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March 13, 2023

Stephen H. Lee, Director
Louisiana Department of Natural Resources
Injection and Mining Division
617 N. 3rd Street
Baton Rouge, Louisiana 70802

Re: Response to Notice of Deficiencies in Reference to the Response to the 1st Supplement to Compliance Order No. IMD 2022-027 Eagle US 2, LLC – Well 6X (SN 57788) & Well 7B (SN 67270)

Dear Mr. Lee,

This response letter is submitted on behalf of Eagle US 2, LLC ("Westlake") who received the Notice of Deficiencies ("NOD") on March 3, 2023; in reference to the Response to the 1st Supplement to Compliance Order No. IMD 2022-027. The NOD required a response within ten (10) days from receipt of letter.

NOD's:

Attachment A – USDW/Surface Water Impacts & Monitoring Plan:

**Reference *Attachment A* for updated plan.

1. The caprock contour data shown on Figure 2 were provided by Lonquist (June 2017, *EAGLE US 2, LLC WELL NO. 25 PERMIT*, Att 9-2). In preparing Figure 2, the -400 contours were inadvertently removed. A revised Figure 2 is provided. The caprock is generally encountered between 600 and 1,000 feet below ground surface beneath the Westlake property on the western portion of the dome. However, the caprock has been encountered at depths less than 400 feet deep in some areas on the eastern side of the dome.
    - See updated Figures as *Attachment A(a)*.
2. The salt depth contours shown on Figure 3 were provided by Lonquist (*Salt Cavern Compliance: 2020 Update*). The data indicate that the top of salt is encountered between approximately 1,000 and 1,500 feet below ground surface.
    - See updated Figures as *Attachment A(a)*.
3. See response to Point 2.
4. Regarding the top of salt contours, please see response for Point 2. Regarding inclusion of all existing caverns on Figure 4, Westlake is of the understanding that all caverns are already included. To provide some clarity on where the LDNR may be identifying a variance with specifically two wells:

- SN 32825 is Brine Well No. 5 drilled by Southern Alkali Corp. (predecessor to PPG). Based on the few documents that are scanned in, there is no indication that Brine Well No. 5 was actually solution mined as a cavern, and there are no available sonars to Westlake's knowledge. The Brine Well No. 5 permit was issued on Jan. 6, 1947. The well was drilled to 1440', surface casing set to 490', and then the well was plugged on April 22, 1947. There are NAD-27 State Plane Coordinates in SONRIS, but there is no "cavern outline".
- SN 973478 is Liberty Gas Storage Well No. 002A which was a second entry well drilled into Liberty Gas Storage Cavern No. 2, and that cavern is outlined on the map.

5. The data were provided by Lonquist and are not original work from ERM. The data were provided in the Fig2 Ref and the *Salt Cavern Compliance: 2020 Update*, and were stamped by a Louisiana licensed PG. References to the Lonquist data have been added to Figures 2, 3, and 4.
    - See updated Figures as *Attachment A(a)*.
6. Surface water criteria were obtained from the current (June 9, 2022) LAC Title 33 Part IX, Table 3-Numeric Criteria and Designated Uses for subsegments 031001 and 030901. The numerical criteria for these drainage basin subsegments are listed as N/A (not available at this time). Bayou d'Inde is listed as artificially impaired for fish and wildlife propagation, primary contact recreation, and secondary contact recreation, (LDEQ 2022 Louisiana's Water Quality Integrated Report, Appendix A). At present, the "Environmental Remedial Evaluation Report" referenced has not been reviewed. A public request has been made to obtain a copy of the report. We were informed that LDNR could not produce the document as it was labeled as "Privileged." Counsel for Westlake asked counsel for Yellow Rock to waive any objection to production of the report. Counsel for Yellow Rock denied that request.
7. The additional details to implement the UDSW evaluation are discussed in the response to Point 8 below. The Work Plan does not specifically address how the USDW will be protected because there is still some uncertainty regarding the depth of the USDW both above and off the dome The Work Plan was prepared to address some of the unknowns and better understand the USDW and potential impacts, either from existing sources such as produced water injected into the caprock, naturally-occurring shallow hydrocarbons, historical sulfur extraction, historical and current exploration and production (E&P) operations, Cavern 7 or other potential sources not related to Cavern 7.
8. The USDW will be evaluated using publicly available data from LDNR's SONRIS database, available publications and literature, and existing technical reports. Research is currently ongoing to obtain access to available sources. The foundation of the USDW evaluation will be Lonquist's October 2014 "*Statewide Order 29-M-3 Compliance Review & Evaluation,*" with additional/more recent data utilized to further refine the USDW. A review will be conducted to ensure available well logs are utilized to establish the USDW in accordance with LDNR guidance (0-1000' <3, 1,000-2,000' <2.5, and >2,000' 2 ohms deep induction with net 100 feet shale

below base of USDW) corrected for borehole deviation. Once all the data are obtained, reviewed, and compiled, a USDW determination will be presented to LDNR for approval.

9. Westlake (Eagle) currently utilizes 5 water wells to provide fresh water for its brine operations. One of the wells is newly installed and is not operational at this time. These wells were selected to be sampled as the closest water wells to Cavern 7 and the most likely to be impacted by any potential release into the USDW from Cavern 7. Based on the publicly available data, knowledgeable on-site personnel, and site reconnaissance, there are no water wells located on the dome. Several shallow monitoring wells have been installed on the dome to depths of approximately 15 feet deep. Many of these monitoring wells could not be located, or are plugged or damaged, and only two were identified as open and accessible, but their condition is unknown. The monitoring wells were not sampled because they are installed in the Chicot upper confining zone which is not representative of the Chicot sands used for industrial and public supply.

   One additional unregistered water well has been identified on private property east of Cavern 7 (see Revised Figure 7). This well was inspected and sampled on March 9, 2023. No additional information is available for this well at this time. This well will be included in the sampling plan with the industrial water wells.

   - See updated Figures as *Attachment A(a)*.

   Monitoring wells have not been proposed to be installed for the following reasons:

   - Sulfur extraction, oil and gas production, brine mining, and hydrocarbon storage operations on the dome have been occurring for over 100 years. Produced saltwater injection has been occurring into the caprock for many decades. Within the last 10 years alone, approximately 2 million barrels of produced water have been injected into the caprock at well SN 110159, and over 4 million barrels of produced water have been injected into the caprock at well SN 109963. Installing monitoring wells on the or near the caprock will likely not provide a representative sample of groundwater off the dome that is potentially consumed for public supply.
   - Due to location of the top Caven 7 on the western side of the dome at a depth of approximately 2,500 feet below the ground surface any potential release from Cavern 7 would likely occur on the western side of the dome. Groundwater flow within the USDW would likely tend to flow toward the industrial water wells due to the structure of the salt dome/caprock potentially acting as a barrier and the influence of high volume (>1,500 gallons per minute), long duration industrial pumping centers to the west/southwest.
   - There are four observation wells installed by Boardwalk on the eastern side of the dome that could potentially be used to monitor water levels or

constituent concentrations. The condition and accessibility of these wells is not known and Westlake is working to obtain access to these wells.

- A water well survey will be conducted to identify water wells that can potentially be used as sampling/monitoring points.
- There has been no indication that monitoring wells are warranted. The groundwater samples collected to date do not indicate the presence of any constituent concentrations that would preclude the use of the USDW.

10. Water well sampling will be conducted on a monthly basis going forward beginning in March 2023. The first samples were collected on January 25-26, 2023.
11. The groundwater analytical parameters were selected based on the water sampling required at similar sites (i.e., typical constituents of concern in the vicinity of producing salt domes). Cations and anions allow for comparative water quality evaluation over time. The other proposed constituents were selected to identify the constituents most likely to be observed as a result of impacts from a brine, or hydrocarbon release to the USDW. Hydrogen sulfide and sulfides were chosen due to the known presence of natural sulfur in the caprock. pH will be added to the analyte list for future sampling. Dissolved gases were selected for comparative analysis with other gas samples.
12. All bubble sites are marked for future monitoring. Some of the locations are located on well pads or within well vaults and are not always visible during dry conditions. The bubble sites will continue to be monitored and sampled per the Work Plan.
13. Samples have been submitted to Isotech for dissolved gas and methane isotopic evaluation ($\delta^{13}C$ and δD of methane). Only data from the initial sampling have been received from the laboratory. The dissolved gas and isotopic data are provided on Table 3. A detailed interpretation will be provided as a separate submittal after the first quarter of sampling as more data are received.
    - See updated Tables as *Attachment A(a)*.
14. The water well sample IDs on the chain-of-custody form and in the laboratory reports is the LDNR water well registration number. Table 1 has been revised to include the Westlake water well number. For reference, Figure 7 also includes the Westlake well number. The LDNR water well registration number will be used for water well samples. Currently, a large data collection effort is ongoing. A detailed report of the water well analytical data will be provided to LDNR after the first quarter of sampling is completed. It is anticipated that the report will be issued in May 2023.
    - See updated Figures as *Attachment A(a)*.
    - See updated Tables as *Attachment A(a)*.
15. It is anticipated that letters transmitting the water well surveys will be sent to property owners within 30 days from receipt of LDNR's approval. Property addresses will be identified using the Calcasieu Parish Tax Assessors records. Approximately 3 weeks will be given to the property owners to provide a written response. After that time, a second letter survey will be sent and work will commence to conduct visual inspections and face-to-face follow-up visits as

needed. That process is expected to take up to 3 weeks. Compiling the data, rectifying records, and well registration (if required) is anticipated to be completed within 90-days of the first letters being mailed.

16. The capture zone analysis will include the area surrounding the dome and the City of Sulphur and will be a minimum of 25 square miles.
17. Potentiometric surface maps and water level data are available on a regional scale. However, the wells are not close enough to the dome to provide the resolution necessary to evaluate the potentiometric surface and groundwater flow direction in the vicinity of the dome. The potential for obtaining water levels from existing wells is still being investigated. At a minimum, preparations are being made to assess the viability of collecting water levels from the existing water wells and determining how those data can be used. Once a determination is made of the useability of the water level data from the existing water wells, a detailed report will be provided to LDNR.
18. Surface water samples have also been sent to Isotech for dissolved gas and methane isotopic analysis. The available results are summarized on Table 3. Figure 8 has been revised to show the LDNR location numbers for the samples collected. Table 2 has been revised to include the LDNR location numbers. Going forward the LDNR location numbers will be used to identify the sample.
    - See updated Figures as *Attachment A(a)*.
    - See updated Tables as *Attachment A(a)*.
19. The statement provided in the work plan refers to interconnection of surface water bodies. Currently the areas where bubbles have been observed in surface water are isolated from other surface water bodies. The hydraulic connection of surface water with subsurface gas, groundwater, or other subsurface fluids addressed in the above referenced reports has not been evaluated. The extensive industrial use of the dome over the past 100 years could have introduced potential pathways for seepage to the surface that would be very difficult if not impossible to identify. However, the central water feature is completely enclosed by roads and has no natural outlet. Rainwater is pumped out of the pond to protect the roads and other facilities from flood damage. Rainwater that is pumped out is either contained within an enclosed swamp or drains into Bayou d'Inde. Other bubble site areas are on well pads where rainwater accumulates in low lying areas. The "Environmental Remedial Evaluation Report" is not available for review or comment at this time.
20. Currently, data collection efforts are on-going and final laboratory reports are still pending for numerous samples. A detailed report, including interpretation of the results, will be prepared following the first quarter of sampling. It is anticipated that the report will be issued to the LDNR in May 2023. As the on-going work continues, quarterly reports will be submitted to the LNDR to present recent findings and provide recommendations.
21. All observed bubble sites will continue to be sampled as outlined in the plan. Those bubble sites in low lying areas of well pads will only be sampled if standing water is present.

22. A portable Myron L Ultrameter II waterproof multiparameter meter (or equivalent) will be used to collect water quality readings during the surface water profile. This meter records pH, specific conductivity (SC), oxidation-reduction potential (ORP), and temperature. The meter is/will be calibrated every day prior to use.
23. Westlake brine field operations has (2) pond pumps located at the Southern perimeter of the central lake on the Sulphur dome. The central lake does not have a connection to the main outfall from the Sulphur dome on Bayou d'Inde, so pumps are used to control the water levels. The pond pumps are operated based on observed water level increases post rain events and/or prior to a large rainfall event. Both pumps discharge from the central lake water to the adjacent area to the south of central lake (see Figure 9). Westlake discharges this stormwater per our water discharge permit with Louisiana Department of Environmental Quality, multi-sector general permit LAR 050000/ AI #86163.
    - See updated Figures as *Attachment A(a)*.
    a. Dilution occurs in the central lake area from rainfall only. Water is not pumped into the lake but is removed when the water level rises to a level that threatens the health, safety, and/or security of the facility and site personnel. While there may be some removal of dissolved solids through the transfer pump, it is more likely that the concentrations within the central lake will remain consistent as a result of evaporation, coupled with rainfall and pumping.
    b. The location of the pumps, underground piping, discharge location, and Bayou d'Inde are provided on Figure 9.

Attachment C – Geomechanical Plan:

**Reference *Attachment C* for updated plan.

24. The timeline within the plan is now visible. Additionally, please refer to the overall project Gantt chart.
25. The analysis of the salt dome was included within the original plan submittal. In the updated plan, the scope of the geomehanical model was elaborated on and further clarified.
26. See updated plan for explanation.
    a. See updated plan for explanation.
27. See updated plan for explanation.
28. This 2017 report was supplied via email to the LDNR on March 7, 2023 by Troy Charpentier.

Attachment D – Failure Analysis Plan:

**Reference *Attachment D* for updated plan.

29. An initial failure analysis report can be submitted by April 21, 2023; however, this report will not include certain supporting evaluations and analytical data. The originally proposed due date was based upon results from other long lead time evaluations being completed and utilized in the report as supporting evidence to theories and technical discussion (e.g. 3D seismic analysis, geomechanical modeling, etc.).
    - If requested by the LDNR, the additional "updated" report can be provided at a later date that would include the supporting data and evaluations (now estimated at approximately August 2023, contingent on the completion of those supporting evaluations).
30. See updated plan.

Attachment E – 3D Seismic Plan:

**Reference *Attachment E* for updated plan.

31. See updated plan for response.
32. See updated plan.
33. See updated plan.
34. The proposed timeline was reviewed again. The timeline was removed from the plan document and is now included in the overall project Gantt chart.

Attachment F – Mircoseismic Monitoring Plan:

**Reference *Attachment F* for updated plan.

35. See updated plan.
36. See *Attachment F(a)* for periodic monitoring update report.
37. See *Attachment F(a)* for periodic monitoring update report. Westlake is planning to submit monitoring updated reports per the following:
    - Throughout Phase 1, 2, & 3 an immediate notification (once identified) to the LDNR of any event.
    - Bi-weekly update reports for the Phase 1 array (due to SD card shipments, this report timing is practical).
    - Weekly update reports for the Phase 2 array. With the understanding that the report frequency can be revisited and perhaps reduced to monthly/quarterly upon discussion with the LDNR.
    - Weekly update reports for the Phase 3 array. With the understanding that the report frequency can be revisited and perhaps reduced to monthly/quarterly upon discussion with the LDNR.
38. See updated plan with PG stamp.

Attachment G – InSAR Subsidence Monitoring Plan:

**Reference *Attachment G* for updated plan.

39. See updated plan.
40. See *Attachment G(a)* for periodic monitoring update report.
41. See updated plan with PG stamp.

B. Review of the NewFields "Preliminary Report – Chemical Fingerprint of Oils" Westlake Sulphur Dome Study

42. See updated report as *Attachment H*.
43. The supplement to the compliance order only required sampling from the tubing and annulus of Fee SWD No. 7. No oil was found in the tubing thus only an annulus sample was acquired. The only other Yellowrock oil sample was taken November 2, 2022 from Well 69 with Intertek lab analysis as *Attachment H(a)*.

C. Additional Action Items Required for Eagle:

44. A fault plane map can be submitted after the geophysical evaluation is completed.
45. Westlake coordinates activities requiring USACE permits with the New Orleans District of the USACE. Most recently, Eagle US 2, LLC obtained Permit MVN-2017-01133-WPP (on file with IMD) for the installation of Brine Well #25 in February 2020.

On behalf of Westlake, ERM will perform a wetland delineation of the property to determine what portions of the property are wetlands. Westlake will continue to engage the USACE in any activities requiring permits.

ERM has emailed the USACE (*Attachment A(b)*) indicating that Westlake is performing site work under an LDNR Compliance Order and would like to arrange a call or meeting to determine if any of this work might require a permit.

46. See *Attachment I* for overall project Gantt chart as of the date of this letter.
47. See *Attachment J*.

If there are any questions, please contact Josh Bradley (Westlake US 2, LLC) or Coleman Hale (Lonquist & Co., LLC).

Sincerely,

R. Coleman Hale
Vice President
Lonquist & Co., LLC

ATTACHMENT LIST

A. Environmental Resources Management ("ERM") Plan – No Change
    a. Updated Plan Figures, Tables, and Additional Lab Results
    b. Email Communication w/ USACE
B. Westlake Emergency Response Plan – No Change
C. Geomechanical Plan – Version 2
D. Failure Analysis Plan – Version 2
E. 3D Seismic Plan – Version 2
F. Microseismic Monitoring Plan – Version 2
    a. Seismic Monitoring Report (January 31 – March 3, 2023)
G. InSAR Subsidence Monitoring Plan – Version 2
    a. Subsidence Monitoring Report (March 2, 2023)
H. NewFields Chemical Fingerprinting Analysis – Version 2
    a. Intertek Lab Analysis of Yellowrock Well 69 Oil
I. Overall Project Gantt Chart
J. Thermal Drone Imagery Report

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ATTACHMENT A

Environmental Resources Management
Plan for USDW/Surface Water Impacts & Monitoring
(No Change)

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Via Email

20 February 2023

Mr. Stephen H. Lee, PG, Esq.
Director, Injection and Mining Division
Office of Conservation
Louisiana Department of Natural Resources
617 North Third Street, LaSalle Building
Baton Rouge, Louisiana 70802

Reference: 0677804

Subject: Groundwater and Surface Water Investigation Work Plan
First Supplement to Compliance Order No. IMD 2022-027
Westlake US 2, LLC
Sulphur Dome
Calcasieu Parish, Louisiana

Dear Mr. Lee:

Environmental Resources Management (ERM), on behalf of Westlake US 2, LLC (Westlake), is pleased to provide this Work Plan in response to the January 19, 2023 Louisiana Department of Natural Resources (LDNR) Office of Conservation's First Supplement to Compliance Order No. IMD 2022-027. This Work Plan addresses the plans to investigate any potential impacts to the Underground Source of Drinking water (USDW) in the vicinity of the Sulphur salt dome, as well as any potential impacts to surrounding surface waters.

1. SITE SETTING

The Sulphur salt dome is located approximately 2 miles northwest of the city of Sulphur Louisiana (Figure 1). Economic production of minerals (sulfur, oil and gas, and brine) from within and surrounding the salt dome has been occurring since the early 1900s and continues to the present. The salt dome cap rock is encountered between approximately 600 to 1,000 feet below ground surface (bgs) (Figure 2), with the salt encountered at approximately 1,500 feet bgs (Figure 3). Current brine production is occurring within salt caverns at depths generally greater than 2,000 feet bgs (Figure 4).

The Chicot Aquifer underlies the site and surrounding area and is used for industrial, irrigation, domestic, and municipal purposes. Numerous water wells are present in the vicinity of the salt dome (Figure 5). Water supply for brine production is from the 500-foot sand of the Chicot Aquifer. The deepest active water well within a 2-mile radius of the salt dome is well ID 019-582, operated by Westlake for brine production, which is installed to a depth of 609 feet. The city of Sulphur utilizes as many as seven water wells for public supply, all of which are screened in the 500-foot sand of the Chicot Aquifer and located approximately 2.5 miles to the southeast of the Sulphur salt dome.

The majority of the salt dome lies within LDEQ surface water drainage basin subsegment 031001, Bayou Choupique from headwater to Intercoastal Waterway (Figure 6). The eastern portion of the dome lies with subsegment 030901, Bayou d'Inde from headwater to Calcasieu River. Due to the estuarine environment of these subsegments, there are no surface water numerical criteria for chloride, sulfate, or total dissolved solids (TDS) within these subsegments.

2. WORK PLAN

This plan addresses Requirement 1.a.of the Supplement to the Order, which requires Westlake to submit "*a plan to investigate any impacts to the Underground Source of Drinking Water ("USDW") and surrounding surface waters*".

2.1 USDW Evaluation

A preliminary evaluation of the USDW was conducted using data publicly available on the LDNR's SONRIS database. Based on this preliminary evaluation, the USDW is shallower directly over the salt dome and deepens with distance from the dome. Understanding the depth to the top of the USDW and the groundwater uses in the vicinity of the dome is critical to identifying and evaluating potential groundwater impacts. ERM has developed a plan to evaluate and better define the depth to the top of the USDW directly over the dome and outside the footprint of the dome and to assess if hypothetical events at the dome could affect groundwater quality within the aquifer.

2.2 Water Well Sampling

ERM proposes to utilize active water wells within the vicinity of the salt dome to monitor groundwater quality (Figure 7). Westlake currently utilizes four water wells southwest of the salt dome, with a fifth well installed but not currently operational. Photographs of the Westlake water wells are provided in Attachment 1. There are also four deep observation wells, installed and owned by Boardwalk Pipelines (Boardwalk), on the southeastern flank of the dome. The active water wells and observation wells are well-positioned to monitor the groundwater between the salt dome and other wells/groundwater users to the southwest and southeast. Samples were collected from the four Westlake water wells on January 26, 2023; data from that sampling event are summarized on Table 1. The results from this initial sampling event will serve as a baseline dataset for subsequent monitoring. For reference, the results of a brine sample collected from Brine Well 6X on January 25, 2023, are also included on Table 1. Final laboratory reports received to date are provided in Attachment 2.

Requests have been made to Boardwalk for access to the four deep observation wells. Once access has been granted, ERM will inspect/evaluate each well to determine the viability of using these wells for monitoring and/or sampling. The condition of these wells is unknown; however, discussions with personnel involved in the installation of these wells indicates they were not installed or constructed using materials and procedures typically used in the installation of environmental monitoring wells. The wells were constructed of oilfield well casing and were not completed with typical slotted well screens. Instead, wells were perforated at variable target intervals. We have not been able to determine in the wells were developed; therefore, drilling residuals could still be present. Once access to the wells is granted, ERM will perform modified slug tests to determine that the wells exhibit a good hydraulic connection with the portion of the Chicot Aquifer in which they were perforated. If the slug test results demonstrate a good hydraulic connection with the Chicot Aquifer, an attempt will be made to develop the wells by purging. Water

level elevation data from these wells may provide valuable information regarding the capture zone from pumping of the Westlake water wells. Samples may be collected from the Boardwalk observation wells with the understanding that they were not installed or intended to be used as environmental sampling points.

Quarterly sampling of the five Westlake wells is proposed for 2023, followed by semi-annual sampling for two additional years. The Boardwalk wells may be sampled, if access can be obtained and it is determined that samples representative of the Chicot Aquifer can be collected. Samples will be analyzed by a Louisiana accredited environmental laboratory for analysis of the following parameters:

- Metals (As, Ba, Cd, Ca, Cr, Fe, Pb, Mg, Mn, Hg, K, Se, Ag, Na, Sr, Zn),
- Chloride, Bromide,
- Bicarbonate, Carbonate
- Sulfate, Sulfide, Hydrogen Sulfide,
- Total Dissolved Solids (TDS),
- Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX), and
- Total Petroleum Hydrocarbon (TPH) fractions

Samples will also be collected for dissolved gases and submitted to Isotech, a Stratum Reservoir company, for isotopic evaluation.

2.3 Water Well Survey

ERM proposes to conduct a water well survey within a one-mile radius of the salt dome. It is important to identify users of groundwater nearest to the dome. The water well survey will consist of a letter survey mailed to property owners, followed by a visual inspection and face-to-face follow-up visit, as necessary. Owners of any unregistered water wells identified will be asked to register the wells with LDNR.

2.4 Capture Zone Analysis

The four active Westlake water wells are pumping a total of approximately 2,000 gallons per minute (gpm) from the 500-foot sand of the Chicot Aquifer (i.e., approximately 2.9 million gallons per day) for brine production. This large-scale pumping is likely inducing a hydraulic gradient causing groundwater to flow toward the wells. However, the extent of the influence of pumping in the vicinity of the salt dome and the influence of pumping occurring by other operators is unknown. ERM proposes to evaluate the capture zone of the wells in the vicinity of the salt dome to better understand the potential migration pathways in the event that site-related constituents were to be detected within the usable portions of the Chicot Aquifer. The capture zone will be evaluated using MODFLOW, MODPATH, and MT3DMS, which are industry standard software packages for evaluating groundwater flow and transport.

2.5 Surface Water Sampling

The surface water in the vicinity of the salt dome is generally isolated with little or no connection to other surface waters within the drainage basin (Figure 8). “Bubble sites” have been observed in and around the well pads, and within a pond centrally located above the salt dome (“the central pond”). The waters where bubbles have been observed are isolated and do not have any connection to surrounding water bodies. The majority of the surface water bodies are shallow. The central pond was measured at <1 inch at the Central Pond sample location and approximately 6 feet deep, following a heavy rainstorm, at CP BS 3. Photographs of the surface water sampling areas are provided in Attachment 1. Final laboratory reports received to date are provided in Attachment 2.

Samples from seven bubble sites have been collected, and the data (if final laboratory reports have been received) are summarized on Table 2. One location adjacent to the PPG 22 Brine Well exhibited visible sheen and oil accumulation at the bubble site. A berm has been built around that location to isolate it from the central pond and from the other surface water bodies. Samples from two other bubble site locations (Brine Well 7A BS, and 110159 BS) were collected from standing water within a well pad as a result of recent rain events.

ERM proposes to sample the bubble site locations quarterly for the first year or until the bubbles are no longer observed. Samples will also be collected as soon as possible if new bubble sites are identified. Three additional samples will be collected from the central pond (Figure 9) quarterly for the first year, then semi-annually for one additional year. Samples will be submitted to a Louisiana accredited environmental laboratory for analysis of the following parameters:

- Metals (As, Ba, Cd, Ca, Cr, Fe, Pb, Mg, Mn, Hg, K, Se, Ag, Na, Sr, Zn),
- Chloride, Bromide,
- Bicarbonate, Carbonate
- Sulfate, Sulfide, Hydrogen Sulfide,
- Total Dissolved Solids (TDS),
- Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX), and
- Total Petroleum Hydrocarbon (TPH) fractions

At active bubbles sites, samples will also be collected for dissolved gases and sent to Isotech, a Stratum Reservoir company, for isotopic evaluation.

2.6 Surface Water Profile

ERM proposes to complete surface water profiling within the central pond. The profiling will consist of taking measurements of pH, Specific Conductivity (SC), Oxidation Reduction Potential (ORP), and temperature within the water column. Measurements will be made using a handheld meter while water is pumped at 1-foot depth intervals. The profiling will occur quarterly for the first year, and then semi-annually for one additional year.

3. REPONSES TO ADDITIONAL ORDER REQUIREMENTS

Westlake has also responded to additional requirements contained in the First Supplement to Compliance Order IMD 2022-027 not specifically included in this Work Plan.

Order 3 – Eagle is ordered as soon as possible but within seven (7) days to collect samples at all observed oil, gas, or brine expressions at the surface. Eagle must expeditiously perform constituent sample analyses on all collected samples.

Samples have been collected from all observed bubble sites and sheen within 7 days of the initial observation. Additional samples will be collected within 7 days if new surface expressions are identified. No brine surface expressions have been observed.

Order 4 – Eagle is ordered as soon as possible but within (7) days to request access from Yellow Rock to collect oil samples from the tubing and tubing annulus of Serial Number 110159, Fee SWD No. S-7. Eagle must perform an isotopic and constituent analysis on these samples to compare them to a similar analysis for the oil collected from PPG 007B.

ERM obtained a sample of tubing oil from well Serial Number 110159 on January 26, 2023. The sample was sent to NewFields in Rockland, Massachusetts for environmental forensic analysis. An attempt was made to collect any other liquids from the well, but no other liquids were produced. Oil samples were also collected from the Westlake oil storage stock tank and the 7B cavern (via transfer pump and Brine Well 20). These oil samples, along with the sheen collected at the Brine Well 22 bubble site, were submitted to NewFields for environmental forensic analysis.

4. SCHEDULE AND REPORTING

ERM has already implemented groundwater, surface water, brine and oil sampling with the assistance of Westlake personnel. The proposed schedule of sampling and reporting described herein is as follows:

4.1 Groundwater

- Sample Westlake production water wells – April, July, October 2023, January and July 2024 and 2025
- Sample deep observation wells – 7 days following approval from Boardwalk, then sampled quarterly with the water wells

Following each quarterly event, ERM will provide a brief summary report to LDNR including a discussion of observations, data trends, laboratory reports, and recommendations, as necessary.

Within 60-days of LDNR approval of this work plan, ERM will prepare a detailed evaluation of the USDW, water wells users in the vicinity of the dome, and capture zone analysis. A review of the sampling activities, data evaluations, findings, and recommendations will also be included.

4.2 Surface water

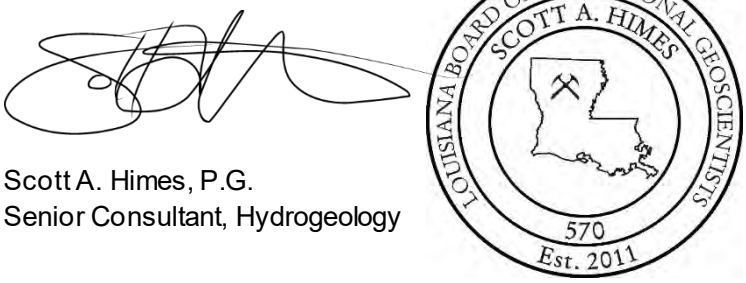
- Surface water sampling – April, July, October 2023, January and July 2024
- Surface water profiling – April, July, October 2023, January and July 2024

The results of the sampling event will be provided within 30-day of receipt of the final analytical data reports.

Following each quarterly event, ERM will provide a brief summary report to LDNR including a discussion of observations, data trends, laboratory reports, and recommendations, as necessary.

Should you have any questions or wish to discuss our proposed plan, please contact us.

Sincerely,



Scott A. Himes, P.G.
Senior Consultant, Hydrogeology

David C. Upthegrove, P.G.
Partner

FIGURES

See updated in Attachment A(a)

TABLES

See updated in Attachment A(a)

ATTACHMENT 1: PHOTO LOG

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
1	Jan 25, 2023

Direction Photo Taken:
N74ºW (286º)

Coordinates:
30.253057ºN; 93.413276ºW

Photo ID:
2023-01-25-11-43-29.jpg

Description:
Brine Well 22 bubble site and sheen sample location

Photo Taken By:
Scott Himes

Photo No.	Date:
2	Jan 25, 2023

Direction Photo Taken:
N64ºW (296º)

Coordinates:
30.253072ºN; 93.413269ºW

Photo ID:
2023-01-25-12-01-28.jpg

Description:
Brine Well 22 bubble site and sheen sample location

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
3	Jan 25, 2023

Direction Photo Taken:
N84ºE (84º)

Coordinates:
30.253078ºN; 93.413405ºW

Photo ID:
2023-01-25-12-07-01.jpg

Description:
Brine Well 22 bubble site and sheen sample location

Photo Taken By:
Scott Himes

Photo No.	Date:
4	Jan 25, 2023

Direction Photo Taken:
N53ºW (307º)

Coordinates:
30.254842ºN; 93.414069ºW

Photo ID:
2023-01-25-13-01-37.jpg

Description:
6X Brine well

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
5	Jan 25, 2023

Direction Photo Taken:
S78ºW (258º)

Coordinates:
30.25487ºN; 93.413973ºW

Photo ID:
2023-01-25-13-32-30.jpg

Description:
6X Brine Well

Photo Taken By:
Scott Himes

Photo No.	Date:
6	Jan 25, 2023

Direction Photo Taken:
N (0º)

Coordinates:
30.253407ºN; 93.415105ºW

Photo ID:
2023-01-25-13-45-12.jpg

Description:
Brine Well 7A bubble site sample location

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
7	Jan 25, 2023

Direction Photo Taken:
N34ºW (326º)

Coordinates:
30.253404ºN; 93.415059ºW

Photo ID:
2023-01-25-13-45-37.jpg

Description:
Brine Well 7A bubble site sample location

Photo Taken By:
Scott Himes

Photo No.	Date:
8	Jan 25, 2023

Direction Photo Taken:
N78ºE (78º)

Coordinates:
30.254765ºN; 93.409999ºW

Photo ID:
2023-01-25-15-32-49.jpg

Description:
Brine Well 20

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
9	Jan 25, 2023

Direction Photo Taken:
S71ºE (109º)

Coordinates:
30.254765ºN; 93.409984ºW

Photo ID:
2023-01-25-15-33-03.jpg

Description:
Oil transfer pump – transferring oil from 7B to 20 (oil sample collection location)

Photo Taken By:
Scott Himes

Photo No.	Date:
10	Jan 25, 2023

Direction Photo Taken:
N27ºW (333º)

Coordinates:
30.253136ºN; 93.40941ºW

Photo ID:
2023-01-25-15-37-47.jpg

Description:
Stock tank oil collection location

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
11	Jan 25, 2023

Direction Photo Taken:
N29ºW (331º)

Coordinates:
30.252985ºN; 93.40927ºW

Photo ID:
2023-01-25-15-38-12.jpg

Description:
Stock tank oil storage

Photo Taken By:
Scott Himes

Photo No.	Date:
12	Jan 25, 2023

Direction Photo Taken:
N31ºW (329º)

Coordinates:
30.252983ºN; 93.409269ºW

Photo ID:
2023-01-25-15-38-25.jpg

Description:
Stock tank oil storage

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
13	Jan 25, 2023

Direction Photo Taken:
S79ºW (259º)

Coordinates:
30.25356ºN; 93.409653ºW

Photo ID:
2023-01-25-16-07-25.jpg

Description:
Culvert with central pond in background

Photo Taken By:
Scott Himes

Photo No.	Date:
14	Jan 25, 2023

Direction Photo Taken:
N87ºE (87º)

Coordinates:
30.253589ºN; 93.409876ºW

Photo ID:
2023-01-25-16-08-30.jpg

Description:
Culvert sample location with pig catcher in background

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
15	Jan 25, 2023

Direction Photo Taken:
N13ºE (13º)

Coordinates:
30.253591ºN; 93.409885ºW

Photo ID:
2023-01-25-16-08-56.jpg

Description:
Boardwalk Brine Well 1 from culvert.

Photo Taken By:
Scott Himes

Photo No.	Date:
16	Jan 25, 2023

Direction Photo Taken:
N (0º)

Coordinates:
30.253548ºN; 93.410115ºW

Photo ID:
2023-01-25-16-10-04.jpg

Description:
Central pond sample location

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
17	Jan 26, 2023

Direction Photo Taken:
N34ºE (34º)

Coordinates:
30.250147ºN; 93.413535ºW

Photo ID:
2023-01-26-07-37-51.jpg

Description:
SN 110159

Photo Taken By:
Scott Himes

Photo No.	Date:
18	Jan 26, 2023

Direction Photo Taken:
N18ºE (18º)

Coordinates:
30.246739ºN; 93.421668ºW

Photo ID:
2023-01-26-07-52-46.jpg

Description:
WW # 19 (019-1055)

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
19	Jan 26, 2023

Direction Photo Taken:
S26ºE (154º)

Coordinates:
30.250421ºN; 93.422586ºW

Photo ID:
2023-01-26-08-22-23.jpg

Description:
WW #13 (019-582)

Photo Taken By:
Scott Himes

Photo No.	Date:
20	Jan 26, 2023

Direction Photo Taken:
N76ºW (284º)

Coordinates:
30.250551ºN; 93.422766ºW

Photo ID:
2023-01-26-08-29-23.jpg

Description:
WW #11 (019-580)

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
21	Jan 26, 2023

Direction Photo Taken:
N32ºE (32º)

Coordinates:
30.250892ºN; 93.425607ºW

Photo ID:
2023-01-26-09-23-54.jpg

Description:
WW #12 (019-995)

Photo Taken By:
Scott Himes

Photo No.	Date:
22	Jan 26, 2023

Direction Photo Taken:
S6ºW (186º)

Coordinates:
30.248171ºN; 93.42008ºW

Photo ID:
2023-01-26-09-44-27.jpg

Description:
WW #40 (019-1603)

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
23	Jan 26, 2023

Direction Photo Taken:
N25ºE (25º)

Coordinates:
30.247773ºN; 93.420209ºW

Photo ID:
2023-01-26-09-45-57.jpg

Description:
WW #40 (019-1603)

Photo Taken By:
Scott Himes

Photo No.	Date:
24	Jan 26, 2023

Direction Photo Taken:
N69ºE (69º)

Coordinates:
30.247838ºN; 93.420247ºW

Photo ID:
2023-01-26-09-49-44.jpg

Description:
WW #40 (019-1603) access port.

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
25	Jan 30, 2023

Direction Photo Taken:
S75ºW (255º)

Coordinates:
30.253243ºN; 93.412588ºW

Photo ID:
2023-01-30-10-37-27.jpg

Description:
Central Pond Bubble Site 1 (CP BS 1)

Photo Taken By:
Scott Himes

Photo No.	Date:
26	Jan 30, 2023

Direction Photo Taken:
N32ºW (328º)

Coordinates:
30.25355ºN; 93.412269ºW

Photo ID:
2023-01-30-11-22-23.jpg

Description:
Central Pond Bubble Site 2 (CP BS 12)

Photo Taken By:
Scott Himes

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
27	Jan 30, 2023

Direction Photo Taken:
N59ºW (301º)

Coordinates:
30.254178ºN; 93.412639ºW

Photo ID:
2023-01-30-12-09-25.jpg

Description:
Central Pond Bubble Site 3 (CP BS 3)

Photo Taken By:
Scott Himes

Photo No.	Date:
28	Feb 10, 2023

Direction Photo Taken:
N16ºE (16º)

Coordinates:
30.250156ºN; 93.413447ºW

Photo ID:
IMG_5822.JPG

Description:
SN 110159 Bubble Site

Photo Taken By:
David Sanguinetti

PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.:
Westlake US 2, LLC	Sulphur Louisiana	0677804

Photo No.	Date:
29	Feb 10, 2023

Direction Photo Taken:
N67ºE (67º)

Coordinates:
30.250139ºN; 93.413419ºW

Photo ID:
IMG_5826.JPG

Description:
SN 110159 Bubble Site

Photo Taken By:
David Sanguinetti

Photo No.	Date:
30	Feb 10, 2023

Direction Photo Taken:
S11ºW (191º)

Coordinates:
30.251336ºN; 93.411711ºW

Photo ID:
IMG_5827.JPG

Description:
Brine Pond 4 Bubble Site

Photo Taken By:
David Sanguinetti

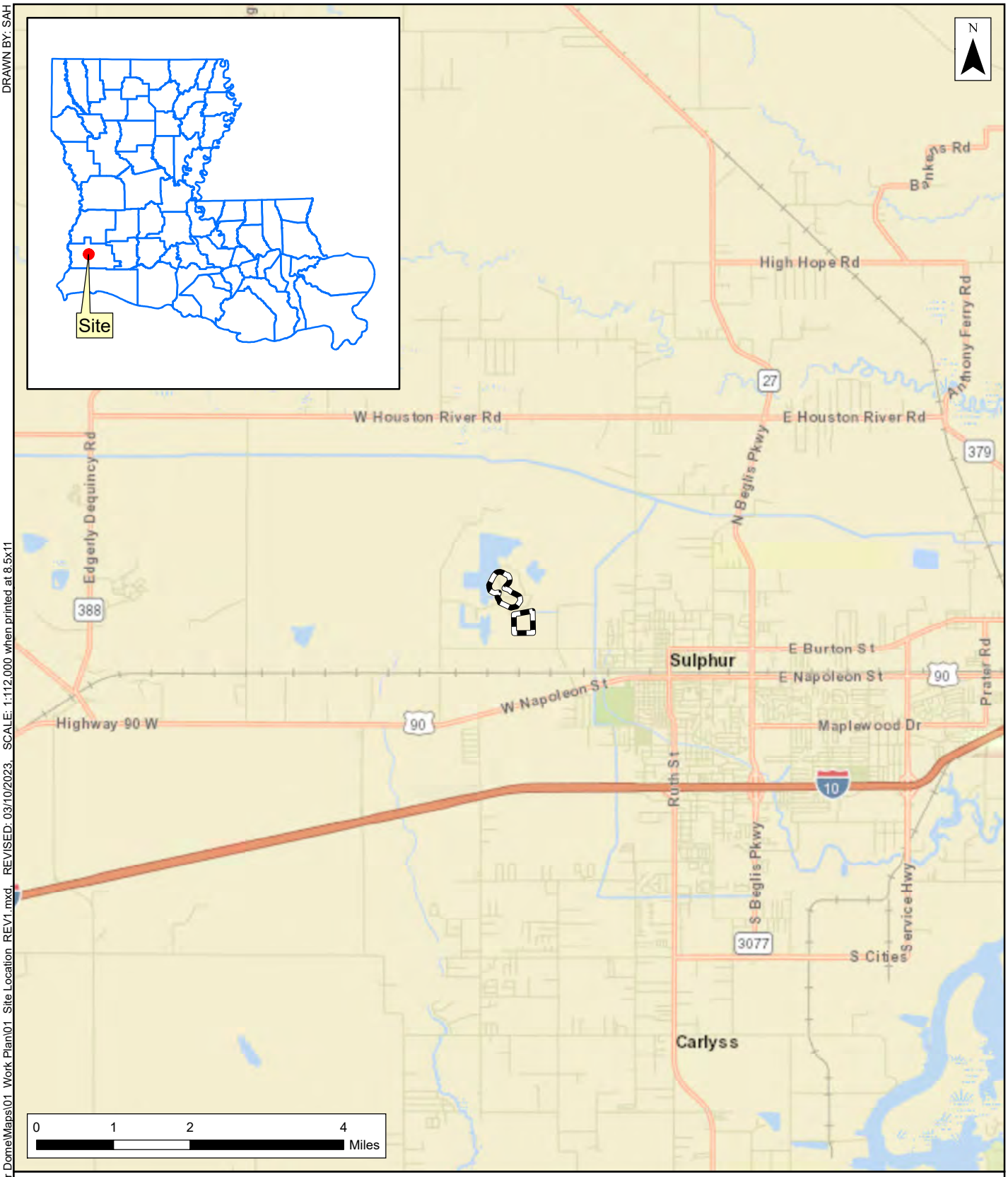
ATTACHMENT 2: LABORATORY REPORTS

See updated in Attachment A(a)

LONQUIST & CO. LLC
PETROLEUM ENGINEERS | ENERGY ADVISORS
AUSTIN · HOUSTON · WICHITA · DENVER · BATON ROUGE · COLLEGE STATION · CALGARY · EDMONTON

ATTACHMENT A(a)

Environmental Resources Management
Updated Figures, Tables, and Additional Lab Results



Legend

Westlake Property

Revised Figure 1
Site Location
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Notes:
World Street Map via ArcGIS online.

Environmental Resources Management
www.erm.com
ERM

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

DRAWN BY: SAH

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\01 Site Location REV1.mxd REVISED: 03/10/2023, SCALE: 1:112,000 when printed at 8.5x11

DRAWN BY: SAH

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\02 Cap Rock Contours REV1.mxd, REVISED: 03/13/2023, SCALE: 1:5,000 when printed at 8.5x11

Legend

Westlake Property

Revised Figure 2
Cap Rock Contours
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Notes:
Data obtained from Lonquist June 2017 *EAGLE US 2, LLC WELL NO. 25 PERMIT, Att 9-2*
200-ft contour interval.
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

Environmental Resources Management
www.erm.com
ERM

DRAWN BY: SAH

SCALE: 1:12,000 when printed at 8.5x11

REVISED: 03/10/2023,

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\03 Salt Contours REV1.mxd,

Legend

Westlake Property

Revised Figure 3
Salt Contours
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Notes:
Data obtained from Lonquist *Salt Cavern Compliance: 2020 Update*
500-ft contour interval.
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Environmental Resources Management
www.erm.com
ERM

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

Legend

- Active SWD
- Active LPG Storage
- Active Brine Well
- Inactive Brine Well
- Plugged & Abandoned
- Observation Well
- Cavern Extent Outline (2-18-2020)
- Westlake Property

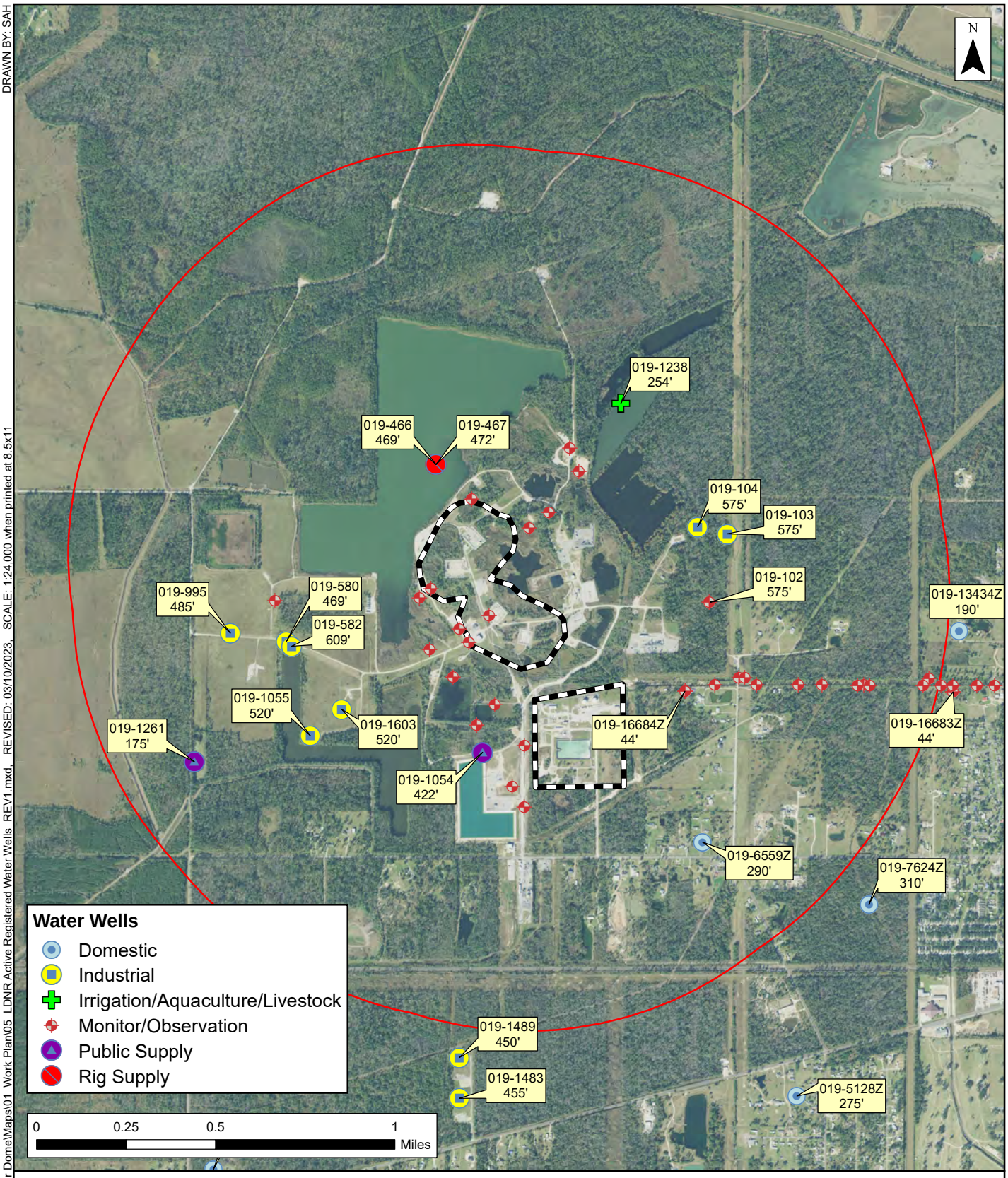
Notes:
Data provided by Lonquist *Salt Cavern Compliance: 2020 Update*
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Revised Figure 4
Salt Caverns
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Environmental Resources Management
www.erm.com
ERM

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

DRAWN BY: SAH
SCALE: 1:6,000 when printed at 8.5x11
REVISED: 03/10/2023,
M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\04 Salt Caverns REV1.mxd



DRAWN BY: SAH

SCALE: 1:24,000 when printed at 8.5x11

REVISED: 03/10/2023,

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\05 LDNR Active Registered Water Wells REV1.mxd,

Legend

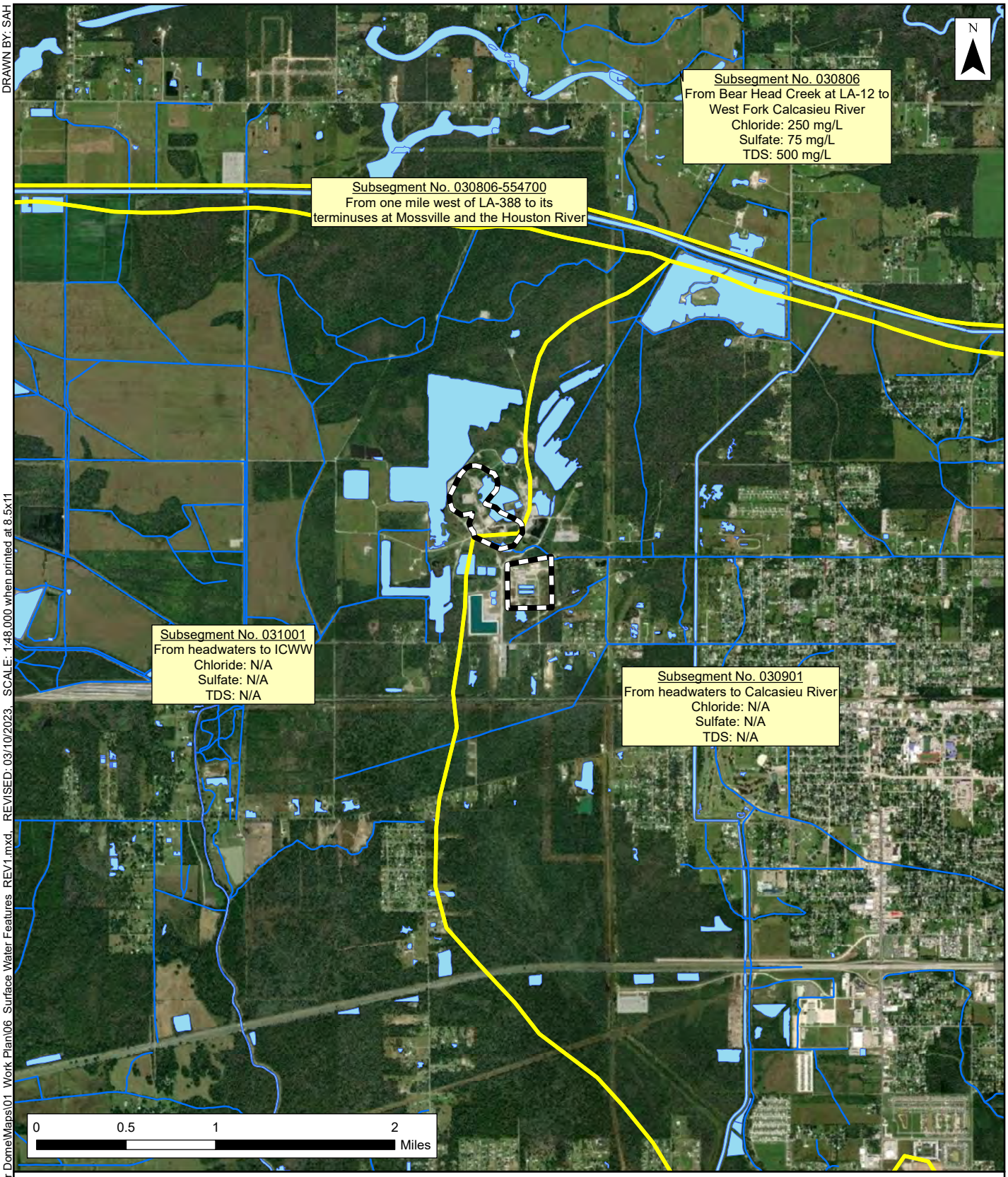
- Salt Dome 1-mile Radius
- Westlake Property

Notes:
Water wells obtained from LDNR SONRIS database.
Only active wells shown.
Shallow Monitoring wells (<30') not labeled.
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

Revised Figure 5
LDNR Active Registered Water Wells (1-mile radius)
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Environmental Resources Management
www.erm.com
ERM



DRAWN BY: SAH

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\06 Surface Water Features REV1.mxd, REVISED: 03/10/2023, SCALE: 1:48,000 when printed at 8.5x11

Legend

- Westlake Property
- Major Water Body
- Minor Waterbody

Notes:
Drainage basin subsegments via LDEQ Interactive Map (GIS).
Subsegment numerical criteria via LAC Title 33, Part IX.
Surface water features via National Hydrogapy Dataset.
World Imagery via ArcGIS online.

Revised Figure 6
Surface Water Features
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Environmental Resources Management
www.erm.com
ERM

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

DRAWN BY: SAH

SCALE: 1:12,000 when printed at 8.5x11

REVISED: 03/10/2023,

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\07 Known Active Water Well Locations REV1.mxd,

Legend

- Active Water Well
- Non-Operational Water Well
- Unregistered Water Well
- Boardwalk Observation Well
- Westlake Property

Source: ESRI - ArcGIS Online; NAD 1983 UTM Zone 15N

Revised Figure 7
Known Active Water Well Locations
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Notes:
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Environmental Resources Management
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ERM

DRAWN BY: SAH

M:\US\Projects\V-Z\Westlake\Sulphur Dome\Maps\01 Work Plan\08 Surface Water Sampling Locations REV1.mxd REVISED: 03/10/2023, SCALE: 1:7,994 when printed at 8.5x11

Legend

- Surface Water Sample Location
- Bubble Site Water Sample Location
- Sheen Sample Location
- Westlake Property
- Major Water Body
- Minor Waterbody

Revised Figure 8
Surface Water Sampling Locations
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Notes:
Surface water features via National Hydrography Dataset.
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Environmental Resources Management
www.erm.com
ERM

Source: ESRI - ArcGIS Online; GCS North American 1983

DRAWN BY: SAH

SCALE: 1:6,000 when printed at 8.5x11 REVISED: 03/10/2023

M:\US\Projects\V-Z\Westlake\Sulphur DomeMaps\01 Work Plan\09 Surface Water Pump.mxd

Legend

- Underground Discharge Piping
- Major Water Body
- Minor Waterbody

Figure 9
Surface Water Pumping Location
Sulphur Dome
Westlake US 2, LLC
Calcasieu Parish, Lousiana

Notes:
Surface water features via National Hydrography Dataset.
2021 Aerial imagery via USGS Earth Explorer (NAIP).

Environmental Resources Management
www.erm.com
ERM

Source: ESRI - ArcGIS Online; GCS North American 1983

Table 1
Groundwater Data Summary
Sulphur Dome
Calcasieu Parish, Louisiana

	Sample ID	019-580	019-582	019-995	019-1055	6X Brine	007-B Brine
	Sample Location	WW #11	WW #13	WW #12	WW #19	SN 57788	SN 67270
	Sample Date	1/26/23	1/26/23	1/26/23	1/26/23	1/25/23	2/16/23
	Sample Interval (ft)	469'	609'	485'	520'	Brine	3,000'
	Sampler	ERM	ERM	ERM	ERM	ERM	ERM
Constituent	**Units**	**Groundwater**				**Brine**	
Total Metals							
Arsenic	mg/L	0.000477 J	0.000812 J	0.000762 J	0.000419 J	0.0300 J	<0.04
Barium	mg/L	**0.23**	**0.239**	**0.214**	**0.265**	**0.220**	<0.19
Cadmium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.01	<0.02
Calcium	mg/L	**26.8**	**25.5**	**26.4**	**28.7**	**722**	**1,320**
Chromium	mg/L	<0.0004	<0.0004	<0.0004	<0.0004	**0.243**	**0.722**
Iron	mg/L	**5.12**	**4.03**	**0.821**	**3.81**	**25.7**	9.65 J
Lead	mg/L	0.00144 J	<0.0006	<0.0006	<0.0006	<0.03	<0.06
Magnesium	mg/L	**8.03**	**7.81**	**8.02**	**8.66**	8.16 J	8.64 J
Manganese	mg/L	**0.412**	**0.417**	**0.388**	**0.42**	**0.953**	0.487 J
Mercury	mg/L	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003	<0.00003
Potassium	mg/L	**2.93**	**2.94**	**3.00**	**3.10**	**14.4**	13.8 J
Selenium	mg/L	<0.0011	<0.0011	<0.0011	0.00114 J	<0.0550	<0.11
Silver	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.01	<0.02
Sodium	mg/L	**31.9**	**28.0**	**29.9**	**34.4**	**100,000**	**82,600**
Strontium	mg/L	**0.246**	**0.240**	**0.241**	**0.262**	**2.66**	**11**
Zinc	mg/L	**0.0147**	**0.0107**	**0.00426**	**0.00993**	**0.481**	**1.7**
Anions/Water Quality Parameters							
Bicarbonate Alkalinity	mg/L	**200**	**180**	**258**	**250**	**159**	**140**
Bromide	mg/L	0.0992 J	0.0860 J	0.0931 J	0.0982 J	<3	<7.5
Carbonate Alkalinity	mg/L	<5	<5	<5	<5	<5	<5
Chloride	mg/L	**35.7**	**23.4**	**28.7**	**38.3**	**213,000**	**201,000**
Sulfate	mg/L	**2.91**	**4.11**	**3.63**	**3.51**	**1,380**	**3,060**
Total Dissolved Solids (TDS)	mg/L	**236**	**212**	**226**	**244**	**239,000**	**300,000**
Sulfides							
Hydrogen Sulfide	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Sulfide	mg/L	<1	<1	<1	<1	<1	<1
Volatile Organic Compounds							
Benzene	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	**0.170**	**0.092**
Ethylbenzene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	0.0075 J	<0.0003
Toluene	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	**0.110**	**0.025**
m,p-Xylene	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	0.013 J	<0.0005
o-Xylene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	0.0091 J	<0.0003
Xylenes, Total	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	**0.022**	<0.0003
TPH Fractions							
Aliphatics >C6-C8	mg/L	<0.01	<0.01	<0.01	<0.01	**0.0997**	**0.0803**
Aliphatics >C8-C10	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	**0.107**
Aliphatics >C10-C12	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	NA
Aliphatics >C12-C16	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	NA
Aliphatics >C16-C35	mg/L	<0.008	<0.008	<0.008	<0.008	<0.008	NA
Aromatics >C8-C10	mg/L	<0.01	<0.01	<0.01	<0.01	**0.0284**	**0.422**
Aromatics >C10-C12	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	NA
Aromatics >C12-C16	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	NA
Aromatics >C16-C21	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	NA
Aromatics >C21-C35	mg/L	<0.009	<0.009	<0.009	<0.009	<0.009	NA

Notes
J - Estimated Value reported below the detection limit.
< - Not Detected at the reporting limit shown.
Bolded values deteted in the sample.
NA - Not Analyzed

Table 2
Surface Water Data Summary
Sulphur Dome
Calcasieu Parish, Louisiana

LDNR Sample No.		#1	#3	#4	#5	#6	#7	#8	#9	#10	#12	#17	#18	#19	WPB PPB No.7A	WPB PPB No.7B	#2		#20
Sample ID		Brine Well 22 BS	CP BS 1	CP BS 2	CP BS 3	BS 06	BS 07	BS 08	Brine Pond 4 BS	1101529-BS	BS 12	BS 17	BS 18	BS 19	Brine Well 7A BS	Brine Well 7B BS	Culvert	Central Pond	No. 20
Sample Date		1/25/23	1/30/23	1/30/23	1/30/23	2/28/23	2/28/23	2/28/23	2/10/23	2/10/23	2/28/23	2/28/23	2/28/23	2/28/23	1/25/23	2/16/23	1/25/23	1/25/23	3/9/23
Sample Interval (ft)		Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Sampler		ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM
Constituent	**Units**	**Bubble Site (Surface Water)**															**Surface Water**		
Total Metals																			
Arsenic	mg/L	0.00149 J	0.000862 J	0.000868 J	0.000769 J	IP	IP	IP	0.00176 J	0.000896 J	IP	IP	IP	IP	0.000767 J	0.0202 J	0.00141 J	0.00192 J	IP
Barium	mg/L	**0.300**	**0.160**	**0.367**	**0.155**	IP	IP	IP	**0.118**	**0.0594**	IP	IP	IP	IP	**0.232**	**1.23**	**0.0832**	**0.146**	IP
Cadmium	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	IP	IP	IP	<0.0002	<0.0002	IP	IP	IP	IP	<0.0002	<0.01	<0.0002	<0.0004	IP
Calcium	mg/L	**71.2**	**75.3**	**64.2**	**77.7**	IP	IP	IP	**38.6**	**55.8**	IP	IP	IP	IP	**24.5**	**141**	**58.2**	**149**	IP
Chromium	mg/L	0.000847 J	<0.0004	<0.0004	<0.0004	IP	IP	IP	<0.0004	<0.0004	IP	IP	IP	IP	0.000474 J	0.114 J	0.00101 J	0.00458 J	IP
Iron	mg/L	**1.14**	0.132 J	0.0258 J	0.125 J	IP	IP	IP	**0.609**	0.0432 J	IP	IP	IP	IP	0.0406 J	3.34 J	**0.207**	**2.07**	IP
Lead	mg/L	**0.00208**	<0.0006	<0.0006	<0.0006	IP	IP	IP	<0.0006	<0.0006	IP	IP	IP	IP	<0.0006	<0.03	<0.0006	<0.00120	IP
Magnesium	mg/L	**19.8**	**15.0**	**12.6**	**15.0**	IP	IP	IP	**4.2**	**5.64**	IP	IP	IP	IP	**1.54**	2.85 J	**5.44**	**37.8**	IP
Manganese	mg/L	**0.797**	**0.266**	**0.458**	**0.232**	IP	IP	IP	**0.204**	**0.0295**	IP	IP	IP	IP	**0.0215**	**0.509**	**0.00934**	**0.847**	IP
Mercury	mg/L	<0.00003	<0.00003	<0.00003	<0.00003	IP	IP	IP	<0.00003	<0.00003	IP	IP	IP	IP	<0.00003	<0.00003	<0.00003	<0.00003	IP
Potassium	mg/L	**2.57**	**2.90**	**2.58**	**2.86**	IP	IP	IP	**1.17**	**2.44**	IP	IP	IP	IP	**1.02**	1.78 J	**2.86**	**3.22**	IP
Selenium	mg/L	<0.0011	<0.0011	<0.0011	<0.0011	IP	IP	IP	<0.0011	<0.0011	IP	IP	IP	IP	<0.0011	<0.055	<0.0011	<0.0022	IP
Silver	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	IP	IP	IP	<0.0002	<0.0002	IP	IP	IP	IP	<0.0002	<0.01	<0.0002	<0.0004	IP
Sodium	mg/L	**156**	**174**	**166**	**19.1**	IP	IP	IP	**64.6**	**37.6**	IP	IP	IP	IP	**8.45**	**26,400**	**158**	**1080**	IP
Strontium	mg/L	**0.619**	**0.556**	**0.482**	**0.578**	IP	IP	IP	**0.243**	**0.237**	IP	IP	IP	IP	**0.167**	**0.678**	**0.341**	**0.941**	IP
Zinc	mg/L	**0.00857**	**0.00452**	0.00213 J	**0.00748**	IP	IP	IP	**0.00496**	**0.00654**	IP	IP	IP	IP	**0.0466**	**1.97**	**0.0153**	**0.0258**	IP
Anions/Water Quality Parameters																			
Bicarbonate Alkalinity	mg/L	**269**	**241**	**238**	**245**	IP	IP	IP	**163**	**107**	IP	IP	IP	IP	**159**	**128**	**210**	**495**	IP
Bromide	mg/L	<0.03	<0.03	<0.03	<0.03	IP	IP	IP	<0.03	<0.03	IP	IP	IP	IP	<0.03	<1.5	<0.03	<0.06	IP
Carbonate Alkalinity	mg/L	<5	<5	<5	<5	IP	IP	IP	<5	<5	IP	IP	IP	IP	<5	<5	<5	<5	IP
Chloride	mg/L	**317**	**308**	**296**	**343**	IP	IP	IP	**95.8**	**47**	IP	IP	IP	IP	**6.45**	**55,900**	**215**	**2090**	IP
Sulfate	mg/L	**45.2**	**113**	**111**	**135**	IP	IP	IP	**16.5**	**133**	IP	IP	IP	IP	**2.97**	**243**	**92.1**	**183**	IP
Total Dissolved Solids (TDS)	mg/L	**676**	**80.0**	**512**	**892**	**710**	**712**	**748**	**290**	**412**	**712**	**732**	**706**	**408**	**320**	**97,400**	**498**	**3600**	IP
Sulfides																			
Hydrogen Sulfide	mg/L	<0.5	<0.5	<0.5	<0.5	IP	IP	IP	<0.5	**23.9**	IP	IP	IP	IP	<0.5	<0.5	<0.5	<0.5	IP
Sulfide	mg/L	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	IP
Volatile Organic Compounds																			
Benzene	mg/L	**0.00120**	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00034 J	0.75 J	<0.0002	<0.0002	IP
Ethylbenzene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	**0.00180**	**2.3**	<0.0003	<0.0003	IP
Toluene	mg/L	0.00079 J	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00055 J	0.73 J	<0.0002	<0.0002	IP
m,p-Xylene	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0020 J	**3**	<0.0005	<0.0005	IP
o-Xylene	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	**2**	<0.0003	<0.0003	IP
Xylenes, Total	mg/L	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	**0.00200**	**5**	<0.0003	<0.0003	IP
TPH Fractions																			
Aliphatics >C6-C8	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	IP
Aliphatics >C8-C10	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	IP
Aliphatics >C10-C12	mg/L	<0.001	<0.001	<0.001	<0.001	IP	IP	IP	<0.001	<0.001	IP	IP	IP	IP	<0.001	<0.001	<0.001	<0.001	IP
Aliphatics >C12-C16	mg/L	**0.0746**	<0.002	<0.002	<0.002	IP	IP	IP	<0.002	<0.002	IP	IP	IP	IP	<0.002	<0.002	<0.002	<0.002	IP
Aliphatics >C16-C35	mg/L	**0.249**	<0.008	<0.008	<0.008	IP	IP	IP	<0.008	<0.008	IP	IP	IP	IP	<0.008	**0.239**	<0.008	<0.008	IP
Aromatics >C8-C10	mg/L	<0.01	<0.01	<0.01	<0.01	IP	IP	IP	<0.01	<0.01	IP	IP	IP	IP	**0.0285**	**0.0192**	<0.01	<0.01	IP
Aromatics >C10-C12	mg/L	<0.001	<0.001	<0.001	<0.001	IP	IP	IP	<0.001	<0.001	IP	IP	IP	IP	<0.001	**0.00551**	<0.001	<0.001	IP
Aromatics >C12-C16	mg/L	**0.0417**	<0.004	<0.004	<0.004	IP	IP	IP	<0.004	<0.004	IP	IP	IP	IP	<0.004	**0.0225**	<0.004	<0.004	IP
Aromatics >C16-C21	mg/L	**0.121**	<0.003	<0.003	<0.003	IP	IP	IP	<0.003	<0.003	IP	IP	IP	IP	<0.003	**0.0188**	<0.003	<0.003	IP
Aromatics >C21-C35	mg/L	<0.009	<0.009	<0.009	<0.009	IP	IP	IP	<0.009	<0.009	IP	IP	IP	IP	<0.009	**0.079**	<0.009	<0.009	IP

Notes
J - Estimated Value reported below the detection limit.
< - Not Detected at the reporting limit shown.
Bolded values deteted in the sample.
IP - In Progress

Table 3

Dissolved Gas Data Summary

Sulphur Dome

Calcasieu Parish, Louisiana

	Sample Location	LDNR #1	LDNR #3	LDNR #4	LDNR #5	WPB PGG No.7B		WW #11	WW #13	WW #12	WW #19	SN 57788
	Sample ID	Brine Well 22 BS	CP BS 1	CP BS 2	CP BS 3	Brine Well 7A BS	Central Pond	019-580	019-582	019-995	019-1055	6X Brine
	Sample Date	1/25/23	1/30/23	1/30/23	1/30/23	1/25/23	1/25/23	1/26/23	1/26/23	1/26/23	1/26/23	1/25/23
	Sampler	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM	ERM
Component	**Units**	Surface Water (Bubble Site)					Surface Water	Water Well				Brine
Carbon Monoxide	mol%	ND	ND	ND	ND	ND	0.26	ND	ND	ND	ND	ND
Helium	mol%	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hydrogen	mol%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Argon	mol%	**1.35**	**1.04**	**0.905**	**1.54**	**0.744**	**1.98**	**1.64**	**1.76**	**1.75**	**1.39**	**1.91**
Oxygen	mol%	**0.47**	**8.91**	**15.5**	**21.68**	**16.39**	**0.41**	**5.59**	**5.03**	**6.3**	**9.78**	**0.74**
Nitrogen	mol%	**61.78**	**45.65**	**65.33**	**69.85**	**41.21**	**84.79**	**79.08**	**82.36**	**80.84**	**82**	**79.17**
Carbon Dioxide	mol%	**7.47**	**3.58**	**1.29**	**2.47**	**0.29**	**12.25**	**13.23**	**10.83**	**10.81**	**6.53**	**5.31**
Methane	mol%	**28.45**	**40.41**	**16.69**	**4.39**	**40.83**	**0.302**	**0.456**	**0.0186**	**0.294**	**0.3**	**11.72**
Ethane	mol%	**0.287**	**0.261**	**0.209**	**0.0472**	**0.397**	**0.0015**	ND	ND	ND	**0.0013**	**0.462**
Ethylene	mol%	ND	**0.0097**	**0.0067**	**0.0022**	**0.0013**	ND	ND	ND	ND	ND	**0.0193**
Propane	mol%	**0.0926**	**0.0702**	**0.0445**	**0.0128**	**0.099**	ND	ND	ND	ND	ND	**0.389**
Propylene	mol%	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**0.0006**
Iso-butane	mol%	**0.0216**	**0.0259**	**0.0115**	**0.0033**	**0.0286**	ND	ND	ND	ND	ND	**0.0312**
N-butane	mol%	**0.0216**	**0.0189**	**0.0091**	**0.0028**	**0.0106**	ND	ND	ND	ND	ND	**0.0893**
Iso-pentane	mol%	**0.0083**	**0.0083**	**0.0032**	**0.0006**	**0.013**	ND	ND	ND	ND	ND	**0.0162**
N-pentane	mol%	**0.0055**	**0.0051**	**0.0019**	ND	ND	ND	ND	ND	ND	ND	**0.0193**
Hexanes +	mol%	**0.0449**	**0.0083**	**0.0029**	**0.0039**	**0.003**	**0.0037**	**0.0042**	**0.0018**	**0.0019**	**0.002**	**0.12**
Methane Stable Isotopes												
$\delta^{13}C$	‰	**-33.03**	**-34.2**	**-38.37**	**-35.45**	**-35.6**	NA	**-56.4**	NA	NA	**-53.9**	**-38.98**
δD	‰	**-129.6**	**-147.2**	**-160.5**	**-143**	**-150.3**	NA	NA	NA	NA	NA	**-171.7**

Notes

Bolded values deteted in the sample.

