Public Briefing

December 18, 2012

Napoleonville, LA

Agenda

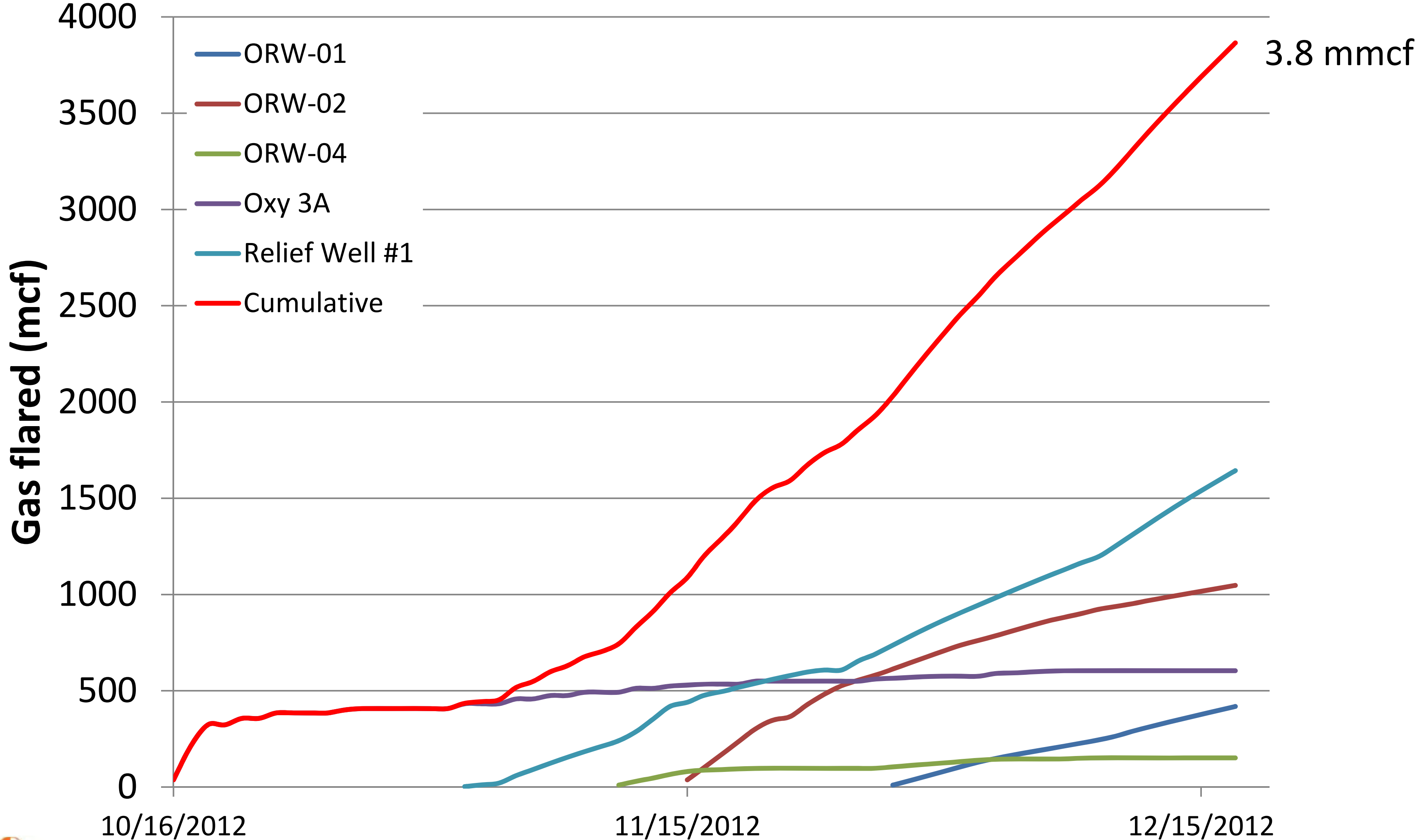
- Gas venting and shallow monitoring results
- Operations changes
- Update on our understanding of situation
- Gas migration analysis including H_2S issue
- Sinkhole update
- Cavern and dome stability

Venting Operations

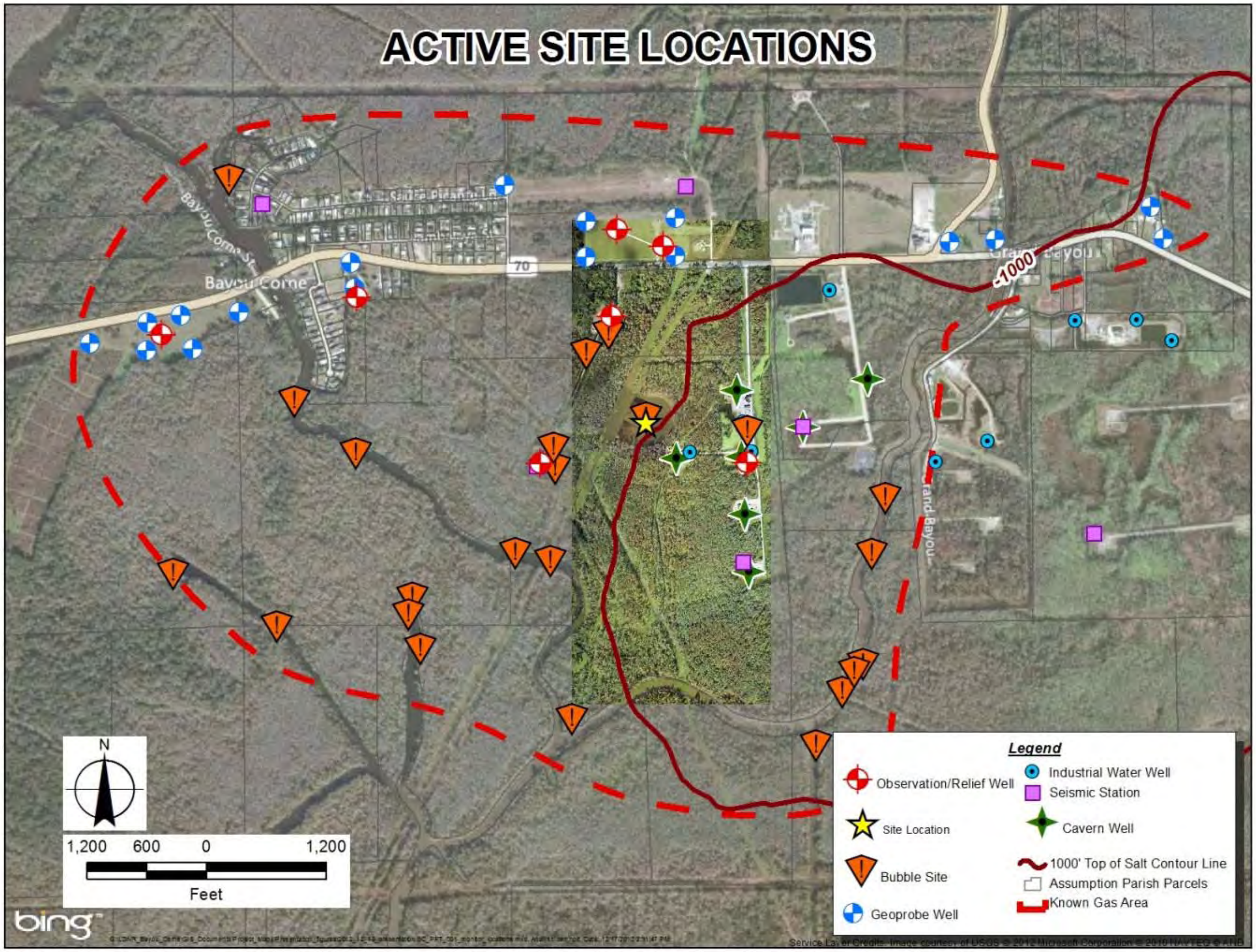
Vent Well Update

- Three wells flowing at Flowing at 15-60 Thousand Ft^3/Day (mcfd)
- Cumulative volume flared—3.8 million Ft^3 (mmcf)
- Pressures in vent wells remaining stable after adjustments for water levels
- No obvious sign of reduction of gas pressures or volumes
- ORW-04 being worked over—lower perfs clogged

Gas Flared to Date
(3.8 million cubic feet)



Vent Well Locations



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New Members on the LDNR Team

- Itasca—rock mechanics and micro-seismicity experts
- Dr. Hartman—Indoor air toxicology expert
- Exploration geologist to evaluate potential reservoirs on west side of dome
- Salt cavern engineer and salt dome and cavern experts to assist with the overall stability analysis of the dome in the vicinity of Oxy 3 cavern.

