

McCollum Park (former Emander Landfill) Groundwater Supplemental Remedial Investigation Work Plan



Snohomish County

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1.0 INTRODUCTION

SCS Engineers (SCS) has prepared this Groundwater Supplemental Remedial Investigation Workplan on behalf of Snohomish County Public Works (the County) to support their efforts under the Model Toxics Control Act (MTCA) to improve the understanding of the nature and extent of residual groundwater contamination associated with the closed Emander Landfill site. The landfill reportedly accepted County municipal solid waste (MSW) between approximately 1947 and 1967, was subsequently covered with a soil cap, and ultimately transferred to the Snohomish County Parks and Recreation Department for the future development of McCollum County Park.

Previous remedial investigations reported the presence of residual groundwater contamination at several monitoring wells immediately downgradient of the former landfill. Subsequent remedial actions, including surface regrading, sludge/soil stabilization, the installation of a geomembrane cover and stormwater drainage systems, and operation of a landfill gas (LFG) extraction/flaring system, were completed under a 1996 Cleanup Action Plan (CAP). A program of quarterly groundwater and LFG monitoring was also initiated and remains ongoing.

Groundwater quality at the site has improved since implementation of the 1996 remedy. However, MTCA groundwater exceedances for several monitored parameters, primarily arsenic, iron, manganese and vinyl chloride, continue to persist at several downgradient wells; an observation that is consistent with the redox conditions typically observed at older, unlined MSW landfills.

SCS Engineers (SCS) recently completed a Landfill Condition Status and Data Gaps Evaluation, which recommended the installation and sampling of additional groundwater wells to better define conditions further downgradient of the existing monitoring network. Based on these recommendations and input from the Washington Department of Ecology (Ecology), the County is seeking to further characterize the nature and downgradient extent of the aforementioned groundwater exceedances, and evaluate their potential for impacting downgradient receptors. This information will be used to determine whether the ongoing program of monitored natural attenuation (MNA) remains adequate to manage the residual groundwater impacts associated with the closed landfill.

1.1 PURPOSE AND SCOPE

The purpose of the proposed supplemental groundwater investigation is to collect additional field and chemical data to better understand the nature and extent of water quality impacts, particularly for pH, specific conductance, arsenic, iron, manganese and vinyl chloride, hydrologically downgradient of the closed Emander Landfill. The supplemental investigation will include the following primary elements:

- Pre-construction well location surveying, access logistics and utility clearing.
- Installation of two pairs of shallow and deep groundwater monitoring wells at locations hydrologically downgradient (southeast and southwest) of the existing groundwater monitoring network. Well completion depths are anticipated to range between 25 and 40 feet below ground surface (bgs) for the shallow wells, and between 100 and 140 feet bgs for the deeper wells.
- Limited subsurface soil sampling during well drilling to evaluate the geochemistry of shallow and deeper aquifer soils.

- Post-construction well development and wellhead elevation surveying at each newly installed monitoring well.
- Collection of groundwater samples from the newly installed downgradient wells. Groundwater samples will be analyzed for the same parameter suite being routinely monitored by the existing Emander Landfill well network.

The results of the supplemental investigation will be compiled into a supplemental remedial investigation report, including lithologic/well construction logs, soil geochemical data, groundwater analytical data, and the identification of any exceedances of MTCA groundwater standards. The report will include an evaluation of the downgradient extent of potential groundwater impacts and provide recommendations.

2.0 BACKGROUND

McCollum Park is situated at 600 128th Street SE, approximately half a mile east of Interstate 5 on 128th Street SE in Snohomish County, Washington, within an unincorporated area near the Mill Creek city limits. The Emander Landfill occupies most of the northern half of the 78-acre park. The landfill extends up to, and possibly beneath, the 128th Street SE right-of-way to the north, to Dumas Road to the east, and is bordered by North Creek to the west, and wetlands or wooded parkland to the south. Site topography slopes shallowly from the northern portions of the landfill to the east, west and south. A site plan of the illustrating the main features of the former Emander Landfill is provided on Figure 1 (Attachment A).

