ARDP Dow Site Subsurface Investigations Approach

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Agenda

- Proposed Groundwater Investigations
- Proposed Geology, Geotechnical, and Seismic Investigations

Objectives:

- NRC Staff feedback on hydrological and geotechnical approaches

Proposed Groundwater Investigations

Regulatory Requirements and Guidance: Groundwater

Environmental Report

- 10 CFR Part 51.45 Environmental Report
- NUREG 1555, Regulatory Guide (RG) 4.2, Rev 3
    - Evaluate the effects of station building and operation on water resources
        - Hydrology
        - Water Use
        - Water Quality
        - Radiological Environmental Monitoring Program (including REMP)

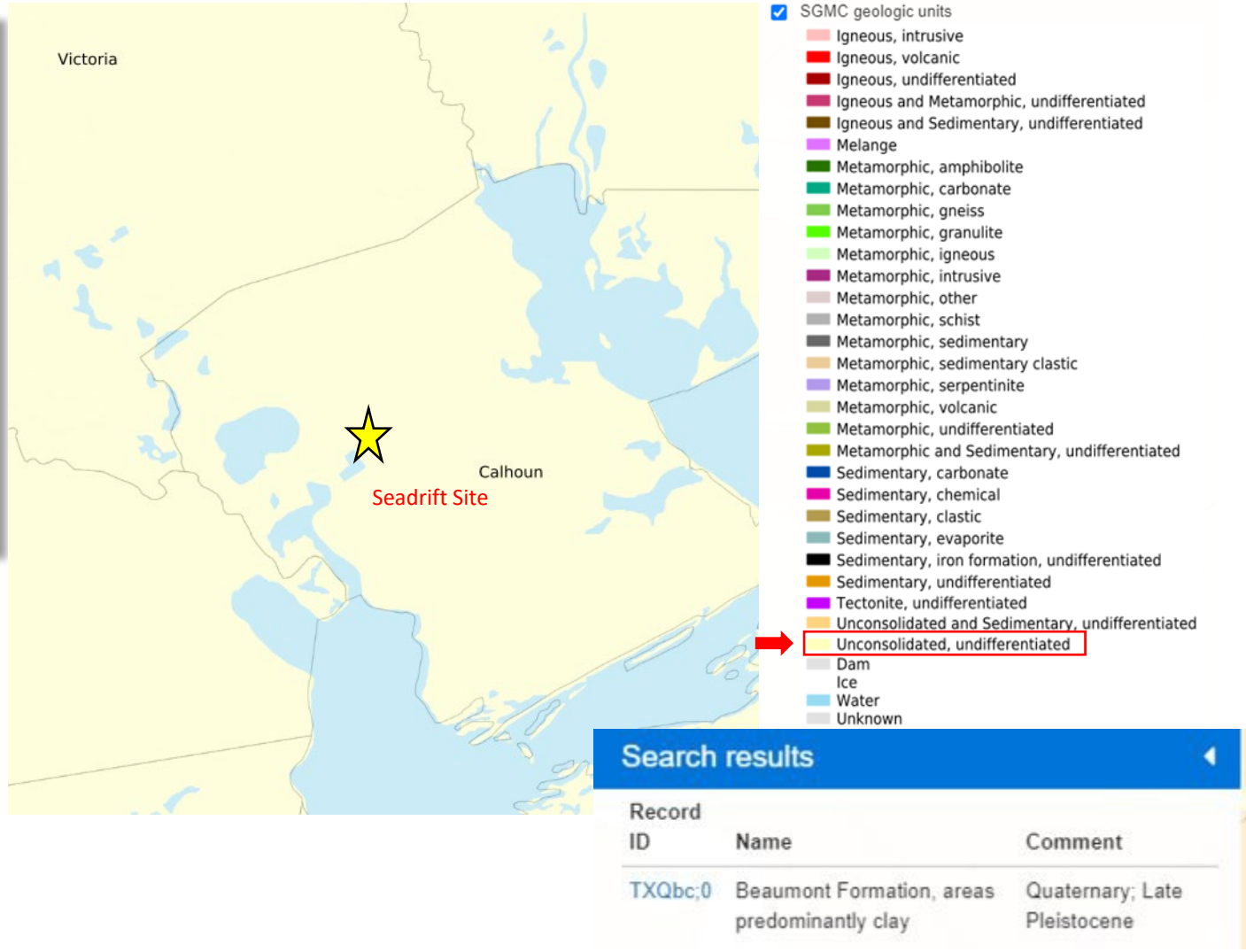
Safety Analysis Report

- 10 CFR 50.34, 10 CFR 100.20(c), 10 CFR 100.21(d)
- NUREG-0800, Chapter 2
    - Section 2.4.12 (hydrology, water use, parameters)
    - Section 2.4.13 (accidental release pathway analysis)
- DANU-ISG-2022-02, Advanced Reactor Content of Application Project (ARCAP), Chapter 2, “Site Information,” May 2023
    - Consistent with current guidance

Regional Stratigraphy

SYSTEM	SERIES	AGE m.y.	Victoria County Station		Approximate Thickness Undifferentiated (feet)	Approximate elevation of formation top (feet)
QUATERNARY	Holocene	0.10	Alluvium & Terrace Deposits	Undifferentiated Deweyville Terrace Deposits	0-50	
	Pleistocene	2		Beaumont Fm	400	0±
				Lissie Fm Willis Formation	600-700	-400
	Pliocene	5		Goliad sand	800 to 1,000	-1,000 to -1,100

