Recommendation for microseismic borehole monitoring at Sulphur Mines Salt Dome

(LDNR Compliance Order No. IMD 2022-027)

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Julie Shemeta
Aug. 9, 2023

Introduction. This report is an update to the planned seismic monitoring at Sulphur Mines Salt Dome and here within are proposed geometries for two borehole seismic arrays deployed in cavern wellbores PPG 6x and PPG 20.

A semi-permanent telemetered surface seismic array is currently in operation at Sulphur Mines Salt Dome. This array consists of seven stations was installed in early April 2023 (Figure 1). The detection threshold of this is array is approximately magnitude -0.5 to 0.5, depending on the background noise level on the array. Biweekly monitoring reports are sent to Louisiana Department of Natural Resources.

Figure 1. Google map image showing the semi-permanent seismic recording station locations (blue symbols) located near and at the Sulphur Mines Salt Dome.

In this updated report, we seek LDNR approval for a finalized plan to install borehole seismic arrays in two existing cavern wellbores PPG 6x and PPG 20 as proposed in the report "Plan to monitor microseismicity at Sulphur Mines Salt Dome", report date March 9, 2023. Figure 2 shows the location of the proposed microseismic monitoring wells and Cavern 7. It is the intent that the borehole seismic array system will replace the surface seismic array system, after confirmation of satisfactory performance of the borehole array system.

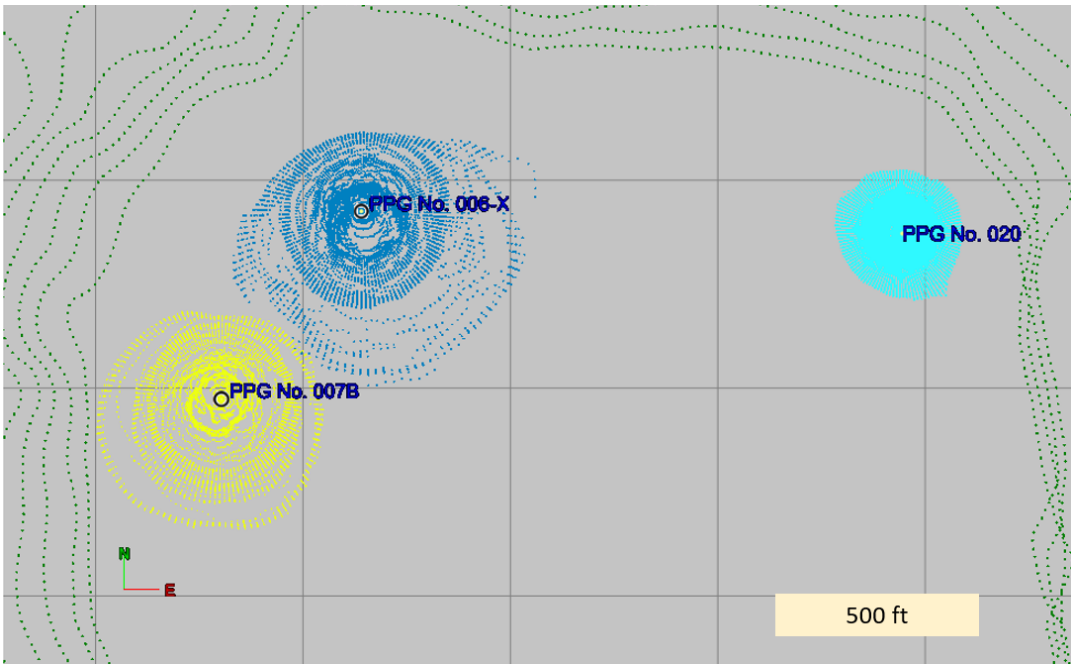


Figure 2. Map of Sulphur Mines dome and proposed microseismic monitoring wells, PPG 6X and PPG 20. The sonar surveys of Cavern 7 (yellow), Cavern 6 (blue) and Cavern 20 (aqua) and wellbore positions. Salt contours are shown by green dots. Grid is 500 feet.

Recommendation for borehole monitoring in existing wellbores. Two retrievable geophone arrays are proposed to constitute a borehole seismic network at Sulphur Mines dome, using existing available cavern wellbores PPG 6X (Serial No 57788) and PPG 20 (Serial No. 973364). These wellbores are proposed because 1) they are either inactive or planned to be converted to inactive status, 2) they have a preferred wellbore casing configuration and casing condition, 3) the feasibility modeling indicated favorable results, and 4) the background noise level surveys performed for 24 hours in May and June 2023 were acceptable levels for borehole seismic monitoring. The analysis to support the feasibility evaluation and recommendation for use as borehole seismic monitoring wells is detailed within this report.

PPG 6x Background Noise Survey

From May 31 to June 1, 2023, a 16 level geophone array was deployed in PPG 6x wellbore for about 24 hours to measure the background noise level in the wellbore to assure the feasibility of the well for long-term seismic monitoring. The geometry of the noise survey deployment is shown in Figure 3.Sixteen (16) geophones were deployed from 1652 to 2390 ft depth with 50 ft spacing between sensors in the 7 5/8 inch cemented production casing and 10 3/4 inch intermediate casing. The geophones for the noise survey were placed at a similar depth range as the suggested depth range of the proposed long-term retrievable geophone array. The background noise survey tools were deployed above a bridge plug set at 2,450 ft within the 7 5/8 inch production casing (approximately 55 ft above the final cemented production casing shoe). The bridge plug was required due to the intention of not manipulating the Cavern 6 pressure, to not depressurize Cavern 6, the inability to install the background noise survey geophone tools with pressure on the well, and to mitigate tool loss-in-cavern risk. A nitrogen gas cap was also installed in the wellbore from surface to 1,000 ft of depth in order to mitigate surface noise contamination of the data set.

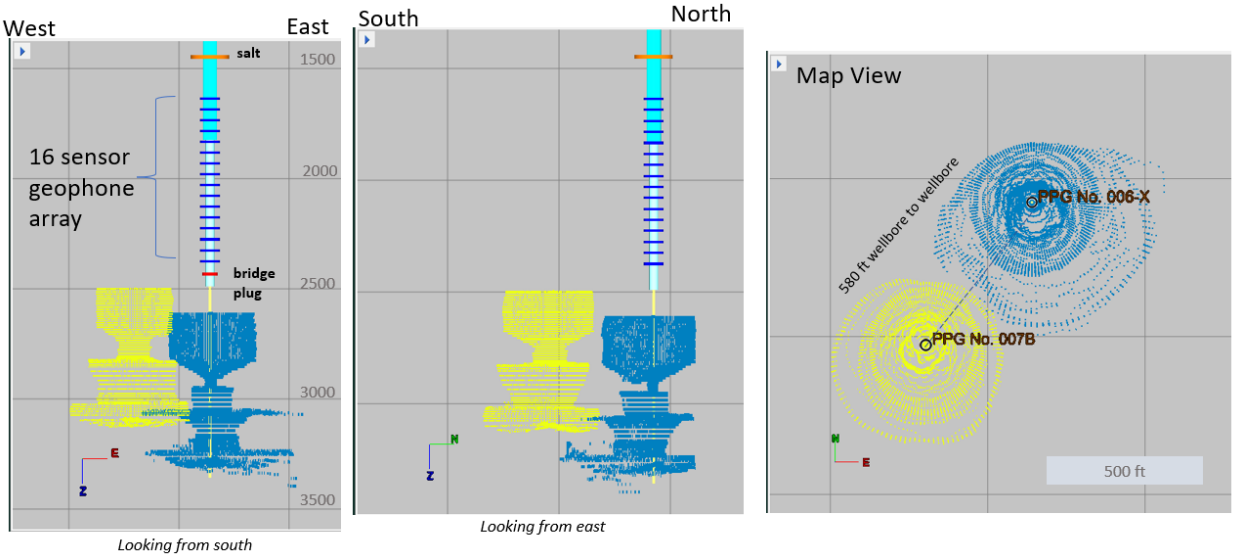


Figure 3. Geophone placement during the borehole noise survey in PPG 6x on May 31-June 1, 2023. Left (West-East) and middle (South-North) figures are cross section views of the sensors deployed in 6x (shown by dark blue markers). Red marker is bridge plug above open cavern during noise survey. Right plot is map view of the wells. Cavern 7 sonar is shown in yellow and Cavern 6 in blue. Grid is 500 ft in all figures. The 7 5/8" and 10 ¾" casing depths are shown in the wellbore.

The geophone array recorded continuous ground motion on Geospace™ DS150 geophones with magnetic clamping. The three component sensors (vertical and two orthogonal horizontal), recorded ground velocity using 2000 Hz sample rate for about 23 hours (Figure 4). A technical recording failure occurred for just over an hour on June 1 from 8:20 to 9:45 am, but this did not affect the viability of the remaining data set.

