environmental
properties management, LLC

May 25, 2018

Mr. Ken Kalman
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852-2738

Mr. Paul Davis
Oklahoma Department of Environmental Quality
707 North Robinson
Oklahoma City, OK 73101

Mr. Robert Evans
U.S. Nuclear Regulatory Commission
1600 East Lamar Blvd; Suite 400
Arlington, TX 76011-4511

Re: Docket No. 70-925; License No. SNM-928
Notes from May 16-17 Meetings on 2017 Pilot Test and 1206 Drainage Evaluation

Dear Sirs:

Environmental Properties Management LLC (EPM) met with the US Nuclear Regulatory Commission (NRC) and the Oklahoma Department of Environmental Quality (DEQ) on May 16th and 17th, 2018. The purposes of the meetings were to:

- Familiarize key agency personnel with the Pilot Test construction and testing work performed in 2017 and 2018,
- Familiarize key agency personnel with assessment work performed in the 1206 Drainages, compiling historic assessment information with information obtained in January 2018,
- Summarize the information obtained in the above-mentioned efforts, and
- Describe how the information obtained results in a revision of the groundwater remediation strategy and the design of groundwater remediation components.

May 16 Site Tour

A tour was conducted at the Cimarron site on May 16th to familiarize agency personnel with the construction work performed and the infrastructure that is now present at the site. All the infrastructure installed for the Pilot Test will be incorporated into the full-scale groundwater remediation system as described in the Decommissioning Plan. The Pilot Test provided valuable groundwater remediation infrastructure constructability and performance data that will be used to optimize the full-scale design. Understanding the work performed, the information obtained, and how that information informed the revision of the groundwater remediation infrastructure design is key to technical review of the Decommissioning Plan.

An agenda for the May 16th site tour is included in these notes as Attachment 1. Agency personnel were not on-site when construction was taking place, so photographs of the construction and installation of Pilot Test trenches were provided. Copies of those photographs are provided as Attachment 2.

Following the site tour, Enercon Services presented an overview of the series of enrichment calculations performed over the past two years to explain the basis for and justification of:

- Maximum enrichment values used for nuclear criticality safety assessment,
- Assumed enrichment values for influent to treatment facilities, and
- Control of uranium and U-235 inventory.

Copies of the presentation slides used for this presentation are provided as Attachment 3.

May 17 Meeting

Meetings were conducted in Oklahoma City on May 17th to provide more detailed information on:

- Trench construction and infrastructure installation issues identified during the Pilot Test,
- Extraction test results for Extraction Trench GETR-BA1-01,
- Sequence stratigraphic analysis, 3-dimensional modeling, and effective porosity assessment for Burial Area #1 (BA1) transition zone material triggered by evaluation of information obtained from the GETR-BA1-01 extraction test,
- Injection test results for Injection Trench GWI-BA1-01 in BA1,
- The impact of the extraction and injection tests and analysis of transition zone deposits on the design of groundwater remediation infrastructure in BA1,
- Injection test results for Injection Trench GWI-UP2-01 in the Uranium Pond #2 (UP2) Area, and the impact of the injection test results on the design of infrastructure for the UP2 Area,
- Injection test results for Injection Trenches GWI-UP1-01 and GWI-UP1-02 in the Uranium Pond #1 (UP1) Area, and the impact of the injection test results on the design of infrastructure for the UP1 Area,
- The assessment of sediment in the 1206 Drainages and the impact of that assessment on the plan for remediation of groundwater in the 1206 Drainages, and
- The layout of relocated treatment facilities and modifications to the biodenitrification processes.

The following summarizes the information presented and the resulting changes to the groundwater remediation and water treatment plans for the site. The agenda for these meetings are provided as Attachment 4. Copies of the presentation slides on the results of the Pilot Test and the 1206 assessment are provided as Attachment 5.

Pilot Test Accomplishments

The Pilot Test provided sufficient information to enable the design team to optimize the design of groundwater remediation infrastructure in BA1 and the UP1 and UP2 Areas. It also

significantly reduced the uncertainties associated with groundwater flow models developed for both transition zone and fractured sandstone formations.

Information was provided showing that the Pilot Test was completed well within the agency-approved budget. There were no recordable safety incidents and no measurable radiation dose to anyone working on site through Pilot Test construction and testing activities. A summary schedule for Pilot Test construction and testing activities was presented.

Burial Area #1 (BA1)

The construction and testing of both the extraction and injection trenches in BA1 was reviewed, as well as information on the installation of monitor wells. Monitor wells were installed to replace those that were abandoned as well as to monitor injection and extraction tests.

Extraction Trench Testing

Groundwater flow modeling conducted during 60% design development produced an estimated extraction rate of 30 gallons per minute (gpm) for Extraction Trench GETR-BA1-01, constructed within the transition zone deposits. A step-rate drawdown test performed in GETR-BA1-01 indicated that a constant-rate pump test could be conducted at 16 gpm. However, a constant-rate pump test conducted at 16 gpm dewatered the trench within approximately 8 hours, prior to achieving steady-stated conditions.

The pump test did provide sufficient information to calculate aquifer parameters within an order of magnitude, and to estimate a maximum capture zone of 50 – 60 feet from the trench (wider to the north and narrower to the south). There was good correlation between distance-drawdown and time-drawdown results.

Injection Trench Testing

Groundwater flow modeling conducted during 60% design development produced an estimated injection rate of 10 gallons per minute (gpm) for Injection Trench GWI-BA1-01, constructed in Sandstone A. Injection testing yielded a steady state injection rate of 10.2 gpm, and head response was observed in all downgradient and upgradient monitor wells. Both groundwater elevation and dye testing indicated that not only do the backfilled BA1 disposal trenches ***not*** represent preferential flow paths, but they are less permeable than the surrounding Sandstone A formation. This means that injected treated water will preferentially flush the sandstone in which uranium-impacted groundwater is present. Injection testing also indicated that the hydraulic influence induced by injection into GWI-BA1-01 likely extends to the transition zone deposits.

Design Implications

The lower than anticipated extraction trench pumping rate demonstrated that the BA1 transition zone is less permeable than previously indicated by groundwater flow modeling. This prompted further assessment of the BA1 transition zone deposits and refinement of the porosity used in previous remediation duration estimates (20%). Review of uranium concentration data for subsurface soil, along with lithological logs, demonstrated that uranium in both soil groundwater is contained within higher permeability strata deposited within the transition zone lithological unit.

Environmental sequence stratigraphy (ESS) analysis and 3-dimensional modeling (using Earth Volumetric Studio® [EVS]) was performed using existing site lithological data. These analyses resulted in a significantly developed 3-dimensional stratigraphic model of the BA1 transition zone deposits. Volume estimates for specific stratigraphic units, generated by the EVS model, and published effective porosity estimates for specific soil types were used to calculate a transition zone ***transmissive porosity*** of approximately 11%.

The lower than anticipated extraction trench pumping rate also prompted the addition of a second BA1 extraction trench in the northwestern portion of the transition zone. Adding this trench will increase the anticipated transition zone extraction rate from 10 – 13 gpm to approximately 20 gpm. A second trench will also facilitate the cycling of groundwater recovery between trenches to enhance recovery of uranium that would otherwise be "stranded" in the vadose zone. This is in an important feature since drawdown in the vicinity of the extraction trenches is likely to be significant, even at the lower than anticipated pumping rates. Because the reduction in transmissive pore volume exceeds that of the extraction rate, the transition zone will likely remediate more quickly than estimated in the 2015 *Facility Decommissioning Plan*. However, the BA1 transition zone is still anticipated to be the schedule driver for decommissioning.

The injection test demonstrated that the extraction trench planned for Sandstone B will not be necessary. Extraction Trench GETR-BA1-02 was to be constructed in Sandstone B northeast of the injection trench to enhance the hydraulic gradient in the sandstone. Because the influence of water injection likely extended to the transition zone, and the design injection rate was achieved without downgradient extraction, this gradient enhancement will not be needed.

The design team will also be evaluating options for relocating and/or extending Injection Trench GWI-BA1-02 to enhance the flushing of Sandstone A into the transition zone deposits.

<u>Uranium Pond #2 (UP2)</u>
The construction and testing of the easternmost 175 feet of Injection Trench GWI-UP2-01 in the UP2 Area was reviewed, as well as information on the installation of monitor wells. Monitor wells were installed to monitor the injection test.

Injection Trench Testing
Groundwater flow modeling produced an estimated injection rate of 2 – 5 gallons per day (gpd) per square foot (ft^2) of saturated trench wall for Injection Trench GWI-UP2-01, constructed in Sandstone A. Injection testing yielded a steady state injection rate of 12 gpm, which represents an injection rate of 12 gpd per ft^2 of trench wall. Head response was observed in all downgradient wells as well as in the upgradient monitor well. The installation of the liner on the south face of the trench did not appear to have a significant influence on the upgradient influence of the injection.

Design Implications
The results of injection testing demonstrate that the two north-trending lateral trenches in GWI-UP2-01 will not be needed. The northernmost ~200 feet of Injection Trench GWI-UP2-04 will also not be needed. All of these will be removed in *Facility Decommissioning Plan – Rev 1*. A cost/benefit analysis was performed for liner installation, and the cost to install the liner is

approximately $270,000 if installed along all 800 feet of injection trench that will still be installed in the UP2 Area.

It was also determined that the rate-limiting factor for injection is ***not*** the acceptance rate for Sandstone A; it is the rate at which the groundwater extraction wells installed along the bluff can capture the groundwater being flushed from the UP2 Area through Sandstone A.

Uranium Pond #1 (UP1)

The construction and testing of Injection Trenches GWI-UP1-01 and GWI-UP1-02 in the UP1 Area was reviewed, as well as information on the installation of monitor wells. Monitor wells were installed to monitor the injection test as well as add to the limited lithologic and contaminant concentration information available in the UP1 Area.

Injection Trench Testing

Groundwater flow modeling conducted during 60% design development produced an estimated injection rate of 1 – 2 gpd per square foot (ft^2) of saturated trench wall for the injection trenches constructed in Sandstone A. Injection testing yielded a steady state injection rate of 30 gpm, which represents an injection rate of 4 gpd per ft^2 of trench wall. Head response was observed in all downgradient monitor wells. Dye testing indicated that preferential flow pathways are present and exert significant influence on the distribution of injected water.

Design Implications

The results of injection testing demonstrate that Injection Trenches GWI-UP1-04 and GWI-UP1-06, and approximately half of GWI-UP1-05, will not be needed. Also, Injection Trench GWI-UP1-03 will not need to extend to the northwest as far as design drawings had originally indicated. Numbered GWI trenches were not shown in the 2015 *Facility Decommissioning Plan* but were identified in pilot test design drawings.

It was also determined that the rate-limiting factor for injection is ***not*** the acceptance rate for Sandstone A; it is the rate at which the groundwater extraction wells installed along the bluff can capture the groundwater being flushed from the UP1 Area through Sandstone A.

1206 Drainage

The location of the 1206 Drainage and the clearing work that was performed in the 1206 West Drainage was presented. It was noted that the duration of remediation was not calculated for this area because the uncertainties associated with defining the flow path and the characteristics of the sediment in the drainage are too great to provide for even order-of-magnitude calculations.

It is now known that groundwater in Sandstone A which discharges to the 1206 West Drainage complies with the MCL for uranium. However, groundwater collected from a drive-point piezometer advanced in the western portion of the 1206 Confluence yielded uranium at a concentration that exceeds both the MCL and the NRC criterion for uranium.

Assessment of sediment thickness in the 1206 West Drainage indicates that approximately 140 cubic yards (cy) of sediment are present from the southern extent of the drainage to the 1206 Confluence.

Assessment of the volume of sediment in the 1206 East Drainage indicates that approximately 2,000 cy of sediment are present from the southern extent of the drainage to the 1206 Confluence.

After excavation of the sediment, Extraction Trench GETR-WAA-01 will be relocated to the south to provide for approximately equal recovery of groundwater from areas north and south of the trench. This is expected to minimize the time needed to remediate groundwater within the thicker sediments in the 1206 Confluence and will significantly reduce the risk associated with remediation of the 1206 Drainages.

Water Treatment

BA1 Water Treatment Facility

Little has changed from the layout or treatment process presented in the 2015 *Facility Decommissioning Plan*. The facility layout was presented, and a brief description of the treatment process was provided.

Western Area Treatment Facility (WATF)

The decision was made to relocate the WATF both to facilitate construction and to circumvent difficulties that would be encountered if renovation was required for the UP1 injection trenches. Also, Veolia Water Technologies has proposed to use a different biodenitrification reactor configuration, part of which will require the use of tall vertical bioreactor tanks. The new configuration and the blending of the influent from both western area groundwater recovery lines greatly simplifies and reduces the cost of operation and maintenance of the groundwater treatment system.

The layout of the WATF and the arrangement of offices, treatment systems, waste processing systems, and the secure storage facility for packaged spent resin was presented. Copies of the slides on the treatment of groundwater are provided as Attachment 6.

Summary

More detailed information on the assessment of the BA1 transition zone, as well as a description of the impact of this assessment to the remediation strategy for this area, was presented in a technical memorandum submitted to the NRC and the DEQ on April 6, 2018.

More detailed information on the assessment of the 1206 Drainages, as well as a revised remediation strategy for the area, was presented in a technical memorandum submitted to the NRC and the DEQ on April 2, 2018.

More detailed information on the Pilot Test trench construction, testing, and design implications will be presented in a report on the Pilot Test, which is scheduled to be submitted within the next few weeks.

The site tour conducted May 16th, and the meetings conducted May 17th, provided familiarization with work performed as well as the technical basis for the revisions to the groundwater remediation plan that will be presented in *Facility Decommissioning Plan – Rev 1*.

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Pilot test data will be provided to the NRC and the DEQ in native files so that agency personnel can evaluate the data independently as desired. In addition, EPM will provide the NRC and the DEQ a table listing each section of the decommissioning plan, and identifying which sections contain only editorial revisions, and which sections are being revised to change the substance of the groundwater remediation design.

Should you have questions or desire clarification of these notes, please contact me at jlux@envpm.com or at 405-642-5152.

Sincerely,

Jeff Lux
Project Manager

Cc: NRC Public Document Room (electronic copy only)

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ATTACHMENT 1
MAY 16, 2018 AGENDA

Cimarron Environmental Response Trust
Project Meeting Agenda
May 16, 2018

1. Burial Area #1
   - Installing silt fence
   - Removing trees – transfer to south of 100-yr floodplain
   - Abandoning monitor wells
   - Finding and excavating from clay borrow area
   - Mixing slurry for GETR-BA1-01
   - Constructing HDPE "infrastructure" for GETR-BA1-01
   - Extraction Trench GETR-BA1-01 construction
   - Injection Trench GWI-BA1-01 construction
   - Pilot trench injection and extraction testing
   - BA1 Treatment Facility location and layout

2. Uranium Pond #2
   - Excavating bench
   - Impacted soil storage area preparation
   - Staging of impacted soil
   - Excavation to depth – measuring depth – staging spoils to the southeast
   - Scouring of north wall of trench
   - Hanging liner on south wall of trench
   - Assembling and installing wells in trench
   - Backfilling with gravel
   - Placing fabric and backfilling with impacted soil to bench
   - Backfilling bench with clean spoils
   - Installing monitor wells 1401 – 1403
   - Placing topsoil and hydro-mulch
   - Transferring frac tanks and filling with potable water
   - Injection testing

3. Dry Detention Basin

4. Western Area Treatment Facility – Site and Layout
   - Offices
   - Influent tank, acid tanks
   - Uranium treatment – resin processing
   - Biodenitrification – solids processing
   - Effluent tank
   - Secure Storage Facility

5. Uranium Pond #1
   - Excavating bench

- Scan and remove non-native material
- Impacted soil storage area preparation
- Staging of impacted soil
- Excavation to depth – measuring depth – staging spoils to the dry detention basin
- Assembling and installing wells in trenches
- Backfilling with gravel
- Placing fabric and backfilling with impacted soil to bench
- Backfilling bench with clean spoils
- Installing monitor wells
- Placing topsoil and hydro-mulch
- Transferring frac tanks and filling with potable water
- Injection testing

6. 1206 East Drainage Remediation Plan
   - Remove sediment to NW corner of UP1
   - Install pipe and gravel
   - Terminate pipe in infiltration gallery
   - Locate GETR-WAA-01 to maximize recovery from transition zone material, minimize recovery from alluvium
   - Mix sediment with clean spoils in UP2 laydown area

7. 1206 West Drainage – Go to north end of road
   - Remove sediment to end of erosion control fabric
   - Locate GETR-WAA-01 to maximize recovery from transition zone material, minimize recovery from alluvium
   - Mix sediment with clean spoils in UP2 laydown area

8. Describe Extraction Wells in Western Alluvial Area

9. Enrichment Calculations

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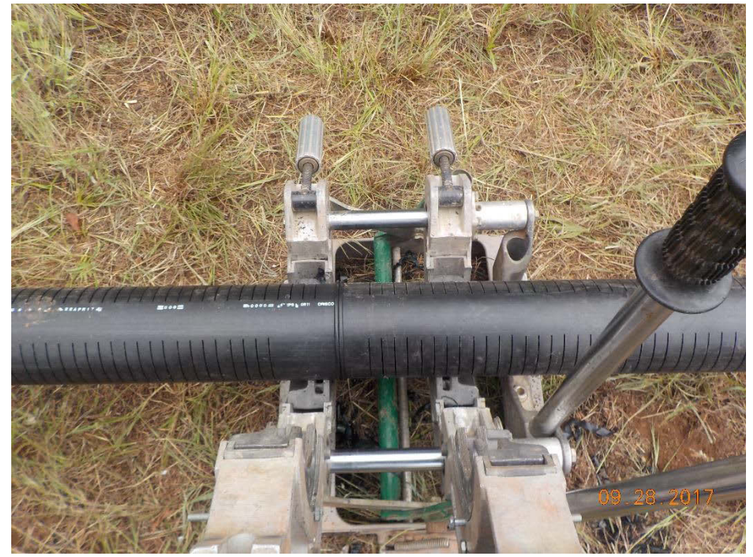
ATTACHMENT 2
SITE TOUR HANDOUTS

Burial Area #1 Groundwater Extraction Trench GETR-BA1-01

1 - Constructing a Working Platform



2 – Welding Lateral Pipe

3 – Mixing Slurry for Frac Tanks

4 – Starting Excavation

5 – Hanging Wells, Sumps & Lateral Pipe

6 – Excavating Through Slurry

Burial Area #1 Groundwater Extraction Trench GETR-BA1-01

7 – Backfilling Trench While Pumping Slurry

8 – Placing Topsoil

9 – Rolling Topsoil to Final Grade

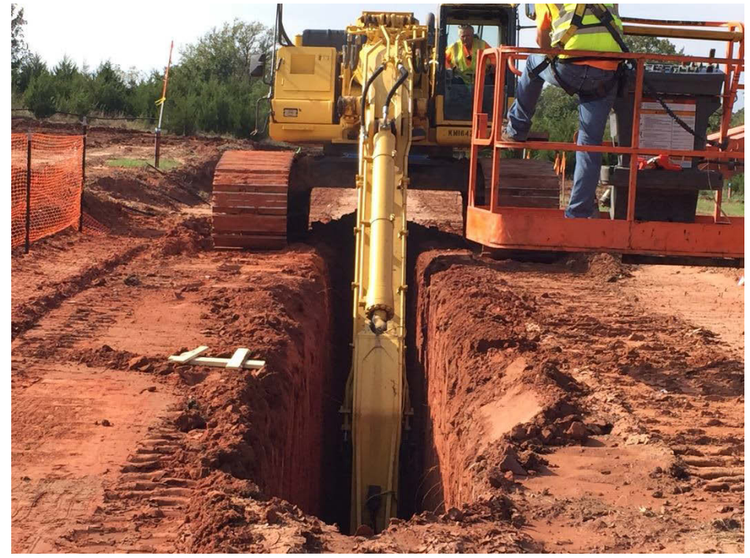
10 – Replacing Road

11 – Grading for Drainage

12 – Setting Up for Pump Test

Burial Area #1 Groundwater Injection Trench GWI-BA1-01

1 – Constructing the Bench



2 – Excavating

3 – Measuring Trench Depth

4 – Hanging a Well in the Trench

5 – Positioning the Well

6 – Backfilling with Gravel

Burial Area #1 Groundwater Injection Trench GWI-BA1-01

7 – Gravel up to Design Depth

8 – Fabric on Top of Gravel

9 – Backfill to Final Grade

Monitor Well Installation

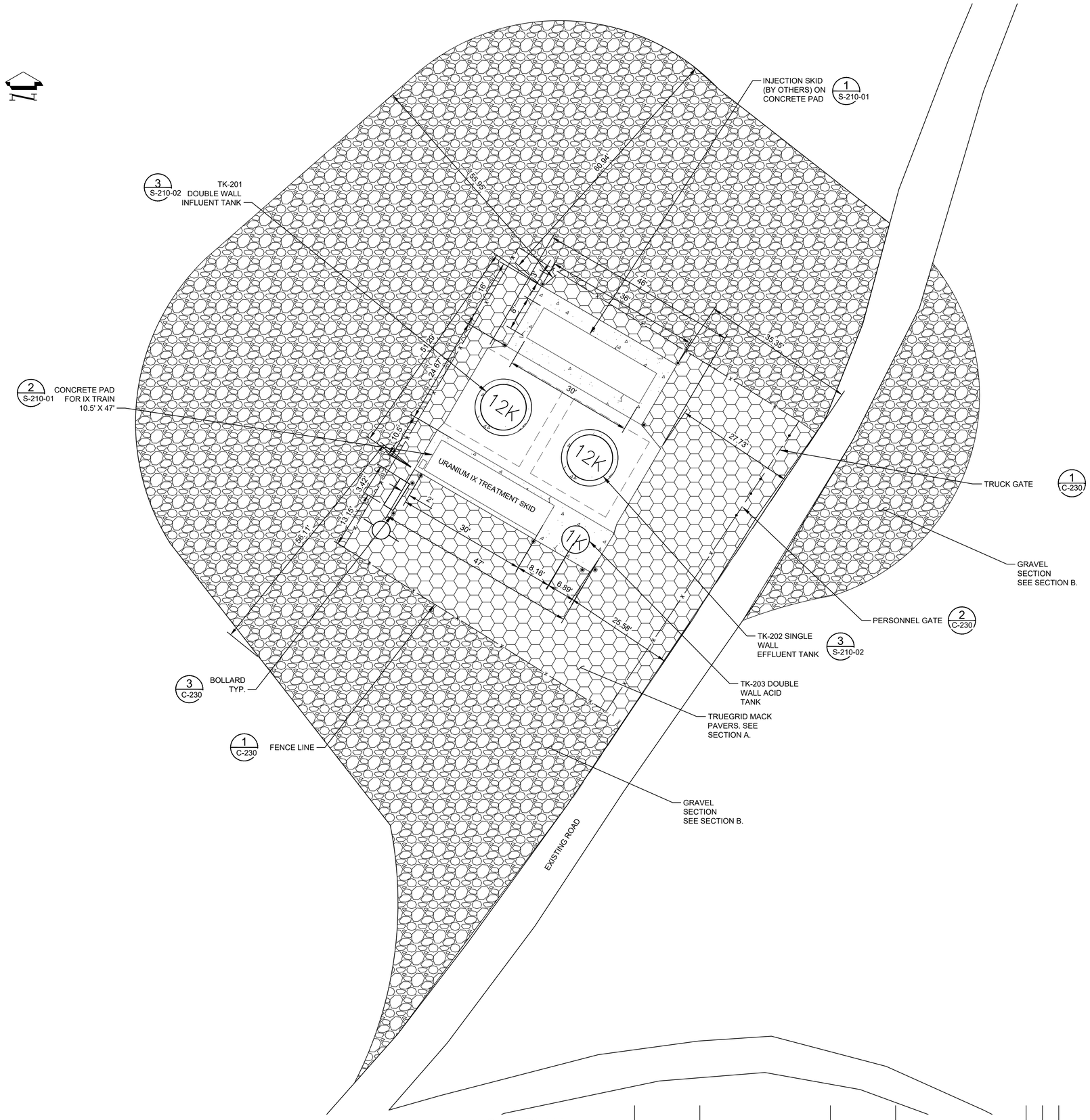
1 – Drilling Rig Set Up in Burial Area #1

2 – Extruded Samples on Slide

3 – Samples from One Boring

4 – Burial Area #1 Soil Samples

5 – Monitor Well Completion



SITE PLAN

SCALE: 1" = 10'-0"

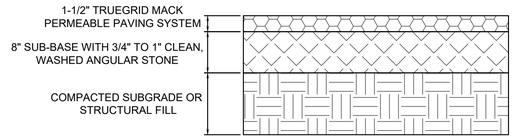
0 10 20 Feet

GENERAL NOTES:

1. SEE K-EPM-DWG-C-201 FOR CIVIL NOTES.
2. SEE K-EPM-DWG-C-220 FOR SITE GRADING PLAN AND UTILITY PLAN.
3. SEE K-EPM-DWG-S-201 FOR STRUCTURAL NOTES.

TANK INFORMATION NOTES:

1. 12,000 GALLON TANK DIMENSIONS:
   DIAMETER = 10'-5" (126")
   HEIGHT = 18'-0" (216")
2. 1,100 GALLON TANK DIMENSIONS:
   DIAMETER = 6'-4" (76")
   HEIGHT = 8'-9" (105")

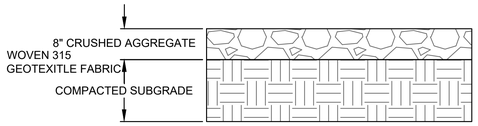


TRUEGRID MACK NOTES:

1. FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF TRUEGRID PRODUCT
2. USE $\frac{3}{8}$" TO $\frac{3}{4}$" AGGREGATE FOR GRAVEL FILL-IN OF GRID.

TRUEGRID MACK PAVING SECTION A

SCALE: NONE



NOTES:

1. FOLLOW MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION OF GEI WORKS WOVEN 315 OR EQUIVALENT GEOFABRIC PRODUCT.

GRAVEL SECTION B

SCALE: NONE

IN-PROCESS
60% DESIGN PACKAGE UPDATE
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Richland, WA 99352
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DRAWN BY D NELSON		VNSFS
ENGINEER D NELSON		VNSFS
PROJ ENG R RASMUSSEN		VNSFS
PROJECT MANAGER J LUEY		VNS
DESIGN AUTHORITY		

CIMARRON
PUMP AND TREAT SYSTEM PROJECT

BURIAL AREA #1
SITE PLAN

SIZE	DWG NO	REV
F	K-EPM-DWG-C-210	A

SCALE SHOWN EDT SHEET 1 OF 1

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	
		NEXT USED ON	

MFD REV REL	REV NO	DESCRIPTION	REV BY DATE	ENGR COMPANY
REVISIONS				

DWG NO K-EPM-DWG-C-210 SH 1 OF 1 REV A

Uranium Pond #2 Groundwater Injection Trench GWI-UP2-01

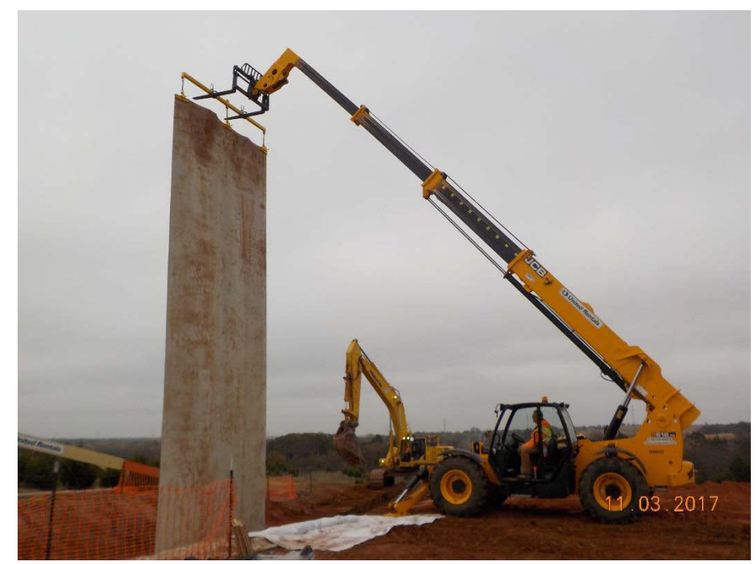
1 – Constructing the Bench

2 – Excavating

3 – Segregating Impacted Soil

4 – Excavating to Depth

5 – Scouring the North Wall



6 – Hanging Liner on South Wall

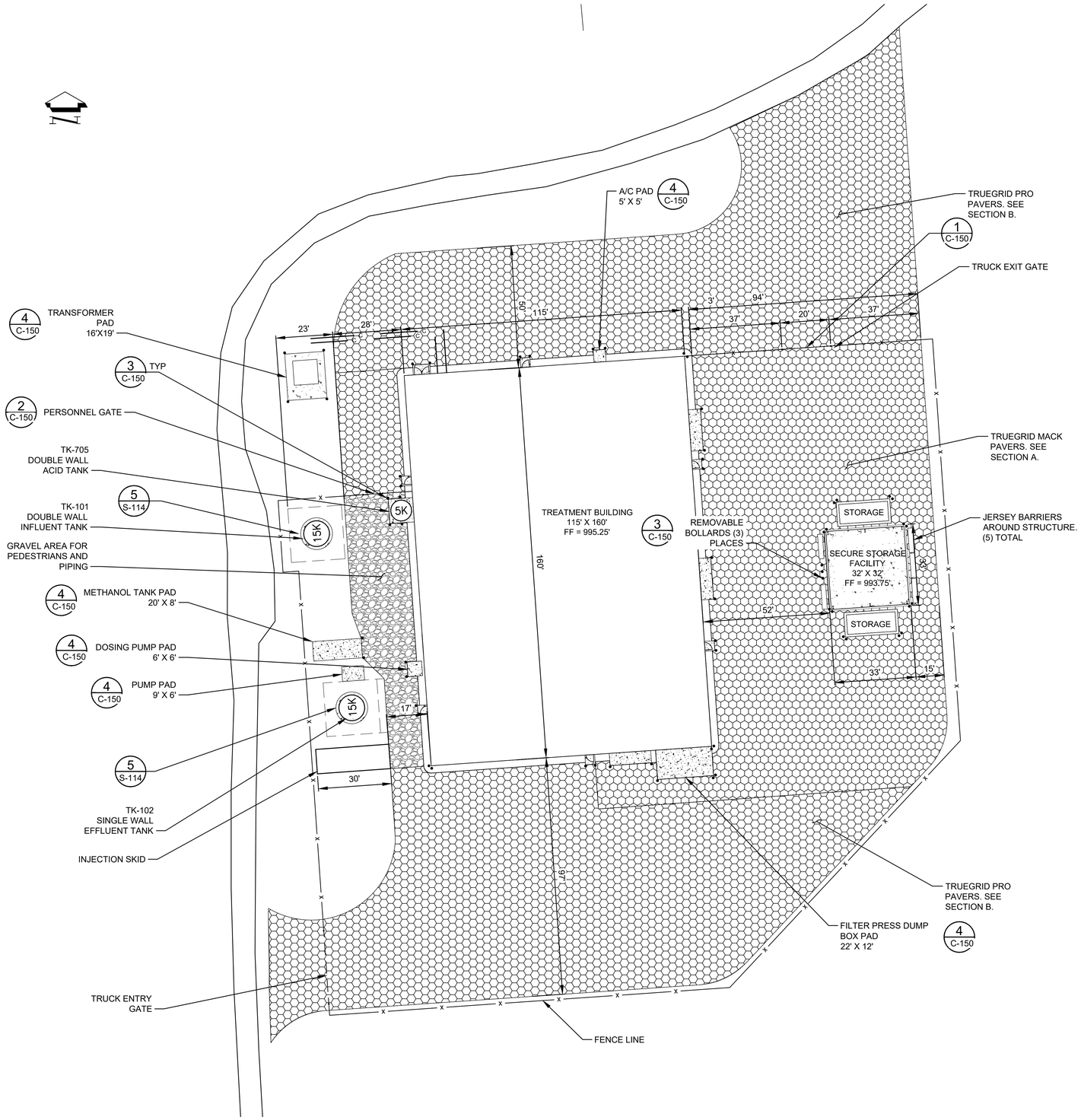
Uranium Pond #2 Groundwater Injection Trench GWI-UP2-01

7 – Anchoring the Trench

8 – Set Wells and Backfill with Gravel

9 – Fabric on Gravel & Impacted Soil on Fabric

10 – Backfill to Grade



SITE PLAN

SCALE: 1" = 20'-0"

GENERAL NOTES:

1. SEE K-EPM-DWG-C-112 FOR SITE GRADING PLAN.
2. SEE K-EPM-DWG-C-113 FOR SITE UTILITY PLAN.
3. SEE K-EPM-DWG-S-101 FOR STRUCTURAL NOTES.

TANK INFORMATION NOTES:

1. 15,000 GALLON TANK DIMENSIONS:
   DIAMETER = 10'-6" (126")
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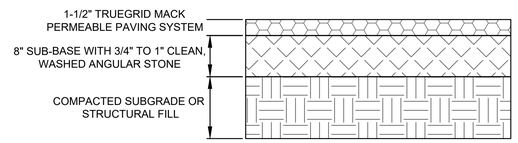

TRUEGRID MACK NOTES:

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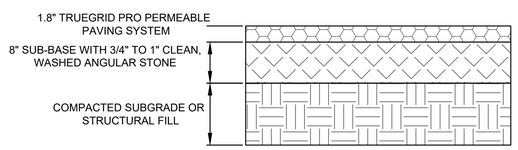
2. USE $\frac{3}{8}$" TO $\frac{3}{4}$" AGGREGATE FOR GRAVEL FILL-IN OF GRID.

TRUEGRID MACK PAVING SECTION A

SCALE: NONE



TRUEGRID PRO NOTES:

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2. USE $\frac{3}{8}$" TO $\frac{3}{4}$" AGGREGATE FOR GRAVEL FILL-IN OF GRID.

