Quality Assurance Project Plan (QAPP)

Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring S8.F

August 2008

Prepared by

Snohomish County Public Works
Surface Water Management Division
3000 Rockefeller Ave
Everett, Washington 98201

Quality Assurance Project Plan

Approvals:

John Herrmann Project Manager — 8/18/08 Date
Snohomish County Surface Water Management

Aaron Young, Laboratory Manager — 8/18/08 Date
Amtest Analytical

Table of Contents

Distribution List viii
Introduction 1
Project Specific NPDES Phase I Requirements 1
Site Selection 2
Stormwater Treatment BMP 2
Hydrologic Management BMP 4
Study Area 5
Snohomish Cascade Sector 3 Phase 1 and 2 5
Emerald Meadows 5
Center Road Pond 5
Gibson Road Pond 6
North Creek Park Division 1 6
Background 8
Previous Snohomish County Studies 8
Existing Snohomish County Efforts 8
Integrated Stormwater Management Grant 9
Evergreen State Fairgrounds 9
Pet Waste Grant 9
Septic Grant 10
Drainage Re-development 10
Green Infrastructure 10
Snohomish County Surface Water Management Ambient Monitoring 11
Snohomish County Water Quality Complaint Investigation Program 12
Illicit Discharge Elimination Program (IDDE) 12
Department of Ecology Studies 12
Regulatory Criteria or Standards 12
Project Description 14
Introduction 14
Stormwater Treatment BMP Monitoring 14
Hydrologic Management BMP 15
Information and Data Needs 15
Organization and Schedule 16
Project Team 16
Schedule 16
Budget and Funding 17

Data Quality Objectives 18
Bias 18
Precision 18
Accuracy 19
Completeness 19
Target Population 21
Study Boundaries 21
Sampling Process Design 22
Stormwater Treatment BMPs 22
Location and Frequency 22
Parameters 23
Sampling Point Set-Up 23
Baseflow Conditions 23
Backflow Conditions 23
Monitoring 24
Hydrologic Treatment BMPs 25
Location and Frequency 25
Parameters 25
Sampling Point Set-Up 25
Monitoring 25
Representativeness 26
Completeness 26
Comparability 26
Sampling Procedures 27
Stormwater Treatment BMPs 27
Calibration 27
Sampling Setup and Retrieval 27
Decontaminating Equipment 30
Field Data Recording 31
Sample Transport and Chain of Custody 31
Hydrologic Treatment BMP 31
Calibration 32
Installation 32
Sample Collection 32
Field Data Recording 32
Sample Transport and Chain of Custody 32
Measurement Procedures 33
Suface Water Samples 33
Sediment Samples 33
Field Duplicate Samples 35
Equipment Blank 35

Field Blank Samples 35
Laboratory Duplicate Analyses 35
Method Blanks 35
Performance Evaluation Samples 36
Corrective Action 36
Field Procedures 36
Laboratory Procedures 36
Decontamination Procedures 36
Data Management Procedures 37
Field Data 37
Laboratory Data 37
Audits and Reports 39
Audits 39
Reports 39
Data Verification 40
Data Validation (Usability) Assessment 41
Stormwater Loads ..... **Error! Bookmark not defined.**
Baseflow Loads ..... **Error! Bookmark not defined.**
References 43
Appendix A BMP Support Information A-2
Snohomish Cascade Sector 3 Phase 1 and 2 ..... A-4
Emerald Meadows A-10
Center Road Pond A-16
Gibson Road Pond A-26
North Creek Park Division 1 ..... A-32
North Creek Park Division 1 ..... A-33
Appendix B Sampler and Meter Information B-1
Appendix C Schedules C-1
Appendix D Draft Conceptual Database Tables D-1
Appendix E Chain of Custody Form E-1
Appendix F Clean Hands Technique for the Automated Sampler F-1
Appendix G Data Verification Decision Flow Chart G-1

Distribution List

Copies of the finalized QAPP and subsequent updates to the QAPP will be provided to the project staff identified in Table 1. The sampling consultant project manager and the laboratory manager will be responsible for distributing the QAPP to additional personnel within their organizations that are involved in this program. The sampling consultant is expected to be identified by January 2009

Table 1 Distribution List

Name	Title	Organization
John Herrmann	Project Manager	Snohomish County
Steve Britsch	Project Reviewer	Snohomish County
TBD	Field Staff	Snohomish County
TBD	Field Staff	Snohomish County
Aaron Young	Laboratory Manager	Am Test Analytical
Rachel McCrea	Ecology Regional Contact	Department of Ecology

Introduction

The Environmental Protection Agency (EPA) developed the National Pollutant Discharge Elimination System (NPDES) Phase I stormwater program in response to the 1987 Amendments to the Clean Water Act (CWA). The program went into effect in 1990 and focused on municipalities with populations greater than 100,000. The Washington State Department of Ecology developed the NPDES Phase I permits in accordance with the EPA's requirements. These permits were issued to municipalities, including Snohomish County, in 1995.

As required by the permit, Snohomish County (County) submitted a Stormwater Management Program to Ecology, which was approved in July 1997. The program required the County to systematically investigate and identify illicit discharges, investigate specific sites identified as sources of stormwater pollution and offer technical assistance to remediate the discharges. Snohomish County was re-issued a NPDES Phase I stormwater permit on January 17, 2007 with an effective date of February 16 2007.

Project Specific NPDES Phase I Requirements

Section 8 of Snohomish County's NPDES Phase I Permit, effective February 16, 2007 discusses monitoring requirements of the permit. This Quality Assurance Project Plan (QAPP) focuses on the permit requirements under Section 8, F Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring.

Section 8, F states:

F. Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring

1. Each Permittee listed in S1.B. and the Ports of Seattle and Tacoma shall conduct full scale field monitoring to evaluate the effectiveness and operation and maintenance requirements of stormwater treatment and hydrologic management BMPs applied in their jurisdiction. A QAPP is required for each BMP and flow reduction strategy being monitored.
2. Each Permittee listed in S1.B. shall monitor at least two treatment BMPs, at no less than two sites per BMP. The Port of Seattle and the Port of Tacoma shall each monitor at least one treatment BMP, at no less than two sites.

To ensure a range of BMP types are monitored, Ecology will restrict the total number of monitoring sites for a BMP category to no more than four. BMPs shall be selected from the following list:

a. Basic Treatment Category: Biofiltration swale, Filter strip, Basic wetpond, Treatment wetland, and Sand filter.

b. Metals/Phosphorus Treatment Category: Amended sand filter, Two facility treatment train, Compost amended filter strips, Bioretention, and Large wetpond.

c. Oil Control Category: Linear sand filter, and Catch basin insert.

3. BMPs shall be designed in accordance with the 2005 *Stormwater Management Manual for Western Washington* unless Ecology approves of an alternate design in the QAPP review. Permittees may also petition Ecology to monitor a BMP that is not on the above list.

4. Permittees must use appropriate sections of Ecology's guidance for "Evaluation of Emerging Stormwater Treatment Technologies" (available on Ecology's website) for preparing, implementing, and reporting on the results of the BMP evaluation program.

The statistical goal is to determine mean effluent concentrations and mean percent removals for each BMP type with 90 - 95 percent confidence and 75 - 80 percent power.

Permittees must use USEPA publication number 821-B-02-001, "Urban Stormwater BMP Performance Monitoring," as additional guidance for preparing the BMP evaluation monitoring, and must collect information pertinent to fulfilling the
"National Stormwater BMP Data Base Requirements" in section Section 3.4.3. of that document.

5. The parameters to be monitored in whole water at each test site include:

   a. For Basic, Enhanced, or Phosphorus treatment BMPs: Total suspended solids, Particle size distribution, pH, Total and ortho-phosphorus, Hardness, and Total and dissolved copper and zinc.

   b. For Oil Control BMPs: Total suspended solids, Particle size distribution, pH, NWTPH-Dx and –Gx, and Oil sheen

6. Parameters to be monitored in accumulated sediment at each test site for Basic, Enhanced, Phosphorus treatment, or Oil Control BMPs include: Percent total solids, Grain size, Total volatile solids, NWTPH-Dx, Total phosphorous, and Total cadmium, copper, lead, and zinc.

7. Each Permittee listed in S1.B. shall monitor the effectiveness of one flow reduction strategy that is in use or planned for installation in their jurisdiction.

   Monitoring of a flow reduction strategy shall include continuous rainfall and surface runoff monitoring. Flow reduction strategies shall be monitored through either a paired site study or against a predicted outcome.

Site Selection

Under the permit requirements specified above three different types of project related sites were required to be identified and selected. The Stormwater Treatment BMP sites where chosen to meet the requirements outlined under S8.F.2, 3, and 4. A hydrologic management BMP site was chosen based on permit requirement S8.F.7, and subsequently a rain gauge site was selected to support the activities for both the hydrologic management BMP and the Stormwater Treatment BMPs. These sites are discussed below.

<u>Stormwater Treatment BMP</u>

Snohomish County conducted a review of its stormwater treatment BMPs, to identify potential BMPs to monitor as part of permit requirement S8.F.2. These BMPs have

been and are built under the guidance of the 1992 State of Washington Stormwater Manual. The sites were identified base on the following criteria:

- Applicability to standard
- Land use
- Age
- Discharge
- Sampling Safety issues
- Number of inlets and outlets
- Amount of basin modifications after construction
- Applicability to sampling

This review identified four specific and somewhat common BMP types used in the County, including 1) modified wetponds, 2) wet vaults with biofiltration swales, 3) wet vaults with stormwater treatment systems and, 4) wetland/detention pond systems.

The wet vaults with stormwater treatment systems are not compatible with the Department of Ecology's BMP treatment analysis goals, because they include a proprietary system. The wet vaults with biofiltration swales were examined, but neither the wet vault or the biofiltration swale of the identified systems met the standards set forth in the 1992 manual. Modified wetponds, are the most predominant and permit applicable BMP in Snohomish County.

The modified wetpond is a pond that is designed to retain a portion of the 2-year, 24-hour runoff event as dead storage and detain up to the 100-year runoff event with the use of a control structure. In Snohomish County detention or flow control is required for major development activities under the Snohomish County Drainage Code (30.63A.210.1). Additional information and design criteria can be found in the Department of Ecology's Stormwater management Manual for Western Washington Volume V (Ecology 2005).

The wetland/detention pond system is designed to retain the same percentage of the 2-year, 24-hour storm as the modified wetpond. These systems utilize wetland vegetation and a two cell system to improve stormwater quality. Additional information and design criteria can be found in the Department of Ecology's Stormwater management Manual for Western Washington Volume V (Ecology 2005).

Snohomish County's review identified eight modified wet ponds that would meet or marginally meet the requirements of the stormwater permit. Of these sites two have incomplete information; two meet the dead storage requirements for the 2-year, 24-hour event, and four do not meet the dead storage requirements in varying degrees. In a November 29, 2007 meeting with the Department of Ecology it was determined that Snohomish County could monitor four modified wetponds storing various percentages of the 2-year, 24-hour event to determine which pond size is most effective. Two of the ponds were determined by Ecology not applicable for this study, as a result Snohomish County identified 2 wetland/detention pond systems which meet the permit requirements and are applicable to this study.

Hydrologic Management BMP

Snohomish County has traditionally managed water discharges by detaining water with control structures in modified wetponds. The County is installing and has recently installed several infiltration style BMPs. Of this grouping of BMPs one site is appropriate for conducting flow monitoring according to permit requirement S8.7. This site is located in the North Creek Park Division 1 subdivision. The site has an existing storm sewer system, with a control structure, that discharges up to the 2-year, 24-hour storm volume to an infiltration swale.

Study Area

Figure 1 shows the location of the four study sites that have been chosen to be monitored to fulfill permit requirement S8.F. Snohomish Cascade Sector 3 is located the Snohomish River Basin, Emerald Meadows is located in North Creek watershed and the Center and Gibson Roads ponds are located in the Swamp Creek Watershed. The hydrologic management site, North Creek Park Division 1, is located in the North Creek Watershed. Additional information and background about these watersheds can be found in the Lower Snohomish River Tributaries Fecal Coliform Bacteria Total Maximum Daily Load Detailed Implementation Plan (Ecology 2003) and the North Creek Fecal Coliform Bacteria Total Maximum Daily Load Detailed Implementation Plan (Ecology 2003a).

Snohomish Cascade Sector 3 Phase 1 and 2

This subdivision is located in the Snohomish River Basin northeast of the City of Mill Creek. The development is part of the larger Snohomish Cascade Master Planned Community. Sector 3 Phase 1 and 2 is approximately 51 acres in size with an impervious area of approximately 21 acres. The land use is characterized as high density residential with lot sizes ranging from 0.09 acres to 0.20 acres, and an average lot size of approximately 0.15 acres. The site was developed around 2001, and from reviewing the hydraulic design report, the subdivision boundaries, and the parcel information, it appears that the site was developed according to plan and the pond was sized to treat this site.

The modified wetpond is a three celled pond with a dead storage volume of 87,522 cubic feet, which is approximately 66 percent of the required treatment volume. The pond discharges water to Thomas Creek on the east side of the subdivision. Additional details and design information, including a map of the site can be found in Appendix A.

Emerald Meadows

The Emerald Meadows subdivision is located southwest of Mill Creek near the intersection of 3rd Ave SE and 170th Place SE. The subdivision is 2.10 acres in size with approximately 44 percent of the land area being impervious surface. There are 10 parcels which range in size from 0.14 acres to 0.22 acres and have an average plot size of approximately 0.16 acres. The land use of the site is considered high density residential, and the drainage is collected via a storm sewer system and discharged to a modified wetpond on the southeast side of the subdivision.

The modified wetpond has two cells and a dead storage volume of 1,265 cubic feet, which is approximately 19 percent of the 2-year, 24-hour event. The pond outlets to the local storm sewer system in 3rd Ave SE and ultimately discharges to North Creek west of the site.

Center Road Pond

The Center Road Pond is part of a larger roadway redevelopment project that was conducted along 112th Street SW and Beverly Park Road, south of the City of Everett. The Center Road Pond drains approximately 5.58 acres with approximately 78 percent of that area representing impervious surfaces along Beverly Park Road. The facility was designed and constructed based on the 2001 Stormwater Management Manual for Western Washington (Ecology 2001). The wetland is a two celled structure with a dead

storage volume of 25,315 cubic feet. Additional details and design information are presented in Appendix A.

Gibson Road Pond

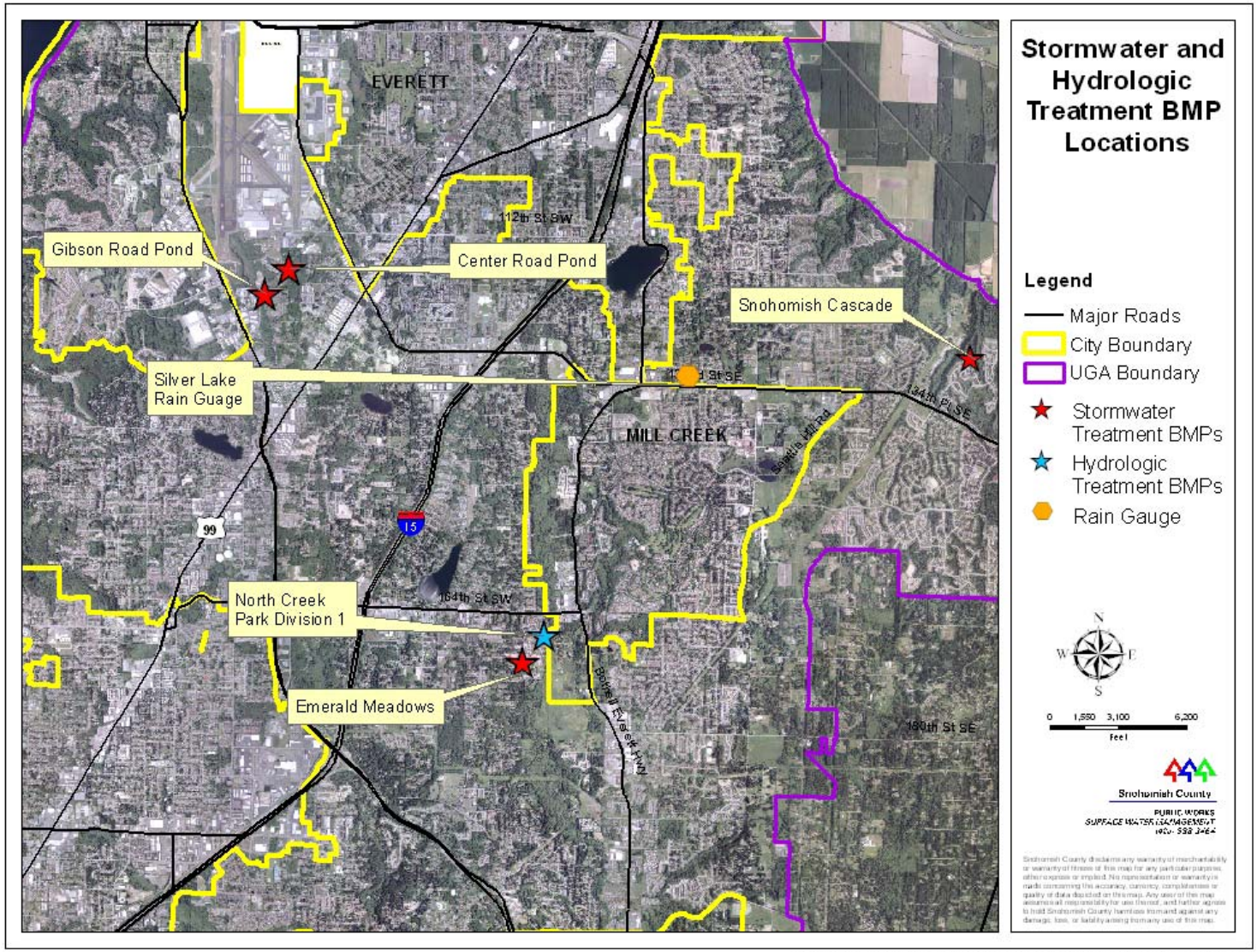
The Gibson Road Pond is part of a larger roadway redevelopment project that was conducted along 112th Street SW and Beverly Park Road, south of the City of Everett. The Gibson Road Pond drains approximately 2.8 acres with approximately 100 percent of that area representing impervious surfaces along Beverly Park Road. The facility was designed and constructed based on the 2001 Stormwater Management Manual for Western Washington (Ecology 2001). The wetland is a two celled structure with a dead storage volume of 15,903 cubic feet. Additional details and design information are presented in Appendix A.

North Creek Park Division 1

This site is the hydrologic treatment BMP for permit requirement S8.7. North Creek Park Division 1 is located just southwest of the City of Mill Creek at the intersection of 167th Street SE and 6th Avenue SE. The subdivision is approximately 38 acres in size with 128 parcels and an average lot size of 0.18 acres. At the time of this QAPP development Snohomish County is constructing an infiltration swale along 6th Avenue SE adjacent to 167th Street SE in the southeast corner of the subdivision.

The drainage discharging to this treatment facility is draining the southern portion of 4th Drive SE up to 167th Street SE and from 167th Street SE along 6th Avenue SE, which is presented in a figure in Appendix A. A control structure is located just upstream of the treatment facility metering the water so that the facility can only receive the 2-year, 24-hour runoff volume. The remaining stormwater surcharges into another system, via an overflow. Details about the design and site conditions are presented in Appendix A.

Figure 1 Snohomish County Monitoring Locations



Background

Snohomish County has conducted limited high intensity stormwater sampling to identify the effectiveness of stormwater BMPs, which produced useful to the Department of Ecology to make BMP management decisions. The few studies conducted focused on evaluating new manufactured stormwater treatment devices such as catch basin inserts and compost stormwater filters.

Currently, the County is conducting a number of projects and studies evaluating public education efforts and the implementation of stormwater BMPs to address nutrient loadings from pet wastes, septic systems, and general stormwater. The projects are being monitored primarily by collecting grab samples for fecal coliform, but also include flow, benthic macroinvertebrates, and public surveys.

Surface Water Management (SWM) conducts three primary monitoring programs; long-term ambient water quality monitoring, water quality complaint response, and dry weather outfall screening throughout the County to analyze, investigate and determine the source of pollutants to the drainage systems. These programs serve SWM's mission by working in partnership with concerned citizens to protect and enhance water quality and aquatic habitats. Furthermore, they help fulfill the requirements of the NPDES municipal stormwater discharge permit issued to Snohomish County by Ecology under the Federal Clean Water Act, 44 U.S.C 1251.

Previous Snohomish County Studies

With the release of the NPDES Phase I permits in 1995 municipalities were looking for options to treat stormwater discharges to their MS4. Manufactures began developing and marketing treatment systems, including catch basin inserts. In 1995 SWM was part of an interagency group to evaluate the pollutant removal ability of commercially available catch basin inserts (Interagency Catch Basin Insert Committee 1995). The study showed that the inserts are able to remove coarse sediments, debris, and vary in their ability to remove petroleum products. Ultimately the study suggested that these devices may be applicable.

Snohomish County conducted a follow-up study in 1998 to evaluate the cost of utilizing catch basin inserts and their ability to remove sediment (Leif 1998). The study concluded that inserts could be acceptable BMPs for the removal of sand and larger sediments, petroleum products from commercial and industrial sites, and the removal of debris. The study also stated that these BMPs would not be acceptable for removing sediments finer than sands, metals and phosphorus dissolved and attached to sediments, and to control large volumes of spilled petroleum products (Leif 1998).

A 1999 study conducted by Snohomish County sampled two compost stormwater filters installed as part of a bridge reconstruction project. The results showed reductions in Total Suspended Solids (TSS), lead, copper, and zinc and may be as efficient as biofiltration swales and wet detention ponds. The study also recommended that this BMP be accepted by the Department of Ecology and local jurisdictions as an alternative to biofiltration swales and wet detention ponds (Leif 1999).

Existing Snohomish County Efforts

Managing stormwater in Snohomish County is a complex task. Providing adequate detention and drainage to reduce flooding, protect water quality and provide healthy habitat for threatened

salmon runs are some of the main challenges. Those challenges are especially acute in urban or urbanizing areas experiencing rapid growth. Over the past ten years, Snohomish County government has made substantial progress dealing with stormwater issues by revising codes to improve drainage and detention standards in new developments, responding to citizen drainage complaints, replacing undersized culverts, maintaining detention facilities and, in the Snohomish County Drainage Needs Report project (2002), inventorying and mapping all of the drainage structures in the urban growth areas (UGAs) of unincorporated Snohomish County and assessing stream habitat conditions for fish.

Snohomish County SWM is currently conducting several projects and studies to reduce stormwater and surface water pollution on a programmatic level.

Integrated Stormwater Management Grant

This project addresses Low Impact Development (LID) strategies to benefit stormwater management issues in the North Creek watershed by identifying, mapping and assessing Native Growth Protection Areas (NGPAs) and working with property owners surrounding selected NGPAs. BMPs will be implemented to improve water quality and water quantity for stormwater in the North Creek watershed from runoff source to piped outfalls. The project will include work at two levels: (1) the individual scale (landowner BMPs), and (2) the neighborhood scale (BMPs for community open space such as NGPAs. Landowner BMPs will be implemented in specific neighborhoods selected using established criteria. BMPs will be implemented in conjunction with landowners and will include a range of possible actions, such as re-vegetation, soil amendments, pollutant reduction, and impervious surface alternatives, such as porous pavement, (lattice concrete or gravel) which, for example, may replace a private residential driveway. At the neighborhood scale, this project will address methods to better use open space for passive stormwater dispersion and treatment.

Evergreen State Fairgrounds

This project consists of a variety of LID improvements at Snohomish County's Evergreen State Fairground site in Monroe. These improvements are intended to begin the process of reducing stormwater runoff and improving water quality by retrofitting an older developed site with pervious surfaces to promote infiltration. This project is also intended to provide an excellent opportunity for public education about stormwater runoff, water quality, and best management practices to control the quantity and quality of stormwater. The fairground is an ideal site since it is annually visited by over a million people, from not only Snohomish County but throughout the region.

Aside from education, the goal of this project is to reduce the quantity of stormwater runoff and improve the quality of the runoff. There are four general types of LID BMPs proposed for this site to address these issues, which include bioretention planter boxes, compost amended soils, porous pavement, and rain gardens.

Pet Waste Grant

This project was designed to reduce pollution from pet and small farm animal waste in the Snohomish Tributaries, North, Swamp, and Little Bear Creeks. The three major components of the project were pet waste reduction, technical assistance to kennels and commercial operations, and small farm outreach.

The County conducted research to determine the barriers to proper disposal and analyze how to motivate and support behavior changes in our area. Using the results of the research, the County developed pilot programs focusing on proper disposal of pet waste. As part of this

program the County identified animal care businesses and contacted owners to provide technical assistance in storing and disposing of waste to prevent runoff.

The County identified several landowners with livestock and the potential for water quality pollution. Streams previously accessed by livestock were fenced to prevent animal access and planting native shrubs and trees were planted in riparian areas. The County is continuing to monitor these sites.

Septic Grant

The County is currently working with the Snohomish County Health District to do the following:

1) compile and integrate the Health District's Onsite Sewage System (OSS) information for Snohomish County Surface Water Management (SWM) using SWM's Geographic Information System (GIS) to provide analytical capacity, identify issues and hot spots, target improvements, and monitor effectiveness,

2) to find and evaluate existing problems by targeting OSS hot spots in total maximum daily load (TMDL) watersheds, conducting systematic sanitary surveys to identify failing systems and, working with system owners to address repairs,

3) extend system life and function by working with system owners to target best management practices (BMPs) through technical assistance, operation and maintenance (O&M) training, and incentives (to be determined after marketing research; however, any financial incentive will not include pumping, full inspection, or repair or replacement of OSS). Hot spots are defined as locations in the TMDL watershed where primarily high counts of fecal coliform bacteria are found.

Drainage Re-development

The jurisdictional protection of aquatic resources in urban areas is primarily achieved through engineered stormwater management in combination with regulated critical areas and buffers, the "green infrastructure." Engineered stormwater detention, retention, and treatment facilities combined with collection and conveyance systems constitute the engineered protection of aquatic resources. Over time, our knowledge regarding engineered protection has increased and we now know that the earlier management strategies used in many urban areas are inadequate for habitat protection and water quantity and quality treatment of runoff . To address drainage and habitat needs in its Urban Growth Areas, Snohomish County completed a $12 million Drainage Needs Report (DNR) inventory of culvert, catch basin, and detention facilities, and identified over 350 projects. An outreach and education program aimed towards homeowner associations who may soon be responsible for maintaining their detention ponds is currently underway.

Green Infrastructure

Our green infrastructure is made up of scattered privately protected NGPA buffers between the resource and adjacent land use, and various public properties. In addition to other functions, these buffers are intended to filter runoff by slowing it down and running it through vegetation and organic "duff." Currently, these buffer areas are not actively managed, and thus they rarely reach their full functional potential. In some locations, stormwater discharges directly to streams or wetlands thereby circumventing the natural value of NGPA buffers. Management challenges exist because NGPAs have also not been mapped or assessed.

Snohomish County Surface Water Management Ambient Monitoring

Snohomish County's SWM has been collecting long term monthly ambient water quality data in creeks throughout the County in 1992. The goal of this monitoring program is to detect trends in fecal coliform bacteria, dissolved oxygen, temperature, nutrients, sediment, and metals. The long term ambient data is maintained in a database that is available for viewing on line at the following address:

www.data.surfacewater.info

Snohomish County's SWM maintains six monitoring sites in the south county area, 11 sites within the Snohomish tributaries and eight sites within the Stillaguamish watershed. Table 2 identifies the current long-term monthly ambient monitoring sites.

Table 2 Snohomish County Ambient Monitoring Sites

Watershed	Waterbody	Site Name	Location	Data Range
Lake Washington	North Creek	NCLU	McCollum Park	1992-Present
Lake Washington	North Creek	NCLD	County Line	1992-Present
Lake Washington	Swamp Creek	SCLU	148th St SW	1992-Present
Lake Washington	Swamp Creek	SCLD	County line	1992-Present
Lake Washington	Little Bear Creek	LBLU	51st St	1993-Present
Lake Washington	Little Bear Creek	LBLD	228th St.	1993-Present
Snohomish	Quilceda Creek	QCLD	88th St. NE	1992-Present
Snohomish	Allen Creek	ACLU	67th Ave NE and 112 St. NE	1998-Present
Snohomish	Allen Creek	ACLD	4th St in Marysville	1992-Present
Snohomish	Woods Creek	WCMF	Yeager Road	1993-2007
Snohomish	Woods Creek West Fork	WCWF	Yeager Road	1993-Present
Snohomish	Woods Creek	WCFA	Florence Acres Road	2008-Present
Snohomish	French Creek	FCLU	167th Ave	1993-Present
Snohomish	French Creek	FCLD	Old-Snohomish Monroe Hwy	1995-Present
Snohomish	Catherine Creek	CATH	12th St NE	1998-Present
Snohomish	Dubuque Creek	DUBQ	OK Mill Road	1998-Present
Snohomish	Little Pilchuck Creek	LPIL	12th St NE	1998-Present
Snohomish	Pilchuck River	PILR	6th ST in Snohomish	1998-Present
Stillaguamish	Church Creek	CCPK	Church Creek Park	1994-Present
Stillaguamish	Fish Creek	FISH	Near Mouth on 5th Ave	1994-Present
Stillaguamish	Pilchuck Creek	PILC	Near Mouth on 236th St NE	1994-Present
Stillaguamish	Portage Creek	PORU	43rd Ave NE	1994-Present
Stillaguamish	Portage Creek	PORL	212th St NE	1994-Present
Stillaguamish	Tributary No. 30	TR30	Silvana Terrace Rd	1994-Present
Stillaguamish	Stillaguamish	MSAR	Highway 9 Bridge	1994-Present
Stillaguamish	Stillaguamish	MSMD	Marine Dr.	1994-Present

Snohomish County Water Quality Complaint Investigation Program

SWM investigates water quality complaints and provides technical assistance and referrals for any pollution problem identified. Since the inception of the water quality complaint response program in 1995, over 1400 county-wide complaints have been logged into the database. Of the 533 water quality complaints received within the Lake Washington Drainages, 53 percent fall within Swamp Creek, 32 percent within North Creek, and the remaining 14 percent were within the Little Bear Creek sub-basin. Of these complaints, 19 percent have originated from construction sites, 13 percent are due to petroleum, 11 percent have dealt with sewage, while only 2 percent stem from manure.

Three hundred and eighty-six complaints have been received for all sub-basins within the Snohomish basin. Ninety three of those complaints are related to construction erosion with 22 of those found in the Pilchuck sub-basin. The second and third most received types of complaints are petroleum and either septic or sewage. Fifty two percent of the petroleum complaints fall within the Quilceda and the Pilchuck sub-basins, while the Pilchuck alone has harbored 25 percent of the sewage-related complaints. In total, Quilceda creek sub-basin has received the most complaints of any sub-basin with 68 complaints of varying types.

Illicit Discharge Elimination Program (IDDE)

SWM staff has conducted dry weather outfall screening during the spring and summer months since 1998. The goal is to detect and trace illicit discharges of polluted water, entering the County drainage system. Ammonia and dissolved oxygen were outside the range of acceptable limits in 50 percent or more of the samples. SWM defined source tracking limits were exceeded for conductivity, nitrates, fecal coliforms, and MBAS in at least 7 percent of the samples.

Department of Ecology Studies

The primary resource on stormwater BMPs in Western Washington is the 2005 Stormwater Management Manual for Western Washington (Department of Ecology 2005), specifically Volume V-Runoff Treatment BMPs. Beyond providing design criteria for the treatment BMPs the reference section identifies additional local studies conducted by the Department of Ecology, universities, counties, cities, and independent researchers and manufacturers.

Regulatory Criteria or Standards

The Washington State Water Quality Standards, set forth in the Washington Administrative Code (WAC) 173-201A amended December 21, 2006, include designated uses, water body classifications, and numeric and narrative water quality criteria for surface waters of the state. Numeric criteria for specific water quality parameters are intended to protect designated uses.

North Creek is not specifically identified in WAC 173-201A-602, but falls under the broader classification in Section 600. Section 600 states that surface waters not identified in Section 602 are protected for the following uses:

- Salmonid spawning, rearing and migration
- Primary contact recreation
- Domestic, industrial, and agricultural water supply
- Stock watering
- Wildlife habitat
- Harvesting
- Commerce and navigation

- Boating
- Aesthetic values

Table 3 identifies the State of Washington's water quality standards for North Creek under WAC 173-201A.

Table 3 State of Washington's Water Quality Standards

Parameter	**Value**
Temperature (7-day average of daily max. temp	17.5° C/63.5° F
Dissolved Oxygen (Lowest 1-day minimum)	6.5 mg/L
Turbidity (Should not exceed)	5 NTU over background when background is 50 NTU or less, or A 10 percent increase in turbidity when the background turbidity is more than 50 NTUs
pH	pH shall be within the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.2 units
Fecal Coliform	Organism levels cannot exceed a geometric mean value of 100 colonies/100mL, with not more than 10 percent of all samples obtained for calculating the geometric mean exceeding 200 colonies/100mL

Project Description

Introduction

There are two parts to this project; the first is monitoring stormwater treatment BMPs in accordance with S8.F2, 3, and 4, the second is monitoring a hydrologic management BMP as specified in S8.F7. The stormwater treatment BMP monitoring is based predominantly on changes in water quality as stormwater is treated by the BMP and will involve the collection of stormwater samples for analysis. Monitoring the hydrologic management BMP is focused on monitoring the flow entering and leaving the BMP to determine how much infiltration occurs.

