GTHT - 1

Public Meeting

12/01/2008

NM OCD

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD
Sent: Thursday, December 18, 2008 9:23 AM
To: 'Damon Seawright'; Michael.Hayter@rasertech.com
Cc: Price, Wayne, EMNRD; VonGonten, Glenn, EMNRD
Subject: RE: Hydrology Meeting

Sensitivity: Personal

Mr. Hayter & Mr. Seawright:

Good morning. The OCD requests that the meeting be absent attorneys or general council in order to complete an unbiased informal technical meeting where the OCD's Senior Hydrologist (Mr. Glenn von Gonten) and attendees may feel free to informally share information, communicate and discuss technical issues related to the proposed project. This meeting is really about the experts and OCD Senior Hydrologist being involved in the technical aspects of the project.

Please contact me if you have questions. Remember, the meeting is voluntary; however, any party (i.e., Americulture or Raser) that would like to abstain or wish to not participate in such a meeting, will result in a meeting cancellation. A communiqué of cancellation to the OCD Hearing Examiner with details would result. Thank you.

Carl J. Chavez, CHMM
New Mexico Energy, Minerals & Natural Resources Dept.
Oil Conservation Division, Environmental Bureau
1220 South St. Francis Dr., Santa Fe, New Mexico 87505
Office: (505) 476-3491
Fax: (505) 476-3462
E-mail: CarlJ.Chavez@state.nm.us
Website: http://www.emnrd.state.nm.us/ocd/index.htm
(Pollution Prevention Guidance is under "Publications")

From: Damon Seawright [mailto:damon@vtc.net]
Sent: Wednesday, December 17, 2008 6:11 PM
To: Chavez, Carl J, EMNRD
Cc: 'Jeffrey Harris'; 'Gary Seawright'; 'James Witcher'
Subject: Hydrology Meeting
Sensitivity: Personal

Dear Carl,

We confirm our willingness to meet at the scheduled time. I assume that we will be meeting at OCD in Santa Fe. Please confirm.

Jim Witcher and myself will be in attendance. It is possible that AmeriCulture Chairman Gary Seawright and AmeriCulture Counsel Jeffrey Harris will be in attendance as well, though they are unable to confirm at the moment.

Sincerely,

Damon Seawright
AmeriCulture, Inc.

You Wrote:

Gentlemen:

I am writing to request a technical meeting with an OCD Senior Hydrologist and expert witnesses from Raser Technologies and AmeriCulture as requested by Mr. David Brooks (NMOCD Hearing Examiner) before ending the hearing on 12/1/2008 in Lordsburg, New Mexico.

I believe the expert witnesses from the hearing are: Mr. Jim Witcher (AmeriCulture) and Mr. John Shomacher (Raser) or Mr. Roger Peery (Raser).

AmeriCulture was unable to meet on January 8, 2008, as proposed by the OCD; therefore, after consulting AmeriCulture on a date, a new date and time for the meeting was selected. Please confirm your intent to attend the meeting in Santa Fe on Tuesday, January 27, 2009 from 1 p.m. to 5:00 p.m. The meeting is voluntary and the OCD cannot provide financial assurance for external parties that attend the meeting.

Please contact me to confirm your attendance at the meeting with a list of persons from your companies that will be attending. Thank you.

Chavez, Carl J, EMNRD

Subject:	Lightning Dock Geothermal No. 1 (HI-01) LLC. (GTHT-1) Post December 1, 2008 Hearing Required Meeting
Location:	NM Oil Conservation Division (Wendell Chino Bldg.), 1220 South St. Francis Drive, Santa Fe, NM 87505
Start:	Tue 1/27/2009 1:00 PM
End:	Tue 1/27/2009 4:00 PM
Show Time As:	Tentative
Recurrence:	(none)
Meeting Status:	Not yet responded
Required Attendees:	Chavez, Carl J, EMNRD; VonGonten, Glenn, EMNRD; Michael.Hayter@rasertech.com; damon@vtc.net
Optional Attendees:	Price, Wayne, EMNRD; Michael Albrecht

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Meeting Attendees:

AmeriCulture: Damon Seawright, Gary Seawright & Jim Witcher (Hydrogeologist or Equivalent)

OCD: Carl Chavez, Wayne Price & Glenn von Gonten (Senior Hydrologist)

Raser Technologies: Michael Albrecht, Michael Hayter, John Shomaker (Hydrogeologist/or Equivalent) or Roger Peery (Hydrogeologist or Equivalent)

Informal Technical Meeting Agenda:

AmeriCulture: Hearing Presentation w/ any new slides to convey hydrogeologic information or main points and support for conclusions in presentation. (group participation w/ questions)

Raser: Technologies: Presentation w/ any new slides to convey agreement or disagreement with AmeriCulture presentation conclusions or new slides to convey or support Raser's discharge permit application, well locations, injection rates, etc. (group participation w/ questions)

OCD: Final questions to presenters. Discussion of possible changes to the initial draft discharge permit issued May 28, 2008, and any questions from presenters about the draft discharge permit, permit process, public notice, process going forward, etc.

Thank you.

Chavez, Carl J, EMNRD

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Chavez, Carl J, EMNRD

From: Price, Wayne, EMNRD
Sent: Friday, December 05, 2008 10:51 AM
To: Jay Hamilton; Chavez, Carl J, EMNRD
Cc: Steve Brown; Michael Hayter; Fesmire, Mark, EMNRD; VonGonten, Glenn, EMNRD; Damon Seawright
Subject: RE: Lightning Dock - Arizona Solid Waste Facilities

Dear Jay,

During the hearing at Lordsburg Mr. Brooks asked if the OCD would have our senior hydro-geologist review the application. As a result of that question, I would like to set up a technical meeting with Razor's geology expert and Seawright's expert. We understand these experts may be expensive, so OCD will try and utilize the time in the most efficient manner. Of course OCD cannot be responsible for associated cost except for our own expenses.

If all parties agree, then we can set a place and time. Please let us know ASAP!

From: Jay Hamilton [mailto:hamiltonenviro@yahoo.com]
Sent: Friday, December 05, 2008 9:24 AM
To: Chavez, Carl J, EMNRD
Cc: Steve Brown; Michael Hayter; Price, Wayne, EMNRD; Fesmire, Mark, EMNRD
Subject: Re: Lightning Dock - Arizona Solid Waste Facilities

Carl,

Thanks for the information. We will not have juicy petroleum hydrocarbon soils in the geothermal drilling process. Please refer to "Method of Disposal of Wast Materials" in the Plan of Operation and in the "Discharge Plan Application for Bine Extraction".

If you have additonal questions please contact me.

Thanks,

Jay

From: "Chavez, Carl J, EMNRD" <CarlJ.Chavez@state.nm.us>
To: Jay Hamilton <hamiltonenviro@yahoo.com>
Sent: Thursday, December 4, 2008 11:51:56 AM
Subject: RE: Lightning Dock - Arizona Solid Waste Facilities

Hey Jay. You may want to make sure that they know the waste is from a geothermal power plant that may have certain exemptions and it will be key to ask specifically if they can handle drill cuttings w/ salt, juicy petroleum hydrocarbon soils, etc. Thanks.

Carl J. Chavez, CHMM
New Mexico Energy, Minerals & Natural Resources Dept.
Oil Conservation Division, Environmental Bureau
1220 South St. Francis Dr., Santa Fe , New Mexico 87505
Office: (505) 476-3491
Fax: (505) 476-3462

E-mail: CarlJ.Chavez@state.nm.us
Website: http://www.emnrd.state.nm.us/ocd/index.htm
(Pollution Prevention Guidance is under "Publications")

From: Jay Hamilton [mailto:hamiltonenviro@yahoo.com]
Sent: Thursday, December 04, 2008 11:11 AM
To: Chavez, Carl J, EMNRD
Cc: Steve Brown; Michael Hayter; Jim Rosser
Subject: Lightning Dock - Arizona Solid Waste Facilities

Carl,

I am in the process of contacting the solid waste landfills in Arizona that can handle RCRA Subtitle "D" Solid Wastes.

Please see attachment.

Thanks,

Jay

This inbound email has been scanned by the MessageLabs Email Security System.

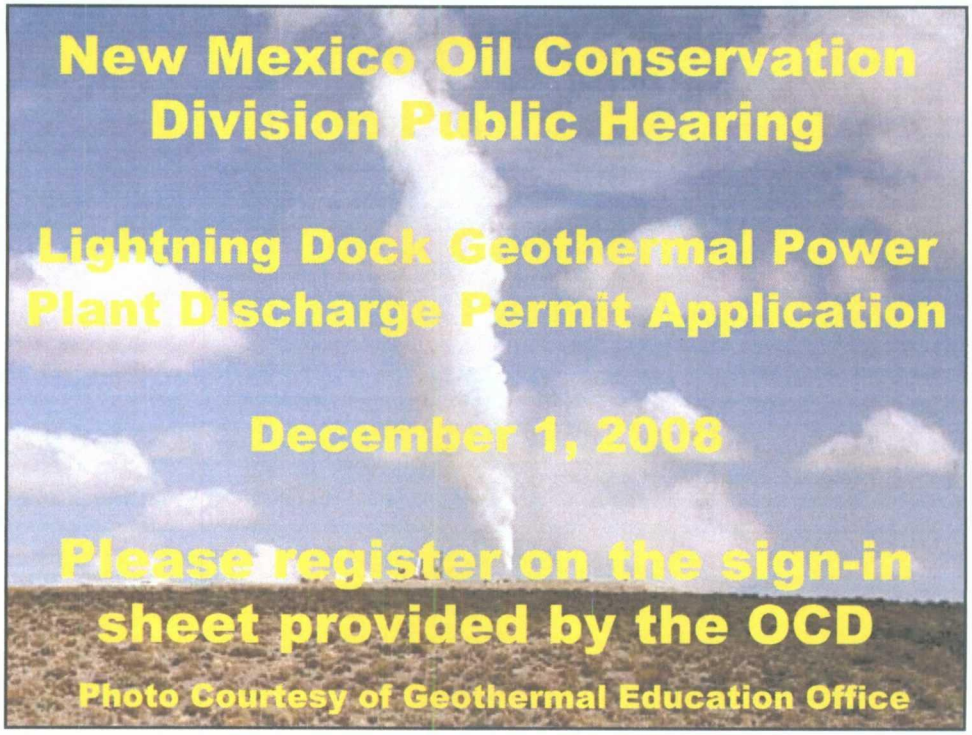
NEW MEXICO OIL CONSERVATION DIVISION
SPECIAL EXAMINER HEARING

Lordsburg, New Mexico

December 1, 2008, 9:00 A.M.