TRUEGRID PRO PAVING SECTION B

SCALE: NONE

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60% DESIGN PACKAGE UPDATE
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NAME	DATE	COMPANY
DRAWN BY D NELSON		VNSFS
ENGINEER D NELSON		VNSFS
PREPARER R RASMUSSEN		VNSFS
PROJECT MANAGER J LUEY		VNS
DESIGN AUTHORITY		

CIMARRON
PUMP AND TREAT SYSTEM PROJECT

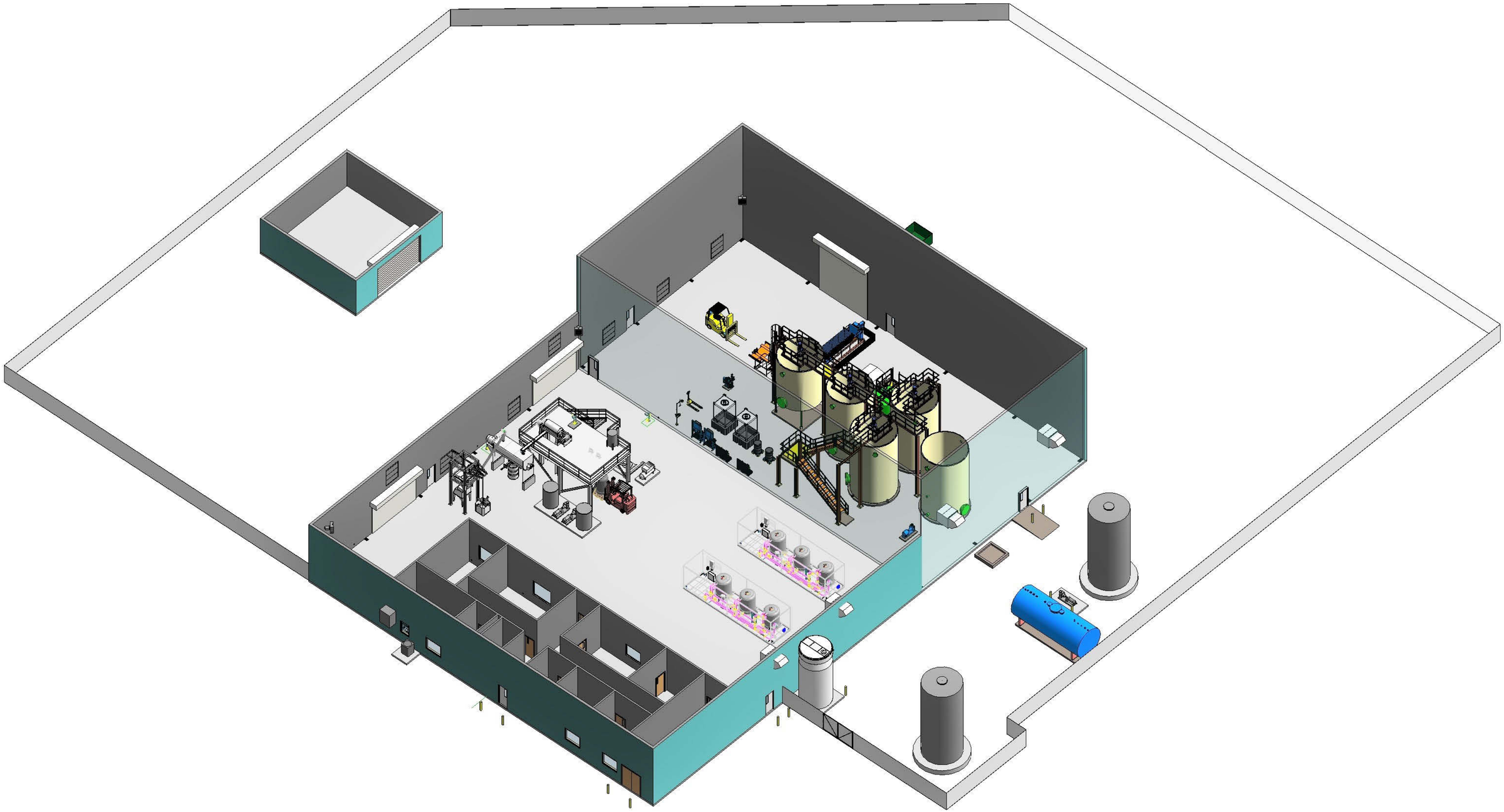
WESTERN AREA TREATMENT FACILITY SITE PLAN

SIZE F | DWG NO K-EPM-DWG-C-110 | REV A
SCALE AS SHOWN | EDT | SHEET 1 OF 1

DWG NO	TITLE	REF NUMBER	TITLE
DRAWING TRACEABILITY LIST		REFERENCES	NEXT USED ON

MFD REV REL	REV NO	DESCRIPTION	REV BY DATE	ENGR COMPANY
REVISIONS				

DWG NO K-EPM-DWG-C-110 | SH 1 OF 1 | REV A



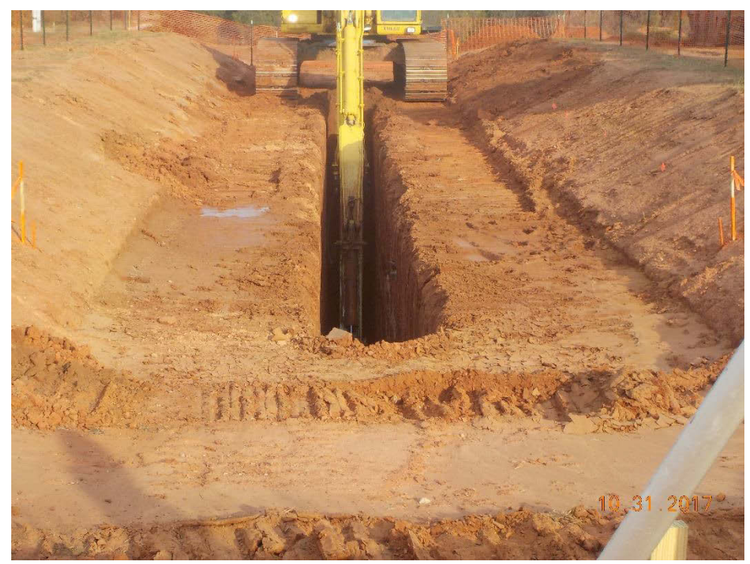
Uranium Pond #1 Groundwater Injection Trenches GWI-UP1-02 and GWI-UP1-01

1 - Constructing the Bench

2 – Debris in Bottom of GWI-UP1-02 Bench

3 – Scanning Debris

4 – Non-Releasable Concrete

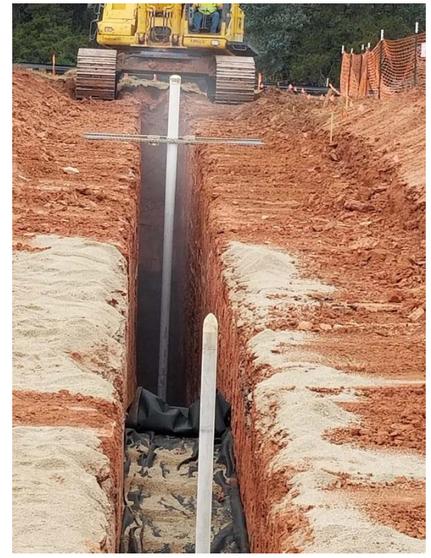


5 – Excavating Trench

6 – Excavating to Depth

Uranium Pond #1 Groundwater Injection Trenches GWI-UP1-02 and GWI-UP1-01

7 – Placing Gravel at North Monitor Well



8 – Backfill and Fabric as Excavation Progresses

9 – Angle at GWI-UP1-02 to GWI-UP1-01

10 – Closeup of Angle from Trench 02 to 01

11 – Fabric on Gravel

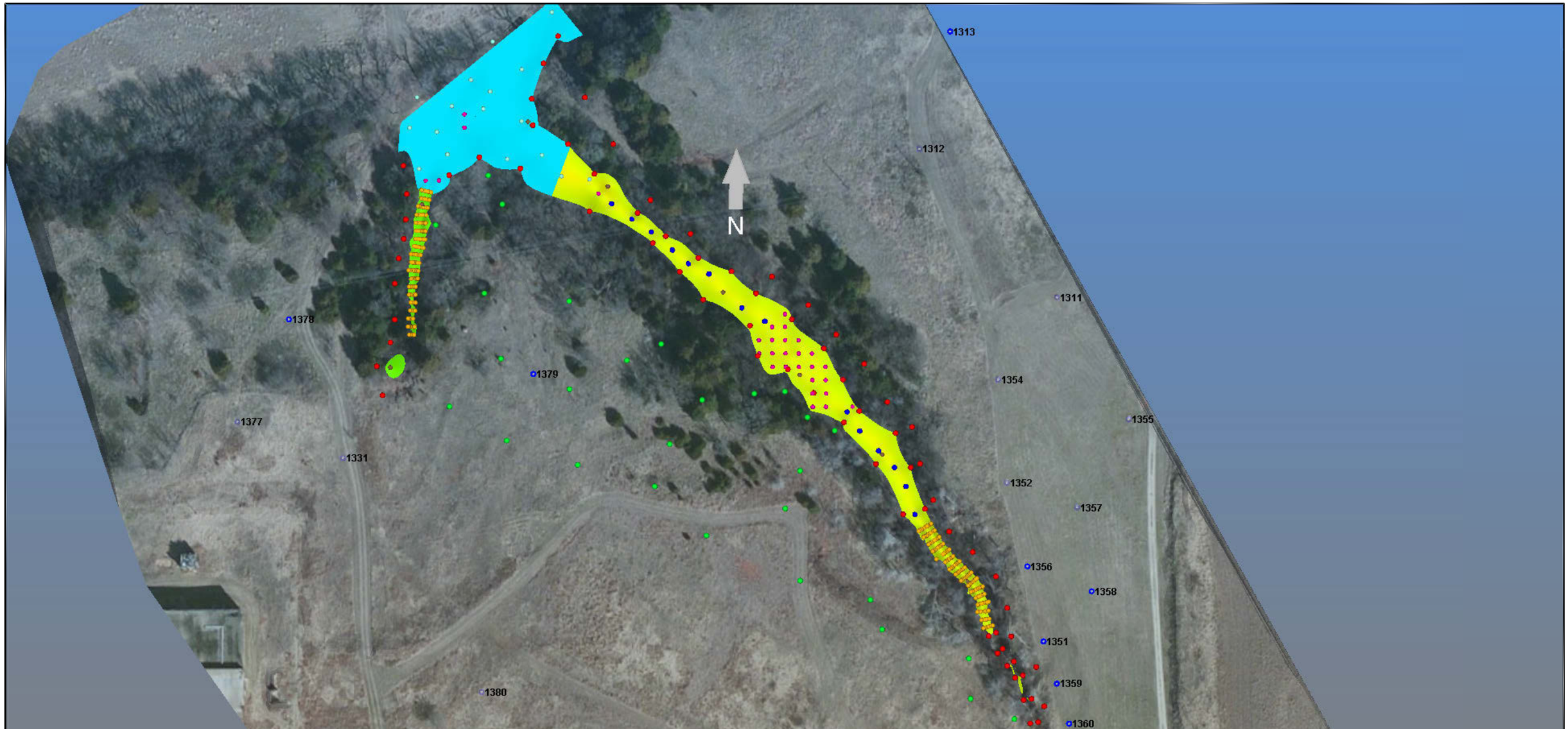
12 – Placing Impacted Soil on Fabric

Uranium Pond #1 Groundwater Injection Trenches GWI-UP1-02 and GWI-UP1-01

13 – Backfilling the Bench

14 – Restoring to Final Grade

15 – Hydromulch in Background



Soil Volume = 5487.9467419345665 Cubic Yards
Soil Mass = 7762297.251613661 Kilograms

Soil Volume = 1969.8362071763843 Cubic Yards
Soil Mass = 2786188.5138674392 Kilograms

Soil Volume = 131.46868648231495 Cubic Yards
Soil Mass = 185952.79286460302 Kilograms

NOTES:
1) 4X VERTICAL EXAGGERATION.
2) PINK, TEAL, BROWN, AND ORANGE SPHERES REPRESENT SOIL BORINGS AND PROBES CONDUCTED IN 1998, 2005, 2014, AND 2018, RESPECTIVELY.
3) BLUE, RED, AND GREEN SPHERES REPRESENT MODEL CONSTRAINING LOCATIONS (SEE ATTACHMENTS 10, 11, AND 12).
4) 1300 LOCATIONS (BLUE SPHERES WITH WHITE CENTERS) REPRESENT MONITOR WELLS.
5) GREEN, YELLOW, AND BLUE SURFACE REPRESENTS WEST DRAINAGE, EAST DRAINAGE, CONFLUENCE (RESPECTIVELY).
6) AERIAL SURFACE BASED ON 2014 LIDAR SURVEY.
7) AERIAL IMAGE TAKEN FROM ARCMAP (ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR, GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGA, AEROGRID, IGN, AND THE GIS USER COMMUNITY).

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Attachment 14
1206 DRAINAGEWAY
SOIL VOLUME ESTIMATES
CIMARRON SITE, OKLAHOMA

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ATTACHMENT 15
REMEDIAL ALTERNATIVE FOR THE 1206 DRAINAGE - SKETCH
CIMARRON SITE, OKLAHOMA

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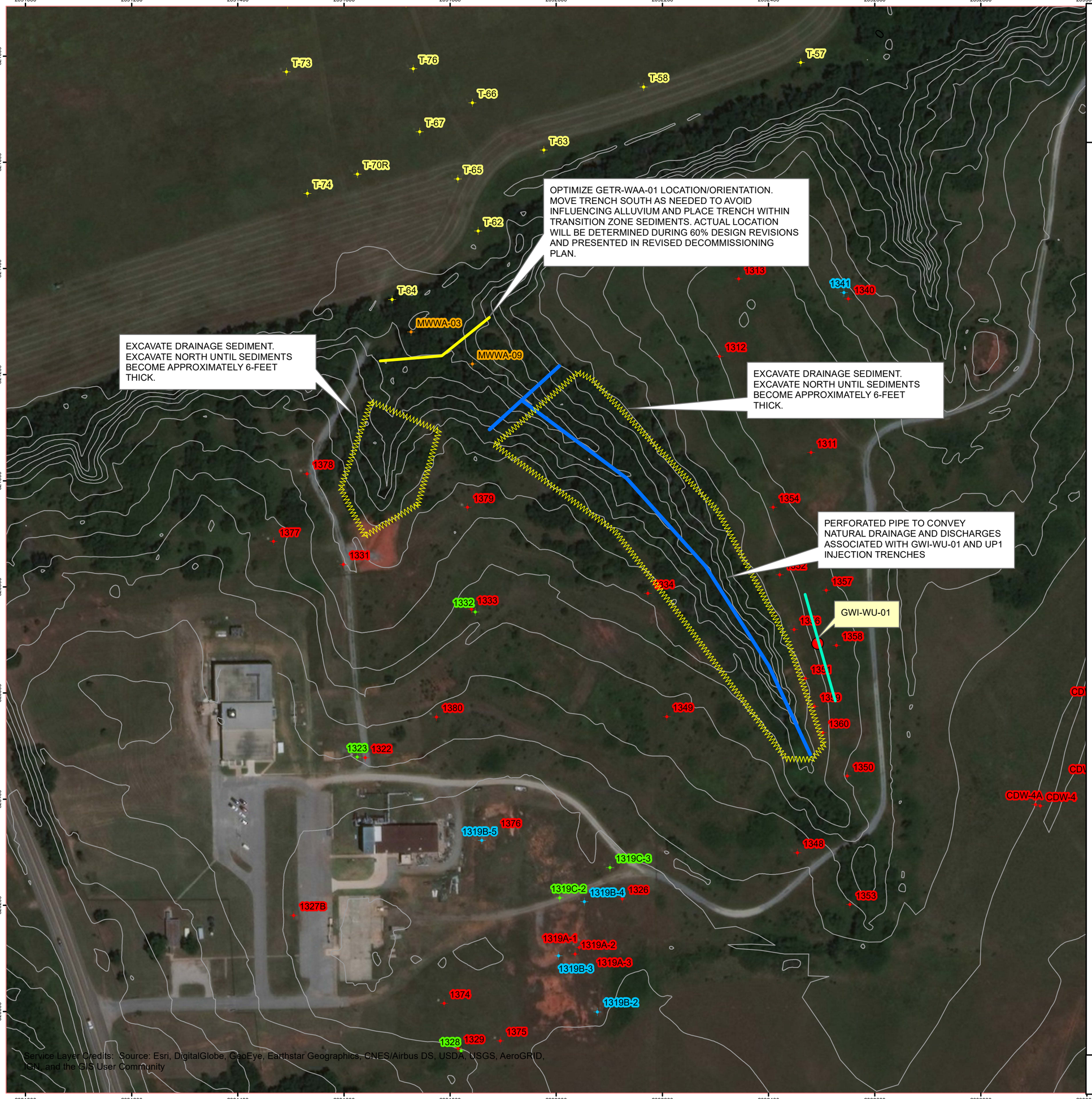

Legend

- INJECTION WELL
- MONITORING WELL IN TRANSITION ZONE
- MONITORING WELL IN ALLUVIUM
- MONITORING WELL IN SANDSTONE A
- MONITORING WELL IN SANDSTONE B
- MONITORING WELL IN SANDSTONE C
- 5-FOOT CONTOUR
- PROPOSED GW EXTRACTION TRENCH
- PROPOSED GW INJECTION TRENCH

0 50 100 200 Feet

N

Source: ESRI and Burns & McDonnell Engineering.

COORDINATES : (NAD 83) STATE PLANE OKLAHOMA NORTH FEET

DATE : AERIAL PHOTO - 2010 / MAP PRODUCED - 3/29/2018

Path: Z:\Clients\ENS\CERT_ClientInfo\Sites\Database\Geospatial\Maps & Dwgs\ArcGIS\BMCD_Files\Arcdocs\2017\2017 Drainage Way Docs\CERT Drainage Way Sketch.mxd
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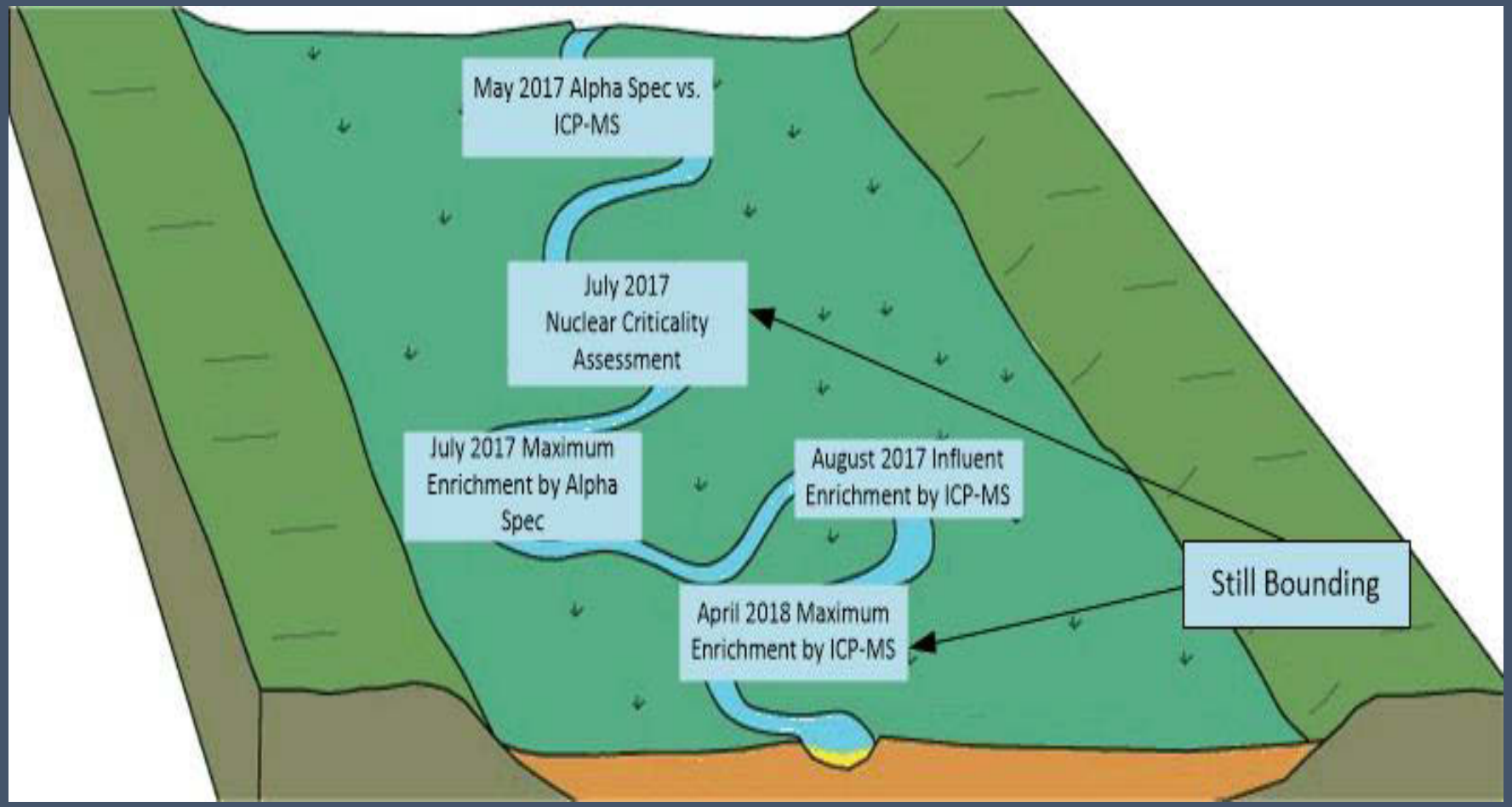
ATTACHMENT 3
PRESENTATION SLIDES ON ENRICHMENT CALCULATIONS

MAXIMUM CONSERVATIVE ENRICHMENT

- Initial enrichment evaluation used alpha-spec data.
- Re-evaluated enrichment used ICP-MS.

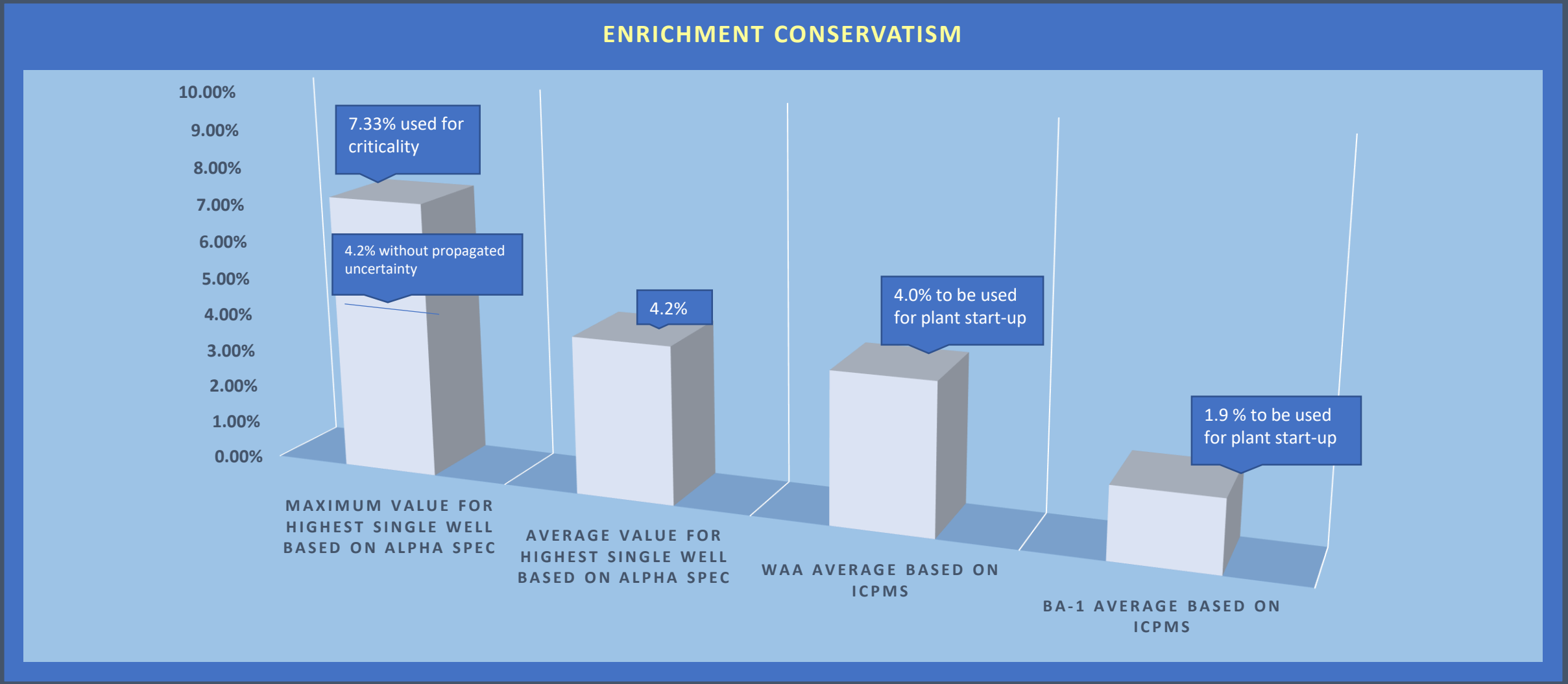
MAXIMUM CONSERVATIVE ENRICHMENT (continued)



CRITICALITY ASSESSMENT

- Previous maximum enrichment of 7.33% was based on alpha spectroscopy.
- Criticality was not credible.
- Revised maximum enrichment is 4.76% based on ICP-MS analysis.
- Consequently, 7.33% value used for criticality assessment is “bounding”.

ESTIMATE OF INITIAL ENRICHMENT



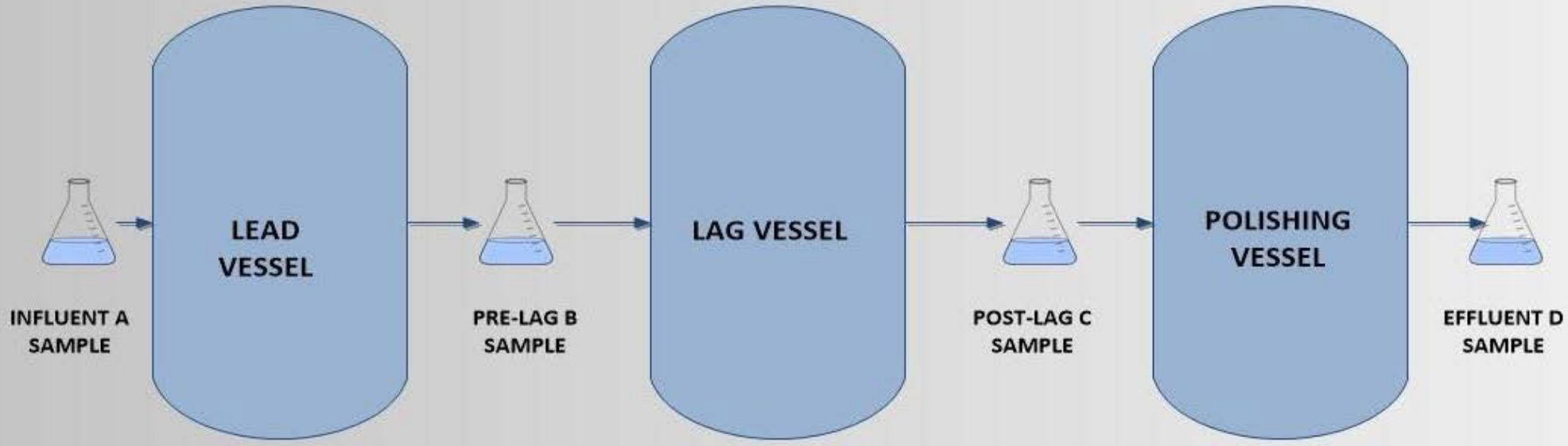
ESTIMATE OF INITIAL INFLUENT ENRICHMENT

- Need to estimate initial influent enrichment.
- Conservative *average* enrichment estimate will be used until resin data provides *actual value*.
- Initial influent enrichment:

  - Trains 1 & 2: 4.0%
  - Train 3: 1.9%

DETERMINATION OF URANIUM & U-235 MASS

- Weekly mass in each vessel
- Weekly mass in each train
- Weekly mass in site-wide inventory
- Total site inventory



(A – B) x LITERS = GRAMS U

(B – C) x LITERS = GRAMS U

(C – D) x LITERS = GRAMS U

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ATTACHMENT 4
MAY 17, 2018 AGENDA

Cimarron Environmental Response Trust
Project Meeting Agenda
May 17, 2018

1. Burial Area #1
    a. Extraction Trench Construction
        i. 100-year floodplain issues
        ii. Slurry trench issues
        iii. Spoils placement
    b. Extraction Test Results
    c. Walk-Through for Transition Zone Pore Volume Determination
        i. Data available / methodology
        ii. Conclusions resulting from study
        iii. Need for additional information?
    d. Impact of Transition Zone Pore Volume Determination
        i. Less water from GETR-BA1-01 means lower influent concentration
        ii. Spent resin will contain lower uranium mass
        iii. Pore volume reduction / extraction rate reduction < 1, so transition zone will remediate more quickly
        iv. More extraction from BA1 U > DCGL Area means this area will remediate more quickly OR pump more from BA1 & < DCGL Area
    e. Injection Test Results
        i. Hydraulic results
        ii. Dye tracer results
        iii. Influence extends into transition zone deposits
        iv. Injection influences sandstone more than former disposal trenches
        v. No need for GETR-BA1-02

2. Uranium Pond #2
    a. Injection Trench Construction
    b. Injection Test Results
        i. Hydraulic results
        ii. Dye tracer results
    c. Impact of Pilot Test on UP2 Design
        i. Liner is not needed
        ii. Trench reconfiguration

3. Uranium Pond #1
    a. Injection Trench Construction
    b. Injection Test Results
        i. Hydraulic results
        ii. Dye tracer results
    c. Impact of Pilot Test on UP2 Design
        i. Trench reconfiguration

4. 1206 Drainage

a. 1206 West
    i. Reason for the assessment
    ii. Assessment results
    iii. Remedial alternatives
b. 1206 East
    i. Reason for the assessment
    ii. Assessment results
    iii. Remedial alternatives

5. Western Area Water Treatment
    a. Overall layout
    b. Blending influent
        i. Impact on uranium concentration and enrichment
        ii. Impact on construction and operation
    c. Biodenitrification process
        i. Benefits of moving process inside & expanding building
        ii. Nitrate system design and treatment process
        iii. Solids removal, processing, & packaging
    d. Uranium treatment process
        i. Ion exchange process
        ii. Spent resin removal, processing, & packaging
    e. Secure storage area

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ATTACHMENT 5
PRESENTATION ON PILOT TEST RESULTS AND 1206 DRAINAGE

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Pilot Test Overview & Results

Cimarron Environmental Response Trust

May 17, 2018

AGENDA

- Pilot Test Overview
- Burial Area #1
  - Construction
  - Extraction test results
  - Transition Zone pore volume assessment
  - Injection test results
  - Design implications
- Uranium Pond #2
  - Construction
  - Injection test results
  - Design implications
- Uranium Pond #1
  - Construction
  - Injection test results
  - Design implications
- 1206 Drainage
  - Rationale for alternative remediation approach
  - Sediment volume assessment
  - Alternative approach - conceptual design and cost

PILOT TEST OVERVIEW

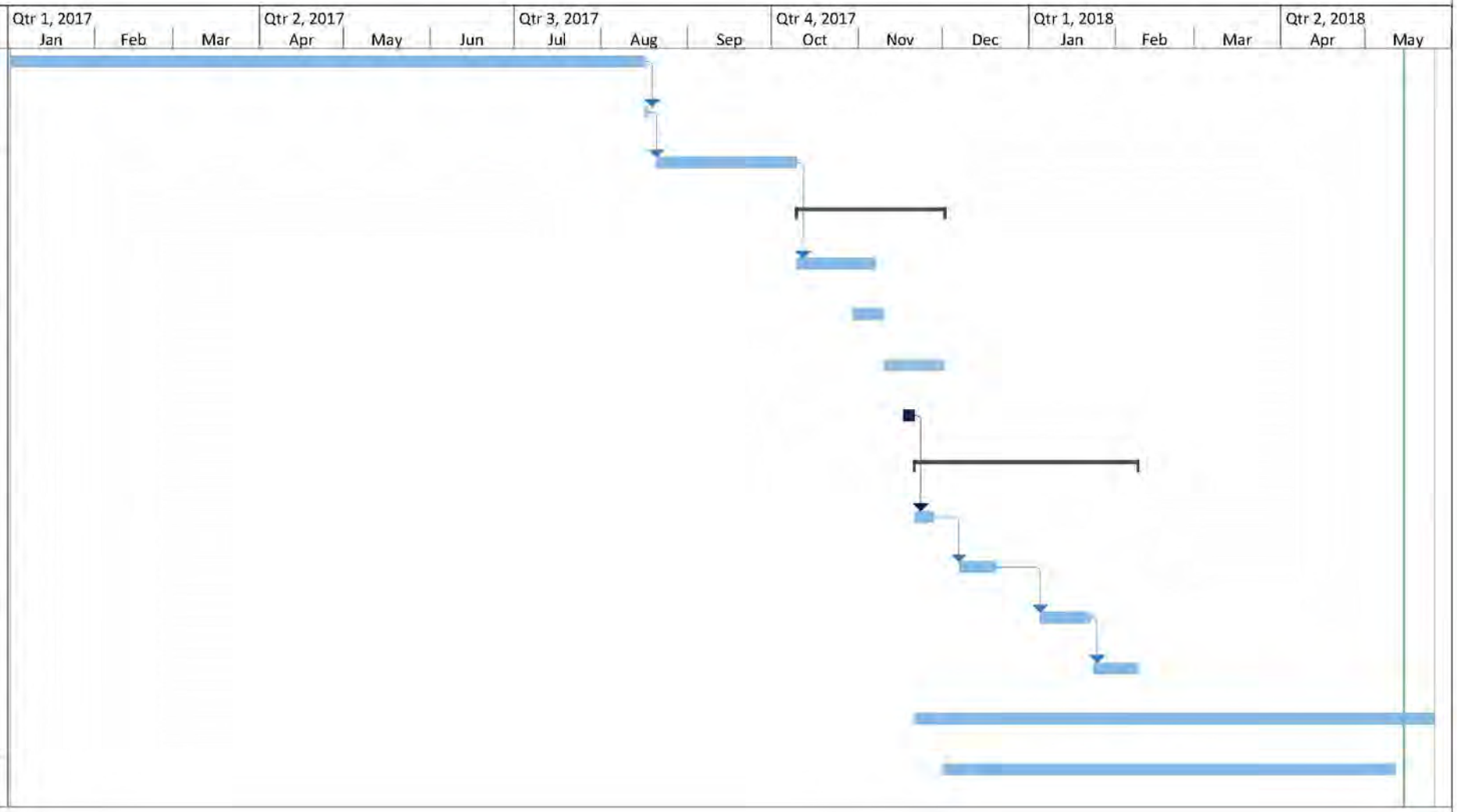
- Budget
  - Budget vs. actuals
  - Additional scope
  - Contingency
- Safety
  - No recordables
  - No measurable radiation dose
  - Over 7,000 total hours worked
- Schedule
  - Design & planning
  - Pre-construction
  - Construction
  - Testing
  - Data review & evaluation
  - Site restoration/stabilization
- Accomplishments
  - Design optimization
  - Reduced uncertainty

BUDGET SUMMARY

- Burns & McDonnell
  - Approved Task 4 Budget: **$2.0MM**
  - Actual Task 4 Spend: **$1.0MM**
  - BMcD Estimated Pilot Test Cost: **$631,000**
  - BMcD Actual Pilot Test Spend: **$610,000**
- Enercon
  - Approved Task 4 Budget: **$272,000**
  - Actual Task 4 Spend: **$208,000**
- Pilot Study
  - Approved Subcontractor Budget: **$1,485,643** (w/o 25% contingency)
  - Actual Subcontractor Spend: **$1,426,000**

PILOT STUDY SCHEDULE

ID	Task Mode	Task Name
1		Design and Planning
2		Contract Award
3		Pre-construction Activities
4		**Construction Activities**
5		BA1 Construction Activities
6		UP2 Construction Activities
7		UP1 Construction Activities
8		Monitor Well Installation
9		**Testing Activities**
10		GETR Testing Activities
11		GWI BA1 Testing Activities
12		GWI UP2 Testing Activities
13		GWI UP1 Testing Activities
14		Data Review and Evaluation
15		Site Restoration/Stabilization

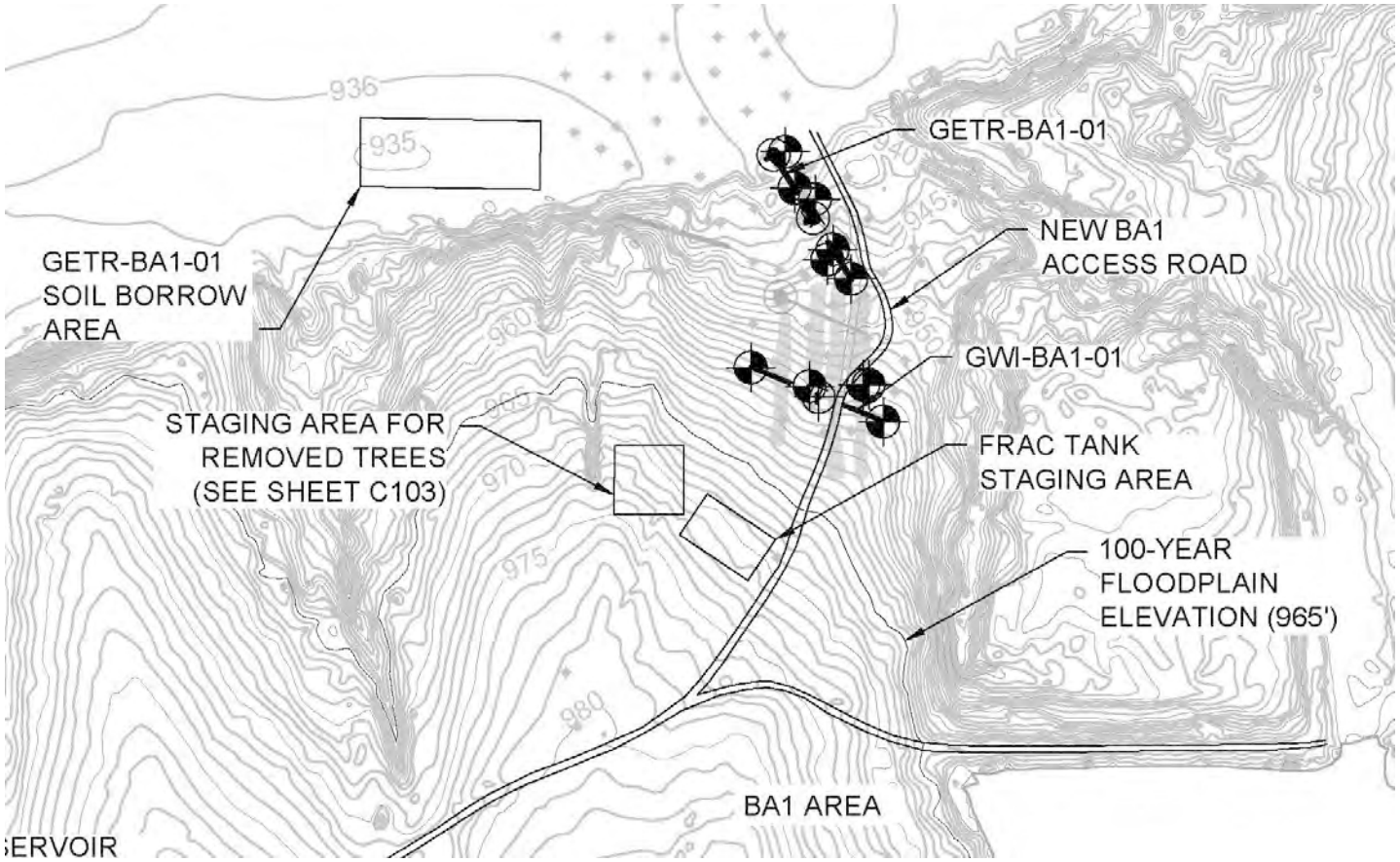


BURIAL AREA #1

BURIAL AREA #1

Extraction Trench Construction Preparation Activities

- 100-year floodplain considerations
- Clearing and spoils placement
- Soil borrow area
- Frac tank staging area
- Weather Impacts