Dr. Will Pettitt

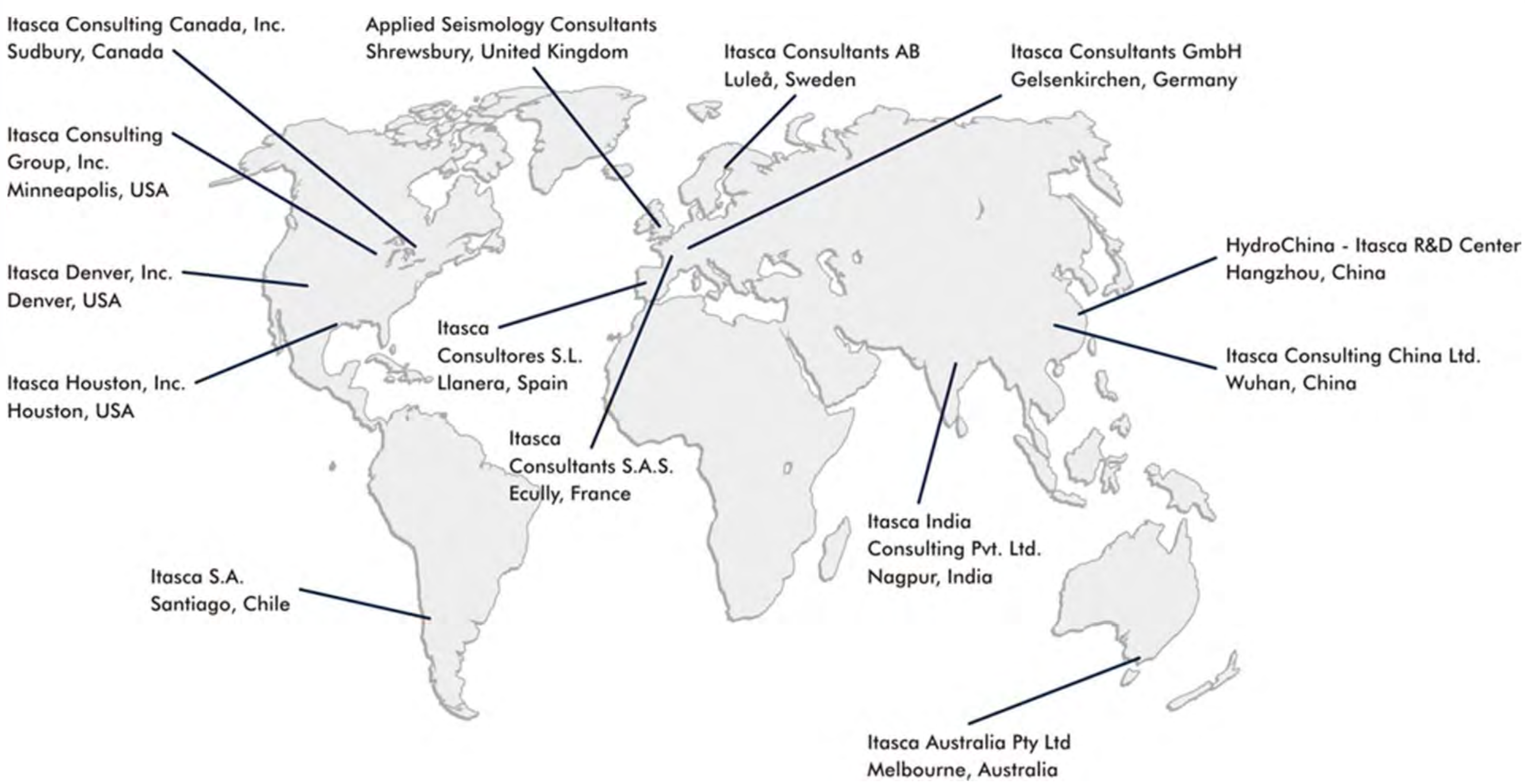
INTRODUCTION TO ITASCA AND OUR ROLE

Introducing Itasca

Itasca is an engineering consulting and software firm.

- A global company specializing in the engineering of rock and its behavior in the engineered environment.
- 14 offices located in twelve countries around the world.
- >150 staff total, >110 professional staff (mining engineers, civil engineers, petroleum engineers, geophysicists, hydrogeologists, hydrochemists, geotechnical engineers, rock mechanics, and software engineers).
- >50 PhDs.
- Offering consulting services from all offices in areas including mining, civil, oil & gas, power and manufacturing industries.
- Develops, sells and supports the world's most widely-used set of commercial numerical modeling software for advanced geotechnical analysis.

Itasca Offices around the World



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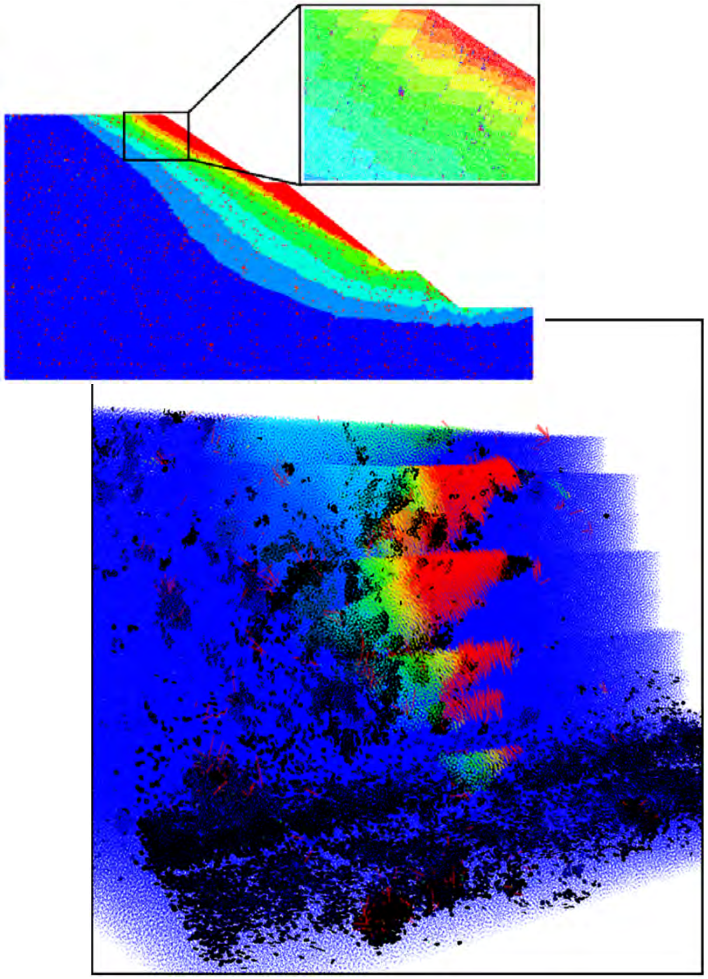
Slope Stability Analysis



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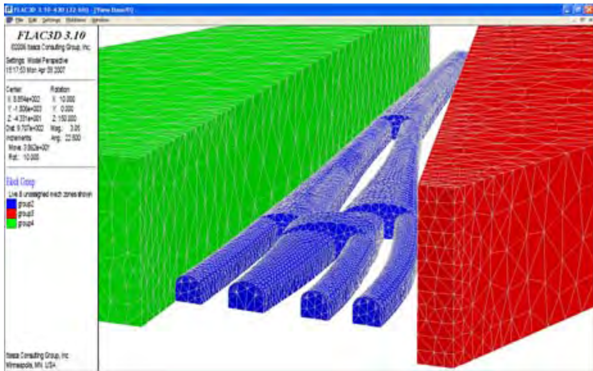
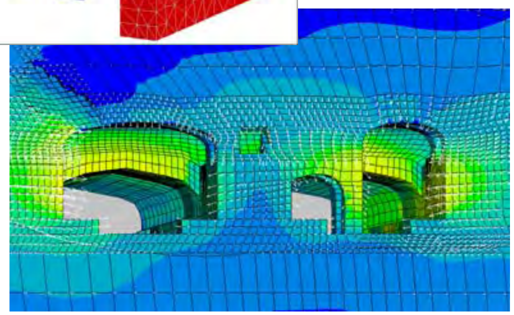
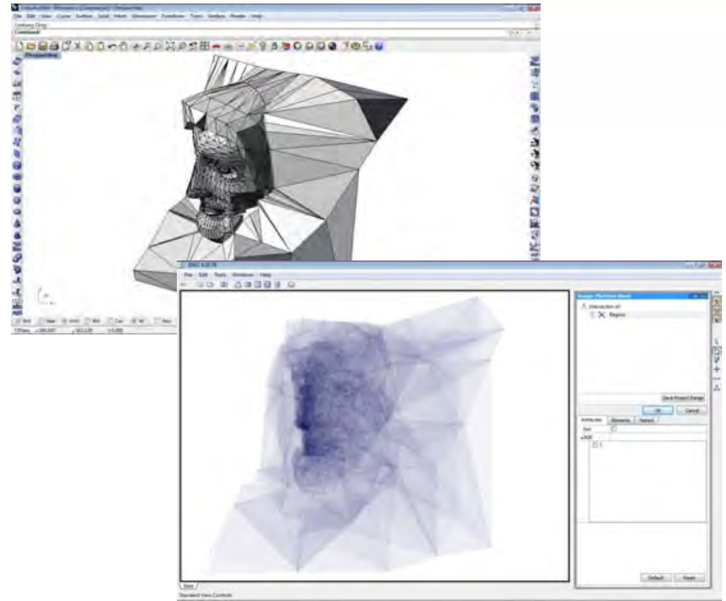
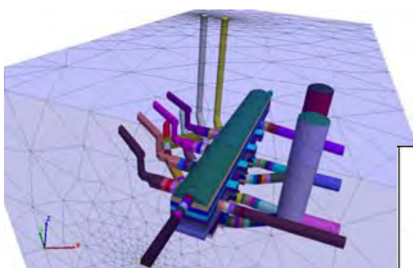
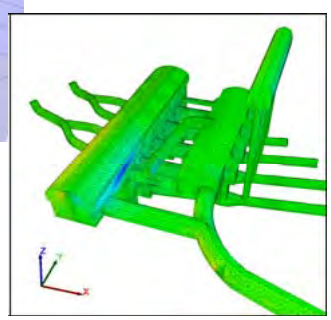
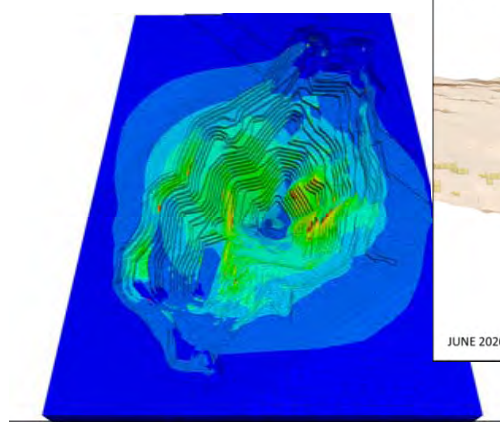

