APPENDIX M

ADDITIONAL EXPERT ANALYSIS BY KUEPER

Expert Report

31st Judicial District Court
Parish of Jefferson Davis
State of Louisiana

Castex Development, LLC vs Anadarko Petroleum Corp et al.

Docket No. C-502-20

Prepared by: **Dr. B.H. Kueper, Ph.D.**
Emeritus Professor
Queen's University

Prepared for:

George Arceneaux III
Liskow & Lewis
Lafayette, LA

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Bernard H. Kueper, Ph.D.

Qualifications

Dr. Kueper is a hydrogeologist with expertise in the area of soil and groundwater contamination, groundwater hydraulics, and subsurface remediation. He received his Ph.D. in hydrogeology from the University of Waterloo in 1989 and joined the faculty at Queen's University in 1990 where he is currently Professor Emeritus. Dr. Kueper's research is focused on the behaviour and remediation of soil and groundwater contaminants in unconsolidated deposits such as clays, silts and sands, as well as fractured rock. His research has included performing field experiments, laboratory experiments, and numerical simulation studies related to the behaviour and remediation of contaminants. In addition to his research duties, which include the supervision of Masters and Ph.D. students, Dr. Kueper's responsibilities at Queen's University included teaching undergraduate and graduate courses in groundwater flow and contaminant hydrogeology, as well as administrative duties.

Dr. Kueper is a former Associate Editor for the Journal of Ground Water, the Journal of Contaminant Hydrology and the Canadian Geotechnical Journal. He has provided professional short courses and training seminars on the topics of soil and groundwater contamination, groundwater hydraulics, and subsurface remediation to regulatory agencies including USEPA, the State of Maine, the State of Texas, CETESB (Sao Paulo), FEEMA (Rio de Janeiro), TIKTVF (Hungary), the province of Ontario, the province of British Columbia, as well as for various licensing bodies including the Massachusetts LSPA and the Connecticut LEPA. In addition, Dr. Kueper has taught in several professional short courses open to practitioners in Australia, China, England, Denmark, Switzerland, Canada and the United States. Appendix A presents a summary of his short course teaching. Dr. Kueper co-authored the definitive EPA guidance titled "Assessment and Delineation of DNAPL Source Zones at Hazardous Waste Sites", and Dr. Kueper is the lead editor of the published textbook "Chlorinated Solvent Source Zone Remediation". Dr. Kueper is the 2019 recipient of the prestigious NGWA M. King Hubbert award for major contributions to the groundwater industry.

In addition to his academic career, Dr. Kueper has provided his services as a technical consultant to government agencies and private industry around the globe for 35 years. This work has included technical expert testimony in court and at public hearings, meetings with USEPA and state/provincial agencies, oversight of site investigation activities, and the preparation of a variety of technical documents. Specific work assignments have included, but are not limited to, evaluation of oil and gas exploration and production sites, design and analysis of pump-and-treat systems, site assessment, delineation of source zones and plumes, assessment of capture zones, plume stability analysis, design of field sampling plans, assessment of remedial options, numerical simulation of groundwater flow and contaminant migration, analysis of the performance of horizontal drain systems, vadose zone leaching analyses, assessment of vapor migration above the water table, and writing of technical workplans.

Opinions

The property that is the subject of this expert report is referred to herein as the Castex site (Site). The Site is located in the southeast portion of Jefferson Davis Parish, Louisiana, approximately one mile southwest of Mermentau, Louisiana. The following opinions are expressed to a reasonable degree of scientific certainty:

1) The geology at the Site primarily comprises low permeability clay-dominant and silt-dominant hydrocodes to a depth of approximately 100 feet (ft) below ground surface (bgs).

2) Discontinuous and isolated water-bearing zones occur in what Plaintiff's consultant (ICON) designates as the A-Zone (approximately 0 to 45 ft bgs) and B-Zone (approximately 45 to 95 ft bgs) at the Site.

3) The discontinuous and isolated water-bearing zones within the upper 100 ft at the Site are not capable of providing a viable water supply according to RECAP, nor in consideration of established principles of groundwater assessment and remediation.

4) Given the geological conditions at the Site (layered and discontinuous nature of the geologic deposits), there is no indication that constituents in the discontinuous and isolated water-bearing zones are discharging to surface water, nor is there a scientific or technical basis to anticipate them doing so at any point in the future.

5) The estimated well yields for the discontinuous and isolated water-bearing zones at the Site, calculated according to generally accepted hydrogeological science and procedure, and expressed in RECAP (2003), range from 75 gpd (CD-5B) to 224 gpd (CD-3A), with a geometric mean value of 150 gpd. The estimated well yields are consistent with the geologic data that demonstrate discontinuous and isolated water-bearing zones, and result in a GW3A classification as per RECAP for the upper 100 ft of the Site. A GW3A classified groundwater zone cannot transmit domestic water supply to even support a single family of four people according the RECAP. Existing data do not support the assertion that the low yields estimated for the Site would be sustained over an extended period of time.

6) The upper 100 ft of the Site are part of the Chicot Aquifer confining unit, and are not in hydraulic communication with the underlying Chicot Aquifer.

7) The chloride, barium and arsenic concentration contours presented in ICON (2024) are overestimated and unreliable because they are extrapolated over large distances without any data to support such interpretations. ICON (2024) failed to

evaluate the mobility, or lack of mobility of the individual constituents.

8) The spatial distribution of chloride (a conservative solute) shows that it has not migrated readily in the A- and B-Zones at the Site. It follows that any barium impacts will not migrate readily in the A- and B-Zones at the Site.

9) The time scales for a pump-and-treat remedy implemented in the upper 100 ft at the Site will be exacerbated by concentration tailing due to back-diffusion from the clays and silts. It follows that operation of a pump-and-treat system in the shallow water-bearing zones is not feasible.

10) I am not aware of groundwater pump-and-treat systems employing 349 extraction wells ever having been implemented in any geologic setting, especially that encountered within the A- and B-Zones at the Site. ICON's proposed approach for groundwater remediation is unreasonable and unjustified for several reasons, including the impracticability of the groundwater pump-and-treat remedy and the fact that the water-bearing zones have been demonstrated to be classified as non-viable groundwater resources according to RECAP.

11) No calibrated numerical groundwater flow and solute transport modeling are presented by ICON (2024) to support their remediation strategy and cost estimates. The state-of-the-practice is to support multi-million-dollar groundwater remediation cost estimates with industry standard numerical modeling approaches.

12) Monitored Natural Attenuation (MNA) is an appropriate remediation strategy for the Site. It is recommended that groundwater monitoring be carried out for between one and three years.

13) RECAP estimations of well yield should be verified in the field by performing pumping tests at multiple locations for periods of time ranging from 7 to 30 days if those yields will be used to predict the long-term performance of remediation extraction wells.

Bases for Opinions

My opinions in this matter are supported by my review of site-specific data, as well as my knowledge, education, research, and consulting experience as summarized in Appendix A of this report. A list of my depositions and other testimony given in the past 60 months is provided in Appendix A.

I reserve the right to modify any or all of my opinions should this be warranted by additional data made available, including any rebuttal or other reports provided in this case and any testimony relating to my opinions. The following is a summary of the bases for my opinions.

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1.0 - Introduction

I was retained by BP America Production Company to evaluate hydrogeological conditions, assess groundwater conditions and review certain expert reports issued by plaintiff in *Castex Development, LLC vs Anadarko Petroleum Corp et al.,* 31st Judicial District Court, Parish of Jefferson Davis, State of Louisiana, Docket No. C-502-20. In connection with work on this report, Dr. B.H. Kueper is being billed at a rate of US $325 per hour.

The property that is the subject of this expert report is referred to herein as the Castex site (Site). The Site is located in the southeast portion of Jefferson Davis Parish, Louisiana, approximately one mile southwest of Mermentau, Louisiana (Figures 1 and 2). The Site is currently being used primarily for rice and crawfish farming.

The Site comprises an area of approximately 1,130 acres in the West Mermentau Oil Field. The land surface is relatively flat and generally slopes from an elevation of approximately 16 feet (ft) NAVD88 along the west Site boundary to approximately 2 ft NAVD88 along the east Site boundary (Figure 3). Environmental investigations (primarily drilling and sampling) have been performed at the Site by ICON Environmental Services Inc. (ICON), Hydro-Environmental Technology Inc. (HET), and Environmental Resources Management (ERM).

2.0 - Geology

Shallow soils at the Site primarily comprise low permeability clays, clayey silts and silty clays of the Beaumont Alloformation (Figure 4). Shallow soils in small areas of Site are also classified as undifferentiated alluvium derived from small upland streams (Figure 4).

Figure 5A presents the locations of environmental borings at the Site with available geologic information. Four geologic cross sections have been prepared for the Site on the basis of available boring logs (compiled in Appendix B). Figure 5B depicts the locations of the four geologic cross sections (A-A' through D'-D') along with the associated projection swaths.

All borehole logs were reviewed, and the geologic descriptions were interpreted into ten categories. These categories were derived and interpreted with respect to hydraulic properties (including geologic layering) and grain size, and are referred to as hydrocodes. The following is a description of each hydrocode:

Clay: The 'Clay' hydrocode was assigned to all occurrences of clay and clay lenses.

Silty Clay/Clayey Silt: The 'Silty Clay/Clayey Silt' hydrocode was assigned to all occurrences of clay with minor to high silt content, clay lenses, silty clay, silt with minor to high clay content, silt lenses, alternating clay and silt, clay with silt lenses throughout, and silt with clay lenses throughout. Additionally applied to three occurrences of 'silt with very fine grain sand and clay content'.

Clay/Sand: The 'Clay/Sand' hydrocode was assigned to all occurrences of clay with minor to high sand content, clay with sand lenses, clay with minor amounts of sand and silt, and sand with moderate clay content.

Silt: The 'Silt' hydrocode was assigned to all occurrences of silt and silt lenses.

Sandy Silt/Silty Sand: The 'Silty Sand/Sandy Silt' hydrocode was assigned to all occurrences of silt with minor to high sand content and sand with minor to high silt content.

Fine Sand: The 'Fine Sand' hydrocode was assigned to all occurrences of sand lenses and very fine to fine grained sand.

Sand: The 'Sand' hydrocode was assigned to all occurrences of sand.

Shells/Wood/Fill/Other: The 'Shells/Wood/Fill/Other' hydrocode was assigned to all occurrences of shells, shell hash, organics, wood, peat and rock.

No Recovery: The 'No Recovery' hydrocode was assigned to all occurrences of no recovery and not logged (two occurrences).

Final borehole logs were relied upon for all hydrocoding. Figure 5C presents a table detailing which consultant boring logs were relied upon for hydrocoding. The hydrocodes were assembled in a database and imported into the computer program Rockworks 2025 by Rockware Incorporated (Rockworks).

Figure 6A presents geologic cross section A-A' which traverses northwest to southeast at the Site. Figure 6A shows that the geologic deposits primarily comprise clay- and silt-dominant hydrocodes (Clay, Silty Clay, Clayey Silt, Silt) extending down to approximately 80 ft below ground surface (bgs) with minor discontinuous occurrences of Fine Sand at certain locations. Figure 6B presents geology cross section B-B' which traverses northwest to southeast at the Site. Figure 6B shows that the geologic deposits primarily comprise low permeability hydrocodes extending down to approximately 80 ft bgs with minor discontinuous occurrences of sand at certain locations.

Figure 6C presents geologic cross section C-C' which traverses southwest to northeast at the Site. Figure 6C shows that the geologic deposits primarily comprise low permeability hydrocodes extending down to approximately 80 ft bgs with minor discontinuous occurrences of sandy-silt/silty-sand at certain locations. Figure 6D presents geologic cross section D-D' which traverses southwest to northeast at the Site. Figure 6D shows that the geologic deposits primarily comprise low permeability hydrocodes extending down to approximately 100 ft bgs with discontinuous occurrences of sand at certain locations.

Figures 6A through 6D show that there are no laterally continuous water-bearing zones within the top 100 ft of the subsurface at the Site. The 'layer cake' model of a laterally continuous water-bearing A-Zone and a laterally continuous water-bearing B-Zone presented by ICON (2024) is not supported by Site-specific data. Figures 6E through 6H present cross sections A-A' through D-D' with monitoring well screen intervals plotted.

Figure 7A presents active LDNR registered water wells (including monitoring wells) on and in the vicinity of the Site. Figure 7B presents LDNR registered plugged and abandoned water wells on and in the vicinity of the Site. Figure 7C presents active LDNR registered domestic water wells present at the Site along with well screen interval information. Figure 7C shows that the shallowest top of screen occurrence for the on-Site domestic water wells is 120 ft bgs, which is below the bottom of the B-Zone.

3.0 - Hydrogeology

3.1 – Estimates of Hydraulic Conductivity

The Louisiana Department of Environmental Quality (LDEQ) Risk Evaluation/Corrective Action Program (RECAP) guidance confirms that pumping and slug tests are the most commonly accepted methods for determining representative hydraulic properties at sites with groundwater monitoring wells (LDEQ, 2003). Pumping tests involve extracting groundwater from a well at a constant rate while at the same time measuring water level drawdown in surrounding wells. The rate of water level drawdown in the surrounding wells can be used to estimate the hydraulic conductivity of the geologic unit being pumped. The hydraulic conductivity is a measure of how easily water can flow through the geologic unit.

Table F-2 in Appendix F of LDEQ (2003) indicates that the Bouwer & Rice (1976) method can be used to estimate hydraulic conductivity from the results of a slug test performed in a leaky water-bearing zone, and that either the Hvorslev (1951) or Cooper et al. (1967) methods can be used to estimate hydraulic conductivity from the results of a slug test performed in a confined zone. The Bouwer & Rice (1976) method was relied upon in this report because it is better suited to a leaky confined condition than the Hvorslev (1951) method. Appendix E of this report presents a summary of slug tests performed by ICON in June 2022 at four monitoring wells (CD-2A, CD-3A, CD-4A and CD-10A) and in July 2024 at two additional monitoring wells (CD-2B and CD-1C). Appendix E also presents the details of ICON's interpretation of the slug tests performed in 2022 to arrive at hydraulic conductivity values and estimated well yields. Appendix E also presents the results of slug testing on monitoring well CD-5B carried out by HET in 2025.

Table D.12 presents BKA's interpretation of the ICON slug tests presented in Appendix

E as well as estimates of hydraulic conductivity for all six monitoring well locations (A-Zone and B-Zone). Table D.12 also presents hydraulic conductivity estimates based on the results of slug testing monitoring well CD-5B. Table D.13 presents BKA's estimate of a Site-wide hydraulic conductivity value. The estimated Site-wide hydraulic conductivity (9.75E-05 cm/s) is consistent with silt-dominant hydrocodes (Freeze & Cherry, 1979), not clean sand or gravel that would comprise a productive aquifer. The estimated Site-wide hydraulic conductivity (9.75E-05 cm/s) is representative of deposits down to approximately 95 ft bgs.

Appendix E contains the results of geotechnical laboratory tests for soil samples collected between 29 and 78 ft bgs from the Site. The results include six separate measurements of hydraulic conductivity, all on the order of 10^{-8} cm/s, consistent with the low permeability geologic deposits at the Site.

Of note is that ICON's field notes (Appendix G) refer to some dry wells (and wells going dry) during waterlevel measurement efforts and groundwater sampling. Example wells include CD-5C, CD-6C, CD-8B, CD-7a, CD-10B, CD-11B, CD-13C, CD-17A and CD-18A. The occurrence of wells going dry during sampling is evidence of low permeability, consistent with the observed A-Zone and B-Zone geology at the Site. The occurrence of wells being dry, and going dry during sampling, is evidence of the non-usable character of the shallow deposits at the Site. In addition, low permeability deposits were encountered during an EPA investigation in the northern portion of the Site.

3.2 – Groundwater Usability and Classification in RECAP

RECAP classifies groundwater into Groundwater Classification 1, 2 or 3, as determined by current or potential use, maximum sustainable yield, and/or Total Dissolved Solids (TDS) concentration (LDEQ, 2003). RECAP notes that the influence of surface water bodies should be taken into account when classifying groundwater. Stated otherwise, if the maximum sustainable yield of an extraction well is influenced by downward leakage from a surface water body, that yield is an overestimate for the purposes of groundwater classification.

Under RECAP, the maximum sustainable groundwater yield is defined as the maximum sustainable volume of groundwater that a well will discharge over a given period of time. Under RECAP, required values of sustainable yield are defined on the basis of a certain number of households, each of which contains four people that consume 100 gallons per day (gpd) with a contingency peaking factor of two to account for higher water usage at certain times of the day. A sustainable yield of 800 gpd, for example, would provide water for one household.

With respect to groundwater quality, RECAP defines maximum levels of TDS. TDS refers to the presence of inorganic salts and small amounts of colloidal size organic matter dissolved in the groundwater. Typical constituents that comprise TDS include cations such as calcium, magnesium, sodium and potassium, and anions such as carbonate, bicarbonate, chloride and sulphate.

RECAP classifies groundwater on the basis of yield and quality as follows (LDEQ, 2003):

> **Class 1A:** Groundwater that currently supplies drinking water to a public water supply.
>
> **Class 1B:** Groundwater that could potentially supply drinking water to a public water supply. The aquifer should provide a maximum sustainable yield of at least 4,800 gpd and have a TDS concentration of no more than 1,000 mg/L.
>
> **Class 2A:** Groundwater that currently supplies water to a domestic water supply, agricultural supply, or any other supply.
>
> **Class 2B:** Groundwater that could potentially supply drinking water to a domestic water supply. The aquifer should provide a maximum sustainable yield of at least 800 gpd, but not more than 4,800 gpd, and have a TDS concentration of no more than 1,000 mg/L.
>
> **Class 2C:** Groundwater that could potentially supply drinking water to a domestic water supply. The aquifer should provide a maximum sustainable yield of at least 800 gpd, and have a TDS concentration of between 1,000 mg/L and 10,000 mg/L.
>
> It is noted, with respect to Groundwater Classification 2, that if a public water supply well is located within one mile of the area of interest boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 1 aquifer (LDEQ, 2003).
>
> **Class 3A:** Groundwater in an aquifer that cannot transmit water to a well at a maximum sustainable yield equal to or greater than 800 gpd, regardless of TDS concentration.
>
> **Class 3B:** Groundwater containing TDS at a concentration of greater than 10,000 mg/L, regardless of maximum sustainable yield.

It is noted, with respect to Groundwater Classification 3, that if a domestic or agricultural water supply well is located within one mile of the area of interest boundaries and is screened in the same stratum as the aquifer of concern or has a direct hydraulic connection, then the aquifer shall be classified as a Groundwater Classification 2 aquifer (LDEQ, 2003).

Appendix F of LDEQ (2003) also defines the maximum sustainable yield as 'the maximum sustainable volume of water that a well will discharge over a given period of time'. The maximum sustainable yield is reported as a flowrate in units of gallons per day (gpd). The term sustainable indicates that the flowrate must be able to be maintained for a significant period of time. LDEQ (2003) state that well yield can be estimated using the Cooper and Jacob (1946) modification to the Theis (1935) non-equilibrium well equation as follows for a confined aquifer:

$$Q = \frac{60\, h_c\, K\, b}{9.3 + \log(K\, b)}$$

where Q is the estimated well yield (gpm), h_c is the confining head above the upper stratigraphic boundary of the confined aquifer (ft), K is the hydraulic conductivity of the aquifer (cm/s), and b is the saturated aquifer thickness (ft).

For an unconfined aquifer, LDEQ (2003) states that well yield can be estimated using a modified version of the above as follows:

$$Q = \frac{16\, K\, b^2}{6.3 + \log(K\, b)}$$

where Q, K, and b are as defined above for the unconfined aquifer case.

It should be noted that the use of the term 'aquifer' when defining the above equations in Appendix F of LDEQ (2003) does not presuppose that the water-bearing zone will meet the industry accepted definition of an aquifer. For example, if the above analyses demonstrate that the shallow water-bearing zones at the Site cannot supply 800 gpd (cannot supply a single household of four people), then the water-bearing zones would not meet the industry accepted definition of an aquifer. As discussed above, the RECAP guidance indicates that pumping and slug tests are the commonly accepted methods for determining representative hydraulic properties (i.e., hydraulic conductivity) at sites with groundwater monitoring wells. These hydraulic properties can then be used to estimate the maximum sustainable yield for the purposes of groundwater classification.

Table D.14 presents BKA's estimates of well yield for monitoring wells CD-2A, CD-3A, CD-4A and CD-10A. The BKA estimates of hydraulic conductivity and well yield are similar to those arrived at by ICON. The estimated well yields arrived at by both ICON and BKA demonstrate a GW3A classification under RECAP. Figure 12A depicts the locations where slug tests were performed along with calculated hydraulic conductivity and estimated RECAP well yield values for monitoring wells CD-2A, CD-3A, CD-4A and CD-10A, all located within the A-Zone at the Site (0 to 45 ft bgs). Figure 12B depicts the locations where slug tests were performed in the B-Zone (45 to 95 ft bgs) along with calculated hydraulic conductivity values for monitoring wells CD-2B, CD-1C and CD-5B, along with an estimated well yield for CD-5B. The hydraulic conductivity values depicted in Figures 12A and 12B are consistent with silt-dominant hydrocodes (Freeze & Cherry, 1979), not clean sand or gravel that would comprise a productive aquifer. Figure 14A presents the location of a bathymetry transect in the Mermentau River that was measured in 2025. Figure 14B shows that the Mermentau River has a maximum depth along the depicted transect of approximately 60 ft. Given the layered and discontinuous nature of the geologic deposits demonstrated to be present at the Site, it is highly unlikely that there is a hydraulic connection between the Mermentau River and any discontinuous water bearing zones at the Site.

