TECHNICAL MEMORANDUM

DATE January 20, 2023 **Project No.** GL152030402

TO Dr. Alan Noell
Washington State Department of Ecology

CC Reserve Silica Reclamation Site Technical Group

FROM Gary Zimmerman **EMAIL gary.zimmerman@wsp.com**

REMEDIAL INVESTIGATION SUPPLEMENTAL SOIL SAMPLING WORK PLAN
RESERVE SILICA RECLAMATION SITE
FACILITY ID NO.: 2041; CLEANUP SITE NO.: 4728

1.0 REMEDIAL INVESTIGATION SOIL SAMPLING RESULTS

Results of the soil and sediment sampling completed in accordance with the Reserve Silica Reclamation Site (Site), Remedial Investigation (RI) and Feasibility Study (FS) Work Plan (Work Plan; Golder 2021) were presented to the Washington State Department of Ecology (Ecology) in a technical memorandum (Golder 2022). Figures 1 and 2 depict the Site location and layout, respectively.

Soil sampling was conducted in three areas identified in the Work Plan with the anticipated highest probability of surficial impacts to soil and sediments attributable to the discharge and overland flow of high pH groundwater from the Lower Disposal Area (LDA). These areas were labeled as Decision Units (DUs)-1, -2, and -3. DU-1 and DU-3 were sampled in October 2021, and DU-2 was sampled in January 2022. The areas sampled included the following:

- DU-1 Seepage precipitation area – this area is readily delineated by the presence of carbonate precipitates that have accumulated along the bench west of the Lower Haul Road and the known areas where high pH groundwater discharges to the surface along the bench. High pH seepage is not uniform across this area, but discharges at clearly visible locations. DU-1 was established to target the areas where the high pH seepage water is or historically has discharged and flowed overland to the seepage collection ditch, and therefore these samples represent the areas of likely highest impact along the bench immediately west of the Lower Haul Road.
- DU-2 Historical overland flow area – Prior to construction of the seepage collection ditch, the high pH groundwater discharging along the bench flowed west and then northwest towards the “constructed wetlands”. The topography in this area, the clear presence of former flow paths, and the historical knowledge of personnel who observed the overland flow in this area allowed for relatively accurate delineation of the boundaries where the high pH water historically flowed. Historical infiltration of high pH water in this area potentially resulted in dissolution and adsorption of metals into the surficial soils. DU-2 samples targeted the surficial soils in this area to evaluate the concentration of metals present.

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- DU-3 South Pond – The South Pond is a man-made depression in the wooded area west of the south end of the seepage bench. Seasonally, when groundwater elevations rise during wet periods, high pH groundwater daylights in the South Pond. Visual observations for the last five years indicate that water seldom extends beyond the margins of the South Pond. When standing water is present within the pond, it results from rising and lowering groundwater, with minimal surface inflow or outflow of stormwater. Most of the year the pond does not contain standing water, as the groundwater is lower than the ground surface. Soils and sediments within the footprint of the South Pond were sampled to evaluate the concentration of metals precipitated from the rising and lowering high pH groundwater.

The locations of these three DUs are shown in Figure 3. In accordance with the procedures in the Work Plan's Sampling and Analysis Plan (Appendix D of the Work Plan), soil samples from DU-1, -2, and -3 were collected using Incremental Sampling Methodology (ISM). ISM is a structured composite sampling and processing protocol that is designed to reduce data variability and increase the representativeness for a specified volume of a given media being investigated (ITRC 2020).

The triplicate ISM sample analytical results for DU-1, DU-2, and DU-3 are summarized in Table 1, and are compared to several preliminary cleanup levels (PCULs) based on various exposure pathways. The applicability of the various exposure pathways and associated cleanup levels will be evaluated in the RI. Table 1 comparison conservately evaluates the detected concentrations to all potential exposure pathways, and indicates the following:

- Antimony soil concentrations reported in all three samples from DU-2 and one sample from DU-3 exceed natural background and PCULs based on soil protection of drinking water, soil protection of surface water, and ecological based on protection of plants. Concentrations reported do not the exceed human health direct contact PCUL.
- Arsenic is the only contaminant of potential concern (COPC) detected in any of the ISM soil samples at concentrations exceeding both the human health for direct contact and ecological PCULs for soil. Arsenic concentrations reported also exceed the PCULs for soil to drinking water, soil to surface water, and protection of sediment.
- Lead was detected in all the ISM soil samples at concentrations exceeding the ecological PSL but below the human health PSL. Lead concentrations were also below the PCULs for soil to drinking water, soil to surface water, and protection of sediment.
- Vanadium was detected all the ISM soil samples at concentrations exceeding the ecological PCUL but below the human health direct contact PCUL. Vanadium concentrations were also below the PCULs for soil to drinking water and protection of sediment.

