River largely motivates the concern over the Tualatin basin water quality. SRI reported on the lake algae problem in 1988. Since then, the Lake Oswego Corporation's (LOC) Water Quality Committee has prepared annual Water Quality Management Plans (WQMP's) for the lake in their effort to comply with DEQ water quality standards. These efforts have revealed the following problems from the SWM study area:

- **Excessive Nutrients**, including both nitrogen and phosphorus, elevate algae concentrations beyond acceptable limits. While Tualatin River nutrient sources abound, contributions from the Oswego Lake basin result primarily from urban non-point source runoff. Yard and channel debris, excess fertilizing, detergents, and livestock and pets are all possible sources. Impervious surfaces collect and quickly transport phosphorus-containing storm water runoff to streams and the lake. Without these surfaces, runoff would be slowed, and pollutants removed by topsoil and vegetation.

- **Substantial Algal blooms** would be supported in the lake were it not for the large copper-based herbicide doses applied. Algae reduces water clarity and swimming visibility as it grows, and creates nuisance odors and consumes dissolved oxygen as it decomposes. Ambient Total Phosphorus concentrations must be reduced below 0.025 mg/l to limit algae growth without herbicides. Low-flow dissolved phosphorus levels are higher, indicating that such low phosphorus levels are not feasible.

- **Sediment** from the SWM study area forms large deltas at the mouths of Springbrook, Lost Dog, and Blue Heron Creeks and supports nuisance rooted aquatic plants on 23 acres of lake bed. Suspended sediment should be reduced to 15 mg/l to minimize these problems.

- **Copper** concentrations required to suppress algae and aquatic plants frequently exceed DEQ standards and may be toxic to some species of zooplankton and fish. Alternatives using sodium aluminate are being considered.

- **Fecal coliform bacteria** indicate the potential presence of disease-causing organisms. Levels occasionally exceeded DEQ contact recreation standards. LOC monitoring observed possible study area sources to be the small spring in Bryant Woods Park draining the unsewered areas west of Oswego Canal, the proximity of livestock and manure piles to Springbrook Creek, and excessive water fowl populations, and from the sanitary sewer trunk running beneath the lake surface. However, the standard was changed in 1991 to Enterococci bacteria which is a better indicator of human waste.

Other major pollutants associated with urban runoff include metals such as lead, zinc, and iron; toxic household and industrial chemicals; and oil and grease. None were observed to be serious problems in the lake, but all are potential threats from an urbanized area.

Approach

OTAK modeled a typical year's storm water total phosphorus contributions for built-out conditions (2012) under three levels of enhanced maintenance practices and compared them with contributions without any maintenance practices under both existing (1991) and built-out conditions. Results from a cost-effective level of maintenance were used to recommend load allocations. OTAK also modeled sediment and phosphorus removal from eight regional pollutant reduction facilities (PRF's). As baseflows contain little particulate phosphorus, no reduction in its load was assumed from any management practice.

1. The first step in any water quality effort is to locate nearby rain gages. Long term hourly precipitation records were required for the computer analysis that was used. These records were available for downtown Portland and the Rex-1-S gage near Newberg. The records from the Rex-1-S gage were selected for use.

2. OTAK used the program RAINEV to isolate significant rainfall events from the continuous 39 year record. These significant events are those large enough to produce runoff during subsequent washoff simulations. Then, instead of modeling washoffs from many years of storms and then averaging the results, OTAK "averaged" the rainfall record first, by assembling monthly records from different years which best represented the monthly averages into an "average" year with 109 significant rainfall events. The following statistics were used:

   - Average event depth
   - Average event duration
   - Average number of events
   - Maximum hourly precipitation
   - Average dry time between events for pollutants to accumulate

3. In order to model pollutant washoffs, the flood control land uses groups were refined into ten categories. These land use categories reflect parameters in addition to impervious area which affect pollutant washoff:

   - **Drainage system:** Grassy swales slow runoff and remove suspended pollution. Significant reduction in storm runoffs and washoffs are possible relative to the traditional curb-and-gutter used to collect runoff.

   - **Street density:** Pollutants generally accumulate along the roadside. Areas with more street per acre allow more pollution to accumulate and wash off. Areas with less street per acre have reduced pollutant loads.

- **Storm inlet density:** More inlets per acre mean less flow into each, less overall sediment-borne pollutant transport, and, if the inlets trap sediment, greater capture efficiency and larger overall available storage volume.

- **Type of land use:** Commercial and industrial areas have higher traffic densities. More sediment is produced, and that sediment usually is much more heavily polluted.

