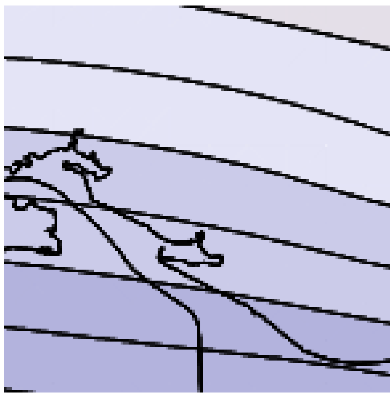

SECARB's Mississippi Test Site: A Field Project Update

for:

7th Carbon Capture & Sequestration Conference
Pittsburgh, PA
May 5-8, 2008

by:

George J. Koperna Jr., Advanced Resources
David Riestenberg, Advanced Resources
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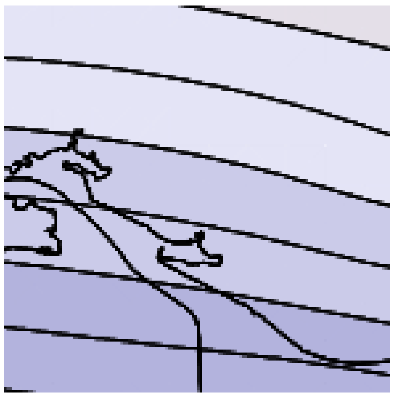
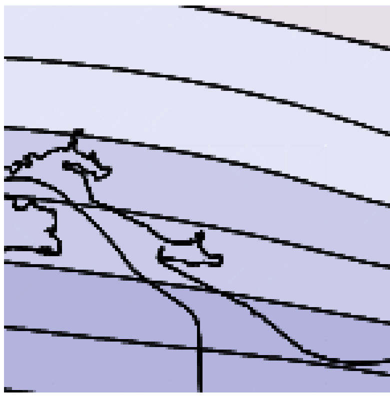
Richard Rhudy, EPRI



Outline for Presentation

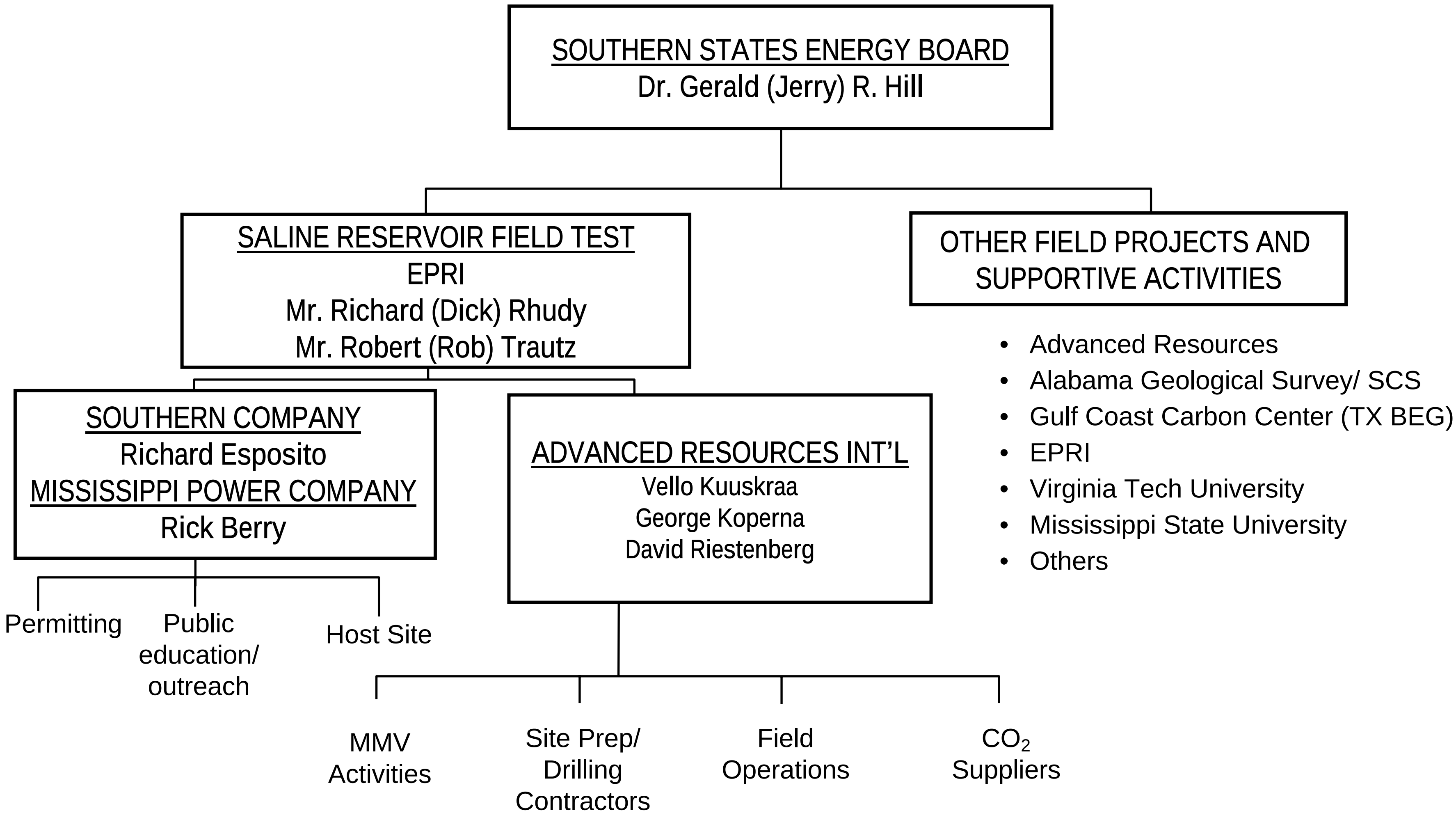
1. Introduction
2. Well Drilling & Completion
3. Reservoir Characterization
4. CO2 Injection Operations
5. Monitoring and Verification
6. Project Schedule and Next Steps



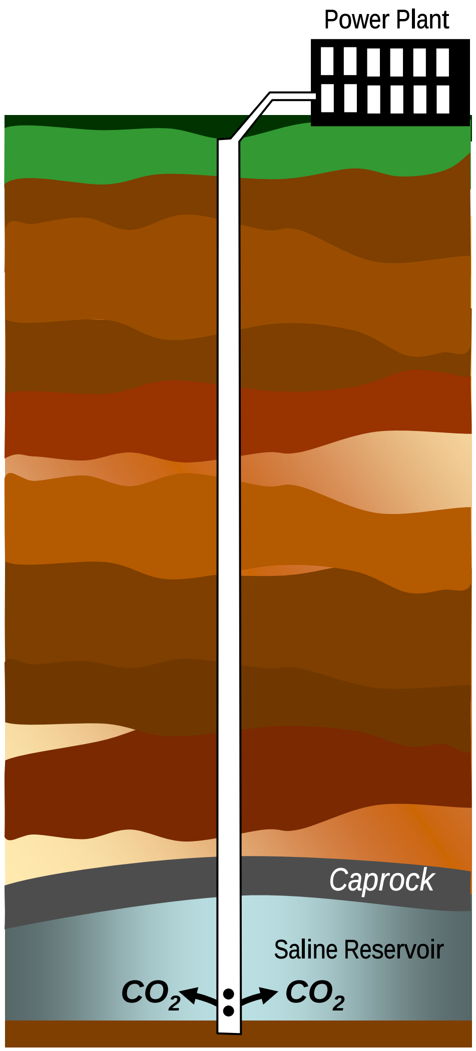
1. Introduction

Key Organizations and Individuals

Southeast Regional CO_2 Sequestration Partnership (SECARB)



Mississippi Saline Reservoir CO_2 Injection Project



- **Purpose:** Locate and test suitable geological sequestration sites in proximity to large coal-fired power plants in the Southeast region
- **Initial Target:** Deep saline reservoirs along MS Gulf Coast with high potential CO_2 storage capacity
- **Objectives:**
  - Build geological and reservoir maps for test site
  - Conduct reservoir simulations to estimate injectivity, storage capacity, and long-term fate of injected CO_2
  - Address state/local regulatory and permitting issues
  - Foster public education and outreach
  - Inject 3,000 tons of CO_2
  - Conduct longer-term monitoring

Victor J. Daniel Power Plant

High capacity CO_2 storage sites exist at Plant Daniel located in Jackson County, Mississippi.

