Carlsbad Brine Well Update

Radioactive and Hazardous Materials Interim Committee meeting in Clovis, NM

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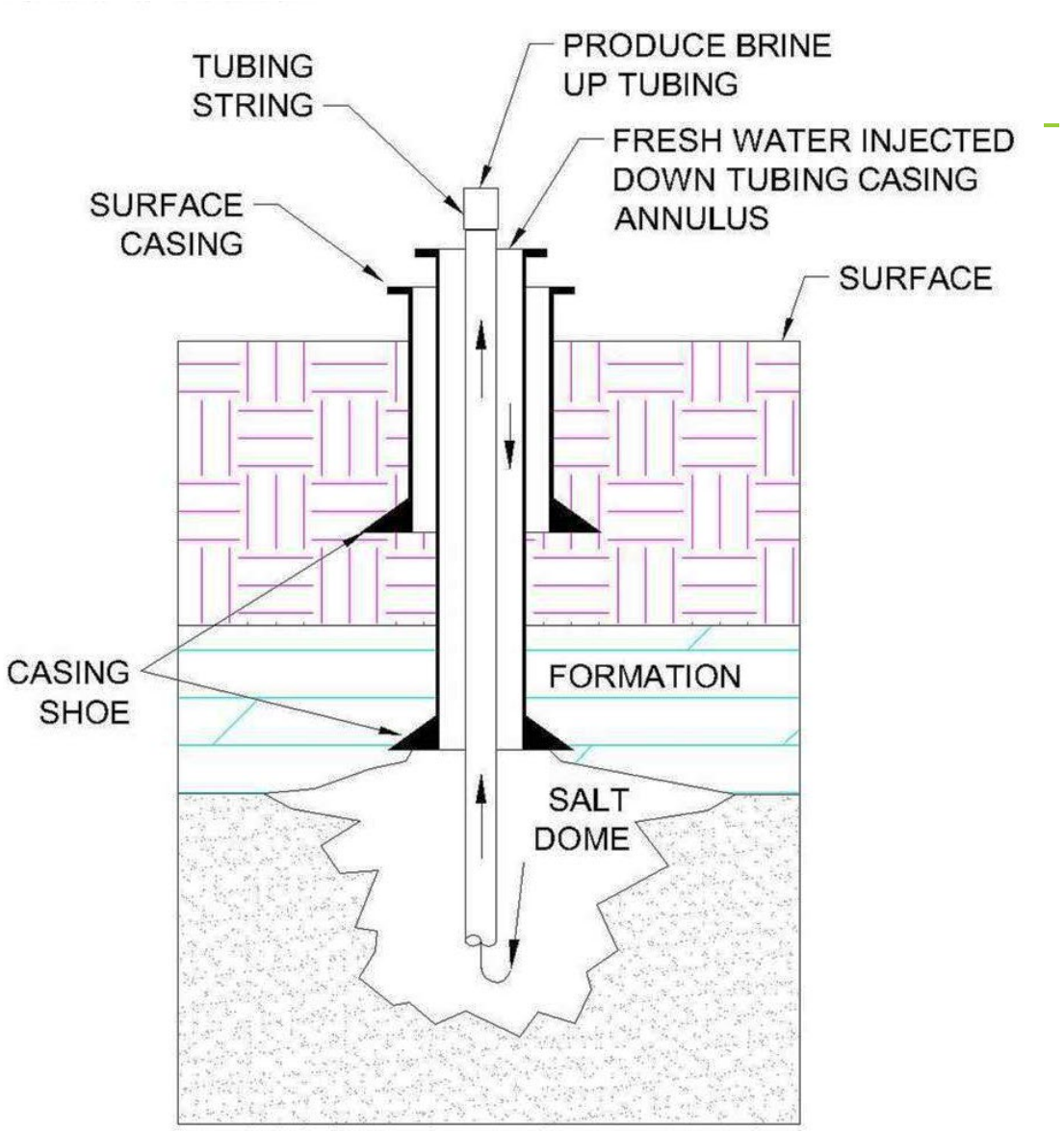
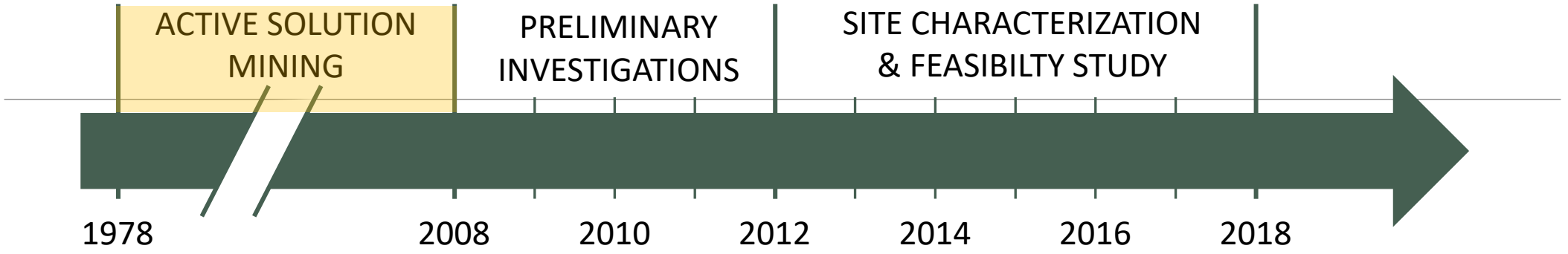
What is a Brine Well?

