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# Green River Study

## Sampling and Analysis Plan Addendum

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April 2013



**King County**

Department of Natural Resources and Parks  
Water and Land Resources Division

**Science and Technical Support Section**

King Street Center, KSC-NR-0600  
201 South Jackson Street, Suite 600  
Seattle, WA 98104

206-296-6519 TTY Relay: 711

[www.kingcounty.gov/environment/wlr/science-section.aspx](http://www.kingcounty.gov/environment/wlr/science-section.aspx)

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# Green River Study

## Sampling and Analysis Plan Addendum

### Prepared for:

King County Department of Natural Resources and Parks  
Wastewater Treatment Division

### Submitted by:

Deb Lester  
King County Water and Land Resources Division  
Department of Natural Resources and Parks



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## **Citation**

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King County. 2013. Green River Study Addendum – Sampling and Analysis Plan. Prepared by Deb Lester. Water and Land Resources Division. Seattle, Washington.

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## **1.0. INTRODUCTION**

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This addendum to the Lower Duwamish Waterway Green River Surface Water Study Sampling and Analysis Plan (SAP) (King County 2011) presents additional water sampling and analysis for 2013 and identifies any deviations from the original SAP.

King County is conducting a study (King County, in progress) of select parameters in whole surface water samples collected from the Green River and four tributaries that discharge to the river. Samples were analyzed for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), total and dissolved arsenic, dissolved organic carbon (DOC), total organic carbon (TOC), and total suspended solids (TSS) at six locations: upper and lower boundary locations along the mainstem of the Green River, and four major tributaries: Soos, Newaukum and Mill Creeks and the Black River. The upper boundary location on the Green River (upriver of the major tributaries sampled) was at the entrance bridge to Flaming Geyser State Park, while the lower boundary location (downstream of the tributaries) was adjacent to the Foster Links Golf Course in Tukwila. The study will provide information to assist in understanding relative differences and contributions of the target contaminants in the tributaries and the main stem of the Green River. It will also evaluate how concentrations differ during dry season baseflow and wet season/storm conditions between sampling locations.

Whole water concentration data collected under this SAP addendum will be used to further evaluate contaminant concentrations in the upper reach of the main stem Green River (below the Howard Hanson Dam). Samples will be collected at Kanaskat-Palmer State Park. The Kanaskat-Palmer sampling location was added to provide additional water quality information from a site further removed from development and urbanization than the upper boundary site (Flaming Geyser State Park) identified in the original SAP. Unless noted otherwise in this document, all sampling and analysis procedures and related information remain the same as that described in the original SAP. The only change to the key staff listed in the original SAP is the Field Science Unit (FSU) field lead. Jeff Droker will be responsible for sample collection efforts. His contact number at the King County Environmental Laboratory (KCEL) is 206-684-2309.

## 2.0. STUDY DESIGN

The study design and data quality objectives for sample collection at the Kanaskat-Palmer sampling location is the same as previously described for the original study. Sampling from the Green River at Kanaskat-Palmer State Park will be conducted between April and December 2013. Samples will be collected during dry season/baseflow conditions and during wet season storm events as described below.

### *Baseflow Sample Collection*

Three samples will be collected during baseflow conditions, defined as July through September. All baseflow samples will be 24 hour time weighted composites collected following an antecedent dry period of at least 3 days.

### *Storm/Wet Season Sample Collection*

Six storm event samples will be collected during wet season conditions, defined as April-June and October-December. Sampling will be triggered by specific rainfall conditions; 0.25 inch of rain with a minimum 24 hour antecedent dry period. Samples will be 24 hour time weighted composites.

All samples will be analyzed for PCB congeners, PAHs, and arsenic (total and dissolved) in addition to TOC, DOC and TSS (Table 2). Flow will be estimated from the USGS gage at Palmer WA (Gage 12106700). Precipitation will be tracked using the King County gauge (BDIA) in Black Diamond.

