King County Department of Natural Resources and Parks

Solid Waste Division

Phase 1 – Interim Actions

CONTRACT NO. E00286E12

Cedar Hills Regional Landfill – East Perched Zone Phase 1 Interim Actions Completion Memo

Prepared by
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King County
Department of
Natural Resources and Parks
Solid Waste Division

Waste **Prevention** | *Resource* **Recovery** | *Waste* **Disposal**

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September 25, 2020
FINAL

MEMORANDUM

Project No. 130088

September 25, 2020

To: Toraj Ghofrani, King County Solid Waste Division

From:

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Re: **Phase 1 Interim Actions Completion Memo**
Cedar Hills Regional Landfill – East Perched Zones RI/FS

Aspect Consulting, LLC (Aspect) prepared this Phase 1 Interim Actions Completion Memo (Memo) for the East Perched Zones (EPZ) of the Cedar Hills Regional Landfill (CHRLF) for King County Solid Waste Division (KCSWD) under Contract E00286E12 for Environmental Control Systems Modifications. Project location and site features are presented on Figures 1 and 2, respectively.

The agency draft Remedial Investigation and Feasibility Study (RI/FS; Aspect, 2016) Report was completed in December 2016 and presented to the Washington State Department of Ecology (Ecology) and Public Health Seattle-King County (PHSKC; collectively herein referred to as the Agencies) in February 2017. Agency comments on the Agency Draft RI/FS were received in March 2017. Additional interim actions (IAs) were recommended by the Agencies to be completed prior to finalizing the RI/FS Report. KCSWD responded to Ecology comments in June 2017 and proposed five phases of IAs. Attachment A presents a summary matrix of the phased approach to completing the IAs. This Memo presents a summary of the Phase 1 IAs elements and findings and closes with a review of next steps.

Infrastructure Upgrades

Phase 1 IAs included multiple infrastructure upgrades to address additional landfill gas (LFG) and groundwater data needs. The following infrastructure upgrades were completed in accordance with the EPZ Infrastructure Upgrades Work Plan (Aspect, 2018a):

- **Decommissioned 29 groundwater extraction wells (EW-1 through EW-29)** in June 2018 to reduce the potential migration pathway for the movement of groundwater and LFG through the EPZ. Figure 3 depicts the former locations of the 29 groundwater extraction wells. This work was documented in a technical memorandum dated July 26, 2018, which includes as-builts documenting total depth of overdrilling and sealing methods (Aspect, 2018b). All 29 extraction wells were decommissioned in accordance with Washington Administrative Code (WAC) 173-160. The extraction wells were overdrilled using rotosonic methods and backfilled and sealed with bentonite grout. During overdrilling, field screening for methane and volatile organic compounds (VOCs) was completed and no elevated levels were detected. Each area disturbed during decommissioning was regraded and restored to the original condition to the extent feasible.
- **Installed 6 groundwater monitoring wells (MW-107 through MW-112)** at the toe of the Main Hill refuse along the eastern boundary within the EPZ, as depicted on Figure 4. This work was documented in the "EPZ Infrastructure Upgrades Technical Memorandum" dated August 31, 2018 (Aspect, 2018c). These new monitoring wells are located in the same area as the decommissioned extraction wells and serve as performance-monitoring wells, as recommended in the RI/FS Report. The monitoring wells were screened to target shallow groundwater based on the previous boring logs and observations during drilling. Wet conditions were encountered in silty gravel in the Stratified Drift and in perched zones within weathered glacial till; conditions were dry at one location. Monitoring wells were developed after installation. Groundwater yield was low, consistent with observed geology, and additional development was conducted in March and April 2019 prior to KCSWD including the wells in their routine sampling.
- **Installed 6 LFG probes (GP-63 A/B/C and GP-64 A/B/C)** in two clusters in front of the Passage Point facility (Figure 4). This work was documented in the "EPZ Infrastructure Upgrades Technical Memorandum" (Aspect, 2018c). Each cluster of probes includes a shallow (denoted with an "A" in the probe name), intermediate (denoted with a "B"), and deep probe (denoted with a "C") targeting depths of approximately 6.5, 25, and 60 feet below ground surface (bgs). These probe clusters provide baseline data for two purposes: 1) to assess the effectiveness of the interim remedial action at reducing LFG migration within the EPZ, and 2) to inform a preliminary assessment of the vapor intrusion exposure pathway to Passage Point.

Landfill Gas Collection System Optimization Activities

Consistent with the preferred alternative from the RI/FS Report, LFG system optimization was initiated as part of the Phase 1 IAs but is an ongoing process. The primary objective of LFG optimization was to reduce methane concentrations in the EPZ to protect groundwater quality from landfill gas-to-groundwater transport mechanisms. An operational objective set during testing was to reduce methane at gas probes GP-57 and GP-58 to zero percent, over time, by methodically increasing LFG collection from locations within the waste extent. LFG is collected throughout the CHRLF, but the Phase 1 IAs for LFG system optimization focused on an area of the East Main Hill near the EPZ.

LFG system optimization was initiated in December 2018 and documented in the "EPZ LFG Optimization Assessment" dated May 31, 2019 (Aspect, 2019c). Precision control valves were installed across the EPZ and adjusted to 15 percent open. LFG monitoring and valve adjustments were conducted twice monthly[1]. Optimization efforts were evaluated based on observations at gas probes, the LFG extraction wellfield, and the Migration Control Flare. At the completion of the Phase 1 IAs, LFG optimization was assessed and documented in the "EPZ LFG Optimization Assessment Update" dated September 1, 2020 (Aspect, 2020a). In summary, the following observations were made based on LFG data collected through 2019:

- Gas probes generally showed continued control of lateral LFG migration. Methane concentrations remained elevated at gas probe GP-57.
- The LFG extraction wellfield showed consistent LFG concentrations at most locations as system pressure, which is the vacuum measured at the flare, decreased from approximately 15 inches water column to 11 inches water column during 2019.
- The Migration Control Flare showed LFG concentrations consistent with previous years under declining system vacuum.
- Recommendations for continued LFG optimization and operations modifications were presented in the EPZ LFG Optimization Assessment Update Report (Aspect, 2020a). These recommendations are discussed further in the Next Steps section of this Memo and are summarized in Attachment A.

Soil Gas Sampling

Four soil gas sampling events were conducted to assess baseline soil gas conditions and to evaluate the efficacy of LFG system optimization. The first sampling event was conducted in July 2018 and represents baseline conditions as it was conducted prior to implementation of LFG system optimization in December 2018. The subsequent three sampling events were conducted in February, May, and August 2019, concurrent with ongoing LFG system optimization activities.

Details of each sampling event were summarized in the following technical memos:

- First Round, July 2018 Event, "EPZ Phase I Interim Actions – Baseline, First Round Soil Gas Sampling Technical Memorandum" (Aspect, 2019a)
- Second Round, February 2019, "EPZ Phase I Interim Actions – Second Round, February 2019 Soil Gas Sampling Technical Memorandum" (Aspect, 2019b)
- Third Round, May 2019, "EPZ Phase I Interim Actions – Third Round, May 2019 Soil Gas Sampling Technical Memorandum" (Aspect, 2020b)
- Fourth Round, August 2019, "EPZ Phase I Interim Actions – Fourth Round, August 2019 Soil Gas Sampling Technical Memorandum" (Aspect, 2020c)

[1] In accordance with the preferred alternative identified in the RI/FS Report and May 2019 Technical Memo (Aspect, 2019c), operating conditions were changed from relaxed/moderate to aggressive/very aggressive as defined in the Solid Waste Association of North America (SWANA) *Landfill Gas Operation and Maintenance Manual of Practice, 1997.*

Naphthalene, identified as a soil gas constituent of concern (COC) in the RI/FS Report, was only detected above MTCA Method B shallow soil gas screening levels during the baseline July 2018 sampling event. Naphthalene has not been detected at any location at concentrations exceeding screening levels since initiating LFG collection system optimization. Benzene exceeded screening levels during baseline soil gas sampling, and in the August 2019 sampling event it was detected at a single location at the same concentration as the shallow soil gas screening level. At deep soil gas probes, 1,3-butadiene was detected during the baseline sampling event at one location at a concentration exceeding MTCA method B soil gas screening levels for deep soil gas. 1,3-butadiene has not been detected at concentrations exceeding the deep soil gas screening level since LFG collection system optimization began.

Throughout the four sampling events, methane was typically not detected in gas probes that were monitored, with the exception of occasional sporadic detections at concentrations less than 2 percent by volume, which is below the regulatory limit of 5 percent by volume. These results indicate that initiating optimization of the LFG collection system has reduced LFG in soil gas in the EPZ.

