Quality Assurance Project Plan

Midway Metals Stormwater Sampling and Analyses

March 2020

Publication Information

The study described in this Quality Assurance Project Plan (QAPP) is funded by the Washington State Department of Ecology. Each study conducted by the Washington State Department of Ecology must have an approved QAPP. The plan describes the objectives of the study and the procedures to be followed to achieve those objectives. After completing the study, Ecology will post the final report of the study to the Internet.

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Midway Metals Stormwater Sampling and Analyses

March 2020

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2.0 Abstract

Midway Metals, located at 258010 Hwy 101 in Sequim, WA, has been used as a scrap metal recycling facility since 1991. In 2008, the site was listed on the Confirmed and Suspected Contaminated Sites list by the Washington State Department of Ecology. A Site Hazard Assessment was completed using the Washington Ranking Method which resulted in a rank of 1, representing the highest level of potential risk. The rankings represent an estimation of the potential threat posed by a site compared to all other ranked sites in the state.

Recent illicit dumping and a fire event on the property have raised concerns over the level of contamination on the property and whether contaminants are flowing into nearby waterways. Clallam County is partnering with the Washington State Department of Ecology to collect and analyze stormwater samples to help determine the degree of contamination running off the property.

The purpose of this Quality Assurance Project Plan is to outline field protocols and describe lab analysis methods for testing stormwater from Midway Metals.

3.0 Background

3.1 Introduction and problem statement

Midway Metals, Washington State Department of Ecology (Ecology) Facility Site ID#1671323, is located in Clallam County (parcel # 04-30-18-43-1000) on the south side of Hwy 101 in Sequim, WA. This site has been used as a scrap metal recycling facility since 1991 and was ranked a “1” under Models Toxics Control Act (MTCA) site in 2008 (Cleanup Site ID# 958).

This site is currently a non-conforming dump site undergoing enforcement by Clallam County. The site has been largely unattended. This has resulted in many uncharacterized substances being dumped at the site. It is also full of home appliances that have not been properly decommissioned, lawnmowers, vehicles and car parts, lead-based batteries, and construction and demolition debris, amongst other solid waste.

Midway Metals has not been in compliance with a required National Pollutant Discharge Elimination System (NPDES) permit (#WAR011112), issued by Ecology, since 2010. The permit was terminated due to non-compliance in 2011. Since local enforcement efforts started in mid-2019, the property owner has applied for a permit but compliance has not been met at this time.

Currently, Clallam County does not know the extent of contamination nor the potential threat to the environment and human health. The County and Ecology would like to know if contaminated stormwater is originating from Midway Metals.

3.2 Study area and surroundings

3.2.1 History of study area

The Midway Metals property has been in operation as a scrap metal recycling facility since the early 1990’s. The property has changed ownership multiple times, with the most recent purchase in 2013.

The property is located on Hwy 101 and is zoned Rural Low (R5), which is described as having a low-density rural setting free from commercial, industrial, and moderate density residential developments. In a review of Ecology’s well log database, there is a well on the property. There is no record of an onsite septic system, and the property does not have a public water source or sewer connection. The well was drilled in 1988 to a depth of 40 feet (CCEH, 2006; GeoEngineers, 2013).

GeoEngineers (2013) identified a groundwater aquifer in the vicinity of the site with depths ranging from 20 feet to 220 feet below ground surface. They encountered shallow groundwater at a depth of 3 to 5 feet below ground surface on the southwest portion of the site, as well as one groundwater well in the same corner of the site.

The terrain of the property slopes up immediately upon entering south onto the easement with a slope of 9.4% (CCEH, 2006). The east side of the property is heavily worked and has a slight slope to the east. Stormwater flows downhill to the north and east from the property and into two drainage ditches located along the road at the northern end of the property.

The primary stormwater conveyance is parallel to the road and drains east directly into McDonald Creek (WRIA #18.0160). McDonald Creek is a Class AA waterbody that supplies water to the Agnew Irrigation District and is a significant, independent tributary that drains into the Strait of Juan de Fuca. McDonald Creek has historically supported several salmon species, including coho and chum salmon, steelhead, cutthroat and rainbow trout, and Dolly Varden trout, all whose smolt are monitored by the Jamestown S'Klallam Tribe (Elwha-Dungeness Planning Unit, 2005).

There is a second conveyance draining directly from the property's easement that flows east until it drains into the Agnew Irrigation District intake. It mixes with irrigation water, which then gets diverted under the road and emptied into a wetland (ID# MS0604). The current drainage was constructed as part of the highway construction project. The Agnew Irrigation District supplies water to area farms and residents downstream (Yuam, 2020).

Please refer to Figure 1 for an aerial photograph delineating parcels in the study area. Midway Metals is in the center of the image (#43-0105). McDonald Creek, not in the image, is downstream (east) of the property.

Figure 1: Map of study area

Clallam County Department of Community Development, 2017

3.2.2 Summary of previous studies and existing data

Clallam County Environmental Health (CCEH) conducted a site assessment in October 2006 via soil sampling. The sample results are described in Table 1 below with the exceedances of the Model Toxic Control Act (MTCA) Method A cleanup levels noted in bold text. Sampling results at Midway Metals indicate that discharges from materials and substances caused contamination levels in soil that exceeded the MTCA Method A cleanup levels for cadmium (Cd), lead (Pb), and total petroleum hydrocarbons (TPH)-heavy oil. One sampling location also had high levels of TPH-Diesel (TPHD) (CCEH, 2006).

Table 1: 2006 Soil Sample Results

Sample	Analyte Found	Sample Result (ppm)	Applicable Standard	(ppm)
Lawn Mower	Cadmium	**4.1**	MTCA A ULU*	2.0
	Lead	172	"	250
	TPH-Diesel	120	"	2,000
	TPH-Heavy Oil	530	"	2,000
Tier 2 West	Cadmium	**3.5**	"	2.0
	Lead	136	"	250
	TPH-Diesel	280	"	2,000
	TPH-Heavy Oil	1,300	"	2,000
Batteries	Cadmium	**7.1**	"	2.0

	Lead	**3,000**	"	250
	TPH-Diesel	1,800	"	2,000
	TPH-Heavy Oil	**10,000**	"	2,000

***MTCA A ULU refers to the Model Toxics Control Act Table 740-1 Method A Soil Cleanup Levels for Unrestricted Land Use**

The site was scored and ranked using the Washington Ranking Method (WARM) as described in Ecology's Publication 90-14 based on the analytical results outlined above in Table 1. Cd, Pb, TPH-diesel and TPH-heavy oil were considered for scoring. Migration potential was valued at the maximum score of 10 due to no run-on/run-off control. A wetland, located 750 feet away from the site, as well as McDonald Creek, which is located 1000 feet downstream, were identified targets (CCEH, 2006; Clallam County, 2020).