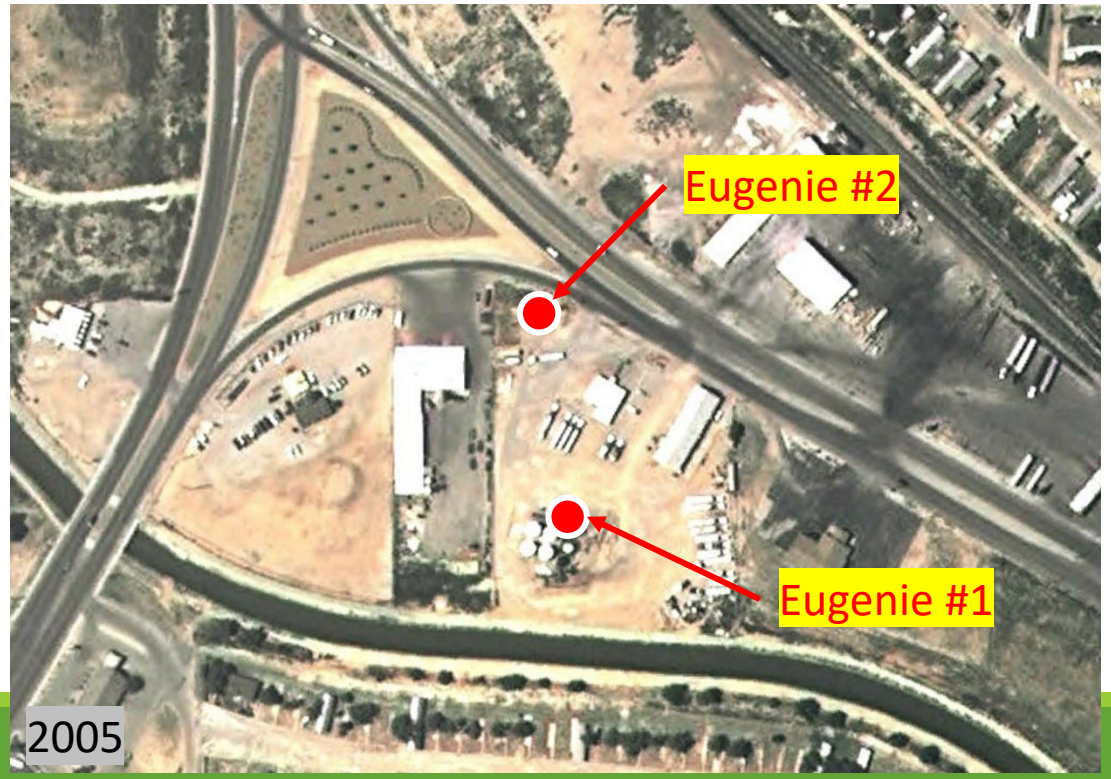
- What is Brine?
  - Brine is saltwater. It has a density of 10 lbs/gal compared to fresh water with a density of 8.3 lbs/gal. It is used in drilling mud and well workovers.
- What is a Brine Well?
  - A brine well is a solution mining operation wherein fresh water is injected underground into natural salt formations to dissolve the salt. The result is a cavern filled with brine that is available for extraction.
- This process can have consequences



Project Background



- Operated from 1978 until July of 2008.
- Dissolving and extracting the subsurface salt deposit in the form of brine (salt-laden water).
- Two wells named Eugenie #1 and Eugenie #2 used in brine production.
- A fracking procedure at Eugenie #2 was conducted in late 1979 to increase brine production.



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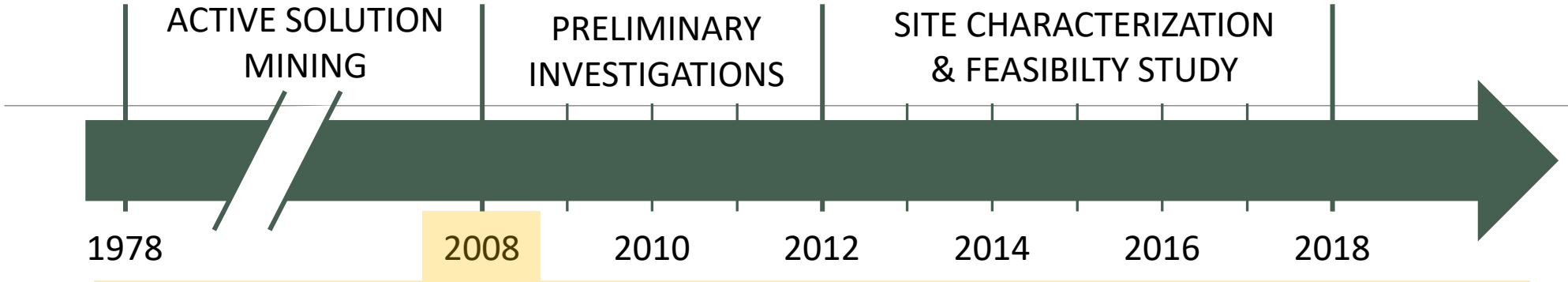
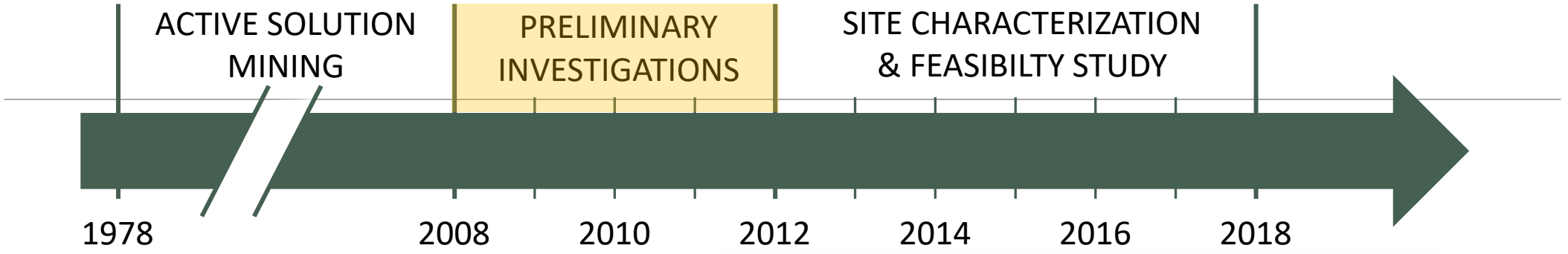


7/16/2008: Brine well southeast of Artesia catastrophically collapsed forming a 100-ft deep sinkhole.