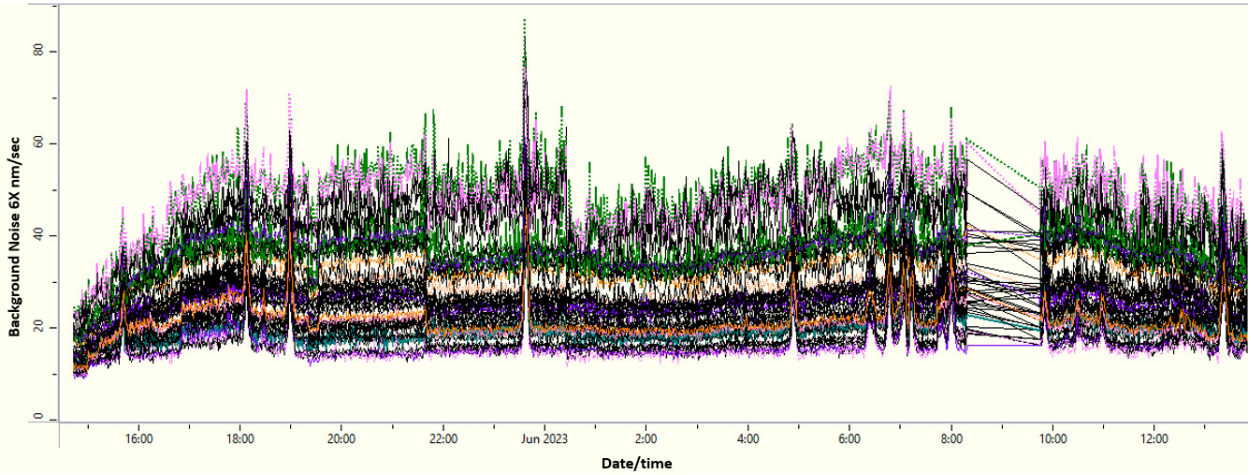


Figure 4. Background noise level in PPG 6x on May 31 to June 1, 2023. Y axis is ground motion amplitude on a 16 level geophone array, in nanometers per second.

Figure 5 shows the median of the background noise levels with depth for each geophone component. The overall median noise level in PPG 6x is ~25.5 nm/sec. The vertical sensors measured higher noise levels with a median of 30 nm/sec and the horizontal sensors were lower, 24 and 21 nm/sec respectively. Vertically-traveling surface noise was observed during the noise survey, from "tube waves", likely generated from surface noise traveling down the wellbore (Figure 6). This may have contributed to the

higher noise levels on the vertical components. A nitrogen gap was placed above the fluid level in the wellbore to suppress tube wave generation, but tube waves were recorded from time to time.

Based on the results of this noise survey, the PPG 6x wellbore background noise profile appears to be satisfactory for use as a microseismic observation wellbore. The microseismic feasibility study modeling detection threshold and location resolution was done using 25 nm/sec background noise level, similar to the noise levels recorded in PPG 6x.

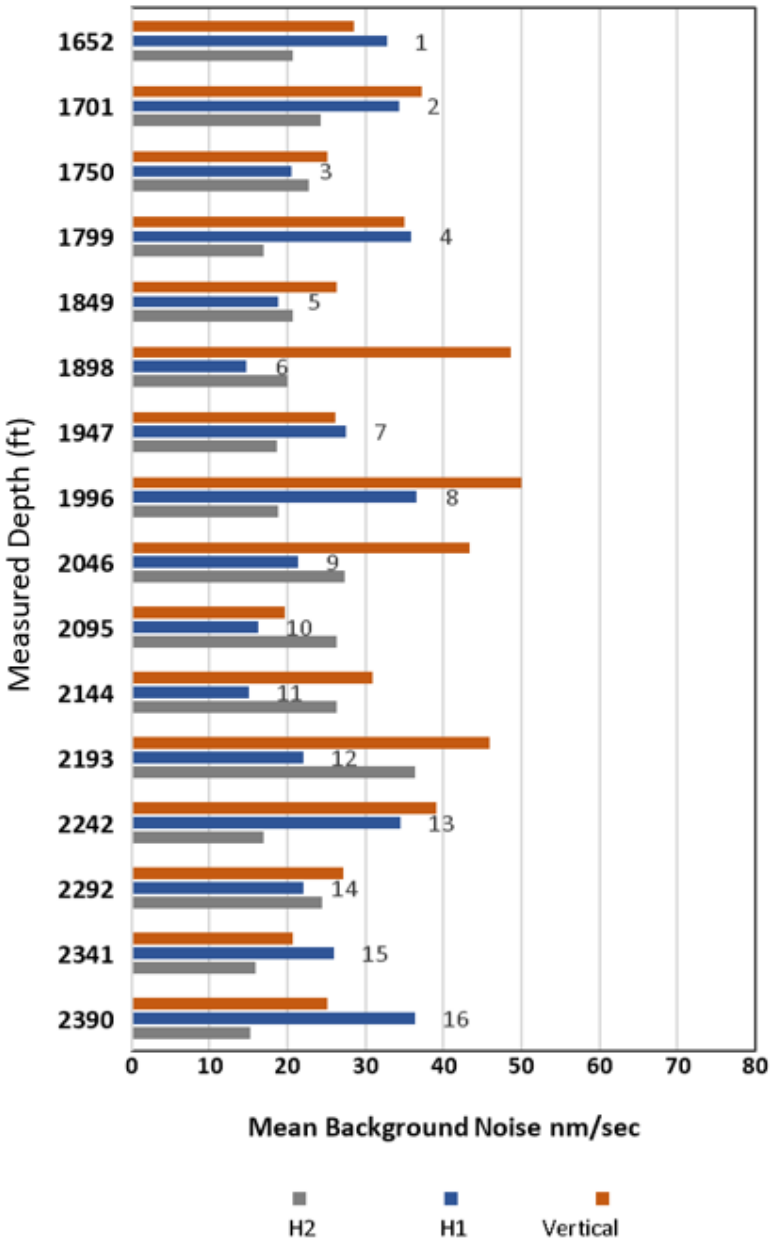


Figure 5. Median background noise recorded in PPG 6x from May 31 to June 1, as described in text. Sensor depth is on the Y axis and the X axis is median noise in nm/sec during the recording period. Vertical sensor is orange, H1 and H2 in blue and gray, as labeled. The geophone level number is plotted on the graph for each of the 16 sensor levels.

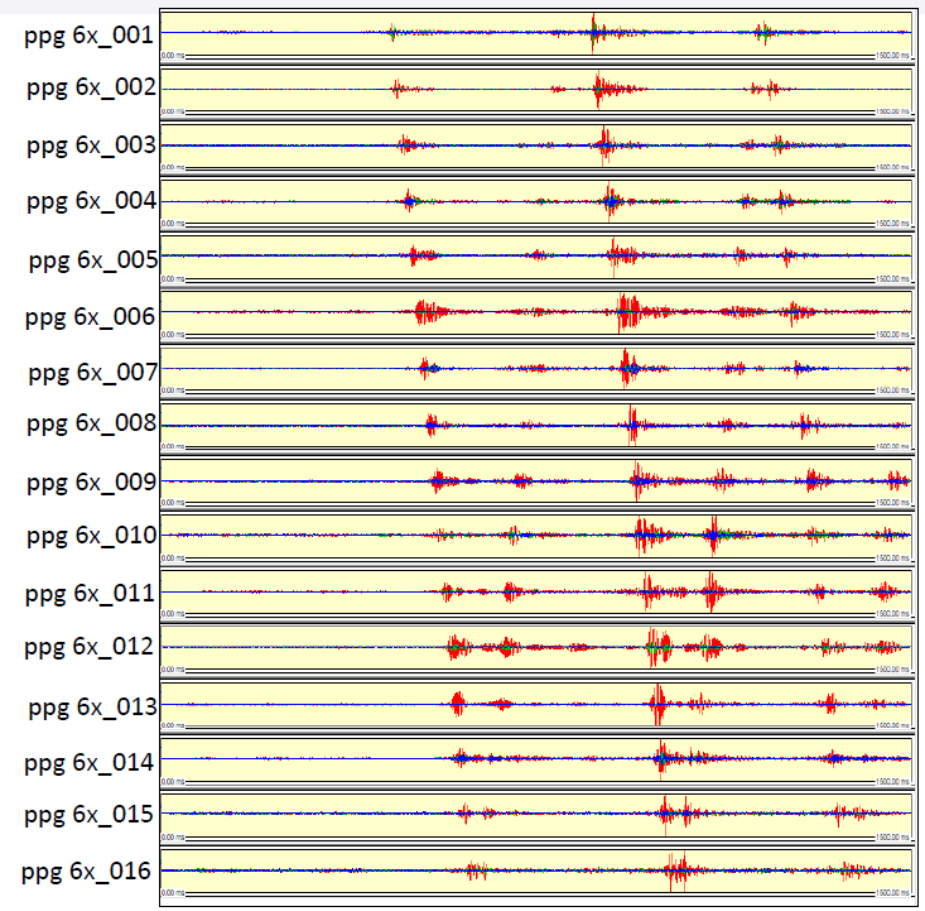


Figure 6. Seismogram (time on x-axis and seismic amplitude on Y axis for each sensor level) showing an example of a "tube wave" recorded during the PPG 6x noise survey (plot from ESG). The three component sensors are shown with overlain traces, the vertical component is plotted in red. The return reflection near the bottom of the trace is suspected to be a reflection of the tube wave off the top of the Cavern 6 (ESG, personal communication, 2023).