FLAC3D 3.10

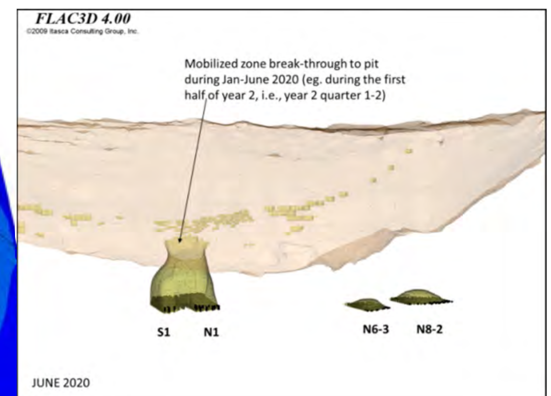






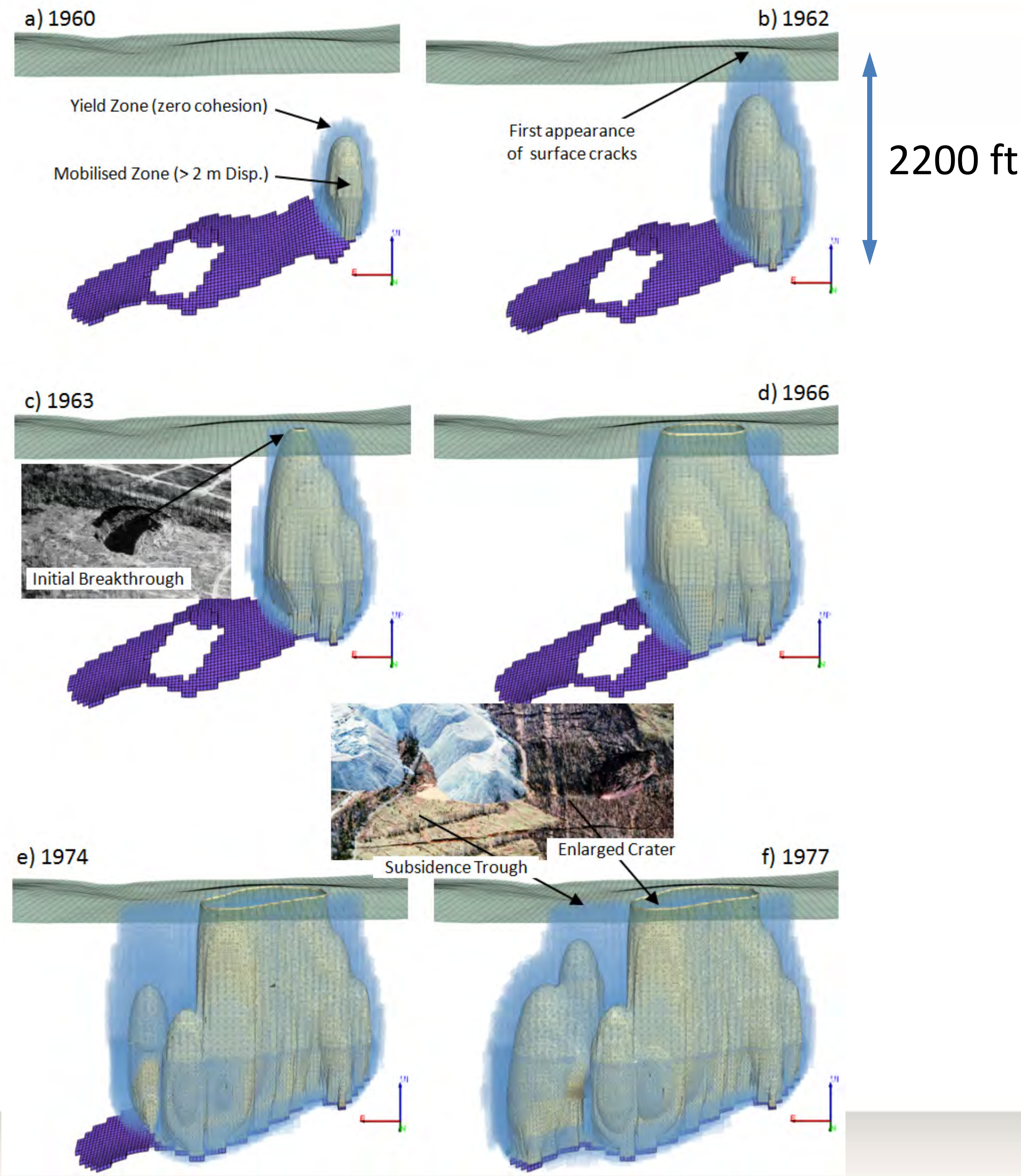





FLAC3D 4.00
©2009 Itasca Consulting Group, Inc.
Mobilized zone break-through to pit during Jan-June 2020 (eg. during the first half of year 2, i.e., year 2 quarter 1-2)
S1
N1
N6-3
N8-2
JUNE 2020

Predicted evolution of a caved zone above Grace Mine, Pennsylvania.

From Sainsbury, Sainsbury and Lorig. "Investigation of Caving Induced Subsidence at the Abandoned Grace Mine," in Caving 2010 (Proceedings, Second International Symposium on Block and Sublevel Caving, Perth, Australia, April 2010), pp. 189-204, Y. Potvin, Ed. Perth: Australian Centre for Geomechanics (2010).



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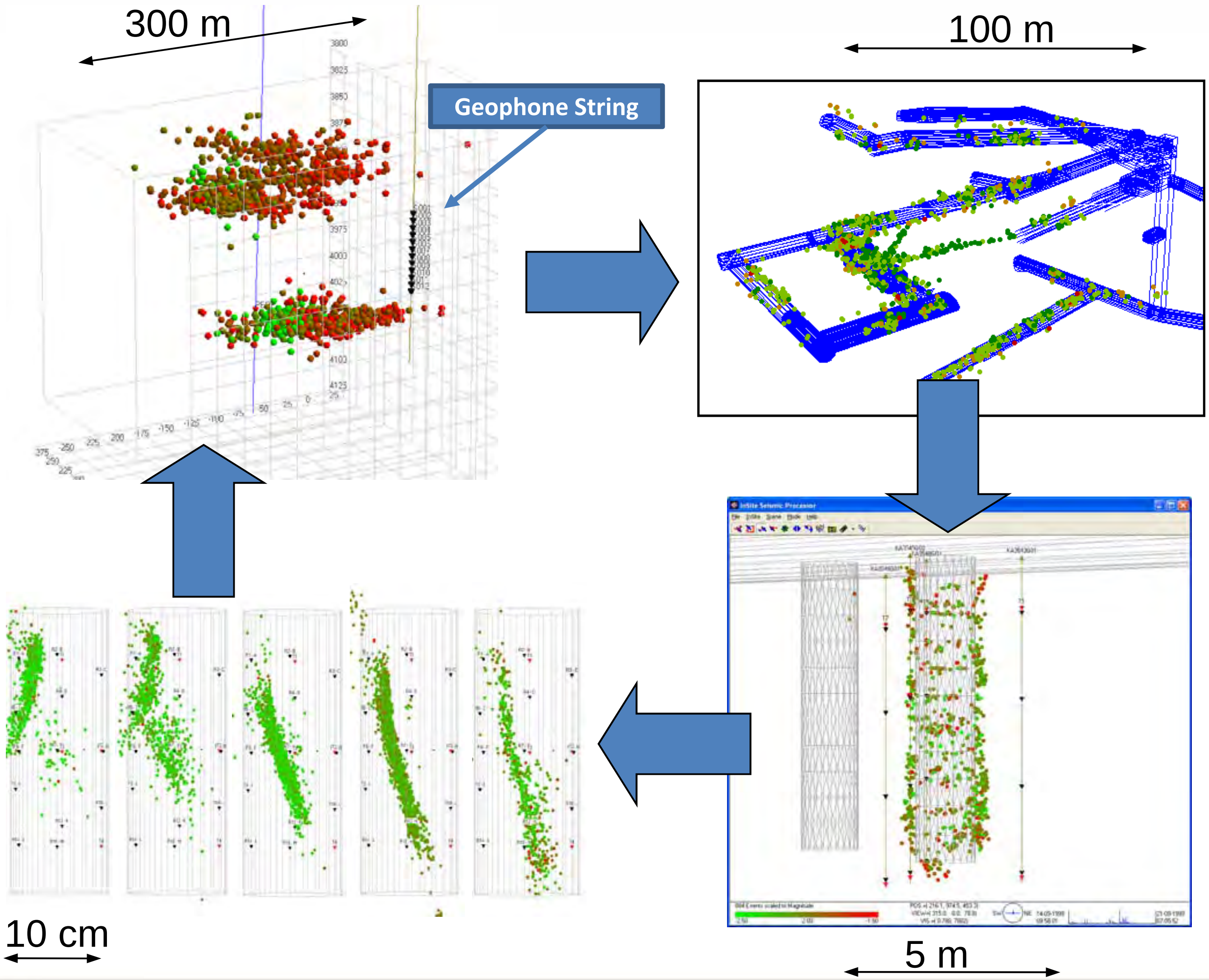
Passive Seismology



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Role of Itasca with Shaw/LDNR

- Review and advice on rock mechanics, geomechanics, seismic monitoring and geophysics.
- Geomechanical modeling is targeted at answering specific key questions:

  Q1: Is it plausible for large scale voids to be produced within the failed zone that could contain large volumes of gas?

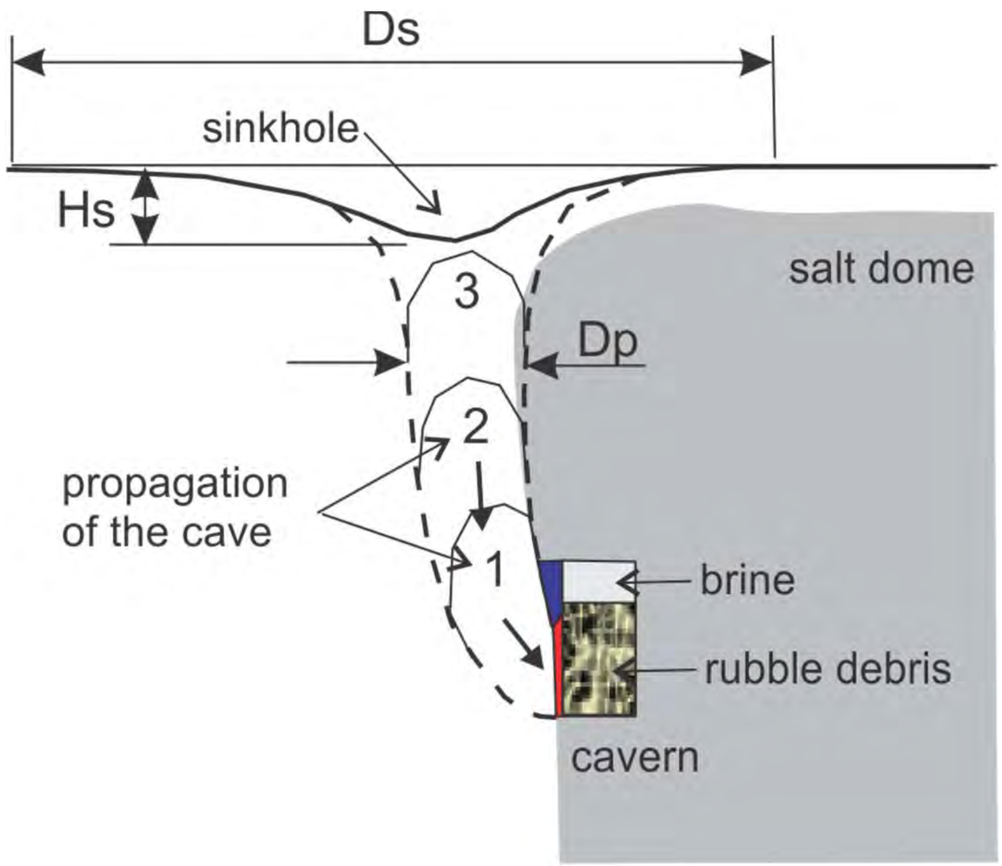
  Q2: What is the maximum dimension of the collapse zone, sink hole and appreciable subsidence?

  Q3: What are the physical processes and chain of events that explains the behavior of the cavern and collapsed zone?

  Q4: What is the interaction between the four TBC caverns, the salt dome wall and the stability of this rock volume?

- Processing of micro-earthquake and microseismic field data for review of TBC contractors and for use in back analysis of failure column and model validation.

