Standard Drywell
Subsurface Disposal Facility
October 1997

PROJECT DESCRIPTION

Historic Information

Subsurface disposal of storm water runoff is widely utilized in areas with permeable or porous soils. In 1988 the Tacoma Pierce County Health Department (TPCHD) studied the potential impact to ground water from existing subsurface disposal facilities (SDFs) in the Chambers Clover Creek Basin. Two existing SDFs were evaluated in commercial locations in the Lakewood area of central Pierce County. Eleven storm events were analyzed over a fourteen month period; samples of influent storm water and shallow groundwater were obtained from each drywell facility. The study indicated that materials entering the storm water facility were migrating into the shallow ground water system with limited attenuation. In addition it was determined that there was a relatively high risk of transportation related spills that would migrate into the storm water system and possibly contaminate ground waters.

As a result the TPCHD and Pierce County Public Works Department in 1990 commissioned a further study with Adolfson Associates, Inc. to develop and evaluate the treatment and effectiveness of alternative designs of SDFs. The purpose of this study was to develop storm water disposal facility designs that allow storm water infiltration to occur with minimal impact to the beneficial uses of ground water and to protect to the maximum extent possible the natural or existing ground water quality. This study evaluated three SDF designs. The Type 1 SDF consisted of a 60 inch diameter manhole and a 25 foot long drainfield for infiltration of storm water. The 60 inch diameter manhole was designed to provide sedimentation and oil separation capabilities. A riser pipe in the manhole, wrapped with filter fabric to trap and prevent migration of fine sediments to the drainfield, was connected to a perforated distribution pipe in the drainfield. The Type 2 SDF included a 48 inch diameter sedimentation manhole which discharges into a 48 inch diameter infiltration manhole filled with washed rock. The Type 3 SDF was a grass-swale with a sedimentation manhole and an infiltration trench.

The Adolphson study ultimately sampled the alternative SDFs during 19 storm events over a 4.5 year period between May 1990 and January 1995. Influent and treated effluent were sampled at all SDFs. Shallow ground water samples were taken from monitoring wells located in close proximity to Types 1 and 3. Ground water at the type two site was not evaluated due to site constraints, specifically, overhead wires which prevented the installation of the monitoring well. In addition the final report states that sediment deposition in the sampling port may have skewed monitoring results, the two inch sampling port with a AT@ was difficult to purge and may have concentrated particles which were then re-suspended during storm events and is likely to have contributed to the levels of metals measured in the SDF type 2 facility.

As a result of this study Pierce County adopted a new drywell design that incorporates a two stage design with a 20 foot long drainfield for infiltration of storm water. A drawing of the standard drywell detail is attached.

Project Objectives

1. To evaluate the effectiveness of the Pierce County standard two stage drywell at removing pollutants from storm water.

Sites

There are six sites at which the County will collect samples;

1. Flow paced composite influent storm water samples.

2. Flow paced composite treated storm water following the second stage.

3. Treated storm water grab sample from the bottom of the drainfield.

4. Ground water grab sample from a shallow monitoring well (approx 20 ft.) in close proximity to the facility.

Design

Flow paced composite storm water samples will be collected utilizing Isco 3700 Automatic Samplers in conjunction with an Isco 4150 Area-Velocity Flow Meter. Flow will be monitored at the junction between the two basins. Composite sampling will be initiated by the detection of flow between the two basins. During installation of the monitoring well information regarding the the soil profile will be recorded and infiltration rates will be determined or estimated. Ground water and treated stormwater samples from the infiltration trench will be collected after purging a minimum of two well casing volumes, until the pH, conductivity and temperature have stabilized to within 10%.

Stormwater sample constituents are anticipated to be typically distributed. Coefficient of variation values from the Portland NPDES Part 2 range from 1.5 for dissolved copper to 0.2 for orthophosphate with an average coefficient of variation of 1. Small settling BMPs such as the two stage drywell are designed primarily to remove suspended solids, therefore the coefficient of variation for suspended solids (0.4 from the Portland NPDES Part 2 application) will be used to determine when a statistically representative number of samples have been collected and analyzed. Therefore, the number of samples required to estimate the mean to a tolerance of 50% of the 90% confidence level is 12. To allow for uncertainty in expectations of the parent distribution, sampling difficulties, the expectation of some samples to be unrepresentative, and other factors this number will be increased to 16. The taking of no more than one sample per month during the rainy season and two samples during the dry season over the course of 18 to

24 months should be sufficient to estimate the pollutants distribution, providing that the distribution reasonably fits the above criteria. Evaluation of data will be continuous throughout the monitoring period and if necessary duration of sampling efforts will be extended to insure statistically useful data.