The PCULs are numerical screening levels against which sample analytical data are compared for identifying constituents of concern during the Site RI, and to evaluate if the nature and extent of impacts to Site media have been determined. The data collected during the RI soil sampling indicated that additional soil sampling is needed to further delineate the extent of soil containing COPCs (antimony, arsenic, lead and vanadium) at concentrations exceeding the PCULs and to evaluate the concentrations of the COPC metals present in background soils of the immediate area. This Supplemental Work Plan presents the additional soil investigation tasks proposed to provide these additional data.

2.0 SUPPLEMENTAL SOIL SAMPLING

2.1 Delineation Around the Decision Units

As described in Section 1, DU-1, DU-2, and DU-3 were delineated, prior to sample collection, based on visual observations of topography, current surface flow of high pH water, daylighting of impacted groundwater, field pH screening of surface water throughout the Site, and Site historical knowledge of surface flow path of high pH seepage. Discrete soil sampling points, located outside each decision unit boundary, are proposed to provide empirical data to further delineate the extent of soil containing COPCs at concentrations exceeding the PCULs. The proposed sampling points around each decision unit are shown in Figure 4 and were selected based on the following data objectives:

- DU-1 – The areas where high pH groundwater seeps to the surface (both current seeps and historical seeps) along the bench west of the LDA are clearly visible as calcium carbonate precipitates have accumulated. The boundary of DU-1 sample area was established along that visually impacted area. Security fencing surrounds the seepage area. Soil samples will be collected north and south of DU-1. East and west of DU-1 are bounded by the Lower Haul Road and LDA to the west, and by the delineation that will occur around DU-2 and DU-3.

- DU-2 – The historical overland flow area is visually apparent based on the topography of the area and the historical observations of flow that occurred prior to completion of the seepage collection ditch and treatment system. The boundary of DU-2 was established along this historical flow area. A line of sampling points along the western edge (see Figure 4), extending along the north and south ends of DU-2, are proposed to evaluate if COPCs are present outside of the DU-2 boundary. The area east of DU-2 is delineated by the sampling completed for DU-1.

  In addition to delineating the lateral extent of COPCs in DU-2, discrete soil samples will also be collected within DU-2 to delineate the vertical extent of COPCs exceeding PCULs. The RI ISM soil samples were collected within the top 4-inches of soil. The surficial soils were targeted as likely containing the highest concentrations of COPCs from the dissolution of metals from the high pH water and adsorption of metals into the surficial soils. Discrete soil samples will be collected at a depth approximately 8 to 12 inches, at the sampling locations shown in Figure 4 within DU-2.

- DU-3 – The limits of the South Pond are apparent based on the soil berm that surrounds the pond and the visual observations of seasonal standing water where the high pH groundwater daylights to the surface. The South Pond is fully fenced. Soil samples will be collected around the outside perimeter of the South Pond fence as shown on Figure 4.

DU-1 and DU-3 both contain high pH groundwater at or near the surface that impacts the saturated soil media in these areas. Evaluation of subsurface risks in these areas in the RI/FS will be driven by the groundwater impacts, thus, deeper soil sampling is not needed at this time in DU-1 or DU-3.

2.2 Site-Specific Background Soil Sampling

The metals detected in the DUs are naturally present in the Site soils and can vary in concentrations depending on the composition of the soil. The concentrations of metals in surface soils can also be affected by anthropogenic activities that are not attributable to releases associated with the disposal of CKD at the Site. An evaluation of the site-specific background concentrations of COPC metals in soils located near the Site will be conducted. This

evaluation is intended to determine if local background soils may contain one or more of the COPC metals at concentrations exceeding PCULs.

The area selected for collection of background soil samples is shown in Figure 4. This area is anticipated to have soils that are of similar composition to Site soils but are in an area that cannot feasibly have been affected by releases from the Site. The Site topography and associated observations of surface flow paths of high pH water, known areas where impacted groundwater daylights, field pH screening of surface water throughout the Site, and Site historical knowledge of surface flow path of high pH seepage confirm that the area selected for background soil sampling cannot have been affected by releases from the Site. Additionally, the geophysics survey and the groundwater data from well MW-9A, confirm that groundwater impacts do not extend to the proposed background soil sampling area.

