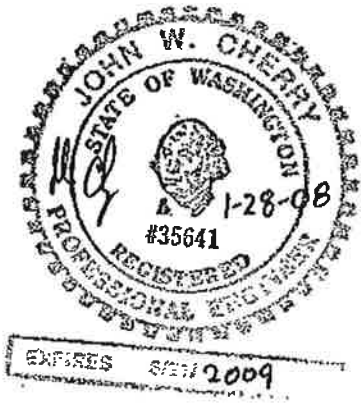
Drainage Report and Stormwater Pollution Prevention Plan (SWPPP) For Crown Short Plat



Prepared for:
Crown Park LLC
c/o Greg Blunt
17117 59th Avenue NE
Arlington, WA 98223

Prepared by:
John Cherry, P.E.

February 1, 2008

CONTENTS

INTRODUCTION

This report addresses drainage analysis and design for three industrial lots to be created on approximately five acres of the 80+ acre Crown Park property south of 172nd Street in Arlington, Washington. The project will include an extension of 169th Street NE, currently under construction to the west of the short plat site.

Drainage from a portion of the development will be diverted to an existing detention pond, and the remainder will be managed in a new pond to be constructed as part of the short plat development.

The design was complicated by a seasonally high water table and by the nearly level terrain, long distances to the natural discharge point and the high proportion of impervious surface likely to be created.

HBA Design Group staff conducted multiple field investigations in all seasons in the years 2000 through 2007, including inspection of soils, ground cover, topography and typical drainage patterns and facilities in the vicinity. Additional geotechnical field investigation has been conducted of the entire Crown Park property by Western Geotechnical Consultants, Inc., but no focused evaluation of the current three-lot development site has been prepared.

Although the short-platting process technically incorporates the remainder of the entire 80+ acre parcel as a fourth lot in reserve for future subdivision, this drainage report focuses solely on the currently proposed development of the three lots. All references to the "short plat", the "site" and the "development" in this report should be assumed to include only the five acres encompassing the three lots, unless otherwise noted.

EXISTING CONDITIONS

The site is located on a pasture southeast of Crown Distributing and the Arlington Airport and is accessed off the south end of 59th Avenue NE. An adjacent project immediately south of Crown Distributing, the 4-T Development, is currently under construction and will include construction of a 700-ft. street, 169th Street NE, extending east from 59th Avenue. The site is located at the end of what will be the new 169th Street.

An agricultural ditch conveys Edgecomb Creek around a 90-degree bend a short distance east and south of the site. Although portions of the stream reach have been degraded by erosion and loss of streamside buffers, the Department of Fish and Wildlife reports that the creek supports populations of coho salmon, chum salmon and cutthroat trout, and is potential bull trout foraging habitat.

Wetlands associated with the stream exist a short distance beyond the eastern boundary of the site.

The nearly-level site drains to the south at a slope of approximately 0.5%. The SCS Snohomish County Soil Survey identifies the predominant underlying soil type in the proposed construction area as Norma loam. Norma soils are typically poor-draining and subject to seasonally high water tables near the surface.

A shallow two-acre stormwater detention pond is adjacent to the west of the site, south of the future 169th Street. Originally designed for runoff from Crown Distributing, it subsequently was determined to have additional capacity. The pond now will accept runoff from 169th Street, and has been determined to have the potential for additional capacity with revisions to the outlet control structure.

DOWNSTREAM FLOW PATH

All runoff generated on this site drains to Edgecomb Creek. At the west boundary of the Crown Park property the agricultural ditch conveying the creek waters turns 90° to the south. The ditch follows a straight line south between agricultural fields for one-half mile before turning west for one-quarter mile, then south again for one-half mile. At this point the creek crosses a railroad right-of-way and takes on a more natural character as it meanders south through a residential area en route to Quilceda Creek approximately 2.5 miles south of the Crown Park property. The agricultural ditch within one-quarter mile downstream is typically four feet deep with 2:1 side slopes, although there are numerous irregularities caused by erosion. The bottom is approximately six feet wide and slopes at less than 1%. The ditch is vegetated intermittently with grasses and brush, and the banks have little significant shading vegetation.

Middle Fork

DEVELOPED CONDITIONS

The new 169th Street, currently under construction, will be extended approximately 300 feet further to the east to serve the proposed development. The three lots will be filled and graded as necessary to facilitate drainage and access, but will otherwise be left undeveloped at this time. Individual site plans will be submitted by future owners of the lots when development plans are finalized.

Because of the flat terrain, both the street and the lots will be elevated above the existing grade to facilitate stormwater drainage, with a maximum fill depth of approximately three feet.

Stormwater from the street extension and from Lot 1 north of the street will be routed through the storm system currently under construction in 169th Street and discharged to the existing shallow detention pond to the west of the short plat. Runoff from south of the street will be collected in a separate shallow detention pond along the south boundary of Lots 2 and 3.

Because the future development configuration of the lots is unknown, the lots will be graded with a 1% slope toward the receiving stormwater systems. Future owners will have the options of installing underground collection and conveyance systems or simply allowing sheet flow across paved surfaces. For design purposes, future development was assumed conservatively to be 95% impervious and 5% lawns and landscaping.

DRAINAGE DESIGN

Existing detention pond:

The existing stormwater detention pond for Crown Distributing was designed in 2001 by John Cherry of Higa Engineering. It was re-evaluated in 2005 by another Higa-Burkholder engineer and was found to have sufficient extra capacity for a two-acre expansion of Crown Distributing. The pond was re-evaluated again in 2006 by John Cherry of HBA Design Group to determine whether it also had capacity for runoff from the new 169th Street to be constructed. Again, it was found to have just barely enough capacity to accommodate this runoff.

This somewhat peculiar result can be explained by the unusual geometry of this particular pond. First, the hydraulics associated with shallow depths and a large control orifice made it impossible in 2001 to fine-tune the release rates to the precision we commonly attain in detention ponds. Consequently, the calculated release rates were significantly less than the theoretically allowable target rates, enabling us to increase the rates without exceeding the targets. Secondly, one of the effects of constructing an unusually large and shallow pond is that any additional water introduced to the system is spread out over a wide area (two acres, in this case). The net result is a negligible increase in water level and a correspondingly small increase in discharge rates, which are largely driven by hydraulic head.

Subsequent to the 2006 re-evaluation, the Crown Distributing expansion was cancelled, leaving excess capacity in the pond again. We have opted to use this capacity for runoff from the 300-foot street extension and runoff from Lot 1 of the short plat.

To evaluate the capacity of the pond to accommodate this new runoff we returned to our original calculations (see appendix) for the initial nine-acre Crown Distributing development, re-creating with new software the results for existing conditions. (The original WaterWorks hydraulic software has been superseded by StormShed 2G, created by the same firm.) We used the same assumptions and the same input values that were used to size the pond in 2001, including a stage/storage table that accounted for both the required 50% oversizing and the effect of the quarry spalls in the bottom of the pond on the storage capacity for smaller storms.

Maintaining the same target release rates and approximate water levels established for the original nine-acre site, we analyzed the combined runoff under developed conditions for the nine-acre Crown Distributing site, the 1.1-acre new street (using pervious and impervious areas as provided by the engineer, Ted Trepanier), the 2.46-acre street extension and Lot 1, and routed it through the pond as constructed. Through multiple iterations it was determined that raising by 2.4 inches the baffle wall inside the existing outlet control structure, it would still be possible to meet the target release rates.

Although release rates were somewhat higher, as expected, they were still below the target rates established for the original nine-acre site.