RECAP estimations of well yield should be verified in the field by performing pumping tests at multiple locations for periods of time ranging from 7 to 30 days, if those yields will be used to predict long-term performance of remediation extraction wells.

4.0 - Distribution of Constituents in Groundwater

Table D.5 (Appendix D) presents a tabulated summary of chloride, arsenic, barium and benzene concentrations in groundwater along with the USEPA Secondary Drinking Water Standard (SDWS) for chloride and the LDEQ RECAP Screening Standards for arsenic, barium and benzene. Table D.6 presents a tabulated summary of TPH-GRO (total petroleum hydrocarbons – gasoline range (C6-C10)), TPH-DRO (total petroleum hydrocarbons – diesel range (C10-C28)) and TPH-ORO (total petroleum hydrocarbons – gasoline range (C28-C35)) mixture concentrations in groundwater along with the LDEQ RECAP Screening Standards. Table D.7 presents a tabulated summary of aliphatic and aromatic hydrocarbon fraction concentrations in groundwater along with the LDEQ RECAP Screening Standards. Figure 5A presents the borehole locations at the site where HET and ICON collected soil and groundwater samples for quality assessment.

4.1 – Distribution of Chloride in Groundwater

Figure 8A presents the distribution of maximum chloride concentration in groundwater for monitoring wells screened in the A-Zone (0 to 45 ft bgs). Figure 8A shows that the highest chloride concentrations in the A-Zone occur at monitoring wells CD-3A and

CD-2A, located in the northern portion of the Site near Johnson & Boudreaux 001-A (sn27755) and Castex Systems SWD 1 (sn34959) [Figure 13]. Castex operated a non-hazardous oilfield waste (NOW) disposal facility in the 1980s, that was Chloride concentrations in the A-Zone drop off precipitously away from monitoring wells CD-3A and CD-2A, consistent with the low hydraulic conductivity of the geologic deposits at the Site and the spatially discontinuous nature of any water bearing zones.

Figure 8B presents the distribution of maximum chloride concentration in groundwater for monitoring wells screened in the B-Zone (45 to 95 ft bgs). Figure 8B shows elevated chloride concentration in the B-Zone at monitoring wells CD-3B and CD-2B, located in the northern portion of the Site near Johnson & Boudreaux 001-A (sn27755) and Castex Systems SWD 1 (sn34959) [Figure 13]. Chloride concentrations in the B-Zone drop off precipitously away from monitoring wells CD-3A and CD-2A, consistent with the low hydraulic conductivity of the geologic deposits at the Site and the spatially discontinuous nature of any water bearing zones. Figure 8B also shows elevated chloride concentrations at monitoring well CD-14B, located in the northeast portion of the Site near the former 'blowout' that occurred at Bruce 002 (sn206253) around 2014. Elevated chloride concentrations also occur at B-Zone monitoring wells CD-4B and CD-5B. Figure 8C shows that there are no exceedances of chloride in groundwater below the B-Zone.

4.2 – Distribution of Arsenic in Groundwater

Figure 9A presents the distribution of maximum dissolved (filtered) arsenic concentrations in groundwater for monitoring wells screened in the A-Zone (0 to 45 ft bgs). Figure 9B presents the distribution of maximum dissolved arsenic concentrations in groundwater for monitoring wells screened in the B-Zone (45 to 95 ft bgs). The relatively widespread occurrence of slight arsenic exceedances in groundwater shown in Figures 9A and 9B are not well-correlated with chloride exceedances and are consistent with naturally occurring arsenic values and the presence of spatially discontinuous water bearing zones at the Site. Figure 9C presents the distribution of dissolved arsenic concentrations in groundwater for monitoring wells screened below the B-Zone. There are no exceedances of dissolved arsenic in monitoring wells screened below the B-Zone.

4.3 – Distribution of Barium in Groundwater

Figure 10A presents the distribution of maximum dissolved (filtered) barium concentrations in groundwater for monitoring wells screened in the A-Zone (0 to 45 ft bgs). Exceedances of the barium groundwater screening standard occur at monitoring wells CD-3A and CD-2A, both located in the northern portion of the Site near Johnson & Boudreaux 001-A (sn27755) and Castex Systems SWD 1 (sn34959)

[Figure 13]. Figure 10A also exhibits a slight barium exceedance in groundwater at monitoring well CD-19A. Figure 10B presents the distribution of maximum dissolved barium concentrations in groundwater for monitoring wells screened in the B-Zone (45 to 95 ft bgs). Exceedances of the barium screening standard for groundwater occur at monitoring wells CD-2B, CD-14B and CD-5B. Figure 10C presents the distribution of dissolved barium concentrations in groundwater for monitoring wells screened below the B-Zone. There are no exceedances of dissolved barium in monitoring wells screened below the B-Zone.

4.4 – Distribution of Benzene in Groundwater

Figure 11A presents the distribution of maximum benzene concentrations in groundwater for monitoring wells screened in the A-Zone (0 to 45 ft bgs). Figure 11A shows that there are no exceedances of benzene concentrations in the A-zone. Figure 11B presents the distribution of maximum benzene concentrations in groundwater for monitoring wells screened in the B-Zone (45 to 95 ft bgs). Figure 11B shows an exceedance of benzene in groundwater at monitoring well CD-14B (location of 'blowout') and an exceedance of benzene in groundwater at monitoring well CD-5B. Figure 11C shows that there are no exceedances of benzene in monitoring wells screened below the B-zone.

4.5 – Distribution of Aliphatic and Aromatic Hydrocarbon Fractions in Groundwater

Table D.7 (Appendix D) presents concentrations of aliphatic and aromatic hydrocarbon fractions in groundwater at the Site. RECAP (2003), Appendix 'D', states "*If TPH fractionation data and TPH mixture data have both been collected at an AOI and the two data sets yield different conclusions concerning management of the AOI, then management decisions shall be based on the fractionation data since the fractionation method yields more specific information regarding the TPH constituents present and thus more accurately characterizes site conditions.*" Table D.7 shows that there is only one exceedance of a hydrocarbon fraction in groundwater at the Site (monitoring well CD-15C, C21 to C35 aromatics).

5.0 - Groundwater Remediation

ICON (2024) propose to 'remediate' groundwater in the A- and B- Zones. ICON (2024) consider two approaches: one (cost of $239,285,174.00) considering offsite disposal of wastewater and one (cost of $47,165,382.00) considering onsite disposal of wastewater in saltwater disposal wells (SWDs).

ICON (2024) states that the groundwater plumes used to calculate their proposed remediation areas are shown on Figures 36 through 51 of their report. ICON (2024) do not present data to justify the spatial extent of their depicted chloride, barium and arsenic plumes, which are the plumes that appear to dictate the volume (and hence costs) of groundwater remediation.

The methodology employed by ICON (2024) to arrive at their groundwater remediation cost estimates was as follows:

- Calculate the average constituent concentration in groundwater,
- Calculate the yield and radius of influence for recovery wells,
- Calculate the number of aquifer pore volumes that need to be extracted to meet concentration-based remediation goals, and
- Calculate the number of extraction wells required and the number of years that the extraction system needs to operate.

Criteria for selecting appropriate site-specific groundwater remedies are well-documented. In general, groundwater remedy selection can be evaluated based on (USEPA, 1990; USEPA, 1997):

- Overall protectiveness (human health and environment)
- Regulatory compliance
- Effectiveness (short-term and long-term)
- Reduction of toxicity, mobility or volume
- Implementability
- Cost

Cohen et al., (1997) and USEPA (1993) summarized constituent and hydrogeologic characteristics that affect groundwater restoration at locations within the Site and provided a generalized remediation difficulty scale based on site use, chemical properties, constituent distribution, geologic conditions, and groundwater flow parameters. Based on Cohen et al., (1997) and USEPA (1993), constituent and hydrogeologic characteristics that are most difficult with respect to the remediation of chloride and barium in groundwater at the Site include: (i) low biotic/abiotic decay potential, (ii) low volatility, (iii) fine-grained soils (clay and silt), and (iv) low hydraulic conductivity (< 10-4 cm/s) of any water bearing zones.

ICON (2024) propose a groundwater pump and treat (P&T) remedy at the Site by utilizing an extraction system comprising 349 pumping wells at a cost of between approximately $47,165,382.00 and $239,285,174.00 (depending on treatment option). Due to the low hydraulic conductivity fine-grained soils (clay- dominant and silt-dominant hydrocodes) at the Site, P&T is not appropriate for remedy selection due to poor implementability and high cost. In addition, the ICON proposal of installation and operation of 349 extraction wells and associated infrastructure will be invasive and disruptive at the Site. Furthermore, P&T remedial time scales will be exacerbated by back-diffusion from clays and silts, and the associated concentration tailing (Kueper et al., 2014). In practice, P&T remedies are typically not considered feasible in clays and silts, and discontinuous isolated sand occurrences. Ultimately, even if the proposed ICON P&T remedy (ICON, 2024) or a similar P&T remedy were implemented, it is unlikely that the P&T remediation would function as ICON predicts (ICON, 2024), and it is highly unlikely that ICON's alleged background chloride and barium concentrations would be achieved in the timeframe (up to 30 years) suggested by ICON (2024).

Major flaws in ICON's groundwater remediation methodology are listed below:

- ICON (2024) assumes that extraction wells can individually pump at average rates of between 634 and 893 gpd. However, as discussed earlier in this report, the slug tests performed at the Site in the shallow water-bearing zones indicate that the average well yield is less than approximately 150 gpd. As such, ICON (2024) underestimates the time scales for a P&T remedy implemented in the A- and B-Zones at the Site.
- The time scales for a P&T remedy implemented at the Site will be exacerbated by concentration tailing (slowly decreasing concentrations) due to back-diffusion from the clays and silts (Kueper et al., 2014).
- The ICON (2024) proposed groundwater remediation plan would be disruptive to the natural environment at the Site given that 349 extraction wells and 33 miles of piping would be required.
- ICON (2024) overestimates the volume of impacted groundwater because the contoured concentrations are extrapolated over large distances without data to support such an interpretation. The interpretation of widespread distribution of constituents in groundwater attributed to on-Site activities by ICON (2024) is not supported by Site-specific lithologic information.
- No calibrated numerical groundwater flow and solute transport modeling are presented by ICON (2024) to support the remediation strategy and cost estimate. The state-of-the-practice is to support a multi-million-dollar groundwater remediation cost estimate with industry-standard numerical modeling approaches.

The ICON (2024) proposed groundwater remedial approaches for the Site are impracticable for the above reasons; I am not aware of groundwater pump-and-treat systems employing as many as 350 extraction wells ever having been implemented in any geologic setting. The proposed approaches are unreasonable and unjustified for several reasons, including: (i) the water-bearing zones have been demonstrated to be classified as non-viable groundwater resources according to RECAP; (ii) there will be concentration tailing due to back-diffusion from clays and silts; (iii) the practical challenges with implementation of a pump-and-treat plan in this environmental setting, including the placement and operation of long-term infrastructure on the land surface that will interfere with currently-available uses; (iv) ICON (2024) overestimates the volume of impacted groundwater, and (v) ICON (2024) assumes that extraction wells can individually pump at average rates of between 634 and 893 gpd, but slug tests performed at the Site indicate that the geometric average well yield for the Site is less than 150 gpd. All data and circumstances for the Site reflect that existing conditions do not interfere with its use; any need for groundwater at the Site would not be satisfied by the shallow water-bearing zones. Any need for groundwater at the Site can be met by the abundant and unimpacted Chicot Aquifer system underlying the Site, consistent with regional practice.

Currently, there are no active oil and gas exploration pits on the Site supplying constituents of concern to groundwater and, therefore source concentrations are in declining conditions. The shallow water-bearing zones (upper 100 ft of the Site) exhibit low well yields (geometric mean of less than 220 gpd) and are unusable for water supply. There is no benefit to implementing a pump-and-treat remedy at the Site. To the extent that a groundwater remedy may be considered for the Site, natural attenuation is an appropriate and feasible strategy and should be carried out for between one and three years.

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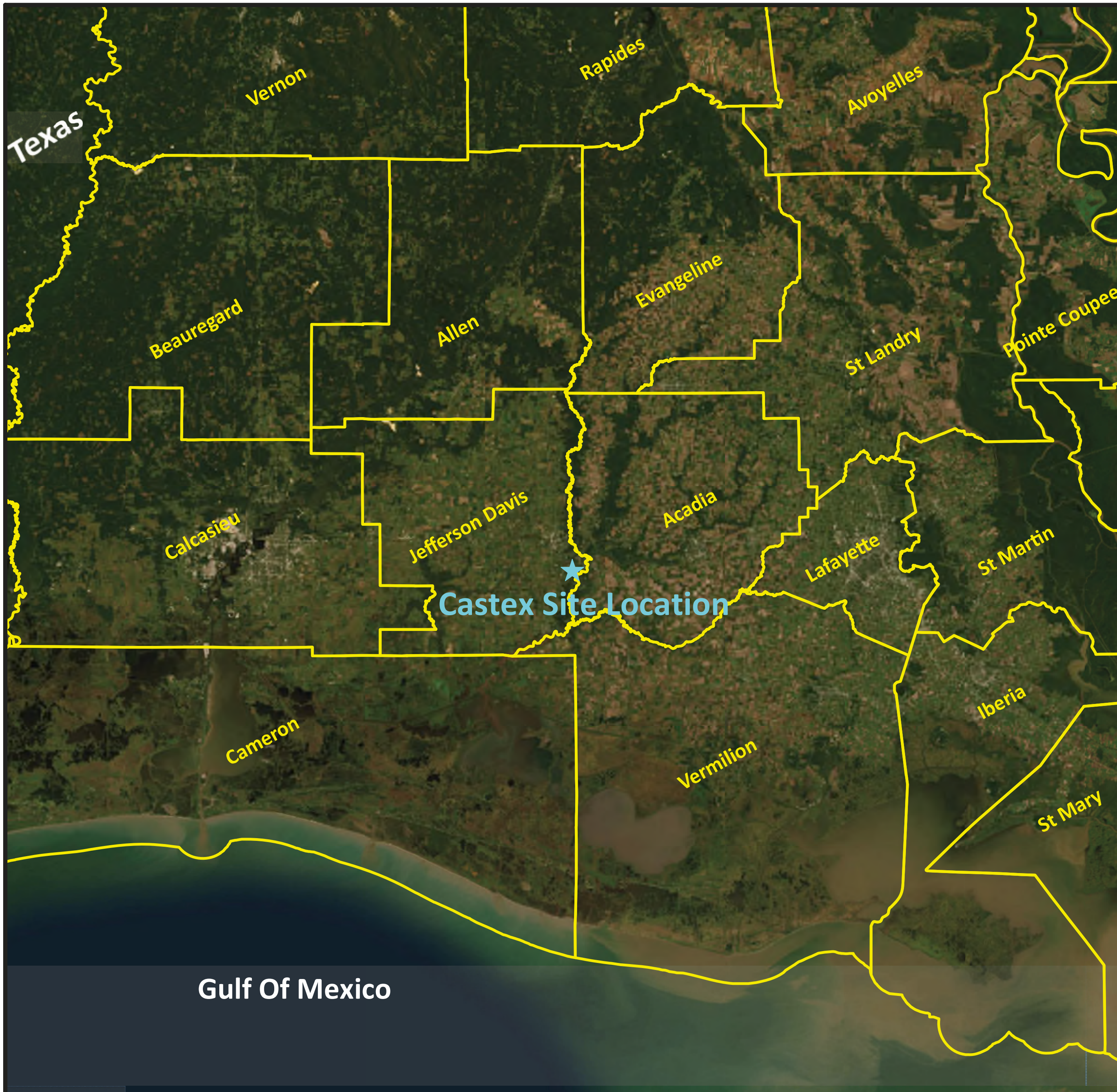


Legend

Parish Boundary (SONRIS)