NAME	E-MAIL	REPRESENTING	LOCATION
Gary L. Seawright	glseawright@msn.com	Amariculture, Inc.	Los Alamos, NM
WAYNE PRICE	WAYNE.PRICE@STATE.NM.US	OCD	SF
JAMES (JIM) WITCHER	JIMWITCHER@ZIANET.COM	WITCHER & ASSOCIATES AMARICULTURE, INC	Las Cruces, NM
Carl Chavez	Carlj.chavez@state.nm.us	OCD	Santa Fe
Paul Silverman	Paul.silvermanpe@gettmore.com	SELF	ABQ
BILL CONWAY	CONWAYLAND	"	SF, NM
Clarence Rudisyl	HCRoad@VTC.Net	HCRO/Self	Animas
Frank Walker	FWalker@TecumsehPa.com	Tecumseh professional Associates, Inc	Albuq. NM
Roger Ellis	hcngr@aznet.net	Hidalgo County	Lordsburg
Mikal Altomare	Mikal.altomare@state.nm.us	OCD	Santa Fe

NAME	E-MAIL	REPRESENTING	LOCATION
Mike Hayter	Mike.hayter@resertech.com	Raser	
Jennifer Wright	jwright2@nalco.com	Raser	
Sean McBride	Sean.mcbride@reserteh.com	Raser	
Roger Peery	rpeery@shomaker.com	Raser	
JOHN BESSE	JOHN_BESSE@BLM.GOV	BLM	
Ed Kerr	edkerr52@hotmail.com	Kerr Cattle, LLC.	
Jimmy Kerr			
Louise Peterson	lpeterson@wildblue.net	LP	
Jay Kelly Peterson	petersondance1@hotmail.com	self	Animas, NM
Dawn Seawright	dawn@utc.net	Agriculture	Animas, NM
Libby Seawright	libby@utc.net	self	Animas, NM
Robert Floyd	FloydsFlock@yahoo	self	Deming, NM
John F Esquibel	Suechama@npgcable.com	Raser	Clifton City



Lightning Dock Geothermal No. 1 (GTHT-1) "Binary-Cycle" Power Generation Plant WQCC Discharge Permit Application

New Mexico

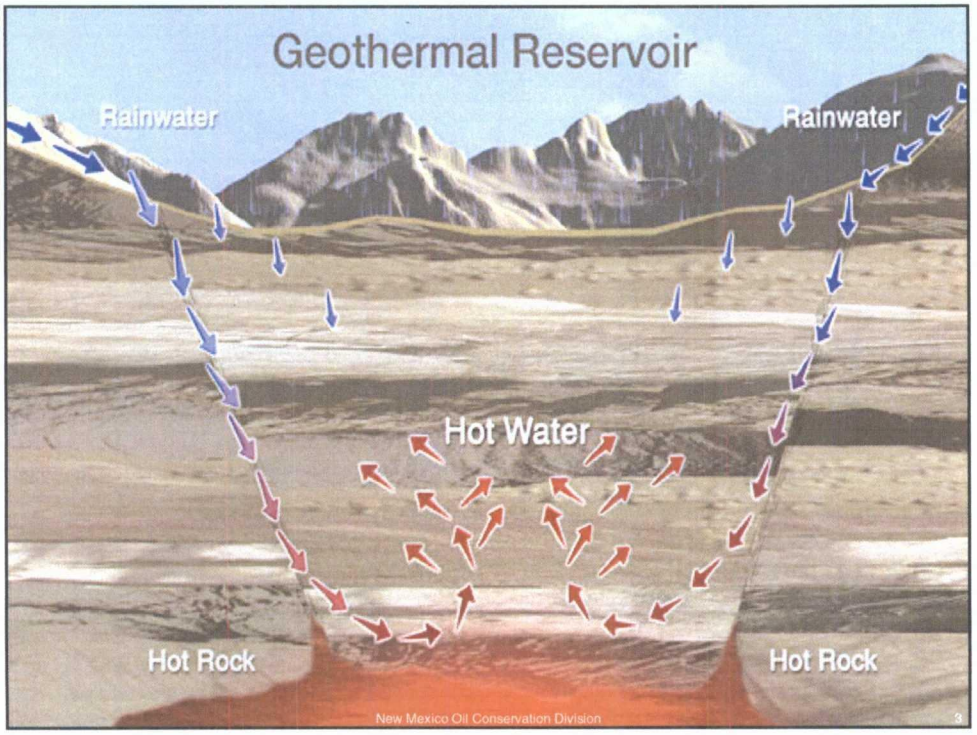
Energy, Minerals, and Natural Resources Department

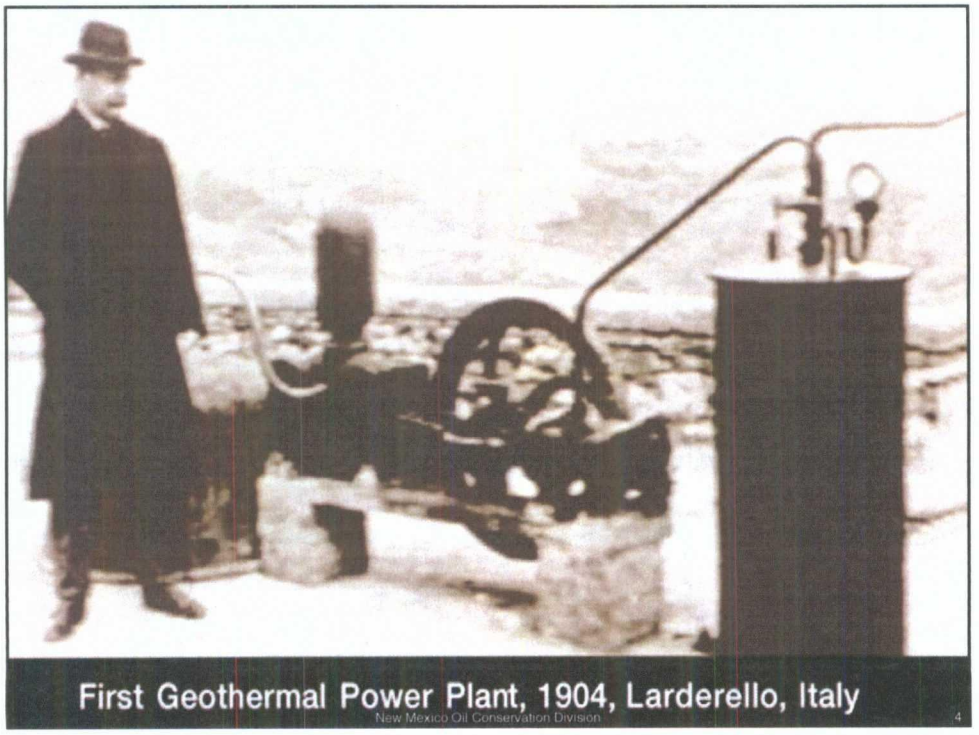
Oil Conservation Division

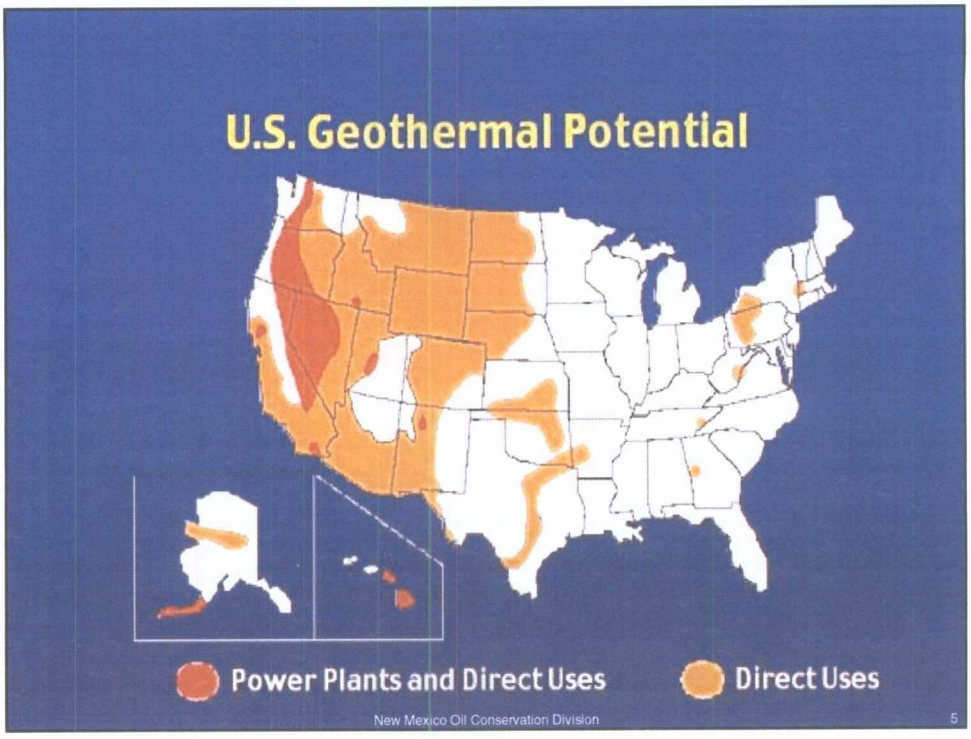
Carl Chavez (Environmental Engineer) & Wayne Price (Environmental Bureau Chief)

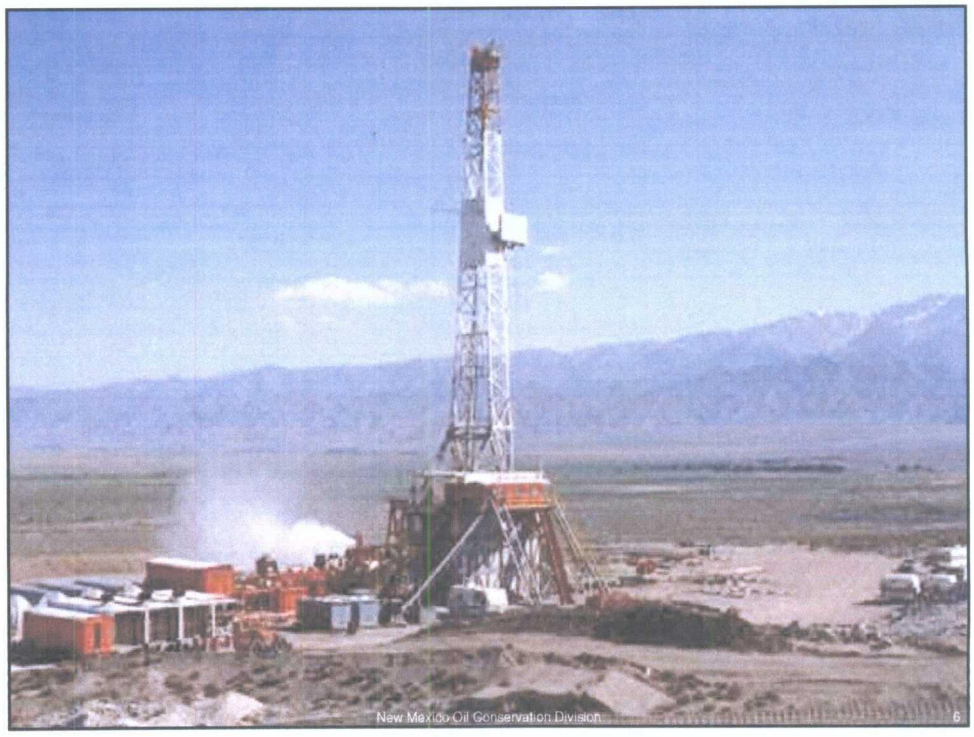
December 1, 2008

Lordsburg, New Mexico


Geothermal Reservoir
Rainwater
Rainwater
Hot Water
Hot Rock
Hot Rock
New Mexico Oil Conservation Division
3


First Geothermal Power Plant, 1904, Larderello, Italy
New Mexico Oil Conservation Division
4


U.S. Geothermal Potential
Power Plants and Direct Uses
Direct Uses
New Mexico Oil Conservation Division
5


New Mexico Oil Conservation Division
6

Benefits of Geothermal Power

- Provides clean and safe energy using little land
- Is renewable and sustainable
- Generates continuous, reliable "baseload" power
- Conserves fossil fuels and contributes to diversity in energy sources
- Avoids importing and benefits local economies
- Offers modular, incremental development and village power to remote sites

Courtesy of Geothermal Education Office


Lightening Dock Geothermal No. HI-01
80
© 2008 Tele Atlas
Image NMRGIS
Image © 2008 DigitalGlobe
Google