ND - Not Detected

NA - Not Analyzed (insufficient volume)

10450 Stancliff Rd. Suite 210
Houston, TX 77099
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February 24, 2023

Scott Himes
Environmental Resources Mgmt.
CityCentre Four
840 W. Sam Houston Pkwy., Suite 600
Houston, TX 77024

Work Order: **HS23020536**

Laboratory Results for: **Sulphur Dome**

Dear Scott Himes,

ALS Environmental received 2 sample(s) on Feb 10, 2023 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,

Bernadette Fini

Generated By: DAYNA.FISHER
Bernadette A. Fini
Project Manager

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Work Order: HS23020536

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS23020536-01	1101529-BS	Water		10-Feb-2023 11:20	10-Feb-2023 16:30	☐
HS23020536-02	Brine Pond 4	Water		10-Feb-2023 12:15	10-Feb-2023 16:30	☐

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt. **CASE NARRATIVE**
Project: Sulphur Dome
Work Order: HS23020536

GC Semivolatiles by Method MA EPH

Batch ID: 189815

Sample ID: HS23020462-07MS

- MS and MSD are for an unrelated sample

GC Volatiles by Method MA VPH

Batch ID: R428336,R428350

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

GCMS Volatiles by Method SW8260

Batch ID: R428439

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

Metals by Method SW6020A

Batch ID: 190037

Sample ID: HS23020553-04MS

- MS and MSD are for an unrelated sample

Metals by Method SW7470A

Batch ID: 189919

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method SW9056

Batch ID: R428633

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

Batch ID: R428518

Sample ID: 1101529-BS (HS23020536-01MS/MSD)

- The MS and/or MSD recovery was outside of the control limits; however, the result in the parent sample is greater than 4x the spike amount. (Sulfate)
- The recovery of the Matrix Spike (MS) and/or Matrix Spike Duplicate (MSD) associated with this analyte was outside of the established control limits. However, the LCS was within control limits. The recovery of the MS/MSD may be due to sample matrix interference. (Bromide)

WetChemistry by Method SM2320B

Batch ID: R428629

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Work Order: HS23020536

CASE NARRATIVE

WetChemistry by Method E376.1

Batch ID: R428412

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method M2540C

Batch ID: R428243

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method SM4500 S2-F

Batch ID: R428053

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: 1101529-BS
Collection Date: 10-Feb-2023 11:20

ANALYTICAL REPORT
WorkOrder:HS23020536
Lab ID:HS23020536-01
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
LOW LEVEL VOLATILES BY SW8260C		**Method:SW8260**					Analyst: AKP
Benzene		U	0.20	1.0	ug/L	1	21-Feb-2023 02:03
Ethylbenzene		U	0.30	1.0	ug/L	1	21-Feb-2023 02:03
m,p-Xylene		U	0.50	2.0	ug/L	1	21-Feb-2023 02:03
o-Xylene		U	0.30	1.0	ug/L	1	21-Feb-2023 02:03
Toluene		U	0.20	1.0	ug/L	1	21-Feb-2023 02:03
Xylenes, Total		U	0.30	1.0	ug/L	1	21-Feb-2023 02:03
Surr: 1,2-Dichloroethane-d4	*81.9*			*70-126*	*%REC*	*1*	*21-Feb-2023 02:03*
Surr: 4-Bromofluorobenzene	*88.7*			*77-113*	*%REC*	*1*	*21-Feb-2023 02:03*
Surr: Dibromofluoromethane	*94.0*			*77-123*	*%REC*	*1*	*21-Feb-2023 02:03*
Surr: Toluene-d8	*100*			*82-127*	*%REC*	*1*	*21-Feb-2023 02:03*
MASSACHUSETTS VPH, FEB 2018, REV 2.1		**Method:MA VPH**					Analyst: PJM
Aliphatics >C6 - C8		U	0.0100	0.0100	mg/L	1	18-Feb-2023 02:20
Aliphatics >C8 - C10		U	0.0100	0.0100	mg/L	1	18-Feb-2023 02:20
Aromatics >C8 - C10		U	0.0100	0.0100	mg/L	1	18-Feb-2023 02:20
Surr: 2,5-Dibromotoluene (Aliphatic)	*108*			*70-130*	*%REC*	*1*	*18-Feb-2023 02:20*
Surr: 2,5-Dibromotoluene (Aromatic)	*114*			*70-130*	*%REC*	*1*	*18-Feb-2023 02:20*
MASSACHUSETTS EPH R2.1, DEC 2019		**Method:MA EPH**			Prep:SW3510 / 17-Feb-2023		Analyst: PPM
Aliphatics >C10 - C12		U	0.00100	0.00100	mg/L	1	23-Feb-2023 10:57
Aliphatics >C12 - C16		U	0.00200	0.00200	mg/L	1	23-Feb-2023 10:57
Aliphatics >C16 - C35		U	0.00800	0.00800	mg/L	1	23-Feb-2023 10:57
Aromatics >C10 - C12		U	0.00100	0.00100	mg/L	1	23-Feb-2023 09:22
Aromatics >C12 - C16		U	0.00400	0.00400	mg/L	1	23-Feb-2023 09:22
Aromatics >C16 - C21		U	0.00300	0.00300	mg/L	1	23-Feb-2023 09:22
Aromatics >C21 - C35		U	0.00900	0.00900	mg/L	1	23-Feb-2023 09:22
Surr: 1-Chlorooctadecane	*73.6*			*40-140*	*%REC*	*1*	*23-Feb-2023 10:57*
Surr: 2-Bromonaphthalene	*77.6*			*40-140*	*%REC*	*1*	*23-Feb-2023 09:22*
Surr: 2-Fluorobiphenyl	*49.2*			*40-140*	*%REC*	*1*	*23-Feb-2023 09:22*
Surr: o-Terphenyl	*92.0*			*40-140*	*%REC*	*1*	*23-Feb-2023 09:22*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: 1101529-BS
Collection Date: 10-Feb-2023 11:20

ANALYTICAL REPORT
WorkOrder:HS23020536
Lab ID:HS23020536-01
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		**Method:SW6020A**			Prep:SW3010A / 23-Feb-2023		Analyst: MSC
Arsenic	**0.000896**	J	**0.000400**	**0.00200**	**mg/L**	1	24-Feb-2023 16:12
Barium	**0.0594**		**0.00190**	**0.00400**	**mg/L**	1	24-Feb-2023 16:12
Cadmium	U		0.000200	0.00200	mg/L	1	24-Feb-2023 16:12
Calcium	**55.8**		**0.0340**	**0.500**	**mg/L**	1	24-Feb-2023 16:12
Chromium	U		0.000400	0.00400	mg/L	1	24-Feb-2023 16:12
Iron	**0.0432**	J	**0.0120**	**0.200**	**mg/L**	1	24-Feb-2023 16:12
Lead	U		0.000600	0.00200	mg/L	1	24-Feb-2023 16:12
Magnesium	**5.64**		**0.0100**	**0.200**	**mg/L**	1	24-Feb-2023 16:12
Manganese	**0.0295**		**0.000700**	**0.00500**	**mg/L**	1	24-Feb-2023 16:12
Potassium	**2.44**		**0.0180**	**0.200**	**mg/L**	1	24-Feb-2023 16:12
Selenium	U		0.00110	0.00200	mg/L	1	24-Feb-2023 16:12
Silver	U		0.000200	0.00200	mg/L	1	24-Feb-2023 16:12
Sodium	**37.6**		**0.0140**	**0.200**	**mg/L**	1	24-Feb-2023 16:12
Strontium	**0.237**		**0.000200**	**0.00500**	**mg/L**	1	24-Feb-2023 16:12
Zinc	**0.00654**		**0.00200**	**0.00400**	**mg/L**	1	24-Feb-2023 16:12
MERCURY BY SW7470A		**Method:SW7470A**			Prep:SW7470A / 21-Feb-2023		Analyst: JS
Mercury	U		0.0000300	0.000200	mg/L	1	21-Feb-2023 14:12
HYDROGEN SULFIDE BY E376.1		**Method:E376.1**					Analyst: CD
Hydrogen Sulfide	**23.9**		**0.500**	**1.00**	**mg/L**	1	15-Feb-2023 15:48
TOTAL DISSOLVED SOLIDS BY SM2540C -2011		**Method:M2540C**					Analyst: DC
Total Dissolved Solids (Residue, Filterable)	**412**		**5.00**	**10.0**	**mg/L**	1	16-Feb-2023 11:30
ALKALINITY BY SM 2320B-2011		**Method:SM2320B**					Analyst: JAC
Alkalinity, Bicarbonate (As CaCO3)	**107**		**5.00**	**5.00**	**mg/L**	1	22-Feb-2023 16:01
Alkalinity, Carbonate (As CaCO3)	U		5.00	5.00	mg/L	1	22-Feb-2023 16:01
SULFIDE BY SM4500 S2-F-2011		**Method:SM4500 S2-F**					Analyst: CD
Sulfide	U		1.00	1.00	mg/L	1	15-Feb-2023 15:16
ANIONS BY SW9056A		**Method:SW9056**					Analyst: TH
Bromide	U		0.0300	0.100	mg/L	1	21-Feb-2023 16:19
Chloride	**47.0**		**0.200**	**0.500**	**mg/L**	1	21-Feb-2023 16:19
Sulfate	**133**		**1.00**	**2.50**	**mg/L**	5	22-Feb-2023 18:11

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: Brine Pond 4
Collection Date: 10-Feb-2023 12:15

ANALYTICAL REPORT
WorkOrder:HS23020536
Lab ID:HS23020536-02
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
LOW LEVEL VOLATILES BY SW8260C		**Method:SW8260**					Analyst: AKP
Benzene		U	0.20	1.0	ug/L	1	21-Feb-2023 02:25
Ethylbenzene		U	0.30	1.0	ug/L	1	21-Feb-2023 02:25
m,p-Xylene		U	0.50	2.0	ug/L	1	21-Feb-2023 02:25
o-Xylene		U	0.30	1.0	ug/L	1	21-Feb-2023 02:25
Toluene		U	0.20	1.0	ug/L	1	21-Feb-2023 02:25
Xylenes, Total		U	0.30	1.0	ug/L	1	21-Feb-2023 02:25
Surr: 1,2-Dichloroethane-d4	*85.8*			*70-126*	*%REC*	*1*	*21-Feb-2023 02:25*
Surr: 4-Bromofluorobenzene	*88.8*			*77-113*	*%REC*	*1*	*21-Feb-2023 02:25*
Surr: Dibromofluoromethane	*94.4*			*77-123*	*%REC*	*1*	*21-Feb-2023 02:25*
Surr: Toluene-d8	*98.8*			*82-127*	*%REC*	*1*	*21-Feb-2023 02:25*
MASSACHUSETTS VPH, FEB 2018, REV 2.1		**Method:MA VPH**					Analyst: PJM
Aliphatics >C6 - C8		U	0.0100	0.0100	mg/L	1	18-Feb-2023 02:58
Aliphatics >C8 - C10		U	0.0100	0.0100	mg/L	1	18-Feb-2023 02:58
Aromatics >C8 - C10		U	0.0100	0.0100	mg/L	1	18-Feb-2023 02:58
Surr: 2,5-Dibromotoluene (Aliphatic)	*111*			*70-130*	*%REC*	*1*	*18-Feb-2023 02:58*
Surr: 2,5-Dibromotoluene (Aromatic)	*113*			*70-130*	*%REC*	*1*	*18-Feb-2023 02:58*
MASSACHUSETTS EPH R2.1, DEC 2019		**Method:MA EPH**			Prep:SW3510 / 17-Feb-2023		Analyst: PPM
Aliphatics >C10 - C12		U	0.00100	0.00100	mg/L	1	23-Feb-2023 11:29
Aliphatics >C12 - C16		U	0.00200	0.00200	mg/L	1	23-Feb-2023 11:29
Aliphatics >C16 - C35		U	0.00800	0.00800	mg/L	1	23-Feb-2023 11:29
Aromatics >C10 - C12		U	0.00100	0.00100	mg/L	1	23-Feb-2023 09:54
Aromatics >C12 - C16		U	0.00400	0.00400	mg/L	1	23-Feb-2023 09:54
Aromatics >C16 - C21		U	0.00300	0.00300	mg/L	1	23-Feb-2023 09:54
Aromatics >C21 - C35		U	0.00900	0.00900	mg/L	1	23-Feb-2023 09:54
Surr: 1-Chlorooctadecane	*84.9*			*40-140*	*%REC*	*1*	*23-Feb-2023 11:29*
Surr: 2-Bromonaphthalene	*88.8*			*40-140*	*%REC*	*1*	*23-Feb-2023 09:54*
Surr: 2-Fluorobiphenyl	*41.8*			*40-140*	*%REC*	*1*	*23-Feb-2023 09:54*
Surr: o-Terphenyl	*83.5*			*40-140*	*%REC*	*1*	*23-Feb-2023 09:54*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: Brine Pond 4
Collection Date: 10-Feb-2023 12:15

ANALYTICAL REPORT
WorkOrder:HS23020536
Lab ID:HS23020536-02
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		**Method:SW6020A**			Prep:SW3010A / 23-Feb-2023		Analyst: MSC
Arsenic	**0.00176**	J	**0.000400**	**0.00200**	**mg/L**	1	24-Feb-2023 16:14
Barium	**0.118**		**0.00190**	**0.00400**	**mg/L**	1	24-Feb-2023 16:14
Cadmium	U		0.000200	0.00200	mg/L	1	24-Feb-2023 16:14
Calcium	**38.6**		**0.0340**	**0.500**	**mg/L**	1	24-Feb-2023 16:14
Chromium	U		0.000400	0.00400	mg/L	1	24-Feb-2023 16:14
Iron	**0.609**		**0.0120**	**0.200**	**mg/L**	1	24-Feb-2023 16:14
Lead	U		0.000600	0.00200	mg/L	1	24-Feb-2023 16:14
Magnesium	**4.20**		**0.0100**	**0.200**	**mg/L**	1	24-Feb-2023 16:14
Manganese	**0.204**		**0.000700**	**0.00500**	**mg/L**	1	24-Feb-2023 16:14
Potassium	**1.17**		**0.0180**	**0.200**	**mg/L**	1	24-Feb-2023 16:14
Selenium	U		0.00110	0.00200	mg/L	1	24-Feb-2023 16:14
Silver	U		0.000200	0.00200	mg/L	1	24-Feb-2023 16:14
Sodium	**64.6**		**0.0140**	**0.200**	**mg/L**	1	24-Feb-2023 16:14
Strontium	**0.243**		**0.000200**	**0.00500**	**mg/L**	1	24-Feb-2023 16:14
Zinc	**0.00496**		**0.00200**	**0.00400**	**mg/L**	1	24-Feb-2023 16:14
MERCURY BY SW7470A		**Method:SW7470A**			Prep:SW7470A / 21-Feb-2023		Analyst: JS
Mercury	U		0.0000300	0.000200	mg/L	1	21-Feb-2023 14:14
HYDROGEN SULFIDE BY E376.1		**Method:E376.1**					Analyst: CD
Hydrogen Sulfide	U		0.500	1.00	mg/L	1	15-Feb-2023 15:48
TOTAL DISSOLVED SOLIDS BY SM2540C -2011		**Method:M2540C**					Analyst: DC
Total Dissolved Solids (Residue, Filterable)	**290**		**5.00**	**10.0**	**mg/L**	1	16-Feb-2023 11:30
ALKALINITY BY SM 2320B-2011		**Method:SM2320B**					Analyst: JAC
Alkalinity, Bicarbonate (As CaCO3)	**163**		**5.00**	**5.00**	**mg/L**	1	22-Feb-2023 16:01
Alkalinity, Carbonate (As CaCO3)	U		5.00	5.00	mg/L	1	22-Feb-2023 16:01
SULFIDE BY SM4500 S2-F-2011		**Method:SM4500 S2-F**					Analyst: CD
Sulfide	U		1.00	1.00	mg/L	1	15-Feb-2023 15:16
ANIONS BY SW9056A		**Method:SW9056**					Analyst: TH
Bromide	U		0.0300	0.100	mg/L	1	21-Feb-2023 16:36
Chloride	**95.8**		**0.200**	**0.500**	**mg/L**	1	21-Feb-2023 16:36
Sulfate	**16.5**		**0.200**	**0.500**	**mg/L**	1	21-Feb-2023 16:36

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Weight / Prep Log

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

Batch ID: 189815 **Start Date:** 17 Feb 2023 06:30 **End Date:** 17 Feb 2023 10:30
Method: MA EPH EXTRACTION-FRACTIONATION **Prep Code:** MA EPH_WPR

Sample ID	Container	Sample Wt/Vol	Final Volume	Prep Factor	
HS23020536-01	1	1000 (mL)	2 (mL)	0.002	1-litre amber glass, HCL to pH <2
HS23020536-02	1	1000 (mL)	2 (mL)	0.002	1-litre amber glass, HCL to pH <2

Batch ID: 189919 **Start Date:** 21 Feb 2023 07:00 **End Date:** 21 Feb 2023 15:00
Method: MERCURY PREP BY 7470A- WATER **Prep Code:** HG_WPR

Sample ID	Container	Sample Wt/Vol	Final Volume	Prep Factor	
HS23020536-01		10 (mL)	10 (mL)	1	120 plastic HNO3
HS23020536-02		10 (mL)	10 (mL)	1	120 plastic HNO3

Batch ID: 190037 **Start Date:** 23 Feb 2023 14:00 **End Date:** 23 Feb 2023 18:00
Method: WATER - SW3010A **Prep Code:** 3010A

Sample ID	Container	Sample Wt/Vol	Final Volume	Prep Factor	
HS23020536-01		10 (mL)	10 (mL)	1	120 plastic HNO3
HS23020536-02		10 (mL)	10 (mL)	1	120 plastic HNO3

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

DATES REPORT

Sample ID	Client Samp ID	Collection Date	Leachate Date	Prep Date	Analysis Date	DF
Batch ID: 189815 (0)	**Test Name :** MASSACHUSETTS EPH R2.1, DEC 2019				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20		17 Feb 2023 12:42	23 Feb 2023 10:57	1
HS23020536-01	1101529-BS	10 Feb 2023 11:20		17 Feb 2023 12:42	23 Feb 2023 09:22	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15		17 Feb 2023 12:42	23 Feb 2023 11:29	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15		17 Feb 2023 12:42	23 Feb 2023 09:54	1
Batch ID: 189919 (0)	**Test Name :** MERCURY BY SW7470A				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20		21 Feb 2023 07:00	21 Feb 2023 14:12	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15		21 Feb 2023 07:00	21 Feb 2023 14:14	1
Batch ID: 190037 (0)	**Test Name :** ICP-MS METALS BY SW6020A				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20		23 Feb 2023 14:00	24 Feb 2023 16:12	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15		23 Feb 2023 14:00	24 Feb 2023 16:14	1
Batch ID: R428053 (0)	**Test Name :** SULFIDE BY SM4500 S2-F-2011				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			15 Feb 2023 15:16	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			15 Feb 2023 15:16	1
Batch ID: R428243 (0)	**Test Name :** TOTAL DISSOLVED SOLIDS BY SM2540C-2011				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			16 Feb 2023 11:30	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			16 Feb 2023 11:30	1
Batch ID: R428336 (0)	**Test Name :** MASSACHUSETTS VPH, FEB 2018, REV 2.1				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			18 Feb 2023 02:20	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			18 Feb 2023 02:58	1
Batch ID: R428350 (0)	**Test Name :** MASSACHUSETTS VPH, FEB 2018, REV 2.1				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			18 Feb 2023 02:20	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			18 Feb 2023 02:58	1
Batch ID: R428412 (0)	**Test Name :** HYDROGEN SULFIDE BY E376.1				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			15 Feb 2023 15:48	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			15 Feb 2023 15:48	1
Batch ID: R428439 (0)	**Test Name :** LOW LEVEL VOLATILES BY SW8260C				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			21 Feb 2023 02:03	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			21 Feb 2023 02:25	1
Batch ID: R428518 (0)	**Test Name :** ANIONS BY SW9056A				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			21 Feb 2023 16:19	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			21 Feb 2023 16:36	1
Batch ID: R428629 (0)	**Test Name :** ALKALINITY BY SM 2320B-2011				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			22 Feb 2023 16:01	1
HS23020536-02	Brine Pond 4	10 Feb 2023 12:15			22 Feb 2023 16:01	1

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

DATES REPORT

Sample ID	Client Samp ID	Collection Date	Leachate Date	Prep Date	Analysis Date	DF
Batch ID: R428633 (0)	**Test Name :** ANIONS BY SW9056A				**Matrix:** Water	
HS23020536-01	1101529-BS	10 Feb 2023 11:20			22 Feb 2023 18:11	5

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 189815 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

MBLK Sample ID: **MBLK-189815** Units: **mg/L** Analysis Date: **22-Feb-2023 21:48**
Client ID: Run ID: **FID-7_428624** SeqNo: **7141475** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	U	0.00100								
Aliphatics >C12 - C16	U	0.00200								
Aliphatics >C16 - C35	U	0.00800								
Surr: 1-Chlorooctadecane	*0.03449*	*0*	*0.04*	*0*	*86.2*	*40 - 140*				

MBLK Sample ID: **MBLK-189815** Units: **mg/L** Analysis Date: **22-Feb-2023 20:13**
Client ID: Run ID: **FID-8_428640** SeqNo: **7141873** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	U	0.00100								
Aromatics >C12 - C16	U	0.00400								
Aromatics >C16 - C21	U	0.00300								
Aromatics >C21 - C35	U	0.00900								
Surr: 2-Bromonaphthalene	*0.03991*	*0*	*0.04*	*0*	*99.8*	*40 - 140*				
Surr: 2-Fluorobiphenyl	*0.02977*	*0*	*0.04*	*0*	*74.4*	*40 - 140*				
Surr: o-Terphenyl	*0.03312*	*0*	*0.04*	*0*	*82.8*	*40 - 140*				

LCS Sample ID: **LCS-189815** Units: **mg/L** Analysis Date: **22-Feb-2023 22:19**
Client ID: Run ID: **FID-7_428624** SeqNo: **7141565** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.05934	0.00100	0.05	0	119	40 - 140				
Aliphatics >C12 - C16	0.1206	0.00200	0.1	0	121	40 - 140				
Aliphatics >C16 - C35	0.4431	0.00800	0.4	0	111	40 - 140				
Surr: 1-Chlorooctadecane	*0.03511*	*0*	*0.04*	*0*	*87.8*	*40 - 140*				

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 189815 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

LCS Sample ID: **LCS-189815** Units: **mg/L** Analysis Date: **22-Feb-2023 20:45**
Client ID: Run ID: **FID-8_428640** SeqNo: **7141912** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.02758	0.00100	0.05	0	55.2	40 - 140				
Aromatics >C12 - C16	0.1217	0.00400	0.2	0	60.9	40 - 140				
Aromatics >C16 - C21	0.1203	0.00300	0.15	0	80.2	40 - 140				
Aromatics >C21 - C35	0.3644	0.00900	0.45	0	81.0	40 - 140				
Surr: 2-Bromonaphthalene	*0.02525*	*0*	*0.04*	*0*	*63.1*	*40 - 140*				
Surr: 2-Fluorobiphenyl	*0.0181*	*0*	*0.04*	*0*	*45.3*	*40 - 140*				
Surr: o-Terphenyl	*0.03127*	*0*	*0.04*	*0*	*78.2*	*40 - 140*				

MS Sample ID: **HS23020462-07MS** Units: **mg/L** Analysis Date: **23-Feb-2023 07:48**
Client ID: Run ID: **FID-7_428624** SeqNo: **7141493** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.08298	0.00100	0.05	0.02385	118	40 - 140				
Aliphatics >C12 - C16	0.1636	0.00200	0.1	0.0318	132	40 - 140				
Aliphatics >C16 - C35	0.5997	0.00800	0.4	0.07777	130	40 - 140				
Surr: 1-Chlorooctadecane	*0.04577*	*0*	*0.04*	*0*	*114*	*40 - 140*				

MS Sample ID: **HS23020460-05MS** Units: **mg/L** Analysis Date: **23-Feb-2023 00:26**
Client ID: Run ID: **FID-7_428624** SeqNo: **7141480** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.04942	0.00100	0.05	0	98.8	40 - 140				
Aliphatics >C12 - C16	0.09136	0.00200	0.1	0	91.4	40 - 140				
Aliphatics >C16 - C35	0.4332	0.00800	0.4	0	108	40 - 140				
Surr: 1-Chlorooctadecane	*0.03433*	*0*	*0.04*	*0*	*85.8*	*40 - 140*				

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 189815 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

MS Sample ID: **HS23020462-07MS** Units: **mg/L** Analysis Date: **23-Feb-2023 06:13**
Client ID: Run ID: **FID-8_428640** SeqNo: **7141891** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.06794	0.00100	0.05	0.06802	-0.174	40 - 140				S
Aromatics >C12 - C16	0.4795	0.00400	0.2	0.4939	-7.17	40 - 140				S
Aromatics >C16 - C21	0.3549	0.00300	0.15	0.3546	0.209	40 - 140				S
Aromatics >C21 - C35	0.5091	0.00900	0.45	0.1494	79.9	40 - 140				
Surr: 2-Bromonaphthalene	*0.04637*	*0*	*0.04*	*0*	*116*	*40 - 140*				
Surr: 2-Fluorobiphenyl	*0.02637*	*0*	*0.04*	*0*	*65.9*	*40 - 140*				
Surr: o-Terphenyl	*0.04581*	*0*	*0.04*	*0*	*115*	*40 - 140*				

MS Sample ID: **HS23020460-05MS** Units: **mg/L** Analysis Date: **22-Feb-2023 22:51**
Client ID: Run ID: **FID-8_428640** SeqNo: **7141878** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.04292	0.00100	0.05	0	85.8	40 - 140				
Aromatics >C12 - C16	0.1861	0.00400	0.2	0	93.0	40 - 140				
Aromatics >C16 - C21	0.1547	0.00300	0.15	0	103	40 - 140				
Aromatics >C21 - C35	0.3983	0.00900	0.45	0	88.5	40 - 140				
Surr: 2-Bromonaphthalene	*0.03951*	*0*	*0.04*	*0*	*98.8*	*40 - 140*				
Surr: 2-Fluorobiphenyl	*0.0216*	*0*	*0.04*	*0*	*54.0*	*40 - 140*				
Surr: o-Terphenyl	*0.03756*	*0*	*0.04*	*0*	*93.9*	*40 - 140*				

MSD Sample ID: **HS23020462-07MSD** Units: **mg/L** Analysis Date: **23-Feb-2023 08:19**
Client ID: Run ID: **FID-7_428624** SeqNo: **7141494** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.07977	0.00100	0.05	0.02385	112	40 - 140	0.08298	3.95	50	
Aliphatics >C12 - C16	0.1505	0.00200	0.1	0.0318	119	40 - 140	0.1636	8.38	50	
Aliphatics >C16 - C35	0.6067	0.00800	0.4	0.07777	132	40 - 140	0.5997	1.15	50	
Surr: 1-Chlorooctadecane	*0.04192*	*0*	*0.04*	*0*	*105*	*40 - 140*	*0.04577*	*8.79*	*50*	

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 189815 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

MSD Sample ID: **HS23020460-05MSD** Units: **mg/L** Analysis Date: **23-Feb-2023 00:58**
Client ID: Run ID: **FID-7_428624** SeqNo: **7141481** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.05905	0.00100	0.05	0	118	40 - 140	0.04942	17.8	50	
Aliphatics >C12 - C16	0.1138	0.00200	0.1	0	114	40 - 140	0.09136	21.8	50	
Aliphatics >C16 - C35	0.4591	0.00800	0.4	0	115	40 - 140	0.4332	5.81	50	
Surr: 1-Chlorooctadecane	*0.03711*	*0*	*0.04*	*0*	*92.8*	*40 - 140*	*0.03433*	*7.77*	*50*	

MSD Sample ID: **HS23020462-07MSD** Units: **mg/L** Analysis Date: **23-Feb-2023 06:44**
Client ID: Run ID: **FID-8_428640** SeqNo: **7141892** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.1033	0.00100	0.05	0.06802	70.6	40 - 140	0.06794	41.3	50	
Aromatics >C12 - C16	0.6643	0.00400	0.2	0.4939	85.2	40 - 140	0.4795	32.3	50	
Aromatics >C16 - C21	0.4958	0.00300	0.15	0.3546	94.1	40 - 140	0.3549	33.1	50	
Aromatics >C21 - C35	0.6053	0.00900	0.45	0.1494	101	40 - 140	0.5091	17.3	50	
Surr: 2-Bromonaphthalene	*0.06179*	*0*	*0.04*	*0*	*154*	*40 - 140*	*0.04637*	*28.5*	*50*	S
Surr: 2-Fluorobiphenyl	*0.03632*	*0*	*0.04*	*0*	*90.8*	*40 - 140*	*0.02637*	*31.7*	*50*	
Surr: o-Terphenyl	*0.05512*	*0*	*0.04*	*0*	*138*	*40 - 140*	*0.04581*	*18.4*	*50*	

MSD Sample ID: **HS23020460-05MSD** Units: **mg/L** Analysis Date: **22-Feb-2023 23:23**
Client ID: Run ID: **FID-8_428640** SeqNo: **7141879** PrepDate: **17-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.03769	0.00100	0.05	0	75.4	40 - 140	0.04292	13	50	
Aromatics >C12 - C16	0.1795	0.00400	0.2	0	89.7	40 - 140	0.1861	3.61	50	
Aromatics >C16 - C21	0.1723	0.00300	0.15	0	115	40 - 140	0.1547	10.7	50	
Aromatics >C21 - C35	0.4704	0.00900	0.45	0	105	40 - 140	0.3983	16.6	50	
Surr: 2-Bromonaphthalene	*0.03696*	*0*	*0.04*	*0*	*92.4*	*40 - 140*	*0.03951*	*6.65*	*50*	
Surr: 2-Fluorobiphenyl	*0.01608*	*0*	*0.04*	*0*	*40.2*	*40 - 140*	*0.0216*	*29.3*	*50*	
Surr: o-Terphenyl	*0.04245*	*0*	*0.04*	*0*	*106*	*40 - 140*	*0.03756*	*12.2*	*50*	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428336 (0) **Instrument:** FID-14 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MBLK Sample ID: **MBLK-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 15:30**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135091** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	U	0.0100								
Aliphatics >C8 - C10	U	0.0100								
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2731*	*0.0100*	*0.25*	*0*	*109*	*70 - 130*				

LCS Sample ID: **LCS-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 14:52**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135090** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.02124	0.0100	0.025	0	84.9	70 - 130				
Aliphatics >C8 - C10	0.02062	0.0100	0.025	0	82.5	70 - 130				
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2743*	*0.0100*	*0.25*	*0*	*110*	*70 - 130*				

MS Sample ID: **HS23020555-04MS** Units: **mg/L** Analysis Date: **17-Feb-2023 17:25**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135094** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.02348	0.0100	0.025	0	93.9	70 - 130				
Aliphatics >C8 - C10	0.02156	0.0100	0.025	0	86.2	70 - 130				
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2748*	*0.0100*	*0.25*	*0*	*110*	*70 - 130*				

MS Sample ID: **HS23020462-07MS** Units: **mg/L** Analysis Date: **17-Feb-2023 19:20**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135162** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.04418	0.0100	0.025	0.02365	82.1	70 - 130				
Aliphatics >C8 - C10	0.04355	0.0100	0.025	0.02066	91.6	70 - 130				
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2778*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*				

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428336 (0) **Instrument:** FID-14 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MSD Sample ID: **HS23020555-04MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 18:03**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135095** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.02232	0.0100	0.025	0	89.3	70 - 130	0.02348	5.03	25	
Aliphatics >C8 - C10	0.02116	0.0100	0.025	0	84.6	70 - 130	0.02156	1.87	25	
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2774*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*	*0.2748*	*0.949*	*25*	

MSD Sample ID: **HS23020462-07MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 19:58**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135098** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.04461	0.0100	0.025	0.02365	83.9	70 - 130	0.04418	0.978	25	
Aliphatics >C8 - C10	0.0391	0.0100	0.025	0.02066	73.8	70 - 130	0.04355	10.8	25	
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2727*	*0.0100*	*0.25*	*0*	*109*	*70 - 130*	*0.2778*	*1.86*	*25*	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428350 (0) **Instrument:** FID-15 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MBLK Sample ID: **MBLK-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 15:30**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135365** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	U	0.0100								
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2723*	*0.0100*	*0.25*	*0*	*109*	*70 - 130*				

LCS Sample ID: **LCS-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 14:52**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135364** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.08705	0.0100	0.1	0	87.1	70 - 130				
Surr: 2,5-Dibromotoluene (Aromatic)	*0.274*	*0.0100*	*0.25*	*0*	*110*	*70 - 130*				

MS Sample ID: **HS23020555-04MS** Units: **mg/L** Analysis Date: **17-Feb-2023 17:25**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135368** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.08842	0.0100	0.1	0	88.4	70 - 130				
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2766*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*				

MS Sample ID: **HS23020462-07MS** Units: **mg/L** Analysis Date: **17-Feb-2023 19:20**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135414** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.1618	0.0100	0.1	0.08535	76.4	70 - 130				
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2891*	*0.0100*	*0.25*	*0*	*116*	*70 - 130*				

MSD Sample ID: **HS23020555-04MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 18:03**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135369** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.08664	0.0100	0.1	0	86.6	70 - 130	0.08842	2.04	25	
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2766*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*	*0.2766*	*0*	*25*	

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428350 (0) **Instrument:** FID-15 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MSD Sample ID: **HS23020462-07MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 19:58**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135372** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.1569	0.0100	0.1	0.08535	71.5	70 - 130	0.1618	3.08	25	
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2891*	*0.0100*	*0.25*	*0*	*116*	*70 - 130*	*0.2891*	*0*	*25*	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 189919 (0) **Instrument: HG04** **Method: MERCURY BY SW7470A**

MBLK Sample ID: **MBLK-189919** Units: **mg/L** Analysis Date: **21-Feb-2023 13:11**
Client ID: Run ID: **HG04_428485** SeqNo: **7138543** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	U	0.000200								

LCS Sample ID: **LCS-189919** Units: **mg/L** Analysis Date: **21-Feb-2023 13:15**
Client ID: Run ID: **HG04_428485** SeqNo: **7138544** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00495	0.000200	0.005	0	99.0	80 - 120				

MS Sample ID: **HS23020523-02MS** Units: **mg/L** Analysis Date: **21-Feb-2023 14:05**
Client ID: Run ID: **HG04_428485** SeqNo: **7138561** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00438	0.000200	0.005	-0.000003	87.7	75 - 125				

MSD Sample ID: **HS23020523-02MSD** Units: **mg/L** Analysis Date: **21-Feb-2023 14:07**
Client ID: Run ID: **HG04_428485** SeqNo: **7138562** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00506	0.000200	0.005	-0.000003	101	75 - 125	0.00438	14.4	20	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 190037 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

MBLK Sample ID: **MBLK-190037** Units: **mg/L** Analysis Date: **23-Feb-2023 23:46**
Client ID: Run ID: **ICPMS06_428628** SeqNo: **7143682** PrepDate: **23-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	U	0.00200								
Barium	U	0.00400								
Cadmium	U	0.00200								
Calcium	U	0.500								
Chromium	U	0.00400								
Iron	U	0.200								
Lead	U	0.00200								
Magnesium	0.01321	0.200								J
Manganese	U	0.00500								
Potassium	U	0.200								
Selenium	U	0.00200								
Silver	U	0.00200								
Sodium	U	0.200								
Strontium	U	0.00500								
Zinc	U	0.00400								

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 190037 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

LCS Sample ID: **LCS-190037** Units: **mg/L** Analysis Date: **23-Feb-2023 23:48**
Client ID: Run ID: **ICPMS06_428628** SeqNo: **7143683** PrepDate: **23-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.05266	0.00200	0.05	0	105	80 - 120				
Barium	0.0485	0.00400	0.05	0	97.0	80 - 120				
Cadmium	0.04978	0.00200	0.05	0	99.6	80 - 120				
Calcium	5.189	0.500	5	0	104	80 - 120				
Chromium	0.04778	0.00400	0.05	0	95.6	80 - 120				
Iron	5.089	0.200	5	0	102	80 - 120				
Lead	0.04784	0.00200	0.05	0	95.7	80 - 120				
Magnesium	5.054	0.200	5	0	101	80 - 120				
Manganese	0.0501	0.00500	0.05	0	100	80 - 120				
Potassium	5.082	0.200	5	0	102	80 - 120				
Selenium	0.05458	0.00200	0.05	0	109	80 - 120				
Silver	0.04904	0.00200	0.05	0	98.1	80 - 120				
Sodium	4.924	0.200	5	0	98.5	80 - 120				
Strontium	0.09649	0.00500	0.1	0	96.5	80 - 120				
Zinc	0.05251	0.00400	0.05	0	105	80 - 120				

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 190037 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

MS Sample ID: **HS23020553-04MS** Units: **mg/L** Analysis Date: **23-Feb-2023 23:58**
Client ID: Run ID: **ICPMS06_428628** SeqNo: **7143688** PrepDate: **23-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual
Arsenic	0.05777	0.00200	0.05	0.002957	110	80 - 120			
Barium	3.387	0.00400	0.05	3.307	161	80 - 120			SEO
Cadmium	0.04702	0.00200	0.05	0.000022	94.0	80 - 120			
Calcium	1366	0.500	5	1326	812	80 - 120			SEO
Chromium	0.05241	0.00400	0.05	0.001921	101	80 - 120			
Iron	31.51	0.200	5	25.72	116	80 - 120			O
Lead	0.05278	0.00200	0.05	0.000099	105	80 - 120			
Magnesium	466.9	0.200	5	449.2	354	80 - 120			SEO
Manganese	7.423	0.00500	0.05	7.064	719	80 - 120			SEO
Potassium	44.43	0.200	5	37.63	136	80 - 120			SO
Selenium	0.05362	0.00200	0.05	0.000643	106	80 - 120			
Silver	0.04683	0.00200	0.05	0.000029	93.6	80 - 120			
Sodium	1062	0.200	5	1035	538	80 - 120			SEO
Strontium	13.92	0.00500	0.1	13.72	197	80 - 120			SEO
Zinc	0.05424	0.00400	0.05	0.006581	95.3	80 - 120			

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 190037 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

MSD Sample ID: **HS23020553-04MSD** Units: **mg/L** Analysis Date: **24-Feb-2023 00:00**
Client ID: Run ID: **ICPMS06_428628** SeqNo: **7143689** PrepDate: **23-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.06087	0.00200	0.05	0.002957	116	80 - 120	0.05777	5.23	20	
Barium	3.574	0.00400	0.05	3.307	534	80 - 120	3.387	5.36	20	SEO
Cadmium	0.04944	0.00200	0.05	0.000022	98.8	80 - 120	0.04702	5	20	
Calcium	1443	0.500	5	1326	2360	80 - 120	1366	5.5	20	SEO
Chromium	0.05408	0.00400	0.05	0.001921	104	80 - 120	0.05241	3.14	20	
Iron	32.97	0.200	5	25.72	145	80 - 120	31.51	4.52	20	SO
Lead	0.05481	0.00200	0.05	0.000099	109	80 - 120	0.05278	3.77	20	
Magnesium	484.7	0.200	5	449.2	710	80 - 120	466.9	3.74	20	SEO
Manganese	7.749	0.00500	0.05	7.064	1370	80 - 120	7.423	4.29	20	SEO
Potassium	46.99	0.200	5	37.63	187	80 - 120	44.43	5.59	20	SO
Selenium	0.05714	0.00200	0.05	0.000643	113	80 - 120	0.05362	6.36	20	
Silver	0.04908	0.00200	0.05	0.000029	98.1	80 - 120	0.04683	4.7	20	
Sodium	1112	0.200	5	1035	1550	80 - 120	1062	4.65	20	SEO
Strontium	14.69	0.00500	0.1	13.72	973	80 - 120	13.92	5.43	20	SEO
Zinc	0.05668	0.00400	0.05	0.006581	100	80 - 120	0.05424	4.39	20	

PDS Sample ID: **HS23020553-04PDS** Units: **mg/L** Analysis Date: **24-Feb-2023 00:03**
Client ID: Run ID: **ICPMS06_428628** SeqNo: **7143690** PrepDate: **23-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.1117	0.00200	0.1	0.002957	109	75 - 125				
Cadmium	0.09301	0.00200	0.1	0.000022	93.0	75 - 125				
Chromium	0.1007	0.00400	0.1	0.001921	98.8	75 - 125				
Iron	36.47	0.200	10	25.72	107	75 - 125				
Lead	0.1031	0.00200	0.1	0.000099	103	75 - 125				
Potassium	48.95	0.200	10	37.63	113	75 - 125				
Selenium	0.1069	0.00200	0.1	0.000643	106	75 - 125				
Silver	0.09095	0.00200	0.1	0.000029	90.9	75 - 125				
Zinc	0.1007	0.00400	0.1	0.006581	94.1	75 - 125				

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: 190037 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

PDS Sample ID: **HS23020553-04PDS** Units: **mg/L** Analysis Date: **24-Feb-2023 15:23**
Client ID: Run ID: **ICPMS06_428763** SeqNo: **7145206** PrepDate: **23-Feb-2023** DF: **100**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Barium	14.97	0.400	10	3.412	116	75 - 125				
Calcium	2238	50.0	1000	1283	95.5	75 - 125				
Magnesium	1500	20.0	1000	462.7	104	75 - 125				
Manganese	16.97	0.500	10	7.271	97.0	75 - 125				
Sodium	2065	20.0	1000	1064	100	75 - 125				
Strontium	25.07	0.500	10	13.27	118	75 - 125				

SD Sample ID: **HS23020553-04SD** Units: **mg/L** Analysis Date: **23-Feb-2023 23:56**
Client ID: Run ID: **ICPMS06_428628** SeqNo: **7143687** PrepDate: **23-Feb-2023** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Arsenic	0.005567	0.0100					0.002957	0	10	J
Cadmium	U	0.0100					0.000022	0	10	
Chromium	0.01026	0.0200					0.001921	0	10	J
Iron	25.92	1.00					25.72	0.792	10	
Lead	U	0.0100					0.000099	0	10	
Potassium	35.84	1.00					37.63	4.73	10	
Selenium	U	0.0100					0.000643	0	10	
Silver	U	0.0100					0.000029	0	10	
Zinc	0.01075	0.0200					0.006581	0	10	J

SD Sample ID: **HS23020553-04SD** Units: **mg/L** Analysis Date: **24-Feb-2023 15:21**
Client ID: Run ID: **ICPMS06_428763** SeqNo: **7145205** PrepDate: **23-Feb-2023** DF: **500**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Barium	3.415	2.00					3.412	0.0893	10	
Calcium	1281	250					1283	0.18	10	
Magnesium	478.4	100					462.7	3.38	10	
Manganese	7.235	2.50					7.271	0.493	10	
Sodium	1153	100					1064	8.42	10	
Strontium	13.35	2.50					13.27	0.581	10	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428439 (0) **Instrument: VOA7** **Method: LOW LEVEL VOLATILES BY SW8260C**

MBLK Sample ID: **VBLKW-230220** Units: **ug/L** Analysis Date: **20-Feb-2023 22:08**
Client ID: Run ID: **VOA7_428439** SeqNo: **7137448** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	U	1.0								
Ethylbenzene	U	1.0								
m,p-Xylene	U	2.0								
o-Xylene	U	1.0								
Toluene	U	1.0								
Xylenes, Total	U	1.0								
Surr: 1,2-Dichloroethane-d4	*43.6*	*1.0*	*50*	*0*	*87.2*	*70 - 123*				
Surr: 4-Bromofluorobenzene	*43.34*	*1.0*	*50*	*0*	*86.7*	*77 - 113*				
Surr: Dibromofluoromethane	*46.55*	*1.0*	*50*	*0*	*93.1*	*73 - 126*				
Surr: Toluene-d8	*49.48*	*1.0*	*50*	*0*	*99.0*	*81 - 120*				

LCS Sample ID: **VLCSW-230220** Units: **ug/L** Analysis Date: **20-Feb-2023 21:25**
Client ID: Run ID: **VOA7_428439** SeqNo: **7137447** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	17.71	1.0	20	0	88.5	74 - 120				
Ethylbenzene	19.04	1.0	20	0	95.2	77 - 117				
m,p-Xylene	37.47	2.0	40	0	93.7	77 - 122				
o-Xylene	18.41	1.0	20	0	92.1	75 - 119				
Toluene	17.82	1.0	20	0	89.1	77 - 118				
Xylenes, Total	55.88	1.0	60	0	93.1	75 - 122				
Surr: 1,2-Dichloroethane-d4	*45.13*	*1.0*	*50*	*0*	*90.3*	*70 - 123*				
Surr: 4-Bromofluorobenzene	*47.07*	*1.0*	*50*	*0*	*94.1*	*77 - 113*				
Surr: Dibromofluoromethane	*48.29*	*1.0*	*50*	*0*	*96.6*	*73 - 126*				
Surr: Toluene-d8	*49.1*	*1.0*	*50*	*0*	*98.2*	*81 - 120*				

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428439 (0) **Instrument: VOA7** **Method: LOW LEVEL VOLATILES BY SW8260C**

MS Sample ID: **HS23020584-07MS** Units: **ug/L** Analysis Date: **21-Feb-2023 05:37**
Client ID: Run ID: **VOA7_428439** SeqNo: **7137469** PrepDate: DF: **25**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	1447	25	500	980.8	93.2	70 - 127				
Ethylbenzene	475.5	25	500	0	95.1	70 - 124				
m,p-Xylene	931.8	50	1000	0	93.2	70 - 130				
o-Xylene	468.1	25	500	0	93.6	70 - 124				
Toluene	452.6	25	500	0	90.5	70 - 123				
Xylenes, Total	1400	25	1500	0	93.3	70 - 130				
Surr: 1,2-Dichloroethane-d4	*1116*	*25*	*1250*	*0*	*89.2*	*70 - 126*				
Surr: 4-Bromofluorobenzene	*1180*	*25*	*1250*	*0*	*94.4*	*77 - 113*				
Surr: Dibromofluoromethane	*1206*	*25*	*1250*	*0*	*96.5*	*77 - 123*				
Surr: Toluene-d8	*1229*	*25*	*1250*	*0*	*98.3*	*82 - 127*				

MSD Sample ID: **HS23020584-07MSD** Units: **ug/L** Analysis Date: **21-Feb-2023 05:59**
Client ID: Run ID: **VOA7_428439** SeqNo: **7137470** PrepDate: DF: **25**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	1403	25	500	980.8	84.5	70 - 127	1447	3.03	20	
Ethylbenzene	460.5	25	500	0	92.1	70 - 124	475.5	3.2	20	
m,p-Xylene	906.4	50	1000	0	90.6	70 - 130	931.8	2.77	20	
o-Xylene	447.9	25	500	0	89.6	70 - 124	468.1	4.41	20	
Toluene	433.8	25	500	0	86.8	70 - 123	452.6	4.25	20	
Xylenes, Total	1354	25	1500	0	90.3	70 - 130	1400	3.31	20	
Surr: 1,2-Dichloroethane-d4	*1096*	*25*	*1250*	*0*	*87.7*	*70 - 126*	*1116*	*1.74*	*20*	
Surr: 4-Bromofluorobenzene	*1174*	*25*	*1250*	*0*	*93.9*	*77 - 113*	*1180*	*0.557*	*20*	
Surr: Dibromofluoromethane	*1198*	*25*	*1250*	*0*	*95.8*	*77 - 123*	*1206*	*0.685*	*20*	
Surr: Toluene-d8	*1236*	*25*	*1250*	*0*	*98.9*	*82 - 127*	*1229*	*0.603*	*20*	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428053 (0) **Instrument: WetChem_HS** **Method: SULFIDE BY SM4500 S2-F-2011**

MBLK Sample ID: **MBLK-R428053** Units: **mg/L** Analysis Date: **15-Feb-2023 15:16**
Client ID: Run ID: **WetChem_HS_428053** SeqNo: **7125029** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	U	1.00								

LCS Sample ID: **LCS-R428053** Units: **mg/L** Analysis Date: **15-Feb-2023 15:16**
Client ID: Run ID: **WetChem_HS_428053** SeqNo: **7125028** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	22.32	1.00	25	0	89.3	85 - 115				

LCSD Sample ID: **LCSD-R428053** Units: **mg/L** Analysis Date: **15-Feb-2023 15:16**
Client ID: Run ID: **WetChem_HS_428053** SeqNo: **7125031** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	22.52	1.00	25	0	90.1	85 - 115	22.32	0.892	20	

MS Sample ID: **HS23020536-01MS** Units: **mg/L** Analysis Date: **15-Feb-2023 15:16**
Client ID: **1101529-BS** Run ID: **WetChem_HS_428053** SeqNo: **7125030** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	22.52	1.00	25	-1.68	96.8	80 - 120				

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428243 (0) **Instrument:** Balance1 **Method:** TOTAL DISSOLVED SOLIDS BY SM2540C-2011

MBLK Sample ID: **WBLK-02162023** Units: **mg/L** Analysis Date: **16-Feb-2023 11:30**
Client ID: Run ID: **Balance1_428243** SeqNo: **7133271** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	U	10.0								

LCS Sample ID: **LCS-021623** Units: **mg/L** Analysis Date: **16-Feb-2023 11:30**
Client ID: Run ID: **Balance1_428243** SeqNo: **7133270** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	1060	10.0	1000	0	106	85 - 115				

DUP Sample ID: **HS23020716-01DUP** Units: **mg/L** Analysis Date: **16-Feb-2023 11:30**
Client ID: Run ID: **Balance1_428243** SeqNo: **7133267** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	282	10.0					282	0	20	

DUP Sample ID: **HS23020536-01DUP** Units: **mg/L** Analysis Date: **16-Feb-2023 11:30**
Client ID: **1101529-BS** Run ID: **Balance1_428243** SeqNo: **7133252** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	412	10.0					412	0	20	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428412 (0) **Instrument: WetChem_HS** **Method: HYDROGEN SULFIDE BY E376.1**

MBLK Sample ID: **MBLK-R428412** Units: **mg/L** Analysis Date: **15-Feb-2023 15:48**
Client ID: Run ID: **WetChem_HS_428412** SeqNo: **7136348** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Hydrogen Sulfide	U	1.00								

LCS Sample ID: **LCS-R428412** Units: **mg/L** Analysis Date: **15-Feb-2023 15:48**
Client ID: Run ID: **WetChem_HS_428412** SeqNo: **7136347** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Hydrogen Sulfide	23.72	1.00	25	0	94.9	80 - 120				

LCSD Sample ID: **LCSD-R428412** Units: **mg/L** Analysis Date: **15-Feb-2023 15:48**
Client ID: Run ID: **WetChem_HS_428412** SeqNo: **7136346** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Hydrogen Sulfide	23.93	1.00	25	0	95.7	80 - 120	23.72	0.892	20	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428518 (0) **Instrument:** ICS-Integrion **Method:** ANIONS BY SW9056A

MBLK Sample ID: **MBLK** Units: **mg/L** Analysis Date: **21-Feb-2023 16:01**
Client ID: Run ID: **ICS-Integrion_428518** SeqNo: **7139569** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	U	0.100								
Chloride	U	0.500								
Fluoride	U	0.100								
Sulfate	U	0.500								

LCS Sample ID: **LCS** Units: **mg/L** Analysis Date: **21-Feb-2023 16:13**
Client ID: Run ID: **ICS-Integrion_428518** SeqNo: **7139570** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	4.11	0.100	4	0	103	80 - 120				
Chloride	20.01	0.500	20	0	100	80 - 120				
Fluoride	4.007	0.100	4	0	100	80 - 120				
Sulfate	20.33	0.500	20	0	102	80 - 120				

MS Sample ID: **HS23020536-01MS** Units: **mg/L** Analysis Date: **21-Feb-2023 16:25**
Client ID: **1101529-BS** Run ID: **ICS-Integrion_428518** SeqNo: **7139572** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	0.9775	0.100	2	0	48.9	80 - 120				S
Chloride	55.82	0.500	10	46.99	88.3	80 - 120				O
Fluoride	1.893	0.100	2	0.0662	91.3	80 - 120				
Sulfate	140.6	0.500	10	138.6	20.0	80 - 120				SEO

MSD Sample ID: **HS23020536-01MSD** Units: **mg/L** Analysis Date: **21-Feb-2023 16:30**
Client ID: **1101529-BS** Run ID: **ICS-Integrion_428518** SeqNo: **7139573** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	0.9883	0.100	2	0	49.4	80 - 120	0.9775	1.1	20	S
Chloride	55.76	0.500	10	46.99	87.7	80 - 120	55.82	0.0968	20	O
Fluoride	1.891	0.100	2	0.0662	91.2	80 - 120	1.893	0.132	20	
Sulfate	140.6	0.500	10	138.6	20.4	80 - 120	140.6	0.0304	20	SEO

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428629 (0) **Instrument: Skalar 03** **Method: ALKALINITY BY SM 2320B-2011**

MBLK Sample ID: **MBLK-R428629** Units: **mg/L** Analysis Date: **22-Feb-2023 16:01**
Client ID: Run ID: **Skalar 03_428629** SeqNo: **7141640** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (As CaCO3)	U	5.00								
Alkalinity, Carbonate (As CaCO3)	U	5.00								

LCS Sample ID: **LCS-R428629** Units: **mg/L** Analysis Date: **22-Feb-2023 16:01**
Client ID: Run ID: **Skalar 03_428629** SeqNo: **7142635** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Carbonate (As CaCO3)	970.4	5.00	1000	0	97.0	85 - 115				

LCSD Sample ID: **LCSD-R428629** Units: **mg/L** Analysis Date: **22-Feb-2023 16:01**
Client ID: Run ID: **Skalar 03_428629** SeqNo: **7142634** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Carbonate (As CaCO3)	932.2	5.00	1000	0	93.2	85 - 115	970.4	4.02	20	

DUP Sample ID: **HS23020497-01DUP** Units: **mg/L** Analysis Date: **22-Feb-2023 16:01**
Client ID: Run ID: **Skalar 03_428629** SeqNo: **7141641** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (As CaCO3)	850.3	5.00					912.6	7.07	20	
Alkalinity, Carbonate (As CaCO3)	U	5.00					0	0	20	

The following samples were analyzed in this batch: HS23020536-01 HS23020536-02

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020536

QC BATCH REPORT

Batch ID: R428633 (0) **Instrument: ICS-Integrion** **Method: ANIONS BY SW9056A**

MBLK Sample ID: **MBLK** Units: **mg/L** Analysis Date: **22-Feb-2023 17:42**
Client ID: Run ID: **ICS-Integrion_428633** SeqNo: **7141701** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	U	0.500								

LCS Sample ID: **LCS** Units: **mg/L** Analysis Date: **22-Feb-2023 17:59**
Client ID: Run ID: **ICS-Integrion_428633** SeqNo: **7141702** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	19.78	0.500	20	0	98.9	80 - 120				

MS Sample ID: **HS23020756-02MS** Units: **mg/L** Analysis Date: **22-Feb-2023 18:28**
Client ID: Run ID: **ICS-Integrion_428633** SeqNo: **7141706** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	12.92	0.500	10	2.76	102	80 - 120				

MSD Sample ID: **HS23020756-02MSD** Units: **mg/L** Analysis Date: **22-Feb-2023 18:34**
Client ID: Run ID: **ICS-Integrion_428633** SeqNo: **7141707** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfate	12.96	0.500	10	2.76	102	80 - 120	12.92	0.346	20	

The following samples were analyzed in this batch: HS23020536-01

ALS Houston, US Date: 24-Feb-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: **HS23020536**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
Arkansas	22-041-0	27-Mar-2023
California	2919 2022-2023	30-Apr-2023
Dept of Defense	L21-682	31-Dec-2023
Florida	E87611-36	30-Jun-2023
Illinois	2000322022-9	09-May-2023
Kansas	E-10352; 2022-2023	31-Jul-2023
Kentucky	123043, 2022-2023	30-Apr-2023
Louisiana	03087, 2022-2023	30-Jun-2023
Maryland	343, 2022-2023	30-Jun-2023
North Carolina	624-2023	31-Dec-2023
North Dakota	R-193 2022-2023	30-Apr-2023
Oklahoma	2022-141	31-Aug-2023
Texas	T104704231-22-29	30-Apr-2023
Utah	TX026932022-13	31-Jul-2023

ALS Houston, US Date: 24-Feb-23

Sample Receipt Checklist

Work Order ID: HS23020536 **Date/Time Received:** **10-Feb-2023 16:30**

Client Name: ERMSW-HOU **Received by:** **Malcolm Burleson**

Completed By:	/S/ Corey Grandits	11-Feb-2023 09:40	**Reviewed by:**	/S/ Bernadette A. Fini	14-Feb-2023 11:36
	eSignature	Date/Time		eSignature	Date/Time

Matrices: **W** Carrier name: **Client**

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
VOA/TX1005/TX1006 Solids in hermetically sealed vials?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	1 Page(s)
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	COC IDs:284580
Samplers name present on COC?	Yes ☑	No ☐	
Chain of custody agrees with sample labels?	Yes ☐	No ☑	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	

Temperature(s)/Thermometer(s):	4.0UC/3.5C	IR31
Cooler(s)/Kit(s):	50357	
Date/Time sample(s) sent to storage:	2/10/23	

Water - VOA vials have zero headspace?	Yes ☑	No ☐	No VOA vials submitted ☐
Water - pH acceptable upon receipt?	Yes ☑	No ☐	N/A ☐
pH adjusted?	Yes ☐	No ☑	N/A ☐
pH adjusted by:			

Login Notes: Received 12 containers per sample, COC indicates 9. ID discrepancy: COC=1101529-BS Label=110159-BS

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

ALS

Cincinnati, OH +1 513 733 5336
Fort Collins, CO +1 970 490 1511
Everett, WA +1 425 356 2600
Holland, MI +1 616 399 6070
Houston, TX +1 281 530 5656
Spring City, PA +1 610 948 4903
South Charleston, WV +1 304 356 3168
Middletown, PA +1 717 944 5541
Salt Lake City, UT +1 801 266 7700
York, PA +1 717 505 5280

Chain of Custody Form

Page ____ of ____

COC ID: 284580

ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis
Purchase Order	0677804	Project Name	Sulphur Dome	A 8260_LL_W (Low Level VOC (8260) BTEX)
Work Order		Project Number		B MA EPH_W_La (MA EPH)
Company Name	Environmental Resources Mgmt.	Bill To Company	Environmental Resources Mgmt.	C MA VPH_LA_W (MA VPH)
Send Report To	Scott Himes	Invoice Attn	Accounts Payable	D 9056_anions_W (Cl,SO4,Br)
Address	CityCentre Four 840 W. Sam Houston Pkwy., Suite 6	Address	CityCentre Four 840 W. Sam Houston Pkwy., Suite 6	E ALK_W 2320B (carb, bicarb) F H2S_W (H2S)
City/State/Zip	Houston, TX 77024	City/State/Zip	Houston TX 77024	G HG_W (Mercury)
Phone	(281) 600-1000	Phone	(281) 600-1000	H ICP_TW (As,Ba,Cd,Ca,Cr,Fe,Pb,Mg,Mn,K,Se,Ag,Na,Sr,Zn)
Fax	(281) 600-1001	Fax	(281) 600-1001	I SULFD_4500S F (Sulfide)
e-Mail Address	scott.himes@erm.com	e-Mail Address	ERMNAAccountsPayable@erm.com	J TDS_W 2540C (TDS)

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	1101529-BS	2/10/2023	1120	W		9	X	X	X	X	X	X	X	X	X	X	
2	Brine Pond 4	2/10/2023	1215	W		9	X	X	X	X	X	X	X	X	X	X	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

HS23020536
Environmental Resources Mgmt.
Sulphur Dome

Sampler(s) Please Print & Sign: David Sanguinetti [signature]

Shipment Method:

Required Turnaround Time: (Check Box) ☐ Other ____ ☒ STD 10 Wk Days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour

Results Due Date:

Relinquished by:	Date:	Time:	Received by:	Notes: ERM Sulphur Dome		
[signature]	2/10/2023	1630				
Relinquished by:	Date:	Time:	Received by (Laboratory): [illegible]	Cooler ID	Cooler Temp.	QC Package: (Check One Box Below)
					[illegible]	☒ Level II Std QC ☐ TRRP Checklist
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):	50351	4.0 [illegible]	☐ Level III Std QC/Raw Data ☐ TRRP Level IV
					[illegible]	☐ Level IV SW846/CLP
						☐ Other

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.
2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.
3. The Chain of Custody is a legal document. All information must be completed accurately.

10450 Stancliff Rd. Suite 210
Houston, TX 77099
T: +1 281 530 5656
F: +1 281 530 5887

March 02, 2023

Scott Himes
Environmental Resources Mgmt.
CityCentre Four
840 W. Sam Houston Pkwy., Suite 600
Houston, TX 77024

Work Order: **HS23020862**

Laboratory Results for: **Sulphur Dome**

Dear Scott Himes,

ALS Environmental received 2 sample(s) on Feb 16, 2023 for the analysis presented in the following report.

The analytical data provided relates directly to the samples received by ALS Environmental and for only the analyses requested. Results are expressed as "as received" unless otherwise noted.

QC sample results for this data met EPA or laboratory specifications except as noted in the Case Narrative or as noted with qualifiers in the QC batch information. Should this laboratory report need to be reproduced, it should be reproduced in full unless written approval has been obtained by ALS Environmental. Samples will be disposed in 30 days unless storage arrangements are made.

If you have any questions regarding this report, please feel free to call me.

Sincerely,

Generated By: JUMOKE.LAWAL
Bernadette A. Fini
Project Manager

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Work Order: HS23020862

SAMPLE SUMMARY

Lab Samp ID	Client Sample ID	Matrix	TagNo	Collection Date	Date Received	Hold
HS23020862-01	Brine Well 007-B (3,000')	Water		16-Feb-2023 08:25	16-Feb-2023 17:05	☐
HS23020862-02	Brine Well 7B-BS	Water		16-Feb-2023 11:45	16-Feb-2023 17:05	☐

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt. **CASE NARRATIVE**
Project: Sulphur Dome
Work Order: HS23020862

GC Semivolatiles by Method MA EPH

Batch ID: 189930

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

GC Volatiles by Method MA VPH

Batch ID: R428336,R428350

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

GCMS Volatiles by Method SW8260

Batch ID: R428926

Sample ID: Brine Well 007-B (3,000') (HS23020862-01)

- Lowest practical dilution due to sample matrix and/or high concentration of non-target analyte(s).

Metals by Method SW6020A

Batch ID: 190201

Sample ID: HS23020797-02MS

- MS and MSD are for an unrelated sample

Sample ID: HS23020798-02MS

- MS and MSD are for an unrelated sample

Sample ID: HS23020800-02MS

- MS and MSD are for an unrelated sample

Sample ID: Brine Well 007-B (3,000') (HS23020862-01)

- Sample ran at a 100X dilution due to high concentration of Sodium.

Sample ID: Brine Well 7B-BS (HS23020862-02)

- Sample ran at a 50X dilution due to high concentration of Sodium.

Sample ID: HS23020797-02PDS

- PDS is for an unrelated sample

Metals by Method SW7470A

Batch ID: 190172

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method E376.1

Batch ID: R428963

- The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Work Order: HS23020862

CASE NARRATIVE

WetChemistry by Method SW9056

Batch ID: R429123

Sample ID: HS23021125-01MS

• MS and MSD are for an unrelated sample

Sample ID: Brine Well 007-B (3,000') (HS23020862-01)

• The reporting limit is elevated due to dilution for high concentrations of non-target analytes. (Bromide)

Sample ID: Brine Well 7B-BS (HS23020862-02)

• The reporting limit is elevated due to dilution for high concentrations of non-target analytes. (Bromide)

WetChemistry by Method SM2320B

Batch ID: R429040

• The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method M2540C

Batch ID: R428539

• The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

WetChemistry by Method SM4500 S2-F

Batch ID: R428482

• The test results meet requirements of the current NELAP standards, state requirements or programs where applicable.