4. OTAK modeled per-acre, or "unit", storm water runoff and solids and phosphorus washoff from each land use category using SIMPTM, a physically-based model that incorporates the processes of accumulation, runoff production, and sediment and pollutant washoff. The following upland control strategies were considered:

   - **Regular street sweeping** to remove phosphorus-laden sediment before it washes off the street surface. Although ten pounds of sediment must be picked up by the sweeper to reduce the seasonal load by one pound, removing litter and debris has popular appeal. But moreover, removing this liter removes phosphorus before it can mobilize and adhere to street dirt.

   - **Sediment trapping catchbasins** to remove coarse sediment and the phosphorus it carries are modeled by SIMPTM. A maximum possible phosphorus reduction of 25% appeared evident.

   - **Grassy Swales** to reduce runoff volume and phosphorus accumulation are modeled by reducing the effective impervious area and phosphorus accumulation rates. Swales work best upstream of pipes, before flow becomes concentrated.

5. Three basin-wide alternative levels of upland water quality control strategies were evaluated along with existing and future conditions. Unit loadings from the previous step (i.e. see 4 above) were combined in proportion to their contributing area to obtain subbasin and basin total loads. Alternative III appeared to be the best of the following five alternatives:

   I. Existing development conditions with existing maintenance practices
   II. Future (2012) development conditions without any maintenance practices
   III. Future development with enhanced maintenance practices
   IV. Future development with twice-as frequent street sweeping
   V. Future development with twice again as frequent street sweeping, and all storm water inlets retrofit with sediment traps

6. Storm water runoffs and solids and phosphorus loads under Alternative III were exported to a separated study of Oswego Lake which was conducted by KCM (1991). The lake study concluded that:

   - The DEQ proposed Oswego Lake total maximum daily loads (Baumgartner, B., 14 March 1991 Memorandum) do not appear attainable.

   - Reduced Tualatin River inflows reduces the loading rate, however, the flushing rate is also reduced.

   - Oswego Lake will remain susceptible to algal blooms without further nutrient reduction. Chemical treatment would thus continue to be needed.

- Lake bottom sediment could provide continuing phosphorus loads internally, irrespective of reduced external contributions.

7. OTAK estimated the phosphorus load reductions likely from regional pollutant reduction facilities (PRF's) located along major stream corridors. As regional sites receive larger flows with finer, harder to remove sediment, wet ponds and wet-dry extended detention are most feasible. However, to match wet-dry performance, wet ponds require extra volume to discourage mixing of inflows and outflows. Wet-dry facilities periodically air the sediment, which helps prevent captured phosphorus from washing out during later storms. Forty potential regional PRF sites were identified which were:

   - Buildable but undeveloped.
   - Located along the major drainage system, downstream of at least one delineated subbasin.

   Of these, only eight feasible (PRF) sites were both:

   - Free of existing significant wetlands, and
   - More than 120 square feet of area per contributing acre, or about 300 cubic feet of volume per acre (established by the project team to allow measurable phosphorus reductions).

8. OTAK modeled PRF performances independently of each other by comparing available storage volume to runoff from each of the 109 "average" year storms, and calculating the total fraction of runoff captured. During an average settling time of 48 hours, 95% of the solids and 50% of the total phosphorus might settle from the captured runoff (Schueler, 1987). Thus the runoff capture was reduced by these ratios for the total solids and total phosphorus removals.

9. These sites were ranked by their estimated construction cost per pound of phosphorus removed. The highest ranked was the large public parcel just east of the Hunt Club on Springbrook creek, which could divert the first several acre-feet of storm water flows exceeding base flow around the north of the Hunt Club. Treated water would slowly be released into the tributary and rejoin the creek downstream of Iron Mountain Blvd.

10. Finally, phosphorus loads estimated from this study were contrasted with the DEQ-required levels. This WQMP concurs with the 1991 KCM Lake Study in concluding that neither the 850 pounds-per-year phosphorus load allocation nor the 0.025 mg/l critical phosphorus concentration in the Lake, nor the no-phosphorus load to the Tualatin, are achievable. It appears that other available, practical methods to limit algae growth must be employed.

Recommended Plan

- Immediately meet with DEQ to negotiate critical changes in the Oswego Lake TMDL and the Tualatin River Load Allocation for total phosphorus, and to reduce the regulated period for the lake to that of the rest of the Tualatin River basin.

Propose the following achievable total phosphorus load allocations:

Basin	Jurisdiction	Regulated Period	Load Allocation (lbs TP) Total	Storm	Baseflow
Oswego	City of Lake Oswego	Annual	1370	990	380
Lake	City of Lake Oswego	May 1 - Oct 31	400	315	85
Tualatin	Clackamas County	May 1 - Oct 31	120	95	25
River	City of Lake Oswego	May 1 - Oct 31	75	60	15
	City of Rivergrove	May 1 - Oct 31	45	35	10

Propose that the DEQ regulated period for Oswego Lake drainages matched that of the rest of the Tualatin Basin: the dry season of May 1 - October 31.