Site Location

Image: Esri Worldwide Basemap

Figure 1

Site Location Map

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

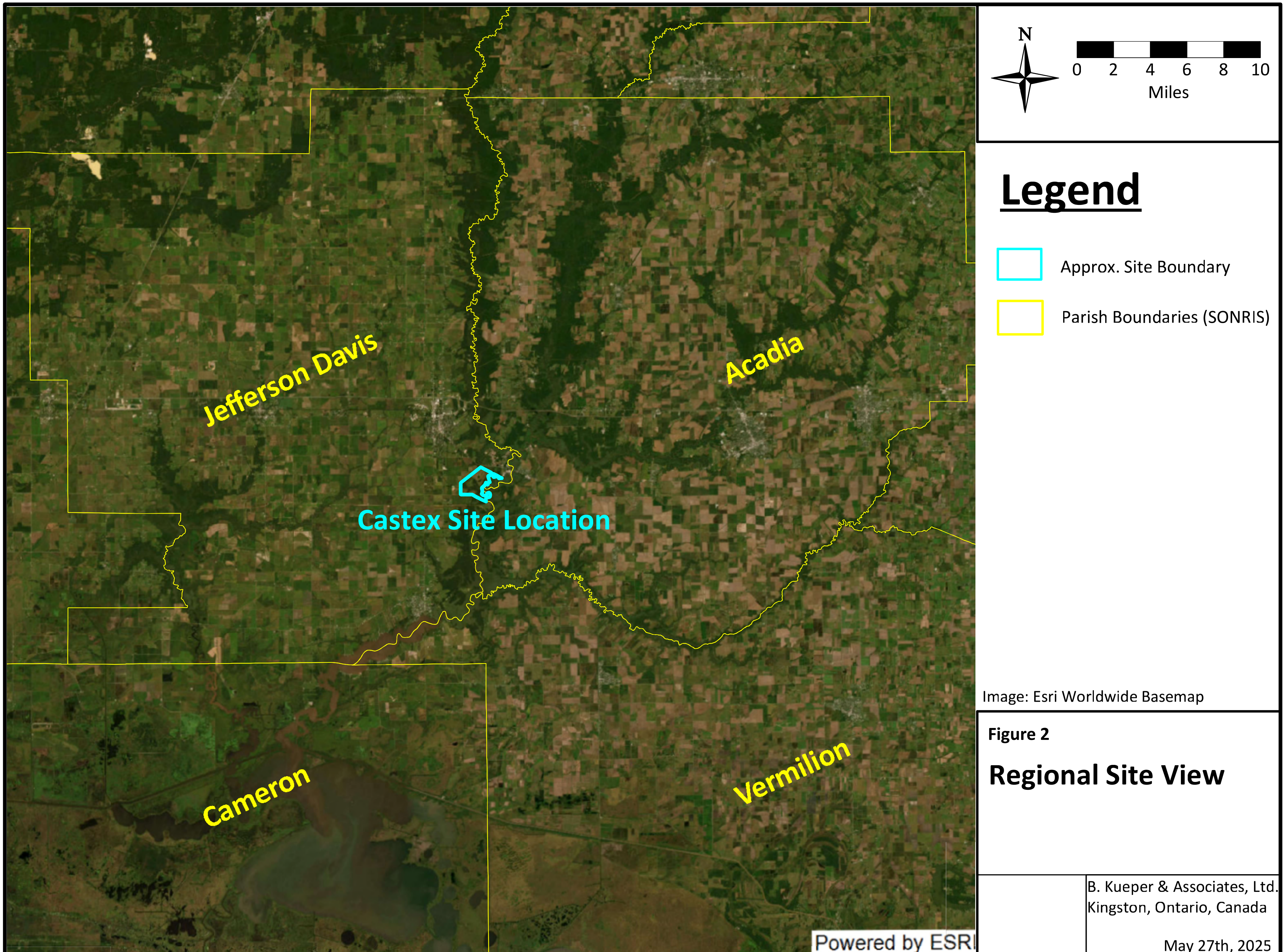


Figure 2

Regional Site View

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

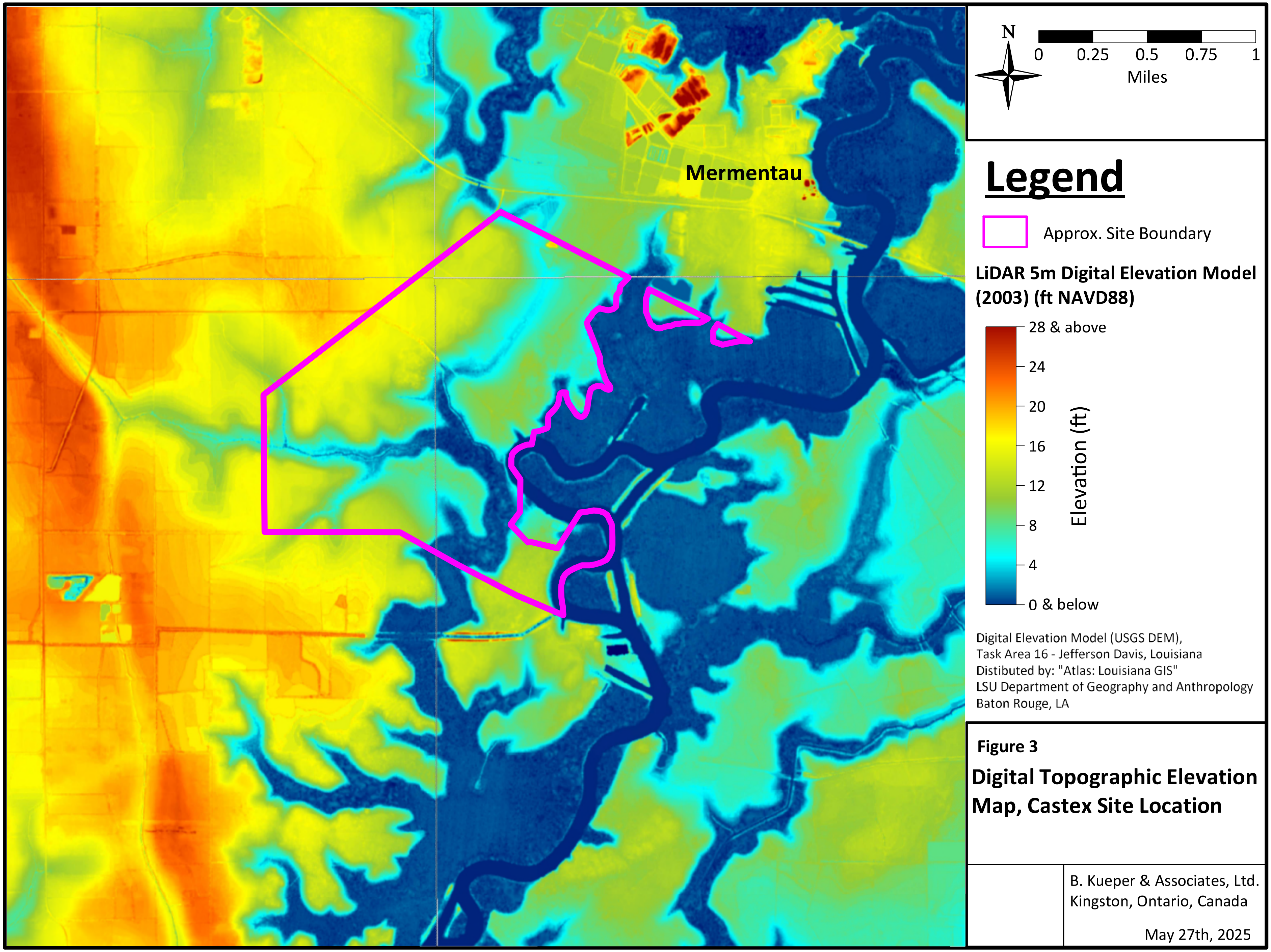
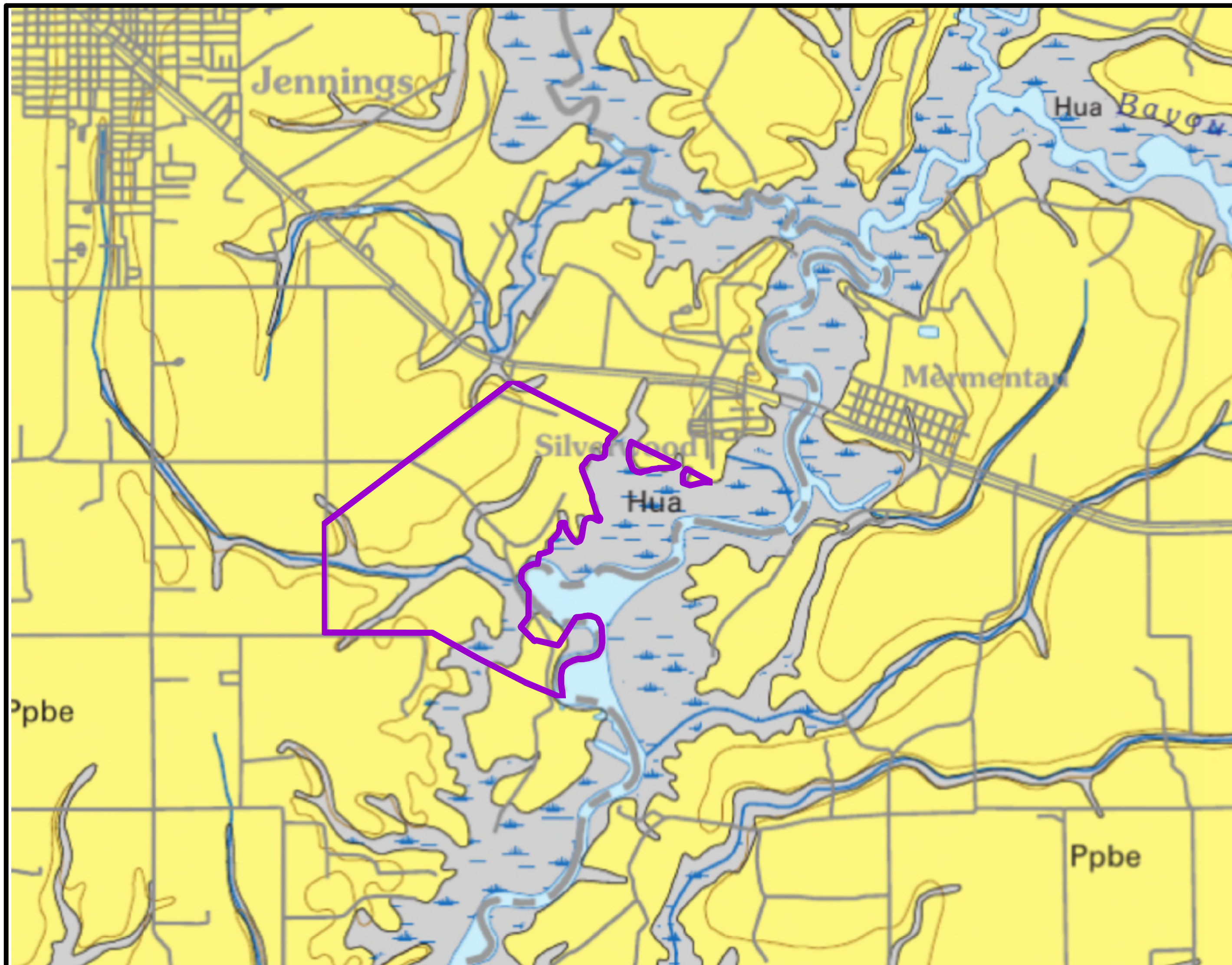


Figure 3

Digital Topographic Elevation Map, Castex Site Location

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Hua	**Undifferentiated alluvium of small upland streams**—alluvial deposits of minor creeks and streams filling valleys cut into older deposits. The modern flood plain within these valleys constitutes the surface of these deposits.
Ppbe	**Beaumont Alloformation**—stratigraphic sequence underlying the oldest and topographically highest of the Prairie surfaces west of the Mississippi alluvial valley. It exhibits the relict channels of the Red River, and includes deposits of the Ingleside barrier trend west of the Crowley quadrangle. It is composed of coastal-plain deposits of late-to-middle Pleistocene streams.

Louisiana Geology Survey Map downloaded from:
https://www.lsu.edu/lgs/maps/100k-Geology/Crowley.pdf

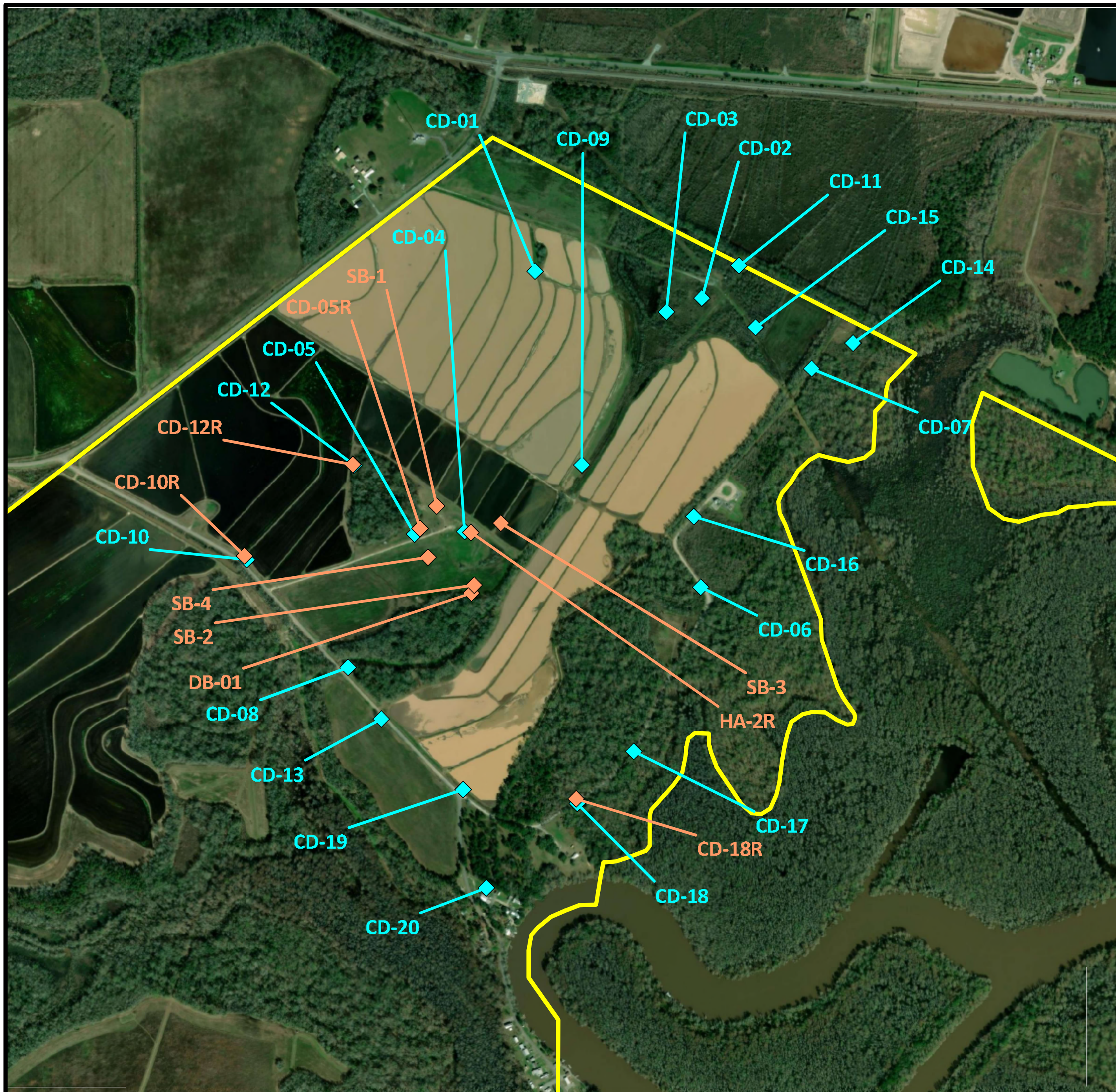
Figure 4

Crowley 30x60 Minute Geologic Quadrangle(2003)

Louisiana Geologic Survey

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

- Approx. Site Boundary
- ICON Boreholes
- HET Boreholes

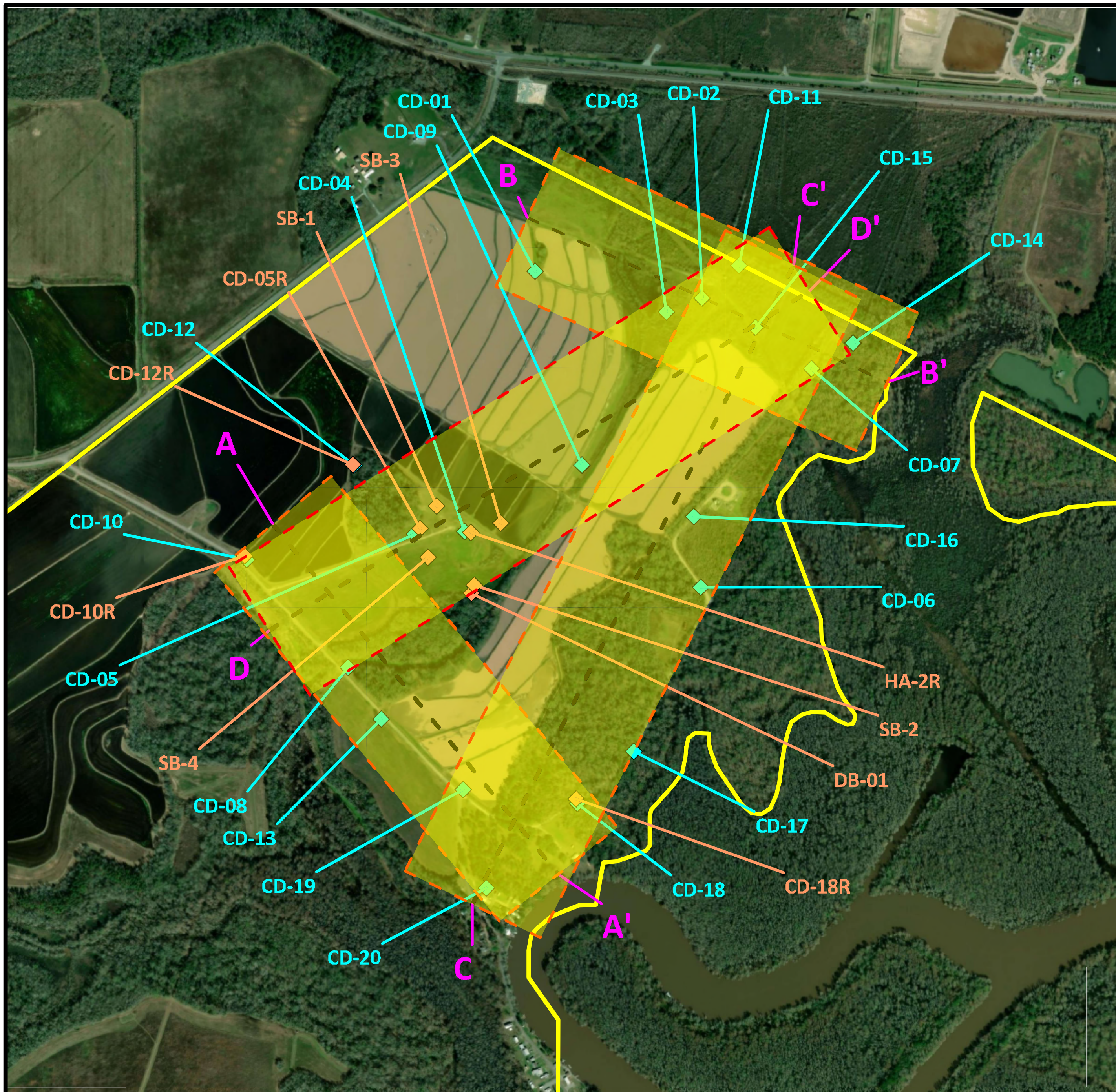
Image: Esri Worldwide Basemap

Figure 5A

Borehole Locations

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

- Approx. Site Boundary
- Projected Transect
- Projected Swath
- ICON Boreholes
- HET Boreholes

Image: Esri Worldwide Basemap

Figure 5B

Boreholes With Lithologic Information and Transects

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

BP-Castex-KUEPER RPT-000030

Borehole	Drilling Contractor	Consultant Borehole Log Used for Hydrocoding and Geologic Striplog
CD-01	ICON Environmental Services, inc.	Environmental Resources Management International Group, LTD. (ERM)
CD-02	ICON Environmental Services, inc.	Environmental Resources Management International Group, LTD. (ERM)
CD-03	ICON Environmental Services, inc.	Environmental Resources Management International Group, LTD. (ERM)
CD-04	ICON Environmental Services, inc.	Environmental Resources Management International Group, LTD. (ERM)
CD-05	ICON Environmental Services, inc.	Environmental Resources Management International Group, LTD. (ERM)
CD-05R	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
CD-06	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-07	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-08	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-09	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-10	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-10R	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
CD-11	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-12	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-12R	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
CD-13	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-14	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-15	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-16	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-17	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-18	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-18R	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
CD-19	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
CD-20	ICON Environmental Services, inc.	Hydro-Environmental Technology, inc (HET)
HA-2R	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
DB-01	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
SB-1	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
SB-2	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
SB-3	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)
SB-4	Hydro-Environmental Technology, inc (HET)	Hydro-Environmental Technology, inc (HET)

Figure 5C
Consultant Used for Geologic Cross Sections

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

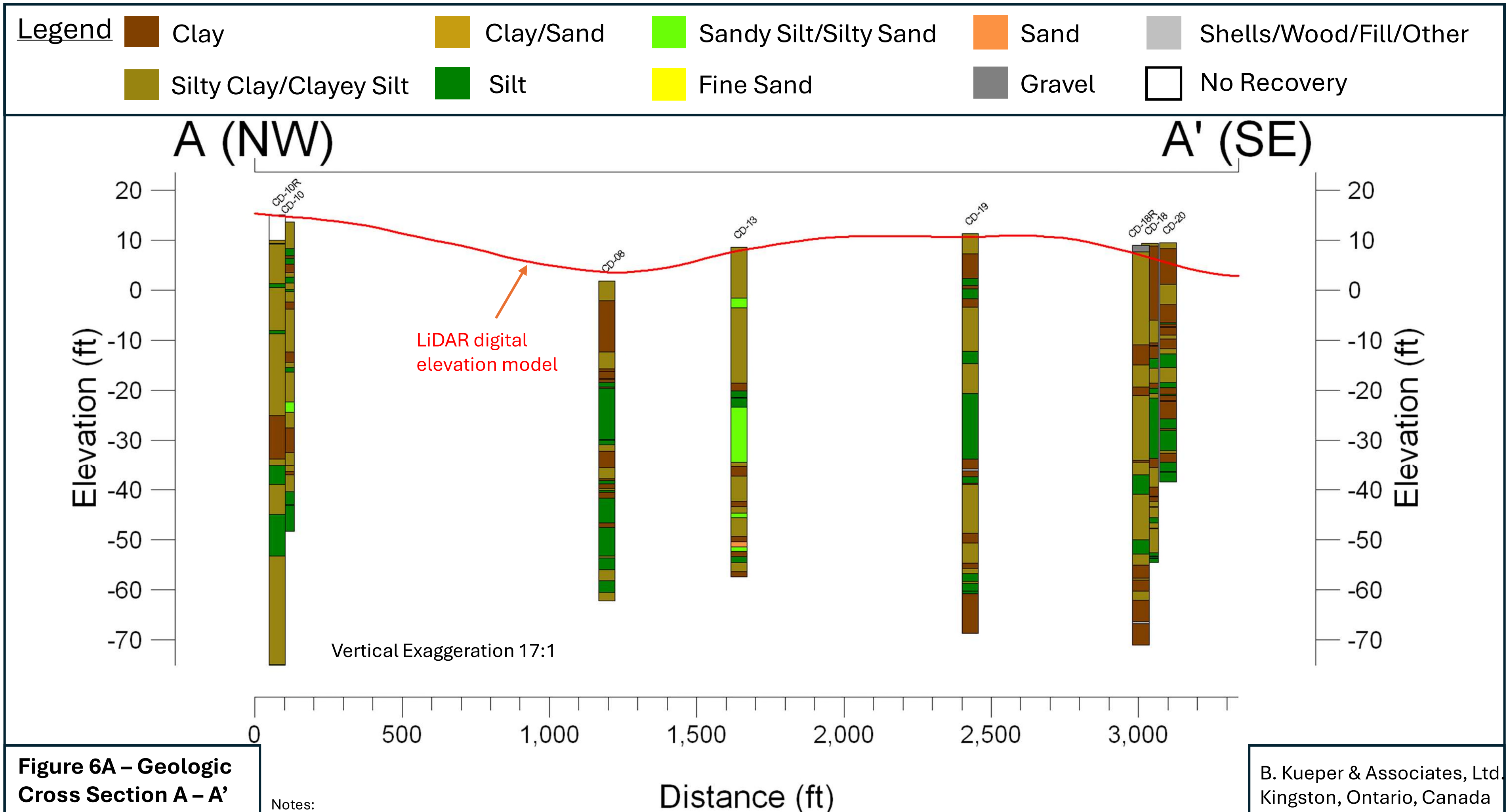


Figure 6A – Geologic Cross Section A – A'