Source: Victoria ESPA

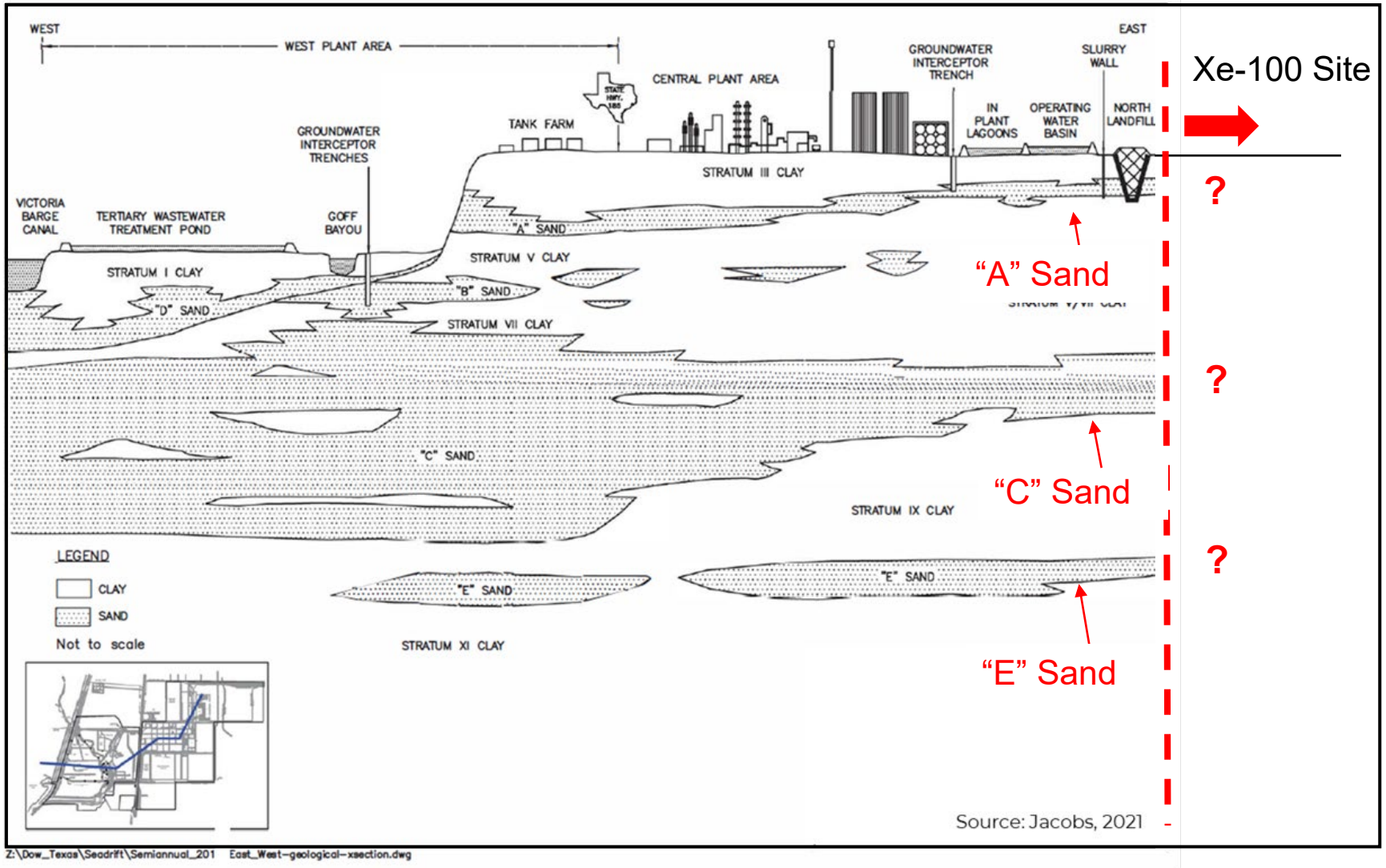


Source: USGS 2023. Geologic maps of US states.
Obtained from:https://mrdata.usgs.gov/geology/state/. Obtained: January 27, 2023.

Hydrostratigraphy of Dow Seadrift Site

Three primary water-bearing zones at Seadrift Site:

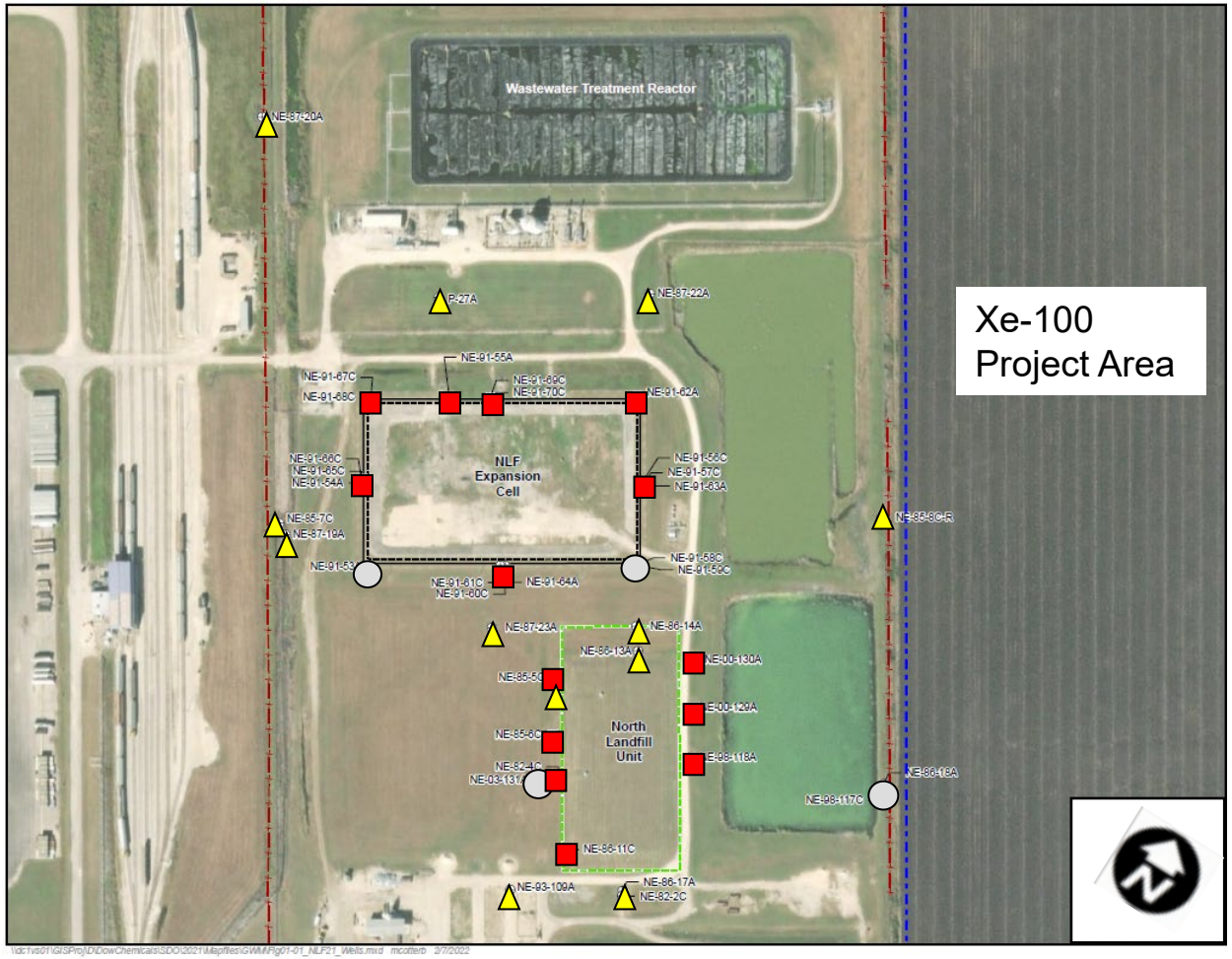
- “A” sands
- “C” sands
- “E” sands



Generalized East-West Cross Section - Dow Seadrift Site

Existing Subsurface Information

- Prior wells associated with Dow North Landfill (NLF) Area
- Other wells/borings associated with Dow Seadrift Site
- Borings associated with planned adjacent site investigations