The peak stage also was three inches higher at 122.71 but still below the overflow spillway elevation of 123.0. As noted previously, a large increase in water volume in a pond with a two-

acre surface area corresponds to a relatively small increase in water level. Consequently there is significantly more emergency volume capacity below the spillway – approximately 21,750 cu. ft. – than there would be in a more conventional smaller pond with comparable water level and spillway elevations.

The following is a summary comparison of the Waterworks design data from 2001 and the Stormshed analysis of the current larger site. Note that the two software programs generated slightly different output for existing flows, even though the input data were identical.

	2001 (Waterworks Software)			2008 (Stormshed software)		
	Existing	Developed	Discharge	Existing	Developed	Discharge
2 year	.60 cfs	3.04 cfs	0.28 cfs	0.62 cfs	4.94 cfs	0.31 cfs
10 year	1.35 cfs	2.60 cfs	0.67 cfs	1.37 cfs	7.41 cfs	0.84 cfs
100 year	2.55 cfs	6.65 cfs	1.45 cfs	2.55 cfs	10.80 cfs	1.83 cfs
		Peak Stage	122.46		Peak Stage	122.71

New detention pond:
A long, narrow two-cell detention pond will be constructed along the south edge of Lots 2 and 3, which will drain as sheet flow directly into the pond. The pond will release a metered discharge through an outlet control structure to a level spreader, which in turn will disperse the flow into the Edgecomb Creek buffer more than 90 feet from the stream bank.

The pond has been sized per 1992 D.O.E. guidelines to provide storage for runoff from a 100-year, 24-hour design storm over the entire area to be developed. The outlet structure was designed to release stormwater at rates not exceeding the pre-development runoff rate for the 10-year and 100-year 24-hour design storms, and not exceeding one-half the pre-development rate for a 2-year 24-hour design storm. After the initial design, the pond volume was expanded horizontally by 50% to provide a safety factor based on the percentage of impervious cover per D.O.E. guidelines.

The pond will include a permanent pool with 6:1 side slopes and a volume more than double the volume of a 6-month water quality design storm. This will allow for sedimentation and vegetative growth in the pond bottom without compromising the required dead storage for water quality treatment. The outflow from the pond will be further treated as it disperses as sheet flow through the stream buffer.

To facilitate surface dispersion of the discharge, the pond has been designed with the bottom of the live storage at least six inches above the adjacent native ground elevation in the stream buffer. The pond will be bermed on three sides; the north side will abut the edge of fill under Lots 2 and 3.

The permanent pool will be excavated approximately one foot below the native ground elevation. Because the native soil is somewhat porous, and because groundwater can be expected to rise

close to the surface at certain times of the year, the pond will be lined with an impervious geosynthetic fabric.

The pond will have a maximum total water depth of 2.6 feet, and will not be fenced.

EROSION RISK ASSESSMENT & PROPOSED CONTROL METHODS

The risk of significant erosion impacts on this site and downstream is moderate. While the Norma-series soil on the site has a low erosion hazard on level ground, it tends to turn quite muddy when disturbed and saturated. This factor, together with the seasonal high groundwater that impacts trenching operations and deep excavations, renders this site marginal for winter grading.

Other concerns include a wetland adjacent to area of disturbance to the east and a critical-habitat stream adjacent to the site to the south and east. The flat terrain, porous soils and vegetated buffers will provide significant protection to the critical water features during construction, as will the constructed erosion control measures to be installed.

The following temporary erosion control measures are recommended at this time:

- Silt fences to keep pollutants from migrating out of the area of disturbance.
- Armored construction entrance to prevent tracking of debris onto public roads.
- Catch basin inlet protection.
- Permanent erosion control in the form of seeding exposed soil (with interim mulching as needed) in accordance with standard erosion control practices.

The detailed erosion control plan in the accompanying site civil construction plans shows locations, installation methods and maintenance requirements for specific erosion control measures. The erosion control plan includes guidelines for rapid response to unanticipated conditions.

Per D.O.E.'s Construction Stormwater General Permit requirements, a Certified Erosion and Sedimentation Control Lead (CESCL) will be assigned to monitor the effectiveness of erosion control installations during construction. Because the area of disturbance does not exceed five acres, water quality testing is not required under D.O.E. regulations.

SUMMARY OF ANALYSIS & DESIGN PARAMETERS FOR NEW DETENTION POND (LOTS 2 & 3)

(Parameters for the existing pond are the same as originally approved in 2001.)

Basin tributary to detention pond	2.60 acres	
SCS soil type	Norma loam, hydrological group C/D	
Existing basin ground cover	Pasture historically used for farming (CN 85)	
2-year, 24-hour rainfall	1.8 inches	
10-year, 24-hour rainfall	2.6 inches	
100-year, 24-hour rainfall	3.7 inches	
(Values same as for original pond design)		
Maximum pond side slope	3:1	
Minimum freeboard	1 foot	
Assumed developed basin ground cover	95% Impervious (CN 98) 5% Landscape (CN 86)	
6-month, 24-hour developed runoff volume (Water quality design storm)	8,530 cu. ft.	
Dead storage provided	17,179 cu. ft.	
	Existing	Developed
2-Year peak discharge	0.16 cfs	0.08 cfs
10-year peak discharge	0.37 cfs	0.23 cfs
100-year peak discharge	0.71 cfs	0.61 cfs
Maximum water storage depth	2.6 feet	

STORMWATER POLLUTION PREVENTION PLAN (SWPPP)
SUPPLEMENTAL NARRATIVE

The complete Stormwater Pollution Prevention Plan for the proposed construction of infrastructure for three lots of the Crown Short Plat, located on 169th Street NE in Arlington, Washington, consists of the following components:

- The full site civil construction plan set prepared by HBA Design Group, dated February 1, 2008 (and any subsequent revisions).
- The drainage report prepared by HBA Design Group, dated February 1, 2008 (and any subsequent revisions).
- This SWPPP Supplemental Narrative.

These three elements together constitute a Level Two Stormwater Pollution Prevention Plan per the guidelines of D.O.E. II-3.1 (2005 edition). D.O.E. regards them as inseparable components of the same plan, and requires that the entire plan be on site or easily accessible to the site during construction. To enable ease of use and to promote compliance, all of the required information of substance is integrated into the accompanying civil construction plans. Most of the required background narrative is incorporated into the drainage report. This supplemental narrative provides required information not presented in the other two documents and fulfills the applicable documentation and paperwork requirements.

Because the proposed area of disturbance exceeds one acre, this project requires a NPDES Stormwater General Permit. At the time of this writing, the starting date for construction had not been determined and the contractor had not been selected. Consequently, application for a Stormwater General Permit has been deferred until later. The application must be submitted to the Washington State Department of Ecology at least 45 days before the start of earth-disturbing work.

Twelve Elements of Construction Stormwater Pollution Prevention:

1. ***Mark clearing limits:*** Clearing limits and marking requirements are shown on the grading and T.E.S.C. plans, Sheet C2.0 of the construction plans. The entire site is subject to clearing.
2. ***Establish construction access:*** An armored construction access is shown on the grading and T.E.S.C. plan, Sheet C2.0 of the construction plans, with a detail on Sheet C2.1. Street sweeping is addressed in T.E.S.C. General Note #12 on Sheet C2.1. Wheel washes are not required at this time by the basic T.E.S.C. plan for dry-season work, but the contingency plan makes it clear that wheel washes are an option that may become mandatory if shown to be necessary on this specific site.
3. ***Control flow rates:*** This project is expected be constructed during the dry season. The site topography ensures that most runoff that occurs during construction will be intercepted and retained by the stormwater ponds. Permanent flow control will be provided by the outlet control structure.
4. ***Install sediment controls:*** Our expectation is that silt barriers properly installed will provide adequate sedimentation control. Locations and details are provided in the construction grading and T.E.S.C. plans.

