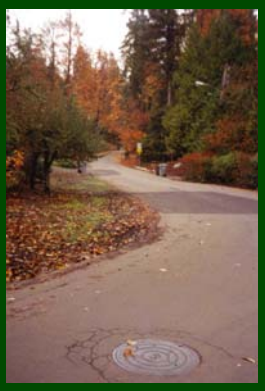
Comprehensive Clackamas County Stormwater Monitoring Plan

Prepared for:

Clackamas County (CCSD #1 & SWMACC)
City of Gladstone
City of Happy Valley
City of Milwaukie
City of Oregon City
City of Rivergrove
City of West Linn



Prepared by

URS

Submitted October 13, 2006
Updated July 1, 2008

Comprehensive NPDES MS4

Stormwater Monitoring Plan For:

Clackamas County Service District #1 (CCSD#1)

Surface Water Management Agency of Clackamas County (SWMACC)

City of Gladstone

City of Milwaukie

City of Oregon City

City of West Linn

City of Happy Valley

City of Rivergrove

Prepared by:

URS Corporation

October 13, 2006

Updated July 1, 2008

TABLE OF CONTENTS

List of Tables

List of Figures

1.0 INTRODUCTION

As part of the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit requirement, Clackamas County co-permittees are required to develop and implement a stormwater monitoring program. Specific stormwater monitoring requirements and objectives are defined in Schedule B of the Clackamas County NPDES MS4 permit (number 101348).

The NPDES stormwater monitoring programs require two components. The first component is program monitoring, which involves the tracking and assessment of programmatic activities, as described in the individual permittees Stormwater Management Plans (SWMP), through the use of performance indicators or metrics. The second component is environmental monitoring which includes the actual collection and analysis of samples. The purpose of this monitoring plan is to address the environmental monitoring component of the requirements. As a result, this Stormwater Monitoring Plan includes the following elements as required by Schedule B of the NPDES MS4 permit:

- a list of monitoring sites,
- a list of parameters to be analyzed,
- the media sampled,
- sample collection frequencies,
- targeted conditions (e.g., weather conditions), and
- protocols for quality assurance/quality control.

Due to the inherent wide ranging variability in stormwater data, collecting and analyzing data that will be sufficient to address the permit environmental monitoring requirements will require significant resources in order to obtain data that are sufficiently robust to be statistically valid. DEQ itself acknowledged this issue and provided the following clause in the permit:

"If representative of the entire area subject to these permit requirements, the co-permittees may develop a cooperative MS4 discharge and in-stream monitoring strategy that assigns monitoring responsibilities to selected co-permittees."

Therefore, given the magnitude of effort associated with implementing an effective monitoring program that will adequately meet permit requirements and objectives, eight Clackamas County co-permittees have agreed to consolidate efforts and prepare one comprehensive stormwater monitoring plan. The co-permittees include CCSD#1, SWMACC, and the cities of Gladstone, Milwaukie, Oregon City, West Linn, Happy Valley and Rivergrove. **This plan was originally prepared for submittal with the November 1, 2006 NPDES Permit Annual Compliance Reports. Based on approval from DEQ, the plan was intended for implementation beginning July 1, 2007. Updates to this plan have been made for the 2008 MS4 NPDES Permit Renewal Submittal. Changes are minor and include the following:**

- Clackamas County moved one of the instream sites on Cow Creek. The site was just moved farther upstream as a result of sampling safety issues. Figure 2 was revised to reflect this change
- A few minor editorial mistakes were corrected in Tables 3, 4 and 5.
- A paragraph was added to Section 6.0 to describe how the Clackamas County co-permittees intend to begin work to characterize pesticides based on a request from DEQ.
- References to Lake Oswego's existing monitoring program were removed from this document as they are not participants in this plan.
- Gladstone's monitoring site was moved from the outfall section to the instream section as the samples are collected from an open channel that is more representative of instream conditions. All map figures were changed accordingly.
- Chlorophyll a was removed from the list of parameters for analysis because this parameter is only relevant to the mainstem Tualatin River as a result of the TMDL. None of the participants to this plan are conducting monitoring on the Tualatin mainstem to serve MS4 monitoring purposes. (Note: there is one Tualatin mainstem site where monitoring is conducted under this plan. It is a continuous automated site and it does collect and report chlorophyll a concentrations.)
- CCSD#1 instream continuous surface water monitoring stations were removed from the plan. While monitoring will continue at some of these sites, the sites were removed from the plan so as to provide more flexibility to CCSD#1 in moving the sites to different locations as desired. Removal of these sites from this plan was considered to be appropriate as these sites provide information which is secondary to meeting the objectives of stormwater monitoring.

The following Stormwater Monitoring Plan is organized into the following sections:

Section 2 summarizes the objectives of the plan, specifically related to the six objectives listed in Schedule B of the 2004-2009 NPDES MS4 permit.
Section 3 describes how 2006 existing monitoring efforts conducted by Clackamas County and its co-permittees were assessed and evaluated with respect to meeting new permit requirements (for the permit expiring in 2009).
Section 4 outlines various data gathering strategies that will be utilized in implementing the new proposed program.
Section 5 describes the proposed monitoring activities including frequency, locations, and parameters.
Section 6 provides a summary of sampling parameters and procedures.
Section 7 summarizes the data analysis and data interpretation activities that will be used to assess the monitoring data gathered.
Section 8 provides an overall and condensed summary of all of the monitoring recommendations described in section 5.0.

2.0 OBJECTIVES

Schedule B of the NPDES MS4 permit lists six specific monitoring objectives that should be addressed with the revised monitoring program. The six objectives are:

1. Determine the status of implementing the components of the SWMP;

2. Evaluate the effectiveness of BMPs for specific source controls;
3. Evaluate the source of specific pollutants;
4. Assess the chemical, biological, and physical effects of MS4 runoff on receiving waters;
5. Characterize MS4 discharges; and
6. Evaluate long-term trends in receiving water quality associated with stormwater discharges.

Each of the monitoring activities listed in Section 5 includes a narrative describing how the above monitoring objectives will be met through implementation of each of the proposed monitoring plan components.

3.0 2006 EXISTING MONITORING PROGRAM REVIEW

Prior to developing the comprehensive monitoring program for CCSD#1, SWMACC, and the cities of Gladstone, Milwaukie, Oregon City, West Linn, Happy Valley and Rivergrove, a review was conducted of each jurisdiction's existing individual monitoring efforts. Per Tables B-1 in the 2004 - 2009 NPDES MS4 permit, each jurisdiction is responsible for conducting specified environmental monitoring and sampling efforts. A revised monitoring plan was to be submitted in May 2006 to address new permit monitoring objectives. A draft of this document was submitted at that time with a commitment to complete the final plan for submittal with the November 1, 2006 annual compliance report.

The monitoring requirements that are listed in Table B-1 of the permit vary between jurisdiction, ranging from large-scale instream and outfall monitoring efforts to a single storm grab sample at an outfall location. As mentioned previously, given the variability in individual monitoring efforts, smaller jurisdictions with limited environmental monitoring requirements listed in Table B-1 would not be able to meet the six new permit monitoring objectives without substantial additional effort, and costs would be beyond what would be considered to be the "maximum extent practicable" for those communities.

Each of the jurisdictions annual reports from 2004-2005 were initially reviewed to summarize current monitoring efforts. Generally, jurisdictions either met or exceeded their requirements described in Table B-1. If a jurisdiction changed monitoring activities from those specified in Table B-1, the annual reports typically discussed and described why such changes occurred. In addition to the annual reports, individual monitoring plans (e.g., those from Clackamas County Service District #1 (CCSD#1) and the Stormwater Management Agency of Clackamas County (SWMACC)) were reviewed if available. Tables were prepared to outline the various instream, outfall, and BMP monitoring activities being conducted by all jurisdictions. The summary tables included information such as the watershed/water body location, the jurisdiction conducting the sampling, the sampling frequency, the method of sampling (field or laboratory; dry or wet-weather), and whether the sampling location was included within the MS4 permit boundary.

Following compilation of the 2006 existing monitoring activities, a meeting was held with all participating jurisdictions to review the tables that outline existing monitoring efforts. Any discrepancies between activities reported in the tables and activities most recently conducted were discussed, and the tables were modified as necessary.

Following the meeting, the tables of existing efforts were reorganized and compared to new permit monitoring requirements in order to identify potential gaps in the data and constraints of the jurisdiction's existing monitoring activities with respect to addressing the new requirements. Section 5.0 includes the tables that summarize existing efforts. General monitoring recommendations were then developed to address potential data gaps, to minimize duplication of monitoring efforts, and to ensure data collected contained information that was sufficiently comprehensive to meet the six new permit monitoring objectives. Additional meetings were held with each jurisdiction individually to further refine details with respect to monitoring recommendations and commitments (e.g., specific monitoring site locations, sample frequencies, etc.). Several additional meetings were also held to refine and finalize the plan. The proposed modified monitoring activities are provided in Sections 5.1 (instream monitoring), 5.2 (outfall monitoring), 5.3 (BMP monitoring), and 5.4 (field screening).

4.0 DATA GATHERING STRATEGIES

There are three primary strategies that are proposed in this new monitoring plan to obtain data and information necessary to meet the six monitoring objectives of the permit. These strategies include the following:

1) Take a detailed look at historic water quality data and other information collected by the co-permittees to see how it already answers questions related to permit objectives and to use it to help refine future monitoring efforts.
2) Collect new water quality data to complement the existing data and address specific objectives that have not been examined previously.
3) Conduct literature reviews to review and track relevant technical information related to stormwater quality that is collected by others.

With respect to item 1 above, a significant amount of stormwater-related data have already been collected by the co-permittees. However, these data have not always been evaluated with respect to addressing the questions in the permit objectives. For example, significant amounts of instream data have been collected on a regular basis (e.g., monthly), but they have not been reviewed with respect to how the dry weather instream data are comparing with the wet weather instream data. Therefore, one of the data gathering strategies will be to get more value out of the significant amounts of data that have already been gathered. Taking a good look at this data will also help to refine future monitoring efforts.

With respect to item 2 above, most of the data that have been collected by Clackamas co-permittees have been instream or in-pipe data. These data may need to be supplemented with analyses for additional parameters (i.e., TMDL or 303(d) parameters) that have not been analyzed in the past. In addition, sample frequencies may need to be adjusted to make the data more statistically robust. And, new types of monitoring may need to be added to the program.

With respect to item 3 above, the scientific community, public agencies, and private organizations interested in stormwater management continue to conduct research related to stormwater characterization and treatment. This research is costly and it is often beyond the means of any one co-permittee to conduct a significant study. Organizations such as the Oregon

Association of Clean Water Agencies (ACWA), the Bay Area Stormwater Management Association (BASMA), the Water Environment Research Foundation (WERF), state transportation departments, vendors of proprietary stormwater treatment systems, and others conduct research and examine complex stormwater-related issues that individual permittees could not accomplish on their own. By participating in these groups and following current research, co-permittees can realize greater benefits from labor and capital investment than if they were to attempt such studies on their own. As such, the co-permittees will take advantage of information garnered by these groups to meet some of the more complex and costly objectives of the permit.