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

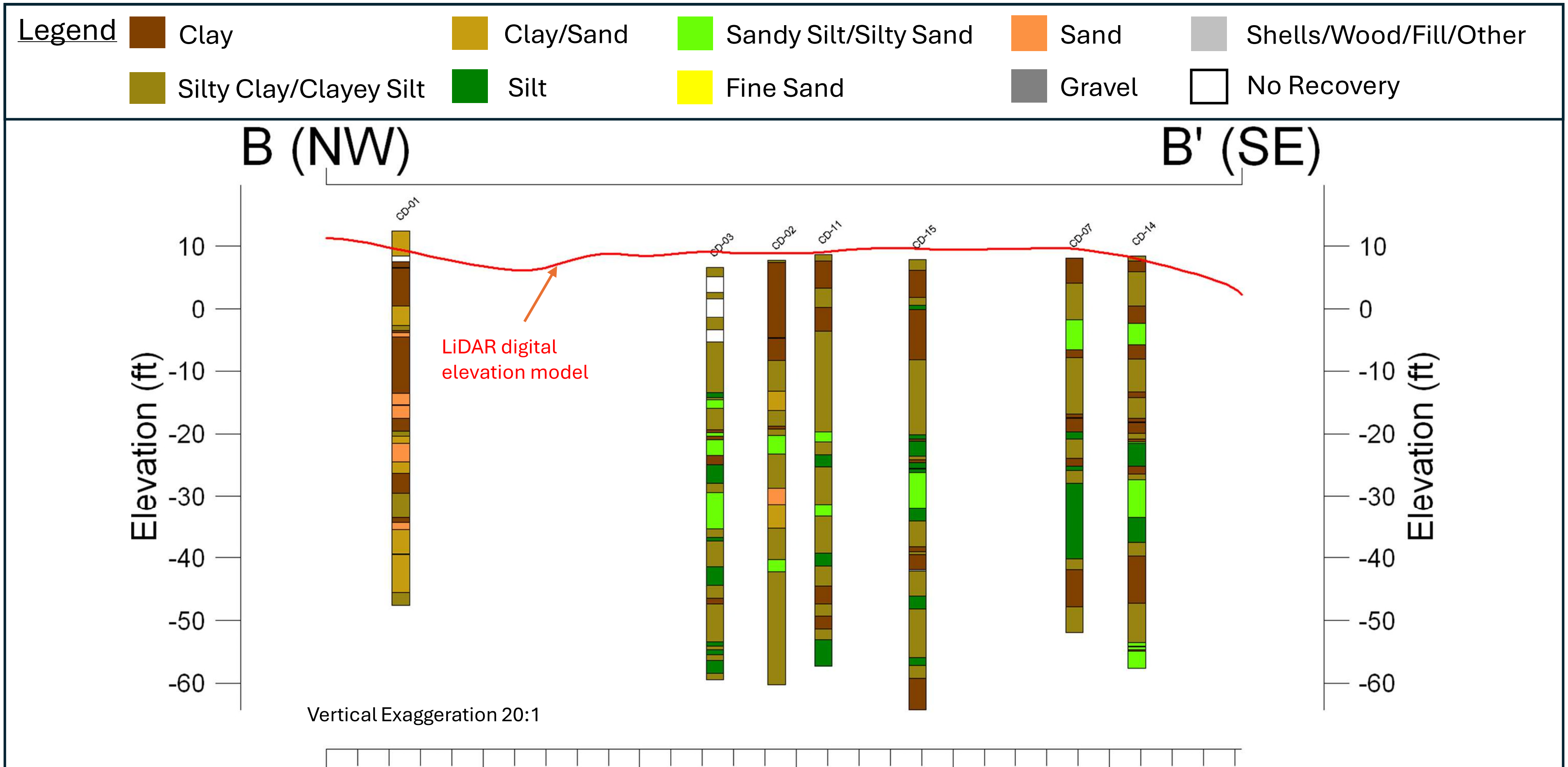


Figure 6B – Geologic Cross Section B – B'

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

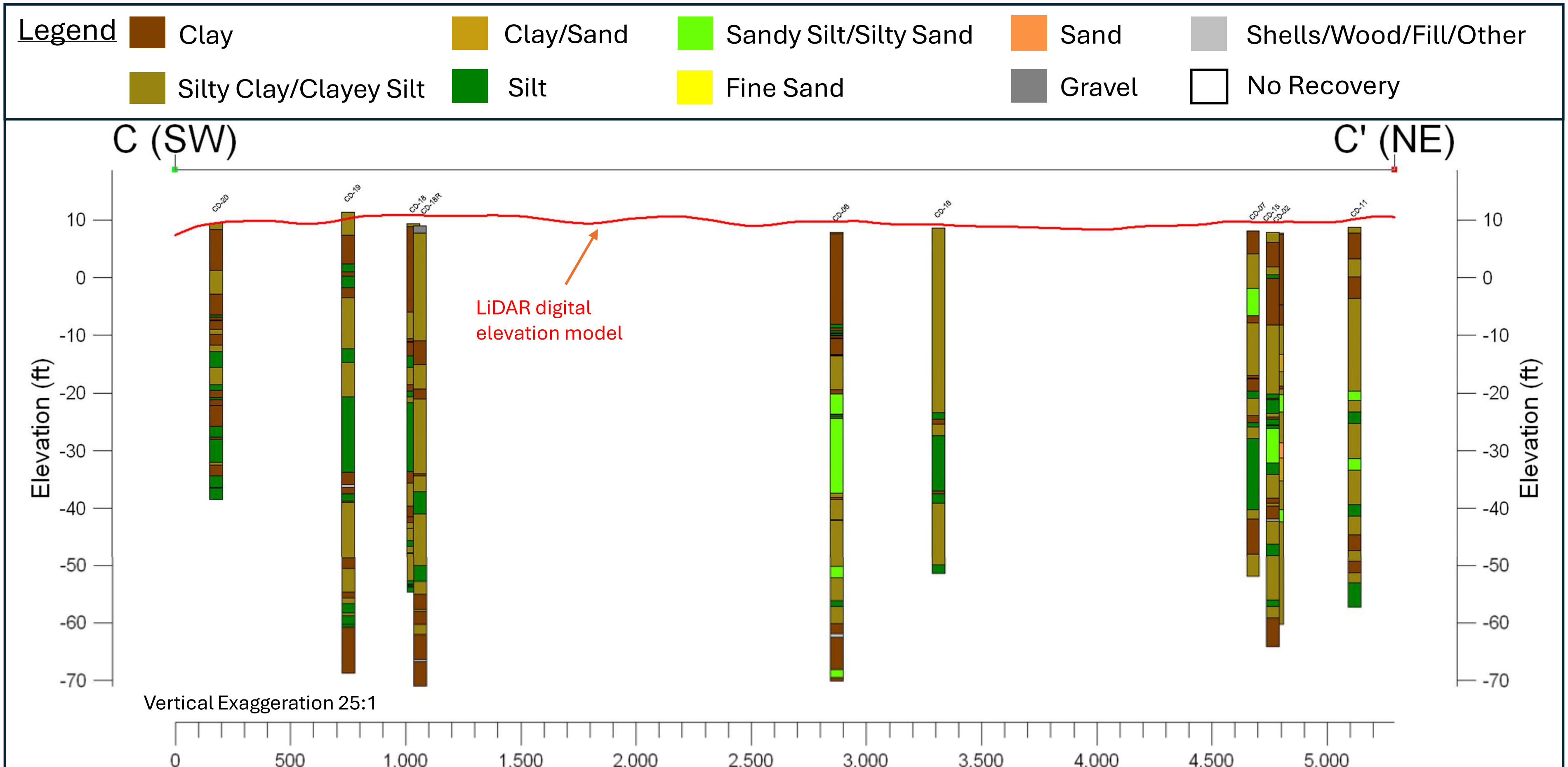


Figure 6C – Geologic Cross Section C – C'

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

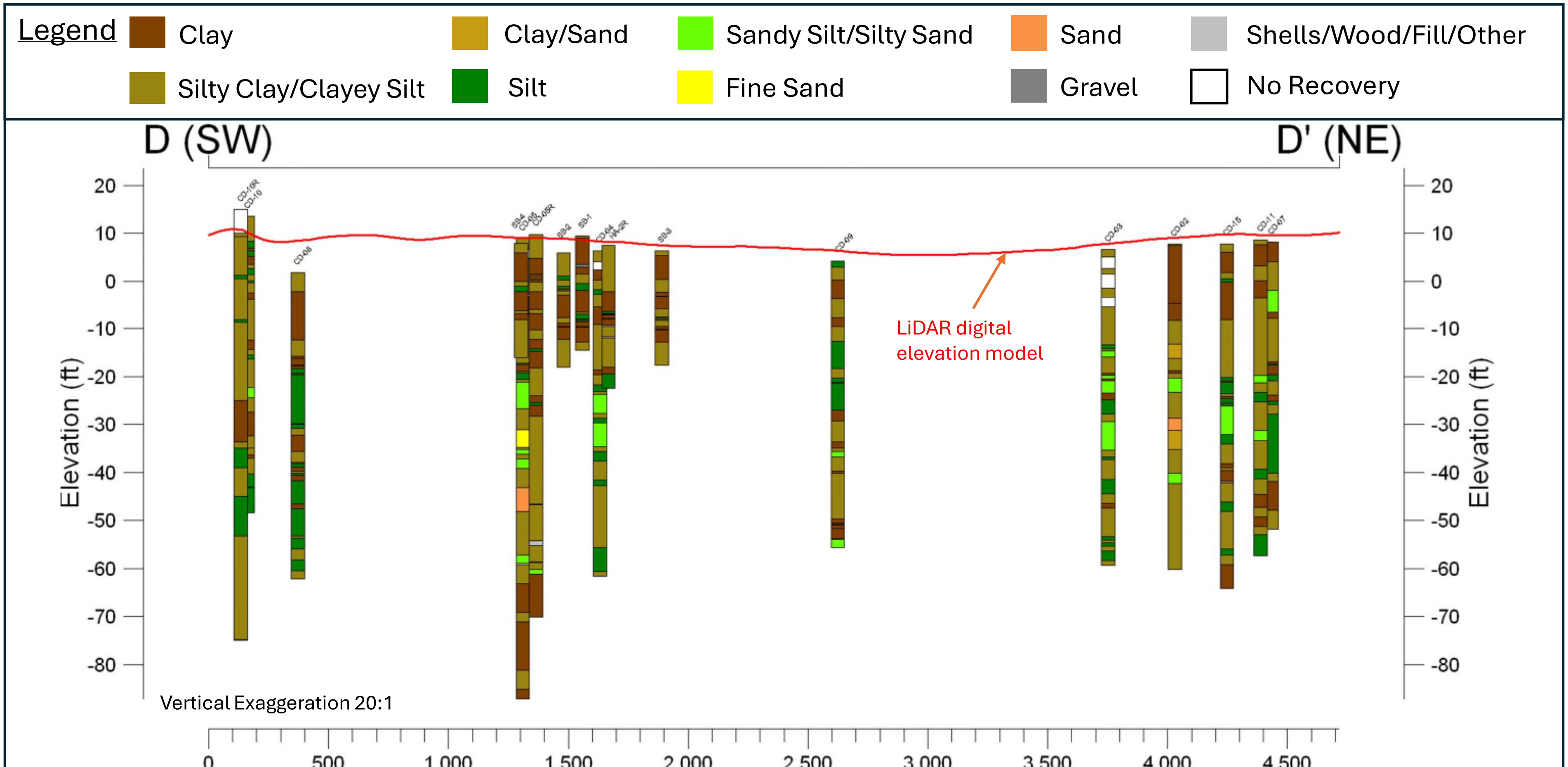


Figure 6D – Geologic Cross Section D – D'