A Park and Ride facility is situated on the northern end of the landfill. A vacant County swimming pool center, locker-room building, and parking lot are located near the northwest edge of the landfill. A segment of Dumas Road crosses the eastern portion of the landfill and an inactive dirt bike (BMX) track is located on the southeast end of the landfill. In addition, two County Parks and Recreation buildings leased by Washington State University Extension Services and a building occupied by Northwest Stream Center (Adopt-a-Stream) are situated immediately southwest of the landfill. Extensive greenfield areas consisting of wetlands to the southwest and a wooded uplands to the southeast lie beyond these structures.

The Emander Landfill occupies land that was reportedly acquired by the County in 1922. Gravel mining operations on the property reportedly commenced in 1929. The gravel pit was subsequently used by the County for refuse disposal between approximately 1947 and 1967. With landfilling operations substantially completed by 1967, a soil cover was installed over the refuse fill footprint. The property was subsequently turned over to the Snohomish County Parks and Recreation Department and became the site of McCollum Park.

2.1 PREVIOUS HYDROGEOLOGICAL INVESTIGATIONS & CORRECTIVE ACTIONS

Between 1990 and 1993, the County installed a series of groundwater monitoring wells and subsurface LFG detection probes around the closed landfill and completed a master planning effort. A 1993 Final Environmental Impact Statement (FEIS) and 1995–1996 Remedial Investigation/Feasibility Study (RI/FS) set the basis for environmental mitigation of the former landfill, including the stabilization of 4,100 cubic yards of sludge and hydrocarbon impacted soils, site-wide regrading, an engineered final cover system, a LFG collection and control system (i.e., GCCS), stormwater control system, groundwater monitoring well network, and landfill gas probes for long term monitoring. Under Agreed Order DE96TC-N126 (1996), the County implemented a

Compliance Monitoring Plan that included quarterly groundwater well and gas probe monitoring that continues through the present day.

The RI established that the Emander Landfill is situated over a single aquifer (Advance Outwash and Esperance Sands) that extends to depths between 80 and 120 feet below ground surface (bgs). The aquifer is underlain by an aquitard (Lawton Clay). Geological cross-sections for the site suggest that aquifer thickness increases towards the south. Local groundwater flows towards the south, with an increasing southwest vector along the southern end of the site. Groundwater sampling during the RI reported the presence of VOCs and metals, with samples from downgradient wells exceeding state groundwater quality standards and/or MTCA Method A groundwater cleanup levels for benzene, vinyl chloride, 1,2-dichloroethane, trichloroethene, arsenic, chromium, and lead. Two deep monitoring wells, MW-16 and MW-18, situated along the southwest perimeter of the landfill, reported notably elevated vinyl chloride concentrations ranging between 14 and 45 µg/L. Offsite monitoring of six residential wells located southeast of McCollum Park did not report any groundwater impacts attributable to the landfill. Over the course of the past two decades, groundwater quality at the Emander Landfill has been gradually improving, although state groundwater quality standards and/or MTCA groundwater standard exceedances for pH, specific conductance, arsenic, iron, manganese and vinyl chloride continue to be observed in several downgradient wells.

2.2 ONGOING COMPLIANCE MONITORING

Groundwater monitoring at the Emander Landfill is conducted by County staff on a quarterly schedule at 13 well locations. The wells consist of standard above-ground completions with two-inch PVC casings and dedicated sampling pumps. Five wells (BH-03, BH-05, BH-06, BH-07, and BH-08) are completed in the upper portion of the aquifer, with 10-foot screens extending to depths ranging between 5.5 and 25 feet bgs. A single well (MW-17) is situated within an intermediate aquifer zone (35-45 feet bgs screen depth). The remaining wells (MW-12, MW-14, MW-15, MW-16, MW-18, MW-19, and MW-20) are all situated in deeper horizons within the aquifer, with screened intervals ranging between 60-70 feet bgs to 110-120 feet bgs. The majority of the monitoring wells are situated along the landfill's southwest and southern perimeter, hydrologically downgradient of the fill zone. Figure 1 displays the location of the active monitoring wells.

Geological cross-sections developed for the site indicate that the deeper wells are positioned near the base of the aquifer near its contact with the Lawton Clay aquitard. The groundwater flow direction is generally towards the south-southwest, with flow velocities in the range of 10 and 33 feet/year in the shallow and deep aquifer zones, respectively. Information from the RI indicates that the underlying saturated zone is a single aquifer extending from near the ground surface to the Lawton Clay. Water level data are similar for adjacent shallow and deep wells. A general downward vertical gradient is apparent from the water level data.