PPG 20 Background Noise Survey

On June 10th and 11th, 2023, a 16 level Geospace™ DS150 three-component geophone array with magnetic clamping was deployed in PPG 20 wellbore to measure the background noise level for 24 hours. The geometry of the noise survey deployment is shown in Figure 7, the 16 geophones were deployed within the 13 3/8 inch final cemented production casing and concentric 16 inch cemented intermediate casing from 1,727 to 3,185 ft depth with 100 ft spacing between sensors (using a similar depth range for the suggested depth of the long-term retrievable borehole array). The borehole tools were deployed above a bridge plug set at 3,244 ft, which is 56 feet above the final cemented production casing shoe of PPG 20. The bridge plug was required to mitigate tool loss-in-cavern risk. A nitrogen gas cap was also installed in the wellbore from surface to 1,000 ft of depth in order to mitigate surface noise contamination of the data set. The overall noise level in PPG 20 is higher than PPG 6x, the overall median noise level is 37 nm/sec. The median overall vertical noise was 36 nm/sec, H1 and H2 were 31 and 43 nm/sec respectively (Figures 8 and 9). A magnitude detection feasibility study was run for 50 nm/sec background noise and is presented below.

PPG 20 is located ~1300 ft north of Yellow Rock's Fee 1031 (SN 253998) well (Figure 7), which was actively drilling during the PPG 20 background noise survey, which may have contributed to the higher

noise during this survey. The frequency content of the background noise peaks at about 350 to 375 Hz (Figure 10). The Fee 1031 drill rig was not active during the 2nd half of PPG 6x noise survey and was jarring during the first part of the PPG 6x noise survey, thus the absence of the drill rig noise during the 6x noise survey. High noise due to active drilling is not a concern for long-term seismic monitoring at Sulphur Mines salt dome as drill rig noise is temporary and if present, can be filtered during data processing.

PPG 20 is also considered satisfactory for use as a microseismic observation wellbore a based on the results of the noise survey.

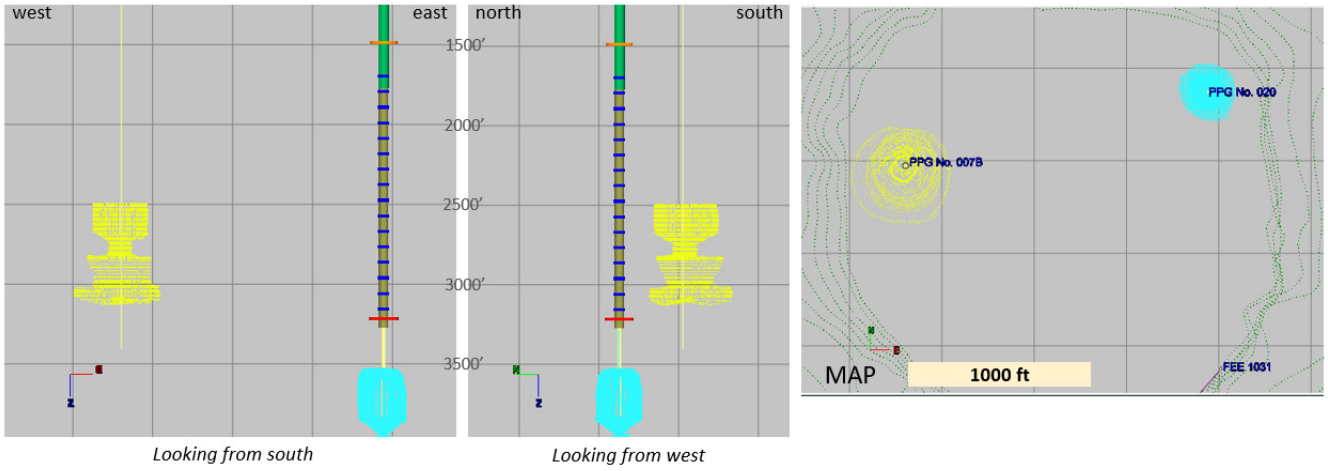


Figure 7. Geophone placement during the borehole noise survey in PPG 20 on June 11-12, 2023. Left (West-East) and middle (North-South) figures are cross section views of the sensors deployed in 20 well bore (shown by dark blue markers). Red marker is bridge plug above open cavern during noise survey and orange marker is top of salt in monitor wellbore. Right plot is map view of the wells. Cavern 7 sonar is shown in yellow and Cavern 20 in cyan. Grid is 500 ft in all figures.

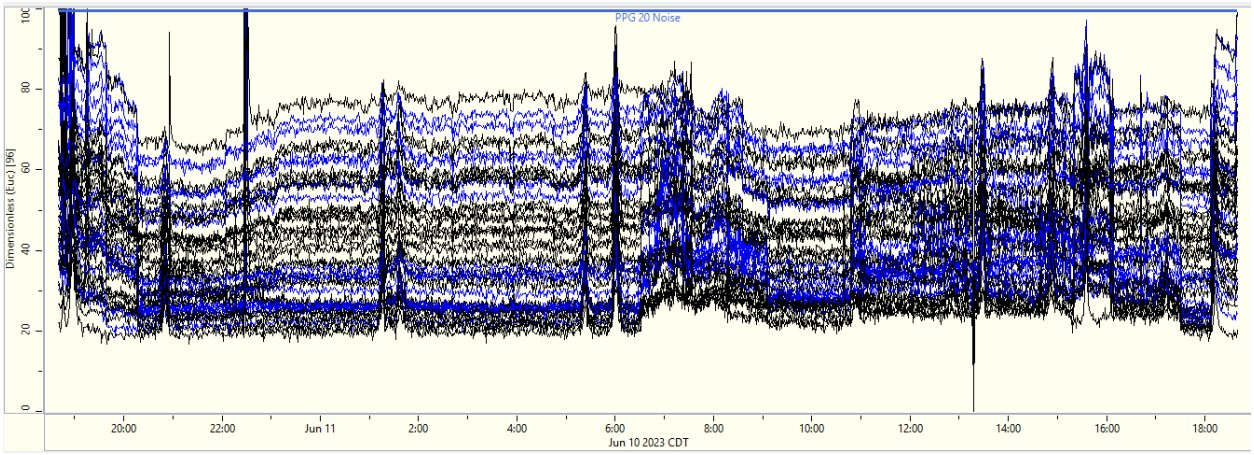


Figure 8. Background noise level versus time during the PPG 20 background noise survey on June 10-11, 2023. Y axis is ground motion amplitude on a 16 level geophone array, in nanometers per second. Blue lines are vertical geophone components, black horizontal sensors.

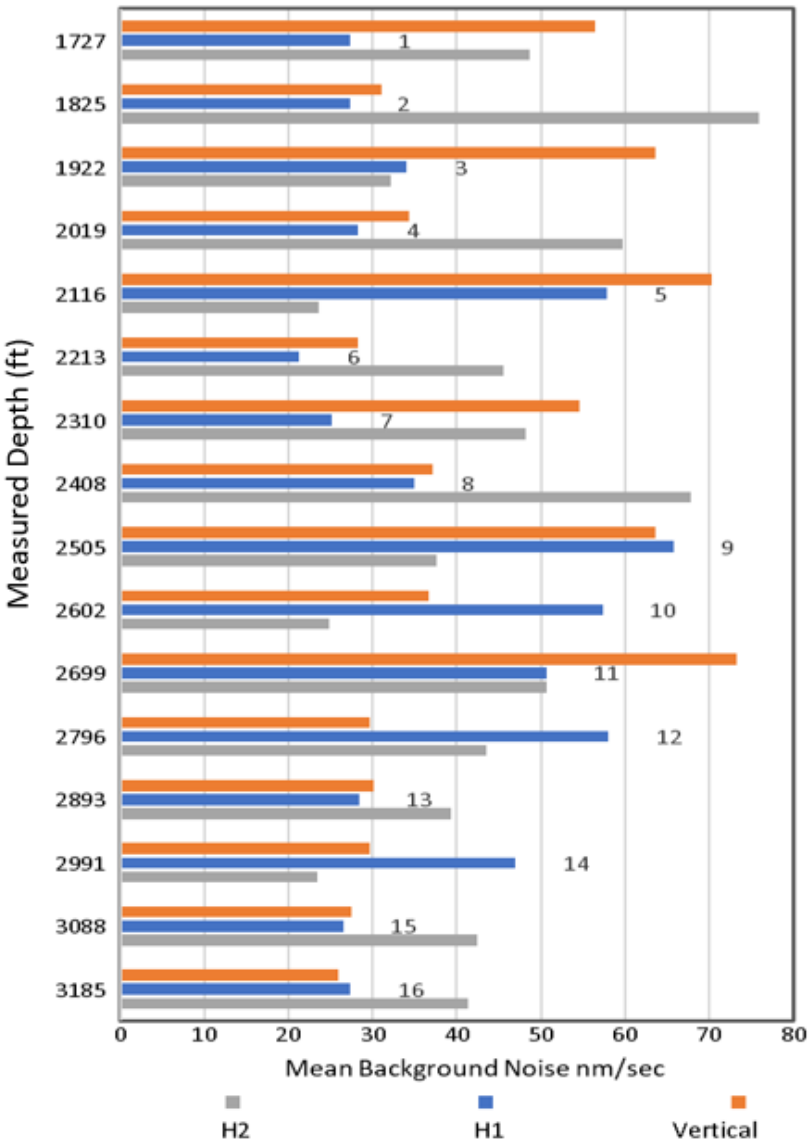


Figure 9. Median background noise recorded in PPG 20 from June 10 -11, 2023, as described in text. Sensor depth is on the Y axis and the X axis is median noise in nm/sec during the recording period. Vertical sensor is orange, H1 and H2 in blue and gray, as labeled. The sensor number is plotted on the graph.