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: Brine Well 007-B (3,000')
Collection Date: 16-Feb-2023 08:25

ANALYTICAL REPORT
WorkOrder:HS23020862
Lab ID:HS23020862-01
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
LOW LEVEL VOLATILES BY SW8260C		**Method:SW8260**					Analyst: AKP
Benzene	**92**		**2.0**	**10**	**ug/L**	10	28-Feb-2023 06:02
Ethylbenzene	U		3.0	10	ug/L	10	28-Feb-2023 06:02
m,p-Xylene	U		5.0	20	ug/L	10	28-Feb-2023 06:02
o-Xylene	U		3.0	10	ug/L	10	28-Feb-2023 06:02
Toluene	**25**		**2.0**	**10**	**ug/L**	10	28-Feb-2023 06:02
Xylenes, Total	U		3.0	10	ug/L	10	28-Feb-2023 06:02
Surr: 1,2-Dichloroethane-d4	*112*			*70-126*	*%REC*	*10*	*28-Feb-2023 06:02*
Surr: 4-Bromofluorobenzene	*101*			*77-113*	*%REC*	*10*	*28-Feb-2023 06:02*
Surr: Dibromofluoromethane	*114*			*77-123*	*%REC*	*10*	*28-Feb-2023 06:02*
Surr: Toluene-d8	*96.9*			*82-127*	*%REC*	*10*	*28-Feb-2023 06:02*
MASSACHUSETTS VPH, FEB 2018, REV 2.1		**Method:MA VPH**					Analyst: PJM
Aliphatics >C6 - C8	**0.0803**		**0.0100**	**0.0100**	**mg/L**	1	18-Feb-2023 03:36
Aliphatics >C8 - C10	**0.107**		**0.0100**	**0.0100**	**mg/L**	1	18-Feb-2023 03:36
Aromatics >C8 - C10	**0.422**		**0.0100**	**0.0100**	**mg/L**	1	18-Feb-2023 03:36
Surr: 2,5-Dibromotoluene (Aliphatic)	*112*			*70-130*	*%REC*	*1*	*18-Feb-2023 03:36*
Surr: 2,5-Dibromotoluene (Aromatic)	*116*			*70-130*	*%REC*	*1*	*18-Feb-2023 03:36*
ICP-MS METALS BY SW6020A		**Method:SW6020A**			Prep:SW3010A / 28-Feb-2023		Analyst: JC
Arsenic	U		0.0400	0.200	mg/L	100	01-Mar-2023 13:52
Barium	U		0.190	0.400	mg/L	100	01-Mar-2023 13:52
Cadmium	U		0.0200	0.200	mg/L	100	01-Mar-2023 13:52
Calcium	**1,320**		**3.40**	**50.0**	**mg/L**	100	01-Mar-2023 13:52
Chromium	**0.722**		**0.0400**	**0.400**	**mg/L**	100	01-Mar-2023 13:52
Iron	**9.65**	J	**1.20**	**20.0**	**mg/L**	100	01-Mar-2023 13:52
Lead	U		0.0600	0.200	mg/L	100	01-Mar-2023 13:52
Magnesium	**8.64**	J	**1.00**	**20.0**	**mg/L**	100	01-Mar-2023 13:52
Manganese	**0.487**	J	**0.0700**	**0.500**	**mg/L**	100	01-Mar-2023 13:52
Potassium	**13.8**	J	**1.80**	**20.0**	**mg/L**	100	01-Mar-2023 13:52
Selenium	U		0.110	0.200	mg/L	100	01-Mar-2023 13:52
Silver	U		0.0200	0.200	mg/L	100	01-Mar-2023 13:52
Sodium	**82,600**		**14.0**	**200**	**mg/L**	1000	01-Mar-2023 16:33
Strontium	**11.0**		**0.0200**	**0.500**	**mg/L**	100	01-Mar-2023 13:52
Zinc	**1.70**		**0.200**	**0.400**	**mg/L**	100	01-Mar-2023 13:52
MERCURY BY SW7470A		**Method:SW7470A**			Prep:SW7470A / 27-Feb-2023		Analyst: JS
Mercury	U		0.0000300	0.000200	mg/L	1	27-Feb-2023 13:58
HYDROGEN SULFIDE BY E376.1		**Method:E376.1**					Analyst: CD
Hydrogen Sulfide	U		0.500	1.00	mg/L	1	21-Feb-2023 17:30

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: Brine Well 007-B (3,000')
Collection Date: 16-Feb-2023 08:25

ANALYTICAL REPORT
WorkOrder:HS23020862
Lab ID:HS23020862-01
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
TOTAL DISSOLVED SOLIDS BY SM2540C -2011		**Method:M2540C**					Analyst: DC
Total Dissolved Solids (Residue, Filterable)	**300,000**		**5.00**	**10.0**	**mg/L**	1	21-Feb-2023 01:00
ALKALINITY BY SM 2320B-2011		**Method:SM2320B**					Analyst: JAC
Alkalinity, Bicarbonate (As CaCO3)	**140**		**5.00**	**5.00**	**mg/L**	1	27-Feb-2023 13:03
Alkalinity, Carbonate (As CaCO3)	U		5.00	5.00	mg/L	1	27-Feb-2023 13:03
SULFIDE BY SM4500 S2-F-2011		**Method:SM4500 S2-F**					Analyst: CD
Sulfide	U		1.00	1.00	mg/L	1	21-Feb-2023 15:15
ANIONS BY SW9056A		**Method:SW9056**					Analyst: TH
Bromide	U		7.50	25.0	mg/L	250	01-Mar-2023 09:37
Chloride	**201,000**		**1000**	**2500**	**mg/L**	5000	01-Mar-2023 09:42
Sulfate	**3,060**		**50.0**	**125**	**mg/L**	250	01-Mar-2023 09:37

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: Brine Well 7B-BS
Collection Date: 16-Feb-2023 11:45

ANALYTICAL REPORT
WorkOrder:HS23020862
Lab ID:HS23020862-02
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
LOW LEVEL VOLATILES BY SW8260C		**Method:SW8260**					Analyst: AKP
Benzene	**0.75**	J	**0.20**	**1.0**	**ug/L**	1	28-Feb-2023 05:39
Ethylbenzene	**2.3**		**0.30**	**1.0**	**ug/L**	1	28-Feb-2023 05:39
m,p-Xylene	**3.0**		**0.50**	**2.0**	**ug/L**	1	28-Feb-2023 05:39
o-Xylene	**2.0**		**0.30**	**1.0**	**ug/L**	1	28-Feb-2023 05:39
Toluene	**0.73**	J	**0.20**	**1.0**	**ug/L**	1	28-Feb-2023 05:39
Xylenes, Total	**5.0**		**0.30**	**1.0**	**ug/L**	1	28-Feb-2023 05:39
Surr: 1,2-Dichloroethane-d4	*109*			*70-126*	*%REC*	*1*	*28-Feb-2023 05:39*
Surr: 4-Bromofluorobenzene	*98.3*			*77-113*	*%REC*	*1*	*28-Feb-2023 05:39*
Surr: Dibromofluoromethane	*108*			*77-123*	*%REC*	*1*	*28-Feb-2023 05:39*
Surr: Toluene-d8	*102*			*82-127*	*%REC*	*1*	*28-Feb-2023 05:39*
MASSACHUSETTS VPH, FEB 2018, REV 2.1		**Method:MA VPH**					Analyst: PJM
Aliphatics >C6 - C8	U		0.0100	0.0100	mg/L	1	18-Feb-2023 06:09
Aliphatics >C8 - C10	U		0.0100	0.0100	mg/L	1	18-Feb-2023 06:09
Aromatics >C8 - C10	**0.0192**		**0.0100**	**0.0100**	**mg/L**	1	18-Feb-2023 06:09
Surr: 2,5-Dibromotoluene (Aliphatic)	*108*			*70-130*	*%REC*	*1*	*18-Feb-2023 06:09*
Surr: 2,5-Dibromotoluene (Aromatic)	*114*			*70-130*	*%REC*	*1*	*18-Feb-2023 06:09*
MASSACHUSETTS EPH R2.1, DEC 2019		**Method:MA EPH**			Prep:SW3510 / 21-Feb-2023		Analyst: PPM
Aliphatics >C10 - C12	U		0.00100	0.00100	mg/L	1	25-Feb-2023 03:36
Aliphatics >C12 - C16	U		0.00200	0.00200	mg/L	1	25-Feb-2023 03:36
Aliphatics >C16 - C35	**0.239**		**0.00800**	**0.00800**	**mg/L**	1	25-Feb-2023 03:36
Aromatics >C10 - C12	**0.00551**		**0.00100**	**0.00100**	**mg/L**	1	25-Feb-2023 03:36
Aromatics >C12 - C16	**0.0225**		**0.00400**	**0.00400**	**mg/L**	1	25-Feb-2023 03:36
Aromatics >C16 - C21	**0.0188**		**0.00300**	**0.00300**	**mg/L**	1	25-Feb-2023 03:36
Aromatics >C21 - C35	**0.0790**		**0.00900**	**0.00900**	**mg/L**	1	25-Feb-2023 03:36
Surr: 1-Chlorooctadecane	*95.1*			*40-140*	*%REC*	*1*	*25-Feb-2023 03:36*
Surr: 2-Bromonaphthalene	*115*			*40-140*	*%REC*	*1*	*25-Feb-2023 03:36*
Surr: 2-Fluorobiphenyl	*50.7*			*40-140*	*%REC*	*1*	*25-Feb-2023 03:36*
Surr: o-Terphenyl	*108*			*40-140*	*%REC*	*1*	*25-Feb-2023 03:36*

Note: See Qualifiers Page for a list of qualifiers and their explanation.

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
Sample ID: Brine Well 7B-BS
Collection Date: 16-Feb-2023 11:45

ANALYTICAL REPORT
WorkOrder:HS23020862
Lab ID:HS23020862-02
Matrix:Water

ANALYSES	RESULT	QUAL	MDL	REPORT LIMIT	UNITS	DILUTION FACTOR	DATE ANALYZED
ICP-MS METALS BY SW6020A		**Method:SW6020A**			Prep:SW3010A / 28-Feb-2023		Analyst: JC
Arsenic	**0.0202**	J	**0.0200**	**0.100**	**mg/L**	50	01-Mar-2023 19:15
Barium	**1.23**		**0.0950**	**0.200**	**mg/L**	50	01-Mar-2023 19:15
Cadmium	U		0.0100	0.100	mg/L	50	01-Mar-2023 19:15
Calcium	**141**		**1.70**	**25.0**	**mg/L**	50	01-Mar-2023 19:15
Chromium	**0.114**	J	**0.0200**	**0.200**	**mg/L**	50	01-Mar-2023 19:15
Iron	**3.34**	J	**0.600**	**10.0**	**mg/L**	50	01-Mar-2023 19:15
Lead	U		0.0300	0.100	mg/L	50	01-Mar-2023 19:15
Magnesium	**2.85**	J	**0.500**	**10.0**	**mg/L**	50	01-Mar-2023 19:15
Manganese	**0.509**		**0.0350**	**0.250**	**mg/L**	50	01-Mar-2023 19:15
Potassium	**1.78**	J	**0.900**	**10.0**	**mg/L**	50	01-Mar-2023 19:15
Selenium	U		0.0550	0.100	mg/L	50	01-Mar-2023 19:15
Silver	U		0.0100	0.100	mg/L	50	01-Mar-2023 19:15
Sodium	**26,400**		**14.0**	**200**	**mg/L**	1000	01-Mar-2023 19:21
Strontium	**0.678**		**0.0100**	**0.250**	**mg/L**	50	01-Mar-2023 19:15
Zinc	**1.97**		**0.100**	**0.200**	**mg/L**	50	01-Mar-2023 19:15
MERCURY BY SW7470A		**Method:SW7470A**			Prep:SW7470A / 27-Feb-2023		Analyst: JS
Mercury	U		0.0000300	0.000200	mg/L	1	27-Feb-2023 14:00
HYDROGEN SULFIDE BY E376.1		**Method:E376.1**					Analyst: CD
Hydrogen Sulfide	U		0.500	1.00	mg/L	1	21-Feb-2023 17:30
TOTAL DISSOLVED SOLIDS BY SM2540C -2011		**Method:M2540C**					Analyst: DC
Total Dissolved Solids (Residue, Filterable)	**97,400**		**5.00**	**10.0**	**mg/L**	1	21-Feb-2023 01:00
ALKALINITY BY SM 2320B-2011		**Method:SM2320B**					Analyst: JAC
Alkalinity, Bicarbonate (As CaCO3)	**128**		**5.00**	**5.00**	**mg/L**	1	27-Feb-2023 13:03
Alkalinity, Carbonate (As CaCO3)	U		5.00	5.00	mg/L	1	27-Feb-2023 13:03
SULFIDE BY SM4500 S2-F-2011		**Method:SM4500 S2-F**					Analyst: CD
Sulfide	U		1.00	1.00	mg/L	1	21-Feb-2023 15:15
ANIONS BY SW9056A		**Method:SW9056**					Analyst: TH
Bromide	U		1.50	5.00	mg/L	50	01-Mar-2023 09:48
Chloride	**55,900**		**200**	**500**	**mg/L**	1000	01-Mar-2023 09:54
Sulfate	**243**		**10.0**	**25.0**	**mg/L**	50	01-Mar-2023 09:48

Note: See Qualifiers Page for a list of qualifiers and their explanation.

Weight / Prep Log

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

Batch ID: 189930 **Start Date:** 21 Feb 2023 13:47 **End Date:** 21 Feb 2023 15:30
Method: MA EPH EXTRACTION-FRACTIONATION **Prep Code:** MA EPH_WPR

Sample ID	Container	Sample Wt/Vol	Final Volume	Prep Factor	
HS23020862-02	1	1000 (mL)	2 (mL)	0.002	1-litre amber glass, HCL to pH <2

Batch ID: 190172 **Start Date:** 27 Feb 2023 08:00 **End Date:** 27 Feb 2023 11:00
Method: MERCURY PREP BY 7470A- WATER **Prep Code:** HG_WPR

Sample ID	Container	Sample Wt/Vol	Final Volume	Prep Factor	
HS23020862-01		10 (mL)	10 (mL)	1	120 plastic HNO3
HS23020862-02		10 (mL)	10 (mL)	1	120 plastic HNO3

Batch ID: 190201 **Start Date:** 28 Feb 2023 10:00 **End Date:** 28 Feb 2023 14:00
Method: WATER - SW3010A **Prep Code:** 3010A

Sample ID	Container	Sample Wt/Vol	Final Volume	Prep Factor	
HS23020862-01		10 (mL)	10 (mL)	1	120 plastic HNO3
HS23020862-02		10 (mL)	10 (mL)	1	120 plastic HNO3

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

DATES REPORT

Sample ID	Client Samp ID	Collection Date	Leachate Date	Prep Date	Analysis Date	DF
Batch ID: 189930 (0)	**Test Name :** MASSACHUSETTS EPH R2.1, DEC 2019				**Matrix:** Water	
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45		21 Feb 2023 13:47	25 Feb 2023 03:36	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45		21 Feb 2023 13:47	25 Feb 2023 03:36	1
Batch ID: 190172 (0)	**Test Name :** MERCURY BY SW7470A				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25		27 Feb 2023 08:00	27 Feb 2023 13:58	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45		27 Feb 2023 08:00	27 Feb 2023 14:00	1
Batch ID: 190201 (0)	**Test Name :** ICP-MS METALS BY SW6020A				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25		28 Feb 2023 10:00	01 Mar 2023 16:33	1000
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25		28 Feb 2023 10:00	01 Mar 2023 13:52	100
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45		28 Feb 2023 10:00	01 Mar 2023 19:21	1000
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45		28 Feb 2023 10:00	01 Mar 2023 19:15	50
Batch ID: R428336 (0)	**Test Name :** MASSACHUSETTS VPH, FEB 2018, REV 2.1				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			18 Feb 2023 03:36	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			18 Feb 2023 06:09	1
Batch ID: R428350 (0)	**Test Name :** MASSACHUSETTS VPH, FEB 2018, REV 2.1				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			18 Feb 2023 03:36	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			18 Feb 2023 06:09	1
Batch ID: R428482 (0)	**Test Name :** SULFIDE BY SM4500 S2-F-2011				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			21 Feb 2023 15:15	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			21 Feb 2023 15:15	1
Batch ID: R428539 (0)	**Test Name :** TOTAL DISSOLVED SOLIDS BY SM2540C-2011				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			21 Feb 2023 01:00	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			21 Feb 2023 01:00	1
Batch ID: R428926 (0)	**Test Name :** LOW LEVEL VOLATILES BY SW8260C				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			28 Feb 2023 06:02	10
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			28 Feb 2023 05:39	1
Batch ID: R428963 (0)	**Test Name :** HYDROGEN SULFIDE BY E376.1				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			21 Feb 2023 17:30	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			21 Feb 2023 17:30	1
Batch ID: R429040 (0)	**Test Name :** ALKALINITY BY SM 2320B-2011				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			27 Feb 2023 13:03	1
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			27 Feb 2023 13:03	1
Batch ID: R429123 (0)	**Test Name :** ANIONS BY SW9056A				**Matrix:** Water	
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			01 Mar 2023 09:42	5000
HS23020862-01	Brine Well 007-B (3,000')	16 Feb 2023 08:25			01 Mar 2023 09:37	250
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			01 Mar 2023 09:54	1000
HS23020862-02	Brine Well 7B-BS	16 Feb 2023 11:45			01 Mar 2023 09:48	50

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 189930 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

MBLK Sample ID: **MBLK-189930** Units: **mg/L** Analysis Date: **24-Feb-2023 20:13**
Client ID: Run ID: **FID-7_428838** SeqNo: **7146371** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual
Aliphatics >C10 - C12	U	0.00100							
Aliphatics >C12 - C16	U	0.00200							
Aliphatics >C16 - C35	U	0.00800							
Surr: 1-Chlorooctadecane	*0.02489*	*0*	*0.04*	*0*	*62.2*	*40 - 140*			

MBLK Sample ID: **MBLK-189930** Units: **mg/L** Analysis Date: **24-Feb-2023 20:13**
Client ID: Run ID: **FID-8_428851** SeqNo: **7146615** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual
Aromatics >C10 - C12	U	0.00100							
Aromatics >C12 - C16	U	0.00400							
Aromatics >C16 - C21	U	0.00300							
Aromatics >C21 - C35	U	0.00900							
Surr: 2-Bromonaphthalene	*0.04025*	*0*	*0.04*	*0*	*101*	*40 - 140*			
Surr: 2-Fluorobiphenyl	*0.02693*	*0*	*0.04*	*0*	*67.3*	*40 - 140*			
Surr: o-Terphenyl	*0.03382*	*0*	*0.04*	*0*	*84.5*	*40 - 140*			

LCS Sample ID: **LCS-189930** Units: **mg/L** Analysis Date: **24-Feb-2023 20:45**
Client ID: Run ID: **FID-7_428838** SeqNo: **7146372** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit Qual
Aliphatics >C10 - C12	0.05097	0.00100	0.05	0	102	40 - 140			
Aliphatics >C12 - C16	0.111	0.00200	0.1	0	111	40 - 140			
Aliphatics >C16 - C35	0.4491	0.00800	0.4	0	112	40 - 140			
Surr: 1-Chlorooctadecane	*0.03546*	*0*	*0.04*	*0*	*88.6*	*40 - 140*			

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 189930 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

LCS Sample ID: **LCS-189930** Units: **mg/L** Analysis Date: **24-Feb-2023 20:45**
Client ID: Run ID: **FID-8_428851** SeqNo: **7146616** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.0512	0.00100	0.05	0	102	40 - 140				
Aromatics >C12 - C16	0.21	0.00400	0.2	0	105	40 - 140				
Aromatics >C16 - C21	0.1653	0.00300	0.15	0	110	40 - 140				
Aromatics >C21 - C35	0.4595	0.00900	0.45	0	102	40 - 140				
Surr: 2-Bromonaphthalene	*0.03461*	*0*	*0.04*	*0*	*86.5*	*40 - 140*				
Surr: 2-Fluorobiphenyl	*0.02008*	*0*	*0.04*	*0*	*50.2*	*40 - 140*				
Surr: o-Terphenyl	*0.03971*	*0*	*0.04*	*0*	*99.3*	*40 - 140*				

MS Sample ID: **HS23020555-04MS** Units: **mg/L** Analysis Date: **24-Feb-2023 21:48**
Client ID: Run ID: **FID-7_428838** SeqNo: **7146374** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.03943	0.00100	0.05	0	78.9	40 - 140				
Aliphatics >C12 - C16	0.07965	0.00200	0.1	0	79.7	40 - 140				
Aliphatics >C16 - C35	0.3205	0.00800	0.4	0	80.1	40 - 140				
Surr: 1-Chlorooctadecane	*0.02406*	*0*	*0.04*	*0*	*60.2*	*40 - 140*				

MS Sample ID: **HS23020555-04MS** Units: **mg/L** Analysis Date: **24-Feb-2023 21:48**
Client ID: Run ID: **FID-8_428851** SeqNo: **7146618** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.05534	0.00100	0.05	0	111	40 - 140				
Aromatics >C12 - C16	0.2249	0.00400	0.2	0	112	40 - 140				
Aromatics >C16 - C21	0.1702	0.00300	0.15	0	113	40 - 140				
Aromatics >C21 - C35	0.4319	0.00900	0.45	0	96.0	40 - 140				
Surr: 2-Bromonaphthalene	*0.03475*	*0*	*0.04*	*0*	*86.9*	*40 - 140*				
Surr: 2-Fluorobiphenyl	*0.02414*	*0*	*0.04*	*0*	*60.3*	*40 - 140*				
Surr: o-Terphenyl	*0.03945*	*0*	*0.04*	*0*	*98.6*	*40 - 140*				

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 189930 (0) **Instrument: FID-7** **Method: MASSACHUSETTS EPH R2.1, DEC 2019**

MSD Sample ID: **HS23020555-04MSD** Units: **mg/L** Analysis Date: **24-Feb-2023 22:19**
Client ID: Run ID: **FID-7_428838** SeqNo: **7146375** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C10 - C12	0.03782	0.00100	0.05	0	75.6	40 - 140	0.03943	4.19	50	
Aliphatics >C12 - C16	0.07687	0.00200	0.1	0	76.9	40 - 140	0.07965	3.55	50	
Aliphatics >C16 - C35	0.3617	0.00800	0.4	0	90.4	40 - 140	0.3205	12.1	50	
Surr: 1-Chlorooctadecane	*0.02587*	*0*	*0.04*	*0*	*64.7*	*40 - 140*	*0.02406*	*7.23*	*50*	

MSD Sample ID: **HS23020555-04MSD** Units: **mg/L** Analysis Date: **24-Feb-2023 22:19**
Client ID: Run ID: **FID-8_428851** SeqNo: **7146619** PrepDate: **21-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C10 - C12	0.05737	0.00100	0.05	0	115	40 - 140	0.05534	3.6	50	
Aromatics >C12 - C16	0.2338	0.00400	0.2	0	117	40 - 140	0.2249	3.9	50	
Aromatics >C16 - C21	0.1735	0.00300	0.15	0	116	40 - 140	0.1702	1.93	50	
Aromatics >C21 - C35	0.4312	0.00900	0.45	0	95.8	40 - 140	0.4319	0.153	50	
Surr: 2-Bromonaphthalene	*0.03575*	*0*	*0.04*	*0*	*89.4*	*40 - 140*	*0.03475*	*2.83*	*50*	
Surr: 2-Fluorobiphenyl	*0.01879*	*0*	*0.04*	*0*	*47.0*	*40 - 140*	*0.02414*	*24.9*	*50*	
Surr: o-Terphenyl	*0.04012*	*0*	*0.04*	*0*	*100*	*40 - 140*	*0.03945*	*1.71*	*50*	

The following samples were analyzed in this batch: HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428336 (0) **Instrument:** FID-14 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MBLK Sample ID: **MBLK-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 15:30**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135091** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	U	0.0100								
Aliphatics >C8 - C10	U	0.0100								
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2731*	*0.0100*	*0.25*	*0*	*109*	*70 - 130*				

LCS Sample ID: **LCS-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 14:52**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135090** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.02124	0.0100	0.025	0	84.9	70 - 130				
Aliphatics >C8 - C10	0.02062	0.0100	0.025	0	82.5	70 - 130				
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2743*	*0.0100*	*0.25*	*0*	*110*	*70 - 130*				

MS Sample ID: **HS23020555-04MS** Units: **mg/L** Analysis Date: **17-Feb-2023 17:25**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135094** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.02348	0.0100	0.025	0	93.9	70 - 130				
Aliphatics >C8 - C10	0.02156	0.0100	0.025	0	86.2	70 - 130				
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2748*	*0.0100*	*0.25*	*0*	*110*	*70 - 130*				

MS Sample ID: **HS23020462-07MS** Units: **mg/L** Analysis Date: **17-Feb-2023 19:20**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135162** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.04418	0.0100	0.025	0.02365	82.1	70 - 130				
Aliphatics >C8 - C10	0.04355	0.0100	0.025	0.02066	91.6	70 - 130				
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2778*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*				

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428336 (0) **Instrument:** FID-14 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MSD Sample ID: **HS23020555-04MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 18:03**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135095** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.02232	0.0100	0.025	0	89.3	70 - 130	0.02348	5.03	25	
Aliphatics >C8 - C10	0.02116	0.0100	0.025	0	84.6	70 - 130	0.02156	1.87	25	
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2774*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*	*0.2748*	*0.949*	*25*	

MSD Sample ID: **HS23020462-07MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 19:58**
Client ID: Run ID: **FID-14_428336** SeqNo: **7135098** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aliphatics >C6 - C8	0.04461	0.0100	0.025	0.02365	83.9	70 - 130	0.04418	0.978	25	
Aliphatics >C8 - C10	0.0391	0.0100	0.025	0.02066	73.8	70 - 130	0.04355	10.8	25	
Surr: 2,5-Dibromotoluene (Aliphatic)	*0.2727*	*0.0100*	*0.25*	*0*	*109*	*70 - 130*	*0.2778*	*1.86*	*25*	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428350 (0) **Instrument:** FID-15 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MBLK Sample ID: **MBLK-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 15:30**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135365** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	U	0.0100								
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2723*	*0.0100*	*0.25*	*0*	*109*	*70 - 130*				

LCS Sample ID: **LCS-230217** Units: **mg/L** Analysis Date: **17-Feb-2023 14:52**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135364** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.08705	0.0100	0.1	0	87.1	70 - 130				
Surr: 2,5-Dibromotoluene (Aromatic)	*0.274*	*0.0100*	*0.25*	*0*	*110*	*70 - 130*				

MS Sample ID: **HS23020555-04MS** Units: **mg/L** Analysis Date: **17-Feb-2023 17:25**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135368** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.08842	0.0100	0.1	0	88.4	70 - 130				
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2766*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*				

MS Sample ID: **HS23020462-07MS** Units: **mg/L** Analysis Date: **17-Feb-2023 19:20**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135414** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.1618	0.0100	0.1	0.08535	76.4	70 - 130				
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2891*	*0.0100*	*0.25*	*0*	*116*	*70 - 130*				

MSD Sample ID: **HS23020555-04MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 18:03**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135369** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.08664	0.0100	0.1	0	86.6	70 - 130	0.08842	2.04	25	
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2766*	*0.0100*	*0.25*	*0*	*111*	*70 - 130*	*0.2766*	*0*	*25*	

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428350 (0) **Instrument:** FID-15 **Method:** MASSACHUSETTS VPH, FEB 2018, REV 2.1

MSD Sample ID: **HS23020462-07MSD** Units: **mg/L** Analysis Date: **17-Feb-2023 19:58**
Client ID: Run ID: **FID-15_428350** SeqNo: **7135372** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Aromatics >C8 - C10	0.1569	0.0100	0.1	0.08535	71.5	70 - 130	0.1618	3.08	25	
Surr: 2,5-Dibromotoluene (Aromatic)	*0.2891*	*0.0100*	*0.25*	*0*	*116*	*70 - 130*	*0.2891*	*0*	*25*	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190172 (0) **Instrument: HG04** **Method: MERCURY BY SW7470A**

MBLK Sample ID: **MBLK-190172** Units: **mg/L** Analysis Date: **27-Feb-2023 13:50**
Client ID: Run ID: **HG04_428880** SeqNo: **7147214** PrepDate: **27-Feb-2023** DF: **1**

Analyte	Result		PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	U		0.000200								

LCS Sample ID: **LCS-190172** Units: **mg/L** Analysis Date: **27-Feb-2023 13:51**
Client ID: Run ID: **HG04_428880** SeqNo: **7147215** PrepDate: **27-Feb-2023** DF: **1**

Analyte	Result		PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00535		0.000200	0.005	0	107	80 - 120				

MS Sample ID: **HS23021142-01MS** Units: **mg/L** Analysis Date: **27-Feb-2023 15:25**
Client ID: Run ID: **HG04_428880** SeqNo: **7147230** PrepDate: **27-Feb-2023** DF: **1**

Analyte	Result		PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00421		0.000200	0.005	0.000051	83.2	75 - 125				

MSD Sample ID: **HS23021142-01MSD** Units: **mg/L** Analysis Date: **27-Feb-2023 15:28**
Client ID: Run ID: **HG04_428880** SeqNo: **7147231** PrepDate: **27-Feb-2023** DF: **1**

Analyte	Result		PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Mercury	0.00413		0.000200	0.005	0.000051	81.6	75 - 125	0.00421	1.92	20	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190201 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

MBLK Sample ID: **MBLK-190201** Units: **mg/L** Analysis Date: **01-Mar-2023 12:20**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7150709** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	U	0.00200								
Barium	U	0.00400								
Cadmium	U	0.00200								
Calcium	U	0.500								
Chromium	U	0.00400								
Iron	U	0.200								
Lead	U	0.00200								
Magnesium	U	0.200								
Manganese	U	0.00500								
Potassium	U	0.200								
Selenium	U	0.00200								
Silver	U	0.00200								
Sodium	U	0.200								
Strontium	U	0.00500								
Zinc	U	0.00400								

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190201 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

LCS Sample ID: **LCS-190201** Units: **mg/L** Analysis Date: **01-Mar-2023 12:22**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7150710** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.05097	0.00200	0.05	0	102	80 - 120				
Barium	0.04844	0.00400	0.05	0	96.9	80 - 120				
Cadmium	0.0494	0.00200	0.05	0	98.8	80 - 120				
Calcium	4.999	0.500	5	0	100.0	80 - 120				
Chromium	0.04827	0.00400	0.05	0	96.5	80 - 120				
Iron	4.934	0.200	5	0	98.7	80 - 120				
Lead	0.04886	0.00200	0.05	0	97.7	80 - 120				
Magnesium	5.162	0.200	5	0	103	80 - 120				
Manganese	0.04999	0.00500	0.05	0	100.0	80 - 120				
Potassium	5.029	0.200	5	0	101	80 - 120				
Selenium	0.05081	0.00200	0.05	0	102	80 - 120				
Silver	0.04869	0.00200	0.05	0	97.4	80 - 120				
Sodium	5.149	0.200	5	0	103	80 - 120				
Strontium	0.09837	0.00500	0.1	0	98.4	80 - 120				
Zinc	0.05204	0.00400	0.05	0	104	80 - 120				

MS Sample ID: **HS23020800-02MS** Units: **mg/L** Analysis Date: **01-Mar-2023 12:39**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152601** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.1623	0.00200	0.05	0.09655	132	80 - 120				S
Lead	0.0537	0.00200	0.05	0.007524	92.4	80 - 120				

MS Sample ID: **HS23020798-02MS** Units: **mg/L** Analysis Date: **01-Mar-2023 12:39**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152596** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.1623	0.00200	0.05	0.09655	132	80 - 120				S
Lead	0.0537	0.00200	0.05	0.007524	92.4	80 - 120				

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190201 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

MS Sample ID: **HS23020797-02MS** Units: **mg/L** Analysis Date: **01-Mar-2023 12:39**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7150750** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.1623	0.00200	0.05	0.09655	132	80 - 120				S
Barium	0.9338	0.00400	0.05	0.9661	-64.5	80 - 120				SO
Cadmium	0.05014	0.00200	0.05	0.000091	100	80 - 120				
Calcium	283.9	0.500	5	300.6	-333	80 - 120				SEO
Chromium	0.05094	0.00400	0.05	0.00001	102	80 - 120				
Iron	33.55	0.200	5	33.77	-4.33	80 - 120				SO
Lead	0.0537	0.00200	0.05	0.007524	92.4	80 - 120				
Magnesium	85.35	0.200	5	84.76	11.9	80 - 120				SO
Manganese	0.6811	0.00500	0.05	0.7378	-113	80 - 120				SO
Potassium	15.04	0.200	5	10.46	91.6	80 - 120				
Selenium	0.05255	0.00200	0.05	0.00076	104	80 - 120				
Silver	0.04814	0.00200	0.05	0.000017	96.3	80 - 120				
Sodium	66.45	0.200	5	63.37	61.7	80 - 120				SO
Strontium	2.027	0.00500	0.1	2.037	-10.7	80 - 120				SEO
Zinc	0.06003	0.00400	0.05	0.02315	73.8	80 - 120				S

MSD Sample ID: **HS23020800-02MSD** Units: **mg/L** Analysis Date: **01-Mar-2023 12:41**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152602** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.162	0.00200	0.05	0.09655	131	80 - 120	0.1623	0.235	20	S
Lead	0.05406	0.00200	0.05	0.007524	93.1	80 - 120	0.0537	0.664	20	

MSD Sample ID: **HS23020798-02MSD** Units: **mg/L** Analysis Date: **01-Mar-2023 12:41**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152597** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.162	0.00200	0.05	0.09655	131	80 - 120	0.1623	0.235	20	S
Lead	0.05406	0.00200	0.05	0.007524	93.1	80 - 120	0.0537	0.664	20	

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190201 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

MSD Sample ID: **HS23020797-02MSD** Units: **mg/L** Analysis Date: **01-Mar-2023 12:41**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7150751** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.162	0.00200	0.05	0.09655	131	80 - 120	0.1623	0.235	20	S
Barium	0.9267	0.00400	0.05	0.9661	-78.8	80 - 120	0.9338	0.766	20	SO
Cadmium	0.04982	0.00200	0.05	0.000091	99.5	80 - 120	0.05014	0.64	20	
Calcium	286.4	0.500	5	300.6	-284	80 - 120	283.9	0.857	20	SEO
Chromium	0.05298	0.00400	0.05	0.00001	106	80 - 120	0.05094	3.95	20	
Iron	33.84	0.200	5	33.77	1.43	80 - 120	33.55	0.854	20	SO
Lead	0.05406	0.00200	0.05	0.007524	93.1	80 - 120	0.0537	0.664	20	
Magnesium	86.27	0.200	5	84.76	30.4	80 - 120	85.35	1.07	20	SO
Manganese	0.6848	0.00500	0.05	0.7378	-106	80 - 120	0.6811	0.548	20	SO
Potassium	15.13	0.200	5	10.46	93.4	80 - 120	15.04	0.579	20	
Selenium	0.05216	0.00200	0.05	0.00076	103	80 - 120	0.05255	0.743	20	
Silver	0.04803	0.00200	0.05	0.000017	96.0	80 - 120	0.04814	0.231	20	
Sodium	66.87	0.200	5	63.37	70.0	80 - 120	66.45	0.625	20	SO
Strontium	2.006	0.00500	0.1	2.037	-31.4	80 - 120	2.027	1.02	20	SEO
Zinc	0.05971	0.00400	0.05	0.02315	73.1	80 - 120	0.06003	0.531	20	S

PDS Sample ID: **HS23020800-02PDS** Units: **mg/L** Analysis Date: **01-Mar-2023 13:00**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152598** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.2156	0.00200	0.1	0.09655	119	75 - 125				
Lead	0.1072	0.00200	0.1	0.007524	99.6	75 - 125				

PDS Sample ID: **HS23020798-02PDS** Units: **mg/L** Analysis Date: **01-Mar-2023 13:00**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152593** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.2156	0.00200	0.1	0.09655	119	75 - 125				
Lead	0.1072	0.00200	0.1	0.007524	99.6	75 - 125				

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190201 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

PDS Sample ID: **HS23020797-02PDS** Units: **mg/L** Analysis Date: **01-Mar-2023 13:00**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7150757** PrepDate: **28-Feb-2023** DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Arsenic	0.2156	0.00200	0.1	0.09655	119	75 - 125				
Barium	0.9789	0.00400	0.1	0.9661	12.8	75 - 125				SO
Cadmium	0.1029	0.00200	0.1	0	103	75 - 125				
Chromium	0.1045	0.00400	0.1	0	105	75 - 125				
Lead	0.1072	0.00200	0.1	0.007524	99.6	75 - 125				
Magnesium	89.17	0.200	10	84.76	44.2	75 - 125				SO
Manganese	0.7288	0.00500	0.1	0.7378	-8.98	75 - 125				SO
Potassium	20.05	0.200	10	10.46	95.9	75 - 125				
Selenium	0.1045	0.00200	0.1	0	105	75 - 125				
Silver	0.09813	0.00200	0.1	0	98.1	75 - 125				
Sodium	70.31	0.200	10	63.37	69.4	75 - 125				SO

PDS Sample ID: **HS23020797-02PDS** Units: **mg/L** Analysis Date: **01-Mar-2023 16:27**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7151775** PrepDate: **28-Feb-2023** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Calcium	337.3	2.50	50	297.8	78.9	75 - 125				O
Iron	83.44	1.00	50	33.69	99.5	75 - 125				
Strontium	2.408	0.0250	0.5	1.917	98.3	75 - 125				
Zinc	0.542	0.0200	0.5	0.02522	103	75 - 125				

SD Sample ID: **HS23020800-02SD** Units: **mg/L** Analysis Date: **01-Mar-2023 12:37**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152600** PrepDate: **28-Feb-2023** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Arsenic	0.09524	0.0100					0.09655	1.36	10	
Lead	0.007598	0.0100					0.007524	0	10	J

SD Sample ID: **HS23020798-02SD** Units: **mg/L** Analysis Date: **01-Mar-2023 12:37**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7152595** PrepDate: **28-Feb-2023** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Arsenic	0.09524	0.0100					0.09655	1.36	10	
Lead	0.007598	0.0100					0.007524	0	10	J

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: 190201 (0) **Instrument: ICPMS06** **Method: ICP-MS METALS BY SW6020A**

SD Sample ID: **HS23020797-02SD** Units: **mg/L** Analysis Date: **01-Mar-2023 12:37**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7150749** PrepDate: **28-Feb-2023** DF: **5**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Arsenic	0.09524	0.0100					0.09655	1.36	10	
Barium	0.9188	0.0200					0.9661	4.9	10	
Cadmium	U	0.0100					0.000091	0	10	
Chromium	0.008482	0.0200					0.00001	0	10	J
Lead	0.007598	0.0100					0.007524	0	10	J
Magnesium	84.28	1.00					84.76	0.563	10	
Manganese	0.695	0.0250					0.7378	5.8	10	
Potassium	10.42	1.00					10.46	0.387	10	
Selenium	U	0.0100					0.00076	0	10	
Silver	U	0.0100					0.000017	0	10	
Sodium	62.78	1.00					63.37	0.936	10	

SD Sample ID: **HS23020797-02SD** Units: **mg/L** Analysis Date: **01-Mar-2023 16:25**
Client ID: Run ID: **ICPMS06_429033** SeqNo: **7151774** PrepDate: **28-Feb-2023** DF: **25**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%D	%D Limit	Qual
Calcium	280.2	12.5					297.8	5.94	10	
Iron	34	5.00					33.69	0.906	10	
Strontium	1.954	0.125					1.917	1.97	10	
Zinc	U	0.100					0.02522	0	10	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428926 (0) **Instrument: VOA11** **Method: LOW LEVEL VOLATILES BY SW8260C**

MBLK Sample ID: **VBLKW-230224** Units: **ug/L** Analysis Date: **27-Feb-2023 21:57**
Client ID: Run ID: **VOA11_428926** SeqNo: **7148217** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	U	1.0								
Ethylbenzene	U	1.0								
m,p-Xylene	U	2.0								
o-Xylene	U	1.0								
Toluene	U	1.0								
Xylenes, Total	U	1.0								
Surr: 1,2-Dichloroethane-d4	*52.8*	*1.0*	*50*	*0*	*106*	*70 - 123*				
Surr: 4-Bromofluorobenzene	*49.81*	*1.0*	*50*	*0*	*99.6*	*77 - 113*				
Surr: Dibromofluoromethane	*55.81*	*1.0*	*50*	*0*	*112*	*73 - 126*				
Surr: Toluene-d8	*49.46*	*1.0*	*50*	*0*	*98.9*	*81 - 120*				

LCS Sample ID: **VLCSW-230224** Units: **ug/L** Analysis Date: **27-Feb-2023 21:14**
Client ID: Run ID: **VOA11_428926** SeqNo: **7148216** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	18.3	1.0	20	0	91.5	74 - 120				
Ethylbenzene	18.41	1.0	20	0	92.0	77 - 117				
m,p-Xylene	35.92	2.0	40	0	89.8	77 - 122				
o-Xylene	18.87	1.0	20	0	94.3	75 - 119				
Toluene	18.15	1.0	20	0	90.7	77 - 118				
Xylenes, Total	54.79	1.0	60	0	91.3	75 - 122				
Surr: 1,2-Dichloroethane-d4	*45.4*	*1.0*	*50*	*0*	*90.8*	*70 - 123*				
Surr: 4-Bromofluorobenzene	*49.3*	*1.0*	*50*	*0*	*98.6*	*77 - 113*				
Surr: Dibromofluoromethane	*48.8*	*1.0*	*50*	*0*	*97.6*	*73 - 126*				
Surr: Toluene-d8	*50.9*	*1.0*	*50*	*0*	*102*	*81 - 120*				

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428926 (0) **Instrument:** VOA11 **Method:** LOW LEVEL VOLATILES BY SW8260C

MS Sample ID: **HS23020907-05MS** Units: **ug/L** Analysis Date: **27-Feb-2023 23:20**
Client ID: Run ID: **VOA11_428926** SeqNo: **7148221** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	18.94	1.0	20	0	94.7	70 - 127				
Ethylbenzene	18.85	1.0	20	0	94.2	70 - 124				
m,p-Xylene	36.83	2.0	40	0	92.1	70 - 130				
o-Xylene	18.33	1.0	20	0	91.6	70 - 124				
Toluene	18.43	1.0	20	0	92.1	70 - 123				
Xylenes, Total	55.16	1.0	60	0	91.9	70 - 130				
Surr: 1,2-Dichloroethane-d4	*45.19*	*1.0*	*50*	*0*	*90.4*	*70 - 126*				
Surr: 4-Bromofluorobenzene	*50.24*	*1.0*	*50*	*0*	*100*	*77 - 113*				
Surr: Dibromofluoromethane	*48.79*	*1.0*	*50*	*0*	*97.6*	*77 - 123*				
Surr: Toluene-d8	*50.1*	*1.0*	*50*	*0*	*100*	*82 - 127*				

MSD Sample ID: **HS23020907-05MSD** Units: **ug/L** Analysis Date: **27-Feb-2023 23:42**
Client ID: Run ID: **VOA11_428926** SeqNo: **7148222** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Benzene	17.97	1.0	20	0	89.9	70 - 127	18.94	5.26	20	
Ethylbenzene	18.32	1.0	20	0	91.6	70 - 124	18.85	2.85	20	
m,p-Xylene	36.16	2.0	40	0	90.4	70 - 130	36.83	1.85	20	
o-Xylene	18.33	1.0	20	0	91.7	70 - 124	18.33	0.0389	20	
Toluene	17.65	1.0	20	0	88.3	70 - 123	18.43	4.29	20	
Xylenes, Total	54.49	1.0	60	0	90.8	70 - 130	55.16	1.22	20	
Surr: 1,2-Dichloroethane-d4	*45.63*	*1.0*	*50*	*0*	*91.3*	*70 - 126*	*45.19*	*0.96*	*20*	
Surr: 4-Bromofluorobenzene	*49.11*	*1.0*	*50*	*0*	*98.2*	*77 - 113*	*50.24*	*2.29*	*20*	
Surr: Dibromofluoromethane	*49.59*	*1.0*	*50*	*0*	*99.2*	*77 - 123*	*48.79*	*1.64*	*20*	
Surr: Toluene-d8	*50.28*	*1.0*	*50*	*0*	*101*	*82 - 127*	*50.1*	*0.362*	*20*	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428482 (0) **Instrument: WetChem_HS** **Method: SULFIDE BY SM4500 S2-F-2011**

MBLK Sample ID: **MBLK-R428482** Units: **mg/L** Analysis Date: **21-Feb-2023 15:15**
Client ID: Run ID: **WetChem_HS_428482** SeqNo: **7138450** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	U	1.00								

LCS Sample ID: **LCS-R428482** Units: **mg/L** Analysis Date: **21-Feb-2023 15:15**
Client ID: Run ID: **WetChem_HS_428482** SeqNo: **7138449** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	22.32	1.00	25	0	89.3	85 - 115				

LCSD Sample ID: **LCSD-R428482** Units: **mg/L** Analysis Date: **21-Feb-2023 15:15**
Client ID: Run ID: **WetChem_HS_428482** SeqNo: **7138448** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	22.52	1.00	25	0	90.1	85 - 115	22.32	0.892	20	

MS Sample ID: **HS23020862-02MS** Units: **mg/L** Analysis Date: **21-Feb-2023 15:15**
Client ID: **Brine Well 7B-BS** Run ID: **WetChem_HS_428482** SeqNo: **7138451** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Sulfide	22.32	1.00	25	-1.28	94.4	80 - 120				

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R428539 (0) **Instrument:** Balance1 **Method:** TOTAL DISSOLVED SOLIDS BY SM2540C-2011

MBLK Sample ID: **WBLK-02212023** Units: **mg/L** Analysis Date: **21-Feb-2023 01:00**
Client ID: Run ID: **Balance1_428539** SeqNo: **7139945** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	U	10.0								

LCS Sample ID: **LCS-022123** Units: **mg/L** Analysis Date: **21-Feb-2023 01:00**
Client ID: Run ID: **Balance1_428539** SeqNo: **7139944** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	1052	10.0	1000	0	105	85 - 115				

DUP Sample ID: **HS23020965-03DUP** Units: **mg/L** Analysis Date: **21-Feb-2023 01:00**
Client ID: Run ID: **Balance1_428539** SeqNo: **7139943** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	892	10.0					892	0	20	

DUP Sample ID: **HS23020887-02DUP** Units: **mg/L** Analysis Date: **21-Feb-2023 01:00**
Client ID: Run ID: **Balance1_428539** SeqNo: **7139931** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Total Dissolved Solids (Residue, Filterable)	588	10.0					588	0	20	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R429040 (0) **Instrument: Skalar 03** **Method: ALKALINITY BY SM 2320B-2011**

MBLK Sample ID: **MBLK-R429040** Units: **mg/L** Analysis Date: **27-Feb-2023 13:03**
Client ID: Run ID: **Skalar 03_429040** SeqNo: **7150646** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (As CaCO3)	U	5.00								
Alkalinity, Carbonate (As CaCO3)	U	5.00								

LCS Sample ID: **LCS-R429040** Units: **mg/L** Analysis Date: **27-Feb-2023 13:03**
Client ID: Run ID: **Skalar 03_429040** SeqNo: **7150645** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Carbonate (As CaCO3)	981.4	5.00	1000	0	98.1	85 - 115				

LCSD Sample ID: **LCSD-R429040** Units: **mg/L** Analysis Date: **27-Feb-2023 13:03**
Client ID: Run ID: **Skalar 03_429040** SeqNo: **7150644** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Carbonate (As CaCO3)	912.8	5.00	1000	0	91.3	85 - 115	981.4	7.24	20	

DUP Sample ID: **HS23020903-23DUP** Units: **mg/L** Analysis Date: **27-Feb-2023 13:03**
Client ID: Run ID: **Skalar 03_429040** SeqNo: **7150647** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Alkalinity, Bicarbonate (As CaCO3)	U	5.00					0	0	20	
Alkalinity, Carbonate (As CaCO3)	298.8	5.00					298.8	0	20	

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: HS23020862

QC BATCH REPORT

Batch ID: R429123 (0) **Instrument: ICS-Integrion** **Method: ANIONS BY SW9056A**

MBLK Sample ID: **MBLK** Units: **mg/L** Analysis Date: **01-Mar-2023 06:54**
Client ID: Run ID: **ICS-Integrion_429123** SeqNo: **7152605** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	U	0.100								
Chloride	U	0.500								
Sulfate	U	0.500								

LCS Sample ID: **LCS** Units: **mg/L** Analysis Date: **01-Mar-2023 07:05**
Client ID: Run ID: **ICS-Integrion_429123** SeqNo: **7152606** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	4.106	0.100	4	0	103	80 - 120				
Chloride	19.64	0.500	20	0	98.2	80 - 120				
Sulfate	20.03	0.500	20	0	100	80 - 120				

MS Sample ID: **HS23021125-01MS** Units: **mg/L** Analysis Date: **01-Mar-2023 07:17**
Client ID: Run ID: **ICS-Integrion_429123** SeqNo: **7152608** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	1.145	0.100	2	0	57.2	80 - 120				S
Chloride	16.27	0.500	10	6.077	102	80 - 120				
Sulfate	125.8	0.500	10	122.2	36.6	80 - 120				SEO

MSD Sample ID: **HS23021125-01MSD** Units: **mg/L** Analysis Date: **01-Mar-2023 07:23**
Client ID: Run ID: **ICS-Integrion_429123** SeqNo: **7152609** PrepDate: DF: **1**

Analyte	Result	PQL	SPK Val	SPK Ref Value	%REC	Control Limit	RPD Ref Value	%RPD	RPD Limit	Qual
Bromide	1.118	0.100	2	0	55.9	80 - 120	1.145	2.4	20	S
Chloride	16.12	0.500	10	6.077	100	80 - 120	16.27	0.976	20	
Sulfate	124.5	0.500	10	122.2	23.0	80 - 120	125.8	1.09	20	SEO

The following samples were analyzed in this batch: HS23020862-01 HS23020862-02

ALS Houston, US Date: 02-Mar-23

Client: Environmental Resources Mgmt.
Project: Sulphur Dome
WorkOrder: **HS23020862**

QUALIFIERS, ACRONYMS, UNITS

Qualifier	Description
*	Value exceeds Regulatory Limit
a	Not accredited
B	Analyte detected in the associated Method Blank above the Reporting Limit
E	Value above quantitation range
H	Analyzed outside of Holding Time
J	Analyte detected below quantitation limit
M	Manually integrated, see raw data for justification
n	Not offered for accreditation
ND	Not Detected at the Reporting Limit
O	Sample amount is > 4 times amount spiked
P	Dual Column results percent difference > 40%
R	RPD above laboratory control limit
S	Spike Recovery outside laboratory control limits
U	Analyzed but not detected above the MDL/SDL

Acronym	Description
DCS	Detectability Check Study
DUP	Method Duplicate
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MBLK	Method Blank
MDL	Method Detection Limit
MQL	Method Quantitation Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PDS	Post Digestion Spike
PQL	Practical Quantitaion Limit
SD	Serial Dilution
SDL	Sample Detection Limit
TRRP	Texas Risk Reduction Program

Unit Reported	Description
mg/L	Milligrams per Liter

CERTIFICATIONS,ACCREDITATIONS & LICENSES

Agency	Number	Expire Date
Arkansas	22-041-0	27-Mar-2023
California	2919 2022-2023	30-Apr-2023
Dept of Defense	L21-682	31-Dec-2023
Florida	E87611-36	30-Jun-2023
Illinois	2000322022-9	09-May-2023
Kansas	E-10352; 2022-2023	31-Jul-2023
Kentucky	123043, 2022-2023	30-Apr-2023
Louisiana	03087, 2022-2023	30-Jun-2023
Maryland	343, 2022-2023	30-Jun-2023
North Carolina	624-2023	31-Dec-2023
North Dakota	R-193 2022-2023	30-Apr-2023
Oklahoma	2022-141	31-Aug-2023
Texas	T104704231-22-29	30-Apr-2023
Utah	TX026932022-13	31-Jul-2023

ALS Houston, US Date: 02-Mar-23

Sample Receipt Checklist

Work Order ID: HS23020862 **Date/Time Received:** **16-Feb-2023 17:05**

Client Name: ERMSW-HOU **Received by:** **Corey Grandits**

Completed By: */S/ Corey Grandits* 17-Feb-2023 09:39 **Reviewed by:** */S/ Bernadette A. Fini* 17-Feb-2023 10:19

eSignature Date/Time eSignature Date/Time

Matrices: **W** Carrier name: **Client**

Shipping container/cooler in good condition?	Yes ☑	No ☐	Not Present ☐
Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
Custody seals intact on sample bottles?	Yes ☐	No ☐	Not Present ☑
VOA/TX1005/TX1006 Solids in hermetically sealed vials?	Yes ☐	No ☐	Not Present ☑
Chain of custody present?	Yes ☑	No ☐	1 Page(s)
Chain of custody signed when relinquished and received?	Yes ☑	No ☐	COC IDs:284526
Samplers name present on COC?	Yes ☐	No ☑	
Chain of custody agrees with sample labels?	Yes ☑	No ☐	
Samples in proper container/bottle?	Yes ☑	No ☐	
Sample containers intact?	Yes ☑	No ☐	
Sufficient sample volume for indicated test?	Yes ☑	No ☐	
All samples received within holding time?	Yes ☑	No ☐	
Container/Temp Blank temperature in compliance?	Yes ☑	No ☐	
Temperature(s)/Thermometer(s):	3.3UC/2.8C	IR31	
Cooler(s)/Kit(s):	49645		
Date/Time sample(s) sent to storage:	2/17/23		
Water - VOA vials have zero headspace?	Yes ☑	No ☐	No VOA vials submitted ☐
Water - pH acceptable upon receipt?	Yes ☑	No ☐	N/A ☐
pH adjusted?	Yes ☐	No ☑	N/A ☐
pH adjusted by:			

Login Notes:

Client Contacted: Date Contacted: Person Contacted:

Contacted By: Regarding:

Comments:

Corrective Action:

Cincinnati, OH +1 513 733 5336 | Fort Collins, CO +1 970 490 1511 | Houston, TX +1 281 530 5656 | Spring City, PA +1 610 948 4903 | South Charleston, WV +1 304 356 3168
Everett, WA +1 425 356 2600 | Holland, MI +1 616 399 6070 | Middletown, PA +1 717 944 5541 | Salt Lake City, UT +1 801 266 7700 | York, PA +1 717 505 5280

Chain of Custody Form

Page _____ of _____

COC ID: 284526

ALS Project Manager:		ALS Work Order #:	

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order	0677804	Project Name	Sulphur Dome	A	8260_LL_W (Low Level VOC (8260) BTEX)
Work Order		Project Number		B	MA EPH_W_La (MA EPH)
Company Name	Environmental Resources Mgmt.	Bill To Company	Environmental Resources Mgmt.	C	MA VPH_LA_W(MA VPH)
Send Report To	Scott Himes	Invoice Attn	Accounts Payable	D	9056_anions_W (Cl,SO4,Br)
Address	CityCentre Four 840 W. Sam Houston Pkwy., Suite 6	Address	CityCentre Four 840 W. Sam Houston Pkwy., Suite 6	E	ALK_W 2320B (carb, bicarb)
				F	H2S_W (H2S)
City/State/Zip	Houston, TX 77024	City/State/Zip	Houston TX 77024	G	HG_W (Mercury)
Phone	(281) 600-1000	Phone	(281) 600-1000	H	ICP_TW (As,Ba,Cd,Ca,Cr,Fe,Pb,Mg,Mn,K,Se,Ag,Na,Sr,Zn)
Fax	(281) 600-1001	Fax	(281) 600-1001	I	SULFD_4500S F (Sulfide)
e-Mail Address	scott.himes@erm.com	e-Mail Address	ERMNAAccountsPayable@erm.com	J	TDS_W 2540C (TDS)

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	Brine Well 007-B(3,conv)	2/14/23	0825	W		10	X	X	X	X	X	X	X	X	X	X	
2	Brine Well 78-B5	2/14/23	1145	W		12	X	X	X	X	X	X	X	X	X	X	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

HS23020862

Environmental Resources Mgmt.

Sulphur Dome

Sampler(s) Please Print & Sign	Shipment Method	Required Turnaround Time: (Check Box)	Results Due Date:
		[X] STD 10 Wk Days [ ] 5 Wk Days [ ] 2 Wk Days [ ] 24 Hour [ ] Other _____	

Relinquished by:	Date:	Time:	Received by:	Notes: ERM Sulphur Dome
	2/14/23	1705		
Relinquished by:	Date:	Time:	Received by (Laboratory):	
			2-16-23 1705	
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):	

Cooler ID	Cooler Temp.
416645	3.5°
IR31	

QC Package: (Check One Box Below)

- [X] Level II Std QC
- [ ] Level II: Std. QC/Raw Data
- [ ] Level IV SVM843/CLP
- [ ] Other
- [ ] TRRP Checklist
- [ ] TRRP Level IV

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.
2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.
3. The Chain of Custody is a legal document. All information must be completed accurately.

ISOTECH
a Stratum Reservoir brand
www.isotechlabs.com

Lab #:	857136	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	Brine Well 22 BS				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/25/2023 12:00	Date Received:	2/01/2023	Date Reported:	2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.35					
Oxygen	0.47					
Nitrogen	61.78					
Carbon Dioxide	7.47					
Methane	28.45	-33.03	-129.6		7.7	5.1
Ethane	0.287				0.084	0.11
Ethylene	nd					
Propane	0.0926				0.026	0.047
Propylene	nd					
Iso-butane	0.0216					
N-butane	0.0216					
Iso-pentane	0.0083					
N-pentane	0.0055					
Hexanes +	0.0449					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.82
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857137	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	6X Brine				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/25/2023	13:30	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.91					
Oxygen	0.74					
Nitrogen	79.17					
Carbon Dioxide	5.31					
Methane	11.72	-38.98	-171.7		2.4	1.6
Ethane	0.462				0.10	0.13
Ethylene	0.0193					
Propane	0.389				0.081	0.15
Propylene	0.0006					
Iso-butane	0.0312					
N-butane	0.0893					
Iso-pentane	0.0162					
N-pentane	0.0193					
Hexanes +	0.120					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.84
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857138	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	Brine Well 7A BS				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/25/2023 14:10	Date Received:	2/01/2023	Date Reported:	2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	0.744					
Oxygen	16.39					
Nitrogen	41.21					
Carbon Dioxide	0.29					
Methane	40.83	-35.60	-150.3		25	17
Ethane	0.397				0.26	0.32
Ethylene	0.0013					
Propane	0.0990				0.061	0.11
Propylene	nd					
Iso-butane	0.0286					
N-butane	0.0106					
Iso-pentane	0.0013					
N-pentane	nd					
Hexanes +	0.0030					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.70
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857139	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	Central Pond				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/25/2023	16:30	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	0.26					
Helium	na					
Hydrogen	nd					
Argon	1.98					
Oxygen	0.41					
Nitrogen	84.79					
Carbon Dioxide	12.25					
Methane	0.302				0.062	0.042
Ethane	0.0015				0.00033	0.00041
Ethylene	nd					
Propane	nd				< 0.0002	< 0.0003
Propylene	nd					
Iso-butane	nd					
N-butane	nd					
Iso-pentane	nd					
N-pentane	nd					
Hexanes +	0.0037					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.86
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
Insufficient methane concentration for carbon and hydrogen isotope analysis.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857140	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	019-1055				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/26/2023 8:00	Date Received:	2/01/2023	Date Reported:	2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.39					
Oxygen	9.78					
Nitrogen	82.00					
Carbon Dioxide	6.53					
Methane	0.300	-53.9			0.12	0.080
Ethane	0.0013				0.00057	0.00071
Ethylene	nd					
Propane	nd				< 0.0001	< 0.0002
Propylene	nd					
Iso-butane	nd					
N-butane	nd					
Iso-pentane	nd					
N-pentane	nd					
Hexanes +	0.0020					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.69
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
Carbon of methane obtained online via GC-C-IRMS.
Insufficient methane concentration for hydrogen isotope analysis.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857141	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	019-582				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/26/2023 8:30	Date Received:	2/01/2023	Date Reported:	2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.76					
Oxygen	5.03					
Nitrogen	82.36					
Carbon Dioxide	10.83					
Methane	0.0186				0.0042	0.0028
Ethane	nd				< 0.0001	< 0.0002
Ethylene	nd					
Propane	nd				< 0.0001	< 0.0003
Propylene	nd					
Iso-butane	nd					
N-butane	nd					
Iso-pentane	nd					
N-pentane	nd					
Hexanes +	0.0018					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.83
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
Insufficient methane concentration for carbon and hydrogen isotope analysis.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857142	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	019-580				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/26/2023	9:10	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.64					
Oxygen	5.59					
Nitrogen	79.08					
Carbon Dioxide	13.23					
Methane	0.456	-56.4			0.12	0.077
Ethane	nd				< 0.0002	< 0.0002
Ethylene	nd					
Propane	nd				< 0.0002	< 0.0003
Propylene	nd					
Iso-butane	nd					
N-butane	nd					
Iso-pentane	nd					
N-pentane	nd					
Hexanes +	0.0042					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.86
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
Carbon of methane obtained online via GC-C-IRMS.
Insufficient methane concentration for hydrogen isotope analysis.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857143	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	019-995				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/26/2023	9:45	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.75					
Oxygen	6.30					
Nitrogen	80.84					
Carbon Dioxide	10.81					
Methane	0.294				0.070	0.047
Ethane	nd				< 0.0002	< 0.0002
Ethylene	nd					
Propane	nd				< 0.0002	< 0.0003
Propylene	nd					
Iso-butane	nd					
N-butane	nd					
Iso-pentane	nd					
N-pentane	nd					
Hexanes +	0.0019					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.84
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
Insufficient methane concentration for carbon and hydrogen isotope analysis.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857144	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	CP BS 1				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/30/2023	11:00	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.04					
Oxygen	8.91					
Nitrogen	45.65					
Carbon Dioxide	3.58					
Methane	40.41	-34.20	-147.2		15	10
Ethane	0.261				0.11	0.13
Ethylene	0.0097					
Propane	0.0702				0.027	0.050
Propylene	nd					
Iso-butane	0.0259					
N-butane	0.0189					
Iso-pentane	0.0083					
N-pentane	0.0051					
Hexanes +	0.0083					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.78
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857145	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	CP BS 2				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/30/2023	11:30	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	0.905					
Oxygen	15.50					
Nitrogen	65.33					
Carbon Dioxide	1.29					
Methane	16.69	-38.37	-160.5		22	15
Ethane	0.209				0.29	0.37
Ethylene	0.0067					
Propane	0.0445				0.060	0.11
Propylene	nd					
Iso-butane	0.0115					
N-butane	0.0091					
Iso-pentane	0.0032					
N-pentane	0.0019					
Hexanes +	0.0029					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.41
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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Lab #:	857146	Job #:	53439	IS-102884	Co. Job#:
Sample Name:	CP BS 3				Co. Lab#:
Company:	Environmental Resources Management (ERM)				
API/Well:					
Container:	IsoFlask				
Field/Site Name:	Sulphur Dome				
Location:	Sulphur, Louisiana				
Formation/Depth:					
Sampling Point:					
Date Sampled:	1/30/2023	12:30	Date Received:	2/01/2023	Date Reported: 2/15/2023

Component	Chemical mol. %	$\delta^{13}C$ ‰	δD ‰	$\delta^{18}O$ ‰	Dissolved gas cc/L	Dissolved gas ppm
Carbon Monoxide	nd					
Helium	na					
Hydrogen	nd					
Argon	1.54					
Oxygen	21.68					
Nitrogen	69.85					
Carbon Dioxide	2.47					
Methane	4.39	-35.45	-143		1.2	0.80
Ethane	0.0472				0.014	0.017
Ethylene	0.0022					
Propane	0.0128				0.0036	0.0065
Propylene	nd					
Iso-butane	0.0033					
N-butane	0.0028					
Iso-pentane	0.0006					
N-pentane	nd					
Hexanes +	0.0039					

Remarks:
Analysis is of gas extracted from water by headspace equilibration. Analysis has been corrected for helium added to create headspace. Helium dilution factor = 0.82
*Addition of helium negates the ability to detect native helium and may negate the ability to detect hydrogen.
Hydrogen of methane obtained online via GC-P-IRMS.

nd = not detected. na = not analyzed. Isotopic composition of hydrogen is relative to VSMOW. Isotopic composition of carbon is relative to VPDB. All gas component carbon isotope values are reported on a scale defined by a two point calibration of LSVEC and NBS 19. Isotopic composition of oxygen is relative to VSMOW, except for carbon dioxide which is relative to VPDB. Chemical compositions are normalized to 100%. Mol. % is approximately equal to vol. %.

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ATTACHMENT A(b)

Environmental Resources Management
Email Communication w/ USACE

David Upthegrove

From: David Upthegrove
Sent: Monday, March 13, 2023 2:03 PM
To: darrell.barbara@usace.army.mil
Subject: Sulphur Dome Assessment and Evaluation

Mr. Barbara:

Westlake is currently performing work at the Sulphur Dome in Calcasieu Parish under an LDNR Compliance Order. We would like to arrange a call or online meeting with appropriate USACE personnel to determine if any of this work might require a USACE permit. If you could possibly offer some suggested dates and times, we can coordinate with our team and set up the meeting. Please just let us know what works for you.

Regards,

David C. Upthegrove, P.G.
Partner

ERM
CityCentre Four | 840 West Sam Houston Parkway North, Suite 600 | Houston, Texas | 77024
T +1 281 600 1000 | **D** +1 832 786 5006 | **M** +1 504 481 6470
E david.upthegrove@erm.com | **W** www.erm.com

ATTACHMENT B

Westlake Emergency Response Plan
(No Change)

WESTLAKE CORPORATION, LLC
INCIDENT ACTION PLAN
SULPHUR MINES DOME

I. Purpose and Scope--This document establishes a plan for responding to any surface expression caused by a failure of any of the brine caverns operated by Westlake on the Sulphur Mines Dome in Calcasieu Parish, Louisiana.

II. Emergency Reporting and Notification Procedures

A. In the event of the appearance of a surface expression, immediately notify Josh Bradley, Brine Field Superintendent, (c) 337-540-6681

B. Following notification of Mr. Bradley immediately notify:

1. Westlake Lake Charles South Facility Shift Superintendent 337-708-4340 or 337-499-6313 who will then activate Lake Charles South Emergency Operations Center and notify:

a. Louisiana State Police Hazardous Materials Hotline (225) 925-6595

b. Louisiana State Police Troop D (337) 491-2511

c. Dome Operators:

i. Boardwalk Doug Fournet 337-764-6965

ii. Liberty Gas Maurice Gilbert 713-206-6713

iii. Yellowrock Vance Hill 337-515-8350

iv. Sasol Heather Kress, Sr. Manager Legal, Americas at Sasol - Heather.Kress@us.sasol.com.

d. LOSCO – Gina Saizan, Program Manager; em gina.saizan@la.gov; office 225.925.6606; desk 225.925.7016; cell 225.933.1600

e. GOHSEP – Melton Gaspard, Section Chief Operations, em melton.gaspard@la.gov; office 225.925.7520; cell 985.634.2520

f. LDNR (225) 342-5515.

g. LDEQ, Lake Charles Regional Office rep or direct phone line.

h. Calcasieu Parish Sheriff's Office (337) 491-3700

NOTE: Plan is subject to timely update and revision commensurate with the known facts and circumstances at that time.

i. Dick Gremillion – Calcasieu Parish Director of Emergency Preparedness - dgremillion@calcasieu.gov

3. 2. Jared Maze – Calcasieu Parish Chief of Operations - jmaze@calcasieu.govEPA National Response Center 1-800-424-8802

4. Entergy 1-800-968-8243

III. Notification to impacted landowners:

A. Mr. Bradley or his designee will also notify the following within 2 hours of the discovery of a surface expression:

1. Landowner:

a. Sulphur Dome LLC. 601-978-1763

IV. Response Assets-Westlake has consulted with vendors and service providers who will be asked to assist in addressing any impacts caused by a surface expression. They are:

A. Hazardous Liquid Spill Containment and Remediation

1. E3 OMI Billy Barnett (337) 502-7779 or 1-800-645-6671

B. Water and Air Sampling and Monitoring

1. ERM (o) (225) 292-3001Angela Levert (c) (504) 812-6378 or Dave Angle (c) (281) 433-3826

C. Wild Well Control

1. Wild Weld Control LLC (281) 784-4700

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ATTACHMENT C

RESPEC Inc.
Plan for Geomechanical Modeling of Sulphur Dome
(Version 2)

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

March 10, 2023

Coleman Hale
Vice President / Sr. Petroleum Engineer
Lonquist & Co., LLC
1415 Louisiana St., Suite 3800
Houston, Texas 77002

Dear Coleman,

RE: Baseline Geomechanical Evaluation of Hypothetical Low-Pressure Conditions in Westlake Cavern 7B at the Sulphur Mines Salt Dome, Calcasieu Parish, Louisiana (RSI/P-8041) (Revision 2)

This letter provides a proposal to perform a geomechanical evaluation of hypothetical low-pressure conditions in Westlake Cavern 7B on the Sulphur Mines salt dome. In late 2021, Cavern 7B experienced a sudden pressure loss event that subsided after approximately 2 weeks. Throughout most of 2022, the cavern returned to a historically typical pressure increase trend. In late 2022, the pressure began to decline in Cavern 7B and at an increasing rate of change. Brine injection operations are currently ongoing to maintain cavern pressure slightly above a brine pressure gradient, and it is presently unknown how low the pressure may drop if brine injections are discontinued. Westlake would like to evaluate the possibility of discontinuing the brine injections and allowing the pressure to drop in Cavern 7B until it stabilizes. Lonquist & Co., LLC, has engaged RESPEC Company, LLC (RESPEC) to perform a geomechanical evaluation of hypothetical low-pressure conditions in Caverns 7B and 6X to determine if the caverns will become unstable, assuming various pressure stabilization conditions. Additionally, the proposed study will evaluate the impact of low-pressure conditions in Caverns 7B and 6X on the surrounding caverns in the salt dome.