Schedule

Samples will be taken monthly during the wet season (Nov-Apr) and twice during the dry season if possible. Sampling will be conducted Monday thru Friday only. Samples will be delivered to the laboratory within four hours of collection.

PROJECT ORGANIZATION

Responsibility Name Organization Phone

Project Manager: Heather Kibbey Pierce County 798-3043

Sampling Leader: John Collins Pierce County 798-3000

Data Entry: John Collins Pierce County 798-3000

Laboratory Coordinator: John Collins Pierce County 798-3000

DATA QUALITY OBJECTIVES

Precision and Bias

Precision may be evaluated by using test replicates both in laboratory analyses and field sampling. Bias will be minimized by following testing protocols in *Standard Methods for the Examination of Water and Wastewater* (Standard methods) and Puget Sound Water Quality Authority guidance document *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*. During each sampling occasion, a field replicate will be taken.

Representativeness

Representativeness will be addressed by collecting samples during storm events that meet specific parameters. An acceptable storm will have a minimum of at least a twenty-four hour dry (i.e., less than 0.01@ total rainfall) antecedent period, and will have more than 0.25" of rain over six hours with no more than a 1 hour interstitial dry period. After a storm event is sampled, the timing of the sampling relative to the storm intensity and duration will be reviewed. If the sample is unrepresentative, it will be rejected. Temperature, conductivity and pH will be measured in the field.

Completeness

Sampling at consistent sites, adhering to sampling protocols, and using accepted field methods, will aid in providing complete data sets during this program.

SAMPLING PROCEDURES

Standard Operating procedures will be followed as outlined in the EPA's *NPDES Storm Water Sampling Guidance Document (1992)* and the Puget Sound Water Quality Authority guidance document *Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound*. Stormwater and sediment samples will be collected with clean, decontaminated equipment. Conductivity, temperature and pH will be measured in the field at the time of sample collection. The field instruments will be calibrated in accordance with manufacturer's instructions.

Each sample container will be labeled with indelible ink prior to sample collection and will include sample number, date and time of collection, sampling location code and correct sample preservation if appropriate. During sample collection, the field crew will complete Field Collection Forms. The Field Collection forms document the sample number, location, sampling method, sample conditions and observations.

Center compartments of automatic samplers will be filled with ice prior to the onset of an anticipated storm event. When full, sample containers will be immediately placed in the cooler, packed with ice, and delivered to the laboratory within 4 hours.

Upon transfer of sample possession to the laboratory, a chain-of-custody form will be signed by the persons transferring custody of the sample containers. Upon receipt of the samples at the laboratory, the condition of the samples will be recorded by the receiver. Chain-of-custody records will be included in the analytical report prepared by the laboratory. **Table 1** lists the containers, preservation methods, and holding times for each parameter.

ANALYTICAL PROCEDURES

All constituents will be analyzed by an accredited laboratory except temperature, pH, and conductivity which will be determined in the field. The analytical methods, source and method number and detection limits are listed in **Table 2**.

Quality Control Procedures

Careful adherence to the established procedures for sample collection, preservation and storage will be followed by all field personnel as outlined in the EPA Storm Water Sampling Guidance. Quality will be assured through laboratory procedures to verify calibration of instruments. Laboratory replicates for assessment of precision will be analyzed at no less than a 5% frequency of the total number of samples submitted to the lab. The analytical laboratory will analyze percent recovery of matrix spikes to help

indicate accuracy and run standard solutions at a minimum frequency of 5% of the total samples submitted.