5.0 PROPOSED MONITORING ACTIVITIES

This Section describes the 2006 existing monitoring efforts being conducted by Clackamas County co-permittees and describes the recommended modifications (including locations, parameters, sampling methods, and sampling frequencies) to the efforts in order to ensure the required objectives of the monitoring program will be effectively met. This Section is organized according to:

- Instream monitoring efforts,
- Outfall monitoring efforts,
- BMP monitoring efforts, and
- Field screening efforts.

The permit monitoring objectives that are met by the specific monitoring component are listed at the beginning of each subsection.

5.1 INSTREAM MONITORING EFFORTS

Instream sampling throughout the Clackamas MS4 permit area will be conducted to address NPDES MS4 objectives 1, 4, 5, and 6 when conducted during both wet and dry weather conditions for comparison.

1. Determine the status of implementing the components of the SWMP;
4. Assess the chemical, biological, and physical effects of MS4 runoff on receiving waters;
5. Characterize MS4 discharges; and
6. Evaluate long-term trends in receiving water quality associated with stormwater discharges.

The following text describes existing instream monitoring efforts (5.1.1), observations related to existing instream monitoring efforts (5.1.2), and modified instream monitoring efforts (5.1.3).

5.1.1 2006 Existing Instream Monitoring Efforts

For purposes of re-evaluating the existing monitoring sites, waterbodies that are considered water quality impaired and currently have either a TMDL in place or are 303(d) listed for a specific parameter were considered to be high priority. Within the Clackamas County area, the TMDL and 303(d) streams are listed in Table 1 below. Instream monitoring activities are

currently being conducted on a number of water bodies throughout the Clackamas County MS4 NPDES permit area. Table 2 includes a summary of the existing instream monitoring organized by jurisdiction. To provide a more comprehensive and condensed summary of the total number and type of samples that are currently collected by jurisdiction, Table 3 is also provided. These sites are also shown on Figure 1.

Table 1 – 2006 Summary of Clackamas County TMDL and 303(d) Listed Streams

Creek	Bacteria	Temp.	DO	Phosphorus	Mercury	PCBs	PAHs	DDT	Dieldrin
TMDLs									
Draft for Willamette	X	X			X				
Tualatin River	X	X	X	X					
303(d) Listed Streams									
Clackamas R.	X	X							
Johnson	X					X	X	X	X
Kellogg	X								
Mt. Scott	X								
Phillips	X								
Spring Brook	X								
Tryon		X							
Cow	X	X							
North Fork Deep	X								
Rock	X								
Sieben	X								
Abernathy		X							

Table 2 - Details of the Clackamas County Co-permittee 2006 Existing Instream Monitoring Efforts

Monitored Waterbody	Responsible Party	Number of Locations	Type of Sample	Sampling Frequency	Parameters Monitored (Field/Lab)*	Storm Event Monitoring (Y/N)**	Specifically Listed as 303(d) Waterbody
Carli Creek	CCSD#1	1	Grab	6-12/year	Field and Lab	N	
Clackamas River	CCSD#1/USGS	2	Grab	6-12/year	Field and Lab	N	X
		1	Automated	Continuous	Field	Y	
Cow Creek	CCSD#1	1	Grab	6-12/year	Field and Lab	N	X
		1	Automated	Continuous	Field	Y	
Dean Creek	CCSD#1	1	Grab	12/year	Field and Lab	N	
Kellogg Creek	CCSD#1	2	Grab	6-12/year	Field and Lab	N	X
Mt Scott Creek	CCSD#1	2	Grab	6-12/year	Field and Lab	N	X
		2	Automated	Continuous	Field at one location, flow at the other	Y	
Phillips Creek	CCSD#1	1	Grab	6-12/year	Field and Lab	N	X
		1	Automated	Continuous	Field	Y	
Rock Creek	CCSD#1	2	Grab	6-12/year	Field and Lab	N	X
		2	Automated	Continuous	Field at one location, flow at the other	Y	
Sieben Creek	CCSD#1	2	Grab	6-12/year	Field and Lab	N	X
		1	Automated	Continuous	Field	Y	
Minthorn Creek	Milwaukie	1	Grab	4/year	Field and Lab	N	
Johnson Creek	Milwaukie	1	Automated	Continuous	Field and Lab	Y	X
Abernathy Creek	Oregon City	1	Grab	4/year	Field	N	X
Caufield Creek	Oregon City	1	Grab	4/year	Field	N	
Coffee Creek	Oregon City	1	Grab	4/year	Field	N	
High School Creek	Oregon City	1	Grab	4/year	Field	N	
Livesay Creek	Oregon City	1	Grab	4/year	Field	N	
Mud Creek	Oregon City	1	Grab	4/year	Field	N	
Newell Creek	Oregon City	1	Grab	4/year	Field	N	
Park Place Creek	Oregon City	1	Grab	4/year	Field	N	
Singer Creek	Oregon City	2	Grab	4/year	Field	N	

Monitored Waterbody	Responsible Party	Number of Locations	Type of Sample	Sampling Frequency	Parameters Monitored (Field/Lab)*	Storm Event Monitoring (Y/N)**	Specifically Listed as 303(d) Waterbody
South End Creek	Oregon City	1	Grab	4/year	Field	N	
Athey Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Field Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Pecan Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Rock Creek (South)	SWMACC	1	Grab	12/year	Field and Lab	N	X
Saum Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Shipley Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Tualatin River	SWMACC/USGS	1	Automated	Continuous	Field	Y	X
Unnamed Creek at Riberia Ln.	SWMACC	1	Grab	12/year	Field and Lab	N	
Wilson Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Tanner Creek	West Linn	1	Grab	5/year	Field and Lab	Y – 3/year N - 2/year	
Trillium Creek	West Linn	1	Grab	5/year	Field and Lab	Y – 3/year N - 2/year	
Summerlinn Creek – tributary to Tualatin River	West Linn	1	Grab	5/year	Field and Lab	Y – 3/year N - 2/year	
Rinearson Creek	Gladstone	1	Grab	1/year	Lab	Y	

***** The term "Field" indicates samples that are analyzed using meters in the field – typically for temperature, conductivity, dissolved oxygen, total dissolved solids, and pH.

** A "N" or no in this column indicates that samples are collected on a regular schedule such as monthly and may or may not include storm events. Specific weather conditions ar not targeted.

Table 3 - Summary of the Clackamas County Co-permittee 2006 Existing Instream Monitoring Efforts

Jurisdiction	Total # of Grab Sampling Sites	Total # of Grab Samples Collected Per Year*	Automated Continuous Sampling Sites	Total # of Sampling Sites
CCSD#1	14	129	1	15
SWMACC	8	96	1	9
Gladstone	0	0	0	0
Milwaukie	1	4	1	2
Oregon City	11	44	0	11
West Linn	3	15	0	3
Gladstone	**1**	**1**	**0**	**1**
TOTAL:	**38**	**289**	**2**	**40**

* - For samples listed as being collected 6 – 12 times per year, an average of 9 times per year was used to provide annual totals for this table.

Number	Jurisdiction	Sampling Method	Site Description	Stream Name
1	CCSD #1	Automated	SE Ambler Rd & 84th Ave	Mt Scott Creek
2	CCSD #1	Automated	Flood Control Facility at SE Pheasent Ct	Mt Scott Creek
3	CCSD #1	Automated	Between Hwy 212 and 224	Rock Creek
4	CCSD #1	Automated	S. Fork Water Intake	Clackamas River
5	CCSD #1	Automated	SE Last Rd	Cow Creek
6	CCSD #1	Automated	Phillips Creek	Phillips Creek
7	CCSD #1	Automated	At Sunnyside Rd	Rock Creek
8	CCSD #1	Automated	At Hwy 212 / 224	Sieben Creek
9	CCSD #1	Grab	Carver Boat Ramp	Clackamas River
10	CCSD #1	Grab	Near Confluence w/ Mt Scott Cr	Dean Creek
11	CCSD #1	Grab	Clackamette Park	Clackamas River
12	CCSD #1	Grab	SE Last Rd	Cow Creek
13	CCSD #1	Grab	120th and Carpenter	Carli Creek
14	CCSD #1	Grab	Hwy 212 and 135th	Sieben Creek
15	CCSD #1	Grab	Hwy 212	Rock Creek
16	CCSD #1	Grab	SE Oaks Bluff Blvd	Mt. Scott Creek
17	CCSD #1	Grab	84th and Sunnybrook	Phillips Creek
18	CCSD #1	Grab	North Clackamas Park	Mt. Scott Creek
19	CCSD #1	Grab	Rusk & Aldercrest	Kellogg Creek
20	CCSD #1	Grab	Kellogg Ck at Hwy 99E	Kellogg Creek
21	CCSD #1	Grab	Rock Creek at Sunnyside Rd	Rock Creek
22	Milwaukie	Grab	Minthorn Creek	Minthorn Creek
23	Milwaukie / USGS	Automated	Johnson Creek	Johnson Creek
24	Oregon City	Grab	At 14490 Glen Oak Rd	Caufield Creek
25	Oregon City	Grab	John Adams	High School Cr
26	Oregon City	Grab	At Livesay Rd	Livesay Creek
27	Oregon City	Grab	Stream Xing at Meyers Rd	Mud Creek
28	Oregon City	Grab	At Mollala Avenue	Newell Creek
29	Oregon City	Grab	South End Cr / Salmonberry Cr	South End Creek
30	Oregon City	Grab	At Holly Lane Bridge	Abernathy Creek
31	Oregon City	Grab	Outfall at Willamette	Coffee Creek
32	Oregon City	Grab	Behind 13530 Redland Rd	Park Place Creek
33	Oregon City	Grab	At N. end of Singer Cr Park	Singer Creek
34	Oregon City	Grab	Singer Cr Baseline Site	Singer Creek
35	SWMACC	Automated	Tualatin River	Tualatin River
36	SWMACC	Grab	SW Elderberry Lane	Fields Creek
37	SWMACC	Grab	SW Boreland Rd	Athey Creek
38	SWMACC	Grab	SW Halcyon Rd	Saum Creek
39	SWMACC	Grab	SW Long farm Rd	Wilson Creek
40	SWMACC	Grab	SW Morgan Rd	Rock Creek
41	SWMACC	Grab	SW Mossy Brae Rd	Pecan Creek
42	SWMACC	Grab	SW Shadow Wood Drive	Shipley Creek
43	SWMACC	Grab	SW Ribera Lane	Unnamed Tributary
44	West Linn	Grab	At Imperial Drive	Tanner Creek
45	West Linn	Grab	At Caloroga Rd	Trillium Creek
46	West Linn	Grab	Tributary to Tualatin River	Summerlinn Creek
47	Gladstone	Grab	Outfall at Risley Road	Rinearson Creek

Legend

- Gladstone
- Happy Valley
- Milwaukie
- SWMACC
- Oregon City
- Rivergrove
- West Linn
- CCSD #1
- Existing Sites
- Existing Sites Proposed for Removal or Relocation
- Urban Growth Boundary

0 0.5 1 2 Miles

Figure 1
Instream Monitoring Locations:Existing Sites
CCSD #1, Gladstone, Milwaukie, Oregon City, SWMACC,
West Linnn, Happy Vally, River Grove

June 2008

URS

K:\Clackamas_Monitoring\2008_June_MXDs\InStream_Figure1.mxd

5.1.2 Observations Related to 2006 Existing Instream Monitoring

The following text provides observations related to the existing instream monitoring efforts that led to recommendations for improvements and modifications in order to meet new permit monitoring requirements.

