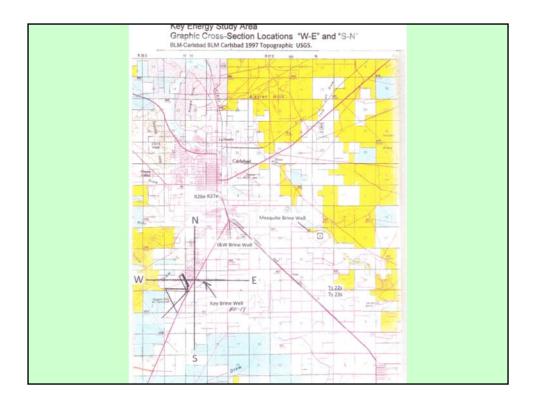
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MEETINGS



Part 1-Location

Location, Location- will be discussed throughout the presentation.



Carlsbad Irrigation Canal is approx. 3-4 miles east of site.

Pecos River- is 5-6 miles east of site.

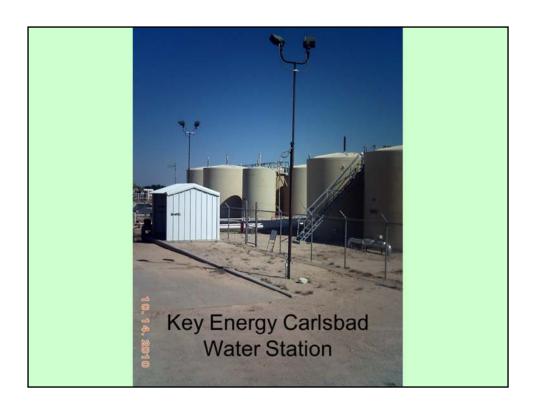
Brine Well Locations.



Red Border- Airport RD on the North, Derrick RD on the South, Nat Parks HWY on he West, Vacant land and Old Cavern HWY on the East.

Yellow Line is City/CTY boundary.

Blue Line- is site and access.



One \$Million on the ground- twice that to rebuild Has BMP's, and utilities

Part 2- Oilfield Facts

Some Oilfield Facts

"Quality" Brine Water is an essential fluid in the oil-patch.

Brine Water is required when drilling through Salt Zones.

Brine Water is 20% heavier than fresh water.

Heavy Brine Water aids in pressure, mud and corrosion control in drilling operations.

Emphasis on Quality

What is a Brine Well?

A well drilled into and completed in known formations that contain pure salt i.e. NaCl.

Water is pumped into the salt zone and after some residence time a heavy brine 10 lbs/gal is produced.

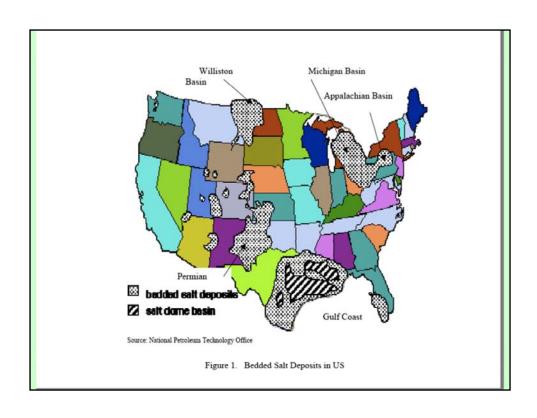
The Brine Water is stored on-site in tanks for usage or sells.

Fresh water is required- however Key is looking <u>at long term plans</u> for treating brackish water.

Downside- presently state government has been requiring stringent permits on these types of systems.

WHY! Complex Issue of ownership of the water and ultimate government control.

Treatment cost!



Why Brine Wells?

Brine wells provide a safe and reliable storage of very large quantities of fluids.

Manual mixing of bags of salt would be impractical and not cost effective.

Transporting, Storing and Mixing large quantities of solid salt and water would be an environmental hazard and require massive tankage and buildings.

Potash and Playa salts have unacceptable Impurities.

Takes approx. one bag of salt (70#) per barrel of water to make 10# brine.

Can mixing 10,000 bbls. Most of the salt is actually stored below ground reducing the size of the battery and potential impact.