In 2012, the Washington State Department of Transportation (WSDOT) conducted remedial activities through Ecology's Voluntary Cleanup Program (VCP) under VCP#SW1202 after acquiring a section of the right-of-way on the northernmost portion of the property. Analyses of soil samples collected from 2 feet below ground surface or less detected concentrations exceeding MTCA Method A soil cleanup levels of these contaminants: heavy metals, TPHs, and total carcinogenic polycyclic aromatic hydrocarbons (cPAHs). Sources identified in the report include surface releases from junked vehicles, lead/acid batteries, and heavy machinery. The report also stated that contaminants of concern (COCs) have been released and mixed with shallow soils due to site activities, and that one of the potential transport mechanisms include soil erosion caused by rainwater runoff and wind, with subsequent downgradient deposition (GeoEngineers, 2012).

3.2.3 Parameters of interest and potential sources

The COCs, their potential sources, and concerns related to the environment and/or public health are summarized in Table 2. Polychlorinated biphenyls (PCBs) have been added to the list of COCs, although not previously tested for in the assessments described above, due to the type of solid waste at the site.

Table 2: Contaminants of Concern

Contaminant	Potential Source	Cause for concern
Cadmium[1]	Batteries, metal plating, pigments, burning oil	Pulmonary irritation; kidney disease; carcinogen; potential developmental toxicant
Chromium[2]	Steel/alloy materials, chrome plating, dyes/pigments, textiles	Effects on respiratory tract; carcinogen; leachability potential
Lead[3]	Lead gasoline, lead/acid batteries, C&D waste, lead-based paints	Highly toxic, especially to children under 6 and pregnant women; affects most organs and systems in body; bioaccumulation
Mercury[4]	Electronic devices, batteries, light bulbs and thermometers	Neurotoxin; developmental toxicant; heart, kidney and lung impairments; bioaccumulation

PAHs[5]	Released in fumes from burning gasoline, oil, trash, creosote, and wood	Irritant, carcinogen, liver and blood abnormalities
PCBs[6]	Transformers, fluorescent lighting lubricants, hydraulic fluids, heat transfer fluids, plasticizers, flame retardant	Cancer; effects on the immune, reproductive, nervous, and endocrine systems; bioaccumulation
TPHG[7]	Gasoline, motor and lubricating oils, heating oils, unknown substances	Affects central nervous system, blood, immune system, lungs, skin, and eyes
TPHD[6]	Gasoline, motor and lubricating oils, diesel fuel, heating oils, unknown substances	Affects central nervous system, blood, immune system, lungs, skin, and eyes

1. EPA, 2016a
2. EPA, 2016b
3. EPA, 2019a
4. EPA, 2019b
5. CDC, 2009
6. EPA, 2019c
7. EPA, 2010

3.2.4 Regulatory criteria or standards

In 2018, the property owners were granted legal, non-conforming use of the property as a wrecking/junk yard by the Clallam County Superior Court (Haymaker, 2018). However, the property owners were still required to comply with all requirements necessary to operate as a legal wrecking yard or junk yard. This would include state licensing requirements, compliance with Clallam County Code, and acquiring and maintaining compliance with a NPDES permit. This permit “limits the discharge of pollutants to surface waters under the authority of the Federal Water Pollution Control Act (U.S.C.S. 1251) and limits the discharge of pollutants to surface and groundwater under the authority of Chapter 90.48 RCW.”

Washington State Administrative Code (WAC) 173-201A-240(1) states that “toxic substances shall not be introduced above natural background levels in waters of the state which have the potential either singularly or cumulatively to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health, as determined by the department [Ecology].”

PCBs are monitored under the federal Toxic Substances Control Act of 1976 (EPA 2019c).

The Midway Metals property was listed as a Models Toxics Control Act site with a rank of “1” in 2008.

3.3 Water quality impairment studies

Not applicable.

4.0 Project Description

4.1 Project goals

The major reasons for analyzing the stormwater flowing from this property are to:

- Characterize the COCs identified by soil samples that are moving off the property, as well as additional contaminants not identified but suspected to be onsite.
- Determine if contaminated stormwater originates from Midway Metals.

4.2 Project objectives

The project objectives are as follows:

- Collect grab samples at 3 different locations along the site's northern property line. Sample locations will be upstream (1) and downstream (2) in the stormwater conveyance.
- Analyze COCs to determine the degree of contamination running off the site.
- Use the data to formulate a report.

4.3 Information needed and sources

The data quality objective (DQO) is to determine the degree of COCs coming from the site with no comparison to cleanup levels.

4.4 Tasks required

The tasks required include:

- Conduct a pre-site visit during wet weather conditions to determine representative sampling locations and obtain sample site geographical coordinates.
- Collect stormwater grab samples and field observations during a significant rain event. Samples will be immediately sent to Manchester Environmental Laboratory (MEL) for analyses.
- Analyze data to determine degree of contamination and subsequent risk to the environment and public health.
- Report on data and upload data to Ecology's Environmental Information Management (EIM) database.

4.5 Systematic planning process

Systematic planning occurred via the development of this quality assurance project plan (QAPP).

5.0 Organization and Schedule

5.1 Key individuals and their responsibilities

Table 3. Organization of project staff and responsibilities

Staff	Title	Responsibilities
Heather Watts Water Quality Program Clallam County Environmental Health Phone: 360-417-2415	Field Manager/QAPP Author	Writes the QAPP. Oversees and participates in sample collections and coordinates transportation of samples to the laboratory via FedEx.
Jennifer Garcelon Director Clallam County Environmental Health Phone: 360-417-2347	Section Manager for the Field Manager	Reviews the project scope and reviews the draft QAPP.
Heather May Section Planner, Toxics Cleanup Program Department of Ecology, SWRO Phone: 360-407-6084	Project Manager	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Rebecca Lawson Toxics Cleanup Manager Department of Ecology, SWRO Phone: 360-407-6241	Ecology Toxics Cleanup Regional Manager	Reviews the project scope and budget, tracks progress, reviews the draft QAPP, and approves the final QAPP.
Arati Kaza Department of Ecology Phone: 360-407-6964	Quality Assurance Officer	Reviews and approves the draft QAPP and the final QAPP.
John Weakland Manchester Environmental Laboratory Phone: 360-871-8801	Manchester Lab, Interim Lab Director	Reviews and approves the final QAPP.

QAPP: Quality Assurance Project Plan

5.2 Special training and certifications

Field staff is trained in collecting grab samples and recording field data. All field personnel will be familiar with stormwater grab sampling standard operating procedures (SOPs) referenced in Section 6.2 and follow field procedures detailed in this QAPP.

MEL is an accredited lab (accreditation number G750-19) whose staff are trained in the methods that will be used to analyze the samples.

5.3 Organization chart

Not Applicable - See Table 3.

