REFERENCE

KENT
WASHINGTON

SURFACE WATER
DESIGN MANUAL

REFERENCE

The City of Kent accepts References 4A, 5, and 6B as provided in the 1998 King County Surface Water Design Manual and they are included herein. References 8-A through 8-J are also provided herein. Some of the references in reference section 8 have been revised by the City. Other reference sections in the 1998 King County Manual (1, 2, 3, 4b, 6A, and 7) are not relevant to the City of Kent Surface Water Design Manual.

Six separate maps relevant to the Manual are included as hard copies and PDF files on disk (See Table of Contents for list).

REFERENCES

4A – Landscape Management Plan Guidelines

5 – Bibliography of Supporting Studies and Research

6B – Pond Geometry Equations

8-A – Technical Information Report (TIR) Worksheet

8-B – Offsite Analysis Drainage System Table

8-C – Flow Control and Water Quality Facility Summary Sheet and Sketch

8-D – Bond Quantities Worksheet – (contact the City of Kent Public Works Department)

8-E – Surface Water and Drainage Facilities Construction Bond

8-F – Declaration of Stormwater Facility Maintenance Covenant

8-G – Drainage Easements

8-H – Water Quality Memorandum

8-I – Adjustment Application Form and Process Guidelines

8-J – Plat Dedication Clause – Final Recording

4A – LANDSCAPE MANAGEMENT PLAN GUIDELINES

REFERENCE 4-A

Guidelines for preparing a landscape management plan

Landscape management plans have the potential to significantly reduce the pollutant load washing off managed green spaces. For this reason, landscape management plans that incorporate key pollution prevention elements and which are consistently implemented can be used in lieu of water quality treatment facilities (see Section 1.2.8). Submittal requirements for obtaining an approved landscape management plan are given in Chapter 2.

GENERAL CONSIDERATIONS

Studies of pollutant transport have consistently shown that forested lands consistently produce lower pollutant loads—of solids, phosphorus and metals—than do lands used for residential, industrial or agricultural purposes. "Loading" refers to the total weight of a pollutant leaving a particular area or site. It is measured by determining both the concentration of a pollutant and the amount of flow leaving a site. Since the Puget Sound area was largely forested before settlement, lakes and streams in the area have developed biotic regimes in response to this low pollutant loading—clear, cool waters supporting salmon and other aquatic life. When the input of pollutants increases, lakes and streams often shift to a more biologically productive mode, often with a concomitant loss of clear water and a shift or even a decline in fish species.

When forests are converted to cities, this increase in pollutant load needs to be managed in order to maintain the beneficial uses of lakes and streams. One way to manage pollutants is to treat stormwater before it enters a water body. Biofiltration swales, wetponds and sand filters, as well as other facilities, can be used to provide this treatment. Another approach to manage pollutant loads is to prevent the pollutants from entering stormwater in the first place.

Our best models on how to keep nutrients and pollutants from entering storm water are from the original, unaltered landscape—the forests. Forests have a soft, absorptive **duff** layer, as well as **dense vegetative cover**, especially near the ground surface. Nutrients are provided in the form of **slow-release** organic materials, or leaves, needles and woody material. Rainfall **runoff is greatly reduced** from the levels seen in developed landscapes. These factors help to keep the total load of nutrients and sediments transported to receiving waters low.

ELEMENTS OF A SUCCESSFUL LANDSCAPE MANAGEMENT PLAN

Good planning, tailored to the specific conditions of the site, as well as good follow-through, are both essential in controlling the pollutants generated when forests are replaced with lawns, gardens or other landscape features. This section will focus on planning. Follow-through, or implementation, will be discussed in the next section.

I. PLAN CONTENTS

A landscape management plan for any particular site works best if developed with the specific site characteristics in mind. Soil type, slope, exposure, depth to groundwater as well as the particular suite of plants chosen for the site all should help direct the specific make-up of the plan. However, there are some basic principles that all sites should consider in order to be successful in controlling the export of soil or

organic matter, fertilizers and pesticides in stormwater runoff. Landscape management plans should address each of the general principles given in Table 1, tailoring them to fit the specific site situation.

Each of the five basic principles is expanded upon in the following section. The recommendations discussed under each principle are intended as a framework for a variety of site situations, from individual homes to large parks and golf courses. Thus, not every landscape management plan may be able to apply each of the listed recommendations. In addition, landscapes are managed for different purposes, some more formal than others. It may be that some recommendations will not be appropriate for very formal sites and thus not adopted, in favor of other management practices that better fit the uses for which the site is intended. In the end, the extent to which a landscape management plan is successful depends on the ability of the practices chosen to retain soil, fertilizers and pesticides on the site and away from water resources throughout the entire year.

Table 1 Basic principles to reduce pollutant transport from landscaped areas

1	Minimize bare soil areas
2	Reduce water demand
3	Reduce extent of turf area—manage remaining turf for low-impact
4	Choose plants with sustainability in mind
5	Manage fertilizer and pesticide use wisely

Principle 1 Minimize bare soil areas

Bare soil areas are one source of solids that can be mobilized and carried downstream by rainfall. Minimizing bare soil areas makes it less likely that solid particles will be dislodged by rainfall. Some pointers on how to manage landscapes to minimize bare soil are given below.

a) Establish dense plantings of pest-resistant groundcover to shade out weeds. Some easy-care recommendations are rock rose (*Cistus* sp.), snowberry (*Symphoricarpus alba*), salal (*Gaultheria shallon*) and kinnickinick (*Arctostaphylos uva-ursi*).

b) If bare soil areas are required, as in plant beds or ball diamonds, surround the bare area with an area of grass or groundcover to filter out solids that may be picked up by stormwater runoff.

- The denser the grass or groundcover, the better it works to capture solids in runoff.
- Try to make the filtering area as level as possible. Avoid low spots, where runoff can concentrate and create channels.
- In general, filter areas should be about one-fourth as long (along the flow path) as the area contributing low, assuming that slopes are gentle (less than about 10 percent). For flat, level areas without dips, this length can be reduced.

c) Repair promptly bare patches in lawns or groundcovers that could contribute solids to stormwater runoff.

d) Don't place bark or loose mulch on slopes where it can be carried to stormdrains.

Principle 2 Reduce water demand

Reducing the need for irrigation reduces the potential movement of pollutants, conserves water and saves money.

a) Use drought tolerant or native vegetation.

b) Install underground irrigation systems timed to water at night or drip irrigation systems.

c) Increase the organic content of soils to improve water-retention capability.

d) Allow for longer water retention by terracing sloped areas.

Principle 3 Reduce turf area and manage remaining turf for low-impact

Turf requires care to look good. In addition to mowing, turf areas typically require water, fertilizer and weed and disease control. However, some practices can reduce or minimize the amount of chemical controls needed.

a) Amend soil with organic matter to a depth of 8 -12 inches before the lawn is established. Till the organic matter into the native soil.

b) Decide if all lawn area needs the same level of upkeep: let some areas have a less formal look if possible, and reduce fertilizer and pesticide use in those areas.

c) Rely on irrigation and lawn aeration as the primary tools to maintain healthy turf.

d) Remove thatch each year to increase water penetration to grass roots and reduce runoff.

e) Plant groundcovers rather than grass in shady areas. Turf grasses usually need at least partial sun to remain vigorous.

Principle 4 Choose plants with sustainability in mind

Plants differ in their ability to cope with different soils, rainfall conditions, pest and diseases and microclimates. Choosing resilient plant species, plants with adaptations for particular environments or creating optimal microenvironments are all techniques that can be used to create landscapes that require less intervention. Less watering and less need for pesticide and fertilizer application means less potential for pollutants to leave the site.

a) Choose disease resistant plants.

b) Choose drought-resistant groundcovers, shrubs and trees in areas with poor soil or little shading.

c) Group plants in clusters with tree, shrub and groundcover layers to create a better micro-environment and to supply organic matter back to the soil.

d) Include plants in the landscape that are important for beneficial insects such as parasitic wasps. If beneficial insects have nothing to sustain them, they won't stick around to control pests when you need them.

e) Use dense plantings or close spacing to shade out weeds rather than herbicides.

f) Use plants with fibrous roots on steeper slopes or erosion-prone areas.[1] Some good choices include:
- *New Zealand flax (*Phormium penax*)
- Ornamental grasses, lawn grasses
- *Rock rose (*Cistus* sp.)
- Rosa rugosa

[1] Note that the County's Sensitive Areas Code (21a) defines and protects steep slopes and landslide hazard areas from encroachment. Generally, clearing of vegetation is prohibited in areas with slopes of 40% or more.

- Salmonberry (*Rubus spectabilis*) -- native
- Snowberry (*Symphoricarpus alba*)-- native

* not hardy in all areas of the County

a) Use wetland plants in areas with seeps or a high water table.

b) Attend to installation details. Write enforceable planting specifications that include details such as soil preparation, plant spacing, plant condition and size, planting depth, transplant handling and irrigation. Inspect the job during planting to prevent short cuts such as blowing the soil mixture around root balls rather than digging the roots into amended native soils.

