

2024 Battelle Chlorinated Conference

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The Evolution and Application of the Puchack Site Geologic Model:

From Paper to Digital, from Lithostratigraphic to Environmental Sequence Stratigraphy

Puchack Well Field Superfund Site

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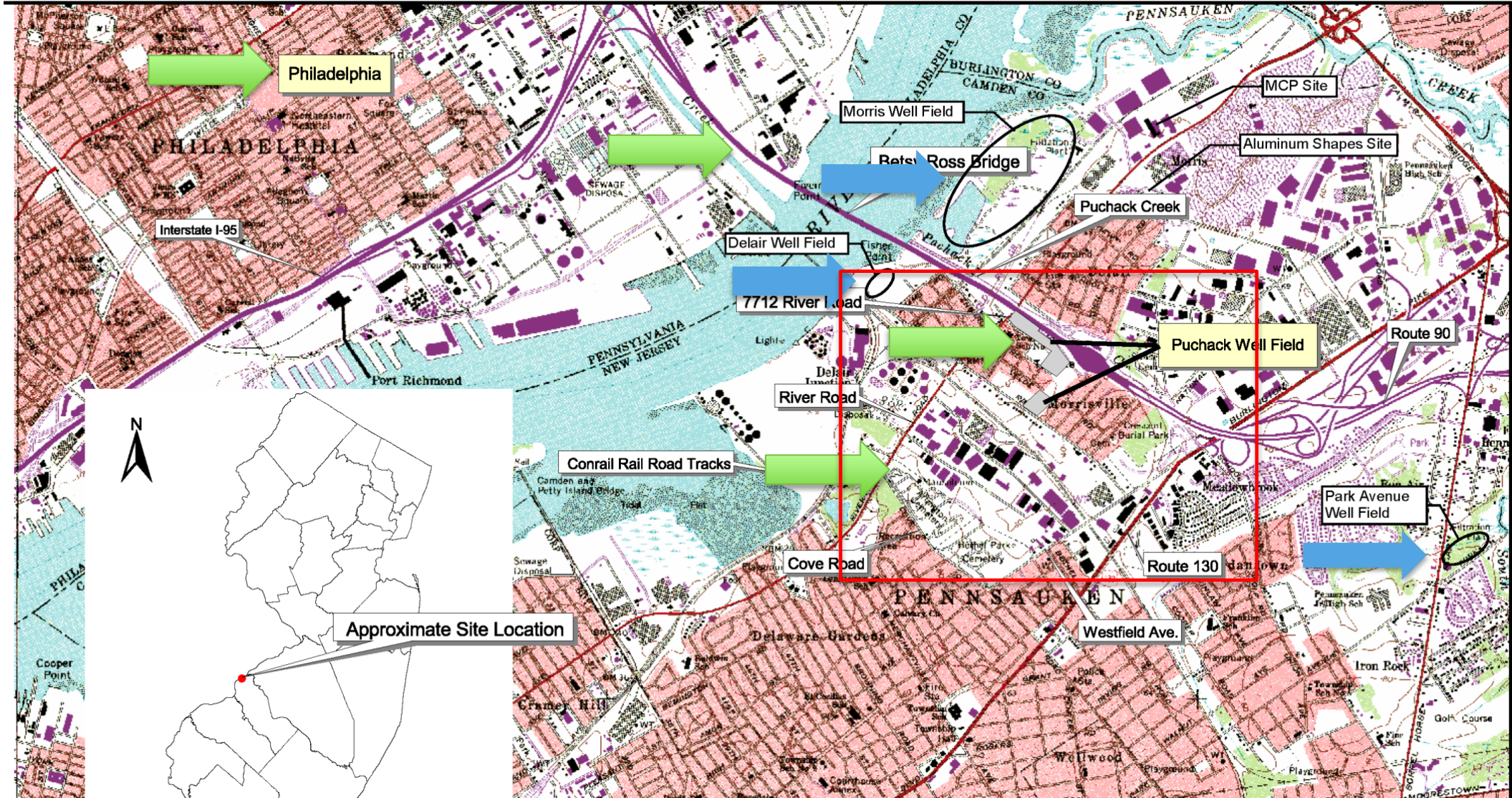
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June 4, 2024





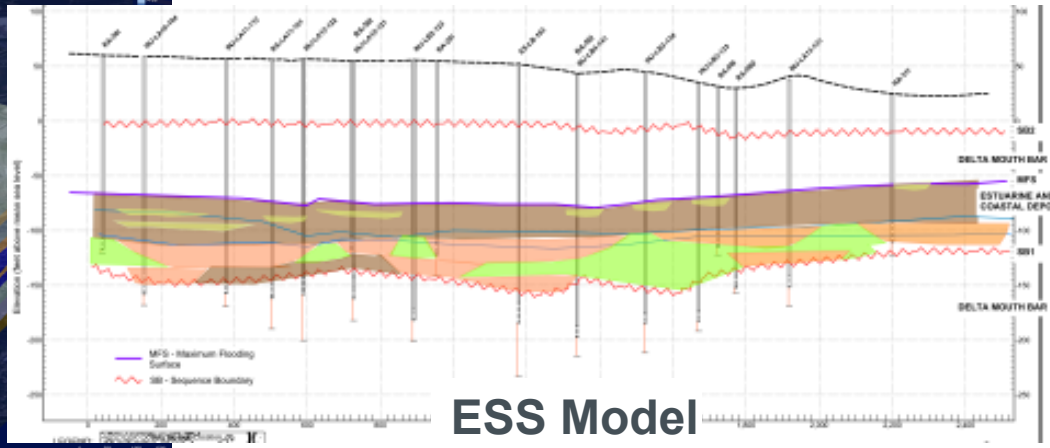
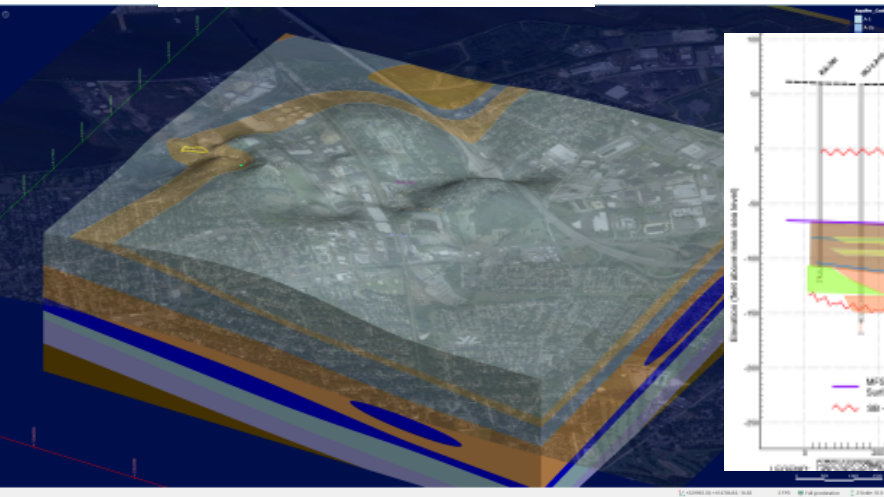
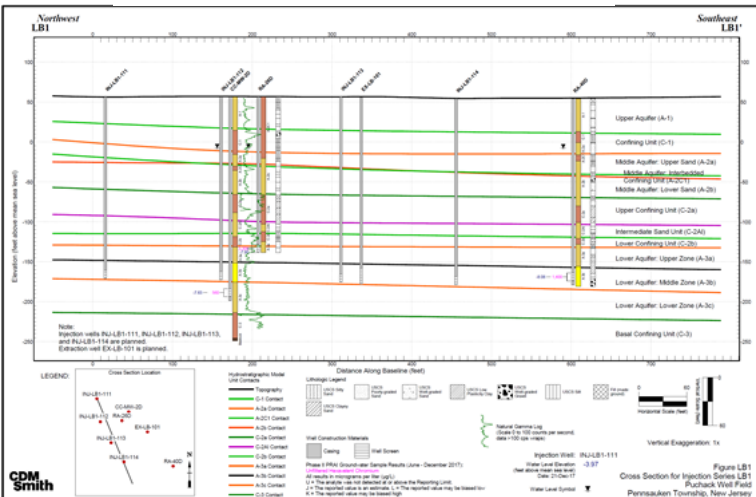
CSM Development at Puchack

- Paper: Lithostratigraphic Model Developed by USGS
- Digital: Application of gINT and Leapfrog Works to Create a 3D model
- Environmental Sequence Stratigraphy (ESS): improved geologic model

Cross Section in gINT

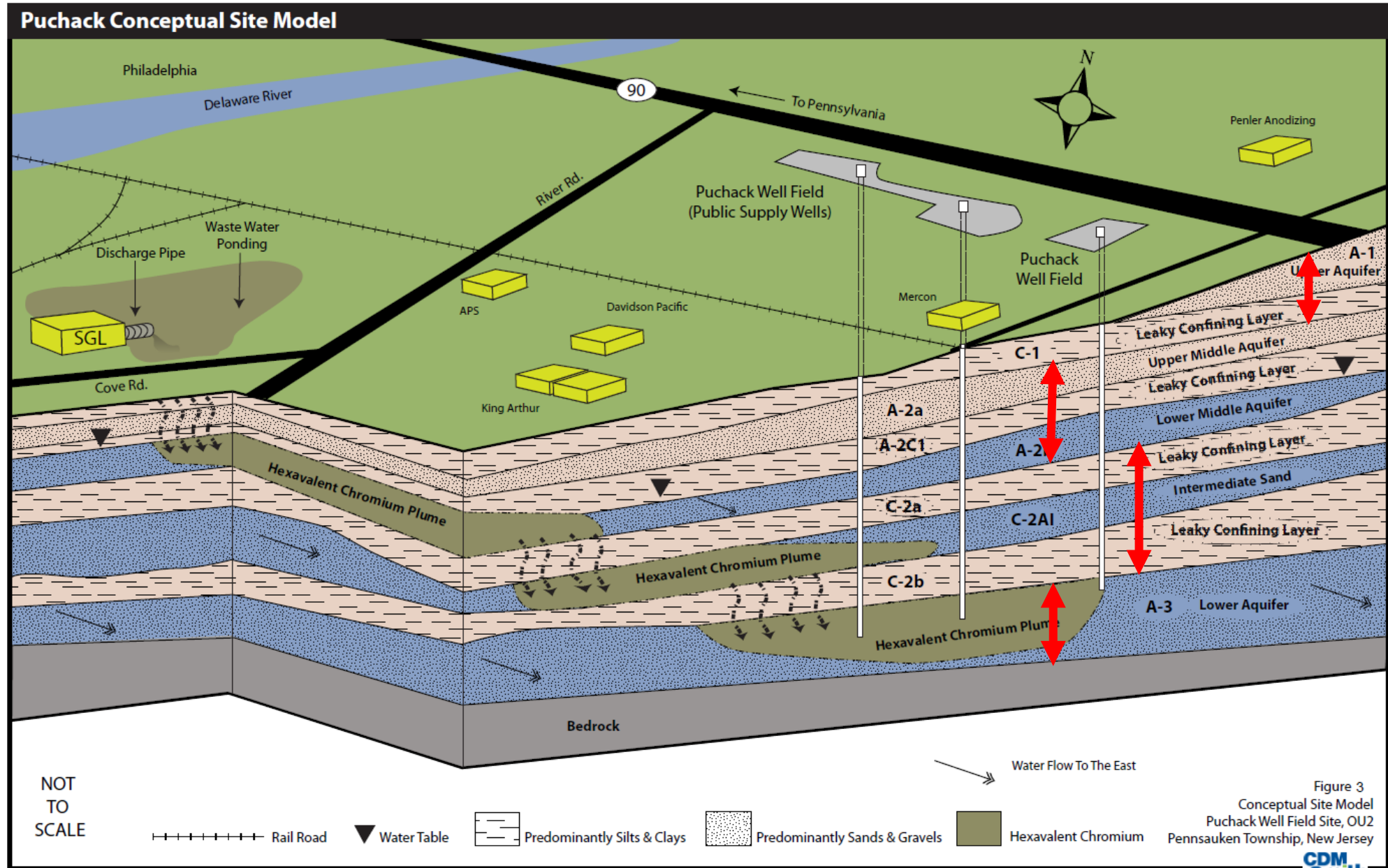
Model in Leapfrog

PREVIOUSLY DESCRIBED FRAMEWORK	USGS Model
UPPERAQUIFER	AQUIFER(A-1)
UPPER/MIDDLE CONFINING UNIT	CONFINING UNIT (C-1)
MIDDLE AQUIFER	UPPERSAND (A-2a)
	INTERBEDDED CONFINING UNIT (A-2C1)
	LOWERSAND (A-2b)
MIDDLE/LOWER CONFINING UNIT	UPPER CONFINING UNIT (C-2a)
	INTERMEDIATE SAND (C-2a1)
	LOWER CONFINING UNIT (C-2b)
LOWERAQUIFER	UPPER ZONE (A-3a)
	MIDDLE ZONE (A-3b)
	LOWER ZONE (A-3c)
LOWER CONFINING UNIT	CLAY OR BEDROCK BASAL CONFINING UNIT (C-3)