RESPEC proposes conducting a geomechanical evaluation in a phased approach. The situation involving a solution-mined cavern near the edge of a salt dome encompasses many different geomechanical phenomena that have complex inter-relationships. The proposed study will initially develop a three-dimensional (3D) numerical model using the currently available information and historically employed modeling techniques to provide a baseline for the geomechanical response of the caverns under hypothetical low-pressure conditions. After a baseline model is developed, additional investigations may be beneficial to evaluate various modeling assumptions, such as the deformation and strength characteristics of the nonsalt formations, the presence of a depleted reservoir next to the salt dome, or the presence of a caprock sheath along the flank of the salt dome. The baseline modeling effort will inform the development of any additional modeling scenarios that may provide further insight into potential risks associated with low-pressure conditions in the caverns.

BACKGROUND

The fluid pressure in a solution-mined cavern helps support the geologic loads that act on the rock surrounding and overlying the cavern. As the cavern pressure decreases, the loads that must be supported by the surrounding rock increase. If the loads exceed the rock strength,

3824 JET DRIVE
RAPID CITY, SD 57703
P.O. BOX 725 // RAPID CITY, SD 57709
605.394.6400

the rock will fail and lose strength. Unlike brittle rock types that fail suddenly, rock salt around a solution-mined cavern will typically begin to fail through microfracturing along the grain boundaries, which is a process referred to as dilation (or damage). If dilatant states of stress are maintained, the microfractures will increase and coalesce, which, in turn, reduces the strength of the salt. Salt damage is a progressive process that can lead to the salt spalling from the roof and walls of the cavern and may lead to salt-web failure or roof collapse. It is desirable to design and operate salt caverns in a manner that precludes the onset of salt dilation to maintain cavern stability.

The cavern and salt-web stability between caverns and between the caverns and the edge-of-salt (i.e., dome flank) is a function of web thickness, web height, and cavern fluid pressures. If the web thickness is small and the cavern pressure is too low, the shear stresses in the salt surrounding the caverns can exceed the strength of the salt. The stability of the caverns and the salt webs will be evaluated by post-analyzing the model-predicted stress states to determine factor-of-safety values with respect to salt dilation using the RESPEC Dilation (RD) criterion[1]. The RD criterion parameter values previously developed by Heiberger [2017][2] for the Sulphur Mines salt dome will be used in this study.

NUMERICAL MODELING

RESPEC proposes conducting a 3D numerical analysis to simulate and analyze the hypothetical pressure-reduction scenarios defined by Lonquist. The proposed numerical analysis will include the representation of the salt dome, caverns within the salt dome, overlying caprock and overburden, and surrounding sedimentary basin. The most recent sonar surveys and well gyroscopic surveys for all caverns in the dome will be used to develop the geomechanical model. The pressure histories for Caverns 7B and 6X, measured brine injection flows for Caverns 7B and 6X, and any relevant geological data will also be required to complete this study. The mechanical properties for the salt will be based on RESPEC's laboratory testing of salt core recovered from Well No. 22[3], similar to the previous RESPEC geomechanical study conducted in 2017[2]. RESPEC has also previously conducted laboratory testing on salt core recovered from Boardwalk Well Nos. 4 and 5, which are further away from Cavern 7B than Well No. 22. If permission is obtained to use the boardwalk data for this study, the test data from Boardwalk Well Nos. 4 and 5 may be reviewed for comparison to the Well No. 22 data. However, because Well No. 22 is closer to Cavern 7B, the test data from Well No. 22 salt core may be more appropriate for defining mechanical properties of the salt for the purposes of this study.

RESPEC will develop a 3D finite difference model of the Westlake Caverns 7B and 6X, and the surrounding caverns. The model will include representation of the entire salt dome boundary, the caprock and overburden, and a simplified representation of the sedimentary basin surrounding the salt dome. Generally, low-pressure conditions in a cavern create a stress perturbation in the surrounding salt, but the spatial influence is typically limited to two or three cavern diameters away from the cavern. Caverns that are sufficiently distant from Caverns 7B and 6X will likely not see any impact from low-pressure conditions in Caverns 7B and 6X; therefore, the proposed numerical modeling will be focused on evaluating the effects of low-pressure conditions in Caverns 7B and 6X and the surrounding nearby caverns. The nearby caverns that may potentially see effects from the low-pressure conditions include, Sulphur Mines Storage No. A-1, PPG No. 16, the gallery of PPG No. 2, PPG No. 4, and PPG No. 5,

[1] **DeVries, K. L., K. D. Mellegard, G. D. Callahan, and W. M. Goodman, 2005.** *Cavern Roof Stability for Natural Gas Storage in Bedded Salt*, RSI-1829, prepared by RESPEC, Rapid City, SD, for the US Department of Energy, National Energy Technology Laboratory, Pittsburgh, PA.

[2] **Heiberger, K. J., 2017.** *Geomechanical Evaluation of the Coalesced Caverns in the Sulphur Mines Salt Dome, Calcasieu Parish, Louisiana,* RSI-2574, prepared by RESPEC, Rapid City, SD, for Lonquist & Co., LLC, Austin, TX.

[3] **Arnold, R. D., 2015.** *Mechanical Properties Testing of Core from Axiall PPG Brine 22, Sulphur Mines Salt Dome, Calcasieu Parish, Louisiana,* RSI-2533, prepared by RESPEC, Rapid City, SD, for Lonquist & Co., LLC, Austin, TX.

Liberty Gas Storage Nos. 1 and 2, Vista No. 1-A, and PPG No. 20. The remaining caverns in the dome will be roughly approximated in the 3D model to capture the general influence of those caverns on the overall stress distribution in the salt dome. The baseline 3D modeling effort will be used to determine if any of the more distant caverns require a more thorough evaluation regarding the low-pressure conditions in Caverns 7B and 6X.

Lonquist will need to provide the most recent dome contours, cavern sonar surveys, and gyroscopic surveys to fully define the 3D model for this study. The 3D model will be used to estimate the in situ stress conditions in the salt dome and the surrounding sedimentary basin to initialize the stress state in the model prior to any cavern development. The model will then be used to simulate the historical development and operations of the existing caverns in the salt dome that are included in the model, up until the recent pressure loss event in Cavern 7B. The pressure histories and brine flow data from Caverns 7B and 6X will be used to approximate the cavern pressure conditions in Caverns 7B and 6X up to present day to estimate the stress state in the surrounding salt stock in March 2023. The model-predicted stress state in the salt surrounding Caverns 7B and 6X at present day will be analyzed to determine factors of safety with respect to salt dilation to establish a baseline condition of cavern and salt web stability prior to simulating the hypothetical pressure-reduction scenarios.

The 3D model will be used to simulate the steady-state creep response of the caverns to gradual pressure reductions. Because the modeling will not account for the transient creep response typically seen during dynamic pressure changes, the model-predicted stresses will not be representative of short-term pressure-reduction conditions. The model will be used to evaluate three hypothetical pressure-reduction scenarios with Cavern 7B at a brine pressure gradient of 0.52 pounds per square inch per foot (psi/ft) of depth at the casing shoe depth and two other pressure gradients to be defined by Lonquist. The pressure histories for Caverns 7B and 6X will be used to estimate correlated pressure reductions in Cavern 6X. The model-predicted stress states with the caverns at the hypothetical reduced pressures will be analyzed to predict dilation factors of safety in the salt surrounding the caverns. The modeling results will provide a comparative analysis of the stress state in the salt webs before and after the cavern pressures are reduced, which can be used to evaluate the potential impact of the low-pressure conditions on cavern stability.

Because of the limited data available for the dome flank and the nonsalt rock immediately adjacent to the salt dome, the deformation and strength properties of the nonsalt rock and the interface with the salt dome cannot be well defined in the numerical model. The proposed baseline 3D modeling approach will assume that the salt is perfectly bonded to the adjacent nonsalt rock formations along the dome flank. This modeling approach has been used historically for evaluating many salt cavern facilities within salt domes in the Gulf Coast region. This modeling assumption may represent artificially higher stiffness and strength for the salt webs between the caverns and the dome flank, which may result in less conservative predictions regarding the stability of the salt webs. Additionally, the leak path from Cavern 7B is undefined, and the model will not represent the presence of a physical void through the salt webs, which may not be a conservative structural representation of the salt webs. Therefore, the proposed analysis will primarily provide a comparative evaluation of the change in stresses at the caverns' surfaces as a result of the cavern pressure being reduced to the hypothetical steady-state conditions.

Additional modeling scenarios may be developed to investigate the assumptions and methods employed in the baseline modeling effort, such as the deformation and strength characteristics of the nonsalt formations next to the salt dome, the presence of a depleted reservoir next to the salt dome, or the presence of a caprock sheath along the flank of the salt dome. These additional scenarios will be

scoped based on the findings of the initial modeling effort, and cost and schedule estimates will be developed for additional modeling scenarios as necessary.

REPORTING

At the conclusion of the study, RESPEC will provide a comprehensive technical presentation that describes the technical approach, assumptions, numerical model, modeling results, and conclusions. A draft PowerPoint will initially be presented and delivered as a PDF to Lonquist for review and comment, and the final presentation can be delivered within approximately 2 weeks after receiving comments on the draft presentation.

SCHEDULE AND COST

RESPEC has several engineers with the experience and skills required to complete the proposed project successfully. Based on current personnel availability, we anticipate this study can be completed within 12 weeks after commencement of the project. A fixed-price contract is proposed, and the estimated cost to complete the scope of work outlined in this proposal is [redacted] Table 1 summarizes the project tasks, costs, and schedule.

Table 1. Project Tasks, Costs, and Schedule

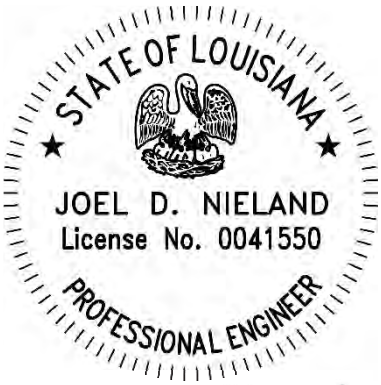
Task	Schedule (weeks)	Fixed-Price Cost ($)
3D Numerical Modeling	8	[redacted]
Project Management & Reporting	4	
Total	12	

Thank you for the opportunity to develop this proposal. If you have questions or comments, please contact me by telephone (605.394.6431) or email (joel.nieland@respec.com).

Sincerely,

Joel Nieland
Staff Consultant

JDN:akm
cc: Project Central File 996-8041



March 10, 2023

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ATTACHMENT D

Lonquist & Co. LLC
Plan for Development of a Failure & Response/Mitigation Report
(Version 2)

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

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Plan for Development of a Failure Analysis Report

Sulphur Mines Cavern No. 7

A "Failure Analysis Report" is under development and at this time can be summarized by way of the following table of contents and brief description of what is planned to be included in each report section. It is expected that this report will be ready by April 21, 2023.

1. Introduction
   - An introduction to the report structure, Sulphur Mines dome history (as possible through available records), and purpose of the report. Visualizations and supportive analysis (as available) will be included as appendices.
2. Cavern 7 History, Pressure Loss Event, & To-Date Status
   - An overview of the operational life of Cavern 7 (as possible through available records), a summary of the operational pressure history of Cavern 7, a discussion of the pressure loss event, and summary of the cavern pressures and operational actions to-date. Visualizations and supportive analysis (as available) will be included as appendices.
3. Sulphur Dome & Cavern 7 Structure
   - An overview of the geologic interpretation of the Sulphur Mines salt dome, Cavern 7 geometry, and its relation to other caverns and features. Visualizations and supportive analysis (as available) will be included as appendices.
4. Examples of Cavern Integrity Failure Incidents
   - A summary of cavern failure incidents from around the world that relate to the ongoing observations of Cavern 7 and the perceived theoretical failure scenarios.
5. Theoretical Failure Scenarios
   - A summary of various failure mechanisms and their projected impact to formations, the surface environment, the USDW, and sub-surface or surface infrastructure. Visualizations and supportive analysis/documentation/reports (as available) will be included as appendices. The scenarios theorized and discussed may not be an exhaustive list, rather, the most likely scenarios based upon the available data/understanding.
6. Pre-Failure Monitoring & Evaluation
   - A summary of the ongoing monitoring and evaluation efforts, and a discussion of the results of those efforts to-date. Including appendices to support (as available).
7. Post-Failure Response & Monitoring
   - A plan for response and monitoring actions assuming a certain failure scenario.
8. Concluding Remarks
   - A summary/concluding statement for the report.
9. References

Teresa H. Rougon, P.G.
Principal Geologist
Louisiana License No. 330

Teresa H. Rougon, P.G.

Date Signed: March 13, 2023
Baton Rouge, LA

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ATTACHMENT E

Lonquist & Co. LLC
Plan to Acquire, Process, & Evaluate 3D Seismic
(Version 2)

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Plan for Evaluation of 3D Seismic

Sulphur Mines Salt Dome

An integrated geologic and geophysical (G&G) evaluation is planned for 3D seismic data licensed over the Sulphur Mines storage facility. The evaluation will utilize the following data and process:

1. Well bores – geologic control
2. Extensive research regarding well locations (surface / bottom hole) and directional surveys
3. Sonar surveys taken within storage caverns
4. 3D surface seismic data – licensed from SEI
5. Local Velocity Surveys
6. Synthetic seismograms generated from nearby sonic logs
7. Utilization of the 2004 VSP data provided by Liberty Gas Storage, LLC, with incorporation of a reprocessing effort of that data.
8. An integrated interpretation of the 3D seismic data which honors well control (formation tops)
9. Initial seismic interpretation will utilize commercially available PSTM data (Pre-Stack Time Migration)
10. Final interpretation of 3D seismic will be after reprocessing thru PSDM (Pre-Stack Depth Migration)
11. Final deliverables will be Top of Salt Map, and additional geologic horizons adjacent to salt face

1) Approximately 400 wells will be included in this integrated G&G interpretation. Extensive historical research of both surface locations and bottom hole locations for well bores were conducted prior to utilizing the formation top information registered by these well penetrations. Additionally, most recent information from publicly available well information (such as SONRIS, IHS, Enervus, TGS,) will be utilized.

2) Sonar information collected over the past 16 years will also be taken into account. The sonar logs will be visualized utilizing CAD software in order to present the vertical and horizontal relationship between caverns, geologic formations (including salt face) and nearby well control.

3) Five square miles of 3D seismic data was licensed from SEI. The acquisition parameters utilized to acquire the data contains sufficient far offset data, and shot/receiver spacing to undertake this study. Nearby velocity surveys are incorporated into the study to establish the time to depth relationship necessary to produce integrated G&G maps. Additionally, local sonic logs will be utilized to generate synthetic seismograms to further validate the time to depth relationship.

Ultimately a comprehensive velocity model will be generated for the area covered by the licensed 3D data. This velocity model will be used for mapping purposes and also for the planned reprocessing thru PSDM.

4) Initial mapping will utilize the PSTM versions of the 3D seismic provided by SEI. The PSTM interpretation will honor the local well control and synthetic seismograms. The subsequent PSDM also will be processed to honor local well depths via a velocity model calibrated to the local well. Our expectation is that the resulting PSDM will yield the "highest" resolution for the given seismic data, and as importantly, will more accurately locate the position and dip of the salt dome and adjacent formations.

5) Final deliverables for this integrated study will be

- Depth calibrated Top of Salt Map
- Depth calibrated maps for at least two additional horizons adjacent to the salt face
- Map representing best estimates for cavern distances to salt face (edge of salt) will be integrated into this study, particularly on the western flank of the dome study area
- In addition to historical research of well information, a surface survey will be conducted to verify wellhead GPS locations for wells that are known to traverse the western flank of the dome, or penetrate the top of salt on the western portion of the Sulphur Mines dome.

The overall timeline for these efforts is outlined within the overall project gantt chart.

Teresa H. Rougon, P.G.

Date Signed: March 13, 2023
Baton Rouge, LA

Teresa H. Rougon, P.G.
Principal Geologist
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ATTACHMENT F

MEQ Geo Inc./Jarpe Data Solutions
Plan to Install Micro-Seismic Monitoring
(Version 2)

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Plan to monitor microseismicity at Sulphur Mines Salt Dome

(LDNR Compliance Order No. IMD 2022-027)

Julie Shemeta
MEQ Geo Inc.
March 9, 2023

LOUISIANA BOARD OF PROFESSIONAL GEOSCIENTISTS
Julie E. Shemeta
License Number 852
Est. 2011
Julie Shemeta
3/10/2023

A three-phase passive seismic monitoring plan has been developed for monitoring seismic activity at Sulphur Mines Salt Dome, using a 1) temporary surface seismic array (currently in operation), 2) a semi-permanent telemetered surface seismic array (proposed) and 3) a dual-array borehole seismic array in two existing cavern wellbores (proposed). These phases are described in detail below:

Phase 1: Temporary Surface Seismic Array.

Seven "temporary" seismic boxes were sent by Jarpe Data Solutions (JDS) to Sulphur Mines and installed at the end of January 2023 to quickly initiate passive seismic recording of seismic data on the dome. The location of the seismic stations has varied; the current locations (as of March 6, 2023) are shown in Figure 1.

Figure 1. Google map image showing the temporary seismic recording station locations at Sulphur Mines Salt Dome. Station locations as of Feb 27, 2023 as provided by Westlake.

Each temporary seismic station records on a removable disk (SD Data card). The removable data cards are exchanged and shipped for data processing every 2-3 days.

The temporary seismic array was functional beginning mid-February 2023, with some intermittent monitoring in early February. The magnitude detection threshold of the surface array based on the background noise levels is an event size of magnitude 1.0. No seismic events have been detected as of the date of this report.

Phase 2: Proposed Semi-Permanent Surface Seismic Array

The data quality is continuing to be reviewed via Root Mean Square (RMS) background noise levels from the temporary seismic array (Phase 1) to determine best placement for the proposed semi-permanent telemetered station locations (Phase 2), which will serve as a semi-permanent surface seismic array. The semi-permanent seismic stations will directly transmit a live continuous data stream via cell phone telemetry to the JDS offices for seismic data processing. JDS will process the data weekly, including event detection and locations.

The semi-permanent surface seismic stations shall be deployed once Louisiana Department of Natural Resources (LDNR) approvals are given, and the Phase 1 background noise results for temporary array station locations are satisfactory. Therefore, the Phase 2 array could be installed as early as the end of March 2023. The Phase 2 array will be installed by JDS, and the seismic sensor for each station will be buried about six inches below ground level. The electrical equipment for recording and transmitting the data will be placed in a sealed box and mounted on a pole. The station is solar powered via a solar panel mounted above the equipment box. The data will be sampled at 125 samples per second with a GPS-synced timing system and continuously telemetered to JDS and for JDS to perform weekly data processing.

Notification to the LDNR will be made within 24 hours if a seismic event is detected and identified. As no activity has been detected to date (monitoring period from January 30 to March 9, 2023), any seismic event will be reported. If seismic activity becomes more common, we will discuss with LDNR an appropriate seismicity level for 24 hour reporting. We propose a bi-weekly seismic monitoring report to be provided to LDNR for Phase 1 and Phase 2. The semi-permanent surface array anticipated to have a magnitude threshold of about +1 to 3.5. Figure 2 shows an example of a semi-permanent, pole-mounted JDS surface seismic station installation. It is expected that this semi-permanent surface seismic array will operate until the proposed borehole array (Phase 3) is operational. The Phase 2 array will eventually be decommissioned after verifying the Phase 3 borehole array is performing as desired.

Figure 2. An example of a JDS pole-mounted seismic station.

Phase 3: Proposed Borehole Seismic Network

Experience in seismic monitoring at the Napoleonville salt dome in response to the 2012 failure of Oxy Geismar 3 cavern has demonstrated that placing geophone sensors into the salt dome 1) greatly lower the background noise levels, 2) allows the recording of seismic vibrations at closer distances, and 3) the seismic signals are not transmitted through the cap rock and near surface swampy surface sediments which attenuate the signal. Borehole arrays have shown to greatly improve the magnitude detection threshold. At Napoleonville, the magnitude detection threshold of the borehole seismic array is about magnitude < -2 for events within 3000 ft of the array (Shemeta, 2023). Borehole arrays are superior for collecting small-magnitude microseismic activity and should indicate areas of low-level subsurface fracturing that might indicate potential areas of concern.

Two retrievable 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 near end of solution mining life, 2) they have a preferred wellbore casing configuration, 3) the feasibility modeling indicated favorable results (discussed in more detail below). The two wellbores are proposed to be instrumented with an Avalon Sciences Ltd. custom-built, six-level analog 15 Hz geophones array. Each array will include a pressure and temperature (PT) gauge: at the time of this plan, it is proposed for the 6X PT gauge to be below the geophones (~2,500' depth) and PPG 20 array to have a PT gauge suspended into the salt cavern body (~3,600'). Six geophone levels are the maximum number of sensors available for Avalon's retrievable seismic array.

The sensor placement 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. The geophones in the PPG 6X wellbore will be placed approximately 120 feet apart, within the 7 5/8" cemented production casing from approximately 1,900 to 2,500 feet. 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 1,875 ft to 3,300 ft (Figure 3).

Wellbore inspection work including casing inspection logs, a cement bond log, a background noise wellbore survey, and a sonar survey will be performed in each wellbore. To further support feasibility of the Phase 3 plans, these inspection workovers will be performed prior to ordering the long lead time borehole seismic equipment. 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. Once the Phase 3 system is operating, the Phase 2 surface array seismic reporting will be replaced by the borehole seismic monitoring.

Borehole Modeling. Altcom, a UK based seismic monitoring company, performed a feasibility study for borehole monitoring using the geometries described above for PPG 6x and PPG 20. The feasibility study was designed to model the location of seismic events in the vicinity of Cavern 7: the salt and sediments above and below the cavern to a depth about 4500 ft. The location uncertainty modeling results are show in figures 4 and 5.

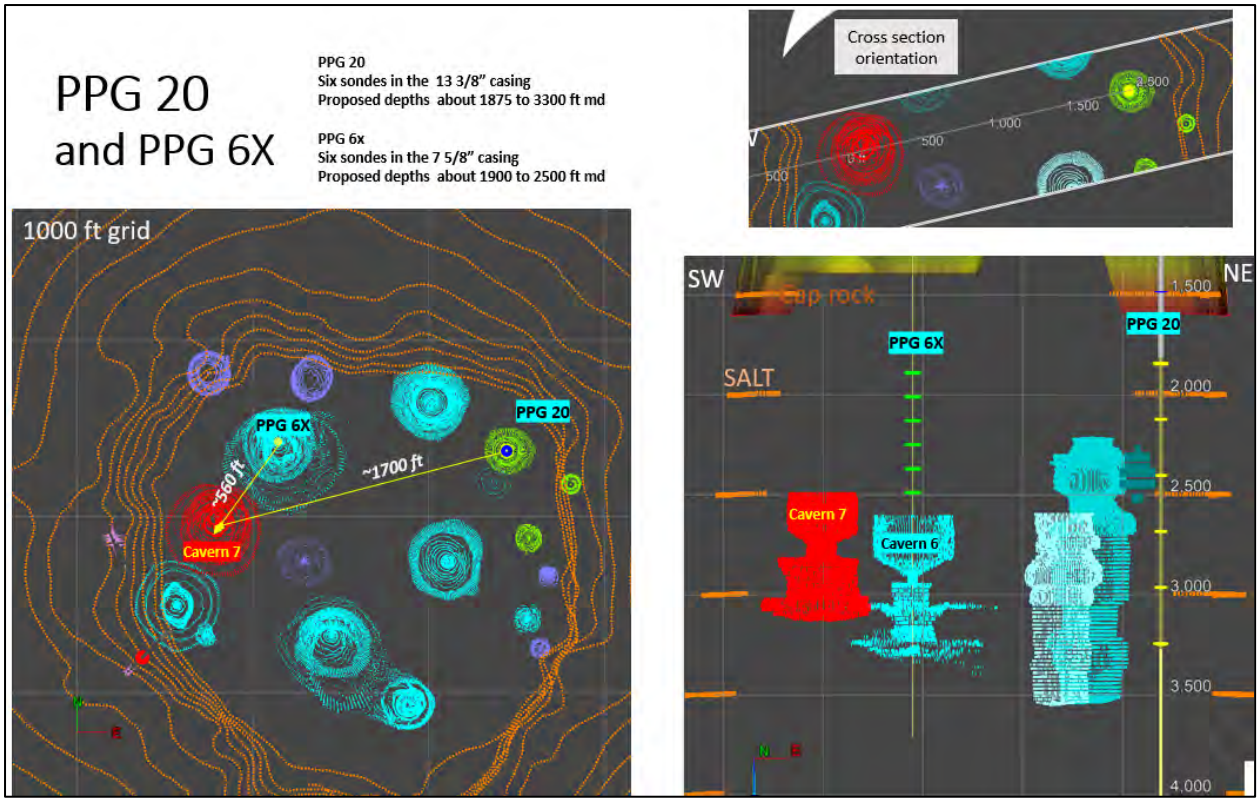
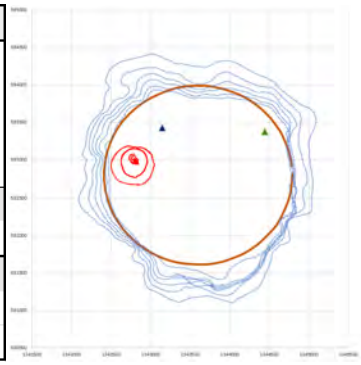


Figure 3. Map (left) and SW-NE cross section (lower right, upper right inset shows orientation of cross section) of the Sulphur Mines Salt Dome showing the location of various caverns. Cavern 7 is shown in red. Potential monitoring wells are PPG6x and PPG 20 (labeled in figures). The proposed geophone 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 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



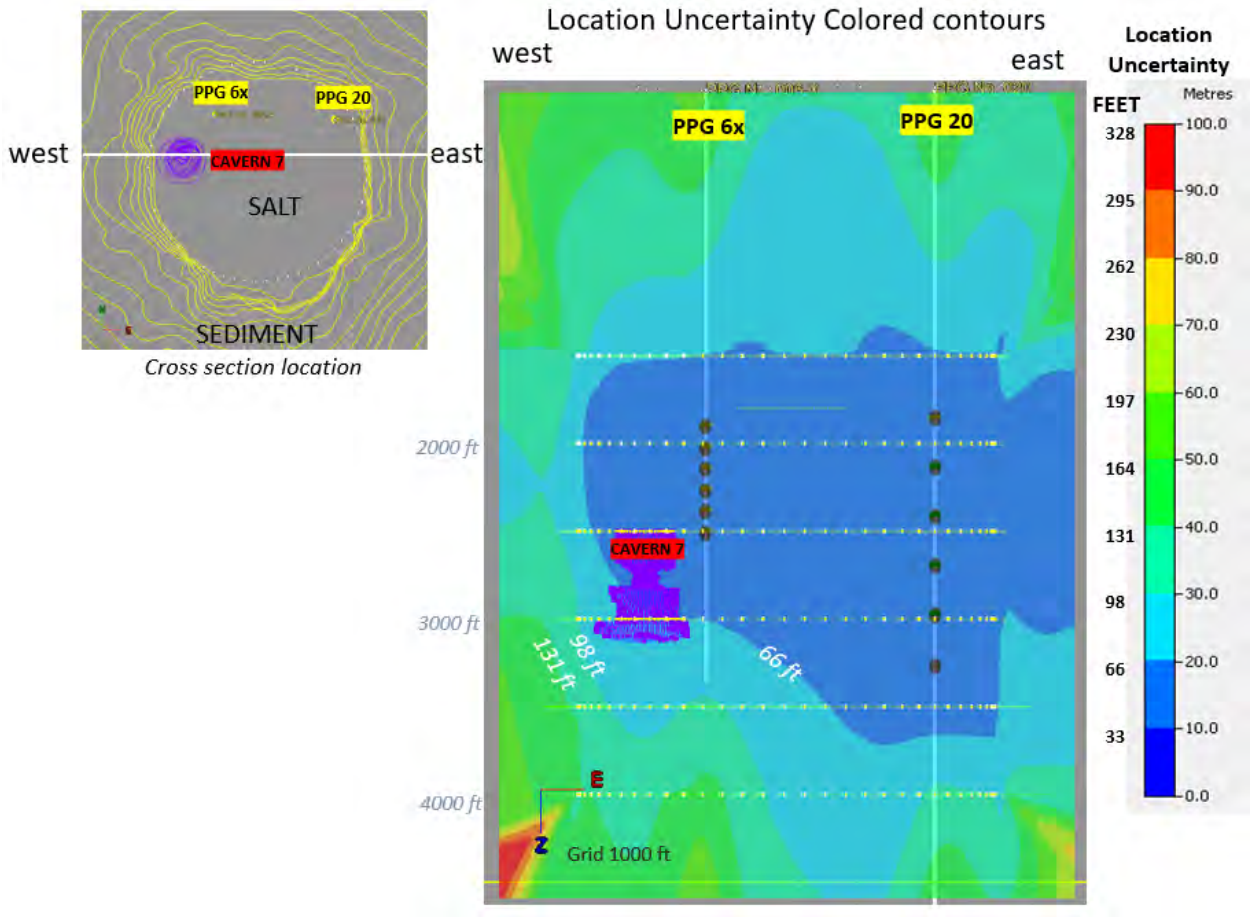


Figure 4. (Right) A east-west cross section showing the uncertainty modeling results from AltCom using wells PPG 6x and PPG 20. Depth is labeled. The upper left plot shows the location of the east-west cross section, bisecting cavern 7. The location of PPG 6x and 20 well bores and geophones are projected 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.

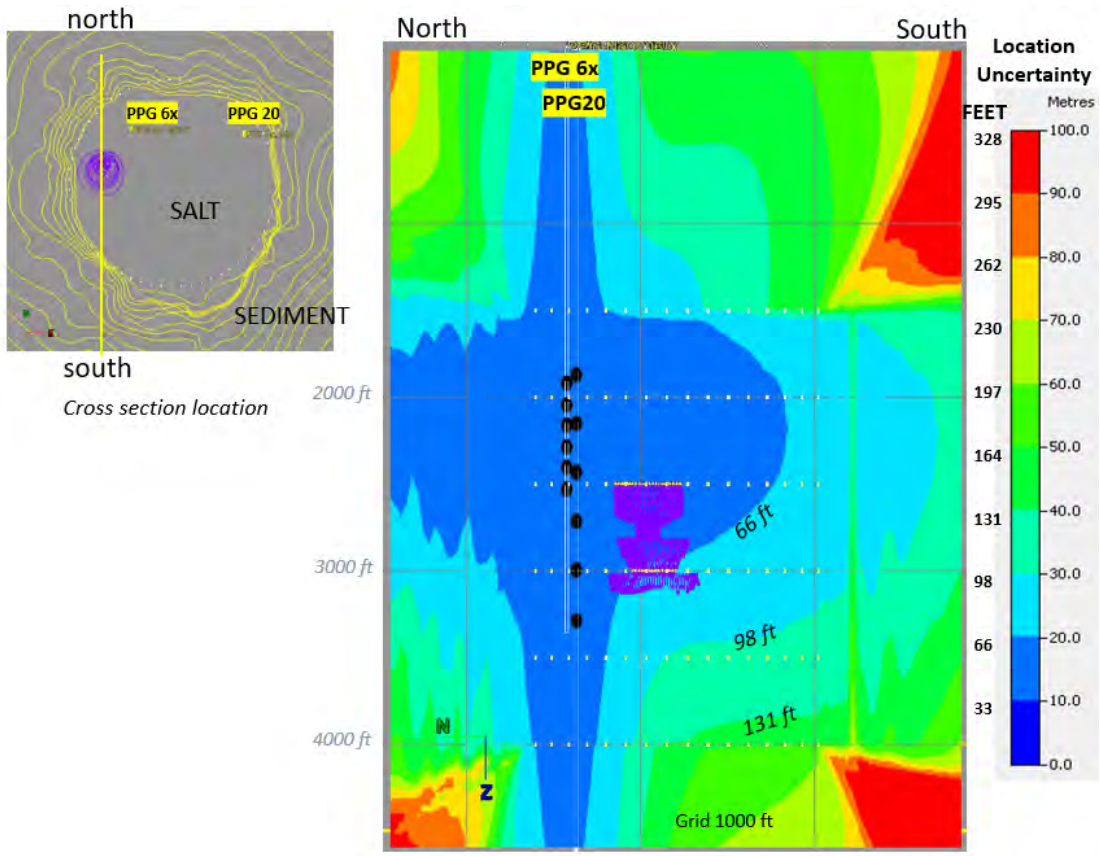


Figure 5 (Right) A north-south cross section showing the uncertainty modeling results from AltCom using wells PPG 6x and PPG 20. Grid on cross section is 1000 feet. The upper left plot shows the location of the east-west cross section, bisecting cavern 7. The location of PPG 6x and 20 well bores and 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 Figures 6 and 7. The 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. For reference, the median magnitude from borehole monitoring at Napoleonville salt dome is about magnitude -1.

The modeling results for both location accuracy and magnitude sensitivity suggest placing six-level removeable geophone arrays in both 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).

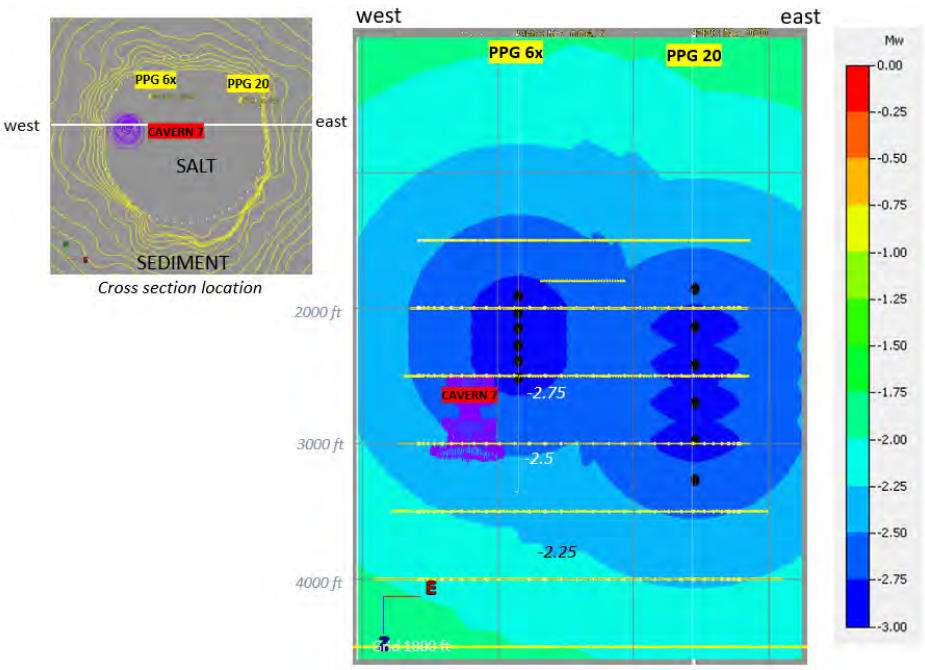


Figure 6. (Right) A east-west cross section showing the magnitude sensitivity modeling results from AltCom using wells PPG 6x and PPG 20. Grid on cross section is 1000 feet. The upper left plot shows the location of the east-west cross section, bisecting cavern 7. The location of PPG 6x and 20 well bores and geophones are projected onto the cross section (black dots). The scale for the colored plots is show in the far right. 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.

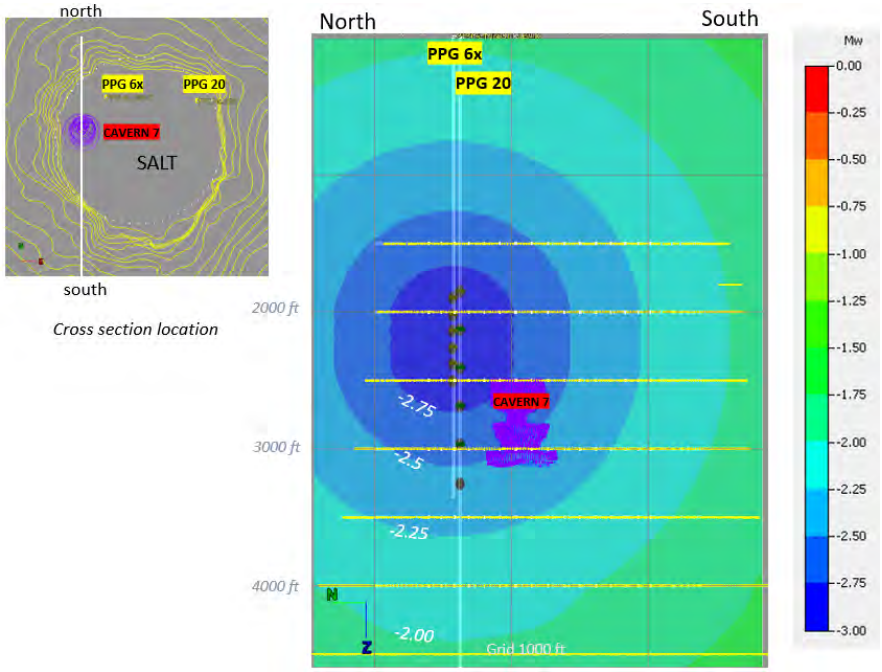


Figure 7. Right) A north-south cross section showing the magnitude sensitivity modeling results from AltCom using wells PPG 6x and PPG 20. Grid on cross section is 1000 feet. The upper left plot shows the location of the north-south cross section, bisecting cavern 7. The location of PPG 6x and 20 well 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.

If the borehole monitoring plan is approved by the LDNR and the subsequent inspection workovers find the wells to be suitable for the Phase 3 array design, then the array design will be finalized and Avalon will commence with building the two arrays. Provided the above-mentioned prerequisites are understood and completed in a timely fashion, the placement of the materials order likely could not be made until early May.

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

Depending on the seismic activity at Sulphur Mines dome, the semi-permanent surface array (Phase 2) will likely be removed once the borehole array (Phase 3) is confirmed to be functional.

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.

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ATTACHMENT F(a)

MEQ Geo Inc./Jarpe Data Solutions
Surface Seismic Monitoring Report
(January 31 – March 3, 2023)

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TEMPORARY SURFACE SEISMIC MONITORING SULPHUR MINES DOME

MONITORING RESULTS FROM JANUARY 31 TO MARCH 3, 2023

Julie Shemeta MEQ Geo Inc.
Steve Jarpe, Jarpe Data Solutions
March 9, 2023

LOUISIANA BOARD OF PROFESSIONAL GEOSCIENTISTS
Julie E. Shemeta
License Number 852
Est. 2011

Julie Shemeta
3/10/2023

This report summaries the deployment and seismic monitoring results of an array of seismic recording instruments deployed at Sulphur Mines salt dome, Louisiana.

Summary Sulphur Mines Dome Seismic Monitoring from January 31 to March 3, 2023

- No seismic events have been detected from January 31 to March 3, 2023.
- The temporary surface array has a magnitude detection threshold of 1, based on background noise levels.
- Seismic monitoring is ongoing. Monitoring started in late January and by February 15, seven seismic stations on the Sulphur Mines dome were collecting seismic data.
- Various seismic stations have been moved during the deployment, in order to reduce background noise levels and for ease of operating logistics of by placing sensors on Westlake property.

Temporary Seismic Array Deployment

Seismic monitoring at Sulphur Mines salt dome started in late January 2023. Jarpe Data Solutions (JDS) is under contract to provide instrumentation and processing for a temporary surface seismic array and a semi-permanent seismic array.

Seven seismic recording boxes were shipped from JDS offices in Arizona and they arrived in Sulphur Mines and deployed on the salt dome in late January 2023. The location of the boxes is shown in Figure 1 and listed in the Appendix Table 1.

Figure 1. Google image showing the location of first deployment of temporary seismic boxes at Sulphur Mines salt dome. Station locations provided by Westlake.

Seismic Station Instrumentation. The temporary stations are three component, 4.5 Hz HG-6HA geophones with a sensitivity of 78.9 volts/meter/sec. The stations are synchronized to GPS timing clock and are battery powered. The data is sampled at 200 samples per second. Each box records continuous ground motion data on an interchangeable SD card.

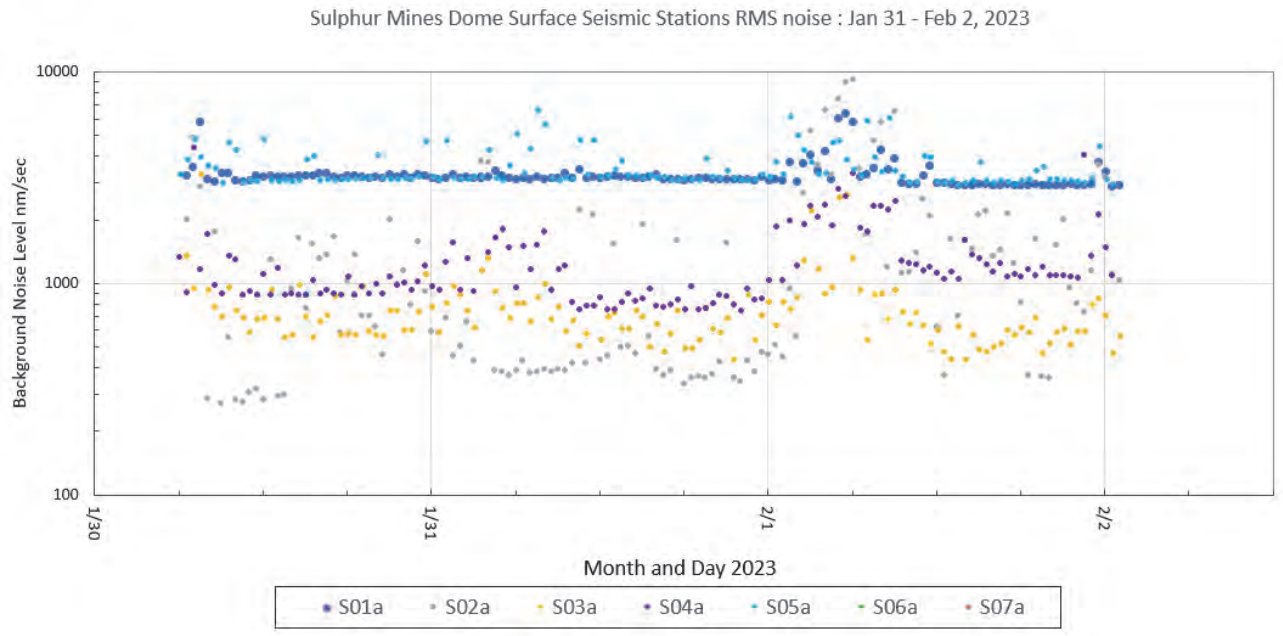

Figure 2. Noise profile from January 30 to February 2, 2023. Plot is a graph of the log of the background noise levels in nm/sec recorded on the seismic boxes at Sulphur Mines salt dome. The colored dots represent different stations, as indicated by key on bottom of graph. Time is in displayed UTC, +6 hours difference from Central time.

Continuous Seismic Data Processing. The SD cards are removed from each station every 2-3 days and a new SD card is swapped in. The individual SD cards are shipped via overnight to a JDS office in Arizona for data processing. Once on site in the processing office, the data is downloaded from each SD card, compiled together and scanned for seismic events. The seismic data processing is based on PhaseNet (Zhu and Berosa, 2019) a deep-neural-network-based seismic arrival-time picking method. PhaseNet uses three-component seismic waveform data as input and generates probability distributions of P arrivals and S arrivals as output, based on thousands of analysts picks of California earthquake network data. The maxima in the probability distributions provide accurate arrival times for both P and S waves. PhaseNet has been shown to be applicable to earthquakes in areas other than California (Zhu, 2022, personal comm.)

The PhaseNet processing produces a list of possible arrival times at each of the stations. These possible event arrival times are then compared, and any group of arrivals within a 2 second window at 3 stations is declared as a possible event. The waveforms of these possible events are visually examined to determine their origin. To date, all of these possible events have been determined to be noise bursts that coincidentally occur at the same time near the individual stations.

Seismic Data Acquisition and Background Noise Levels at Sulphur Mines Dome. Seismic recording started on January 30, 2023. Five of the seven boxes recorded seismic data (Figure 2). Boxes 6a and 7a did not record

any data during the initial deployment days. The background noise levels vary from about 250 to 4000 nm/sec. The quietest stations are 2a, located on the northeast of Sulphur Mines dome and 3a, located west part of Sulphur Mines dome. The two noisiest stations are 5a and 1a, located north (1a) and southwest (5a) with noise levels consistently over 2000 nm/sec. Based on the noise data, and experience monitoring in other areas, the estimated magnitude detection threshold of the surface array is approximately a magnitude +1.

From February 3 to 15, intermittent data was collected as issues arose with exchanging SD cards. The Data from station 6a was collected Feb. 3-8, at low background noise levels (200-300 nm/sec) and no seismic events were detected. The issues with SD card exchanges were identified and resolved by February 15.

Three stations 1a, 2a and 3a, were moved February 9 to sites on Westlake property (Figure 4 and appendix 1). Data from the new sites 1b, 2b and 3b measured noise levels in the 1000 nm/sec range (Figure 5).

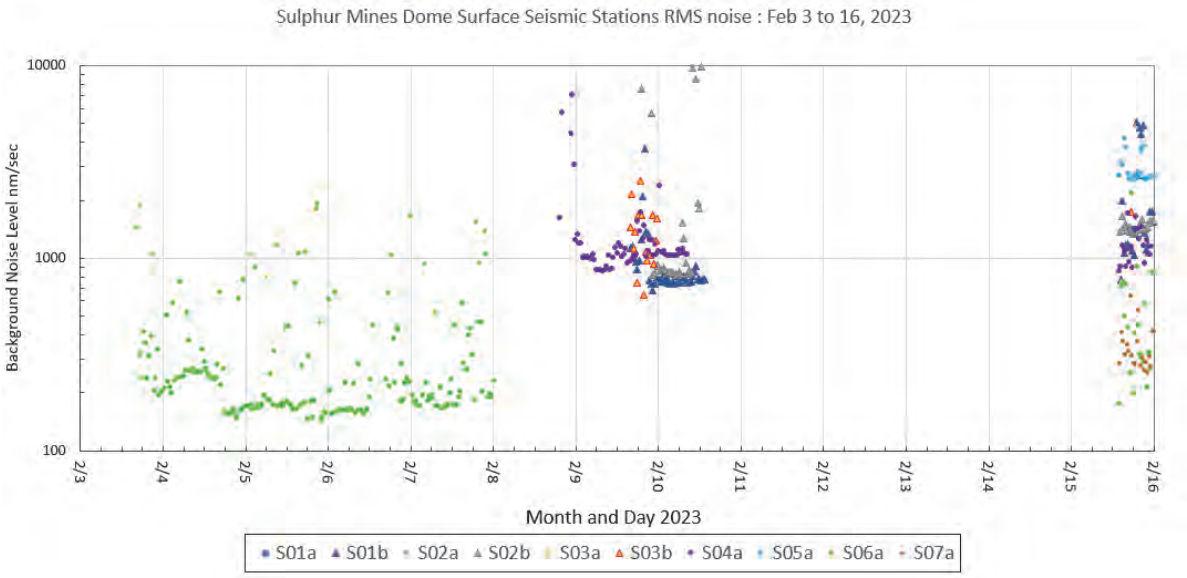

Figure 3. Noise profile from February 3-15, 2023. Graph of the log of the background noise levels in nm/sec recorded on the seismic boxes at Sulphur Mines salt dome. The colored dots represent different stations, as indicated by key on bottom of graph. Time is in displayed UTC, +6 hours difference from Central time.

Figure 4 Google image showing the location of station moves of stations 1, 2 and 3 on February 9, 2023 at Sulphur Mines salt dome. Station locations provided by Westlake.

Starting about February 15 to March 3, seismic data was recorded from six of the seven boxes, with station 3b collecting data starting February 24 (Figure 5). The background noise levels on almost every station varies over time, likely based on local field activites on the salt dome, equipment operating in the area, etc.. Box 6a and 7a, located just west of PPG cavern 7 measure consitently the lowest background noise levels, typically below 500 nm/sec. Boxes 2b and 5a measured the highest noise levels, typically > 2000 nm/sec, while the remaining boxes were in the 700 to 2000 nm/sec range (Figure 5). Box 5a noise dropped significalty after ~Feb. 26. No seismic events were detected during this time period.

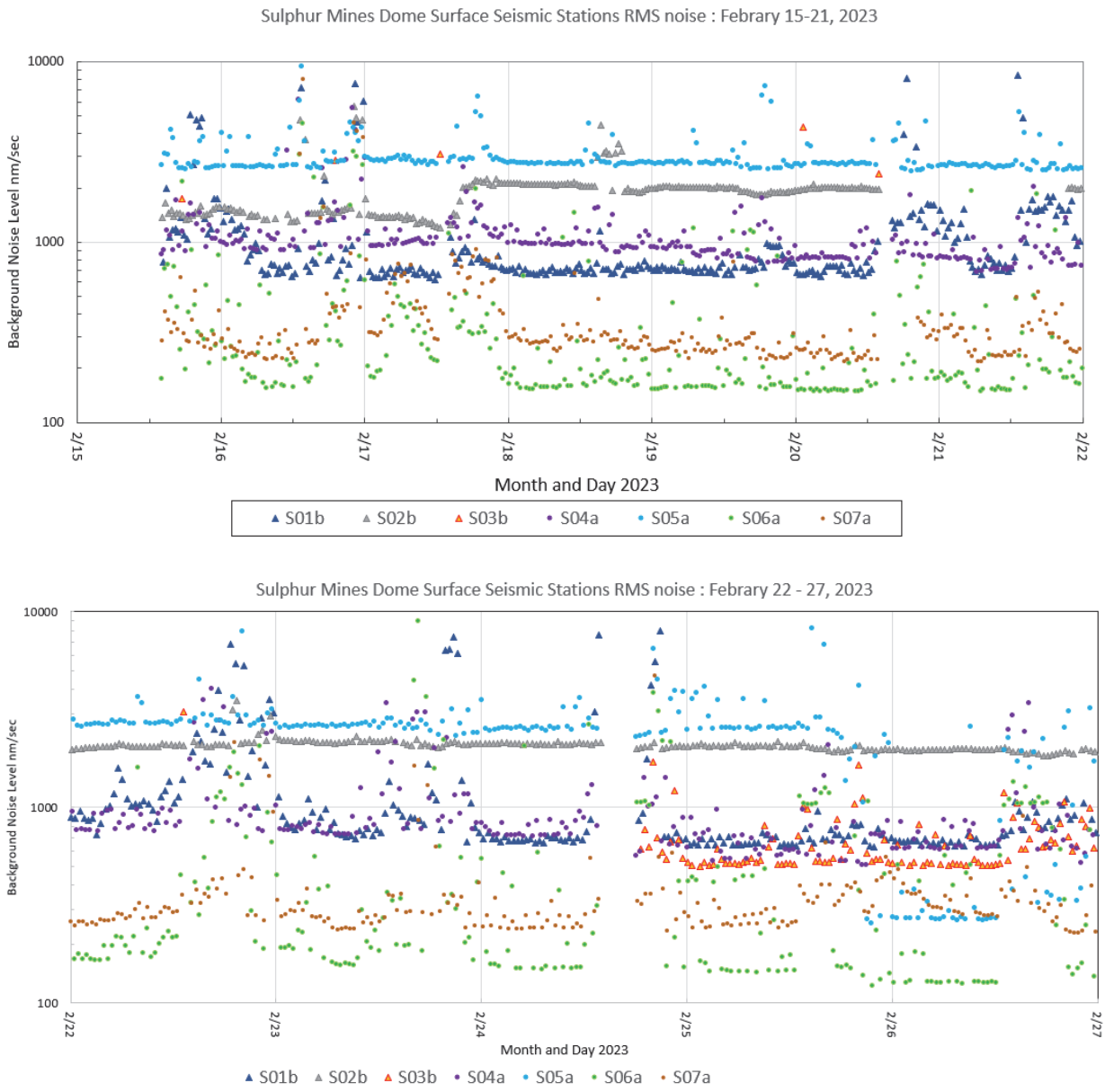

Figure 5. Noise profile from Feb. 15-21, 2023 (upper plot) and Feb 22-27 (lower plot). Graphs show the of the log of the background noise levels in nm/sec recorded on the seismic boxes at Sulphur Mines salt dome. The colored dots represent different stations, as indicated by key on bottom of graph. Time is in displayed UTC, +6 hours difference from Central Time.

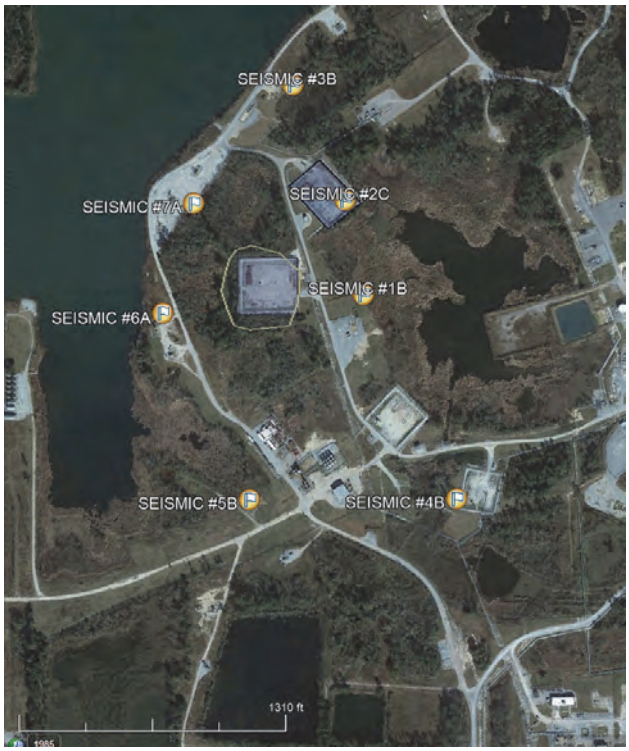

Figure 6. Google image showing the location of station moves of stations 2c, 4b and 5b on ~March 1, 2023 at Sulphur Mines salt dome. Station locations provided by Westlake.

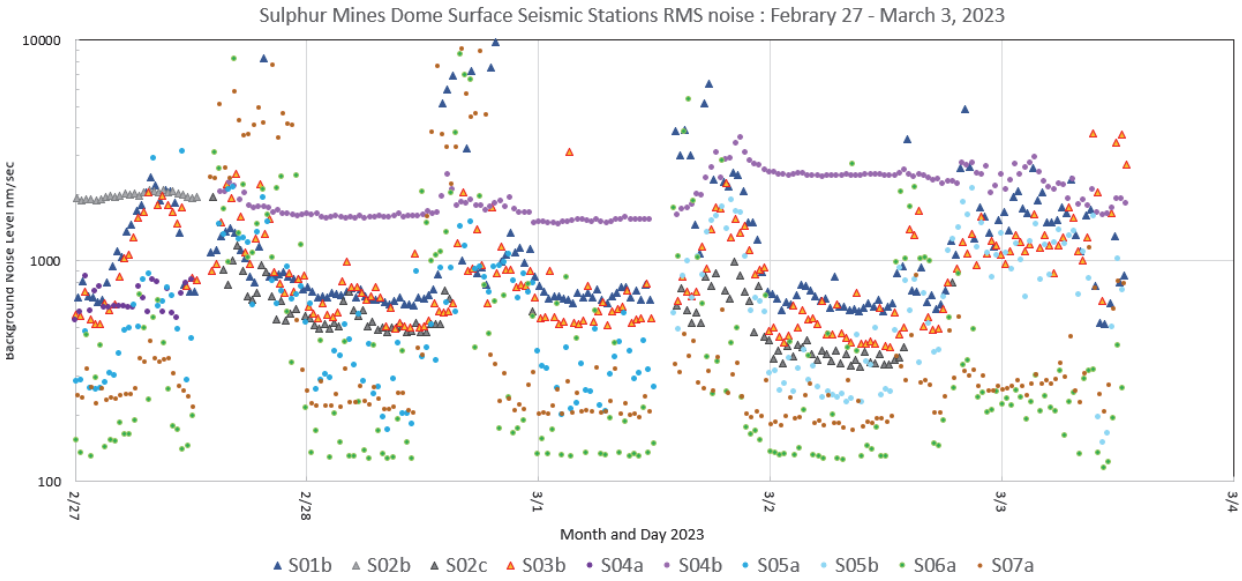

Figure 7. Noise profile from Feb. 27 to March 3, 2023. Graph of the log of the background noise levels in nm/sec recorded on the seismic boxes at Sulphur Mines salt dome. The colored dots represent different stations, as indicated by key on bottom of graph. Time is in displayed UTC, +6 hours difference from Central time.

Several additional stations were move occurred on February 27: station 4a moved to 4b, 2b to 2c, and 5a to 5b (Figure 6). All the seismic records show RMS background noise below 1000 nm/sec at night, except station 4c, which is between approximately 1200 to 2500 nm/sec. Diurnal noise is clear in this plot: the background noise level rise during working hours and are reduced at night.

Background Noise Frequency Content. An example of the frequency content of the background noise for a noisy station (2b is displayed) shows the highest noise is mostly less than 22 Hz, with bands of noise at about ~ 33, 39, 57, 74, 91 Hz, likely due to equipment or other sources of repeating vibrations in the area.

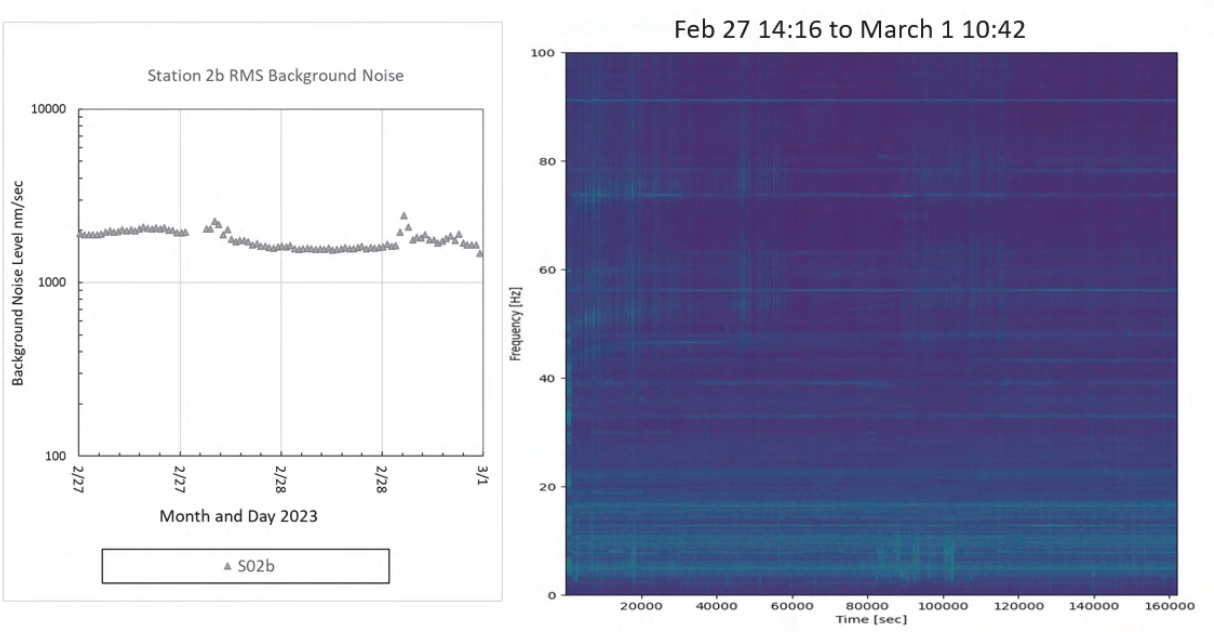

Figure 8. Left graph is log of the background noise levels in nm/sec for station 2b from February 27 to March 1, 2023. On right is a spectrogram (frequency on Y axes and time on x axis) with time in seconds starting from February 27 14:16 to March 1 10:42 (UTC). The spectrogram is colored by intensity with cool colors low values and warmer colors higher values.

Velocity model. A velocity model is under construction using VSP, sonic well logs and information published for the Napoleonville salt dome (Figure 7). P and S-wave velocity models for both salt and the sediments outside the Sulphur Mines dome are under construction.

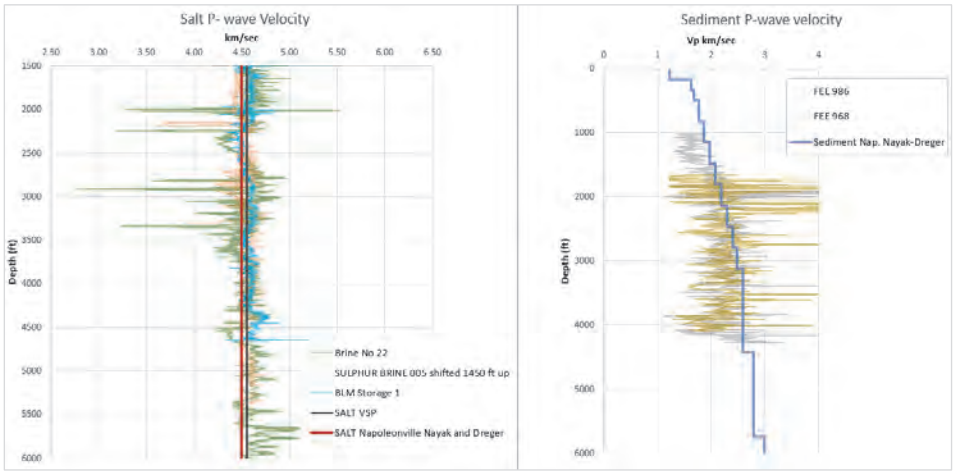

Figure 9. Preliminary P wave velocities for Sulphur Mines salt dome and vicinity.

Appendix

Station	LAT WGS84	LON WGS84	Date start	Date end
1a	30.257519	-93.412295	1/30/2023	2/9/2023
1b	30.253427	-93.413504	2/9/2023	
2a	30.257004	-93.409735	1/30/2023	2/9/2023
2b	30.255468	-93.413201	2/9/2023	2/27/2023
2c	30.254707	-93.413785	2/27/2023	
3a	30.253309	-93.409116	1/30/2023	2/9/2023
3b	30.256257	-93.414608	2/9/2023	
4a	30.248590	-93.412296	1/30/2023	2/27/2023
4b	30.250684	-93.412051	2/27/2023	
5a	30.250159	-93.415560	1/30/2023	2/27/2023
5b	30.250672	-93.415279	2/27/2023	
6a	30.253187	-93.416629	1/30/2023	
7a	30.254665	-93.416147	1/30/2023	

Table 1. Seismic station locations and operational dates at Sulphur Mines dome. Station locations provided by Westlake.

References

Weiqiang Zhu, Gregory C Beroza (2019) PhaseNet: a deep-neural-network-based seismic arrival-time picking method. *Geophysical Journal International*, Volume 216, Issue 1, January 2019, Pages 261–273, https://doi.org/10.1093/gji/ggy423

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ATTACHMENT G

Lonquist & Co. LLC
Plan for Enhanced Subsidence Monitoring
(Version 2)

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

Sulphur Mines Salt Dome

Calcasieu Parish, LA

Enhanced Subsidence Monitoring Program

Continuous InSAR Monitoring of Ground Displacement Near Western Caverns and Dome Flank

LCO Project F2219.7

Prepared for:

Westlake US 2 LLC

Prepared by:

Lonquist & Co., LLC
8591 United Plaza Blvd., Suite 280
Baton Rouge, LA 70809

Louisiana Firm License Number EF-5937

March 2023

Enhanced Subsidence Monitoring Program

Continuous InSAR Monitoring of Ground Displacement Near Western Caverns and Dome Flank

Sulphur Mines Salt Dome

CERTIFIED BY:
Lonquist & Co., LLC

Louisiana Registration No. EF5937

Teresa H. Rougon, P.G.

Date Signed: March 13, 2023
Baton Rouge, LA

Teresa H. Rougon, P.G.
Principal Geologist
Louisiana License No. 330

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Introduction

Salt caverns are created through a process called solution salt mining. This is done by drilling into a salt formation and circulating water into the drilled hole to dissolve the salt. This process forms a brine-filled cavern within the salt structure. Salt caverns can then be used to store petroleum, natural gas and various other gases such as hydrogen and ammonia. Salt domes have been known to experience deformation due to gradual closure of the mined spaces within the salt formation or other geological processes related to the salt and overlying caprock. The gradual closure of cavern space is formally known as salt creep and stops only when the cavern has reached a geostatic equilibrium with the surrounding rock. Factors such as cavern depth, temperature, salt properties, regional stresses, overburden density, operating pressures, and the geometry of and proximity to neighboring caverns affect the magnitude of salt creep.

Due to salt creep, the overburden rock structure begins to move downward towards the caverns. This can be seen on the surface as ground subsidence (or ground displacement) vertically and to a lesser extent horizontally toward the center of the subsidence basin. Consequently, it is anticipated that surface subsidence will transpire over all solution-mined caverns in domal and bedded salt to varying extents. The vertical movement over a solution-mined cavern generally ranges from less than ¼ inch annually to several inches per year. Pursuant to the provisions of Statewide Order 29-M (LAC 43: XVII. Subpart 3) and Statewide Order 29-M-3 (LAC 43: XVII. Subpart 5), this subsidence or displacement must be measured annually over all solution-mining and storage caverns.

At Sulphur Mines Salt Dome, recent events have required that an enhanced monitoring effort be implemented on the western side of the dome flank by Westlake 2 US, LLC (“Westlake”). Westlake has contracted Lonquist and Co. LLC (“Lonquist”) to implement the features of this enhanced monitoring plan. This plan is being submitted to comply with Item 2 of the First Supplement to Compliance Order IMD 2022-027.

An annual subsidence monitoring plan for the Sulphur Mines Salt Dome is being prepared under a separate cover. This enhanced monitoring plan is not intended to replace or recreate the analyses conducted in the annual subsidence monitoring surveys submitted by the three cavern operators on the dome. The deliverables from the enhanced plan will be supplementary, with a focus on early detection of trend deviation or changes in displacement acceleration for areas generally on the western side of the dome.

Continuous Subsidence Monitoring Methodology

An investigation of the technologies and methods available for frequent monitoring of ground displacement was performed. Interferometric Synthetic Aperture Radar (InSAR) was identified as the most well established and rapidly deployable method to continually evaluate small, normally undetectable, ground movement over a large area. InSAR is a high-accuracy, remote sensing technology that effectively provides an updated level survey of a target area with each successive pass of an orbiting satellite. Spatial density of the measurement points varies, but in areas of non-vegetated ground cover, a great number of datapoints can be continually gathered. This is the primary feature that sets the technology apart from other surveying methods.

TRE-Altamira ("TREA"), a global leader in InSAR ground displacement monitoring, has been contracted by Lonquist to collect, process, and deliver ground displacement data with each orbital pass from a collection of satellites. TREA utilizes an advanced, proprietary form of InSAR data processing that tracks ground movement by analyzing a stack of radar images collected over time. This technology, termed SqueeSAR, provides a collection of spatially distributed measurement points that each contain a time-series of ground deformation measurements reported to a 0.1 mm (0.004 inch) scale. Appendix A has been prepared by TREA and should be referenced for a detailed description of the InSAR monitoring system and data processing method.

InSAR Data Collection and Monitoring Frequency

Data Properties

Imagery collected via satellites over successive orbital passes is used to identify and define measurement points on the ground. Objects or ground features providing a stable reflection of radar energy such as buildings, roads, and infrastructure produce the highest quality measurement points. Measurement points can be generated in some areas with vegetation, but data quality is affected by changing ground characteristics over time, leading to data gaps in areas with dense vegetation or wetlands. In the absence of stable reflectors, additional datapoints can sometimes be generated in areas with lower but homogenous signal return by averaging groups of readings into a single measurement point.

InSAR uses phase and amplitude in the radar signal images to measure the distance between the satellite sensor and the measurement points on the ground. The data generated from the InSAR technique results in a time-series of displacement values at each measurement point. These displacement values are reported in relation to the original distance measured for each point in the dataset.

When a measurement point on the ground moves, whether that be vertically or laterally, the phase value detected by the sensor on the satellite is impacted due to a change in the distance between the sensor and ground target. Displacement values generated in this way are referred to as 1-D Line-of-sight ("LOS") measurements, referring to the line-of-sight of the satellite to the ground target. Data collected in this manner is understood to convey a movement distance that is not purely vertical. This distinction only affects the assignment of a precise direction to the movement identified. As the primary component of the observed displacement is often vertical, InSAR analyses based on 1-D data are regularly used to identify and monitor the consistency of movement trends related to ground subsidence.