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

Figure 6E – Geologic Cross Section A – A' with Well Screens

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

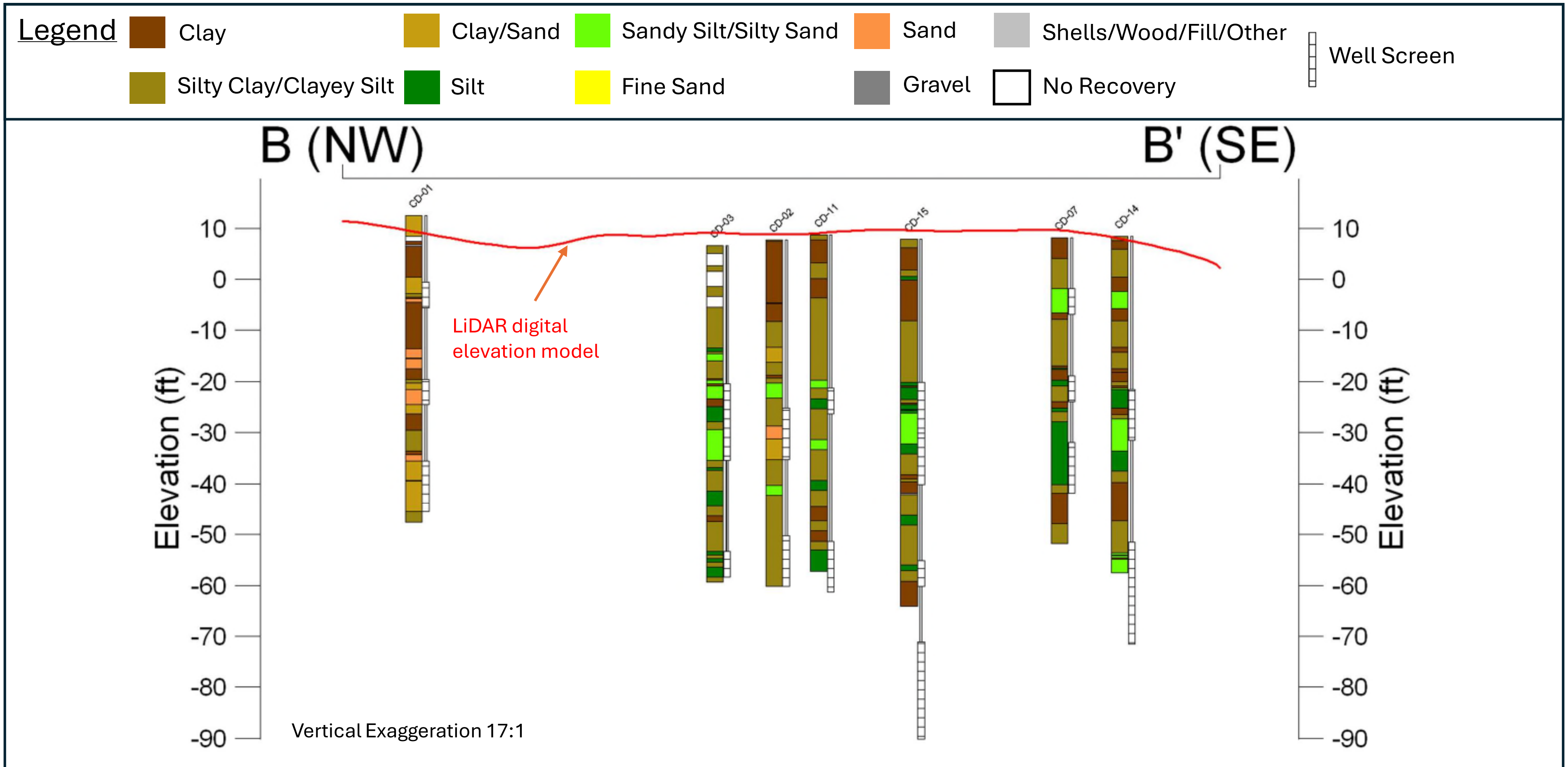


Figure 6F – Geologic Cross Section B – B' with Well Screens

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

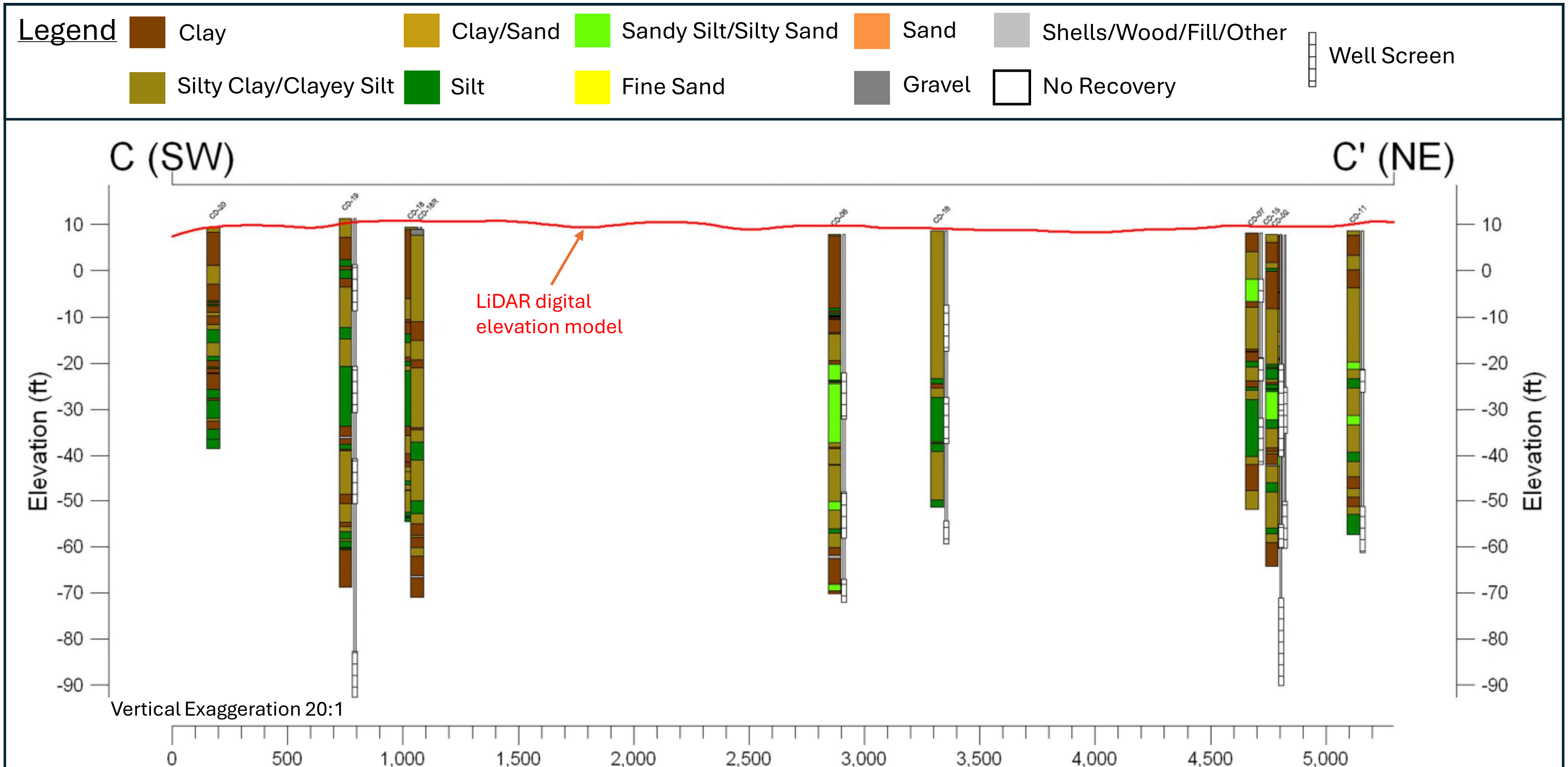


Figure 6G – Geologic Cross Section C – C' with Well Screens

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

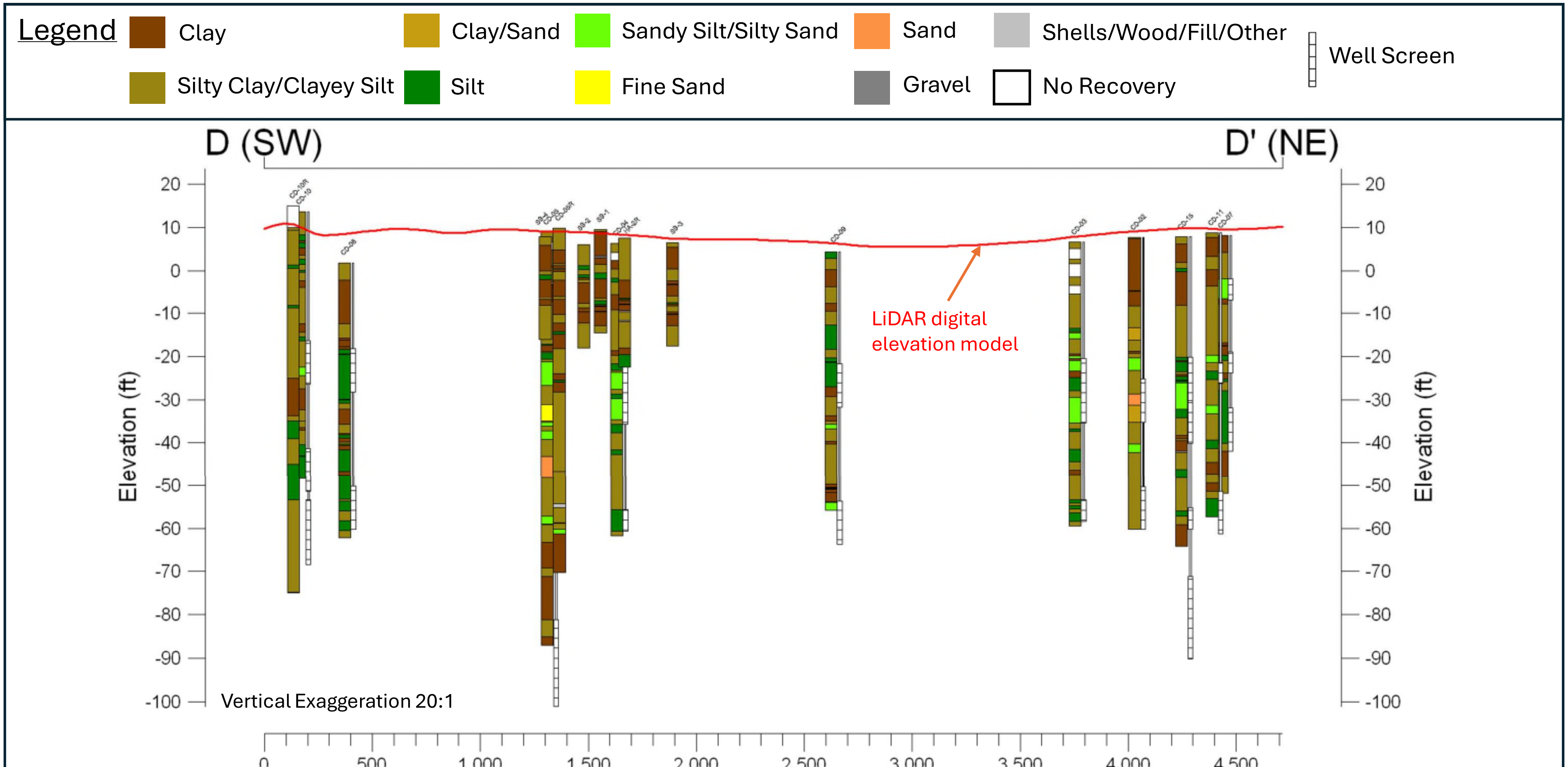
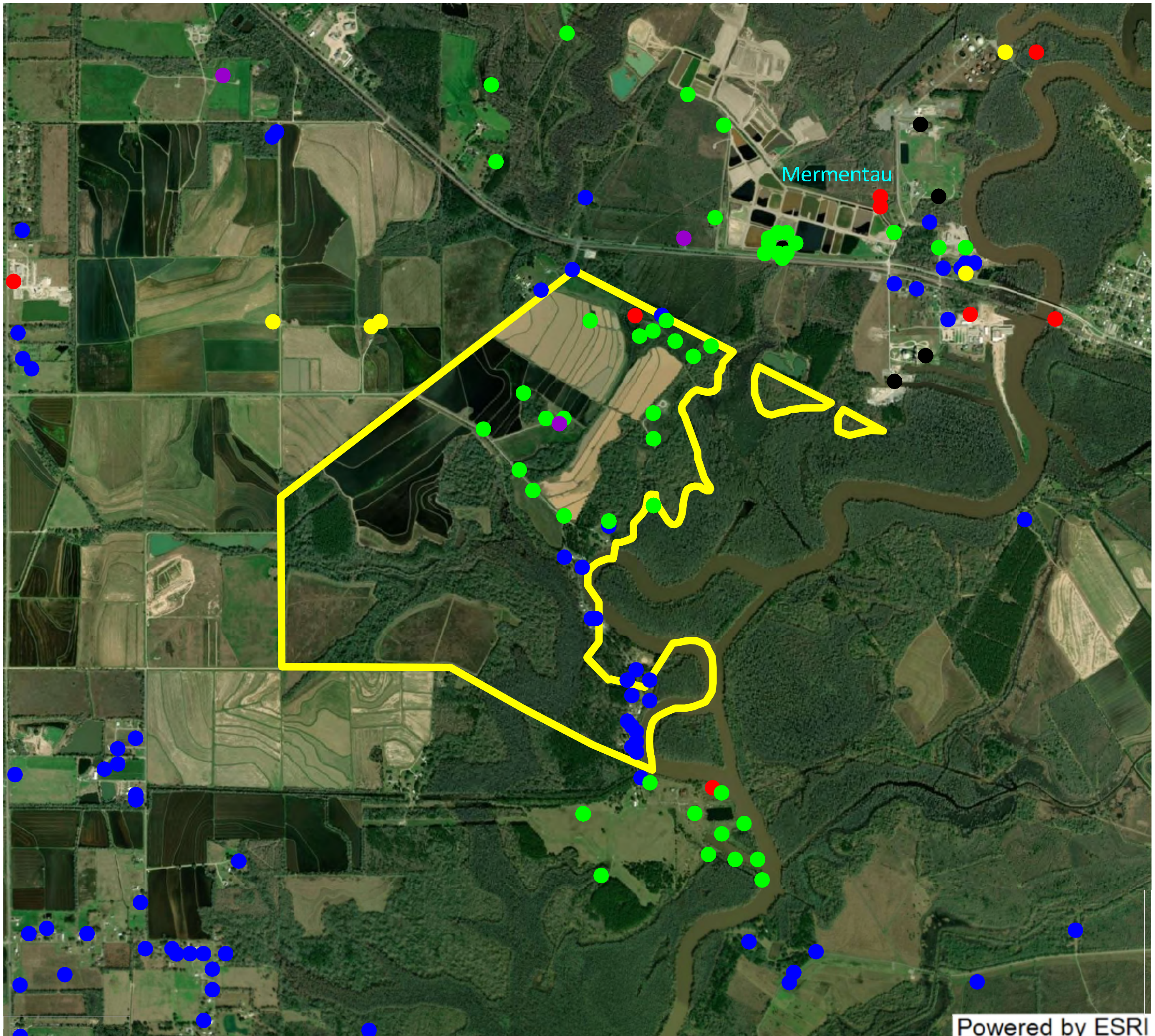


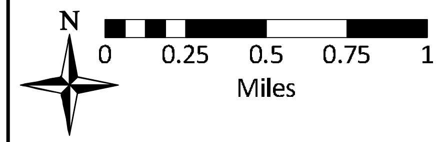
Figure 6H – Geologic Cross Section D – D' with Well Screens

Notes:
All boreholes are projected onto the transect.
Vertical Datum is NAVD88.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025





Legend

Approx. Site Boundary

Well Use Description (SONRIS)

- Irrigation
- Domestic
- Industrial
- Monitor
- Rig Supply
- Public Supply

Image: Esri Worldwide Basemap

Water Well Source:
Downloaded from the Strategic Online Natural Resources Information System (SONRIS)
https://sonris-www.dnr.state.la.us/gis/agsweb/IE/JSViewer/index.html?TemplateID=181

Figure 7A

LDNR Registered Active Water Wells Within One Mile of Site Boundary

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

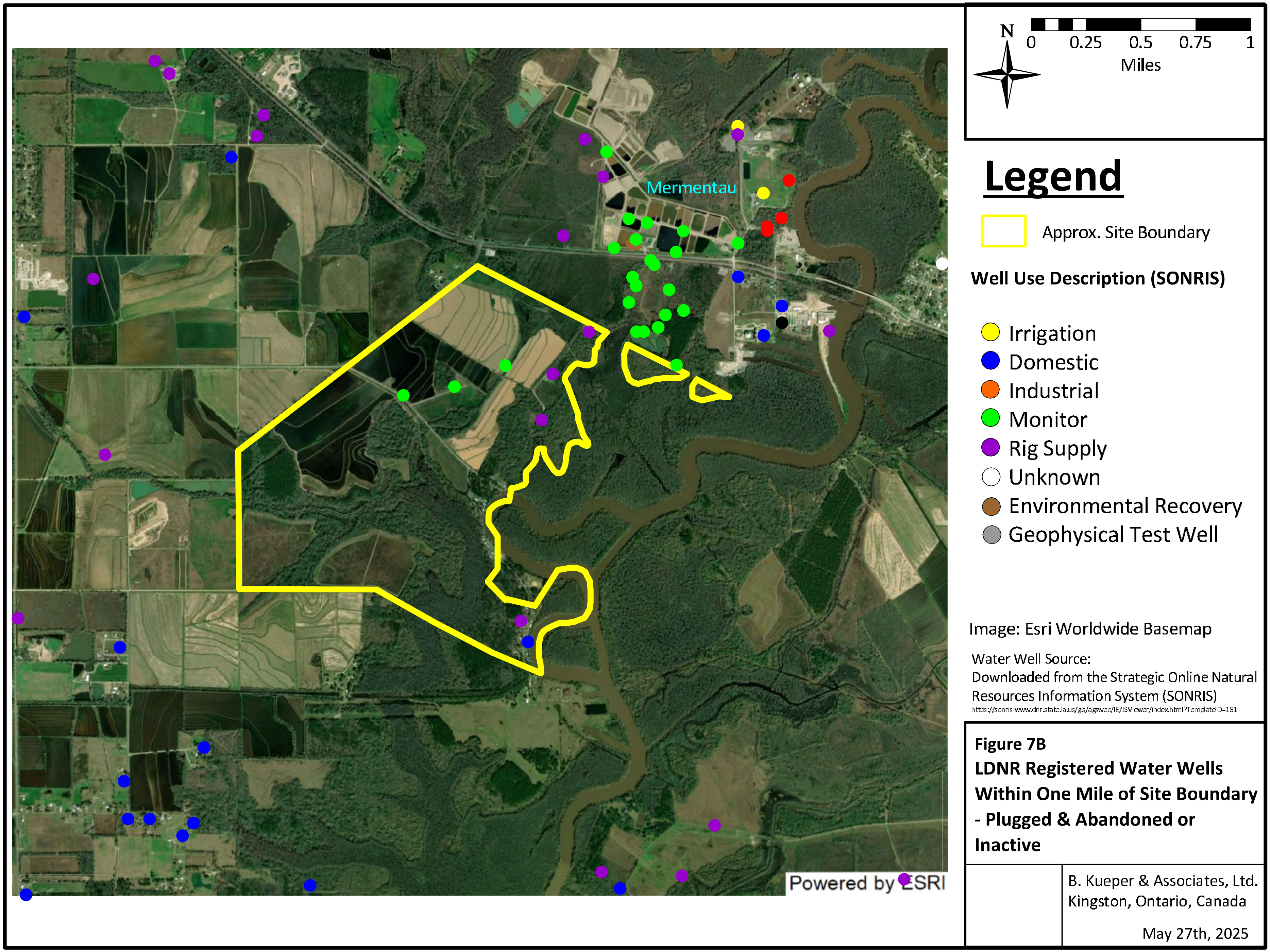
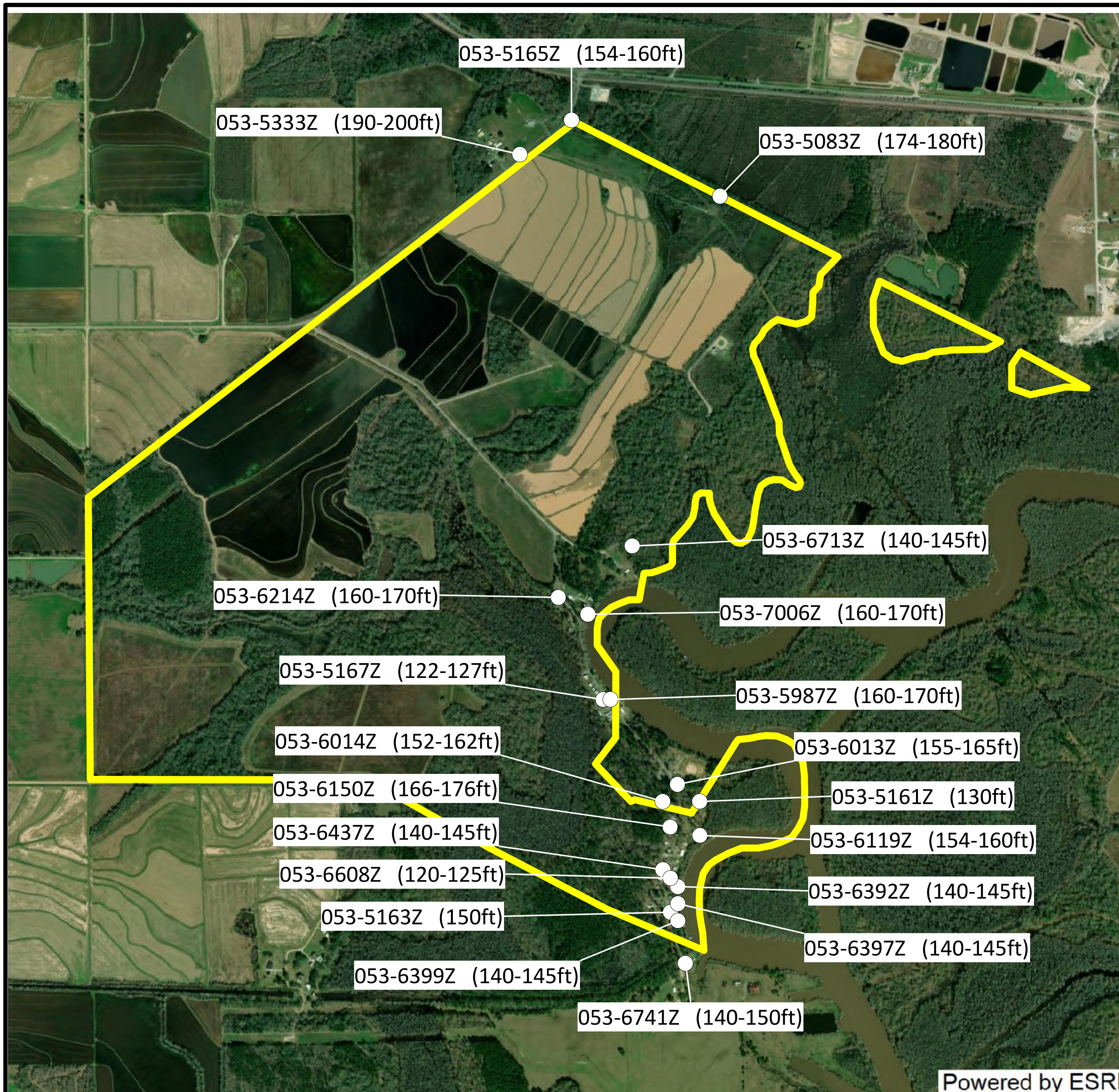


Figure 7B
LDNR Registered Water Wells Within One Mile of Site Boundary - Plugged & Abandoned or Inactive



Legend

Approx. Site Boundary

Well Use Description (SONRIS)

Domestic Well - Active

(053-5333Z) Water Well Number

(190-200ft) Registered Well Screen Interval

Only wells with a screen interval or total depth reported on the original well are plotted.

For wells that do not have screen information, only total depth is shown.

Image: Esri Worldwide Basemap

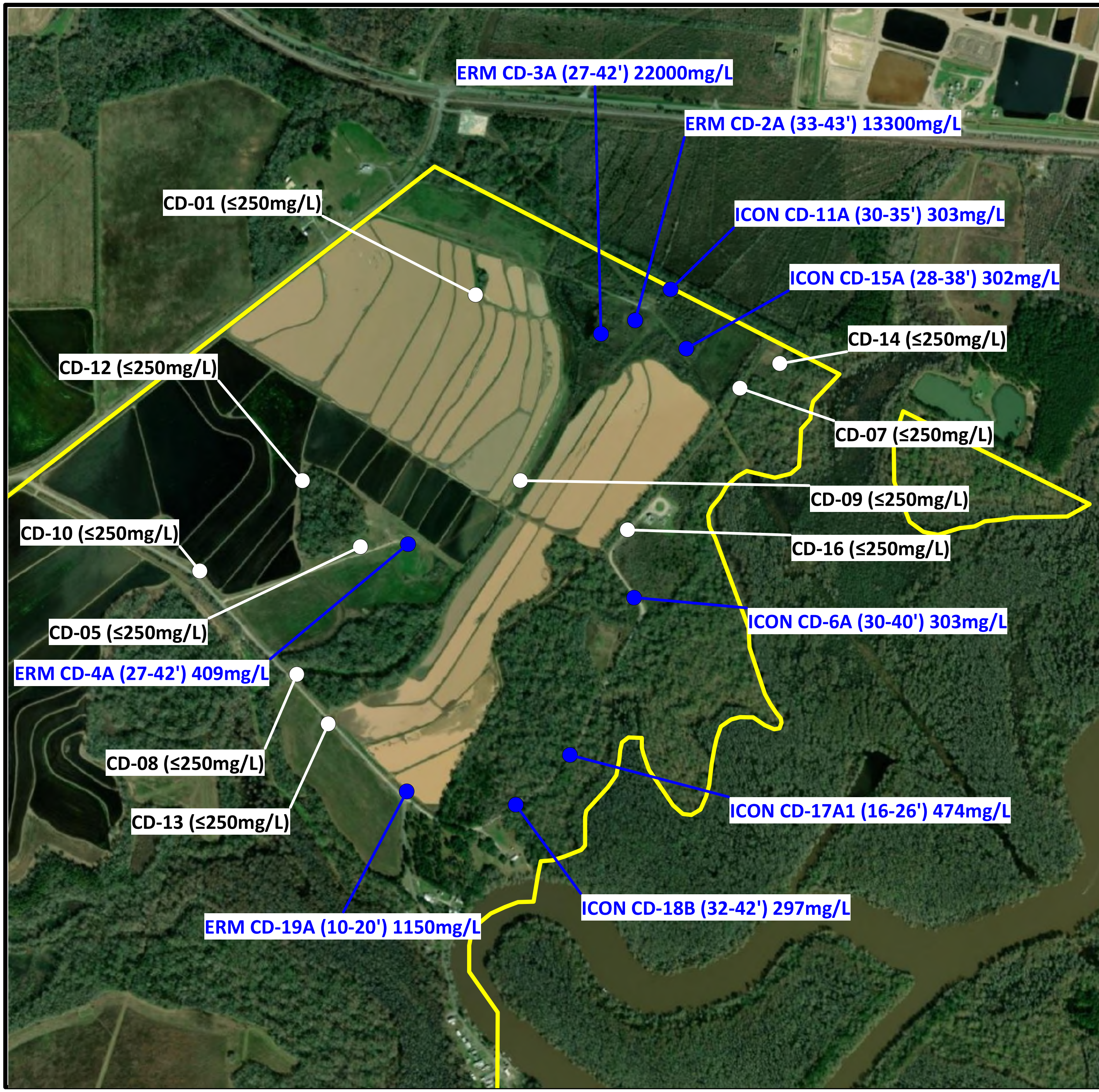
Figure 7C

LDNR Registered Domestic Water Wells Active on Site with Depth

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

BP-Castex-KUEPER RPT-000042



Legend

Approx. Site Boundary

Chloride Concentration in Groundwater (mg/L)

≤ 250mg/L

> 250mg/L

LDEQ RECAP Screening Standard: 250mg/L

If more than one well screen in zone interval (0-45ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

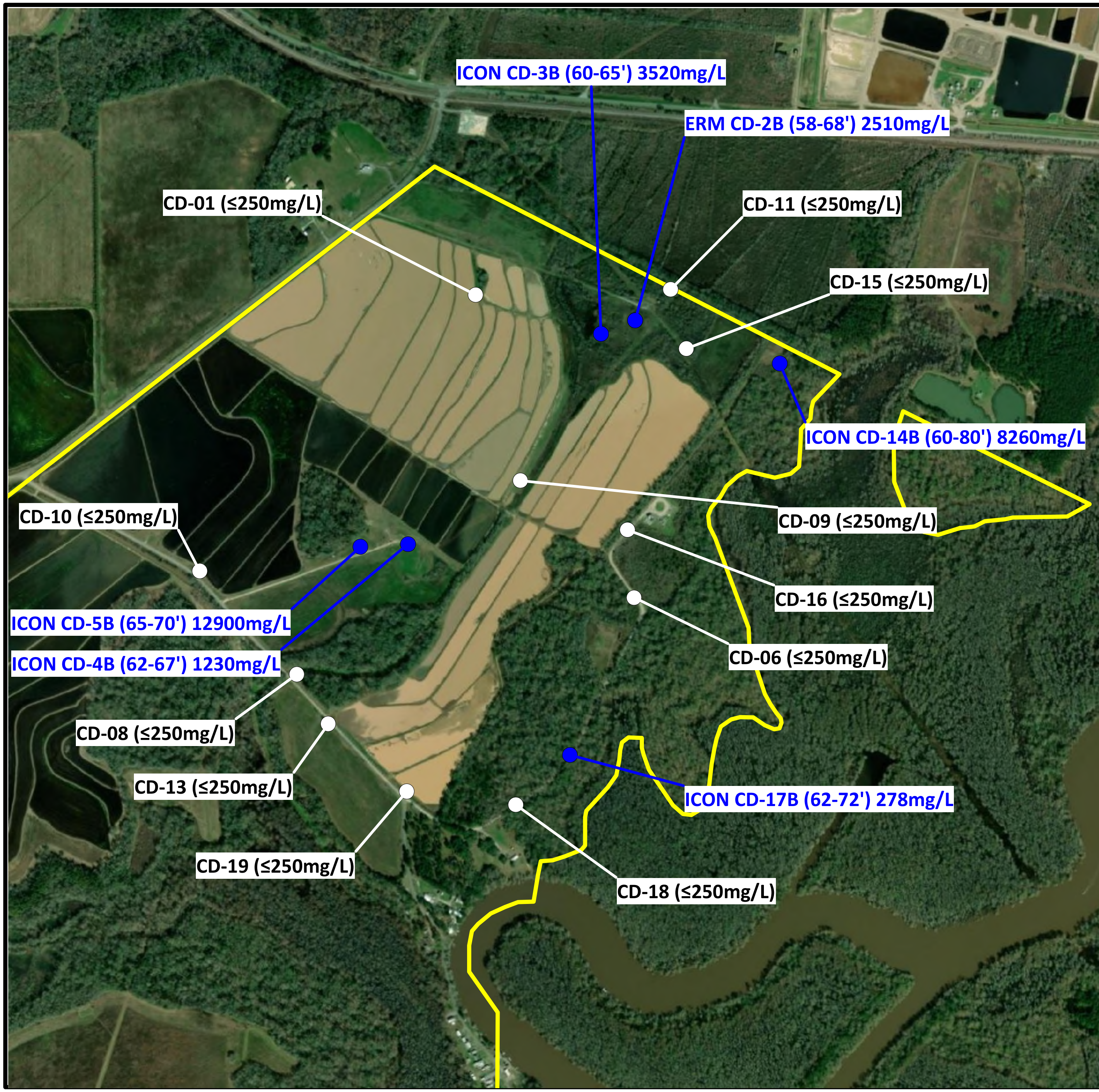
Image: Esri Worldwide Basemap

Figure 8A

Laboratory Measured Maximum Chloride Concentration in Groundwater - A Zone (0-45ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Chloride Concentration in Groundwater (mg/L)

≤ 250mg/L

> 250mg/L

LDEQ RECAP Screening Standard: 250mg/L

If more than one well screen in zone interval (45-95ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