ESS Model

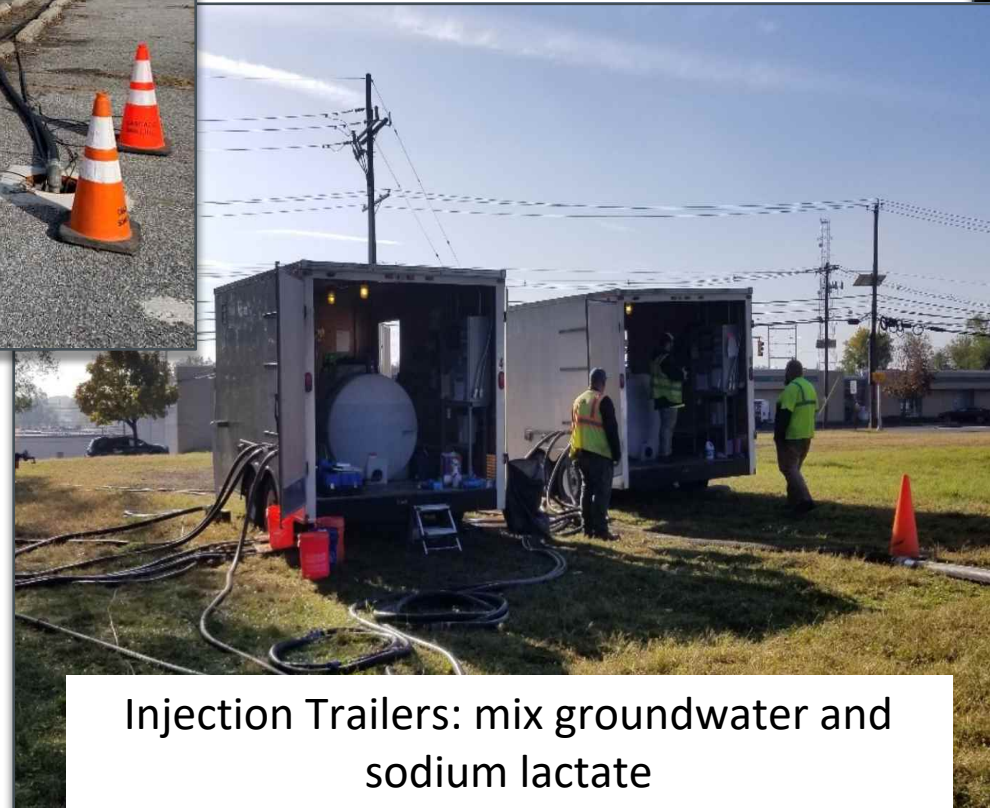
CSM Development at Puchack: Lithostratigraphic Model



In Situ Treatment - Geochemical Fixation



Extraction Well



Injection Trailers: mix groundwater and sodium lactate



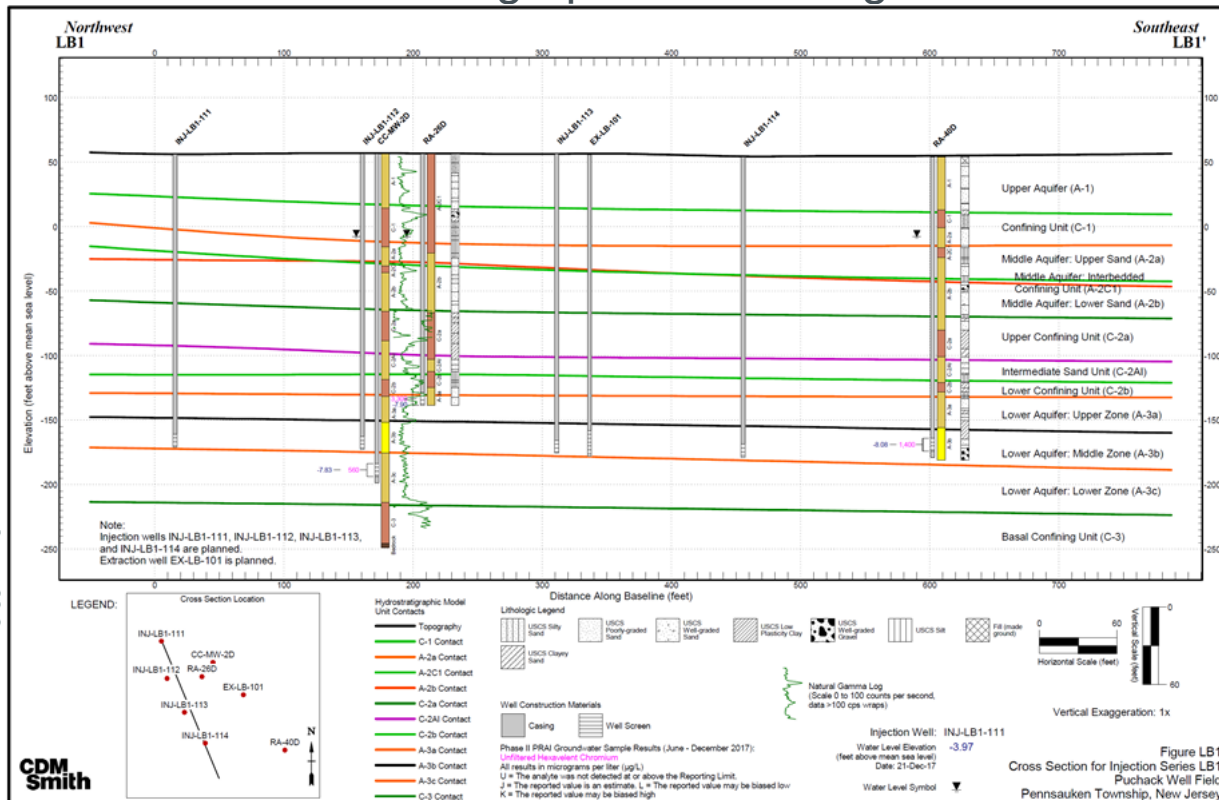
Injection Well

Geologic Model Development

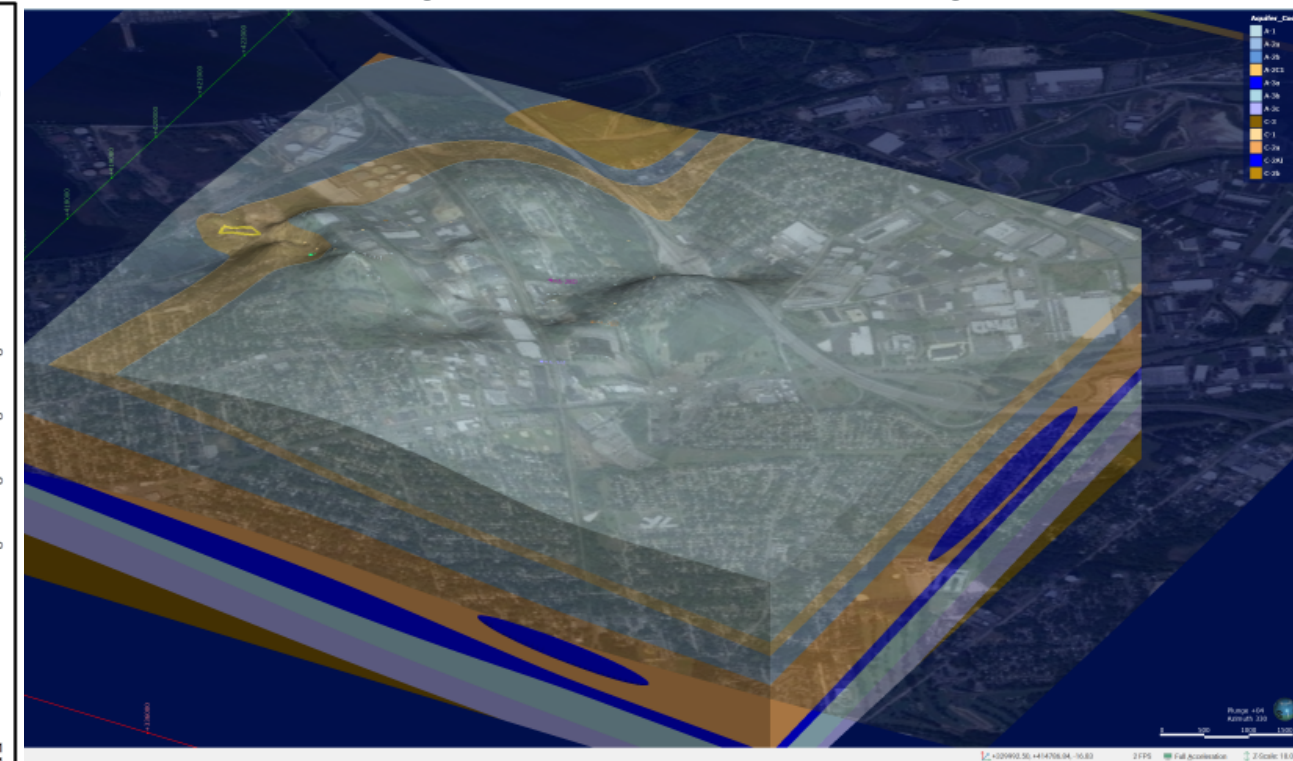
- Phase I Remedial Action (2007-2013): data were input into gINT but evaluation in cross section was done on paper.

- Phase II Remedial Action (2017-2022): use geologic data in gINT to develop model in Leapfrog, gINT cross sections