Table 1- Containers, Preservatives and Holding Times for Parameters of Interest

Parameter	Container	Preservative	Holding Time
Alkalinity	250 ml HDPE	none, 4^{o} C	14 days
Temperature	none	none, 4^{o} C	Performed in Field
pH	none	none, 4^{o} C	Performed in Field
Conductivity	none	none, 4^{o} C	Performed in Field
Total and Dissolved Metals (As, Cd, Cr, Cu, Ni, Pb, Zn)	500 ml plastic	none, 4^{o} C	180 days
Mercury	from metals container	none, 4^{o} C	28 days
Dissolved Oxygen	none	none, 4^{o} C	Performed in Field
Biochemical Oxygen Demand	2 L plastic	none, 4^{o} C	48 hours
Chemical Oxygen Demand	from BOD bottle	none, 4^{o} C	48 hours
Total Suspended Solids	1 L plastic	none, 4^{o} C	7 days
Turbidity	500 ml plastic	none, 4^{o} C	48 hours
Hardness	from TSS bottle	none, 4^{o} C	14 days
Total Phosphorus	500 ml brown plastic	none, 4^{o} C	48 hours
Orthophosphorus	from TP bottle	none, 4^{o} C	48 hours
Nitrate+Nitrite (NO2-N+NO3-N)	from TP bottle	none, 4^{o} C	48 hours

Table 1- Containers, Preservatives and Holding Times for Parameters of Interest			
Parameter	**Container**	**Preservative**	**Holding Time**
Ammonia (NH3-N)	from TP bottle	none, 4^{o} C	48 hours
Volatile Suspended Solids	1 L sterilized plastic	none, 4^{o} C	7 days
Total Solids	1 L sterilized plastic	none, 4^{o} C	7 days
PAH	2.5L Amber Glass	.008NA2S2O3	14 days
BTEX	2 40mL VOA	none, 4^{o} C	14 days
Chlorodane	1 L Amber Glass	none, 4^{o} C	14 days
Diazinon	1 L Amber Glass	none, 4^{o} C	14 days
Bis(2ethylhexyl)phalate	1 L Amber Glass	none, 4^{o} C	14 days
Chloride	1 L Glass	none, 4^{o} C	14 days
Fecal Coliform	250 mL Plastic	none, 4^{o} C	24 hours

Table 2- Methods and Practical Quantification Limits			
Parameter	**Methods**	**Units**	**PQL**
Alkalinity	EPA 310.1	mg/l	1
Temperature	hand held meter	C	0.1
pH	hand held meter	pH units	0.1
Conductivity	hand held meter	mMHOSs	0.5
Metals (See below)	See below	mg/L	See Below
Mercury	EPA 7470	mg/L	0.002
Chemical Oxygen Demand	SM-5520-D	mg/L	3
Total Suspended Solids	SM-2540-D	mg/L	0.5

Table 2- Methods and Practical Quantification Limits			
Parameter	**Methods**	**Units**	**PQL**
Turbidity	SM-2130-B	NTU	0.5
Hardness	SM-2340-C	mg/L	0.5
Total Phosphorus	SM-4500-P-B, E	mg/L	0.005
Orthophosphorus	SM-4500-P-F	mg/L	0.002
Nitrate+Nitrite (NO2-N+NO3-N)	SM-4500-NO3-F	mg/L	0.05
Ammonia (NH3-N)	SM-5500-NH3-H	mg/L	0.02
Volatile Suspended Solids	SM2540-E	mg/L	0.5
PAH=s	EPA 3270	ug/l	1
Chlorodane	EPA 8080	ug/L	0.10
Diazinon	EPA 8141	ug/L	
Bis(2ethylhexyl)phalate	EPA 2720	ug/L	10
Chloride	EPA 330	mg/L	0.1
BTEX	EPA 8020	ug/l	1
Fecal Coliform	SM9221C	mg/L	1

Table 3- Metals Methods and Practical Quantification Limits		
Metal	**Method**	**PQL (mg/L)**
Cadmium T & D	EPA 7131	0.001
Chromium T & D	EPA 7191	0.010
Copper T & D	EPA 200.7	0.025
Nickel T & D	EPA 200.7	0.040

Table 3- Metals Methods and Practical Quantification Limits		
Metal	**Method**	**PQL (mg/L)**
Lead T & D	EPA 200.7	0.050
Zinc T & D	EPA 7950	0.05
Mercury T & D	EPA 7470	0.002

The analytical laboratory will analyze samples using the recommended EPA methods or their equivalent. Data evaluations will include an assessment of the following:

* Holding times for analyses

* Documentation and chain-of-custody procedures

* Contamination of field and laboratory blanks by problem chemicals

* Control limit for laboratory replicate and matrix spike results

* Control limits for blind field replicate results

If the QA review indicates that any of the QC checks do not meet data quality objectives, then the data will be qualified.