Principle 5 Manage fertilizer and pesticide use wisely

Many landscape plants and turf simply won't do well without fertilization and some amount of pest management. It's therefore important for landscape management plans to address when and how these actions will be taken.

a) Keep plants healthy by building healthy soil using composted organic material. Healthy plants can better resist diseases and insect pests.

b) Tailor fertilizer make-up to lawn needs. Adjust application rate and timing of fertilizer applications to avoid carry-off in storm runoff.

c) Reduce the phosphorus (P) concentration in fertilizers when possible by using a low phosphorous formulation or formulations containing only nitrogen or potassium. Added phosphorus is often not needed for health foliage growth, only for encouraging profuse blooms.

d) Use an integrated pest management approach to control pests. Keep current about non-chemical controls as a first-defense against pests.

e) Encourage a diverse insect community in your landscape: Beneficial insects can help control pests, especially pests of trees and shrubs.

f) Target pesticide application to the specific pest of concern. Avoid pesticide "mixes" targeting generic problems (such as weed and feed) unless you actually need each of the formulations for a current problem.

g) Only apply pesticides during the life-stage when the pest is vulnerable.

h) Use fungicides very sparingly—they disrupt the base of aquatic food webs. If you need to use fungicides, spray formulations with faster break-down times. Consult a golf course management text for information on the attributes of various fungicides (and other pesticides). Balough and Walker, 1992, *Golf course management and construction* by Lewis Publishers is one source of information.

i) Tolerate some weeds.

References

"Weed management for lawns and gardens." Washington Toxics Coalition Fact Sheet, 1989.

"Least toxic lawn management." The BioIntegral Resource Center (BIRC), P.O. Box 7414, Berkeley, CA 94707

Washington State Cooperative Extension publications on lawn care, Bulletin Office, Cooperative Extension, Cooper Publication Building, Washington State University, Pullman, WA 99164-5912

Selected tittles include: "Turf grass diseases" and supplement (EB0713 and EB0713S); "European crane fly"(EB0856); "Fertilizer guide: western Washington" (FG0041); "Disease control in home lawns" (EB0938); "Home lawns" (EB0482).

II PLAN IMPLEMENTATION

A landscape management plan, no matter how good, will not reduce pollutants in runoff if it is not implemented. And implementation often means that the plan needs to be modified over time, since as plants grow and as the cycle of pests change, the original plan may not fit the site. The following must be addressed before a landscape management plan can be approved.

1. Identify who will be responsible for assuring the management plan is carried out.
2. Identify how the applicant will assure that grounds crews or homeowners have the training and/or resources required to implement the plan and keep up to date on advances in landscape care practices and products.
3. Agree to keep records of fertilizer and pesticide application, including rate of application, area treated and disposal or storage of residue.
4. Agree to certify each year that the landscape management plan for the project in question has been carried out, and that needed amendments or updates have been made.
5. Provide the plan to County maintenance or inspection personnel on request
6. Agree to pay an annual fee (based on time expended) to allow the County to administer the certification process, including review of plans, tracking of information, periodic field inspections and sampling.

5 – BIBLIOGRAPHY OF SUPPORTING STUDIES AND RESEARCH

BIBLIOGRAPHY OF SUPPORTING STUDIES & RESEARCH

Several studies, issue papers and reports were prepared by King County Surface Water Management (SWM) Division staff and consultants in support of the 1996 revisions to this manual. This section presents a bibliography of these documents which are available from the SWM Division.

FLOW CONTROL ISSUE PAPERS

Director's Briefing - Summary of Key Issues to the King County Surface Water Design Manual Update. Rick Schaefer, R.W. Beck and Associates; Linda Holden, Jeff Stern, King County Surface Water Management. September, 1993. Briefing paper presenting an overview of proposed changes in flow control, water quality and the review process. Each section establishes the need for a change, evaluates options for implementing the change, recommends an option, and discusses effects of the recommendation.

Comparison of Current and Proposed Detention Standards. Linda Holden, Jeff Stern, King County Surface Water Management. September, 1993. Comparison of current and proposed peak and duration standards, in terms of peak flow increases, flooding frequency, and impacts to resources.

Detention Issue Paper. Malcolm Leytham, Northwest Hydraulic Consultants; Linda Holden, Kelly Whiting, King County Surface Water Management. April, 1994. Provides an overview of proposed detention-related changes, including:

- comparison of alternative design techniques - Discusses advantages and disadvantages of various hydrological models including the "Y&W" method, SCS/SBUH 24-hour event method, SCS 7-day event method, HSPF Version 10, and HSPF Runoff Files.

- components of design - Discusses use of various models for design of conveyance systems, R/D facilities and other miscellaneous hydraulic structures, with emphasis on applicability of KCRTS.

- impact analysis - Presents impacts on detention sizing for several development case studies, comparing SBUH 24-hour method and KCRTS for a variety of detention performance standards.

The "Runoff Files" Implementation of HSPF. Malcolm Leytham, Northwest Hydraulic Consultants; Linda Holden, Kelly Whiting, King County Surface Water Management. April, 1994. Provides details on the Runoff Files method, including principles and background, application of runoff files for facility design, and responses to some common questions and concerns.

Retention/Detention Standards: Benefits and Limits in King County Basins. Rhett Jackson, Derek Booth, King County Surface Water Management. July, 1993. A discussion on the range of R/D standards available, the role of management objective and design methodology on their effectiveness, and fundamental limitations of onsite R/D on a basin-wide scale. Includes a comparison of KCRTS and SBUH standards and effectiveness.

Rationale For a "Threshold of Concern" in Stormwater Release Rates. Derek Booth, King County Surface Water Management. March, 1993. Discusses selection of "50% of the 2-year storm" as the lower threshold for duration control for stream protection detention standards.

A Comparison of 7-Day and 24-Hour Detention Pond Design Standards - The Consequences of Inadequate Detention. Rhett Jackson, King County Surface Water Management. August, 1992. A comparison of the effectiveness of 1990 Design Manual 24-hour SBUH ponds and SBUH 7-day ponds ("Barker method") as specified in the East Lake Sammamish Basin Plan, including effects on stream channels, water quality, stream and wetland habitats, and proposed capital improvement projects.

WATER QUALITY ISSUE PAPERS

Incentives analysis of five case studies. Gaynor Landscape Architechs/Designers, Inc. September, 1992. Five case studies exploring better ways to integrate stormwater facilities into sites--emphasis is on aesthetic enhancements.

The selection and sizing of treatment BMPs in new developments to achieve water quality objectives. 1993. Prepared by Gary Minton, Resource Planning Associates with the assistance of Herrera Environmental Consultants and R.W. Beck. A summary of the literature and some original analysis related to the size and performance of water quality facilities.

Water quality thresholds decision paper. Louise Kulzer, King County Surface Water Management, April 15, 1994. Explores the need to revise the 5,000 square pollution-generating impervious surface foot threshold used to trigger water quality facilities. Roof runoff quality explored. Summaries stormwater from a number of local studies in Table 1.

High use/ Oil control decision paper. Jennifer Gaus, King County Surface Water Management. October, 1994. Examines the intensity of vehicle use and other "high use" land uses which would generate a concentration of oil in stormwater treatable via oil/water separators. Based on assumptions of uniform oil loss per vehicle. Redevelopment water quality controls also discussed. Identifies land use types affected and benefits of better oil control.

Water quality credits decision paper. Sheryl Corrigan, John Heal, Louise Kulzer. King County Surface Water Management. November, 1994. Identifies actions that reduce pollutant loading and presents example cases to show effect of source reduction versus stormwater treatment on annual phosphorus loading.

WATER QUALITY BENCH TESTS & MODELING STUDIES

Oil leachate tests for various adsorbant filter media. Randy Brake, King County Surface Water Management. May, 1994. Presents results of bench tests exploring the release of oil into water from six oil absorbant media once oil saturated. Developed a standardized testing protocol.

Infiltration and pollutant removal characteristics of a proposed sand filter configuration. John Koon, King County Surface Water Management. May 1994. DRAFT, revision write-up expected November 1995. Presents results of infiltration plugging potential and pollutant removal (TSS, turbidity & TP) from sand column tests using mortar sand. Silty alluvial Duwamish valley sediments used to determine plugging potential.

Sand Filter sizing and costing. Linda Holden, King County Surface Water Management. May, 1995. Extensive exploration of the effect of various sand filter design parameters and criteria on facility size using the KCRTS model. Summary of options & recommendation, supported by spreadsheets detailing results of various options.

Infiltration, hydraulic conductivity and pollutant removal characteristics of sand filter materials. John Koon, King County Surface Water Management, March, 1995. Field Notes. Report expected November, 1995. Sand column tests expanded and modified to determine hydraulic conductivity in addition to infiltration rate. Pollutant removal (TSS, turbidity, TP) of various fast and slow draining sands.

Sand filter sand specifications. John Koon, King County Surface Water Management. June 16, 1995 Memo to Louise Kulzer. Documents sand mixes examined and logic for the sand specification recommended, including vendor availability.

OTHER ISSUE PAPERS AND STUDIES

King County Surface Water Design Manual Update - Cost Analysis. Bruce Johnson, King County Surface Water Management. December, 1995. Assessment of costs associated with proposed flow control and water quality changes.

Infiltration Issue Paper. Steve Foley, King County Surface Water Management. April, 1994. Summarizes and discusses recent changes to portions of the manual dealing with infiltration, including revisions intended to increase the use of infiltration, provide increased water quality protection, and improve the functioning of infiltration facilities.