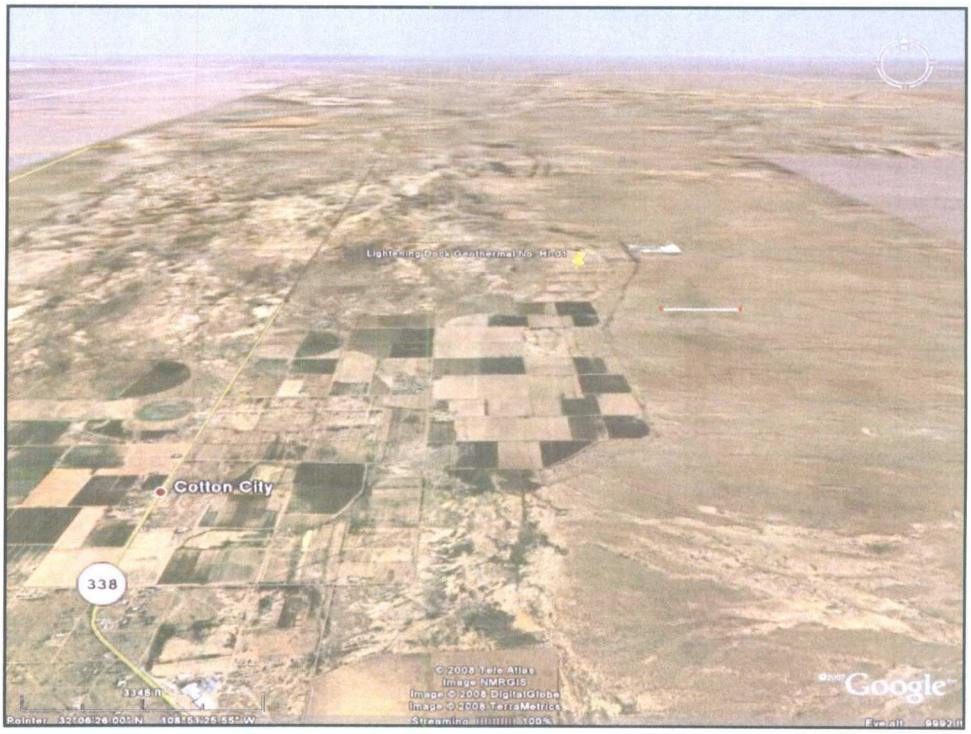

Lightening Dock Geothermal No. HI-01
Cotton City
338
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Image © 2008 DigitalGlobe
Image © 2008 TerraMetrics
Google


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338
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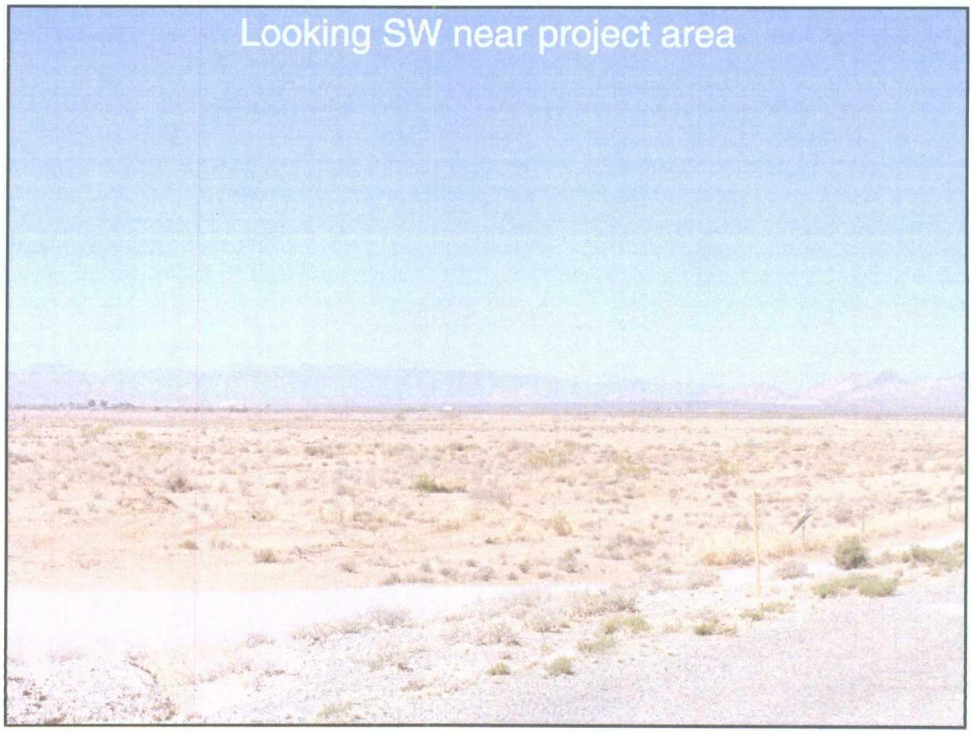
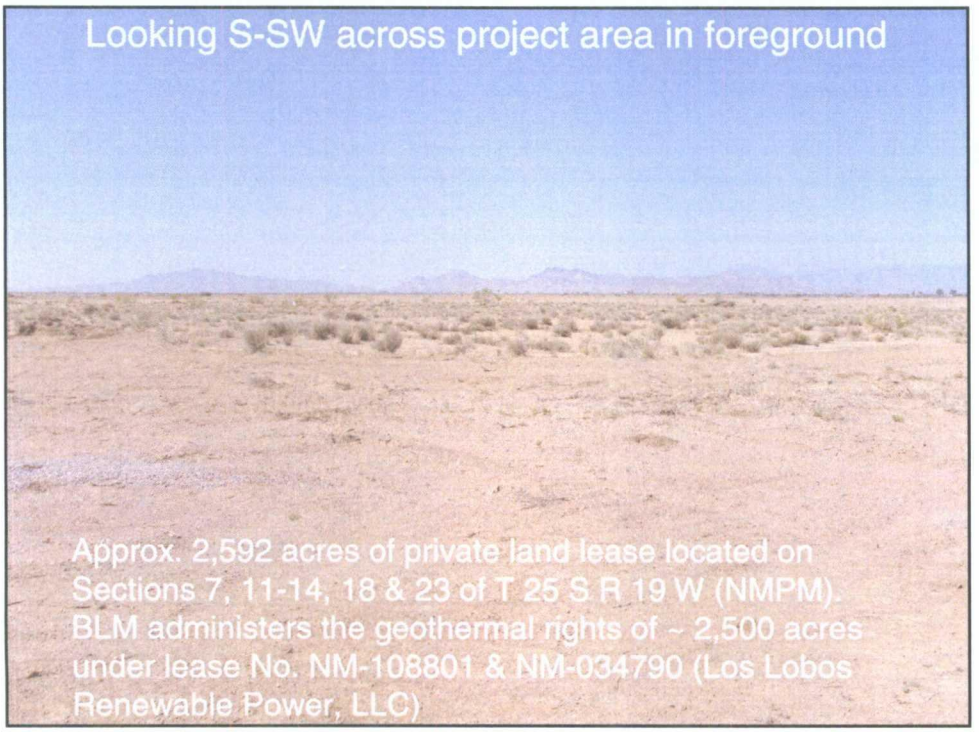
Looking E-SE toward nursery

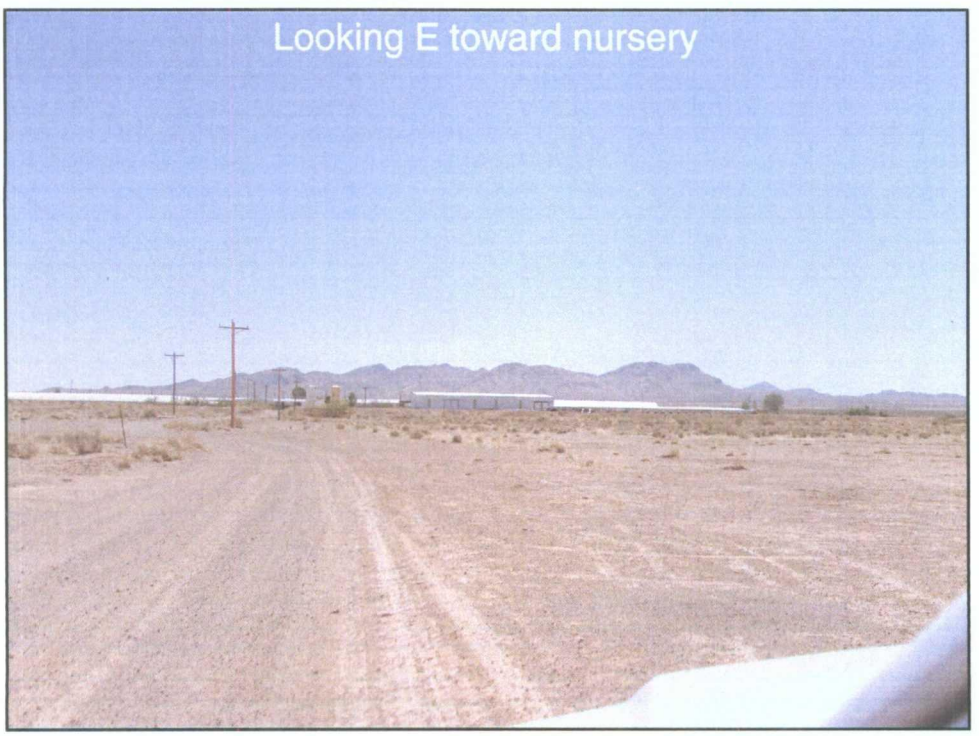

Looking SW near project area

Looking S-SW across project area in foreground

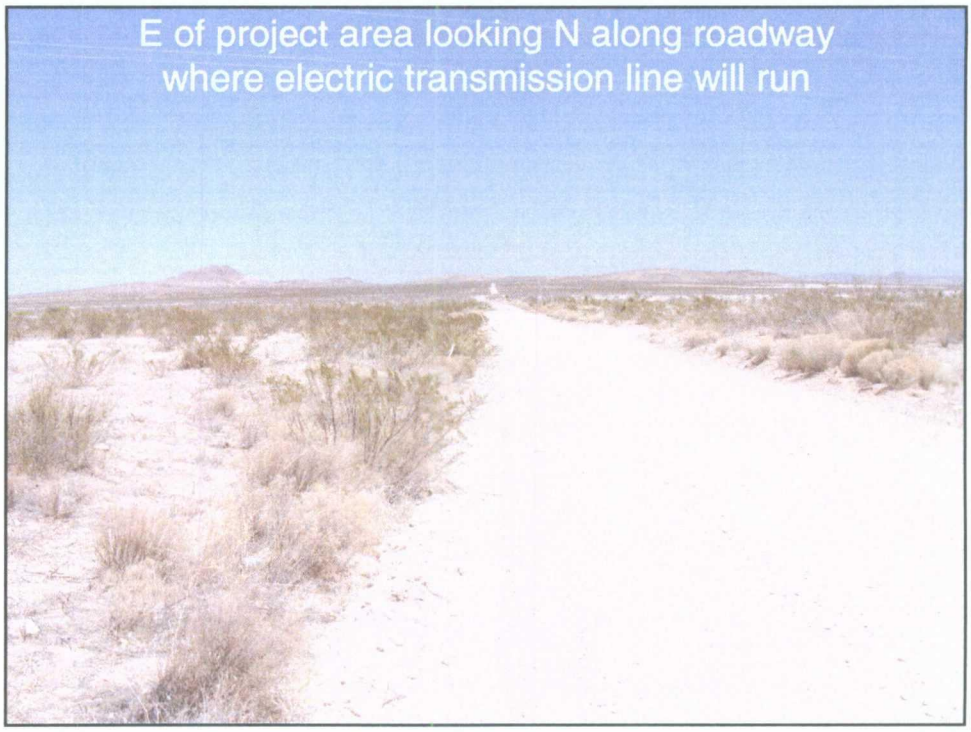


Approx. 2,592 acres of private land lease located on Sections 7, 11-14, 18 & 23 of T 25 S R 19 W (NMPM). BLM administers the geothermal rights of ~ 2,500 acres under lease No. NM-108801 & NM-034790 (Los Lobos Renewable Power, LLC)