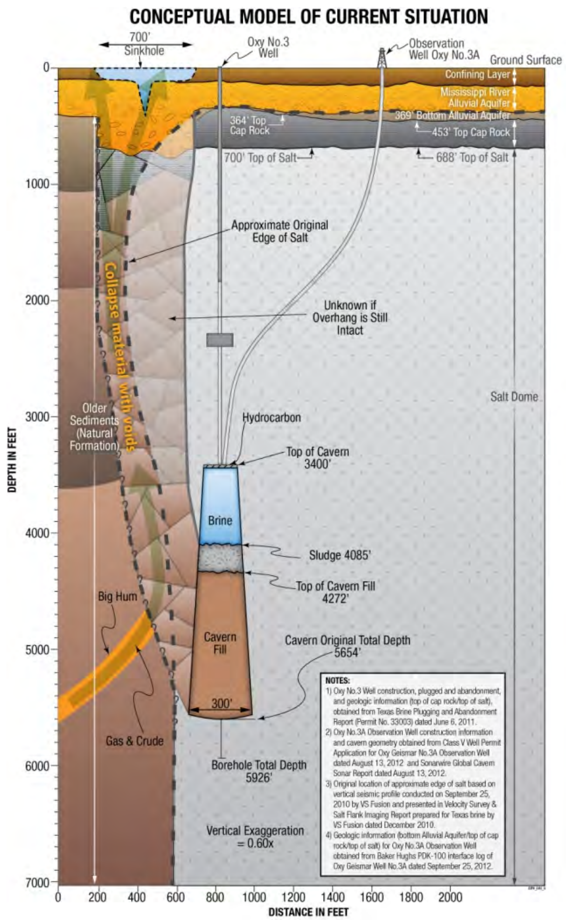
Caving Model



Conceptual Model – not to scale

Current Situation

- What do we know?
  - Sinkhole size and shape.
  - Amount of debris filling the cavern.
  - Size and shape of the cavern.
  - Gas behavior in the near surface.
  - Some information on site geometry and rock properties.



- What do we NOT know?
  - Size and shape of the collapse column.
  - Behavior of the collapse column at depth.
  - Good geometry of the salt dome wall and current condition.
  - Effect of collapse on the interaction between the close caverns.
  - Rock properties through the sedimentary layers.

Here is what we are doing to help?

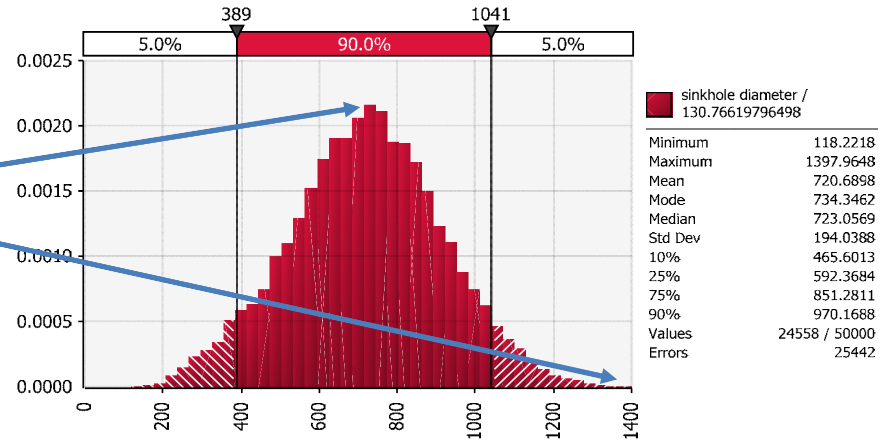
1) We use our best estimate.

Parameters	Stochastic Variable	Value	Statistical Distribution
Initial cavern wall volume in % of cavern debris volume, ***Vwi***, (%)	Yes	0 to 100	Uniform
Wall bulking factor, BF_w	Yes	0 to 1	Uniform
Rock column radius, R_{rc}, (ft)	Yes	50 to 150	Uniform
Rock column height, H_{rc}, (ft)	No	4013 or 3400 [(a)]	NA
Rock column bulking factor, BF_{rc}	Yes	0 to 1	Uniform
Angle of repose of near-surface material, φ (°)	Yes	15 to 45	Uniform
Bulking factor of material at sinkhole perimeter, BF_{sp}	Yes	0 to 1	Uniform
Cavern debris volume current, V_d, (ft^3)	No	89,840,188	NA
Cavern debris volume full, V_{df}, (ft^3)	No	109,345,995	NA
Sinkhole volume current, V_{sc}, (ft^3)	No	17,970,366	NA

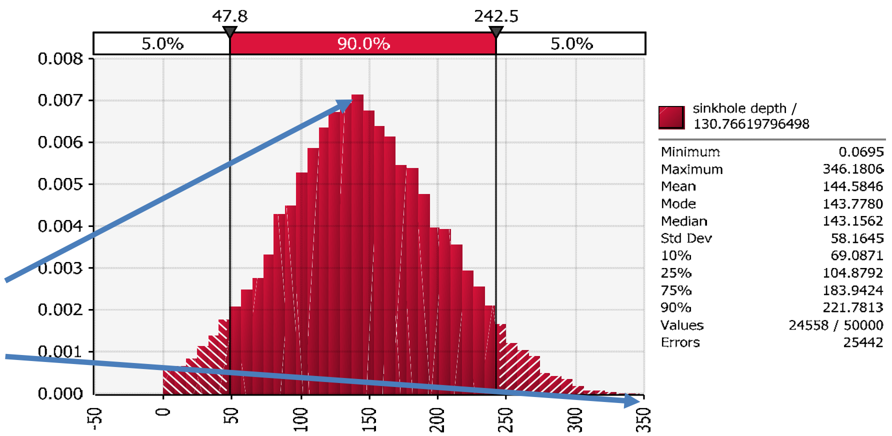
(a) Two scenarios are evaluated (1) 4013-ft depth that refers to the top of the current cavern debris level, and (2) 3400-ft depth that refers to the top of the maximum debris level (i.e., cavern full of debris).

Statistical Analysis for Final Sinkhole Size

Sinkhole Diameter
Most Likely = 734 ft
Worst Case = 1398 ft



Sinkhole Depth
Most Likely = 144 ft
Worst Case = 346 ft



Sophisticated computer modeling is examining all this in greater detail….

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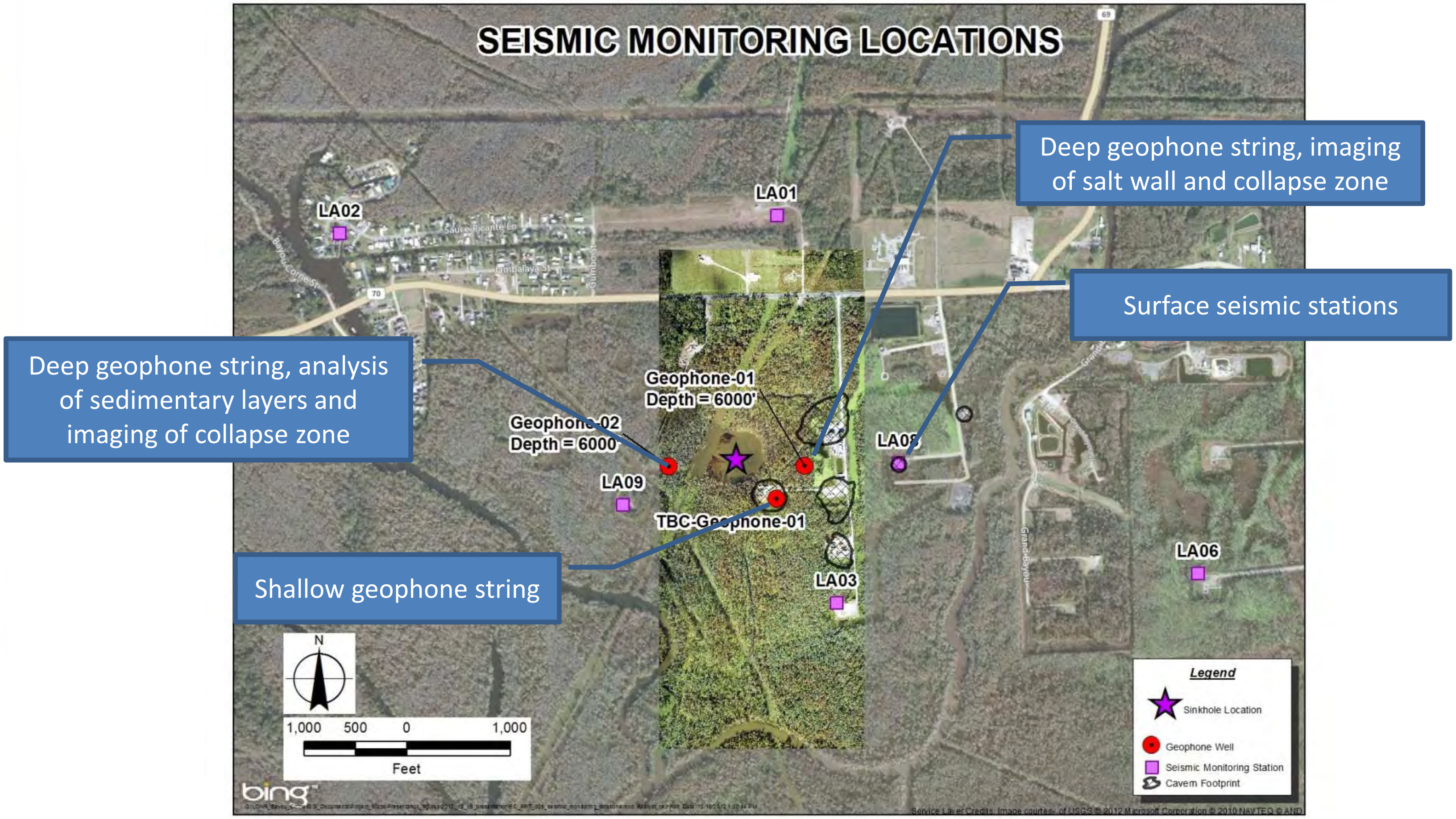
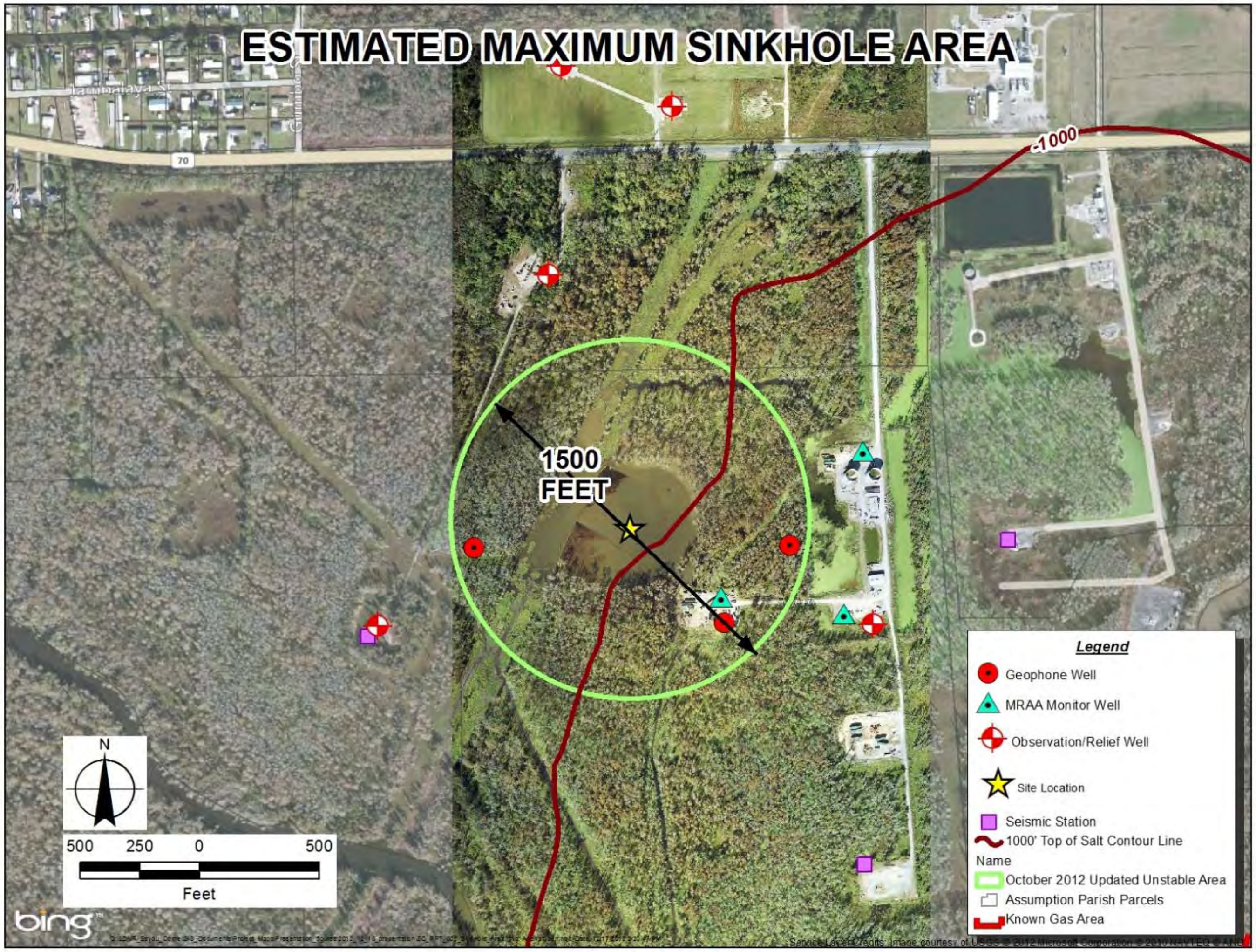
2) We make field measurements.



