Next Generation Liquefaction Database and Cloud Computing

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Outline

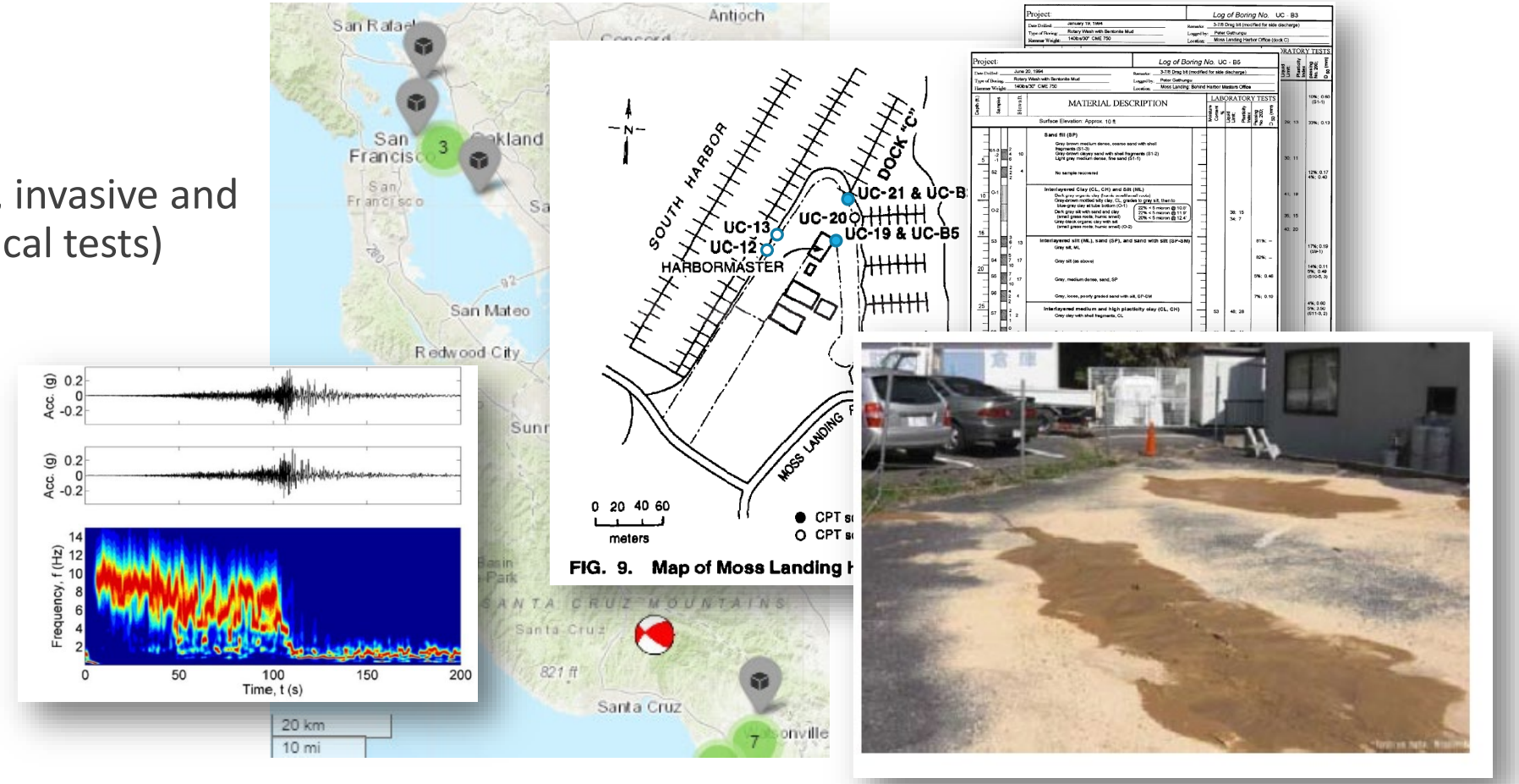
- Database Contents
  - Types of information
  - Database size
  - Earthquakes
- Database Access
  - Different ways to access database content
  - Tools and resources to help you connect