Background Well

Compliance Well

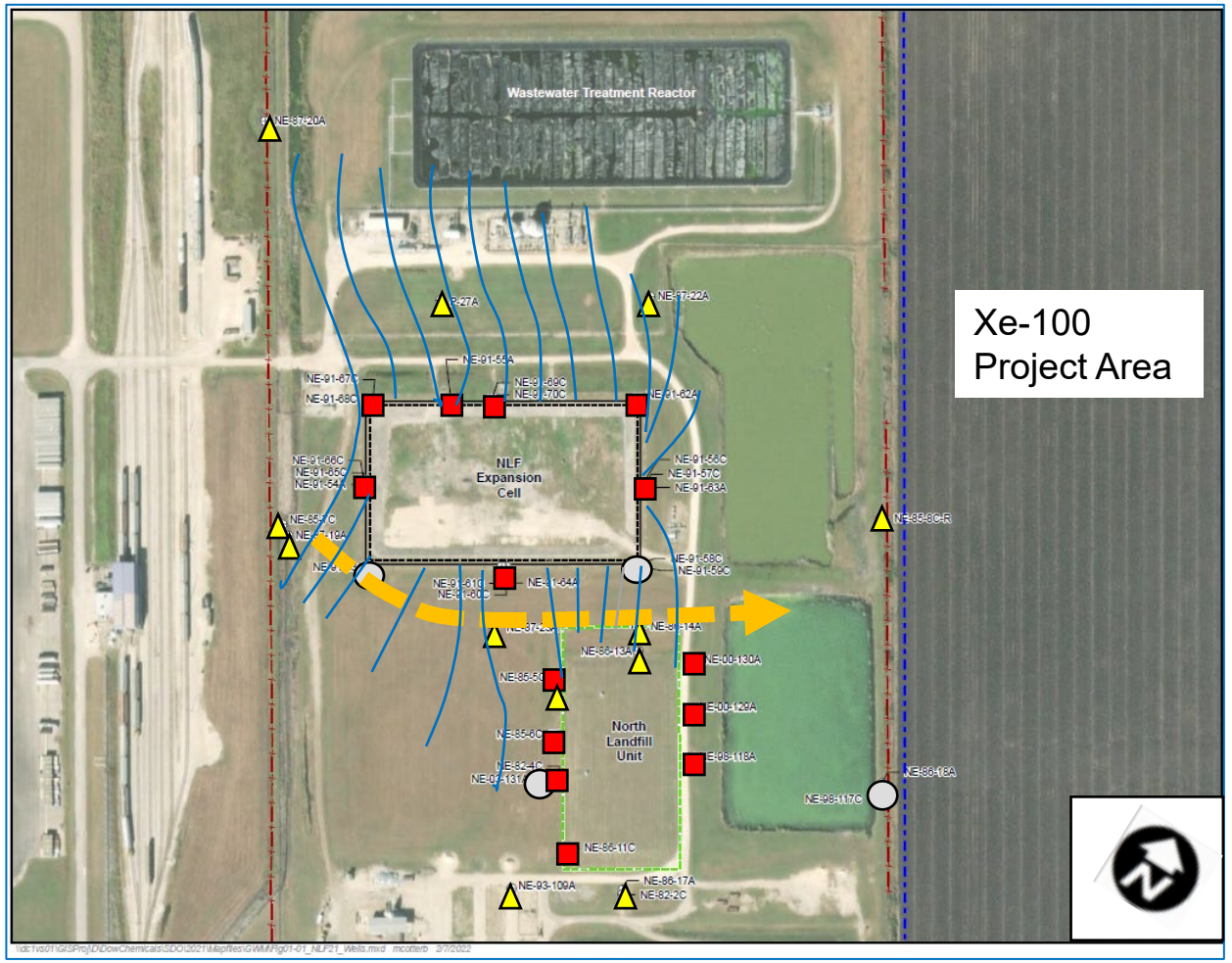
Piezometer

Existing Wells and Piezometers Adjacent to Project Site

Geologic and Hydrologic Investigation

“A” Sands

- Depth range:
  - 20-25 ft bgs
- Direction of Flow:
  - East/Northeast
  - Influenced by perched basins



“A” Sands Directional Flow

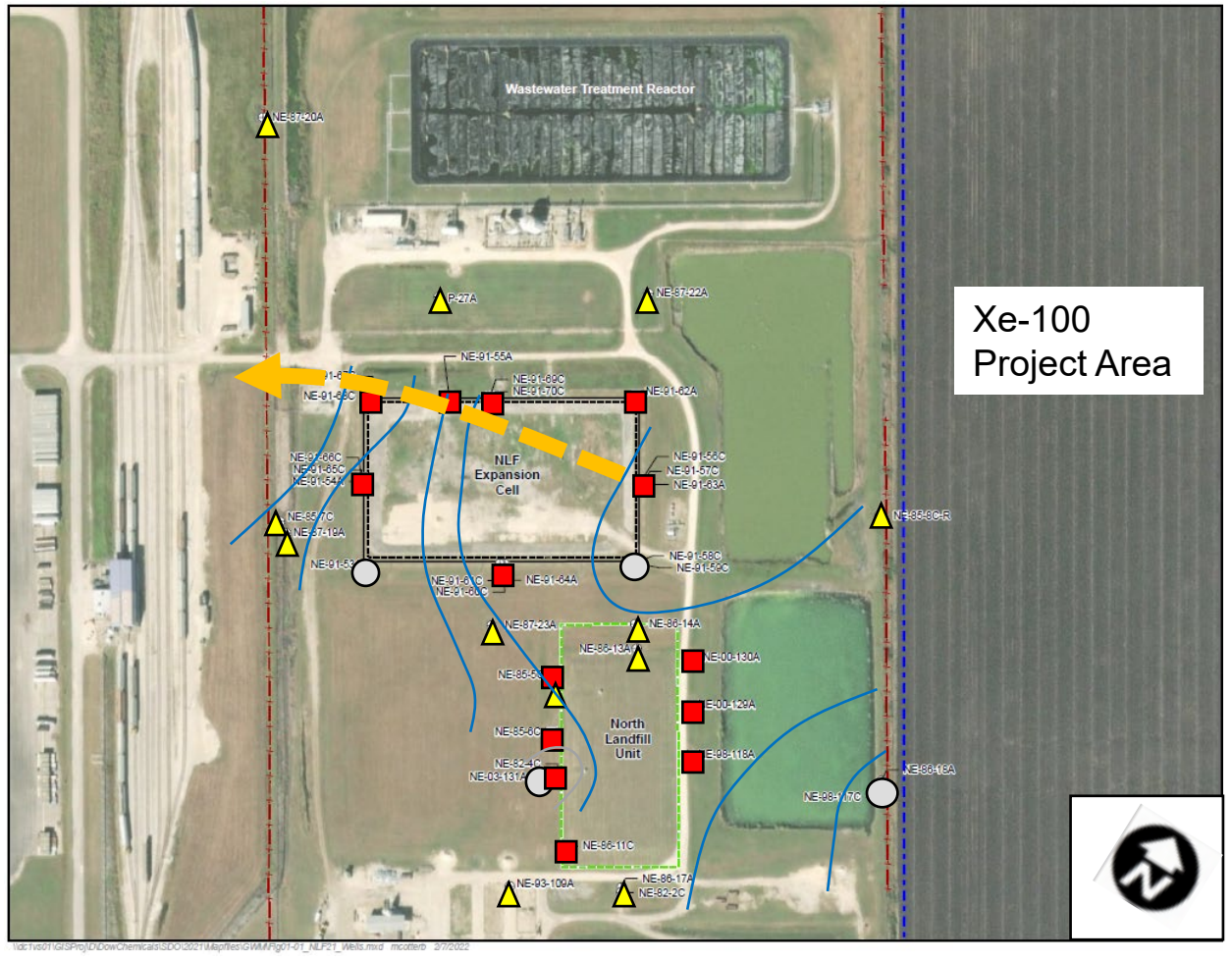
Geologic and Hydrologic Investigation

“C” Sands

- Depth range: 70-110 ft bgs (30 ft thick)
- Direction of Flow:
  - West toward Victoria Barge Canal and Guadalupe River

“E” Sands

- Depth: 110-160 ft bgs (10-30 ft thick)
- Direction of Flow:
  - Expected to be similar to C Sands)



Background Well

Compliance Well

Piezometer

“C” Sands Directional Flow

Objectives for Well Plan Development (ER and PSAR)

Basis for Well Plan Development

1. Spatial configuration of the well array (vertical and horizontal placement) that properly allows characterization of appropriate water-bearing geologic formations.
2. Need to support data needs as per RG 4.2/NUREG 1555 for groundwater and soil physical parameters and groundwater water quality parameters.
3. Establishment of upgradient wells to act as monitoring locations for the potential constituent migration from the NLF area, and as background data for future construction and operation of the Xe-100 facility
4. Establishment of downgradient wells to facilitate monitoring of construction and operational effects.
5. Support for documentation of temporal variation in groundwater conditions.
6. Provide appropriate data for calculation of parameters for PSAR Chapter 2.

