



WESTCARB Phase II Kickoff

Geologic Storage Pilots

Sally Benson

Earth Sciences Division

Lawrence Berkeley National Laboratory

(510) 486-5875; smbenson@lbl.gov

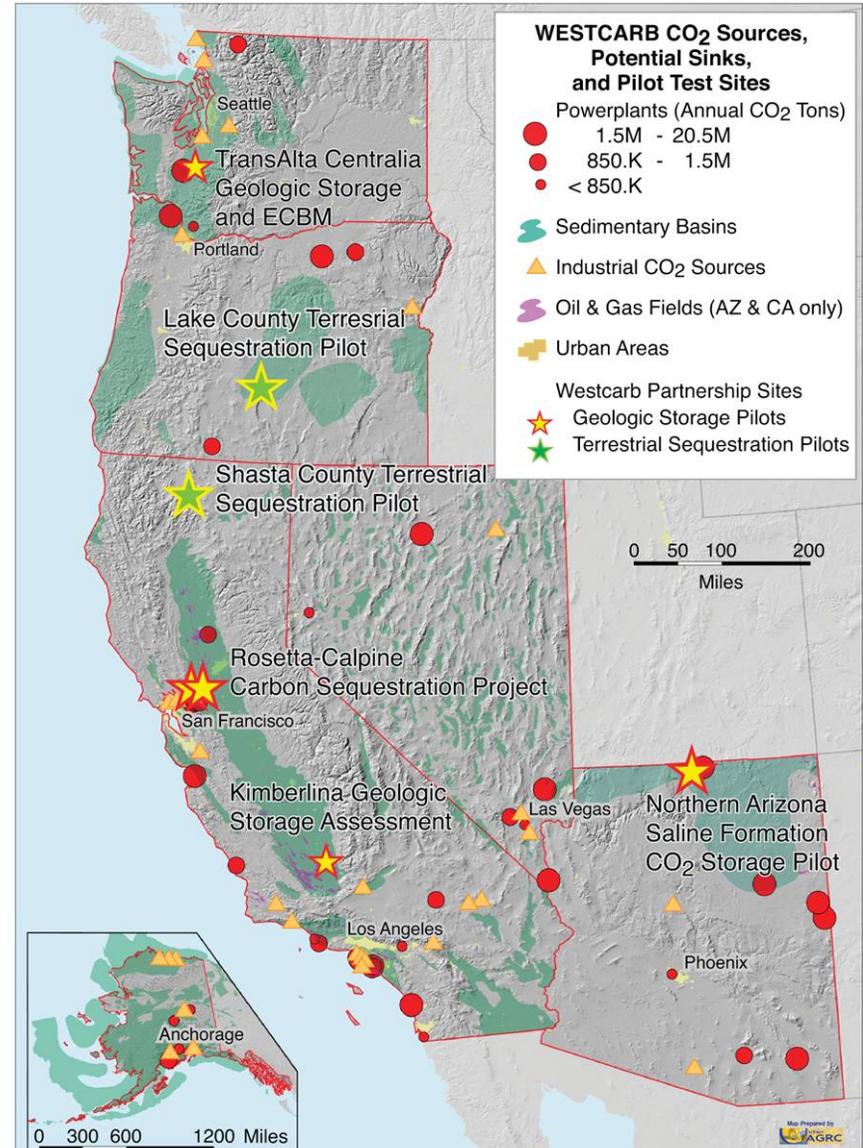
Berkeley, CA

November 8, 2005

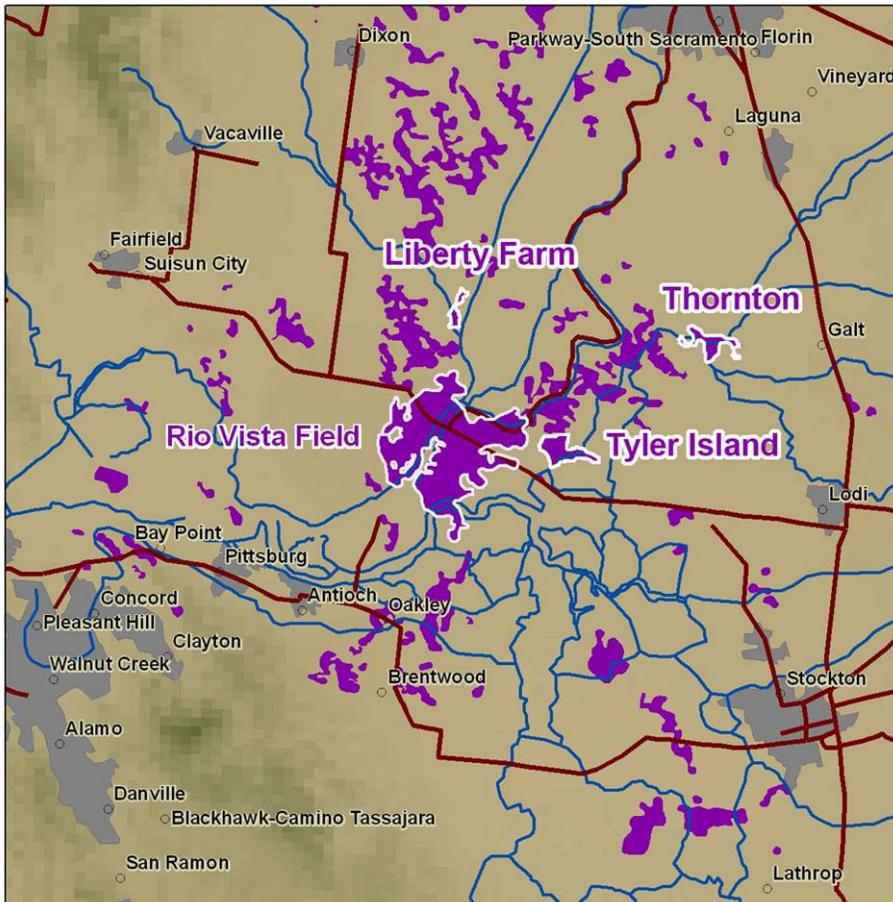


WESTCARB Geologic Storage Pilots

- Rosetta-Calpine Carbon Sequestration Project
- Northern Arizona Saline Formation CO₂ Storage Pilot
- Kimberlina Geologic Storage Assessment
- TransAlta Centralia Geologic Storage and ECBM Assessment