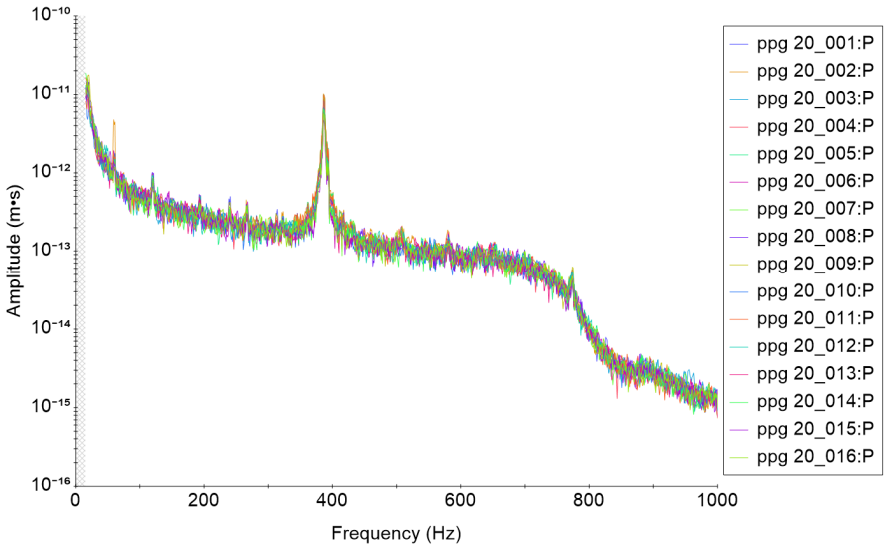


Figure 10. Spectra of a sample of background noise at PPG 20. The data has a peak at about 350 to 375 Hz. The noise peak likely due to the active drilling on the salt dome at the time by Yellow Rock south of the PPG 20 well.

Borehole Seismic Feasibility Modeling. Altcom, a UK-based seismic monitoring company, performed feasibility studies for borehole monitoring based on the sensor geometries proposed to be utilized which are shown in Figure 10 for PPG 6x and PPG 20. These feasibility studies were designed to model the location accuracy and magnitude detection threshold for seismic events in the vicinity of Cavern 7 related to the salt and sediments above and below the cavern to a depth of about 4500 ft. The model set up is shown in Figure 10 and listed in Table 1. The location uncertainty modeling results are show in Figures 11 and 12. The magnitude detection thresholds for both 25 nm/sec and 50 nm/sec background noise levels are shown in Figure 13.

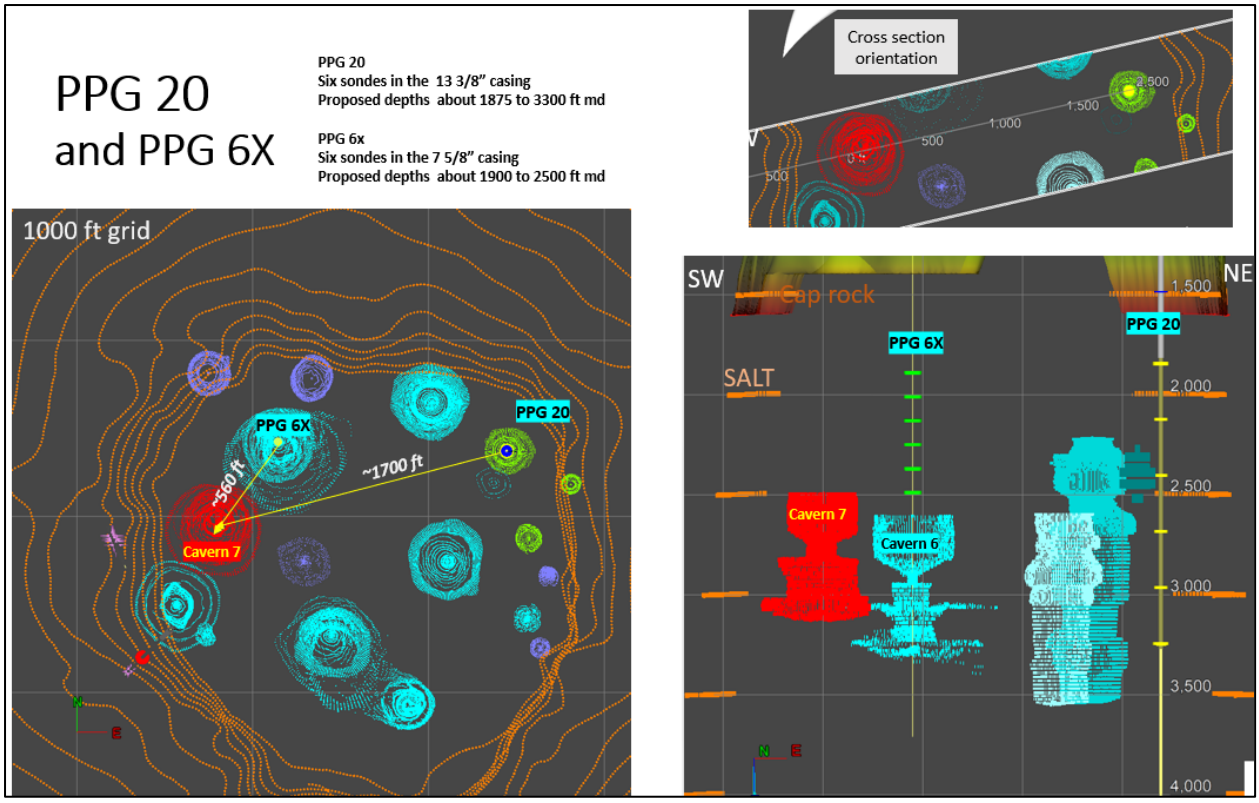
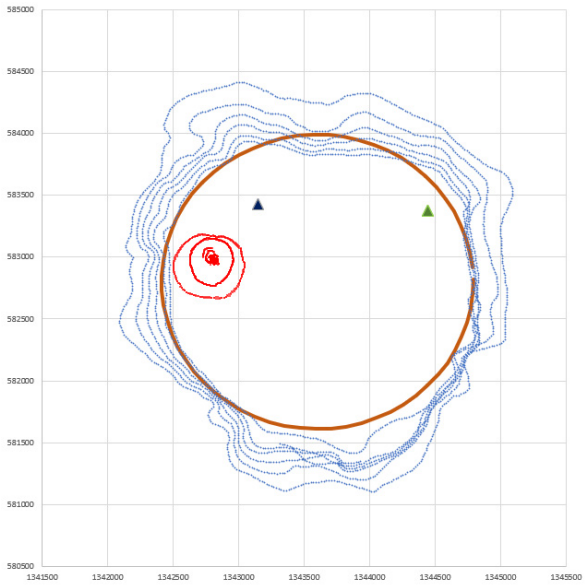


Figure 10. Map (left) and SW-NE cross section (lower right, upper right inset shows orientation of cross section) of the Sulphur Mines Salt Dome showing the location of various caverns. Cavern 7 is shown in red. Potential monitoring wells are PPG6x and PPG 20 (labeled in figures). The proposed geophone locations are shown in the cross section marked along the wellbores. Salt boundary is shown by orange dots.

Table 1. Input parameters for modeling study (left). On right is a map view of cylindrical salt body used for model study (orange circle. Light blue lines show the salt contours at Sulphur Mines. Cavern 7 is show by red dots, the observation well locations are shown by triangles.

Modeling Input Parameters		
Magnitude	-1	
RMS noise level wellbore	25 and 50 nm/sec	
Azimuth Uncertainty	±15°	
Inclination Uncertainty	±15°	
Picking Picking Uncertainty	P wave	S wave
± milliseconds	±4	±5
Velocity Model ft/sec	P wave	S wave
Salt	14,928	8,202
Sediment	7,710	4,259