5.4 Proposed project schedule

The following schedule is contingent on timing of rain event:

February 2020

- Conduct a pre-visit sample to determine the most representative sampling site to safely collect samples and achieve project goals and objectives.
- Obtain sampling bottles from Manchester Lab.
- Create sampling kit to be ready for use when rain event occurs.

March 2020

- Monitor weather until significant enough rain event takes place that allows for sampling described in Section 7.l.
- Sample during a significant rain event that allows for a representative sample and send samples to MEL via overnight delivery.
- MEL analyzes samples upon arrival and sends data to CCEH as it is available.

April 2020

- CCEH analyzes data and writes final report.
- Complete EIM upload.

Table 4. Proposed schedule for completing field and laboratory work, data entry into EIM, and reports

Field and laboratory work	Due date	Lead staff
Field work completed	March 2020	Heather Watts
Laboratory analyses completed	March 2020	
Environmental Information System (EIM) database		
EIM Study ID	MM-Clallam-2020	
Product	Due date	Lead staff
EIM data loaded	April 2020	MEL
EIM complete	April 2020	Gaylen Sinclair/Suzan Pool
Final report		
Author lead	Heather Watts	
Schedule		
Draft due to supervisor	April 2020 – Jennifer Garcelon	
Draft due to client/peer reviewer	April 2020 – Andrew Gosnell	
Draft due to external reviewer(s)	April 2020 – Rebecca Lawson/Heather May	
Final report due on web	April 2020 – Rebecca Lawson/Heather May	

5.5 Budget and funding

CCEH will provide two field staff personnel to collect the samples whose staff time will be paid for by Clallam County's Water Quality General Fund. The lab analyses will be paid for by Ecology's Toxics Cleanup Program (TCP).

Table 5 outlines the cost for each analyte per sample. Table 6 summarizes the total project budget, including quality assurance (QA), which is not included in Table 5.

Table 5: MEL Analytical Services Bid: Pricing summary

MEL Analytical Services Bid

Project: **Midway Metals Stormwater Testing**
Project Officer: **May, Heather**

Printed: **2/18/2020**
Effective: **10/21/2019**
Expires: **10/20/2020**

Pricing Summary

	Analysis	Qty	TAT (days)	Unit Price	Ext. Price
Water					
Volatile Petroleum Products	TPHG	5	30	$95.00	$475.00
Semivolatile Petroleum Products	TPHD	5	30	$160.00	$800.00
Polychlorinated Biphenyls	PCB	6	30	$105.00	$630.00
Determination of Trace Elements by ICPMS	PB	6	30	$82.00	$492.00
Semivolatile Organics by GC/MS	PAH-SIM	6	30	$310.00	$1,860.00
Mercury by CVAA	HG	6	30	$40.00	$240.00
Determination of Trace Elements by ICPMS	CR	0	30	$0.00	$0.00
Determination of Trace Elements by ICPMS	CD	0	30	$0.00	$0.00
				Bid Total:	**$4,497.00**

Table 6. Project budget and funding

Parameter	Number of Samples	Field QA Samples	Lab QA Samples	Total Number of Samples	Cost Per Sample ($)	Lab Subtotal ($)
TPHG	3	1	1	5	95.00	475.00
TPHD	3	1	1	5	160.00	800.00
Metals (Pb, Cr, Cd)	3	1	2	6	82.00	492.00
PAH-SIM[1]	3	1	2	6	310.00	1860.00
Mercury (Hg)	3	1	2	6	40.00	240.00
PCBs	3	1	2	6	105.00	630.00
				Lab Grand Total		4497.00

[1.] PAH-SIM: Polyaromatic Hydrocarbon-Selected Ion Monitoring

6.0 Quality Objectives

6.1 Data quality objectives

The field data quality objectives (DQOs) for this project are to:

- Collect upstream samples to serve as baseline measurement of contamination due to proximity of the road.
- Collect a water sample that is representative of the runoff at Midway Metals. Sample #1 will be collected upstream of the property. Sample #2 will be collected downstream of the property. Sample #3 and a field replicate will be collected at the property outflow.

The lab DQOs for this project are to:

- Follow standard lab procedures and quality assurance protocols.
- The analysis will use accredited standard methods to obtain total concentration data for COCs (Table 2) that meet measurement quality objectives (MQOs) that are described below.
- Perform matrix spikes/matrix spike duplicates (MS/MSD) to demonstrate quality assurance.

6.2 Measurement quality objectives

6.2.1 Targets for precision, bias, and sensitivity

The MQOs for project results, expressed in terms of acceptable precision, bias, and sensitivity, are described in this section and summarized in Table 7.

Table 7. Measurement quality objectives

MQO →	Precision			Bias			Sensitivity
Parameter	Duplicate Samples	LCS Duplicates	Matrix Spike-Duplicates	LCS[1]	Matrix Spikes*	Surrogate Standards	LLOQ/MRL
	Relative Percent Difference (% RPD)			Recovery Limits (%)			Concentration Units
TPHG	50	40	N/A	70-130	70-130	70-130	0.070 mg/L
TPHD	40	40	N/A	70-130	70-130	50-150	0.15-0.38 mg/L
Lead (Pb)	20	20	20	85-115	75-125	N/A	0.1 µg/L
PAH-SIM	NA	40	40	10-150	Varies	Varies	0.050 µg/L
Mercury (Hg)	20	20	20	85-115	75-125	N/A	0.05 µg/L
Chromium (Cr)	20	20	20	85-115	75-125	N/A	0.1 µg/L
Cadmium (Cd)	20	20	20	85-115	75-125	N/A	0.1 µg/L
PCBs	NA	40	40	50-150	50-150	50-150	0.025 µg/L

[1.] Laboratory Control Samples: recoveries are compound specific.

6.2.1.1 Precision

Field duplicates will be collected at Sample site #3. Please refer to Figure 2.

Lab precision will be measured via matrix spikes and matrix spike duplicates and by using previously determined minimum reporting limits (MRLs) listed in table 7. Separate samples will be collected from Sample Site #1 to run lab precision analysis.

6.2.1.2 Bias

Bias is quantified as recovery limits, shown in Table 7.

6.2.1.3 Sensitivity

Please refer to Table 7.

6.2.2 Targets for comparability, representativeness, and completeness

6.2.2.1 Comparability

Comparability expresses the confidence with which one set of data can be compared to another. Comparability will be ensured to the extent possible by implementing standardized procedures for sampling and analysis.

Field procedures will be conducted using Ecology's "Collecting Grab Samples from Stormwater Drainages" SOP, publication 18-10-023 (Ecology, 2018).

Laboratory procedures will follow "Manchester Environmental Laboratory Lab User's Manual" and the "Quality Assurance Manual" (MEL, 2016a; MEL, 2016b).

