



Integral Consulting Inc.
110 Marter Ave.
Suite 304
Moorestown, NJ 08057

telephone: 856.399.7700
www.integral-corp.com

MEMORANDUM

To:	James Fish— Environmental Program Specialist, Alaska Department of Environmental Conservation
From:	Integral Consulting Inc.
Date:	August 8, 2024 (Revised October 3, 2024)
Subject:	Interim Removal Action Work Plan Technical Memorandum— On-Refinery PFAS, Williams Alaska Petroleum, Inc., Former North Pole Refinery, North Pole, Alaska
Project No.:	CF2052

On behalf of Williams Alaska Petroleum (Williams), Integral Consulting Inc. (Integral) has prepared this Interim Removal Action Work Plan (Work Plan) for the former Flint Hills Resources Alaska (FHRA) North Pole Refinery (Refinery), located on H and H Lane in North Pole, Alaska (Site; Figure 1). This Work Plan is submitted per Section 2.e of the Amended Judgment for Injunctive Relief (Amended Judgment) dated December 4, 2023. In accordance with the Amended Judgment (Section 2.d), a remedial alternatives matrix was developed to identify interim removal actions to clean up known per- and polyfluoroalkyl substances (PFAS) source areas in soil and eliminate or mitigate off-Refinery PFAS migration in groundwater. The targeted excavation and colloidal injection alternatives were selected for an interim remedial action from the remedial alternatives matrix, which was approved by the Alaska Department of Environmental Conservation (ADEC) on July 12, 2024 (Fish 2024, pers. comm.) following the July 9, 2024, project update meeting. During the July 9, 2024, project update meeting at the FHRA, the areas proposed for implementation of excavation and colloidal injection were approved by ADEC.

The objective of this interim removal action is to reduce on-Refinery PFAS concentrations and limit off-Refinery PFAS migration by addressing onsite soil and groundwater that exceeds the ADEC cleanup levels for perfluorooctanoic acid (PFOA) and perfluorooctanoic sulfonate (PFOS) (18 Alaska Administrative Code [AAC] 75.341.). This Work Plan outlines the implementation process for targeted excavation and colloidal injection that will address PFAS source material and off-Refinery migration. The excavation activities planned for 2024 will include targeting the removal of soils located north and northeast of the

excavation completed in 2015 that exceed the ADEC soil cleanup levels for human health found in 18 AAC 75.341 (Figure 2; Arcadis 2015). Groundwater and contaminant mass flux evaluation activities planned for 2024 will support a colloidal pilot study (planned to be completed in 2025) and potentially the design of full-scale implementation. The 2024 IRA Work Plan activities will focus on addressing groundwater with ADEC human health cleanup level exceedances (Figure 3). This work will include completing site characterization and conducting a groundwater and contaminant mass flux evaluation for the pilot study design. Site characterization field activities were completed earlier in 2024, and these analytical results supported further refinement of the areas being addressed in this interim removal action.

SITE DESCRIPTION AND BACKGROUND

The former FHRA North Pole Refinery facility is located within the city limits of North Pole in the Fairbanks North Star Borough, Alaska, on 240 acres, approximately 13 miles southeast of Fairbanks (Figure 1). The site is currently a bulk storage and terminal facility owned and operated by Marathon Petroleum (Marathon). Current and historical site features are included on Figure 4. Historical operations (summarized in the 2021 Site Characterization Report—Groundwater [Integral 2021]) lead to impacted soil and groundwater. This Work Plan addresses soils and groundwater impacted by PFAS at levels that exceed the ADEC PFOA and PFOS human health soil cleanup levels and the groundwater cleanup levels.

Past investigations show that the majority of soil exceedances are located within or adjacent to features associated with former Refinery operations (Figure 5a-c), including soil left in place following the 2015 soil excavation activities (Figure 2; Arcadis 2015). The overall groundwater flow runs parallel to the flow of the adjacent Tanana River and travels northwest from the Site. The horizontal gradient from the southeast to the northwest edge of the Site is approximately 0.001 ft/ft (Integral 2021), and groundwater levels fluctuate by 0.1 to 10 ft seasonally depending on the area of the site (Barr 2011). The groundwater PFAS exceedances are generally located in the central portion of the Refinery, with the greatest concentrations of PFAS observed at the water table (Figure 3 and Figures 6a-c).

Site characterization data were evaluated to develop the remedial alternatives matrix and select the most effective and feasible interim removal action. Additional site investigations were completed in 2024 to further delineate on-Refinery impacts in soil and groundwater (Figure 7).

REMEDIAL ALTERNATIVES EVALUATION

The ADEC-approved remedial alternatives matrix was developed to identify interim removal actions that are the most effective and feasible for 2024. The matrix was used to evaluate remedial technologies to identify the most effective and feasible interim removal action to limit exposure to and the off-Refinery migration of PFAS by addressing PFAS source material and impacted groundwater. Technologies that were retained during the initial screening process were rated on effectiveness in achieving cleanup goals, implementability, short- and long-term risks, and cost.

2024 INTERIM REMOVAL ACTION

For the 2024 interim action, targeted excavation was retained as the most effective and feasible technology to address PFAS sources, with the fewest challenges associated with implementation, and the fewest short- and long-term risks. Excavation of impacted soils, followed by incineration, will eliminate PFAS source material within a short period of time relative to other technologies that may leave residual material in place or require extended time frames for treatment. Short term risks of exposure to PFAS during implementation can be managed through proper soil management and best management practices. Long-term operation, maintenance, and monitoring, and risk will be eliminated or limited following the removal and destruction of PFAS source material in comparison to other technologies.

The 2024 interim removal action includes site characterization and contaminant mass studies (FluxTracer®) to support a colloidal injection pilot study (to take place in 2025). Colloidal injection to manage migration of PFAS in groundwater was retained for the interim removal action because it is a technology well proven to effectively treat PFAS through sorption. Colloidal injection will form a permeable barrier that prevents further migration of PFAS but does not inhibit groundwater flow. Colloidal injection will require a pilot study prior to full-scale implementation. Although collection of additional data requires time, PFAS migration will be controlled within a relatively shorter time frame with fewer long-term operation, maintenance, and monitoring requirements in comparison to pump and treat technologies. Information on identification of remediation areas, delineation of the excavation, and the mass flux study are described in the following sections.

FIRE TRAINING AREA EXCAVATION

After reviewing FHRA's site characterization data, Integral proposes a targeted excavation of the fire training area (FTA) for the 2024 interim removal action. The excavation footprint for the FTA is shown in Figure 8. The excavation will target the north and northeastern edges of the 2015 excavation, where sidewall post-excavation samples indicate remaining exceedances of human health soil cleanup levels (Figure 8; Arcadis 2015).

The FTA excavation footprint is approximately 6,500 ft². Excavation of the FTA footprint will extend no farther than 4 ft below ground surface (beyond the extent of human health soil cleanup level exceedances observed in the 2024 investigation). The excavation may be adjusted to a shallower depth should the excavation encounter the water table above 4 ft below ground surface. The excavation footprint encompasses approximately 1,000 bank cubic yards of material, which may increase to allow for side slopes to meet Occupational Safety and Health Administration (OSHA) health and safety requirements for work in excavations.

Additional 2024 site investigations have been completed following the work plan technical memoranda for groundwater, soil characterization, and onsite soil and groundwater (Integral 2022, 2024a,b), including soil boring to further delineate the excavation footprint (Figure 8). The excavation footprint has been delineated based on these data, targeting those soils that are above ADEC human health soil cleanup levels. The excavation footprint has been finalized in coordination with ADEC. The 2024 interim removal action excavation will be limited to the ADEC approved footprint. The need for additional targeted excavation, if required, will be addressed as a part of future interim removal actions.

Excavation

The FTA is outside of the main Refinery extents, and it is believed that excavating at this location can proceed faster with less disturbance to the current site owner (Marathon) than performing excavations in other areas. The area will be accessed during the hours agreed upon with the owner. The construction area will be secured to prevent unauthorized access. Prior to excavation the area will be cleared for utilities. All environmental and safety controls will be in place and monitored throughout construction to prevent off-Refinery migration and exposure to PFAS. All work will be completed following the federal, state, and local regulatory requirements, including but not limited to, the Alaska Administrative Code for cleanup operations (18 AAC 75.360), soil storage and disposal (18 AAC 75.370; 18 AAC 75.325(i)), and transportation (18 AAC 60.015). The Contaminant Media Transport Approval Form will be submitted to ADEC prior to the initiation of excavation activities. All workers will have the necessary health and safety measures in place (training, personal

protective equipment, and controls). Excavation will be completed following OSHA or OSHA-approved state plan requirements for excavation safety.

Excavated material will be directly loaded to haul trucks, secured, and transported to the nearby incineration facility. All equipment will be properly decontaminated and inspected prior to leaving the construction area. The amount of material transported will be documented to report the final excavation volume. Waste characterization will be completed to meet the requirements of the incineration facility. Waste manifests will be documented for all material transported for disposal.

Excavation sidewall and base samples will be collected (described in the following section) prior to placing a demarcation layer at the base of the excavation. Once the demarcation layer is in place, the excavation will be backfilled. Backfill will consist of material similar to the existing fill, free of debris and contamination (proven by analytical testing). Backfill will be placed in lifts and compacted to an extent that prevents future settling and consolidation as described in Alaska Department of Transportation and Public Facilities standards. The area will be backfilled to existing grade and restored with gravel.

Confirmation Sampling

Excavation sidewall and base samples will be collected following the ADEC Field Sampling Guidance (ADEC 2024), with a minimum of one sidewall and one base sample, plus additional sidewall and base samples collected for every 250 ft². Sidewall samples are to be collected at the soil horizon (top of confining layers, at the base of more porous layers, at the groundwater interface, or along any other preferential pathways identified in the field; ADEC 2024). Confirmation samples will be collected as grab samples using precleaned/decontaminated stainless-steel trowels and/or hand augers (depending on the soil conditions). The location of confirmation samples will be recorded in the field using a handheld global positioning system unit with sub-meter accuracy. The excavation footprint includes 6 sidewalls (approximate area of 1,720 ft²), requiring 10 sidewall samples. The excavation footprint is approximately 6,500 ft², requiring 26 base confirmation samples. Confirmation sample locations will be biased towards areas not previously excavated and backfilled during the 2015 remedial activities.

Soil samples will be collected and managed following the quality control procedures described in the ADEC Field Sampling Guidance (ADEC 2024). Field quality control samples will be collected at a minimum of 1 field duplicate per every 10 samples and 1 field equipment blank per 20 samples (ADEC 2024). The soil samples will be submitted for analysis using U.S. Environmental Protection Agency (EPA) Method 1633. Sampling and reporting will follow the ADEC guidance Minimum Quality Assurance Requirements for

Sample Handling, Reports and Laboratory Data (ADEC 2019). The results of these analyses will be validated by EcoChem, which will perform a compliance validation (EPA Stage 2A). That validation will be based on the EPA National Functional Guidelines for Organic Data Review (USEPA 2017, 2020).

SITE CHARACTERIZATION AND MASS FLUX STUDY

A PlumeStop® Colloidal Activated Carbon™ (PlumeStop) injection barrier is proposed to address off-Refinery PFAS migration through groundwater. Site characterization, well installation, a mass flux study (FluxTracer®), and a pilot study are necessary to support the full-scale design. The 2024 interim removal action activities will include the site characterization, well installation, and mass flux study to support the pilot study design. The pilot study will aim to demonstrate the efficacy of the injectable colloidal activated carbon approach and determine key criteria for future development of full-scale remediation at the site.

The proposed injection barrier for the 2025 pilot study will be placed to intersect groundwater flow at the northwest edge of the plume, where PFAS concentrations exceed the groundwater cleanup level for PFOA and PFOS (Figure 3). The PlumeStop pilot study will consist of a 50-ft injection barrier that is perpendicular to groundwater flow with a treatment zone that extends from 10 to 25 ft below ground surface to capture the zone where PFAS concentrations exceed the groundwater cleanup level.

Site Characterization

Site characterization data collected during previous investigations and the 2024 investigations will support the pilot study design. Hydrogeologic data, such as soil types, groundwater velocity, and hydraulic gradient will support the pilot study design to account for groundwater flux. High groundwater velocities may require additional design considerations to maintain the placement of the injection barrier, such as calcium chloride to prevent migration of activated carbon. Groundwater chemistry, including geochemistry and other chemicals associated with Refinery operations, will support selection of the activated carbon and sorption capacity for treating PFAS constituents.

Well Installation and Sampling

Monitoring wells will be installed to document PFAS concentrations upgradient, in the center of, and downgradient of the injection barrier (Figure 9). The proposed injection barrier will be installed perpendicular to groundwater flow direction and wells placed

along the centerline of the barrier wall. Monitoring wells will have a 2-in. PVC casing, with a 10-ft screen placed across the Water Table Zone. The screen length and placement correspond with the proposed groundwater treatment interval. The screen will be placed to capture the Water Table Zone using field observations. It is anticipated that each well will be placed with a total depth of 15 ft below ground surface, with screens extending from 5 to 15 ft below ground surface. One well will be placed at the center of the proposed colloidal injection location, with one well placed 15 ft upgradient and one well placed 15 ft downgradient of the center location (Figure 9). Placing wells 15 ft from the barrier wall will ensure that the wells are outside of the radius of influence (extent of colloidal carbon distribution following injection). Wells will be installed and developed following ADEC Monitoring Well Guidance (ADEC 2013) and in compliance with Alaska Administrative Code (18 AAC 75 and 18 AAC 78).

In support of the pilot study design, data collected from these wells will be used to further investigate groundwater trends. Soil samples will be collected from the surface of the Water Table Zone (6-in. interval) to support the pilot study design. Groundwater samples will be collected following low-flow purging and sampling methods described in the Field Sampling Guidance (ADEC 2024), with sample collection taking place no sooner than 2 weeks from completion of new well development, to eliminate/reduce the potential for cross-contamination. These wells will be monitored when the pilot system is in place to estimate sorption and PFAS removal efficiency.