PREVENTATIVE MAINTENANCE

Instrument maintenance will be performed as necessary by the field crew. Maintenance can include visual inspection and removal of debris or obstructions.

DATA ASSESSMENT PROCEDURES

When water quality data are received from the lab, the data will be reviewed for quality assurance and completeness. Data will be reported in the units specified for the particular method. For results in which the analyte was not detected, the results will be reported as less than the detection limit. If necessary, errors will be corrected and additional samples collected. The data will be entered into a database for storage, retrieval and manipulation. Information from the field notes and relevant data on land use, etc. will also be entered into the same database. The original analysis report from an accredited analytical laboratory will be retained indefinitely by Pierce County.

CORRECTIVE ACTION

Corrective action measures will be taken as needed with either: (1) concerns associated sample collection, sample handling equipment failures, data processing, data management, and/or data analysis; and (2) non-conformance or non-compliance of the analytical laboratories with QA requirements.

The project manager will be kept informed of any major quality assurance problems. The project manager will be notified immediately by telephone should a field or laboratory quality assurance problem arise that may potentially jeopardize the use of the collected data. Corrective action will be taken by the project manager when field methods are determined to be inappropriate or analytical data found to be outside predetermined limits of acceptability. Corrective actions may include a procedural change, additional performance and system audits, meeting with laboratory personnel, retesting of existing samples or re-sampling, or in extreme cases obtaining a new laboratory contact. The project manager will be notified should procedural corrective action not be satisfactory. All data validation problems and solutions will be documented.

Data Reduction and Review

All data received from the laboratory will be reviewed by Pierce County staff, who will check the material for omissions or errors. Examination of chain of custody documents will be part of this review.

REPORTING

The data results will be reported as required under the provisions of the National Pollutant Discharge Elimination System Municipal Stormwater Discharge Permit.

REFERENCES

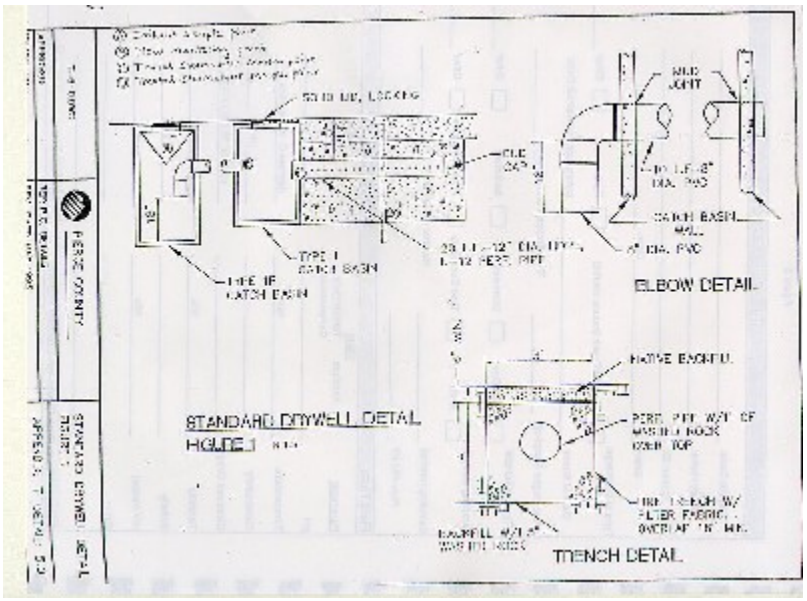
U.S. EPA, 1992. *NPDES Storm Water Sampling Guidance Document.* EPA 833-B-92-001, U.S. Environmental Protection Office, Office of Wastewater Enforcement and Compliance, Washington, DC.

Wa. State DOE, 1996. *Implementation Guidance for the Ground Water Quality Standards*. Washington State Department of Ecology, Water Quality Program, Watershed Management Section, Olympia, WA.