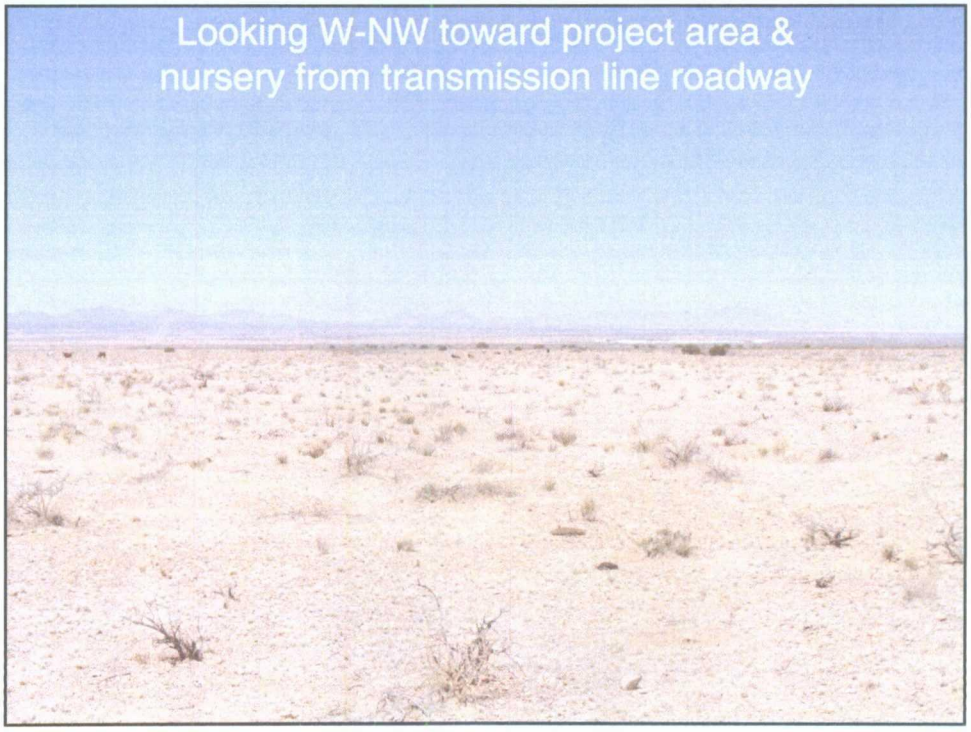
Looking E toward nursery



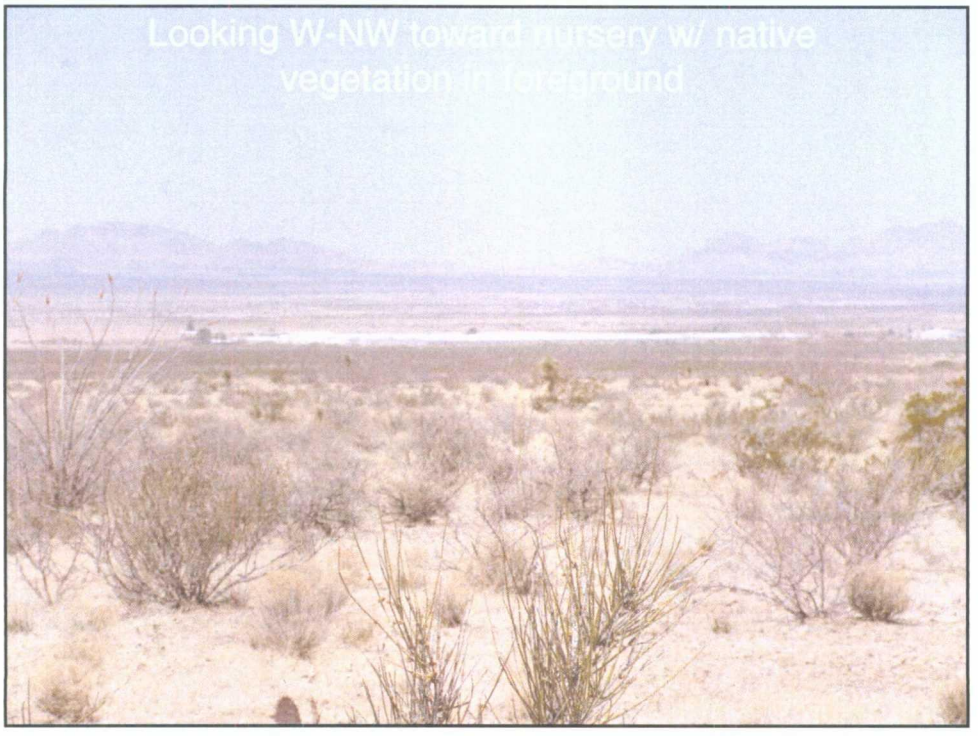
E of project area looking N along roadway where electric transmission line will run



Looking W-NW toward project area & nursery from transmission line roadway



Looking W close-up of project area



Looking W-NW toward nursery w/ native vegetation in foreground

New Mexico Oil Conservation Division Geothermal Regulations

Chapter 71: Energy & Minerals
Article 5: Geothermal Resources Conservation Act
"Chapter 71, Article 5 NMSA 1978"

71-5-2.1. Exclusion; incidental loss or extraction of heat. When the application of potable water to a beneficial use involves the incidental loss or extraction of heat, and the water is 250 degrees Fahrenheit or less, then that heat is not a geothermal resource for which a royalty is due. In such a case, the use is not governed by laws related to geothermal resources but is simply governed by Chapter 72 NMSA 1978.

Title 19: Natural Resources & Wildlife
Chapter 14: Geothermal Power
"Title19, Chapter 14 NMAC 1983"
Recompiled 12/31/01

New Mexico Water Quality Control Commission (WQCC) Regulations

Title 20 Environmental Protection
Chapter 6 Water Quality
Part 2 Ground & Surface Water Protection
§ 20.6.2 NMAC, et seq.
Effective: 7/16/06

Title 20 Environmental Protection
Chapter 6 Water Quality
Part 4 Standards for Interstate & Intrastate Surface Waters
§ 20.6.4 NMAC, et seq.
Effective: 7/17/05

EPA delegated OCD primacy over UIC Program for Class I, III, IV and V (Geoseq. & Geotherm.) UIC Wells July 11, 1983 §1422 48FR31640

OCD delegated authority by Water Quality Control Commission (WQCC) over State UIC Program July 21, 1989 § 20.6.2.5000-5299 NMAC

Geothermal Well Locations

Sections 7, 12 & 18, T 25 S, R 19 W
(Hidalgo County) 10 mi. S of I-10 on CR-338
(East of CR-338 ~ 1000' W Greenhouse #3)

Class V Geothermal Injection Wells

51-07 NW/4, NE/4 of Section 7, 169.2 FNL 2406.9 FEL
53-12 SW/4, NE/4 of Section 12, 1574.8 FNL 3350 FWL
42-18 NE/4, NW/4 of Section 18, 1307 FNL 2123 FWL

Production or Development Wells

13-07 SW/4, NW/4 of Section 7, 3781 FSL 530 FWL
33-07 SE/4, NW/4 of Section 7, 3721.2 FSL 1789.4 FWL
45-07 NE/4, SW/4 of Section 7, 2360 FSL 2278.2 FWL
47-07 SE/4 SW/4 of Section 7, 1219.1 FSL 2266.3 FWL
53-07 SW/4 NE/4 of Section 7, 3775.3 FSL 3052.1 FWL

BRIEF HISTORY OF PROJECT

- Geothermal application received 5/13/2008
- Application deemed "Administratively Complete" on 5/28/2008
- Public comments received from AmeriCulture on 7/11/2008
- OCD issues notice of public hearing on 10/1/2008 for 12/1/2008 hearing at Lordsburg Special Events Center
- Pre-hearing statements requested from applicant, public commenter & OCD on 11/13/2008

SCOPE OF PROJECT

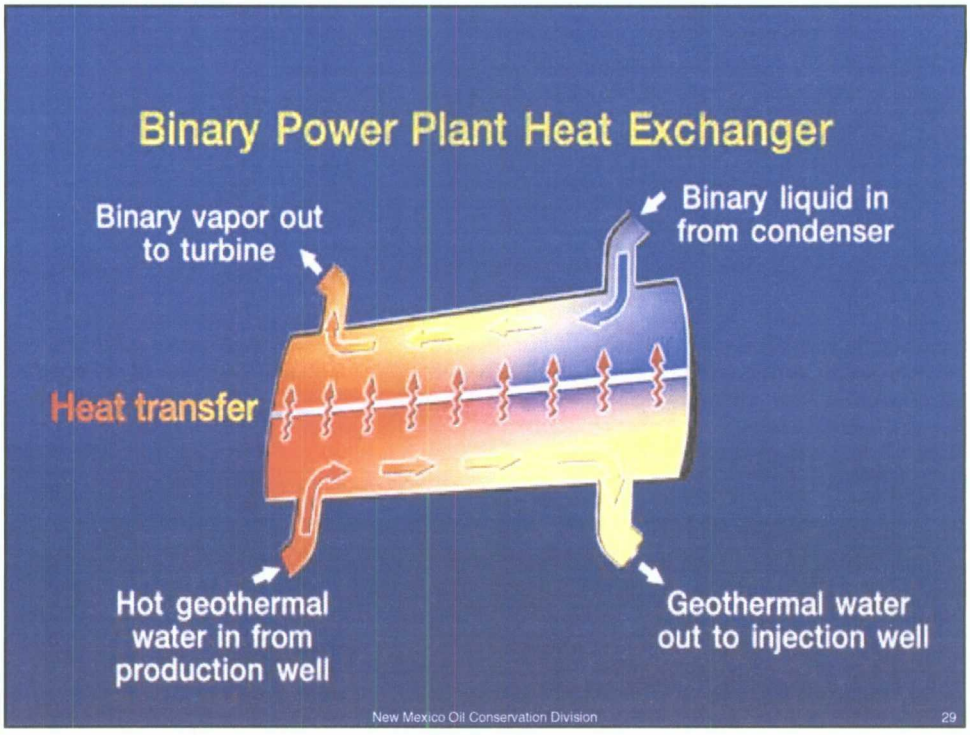
- Portable "Binary-Cycle" power generation units (~ 50 @ 225 kW ea.) deployed at 15 MWe Geothermal Power Plant (5 Production/ Development Wells & 3 Class V Geothermal Injection Wells @ target depth of 3,400 ft. bgl)
- Plant will produce 11 MWe for Phoenix Mkt. over 20-yr. purchased power agreement w/ Salt River Project (AZ Utility) to power 5,500 homes, but the geothermal resource may allow production of about 2x much energy *(Albuquerque Journal- 7/3/2008)*.
- Production wells produce ~ 15k gpm of 250–300 °F water w/ TDS ~ 1,300 mg/L from the Horquilla Fm. (geothermal carbonate reservoir) @ TD 3400 ft. bgl. Water routed in parallel into portable binary-cycle units.