Bulk mixing would be even worst. Small Environmental clean-ups can cost into the \$millions.

Key's management is concerned about the logistics and liability.

Part 3- Failures, Collapse and Prevention



A topic that must be discussed! Why did this happen? Can Tell History of Brine Wells in NM.

However, it did happen and the emphasis needs to be on prevention.

Key Energy is raising its right hand and adamantly states it will not happen. Building Analogy.

Why Did This Happen?

How do we make sure it won't happen again?

Brine Well Collapse Issues Summary

Primary Reasons for Collapse Occurrence:

- Inadequate overburden structures
- Cavity size exceeds safe limits
- ❖No defined "End of Life" requirements
- Formation not adequate for brine well
- Improper completion in zone of interest
- Improper operating and monitoring
- ❖Wells completed in Shallow Salt Zones

Building analogy: Small I-beams, too large of span, End of Life when using made made materials, were are using mother natures i.e. Carlsbad Caverns,

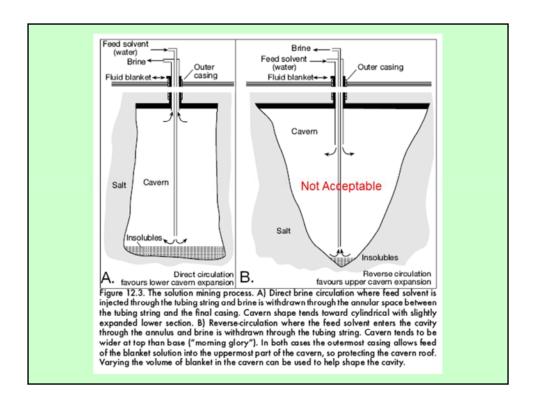
Don't build on unstable ground, Build something you have to maintain it.

Brine Well Collapse Issues cont'

Primary Concerns of a Potential Collapse:

- ❖Public health and safety issues.
- ❖Damage to infrastructure.
- ❖Loss of property
- ❖Groundwater and "Surface Water" Issues
- Tax payers may become responsible
- ❖Fear and outrage

If done properly, all of these items diminish or become a non-issue.



General discussion of cavern development

Part 4

- Siting
- Design
- Operational
- Closure

Siting/Design/Operation/Closure Requirements:

- Adequate "Set-Backs" has been established for all permanent features such as houses, buildings, pipelines, wells, roads, canals, etc.
- •Not located in a water wellhead protection areas.
- Not located in a Flood Zone.
- •Land and public access control issues have been addressed.
- •Not located in a disturbed or un-stable area.
- Area Of Reviews (AOR) has been conducted.

Obviously, the old permitted brine wells did not adhere to these requirements. Why? Probably because of some of the old federal mineral acts gave an implied primacy over land use.

These type of local proceedings will probably began to have an impact on those laws!

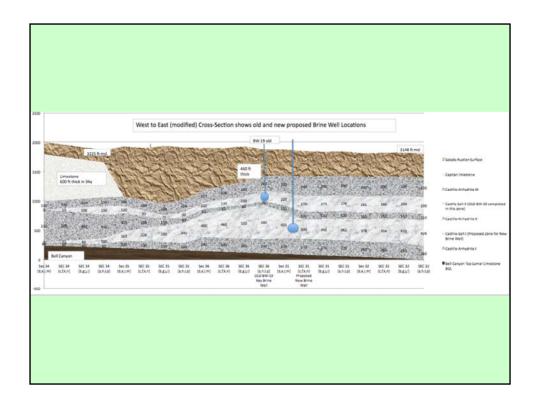
Design Considerations:

- •A comprehensive site Geologic, Hydrologic and Tectonic characterization study and report has been completed.- <u>Peer review by Dr. Dennis Powers</u>
- •A deep salt zone in the <u>Castile Formation</u> with a sound structural overburden has been identified.
- •The brine well cavity will be properly developed.
- •The well bore is designed to have two casing and tubing strings isolating the groundwater and salt zones.