Consistent with the methods for defining background concentrations contained in Washington Administrative Code 173-340-709, 20 discrete soil samples will be collected from the background area for statistical determination of site-specific background. The samples will be collected from the top 4 inches of soil, which is consistent with the sample depth interval used for DU-1, DU-2, and DU-3.

3.0 SAMPLING METHODOLOGY

Soil sampling and analyses will be conducted in accordance with the procedures detailed in the Work Plan's Sampling and Analysis Plan and Quality Assurance Project Plan (Appendices D and E of the Work Plan). Except for the deeper soil samples collected in DU-2, soil samples will be collected from the top 4-inches of soil using hand-held stainless steel sampling tools. Soil sample analysis will include antimony, arsenic, lead, vanadium, total organic carbon, and pH. Soil samples will be shipped to ALS Environmental Laboratory located in Kelso, Washington for processing and analysis.

Golder Associates USA Inc.

Gary Zimmerman
Technical Principal

Frank Shuri, LG, LEG, PE
Senior Consultant

GZ/FS/ks

Distribution: See email distribution list

Attachments: Table 1 – Summary of Soil Laboratory Analytical Data – ISM Sampling
Figure 1 – Site Location Map
Figure 2 – Site Plan
Figure 3 – ISM Decision Units and Sampling Locations
Figure 4 – Delineation and Background Soil Sampling Locations

https://golderassociates.sharepoint.com/sites/119026/project files/6 deliverables/ri tech memos/2021 2022 soil and infil pond sediments sampling/2022-supp soil sampling wp/final-soil sampling work plan/2023-revised-supplemental soil/152030402-tm-rev1-supplemental soil-sampling work plan-20230120.docx

4.0 REFERENCES

Golder Associates Inc. (Golder). 2021. Remedial Investigation/Feasibility Study Work Plan, Reserve Silica Reclamation Site, Ravensdale, Washington. July 22.

Golder Associates Inc. (Golder). 2022. Remedial Investigation Soil and Infiltration Pond Sediment Sampling Results, Reserve Silica Reclamation Site, Ravensdale, Washington. August 11.

Interstate Technology and Regulatory Council (ITRC). 2020. Technical and Regulatory Guidance: Incremental Sampling Methodology (ISM) Update. ISM-2. October.