Analysis of an InSAR dataset allows for the identification of displacement velocity in inches/year and acceleration in inches/year^2. Measurement precision is affected by the satellite sensor resolution and the timeframe of the dataset. Average accuracy ranges for individual measurements can vary between ±0.20 inches for a low-resolution satellite and ±0.03 inches for a high-resolution satellite. With time, velocity trends can be measured with high accuracy yielding standard deviations in the range of ±0.01 inches/year.

Data Collection Frequency

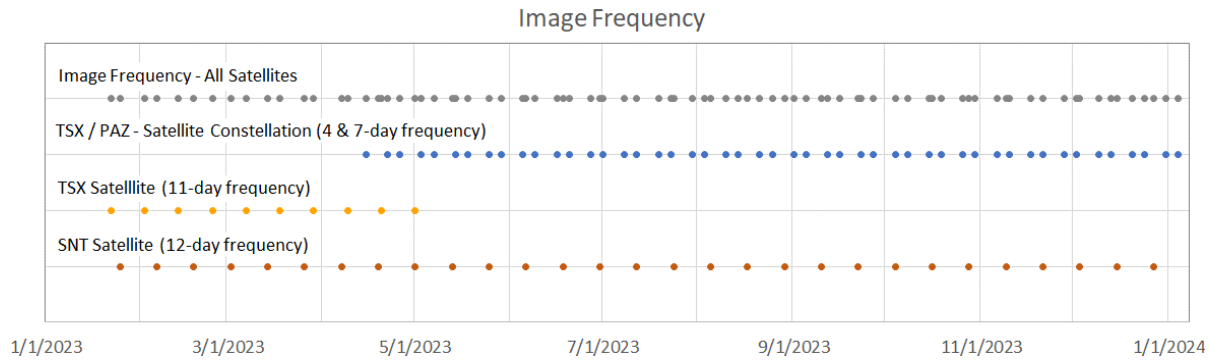
The two InSAR datasets that will be used to facilitate continuous monitoring of the Sulphur Mines Salt Dome are 1-D readings acquired from InSAR satellites on both ascending and descending orbits. An

ascending orbit denotes the satellite's longitudinal course from south to north as it passes over the site, while a descending orbit denotes the satellite is moving from north to south.

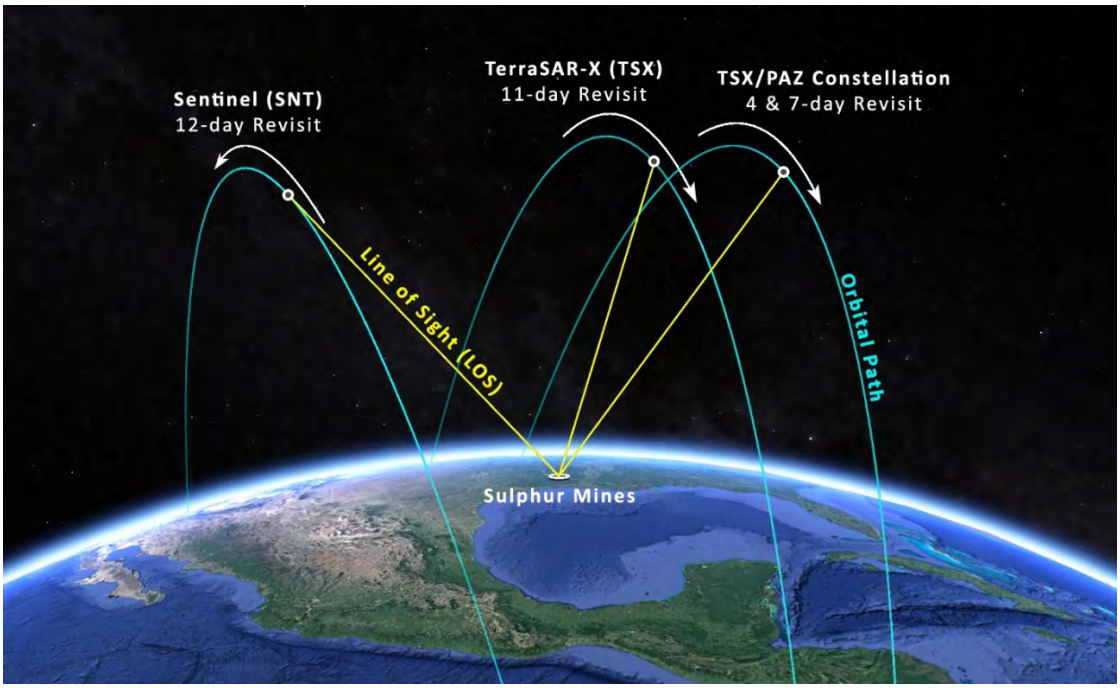
The first dataset is captured from a Sentinel 1 ("SNT") low-resolution satellite on an ascending orbit. The dataset timeframe covers October 4, 2016 to present and new images are captured with each pass on a 12-day revisit frequency. The second dataset is gathered via a TerraSAR-X ("TSX") high-resolution satellite on a descending orbit with an 11-day revisit frequency. The dataset timeframe covers June 16, 2022 to present. As of the date of this report, four (4) SNT datasets and five (5) TSX datasets have been received and evaluated for trend consistency over the western part of the dome as part of this continuous monitoring effort.

Beginning in late-March 2023 the source for the second dataset will transition to a pair of high-resolution satellites that share the same orbit. These are a second TSX satellite and the PAZ satellite, both with an 11-day revisit frequency. Their orbits are offset with the PAZ satellite passing over the site 4 days after the TSX satellite. This pair is referred to as the TSX/PAZ satellite constellation. The reason for the transition to the TSX/PAZ constellation in April is the increased data frequency that will result from a 4 and 7-day revisit period. Data capture for the TSX/PAZ constellation began in late January 2023 and a sufficient image stack for processing is estimated to be available by late-March 2023. Figure 1 below provides additional information on the image timeline, satellite data parameters, and a diagram of the orbital paths in relation to the Sulphur Mines Salt Dome.

Figure 1 – InSAR Image Collection Frequency, Satellite Data Parameters and Orbit Visualization



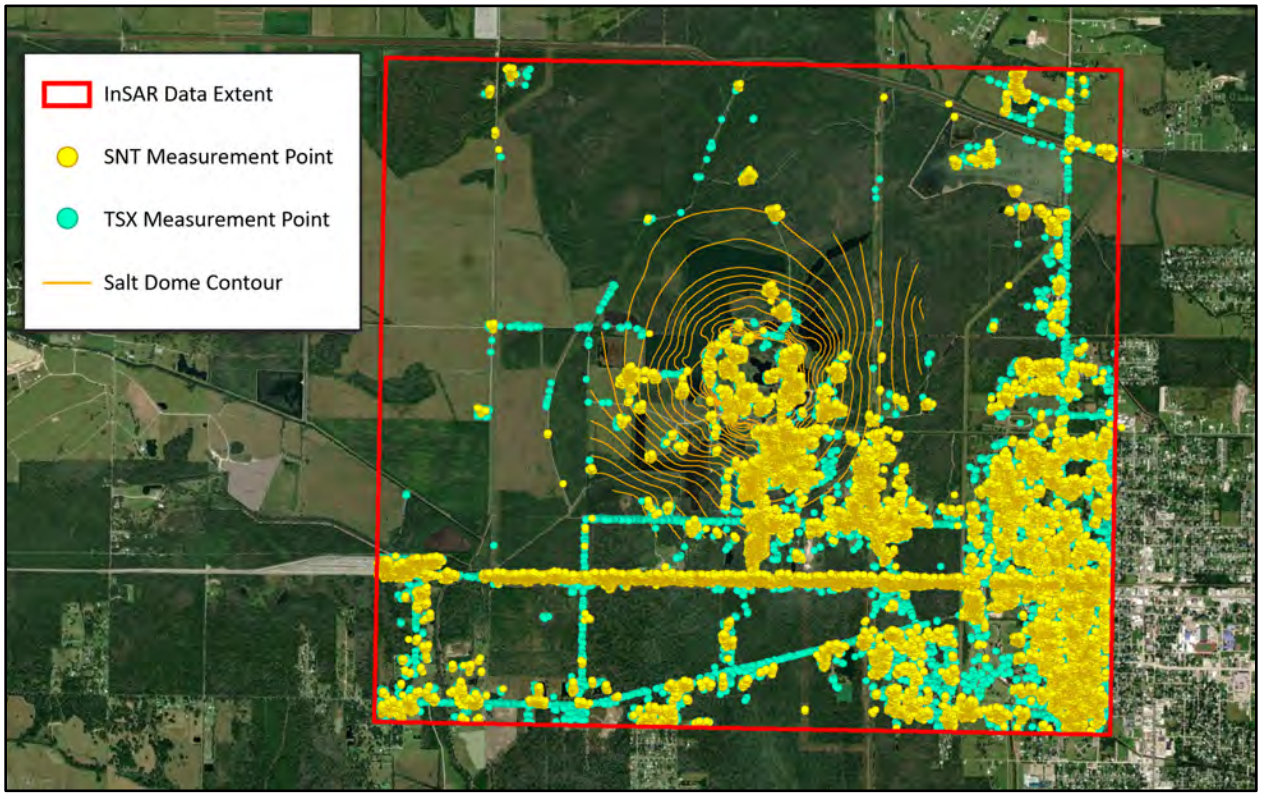
			TSX/PAZ Constellation	
	Sentinel-1	**TerraSAR-X**	**TerraSAR-X**	**PAZ**
Mode / Resolution	16 x 65 ft	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)
Track	T136	T29	T67	T120
Band (wavelength)	C-Band (2.32 in)	X-Band (1.22 in)	X-Band (1.22 in)	X-Band (1.22 in)
Nominal frequency	12- day	11- day	11- day	11- day
Orbit (LOS angle)	Ascending 43°	Descending 17°	Descending 37°	Descending 37°
Date range	04 Oct 2016 – 20 Jan 2024	16 Jun 2022 – 01 May 2023	24 Jan 2023 – 11 Jan 2024	28 Jan 2023 – 15 Jan 2024
Number of images	199	30	34	33



Subsidence Monitoring Areas of Interest (AOIs)

Each of the InSAR datasets cover a 14-square mile area that extends roughly 1.85 miles out from the center of the Sulphur Mines Salt Dome. Figure 2 below depicts the measurement point locations and data extent for the most recent SNT and TSX datasets in relation to the dome structure contours.

Figure 2 – SNT and TSX InSAR Measurement Points

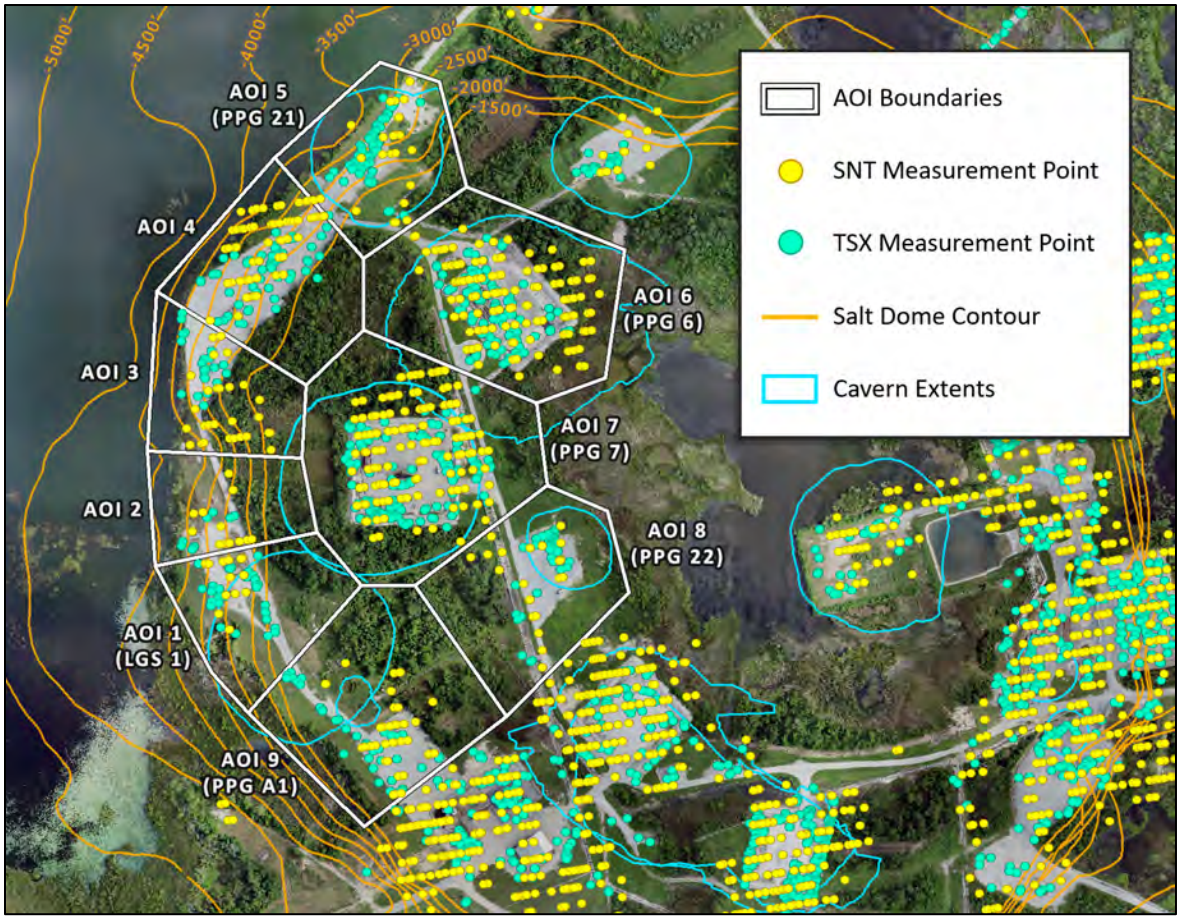


The displacement values associated with each measurement point can be used to generate contour maps of displacement velocity and acceleration, indicating the spatial distribution of subsidence magnitudes. Velocity and acceleration rates are determined via trend analysis of the displacement time-series for each individual measurement point. In total, 1,051 measurement points lie within the analysis extent planned for this continuous monitoring effort. In order to visually convey and evaluate trend consistency in each displacement time-series, it is necessary to group measurement points and generate time-series charts of the averaged displacement values for each group. Averaging of the displacement data within point groups also allows for the reduction of scatter (noise) associated with measurement accuracy in the time-series charts of individual measurement points.

To accomplish this, nine (9) Areas of Interest ("AOIs") have been defined as proposed point groups for calculation and display of average displacement rates and trend behavior. These AOIs are listed below in Figure 3 along with their associated areas and measurement point counts, as identified in the most recent SNT and TSX datasets. The map in Figure 3 depicts the AOI boundaries in relation to the InSAR data, dome contours, and cavern extents.

Figure 3 – InSAR Areas of Interest (AOIs)

Name	Area (Acres)	SNT Count	TSX Count	Total MP Count
AOI 1 *(LGS 1)*	3.86	13	38	51
AOI 2	2.49	15	9	24
AOI 3	2.94	29	22	51
AOI 4	4.28	62	65	127
AOI 5 *(PPG 21)*	3.59	25	66	91
AOI 6 *(PPG 6)*	6.35	134	119	253
AOI 7 *(PPG 7)*	7.20	140	170	310
AOI 8 *(PPG 22)*	4.43	21	43	64
AOI 9 *(PPG A1)*	5.09	39	41	80



Continuous Monitoring and Evaluation Plan

New data gathered with each pass of the InSAR satellites is processed and delivered by TREA within 48 hours of image capture. Once received, Lonquist will perform a same-day, preliminary review of the data and confirm that no material deviations from the established linear subsidence trends have been observed. In the event that a notable deviation is observed, a same-day preliminary report will be issued to Westlake detailing the observed trend deviation.

Following the preliminary review, Lonquist will process and evaluate the data, and issue a standardized report within 24-48 hours which will be provided to Westlake and the DNR. The streamlined system for generating this standardized report is under development, and is planned to be in operation by mid-April 2023. Evaluation of the nine (9) datasets that have been received from TREA since late January 2023 have been performed manually by evaluating trend consistency in the measurement point groups around the caverns and flank on the western side of the dome. To-date there has been no material deviation from the established subsidence trends in the areas investigated.

The standardized reporting method that is being developed will streamline the performance of the reviews that have been carried out to date. Grouping and averaging of the measurement points defined in the nine (9) AOI regions will be used to depict subsidence trends on a time-series plot for each AOI. Both recent and long-term trends will be depicted, and the associated velocity and acceleration values generated by each trend line will be indicated on the plots for comparison.

In addition, both recent and long-term velocity and acceleration rates will be calculated for each individual measurement point and used to produce contour maps over the western side of the dome. An additional pair of maps depicting the difference (subtraction) of the recent and long-term velocity and acceleration will be generated to highlight the intensity and location of trend variation if present. This approach will provide a clearer distinction between locations that may be experiencing slight changes in subsidence behavior in relation to historically consistent motion.

If notable observations are made during these efforts, additional investigation of key regions will be performed and reported, and these regions will remain an area of focus in subsequent datasets. Additional deliverables may be utilized as necessary to convey specific observations such as time-series plots of smaller point groups and their associated trends or cross sections of certain dome regions depicting profiles of displacement magnitude over time.

Appendix A – InSAR Measurement Technique Outline

TRE ALTAMIRA
A CLS Group Company

March 10, 2023

To:

Teresa Rougon
Lonquist & Co. LLC
12912 Hill Country Blvd F-200
Austin, TX, 78738

Subject: InSAR Measurement Technique Outline for Subsidence Monitoring Plans

Hello,

Please find enclosed a summary of the InSAR measurement technique used by Lonquist for their subsidence monitoring plan. The document describes the collection of the radar imagery, how InSAR measurements are obtained, the measurement precision and location accuracy as well as the differences between 1-D and 2-D measurements.

It also includes a section on the Quality Assurance and Quality control procedures followed by TRE Altamira Inc to produce InSAR measurements.

We are available to answer any additional queries you may have on the InSAR technique and on best practices for its use in subsidence monitoring plans.

Best regards

Giacomo Falorni
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Subsidence Monitoring Method

InSAR

InSAR is a technique to process Synthetic Aperture Radar (SAR) satellite imagery to measure displacement of the Earth's surface. The satellites are active systems that are able to acquire images in all weather conditions during both the day and the night. The SAR instrument sends pulse bursts of radar energy to the Earth's surface. Much of the radar signal is scattered or absorbed, but some is reflected back from the ground surface and collected by the receiver on the satellite to form a SAR image, which is a matrix of complex numbers containing both signal amplitude and phase values.

Amplitude values are related to the amount of energy backscattered to the sensor. Generally, metallic and solid objects such as well heads, exposed rocks, and artefacts provide a strong reflected signal and are therefore clearly visible in a radar image (they appear brighter). Vegetated areas typically produce relatively low amplitude values, while water bodies appear as dark and smooth surfaces since the signal is reflected specularly away from the satellite (i.e. no signal is returned to the satellite). Bright areas will typically provide a higher density of measurement points. Amplitude values are also important for assessing the visibility of corner reflectors.

The phase values provide the basis for Interferometric Synthetic Aperture Radar (InSAR), also referred to as SAR Interferometry, which is the measurement of signal phase change over time. When a point on the ground moves, the distance between the sensor and the ground target changes, affecting the phase value recorded by the SAR sensor. Figure 1 shows the relationship between ground movement and the corresponding shift in signal phase between two SAR signals acquired over the same area at different times.

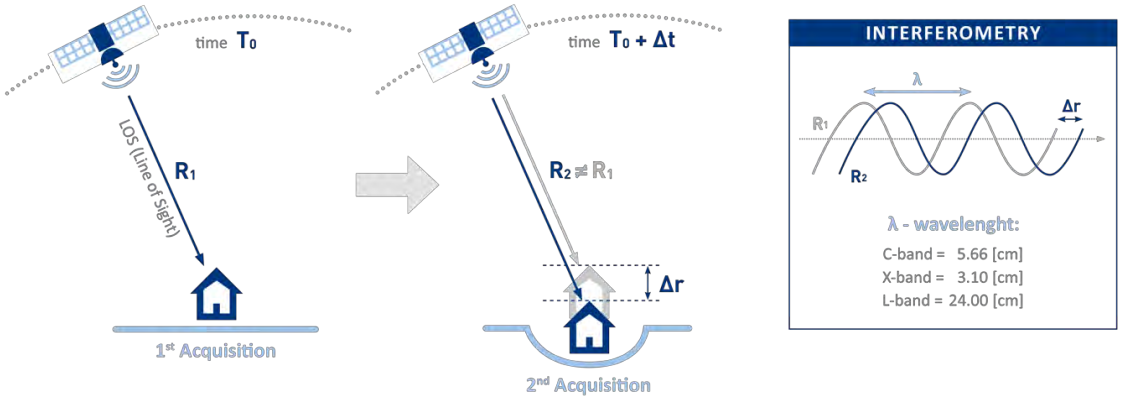

Figure 1: The relationship between ground displacement and signal phase shift.

Any displacement of a radar target is measured along the satellite Line-Of-Sight (LOS) which is the sensor to target direction or angle at which the satellite views the ground. By examining small changes in the reflected radar wavelengths between sequential images it is possible to accurately determine the amount and rate of ground movement. By combining multiple images, a comprehensive history of ground movement can be established (Ferretti, Prati, & Rocca, 2000).

Satellites

SAR satellites have sun-synchronous orbits, which are slightly inclined in comparison with the meridians. They are right looking and can illuminate a land strip (swath) up to 155 mi wide, depending on the satellite. The combination of sun synchronous orbits and the satellite look direction allow areas to be imaged from both the east (descending orbit, with the satellite traveling from north to south and pointed west) and from the west (ascending orbit, with the satellite traveling from south to north and pointed east; Figure 2). Areas of interest can therefore be observed from opposite directions. This characteristic can be used to extract 2-D (vertical and E-W) measurements.

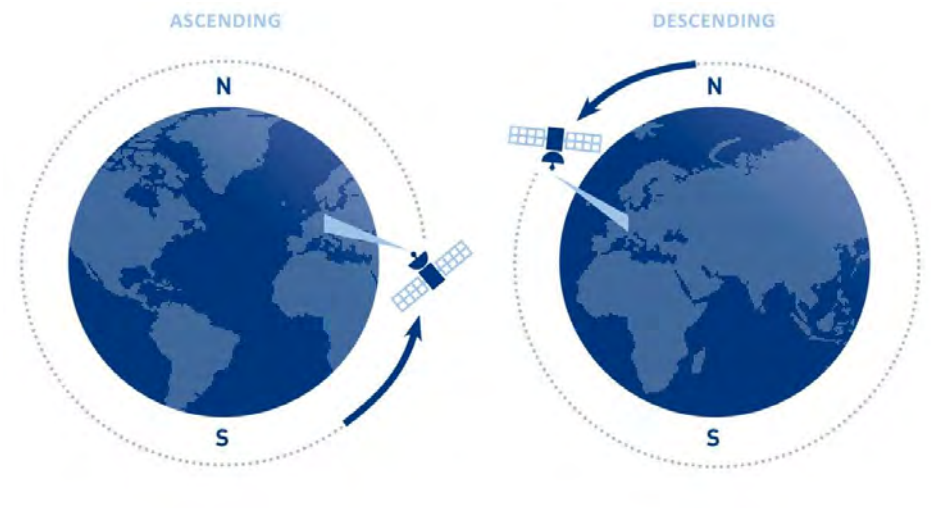

Figure 2: Ascending and descending orbit acquisitions.

SqueeSAR Analysis

SqueeSAR® is an advanced multi-image InSAR algorithm patented by TRE ALTAMIRA that provides high precision measurements of ground displacement in the form of a point cloud. The algorithm identifies measurement points (MPs) from objects on the ground that display a stable return to the satellite in every image of an archive (at least 15 images) and can measure both linear and non-linear ground movement (Ferretti et. al., 2011). The MPs belong to two different classes (Figure 3):

- **Permanent Scatterers (PS)**: point-wise radar targets characterized by a highly stable radar signal return (e.g. buildings, rocky outcrops, linear infrastructures, etc.)
- **Distributed Scatterers (DS)**: patches of ground exhibiting a lower but homogenous radar signal return (e.g. rangeland, debris fields, arid areas, etc.) that can be aggregated. DS therefore refer to small areas covering several pixels rather than to a single target or object on the ground. For clarity of presentation and ease of interpretation, DS are represented as individual points.

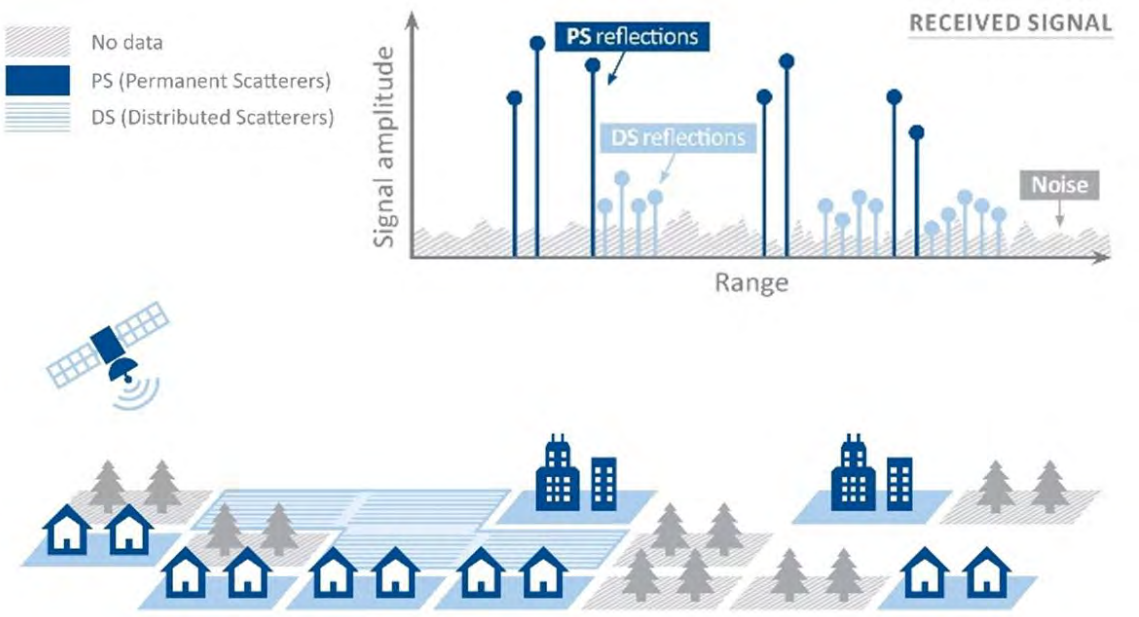

Figure 3: Schematic of PS and DS radar targets.

Each SqueeSAR MP provides the following information:

- Position and elevation estimated with respect to average sea level (ft)
- Displacement time series (TS) representing the evolution of the displacement for each acquisition date (in)
- Average annual displacement rate (in/yr), calculated from a linear regression of the displacement time series over the analysis period.

The density and distribution of the MPs is related to the resolution of the imagery and the surface characteristics of the area. In general, MP density increases with satellite resolution and over areas with man-made structures or bare ground and decreases with the presence of vegetation and over areas with changes to the ground cover over time (e. g. snow, operational activities).

1-D Measurements

In InSAR analyses, measurements are 1-D readings along the sensor's line-of-sight (LOS) where the vector of ground displacement is projected onto the LOS. If a ground movement is purely vertical, it will produce similar readings when viewed from similar angles, even if acquired from different orbits. However, a same ground displacement will produce different readings when viewed from different angles (Figure 4) or if a horizontal movement component is present.

Each measurement point corresponds to a Permanent Scatterer (PS) or a Distributed Scatterer (DS), and is color-coded according to its annual rate of movement and direction. In a 1-D LOS analysis, negative values (red) indicate movement away from the satellite, while positive values (blue) indicate movement towards the satellite.

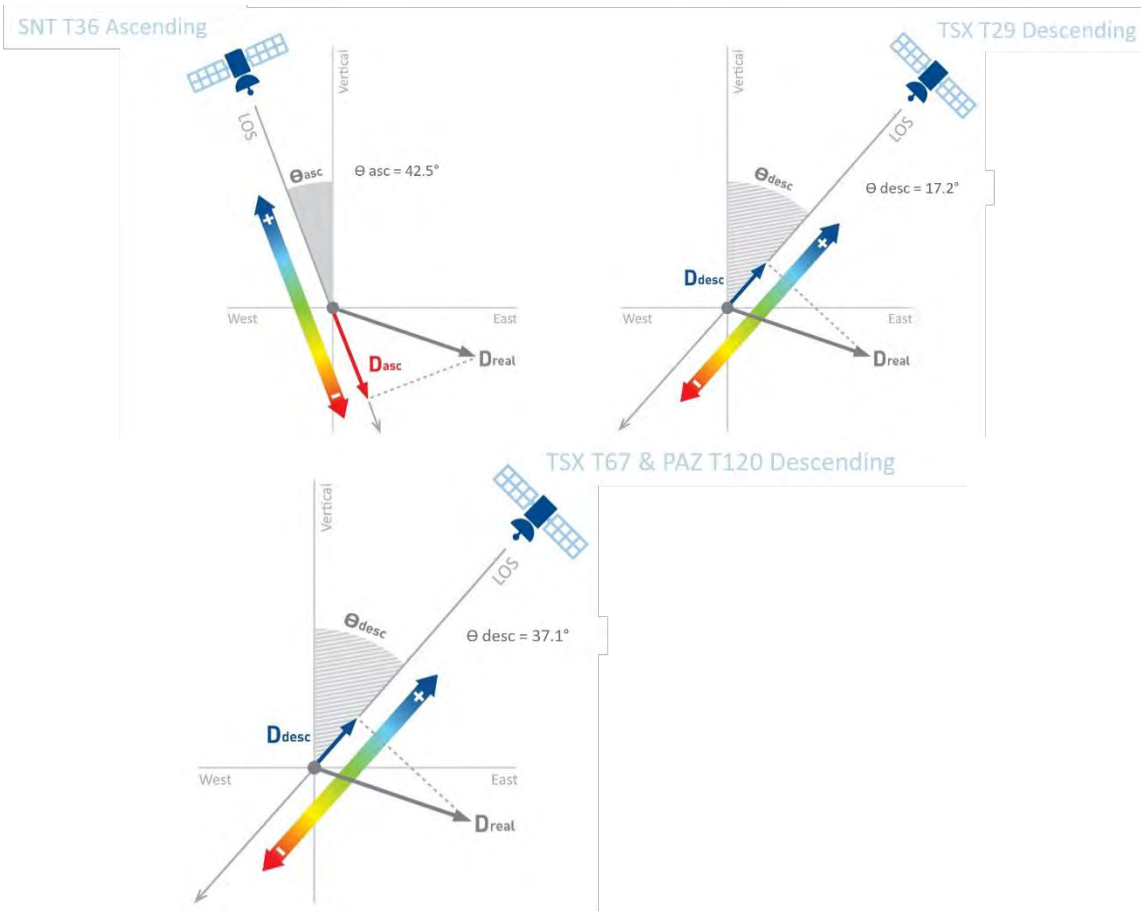

Figure 4: SqueeSAR measures the projection of real movement (Dreal) onto the LOS. The same real movement (Dreal) will produce a different value from a different LOS (different inclination or different orbits). The above figure shows the individual satellites and respective orbits used for the InSAR monitoring. SNT and TSX monitoring is ongoing while TSX and PAZ monitoring will begin in March 2023.

Reference Point

SqueeSAR measurements are differential in space and time. Measurements are spatially related to the local reference point, and temporally to the date of the first available satellite image.

The local reference point is assumed to be motionless and selected for its optimal radar properties and motion behavior. The reference point corresponds to a radar target with a high signal to noise ratio for all images of the archive, and that is not affected by displacement rate variations (non-linear movement or cyclical displacement) in the time period covered. The selection of the reference point is imagery dependent. If the number of images and/or time span varies the reference point may change, to maintain the highest quality of the results and reduce noise in the displacement readings. In any case, in instances where a reference point is changed, it is compared with previous reference points to align the measurement time series and ensure continuity of the measurements in time. Reference points may be affected by linear regional displacement phenomena (e.g. gradual regional subsidence or tectonic movements) but this does not impact the measurement precision nor any differential displacement, as both the reference point and all other points are equally affected by the regional movement.

Measurement Precision

SqueeSAR measurements contain two precision indices: the displacement rate standard deviation and the time series error bar.

The displacement rate standard deviation characterizes the error associated with the displacement rate with respect to the reference point. Given the standard deviation (σ), and assuming that the errors are normally distributed (Gaussian), 95% of the values tend to be included in a ±2σ range. The displacement rate standard deviation is inversely proportional to the number of processed images and the length of the interval covered by the imagery. This value is evaluated for both the 1-D and the 2-D measurements.

The displacement time series error bar indicates how well an analytical model fits the displacement time series. The model is selected individually for each measurement point with an advanced Model Order Selection technique that also considers the quality of the image archive (number of processed images, time span covered by the archive and possible gaps in the acquisitions). The lower the standard deviation, the lower the average residual with respect to the analytical model (i.e. the smaller the error bar of the time series). This parameter is evaluated only for 1-D measurements.

Table 1 provides a summary of the factors affecting the measurement precision and the geolocation (position in space) precision of the MPs estimated from a 1-D SqueeSAR analysis, as well as typical precision values.

Table 1: Factors affecting the measurement and geolocation precision of SqueeSAR points with typical values at mid-latitudes. Values are referred to a MP less than 0.62 mi from the reference and a dataset of at least 30 radar images covering a 2-year period.

	Measurement Precision	Geolocation Precision	
Factors	• Period of analysis • Temporal continuity of acquisitions • Number of images processed • Distance from the reference point (REF) • Measurement point density	• Satellite resolution • Satellite orbit accuracy (normal baseline) • Number of radar images (for z values) • Absolute accuracy of the REF	
Typical Values	**Displacement Rate Standard Deviation:** <1 mm/yr (< 0.04 in/yr) **Time series Error Bar**: ±5 mm (±0.2 in)	**TerraSAR-X / PAZ** x = ±3 ft y = ±10 ft z = ±5 ft	**Sentinel-1** x = ±26 ft y = ±39 ft z = 26 ft

Quality Assurance & Quality Control Procedures

TRE Altamira (TREA) has standardized Quality Control (QC) procedures in place and all work is quality controlled through oversight of the reports and statistical analysis of provided databases. TREA production is ISO 9000 certified, guaranteeing that all phase products undergo ISO approved QC controls. TREA implements a full documentation control system and TREA reports are checked and approved by at least one higher level of management.

TREA has successfully managed many similar corporate-wide projects and uses standard industry project management practices. A Project Manager is appointed for the project and a Technical Responsible (TR) is assigned for each site and is the primary lead for all data products over that site. The TR develops a specific knowledge and experience of the site and is then involved in all reporting and training activity over the site. The TR(s) report directly to Project Manager and then up to the Technical Director, who maintains oversight and is engaged in the reporting and delivery phases. The TR's duties include communication with the end-user, managing the reporting and data, and technical support to the end-users. A backup TR is constantly updated and steps in during periods of principal TR unavailability. Change management and change control are implemented via continued communications between the Project Manager and the Technical Director on any aspect of the project. TREA reports are reviewed and approved by the Technical Director.

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ATTACHMENT G(a)

Lonquist & Co. LLC
Subsidence Monitoring Report
(March 2, 2023)

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

SNT Satellite Update

Continuous InSAR Monitoring of Ground Displacement Near Western Caverns and Dome Flank

Sulphur Dome
Westlake Chemical

March 2, 2023 Update

LOUISIANA BOARD OF PROFESSIONAL GEOSCIENTISTS
TERESA H. ROUGON
LICENSE NUMBER 330
Est. 2011

Teresa H. Rougon, P.G.

Date Signed: March 13, 2023
Baton Rouge, LA

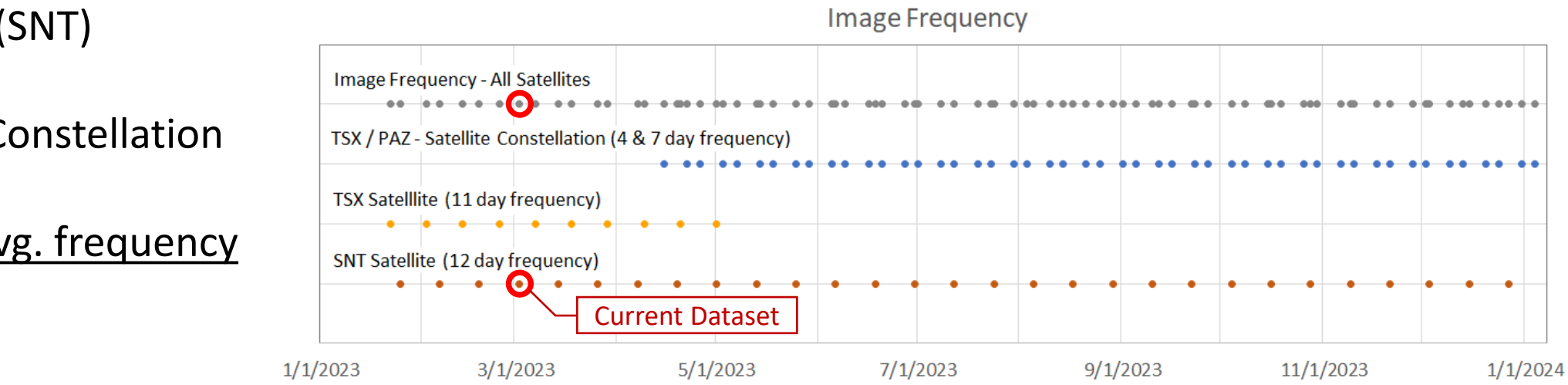
Teresa H. Rougon, P.G.
Principal Geologist
Louisiana License No. 330

LONQUIST & CO. LLC
PETROLEUM ENGINEERS | ENERGY ADVISORS

Parameters of InSAR Dataset and Collection Frequency

- Current Satellite and Data Delivery Frequency:
  - Sentinel 1 (SNT) 12 days
  - TerraSAR-X (TSX) 11 days
  - 5.40-day avg. frequency
- Starting April 2023:
  - Sentinel 1 (SNT) 12 days
  - TSX / PAZ Constellation 4 & 7 days
  - 3.96-day avg. frequency

	Sentinel-1	TerraSAR-X	TerraSAR-X	PAZ
Mode / Resolution	16 x 65 ft	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)
Track	T136	T29	T67	T120
Band (wavelength)	C-Band (2.32 in)	X-Band (1.22 in)	X-Band (1.22 in)	X-Band (1.22 in)
Nominal frequency	12- day	11- day	11- day	11- day
Orbit (LOS angle)	Ascending 43°	Descending 17°	Descending 37°	Descending 37°
Date range	04 Oct 2016 – 20 Jan 2024	16 Jun 2022 – 01 May 2023	24 Jan 2023 – 11 Jan 2024	28 Jan 2023 – 15 Jan 2024
Number of images	199	30	34	33



Overview and Monitoring History

- Beginning in late January, ground displacement over the western portion of the Sulphur Mines Salt Dome has been evaluated following the delivery of each dataset update from TRE-Altamira
- An automated process and set of deliverables to convey the results of the datasets is being developed that will evaluate multiple factors including trend consistency and mapped acceleration of ground displacement
- Current updates are focused on the review of time series charts of averaged data for selections of points around the dome and caverns on the western flank
- The SNT satellite (12-day revisit) passed by Sulphur on Thursday March 2, 2023
- The following slides present the time series and associated linear trends for each location evaluated from this dataset
- To-date there has been no material deviation from the established subsidence trends in the areas investigated

SNT Satellite - March 2, 2023 Update

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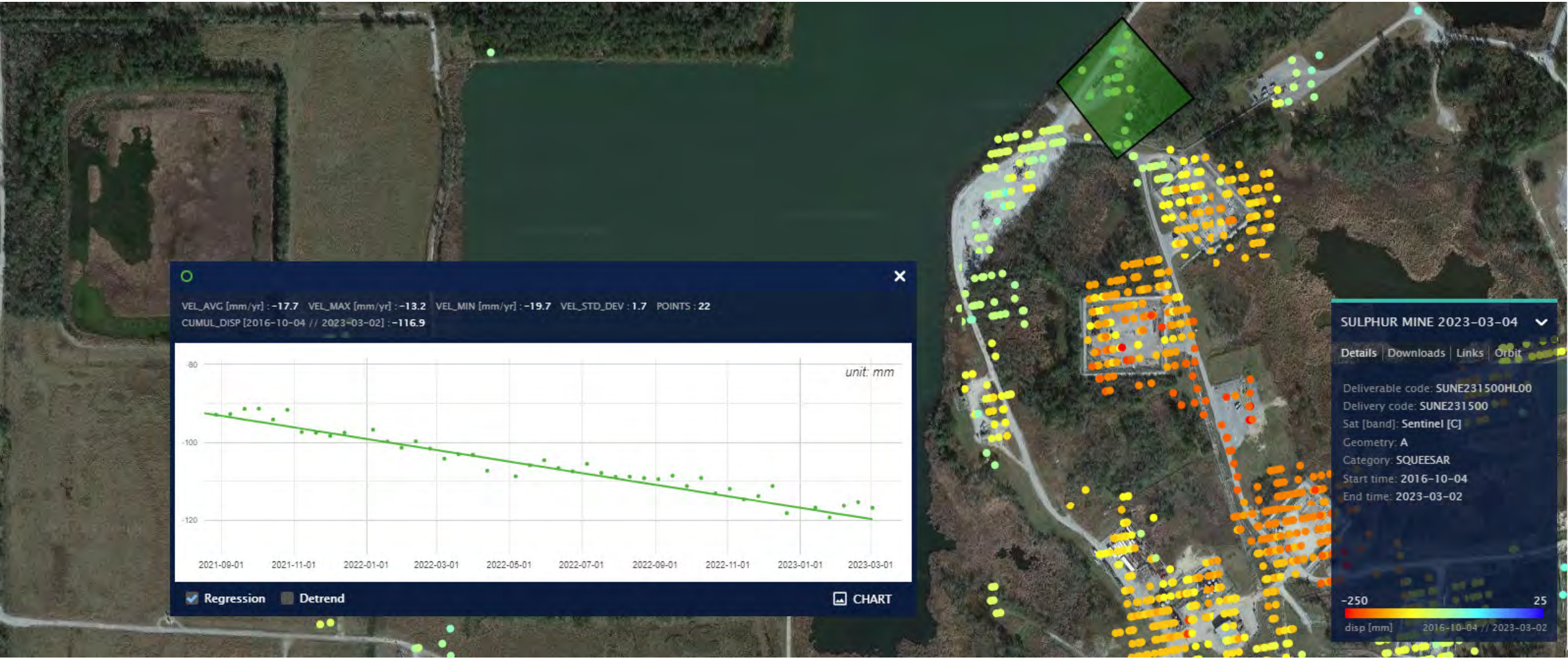
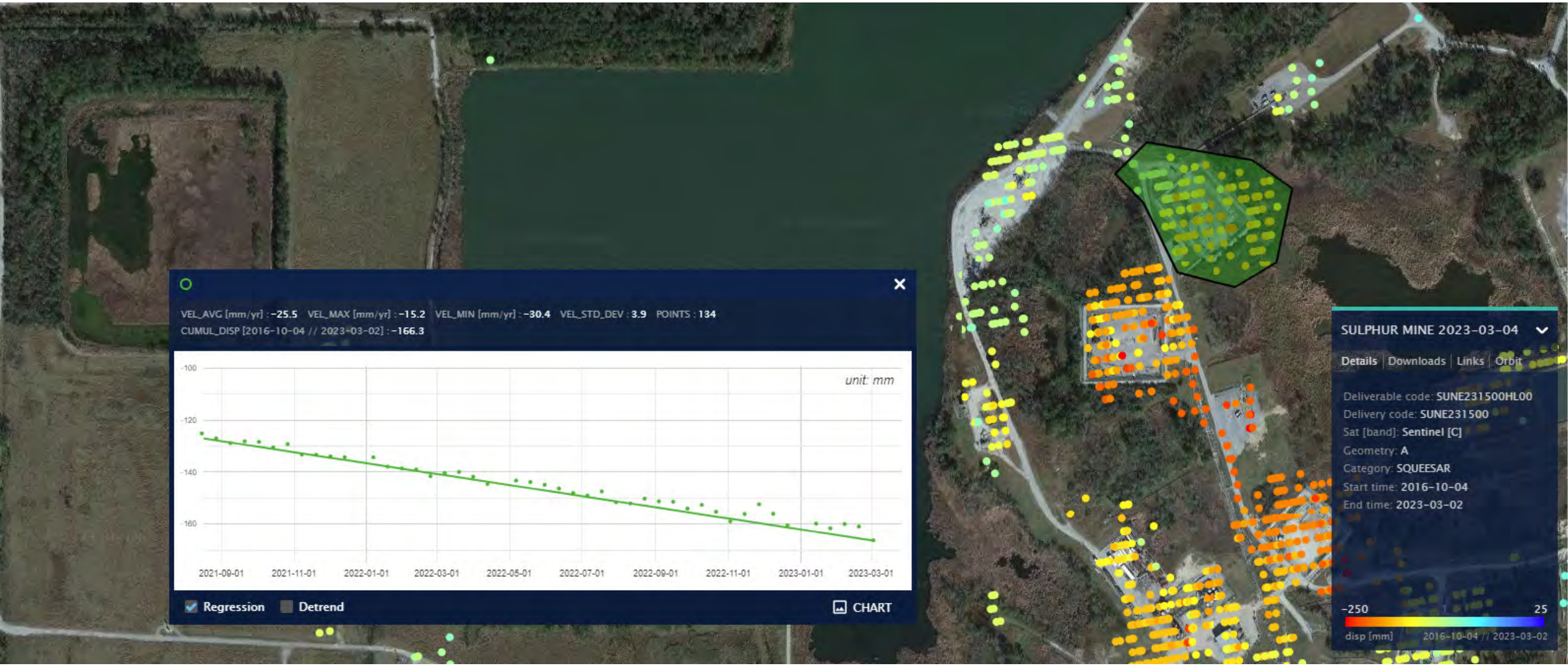
PPG 21



LONQUIST & CO. LLC

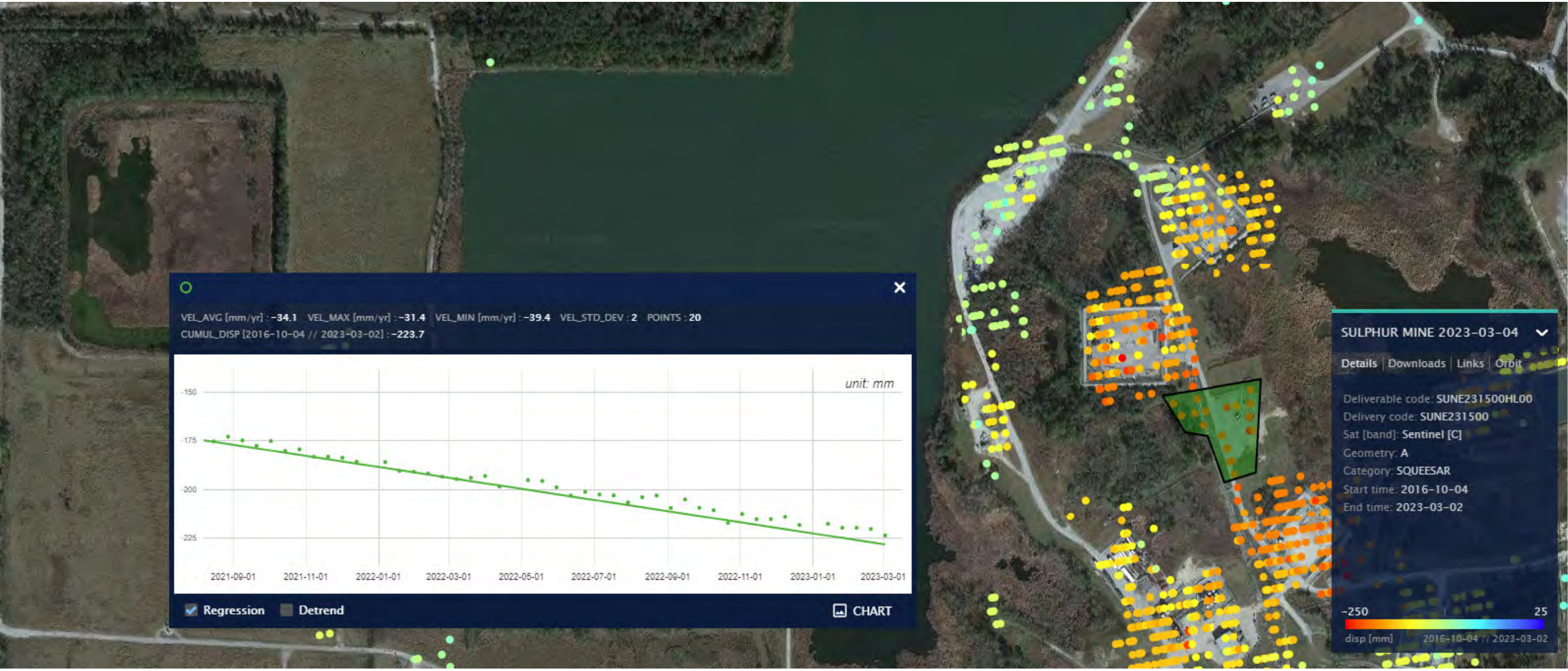
PPG 6



PPG 7


VEL_AVG [mm/yr] : -29.7 VEL_MAX [mm/yr] : -22.9 VEL_MIN [mm/yr] : -42.7 VEL_STD_DEV : 3 POINTS : 139
CUMUL_DISP [2016-10-04 // 2023-03-02] : -190.9
unit: mm
-140
-160
-180
-200
2021-09-01
2021-11-01
2022-01-01
2022-03-01
2022-05-01
2022-07-01
2022-09-01
2022-11-01
2023-01-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-04
Details | Downloads | Links | Orbit
Deliverable code: SUNE231500HL00
Delivery code: SUNE231500
Sat [band]: Sentinel [C]
Geometry: A
Category: SQUEESAR
Start time: 2016-10-04
End time: 2023-03-02
-250
25
disp [mm]
2016-10-04 // 2023-03-02

PPG 22


VEL_AVG [mm/yr] : -34.1 VEL_MAX [mm/yr] : -31.4 VEL_MIN [mm/yr] : -39.4 VEL_STD_DEV : 2 POINTS : 20
CUMUL_DISP [2016-10-04 // 2023-03-02] : -223.7
unit: mm
-150
-175
-200
-225
2021-09-01
2021-11-01
2022-01-01
2022-03-01
2022-05-01
2022-07-01
2022-09-01
2022-11-01
2023-01-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-04
Details | Downloads | Links | Orbit
Deliverable code: SUNE231500HL00
Delivery code: SUNE231500
Sat [band]: Sentinel [C]
Geometry: A
Category: SQUEESAR
Start time: 2016-10-04
End time: 2023-03-02
-250
25
disp [mm]
2016-10-04 // 2023-03-02

AOI #1


VEL_AVG [mm/yr] : -26.9 VEL_MAX [mm/yr] : -17.8 VEL_MIN [mm/yr] : -33.1 VEL_STD_DEV : 2.5 POINTS : 121
CUMUL_DISP [2016-10-04 // 2023-03-02] : -172.3
unit: mm
120
140
160
180
2021-09-01
2021-11-01
2022-01-01
2022-03-01
2022-05-01
2022-07-01
2022-09-01
2022-11-01
2023-01-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-04
Details | Downloads | Links | Orbit
Deliverable code: SUNE231500HL00
Delivery code: SUNE231500
Sat [band]: Sentinel [C]
Geometry: A
Category: SQUEESAR
Start time: 2016-10-04
End time: 2023-03-02
-250
25
disp [mm]
2016-10-04 // 2023-03-02

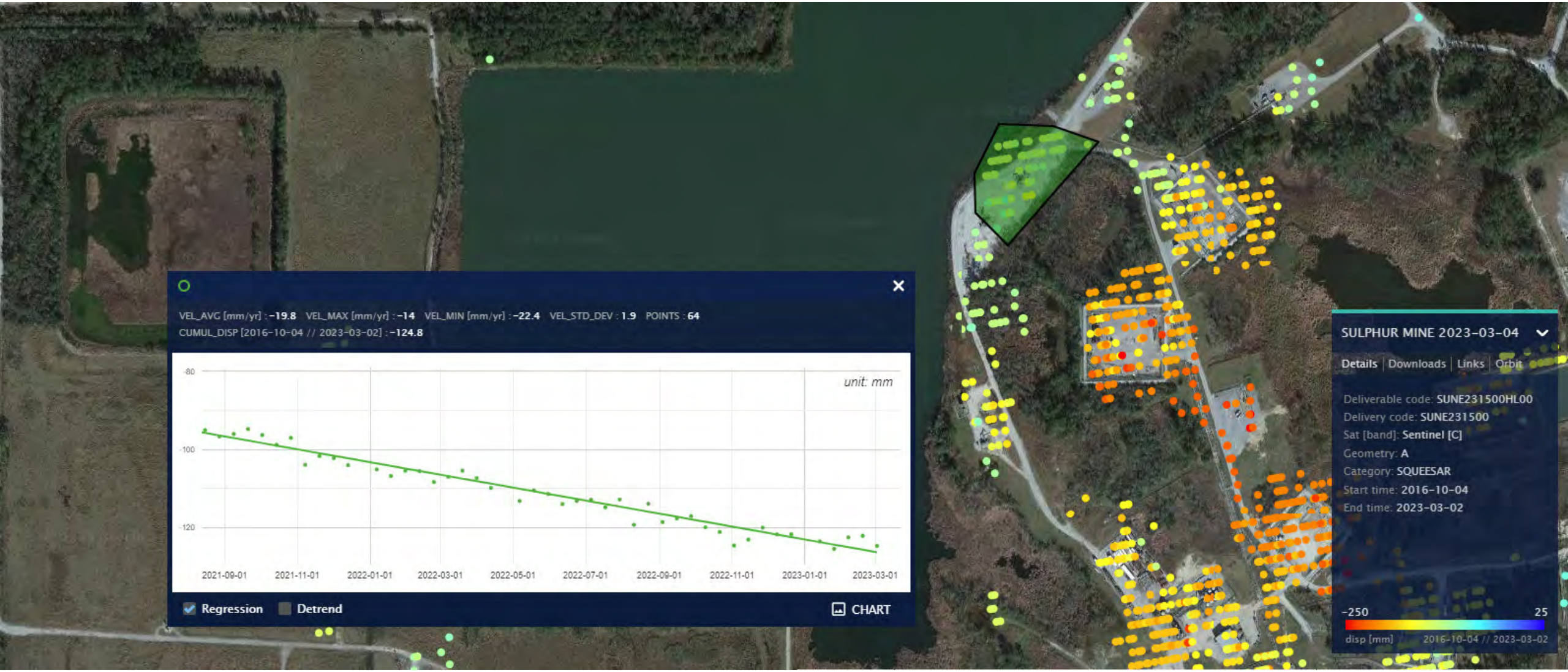
LONQUIST & CO. LLC

AOI #2

AOI #3


VEL_AVG [mm/yr] : -18.5 VEL_MAX [mm/yr] : -15.5 VEL_MIN [mm/yr] : -19.6 VEL_STD_DEV : 0.9 POINTS : 30
CUMUL_DISP [2016-10-04 // 2023-03-02] : -114.2
unit: mm
-80
-100
-120
2021-09-01
2021-11-01
2022-01-01
2022-03-01
2022-05-01
2022-07-01
2022-09-01
2022-11-01
2023-01-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-04
Details | Downloads | Links | Orbit
Deliverable code: SUNE231500HL00
Delivery code: SUNE231500
Sat [band]: Sentinel [C]
Geometry: A
Category: SQUEESAR
Start time: 2016-10-04
End time: 2023-03-02
-250
25
disp [mm]
2016-10-04 // 2023-03-02

AOI #4


VEL_AVG [mm/yr] : -19.8 VEL_MAX [mm/yr] : -14 VEL_MIN [mm/yr] : -22.4 VEL_STD_DEV : 1.9 POINTS : 64
CUMUL_DISP [2016-10-04 // 2023-03-02] : -124.8
unit: mm
-80
-100
-120
2021-09-01
2021-11-01
2022-01-01
2022-03-01
2022-05-01
2022-07-01
2022-09-01
2022-11-01
2023-01-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-04
Details | Downloads | Links | Orbit
Deliverable code: SUNE231500HL00
Delivery code: SUNE231500
Sat [band]: Sentinel [C]
Geometry: A
Category: SQUEESAR
Start time: 2016-10-04
End time: 2023-03-02
-250
25
disp [mm]
2016-10-04 // 2023-03-02

TSX Satellite Update

Continuous InSAR Monitoring of Ground Displacement Near Western Caverns and Dome Flank

Sulphur Dome
Westlake Chemical

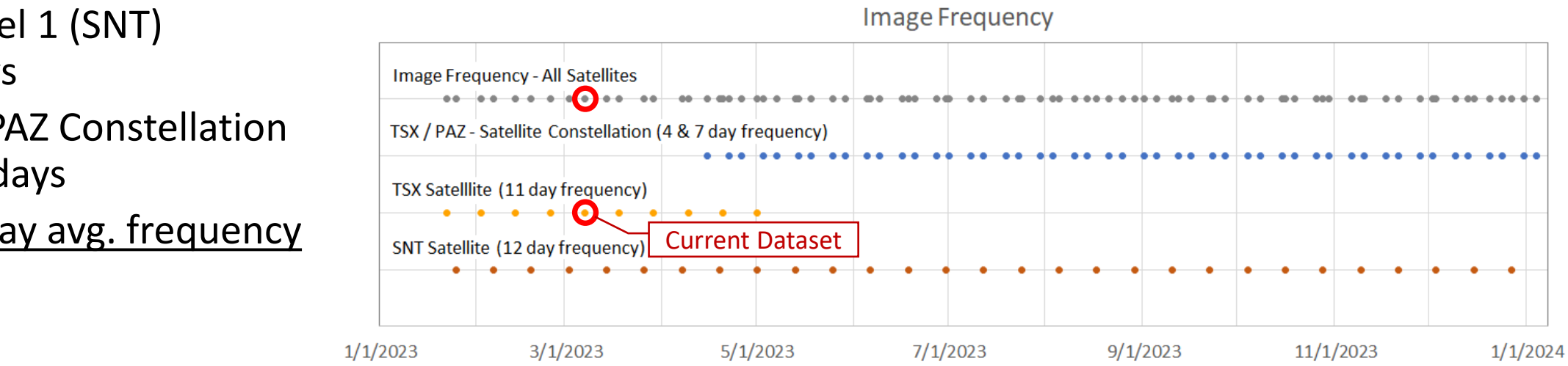
March 7, 2023 Update

LONQUIST & CO. LLC
PETROLEUM ENGINEERS | ENERGY ADVISORS

Parameters of InSAR Dataset and Collection Frequency

- Current Satellite and Data Delivery Frequency:
  - Sentinel 1 (SNT) 12 days
  - TerraSAR-X (TSX) 11 days
  - 5.40-day avg. frequency
- Starting April 2023:
  - Sentinel 1 (SNT) 12 days
  - TSX / PAZ Constellation 4 & 7 days
  - 3.96-day avg. frequency

	Sentinel-1	TerraSAR-X	TerraSAR-X	PAZ
Mode / Resolution	16 x 65 ft	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)	Spotlight (3 x 3 ft)
Track	T136	T29	T67	T120
Band (wavelength)	C-Band (2.32 in)	X-Band (1.22 in)	X-Band (1.22 in)	X-Band (1.22 in)
Nominal frequency	12- day	11- day	11- day	11- day
Orbit (LOS angle)	Ascending 43°	Descending 17°	Descending 37°	Descending 37°
Date range	04 Oct 2016 – 20 Jan 2024	16 Jun 2022 – 01 May 2023	24 Jan 2023 – 11 Jan 2024	28 Jan 2023 – 15 Jan 2024
Number of images	199	30	34	33



Overview and Monitoring History

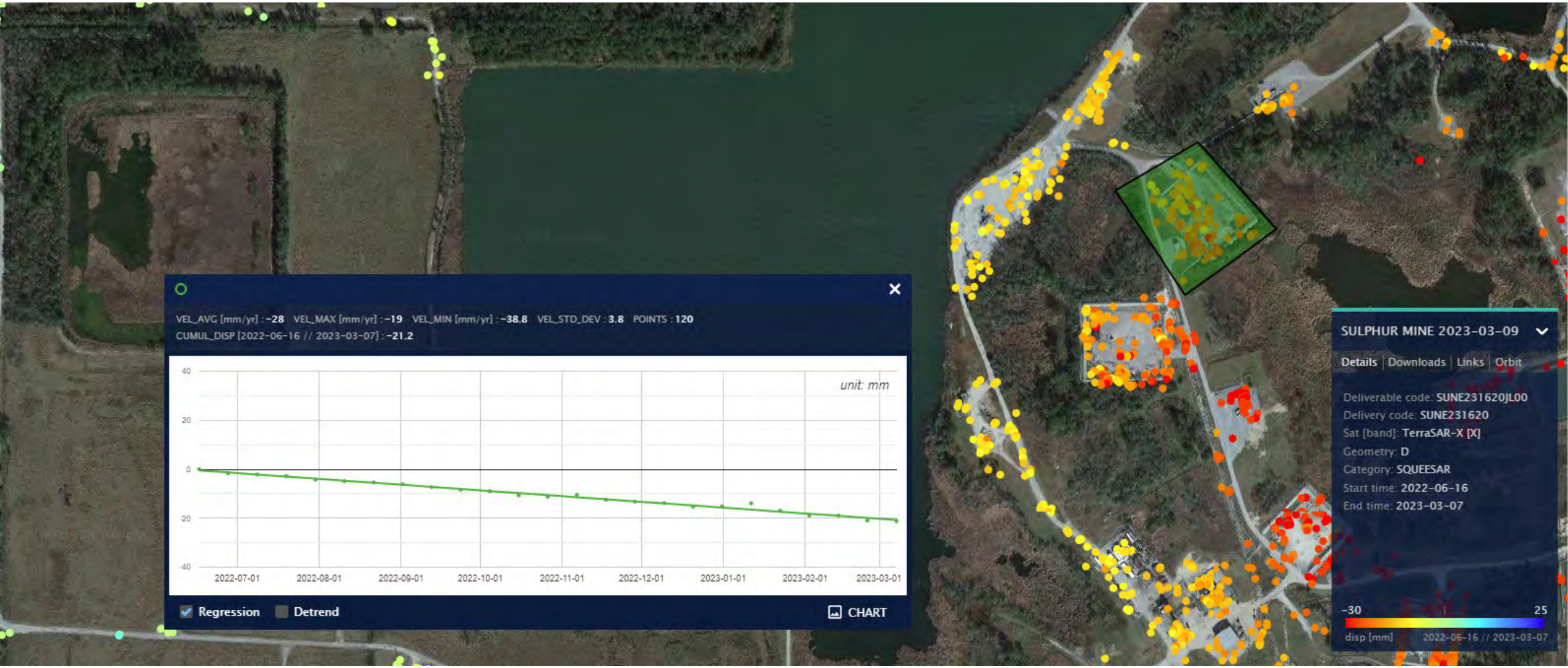
- Beginning in late January, ground displacement over the western portion of the Sulphur Mines Salt Dome has been evaluated following the delivery of each dataset update from TRE-Altamira
- An automated process and set of deliverables to convey the results of the datasets is being developed that will evaluate multiple factors including trend consistency and mapped acceleration of ground displacement
- Current updates are focused on the review of time series charts of averaged data for selections of points around the dome and caverns on the western flank
- The TSX satellite (11-day revisit) passed by Sulphur on Tuesday March 7, 2023
- The following slides present the time series and associated linear trends for each location evaluated from this dataset
- To-date there has been no material deviation from the established subsidence trends in the areas investigated

TSX Satellite - March 7, 2023 Update

LONQUIST & CO. LLC

PPG 21

PPG 6


VEL_AVG [mm/yr] : -28 VEL_MAX [mm/yr] : -19 VEL_MIN [mm/yr] : -38.8 VEL_STD_DEV : 3.8 POINTS : 120
CUMUL_DISP [2022-06-16 // 2023-03-07] : -21.2
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details | Downloads | Links | Orbit
Deliverable code: SUNE231620JL00
Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

PPG 7


VEL_AVG [mm/yr] : -27.6 VEL_MAX [mm/yr] : -14.1 VEL_MIN [mm/yr] : -46.1 VEL_STD_DEV : 5.5 POINTS : 169
CUMUL_DISP [2022-06-16 // 2023-03-07] : -21.1
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details | Downloads | Links | Orbit
Deliverable code: SUNE231620JL00
Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

PPG 22


VEL_AVG [mm/yr] : -37.1 VEL_MAX [mm/yr] : -27.5 VEL_MIN [mm/yr] : -40.5 VEL_STD_DEV : 3.1 POINTS : 43
CUMUL_DISP [2022-06-16 // 2023-03-07] : -26.8
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details | Downloads | Links | Orbit
Deliverable code: SUNE231620JL00
Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

AOI #1


VEL_AVG [mm/yr] : -22 VEL_MAX [mm/yr] : -13.8 VEL_MIN [mm/yr] : -31.6 VEL_STD_DEV : 3.8 POINTS : 137
CUMUL_DISP [2022-06-16 // 2023-03-07] : -16
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details | Downloads | Links | Orbit
Deliverable code: SUNE231620JL00
Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

AOI #2


VEL_AVG [mm/yr] : -18.7 VEL_MAX [mm/yr] : -14.1 VEL_MIN [mm/yr] : -24.4 VEL_STD_DEV : 2.3 POINTS : 47
CUMUL_DISP [2022-06-16 // 2023-03-07] : -14.4
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details | Downloads | Links | Orbit
Deliverable code: SUNE231620JL00
Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

AOI #3


VEL_AVG [mm/yr] : -17.6 VEL_MAX [mm/yr] : -14.7 VEL_MIN [mm/yr] : -24.8 VEL_STD_DEV : 2.1 POINTS : 37
CUMUL_DISP [2022-06-16 // 2023-03-07] : -14
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details | Downloads | Links | Orbit
Deliverable code: SUNE231620JL00
Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

AOI #4


VEL_AVG [mm/yr] : -18.1 VEL_MAX [mm/yr] : -13.6 VEL_MIN [mm/yr] : -24 VEL_STD_DEV : 2.6 POINTS : 51
CUMUL_DISP [2022-06-16 // 2023-03-07] : -14.5
unit: mm
40
20
0
-20
-40
2022-07-01
2022-08-01
2022-09-01
2022-10-01
2022-11-01
2022-12-01
2023-01-01
2023-02-01
2023-03-01
Regression
Detrend
CHART
SULPHUR MINE 2023-03-09
Details
Downloads
Links
Orbit
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Delivery code: SUNE231620
Sat [band]: TerraSAR-X [X]
Geometry: D
Category: SQUEESAR
Start time: 2022-06-16
End time: 2023-03-07
-30
25
disp [mm]
2022-06-16 // 2023-03-07

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ATTACHMENT H

NewFields
Chemical Fingerprinting Analysis Report
(Version 2)

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

NewFields
Perspective. Vision. Solutions.

March 10, 2023

Troy Charpentier
Partner
Kean Miller LLP
400 Convention Street, Suite 700
Baton Rouge, Louisiana 70802

Full Report - Chemical Fingerprint of Oils
Westlake Sulphur Dome Study

Dear Mr. Charpentier,

NewFields is pleased to provide you with this report of chemical fingerprinting results for five samples relevant to the investigation of the Westlake US 2 LLC (Westlake) salt dome caverns in the Sulphur Mines oil field, Calcasieu Parish, Louisiana. A preliminary report previously provided to you summarized these results,[1] which are now fully explained herein in an expanded *Results & Discussion* section.

Not all of the facts are known to me presently, but from our conversation(s) I understand the study was conducted as one piece of Westlake's investigation into the cause(s) for a pressure drop within a salt cavern. The cavern was solution mined from the late 1950's to 1980's, at which point it was used to store crude oil as part of the Strategic Petroleum Reserve (SPR) for a few years. SPR oil storage also ended and solution mining of the cavern resumed until 2001 at which time the cavern was idled.

Samples

An inventory of the five samples submitted for study is provided in **Table 1**. The descriptions in Table 1 were provided by Mr. Scott Himes (ERM), who also collected the samples. The samples were collected on January 25, 2023, held securely and chilled, and then shipped via overnight carrier on January 30, 2023 to NewFields alliance laboratory, Alpha Analytical (Mansfield, Massachusetts, USA), where they arrived safely on January 31, 2023. A copy of the chain-of-custody received with the sample is found in **Attachment 1**.