NGL
NEXT GENERATION LIQUEFACTION

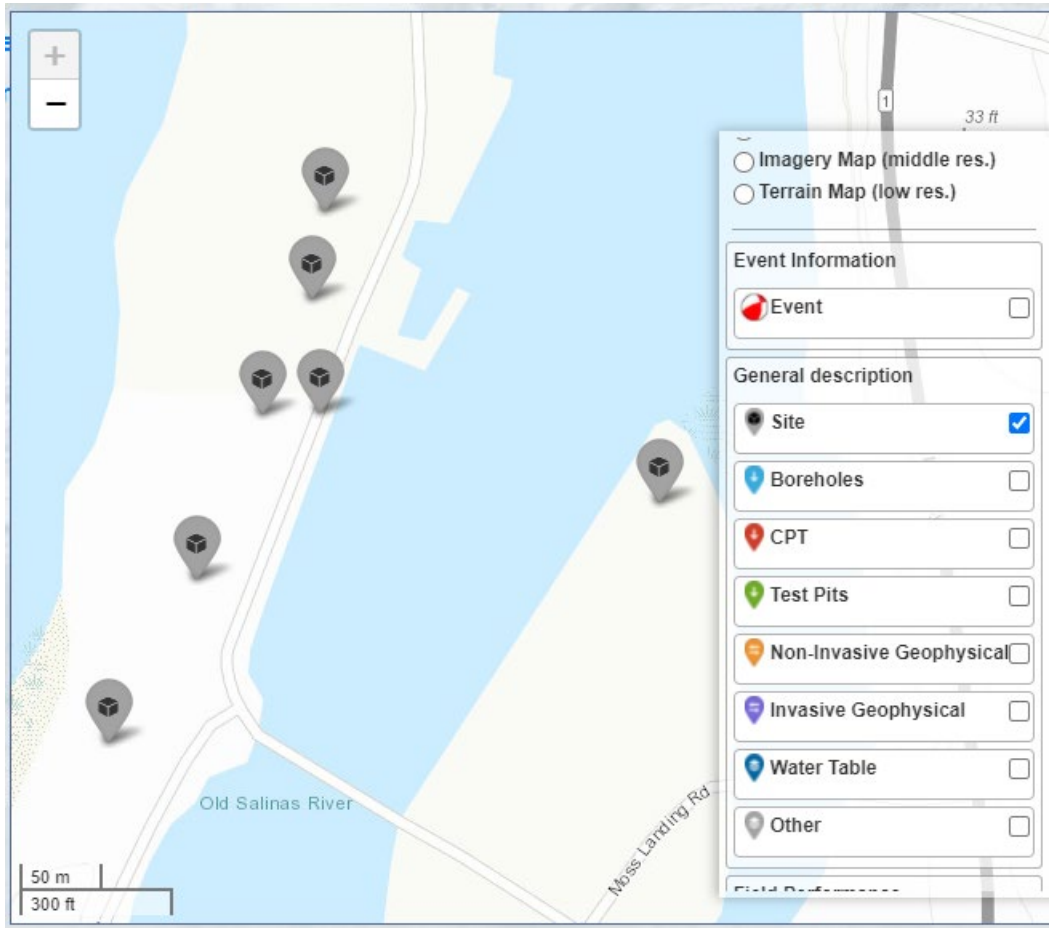
Database Contents

Database Contents

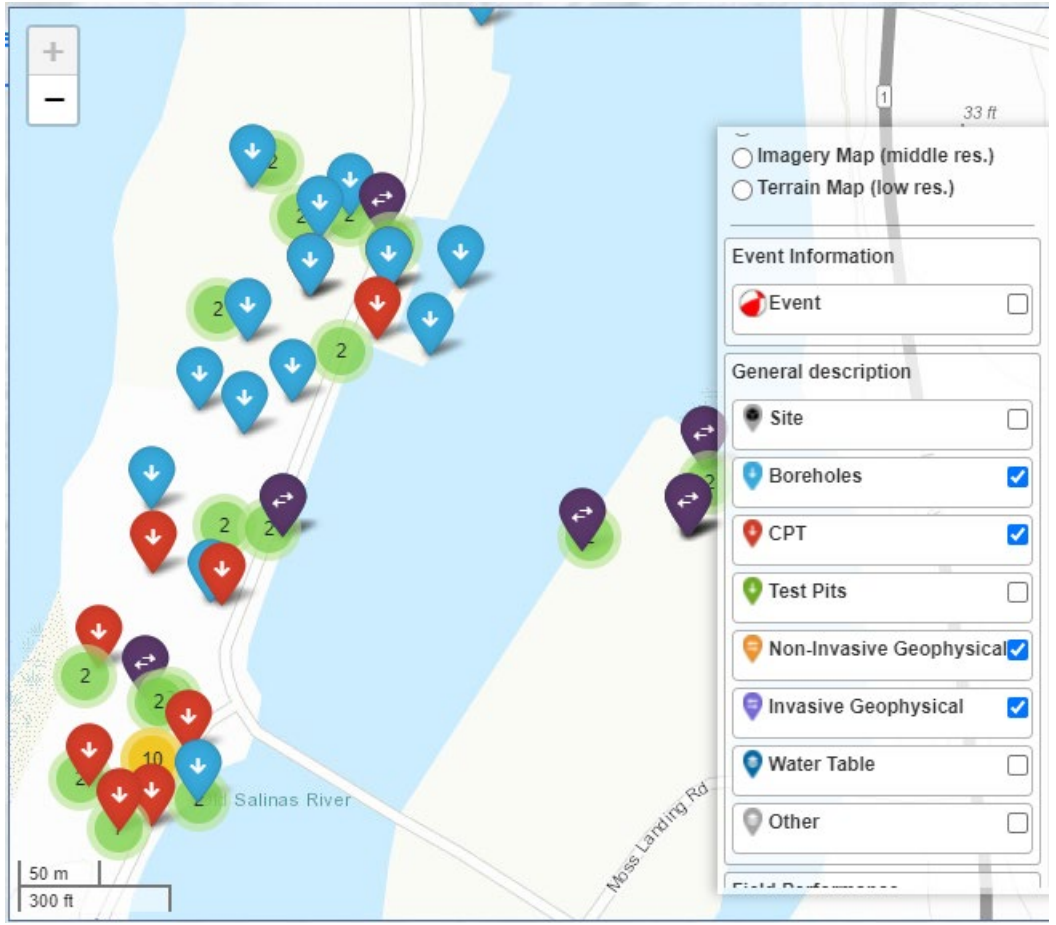
- **Events**
- **Sites**
- **In-situ Tests** (SPT, CPT, invasive and non-invasive geophysical tests)
- **Observations**
- **Laboratory Tests**