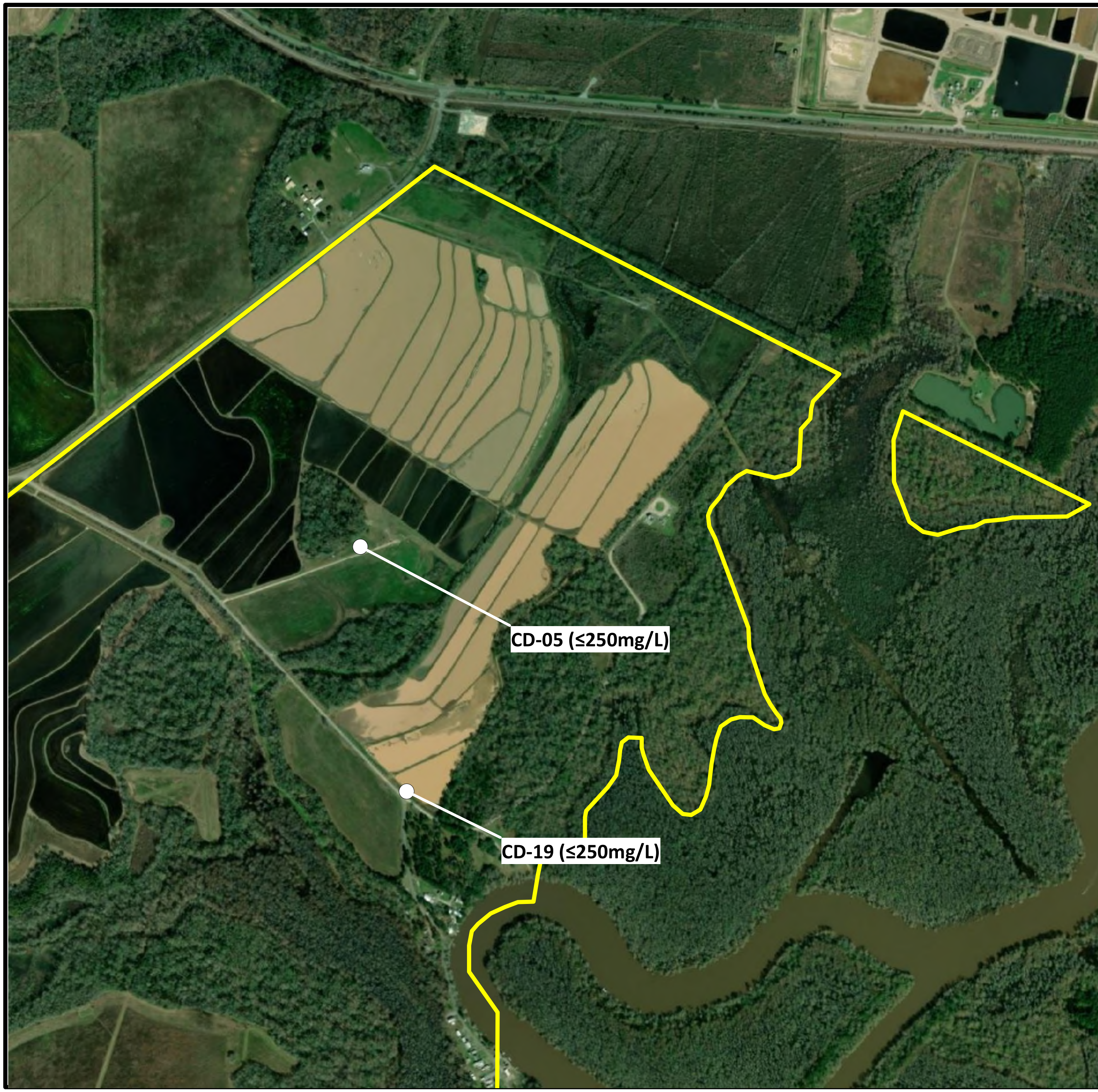
Image: Esri Worldwide Basemap

Figure 8B
Laboratory Measured Maximum Chloride Concentration in Groundwater - B Zone (45-95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

BP-Castex-KUEPER RPT-000044



Legend

Approx. Site Boundary

Chloride Concentration in Groundwater (mg/L)

≤ 250mg/L

> 250mg/L

LDEQ RECAP Screening Standard: 250mg/L

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

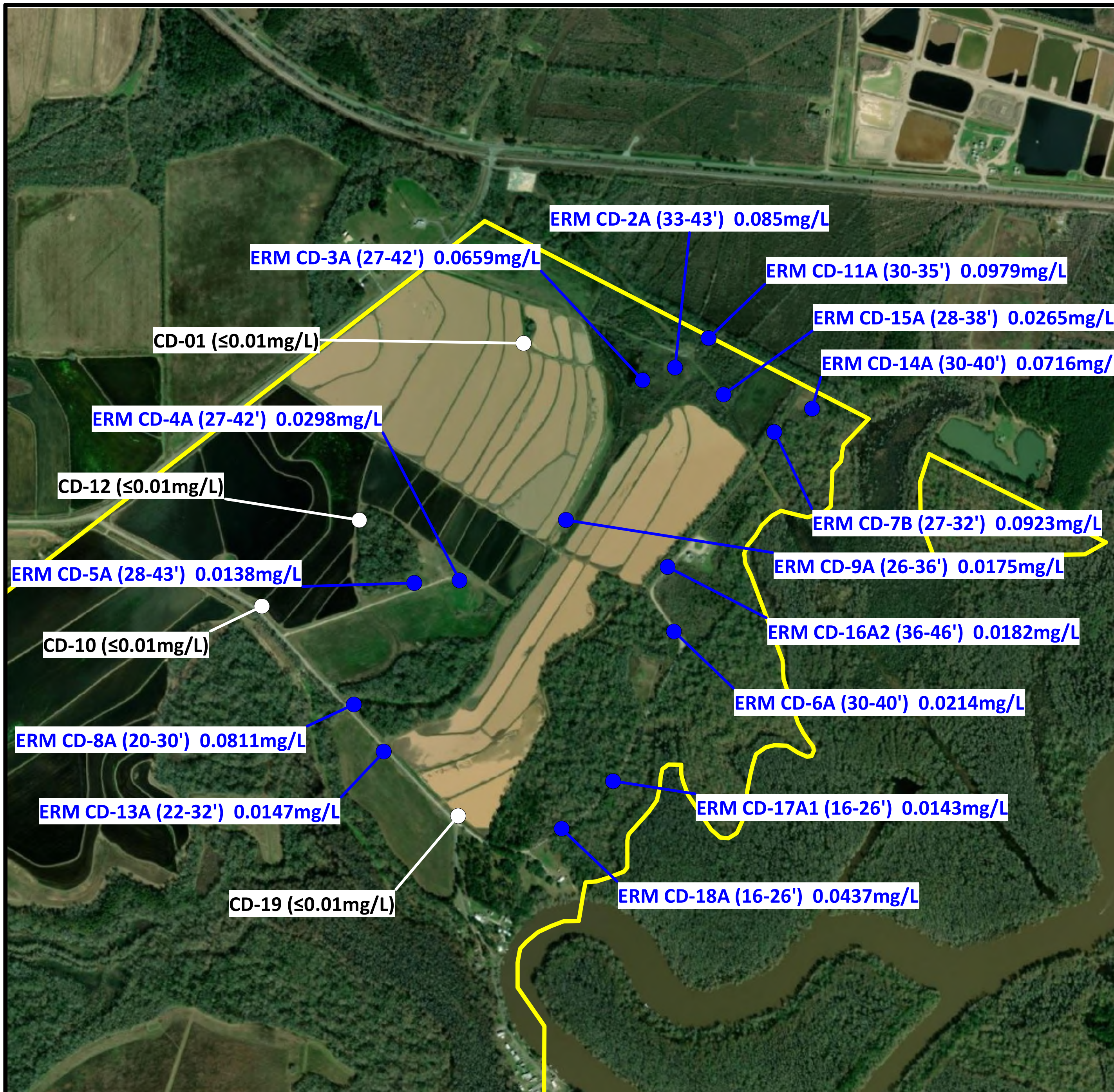
Image: Esri Worldwide Basemap

Figure 8C

Laboratory Measured Maximum Chloride Concentration in Groundwater - Below B Zone (>95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Dissolved Arsenic Concentration in Groundwater (mg/L)

○ ≤ 0.01mg/L

● > 0.01mg/L

LDEQ RECAP Screening Standard: 0.01mg/L

If more than one well screen in zone interval (0-45ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

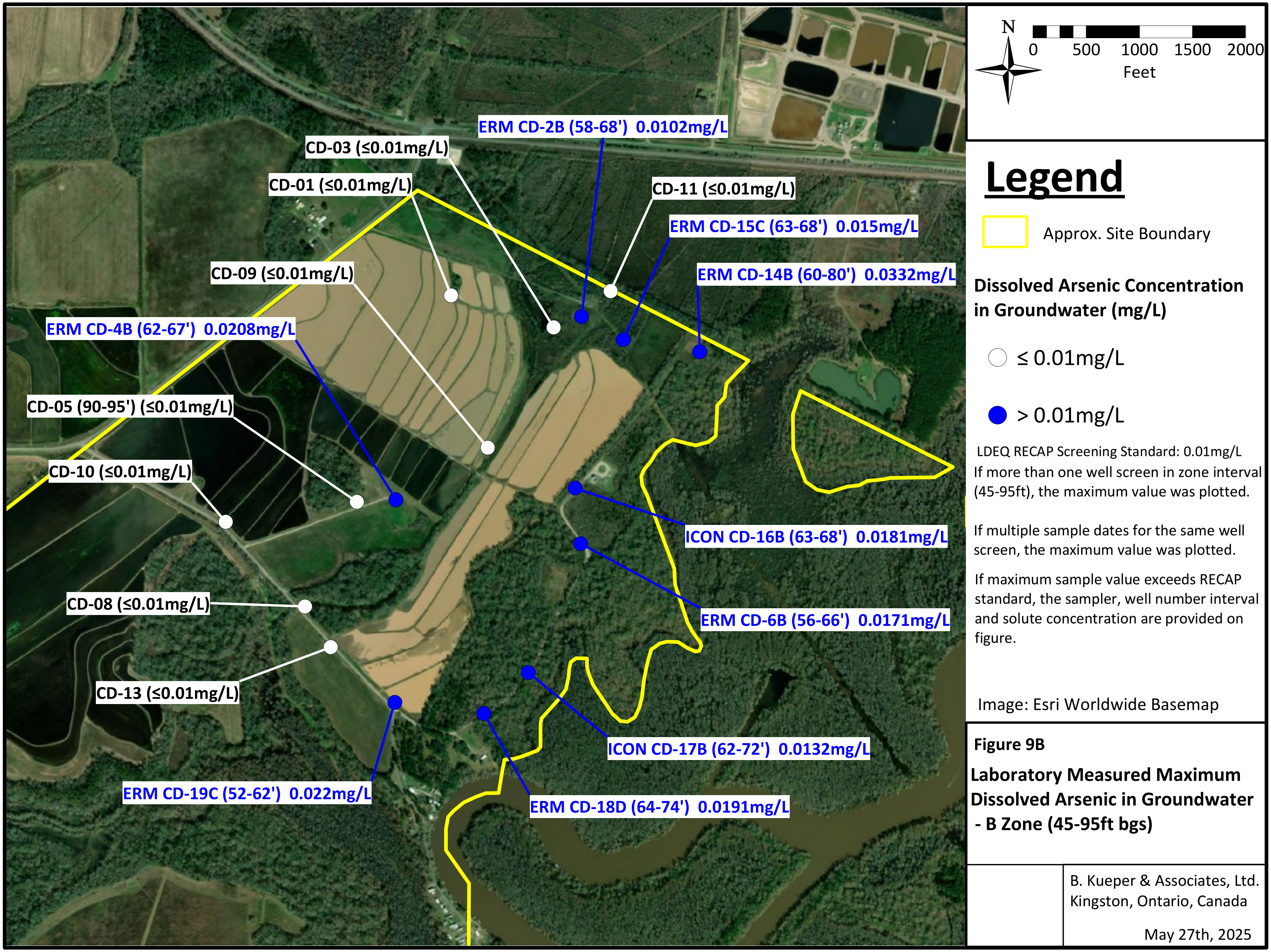
Image: Esri Worldwide Basemap

Figure 9A

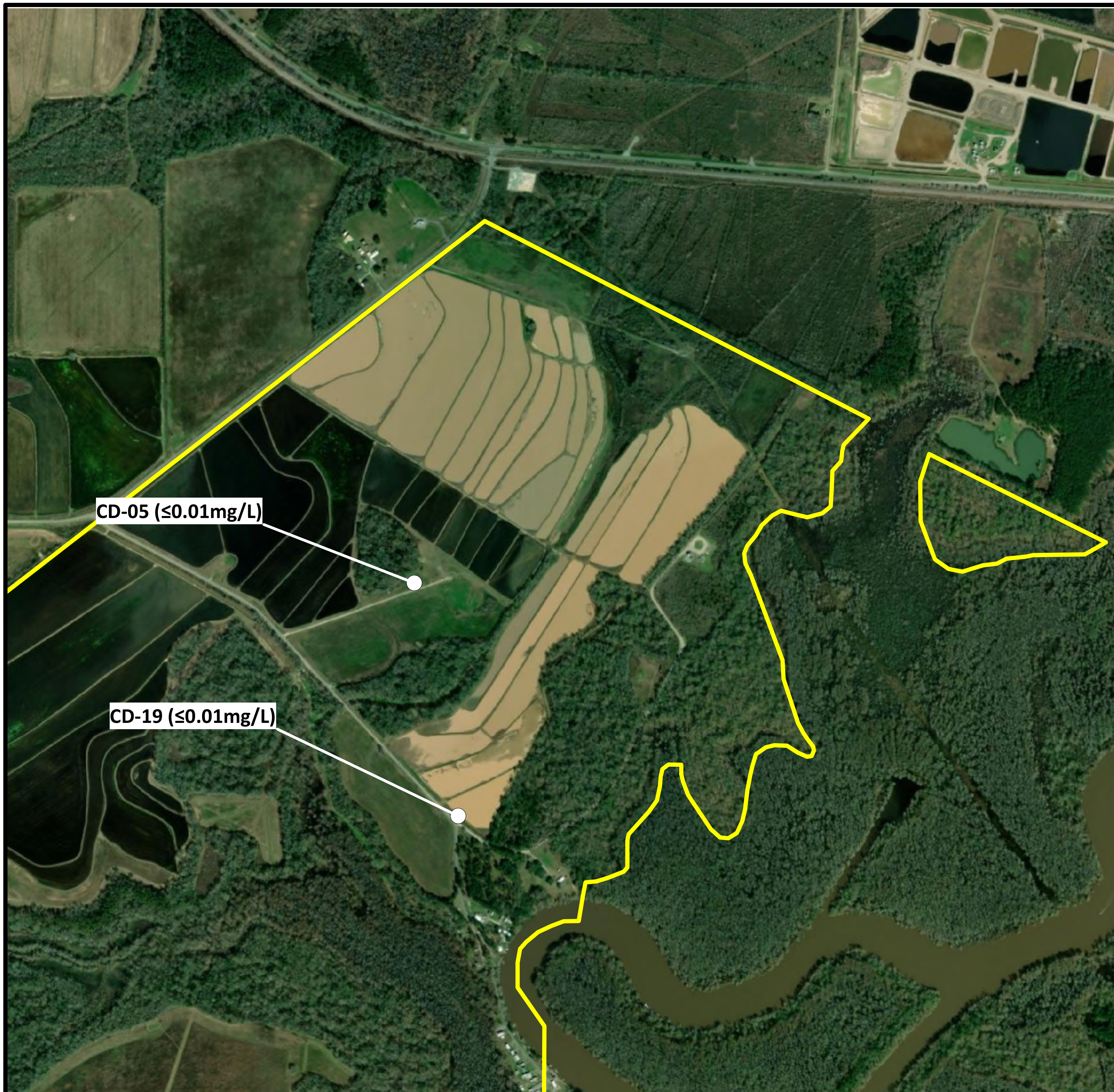
Laboratory Measured Maximum Dissolved Arsenic in Groundwater - A Zone (0 - 45ft bls)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



ERM CD-2B (58-68') 0.0102mg/L
CD-03 (≤0.01mg/L)
CD-01 (≤0.01mg/L)
CD-11 (≤0.01mg/L)
ERM CD-15C (63-68') 0.015mg/L
ERM CD-14B (60-80') 0.0332mg/L
CD-09 (≤0.01mg/L)
ERM CD-4B (62-67') 0.0208mg/L
CD-05 (90-95') (≤0.01mg/L)
CD-10 (≤0.01mg/L)
ICON CD-16B (63-68') 0.0181mg/L
CD-08 (≤0.01mg/L)
ERM CD-6B (56-66') 0.0171mg/L
CD-13 (≤0.01mg/L)
ICON CD-17B (62-72') 0.0132mg/L
ERM CD-19C (52-62') 0.022mg/L
ERM CD-18D (64-74') 0.0191mg/L
N
0 500 1000 1500 2000
Feet
Legend
Approx. Site Boundary
Dissolved Arsenic Concentration in Groundwater (mg/L)
≤ 0.01mg/L
> 0.01mg/L
LDEQ RECAP Screening Standard: 0.01mg/L
If more than one well screen in zone interval (45-95ft), the maximum value was plotted.
If multiple sample dates for the same well screen, the maximum value was plotted.
If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.
Image: Esri Worldwide Basemap
Figure 9B
Laboratory Measured Maximum Dissolved Arsenic in Groundwater - B Zone (45-95ft bgs)
B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada
May 27th, 2025



Legend

Approx. Site Boundary

Dissolved Arsenic Concentration in Groundwater (mg/L)

≤ 0.01mg/L

> 0.01mg/L

LDEQ RECAP Screening Standard: 0.01mg/L

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

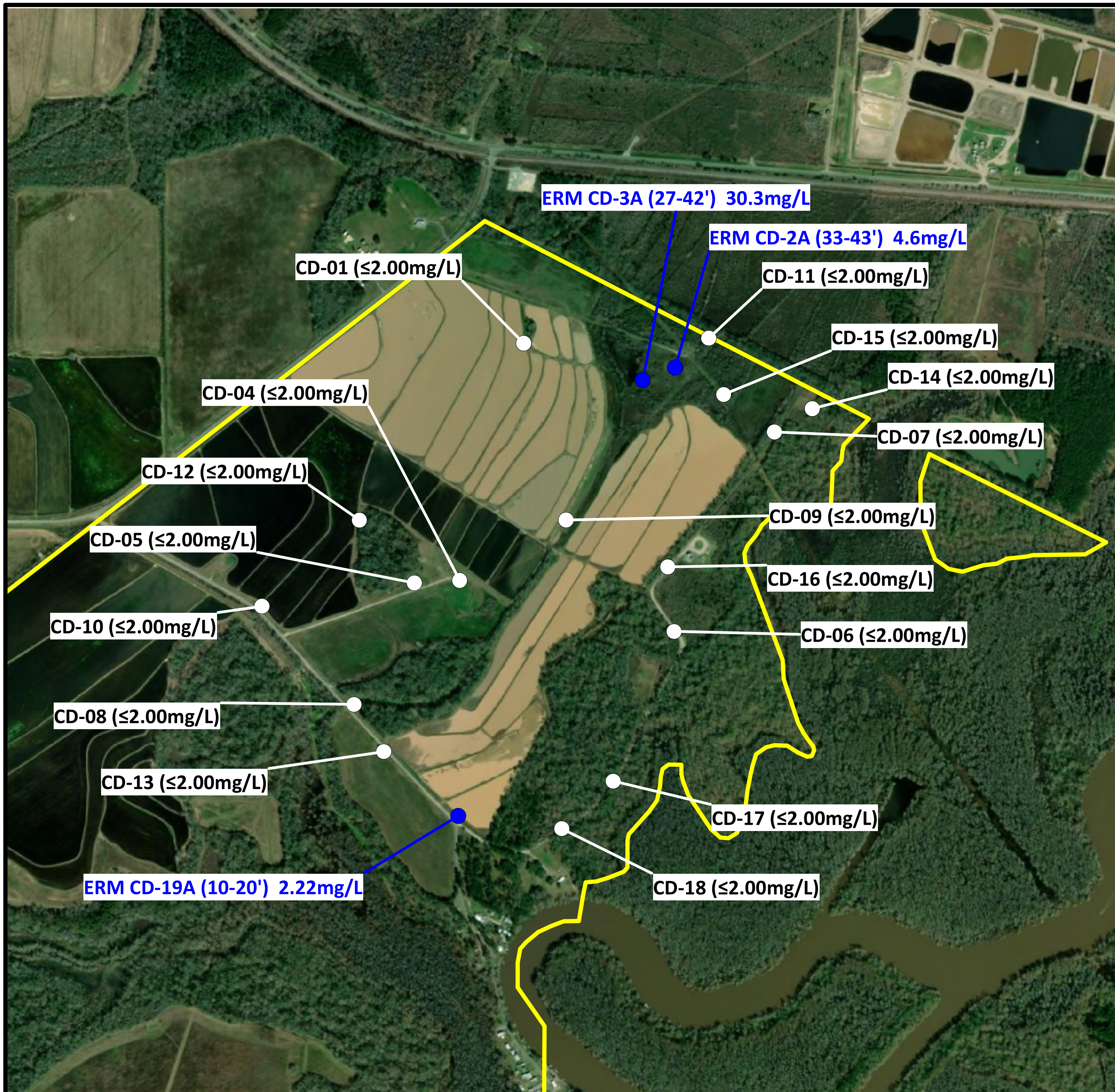
Image: Esri Worldwide Basemap

Figure 9C

Laboratory Measured Maximum Dissolved Arsenic in Groundwater - Below B Zone (>95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Dissolved Barium Concentration in Groundwater (mg/L)