6.2.2.2 Representativeness

Sampling locations were selected for representativeness based on the following reasoning:

- Upstream from the site to the west of the property line: baseline measurement
- In the stormwater conveyance running directly off the property: represents level of contamination leaving site
- In the conveyance that drains directly into McDonald Creek: represents degree of site contamination flowing into waterway

All samples will be collected mid-stream in the channel where water is free-flowing to ensure adequate mixing and that the samples represent runoff from the targeted drainage areas.

6.2.2.3 Completeness

Completeness establishes whether a sufficient amount of valid measurements were obtained to meet project objectives. The number of samples and results expected establishes the comparative basis for completeness.

The completeness goal for this project is to collect and analyze 100% of the measurements and samples. However, problems occasionally arise during sample collection that cannot be controlled; thus a completeness of 95% is acceptable.

6.3 Acceptance criteria for quality of existing data

Field replicates will determine adherence to sampling protocol by CCEH personnel. MEL will follow quality assurance protocol in quality control tests and follow standard lab procedures to ensure quality per their protocols as described in their lab and QA manual.

6.4 Model quality objectives

Not applicable.

7.0 Study Design

7.1 Study boundaries

Three samples will be collected in the stormwater conveyance parallel to U.S. Hwy 101 in Port Angeles. The conveyance is located on the WSDOT right-of-way. The stormwater flows west to east and drains into McDonald Creek (Elwha-Dungeness Planning Unit, 2005).

Please refer to Figure 2 below for sampling locations.

7.2 Field data collection

7.2.1 Sampling locations and frequency

Midway Metals is located in the center of Figure 2. This figure presents sampling locations in the stormwater conveyances located on each side of the property (1 and 2) and at the outflow point at the northeastern corner of the property (3). The main stormwater conveyance is parallel to the road and flows directly into McDonald Creek, which is located 1000 feet downstream. The conveyance at the outflow runs parallel and 15-20 feet south of the main conveyance until it flows into the Agnew Irrigation District's intake about 250 feet downstream.

Table 8 below lists each sample location's geographical coordinates.

Figure 2. Map showing boundary of project study area and sample collection sites

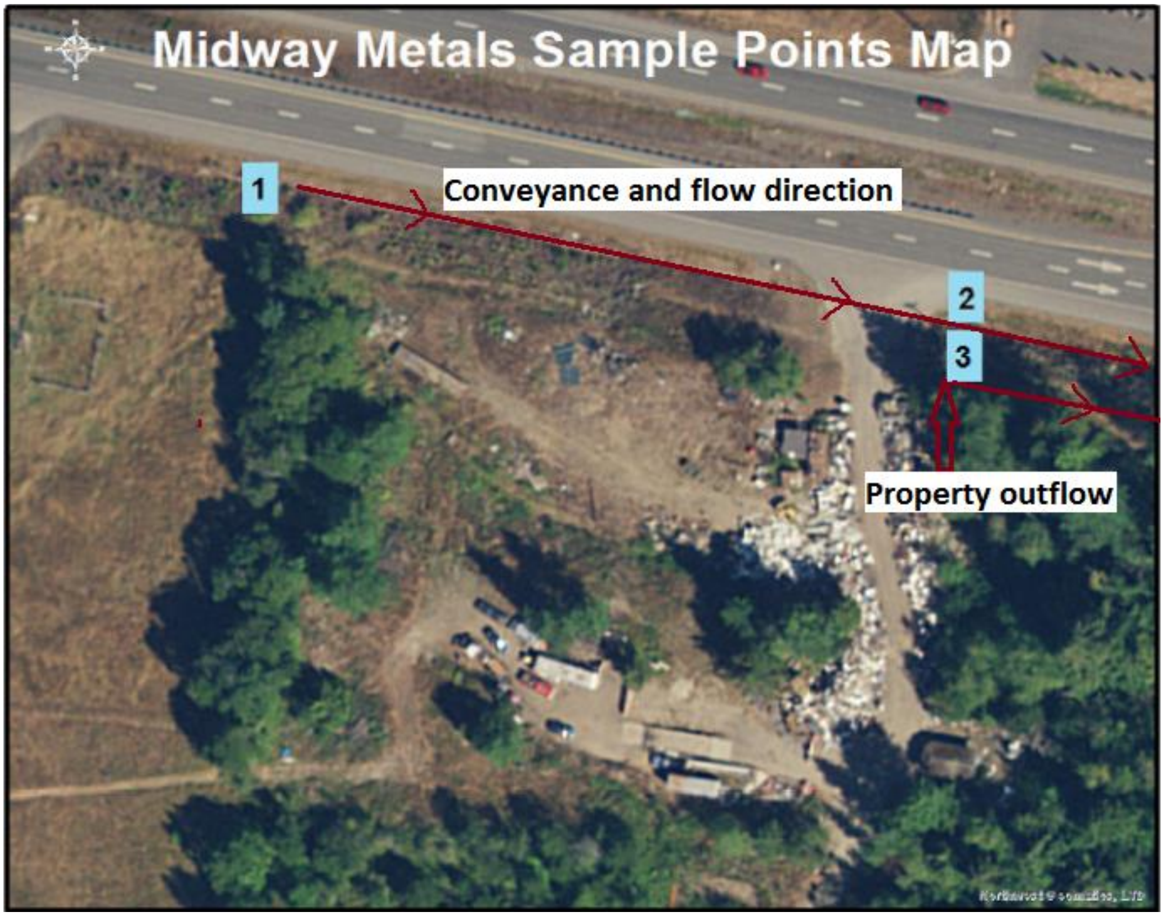

Table 8: Sample locations Geographical Coordinates

Sample Site Name	Sample ID	Latitude	Longitude
Site #1	1	48.091093	-123.253339
Site #2	2	48.089270	-123.240351
Site #3	3	48.089263	-123.240727
Site #3	3FR	48.089263	-123.240727

Sampling locations were selected for representativeness based on this reasoning:

- Sample site #1: stormwater conveyance located parallel to the highway and upstream from the active portion of the site at the property line to serve as baseline measurement
- Sample site #2: Stormwater conveyance downstream from sample site #1
- Sample site #3: Stormwater conveyance running directly off the property and into Agnew irrigation intake and occasionally overflowing into sample site #2 conveyance.

7.2.2 Field parameters and laboratory analytes to be measured

Please refer to table 2 in section 3.2.3 above.

7.3 Modeling and analysis design

Not applicable.

7.4 Assumptions underlying design

There will be a certain degree of contaminants of concern present in the baseline samples due to proximity to the highway. The study design assumes that the stormwater conveyances being sampled adequately capture the contaminants flowing off of the property, and a single snapshot provides a representative enough picture to determine the need for future monitoring/enforcement.

7.5 Possible challenges and contingencies

Challenges include being able to safely access the sampling sites during a rain event, as well as having enough flow in the channels to collect a representative sample. These risks will be evaluated during before sampling.

7.5.1 Logistical problems

- Precipitation must be significant enough to create enough flow in the channels.
- The timing of the sampling has to occur within reasonable working hours.
- Road conditions also have to feel safe given sampling locations.