5. ***Stabilize soils:*** The T.E.S.C. notes on Sheet C2.1 of the construction plans provide specifications to meet D.O.E. stabilization requirements for the disturbed area.
6. ***Protect slopes***: This site has no steep slopes requiring special consideration.
7. ***Protect drain inlets:*** The T.E.S.C. plan specifics protection for catch basin inlets.
8. ***Stabilize channels and outlets:*** This project has no channels or culvert outfalls.
9. ***Control pollutants:*** T.E.S.C. General Note #10 on Sheet C2.1 instructs the contractor to use industry best management practices to prevent release of pollutants.
10. ***Control De-Watering:*** T.E.S.C. General Note #11 on Sheet C2.1 instructs the contractor to discharge dewatering wastewater to an upland area. Groundwater pumped out of trenches may be dispersed in the pastures east of the property (under the same ownership), provided the discharge point is well away from the stream and wetlands. De-watering volumes are expected to be significantly smaller if the trenching occurs during the dry season.
11. ***Maintain BMPs:*** T.E.S.C. General Notes #8 and #9 on Sheet C2.1 address inspection, maintenance and removal of temporary erosion control facilities. Maintenance and inspection will be managed and enforced by a designated Certified Erosion and Sediment Control Lead (CESCL).
12. ***Manage the Project:*** Phasing: Provided the work is completed during the dry season, we have determined that phasing will not be necessary. Seasonal Work Limitation: Because of shallow groundwater, moisture-sensitive soils and nearby critical surface waters, this site is only marginally suitable for winter grading. The flat terrain, however, will facilitate the prevention of contaminated runoff leaving the site if winter site work is necessary. Coordination with Utilities and Other Contractors: It is anticipated that all work on this site will be performed under the direction of a single general contractor with a single unified erosion control plan. Inspection and monitoring: T.E.S.C. General Notes #8 and #9 on Sheet C2.1 address inspection, maintenance and removal of temporary erosion control facilities. Maintenance and inspection will be managed and enforced by a designated Certified Erosion and Sediment Control Lead (CESCL) to be identified when application is made to D.O.E. for a Construction Stormwater General Permit. The CESCL will be responsible for establishing a monitoring and reporting schedule in accordance with site conditions and state requirements, and shall attend any pre-construction conference with city staff. Because the area of disturbance does not exceed five acres, water quality testing is not required under D.O.E. regulations. Maintenance of the Construction SWPPP: "The Construction SWPPP shall be retained on site or within reasonable access to the site. The Construction SWPPP shall be modified whenever there is a significant change in the design, construction, operation or maintenance at the construction site" (D.O.E. II-3.2.3)

Additional documentation requirements per D.O.E. II-3.3.1:

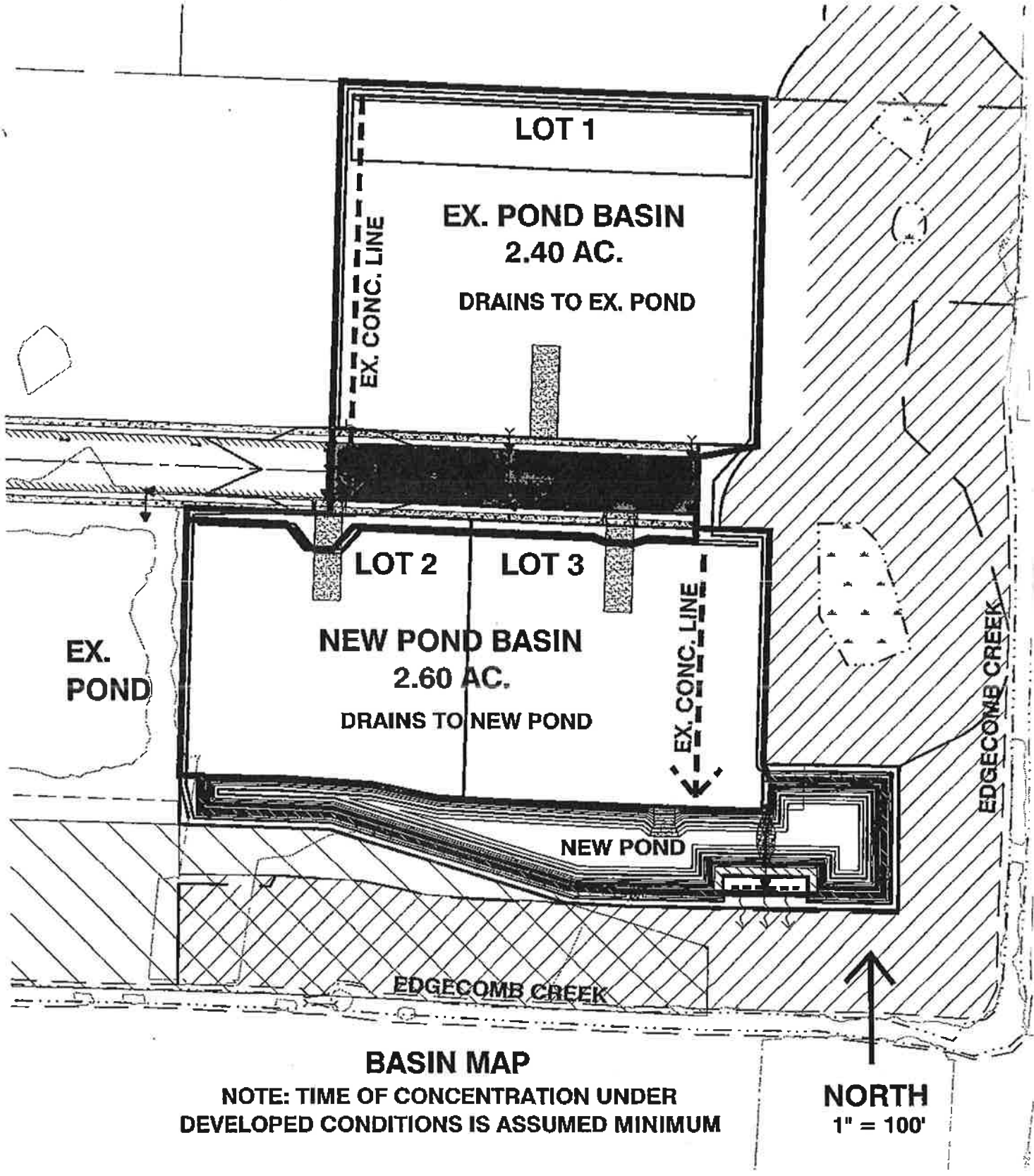
Project description: See drainage report.
Existing conditions: See drainage report.
Adjacent areas: See drainage report.
Critical areas: See drainage report.
Soil: See drainage report.

Potential erosion problem areas: All areas of exposed disturbed soil are potential problem areas. This site has no unusual conditions requiring extraordinary measures beyond industry best management practices.
Construction phasing: As of this writing, the owner does not plan to sub-phase this project. The construction sequence is described on Sheet C1.0 of the construction plans.
Construction schedule: Work is expected to begin in spring or summer of 2008. The work should be substantially completed and the site should be stabilized by the end of the dry season.
Financial/ownership responsibilities: The owner is Crown Park LLC, whose contact information is provided on Sheet C1.0 of the construction plans. The owner or his representative is responsible for selecting a contractor, who in turn is responsible for ensuring that the work is done in accordance with the approved plans to the satisfaction of the owner and the City inspector. Environmental bonding requirements, if any, will be administered by the City of Arlington in accordance with applicable codes.
Engineering calculations: See drainage report.
Certified erosion control specialist: A designated Certified Erosion and Sediment Control Lead (CESCL) will be identified when application is made to D.O.E. for a Construction Stormwater General Permit approximately 45 days before the scheduled start of site work, subject to change with written notification prior to the start of construction.