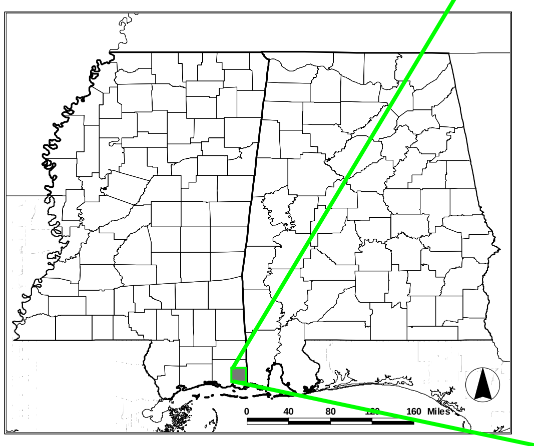


Image Source: Google Earth

Saline Reservoir Units and Seals
(SE Mississippi)

Potential CO_2 Storage Units

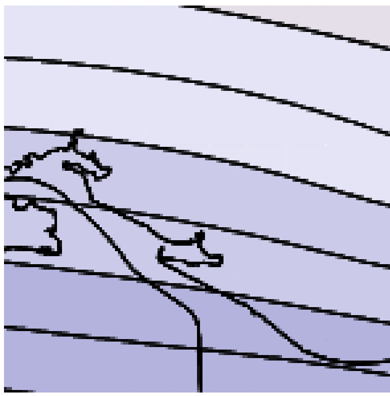
- Lower Tuscaloosa Massive Sand Unit (U. Cretaceous)
- Dantzler Formation (L. Cretaceous)

Confining Units (Seals):

- Marine Tuscaloosa
- Austin Formation (Fm.)
- Selma Chalk/Navarro Fm.
- Midway Shale

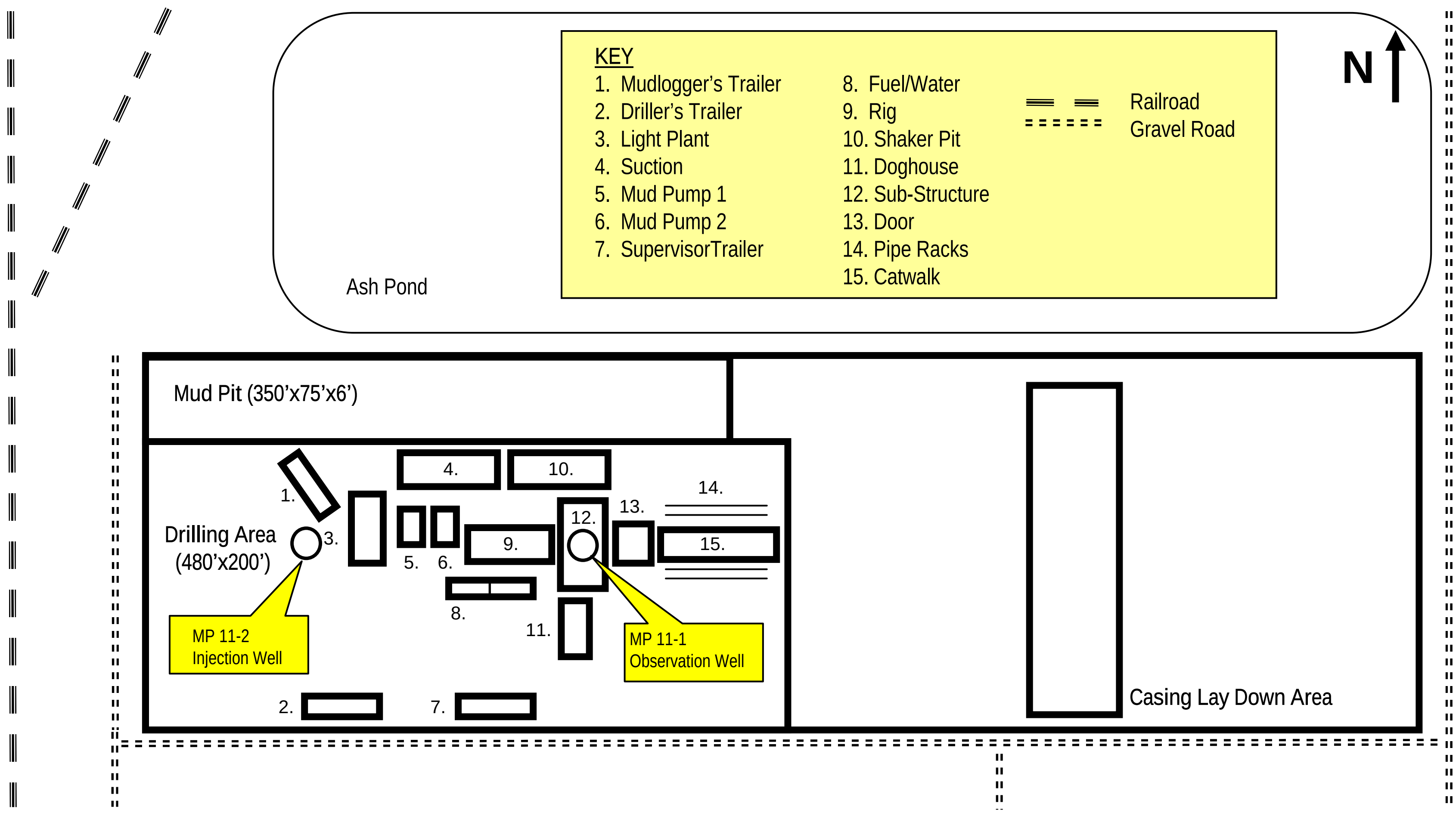
System	Series	Stratigraphic Unit	Sub-Units	Hydrology	
Tertiary	Miocene	Misc. Miocene Units	Pascagoula Fm.	Freshwater Aquifers	
			Hattiesburg Fm.		
			Catahoula Fm.		
	Oligo-cene	Vicksburg		SalineReservoir	
			Red Bluff Fm.	Minor confining unit	
	Eocene	Jackson		SalineReservoir	
		Claiborne		SalineReservoir	
		Wilcox		SalineReservoir	
	Paleo-cene	Midway Shale		Confining unit	(Seal)
Cretaceous	Upper	Selma Chalk	Navarro Fm.	Confining unit	(Seal)
			Taylor Fm.		
		Eutaw	Austin Fm.	Confining unit	(Seal)
			Eagle Ford Fm.	Saline Reservoir	← CO_2
		Tuscaloosa Group	Upper Tusc.	Minor Reservoir	
			Marine Tusc.	Confining unit	(Seal)
			Lower Tusc.	Saline Reservoir	← CO_2
	Lower	Washita Fredricksburg	Dantzler Fm.	Saline Reservoir	← CO_2
			"Limestone Unit"		