Samples will be analyzed by an ADEC-certified analytical laboratory using EPA Method 1633 for PFAS compounds, along with analysis of sulfolane (EPA Method 8270E), total organic carbon (SW-846 Method 9060 or similar), volatile organic compounds (groundwater samples only; SW8260D), calcium (groundwater samples only; EPA Method 6010) and chloride (groundwater samples only; EPA Method 300.0), and petroleum hydrocarbons (soil samples; total petroleum hydrocarbons, gasoline-range organics and diesel-range organics; Method AK 101, AK 102, and AK 103). Sampling will also follow the ADEC guidance Minimum Quality Assurance Requirements for Sample Handling, Reports and Laboratory Data (ADEC 2019). Quality assurance and quality control (QA/QC) protocols for water sample collection will include 1 field duplicate per every 10 samples and 1 field equipment blank per sampling team/equipment per day (ADEC 2019).

FluxTracer® Study

A mass flux study will be conducted using FluxTracer® devices from REGENESIS® (Attachment A). The devices are canisters that are deployed in the monitoring well at the center of the proposed pilot study (Figure 9) at a depth to capture the Water Table Zone,

which corresponds with the 10-ft treatment interval. The canisters are filled with a sorbent material to target PFAS compounds and a biodegradable tracer to capture contaminant mass flux and Darcy velocity over the course of 2 weeks. Over the 2-week period, contaminants accumulate on the sorbent, and the biodegradable tracer is depleted to evaluate groundwater velocity. After the 2-week period the device is retrieved and sent to REGENESIS® for analysis. The data will provide an estimate of the vertical profile of contaminant mass flux (mg/m²-day) and groundwater Darcy velocity (cm/day) across the treatment zone. A FluxTracer® device will be installed at the center of the proposed injection barrier location (Figure 9). The need for additional devices will be evaluated with support from REGENESIS®. Following a review of the FluxTracer® specifications and the ADEC Monitoring Well Guidance (ADEC 2013), it is not anticipated that permits will be needed for this phase of the work. However, at the request of ADEC, Integral will contact EPA Region 10 to confirm that an underground injection control permit is not required.

Investigation-Derived Waste

Following completion of sampling activities, investigation-derived waste generated during well installation, development, and monitoring, and confirmation sampling will be containerized characterized to meet disposal facility requirements. Prior to transport or treatment, the Contaminated Media Transport and Treatment or Disposal Approval Form will be prepared and submitted to ADEC for approval.

ROLES AND RESPONSIBILITIES

All work will be completed in compliance with federal, state, and local regulations, including but not limited to, proper training and licensing for the personnel. QA/QC measures and reporting will be maintained throughout the 2024 interim removal action activities. Integral will have the role of Construction Quality Assurance (CQA). The CQA team will oversee construction activities and work with the Contractor to ensure that work is completed following construction plans. The Contractor will be responsible for completing the construction and maintaining quality control measures. The Contractor will provide documentation of quality control to the CQA team, including surveys, best management practices, and any deviations from the Work Plan. The CQA team will be responsible for compiling all construction documents and communicating with the owner (Marathon) and the performing party (Williams) on progress and completion.

SCHEDULE

Following approval from ADEC, it is anticipated that activities will begin mid - to late-September. It is estimated that excavation will take 10 days. Monitoring well installation and FluxTracer® deployment will likely take 3 weeks. The 2024 interim removal action is expected to be complete by mid-October. The current estimated schedule is presented in Figure 10.

REPORTING

Integral will prepare a report summarizing completion of excavation and the FluxTracer study. The final report will include completed ADEC Laboratory Data Review Checklists and a QA/QC assessment of both soil and groundwater sample results. Data collected during monitoring well installation, the FluxTracer study, and 2024 investigation results that support the colloidal activated carbon pilot study will be summarized in a Pilot Study Memorandum and submitted to ADEC. The Pilot Study Memorandum will include data supporting the pilot study design, the proposed pilot study design (including the carbon dosing, calcium chloride dosing, injection methods and placement), and the monitoring parameters and schedule. Following completion of the 2024 interim removal action, annual interim removal action work plans will be prepared for ADEC as described in the Amended Judgment.

REFERENCES

ADEC. 2013. Monitoring well guidance. Alaska Department of Environmental Conservation, Division of Spill Prevention and Response Contaminated Site Program. September.

ADEC. 2019. Minimum quality assurance requirements for sample handling, reports and laboratory data. Alaska Department of Environmental Conservation, Division of Spill Prevention and Response Contaminated Sites Program. October.

ADEC. 2024. Field sampling guidance. Alaska Department of Environmental Conservation, Division of Spill Prevention and Response Contaminated Site Program. January.

Arcadis. 2015. 2015 Onsite excavation report. North Pole Terminal, North Pole, Alaska. Arcadis U.S., Inc. November 30.

Barr. 2011. Site characterization and first quarter 2011 groundwater monitoring report. North Pole Refinery, North Pole, Alaska. DEC File Number: 100.38.090. Prepared for Flint Hills Resources Alaska, LLC. Barr Engineering Company, Minneapolis, MN. May.

Fish, J.T. 2024. Personal communication (email to E. Palko, Integral Consulting Inc., dated July 12, 2024, regarding Reporting and Work Plans. Alaska Department of Environmental Conservation.

Integral. 2021. Site characterization report—Groundwater, Williams Alaska Petroleum, Inc., Former North Pole Refinery, North Pole, AK. Integral Consulting Inc. August 25.

Integral. 2022. Work plan technical memorandum—Groundwater, Williams Alaska Petroleum, Inc., Former North Pole Refinery, North Pole, Alaska. Integral Consulting Inc., Moorestown, NJ. May 4.

Integral. 2024a. Work plan technical memorandum—Soil characterization, Williams Alaska Petroleum, Inc., Former North Pole Refinery, North Pole, Alaska. Integral Consulting Inc., Moorestown, NJ. July 1.

Integral. 2024b. Work plan technical memorandum—Onsite soil and groundwater characterization, Williams Alaska Petroleum, Inc., Former North Pole Refinery, North Pole, Alaska. Integral Consulting Inc., Moorestown, NJ. August.

USEPA. 2017. EPA Contract Laboratory Program national functional guidelines for organic Superfund methods data review. EPA-540-R-2017-002. U.S. Environmental Protection Agency, Washington, DC. January.

USEPA. 2020. EPA Contract Laboratory Program national functional guidelines for organic Superfund methods data review. EPA-540-R-20-005. U.S. Environmental Protection Agency, Washington, DC. November.

Integral Response to Comments ADEC Comments (August 20, 2024)

Interim Removal Action Work Plan Technical Memorandum) –

On-Refinery PFAS, Williams Alaska Petroleum, Inc., Former North Pole Refinery, From Integral Consulting, Inc. to James Fish, ADEC; August 8, 2024

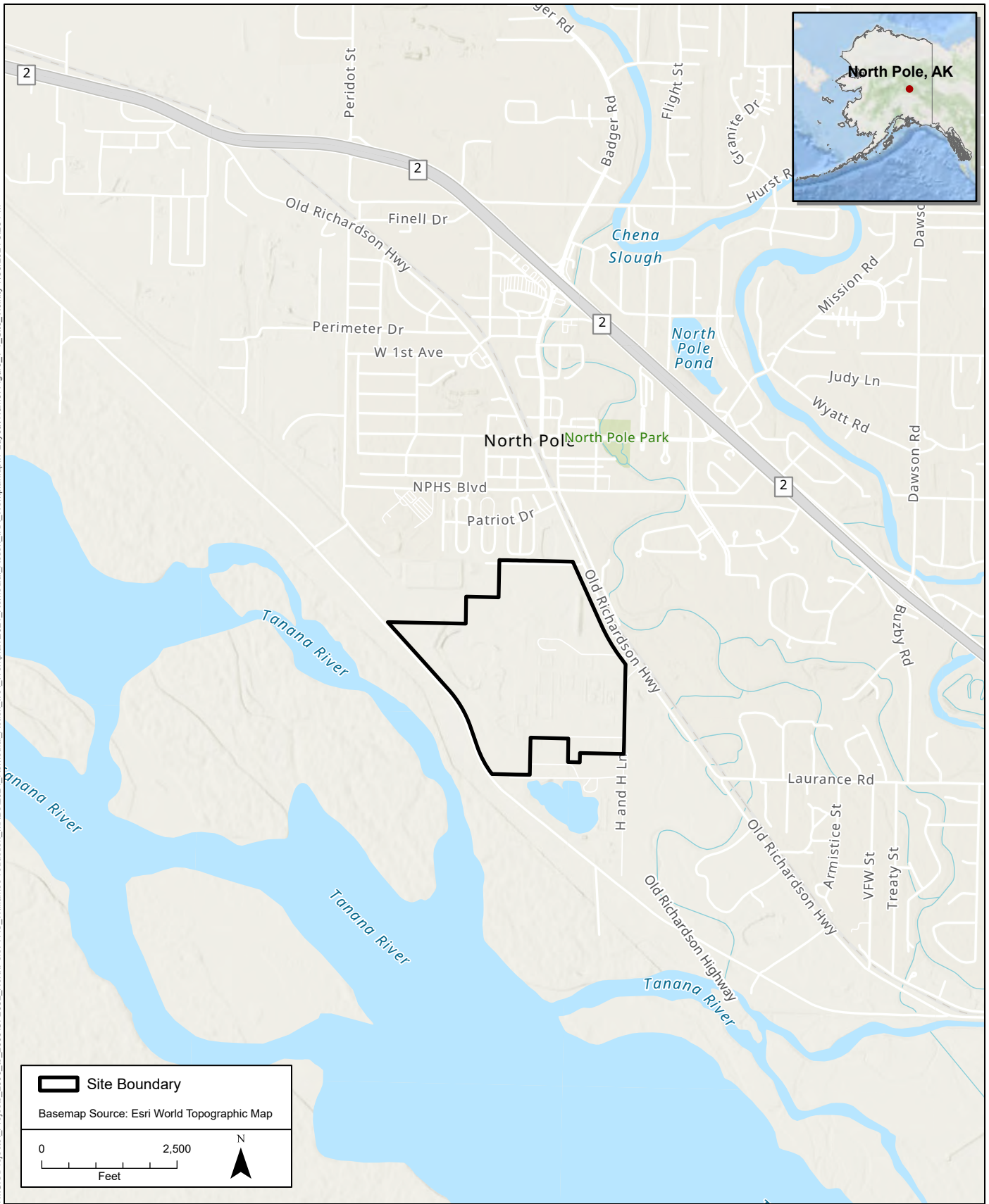
Num.	Page	Section	Comment	Integral RTC	DEC Response 9-23
N/A	N/A	N/A	General comment (following September 5, 2024 meeting): Description of the overall plan and objectives for the FluxTracer study.	The FluxTracer will inform the pilot study design by providing information on the groundwater and PFOA and PFOS mass flux in the area of the proposed pilot study. This information will ensure the correct carbon and CaCl ₂ dosing is provided in the pilot study. The FluxTracer will be placed at the center of the proposed injection site (Figure 9). The device will be removed from the well after approximately 2 weeks for data analysis by the vendor. Results from the FluxTracer, pilot study design, and performance monitoring will be provided to ADEC in a future memorandum.	See response to Comment #8 below
1	4-5	Fire Training Area Excavation	Confirm that the excavation of PFAS-contaminated soils from the former Fire House (former Lab) was abandoned for this interim action, presumably due to interference from subsurface/buried utilities. What options have been identified for addressing the very high levels of PFAS in the soil at this location?	The IRA in the Fire House/Lab area has not been determined at this time. Following receipt of soil samples collected in August an evaluation will be conducted to determine what options are available. The same screening matrix used to assess the FTA will also be used for the Fire House/Lab. The results of the screening will be provided to ADEC.	OK DEC anticipates receiving a 2025 interim action work plan addendum per the Injunction to address the Fire House/Lab area after Integral/Williams has evaluated the 2024 soil sample results.
2	4-5	Fire Training Area Excavation	For Confirmation Sampling, Integral plans to follow DEC's field sampling guidance. Please confirm the total number of anticipated confirmation samples for laboratory analysis (sidewall and bottom totals based on square footage of excavation).	From the current excavation prism dimensions (5500 ft ² base and 2600 ft ² sidewall area [considering side slopes]) it is estimated that 25 base confirmation samples and 12 sidewall confirmation samples will be collected. The number of confirmation samples will be recalculated when the excavation prism is finalized.	OK; the final number of base and sidewall confirmation samples will be based on the final excavation prism size in compliance with DEC's field sampling guidance.
3	4-5	Fire Training Area Excavation	Utilize Contaminant Media Transport Approval Form, located: https://dec.alaska.gov/media/srbdqika/transport-treatment-disposal-approval-form-for-contaminated-media.pdf	Contaminant Media Transport Approval Form will be submitted to ADEC.	OK
4	Fig. 9	Site Characterization and Mass Flux Study	Please create a companion figure that shows all existing analytical information (soil sample results and recent groundwater monitoring results) for all locations within the planned pilot test area shown in Figure 9 (or modified if appropriate).	The most recent groundwater and soil results are presented on Figures 4 through 6c. However, the results of the 2024 field program have not yet been finalized. Those results will be provided to ADEC as part of a separate document once complete. The pilot study is proposed to be implemented in 2025, following review of the FluxTracer study results and pilot study design. The only colloidal injection work proposed for 2024 is the FluxTracer study, including installation of monitoring wells. Prior to pilot study implementation in 2025, additional information will be provided in a future memorandum summarizing the pilot study design. This memorandum will include analytical data, results from the FluxTracer study (groundwater and contaminant mass flux results), the pilot study design, and the performance monitoring plan.	DEC understands that the 2024 field results have not yet been finalized. In the future memorandum summarizing the pilot study design, DEC requests inclusion of a single figure showing all analytical information (all soil and recent groundwater results) for the pilot test area. DEC does not anticipate this being an onerous request, because Integral should have all the data in their GIS database. This figure will be instrumental in DEC's review of the 2025 Pilot Test work plan memorandum and pilot test results.