The compliance monitoring parameter suite for the Emander Landfill includes field parameters, geochemical and leachate indicators, VOCs and dissolved and total/dissolved metals. During recent years, monitoring results have reported groundwater quality standard exceedances for two field parameters (pH and specific conductance), three metals (arsenic, iron and manganese), and one VOC (vinyl chloride) at several shallow and deeper downgradient monitoring wells. Field parameter exceedances have been sporadic, typically ranging between 5.8 and 6.4 SU for pH, and 809 to 885 umhos/cm² for specific conductance. Total arsenic exceedances have ranged between 0.219 and 20.74 mg/L, with three wells (BH-7, MW-16 and MW-18) exceeding the 10 mg/L federal MCL. The most elevated iron and manganese concentrations were also reported in these three wells, with sitewide exceedances ranging between 0.33 and 16.9 mg/L for iron, and 0.057 and 3.87 mg/L for manganese. As noted above, these exceedances are consistent with the redox conditions typically observed at older, unlined MSW landfills.

Over the past two years, vinyl chloride exceedances have been reported in four shallow wells (BH-03, BH-05, BH-06, BH-07) at concentrations ranging between 0.05 and 2.78 µg/L, and in three deep wells at concentrations ranging between 0.02 and 6.97 µg/L. The most elevated vinyl chloride levels are consistently observed in deep well MW-18.

LFG monitoring is performed in general conformance with Chapter 173-340 Washington Administrative Code (WAC), as defined by the CAP. Similar to the majority of older solid waste landfills, the explosive components of LFG (methane) have declined significantly over the decades, with the flare station measurements typically ranging between 5 and 20 percent methane by volume during recent years. Perimeter probe monitoring has typically reported no detectable methane concentrations, indicating a low potential for offsite LFG migration. The locations of the actively monitored LFG probes are shown on Figure 1.

3.0 SUPPLEMENTAL GROUNDWATER INVESTIGATION

The objective of this work plan is to obtain additional field and chemical data to better define observed MTCA groundwater exceedances associated with the closed Emander Landfill. The investigative effort will focus on evaluating the downgradient extent of these water quality exceedances, particularly for arsenic, iron, manganese and vinyl chloride. This will be accomplished through the installation and sampling of two pairs of shallow and deep groundwater monitoring wells (DMW-1S/DMW-1D and DMW-2S/DMW-2D) that will be located hydrologically downgradient of the existing Emander Landfill groundwater monitoring wells.

This work plan presents project-specific details associated with each of the following investigative tasks:

- Logistics Evaluation/Utility Clearance for Monitoring Wells
- Health and Safety Plan
- Borehole Advancement and Groundwater Well Construction/Development
- Groundwater Sampling
- Reporting and Documentation
- Schedule

3.1 LOGISTICS EVALUATION/UTILITY CLEARANCE FOR MONITORING WELLS

A preliminary site visit has been conducted by SCS and County staff to initially evaluate potential locations and equipment access considerations for the proposed additional downgradient groundwater wells. The proposed locations for these wells are illustrated on attached Figure 2 (Attachment A), and are based upon an evaluation of the groundwater flow direction, as well as input from County environmental staff. It should be noted, however, that the County will need to coordinate permissions for site access to both of the proposed well pair locations since they are situated on parcels that Snohomish County assessor records indicate are either leased to (by the County) or owned outright by the neighboring Adopt-a-Stream foundation.

Well pair DMW-1S/DMW-1D will be situated approximately 250 feet south-southeast of existing well MW-18, along the southern end of the Adopt-a-Stream foundation building's parking area. It should be noted that access further to the south-southeast is restricted due to the presence of North Creek and associated wetlands. Well pair DMW-2S/DMW-2D will be located in a wooded upland area

approximately 400 feet south of existing well BH-05. The shallow (S) and deep (D) wells installed at each downgradient location will be situated approximately 5 to 10 feet apart from each other.