BURIAL AREA #1 - CLEARING

BA1 Tree Removal

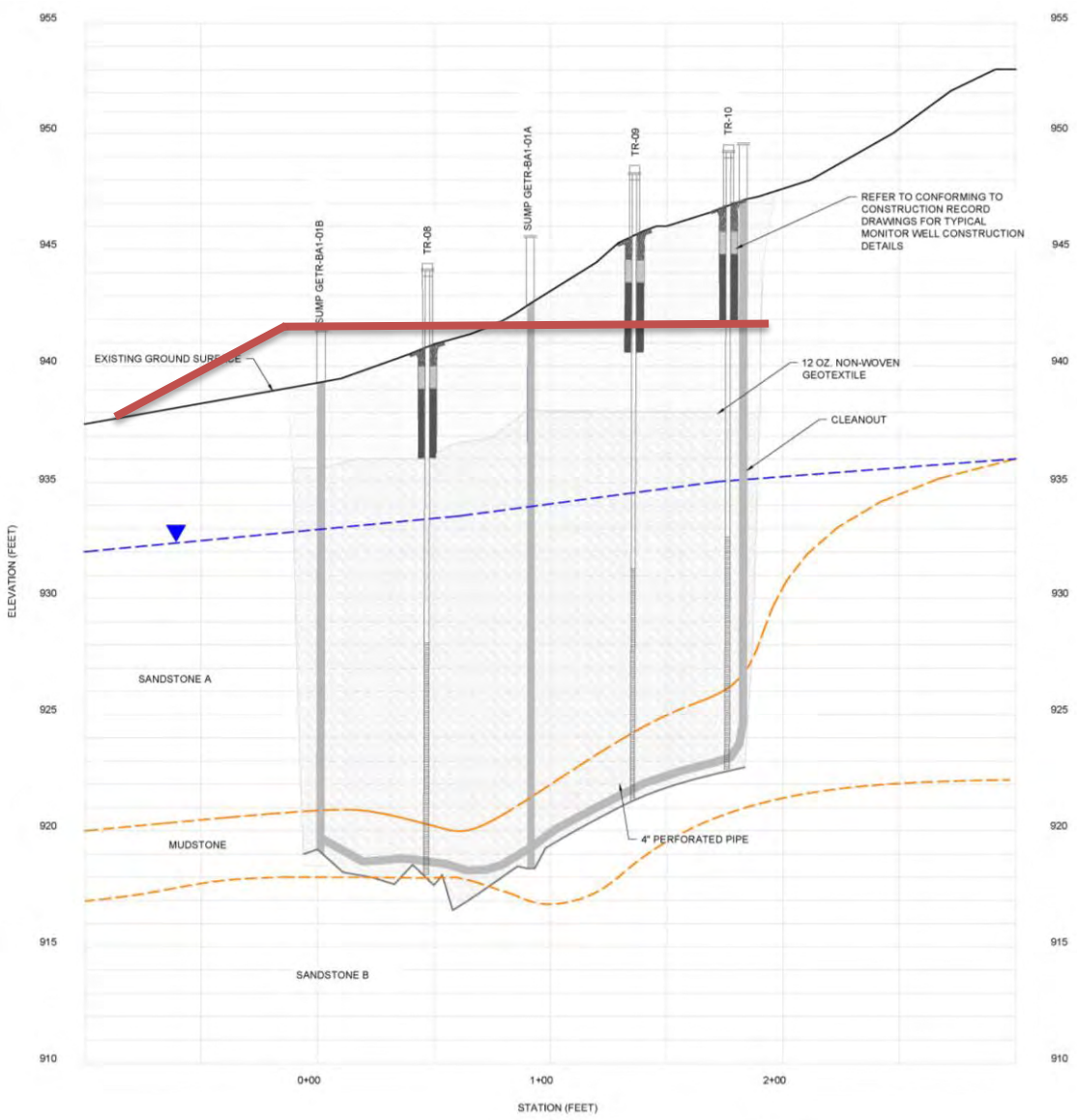
Stockpile Area

BURIAL AREA #1 – FRAC TANK STAGING

BURIAL AREA #1

Extraction Trench Construction

- Monitor well abandonment
- Access/leveling platform
- Borrow soil requirements



BURIAL AREA #1 – MONITOR WELL ABANDONMENT

Monitor Well Removal

Material Scanning

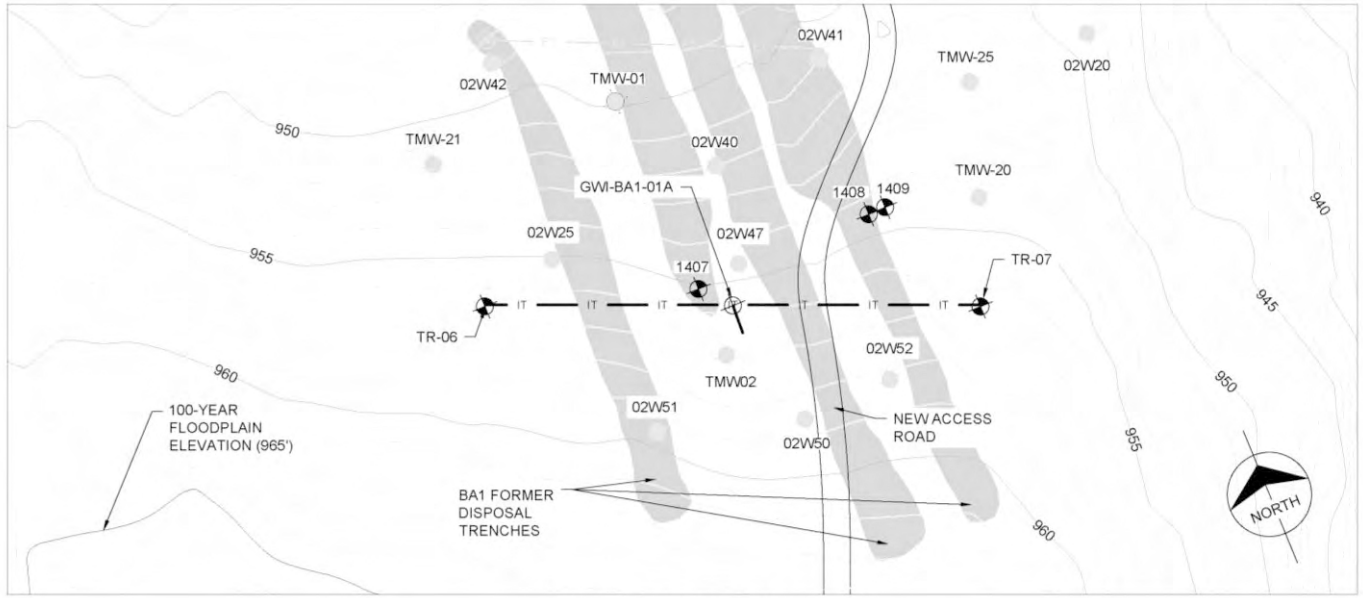
BURIAL AREA #1 – TRENCH ACCESS/LEVELING

Soil Borrow Area

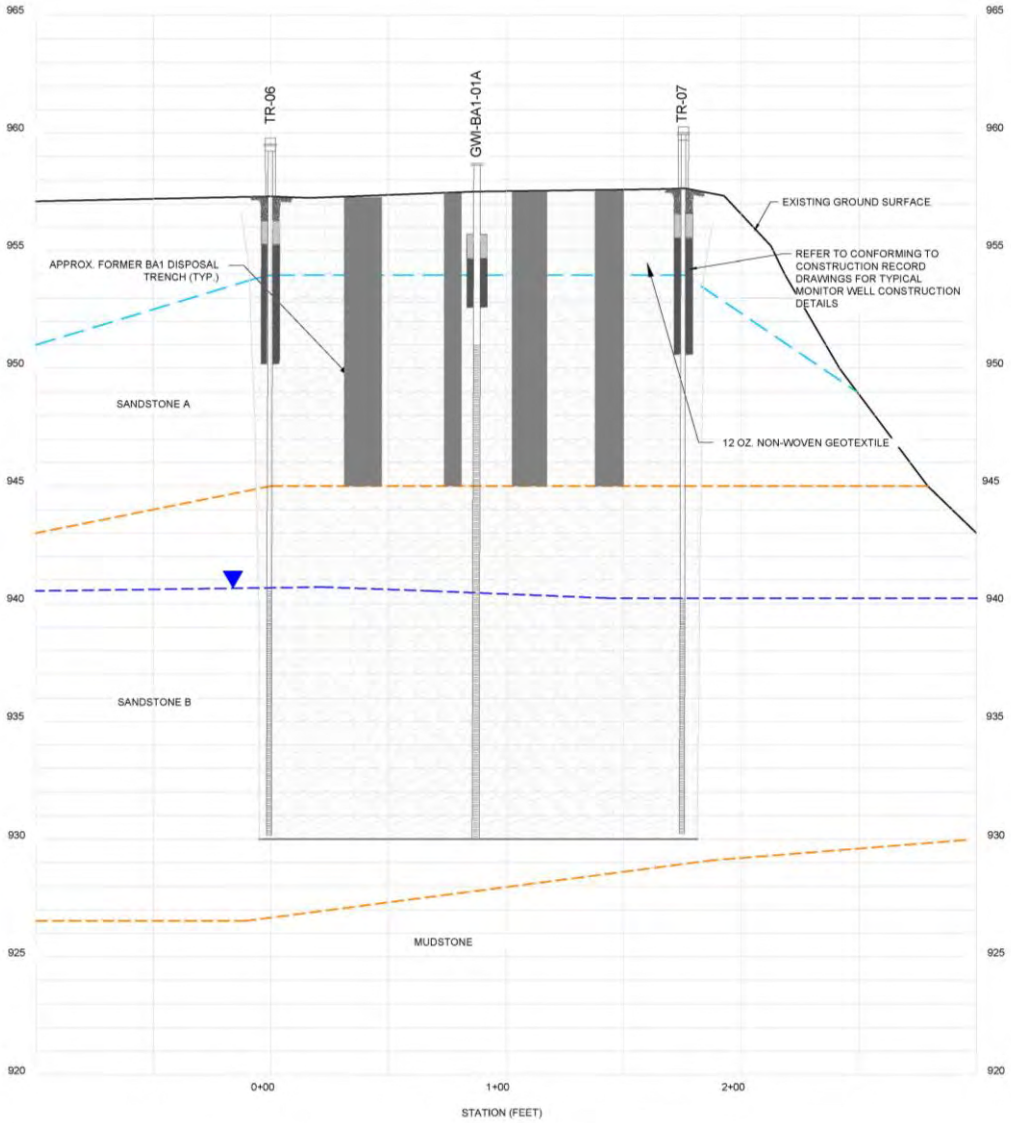
Platform Preparation

BURIAL AREA #1 – WEATHER IMPACTS

BURIAL AREA #1



INJECTION TRENCH GWI-BA1-01
PLAN VIEW



BURIAL AREA #1

GWI-BA1 Trench Progress

Typical In-trench
SS Monitor Well

BURIAL AREA #1

Bucket with Rock Teeth

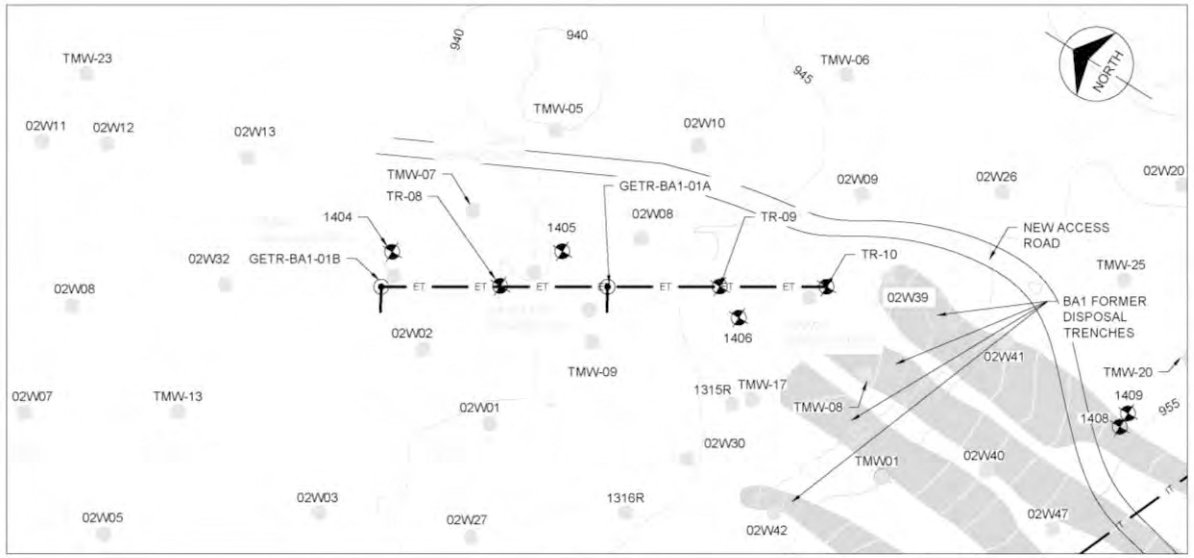
Rock Hammer Attachment

BURIAL AREA #1

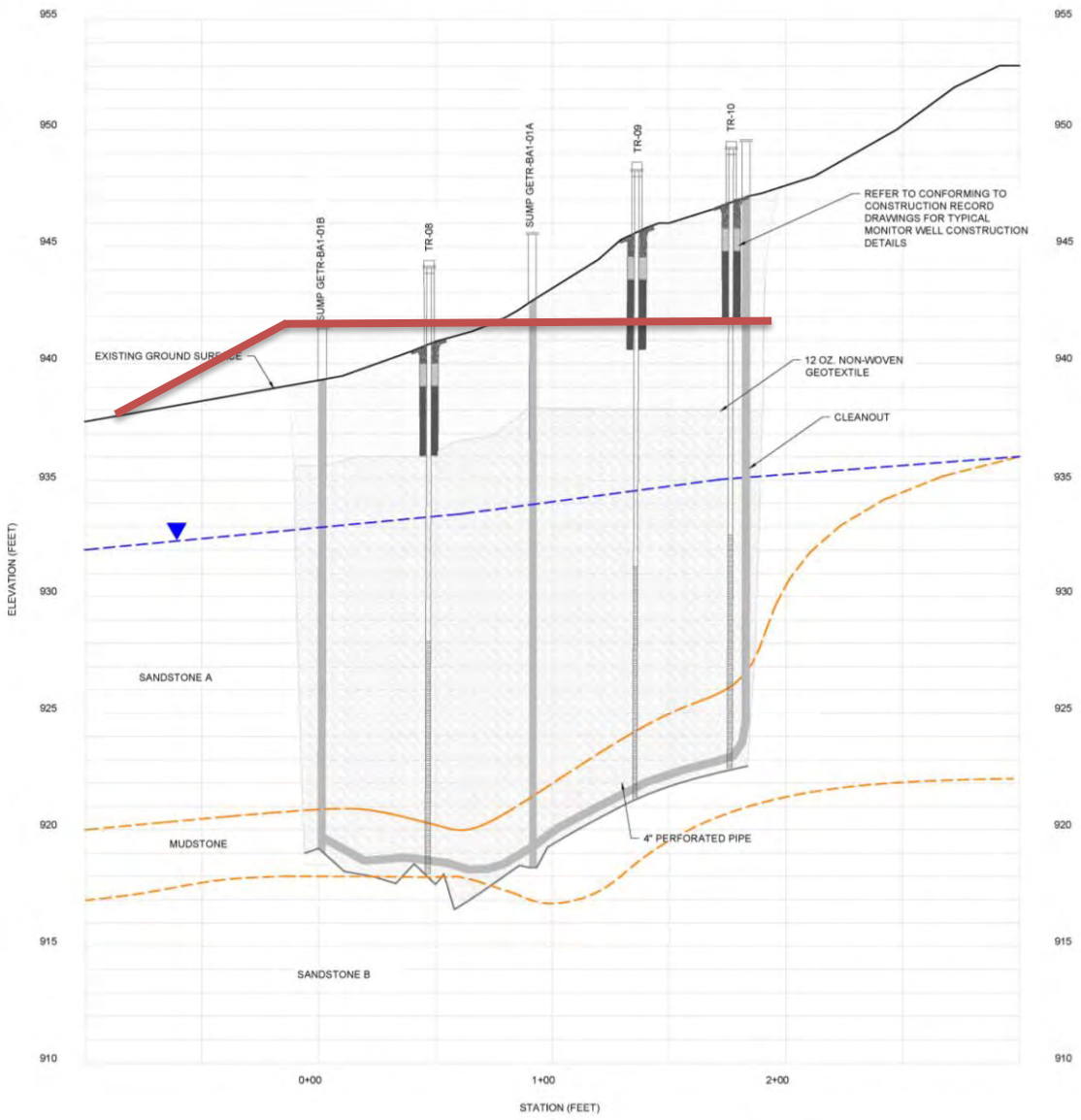
Geotextile Placement

GWI-BA1 Restoration

BURIAL AREA #1



EXTRACTION TRENCH
GETR-BA1-01 PLAN VIEW

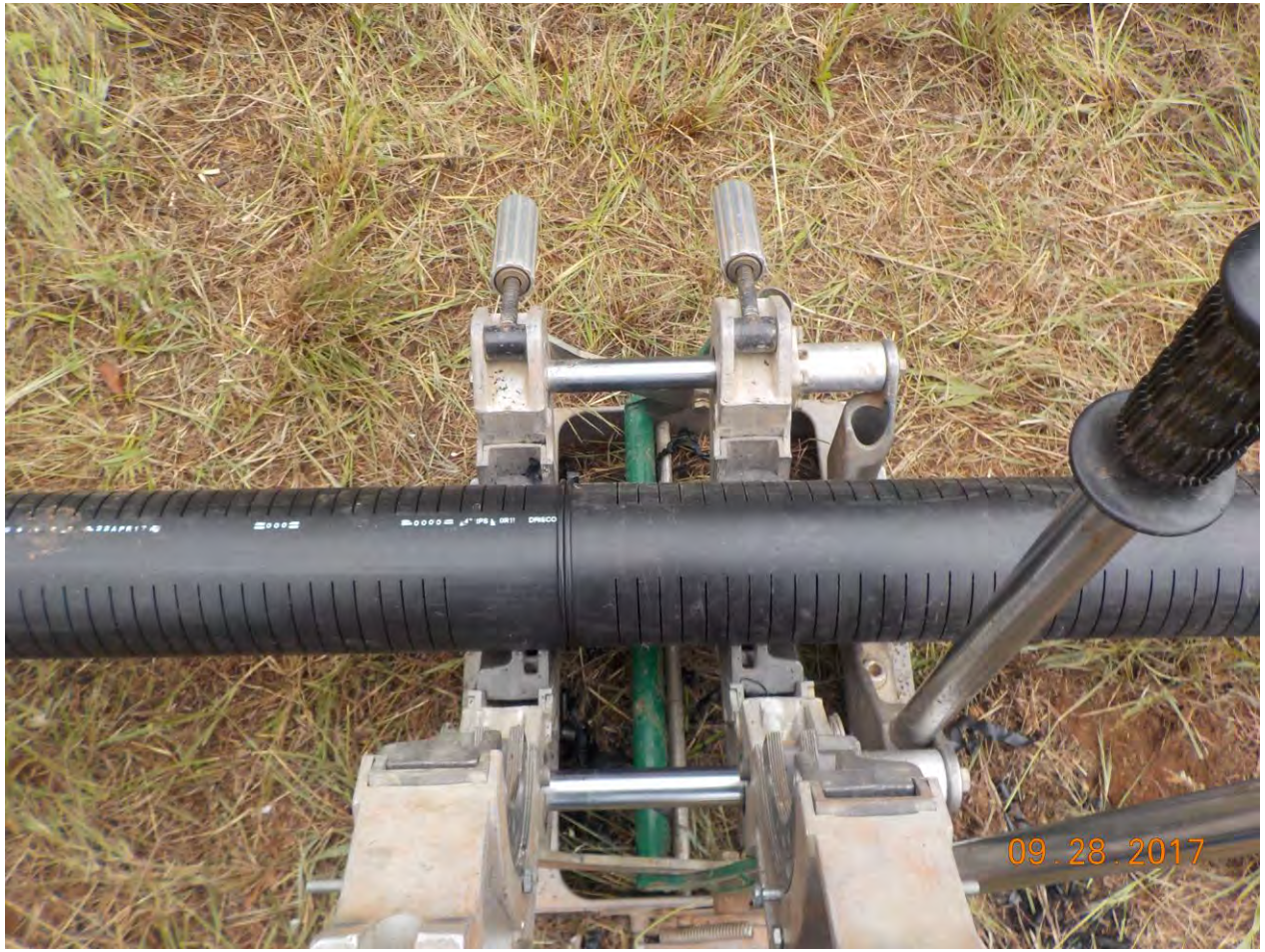


BURIAL AREA #1

Trench Alignment Marking

Slurry Introduction

BURIAL AREA #1



HDPE Fusion Welding

Cleanout and Monitor Well

BURIAL AREA #1

Slurry Recirculation Pump

Breaker Recirculation

BURIAL AREA #1

Slurry Breaking Fluid

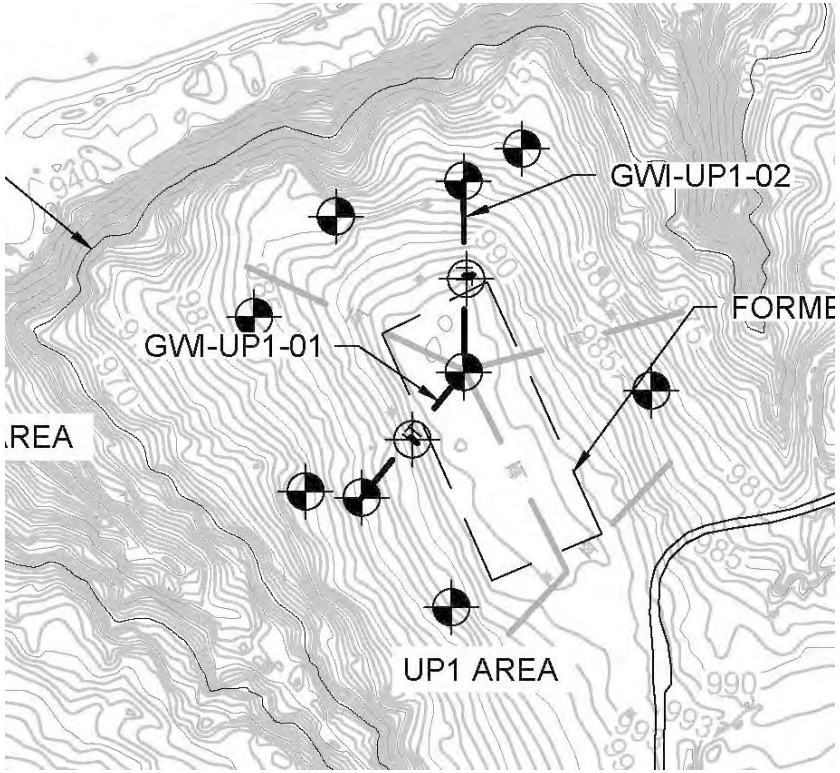
Marsh Funnel Test

BURIAL AREA #1

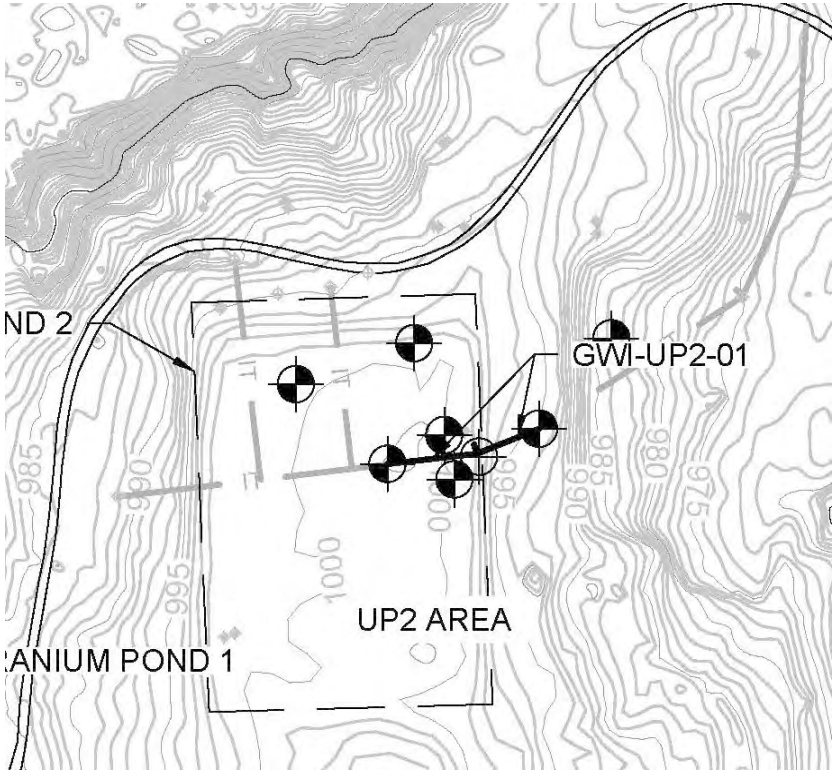
Geotextile Placement

Trench Area Restoration

MONITOR WELL INSTALLATION



UP1



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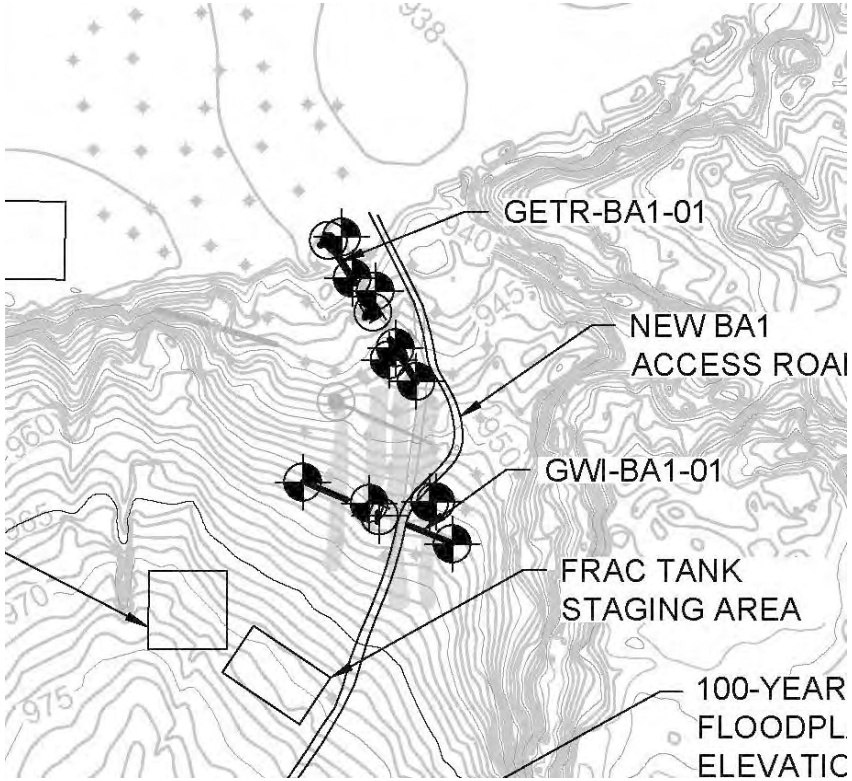

BA1

MONITOR WELL INSTALLATION

Monitor Well Install

Monitor Well Install

MONITOR WELL INSTALLATION

Drill Cuttings

Well Pad Completion

BURIAL AREA #1 – LESSONS LEARNED

- Borrow soil quantification and location
- Excavator hydraulic hammer availability
- Monitor well protection in congested areas
  - Spotters, buffers, designated roads, and visual aids.

BURIAL AREA #1

Extraction Trench Test Results

- Pumping test rate: 16 gpm
  - Design pumping rate = 30 gpm
- Max drawdown: 11’ at 420 min. – **Drawdown Figure**
- Aquifer parameters (T, K, S) representative of heterogeneous conditions
- Extrapolated capture radius (from dist./drawdown analysis): 50’ to 60’
- Pumping test results more representative than numerical modeling results

BURIAL AREA #1

Transition Zone Pore Volume Assessment

- 3 Step Process
  1. GETR-BA1-01 pumping test
  2. Soil data / lithology review
  3. ESS analysis

- Environmental Sequence Stratigraphy (ESS) Analysis:
  - Lower & Upper Gully Fill (LGF, UGF) deposits
  - Intermittent, partially connected sand channel deposits
  - **ESS Figures**
  - **Isopach / Isopleth Figure**

- Transmissive Porosity Estimation
  - 3D Visualization analysis – **Dynamic Model Demo.**
  - Volume calculations
  - Revised transmissive porosity – 11% (vs. 20% used in previous duration estimates)

BURIAL AREA #1

Injection Trench Test Results

- Steady state injection rate: 10.2 gpm
  - Design rate: 10 gpm (with GETR-BA1-02)
- **Hydraulic Mound Figure**
  - Mound likely extends to Transition Zone
  - Mound extends upgradient
- **Head Response Trend Chart**
  - Response at TMW-20 significantly lagged 1409 – preferential flow to 1409, but not TMW-20
- Well pair results
  - 1408/1409 and 1407/02W47/1407 results indicate lower permeability in disposal trench backfill

BURIAL AREA #1

Design Implications

- Transition Zone Pore Volume Assessment
  - Pore volume reduction / extraction rate reduction > 1 – Transition Zone will remediate more quickly
- Extraction Test
  - Design modifications required to achieve remediation/schedule goals – **Remedy Optimization Figure**
  - Max. combined anticipated extraction rate (assuming 2 trenches): 20 gpm (vs. design rate of 30 gpm)
    - Lower TZ flow rate & higher injection rates results in lower influent concs. and U resin mass
    - Lower TZ flow rate provides additional capacity for alluvial GE wells
    - TZ remains the BA1 remediation schedule driver
- Water Infiltration Test
  - GETR-BA1-02 can be relocated
  - Necessitated reconfiguration of GWI-BA1-02

FIGURE 1A
CROSS-SECTION LOCATION MAP
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

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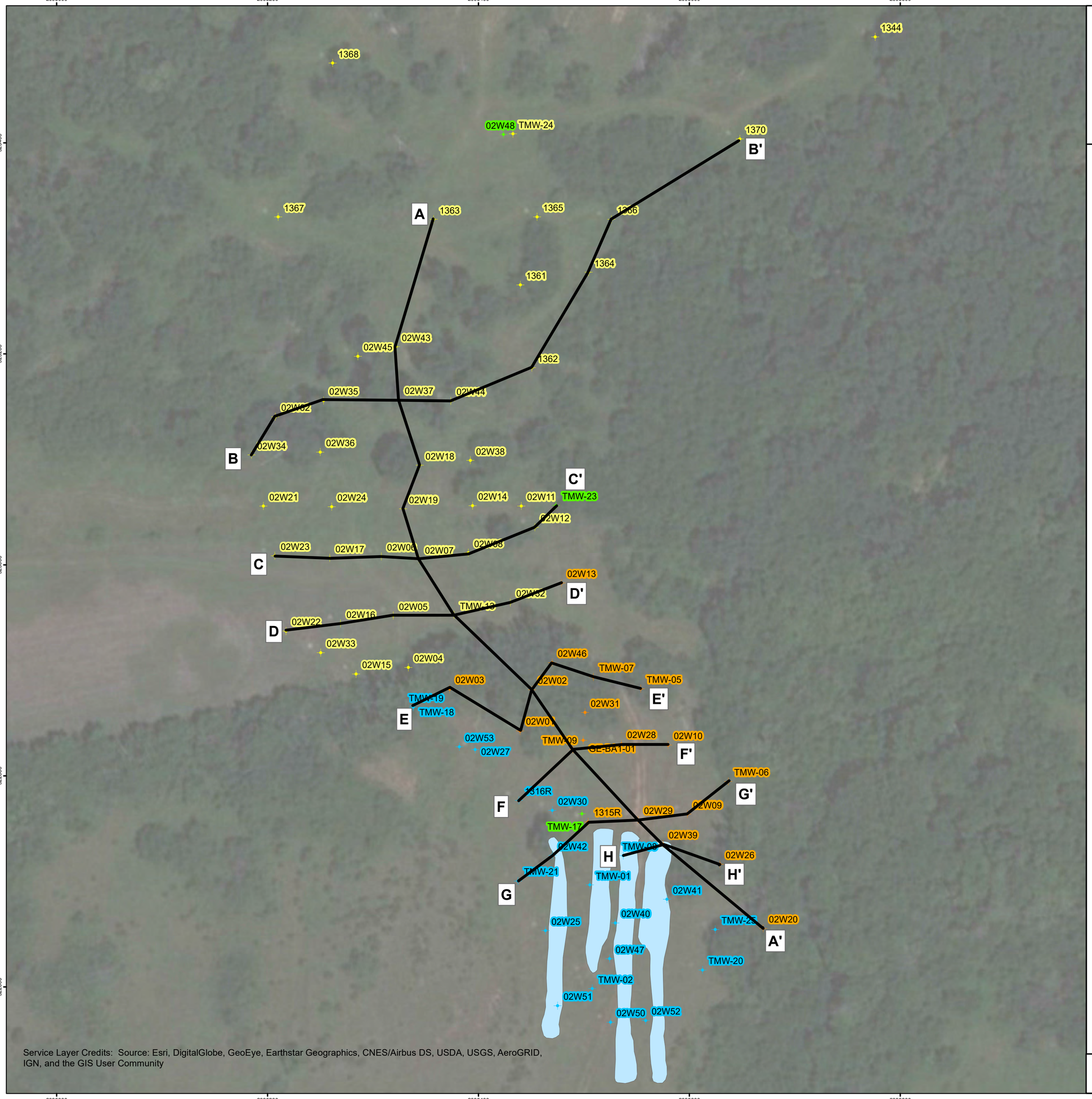

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- MONITORING WELL IN TRANSITION ZONE
- MONITORING WELL IN ALLUVIUM
- MONITORING WELL IN SANDSTONE A
- MONITORING WELL IN SANDSTONE B
- MONITORING WELL IN SANDSTONE C
- WASTE DISPOSAL TRENCH
- CROSS-SECTION LINE

0 50 100 200 Feet

N

Source: ESRI and Burns & McDonnell Engineering.