Num.	Page	Section	Comment	Integral RTC	DEC Response 9-23
5	6	Site Characterization and Mass Flux Study	More thorough details should be provided on the colloidal activated carbon study, including estimated amounts of CAC and CaCl ₂ to be used in the study, depth of the injection barrier, and details on CAC injection method (e.g. if temporary drive points are to be used, the spacing between points, injection method – pump or gravity feed).	Data collected from the FluxTracer study will be used to finalize the pilot study design, including the CAC and CaCl ₂ amounts, injection depths and methods. Information on the pilot study design will be provided to ADEC in a future memorandum.	OK
6	6-7	Site Characterization and Mass Flux Study – Well Installation and Sampling	Please confirm details of the monitoring well installation and sampling for the injection pilot study: - What are the proposed monitoring well distances upgradient and downgradient of the barrier and how were these determined? - Please consider and comment on the potential benefits of adding additional monitoring points. The use of only one downgradient well will not provide any information on the lateral effectiveness of the CAC. Additional wells would provide for more comprehensive assessment of the effectiveness. - Will any soil samples be collected from the injection well or monitoring wells? If so, please provide details.	Three monitoring wells will be installed, including 15 ft upgradient, at the center, and 15 ft downgradient of the proposed injection barrier wall location (Figure 9). Wells will be installed and screened to capture the Water Table Zone. Originally, it was proposed that wells would be screened from 10 to 25 feet bgs. Further review of recent groundwater elevation data indicates that wells should be screened to target 5 to 15 feet bgs. Placing the wells 15 ft from the barrier wall will ensure that wells are outside of the radius of influence (extent of colloidal carbon distribution following injection). The proposed injection barrier will be installed perpendicular to groundwater flow direction and wells placed along the centerline of the barrier wall. The proposed number of wells and well placement has proven to be effective at evaluating the efficacy of pilot studies completed at sites with similar characteristics. Soil samples will be collected from the treatment zone at the monitoring well locations for PFAS compounds (EPA Method 1633; p. 7 of the memorandum). The future pilot study memorandum will include information on the monitoring plan to evaluate effectiveness, the need for additional monitoring wells, and any soil sampling.	Concur for monitoring details to be provided in the future work plan memorandum. Future discussions with Integral/Williams regarding their longer-term plan for potentially scaling up the pilot scale remedial program to full-scale PFAS remediation at the site may provide insight into the cost-benefit of using additional monitoring wells for this pilot study.

Num.	Page	Section	Comment	Integral RTC	DEC Response 9-23
7	6-7	Well Installation and Sampling	- What are the anticipated screen length and screened intervals relative to water table position and expected seasonal fluctuations? - What is the expected groundwater sampling schedule and duration for the pilot study? What factors will be used to determine when the test should end? - Please confirm which PFAS will be monitored. - When sampling MWs with the CAC injection site, DEC recommends also sampling for BTEX, GRO, DRO, and sulfolane and determining if LNAPL is present to understand competitive sorption of contaminants onto injected carbon. - The text also discusses groundwater geochemistry; what geochemical parameters will be included in the sampling protocol?	Wells will be installed to monitor PFAS (EPA Method 1633 compounds) concentrations upgradient, in the center of, and downgradient of the injection barrier. Monitoring wells will have a 2-in. PVC casing, with the screen placed approximately 5 to 15 ft below ground surface to target the Water Table Zone and the proposed treatment interval (p. 6 of the memorandum). The future pilot study memorandum will include information on performance monitoring including any additional analytes and geochemical parameters.	Concur for monitoring details to be provided in the future work plan memorandum. <i>Note for comment tracking purposes, this comment #7 was part of DEC's original comment #6.</i>
8	6-7	Site Characterization and Mass Flux Study- Flux Tracer Study	Please provide more information about the FluxTracer Study. - Integral plans to install a FluxTracer device in the study site to measure mass flux rate and Darcy velocity (groundwater flux). According to the workplan, the device is to be installed in the center of the proposed injection barrier. Is the intention of the FluxTracer study to measure the mass flux entering the injection barrier (an assumption is made that mass flux measurements will include at least both PFOA and PFOS, since mass flux rates will be different for each compound given differences in retardation). If so, a more thorough study would also include mass flux measurements downgradient from the injection barrier. Such a study would provide information on the change (or lack of change) in PFAS mass flux due to the introduction of CAC. Please specifically describe the purpose of the mass flux study, - What groundwater monitoring will be performed before or after the flux tracer study to support the study? - When reporting results of mass flux estimates, please provide calculations or Regenes calculator outputs.	The FluxTracer Study will inform the pilot study design by providing information on the groundwater and PFOA and PFOS mass flux in the area of the proposed study. This information will ensure the correct carbon and CaCl₂ dosing is provided in the pilot study. The FluxTracer will be removed from the well after approximately 2 weeks to data analysis. FluxTracer devices will not be in place during the pilot study. A one-time groundwater monitoring event will be completed no sooner than 2 weeks from development of the new wells and will be analyzed for EPA Method 1633 (p. 7 of the memorandum). Information on FluxTracer results (including calculations), the pilot study design, and performance monitoring will be provided in a future memorandum submitted to ADEC.	OK <i>Note for comment tracking purposes, this comment #8 DEC's original comment #7.</i>

Figures

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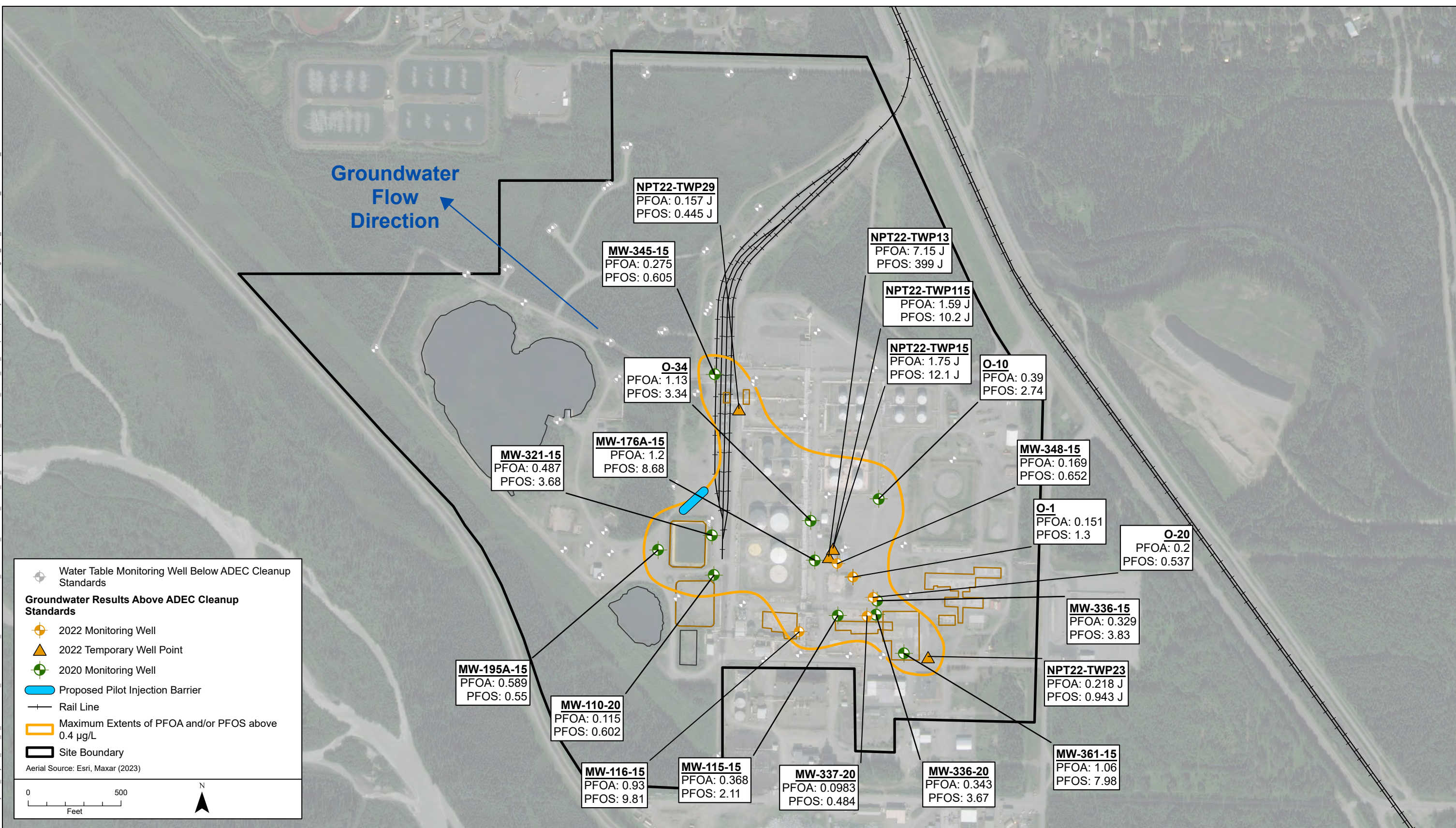
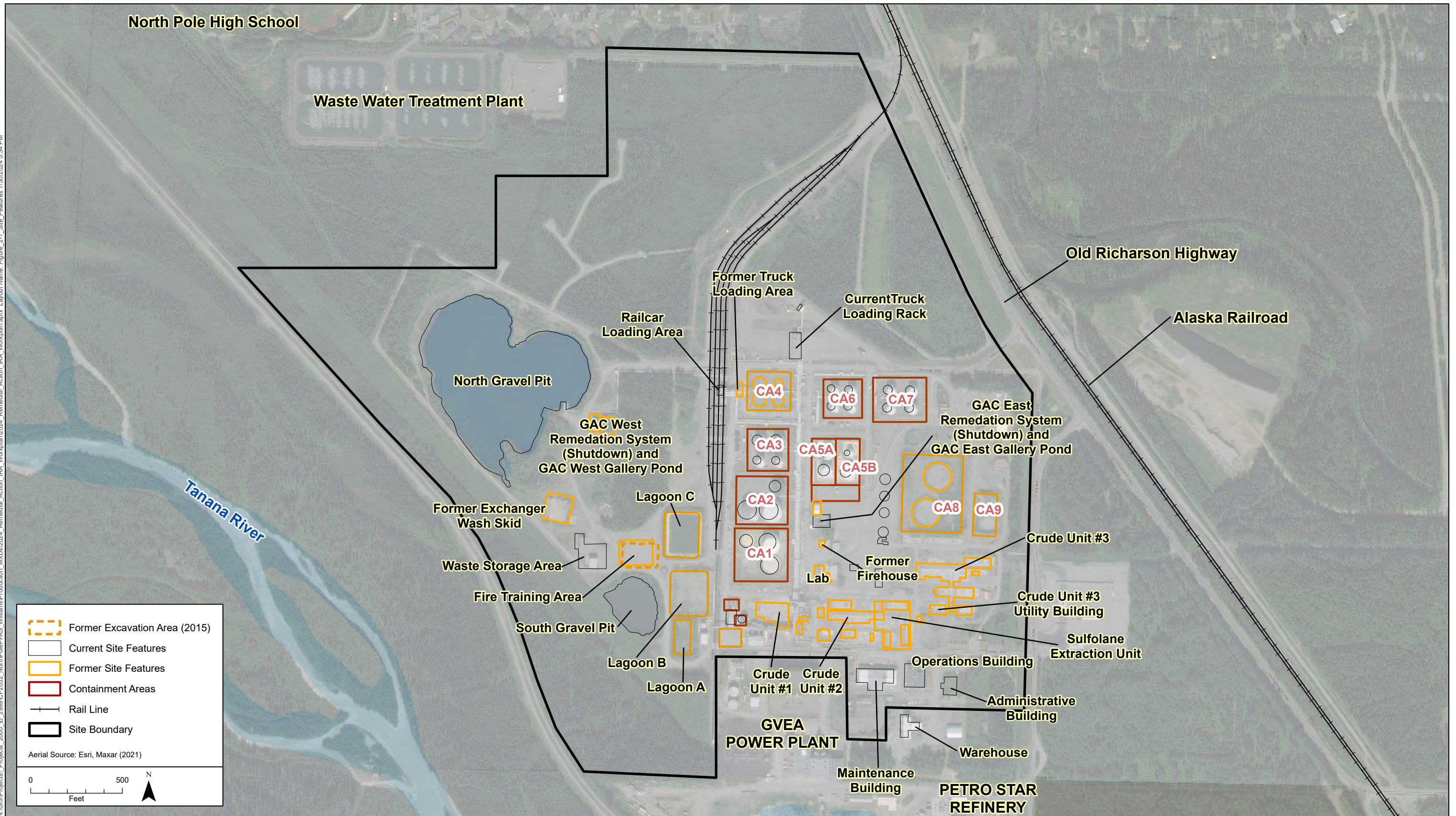


Figure 3.
Previous Groundwater Exceedances of
PFAS Cleanup Levels
North Pole, AK
Interim Removal Action Work Plan