Once site access has been obtained, additional site evaluations will be performed to address drilling equipment access, potential traffic constraints, site operations limitations, and potential utility line interferences. The final locations for the monitoring wells will be selected and staked in consultation with County staff. Site preparation activities such as vegetation removal or minor earth work will likely be required, and approved by the County and/or parcel-owner, prior to mobilization of well drilling equipment. During the selection of the final drilling locations, attempts will be made to minimize the amount of required site preparation and possible disruptions to site use to the extent possible.

3.1.1 Utility Clearance

Public and private utility locate services will be used before intrusive work begins. Clearance activities will include standard utility notification procedures as well as review of available utility drawings or corridor information. Utility constraints may affect both drilling rig access and well locations, and will potentially require field adjustments at the time of investigation.

3.2 HEALTH AND SAFETY PLAN

Field activities will be completed under a site-specific health and safety framework appropriate for intrusive landfill perimeter work. This will include consideration of:

- Utility hazards;
- Traffic or roadside/parking area work;
- Uneven terrain or unstable ground conditions.;
- Combustible gas generation during well drilling operations;
- Contact with potentially contaminated groundwater during well construction, development and sampling, and
- Equipment operation in wooded or developed settings.

Traffic control may be required in areas adjacent to roads or access driveways.

3.3 BOREHOLE ADVANCEMENT AND GROUNDWATER MONITORING WELL CONSTRUCTION

As previously noted, the RI established that the Emander Landfill is situated over a single, unconfined aquifer that extends to depths between 80 and 120 feet bgs. In addition, the existing groundwater monitoring network consists of shallow wells (ranging between 13 to 36 feet deep) and deeper wells (ranging between 70 to 120 feet deep). Given the available information, the projected wells depths for the proposed downgradient well pairs are anticipated to range between 25 and 40 feet bgs for the shallow wells, and between 100 and 140 feet bgs for the deeper wells. However, the final depth of the proposed well pairs will be determined based upon the conditions encountered in the field.

3.3.1 Drilling Methodology and Limited Soil Sampling

Based on the projected depth of the deeper wells, sonic drilling methods are recommended. However, as previously noted, access to the drilling locations may prove challenging, and could require new roadwork and/or the use of limited access (i.e., track-mounted) drilling equipment. All

borehole drilling/well installation activities will be conducted by a state-licensed well driller under the direction of a licensed hydrogeologist. A field geologist will be onsite during borehole advancement to relay information to the licensed hydrogeologist and create detailed logs of the soil types for each well location. Samples will be described in accordance with the Unified Soil Classification System (USCS), and photographed before disposal. Drill cuttings will be examined to determine gross deviations from the soil types anticipated for each borehole, and those differences will be noted.

Given that the proposed drilling will be confined to native soils, it is anticipated the all generated soil cuttings will be suitable for return to the ground surface. However, given the park-like setting surrounding the drilling areas, conditions may require more restrictive management of generated soil cuttings, so soil management will be coordinated with the County. All drilling equipment will be decontaminated prior to initiating onsite drilling activities and between boreholes to minimize the potential for cross-contamination. Drilling water generated during borehole advancement and well installation will be containerized, characterized and either approved for onsite discharge by the landowner or, if necessary, removed for offsite disposal.

Limited soil sampling will be performed at select locations to evaluate the geochemical character of the shallow and deeper saturated soils, and provide preliminary information regarding their suitability as matrixes for future active groundwater remediation. Based on field observations, a maximum of four (4) soil samples (one sample of aquifer material from each boring) will be collected for geochemical analysis. The collected samples will be analyzed for pH, RCRA 8 metals, and total organic carbon (TOC).

3.3.2 Groundwater Well Construction

After the target depth has been reached at each location, a groundwater monitoring well will be installed. The field geologist will oversee the completion of each monitoring well to ensure the screen, blank pipe, sand pack, and seal are properly placed. The groundwater monitoring wells will be constructed in accordance with WAC 173-160-420 (Minimum Standards for Construction and Maintenance of Wells; Resource Protection Wells) by the state licensed driller.