Limited Number of Storm Event Samples: Based on the initial assessment of instream monitoring sites, it appears that there is sufficient geographic coverage of local rivers, creeks, and streams, and a significant number of samples are being collected. The main issue with the existing instream sampling is that for the most part, samples are collected at regular intervals and specific weather conditions are not targeted. Collecting samples at regular intervals is likely to result in samples collected during storm events, however, it would be desirable to target a minimum number of events. CCSD#1 reviewed the last four and a half years of monthly data (53 months) to determine how many of those monthly samples were collected during rain events. The result was 10 events or approximately 19%. As the quality of water during storms is likely to be more variable than the quality of water during ambient conditions, collecting more than 19% (i.e., at least one third) of the samples during storms is recommended.

Limited Number of Parameters Analyzed: For a number of streams monitored, only field data (temperature, conductivity, total dissolved solids, pH, dissolved oxygen) are being collected. In order to address permit objectives when evaluating instream sites for impacts due to stormwater runoff, the parameters of concern should be consistent with water quality constituents relevant to TMDLs and source identification efforts. Therefore, a more representative or informative list of parameters should be analyzed. Parameters of concern in waterbodies throughout the Willamette Valley include parameters such as nutrients, heavy metals, organics, and bacteria, which require laboratory analysis.

Samples are Not Representative of the Entire Hydrograph: With the exception of some continuous field monitors, all samples collected are grab samples. Grabs represent a point in time. Depending on resource limitations, it would be worthwhile to collect composite samples that represent a larger portion of the entire hydrograph. Fluctuations of pollutant concentrations typically vary widely throughout an event and a composite sample would better represent those variations.

Further Data Evaluation is Needed: A significant amount of data has been collected over the past years. It would be very useful and informative to separate the dry weather from the wet weather data and to evaluate the concentrations that are typical during these conditions. This evaluation would likely provide insights into the relative contribution of various pollutants that are associated with runoff. It would also likely lead to additional questions, which would help provide information to further refine the monitoring plan. Section 7 of this document includes recommendations regarding data evaluations.

5.1.3 Modified Instream Monitoring Efforts

In order to gain the most benefit from the instream monitoring activities currently being conducted and to gather information that more directly relates to the permit monitoring

objectives at hand, adjustments were made to the existing instream activities. The final changes were made after draft changes were initially proposed to the participating jurisdictions and then further refined in individual meetings with each jurisdiction. The resulting modifications are described below.

Locations for Instream Monitoring

As shown in Tables 2 and 3, there are currently 40 sampling sites representing 34 water bodies. Tables 4 and 5 include the list of existing sampling sites with proposed changes noted in the table and a description of the rationale for those changes. The modified sampling sites are also shown on Figure 2. The modifications include a total of 26 sampling sites representing 23 water bodies. While the reduction of monitoring sites may appear on the surface to represent a reduction in resources, this is not the case. The resources are being shifted and re-allocated towards capturing more storm specific data, collecting composite samples as opposed to grabs, analyzing additional parameters considered necessary, and more thoroughly evaluating data as discussed below. These changes will result in data that are more useful in meeting permit monitoring objectives and in supporting stormwater management decisions. As an example, currently, approximately 289 grab samples are collected instream per year (Table 3). However, approximately 60 of those samples are collected during storms; the samples are collected as grabs; and the grabs are analyzed for a limited number of parameters. Under the modified program, approximately 154 samples will be collected instream per year (Table 5). Approximately 62 of these samples will be collected during targeted storm events. This is the same number of storm samples that were previously collected. However, these samples will be composites as opposed to grabs and they will be analyzed for a much longer list of constituents.

Water Quality Sampling and Frequency

URS recommended that instream water quality samples should be collected bi-monthly during both the dry and wet weather seasons (3-dry season and 3-wet season), at a minimum. The three wet-season instream samples should be collected during storm events. Samples should be collected as composite grab samples, which will require samples to be collected at a defined frequency and combined prior to analysis for most parameters. Both field-testing and laboratory testing (of the composite samples) is recommended for the parameters listed in Section 6 of this document. In addition, a data evaluation is recommended to begin to take a look at previously collected instream data with respect to the impact that runoff is having on instream water quality (see Section 7.0). The sample frequencies that are proposed by each jurisdiction vary somewhat based on what is considered to be the "maximum extent practicable" for that jurisdiction. Resulting changes to sample frequencies are provided in Table 4.

NOTE: The most resource-intensive element of water quality monitoring is sampling of storms. Because of the difficulty of identifying suitable storms, and then mobilizing in a timely manner to allow for characterizing the storm, storm sampling requires a large time commitment. Staff are assigned other responsibilities in addition to monitoring. To ensure that monitoring doesn't consume inordinate resources at the expense of activities that reduce pollution, the following limitations apply to the commitments made in this plan related to storm sampling.

- In a given year, in order to obtain samples from three storms, staff from CCSD#1 will track an unlimited number of storms via weather forecasts. If a storm is forecasted that looks like it may be sufficient for sampling, CCSD#1 will notify all other participating co-permittees. Co-permittees will then clear work and/or personal schedules up to ten times to allow for mobilization. Actual mobilize for a storm will occur up to five times. Once this level of effort has been made, co-permittees will consider the storm monitoring commitment for the year to have been met.
- Storms will not be sampled on major holidays, including Thanksgiving, Christmas, New Year's, President's Day and Easter.
- The criteria for determining whether a storm is appropriate for sampling will be based on the climate of the Pacific Northwest. Storms should be of a size that once a crew is mobilized, runoff is anticipated to occur for a minimum of two hours. Antecedent dry periods are not specified but will be noted when data are reported.
- Finally, the duration of time between the collection of individual samples will be varied as necessary to meet the goal of obtaining at least three samples per storm (these three samples will then be composited into one sample at the lab into for analyses). Samples will not be taken more frequently than once each hour. In some cases a storm may not last long enough to collect three time-weighted samples. In these cases, the samples that are collected will be composited and analyzed; no minimum number of samples is specified.

Flow and Temperature Monitoring

Accurate assessment of flow is beneficial to pollutant loads assessments and analysis. Continuous flow data, collected as part of the instream monitoring effort, is available for nine of the instream monitoring sites. Generally, water quality data collected at these sites includes temperature and pH, although some sites are also be sampled for dissolved oxygen. The primary benefit of these continuous monitoring sites is the ability to gage the increase in flow due to a storm event and apply concentration data (whether instream or runoff specific) to calculate instream pollutant loading. Clackamas County co-permittees should continue to maintain the continuous monitoring locations on these instream monitoring sites. Additional flow monitoring sites are not recommended as flow monitoring is resource intensive and those resources would be better spent on collecting water quality data given that flows may be estimated using standard engineering calculations.

Other Regional Instream Monitoring Efforts

It is worth noting that other regional jurisdictions are conducting instream monitoring activities that would be relevant to some of the streams that flow through the Clackamas County NPDES permit area. One example of this would be monitoring currently conducted on Johnson Creek.

A small part of the Johnson Creek watershed lies within CCSD#1 and the City of Milwaukie. Given the minimal proportion of watershed within the Clackamas County NPDES permit area (e.g., only about 2%, or 727.5 acres, of the entire Johnson Creek watershed, which is 55 square miles, lies within CCSD#1 and/or the City of Happy Valley), WES and the City of Milwaukie have elected to participate in interjurisdictional water quality and flow monitoring efforts to

produce high-quality data in a coordinated, cost-effective manner. Coordinated monitoring projects during the 2005-2006 reporting period include, but aren't limited to:

- **Turbidity, Total Suspended Solids, and Pesticide Measurements in the Waters of Johnson Creek:** Water Environment Services, in partnership with the cities of Gresham, Happy Valley, Milwaukie, and Portland, the Johnson Creek Watershed Council, and Multnomah County, provided in-kind contributions (i.e., labor) towards a study that is exploring the relationship between DDT, turbidity, total suspended solids (TSS), and dieldrin. Section 319 grant funds from DEQ supported a portion of this study. Creek water samples are being analyzed in an effort to determine which levels of TSS and turbidity can be expected to correlate with certain levels of these pesticides. Lab analysis for these pesticides is very expensive and it is hoped that TSS or turbidity can be found to be a reliable surrogate. As of October 2006, the study is incomplete and ongoing. Additional information regarding this study is not included in this report. Please contact Andrew Swanson of WES at 503-353-4598 for more information about this study.
- **USGS' Continuous Monitoring Stations in the Johnson Creek Watershed:** Water Environment Services, in partnership with the cities of Gresham, Happy Valley, Milwaukie, Portland, Multnomah County and the USGS, contributed funds towards the operation of five continuous monitoring stations in the Johnson Creek watershed during the 2005-2006 reporting period. These stations collect data 24 hours/day, seven days/week. Data was collected at all stations for the following parameters: water temperature and water flow. In addition, turbidity was collected at two stations, Gresham's and Milwaukie's, during this time period. Additional information regarding these USGS stations is not included in this report, but it can be viewed on this USGS webpage: **http://waterdata.usgs.gov/or/nwis/current/?type=quality**. Please contact the USGS or Andrew Swanson of WES at 503-353-4598 for more information about these stations.