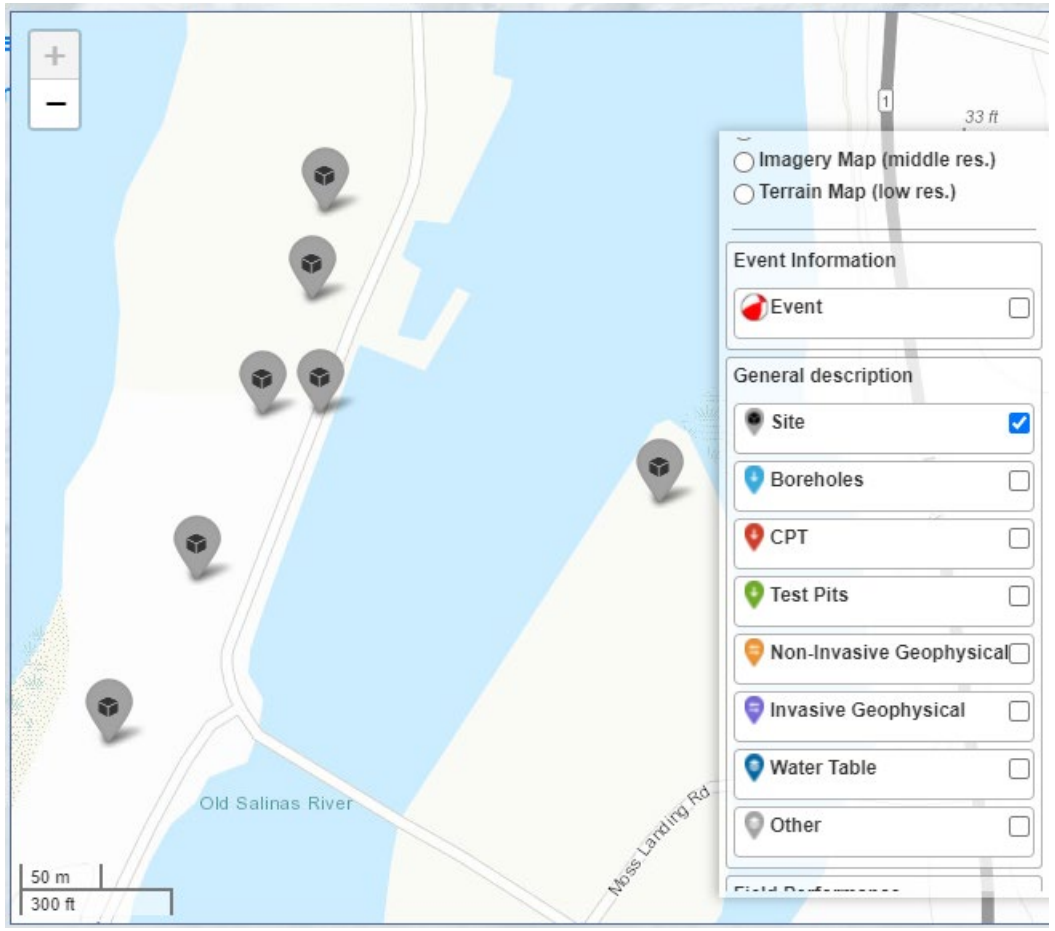
Sites



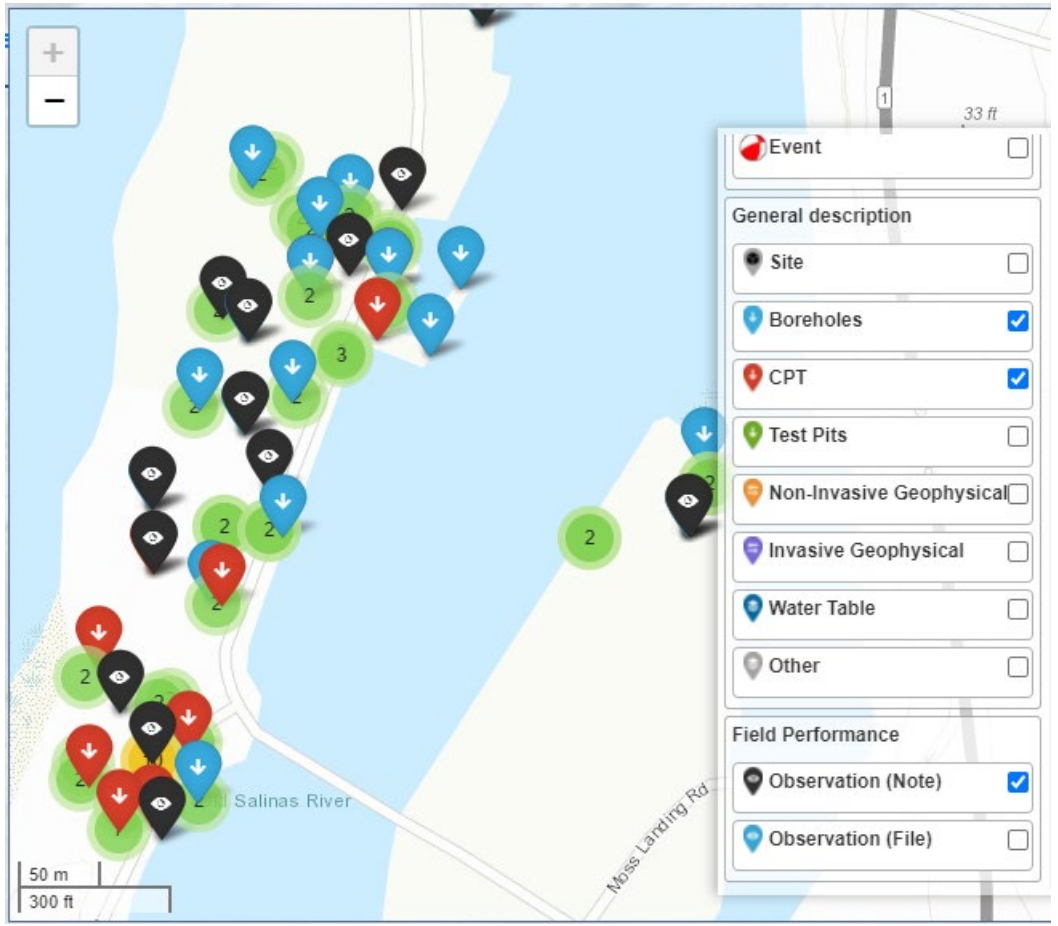
In-Situ Tests



Sites



Observations and Tests



Database Contents

Type	Total Number	In Preparation	Under Review (No Reviews)	Under Review (One Review)	Reviewed (Two Reviews)
CPT Soundings	**935**	273	27	81	554
Boreholes	**910**	220	44	61	585
Surface Wave Measurements	**39**	13	7	0	19
Invasive Vs Profiles	**139**	0	14	1	124
Liquefaction Observations	**695**	131	32	51	481
Non-Liquefaction Observations	**494**	89	23	73	308

Database Contents

	Total Number
Index (Gs, wc, FC)	4641
Plasticity	1675
Grain Size	5376
Relative Density	77
Consolidation	9
Triaxial	64
Simple Shear	72

Current Database size: 1.56 GB

Earthquake Events

Year	Event	M	Yes	No	CPT	SPT	Vs
1944	Tohnankai	8.2	3	0	0	3	0
1948	Fukui	6.84	2	1	0	3	0
1964	Niigata	7.6	17	5	5	38	0
1968	Inangahua, New Zealand	7.1	0	1	1	0	0
1968	Tokachi-oki - off the east coast of Honshu	8.2	6	4	0	16	1
1971	San Fernando	6.61	13	0	12	6	0
1975	Haicheng (Liaoning), China	7	5	2	9	5	7
1976	Tangshan	7.6	12	7	21	19	15
1976	Guatemala	7.5	1	4	0	4	0
1977	San Juan (Caucete), Argentina	7.4	16	4	0	6	0
1978	Miyagiken-Oki 2	7.7	22	10	0	27	0
1978	Miyagiken-Oki 1	6.5	1	16	0	27	0
1979	Imperial Valley-06	6.53	8	4	30	22	7
1980	Victoria, Mexico	6.33	4	1	13	5	0
1980	Mid-Chiba, Japan	6	0	1	1	1	0
1981	Westmorland	5.9	3	2	44	16	3
1983	Nihonkai-Chubu Aftershock	6.8	1	0	0	1	0
1983	Nihonkai-Chubu - near the west coast of Honshu	7.7	33	14	3	38	3
1987	Superstition Hills-02	6.54	1	7	48	23	7
1987	New Zealand-02 (Edgecumbe)	6.6	20	7	53	5	0
1987	Superstition Hills-01	6.22	0	3	28	8	3
1989	Loma Prieta	6.93	154	56	214	109	43
1990	Luzon, Philippines	7.7	38	6	0	15	0
1993	Kushiro-oki - Hokkaido	7.6	6	2	0	7	3

Year	Event	M	Yes	No	CPT	SPT	Vs
1994	Toho-oki - Hokkaido (Kuril Islands)	8.3	2	1	0	5	3
1994	Northridge-01	6.69	11	0	63	31	5
1995	Kobe, Japan	6.9	51	37	36	73	3
1999	Hokkaido	6.2	0	1	0	1	1
1999	Kocaeli, Turkey	7.51	17	2	70	41	22
1999	Chi-Chi, Taiwan	7.62	58	175	53	53	22
2000	Tottori, Japan	6.61	1	0	0	1	1
2002	Au Sable Forks NY	4.99	1	1	0	18	0
2003	Tokachi	8.3	3	1	3	8	6
2007	Chuetsu-oki	6.8	1	0	0	1	1
2010	El Mayor-Cucapah	7.2	6	2	29	7	5
2010	Darfield, New Zealand	7	46	16	184	27	1
2010	Maule, Chile	8.8	11	1	9	10	4
2011	Tohoku-oki	9.1	23	19	22	36	32
2011	Lyttleton Earthquake, New Zealand	5.9	12	10	159	28	0
2011	Lyttleton Foreshock, New Zealand	5.8	1	0	11	2	0
2011	Christchurch SE Earthquake 0613, New Zealand	6	14	14	185	36	0
2011	Christchurch SE Foreshock 0613, New Zealand	5.2	3	5	49	6	0
2011	Christchurch 20110416, New Zealand	5	6	2	29	0	0
2011	Christchurch, New Zealand	6.2	55	14	251	45	1
2012	Emilia, Italy	5.8	1	0	1	0	0
2013	Obihiro – Hokkaido	6.9	0	1	0	1	1
2021	Near East Coast of Honsu	6	0	12	10	7	5
	TOTAL	**47**	**689**	**471**	**1646**	**841**	**205**

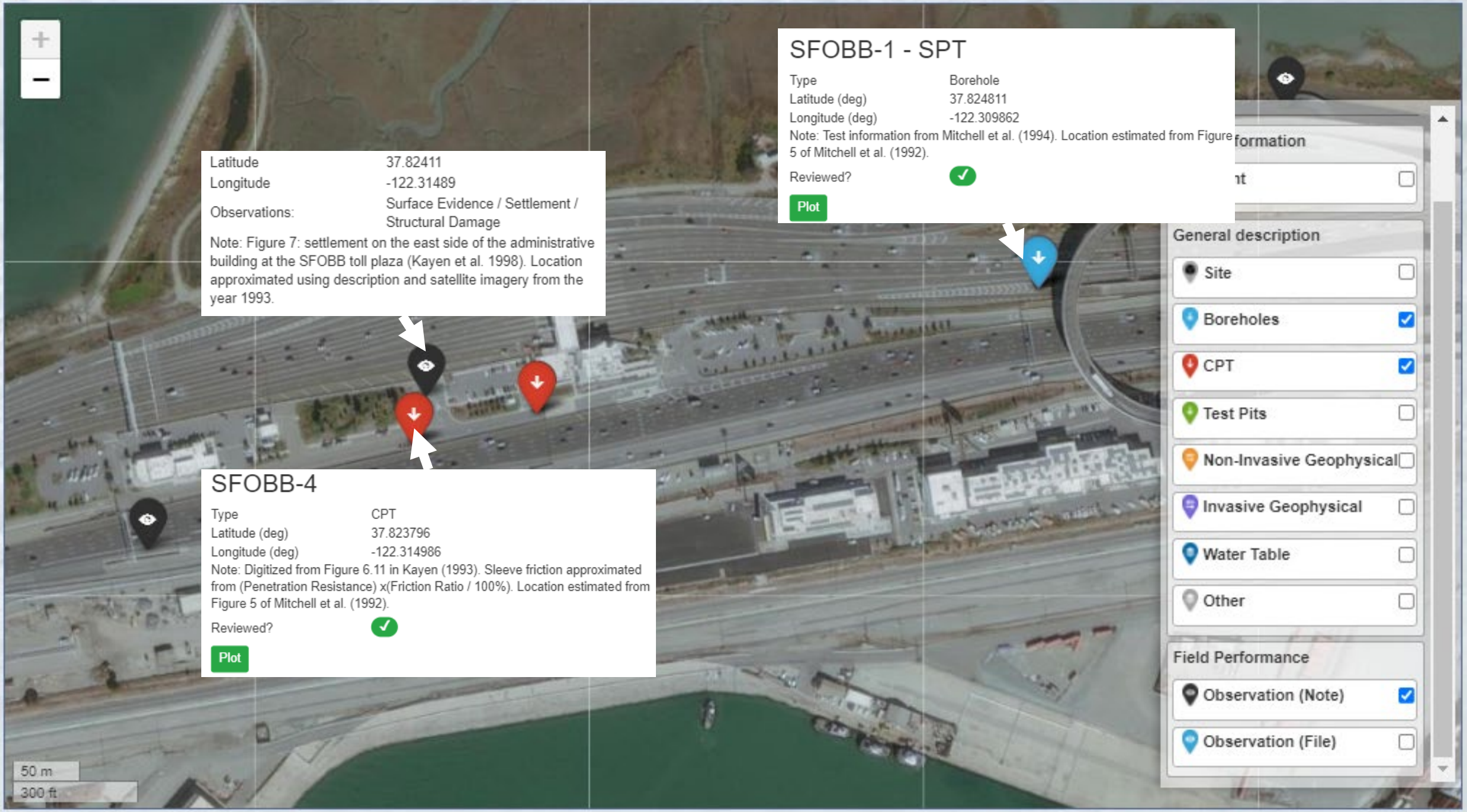
Yes = A latitude/longitude coordinate where surficial evidence of liquefaction was observed (e.g., sand boil, lateral spread, settlement, structural damage, etc.)
No = A latitude/longitude coordinate where no surficial evidence of liquefaction was observed