<u>Stormwater Treatment BMP Monitoring</u>

The goal of this study is:

> To identify what percentage of the 2-year, 24-hour storm retained in a modified wetpond is most effective at removing pollutants from typical stormwater.

The objectives are:

- To monitor the inflow and outflow of four modified wetponds to determine the mean effluent concentrations and mean percent removals with a 90-95 percent confidence and a 75-80 percent power.

- To collect sufficient quality and quantity of samples to obtain a 90-95 percent confidence and a 75 percent power for the total suspended solids data.

The modified wetponds identified are long term detention time BMPs because they capture and release stormwater at a designed rate. As a result, it may take the pond several days or longer to drain to the dead storage level. To better characterize the discharge from these modified wetponds, Snohomish County will be using the Department of Ecology's modified Technology Assessment Protocol-Ecology (TAPE) to evaluate stormwater treatment technologies with long term detention times. This methodology calls for a stratified-random approach rather than a storm based approach to sampling stormwater discharged to and from modified wetponds.

Using this approach Snohomish County will select, prior to the sampling period, random days to collect stormwater samples at the pond inlet and outlet. The sampling strategy is not paired, therefore the inflow and outflow samples are not related, so the random days selected for the inflow and outflow will be chosen separately using the same calendar to be truly randomized. As a result, sampling of the inflow and outflow pipes will occasionally occur on the same date. An automated stormwater sampler will be used in conjunction with an area velocity flow meter to collect the samples. More detailed information regarding these two units is provided in Appendix B. The flow meter will continuously collect flow data from the site, but the stormwater sampler will not collect samples from the sampling point until it's previously identified sampling day. Prior to the randomly selected day the sampler will be programmed to collect samples during the scheduled 24-hour period. If stormwater flow is present a sample will be taken, if not, the sampler will shut off and wait until its next scheduled sampling day. Flow-weighted composite samples will be collected.

Accumulated sediment will also be sampled at each site annually or until the stormwater sampling meets the statistical requirements and/or the BMP sampling program is completed. A

number of analyses will be conducted on the sediments to determine which sediments are being trapped by the BMP and which are being discharged and the types of pollutants attached to those sediments.

Information pertinent to fulfilling the "National Stormwater BMP Database Requirements" will be collected and the data will be submitted to the Department of Ecology for review. The Department of Ecology will utilize this data to update the Stormwater Management Manual for Western Washington.

Hydrologic Management BMP

Snohomish County currently addresses flow attenuation in County Code Chapter 30.63A, but does not address flow reduction through infiltration methods. The County has been designing and implementing flow reduction BMPs as part of its Integrated Stormwater Treatment Centennial Grant. This study will monitor site developed under this grant and located at North Creek Park Division 1, discussed previously. This site provides the best opportunity to monitor flow reduction throughout the BMP.

The question asked by this study is:

> Is a measurable reduction in stormwater occurring in modified drainage structures designed to infiltrate stormwater?

The goal of this study is:

> To monitor the inflow and outflow of one modified drainage structure to determine if a reduction of stormwater volume is occurring in this type of BMP due to designed retrofits that encourage infiltration.

Continuous flow meters will be installed upstream of the project site with the flow meter probe set in the BMP's inlet pipe. The flow meter will be kept in a steel box anchored to the ground next to the pipe. A second continuous flow meter will be installed downstream of the BMP in a catch basin. The probe of the flow meter will be installed in the outlet pipe from the BMP as it discharges to the catch basin. The monitoring sites are represented in the figure in Appendix A. Both flow meters will be programmed to collect 15 minute continuous flow. Data will be downloaded from the flow meter on a monthly basis or as needed.

The data will be used to calculate a mass water balance to identify the effectiveness of the BMP in this environment.

Information and Data Needs

Snohomish County's 2009 budget will not be finalized until November 2008. Therefore, a detailed budget for the sampling program is not provided in the QAPP. Additionally, a consultant to assist in setting up and implementing the program will not be selected until the summer of 2008.

Organization and Schedule

Project Team

The project team is composed of several Snohomish County SWM employees who will sample, manage the project and oversee the quality control process. AmTest Inc. is currently under contract with Snohomish County SWM to provide laboratory services. Additional detail is provided in Table 4.

Table 4 Project Tasks, Staff, and Responsibilities

Name	Organization	Phone Number	Responsibility
John Herrmann	Snohomish County SWM	425-388-3464 ext. 4584	Project Management
Steve Britsch	Snohomish County SWM	425-388-3464 ext. 4668	Project Review
SWM Water Quality Analyst	Snohomish County SWM	425-388-3464	Field Staff
SWM Water Quality Analyst	Snohomish County SWM	425-388-3464	Field Staff
Dennis Higgins	King County GIS Center	206-263-4523	Project Manager for database development
Aaron Young	AmTest, Inc	425-885-1664	Laboratory Services
John Coddington	Anatek Labs, Inc.	208-883-2839	Subcontractor for AmTest, Inc
Rachel McCrea	Department of Ecology	(425) 649-7223	Regional Permit Coordinator

Schedule

Currently Snohomish County dose not have existing data to identify the number of samples needed to meet the statistical requirements, as specified by the methods in Appendix J of the Long Term Detention TAPE Protocol (Ecology 2007). As a result the guidance presented in Appendix D of the standard TAPE Protocol (Ecology 2008) will be used to identify the number of samples for the first year of sampling. This guidance states:

> *In all cases, at least 12 sample events are required in order to be reasonably certain of the actual coefficient of variation (COV) and to be able to calculate good statistical relevance values."*

To provide additional confidence Snohomish County will target collecting 15 storm events at each site.

The Lakemont Stormwater Treatment Facility Monitoring Program Final Report (City of Bellevue 1999) developed a rainfall probability to identify how many targeted sampling days would be required to collect the required number of storm events. Snohomish County used this document as a guide to scheduling sampling days.

Rainfall data collected at the Silver Lake rain gauge (Figure 1) from 1996 to 2006 was analyzed and found that on average there are approximately 184 days of rainfall annually. Using the minimum rainfall depth criteria of 0.10-inches, identified in S8.D of the stormwater permit, the average number of rainfall events annually with 0.10–inches or greater of rainfall is narrowed

down to 107 days. There is approximately a 28 percent chance that on any given day a rainfall of 0.10-inches or greater will occur. The rainfall criteria of 0.10-inches was used for the 2009 sampling period, but will increase to 0.15-inches for 2010 to meet the requirements outlined in the TAPE.

Snohomish County will not be sampling on weekends, holidays or Fridays because of field staff and laboratory availability. This reduces the average number of days with rainfall greater than or equal to 0.10-inches to approximately 60 days, which equates to a 16 percent chance on any given day of having a rainfall event greater or less than 0.10 inches.

The County has scheduled 93 days of inflow sampling and 93 days of outflow sampling to statistically allow for the county to collect 15 samples annually (15 samples/16 percent =93 days). The 93 required days for inflow and outflow sampling were entered into Excel and randomized against the 2009 calendar to identify a schedule of sampling days. As a result 139 days of scheduled sampling have been scheduled with 47 days where both the inflow and the outflow are sampled concurrently. A copy of the sampling schedule for February 2009 to February 2010 is presented in Appendix C. If upon reviewing the data the County determines 15 samples will not meet the statistical requirements then the number of scheduled sampling days will be reviewed and modified as necessary. Changes to the schedule or the addition of additional sampling years will be provided once that decision is made.

To determine the 2010-2011 sampling schedule Snohomish County will utilize the data collected during the 2009-2010 season and follow the protocols set out in Appendix J of the Draft Technology Assessment Protocol—Ecology (TAPE), Evaluating Stormwater Treatment technologies with Long Detention Times (2007). An updated schedule will be provided as an addendum to this QAPP, as necessary.

Flow reductions for the hydrologic treatment BMP identified in permit requirement S8.F.7 will be monitored continuously with at least monthly downloads.

An overall project schedule for 2008-2010 is also presented in Appendix C.

Budget and Funding

Snohomish County's 2008 budget will not be finalized until November 2007, and its 2009 budget will not be finalized until November 2008. Therefore, a detailed budget for the sampling program will not be provided in the QAPP. An estimated cost of implementing this program is provided in Table 5.

Table 5 Project Budget

Task	**Estimated Budget**
Project Setup	$97,000
Equipment Purchase	$128,600
Sampling (1 year 30 sample sets)	$221,000
Laboratory Costs	$18,600
Total	**$465,200**

Data Quality Objectives

The data quality objective for stormwater treatment monitoring identified in the permit under section S.8.F.4 states:

> *The statistical goal is to determine mean effluent concentrations and mean percent removals for each BMP type with 90-95 percent confidence and 75-80 percent power.*

The quality of data collected for a project can be affected by a number of factors. To ensure that the project objectives are met, the quality of the data collected will be measured at each stage of data collection and analysis. Data quality will be assessed by determining the precision and accuracy of the data (Table 6 and Table 7)

Bias

Definition: The difference between the population mean and the true value.

Example: The bias and precision associated with data collection can directly affect the level of uncertainty in parameter estimates. Bias and precision (collectively known as accuracy) are two principal attributes, or characteristics, of data quality in environmental studies. Bias represents systematic error (i.e., persistent distortion that causes constant errors in a particular direction), while precision represents random error (i.e., error among repeated measures of the same property under identical conditions, but not systematically in the same direction. Estimates of measurement bias and precision and associated minimum detection limits or quantization limits are used to determine how well a measurement method performs for a specific range of concentrations. One method for measuring bias can be done by assessing matrix spikes. This will only address the treatment BMP.

Precision

Precision is a measure of how close the computed value is to the same quantity measured several times. Precision will be evaluated using field and laboratory duplicate sample analysis. Field duplicate analyses will indicate the degree of imprecision due to the combined effects of heterogeneity of the stream, variation in sample collection methods, and imprecision of analytical methods. Laboratory duplicate analyses will indicate the degree of imprecision due to the combined effects of sample splitting in the laboratory, and imprecision of analytical methods. Measurement precision will be determined by calculating the RPD expressed as a percent. In general, a precision of 20 percent (Table 6) for water samples and 35 percent (Table 7) for sediment samples is considered acceptable for this study. This will only address the treatment BMP.

$$\%RPD = \frac{(S - D)}{(S+D)/2} \times 100\%$$

Where:

%RPD = relative percent difference
S = Analytical result of sample of origin
D = Analytical result of the duplicate sample

Accuracy

Accuracy is the degree of agreement of a measurement result and a true value and is represented as the percent recovery of a spike.

Accuracy = % recovery of the MS/MSD samples

$$\%R \frac{Xs - Xo}{Cs} X\ 100\%$$

Where:

%R = percent recovery
Xs = spike sample result
Xo = original sample amount

The results of the water quality sampling and laboratory quality assurance and quality control samples will be reviewed. Results from the sampling and laboratory quality assurance and controls samples will be compared to the criteria in Table 6 and Table 7. Results that do not meet the measurement quality objectives will be noted. Appropriate qualifiers will be applied to any decision that relies on data that do not meet the measurement quality objectives. This will only address the treatment BMP.

Completeness

Completeness is the measure of the amount of valid data needed to be obtained from a measurement. The targeted completeness goal will be 90 percent. This target will be held for both the treatment BMP monitoring as well as the hydrologic BMP monitoring.

Table 6 Stormwater Measurement Quality Objectives

Parameter	Units	Accuracy (percent)	Precision (%RPD)	Required Reporting Limit	Analytical Methods
Field Constituents (Water Samples					
pH	Units	±0.2 units	NA	0.2	N/A
Lab Constituents (Water Samples)					
Fecal Coliform Bacteria	Colonies/ 100mL	NA	NA	2min, 2e6 max	SM9221E†
Total Suspended Solids	mg/L	NA	NA	1.0 mg/L	SM2540B†
Particle Size Distribution	ml/L	NA	NA	NA	Coulter Counter, Laser Diffraction†
Total Phosphorus	mg P/L	68-130	29	0.01 mg P/L	SM4500PE†
Ortho-phosphorus	mg P/L	75-130	29	0.01 mg P/L	SM 4500PE†
Hardness as $CaCO_3$	mg/L	NA See Ca&Mg	NA See Ca&Mg	1.0 mg/L	EPA 200.7†
Total Recoverable Copper	µg/L	70-130	20	0.1 µg/L	EPA 200.8‡
Dissolved Copper	ug/L	70%-130	20	0.1 ug/l	EPA 200.8 ‡
Total Recoverable Zinc	µg/L	70-130	20	5.0 µg/L	EPA 200.8‡
Dissolved Zinc	ug/L	70%-130	20	1.0 ug/l	EPA 200.8 ‡

† Amtest Accredited
‡ Anatek Accredited

Table 7 Sediment Measurement Quality Objectives

Parameter	Units	Accuracy (percent)	Precision (%RPD)	Required Reporting Limit	Analytical Methods
Percent Total Solids	Mg/L	NA	NA	NA	SM2540B†
Grain Size	Mm	NA	NA	NA	ASTM D422 †
Total Volatile Solids	%	70-130	35	0.1%	EPE160.4 †
NWTPH-Dx	mg/kg	NA	NA	25.0-100.0 mg/kg	Ecology 1997 (Pub No. 97-602) †
Total Phosphorous	mg P/L	65-135	35	0.01 mg P/L	SM4500PE†
Total Recoverable Copper	mg/kg	70-130	20	0.1 mg/kg	EPA 200.8‡
Total Recoverable Zinc	mg/kg	70-130	20	5.0 mg/kg	EPA 200.8‡
Total Recoverable Lead	mg/kg	70-130	20	0.1 mg/kg	EPA 200.8‡
Total Recoverable Cadmium	mg/kg	70-130	20	0.1 mg/kg	EPA 200.8‡

Target Population

The target population for the stormwater treatment BMPs is the stormwater, sediment, and their associated contaminants entering and leaving the stormwater treatment BMP. This population will be targeted using a randomized sampling scheme previously discussed in this QAPP.

The target population for the hydrologic treatment BMP is the stormwater entering and leaving the treatment BMP.

Study Boundaries

The study boundary is defined by the subdivision and drainage boundaries of the five selected sites:

- Snohomish Cascade Sector 3
- Emerald Meadows
- Center Road Pond
- Gibson Road Pond
- North Creek Park Division 1

Sampling Process Design

Stormwater Treatment BMPs

The inflow and outflow pipes at four different locations were selected for monitoring and approved by the Department of Ecology. Of the four modified wetpond sites selected three basins have land uses that typically represent higher density residential developments and one site has a land use consistent with lower density developments in Snohomish County. These sites should have stormwater concentrations consistent with values reported by the National Urban Runoff Program (NURP) and the National Stormwater Quality Database (NSQD). The median values for residential land uses reported by these two datasets are presented in Table 8.

Table 8 Median Residential Stormwater Values

Parameter	NURP Median Residential	NSQD Median Residential
Total Suspended Solids (mg/L)	101	48
Total Phosphorus (mg P/L)	0.38	0.3
Copper (ug/L)	33	12
Zinc (ug/L)	135	73

(EPA 1983 and Pitt et al 2004)

Research has shown that the residential basins draining to the modified wetponds would have higher nutrient loads and TSS and likely lower metals. Since basic wetponds are reported to be more effective at reducing TSS and, our study question should be valid. The high density residential sites may show greater concentrations of metals, but since traditional basic wetponds are not typically designed for metals reduction this may not influence the study question. The added detention component to the wetpond, found in Snohomish County's BMPs may also change the function of the wetpond and may influence the answer to the study question.

<u>Location and Frequency</u>

The study sites are located in the following subdivisions located in Snohomish County:

- Snohomish Cascade Sector 3
- Emerald Meadows
- Center Road Pond
- Gibson Road Pond

A description and location of these sites were previously discussed in this QAPP. Additional details about each site are provided in Appendix A.

The frequency of data collection is based on the randomized sampling schedule discussed previously in this QAPP. The sampling schedule for the sampling year 2009-2010 is provided in Appendix C.

Parameters

The sample parameters were selected based on the NPDES Phase I permit requirement S8.F.5.a for water samples and S8.F.6 for sediment samples. These requirements state:

S8.F.5--The parameters to be monitored in whole water at each site include:

a. For basic, enhanced, or phosphorus treatment BMPs: total suspended solids, particle size distribution, pH, total and ortho-phosphorus, hardness, and total and dissolved copper and zinc.

S8.F.6—Parameters to be monitored in accumulated sediment at each test site for basic, enhanced, phosphorus treatment, or oil control BMPs include: percent total solids, grain size, total volatile solids, NWTPH-Dx, total phosphorus and total cadmium, copper, lead, and zinc.

pH will be measured in the field and the remainder of the parameters including hardness, TSS, particle size distribution, total and ortho-phosphorus, and total and dissolved copper and zinc, will be analyzed in the laboratory. Sediment samples will be analyzed in the laboratory.

Sampling Point Set-Up

Samplers will be locked inside a steel box, anchored to the ground. Conduit pipe will protect the flow meter cable and the intake hose between the sampler box and the outfall on the above ground installation. One automated sampler will be installed near the inlet pipe and another near the outlet pipe of the structure. Each sampler will collect water dischargeing from the respective inlet and outlet pipes.

A scissor ring will be installed inside the outlet pipe at the sampling location as a base to mount the flow meter sensor and the intake line. The flow meter cannot detect flow rates if the water depth is less than one-inch. To compensate for this and capture the beginning of the storm event a broad crested weir will be installed in the pipe to provide the needed water depth to capture the entire storm or low flow events.

Baseflow Conditions

At the time of this QAPP none of the sites appear to have base flow conditions. Continuous flow data will be collected at this site to quantify the volume of the baseflow discharge for both the wet and dry season. Twenty-four hour time weighted samples will be collected twice each season during the first year. Those samples will be analyzed for each of the permit required analytes. This data will be used to characterize the pollutant load of the baseflow.

Backflow Conditions

Back flow may occur in the inlet pipes of most of the ponds as the elevation of the water in the pond increases. To restrict contaminating the stormwater sample with backflow a flexible rubber check valve will be installed on the end of the outfall pipe downstream of the sampling point.

Monitoring

Automatic Flow Weighted Composite Sampling

A composite sampler with a peristaltic pump will be used in coordination with a flow meter to collect flow-weighted composite samples at each of the stormwater treatment BMP monitoring sites. Each of the modified wetpond sites are surrounded by a locked chain link fence. Four concrete footing blocks will be buried next to each sampling point and a steel lock box will be bolted to the concrete footing blocks. The sampler will be kept inside of the steel lock box for security purposes. The intake for the sampler will be mounted approximately one foot inside of the respective pipes along the invert of the pipe.

Flow weighted composite samples will be taken based on the randomized schedule located in Appendix C. At each scheduled day the samplers will be programmed to begin collecting flow weighted composite samples at 10:00 AM on the selected day and continue collecting samples for 24-hours. If flow is not present the samplers will remain in standby until flow is detected and a sample is taken, or until the 24-hour period has ended. Based on the guidance in the TAPE (Ecology 2007) approximately 10 aliquots will be taken, if flow is present. These aliquots will then be combined into one composite sample proportioned to the flow and delivered to the laboratory.

In-Situ Monitoring

A OAKTON ® Waterproof pHTestr ™ or similar device will be used to gather pH measurements during each sampling event. This device has an accuracy and resolution of 0.1 units.

Continuous Flow Monitoring

Each monitored site will be equipped with an area velocity flow module. The flow module attaches to the sampler and guides sample collection. The flow meter sensor will be installed approximately one foot inside the pipe invert. The flow meter will collect flow data at the sampling point for the duration of the sampling event at 15-minute intervals.

Rainfall Monitoring

An existing Snohomish County automatic rain gauge (Si) will be used to collect 15-minute rainfall at 0.01-inch increments. The flow meter is a High Sierra Electronics Model 2400 tipping bucket attached to a data logger. A map showing the location of the sampling points and the rain gauge is provided in Figure 1.

Sediment Sampling

Sediment will be collected at each sample site within the first year of the initiation of the monitoring program, and again at the end of the monitoring program. A clean double bagged scoop will be utilized for each sample site. The stainless steel scoop will be used to collect the sample and transfer it to clean glass bottles supplied by the laboratory.

The sediment sampling points are located immediately within the stormwater ponds and will be a composite sample collected throughout the cells of the pond. The initial pond may provide a significant amount of the sediment collected. The samples will attempt to be a representative of the pond and its sediment collection abilities. Effort will be given not to collect sediment that may represent the bottom of the pond.

Hydrologic Treatment BMPs

One sampling site was selected for monitoring the flow reduction strategy specified under permit requirement S8.F.7. It is expected that the designed BMP will reduce stormwater volume prior to reaching the outfall through infiltration. To predict the expected performance of the system the site will be modeled using the Western Washington Hydrologic Model (WWHM). In order to calibrate the model the seasonal high groundwater table will need to be identified in the vicinity of the BMP. The seasonal high groundwater level will be measured using a piezometer that will be installed on site.

Location and Frequency

The study site is limited to the southwest corner of the North Creek Park Division 1, which collects drainage from 4th Drive SE, 167th Street SE, and 4th Ave SE. A description of this site was previously discussed in this QAPP. Additional details are provided in Appendix A.

The flow will be logged on a 15-minute interval and seasonal high groundwater elevations will be checked every two weeks during the 2009 monitoring year and monthly thereafter.

Parameters

Stormwater flow will be the only parameter collected.

Sampling Point Set-Up

A scissor ring will be installed inside the pipe at the sampling location as a base to mount the flow meter sensor. The flow meter cannot detect flow rates if the water depth is less than one-inch. To compensate for this and capture the beginning of the storm event a broad crested weir will be installed in the pipe to provide the needed water depth to capture the entire storm or low flow events.

The piezometer will be installed in the vicinity of the BMP, but within the County right-of-way on the north end of 6th Ave (Appendix A). A hole will be bored into the soil to the depth of the hydrogeologic confining layer immediately below the BMP. The tip of the well point will be placed in this confining layer without breaking the confining layer and creating an artesian effect. If a confining layer is not present then the well point will be installed to a depth of no more than three feet below the bottom of the BMP.

Monitoring

Continuous Flow Monitoring

An area velocity flow meter will be used to monitor flow. The flow meter sensor will be installed approximately one foot inside the pipe invert in the catch basins immediately upstream and downstream of the site. The flow data will be collected at the sampling point during the entire sampling event. The will flow will be logged on a 15-minute interval.

The area in between the upstream and downstream catch basins contributes stormwater to the system, because it is an open drainage system. Flow will not be monitored because it drains via sheet flow. The flow volume for this reach will be calculated and compared against the results of the flow data.

Seasonal High Groundwater Monitoring

A rod with a line of water finding paste will be inserted into the top of the piezometer and lowered to the lowest point in the piezometer. The rod will gently be removed and measured from the point where the paste changes color to the bottom of the rod. This will indicate the depth of the seasonal high ground water. The seasonal high ground water level will be measured twice per month for the 2008-2009 water year and then monthly thereafter until the end of the program.

Rainfall Monitoring

The Silver Lake (Si) rain guage will be used for this site as well. A map showing the location of the sampling points and the rain gauge is provided in Figure 1.

Representativeness

The representativeness of the sample will be evaluated by reviewing the storm event and sampling event criteria to the requirements set out in this QAPP.

Completeness

Completeness is defined as the percentage of valid analytical determinations with respect to the total number of determinations. A reasonable completeness goal is 90 percent. Typical field problems such as sample container contamination or equipment failure may result in completeness of less than 100 percent. Another factor that may reduce completeness is the identification of nonstandard field conditions following data or sample collection. Completeness will be evaluated and documented throughout the project, and corrective action taken as warranted on a case-by-case basis.

Comparability

The methodology outlined in this QAPP is taken from the Department of Ecology's modified TAPE, which is based on the Lakemont Stormwater Treatment Facility Monitoring Program (Bellevue 1999). The Lakemont study states:

> *The only drawback of the statistical sampling approach is that it is not possible to evaluate facility performance during individual storms because pollutant removal efficiency is estimated for the entire monitoring period rather than for individual storm events. Similarly, the statistical approach does not permit the calculation of event mean pollution concentrations, which have commonly been used to evaluate other stormwater treatment systems, thus limiting the comparability to previous studies.*

This study will have the same issues with comparability as the Lakemont study. However, the data collected will still provide information pertinent to fulfilling the National Stormwater BMP Database Requirements, as specified in the permit requirement S8.F.4.

Sampling Procedures

Stormwater Treatment BMPs

Section S8.F.4 of Snohomish County's NPDES Phase I permit states:

> *Permittees must use appropriate sections of Ecology's guidance for "Evaluation of Emerging Stormwater Treatment Technologies" for preparing, implementing, and reporting on the results of the BMP evaluation program*
>
> *Permittees must use USEPA publication number 821-B-02-001, "Urban Stormwater BMP Performance Monitoring," as additional guidance for preparing the BMP evaluation monitoring, and must collect information pertinent to fulfilling the "National Stormwater BMP Database Requirements" in Section 3.4.3 of that document.*

Snohomish County's sampling protocol will follow these guidance documents, as well as the Department of Ecology's modified TAPE for evaluating stormwater treatment technologies for sites with long detention times.

Calibration

Automated Sampler

The auto sampler will be calibrated and maintained according to the manufacture's instructions.

As part of the calibration process the intake tubing and strainer will be inspected, cleaned or replaced as necessary. Calibration dates and results will be recorded in a log. The auto sampler battery will be checked when programming the sampler for an upcoming event.

Flow Meter

Flow meter calibration and checks for the flow meter will be conducted as specified by the manufacturer or when needed. The desiccant will be checked or replaced as necessary. Calibration dates and results will be recorded in a log.

In-Situ Measuring Device

The OAKTON ® Waterproof pHTestr ™ will be calibrated as per the manufacturer's specifications prior to beginning the sampling run. Calibration dates and results will be recorded in a log.

Sampling Setup and Retrieval

A composite sampler with a peristaltic pump will be used in coordination with a flow meter to collect flow-weighted composite samples at each of the monitoring sites. The following actions will be completed to initiate the sampler prior to the pre-scheduled sampling period:

- Check the battery, tubing, and functionality of the sampler
- Check sample line and strainer
- Remove sample bottle lids and load the bottles in the sampler
- Program the sampler to conduct a back purge and a intake tube purge prior to the collection of each aliquot.
- Program the sampler to begin sampling at the start time at the appropriate flow volume

- Input the flow volume per sampler for flow pacing.
- Secure sampler in lock box

To collect the flow weighted composite sample, flow pacing must be programmed into the flow meter and sampler to identify and collect a flow volume as a sample aliquot and continue collecting that volume through out the event. At least 10 aliquots will be attempted to be collected during the 24-hour sampling period.

Snohomish County will begin collecting rainfall and runoff data approximately six months prior to stormwater sampling. This data will be used to create a rainfall-runoff rating curve to predict the volume of water needed to collect 10 aliquots for each targeted storm event based on predicted rainfall amounts. On-line internet weather forecasts for rainfall depth will be used to identify the appropriate flow pacing for the storm event when programming the flow meter. If a storm is already in progress the percent of the remaining storm and flow volume will be estimated. This data will be plugged into the rainfall-runoff rating curve to identify the predicted runoff volume. Additionally, the following formula may be used (Caltrans 2003):

$$V_r\,(ac\text{-}ft) = QPF(in) * 1(ft) / 12(in) * A(ac) * C$$

$$V_r\,(cf) = V_r\,(ac\text{-}ft) * 43560(cf) / 1(ac\text{-}ft)$$

$$V_s\,(cf) = V_r\,(cf) / CSA$$

QPF = quantity of precipitation forecast
A = drainage area
C = runoff coefficient
V_r = total runoff volume for forecast storm (calculated)
CSA = number of composite sample aliquots required for complete composite
V_s = flow volume per sample

The samples will be collected in a single bottle at each site; therefore already represent a composite sample. The sample bottles will be capped with a clean lid prior to removing from the sampler to reduce contamination and spilling. Labels will be completed identifying the date, time, sample location, and attached to the bottles. The composite sample in the original glass sampling jar will be packed in a cooler with ice, as stated in 40 CFR Part 136, stored out of direct sunlight for transport and delivered to the lab, with a completed chain of custody (COC) form, for filtering, splitting, preservation and analysis. The laboratory will be required to filter the dissolved metals and orthophosphate samples immediately upon receipt. An example COC form is provided in Appendix E.

If the sample collection occurs during the laboratory's non-business hours or the laboratory is not able to receive, filter or process the samples, sampling staff will filter, split and preserve the sample as soon as possible. The dissolved metals and orthophosphate samples will be filtered immediately upon returning to the office. The samples will be placed in a refrigerator and the required hold temperature and delivered to the laboratory the morning of the next business day.

Bottle, preservative and hold time information is presented in Table 9

Table 9 Stormwater Sample Collection Requirments

Paramter	Sample Size	Container	Preservation	Holding Time
Field Constituents				
pH	NA	NA	NA	NA
Lab Constituents				
Particle Size Distribution	1000 mL	Plastic, Glass	NA	
Total Suspended Solids	250 mL	Plastic, Glass	4^0C	7 days
Total Phosphorus	250 mL	Plastic, Glass	4^0C/ H_2SO_4	28 days
Ortho-Phosphate	250 mL	Plastic	4^0C	48 hours
Hardness as $CaCO_3$	100 mL	Plastic, Glass	HNO_3	180 days
Dissolved Copper	250 mL	Plastic, Glass	HNO_3	6 months
Total Recoverable Copper	250 mL	Plastic, Glass	HNO_3	6 months
Dissolved Zinc	250 mL	Plastic, Glass	HNO_3	6 months
Total Recoverable Zinc	250 mL	Plastic, Glass	HNO_3	6 months

Flow meter

Approximately 6 months prior to the sampling period the flow data will be collected to construct a rainfall-runoff curve for the site. A scissor ring will be installed inside the pipe at the sampling location as a base to mount the flow meter sensor and the intake line. The flow meter cannot detect flow rates if the water depth is less than on-inch. To compensate for this and capture the beginning of the storm event a broad crested weir will be installed in the pipe to provide the needed water depth to capture the entire storm or low flow events. A product information sheet for the flow meter is provided in Appendix B.

The flow data during this period of the project will be downloaded approximately every two weeks to one month. The meter will be calibrated and maintained prior to leaving the site, as necessary and as recommended by the manufacturer.

During the sampling period, flow data will be downloaded from the flow meter following the collection of stormwater samples. Meter calibration and maintenance will be done prior to leaving the site, as necessary or as recommended by the manufacturer.

In Situ Monitoring

The pH of the stormwater will be measured using a OAKTON ® Waterproof pHTestr ™ or similar device during the first site visit of a qualifying event. If the depth of water at the sampling site is not deep enough for submersion of the instrument or unable to be tested directly, a bucket will be rinsed with the sample water 3 times, and the rinse water will be discarded downstream. On the fourth grab, the instrument will be submerged into the bucket containing the sample water.

Sediment Sampling

Sediment will be collected at each sample site within the first year of the initiation of the monitoring program, and again at the end of the monitoring program. A clean double bagged

scoop will be utilized for each sample site. The stainless steel scoop will be used to collect the sample and transfer it to clean glass bottles supplied by the laboratory. Personnel will be required to use powder free nitrile gloves during the sampling. To reduce the risk of contamination staff will not open sample bottles until the sample is prepared to be taken, touch the inside of the sample bottle or cap, and not store contaminated equipment in the same container as clean equipment or bottles. A clean scoop and gloves will be required for each site.

The sediment sampling points are located immediately within the stormwater ponds and will be a composite sample collected throughout the cells of the pond. The initial pond may provide a significant amount of the sediment collected. The samples will attempt to be a representative of the pond and its sediment collection abilities. Samples will not be taken so that sediment from the top to the bottom of the deposited layer is collected in any intended fashion. Effort will be given not to collect sediment that may represent the bottom of the pond. Once the sediment is placed in the sample bottle the bottle will be sealed; labeled with the date, time, site ID and crew; and placed in a cooler with ice and chilled to a temperature of 4°C. Exposure of the sample to sunlight will be kept at a minimum. The samples will be delivered to the lab. Bottle, preservative and hold time information is presented in Table 10.

Table 10 Sediment Sample Collection Requirements

Parameter	Sample Size	Container	Preservation	Holding Time
Lab Constituents				
Percent Total Solids	NA	Plastic, Glass	NA	NA
Grain Size	NA	Plastic, Glass	NA	NA
Total Volatile Solids	NA	Plastic, Glass	4^0C	NA
NWTPH-Dx	250 mL	Plastic, Glass	4^0C	14 days
Total phosphorus	250 mL	Plastic, Glass	4^0C	28 days
Total Recoverable Copper	250 mL	Plastic, Glass	4^0C	180 days
Total Recoverable Zinc	250 mL	Plastic, Glass	4^0C	180 days
Total Recoverable Lead	250 mL	Plastic, Glass	4^0C	180 days
Total Recoverable Cadmium	250 mL	Plastic, Glass	4^0C	180 days

Decontaminating Equipment

The sample bottles and lids, and the sediment scoops will need to be cleaned prior to the next use. The fouled materials will be brought back to the Snohomish County water lab and cleaned using the following process (Caltrans 2003):

1. Make up a 2% solution of disinfectant soap in warm tap water.
2. Rinse tubing three times with the solution, wash lids, strainers, and scoops with a plastic brush
3. Rinse three times with tap water.