Table 4 - Modifications to the Clackamas County Co-permittee's Existing Instream Monitoring Efforts

Monitored Waterbody	Responsible Party	Number of Locations	Type of Sample	Sampling Frequency	Parameters Monitored (Field/Lab)*	Storm Event Monitoring (Y/N)**	Summary of Changes
Carli Creek	CCSD#1	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	CCSD#1 reduced the number of sites by 6 in order to free up additional resources to collect composites and to target storm events. The sites that were eliminated were considered to be lower priority based on location within the UGB and based upon 303(d) listings.
Clackamas River	CCSD#1	2	Grab	6-12/year	Field and Lab	N	
	CCSD#1/USGS	1	Automated	Continuous	Field	Y	
Cow Creek***	CCSD#1	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Dean Creek	CCSD#1	1	Grab	12/year	Field and Lab	N	
Kellogg Creek	CCSD#1	2	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Mt Scott Creek	CCSD#1	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Phillips Creek	CCSD#1	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Rock Creek	CCSD#1	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Sieben Creek	CCSD#1	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Minthorn Creek	Milwaukie	1	Grabs and Composites	4/year	Field and Lab	Y (2 of 4)	
Johnson Creek	Milwaukie (via	1	Automated	Continuous	Field and Lab	Y	
Abernathy Creek	Oregon City	2	Grabs and Composites	4/year	Field and Lab	Y (2 of 4)	
Caufield Creek	Oregon City	1	Grab	4/year	Field	N	
Coffee Creek	Oregon City	1	Grabs and Composites	4/year	Field and Lab	Y (2 of 4)	
High School Creek	Oregon City	1	Grab	4/year	Field	N	No changes were considered necessary except to specifically target storm events.
Livesay Creek	Oregon City	1	Grab	4/year	Field	N	
Mud Creek	Oregon City	1	Grab	4/year	Field	N	Added an additional site on Abernathy so that there will be one site upstream and one site downstream of City impacts. Also reduced sites to free up resources for conducting additional analyses, collecting composites and targeting storm events. Duplication of land use representation was considered when eliminating sites.
Newell Creek	Oregon City	1	Grab	4/year	Field	N	
Park Place Creek	Oregon City	1	Grabs and Composites	4/year	Field and Lab	Y (2 of 4)	
Singer Creek	Oregon City	2	Grabs and Composites	4/year	Field and Lab	Y (2 of 4)	
South End Creek	Oregon City	1	Grab	4/year	Field	N	
Athey Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Field Creek	SWMACC	1	Grab	12/year	Field and Lab	N	
Pecan Creek	SWMACC	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Rock Creek (South)	SWMACC	1	Grab	12/year	Field and Lab	N	
Saum Creek	SWMACC	1	Grab	12/year	Field and Lab	N	

Monitored Waterbody	Responsible Party	Number of Locations	Type of Sample	Sampling Frequency	Parameters Monitored (Field/Lab)*	Storm Event Monitoring (Y/N)**	Summary of Changes
Shipley Creek	SWMACC	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	Many of these sites were located in rural areas with very similar land use and some sites were eliminated to free up resources for conducting additional analyses, collecting composites and targeting storm events.
Tualatin River	SWMACC/USGS	1	Automated	Continuous	Field	Y	
Unnamed Creek at	SWMACC	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Wilson Creek	SWMACC	1	Grabs and Composites	9/year	Field and Lab	Y (3 of 9)	
Summerlinn– tributary	West Linn	1	Grabs and Composites	5/year	Field and Lab	Y (3 of 5)	
Tanner Creek	West Linn	1	Grabs and Composites	5/year	Field and Lab	Y (3 of 5)	
Trillium Creek	West Linn	1	Grabs and Composites	5/year	Field and Lab	Y (3 of 5)	
Rinearson Creek	Gladstone	1	Grabs and Composites	3/year	Field and Lab	Y (3 of 3)	Sites were considered appropriate and only minor changes were made to the parameter list.

Shading indicates where sample locations have changed.

***** The term "Field" indicates samples that are analyzed using meters in the field – typically for temperature, conductivity, dissolved oxygen, total dissolved solids, and pH.

** A "N" or no in this column indicates that samples are collected on a regular schedule such as monthly and may or may not include storm events. Specific weather conditions are not targeted.

*** The Cow Creek sampling locations were relocated from the existing location at SE Fish Hatchery Rd. to SE Last Rd.

Site was considered appropriate and changes were only made to sampling frequency, type of sample, and the parameter list.

Table 5 - Summary of the Modified Clackamas County Co-permittee Instream Monitoring Efforts

Jurisdiction	Modified Total # of Composite Sampling Sites	Previous 2006 Total # of Storm Event Grab Samples Collected Per Year (# of those which are storm samples is in parenthesis)	Modified Total # of Composite Samples Collected Per Year (# of those which are storm samples is in parenthesis)	Automated Continuous Sampling Sites	Modified Total # of Sampling Sites
CCSD#1	8	23*	72 (24)	1	9
SWMACC	4	18*	36 (12)	1	5
Gladstone	0	0	0 (0)	0	0
Milwaukie	1	1*	4 (2)	1	2
Oregon City	6	8*	24 (12)	0	6
West Linn	3	9	15(9)	0	3
Gladstone	**1**	**1**	**3 (3)**	**0**	**1**
TOTAL:	**23**	**289 (60)**	**154 (62)**	**2**	**26**

* For instream monitoring at these sites, storm events were not targeted. To estimate the number of storm samples collected, the total number of samples collected was multiplied by 0.19 (or 19%) as Clackamas County reviewed previously collected data and estimated that 19% of the instream samples were collected when runoff was occurring.

Shading = this column shows the previous number of samples collected for comparison to the modified program.

Number	Jurisdiction	Sampling Method	Site Description	Steam Name
1	CCSD #1/USGS	Automated	S. Fork Water Intake	Clackamas River
2	CCSD #1	Grab and Composite	120th and Carpenter	Carli Creek
3	CCSD #1	Grab and Composite	Hwy 212 and 135th	Sieben Creek
4	CCSD #1	Grab and Composite	Hwy 212	Rock Creek
5	CCSD #1	Grab and Composite	84th and Sunnybrook	Phillips Creek
6	CCSD #1	Grab and Composite	North Clackamas Park	Mt. Scott Creek
7	CCSD #1	Grab and Composite	Rusk & Aldercrest	Kellogg Creek
8	CCSD #1	Grab and Composite	Kellogg Ck at Hwy 99E	Kellogg Creek
9	CCSD #1	Grab and Composite	SE Last Rd.	Cow Creek
10	Milwaukie	Grab and Composite	Minthorn Creek	Minthorn Creek
11	Milwaukie / USGS	Automated	Johnson Creek	Johnson Creek
12	Oregon City	Grab and Composite	At Holly Lane Bridge	Abernathy Creek
13	Oregon City	Grab and Composite	Abernathy Creek - Downstream	Abernathy Creek
14	Oregon City	Grab and Composite	Outfall at Willamette	Coffee Creek
15	Oregon City	Grab and Composite	Behind 13530 Redland Rd	Park Place Creek
16	Oregon City	Grab and Composite	At N. end of Singer Cr Park	Singer Creek
17	Oregon City	Grab and Composite	Singer Cr Baseline Site	Singer Creek
18	SWMACC/USGS	Automated	Tualatin River	Tualatin River
19	SWMACC	Grab and Composite	SW Long farm Rd	Wilson Creek
20	SWMACC	Grab and Composite	SW Mossy Brae Rd	Pecan Creek
21	SWMACC	Grab and Composite	SW Shadow Wood Drive	Shipley Creek
22	SWMACC	Grab and Composite	SW Ribera Lane	Unnamed Tributar
23	West Linn	Grab and Composite	At Imperial Drive	Tanner Creek
24	West Linn	Grab and Composite	At Caloroga Rd	Trillium Creek
25	West Linn	Grab and Composite	Tributary to Tualatin River	Summerlinn Creek
26	Gladstone	Grab and Composite	Outfall at Risley Rd.	Rinearson Creek

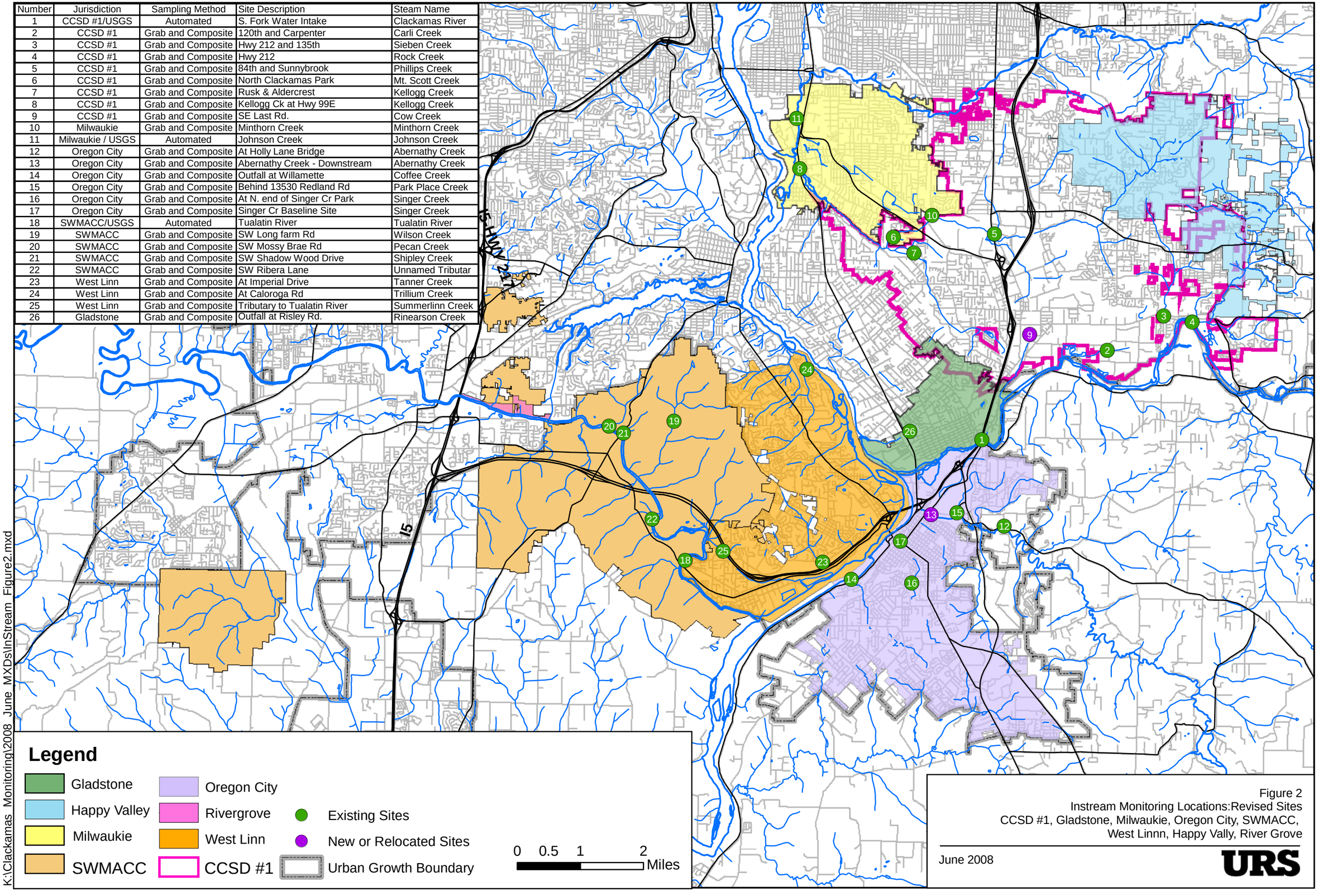


Figure 2
Instream Monitoring Locations:Revised Sites
CCSD #1, Gladstone, Milwaukie, Oregon City, SWMACC,
West Linnn, Happy Vally, River Grove

June 2008

URS

K:\Clackamas Monitoring\2008 June MXDs\InStream Figure2.mxd

5.2 OUTFALL MONITORING EFFORTS

Collecting grab samples at outfall locations throughout the Clackamas MS4 permit area will be conducted to address NPDES MS4 objectives 1, 4, 5, and 6 when conducted during wet weather conditions.

1. Determine the status of implementing the components of the SWMP;
3. Evaluate the source of specific pollutants;
4. Assess the chemical, biological, and physical effects of MS4 runoff on receiving waters; and
5. Characterize MS4 discharges.