Rosetta-Calpine Carbon Sequestration Project



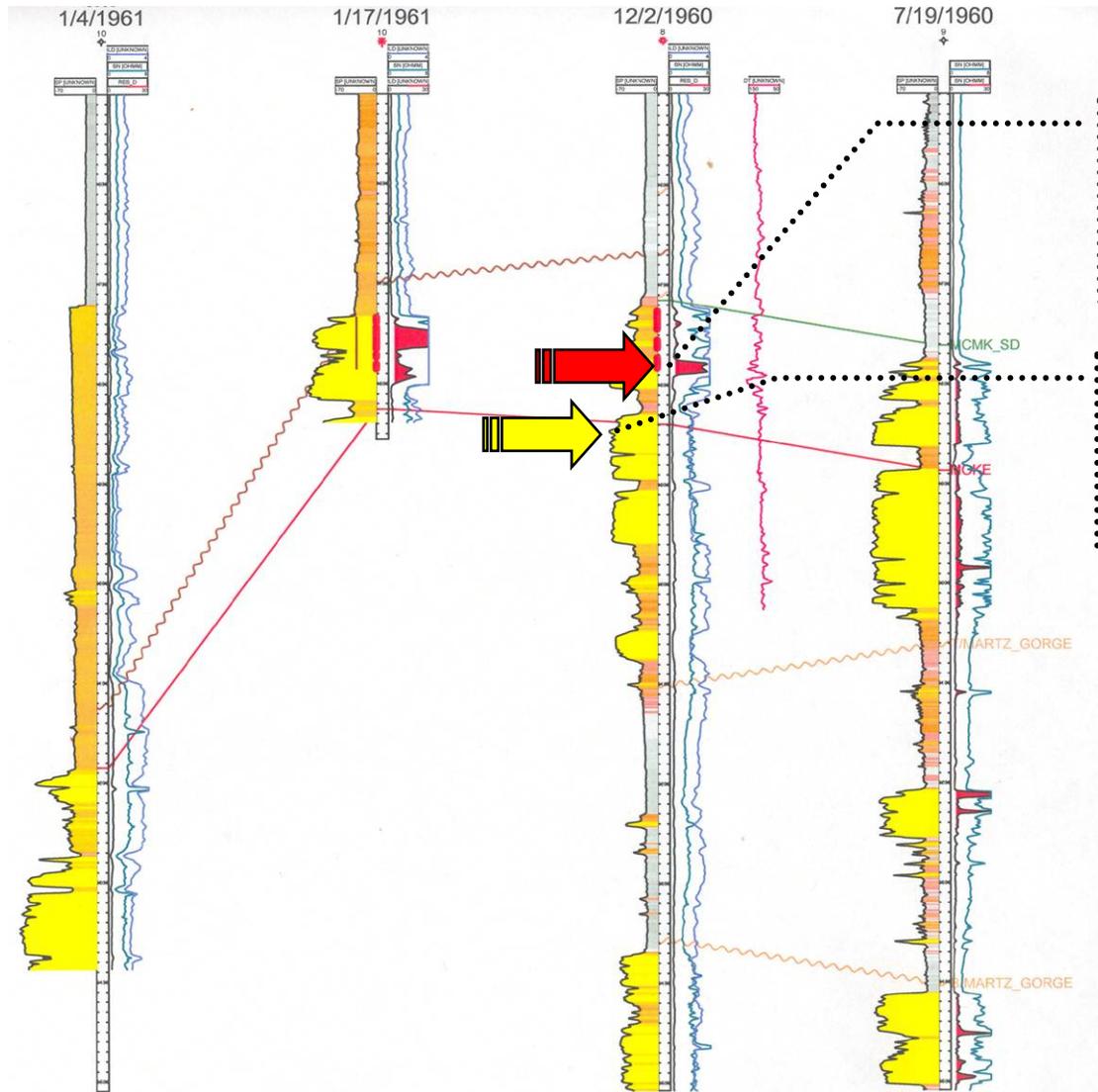
- 1.8 GtCO₂ storage capacity in depleted gas fields in Sacramento Valley (128 fields)
- Estimated 140-840 GtCO₂ storage capacity in saline formations in California based on ten largest basins

westcarb.org

WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP



Rosetta-Calpine: Geological Cross Section



Depleted gas and EGR pilot test (~2000 tonnes CO₂ injection)