COORDINATES : (NAD 83) STATE PLANE OKLAHOMA NORTH FEET

DATE : AERIAL PHOTO - 2010 / MAP PRODUCED - 4/6/2018

Path: Z:\Clients\ENS\CERT_ClientInfo\Sites\Database\Geospatial\Maps & Dwgs\ArcGIS\BMCD_Files\Arcdocs\2018\ESS Tech Memo\Basemap.mxd
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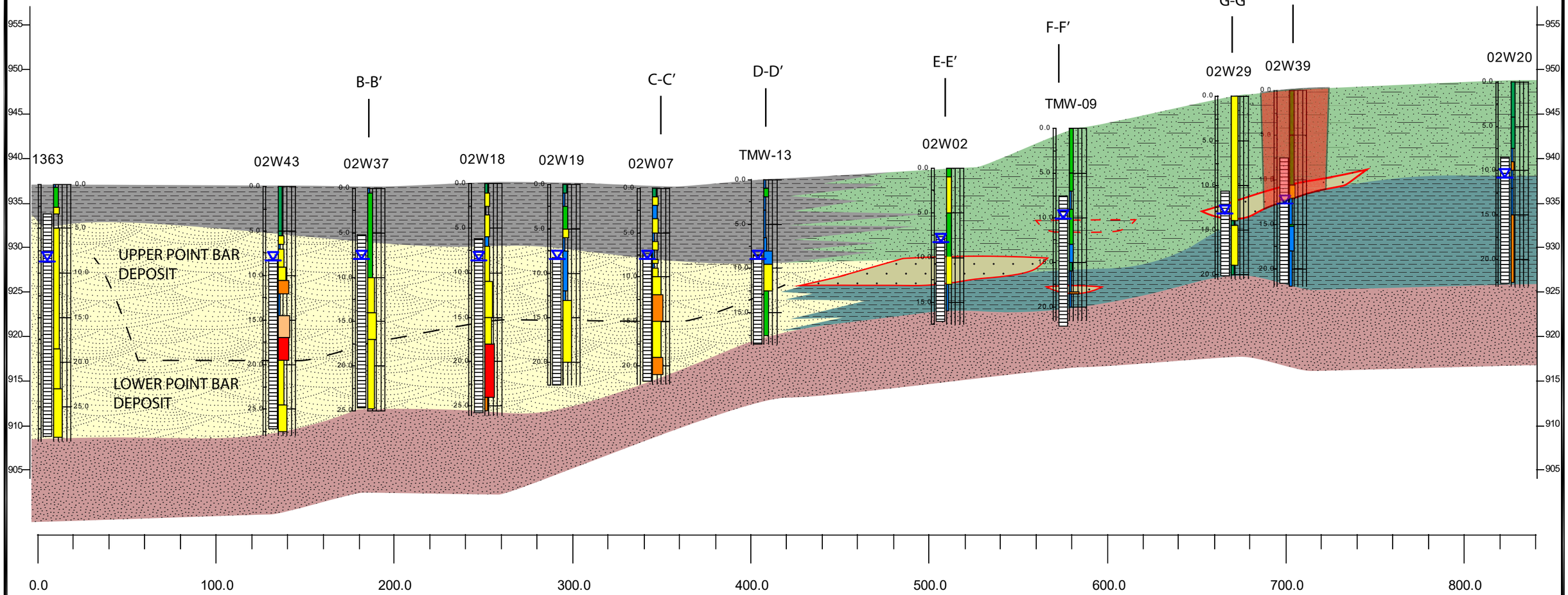
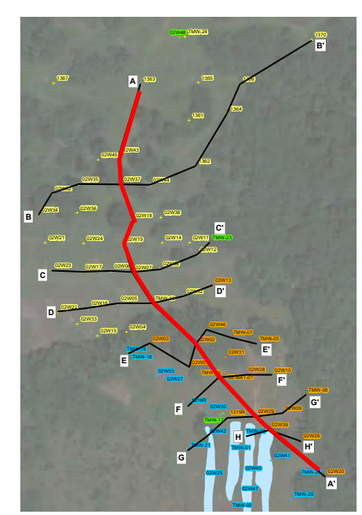
Cross-Section A-A'





NOTES
1) Y-AXIS MEASURED IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN VERTICAL DATUM 1983)
2) X-AXIS MEASURED IN FEET
3) ALL CROSS-SECTION SYMBOLS ARE DEFINED ON FIGURE 1B
4) HORIZONTAL AND VERTICAL SCALES ARE APPROXIMATE
5) SURFACE TOPOGRAPHY IS APPROXIMATE
6) GROUNDWATER ELEVATIONS MEASURED NOVEMBER 6, 2017, EXCEPT 02W29 (MEASURED JULY, 31 2017)
7) CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT

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Figure 2A

CROSS-SECTION A-A'
BURIAL AREA 1
CIMMARON SITE, OKLAHOMA

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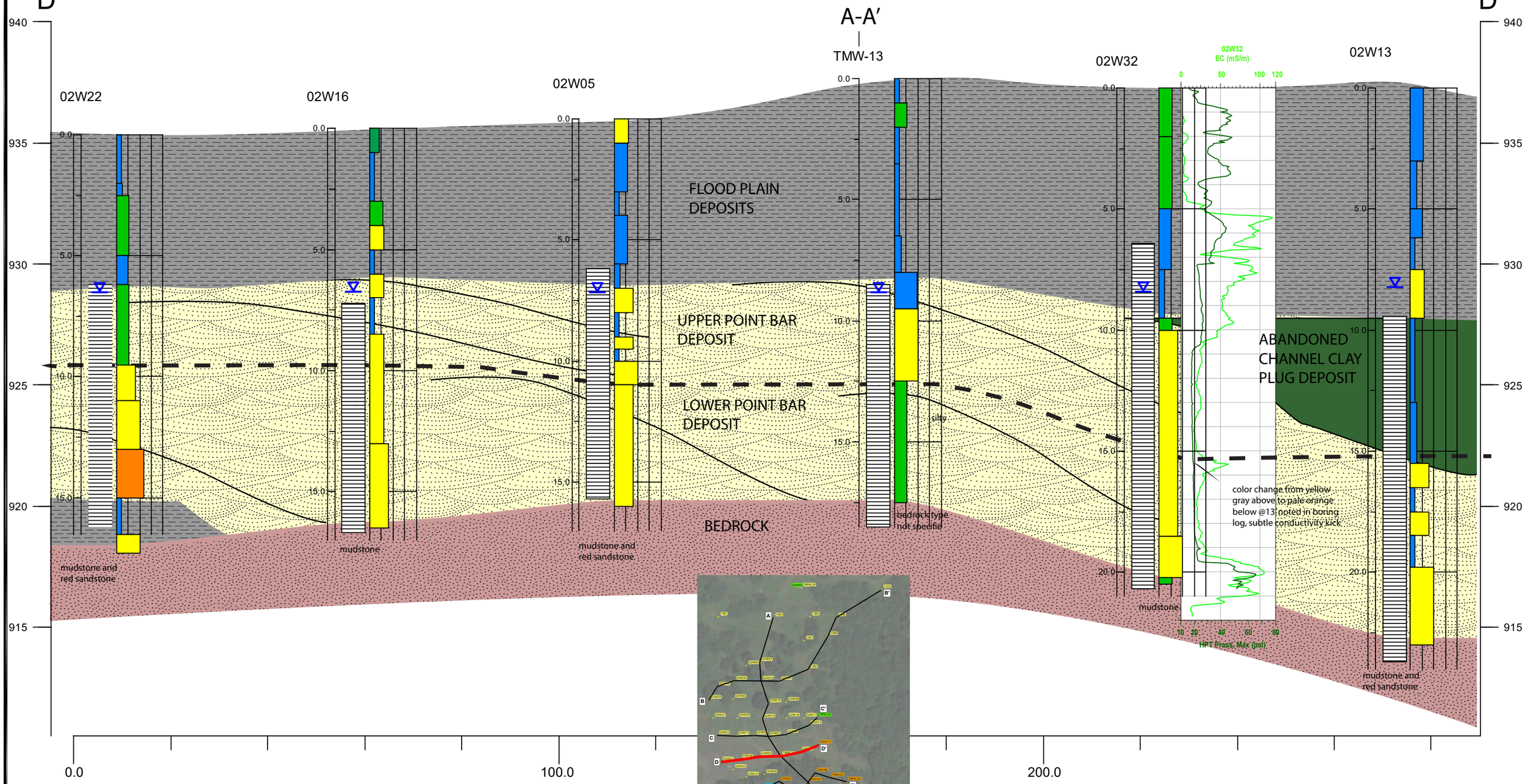
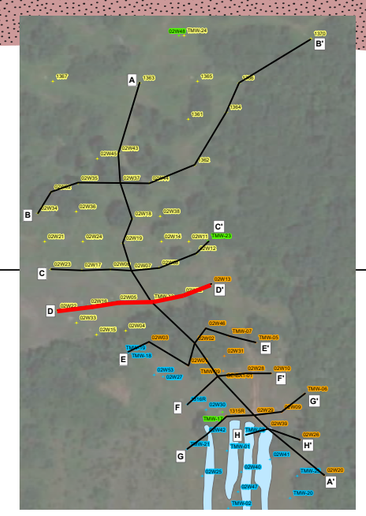
Cross-Section D-D'

WEST D — EAST D'





NOTES
1) Y-AXIS MEASURED IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN VERTICAL DATUM 1983)
2) X-AXIS MEASURED IN FEET
3) ALL CROSS-SECTION SYMBOLS ARE DEFINED ON FIGURE 4-1
4) HORIZONTAL AND VERTICAL SCALES ARE APPROXIMATE
5) SURFACE TOPOGRAPHY IS APPROXIMATE
6) GROUNDWATER ELEVATIONS MEASURED NOVEMBER 6, 2017
7) CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT

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Figure 2D

CROSS-SECTION D-D'
BURIAL AREA 1
CIMMARON SITE, OKLAHOMA

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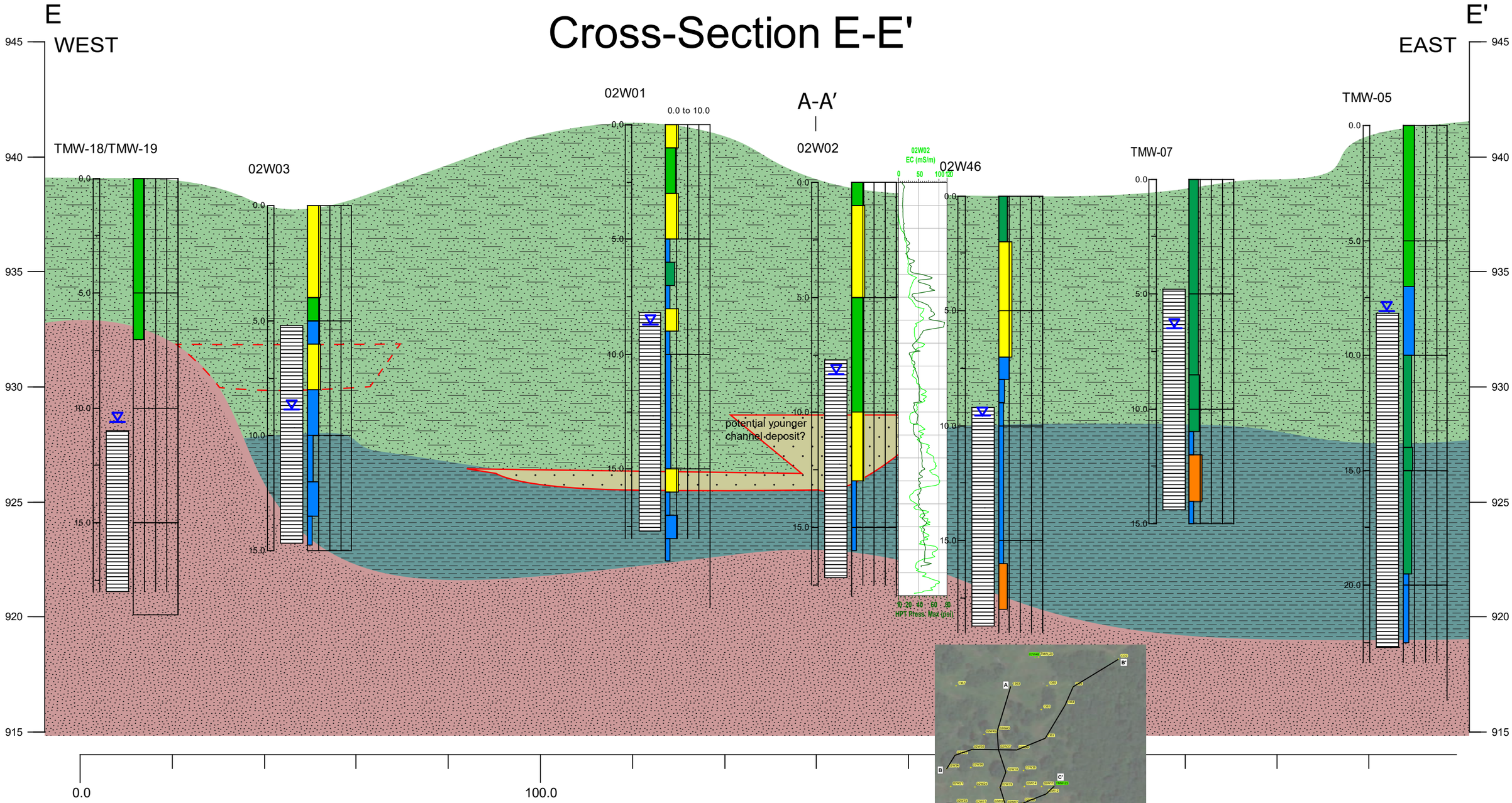
Cross-Section E-E'



NOTES
1) Y-AXIS MEASURED IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN VERTICAL DATUM 1983)
2) X-AXIS MEASURED IN FEET
3) ALL CROSS-SECTION SYMBOLS ARE DEFINED ON FIGURE 4-1
4) HORIZONTAL AND VERTICAL SCALES ARE APPROXIMATE
5) SURFACE TOPOGRAPHY IS APPROXIMATE
6) GROUNDWATER ELEVATIONS MEASURED NOVEMBER 6, 2017, EXCEPT 02W46 (MEASURED JULY 31, 2017)
7) CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT

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Figure 2E

CROSS-SECTION E-E'
BURIAL AREA 1
CIMMARON SITE, OKLAHOMA

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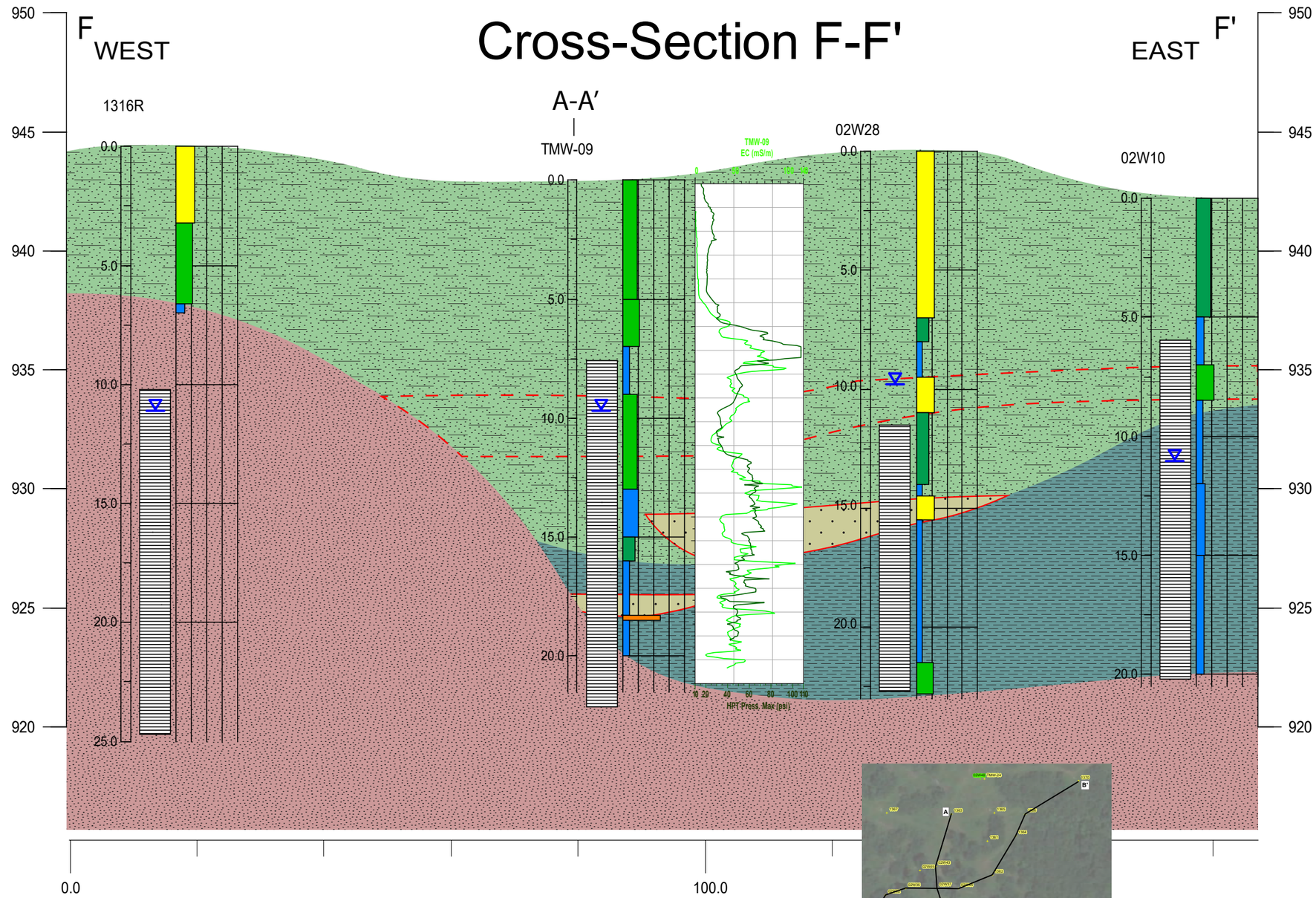
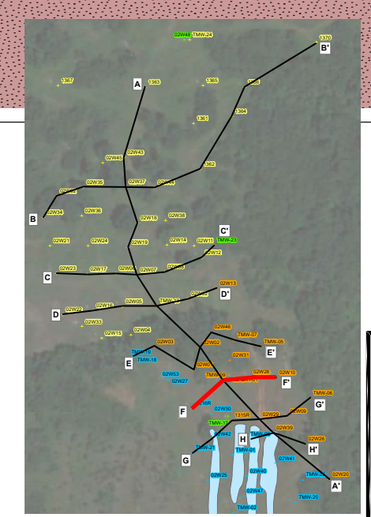
Cross-Section F-F'





NOTES
1) Y-AXIS MEASURED IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN VERTICAL DATUM 1983)
2) X-AXIS MEASURED IN FEET
3) ALL CROSS-SECTION SYMBOLS ARE DEFINED ON FIGURE 4-1
4) HORIZONTAL AND VERTICAL SCALES ARE APPROXIMATE
5) SURFACE TOPOGRAPHY IS APPROXIMATE
6) GROUNDWATER ELEVATIONS MEASURED NOVEMBER 6, 2017
7) CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT

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Figure 2F

CROSS-SECTION F-F'
BURIAL AREA 1
CIMMARON SITE, OKLAHOMA

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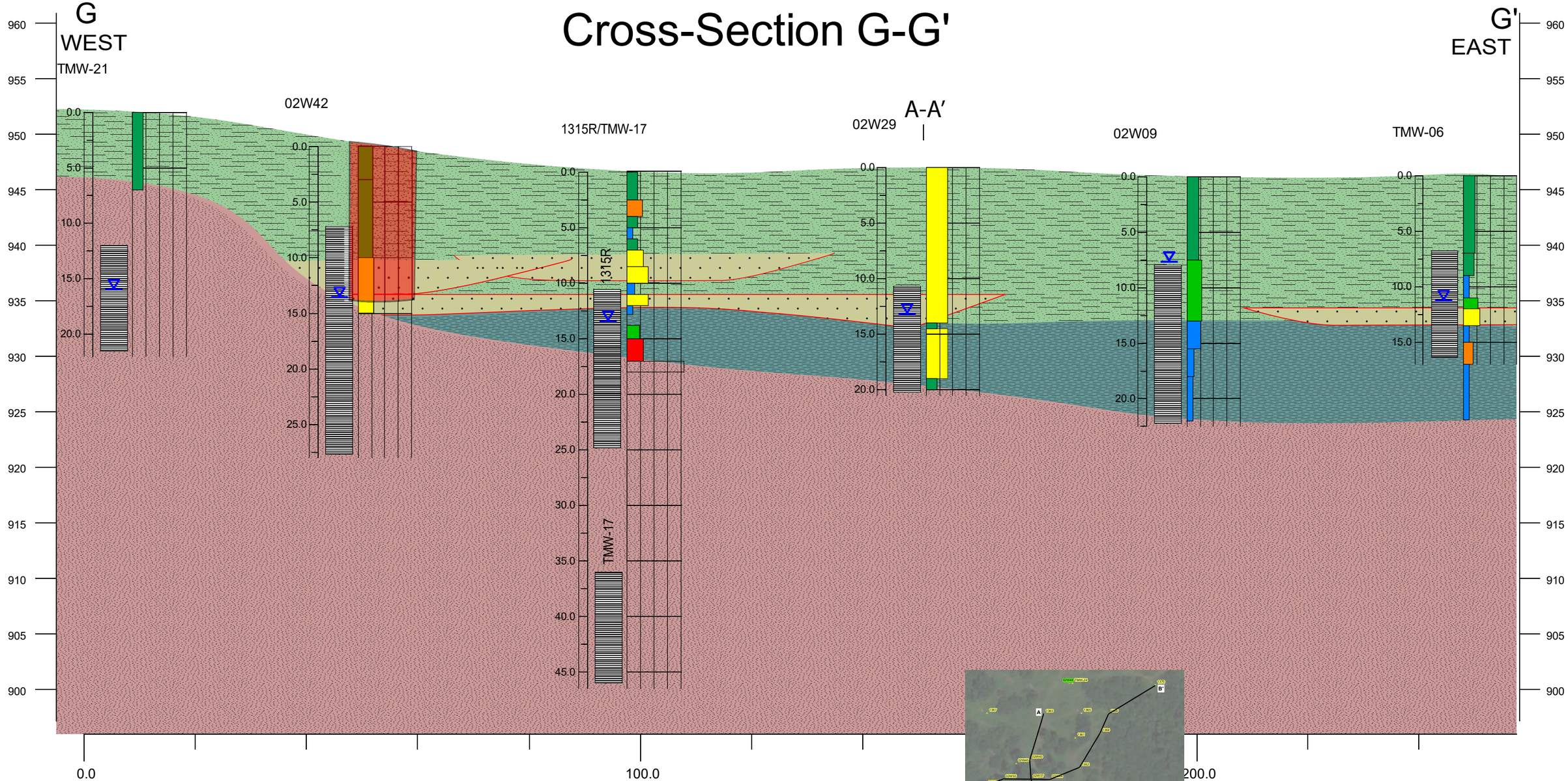
Cross-Section G-G'



NOTES
1) Y-AXIS MEASURED IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN VERTICAL DATUM 1983)
2) X-AXIS MEASURED IN FEET
3) ALL CROSS-SECTION SYMBOLS ARE DEFINED ON FIGURE 4-1
4) HORIZONTAL AND VERTICAL SCALES ARE APPROXIMATE
5) SURFACE TOPOGRAPHY IS APPROXIMATE
6) GROUNDWATER ELEVATIONS MEASURED NOVEMBER 6, 2017, EXCEPT 02W29 (MEASURED JULY, 31 2017)
7) CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT

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Figure 2G

CROSS-SECTION G-G'
BURIAL AREA 1
CIMMARON SITE, OKLAHOMA

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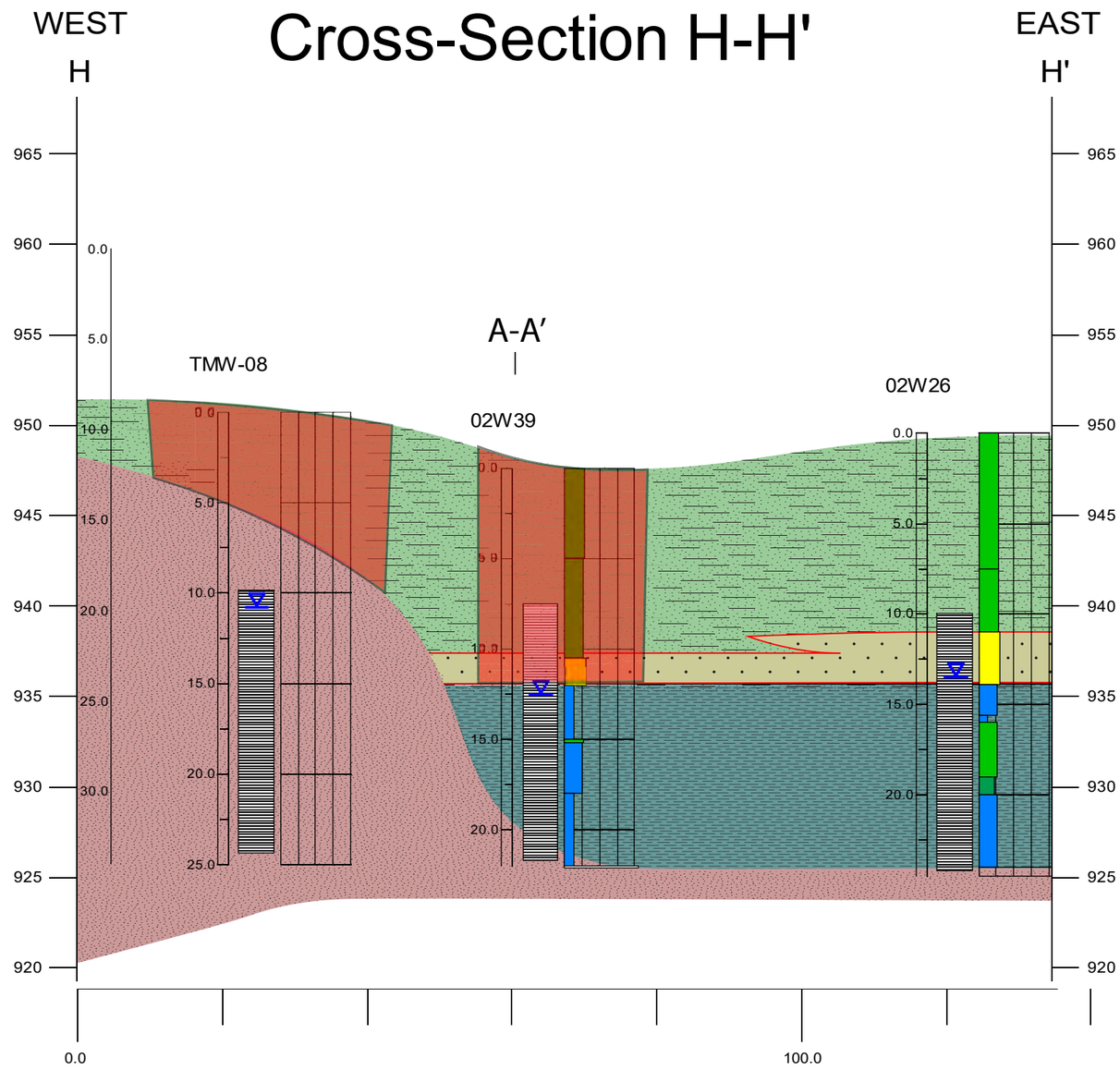
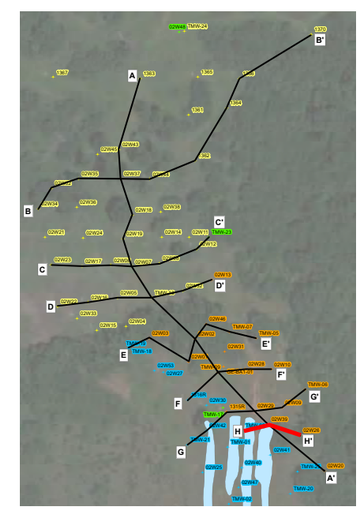
Cross-Section H-H'





NOTES
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3) ALL CROSS-SECTION SYMBOLS ARE DEFINED ON FIGURE 4-1
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7) CORRELATION OF UNITS IS AN INTERPRETATION AND NOT NECESSARILY A DELINEATION OF ACTUAL EXTENT AND THICKNESS OF EACH INDIVIDUAL UNIT

BURNS McDONNELL

Figure 2H

CROSS-SECTION H-H'
BURIAL AREA 1
CIMMARON SITE, OKLAHOMA

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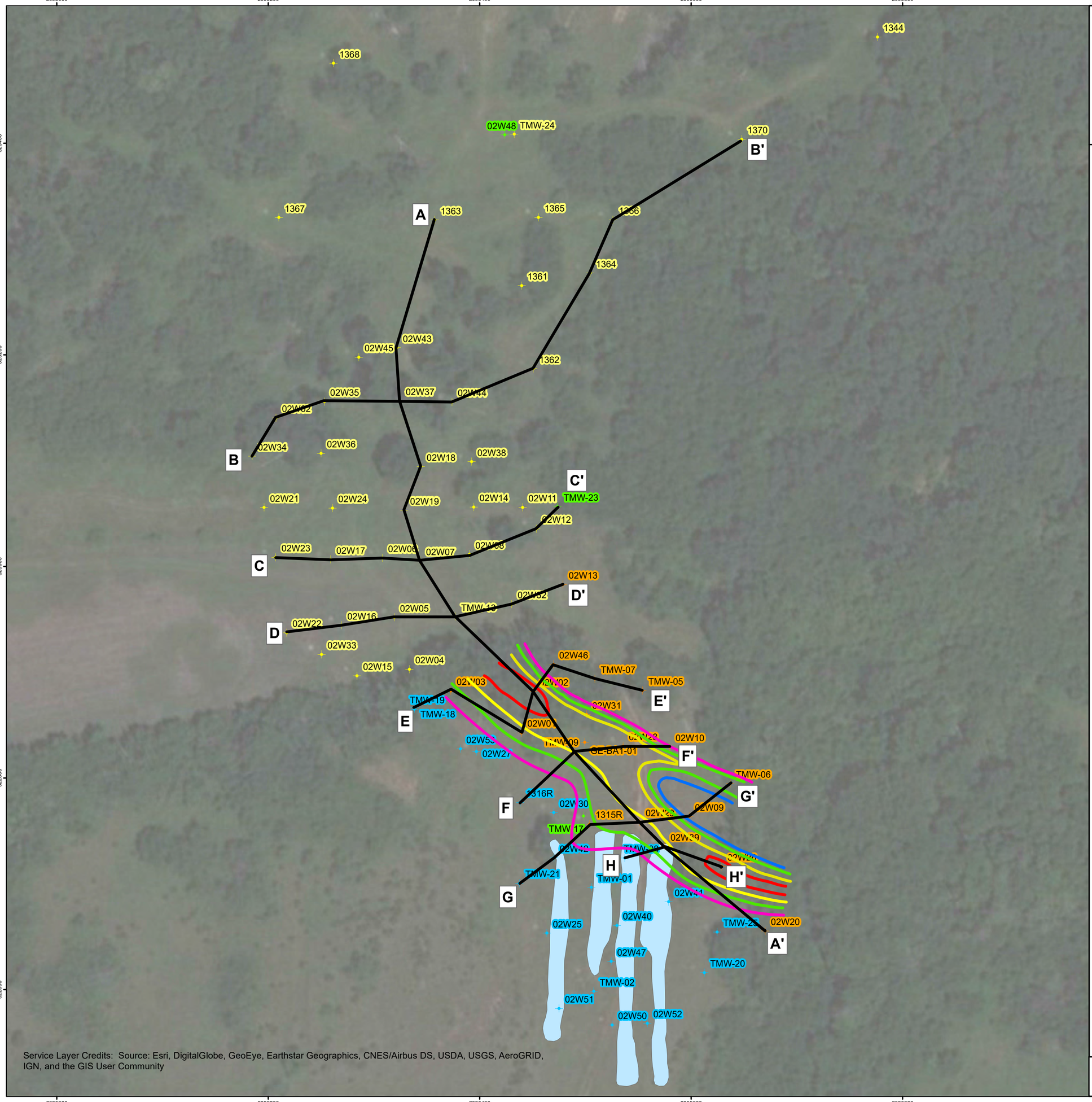
FIGURE 3A
ISOPACH CONTOURS
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

BURNS McDONNELL

environmental properties management, LLC



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- MONITORING WELL IN TRANSITION ZONE
- MONITORING WELL IN ALLUVIUM
- MONITORING WELL IN SANDSTONE A
- MONITORING WELL IN SANDSTONE B
- MONITORING WELL IN SANDSTONE C
- WASTE DISPOSAL TRENCH
- CROSS-SECTION LINE

ESTIMATED THICKNESS OF RELATIVELY PERMEABLE STRATA

- ZERO EDGE
- ONE FOOT
- TWO FEET
- THREE FEET

NOTES:

ISOPACH THICKNESS CONTOUR LINES APPROXIMATED. LINES BASED ON BASAL, SATURATED, INTRA-GULLY STREAM DEPOSITS.

0 50 100 200 Feet

N

Source: ESRI and Burns & McDonnell Engineering.

COORDINATES : (NAD 83) STATE PLANE OKLAHOMA NORTH FEET

DATE : AERIAL PHOTO - 2010 / MAP PRODUCED - 4/6/2018

Path: Z:\Clients\ENS\CERT_ClientInfo\Sites\Database\Geospatial\Maps & Dwgs\ArcGIS\BMCD_Files\Arcdocs\2018\ESS Tech Memo\Isopach Map.mxd
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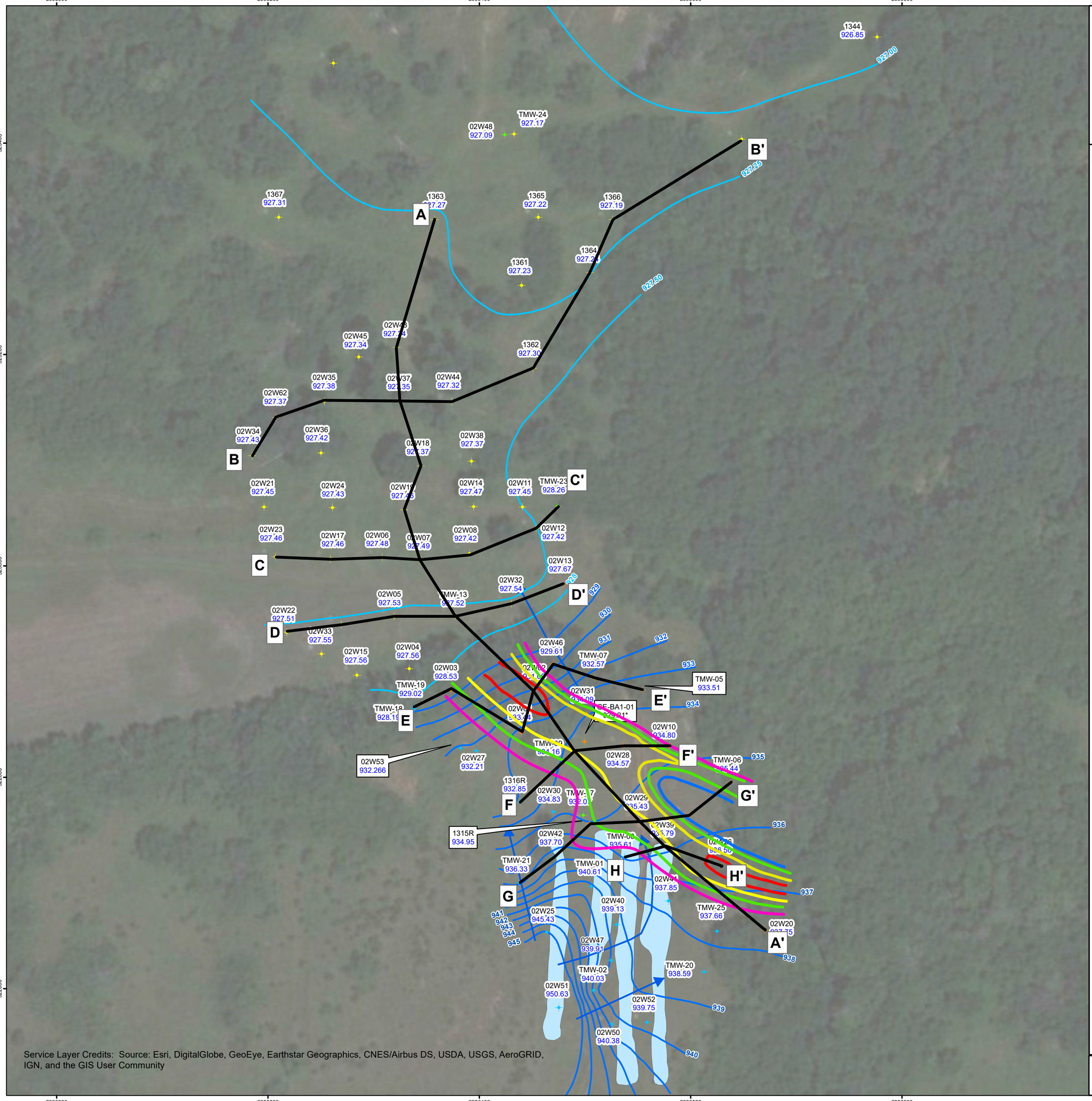
FIGURE 3B
ISOPACH CONTOURS WITH POTENTIOMETRIC SURFACE
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

BURNS McDONNELL

environmental properties management, LLC



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- MONITORING WELL IN TRANSITION ZONE
- MONITORING WELL IN ALLUVIUM
- MONITORING WELL IN SANDSTONE A
- MONITORING WELL IN SANDSTONE B
- MONITORING WELL IN SANDSTONE C
- GROUNDWATER FLOW DIRECTION
- ALLUVIUM DEPOSITS GW CONTOURS
- SANDSTONE B GW CONTOURS
- WASTE DISPOSAL TRENCH
- CROSS-SECTION LINE
- **ESTIMATED THICKNESS OF RELATIVELY PERMEABLE STRATA**
- ZERO EDGE
- ONE FOOT
- TWO FEET
- THREE FEET

NOTES:

GROUNDWATER ELEVATION DATA COLLECTED MARCH 18, 2015

ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL (NORTH AMERICAN VERTICAL DATUM 1988)

*DATA FROM GE-BA1-01 NOT USED IN CONTOURING

ISOPACH CONTOUR LINES APPROXIMATED. LINES BASED ON BASAL, SATURATED, INTRA-GULLY STREAM DEPOSITS.

GW - GROUNDWATER

0 50 100 200 Feet

N

Source: ESRI and Burns & McDonnell Engineering.

COORDINATES : (NAD 83) STATE PLANE OKLAHOMA NORTH FEET

DATE : AERIAL PHOTO - 2010 / MAP PRODUCED - 4/6/2018

Path: Z:\Clients\ENS\CERT_ClientInfo\Sites\Database\Geospatial\Maps & Dwgs\ArcGIS\BMCD_Files\Arcdocs\2018\ESS Tech Memo\Isopach Poten Conc Map.mxd
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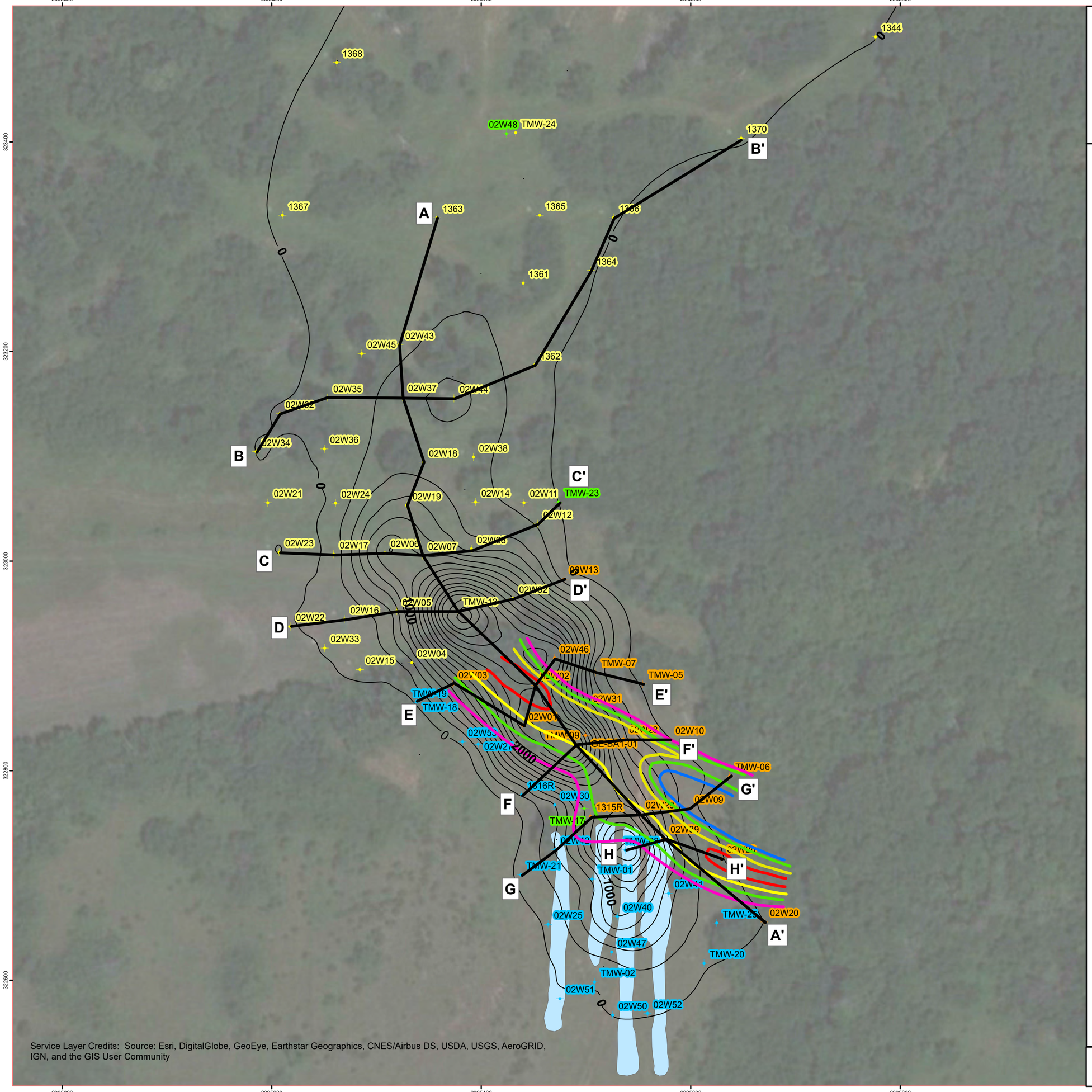
FIGURE 3C
ISOPACH CONTOURS WITH URANIUM ISOPLETHS BURIAL AREA 1 CIMARRON SITE, OKLAHOMA

BURNS McDONNELL

environmental properties management, LLC



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- MONITORING WELL IN TRANSITION ZONE
- MONITORING WELL IN ALLUVIUM
- MONITORING WELL IN SANDSTONE A
- MONITORING WELL IN SANDSTONE B
- MONITORING WELL IN SANDSTONE C
- URANIUM CONTOURS IN UG/L
- WASTE DISPOSAL TRENCH
- CROSS-SECTION LINE

ESTIMATED THICKNESS OF RELATIVELY PERMEABLE STRATA

- ZERO EDGE
- ONE FOOT
- TWO FEET
- THREE FEET

NOTES:

UG/L - MICROGRAMS PER LITER

ISOPACH CONTOUR LINES APPROXIMATED. LINES BASED ON BASAL, SATURATED, INTRA-GULLY STREAM DEPOSITS.