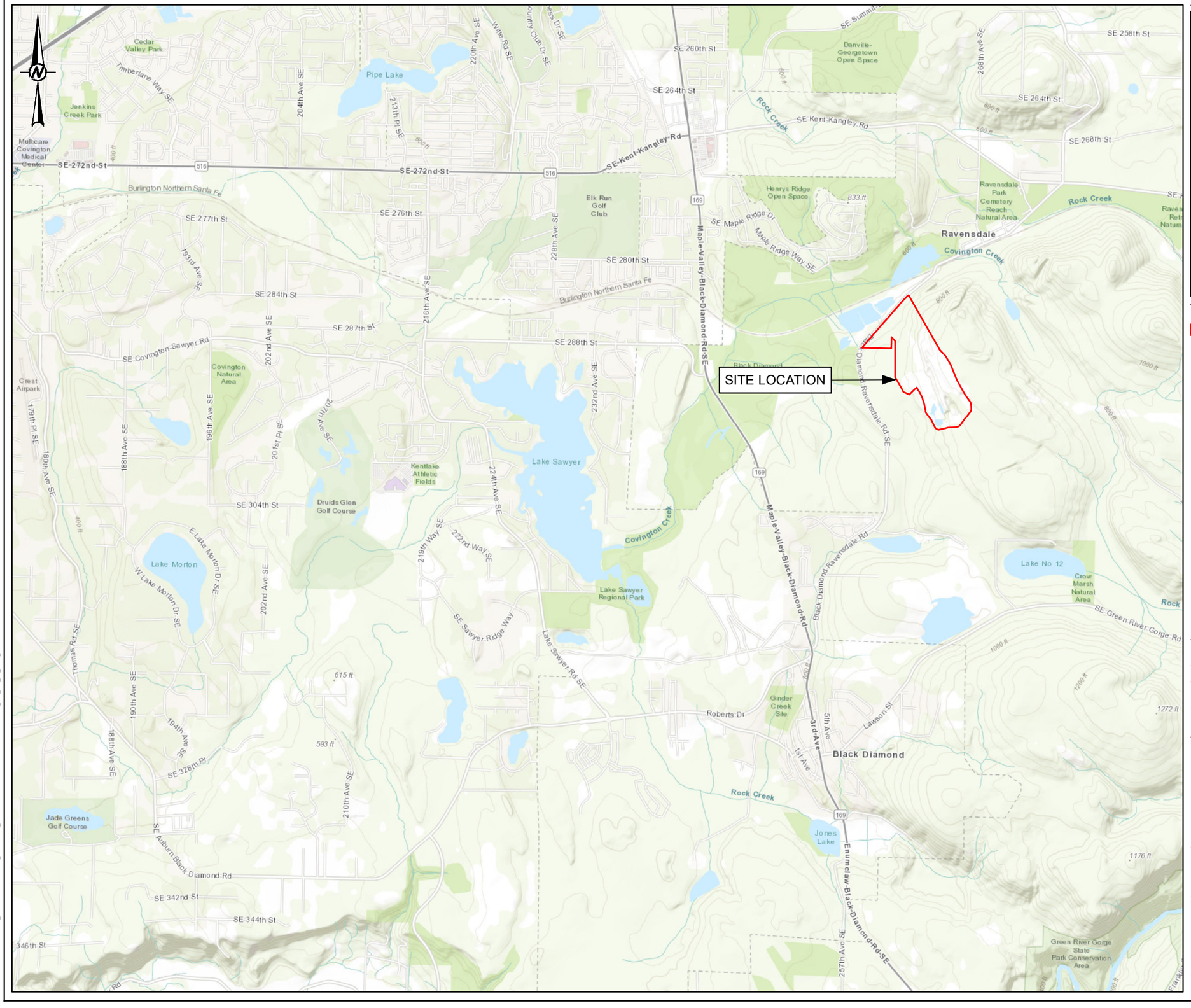
Table

Table 1: Summary of Soil Laboratory Analytical Data - ISM Sampling

							Decision Unit ID	**DU-1 (seep area)**			**DU-2 (historical flow area)**			**DU-3 (South Pond)**	
							Sample ID	**ISM1**	**ISM2**	**ISM3**	**ISM1**	**ISM2**	**ISM3**	**ISM1**	**ISM2**	**ISM3**
							Collection Date	**10/19/2021**	**10/19/2021**	**10/19/2021**	**1/25/2022**	**1/25/2022**	**1/25/2022**	**10/19/2021**	**10/19/2021**	**10/19/2021**
	Preliminary Cleanup Levels (PCULs) in mg/kg															
Analyte	Direct Contact	Protection of Drinking Water Vadose Zone	Soil Protect Surface Water Vadose Zone	Protect Sediment Vadose Zone	TEE Eco. Indic. Soil Conc. Unrestricted Land Use	Natural Background Ecology (1994)										
Antimony (mg/kg)	32	5.42	5.06	1233	5	-		0.879	0.916	0.86	14.3 J-	14.3	13.4	5.47 J-	4.37	4.94
Arsenic (mg/kg)	0.67	0.34	0.01	219	7	7.3		65.2	44.4	39.8	87.9	98.8	86.9	58.6	45.6	52.7
Lead (mg/kg)	250	3000	503	420	50	17		63.8	64.5	56.1	120	145	130	178	176	164
Vanadium (mg/kg)	720	2881	-	5957	2	-		13.5	14.5	12.3	12.8	15.1	13.8	27.4	25.1	27.2
Total Solids	-	-	-	-	-	-		99.6%	99.6%	99.5%	99.3%	99.2%	99.1%	96.7%	94.7%	98.2%
Total Organic Carbon	-	-	-	-	-	-		0.566%	0.883%	0.918%	2.21%	1.76%	1.55%	2.73%	2.73%	1.54%
pH	-	-	-	-	-	-		9.23 J	8.46 J	9.86 J	8.27 J	8.14 J	8.25 J	8.63 J	8.46 J	8.81 J

Notes:
J-: Analyte concentration estimated and potentially biased low.
J: Analysis exceeded recommended hold time.
PCULs: Preliminary Cleanup Level: Ecology Provided PCULs tables dated 30 September 2022
Indicates result exceeds at least one of the PCULs and is above natural background
" -" Screening Level not available
mg/kg: milligram per kilogram
Ecology 1994 - Natural Background Soil Metals Concentrations in Washington State; October 1994, Publication #94-115