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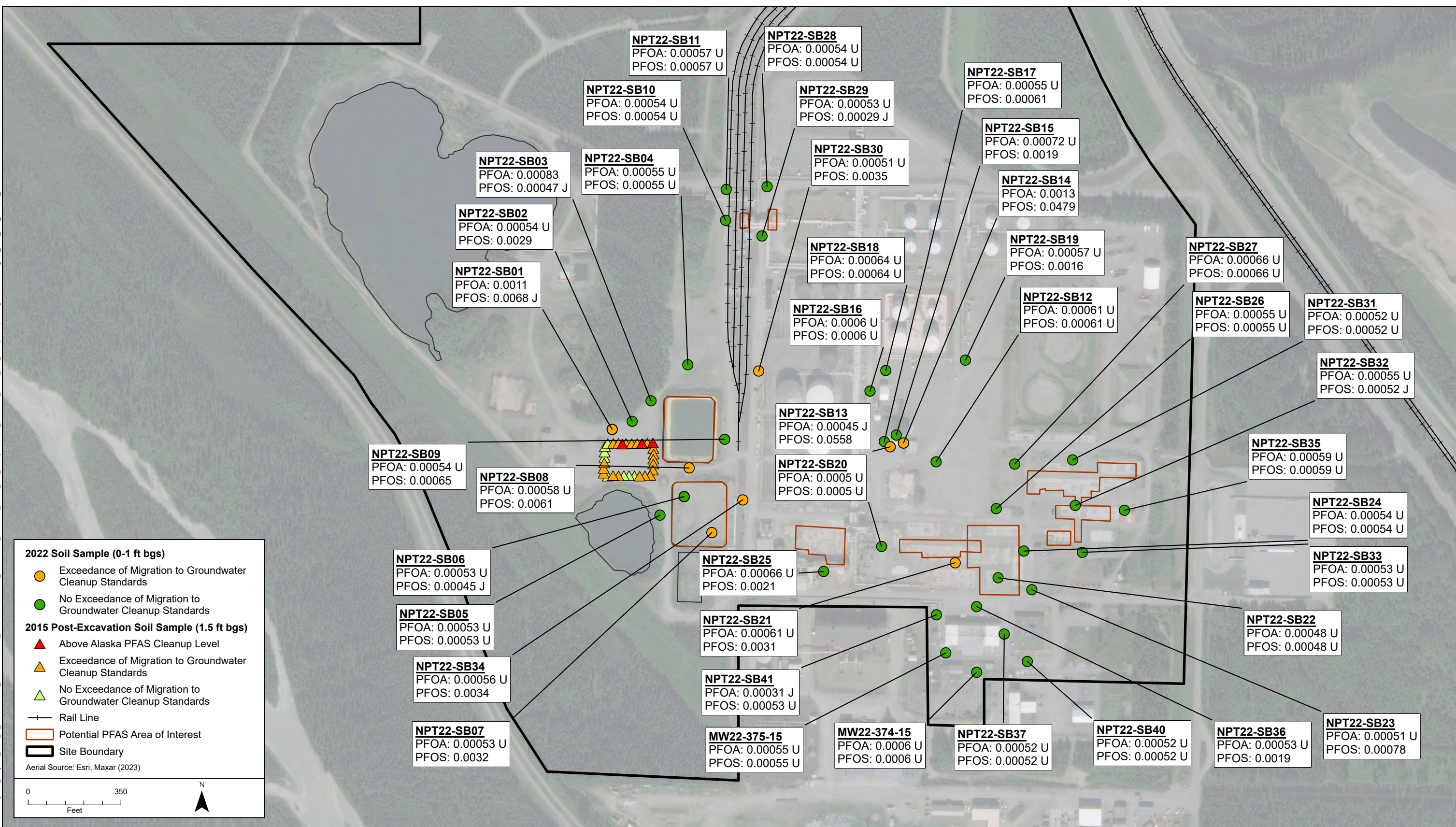
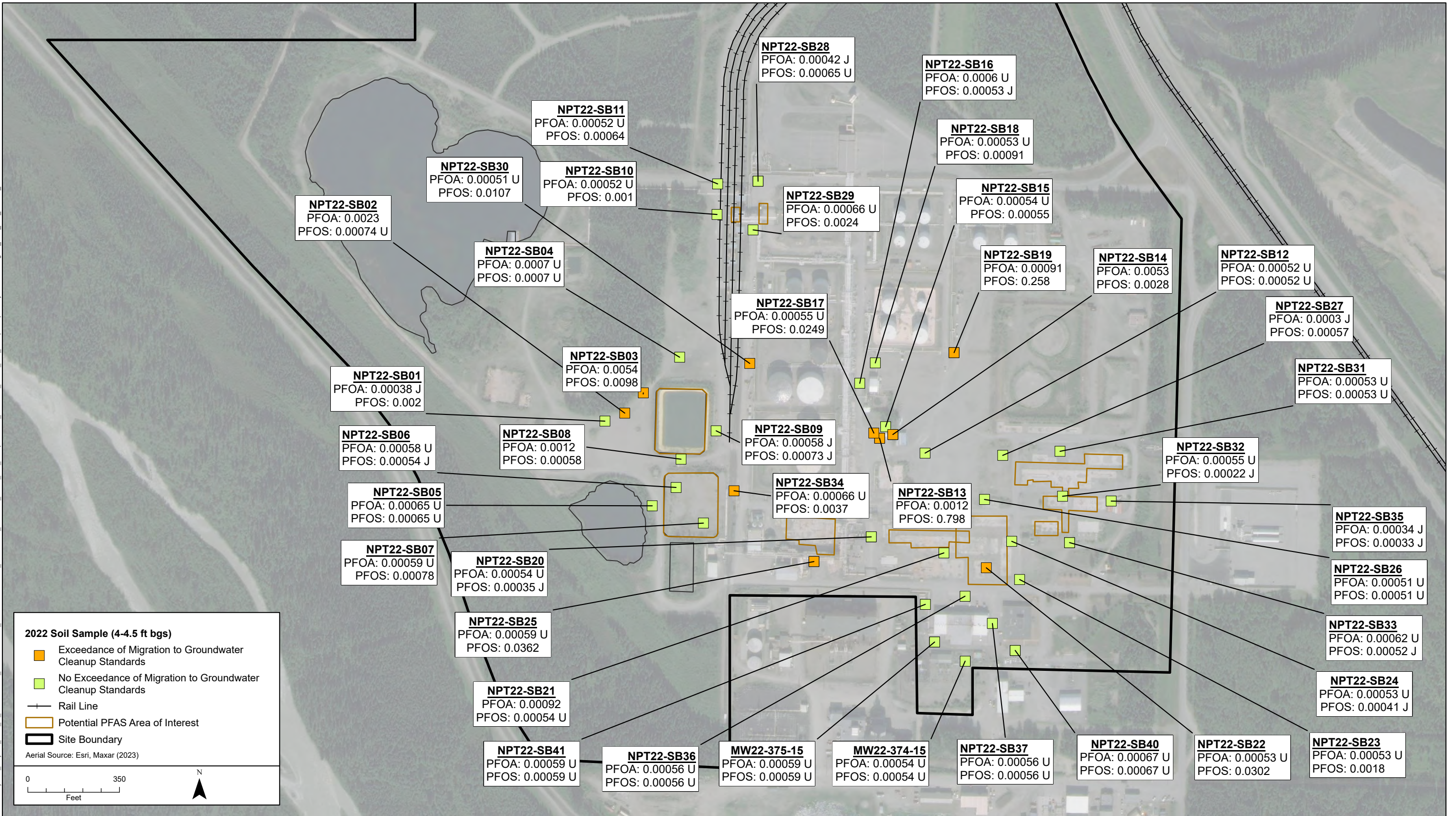
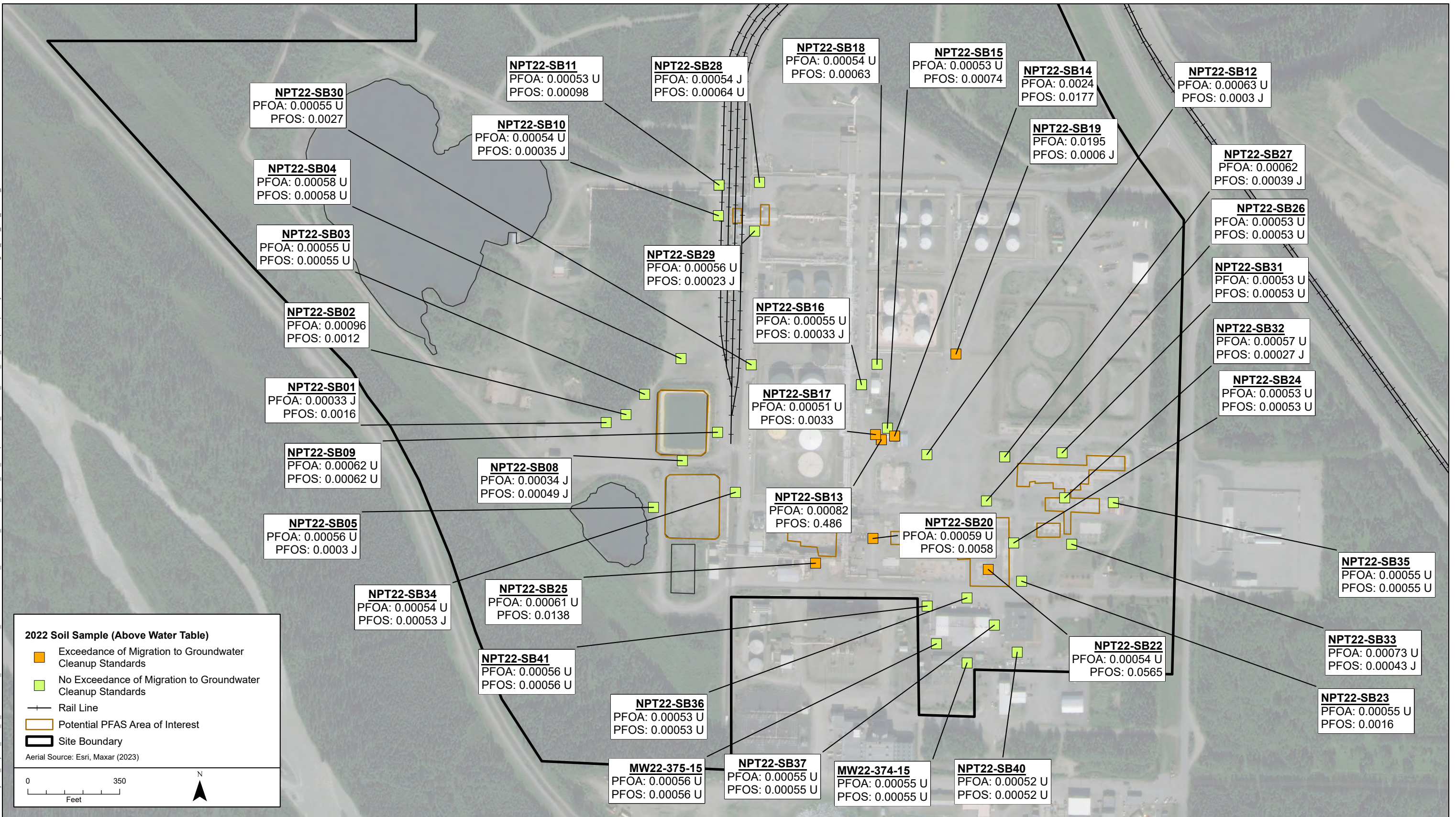


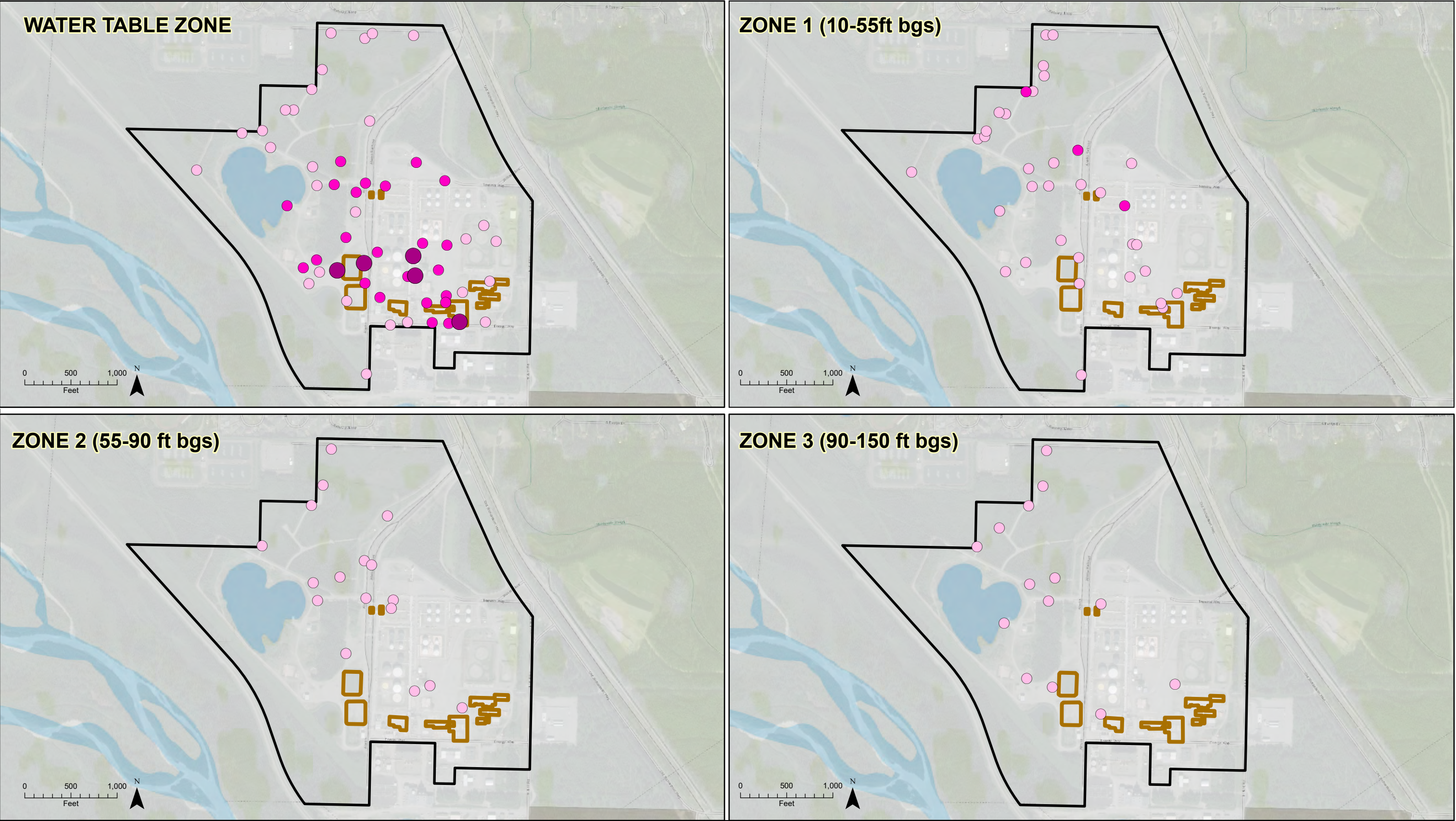
Figure 5a.
Surface Soil Analytical Results (mg/kg)
0-1.5 ft bgs
North Pole, AK
Interim Removal Action Work Plan