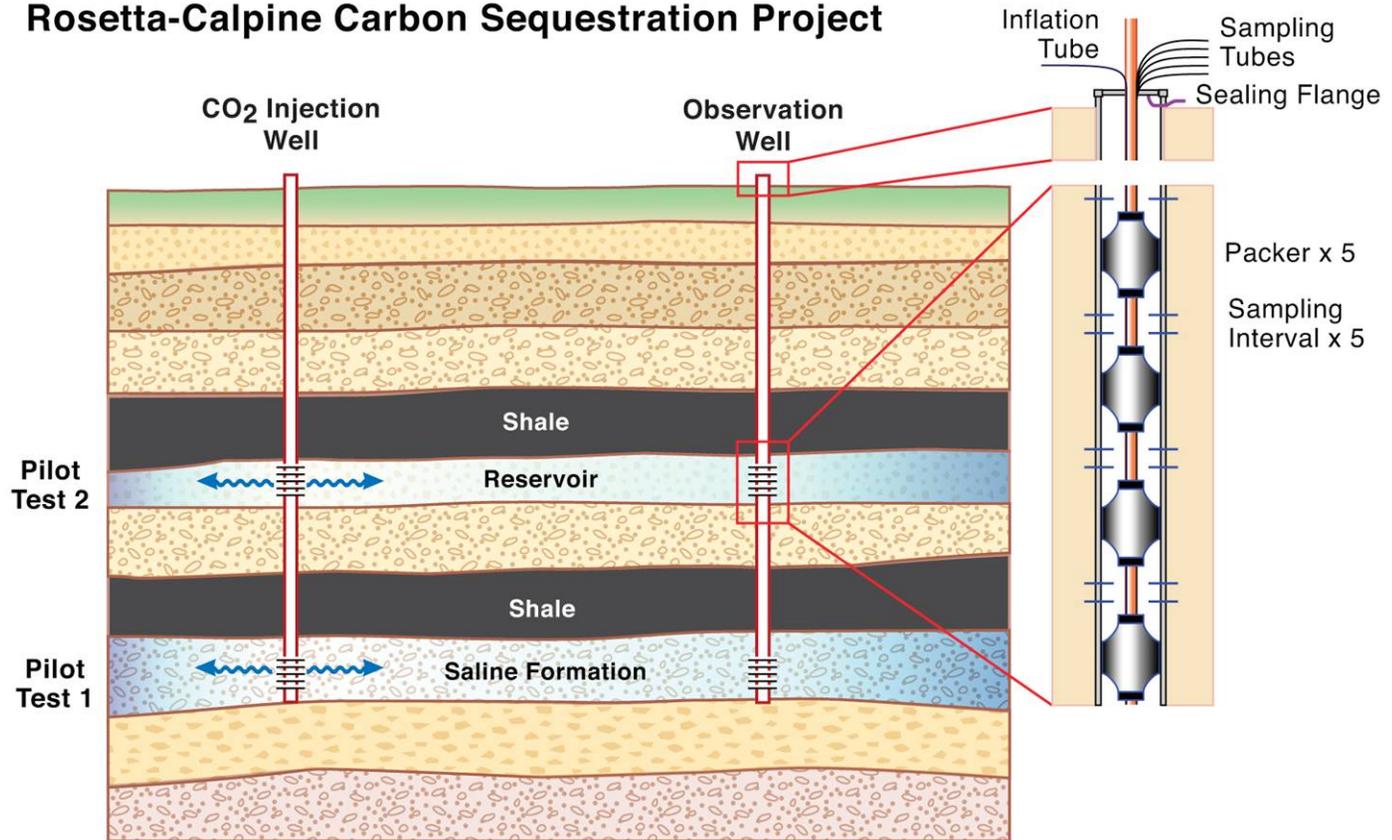
Saline formation pilot test (~2000 tonnes CO₂ injection)