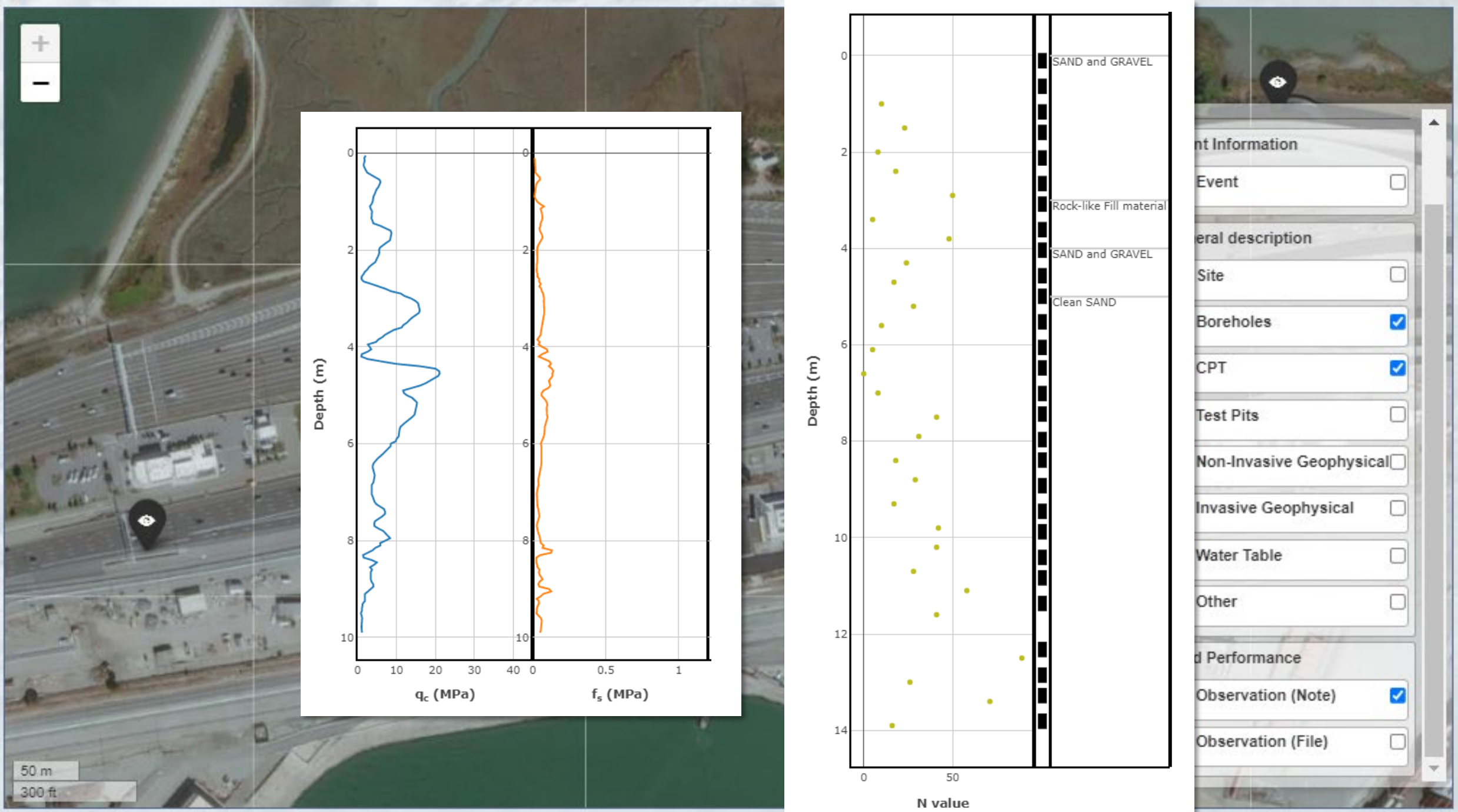
Database Access

Tools and Resources

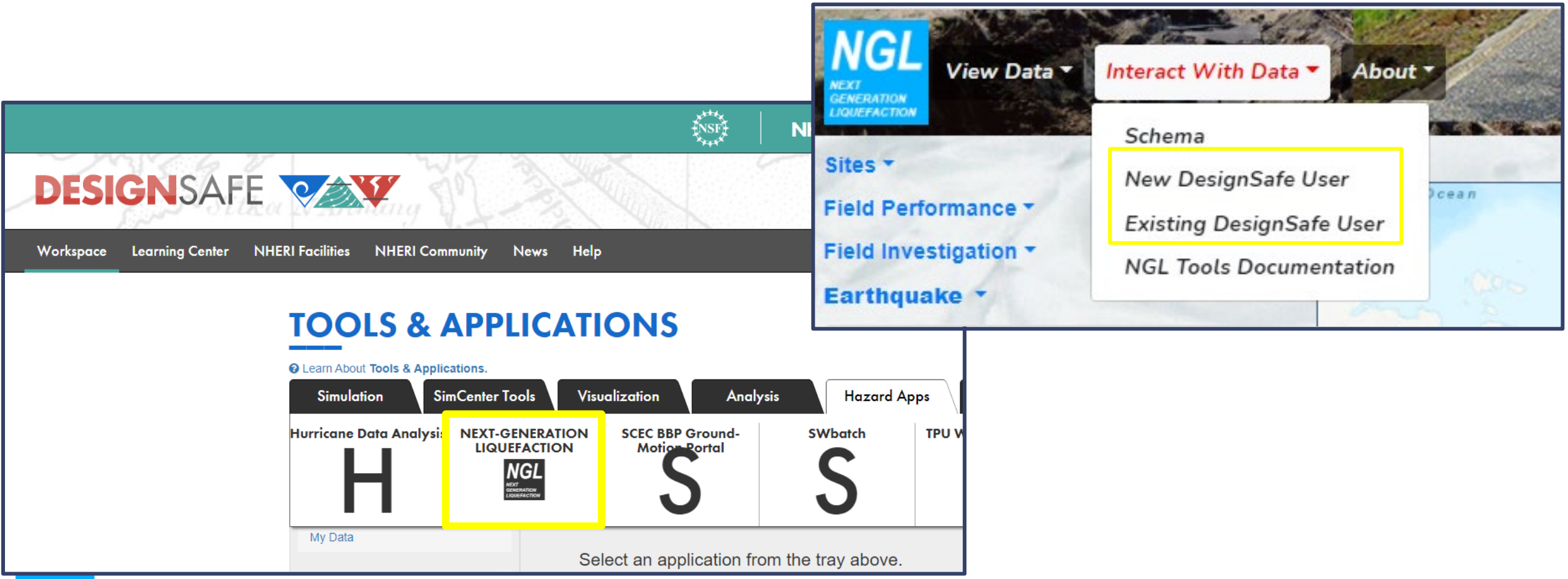
- Graphical User Interface (GUI) https://nextgenerationliquefaction.org/
- Connect to the NGL database through Jupyter Notebooks on DesignSafe https://www.designsafe-ci.org/
- Schema website https://nextgenerationliquefaction.org/schema/index.html
- NGL Tools Documentation
  - Use case documentation on DesignSafe (https://www.designsafe-ci.org/rw/use-cases/)
  - https://ngl-tools.readthedocs.io/en/latest/
- NGL YouTube Channel
  - Webinars on case histories and related topics
  - October DesignSafe Workshop: creating Jupyter Notebooks