Temporary Erosion and Sedimentation Control Decision Paper. Thor Tyson, King County Surface Water Management. November, 1993. Discussion and recommendations on recently implemented TESC issues, including maintenance standards,

TESC contact persons, wet season requirements and extensions, performance standards, stream and wetland protection and BMP revisions.

Summary of Proposed Changes to the Variance Process. Amy Carlson, Don Althauser, King County Surface Water Management. February, 1994. Discussion of changes proposed to the variance process with the goals of increasing flexibility and predictability and reducing review time and costs.

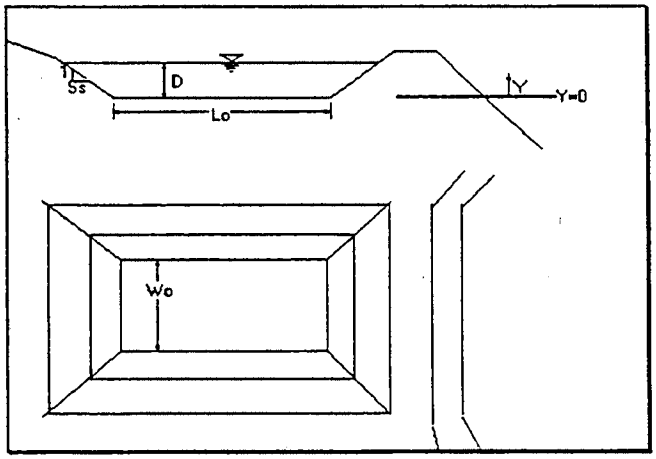
Shared Surface Water Facilities. Matrix Management Group. May, 1994. Outlines a proposal to provide developers with the option of constructing shared surface water detention and treatment facilities as an alternative to currently required on-site facilities, including a discussion on financing options.

Application of Surface Water Control to Roadways. Rick Schaefer, R.W. Beck and Associates. December, 1992. Identifies provisions of the current Design Manual that fail to address design challenges inherent in linear (roadway) projects, and recommends alternative methods of surface water quantity and quality control.

6B – POND GEOMETRY EQUATIONS

Reference Section 6-B

Pond Geometry Calculations



<Known>

Volume	(V)
Pond Depth	(D)
Side Slope	(S_S)
Length-to-Width Ratio	(R)

<Find>

Bottom Area of Rectangular Pond

<Solution>

Y = depth of section measured from bottom, from zero to D
W_0= width at pond bottom

The pond width (W) at any depth, Y

$$W_Y = W_0 + 2S_S Y \qquad \text{Eq. 1}$$

The pond length (L) at any depth, Y

$$L_Y = RW_0 + 2S_S Y \qquad \text{Eq. 2}$$

The pond area at any depth, Y

$$A_Y = L_Y W_Y = (RW_0 + 2S_S Y)(W_0 + 2S_S Y) \qquad \text{Eq. 3}$$

or,

$$A_Y = RW_0^2 + (R+1)2W_0 S_S Y + 4S_S^2 Y^2 \qquad \text{Eq. 4}$$

The equation for the pond-full volume (V) is obtained by integrating between Y=0 and Y=D

$$V = \int_0^D \left(RW_0^2 + (R+1)2W_0 S_S Y + 4S_S^2 Y^2\right) dY \qquad \text{Eq. 5}$$

or,

$$V = \left[RW_0^2 Y + (R+1)W_0 S_S Y^2 + \frac{4}{3} S_S^2 Y^3 \right]_0^D \qquad \text{Eq. 6}$$

or,

$$V = RDW_0^2 + S_S D^2 (R+1)W_0 + \frac{4}{3} S_S^2 D^3 \qquad \text{Eq. 7}$$

Where

V =	Volume of rectangular pond	R =	Length-to-width ratio
D =	Depth	Ss =	Side Slope
W_0 =	Bottom width		

Rearrange equation to solve for W_0 using quadratic equation, $0 = ax^2 + bx + c$

$$0 = RDW_0^2 + S_S D^2 (R+1)W_0 + \frac{4}{3} S_S^2 D^3 - V \qquad \text{Eq. 8}$$

Use Quadratic Equation to solve for positive solution of W_0, $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

$$W_0 = \frac{-S_S D^2 (R+1) \pm \sqrt{\left[S_S D^2 (R+1)\right]^2 - 4RD\left(\frac{4}{3} S_S^2 D^3 - V\right)}}{2RD} \qquad \text{Eq. 9}$$

Use Equation 2 for Length of pond at Y=0,
$L_0 = RW_0$

Use Equation 3 for Area of pond at Y=0,
$A_O = L_0 W_0 = RW_0^2$

8-A – TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

FIGURE 1, PAGE 1 OF 2
CITY OF KENT PUBLIC WORKS DEPARTMENT
TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

PART 1 PROJECT OWNER AND PROJECT ENGINEER

Project Owner _____

Address _____

Phone _____

Project Engineer _____

Company _____

Address/Phone _____

PART 2 PROJECT LOCATION AND DESCRIPTION

Project Name _____

Location

Township _____

Range _____

Section _____

PART 3 TYPE OF PERMIT APPLICATION

- ☐ Subdivision
- ☐ Short Subdivision
- ☐ Grading
- ☐ Commercial
- ☐ Other _____

PART 4 OTHER PERMITS

- ☐ DFW HPA
- ☐ COE 404
- ☐ DOE Dam Safety
- ☐ FEMA Floodplain
- ☐ COE Wetlands
- ☐ Shoreline Management
- ☐ Rockery
- ☐ Structural Vaults
- ☐ Other

PART 5 SITE COMMUNITY AND DRAINAGE BASIN

Community:

Drainage Basin:

PART 6 SITE CHARACTERISTICS

- ☐ River _____
- ☐ Stream _____
- ☐ Critical Stream Reach
- ☐ Depressions/Swales
- ☐ Lake _____
- ☐ Steep Slopes _____
- ☐ Floodplain _____
- ☐ Wetlands _____
- ☐ Seeps/Springs
- ☐ High Groundwater Table
- ☐ Groundwater Recharge
- ☐ Other _____

PART 7 SOILS

Soil Type	Slopes	Erosion Potential	Erosive Velocities

☐ Additional Sheets Attached

Figure 1, page 2 of 2
City of Kent Public Works Department

TECHNICAL INFORMATION REPORT (TIR) WORKSHEET

PART 8 DEVELOPMENT LIMITATIONS

REFERENCE	LIMITATION/SITE CONSTRAINT
☐ _____	_____
☐ _____	_____

☐ Additional Sheets Attached

PART 9 ESC REQUIREMENTS

MINIMUM ESC REQUIREMENTS DURING CONSTRUCTION

- ☐ Sedimentation Facilities
- ☐ Stabilized Construction Entrance
- ☐ Perimeter Runoff Control
- ☐ Clearing and Grading Restrictions
- ☐ Cover Practices
- ☐ Construction Sequence
- ☐ Other

MINIMUM ESC REQUIREMENTS FOLLOWING CONSTRUCTION

- ☐ Stabilize Exposed Surface
- ☐ Remove and Restore Temporary ESC Facilities
- ☐ Clean and Remove All Silt and Debris
- ☐ Ensure Operation of Permanent Facilities
- ☐ Flag Limits of SAO and Open Space Preservation Areas
- ☐ Other

PART 10 SURFACE WATER SYSTEM

- ☐ Grass Lined Channel
- ☐ Pipe System
- ☐ Open Channel
- ☐ Dry Pond
- ☐ Wet Pond
- ☐ Tank
- ☐ Vault
- ☐ Energy Dissipater
- ☐ Wetland
- ☐ Stream
- ☐ Infiltration
- ☐ Depression
- ☐ Flow Dispersal
- ☐ Waiver
- ☐ Regional Detention

Method of Analysis _____

Compensation/Mitigation of Eliminated Site Storage _____

Brief Description of System Operation: _____

Facility Related Site Limitations

Reference	Facility	Limitation
_____	_____	_____
_____	_____	_____

Part 11 STRUCTURAL ANALYSIS

- ☐ Cast in Place Vault
- ☐ Retaining Wall
- ☐ Rockery > 4 ' High
- ☐ Structural on Steep Slope
- ☐ Other

PART 12 EASEMENTS/TRACTS

- ☐ Drainage Easement
- ☐ Access Easement
- ☐ Native Growth Protection Easement
- ☐ Tract
- ☐ Other

PART 13 SIGNATURE OF PROFESSIONAL ENGINEER

I or a civil engineer under my supervision have visited the site. Actual site conditions as observed were incorporated into this worksheet and the attachments. To the best of my knowledge the information provided here is accurate.

_____

_____
Signed/Date

8-B – OFFSITE ANALYSIS DRAINAGE SYSTEM TABLE

OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
Surface Water Design Manual, Core Requirement #2

Basin: **Subbasin Name:** **Subbasin Number:**

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensative area, volume	%	1/4 mi = 1,320 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts.