7.5.2 Practical constraints

Collection opportunities must occur within reasonable working hours.

7.5.3 Schedule limitations

The schedule limitations are due to timing of a significant rain event.

8.0 Field Procedures

8.1 Invasive species evaluation

Not applicable.

8.2 Measurement and sampling procedures

The sampling procedures are taken from Ecology's "Stormwater Grab Samples from Stormwater Discharges," SOP: publication #18-10-023 (Ecology, 2018)

8.3 Containers, preservation methods, holding times

Please refer to Table 9 for information regarding containers, preservation techniques, and holding times.

Table 9. Sample containers, preservation, and holding times

Parameter	Matrix	Minimum Quantity Required	Container	Preservative	Holding Time
Pb	Water	750 ml	500mL HDPE	1:1 HNO_3 to pH<2, Cool to ≤6°C	6 months
Cr	Water	750 ml	500mL HDPE	1:1 HNO_3 to pH<2, Cool to ≤6°C	6 months
Cd	Water	750 ml	500mL HDPE	1:1 HNO_3 to pH<2, Cool to ≤6°C	6 months
Mercury	Water	750 ml	500mL HDPE	1:1 HNO_3 to pH<2, Cool to ≤6°C	28 days
PAH-SIM	Water	1000ml	1 Liter amber glass bottle	Cool to ≤6°C	7 days
TPHD	Water	1000ml	1 Liter amber glass bottle	1:1 HCl to pH<2, Cool to ≤6°C	14 Days
TPHG	Water	80ml	(3) 40ml vials w/septum	1:1 HCl to pH<2, Cool to ≤6°C	14 Days
PCB	Water	1000ml	1 Liter amber glass bottle	Cool to ≤6°C	1 Year

8.4 Equipment decontamination

Not applicable.

8.5 Sample ID

Please refer to table 8, above.

8.6 Chain of custody

Please refer to chain of custody form in Appendix A.

8.7 Field log requirements

Please refer to the field log in Appendix A.

The field log will be printed on waterproof paper. All observations and measurements will be written using permanent, waterproof ink or pencil. Corrections will be made with single line strikethroughs and will be initialed and dated. It will contain the following information:

- Name and location of project
- Field personnel
- Sequence of events
- Any changes or deviations from the QAPP
- Environmental conditions
- Unusual circumstances that might affect interpretation of results
- Pro-DSS measurements if applicable

The following field log requirements will be recorded on the chain of custody form:

- Date, time, sample site ID number, and descriptions as necessary for each sample
- Field measurement results
- Identity of quality control (QC) samples collected

8.8 Other activities

- Field staff will be familiar with standard SOPs for water quality sampling and trained to collect representative environmental samples.
- Field staff will be briefed and trained using Ecology's stormwater grab sampling SOP (Ecology, 2018)
- If Pro-DSS probe is available: Periodic maintenance performed by Streamkeepers of Clallam County in accordance with Streamkeepers QAPP (Chadd, 2016).

9.0 Laboratory Procedures

9.1 Lab procedures table

Please refer to Table 10, which contains information for each analysis to be performed.

Table 10. Measurement methods (laboratory)

Analyte	Sample Matrix	Samples (Number/ Arrival Date)	Detection or Reporting Limit	Sample Prep Method	Analytical (Instrumental) Method
Pb	Water	6/March 11	0.1 µg/L	EPA 200.2	EPA 200.8
Cr	Water	6/March 11	0.1 µg/L	EPA 200.2	EPA 200.8
Cd	Water	6/March 11	0.1 µg/L	EPA 200.2	EPA 200.8
Mercury	Water	6/March 11	0.05 µg/L	EPA 245.1	EPA 245.1
TPHG	Water	5/march 11		SW 5030B	NWTPH-Gx
TPHD	Water	5/March 11	0.15-0.38 mg/L	EPA 3535A	NWTPH-Dx
PAH-SIM	Water	6/March 11	0.050 µg/L	EPA 3535A	EPA 8270E-SIM
PCB	Water	6/March 11	0.025 µg/L	EPA3510C	SW8082A

9.2 Sample preparation method(s)

The laboratory will follow sample preparation procedures described in the analytical methods listed in Table 10.

9.3 Special method requirements

There are no special method requirements for this project.

9.4 Laboratories accredited for methods

MEL is an accredited laboratory (#G750-19) for all methods used to analyze samples.

10.0 Quality Control Procedures

10.1 Table of field and laboratory quality control

There will be one field replicate collected at sample site #3. The lab will perform MS/MSD for metals, PAH-SIM and PCB samples and perform DUPS on TPHG and TPHD on one sample. Please refer to Table 11 for more detailed information. Each type of QC sample listed below has MQOs associated with it (Section 6.2) that will be used to evaluate the quality and usability of the results.

Table 11. Quality control samples, types, and frequency

Parameter	Field		Laboratory			
	Blanks	Replicates	Lab Control	Method Blanks	Analytical Duplicates	Matrix Spikes
Lead	N/A	1	2/batch	1/batch	1/batch	1/batch
Mercury			2/batch	1/batch	1/batch	1/batch
Chromium			2/batch	1/batch	1/batch	1/batch
Cadmium			2/batch	1/batch	1/batch	1/batch
TPHG			2/batch	1/batch	1/batch	N/A
TPHD			2/batch	1/batch	1/batch	N/A
PAH-SIM			2/batch	1/batch	N/A	2/batch
PCB			2/batch	1/batch	N/A	2/batch

10.2 Corrective action processes

Corrective actions will be taken if activities are found to be inconsistent with the QAPP, field procedures, laboratory analyses, data review processes, MQOs or performance expectations, or if some other unforeseen problem arises. Such actions may include:

- Re-calibrating the analytical instrument.
- Collecting new samples using the method described in the approved QAPP.
- Accepting and qualifying lab results that do not meet all QC criteria.
- Reanalyzing lab samples that do not meet QC criteria.
- Convening project personnel and technical experts to decide on the next steps that need to be taken to improve performance of project components.

11.0 Data Management Procedures

11.1 Data recording and reporting requirements

All field data will be compiled and staged to Ecology's EIM database by MEL. The data will be reviewed and uploaded by an EIM coordinator.

11.2 Laboratory data package requirements

MEL will provide a cover narrative with attached detailed results presented in a standard package when work has been completed and will provide all relevant quality control data.

11.3 Electronic transfer requirements

MEL will submit data to CCEH electronically, in a readily-usable format, to minimize data entry problems and facilitate data analysis.

11.4 EIM/STORET data upload procedures

All data will be uploaded to Ecology's EIM database by an EIM coordinator.

11.5 Model information management

Not applicable.

12.0 Audits and Reports

12.1 Field, laboratory, and other audits

No audits are planned.

12.2 Responsible personnel

Not applicable.