NGL
NEXT GENERATION LIQUEFACTION
View Data
Interact With Data
About
Sign In
Sites
Field Performance
Field Investigation
Earthquake
Type event name
Magnitude:
min
max
(choose one or type
Submit
Reset
Statistics
https://www.nextgenerationliquefaction.org/
NORTH AMERICA
EUROPE
ASIA
Atlantic Ocean
Pacific Ocean
AFRICA
SOUTH AMERICA
Indian Ocean
AUSTRALIA
Topographic Map (high res.)
Imagery Map (middle res.)
Terrain Map (low res.)
Event Information
Event
General description
Site
Boreholes
CPT
Test Pits
Non-Invasive Geophysical
Invasive Geophysical
Water Table
Other
3000 km
2000 mi
SwRI
PEER
Caltrans
U.S.NRC
MPC
MOUNTAIN-PLAINS CONSORTIUM
LTDOT
Keeping Utah Moving


Latitude 37.82411
Longitude -122.31489
Observations: Surface Evidence / Settlement / Structural Damage
Note: Figure 7: settlement on the east side of the administrative building at the SFOBB toll plaza (Kayen et al. 1998). Location approximated using description and satellite imagery from the year 1993.
SFOBB-1 - SPT
Type Borehole
Latitude (deg) 37.824811
Longitude (deg) -122.309862
Note: Test information from Mitchell et al. (1994). Location estimated from Figure 5 of Mitchell et al. (1992).
Reviewed?
Plot
SFOBB-4
Type CPT
Latitude (deg) 37.823796
Longitude (deg) -122.314986
Note: Digitized from Figure 6.11 in Kayen (1993). Sleeve friction approximated from (Penetration Resistance) x(Friction Ratio / 100%). Location estimated from Figure 5 of Mitchell et al. (1992).
Reviewed?
Plot
General description
Site
Boreholes
CPT
Test Pits
Non-Invasive Geophysical
Invasive Geophysical
Water Table
Other
Field Performance
Observation (Note)
Observation (File)
50 m
300 ft


Depth (m)
0
2
4
6
8
10
0
10
20
30
40
q_c (MPa)
0
0.5
1
f_s (MPa)
SAND and GRAVEL
Rock-like Fill material
SAND and GRAVEL
Clean SAND
0
50
N value
50 m
300 ft
nt Information
Event
eral description
Site
Boreholes
CPT
Test Pits
Non-Invasive Geophysical
Invasive Geophysical
Water Table
Other
d Performance
Observation (Note)
Observation (File)

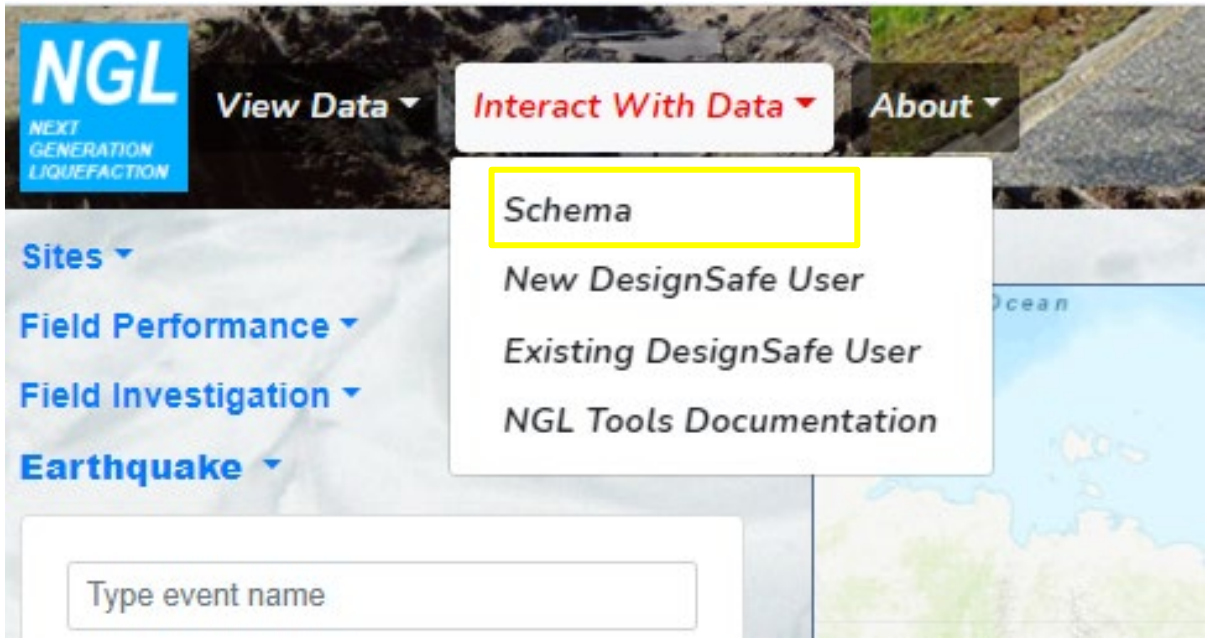
Connecting to the NGL Database through DesignSafe