URANIUM COTOURS ARE BASED ON 95% UCL FROM DATA COLLECTED 2011 THROUGH 2ND QUARTER 2017.

0 50 100 200 Feet

N

Source: ESRI and Burns & McDonnell Engineering.

COORDINATES : (NAD 83) STATE PLANE OKLAHOMA NORTH FEET

DATE : AERIAL PHOTO - 2010 / MAP PRODUCED - 4/6/2018

Path: Z:\Clients\ENS\CERT_ClientInfo\Sites\Database\Geospatial\Maps & Dwgs\ArcGIS\BMCD_Files\Arcdocs\2018\ESS Tech Memo\Isopach U Conc Map.mxd
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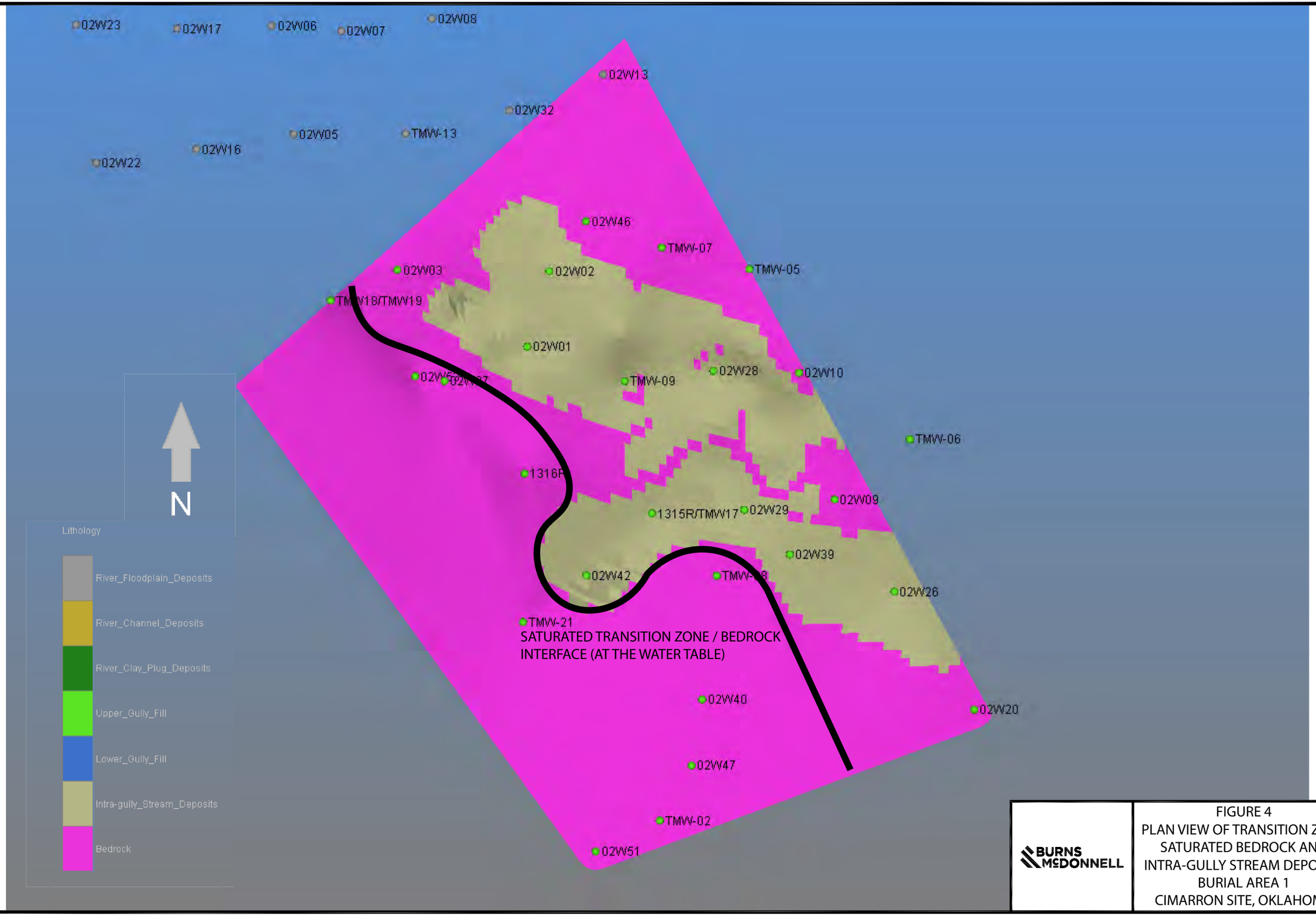

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FIGURE 4
PLAN VIEW OF TRANSITION ZONE
SATURATED BEDROCK AND
INTRA-GULLY STREAM DEPOSITS
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

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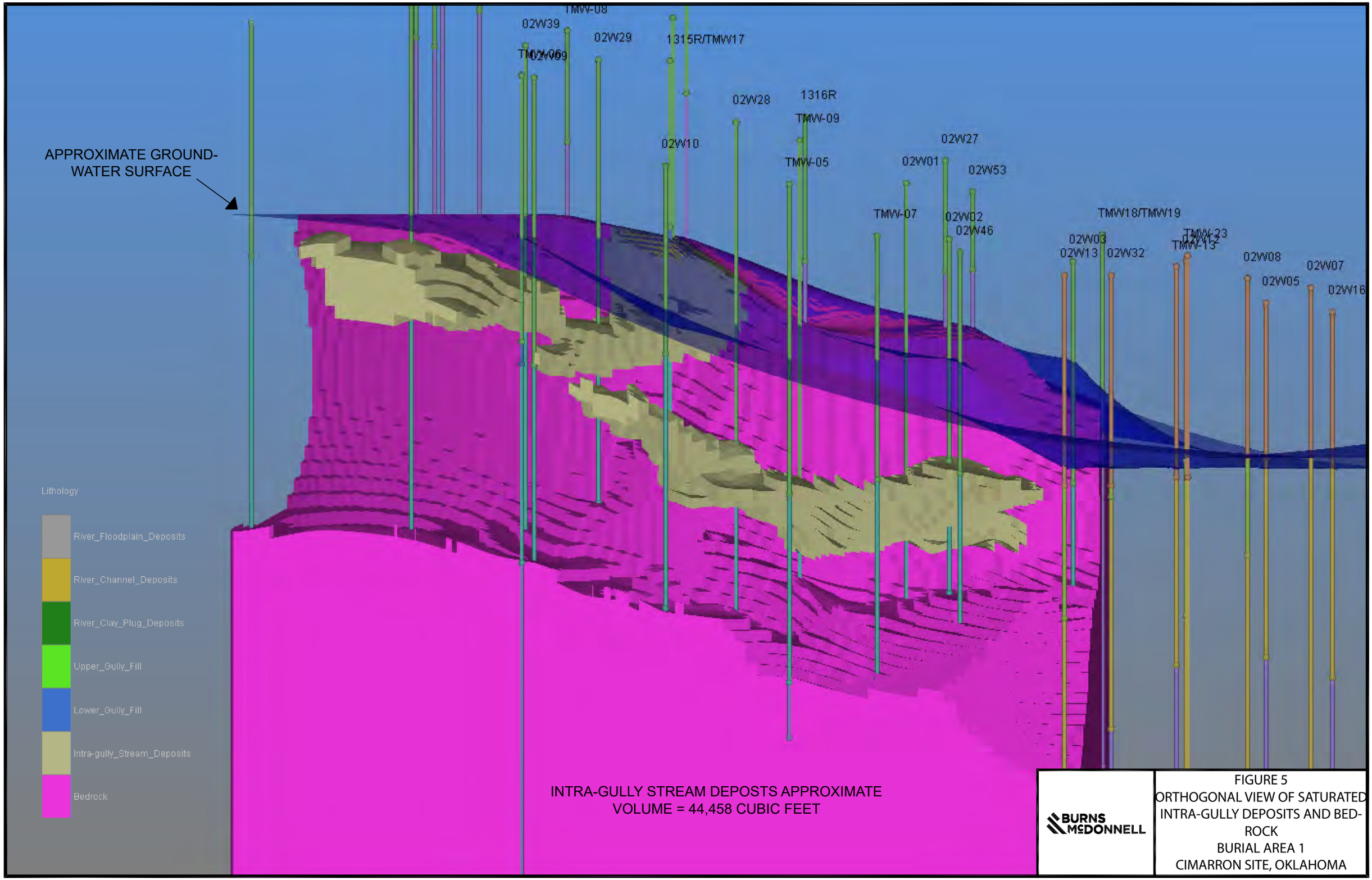

BURNS McDONNELL

FIGURE 5
ORTHOGONAL VIEW OF SATURATED INTRA-GULLY DEPOSITS AND BED-ROCK
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

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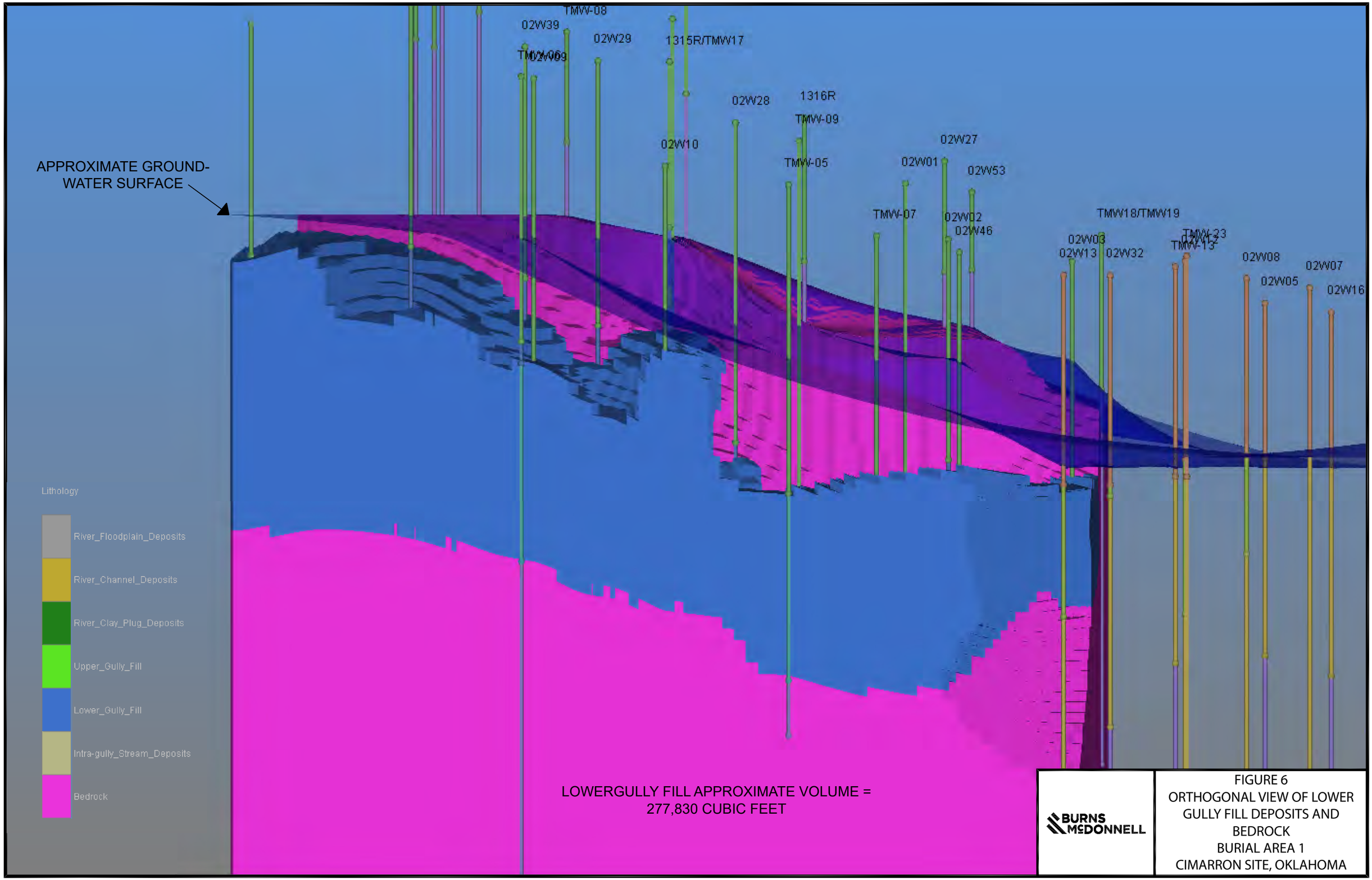

BURNS McDONNELL

FIGURE 6
ORTHOGONAL VIEW OF LOWER GULLY FILL DEPOSITS AND BEDROCK
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

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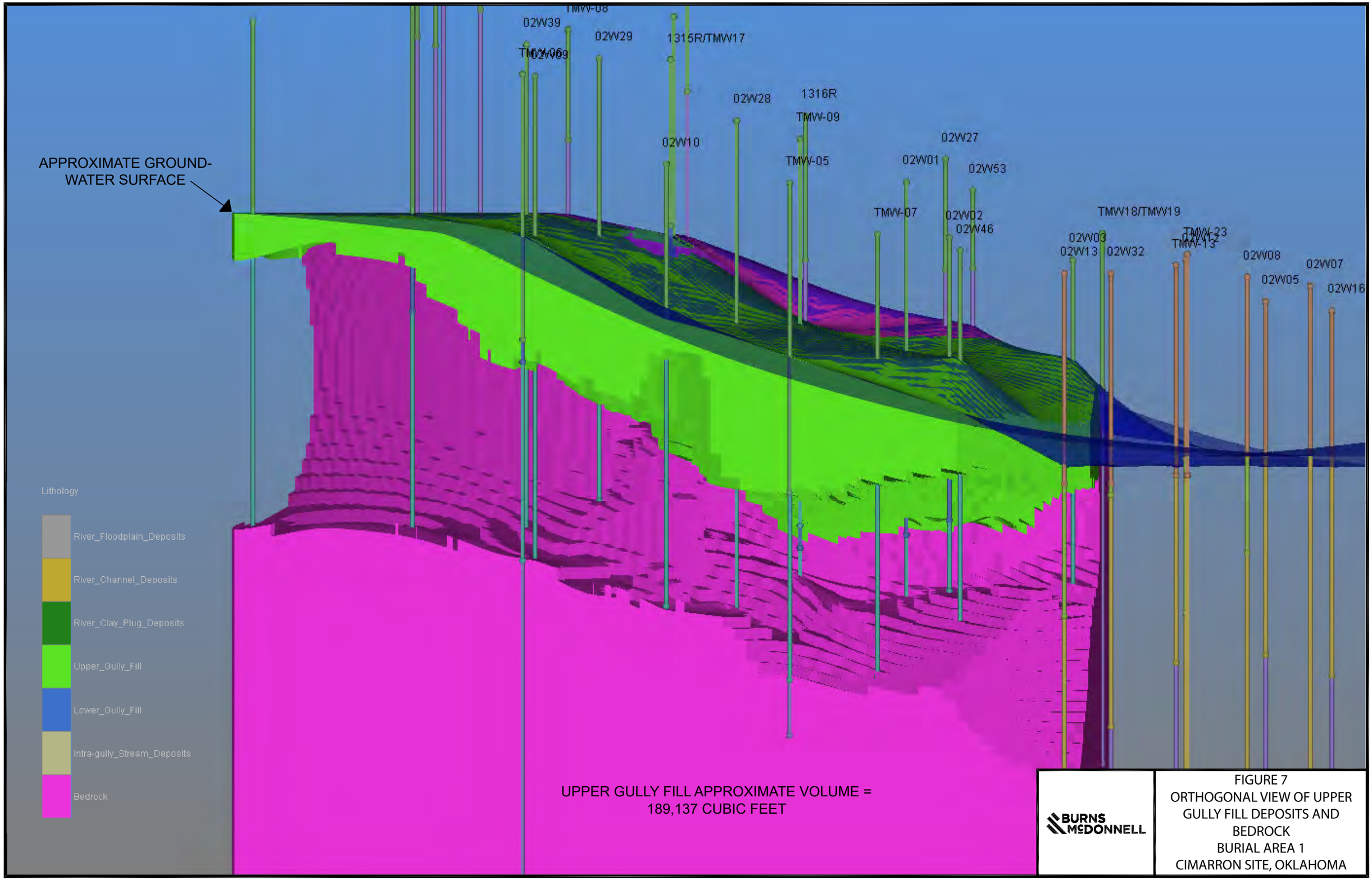

BURNS McDONNELL

FIGURE 7
ORTHOGONAL VIEW OF UPPER GULLY FILL DEPOSITS AND BEDROCK
BURIAL AREA 1
CIMARRON SITE, OKLAHOMA

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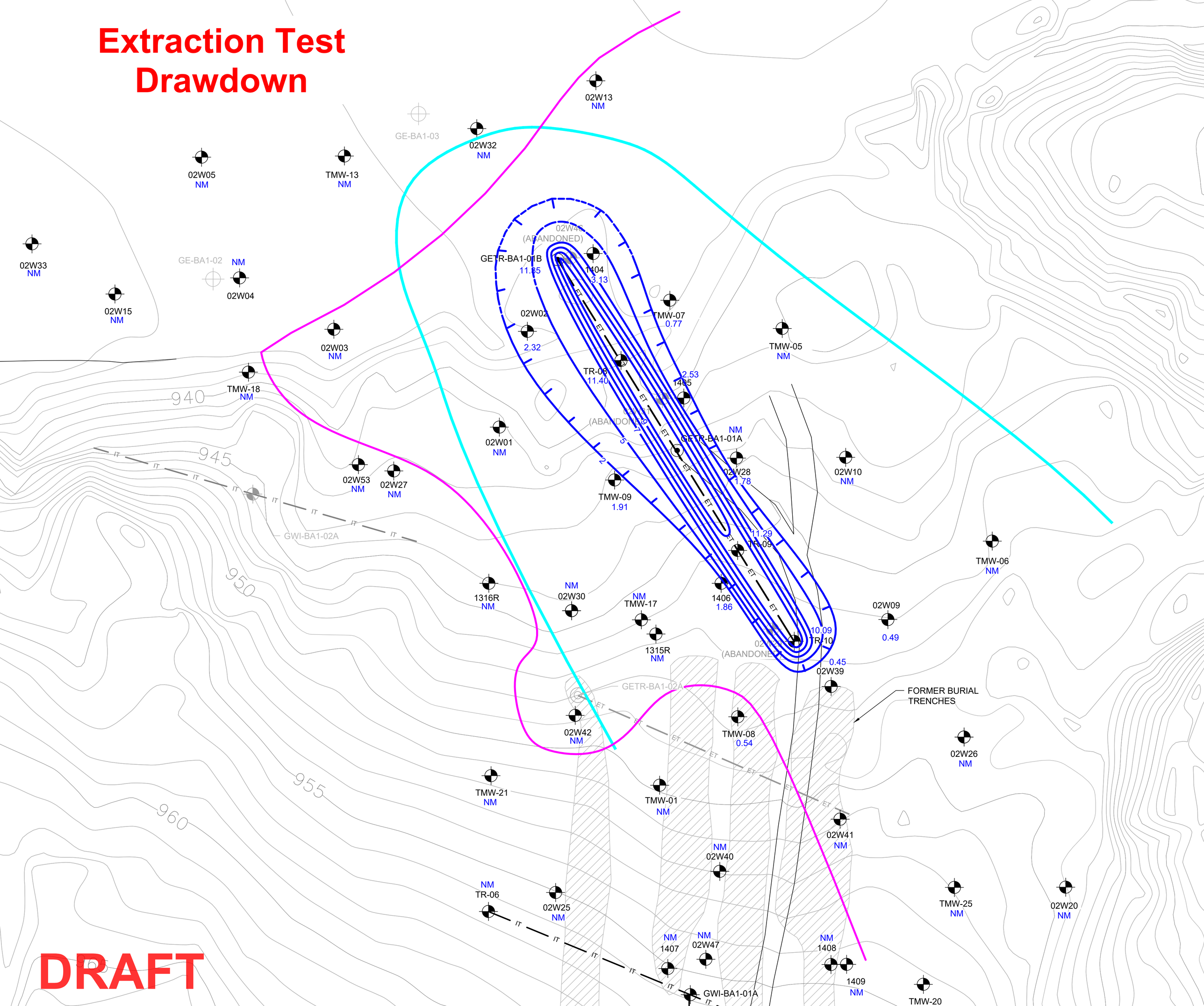
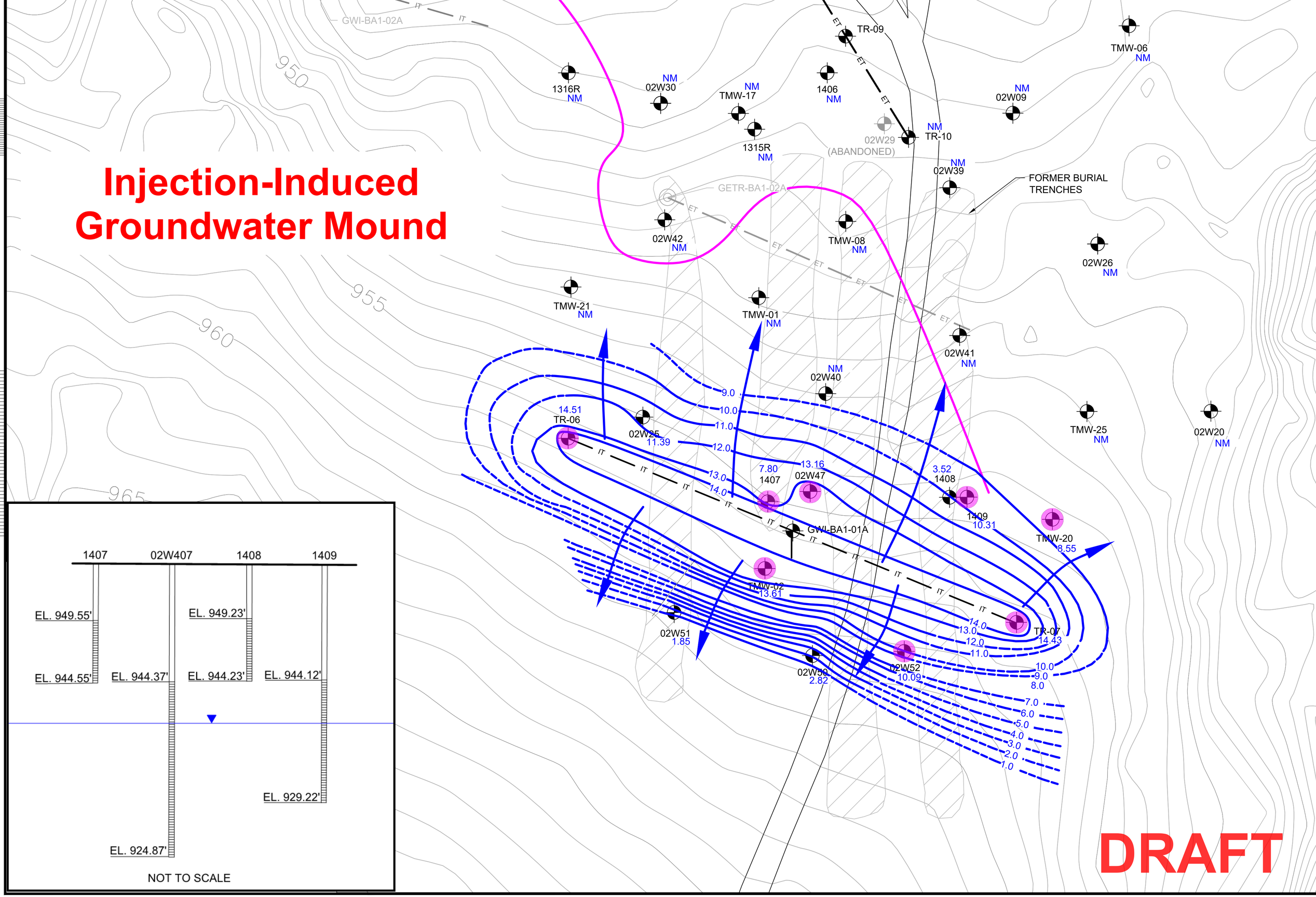
Extraction Test Drawdown



DRAFT

Injection-Induced Groundwater Mound



DRAFT

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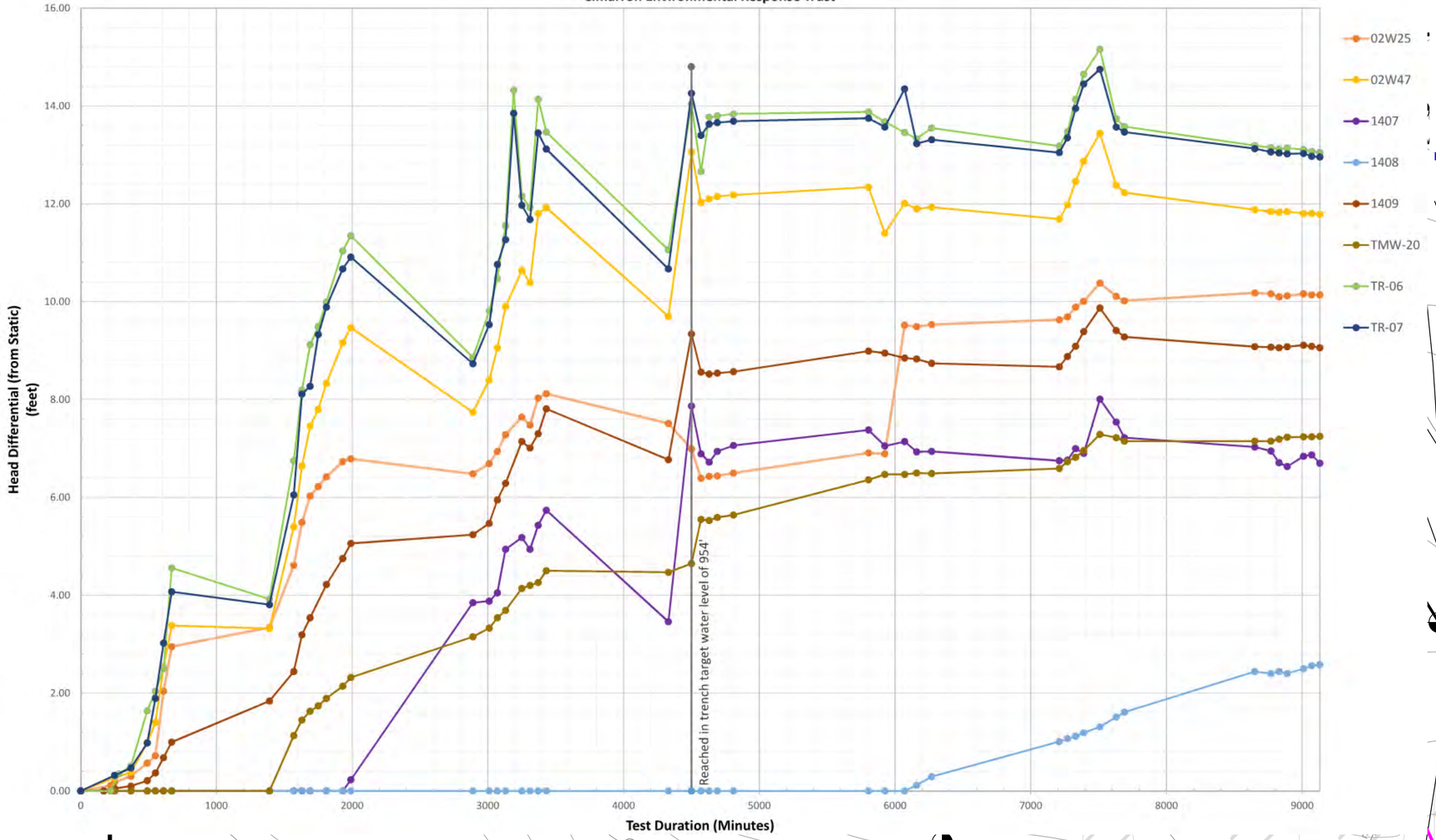
Head Response
(In-Trench & Downgradient Wells)



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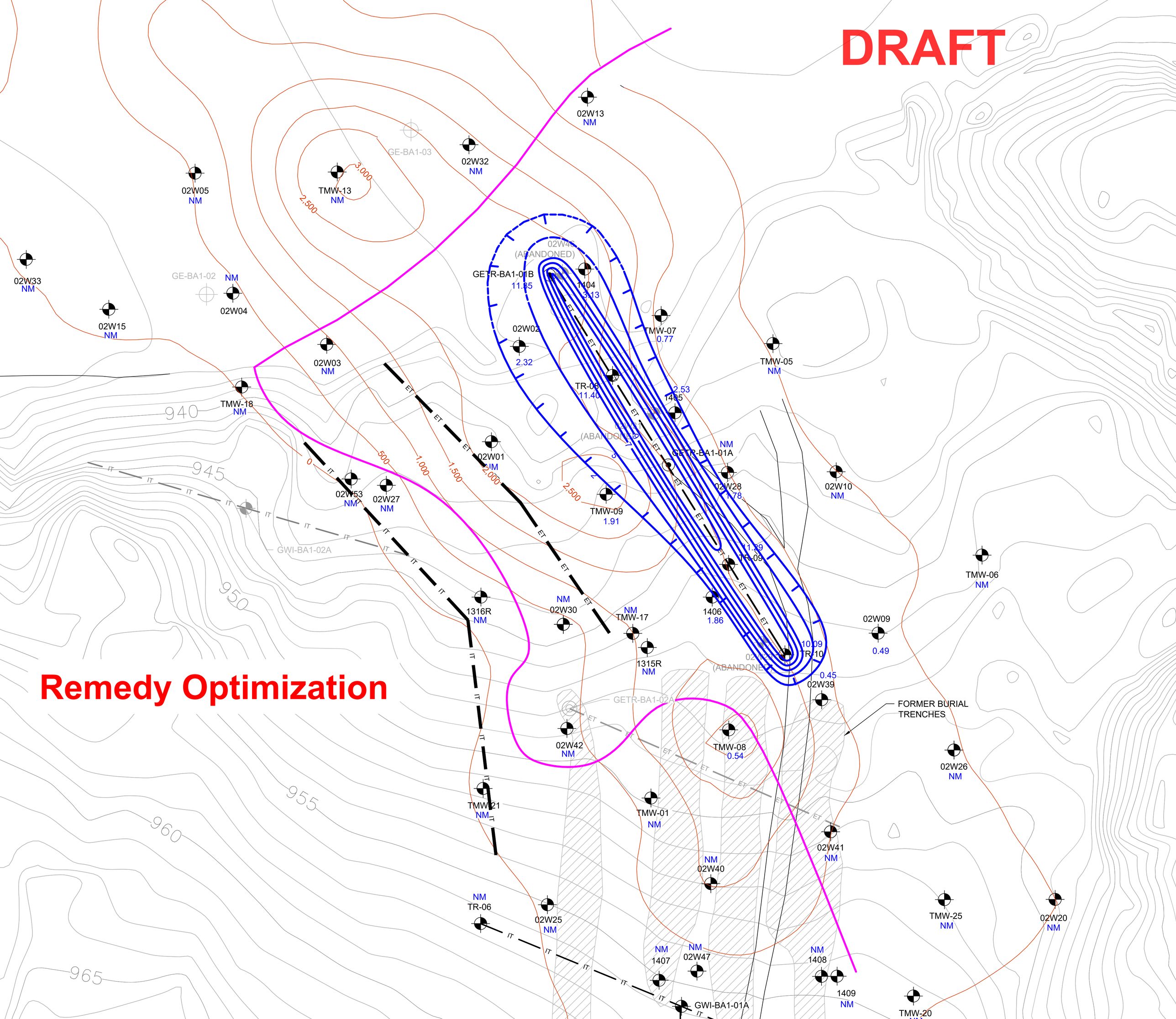
DRAFT