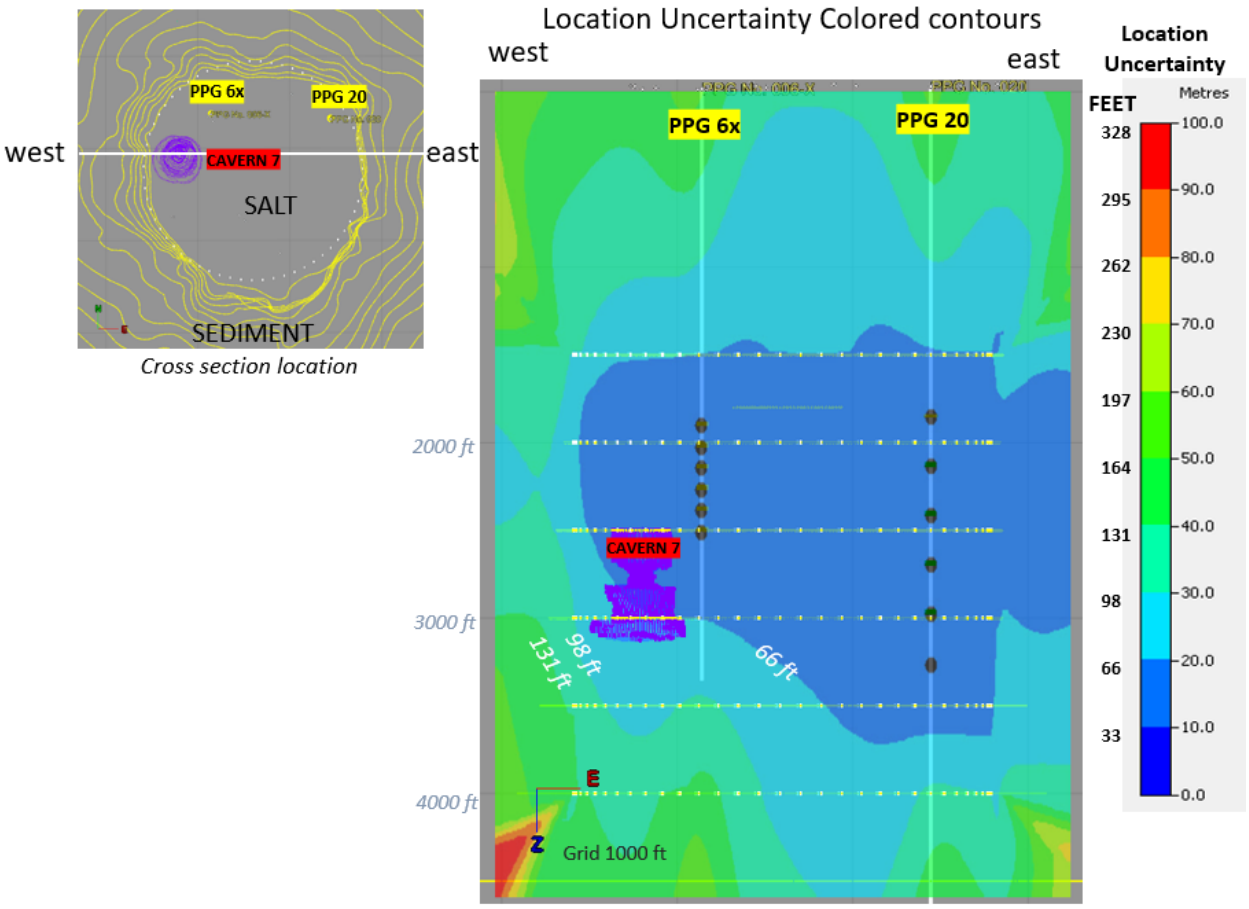


Figure 11. (Right) An east-west cross section showing the uncertainty modeling results from AltCom using wells PPG 6x and PPG 20. Depth is labeled. The upper left plot shows the location of the east-west cross section, bisecting cavern 7. The location of PPG 6x and 20 well bores and geophones are projected onto the cross section (black dots). The scale for the colored plots is show in the far right, labeled in both feet and meters. The location of cavern 7 is shown by purple dots, as labeled. The white dots show the modeled salt location.

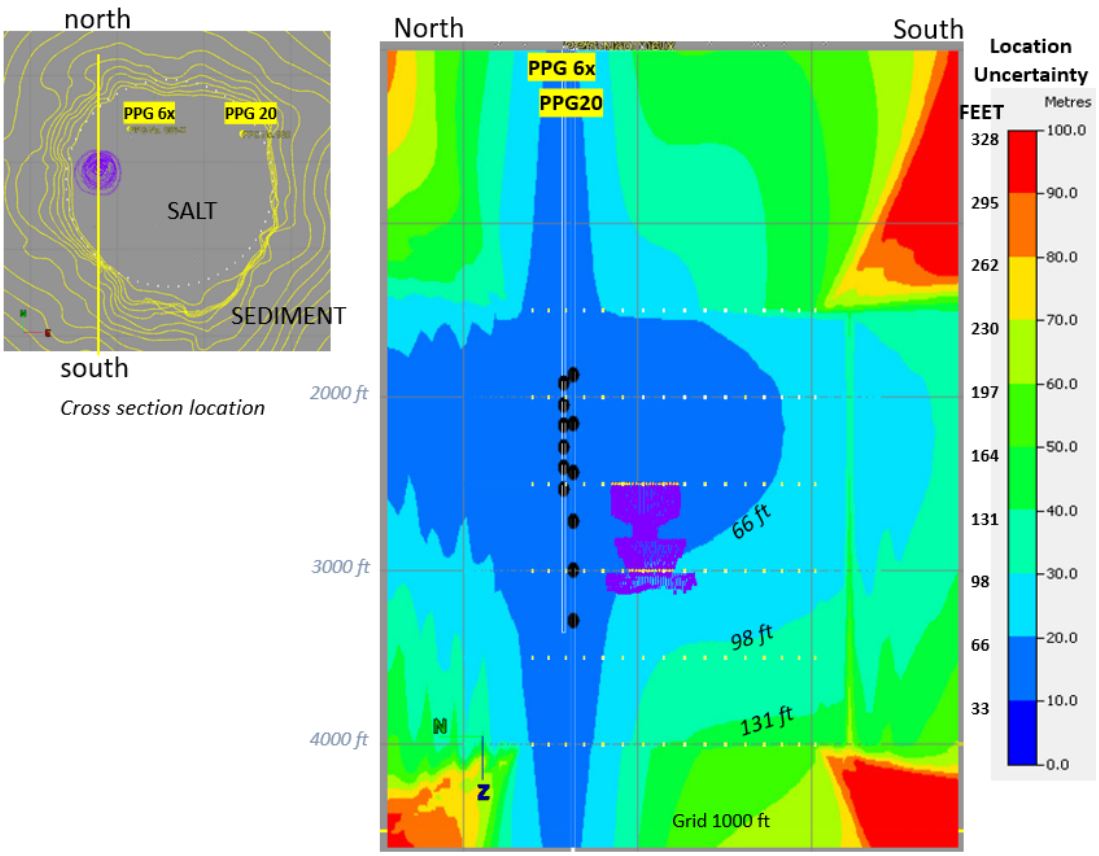


Figure 12 (Right) A north-south cross section showing the uncertainty modeling results from AltCom using wells PPG 6x and PPG 20. Grid on cross section is 1000 feet. The upper left plot shows the location of the east-west cross section, bisecting cavern 7. The location of PPG 6x and 20 well bores and geophones are projected onto the cross section (black dots). The scale for the colored plots is show in the far right, labeled in both feet and meters. The location of cavern 7 is shown by purple dots. The white dots show the modeled salt boundary.

The magnitude sensitivity modeling results using geophones in PPG 6x and PPG 20 are shown in Figure 13. Two models were run, one for a "low-noise" level of 25 nm/sec and a "high-noise" model at 50 nm/sec. The low-noise model results show a magnitude sensitivity of at least -2.25 for the entire region around cavern 7, with slightly higher magnitude sensitivity on the east side and above cavern 7 (Figure 13). The high-noise model shows -2 to -1.75 near Cavern 7 (Figure 13). For reference, the median magnitude from borehole monitoring at Napoleonville salt dome is about magnitude -1 (Shemeta, 2023).

The modeling results for both location accuracy and magnitude sensitivity suggest placing six-level removeable geophone arrays in cavern wellbores PPG 6x and PPG 20 will be suitable for borehole seismic monitoring resulting in event locations with both good location accuracy (< ±100 ft) and magnitude sensitivity (> -2.25 to -1.75, for low and high background noise levels).