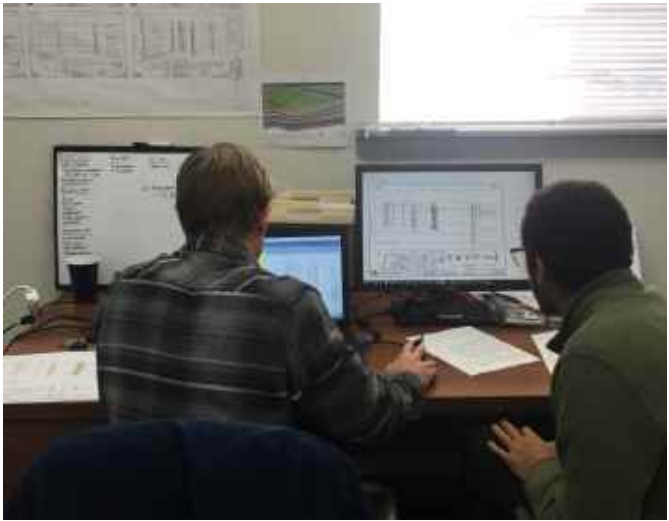
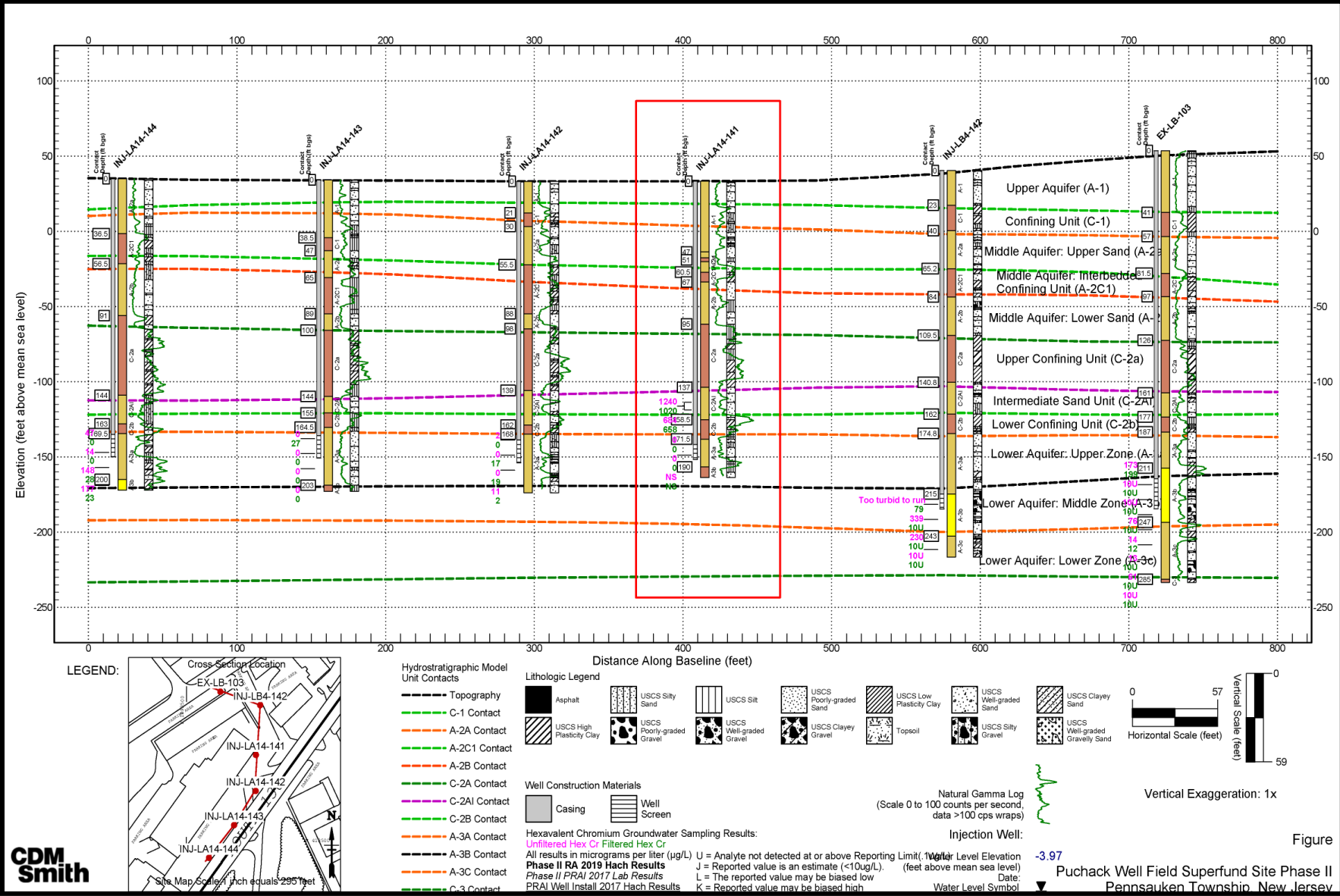
Lithostratigraphic Model in gINT



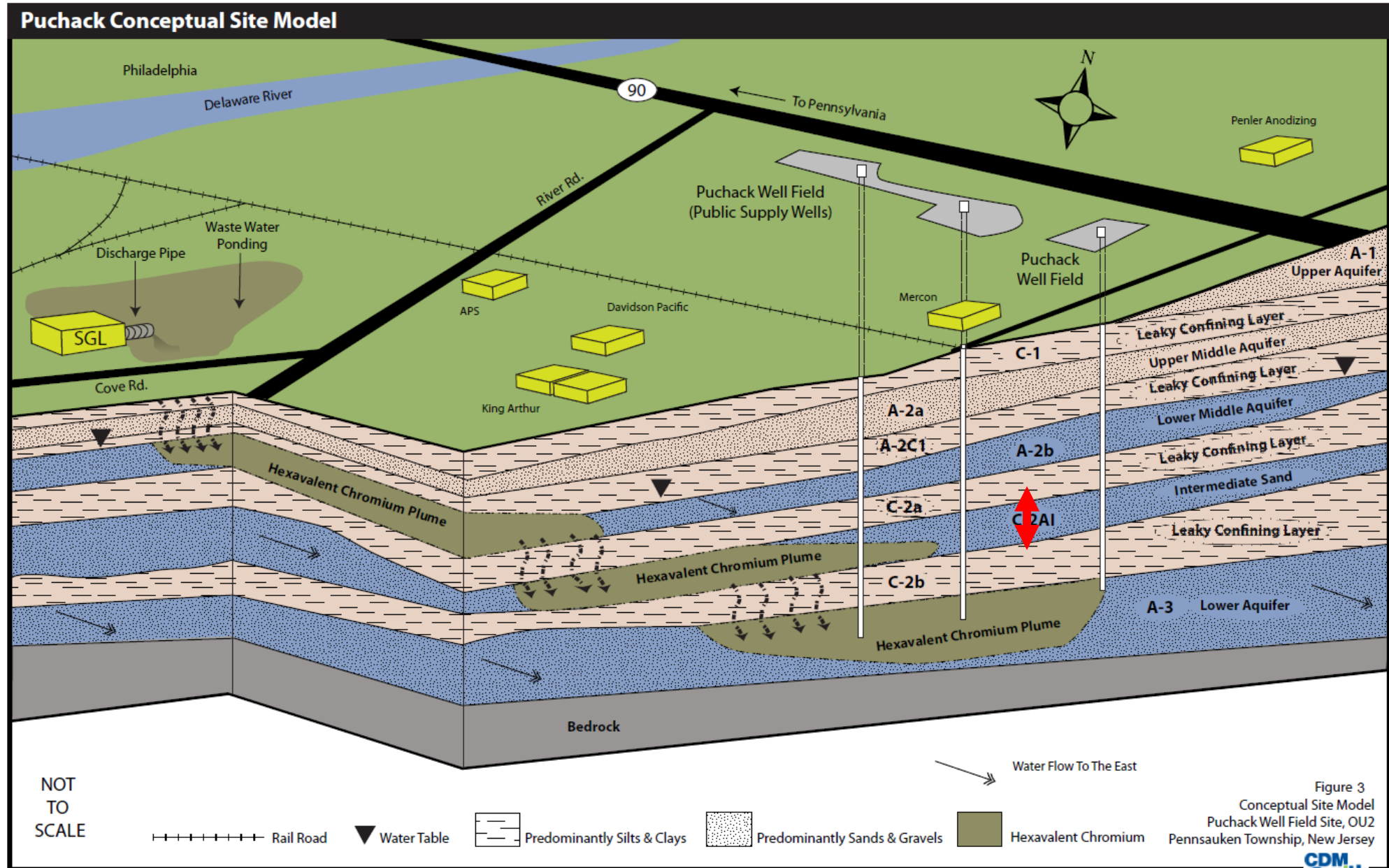
Lithostratigraphic Model in Leapfrog Works



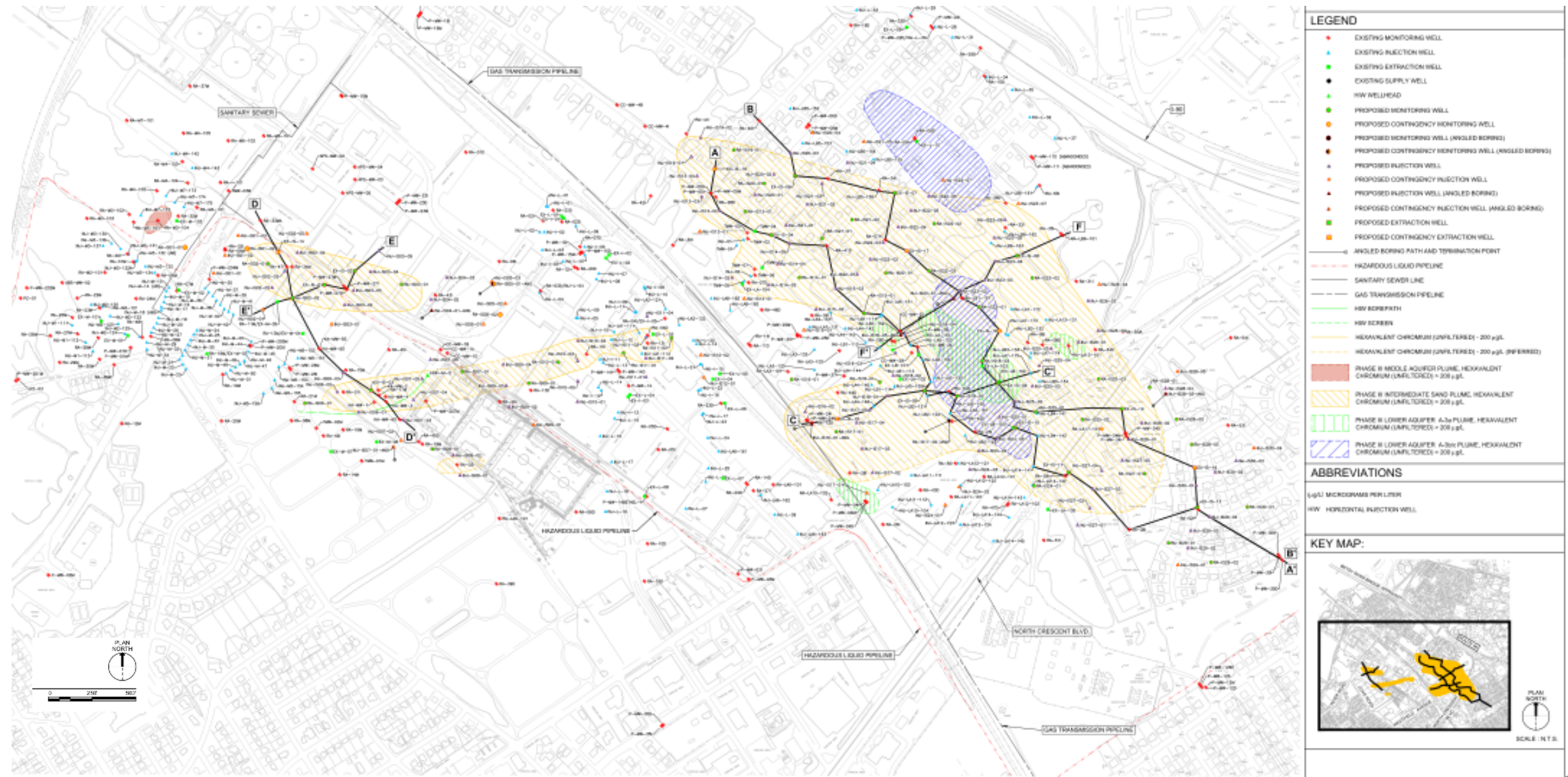
Real Time Data Collection, Compilation, and Analysis