Injection Target



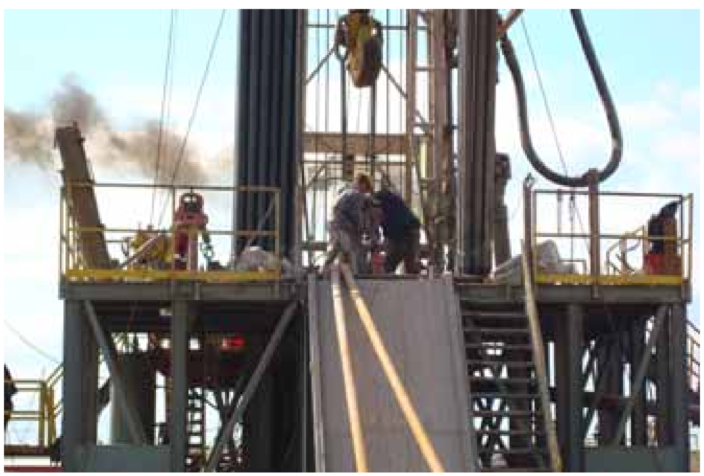
2. Well Drilling & Completion

Surface Location

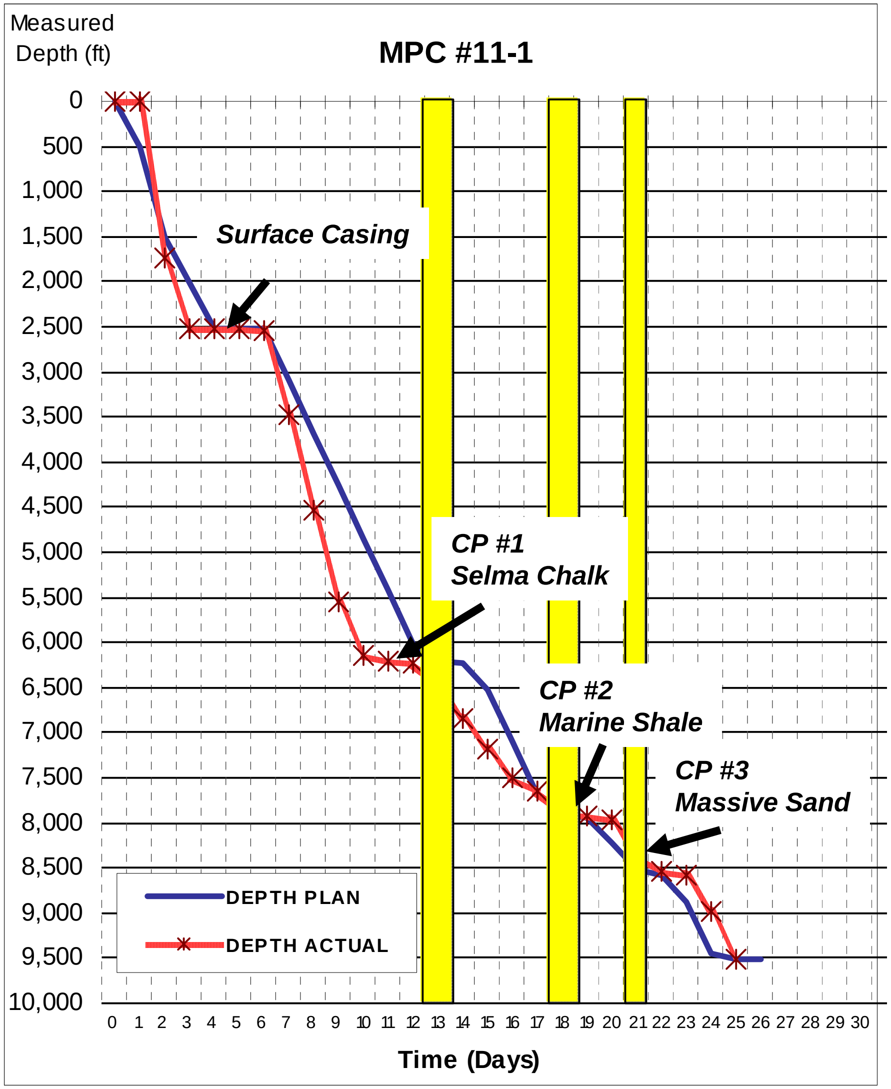


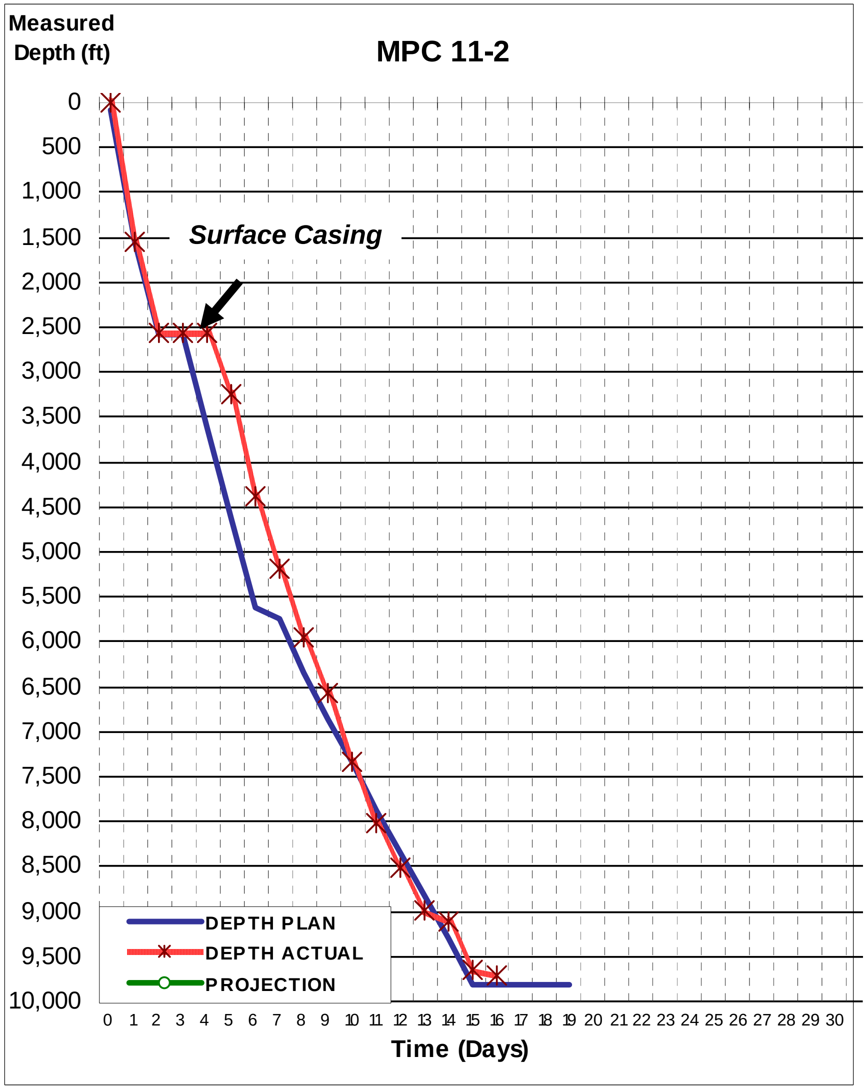
Surface Location Preparation

Well Drilling and Completion

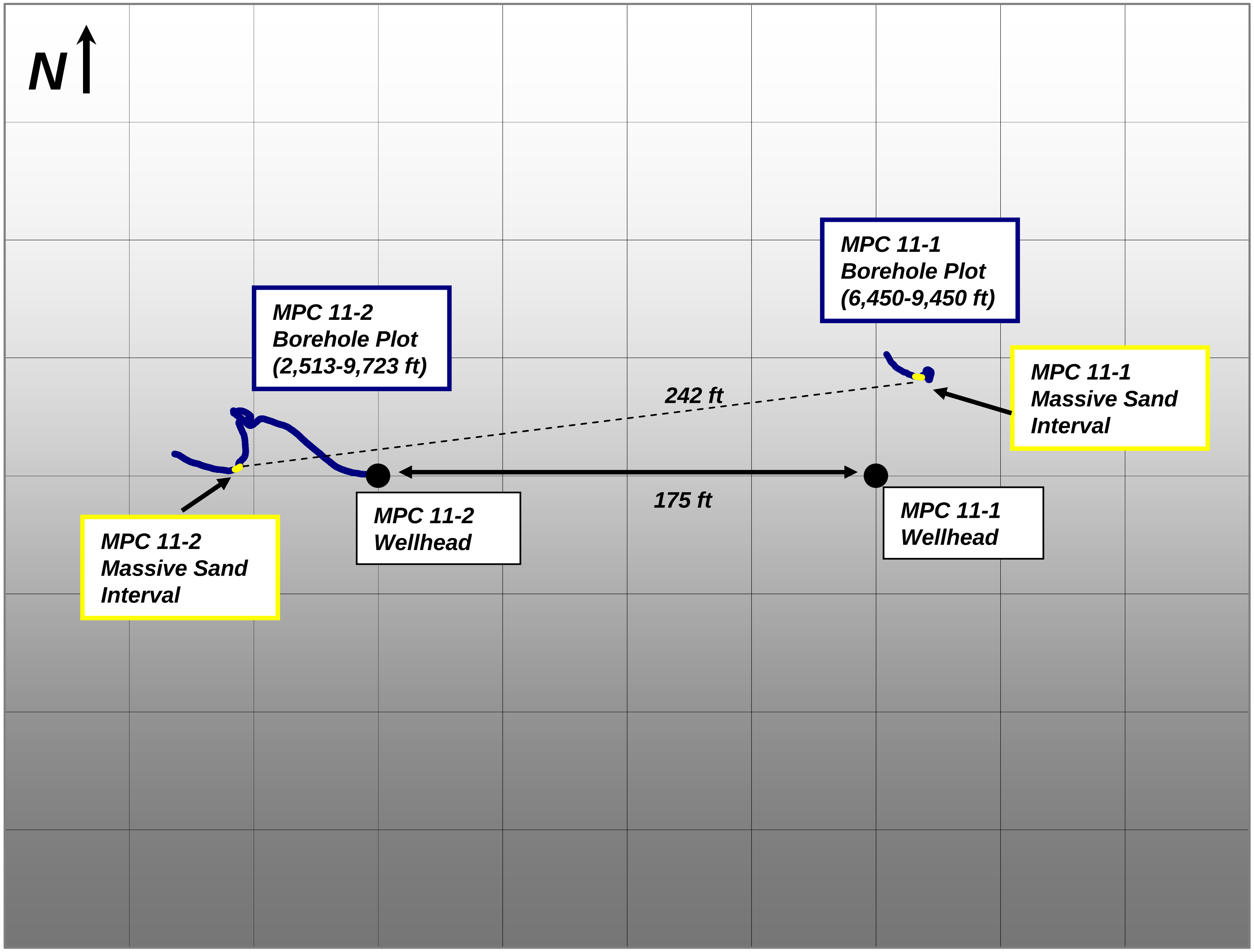


Well Drilling and Completion



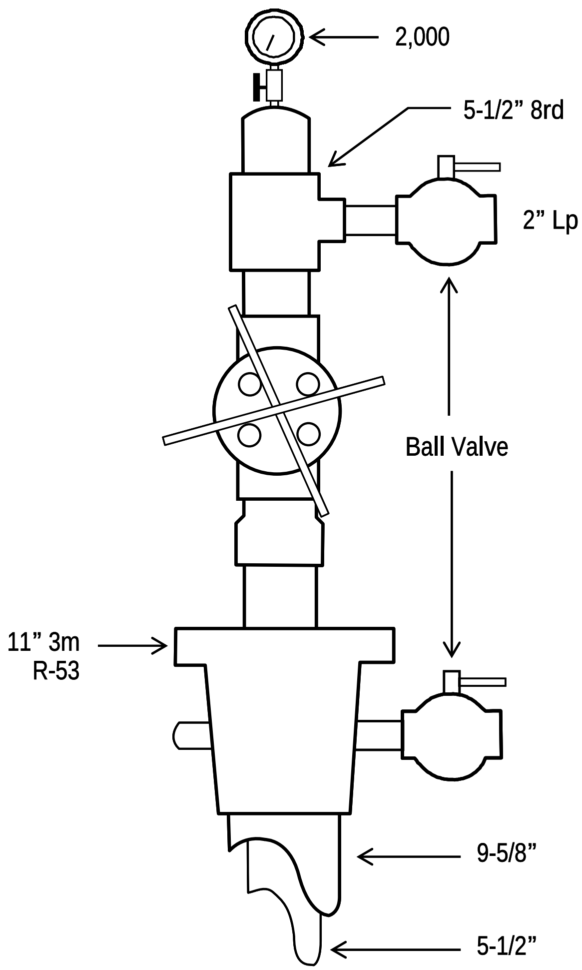


Well Drilling and Completion



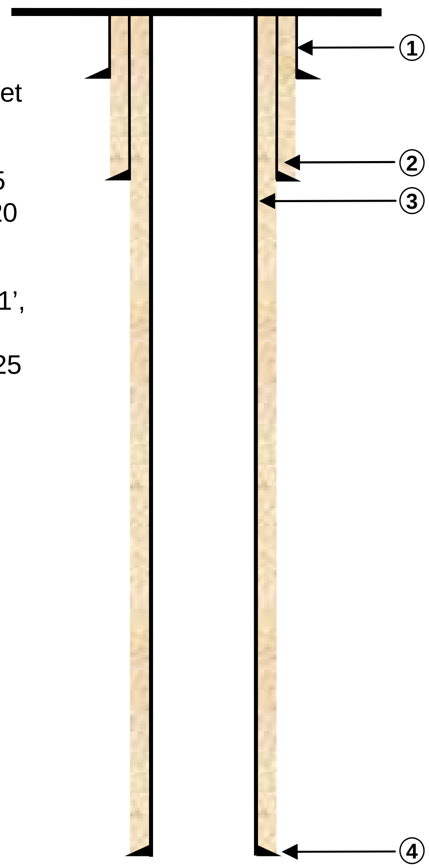
Observation Wellhead and Observation Well Design

WELLHEAD ASSEMBLY DETAIL



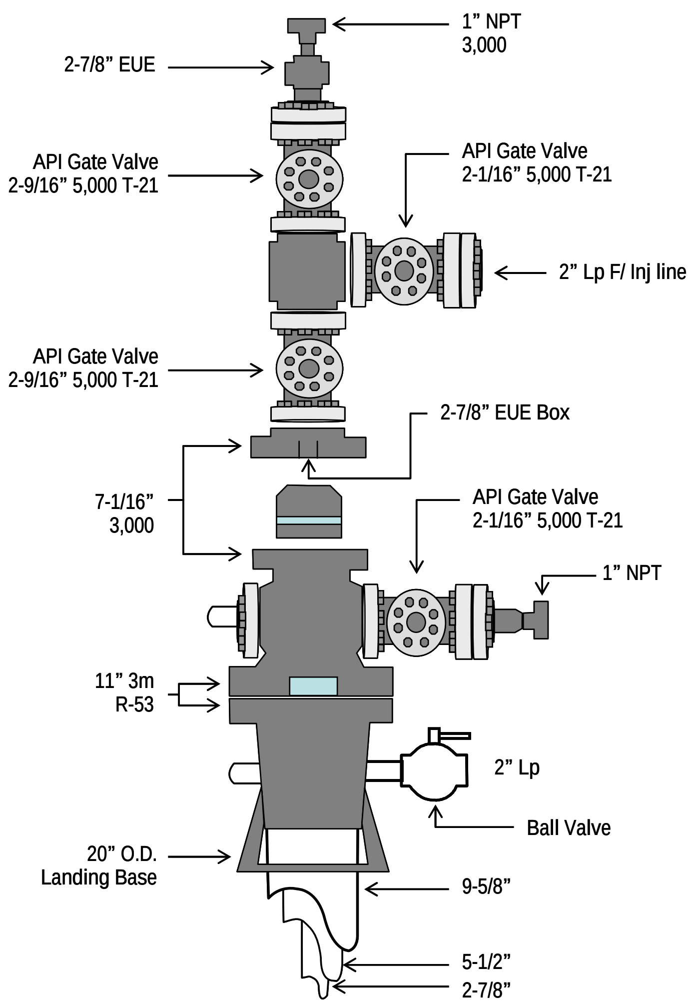
COMPLETION DETAIL

1. ~16" Conductor Pipe set at 90 feet
2. 9-5/8" Surface Casing @ 2,526', set in 12-1/4" hole; 40.0 lb/ft J-55 STC; Cemented to surface w/ 420 sacks.