4. Rinse three times with de-ionized water.
5. Rinse three times with a 2N nitric acid solution (80mLl conc. HNO_3 (16N) per gallon of de-ionized)
6. Rinse three times with de-ionized.
7. Seal the tubing on both ends with clean latex material
8. Individually double-bag tubing in new plastic bags properly labeled. Individually double-bag lids, strainers, and scoops in zip lock bags.

Sample containers will be supplied by the laboratory contracted to test the samples. The laboratory is responsible for generating an acceptable equipment blank or documentation to demonstrate that the containers are free from trace contamination before they are shipped to SWM.

The calibration, maintenance and decontamination checks and procedures will be conducted following a sampling event in preparation for the next event. All calibration, maintenance and decontamination activities performed will be documented and stored in the project field files.

Field Data Recording

Data from the flow meter and sampler will be downloaded using a field computer. Other field data will be collected in a database using a field computer. The database is currently under development and a beta version is expected to be completed by October 2009. Draft conceptual tables for the database, which show the data that will be collected in the field and in the office, are located in Appendix D. The data outlined in these tables is based on both sampling data and permit requirements.

Any additional information that could affect the sampling results will be recorded in a field notebook, as deemed necessary. Otherwise all data will be recorded in the database accessed by the field computer.

Photographs of the sample site will be taken at each site visit to record any visual indicators that would suggest the presence or absence of a water quality issue or a change in site conditions.

Sample Transport and Chain of Custody

While in the field, samples will be stored and transported in a cooler at the analytes specific temperature requirements as stated in 40 CFR, Part 136. A COC will be maintained on all samples transported to the office or laboratory using a form supplied by the laboratory. Each custodian will sign the form when relinquishing or accepting sample custody. Samples will be stored per analyte requirements in coolers under direct observation or in a locked vehicle. The project manager will maintain a file of COC forms. An example copy of a completed COC form is presented in Appendix E.

Hydrologic Treatment BMP

Section S8.F.7 of Snohomish County's NPDES Phase I permit states:

> *Each Permittee listed in S1.B. shall monitor the effectiveness of one flow reduction strategy that is in use or planned for installation in their jurisdiction.*
>
> *Monitoring of a flow reduction strategy shall include continuous rainfall and surface runoff monitoring. Flow reduction strategies shall be monitored through either a paired site study or against a predicted outcome.*

Snohomish County will monitor one flow reduction strategy, as previously discussed, using a paired monitoring approach.

Calibration

Flow meter

Flow meter calibration and checks for the flow meter will be conducted as specified by the manufacture or as needed. The desiccant will be checked or replaced as necessary. Calibration dates and results will be recorded in a log.

Installation

A scissor ring will be installed inside the pipe at the sampling location as a base to mount the flow meter sensor. The flow meter cannot detect flow rates if the water depth is less than on-inch. To compensate for this and capture the beginning of the storm event a broad crested weir will be installed in the pipe to provide the needed water depth to capture the entire storm or low flow events. A product information sheet for the flow meter is provided in Appendix B. The installation points are provided in Appendix A.

Sample Collection

Flow data will be collected by each of the flow meters, but no water quality samples will be taken at this site.

Field Data Recording

The flow meter will be downloaded using a field computer. Other field data will be collected in a database using a field computer as discussed previously.

Any additional information will be recorded in a field notebook.

Photographs of the sample site will be taken at each site visit to record any visual indicators that would suggest the presence or absence of a water quality issue or a change in site conditions.

Sample Transport and Chain of Custody

No water quality samples will be collected at the hydrologic BMP treatment site.

Measurement Procedures

The analytical laboratories used in this project to analyze surface water and sediment samples are accredited by Ecology for all parameters and analytical methods in the project. The analytical laboratory shall maintain Ecology's accreditation during the contract period with Snohomish County.

Surface Water Samples

Table **11** summarizes laboratory procedures for surface water samples for this project. Table 9 identifies the parameter, volume of sample required, the bottle type, the holding time and preservation for the surface water samples collected.

Table 11 Lab Procedures for Stormwater Samples

Water Samples

Analyte	No. of Samples	Required Reporting Limit	Analytical Method
Total Suspended Solids	120	1.0 mg/L	SM2540D†
Particle Size Distribution	120	NA	Coulter Counter, Laser diffraction, or comparable method†
Total Phosphorus	120	0.01 mg P/L	SM4500PE†
Ortho-Phosphorus	120	0.01 mg P/L	SM4500PE†
Hardness as $CaCO_3$	120	1.0 mg/L	EPA 200.7†
Total Recoverable Copper	120	0.1 µg/L	EPA 200.8 ‡
Dissolved Copper	120	0.1 µg/L	EPA 200.8 ‡
Total Recoverable Zinc	120	5.0 µg/L	EPA 200.8 ‡
Dissolved Zinc	120	0.1 µg/L	EPA 200.8 ‡

† Amtest Accredited
‡ Anatek Accredited

Sediment Samples

Table **12** summarizes laboratory procedures for surface water samples for this project. Table **10** identifies the parameter, volume of sample required, the bottle type, the holding time and preservation for the sediment samples collected.

Table 12 Lab Procedures for Sediment Samples

Analyte	No. of Samples	Expected Range of Results	Required Reporting Limit	Analytical Method
Percent Total Solids	8	Unknown	NA	SM 2540B†
Grain Size	8	Unknown	NA	ASTM -D422†
Total Volatile Solids	8	Unknown	0.1%	EPA 160.4 †
NWTPH-DX	8	Unknown	25.0-100.0 mg/kg	Ecology, 1997 (publication No. 97-602) †
Total Phosphorous	8	Unknown	0.01 mg P/L	SM4500PE†
Total Recoverable Copper	8	Unknown	0.1 mg/kg	EPA 200.8 †
Total Recoverable Lead	8	Unknown	5.0 mg/kg	EPA 200.8 †
Total Recoverable Zinc	8	Unknown	0.1 mg/kg	EPA 200.8 †
Total Recoverable Cadmium	8	Unknown	0.1 mg/kg	EPA 200.8 †

† Amtest Accredited
‡ Anatek Accredited

Quality Control

Field Duplicate Samples

A minimum of one field duplicate water sample will be collected for every ten storm events collected. The duplicate sample will be analyzed for each permit required analytes. The samples will be split off from the final composite sample collected at a site. The flow pacing will be adjusted when programming the sampler to obtain the appropriate volume. If a bottle change is required it will follow the procedures previously discussed. The duplicate sample site will rotate between the sample sites every tenth storm event. The samples will be labeled in such a manner that the laboratory will not know which sample site the duplicate was taken at.

One field duplicate sediment sample will be collected with each sampling period for one site, if enough sediment is available at the outfall the sample will be collected and split for QA/QC.

Equipment Blank

Equipment blanks on each of the auto samplers will involve drawing de-ionized water through the strainer and tubing into the composite sample bottles. The bottles will be capped placed on ice and delivered to the lab for analysis. Equipment blanks for the auto samplers will be taken immediately after the initial installation of the auto sampler, following the first sampling event, and annually there after.

Equipment blanks on the sampling scoop for the sediment analysis will be taken by pouring de-ionized water over a decontaminated scoop. The sample is capped, placed on ice and taken to the laboratory. Blanks on the sediment scoop will be taken annually.

Field Blank Samples

A minimum of one field blank water sample will be prepared for every ten field samples collected for each analytical parameter. The field blank sample will be prepared by filling an auto sampler bottle with de-ionized water, and then transferring that water to a composite sample bottle in the water quality lab. These data shall be used to evaluate the compound effects of imprecision plus bias.

Field sediment blanks will be conducted with each sampling period and will involve filling sample containers with “clean” sediment obtained from the laboratory. The blank prepared by emulating field sampling techniques.

Laboratory Duplicate Analyses

The laboratory shall be directed to randomly select one water sample from each batch of up to twenty samples, thoroughly mix and split this sample, and perform all required analyses on both samples. The laboratory shall use these data to determine internal quality control and take any corrective action required, and shall report all data to the County.

Method Blanks

Method blanks will be conducted by the laboratory for each batch of samples and the results reported with the sample results.

Performance Evaluation Samples

The laboratory shall report to the County the results of all external performance evaluation analyses for parameters in this project, including all evaluation samples submitted by the US Environmental Protection Agency or Ecology. These data shall be used to evaluate overall accuracy.

Corrective Action

The data collected above along with QAPP audits will assist in identifying deviations from the QAPP and issues with QA/QC during field sampling, laboratory analysis and the decontamination process. Issues with all three sectors of this program will be identified predominantly through the data verification process discussed later in this document. This process will identify faulty data and produce a report identifying the nature of the compromised data. The QA/QC process will review these reports and conduct corrective actions accordingly.

Field Procedures

Issues with the quality of sample collection or processing my sampling staff will be addressed by the project manager. The project manager may required a review of the QAPP, on-site process inspections and reviews, or provide additional training to staff. If the problem is determined to be a programmatic issue the methods outlined in the QAPP will be reviewed by the project manager and sampling staff to improve the process.

In the event a field measurement is not recorded or is missed entirely, the project manager will evaluate factors such as changing water levels, accessibility of the site, and the length of time since the last sampling when deciding the appropriate corrective action. Re-measuring a missed field measurement after the sampling round is complete will occur at the project manager's discretion.

Laboratory Procedures

The project manager will contact the analytical laboratory if any data or quality control information is not included in the laboratory data package. Laboratory quality issues will be documented by the project manager and reviewed with the laboratory manager or if identified by the laboratory manager shared with the project manager. The laboratory manager will be required to make corrective actions prior to the next sampling event.

Decontamination Procedures

Contamination issues will be addressed by the project manager. The project manager may require additional rinsate or equipment blanks, a review of the QAPP procedures, process inspections or reviews, or provide additional training to staff. If the problem is determined to be a programmatic issue the methods outline in the QAPP will be reviewed by the project manager and sampling staff to improve the process.

Data Management Procedures

Field Data

Field data including the date, time, field conditions, staff, and sampling status will be recorded in the project database using a field computer. Draft conceptual database tables are provided in Appendix D.

Flow, sample, and rainfall data will be downloaded from each piece of equipment using a field computer. Once this raw data has been manipulated it will be uploaded into the project database for data storage.

The database will be a web based database so that data entered in the field will automatically be saved on the County's server. The project manager, Table **4**, will conduct spot checks to ensure that the data is being entered in completely and accurately.

Laboratory Data

Data packages from a completed set of samples will be sent to SWM by the laboratory within 10 days of the sampling date. The data packages will be provided electronically via the laboratory's website and hard copies will be mailed to the project manager. Data reports from the analytical laboratory will be reviewed for completeness by the project manager. Potential errors and omissions will be reported to the responsible laboratory personnel. The analytical reports will be compared to the COC by the project manager or designee to ensure that all requested analyses have been performed. Errors or missing data will be reported to the responsible laboratory personnel immediately. Amended and corrected analytical reports will be attached to the report being corrected to ensure that only the corrected data are reported in the database and used in the data analysis. Acceptable laboratory reports will be stored in project notebooks. Laboratory results will be entered into a database and verified. Based on the distributions and statistical characteristics of the data, various statistical and probabilistic methods may be used to compare and analyze the data. The statistical methodologies and assumptions used in the assessment of water quality data will be discussed in the annual and final project reports.

An analytical laboratory data report will be reviewed for completeness by the project manager or designee. Each laboratory report will contain the following information:

- Laboratory ID
- Laboratory Name
- Project Name
- Action ID #
- Sample Analysis Type
- Date/Time Samples
- Date/Time Analyzed
- Hold Time
- Hold Time Units
- Receiving Temperature
- Parameter Name
- Results
- Units
- Method
- Detection Limit
- Analyst
- Qualifier
- QAQC result Type
- True Value
- Measured Value
- Units
- Sample + spike result
- RPD
- Percent Recoverable
- Limits

Data will be accepted without qualifiers if the analytical reports meet the quality assurance guidelines detailed in this QAPP. Before qualifiers are attached to any data, the project manager will make every effort to correct the data by reviewing the sample documentation, meeting with Snohomish County SWM staff, and contacting the analytical laboratory. Appropriate qualifiers will be attached to any data that do not meet the QAPP standards. All data will be reported, regardless of the qualifiers attached; however, the project manager may elect not to include qualified data in the water quality data analysis.

Audits and Reports

Audits

A technical systems audit will be conducted three months following the initiation of the monitoring program. The audit will review the staff conformance to the QAPP procedures. If project implementation is not in conformance to the QAPP, corrective procedures will be taken as soon as possible. If the audit identifies a deficiency or a required change in the QAPP, that change will be made and submitted to the Department of Ecology as soon as possible. The audit will be conducted by the project reviewer identified in .

Reports

Snohomish County will produce project reports according to its NPDES Phase I permit. The permit requires under S8.H:

1) *The stormwater monitoring report shall be submitted with the annual report each year, beginning in 2009 for independent monitoring and 2010 for collaborative monitoring. Each report shall include all monitoring data collected during the preceding period from October 1 through September 30. Each report shall also integrate data from earlier years into the analysis of results, as appropriate. Permittees that choose to participate in an integrated water quality monitoring program shall submit a single integrated monitoring report. Reports shall be submitted in both paper and electronic form and shall include:*
   c) *Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring Reporting*
      i) *A summary including the BMP type location, land use, drainage area size and hydrology for each site.*
      ii) *The status of implementing the monitoring program,*
      iii) *A comprehensive data and QA/QC report for each part of the monitoring program, with an explanation and discussion of the results of each monitoring project,*
      iv) *Performace data or flow reduction performance. Performance data for treatment BMPs shall be reported consistent with:*
         - *The guidelines in appropriate sections of Ecology's guidance for "Evaluation of Emerging Stormwater Treatment Technologies," and*
         - *USEPA publication number 821-B-02-00, "Urban Stormwater BMP Performance Monitoring," including information pertinent to fulfilling the "National Stormwater BMP Database Requirments" in section 3.4.3 of that document.*

Data Verification

Data verification will be conducted by reviewing the field data inputs, the completed COC, and laboratory reports. Additional information including bench sheets, laboratory certifications, and laboratory process documentation may be reviewed if poor data quality trends or significant problems are identified. The data verification process will be conducted by the project manager. The data verification procedures will use the flow chart modified from Caltrans (2003) presented in Appendix F as a guide.

Any changes to the results as originally reported by the laboratory should either be accompanied by a note of explanation from the data verifier or the laboratory, or reflected in a revised laboratory data report.

Data verification records include certification statements that certify the data have been verified and signed by appropriate personnel. Data verification records can also include a narrative that identifies technical non-compliance issues or shortcomings of the data produced during the field or laboratory activities.

Data Validation (Usability) Assessment

Data validation and usability assessments will be conducted bi-annually following the conclusion of each wet and dry season. A data validation report will be completed documenting the process and results. This report will be filed in the project files. The data verification process will be conducted by the consultant identified in Table 4.

Preliminary Data Review

Initial data validation or usability assessments will focus on reviewing the data verification records, laboratory reports, field reports and COCs. This review will look at qualified or flagged data previously identified and evaluate its impact to the overall data quality objectives. If the data does not meet the statistical data review criteria, then the data point will be removed from the overall dataset. The preliminary review may incorporate statistical review methods described later in this section. Data issues that may threaten the usability of the data may include: apparent anomalies in recorded data, missing values, deviations from standard operating procedures, and the use of nonstandard data collection methodologies (EPA 2000).

Statistical Data Review

A statistical data review will be conducted to identify outliers and other abnormalities in the data. Statistical analysis will calculate the mean, median, mode, sample range, sample variance, standard deviation and the coefficient of variation. A list of statistical equation is provided in Figure 2. Outliers or data that is anomalous with the entire data set will be reviewed for the origin of the error in data collection, laboratory analysis, data input and recording, QA/QC, and data verification. If the data is unable to conform, does note meet the data quality objectives or it is uncertain if the data is able to conform with the project data set and goals then the data will be removed.

Figure 2 Statistical Equations

Box 2-4: Directions for Calculating the Measures of Dispersion

Let $X_1, X_2, \ldots, X_n$ represent the n data points.

Sample Range: The sample range (R) is the difference between the largest value and the smallest value of the sample, i.e., R = maximum - minimum.

Sample Variance: To compute the sample variance (s^2), compute:

$$s^2 = \frac{\sum_{i=1}^{n} X_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} X_i\right)^2}{n-1}$$

Sample Standard Deviation: The sample standard deviation (s) is the square root of the sample variance, i.e.,

$$s = \sqrt{s^2}$$

Coefficient of Variation: The coefficient of variation (CV) is the standard deviation divided by the sample mean (Section 2.2.2), i.e., CV = s/ $\bar{X}$. The CV is often expressed as a percentage.

Interquartile Range: Use the directions in Section 2.2.1 to compute the 25th and 75th percentiles of the data (y(25) and y(75) respectively). The interquartile range (IQR) is the difference between these values, i.e.,
IQR = y(75) - y(25).

EPA 2000

Graphical Review

The data will be plotted using a scatter plot to identify additional outliers or confirm outliers and abnormal data. Outlying data will be compared against the statistical and the preliminary data review to confirm that the point is an outlier or anomaly.

Non-Detects
Non-detected data will not be addressed through deletion or substitution, but will be statistically incorporated into the data set by using commercially available software. The method and software have not been identified as of the data of this QAPP.

Data Analysis
The automated stormwater sampler will collect the sample in a single bottle or multiple containers are used the sample will be composited prior to conducting the laboratory analysis. The result will therefore represent the Event Mean Concentration (EMC).

Statistical Goals
The efficiency calculator presented in the TAPE protocol will be used to calculate the statistical goal of this program. A copy of the TAPE guidance is provided in Appendix E.

References

California Department of Transportation (Caltrans). 2003. Caltrans Comprehensive Protocols Guidance Manual. Sacramento, CA. Publication No. CTSW-RT-03-105.51.42

City of Bellevue. 1999. Lakemont Stormwater Treatment Facility Monitoring Program—Final Report. Bellevue, WA

Department of Ecology (DOE). 1992. Stormwater Program Guidance Manual for Puget Sound. Lacey, WA.

Department of Ecology (DOE). 2001. Stormwater Management Manual for Western Washington.

Department of Ecology (DOE). 2003. Lower Snohomish River Tributaries Fecal Coliform Bacteria Total Maximum Daily Load Detailed Implementation Plan. Bellevue, WA. Publication No. 03-10-031.

Department of Ecology (DOE). 2003a. North Creek Fecal Coliform Bacteria Total Maximum Daily Load: Detailed Implementation Plan. Bellevue, WA. Publication No. 03-10-047.

Department of Ecology (DOE). 2005. Stormwater Management Manual for Western Washington. Publication Number: 05-10-33

Department of Ecology (DOE). 2007. Draft Guidance for Evaluating Emerging Stormwater Treatment Technologies-Technology Assessment Protocol—Ecology (TAPE)—Modification:Evaluating Stormwater Treatment Technologies with Long Detention Times.

Department of Ecology (DOE). 2008. Guidance for Evaluating Emerging Stormwater Treatment Technologies-Technology Assessment Protocol—Ecology (TAPE)

Interagency Catch Basin Insert Committee. 1995. Evaluation of Commercially Available Catch Basin Inserts for the Treatment of Stormwater Runoff from Developed Sites.

Leif, William. 1998. Sediment Removal in Catch Basins and Catch Basin Inserts. Snohomish County, WA.

Leif, William. 1999. Compost Stormwater Filter Evaluation Final Report. Snohomish County, WA.

Lombard, S.M., and Kirchmer, C.J. 2001. Guidelines for preparing quality assurance project plans for environmental studies: Washington Department of Ecology Publication No. 01-03-003, 37 pp. Olympia, WA.

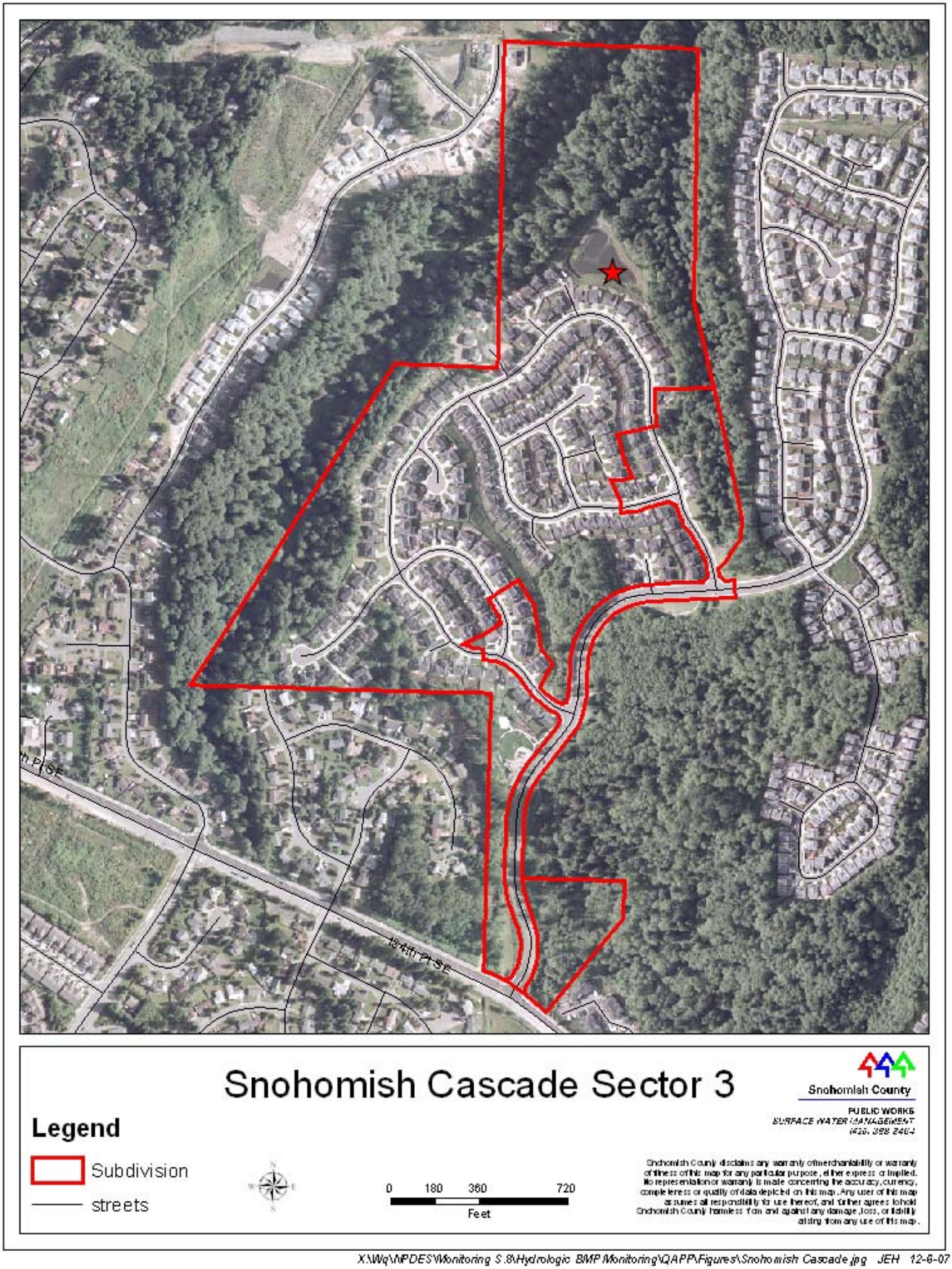
Snohomish County Surface Water Management (SWM). 2002. Drainage Needs Report. Everett, Wa.

Snohomish County Surface Water Management (SWM). 2003. Vegetation Monitoring Manual. Everett, WA.

Appendix A BMP Support Information

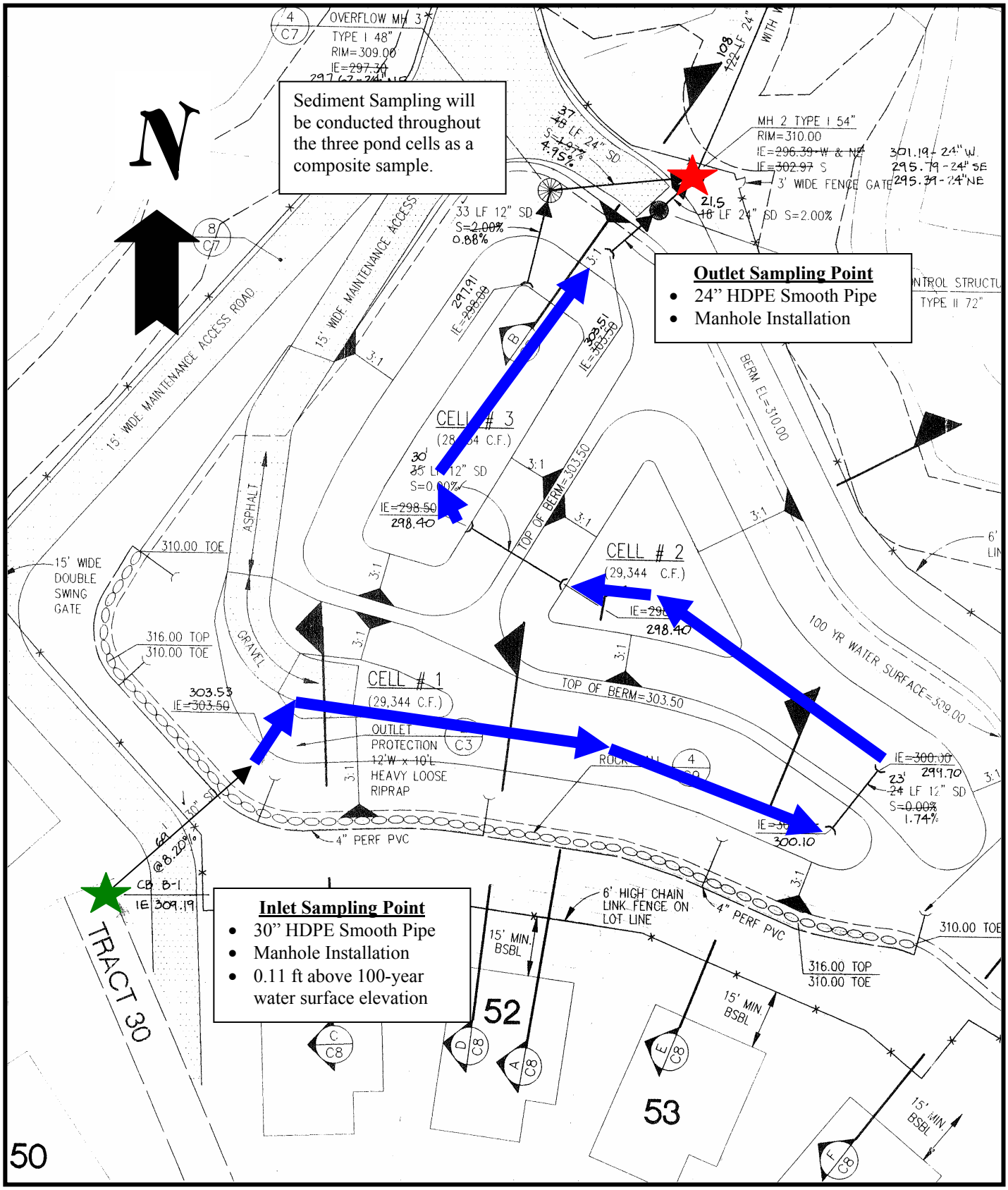
Snohomish Cascade Sector 3 Phase 1 and 2

Figure A-1 Study Area Drainage Map



X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\QAPP\Figures\Snohomish Cascade.jpg JEH 12-6-07

Figure A-2 Sampling Site Map



Water Flow through the System

Snohomish Cascade

1. **The percent impervious:**
   According to the Targeted Drainage Report, the project total area is 57 Acres. The project area is divided in two basins: Larimer South with 3.54 Acres and Larimer West with 53.4 Acres.

   The Targeted drainage report shows that the design engineer consider 2.48 acres of impervious surface from the Larimer South basin and 21.10 Acres of impervious from Larimer West draining to the pond. Thus, the total is 23.58 Acres of impervious surface; which equals to 41.4% of the 57 Acres (project total area). See Targeted Drainage Report: Basin Summary.

2. **Depth of pertinent rainfall events:**
   2-year, 24-hour rainfall depth: 1.70-inches
   Water Quality event: 1.22-inches

3. **Dead storage volume:**
   The pond was designed based on the 1992 stormwater manual. According to the manual guidance the volume of the required dead storage should be 124,059 cubic feet. The dead storage volume was recalculated using the as-built drawings and is 81,918 cubic feet. The constructed volume is approximately 66 percent of the required volume. This is a 42,141 cubic foot deficiency. The dead storage water surface elevation is 303.34 feet and the surface area is 24,776 square feet. The flat bottom area of the pond is 5,869 square feet.

4. **Dead Storage Cell function**
   The shape and flow of water through each of the cells is provided in Figure A-2. The total flow length though the cells is 484 feet. The bottom elevation of each of the three cells is 298 feet, which provides 5.34 feet water quality storage depth. The storage volume for each cell is:

   Cell 1: 23,434 cubic feet
   Cell 2: 29,388 cubic feet
   Cell 3: 29,096 cubic feet

5. **Bypass and overflow**
   No bypasses to this system exist upstream. A pond overflow does exist at the north end of cell 3. The overflow bypasses water from the control structure when the water elevation in the pond exceeds 309 feet, the 100-year water surface elevation.

6. **Sediment storage volume:**
   As-built plans do not show a forebay in the pond and no extra volume is provided in the cells for sediment accumulation.

7. **Plans and Drainage Calculations**
   Site plans and the detail drainage report were provided to the Department of Ecology (Ed O'Brien) on November 29, 2007.

8. **Groundwater**
   The as-built drawing shows the presence of a 20-mil HDPE pond liner in each cell to preclude groundwater intrusion. This liner extends throughout the pond and up to the 100-year water surface elevation. The retaining wall on the south end of the pond is drained by a 4-inch perforated PVC pipe. Visual observations at the site do not indicate substantial discharge of groundwater to the pond from this drainage system. Additionally, no other groundwater seeps were identified from adjacent land around the pond.

9. **Detention Emptying Time:**
   These numbers represent the emptying time for the detention component of the system and do not represent the dead storage area.

   Brim-full emptying time: 96 hours
   Half brim-full emptying time: 70 hours

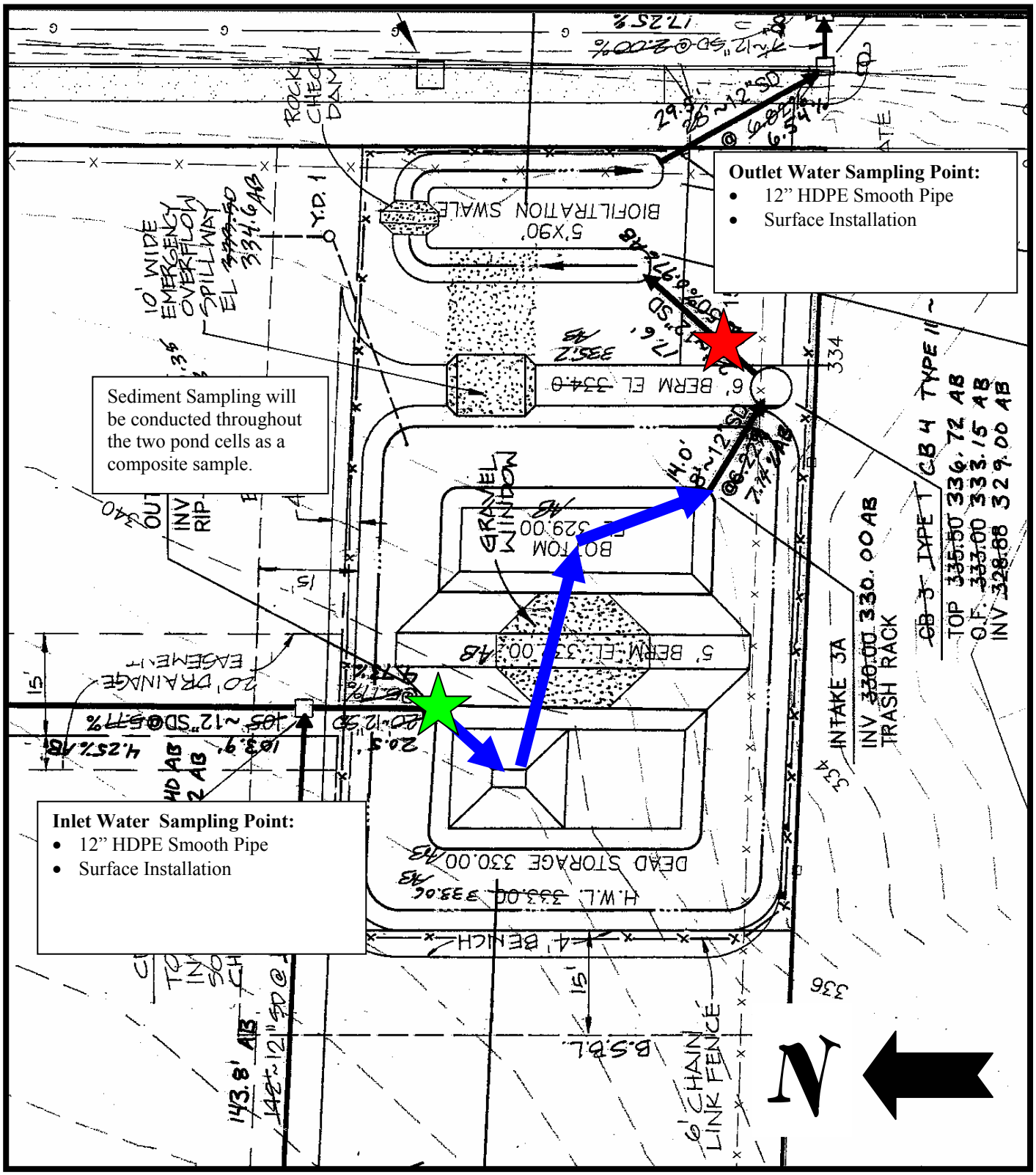
10. **Maintenance**
    The site will be inspected and maintained as necessary in spring/summer 2008.