Lithostratigraphic CSM



Intermediate Sand Chromium Plume

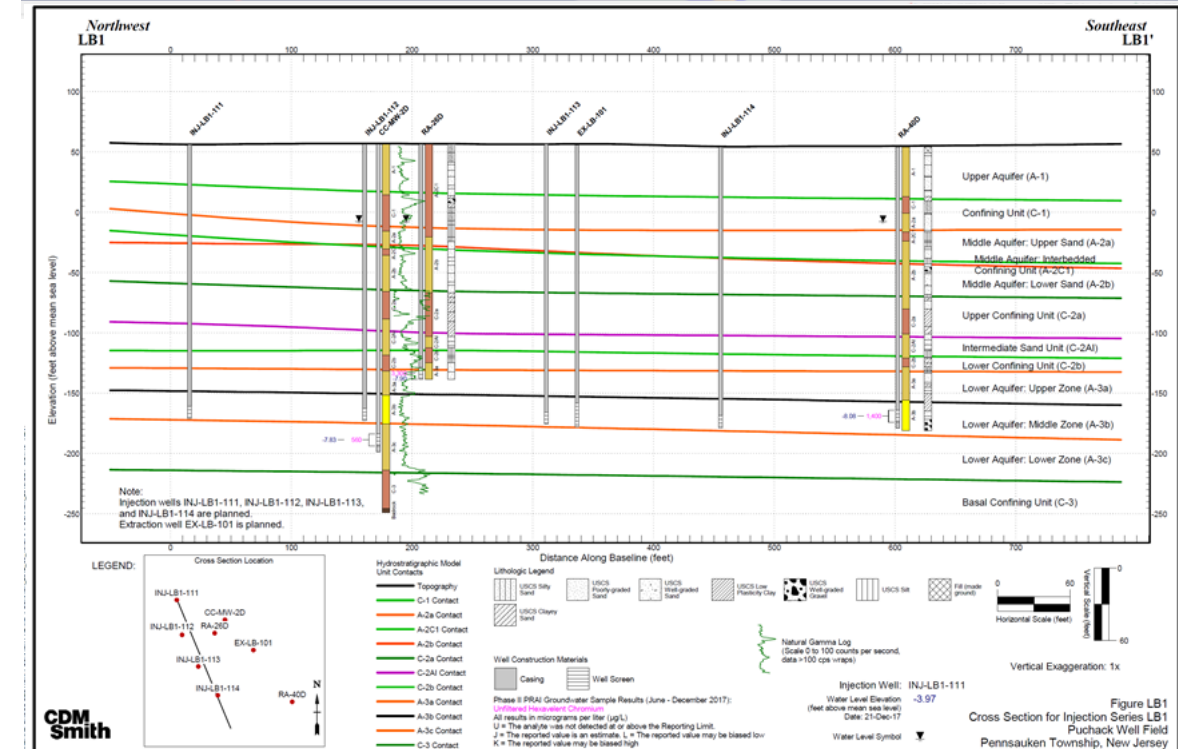
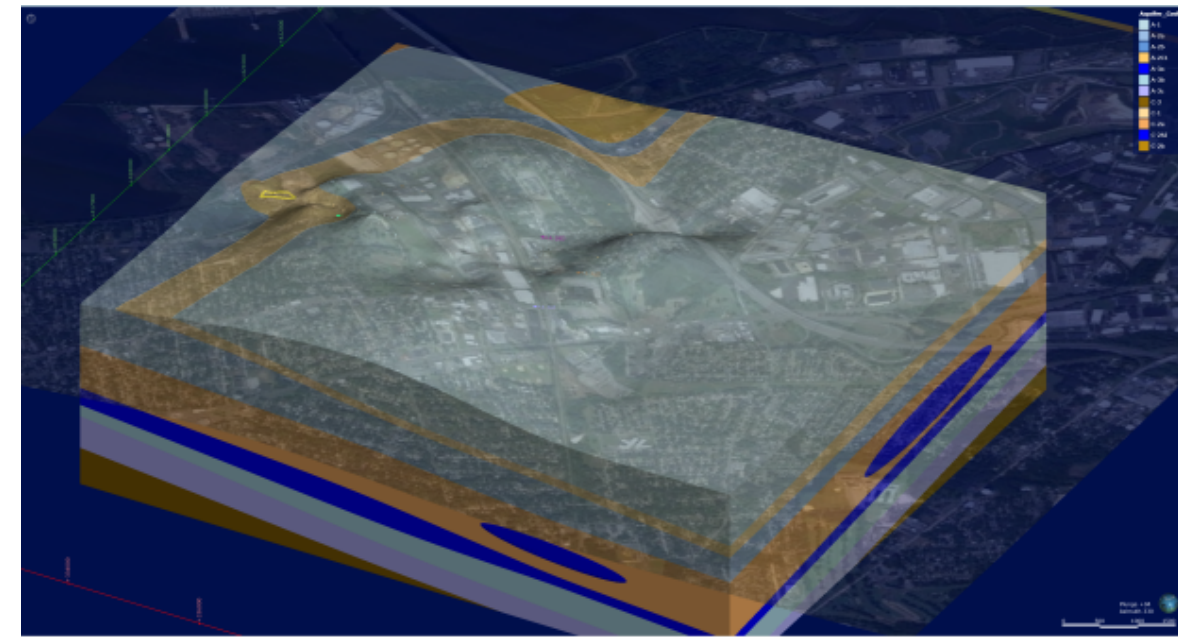


CSM Update Process

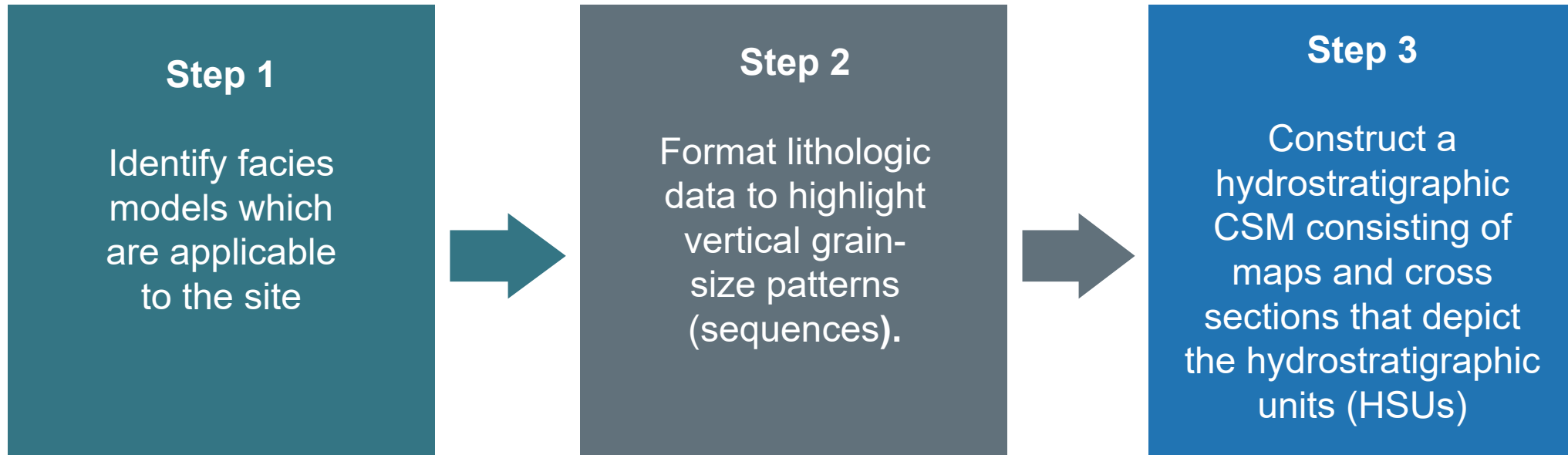
Incorporate HSUs, natural gamma log, and grain size logs (GSLs) from 211 borings completed during Phase 2.

Update the CSM in Leapfrog Works software, export HSU surfaces to gINT and groundwater flow model.

Apply Environmental Sequence Stratigraphy (ESS) principles per “Lesson Learned”.



CSM Update: Applying ESS



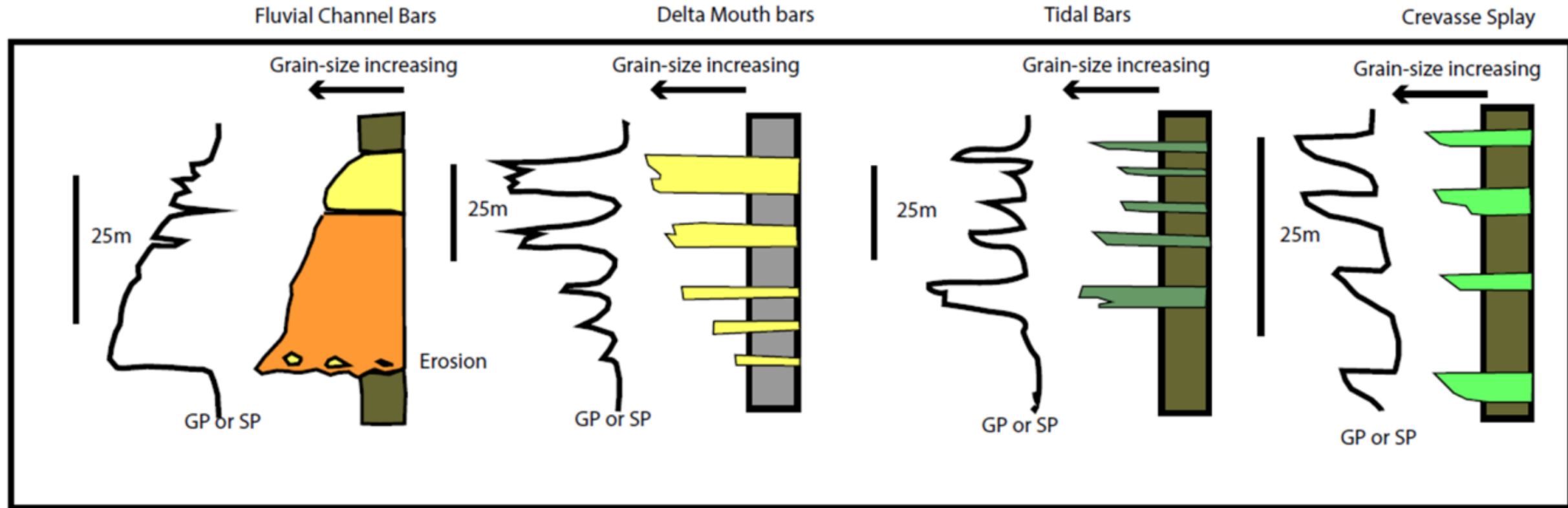
Groundwater Issue

Best Practices for Environmental Site Management: A Practical Guide for Applying Environmental Sequence Stratigraphy to Improve Conceptual Site Models

Michael R. Shultz¹, Richard S. Cramer¹, Colin Plank¹, Herb Levine², Kenneth D. Ehman³

Schultz, et al. (2017)

Step 1: Identify Facies Models



From Sadeque (2019)

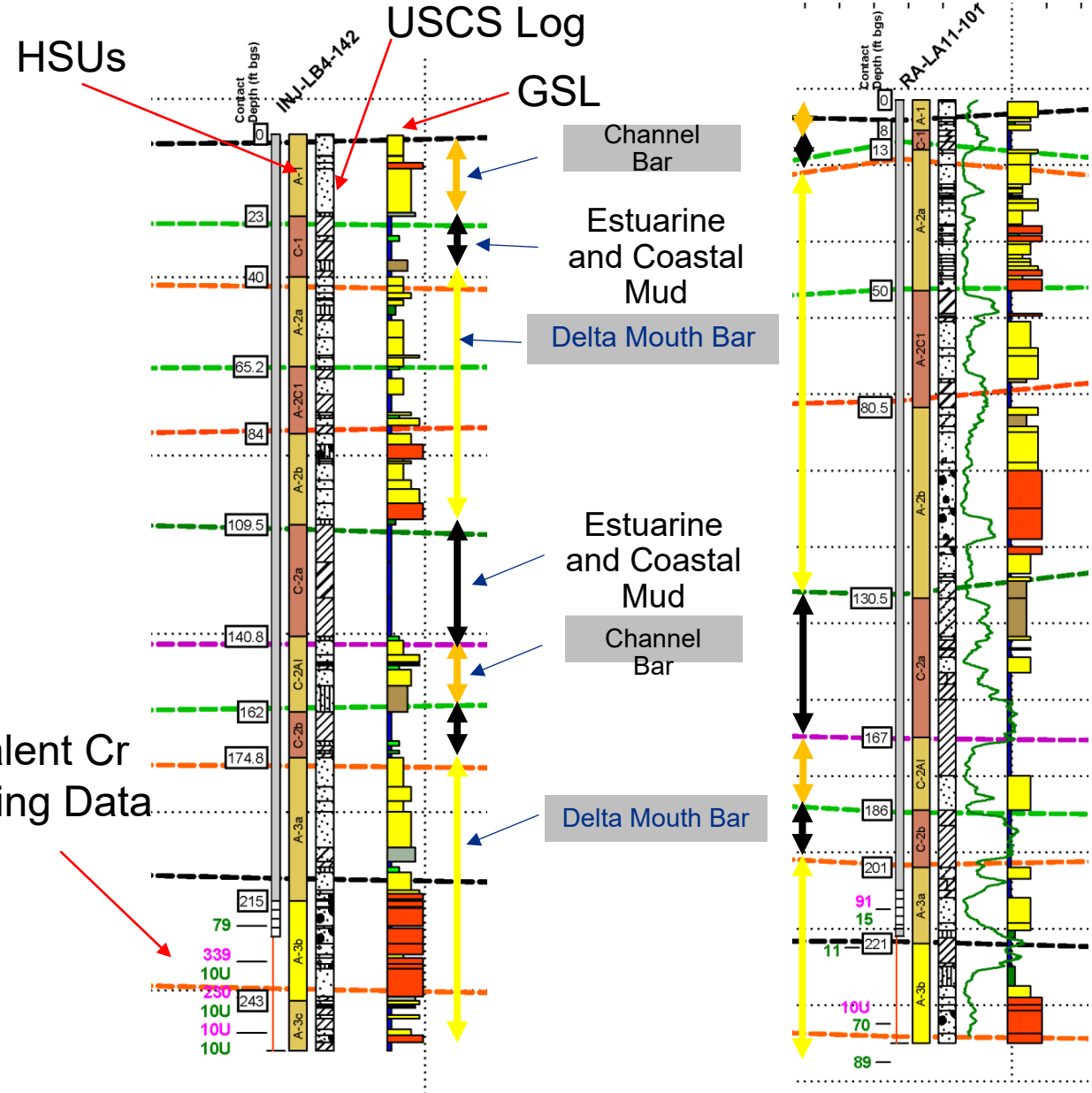
Step 2: Grain Size Log

- GSLs used to quickly identify and review HSUs
- GSLs allow quick interpretation of patterns within the boring
- Used to determine sequences with and without natural gamma logs