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Concentrations of PFOA

- ND - 0.070 ug/L
- 0.070 - 0.400 ug/L
- Greater than 0.400 ug/L

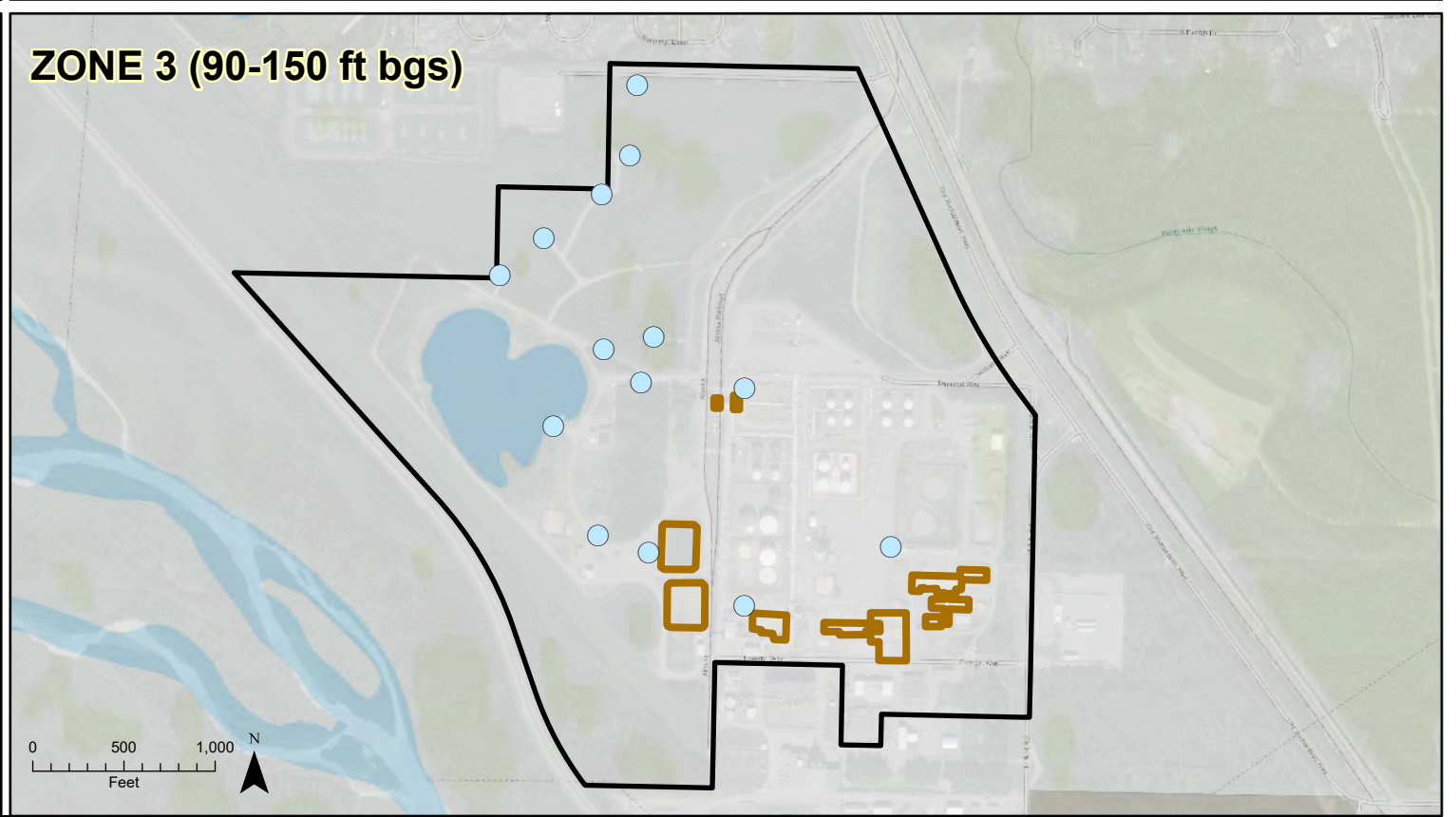
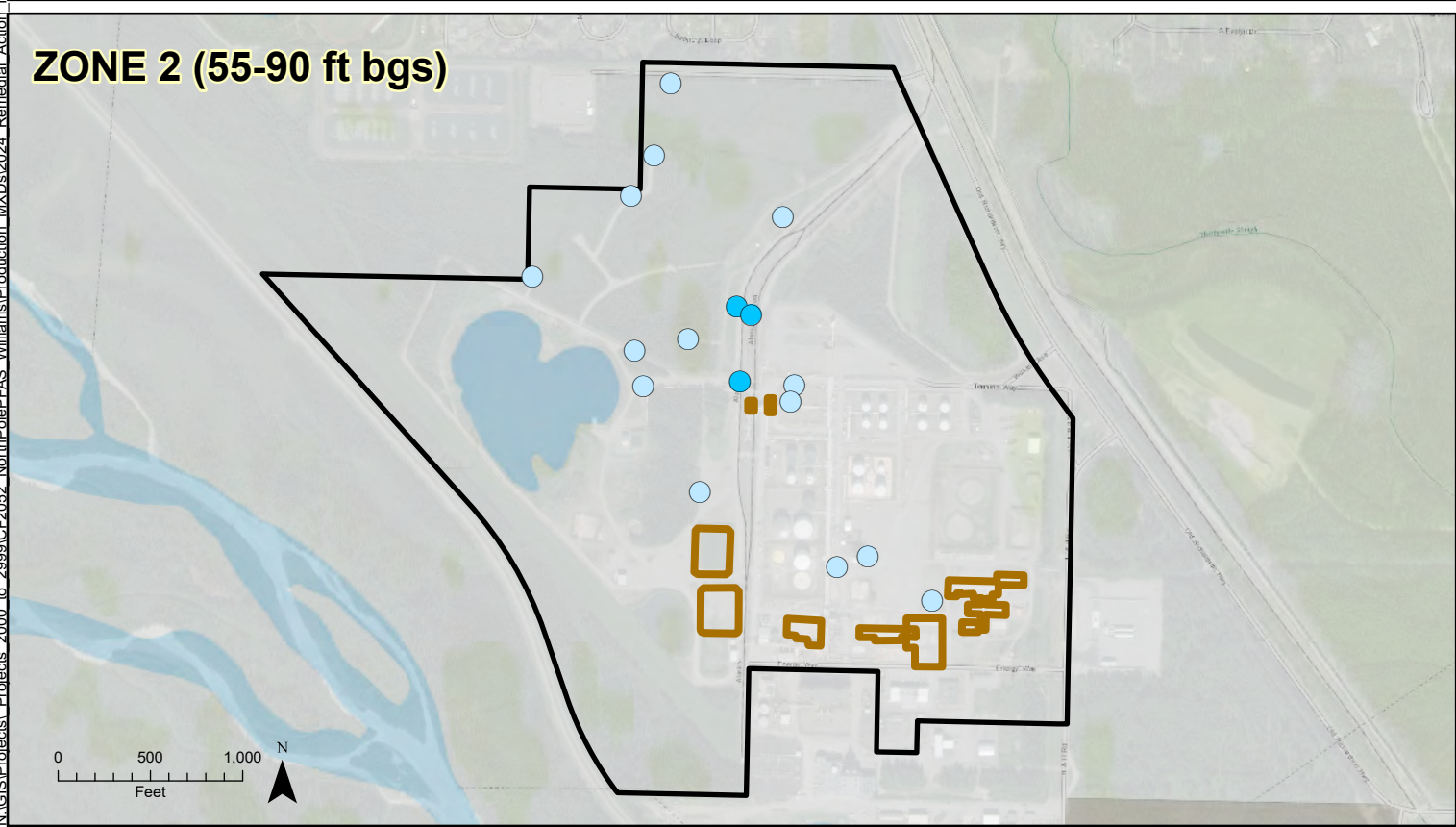
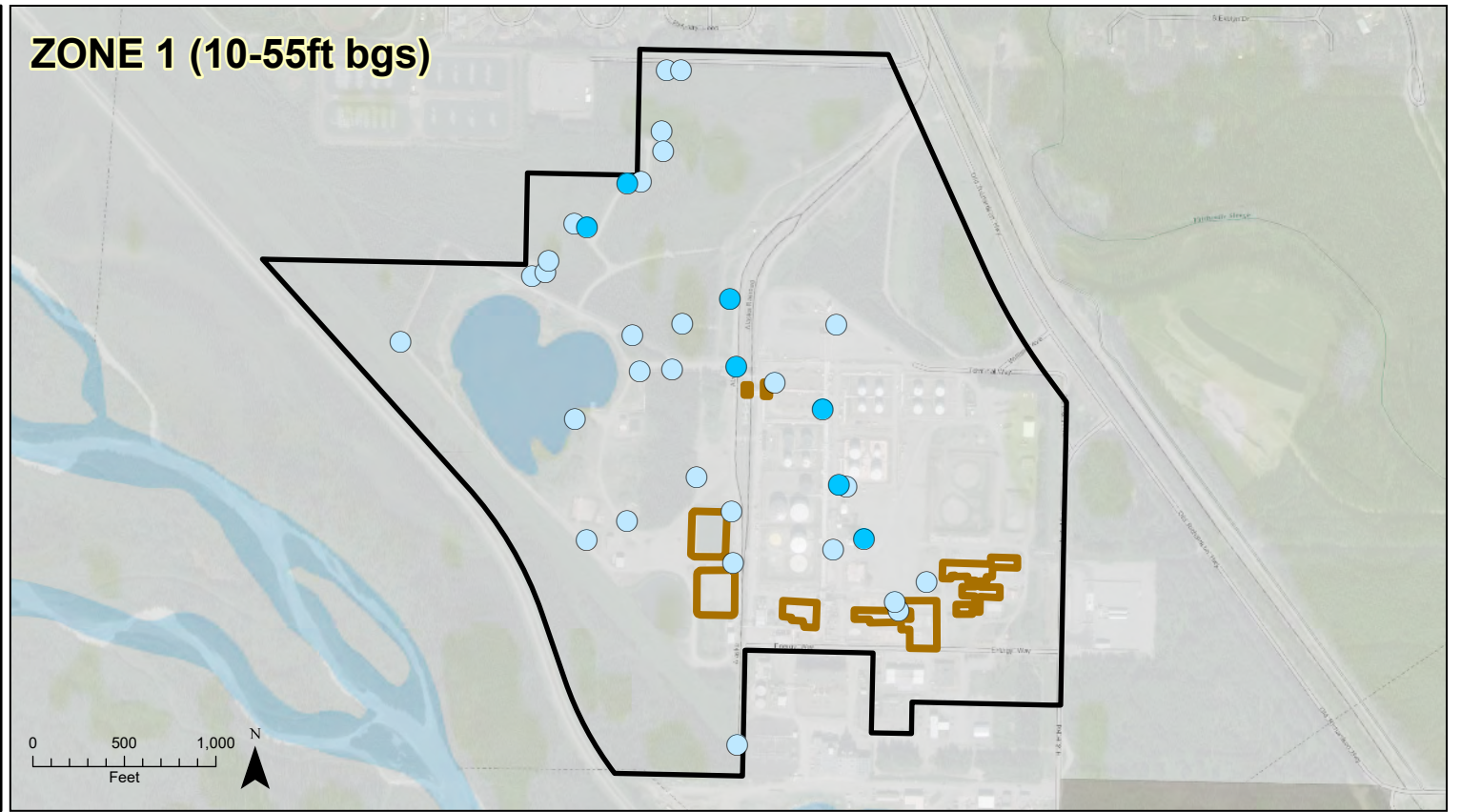
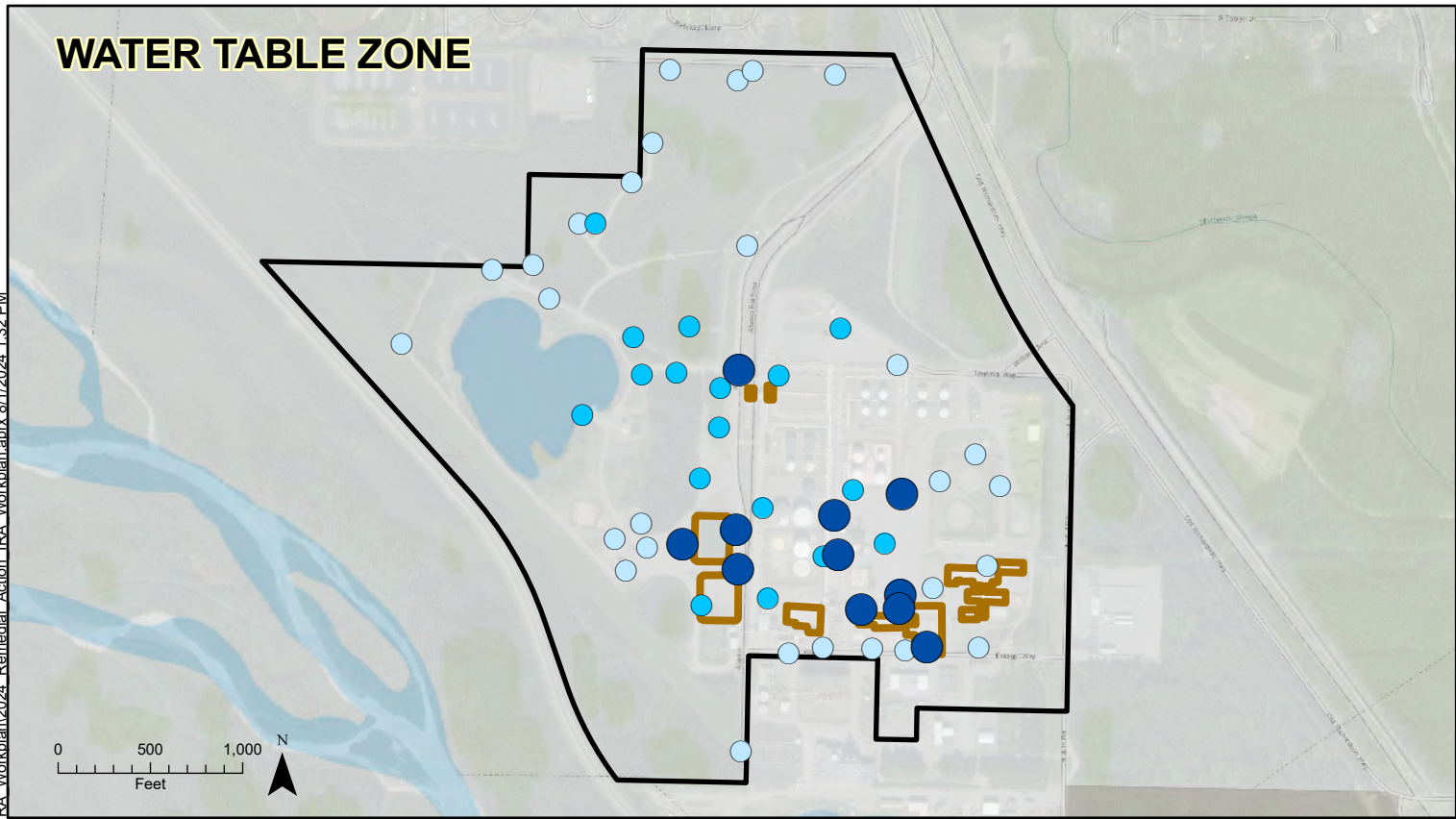
Potential Source Features

- Site Boundary

Aerial Source: Esri, World Topographic Map and World Imagery.