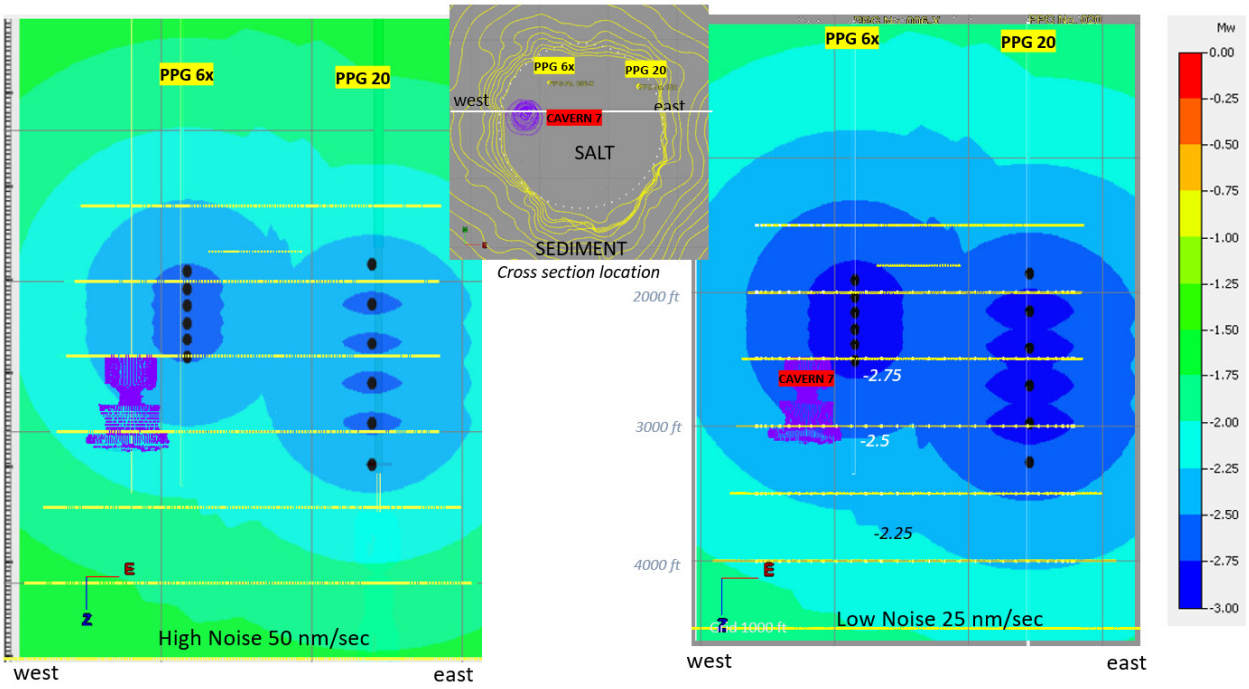


Figure 13. (Right and Left) A east-west cross sections showing the magnitude sensitivity modeling results from AltCom using wells PPG 6x and PPG 20. Left is modeling with "high noise" 50 nm/sec noise level and right is "low noise" 25 nm/sec noise level. Grid on cross section is 1000 feet. The upper center plot shows the location of the east-west cross section, bisecting cavern 7. The location of PPG 6x and 20 well bores and geophones are projected onto the cross section (black dots). The scale for the colored plots is show in the far right. The location of cavern 7 is shown by purple dots and label. The white dots show the modeled cylindrical salt boundary, the yellow dots the interpreted salt geometry.

Sensor Placement. The sensor depth placement of the Avalon retrievable geophone arrays in each well was chosen to: 1) place the geophones in a single layer of cemented casing to improve signal coupling to the salt and 2) extend the length of the array as much as possible to improve the resolution of interpreting the event locations, 3) avoid areas of poor cement and use the background noise survey results to help guide the sensor placement.

PPG 6x Recommended Sensor Placement. The borehole geophones in the PPG 6X wellbore will be placed approximately 125 feet apart, within the 7 5/8" cemented production casing from approximately 1,860 ft MD to 2,485 ft (Figure 14 and Exhibit 1). The background noise survey was within acceptable levels for almost all of the sensor positions and the Cement Bond log from June 2023 showed good bond from 1800 feet MD to the casing shoe (C. Sessions, Lonquist, personal communication, 2023).

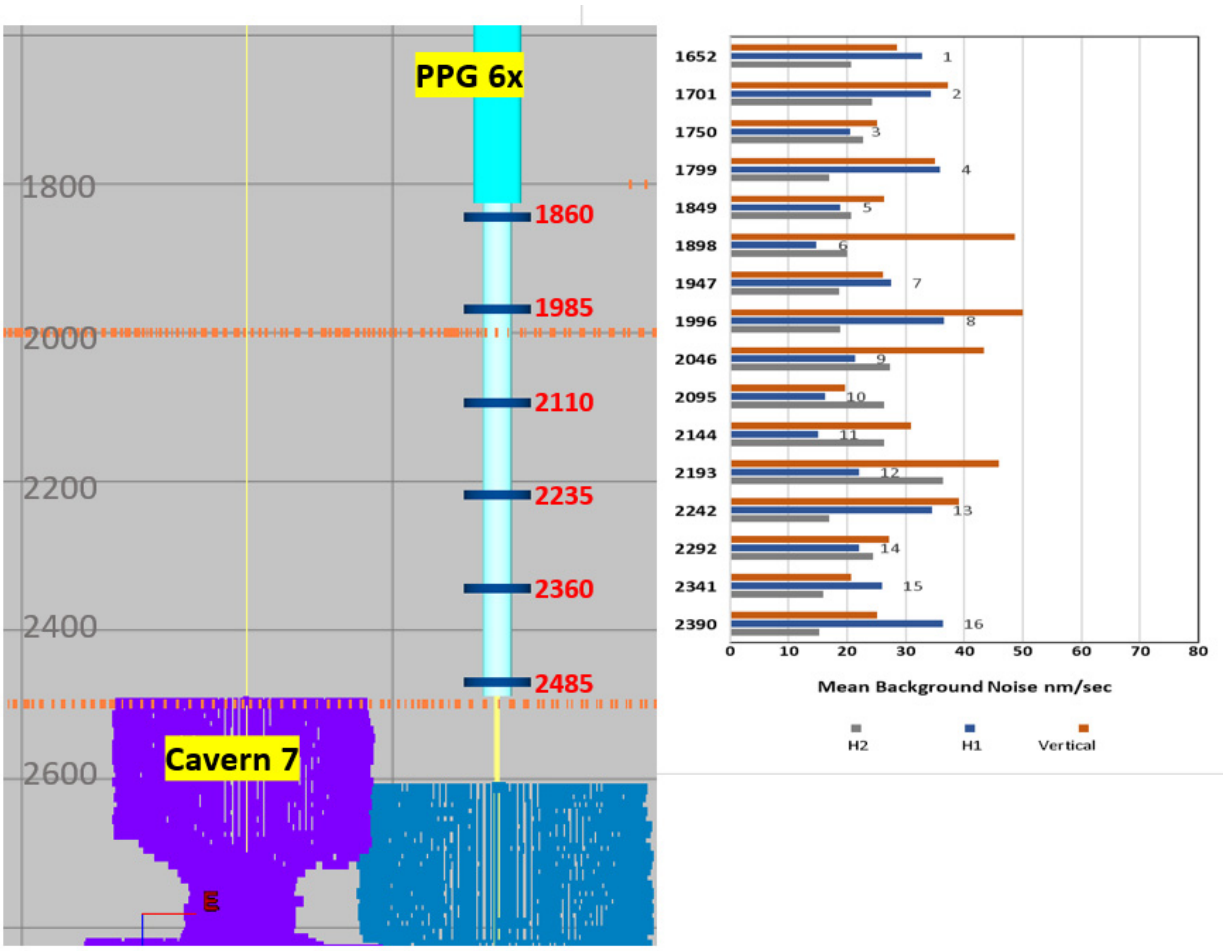


Figure 14. Left shows vertical West-East cross section showing the PPG 6x suggested sensor placement. Right plot is noise survey results in 6x.

PPG 20 Recommended Sensor Placement. Figure 15 and Exhibit 2 shows the suggested placment for the six Avalon sensors in PPG 20. The background noise level and the 2023 Cement Bond log was used to help guide the sensor placement. The bottom sensor depth will be placed as deep as possible in the 13 3/8 inch production casing, the bottom of the casing is at 3,300 ft. The sensors proposed for the wellbore of PPG 20 will be within the 13 3/8" cemented production casing, spaced at approximately 280 feet apart and span from approximately 1,850 ft to 3,230 ft. Poor quality cement was noted in the PPG 20 cement bond log run on June 8, 2023 between approximately 2612-2664 ft, however, this section of the wellbore was not used to place a geophone.

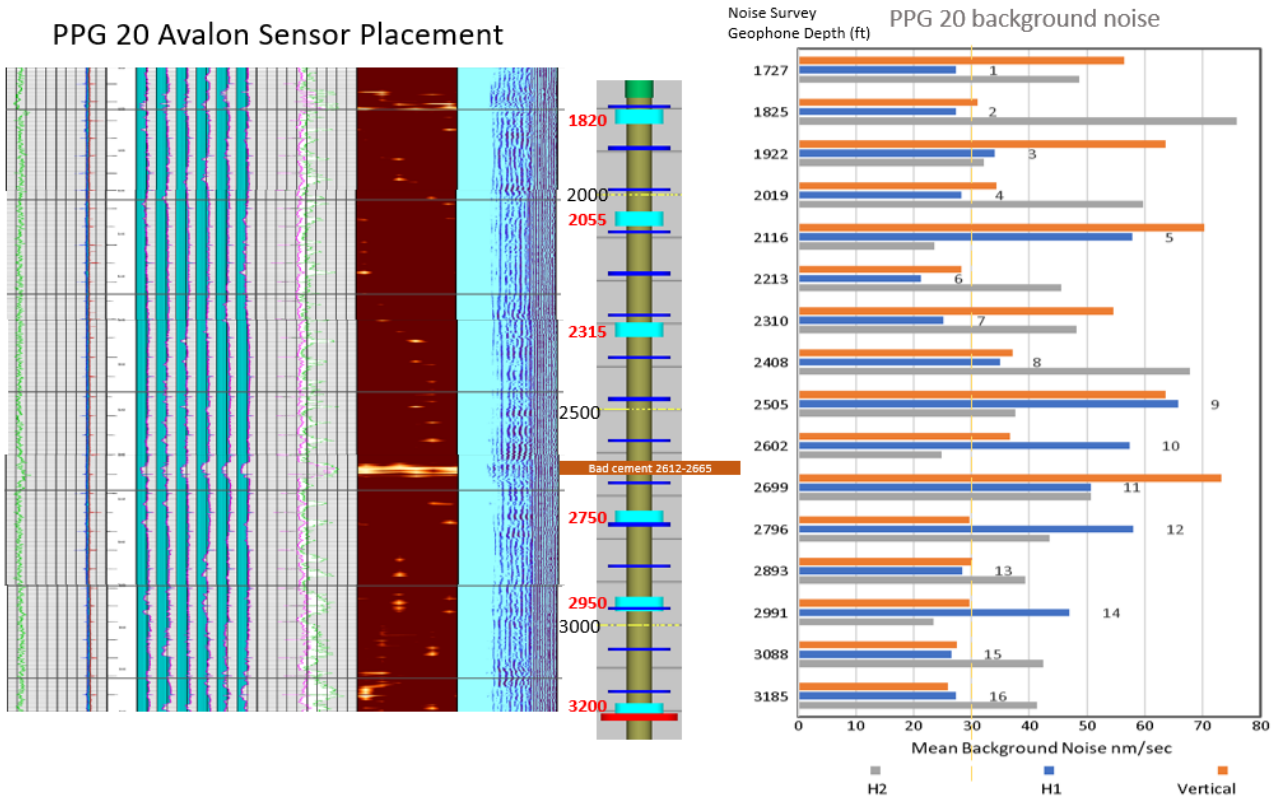


Figure 15. Avalon sensor placement for the PPG 20 wellbore. Cement bond log for PPG 20 (left), center shows schematic of suggested depth for the six Avalon tools (cyan) and noise survey geophones (dark blue), right most plot is median background noise for 24 hour time period in PPG 20. Poor cement is noted from ~2612 to 2665, where no geophones are planned to be installed.