Emerald Meadows

Figure A-3 Study Area Drainage Map

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\QAPP\Figures\Emerald Meadows.jpg JEH 12-6-07

Figure A-4 Sampling Site Map



Water Flow through the system

Emerald Meadows

1. **The percent impervious:**
   According to the Targeted Drainage Report, the project total area is 2.1 Acres. The Targeted drainage report shows that the design engineer consider 0.92 acres of impervious surface; which equals to 44% of the total area.

2. **Depth of pertinent rainfall events:**
   2-year, 24-hour rainfall depth: 1.55-inches
   Water Quality event: 1.12-inches

3. **Dead storage volume:**
   The pond was designed based on the 1992 stormwater manual. According to the manual guidance the volume of the required dead storage should be 4,269 cubic feet. The dead storage volume was recalculated using the as-built drawings and is 1,362 cubic feet. The constructed volume is approximately 32 percent of the required volume. This is a 2,907 cubic foot deficiency. The dead storage water surface elevation is 330.00 feet and the surface area is 1,440 square feet. The flat bottom area of the pond is 1,440 square feet.

4. **Dead Storage Cell function**
   The shape and flow of water through each of the cells is provided in Figure A-4. The total flow length though the cells is 52 feet. Specifics of each cell are provided below:

Cell	Bottom Elevation (Feet)	Dead Storage Elevation (Feet)	Storage Volume (cubic feet)
West Cell	326.60	330.00	708
East Cell	329.00	330.00	444

5. **Bypass and overflow**
   No bypasses to this system exist upstream. An emergency overflow spillway does exist at the east end of the east cell. The overflow bypasses water from the control structure when the water elevation in the pond exceeds 334.6 feet, the 100-year water surface elevation.

6. **Sediment storage volume:**
   Per a rough estimate from as-built plan the forebay volume is 210 cu-ft.

7. **Plans and Drainage Calculations**
   Site plans and the detail drainage report were provided to the Department of Ecology (Ed O'Brien) on November 29, 2007.

8. **Groundwater**
   The as-built drawing shows the presence of a 20-mil HDPE pond liner in each cell to preclude groundwater intrusion. This liner extends throughout the pond and up to the 100-year water surface elevation. No groundwater seeps were identified from adjacent land around the pond.

9. Detention Emptying Time:

These numbers represent the emptying time for the detention component of the system and do not represent the dead storage area.

Brim-full emptying time:	70 hours
Half brim-full emptying time:	45 hours

10. Maintenance

The site will be inspected and maintained as necessary in spring/summer 2008.

Center Road Pond

Figure A-5 Center Road Drainage Map

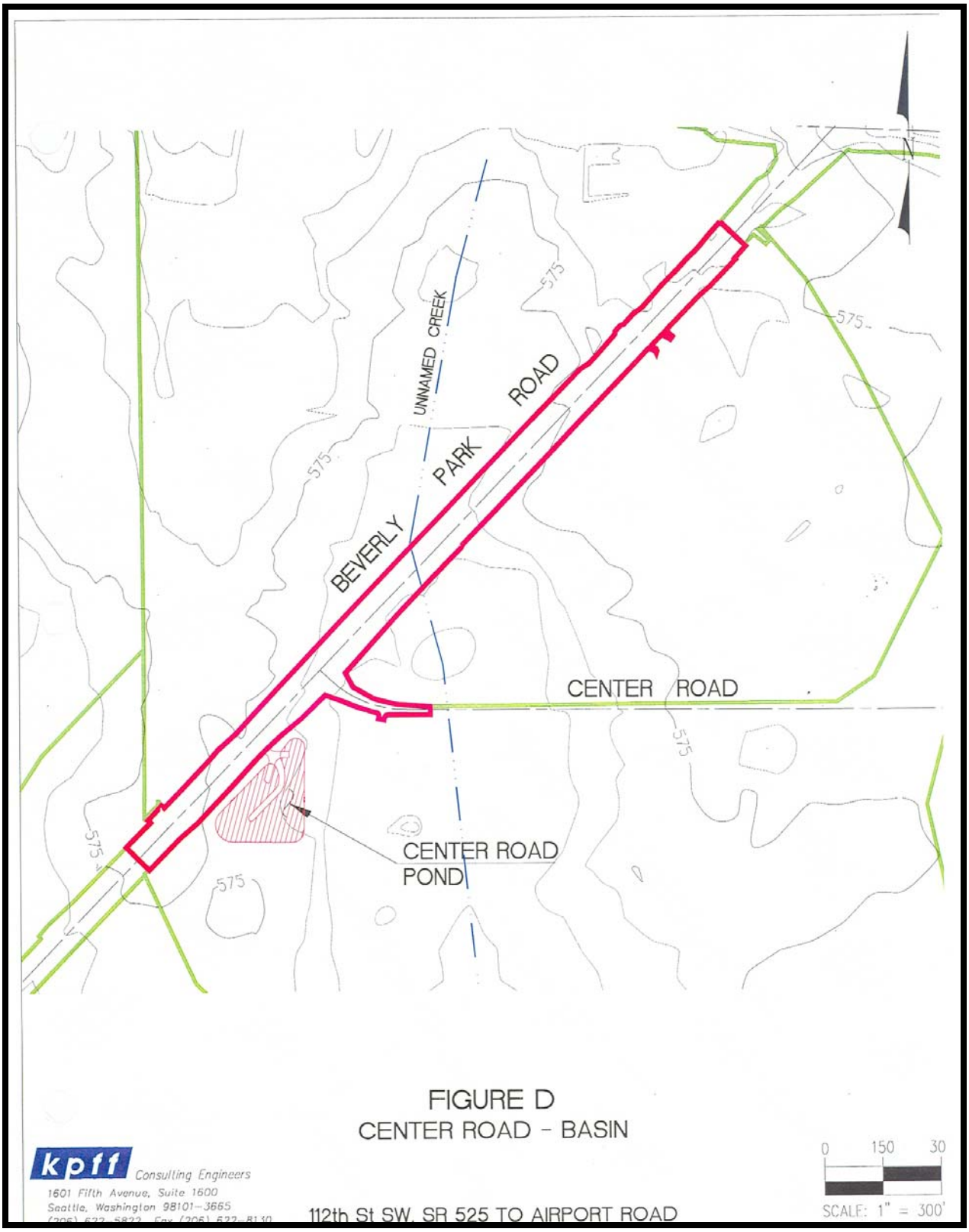
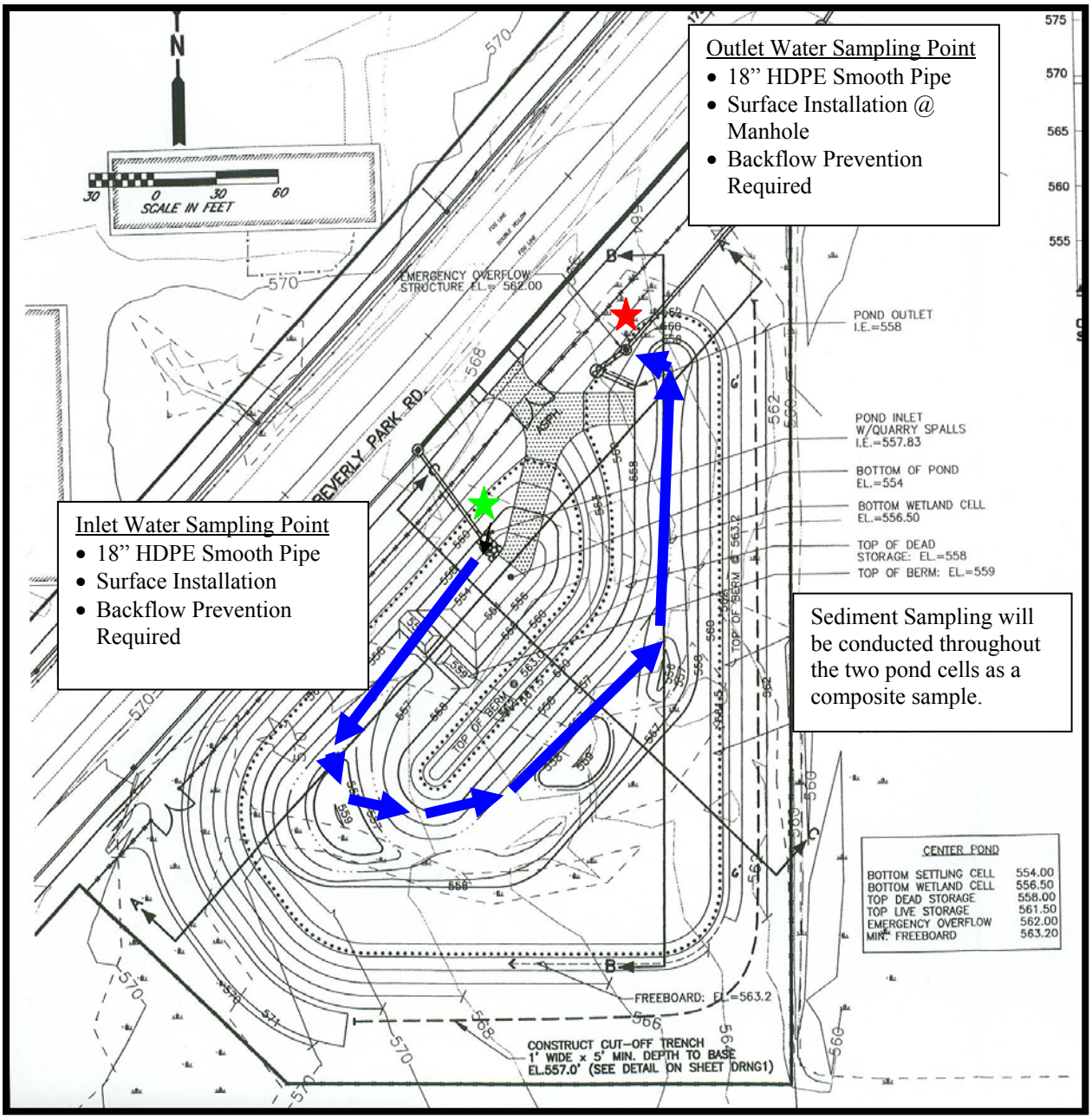


Figure A-6 Center Road Pond Sampling Site Map



Center Road Pond

1. **The percent impervious:**
   According to the Targeted Drainage Report, the project total area is 5.58 Acres. The Targeted drainage report shows that the design engineer consider 4.38 acres of impervious surface; which equals to 78% of the total area.

2. **Depth of pertinent rainfall events:**
   2-year, 24-hour rainfall depth: 1.50-inches
   Water Quality event: 1.08-inches

3. **Dead storage volume:**
   The pond was designed based on the 2001 stormwater manual. According to the manual guidance the volume of the required dead storage should be 20,702 cubic feet. The dead storage volume was recalculated using the as-built drawings and is 25,315 cubic feet. The constructed volume is approximately 4,613 cubic feet greater than required volume. The dead storage water surface elevation is 558.00 feet and the surface area is 20,085 square feet. The flat bottom area of the pond is 10,846 square feet.

4. **Dead Storage Cell function**
   The shape and flow of water through each of the sequential cells is provided in Figure A-6. The total flow length though the cells is 465 feet. Specifics of each cell are provided below:

Cell	Bottom Elevation (Feet)	Dead Storage Elevation (Feet)	Storage Volume (cubic feet)
Settling Cell	554.00	558.00	6,456.00
Wetland Cell	556.5	558.00	13,629

5. **Bypass and overflow**
   This system is an inline system and no bypasses to this system exist upstream. An emergency overflow spillway does exist at the north end of the pond. The overflow bypasses water from the control structure when the water elevation in the pond exceeds 562.00 feet, 0.50 feet above the 100-year water surface elevation.

6. **Sediment storage volume:**
   Per a rough estimate from as-built plan the settling cell is 6,456 cu-ft.

7. **Plans and Drainage Calculations**
   Site plans and the detail drainage report were provided to the Department of Ecology (Ed O'Brien) on May 30, 2008.

8. **Plants**
   The planting list for this project indicates that the following plants were installed:

Quantity	Common Name	Species	Size
250	Douglas spirea	Spiraea douglasii	1 gallon
150	Scouler's willow	Salix scouleriana	Live Stake
300	Sitka willow	Salix sitchensis	Live Stake

9. **Groundwater**
   A pond liner was not part of the design or construction of these structures because till material is present approximately 2 feet below the surface, which will exclude groundwater infiltration and ex-filtration. No groundwater seeps were identified from adjacent land around the pond. Flow meters installed at the inlet and outlet will identify if groundwater gains or losses are occurring.

10. **Traffic Volume:**
    Traffic count reports for Beverly Park Road and Gibson Road including count, peak hour, and volume can be found below.

11. **Detention Emptying Time:**
    These numbers represent the emptying time for the detention component of the system and do not represent the dead storage area.

    Brim-full emptying time: 32 days
    Half brim-full emptying time: 26 days

12. **Maintenance**
    The site will be inspected and maintained as necessary in spring/summer 2008.

Snohomish County Traffic Engineering
3000 Rockefeller Admin 5-W
Everett, WA 98201

Location : BEV PK RD NB SW/O GIBSON RD
Weather : 2 RAIN
Client : SIGNAL DON

Site: 91627-0.52
Date: 2/5/2008
Tuesday

Daily Volume, per Channel
Channel: NB

Interval Begin			Interval Begin		
12:00 AM	21	51	12:00 PM	159	560
12:15 AM	8		12:15 PM	155	
12:30 AM	13		12:30 PM	121	
12:45 AM	9		12:45 PM	125	
1:00 AM	9	31	1:00 PM	153	586
1:15 AM	11		1:15 PM	162	
1:30 AM	7		1:30 PM	143	
1:45 AM	4		1:45 PM	128	
2:00 AM	11	30	2:00 PM	159	627
2:15 AM	5		2:15 PM	135	
2:30 AM	9		2:30 PM	174	
2:45 AM	5		2:45 PM	159	
3:00 AM	6	40	3:00 PM	207	860
3:15 AM	9		3:15 PM	185	
3:30 AM	13		3:30 PM	243	
3:45 AM	12		3:45 PM	225	
4:00 AM	17	133	4:00 PM	218	893
4:15 AM	27		4:15 PM	213	
4:30 AM	41		4:30 PM	236	
4:45 AM	48		4:45 PM	226	
5:00 AM	74	401	5:00 PM	214	852
5:15 AM	89		5:15 PM	247	
5:30 AM	118		5:30 PM	195	
5:45 AM	120		5:45 PM	196	
6:00 AM	106	597	6:00 PM	161	638
6:15 AM	124		6:15 PM	191	
6:30 AM	154		6:30 PM	147	
6:45 AM	213		6:45 PM	139	
7:00 AM	191	713	7:00 PM	125	425
7:15 AM	185		7:15 PM	113	
7:30 AM	164		7:30 PM	103	
7:45 AM	173		7:45 PM	84	
8:00 AM	165	553	8:00 PM	72	271
8:15 AM	120		8:15 PM	72	
8:30 AM	107		8:30 PM	66	
8:45 AM	161		8:45 PM	61	
9:00 AM	96	395	9:00 PM	83	226
9:15 AM	101		9:15 PM	42	
9:30 AM	95		9:30 PM	58	
9:45 AM	103		9:45 PM	43	
10:00 AM	80	378	10:00 PM	38	158
10:15 AM	101		10:15 PM	44	
10:30 AM	94		10:30 PM	43	
10:45 AM	103		10:45 PM	33	
11:00 AM	121	488	11:00 PM	15	85
11:15 AM	117		11:15 PM	19	
11:30 AM	118		11:30 PM	31	
11:45 AM	132		11:45 PM	20	

	NB
24 Hour Volume	9991

	12:00 AM - 12:00 PM	**12:00 PM - 12:00 AM**
	NB	NB
Count	3810	6181
Peak Hour	6:45 AM	4:30 PM
Volume	753	923
Factor	0.88	0.93

File: S:\TES\TRAFFIC\Max\INCOMING\REG WORK STEVE\02050819.JDF

Snohomish County Traffic Engineering
3000 Rockefeller Admin 5-W
Everett, WA 98201

Location : BEV PK RD NB SW/O GIBSON RD
Weather : 2 RAIN
Client : SIGNAL DON

Site: 91627-0.52
Date: 2/6/2008
Wednesday

Daily Volume, per Channel
Channel: NB

Interval Begin			Interval Begin		
12:00 AM	24	62	12:00 PM	158	568
12:15 AM	12		12:15 PM	132	
12:30 AM	13		12:30 PM	152	
12:45 AM	13		12:45 PM	126	
1:00 AM	7	24	1:00 PM	140	631
1:15 AM	8		1:15 PM	170	
1:30 AM	4		1:30 PM	157	
1:45 AM	5		1:45 PM	164	
2:00 AM	7	22	2:00 PM	156	589
2:15 AM	3		2:15 PM	145	
2:30 AM	10		2:30 PM	144	
2:45 AM	2		2:45 PM	144	
3:00 AM	4	38	3:00 PM	195	807
3:15 AM	8		3:15 PM	181	
3:30 AM	17		3:30 PM	219	
3:45 AM	9		3:45 PM	212	
4:00 AM	14	126	4:00 PM	210	877
4:15 AM	28		4:15 PM	214	
4:30 AM	30		4:30 PM	244	
4:45 AM	54		4:45 PM	209	
5:00 AM	80	398	5:00 PM	227	895
5:15 AM	87		5:15 PM	219	
5:30 AM	105		5:30 PM	239	
5:45 AM	126		5:45 PM	210	
6:00 AM	114	601	6:00 PM	163	631
6:15 AM	149		6:15 PM	169	
6:30 AM	146		6:30 PM	178	
6:45 AM	192		6:45 PM	121	
7:00 AM	173	709	7:00 PM	128	405
7:15 AM	190		7:15 PM	109	
7:30 AM	173		7:30 PM	91	
7:45 AM	173		7:45 PM	77	
8:00 AM	123	501	8:00 PM	95	337
8:15 AM	137		8:15 PM	67	
8:30 AM	103		8:30 PM	89	
8:45 AM	138		8:45 PM	86	
9:00 AM	94	369	9:00 PM	84	248
9:15 AM	95		9:15 PM	61	
9:30 AM	94		9:30 PM	58	
9:45 AM	86		9:45 PM	45	
10:00 AM	100	399	10:00 PM	47	177
10:15 AM	96		10:15 PM	54	
10:30 AM	92		10:30 PM	37	
10:45 AM	111		10:45 PM	39	
11:00 AM	118	499	11:00 PM	30	114
11:15 AM	112		11:15 PM	29	
11:30 AM	134		11:30 PM	33	
11:45 AM	135		11:45 PM	22	

	NB
24 Hour Volume	10027

	12:00 AM - 12:00 PM NB	**12:00 PM - 12:00 AM** NB
Count	3748	6279
Peak Hour	6:45 AM	4:30 PM
Volume	728	899
Factor	0.95	0.92

File: S:\TES\TRAFFIC\Max\INCOMING\REG WORK STEVE\02050819.JDF

Page 2

Snohomish County Traffic Engineering
3000 Rockefeller Admin 5-W
Everett, WA 98201

Location : BEV PK RD SB SW/O GIBSON RD
Weather : 2 RAIN
Client : SIGNAL DON

Site: 91627-0.52
Date: 2/5/2008
Tuesday

24 Hour Volume, per Channel
Channel: S/B

Interval Begin			Interval Begin		
12:00 AM	12	41	12:00 PM	110	420
12:15 AM	8		12:15 PM	99	
12:30 AM	10		12:30 PM	109	
12:45 AM	11		12:45 PM	102	
1:00 AM	12	33	1:00 PM	114	449
1:15 AM	12		1:15 PM	104	
1:30 AM	3		1:30 PM	109	
1:45 AM	6		1:45 PM	122	
2:00 AM	13	49	2:00 PM	140	608
2:15 AM	13		2:15 PM	145	
2:30 AM	18		2:30 PM	157	
2:45 AM	5		2:45 PM	166	
3:00 AM	4	29	3:00 PM	159	710
3:15 AM	7		3:15 PM	183	
3:30 AM	4		3:30 PM	192	
3:45 AM	14		3:45 PM	176	
4:00 AM	12	89	4:00 PM	211	749
4:15 AM	20		4:15 PM	168	
4:30 AM	30		4:30 PM	175	
4:45 AM	27		4:45 PM	195	
5:00 AM	42	316	5:00 PM	199	727
5:15 AM	61		5:15 PM	207	
5:30 AM	100		5:30 PM	174	
5:45 AM	113		5:45 PM	147	
6:00 AM	115	569	6:00 PM	156	538
6:15 AM	121		6:15 PM	143	
6:30 AM	140		6:30 PM	127	
6:45 AM	193		6:45 PM	112	
7:00 AM	141	590	7:00 PM	104	345
7:15 AM	128		7:15 PM	68	
7:30 AM	156		7:30 PM	94	
7:45 AM	165		7:45 PM	79	
8:00 AM	122	481	8:00 PM	92	287
8:15 AM	102		8:15 PM	67	
8:30 AM	134		8:30 PM	67	
8:45 AM	123		8:45 PM	61	
9:00 AM	92	355	9:00 PM	74	200
9:15 AM	72		9:15 PM	52	
9:30 AM	104		9:30 PM	45	
9:45 AM	87		9:45 PM	29	
10:00 AM	68	351	10:00 PM	44	169
10:15 AM	103		10:15 PM	33	
10:30 AM	100		10:30 PM	62	
10:45 AM	80		10:45 PM	30	
11:00 AM	107	488	11:00 PM	33	106
11:15 AM	119		11:15 PM	25	
11:30 AM	142		11:30 PM	22	
11:45 AM	120		11:45 PM	26	

	S/B
	8699

	24 Hour Volume 12:00 AM - 12:00 PM S/B	**12:00 PM - 12:00 AM** S/B
Count	3391	5308
Peak Hour	6:45 AM	4:30 PM
Volume	618	776
Factor	0.80	0.94

File: S:\TES\TRAFFIC\Max\INCOMING\REG WORK STEVE\02050829.JDF

Page 1

Snohomish County Traffic Engineering
3000 Rockefeller Admin 5-W
Everett, WA 98201

Location : BEV PK RD SB SW/O GIBSON RD
Weather : 2 RAIN
Client : SIGNAL DON

Site: 91627-0.52
Date: 2/6/2008
Wednesday

24 Hour Volume, per Channel
Channel: S/B

Interval Begin			Interval Begin		
12:00 AM	12	41	12:00 PM	111	481
12:15 AM	14		12:15 PM	121	
12:30 AM	8		12:30 PM	126	
12:45 AM	7		12:45 PM	123	
1:00 AM	12	34	1:00 PM	129	465
1:15 AM	12		1:15 PM	104	
1:30 AM	7		1:30 PM	100	
1:45 AM	3		1:45 PM	132	
2:00 AM	16	55	2:00 PM	139	620
2:15 AM	12		2:15 PM	142	
2:30 AM	15		2:30 PM	177	
2:45 AM	12		2:45 PM	162	
3:00 AM	3	29	3:00 PM	134	645
3:15 AM	7		3:15 PM	145	
3:30 AM	5		3:30 PM	175	
3:45 AM	14		3:45 PM	191	
4:00 AM	9	59	4:00 PM	234	821
4:15 AM	14		4:15 PM	187	
4:30 AM	17		4:30 PM	203	
4:45 AM	19		4:45 PM	197	
5:00 AM	14	167	5:00 PM	209	768
5:15 AM	30		5:15 PM	213	
5:30 AM	45		5:30 PM	179	
5:45 AM	78		5:45 PM	167	
6:00 AM	10	165	6:00 PM	142	522
6:15 AM	15		6:15 PM	127	
6:30 AM	80		6:30 PM	132	
6:45 AM	60		6:45 PM	121	
7:00 AM	92	508	7:00 PM	92	316
7:15 AM	139		7:15 PM	90	
7:30 AM	141		7:30 PM	74	
7:45 AM	136		7:45 PM	60	
8:00 AM	116	456	8:00 PM	71	247
8:15 AM	104		8:15 PM	58	
8:30 AM	128		8:30 PM	62	
8:45 AM	108		8:45 PM	56	
9:00 AM	86	371	9:00 PM	51	194
9:15 AM	99		9:15 PM	59	
9:30 AM	98		9:30 PM	46	
9:45 AM	88		9:45 PM	38	
10:00 AM	93	381	10:00 PM	39	169
10:15 AM	86		10:15 PM	40	
10:30 AM	101		10:30 PM	61	
10:45 AM	101		10:45 PM	29	
11:00 AM	119	488	11:00 PM	38	98
11:15 AM	120		11:15 PM	23	
11:30 AM	137		11:30 PM	28	
11:45 AM	112		11:45 PM	9	

	S/B
24 Hour Volume	8100

	12:00 AM - 12:00 PM	**12:00 PM - 12:00 AM**
	S/B	S/B
Count	2754	5346
Peak Hour	7:15 AM	4:30 PM
Volume	532	822
Factor	0.94	0.96

File: S:\TES\TRAFFIC\Max\INCOMING\REG WORK STEVE\02050829.JDF

Gibson Road Pond

Figure A-7 Gibson Road Pond Drainage Map

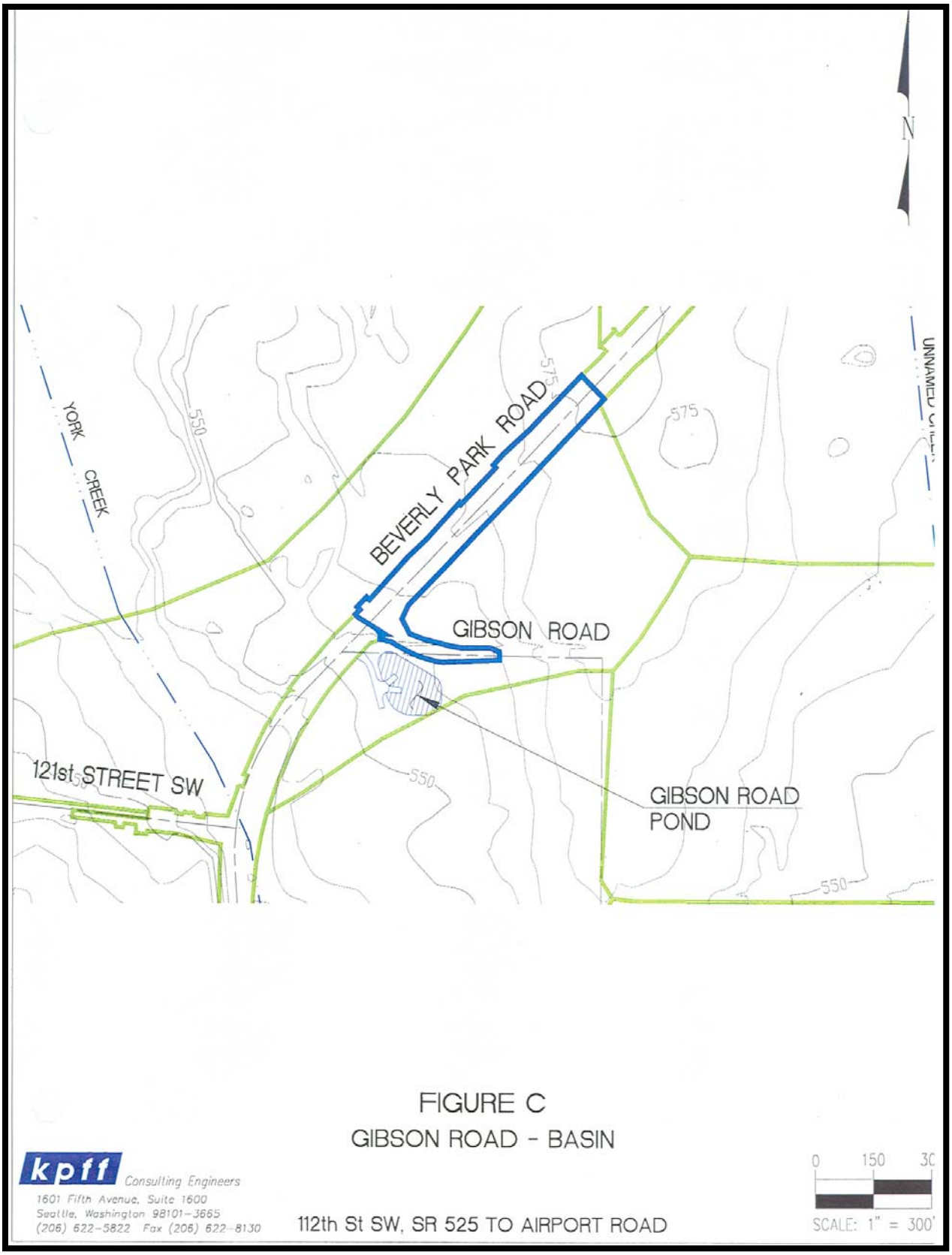
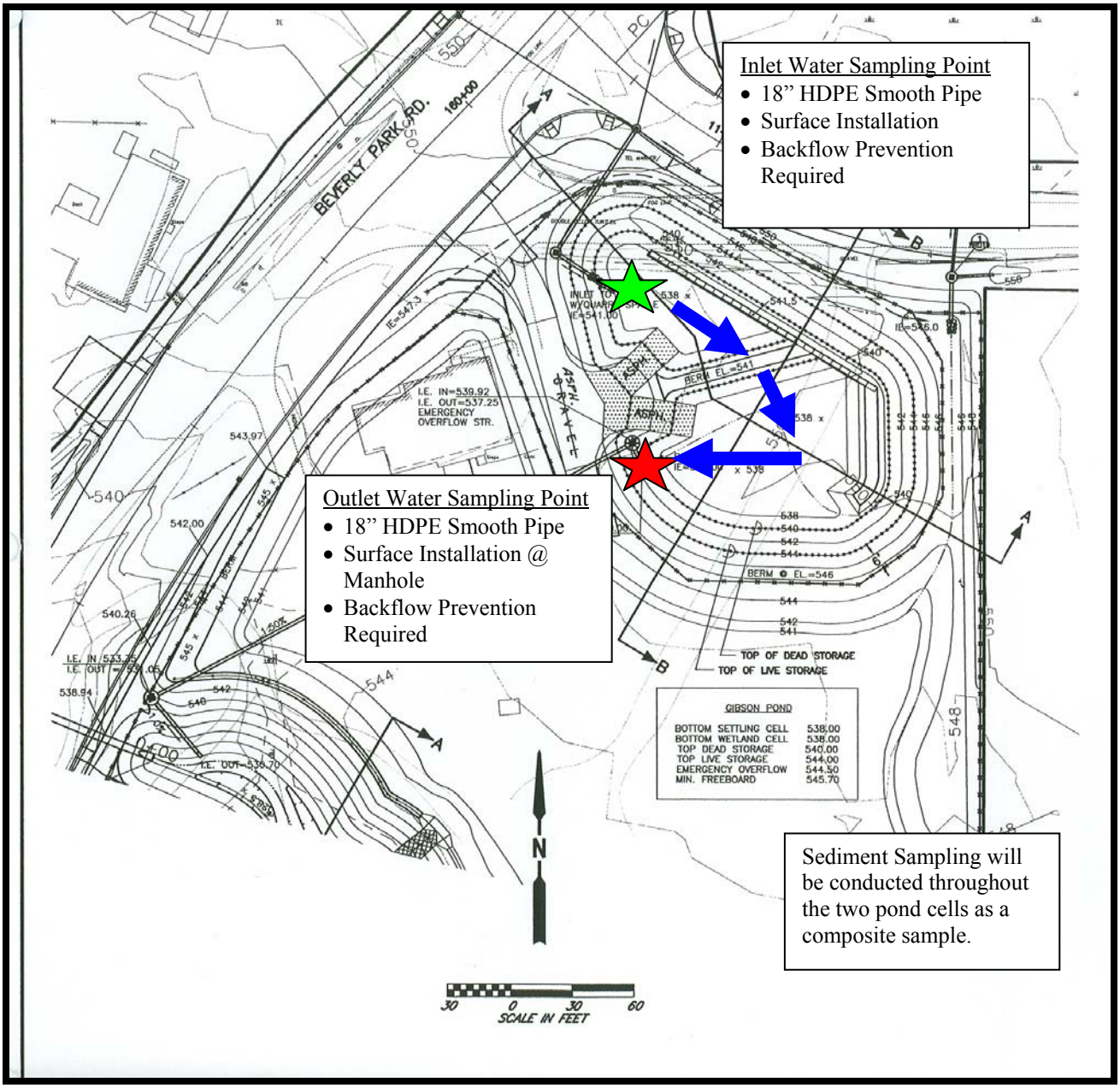


Figure A-8 Gibson Road Pond Sampling Site Map



Water Flow through the System

Gibson Road Pond

1. **The percent impervious:**
   According to the Targeted Drainage Report, the project total area is 2.81 acres with approximately 100 percent impervious cover.