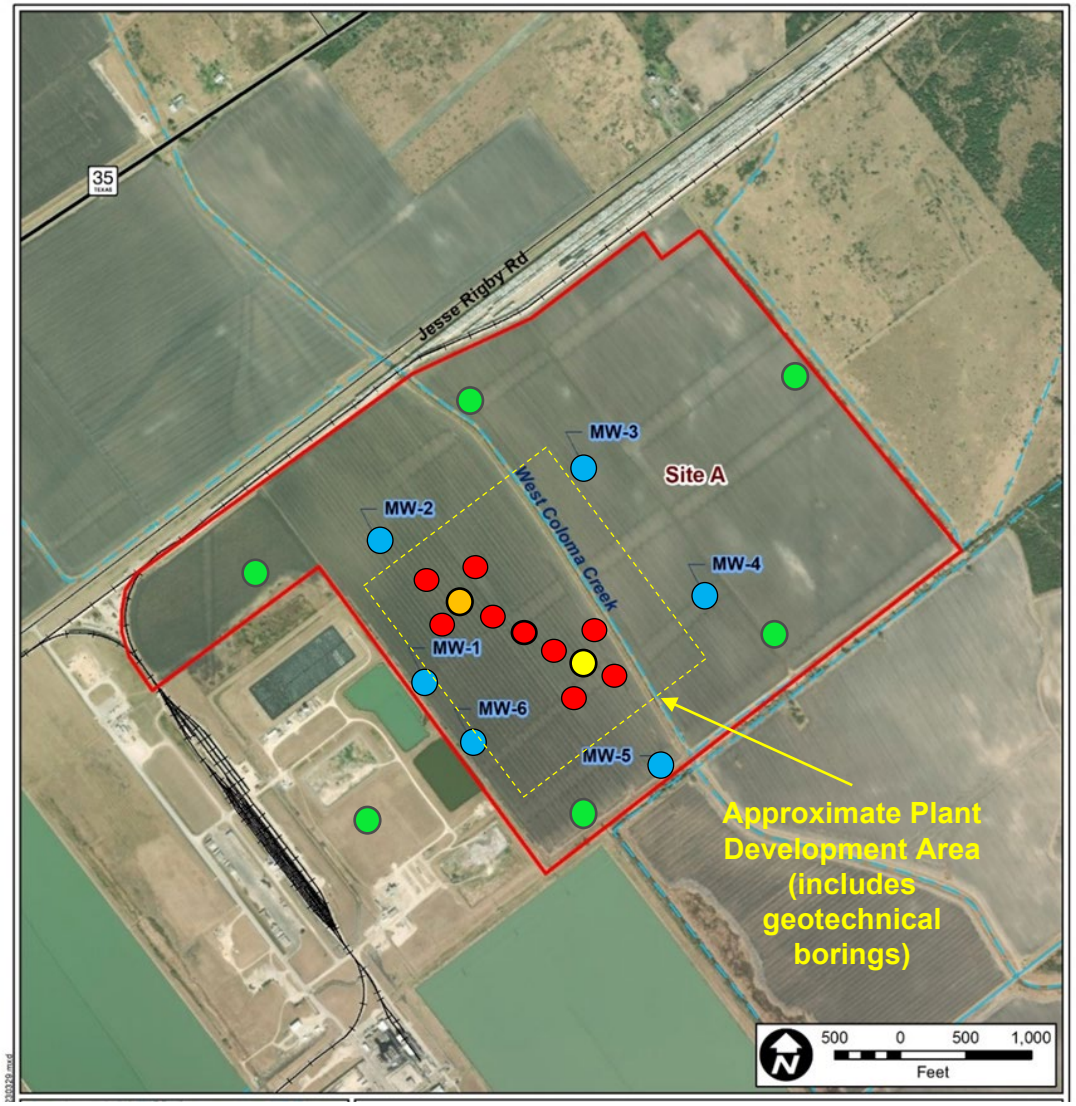
ER and PSAR Well Configuration

Proposed Well Configuration

ER Water Quality Well
(A, C and E Sands)

PSAR monitoring and testing wells
SAR-1 to SAR 106
(well pairs screened in the middle and lower aquifers)

PT-1 Pump Test Well
PT-2 Pump Test Well
Paired Sentinel Wells



Proposed Geology, Geotechnical, and Seismic Investigations

energy

Regulatory Requirements and Guidance: Subsurface Investigations

Appendix A to 10 CFR 50, XE-100 Principal Design Criteria 2

- Assessment of the potential impact of natural phenomena affecting the site is necessary to support a determination of adequacy of plant design and operation (*same in RG 1.232 for mHTGR designs*)

10 CFR 100 Reactor Site Criteria

- All seismic and geologic factors that may affect design/operation of proposed plant must be investigated

Reg Guide 1.132, Sect C.4, Detailed Site Investigation

- Number and depths of core borings/ground water monitoring criteria established

Reg Guide 1.208, Sect C.1, Geological, Geophysical, Seismological, and Geotechnical Investigation