Figure 6a.
December 2020 Ground Water Sampling -
PFOA Results
North Pole, AK
Interim Removal Action Work Plan

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Concentrations of PFOS

- ND - 0.070 ug/L
- 0.070 - 0.400 ug/L
- Greater than 0.400 ug/L

Potential Source Features

- Site Boundary

Aerial Source: Esri, World Topographic Map and World Imagery.

Figure 6b.
December 2020 Ground Water Sampling -
PFOS Results
North Pole, AK
Interim Removal Action Work Plan

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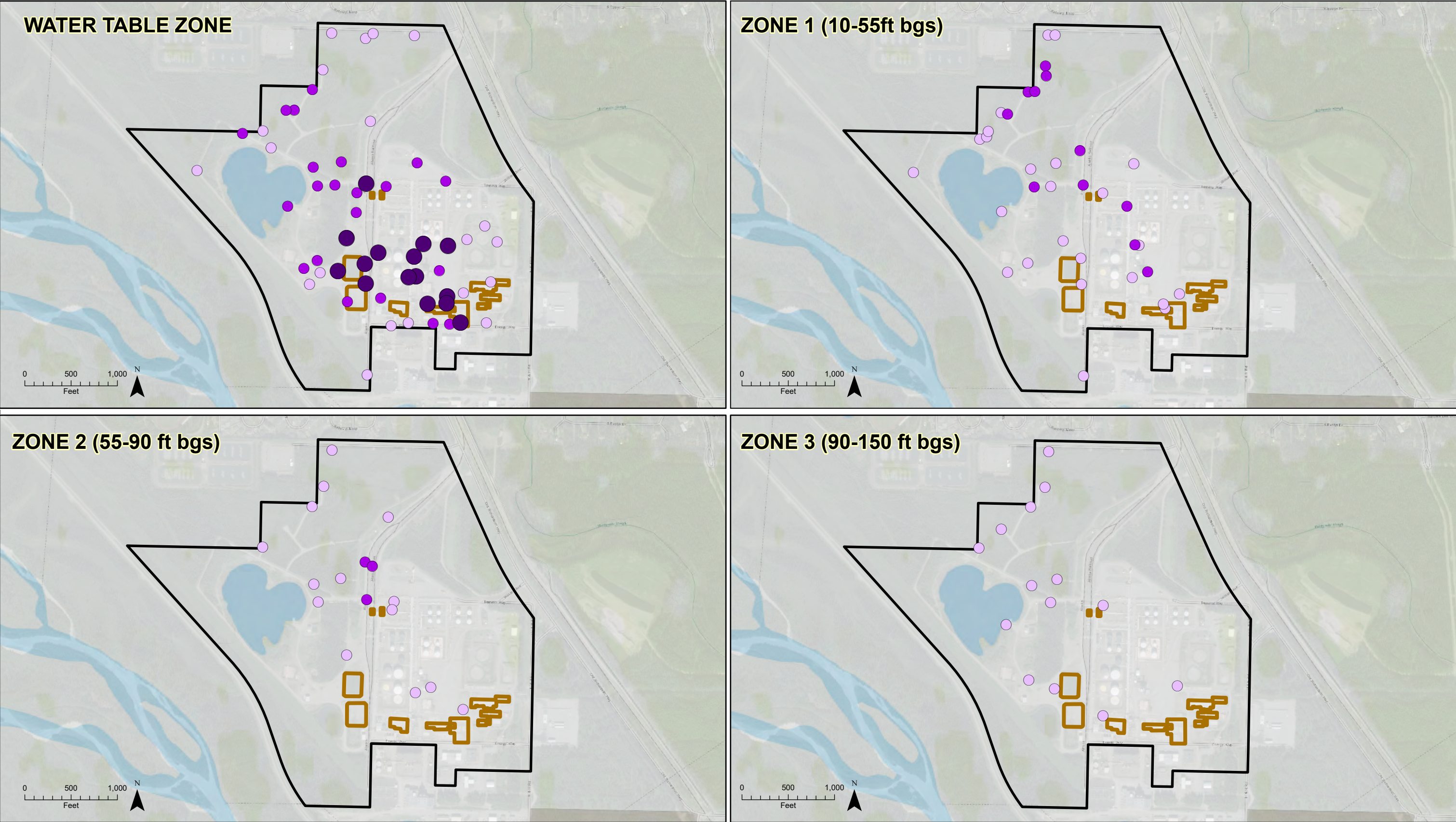
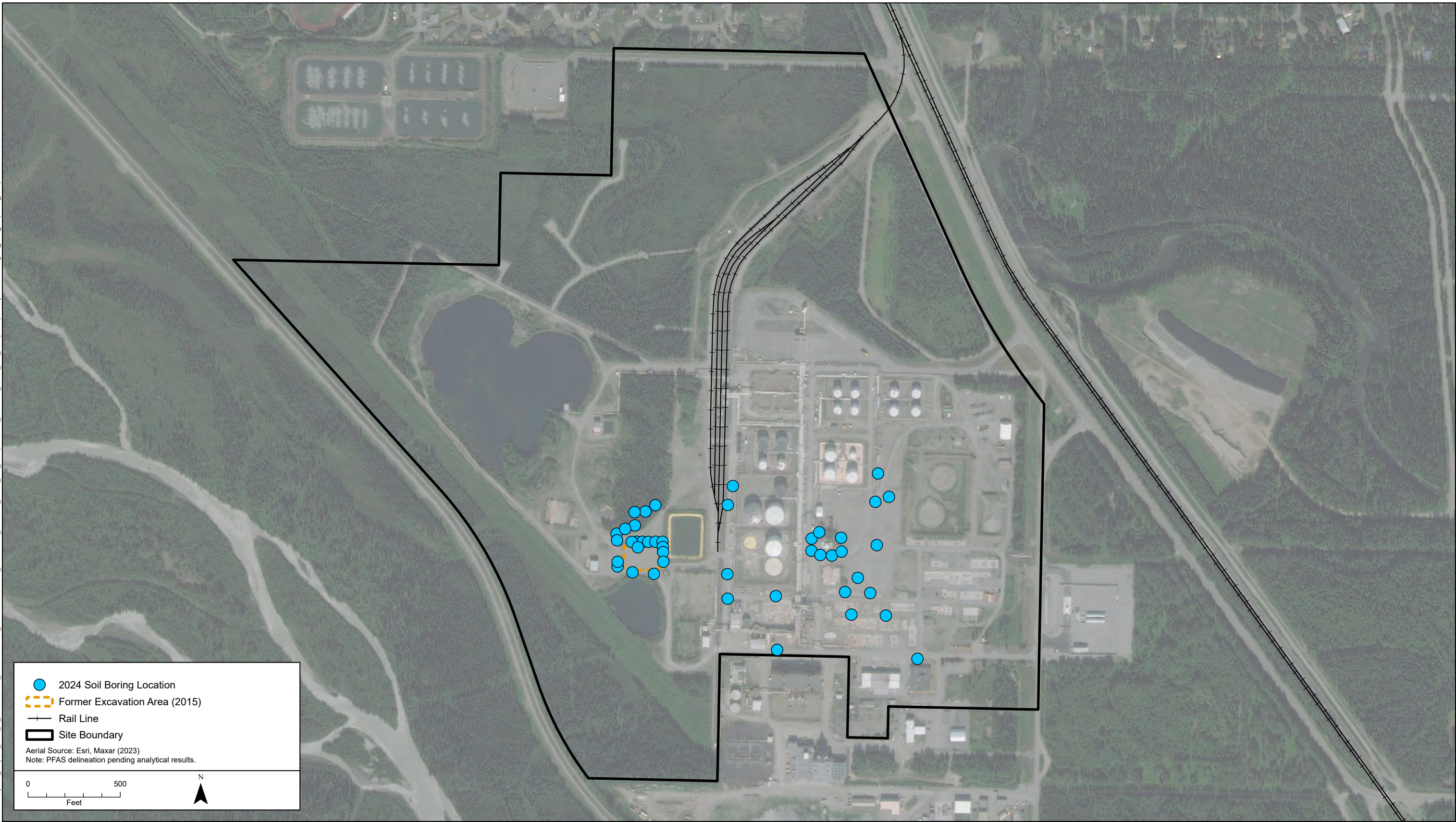
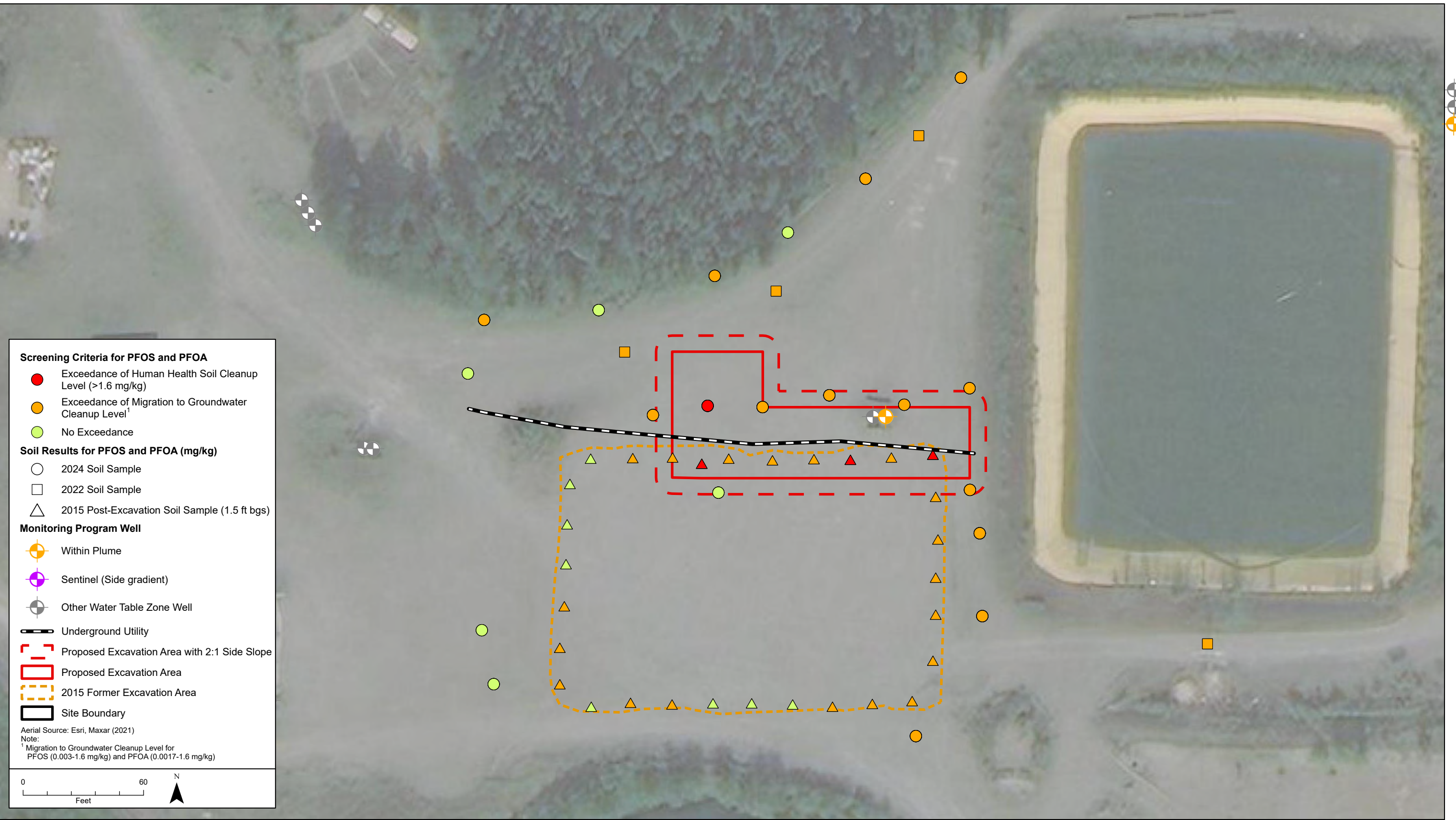


Figure 6c.
December 2020 Ground Water Sampling -
Combined PFOA+PFOS Results
North Pole, AK
Interim Removal Action Work Plan

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Attachment A

FluxTracer[®] Specifications



FluxTracer Overview

Technology at-a-Glance

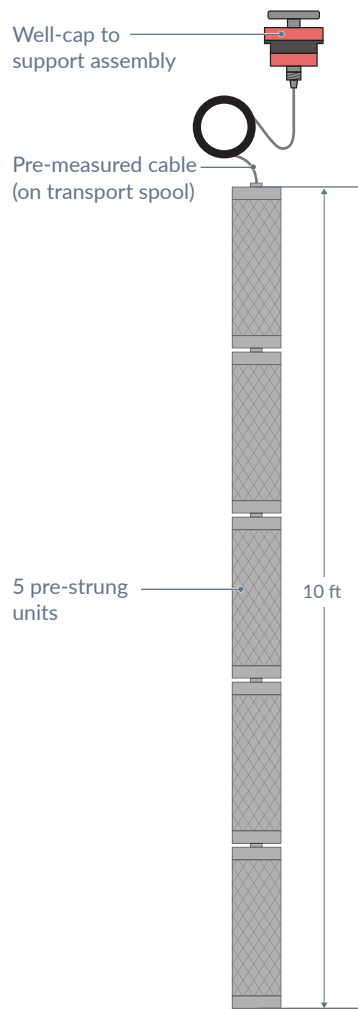
Overview

FluxTracer: Technology at-a-glance



FluxTracer® Flux Mapping Tools are easy-to-use devices that vertically delineate contaminant mass flux and groundwater velocity within existing monitoring wells to aid in site characterization and remedial designs.