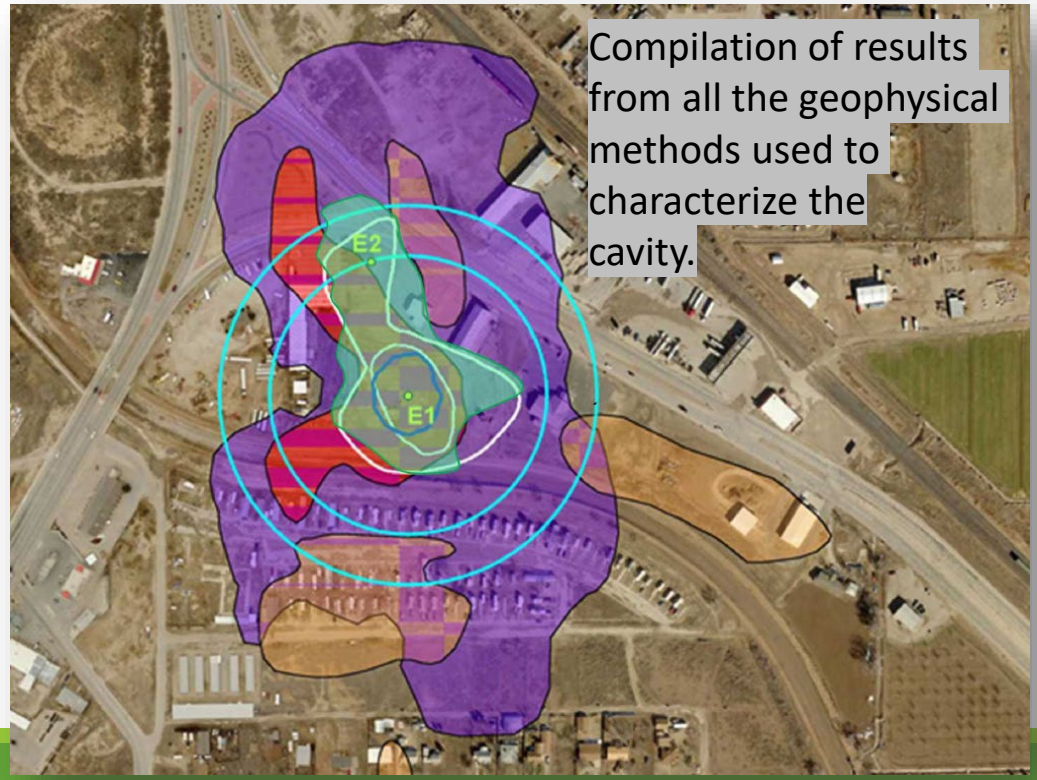
7/22/2008: Brine production at the site was terminated at OCD's direction.

11/3/2008: Second brine well collapse occurred north of Loco Hills, NM.

Project Background

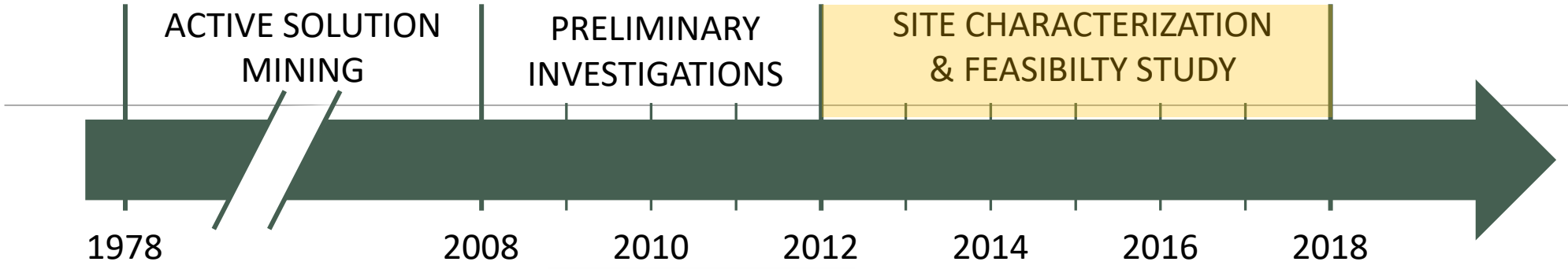


- Geophysical surveys were performed from 2009 to 2012 to provide an initial understanding of the cavity.
- Geophysical methods include:
  - Seismic reflection and refraction,
  - Reflection microtremor (ReMi),
  - High-resolution magnetotelluric (MT) Z-Scan,
  - Microgravity, and
  - 2-D electrical resistivity.