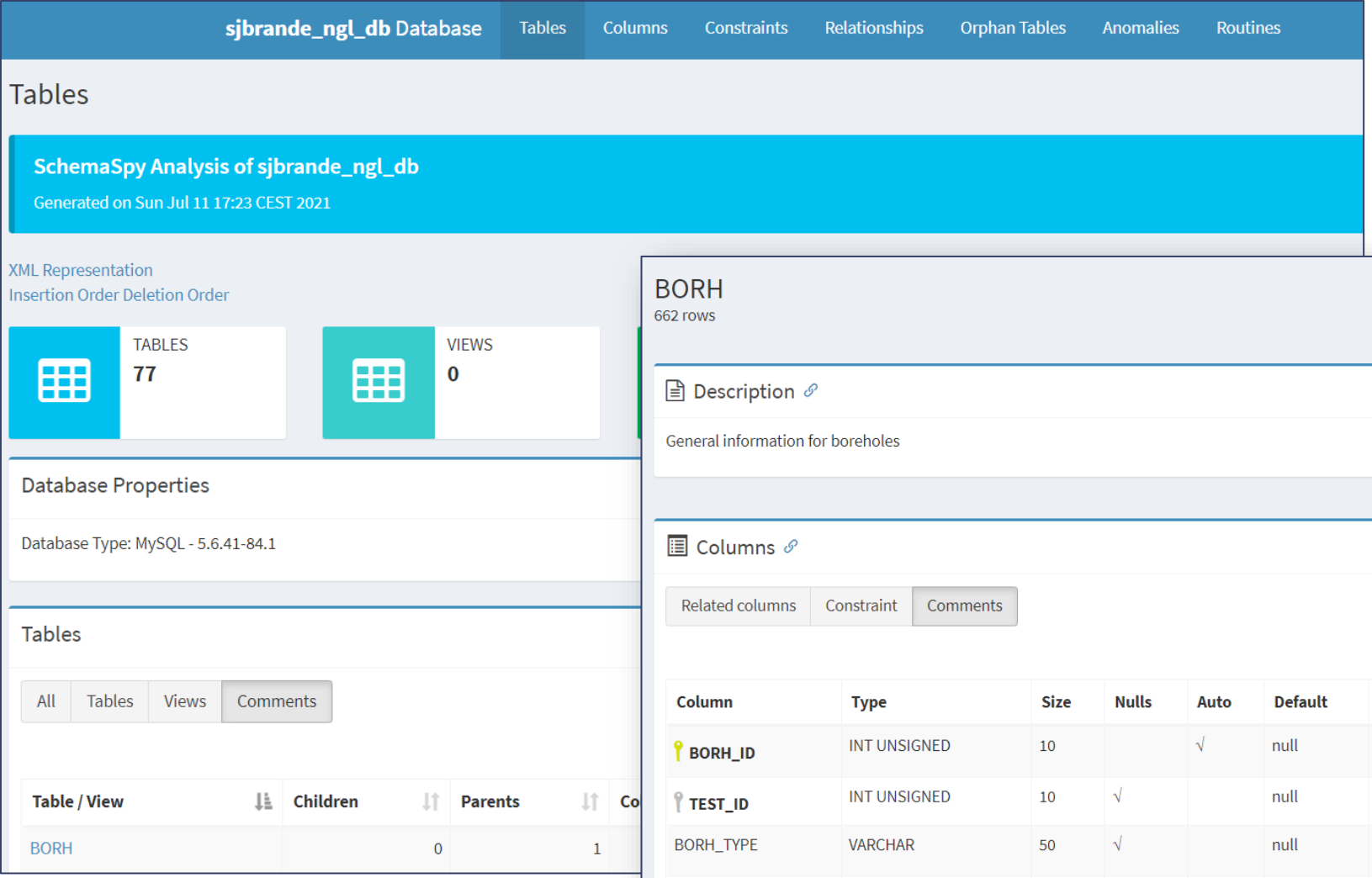


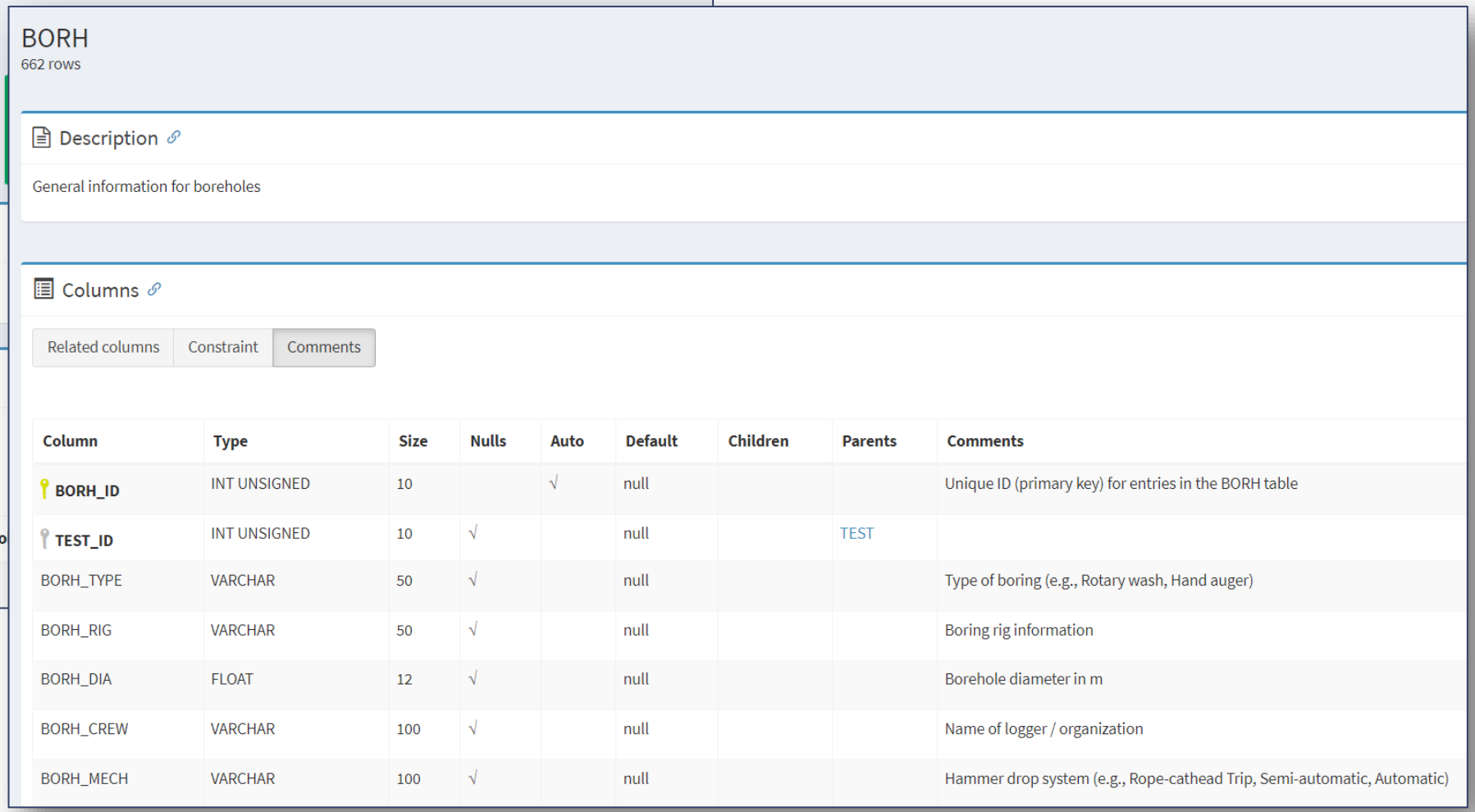

jupyter
Logout
Control Panel
Files
Running
Clusters
Select items to perform actions on them.
Upload
New
0
/ CommunityData / NGL
Name
Last Modified
File size
..
seconds ago
CPT_viewer.ipynb
2 months ago
91.1 kB
ExampleQueries.ipynb
2 months ago
53.3 kB
SPT_Viewer.ipynb
17 hours ago
27.1 kB
SPT_Viewer_old.ipynb
a month ago
17.3 kB
VS_Invasive_viewer.ipynb
17 hours ago
71.4 kB
VS_Invasive_viewer_old.ipynb
2 years ago
96.9 kB
VS_non_Invasive_viewer.ipynb
2 years ago
109 kB
footer.png
2 years ago
61.7 kB
NGLlogo-italic.png
2 years ago
20.8 kB
README.html
2 months ago
90 B

NGL Schema

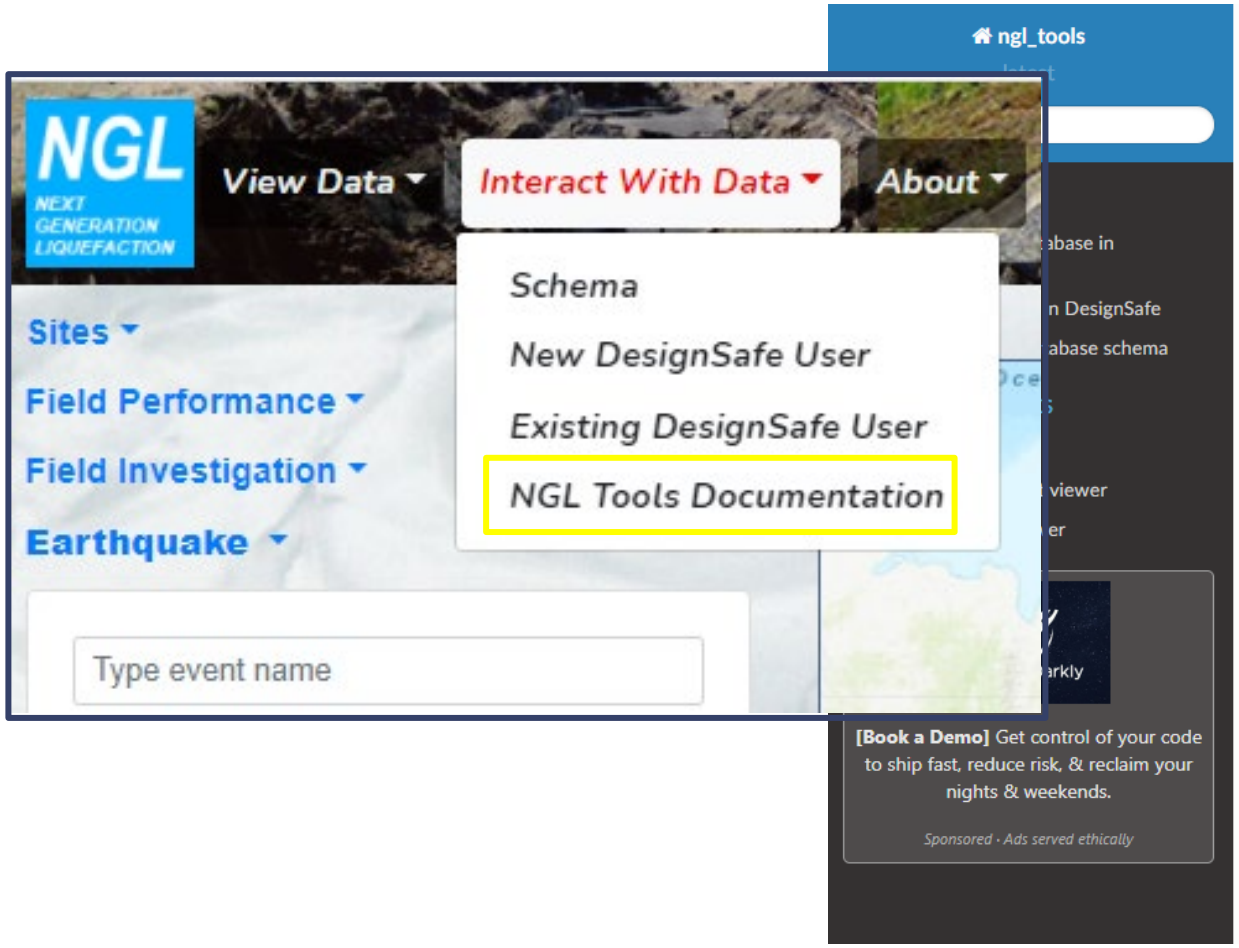
- https://nextgenerationliquefaction.org/schema/index.html