PPG 6x and PPG 20 Final Cemented Casing Condition. During the noise monitoring workovers taken place in Q2 2023, a full suite of casing inspection logs was performed on the final cemented production casing of both wells including a wall thickness measurement (Weatherford Flux View on PPG 6X, and Baker Hughes Vertilog on PPG 20). On PPG 6X, the wall thickness log shows the overall wellbore cemented production casing is in good condition with no concerning anomalies or casing deformations. On PPG 6x, there are some noted class 2 joints below 1,800' but there are no concerns of any rapid changes in further wall loss. Similarly, on PPG 20, the wall thickness log indicates the overall wellbore cemented production casing is in good condition with no concerning anomalies or casing deformations. There are some noted class 2 joints that appear to be minor internal pitting and do not cause concerns regarding current and future integrity or use of the well as a geophone monitoring well. In conclusion, the cemented production casing integrity on both wells is proven to be in good condition.

Concluding comments. The two wellbores are recommended to be instrumented with an Avalon Sciences Ltd. custom-built, six-level analog 14 Hz, three-component geophone array. Each array will include a pressure and temperature (PT) gauge suspended below the geophone array to measure downhole pressure and temperature data. The 6X PT gauge will be, generally, immediately below the geophones (~2,500 ft depth) due to Cavern 6 remaining planned to be remaining pressurized at the time of the system install on that well, which requires a bridge plug to be installed in the bottom of the 7 5/8" production casing to temporarily isolate the Cavern 6 pressure from the wellbore. A pump-out sub will be incorporated into the bridge plug so that after the initial geophone install, cavern pressure can be re-

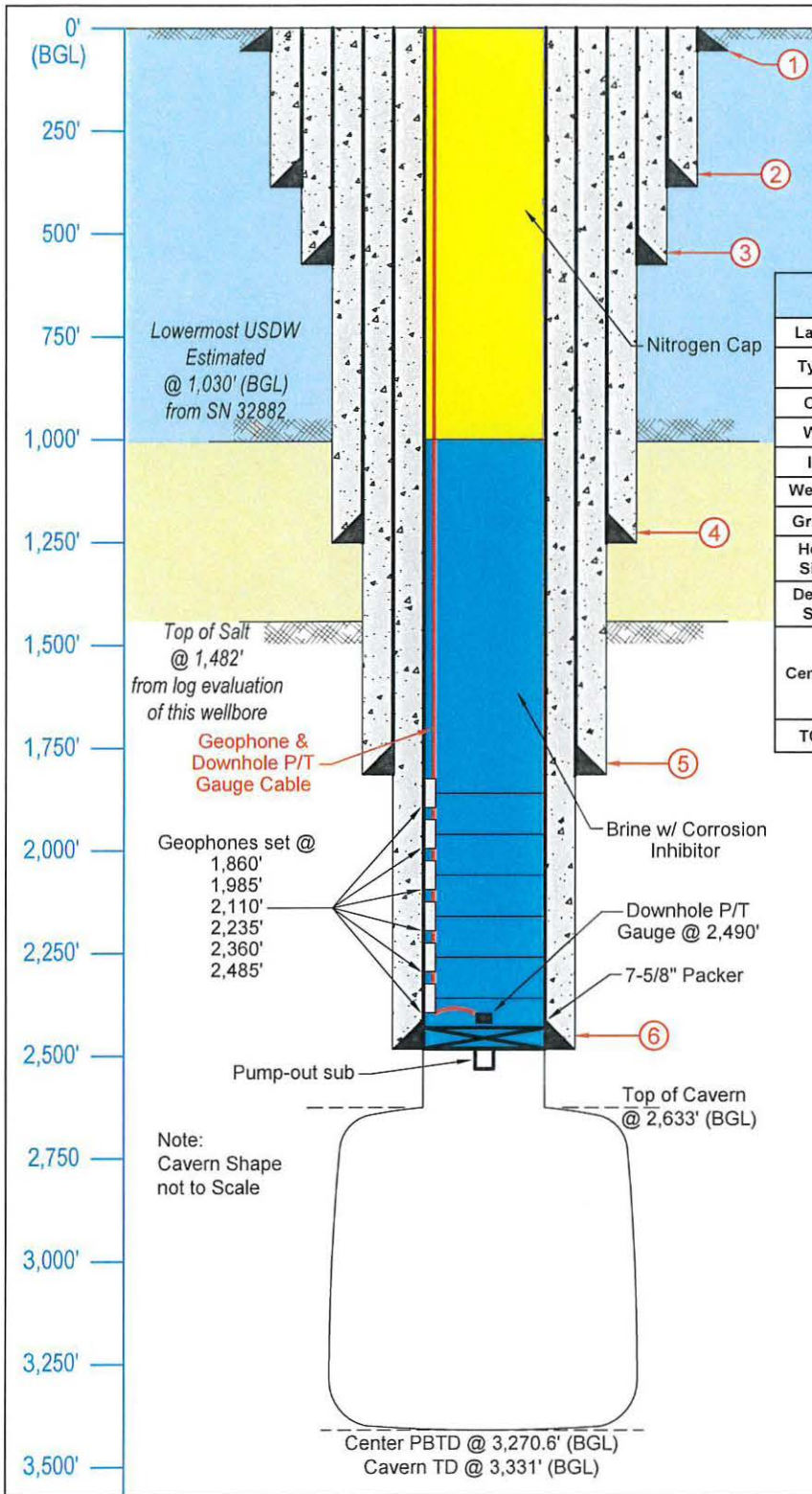
introduced to the PPG 6X cased wellbore, geophone string, and PT gauge. The PPG 20 array will have a PT gauge suspended into the salt cavern body (~3,600 ft – approximately 50 ft below the cavern roof) with no need for a bridge plug during the initial installation of the geophone string (because Cavern 20 can be de-pressured). Six geophone levels are the maximum number of sensors available for Avalon's retrievable analog seismic array. The Avalon borehole seismic array has a time-delayed clamp arm that will position the geophones in direct contact with the cemented casing and at proposed depths for each geophone where good cement bond was indicated on the cement evaluation log of each well to achieve optimum geophone detection performance. With this system the entire borehole array can be removed if access to the cavern is needed or if the borehole sensors need maintenance. The wellbores will also incorporate a nitrogen gas cap in the upper 1,000 ft of the wellbore (to mitigate surface background noise affects), and a corrosion inhibitor fluid will be installed across the geophone arrays in both wells. Please see Exhibit 1 and 2 for the proposed wellbore diagrams.

Plans following LDNR approval. Following the approval of the updated seismic monitoring plan by LDNR, an order will be placed with Avalon Sciences Ltd. for the two arrays. The build time for the custom seismic arrays varies, but is estimated to be completed in ~24 weeks upon initiation of the materials/design order, and installation of the materials into the wellbores would be completed within 2-3 weeks of material delivery. Depending on the seismic activity observed at Sulphur Mines dome and after confirmation of adequate operation of the borehole array (Phase 3), the semi-permanent surface array (Phase 2) will likely be removed.

We propose the microseismic activity reporting for the borehole arrays will be weekly and a preliminary seismic alert system will be developed in order to inform LDNR of any significant changes of microseismic activity. We anticipate it will take about 30 days of monitoring prior to development of the alert system. Depending on the seismic activity level and other monitoring data, we will continue to discuss reporting and alerts with LDNR to assure the results are reported in a timely manner.

References

Shemeta, J., 2023, Borehole Microseismic Monitoring at Napoleonville Salt Dome, Louisiana: Nine Years of Microseismicity Associated with Brining and Storage Facilities on a Gulf Coast Salt Dome, USA, abstract submitted for the Solution Mining Research Institute Spring 2023 Technical Conference, to be presented at Detroit, Michigan 23-26 April 2023.