APPENDIX

Basin Map
Drainage Calculations & Pond Design
(Existing Pond Analysis)
(New Pond Design)
Soils Information
Drainage Facilities Maintenance & Operation

Basin Map



BASIN MAP

NOTE: TIME OF CONCENTRATION UNDER DEVELOPED CONDITIONS IS ASSUMED MINIMUM

Drainage Calculations
& Pond Design

Existing Detention Pond Analysis
For Lot 1, 169th Street, 4-T Development & Crown Distributing

WATERWORKS 2001
EXISTING DETENTION POND DESIGN

CROWN PARK/CROWN DISTRIBUTING
REVISED DETENTION POND SIZING

BASIN SUMMARY

BASIN ID: DV002 NAME: DEVELOPED SITE 2 YR STORM
SBUH METHODOLOGY

TOTAL AREA.....:	9.00 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	1.90 inches	AREA..:	0.80 Acres	8.20 Acres
TIME INTERVAL....:	10.00 min	CN....:	86.00	98.00
		TC....:	23.84 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 75.00 ns:0.1500 p2yr: 1.80 s:0.0025
impTcReach - Channel L:1399.24 kc:17.00 s:0.0025
PEAK RATE: 3.04 cfs VOL: 1.12 Ac-ft TIME: 480 min

BASIN ID: DV006MO NAME: DEVELOPED SITE 6 MONTH STORM
SBUH METHODOLOGY

TOTAL AREA.....:	9.00 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	1.15 inches	AREA..:	0.80 Acres	8.20 Acres
TIME INTERVAL....:	10.00 min	CN....:	86.00	98.00
		TC....:	23.80 min	5.00 min

ABSTRACTION COEFF: 0.20
TcReach - Channel L: 825.00 kc:42.00 s:0.0025
impTcReach - Channel L:1399.24 kc:17.00 s:0.0025
PEAK RATE: 1.80 cfs VOL: 0.66 Ac-ft TIME: 480 min

BASIN ID: DV010 NAME: DEVELOPED SITE 10 YR STORM
SBUH METHODOLOGY

TOTAL AREA.....:	9.00 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	2.60 inches	AREA..:	0.80 Acres	8.20 Acres
TIME INTERVAL....:	10.00 min	CN....:	86.00	98.00
		TC....:	23.80 min	5.00 min

ABSTRACTION COEFF: 0.20
impTcReach - Channel L:1399.24 kc:17.00 s:0.0025
PEAK RATE: 4.56 cfs VOL: 1.71 Ac-ft TIME: 480 min

BASIN ID: DV100 NAME: DEVELOPED SITE 100 YR STORM
SBUH METHODOLOGY

TOTAL AREA.....:	9.00 Acres	BASEFLOWS:	0.00 cfs	
RAINFALL TYPE....:	TYPE1A		PERV	IMP
PRECIPITATION....:	3.70 inches	AREA..:	0.80 Acres	8.20 Acres
TIME INTERVAL....:	10.00 min	CN....:	86.00	98.00
		TC....:	23.80 min	5.00 min

ABSTRACTION COEFF: 0.20
impTcReach - Channel L:1399.24 kc:17.00 s:0.0025
PEAK RATE: 6.65 cfs VOL: 2.52 Ac-ft TIME: 480 min

CROWN PARK/CROWN DISTRIBUTING
REVISED DETENTION POND SIZING

BASIN SUMMARY

BASIN ID: EX002 NAME: EXISTING SITE 2 YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 9.00 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERV IMP
PRECIPITATION....: 1.80 inches AREA..: 9.00 Acres 0.00 Acres
TIME INTERVAL....: 10.00 min CN....: 86.00 98.00
TC....: 60.67 min 5.00 min
ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.1500 p2yr: 1.80 s:0.0050
TcReach - Shallow L: 275.00 ks:11.00 s:0.0050
PEAK RATE: 0.60 cfs VOL: 0.53 Ac-ft TIME: 520 min

BASIN ID: EX010 NAME: EXISTING SITE 10 YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 9.00 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERV IMP
PRECIPITATION....: 2.60 inches AREA..: 9.00 Acres 0.00 Acres
TIME INTERVAL....: 10.00 min CN....: 86.00 98.00
TC....: 60.67 min 5.00 min
ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.1500 p2yr: 1.80 s:0.0050
TcReach - Shallow L: 275.00 ks:11.00 s:0.0050
PEAK RATE: 1.35 cfs VOL: 0.99 Ac-ft TIME: 490 min

BASIN ID: EX100 NAME: EXISTING SITE 100 YR STORM
SBUH METHODOLOGY
TOTAL AREA.....: 9.00 Acres BASEFLOWS: 0.00 cfs
RAINFALL TYPE....: TYPE1A PERV IMP
PRECIPITATION....: 3.70 inches AREA..: 9.00 Acres 0.00 Acres
TIME INTERVAL....: 10.00 min CN....: 86.00 98.00
TC....: 60.67 min 5.00 min
ABSTRACTION COEFF: 0.20
TcReach - Sheet L: 300.00 ns:0.1500 p2yr: 1.80 s:0.0050
TcReach - Shallow L: 275.00 ks:11.00 s:0.0050
PEAK RATE: 2.55 cfs VOL: 1.71 Ac-ft TIME: 490 min

HYDROGRAPH SUMMARY

HYD NUM	PEAK RUNOFF RATE cfs	TIME OF PEAK min.	VOLUME OF HYDRO cf\AcFt	Contrib Area Acres
1	0.283	1450	41421 cf	9.00
2	0.675	980	60704 cf	9.00
3	1.451	680	94867 cf	9.00
4	0.238	1330	28112 cf	9.00

STORAGE STRUCTURE LIST

STORAGE LIST ID No. STG-STO
Description: STAGE STORAGE POND

DISCHARGE STRUCTURE LIST

COMBINATION DISCHARGE ID No. COMBO
Description: COMBO FOR ORIFICE & NOTCH
Structure: NOTCH Structure:
Structure: ORIFICE Structure:
Structure:

NOTCH WEIR ID No. NOTCH
Description: OUTLET CONTROL WEIR
Weir Length: 5.0000 ft. Weir height (p): 0.8000 ft.
Elevation : 122.30 ft. Weir Increm: 0.10

MULTIPLE ORIFICE ID No. ORIFICE
Description: DISCHARGE ORIFICE IN WEIR
Outlet Elev: 121.50
Elev: 119.50 ft Orifice Diameter: 3.5000 in.