Plans for Field Measurements (Shaw/TBC/LDNR/Itasca)

- Passive Seismic
  - Surface Array
  - Shallow Down-hole Array
  - Deep Down-hole Array
- Active Seismic
  - Vertical Seismic Profiling (VSP)
  - Cross-hole Seismic
- Geotechnical Measurements
  - Cores and lab testing
  - Geological and geophysical well logging

Estimated Area of Maximum Subsidence



Consistent with initial model results by Itasca

Analysis of Current Situation (Stability Analysis)

1. Gas migration
2. Sinkhole
3. H_2S gas situation
4. Cavern stability and collapse zone

Update on Situational Understanding

- Settlement markers won't be installed in area because of shallow methane gas problems
- Hydrocarbon and gas fingerprints from cavern don't match samples from Big Hum production well
- Additional oil and gas data will come from deep borehole
- Collapse model updated—gradual caving collapse as opposed to sudden single event

Shaw Geoprobe Well Seals

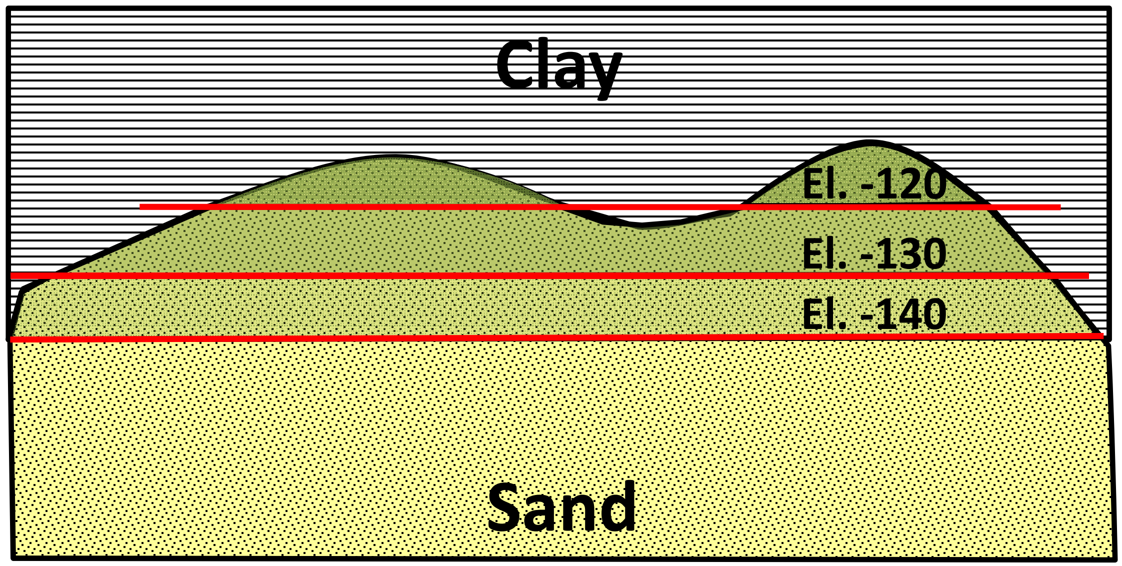
- Tested wells to ensure that they function correctly to monitor pressure
- Wells tested and all passed 10 psi for 1 hour pressure test
- Conclusion: Wells function to monitor pressure

Quantify Flow Rates of Gas Bubbles with the Bubble-o-meter

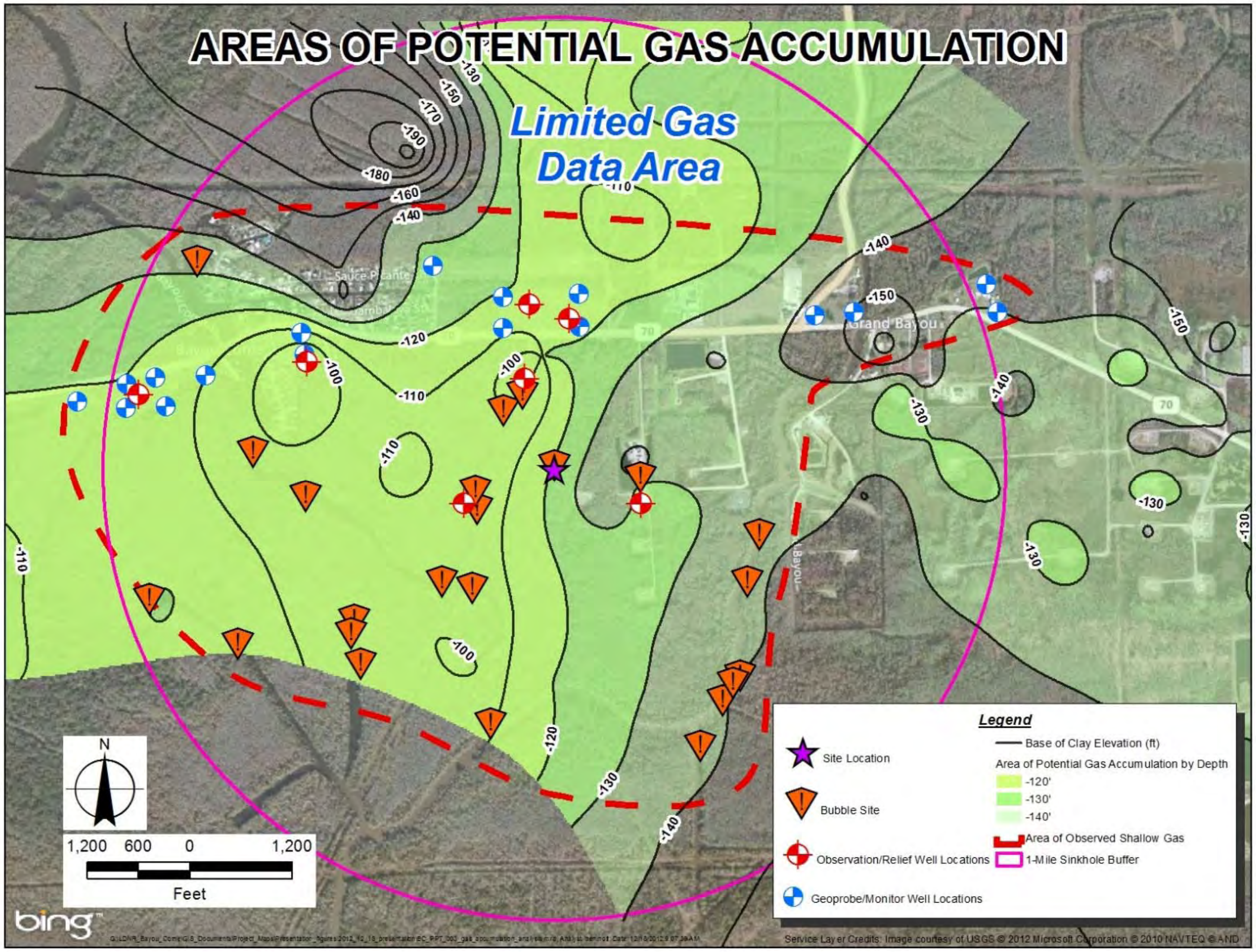
Results—5 to 50 cubic feet per hour (100 to > 1,000 ft^3/day)
Known bubble sites—15 mcfd total over 26 sites

Initial Gas Accumulation Volume Calculations

- Determine volume of alluvial aquifer between one elevation and the base of the clay and then do standard gas volumetric calculations
- Estimate depends on where we think bottom of gas is
- Gas top ranges from -95 to -142 feet
- Gas bottom ranges from -125 to -152 feet