2. **Depth of pertinent rainfall events:**
   2-year, 24-hour rainfall depth: 1.50-inches
   Water Quality event: 1.08-inches

3. **Dead storage volume:**
   The pond was designed based on the 2001 stormwater manual. According to the manual guidance the volume of the required dead storage should be 18,257 cubic feet. The dead storage volume was recalculated using the as-built drawings and is 15,903 cubic feet. The constructed volume is approximately 2,354 cubic feet less than required volume. The dead storage water surface elevation is 540.00 feet and the surface area is 9,263 square feet. The flat bottom area of the pond is 6,640 square feet.

4. **Dead Storage Cell function**
   The shape and flow of water through each of the sequential cells is provided in Figure A-8. The total flow length though the cells is 465 feet. Specifics of each cell are provided below:

Cell	Bottom Elevation (Feet)	Dead Storage Elevation (Feet)	Storage Volume (cubic feet)
Settling Cell	538.00	540.00	4,929.00
Wetland Cell	538.00	540.00	10,974.00

5. **Bypass and overflow**
   This system is an inline system and no bypasses to this system exist upstream. An emergency overflow spillway does exist at the north end of the pond. The overflow bypasses water from the control structure when the water elevation in the pond exceeds 544.50 feet, 0.50 feet above the 100-year water surface elevation.

6. **Sediment storage volume:**
   Per a rough estimate from as-built plan the settling cell is 4,929 cu-ft.

7. **Plans and Drainage Calculations**
   Site plans and the detail drainage report were provided to the Department of Ecology (Ed O'Brien) on May 30, 2008.

8. **Plants**
   The planting list for this project indicates that the following plants were installed:

Quantity	Common Name	Species	Size
100	Douglas spirea	Spiraea douglasii	1 gallon
150	Sitka willow	Salix sitchensis	Live Stake

9. **Groundwater**
   A pond liner was not part of the design or construction of these structures because till material is present approximately 2 feet below the surface, which will exclude groundwater infiltration and ex-filtration. No groundwater seeps were identified from adjacent land around the pond. Flow meters installed at the inlet and outlet will identify if groundwater gains or losses are occurring.

10. **Traffic Volume:**
    Traffic count reports for Beverly Park Road and Gibson Road including count, peak hour, and volume can be found under the Center Road Pond discussion.

11. **Detention Emptying Time:**
    These numbers represent the emptying time for the detention component of the system and do not represent the dead storage area.

    Brim-full emptying time: 13 days
    Half brim-full emptying time: 11 days

12. **Maintenance**
    The site will be inspected and maintained as necessary in spring/summer 2008.

North Creek Park Division 1

North Creek Park Division 1

1. **The percent impervious:**
   The figure provided below shows the drainage area contributing stormwater to the treatment facility. The total drainage area for this site is 2.73 acres with approximately 53 percent (1.46 acres) representing impervious land cover. The impervious land cover is represented by roofs, driveways, and roadways in the high density residential neighborhood.

2. **Volumes of the various rainfall runoff events:**
   The figure provided below illustrates three distinct sections to the drainage area; Section A, black hatching; Section B, red hatching; and Section C, brown hatching. These three sections represent different conditions in the drainage area contributing stormwater to the treatment system.

   Section A
   Section A is 0.133 acres in size with 64 percent of the land area represented by impervious cover, 21 percent pervious land cover, and 15 percent by pervious concrete. Since this drainage are is directly adjacent to the treatment area 100 percent of the runoff sheet flows into the treatment system downstream of the upper monitoring site and upstream of the lower monitoring site.

   The flow entering the system will be modeled for each rainfall-runoff event to determine the volume entering the system. This volume will be entered into the water budget for the site to determine the overall effectiveness of the project. A summary of the hydrologic calculations with is provided below.

   Section B
   Section B is 0.858 acres in size with 48 percent of its area represented by impervious cover. The area is drained via overland flow to a piped storm sewer system which ultimately discharges 100 percent of the storm flow to the treatment facility at the upstream monitoring point. A summary of the hydrologic calculations with is provided below.

   Section C
   This section is 1.74 acres in size and has an impervious cover of approximately 55 percent. The flow collected from this area in the storm sewer system drains to an in-line control flow splitter on 167th Street SE. The control structure allows a maximum of 0.27 Cubic Feet per Second (cfs) to flow through and ultimately discharge to the treatment facility. The remaining flow is directed to an adjacent drainage system.

   The original design calculated 0.27cfs as the water quality treatment volume as defined by the Stormwater Program Guidance Manual for Puget Sound (Ecology 1992). A review of the design calculation showed that more recent precipitation data was available for the hydrologic calculations. This data shows that the water quality treatment volume released by the control structure should be 0.37 cfs. At this time, increasing the size of the orifice is not being considered due to downstream capacity concerns. A summary of the hydrologic calculations with the updated rainfall amounts is provided below.

3. **Existing soils**

The Soil Survey of Snohomish County was used to identify the soils present on this site. The project site contains or is influenced by two soils, the Norma Loam and the Alderwood Urban Land Complex. Physical inspections of the soil, conducted by the project engineer suggested that the existing material has characteristics of both soils. These types of soils are characteristic of Snohomish County soils along waterway cooridors. Information about these soils from the soil survey is provided below:

39-Norma Loam

Depth (in)	Clay <2mm (pct)	Permeability (in/hr)	Available Water Capacity (in/in0	USDA Texture
0-10	10-15	0.6-2.0	0.19-0.21	Loam
10-28	5-10	2.0-6.0	0.12-0.15	Sandy loam, fine sandy loam, silt loam
26-60	5-20	0.6-2.0	0.12-0.15	Stratified loamy sand to silty clay loam

6-Alderwood Urban Land Complex

Depth (in)	Clay <2mm (pct)	Permeability (in/hr)	Available Water Capacity (in/in0	USDA Texture
0-7	5-10	2.0-6.0	0.07-0.11	Gravelly sandy loam
7-35	5-10	2.0-6.0	0.07-0.11	Very gravelly loam, very gravelly sandy loam
35	NA	NA	NA	cemented

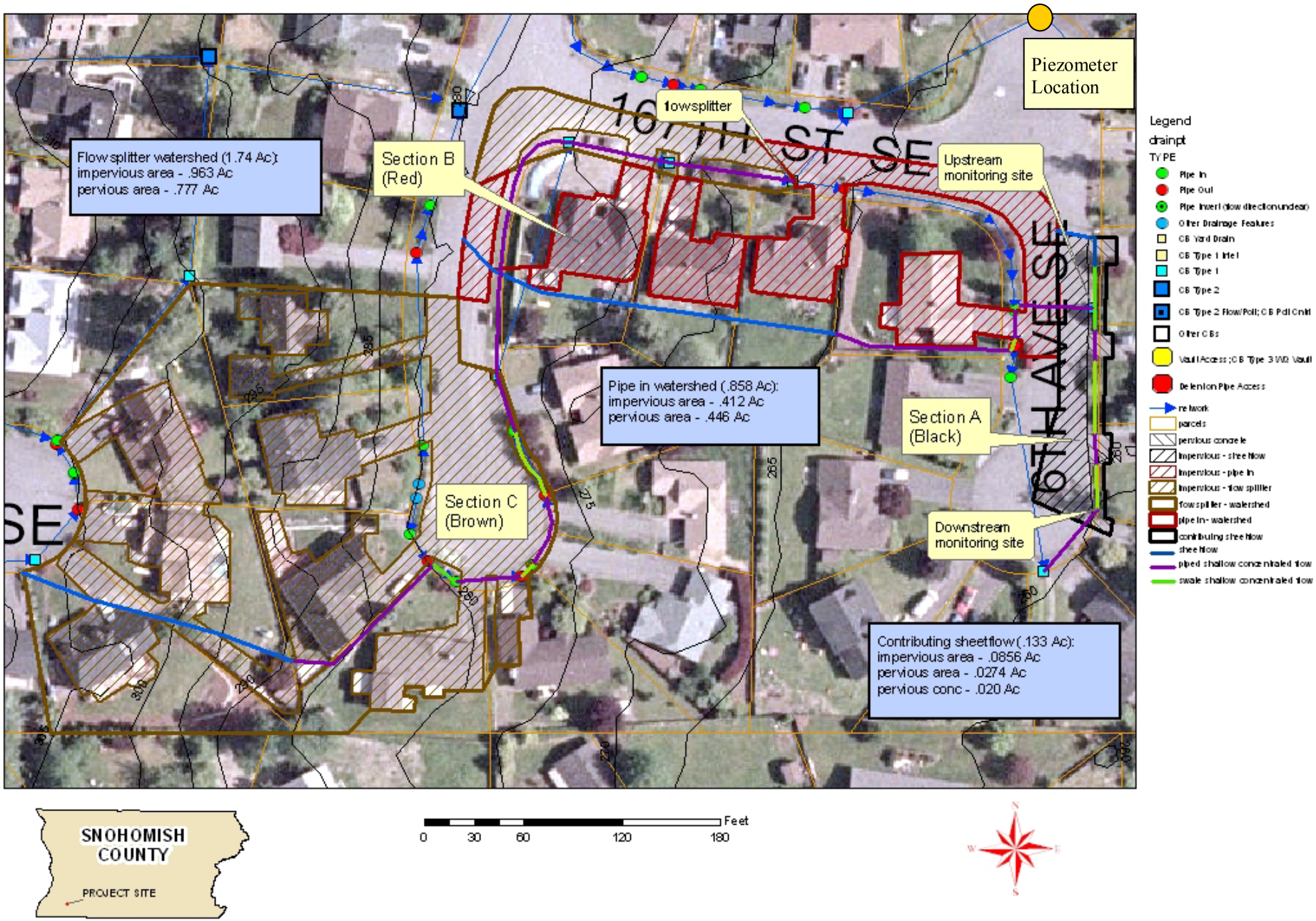
4. **Compost Materials**

The compost and sand specifications, provided by Cedar Grove Composing are provided below.

5. **Plans and Drainage Calculations**

The drainage calculations and site plans are provided below.

6TH AVE SE - MONITORING
CONTRIBUTING AREA



0 30 60 120 180 Feet

Project Title:	**Section A**
Project Number:	**RR47368**

INPUT PARAMETERS

Given: *EXISTING SITE CONDITIONS**

Area =	***0.133***	acres	{total of PERVIOUS + IMPERVIOUS}	
Tc =	**3**	min.		

PERVIOUS Parcel			IMPERVIOUS Parcel		
Area =	**0.0274**	acres	Area =	**0.1056**	acres
CN =	**90**		CN =	**98**	

* Input data per "2001 Stormwater Managment Manual for Western Washington, III-2.3.2 Runoff Parameters."

Rainfall: *FROM ISOPLUVIALS (except WQ, as noted)*

WQ =	***1.44***	inches	{per "2001 Stormwater Mgnt. Man. for Western Washington" = (0.72)(2yr/24hr)}
2yr/24hr =	**2.00**	inches	
5yr/24hr =	**0.00**	inches	
10yr/24hr =	**2.63**	inches	
25yr/24hr =	**2.98**	inches	
50yr/24hr =	**3.50**	inches	
100yr/24hr =	**3.86**	inches	

CORRECTION FACTOR

79% Existing Site Impervious Cover

1.1

"2001 Stormwater Mgnt. Man. for Western Washington" Fig. 2-1, Pg. 2-5, Vol. III

SUMMARY OF PEAK FLOW AND HYDROGRAPH VOLUME

DESIGN STORM		*EXISTING*		*EXISTING*
WQ	Qpeak =	**0.05**	c.f.s.	
	Vol =	***531.41***	cu.ft.	
2yr/24hr	Qpeak =	**0.07**	c.f.s.	**0.07**
	Vol =	***788.97***	cu.ft.	
5yr/24hr	Qpeak =	**0.00**	c.f.s.	**0.00**
	Vol =	***0.00***	cu.ft.	
10yr/24hr	Qpeak =	**0.09**	c.f.s.	**0.10**
	Vol =	***1083.86***	cu.ft.	
25yr/24hr	Qpeak =	**0.11**	c.f.s.	**0.12**
	Vol =	***1249.04***	cu.ft.	
50yr/24hr	Qpeak =	**0.13**	c.f.s.	**0.14**
	Vol =	***1495.61***	cu.ft.	
100yr/24hr	Qpeak =	**0.14**	c.f.s.	**0.16**
	Vol =	***1666.90***	cu.ft.	

Project Title:	**Section B**
Project Number:	**RR4736 8**

INPUT PARAMETERS

Given: *EXISTING SITE CONDITIONS**

Area =	***0.858***	acres	{total of PERVIOUS + IMPERVIOUS}				
Tc =	**16**	min.					
PERVIOUS Parcel			IMPERVIOUS Parcel				
Area =	**0.446**	acres	Area =	**0.412**	acres		
CN =	**86**		CN =	**98**			

* Input data per "2001 Stormwater Managment Manual for Western Washington, III-2.3.2 Runoff Parameters."

Rainfall: *FROM ISOPLUVIALS (except WQ, as noted)*

WQ =	***1.44***	inches	{per "2001 Stormwater Mgnt. Man. for Western Washington" = (0.72)(2yr/24hr)}
2yr/24hr =	**2.00**	inches	
5yr/24hr =	**0.00**	inches	
10yr/24hr =	**2.63**	inches	
25yr/24hr =	**2.98**	inches	
50yr/24hr =	**3.50**	inches	
100yr/24hr =	**3.86**	inches	

CORRECTION FACTOR

48%	Existing Site Impervious Cover
1.1	"2001 Stormwater Mgnt. Man. for Western Washington" Fig. 2-1, Pg. 2-5, Vol. III

SUMMARY OF PEAK FLOW AND HYDROGRAPH VOLUME

	DESIGN STORM	*EXISTING*		*w/ CORRECTION FACTOR* *EXISTING*
WQ	Qpeak =	**0.15**	c.f.s.	
	Vol =	***2559.39***	cu.ft.	
2yr/24hr	Qpeak =	**0.25**	c.f.s.	**0.27**
	Vol =	***4028.17***	cu.ft.	
5yr/24hr	Qpeak =	**0.00**	c.f.s.	**0.00**
	Vol =	***0.00***	cu.ft.	
10yr/24hr	Qpeak =	**0.36**	c.f.s.	**0.39**
	Vol =	***5775.69***	cu.ft.	
25yr/24hr	Qpeak =	**0.42**	c.f.s.	**0.47**
	Vol =	***6774.12***	cu.ft.	
50yr/24hr	Qpeak =	**0.52**	c.f.s.	**0.57**

	Vol =	***8282.38***	cu.ft.	
100yr/24hr	Qpeak =	**0.59**	c.f.s.	**0.65**
	Vol =	***9339.79***	cu.ft.	

Project Title:	**Section C**
Project Number:	**RR47368**

INPUT PARAMETERS

Given: *EXISTING SITE CONDITIONS**

Area =	***1.74***	acres	{total of PERVIOUS + IMPERVIOUS}
Tc =	**9**	min.	

PERVIOUS Parcel			IMPERVIOUS Parcel		
Area =	**0.777**	acres	Area =	**0.963**	acres
CN =	**86**		CN =	**98**	

* Input data per "2001 Stormwater Managment Manual for Western Washington, III-2.3.2 Runoff Parameters."

Rainfall: *FROM ISOPLUVIALS (except WQ, as noted)*

WQ =	***1.44***	inches	{per "2001 Stormwater Mgnt. Man. for Western Washington" = (0.72)(2yr/24hr)}
2yr/24hr =	**2.00**	inches	
5yr/24hr =	**0.00**	inches	
10yr/24hr =	**2.63**	inches	
25yr/24hr =	**2.98**	inches	
50yr/24hr =	**3.50**	inches	
100yr/24hr =	**3.86**	inches	

CORRECTION FACTOR

55%	Existing Site Impervious Cover
1.1	"2001 Stormwater Mgnt. Man. for Western Washington" Fig. 2-1, Pg. 2-5, Vol. III

SUMMARY OF PEAK FLOW AND HYDROGRAPH VOLUME

	DESIGN STORM	*EXISTING*		*w/ CORRECTION FACTOR* *EXISTING*
WQ	Qpeak =	**0.37**	c.f.s.	
	Vol =	***5545.85***	cu.ft.	
2yr/24hr	Qpeak =	**0.59**	c.f.s.	**0.65**
	Vol =	***8597.21***	cu.ft.	
5yr/24hr	Qpeak =	**0.00**	c.f.s.	**0.00**
	Vol =	***0.00***	cu.ft.	
10yr/24hr	Qpeak =	**0.85**	c.f.s.	**0.93**
	Vol =	***12198.61***	cu.ft.	
25yr/24hr	Qpeak =	**0.99**	c.f.s.	**1.09**
	Vol =	***14248.12***	cu.ft.	

50yr/24hr	Qpeak =	**1.21**	c.f.s.	**1.33**
	Vol =	***17336.97***	cu.ft.	
100yr/24hr	Qpeak =	**1.37**	c.f.s.	**1.50**
	Vol =	***19498.71***	cu.ft.	

Cedar Grove Composting
Compost Quality Assurance Program 2007

Two Way Topsoil Mix 2007

On February 11, 2004 the Washington State Department of Ecology imposed new minimum functional standards for all composting facilities. WAC 173-350-220 specifically defines compost manufacturing and product quality standards. Cedar Grove Composting meets these required standards. *(The new standards replace The Interim Guidelines for Grade AA Compost Quality.)*

As required, based on our production schedule at Cedar Grove, we sample every 10,000 yards of Type 1* and every 5,000 yards of Type 3* feedstock and send the samples to outside laboratories for the following **required** tests. Chart 1, Tables A & B below details the State Standards and Cedar Grove results.

In addition, on a quarterly basis, Cedar Grove tests the current compost sales inventory for moisture, nutrients and trace elements, salts, organic matter, and chlopyralid. Chart 2, Table C on the next page outlines our additional **voluntary** testing protocol.

Chart 1. Washington Administrative Code (WAC) – Solid Waste Handling Standards
(Chapter 173-350 Section 220, page 29 & 30)

REQUIRED TESTING		*As of 2-11-2004* WAC 173-350-220 Standard	Cedar Grove Topsoil
Table A		**Limit**	**As of 3/01/07**
Metals		***(mg/kg dry weight)***	
Arsenic	*parts per million dry weight*	**<=20**	4
Cadmium		**<=10**	2
Copper		**<=750**	36
Lead		**<=150**	15
Mercury		**<=8**	<1
Molybdenum		**<=9**	2
Nickel		**<=210**	36
Selenium		**<=18**	<1
Zinc		**<=1400**	98
Table B			
Other Parameters		**Limit**	**Cedar Grove**
pH		**5-10 (range)**	7.46
Salmonella	*CFU /g dry wt*	**< 3 Most Probable Number per 4 grams of total solids**	<3
Sharps		**0 percent**	0
Manufactured Inerts		**< 1 percent**	<0.5
Total Nitrogen	*% dry basis*	**report every 10,000 yds**	0.71
Stability	*Respiration rate (mgCO2-C/gOM/day)*	**Very Stable, Stable, or Moderately Unstable**	Stable

**Type 1 Feedstock as defined by the WAC means source separated yard and garden waste, wood wastes, agricultural crop residue, wax-coated cardboard, and pre-consumer food wastes.*Type 3 Feedstock as defined by WAC means meat and post-consumer source separated food wastes.*

Chart 2. Cedar Grove Composting Voluntary Testing
(Performed Quarterly by Outside Laboratory)

VOLUNTARY TESTING		
Table C		**As of 3/1/07**
Nutrients -Primary & Secondary		
Ammonia	*(parts per million dry weight)*	19
Nitrate		276
Phosphorus		1360
Potassium		4602
Sulfate		121
Calcium	*(percent dry weight)*	0.86
Magnesium		0.92
Trace Elements		
Copper	*(parts per million dry weight)*	36
Zinc		98
Boron		1
Salts, Bulk Density, Etc.		
Sodium	*(percent dry weight)*	0.03
Chloride		0.11
Organic Nitrogen		0.68
Organic Matter		19.9
Organic Carbon		10.5
Moisture	*(Percent)*	36.1
Total Solids		93.9
Bulk Density	*(lb/cu ft)*	44
Carbon to Nitrogen Ratio	*(Ratio)*	15
Electrical Conductivity	*(dS/m = mmhos/cm)*	1.72
Particle Size	**Percent Retained**	**Percent Passing**
>2.0 inches	0.0	100
1.0 to 2.0 in.	0.0	100
0.64 to 1.0 in.	0.0	100
0.38 to0.64 in.	0.0	97.1
0.25 to 0.38 in.	1.2	93.9
0.16 to 0.25 in.	6.2	86.6
0.08 to 0.16 in.	15.5	60.3
<0.08	77.1	

CONCRETE NOR'WEST

Division of Miles Sand Gravel Co.
PO Box 280
Mount Vernon, WA 98273
(360)757-3121

Aggregate Test Report

Product: ASTM C33 Sand Location: Getchell Pit

Project: Stock Material Contractor:

U.S. Sieve #		Grams Retained	% Sample Retained	% Sample Passing	% Passing Spec.
Sample Size:		1266			
2 1/2 In.					
2 In.					
1 1/2 In.					
1 1/4 In.					
1 In.					
3/4 In.					
5/8 In.					
1/2 In.					
3/8 In.		0	0.0%	100.0%	100%
1/4 In.					
No.4	4.75 mm	4	0.3%	99.7%	95-100%
No.8	2.36 mm	196	15.5%	84.5%	80-100%
No.10					
No.16	1.18 mm	466	36.8%	63.2%	50-85%
No.30	.6 mm	752	59.4%	40.6%	25-60%
No.40					
No.50		1066	84.2%	15.8%	10-30%
No.100	.15 mm	1236	97.6%	2.4%	2-10%
No.200	.075 mm	1264	99.8%	0.2%	0-3%

#5 4 mm
#18 1 mm

Testing: Wet Sieve

Remarks:

Sampled By: J.S. Tested By: C.B.

Submitted By: Date: 3/13/2007

CNW'99

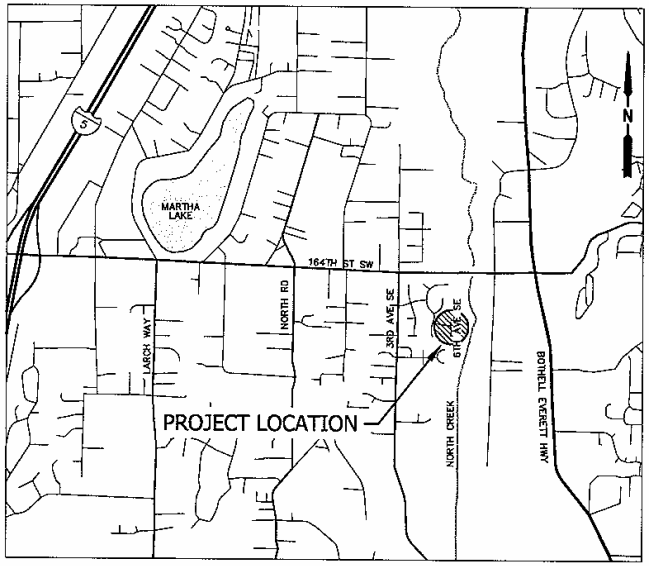
16723 6TH AVE SE DRAINAGE IMPROVEMENT

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

SURFACE WATER MANAGEMENT

PROJECT NO. RR47368

SECTION 7, T. 27 N., R.5 E.



VICINITY MAP
N.T.S.

SHEET INDEX

SHEET NAME	SHEET #
LEGEND/NOTES/QUANTIES	2
PLAN AND PROFILE	3–7
SWPP PLAN	8
DETAILS	9

Snohomish County Officials

DIRECTOR OF PUBLIC WORKS
STEVEN E. THOMSEN, P.E.

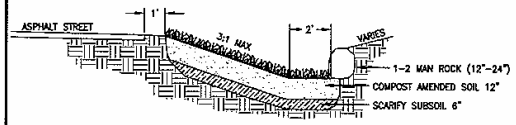
COUNTY ENGINEER
OWEN B. CARTER, P.E.

EXECUTIVE
AARON G. REARDON

COUNCIL MEMBERS
JOHN KOSTER – DIST. 1
KIRKE SIEVERS – DIST. 2
GARY NELSON – DIST. 3
DAVE GOSSETT – DIST. 4
DAVE SOMERS – DIST. 5

Sep 05, 2007 - 3:28pm spwtg X:\INFORUDC\Proj\Projects\2007\WA7368_6TH_AV_SE\Engineering\ACAD\6th Ave SE (final).dwg Layout Name: CV (1)

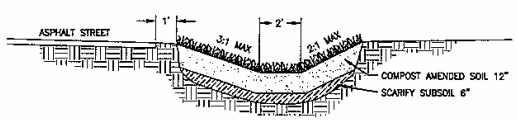
Last Saved By: spwtg Sep 05, 2007 – 3:13pm



SECTION A–A4,5,6
N.T.S.

NOTES:

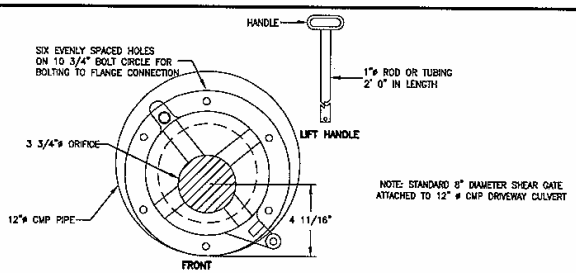
1. AMENDED SOIL MIX (BY VOLUME) : 60% UTILITY SAND, 40 COMPOST. AN ACCEPTABLE ALTERNATIVE IS BIORETENTION SOIL MIX #2 FROM THE LOW IMPACT DEVELOPEMENT TECHNICAL GUIDE.
2. SEED MIX (BY WEIGHT) : 70–80% TALL OR MEADOW FESCUE, 10–15% SEASIDE/ CREEPING BENTGRASS, 5–10% REDTOP BENTGRASS.
3. HYDROSEED AT A MINIMUM RATE OF 2000# PER ACRE OF MULCH WITH A 3% TACKIFIER.
4. COVER WITH EROSION CONTROL BLANKET



SECTION B–B3
N.T.S.

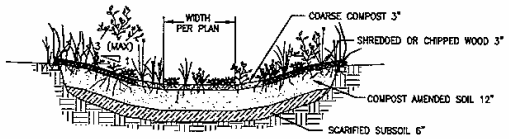
NOTES:

1. AMENDED SOIL MIX (BY VOLUME) : 60% UTILITY SAND, 40 COMPOST. AN ACCEPTABLE ALTERNATIVE IS BIORETENTION SOIL MIX #2 FROM THE LOW IMPACT DEVELOPEMENT TECHNICAL GUIDE.
2. SEED MIX (BY WEIGHT) : 70–80% TALL OR MEADOW FESCUE, 10–15% SEASIDE/ CREEPING BENTGRASS, 5–10% REDTOP BENTGRASS.
3. HYDROSEED AT A MINIMUM RATE OF 2000# PER ACRE OF MULCH WITH A 3% TACKIFIER.
4. COVER WITH EROSION CONTROL BLANKET.



NOTE: STANDARD 8" DIAMETER SHEAR GATE ATTACHED TO 12" ø CMP DRIVEWAY CULVERT

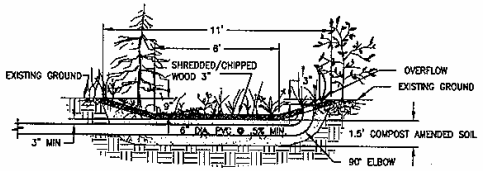
SHEARGATE WITH ORIFICE
N.T.S.



SECTION C–C4
N.T.S.

NOTES:

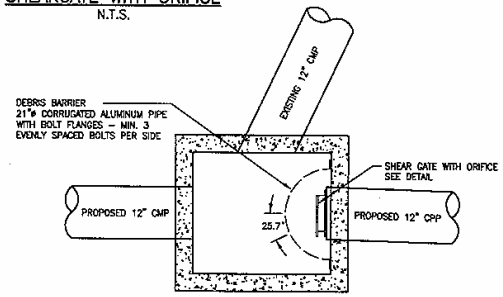
1. AMENDED SOIL MIX (BY VOLUME) : 60% UTILITY SAND, 40 COMPOST. AN ACCEPTABLE ALTERNATIVE IS BIORETENTION SOIL MIX #2 FROM THE LOW IMPACT DEVELOPEMENT TECHNICAL GUIDE.
2. COVER SWALE SWALE BOTTOM WITH EROSION CONTROL BLANKET.
3. PLANTINGS BY SWM STAFF.
4. TO BE STAKED BY DESIGNER IF REQUESTED.

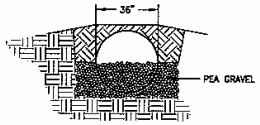


RAIN GARDEN (4/4)
N.T.S.

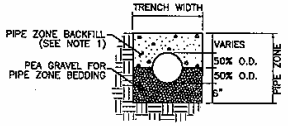
NOTES:

1. AMENDED SOIL MIX (BY VOLUME) : 60% UTILITY SAND, 40 COMPOST. AN ACCEPTABLE ALTERNATIVE IS BIORETENTION SOIL MIX #2 FROM THE LOW IMPACT DEVELOPEMENT TECHNICAL GUIDE.
2. COVER SWALE BOTTOM WITH EROSION CONTROL BLANKET.
3. PLANTINGS BY SWM STAFF.
4. TO BE STAKED BY DESIGNER IF REQUESTED.





SWALE C SECTION @ CUVERT (5/5)
N.T.S.

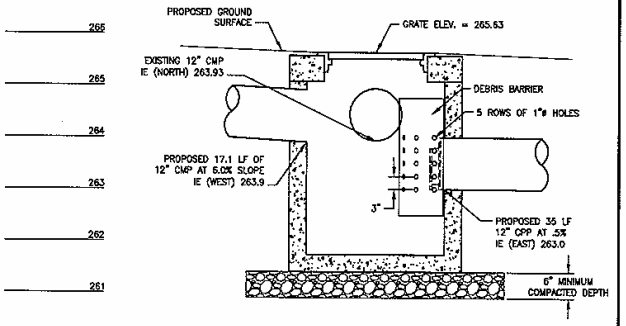


CORRUGATED METAL PIPE

PIPE BEDDING AND BACKFILL
N.T.S.

NOTES:

1. SEE WSDOT/APWA STANDARD SPECIFICATIONS SECTION 7-08.3(3) FOR PIPE ZONE BACKFILL.
2. SEE STANDARD SPECIFICATIONS SECTION 9-03.12(3) FOR GRAVEL BACKFILL FOR PIPE ZONE BEDDING



CB1 WITH FLOW CONTROL (6/7)
N.T.S.

PLAN CHECK	BY	DATE				
			DATE	NO.	REVISION	BY

Last Saved By: spw1jg Sep 05, 2007 – 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GELSON | DRAWN BY: T.HEMRICH
FIELD BOOK(S): | UPI#

APPROVED FOR CONSTRUCTION

OWEN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

FUNDING NO. RR47388

16723 6TH AVE SE
DRAINAGE IMPROVEMENT

DETAILS

REFERENCE SHEET NO.

SHEET 9 OF 9 SHEETS

GENERAL NOTES:

1. ALL MATERIALS AND CONSTRUCTION ARE TO COMPLY WITH THE CURRENT EDITION OF THE SNO. CO. P.W. ENGINEERING DESIGN AND DEVELOPMENT STANDARDS, SNOHOMISH COUNTY CODE TITLE 30, AND/OR W.S.D.O.T. STANDARD PLANS AND SPECIFICATIONS, UNLESS NOTED OTHERWISE.

2. UTILITY LOCATIONS ARE BASED ON RBI/SWM POTHOLE DATA. LOCATIONS SHALL BE VERIFIED BY ROAD MAINTENANCE PRIOR TO CONSTRUCTION AND CONFLICTS WILL BE BROUGHT TO THE ATTENTION OF THE DESIGNER FOR RESOLUTION.

3. DETOURS, ROAD CLOSURES, AND TRAFFIC CONTROL WILL BE THE RESPONSIBILITY OF ROAD MAINTENANCE.

4. A PRE-CONSTRUCTION CONFERENCE SHALL BE SCHEDULED BY THE DESIGNER WITH ROAD MAINTENANCE PRIOR TO ACTUAL CONSTRUCTION.

5. ROAD MAINTENANCE SHALL SUPPLY THE EQUIPMENT AND MATERIALS NEEDED FOR CONSTRUCTION OF THIS PROJECT.

6. CLEAN, NON TURBID DEWATERING WATER CAN BE DISCHARGED TO WATERS OF THE STATE PROVIDED THE DEWATERING FLOW DOES NOT CAUSE EROSION OR FLOODING OF RECEIVING WATERS. THESE CLEAN WATERS SHOULD NOT BE ROUTED THROUGH STORMWATER SEDIMENT PONDS.
HIGHLY TURBID OR CONTAMINATED DEWATERING WATER FROM CONSTRUCTION EQUIPMENT OPERATION, OPEN TRENCHES OR WORK INSIDE A COFFER DAM SHALL BE HANDLED SEPARATELY FROM STORMWATER. OTHER DISPOSAL OPTIONS FOR DEWATERING MAY INCLUDE:
a) ONSITE INFILTRATION.
b) TRANSPORT OFF SITE IN VEHICLE, SUCH AS A VACUUM FLUSH TRUCK, FOR LEGAL DISPOSAL IN A MANNER THAT DOES NOT POLLUTE STATE WATERS.
c) ONSITE TREATMENT USING CHEMICAL TREATMENT OR OTHER SUITABLE TREATMENT TECHNOLOGIES.
d) SANITARY SEWER DISCHARGE WITH LOCAL SEWER DISTRICT APPROVAL, OR
e) USE OF A SEDIMENTATION BAG WITH OUT FALL TO A DITCH OR SWALE OR SMALL VOLUMES OF LOCALIZED DEWATERING.