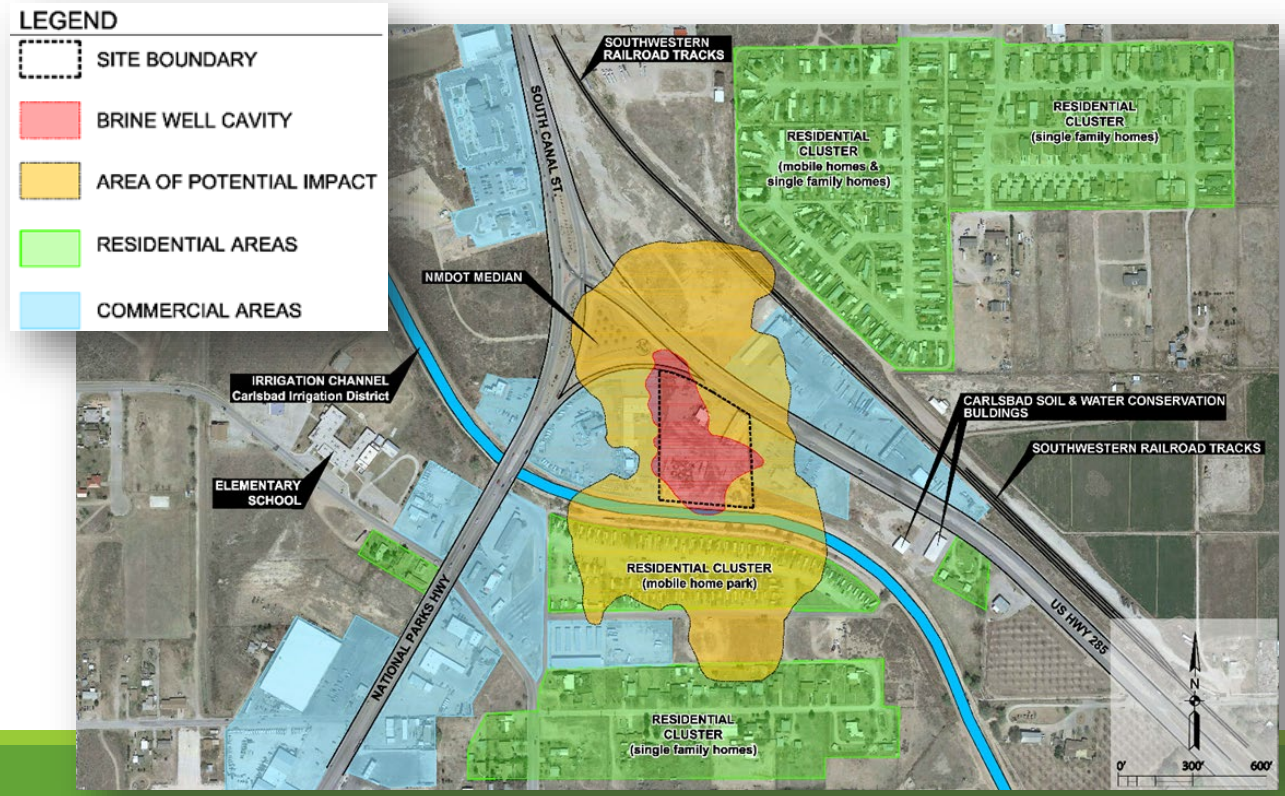


Compilation of results from all the geophysical methods used to characterize the cavity.

Project Background



- Coring and drilling campaigns
- Cavity sonar surveys
- Analysis and modeling of the cavity
- InSAR to assess settlement / surface movement
- Evaluate and select the remediation approach