- Implement the following upland water quality control plan (Alternative III):

  — Sweep curbed residential streets 6 times per year
  — Sweep curbed major streets 12 times per year
  — Clean public and private sediment trapping catchbasins 2 times per year
  — Drain half of new development with grassy swales or on-site retention and infiltration
  — Drain all major arterials using curbs and gutters

- Prioritize regional PRF's based upon project cost per pound of phosphorus removed

- Obtain the five most feasible sites early, while they are still undeveloped. If facilities are not constructed, either maintain sites as open space or resell the property.

- Construct the most favorable PRF, along Springbrook Creek east of the Hunt Club, and monitor its performance to refine the design and construction process.

- Continually monitor water quality and best management practice (BMP) effectiveness using three sites in Springbrook Creek, above and below the highest-priority regional PRF, and further upstream at an outfall from a 90-acre residential area with curbed streets. Coordinate monitoring with the National Pollutant Discharge Elimination System (NPDES) permit application.

- Continue NPDES Permit application with Clackamas County to comply with the NPDES, Part 2, surface water regulations.

- Rehabilitate stream corridors, incorporating riparian corridor enhancement, stream stability, stream bank erosion control, soil bioengineering, and naturescaping.

- Plan for and protect sensitive lands along the riparian corridors.

- Continue to reduce soil erosion problems by inspecting construction site erosion controls, enforcing requirements and responding to complaints.

- Continue to develop and implement industrial pretreatment ordinances and spill response programs for sanitary and storm sewer systems.

- Continue to evaluate WQMP recommendations based upon continued monitoring.

- Implement projects in a timely manner to demonstrate good-faith efforts to comply with DEQ requirements.

RECOMMENDED IMPLEMENTATION PLAN

This plan recommends the formation of a Surface Water Management (SWM) Utility to implement the SWM Master Plan and improve, operate and maintain the surface water system within Lake Oswego. Monthly utility rates, supplemented by a system development charge for new development, would entirely fund operations and cover revenue bonds which would fund capital improvements.

Since 1988, storm water management in Lake Oswego has been funded through a flat fee of $3.50 attached to each bi-monthly sanitary sewer bill. It was designed to offset costs of some maintenance and the SWM master planning effort, but is insufficient to implement the SWM Master Plan. Although limited City general funds can be increased through higher property taxes, they fail to satisfy the DEQ requirement of a dedicated funding source.

Recommended Utility Programs

The SWM utility should incorporate the following new or existing programs:

- **Finance and Billing:** Prepare utility billings, track accounts receivable and accounts payable, monitor expenses, and perform other finance related and general administration tasks.

- **Operations and Maintenance:** Regularly maintain and clean the existing storm water system consisting of an estimated 150 miles of pipe and open channels, 2880 storm water inlets and catchbasins, and 170 miles of publicly owned streets.

- **Water Quality Management:** Implement and manage programs that directly benefit surface water quality. Identified programs include:

  — Stream Rehabilitation Engineering Design: Riparian corridor enhancement, stream stability, stream bank erosion control, soil bioengineering, and naturescaping. (Construction is funded as a capital expense.)

  — Sensitive Land Advance Planning: Plan for and protect sensitive lands along the riparian corridors.

  — Monitoring: Monitor area wide water quality and best management practices (BMP's).

  — NPDES Permit: Complete application with Clackamas County for the National Pollutant Discharge Elimination System (NPDES), Part 2, municipal storm water permit.

  — Erosion Control: Inspect construction site erosion controls, enforce regulations and respond to complaints.

- **Plan Review and Construction Inspection:** Review development plans for storm water (quantity and quality) management systems, wetlands, floodplain, stream corridors, and erosion control plans. The plan review commences at pre-application and continues through approval of construction plans. Conduct limited construction inspection (re-vegetation and wetlands). The following tasks are anticipated:

  — Development Plan Review
  — Building Plan Review and Inspection
  — Construction Inspection

- **Regulation:** Develop a Drainage Manual, revise the Erosion Control and Water Quality Manuals, as necessary, and revise the development standards. This task includes staff time to prepare the NPDES permit application including on-going work necessary for compliance. It also includes time needed to administer the National Flood Insurance Program within the City.

- **Small Works:** Solve minor storm water system problems through small construction projects. Provide complaint response to drainage related problems.