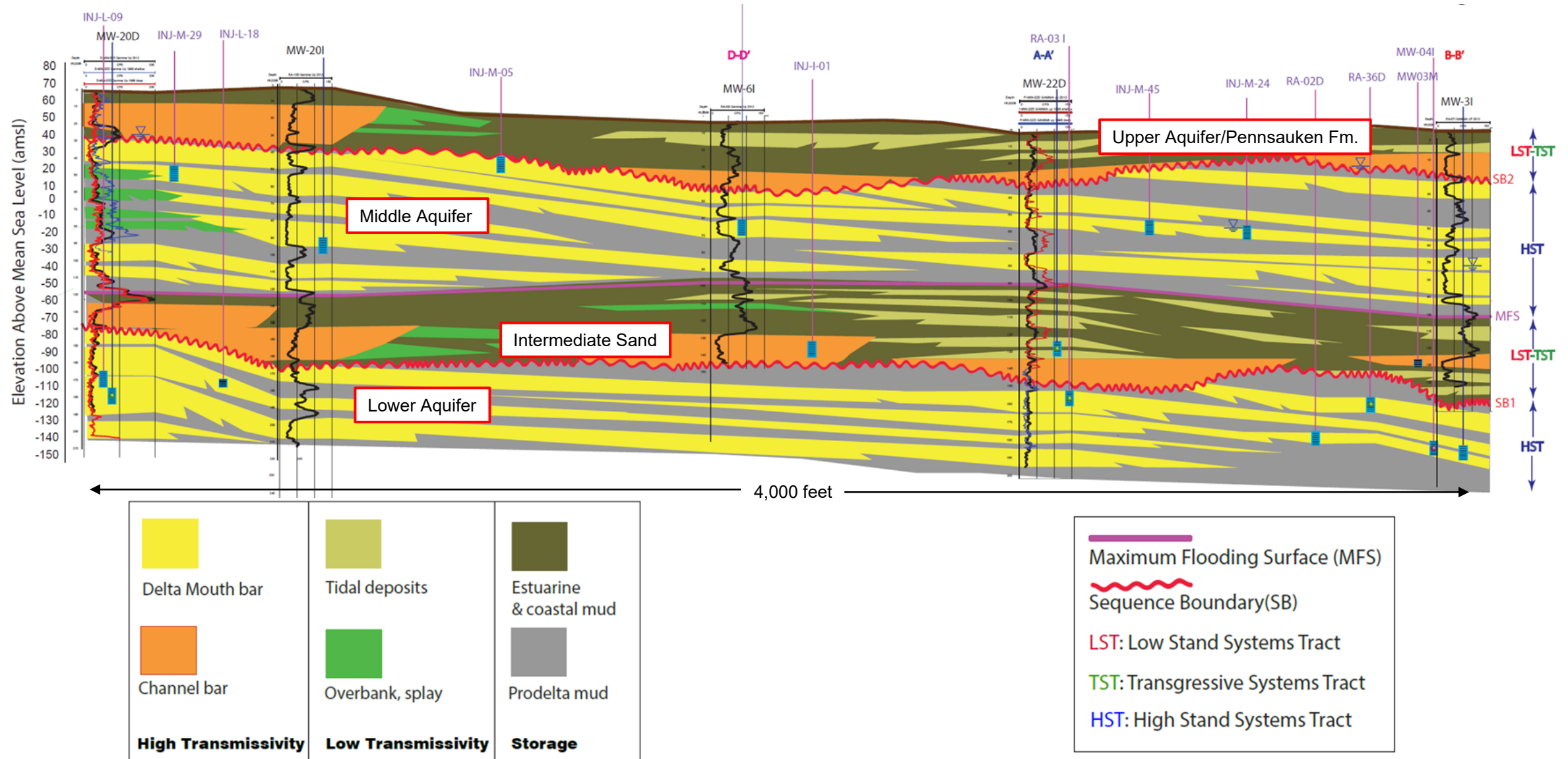
GSL Legend



Hexavalent Cr Screening Data

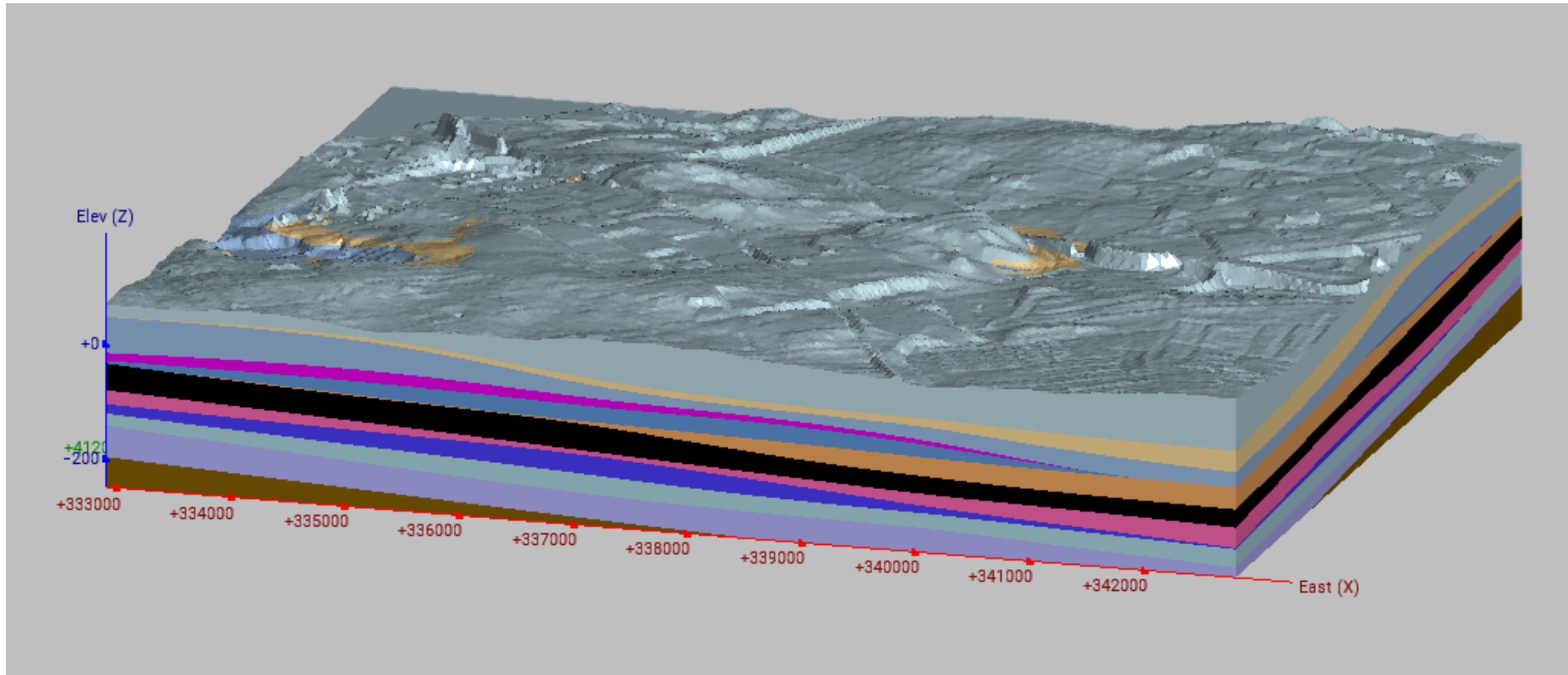


Step 3: Cross Section with ESS Interpretation

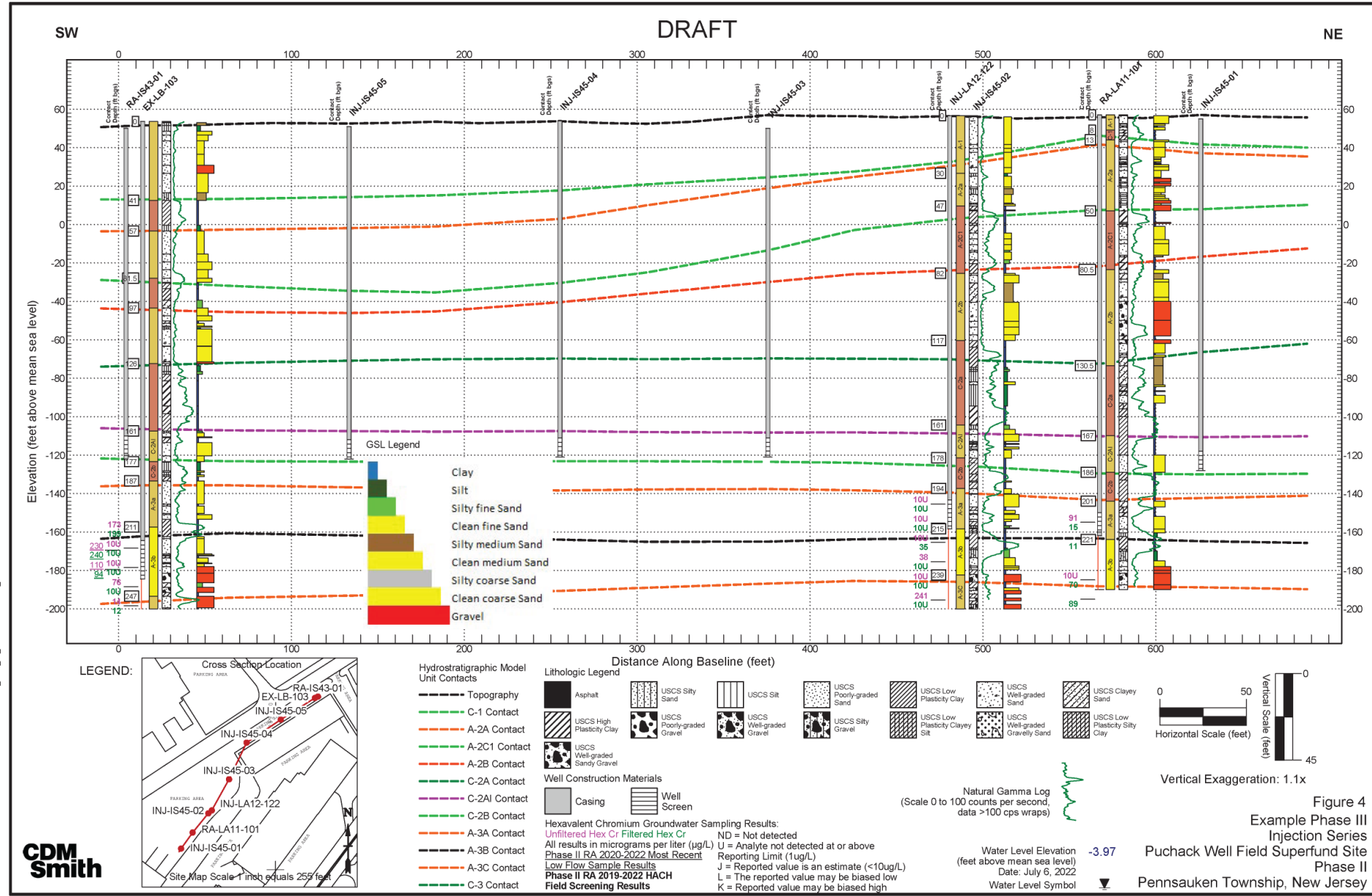


Base cross section from Sadeque (2019)