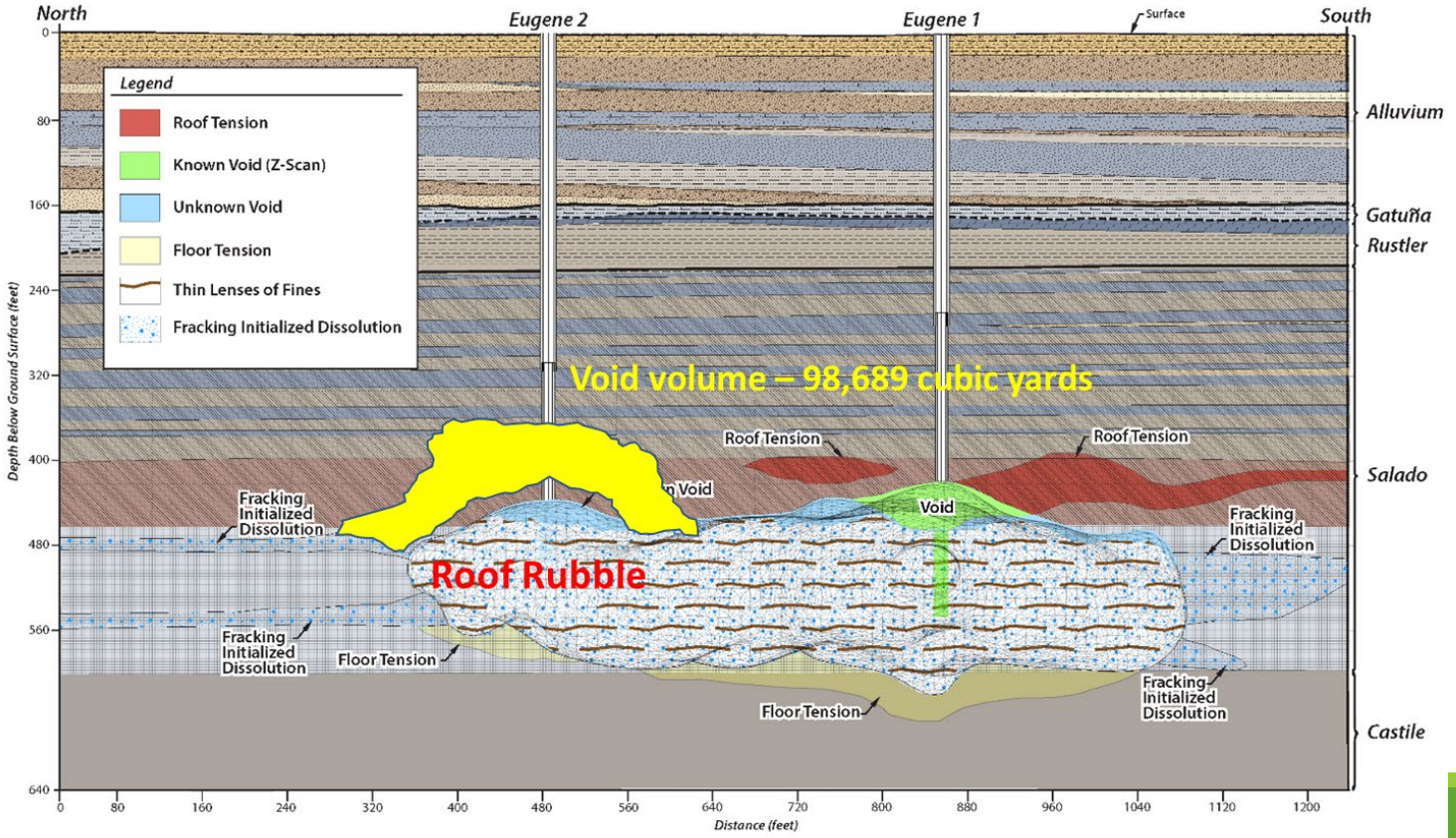
Initial Remediation Plan

- The initial remediation plan consisted of the following:
  - 16 grout wells
  - Approximately 500 ft deep
  - 125 ft diameter area of influence
- Grout Well Installation plan:
  - Maintain cavity pressure
  - Balance the volume of brine removed with volume of grout injected
  - Install a grout cap using high mobility grout to support cavity roof
  - Install grout “columns” using low mobility grout to consolidate undissolved material and support the grout cap
- Construction began in September 2019
- Southern portion of the cavern was stabilized by December 2019

Drilling & Grouting Equipment

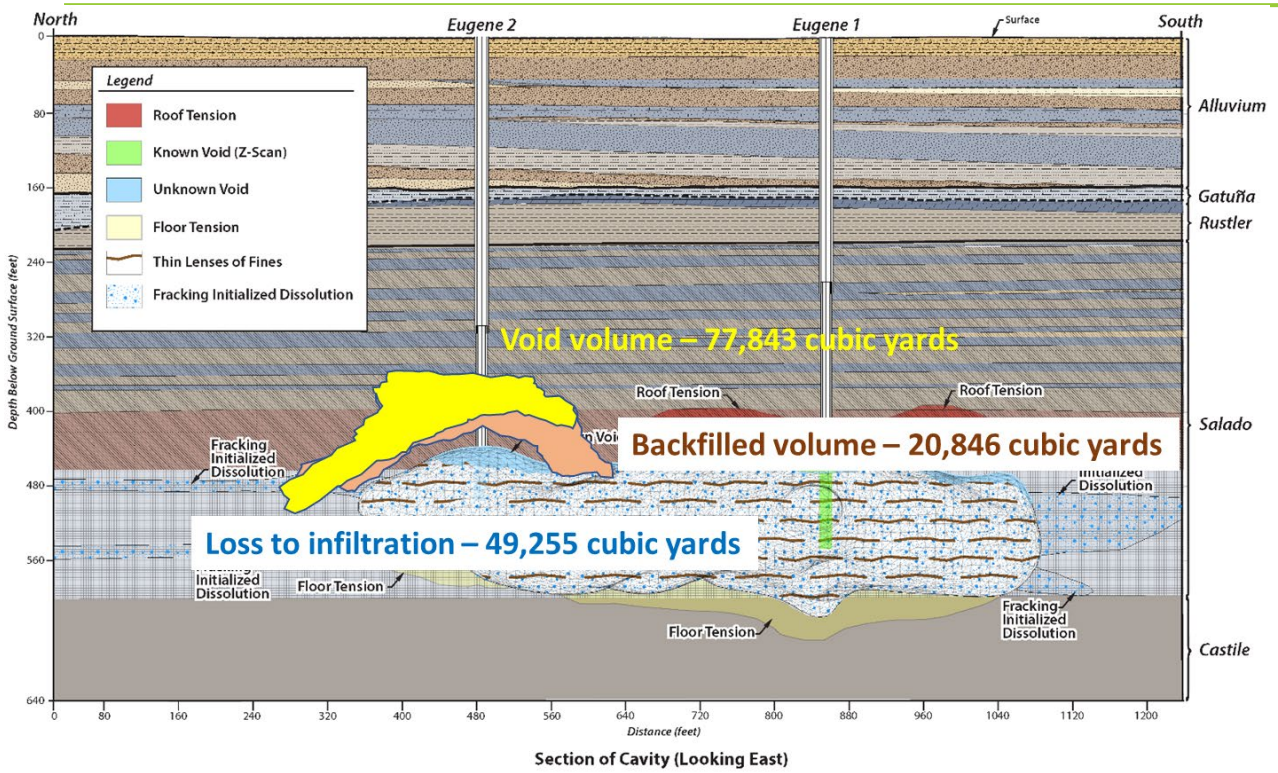
Updated Remediation Plan

- In December of 2019, a very large void was discovered in the northern portion of the cavern that was the result of significant roof failures occurring over the past 20+ years.
- Given its size, it was determined that the backfilling material should be changed to sand which provides equal stability at a lower unit cost. Injection of grout into a large open void is cost-ineffective.
- Operations transitioned to sand deployment in January of 2020