3. 5-1/2" Protection Casing @ 9,501', set in 7-7/8" hole; 20.0 lb/ft N-80 LTC; Cemented to 1,300' w/ 1,125 sacks.
4. Total Depth @ 9,500'



Injection Wellhead and Injection Well Design

WELLHEAD ASSEMBLY DETAIL



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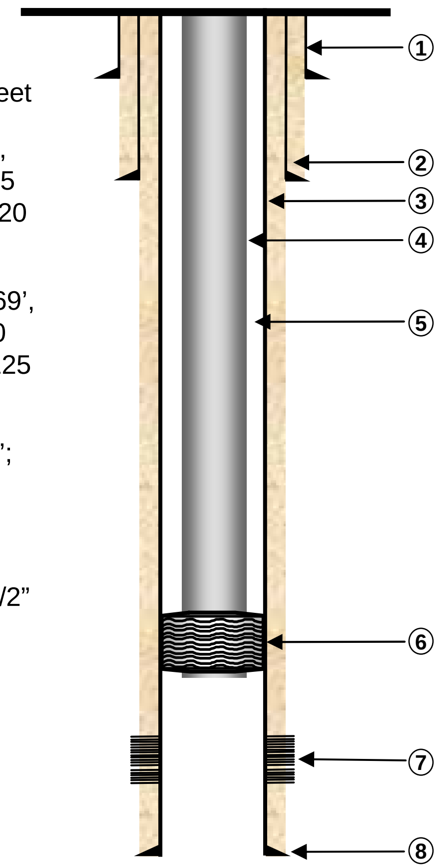
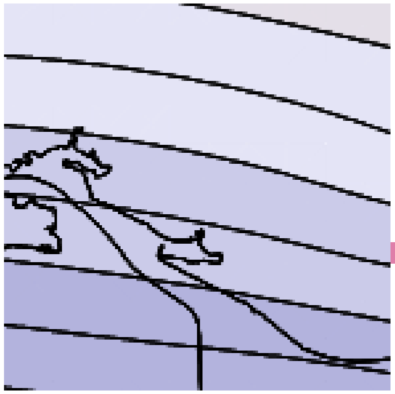
3. 5-1/2" Protection Casing @ 9,669', set in 7-7/8" hole; 20.0 lb/ft N-80 LTC; Cemented to 1,100' w/ 1,125 sacks.
4. 2-7/8" Injection Tubing @ 8,500'; 6.5 lb/ft J-55 EUE 8rd.
5. Annular Fluid: TBD
6. Injection Packer @ ~8,500'; 5-1/2" x 2-7/8" retrievable production packer.
7. Perforations: TBD
8. Total Depth @ 9,668'