CROWN PARK/CROWN DISTRIBUTING
REVISED DETENTION POND SIZING

LEVEL POOL TABLE SUMMARY

DESCRIPTION--------->	MATCH (cfs)	INFLOW (cfs)	-STO- --id-	-DIS- --id-	<-PEAK-> <-STAGE>	id	OUTFLOW (cfs)	STORAGE VOL (cf)
2 YR 2.30		3.04	STG-STO	COMBO	122.23	1	0.28	30483.64 cf
10 YR 1.35		4.56	STG-STO	COMBO	122.37	2	0.67	41578.36 cf
100 YR 2.55		6.65	STG-STO	COMBO	122.46	3	1.45	48782.52 cf
6 MONTH 1.80		1.80	STG-STO	COMBO	122.02	4	0.24	13859.95 cf

Appended on: 14:55:08 Monday, January 28, 2008

LPOOLCOMPUTE [DETENTION POND] SUMMARY using Puls

Start of live storage: 121.5000 ft

Event	Match Q (cfs)	Peak Q (cfs)	Peak Stg (ft)	Vol (cf)	Vol (acft)	Time to Empty
2 year	0.3132	0.3096	122.3678	53452.54	1.2271	138.33
10 year	1.3711	0.8357	122.5989	71989.54	1.6527	151.33
100 year	2.5516	1.8311	122.7063	80746.87	1.8537	152.33

Summary Report of all Detention Pond Data

Event	Precip (in)
WQ Storm	1.1500
2 year	1.8000
10 year	2.6000
100 year	3.7000

BasinID	Event	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-cf)	Area (ac)	Method/Loss	Raintype
DEVELOPED	2 year	4.9164	8.00	1.6695	13.31	SBUH/SCS	TYPE1A
DEVELOPED	10 year	7.3774	8.00	2.5349	13.31	SBUH/SCS	TYPE1A
DEVELOPED	100 year	10.7529	8.00	3.7370	13.31	SBUH/SCS	TYPE1A
EXISTING	2 year	0.6264	8.67	0.5255	9.00	SBUH/SCS	TYPE1A
EXISTING	10 year	1.3711	8.50	0.9942	9.00	SBUH/SCS	TYPE1A
EXISTING	100 year	2.5516	8.50	1.7072	9.00	SBUH/SCS	TYPE1A

Record Id: DEVELOPED

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	1.08 ac	**DCIA**	12.23 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	23.80 min	**DC TC**	5.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Crown Dist. landscape (from 2001 report)	0.80 ac	86.00
169th Street landscape (from Ted Trepanier)	0.16 ac	86.00
Short plat landscape	0.12 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Fixed	From 2001 report					23.80 min
Pervious TC						23.80 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Crown Dist. impervious area (from 2001 report)	9.00 ac	98.00
169th Street impervious (from Ted Trepanier)	0.95 ac	98.00
Short plat impervious	2.28 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Fixed	From 2001 Report					5.00 min
Directly Connected TC						5.00min

Record Id: COMBO

Descrip:	From 2001 report	Increment	0.10 ft
Start El.	121.5000 ft	Max El.	124.0000 ft
List of Discharge Structures:		ORIFICE RISER NOTCH WEIR	

Record Id: ORIFICE

Descrip:	From 2001 report	Increment	0.10 ft
Start El.	121.5000 ft	Max El.	124.0000 ft
Orif Coeff	0.62	Lowest Orif El.	119.50
Lowest Diam	3.5000 in	Dist to next	0.0000 ft

Record Id: RISER

Descrip:	Prototype Structure	Increment	0.10 ft
Start El.	122.7500 ft	Max El.	125.0000 ft
Riser Diam		8.00 in	
Weir Coeff	9.7390	Orif Coeff	3.7820

Record Id: NOTCH WEIR

Descrip:	From 2001 report	Increment	0.10 ft
Start El.	122.5000 ft	Max El.	124.0000 ft
Length		5.00 ft	
Cd	3.1300	Use Constant Cd for calcs	

SPILLWAY SIZING FOR DETENTION POND

100-year peak flow rate into pond (from StormShed analysis):

$Q_{100} = 2.15$ cfs

Allowable depth of water over weir (3 inches):

$H = 0.25$ ft.

Gravity constant:

$g = 32.2$ ft/s^2

Broad-crested weir coefficient:

$K = 0.39$

Minimum required length of spillway:

$$L = \frac{Q100}{K\sqrt{2gH^{1.5}}}$$

L= 2.0 ft.

The capacity of the proposed **6-foot spillway** exceeds the entire potential undetained 100-year peak flow (2.15 cfs) into the pond from all sources under developed conditions.

New Detention Pond Design
For Lots 2 & 3

POND SIZING TABLE

LIVE STORAGE VOLUME

The following table was used in reverse to convert actual pond dimensions (including 50% correction factor) to design dimensions for entry into a StormShed stage/storage table ("NEW-POND-GEO") for final design verification.

STAGE (FT)	CORRECTED AREA (+50%) (SQ FT)	DESIGN AREA (SQ FT)
124.5	15968	10645
125.0	17691	11794
125.5	19432	12955
126.0	21189	14126
126.5	22963	15309

The following table based on final design dimensions was used to verify that the water quality dead storage is adequately sized to store nearly twice the 6-month runoff volume as calculated by StormShed for the developed contributing basin.

DEAD STORAGE VOLUME

STAGE (FT)	AREA (SQ. FT.)
123.0	6937
124.50	15968
AVG. AREA (FT)	11453
AVG. DEPTH (FT)	1.5
DESIGN VOLUME (CF)	17179
REQ. VOLUME (CF)	8530

NEW EXISTING Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
WQ Storm	0.0429	10.00	0.0537	2.6000	SBUH	TYPE1A
2 year	0.1640	8.67	0.1413	2.6000	SBUH	TYPE1A
10 year	0.3741	8.50	0.2727	2.6000	SBUH	TYPE1A
100 year	0.7128	8.50	0.4748	2.6000	SBUH	TYPE1A

Record Id: NEW EXISTING

Design Method	SBUH	Rainfall type	TYPE1A
Hyd Intv	10.00 min	Peaking Factor	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	2.60 ac	DCIA	0.00 ac
Pervious CN	85.00 -	DC CN	0.00
Pervious TC	57.68 min	DC TC	0.00 min

Pervious CN Calc		
Description	SubArea	Sub cn
New short plat area	2.60 ac	85.00
Pervious Composited CN (AMC 2)		85.00

Pervious TC Calc						
Type	Description	Length	Slope	Coeff	Misc	TT
Sheet	Longest distance across site	200.00 ft	0.50%	0.2400	1.80 in	57.68 min
Pervious TC						57.68 min

NEW DEVELOPED Event Summary

Event	Peak Q (cfs)	Peak T (hrs)	Hyd Vol (acft)	Area (ac)	Method	Raintype
WQ Storm	0.5857	8.00	0.1958	2.6000	SBUH	TYPE1A
2 year	0.9867	8.00	0.3320	2.6000	SBUH	TYPE1A
10 year	1.4775	8.00	0.5022	2.6000	SBUH	TYPE1A
100 year	2.1491	8.00	0.7380	2.6000	SBUH	TYPE1A

Record Id: NEW DEVELOPED

Design Method	SBUH	**Rainfall type**	TYPE1A
Hyd Intv	10.00 min	**Peaking Factor**	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	0.13 ac	**DCIA**	2.47 ac
Pervious CN	86.00	**DC CN**	98.00
Pervious TC	6.00 min	**DC TC**	6.00 min

Pervious CN Calc

Description	SubArea	Sub cn
Short plat landscaping (5%)	0.13 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Pervious TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Fixed	Minimum					6.00 min
Pervious TC						6.00 min

Directly Connected CN Calc

Description	SubArea	Sub cn
Short plat impervious (95%)	2.47 ac	98.00
DC Composited CN (AMC 2)		98.00

Directly Connected TC Calc

Type	Description	Length	Slope	Coeff	Misc	TT
Fixed	Minimum					6.00 min
Directly Connected TC						6.00min

LPOOLCOMPUTE [NEW DETENTION POND] SUMMARY using Puls

Start of live storage: 124.5000 ft

Event	Match Q (cfs)	Peak Q (cfs)	Peak Stg (ft)	Vol (cf)	Vol (acft)	Time to Empty
2 year	0.0820	0.0765	125.3484	9863.01	0.2264	134.67
10 year	0.3741	0.2311	125.4727	11446.05	0.2628	138.17
100 year	0.7128	0.6097	125.5847	12903.66	0.2962	138.83