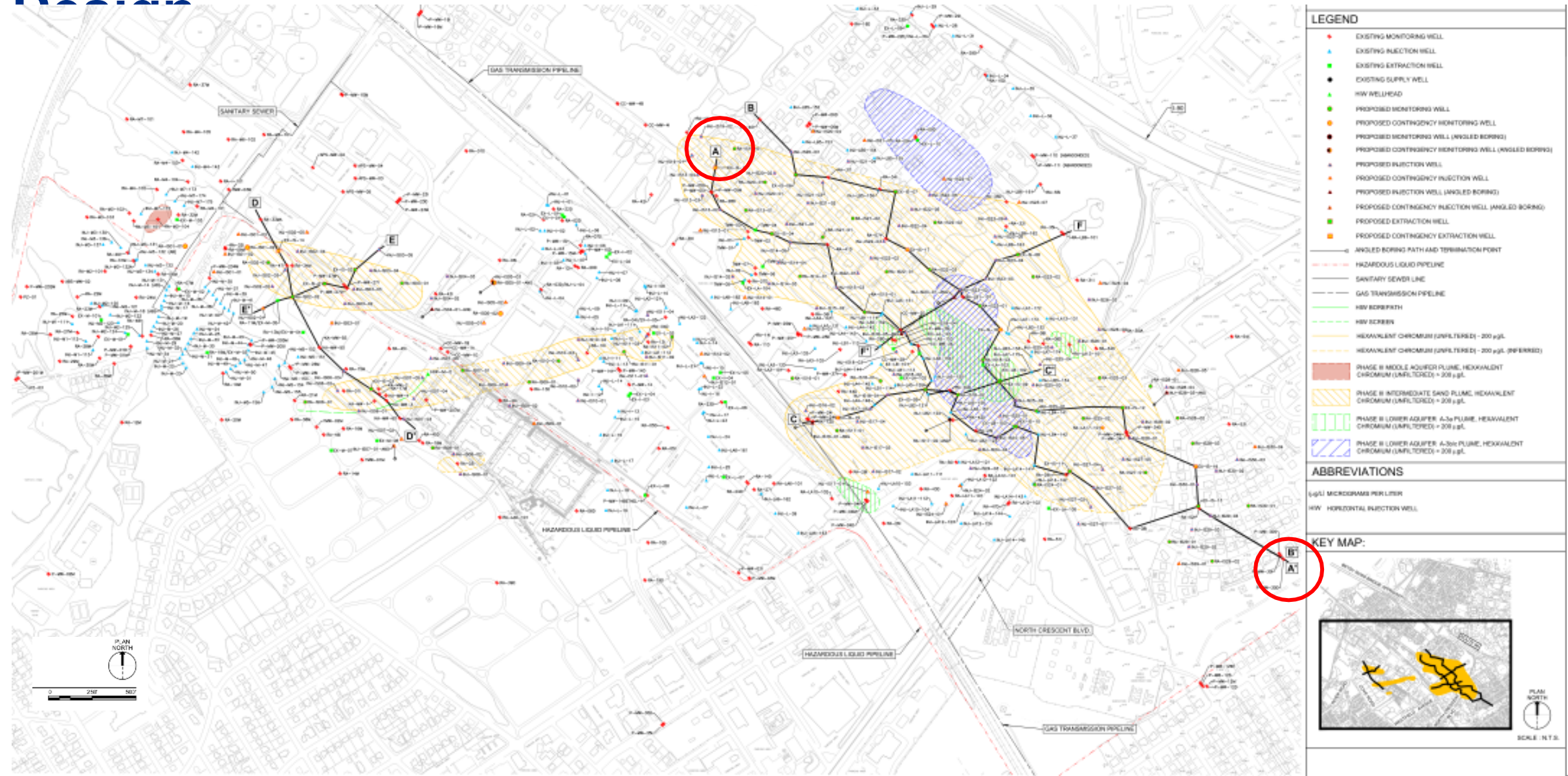
Updated Geologic Model in Leapfrog



Model Surfaces: Export from Leapfrog, Import into gINT



Cross Sections Developed to Apply ESS to Phase 3 Well Region



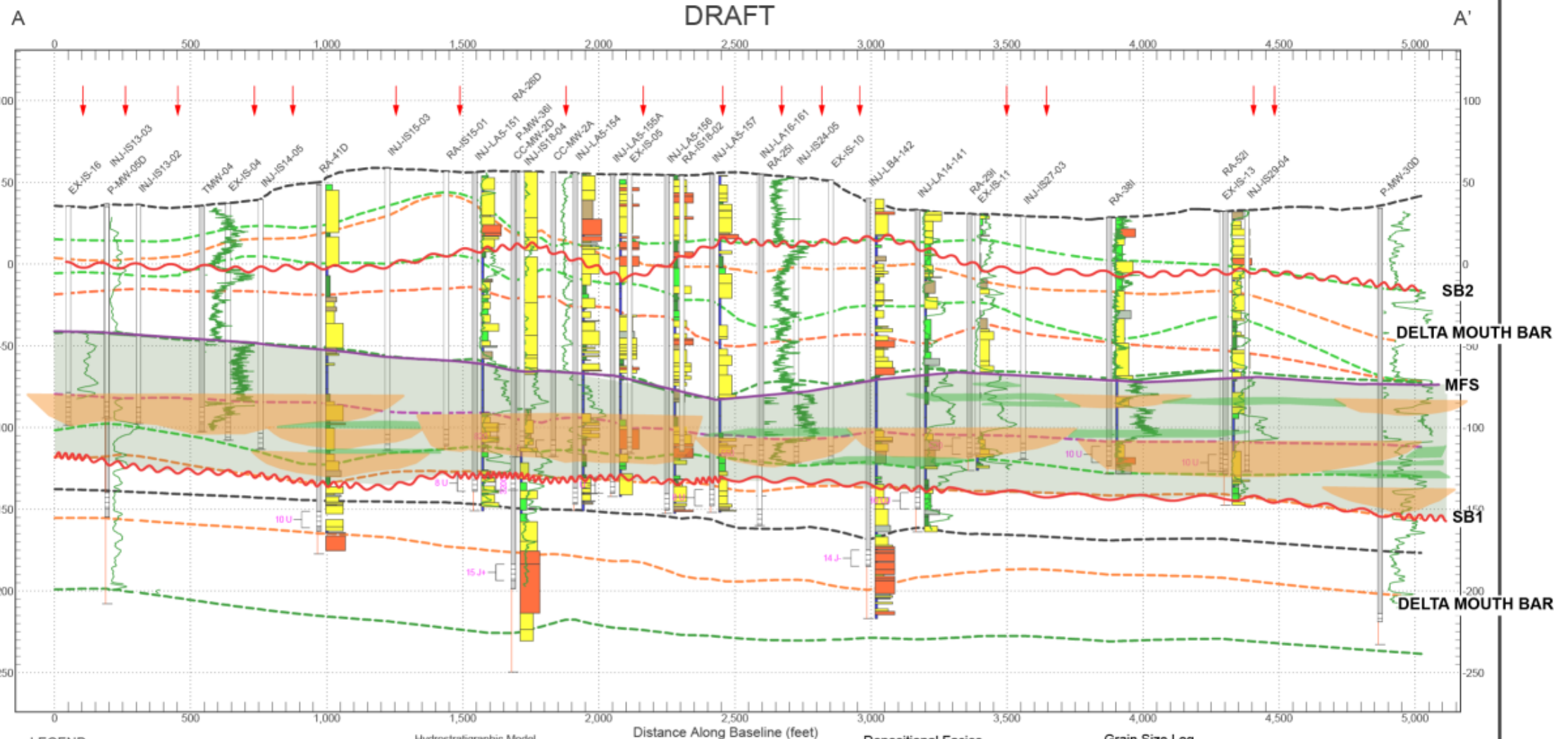
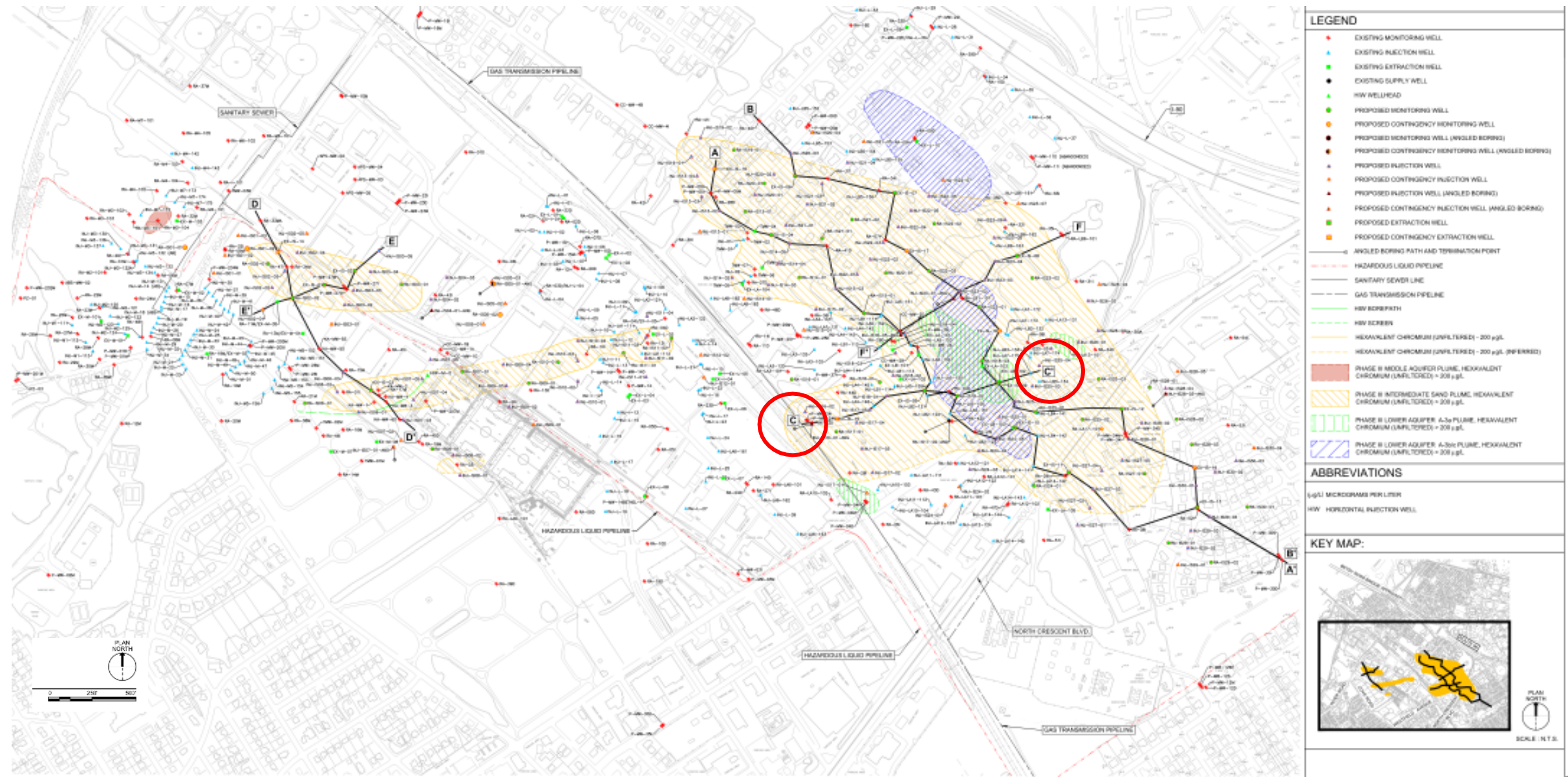
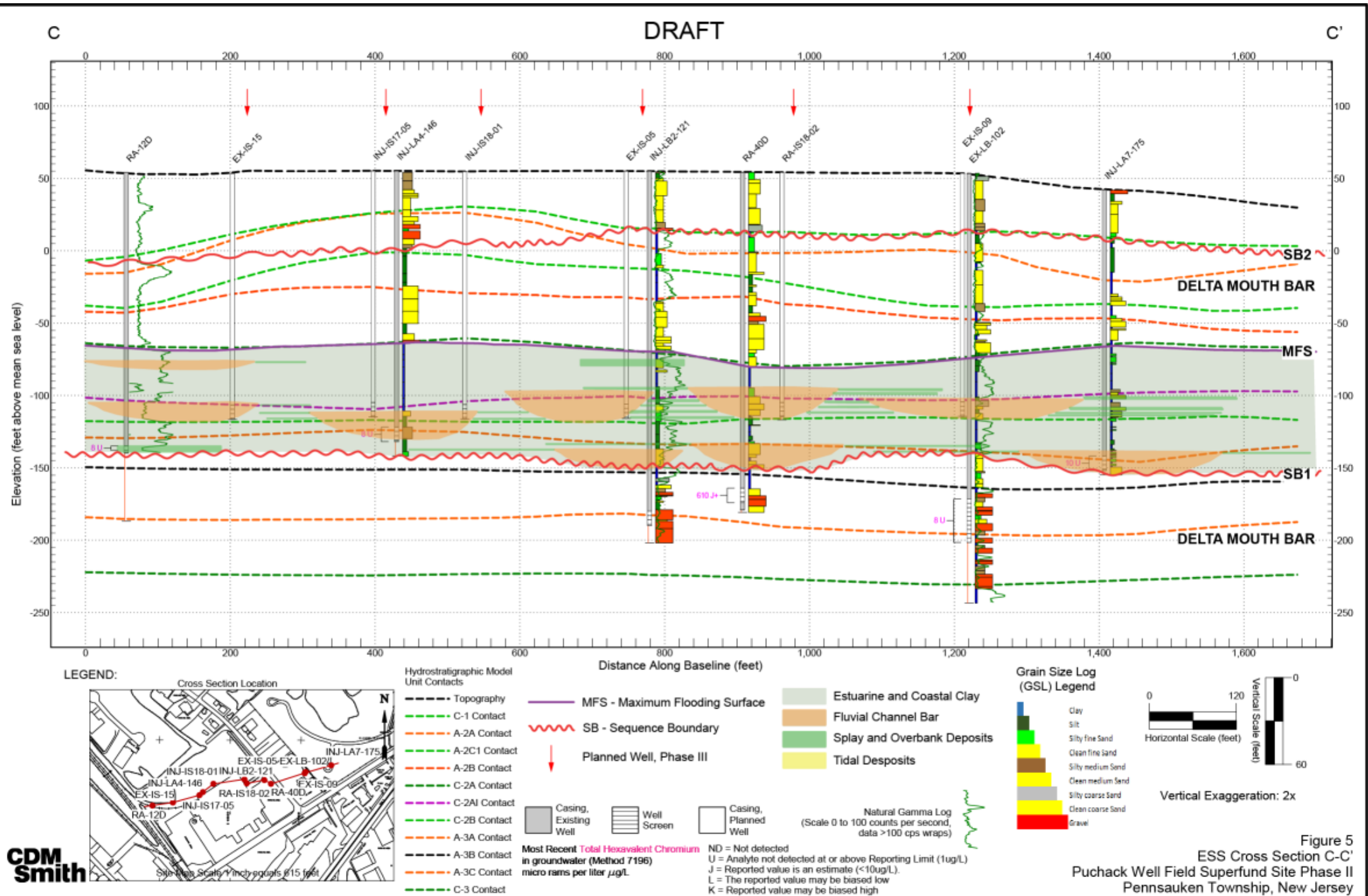