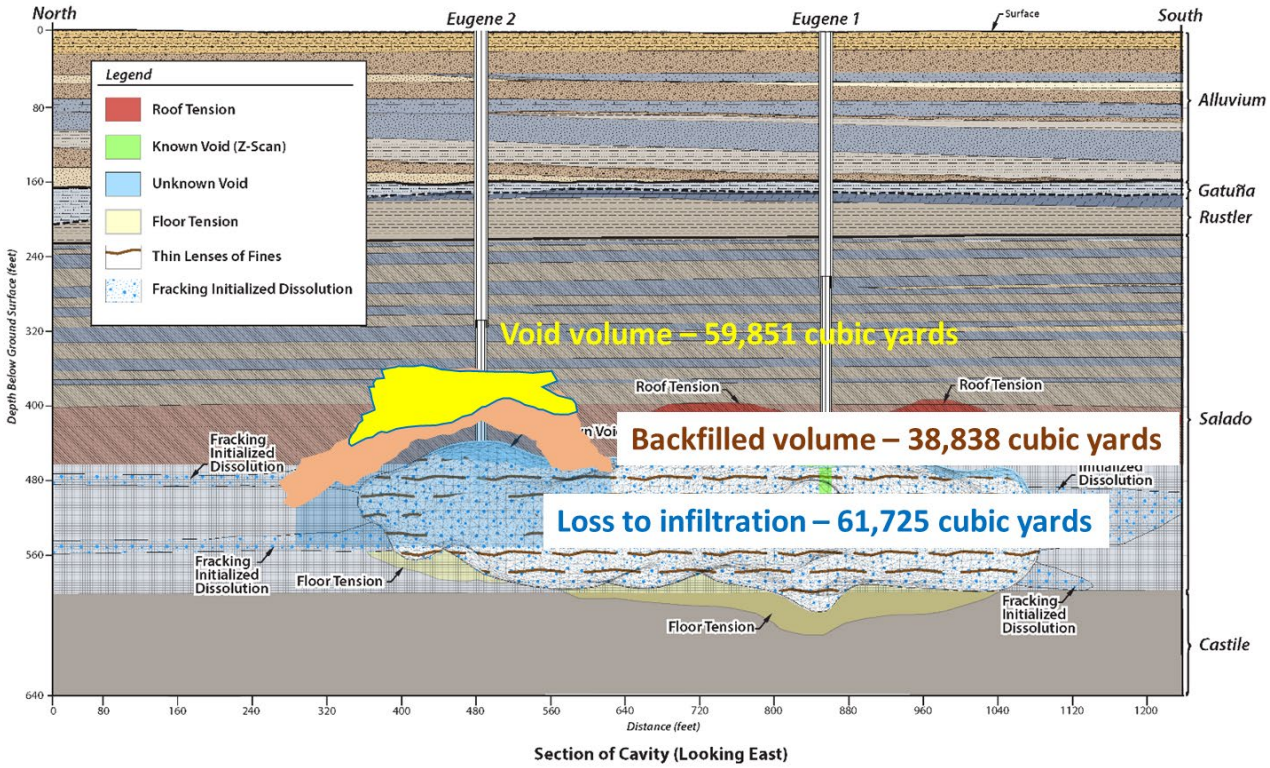
Section of Cavity (Looking East)

Backfilling Progress Over Time



Sonar log of May 2020 after injecting
70,101 cubic yards of sand

Sonar log of July 2020 after injecting
100,563 cubic yards of sand



Current Project Status

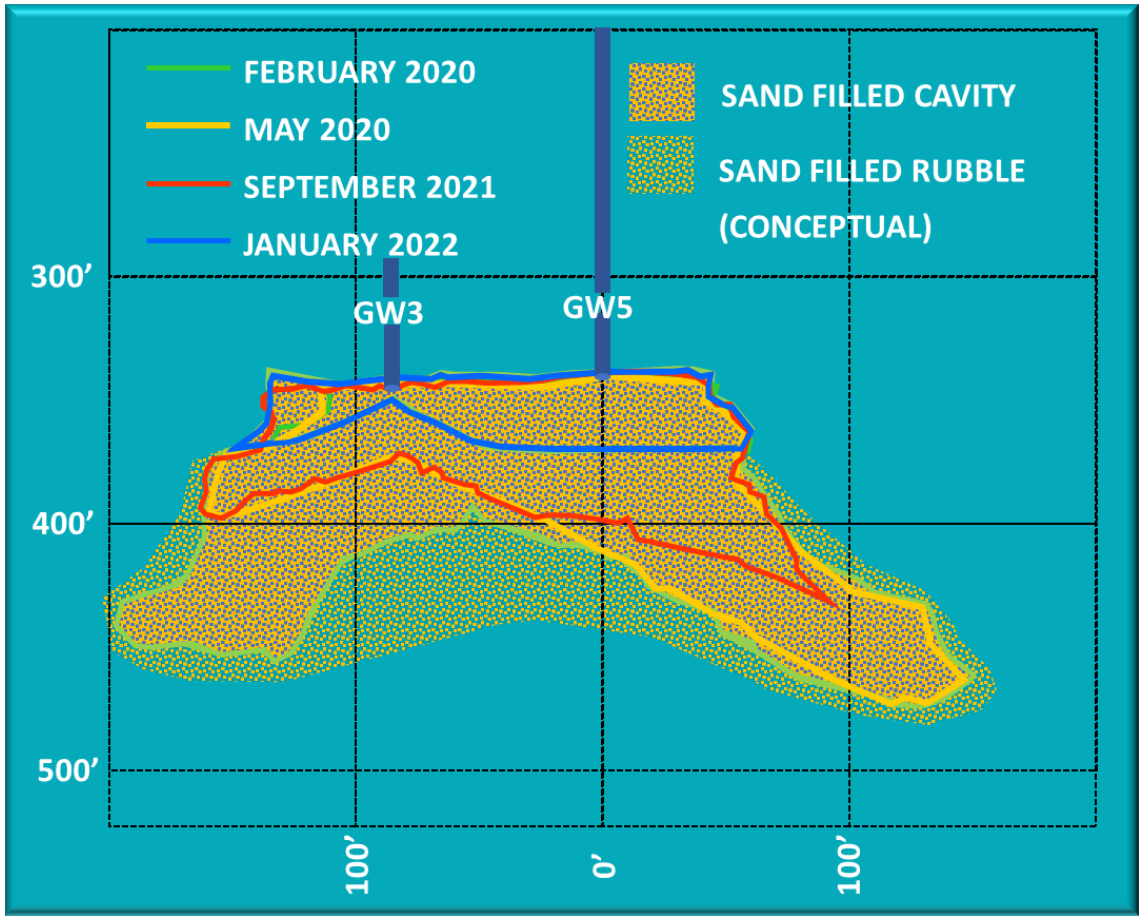
No.	Description	March 1, 2022 Cost Update
	Amended Contract Price prior to this Change Order (Excluding NMGRT)	**$ 63,450,757.59**
	Amended Contract Price prior to this Change Order (Including NMGRT)	**$ 68,443,847.48**
	Total Invoiced Through Feb. 2022 (Including NMGRT)	$ 62,020,866.95
	Remaining Contract Budget (Including NMGRT)	**$ 6,422,980.53**
	Forecast to Complete	
1	Phase 2 Work (Remaining Tasks From Amendment 2)	
1.1	Monitoring System Operations	$ 67,093.00
1.2	Traffic Control	$ 8,387.00
1.3	PM/ADMIN, Construction Management and Technical Support	$ 527,790.00
1.4	Wells Plug and Abandon	$ 290,901.00
1.5	Brine Disposal	$ 145,927.00