Ultimately, all of this data will be presented together and evaluated in the revised RI/FS report to be prepared as part of Phase 4. The main findings of the soil gas sampling are presented in the Draft "EPZ Phase I Interim Actions – Fourth Round, August 2019 Soil Gas Sampling Technical Memorandum" in May 2020 (Aspect, 2020c).

Passage Point Methane Monitoring Data Review

Aspect reviewed all available methane monitoring data from inside Passage Point from 2012 to 2018. The purpose of the data review was to evaluate methane concentrations and observe any potential trends in presence of LFG and assess potential LFG migration. Based on our review, the following key observations were made:

- Methane detections inside Passage Point may be more representative of background methane concentrations in the ambient air. No potential trends in presence of methane concentrations were observed.
- During Aspect's one year of quarterly soil gas sampling, methane detections were less than 0.5 percent by volume at the two gas probe clusters adjacent to Passage Point (GP-63A/B/C and GP-64A/B/C).
- Methane typically has not been detected at gas probes GP-1, GP-6, GP-7, GP-8, GP-9, and GP-16 from 2014 through 2019, with a few sporadic exceptions of trace concentrations.
- Gas probes generally showed continued control of lateral LFG migration.
- Concentrations of VOCs detected in soil gas samples collected from gas probes around Passage Point were below MTCA Method B screening levels, since optimization of the landfill gas collection system began in December 2018. The only exception was a single detection of benzene at GP-16A in August 2019, which was detected at the same concentration as the MTCA Method B screening level.

Based on these observations, sub-slab soil gas sampling at Passage Point is not warranted at this time but may be reevaluated as part of the Phase 2 IAs.

To improve methane monitoring efficiency and accuracy, Aspect recommends monitoring the two closest probe clusters to Passage Point as sentinel gas probes for evaluating migration of landfill gas toward Passage Point.

Detections of methane at these probes in the future (for example, 3 consecutive months of detectable methane above 1 percent), could be used as a threshold for initiating indoor air monitoring and sub-slab soil gas sampling inside of Passage Point.

Groundwater Data Review

Four quarters of groundwater sampling were completed by KCSWD in 2019 and documented in the 2019 Annual Groundwater Data Evaluation Report (KCSWD, 2020). To evaluate changes in groundwater conditions after initiation of LFG optimization, the new wells and select additional EPZ wells were added the KCSWD's quarterly monitoring program begin in April 2019, as recommended in the RI/FS Report. As part of the Phase 1 IAs, Aspect completed a data review for each quarter This groundwater data review included evaluating groundwater quality results from monitoring wells:

- EPZ wells – EB-6, MW-30A, MW-47, MW-50, MW-102, MW-103, MW-104, MW-107, MW-108, MW-109, MW-110, MW-111, and MW-112
- Regional Aquifer wells – MW-64, MW-67, MW-68, MW-75, MW-80, MW-81, MW-85, MW-87, and MW-93.

These wells represent the proposed point of compliance wells and performance monitoring wells within the EPZ. The following are the key conclusions from Aspect's groundwater data review:

Metals. Arsenic, iron, and manganese were identified as contaminants of concern (COCs) in the RI/FS Report. In the first quarter 2019, manganese was the only metal detected at concentrations above its proposed cleanup levels[2] (CULs) in any shallow perched wells. In the second, third, and fourth quarters of 2019, arsenic, chromium, iron, manganese, and vanadium were detected at concentrations above their proposed CULs in shallow perched groundwater wells. No other metals were detected above proposed CULs. In general, the dissolved arsenic concentrations appear to be decreasing. Figure 5 depicts the results of dissolved metals in shallow perched groundwater during the 3rd and 4th quarters of 2019.

VOCs. Vinyl chloride is the only VOC identified as a COC in the RI/FS. Vinyl chloride was reported at concentrations exceeding proposed CULs in one or more sample for all four quarters. The concentration of vinyl chloride exceeded proposed CULs at MW-47 for all quarters and were consistent with historical levels evaluated during the RI/FS. In the second quarter 2019, the concentration of vinyl chloride exceeded proposed CULs at newly installed MW-107. This was the first sampling of MW-107 and only event where vinyl chloride exceeded proposed CULs. In the third and fourth quarters, concentrations of vinyl chloride also exceeded proposed CUL at monitoring well

[2] This incorporates Ecology's May 2019 updates to MTCA Method B CULs, which resulted in changes to eight groundwater analytes included in performance monitoring at CHRLF.

MW-109. Figure 6 depicts the results of VOCs in shallow perched groundwater during the 3rd and 4th quarters of 2019.

Total Dissolved Solids (TDS) and Nitrate. Although not identified as COCs in the RI/FS, total dissolved solids (TDS) and nitrate were detected at concentrations above CULs at monitoring wells MW-47, MW-109 (TDS only), and MW-30A (nitrate only) in one or more sampling events. TDS detected in MW-47 was at a concentration consistent with historical concentrations presented in the RI/FS. Nitrate has been increasing in monitoring well MW-30A but has only exceeded the CUL since 2017.

Dissolved Gases. Sampling of dissolved gases (ethane, ethene, and methane) began in the second quarter 2019. Results of the second through fourth quarters indicate elevated concentrations of dissolved methane at MW-47, MW-107, MW-109, and MW-110. These wells also had the highest concentrations of ethene along with the presence of vinyl chloride, which may be an indicator of the influence of LFG on groundwater and/or reductive dechlorination occurring in the groundwater.

2019 Regional Aquifer Findings. In the regional aquifer, arsenic and manganese were the only metal COCs detected at a concentration greater than their respective CULs at monitoring wells MW-64, MW-67, and MW-68 during the second, third, and fourth quarter 2019. In the first quarter, arsenic at MW-68 was the only COC detected at a concentration exceeding the CUL. For all quarters, the concentrations of total and dissolved arsenic detected at MW-68 were lower than historical concentrations presented in the RI/FS. Concentrations of dissolved metal COCs in the regional aquifer are presented on Figure 7. No VOC COCs were detected in the samples collected from regional aquifer wells. Detections of VOC COCs in the regional aquifer are presented on Figure 8.

Next Steps

This section summarizes the recommendations and considerations for the Phase 2 and 3 IAs. A summary of the proposed elements of the Phase 2 through 5 IAs is presented in Attachment A. Further details on LFG-related recommendations were presented in the LFG Optimization Update Tech Memo (Aspect, 2020a). Phase 2 work will be initiated under a separate contract, likely to be issued late 2020 or early 2021.

Phase 2 Recommendations include refining LFG collection optimization, ensuring sufficient LFG collection infrastructure is available to reduce LFG migration beyond the extent of waste, and monitoring the progress of groundwater quality improvement as LFG optimization progresses. These recommendations were compiled based on results of the Phase 1 IAs and through discussions with the Agencies based on comments on the RI/FS Report. Phase 2 is expected to take 2 to 5 years, although operational changes may be appropriate for continuation beyond Phase 2. The following is a summary of the recommended Phase 2 IAs:

- KCSWD to continue to conduct routine LFG optimization activities and implement the Phase 2 recommendations presented in the LFG Optimization Assessment Update Tech Memo (Aspect, 2020a).
- Add GP-63A/B/C and GP-64A/B/C to the monthly compliance LFG monitoring program to monitor the presence of methane, as these are the closest probes to Passage Point (Aspect, 2020a).

- Conduct the following operational recommendations for implementing data collection and LFG migration control adjustments:
    - Remain on the current monitoring and valve adjustment schedule (biweekly) for LFG collection optimization.
    - With the current PCV setup at wellheads, adopt the criteria for LFG optimization valve adjustments in the EPZ Area presented in the LFG Optimization Assessment Update (Aspect, 2020a). Apply the valve adjustment criteria for all locations connected to the Migration Control Flare.
    - Record the valve position at each well as prescribed in the LFG Optimization Assessment Update (Aspect, 2020a).
    - Apply the valve adjustment criteria for all LFG explorations connected to the Migration Control Flare.
    - To ensure reliable compliance data is collected, follow the sampling procedures described in the LFG Optimization Assessment Update (Aspect, 2020a).
- Infrastructure recommendations focus on assessing, rehabilitating, and expanding the LFG collection infrastructure to prevent LFG migration. These recommendations are summarized below, and additional details are provided in the LFG Optimization Assessment Update (Aspect, 2020a).
    - Inspect the integrity of the existing LFG collection and monitoring infrastructure to aid in LFG optimization efforts and prioritize rehabilitation efforts, if warranted. This should include those locations not currently part of the extraction network.
    - Following inspection and rehabilitation, install four new shallow LFG collection wells inside the extent of waste along the east perimeter road (in the vicinity between E-36A and E-12), following inspection and rehabilitation of existing infrastructure. Connect the new shallow LFG collection wells to the extraction system.
    - Install four new deep LFG collection wells inside the extent of waste near the east perimeter road (in the vicinity between E-36A and E-12), and connect them to the extraction system. These new wells should be completed through the waste into the same geologic unit as deep gas probes (e.g., GP-55, GP-57, and GP-59) and extraction wells. Collection from these new wells should prevent the migration of LFG beyond the toe of refuse.
- Continue expanded groundwater monitoring including the expanded monitoring locations and analyte list, as performed in 2019.
- Initiate groundwater trend analysis to identify if LFG optimization is improving LFG control and reducing gas-to-groundwater impacts, as well as if additional groundwater wells are needed.