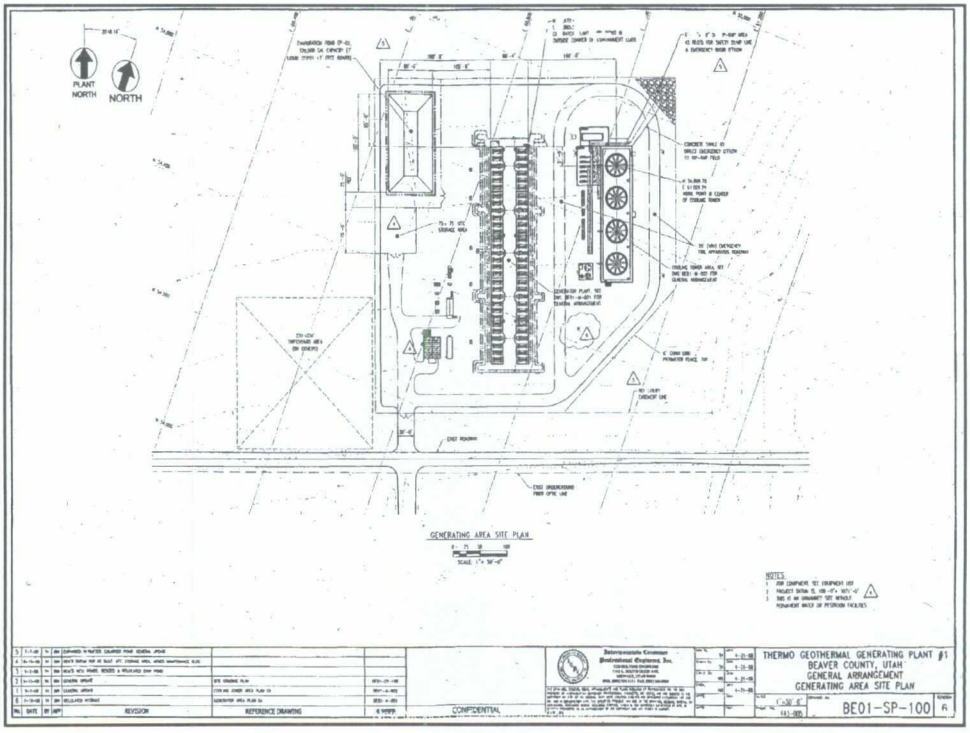
SCOPE OF PROJECT

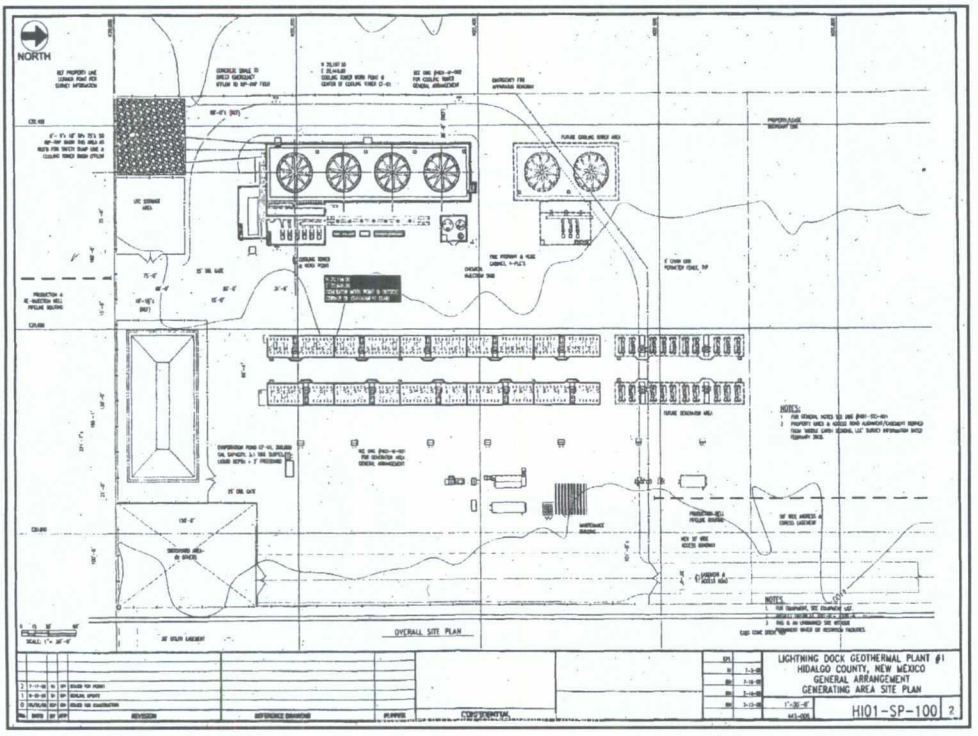
- ~ 1500 gpm shallow GW (makeup water) w/ TDS ~ 300 mg/L cycled into cooling tower unit (removes heat from hot condensate)
- ~ 425 gpm blow-down effluent w/ remainder of produced water (180–225 °F) injected into geothermal reservoir (~3400 ft bgl) via each Class V Injection Well @ 4–5k gpm @ avg. surface injection pressure of 75 psi
- Lined evaporation pond temporarily stores excess cooling tower blow-down fluid during emergencies
- Cooling tower blow-down fluid diluted w/ spent produced water must meet WQSs before injection
- Discharge permit addresses well construction, operation, monitoring, testing of the wells, assoc. surface facilities, and provides a contingency plan in the event of accidental spills, leaks, & other accidental discharges to protect fresh water.

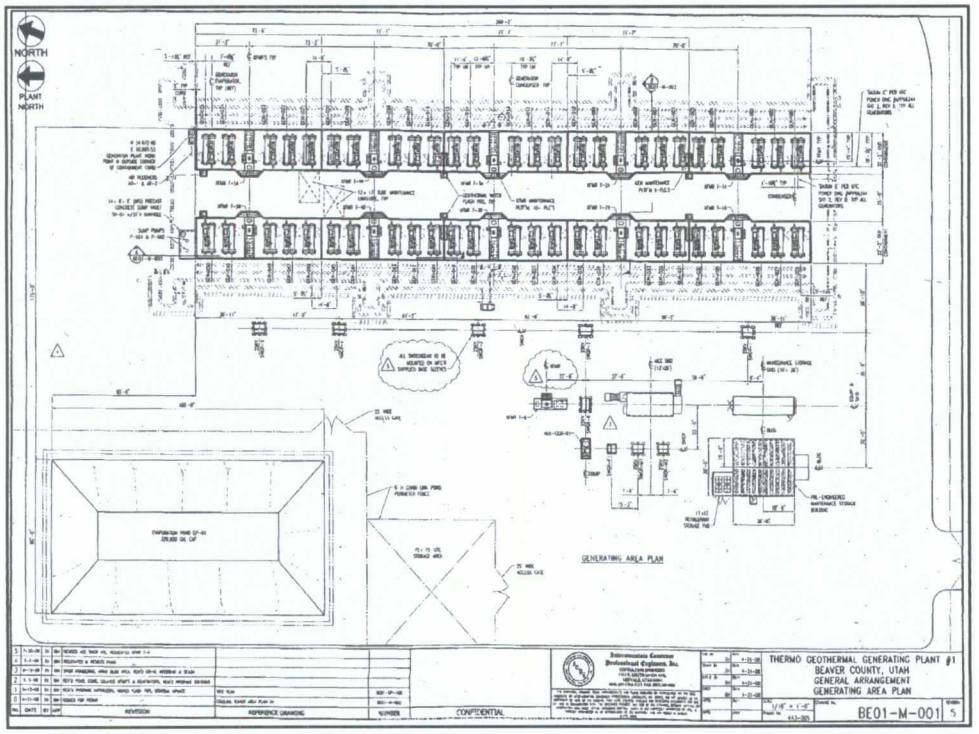
SCOPE OF PROJECT

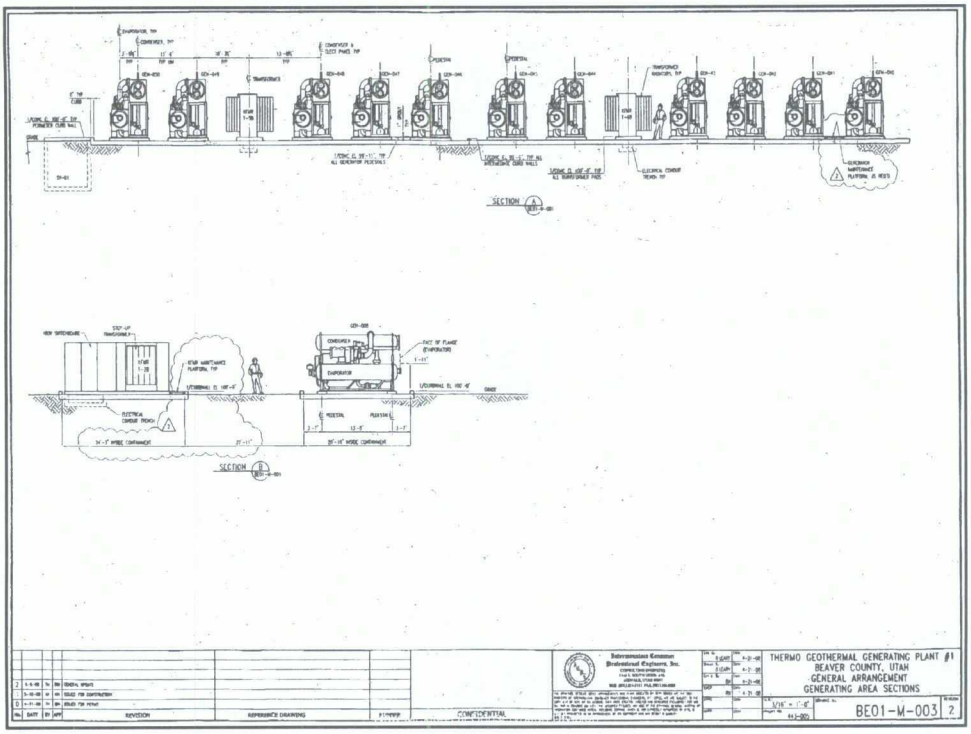
- Spent produced geothermal water is routed into Class V injection wells to replenish the reservoir & possibly be reused
- All drilling & well construction must conform to OCD Geothermal Regulations
- Nearest landfill to facility is at the Butterfield Trail Regional Landfill 15 mi. W of Deming, NM, scheduled to be completed Spring of 2009. OCD may approve other waste facilities


Binary Power Plant Heat Exchanger
Binary vapor out to turbine
Binary liquid in from condenser
Heat transfer
Hot geothermal water in from production well
Geothermal water out to injection well
New Mexico Oil Conservation Division
29


PLANT NORTH
NORTH
GENERATING AREA SITE PLAN
THERMO GEOTHERMAL GENERATING PLANT #1
BEAVER COUNTY, UTAH
GENERAL ARRANGEMENT
GENERATING AREA SITE PLAN
BE01-SP-100


NORTH
OVERALL SITE PLAN
CONFIDENTIAL
LIGHTNING DOCK GEOTHERMAL PLANT #1
HIDALGO COUNTY, NEW MEXICO
GENERAL ARRANGEMENT
GENERATING AREA SITE PLAN
HI01-SP-100


NORTH
PLANT NORTH
GENERATING AREA PLAN
CONFIDENTIAL
THERMO GEOTHERMAL GENERATING PLANT #1
BEAVER COUNTY, UTAH
GENERAL ARRANGEMENT
GENERATING AREA PLAN
BE01-M-001



WQCC DISCHARGE PERMIT APPLICATION PROCESS § 20.6.2 NMAC, et seq.

OCD discharge permit (5-Yr.) typical process:

1. Submit geothermal discharge permit application w/ processing fee ($100).
2. OCD reviews application to determine whether application is "Administratively Complete" within 15 days of receipt.
3. Administrative completeness determination starts public notice process w/ draft permit issuance (30-day public notice in regional & local newspapers), notification(s), signage, etc.

WQCC DISCHARGE PERMIT APPLICATION PROCESS § 20.6.2 NMAC, et seq.

OCD discharge permit (5-Yr.) typical process:

4. Final discharge permit generally issued within 60-days of administrative completeness, unless public comments are received that warrant a public hearing under an OCD Hearing Examiner.
5. At completion of hearing, based on the Hearing Examiner's conclusion(s), the Division may issue the final permit, which may include additional conditions.
6. The discharge permit fee is $1700 renewable every 5-years.

OCD DISCHARGE PERMIT

What does it do?

- Prevents contamination of surface (storm water) and ground water by evaluating chemical process areas relative to storm water, pollution prevention infra-structure, monitoring at or near potential point source areas where treatment, storage, and spills/leaks may occur.
- Prevents the owner/operator from discharging above WQSs to surface and ground water.
- Provides for OCD inspections with immediate modifications to the permit to protect the environment as conditions warrant.

OUTSTANDING WQCC ISSUES

The following issues have not been sufficiently addressed in the application:

Ground Water & Surface Water:

- Fresh water appears to be present from water table to depth of injection w/ no cap rock or impermeable zones separating fresh from non-fresh water zones. Consequently, cooling tower blow-down with spent produced water may need to be recycled, reused, or treated to meet WQSs before any injection is allowed. Currently, the applicant believes that the Nalco paper w/ proposed chemicals & cooling tower blow-down & dilution with spent produced water (~ 1300 mg/L TDS) will meet WQSs & protect wildlife before injection. OCD will require WQ testing in Horquilla Fm. @ Prod. & Injection wells to establish background conditions in geothermal reservoir.
- Daily testing of the cooling tower blow-down & produced spent water stream to characterize & verify that fluid may be reused, stored and/or that it meets WQSs or needs treatment before injection will be required.