Figures



KEY MAP

LEGEND

Property Boundary

0 3,000 6,000

1 " = 3,000 FEET FEET

REFERENCE(S)

1. ASPECT CONSULTING (PROPERTY BOUNDARY)
2. ESRI (WASHINGTON STATE COUNTY BOUNDARY)
3. COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON NORTH FIPS 4601 FEET
4. MAP SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY

CLIENT
HOLCIM

PROJECT
RI WORK PLAN 2020
RAVENSDALE, WA

TITLE
SITE LOCATION MAP

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2021-02-10
DESIGNED	TL
PREPARED	TL
REVIEWED	JX
APPROVED	GZ

PROJECT NO.	PHASE	REV.	FIGURE
152030420	004	A	1

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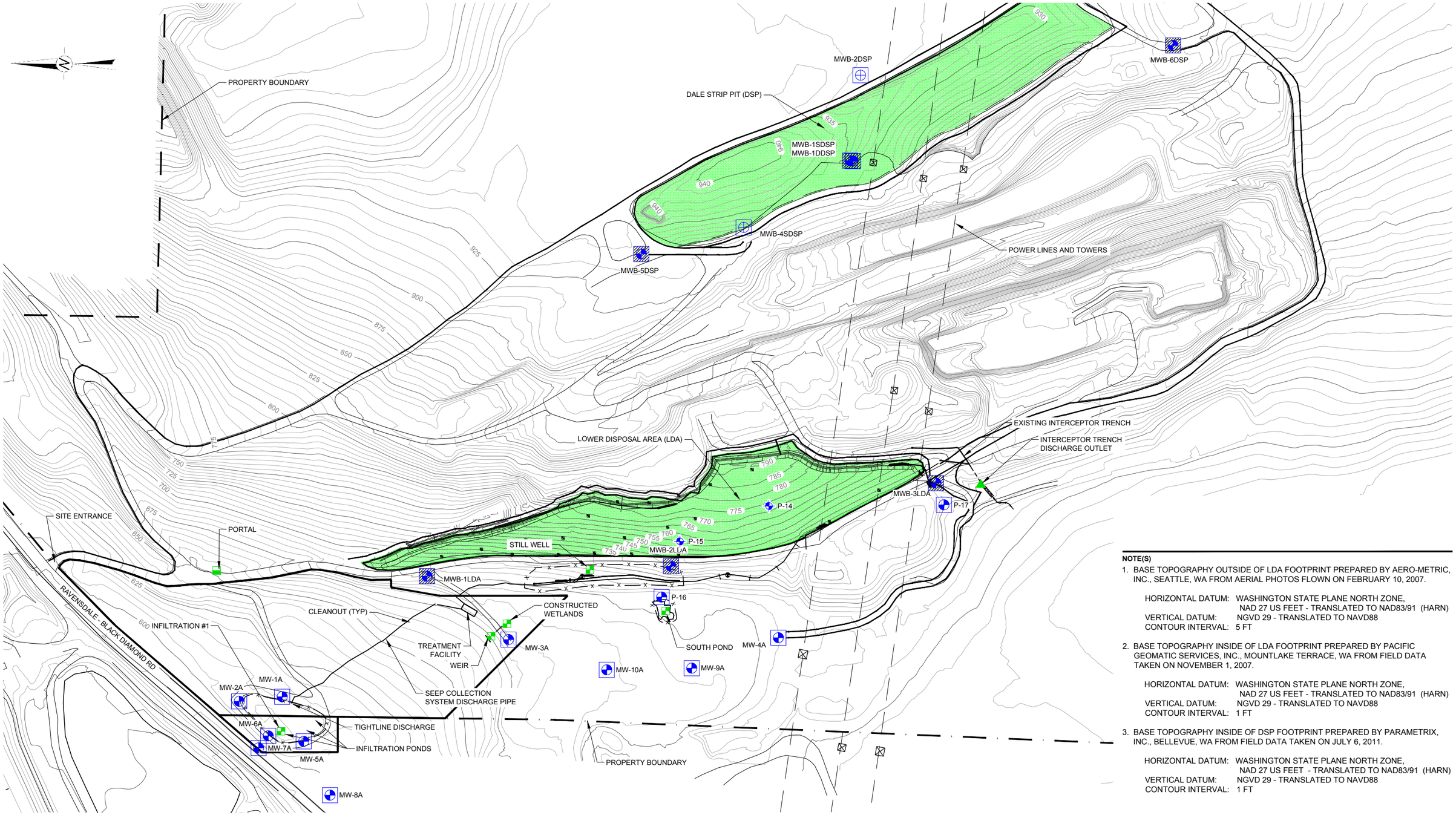