The following text describes existing outfall monitoring efforts (5.2.1), observations related to existing outfall monitoring efforts (5.2.2), and modified outfall monitoring efforts (5.2.3).

5.2.1 2006 Existing Outfall Monitoring Efforts

Grab samples are collected at outfall locations throughout the Clackamas County MS4 area. Generally samples are collected during storm events, anywhere from one to four times per year. There is one location sampled by the City of Milwaukie, that is monitored at defined frequencies throughout the year (e.g., monthly), and sampling is not isolated to wet weather conditions. This location represents an area with baseflow and thus monitoring data would not be completely representative of MS4 runoff. A few other locations in Clackamas County are monitored at defined frequencies because the sites are behind locked gates and cannot be accessed after normal business hours.

Existing outfall monitoring locations were classified by land use, as an initial way to estimate and evaluate the sources of specific pollutants. Classification of stormwater quality based on land use can be used for pollutant load modeling efforts. It can also be used to target best management practices in land uses with the greatest loadings for specific parameters. Each current monitoring location is listed below in Table 6, along with a reference regarding the sampling frequency, general parameters monitored, and whether monitoring is conducted during storm events. A more condensed summary of outfall monitoring is provided in Table 7. The locations of existing outfall monitoring sites are also shown on Figure 3.

Table 6 - Detailed Summary of the 2006 Existing Outfall Monitoring Locations

Upstream Land Use	Outfall Description	Responsible Party	Sampling Frequency	Parameters Monitored (Field/Lab)	Targeted Storm Event Monitoring (Y/N)(1)
Residential	Outfall #19 – SE Webster Rd. at Kellogg Creek	CCSD#1	1/year	Field and Lab	Y
Mixed Use (Industrial, highway, commercial, residential)	Outfall #12 – SE Pheasant Ct.		1/year	Field and Lab	Y
Mixed Use (Industrial, school, commercial, residential)	Outfall #26 – SE Tolbert Rd. and 94th Ave.		1/year	Field and Lab	Y
Industrial	Riverside Park Storm Sewer Outfall		6-12/year	Field (all samples) and Lab (4x/year)	N
Industrial	106th Ave. Storm Sewer Outfall		6-12/year	Field (all samples) and Lab (4x/year)	N
Residential	Outfall #25262 to Johnson Creek	Milwaukie	4/year	Field and Lab	N
Commercial	Clackamas River outfall at Oregon City Shopping Center	Oregon City	3/year	Field and Lab	Y
Industrial	Clackamas River outfall at Clackamette Cove		3/year	Field and Lab	Y
Residential	12" Outfall – SW Terry Ave. and Childs Rd.	SWMACC	1/year	Field and Lab	Y
Residential and Park	City of Rivergrove Boat Ramp	SWMACC	1/year	Field and Lab	Y
Residential	Outfall to the Tualatin at River Heights Circle	West Linn	2/year	Field and Lab	Y

Notes:

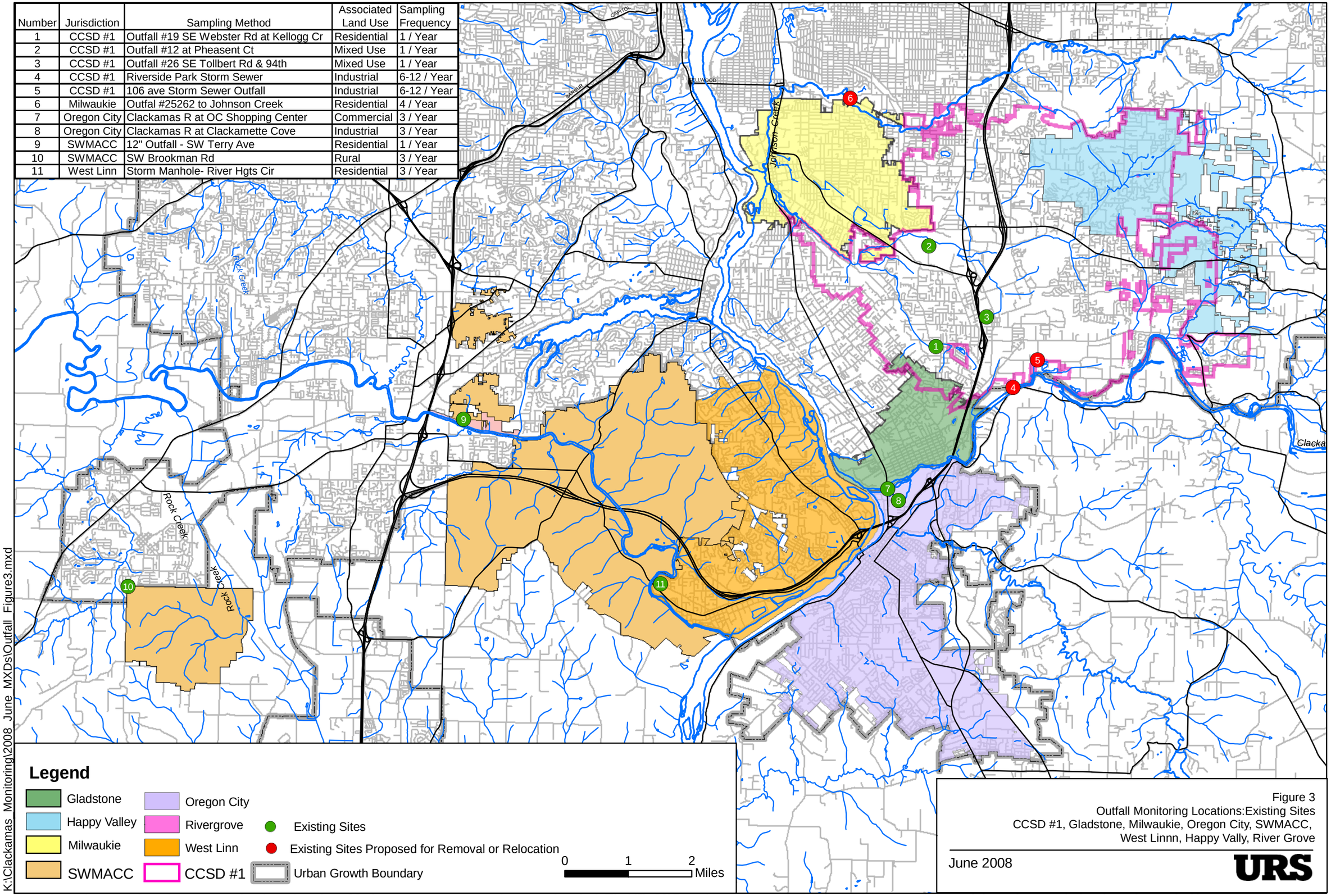
(1) A no indicates that sampling is conducted on a regular basis. It is possible that storms are occurring during these regular sampling events.

Table 7 - Overall Summary of 2006 Existing Outfall Monitoring Locations

Upstream Land Use	# of Outfalls Monitored	Responsible Party	Total # of Samples Collected Per Year	Parameters Monitored (Field/Lab)	Sites Where Targeted Storm Event Monitoring is Conducted (Y/N)
Residential					
	5	CCSD#1 (1) SWMACC (2) West Linn (1) Milwaukie (1)	9	Field and Lab	Y for 4 N for 1 - (Milwaukie)
Commercial					
	1	Oregon City	3	Field and Lab	Y
Mixed Use					
	2	CCSD#1	2	Field and Lab	Y
Industrial					
	3	CCSD#1 (2) Oregon City (1)	21*	Field and Lab	N for 2 - (CCSD#1) Y for 1
Open Space					
	0	NA	0	NA	NA
Rural					
	1	SWMACC	1	Field and Lab	Y
Total:	**12**		**36**		

***** For samples that were listed as being collected 6 to 12 times per year, an average of 9 times per year was used to provide the total number of samples collected per year.

Number	Jurisdiction	Sampling Method	Associated Land Use	Sampling Frequency
1	CCSD #1	Outfall #19 SE Webster Rd at Kellogg Cr	Residential	1 / Year
2	CCSD #1	Outfall #12 at Pheasent Ct	Mixed Use	1 / Year
3	CCSD #1	Outfall #26 SE Tollbert Rd & 94th	Mixed Use	1 / Year
4	CCSD #1	Riverside Park Storm Sewer	Industrial	6-12 / Year
5	CCSD #1	106 ave Storm Sewer Outfall	Industrial	6-12 / Year
6	Milwaukie	Outfal #25262 to Johnson Creek	Residential	4 / Year
7	Oregon City	Clackamas R at OC Shopping Center	Commercial	3 / Year
8	Oregon City	Clackamas R at Clackamette Cove	Industrial	3 / Year
9	SWMACC	12" Outfall - SW Terry Ave	Residential	1 / Year
10	SWMACC	SW Brookman Rd	Rural	3 / Year
11	West Linn	Storm Manhole- River Hgts Cir	Residential	3 / Year



Legend

- Gladstone
- Happy Valley
- Milwaukie
- SWMACC
- Oregon City
- Rivergrove
- West Linn
- CCSD #1
- Existing Sites
- Existing Sites Proposed for Removal or Relocation
- Urban Growth Boundary

0 1 2 Miles

Figure 3
Outfall Monitoring Locations:Existing Sites
CCSD #1, Gladstone, Milwaukie, Oregon City, SWMACC,
West Linnn, Happy Vally, River Grove

June 2008

URS

K:\Clackamas Monitoring\2008 June MXDs\Outfall Figure3.mxd

5.2.2 Observations Related to 2006 Existing Outfall Monitoring Efforts

The following text provides observations related to the existing outfall monitoring efforts that lead to recommendations for improvements in order to meet new permit requirements.

Limited Representation of Some Land Uses: Based on the assessment of existing outfall monitoring efforts, and considering the distribution of land uses in the permit area, it appears that significant activity is occurring throughout the residential and industrial land use categories, but there is limited monitoring occurring for commercial and open space areas.

Some Sample Locations Include Dry Weather Flows: There is one location currently being monitored on a regularly scheduled basis during both dry and wet weather events. A stormwater outfall can only be monitored during dry weather if a continuous baseflow exists. Outfalls with continual flow during dry weather conditions are not representative locations for observing specific land use based stormwater runoff quality and quantity conditions, rather they can be used to indicate the effect of stormwater runoff on receiving waters, if samples are taken during dry and wet weather conditions and compared as if they were instream samples. Depending upon the magnitude of baseflow observed at this location, monitoring of this site would be better classified as instream monitoring instead of outfall monitoring. If this site is removed from the table above, it reduces the number of residential sites from 5 to 4. In addition, two sites are located behind locked gates and access is restricted to normal business hours. In terms of monitoring storm events, this restriction is very limiting as monitoring may need to occur during evenings and weekends. If you remove these two sites from the table above, it reduces the number of industrial sites from 3 to 1.