○ ≤ 2.0mg/L

● > 2.0mg/L

LDEQ RESPEC Screening Standard: 2.0mg/L

If more than one well screen in zone interval (0-45ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

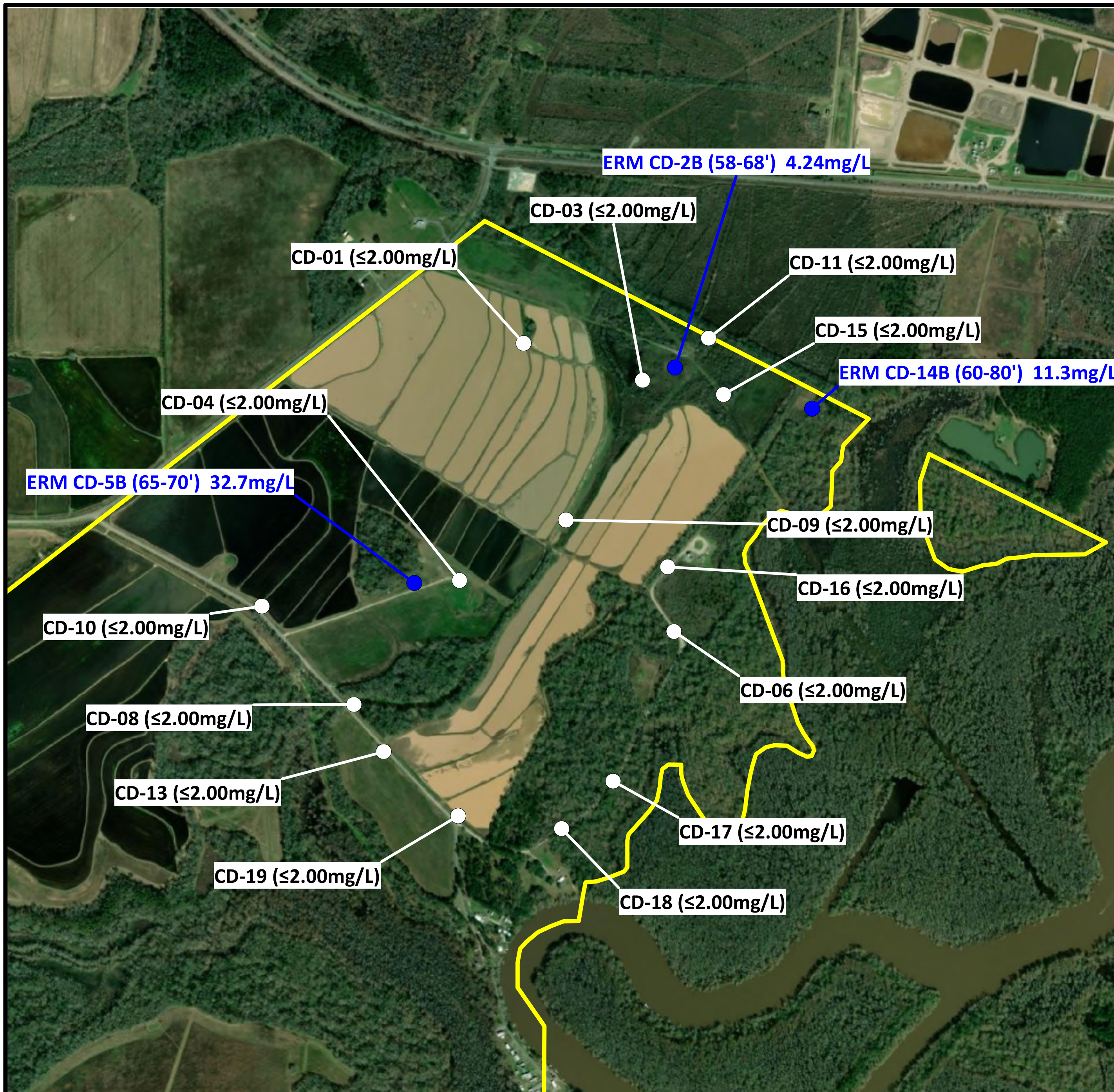
If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

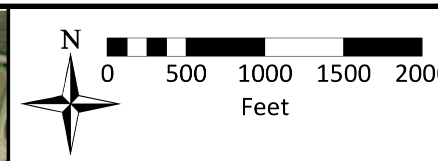
Image: Esri Worldwide Basemap

Figure 10A
Laboratory Measured Maximum Dissolved Barium in Groundwater - A Zone (0-45ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025





Legend

Approx. Site Boundary

Dissolved Barium Concentration in Groundwater (mg/L)

≤ 2.0mg/L

> 2.0mg/L

LDEQ RESPEC Screening Standard: 2.0mg/L

If more than one well screen in zone interval (45-95ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

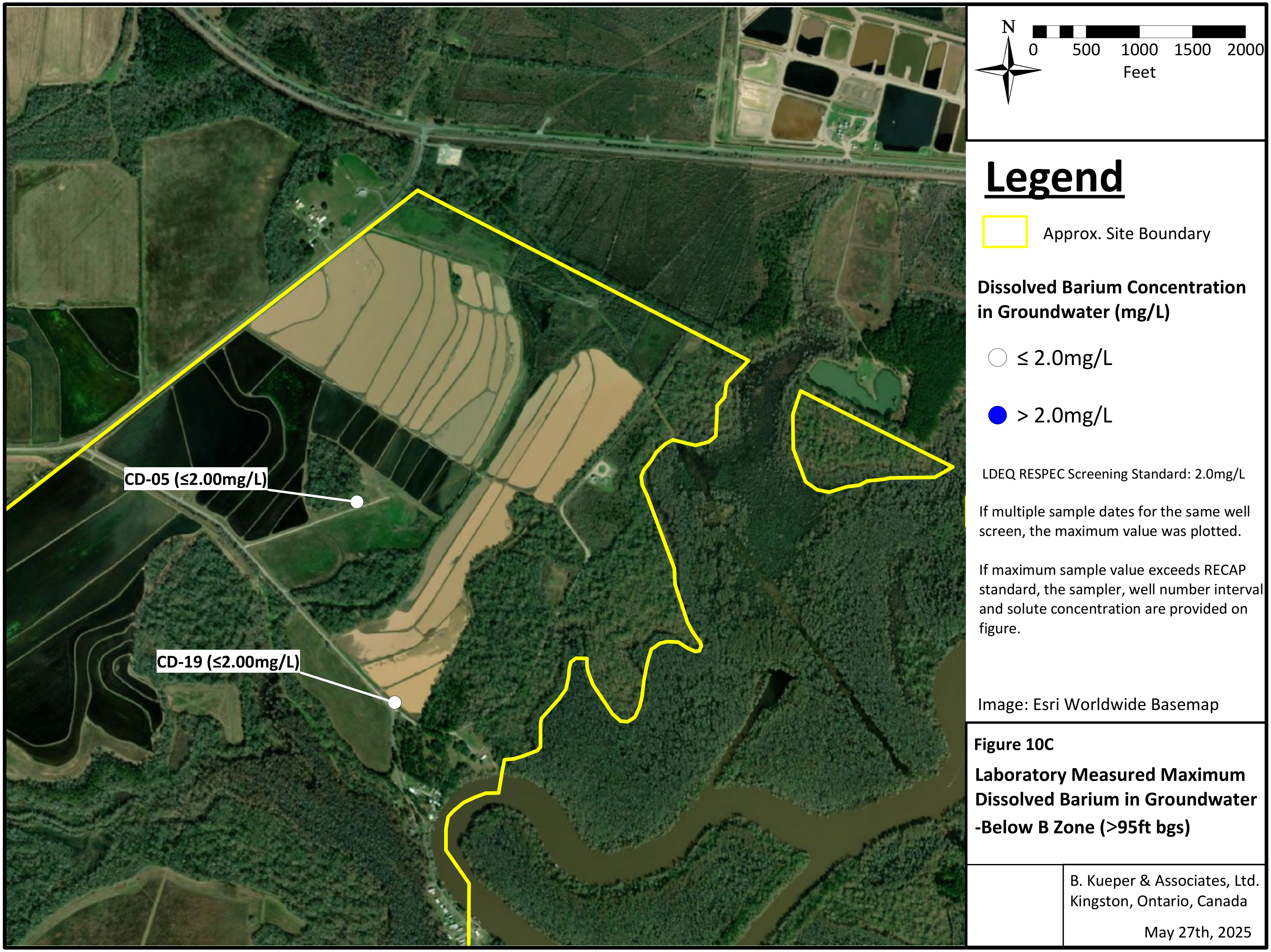
Image: Esri Worldwide Basemap

Figure 10B

Laboratory Measured Maximum Dissolved Barium in Groundwater - B Zone (45-95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Dissolved Barium Concentration in Groundwater (mg/L)

○ ≤ 2.0mg/L

● > 2.0mg/L

LDEQ RESPEC Screening Standard: 2.0mg/L

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

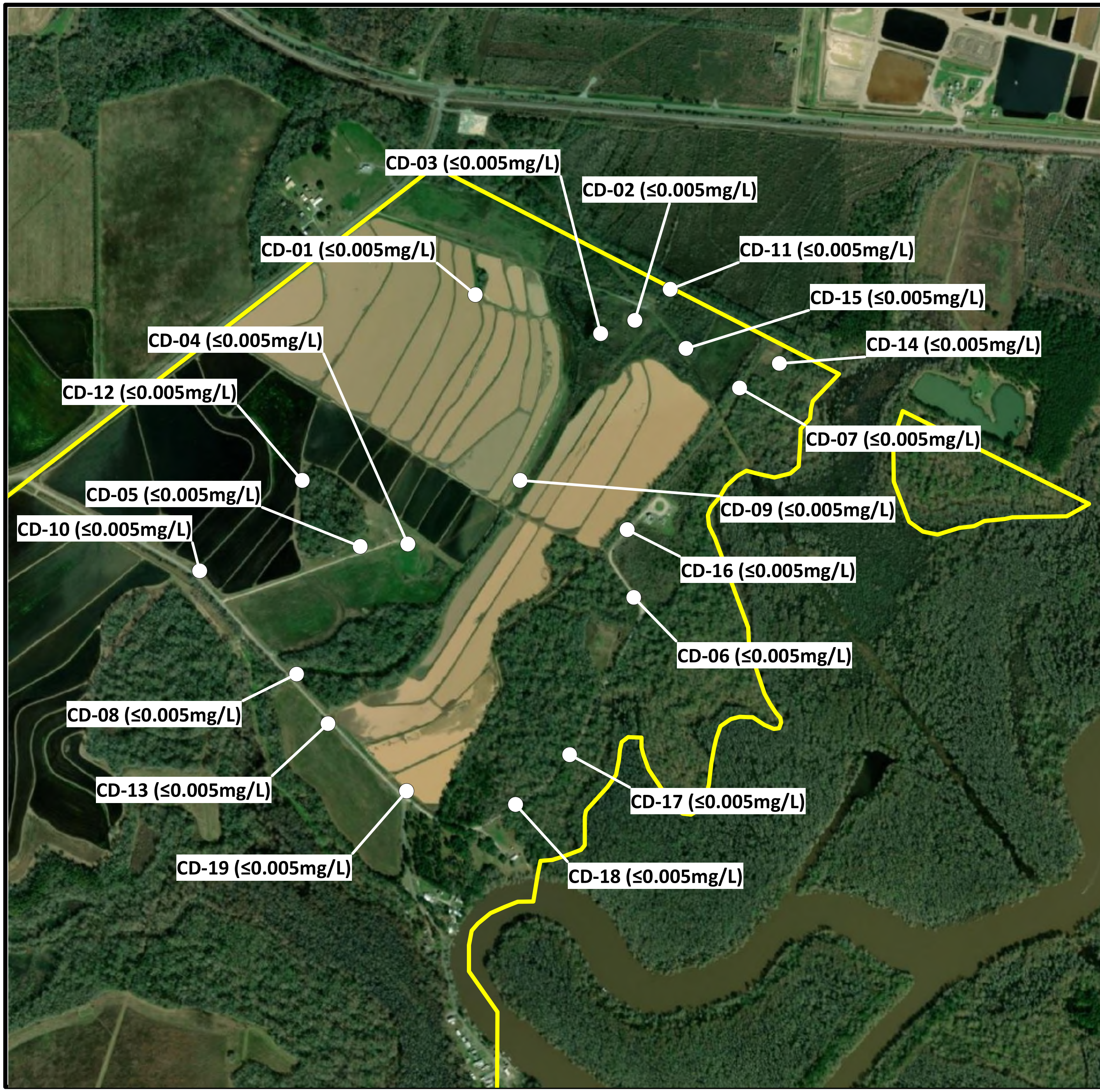
Image: Esri Worldwide Basemap

Figure 10C

Laboratory Measured Maximum Dissolved Barium in Groundwater -Below B Zone (>95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Benzene Concentration in Groundwater (mg/L)

≤ 0.005mg/L

> 0.005mg/L

LDEQ RECAP Screening Standard: 0.005mg/L

If more than one well screen in zone interval (0-45ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

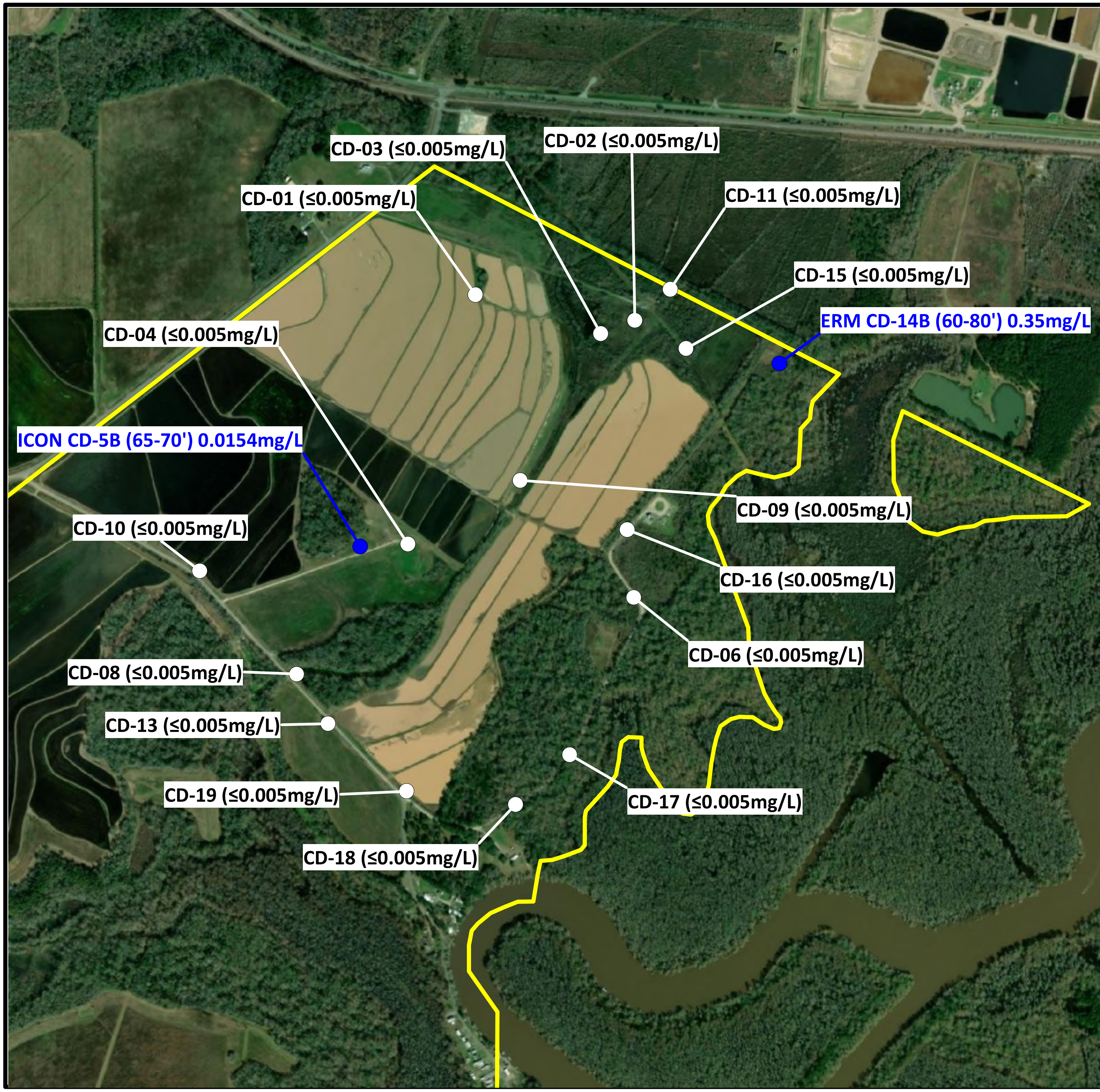
If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

Image: Esri Worldwide Basemap

Figure 11A
Laboratory Measured Maximum Benzene Concentration in Groundwater - A Zone (0-45ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

Benzene Concentration in Groundwater (mg/L)

≤ 0.005mg/L

> 0.005mg/L

LDEQ RECAP Screening Standard: 0.005mg/L

If more than one well screen in zone interval (45-95ft), the maximum value was plotted.

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

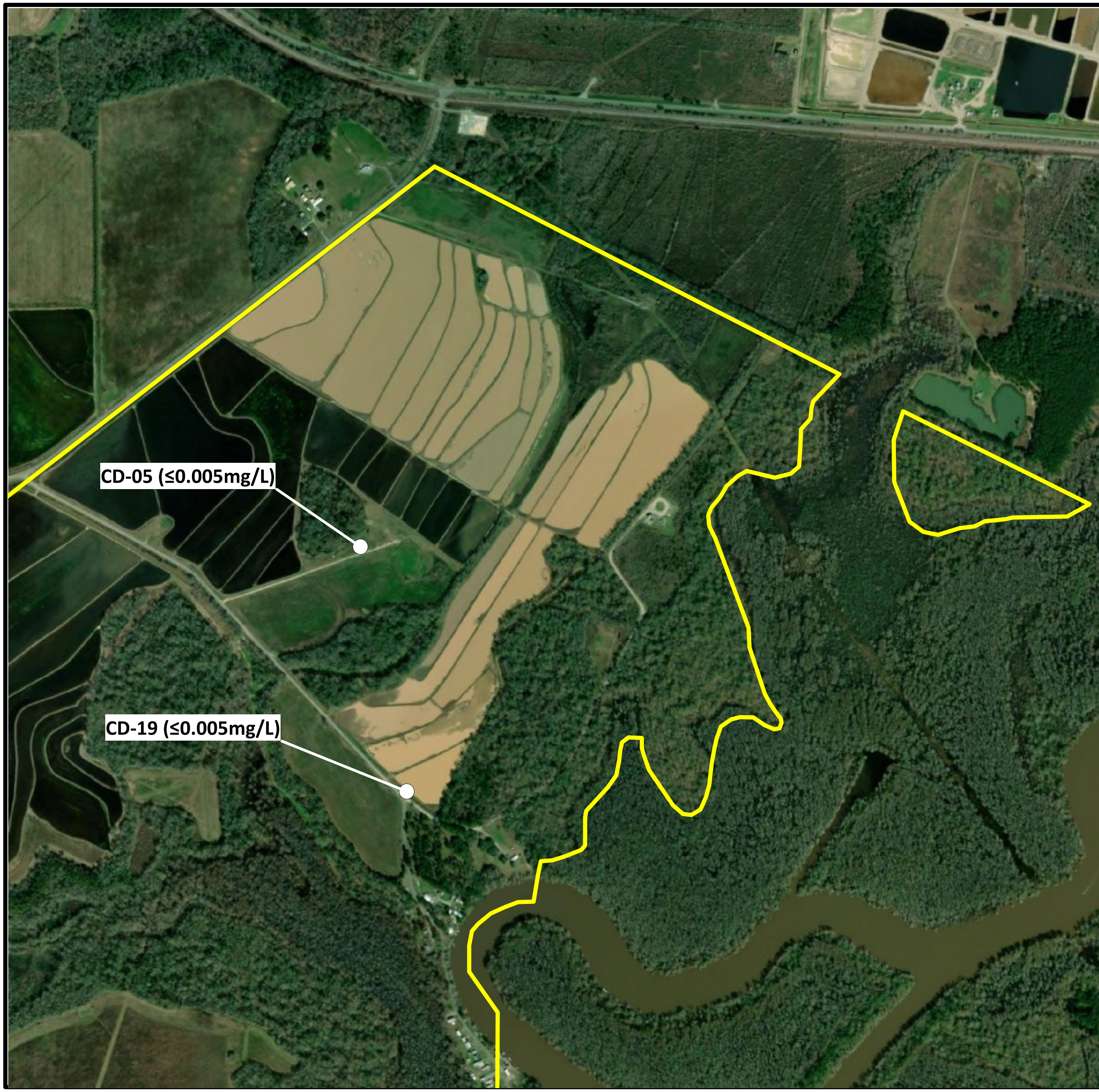
Image: Esri Worldwide Basemap

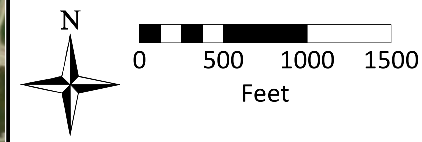
Figure 11B

Laboratory Measured Maximum Benzene Concentration in Groundwater - B Zone (45-95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025





Legend

Approx. Site Boundary

Benzene Concentration in Groundwater (mg/L)

≤ 0.005mg/L

> 0.005mg/L

LDEQ RECAP Screening Standard: 0.005mg/L

If multiple sample dates for the same well screen, the maximum value was plotted.