LEGEND

- COVER AREA
- MW-1A — ALLUVIAL MONITORING WELL
- MWB-1DDSP — BEDROCK MONITORING WELL
- MWB-2DSP — BEDROCK MONITORING WELL (NOTE 4)
- DISPOSAL AREA MONITORING WELL
- LDA SURFACE WATER SAMPLING LOCATION
- DSP BEDROCK SAMPLING LOCATION (PORTAL)
- INTERCEPTOR TRENCH SAMPLING LOCATION
- FENCE LINE

0 150 300
1" = 150' FEET

NOTE(S)

1. BASE TOPOGRAPHY OUTSIDE OF LDA FOOTPRINT PREPARED BY AERO-METRIC, INC., SEATTLE, WA FROM AERIAL PHOTOS FLOWN ON FEBRUARY 10, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET - TRANSLATED TO NAD83/91 (HARN)
   VERTICAL DATUM: NGVD 29 - TRANSLATED TO NAVD88
   CONTOUR INTERVAL: 5 FT
2. BASE TOPOGRAPHY INSIDE OF LDA FOOTPRINT PREPARED BY PACIFIC GEOMATIC SERVICES, INC., MOUNTLAKE TERRACE, WA FROM FIELD DATA TAKEN ON NOVEMBER 1, 2007.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET - TRANSLATED TO NAD83/91 (HARN)
   VERTICAL DATUM: NGVD 29 - TRANSLATED TO NAVD88
   CONTOUR INTERVAL: 1 FT
3. BASE TOPOGRAPHY INSIDE OF DSP FOOTPRINT PREPARED BY PARAMETRIX, INC., BELLEVUE, WA FROM FIELD DATA TAKEN ON JULY 6, 2011.
   HORIZONTAL DATUM: WASHINGTON STATE PLANE NORTH ZONE, NAD 27 US FEET - TRANSLATED TO NAD83/91 (HARN)
   VERTICAL DATUM: NGVD 29 - TRANSLATED TO NAVD88
   CONTOUR INTERVAL: 1 FT

CLIENT
HOLCIM

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-01-20
DESIGNED	JX
PREPARED	REDMOND
REVIEWED	JX
APPROVED	GZ

PROJECT
RI WORK PLAN 2020
RAVENSDALE, WA

TITLE
SITE PLAN

PROJECT NO.	PHASE	REV.	FIGURE
152030420	004	A	2

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LEGEND

- Sampling Location
- Decision Unit
- Treatment Tank
- South Pond
- Site Boundary
- Parcel

0 100 200

1 " = 100 FT FEET

REFERENCE(S)

1. GOLDER (DECISION UNITS, SAMPLING LOCATIONS, TREATMENT TANK)
2. ASPECT CONSULTING (SITE BOUNDARY, PARCEL)
3. COORDINATE SYSTEM: NAD 1983 STATEPLANE WASHINGTON NORTH FIPS 4601 FT US
4. MAP SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, INTERMAP, INCREMENT P CORP., GEBCO, USGS, FAO, NPS, NRCAN, GEOBASE, IGN, KADASTER NL, ORDNANCE SURVEY, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT
HOLCIM