OUTSTANDING WQCC ISSUES

The following issues have not been sufficiently addressed in the application:

Ground Water & Surface Water:

- Water table monitoring of seasonal flow direction & hydraulic gradient w/ upgradient & downgradient water quality monitoring from potential point source locations will be required to monitor for environmental impacts.
- Focus on hydrogeologic characterization & water quality sampling of aquifer(s) (if possible) during drilling and well development activities.
- Proper ASTM field geotechnical applications must be applied during construction.

Waste:

- Proper disposition of all wastes.

PROJECT GOING FORWARD

If the geothermal power generation plant is permitted by the OCD, the following will occur:

- OCD sends final version of discharge permit w/ public hearing considerations to applicant for signature & return w/ final fee of $1700. The OCD must receive a final signed DP w/ final fee.
- Well bonds or financial assurance must be approved via letter from OCD.
- Once bonds are approved, OCD Artesia may approve well APDs for the Administrative Record.
- Geothermal exploration drilling & well testing may begin w/ OCD geothermal forms documentation of geothermal resource per well for verification & documentation of well construction, hydrogeology, depth, temperatures w/ verification that a high-temp. geothermal reservoir(s) exists.

PROJECT GOING FORWARD

If the geothermal power generation plant is permitted by the OCD, the following will occur:

Geothermal Production/Injection Wells

- If a high-temp. geothermal reservoir(s) exists & owner/ operator wishes to produce the reservoir & inject, signed Forms G-104 and G-112 per well must be submitted and approved by the OCD Santa Fe before geothermal well production & injection may begin.
- Other agencies (i.e., USGS & NMBGM) may receive copies of geothermal forms or be directed to OCD Online "GTHT-1" for forms & records.
- Injection wells must comply with WQCC and OCD geothermal regulations, while production/development wells must comply with OCD geothermal regulations.

NM RENEWABLE ENERGY PROGRAM

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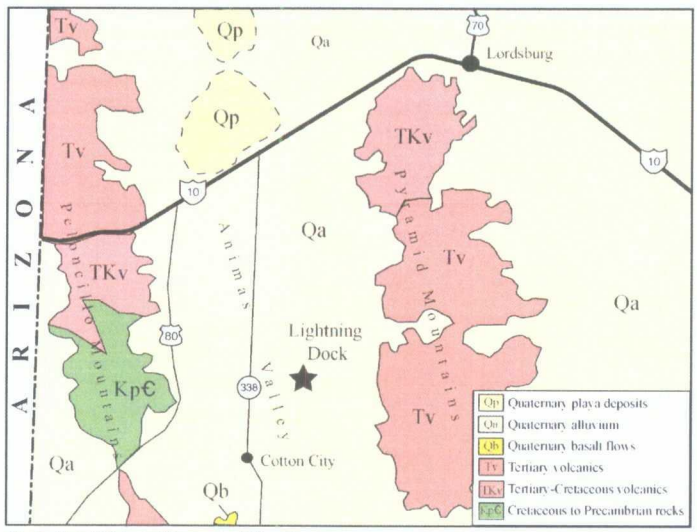
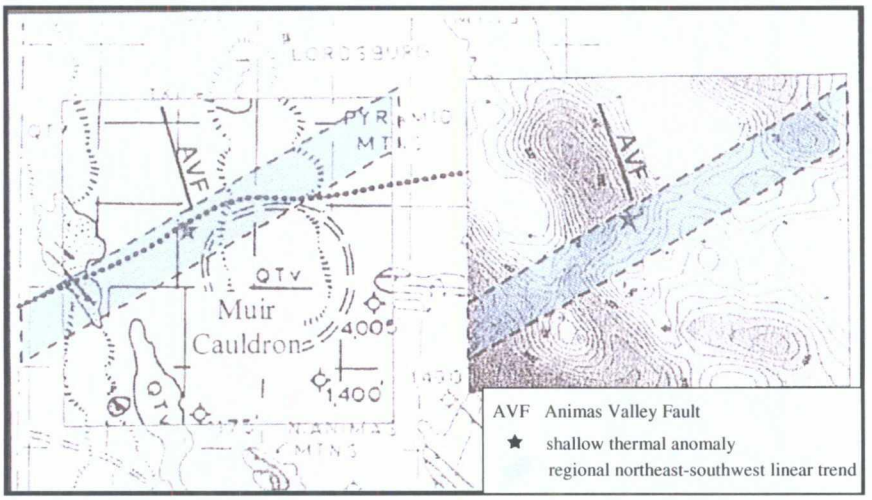
Website: www.emnrd.state.nm.us/ocd
Go to: "OCD Online, Imaging, Administrative Order.... (GTHT-1)"

Los Lobos



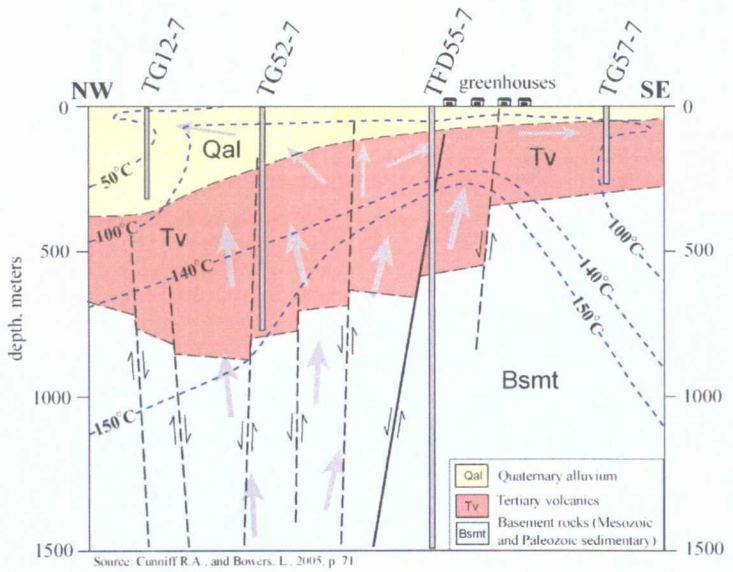
Source: Cunniff R.A., and Bowers, L., 2005, p. 5.

Geologic map of the Animas Valley region.



Source: Cunniff, R.A., and Bowers, L., 2005, p. 57.

Integrated regional geology.



Source: Cunniff R.A., and Bowers, L., 2005, p. 71

New conceptual model.

AmeriCulture

DISCUSSION OVERVIEW

- Basics of geothermal systems in southern Basin and Range Rio Grande rift.
- Total natural heat loss at Lightning Dock.
- Structure controls for the geothermal system at Lightning Dock.
- Summary of subsurface geology.
- Water chemistry of thermal water.
- Isotopic composition of thermal water.
- Summary of findings.
- Recommendations

EXHIBIT 1

GEOTHERMAL DOMAINS

Red
Convective Systems

Light Blue
Deep Conductive Systems in Tertiary Basins

Dark Blue
Deep Conductive Systems in Paleozoic and Mesozoic Basins

EXHIBIT 2

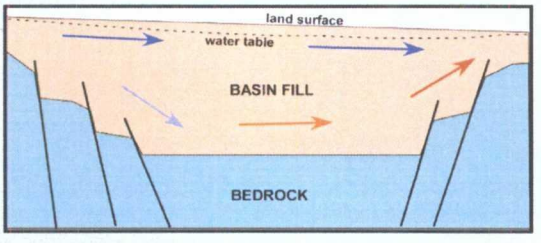
TYPICAL CONVECTIVE GEOTHERMAL SYSTEM CONTROLS

- Heat Source
- Structure
  - fracture permeability (reservoir permeability and storage)
  - hydrogeologic windows (primary discharge site)
- Flow Dynamics
  - Free convection (density driven flow)
  - Forced convection (ground water head driven flow)
    - ✓ deep seated regional ground water flow systems
    - ✓ thermal sweep of background regional heat flow

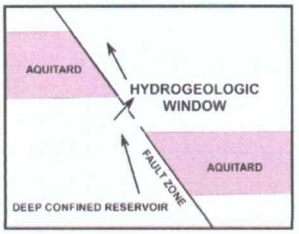
EXHIBIT 3

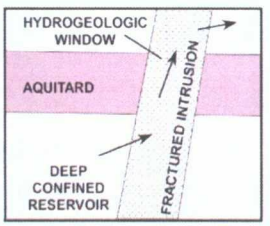
HYDROGEOLOGY

Rift basin ground water flow constrictions (or outlets)



Hydrogeologic windows





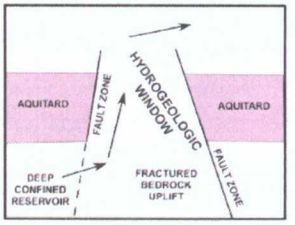


EXHIBIT 4

OUTFLOW PLUME DYNAMICS

- Mixing with near surface ground water.
- Flow direction follows shallow hydraulic gradient.

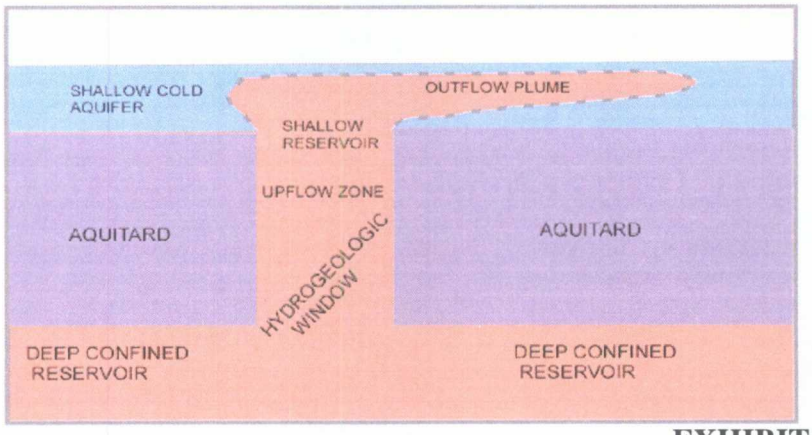
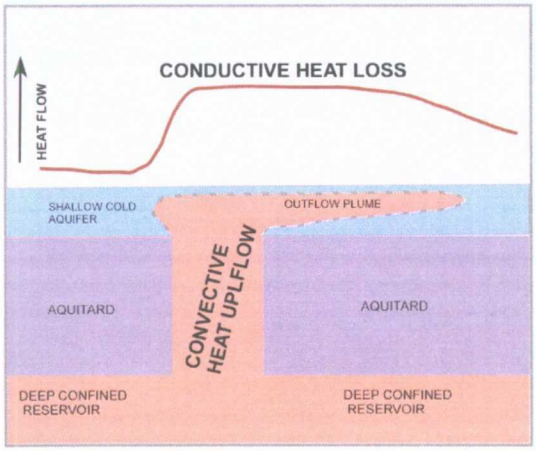


EXHIBIT 5

TOTAL CONDUCTIVE HEAT LOSS

- $q_z = k(dT/dz)$
  - q_z conductive heat flow(mW/m^2)
  - k thermal conductivity (W/m^oK)
  - dT/dz temperature gradient ($^oC/km$)
  - k = 1.8 W/m^oK basin fill
  - k = 2.2 W/m^oK volcanics
- $Q = \int q_z dA - \int q_b dA$
  - Q total system heat loss
  - q_b regional heat flow (90 mW/m^2)
  - dA area of integration (km^2)



Assumptions:

- All heat is lost by conduction over top of outflow plume.
- Estimated thermal conductivity does not introduce excessive error.
- Borehole density is adequate to characterize system.