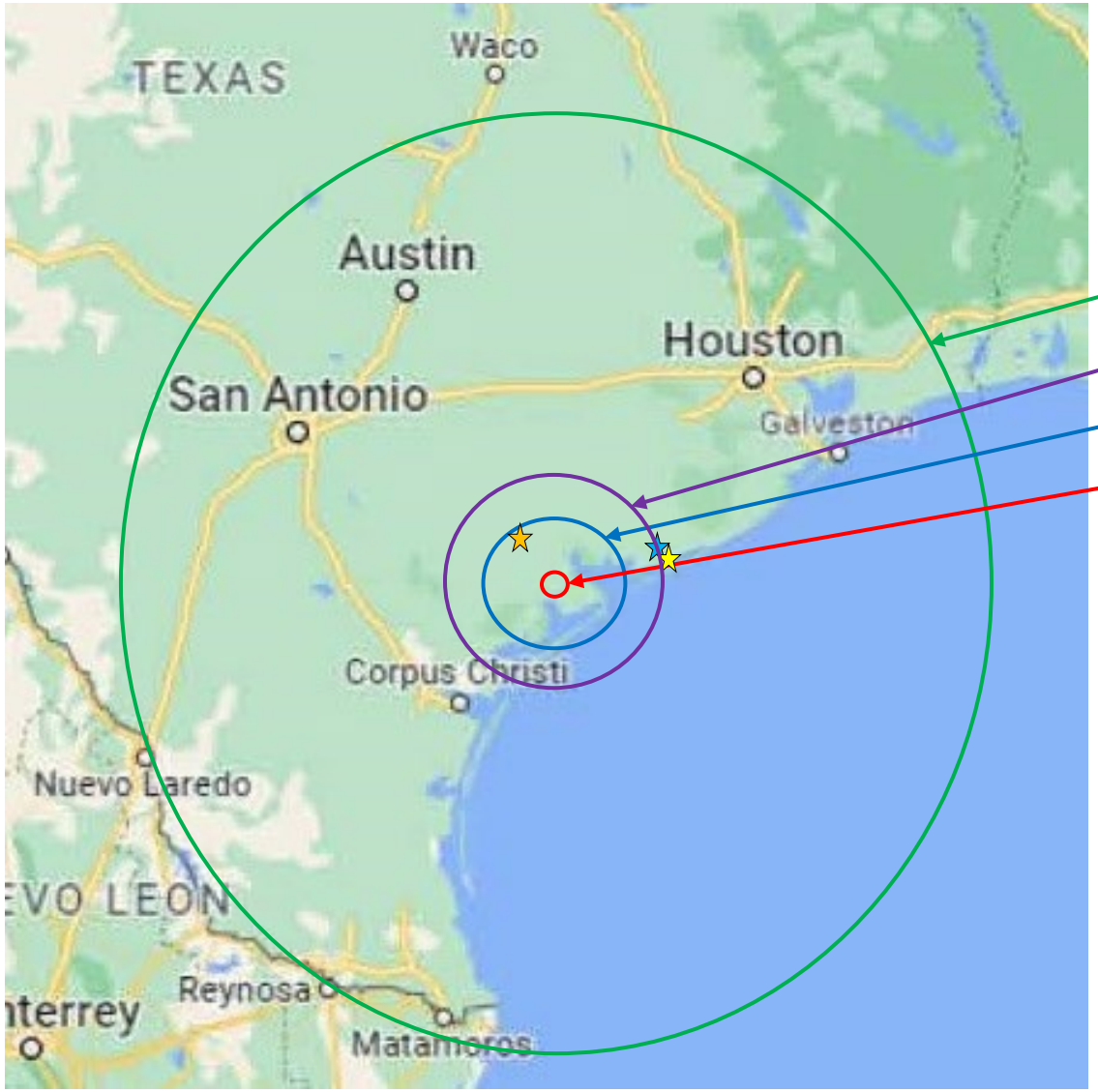
- Comprehensive site area and regional investigations should be conducted to support performance-based approach to site specific earthquake ground motion

NUREG/CR-5378, Field Investigations for Foundations of Nuclear Facilities

- The depth, layout, spacing of sampling borings, and sampling requirements for a site study depends on the subsurface requirements of the foundation

(Also, RG 4.2, 4.7, NUREG-0800, etc.)

Geologic and Hydrologic Investigation



Seismology, Geology, Meteorology, Hydrology

- **Region** (radius of 200 miles)
- **45 Mile Radius**
- **Vicinity** (radius of 25 miles)
- **Area** (radius of 5 miles)
- **VCS**
- **STP**
- **MAT**

Facility	Approximate Distance from Site A – Miles (kilometers)
Xe-100 at Site A	n/a
Matagorda (MAT)	49 (78)
South Texas Project (STP)	48 (77)
Victoria County Station (VCS)	17 (27)

Geologic and Hydrologic Investigation

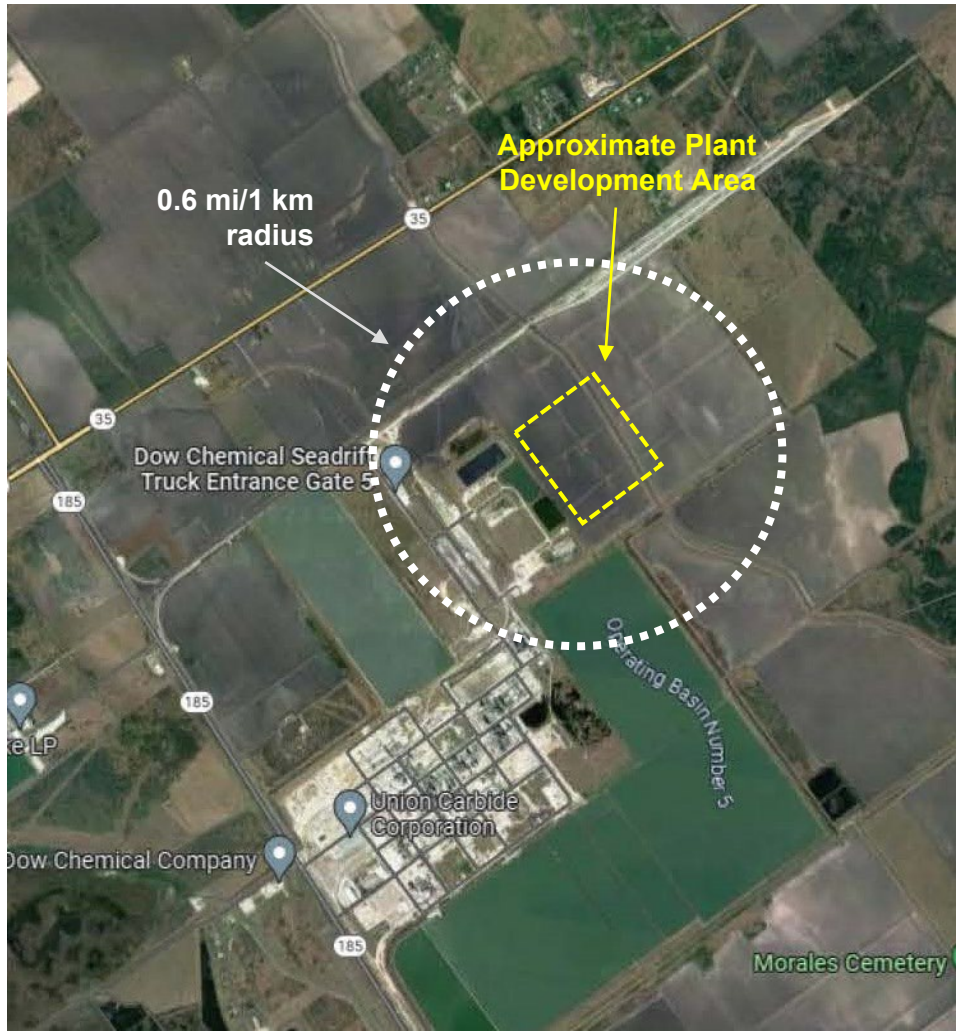
Site Location (radius of 0.6 miles/1 km)

RG 1.132, Appendix D

- *For favorable, uniform geologic conditions, where continuity of subsurface strata is found, the recommended spacing is as indicated for the type of structure.*
- *At least three borings should be at locations within the footprint of every safety-related structure, unless other reliable information is available in the immediate vicinity or otherwise justifiable.*