OFF-SITE ANALYSIS DRAINAGE SYSTEM TABLE
Surface Water Design Manual, Core Requirement #2

Basin: Crystal Drainage Basin **Subbasin Name:** Clear Creek **Subbasin Number:** AA

Symbol	Drainage Component Type, Name, and Size	Drainage Component Description	Slope	Distance from site discharge	Existing Problems	Potential Problems	Observations of field inspector resource reviewer, or resident
see map	Type: sheet flow, swale, stream, channel, pipe, pond; Size: diameter, surface area	drainage basin, vegetation, cover, depth, type of sensative area, volume	%	1/4 mi = 1,320 ft	constrictions, under capacity, ponding, overtopping, flooding, habitat or organism destruction, scouring, bank sloughing, sedimentation, incision, other erosion		tributary area, likelihood of problem, overflow pathways, potential impacts
A	Site Discharge Location	Crystal Drainage Basin		0'			
A - B	Natural Swale	Natural, dense vegetation	2%	0 - 240'	None	None	Swale has capacity; no erosion exists.
B - C	12" CMP	Under private drive	3%	240' - 260'	None	Under capacity	No erosion exists
C - D	Draw	Natural, dense vegetation	8%	260' - 500'	Erosion	Further erosion	Tributary area about 650 - 1900 acres
D - E	18" CMP	Under 57th Street	6%	500' - 660'	None	Under capacity	Overtopping is unlikely. If culvert were plugged, drainage would flow toward roadside ditch.
E - F	Seasonal stream	Natural, dense vegetation with gravel and sand at the flow line	5%	660' - 860'	None	None	No erosion exists.
G - H	36" RCP	Under 15th Street	5%	860' - 1010'	None	Under capacity	No erosion exists.
H - I	36" RCP	Under I-22	3%	1010' - 1160'	None	Under capacity	No erosion exists.
I - J	36" RCP	Adjacent to Smith Street	1.5%	1160' - 1310'	Flooding and Sedimentation	Under capacity	No erosion exists.
J - K	Clear Creek	Type 2 Stream	1.5%	1310' - 1610'	Erosion	Further erosion	No erosion exists.
K - L	Wetland CL21	Type 2 Wetland		1610' - 1660'			Tributary area 15 sq. mi.
L - M	Crystal Lake			1660'			

8-C – FLOW CONTROL AND WATER QUALITY FACILITY SUMMARY SHEET AND SKETCH

STORMWATER FACILITY SUMMARY SHEET

Development_____Date_____

Location_____

ENGINEER	DEVELOPER
Name	Name
Firm	Firm
Address	Address
Phone	Phone

Developed Site: Acres_____ Number of lots_____

Number of detention facilities on site:
_____ ponds
_____ vaults
_____ tanks

Number of infiltration facilities on site:
_____ ponds
_____ vaults
_____ tanks

Flow control provided in regional facility (give location)_____
No flow control required_____ Exemption number _____
Downstream Drainage Basins

		Immediate	Major Basin
	Basin A		
	Basin B		
	Basin C		
	Basin D		

Number & type of water quality facilities on site:

_____ biofiltration swale (regular/wet/ or continuous inflow?)
_____ combined detention/WQ pond (WQ portion basic or large?)
_____ combined detention/wetvault
_____ compost filter
_____ filter strip
_____ flow dispersion
_____ farm management plan
_____ landscape management plan

_____ sand filter (basic or large?)
_____ sand filter, linear (basic or large?)
_____ sand filter vault (basic or large?)

_____ stormwater wetland
_____ wetpond (basic or large?)
_____ wetvault

_____ oil/water separator (baffle or coalescing plate?)
_____ catch basin inserts: Manufacturer_____

_____ pre-settling pond
_____ pre-settling structure: Manufacturer_____
_____ flow-splitter catchbasin

DESIGN INFORMATION	INDIVIDUAL BASIN			
	A	B	C	D
Water Quality design flow				
Water Quality treated volume or wetpond Vr				

DESIGN INFORMATION, cont'd	TOTAL	INDIVIDUAL BASIN			
Drainage basin(s)		A	B	C	D
Onsite area					
Offsite area					
Type of Storage Facility					
Live Storage Volume					
Predeveloped Runoff Rate	2-year				
	10-year				
	100-year				
Developed runoff rate	2-year				
	10-year				
	100-year				
Type of restrictor					
Size of orifice/restriction	No. 1				
	No. 2				
	No. 3				
	No. 4				

FLOW CONTROL & WATER QUALITY FACILITY SUMMARY SHEET SKETCH

All detention, infiltration and water quality facilities must include a sketch per the following criteria:

1. Heading for the drawings should be located at the top of the sketch (top right-hand corner). The heading should contain:
   - North arrow (point up or to left)
   - Plat name or short plat number
   - Date drawn (or updated)
   - D9#_____
   - Address (nearest)
   - Thomas Brothers page, grid number
2. Label CBs and MHs with the plan and profile designation. Label the control structure in writing or abbreviate with C.S. Indicate which structures provide spill control.
3. Pipes-- indicate:
   Pipe size
   Pipe length
   Flow direction
   Use s single heavyweight line
4. Tanks-- use a double, heavyweight line and indicate size (diameter)
5. Access roads
   - Outline the limits of the road
   - Fill the outline with dots if the road is gravel. Label in writing if another surface.
6. Other Standard Symbols:
   - Bollards: ● ● ● ● ■ ■ ■ ■
   - Rip rap oooooo
     oooooo

Fences --x---x---x---x---x---x---

   - Ditches ~D~~→D~~→D~~→D
7. Label trash racks in writing.
8. Label all streets with the actual street sign designation. If you don't know the actual street name, consult the plat map.
9. Include easements and lot lines or tract limits when possible.
10. Arrange all the labeling or writing to read from left to right or from bottom to top with reference to a properly oriented heading.
11. Indicate driveways or features that may impact access, maintenance or replacement.

8-D – BOND QUANTITIES WORKSHEET
(CONTACT KENT PUBLIC WORKS)

8-E – SURFACE WATER AND DRAINAGE FACILITIES CONSTRUCTION BOND

KENT
WASHINGTON

MAIL TO:
PROPERTY MANAGEMENT
City of Kent
220 4TH Avenue South
Kent, Washington 98032
Attn:_____

SURFACE WATER AND DRAINAGE FACILITIES CONSTRUCTION BOND

STATE OF WASHINGTON)
)SS
COUNTY OF KING)

PROJECT NAME:_____
PROJECT NUMBER:_____
KIVA # _____

KNOW ALL MEN BY THESE PRESENTS, that we _____, as Principal, and the _____, a Corporation organized and existing under and by virtue of the laws of the State of _____ and authorized to transact the business of surety in the State of Washington, as surety, are held and firmly bound unto the City of Kent, in the penal sum of _____ for payment of which, well and truly to be made, we bind ourselves and each of our heirs, executors, administrators and assigns, jointly and severally, firmly by these presents.

The condition of the foregoing obligation is such that the above described principal is about to construct _____, hereinafter referred to as "Improvements," that may cause damage and disruption to certain lands and/or public rights-of-way within the City limits of Kent and in the County of King in accordance with approved plans on file with the City of Kent Engineering Department.

The principals of this bond agree to the following terms and conditions:

1. Said Improvements and their appurtenances thereto shall be constructed in accordance with the approved plans;
2. Construction shall be completed within ____ days after construction begins unless the City Engineer, for good cause shown, has granted an extension of time;
3. All construction and restoration shall be in accordance with the City of Kent Standards, APWA Standards and Surface Water and Drainage Ordinance as set forth by City of Kent Ordinance Nos. 1142, 1672, and 3208 and as may hereafter be amended.

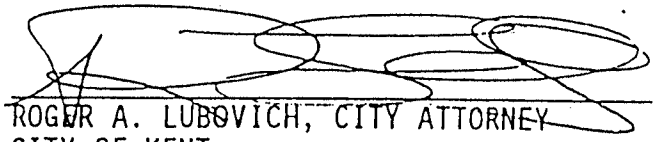
4. Traffic control shall be implemented in accordance with the US Department of Transportation Manual on Uniform Traffic Control Devices as may hereafter be amended as set forth in Part VI within said manual.

The Construction Inspector of the City of Kent shall be given twenty-four (24) hours notice prior to the commencement of any work.

The condition of this obligation is such that if the principal shall construct said improvements in accordance with the terms and conditions set forth herein this obligation shall terminate. Otherwise, it shall remain in full force and effect. This obligation shall be released after final acceptance of the improvements by the City and upon receipt by the City of the required maintenance bond for the one-year maintenance period, otherwise to remain in full force and effect.

Signed, sealed and dated this _____ day of _____, 20_____.

APPROVED AS TO FORM:



ROGER A. LUBOVICH, CITY ATTORNEY
CITY OF KENT

_____
PRINCIPAL

_____
ADDRESS

_____

_____
PHONE

_____
ATTEST

_____
PRESIDENT

_____
COUNTERSIGNED

_____
SECRETARY

_____
BONDING COMPANY

*By:_____

*AUTHORIZATION FOR ATTORNEY-IN-FACT ATTACHED HERETO.