Each new groundwater well will be constructed using 2-inch diameter, flush-threaded, schedule 40 PVC casing with a 5-foot section of machine-slotted PVC screen. A clean silica sand filter pack will be placed in the annular space between each well screen and the surrounding formation to a depth of approximately three feet above the top of the screen. The remainder of the annular space in each boring will be filled with bentonite slurry to within three feet of ground surface to establish a surface seal. Only bentonite materials that meet ANSI/NSF standards for use in potable water wells will be used. The PVC well casings will terminate approximately 2.5 feet above the ground surface. Each well will be completed at the ground surface with locking steel stick-up protectors set in concrete and surrounded by protective bollards. However, for well(s) that can only be constructed in high traffic areas (i.e., roadways or parking lot), the finished monument will consist of a traffic rated, flush-mounted completion. Well identification tags will be affixed to the wells and permanent elevation reference points will be marked on the top of the PVC casings.

Upon completion of the groundwater monitoring wells, a licensed surveyor will measure and record actual locations and elevations (top of casing and land surface) of all the newly installed groundwater wells (horizontally and vertically to the nearest 0.01 ft). The survey should be reported using the North American Vertical Datum 1988 (NAVD88).

3.3.3 Well Development

The groundwater monitoring wells will be developed following installation to ensure a good hydraulic connection between the well and the aquifer and to remove solids that could potentially be mobilized during the sampling process. Sometimes a “skin” of clay and silt particles forms on the borehole wall as a result of drilling. The development process is designed to remove this skin to maximize hydraulic continuity, as well as to “set” the sand pack and remove fine-grained material from the area immediately adjacent to the well screen in the interest of reducing artifact turbidity in samples.

Well development will be accomplished using surging and over pumping techniques. Turbidity will be measured and documented during the development process. Development will continue until turbidity has declined and stabilized. All non-disposable well development equipment will be decontaminated using a non-phosphate detergent (Alconox) wash and an initial clean tap water rinse followed by a final distilled water rinse. All water generated during well development will be containerized in 55-gallon drums pending the subsequent analysis of collected groundwater samples. Groundwater confirmed to meet MTCA standards is assumed to be suitable for discharge to the ground surface (a minimum of 50 feet away from the nearest well location).

3.4 GROUNDWATER SAMPLING AND ANALYSIS

A minimum of 48 hours after well development will be allowed before groundwater samples can be collected from newly installed downgradient wells. The initial groundwater sampling will be conducted using a portable sampling pump. Subsequent installation of dedicated sampling equipment will be assessed by the County as part of the Emander Landfill monitoring program.

Sampling of the new wells will focus on the analysis of field and laboratory parameters consistent with those routinely performed during ongoing compliance monitoring at the Emander Landfill. As a consequence, it is recommended that the sampling of the newly installed wells be coordinated with the Emander Landfill’s quarterly groundwater monitoring events to allow for the acquisition of a time-synchronous data set over the entire site. At least two sampling events are planned for the new monitoring wells as part of the supplemental RI.

3.4.1 Sample Collection

Prior to sampling, the depth to groundwater will be measured in each downgradient well to the nearest 0.01 foot to document the water table elevation and provide data for the subsequent calculation of the groundwater flow direction. Groundwater samples will be collected using low-flow/low-volume well purging/sampling techniques. Low-flow sampling can control sample turbidity and minimize sample chemistry alteration by 1) pumping at a very low flow rate (i.e., less than 500 milliliters per minute) from the well screen zone, 2) avoiding disturbance of the water column above the screen, and 3) minimizing stress on the surrounding formation. Samples obtained in this manner will best reflect the groundwater chemistry at each location. In addition, low-flow sampling will minimize the volume of purge water that will be generated during each sampling event.

During well purging, field water-quality parameters of specific conductance, pH, dissolved oxygen, oxidation-reduction potential (Eh), and temperature will be measured. After the groundwater quality field parameters have stabilized, representative groundwater samples will be collected directly from the discharge tube of the sample pump into pre-cleaned, laboratory-supplied containers with preservatives appropriate for the intended analysis. Samples to be submitted for dissolved metals analysis will be field filtered prior to collection. The collected samples will be immediately placed on ice in a field cooler pending delivery to the analytical laboratory.

All non-disposable sampling equipment (pump housing, clamps, valves, water level probe, etc.) must be decontaminated between sampling locations. Disposable supplies (pump bladders, pump hosing, sampling gloves, etc.) should be properly discarded after the collection of each discrete sample.