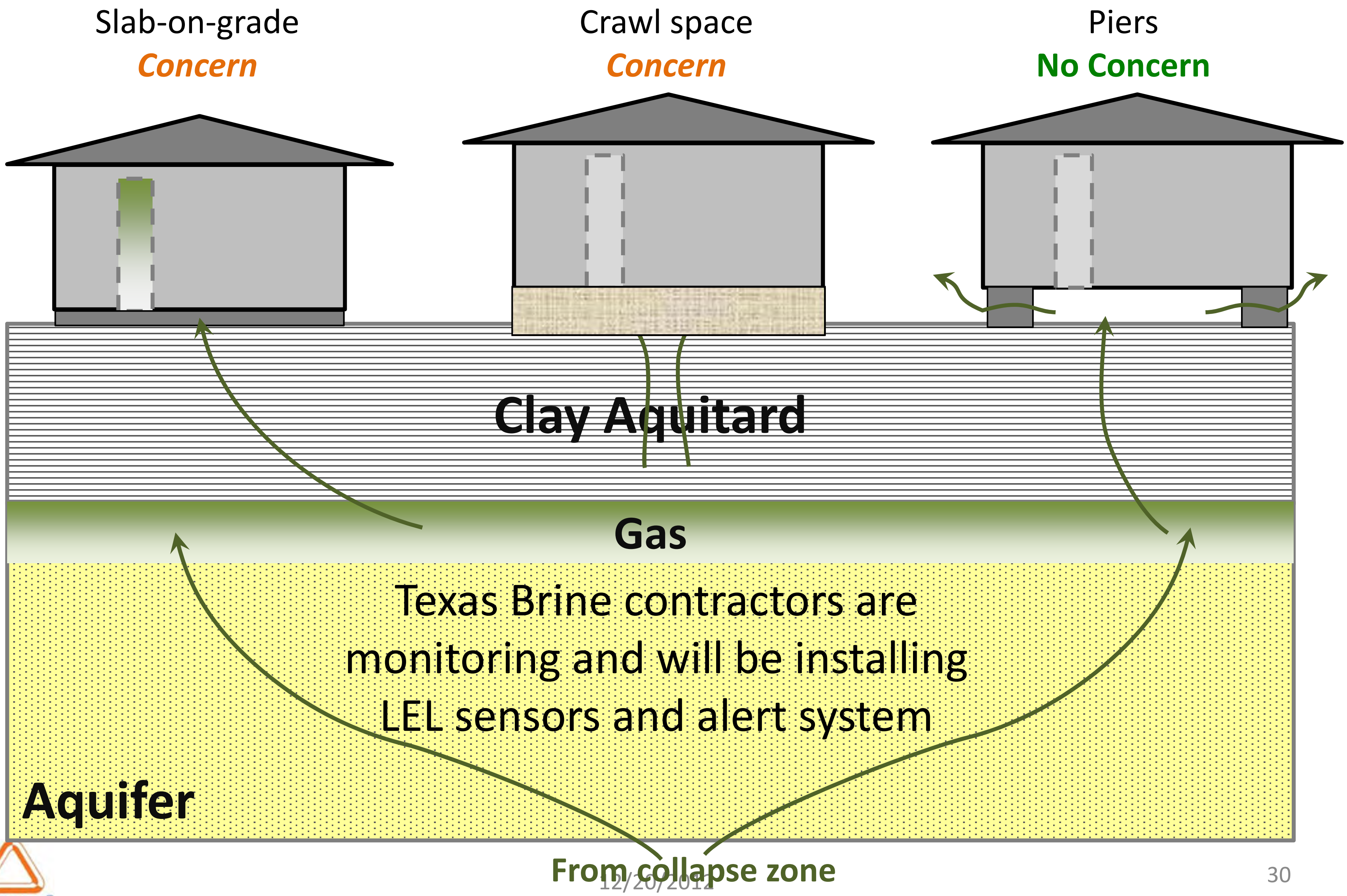
Shallow Gas Accumulation Area



Shallow Gas Area

- Area—over 2 square miles
- Depths—120 to 150 feet in aquifer
- Volume in aquifer—50 to 100 million cubic feet at 50 psi formation pressure

Potential Gas Migration Into Homes



H_2S (Hydrogen sulfide) Gas Situation

- H_2S occurs naturally in swamp environment
- Detections
  - Cavern
  - Cap rock
  - Small blips in aquifer and Geoprobe well vaults
- No current threat to public but need to monitor
- Ongoing monitoring and analysis during Shaw field work and flaring
  - Shaw is managing as an H_2S job from a worker protection and monitoring standpoint
  - Personnel monitors and 4-gas meter
  - Vent wells checked every hour

H_2S Monitors

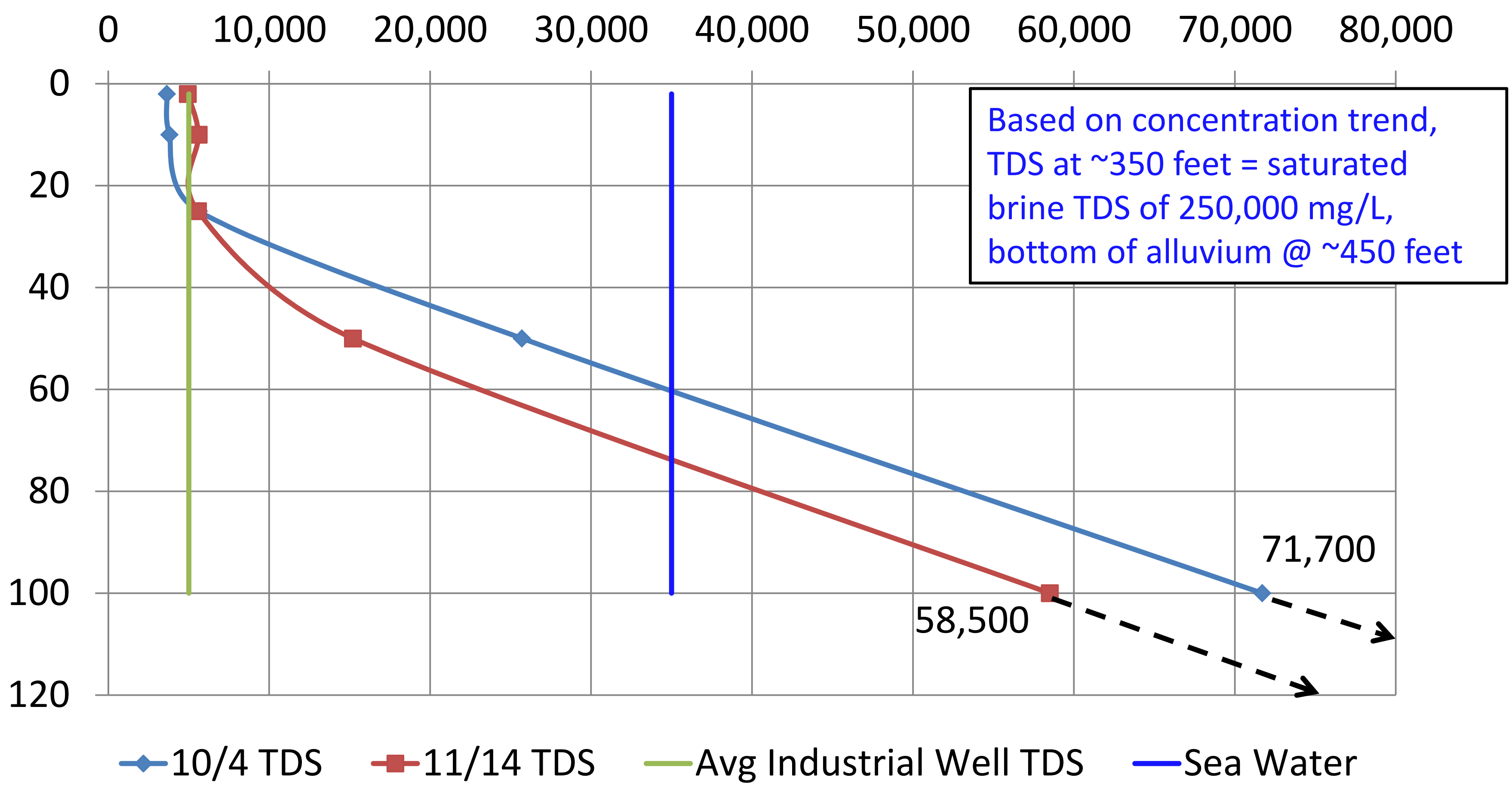
Why Not Vent H_2S from Cap Rock?

- Little to be gained in terms of immediate concern
- Need to protect MRAA from H_2S as venting is performed
- Future management issue after methane is under control and cavern stability is determined
- Shaw recommends that the cap rock H_2S be left in place for now

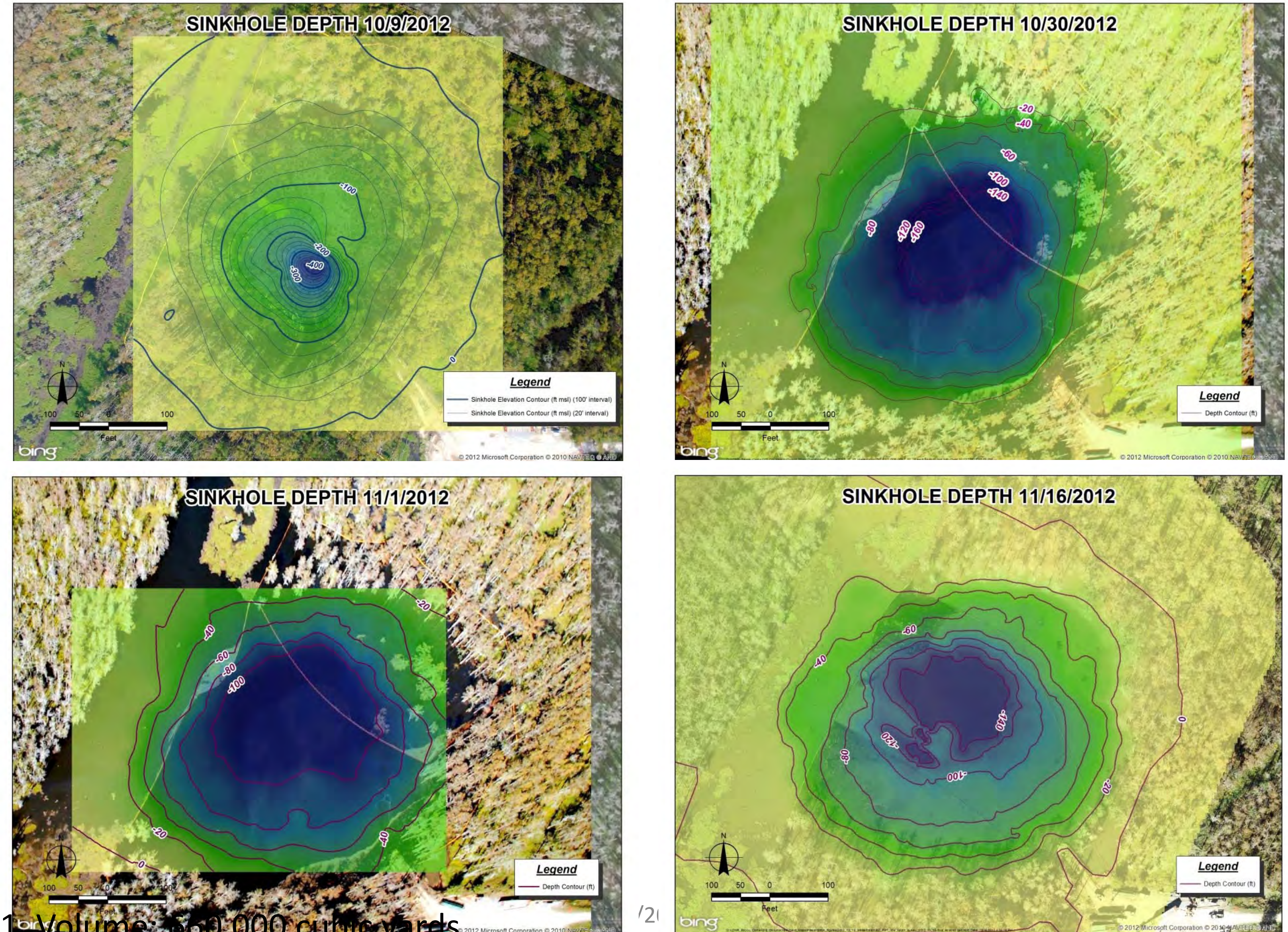
Sinkhole Status

- Area of sinkhole—8 acres as of first November with overall area of subsidence over 12 acres
- Gradual subsidence noted outside of sinkhole to the west
- Sinkhole continues to burp gas and change shape on a periodic basis