DRAFT
Remedy Optimization
02W13
NM
GE-BA1-03
02W32
NM
02W05
NM
TMW-13
NM
3,000
2,500
02W33
NM
GE-BA1-02
NM
02W04
02W15
NM
02W03
NM
TMW-18
NM
940
945
950
955
960
965
GETR-BA1-01B
11.85
1404
3.13
02W02
2.32
TMW-07
0.77
TMW-05
NM
TR-08
11.40
2.53
1405
NM
GETR-BA1-01A
02W01
NM
0
500
1,000
1,500
2,000
2,500
02W53
NM
02W27
NM
TMW-09
1.91
02W28
1.78
02W10
NM
GWI-BA1-02A
11.29
TR-09
TMW-06
NM
1316R
NM
NM
02W30
NM
TMW-17
1406
1.86
02W09
0.49
1315R
NM
10.09
TR-10
0.45
02W39
FORMER BURIAL
TRENCHES
GETR-BA1-02A
02W42
NM
TMW-08
0.54
02W26
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TMW-21
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02W40
NM
TR-06
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TMW-25
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02W20
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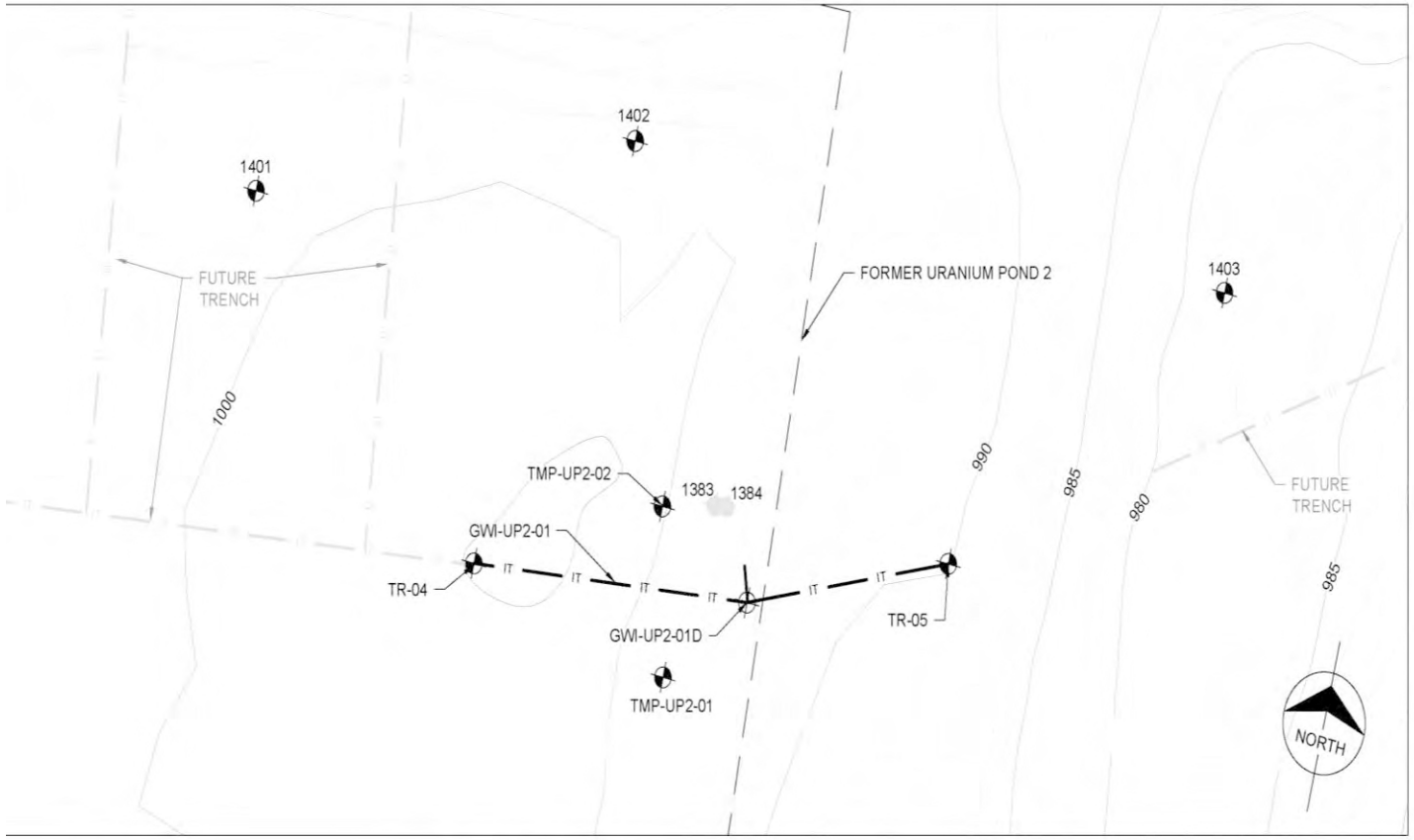
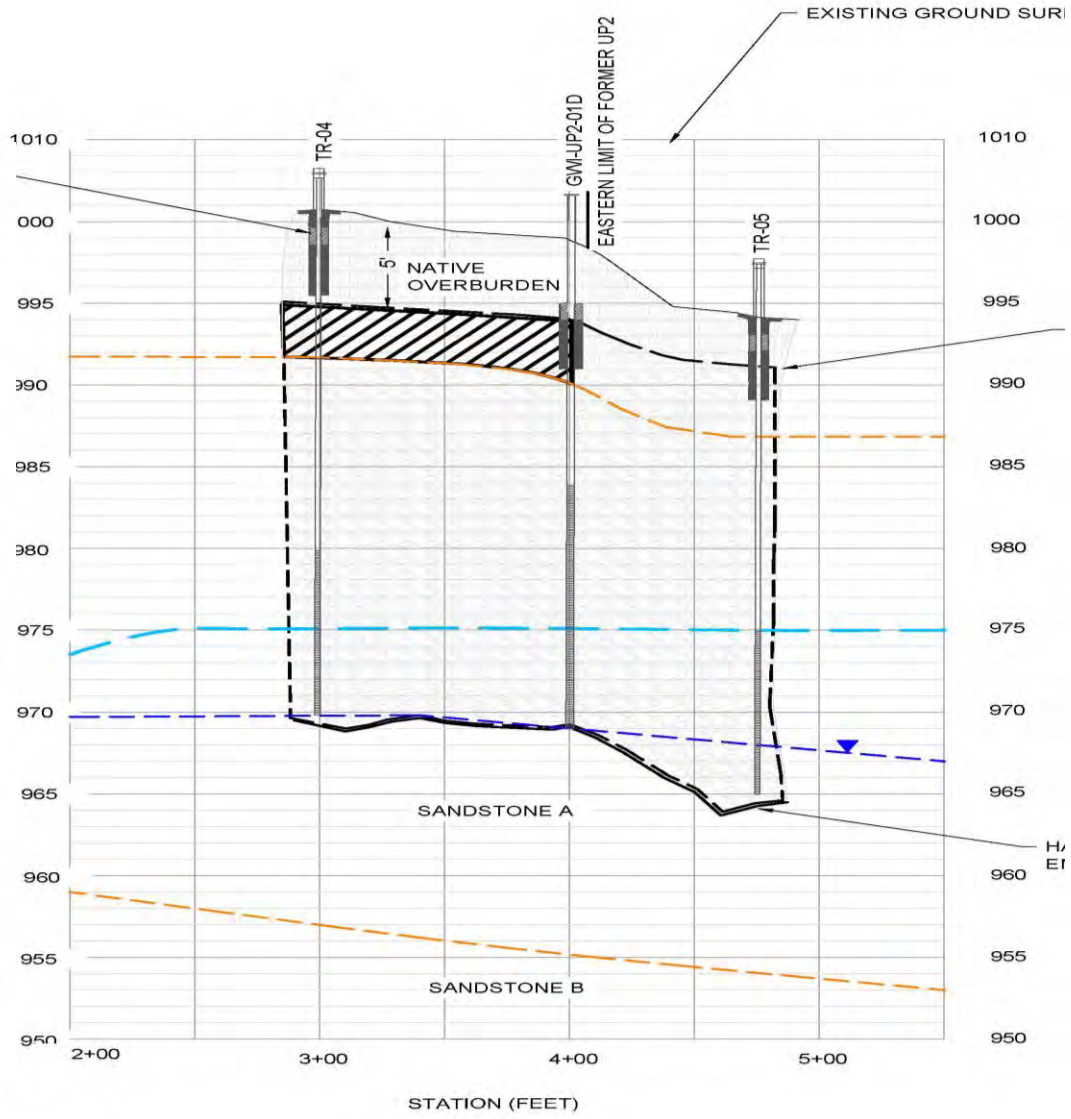
TMW-20

URANIUM POND #2

URANIUM POND #2



INJECTION TRENCH GWI-UP2-01
PLAN VIEW



URANIUM POND #2

Debris Scanning

Trench Progress

URANIUM POND #2

Impacted Soil Management Area

Equipment Scanning

URANIUM POND #2

GWI-UP2 Trench View

Trench Backfilling

URANIUM POND #2

Geotextile Placement

Impacted Material Backfill

URANIUM POND #2

Bench Backfilling

Final Compaction

URANIUM POND #2 – LESSONS LEARNED

- GCL placement in water
- Detailed soil management plan is key
- Working bench – above potentially impacted soil zone

URANIUM POND #2

Injection Trench Test Results

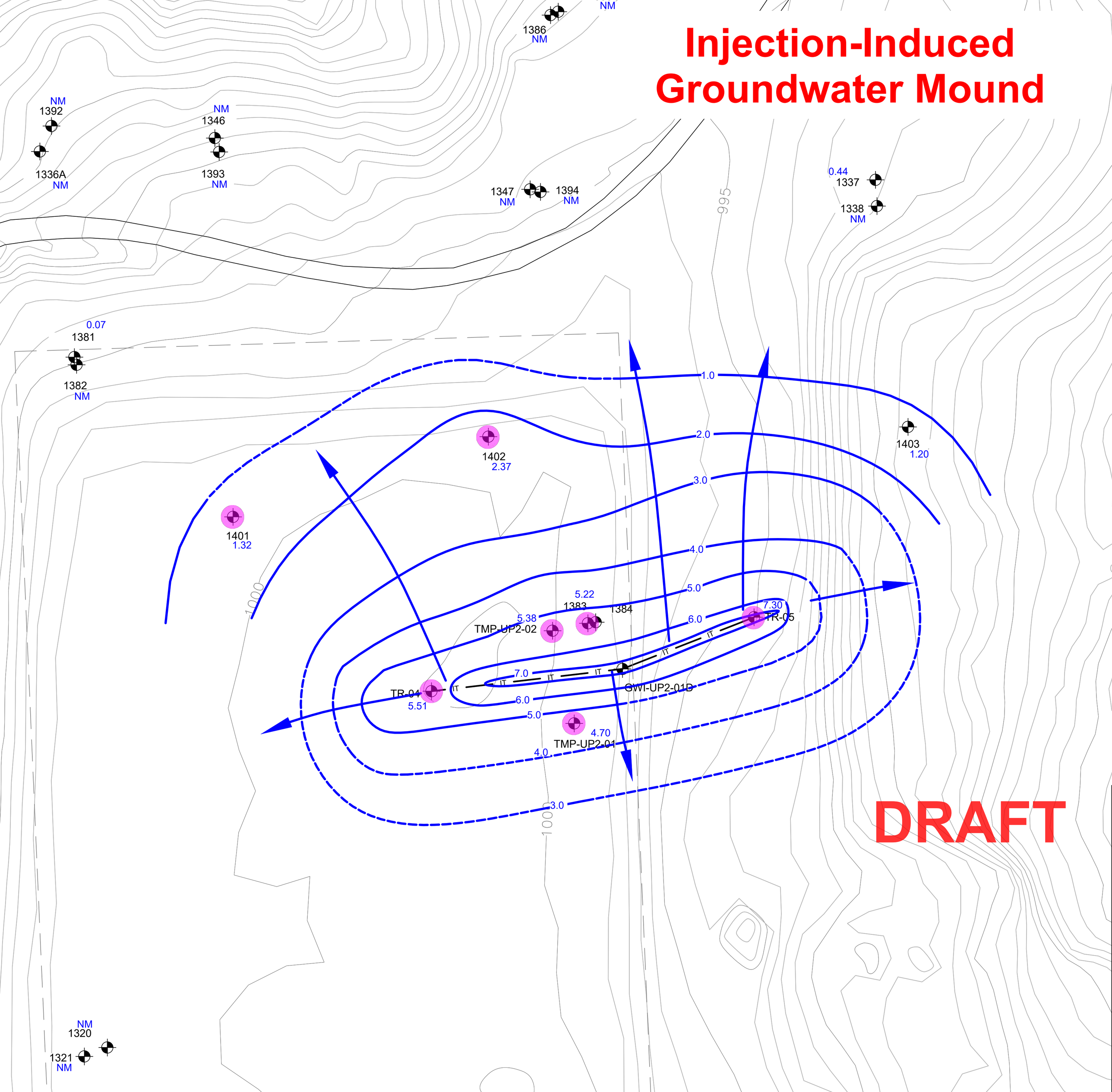
- Steady state injection rate: 12 gpm (12 gpd per ft^2)
  - Previous est.: 2 to 5 gpd per ft^2 (based on UP2 packer test results)
  - Limitation is capture, not aquifer acceptance
- **Hydraulic Mound Figure**
- **Head Response Trend Chart**
  - Head responses generally commensurate with MW location

URANIUM POND #2

Design Implications

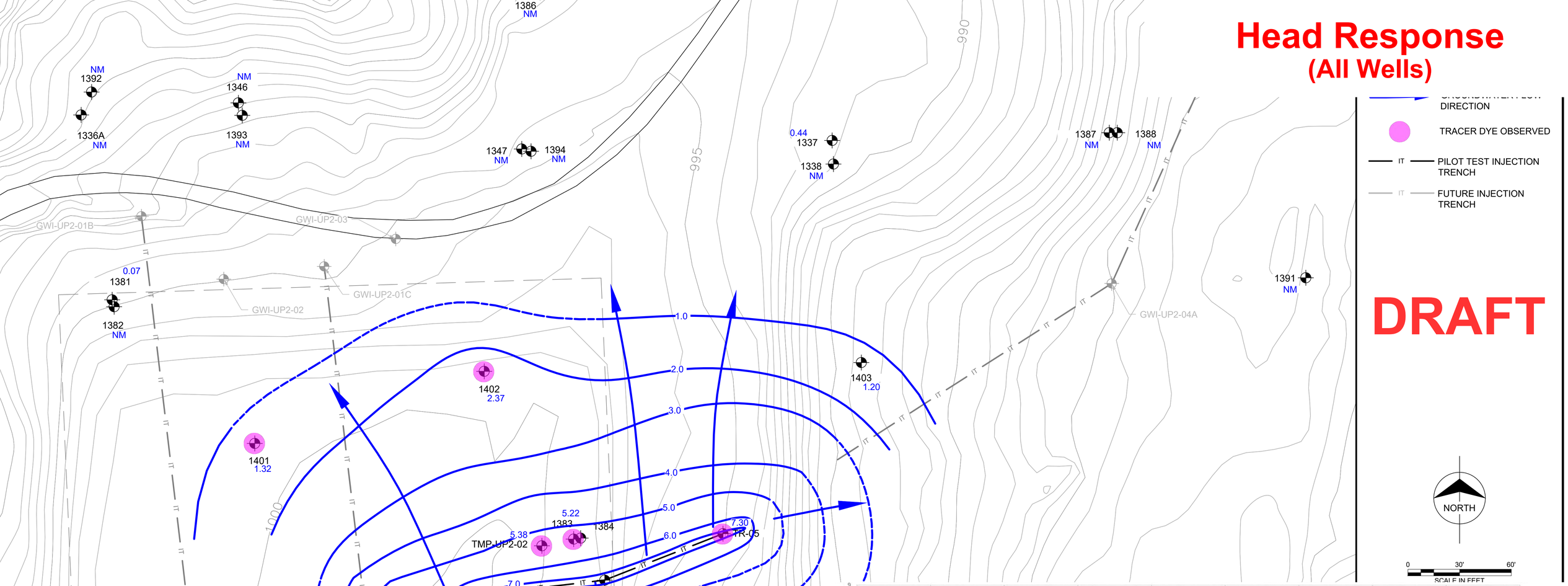
- Trench design optimization
  - Elimination of north/south laterals
  - Reconfiguration and length reduction for GWI-UP2-01 and GWI-UP2-04
  - Liner will be installed on southern/eastern faces of GWI-UP2-01 and GWI-UP2-04
- Revisions to timing of injected water front arrival at WAA extraction wells and impact on WATF influent concentration trends

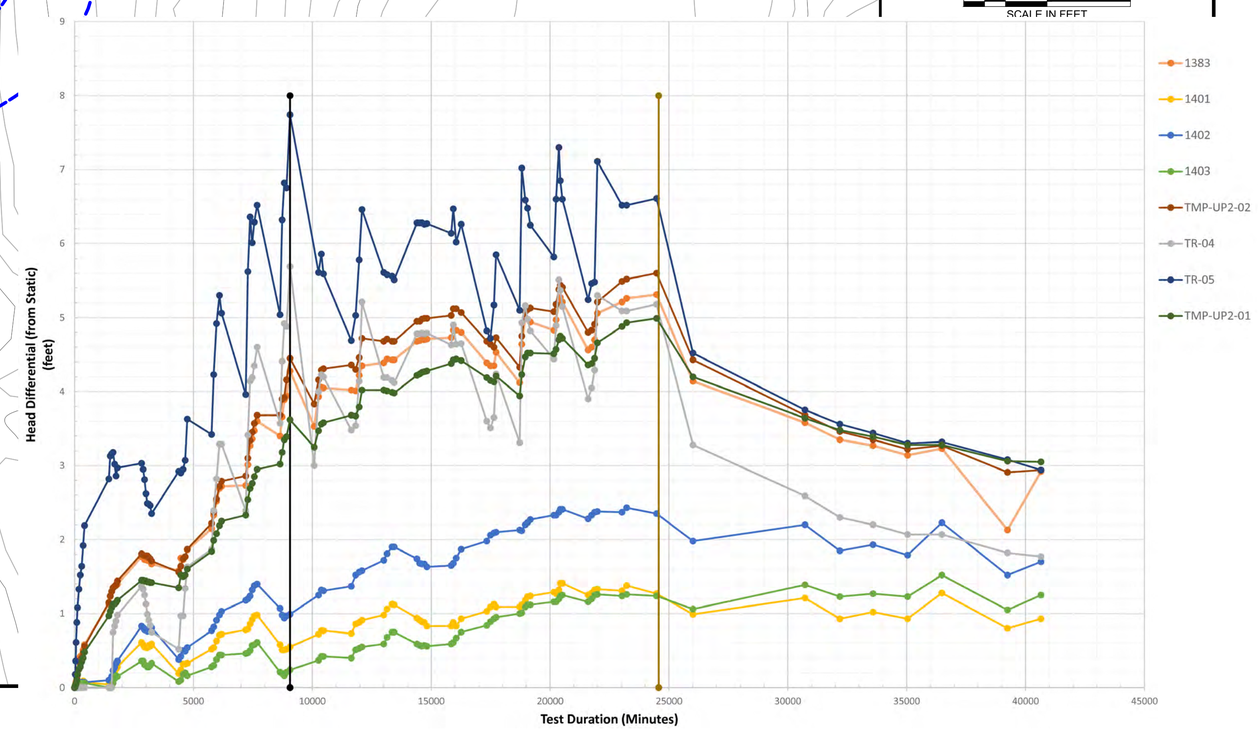
Injection-Induced Groundwater Mound

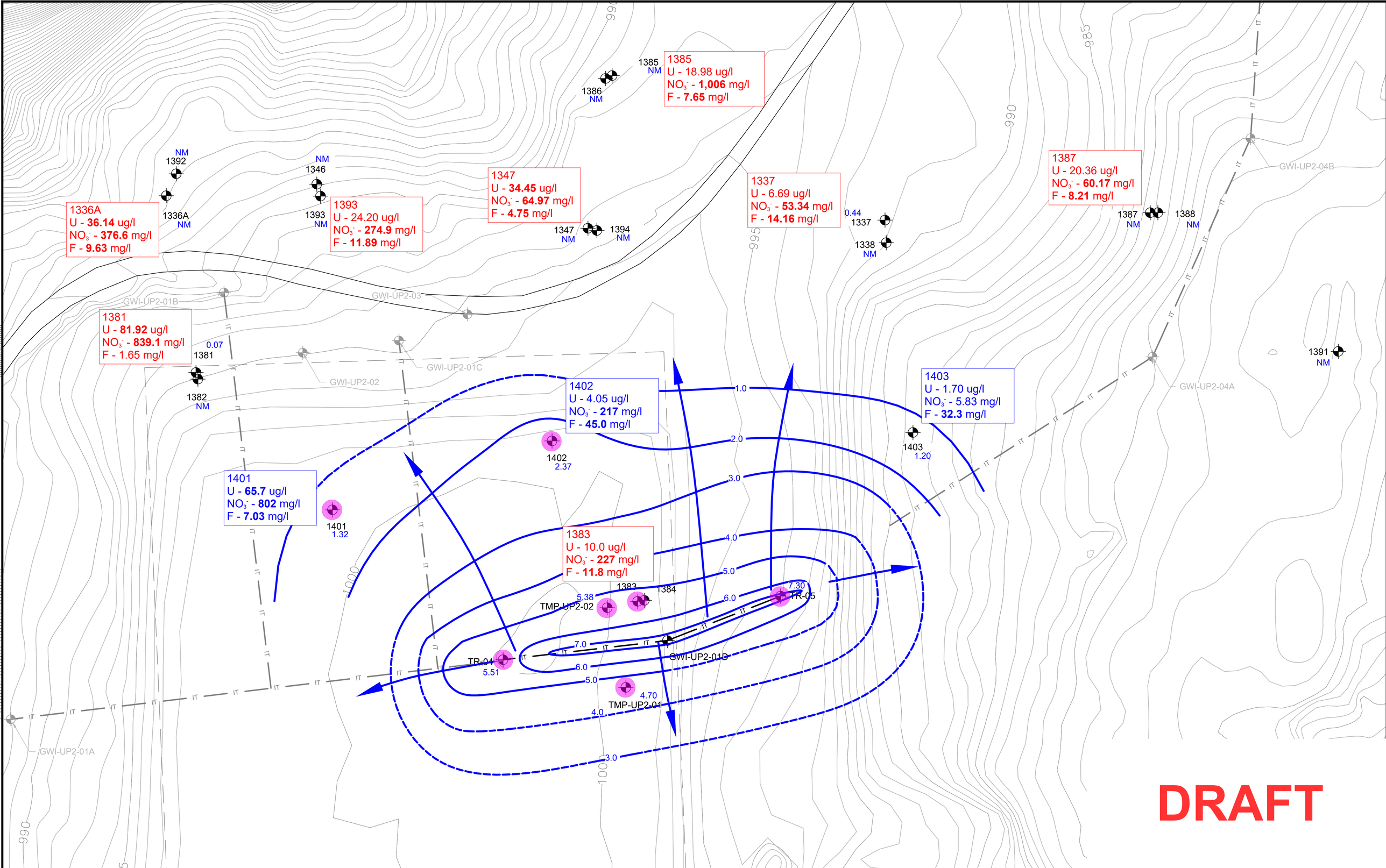


DRAFT

Head Response
(All Wells)

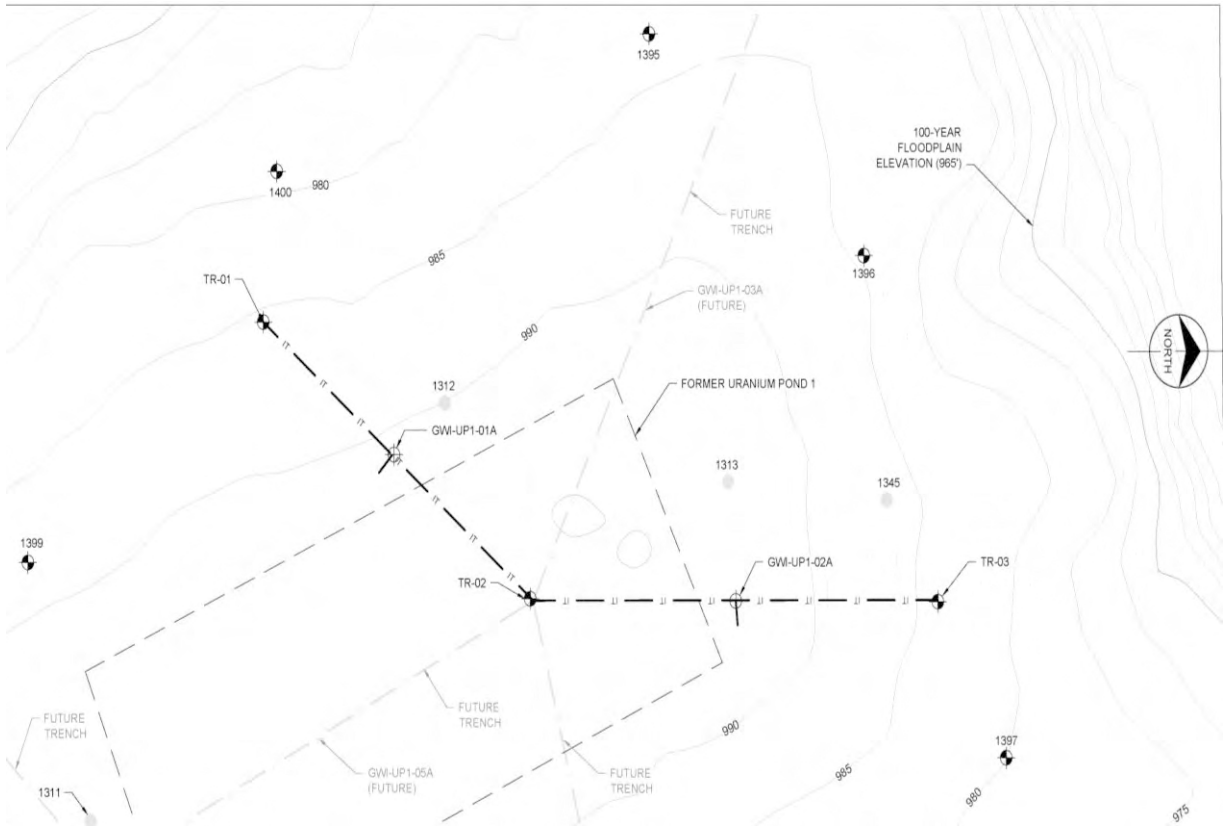


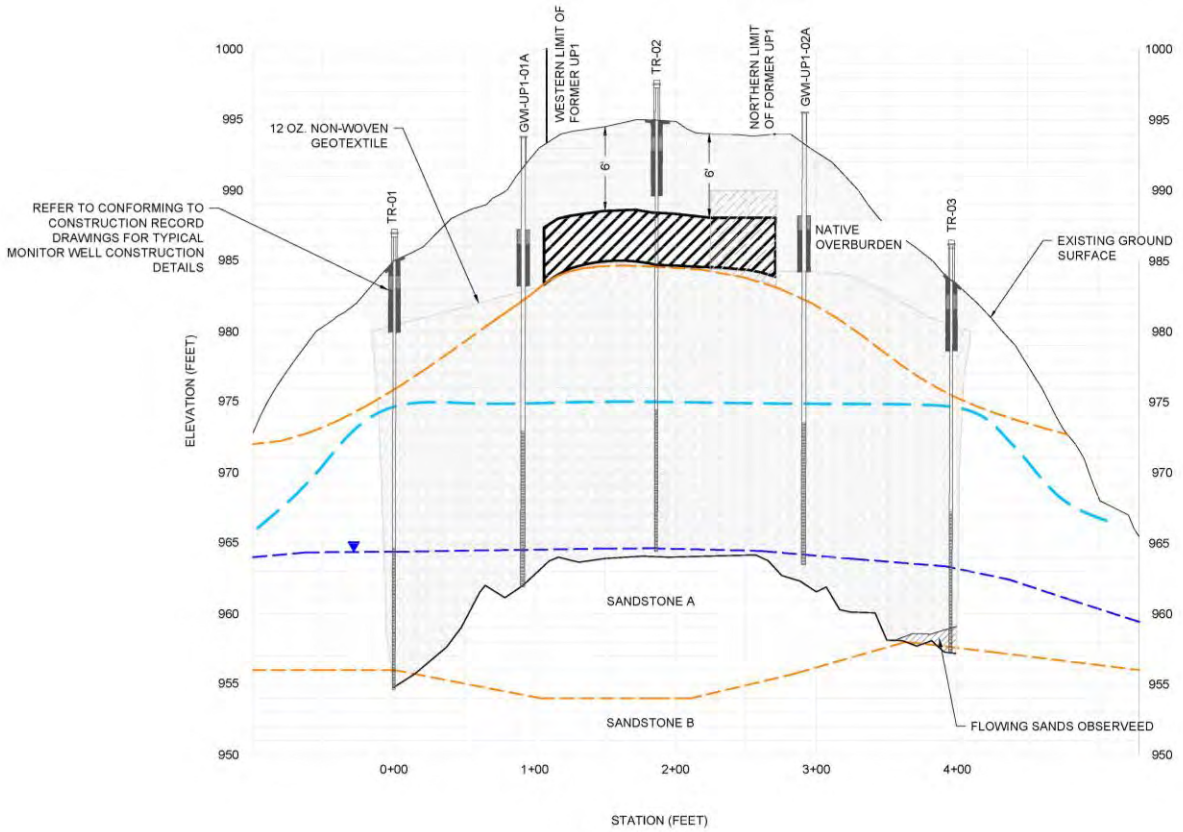



1385
U - 18.98 ug/l
NO_3^- - 1,006 mg/l
F - 7.65 mg/l
1385
NM
1386
NM
1336A
U - 36.14 ug/l
NO_3^- - 376.6 mg/l
F - 9.63 mg/l
NM
1392
1336A
NM
NM
1346
1393
NM
1393
U - 24.20 ug/l
NO_3^- - 274.9 mg/l
F - 11.89 mg/l
1347
U - 34.45 ug/l
NO_3^- - 64.97 mg/l
F - 4.75 mg/l
1347
NM
1394
NM
1337
U - 6.69 ug/l
NO_3^- - 53.34 mg/l
F - 14.16 mg/l
0.44
1337
1338
NM
1387
U - 20.36 ug/l
NO_3^- - 60.17 mg/l
F - 8.21 mg/l
1387
NM
1388
NM
GWI-UP2-04B
GWI-UP2-04A
GWI-UP2-01B
GWI-UP2-03
1381
U - 81.92 ug/l
NO_3^- - 839.1 mg/l
F - 1.65 mg/l
0.07
1381
1382
NM
GWI-UP2-02
GWI-UP2-01C
1402
U - 4.05 ug/l
NO_3^- - 217 mg/l
F - 45.0 mg/l
1402
2.37
1403
U - 1.70 ug/l
NO_3^- - 5.83 mg/l
F - 32.3 mg/l
1403
1.20
1391
NM
1401
U - 65.7 ug/l
NO_3^- - 802 mg/l
F - 7.03 mg/l
1401
1.32
1383
U - 10.0 ug/l
NO_3^- - 227 mg/l
F - 11.8 mg/l
1383
1384
5.38
TMP-UP2-02
7.30
TR-05
TR-04
5.51
GWI-UP2-01D
4.70
TMP-UP2-01
GWI-UP2-01A
1.0
2.0
3.0
4.0
5.0
6.0
7.0
1000
995
990
985
DRAFT

URANIUM POND #1

URANIUM POND #1





URANIUM POND #1

GWI-UP1 Trench Progress

In-trench monitor well

URANIUM POND #1

Debris Removal

Impacted Debris Segregation

URANIUM POND #1

Former UP1 Pond Liner

Impacted Material Segregation

URANIUM POND #1

GWI-UP1-01/02 Joint

GWI-UP1-01/02 Joint

URANIUM POND #1

Groundwater Accumulation

Trench Backfilling

URANIUM POND #1

Geotextile Placement

Impacted Material Backfill

URANIUM POND #1

Bench Backfilling

Final Compaction

SITE RESTORATION

BA1 New Access Road

BA1 Seeding

SITE RESTORATION

BA1 Vegetation Progress

1206 Vegetation Progress

URANIUM POND #1

Injection Trench Test Results

- Steady state injection rate: 30 gpm (4 gpd per ft^2)
  - Previous est.: 1 to 2 gpd per ft^2 (based on UP1 packer test results)
  - Limitation is capture, not aquifer acceptance
- **Hydraulic Mound Figure**
- **Head Response Trend Chart**
  - Head responses generally commensurate with MW location

URANIUM POND #1

Injection Trench Test Results

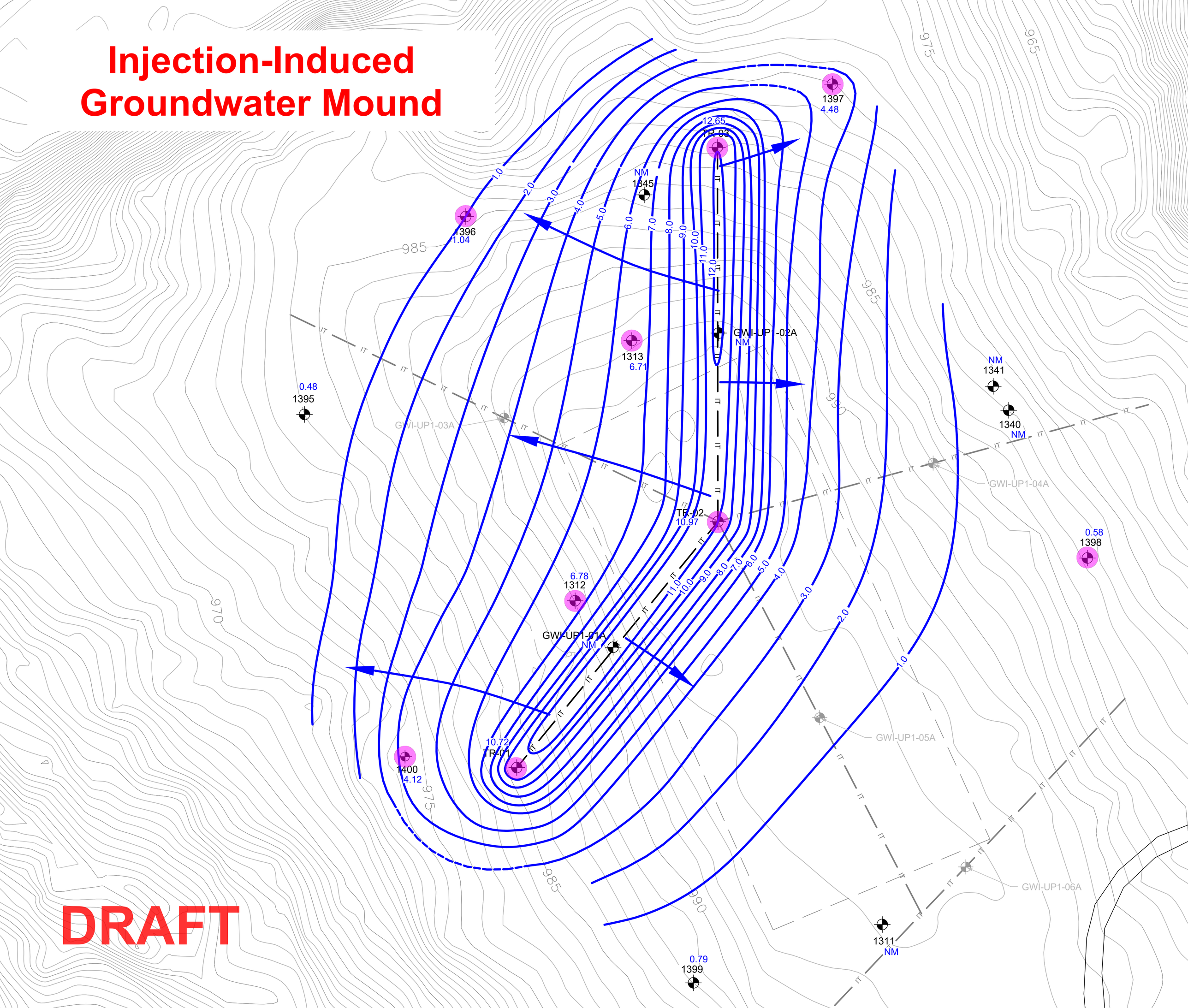
- Dye Tracer Results
  - Indicative of preferential flow toward areas of lower elevation
    - Dye observed in 1396 through 1398 before 1313
    - Dye observed in 1400 before 1312
    - Hydraulic mound contours near 1397
  - Flow distribution appears dependent on trench water level elevation
    - Preferential flow toward areas of lower elevation at higher trench levels
    - Dye concentrations shift to center of trench with falling water level

URANIUM POND #1

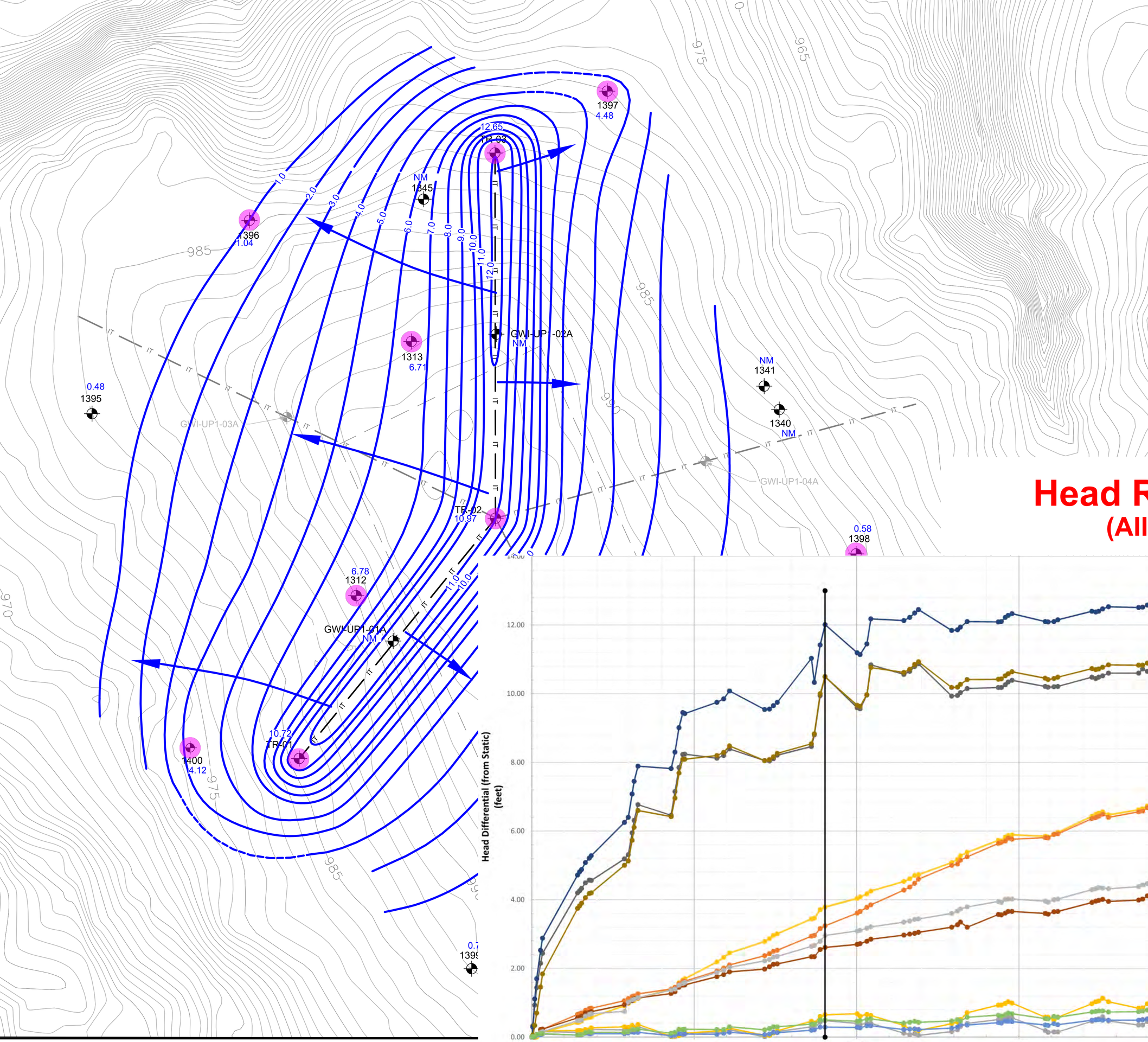
Design Implications

- Length reduction for GWI-UP1-03 through GWI-UP1-06
  - Consider reducing extent within areas of lower elevation
- Trench reconfiguration
  - Maximize mounding within former UP1 footprint vs. perimeter
- Revisions to timing of injected water front arrival at WAA extraction wells and impact on WATF influent concentration trends