1.6	Wood Demobilization	$ 83,866.00
1.7	Site Restorations	$ 419,329.00
1.8	Final Construction Report and Administrative Closeout of Phase 2	$ 66,934.00
1.9	Site Maintenance, Site Services, Site Utilities and Equipment Rental	$ 67,093.00
1.10	Sand Slurry Support Work (Feb Subcontractor Costs to be Invoiced in Mar)	$ 173,596.00
	Subtotal	**$ 1,850,916.00**
2	Change Order 5	
2.1	Develop Interim Technical Report	$ 35,334.00
2.2	Post-Filling Baseline Monitoring (Includes New Monitoring Wells)	$ 359,192.00
2.3	Post-Filling Depressurization	$ 555,912.00
2.4	Develop Post-Remediation Monitoring Plan	$ 53,662.00
2.5	Phase 3 Post-Filling Quarterly Monitoring and Reporting	$ 1,774,643.00
	Subtotal	**$ 2,778,743.00**
	Total Forecast to Complete	**$ 4,629,659.00**
3	NMGRT	$ 364,585.65
	Total Cost	**$ 4,994,244.65**
4	Contingency (Governed by the State of New Mexico EMNRD)	$ 1,428,735.88
	Grand Total	**$ 6,422,980.53**
	Additional Funding Needed	**$ -**