3.4.2 Analytical Schedule

The collected groundwater samples will be submitted to a state-certified analytical laboratory for water quality testing. The analytical schedule will be comprised of the same chemical parameter suite being routinely monitored by for existing Emander Landfill well network, and will consist of the following:

- Field Measurements: temperature, specific conductivity, pH, dissolved oxygen turbidity, and static water level.
- Geochemical Indicator Parameters: alkalinity, ammonia, bicarbonate, calcium, chemical oxygen demand, chloride, magnesium, nitrate, nitrite, potassium, sodium, sulfate, total dissolved solids, total organic carbon.
- Metals (total and dissolved): antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, nickel, manganese, nickel, selenium, silver, thallium, vanadium, and zinc.
- Volatile Organic Compounds: (VOCs) as listed in Appendix I (46 compounds).

Laboratory method detection and reporting limits will be the same as those utilized/reported during the routine quarterly analysis of the Emander Landfill groundwater samples. A table listing the full parameter suite analyzed under the current quarterly compliance monitoring program is provided in Attachment 2, along with their laboratory detection limits. The laboratory will perform all analysis within the appropriate holding times.

3.4.3 Quality Assurance/Quality Control

In addition to the primary groundwater samples, quality assurance/quality control (QA/QC) samples will be obtained as part of the supplemental groundwater investigation. This will consist of one downgradient field duplicate sample to be analyzed for all parameter groups, and one VOC trip blank sample. These samples will be collected, handled, transported and analyzed using the same methods employed for the primary samples. All QA/QC samples will be submitted as blind duplicates (i.e. under a separate, unique sample number).

The laboratory will also perform method-specific QC activities, including surrogate recoveries, matrix spike, duplicates, and blanks. The data will be considered valid if percent recoveries fall between their laboratory specified, method-specific, lower and upper control limits.

4.0 DATA EVALUATION AND REPORTING

Field and chemical data obtained during the downgradient groundwater assessment will be evaluated and presented in a supplemental remedial investigation report. The report will present the details of the field investigation, including well installation and development protocols, sampling and laboratory testing methods, and chemical test results. The document will be prepared and stamped by a Washington State licensed Hydrogeologist.

The document will provide an investigative area location map, surveyed downgradient well elevations and locations, final borehole/well construction logs, well development records, an updated

groundwater contour map, data tables summarizing groundwater analytical results with comparisons to MTCA standards, and supporting field and laboratory documentation. In addition, the report will provide conclusions regarding the downgradient extent of water quality impacts associated with the closed landfill, and present recommendations regarding potential additional investigations.

5.0 SCHEDULE

A definitive schedule for completion of the tasks outlined in this work plan cannot be finalized pending confirmation of site trespass permissions and the resolution of potential equipment access restrictions, including existing utilities and protection of greenspace areas. As previously discussed, the drilling locations for the proposed downgradient well pairs are located on land that Snohomish County assessor records indicate are either leased to (by the County) or owned outright by the neighboring Adopt-a-Stream foundation. Although the timing for obtaining the required permissions remains uncertain, the following table presents a preliminary schedule for completion of the project work tasks.

Preliminary Schedule – Select Tasks
Groundwater Supplemental Remedial Investigation

PROJECT TASK	PERFORMANCE PERIOD
County Negotiations for Site Access Coordination	Unknown
Pre-Construction Well Location/Boring Survey and Utility Clearing	2 weeks after confirmation of access permissions
Equipment Mobilization/Access, Borehole Completion, Geologic Logging, Groundwater Well Construction	4 to 6 weeks
Well Survey and Well Development,	2 weeks
Groundwater Monitoring of New Downgradient Wells	Two events scheduled at least 30 days apart. Coordinated with at least one quarterly landfill monitoring event.
Laboratory Testing	3 to 4 weeks after each event
Data Evaluation and Preparation of Supplemental Remedial Investigation Report	6 to 8 weeks following second round of sampling

6.0 CERTIFICATION

This Groundwater Supplemental Remedial Work Plan was prepared under the direction and supervision of the undersigned. We certify that the undersigned are qualified hydrogeologists and/or engineers, licensed in the State of Washington, who have sufficient training and experience in landfill related groundwater studies and related fields as demonstrated by state registration and completion of accredited university courses that enable us to make sound, professional judgments regarding this Groundwater Supplemental Remedial Work Plan. The information contained within this plan is to the best of our knowledge and belief, true, accurate, and complete.