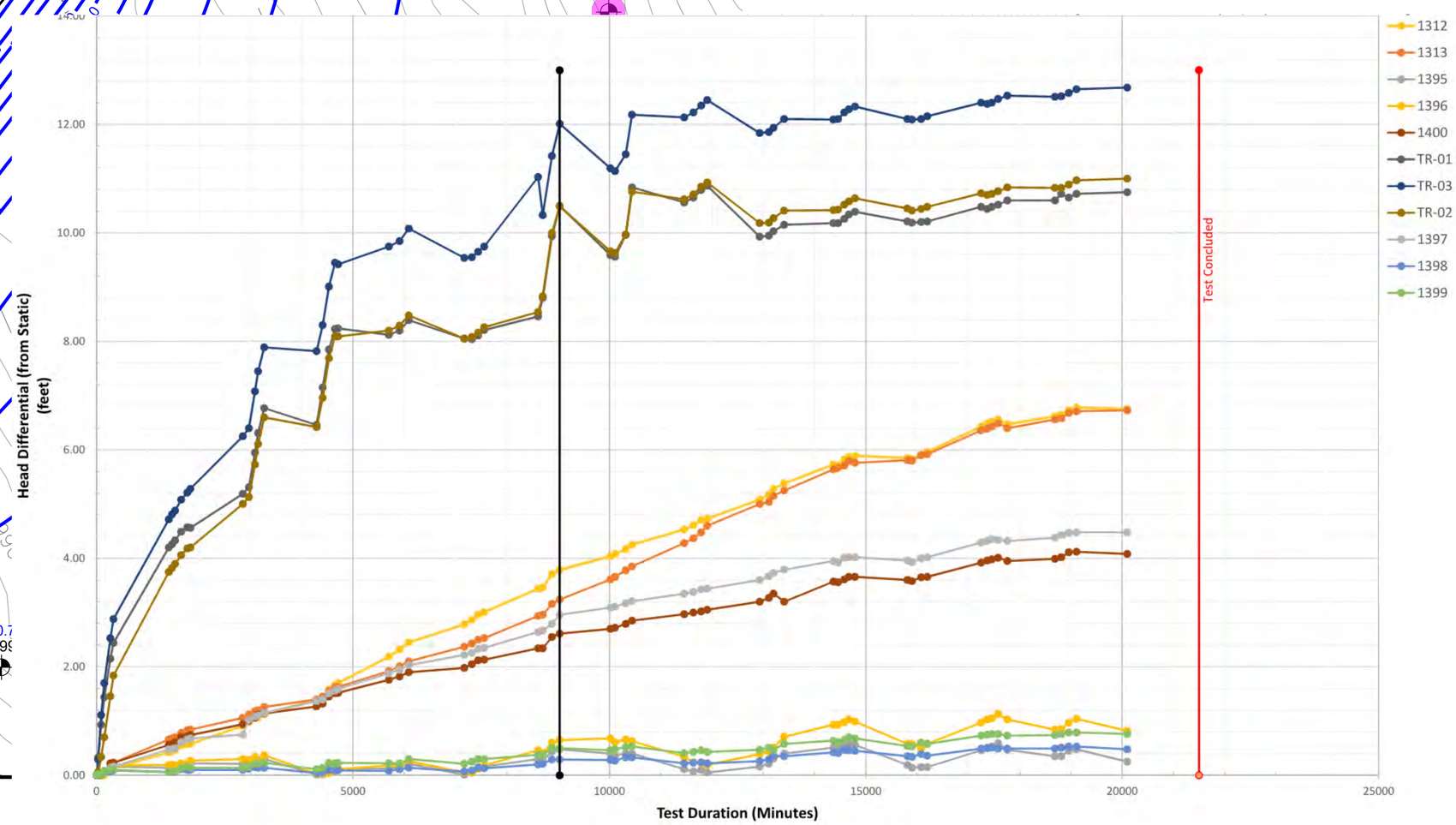
Injection-Induced Groundwater Mound

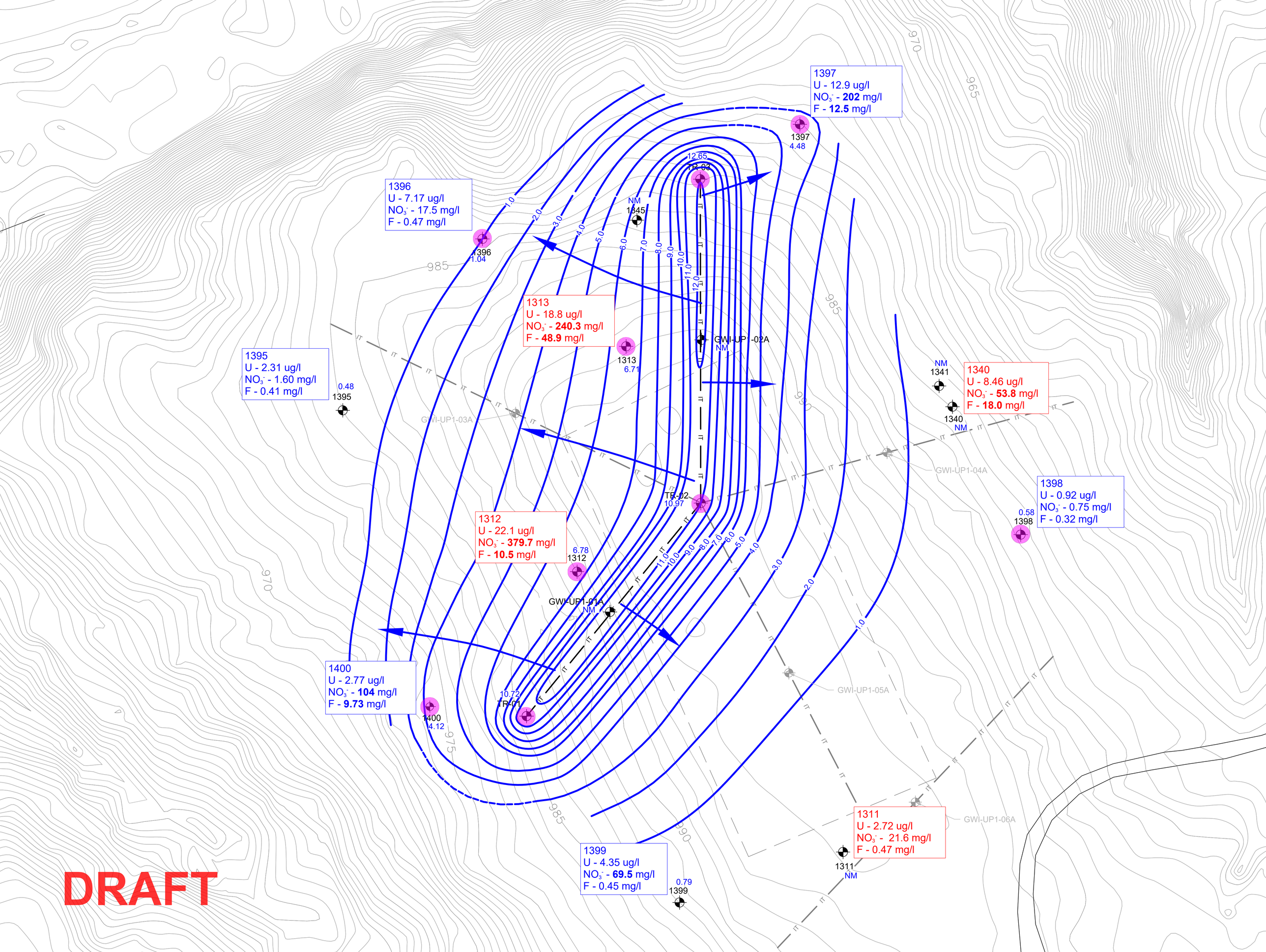


DRAFT



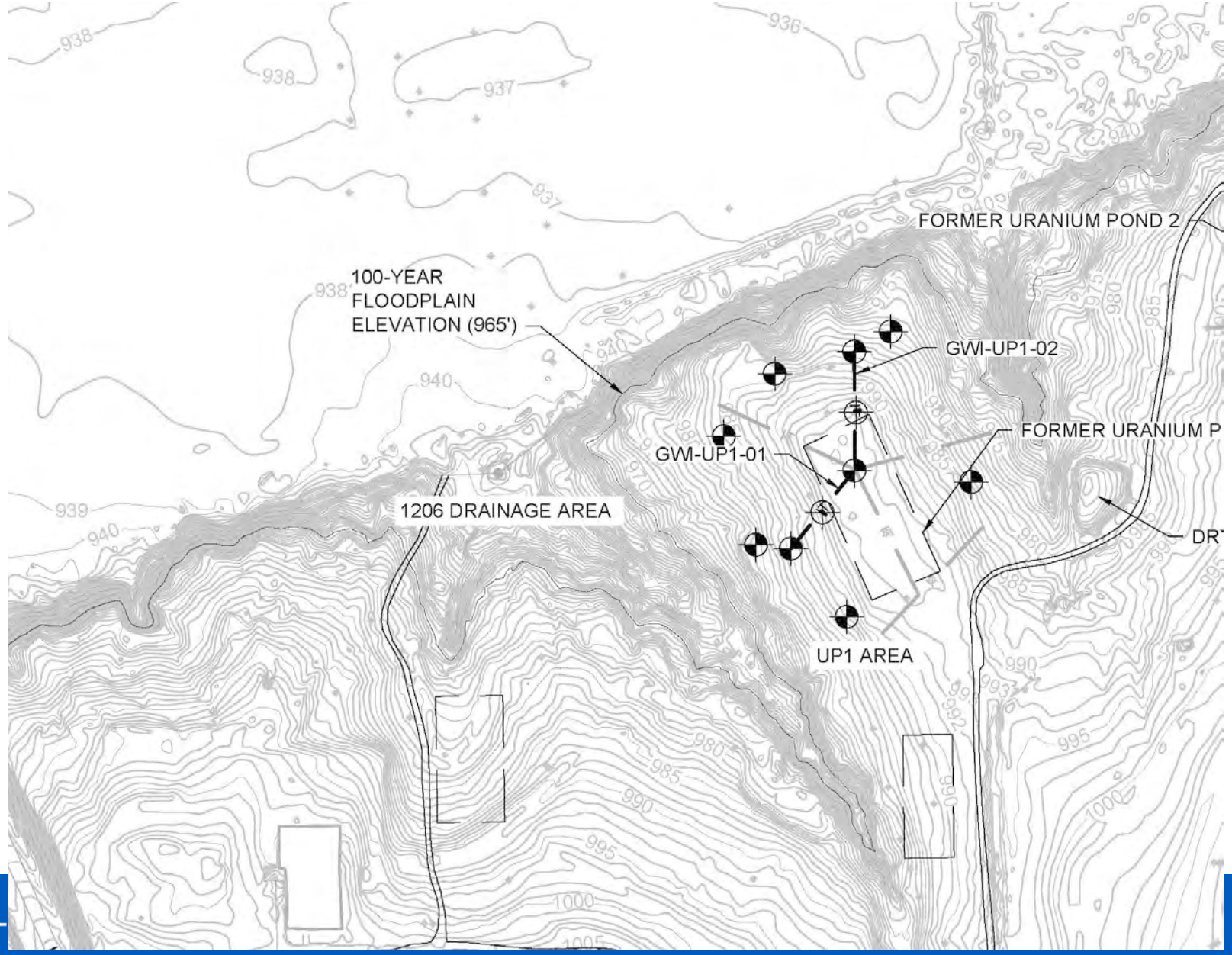
Head Response
(All Wells)




1397
U - 12.9 ug/l
NO_3^- - **202** mg/l
F - **12.5** mg/l
1397
4.48
1396
U - 7.17 ug/l
NO_3^- - 17.5 mg/l
F - 0.47 mg/l
1396
1.04
1313
U - 18.8 ug/l
NO_3^- - **240.3** mg/l
F - **48.9** mg/l
1313
6.71
1395
U - 2.31 ug/l
NO_3^- - 1.60 mg/l
F - 0.41 mg/l
0.48
1395
1340
U - 8.46 ug/l
NO_3^- - **53.8** mg/l
F - **18.0** mg/l
1340
1398
U - 0.92 ug/l
NO_3^- - 0.75 mg/l
F - 0.32 mg/l
0.58
1398
1312
U - 22.1 ug/l
NO_3^- - **379.7** mg/l
F - **10.5** mg/l
6.78
1312
1400
U - 2.77 ug/l
NO_3^- - **104** mg/l
F - **9.73** mg/l
1400
4.12
1399
U - 4.35 ug/l
NO_3^- - **69.5** mg/l
F - 0.45 mg/l
0.79
1399
1311
U - 2.72 ug/l
NO_3^- - 21.6 mg/l
F - 0.47 mg/l
1311
NM
12.65
TR-03
TR-02
10.97
10.72
TR-01
GWI-UP1-01A
NM
GWI-UP1-02A
NM
NM
1345
NM
1341
NM
GWI-UP1-03A
GWI-UP1-04A
GWI-UP1-05A
GWI-UP1-06A
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
970
965
985
990
975
DRAFT

1206 DRAINAGE

1206 DRAINAGE CLEARING



1206 DRAINAGE CLEARING

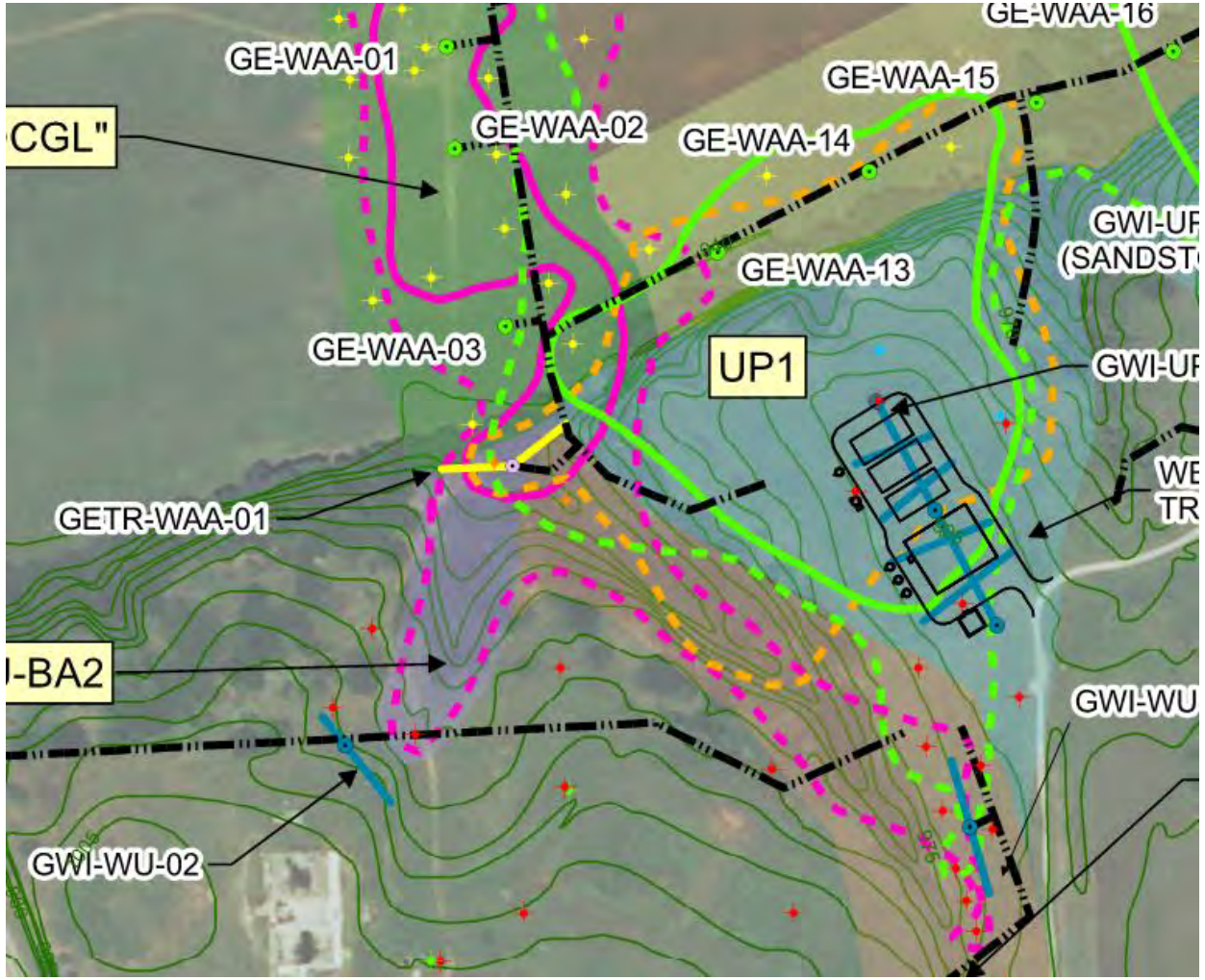
Tree Removal

Final Grading

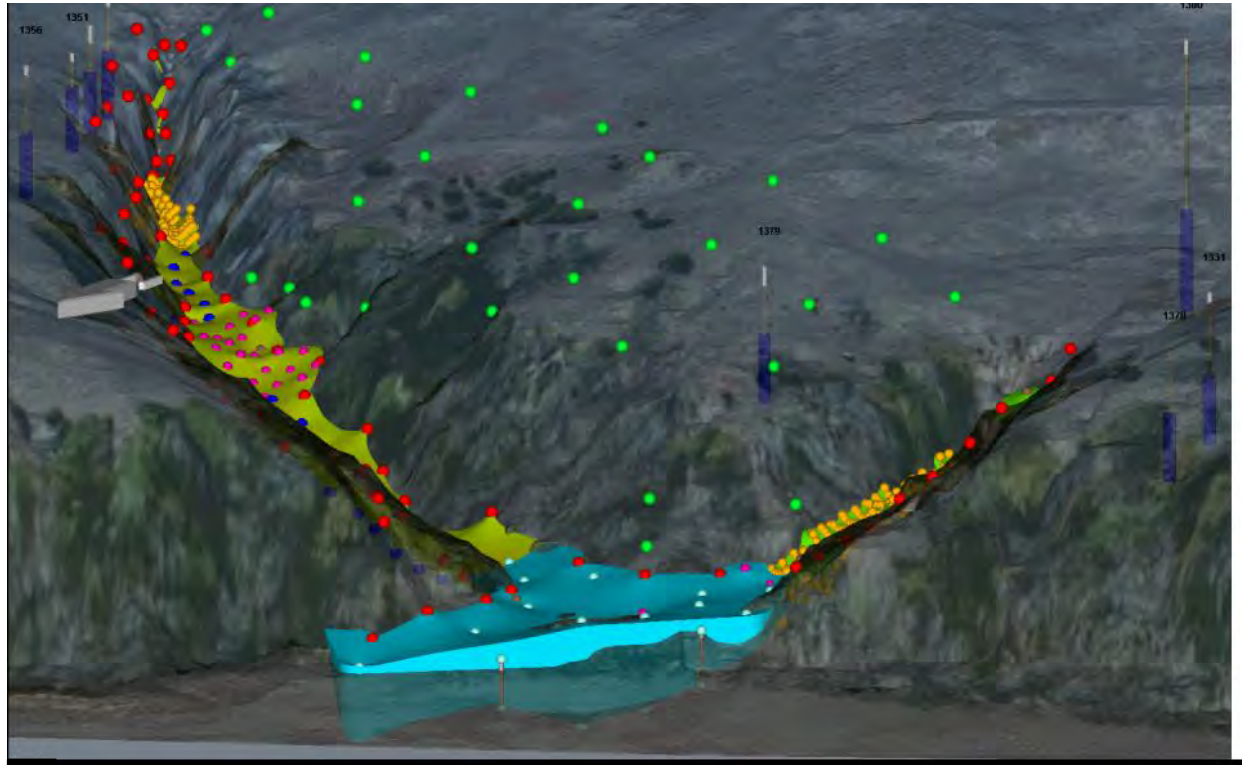
1206 DRAINAGE

Drainage Sediment Assessment and RAE

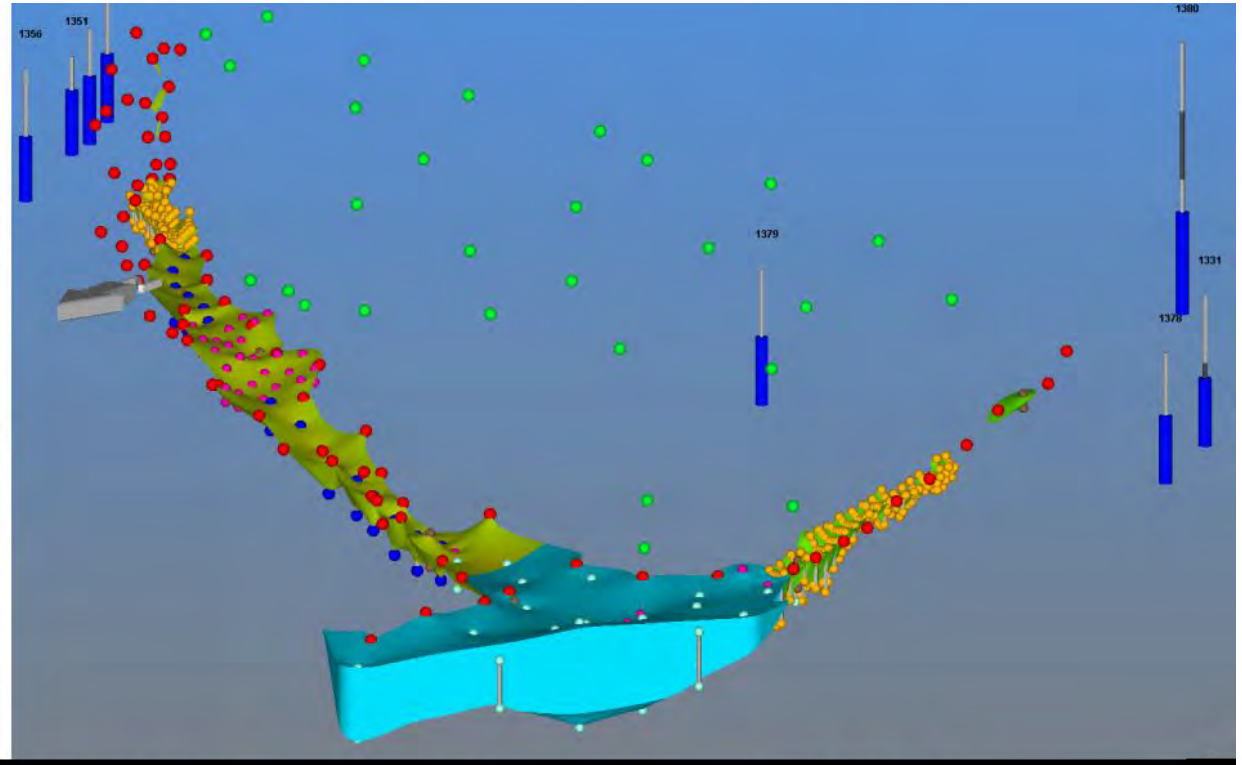
- Background
  - Burial Area #2 (BA2) remediation not required
  - 1206 West groundwater exceeds DEQ U criterion
    - Injection may not be appropriate
  - 1206 East groundwater exceeds DEQ/NRC U criteria
    - Remediation timeframe uncertain
  - Investigation and volume estimates needed to evaluate alternatives (e.g., excavation)



1206 DRAINAGE



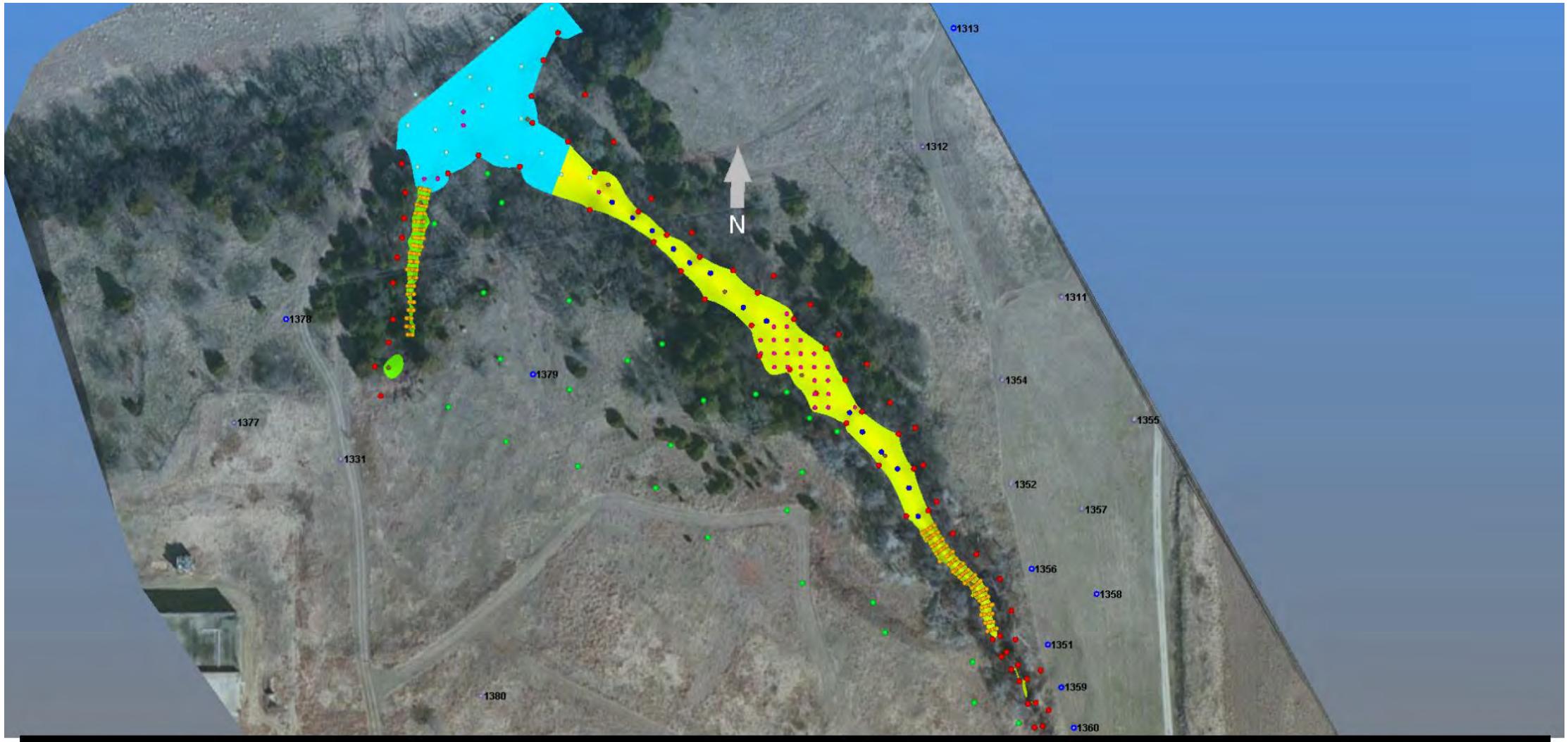
Soil Volume = 5487.9467419345665 Cubic Yards
Soil Mass = 7762297.251613661 Kilograms



Soil Volume = 1969.8362071763843 Cubic Yards
Soil Mass = 2786188.5138674392 Kilograms

Soil Volume = 131.46868648231495 Cubic Yards
Soil Mass = 185952.79286460302 Kilograms

1206 DRAINAGE



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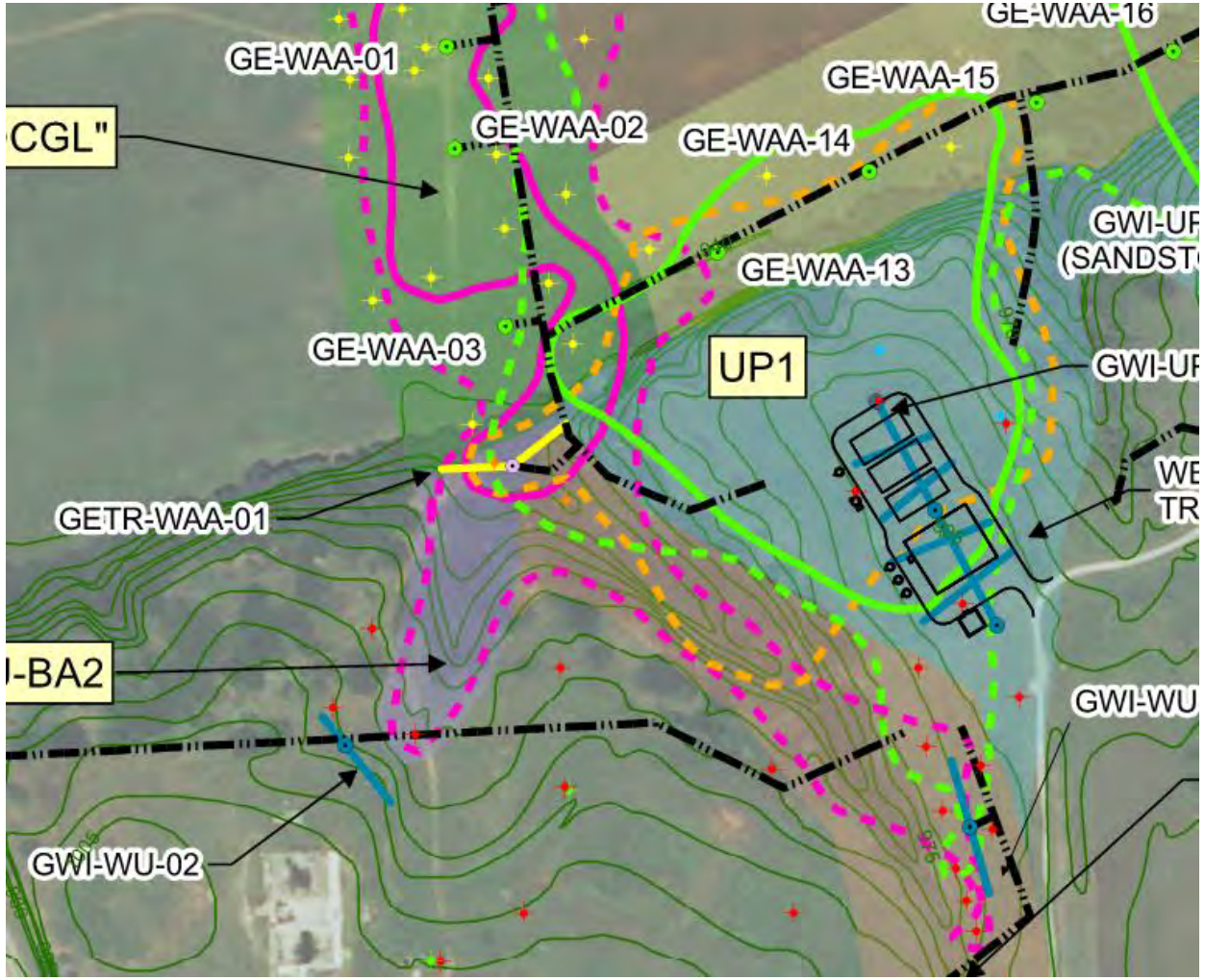
Soil Volume = 131.46868648231495 Cubic Yards
Soil Mass = 185952.79286460302 Kilograms

1206 DRAINAGE

Remedial Alternatives Evaluation

- Alternatives Considered
  - Alternative 1 – Treated Water Injection
  - Alternative 1A – Enhanced Treated Water Injection (1206 East only)
  - Alternative 2 – Groundwater Extraction
  - Alternative 3 – Excavation & Removal
- Alternatives Eliminated
  - Injection & Extraction
    - Minimal saturated thickness
    - Low permeability
    - Relatively low sediment volume

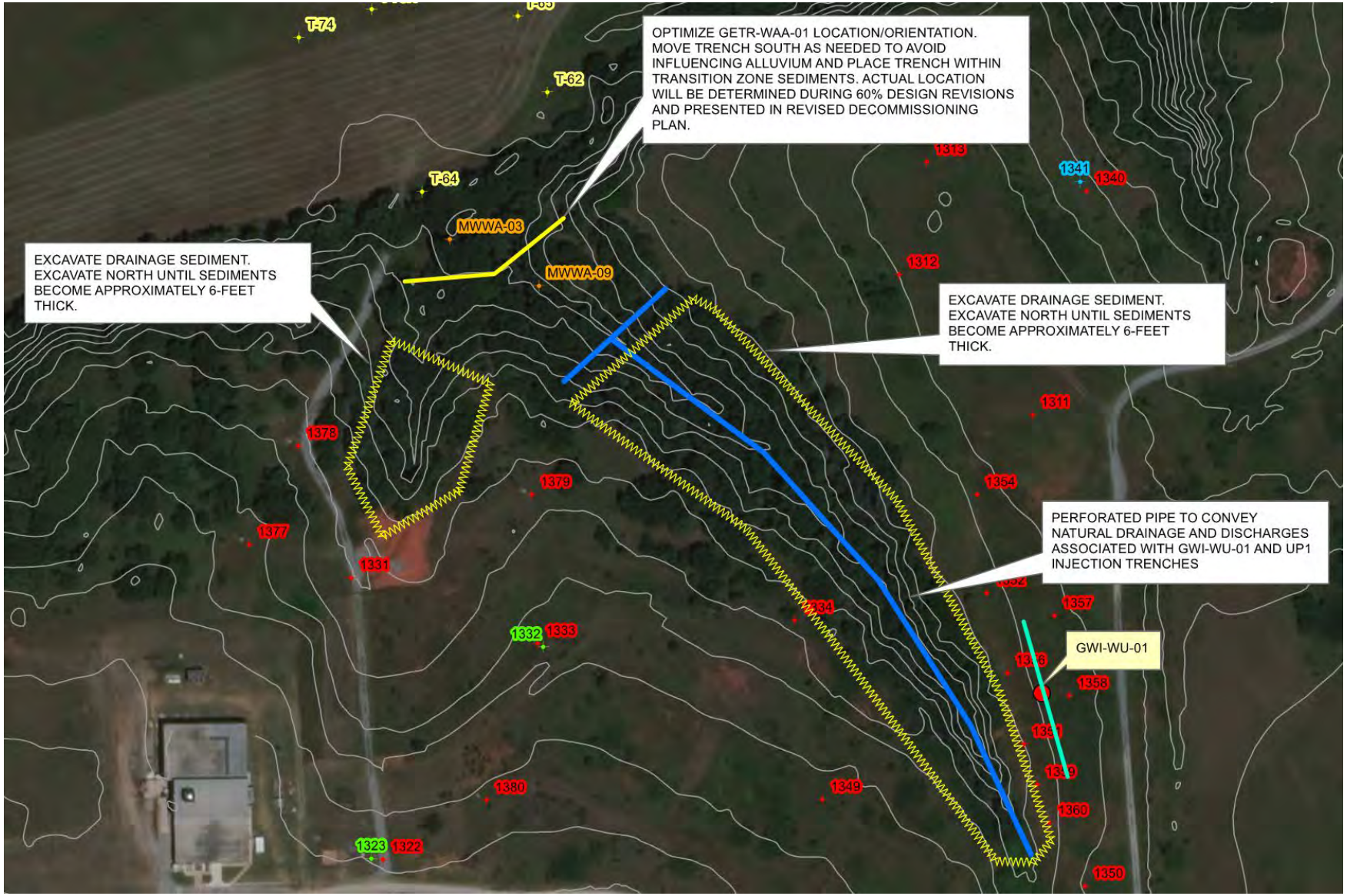


1206 DRAINAGE

Selected Alternative – Excavation & Removal

- Benefits:
  - Sediment compliant with NRC criteria; potentially allows for on-site disposal, pending DEQ approval
  - Eliminates cost of installing and operating additional injection/extraction components
  - Achieves immediate remediation of 1206 Drainages
  - Expedites remediation of 1206 Confluence
  - Greatly reduces uncertainties related to remediation of 1206 Drainage Sediments

1206 DRAINAGE



1206 DRAINAGE

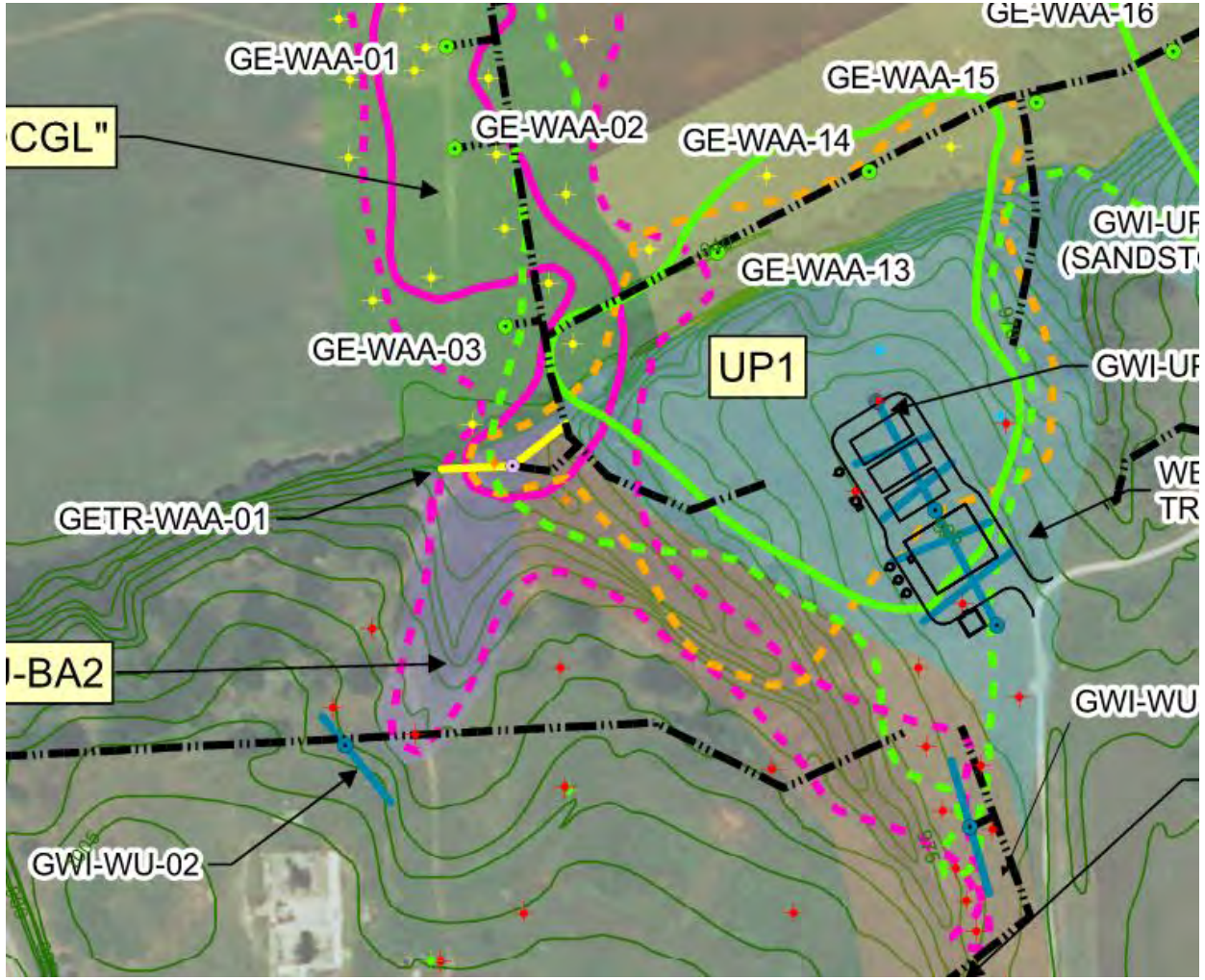
Remediation Concept

- 1206 Drainage Remediation Alternative Concept
  - Clearing/grubbing of 1206 East Drainage
    - 1206 West clearing complete
  - Sediment excavation, mixing, and stabilization
  - French drain installation within 1206 East
  - Optimization of GETR-WAA-01
    - Repositioned to the south to:
      - Avoid hydraulically influencing WAA
      - Maximize groundwater recovery within 1206 Confluence (Transition Zone sediments)