- **Public Awareness and Involvement:** Develop programs to raise the public's awareness and educate them through such methods as bulletins, brochures, etc. Encourage involvement in programs such as streamwalk, catchbasin stenciling, stream corridor cleanup, and public meetings.

Recommended Utility Budget

The project team recommends two budget categories: operating and capital needs. Capital needs fund improvements needed to convey floodwater, the recommended regional PRF's, and some sensitive land acquisition within the stream corridors. Operating needs fund the on-going utility programs. The SWM project team recommends the following budget (1992 dollars):

OPERATING NEEDS

Program Element	FTE *	Labor Cost	Direct Expense	Total Cost
Finance and Billing	0.5	$ 25,250	$ 20,000	$ 45,250
Operation and Maintenance	3.0	147,700	114,800	262,500
Water Quality Management	0.6	34,500	50,000	84,500
Plan Review and Inspection	0.3	-0-	-	-0-
Regulation	0.4	23,000	-	23,000
Small Works	0.5	28,750	-	28,750
Public Involvement	0.2	11,500	5,500	17,000
TOTALS	5.5	$ 270,700	$ 190,300	$ 461,000

* Full Time Equivalent

Note: Development fees fund Plan Review and Construction Inspection.

It should be noted that the recommended utility budget for both operating needs presented above and the capital needs presented next are based on 1992 dollars. Total program costs will increase due to inflation over the 20-year CIP and the utility rate initially established will have to increase over time also.

CAPITAL NEEDS

Program Element	Annual Cost	Total Cost
I. Water Quantity		
Major Drainages	$ 128,700	$ 2,574,000 [1]
Small Works	75,000	1,500,000
II. Water Quality		
PRF's	62,500	1,250,000 [1]
Stream Rehabilitation Construction	25,000	500,000
III. Sensitive Lands Protection	10,000	200,000
TOTAL	$ 301,200	$ 6,024,000

[1] These CIP program element costs include 15% for construction contingencies, 12% for engineering design, and 8% for construction inspection.

Recommended Funding Sources

The SWM Policy Committee considered a number of funding approaches in light of the cap on property tax revenues of Measure 5. Although the caps may allow funding for the recommended capital improvements to exceed the limits, the SWM Policy Committee recommended that any financial structure implemented be entirely outside the bounds of Measure 5. Accordingly, all options discussed during formation of this financial analysis were reviewed to determine whether or not they met the "Measure 5 test" of being "avoidable, controllable and not a direct result of property ownership." The SWM Policy Committee considered a number of funding options, including a "pay-as-you-go" approach of funding capital improvement projects entirely from utility charges as they are built. This would require a higher initial monthly rate, (i.e. $5.00 versus $3.75 for 100% CIP bonding) and CIP monies would have to be accrued before the CIP could be constructed. A system development charge for new development was recommended, but these fees will only fund a small portion of the recommended CIP. The Policy Committee recommended that a SWM utility funded by a dedicated service charge be formed subject to the following additional recommendations:

- Allow adequate time to inform the public about the SWM program, regulatory mandates, costs, and rate approach before implementing the surface water charge.
- Fully fund SWM utility operating expenses. Fund capital improvements which are immediately required through revenue bonds. Fund longer-term capital improvements as they are incurred ("pay as you go").
- Recognize the total impact of increasing water and sewer utility rate when setting the surface water service utility rate.

- Establish a Utilities Advisory Committee of Lake Oswego residents affected by utility fees to advise the City Council on water, sewer, and SWM utility rates. Involve this committee in establishing the SWM credit system.

- Base the SWM utility rate on the amount runoff contributed by impervious area.

- Charge single-family homes as a single a uniform rate based upon their average impervious area, or "Equivalent Service Unit" (ESU), measured to be 3,030 square feet.

- Charge other customers by their impervious surface area contributing, measured in number of ESU's.

- Exempt undeveloped properties from the charge.

- Include all publicly owned property except public streets.

- Allow no exemptions based on property use (other than undeveloped) or tax exempt status.

- Offer credits for existing on-site surface water mitigation facilities constructed and maintained to the City's standards. Credits should only reflect costs which are affected by a customer's on-site management of storm water runoff.

- Provide for those properties within Lake Oswego that fully retain and dispose of all surface water on-site and are not served by the Utility with a "nonservice abatement."

- Consider a "funding mix" with a number of secondary funding sources.

- Assess system improvement costs and adopt a system development charge for new or re-development, based on the SWM Master Plan findings.

The SWM Policy Committee recommended that a monthly SWM Utility rate of $3.75 per ESU area of 3,030 impervious square feet for the first three years. They further recommended that future rate increases be similarly "levelized" and held constant over several years.