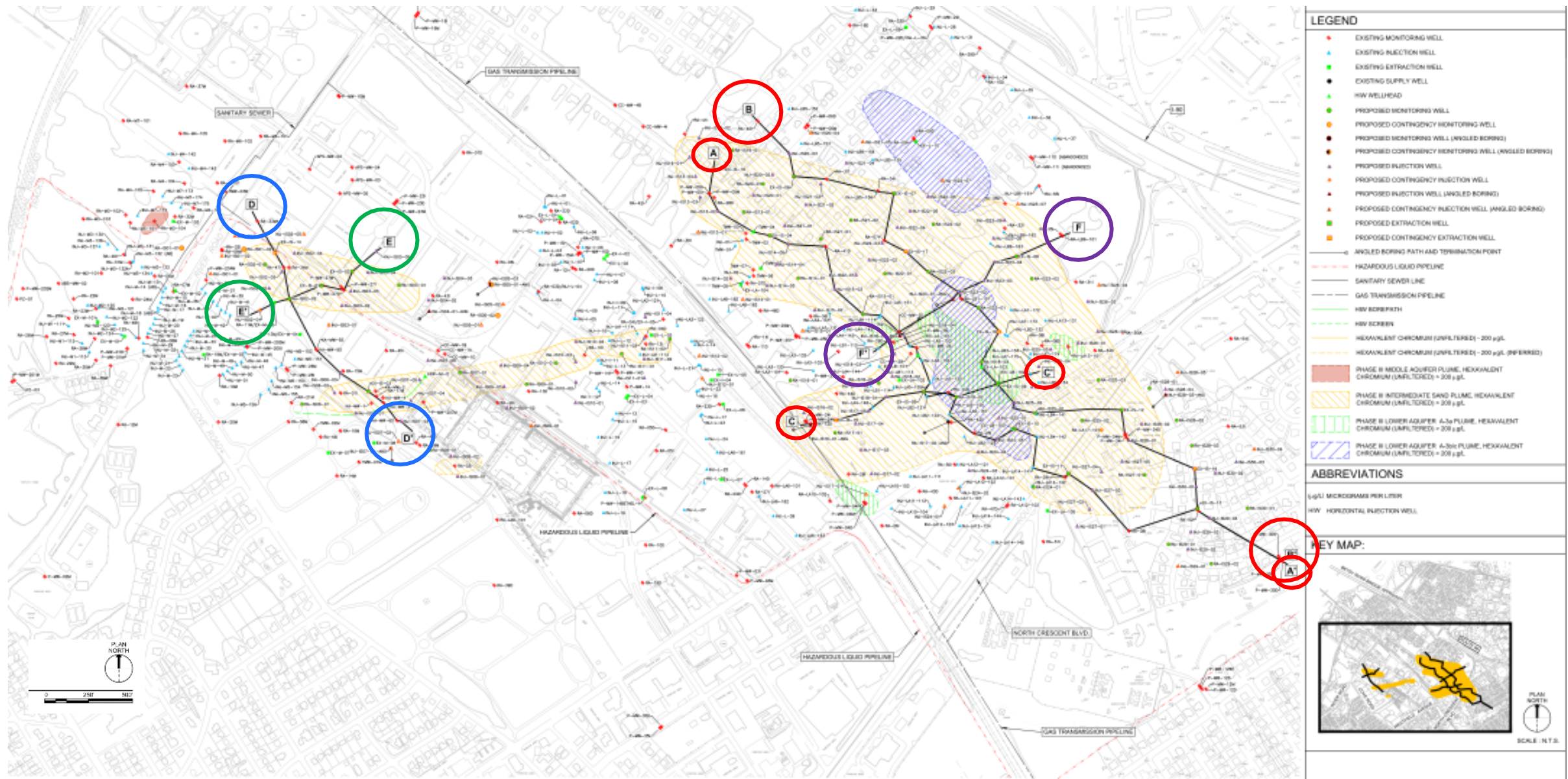
Figure 3
ESS Cross Section A-A'
Puchack Well Field Superfund Site Phase II
Pennsauken Township, New Jersey

Cross Section C





A Total Six Cross Sections Were Developed



ESS Cross Sections in Leapfrog



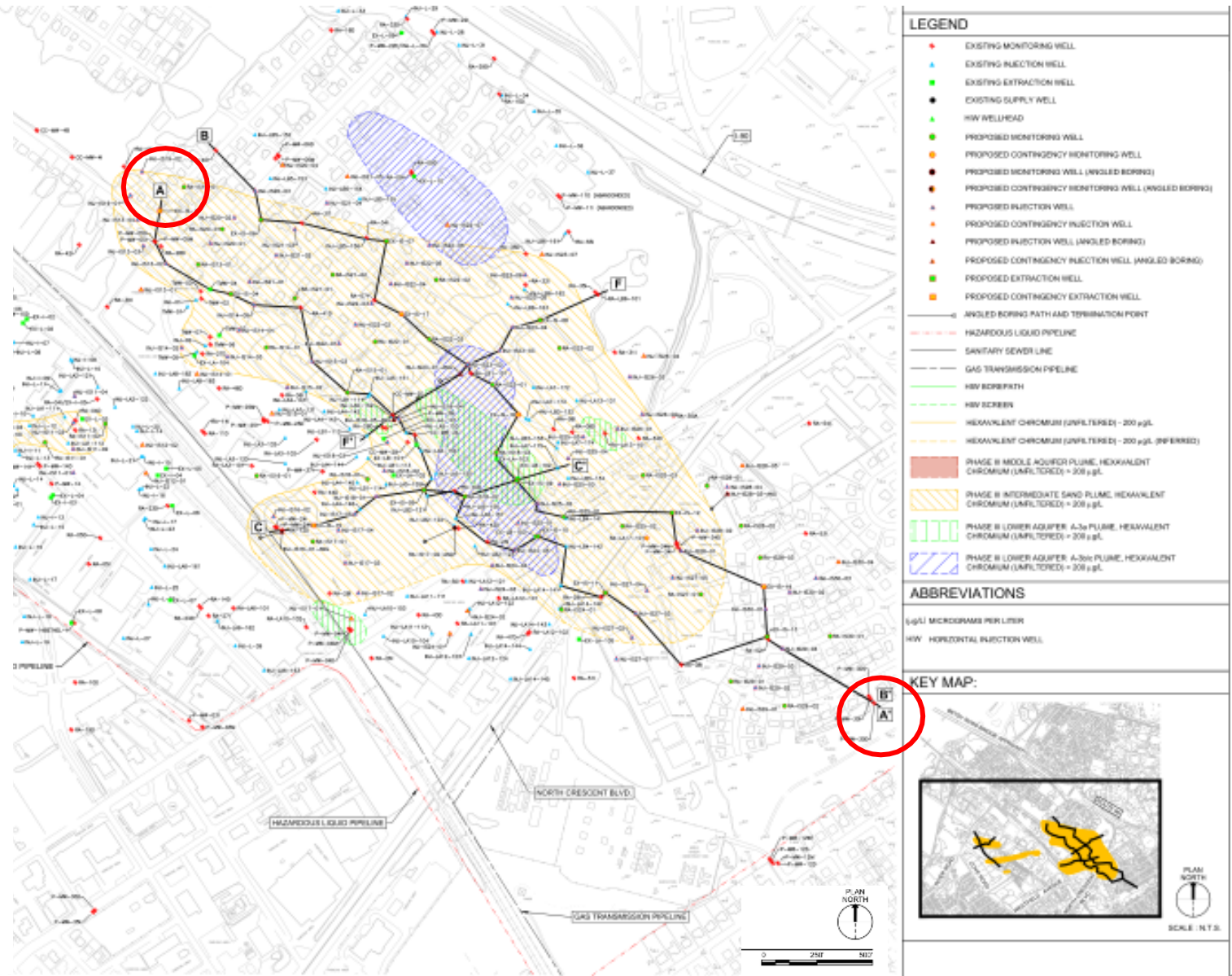
ESS Analysis: Scope

215 wells planned for installation during Phase 3

- 20 extraction wells (19 in the Intermediate Sand)
- 142 injection wells (125 in the Intermediate Sand)
- 53 monitoring wells (43 in the Intermediate Sand)