7. DISTURBED AREAS SHALL BE RESTORED BY ROAD MAINTENANCE TO EXISTING CONDITIONS OR BETTER.

8. ALL VEGETATION AND IMPROVEMENTS ON PRIVATE PROPERTY (OUTSIDE DRAINAGE EASEMENT) SHALL BE PROTECTED. IF DAMAGED BY ROAD MAINTENANCE (RM), RM SHALL RESTORE TO EQUAL OR BETTER CONDITION AND AS DIRECTED BY THE DESIGNER. DISTURBED VEGETATION AND IMPROVEMENTS WITHIN THE DRAINAGE EASEMENT SHALL BE RESTORED TO EQUAL OR BETTER CONDITION IF SAID VEGETATION AND IMPROVEMENTS DO NOT CONFLICT WITH THE DRAINAGE DESIGN. DRAINAGE DESIGNER SHALL DETERMINE CONFLICT.

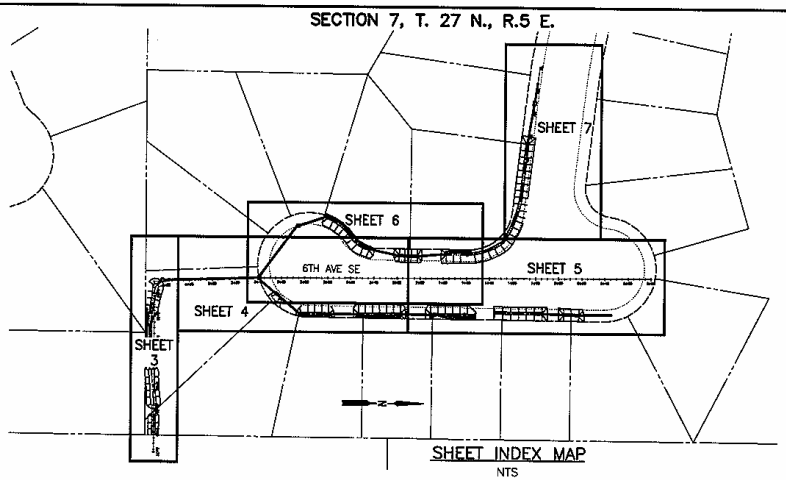
9. ANY GRADING WITHIN THE CRITICAL ROOT ZONE OF PROTECTED TREES SHALL BE UNDER THE DIRECTION OF THE DESIGNER.

10. WATER METER RELOCATION SHALL BE BY ALDERWOOD WATER AND SEWER DISTRICT. FOR WATER METERS CONTACT CATHERINE FOREST AT (425) 743-4605.

11. PROPERTY AND R-O-W LINES ARE APPROXIMATE AND ARE SHOWN FOR PROJECT LOCATION ONLY.

12. EROSION CONTROL BMPS SHALL BE INSTALLED AND DOCUMENTED BY ENGINEER BEFORE THE START OF EXCAVATION AS REQUIRED IN GRADING PERMIT.

13. NATIVE SOIL MAY BE USED FOR FINAL BACKFILL LIFTS IF APPROVED BY DESIGNER.



SHEET INDEX MAP
NTS

LEGEND

- EDGE OF ASPHALT
- RIGHT-OF-WAY (APPROX.)
- PROPERTY LINE (APPROX.)
- EDGE OF CONCRETE
- EDGE OF GRAVEL
- FENCE
- EXISTING CULVERT
- PROPOSED CULVERT
- COMMUNICATIONS (UNDERGROUND)
- POWER (UNDERGROUND)
- GAS
- SANITARY SEWER
- CONTOUR (MAJOR)
- CONTOUR (MINOR)
- TEMPORARY SILT FENCE
- EXISTING FLOWLINE
- PROPOSED FLOWLINE
- DRAINAGE EASEMENT
- EXISTING STORM DRAIN
- SAWCUT
- LANDSCAPE TIMBER
- ROCK RETAINING WALL
- EXISTING CATCH BASIN TYPE 1
- PROPOSED CATCH BASIN TYPE 1
- YARD DRAIN
- MAIL BOX
- STREET LIGHT
- MONUMENT
- POWER VAULT
- WATER METER
- WATER VALVE
- EVERGREEN TREE
- DECIDUOUS TREE

SUMMARY OF QUANTITIES

412	LF	12"ø ALUMINIZED CORRUGATED METAL PIPE
20	LF	38"ø ALUMINIZED CORRUGATED METAL PIPE
28	LF	6"ø PVC PIPE
10	LF	6"ø PVC PIPE (PERFORATED) WITH END CAP
1	EA	6"ø PVC LONG SWEEP ELBOW
1	EA	6"ø PVC GRATE
1	EA	8"ø SHEAR GATE WITH ORIFICE
1	EA	DEBRIS BARRIER (CUSTOM)
2	EA	36"ø DEBRIS BARRIER
2	EA	TYPE 1-L CATCH BASIN WITH VANE GRATE
2	EA	TYPE 1 CATCH BASIN WITH VANE GRATE
5	CY	ATB
5	CY	CLASS B ASPHALT
3	TON	ONE MAN ROCK (12"-18")
20	TON	TWO MAN ROCK (18"-28")
1	CY	2 1/2" MINUS
55	CY	PEA GRAVEL (1/4" -1/8")
42	CY	PIPE ZONE BACKFILL
160	CY	COMPOST AMENDED SOIL
5	YDS	COARSE COMPOST
1046	SY	GEO-JUTE EROSION CONTROL BLANKET
204	LBS	HYDROMULCH
12	CY	SHREDDED / CHIPPED WOOD MULCH
15	LBS	SEED MIX
490	LF	SAWCUT
366	CY	EXCAVATION / DISPOSAL

SUGGESTED CONSTRUCTION SEQUENCE

1. INSTALL EROSION CONTROL BMP'S PER SWPP.
2. REMOVE EXISTING STORM DRAIN FROM WITHIN THE SOUTH PORTION OF THE DRAINAGE EASEMENT. EXCAVATE SWALE.
3. INSTALL TWO 36"ø CULVERTS WITHIN DRAINAGE EASEMENT PER DETAIL.
4. CONSTRUCT BIO-RETENTION SWALES WITHIN THE DRAINAGE EASEMENT AS PER DETAIL.
5. REMOVE EXISTING STORM DRAIN SYSTEM FROM REMAINDER OF DRAINAGE EASEMENT AND THE SOUTH CUL-DE-SAC. INSTALL NEW STORM DRAIN.
6. REMOVE AND REPLACE DRIVEWAY CULVERTS ON 6TH AVE SE.
7. EXCAVATE AND CONSTRUCT BIO-RETENTION SWALES WITHIN THE ROW AS PER DETAIL.
8. EXCAVATE AND CONSTRUCT RAINGARDEN PER DETAIL.
9. REMOVE EXISTING CATCH BASIN AND DRIVEWAY CULVERT AT 532 167TH ST SE. INSTALL NEW STORM DRAIN SYSTEM WITH FLOW CONTROL.
10. REGRADE DITCH ALONG 167TH ST SE.

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: spatjg Sep 05, 2007 - 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON
DRAWN BY: T.HEINRICH
FIELD BOOK(S):
UPI#

APPROVED FOR CONSTRUCTION

OWEN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

FUNDING NO. RR47368

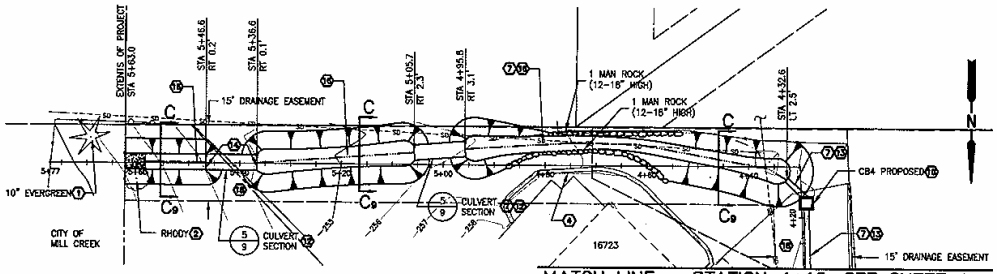
16723 6TH AVE SE
DRAINAGE IMPROVEMENT

LEGEND/NOTES/QUANTITIES

REFERENCE SHEET NO.

SHEET 2 OF 9 SHEETS

SECTION 7, T. 27 N., R.5 E.

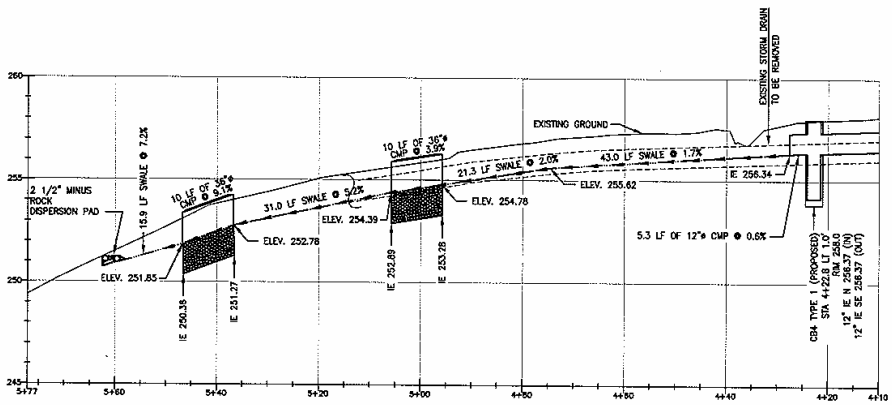


MATCH LINE – STATION 4+10, SEE SHEET 4

PLAN VIEW

SCALE: 1"=20'

NOTE: STATION AND OFFSET ARE PROJECTIONS OFF DRAINAGE EASEMENT CENTERLINE. ACTUAL LENGTH OF PIPE MAY VARY FROM THAT SHOWN IN PROFILE.



PROFILE VIEW

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

NOTE: STATION AND OFFSET ARE PROJECTIONS OFF ROAD CENTERLINE. ACTUAL LENGTH OF PIPE MAY VARY FROM THAT SHOWN IN PROFILE.

VERTICAL CONTROL DERIVED BY GPS, AND ADJUSTED TO SNOHOMISH COUNTY'S PLSS CONTROL POINT NO. 1349, DESIGNATED AS 333/810. ELEV = 276.83 FEET

NAVD88

DATUM CONVERSION:
NAVD88 – NGVD29 = 3.65 FEET
(BASED ON VERTCON 2.0 PROGRAM)

PLAT MONUMENTED CONTROL POINTS

NO.	NORTHING	EASTING	ELEV.	DESCRIPTION
A	639806.292	1627178.073	260.39	BRASS SURFACE DISK W/"+"
B	640061.252	1627180.026	262.50	BRASS SURFACE DISK W/"+"
C	639806.183	1627193.068	260.27	BRASS SURFACE DISK W/"+"
D	639944.101	1627194.160	261.41	BRASS SURFACE DISK W/"+"
E	640011.291	1627135.081	263.25	BRASS SURFACE DISK W/"+"

CONSTRUCTION NOTES

1. PROTECT EXISTING TREES/SHRUBS.
2. REMOVE EXISTING TREES/SHRUBS.
3. PROTECT LANDSCAPE TIMBER/PLANTER.
4. REMOVE LANDSCAPE TIMBER/PLANTER.
5. RELOCATE MAILBOXES DURING CONSTRUCTION. AFTER PROJECT COMPLETION, RETURN TO THE ORIGINAL LOCATION.
6. SAWCUT AND REMOVE PAVEMENT.
7. REMOVE EXISTING STORM DRAIN.
8. REMOVE EXISTING CATCH BASIN.
9. ABANDON EXISTING STORM DRAIN. LEAVE IN PLACE. PLUG EXISTING PIPE ENDS WITH CONCRETE.
10. INSTALL CATCH BASIN WITH FRAME AND GRATE. BACKFILL SHALL CONSIST OF PEA GRAVEL.
11. INSTALL FLOW CONTROL CATCH BASIN WITH FRAME AND GRATE PER 'CB1 WITH FLOW CONTROL' DETAIL ON SHEET 9.
12. INSTALL CULVERT PER DETAIL 'SWALE SECTION C AT CULVERT'.
13. INSTALL STORM DRAIN PER 'PIPE BEDDING AND BACKFILL' DETAIL ON SHEET 9. BEDDING SHALL CONSIST OF PEA GRAVEL.
14. INSTALL DEBRIS BARRIER.
15. REGRADE DITCH AND SEED.
16. CONSTRUCT BIO-RETENTION SWALE TO PROPOSED CONTOURS ON PLAN/PROFILE AND DETAILS ON SHEET 9 PER LABELED SECTION.
17. CONSTRUCT RAINGARDEN PER DETAIL ON SHEET 9.
18. RESTORE EASEMENT-PROPERTY INCLUDING FENCE (2), STONE WALKWAY, YARD, AND GRAVEL PARKING AREA. DISTURBED GRASS AREAS SHALL BE COVERED WITH 12" OF COMPOST AMENDED SOIL AND HYDROSEEDED.
19. RESTORE ASPHALT DRIVEWAYS PER EDDS 2-030.
20. RESTORE ASPHALT ROAD PER EDDS 3-040.

UTILITY SCHEDULE

1. UNABLE TO LOCATE UTILITY
2. DID NOT POTHOLE AT THIS LOCATION

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: sewjg Oct 11, 2007 – 2:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON
DRAWN BY: T.HEMRICH
FIELD BOOK(S):
UPI#

APPROVED FOR CONSTRUCTION

DWIN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

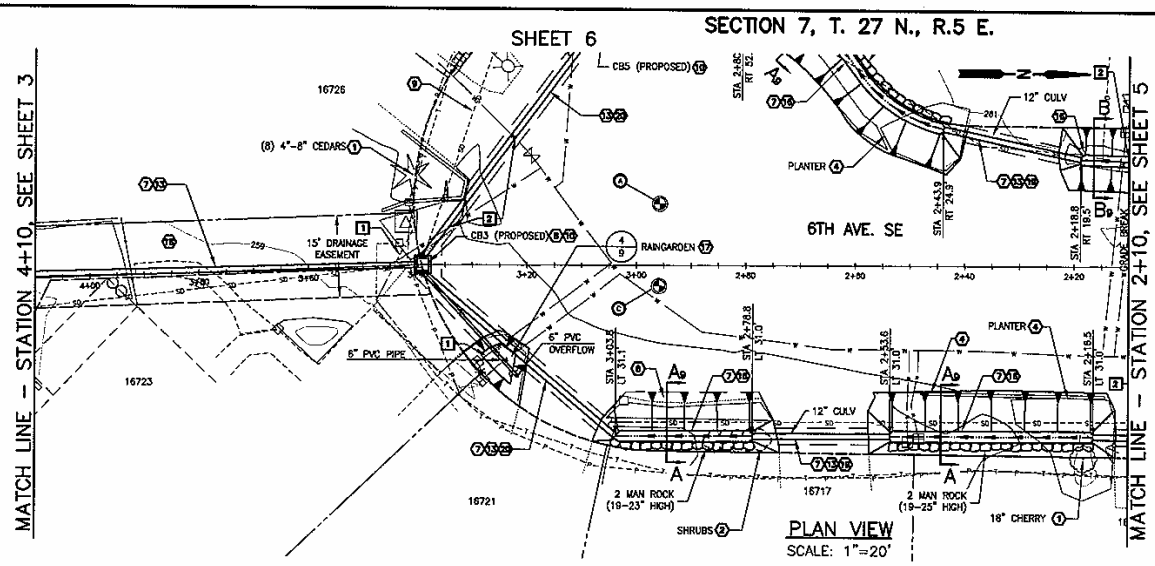
FUNDING NO. RR47368

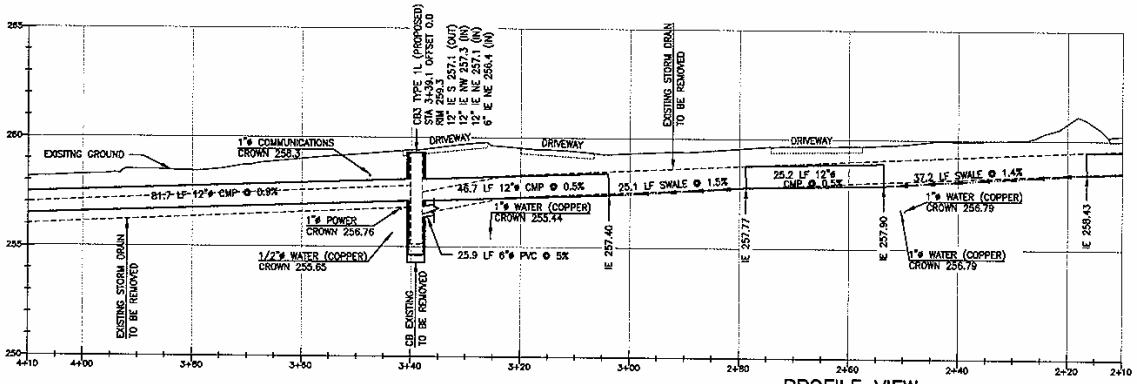
16723 6TH AVE SE
DRAINAGE IMPROVEMENT

PLAN & PROFILE

REFERENCE SHEET NO.

SHEET 3 OF 9 SHEETS





NOTE: STATION AND OFFSET ARE PROJECTIONS OFF ROAD CENTERLINE. ACTUAL LENGTH OF PIPE MAY VARY FROM THAT SHOWN IN PROFILE.

VERTICAL CONTROL DERIVED BY GPS, AND ADJUSTED TO SNOHOMISH COUNTY'S PLSS CONTROL POINT NO. 1349, DESIGNATED AS 333/818. ELEV = 276.83 FEET

NAVD88

DATUM CONVERSION: NAVD88 – NGVD29 = 3.83 FEET (BASED ON VERTCON 2.0 PROGRAM)

PLAT MONUMENTED CONTROL POINTS

NO.	NORTHING	EASTING	ELEV.	DESCRIPTION
A	639806.292	1627178.573	240.36	BRASS SURFACE DISK w/"+"
C	639808.183	1627193.068	280.27	BRASS SURFACE DISK w/"+"

CONSTRUCTION NOTES

1. PROTECT EXISTING TREES/SHRUBS.
2. REMOVE EXISTING TREES/SHRUBS.
3. PROTECT LANDSCAPE TIMBER/PLANTER.
4. REMOVE LANDSCAPE TIMBER/PLANTER.
5. RELOCATE MAILBOXES DURING CONSTRUCTION. AFTER PROJECT COMPLETION, RETURN TO THE ORIGINAL LOCATION.
6. SAWCUT AND REMOVE PAVEMENT.
7. REMOVE EXISTING STORM DRAIN.
8. REMOVE EXISTING CATCH BASIN.
9. ABANDON EXISTING STORM DRAIN. LEAVE IN PLACE. PLUG EXISTING PIPE ENDS WITH CONCRETE.
10. INSTALL CATCH BASIN WITH FRAME AND GRATE. BACKFILL SHALL CONSIST OF PEA GRAVEL.
11. INSTALL FLOW CONTROL CATCH BASIN WITH FRAME AND GRATE PER 'CB1 WITH FLOW CONTROL' DETAIL ON SHEET 9.
12. INSTALL CULVERT PER DETAIL 'SWALE SECTION C AT CULVERT'.
13. INSTALL STORM DRAIN PER 'PIPE BEDDING AND BACKFILL' DETAIL ON SHEET 9. BEDDING SHALL CONSIST OF PEA GRAVEL.
14. INSTALL DEBRIS BARRIER.
15. REGRADE DITCH AND SEED.
16. CONSTRUCT BIO-RETENTION SWALE TO PROPOSED CONTOURS ON PLAN/PROFILE AND DETAILS ON SHEET 9 PER LABELED SECTION.
17. CONSTRUCT RAINGARDEN PER DETAIL ON SHEET 9.
18. RESTORE EASEMENT-PROPERTY INCLUDING FENCE (2), STONE WALKWAY, YARD, AND GRAVEL PARKING AREA. DISTURBED GRASS AREAS SHALL BE COVERED WITH 12" OF COMPOST AMENDED SOIL AND HYDROSEEDED.
19. RESTORE ASPHALT DRIVEWAYS PER EDDS 2-030.
20. RESTORE ASPHALT ROAD PER EDDS 3-040.

UTILITY SCHEDULE

1. UNABLE TO LOCATE UTILITY
2. DID NOT POTHOLE AT THIS LOCATION

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: sewtig Sep 05, 2007 - 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON | DRAWN BY: T.HEMRICH
FIELD BOOK(S): | UPI#

APPROVED FOR CONSTRUCTION

OWEN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

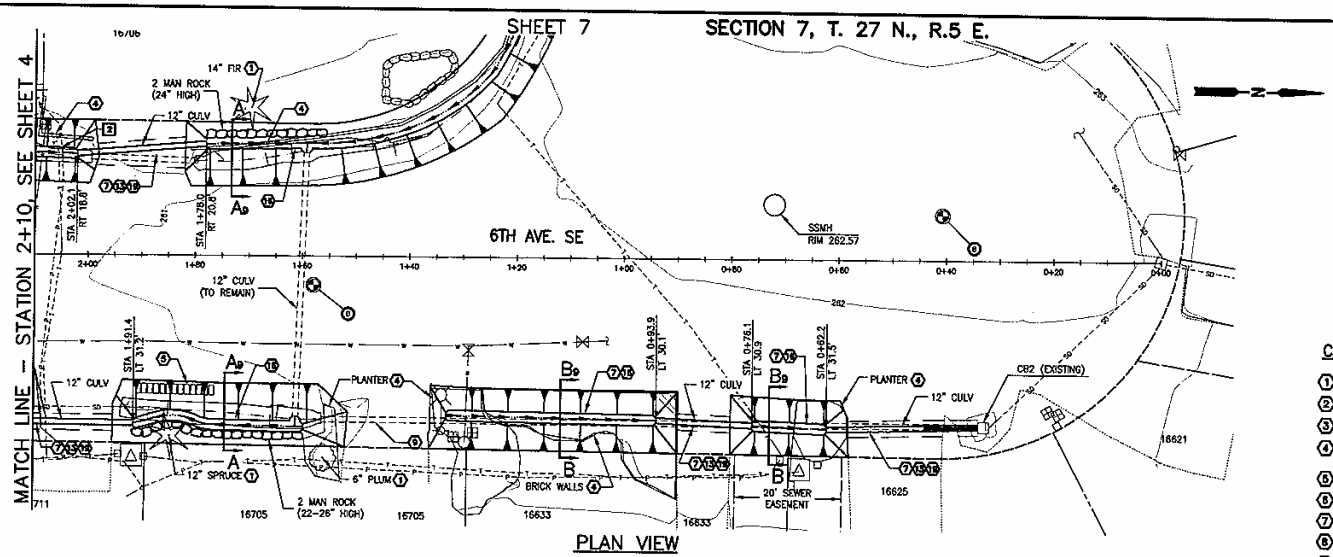
FUNDING NO. RR47368

16723 6TH AVE SE DRAINAGE IMPROVEMENT

PLAN & PROFILE

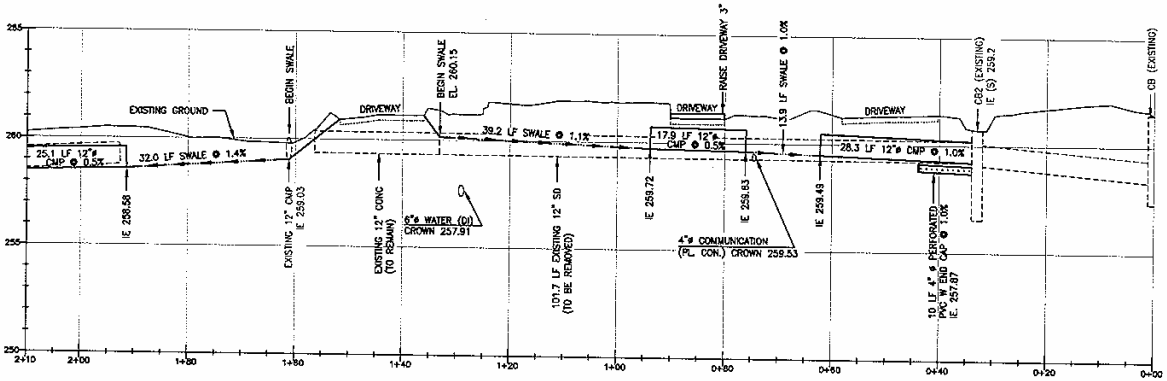
REFERENCE SHEET NO.

SHEET 4 OF 9 SHEETS



PLAN VIEW

SCALE: 1"=20'



PROFILE VIEW

HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

NOTE: STATION AND OFFSET ARE PROJECTIONS OFF ROAD CENTERLINE. ACTUAL LENGTH OF PIPE MAY VARY FROM THAT SHOWN IN PROFILE.

VERTICAL CONTROL DERIVED BY GPS, AND ADJUSTED TO SNOHOMISH COUNTY'S PLSS CONTROL POINT NO. 1349, DESIGNATED AS 333/819. ELEV = 276.83 FEET

DATUM CONVERSION: NAVD88 – NGVD29 = 3.65 FEET (BASED ON VERTCON 2.0 PROGRAM)

PLAT MONUMENTED CONTROL POINTS

NO.	NORTHING	EASTING	ELEV.	DESCRIPTION
B	640061.252	1527180.026	262.50	BRASS SURFACE DISK W/"+"
D	638944.101	1527194.160	251.41	BRASS SURFACE DISK W/"+"

CONSTRUCTION NOTES

1. PROTECT EXISTING TREES/SHRUBS.
2. REMOVE EXISTING TREES/SHRUBS.
3. PROTECT LANDSCAPE TIMBER/PLANTER.
4. REMOVE LANDSCAPE TIMBER/PLANTER.
5. RELOCATE MAILBOXES DURING CONSTRUCTION. AFTER PROJECT COMPLETION, RETURN TO THE ORIGINAL LOCATION.
6. SAWCUT AND REMOVE PAVEMENT.
7. REMOVE EXISTING STORM DRAIN.
8. REMOVE EXISTING CATCH BASIN.
9. ABANDON EXISTING STORM DRAIN. LEAVE IN PLACE. PLUG EXISTING PIPE ENDS WITH CONCRETE.
10. INSTALL CATCH BASIN WITH FRAME AND GRATE. BACKFILL SHALL CONSIST OF PEA GRAVEL.
11. INSTALL FLOW CONTROL CATCH BASIN WITH FRAME AND GRATE PER 'CB1 WITH FLOW CONTROL' DETAIL ON SHEET 9.
12. INSTALL CULVERT PER DETAIL 'SWALE SECTION C AT CULVERT'.
13. INSTALL STORM DRAIN PER 'PIPE BEDDING AND BACKFILL' DETAIL ON SHEET 9. BEDDING SHALL CONSIST OF PEA GRAVEL.
14. INSTALL DEBRIS BARRIER.
15. REGRADE DITCH AND SEED.
16. CONSTRUCT BIO-RETENTION SWALE TO PROPOSED CONTOURS ON PLAN/PROFILE AND DETAILS ON SHEET 9 PER LABELED SECTION.
17. CONSTRUCT RAINGARDEN PER DETAIL ON SHEET 9.
18. RESTORE EASEMENT-PROPERTY INCLUDING FENCE (2), STONE WALKWAY, YARD, AND GRAVEL PARKING AREA. DISTURBED GRASS AREAS SHALL BE COVERED WITH 12" OF COMPOST AMENDED SOIL AND HYDROSEEDED.
19. RESTORE ASPHALT DRIVEWAYS PER EDDS 2-030.
20. RESTORE ASPHALT ROAD PER EDDS 3-040.

UTILITY SCHEDULE

1. UNABLE TO LOCATE UTILITY
2. DID NOT POTHOLE AT THIS LOCATION

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: spwtg Sep 05, 2007 – 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON
DRAWN BY: T.HEMRICH
FIELD BOOK(S):
UPI#

APPROVED FOR CONSTRUCTION

OWEN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

FUNDING NO. RR47388

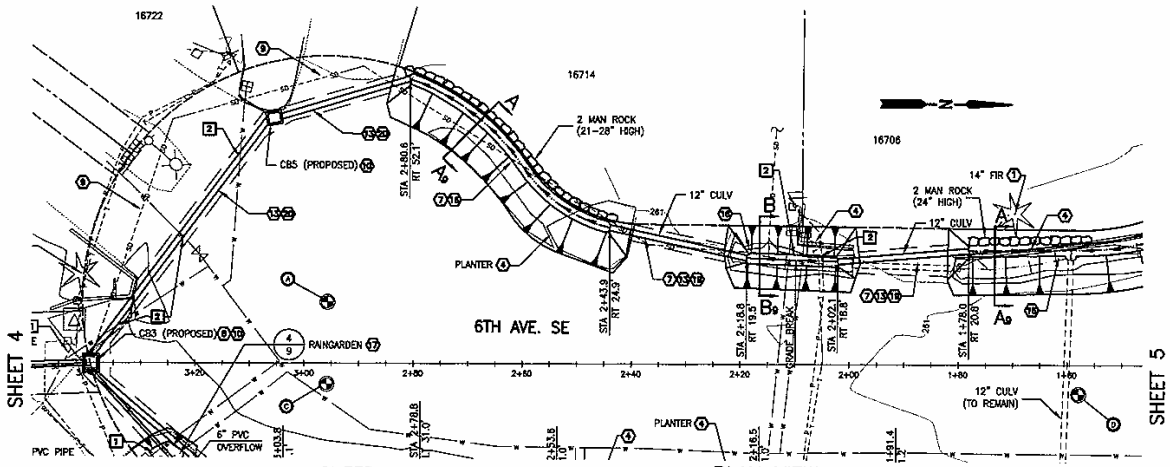
16723 6TH AVE SE
DRAINAGE IMPROVEMENT

PLAN & PROFILE

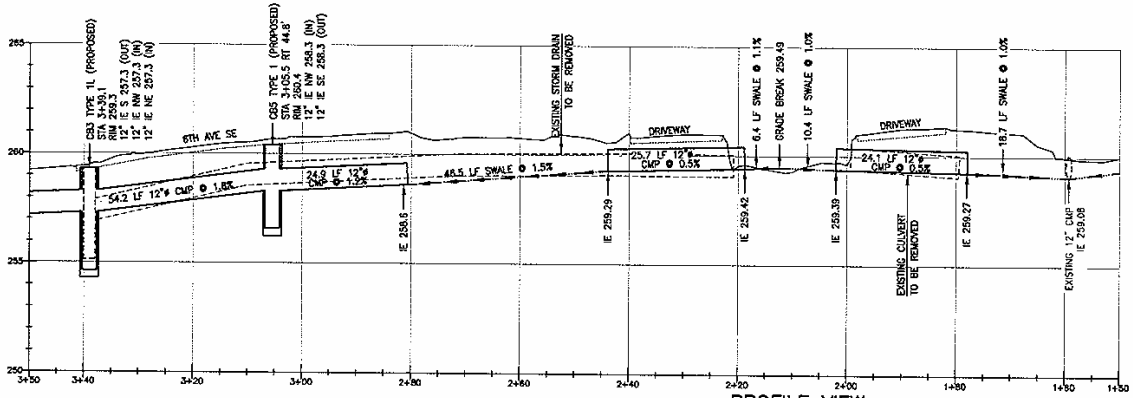
REFERENCE SHEET NO.

SHEET 5 OF 9 SHEETS

SECTION 7, T. 27 N., R.5 E.



PLAN VIEW
SCALE: 1"=20'



PROFILE VIEW
HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

NOTE: STATION AND OFFSET ARE PROJECTIONS OFF ROAD CENTERLINE. ACTUAL LENGTH OF PIPE MAY VARY FROM THAT SHOWN IN PROFILE.