Objectives

The objective of the study was to determine the specific chemical character of the oil recovered from within the cavern and compare it the other four samples collected from the site (Table 1). Of specific interest was to;

(1) determine if the cavern oil (7B) was consistent or inconsistent with the stock tank oil (Stock Tank), which was known to have been used as a "blanket" within the brine-filled cavern and, if inconsistent, was the cavern oil consistent with the oil within the annulus of a nearby Yellow Rock salt disposal well (110159); and

(2) determine if the oil found floating within a brine well excavation (Brine well 22 BS) was consistent with the stock tank oil (Stock Tank) or oil within the annulus of a nearby Yellow Rock salt disposal well (110159).

[1] Stout, S.A. (2023) Preliminary Report – Chemical Fingerprinting of Oils, Westlake Sulphur Dome Study. NewFields report dated February 24, 2023.

These objectives were pursued using specific chemical fingerprinting analyses and interpretation protocols employed in oil spill identification studies, as described in the following sections and referenced attachments.

Chemical Fingerprinting Analyses

The five samples were prepared and analyzed in a single analytical batch using well-established and previously published chemical fingerprinting methods tailored for oil spill identification.[2] Detailed descriptions of these methods are found in **Attachment 2**.

Data Interpretation

The chemical fingerprinting data collected were evaluated using current geochemical practice utilized in oil spill investigations.[3] The chemical fingerprinting data collected were evaluated using a multi-tiered approach based upon the Centre for European Norms (CEN) oil spill identification protocol, which is used worldwide by many laboratories (Fig. 1).[4] This protocol relies on qualitative and quantitative (statistical) comparisons between spill and field samples to yield one of four possible conclusions, viz., *Positive match, Probable match, Inconclusive* or *Non-match* (Fig. 1), which are defined and described in detail in **Attachment 3**. A modification of the strict statistical criteria was used to accommodate the fact that the present investigation does not involve a known source oil spilled into the environment.

Results & Discussion

The complete Alpha Environmental Testing Report (ETRs) including all sample preparation data, instrument calibrations, QC data and chromatograms is maintained on file by NewFields (ETR L2305221). The tabulated results for the targeted compounds in each analysis performed are contained in **Attachment 4**. The full-size GC/FID chromatograms obtained in the Tier 1 (modified EPA Method 8015D) analysis are provided in **Attachment 5** and selected extraction ion profiles (EIPs) obtained in the Tier 2 (modified EPA Method 8270D) are provided in **Attachment 6**.

Specific results most relevant to the study's objectives are presented in **Tables 2 and 3** and **Figures 2 through 5**. Discussion of these results is provided in the following sections.

<u>Tier 1 – General Character/Comparison of the Samples Studied</u>

Figure 2 shows the GC/FID (C8+) chromatograms for the five samples studied, which are described in the following paragraphs.

Cavern Oil and Stock Tank Oil: The chromatograms for the 7B cavern oil (Fig. 2A) and stock tank oil (Fig. 2B) appear generally comparable and can be described together. Both oils contain compounds that extend up to ~C40. Resolved compounds (peaks) over this range are dominated by n-alkanes that decline in abundance with increasing carbon number. These prominent n-alkanes yield only a broad, low unresolved complex mixture (UCM) spanning both oils' chromatograms. Also resolved are numerous acyclic isoprenoids, including pristane (Pr) and

[2] Stout, S.A. and Wang, Z. (2016). Chemical fingerprinting methods and factors affecting petroleum fingerprints in the environment. In: *Standard Handbook of Oil Spill Environmental Forensics: Fingerprinting and Source Identification*, 2nd Ed., S.A. Stout and Z. Wang, Eds., Elsevier Publishing Co., Boston, MA, p. 61-130.

[3] *Standard Handbook of Oil Spill Environmental Forensics: Fingerprinting and Source Identification*, 2nd Ed. (2016), S.A. Stout and Z. Wang, Eds., Elsevier Publishing Co., Boston, MA, 1107 p.

[4] Kienhaus, P.G.M. et al. 2016. CEN methodology for oil spill identification. In: *Standard Handbook of Oil Spill Environmental Forensics: Fingerprinting and Source Identification*, 2nd Ed., S.A. Stout and Z. Wang, Eds., Elsevier Publishing Co., Boston, MA, p. 685-728.

phytane (Ph) that occur in similar but not identical proportions to each other (Pr/Pr ~1.0 and 1.2) and to nearby n-alkanes (C17/Pr and C18/Ph; see Fig. 2A & B insets and Table 2). Collectively, these Tier 1 results/features indicate that:

- Both the cavern oil (7B) and stock tank oil are comprised of unweathered[5] crude oils that appear, based on Tier 1 results to be similar but not identical to one another.

Yellow Rock Well Annulus Oil: The chromatogram for the oil from the Yellow Rock well (110159) annulus (Fig. 2C) shows it contains a broad range of compounds extending up to ~C40. The annulus oil does contain some n-alkanes although these occur in reduced relative abundance compared to acyclic isoprenoids (Pr and Ph) and many other (unlabeled) compounds, including alkylated benzenes, decalins, and naphthalenes below ~C15 and triterpane biomarkers (norhopane and hopane) around ~C30 (Fig. 2C). Notably, the Pr/Ph ratio is ~3.2, i.e., much higher than the cavern and stock tank oils (Table 2). Owing to the reduced abundance of n-alkanes the annulus oil's UCM hump is prominent. Collectively, these Tier 1 results/features indicate that:

- The oil collected from the Yellow Rock well (110159) annulus is a moderately weathered, namely biodegraded, crude oil. Irrespective of weathering differences, the oil's high Pr/Pr ratio is distinct from those of cavern and stock tank oils (described above).

Brine Well 22 Excavation Oil: The chromatogram for the oil floating within the brine well 22 excavation (Fig. 2D) contains compounds ranging from ~C12 to C40. There are very few resolved compounds present and most of these appear to be petroleum biomarkers in the C25+ range, including prominent norhopane and hopane. No n-alkanes or isoprenoids appear present. The oil is overwhelmingly comprised of a broad UCM hump that reaches a maximum around C30. Collectively, these Tier 1 results/features indicate that:

- The brine well 22 excavation oil is a severely weathered, including biodegraded, evaporated, and likely water-washed, crude oil. The severity of weathering exhibited by the excavation oil precludes its comparison to the cavern, stock tank, and Yellow Rock well oils (described above) based on the Tier 1 results (alone).

Central Pond Sheen: The chromatogram for the material collected floating on the central pond exhibits features inconsistent with (refined or crude) petroleum (Fig. 2E). The sample's chromatogram shows two clusters of resolved peaks with no discernable petroleum-like pattern(s) that occur centered around ~C20 and C30. The latter cluster does include a series of odd-carbon numbered n-alkanes between C23 and C33 (see Attachment 4, Table 4-1). There is a notable absence of any significant UCM, the presence of which is a common feature of petroleum (as was evident in the other samples studied). Collectively, these Tier 1 results/features indicate that:

- The sheen collected from the central pond is not petroleum. Rather, the sheen is comprised of naturally-occurring, biologically-derived (i.e., biogenic) material, including

[5] *Unweathered* is used here since this oil exhibits no obvious evidence of *weathering*, a term that refers to changes an oil can experience due to various processes (e.g., evaporation, water-washing, photo-oxidation, biodegradation). The changes due to weathering are well recognized and accounted for in oil spill identification protocol, which instead focuses upon those chemical fingerprinting features resistant to weathering.

plant waxes and sesqui-, di- and tri-terpenoids. Such biogenics are common in near-surface environments.[6]

The overall objective of Tier 1 in the CEN oil spill identification protocol (Fig. 1) is to determine if there are sufficient differences between samples, which cannot be attributed to weathering, to conclude that samples cannot possibly "match". The Tier 1 results described above unequivocally demonstrate that the central pond sheen is a "non-match" any of the oils studied since it is not even comprised of (crude or refined) oil. Further, although there is some disparity in Tier 1 diagnostic features (e.g., Pr/Ph; Tier 2), the wide range in weathering exhibited by the other four samples comprised of crude oil (i.e., unweathered-to-moderately-to-severely weathered) warrants that they be further compared using the many source-specific and weathering resistant diagnostic features afforded by the Tier 2 (GCMS) results before any final conclusion(s) is reached regarding their "match" category (Fig. 1). These features and comparisons are described in the next section.

Tier 2 – Detailed Character/Comparison of the Samples Studied

As noted above, diagnostic features/ratios based upon Tier 1's GC/FID results can be altered due to weathering and thereby warrant some caution. On the other hand, diagnostic features/ratios based upon PAHs, sulfur-containing aromatics, and petroleum biomarkers based on Tier 2's GC/MS results are generally more useful given because, under most environmental conditions and timescales, they are highly resistant to weathering. Petroleum biomarkers are particularly useful in oil spill fingerprinting because they are highly source-specific "chemical fossils" that vary from oil-to-oil, even between individual oil reservoirs.

Figures 3, 4, and 5 show the EIPs of the three groups of petroleum biomarkers measured in the samples studied, i.e., triterpanes, steranes, and triaromatic steroids, respectively. Panel E in each figure includes the EIP for the central pond sheen sample, which shows an absence of petroleum biomarkers in each instance (Figs. 3E, 4E, and 5E). The absence of petroleum biomarkers in this sheen samples confirms the Tier 1 conclusion, i.e., this sample does not contain petroleum. This sample's Tier 2 will not be discussed further.

Casual inspection/comparison of the four oil samples' EIPs reveals a general similarity among them (Figs. 3A-D, 4A-D, and 5A-D). This general similarity is completely expected since nearly all crude oils contain comparable suites of petroleum biomarkers derived from comparable suites of ancient organic matter that gave rise to the oil over geologic time. For example, all four of the oils contain prominent norhopane (T15) and hopane (T19; Fig. 3A-D), derived from ubiquitous bacterial membranes in ancient sediments, but inspection reveals their proportions (as reflected by the relative size of the peaks) vary among the samples. Thus, petroleum biomarker comparisons necessarily are based upon detailed differences that petroleum geochemists have (over decades of study) come to recognize as being diagnostic of different crude oils. Oil spill fingerprinting capitalizes on these differences and the CEN protocol (employed herein) relies upon statistical comparisons between a suite of largely prescribed diagnostic ratios (Attachment 3).

Tables 2 and 3 provide inventories of the 27 diagnostic ratios used in this study. The same ratios are presented in both tables, but each table was prepared to address the study's two primary objectives (see *Objectives* above), which are discussed separately below. The top three ratios in both tables were determined from the Tier 1 (GC/FID) results (discussed above) while all

[6] For example; Wang, Z. et al. (2009) Forensic differentiation of biogenic organic compounds from petroleum hydrocarbons in biogenic and petrogenic compounds cross-contaminated soils and sediments. J. Chromatogr. A, 1216: 1174-1191.

remaining 24 ratios were determined from the Tier 2 (GC/MS) results. The measured concentrations of all targeted analytes in the samples, many of which were used in the 24 Tier 2 diagnostic ratios, are given in Attachment 4.

Origin of the 7B Cavern Oil: Table 2 provides the results relevant to this study's first objective as it compares the 7B cavern oil to the other three oils in order to determine if any of them "match" the cavern oil. The color-coding in Table 2 reveals those diagnostic ratios that statistically match (green) and statistically differ (red) from the 7B cavern oil. (See Attachment 4 for the description of 95% confidence level statistical criteria used within the CEN protocol.) Most of the matching and non-matching ratios can be qualitatively visualized upon inspection of Figures 3 to 5.

Inspection of Table 2 reveals that the stock tank oil exhibits the highest number of diagnostic ratios that are statistically matched to the 7B cavern oil. Specifically, 17 of the 27 diagnostic ratios for the stock tank oil are statistically matched to the 7B cavern oil (Table 2). Alternatively, only two to five of the 27 diagnostic ratios for the Yellow Rock well oil and brine well 22 excavation oil statistically match the cavern oil. Qualitative visual comparison of these samples' EIPs (Figs. 3-5) reveals a comparable assessment, i.e., the stock tank oil is clearly the most comparable oil to the 7B cavern oil whereas the Yellow Rock well oil and brine well 22 excavation oil are clearly distinct from it. The latter oils' clearly distinct characters confirm:

- The 7B cavern oil is a "non-match" to both the Yellow Rock well oil and brine well 22 excavation oil.

Despite the stock tank oil's mostly comparable character to the cavern oil (Figs. 2-5), the 10 non-matching diagnostic ratios (Table 2) provide a sufficient basis to conclude these two oils are not "positive matches". More appropriately:

- The 7B cavern oil is a "probable match" to the stock tank oil.

In other words, these two oils are clearly related but they are not exactly the same oil. I considered three possible explanations for this finding that are described in the following paragraphs.

First, it is possible that the specific stock tank oil included in this study, which was present at the site when the sample was collected (Jan. 25, 2023), is simply not the same (identical) stock tank oil that historically was used to form a "blanket" within the brine-filled cavern. More information on the homogeneity, consistency, and origin(s) of the stock tank oil present on site over time may shed light on this possibility.

Second, it is also reasonable to consider that the 7B cavern oil may contain a mixture of mostly stock tank oil with a smaller amount of a different oil, the latter of which altered some diagnostic features/ ratios of the cavern oil. This possibility would seem particularly viable considering the cavern was formerly used to store crude oil as part of the SPR, whereby some small volume of a SPR oil(s) remained in the cavern after SPR storage was discontinued, only to become mixed with a stock tank oil "blanket" later added to the cavern. To my knowledge there is no information/data that could be used to evaluate this possibility further.[7]

[7] Some features of the cavern oil that differ from the stock tank oil provide clues as to features of the hypothetical "SPR oil". These include low Pr/Ph and oleanane (T18) and high C24-tetracylcic terpane (T6a), bisnorhopane (T14a), norhopane (T15), and homohopanes (T21 to T33), including C35 homohopanes (T34 and T35). Interestingly, geochemical practice indicates all of these features are consistent with a crude oil produced in a carbonate (non-shale) source rock environment. If it were

Finally, it is also reasonable to consider if the 7B cavern oil may contain a mixture of mostly stock tank oil with a smaller amount of locally-produced crude oil that may have entered the cavern. This possibility can only be evaluated presently if the Yellow Rock well 110159 annulus oil is considered representative of locally-produced crude oil(s). However, the data collected herein excludes the possibility that a mixture of stock tank oil and Yellow Rock well annulus oil could produce and be a "positive match" to, the 7B cavern oil. This can be readily seen in Table 2 wherein any theoretical mixture of Yellow Rock oil and stock tank oil could only yield an oil with diagnostic ratios "in between" these two end-member oils' ratios. However, inspection shows that none of the 10 non-matching diagnostic ratios in the 7B cavern oil fall in between the Yellow Rock oil and stock tank oil ratios, which excludes the possibility of their mixture "matching" the cavern oil.[8]

In summary,

- The origin of the 7B cavern oil appears exclusively to mostly derived from stock tank oil, perhaps just not the exact same stock tank oil as was sampled for this study or perhaps stock tank oil that is mixed with a small amount of another crude oil (e.g., some lingering SPR oil).
- The possible mixing of stock tank oil with a small amount of locally-produced crude oil, as represented by the Yellow Rock well annulus oil studied, to produce the cavern oil, however, can be excluded.

Origin of the Brine Well 22 Excavation Oil: Table 3 provides the results relevant to this study's second objective as it compares the brine well 22 excavation oil to the other three oils in order to determine if any of them "match" the excavation oil. Again, the color-coded ratios reveal those diagnostic ratios that statistically match (green) and statistically differ (red) from the brine well 22 excavation oil. (See Attachment 4 for the description of 95% confidence level statistical criteria used within the CEN protocol.) Most of the matching and non-matching ratios can be qualitatively visualized upon inspection of Figures 3 to 5.[9]

Inspection of Table 3 reveals that the brine well 22 excavation oil exhibits the highest number of diagnostic ratios that are statistically matched to the Yellow Rock well 110159 annulus oil. Specifically, 14 of the 24 Tier 2 diagnostic ratios for the Yellow Rock well oil are statistically matched to the brine well 22 excavation oil (Table 3).[10] Alternatively, only three to eight of the 24 Tier 2 diagnostic ratios for the stock tank oil or cavern well oil statistically match the brine well

possible to determine the origin(s) of SPR oil formerly stored in the cavern these features may be further evaluated and possibly confirm/refute the possible mixing of stock tank oil with a real SPR oil.

[8] A more rigorous quantitative analysis based upon biomarker concentrations, rather than ratios, was not necessary in this simple assessment given the obvious qualitative differences.

[9] There is a notable anomaly exhibited in the triterpane distributions of both the brine well 22 excavation oil and the Yellow Rock well oil. Specifically, both these oils show an excess abundance of 22R-bishomohopane (T27; Fig. 3C-D) that indicates both oils likely contain the same co-eluting and anomalous compound; compare to 3A-B, wherein T27 appears in a more typical abundance relative to T26. This anomaly further confirms the matching character of the brine well 22 excavation oil and the Yellow Rock well oil. This anomaly may be a "marker" for locally-produced crude oil.

[10] Note that the severe degree of weathering of the brine well 22 excavation oil, which removed all n-alkanes and isoprenoids (Fig. 2D), renders the three Tier 1 (GC/FID) diagnostic ratios useless in this comparison, resulting in only 24 Tier 2 diagnostic ratios available for this comparison (Table 3). Additionally, while some of the non-matching Tier 2 diagnostic ratios could possibly be altered by the severe weathering (e.g., methyl-dibenzothiophene and methyl-phenanthrene based diagnostic ratios (4-MDT/1-MDT and 2-MP/1MP; Table 3), not all non-matching ratios can be so explained.

22 excavation oil. Qualitative visual comparison of these samples' EIPs (Figs. 3-5) reveals a comparable assessment, i.e., the Yellow Rock well oil is clearly the most comparable oil to the brine well 22 excavation oil, whereas the stock tank oil and cavern oil are clearly distinct from it. The latter oils' clearly distinct characters confirm:

- The brine well 22 excavation oil is a "non-match" to both the stock tank oil and the cavern oil.

Despite the Yellow Rock well oil's mostly comparable character to the brine well 22 excavation oil (Figs. 2-5), the numerous non-matching diagnostic ratios (Table 3) provide a sufficient basis to conclude these two oils are not "positive matches". More appropriately:

- The brine well 22 excavation oil is a "probable match" to the Yellow Rock well oil.

In other words, the brine well 22 excavation oil and Yellow Rock well oil appear to be related but they are not exactly the same oil. Based upon these results it is evident that:

- The origin of the oil floating in the brine well 22 excavation appears to be spillage, leakage, or seepage (and advancement in weathering) of a locally-produced crude oil, similar to that represented by the Yellow Rock well 110159 oil.
- The severe degree of weathering of the excavation oil may indicate it has been in the near surface environment for an extended period of time.

These conclusions may be deemed consistent with the reported presence of an abandoned oil well in the vicinity of the excavation (Table 1).

Summary of Findings

Based upon the samples and data collected to date the following conclusions can be offered.

First, regarding the general character of the oil within the samples studied:

(1) The oil recovered from within the cavern (7B) is an unweathered crude oil.

(2) The site's stock tank oil (Stock Tank) is an unweathered crude oil.

(3) The oil collected from the Yellow Rock well annulus (110159) is a moderately weathered crude oil.

(4) The oil recovered from the brine well 22 excavation (Brine well 22 BS) is a severely weathered crude oil.

(5) The sheen collected at the request of LDNR (Central Pond) contained no petroleum but was instead comprised of naturally-occurring biogenic material.

Second, regarding comparisons of weathering-independent features among the oils studied:

(6) The cavern oil and stock tank oil are highly comparable and are classified as "probable matches" to one another. Multiple statistical differences preclude them from being classified as "positive matches". Both these oils are completely dissimilar and "non-matches" to the brine well 22 excavation oil and the Yellow Rock well annulus oil.

(7) The brine well 22 excavation oil and the Yellow Rock well annulus oil are highly comparable and are classified as "probable matches" to one another. Multiple statistical

differences preclude being classified as “positive matches”. As per (6), both of these oils are completely dissimilar and “non-matches” to the cavern oil and stock tank oil.

(8) The statistical differences noted in (6) cannot be attributed to mixing of the stock tank oil with the Yellow Rock well annulus oil. As such, the differences evident are more likely attributable to some variation in the specific character of the stock tank oil in use over time or mixing of the stock tank oil with a small amount of a different oil (e.g., residual former Strategic Petroleum Reserve oil) within the cavern. Regardless, if there is a different oil admixed with the stock tank oil within the cavern this different oil cannot be the Yellow Rock well oil.

Synthesis of these results argues that, at present;

(9) There is no evidence that locally-produced crude oil, as represented by the Yellow Rock well (110159) annulus oil sample, is present in the cavern.

(10) The oil found within the excavation at brine well 22 is comprised of locally-produced crude oil, as represented by, but slightly different than, the Yellow Rock well (110159) oil sample, and not stock tank or cavern oil.

Please let me know if you have any questions.

Sincerely,

Scott A. Stout, Ph.D., P.G.
Sr. Geochemist

Attachments:
1: Chain-of-custody
2: Analytical Methods
3: Interpretive Method
4: tabulated PIANO, TPH/SHC, PAH, and biomarker concentrations
5: full size GC/FID chromatograms
6: selected GC/MS extraction ion profiles

Table 1: Inventory of oil samples studied.

Client/ Field ID	Lab ID	Matrix	Date Collected	Description of Sample
7B*	L2305221-04	Oil	1/25/2023	Cavern oil from brine well 7B; oil was collected after being removed from the cavern during its transfer to another cavern
110159	L2305221-02	Oil	1/25/2023	Oil from nearby salt disposal well** (Serial #110159); contained oil under pressure within the casing annulus that was sampled
STOCK TANK	L2305221-03	Oil	1/25/2023	Stock tank oil used within the cavern to “blanket” brine; reportedly a "refined crude oil"
BRINE WELL 22 BS*	L2305221-01	Teflon Net	1/25/2023	Surface oil from brine well 22 "bubble site"; floating oil was collected from small excavation near a brine well 22 pad and (also reportedly) near an old oil well
CENTRAL POND	L2305221-05	Teflon Net	1/25/2023	Surface sheen from central pond collected at the direction of LDNR

* sample was prepared and analyzed in duplicate

** Operated by Yellow Rock, LLC

Table 2: CEN diagnostic ratios for the oil samples studied versus 7B Cavern Oil.

Top three ratios are derived from Tier 1 GC/FID data; all others from Tier 2 GC/MS data.

CEN Diagnostic Ratios	CEN Diagnostic Ratios per Alpha Abbreviations	7B Cavern Oil	7B Cavern Oil (Dup)	7B Cavern Oil (Avg; n=2)	Well 110159 Oil	Stock Tank Oil	Brine Well 22 BS Oil	Brine Well 22 BS Oil (Dup)
NR-C17/pris	C17/Pr	2.35	2.42	2.38	0.24	1.96	ndp	ndp
NR-C18/phy	C18/Ph	2.18	2.16	2.17	0.57	**2.17**	ndp	ndp
NR- pris/phy	Pr/Ph	1.02	0.99	1.01	3.16	1.20	ndp	ndp
NR-4-MD/1-MD	4-MDBT/1-MDBT	2.15	2.14	2.14	3.80	**2.16**	1.85	1.51
NR-2-MP/1-MP	2-MP/1-MP	0.99	1.02	1.01	**1.14**	**1.10**	0.66	0.57
NR-27Ts/30ab	T11/T19	0.23	0.24	0.23	0.14	**0.21**	0.19	0.19
NR-27Tm/30ab	T12/T19	0.28	0.29	0.29	0.21	**0.26**	0.25	0.25
NR-28ab/30ab	T14a/T19	0.20	0.20	0.20	0.05	0.10	0.06	0.05
NR-29ab/30ab	T15/T19	0.81	0.87	0.84	0.62	**0.74**	0.69	0.67
NR-30O/30ab	T18/T19	0.04	0.04	0.04	0.10	0.09	0.18	0.18
NR-31abS/30ab	T21/T19	0.59	0.60	0.59	0.26	0.41	0.26	0.26
NR-27dbR/27dbS	S4/S5	0.52	0.47	0.50	0.59	**0.48**	0.60	**0.54**
NR-27bb/29bb	(S14+S15)/(S26+S27)	0.86	0.84	0.85	0.69	**0.77**	0.58	0.56
NR-SC26/ RC26+SC27	TAS09/TAS01	0.13	0.13	0.13	0.33	0.18	0.28	0.31
NR-SC28/RC26 + SC27	TAS02/TAS01	0.70	0.69	0.69	**0.80**	**0.78**	0.82	0.85
NR-RC27/RC26+ SC27	TAS03/TAS01	0.76	0.74	0.75	0.61	**0.74**	0.57	0.59
NR-RC28/RC26+SC27	TAS04/TAS01	0.59	0.57	0.58	**0.63**	**0.66**	**0.64**	0.71
DR-Ts/Tm	T11/T12	0.84	0.80	0.82	0.69	**0.79**	**0.78**	**0.77**
DR-29Ts30ab	T16/T19	0.20	0.22	0.21	**0.24**	**0.20**	0.32	0.32
DR-29bb/29aa	(S26+S27)/(S25+S28)	1.16	1.14	1.15	0.85	**1.22**	0.90	0.86
DR-C2-dbt/C2-phe	DBT2/PA2	2.29	2.28	2.28	0.30	1.97	0.27	0.28
DR-C3-dbt/C3-phe	DBT3/PA3	2.63	2.62	2.62	0.42	**2.35**	0.43	0.44
DR-C28C29/30ab	T7 to T10/T19	0.18	0.20	0.19	0.07	0.13	0.09	0.09
DR-29aaS/29aaR	S25/S28	1.41	1.30	1.36	1.12	**1.34**	1.06	**1.32**
DR-C20TA/C21TA	TAS05/TAS06	0.97	0.93	0.95	1.36	**0.99**	1.12	**0.92**
DR-TA21/ RC26+SC27	TAS06/TAS01	0.49	0.49	0.49	0.18	0.42	0.14	0.14
DR-30ba/30ab	T20/T19	0.07	0.07	0.07	0.20	0.15	0.20	0.20
Conclusion:					Non-Match	**Probable Match**	Non-Match	Non-Match

red: indicates statistical non-match to the 7B Cavern Oil (Avg)

green: indicates statistical match to the 7B Cavern Oil (Avg)

Dup: sample prepared and analyzed in duplicate

Avg: average of duplicate ratios

ndp: no determination possible/division by zero

Table 3: CEN diagnostic ratios for the oil samples studied versus Brine Well 22 BS Oil.

Top three ratios are derived from Tier 1 GC/FID data; all others from Tier 2 GC/MS data.

CEN Diagnostic Ratios	CEN Diagnostic Ratios per Alpha Abbreviations	Brine Well 22 BS	Brine Well 22 BS (Dup)	Brine Well 22 BS (Avg)	Well 110159 Oil	Stock Tank Oil	7B Cavern Oil	Cavern Oil 7B (Dup)
NR-C17/pris	C17/Pr	ndp	ndp	ndp	0.24	1.96	2.35	2.42
NR-C18/phy	C18/Ph	ndp	ndp	ndp	0.57	2.17	2.18	2.16
NR- pris/phy	Pr/Ph	ndp	ndp	ndp	3.16	1.20	1.02	0.99
NR-4-MD/1-MD	4-MDBT/1-MDBT	1.85	1.51	1.68	3.80	2.16	2.15	2.14
NR-2-MP/1-MP	2-MP/1-MP	0.66	0.57	0.62	1.14	1.10	0.99	1.02
NR-27Ts/30ab	T11/T19	0.19	0.19	0.19	0.14	**0.21**	0.23	0.24
NR-27Tm/30ab	T12/T19	0.25	0.25	0.25	0.21	**0.26**	**0.28**	0.29
NR-28ab/30ab	T14a/T19	0.06	0.05	0.06	**0.05**	0.10	0.20	0.20
NR-29ab/30ab	T15/T19	0.69	0.67	0.68	**0.62**	**0.74**	0.81	0.87
NR-30O/30ab	T18/T19	0.18	0.18	0.18	0.10	0.09	0.04	0.04
NR-31abS/30ab	T21/T19	0.26	0.26	0.26	**0.26**	0.41	0.59	0.60
NR-27dbR/27dbS	S4/S5	0.60	0.54	0.57	**0.59**	0.48	**0.52**	0.47
NR-27bb/29bb	(S14+S15)/(S26+S27)	0.58	0.56	0.57	0.69	0.77	0.86	0.84
NR-SC26/ RC26+SC27	TAS09/TAS01	0.28	0.31	0.30	**0.33**	0.18	0.13	0.13
NR-SC28/RC26 + SC27	TAS02/TAS01	0.82	0.85	0.83	**0.80**	**0.78**	0.70	0.69
NR-RC27/RC26+ SC27	TAS03/TAS01	0.57	0.59	0.58	**0.61**	0.74	0.76	0.74
NR-RC28/RC26+SC27	TAS04/TAS01	0.64	0.71	0.68	**0.63**	**0.66**	0.59	0.57
DR-Ts/Tm	T11/T12	0.78	0.77	0.78	**0.69**	**0.79**	**0.84**	**0.80**
DR-29Ts30ab	T16/T19	0.32	0.32	0.32	0.24	0.20	0.20	0.22
DR-29bb/29aa	(S26+S27)/(S25+S28)	0.90	0.86	0.88	**0.85**	1.22	1.16	1.14
DR-C2-dbt/C2-phe	DBT2/PA2	0.27	0.28	0.27	**0.30**	1.97	2.29	2.28
DR-C3-dbt/C3-phe	DBT3/PA3	0.43	0.44	0.43	**0.42**	2.35	2.63	2.62
DR-C28C29/30ab	T7 to T10/T19	0.09	0.09	0.09	0.07	0.13	0.18	0.20
DR-29aaS/29aaR	S25/S28	1.06	1.32	1.19	**1.12**	**1.34**	1.41	**1.30**
DR-C20TA/C21TA	TAS05/TAS06	1.12	0.92	1.02	1.36	**0.99**	**0.97**	**0.93**
DR-TA21/ RC26+SC27	TAS06/TAS01	0.14	0.14	0.14	0.18	0.42	0.49	0.49
DR-30ba/30ab	T20/T19	0.20	0.20	0.20	**0.20**	0.15	0.07	0.07
Conclusion:					**Probable Match**	Non-Match	Non-Match	Non-Match

red: indicates statistical non-match to the Brine Well 22 BS (Avg)

green: indicates statistical match to the Brine Well 22 BS (Avg)

Dup: sample prepared and analyzed in duplicate

Avg: average of duplicate ratios

ndp: no determination possible/division by zero

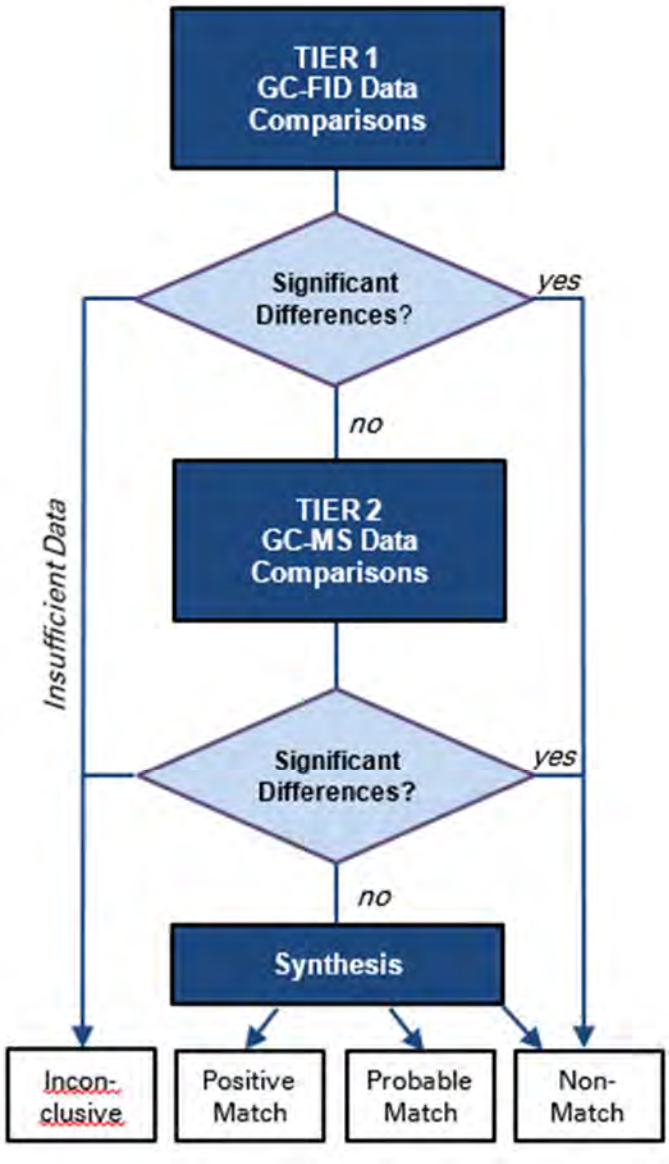

Figure 1: Simplified flowchart depicting the CEN (2012) oil spill identification protocol.

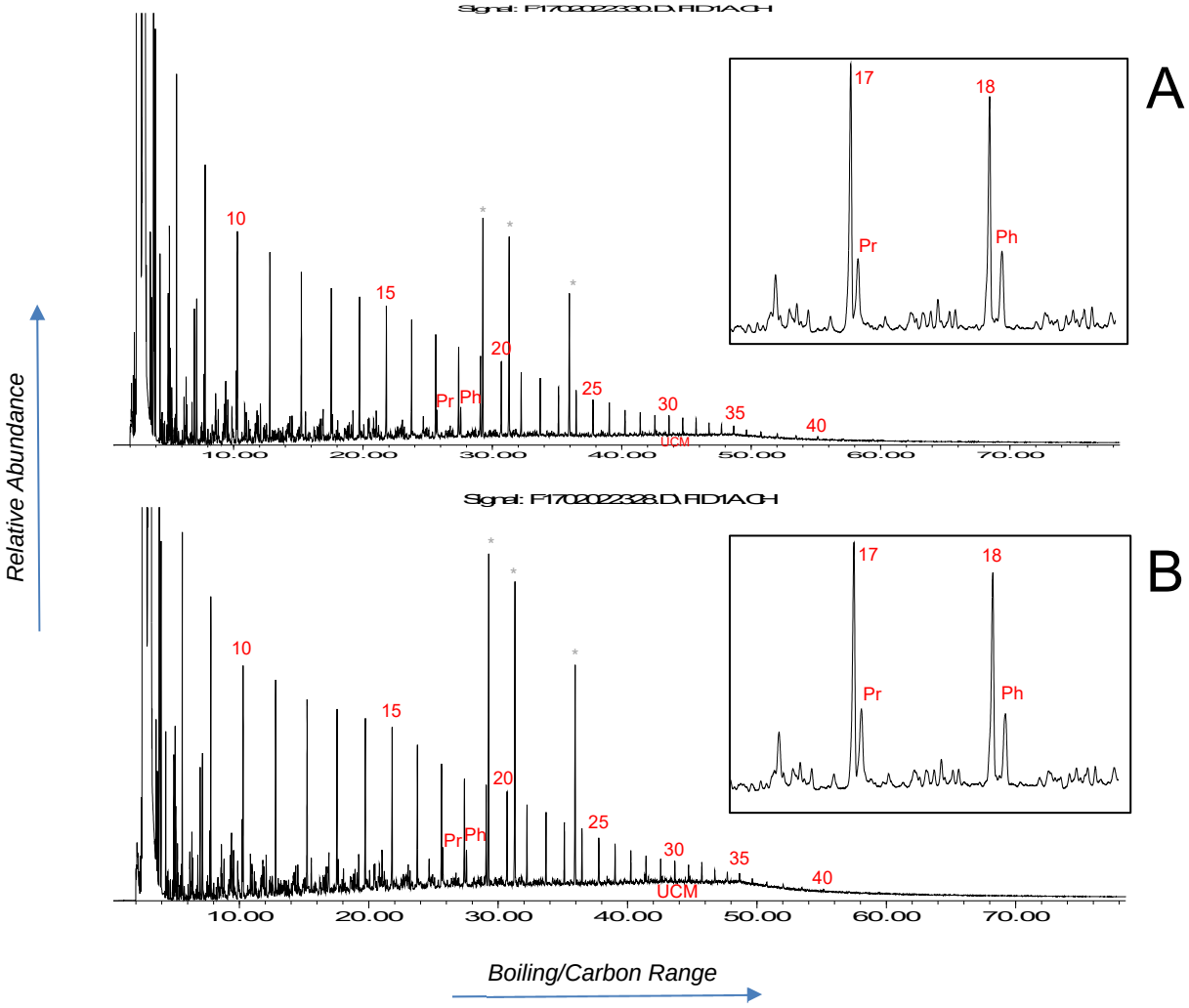

Figure 2: GC/FID (C8+) chromatograms for the oil samples studied. (A) 7B Cavern Oil, (B) Stock Tank Oil, (C) Well 110159 Oil, (D) Brine Well Bubble Site 22 BS, and (E) Central Pond Sheen. Insets show further expanded view of C17-C18 range. #: n-alkane carbon number; Pr: pristane; Ph: phytane; UCM: unresolved complex mixture; *: internal standard.

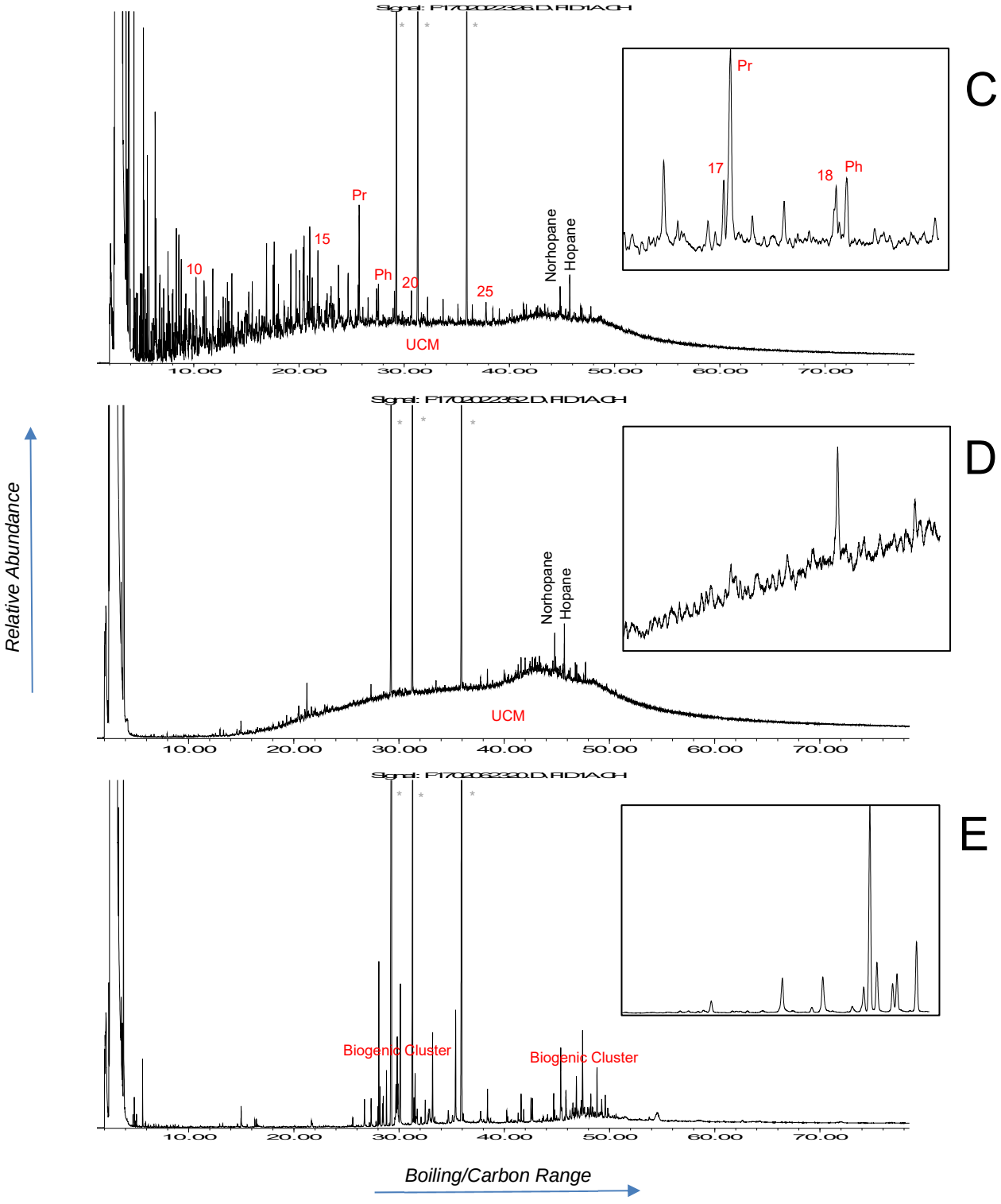

Figure 2: continued

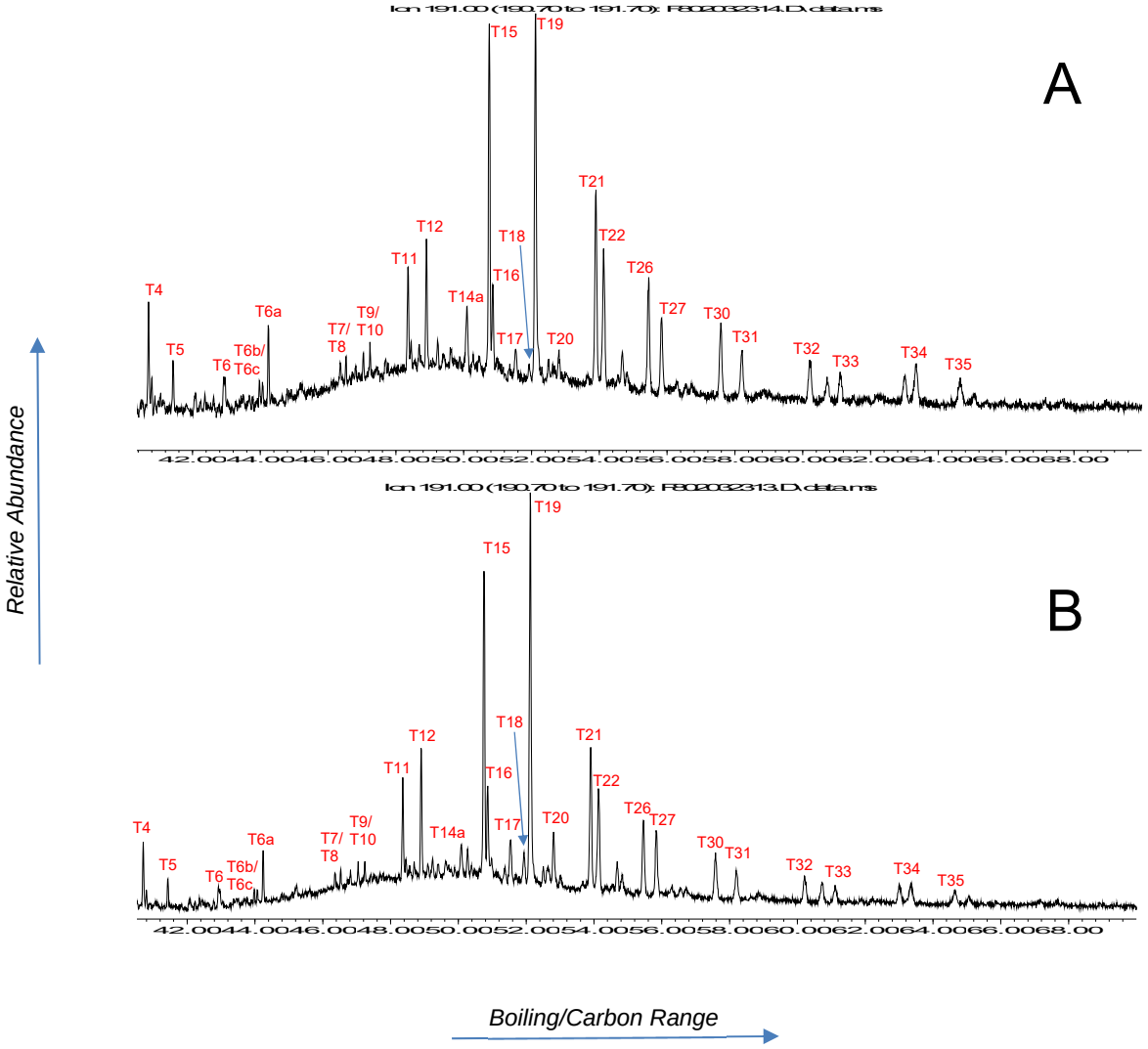

Figure 3: Partial extracted ion chromatograms (*m/z* 191) for the samples studied. (A) 7B Cavern Oil, (B) Stock Tank Oil, (C) Well 110159 Oil, (D) Brine Well Bubble Site 22 BS, and (E) Central Pond Sheen. red labels: various triterpane biomarkers, see Attachment 4, Table 4-4 for compound names.

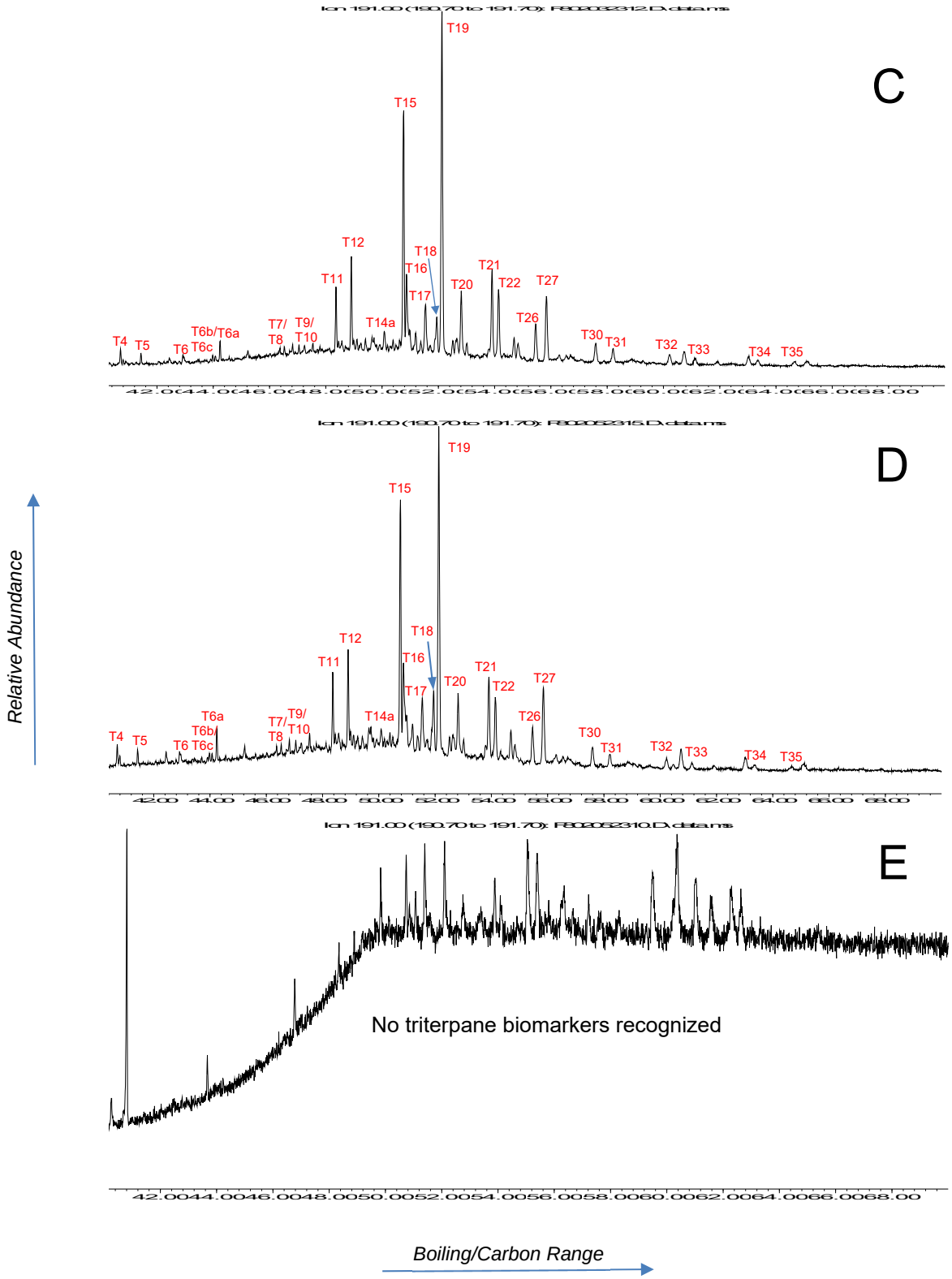

Figure 3: continued

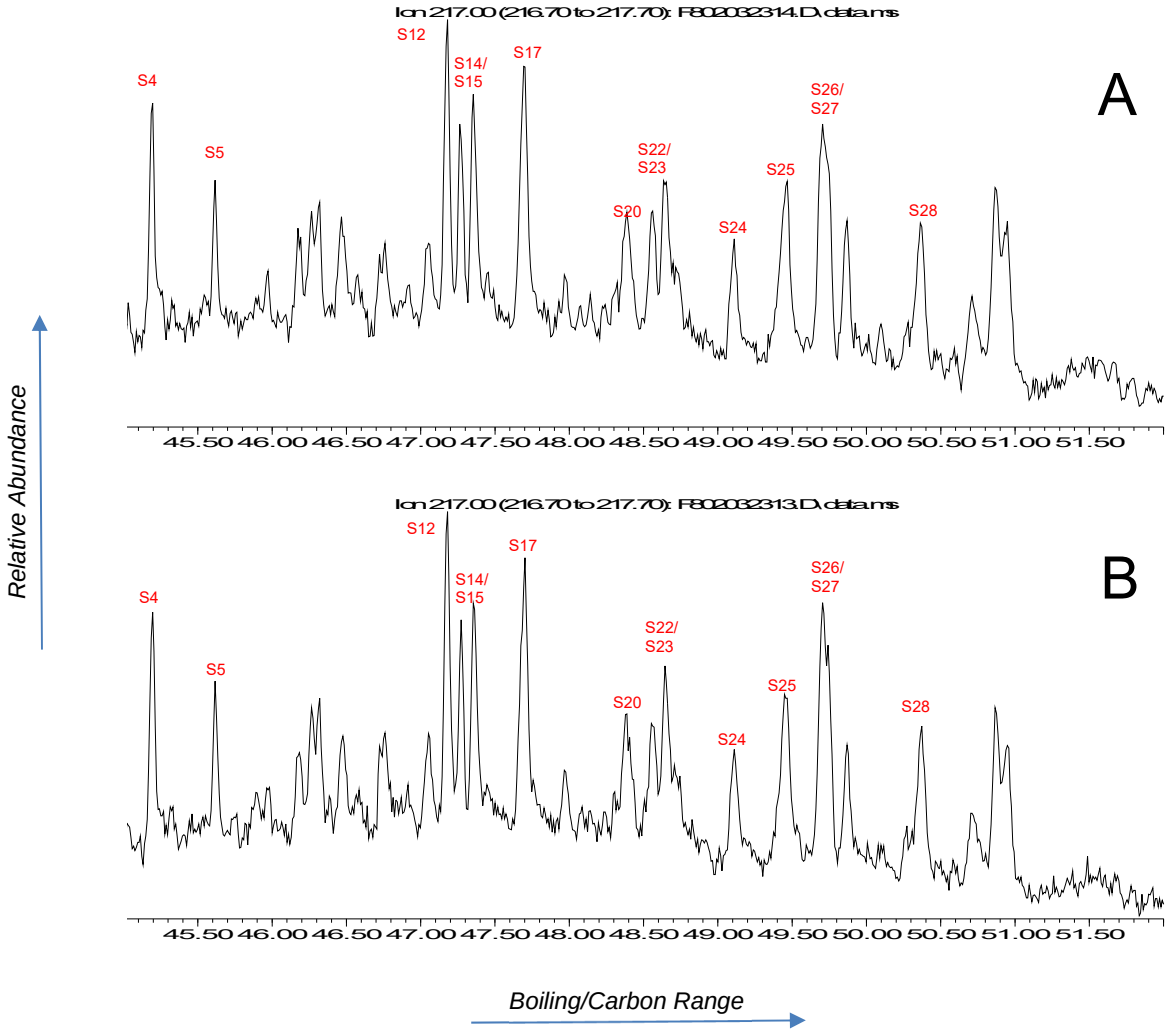

Figure 4: Partial extracted ion chromatograms (*m/z* 217) for the oil samples studied. (A) 7B Cavern Oil, (B) Stock Tank Oil, (C) Well 110159 Oil, (D) Brine Well Bubble Site 22 BS, and (E) Central Pond Sheen. #: n-alkane; red labels: various sterane biomarkers, see Attachment 4, Table 4-4 for compound names.

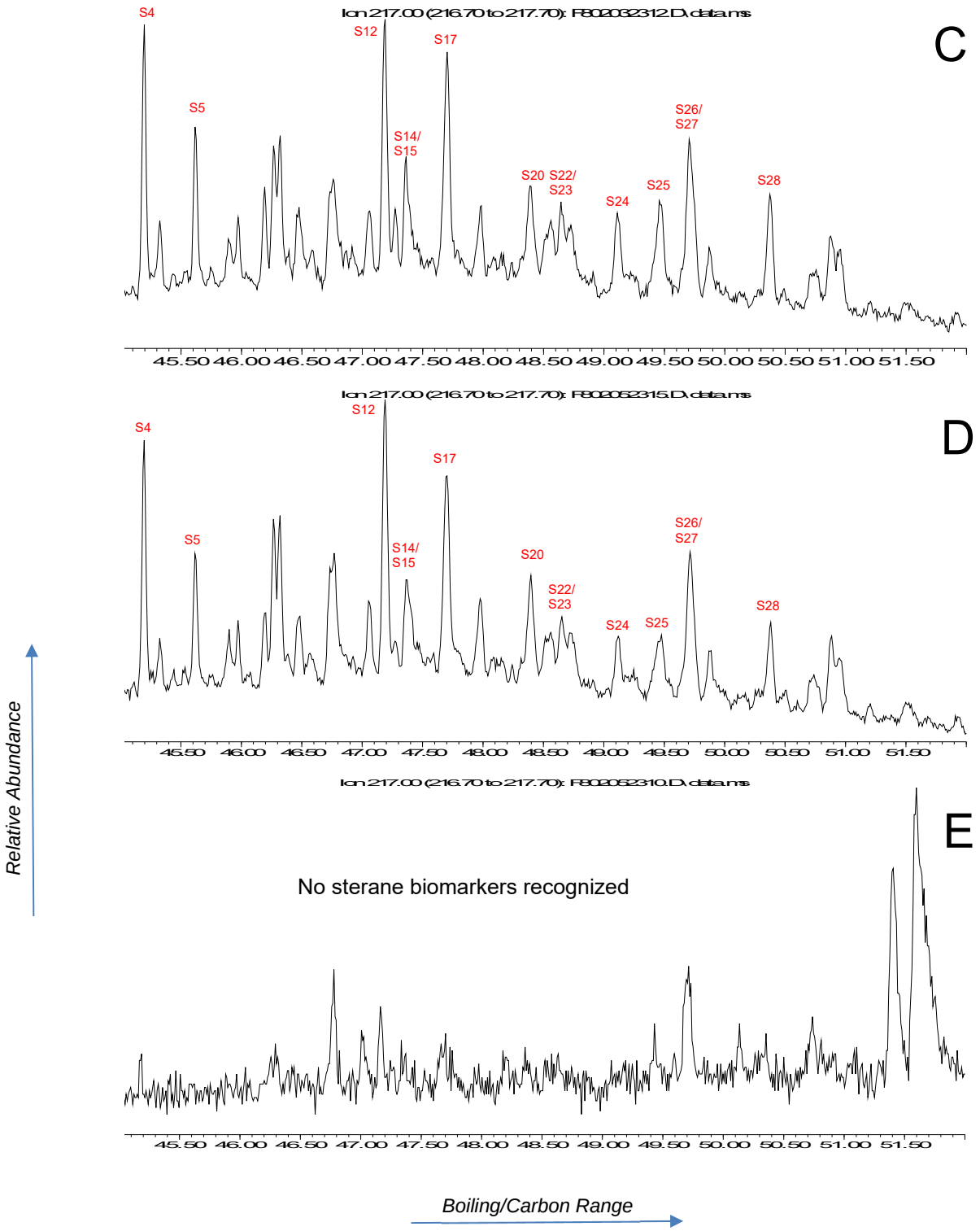

Figure 4: continued

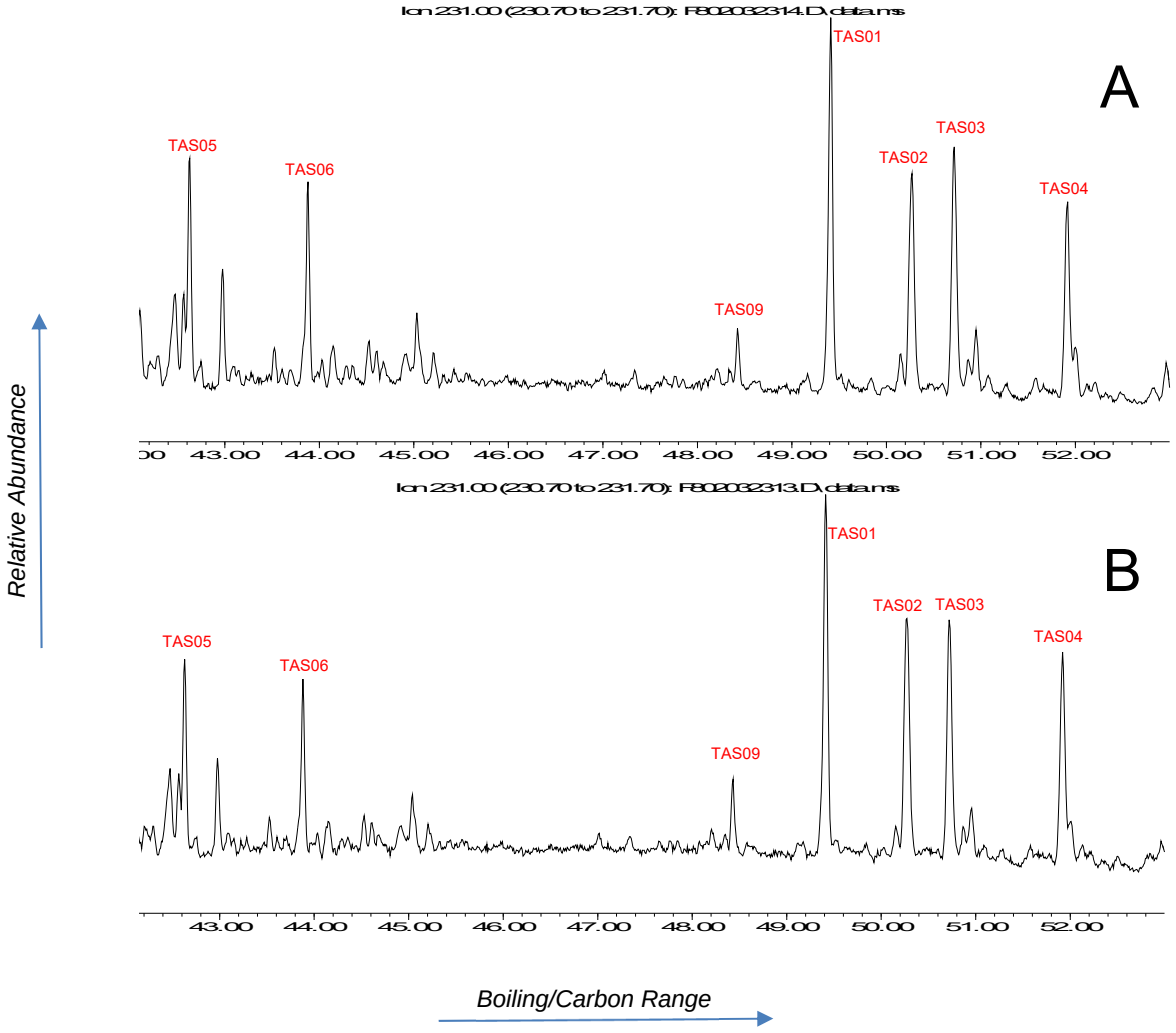

Figure 5: Partial extracted ion chromatograms (*m/z* 231) for the samples studied. (A) 7B Cavern Oil, (B) Stock Tank Oil, (C) Well 110159 Oil, (D) Brine Well Bubble Site 22 BS, and (E) Central Pond Sheen. #: n-alkane; red labels: various triaromatic steroid biomarkers, see Attachment 4, Table 4-4 for compound names.

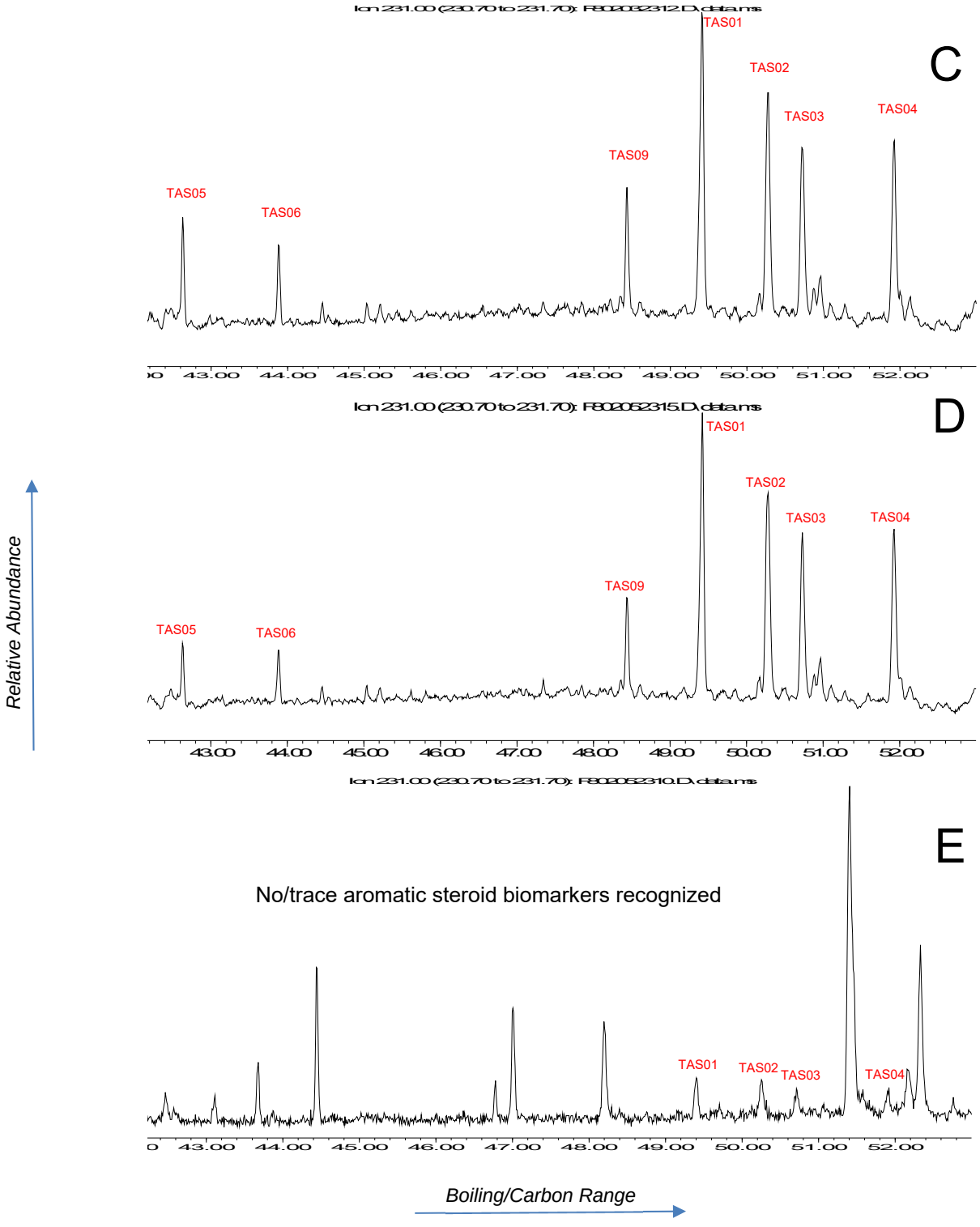

Figure 5: continued

ATTACHMENTS

NewFields
Perspective. Vision. Solutions.

Chain of Custody

Environmental Forensics Practice LLC

Proj. No	Proj. Name
0677804	Sulphur Dome

SAMPLERS: Signature

Scott Himes

DATE	TIME	LAB ID	CLIENT ID	SAMPLE DESCRIPTION	MATRIX (* see below)	GC-FID-TPH (C_6+)	GCMS-Alkyl PAH	GCMS-Biomarkers	PIANO - VOA	Organic Lead	METALS	PCB	Pesticides	PRESERVED	Total Number of Containers
1/25/23	1200		Brine Well 22 B5	Sheen	O	X	X		X						1
1/25/23	1500		110159	Oil	O	X	X		X						2
	1520		Stock Tank	Oil	O	X	X		X						2
	1530		7B	Oil	O	X	X		X						2
↓	1630		Central Pond 8	Sheen	O	X	X		X						1

Relinquished by:	Date/Time	Received by:	Date/Time
	1/30/23 1600	Fedex	
Relinquished by: Fedex	Date/Time	Received by:	Date/Time 1/31/23 11:27
Relinquished by:	Date/Time	Received by:	Date/Time

* O=Oil
SO=Soil
SE=Sediment
T=Tissue
W=Water

Samples to be shipped to: Alpha Laboratory
320 Forbes Blvd.
Mansfield, MA 02048
Tel: (508) 844-4117
Attn: Sue O'Neil

Comments: Contact Scott Stout for further details.

Attachment 1

Chain-of-Custody

Attachment 2

Analytical Methods

Sample Preparation

An aliquot (~100 mg) of each oil sample was diluted in dichloromethane (DCM: 10 mg/mL). A 1.0 mL aliquot of the extract was then spiked with recovery internal surrogates (RIS; 5α-androstane, acenaphthene-d_{10}, chrysene-d_{12}) and surrogate internal standards (SIS; o-terphenyl, n-tetracosane-d_{50}, 2-methylnaphthalene-d_{10}, pyrene-d_{10}, benzo(b)fluoranthene-d_{12}, and 5β(H)-cholane) prior for instrument analysis. Net samples were spiked with RIS and serially-extracted (3x) using fresh DCM on a shaker table. The extracts were combined, passed through glass wool, dried with sodium sulfate, concentrated to 1.0 ml, and spiked with SIS prior to instrument analysis. No silica-gel cleanup of the sample extracts was performed.

Each analytical batch included a procedural blank (PB; 1 mL of DCM), a laboratory control sample (LCS) and LCS duplicate (LCSD), each consisting of 1 mL of DCM spiked with selected hydrocarbons in known concentrations to monitor method accuracy, a reference (North Slope) crude oil standard, and at least one sample duplicate (i.e., a single oil prepared twice) as a measure of precision and reproducibility of the data.

Sample Instrument Analysis

Two analytical methods were employed in the chemical analysis of the oil and net extracts. These methods are routinely employed in oil spill investigations and are modifications of US EPA methods. The modifications include; (1) expansion of the prescribed target analyte lists to include many additional (conventionally, non-target analyte) hydrocarbons that are useful in distinguishing differences between and changes in petroleum after its release into the environment and (2) increasing the sensitivity of the instrumentation used through adjustments that lower the method detection limit (MDL) for targeted analytes providing few “non-detections” among the results.