60 wells (28%) were included in at least one ESS cross section

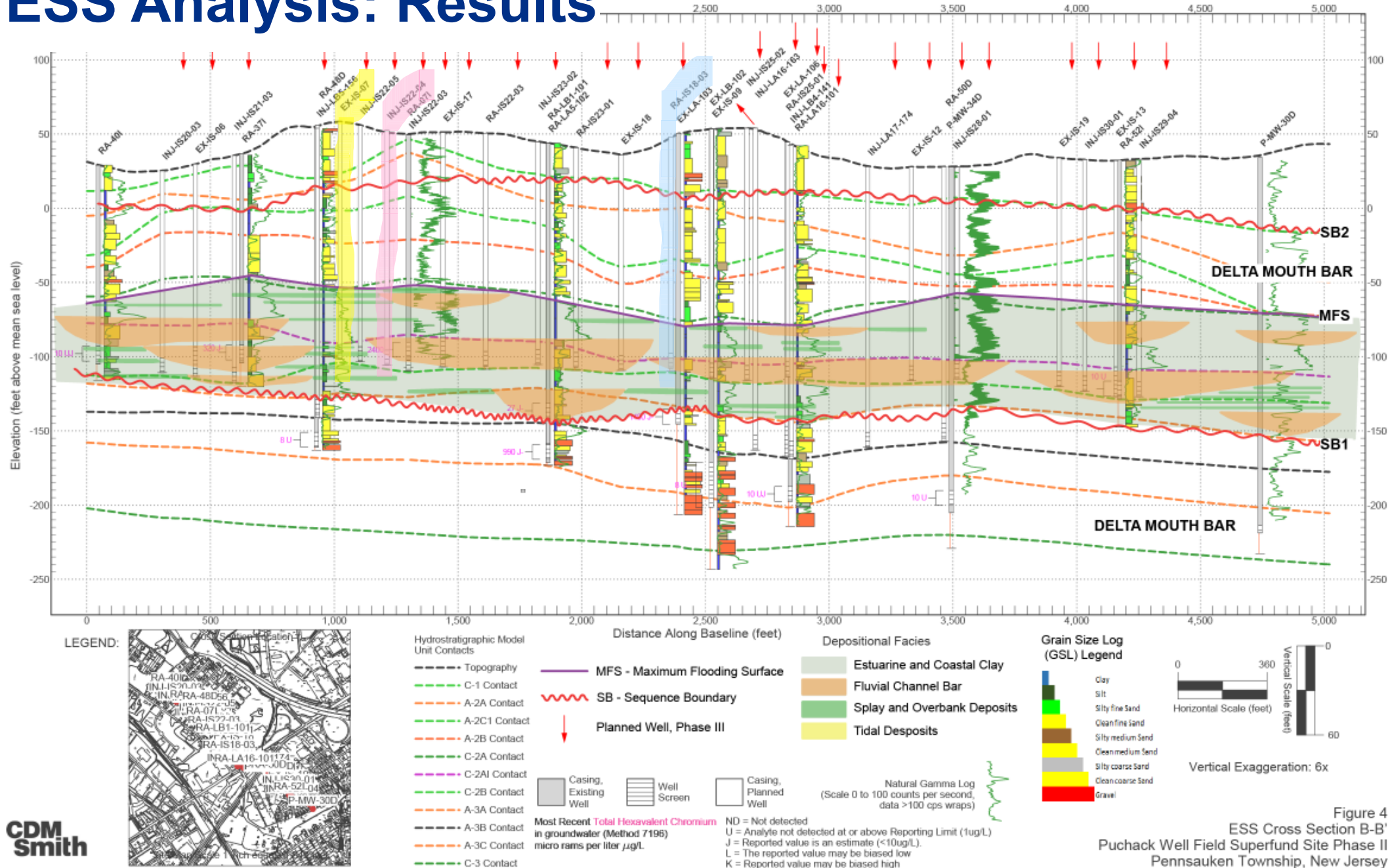
- 20 extraction wells (100%)
- 29 injection wells (20%)
- 11 monitoring wells (21%)



ESS Analysis: Results

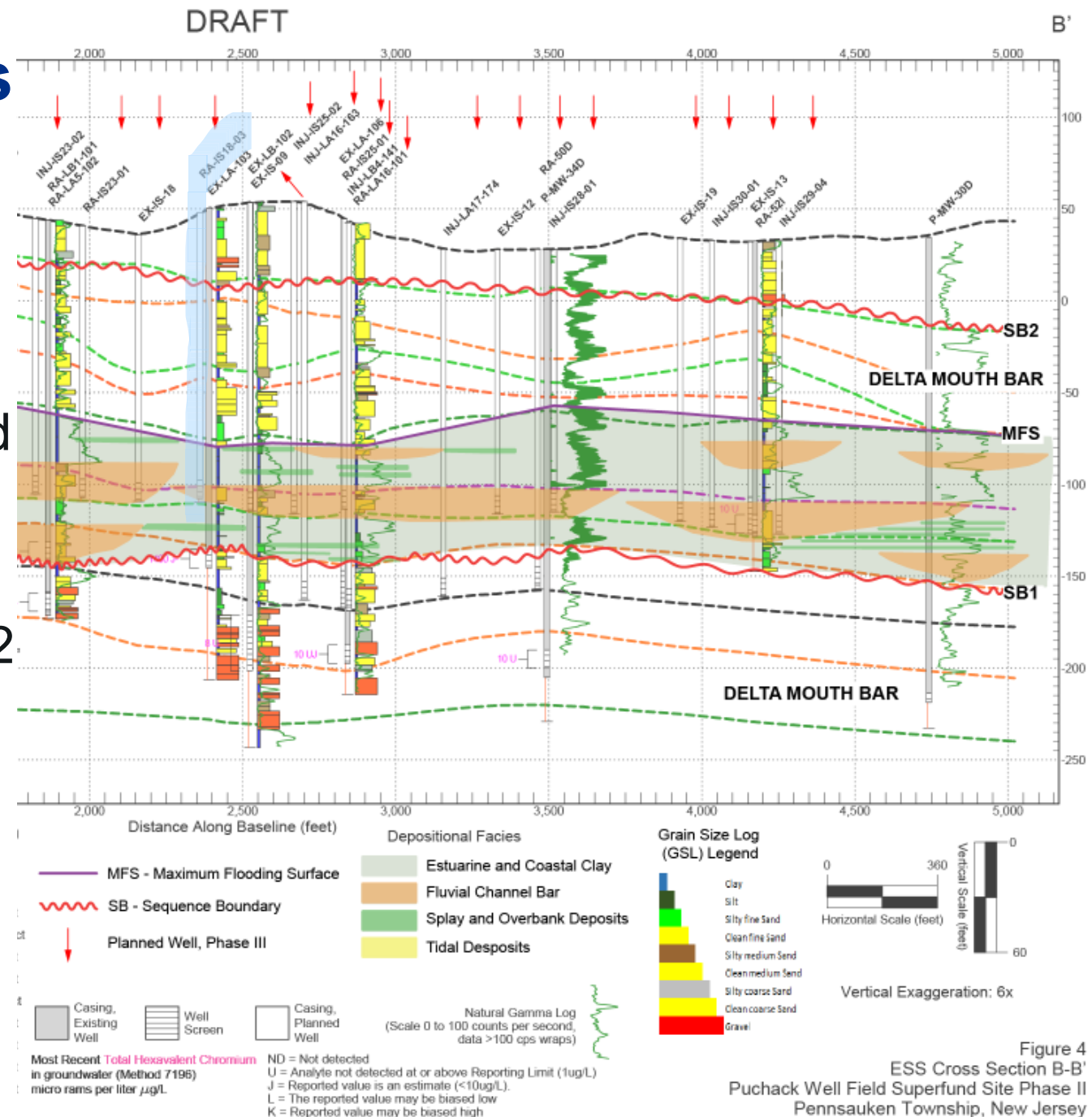
DRAFT

B'



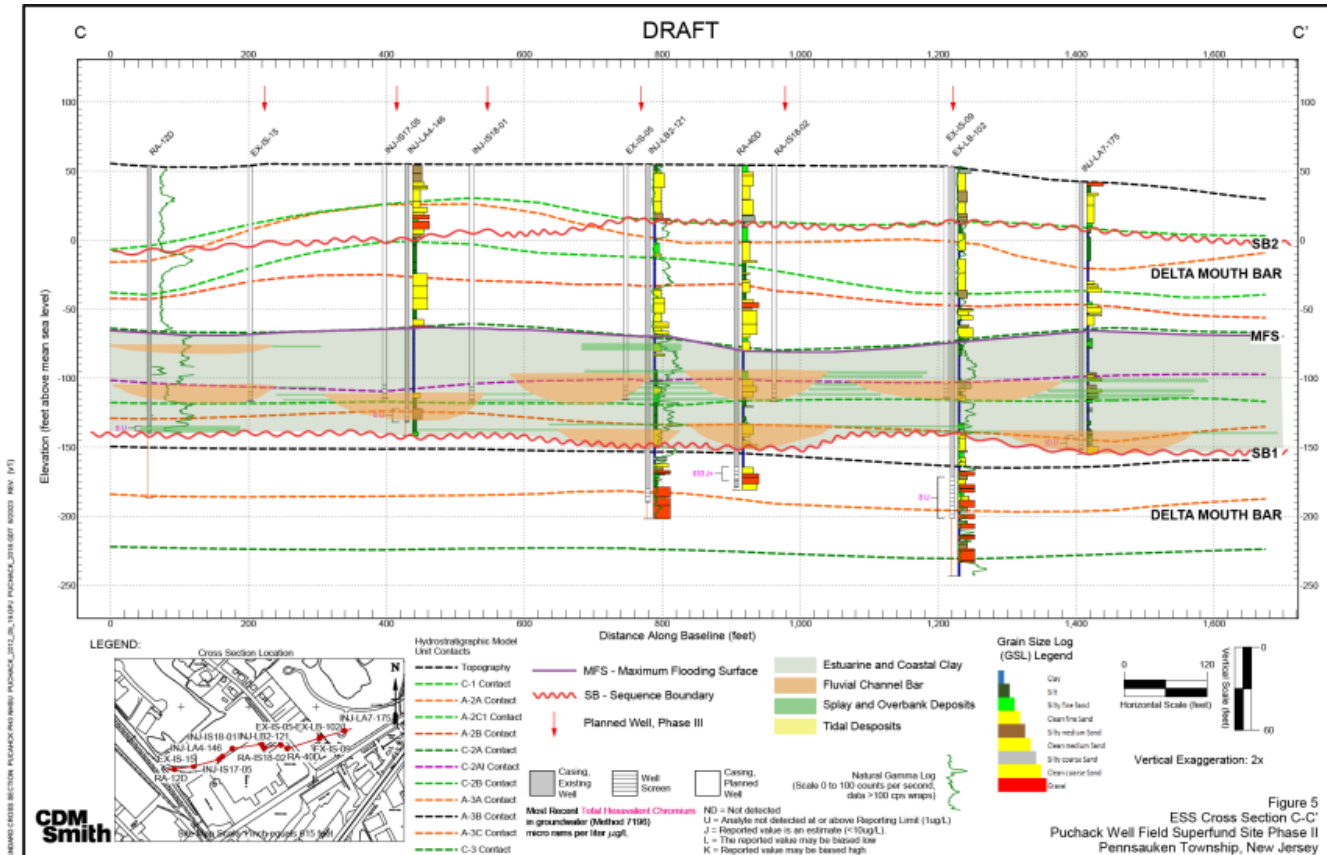
ESS Analysis: Results

- Screened zone depositional facies of 60 (28%) out of a projected 215 wells were evaluated.
- Six wells (10%) are projected to be screened in estuarine or coastal clay
- Results suggest that 21 or 22 wells, 10% of planned wells, are likely screened in estuarine or coastal clay and may need to be relocated (if screening the well in a high transmissivity unit is a priority).



Takeaways Regarding the Application of ESS to CSM Development

- ESS provides a more realistic geologic model consistent with basic principles
- ESS improved the CSM by allowing us to fill in the space between borings with a realistic geologic model
- Using it to better plan extraction and injection well screen locations
- More cost-effective characterization and remediation



Thank you!



To learn more, contact:

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List of References

Sadeque, Junaid. 2019. *Technical Memorandum: Environmental Sequence Stratigraphy for the Puchack Well Field Superfund Site Camden, New Jersey*. Project File 60590332. Dallas, Texas: AECOM. EP-W-14-001 (EPA OSRTI Technical Assessment Support, Outreach and Training)

Shultz, Michael, R., Richard S. Cramer, Colin Plank, Herb Levine, and Kenneth D. Ehman. *Best Practices for Environmental Site Management: A Practical Guide for Applying Environmental Sequence Stratigraphy to Improve Conceptual Site Models*. USEPA: Fairfax, VA. EPA/600/R-17/293.