*Compliments of
Rob Trautz, LBNL*

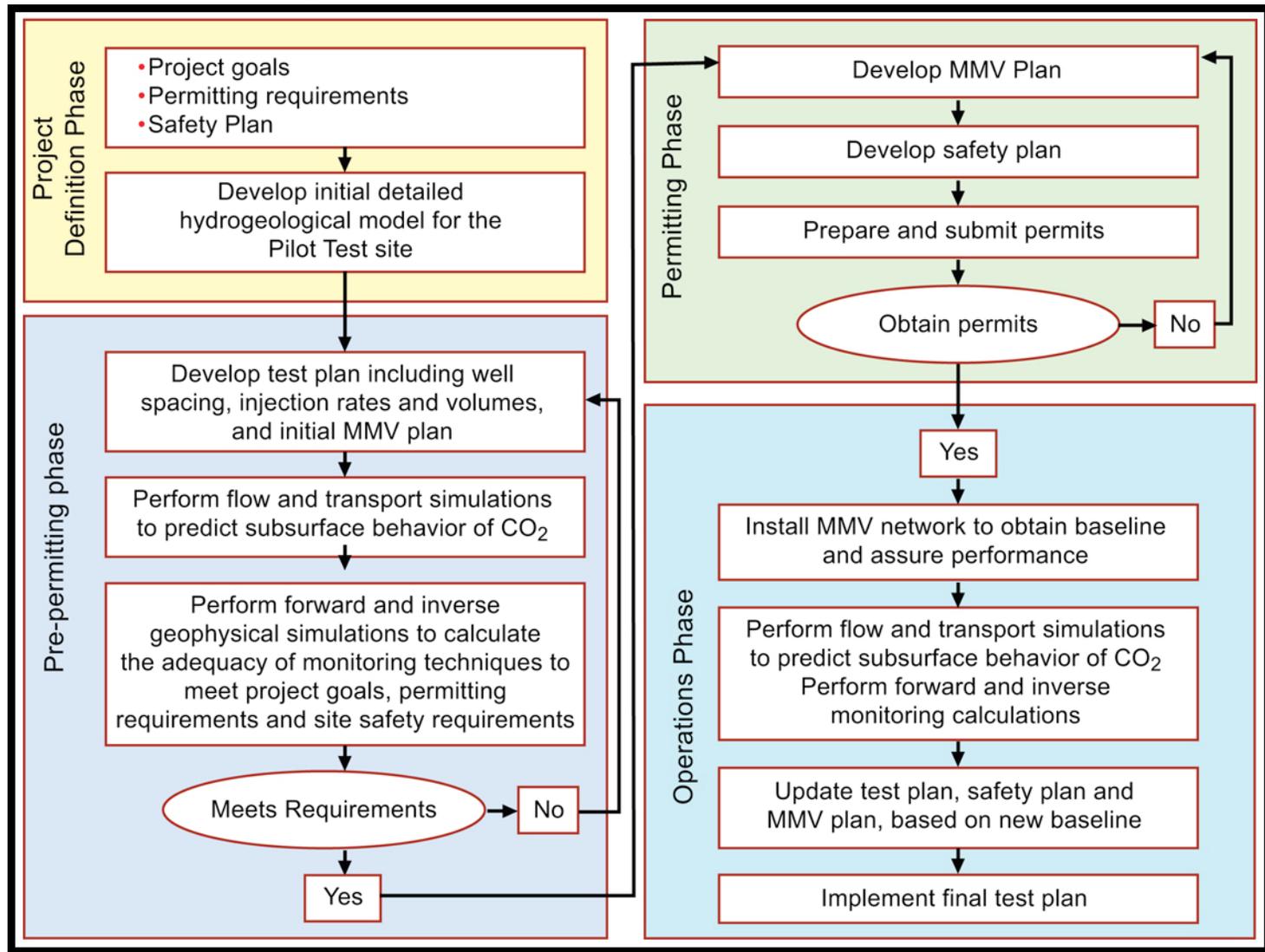
Rosetta-Calpine: Two-well Pilots

- Fluid and gas sampling
- Cross-well seismic
- VSP
- Reservoir pressure and temperature
- Well logs, including possible RST

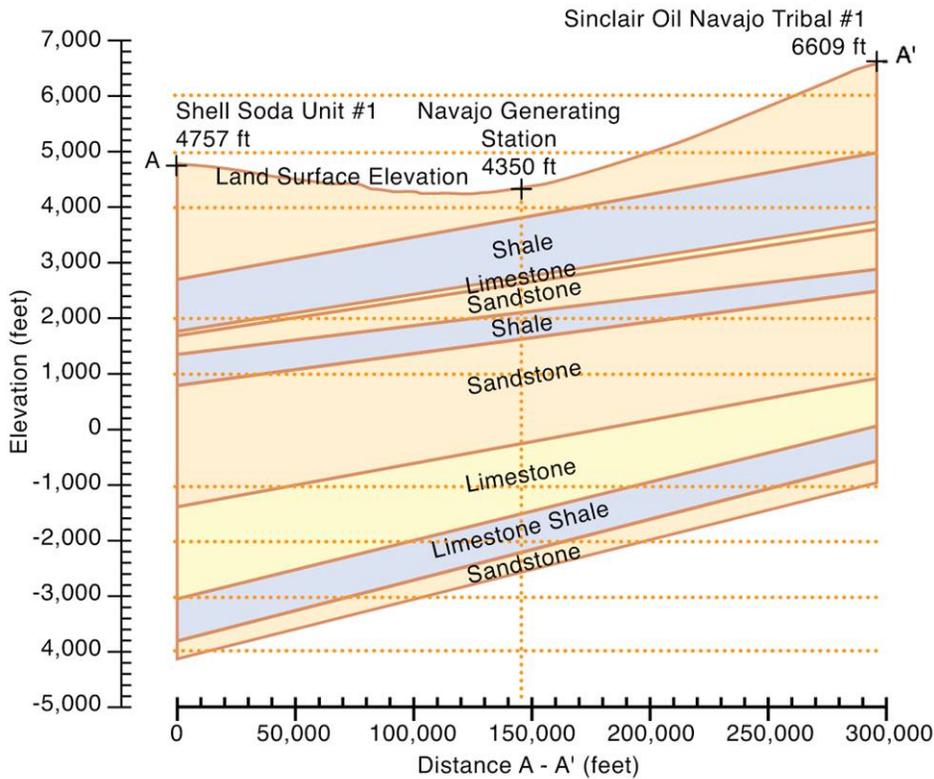
Rosetta-Calpine Carbon Sequestration Project



Rosetta-Calpine: Project Plan



Northern Arizona Saline Formation CO₂ Storage Pilot



North eastern Arizona

Large but uncharacterized storage capacity in the Colorado Plateau and basins of northern Arizona