EXHIBIT 6

EXAMPLE OF GEOTHERMAL SYSTEM SUBSURFACE THERMAL REGIME

- Annual temperature wave near surface
- Conductive gradient above water table or geothermal system
- Temperature "rollover" in outflow plume

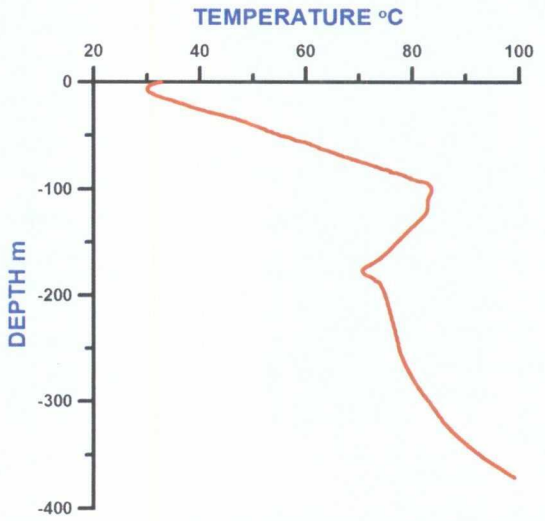


EXHIBIT 7

LIGHTNING DOCK

EXHIBIT 8

LIGHTNING DOCK HEAT FLOW

- Maximum Heat Flow

  2543 *m*W/m²

- Area of Heat Flow over 90 *m*W/m²

  17 km²

- Reservoir Volume

  <4 km³

- Heat Loss

  <10 MWt

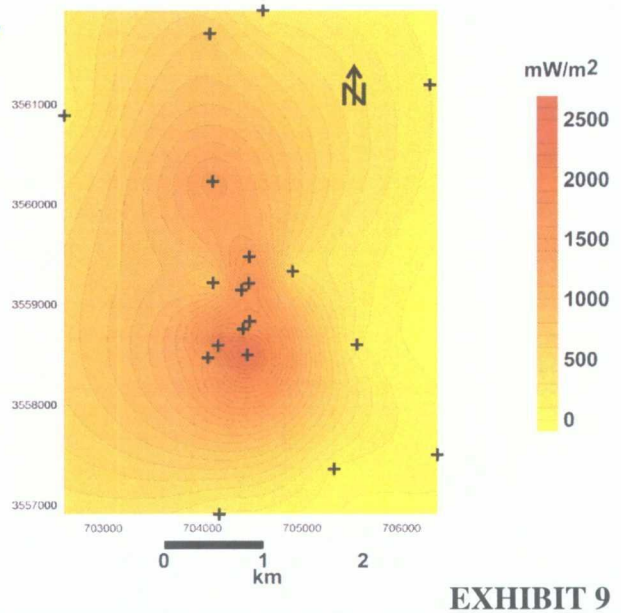


EXHIBIT 9

McGREGOR

EXHIBIT 10

McGREGOR HEAT FLOW

- Maximum Heat Flow
  454 *m*W/m²
- Area of Heat Flow
  over 90 *m*W/m²
  100 km²
- Reservoir Volume
  >50 km³
- Heat Loss
  >16 MWt

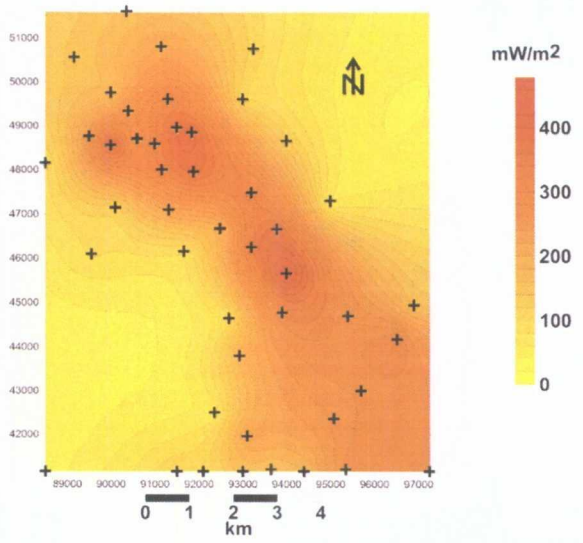


EXHIBIT 11

STRUCTURAL SETTINGS

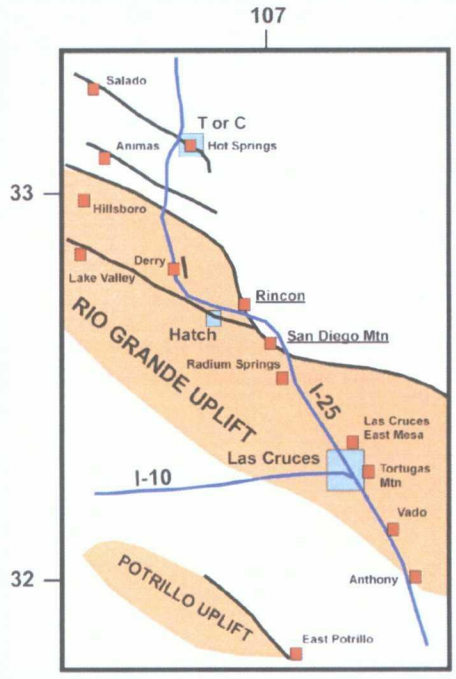
- Pleistocene/Holocene rift normal faults
  - Lightning Dock
- Ring fracture zones of Tertiary cauldrons
  - Lightning Dock
- Rift accommodation zones/normal fault transfer zones
  - Lightning Dock
- Laramide basement-cored compression uplift
  - Lightning Dock

EXHIBIT 12

GEOTHERMAL SYSTEMS AROUND THE LARAMIDE RIO GRANDE UPLIFT

System located on Laramide basement-cored uplift:

- San Diego Mtn
- Hot Springs
- Rincon
- Lake Valley
- Animas
- Salado
- Radium Springs
- Derry
- East Portrillo

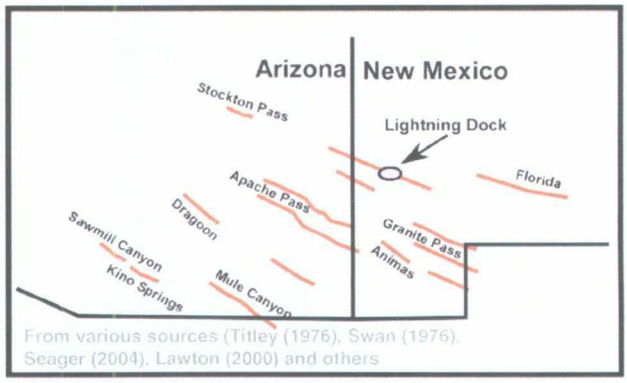


Modified from Seager and Mack (2003)

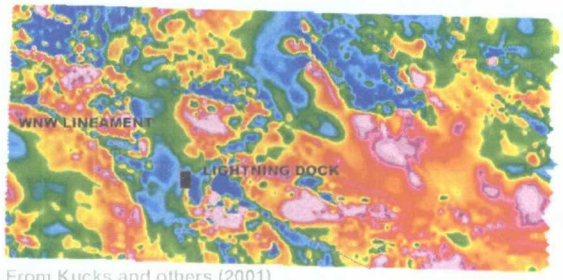
EXHIBIT 13

LIGHTNING DOCK REGION

- Potential for deep seated fracture permeability
- Structures have long and repeated deformation history



From various sources (Titley (1976), Swan (1976), Seager (2004), Lawton (2000) and others



From Kucks and others (2001)

EXHIBIT 14

A WNW STRUCTURE CONTOL AT LIGHTNING DOCK

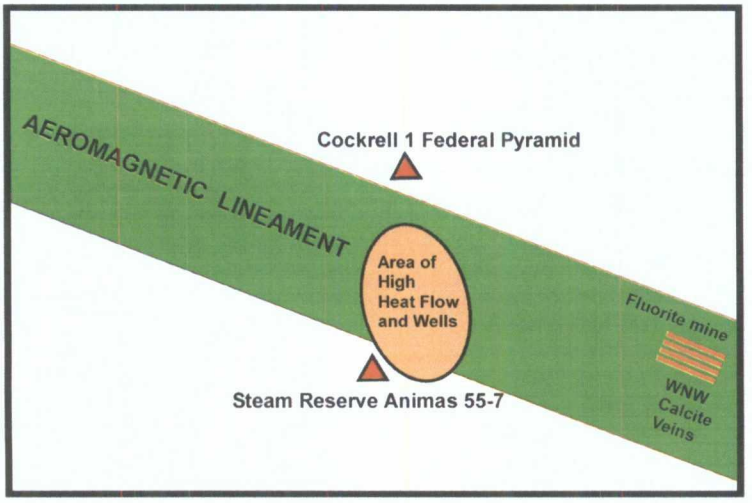


EXHIBIT 15

DIAGRAMMATIC CROSS SECTION OF DEEP SUBSURFACE AND MAJOR TECTONIC INVERSION OF A WNW FAULT

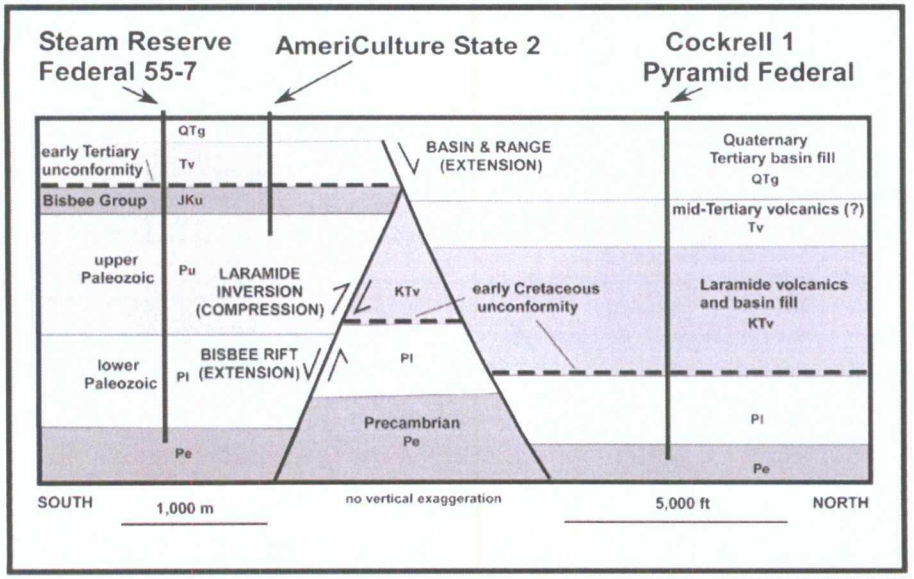


EXHIBIT 16

COMPLETE BOUGUER GRAVITY MAP OF LIGHTNING DOCK REGION

Geothermal system is contained within a buried intrabasin horst Block.