In brief, the samples were analyzed using a (1) modified EPA Method 8015B and (2) modified EPA Method 8270D as described in the following paragraphs. The latter analysis was performed twice, once on the whole extract targeting PAHs and related compounds and once on the F1 fraction targeting aliphatic biomarkers. Additional details of these methods are described elsewhere.[1]

Modified EPA Method 8015D was conducted via gas chromatography-flame ionization detection (GC-FID; Agilent 6890) equipped with a Restek Rtx-5 (60m x 0.25 mm ID, 0.25 μm film) fused silica capillary column. Extracts were injected (1 μL, pulsed splitless) into the GC programmed from 40°C (1 min) and ramped at 6°C/min to 315°C (30 min) using H_2 (~1 mL/min) as the carrier gas. This analysis was used to determine the concentrations of GC-amenable total petroleum material (TPH; C_9-C_{44}) and individual *n*-alkanes (C_9-C_{40}) and (C_{15}-C_{20}) acyclic isoprenoids. Prior to sample analysis a minimum five-point calibration was performed to demonstrate the linear range of the analysis. The calibration solution was composed of selected aliphatic hydrocarbons within the *n*-C_9 to *n*-C_{40} range. Analyte concentrations in the standard solutions ranged from 1 ng/μL to 200 ng/μL. Target analytes that were not in the calibration solution had the average

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[1] Douglas, G.D., Emsbo-Mattingly, S.D., Stout, S.A., Uhler, A.D., and McCarthy, K.J. (2015) Hydrocarbon Fingerprinting Methods. In: *Introduction to Environmental Forensics, 3rd Ed.*, B. Murphy and R. Morrison, Eds., Academic Press, New York, pp. 201-309.

response factor (RF) of the nearest eluting compound(s) assigned as follows: RF of *n*-C_{14} assigned to C_{15} isoprenoids, *n*-C_{15} assigned to C_{16} isoprenoids; *n*-C_{17} assigned to nor-pristane, and *n*-C_{40} assigned to *n*-C_{39}. All calibration solution compounds that fall within the window were used to generate the average RF for TPH. TPH was quantified by integrating the total C_9-C_{44} area after blank subtraction. Calibration check standards representative of the mid-level of the initial calibration and the instrument blank were analyzed every 10 samples. The check standard's response was compared versus the average RF of the respective analytes contained in the initial calibration. All authentic samples and quality control samples were bracketed by passing mid-check standards.

Modified EPA Method 8270D was conducted via gas chromatography-mass spectrometry (GC-MS; Agilent 7890 GC with 5975c MS) with the MS operated in the selected ion monitoring (SIM) mode for improved sensitivity. The oil and net extracts were injected (1 μL, pulsed splitless) into the GC containing a 60m x 0.25 mm ID, 0.25 μm film, Phenomenex ZB-5 capillary column and the oven programmed from 35°C (1 min) and ramped at 6°C/min to 315°C (30 min) using He as the carrier gas.

The analysis was used to determine the concentrations of 79 parent and alkylated decalins, polycyclic aromatic hydrocarbons (PAH), and sulfur-containing aromatics, as well as 62 petroleum biomarkers, including tricyclic and pentacyclic triterpanes, regular steranes, rearranged steranes, and triaromatic steroids.

In each analysis, prior to sample analysis, the GC-MS was tuned with perfluorotributylamine (PFTBA) at the beginning of each analytical sequence. A minimum 5-point initial calibration consisting of selected target compounds was established to demonstrate the linear range of the analysis. Analyte concentrations in the standard solutions ranged from 0.01 to 10.0 ng/μL for PAH and 0.01 to 20.0 ng/μL for biomarkers. Quantification of target compounds was performed by the method of internal standards using average response factor (RF) determined in the 5-point initial calibration. Alkylated PAHs were quantified using the RF of the corresponding parent, triterpanes were quantified using the RF's for 17α(H),21β(H)-hopane, and steranes and triaromatic steroids were quantified using the RF of 5β(H)-cholane. Biomarker identifications were based upon comparison to selected authentic standards (*Chiron Laboratories*), elution patterns in the peer-reviewed literature, and mass spectral interpretation from full scan GC/MS analyses conducted at Alpha.

Aliquots of each sample extract were used to determine the gravimetric weight of the recoverable oil, thereby allowing the concentrations of target analytes in the oil and net samples to be reported on an oil weight basis (mg/kg_{oil}). All concentrations are not surrogate corrected.

Attachment 3

Interpretation Methods

Data Interpretation

The chemical fingerprinting data collected were evaluated using current geochemical practice utilized in oil spill investigations.[2] For those objectives requiring detailed comparison among samples, the chemical fingerprinting data collected were evaluated using a multi-tiered approach based upon the Centre for European Norms (CEN) oil spill identification protocol, which is used worldwide by many laboratories.[3] Tier 1 involved a qualitative review of each sample's overall (GC/FID) fingerprint that determined the character, boiling range, and weathering state of any oil present. Tier 2 was a 2-step comparison whereupon (a) the first step involved a qualitative review of each sample's PAH (GC/MS EIPs, *m/z* 198, 192, 216, and 242) and biomarker fingerprints (GC/MS EIPs, *m/z* 83, 85, 191, 177, 217, 218, and 231) and (b) the second step utilized the CEN protocol's statistical comparison of diagnostic ratios calculated from PAH and/or biomarker concentrations.[4] Finally, a synthesis of the Tier 1 and Tier 2 results serve to as a confirmation check, before reaching one of the following conclusions:

Positive Match: the samples are considered to match to a high degree of scientific certainty; any differences are explained by weathering and/or are less than the precision of the method.

Probable Match: the samples are considered to match to a reasonable degree of scientific certainty; any differences are possibly explained by weathering, mixing, and/or sample heterogeneity.

Inconclusive: the samples results preclude any other conclusion, often owing to small sample size leading to low data quality.

Non-Match: the samples are considered to not match to a high degree of scientific certainty; any differences are not explained by weathering and/or are greater than the precision of the method.

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[2] Stout, S.A. and Wang, Z. (2016). Chemical fingerprinting methods and factors affecting petroleum fingerprints in the environment. In: *Standard Handbook of Oil Spill Environmental Forensics: Fingerprinting and Source Identification*, 2nd Ed., S.A. Stout and Z. Wang, Eds., Elsevier Publishing Co., Boston, MA, p. 61-130.

[3] Kienhaus, P.G.M. et al. 2016. CEN methodology for oil spill identification. In: *Standard Handbook of Oil Spill Environmental Forensics: Fingerprinting and Source Identification*, 2nd Ed., S.A. Stout and Z. Wang, Eds., Elsevier Publishing Co., Boston, MA, p. 685-728.

[4] The quantitative (statistical) comparisons relied upon the 95% confidence level ($r_{95\%}$) for each diagnostic ratio wherein:

$$r_{95\%} = 2.8 * RSD_R \quad where\ RSD_R = 5\%\ \text{standard error, thus}$$

$$r_{95\%} = 14\%$$

If the $r_{95\%}$ between the measured diagnostic between two samples <14% the ratios were considered to statistically **match**, and *vice versa*.

Attachment 4

Tabulated Concentrations

Table 4-1: Concentrations (mg/kg) of n-alkanes and isoprenoids in the samples studied.

Client ID	7B	7B (Dup)	110159	STOCK TANK	BRINE WELL 22 BS	Brine Well 22 BS (Dup)	CENTRAL POND
Lab ID	L2305221-04	WG1740064-5	L2305221-02	L2305221-03	L2305221-01	WG1740214-5	L2305221-05
Analytes	Result	Result	Result	Result	Result	Result	Result
n-Nonane (C9)	9,530	9,610	438	7,050	10	10	nd
n-Decane (C10)	8,570	8,680	860	6,610	nd	nd	58
n-Undecane (C11)	8,120	8,270	966	6,460	9	8	33
n-Dodecane (C12)	7,530	7,570	773	6,120	nd	nd	48
n-Tridecane (C13)	6,840	6,990	1,200	5,780	nd	nd	42
2,6,10 Trimethyldodecane (1380)	1,330	1,370	1,190	1,210	61	55	nd
n-Tetradecane (C14)	6,270	6,370	1,310	5,370	82	77	42
2,6,10 Trimethyltridecane (1470)	1,890	1,920	1,920	1,840	nd	nd	88
n-Pentadecane (C15)	6,240	6,450	1,470	5,700	nd	nd	329
n-Hexadecane (C16)	5,310	5,380	1,080	4,580	nd	nd	50
Norpristane (1650)	1,180	1,200	1,160	1,090	nd	nd	26
n-Heptadecane (C17)	4,550	4,620	631	3,850	nd	nd	544
Pristane	1,940	1,910	2,680	1,960	nd	nd	nd
n-Octadecane (C18)	4,150	4,140	488	3,560	274	289	1,720
Phytane	1,900	1,920	849	1,640	nd	nd	nd
n-Nonadecane (C19)	3,750	3,840	512	3,280	nd	nd	112
n-Eicosane (C20)	3,530	3,620	515	3,110	nd	nd	29
n-Heneicosane (C21)	2,820	2,880	404	2,490	nd	nd	63
n-Docosane (C22)	2,430	2,480	386	2,160	nd	nd	55
n-Tricosane (C23)	2,040	2,040	304	1,780	nd	nd	807
n-Tetracosane (C24)	1,940	1,950	281	1,740	nd	nd	64
n-Pentacosane (C25)	1,970	2,020	703	1,880	202	205	1,040
n-Hexacosane (C26)	1,450	1,480	247	1,310	nd	nd	99
n-Heptacosane (C27)	1,170	1,180	210	1,020	nd	nd	730
n-Octacosane (C28)	1,010	1,010	143	860	nd	nd	196
n-Nonacosane (C29)	993	988	158	797	nd	nd	1,320
n-Triacontane (C30)	882	893	nd	689	nd	nd	244
n-Hentriacontane (C31)	794	800	nd	604	nd	nd	1,540
n-Dotriacontane (C32)	817	807	787	706	943	909	203
n-Tritriacontane (C33)	644	661	323	500	328	332	696
n-Tetratriacontane (C34)	620	592	341	462	371	369	nd
n-Pentatriacontane (C35)	590	586	nd	410	nd	nd	533
n-Hexatriacontane (C36)	325	321	nd	219	nd	nd	1,880
n-Heptatriacontane (C37)	352	380	nd	238	nd	nd	nd
n-Octatriacontane (C38)	323	332	nd	191	nd	nd	nd
n-Nonatriacontane (C39)	273	277	nd	147	nd	nd	78
n-Tetracontane (C40)	263	262	nd	134	nd	nd	nd
Total Saturated Hydrocarbons	104,000	106,000	22,300	87,500	2,280	2,250	12,700
Total Petroleum Hydrocarbons (C9-C44)	629,000	640,000	731,000	705,000	660,000	661,000	348,000

Table 4-2: Concentrations (mg/kg) of PAHs, related compounds and petroleum biomarkers in the samples studied.

	Client ID	7B	7B (Dup)	110159	STOCK TANK	BRINE WELL 22 BS	Brine Well 22 BS (Dup)	CENTRAL POND
	Lab ID	L2305221-04	WG1740064-5	L2305221-02	L2305221-03	L2305221-01	WG1740214-5	L2305221-05
	Analytes	Result	Result	Result	Result	Result	Result	Result
D0	cis/trans-Decalin	236.0	235.0	802	227	1.37	1.35	10.5
D1	C1-Decalins	349.0	352.0	1000	348	13.9	13.3	40.8
D2	C2-Decalins	282	281	818	347	122	130	23.4
D3	C3-Decalins	162	169	470	264	157	150	nd
D4	C4-Decalins	149	166	551	288	290	292	nd
BT0	Benzothiophene	10.70	10.50	7.37	9.15	nd	nd	nd
BT1	C1-Benzo(b)thiophenes	49.9	49.7	27.3	43.5	3.14	3.22	nd
BT2	C2-Benzo(b)thiophenes	171.00	173.00	25.5	150	8.28	6.84	nd
BT3	C3-Benzo(b)thiophenes	296.0	302.0	41.7	264	27.5	26.7	nd
BT4	C4-Benzo(b)thiophenes	216.0	220.0	26.5	191	nd	nd	nd
N0	Naphthalene	276.0	275.0	192	235	0.224	nd	15.2
N1	C1-Naphthalenes	842	851	836	709	1.50	1.36	14.7
N2	C2-Naphthalenes	1220	1240	1460	1070	9.21	7.07	58.7
N3	C3-Naphthalenes	971	986	1090	857	29.0	26.8	14.4
N4	C4-Naphthalenes	528	535	602	494	102	102	nd
B	Biphenyl	49	50	53.4	56.9	nd	nd	20.3
DF	Dibenzofuran	29.3	30	46.9	24.6	nd	nd	18.8
AY	Acenaphthylene	4.98	4.06	8.12	4.67	3.10	2.84	1.20
AE	Acenaphthene	10.1	10.5	15.8	13.3	2.76	2.66	6.82
F0	Fluorene	59.3	61.3	60.8	47.2	nd	nd	5.27
F1	C1-Fluorenes	158	160	164	133	16.1	16.0	7.99
F2	C2-Fluorenes	249	254	252	228	69.7	70.1	nd
F3	C3-Fluorenes	246	250	203	242	127	125	nd
A0	Anthracene	10.3	10.6	8.29	10.1	3.15	3.26	6.89
P0	Phenanthrene	128.0	130.0	133	110	4.10	3.01	45.6
PA1	C1-Phenanthrenes/Anthracenes	328	330	286	283	30.1	28.4	39.0
PA2	C2-Phenanthrenes/Anthracenes	368	379	310	342	99.0	98.2	15.9
PA3	C3-Phenanthrenes/Anthracenes	260	270	199	243	119	122	nd
PA4	C4-Phenanthrenes/Anthracenes	127.0	134.0	95.3	124	94.8	91.4	nd
RET	Retene	nd	nd	60.3	nd	nd	nd	nd
DBT0	Dibenzothiophene	282.0	282.0	27.4	200	nd	nd	3.90
DBT1	C1-Dibenzothiophenes	628.0	642.0	95.1	488	7.71	10.0	6.43
DBT2	C2-Dibenzothiophenes	841	863	93.2	675	26.6	27.4	13.6
DBT3	C3-Dibenzothiophenes	683	707	82.6	570	51.2	53.6	nd
DBT4	C4-Dibenzothiophenes	349.0	359.0	42.8	303	36.0	35.4	nd
BF	Benzo(b)fluorene	nd	nd	4.13	5.34	2.86	2.95	8.01
FL0	Fluoranthene	1.80	1.33	3.60	2.88	1.70	1.79	65.1
PY0	Pyrene	11.5	11.7	8.56	14.9	4.75	4.66	61.4
FP1	C1-Fluoranthenes/Pyrenes	53.5	53.5	42.4	60.4	32.8	35.0	33.3
FP2	C2-Fluoranthenes/Pyrenes	112.0	113.0	65.1	112	70.7	67.7	26.8
FP3	C3-Fluoranthenes/Pyrenes	148.0	151.0	80.4	140	113	146	nd
FP4	C4-Fluoranthenes/Pyrenes	126.0	130.0	67.9	121	108	131	nd
NBT0	Naphthobenzothiophenes	65.30	66.60	8.30	48.7	3.12	2.70	12.6
NBT1	C1-Naphthobenzothiophenes	215.0	220.0	24.9	170	23.1	29.5	12.2
NBT2	C2-Naphthobenzothiophenes	321.0	328.0	33.0	261	38.0	44.8	20.0
NBT3	C3-Naphthobenzothiophenes	286.0	294.0	24.0	237	41.8	48.2	21.0
NBT4	C4-Naphthobenzothiophenes	203.0	208.0	25.1	176	37.7	51.0	nd
BA0	Benz[a]anthracene	1.49	1.79	1.69	3.63	1.24	0.900	33.2
C0	Chrysene/Triphenylene	19.6	20.8	11.3	20.2	12.8	12.7	56.5
BC1	C1-Chrysenes	48.2	49.2	29.6	57.9	28.1	27.3	16.8
BC2	C2-Chrysenes	77.7	78.0	43.0	88.6	51.2	54.3	nd
BC3	C3-Chrysenes	104.0	110.0	55.0	112	91.1	87.6	nd
BC4	C4-Chrysenes	80.7	83.4	39.0	80.8	72.5	69.8	nd

Table 4-2: continued

	Client ID	7B	7B (Dup)	110159	STOCK TANK	BRINE WELL 22 BS	Brine Well 22 BS (Dup)	CENTRAL POND
	Lab ID	L2305221-04	WG1740064-5	L2305221-02	L2305221-03	L2305221-01	WG1740214-5	L2305221-05
	Analytes	Result	Result	Result	Result	Result	Result	Result
BBF	Benzo[b]fluoranthene	3.48	3.84	2.10	3.70	2.12	2.30	55.0
BJKF	Benzo[j]fluoranthene/Benzo[k]fluoranthene	nd	nd	nd	nd	nd	nd	34.0
BAF	Benzo[a]fluoranthene	nd	nd	nd	nd	nd	nd	6.31
BEP	Benzo[e]pyrene	8.50	9.08	2.90	9.24	4.72	4.40	41.4
BAP	Benzo[a]pyrene	1.44	1.92	1.89	4.02	1.24	1.11	39.6
PER	Perylene	nd	nd	7.48	5.53	8.56	9.24	10.1
IND	Indeno[1,2,3-cd]pyrene	nd	nd	0.790	1.09	nd	nd	32.6
DA	Dibenz[ah]anthracene/Dibenz[ac]anthrace	nd	nd	nd	1.01	nd	nd	8.21
GHI	Benzo[g,h,i]perylene	3.20	2.80	1.59	2.86	2.07	1.98	41.4
CAR	Carbazole	6.76	6.12	nd	3.68	nd	nd	3.82
4MDT	4-Methyldibenzothiophene	266.0	268.0	34.6	203	3.30	3.65	2.91
2MDT	2/3-Methyldibenzothiophene	228.0	232.0	46.1	177	nd	nd	nd
1MDT	1-Methyldibenzothiophene	124.00	125.00	9.10	93.9	1.78	2.41	1.70
3MP	3-Methylphenanthrene	59.0	60.0	67.3	54.7	5.80	5.98	nd
2MP	2-Methylphenanthrene	74	75	64.7	64.7	3.80	3.32	5.69
2MA	2-Methylanthracene	2.53	2.38	4.35	3.79	3.12	3.17	3.84
9MP	9/4-Methylphenanthrene	114.0	117.0	86.6	93.1	9.24	8.63	nd
1MP	1-Methylphenanthrene	74.8	73.2	56.6	59.0	5.77	5.81	nd
2MN	2-Methylnaphthalene	738	747	882	638	1.06	0.886	14.7
1MN	1-Methylnaphthalene	663	669	501	541	nd	nd	7.01
26DMN	2,6-Dimethylnaphthalene	606	615	889	548	1.51	nd	87.9
235TMN	2,3,5-Trimethylnaphthalene	153	128	158	117	nd	nd	nd
PY2	2-METHYLPYRENE	3.77	3.69	3.13	7.11	2.28	2.98	3.10
PY4	4-METHYLPYRENE	13.9	13.8	5.71	14.6	4.96	4.68	2.84
PY1	1-METHYLPYRENE	8.33	8.51	3.46	10.3	3.55	3.66	2.08
T4	C23 Tricyclic Terpane	21.60	20.00	16.7	22.1	27.8	26.7	nd
T5	C24 Tricyclic Terpane	10.50	10.20	11.1	10.1	18.1	17.1	nd
T6	C25 Tricyclic Terpane	13.3	11.8	17.5	15.4	25.8	21.2	nd
T6a	C24 Tetracyclic Terpane	14.60	13.00	20.9	16.7	40.0	38.5	nd
T6b	C26 Tricyclic Terpane-22S	4.98	3.9	5.61	3.95	11.6	9.73	nd
T6c	C26 Tricyclic Terpane-22R	4.52	3.93	6.26	3.96	8.56	8.26	nd
T7	C28 Tricyclic Terpane-22S	3.86	3.34	6.82	6.02	10.1	11.8	nd
T8	C28 Tricyclic Terpane-22R	4.39	5.5	10.7	6.62	12.3	12.7	nd
T9	C29 Tricyclic Terpane-22S	5.59	5.3	9.75	7.25	15.4	19.0	nd
T10	C29 Tricyclic Terpane-22R	4.52	5.13	10.5	5.67	14.4	11.8	nd
T11	18a-22,29,30-Trisnorneohopane-TS	23.2	23	79.2	39.5	116	115	nd
T11a	C30 Tricyclic Terpane-22S	5.78	6.84	13.0	7.72	29.6	27.5	nd
T11b	C30 Tricyclic Terpane-22R	6.67	6.83	8.19	6.78	11.0	12.1	nd
T12	17a(H)-22,29,30-Trisnorhopane-TM	27.6	28.7	115	49.7	148	150	nd
T14a	17a/b,21b/a 28,30-Bisnorhopane	20	19.4	30.1	19.7	36.3	32.5	nd
T14b	17a(H),21b(H)-25-Norhopane	nd	nd	10.6	3.87	17.7	19.0	nd
T15	30-Norhopane	81.2	84.6	339	140	416	410	27.3
T16	18a(H)-30-Norneohopane-C29Ts	20.3	21.7	130	38.7	191	197	nd
X	17a(H)-Diahopane	nd	nd	26.9	8.65	51.0	48.6	nd
T17	30-Normoretane	9.47	8.9	95.6	27.0	121	126	nd
T18	18a(H)&18b(H)-Oleananes	4.07	3.48	56.1	17.2	108	111	nd
T19	Hopane	99.9	97.3	549	190	604	612	33.5
T20	Moretane	7.03	6.46	109	28.3	118	120	21.5
T21	30-Homohopane-22S	58.5	58.5	143	77.8	158	158	21.1
T22	30-Homohopane-22R	44.5	45.4	126	67.1	142	138	23.3

Table 4-2: continued

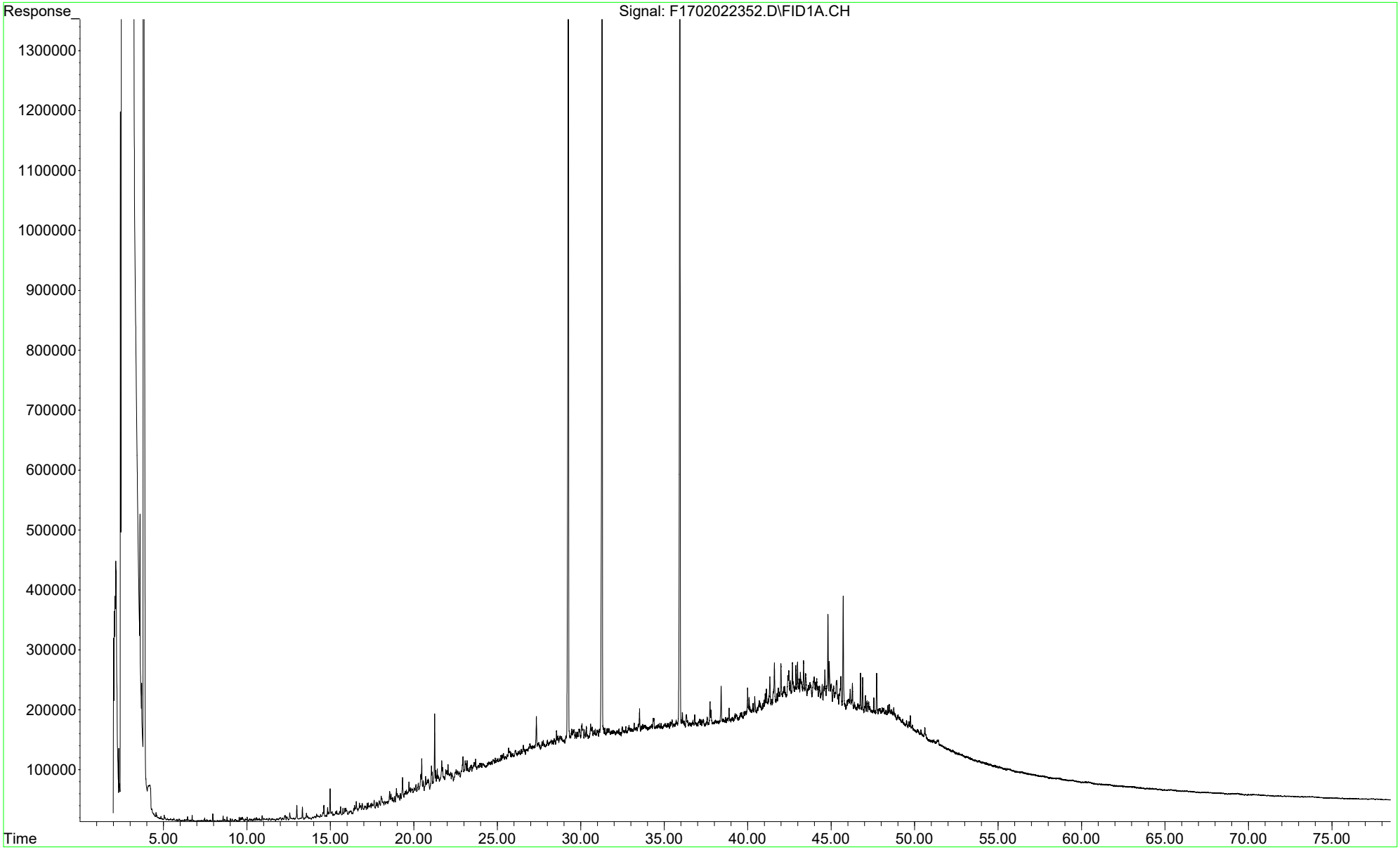
	Client ID	7B	7B (Dup)	110159	STOCK TANK	BRINE WELL 22 BS	Brine Well 22 BS (Dup)	CENTRAL POND
	Lab ID	L2305221-04	WG1740064-5	L2305221-02	L2305221-03	L2305221-01	WG1740214-5	L2305221-05
	Analytes	Result	Result	Result	Result	Result	Result	Result
T22A	T22a-Gammacerane/C32-diahopane	11.2	10.5	32.6	15.7	63.5	63.8	nd
T26	30,31-Bishomohopane-22S	36.6	36.3	72.4	44.3	88.4	85.8	53.3
T27	30,31-Bishomohopane-22R	26.8	27.1	129	38.0	182	182	nd
T30	30,31-Trishomohopane-22S	25.8	27.1	45.8	33.1	50.7	48.7	nd
T31	30,31-Trishomohopane-22R	16.1	19.6	31.2	25.0	34.0	33.0	nd
T32	Tetrakishomohopane-22S	20.1	20.2	26.2	21.9	36.3	33.0	nd
T33	Tetrakishomohopane-22R	12.3	15	21.4	13.0	19.7	25.6	51.2
T34	Pentakishomohopane-22S	20.1	17.3	15.1	16.6	15.4	18.5	nd
T35	Pentakishomohopane-22R	13.8	13.2	14.8	14.2	16.7	15.2	nd
S4	13b(H),17a(H)-20S-Diacholestane	27.8	27.0	66.5	32.3	95.8	102	nd
S5	13b(H),17a(H)-20R-Diacholestane	14.5	12.7	39.3	15.4	57.9	55.1	nd
S8	13b,17a-20S-Methyldiacholestane	15.0	12.1	34.7	15.5	60.3	65.8	nd
S12	14a(H),17a(H)-20S-Cholestane/13b(H),17a	33.6	35.6	71.4	41.0	127	129	8.67
S17	14a(H),17a(H)-20R-Cholestane/13b(H),17a	43.7	45.1	80.2	43.7	118	118	nd
S18	Unknown Sterane (S18)	8.2	8.8	22.0	11.5	41.3	47.3	nd
S19	13a,17b-20S-Ethyldiacholestane	3.6	3.9	3.32	2.79	4.63	4.37	nd
S20	14a,17a-20S-Methylcholestane	20.3	22.9	38.1	23.1	63.8	67.5	nd
S24	14a,17a-20R-Methylcholestane	19.0	17.8	30.3	21.9	33.6	35.6	nd
S25	14a(H),17a(H)-20S-Ethylcholestane	37.2	36.6	44.6	36.5	52.6	62.5	nd
S28	14a(H),17a(H)-20R-Ethylcholestane	26.3	28.1	39.9	27.2	49.4	47.2	nd
S14	14b(H),17b(H)-20R-Cholestane	31.0	31.4	23.0	29.6	21.5	20.8	nd
S15	14b(H),17b(H)-20S-Cholestane	31.8	30.4	26.4	30.4	32.0	32.2	nd
S22	14b,17b-20R-Methylcholestane	25.5	29.2	25.7	26.6	32.5	31.0	nd
S23	14b,17b-20S-Methylcholestane	33.3	34.7	33.5	33.3	49.8	54.7	nd
S26	14b(H),17b(H)-20R-Ethylcholestane	45.4	44.2	40.6	51.3	59.7	57.1	11.9
S27	14b(H),17b(H)-20S-Ethylcholestane	28.0	29.8	31.2	26.5	32.4	36.8	6.23
TAS05	C20 PREGNANE	93.1	92.2	62.5	82.6	70.6	56.3	nd
TAS06	C21 20-METHYLPREGNANE	95.5	99.2	45.9	83.2	63.2	61.5	nd
TAS07	C22 20-ETHYLPREGNANE (A)	35.2	37.6	12.7	32.0	25.2	20.7	nd
TAS08	C22 20-ETHYLPREGNANE (B)	18.9	18.1	13.2	14.0	22.7	19.4	nd
TAS09	C26,20S TAS	26	26.3	81.3	34.9	126	132	nd
TAS01	C26,20R+C27,20S TAS	194	202	250	198	446	427	20.9
TAS02	C28,20S TAS	135	140	199	155	366	362	23.7
TAS03	C27,20R TAS	148	150	153	146	253	250	16.4
TAS04	C28,20R TAS	114	116	158	130	287	304	13.0
TAS10	C29,20S TAS	52.3	56.2	57.9	45.8	106	98.3	nd
TAS11	C29,20R TAS	24.7	23	40.3	19.6	71.7	62.8	nd

Attachment 5

GC/FID Chromatograms

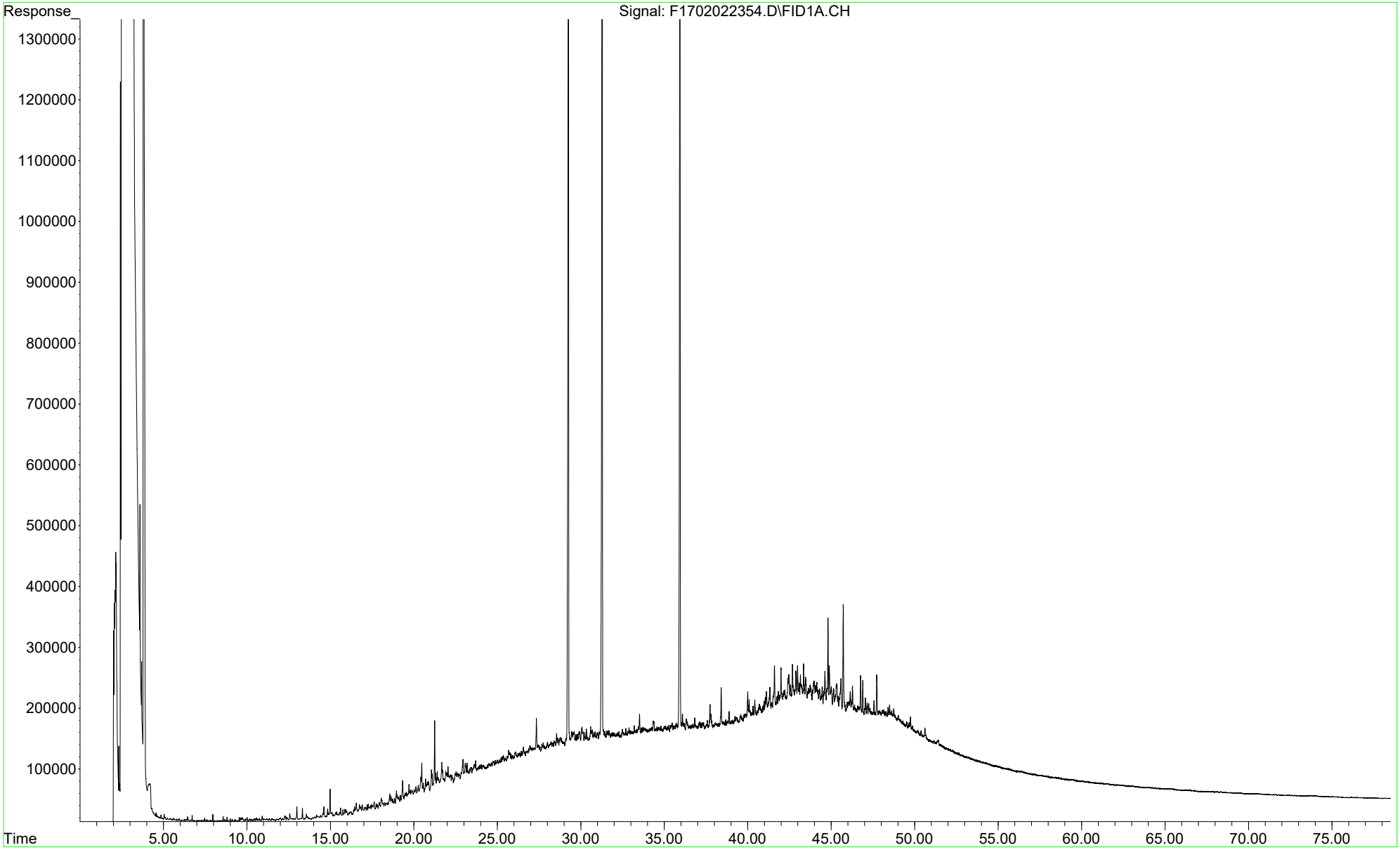
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702022352.D
Operator : FID17:WR
Instrument : FID17
Acquired : 04 Feb 2023 2:08 am using AcqMethod FID17A.M
Sample Name: l2305221-01,42,,
Misc Info : WG1740267,WG1740214,ICAL19667

BRINE WELL 22 BS
L2305221-01



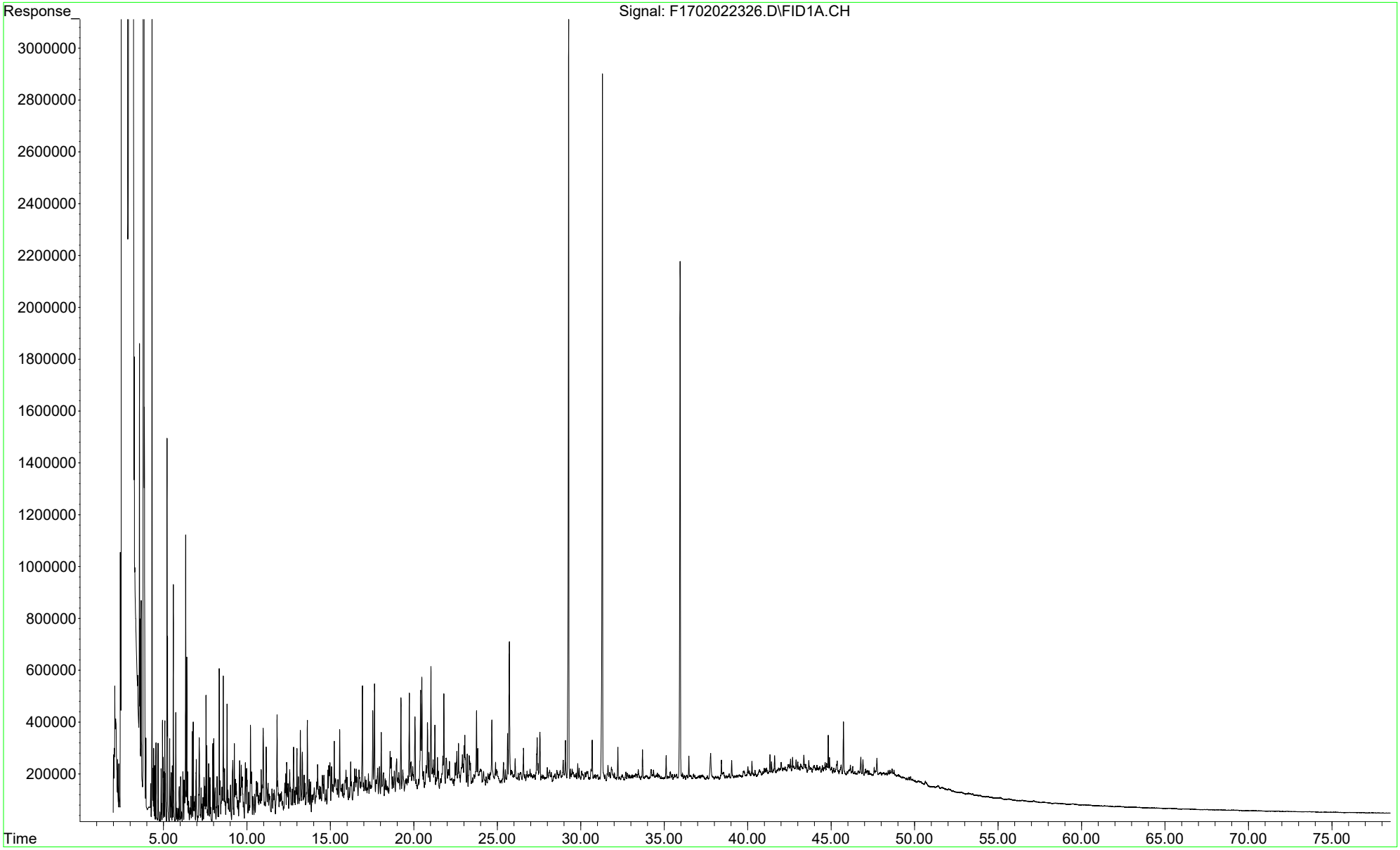
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702022354.D
Operator : FID17:WR
Instrument : FID17
Acquired : 04 Feb 2023 3:37 am using AcqMethod FID17A.M
Sample Name: WG1740214-5,42,,
Misc Info : WG1740267,WG1740214,ICAL19667

BRINE WELL 22 BS Duplicate
WG1740214-5



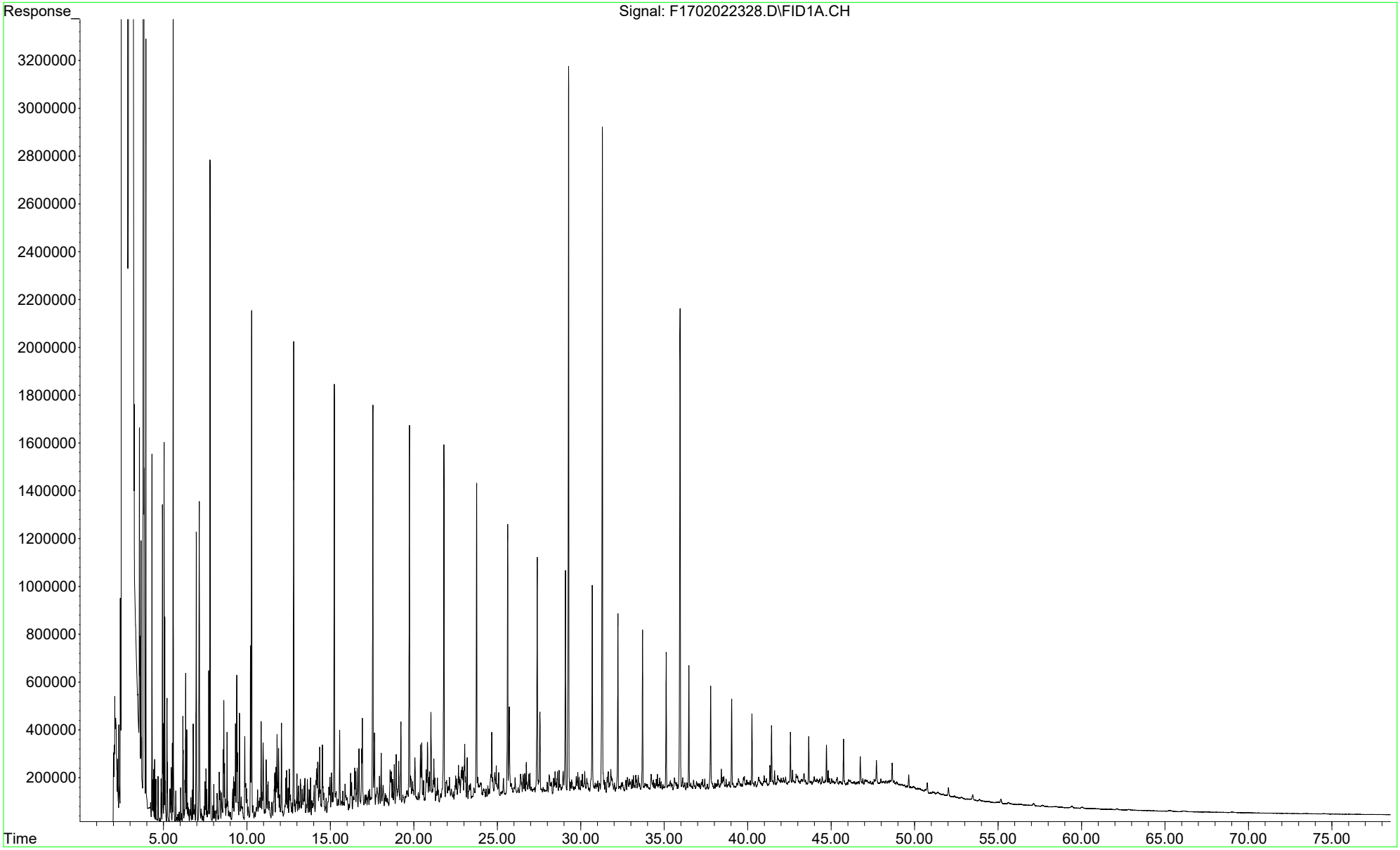
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702022326.D
Operator : FID17:WR
Instrument : FID17
Acquired : 03 Feb 2023 6:42 am using AcqMethod FID17A.M
Sample Name: l2305221-02,42,,
Misc Info : WG1740267,WG1740064,ICAL19667

110159
L2305221-02



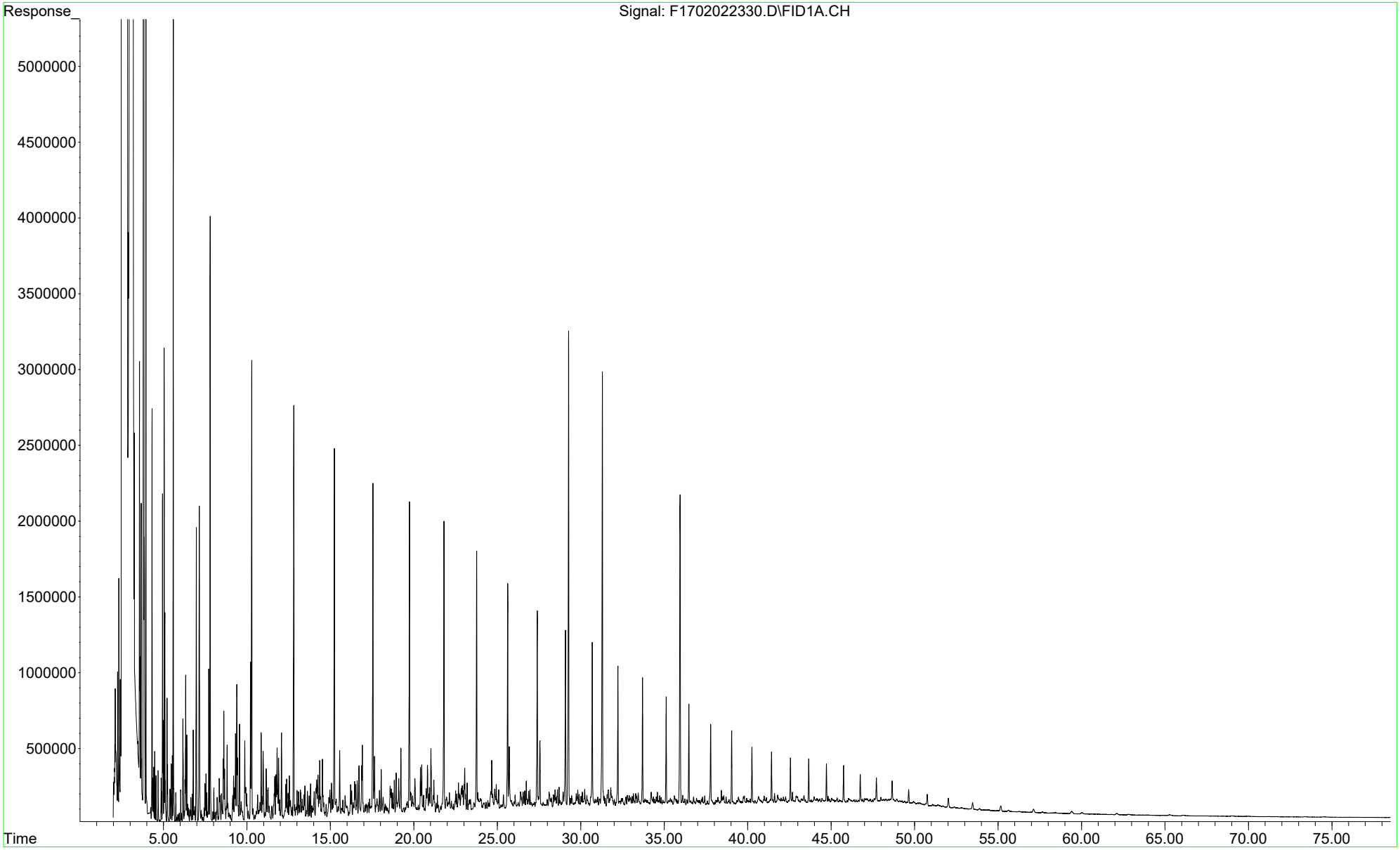
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702022328.D
Operator : FID17:WR
Instrument : FID17
Acquired : 03 Feb 2023 8:12 am using AcqMethod FID17A.M
Sample Name: l2305221-03,42,,
Misc Info : WG1740267,WG1740064,ICAL19667

STOCK TANK
L2305221-03



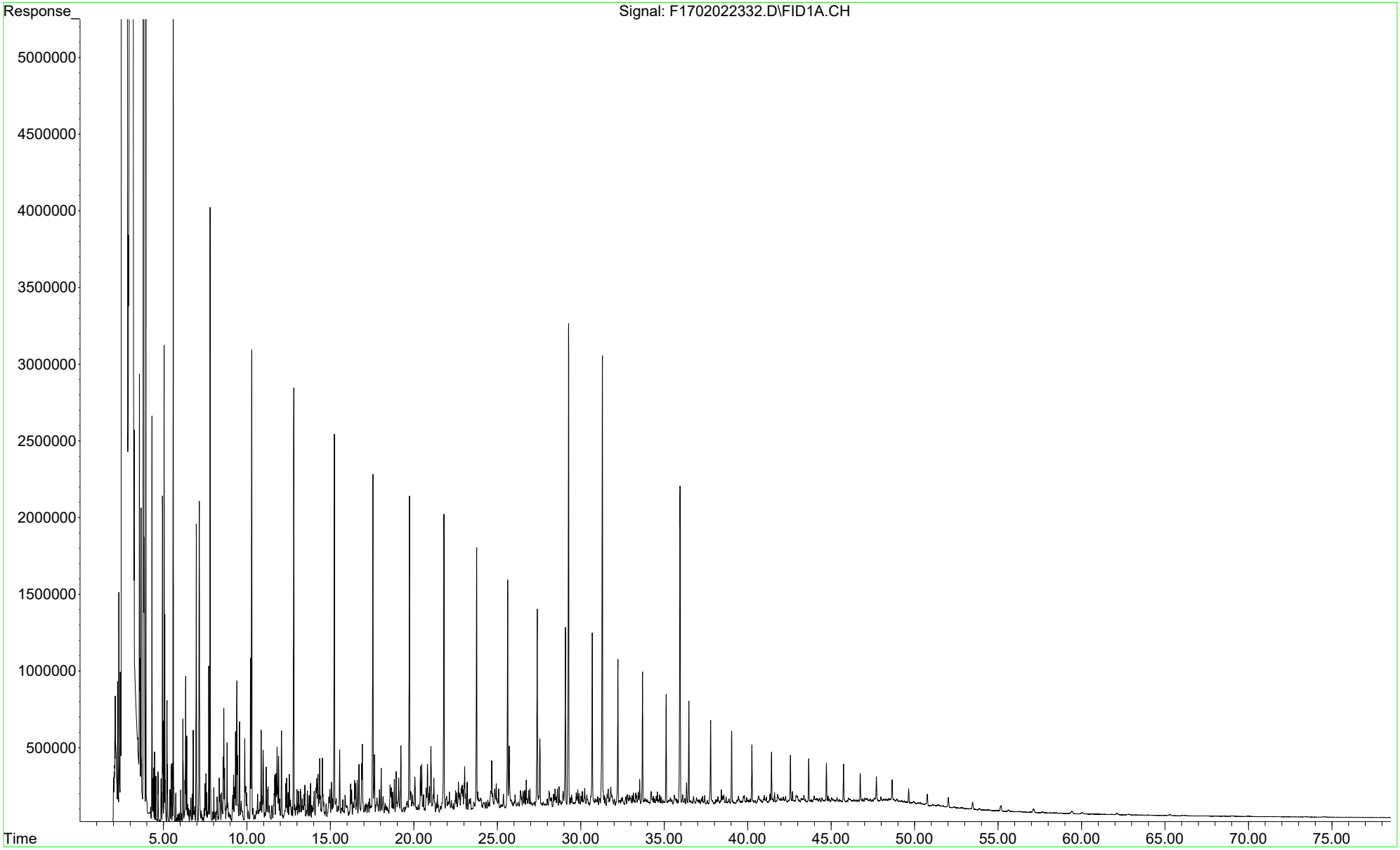
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702022330.D
Operator : FID17:WR
Instrument : FID17
Acquired : 03 Feb 2023 9:43 am using AcqMethod FID17A.M
Sample Name: l2305221-04,42,,
Misc Info : WG1740267,WG1740064,ICAL19667

7B
L2305221-04



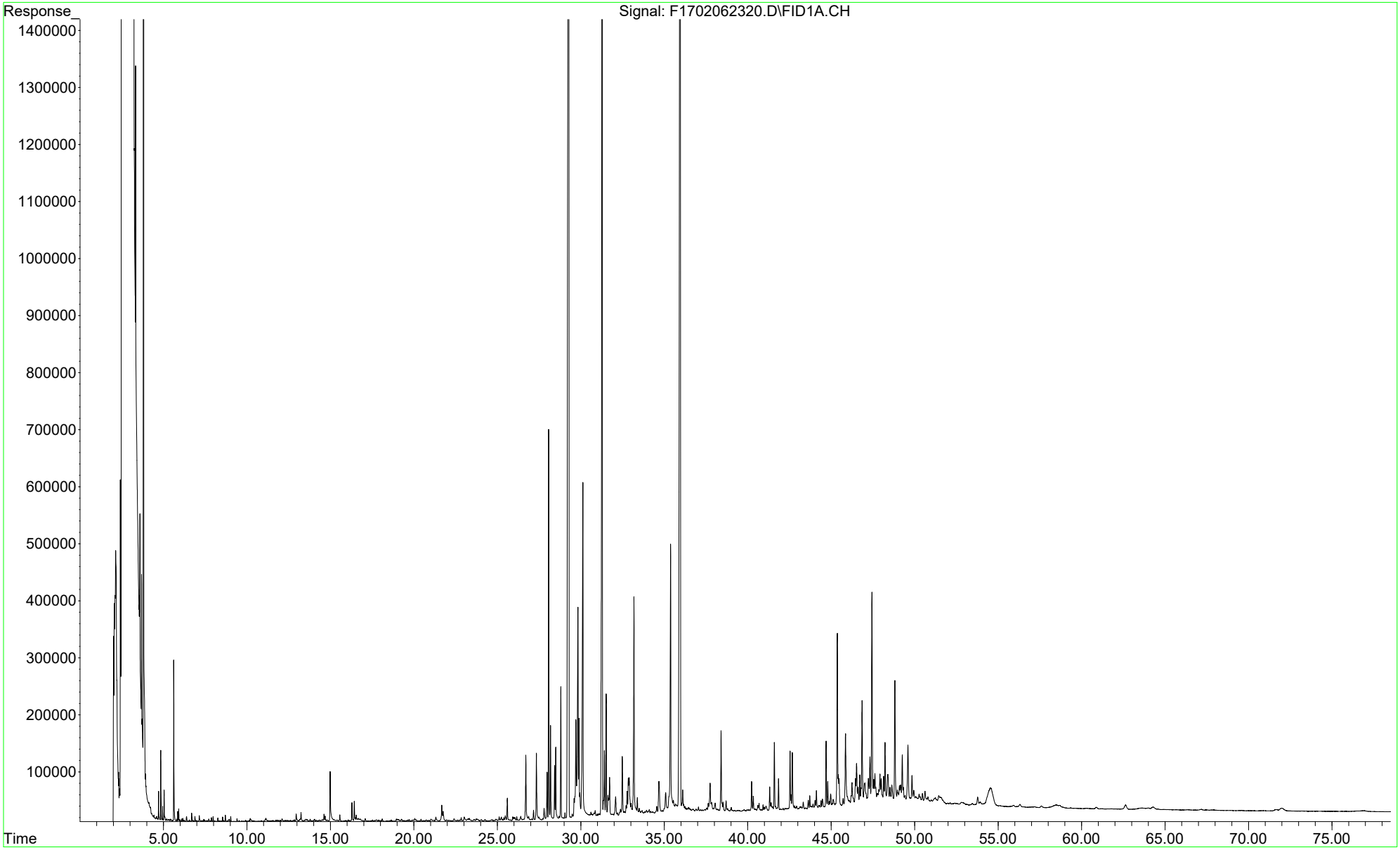
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702022332.D
Operator : FID17:WR
Instrument : FID17
Acquired : 03 Feb 2023 11:13 am using AcqMethod FID17A.M
Sample Name: WG1740064-5,42,,
Misc Info : WG1740267,WG1740064,ICAL19667

7B Duplicate
WG1740064-5



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\SH
... C\F1702062320.D
Operator : FID17:WR
Instrument : FID17
Acquired : 07 Feb 2023 1:42 am using AcqMethod FID17A.M
Sample Name: l2305221-05,42,,
Misc Info : WG1741452,WG1740246,ICAL19667

CENTRAL POND
L2305221-05

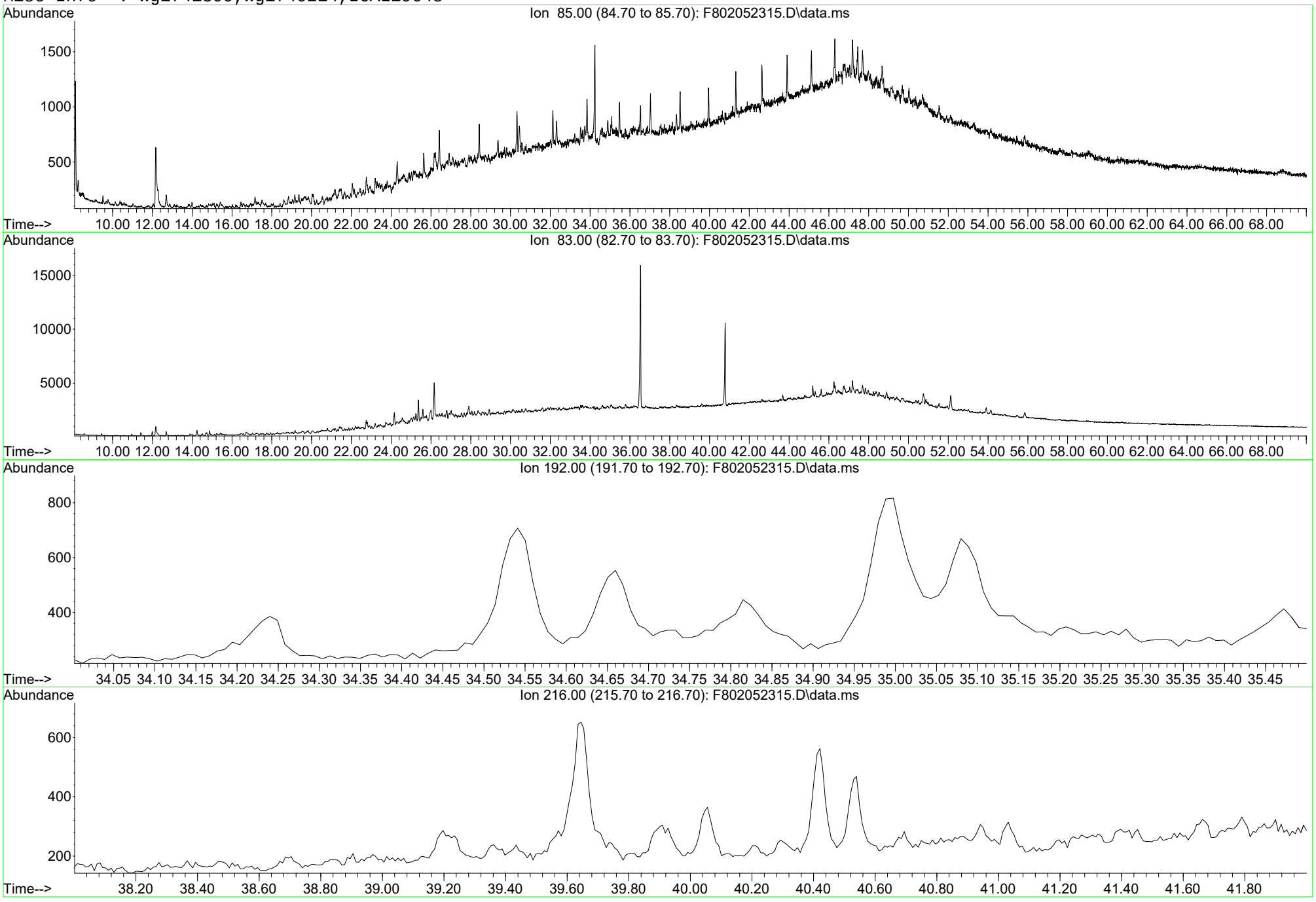


Attachment 6

GC/MS Extracted Ion Profiles

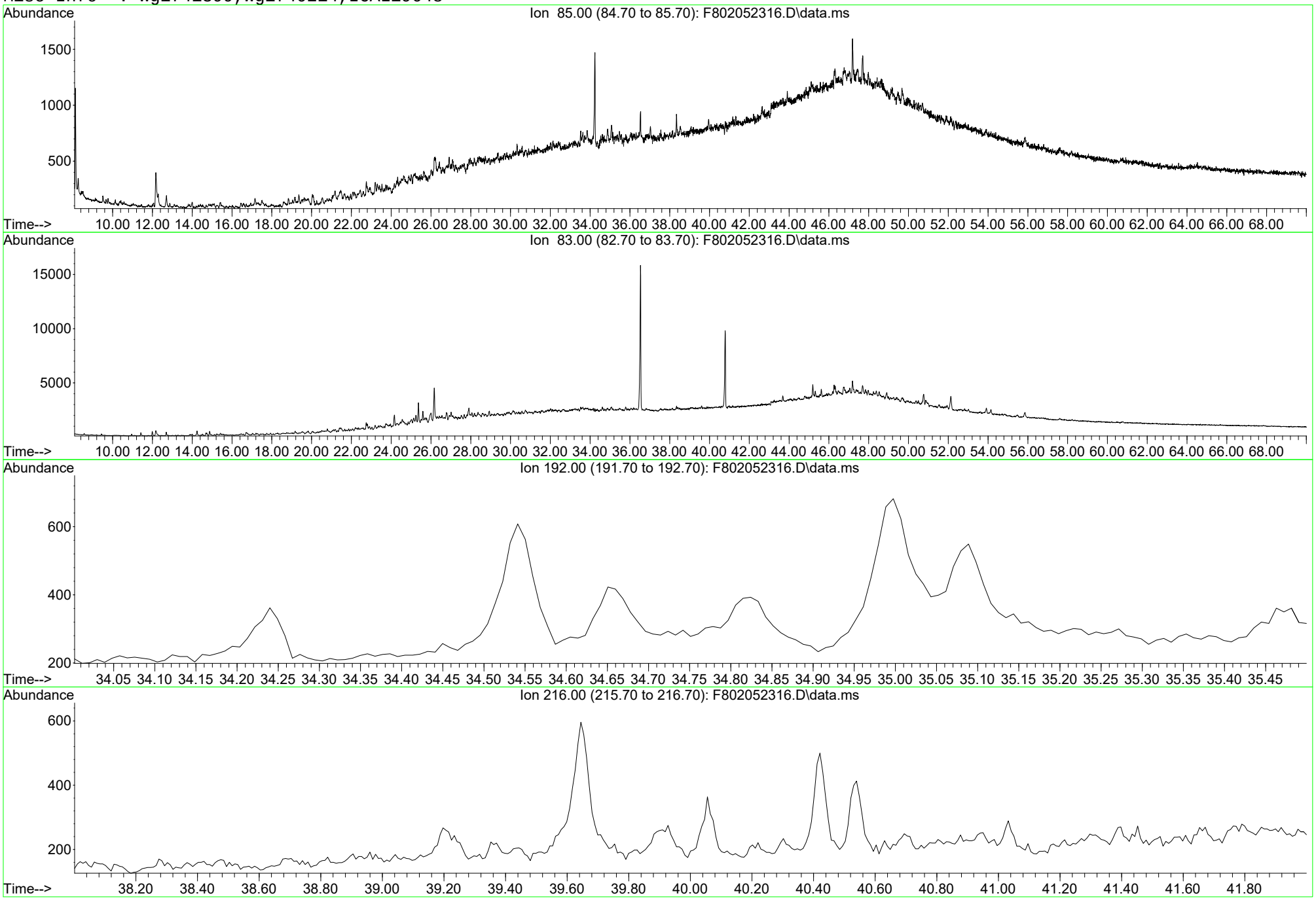
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802052315.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 6 Feb 2023 7:01 am using AcqMethod FRNC8A.M
Sample Name: l2305221-01,32,,
Misc Info : wg1741399,wg1740214,ICAL19648

BRINE WELL 22 BS
L2305221-01



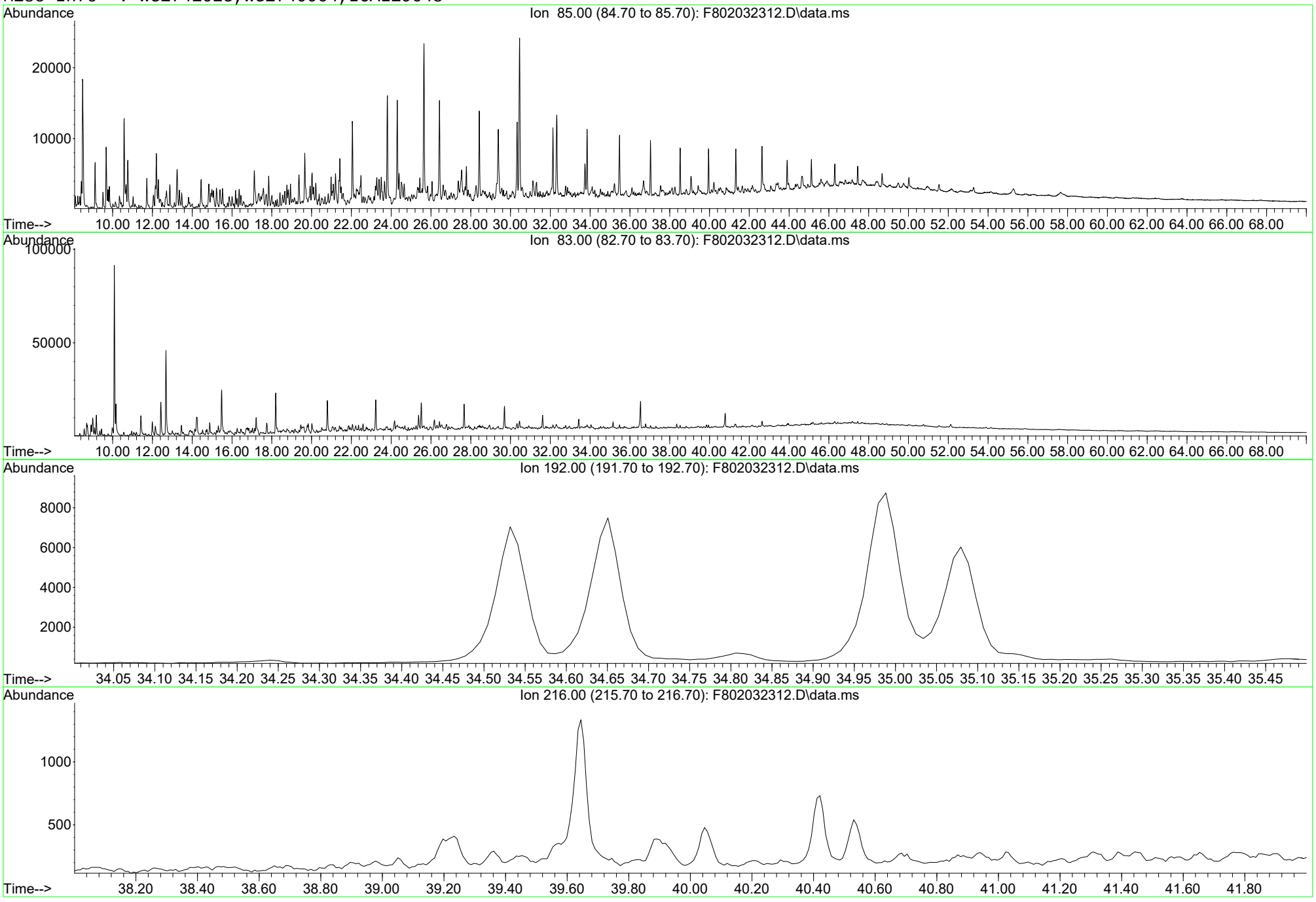
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802052316.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 6 Feb 2023 8:27 am using AcqMethod FRNC8A.M
Sample Name: wg1740214-5,32,,
Misc Info : wg1741399,wg1740214,ICAL19648

BRINE WELL 22 BS Duplicate
WG1740214-5



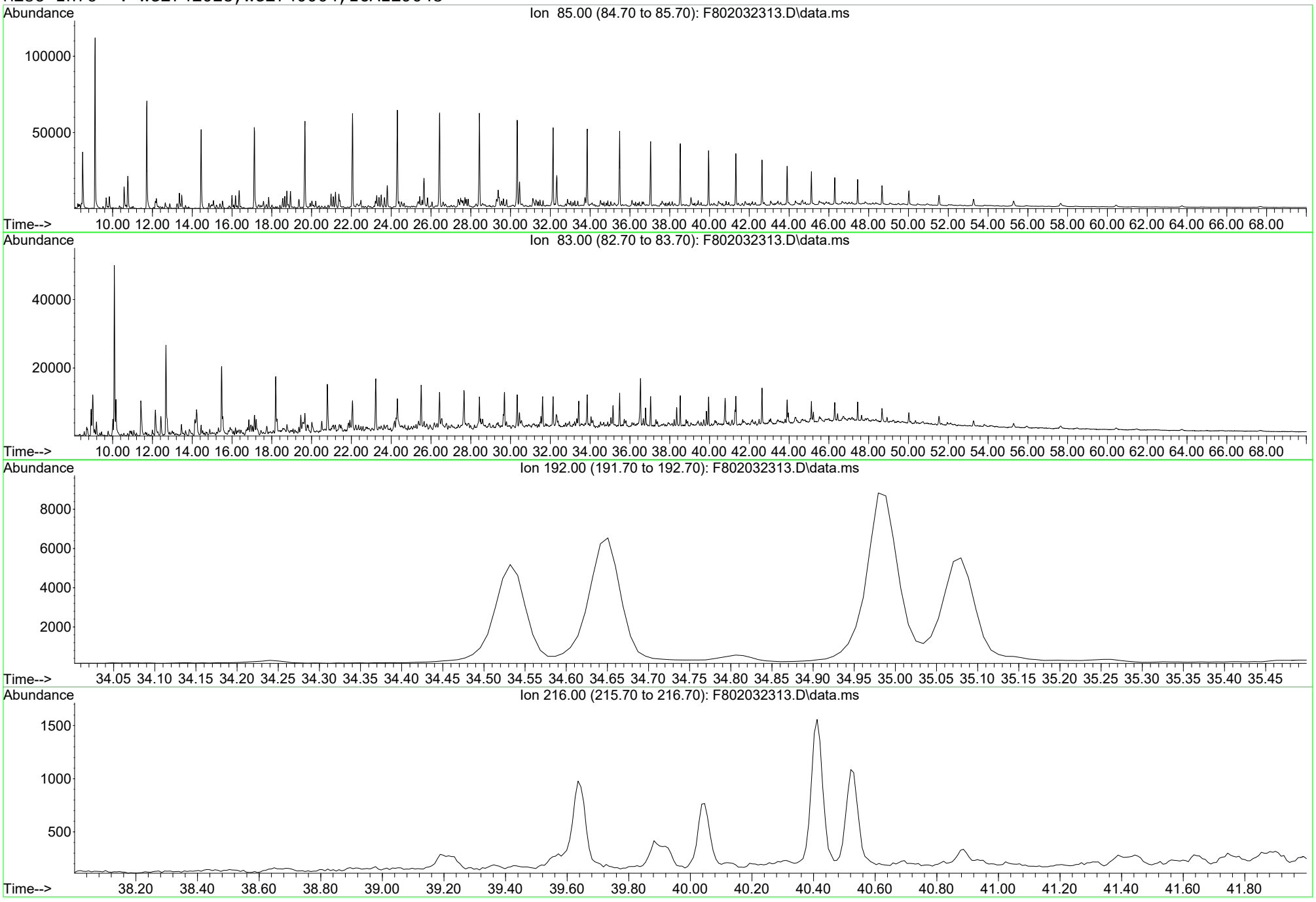
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802032312.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 1:27 am using AcqMethod FRNC8A.M
Sample Name: L2305221-02,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