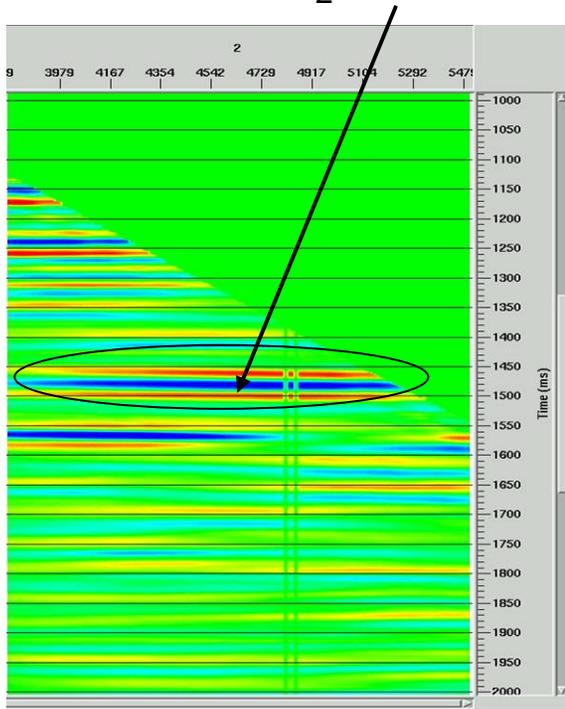


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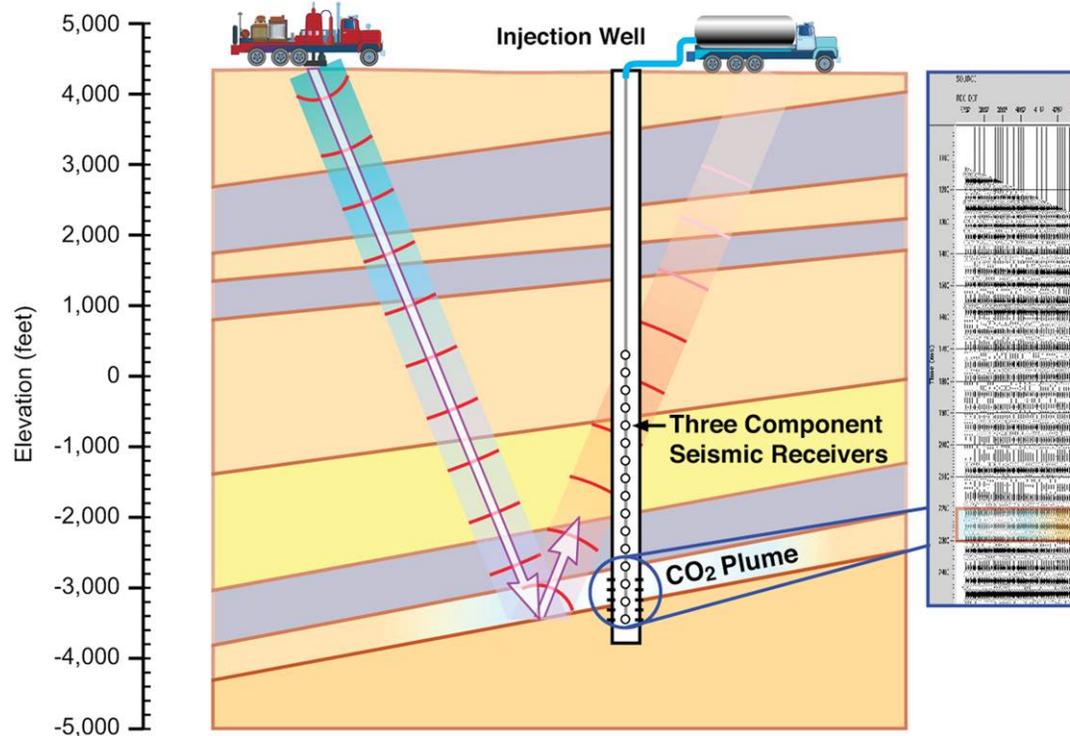
Northern Arizona Saline Formation CO₂ Storage Pilot

Reflection from 1600 tonne CO₂ plume



VSP Results from Frio Formation

Single well test plan



2000 tonne CO₂ injection

TransAlta Centralia Geologic Storage and ECBM Assessment



Centralia Generating Station



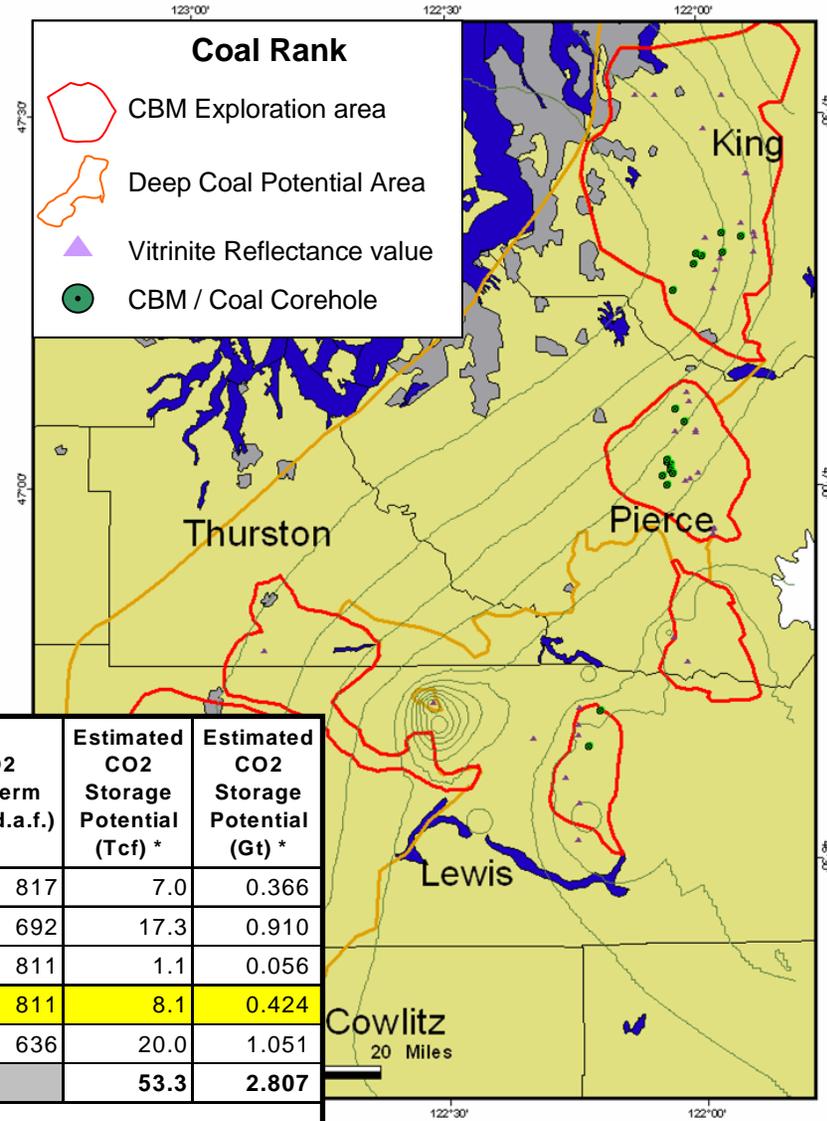
Assess ECBM and storage potential



Coal bed

Puget, WA Deep Coals Could be Sink for Centralia Plant

- Favorable coal rank: sub-bituminous in the W to anthracite in E
- El Paso Production pilot tested 5 md permeability in coals