Conventional methods (pump and slug tests) give a single value for groundwater velocity whereas passive tools like FluxTracer are designed to distinguish individual zones within an aquifer. This level of resolution is especially useful for remediation design. See [Figure 1](#) for visual representation.



A Dual-Functioning, Passive Sampling Technology For Site Characterization and *In Situ* Remediation Designs

The FluxTracer consists of five separate two-foot-long stainless steel cannisters secured in a series on a premeasured central wire line equipped with a modified J-plug. FluxTracers are always pre-assembled, arriving at your site ready to deploy with no on-site construction required. The unique design provides joint-like flexibility between the closely stacked cannisters to easily install and remove from a well.

Key Benefits:

- High Data Resolution and Accuracy
- Plume Characterization
- Estimate *In Situ* Product Longevity
- Reliable Turnaround Time
- Affordable with Full Customer Support

Fast Installation:

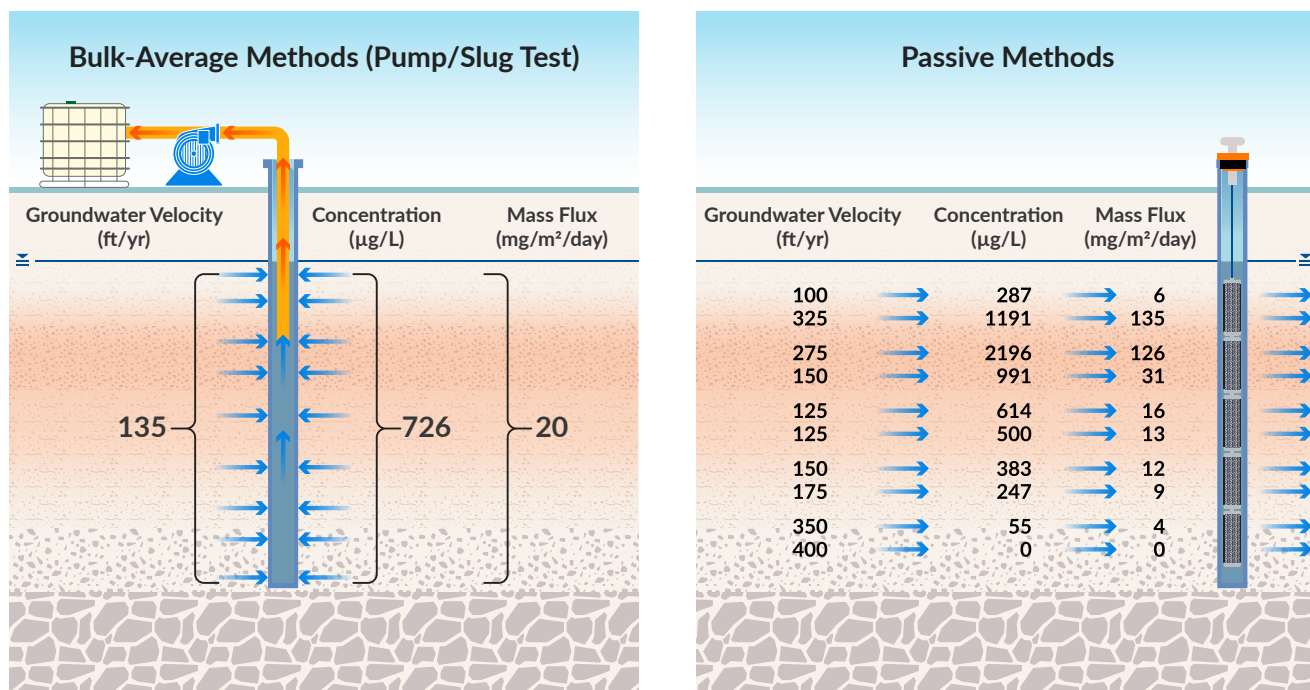
- 15-Minute Install Per Device
- Ready to Deploy Upon Arrival
- No Assembly Required

Target Contaminants:

- Chlorinated Volatile Organic Compounds (CVOCs)
- PFAS
- Benzene, Toluene, Ethylbenzene, Xylene (BTEX) and Total Petroleum Hydrocarbons (TPH) (PFM)*

* Analysis for BTEX and TPH are in development. Please refer to EnviroFlux PFM for these analytes.

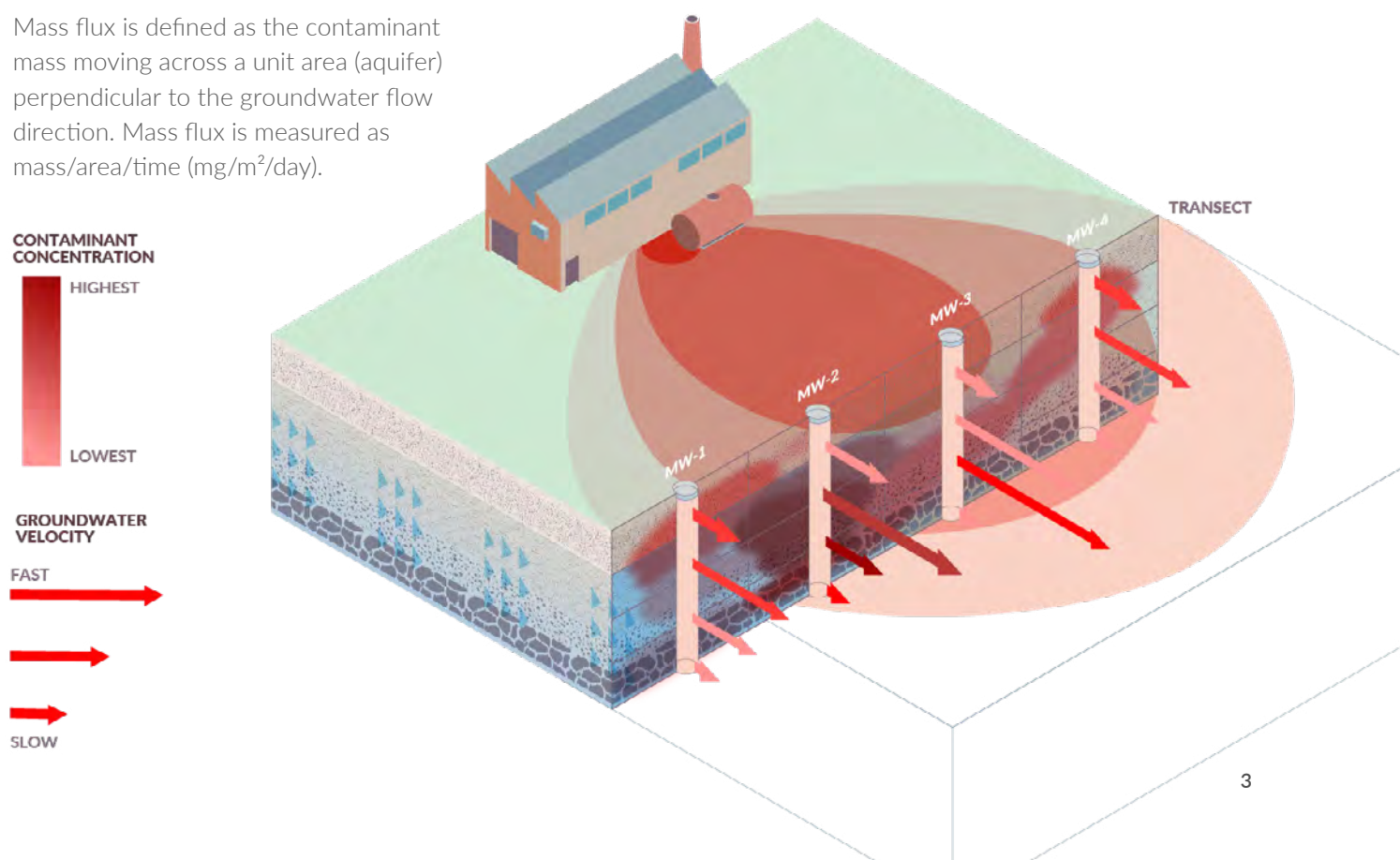
Figure 1 Measuring Groundwater Velocity & Mass Flux: Data Comparison



A comparison of conventional and passive methods of velocity and flux measurement

What is Mass Flux?

Mass flux is defined as the contaminant mass moving across a unit area (aquifer) perpendicular to the groundwater flow direction. Mass flux is measured as mass/area/time (mg/m²/day).



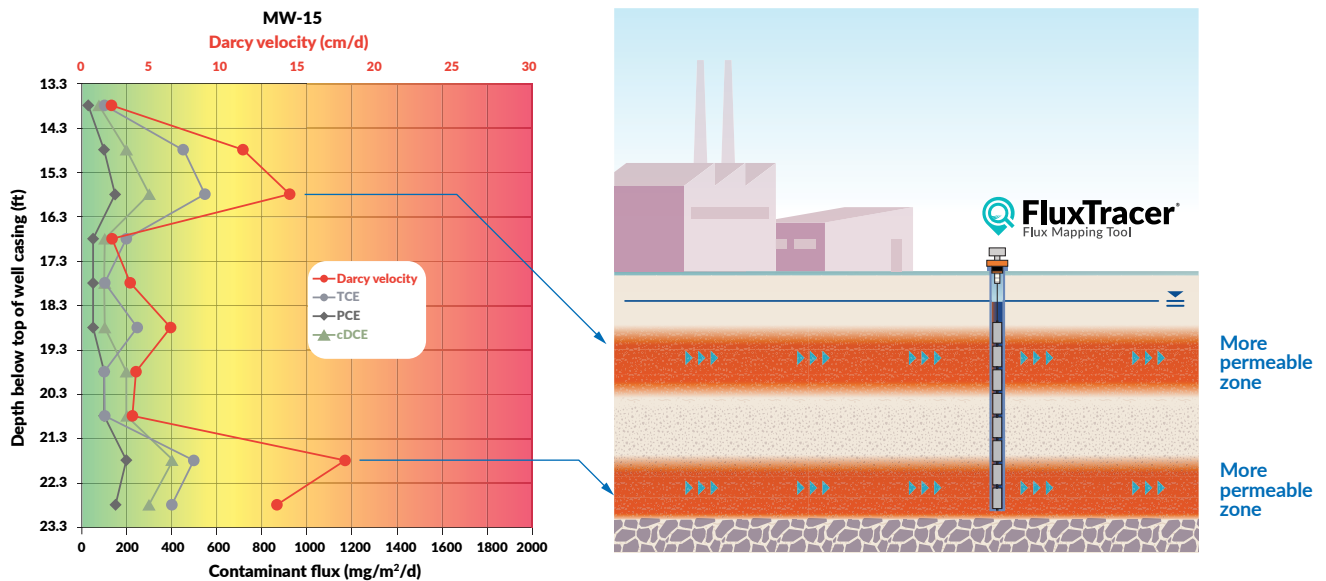
Why Design with Mass Flux and Groundwater Velocity?

- Identify impacted zone beyond well interval
- Developed for *in situ* remediation scale products
- High resolution data on conductive zones
- Estimate longevity of permeable reactive barriers
- Identify discrete zones with the highest contaminant mass
- Comparable cost to pump and slug tests
- Lower costs than HPTs

Oftentimes 90% of contaminant mass is moving through 10% of the aquifer

Figure 2

Conceptual Site Model



Site data showing mass flux of chlorinated contaminants (PCE, TCE, cDCE). Data shows highest TCE mass flux at 15.75' depth below casing and highest cDCE at 14.75' depth below casing. The mass flux data can be used to design with more certainty through applying additional focus on areas of the interval with the highest flux.

Conventional Methods can Significantly Underestimate Velocities in Flux Zones

Groundwater velocity is a major component of contaminant mass flux and understanding the flux is essential to designing for in-situ remediation. The study summarized in the chart below shows that groundwater velocity can be underestimated 50% of the time using conventional methods such as slug and pump testing, and hydraulic profiling tools (HPTs). Slug and pumping tests provide bulk water averages and do not provide the resolution required for in-situ remediation designs. HPTs can provide resolution and has good vertical response across the target zone using k values, but the data generated are qualitative and not quantitative.