Puget Sound Water Quality Authority, 1996. *Reccommended Protocols for Measuring Selected Environmental Variables in Puget Sound*. U.S. Environmental Protection Agency, Region 10, Office of Puget Sound, Seattle, WA.

APPENDIX

A. <u>Standard Drywell Detail</u>



B. Sample Collection Form

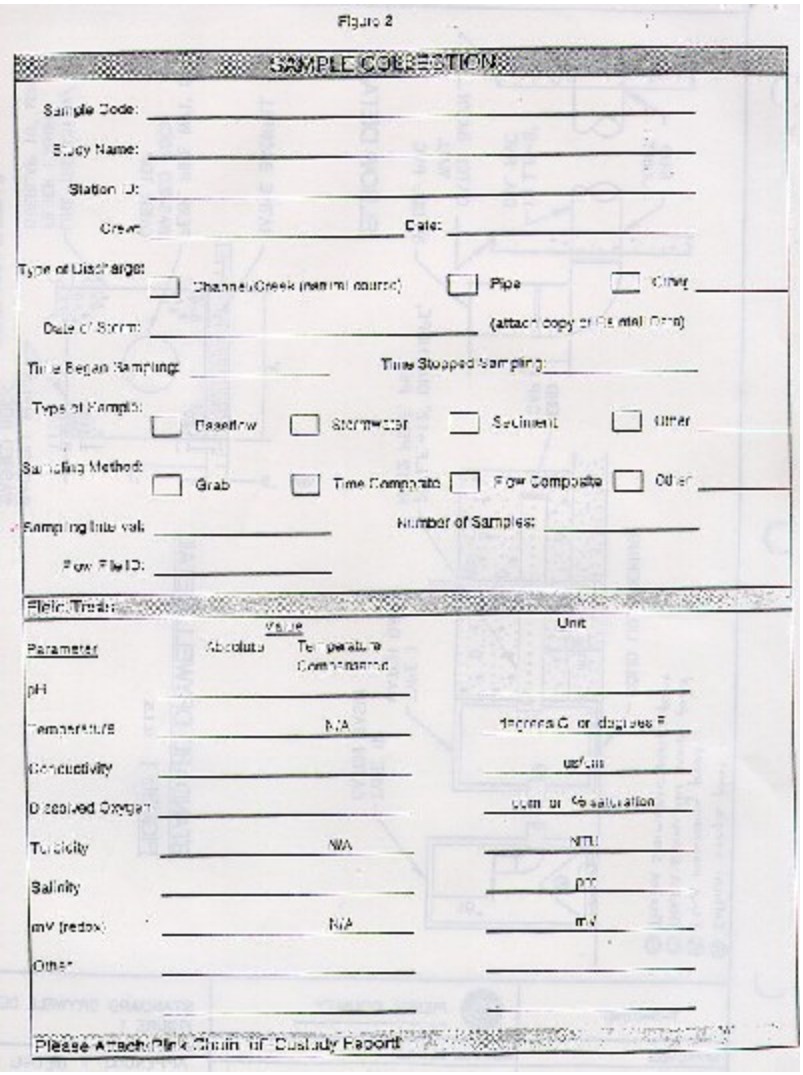


Figure 2

SAMPLE COLLECTION

Sample Code: _____

Study Name: _____

Station ID: _____

Crew: _____ Date: _____

Type of Discharge: ☐ Channel/Creek (natural source) ☐ Pipe ☐ Other _____

Date of Storm: _____ (attach copy of rainfall data)

Time Began Sampling: _____ Time Stopped Sampling: _____

Type of Sample: ☐ Baseflow ☐ Stormwater ☐ Sediment ☐ Other _____

Sampling Method: ☐ Grab ☐ Time Composite ☐ Flow Composite ☐ Other _____

Sampling Interval: _____ Number of Samples: _____

Flow File ID: _____

Field Tests:

Parameter	Value (Absolute Temperature Compensated)	Unit
pH		
Temperature	N/A	degrees C or degrees F
Conductivity		uS/cm
Dissolved Oxygen		mg/l or % saturation
Turbidity	N/A	NTU
Salinity		ppt
mV (redox)	N/A	mV
Other		

Please Attach/Link Chain of Custody Report

C. Cost Estimate Worksheet