Sinkhole Total Dissolved Solids (salt in water)



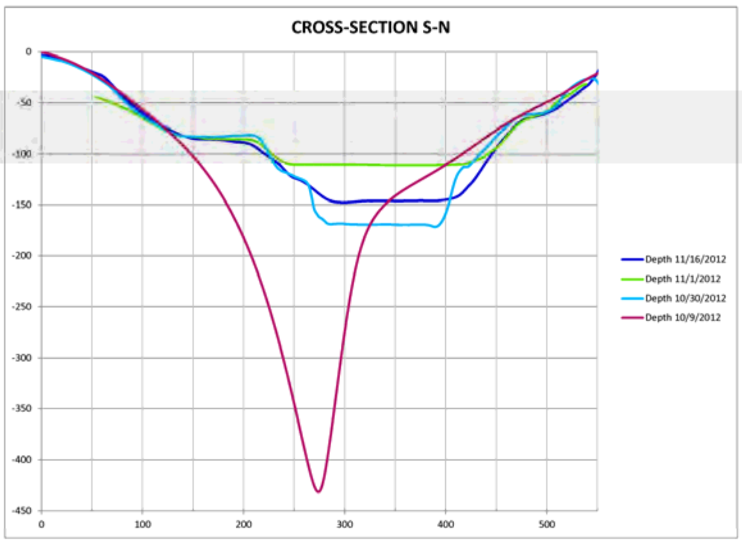
Sinkhole Changes Over Time



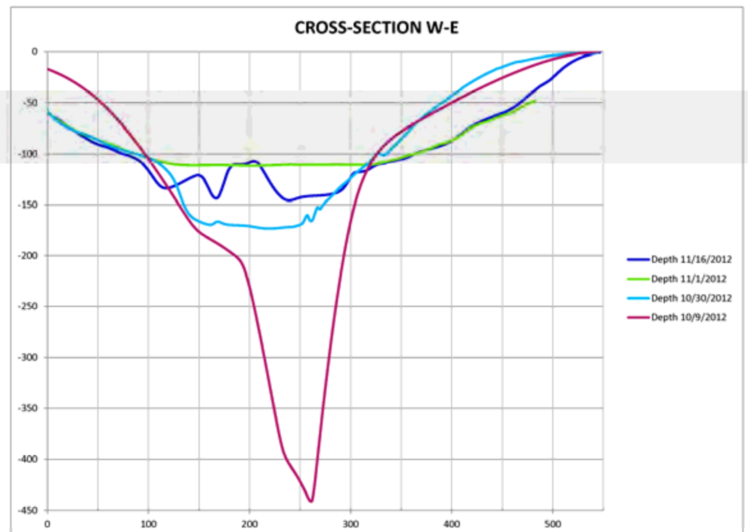
Nov. 1 Volume: 660,000 cubic yards

Sinkhole Cross-Sections

South to North



West to East



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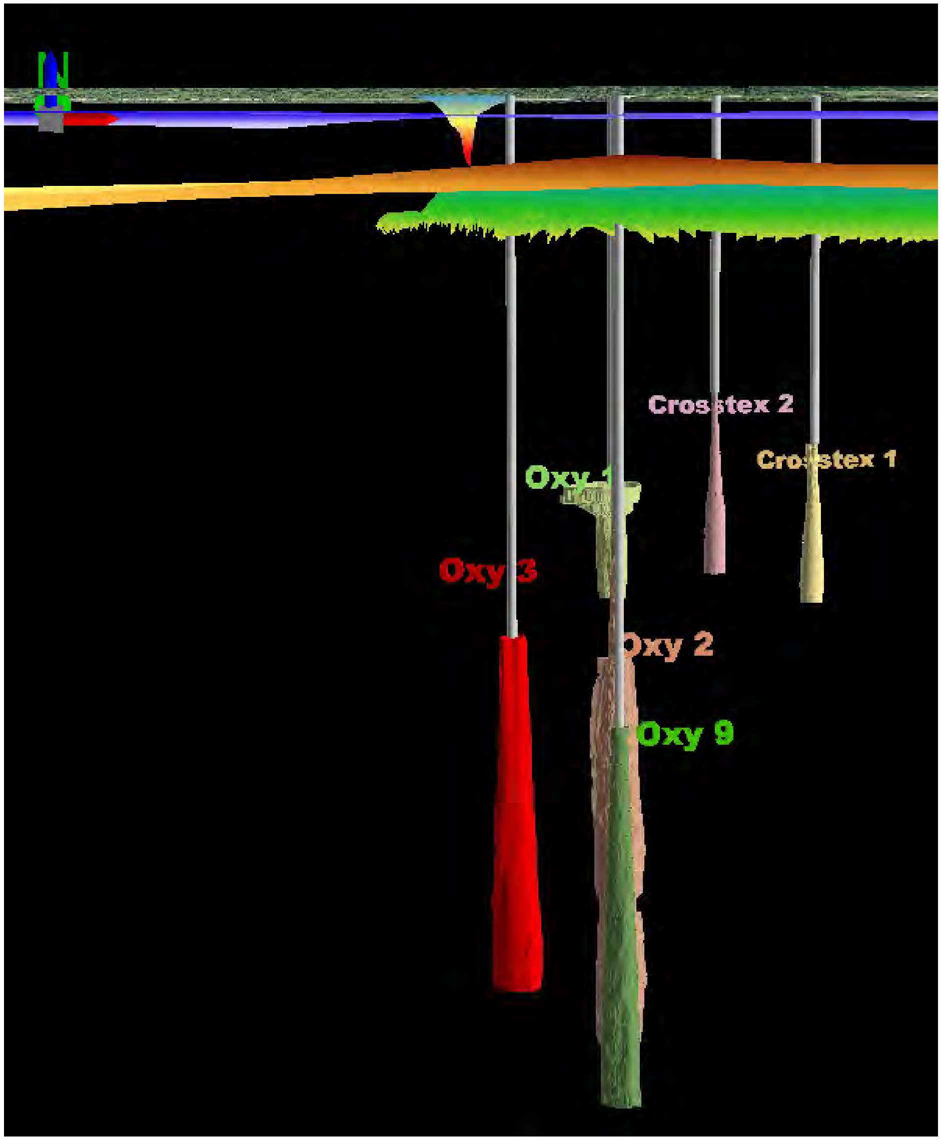
Cavern Stability

Conceptual Model Basics

- Size of Voids still an issue but we are getting closer to answers
- Sinkhole "burping" --Strong indication of voids that fill with gas and then release
- Sinkhole changes indicate that collapse zone changing
- Seismic tremors—two types
  - Rock movement
  - Gas moving thru voids
- Incorporating other caverns in vicinity of Oxy 3 in stability analysis and modeling