Preliminary Phase 3 Recommendations include long-term considerations presented in the LFG Optimization Update (Aspect, 2020a) and through discussions with the Agencies based on comments on the RI/FS Report. Actual components of Phases 3 through 5 will be reevaluated during a decision gate meeting at the end of Phase 2, and after the completion of each subsequent IAs phase. At this time, the recommended Phase 3 IAs include the following:

- LFG Infrastructure Changes (Aspect, 2020a)
    - To reduce leachate and condensate accumulation in LFG extraction wells and promote effective gas collection, adjustments to flow and vacuum can be made or in-well pumps can be installed to manage the liquids (Aspect, 2020a).
    - LFG extraction wells operated with little to no methane may be connected to a separate blower and treatment system instead of the Migration Control Flare. This would increase operational reliability of the Migration Control Flare by preventing dilution of the gas stream. It would also increase system vacuum available to LFG extraction wells with greater than 35 percent methane, where additional flow is desirable (Aspect, 2020a).
- Perimeter Gas Collection – Consider connecting GP-58 to LFG extraction system, if warranted.
- Influence Testing – Conduct LFG wellfield influence tests to evaluate extraction facilities in the EPZ.
- Lining Stormwater Ditches – Consider installation of a line ditch from Wetland B to main stormwater line (Option 1 within AMEC-Geomatrix, 2011).

The Phase 4 and 5 IAs are presented in Attachment A. As noted above, the actual components of these phases will be reevaluated during decision gate meetings at the end of each preceding phase. Reevaluating the activities for subsequent tasks, based on the results gathered to date, allows for flexibility to ensure the IAs implemented are in the best interest in the common goal of completing the remedial action and complying with MTCA.

References

AMEC-Geomatrix, 2011, Draft Cedar Hills Regional Landfill Wetland Alternatives Evaluation Report, January 2011.

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Aspect Consulting, LLC (Aspect), 2018c, Cedar Hills Regional Landfill – EPZ Phase I Interim Actions Infrastructure Upgrades Technical Memorandum, August 31, 2018.

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Aspect Consulting, LLC (Aspect), 2020a, Cedar Hills Regional Landfill – East Perched Zone Landfill Gas Optimization Assessment Update, September 1, 2020.

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Aspect Consulting, LLC (Aspect), 2020c, Cedar Hills Regional Landfill – EPZ Phase I Interim Actions – Fourth Round, August 2019 Soil Gas Sampling Technical Memorandum, September 2, 2020.

King County Solid Waste Division (KCSWD), 2020, 2019 Annual Groundwater Data Evaluation Report, 2020

Solid Waste Association of North America (SWANA), 1997, Landfill Gas Operation and Maintenance Manual of Practice, March 1997.

Limitations

Work for this project was performed for King County Solid Waste Division (Client), and this memorandum was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This memorandum does not represent a legal opinion. No other warranty, expressed or implied, is made.

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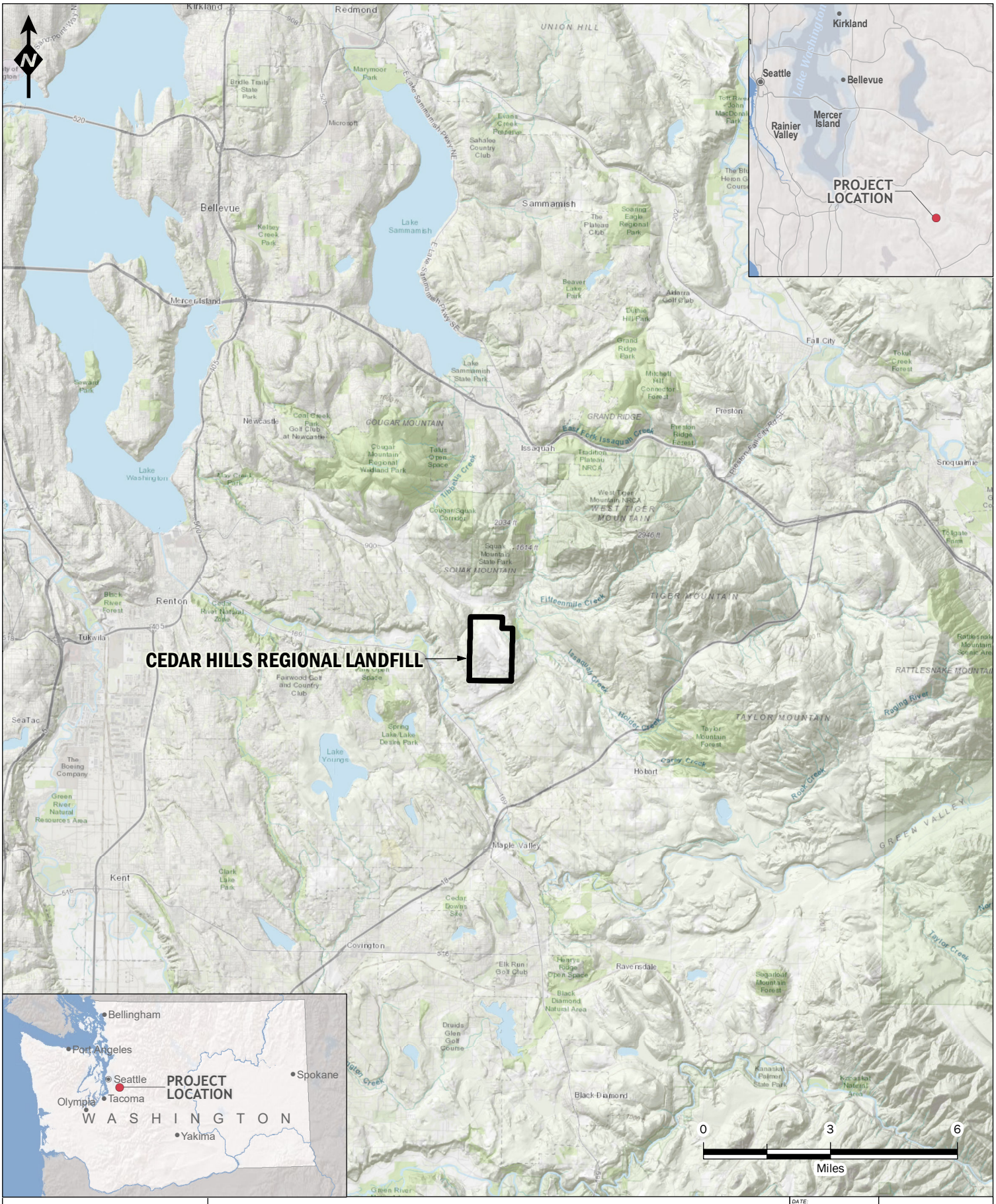
Attachments:
Figure 1 – Project Location Map
Figure 2 – Site Features Maps
Figure 3 – Decommissioned Extraction Wells
Figure 4 – EPZ Features and Monitoring Locations
Figure 5 – Concentration of Dissolved Metals in Shallow Perched Zone Groundwater 2019 Q3 and Q4
Figure 6 – Concentration of VOCs in Shallow Perched Zone Groundwater 2019 Q3 and Q4
Figure 7 – Concentration of Dissolved Metals in Regional Zone Groundwater 2019 Q3 and Q4
Figure 8 – Concentration of VOCs in Regional Zone Groundwater 2019 Q3 and Q4
Attachment A – RI/FS Completion, Phased Action Approach Matrix