Further Data Evaluation is Needed: Significant amounts of land use based stormwater runoff data were collected during the first MS4 NPDES Phase I permit term. Through ACWA, these data were compiled as a whole and evaluated in 1996. Due to the size of the data set and the inherent variability in the data, the results showed that collecting additional data at the time would not provide much value in the way of further refining the data. Therefore, many of the NPDES Phase I jurisdictions got permission from DEQ to redirect their monitoring efforts away from land use based monitoring and instead focused on BMP and instream monitoring. However, it has been 10 years since that report was produced and significant effort has gone into implementing stormwater management BMPs since that time. It would be worthwhile to take another look at the land use data now that additional time has passed to determine whether there have been changes that are statistically verifiable. The results of this evaluation may also generate additional questions that would help to guide future monitoring decisions. This recommendation is included in Section 7.0.

Limited Number of Parameters Analyzed: The parameters of concern, when evaluating outfall sites for impacts due to stormwater runoff, should be consistent with water quality constituents relevant to TMDLs and source identification efforts. Therefore, laboratory testing for a more representative list of parameters should be conducted. The recommended list of analytes is provided in Section 6.0.

Samples are Not Representative of the Entire Hydrograph: The existing storm samples are typically collected as grab samples. Grabs represent a point in time. Composite samples that are more representative of the entire hydrograph are recommended. Fluctuations of pollutant concentrations typically vary widely throughout an event and a composite sample will better represent those variations.

5.2.3 Modified Outfall Monitoring Efforts

In order to ensure that outfall sampling is conducted to meet the objectives of the monitoring program, it is recommended that some of the locations and the frequency and methods of sampling be modified to ensure representative stormwater samples of each land use are collected.

Locations for Outfall Monitoring

Based on the initial analysis of outfall monitoring sites, there are limited sites where runoff conditions are representative of either a commercial or an open space land use category. Therefore, Clackamas County co-permittees have considered reallocating current efforts towards selecting outfalls sites representative of commercial and open space land uses. As a result, CCSD#1 added one commercial site. In addition, monitoring sites that included flow during dry weather were removed from the outfall monitoring list as they are not completely representative of urban runoff. Table 8 includes a summary of the modifications that were made to the existing sampling sites. Table 9 includes a more condensed summary of the modified sites. The modified site locations are also shown on Figure 4.

Outfall Water Quality Sampling and Frequency

Outfall samples will be collected during three storm events per year as a composite of 3 timed-weighted samples collected throughout the event. See the **Note** on page 12 regarding limitations on the commitments for storm sampling. Both field and laboratory testing is recommended for the parameters listed in Section 6.0. In addition, a data evaluation is recommended to compare recent data to the ACWA 1996 data. This comparison may lead to questions that would result in refinements to the monitoring plan (see Section 7.0). A more detailed summary of the resulting changes to jurisdictional sampling programs is provided in Table 8.

Again, as stated for the instream sampling, it may appear that with the reduction of one sampling site, that this modified plan represents a reduction in resources. This is not the case. The resources are being re-allocated to collecting composite as opposed to grab samples and to analyzing the samples for a longer list of constituents. See Table 9 for a comparison of the previous sampling to the modified sampling. The modifications are expected to result in data that are more useful and more robust.

Table 8 - Detailed Summary of Modified Outfall Monitoring Locations

Upstream Land Use	Outfall Description	Responsible Party	Sampling Frequency	Parameters Monitored (Field/Lab)	Targeted Storm Event Monitoring (Y/N)[1]	Summary and Rationale for Changes
Residential	Outfall #19 – SE Webster Rd. at Kellogg Creek	CCSD#1	3/year	Field and Lab	Y	
Mixed Use (Industrial, highway, commercial, residential)	Outfall #12 – SE Pheasant Ct.	CCSD#1	3/year	Field and Lab	Y	
Mixed Use (Industrial, school, commercial, residential)	Outfall #26 – SE Tolbert Rd. and 94th Ave.	CCSD#1	3/year	Field and Lab	Y	
Commercial	**SE Oregon Trail Dr. near SE Sieben Park Way**	**CCSD#1**	**3/year**	**Field and Lab**	**Y**	**Needed additional representation of commercial land use.**
~~Industrial~~	~~Riverside Park Storm Sewer Outfall~~	~~CCSD#1~~	~~6-12/year~~	~~Field (all samples) and Lab (4x/year)~~	~~N~~	These sites are behind locked gates after normal business hours and access would be too limited.
~~Industrial~~	~~106th Ave. Storm Sewer Outfall~~	~~CCSD#1~~	~~6-12/year~~	~~Field (all samples) and Lab (4x/year)~~	~~N~~	
Residential	Outfall at Risley Rd.	Gladstone	3/year	Field and Lab	Y	
~~Residential~~	~~Outfall #25262 to Johnson Creek~~	~~Milwaukie~~	~~4/year~~	~~Field and Lab~~	~~N~~	Not 100% representative of runoff as these sites have flow during dry weather.
Residential	**Outfall #23003 to Johnson Creek at Roswell Street**	**Milwaukie**	**3/year**	**Field and Lab**	**Y**	**New site added to replace the previous site that had dry weather flows.**
Commercial	Clackamas River outfall at Oregon City Shopping Center	Oregon City	3/year	Field and Lab	Y	
Industrial	Clackamas River outfall at Clackamette Cove	Oregon City	3/year	Field and Lab	Y	

Upstream Land Use	Outfall Description	Responsible Party	Sampling Frequency	Parameters Monitored (Field/Lab)	Targeted Storm Event Monitoring (Y/N)[1]	Summary and Rationale for Changes
Residential	12" Outfall – SW Terry Ave. and Childs Rd.	SWMACC	3/year	Field and Lab	Y	
Rural	Outfall at SW Brookman Rd. near Sherwood	SWMACC	3/year	Field and Lab	Y	
Residential	Outfall to the Tualatin at River Heights Circle	West Linn	3/year	Field and Lab	Y	

Notes:
Shading = eliminate this site from further monitoring.
Bold Text = site added.

(1) A no indicates that sampling is conducted on a regular basis. It is possible that storms are occurring during these regular sampling events.

Table 9 - Outfall Monitoring Recommendations Compared to 2006 Existing Monitoring

	Previous Monitoring			Modified Monitoring	
Upstream Land Use	**# of Outfalls Currently Monitored**	**Total # of Samples Collected Per Year**	**Total # of Targeted Storm Samples Collected Per Year**	**# of Outfalls Recommended for Monitoring**	**Total # of Samples Recommended for Collection Per Year**
Residential					
	5	9	5	5	15
Commercial					
	1	3	3	2	6
Mixed Use					
	2	2	2	2	6
Industrial					
	3	21*	3	1	3
Rural					
	1	1	1	1	3
Total:	**12**	**36**	**14**	**11**	**33**

* Where 6 to 12 samples per year were listed as the sampling frequency, an average of 9 samples per year was used to come up with a total number of samples collected per year.

Number	Jurisdiction	Sampling Method	Site Description	Associated Land Use	Sampling Frequency
1	CCSD #1	Outfall	Outfall #19 SE Webster Rd at Kellogg Cr	Residential	1 / Year
2	CCSD #1	Outfall	Outfall #12 at Pheasent Ct	Mixed Use	1 / Year
3	CCSD #1	Outfall	Outfall #26 SE Tollbert Rd & 94th	Mixed Use	1 / Year
4	CCSD #1	Outfall	Near 147 Ave and Sunnyside Rd	Commercial	3 / Year
5	Milwaukie	Outfall	Outfall #23003 at Roswell Street	Residential	3 / Year
6	Oregon City	Outfall	Clackamas R at OC Shopping Center	Commercial	3 / Year
7	Oregon City	Outfall	Clackamas R at Clackamette Cove	Industrial	3 / Year
8	SWMACC	Outfall	12" Outfall - SW Terry Ave	Residential	1 / Year
9	SWMACC	Outfall	SW Brookman Rd	Rural	3 / Year
10	West Linn	Outfall	Storm Manhole- River Hgts Cir	Residential	3 / Year

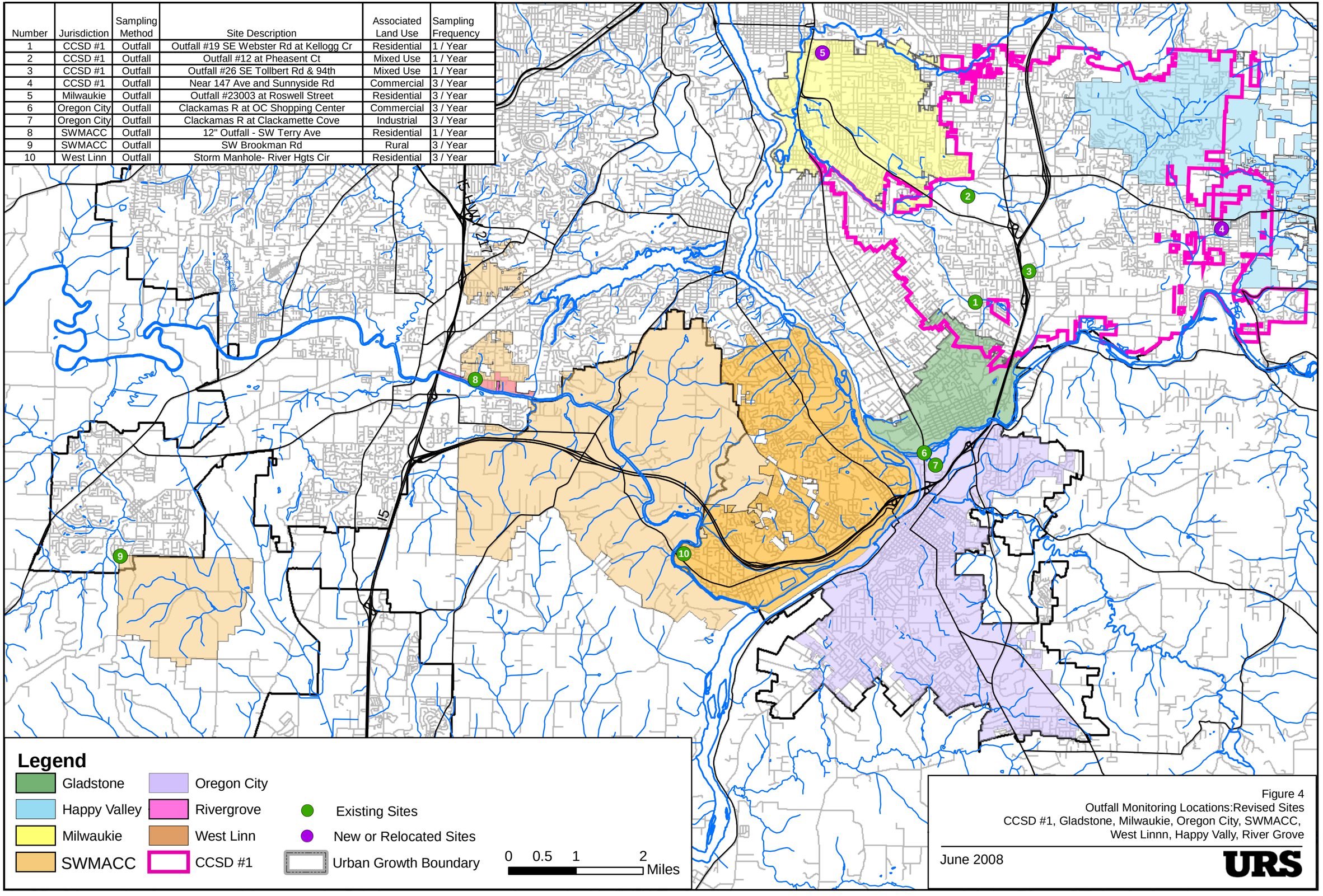


Figure 4
Outfall Monitoring Locations:Revised Sites
CCSD #1, Gladstone, Milwaukie, Oregon City, SWMACC,
West Linnn, Happy Vally, River Grove

June 2008

URS

5.3 BEST MANAGEMENT PRACTICE (BMP) MONITORING EFFORTS

Monitoring to analyze the effectiveness of BMPs will be conducted to address NPDES MS4 objectives 1 and 2.