RG 1.132, Section C.5

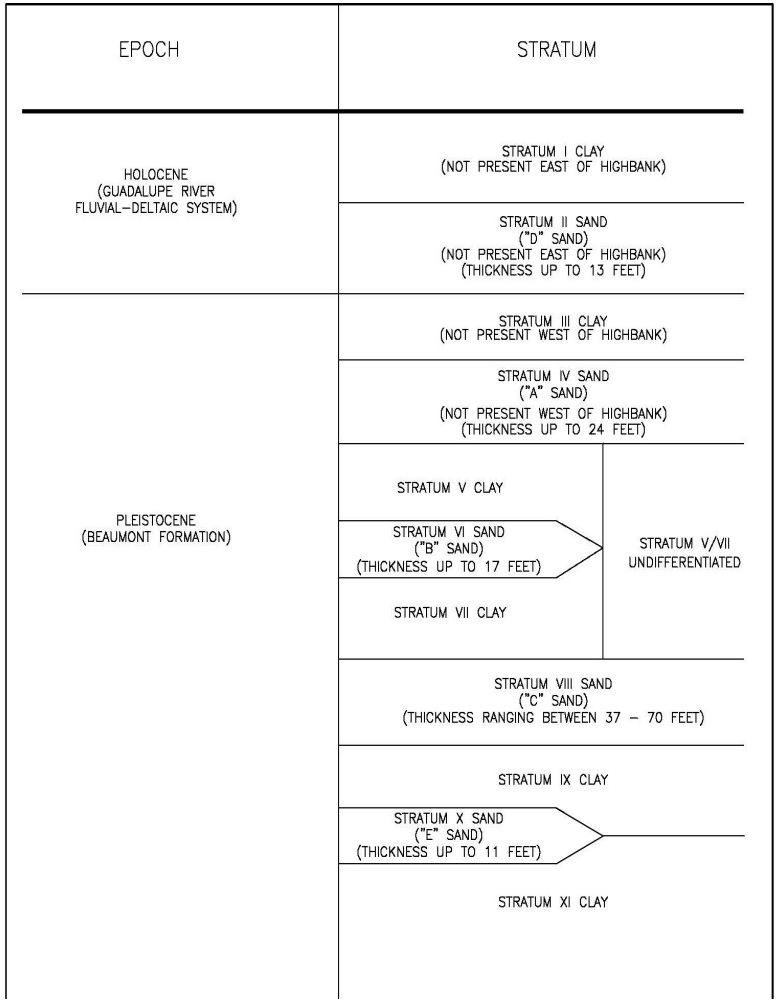
- *Groundwater observation wells should be installed in as many locations as needed to adequately define the ground water environment.*



Geotechnical Site Investigation – Historical Data

Characterization of Affected Environment - Geology

- Regional geology well understood with relative uniformity based on prior nearby data records:
  - Victoria ESP
  - South Texas investigation
  - Matagorda investigation
  - Boring logs indicate relatively consistent soil densities and composition
  - Subsurface profiles indicate relatively uniform strata thicknesses across the Seadrift area
  - Including soil properties (permeabilities or transmissivities, storage coefficients or specific yields, total and effective porosities, clay content, and bulk densities)
- ER and PSAR to utilize the same information, for continuity
- Subsurface explorations and laboratory testing will be conducted in accordance with NRC RG 1.132 to confirm the preliminary design basis evaluations and findings that will be presented in the PSAR.
- These data will be incorporated into the design basis during final structural design and prior to construction.



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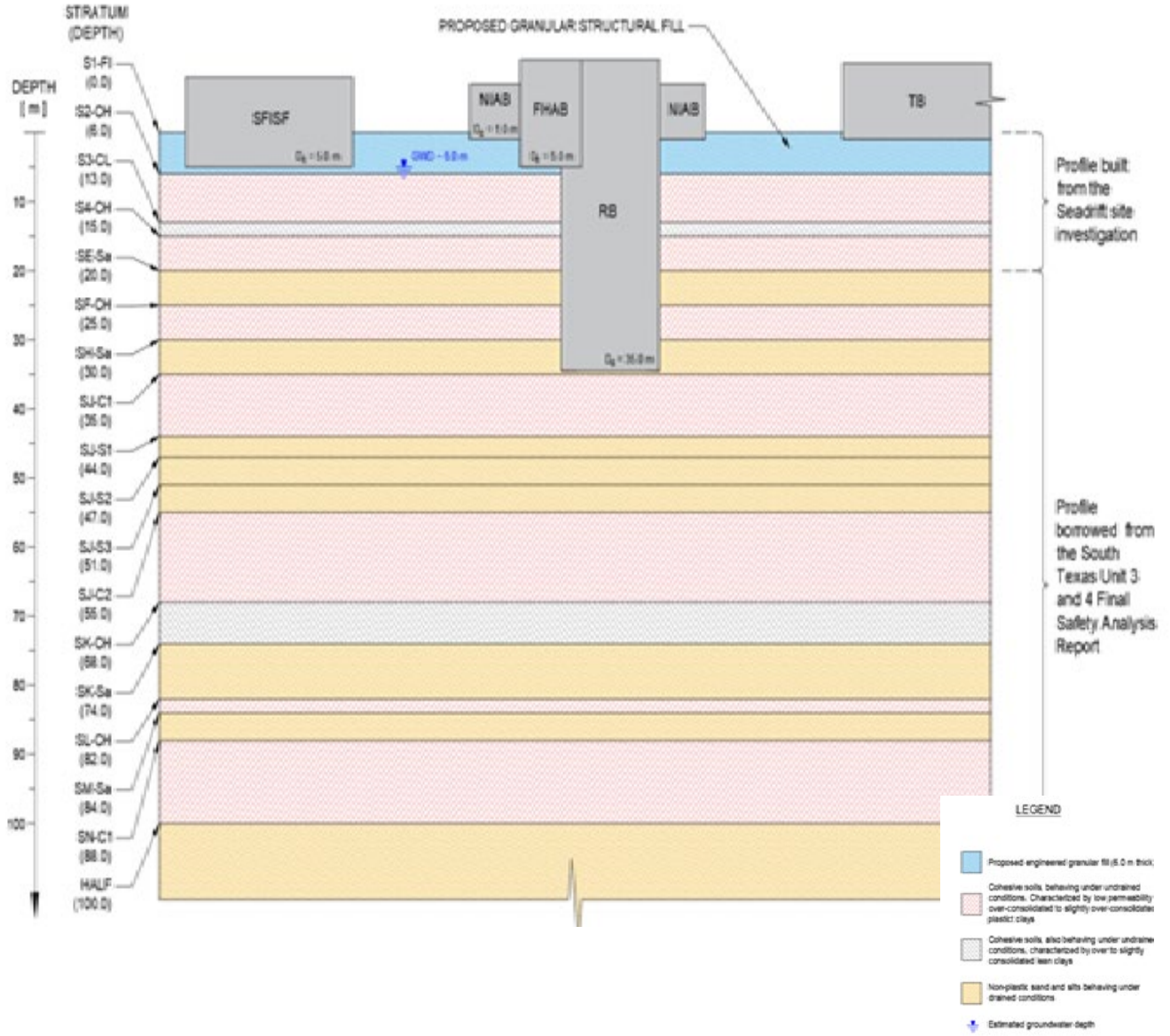
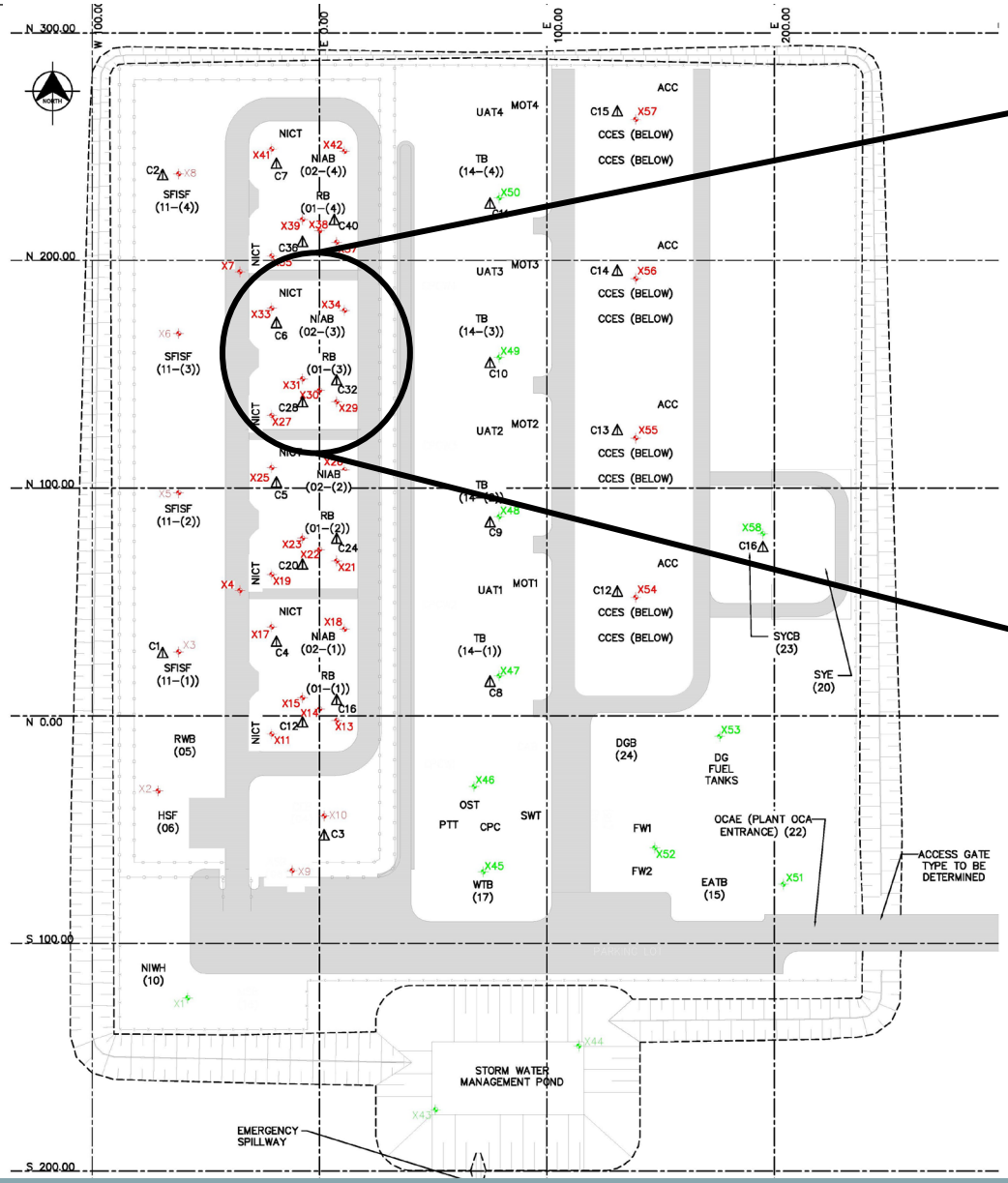