FIGURES



King County

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Project Location Map

Cedar Hills Regional Landfill

King County, Washington

DATE: Jun-2020	PROJECT NO. 130088
DESIGNED BY: KSL/RAP	
DRAWN BY: KSL/RAP	FIGURE NO. 1
REVISED BY: ---	

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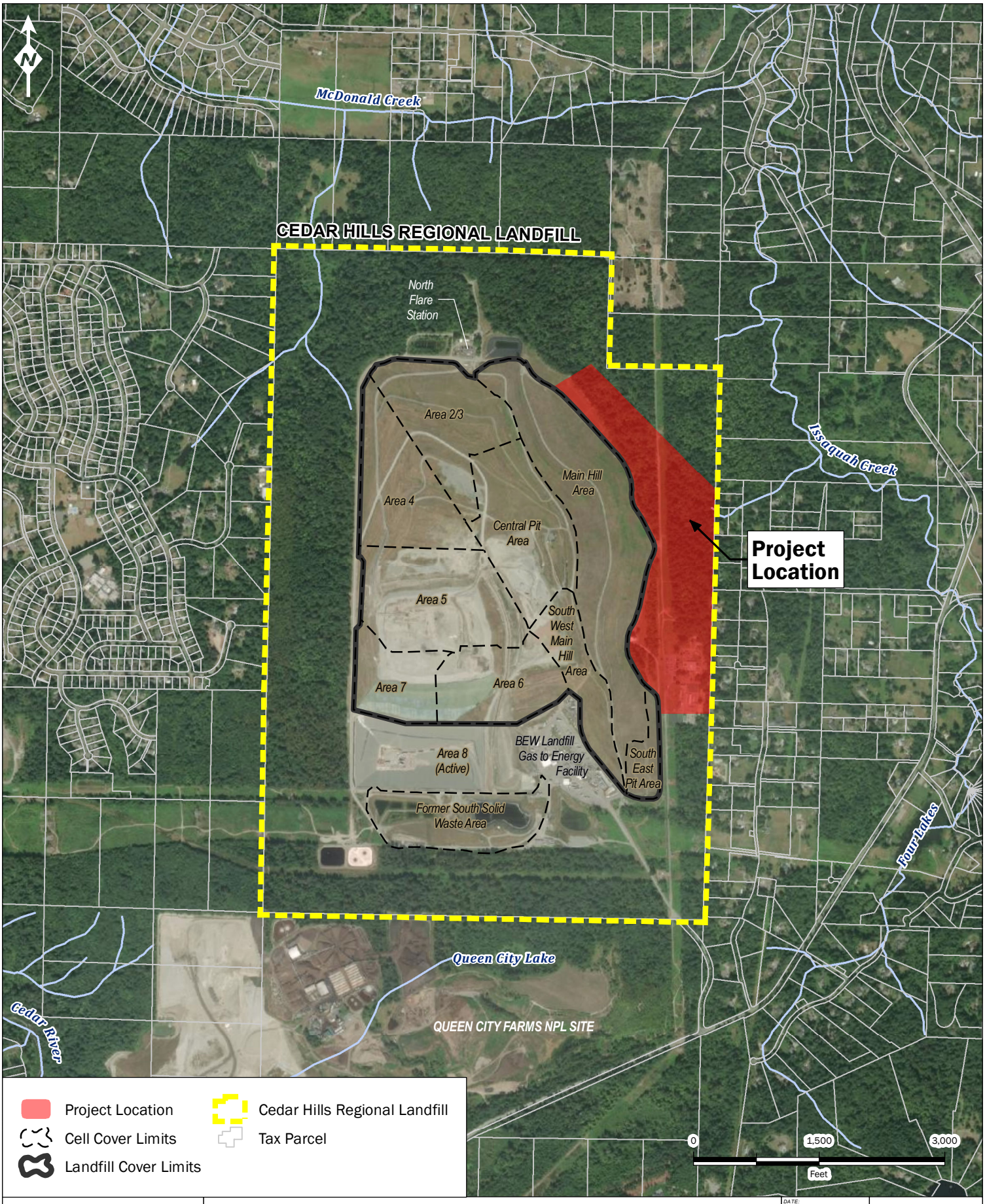

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Site Features Map

Cedar Hills Regional Landfill

King County, Washington

DATE: Jun-2020	PROJECT NO. 130088
DESIGNED BY: KSL/RAP	
DRAWN BY: KSL/RAP	FIGURE NO. 2
REVISED BY: PPW	

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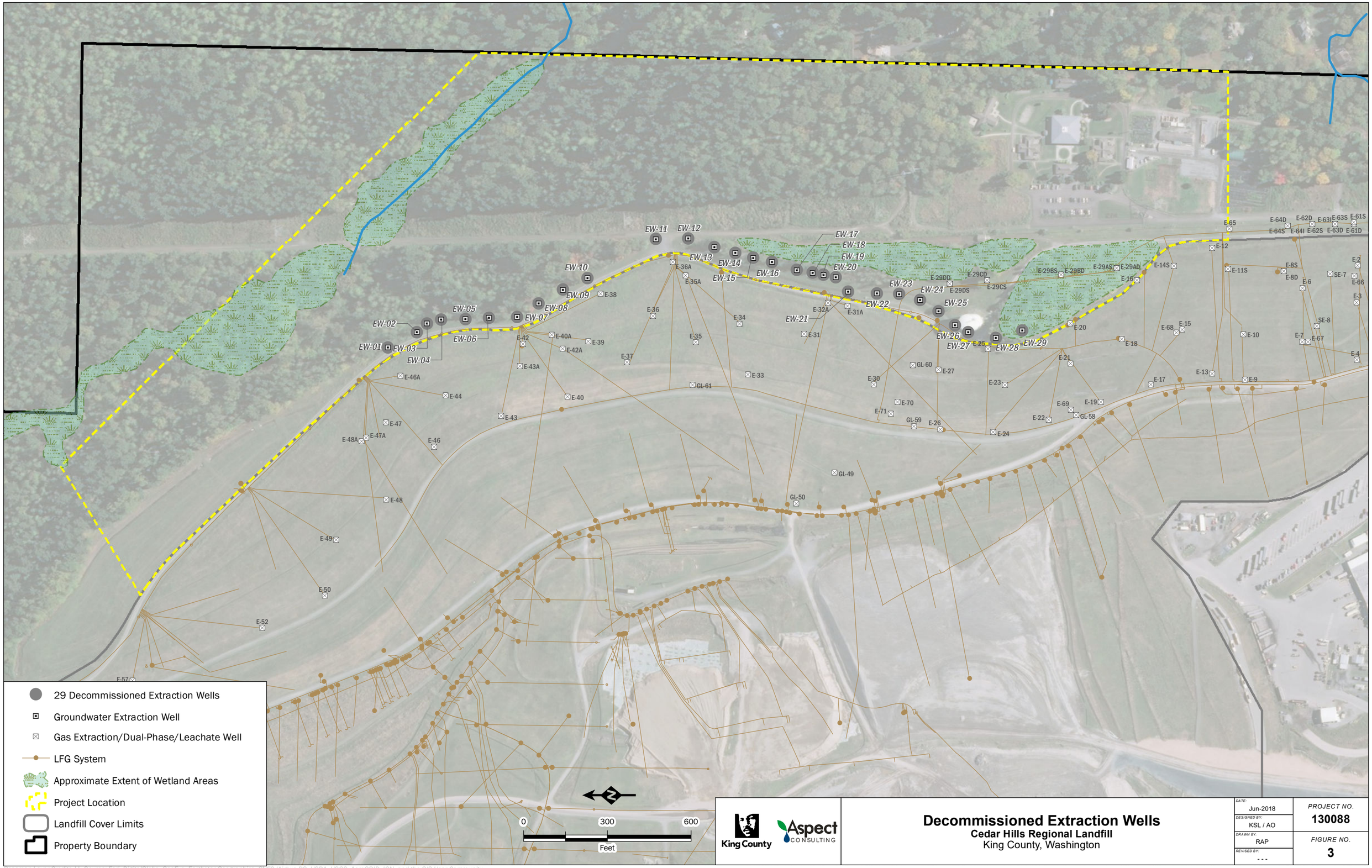