PROJECT
RI 2021 AND 2022 ISM AND INFILTRATION POND SAMPLINGRAVENSDALE, WA

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2022-05-26
DESIGNED	TL
PREPARED	MK/MR
REVIEWED	JX
APPROVED	GZ

TITLE
ISM DECISION UNITS AND SAMPLING LOCATIONS

PROJECT NO.	PHASE	REV.	FIGURE
152030402	004	0	3

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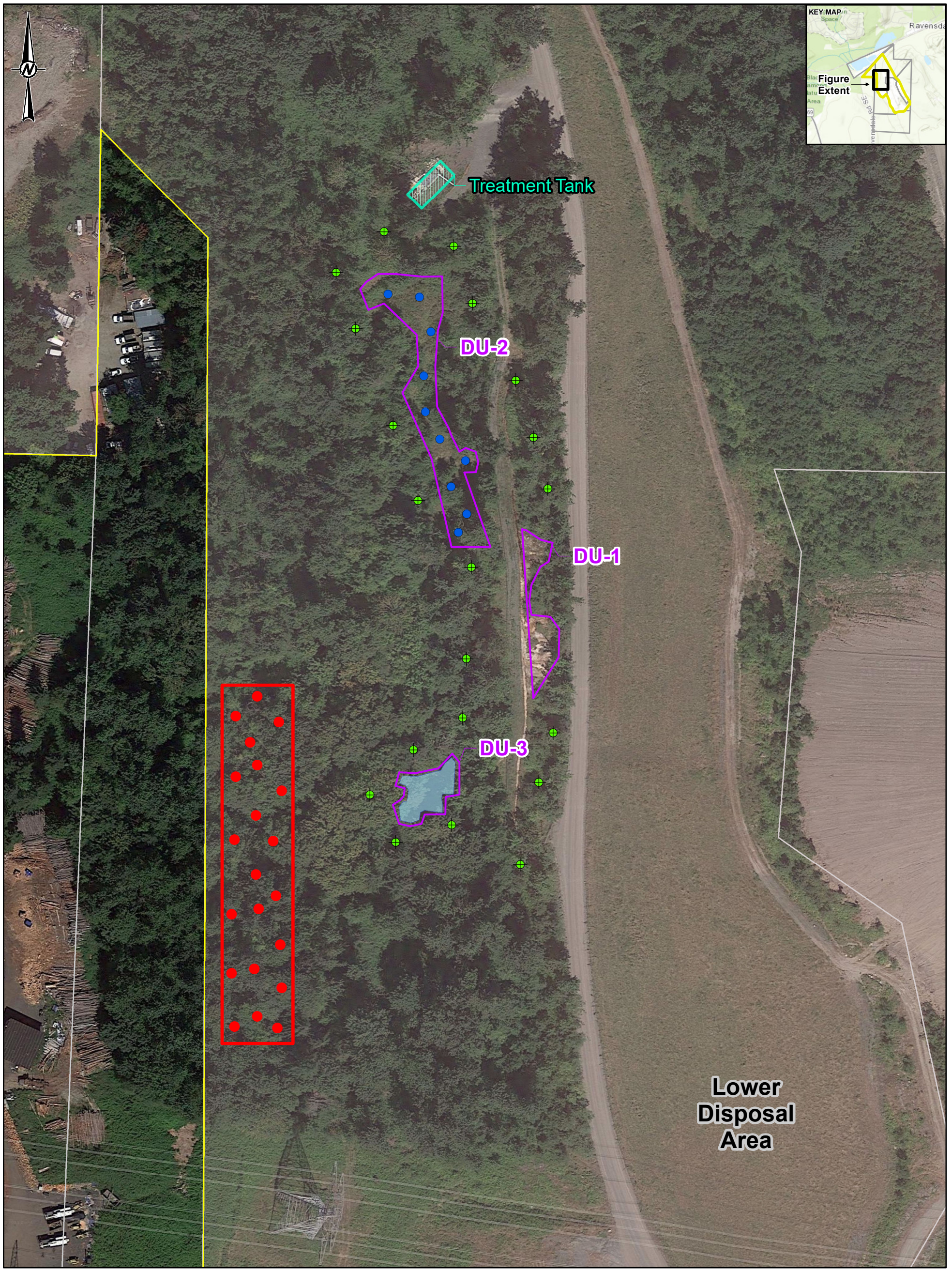

LEGEND

- DU-2 Deeper Soil Sampling Location
- Approximate Delineation Soil Sampling Locations
- Area Background Soil Sample Locations
- Background Area
- Decision Unit
- Treatment Tank
- South Pond
- Parcel
- Site Boundary

0 100 200

1 " = 100 FT FEET

REFERENCE(S)

1. GOLDER (DECISION UNITS, SAMPLING LOCATIONS, TREATMENT TANK)
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CLIENT
HOLCIM

PROJECT
RI SUPPLEMENTAL SOIL SAMPLING RAVENSDALE, WA

CONSULTANT
wsp

YYYY-MM-DD	2023-01-12
DESIGNED	TL
PREPARED	MK
REVIEWED	JX
APPROVED	GZ

TITLE
DELINEATION AND BACKGROUND SOIL SAMPLING LOCATIONS

PROJECT NO.	PHASE	REV.	FIGURE
152030402	004	0	4

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