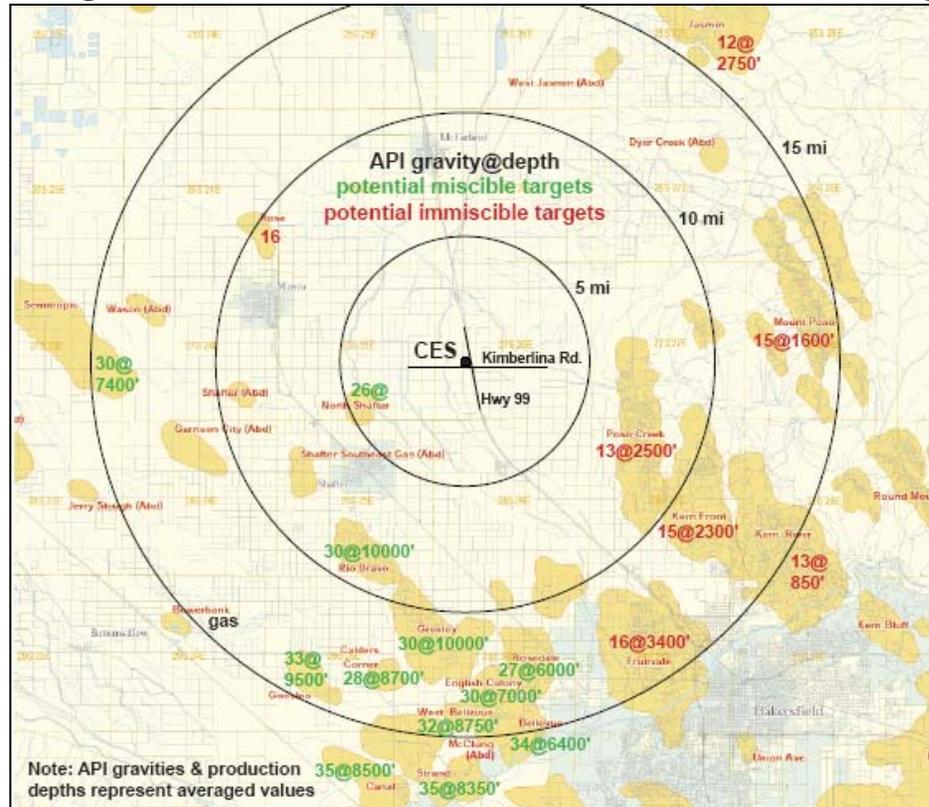
Sub-Basin	Area (sq mi)	Avg Coal Thickness (ft)	Ash + Moisture (%)	Net Coal Tonnage (million tonnes)	Avg Depth (ft)	CO2 Isotherm (scf/t d.a.f.)	Estimated CO2 Storage Potential (Tcf) *	Estimated CO2 Storage Potential (Gt) *
Carbonado	125	130	57%	8,513	1,691	817	7.0	0.366
Black Diamond	466	110	60%	24,979	1,550	692	17.3	0.910
Storm King	57	65	71%	1,309	1,860	811	1.1	0.056
Centralia	209	100	61%	9,930	1,860	811	8.1	0.424
Rest of Puget Region	1,777	50	71%	31,391	1,500	636	20.0	1.051
Totals	2,634			76,122			53.3	2.807

* Represents TOTAL available potential for each region; actual Stored volume would be significantly less (~15-50%)

Kimberlina: Assess Storage and EOR Opportunities

Image from Lawrence Livermore National Laboratory

Freeman Shale	8000
Vedder Sandstone	8500
Kreyenhagen and Turney Shales	9000
Domengine Sandstone	9500
Tule River Shale	10000
	10500
	11000
Mushrush Sandstone	11500
	12000
Basement	12500



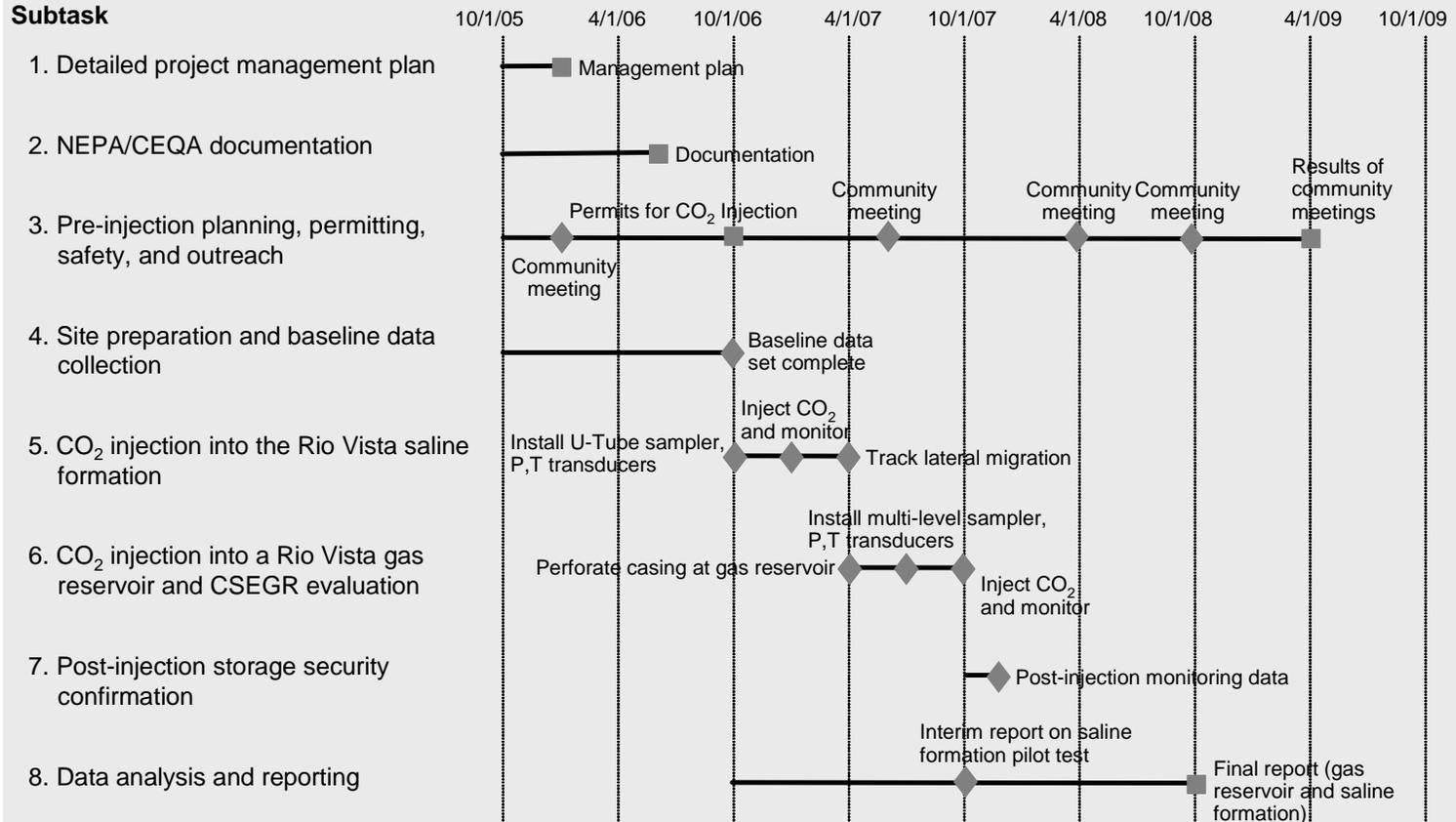
- 3.4 GtCO₂ storage capacity in 121 oil fields in California
- Potential for 5.4 billion barrels of oil production with CO₂-EOR in California