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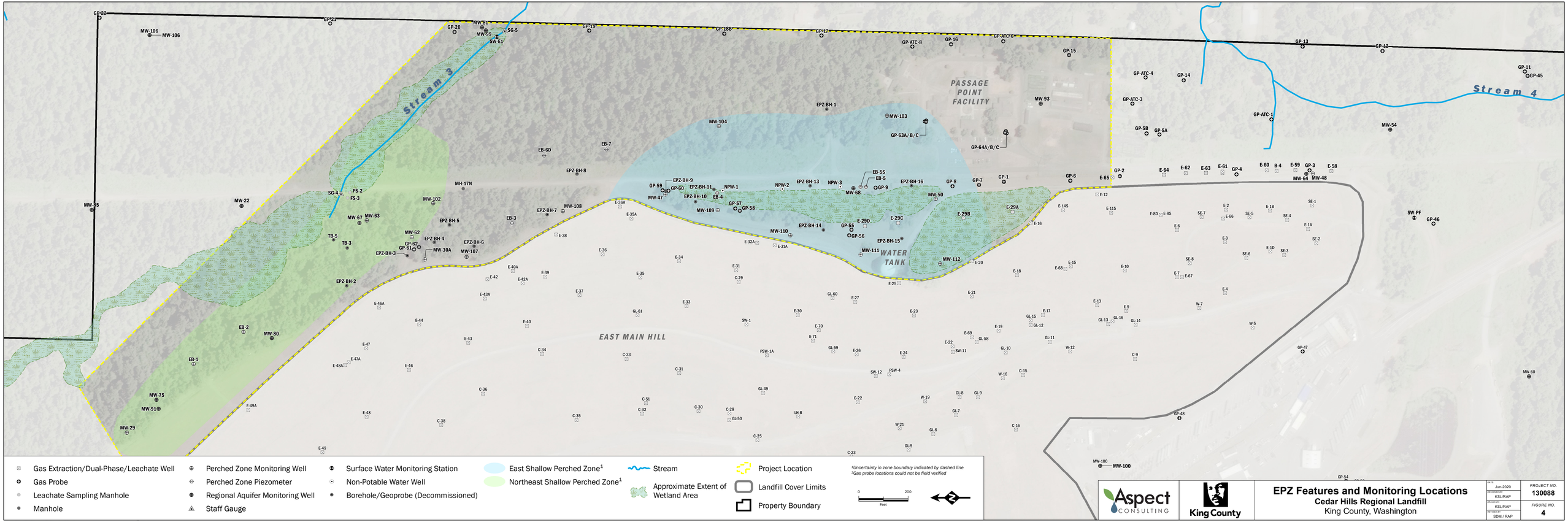
Decommissioned Extraction Wells

Cedar Hills Regional Landfill

King County, Washington

DATE: Jun-2018	PROJECT NO. 130088
DESIGNED BY: KSL / AO	
DRAWN BY: RAP	FIGURE NO. 3
REVISED BY: - - -	



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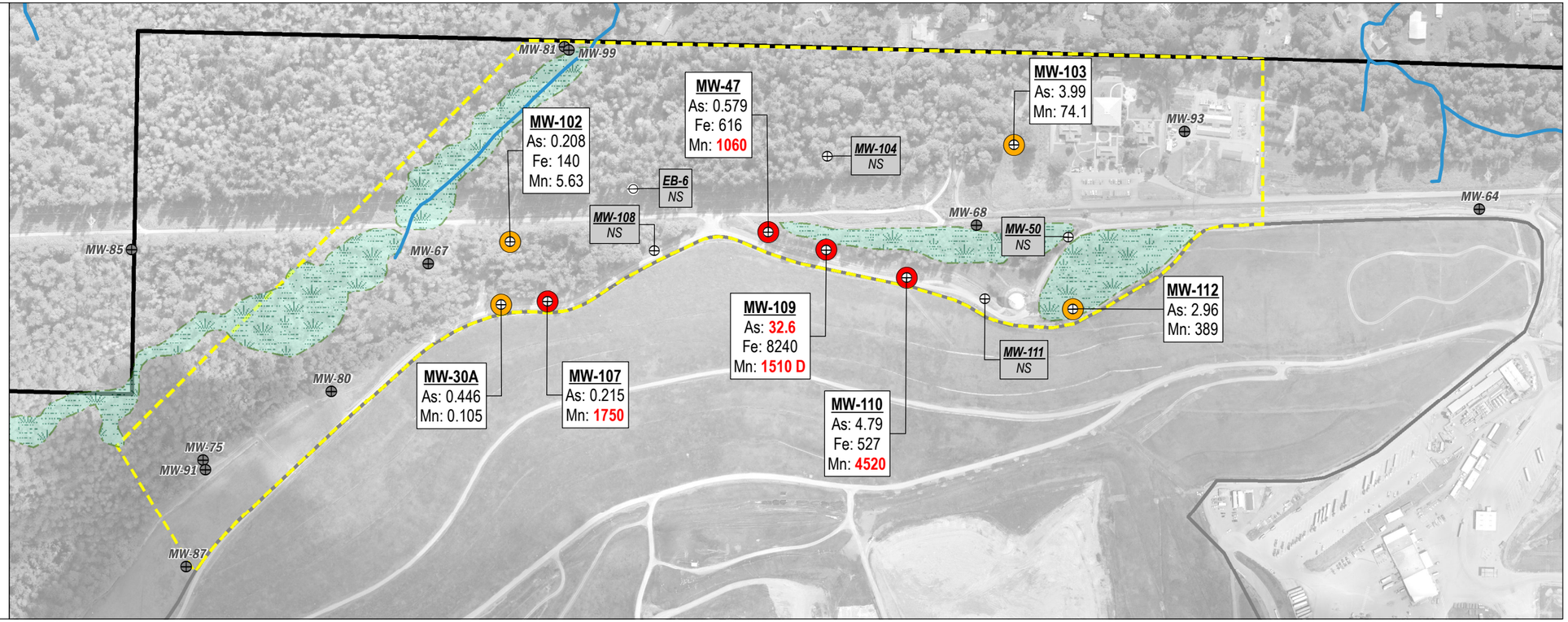
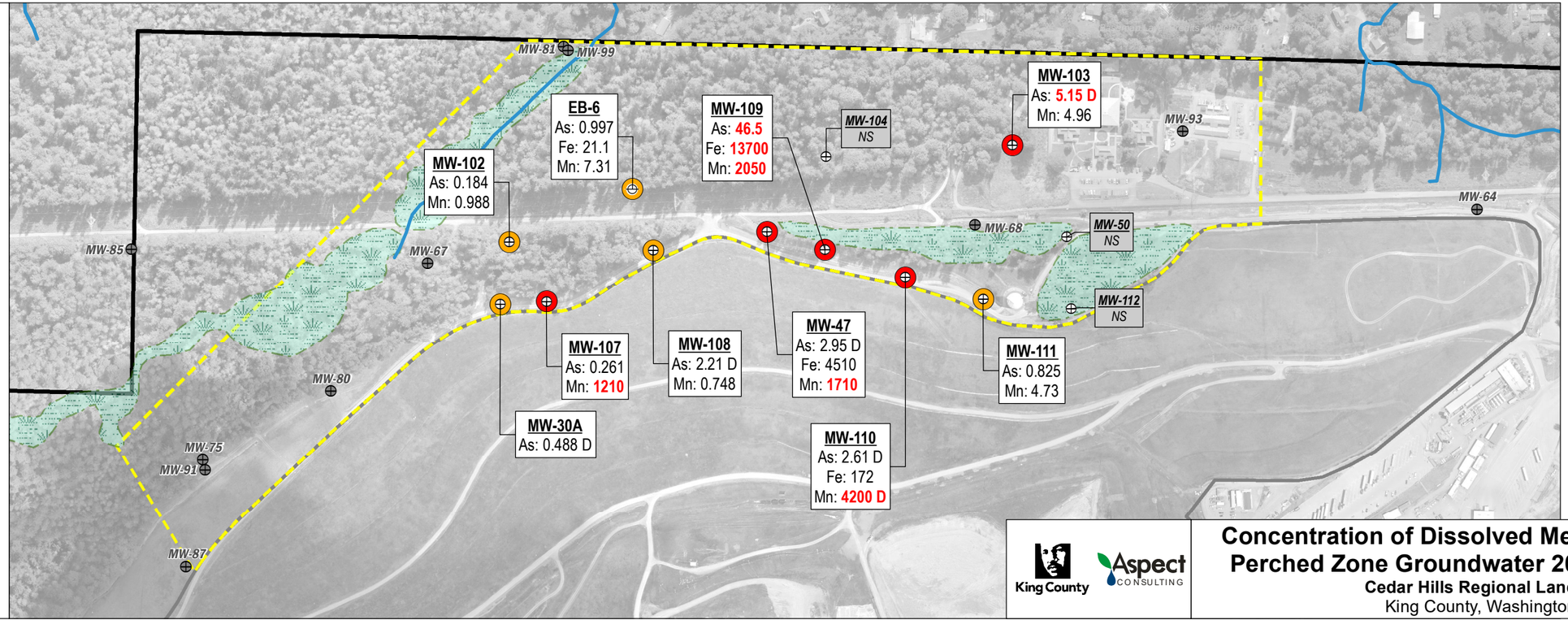
Q3 2019