Geotechnical Site Investigation

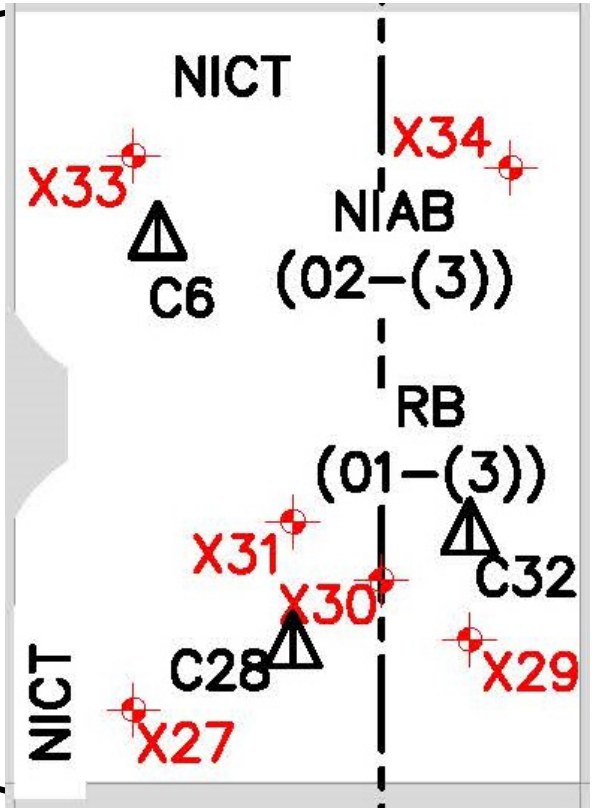
BOREHOLE / SCPT NO.	DEPTH (m)
X1	30
X2	30
X3 / C1	70, SEE NOTE 5
X4	30
X5	70
X6	70
X7	30
X8 / C2	70, SEE NOTE 5
X9	30
X10 / C3	70, SEE NOTE 5
X11	50
C12	70
X13	70
X14	200
X15	70
C16	70
X17 / C4	50, SEE NOTE 5
X18	50
X19	50
C20	70
X21	70
X22	122
X23	70
C24	70
X25 / C5	50, SEE NOTE 5
X26	50
X27	50
C28	70
X29	70
X30	122
X31	70
C32	70
X33 / C6	50, SEE NOTE 5
X34	50
X35	50
C36	70
X37	70
X38	200
X39	70
C40	70
X41 / C7	50, SEE NOTE 5
X42	50
X43	10
X44	10
X45	30
X46	45
X47 / C8	60, SEE NOTE 5
X48 / C9	60, SEE NOTE 5
X49 / C10	60, SEE NOTE 5
X50 / C11	60, SEE NOTE 5
X51	30
X52	30
X53	30
X54 / C12	100, SEE NOTE 5
X55 / C13	100, SEE NOTE 5
X56 / C14	100, SEE NOTE 5
X57 / C15	100, SEE NOTE 5
X58 / C16	60, SEE NOTE 5



NOTES:

1. THE CONFIGURATION AS SHOWN IS APPLICABLE FOR AIR COOLED CONDENSER (ACC) EQUIPMENT AT THE SELECTED SITE. PLANT COORDINATE BASE POINT (0,0) IS AT THE CENTER OF THE UNIT 1 REACTOR AT GRADE.
2. PERFORM PS SUSPENSION LOGGING IN BORINGS X14, X22, X30, AND X38. CONFIRMATORY ANALYSIS SHALL BE PERFORMED USING DOWNHOLE TEST FOR DETERMINATION OF SHEAR WAVE VELOCITY.
3. PERFORM RESISTIVITY TESTS CENTERED AT THE LOCATIONS OF BORINGS X14, X22, X30, X38, X45, X47, X48, X49, X50, AND X58.
4. UNDISTURBED SAMPLES SHALL BE EXTRACTED THROUGHOUT THE DEPTH OF ALL BOREHOLES TO BE USED FOR ADVANCED TESTING (TRIAXIAL, CONSOLIDATION, AND DIRECT SHEAR). STANDARD PENETRATION TESTS (SPT) AND SHEAR VANE TESTS SHALL ALSO BE COMPLETED AT EVERY BOREHOLE
5. CPTS SOUNDINGS SHALL EXTEND TO PLANNED DEPTH OR REFUSAL, WHICHEVER IS SHALLOWEST (USING A MINIMUM 30 TON RIG).