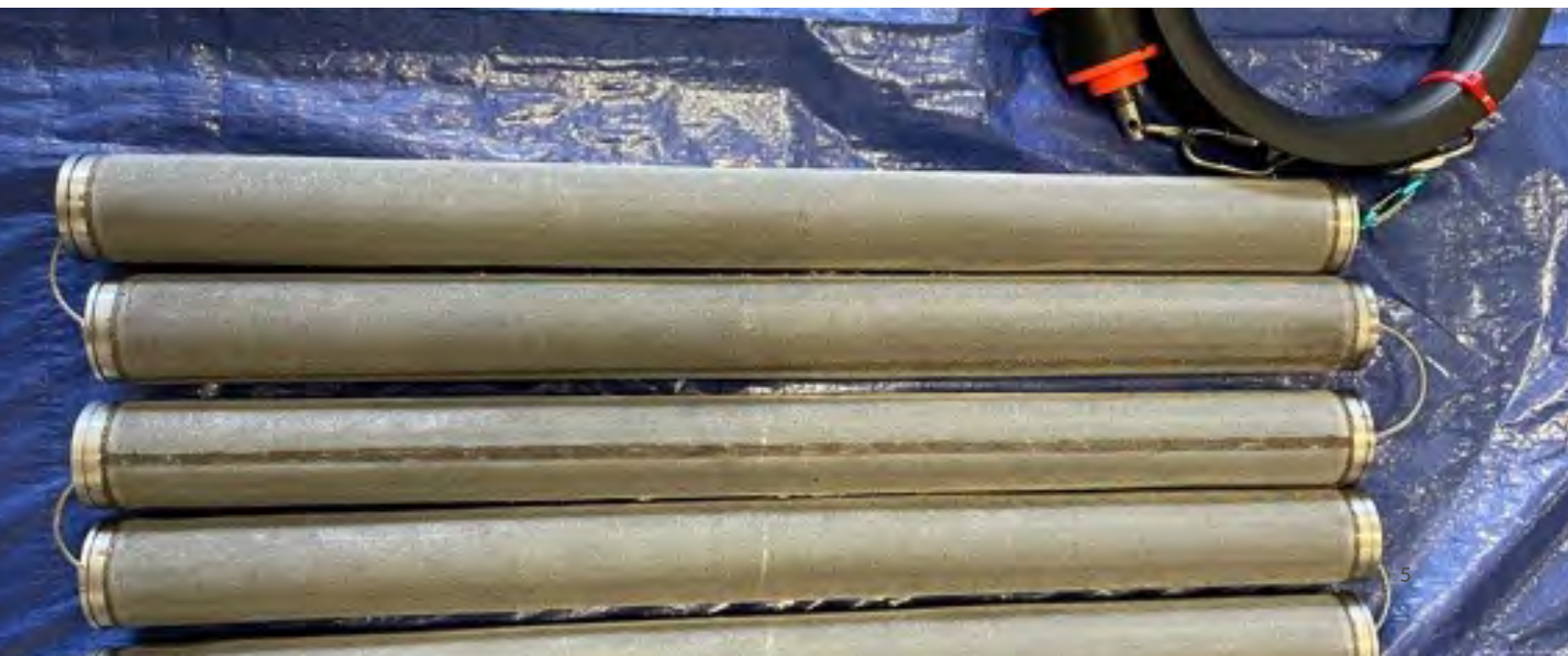
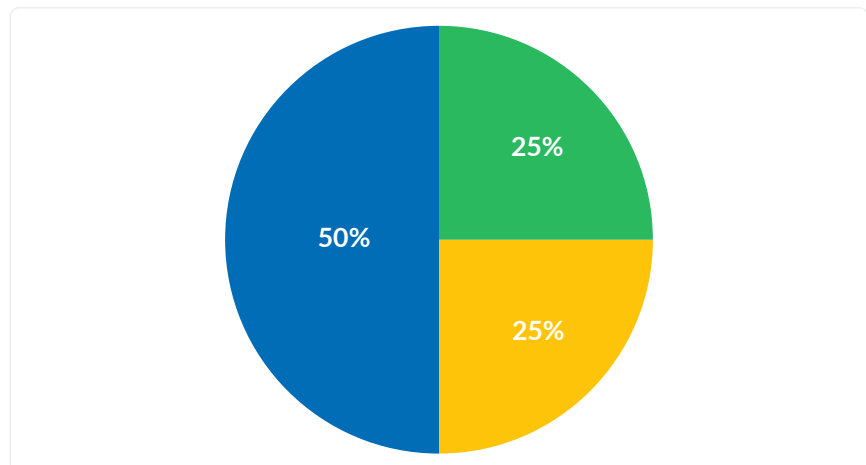
Approximately 50% of designs are modified after conducting FluxTracer measurements

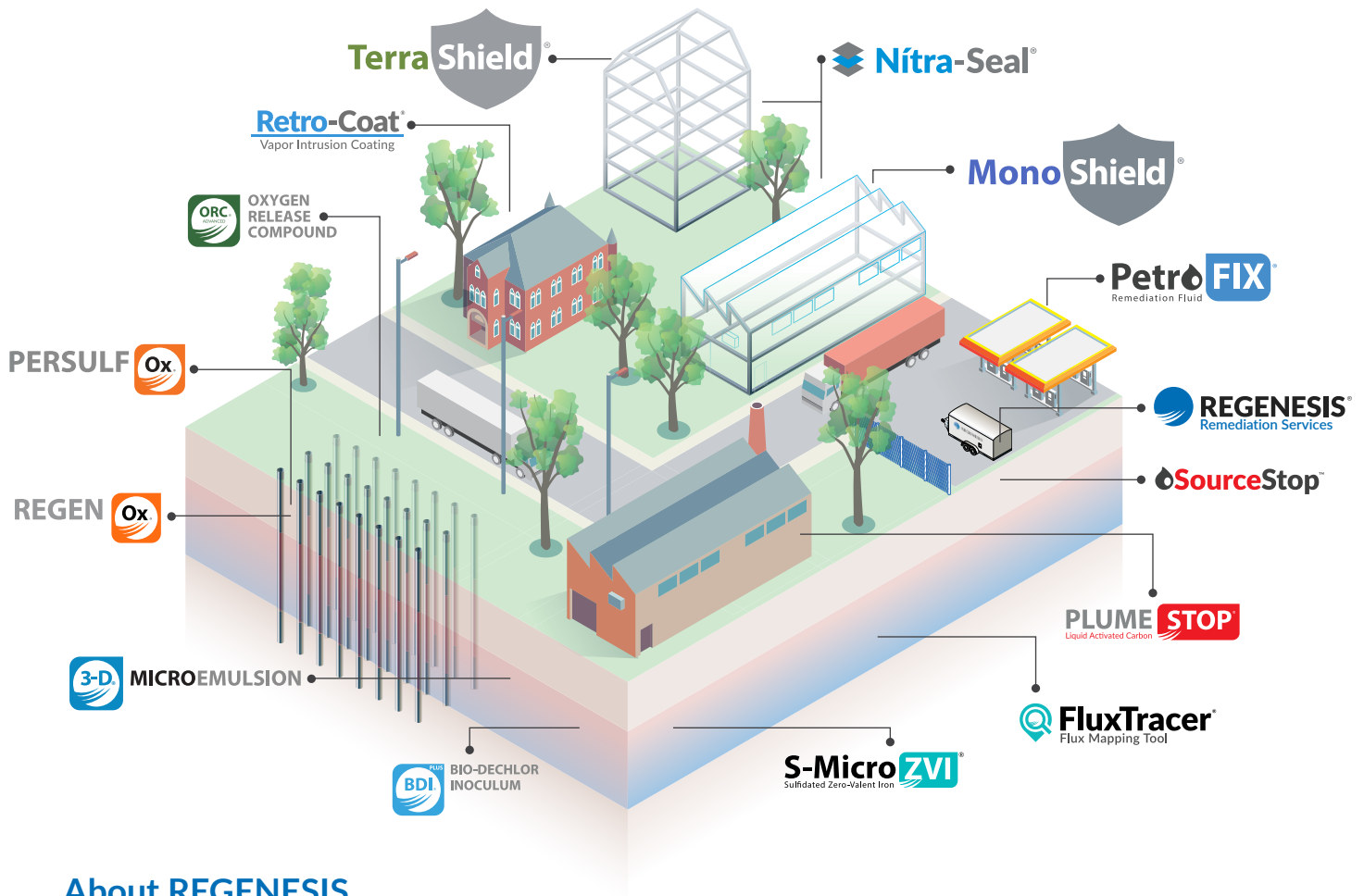
Figure 3

Passive Flux Device & Traditional Seepage Velocity Comparison

Traditional seepage velocities are those derived from slug tests or pump tests

- Flux Device Measures Slower Than Seepage Estimate
- Flux Device & Seepage Generally Match
- Flux Device Reads Higher Than Seepage Estimate





About REGENESIS

At REGENESIS we value innovation, technology, expertise and people which together form the unique framework we operate in as an organization. We see innovation and technology as inseparably linked with one being born out of the other.

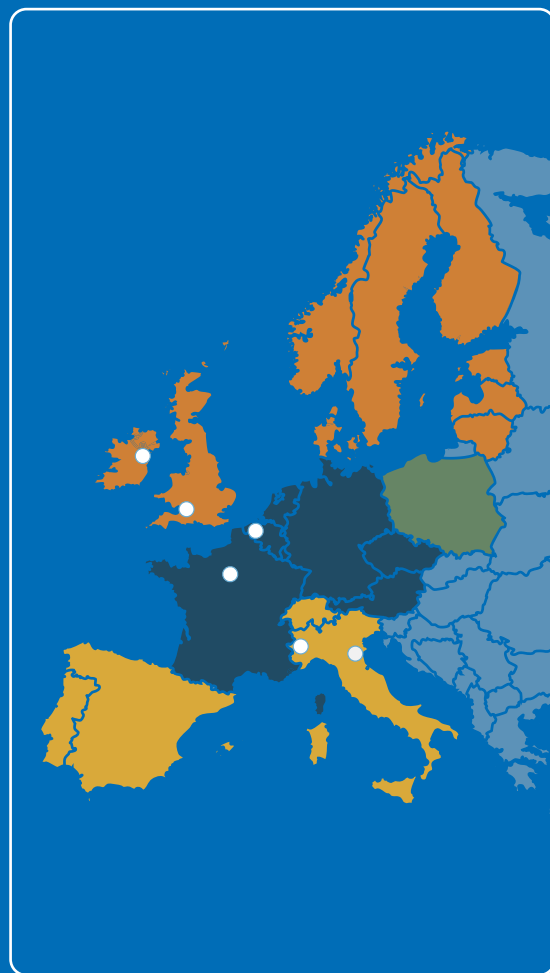
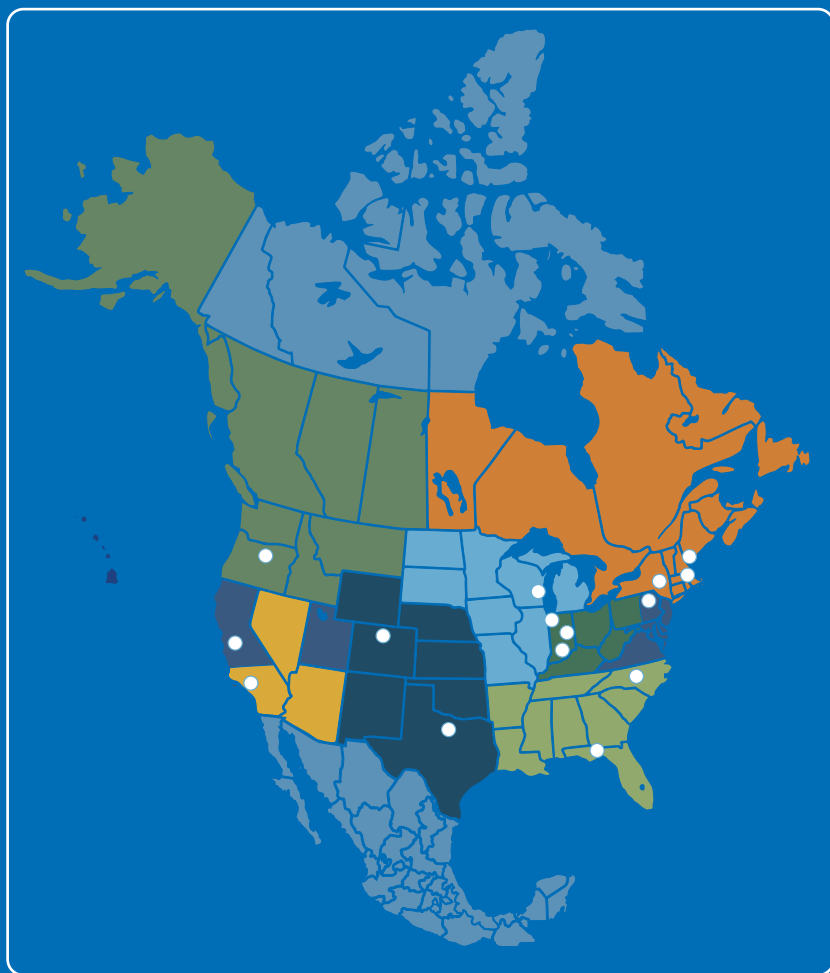
Inherently, innovation imparts new and better ways of thinking and doing. For us this means delivering expert environmental solutions in the form of the most advanced and effective technologies and services available today.

We value expertise, both our customers' and our own. We find that when our experienced staff collaborates directly with customers on complex problems there is a high potential for success including savings in time, resources and cost.

At REGENESIS we are driven by a strong sense of responsibility to the people charged with managing the complex environmental problems we encounter and to the people involved in developing and implementing our technology-based solutions. We are committed to investing in lasting relationships by taking time to understand the people we work with and their circumstances. We believe this is a key factor in achieving successful project outcomes.

We believe that by acting under this set of values, we can work with our customers to achieve a cleaner, healthier, and more prosperous world.

We're Ready to Help You Find the Right Solution For Your Site



Global Headquarters

1011 Calle Sombra
San Clemente, CA 92673 USA

Ph: (949) 366-8000
Fax: (949) 366-8090

Europe

Bath, United Kingdom
Ph: +44 (0) 1225 61 81 61

Dublin, Ireland
Ph: +353 (0) 9059 663

Torino, Italia
Ph: +39 338 8717925

Ieper, België
Ph: +32 (0) 57 35 97 28



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