Q4 2019



Dissolved Metal COCs in Groundwater

- One or More Detected Above Cleanup Level
- One or More Detected Below Cleanup Level
- No Detections
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well
- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary

Note: *Only Dissolved Metals detected above laboratory RDLs are listed.*

Red, bold *text indicates Cleanup Level exceedance.*
A "D" qualifier indicates a result reported from a dilution.
NS = Not sampled

Metals	Cleanup Level (µg/L)
Arsenic	5 µg/L
Iron	11,000 µg/L
Manganese	750 µg/L

0 450 900
Feet

King County

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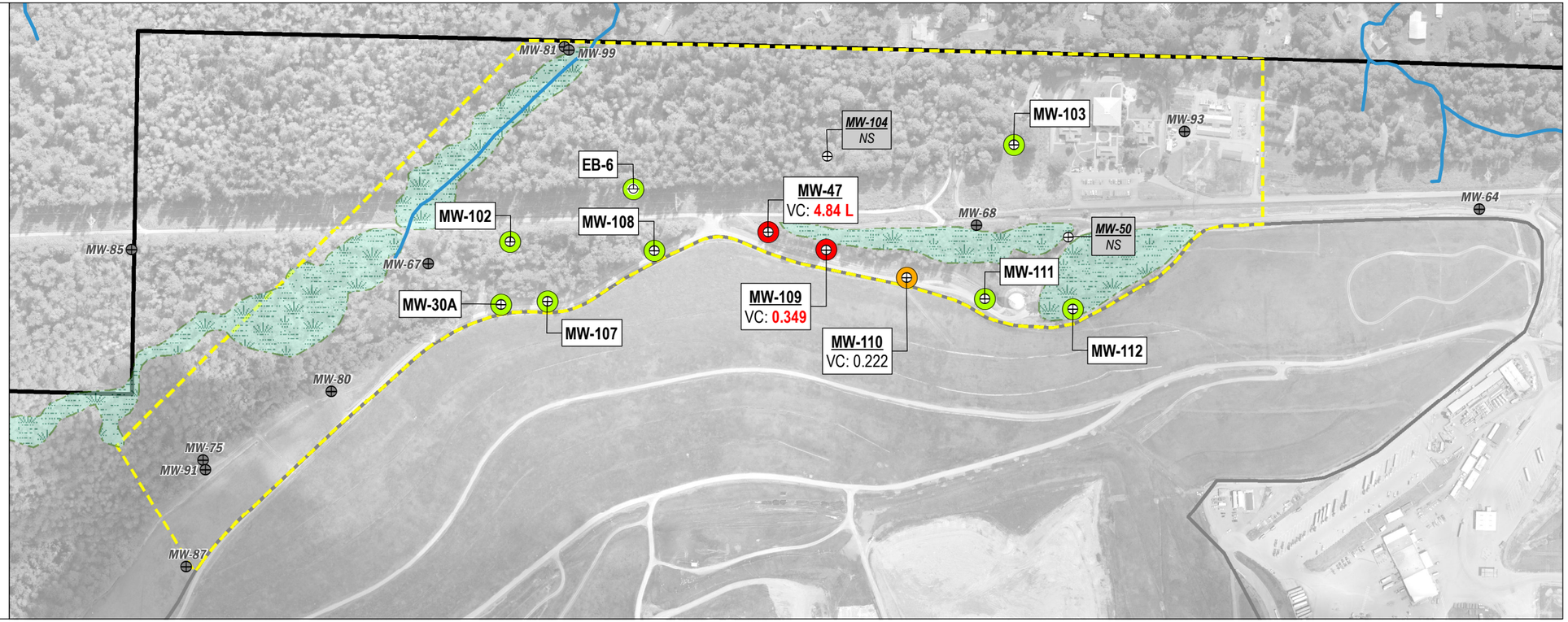
Concentration of Dissolved Metals in Shallow Perched Zone Groundwater 2019 Q3 and Q4

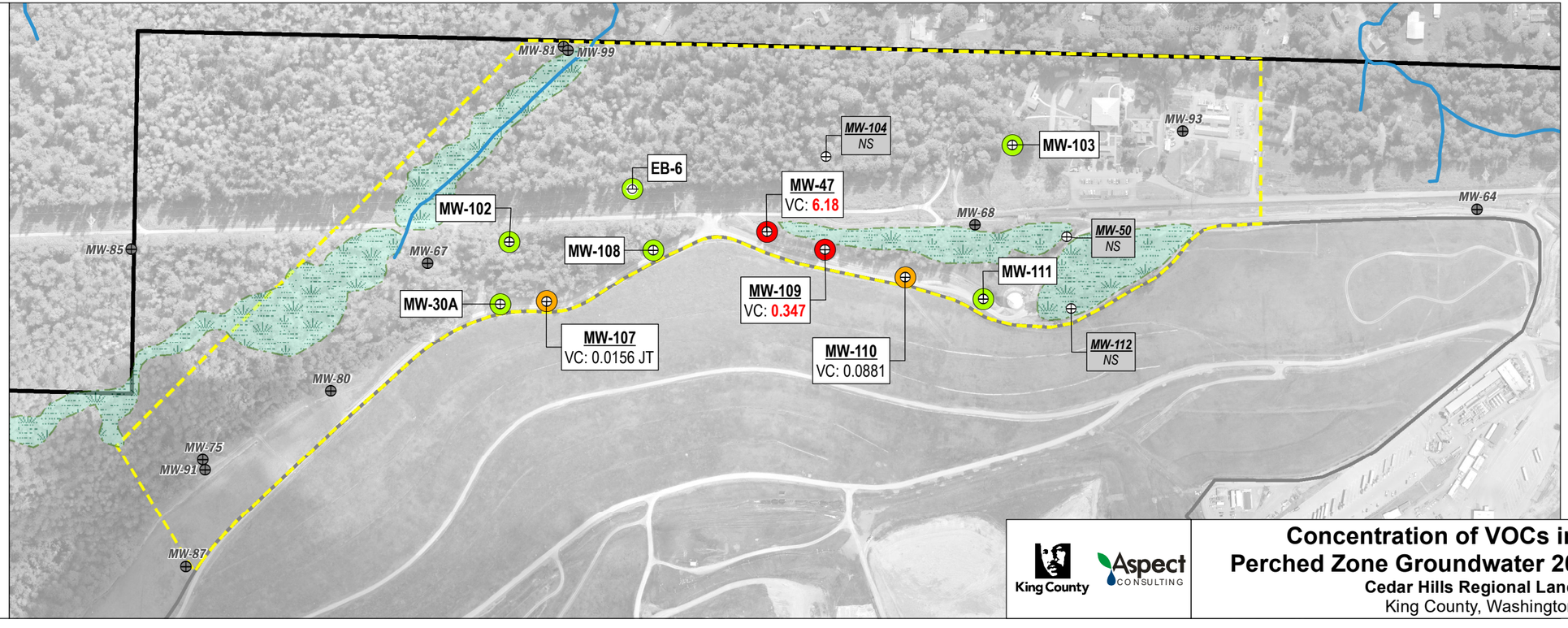
Cedar Hills Regional Landfill
King County, Washington

DATE: Jun-2020	PROJECT NO. 130088
DESIGNED BY: AY	
DRAWN BY: RAP	FIGURE NO. 5
REVISED BY: TDR	

Q3 2019



Q4 2019



VOC COCs in Groundwater

- One or More Detected Above Cleanup Level
- One or More Detected Below Cleanup Level
- No Detections
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well
- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary

Note: ***Red, bold*** *text indicates Cleanup Level exceedance.*

A "J" qualifier indicates an estimated result.
A "T" qualifier indicates detected between MDL and RL.
NS = Not sampled