The locator, locator description and sample coordinates are presented in Table 1 and shown in Figure 1. The locator name, the date of collection and the unique sample identification numbers generated by KCEL will be used to identify individual samples collected at this location. Table 2 summarizes the number of samples per analyte type to be collected, including the estimated number of replicate samples. One equipment blank will also be collected at KCEL.

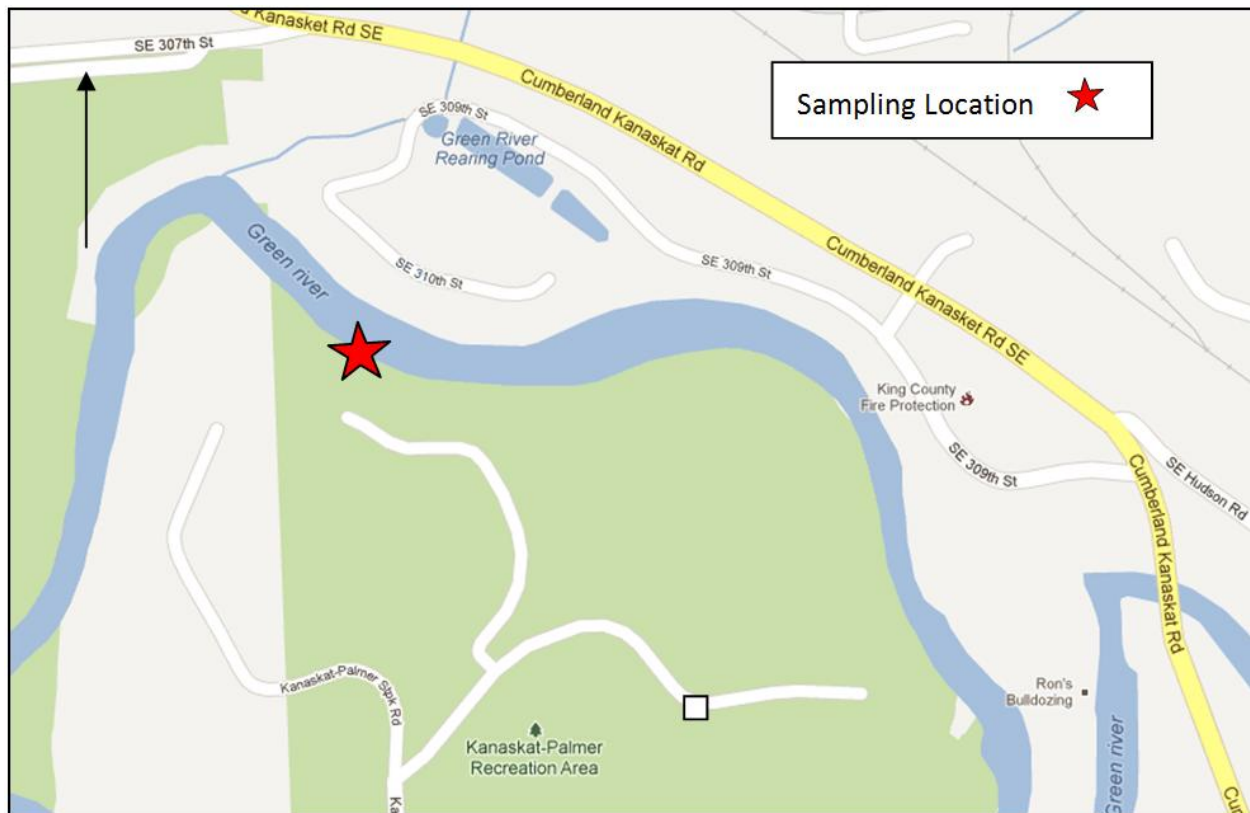
**Table 1. Sampling Location and Corresponding Locator Name.**