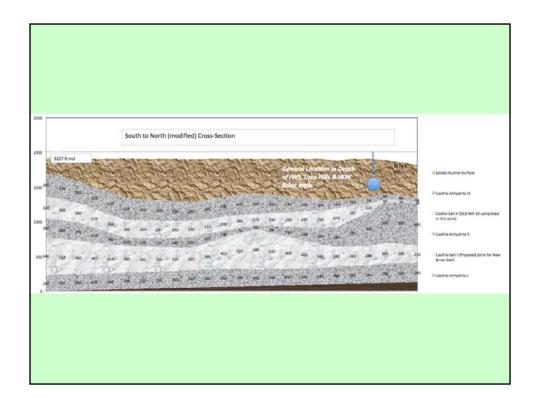
The third bullet point is somewhat of a misnomer, as proper cavern development depends on many facets of operations-

PB Energy specializes in such engineering practices. The emphasis of the slide is basically to point out how government agencies

Required operating conditions that actually harmed the environment



General explanation- explain the limestone- dip of the beds and pinch out.



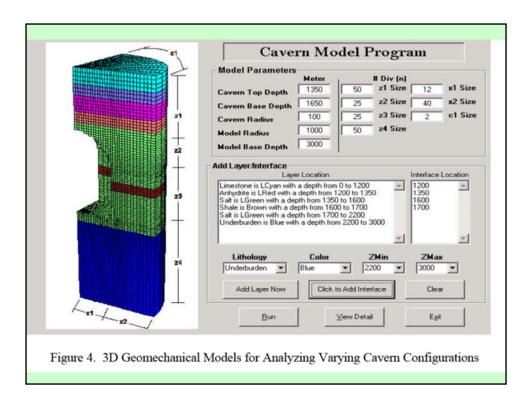
Discuss the dip and pinch out- also relative position of the other brine wells.

Design cont':

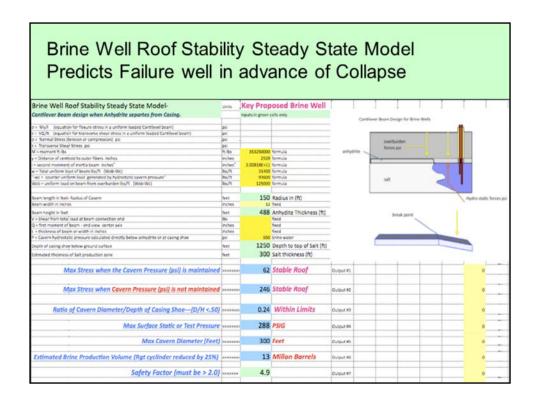
- •The system will be designed so continuous pressure can be maintained on the annuals and formation.
- •A modeling program has been developed to determine when the optimum size of the cavity has been reached with stringent safety factors employed.
- •The brine well cavity will be limited in size and life.
 - •The safe estimated production will be 12 million bbls.
 - •The Life Time of the well is estimated to be 20 years.
 - •The Maximum Radius is calculated at 150 feet.

Pressure maintenance and over pressure in the guidelines. Focus on water protection not collapse. Guidelines still wrong.

Key will set the bar.



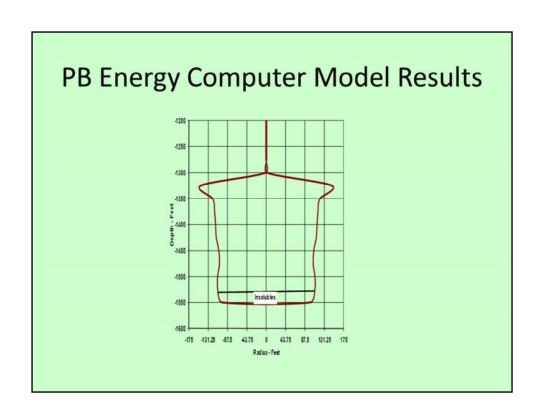
Example only

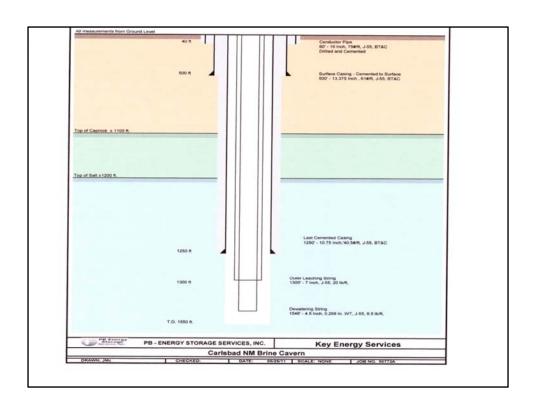


Discuss model in general **Cantilever design With and with out water pressure.**

Current guidelines that talks about ratio of cavern diameter versus depth really does not predict failure per se, but gives how bad.