VOCs	Cleanup Level (µg/L)
Vinyl Chloride	0.29 µg/L

N

0 450 900

Feet

King County

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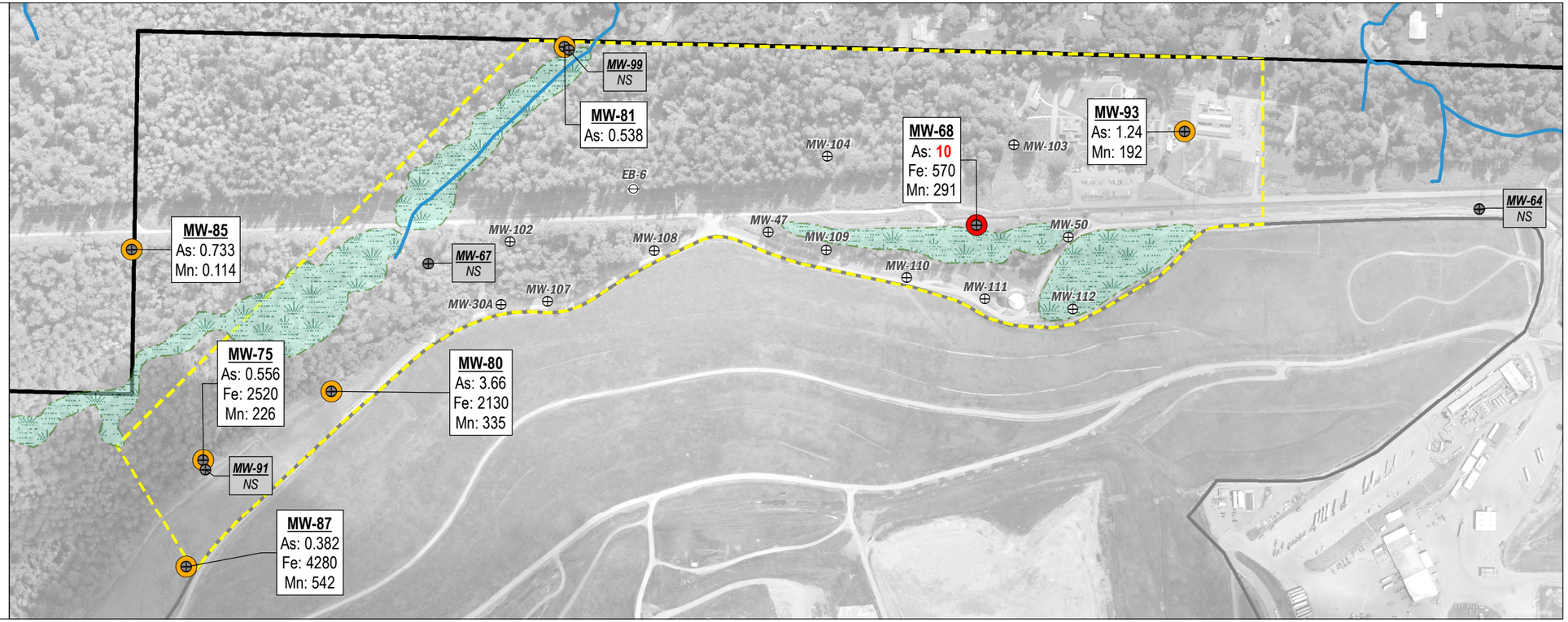
Concentration of VOCs in Shallow Perched Zone Groundwater 2019 Q3 and Q4

Cedar Hills Regional Landfill

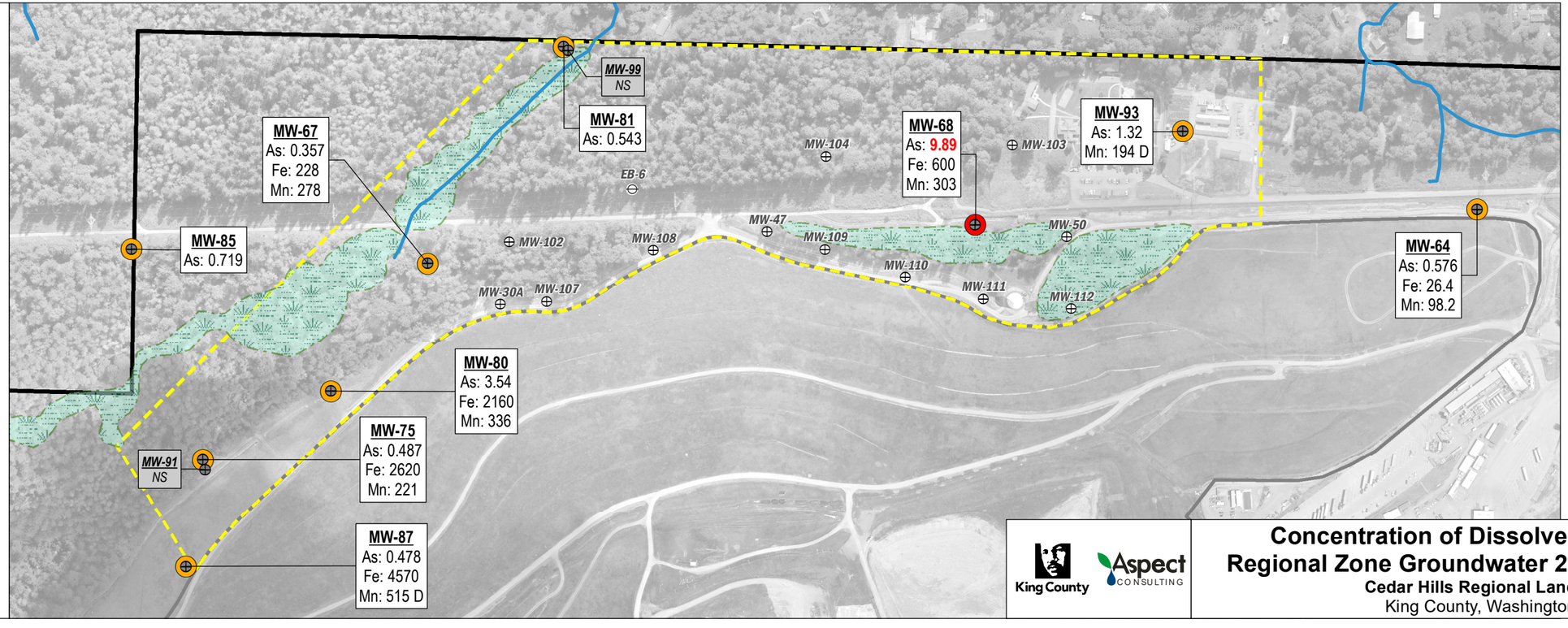
King County, Washington

DATE: Jun-2020	PROJECT NO. 130088
DESIGNED BY: AY	
DRAWN BY: RAP	FIGURE NO. 6
REVISED BY: TDR	

Q3 2019



Q4 2019



Dissolved Metal COCs in Groundwater

- One or More Detected Above Cleanup Level
- One or More Detected Below Cleanup Level
- No Detections
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well
- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary

Note: *Only Dissolved Metals detected above laboratory RDLs are listed.*

Red, bold *text indicates Cleanup Level exceedance.*
A "D" qualifier indicates a result reported from a dilution.
NS = Not sampled

Metals	Cleanup Level (µg/L)
Arsenic	5 µg/L
Iron	11,000 µg/L
Manganese	750 µg/L

N

0 450 900

Feet

King County

Aspect CONSULTING

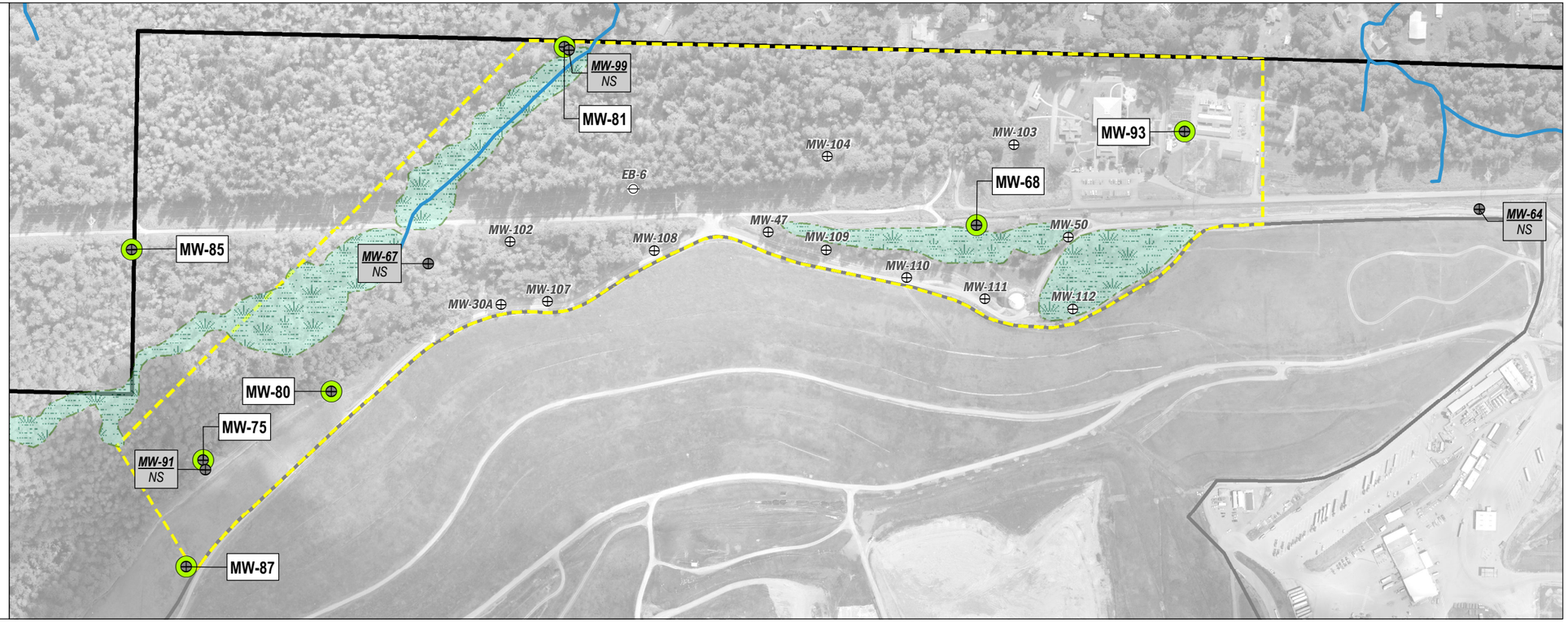
Concentration of Dissolved Metals in Regional Zone Groundwater 2019 Q3 and Q4