DOE Roadmap Goals for Geological Storage of CO₂ and WESTCARB Contributions

Storage Security and Permanence	Storage Capacity and Optimization	Measurement Mitigation and Verification
<ul style="list-style-type: none"> ■ Demonstrate safe and secure storage in a depleting gas reservoir ■ Demonstrate safe and secure injection into 2 saline formations ■ Improve understanding and modeling of multi-phase flow and residual gas trapping in a saline formation ■ Improve understanding and modeling of solubility trapping ■ Predict mineral trapping rates and quantities in two different geologic settings 	<ul style="list-style-type: none"> ■ Perform the first ever test of CO₂-EGR in a natural gas reservoir ■ Improve understanding and modeling of CO₂ storage capacity in heterogeneous high permeability sandstones ■ Improve understanding and modeling of storage capacity in lower permeability, highly consolidated sandstones ■ Develop methods for predicting storage capacity in depleting gas reservoirs ■ Improve capacity estimation methodology by history matching the injection pilots 	<ul style="list-style-type: none"> ■ Develop methods for monitoring CO₂ storage in gas reservoirs ■ Test methods for monitoring permeability changes due to CO₂ injection ■ Enhance and demonstrate the utility of VSP for monitoring CO₂ mitigation from single-well pilot tests ■ Demonstrate and refine the use of cross-well seismic monitoring to achieve high resolution images of CO₂ migration ■ Demonstrate and expand the utility of down-hole pressure measurements for monitoring CO₂ injection operations