Summary Report of all Detention Pond Data

Event	Precip (in)
WQ Storm	1.1500
2 year	1.8000
10 year	2.6000
100 year	3.7000

BasinID	Event	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-cf)	Area (ac)	Method/Loss	Raintype
NEW DEVELOPED	2 year	0.9867	8.00	0.3320	2.60	SBUH/SCS	TYPE1A
NEW DEVELOPED	10 year	1.4775	8.00	0.5022	2.60	SBUH/SCS	TYPE1A
NEW DEVELOPED	100 year	2.1491	8.00	0.7380	2.60	SBUH/SCS	TYPE1A
NEW EXISTING	2 year	0.1640	8.67	0.1413	2.60	SBUH/SCS	TYPE1A
NEW EXISTING	10 year	0.3741	8.50	0.2727	2.60	SBUH/SCS	TYPE1A
NEW EXISTING	100 year	0.7128	8.50	0.4748	2.60	SBUH/SCS	TYPE1A

Record Id: NEW DEVELOPED

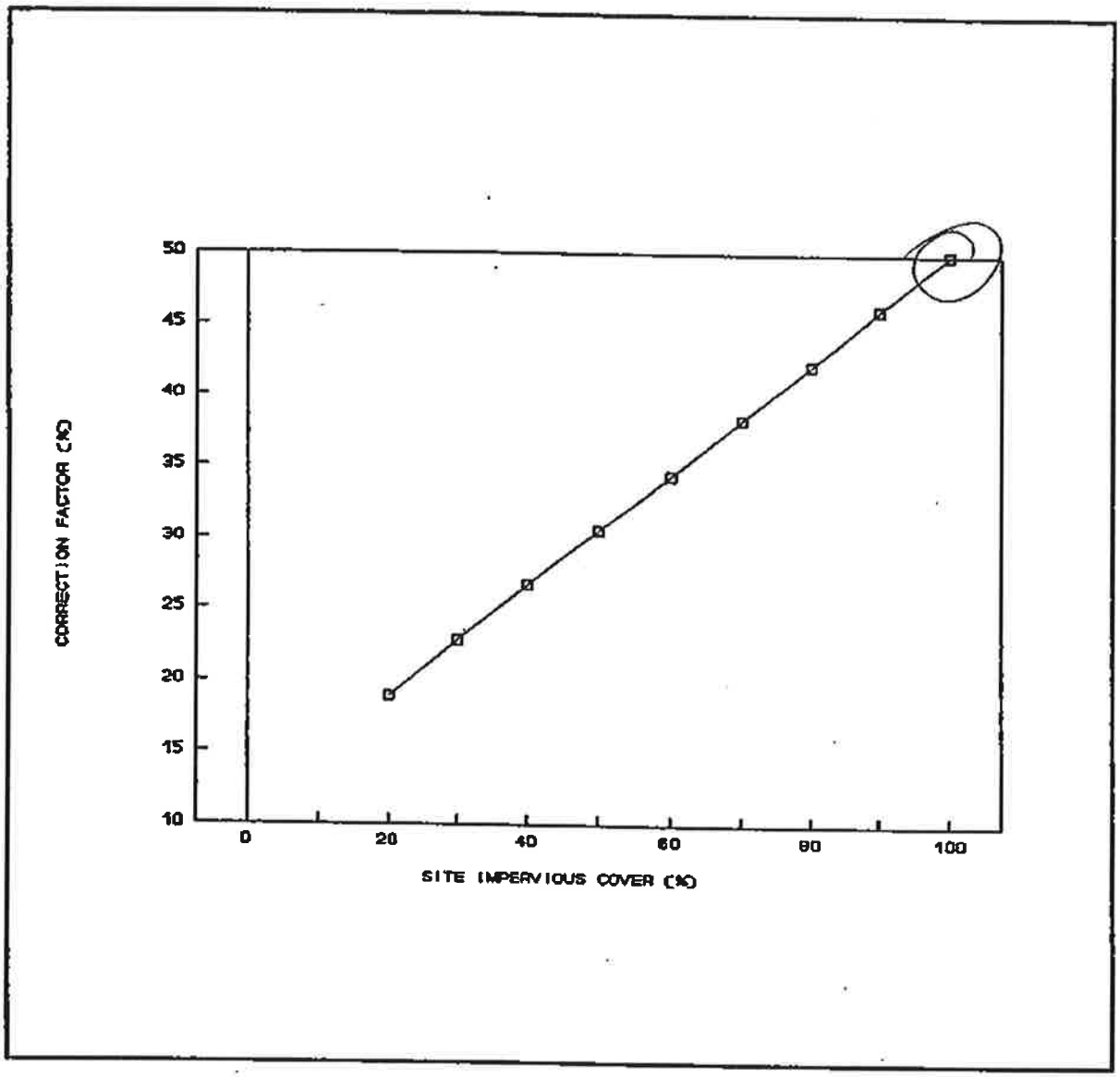
Design Method	SBUH	Rainfall type	TYPE1A
Hyd Intv	10.00 min	Peaking Factor	484.00
		Abstraction Coeff	0.20
Pervious Area (AMC 2)	0.13 ac	DCIA	2.47 ac
Pervious CN	86.00	DC CN	98.00
Pervious TC	6.00 min	DC TC	6.00 min

Pervious CN Calc		
Description	SubArea	Sub cn
Short plat landscaping (5%)	0.13 ac	86.00
Pervious Composited CN (AMC 2)		86.00