If maximum sample value exceeds RECAP standard, the sampler, well number interval and solute concentration are provided on figure.

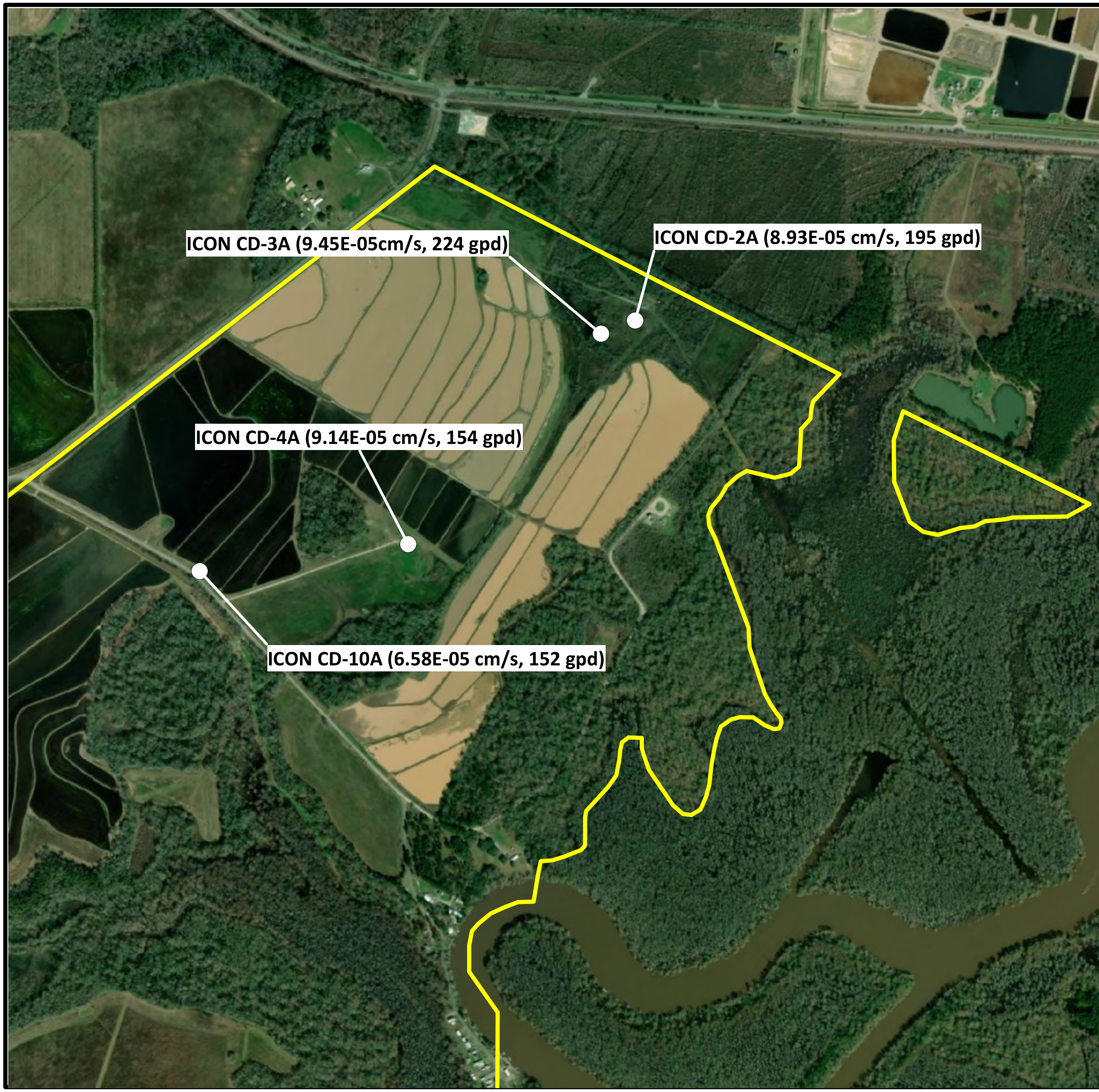
Image: Esri Worldwide Basemap

Figure 11C

Laboratory Measured Maximum Benzene Concentration in Groundwater - Below B Zone (>95ft bgs)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



N

0 500 1000 1500
Feet

Legend

Approx. Site Boundary

(1.00E-05 cm/s) Estimated Hydraulic Conductivity

(100 gpd) Estimated RECAP Yield

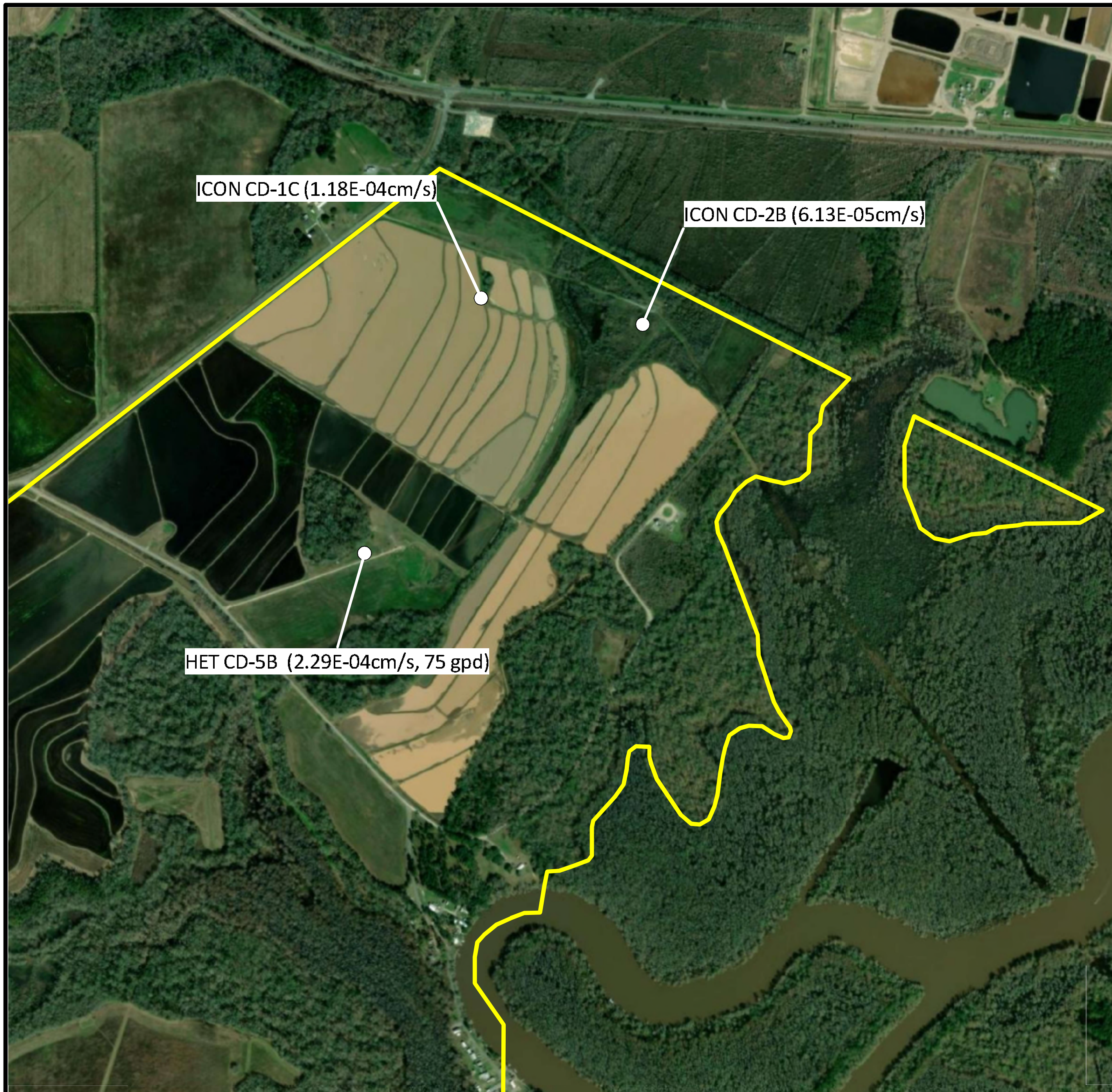
Image: Esri Worldwide Basemap

Figure 12A

Estimated Hydraulic Conductivity from Slug Testing and Estimated RECAP Yield - A Zone (0-45ft)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025



Legend

Approx. Site Boundary

(1.00E-05 cm/s) Estimated Hydraulic Conductivity

(100 gpd) Estimated RECAP Yield

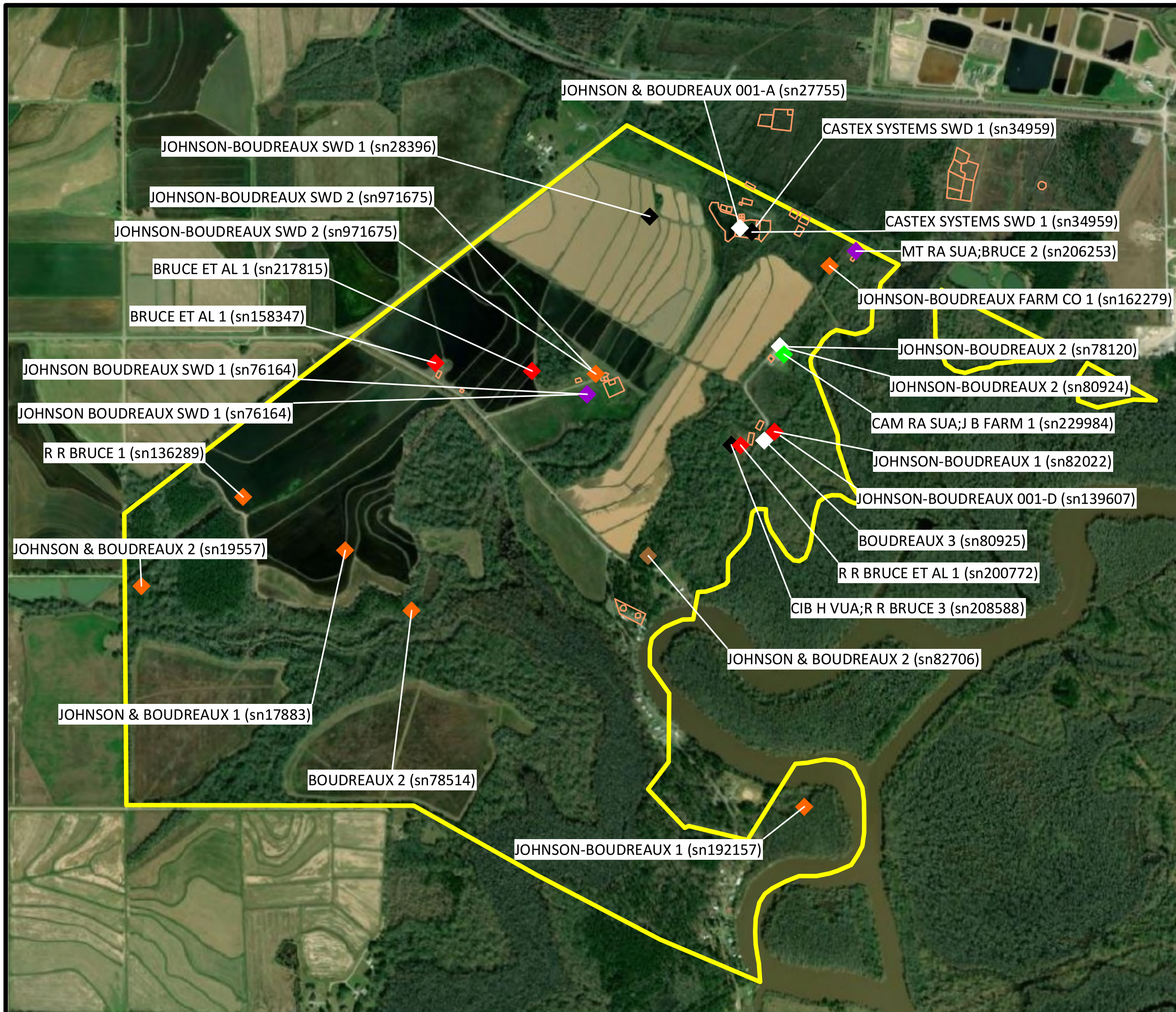
Image: Esri Worldwide Basemap

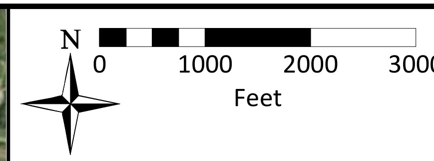
Figure 12B

Estimated Hydraulic Conductivity from Slug Testing and Estimated RECAP Yield - B Zone (45-95ft)

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025





Legend

- Approx. Site Boundary
- Approx. Pit Locations
- ACT 404 Orphan Well
- Shut In - Future Utility Gas
- Dry and Plugged - No Product Specified
- Permit Expired
- Plugged & Abandoned - No Product Specified
- Unable to Locate Well - Not Plugged & Abandoned

Image: Esri Worldwide Basemap

Figure 13

LDNR Registered Oil, Gas and Injection Wells Within Site Boundary

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

May 27th, 2025

Oil & Gas/Injection Well Data Source:
Downloaded from the Strategic Online Natural Resources Information System (SONRIS)
https://sonris-www.dnr.state.la.us/gis/agsweb/IE/JSViewer/index.html?TemplateID=181

BP-Castex-KUEPER RPT-000057

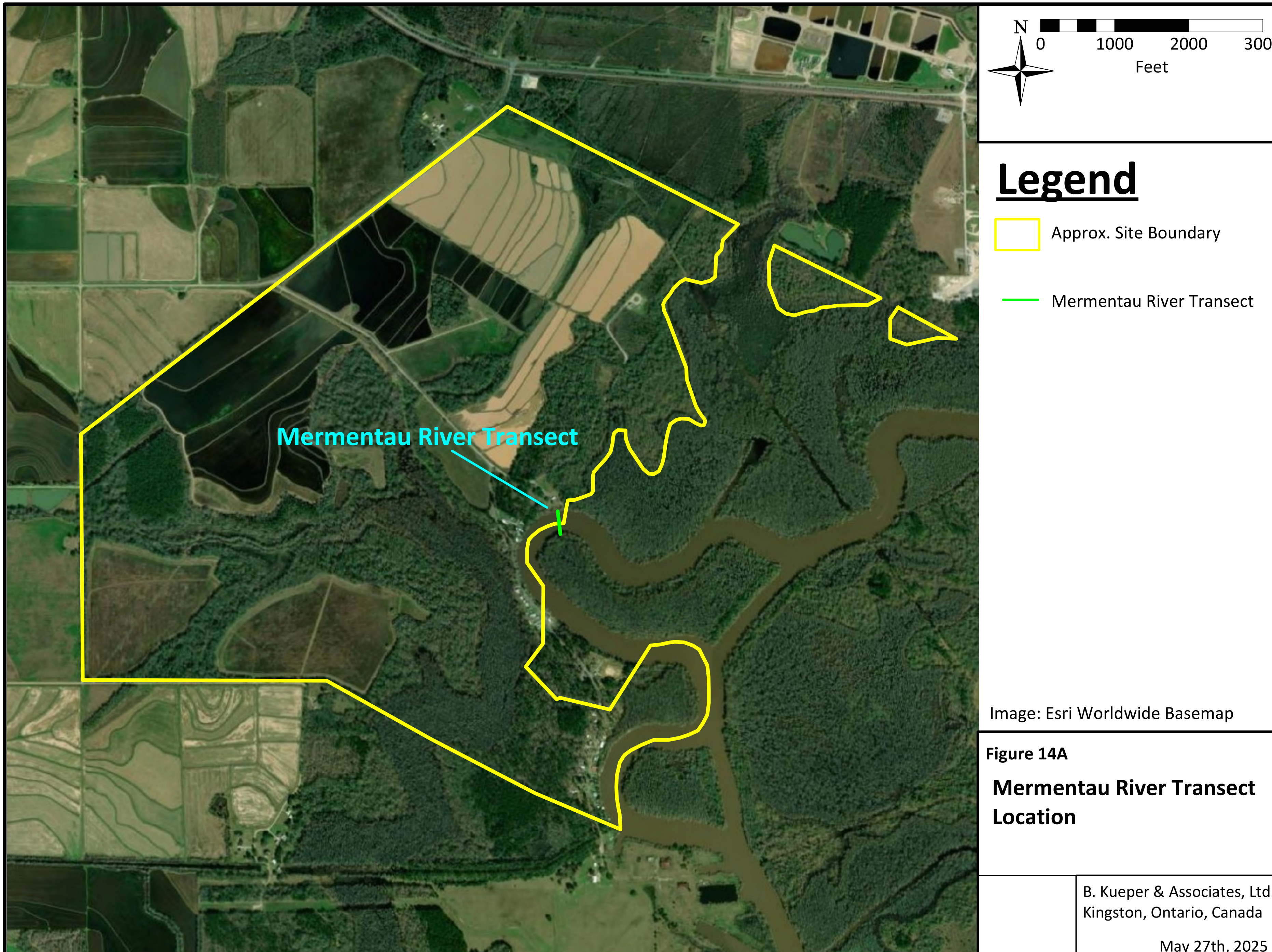


Figure 14A

Mermentau River Transect Location

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada

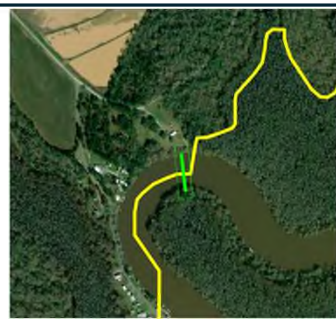
May 27th, 2025

Figure 14B – Mermentau River Bathymetry.

B. Kueper & Associates, Ltd.
Kingston, Ontario, Canada
May 27th, 2025

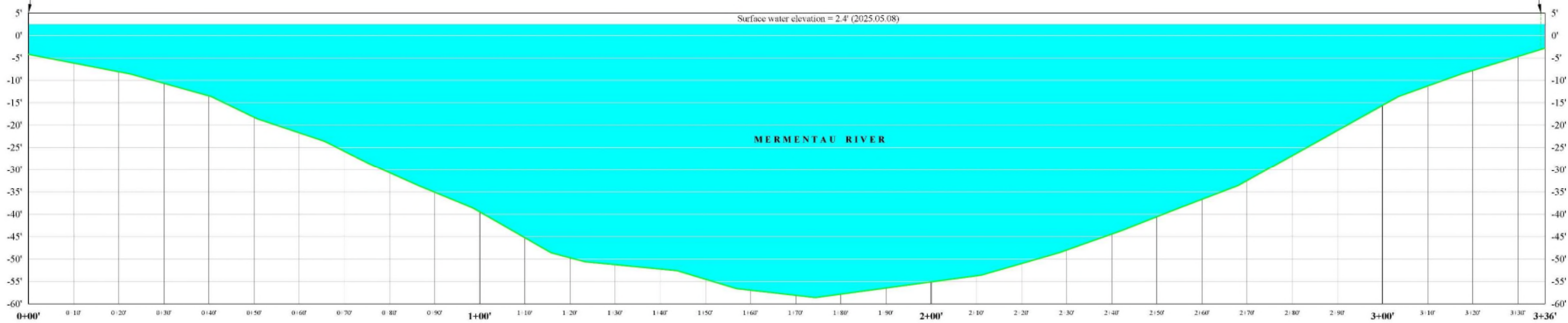
MERMENTAU RIVER TRANSECT

LEGEND:
Surveyed Water Bottom Elevations



Beginning Station 0+00'
Lat. (DMS) = 30° 10' 36.33" North
Long. (DMS) = 92° 37' 04.01" West

Ending Station 3+35'
Lat. (DMS) = 30° 10' 33.28" North
Long. (DMS) = 92° 37' 03.62" West



Mermentau River
Surface Water Elevation = 2.4' on 2025.05.08.

I certify this survey was performed by myself or under my direct supervision and control. This is not a property boundary survey.

REGISTERED LAND SURVEYOR NO. 5144
STATE OF LOUISIANA
TERRY J. ORTEGO
SOUTHEAST ENGINEERS & LAND SURVEYORS
P.O. BOX 1834, SCOTT, LA 70583
337-266-9500
C3D Transect T10SR2-3W HET (SELS-25-0504).dwg

STATE OF LOUISIANA
TERRY J. ORTEGO
License No. 5144
LICENSED
PROFESSIONAL
5/22/2025
LAND SURVEYOR

Notes:
1. Scope of work does not include wetlands determinations, servitudes, easements or rights-of-way, unless specifically noted with accompanying recorded document.
2. All latitude & longitude values are based on the Louisiana State Plane Coordinate System of NAD 1983 (2011), South Zone.
3. All elevations are derived using the NAVD 1988 and referenced to the GEOID18.
4. All stations indicated hereon are rounded to the nearest foot (1').
5. Transect survey performed on May 8, 2025.

MERMENTAU RIVER TRANSECT
PREPARED FOR
HYDRO-ENVIRONMENTAL TECHNOLOGY, INC.
LOCATED AT
CASTEX PROJECT
SITUATED IN T. 10 S., R. 2 – 3 W.
JEFFERSON DAVIS & ACADIA PARISH, LOUISIANA

SCALE: 1" = 10'

May 22, 2025