12.3 Frequency and distribution of reports

A final report will be completed by CCEH and distributed to Ecology's TCP and various Clallam County department heads.

12.4 Responsibility for reports

Heather Watts, field manager, will be responsible for submitting the final report.

13.0 Data Verification

13.1 Field data verification, requirements, and responsibilities

Field data will be collected following SOPs described in section 6.2.2.1 to ensure MQOs are met.

Data verification will be performed by Ecology staff listed in Table 3.

13.2 Laboratory data verification

The laboratory conducting the analysis will review and verify laboratory results according to the laboratory's established protocols. MEL's Quality Assurance Coordinator will serve as an independent third-party and review, verify, and validate contract lab data.

13.3 Validation requirements, if necessary

Not applicable.

13.4 Model quality assessment

Not applicable.

14.0 Data Quality (Usability) Assessment

14.1 Process for determining project objectives were met

It will be assumed that if the field and lab procedures outlined in this QAPP and supporting documents are followed that the usability of project outcomes will have met the project objectives.

14.2 Treatment of non-detects

The following qualifiers will be used for non-detects, estimates, and tentatively-identified analytes:

- U - Analyte was not detected at or above the reported result.
- J - Analyte was positively identified. The reported result is an estimate.
- UJ - Analyte was not detected at or above the reported estimate.
- NJ - Analyte has been "tentatively identified". The reported result is an estimate.

- R - The sample results are rejected due to severe deficiencies in the ability to analyze the sample and meet the quality control criteria. The presence or absence of the compound cannot be verified.

14.3 Data analysis and presentation methods

Summary tables will be used to present and summarize the final data results. The report will include whether data results for the routinely monitored parameters meet or exceed discharge limits specified in the industrial user's permit.

14.4 Sampling design evaluation

The project manager, in consultation with others working on this project, will comment in the final report on the adequacy of the sampling design and whether changes should be made in further efforts.

14.5 Documentation of assessment

Results and discussion will be documented in the final report.

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16.0 Appendices

Appendix A: Forms

Chain of custody form provided by MEL

Project Name: ________ Lab Work Order #: ________

EIM ID: ___ ___ ___ ___ ___ Program: ________ Date Results needed by: ________ # of coolers ____ MIC Code (8 digits): ________

Send Results to: ________ Mail Stop: ________ Project Name/Reference # of QAPP for this project: ________

Sampling: Date (Year: 2020; Mo, Day)	Sampling: Time ((Military) 0001 - 2400; Hr, Mn)	Field Station Identification	Manchester Laboratory Work Order Number: / Sample Number	Matrix Code	Source Code	No. of Containers	General Chemistry	Micro	Metals	Organic Chemistry
							Alkalinity; Conductivity; pH; Turbidity; Bromide; ☐Chloride ☐Sulfate; Fluoride; Settleable Solids (SS); Suspended Sediment (SSC); Total Dissolved Solids (TDS); Total Solids ☐% Sol ☐% Vol Sol; Total Suspended Solids (TSS); TOC; DOC; BOD5; Oil & Grease; Ammonia (NH3); Nitrite/Nitrate (NO2NO3); Orthophosphate (OP); Total Phosphorus (TP8H); TPN; Chlorophyll ☐filters	Fecal Coliform ☐ MF ☐ MPN; Total Coliform ☐ MF ☐ MPN; E. Coli ☐ MF ☐ MPN; % Klebsiella; Enterococcus	PP Mets (13 elements); Mercury (Hg) ☐ low level; Hardness; Individual Elements (please list) ☐ Total ☐ Dissolved	VOA; BTEX; TPHG; TPHD; HCID Only (Hydrocarbon ID); PCB aroclors; PCB congeners; Pest 2☐ w/ PCB aroclors; PESTMS; Carbamates; Herbicides; PBDE; BNA; PAH; PAH / Phthalates; PAH-SIM; PCB cong (HRMS - contract)

Page 1

Project Officer: ________

Phone Number: ________

Cell Number: ________

Samplers: ________

Chain-of Custody Record: Relinquished By:	Received By:	Yr	Mo	Da	Hr	Mn	Tag # or Seal I.D.	Location/ Locker #	Comments (Condition of Seals, Temperature, Preservation, etc.)

Recorder: ________ Comments: ________

Field Log

Field Log

Project name: Midway Metals Stormwater Sampling & Analyses Project location: 258010 Hwy 101, Port Angeles, WA

Project EIM ID ____________________

Presampling site visit:

Date ____________ Field personnel ____________________

Sequence of events

Time:	Observation/event

Environmental conditions: ____________________

Sample site locations

Site Name	Latitude	Longitude
Sample site #1		
Sample site #2		
Sample site #3		

Field Sampling:

Date ____________ Field personnel ____________________

Sequence of events

Time:	Observation/event

Environmental conditions: ____________________

Deviations from QAPP:
(include explanation) ____________________

Unusual circumstances: ____________________

Pro-DDS measurements

Site Name	Time	Conductivity (µS/cm)	Temperature (°C)	pH
Sample site #1				
Sample site #2				
Sample site #3				

Appendix B: Glossaries, Acronyms, and Abbreviations

Glossary of General Terms

Ambient: Background or away from point sources of contamination. Surrounding environmental condition.

Char: Fish of genus *Salvelinus* distinguished from trout and salmon by the absence of teeth in the roof of the mouth, presence of light-colored spots on a dark background, absence of spots on the dorsal fin, small scales, and differences in the structure of their skeleton. (Trout and salmon have dark spots on a lighter background.)

Clean Water Act: A federal act passed in 1972 that contains provisions to restore and maintain the quality of the nation's waters. Section 303(d) of the Clean Water Act establishes the TMDL program.

Conductivity: A measure of water's ability to conduct an electrical current. Conductivity is related to the concentration and charge of dissolved ions in water.

Designated uses: Those uses specified in Chapter 173-201A WAC (Water Quality Standards for Surface Waters of the State of Washington) for each water body or segment, regardless of whether or not the uses are currently attained.

Geometric mean: A mathematical expression of the central tendency (an average) of multiple sample values. A geometric mean, unlike an arithmetic mean, tends to dampen the effect of very high or low values, which might bias the mean if a straight average (arithmetic mean) were calculated. This is helpful when analyzing bacteria concentrations, because levels may vary anywhere from 10 to 10,000 fold over a given period. The calculation is performed by either: (1) taking the nth root of a product of n factors, or (2) taking the antilogarithm of the arithmetic mean of the logarithms of the individual values.

National Pollutant Discharge Elimination System (NPDES): National program for issuing, modifying, revoking and reissuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements under the Clean Water Act. The NPDES program regulates discharges from wastewater treatment plants, large factories, and other facilities that use, process, and discharge water back into lakes, streams, rivers, bays, and oceans.

pH: A measure of the acidity or alkalinity of water. A low pH value (0 to 7) indicates that an acidic condition is present, while a high pH (7 to 14) indicates a basic or alkaline condition. A pH of 7 is considered to be neutral. Since the pH scale is logarithmic, a water sample with a pH of 8 is ten times more basic than one with a pH of 7.