Record Id: NEW RISER

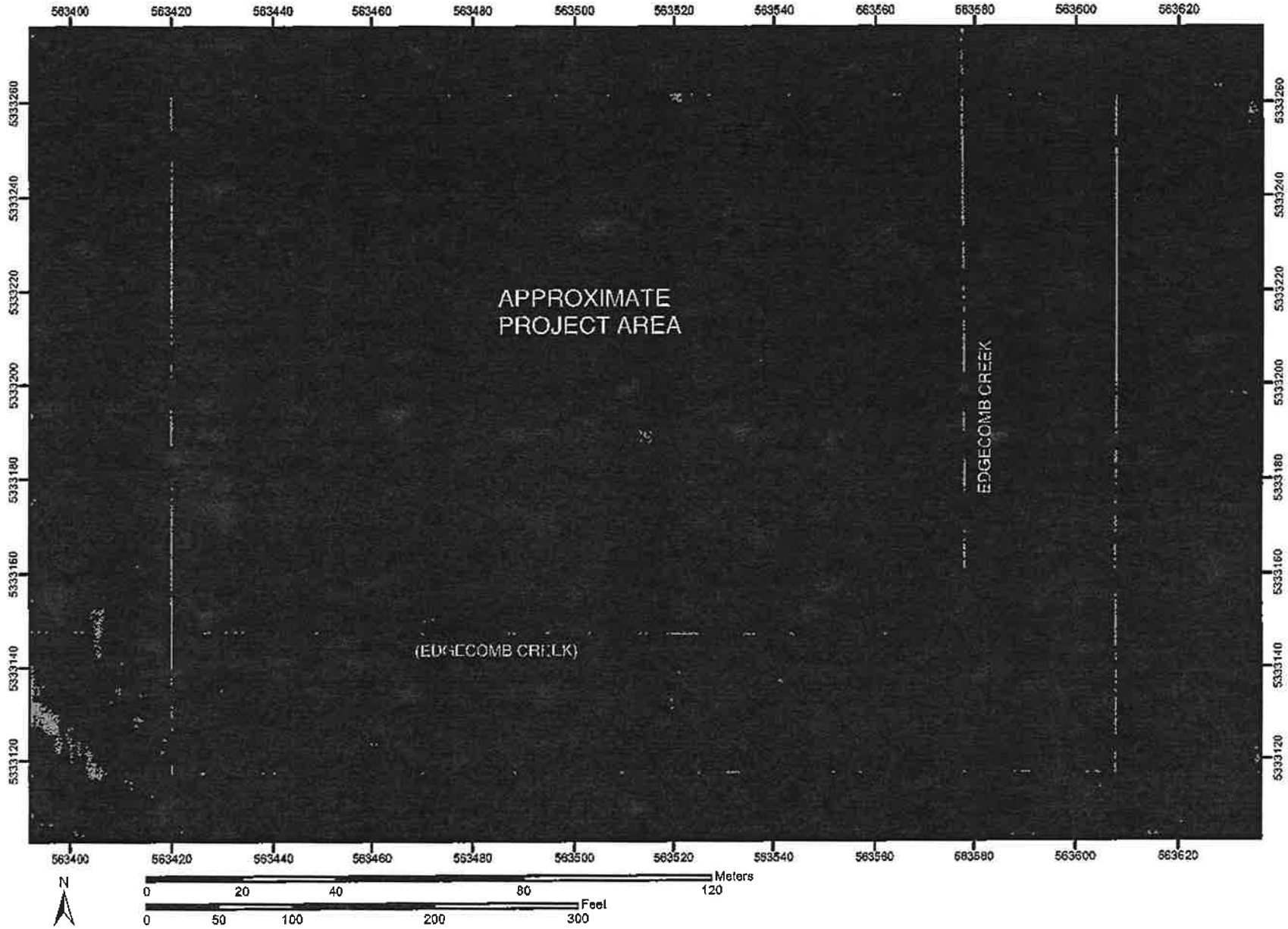
Descrip:	Short plat pond	Increment	0.10 ft
Start El.	125.4000 ft	Max El.	128.0000 ft
Riser Diam		8.00 in	
Weir Coeff	9.7390	Orif Coeff	3.7820

FIGURE III-1-1
Volume Correction Factor to Be Applied to Streambank Erosion Control BMPs
Based on Site Impervious Cover



Soils Information

Soil Map–Snohomish County Area, Washington
(Crown Park 3-Lot Short Plat)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other

Special Line Features
- Gully
- Short Steep Slope
- Other

Political Features

Municipalities
- Cities
- Urban Areas

Water Features
- Oceans
- Streams and Canals

Transportation
- Rails

Roads
- Interstate Highways
- US Routes
- State Highways
- Local Roads
- Other Roads

MAP INFORMATION

Original soil survey map sheets were prepared at publication scale. Viewing scale and printing scale, however, may vary from the original. Please rely on the bar scale on each map sheet for proper map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Snohomish County Area, Washington
Survey Area Data: Version 4, Dec 12, 2006

Date(s) aerial images were photographed: 7/10/1990; 7/18/1990

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Snohomish County Area, Washington (WA664)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
39	Norma loam	7.2	100.0%
Totals for Area of Interest (AOI)		7.2	100.0%

Drainage Facilities
Maintenance & Operation

Maintenance

General. Maintenance is of primary importance if detention ponds are to continue to function as originally designed. A local government, a designated group such as a homeowners' association, or some individual must accept the responsibility for maintaining the structures and the impoundment area. A specific maintenance plan must be formulated outlining the schedule and scope of maintenance operations. Debris removal in detention basins can be achieved through the use of trash racks or other screening devices.

Design with maintenance in mind. Good maintenance will be crucial to successful use of the impoundment. Hence, provisions to facilitate maintenance operations must be built into the project when it is installed. Maintenance must be a basic consideration in design and in determination of first cost. See Table 3.3 for specific maintenance requirements.

Any standing water removed during the maintenance operation must be disposed of to a sanitary sewer at an approved discharge location *Pretreatment may be necessary.* Residuals must be disposed in accordance with state and local solid waste regulations (See Minimum Functional Standards For Solid Waste Handling, Chapter 173-304 WAC).

Vegetation. If a shallow marsh is established, then periodic removal of dead vegetation may be necessary. Since decomposing vegetation can release pollutants captured in the wet pond, especially nutrients, it may be necessary to harvest dead vegetation annually prior to the winter wet season. Otherwise the decaying vegetation can export pollutants out of the pond and also can cause nuisance conditions to occur. If harvesting is to be done in the wetland, a written harvesting procedure should be prepared by a wetland scientist and submitted with the drainage design to the local government.

Sediment. Maintenance of sediment forebays and attention to sediment accumulation within the pond is extremely important. Sediment deposition should be continually monitored in the basin. Owners, operators, and maintenance authorities should be aware that significant concentrations of metals (e.g., lead, zinc, and cadmium) as well as some organics such as pesticides, may be expected to accumulate at the bottom of these treatment facilities. Testing of sediment, especially near points of inflow, should be conducted regularly to determine the leaching potential and level of accumulation of potentially hazardous material before disposal.

Table 3.3
Specific Maintenance Requirements for Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
General	Trash & Debris	Any trash and debris which exceed 5 cubic feet per 1,000 square feet (this is about equal to the amount of trash it would take to fill up one standard size garbage can). In general, there should be no visual evidence of dumping. If less than threshold all trash and debris will be removed as part of next scheduled maintenance.	Trash and debris cleared from site.
	Poisonous Vegetation and noxious weeds	Any poisonous or nuisance vegetation which may constitute a hazard to maintenance personnel or the public. Any evidence of noxious weeds as defined by State or local regulations. (Apply requirements of adopted Integrated Pest Management (IPM) policies for the use of herbicides).	No danger of poisonous vegetation where maintenance personnel or the public might normally be. (Coordinate with local health department) Complete eradication of noxious weeds may not be possible. Compliance with State or local eradication policies required
	Contaminants and Pollution	Any evidence of oil, gasoline, contaminants or other pollutants (Coordinate removal/cleanup with local water quality response agency).	No contaminants or pollutants present.
	Rodent Holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. (Coordinate with local health department and Ecology Dam Safety Office if pone exceeds 10 acre feet)

Table 3.3
Specific Maintenance Requirements for Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
	Beaver Dams	Dam results in change or function of the facility.	Facility is returned to design function. (Coordinate trapping of beavers and removal of dams with appropriate permitting agencies)
	Insects	When insects such as wasps and hornets interfere with maintenance activities.	Insects destroyed or removed from site. Apply insecticides in compliance with adopted IPM policies
	Tree Growth and Hazard Trees	Tree growth does not allow maintenance access or interferes with maintenance activity (i.e., slope mowing, silt removal, vactoring, or equipment movements). If trees are not interfering with access or maintenance, do not remove If dead, diseased, or dying trees are identified (Use a certified Arborist to determine health of tree or removal requirements)	Trees do not hinder maintenance activities. Harvested trees should be recycled into mulch or other beneficial uses (e.g., alders for firewood). Remove hazard trees
Side Slopes of Pond	Erosion	Eroded damage over 2 inches deep where cause of damage is still present or where there is potential for continued erosion. Any erosion observed on a compacted berm embankment.	Slopes should be stabilized using appropriate erosion control measure(s); e.g., rock reinforcement, planting of grass, compaction. If erosion is occurring on compacted berms a licensed civil engineer should be consulted to resolve source of erosion.