- App B
- Non-App B



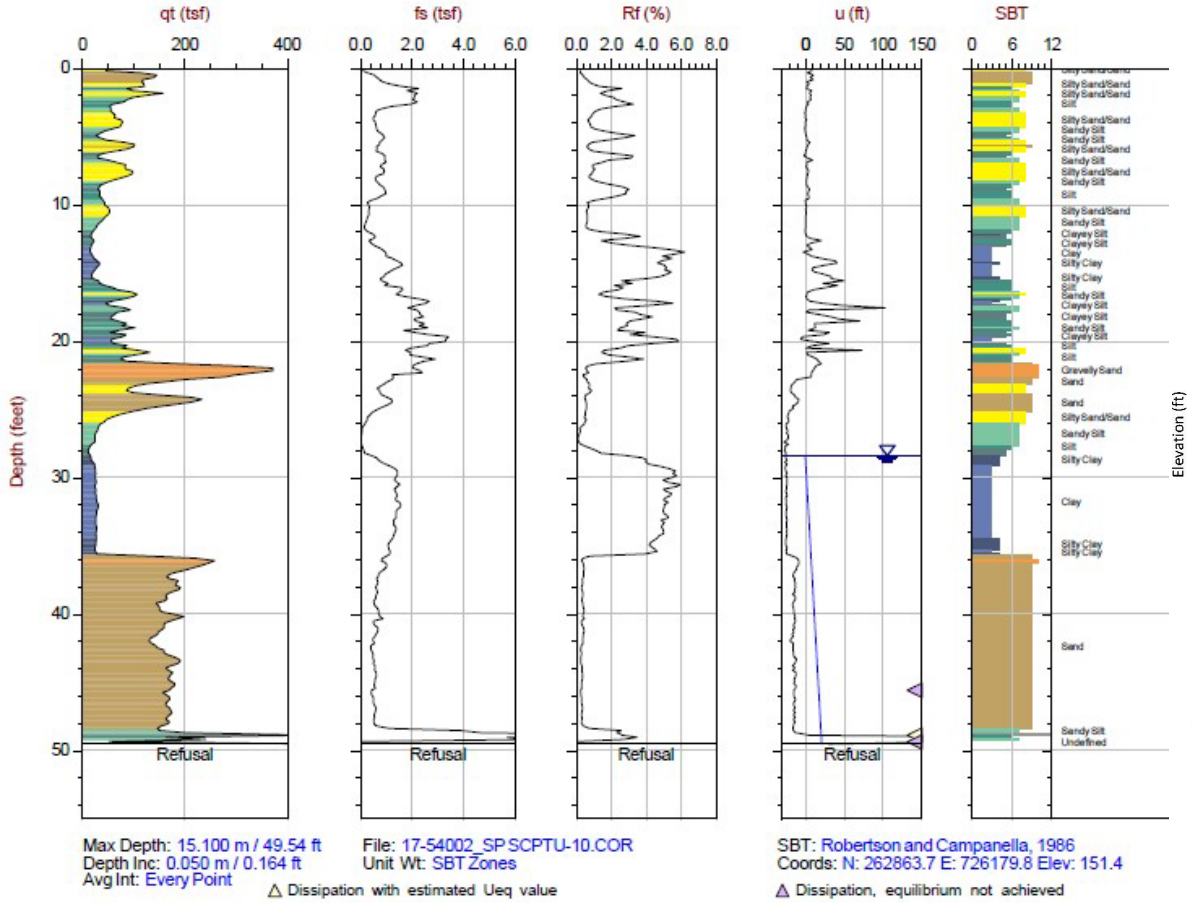
Proposed Boring Plan

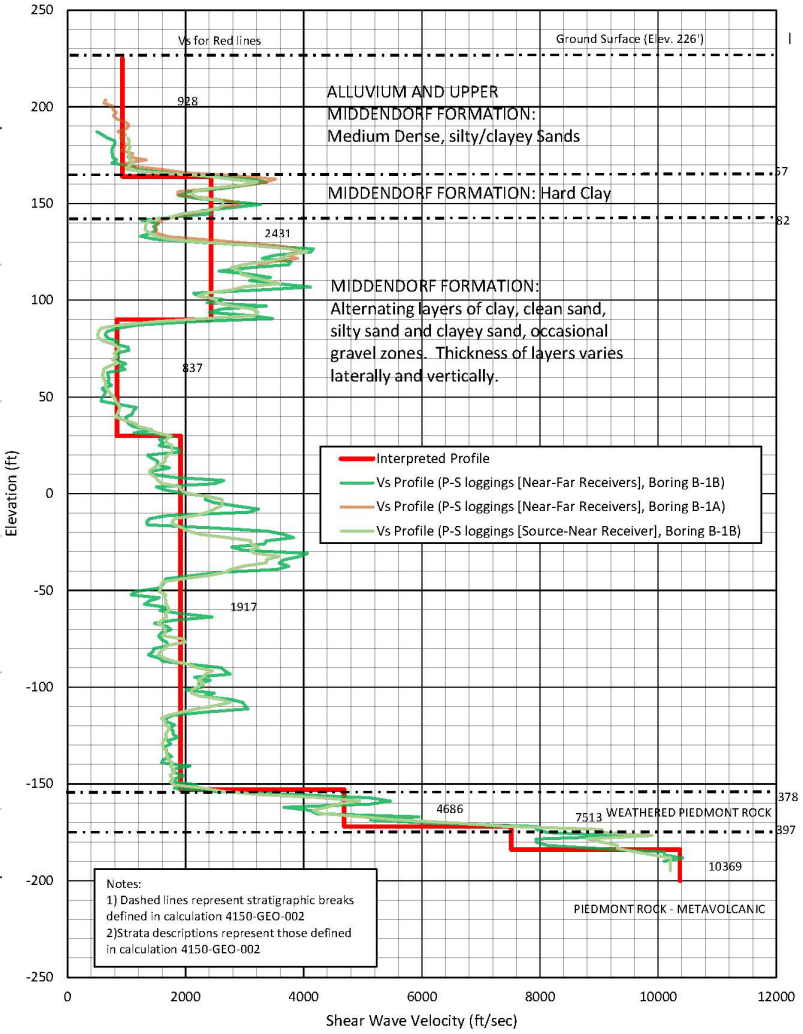
- 50 borings by conventional drilling methods
- (mud-rotary)
- Disturbed and undisturbed sampling
- 24 SCPTs with select downhole geophysics

Seismic Investigation & Analysis

Seismic Testing

- P-S suspension logging
- Shear wave velocity
- Natural/spectral gamma
- Resistivity and conductivity
- Refraction and reflection





Summary

- Groundwater
  - GW well for ER will be installed under 10 CFR 50 Appendix B for dual use in ER and PSAR
  - PSAR wells installed under 10 CFR 50 Appendix B

- Geotechnical
  - Meets intent of RG 1.132
  - Subsurface expected to be relatively uniform
  - Number of borings driven by site layout and size of reactor building
  - Non-Appendix B borings driven by investment protection rather than NRC guidance

- Seismic
  - Shear wave velocity determination to assist in development of Probabilistic Seismic Hazard Analysis (PSHA) and Ground Motion Response Spectra (GMRS)

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