Firm:
SCS Engineers

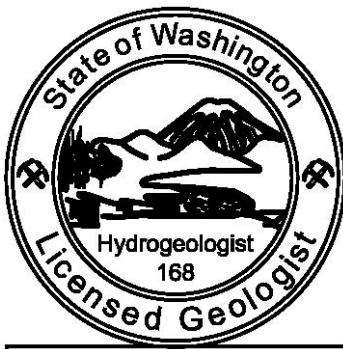


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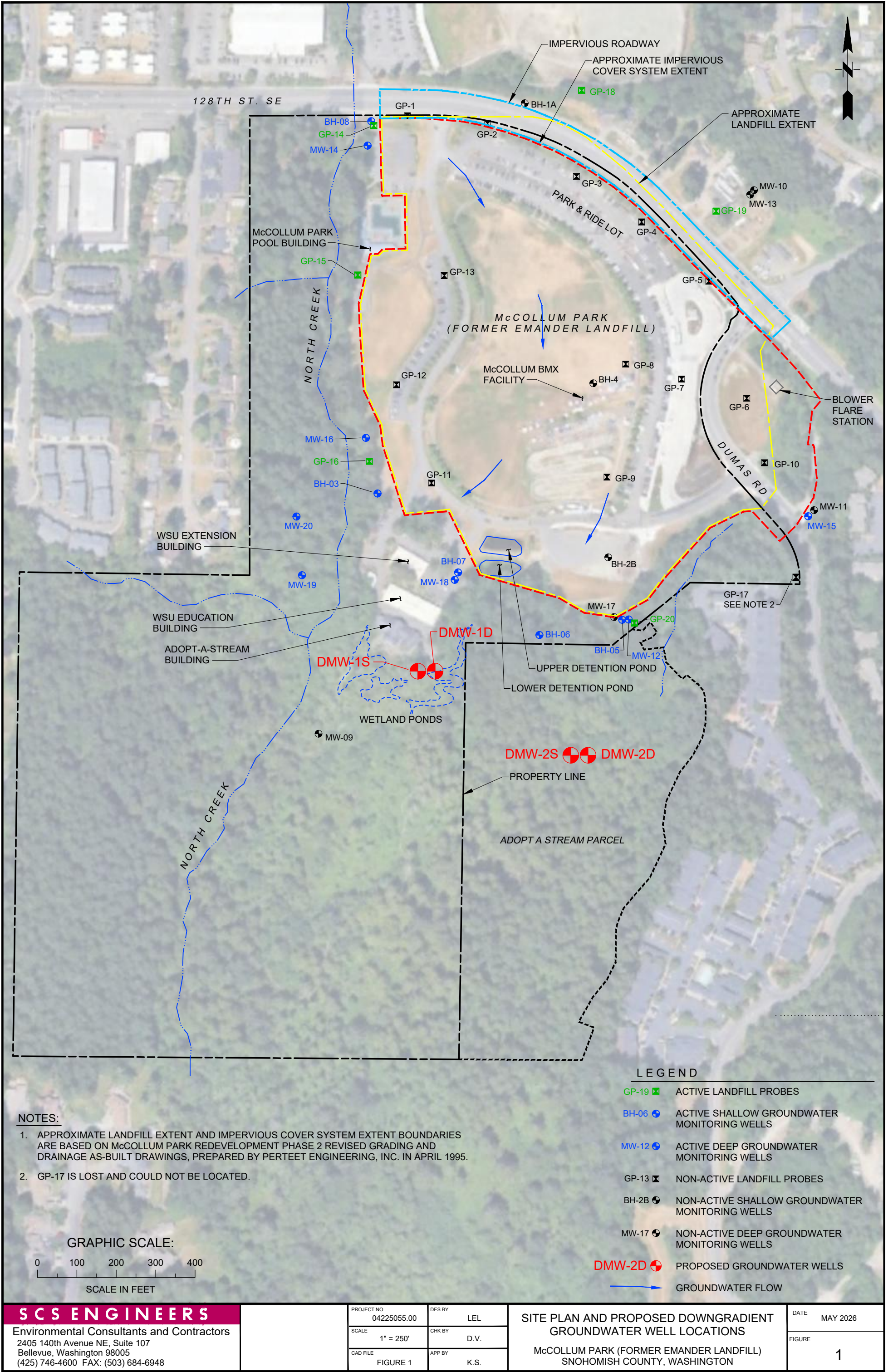
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Attachment 1