Would have predicted the two failures- discuss I&W





Operational Controls:

The well volumes and pressures will be monitored with state-of-the-art monitoring devices.

Cavity size calculations will be made routinely and reported to the OCD.

Chemical analysis will be run to determine the injection and produced water characteristics.

Absolute must. Water iN- Water OUT

Actual cavern size.

Chemical analysis were used for the wrong reasons!

Operational Controls cont':

<u>Groundwater Monitoring</u> and reporting systems will be installed for early detection and recovery.

<u>Subsidence Monitors</u> will be installed and monitored through-out the life of the well and post closure.

Financial Assurance \$Bonds\$ will be maintained.

Emergency Contingency Plans have been developed and will be implemented with Local Emergency Response Agencies.

Money, Money how much and to who?

Closure and Post Closure:

Environmental closure assessment and approval from both Local, State, and Federal governmental agencies.

Long-term monitoring program.

Financial Responsibility.

Part 5- Water Issues

Water Supply, Average Usage and Protection

Water Supply- Various Water Sources

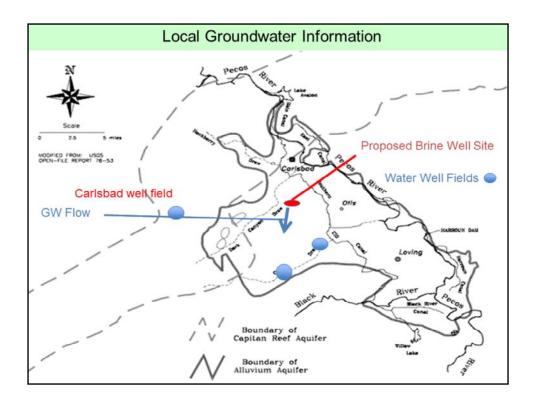
Water Usage- from 25-50 GPM

Water Rights Required - 50 acre ft/year

Major Surface Features- Non-Applicable

Public Water Supplies- Over 5 miles

Currently connected and is using! Max usage is 69,000 gal/day 1666 bb/day Average is about 60% of maximum. 25-50 gpm Dark Canyon, up-gradient, and Canal is 3-4 miles away.



Carlsbad well field, Loving, Otis and Malaga- Had previous public meeting.

Estimated Groundwater Flow Rateusing Darcy's Law

Velocity of GW (ft/day) = (K * i)/n

Where K = hydraulic conductivity ft/day I = hydraulic gradient in ft/ft n = porosity = 30%

From actual pump test in Carlsbad Alluvium aquifer K = 100 ft/day I = .00152 (no units) potentiometric surface measured from the Key site to Cass Draw from GW contours OSE 3080-3040 = 40 ft Distance from site to Cass draw = 5 miles.

V = .506 ft/day

(5 mi x 5280 ft/mi)/ .506 ft/day = 52174 days/365 day./yr = 143 years Using a 3:1 SF 143/3 = 48 years

Estimated time to reach Cass Draw is 48 years.

Self-explanatory

Part 6- Business Model

Key Energy Services currently is the largest rigbased oil well services company in the industry with significant operations in New Mexico.
Key's primary business in the "Carlsbad Area" is providing essential trucking and tank services in the oil patch.
water-hauling (fresh, produced & brine water)
waste disposal (produced fluids)
brine supply (drilling & completion)

Current Key Business Model for Carlsbad, NM

- 1.Key is currently in the process of doubling the workforce from 36 to 72 employees and starting an additional night shift.
- 1.Since Carlsbad, NM is considered to be a future oilfield strategic location, Key is planning on building a "Super Oilfield Service Center"