Table 3.3
Specific Maintenance Requirements for Detention Ponds

Maintenance Component	Defect	Conditions When Maintenance Is Needed	Results Expected When Maintenance Is Performed
Storage Area	Sediment	Accumulated sediment that exceeds 10% of the designed pond depth unless otherwise specified or affects inletting or outletting condition of the facility.	Sediment cleaned out to designed pond shape and depth; pond reseeded if necessary to control erosion.
	Liner (If Applicable)	Liner is visible and has more than three 1/4-inch holes in it.	Liner repaired or replaced. Liner is fully covered.
Pond Berms (Dikes)	Settlements	Any part of berm which has settled 4 inches lower than the design elevation. If settlement is apparent measure berm to determine amount of settlement. Settling can be an indication of more severe problems with the berm or outlet works. A licensed civil engineer should be consulted to determine the source of the settlement.	Dike is built back to the design elevation.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.
Emergency Overflow/Spillway and Berms over 4 feet in height.	Tree Growth	Tree growth on emergency spillways create blockage problems and may cause failure of the berm due to uncontrolled overtopping. Tree growth on berms over 4 feet in height may lead to piping through the berm which could lead to failure of the berm.	Trees should be removed. If root system is small (base less than 4 inches) the root system may be left in place. Otherwise the roots should be removed and the berm restored. A licensed civil engineer should be consulted for proper berm/spillway restoration.
	Piping	Discernable water flow through pond berm. Ongoing erosion with potential for erosion to continue. (Recommend a Goethechnical engineer be called in to inspect and evaluate condition and recommend repair of condition.	Piping eliminated. Erosion potential resolved.

Table 3.3 Specific Maintenance Requirements for Detention Ponds			
Maintenance Component	**Defect**	**Conditions When Maintenance Is Needed**	**Results Expected When Maintenance Is Performed**
Emergency Overflow/Spillway	Emergency Overflow/ Spillway	Only one layer of rock exists above native soil in area five square feet or larger, or any exposure of native soil at the top of out flow path of spillway. (Rip-rap on inside slopes need not be replaced.)	Rocks and pad depth are restored to design standards.
	Erosion	See "Side slopes of Pond"	

Maintenance. Control structures and catch basins have a history of maintenance-related problems and it is imperative that a good maintenance program be established for their proper functioning. A typical problem is that sediment builds up inside the structure which blocks or restricts flow to the inlet. To prevent this problem these structures should be routinely cleaned out at least twice per year. Regular inspections of control structures should be conducted to detect the need for non-routine cleanout, especially if construction or land-disturbing activities are occurring in the contributing drainage area.

A 15-foot wide access road to the control structure should be installed for inspection and maintenance.

Table 3.5 provides maintenance recommendations for control structures and catch basins.

Table 3.5
Maintenance of Control Structures and Catchbasins

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
General	Trash and Debris (Includes Sediment)	Material exceeds 25% of sump depth or 1 foot below orifice plate.	Control structure orifice is not blocked. All trash and debris removed.
	Structural Damage	Structure is not securely attached to manhole wall.	Structure securely attached to wall and outlet pipe.
		Structure is not in upright position (allow up to 10% from plumb).	Structure in correct position.
		Connections to outlet pipe are not watertight and show signs of rust.	Connections to outlet pipe are water tight; structure repaired or replaced and works as designed.
		Any holes--other than designed holes--in the structure.	Structure has no holes other than designed holes.
Cleanout Gate	Damaged or Missing	Cleanout gate is not watertight or is missing.	Gate is watertight and works as designed.
		Gate cannot be moved up and down by one maintenance person.	Gate moves up and down easily and is watertight.
		Chain/rod leading to gate is missing or damaged.	Chain is in place and works as designed.
		Gate is rusted over 50% of its surface area.	Gate is repaired or replaced to meet design standards.
Orifice Plate	Damaged or Missing	Control device is not working properly due to missing, out of place, or bent orifice plate.	Plate is in place and works as designed.
	Obstructions	Any trash, debris, sediment, or vegetation blocking the plate.	Plate is free of all obstructions and works as designed.
Overflow Pipe	Obstructions	Any trash or debris blocking (or having the potential of blocking) the overflow pipe.	Pipe is free of all obstructions and works as designed.

Table 3.5
Maintenance of Control Structures and Catchbasins

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
Manhole	See Table 3.4	See Table 3..4	See Table 3.4
CATCH BASINS			
General	Trash & Debris	Trash or debris which is located immediately in front of the catch basin opening or is blocking inletting capacity of the basin by more than 10%.	No Trash or debris located immediately in front of catch basin or on grate opening.
		Trash or debris (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of six inches clearance from the debris surface to the invert of the lowest pipe.	No trash or debris in the catch basin.
		Trash or debris in any inlet or outlet pipe blocking more than 1/3 of its height.	Inlet and outlet pipes free of trash or debris.
		Dead animals or vegetation that could generate odors that could cause complaints or dangerous gases (e.g., methane).	No dead animals or vegetation present within the catch basin.
	Sediment	Sediment (in the basin) that exceeds 60 percent of the sump depth as measured from the bottom of basin to invert of the lowest pipe into or out of the basin, but in no case less than a minimum of 6 inches clearance from the sediment surface to the invert of the lowest pipe. Measured from the bottom of basin to invert of the lowest pipe into or out of the basin.	No sediment in the catch basin
	Structure Damage to Frame and/or Top Slab	Top slab has holes larger than 2 square inches or cracks wider than 1/4 inch (Intent is to make sure no material is running into basin).	Top slab is free of holes and cracks.
		Frame not sitting flush on top slab, i.e., separation of more than 3/4 inch of the frame from the top slab. Frame not securely attached	Frame is sitting flush on the riser rings or top slab and firmly attached.
	Fractures or Cracks in Basin Walls/ Bottom	Maintenance person judges that structure is unsound.	Basin replaced or repaired to design standards.
		Grout fillet has separated or cracked wider than 1/2 inch and longer than 1 foot at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through cracks.	Pipe is regrouted and secure at basin wall.
	Settlement/ Misalignment	If failure of basin has created a safety, function, or design problem.	Basin replaced or repaired to design standards.
	Vegetation	Vegetation growing across and blocking more than 10% of the basin opening.	No vegetation blocking opening to basin.
		Vegetation growing in inlet/outlet pipe joints that is more than six inches tall and less than six inches apart.	No vegetation or root growth present.

Table 3.5
Maintenance of Control Structures and Catchbasins

Maintenance Component	Defect	Condition When Maintenance is Needed	Results Expected When Maintenance is Performed
	Contamination and Pollution	See "Detention Ponds"	No pollution present.
Catch Basin Cover	Cover Not in Place	Cover is missing or only partially in place. Any open catch basin requires maintenance.	Catch basin cover is closed
	Locking Mechanism Not Working	Mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have less than 1/2 inch of thread.	Mechanism opens with proper tools.
	Cover Difficult to Remove	One maintenance person cannot remove lid after applying normal lifting pressure. (Intent is keep cover from sealing off access to maintenance.)	Cover can be removed by one maintenance person.
Ladder	Ladder Rungs Unsafe	Ladder is unsafe due to missing rungs, not securely attached to basin wall, misalignment, rust, cracks, or sharp edges.	Ladder meets design standards and allows maintenance person safe access.
Metal Grates (If Applicable)	Grate opening Unsafe	Grate with opening wider than 7/8 inch.	Grate opening meets design standards.
	Trash and Debris	Trash and debris that is blocking more than 20% of grate surface inletting capacity.	Grate free of trash and debris.
	Damaged or Missing.	Grate missing or broken member(s) of the grate.	Grate is in place and meets design standards.