Key Geologic Horizons

Formation Tops	*Depth Feet*	*Interval Thickness Feet*
Bottom of Fresh Water (<1,000 mg/l)	***1,400***	***1,400***
Bottom of Potable Water (<10,000 mg/l)	***2,200***	***800***
Selma Chalk Group	***5,910***	***1,240***
Eutaw Group	***-***	***280***
Austin Chalk Formation	***7,150***	***90***
Eagle Ford Formation	***7,240***	***190***
Tuscaloosa Group	***-***	***1,290***
Upper Tuscaloosa Formation	***7,430***	***240***
Marine Tuscaloosa Formation	***7,670***	***490***
Lower Tuscaloosa Formation	***-***	***560***
Interbeds	***8,160***	***350***
Massive Sand Member	***8,510***	***210***
Lower Cretaceous Group	***8,720***	***-***

Thicknesses taken from MPC 11-1



3. Reservoir Characterization

Observation Well: Reservoir Characterization

A variety of data gathering activities were performed in the observation well to characterize the subsurface, to assure the integrity of the completed well and to prepare for MMV:

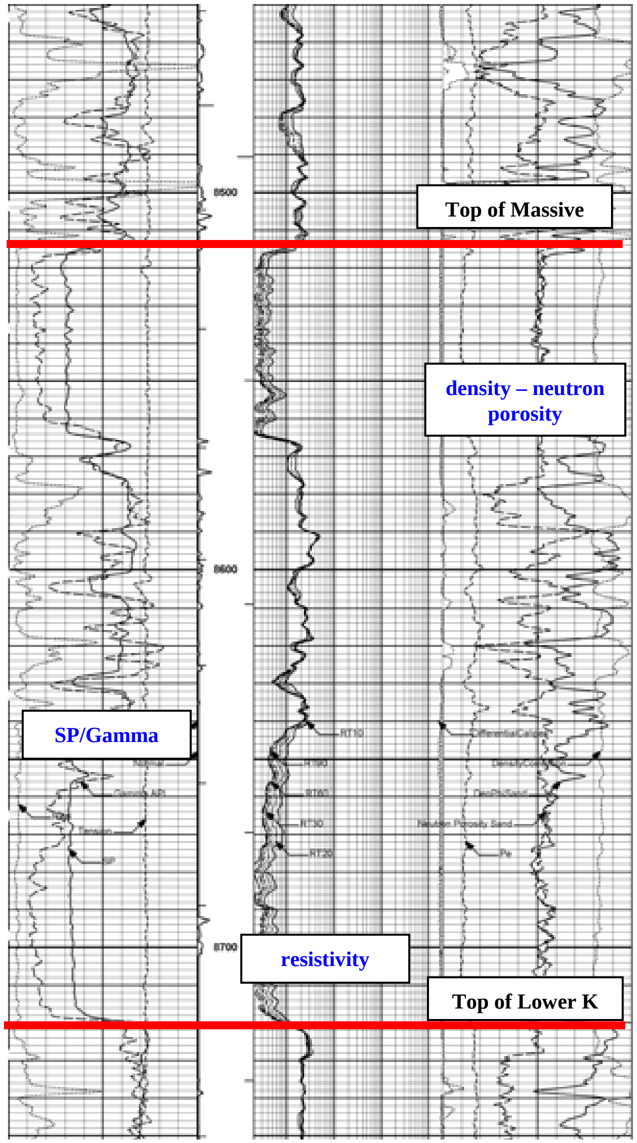
- Mud Logging from 6,000 ft to TD
- Nearly 120 feet of whole core from three formations:
  - Selma (30'/27'), Marine Shale (28'/26'), and Tuscaloosa Massive Sand (60'/58').
- Core analysis will include permeability (horizontal and vertical), porosity, capillary pressure, relative permeability and mineralogy.
- Wireline Logging included:
  - Halliburton's Triple Combo (gamma ray, resistivity, and porosity).
  - Cement Bond Log with Cast V Evaluation
  - Thermal Decay Log for baseline and time-lapse for gas saturation identification
- Vertical Seismic Profiling (VSP) was performed on April 30:
  - Confirm geologic description
  - Provide baseline for CO_2 plume monitoring (time-lapse)

Injection Well: Reservoir Characterization

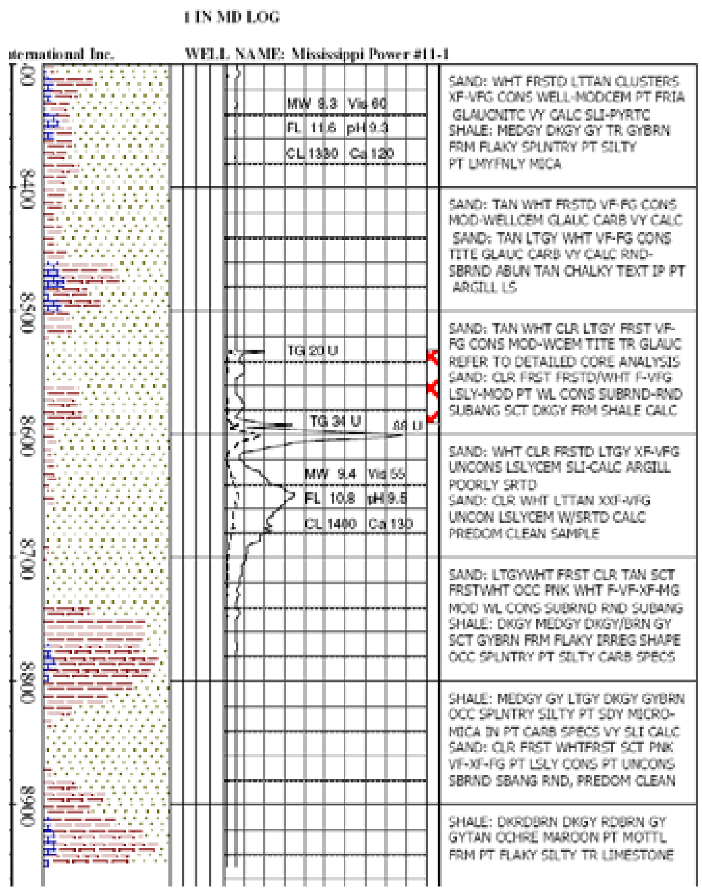
Additional geologic characterization and well integrity activities were conducted in the injection well:

- Wireline Logging included:
  - Schlumberger's Platform Express Log
  - Thermal Decay Log
  - Mechanical Properties Log
  - Combinable Magnetic Resonance
  - Elemental Capture Spectroscopy
  - Cement Bond Log with Cast V Evaluation
- Sidewall coring of the Marine Shale, Massive Sand and Washita-Fredericksburg formations
- Water sampling.
- 2-Day pressure transient testing scheduled for mid-June.
- Completion of the MIT in mid-June.