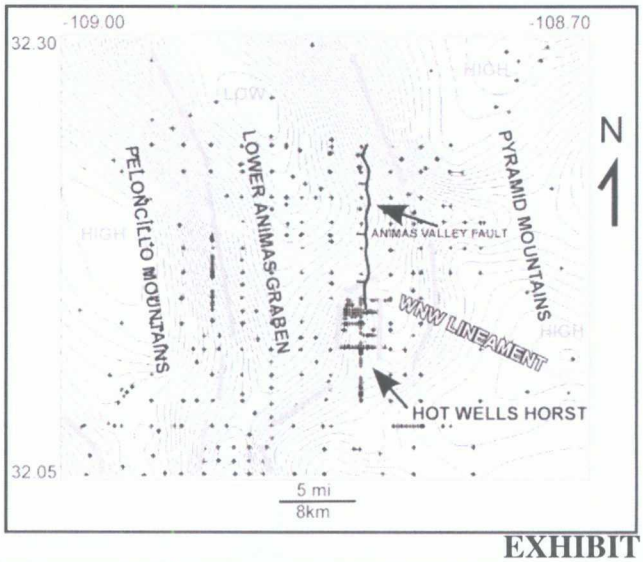


EXHIBIT 17

SUMMARY GEOLOGIC LOG OF THE AMERICULTURE 2 WELL

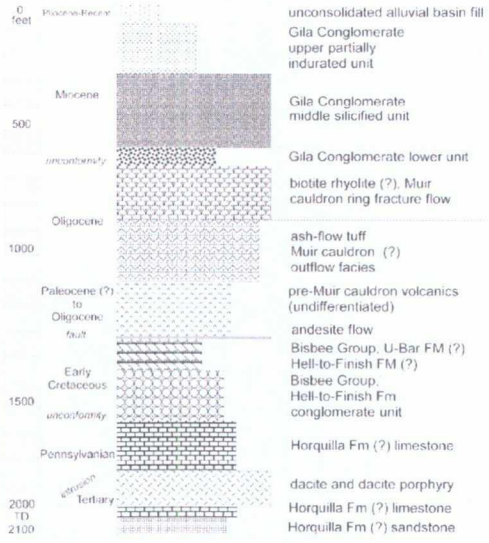


EXHIBIT 18

GEOLOGIC CROSS SECTION 1

QTgc – basin fill/Gila Conglomerate

Trf – ring fracture zone rhyolite

Tv – Tertiary volcanics

JKbg – Mesozoic Bisbee Group

PPh – Paleozoic limestone

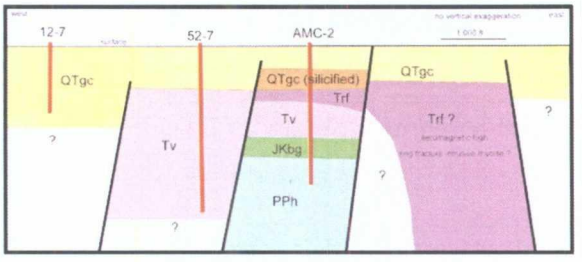


EXHIBIT 19

GEOLOGIC CROSS SECTION 2

QTgc – basin fill/Gila Conglomerate

Tv – Tertiary volcanics

JKbg – Mesozoic Bisbee Group

PPh – Paleozoic limestone

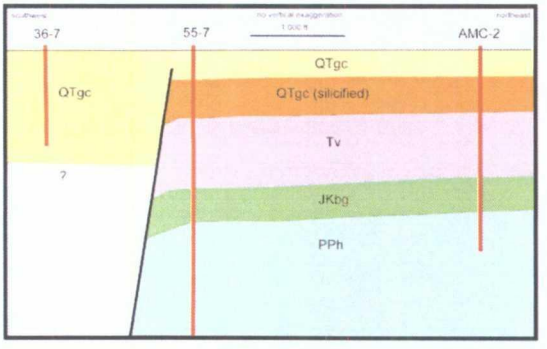


EXHIBIT 20

LOCATION MAP OF WELLS, FAULTS, AND CROSS SECTION LINES

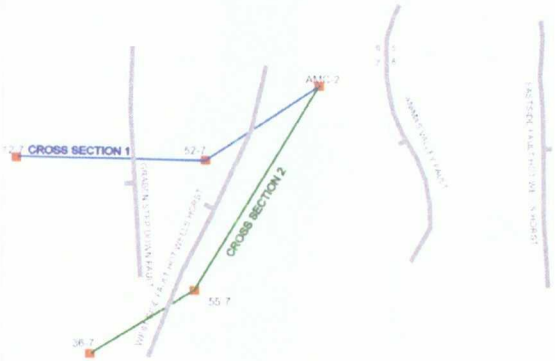


EXHIBIT 21

SUMMARY OF LIGHTNING DOCK STRUCTURAL ELEMENTS

1) Cockrell 1 Pyramid
2) AmeriCulture 2
3) Steam Reserve 55-7

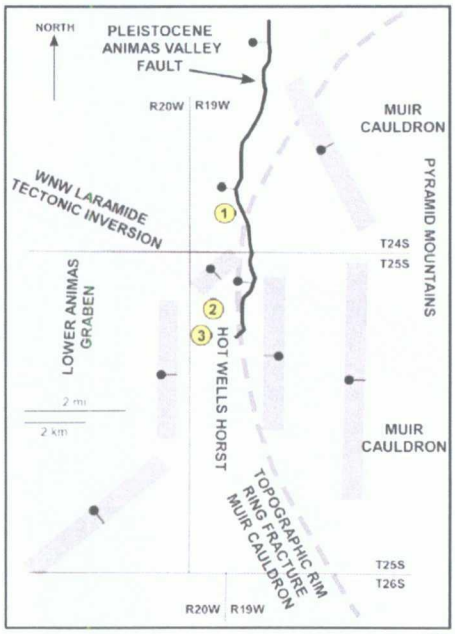


EXHIBIT 22

PIPER DIAGRAM OF THERMAL WATER CHEMISTRY

- Low TDS (<1200 mg/L)
- Sodium sulfate water

Flow through Paleozoic carbonate rocks is unlikely.

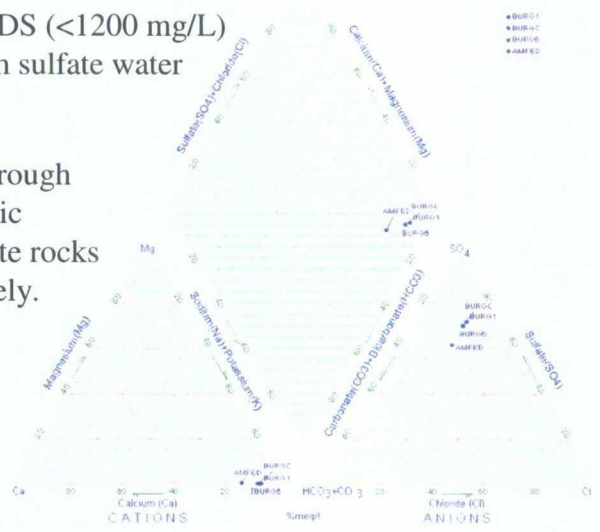


EXHIBIT 23

OXYGEN AND HYDROGEN ISOTOPES ANIMAS VALLEY

Blue cross – non thermal water

Red triangle – thermal water

INTERPRETATION

1) Thermal and non thermal waters are meteoroic water.

2) Shift to right of Global Mean Water Line is evaporation and (possibly subsurface boiling).

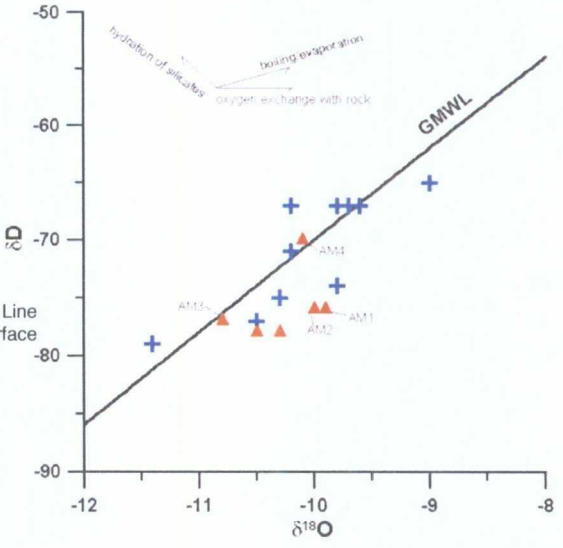


EXHIBIT 24

ISOTOPIC EVIDENCE FOR RESERVOIR AND FLOW PATH

SAMPLE	SITE	D/H	18O/16O	13C/12C	34S/32S	87Sr/86Sr
AM1	Burgett #1	-76	-9.9	-10.6	8.50	0.728344
AM2	Burgett #C	-76	-10.0	-8.6	8.55	0.725616
AM3	Burgett #6	-77	-10.8	n/a	8.34	0.727433
AM4	Americulture Fed	-70	-10.1	-10.0	8.84	0.728861

- Carbon isotopes are too low for water that has flowed through Paleozoic carbonate rocks (0 to +6)
- Sulfur isotopes show very little variation and suggest a single mineral source such as pyrite. The sulfur isotope ratio is too low for Paleozoic marine sulfate (+10 to +30) and is consistent with magmatic ratios (accessory pyrite in volcanics and intrusives).
- Strontium isotope ratios are too high for flow through Paleozoic carbonate rocks and mafic and intermediate volcanic rocks (<0.710) and indicates flow through rhyolite and granite of mid-Tertiary to Precambrian age.

EXHIBIT 25

SUMMARY OF FINDINGS

- The Lightning Dock system is a very small geothermal system and will not sustain power production greater than 2 or 3 MW.
- The nature of the upflow zone is not well defined except to infer that it is very localized and may be less than a few tens of acres in planar cross section area.
- The geothermal fluids do not flow across or originate in Paleozoic carbonate rocks.
- Proposed injection and production wells are located from one another in dramatically different hydrogeologic domains.
- Characterization of deep resource potential is not well defined and can only be classified in an immature exploration stage.
- Excessive production and injection or improperly located wells will quench the current resource.

EXHIBIT 26

RECOMMENDATIONS

- APD's <u>should not</u> be approved for injection purposes.
  No reservoir hydraulic information is available to assess impact on reservoir for thermal break through and injection well spacing.
- APD's <u>should not</u> be approved for production purposes.
  Without reservoir testing, viable well spacing, and deep water chemistry is unknown. Projected reservoir hosts in Palezoic limestone will have dramatically different and more saline water chemistry than current production from silicic volcanic and intrusive rocks.
- APD's should be approved only for test or exploration drilling with permit approval to injection and production contingent upon detailed reservoir hydraulics and chemistry information. Injected chemicals should be limited to approved substances potable water.

EXHIBIT 27

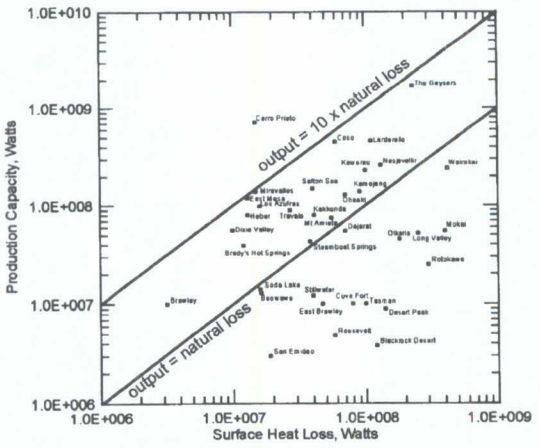


EXHIBIT 28

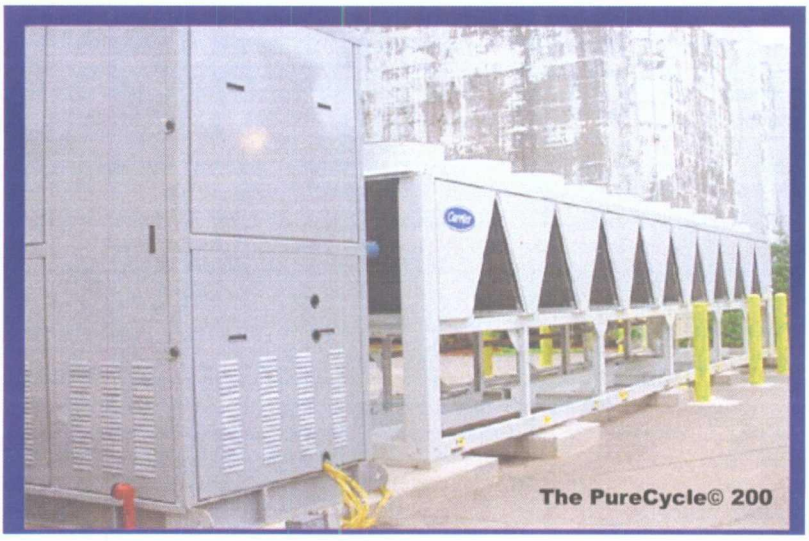


EXHIBIT 29