DATUM

NAVD88

VERTICAL CONTROL DERIVED BY GPS, AND ADJUSTED TO SNOHOMISH COUNTY'S PLSS CONTROL POINT NO. 1349, DESIGNATED AS 333/819. ELEV = 276.83 FEET

DATUM CONVERSION:
NAVD88 – NGVD29 = 3.85 FEET
(BASED ON VERTCON 2.0 PROGRAM)

PLAT MONUMENTED CONTROL POINTS

NO.	NORTHING	EASTING	ELEV.	DESCRIPTION
A	639806.292	1627178.073	260.39	BRASS SURFACE DISK W/"+"
C	639806.183	1627193.066	260.27	BRASS SURFACE DISK W/"+"
D	639944.101	1627194.160	261.41	BRASS SURFACE DISK W/"+"

CONSTRUCTION NOTES

1. PROTECT EXISTING TREES/SHRUBS.
2. REMOVE EXISTING TREES/SHRUBS.
3. PROTECT LANDSCAPE TIMBER/PLANTER.
4. REMOVE LANDSCAPE TIMBER/PLANTER.
5. RELOCATE MAILBOXES DURING CONSTRUCTION. AFTER PROJECT COMPLETION, RETURN TO THE ORIGINAL LOCATION.
6. SAWCUT AND REMOVE PAVEMENT.
7. REMOVE EXISTING STORM DRAIN.
8. REMOVE EXISTING CATCH BASIN.
9. ABANDON EXISTING STORM DRAIN. LEAVE IN PLACE. PLUG EXISTING PIPE ENDS WITH CONCRETE.
10. INSTALL CATCH BASIN WITH FRAME AND GRATE. BACKFILL SHALL CONSIST OF PEA GRAVEL.
11. INSTALL FLOW CONTROL CATCH BASIN WITH FRAME AND GRATE PER 'CB1 WITH FLOW CONTROL' DETAIL ON SHEET 9.
12. INSTALL CULVERT PER DETAIL 'SWALE SECTION C AT CULVERT'.
13. INSTALL STORM DRAIN PER 'PIPE BEDDING AND BACKFILL' DETAIL ON SHEET 9. BEDDING SHALL CONSIST OF PEA GRAVEL.
14. INSTALL DEBRIS BARRIER.
15. REGRADE DITCH AND SEED.
16. CONSTRUCT BIO-RETENTION SWALE TO PROPOSED CONTOURS ON PLAN/PROFILE AND DETAILS ON SHEET 9 PER LABELED SECTION.
17. CONSTRUCT RAINGARDEN PER DETAIL ON SHEET 9.
18. RESTORE EASEMENT-PROPERTY INCLUDING FENCE (2), STONE WALKWAY, YARD, AND GRAVEL PARKING AREA. DISTURBED GRASS AREAS SHALL BE COVERED WITH 12" OF COMPOST AMENDED SOIL AND HYDROSEEDED.
19. RESTORE ASPHALT DRIVEWAYS PER EDDS 2-030.
20. RESTORE ASPHALT ROAD PER EDDS 3-040.

UTILITY SCHEDULE

1. UNABLE TO LOCATE UTILITY
2. DID NOT POTHOLE AT THIS LOCATION

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: spwjg Sep 05, 2007 – 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON
DRAWN BY: T.HEMRICH
FIELD BOOK(S):
UPI#

APPROVED FOR CONSTRUCTION

OWEN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

FUNDING NO. RR47368

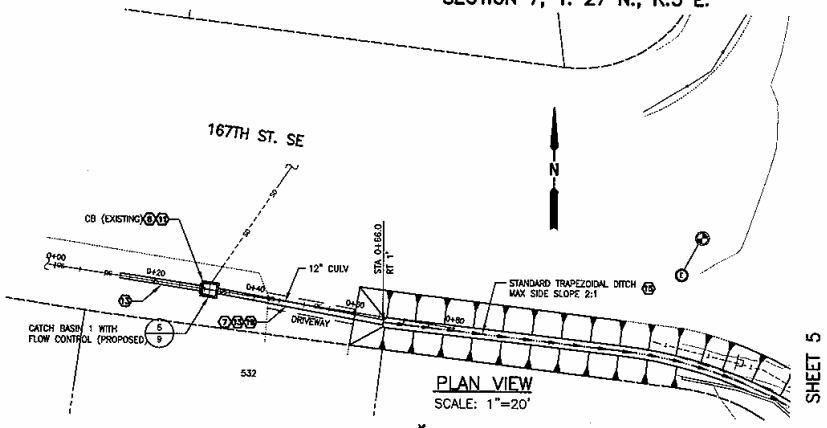
16723 6TH AVE SE
DRAINAGE IMPROVEMENT

PLAN & PROFILE

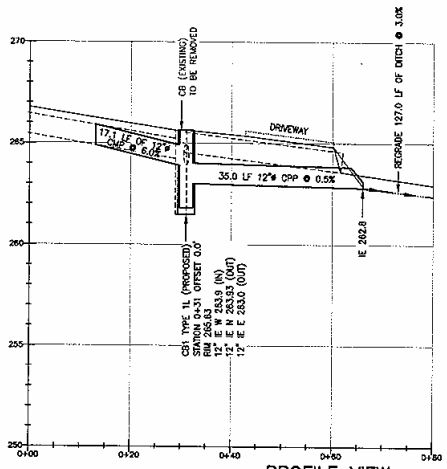
REFERENCE SHEET NO.

SHEET 6 OF 9 SHEETS

SECTION 7, T. 27 N., R.5 E.



PLAN VIEW
SCALE: 1"=20'



PROFILE VIEW
HORIZONTAL SCALE: 1"=20'
VERTICAL SCALE: 1"=5'

VERTICAL CONTROL DERIVED BY GPS, AND ADJUSTED TO SNOHOMISH COUNTY'S PLSS CONTROL POINT NO. 1349, DESIGNATED AS 333/819. ELEV = 276.83 FEET

NAVD88

DATUM CONVERSION:
NAVD88 – NGVD29 = 3.65 FEET
(BASED ON VERTCON 2.0 PROGRAM)

PLAT MONUMENTED CONTROL POINTS

NO.	NORTHING	EASTING	ELEV.	DESCRIPTION
E	640011.291	1637135.061	263.25	BRASS SURFACE DISK W/"+"

CONSTRUCTION NOTES

1. PROTECT EXISTING TREES/SHRUBS.
2. REMOVE EXISTING TREES/SHRUBS.
3. PROTECT LANDSCAPE TIMBER/PLANTER.
4. REMOVE LANDSCAPE TIMBER/PLANTER.
5. RELOCATE MAILBOXES DURING CONSTRUCTION. AFTER PROJECT COMPLETION, RETURN TO THE ORIGINAL LOCATION.
6. SAWCUT AND REMOVE PAVEMENT.
7. REMOVE EXISTING STORM DRAIN.
8. REMOVE EXISTING CATCH BASIN.
9. ABANDON EXISTING STORM DRAIN. LEAVE IN PLACE. PLUG EXISTING PIPE ENDS WITH CONCRETE.
10. INSTALL CATCH BASIN WITH FRAME AND GRATE. BACKFILL SHALL CONSIST OF PEA GRAVEL.
11. INSTALL FLOW CONTROL CATCH BASIN WITH FRAME AND GRATE PER 'CB1 WITH FLOW CONTROL' DETAIL ON SHEET 9.
12. INSTALL CULVERT PER DETAIL 'SWALE SECTION C AT CULVERT'.
13. INSTALL STORM DRAIN PER 'PIPE BEDDING AND BACKFILL' DETAIL ON SHEET 9. BEDDING SHALL CONSIST OF PEA GRAVEL.
14. INSTALL DEBRIS BARRIER.
15. REGRADE DITCH AND SEED.
16. CONSTRUCT BIO-RETENTION SWALE TO PROPOSED CONTOURS ON PLAN/PROFILE AND DETAILS ON SHEET 9 PER LABELED SECTION.
17. CONSTRUCT RAINGARDEN PER DETAIL ON SHEET 9.
18. RESTORE EASEMENT-PROPERTY INCLUDING FENCE (2), STONE WALKWAY, YARD, AND GRAVEL PARKING AREA. DISTURBED GRASS AREAS SHALL BE COVERED WITH 12" OF COMPOST AMENDED SOIL AND HYDROSEEDED.
19. RESTORE ASPHALT DRIVEWAYS PER EDDS 2-030.
20. RESTORE ASPHALT ROAD PER EDDS 3-040.

UTILITY SCHEDULE

1. UNABLE TO LOCATE UTILITY
2. DID NOT POTHOLE AT THIS LOCATION

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: sawtjg Sep 05, 2007 – 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON
DRAWN BY: T.HEMRICH
FIELD BOOK(S): UPI#

APPROVED FOR CONSTRUCTION

OWEN S. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

FUNDING NO. RR47388

16723 6TH AVE SE
DRAINAGE IMPROVEMENT

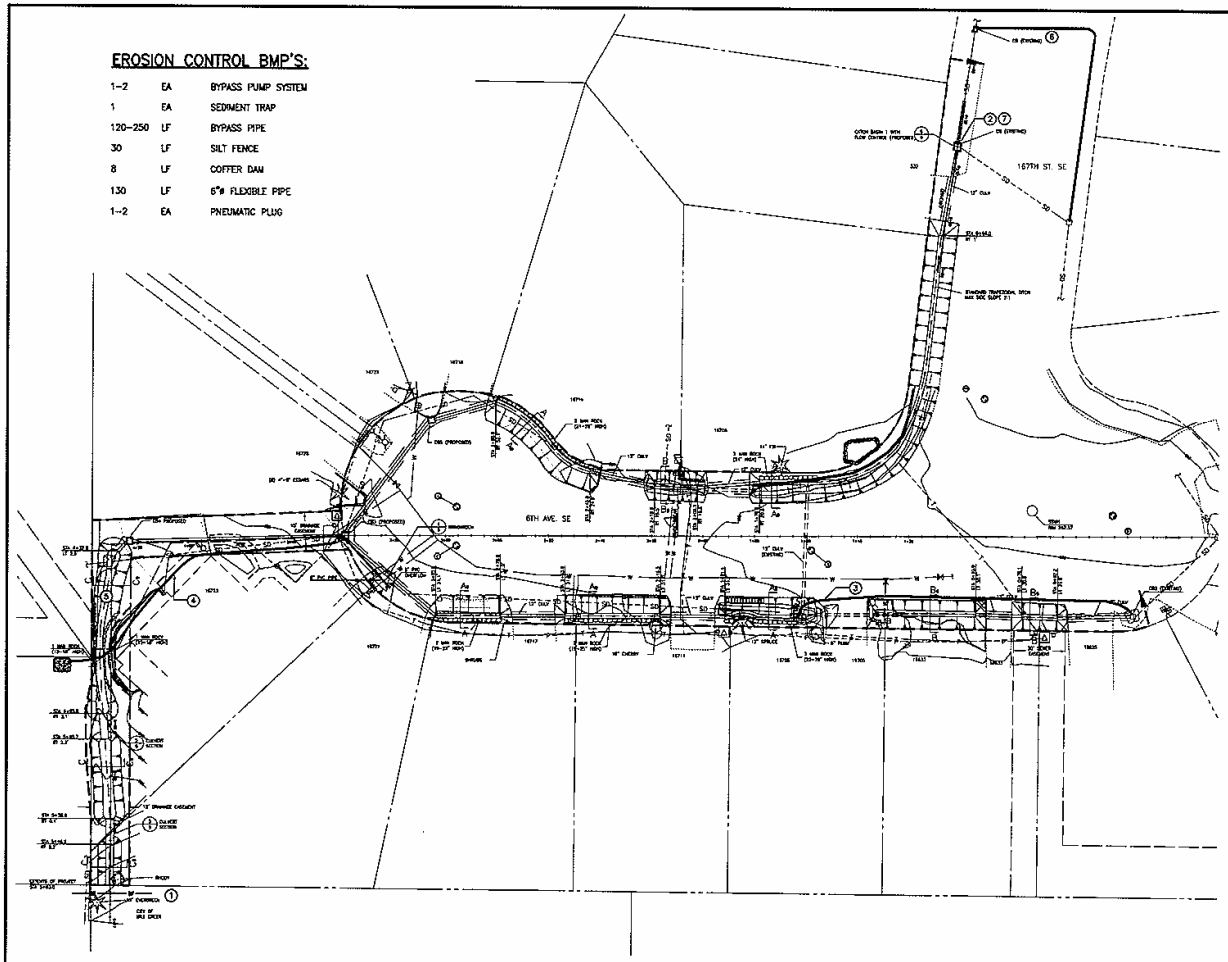
PLAN & PROFILE

REFERENCE SHEET NO.

SHEET 7 OF 9 SHEETS

EROSION CONTROL BMP'S:

1-2	EA	BYPASS PUMP SYSTEM
1	EA	SEDIMENT TRAP
120-250	LF	BYPASS PIPE
30	LF	SILT FENCE
8	LF	COFFER DAM
130	LF	6"ø FLEXIBLE PIPE
1-2	EA	PNEUMATIC PLUG



S.W.P.P.P. NOTES:

1. INSTALL TEMPORARY SILT FENCE.
2. INSTALL PNEUMATIC PLUG INTO EAST PIPE INLET DIVERTING WATER TO THE NORTHEAST CROSS CULVERT.
3. INSTALL TEMPORARY COFFER DAM WITH WITH PUMP AND PIPE BYPASS TO CB2 AS NEEDED.
4. INSTALL PNEUMATIC PLUG, PUMP, AND BYPASS FROM CB3 TO SEDIMENT BAG AT EXISTING CHANNEL AS NEEDED.
5. AT THE COMPLETION OF THE BIORETENTION SWALES WITHIN THE EASEMENT, INSTALL A COFFER DAM AT THE WEST PIPE OUTLET WITH A 6"ø TEMPORARY BYPASS PIPE TO THE EAST END OF THE EASEMENT. THE BYPASS SHALL NOT BE REMOVED UNTIL AFTER SOILS AND VEGETATION HAVE STABILIZED.
6. PRIOR TO REPLACING THE CB ALONG 167TH STREET SE, INSTALL A PNEUMATIC PLUG AT OUTLET OF UPSTREAM CB. USE A TEMPORARY PUMP AND BYPASS TO DIRECT THE WATER TO THE CB ON THE NORTH SIDE OF THE STREET ON AN AS NEEDED BASIS.
7. AT THE END OF CONSTRUCTION, A PNEUMATIC PLUG SHALL BE PLACED INTO THE EAST PIPE (WITH FLOW CONTROL) AT CB1 . THE PLUG SHALL REMAIN IN PLACE UNTIL SOILS AND VEGETATION HAS STABILIZED.

TEMPORARY SEDIMENT AND EROSION CONTROL NOTES:

1. SEDIMENT CONTROL DEVICES SHALL BE INSPECTED FREQUENTLY DURING CONSTRUCTION.
2. AFTER COMPLETION OF PROJECT, REMOVE SEDIMENT BUILDUP IN FRONT OF BMP'S AS WELL AS BMP'S UNLESS OTHERWISE STATED.
3. ALL EXPOSED SOILS RESULTING FROM THE CONSTRUCTION ARE TO BE REVEGETATED WITH SEED, FERTILIZER AND MULCH OR OTHER ACCEPTABLE METHODS.

S.W.P.P.P. LEGEND:

- TEMPORARY COFFER DAM
- TEMPORARY SILT FENCE
- BYPASS PIPE
- CONSTRUCTION LIMITS
- DEWATERING PUMP
- SEDIMENT TRAP

PLAN CHECK	BY	DATE	DATE	NO.	REVISION	BY

Last Saved By: sawky Sep 05, 2007 - 3:13pm

REGION NO.	STATE	FED. AID PROJ. NO.	SURVEY NO.
10	WASH.		4097

DESIGNED BY: T.GILSON
DRAWN BY: T.HEMRICH
FIELD BOOK(S):
UPI#

APPROVED FOR CONSTRUCTION

OWEN B. CARTER, P.E.
SNOHOMISH COUNTY ENGINEER

DATE APPROVED:

SNOHOMISH COUNTY DEPARTMENT OF PUBLIC WORKS

FUNDING NO. RR47388

16723 6TH AVE SE
DRAINAGE IMPROVEMENT

SWPPP

REFERENCE SHEET NO.

SHEET 8 OF 9 SHEETS

Appendix B Sampler and Meter Information

SIGMA 900 MAX Portable Sampler

Sigma Portable Sampler Specification

Model 900 Portable Sampler Specifications

General Specifications:

Dimensions:

- Compact Base - Diameter 17-3/8" (44.1 cm), Height 24" (61 cm).
- Standard Base - Diameter 19-7/8" (50.1 cm), Height 27-3/16" (69.4 cm).

Sample Pump:

- High speed peristaltic, dual roller, with 3/8" (.95 cm) ID by 5/8" (1.6 cm) OD pump tube.

Pump Body:

- High impact, corrosion resistant, glass reinforced Delrin*.

Vertical Lift:

- 27 ft. (8.2 m) maximum (note: Remote Pump Option recommended for lifts from 22 ft. (6.7 m) to 35 ft. (10.7 m).

Sample Transport Velocity:

- 2 ft./sec. (.6 m/sec.) minimum at 15 ft. (4.6 m) vertical lift in a 3/8" (.95 cm) ID intake tube.

Pump Flow Rate:

- 60 ml/sec at 3 ft. vertical lift in a 3/8" (.95 cm) ID intake tube.

Liquid Sensor:

- Single sensor, non-contact.

Sample Volume:

- Programmed in milliliters, in one ml increments from 10 to 9,999 ml.

Sample Volume Repeatability:

- ±5% typical.

Sample Bottle Capacity:

- **Composite:** 2.5 gal. glass, 3 gal. polyethylene, 4 gal. polyethylene, 5.5 gal. polyethylene, and 6 gal. polyethylene.
  Multiple Bottle: (2) 1 gal. glass, (2) 1 gal. polyethylene, (4) 1 gal. glass, (4) 1 gal. polyethylene, (8) 950 ml glass, (8) 1.9 liter glass, (8) 2.3 liter polyethylene, (12) 950 ml glass, (24) 350 ml glass, and (24) 575 ml polyethylene and (24) 1 liter polyethylene.

Sampling Modes:

- Multiple Bottle Time,
- Multiple Bottle Flow,
- Composite Time,
- Composite Flow,
- Flow with Time Override,
- Variable Interval,
- Start/Stop,
- Level Actuation.

Interval Between Samples:

- Selectable in single increments from 1 to 9,999 flow pulses (momentary contact closure 25 msec. or 5-12 VDC pulse; 4-20 mA interface optional), or 1 to 9,999 minutes in one minute increments.

Multiplex:
Multiple Bottle Mode:

- multiple samples per bottle and/or multiple bottles per sample collection.

Intake Purge:

- Air purged automatically before and after each sample; duration automatically compensated for varying intake line lengths.

Pump/Controller Housing:

- High impact injection molded ABS; submersible, watertight, dust tight, corrosion & ice resistant; NEMA 4X,6.

Control Panel:

- 18 key membrane switch keypad; 24 character alphanumeric liquid crystal display.
- **Internal Clock:** Indicates real time and date; 0.007% time base accuracy.
- **Diagnostics:** Tests RAM, ROM, pump, and distributor.
- **Program Delay:** Sampler start at time of day or delay in minutes.
- **Manual Sample:** Initiates a sample collection independent of program in progress.
- **Intake Rinse:** Intake line automatically rinsed with source liquid prior to each sample, from 1 to 3 rinses.
- **Intake Fault:** Sample collection cycle automatically repeated from 1 to 3 times if sample not obtained on initial attempt.
- **Multiple Programs:** Stores up to five sampling programs.
- **Cascade:** Allows using two samplers in combination where the first sampler at the completion of the program initiates the second.
- **Data Logging:** Records program start time and date, stores up to 400 sample collection

times/dates, all program entries, operational status including number of minutes or pulses to next sample, bottle number, number of samples collected, number remaining, sample volume collected, volume remaining, sample identification number.

Status Output:

- Low main battery,
- Low memory power
- Plugged intake
- Jammed distributor arm
- Sample collected
- Purge failure.

Automatic Shutdown:

- **Multiple Bottle Mode:** After complete revolution of distributor arm (unless Continuous Mode selected).
- **Composite Mode:** After preset number of samples have been delivered to composite container, from 1-999 samples, or upon full container.
- **Program Lock:** Access code protection precludes tampering.
- **Intake Tubing:** 3/8" ID vinyl.1/4" ID vinyl.3/8" ID Teflon and polyethylene.
- **Intake Strainer:** Teflon® and 316 stainless construction.All 316 stainless steel in standard size and low profile for shallow depth applications.
- **Sampler Case:** High impact ABS, 3 section construction; double walled insulated base.

Power Requirements:

- **12 VDC** (supplied by 12 VDC battery or AC adapter).
- **Optional AC Power Backup:** Rechargeable 6 Amp-hour gel lead acid battery takes over automatically with AC line power failure. Integral trickle charger maintains battery at

full charge.

- **Internal Battery:** 5 year lithium battery maintains program settings and real time clock.
- **Overload Protection:** 5 amp DC line fuse 1 amp DC line fuse (AC power converter).

Temperature Range:

- **General use:** 32° to 120°F (0° to 49°C)
- **Liquid Crystal Display:** Operating - 14° to 158°F (-10° to 70°C)
- **Storage:** -40°F to 176°F (-40° to 80°C).

Note: Specifications are subject to change without notice.

SIGMA 910 Area Velocity Flow Meter

Specifications

Model 910 Area Velocity Flow Meter

Specifications General:

- **Dimensions:** 4.5" dia. x 17.625" L (11.4 cm dia. x 44.8 cm L).
- **Weight:** 7.8 lbs. (3.54 kg) with battery.
- **Enclosure Material:** PVC.
- **Enclosure Rating:** NEMA 6P (IP67).
- **Operating Temperature Range:** 0 to 140°F (-18 to 60°C).
- **Storage Temperature Range:** -40 to 140°F (-40 to 60°C).
- **Power Source:** One (6V) Alkaline lantern battery.
- **Battery Life:** 60 days typical with a 15-minute recording interval, 1 level and 1 velocity, data download once per week, at 50° F (10°C) (also affected by site conditions).
- **User Interface:** IBM compatible PC.
- **Monitoring Intervals:** 1, 2, 3, 5, 6, 10, 12, 15, 20, 30, 60-minutes.
- **Program Memory:** Non-volatile, programmable flash, can be updated via RS-232 port.
- **Time Based Accuracy:** ±1 second per day.

Units of Measurement:

- **Level:** in., m, cm, ft.
- **Flow:** GPS, GPM, GPH, LPS, LPM, LPH, MGD, AFD, CFS, CFM, CFH, CFD, M3S, M3M, M3H, M3D.
- **Totalized Flow:** gal., ft.^{3}, acre-ft., L, m^3.

Data Storage:

- **Capacity:** 90 days of 1 level reading and 1 velocity reading at a 15-minute recording interval.
- **Data Types:** Level and velocity.
- **Storage Mode:** Wrap or slate.
- **Communications:** Serial connection to IBM compatible computer with Sigma analysis software

Velocity Measurement Accuracy:

- **Method:** Doppler ultrasonic.
- **Transducer Type:** Twin 1 MHz piezoelectric crystals.
- **Typical minimum depth for velocity:** .8 in. (2 cm).
- **Range:** -5 to 20 fps (-1.52 to 6.10 m/s).
- **Zero Stability:** <.05 fps. (.015 m/s).
- **Accuracy:** ±2% of reading.

Integral Submerged Depth/ Velocity Sensor Accuracy:

- **Level Measurement (non-linearity and hysteresis):**
  - **Standard:** .018 to 11.5 ft. ±. 023 ft. (.005 m - 3.5 m ± .007 m);
  - **Extended :** .018 to 34.6 ft ± .07 ft. (.005 - 10.5 m ± .021 m).

- **Maximum Allowable Level:** 3x over pressure.
- **Operating Temperature Range:** 32 to 160°F (0-71°C).
- **Compensated Temperature Range:** 32 to 86°F (0-30°C).
- **Temperature Error:** .018 - 34.6 ft. ±.012 ft./°F (.018-10.5 m ± .006 m/°C). .018 - 34.6 ft. ± .012 ft./°F (.018-10.5 m ± .006 m/°C) (maximum error within compensated temperature range - per degree of change).
- **Velocity Induced Error on Depth (patent pending):** 0 to 10 ft/sec. (0 to 3.05 m/s) = .085% of reading.
- **Air Intake:** Atmospheric pressure reference is desiccant protected.

General:

- **Material:** Polymer body with stainless steel diaphragm.
- **Cable:** Urethane sensor cable with air vent.
- **Cable Length:** 25' (7.6 m) standard. 250' (76 m) maximum.
- **Dimensions (combination sensor):** .8" H x 1.5" W x 5" L (2 cm x 3.8 cm x 12.7 cm).

This Instruction Manual is also available for download on our Web-site: eutechinst.com or 4oakton.com

EUTECH INSTRUMENTS
Technology Made Easy ...

OAKTON

INSTRUCTION MANUAL

pHTestr 10, 20, 30, 10BNC, Spear

Large Screen
Waterproof pH / Temperature Tester
Double Junction

Introduction

Thank you for selecting our microprocessor waterproof pH tester with USA or NIST buffer set selection. You have one of five models:

- pHTestr10
- pHTestr20
- pHTestr30
- pHTestr10BNC
- pHSpear

This manual provides a step-by-step guide to operate the testers.

Before you begin:

Condition your pHTestr 10, 20, 30 electrodes by immersing it in electrode storage solution or tap water for at least 30 minutes before use. DO NOT use de-ionized water.

Ensure that your pHSpear electrode is always soaked in the electrode storage solution or tap water via its protective cap.

Note: For pHTestr10BNC, please refer to the pH electrode's instruction manual.

pH Buffer Set Selection

Your tester features USA (pH 4.01, pH 7.00 and pH 10.01) or NIST (pH 4.01, pH 6.86, and pH 9.18) standards. Select either one to suit your requirements.

1. While pressing the HOLD/ENT button, switch on the tester by pressing the ON/OFF button.
2. Release the HOLD/ENT button. The display will flash either USA or NIST.
3. Press CAL button to toggle between the two buffer set standards.
4. Press the HOLD/ENT button to confirm the selection of the buffer set.

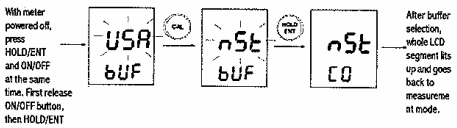


Figure 1: Buffer Selection Sequence

pH Calibration

Calibration should be done regularly, preferably once a week. You can calibrate up to three points using either the USA or the NIST buffer set standards.

1. Press ON/OFF button to switch unit on.
2. Dip electrode about 2 to 3 cm into the pH standard buffer solution.
3. Press the CAL button to enter calibration mode. The 'CAL' indicator will be shown. The upper display will show the measured reading based on the last calibration while the lower display will indicate the pH standard buffer solution.

Note: All testers have dual display during calibration mode
Note: To abort calibration, press the 'CAL' button.

4. Allow about 2 minutes for the tester reading to stabilize before pressing the HOLD/ENT button to confirm the first calibration point. The upper display will be calibrated to the pH standard buffer solution and the lower display will then be toggling in between readings of the next pH standard buffer solution.
5. Repeat with other buffers if necessary. Rinse electrode in tap water before dipping into next buffer.

Note: The calibration mode allows you to perform up to three calibration points before returning to the measurement mode automatically. However, if you opted to have only one or two calibration points, simply skip the remaining calibration points by exiting to the measurement mode by pressing the CAL button.

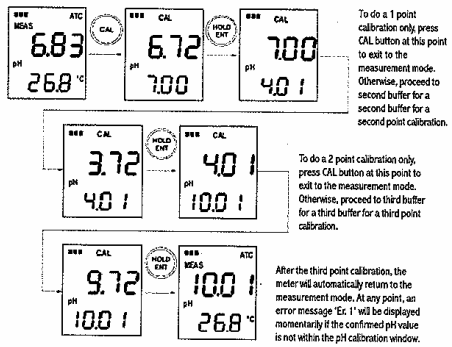


Figure 2: Example of pH Calibration Sequence

pH Measurement

1. Press the ON/OFF button to switch the tester on.
2. Dip the electrode about 2 to 3 cm into the test solution. Stir and let the reading stabilize. For pHSpear, pierce the penetrating tip electrode through your semi solid sample as per the desired depth. Rotate left and right several times and tilt to ensure sample contact.
3. Note the pH value or press HOLD/ENT button to freeze the reading. To release the reading, press HOLD/ENT again.
4. Press ON/OFF to turn off tester. If you do not press a button for 8.5 minutes, the tester will automatically shut off to conserve batteries.

HOLD Function

This feature lets you freeze the display for a delayed observation

1. Press HOLD/ENT button to freeze the measurement. A 'HOLD' indicator will be displayed and the measurement will be frozen.
2. Press HOLD/ENT again to release the measurement. The 'HOLD' indicator will not be displayed anymore indicating the held measurement is released.

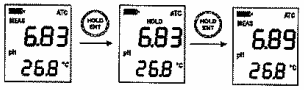


Figure 4: Example of HOLD Function

User Reset

You can reset the pH calibration to the factory default by using the user reset function. Buffer set selection and temperature user calibration (pHTestr30) are not affected by the user reset function.

1. Switch off the tester.
2. While pressing the 'CAL' button, press and release the ON/OFF button to enter the 'User Reset' selection menu. The screen will display 'rSt' on the bottom display with a flashing 'nO' selection.
3. Use the 'CAL' button to toggle between 'nO' and 'YES' selection.
   - nO deactivates reset selection
   - YES activates the reset selection
4. Press the HOLD/ENT button to confirm the selection made.
5. If you have selected 'YES', the unit will show 'CO' momentarily and proceed to the measurement mode with the calibration reset back to factory default value.
6. If 'nO' is selected, the unit will proceed to the measurement mode without any calibration reset performed.

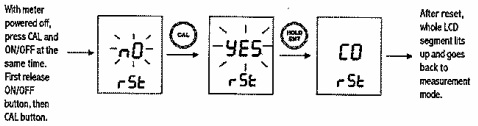


Figure 5: User Reset Sequence

Automatic Temperature Compensation (ATC)

ATC feature is available only in pHTestr 10, pH Testr 20 and pH Testr 30. Through its in-built temperature sensor, the measurement error due to the changes in electrode sensitivity due to changes in temperature is compensated to give the actual pH reading of the sample measured.

pH Testr10BNC and pH Spear has no ATC function and therefore the error should be calculated to derive the actual pH reading of the sample. For these testers, the impact on temperature compensation is 0.003 pH /°C / pH away from pH 7. For example, if pHSpear is calibrated at room temperature (25 °C) and is measuring sample around pH 4 at around 5 °C.

Temperature difference : 25°C - 5°C = 20 °C
pH away from neutral : 7pH - 4pH = 3 pH
Total error : 0.003 x 20 x 3 = 0.18 pH

This error value of 0.18 pH should be taken into consideration to derive the actual pH reading of the sample.

Temperature Calibration (Only for pHTestr 30)

From the measurement mode,

1. Press the HOLD/ENT button to bring the tester to the 'HOLD' mode.
2. Press the CAL button for 3 seconds to switch to the °C or °F mode setting selection screen. Pressing the CAL button continuously for 3 seconds allows you to toggle in between the °C and °F mode setting selection screen.
3. Release the CAL button to confirm your mode selection and the display will go to the temperature calibration mode with the upper display flashing. The upper display shows the current measured temperature reading based on the last set offset and the lower display shows the current measured temperature reading based on factory default calibration.
4. Dip the tester into a solution of known temperature and allow time for the in built temperature sensor to stabilize.
5. Press the HOLD/ENT button to set the upper display to the temperature value of the solution.
6. Once the new temperature setting is reached, the new value is automatically confirmed and returns to the measurement mode if no button is pressed after 5 seconds.

Notes: To exit this program without confirming the calibration, press the CAL button before the automatic confirmation takes place.

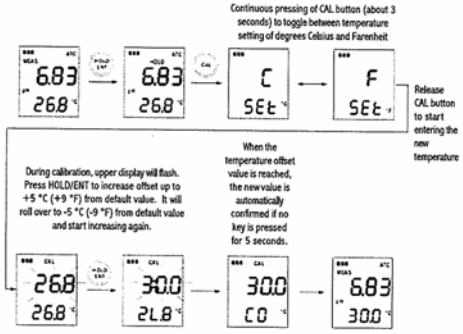


Figure 6: Temperature Calibration Sequence (Only for pHTestr 30DJ)

Electrode Maintenance

1. Rinse the electrode with tap water or electrode storage solution after each measurement. Care has to be taken not to damage the sensor's glass electrode especially while rinsing the pHSpear penetrating tip electrode.
2. In aggressive chemicals, dirty or viscous solutions, and solutions with heavy metals or proteins, take readings quickly and rinse electrode immediately afterward. For the pHSpear, the remnants of the semi solid samples on the penetrating electrode can be removed by rubbing it with some table salt and then rinsing. Mild detergent can be used to wash the penetrating electrode clean.
3. If possible, keep a small piece of paper or sponge in the electrode cap – moistened with clean water or electrode storage solution (NOT de-ionized water) – and close the cap over the electrode. For pHSpear, ensure that the electrode is kept soaked in electrode storage solution or tap water via its protective cap.

Changing Batteries

1. Open battery compartment lid (with attached lanyard loop).
2. Remove old batteries; replace with fresh ones. Note polarity

Self-Diagnostic Messages

Low battery indicator		3 Bars indicates Battery is full (100%)
		2 Bars indicates 50% of the battery life is left
		1 Bar indicates 25% of the battery life is left
		Blinking battery casing indicates the need to replace batteries with fresh ones as specified by manufacturer
Over range / Under range signal	Or / Ur (Still)	Electrode is not in contact with solution or electrode is failing.
		Replacement sensor is not connected properly to the tester during sensor replacement
		Measured pH value or temperature value (pHTestr30) exceeds its specified maximum or minimum value
	ATC / Or / Ur (Blinking)	Blinking 'ATC', 'Or' or 'Ur' indicates that there is a short or open circuit at the built in temperature sensor
Error Message	Er.0	Temperature calibration error of attempting to calibrate tester to a value which is out of range or under range
	Er.1	pH calibration error of attempting to confirm a calibration value which is not within the specified calibration window

Electrode Replacement

You can replace the electrode module at the fraction of the cost of a new tester. When the tester fails to calibrate or gives fluctuating readings in calibration standards, you need to change the electrode.

1. With dry hands, grip the ribbed tester collar with electrode facing you. Twist the collar counter clockwise (see picture A). Save the ribbed tester collar and O-ring for later use.
2. Pull the old electrode module away from the tester.
3. Align the four tabs on the new module so that they match the four slots on the tester (see picture B).
4. Gently push the module onto the slots to sit it in position. Push the smaller O-ring fully onto the new electrode module. Push the collar over the module and thread it into place by firmly twisting clockwise.