Observation Well: Logs and Core



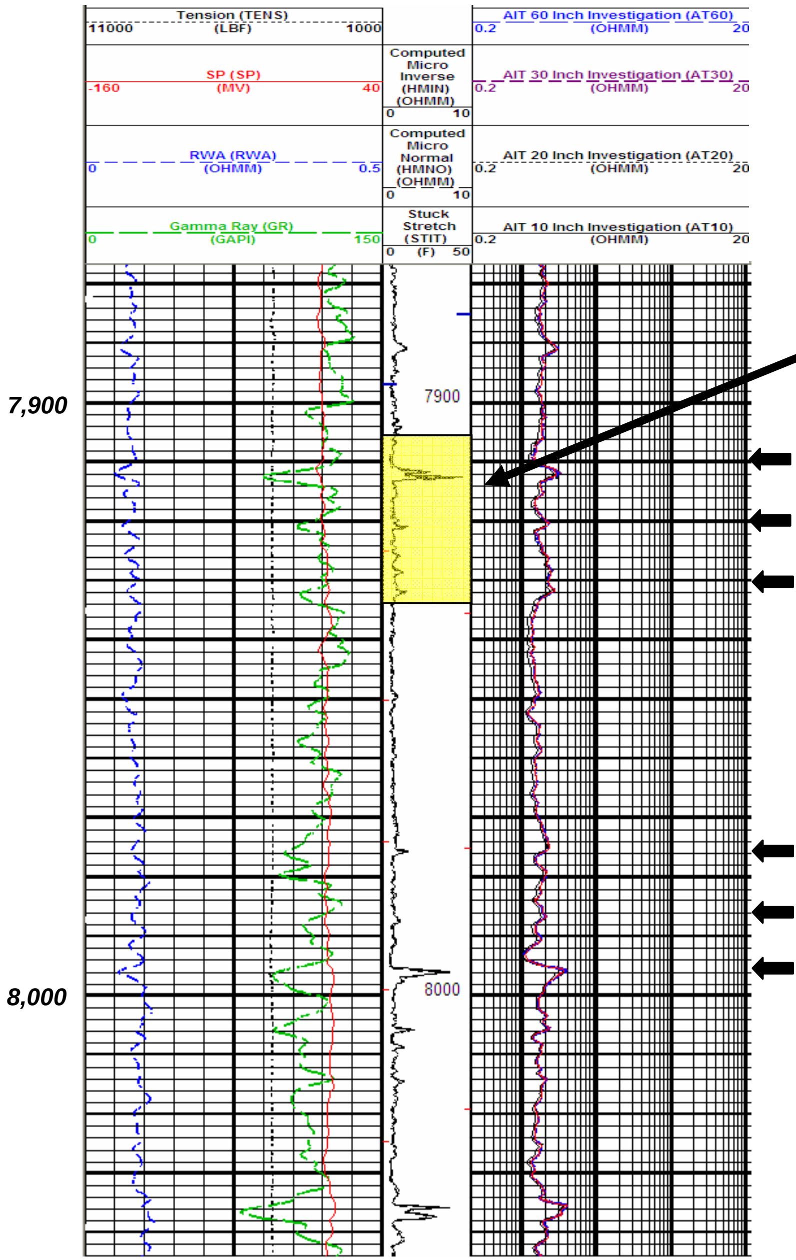
Open-Hole Logging of MPC 11-1



Mud Log of the Lower Tuscaloosa Massive Sand, MPC 11-1

Marine Shale Whole Core MPC 11-1

Evaluating the Tuscaloosa Marine Shale Caprock

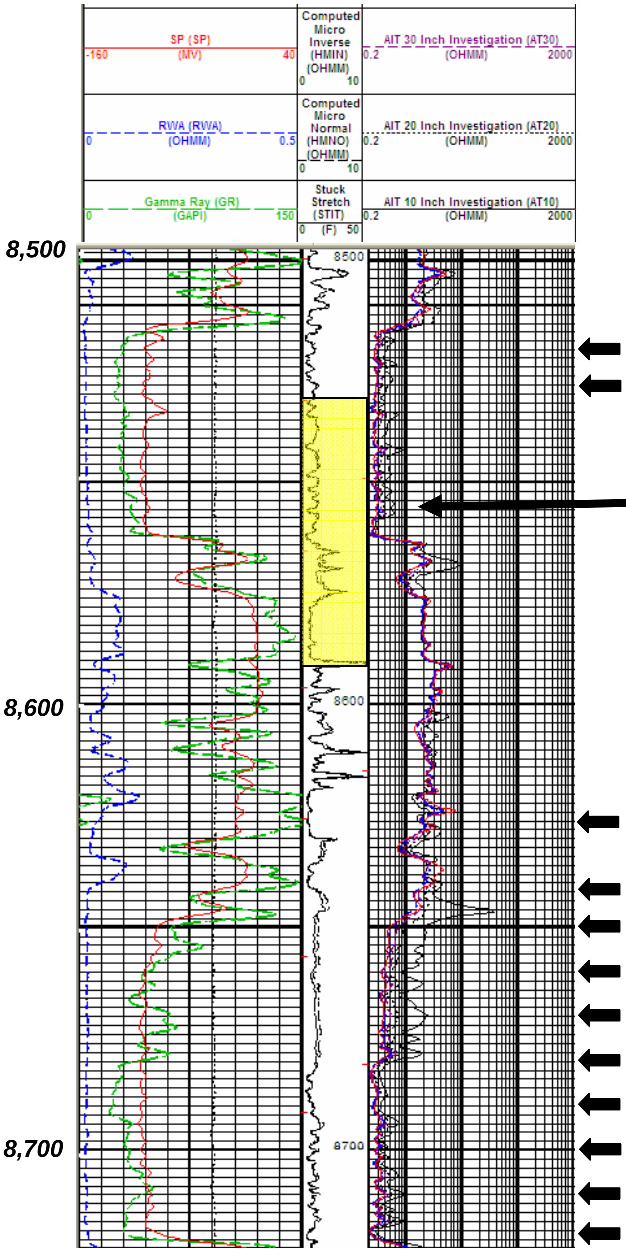


- **28 ft whole-core sample was taken from MPC 11-1 (~26' recovery)**
- **Six sidewall cores were taken in MPC 11-2**
- **Core analysis is currently underway, including permeability, porosity, capillary pressure**

Core Point #2
Marine Tuscaloosa
7,906'-7,934'

Sidewall Core Pts

Evaluating the Lower Tusc. Massive Sand Storage Formation



- **60 ft whole-core sample was taken from MPC 11-1 (~57' recovery)**
- **Twelve sidewall cores were taken in MPC 11-2**
- **Core analysis is currently underway, including permeability, porosity, capillary pressure**

Sidewall Core Pts

Core Point #3
Massive Sand
8,531'-8,591'

Sidewall Core Pts

Preliminary Massive Sand Core Analysis Results (Lower Tuscaloosa Massive Sand Storage Formation)

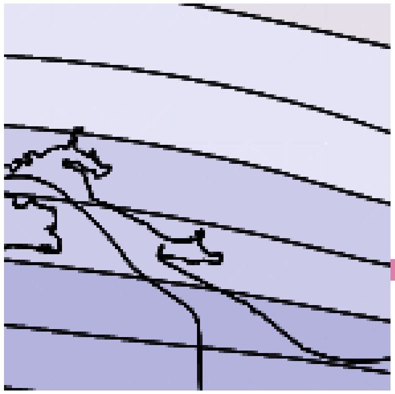
Core Number	Sample Number	Sample Depth, (ft)	Pemeability millidarcys,		Porosity, percent		Grain Density, gm/cc
			to Air	Klinkenberg	Ambient	2500 psi	
3	3-1	8531.45	1450.	1380.	22.7	22.4	2.65
3	3-5	8535.50	2390.	2300.	24.5	24.2	2.64
3	3-9	8539.50	1930.	1850.	24.1	23.8	2.65
3	3-13	8543.45	652.	614.	19.7	19.4	2.67
3	3-17	8547.50	1460.	1400.	23.8	23.5	2.65
3	3-21	8551.50	936.	888.	23.2	22.9	2.65
3	3-25	8555.50	848.	804.	22.8	22.5	2.66
3	3-29	8559.50	1030.	977.	24.4	24.1	2.65
3	3-33	8563.50	641.	603.	23.4	23.1	2.65
3	3-37	8567.50	3390.	3280.	25.3	25.0	2.65
3	3-41	8571.40	0.0082	0.0028	7.8	7.5	2.71
3	3-45	8575.50	7.16	5.63	17.9	17.6	2.68
3	3-49	8579.50	+		9.1		2.75
Average values:			1230.	1180.	20.7	21.3	2.66

\+ Indicates the sample is unsuitable for this type of measurement

Preliminary Sidewall Core Analysis Results

In. Rec.	Sample Depth Feet	Permeability mD	Porosity %
Lower Tuscaloosa Marine Shale			
0.0	7910.0		
1.7	7920.0	<0.1	8.2
1.4	7930.0	<0.1	9.2
1.4	7976.0	<0.1	8.8
0.0	7986.0		
1.5	7996.0	<0.1	8.3
Lower Tuscaloosa Interbeds			
0.9	8500.0	5.1	17.4
1.6	8510.0	<0.1	9.6
0.8	8520.0	420.0	20.3
0.9	8530.0	800.0	22.9
Massive Sand Interlobe			
1.0	8630.0	3.8	16.5
0.8	8642.0	9.5	18.6

In. Rec.	Sample Depth Feet	Permeability mD	Porosity %
Massive Sand Lower Lobe			
0.8	8650.0	450.0	23.2
1.1	8660.0	550.0	23.4
0.8	8670.0	300.0	22.5
1.1	8680.0	900.0	23.3
0.6	8690.0	980.0	24.0
0.6	8700.0	175.0	19.3
0.9	8710.0	660.0	22.9
1.0	8720.0	600.0	21.6
Lower Cretaceous			
0.9	8820.0	3.0	17.5
0.5	8830.0	56.0	20.0
1.5	8840.0	1000.0	23.1
1.0	8850.0	950.0	22.8
0.0	8860.0		
1.0	9010.0	525.0	22.4
1.0	9020.0	1050.0	22.1
1.1	9030.0	775.0	22.9
1.0	9040.0	580.0	23.1
1.2	9050.0	1050.0	24.4



4. CO2 Injection Operations

Surface Equipment

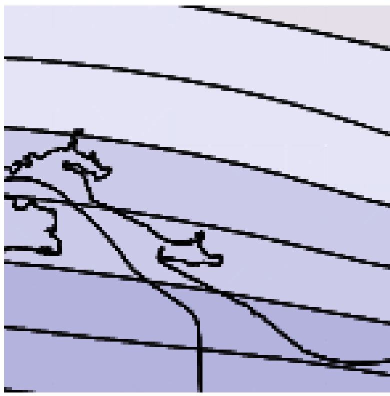
- After completion of the well, surface equipment will include the wellhead assembly and:
  - CO_2 storage tanks
  - In-line heater
  - CO_2 pump
  - Automated operations data collection system (pressures and rates)
- Advanced Resources is currently planning to begin CO2 injection operations in October of 2008. This will allow adequate time to analyze the data collected and conduct detailed modeling studies incorporating the new newly collected reservoir data.