8-F – DECLARATION OF STORMWATER FACILITY MAINTENANCE COVENANT

AFTER RECORDING MAIL TO:

Property Management
City of Kent
220 4th Avenue South
Kent, WA 98032
Attn:_____

Reference Number of Related Document:
Grantor(s):
Grantee(s): City of Kent
Abbreviated Legal Description:
Additional Legal Description is on Page(s)____of Document
Assessor's Tax Parcel No.
Project:

DECLARATION OF STORMWATER FACILITY MAINTENANCE COVENANT

(INDIVIDUAL)

IN CONSIDERATION OF THE City of Kent (" City") approval for: _____relating to real property legally described as follows:

the undersigned Grantor(s) declares that the above-described property is subject to a privately maintained stormwater drainage, detention, and/or stormwater treatment system (the, " Stormwater Facilities"), and also covenants and agrees as follows:

DUTIES OF GRANTOR(S):

1. Grantor(s) shall regularly inspect and maintain/repair the private Stormwater Facilities on the said-described property in accordance with the standards specified in the ~~City's~~ Construction Standards, specifically including Appendix D (" Maintenance Requirements for Privately Maintained ~~Drainage~~ Facilities"), as now collectively enacted or hereafter amended, which are incorporated by this reference as if fully set forth herein (the, " City Construction Standards").

2. Grantor(s) shall inspect the Stormwater Facilities as often as conditions require, but in any event at least once each year. Grantor(s) shall, within four weeks after each inspection, maintain/repair the Stormwater Facilities as required by the City Construction Standards.

3. Grantor(s) shall inspect each element of the Stormwater Facilities whenever the City's Public Works Director (" Director"), in his/her sole discretion, determines that unacceptable conditions exist within or adjoining to the Stormwater Facilities. Similarly, the Director, in his/her sole discretion, may require the Grantor(s) to complete the maintenance/repair of the Stormwater Facilities within a shorter time period than allowed in Section 2, above.

4. Grantor(s), in effecting this maintenance/repair, shall restore the Stormwater Facilities to like new condition, or if that is not practical, to an acceptable condition to the extent listed and/or described in the City Construction Standards.

5. Grantor(s) is hereby required to obtain written approval from the Director prior to grading, filling, piping, cutting or removing vegetation (except for routine and minor landscape maintenance) in open vegetated drainage facilities (such as biofiltration swales, channels, ditches, ponds, etc.) or performing any alterations or modifications to the Stormwater Facilities. Grantor(s) shall obtain all necessary permits and provide all required land surveys as required by the City Construction Standards.

6. Grantor(s) shall assume all responsibility for the implementation and cost of any maintenance and/or repairs to the Stormwater Facilities.

RIGHTS OF THE CITY:

1. The City shall have ingress and egress rights to the said-described property for inspection and monitoring of the Stormwater Facilities in order to determine performance, operational flows or defects in the Stormwater Facilities, all in accord with the City Construction Standards.

2. If the City determines that, pursuant to the City Construction Standards, the Stormwater Facilities require maintenance and/or repair work, the Director shall deliver written notice to the Grantor specifically describing the required maintenance and/or repair. The notice shall also set a reasonable time in which Grantor must complete the described work. The notice shall also state that the City or its authorized agent may perform the authorized maintenance and/or repair if the Grantor(s) fails to complete the maintenance and/or repair within the time allowed.

3. If the Grantor(s) does not complete the required maintenance and/or repair within the time allowed as set forth in the Director's notice, the City of its authorized agent will not commence the maintenance and/or repair work described in the Director's notice until at least seven (7) calendar days after the expiration of the time allotted to Grantor to make the maintenance and/or repair. However, if the Director determines, at his or her sole discretion, that an imminent danger exists, the City's obligation to provide written notice shall be deemed waived, and the City or its authorized agent may immediately begin the required maintenance and/or repair work.

4. If the City or its authorized agent performs the required maintenance and/or repairs to the Stormwater Facilities, Grantor(s) shall reimburse the City all its costs incurred in completing the maintenance and/or repairs within thirty (30) calendar days of Grantor's receipt of the City's invoice for that work. Overdue payments shall accrue interest at the rate of twelve percent (12%) per annum.

5. If the Director determines, in his/her sole discretion, that the Stormwater Facilities, if originally constructed in accordance with the City's approve design, need further modifications, Grantor(s) authorizes the City to enter the Stormwater Facilities property in order to make these modifications.

Any notice or consent required to be given or otherwise provided for by the provisions of this agreement shall be effective either upon personal delivery or three (3) calendar days after mailing by Certified Mail, return receipt requested.

This Covenant is intended to protect the value and desirability of the property described above, including the larger parcel(s), if any, benefited by the Stormwater Facilities. Further, this Covenant shall inure to the benefit of all the citizens of the City and shall bind Grantor(s), and its heirs, successors and assigns.

_____ _____

GRANTOR GRANTOR

(Address): (Phone): _____

_____

_____

_____

STATE OF WASHINGTON)
)SS
COUNTY OF KING)

I, the undersigned, a Notary Public in and for the State of Washington, hereby certify that on this _____day of _____, 20__, personally appeared before me _____ and _____ to me known to be the **individual(s)** described in and who executed the foregoing instrument and acknowledged that they signed and sealed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

_____

Print Name _____
Notary Public in and for the State
Washington, residing at _____

_____

My Commission Expires _____

8-G – DRAINAGE EASEMENT

AFTER RECORDING MAIL TO:

Property Management
City of Kent
220 4th Avenue South
Kent, WA 98032
Attention:

Reference Number of Related Document:
Grantor(s):
Grantee(s): City of Kent
Abbreviated Legal Description:
Additional legal Description is on Page(s)____of Document
Assessor's Tax Parcel No.:

Project Name:

Easement
Individual

THIS INSTRUMENT made this_____day of_____20_____by and between _____ hereinafter called "Grantor" and CITY OF KENT, a municipal corporation of King County, State of Washington, hereinafter called "Grantee":

WITNESSETH: That said Grantors for and in consideration of _____and/or other valuable consideration receipt of which is hereby acknowledged by said Grantors, do by these presents grant, bargain, sell, convey, and confirm forever unto the said Grantee, its successors and/or assigns, an easement for _____ with necessary appurtenances, including use of incidental areas immediately adjacent for the installation, operation, maintenance, extending, construction, altering, reconstructing and repair over, through, across under and upon the following described property situated in King County, Washington, more particularly described as follows:

The said Grantee shall have the right without prior institution of suit or proceeding at law, at times as may be necessary, to enter upon said property and immediate adjacent areas with the necessary equipment for the purposes of altering installation, operation, maintenance, extending, constructing, repair and reconstructing of said _____or making any connections therewith without incurring any legal obligation or liability therefore; providing that said altering, installation, operation, maintenance, extending, constructing, repair and reconstructing of said _____shall be accomplished in such a manner that the private improvements existing within this easement area including said incidental areas shall not be disturbed or destroyed, or in the event they are disturbed or destroyed, they will be replaced in as good a condition as they

were immediately before the property was entered upon by the Grantee.

The Grantor shall retain the right to use the surface of this easement including said incidental areas so long as said use does not interfere with the uses heretofore defined. Under no circumstances shall any cement concrete or any structures be placed or erected on this easement. This easement shall be a covenant running with the land forever and shall be binding on the Grantor's successors, heirs, and assigns.

Dated this_____day of_____20_____

_____ _____

STATE OF WASHINGTON)
)SS
COUNTY OF KING)

I, the undersigned, a Notary Public in and for the State of Washington, hereby certify that on this _____day of _____ _____, 20____, personally appeared before me _____ _____ to me known to be the individual(s) described in and who executed the foregoing instrument and acknowledged that they signed and sealed the same as their free and voluntary act and deed for the uses and purposes therein mentioned.

_____

Print Name_____
Notary Public in and for the State of Washington,
residing at_____
My Commission Expires_____

11/1

8-H – WATER QUALITY MEMORANDUM

DESIGNATION OF WATER BODIES IN THE CITY OF KENT WITH RESPECT TO STORMWATER TREATMENT

Prepared for Entranco Engineers
Under contract with the City of Kent
to update the City's Stormwater Manual

Prepared by
Gary R.Minton, PhD, PE
Resource Planning Associates
Seattle, Washington

September 28, 2000

The City of Kent intends to adopt the King County surface water design manual[1]. With respect to stormwater treatment, the County manual identifies four levels of treatment: "basic" , "biologically significant (sensitive) streams", "sensitive lakes", and "sphagnum bogs". For each treatment level there is a menu of treatment options. "Basic" is the lowest treatment level, roughly corresponding to the treatment efficiency achieved by the BMPs identified in the Department of Ecology's 1992 stormwater manual[2]. "Basic" is applied to any water body unless it has been specifically designated into one of the other three groupings. The County's current designation is presented in a fold-out plate contained within its manual.

The question for the City of Kent is how shall it designate its surface water bodies, which in turn determines the treatment level. Which lakes, if any, should be classified as "sensitive"? Which streams, if any, should be classified as "biological significant"? The City has no sphagnum bogs and therefore that grouping is not considered here.

Designation of particular receiving waters for higher levels of treatment should be based on the consideration of several factors. Amongst these are:

- How King County designated its water bodies.
- City ordinances, policies and broad community objectives with respect to water quality and aquatic health.
- Existing management plans for specific water bodies.
- Water quality data.
- 303d listing of the Department of Ecology.
- Ecology's updated manual, Final Draft
- Fisheries and aquatic habitat data.
- The effectiveness of "basic" treatment systems to protect the City's creeks and lakes.