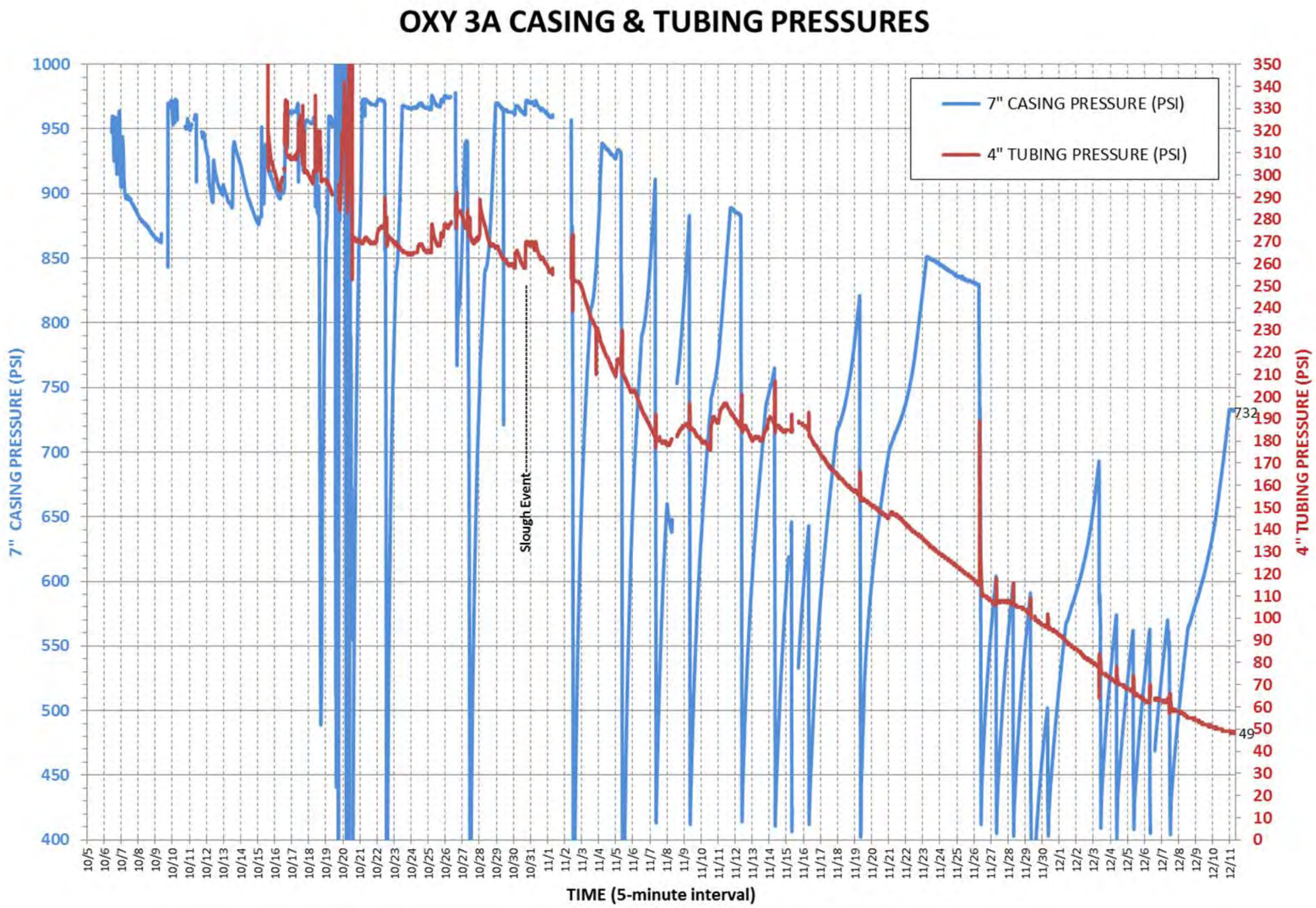


View looking due North
From 3D Geologic Model

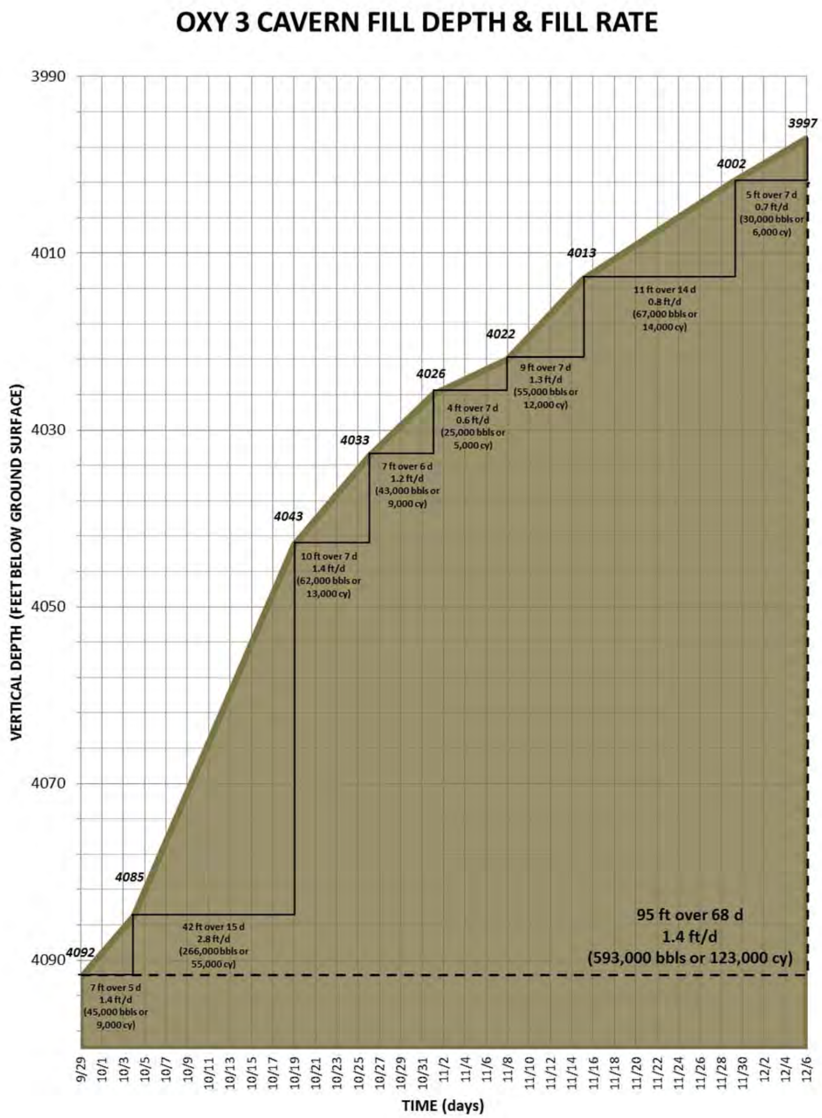
Oxy 3 Cavern Summary

- Hydrocarbon and gas inflow declined in past month to almost negligible amount
- Cavern brine pressure declined to near zero
- Continue to monitor overall cavern pressure (gas + liquid)
- Cavern still filling in but a bit slower

Cavern Pressure Steady Decline



Cavern In-Filling Rate



- Vertical depths plotted (not measured depths)
- Rate of in-filling slowing
- Roof of cavern at 3400 vertical depth

Stability of Other Caverns on West Side of Dome

- Analogous to a tropical storm off west coast of Africa—Need to closely watch situation with appropriate instrumentation and evaluations
- *DNR is requiring immediate installation of instruments and data collection for comprehensive and quantitative understanding of this unprecedented situation*
- Shaw and our experts reviewed recent sonar surveys of all caverns in area and MIT results
- Caverns appear to be stable but, out of caution, require immediate and long-term monitoring

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Ongoing Evaluations of West Side Caverns

- Evaluating current 3D geometry of caverns near Oxy 3
- Salt cavern experts evaluating sonar surveys over time for each cavern in area
- Itasca has rock mechanics modeling running right now to evaluate progression of Oxy 3 collapse, affected area, and effect of surrounding caverns
- Evaluating seismic events and why Amend 5 requires deep seismic arrays to 6000 feet.

Seismic Monitoring

- Current Seismic Monitoring System
  - Surface seismic array
  - Itasca currently reviewing CERI helicorder data daily
  - Shallow geophone well at 500 feet
- Amendment 5 Directives
  - Two deep geophone wells to 6,000 feet
  - Permanent long-term seismic monitoring system
  - Seismic imaging of edge of salt and collapse zone to determine if large voids are present

Texas Brine Surface Vibe Survey

T-Rex Tri-Axial Vibroseis Unit

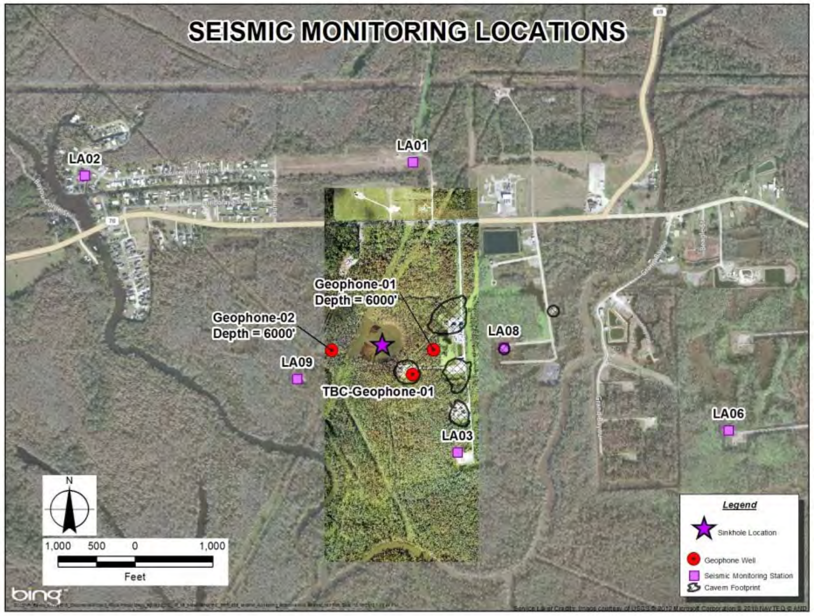
- Scheduled for mid-to late-January along main roads to refine shallow velocity model
- Needed to refine shallow seismic velocity model to better locate seismic events

Texas Brine Replacing Surface Seismic Array

- Itasca providing technical input and review of new array
- Nanometrics replacing existing seismic array by middle January—upgrading system under direction of Dr. Julie Shemeta TBC will make data available to public seismic monitoring system
- On-going seismic data analysis by Nanometrics and Dr. Shemeta under TBC contract
- CERI and USGS future involvement being determined but they will have access to data

Deep Boreholes and Seismic Imaging (Ears and x-rays on situation)

- TBC-Geophone-01:First borehole seismic monitor
- Geophone-01: Deep seismic monitoring in salt as soon as possible
- Geophone-02:
  - Samples for rock mechanics testing
  - Data on formation oil and gas characteristics and production horizons
  - Deep seismic monitoring west of dome
- Use boreholes for deep VSP and cross-hole seismic tomography



Temporary 2 Hz Geophone Specifications (from Texas Brine seismic work plan)

Specs courtesy Hasting Micro-seismic Consulting

- Fully gimbaled, 18° maximum tilt
- Withstands up to 50°C
- Passive sensors
- For permanent or semi permanent installations

Parameter	Specification
Geophone orientation	Triaxial, Orthogonal
Natural frequency	2 Hz
Operational temperature	45° to +50°C
Operational pressure	10,000 psi (69 MPa)
Tilt tolerance	± 18°
DC resistance	3810 Ω
Sensitivity	2.0 V/in/sec
Open circuit damping	0.61
Moving mass	23 g
Max coil excursion p-p	0.30 in (0.76 cm)
Normalised transduction constant	0.0317 $\sqrt{R_c}$ V/in/sec

Dimensions	
Outer diameter	3.5 in (8.8 cm)
Wall thickness	0.213 in (0.541 cm)
Height	3.5 ft (106.68 cm)
Weight	30 kg
Casing Material	316 stainless steel

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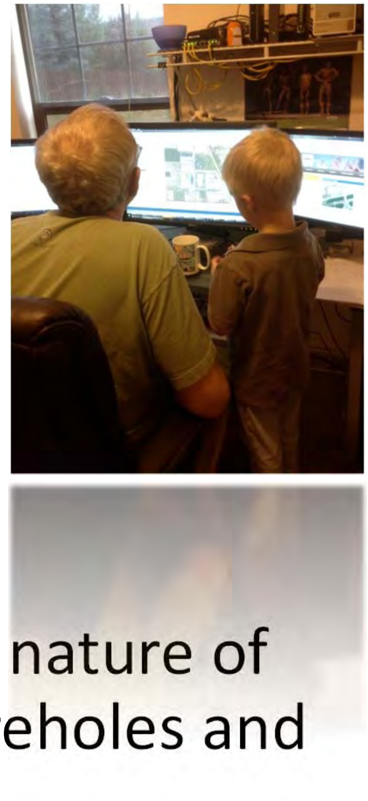
Path Forward



- Getting people back home
  - Ventilation of enclosed spaces
  - Permanent methane monitors in homes
  - Need to determine potential volume and nature of voids in collapse zone from 6000 foot boreholes and seismic imaging
- Determining stability of collapse zone
  - Analysis of ongoing seismic events
  - Seismic imaging of collapse zone
  - Rock mechanics modeling


You are in our thoughts every day
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Questions?