Point source: Source of pollution that discharges at a specific location from pipes, outfalls, and conveyance channels to a surface water. Examples of point source discharges include municipal wastewater treatment plants, municipal stormwater systems, industrial waste treatment facilities, and construction sites where more than 5 acres of land have been cleared.

Pollution: Contamination or other alteration of the physical, chemical, or biological properties of any waters of the state. This includes change in temperature, taste, color, turbidity, or odor of the waters. It also includes discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state. This definition assumes that these changes will, or are likely to, create a nuisance or render such waters harmful, detrimental, or injurious to (1) public health, safety, or welfare, or (2) domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or (3) livestock, wild animals, birds, fish, or other aquatic life.

Sediment: Soil and organic matter that is covered with water (for example, river or lake bottom).

Stormwater: The portion of precipitation that does not naturally percolate into the ground or evaporate but instead runs off roads, pavement, and roofs during rainfall or snow melt. Stormwater can also come from hard or saturated grass surfaces such as lawns, pastures, playfields, and from gravel roads and parking lots.

Surface waters of the state: Lakes, rivers, ponds, streams, inland waters, salt waters, wetlands and all other surface waters and water courses within the jurisdiction of Washington State.

Watershed: A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.

303(d) list: Section 303(d) of the federal Clean Water Act, requiring Washington State to periodically prepare a list of all surface waters in the state for which beneficial uses of the water – such as for drinking, recreation, aquatic habitat, and industrial use – are impaired by pollutants. These are water quality-limited estuaries, lakes, and streams that fall short of state surface water quality standards and are not expected to improve within the next two years.

90th percentile: An estimated portion of a sample population based on a statistical determination of distribution characteristics. The 90th percentile value is a statistically derived estimate of the division between 90% of samples, which should be less than the value, and 10% of samples, which are expected to exceed the value.

Acronyms and Abbreviations

CCEH	Clallam County Environmental Health
Cd	Cadmium
COC	Contaminants of concern
Cr	Chromium
DQO	Data quality objective
Ecology	Washington State Department of Ecology
EIM	Environmental Information Management database
EPA	U.S. Environmental Protection Agency
et al.	And others
Hg	Mercury
i.e.	In other words
MEL	Manchester Environmental Laboratory
MS/MSD	Matrix spike/matrix spike duplicate
MTCA	Model Toxics Control Act
MQO	Measurement quality objective
NPDES	(See Glossary above)
PAH	Polyaromatic hydrocarbon
Pb	Lead
QA	Quality assurance
QAPP	Quality assurance project plan
QC	Quality control
RPD	Relative percent difference
RSD	Relative standard deviation
SOP	Standard operating procedures
TPHD	Total Petroleum hydrocarbons - diesel
TPHG	Total Petroleum hydrocarbons – gas
VCP	Voluntary compliance program
WAC	Washington Administrative Code
WADOT	Washington State Department of Transportation
WARM	Washington Ranking Method
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area

Units of Measurement

°C	degrees centigrade
cfs	cubic feet per second
cm	centimeter
ft	feet
g	gram, a unit of mass
kg	kilograms, a unit of mass equal to 1,000 grams
mg	milligram
mgd	million gallons per day
mg/d	milligrams per day

mg/kg	milligrams per kilogram (parts per million)
mg/L	milligrams per liter (parts per million)
mg/L/hr	milligrams per liter per hour
mL	milliliter
s.u.	standard units
µg/g	micrograms per gram (parts per million)
µg/kg	micrograms per kilogram (parts per billion)
µg/L	micrograms per liter (parts per billion)
µm	micrometer
µM	micromolar (a chemistry unit)
µS/cm	microsiemens per centimeter, a unit of conductivity

Quality Assurance Glossary

Accreditation: A certification process for laboratories, designed to evaluate and document a lab's ability to perform analytical methods and produce acceptable data. For Ecology, it is "Formal recognition by (Ecology)…that an environmental laboratory is capable of producing accurate analytical data." [WAC 173-50-040] (Kammin, 2010)

Accuracy: The degree to which a measured value agrees with the true value of the measured property. USEPA recommends that this term not be used, and that the terms *precision* and *bias* be used to convey the information associated with the term *accuracy* (USGS, 1998).

Analyte: An element, ion, compound, or chemical moiety (pH, alkalinity) which is to be determined. The definition can be expanded to include organisms, e.g., fecal coliform, Klebsiella (Kammin, 2010).

Bias: The difference between the sample mean and the true value. Bias usually describes a systematic difference reproducible over time and is characteristic of both the measurement system and the analyte(s) being measured. Bias is a commonly used data quality indicator (DQI) (Kammin, 2010; Ecology, 2004).

Blank: A synthetic sample, free of the analyte(s) of interest. For example, in water analysis, pure water is used for the blank. In chemical analysis, a blank is used to estimate the analytical response to all factors other than the analyte in the sample. In general, blanks are used to assess possible contamination or inadvertent introduction of analyte during various stages of the sampling and analytical process (USGS, 1998).

Calibration: The process of establishing the relationship between the response of a measurement system and the concentration of the parameter being measured (Ecology, 2004).

Check standard: A substance or reference material obtained from a source independent from the source of the calibration standard; used to assess bias for an analytical method. This is an obsolete term, and its use is highly discouraged. See Calibration Verification Standards, Lab Control Samples (LCS), Certified Reference Materials (CRM), and/or spiked blanks. These are all check standards but should be referred to by their actual designator, e.g., CRM, LCS (Kammin, 2010; Ecology, 2004).

Comparability: The degree to which different methods, data sets and/or decisions agree or can be represented as similar; a data quality indicator (USEPA, 1997).

Completeness: The amount of valid data obtained from a project compared to the planned amount. Usually expressed as a percentage. A data quality indicator (USEPA, 1997).

Continuing Calibration Verification Standard (CCV): A quality control (QC) sample analyzed with samples to check for acceptable bias in the measurement system. The CCV is usually a midpoint calibration standard that is re-run at an established frequency during the course of an analytical run (Kammin, 2010).

Control chart: A graphical representation of quality control results demonstrating the performance of an aspect of a measurement system (Kammin, 2010; Ecology 2004).

Control limits: Statistical warning and action limits calculated based on control charts. Warning limits are generally set at +/- 2 standard deviations from the mean, action limits at +/- 3 standard deviations from the mean (Kammin, 2010).

Data integrity: A qualitative DQI that evaluates the extent to which a data set contains data that is misrepresented, falsified, or deliberately misleading (Kammin, 2010).

Data quality indicators (DQI): Commonly used measures of acceptability for environmental data. The principal DQIs are precision, bias, representativeness, comparability, completeness, sensitivity, and integrity (USEPA, 2006).