110159
L2305221-02



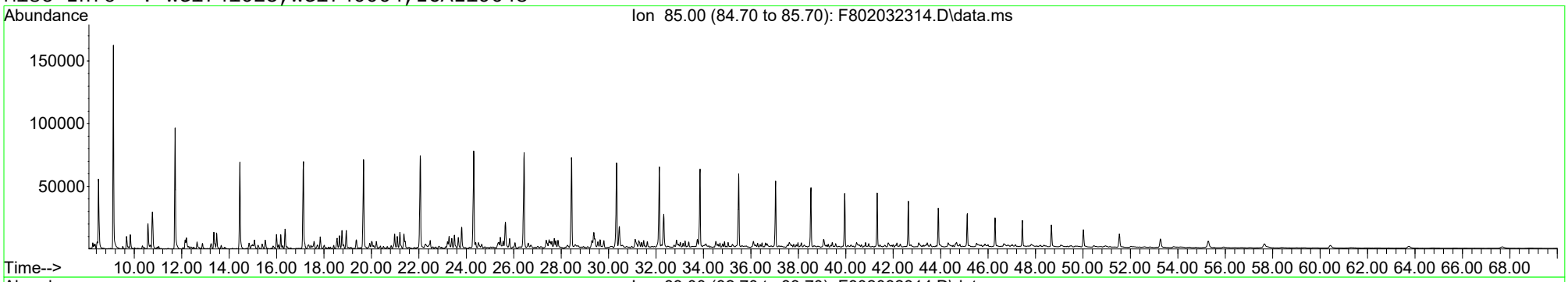
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802032313.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 2:52 am using AcqMethod FRNC8A.M
Sample Name: L2305221-03,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

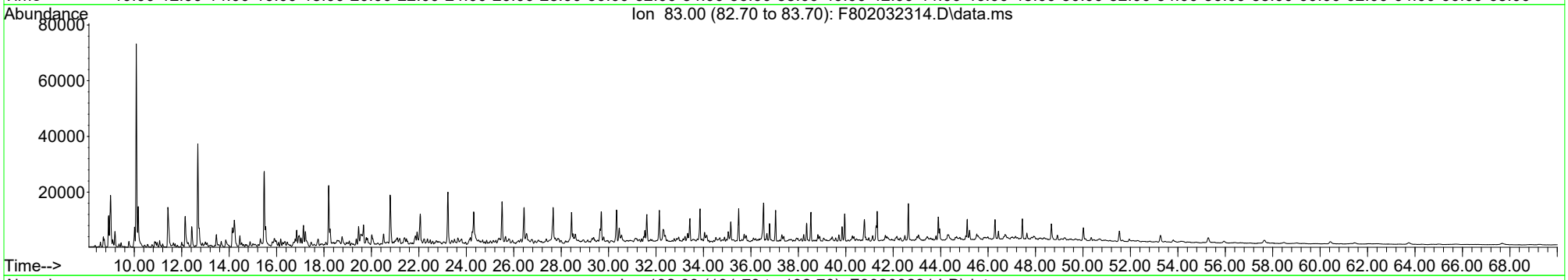
STOCK TANK
L2305221-03

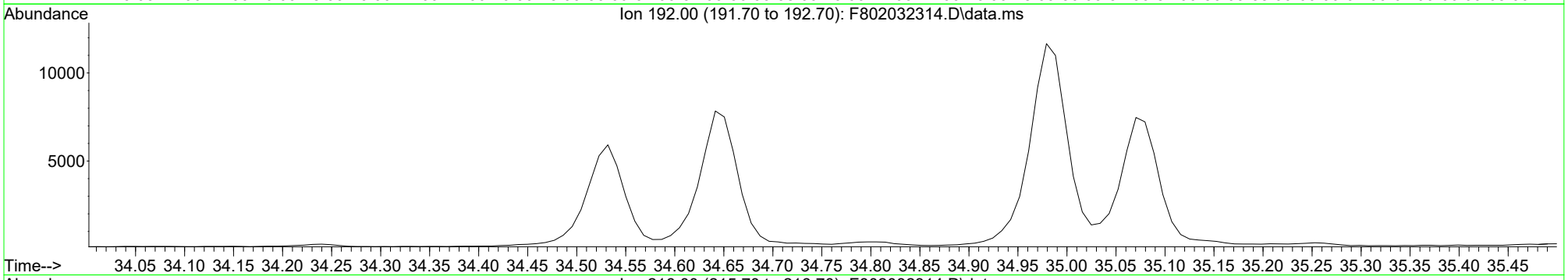


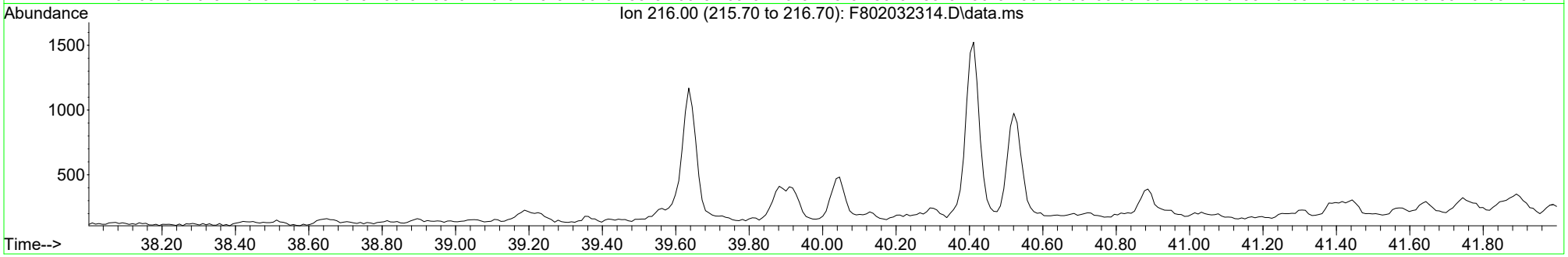
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802032314.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 4:15 am using AcqMethod FRNC8A.M
Sample Name: L2305221-04,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

7B
L2305221-04



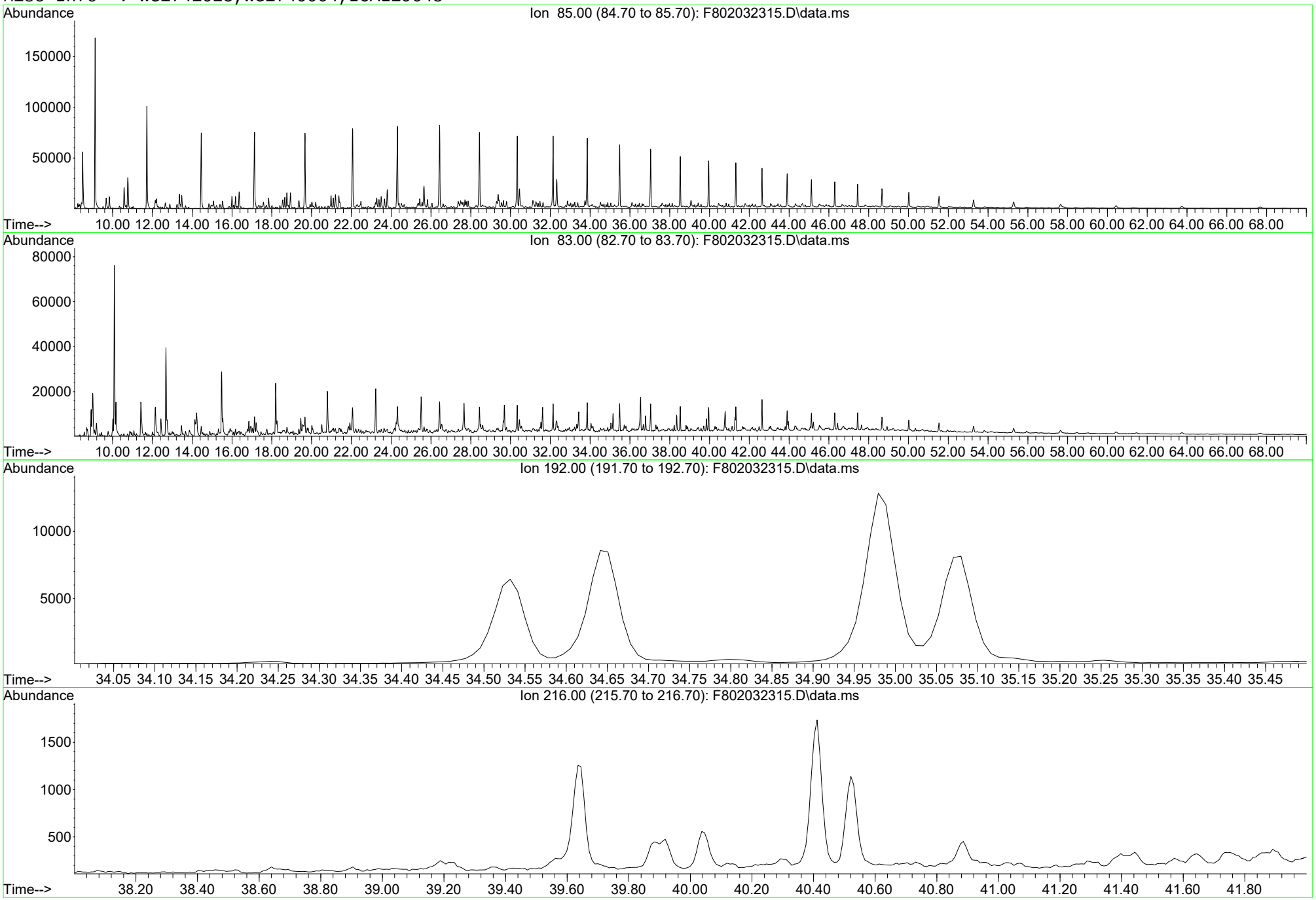






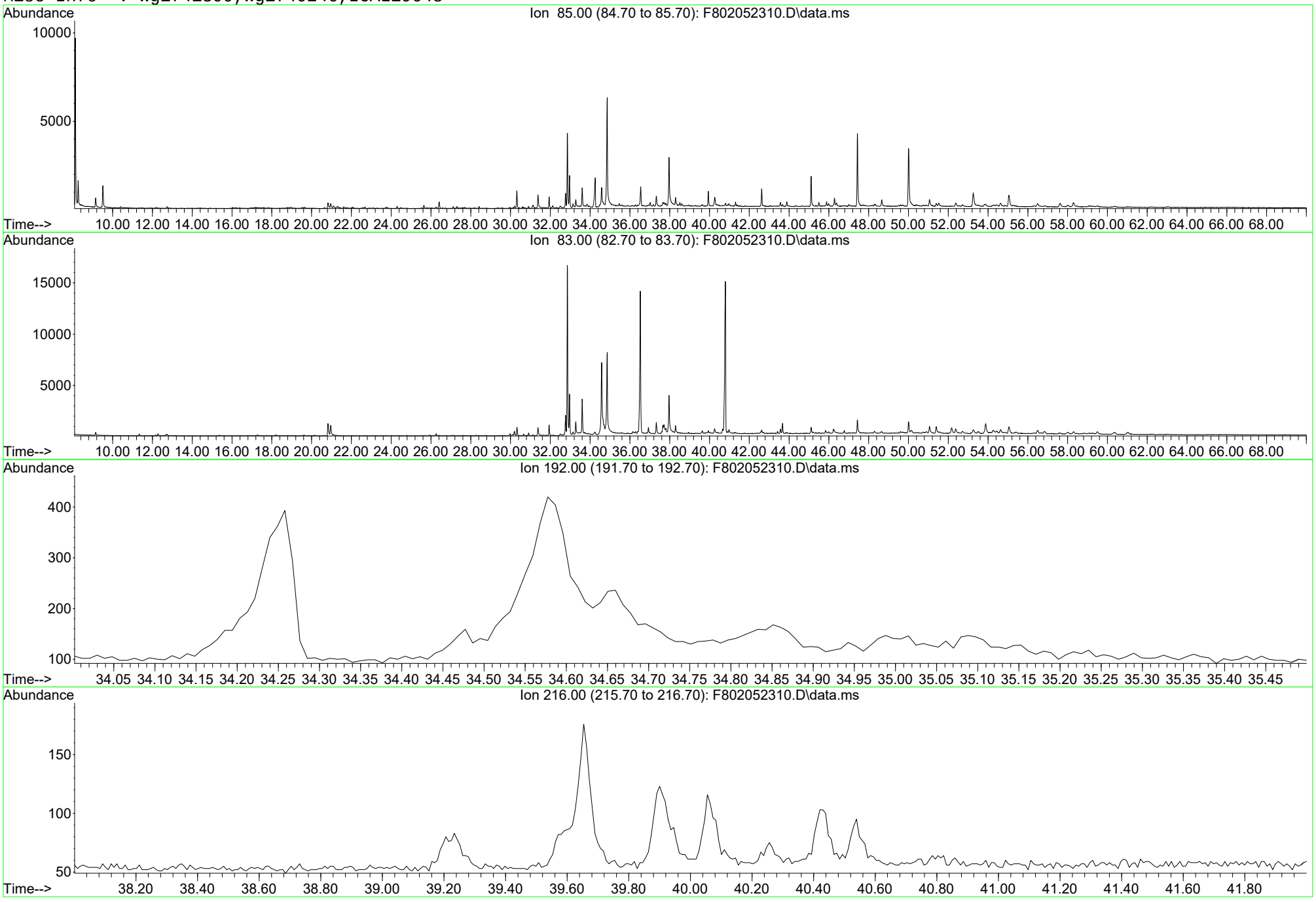
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802032315.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 5:39 am using AcqMethod FRNC8A.M
Sample Name: WG1740064-5,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

7B Duplicate
WG1740064-5



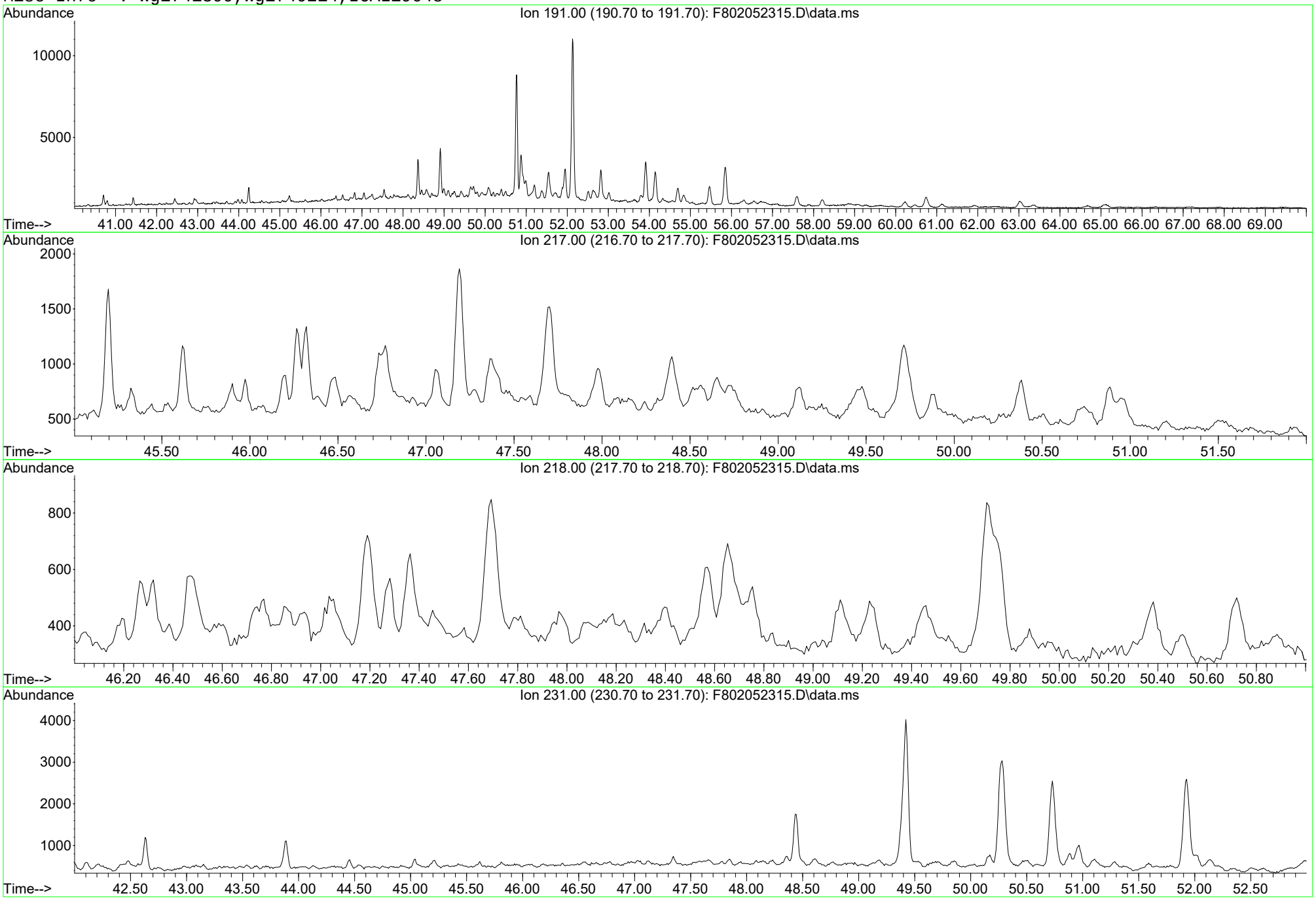
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802052310.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 5 Feb 2023 11:51 pm using AcqMethod FRNC8A.M
Sample Name: l2305221-05,32,,
Misc Info : wg1741399,wg1740246,ICAL19648

CENTRAL POND
L2305221-05



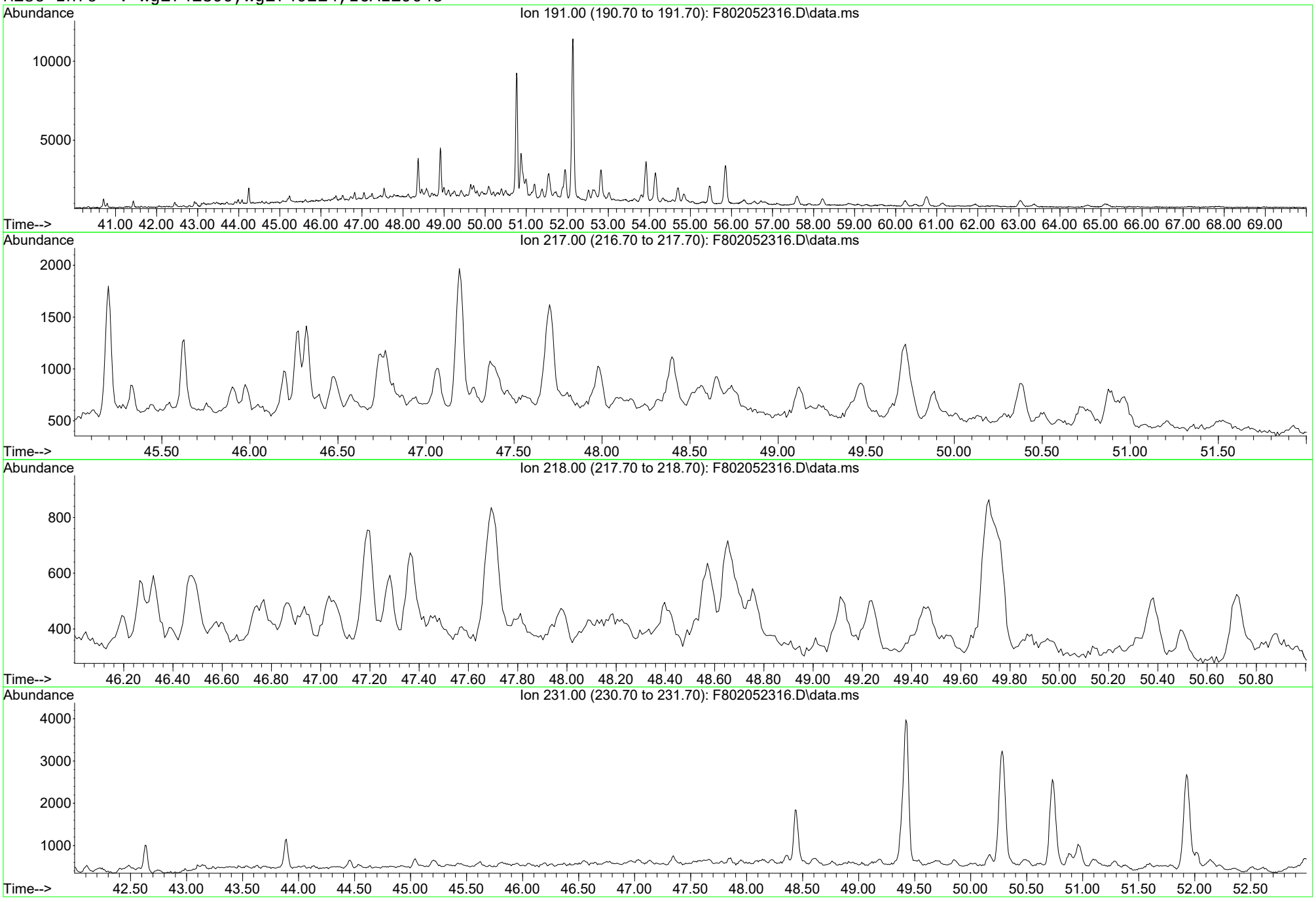
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802052315.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 6 Feb 2023 7:01 am using AcqMethod FRNC8A.M
Sample Name: l2305221-01,32,,
Misc Info : wg1741399,wg1740214,ICAL19648

BRINE WELL 22 BS
L2305221-01



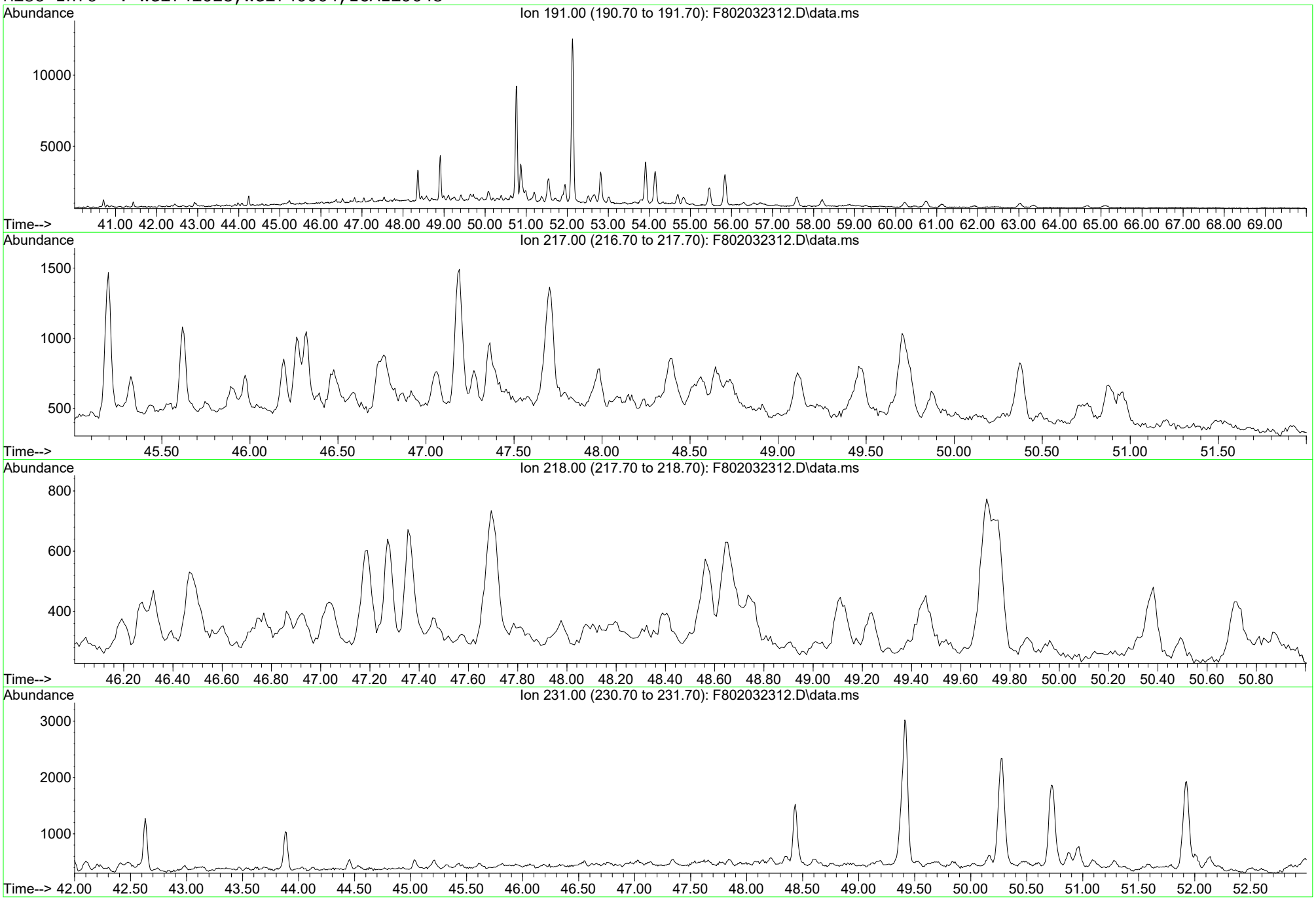
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802052316.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 6 Feb 2023 8:27 am using AcqMethod FRNC8A.M
Sample Name: wg1740214-5,32,,
Misc Info : wg1741399,wg1740214,ICAL19648

BRINE WELL 22 BS Duplicate
WG1740214-5



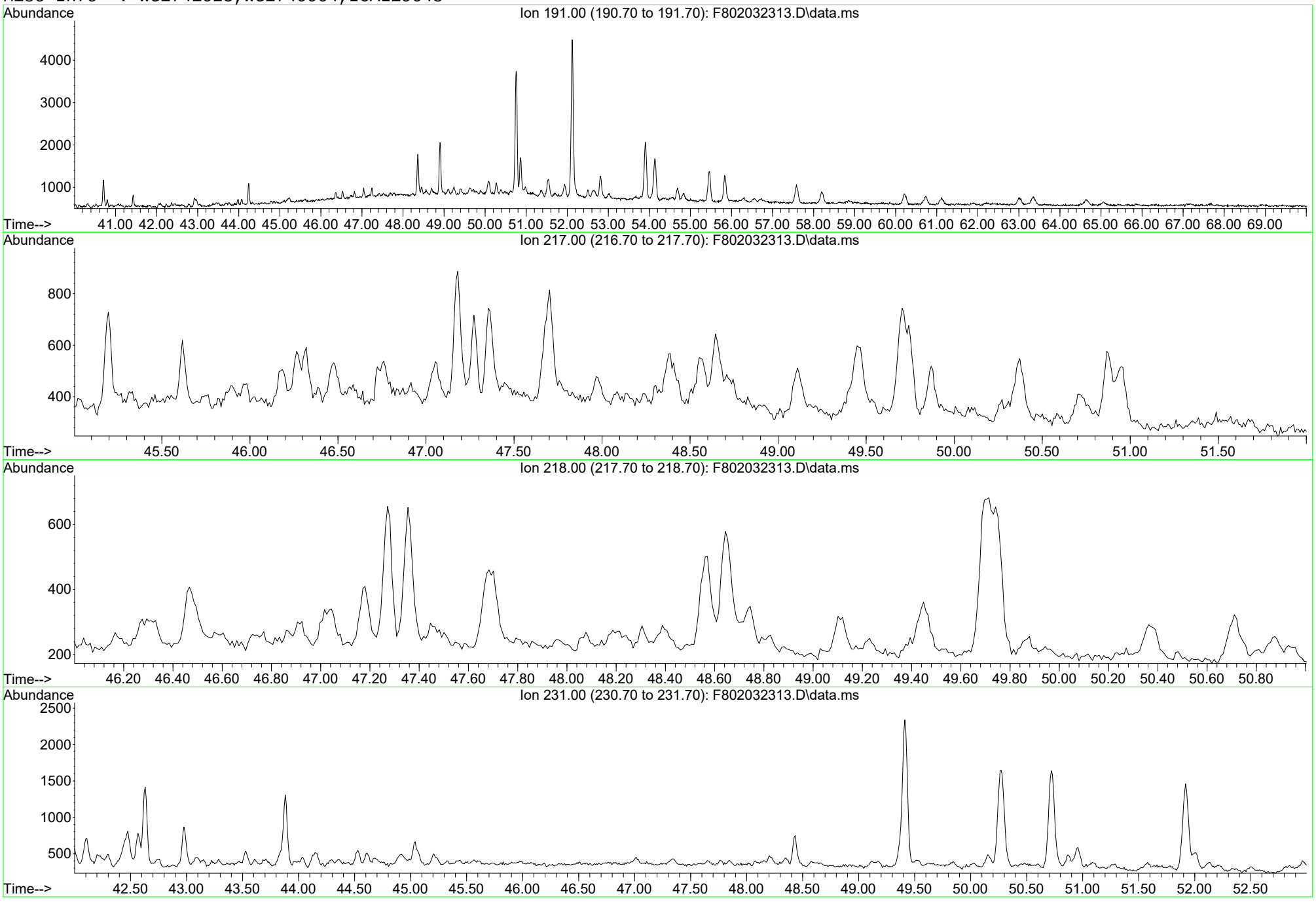
File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802032312.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 1:27 am using AcqMethod FRNC8A.M
Sample Name: L2305221-02,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

110159
L2305221-02



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802032313.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 2:52 am using AcqMethod FRNC8A.M
Sample Name: L2305221-03,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

STOCK TANK
L2305221-03



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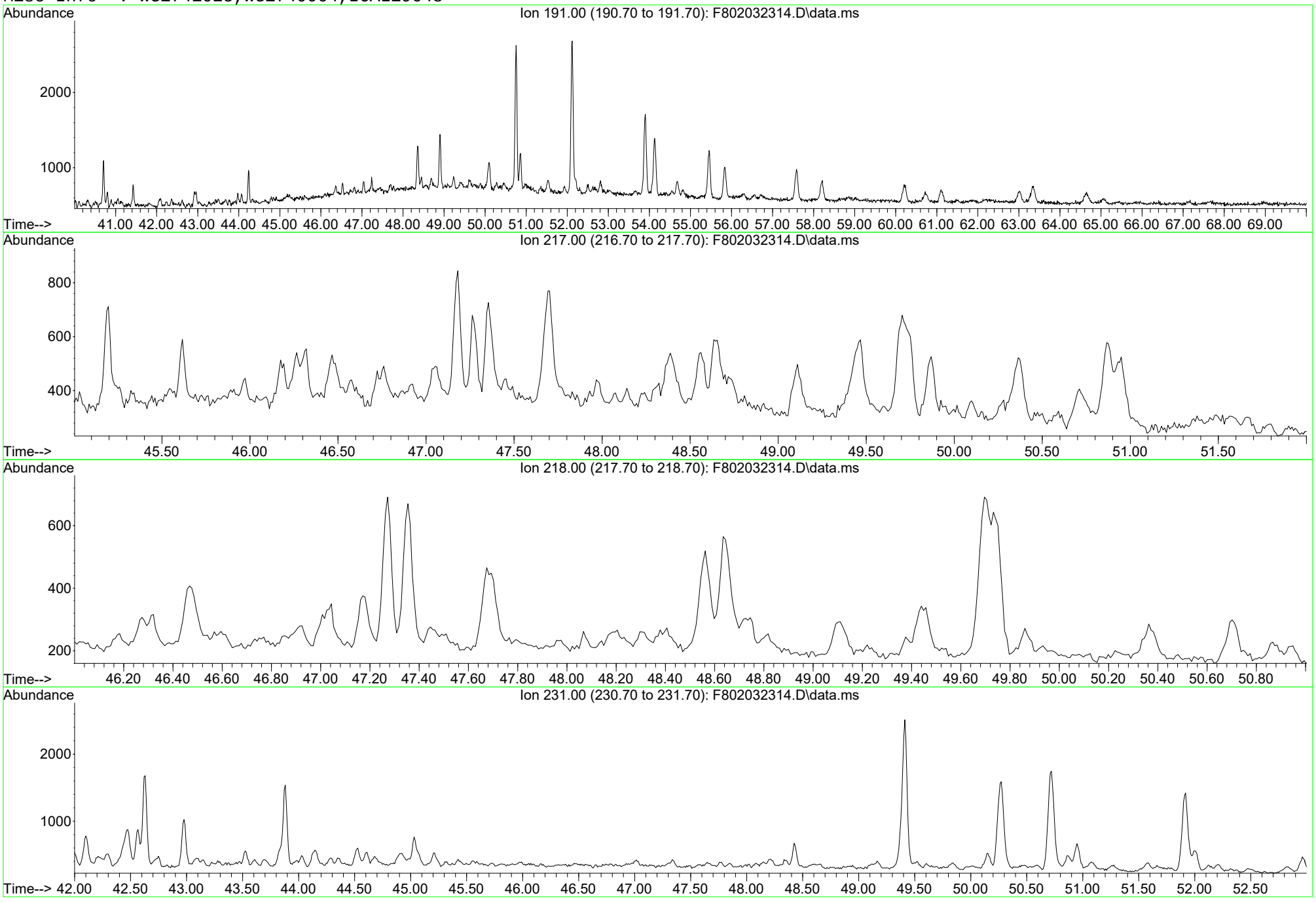
... KPAH\F802032314.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 4:15 am using AcqMethod FRNC8A.M
Sample Name: L2305221-04,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

7B
L2305221-04



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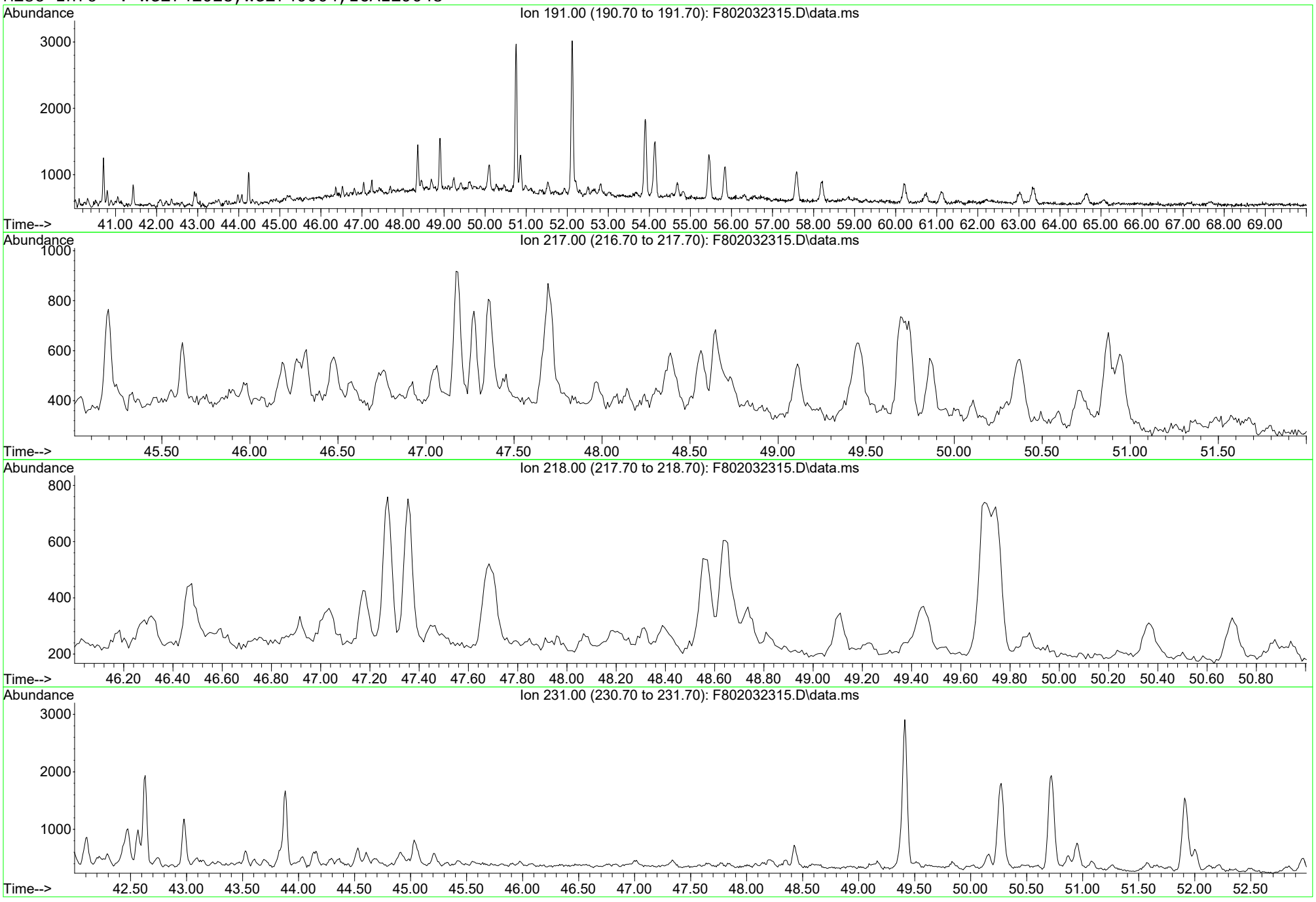
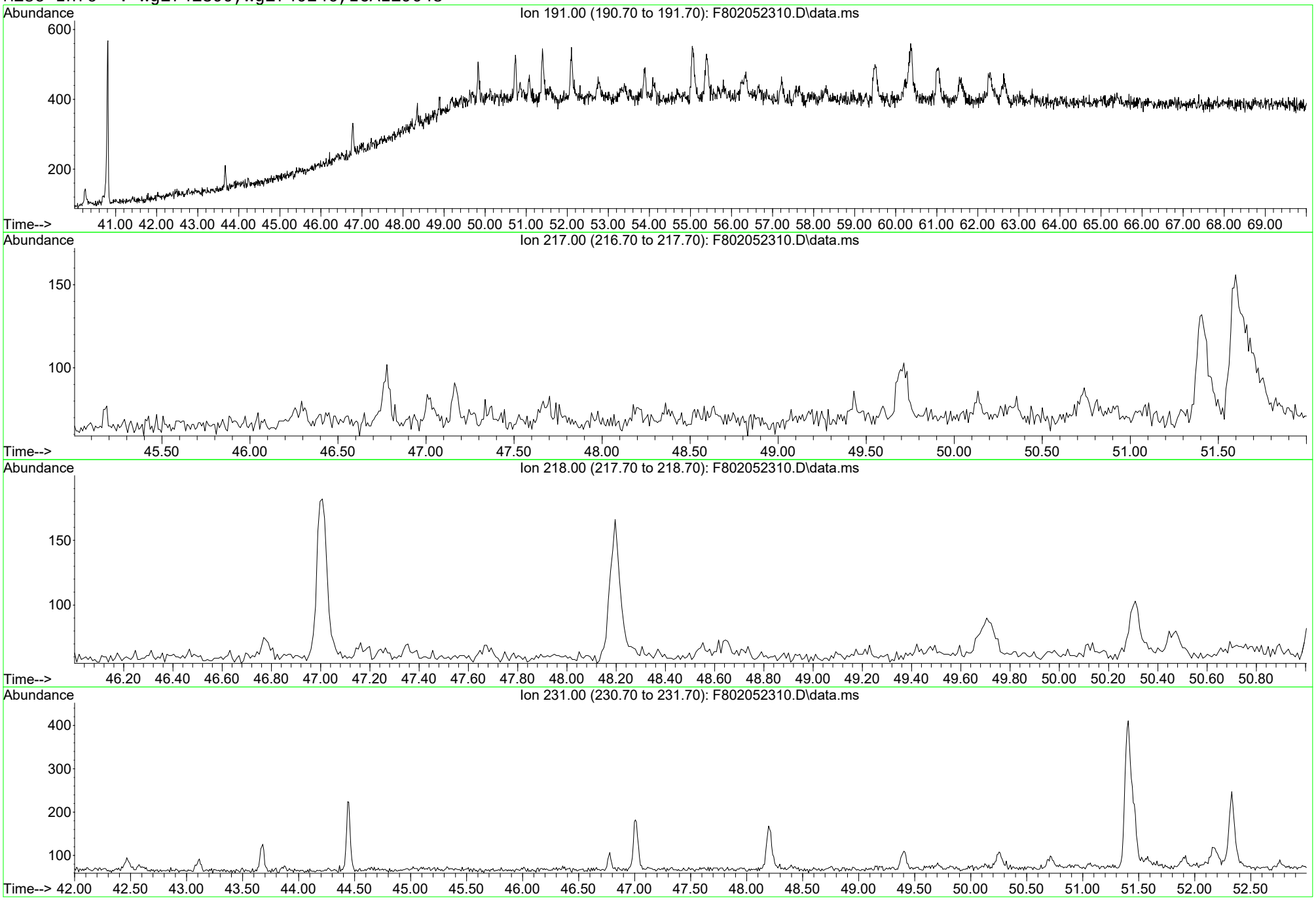
... KPAH\F802032315.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 4 Feb 2023 5:39 am using AcqMethod FRNC8A.M
Sample Name: WG1740064-5,32,,
Misc Info : WG1741025,WG1740064,ICAL19648

7B Duplicate
WG1740064-5



File :D:\West Lake Salt Dome_850.000079.023\Alpha Data\L2305221\AL
... KPAH\F802052310.D
Operator : PAH8:CNC
Instrument : PAH8
Acquired : 5 Feb 2023 11:51 pm using AcqMethod FRNC8A.M
Sample Name: l2305221-05,32,,
Misc Info : wg1741399,wg1740246,ICAL19648

CENTRAL POND
L2305221-05



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ATTACHMENT H(a)

Intertek
Lab Analysis of Yellowrock Well 69 Oil

intertek caleb brett

Certificate of Analysis

Client:	Lonquist Field Services, LLC	**Client Reference Number:**	
Job Location:	Lonquist Field Services, Sulphur, LA	Oil Sampling 11-2-2022	
Our Reference Number:	US250-0022083		
Lab Reference Number:	2022-NEDR-001562		

Sample ID:	**2022-NEDR-001562-002**	**Date Taken:**	**02-Nov-2022**
Sample Designated As:	**Crude Oil**	**Date Submitted:**	**02-Nov-2022**
Vessel/Location:	**Yellowrock Well Sample**	**Date Tested:**	**02-Nov-2022**
Representing:	**Yellowrock 69**		

Method	Test	Result	Unit
ASTM D5002	Average API Gravity	26.0	°API
ASTM D4294	Sulfur Content	0.302	Wt %
ASTM D5708	Procedure	Test Method A	
ASTM D5708	Vanadium Content	1.23	mg/kg
ASTM D5708	Nickel Content	7.04	mg/kg
ASTM D5708	Iron Content	6.57	mg/kg
ASTM D3230	Salt Content (as electrometric chloride)	363.36	lb/1000bbl
ASTM D7536 MOD	Sample Preparation	Centrifuged	
ASTM D7536 MOD	Organic Chloride Content	89.0	mg/kg
ASTM D7536 MOD	Total Chloride Content	146.1	mg/kg
ASTM D7536 MOD	Inorganic Chloride Content	57.1	mg/kg
ASTM D7536 MOD	Note:	Average of duplicate	

Signed: Paul Schroeder Date: 11/03/2022

Paul Schroeder, Laboratory Technician

2780 Highway 69 North, Nederland, Texas 77627 USA
Tel.: +1 409 727 3664 Fax.: +1 409 727 7457 Email: cbwnederland@intertek.com

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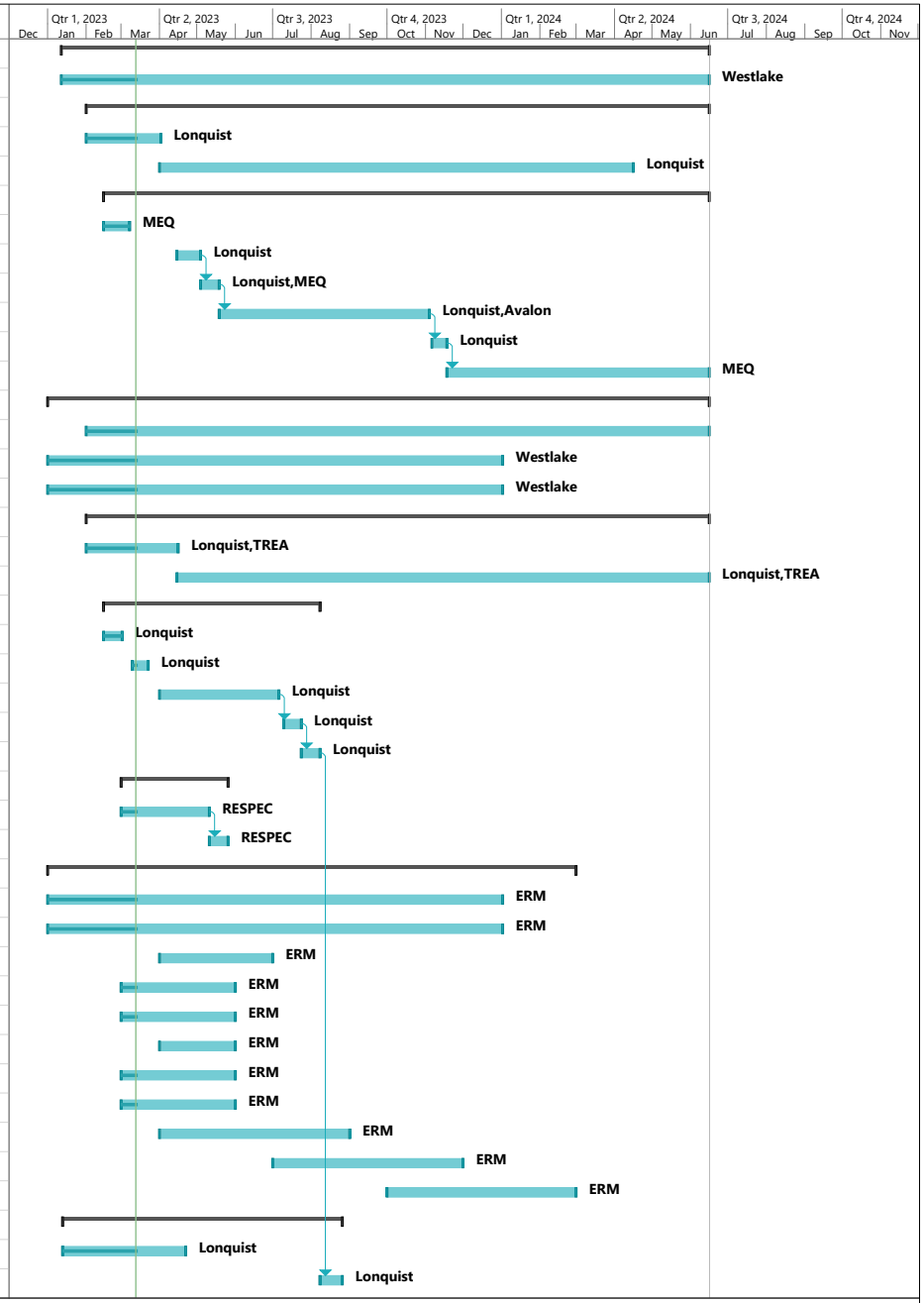
ATTACHMENT I

Lonquist & Co. LLC
Overall Project Gantt Chart

ID	Task Name	Duration	Start	Finish	Resource Names
1	**1 Site Observations**	**372 days**	**Thu 1/12/23**	**Sat 6/15/24**	
2	1.1 24 Hour Observations + Daily Reporting	373 days	Thu 1/12/23	Sat 6/15/24	Westlake
3	**2 Micro-Seismic Monitoring**	**358 days**	**Wed 2/1/23**	**Sat 6/15/24**	
4	2.1 Phase 1: Temporary Install and Reporting	44 days	Wed 2/1/23	Sat 4/1/23	Lonquist
5	2.2 Phase 2: Semi-Permanent Install and Reporting	272 days	Sat 4/1/23	Mon 4/15/24	Lonquist
6	**2.3 Phase 3: Borehole Array**	**348 days**	**Wed 2/15/23**	**Sat 6/15/24**	
7	2.3.1 Desktop Modeling (PPG 6X & PPG 20)	15 days	Wed 2/15/23	Tue 3/7/23	MEQ
8	2.3.2 Workover Inspection + Sonar (PPG 6X & PPG 20)	14 days	Sat 4/15/23	Wed 5/3/23	Lonquist
9	2.3.3 Evaluate Data	11 days	Thu 5/4/23	Thu 5/18/23	Lonquist,MEQ
10	2.3.4 Materials Order	121 days	Fri 5/19/23	Fri 11/3/23	Lonquist,Avalon
11	2.3.5 Install in PPG 6X & PPG 20	10 days	Mon 11/6/23	Fri 11/17/23	Lonquist
12	2.3.6 Monitoring/Analysis/Reporting	152 days	Sat 11/18/23	Sat 6/15/24	MEQ
13	**3 Well Servicing PPG 7B**	**380 days**	**Sun 1/1/23**	**Sat 6/15/24**	
14	3.1 Periodic Sonar Surveys	359 days	Wed 2/1/23	Sat 6/15/24	
15	3.2 Brine Injection (Assumed 24/7 Until Further Notice)	262 days	Sun 1/1/23	Mon 1/1/24	Westlake
16	3.3 Oil Withdrawal (As Needed)	262 days	Sun 1/1/23	Mon 1/1/24	Westlake
17	**4 InSAR Subsidence Monitoring**	**358 days**	**Wed 2/1/23**	**Sat 6/15/24**	
18	4.1 Avg. 5.4-Day Frequency Monitoring/Analysis/Reporting	54 days	Wed 2/1/23	Sat 4/15/23	Lonquist,TREA
19	4.2 Avg. 4-Day Frequency Monitoring/Analysis/Reporting	307 days	Sat 4/15/23	Sat 6/15/24	Lonquist,TREA
20	**5 3D Seismic**	**124 days**	**Wed 2/15/23**	**Mon 8/7/23**	
21	5.1 Initial PSTM Interpretation	11 days	Wed 2/15/23	Wed 3/1/23	Lonquist
22	5.2 Validate Current Well Control	9 days	Fri 3/10/23	Wed 3/22/23	Lonquist
23	5.3 Reprocess Through PSDM	69 days	Sat 4/1/23	Wed 7/5/23	Lonquist
24	5.4 Interpret PSDM	11 days	Mon 7/10/23	Sun 7/23/23	Lonquist
25	5.5 Integrate Sonar Data and Generate Report	11 days	Mon 7/24/23	Mon 8/7/23	Lonquist
26	**6 Geomechanics Modeling**	**62 days**	**Wed 3/1/23**	**Thu 5/25/23**	
27	6.1 Draft Development	51 days	Wed 3/1/23	Wed 5/10/23	RESPEC
28	6.2 Final Draft Development	11 days	Thu 5/11/23	Thu 5/25/23	RESPEC
29	**7 Environmental Monitoring / Sampling + USDW Evaluation**	**304 days**	**Sun 1/1/23**	**Thu 2/29/24**	
30	7.1 Bubble / Surface Water Sampling	262 days	Sun 1/1/23	Mon 1/1/24	ERM
31	7.2 Water Well Sampling	262 days	Sun 1/1/23	Mon 1/1/24	ERM
32	7.3 Water Well Survey	66 days	Sat 4/1/23	Fri 6/30/23	ERM
33	7.4 USDW Evaluation	66 days	Wed 3/1/23	Wed 5/31/23	ERM
34	7.5 Capture Zone Analysis	66 days	Wed 3/1/23	Wed 5/31/23	ERM
35	7.6 Surface Water Profiling	44 days	Sat 4/1/23	Wed 5/31/23	ERM
36	7.7 Wetlands Delineation	66 days	Wed 3/1/23	Wed 5/31/23	ERM
37	7.8 1st Quarter Sampling and Reporting	66 days	Wed 3/1/23	Wed 5/31/23	ERM
38	7.9 2nd Quarter Sampling and Reporting	110 days	Sat 4/1/23	Thu 8/31/23	ERM
39	7.10 3rd Quarter Sampling and Reporting	110 days	Sat 7/1/23	Thu 11/30/23	ERM
40	7.11 4th Quarter Sampling and Reporting	110 days	Sun 10/1/23	Thu 2/29/24	ERM
41	**8 Failure Analysis Report**	**161 days**	**Fri 1/13/23**	**Fri 8/25/23**	
42	8.1 Base Report	71 days	Fri 1/13/23	Fri 4/21/23	Lonquist
43	8.2 Final Report w/ Supporting Analysis	14 days	Tue 8/8/23	Fri 8/25/23	Lonquist



Project: PPG 7B Action Items G
Date: Mon 3/13/23

Task | Split | Milestone | Summary
Project Summary | Inactive Task | Inactive Milestone | Inactive Summary
Manual Task | Duration-only | Manual Summary Rollup | Manual Summary
Start-only | Finish-only | External Tasks | External Milestone
Deadline | Progress | Manual Progress

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ATTACHMENT J

Porche Aerial Imagery, LLC
Thermal Drone Imagery Report

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

WC Brine Dome - 20230217 Radiometric Thermal Report

Company: Porche Aerial Imagery LLC - **Pilot**: Cody Porche, FAA RPIC #3905699

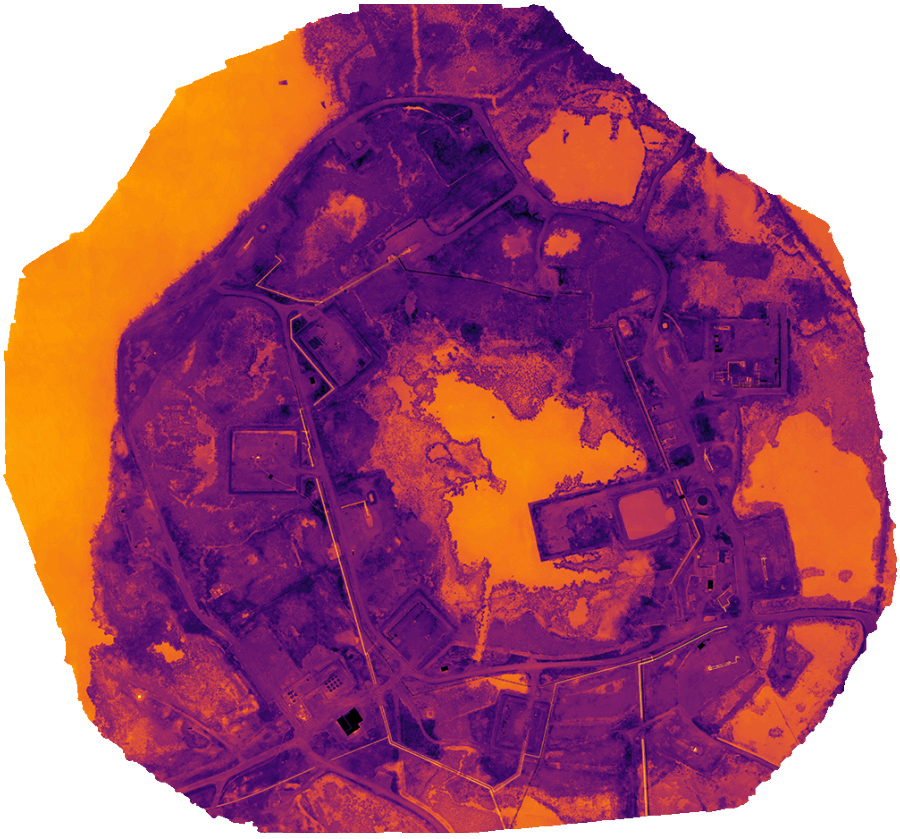
Map Details Summary

Project Name	WC Brine Fields - 20230217 Radiometric Thermal
Photogrammetry Engine	DroneDeploy Proprietary, Enterprise
Date Of Capture	Feb 17, 2023 @ 6:50 PM - 10:12 PM
Date Processed	Feb 18, 2023
GSD Orthomosaic (GSD DEM)	2.09in/px (DEM 8.37in/px)
Area Bounds	13752596.22ft^2
Image Sensors	DJI - ZH20T
Average GPS Trust	0.07ft

Quality & Accuracy Summary

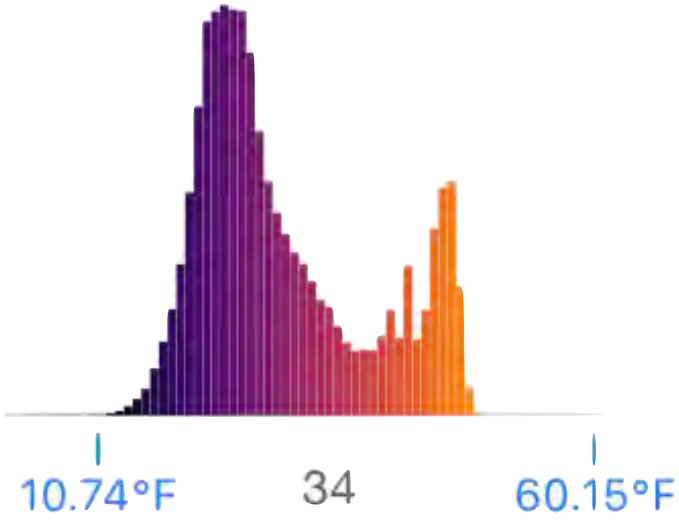
Image Quality		High texture images
Images Uploaded (Aligned %)		5176 (94%)
Camera Optimization		0.02% variation from reference intrinsics

Radiometric Deliverable



Radiometric Temperature Ranges

Radiometric Processing	Yes
Exported Range	*(~)* 10º F — 60ºF
Temperature Spectrum (Low, *Colder*)	Darker Areas *(Black, Deep Purple)*
Temperature Spectrum (High, *Warmer*)	Brighter Areas *(Orange, Yellow)*



Recorded Weather
(during data capture/flight)

	Dataset Capture (Start)	**Dataset Capture (End)**
Time	6:50 PM	10:12 PM
Temperature	42º F	39º F
Wind	6 mph N *(22 mph @ 400' AGL)*	5 mph NNE *(20 mph @ 400' AGL)*
Visibility	18 mi	17 mi
Precipitation	0"	0"
Humidity	64%	72%

Source: Apple Weather / The Weather Channel

Summary Report

Initial Dataset & Modifications: Initial thermal map data collection flights took place on Feb 9th, 2023 from 7:00 AM to 10:30 AM. After processing, it was made clear there was a high thermal difference due to the sunrise and subsequent heating of the area. The radiometric imagery resulted in a deliverable with a noticeable temperature variance throughout the initial deliverable. Therefore, in order to produce a better deliverable with consistent thermal background, we opted to collect data in the evening after sunset. This second dataset capture took place on February 17th, 2023 and is the final deliverable which is discussed in this report. As predicted, the final deliverable resulted in a very consistent thermal background (or general area temperatures).

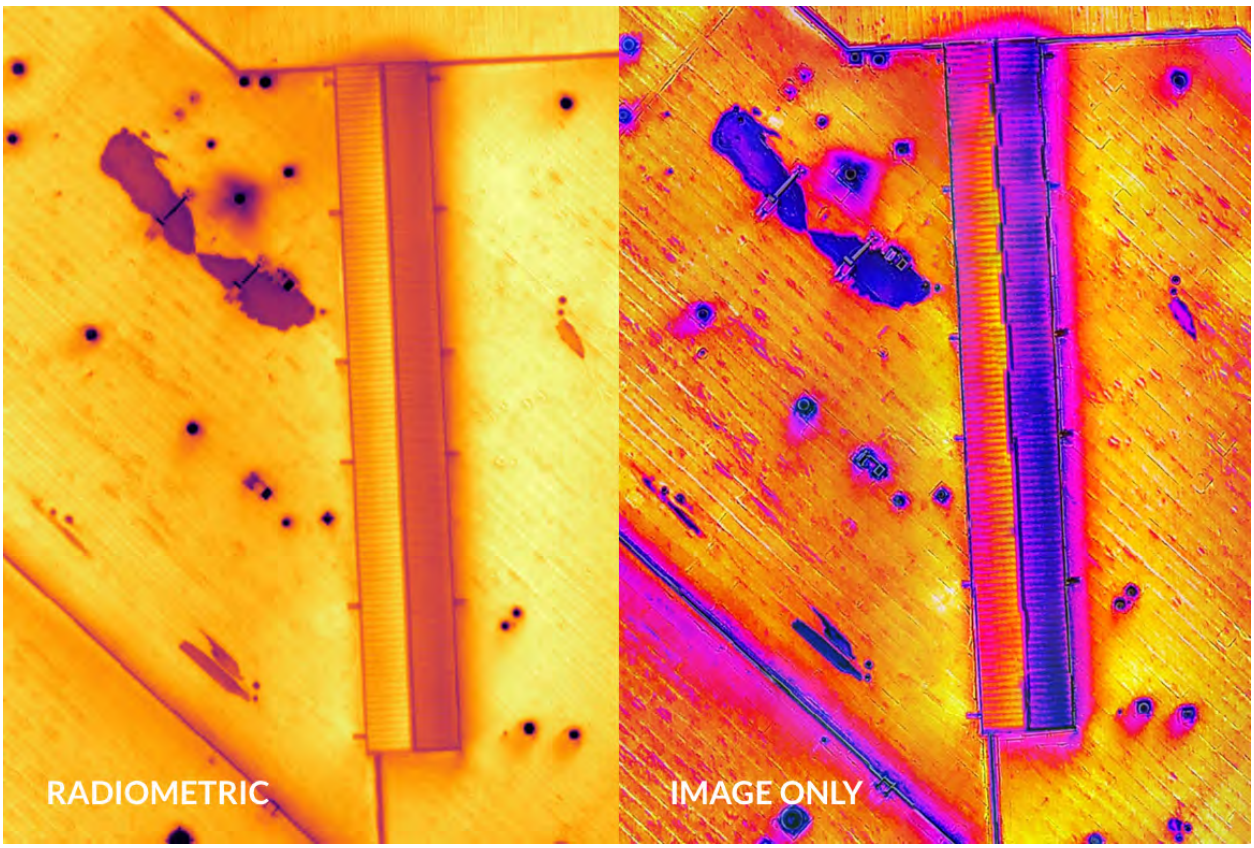
Scope of Work: Our scope of work consisted of collecting thermal data across a large area and combining this data into a singular deliverable for the purpose of showing temperature variances across said area. This was achieved by using an industrial unmanned systems (sUAS) platform with a thermal payload attached. This payload allows for the collection of Radiometric thermal images, each separate image containing temperature values in every pixel.

How is the data collected? We pre-program the sUAS with software allowing us to automate flights to reduce human error of manual flight. The sUAS makes predetermined passes over the large area collecting thermal images along the flight path at 2 second intervals. In this particular dataset, the sUAS captured over 5,000 images in linear paths with 80% side and frontlap @ 399' AGL (above ground level). *Note: The FAA prohibits sUAS flights to take place above 400' AGL*

Processed images captured during dataset showing linear flight paths.

Summary Report (cont.)

How is the data processed?: We process our maps via Drone Deploy Enterprise, an industry-leading cloud-based software allowing for the processing of Radiometric Thermal maps. Each image is processed through an AI-engine which aligns images via visible pixels and then processes the map with the embedded Radiometric data. The embedded temperature values from each Radiometric image results in a consistent, broad-area thermal image with temperature values.



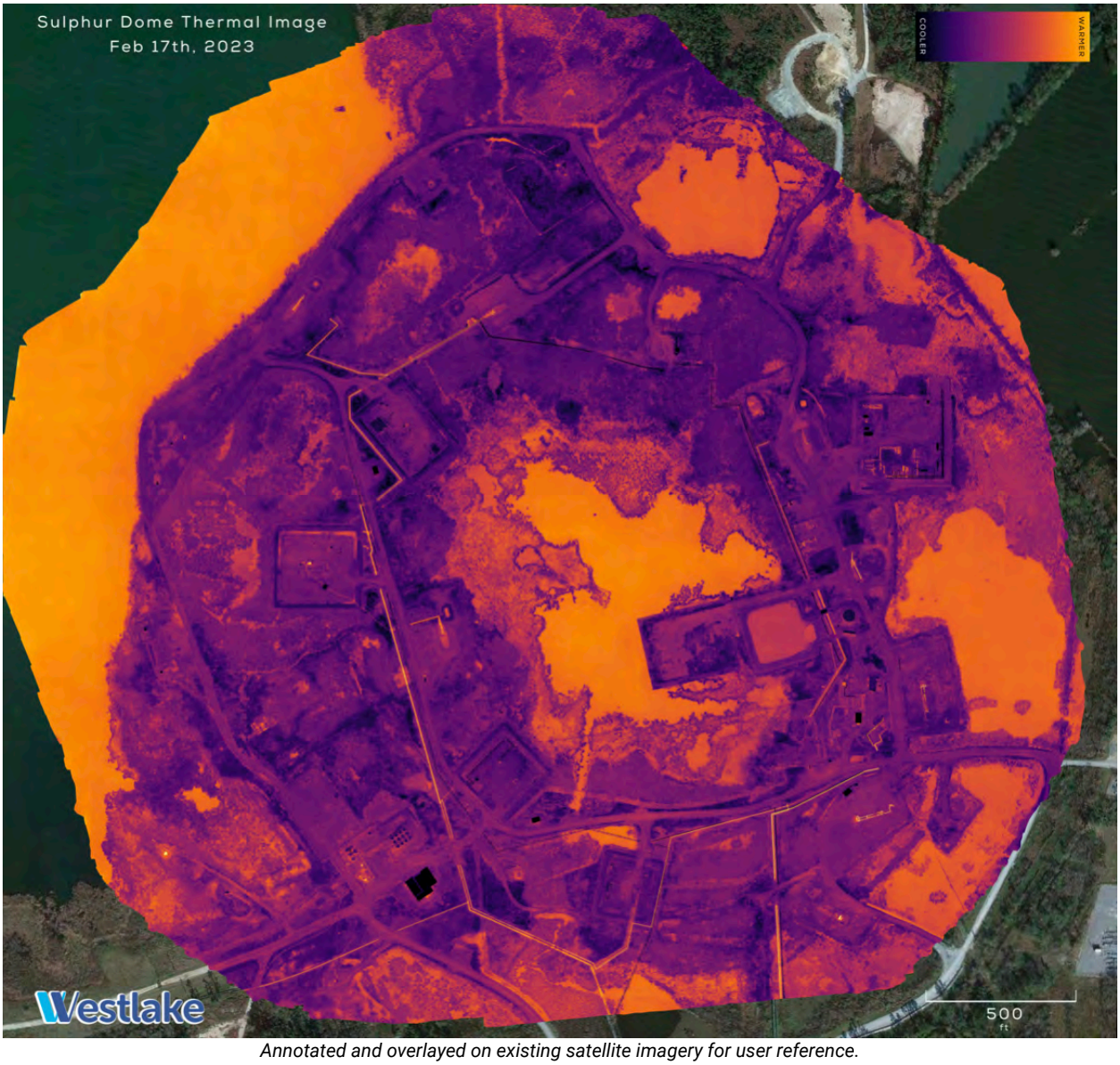
Radiometric vs. Image only Processing: Radiometric processing uses absolute thermal data embedded into each image providing a consistent thermal processing across the entire map area. Image only processing ignores temperature values embedded in each pixel and instead creates a wide-area orthomosaic stitch solely relying on the thermal field-of-view at the time of capture.

Comparison Images (above)
The Radiometric version (left) provides a more consistent view, encompassing all temperature values into one consistent deliverable. The Image-based version (right) provides much easier determination of temperature differences in one particular scene/subject.

Summary Report Conclusion
Project: WC Brine Fields - 20230217 Radiometric Thermal

Our initial findings regarding the importance of collecting data across an even thermal background allowed us to make the important shift to night flights/data captures. These post-sunset captures resulted in a much more consistent radiometric deliverable allowing for end-users to make data/thermal analysis over the entire dome area. The final deliverable shows areas where thermal differences vary based on the time of the capture at that specific point in time.

Final Deliverable:



Annotated and overlayed on existing satellite imagery for user reference.

sUAS Service Provided by:

PORCHE AERIAL
IMAGERY

4720 Nelson Road, Suite 100 • Lake Charles, LA 70605 • (337) 540-8522 • www.porcheai.com