KING COUNTY DESIGNATION PROCESS

Streams: The County developed a procedure to identify regionally and locally significant resource areas. Three criteria were used for regionally significant streams[3]:

1. "Watershed functions are not appreciably altered from predevelopment conditions ...;
2. The diversity and abundance of aquatic and associated terrestrial habitat are of consistently high quality and are dispersed throughout the system; and,
3. Freshwater ... life, particularly salmonids, approach or exceed the abundance and diversity of equivalent undisturbed systems and make a significant contribution to the regional fishery resource o f Puget Sound".

Three criteria were used for locally significant streams;

1. "Watershed functions have been altered ... (but conditions) are adequate for spawning and rearing of salmonids... and these functions include migration corridors connected to... regional significant streams...;
2. The diversity and abundance of aquatic and associated riparian habitats are good but not exceptional...; and,
3. Freshwater ... life, particularly salmonids, are supported at one more species and life stages at population levels that are low but sustainable".

Concerning creeks within watersheds relevant to the City, the County designated Covington and Jenkens Creeks as regionally significant. It did not identify any streams as locally significant suggesting that the criteria of Booth et al.[3] was not used at least for this category. The above criteria are considered later in this memorandum when reviewing the available data on fish habitat in the City. It is of interest to note that existing water quality did not factor into the County's designations.

Lakes: The procedure[4] followed by King County for the designation of lakes has three criteria:

1. Trophic Status Index (TSI);
2. Resource value, which relates to public access and wetland resource information;
3. Land use, expressed as percent of the watershed that is forested now and in the future.

The evaluation paper[4] considered 40 lakes, including Lake Meridian but not Lake Fenwick. The 40 lakes were scored 3, 2, 1, and 0: 3 representing the highest score with respect to potential sensitivity. In its manual King County identifies three "sensitive" lakes: Cottage, Beaver, and Desire. These designations apparently did not flow from the procedures paper. Although Beaver and Desire received scores of 3, Cottage received a score of only 2 yet was designated "sensitive". Further, several other lakes with scores of 3 were not designated "sensitive". Lake Merdian was given a score of 2.

CITY ORDINANCES, POLICIES

City Ordinance 7.05.140 requires that stormwater containing pollutants discharges have a permit. The ordinance states that determination of whether pollutants will be present in the stormwater is to be determined by the public works director using a variety of sources of information including the water quality standards for the State (Chapter 173-201 WAC). However, the ordinance does not specify whether the pollutants are to be decreased, or controlled or mitigated in any manner.

The City's comprehensive plan (1995) notes that in 1985 the City in conjunction with the establishment of the stormwater utility adopted the following water quality goal: "Reduce the environmentally detrimental effects of present and future runoff in order to maintain or improve stream habitat wetlands, particularly water quality, and protected water-related uses".

The comprehensive plan (1995) established Goal LU-23, entitled "Protect and enhance water resources for multiple benefits, including recreation, fish and wildlife resources and habitat, flood protection, water supply, and open space". Sub-policies LU-23.1 and LU-23.2 speak to protecting wetlands. Sub-policy LU-23.4 states that the City shall "Maintain rivers and major and minor streams in their natural state". To implement this sub-policy requires that stormwater discharges be treated to a high level.

EXISTING WATERSHED OR BASIN PLANS

There are two significant lakes in the City: Fenwick and Meridian. Lake Fenwick has a lake management plan. The plan does not call for inordinately high (more than "basic") levels of treatment in new developments. Further, the watershed is essentially developed. Hence, requiring higher levels of treatment for any new developments would not be of any use. In light of the management program underway for Lake Fenwick, it should not receive special designation at this time. It is possible in the future that the City might conclude that the management plan needs to be revisited. If that occurs, special designation could be considered at that time. There is no management plan for Lake Meridian because water quality has not been a problem.

WATER QUALITY DATA

Lakes: Given the above conclusion concerning Lake Fenwick, only Lake Meridian is left for consideration. Like Lake Fenwick, the watershed of Lake Meridian is essentially developed. Only about 15% of the watershed is available for development[5]. Recent data[6] indicate that the trophic state of Lake Meridian continues to be in the oligotrophic-mestrophic stage. In recent years water quality has improved. Average summer total phosphorus concentrations have decreased from about 18 ug/L in 1994 to about 9 ug/L in 1998. The dominant alga has been the blue-green Anabaena. Nonetheless, it is unlikely that development of the remaining 15% of the watershed will have a noticeable impact on the water quality of the lake. Hence, Lake Meridian should not be designated "sensitive".

Streams: The relevant data are of samples taken from creeks during storms. The City recently sampled two storms at 15 stations[7]. While there are many pollutants in stormwater that are potentially toxic, the constituents of particular concern to fish are the metals. Stations where the metals standards were exceeded in either storm are summarized below.

Storm 1: Chronic standard for copper exceeded in upper Meridian Valley Creek
Chronic standard for mercury exceeded in one of three stations in Big Soos Creek, two of three stations in McSorley Creek, and at the mouths of Mullen Slough and Mill Creek-Auburn.
Acute and chronic criteria for zinc exceeded one of three stations in McSorley Creek

Storm 2: Neither zinc or copper standards exceeded at any station. Mercury was not analyzed.

Metals standards depend on water hardness: the higher the hardness, the higher the numeric standard. The City's data indicate that the hardness is highly variable, ranging from 19 to 94 between the stations over the two storms. An examination of the data for dissolved zinc indicate a weak inverse relationship to hardness: that is, the higher the hardness the lower the concentration of dissolved zinc. This likely reflects the differences in the proportions of stormwater and base stream flow at each station during each storm. The hardness of stormwater tends to be significantly lower than base stream flows. Hence, the greater the storm, the lower the hardness in the stream during the storm because the majority of the flow in the stream is of storm runoff. This analysis suggests that during large storms, particularly during the early period of each storm when concentrations tend to be highest, that the metals standards are most likely to be exceeded.

It is also important to note that the City's data are event mean concentrations (EMC), composites of several individual samples taken over several hours. However, the acute standard is the average concentration during any one hour period. Consequently, it is possible that the acute standard was exceeded at other stations than those listed above. Taking this into consideration, assume that peak metals concentrations were double the observed EMC. If this were the case, the following exceedances for copper and zinc may have occurred:

Storm 1: Acute standard for copper exceeded in upper Meridian Valley Creek.
Acute standard for zinc exceeded at one of three stations in Meridian Valley Creek.

Storm 2: Neither zinc or copper standards exceeded at any station.

The above analysis indicates that doubling the observed concentrations has a minor effect. Stated differently, with the exceptions noted the EMCs were considerably below the standard. The chronic standard is not considered as it is the average concentration over a four day period.

It is of interest to note that the concentrations in Springbrook Creek, below its confluence with Mill Creek, were not notably high relative to the standards. Mill Creek is on the Department of Ecology 303d (see below) list for metals. Samples were not taken in Mill Creek.

The above analysis leads to the conclusion that there is too little data to base a decision on designation. It is important to understand that with regard to metals standards, an exceedance is allowed only once over a three year period. Approximately 150 storm runoff events occur over a three year period. Failing to meet the standard of only one metal during only one of 150 events constitutes a violation.

303D LISTING OF THE DEPARTMENT OF ECOLOGY

A water body lake that receives 303d designation means that water quality standards are not being met for the particular water quality parameters listed for the particular water body. Creeks within the City that have received this designation are: segments of Soos Creek and its tributaries, and Mill Creek. Parameters specified for the specified segments of the Soos Creek system include dissolved oxygen, fecal coliform, and temperature. Meridian Valley Creek, a tribututary of the Soos, is not a designated segment. The parameters specified for Mill Creek are dissolved oxygen, fecal coliform, temperature, dissolved chromium, dissolved copper, total mercury, and dissolved zinc.

Stormwater treatment systems are generally ineffective in reliably reducing fecal coliform in stormwater and have little relevance to temperature. They do remove organic matter which affects dissolved oxygen in streams, and metals. However, temperature and dissolved oxygen problems in Mill and Soos Creek likely occur during dry-weather and in the summer months, and have no relationship to storm events.

Based on its 303d listing Mill Creek should be designated "sensitive" with particular attention to the control of dissolved metals. Irrespective of the City's designation for Mill Creek, only treatment technologies capable of removing dissolved metals should be allowed. For example, a wet vault should not be acceptable method of treatment. As metals are not specified for Soos Creek, is tributaries within the City (Soosette Creek and Big Soos) should not be designated "sensitive" based on the 303d list.

Despite the fact that the water quality of Lake Meridian appears to be acceptable (identified as oligotrophic-mestrophic), the lake is designated on Ecology's 303d list. It is listed for fecal coliform and total phosphorus. However, as previously noted little of the watershed remains undeveloped. Hence, requiring higher levels of phosphorus removal by new developments will be of little benefit. If it is the view of the City that listing by the Department of Ecology is valid then the City should proceed to develop a management plan. If however the City believes the listing is not valid, it is recommended that the City seek de-listing.