CO_2 Supply and Injection

In October 2008, approximately 3,000 tons of CO_2 will be injected at a rate of 100 tons (1.72 MMcf) per day for 30 days.

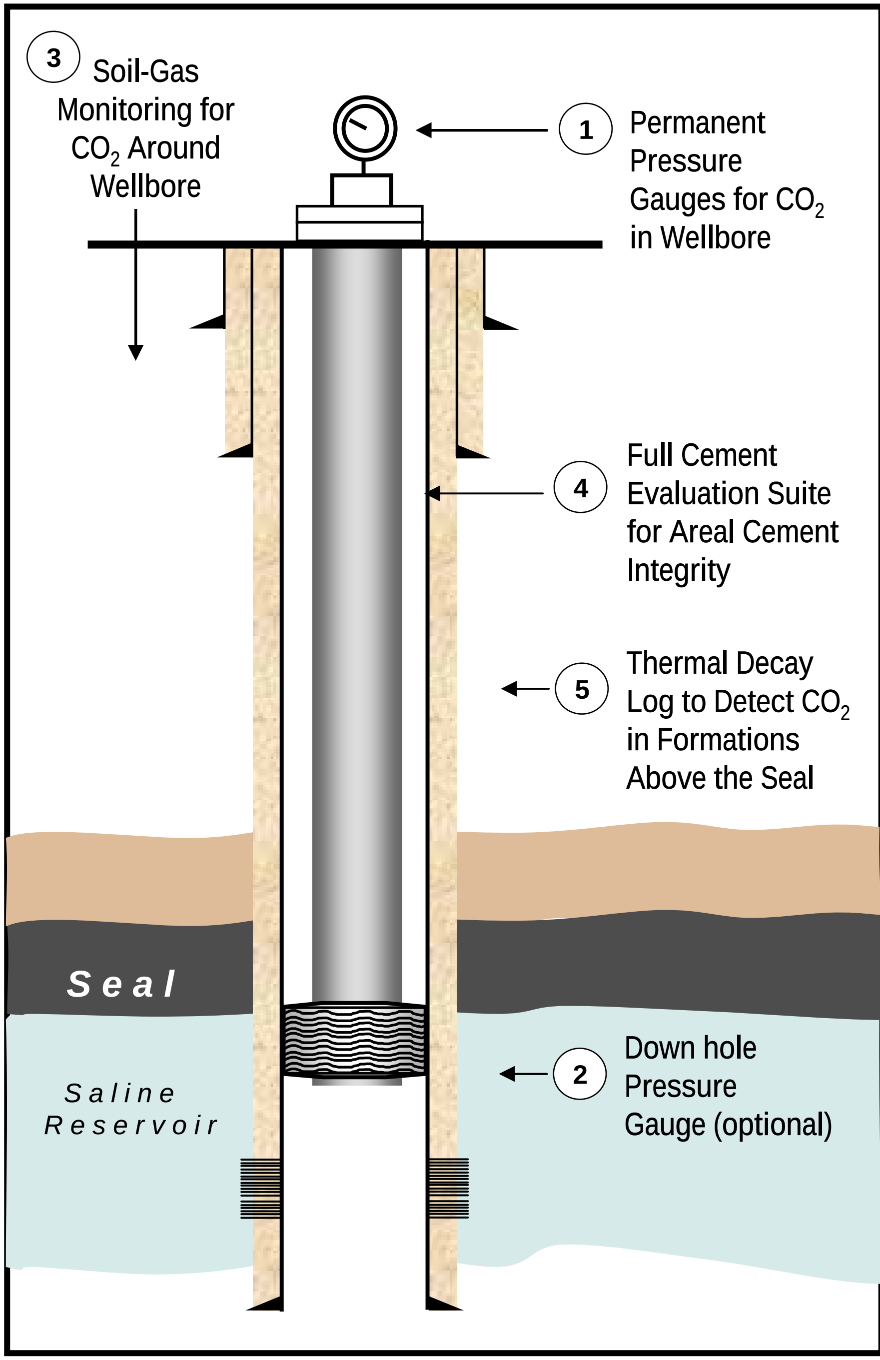
- CO_2 supply will be from Denbury's CO_2 pipeline outlet in central Mississippi.
- A to be determined provider will deliver the CO_2 to the plant site; anticipate 4 to 6 trucks of liquid CO_2 per day.
- CO_2 will be stored on-site, heated and pumped into the formation.

After completion of CO_2 injection, a slug of N_2 may be used to drive the CO_2 into the formation.



5. Monitoring, Measurement and Verification (MMV)

Well Integrity and Pressure Monitoring



The project will include a series of MMV activities to assure well integrity:

- To assure well integrity at the surface, we will: (1) install a pressure gauge on the wellhead to measure sustained casing pressure (CO_2 leakage in the well); (2) conduct continuous monitoring of annular and down hole pressure (optional); and, (3) conduct near-surface soil gas measurements.
- To assure downhole well integrity, we will: conduct (4) Cement bond evaluation both after cementing and after CO_2 injection; and, (5) run a series of Thermal Decay Logs to detect any CO_2 above the reservoir seal.

CO_2 Plume Monitoring

To monitor the flow and storage of CO_2 in the saline reservoir, we will use well logs, seismic and other tools:

- For monitoring the areal profile of the CO_2 plume, we will use time-lapse Vertical Seismic Profiles (VSP) before CO_2 injection and about 3 months after CO_2 injection.
- For monitoring the vertical profile of the CO_2 plume, we will use: (1) a time lapse series of thermal decay logs (in both wells) and (2) also use time-lapse VSP.

Baseline VSP Deployment

- A baseline Vertical Seismic Profile (VSP) was collected in April
- A four-level geophone string was deployed in the observation well (11-1)
- Two seismic sources were utilized, at near and far offset locations
- Two locations were monitored by staff from Vibra-Tech for potentially damaging vibrations and noise