1206 DRAINAGE

Remedial Alternatives Cost Evaluation

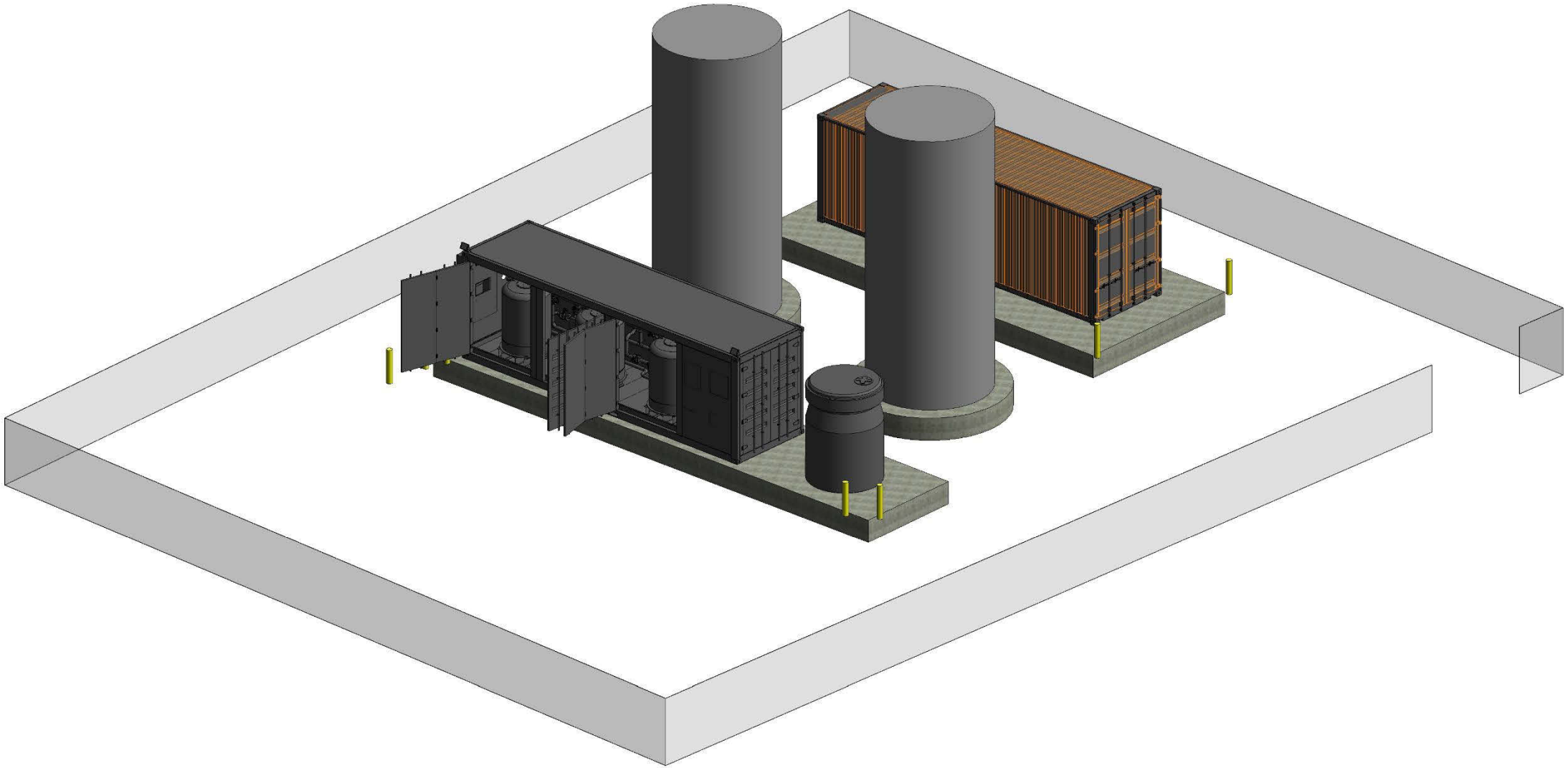
- 1206 West
  - GWI-WU-02 - $73,000
  - Sediment Removal – <$10,000
    - Clearing completed in 2017
- 1206 East
  - Sediment Removal - $210,000
    - Reduced remedial timeframe uncertainty
  - Annual Treatment System O&M - $1MM to $2MM
    - Potentially extended system operational time due to sediment treatment duration uncertainty



environmental
properties management, LLC

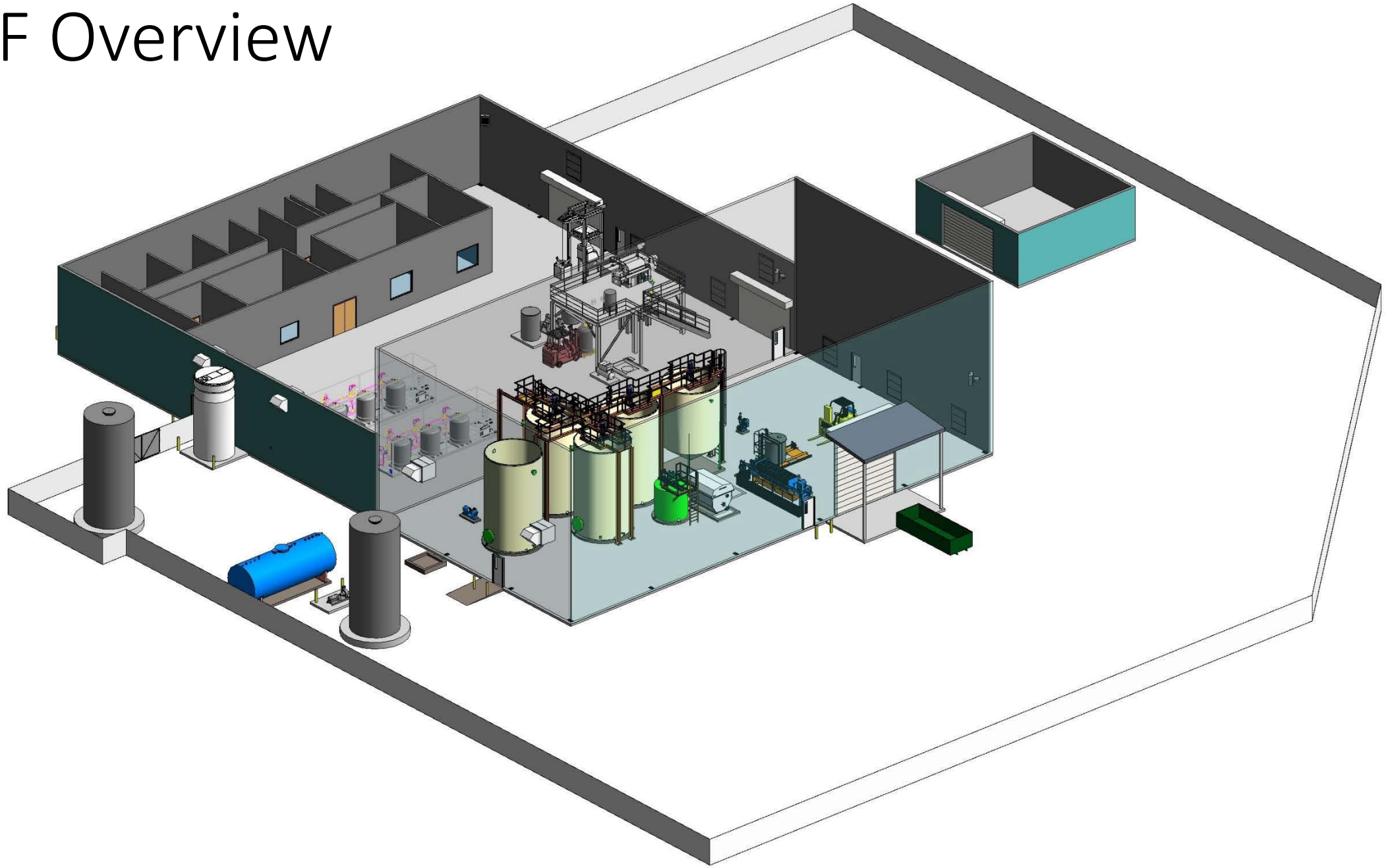
ATTACHMENT 6
PRESENTATION ON WATER TREATMENT FACILITIES

Burial Area #1

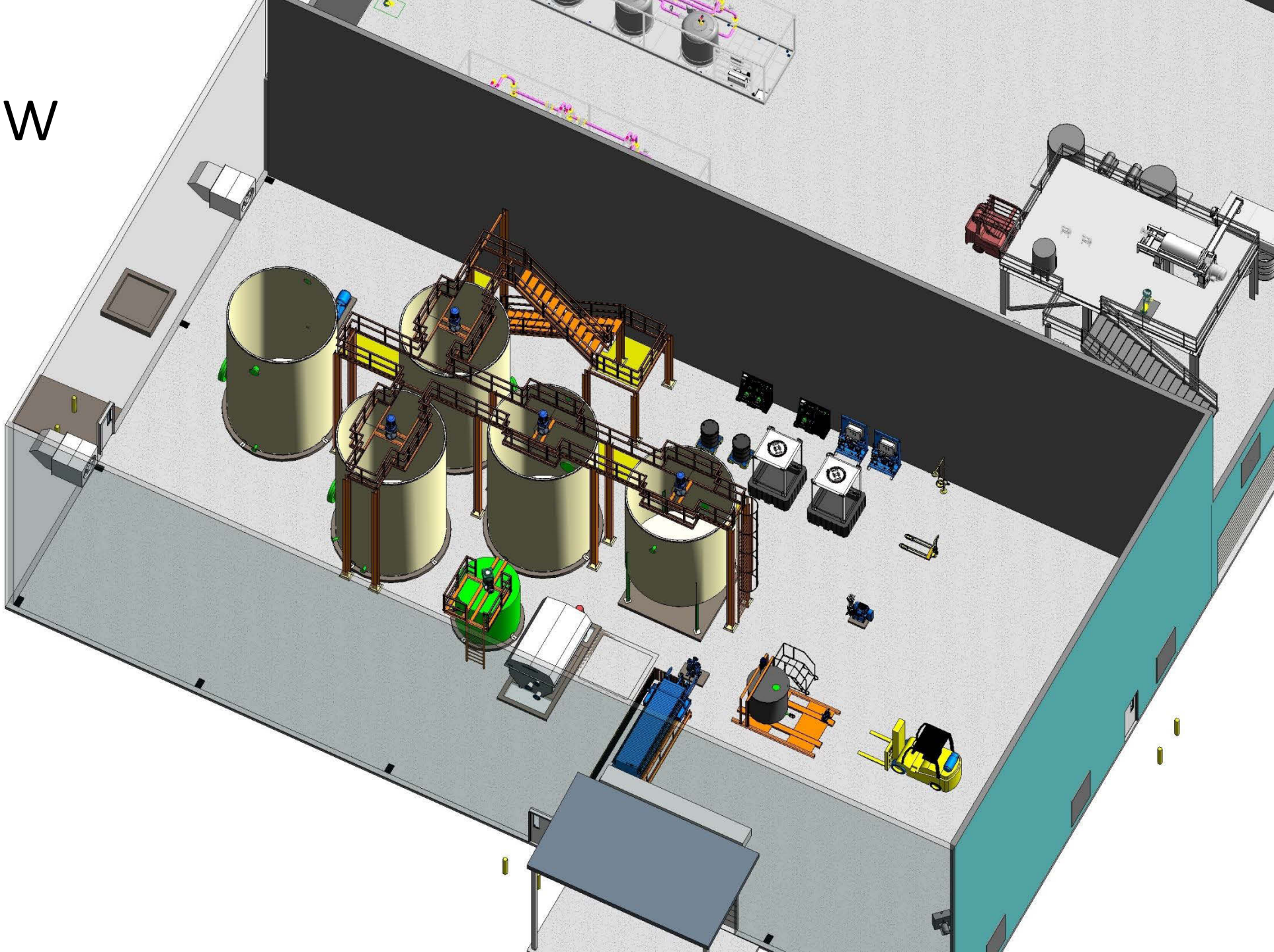


Modules For Project in United Kingdom

WATF Overview

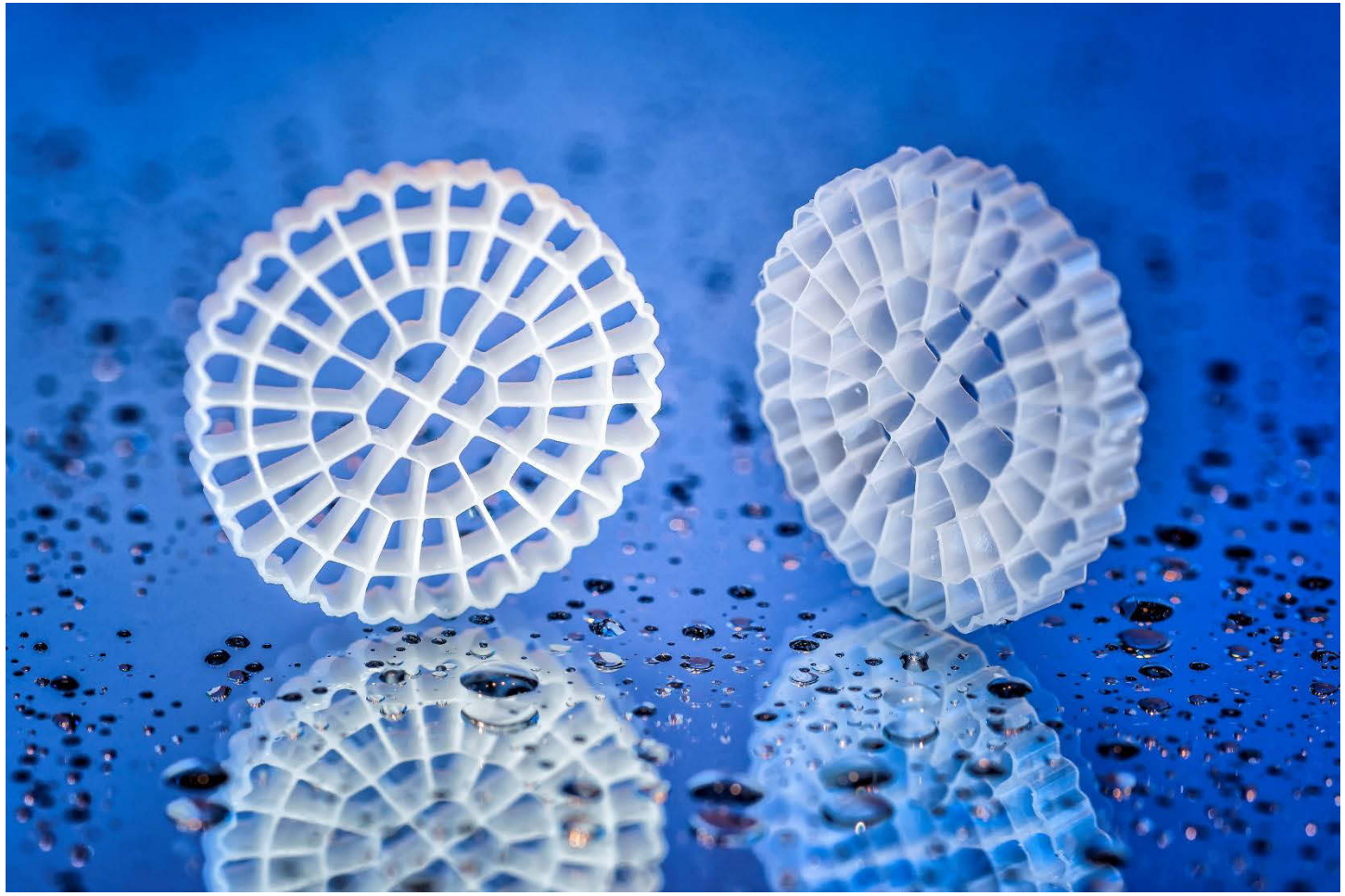


WATF – New Addition



Example Bioreactor Interior

Anoxkaldnes K5 MBBR Media



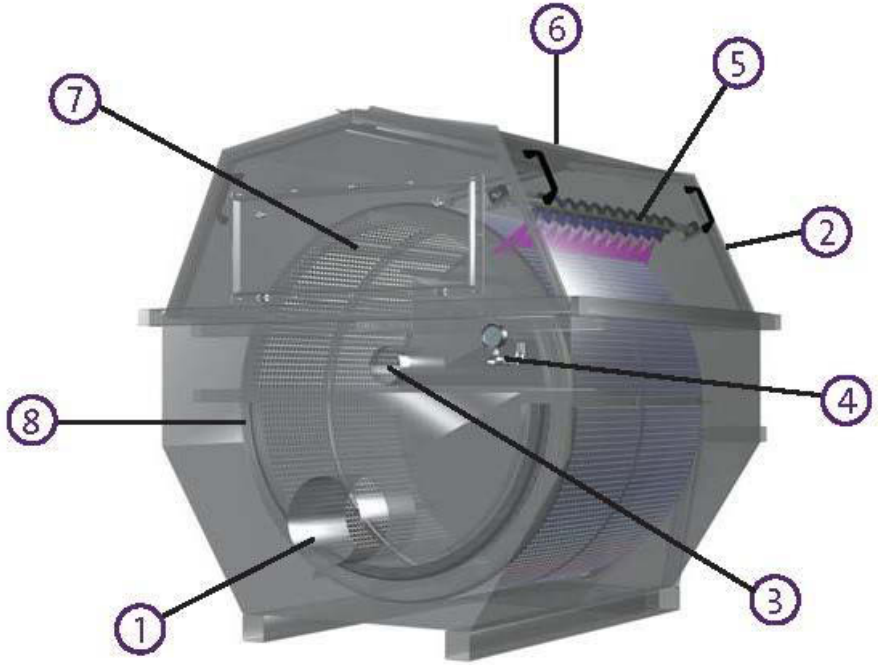
Top of (large) Denit Bioreactor Tank

Typical Methanol Tank

Example of Biosolids Separation/Filtration

1. Inlet
2. Outlet
3. Solid Outlet
4. Rinse Water Connection
5. Back-wash Header
6. Drive Unit
7. Filter Panels
8. Rubber lip sealing

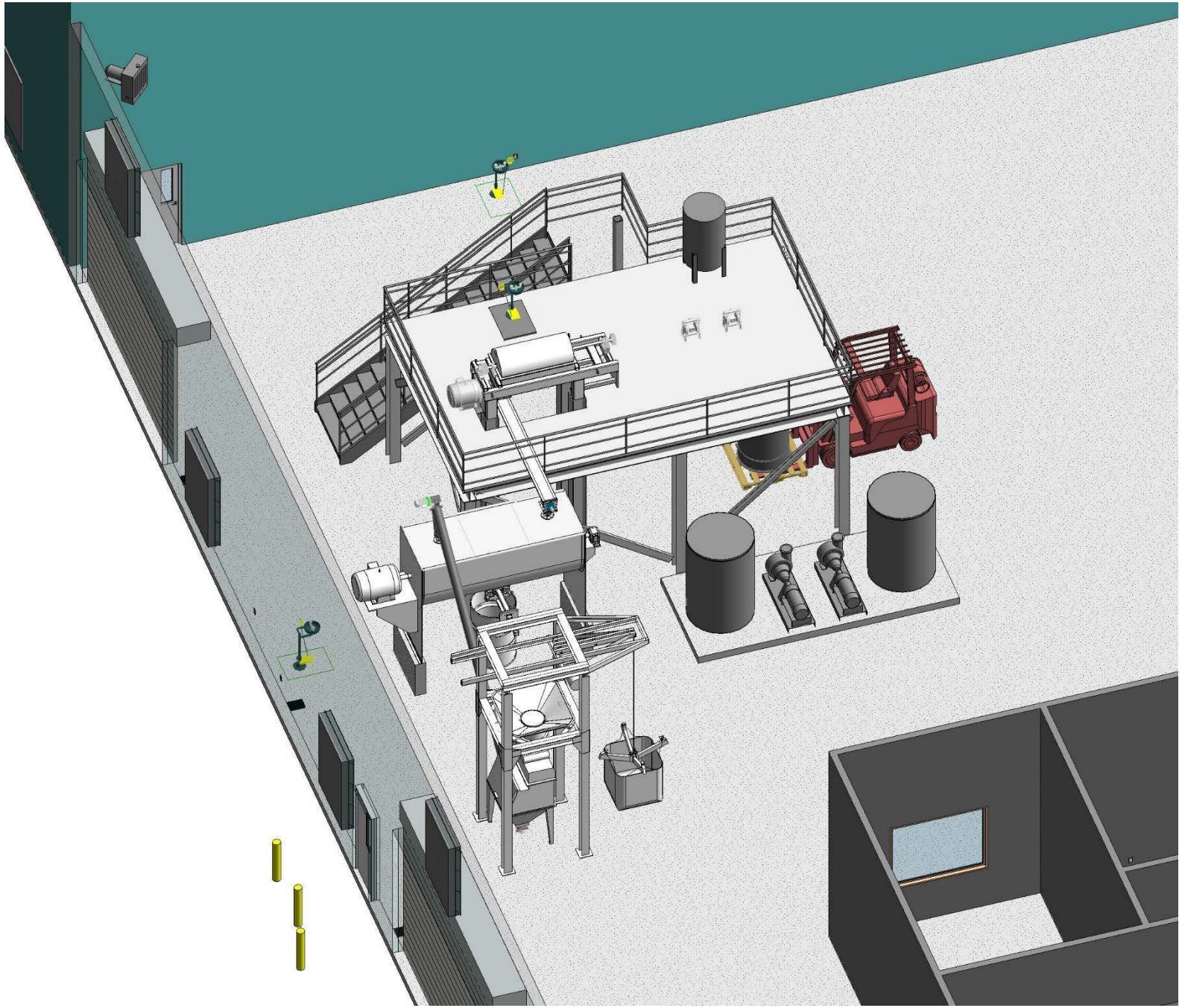
Additional information can be found at:
https://www.youtube.com/watch?v=ljail9FVuRI



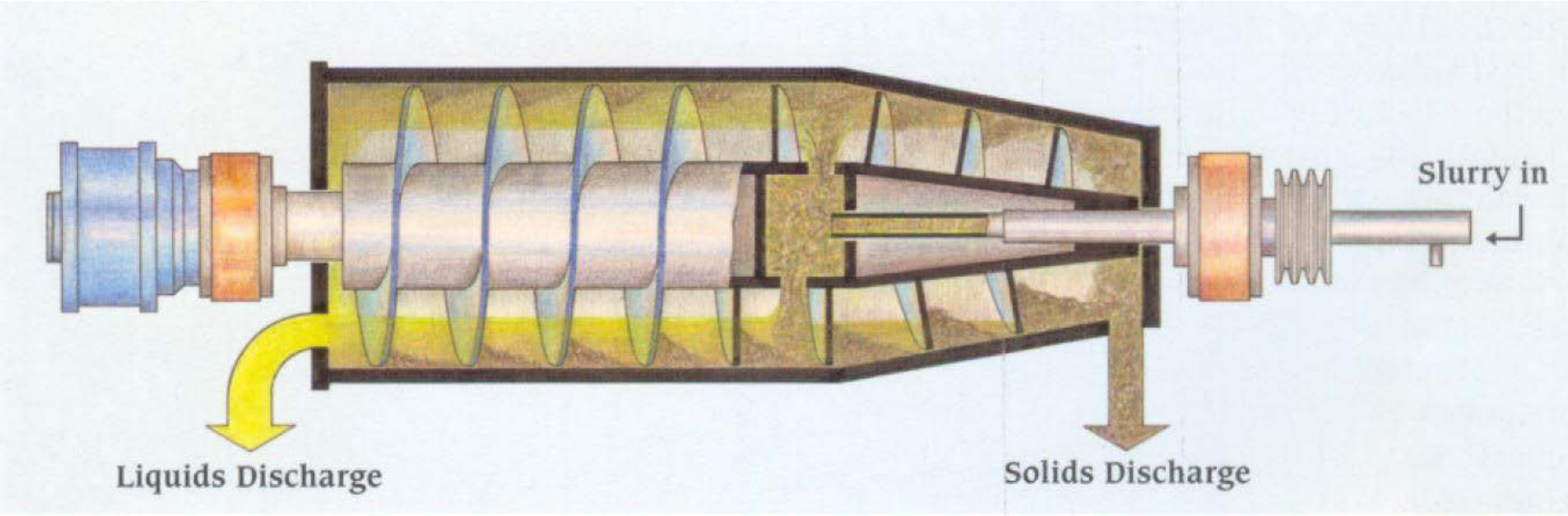
Typical Filter Press

Typical Thickener Tank

WATF – Spent Resin Handling



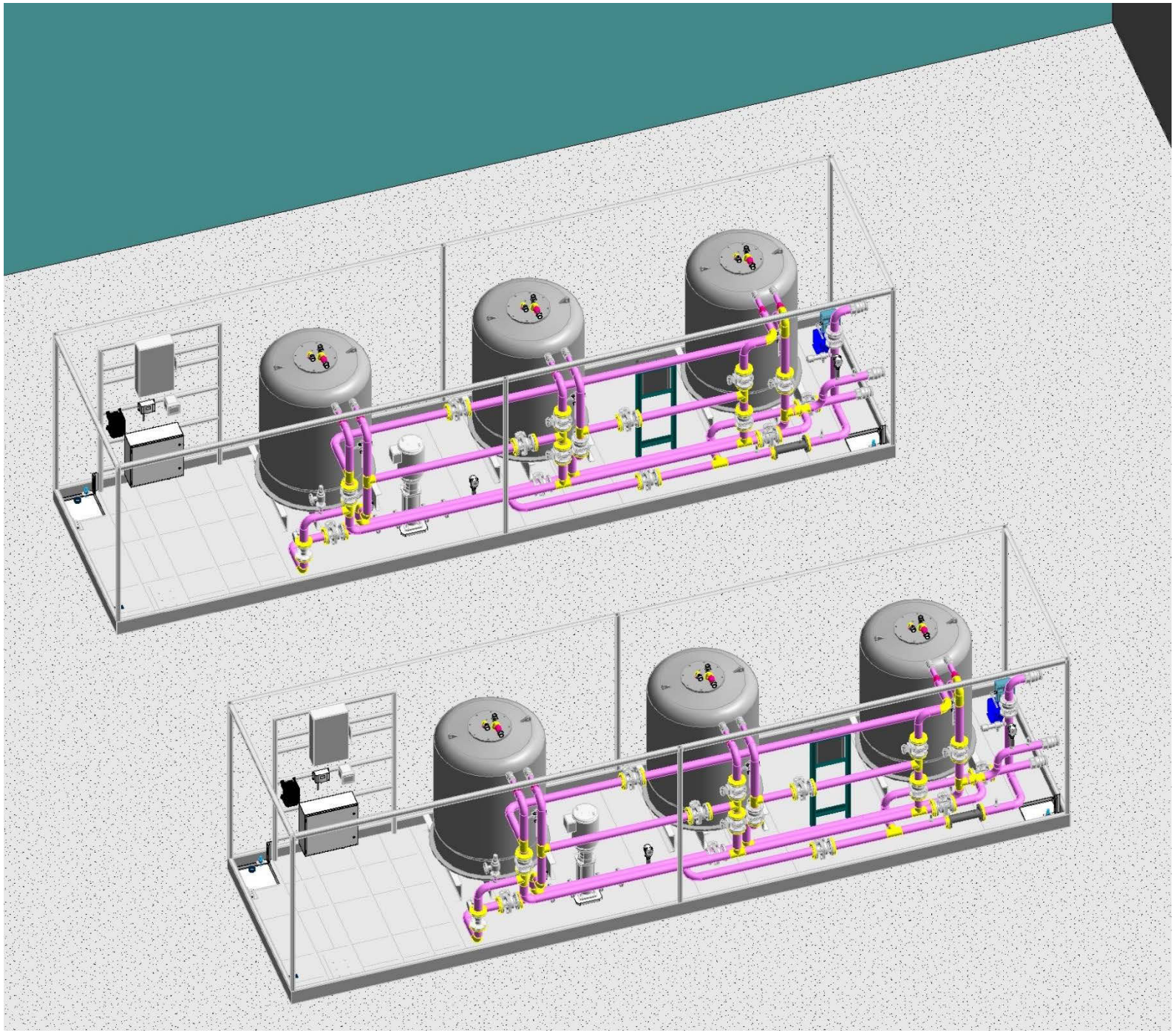
Scrolling Centrifuge Schematic



Scrolling Centrifuge Exterior

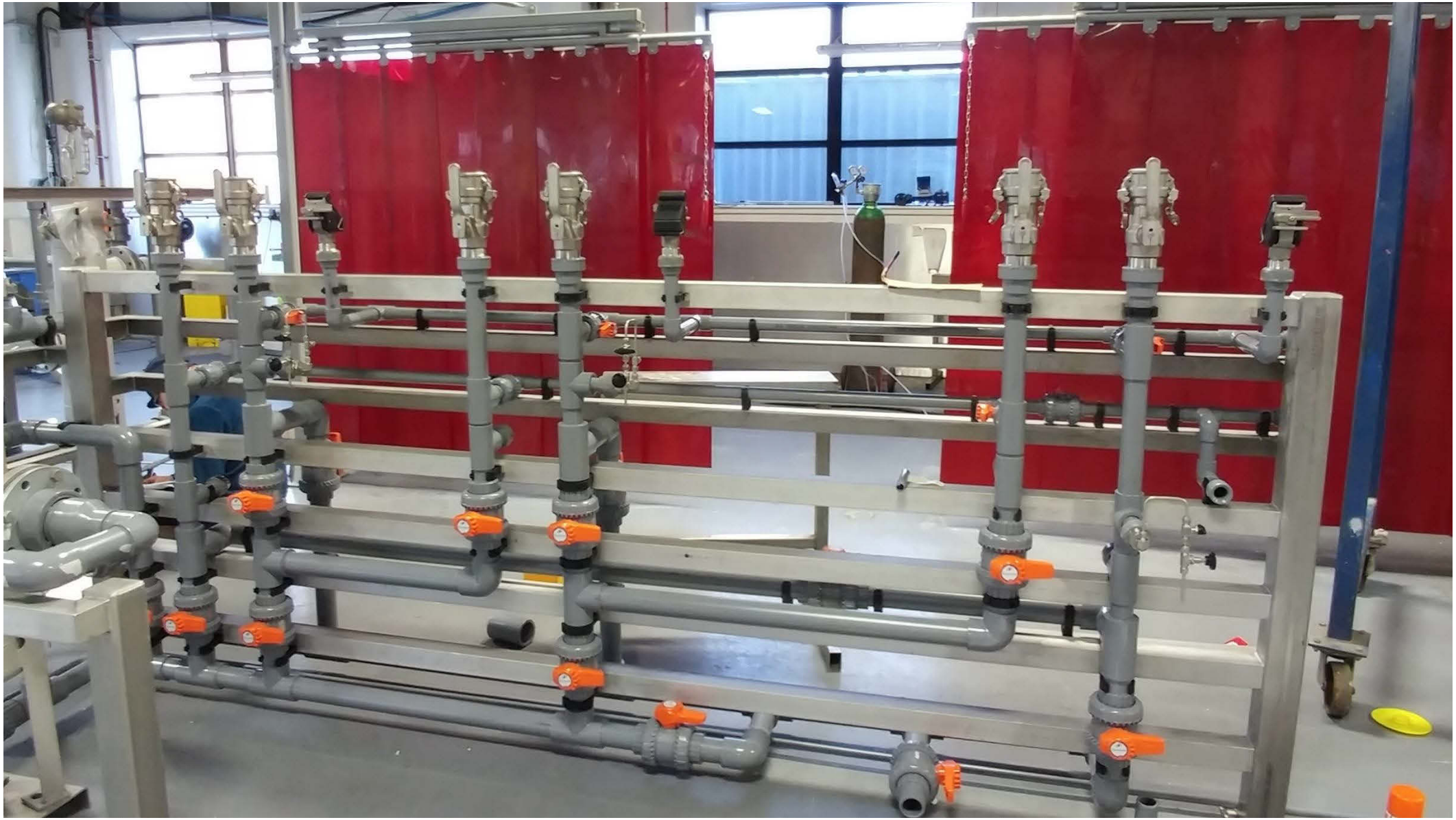
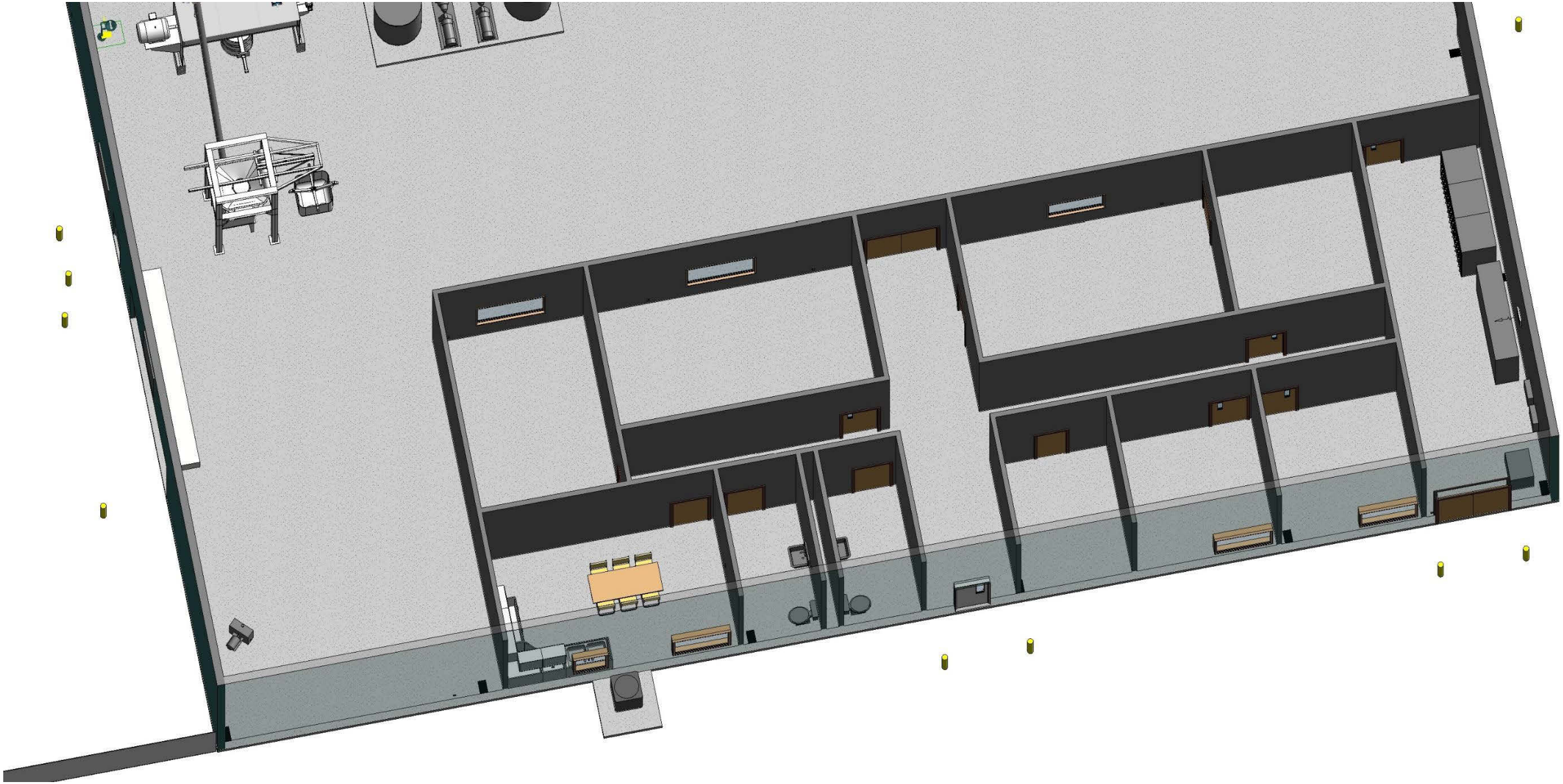
Typical Ribbon Blender Interior

WATF – Uranium Treatment



Typical Ion Exchange Vessel

Piping System For Project in United Kingdom



WATF – Non-Process Area