DEPARTMENT OF ECOLOGY'S NEW STORMWATER MANUAL

Ecology just recently published the Final Draft of its new manual[12]. The final manual is to be adopted by the end of the year. Ecology has defined two levels of treatment: basic and enhanced. Basic treatment represents AKART and includes those treatment systems and sizes described in

Ecology's 1992 manual[2]. With respect to enhanced treatment, Ecology has generally followed the concept originally developed by King County. However, Ecology has included two unique concepts with respect to streams. First, Ecology identifies enhanced treatment has the removal of dissolved metals (King County focuses on total metals, represented by zinc). Secondly, Ecology has specified that enhanced treatment shall be used for all discharges that enter "fish bearing streams" or "streams that flow to fish bearing streams". Whether this concept will remain in the final manual is not know. However, to follow Ecology's lead would mean that enhanced treatment would be required of all discharges entering all of the City's streams.

FISHERIES AND AQUATIC HABITAT DATA

Data are synthesized from several sources. The City's creeks have recently been scored[8] with respect to two habitat indices: the B-IBI, index of biological integrity, and the RBI, rapid bioassessment of habitat. The former is based on invertebrates; the latter is based on several habitat metrics. Rating ranges for each creek are summarized in Table 1. For the B-IBI, above 40 is considered "excellent; 30 to 40 is considered "good"; 20 to 30 is considered "fair", and less than 20 is considered "poor".

Following the criteria used by King County , the data in Table 1 suggest Big Soos could be classified as "locally significant".

TABLE 1 HABITAT DATA SUMMARY

CREEK	B-IBI	RBP
Mill	14 – 20	58 to 139
Springbrook	18	116
Garrison	14 - 20	120 to 150
Soosette	16 to 22	59 to 132
Meridian Valley	18 to 22	97 to 131
Big Soos	26 to 32	148 to 170
McSorley	20 to 22	114 to 151

Three studies have examined fish habitat conditions[9,10,11]. Harza (1999) rated various stream segments and identified potential limiting factors. The ratings are summarized in Table 2.

TABLE 2 SUMMARY OF CREEK RATING CONCLUSIONS

CREEK	RATING
Big Soos	Good
Midway	Poor to good depending on reach
Mill mouth-Auburn	Good
Mullen Slough	Good
Soosette	Poor to excellent depending on reach.
Meridian Valley	Poor to excellent depending on reach.
Clark lake outlet	Poor

The 1999 study did not include the Springbrook-Mill-Garrison system as it had been examined in the 1996 study. However, the 1996 study did not include ratings. The 1996 study did observe that coho were found most frequently in the upper reaches and not on the valley floor.

The above information appears to be too limited to draw firm conclusions concerning designation. Since portions of the Soosette and Meridian Valley Creeks are rated "excellent", perhaps special protection should be applied to the entirety of each creek. It makes little sense to apply the designation to only a portion of each creek.

THE EFFECTIVENESS OF "BASIC" TREATMENT SYSTEMS

Since King County initially identified its menus of advanced treatment for streams and lakes (about 1995) there have been additional data generated on the performance of certain treatment systems. It is reasonable to ask whether in fact some if not all of the "basic" treatment systems provide adequate protection even for streams like Mill Creek.

The question is whether "basic" treatment is insufficient to protect streams in those watersheds within City where all land within each watershed will be essentially 100% developed. In this case, the assumption is that if the effluent from a "basic" treatment system does not meet receiving water standards, that there likely will be receiving water violations. This is because almost all of the stream flow during a storm in heavily developed watersheds will be runoff from the developed lands.

To address this question, performance data were compiled of individual treatment systems that have been studied in the Pacific Northwest. PNW data are available from only eight facilities: three grass swales[13,14,15], two wet ponds[16], and three sand filters[17,18]. However, the sizes of the two ponds do not fit either current King County or Ecology criteria. One pond is very small and one is very large, about 7% and 150% of the King County "basic" facility, respectively. The large pond is in essence an "enlarged" pond according to King County criteria. There are no PNW data for constructed wetlands. Wet vaults are not considered as they do not remove dissolved metals and therefore should not be allowed as stand-alone treatment systems.

Copper and zinc are used to assess the effectiveness of "basic" treatment systems with respect to streams. Receiving water standards are based on the dissolved fraction. Unfortunately, for the eight research facilities identified above, influent and effluent samples were evaluated for dissolved metals for only the swales and one of the sand filters.

Presented in Figure 1 is a plot of the zinc data for individual storms for the three swales and two of the three sand filters. Data are not included for one of the filters (the Lakemont filter) because the report does not present data for individual storms. For the three swales, Figure 1 presents data for dissolved zinc. However, only total zinc is available for the two remaining sand filters (only the Lakemont study analyzed dissolved). Therefore, these data were multiplied by 0.5, assuming that 50% of the total zinc was in the dissolved form. This is a reasonable assumption: on average the dissolved fraction is about 50% of the total although it can range from 20% to 80% for individual storms. Sand filters are able to remove dissolved zinc[17,19].

The standard for dissolved metals depends upon the hardness: rising with increasing hardness. However, only Koon[15] measured hardness: it was found to vary from 18 to 50 with an average of about 25. The acute standard for zinc at a hardness of 25 is 0.032 mg/L. Within the hardness range of 15 to 50, the acute standard for zinc ranges from 0.021 to 0.058 mg/L (the chronic standard is about 90% of the acute).

A similar graph was prepared for copper: Figure 2. The acute standard for copper at a hardness of 25 is 0.0038 mg/L. Within the hardness range of 15 to 50, the acute standard ranges from 0.0032 to 0.008 mg/L (the chronic standard is about 70% of the acute).

A comparison of the standards for each metal to the performances represented in Figures 1 and 2 leads to the following observations.

1. For most of the storms sampled in the swale studies the influent concentrations of zinc and copper were less than their respective standard. It is possible that this is also the case for the sand filters if it were assumed that the dissolved/total ratio was about 0.25 rather than 0.50. But the low ratio is unlikely. But it does suggest that metals concentrations from residential properties may be generally less than the standard: all three swales were located in residential developments.
2. Where the influent concentrations of zinc or copper exceeded their respective standards, grass swales are not able to meet either standard. Of 20 storms sampled, the removal efficiency was zero or negative in eight events for both metals. Sand filters appear to be more effective and reliable than swales. However, even sand filters may not be able to reduce zinc below the standard when the hardness is less than about 20 and the influent concentration is above about 0.2 mg/L. Swales probably cannot reduce the copper concentration to below the standard irrespective of the hardness or influent concentration.
3. King County has identified a performance goal of removing 50% by "enhanced" treatment systems. Grass swales are not able to meet the 50% performance goal for either copper or zinc. However, the "basic" sand filter appears able to remove 50%, meaning a sand filter provides "enhanced" treatment.

The findings of the study[17] of the Lakemont sand filter are consistent with the above observations. A range of concentrations was given in the report of the filter which serves a residential area: influent values for dissolved zinc ranged from 0.0016 to 0.016 mg/L; effluent concentations ranged from 0.0006 to 0.0014 mg/L. However, it appears likely that the influent concentration never rose above the standard. Dissolved copper was also reduced: influent values ranged from 0.0013 to 0.0068 mg/L; effluent concentations ranged from 0.0008 to 0.0013 mg/L. It is likely that the influent concentration for dissolved copper did at times exceed the standard.

SUMMARY

The following streams could be considered for special designation.

- Mill Creek: justification, placement on the 303d list
- Soosette Creek: justification, value of current fishery
- Meridian Valley Creek: justification, value of current fishery.
- Big Soos: value of habitat (B-IBI and RBP)

It is possible that upper Garrison Creek should be designated "sensitive" based on the RBP score.

Alternatively, it could be decided that "enhanced" treatment will be used throughout the City. The logic of this decision is that "basic" treatment is likely insufficient to meet water quality standards in those watersheds that are currently or in the future will be heavily developed. Also, the City is attempting to maintain the current relatively healthy fishery, e.g. Soosette Creek. Requiring enhanced treatment throughout the City is consistent with the new manual of the Department of Ecology that calls for such treatment for all "fish-bearing streams".

Irrespective of the designation, only systems capable of reliably removing dissolved metals should be allowed. This precludes the following stand-alone systems listed in the King County manual: biofiltration swales, filter strips, and wet vaults. The restriction also prevents the use of several proprietary, prefabricated devices as stand-alone systems: Stormceptor, Vortechs, V2B1, Downstream Defender, CDS, and BaySaver. These systems can be used as pretreatment units.

The City should consider the inclusion of two proprietary, prefabricated devices: StormFilter and StormTreat. Both are capable of removing dissolved metals. However, performance data are very limited on both systems. Neither have sufficient data to meet the Puget Sound protocol[20]. Therefore, their inclusion could be considered provisional until the protocol is met. Or they need not be included in the manual, but allowed in a few sites on the condition that data are collected.

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19. Harper, H.H., et al., 1993, Treatment Efficiencies of Detention with Filtration Systems", St. Johns River Water Management District, Florida.
20. Protocol for the Acceptance of Unapproved Stormwater Treatment Technologies for use in the Puget Sound Watershed, Washington Chapter APWA, November, 1999.