GL:	12.0'
Spud:	8-26-1955
Depths indicated are Measured Depths unless otherwise noted	

Casing Information

Label	1	2	3	4	5	6
Type	Drive Pipe	Conductor #1	Conductor #2	Surface	Intermediate	Production
OD	30"	18"	16"	13-3/8"	10-3/4"	7-5/8"
WT	N/A	N/A	0.375"	0.38"	0.279"	0.328"
ID	N/A	N/A	15.25"	12.615"	10.192"	6.969"
Weight	N/A	N/A	62.50 lb/ft	54.5 lb/ft	32.75 lb/ft	26.50 lb/ft
Grade	N/A	N/A	H Welded	J-55 8RD	J-55 8RD	K-55 8RD
Hole Size	30"	22"	22"	15"	13-3/8"	12-1/4"
Depth Set	48'	407'	607'	1,272'	1,841'	2,505'
Cement	Driven to Refusal	Volume: unknown	Volume: 500 sks	Volume: 335 sks	Volume: 500 sks	Volume: 500 sks
TOC		Surface	Surface	Surface	Surface	Surface

STATE OF LOUISIANA
BEN H. BERGMAN
License No. 40184
8/7/23
PROFESSIONAL ENGINEER
P.E.

Additional Notes

Sonar Data:
Date: 3-12-2022 Sonar Volume: 10,007,580 bbls
Top of Cavern: 2,633' Bottom of Cavern: 3,331'
Max Radius: 390.8' in E-SE direction @ 3,085' depth

Sonar Data:
Date: 7-6-2016 Sonar Volume: 10,125,698.5 bbls
Top of Cavern: 2,628' Bottom of Cavern: 3,271'
Max Radius: 430.7' in E-NE direction @ 3,081' depth

Sonar Data:
Date: 7-13-2011 Sonar Volume: 10,291,696 bbls
Top of Cavern: 2,628' Bottom of Cavern: 3,412'
Max Radius: 424.4' in E-NE direction @ 3,085' depth

LONQUIST FIELD SERVICE
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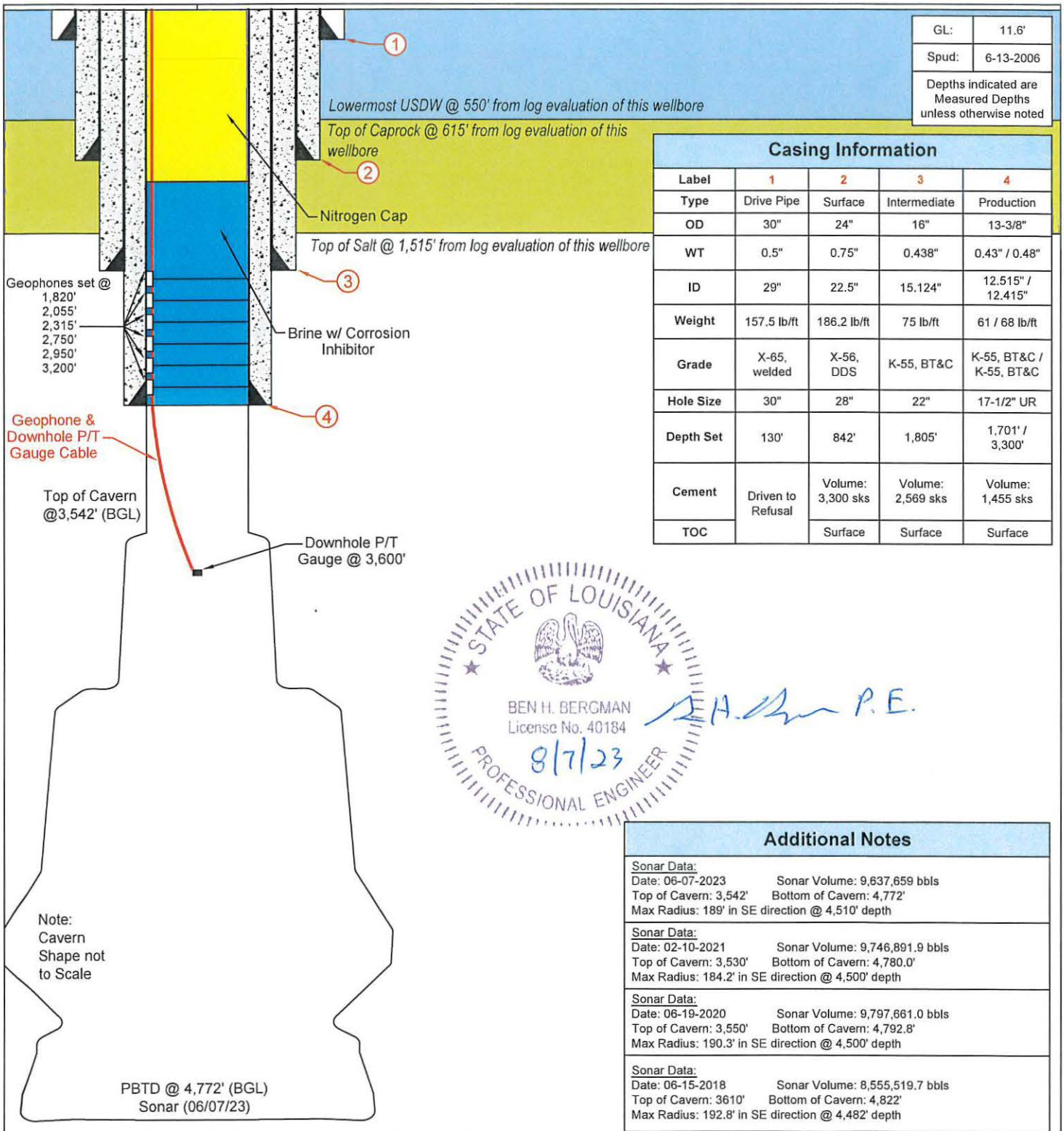
HOUSTON | CALGARY

Louisiana License EF-5853

1415 Lousiana Street, Suite 3800
Houston, Texas 77002
Tel: 713.559.9990

Westlake US 2, LLC	PPG No. 006-X	
Country: USA	**State/Province:** Louisiana	**County/Parish:** Calcasieu
Location: 12 mi. west of Lake Charles	**Site:** Sulphur Mines Brine Field	**Status:** Inactive
Survey/STR: S-029 T-09S R-10W	**Field:** Sulphur Mines (8759)	**Serial No:** 57788
Well API No: 17-019-04009	**Project No:** F2219.14	**Date:** 08/07/2023
Drawn: Joseph Lovewell	**Reviewed:** R. Coleman Hale, P.E.	**Approved:** Ben H. Bergman, P.E.
Rev No:	**Notes:** Geophone Monitoring	



GL:	11.6'
Spud:	6-13-2006
Depths indicated are Measured Depths unless otherwise noted	

Casing Information

Label	1	2	3	4
Type	Drive Pipe	Surface	Intermediate	Production
OD	30"	24"	16"	13-3/8"
WT	0.5"	0.75"	0.438"	0.43" / 0.48"
ID	29"	22.5"	15.124"	12.515" / 12.415"
Weight	157.5 lb/ft	186.2 lb/ft	75 lb/ft	61 / 68 lb/ft
Grade	X-65, welded	X-56, DDS	K-55, BT&C	K-55, BT&C / K-55, BT&C
Hole Size	30"	28"	22"	17-1/2" UR
Depth Set	130'	842'	1,805'	1,701' / 3,300'
Cement	Driven to Refusal	Volume: 3,300 sks	Volume: 2,569 sks	Volume: 1,455 sks
TOC		Surface	Surface	Surface

STATE OF LOUISIANA
BEN H. BERGMAN
License No. 40184
8/7/23
PROFESSIONAL ENGINEER
B.H. Bergman P.E.

Additional Notes

Sonar Data:
Date: 06-07-2023 Sonar Volume: 9,637,659 bbls
Top of Cavern: 3,542' Bottom of Cavern: 4,772'
Max Radius: 189' in SE direction @ 4,510' depth

Sonar Data:
Date: 02-10-2021 Sonar Volume: 9,746,891.9 bbls
Top of Cavern: 3,530' Bottom of Cavern: 4,780.0'
Max Radius: 184.2' in SE direction @ 4,500' depth

Sonar Data:
Date: 06-19-2020 Sonar Volume: 9,797,661.0 bbls
Top of Cavern: 3,550' Bottom of Cavern: 4,792.8'
Max Radius: 190.3' in SE direction @ 4,500' depth

Sonar Data:
Date: 06-15-2018 Sonar Volume: 8,555,519.7 bbls
Top of Cavern: 3610' Bottom of Cavern: 4,822'
Max Radius: 192.8' in SE direction @ 4,482' depth

LONQUIST FIELD SERVICE
HOUSTON CALGARY AUSTIN WICHITA DENVER

Louisiana License EF-5853

1415 Louisiana St., Suite 3800
Houston, Texas 77002
Tel: 713.559.9950
Fax: 713.559.9959

Westlake US 2, LLC

PPG Well No. 020

Country: USA	**State/Province:** Louisiana	**County/Parish:** Calcasieu
Location: 12 mi. west of Lake Charles	**Site:** Sulphur Mines Brine Field	**Status:** Active Injection
Survey/STR: S-029 T-09S R-10W	**Field:** Sulphur Mines (8759)	**Serial No:** 973364
Well API No: 17-019-88089	**Project No:** F2219.14	**Date:** 08/07/2023
Drawn: Joseph Lovewell	**Reviewed:** R. Coleman Hale, P.E.	**Approved:** Ben H. Bergman, P.E.
Rev No:	**Notes:** Geophone Monitoring	