1. Determine the status of implementing the components of the SWMP; and
2. Evaluate the effectiveness of BMPs for specific source controls.

Best Management Practices (BMPs) is a broad term that can be used to describe practices ranging from structural water quality facilities to source control/programmatic activities (as reported in the co-permittees Stormwater Management Plans) that are implemented to achieve a net water quality benefit. The monitoring of a structural BMP facility (detention and retention ponds, swales, constructed wetlands, proprietary systems) would represent an environmental monitoring effort, while monitoring of source control/ programmatic activities or BMPs (erosion and sediment control, stormwater conveyance system cleaning and maintenance, industrial and business inspection programs and public education and outreach) would represent a program monitoring effort. Although this monitoring plan is intended to focus on environmental monitoring efforts, programmatic monitoring of source control activities would also help to meet select monitoring objectives and is discussed where relevant in this section.

The following text describes existing BMP monitoring efforts (5.3.1), observations related to existing BMP monitoring efforts (5.3.2), and modified BMP monitoring efforts (5.3.3).

5.3.1 2006 Existing BMP Monitoring Efforts

Clackamas County co-permittees currently conduct a variety of program monitoring efforts, generally related to implementation of their SWMPs. There is currently limited environmental monitoring occurring that is associated with performance of structural BMPs. A general description of the existing BMP monitoring efforts is provided below.

Structural BMPs

Currently, CCSD#1, SWMACC, and the City of Milwaukie are involved in an ongoing monitoring program related to underground injection controls (UIC). Coordination of this program is the result of UIC permit requirements, not MS4 permit requirements, and the monitoring program is expected to continue on an annual basis. UICs are not considered to be part of the MS4 system, as they convey stormwater to the subsurface rather than through an MS4 conveyance system into surface water bodies. However, results of the UIC monitoring program will be beneficial to the MS4 program because the monitoring that is being conducted for this program is evaluating the effluent from structural BMPs prior to its discharge into a UIC. There are seven BMPs that are currently being evaluated including sedimentation manholes, catchbasin inserts, a Stormceptor, an oil-water separator, a StormFilter, and sumped catchbasins. To date four years of samples have been collected from each site and the fifth year of sampling (2006/2007) has been initiated. Sampling of these sites is conducted on a storm basis only. One of the sites is located within Clackamas County.

Erosion and Sediment Control

Through various ordinances, Clackamas County co-permittees are required to implement erosion and sediment control measures for earth disturbing activities within the various cities. Clackamas County co-permittees have erosion control related BMPs included in their SWMPs. Each jurisdiction, whether individually or through an intergovernmental agreement with another jurisdiction, reviews erosion control plans for appropriate structural and non-structural BMPs and conducts periodic inspections of erosion control facilities. During inspections, City or County inspectors may observe how various facilities and practices are influencing construction related pollutant discharges from entering the stormwater conveyance system and gage how the erosion control process and procedures, as outlined in the SWMP, are being implemented. This process has been providing subjective but valuable information related to the effectiveness of construction site BMPs.

Source Control

As mentioned previously, Clackamas County co-permittees have each completed revised SWMPs for this permit which outline source control/ programmatic BMPs to minimize water quality impacts related to stormwater runoff. Such BMPs include operation and maintenance activities, implementation of planning and development standards, industrial controls, and public education. These activities provide a net water quality benefit, yet effectiveness of these activities cannot practically be measured or quantified. Program monitoring is described in each of the co-permittees SWMPs and involves the use of performance indicators to evaluate how implementation of these SWMP components benefits water quality. Performance indicators include tracking the volume of debris removed during maintenance activities, tracking the number of sites inspected for various activities, and tracking programmatic modifications to various program components. Program monitoring of these source control/ programmatic BMPs is discussed here because it will help to meet the permit monitoring objectives related to BMP effectiveness as listed above.

5.3.2 Observations Related to 2006 Existing BMP Monitoring Efforts

Clackamas County co-permittees generally conduct program monitoring individually, to fulfill SWMP requirements. Therefore, until quantitative data exists that can verify and validate the effectiveness of these various source control/ programmatic BMPs, there are no recommended modifications related to the jurisdictions program monitoring activities. Other than the UIC BMP-related monitoring that is currently being conducted, there are no other significant structural BMP monitoring efforts (i.e., environmental monitoring) being conducted.

5.3.3 Recommendations for BMP Monitoring

As stormwater management and stormwater treatment are continually changing and evolving fields, extensive existing and new literature regarding the monitoring of various treatment technologies (structural BMPs) is being generated by researchers, public entities, and private companies to meet both regulatory and non-regulatory needs. Regionally, there are a number of local jurisdictions that are actively collecting effectiveness information for various structural

controls. There are also ongoing efforts to gather information related to source control effectiveness as well, but such information is currently limited.

The primary recommendation regarding this monitoring component is related to the collection and tracking of literature. By collecting literature and tracking local monitoring efforts, Clackamas County co-permittees will gain information that will aid their individual stormwater management efforts and possibly influence future decision-making regarding appropriate levels of treatment technology to require for new and redevelopment. Specifically, Clackamas County co-permittees will track available data related to the performance and cost effectiveness of both structural and source control BMPs. Actively tracking and reviewing literature will also allow the co-permittees to effectively keep up with current inventions and technological advances.

A number of Clackamas County co-permittees are actively involved in ACWA, which provides an open forum for stormwater management discussions and provides additional educational opportunities for local officials regarding stormwater quality and treatment. Recently, select co-permittees contributed to the development of a BMP effectiveness database that ACWA commissioned. Participation in ACWA will continue to support literature tracking efforts.

Potential current literature sources include the following:

- ACWA BMP Effectiveness Database 2005.
- ACWA UIC Monitoring Study.
- ASCE and USEPA (2004). International Stormwater Best Management Practices (BMP) Database. [online] http://www.bmpdatabase.org
- WERF and NCHRP Stormwater Research Efforts. Both organizations are active in preparing research documents on stormwater runoff and best management practices performance.
- Federal Highway Administration (FHWA) (2000). Stormwater Best Management Practices in an Ultra-Urban Setting: Selection and Monitoring. Prepared by Tetra-Tech, Inc. and Hagler Bailly Services, Inc. FHWA-EP-00-002, Washington, DC.
- Green, D., Grizzard, T., Randall, C. (1994). "Monitoring of Wetlands, Wet ponds, and Grassed Swales." Proc Eng Found Conf Stormwater NPDES Related Monitoring Needs, p 487-513
- Heyvaert, A.C., Reuter, J.E. and E.W. Strecker, Selected Results from Monitoring Relevant to the Design and Performance of Stormwater BMPs in the Tahoe Basin, Draft Report Prepared for California Tahoe Conservancy, South Lake Tahoe, California, 2003
- Pitt, R.E. (2002a). "Emerging Stormwater Controls for Source Areas." In Management of Wet Weather Flows in Watershed. Sullivan, D. and Field, R., eds., CRC Press, Boca Raton.
- Pitt, R.E., Maestre, A. and Morquecho, R. (2004). "The National Stormwater Quality Database (NSQD, version 1.1)." Proc. Of the World Water and Environmental Resources Congress, Salt Lake City, UT. June 2004, ASCE, Reston, VA, CD-ROM. (Online at : http://unix.eng.ua.edu/~rpitt/Research/ms4/Paper/recentpaper.htm)
- Schueler, T. (1987). Controlling Urban Runoff- A Practical Manual for Planning and Designing Urban Best Management Practices. Metropolitan Washington Council of Governments. Washington, DC, 240 pp

5.4 2006 FIELD SCREENING AND DRY WEATHER OUTFALL MONITORING

Field screening activities and dry weather outfall monitoring are conducted to detect and eliminate illicit discharges and pollutants associated with illicit discharges that are entering the MS4 system. Illicit discharges are typically defined as non-stormwater discharges that occur due to an individual's activities. Field screening and dry weather outfall monitoring involves the inspection of select outfalls during dry weather conditions to determine if any discharge is occurring. If a discharge is occurring, the next step is to determine the source of the discharge and whether the discharge is preventable and whether it is adding pollutants into the MS4. If the discharge is considered to be problematic efforts are made to eliminate it.

Field screening and dry weather outfall monitoring activities are generally conducted by individual jurisdictions annually, and the methodology and procedures are described and/or referenced in their SWMPs. Field screening and dry weather outfall monitoring activities meet the following three monitoring objectives:

1. Determine the status of implementing the components of the SWMP;
2. Evaluate the effectiveness of BMPs for specific source controls;
3. Evaluate the source of specific pollutants.

5.4.1 2006 Existing Field Screening Monitoring Efforts

Each jurisdiction has included field screening programs that are described in their SWMPs. They developed these programs to be "maximum extent practicable" for their jurisdiction. This monitoring plan does not include a review of those field screening efforts or recommendations for modifications. These programs are only mentioned here because they will assist in addressing the three permit monitoring objectives listed above.

6.0 SAMPLING PARAMETERS AND PROCEDURES INCLUDING QA/QC

The recommended parameter list was established by comparing the current field sampling and laboratory analysis parameters monitored by the co-permittees with the parameter lists used by CCSD#1 and SWMACC, the City of Portland, and Clean Water Services for their MS4 sampling programs. The purpose of this comparison was to maximize consistency on a regional basis. Projected TMDLs were also considered when establishing the final parameter list. As the purpose of both the instream and stormwater outfall monitoring efforts is to assess the degree to which ambient water quality is impacted by stormwater runoff, the same parameters were chosen for both the instream and outfall monitoring.

Field grab sampling and analysis is recommended for both instream (dry and wet weather) and outfall (wet weather) monitoring locations. Field grab sampling is necessary for parameters that have short holding times. Composite sampling and laboratory analyses are also recommended at both instream and outfall locations. Composite samples will include a composite of three samples collected at regularly timed intervals throughout the event. As mentioned in the **Note** on page 12, in some cases a storm may not last long enough to collect three time-weighted samples.

In this case, the samples that are collected will be composited and analyzed. A summary of the recommended parameters for analyses is included in Table 11.