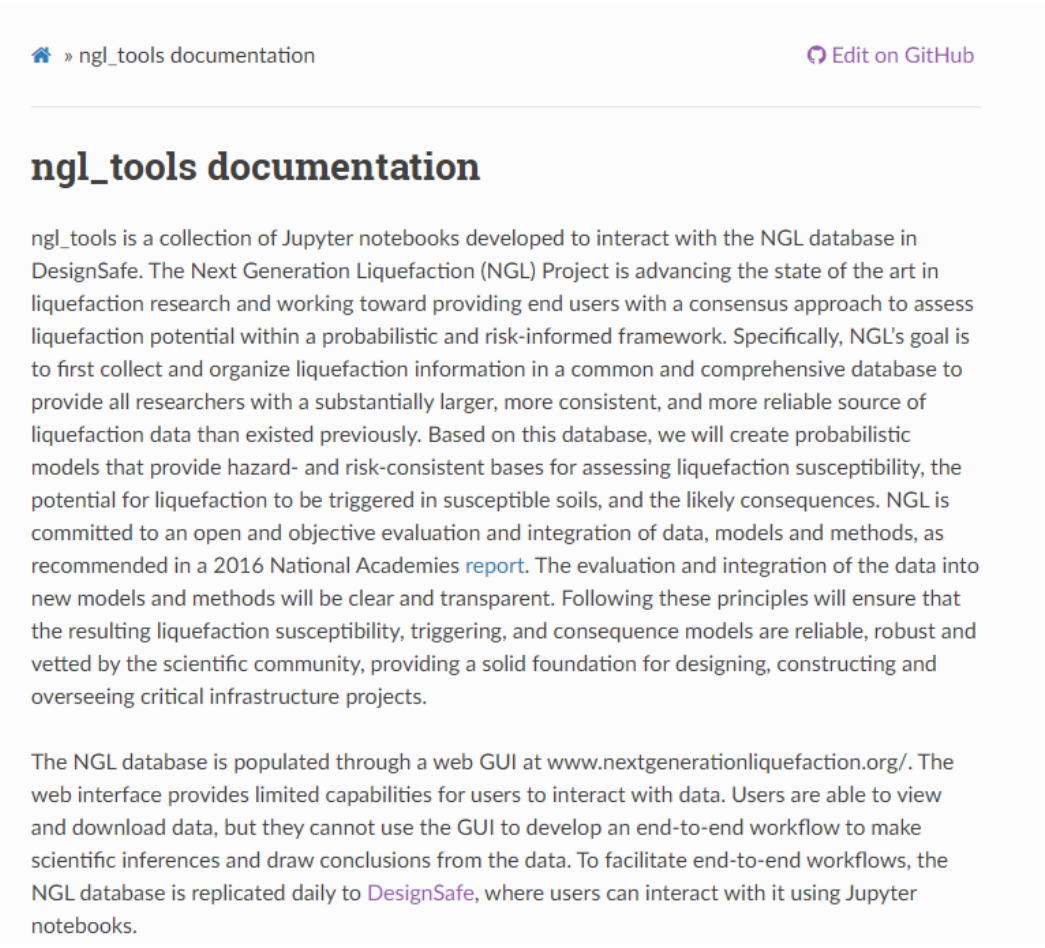


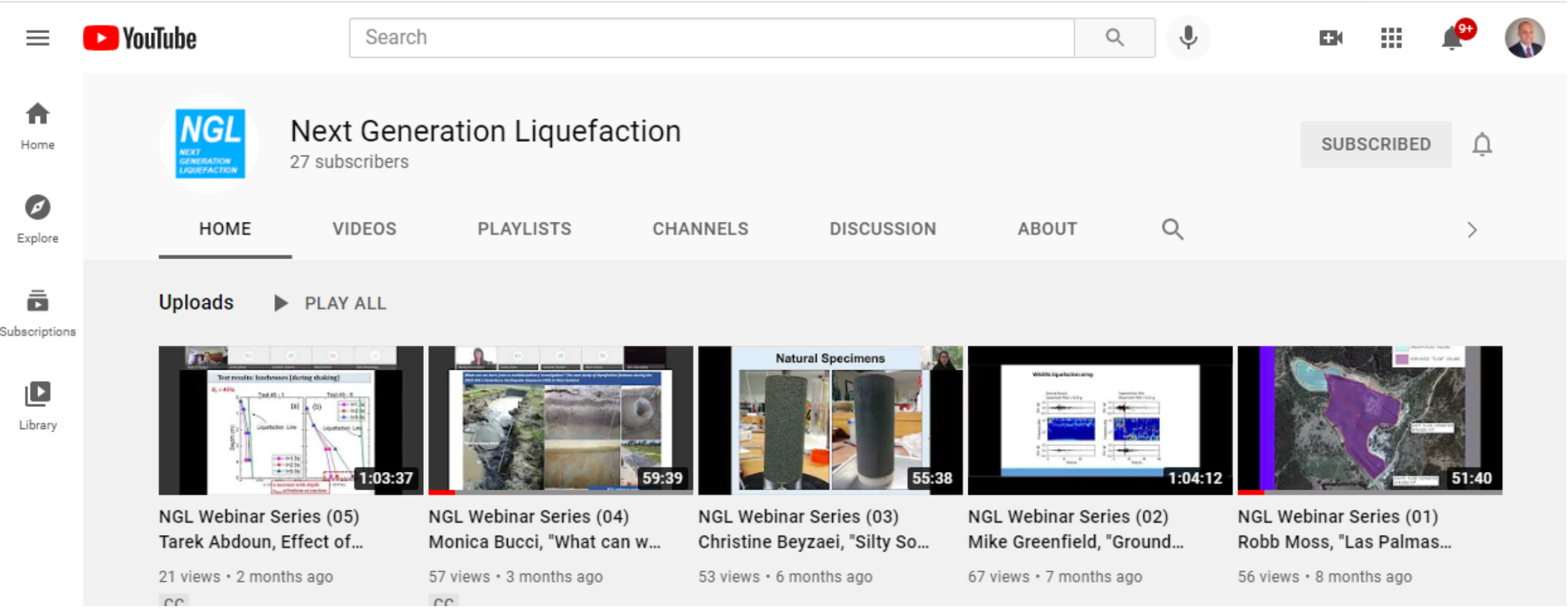

sjbrande_ngl_db Database
Tables
Columns
Constraints
Relationships
Orphan Tables
Anomalies
Routines
Tables
SchemaSpy Analysis of sjbrande_ngl_db
Generated on Sun Jul 11 17:23 CEST 2021
XML Representation
Insertion Order Deletion Order
TABLES
77
VIEWS
0
Database Properties
Database Type: MySQL - 5.6.41-84.1
Tables
All
Tables
Views
Comments
Table / View
Children
Parents
BORH
0
1