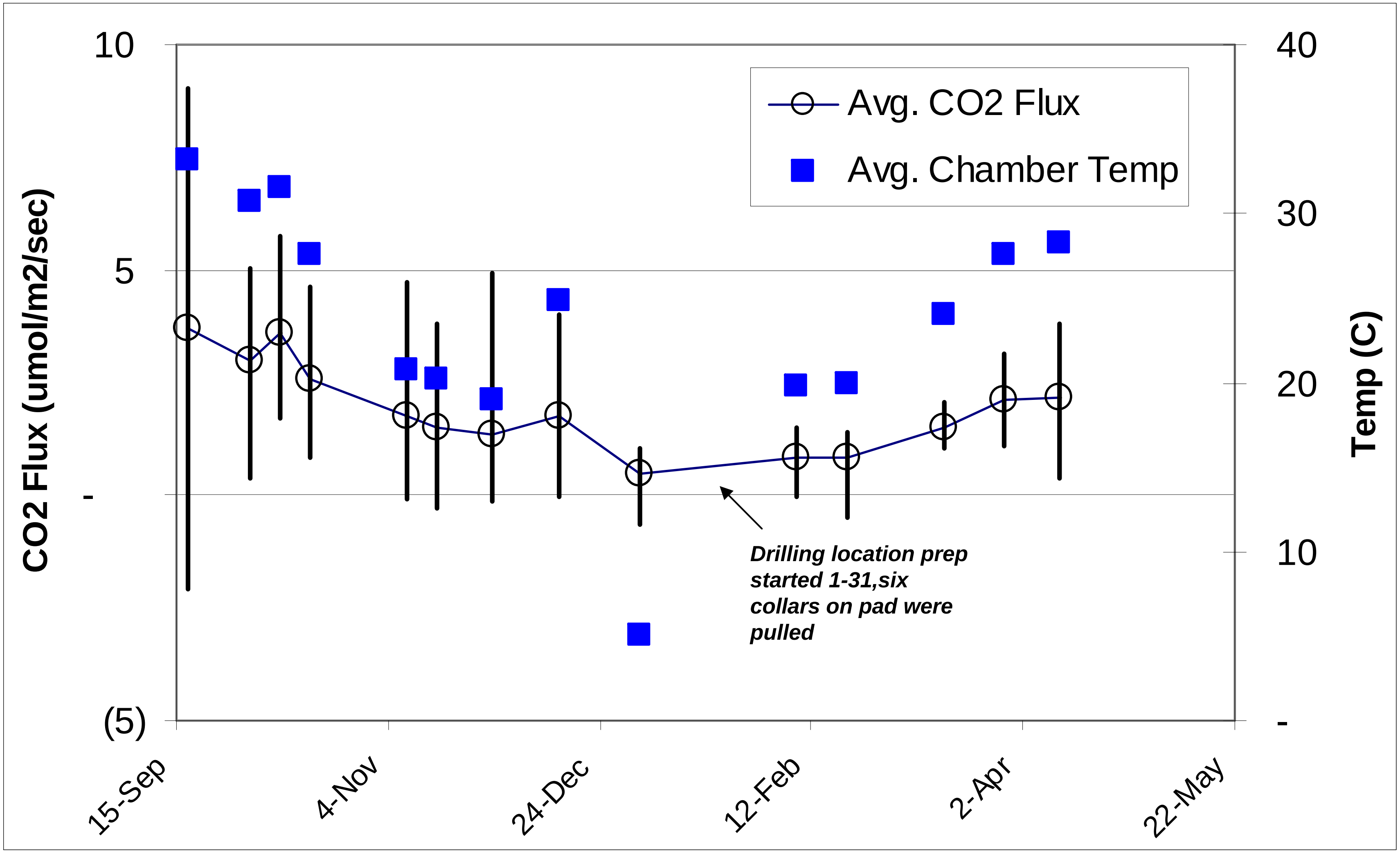
Near-Surface Monitoring

- **Soil Flux.** An automated real-time monitoring system will be used to determine surface soil CO_2 flux.
- **Tracer Injection with CO_2.** Perfluorocarbon Tracers (PFT's) will be added at the wellhead and used to tag and track injected CO_2. Surface sweep monitoring using Praxair's SeeperTrace™ sample collection will be performed.
- **CO_2 Isotopes.** Isotopic sampling of surface CO_2 will be conducted using shallow (1 meter) boreholes.
- **Water Sampling.** Shallow water wells will be sampled on a quarterly basis for pH, salinity, metals, alkalinity, conductivity and temperature.
- **Base-line Monitoring.** Monitoring will be performed before, during, and after injection CO_2 injection for all MMV protocols.

Soil CO_2 Flux Monitoring Stations

- Permanent soil monitoring stations
- Near-well soil monitoring stations (will be affected by drilling/injection operations
- Soil monitoring stations within the drilling footprint (may be affected by drilling/injection operations)
- Control soil monitoring stations

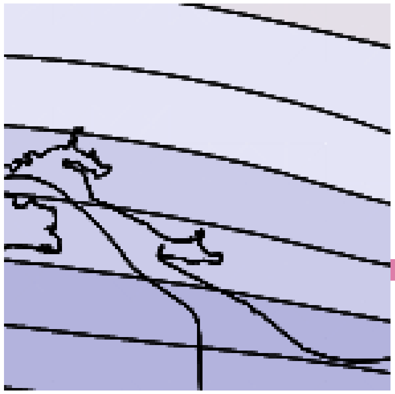
Soil Flux Baseline Monitoring



Deep Water Well Baseline Chemistry (Plant Daniel)

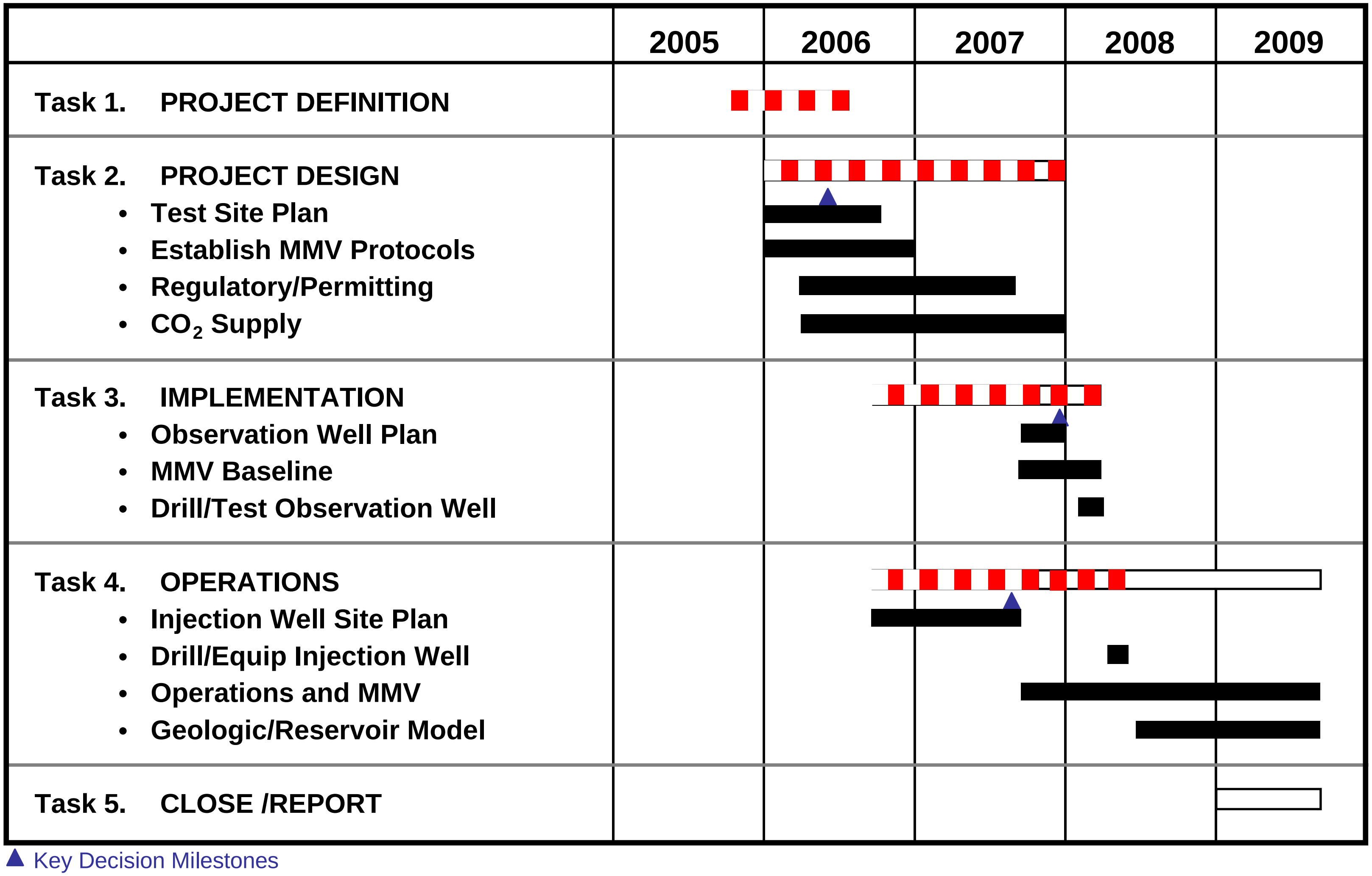
Analyte	Well #1	Well #2	Units
Classical Chemistry Parameters			
Bicarbonate Alkalinity	353	355	mg/L
Chloride	18	17	mg/L
Specific Conductance (EC)	651	657	umhos/cm
Silica (SiO2)	18.2	18.0	mg/L
Sulfate as SO4	4.07	2.80	mg/L
Metals			
Aluminum	0.050	ND	mg/L
Calcium	0.757	0.649	mg/L
Iron	ND	ND	mg/L
Magnesium	0.110	0.089	mg/L
Potassium	0.551	0.496	mg/L
Sodium	174	174	
Field Test			
pH	9.03	9.15	pH Units
Temperature	70.0	70.0	°F

ND = Not Detected



6. Project Schedule/Next Steps

Proposed Project Schedule



Next Steps (2008)

- Complete Core Analysis Laboratory Work (May)
- Complete VSP processing (May)
- Update Reservoir Modeling Work (May/June)
- Water Sampling, Pressure Transient Testing & MIT Testing in the Injection Well (June)
- Rig Up Injection Site and Test Equipment (late September)
- Begin Injection (October)
- Quick-look Report (October)
- Periodic Pulsed Neutron Logging (October)
- Revisit Reservoir Modeling Work (November/December)
- Time-lapse VSP (December)