Data quality objectives (DQO): Qualitative and quantitative statements derived from systematic planning processes that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions (USEPA, 2006).

Data set: A grouping of samples organized by date, time, analyte, etc. (Kammin, 2010).

Data validation: An analyte-specific and sample-specific process that extends the evaluation of data beyond data verification to determine the usability of a specific data set. It involves a detailed examination of the data package, using both professional judgment and objective criteria, to determine whether the MQOs for precision, bias, and sensitivity have been met. It may also include an assessment of completeness, representativeness, comparability, and integrity, as these criteria relate to the usability of the data set. Ecology considers four key criteria to determine if data validation has actually occurred. These are:

- Use of raw or instrument data for evaluation.
- Use of third-party assessors.
- Data set is complex.
- Use of EPA Functional Guidelines or equivalent for review.

Examples of data types commonly validated would be:

- Gas Chromatography (GC).
- Gas Chromatography-Mass Spectrometry (GC-MS).
- Inductively Coupled Plasma (ICP).

The end result of a formal validation process is a determination of usability that assigns qualifiers to indicate usability status for every measurement result. These qualifiers include:

- No qualifier – data are usable for intended purposes.
- J (or a J variant) – data are estimated, may be usable, may be biased high or low.
- REJ – data are rejected, cannot be used for intended purposes.
  (Kammin, 2010; Ecology, 2004).

Data verification: Examination of a data set for errors or omissions, and assessment of the Data Quality Indicators related to that data set for compliance with acceptance criteria (MQOs). Verification is a detailed quality review of a data set (Ecology, 2004).

Detection limit (limit of detection)**:** The concentration or amount of an analyte which can be determined to a specified level of certainty to be greater than zero (Ecology, 2004).

Duplicate samples: Two samples taken from and representative of the same population, and carried through and steps of the sampling and analytical procedures in an identical manner. Duplicate samples are used to assess variability of all method activities including sampling and analysis (USEPA, 1997).

Field blank: A blank used to obtain information on contamination introduced during sample collection, storage, and transport (Ecology, 2004).

Initial Calibration Verification Standard (ICV): A QC sample prepared independently of calibration standards and analyzed along with the samples to check for acceptable bias in the measurement system. The ICV is analyzed prior to the analysis of any samples (Kammin, 2010).

Laboratory Control Sample (LCS): A sample of known composition prepared using contaminant-free water or an inert solid that is spiked with analytes of interest at the midpoint of the calibration curve or at the level of concern. It is prepared and analyzed in the same batch of regular samples using the same sample preparation method, reagents, and analytical methods employed for regular samples (USEPA, 1997).

Matrix spike: A QC sample prepared by adding a known amount of the target analyte(s) to an aliquot of a sample to check for bias due to interference or matrix effects (Ecology, 2004).

Measurement Quality Objectives (MQOs)**:** Performance or acceptance criteria for individual data quality indicators, usually including precision, bias, sensitivity, completeness, comparability, and representativeness (USEPA, 2006).

Measurement result: A value obtained by performing the procedure described in a method (Ecology, 2004).

Method: A formalized group of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, data analysis), systematically presented in the order in which they are to be executed (EPA, 1997).

Method blank: A blank prepared to represent the sample matrix, prepared and analyzed with a batch of samples. A method blank will contain all reagents used in the preparation of a sample, and the same preparation process is used for the method blank and samples (Ecology, 2004; Kammin, 2010).

Method Detection Limit (MDL): This definition for detection was first formally advanced in 40CFR 136, October 26, 1984 edition. MDL is defined there as the minimum concentration of an analyte that, in a given matrix and with a specific method, has a 99% probability of being identified, and reported to be greater than zero (Federal Register, October 26, 1984).**Percent**

Relative Standard Deviation (%RSD): A statistic used to evaluate precision in environmental analysis. It is determined in the following manner:

%RSD = (100 * s)/x

where s is the sample standard deviation and x is the mean of results from more than two replicate samples (Kammin, 2010).

Parameter: A specified characteristic of a population or sample. Also, an analyte or grouping of analytes. Benzene and nitrate + nitrite are all parameters (Kammin, 2010; Ecology, 2004).

Population: The hypothetical set of all possible observations of the type being investigated (Ecology, 2004).

Precision: The extent of random variability among replicate measurements of the same property; a data quality indicator (USGS, 1998).

Quality assurance (QA): A set of activities designed to establish and document the reliability and usability of measurement data (Kammin, 2010).

Quality Assurance Project Plan (QAPP): A document that describes the objectives of a project, and the processes and activities necessary to develop data that will support those objectives (Kammin, 2010; Ecology, 2004).

Quality control (QC): The routine application of measurement and statistical procedures to assess the accuracy of measurement data (Ecology, 2004).

Relative Percent Difference (RPD): RPD is commonly used to evaluate precision. The following formula is used:

[Abs(a-b)/((a + b)/2)] * 100

where "Abs()" is absolute value and a and b are results for the two replicate samples. RPD can be used only with 2 values. Percent Relative Standard Deviation is (%RSD) is used if there are results for more than 2 replicate samples (Ecology, 2004).

Replicate samples: Two or more samples taken from the environment at the same time and place, using the same protocols. Replicates are used to estimate the random variability of the material sampled (USGS, 1998).

Representativeness: The degree to which a sample reflects the population from which it is taken; a data quality indicator (USGS, 1998).

Sample (field): A portion of a population (environmental entity) that is measured and assumed to represent the entire population (USGS, 1998).

Sample (statistical): A finite part or subset of a statistical population (USEPA, 1997).

Sensitivity: In general, denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit (Ecology, 2004).

Spiked blank: A specified amount of reagent blank fortified with a known mass of the target analyte(s); usually used to assess the recovery efficiency of the method (USEPA, 1997).

Spiked sample: A sample prepared by adding a known mass of target analyte(s) to a specified amount of matrix sample for which an independent estimate of target analyte(s) concentration is available. Spiked samples can be used to determine the effect of the matrix on a method's recovery efficiency (USEPA, 1997).

Split sample: A discrete sample subdivided into portions, usually duplicates (Kammin, 2010).

Standard Operating Procedure (SOP): A document which describes in detail a reproducible and repeatable organized activity (Kammin, 2010).

Surrogate: For environmental chemistry, a surrogate is a substance with properties similar to those of the target analyte(s). Surrogates are unlikely to be native to environmental samples. They are added to environmental samples for quality control purposes, to track extraction efficiency and/or measure analyte recovery. Deuterated organic compounds are examples of surrogates commonly used in organic compound analysis (Kammin, 2010).

Systematic planning: A step-wise process which develops a clear description of the goals and objectives of a project, and produces decisions on the type, quantity, and quality of data that will be needed to meet those goals and objectives. The DQO process is a specialized type of systematic planning (USEPA, 2006).

References for QA Glossary

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