BORH
662 rows
Description
General information for boreholes
Columns
Related columns
Constraint
Comments
Column
Type
Size
Nulls
Auto
Default
Children
Parents
Comments
BORH_ID
INT UNSIGNED
10
√
null
Unique ID (primary key) for entries in the BORH table
TEST_ID
INT UNSIGNED
10
√
null
TEST
BORH_TYPE
VARCHAR
50
√
null
Type of boring (e.g., Rotary wash, Hand auger)
BORH_RIG
VARCHAR
50
√
null
Boring rig information
BORH_DIA
FLOAT
12
√
null
Borehole diameter in m
BORH_CREW
VARCHAR
100
√
null
Name of logger / organization
BORH_MECH
VARCHAR
100
√
null
Hammer drop system (e.g., Rope-cathead Trip, Semi-automatic, Automatic)

NGL Tools Documentation







https://www.youtube.com/channel/UCtcbOIVb3soaJ5X60vdgKkw

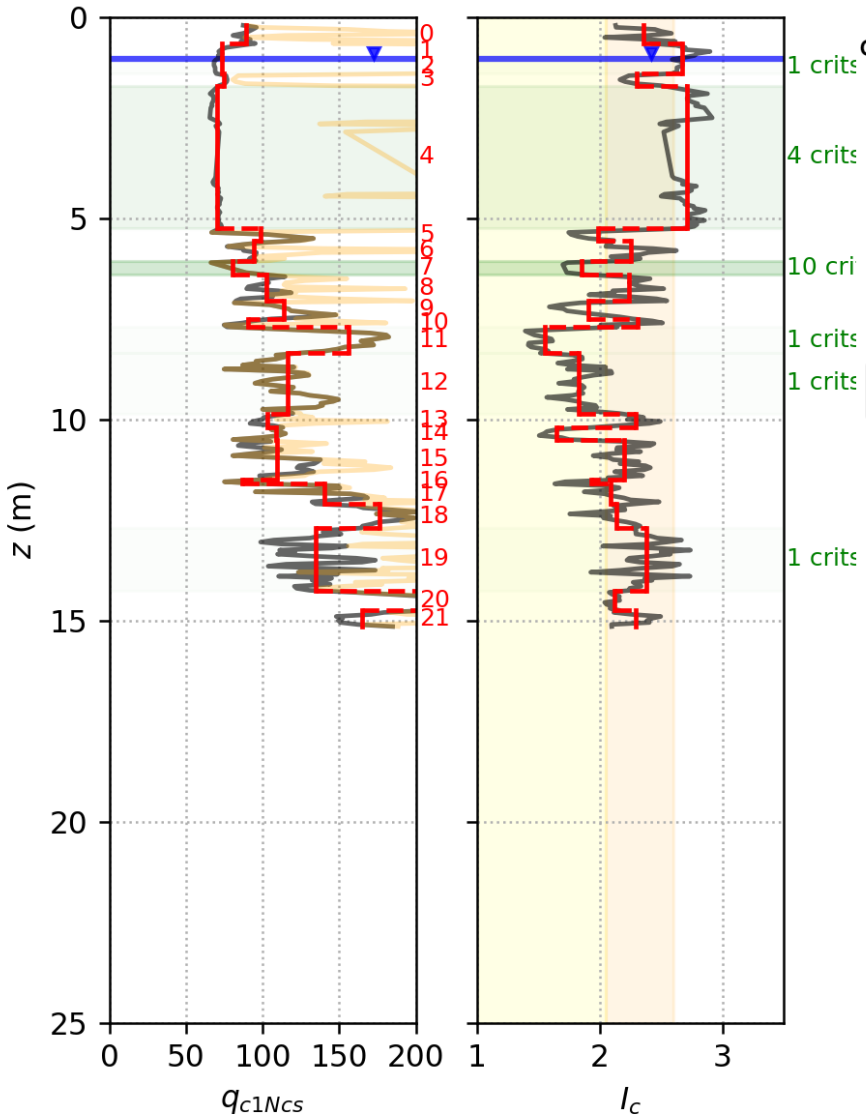
Jupyter Notebooks

- Jupyter notebooks allow us to do more
  - Import sophisticated analysis packages
  - Directly query the NGL database
  - Incorporate other publicly available information (e.g., spatial data)
- Example: visualizing individual case histories

Case #: 206

Figure 8

SITE: Wufeng Site A, TEST: WAC-2,
EVNT: Chi-Chi, Taiwan,
FLDM: 1010 = No, 0.0m away



System Effects

- [ ] Interbedding
- [ ] Deep Liq
- [ ] Strong Crust
- [ ] Partial Drainage

Other

- [ ] Critical Layer w/ High Ic

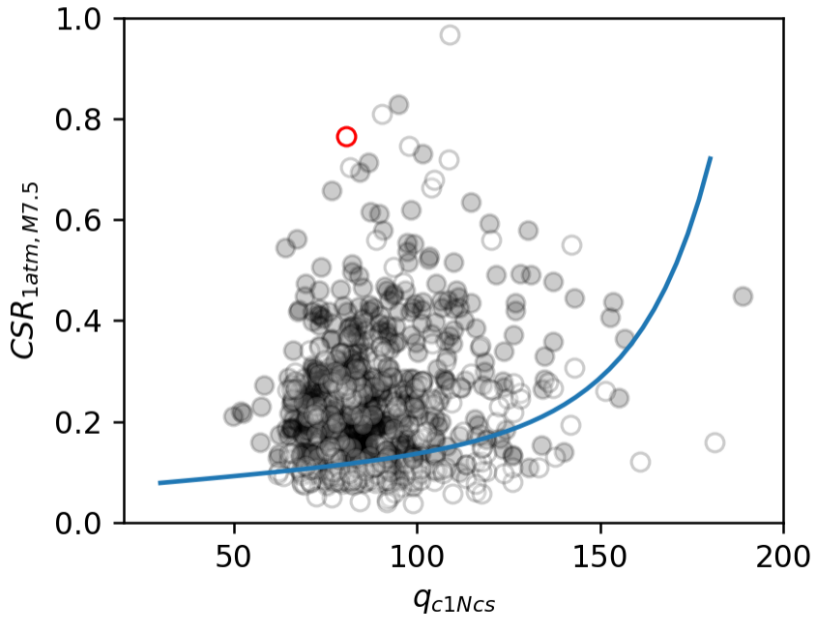
Comments:

Case #: 206

Layer: 7

Figure 10

Layer No 7
(Criteria 1, 2, 3, 4, 5, 6, 7, 8, 17, 18)



Conclusions

- The NGL Database is populated with data to support your research
- Connecting to the database is facilitated through the GUI and Jupyter notebooks in DesignSafe
- Getting involved with NGL:
  - Have a case history to share? Contact us!
  - Want to use the database? The database itself and links to resources are available: https://nextgenerationliquefaction.org
  - Want to support the NGL project? Contact us!

Questions

Contact Information

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Kristin Ulmer kulmer@swri.org

References

Brandenberg, S. J., Zimmaro, P., Stewart, J. P., Kwak, D. Y., Franke, K. W., Moss, R. E., Cetin, K.O., Can, G., Ilgac, M., Stamatakos, J., Weaver, T., & Kramer, S. L. (2020). Next-generation liquefaction database. *Earthquake Spectra*, 36(2), 939-959.

Next Generation Liquefaction (NGL) database. https://nextgenerationliquefaction.org (DOI: 10.21222/C2J040)

Rathje, E., Dawson, C. Padgett, J.E., Pinelli, J.-P., Stanzione, D., Adair, A., Arduino, P., Brandenberg, S.J., Cockerill, T., Dey, C., Esteva, M., Haan, Jr., F.L., Hanlon, M., Kareem, A., Lowes, L., Mock, S., and Mosqueda, G. 2017. "DesignSafe: A New Cyberinfrastructure for Natural Hazards Engineering," *ASCE Natural Hazards Review*, doi:10.1061/(ASCE)NH.1527-6996.0000246. https://www.designsafe-ci.org/