Injection operations were completed February 15, 2022 with 5,600 cubic yards of grout and 170,000 cubic yards of sand deployed

Overall Spend to Date:

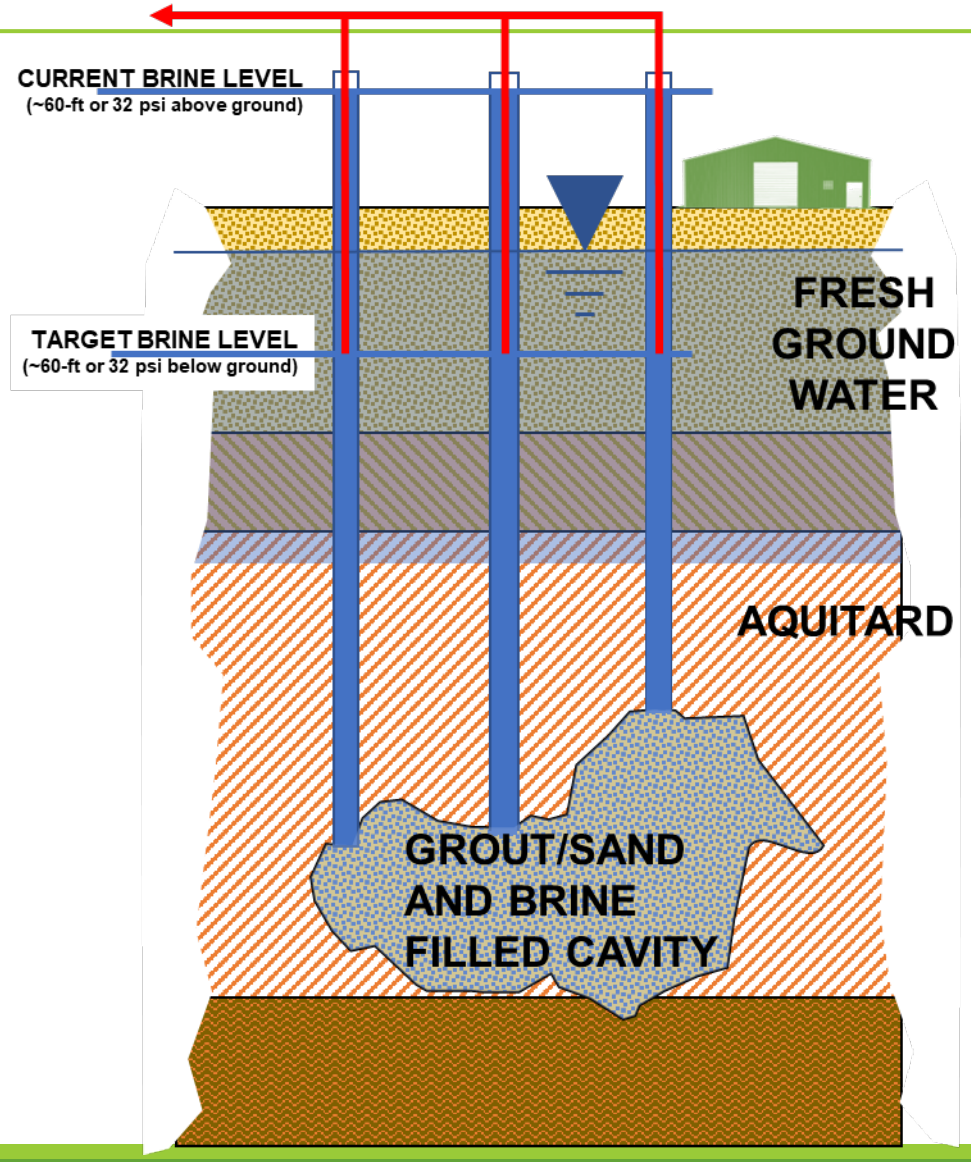
$66,353,925.59

- incl. Wood Contract,
- Use Agreements,
- & Other Related Expenses



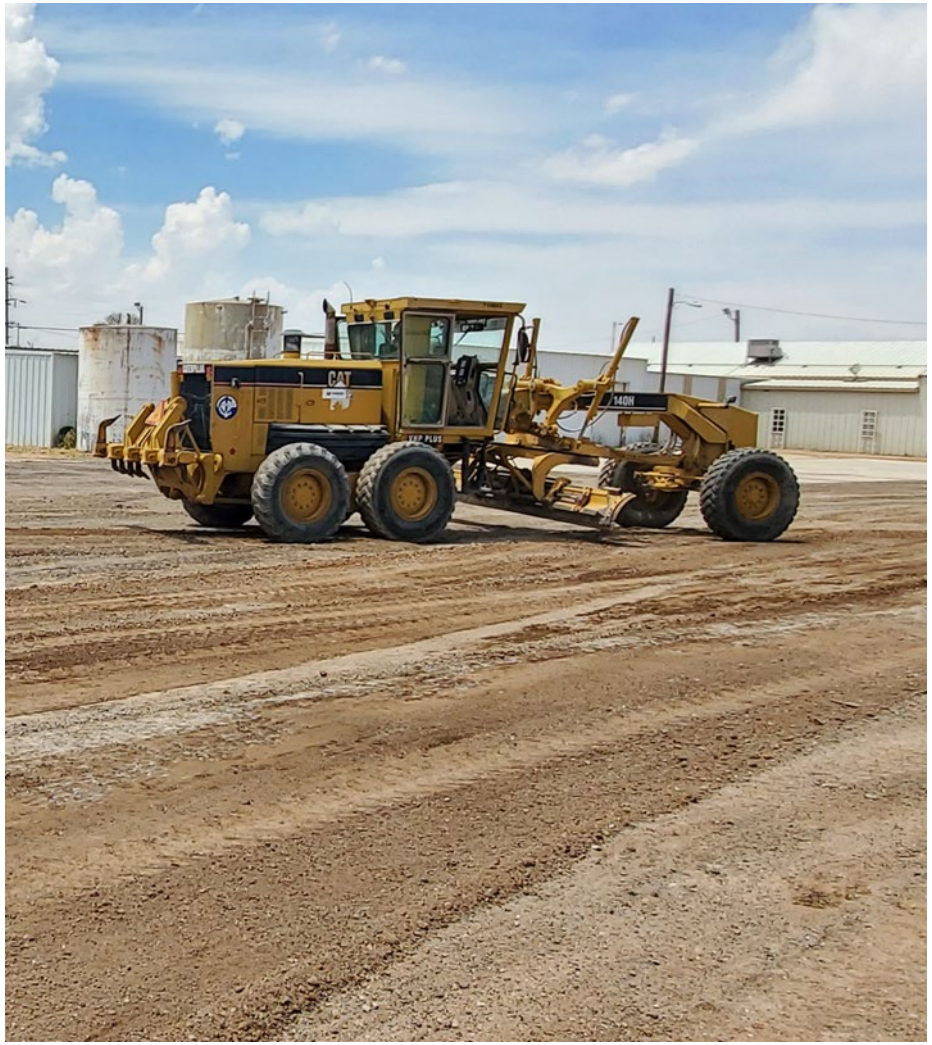
Cavity Depressurization

- Objectives
  - Decrease pressure of brine in cavity
  - Protect freshwater aquifer
- Stepwise Depressurization
  - Decrease cavity pressure incrementally
  - Monitor performance with existing instrumentation
  - Ease off pressure to preserve integrity of aquitard *(barrier between cavity and freshwater aquifer)*



Site Surface Restoration

- Demobilize equipment and unused materials
- Restore / Replace
  - Grades and pavements
  - Fencing and gates
  - Septic System
- Remove Project Infrastructure
  - Site Office
  - Storage buildings
  - Surface runoff control features
  - Brine storage



Post Remediation Monitoring

- Two years of monitoring following depressurization
- What will be monitored?
  - Existing monitoring system to measure changes subsurface
  - Brine and sand level in cavity (gauging using water-level sounder)
  - Fresh groundwater quality
  - Ground surface movement (InSAR)
- Why is it smart to monitor?
  - Adjust level of brine if rising
  - Assess condition of cavity before plugging wells
  - Assure freshwater quality is maintained
- Quarterly reporting

Meeting the Project Objectives

Mitigate the risk of a sinkhole forming at the project site and surrounding area.

- With the completion of sand deployment at the northern void the risk of a sinkhole forming at the surface has been mitigated to the extent possible.

Protect the freshwater aquifer above the cavity from brine impacts.

- A significant portion of the risk of brine and freshwater mixing due to a cavity roof collapse was abated by filling the cavity with grout and sand.
- IN PROGRESS — Carefully lowering the brine level (stepwise depressurization) will further reduce the risk of brine from the cavity impacting the freshwater above.