Phase II, Task II

TASK 2: RIO VISTA (CA) SALINE FORMATION AND GAS RESERVOIR CO₂ STORAGE PILOTS

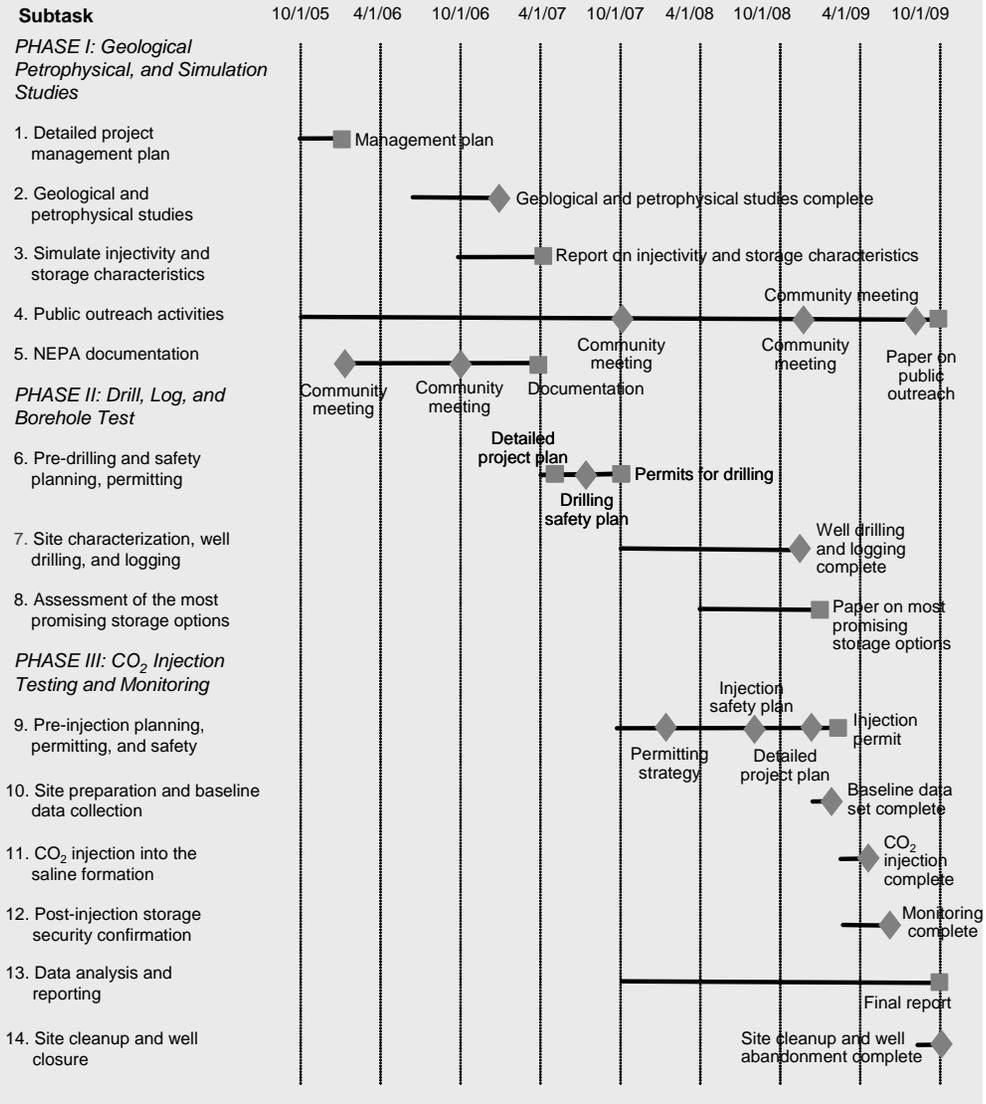


Key: ◆ Subtask Milestone
 ■ Subtask Deliverable



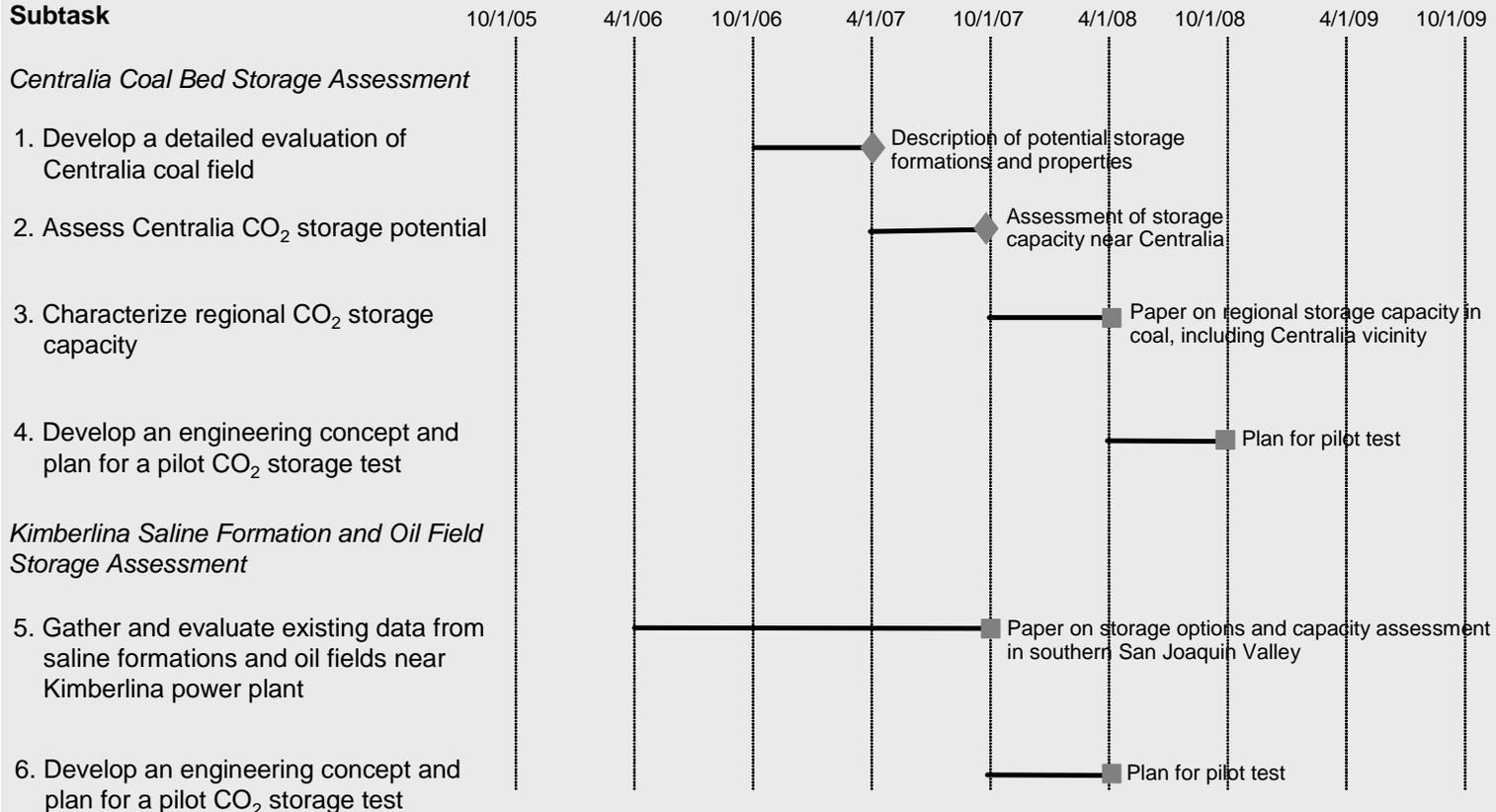
Phase II, Task III

TASK 3: NORTHERN ARIZONA SALINE FORMATION CO₂ STORAGE PILOT



Phase II, Task IV

TASK 4: INVESTIGATIONS FOR ADDITIONAL CO₂ STORAGE PILOTS (CENTRALIA COAL BED AND KIMBERLINA SALINE FORMATION AND OIL FIELD CO₂ STORAGE PILOTS)



Key: ◆ Subtask Milestone
 ■ Subtask Deliverable