Site Plan and Proposed Downgradient Groundwater Well Locations



Attachment 2

List of Groundwater Parameters Emander Landfill Quarterly Monitoring

LIST OF GROUNDWATER PARAMETERS - EMANDER LANDFILL *

FIELD PARAMETERS	Method Detection Limit
pH (SU)	0.1
Specific Conductance	0.1
Dissolved Oxygen (mg/L)	0.1
Temperature (°C)	0.1
Turbidity (NTU)	0.5
Static Water Level (feet)	0.01
CONVENTIONAL GEOCHEMISTRY PARAMETERS (mg/L) EPA Methods 300, 350.1, 415.1, 6010 & SM 522DD	(mg/L)
Alkalinity (as CaCO ₃)	2.0
Ammonia Nitrogen	0.02
Bicarbonate	2.0
Calcium, Dissolved	0.2
Chemical Oxygen Demand	10
Chloride	0.5
Magnesium, Dissolved	0.2
Nitrate Nitrogen (mg-N/L)	0.02
Nitrite Nitrogen (mg-N/L)	0.002
Potassium, Dissolved	0.5
Sodium, Dissolved	0.2
Sulfate	0.1
Total Dissolved Solids	1.0
Total Organic Carbon	0.5
TOTAL/DISSOLVED METALS (µg/L) EPA Methods 200.7/200.8	(µg/L)
Antimony	0.3
Arsenic	0.1
Barium	10
Beryllium	1.25
Cadmium	0.1
Chromium	17
Cobalt	2.0
Copper	10
Iron	23.3
Lead	0.06
Manganese	5.0
Nickel	3.0
Selenium	0.5
Silver	0.2
Thallium	0.05
Vanadium	20
Zinc	2

VOLATILE ORGANIC COMPOUNDS (VOCs) (µg/L) EPA Method 8260 (µg/L)	(µg/L)
1,1,1-Trichloroethane	1.0
1,1,2,2-Tetrachloroethane	1.0
1,1,2-Trichloroethane	2.0
1,1-Dichloroethane	1.0
1,1-Dichloroethylene	1.0
1,2,3-Trichloropropane	1.0
1,2-Dibromo-3-chloropropane	0.03
1,2-Dibromoethane	0.01
1,2-Dichlorobenzene	1.0
1,2-Dichloroethane	0.03
1,2-Dichloropropane	0.02
1,4-Dichlorobenzene	1.0
2-Butanone	5.0
2-Hexanone	2.0
4-Methyl-2-Pentanone (MIBK)	3.0
Acetone	5.0
Acrylonitrile	0.1
Benzene	0.1
Bromodichloromethane	0.0
Bromoform	2.0
Bromomethane	2.0
Carbon Disulfide	3.0
Carbon Tetrachloride	0.0
Chlorobenzene	0.0
Chlorodibromomethane	0.1
Chloroethane	0.02
Chloroform	1.0
Chloromethane	0.1
cis-1,2-Dichloroethene	0.03
cis-1,3-Dichloropropene	0.03
Dibromomethane	0.02
Ethylbenzene	1.0
m,p-Xylene	5.0
Methyl Iodide	3.0
Methylene Chloride	3.0
o-Xylene	1.5
Styrene	2.0
Tetrachloroethylene	0.03
Toluene	2.0
trans-1,2-Dichloroethene	1.0
trans-1,3-Dichloropropene	0.03
trans-1,4-Dichloro-2-butene	2.0
Trichlorethene (1,1,2-Trichloroethylene)	2.0
Trichlorofluoromethane	2.0
Vinyl Acetate	3.0
Vinyl Chloride	0.01

* Suite of groundwater parameters and reported laboratory detection limits for quarterly monitoring.