Locator	Locator Description	Northing <sup>a</sup>	Easting <sup>a</sup>
KP319	<b>Green River – Kanaskat – Palmer State Park</b>	119148	1373725

<sup>a</sup> State plane coordinates in North American Datum 1983 (NAD983) Washington State Plane North (4601)

**Table 2. Summary of Samples, Replicates by Analyte Type.**

Event Conditions	Sample Events	Number of Total Samples				
		Field Replicate	Arsenic	PAHs	PCBs Congeners	Conventional Parameters
Baseflow	3	0	3	3	3	3
Storm	6	1	7	7	7	7
<b>Totals</b>	<b>9</b>	<b>1</b>	<b>10</b>	<b>10</b>	<b>10</b>	<b>10</b>



**Figure 1. Green River Kanaskat – Palmer Sampling Location**

## **3.0. SAMPLING PROCEDURES**

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King County FSU staff will conduct all sampling following the procedures described in the original SAP (King County 2011). Any methods specific to main stem Green River samples will apply to collection of samples covered under this SAP addendum.

In summary, composite water quality samples will be collected using ISCO® autosamplers equipped with 10-liter glass carboys. Auto samplers will be fitted with a minimum of new and pre-cleaned silicon tubing in the peristaltic pump for each sampling event. Teflon® tubing and stainless steel (SS) fittings shall be used for all other tubing runs. Teflon tubing will be dedicated to a sampling location. Autosamplers will be secured at monitoring sites in locked housings or utility boxes (or other suitable option). A target amount of five-seven liters of water will be collected over the course of each sampled event. All sample handling, sampling equipment, decontamination procedures, and chain-of-custody (COC) and sample documentation will be the same as that listed in the original SAP.

One field replicate will be collected using a separate additional auto sampler; the sample will be analyzed for all parameters. Quality control (QC) samples will include one equipment blank to be collected at KCEL using the same procedures described in the original SAP. An aliquot of a clean reference matrix (reverse osmosis water) will be processed through the sampling equipment as a blank and analyzed for PCB congeners, PAHs, DOC, TOC and arsenic. The equipment blank sample must be collected with the same tubing and sampling apparatus to be used to collect the samples. The equipment blank sample shall be preserved, stored, and analyzed in the same manner as environmental samples.



## 4.0. ANALYTICAL METHODS AND DETECTION LIMITS

Samples will be analyzed using the same methods described in the original SAP. In summary, total and dissolved arsenic samples will be analyzed and reported by EPA Method 200.8 (Inductively Coupled Plasma-Mass Spectrometry [ICP-MS]), KCEL SOP 624.

PAH samples will be analyzed by liquid-liquid extraction as detailed in method EPA method 3520C, KCEL SOP 701. Samples will be analyzed according to EPA Method 8270D; Gas Chromatography/Mass Spectrometry with Selected Ion Monitoring and Large Volume Injection method (GC/MS-SIM LVI), KCEL SOP 772. The specific PAHs to be analyzed include those listed below in Table 3.

**Table 3. Summary of Samples, Replicates by Analyte Type.**

Analyte	MDL	RDL	Analyte	MDL	RDL
2-Methylnaphthalene	0.0013	0.00600	Chrysene	0.00050	0.00100
Acenaphthene	0.00070	0.00300	Dibenzo(a,h)anthracene	0.00070	0.00200
Acenaphthylene	0.00050	0.00100	Fluoranthene	0.00033	0.00200
Anthracene	0.00050	0.00100	Fluorene	0.00050	0.00200
Benzo(a)anthracene	0.00050	0.00100	Indeno(1,2,3-cd)Pyrene	0.00070	0.00200
Benzo(a)pyrene	0.0010	0.00200	Naphthalene	0.0013	0.0100
Benzo(b,j,k)fluoranthene	0.0010	0.00200	Phenanthrene	0.00040	0.00400
Benzo(g,h,i)perylene	0.00060	0.00200	Pyrene	0.00050	0.00200

NOTE: The MDL/RDL limits are calculated on a 1 liter extraction to a final volume of 1 ml. MDL/RDL limits will vary depending on amount extracted and final volume.