Cedar Hills Regional Landfill

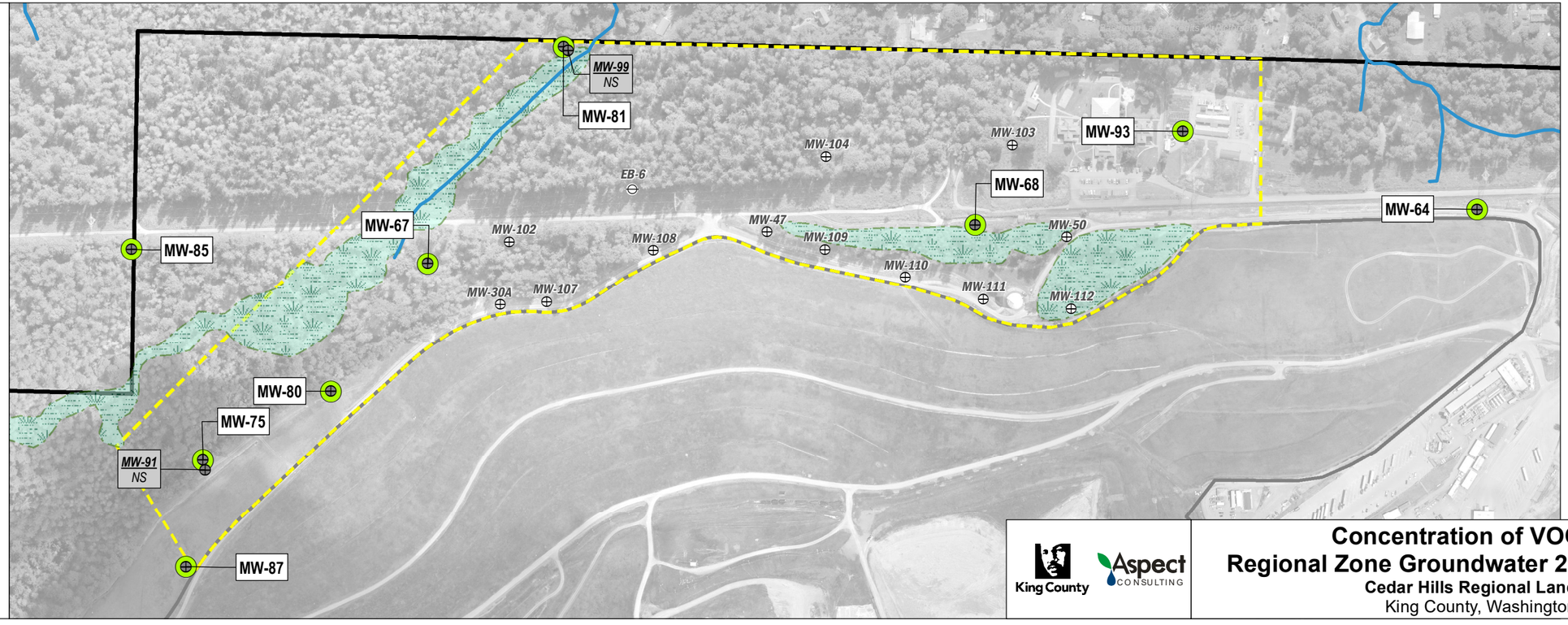
King County, Washington

DATE: Jun-2020	PROJECT NO. 130088
DESIGNED BY: AY	
DRAWN BY: RAP	FIGURE NO. 7
REVISED BY: TDR	

Q3 2019



Q4 2019



VOC COCs in Groundwater

- One or More Detected Above Cleanup Level
- One or More Detected Below Cleanup Level
- No Detections
- Perched Zone Monitoring Well
- Perched Zone Piezometer
- Regional Aquifer Monitoring Well
- Approximate Extent of Wetland Areas
- Project Location
- Landfill Cover Limits
- Property Boundary

Note: ***Red, bold*** *text indicates Cleanup Level exceedance.*

NS = Not sampled

VOCs	Cleanup Level (µg/L)
Vinyl Chloride	0.29 µg/L

0 450 900

Feet

King County

Aspect CONSULTING

Concentration of VOCs in Regional Zone Groundwater 2019 Q3 and Q4

Cedar Hills Regional Landfill

King County, Washington

DATE: Jun-2020	PROJECT NO. 130088
DESIGNED BY: AY	
DRAWN BY: RAP	FIGURE NO. 8
REVISED BY: TDR	

ATTACHMENT A

RI/FS Completion, Phased Action Approach Matrix

RI/FS Completion
Phased Action Approach Matrix
(v4 - updated July 2020)

Phase 1	Year 1-2	**Decommissioning GW Extraction Wells**	Interim Action - Alternative 2 Components **COMPLETED**
		-Decommission existing 'EW' groundwater extraction wells and replace with 6 new wells for compliance monitoring.	
		Optimize Existing LFG System	
		Compliance Gas Probes	
		(1a) Install 2 nested gas probes (6 total) to replace GP-ATC-5 and GP-ATC-7	
		(1b) Sample 6 new gas probes and select previously sampled probes Quarterly (baseline and three post-optimization events)	
		Passage Point Methane Monitoring	
		-Evaluate existing Passage Point methane monitoring data	
		-Review Passage Point construction information	
		-Evaluate need for sub-slab sampling at Passage Point.	
		Groundwater Monitoring	
		-County conduct expanded groundwater monitoring	
Decision Gate - July 2020			
Phase 2	Year 2-3	**Perimeter Gas Collection**	Interim Action - Alternative 3 Components
		-Install 4 new deep LFG extraction wells inside waste and connect to extraction system. *-Evaluate the location for and install 4 new shallow LFG extraction wells inside waste and connect to extraction system.*	
		LFG Extraction System & Monitoring	
		-Implement intermediate-term recommendations presented in LFG Optimization Update Tech Memo (Aspect, 2020). Evaluate and modify routine LFG monitoring locations.	
		-County conduct routine LFG optimization activities and implement near term recommendations presented in LFG Optimization Update Tech Memo (Aspect, 2020).	
		Groundwater Monitoring	
		-County continue conducting expanded groundwater monitoring	
		-Initiate groundwater trending (see Ecology comment 20). Will support identifying if new wells are needed and if optimization is helping.	
Decision Gate			
Phase 3	Year 5+	**Perimeter Gas Collection**	Interim Action - Alternative 3 Components (if needed)
		-Connect GP-58 to extraction system, if needed.	
		Influence Testing	Additional Investigations
		- Conduct LFG well field influence tests to evaluate extraction facilities in the EPZ.	
		Lining Stormwater Ditches	
		-Line ditch from Wetland B to main stormwater line as per Option 1 from AMEC 2011	
Decision Gate			
Phase 4	Year ++	**Ecology's Requested Additional Investigations**	Additional Investigations
		-Wetland staff gauges *-Trend analysis for inorganics* *-LandGEM analysis - LFG generation*	
		Finalize RI/FS Report	RI/FS
		-see additional reporting comments to be addressed	
		Prepare Cleanup Action Plan	
Agency Review & Approval			
Phase 5	Year +++	**Load Data to EIM**	RI/FS
		Implement Preferred Alternative & Long-Term O&M	Remedial Action - Alternative 4 Components (if needed)
		-TBD (based on results from Phases 1 and 2) Implement expanded LFG collection with East Main Hill Refuse extraction wells	
		-Long-term O&M activities: groundwater and LFG monitoring, continued LFG optimization.	