Figure 1 Zinc Removal

PNW data - 3 swales, 2 sand filters

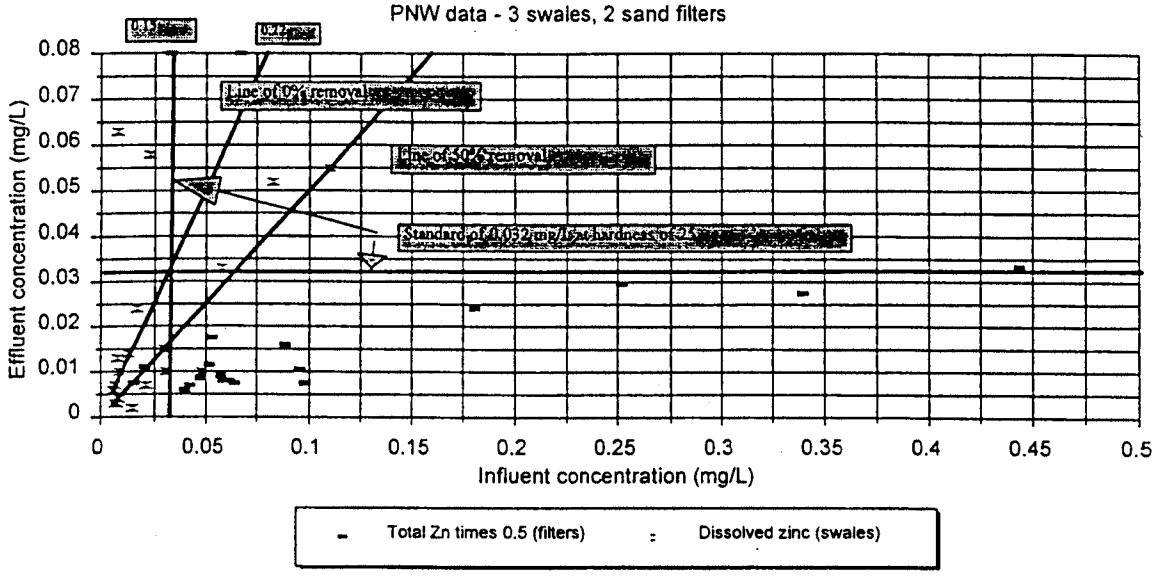
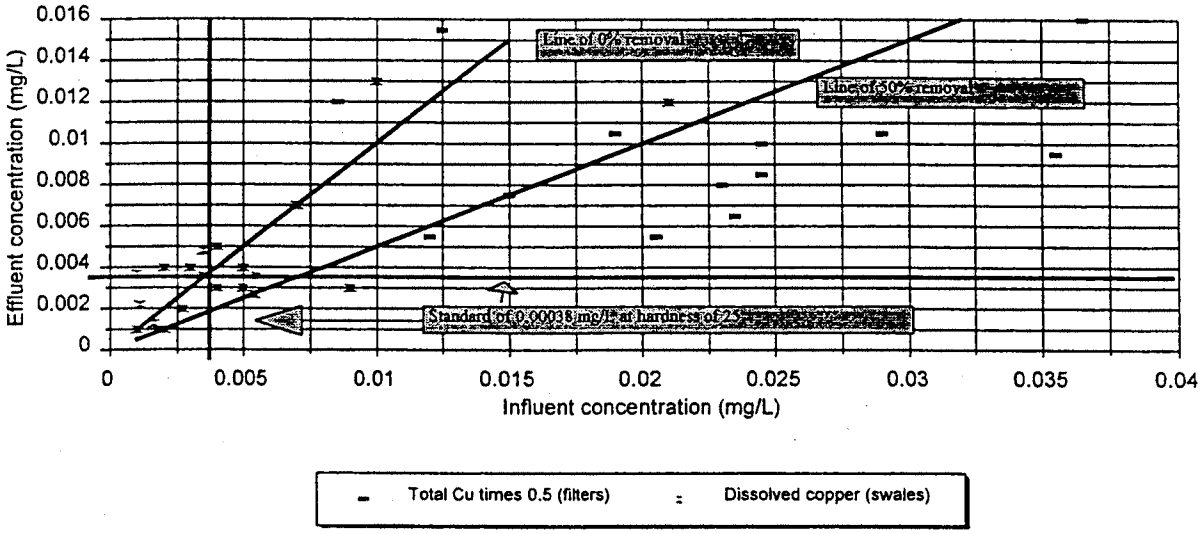


Figure 2 Copper Removal

PNW data - 3 swales, 2 filters



8-I – ADJUSTMENT APPLICATION FORM AND PROCESS GUIDELINES

SURFACE WATER DESIGN MANUAL REQUIREMENTS / STANDARDS ADJUSTMENT REQUEST

Project Name:	File No. Enginer/Planner Name:
Project Address:	Design Engineer:
Applicant:	Signature: Date:
Signature: Date:	Engineering Firm Name:
Address: City, State, Zip:	Address: City, State, Zip:

INSTRUCTIONS TO APPLICANT/DESIGN ENGINEER:
Please be sure to include all plans, sketches, photos, and maps which may assist in complete review and consideration of this adjustment request. Failure to provide all pertinent information may result in delayed processing or denial of your request. Please submit this request and all applicable fee

REFER TO SECTION 1.4 IN CHAPTER 1 OF THE SURFACE WATER DESIGN MANUAL FOR ADJUSTMENTS

DESCRIPTION OF ADJUSTMENT REQUEST: ○ Standard ○ Complex ○ Experimental ○ Blanket ○ Pre-application

APPLICABLE SECTION(S) OF STANDARDS:

JUSTIFICATION (see attachments, pages _____ to _____):

AUTHORIZATION SIGNATURES:

Director/Designee Determination:

☐ Approval ☐ Conditional Approval (see below) ☐ Denial

☐ Approval Signed: _____ Date: _____ (Experimental & Blanket adjustments only)

CONDITIONS OF APPROVAL:

☐ See attached memo dated: _____

Engineering Review Supervisor:	
Signed: Date:	

REFERENCE 8-J

ADJUSTMENT PROCESS GUIDELINES

1.0 PREAPPLICATION ADJUSTMENT PROCESS

This process is used when the applicant needs an adjustment decision to determine if a project is feasible or the results are needed to determine if a project is viable before funding a full application. Preapplication adjustment requests will be accepted when 1) an issue is raised or a potential constraint is identified at a preapplication conference with DDES, and 2) sufficient engineering information to evaluate the request is provided. A higher preapplication adjustment fee will apply to these requests, and any unused adjustment fee will be credited towards the permit application fee.

Steps in the processing of a preapplication adjustment shall include:

- A DDES preapplication conference is scheduled at which the applicant provides justification that a decision on the adjustment will effect viability of the project. An example could include a need to divert flows due to a downstream problem.

- King County may request additional information and site visits due to the limited data and lack of prior project review.

- A preapplication deposit is required and fee for review will be an hourly rate billing applied against the deposit. Any unused fees could be returned to the applicant. Any fees in excess of the deposit must be paid prior to the issuance of a decision.

- For approved preapplication adjustment, the applicant can apply that approval to the applied for permit proposal provided conditions of the approval are met, the proposal has not substantially changed and the applicable regulations have not changed. This will be determined by DDES.

The criteria for granting a preapplication adjustment are the same as for a Standard or Complex adjustment. However, preapplication adjustments will be tied by condition to the project proposal resented at the preapplication meeting. The appeal process is also the same as for a Standard adjustment or a Complex adjustment. This approval will expire 1 year after the approval date, unless a complete permit application is submitted and accepted.

3.0 FEE REDUCTION

This process is used for adjustments that are determined to meet either of the conditions A or B identified below. The DDES Director or designee shall be responsible for making the determination for a fee reduction.

A. Minor adjustment requests that are defined as issues requiring no engineering review to determine appropriateness. These include:

- New or revised standard specifications for engineering and construction which are cited in the Manual (e.g., APWA standard specifications for public works construction, WSDOT standard specifications),
- Minor design alternatives that meet the stated intent in the Manual,
- Identified errors in the Manual.

B. Blanket Adjustments (See Reference Section 10-A Blanket Adjustments, for approved Blanket Adjustments).

8-J – DEDICATION CLAUSE – FINAL RECORDING

DEDICATION

Know all people by these presents that we, the undersigned owners of interest in the land hereby subdivided, hereby declare this plat to be the graphic representation of the subdivision made hereby, and do hereby dedicate to the use of the public forever all streets and avenues not shown as private hereon and dedicate the use thereof for all public purposes not inconsistent with the use thereof for public highway purposes. Also the right to make all necessary slopes for cuts and fills upon the lots shown thereon in the original reasonable grading of said streets and avenues, and further , the undersigned owners of the land hereby subdivided , waive for themselves , their heirs and assigns and any person or entity deriving title from the undersigned , any and all claims for damages against the City of Kent , its successors and assigns which may be occasioned by the establishment , construction , or maintenance of roads and/ or drainage systems within this subdivision . Also tract(s) " (and) " is hereby dedicated to the use of the public forever for any and all public purposes . This subdivision , dedication , waiver of claims and agreement to hold harmless is made with the free consent and in accordance with the desires of the said owners. Also the specific conditions and/or agreements that are conditions of this plat are made a part hereto and the owners and their assigns do hereby agree to and/or comply with all these conditions .

IN WITNESS WHEREOF we set our hands and seals.