Note: It is necessary that you recalibrate your tester prior to measurement after an electrode replacement.

Figure 7: Removal of collar from tester

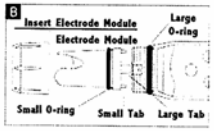


Figure 8: Example of electrode module fitting alignment

Applications

Water quality testing • pools • spas • aquariums • aquaculture • hydroponics • ecology studies • water and wastewater treatment • boilers • steam generators • car washes • sanitation plants • labs • food sectors and more!

Warranty

The waterproof pHTestr10, pHTestr20, pHTestr30, pHTestr10BNC and pHSpear are warranted to be free from manufacturing defects for 2 years and electrode module for 6 months. If repair, adjustment or replacement is necessary and has not been the result of abuse or misuse within the time period, please return the tester – freight prepaid – and correction will be made without charge. Out of warranty products will be repaired on a charge basis.

Return of Items

Authorization must be obtained from your distributor before returning items for any reason. When applying for authorization, please include information regarding the reason the item(s) are to be returned.

Note: We reserve the right to make improvements in design, construction and appearance of products without notice. Prices are subject to change without notice.

Accessories

Item	Eutech Instruments Order Code	Oakton Instruments Order Code
pHTestr 10,20,30 replacement sensor	ECPHWPSEN03	OKPHWPSEN03
pHTestr10BNC replacement sensor	ECPHWPSENBNC	OKPHWPSENBNC
pHSpear replacement sensor	ECPHWPSEN04	OKPHWPSEN04

Specifications

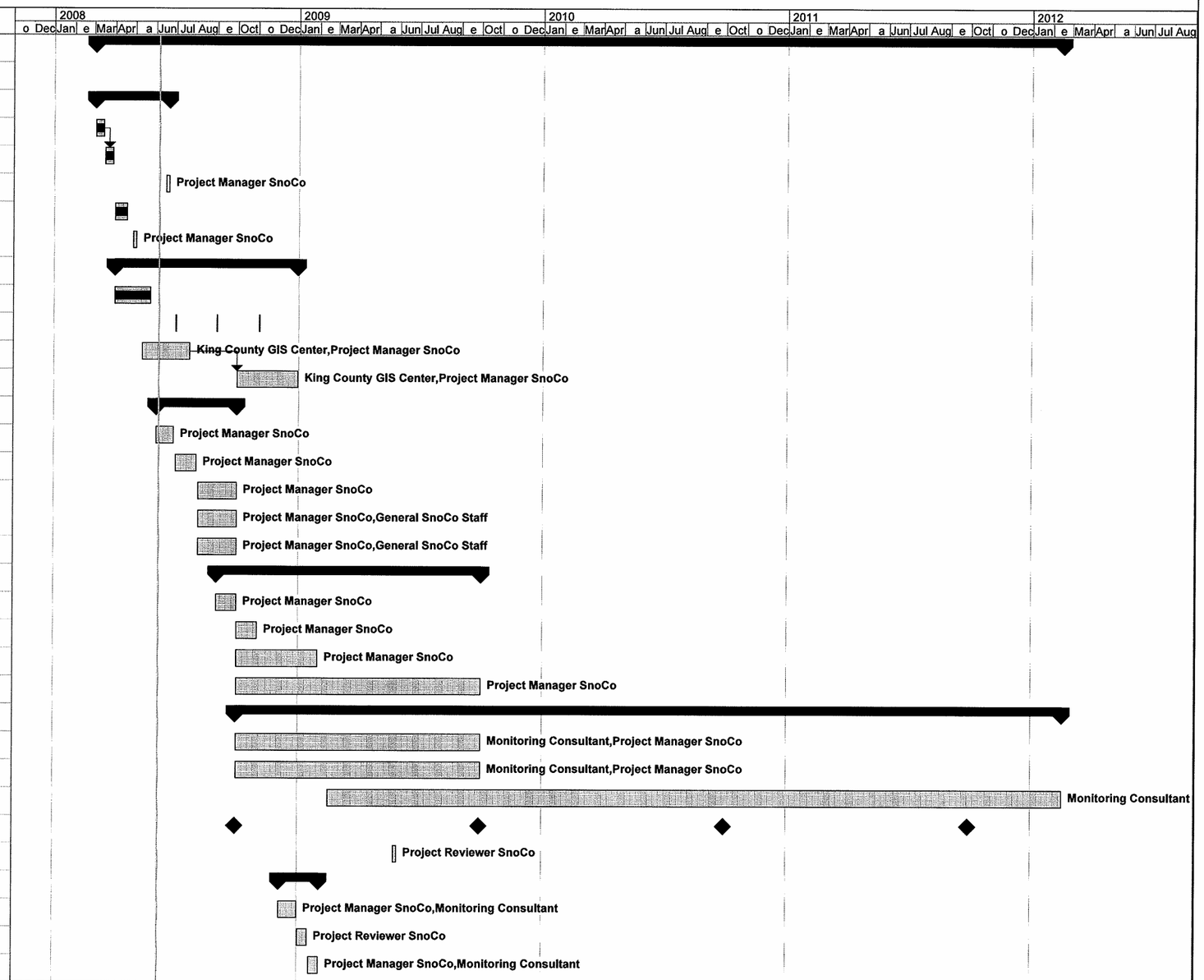
Large Screen Testers	pHTestr10	pHTestr20	pHTestr30	pHTestr 10BNC	pHSpear
pH Range	-1.0 to 15.0 pH	-1.00 to 15.00 pH			
Resolution	0.1 pH	0.01 pH			
Relative Accuracy	0.1 pH	0.01 pH			
Calibration Points	Up to 3 points	Up to 3 points			
Buffer Set Standard Selection	USA - 4.0/7.0/10.0 NIST - 4.0/6.9/9.2	USA - 4.01/7.00/10.01 NIST - 4.01/6.86/9.18			
Calibration Window (USA Buffer Set Standard)	+/-1.0 pH (pH 4.0 & pH 10.0), +/-1.5 pH (pH 7.0)	+/-1.00 pH (pH 4.01 & pH 10.01), +/-1.50 pH (pH 7.00)			
Calibration Window (NIST Buffer Set Standard)	+/-1.0 pH (pH 4.0 & pH 9.2), +/-1.2 pH (pH 6.9)	+/-1.00 pH (pH 4.01 & pH 9.18), +/-1.25 pH (pH 6.86)			
Temperature Display	No		0-50.0°C or 32.0-122.0°F	No	
Automatic Temperature Compensation (ATC)	Yes			No (Fix Temp Compensation at 25°C)	
Temp Resolution	No		0.1 °C / °F	No	
Temp Accuracy	No		0.5 °C / 0.9 °F	No	
Temp Calibration Window	No		+/- (5°C /9 °F) from default value	No	
Auto Off	After 8.5 minutes from last key press				
User reset	Yes				
Non Volatile Memory Backup	Yes				
LCD Display	Dual				
Power Requirement	4 x 1.5V "A 76" micro Alkaline Batteries				
Battery life	More than 500 hrs				
Operating Temperature	0 – 50 °C				
Tester Dimensions	6.5 "L x 1.5"dia. (165 x 38 mm)				9.75 "L x 1.5"dia. (247 x 38 mm)
Weight	3.25 oz (90 gm)				
Penetrating electrode total length	Not applicable				91 mm
Shaft length	Not applicable				31 mm
Penetrating electrode upper diameter	Not applicable				12 mm
Shaft diameter	Not applicable				7 mm

68X068042 11/04 Rev 2

Appendix C Schedules

S8.D Stormwater Monitoring
Schedule

ID	Task Name
1	**Monitoring Implementation**
2	
3	**Equipment Purchase**
4	Review equipment and get cost estimate
5	Submit Requirements to purchasing
6	Purchase ISCOs and Equipment
7	Identify ISCO storgage location
8	Purchase Decon Equipment
9	**Database Development**
10	Database Scoping Meeting
11	**Project Meetings**
15	Construct Database
16	Beta Test Database
17	**Install Equipment**
18	Identify Staff to Assist with Install
19	Install Workshop with Vendor
20	Install Rain Gauges
21	Install Flow Meters
22	Install Samplers
23	**Test Equipment**
24	Sampling Workshop with Vendor
25	Conduct Blank Sampling
26	Collect Three Sets of Test Samples
27	Collect Base Flow Sampler (at least 2 per season per site)
28	**Initiate Sampling**
29	Collect Rainfall Data
30	Collect Runoff Data
31	Water Sampling
32	**Sediment Sampling**
37	QAPP Audit
38	**Annual Report**
39	Begin Annual Report
40	Review Draft
41	Finalize Monitoring Section of Annual Report



Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

February 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17 Outflow	18 Outflow	19 Inflow	20	21
22	23 Inflow	24 Inflow Outflow	25	26 Inflow	27	28

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

March 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3 Inflow	4 Inflow, Outflow	5	6	7
8	9 Outflow	10 Outflow	11	12	13	14
15	16	17 Inflow	18	19 Outflow	20	21
22	23 Inflow	24	25	26 Inflow, Outflow	27	28
29	30	31 Inflow				

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

April 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 Inflow, Outflow	2 Inflow	3	4
5	6 Outflow	7 Outflow	8 Outflow	9 Outflow	10	11
12	13 Inflow, Outflow	14 Inflow	15 Inflow	16	17	18
19	20 Inflow	21 Inflow, Outflow	22 Outflow	23	24	25
26	27	28 Inflow, Outflow	29 Inflow, Outflow	30		

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

May 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5	6	7 Inflow Outflow	8	9
10	11	12 Outflow	13 Inflow Outflow	14 Inflow Outflow	15	16
17	18	19	20 Outflow	21	22	23
24	25	26 Inflow Outflow	27 Inflow	28 Inflow Outflow	29	30
31						

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

June 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 Inflow	2 Inflow	3 Inflow	4	5	6
7	8 Inflow	9	10 Inflow	11 Outflow	12	13
14	15 Inflow	16 Outflow	17	18 Outflow	19	20
21	22 Inflow	23 Inflow, Outflow	24 Outflow	25 Inflow	26	27
28	29 Inflow, Outflow	30 Outflow				

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

July 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1 Inflow	2 Outflow	3	4
5	6 Outflow	7 Inflow, Outflow	8	9 Outflow	10	11
12	13 Inflow	14 Outflow	15 Inflow, Outflow	16	17	18
19	20 Inflow	21	22	23	24	25
26	27	28 Inflow, Outflow	29 Outflow	30	31	

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

August 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3 Inflow, Outflow	4	5 Outflow	6 Outflow	7	8
9	10 Outflow	11 Outflow	12	13 Outflow	14	15
16	17 Inflow	18 Inflow, Outflow	19 Inflow, Outflow	20 Inflow	21	22
23	24 Inflow	25 Outflow	26 Outflow	27 Inflow, Outflow	28	29
30	31					

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

September 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1 Inflow	2	3 Outflow	4	5
6	7	8 Outflow	9 Inflow	10 Inflow, Outflow	11	12
13	14 Inflow	15 Inflow	16 Inflow	17 Inflow, Outflow	18	19
20	21 Inflow, Outflow	22 Outflow	23 Outflow	24 Outflow	25	26
27	28	29 Inflow, Outflow	30			

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

October 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1	2	3
4	5	6 Inflow	7 Outflow	8 Inflow	9	10
11	12	13 Outflow	14 Inflow	15 Inflow	16	17
18	19	20 Inflow Outflow	21 Inflow Outflow	22	23	24
25	26 Inflow Outflow	27	28	29 Outflow	30	31

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

November 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2 Inflow, Outflow	3 Inflow	4 Inflow	5	6	7
8	9	10 Outflow	11	12 Inflow, Outflow	13	14
15	16 Inflow, Outflow	17 Outflow	18	19	20	21
22	23 Outflow	24 Inflow	25 Inflow, Outflow	26	27	28
29	30					

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

December 2009

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2 Inflow	3 Outflow	4	5
6	7 Outflow	8 Inflow Outflow	9	10 Outflow	11	12
13	14	15	16	17 Inflow Outflow	18	19
20	21 Inflow Outflow	22 Inflow	23 Outflow	24	25	26
27	28 Inflow Outflow	29	30 Inflow Outflow	31		

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

January 2010

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
					1	2
3	4	5 Inflow	6 Inflow, Outflow	7 Inflow, Outflow	8	9
10	11 Outflow	12	13 Inflow	14 Inflow	15	16
17	18	19 Inflow	20	21 Inflow, Outflow	22	23
24	25 Inflow	26 Inflow, Outflow	27 Inflow, Outflow	28 Outflow	29	30
31						

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Snohomish County NPDES Phase I Permit S8.F
Stormwater Treatment BMP Monitoring Schedule

February 2010

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1 Inflow Outflow	2 Inflow	3 Inflow Outflow	4	5	6
7	8	9 Inflow Outflow	10	11 Inflow Outflow	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

X:\Wq\NPDES\Monitoring S.8\Hydrologic BMP Monitoring\Schedule\Sampling Schedule.mpp
Wed 2/6/08

Appendix D Draft Conceptual Database Tables

Action Table

Monitoring Site ID
Action ID
Date Crew
Action Type

- *Stormwater sampling*
- *Sediment sampling*
- *Toxicity*
- *Flow download*
- *Precip download*
- *Replace strainer*
- *Replace hose*
- *Check/replace battery*
- *Replace sampler*
- *Replace flow meter*
- *Calibrate flow*
- *Calibrate sampler*
- *Calibrate rain guage*

Precipitation Summary Table

Monitoring Site ID
Action ID
Rain Start Date
Rain Start Time
Rain End Date
Rain End Time
Total Rain Fall
Max Intensity
Antecedent Dry Days
Antecedent Rain Event

Precipitation Data Table

Monitoring Site ID
Action ID
Date
Time
Precipitation
Errors

Runoff Summary Table

Monitoring Site ID
Action ID
Peak Flow Captured Y/N
Runoff Start Date
Runoff Start Time
Runoff End Date
Runoff End Time
Total Flow Volume
Peak Flow
Estimated Peak Capture

Runoff Data Table

Monitoring Site ID
Action ID
Date
Time
Runoff
Errors

Maintenance Actions Table	**Decontamination Summary Table**
Monitoring Site ID	Monitoring Site ID
Action ID	Action ID
Replaced Sampler	Equipment
• y/n	• *Hose*
• Comments	• *Strainer*
Replaced Flow Meter	• *Scoop*
Replaced Sampler Battery	• *Sample Bottles*
Replaced Sampler Hose	Equipment ID
Replaced Flow Meter Desiccant	Blank Taken
Calibrated Flow Meter	• y/n
Calibrated Sampler	
Calibrated Rain Gauge	

SW Sampling Data Table	Sed. Sampling Data Table	Parameter Info Table
Monitoring Site ID	Monitoring Site ID	Parameter
Action ID	Action ID	Unit
Sample Start Time	Sample Type	Method
Sample End Time	Date Analyzed	Detection Limit
Sample Type	Date Sampled	Reporting Limit
Date Analyzed	Total Solids Results	Collection Method
Date Sampled	Grain Size	• Grab
TSS	TOC	• Autosampler
Turbidity	Cu	Hold Time
Conductivity	Zn	Lab
Chloride	Cd	
BOD5	Pb	
Hardness	Hg	
MBAS	PAH	
Fecal Coliform	Phthalates	
Total Phosphorus	2,4-D	
Ortho Phosphorus	MCPP	
TKN	Triclopyr	
Nitrite Nitrate	Diazinon	
Total Cu	Malathion	
Dissolved Cu	Chlorpyrfos	
Total Pb	Dichhlrobenil	
Dissolved Pb	Prometon	
Total Zn	Pentachlorophenol	
Dissolved Zn	Total Volatile Solids	
Total Cd	NWTPH-Gx	
Dissolved Cd	NWTPH-Dx	
Mercury	Total Phosphorus	
PAH		
Phthalates		
2,4-D		
MCPP		
Triclopyr		
Diazinon		
Malathion		
Chlorpyrfos		
Dichhlrobenil		
Prometon		
Pentachlorophenol		
Particle Size Distribution		
pH		
NWTPH-Gx		
NWTPH-Dx		
Toxicology		

Test Site Location Table	**Contacts Table**	**BMP Monitoring Status Table**	**BMP Basin Structural Info Table**
Monitoring Site ID	Agency/Firm/Homeowner	Station ID	Station ID
Jurisdiction	Name	Upstream BMP	Water Quality Detention Volume
State	Address	• Wetpond	WQ Detention Area
Zip	Phone	• 2 treatment	WQ Detention Basin Length
Country	E-mail	Relationship to Upstream BMP	Detention Basin Bottom Area
Altitude	Role	• Inflow	Brim Full Volume Empty Time
Lat	Site ID	• Outflow	Half Brim Full Volume Empty Time
Long	• Individual	• N/A	Bottom Stage Volume
Watershed	• All	Downstream BMP	Bottom Stage Volume
Total Watershed Area		• Wetpond	Micropool?
percent Impervious Area		• Two Treatment	Forebay Volume
Regional Climate Station		Relationship to Downstream BMP	Forbay Surface Area
		• Inflow	Vegetative Cover Description
		• Outflow	Flood Control Volume
		• N/A	Design Flood Return Periods
		Structural BMP name	
		Structural BMP Type	
		Date Facility put into service	
		# Separate inflows	
		Type of BMP outlet	
		Does BMP have a bypass	
		Drawing	

BMP Biofilter Info Table
Filter Length
Slope
Flow Depth During 2-year Storm
2-yr Peak Flow Velocity
Grass Species Density
Irrigated?

Appendix E Chain of Custody Form

AMTEST LABORATORIES
Professional Analytical Services

AmTest Chain of Custody Record

14603 NE 87th St. Redmond, WA 98052
Ph (425) 885-1664 Fx (425) 883-3495
www.amtestlab.com

Page_____ of_____

Chain of Custody No._____

Client Name & Address:	Invoice To:
Contact Person:	Invoice Contact:
Phone No:	PO Number:
Fax No:	Invoice Ph/Fax:
E-mail:	Invoice E-mail:
Report Delivery: (Choose all that apply) Mail / Fax / Email / Posted Online	Data posted to online account: YES / NO Web Login ID:

Special Instructions:

Requested TAT: (Rush must be pre-approved by lab)
Standard RUSH (5 Day / 3 Day / 48 HR / 24 HR)

RUSH Request Approved By:

Project Name:

Project Number:

AmTest ID	Client ID (35 characters max)	Date Sampled	Time Sampled	Matrix	No. of containers	Analysis Requested									

Collected/Relinquished By:	Date	Time	Received By:	Date	Time
Relinquished By:	Date	Time	Received By:	Date	Time
Relinquished By:	Date	Time	Received By:	Date	Time

COMMENTS:

Appendix F Clean Hands Technique for the Automated Sampler

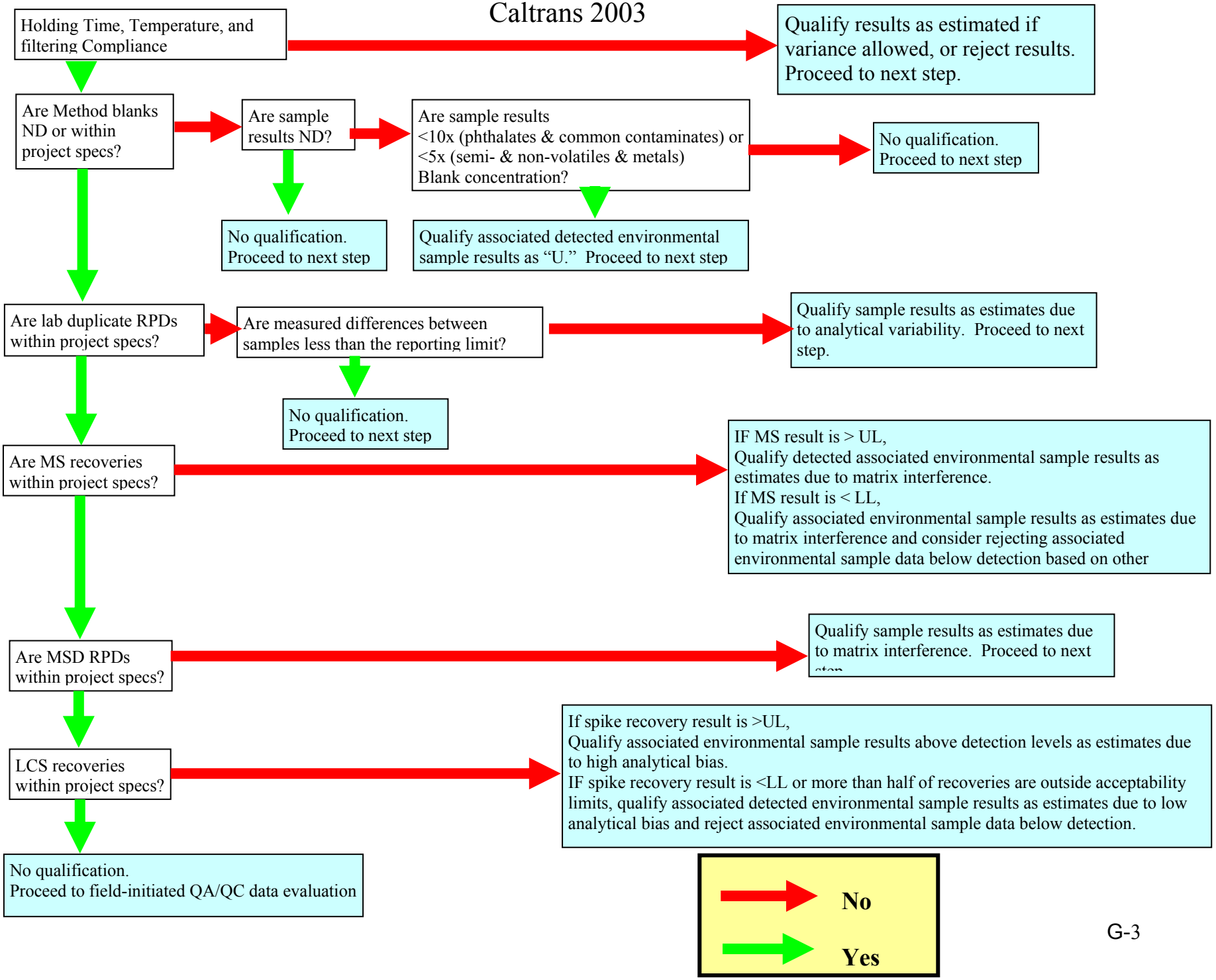
Clean Hands Technique

The following procedure is taken from Caltrans Comprehensive Protocols Guidance Manual (2003). The procedure describes the method for changing bottles out of the sampler without contaminating the bottles or sampler. This method is referenced as the clean hands technique.

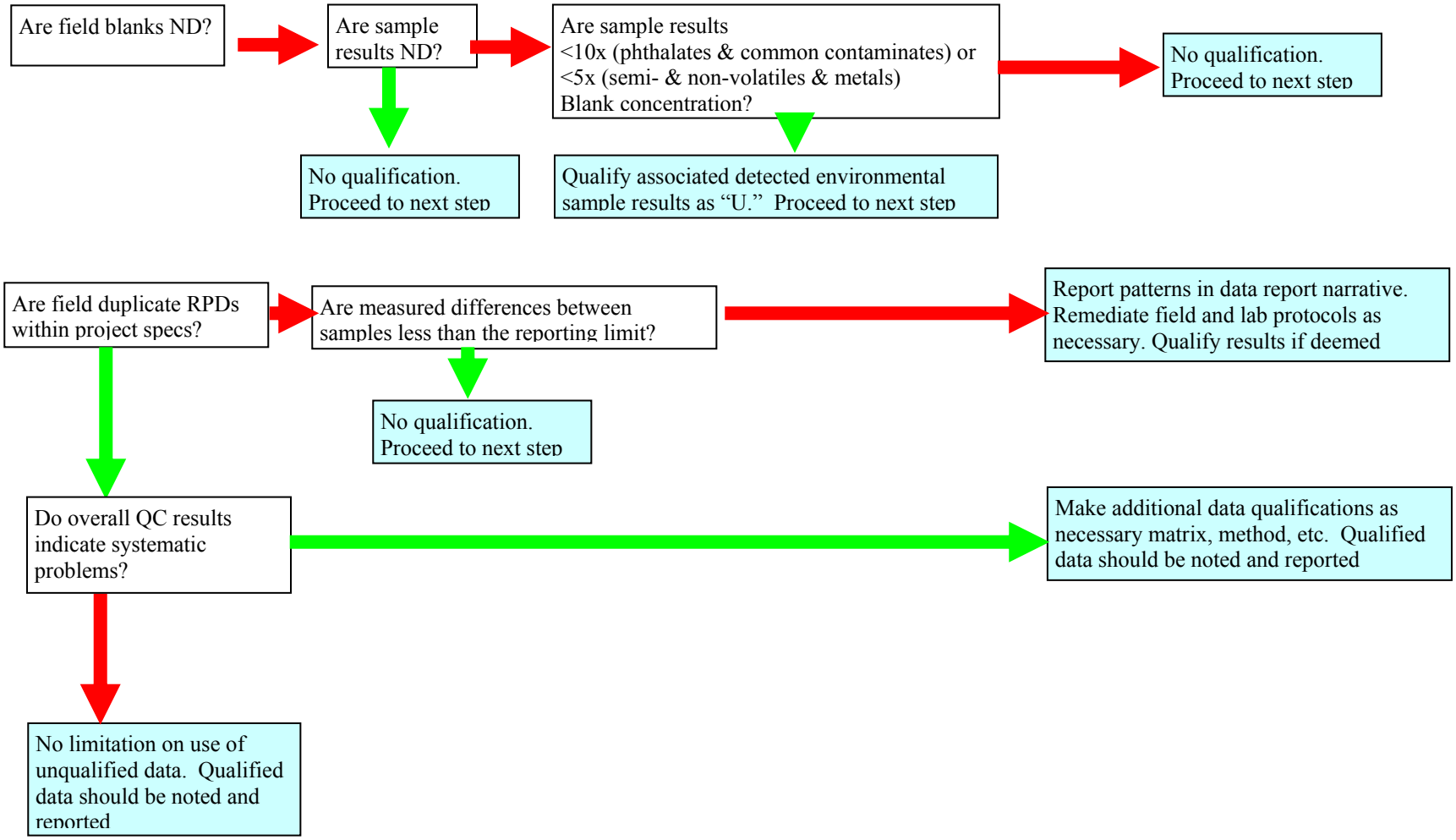
1. The automated sampling equipment is placed in pause mode prior to the initiation of a composite bottle change. This action is accomplished in the field or by remote monitoring personnel if the monitoring station is equipped with telemetry.
2. Composite bottle changing requires two field crew members-"clean hands" and "dirty hands." Both team members wear clean, powder-free nitrile gloves. "Clean hands" only touches suction tubing and Teflon composite bottle lids. Keep extra gloves within easy reach.
3. Prior to putting on clean gloves, the clean empty sample bottle is placed near the automated sampling unit, and the sampler is opened.
4. Wearing clean powder-free nitrile gloves, "dirty hands" removes the lid clamps from both the full sample bottle and the clean sample bottle.
5. "Clean hands" removes the end of the pump tubing from the composite bottle and "dirty hands" places a clean zip lock bag over the end of the tubing securing it with a rubber band. The inside of the bag should never be touched by sampling personnel.
6. "Clean hands" switches the bottle lids, putting the solid lid on the full bottle and the perorated lid on the clean empty bottle.
7. "Dirty hands" installs the lid clamps on both bottles, removes the full bottle from the sampler, replacing it with the clean empty bottle.
8. "Clean hands" holds the tubing while "dirty hands" removes the zip lock bag from the end of the pump tubing, being careful not to touch the tubing.
9. "Clean hands" inserts the tubing through the lid of the clean bottle.
10. The sampler is closed and sampling equipment is placed in sample mode. Remote operation personnel are notified as soon as the bottle change I complete.
11. The sampling team fills out the appropriate information on the label of the full sample bottle.
12. The full bottle is surrounded with fresh ice or frozen refreezable ice packets, and secured inside the vehicle for transport.

Appendix G Data Verification Decision Flow Chart

Technical Data Evaluation for Lab-Initiated QA/QC Samples
Caltrans 2003



Technical Data Evaluation for Field-Initiated QA/QC Samples
Caltrans 2003



Appendix H Efficiency Calculator Guidance (TAPE)

Appendix J – TO USE EFFICIENCY CALCULATOR

EFFICIENCY CALCULATOR is an Excel VBA macro developed for this modified guidance. It was developed specifically to compare influent and effluent data to produce the confidence limits of the treatment efficiency when two data sets have unequal values for *n*, sample size.

With the "Efficiency Calculator" software for Excel, simply input the number of inflow and outflow points and the means and standard deviations of SMC values in order to arrive at the Treatment Efficiency (TE) for concentration. If the confidence interval is sufficiently narrow, you are finished evaluating the BMP. The confidence interval should be no more broad than +/- 50% of TE (for example 60% TE +/- 30 %). If you desire to show, for example, that the BMP provides at least 50% removal, your desired confidence interval would be +/- 10% or smaller, requiring more data to show.

The Efficiency Calculator should also be used to calculate the TE on a loading basis. (See Methods #1 and #2 in the "DATA EVALUATION METHODOLOGY" section of the long-detention time BMP guidance. The calculator will show TE (treatment efficiency) and a confidence interval. If not as narrow as desired, collect more data points.

The efficiency calculator can be applied to results at mid-season to provide an indication of whether sufficient data have been collected, or to what extent more data need be collected.

The calculator employs a Monte Carlo approach to generate simulated concentration values for the number of influent and effluent data points. A distribution for actual influent as well as effluent concentrations is delineated by mean and standard deviation. This distribution is then used to generate simulated from which removal efficiencies are calculated. For example if concentrations for 12 influent and 15 effluent samples have been determined, the Efficiency Calculator will generate large numbers of simulated samples (with 12 influent and 15 effluent data points each.) Then the mean and standard deviation of the resulting simulated removal efficiencies is calculated (for example 2,000 removal efficiency values for 2,000 iterations). From this, the confidence limits of the removal efficiencies are calculated.

Its use is simple and intuitive. Input the mean, standard deviation, and *n* (sample size) for influent data as well as effluent data. Output is the treatment efficiency and its confidence interval. (eg. 56% +/- 6.8% for 95% confidence).

Inputs should be simple means (averages) and standard deviations (*not* log means or log standard deviations). This enables EFICIENCY CALCULATOR to calculate confidence intervals for treatment efficiency.

EFFICIENCY CALCULATOR is based on the assumption that the *mean* of all SMCs (Sample Mean Concentrations) resulting from a season(s) of sampling are normally distributed. This tends to be the case for data that themselves are not normally distributed. That is, the *values* of SMCs may tend to be log-normally distributed, but the means of all those values can be expected to be normally distributed. EFFICIENCY CALCULATOR processes at the level of individual mean values – one for influent and one for effluent no matter how large the study.

Settings for EFFICIENCY CALCULATOR

Set:

Tools> Add-ins:	check boxes for:	- Analysis ToolPak - Analysis ToolPak VBA - Solver Add-in

Appendix K – Calculating sample size for experimental design

The experimental design prior to sampling requires an estimate of mean and standard deviation of influent as well as effluent data. The user provides an estimate of expected influent and effluent mean concentrations as well as standard deviation. If standard deviations cannot be estimated, predicted, the typical COV values shown in Table 1 of TAPE Appendix D gives COVs (Coefficients of Variation) for BMPs with different treatment levels. COV can be used to estimate standard deviations (since COV = standard deviation / mean). The online calculator referenced below can be used to determine desired sample size for studies of long-detention time BMPs (in the place of Tables 1-3 and Figure 2).

The calculator gives a single value for sample size, to be used both for influent and effluent samples. It is only upon actual monitoring that a difference in influent and effluent sample sizes will be known.

The use of the calculator is unrestricted. It is stated at the internet site: "Feel free to use these and pass the links along to anyone that might be interested."

Link to calculator:
http://www.dssresearch.com/toolkit/sscalc/size_a2.asp
DSS Research homepage:
http://www.dssresearch.com/home.asp

Two Samples Using Average Values

Average Value for Sample 1:	4.0	(Value measured from Sample 1 or expected from it)
Average Value for Sample 2:	3.1	(Value measured from Sample 2 or expected from it)
Standard Deviation for Sample 1:	1.0	
Standard Deviation for Sample 2:	0.8	
Alpha Error Level or Confidence Level:	5%	(Probability of incorrectly rejecting the null hypothesis that there is no difference in the average values). An Alpha of 5% corresponds to a 95% Confidence Interval.
Beta Error Level or Statistical Power [1 - Beta]:	20%	(Probability of incorrectly failing to reject the null hypothesis that there is NO difference in the average values -- assuming no difference when a real difference exists). A Beta of 50% is used in most simple calculations of sampling error.

Calculate Sample Size

Sample Size = 13 for both samples!

Notes for use of the calculator:

- The values for alpha and beta recommended by Pitt (Appendix D of TAPE) are 95% and 80% respectively. These are entered on the online calculator as alpha (5%) and beta (20%). Other values can be used.
- Both standard deviations can be input as the same value.
- The COVs for stormwater BMPs listed in Table 1 of Appendix D can be used to derive inputs to the online calculator. COV = (standard deviation) / (mean). For an expected standard deviation, COV values can be used to calculate mean values to enter into the online calculator. Similarly for expected means, COV values can be used to calculate standard deviations to enter.