PCB congener analysis for all 209 congeners will follow EPA Method 1668A Revision C (EPA 2010), which is a high-resolution gas chromatography/high-resolution mass spectroscopy (HRGC/HRMS) method using an isotope dilution internal standard quantification. All conventional analyses will follow Standard Methods (SM) protocols (American Public Health Association [APHA] 1998) as described in the original SAP.

For the PAH analyses, the spike blank (and spike blank duplicate if applicable), matrix spike, matrix spike duplicate and surrogate recovery limits will be based on laboratory QC limits; these are empirically derived performance-based laboratory control limits. These limits may be updated once per calendar year and the limits in effect at the time of analysis will be used. QA/QC frequency and current control limits for PAH analysis are shown in Table 4.

**Table 4. PAH QA/QC Frequency and Acceptance Criteria**

Frequency	Method Blank	Spike Blank and Spike Blank Duplicate (% Recovery)**	Matrix Spike and Matrix Spike Duplicate (% Recovery)**	RPD for Spike Blank/Spike Blank Duplicate
	1 per Extraction batch*	1 per Extraction batch*	1 per Extraction batch*	1 per Extraction batch*
2-Methylnaphthalene	<MDL	21-136	28-97	40
Acenaphthene	<MDL	45-114	38-90	40
Acenaphthylene	<MDL	56-124	48-107	40
Anthracene	<MDL	47-107	49-112	40
Benzo(a)anthracene	<MDL	86-111	83-114	40
Benzo(a)pyrene	<MDL	40-135	27-150	40
Benzo(b,j,k)fluoranthene	<MDL	71-131	43-146	40
Benzo(g,h,i)perylene	<MDL	63-126	26-140	40
Chrysene	<MDL	77-111	68-115	40
Dibenzo(a,h)anthracene	<MDL	61-139	24-150	40
Fluoranthene	<MDL	73-116	65-125	40
Fluorene	<MDL	54-122	42-113	40
Indeno(1,2,3-cd)Pyrene	<MDL	58-137	20-150	40
Naphthalene	<MDL	32-110	20-90	40
Phenanthrene	<MDL	57-104	51-98	40
Pyrene	<MDL	66-143	38-150	40

Surrogate / Frequency	Surrogate (% Recovery)**
	Added to all samples and QC
2-Fluorobiphenyl	23-124
D14-Terphenyl	63-150

\* QC Extraction batch = 20 samples or less prepared within a 12 hour shift

\*\* These are the current spike blank/spike blank duplicate, matrix spike/matrix spike duplicate and surrogate recovery control limits. Empirically derived performance-based control limits may be updated once per calendar year and the limits in effect at the time of analysis will be used as QC limits for all ongoing precision and accuracy QC samples and surrogates. Changes to QC Limits due to annual updates should be noted in a SAP addendum.

< MDL = Method Blank result should be less than the *method detection limit*.

RPD = Relative Percent Difference

For arsenic, QA/QC requirements for the laboratory control samples will also be based on laboratory QC limits; all other requirements are the same as in the original SAP.

## **5.0. DATA VALIDATION, REPORTING AND RECORD KEEPING**

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Data validation, reporting and record keeping will follow the procedures outlined in the original SAP unless noted otherwise below.

All data collected from the Green River Palmer-Kanaskat sampling location will be documented in a technical memoranda and include the data validation memoranda and copies of COC forms. All analytical data will be submitted for loading into Ecology's Environmental Information Management (EIM) database. It is expected the draft technical memoranda will be completed in first quarter of 2014 unless sample collection extends into December of 2013, in which case, the memoranda will be available in the second quarter of 2014.

## **6.0. REFERENCES**

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