In addition to what is provided in Table 11, for the 2009 permit renewal application, DEQ has requested that pesticides should be included in the monitoring plan. With respect to pesticides, monitoring will be conducted for selected pesticides at selected monitoring locations during the upcoming 2009-2014 MS4 permit term. It is very likely that many, and possibly all, of the other Clackamas County co-permittees will conduct this monitoring jointly in a single coordinated study. An initial meeting with USGS was held on June 17, 2008, and it appears likely that the USGS will be able to serve as a partner in this study. If a formal agreement is established, the USGS' role will likely include, at minimum, creation of the study's design, the provision of laboratory analytical services, data interpretation, and final report writing. MS4 co-permittees may be responsible for collecting surface/stormwater samples and for conducting GIS work for the report, although this has not been determined with certainty. At least two storms, one in Spring and one in Summer or early Fall, will be captured at each selected monitoring location during this coordinated study. The pesticides to be analyzed have not yet been selected, but both herbicides and insecticides will be chosen. The monitoring locations have also not been selected, but no less than six will be selected in representative locations in the study area. If, for some reason, the final USGS proposal for conducting this study is not appropriate or feasible for an individual Clackamas County co-permittee, or a group of co-permittees, those not participating in the proposed USGS study would prepare and submit coordinated or individual monitoring proposals with the first annual report to address the analysis of pesticides.

With respect to costs, the estimated analytical cost for one site is approximately $411/event. This does not include mercury or Johnson Creek 303(d) listed toxics which are outlined in bold in Table 11. In summary, the following table (Table 10) provides an estimate of annual analytical costs by jurisdiction.

Table 10 – Summary of Annual Analytical Cost Estimates by Jurisdiction

Jurisdiction	# of Instream Sites*	# of Outfall Sites	Total # of Instream Samples/Year	Total # of Outfall Samples/Year	Total # of Samples	Annual Analytical Costs	**Analytical Costs Plus 10% for QA/QC**
CCSD#1	8	4	72	12	84	$34,524	**$37,976**
SWMACC	4	2	36	6	42	$17,262	**$18,988**
Gladstone	1	0	3	0	3	$1,233	**$1,356**
Milwaukie	1	1	4	3	7	$2,877	**$3,165**
Oregon City	6	2	24	6	30	$12,330	**$13,563**
West Linn	3	1	15	3	18	$7,398	**$8,138**
Total	**23**	**10**	**154**	**30**	**184**	**$75,624**	**$83,186**

* This column does not include the automated instream sites or analyses of mercury, PAHs, dieldrin, PCBs, DDT/DDE. These parameters may be added at a later date based on direction from DEQ associated with upcoming implementation of the Willamette River and Johnson Creek TMDLs.

Table 11 - Instream and Outfall Parameters for Clackamas County Stormwater Quality Monitoring

Type (Field or Laboratory)	Analyte	Sample Type (Grab or Time-weighted Composite)	Unit	Analytical Method	Estimated MDL	Notes	Analyzed In-House vs Send-Out
Field	Specific Conductivity	Grab	µmhos/cm	SM 2510 B	1		
Field	PH	Grab	Std units	SM-4500-H B	0.1		
Field	Temperature	Grab	Deg Celsius	SM 2550-B	0.1		
Field	Flow	Grab	NA	NA	NA	Measure if possible. May use velocity and depth measurements.	
Field	Dissolved Oxygen	Grab	mg/L	EPA 360.1	0.1	Method assumes use of probe.	
Lab	Copper, Total*	Composite	µg/L	EPA 200.8*	0.03		Send-Out
Lab	Copper, Dissolved*	Composite	µg/L	EPA 200.8*	0.03		Send-Out
Lab	E. coli*	Grab	MPN/ 100mL	SM 9223 B*	1		In-House
Lab	Total Hardness*	Composite	Mg $CaCO^3$/L	EPA 130.2*	1		In-House
Lab	Lead, Total*	Composite	µg/L	EPA 200.8*	0.008		Send-Out
Lab	Lead, Dissolved*	Composite	µg/L	EPA 200.8*	0.008		Send-Out
Lab	Nitrogen – Ammonia*	Composite	mg/L	EPA 130-A*	0.02		In-House
Lab	Nitrogen – Nitrate*	Composite	mg/L	EPA 126-A*	0.1		In-House
Lab	Phosphorus, Total*	Composite	mg/L	EPA 135-A*	0.03		In-House
Lab	Phosphorus, Ortho-phosphate*	Composite	mg/L	EPA 118-A*	0.02		In-House
Lab	Solids - Total	Composite	mg/L	SM 2540 B	2		In-House

Type (Field or Laboratory)	Analyte	Sample Type (Grab or Time-weighted Composite)	Unit	Analytical Method	Estimated MDL	Notes	Analyzed In-House vs Send-Out
Lab	Solids – Total suspended*	Composite	mg/L	SM 2540 D*	0.2		In-House
Lab	Solids – Total dissolved*	Composite	mg/L	SM 2540 C*	2		In-House
Lab	Solids – Total volatile	Composite	mg/L	SM 2540 B	2	Only applies if discharging to the Tualatin.	In-House
Lab	Zinc, Total*	Composite	µg/L	EPA 200.8*	0.3		Send-Out
Lab	Zinc, Dissolved*	Composite	µg/L	EPA 200.8*	0.3		Send-Out
Lab	PAHs	Composite	µg/L	EPA 608/624		Need to verify procedures. Only applies for tributaries to Johnson Creek.	
Lab	Dieldrin	Composite	µg/L	EPA 608/624			
Lab	PCBs	Composite	µg/L	EPA 625			
Lab	DDE/DDT	Composite	µg/L	EPA 625			
Lab	Mercury (Total)	Composite	µg/L	EPA 245.1, 245.7	0.1		
Lab	Mercury (Methyl)	Composite	µg/L	SM 1630	0.01		

* = analytes for which we had the Clackamas County analytical method.

Note: Mercury and other toxics may be added to the list of analytes based on direction from DEQ associated with the upcoming implementation of the Willamette River and Johnson Creek TMDLs.

ACWA developed detailed QA/QC procedures for stormwater data collection and analysis as part of the ACWA UIC Monitoring Study. Attachment 1 provides Standard Operating Procedures (SOPs) for tasks associated with surface water quality monitoring extracted from this document. Co-permittees will use laboratories that have comprehensive Quality Assurance Programs and are approved by both ODEQ and EPA for permit compliance water quality analysis.

7.0 DATA ANALYSIS AND INTERPRETATION

The purpose of preparing a coordinated monitoring plan is to distribute resources widely and produce data that will provide comprehensive information for the County as a whole. Therefore, it is recommended that the data analyses and interpretations be conducted as a whole and not as individual jurisdictions.

Prior to conducting analyses on any new data that are collected as a result of this report, an analysis of previously collected data is recommended. Although most of the data have been analyzed, the existing wet weather and dry weather data have not been segregated. Comparing dry weather to wet weather data may provide further insights into the extent to which runoff is impacting streams for various parameters.

For the data collected as a result of this proposed monitoring plan, some analyses would be conducted annually and submitted with the annual compliance reports while other analyses would be conducted after several years of data have been collected (e.g., the five year permit period) so that the data are more statistically robust in terms of providing information. The following general recommendations are made with respect to the data analyses for both instream and outfall monitoring.

<u>Instream Monitoring:</u>

Annual Reporting would include the following:

- A summary table that presents the monitoring results from each station for each parameter for each event monitored.
- Descriptive statistics for each station for each parameter including the minimum, maximum, and mean values. Data would be segregated by wet vs. dry weather and compiled and presented in tabular format.
- A comparison of the data to water quality standards that may be of interest.

End of Permit Cycle Reporting (i.e., after at least 5 years of data have been collected) would include the following:

- A comparison of descriptive statistics between the upstream and downstream stations (where applicable) to look for statistically significant differences.
- Where sufficient data exist, newer data can be compared to previously collected data to determine whether water quality conditions are improving over time.
- A comparison of results to applicable water quality standards.

Outfall Monitoring:

Annual Reporting would include the following:

- A summary table that presents the results from each station for each parameter for each event monitored organized by land use.
- Descriptive statistics for each station and each land use for each parameter including the minimum, maximum, and mean values.
- A comparison of the data to water quality standards or other water quality indicators (e.g., industrial permit benchmarks, etc.) that may be of interest.

End of Permit Cycle Reporting (i.e., after at least five years of data have been collected) would include the following:

- A statistical summary of the results from the storm events monitored at each outfall for each parameter examined including mean, median, standard deviation, and number of samples analyzed will be prepared. A comparison of descriptive statistics between the land use stations will be conducted for monitored parameters to determine whether or not a significant difference in land uses is apparent.
- A comparison of the results to previous results reported in the ACWA database (1996) in order to determine whether statistically significant water quality changes have occurred.

As a part of the data reports that are produced, information that has been gathered and interpreted from literature reviews should also be included, as well as insightful results from field screening programs and any program monitoring that is conducted so that the information can be reviewed and interpreted as a whole.

Attachment 1:
Standard Operating Procedures
From the WES Sampling Program
(prepared by Water Quality Laboratory)

SOP A-1: Grab Sampling

Set up a safety zone, if appropriate (this may include the placement of traffic cones, etc.). Then provide access to the sample collection point. Take notes regarding site conditions and sampling notes in the notebook.

Grab Sampling

The grab sampling technique is described as follows:

- Place the sample bottle in the middle of the flow stream. If the sample collection location is deep, a long-handled sample collection pole or rope w/bailer will be needed. One can also "zip tie" the bottle onto the pole and collect the sample in the bottle. E.coli samples must be collected directly into the bottle.
- Once the bottle is filled to the proper level, replace the lid on the sample bottle, fill out the label (or write directly on the bottle with a sharpie pen) and place it in the cooler with ice.
- Write the sample collection time and other relevant information in the notebook.

SOP A-2: Chain of Custody Records

A chain of custody record (COC) is a legal document designed to track samples and persons who are responsible for them during preparation of the sample container, sample collection, sample delivery, and sample analysis. These forms are supplied by the WQL. The procedures for filling out these forms are as follows:

Prior to sampling

After bottles are labeled and placed in iced coolers, and you're in the field, fill out the general information on the COC form including:

- Source/Location
- LIMS ID
- Persons sampling
- Type of sample (composite or grab)
- Parameters desired for analysis

Place COC in a Ziploc bag in the cooler or in another secure location.

After sampling is complete

After sampling has been completed, fill out remainder of the COC including:

- Time and date that sampling was initiated

At Laboratory or upon transfer to another person

Whenever custody of the samples is relinquished:

- Provide signature, date, time, and job title
- Relay special instructions, if any

SOP A-3: Transporting, Packaging, and Shipping Samples from Field to Lab

- Keep the chain of custody record form with the samples.
- Pack samples well within ice chest to prevent breakage or leakage.
- As was stated previously, samples should be packed in ice or an ice substitute to maintain a sample temperature of four degrees Celsius during transport. Acquire more ice at a convenience store, if necessary.
- Samples must be delivered to the WQL within 6 hours of bacteria sample collection.
- Samples will be preserved by laboratory personnel upon arrival.

URS

111 SW Columbia Street
Suite 1500
Portland, OR 97201
503.222.7200