

**Energy Research and Development Division  
FINAL PROJECT REPORT**

**RESERVOIR CONFIRMATION OF THE  
BUCKEYE POWER PLANT AREA**

**Wildhorse State 36 Confirmation Well,  
Northwest Geysers**

**Appendix B**

Prepared for: California Energy Commission

Prepared by: Geysers Power Company, LLC ("Calpine")



MARCH 2011  
CEC-500-2013-APB

***Prepared by:***

***Primary Authors:***

Joe Beall, Ph.D.

Mark Walters, PG #3344

Geysers Power Company, LLC  
10350 Socrates Mine Road  
Middletown, CA 94561  
707-431-6000

***Grant Number: GEO-07-006***

***Prepared for:***

**California Energy Commission**

Gail Wiggett, Ph.D.

***Project Manager***

Linda Spiegel

***Office Manager***

***Energy Generation Research Office***

Laurie ten Hope

***Deputy Director***

***ENERGY RESOURCE DEVELOPMENT DIVISION***

Robert P. Oglesby

***Executive Director***

**DISCLAIMER**

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

## **ACKNOWLEDGEMENTS**

Marc Steffen, Drilling Manager, Geysers Power Company  
Richard Lemon, Drilling Supervisor, Geysers Power Company  
Clarence Reams, Drilling Supervisor, Geysers Power Company  
Bruce Carlson, Safety, Health and Environment Manager, Geysers Power Company  
Melinda Wright, Geologist/Geochemist, Geysers Power Company  
Julio Garcia, Reservoir Engineer, Geysers Power Company  
Bob Young, Wireline Supervisor, Geysers Power Company  
Keshav Goyal, Reservoir Engineer, Geysers Power Company  
Ron Donnelly, Drilling Consultant  
Russ Silva, Drilling Consultant  
Keith Powers, Drilling Consultant  
Gail Wiggett, California Energy Commission

## PREFACE

The California Energy Commission Energy Research and Development Division supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The Energy Research and Development Division conducts public interest research, development, and demonstration (RD&D) projects to benefit California.

The Energy Research and Development Division strives to conduct the most promising public interest energy research by partnering with RD&D entities, including individuals, businesses, utilities, and public or private research institutions.

Energy Research and Development Division funding efforts are focused on the following RD&D program areas:

- Buildings End-Use Energy Efficiency
- Energy Innovations Small Grants
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy Technologies
- Transportation

*Reservoir Confirmation of the Buckeye Power Plant Area, Wildhorse State 36 Confirmation Well, Northwest Geysers* is the final report for the Wildhorse State 36 Confirmation Well Project (Grant Award Number GEO-07-006) conducted by Geysers Power Company (“Calpine”). The information from this project contributes to Energy Research and Development Division’s Resource Assessment Studies.

For more information about the Energy Research and Development Division, please visit the Energy Commission’s website at [www.energy.ca.gov/research/](http://www.energy.ca.gov/research/) or contact the Energy Commission at 916-327-1551.

## ABSTRACT

The Wildhorse State 36 well was drilled as one of three wells needed to confirm financing of a proposed new 33 megawatt Buckeye Power Plant in the northwest area of The Geysers geothermal field in Sonoma County, California. The project was co-funded by the California Energy Commission. Wildhorse State 36 was drilled, completed and tested between October 2009 and December 2010. The well was drilled to a depth of 12,340 feet at a cost of about \$7.5 million.

A resource was found but proved insufficient to justify constructing a new generator in the Buckeye Power Plant area. The power density estimated in previous studies and the hypothesis that the Buckeye area exists in a separate structural zone or “compartment” isolating it from nearby areas were not confirmed. Testing results showed that the Wildhorse State 36 well may have the capacity to produce less than 1.5 megawatts of equivalent steam. This does not justify investing in the new deep wells that would be needed to support construction of a new generator. Wildhorse State 36 was completed as an injector well but cannot serve as an injector in an enhanced geothermal system because it was drilled through a deep high temperature reservoir into a lower temperature zone. Steam from the well could be collected and piped to existing power plants. The geochemical, temperature, rock type, geologic structure, and isotope data gained from the tests and analyses on this well and other nearby wells will be valuable in planning future exploration in the northern part of The Geysers.

**Keywords:** California Energy Commission, geothermal, The Geysers, northwest Geysers, geology, geochemistry, isotopes, well test, exploration, Geysers development, reservoir compartmentalization.

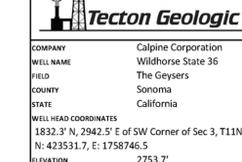
Please use the following citation for this report:

Beall, J.J. and Walters, M.A. (Geysers Power Company, LLC), 2011, *Reservoir Confirmation of the Buckeye Power Plant Area: Wildhorse State 36 Confirmation Well*. California Energy Commission. Publication number: CEC-500-2013-076-APB.

# TABLE OF CONTENTS

Acknowledgements .....	i
PREFACE .....	ii
ABSTRACT .....	iii
TABLE OF CONTENTS.....	iv
APPENDIX B: Tecton Geologic Log.....	B-1

**APPENDIX B:  
Tecton Geologic Log**



**COMPANY** Calpine Corporation  
**WELL NAME** Wildhorse State 36  
**FIELD** The Geysers  
**COUNTY** Sonoma  
**STATE** California  
**WELL HEAD COORDINATES** N 1832.3' N, 2945.5' E of SW Corner of Sec 3, T11N, R9W  
**ELEVATION** 2753.7'  
**IN - DAY DATE START DATE** 10/19/2009  
**TO DATE** 1/27/2010  
**TOTAL DEPTH** 12340'  
**TRUE VERTICAL DEPTH** 11259'  
**LOG SCALE** 3151.4' S and 1468.0' E of  
**Wellhead**  
**Drilling Contractor** Thermasource  
**Company Representatives** Logan, Silva  
**LOG INTERVAL**  
**DATE LOGGED** 10/19/09 TO 1/7/10  
**MUD LOGGED** 10/19/09 TO 12340'  
**MUD DRILLING** 3188' TO 3188'  
**AIR DRILLING** 3188' TO 12340'  
**LOGS W/O** 1:720  
**JOINT NO.** C23  
**LOGGING GEOLOGISTS**  
 Dick Dunlap (DD), Patrick Broderick (PB), Andrew Schefflin (AS), Eric ter Weele (ET), Charley Wahl (CW), Matt Lamont (ML), Jon Pollard (JP), Dan Bida (DB)

**HOLE**  
 26° TO 606'  
 17.5° TO 3188'  
 10.625° TO 10123'  
 8.5° TO 12340'

**CASING**  
 20" FROM 0 TO 602'  
 FROM 0 TO 3177'  
**LINER**  
 7" FROM 0 TO 2984'  
 FROM 0 TO 2987'  
 FROM 0 TO 2335'

**ABBREVIATIONS**  
 NB New Bit BHT Bottoms Hole Temp  
 RB Re-run Bit c Carbide Test  
 CB Core Bit No Returns  
 WS Weight on Bit Logged After Trip  
 SPM Strokes per Minute Cubic Feet per Min  
 RPM Pump Pressure Bottoms Up Temp  
 MPM Revolutions per Min

**LITHOLOGY**  
 Argillite Siliceous Graywacke  
 Chert Metamorphic Ultramafic  
 Siltstone Meak Ultramafic  
 Greenstone Strong Foliation  
 Serpentine Marginal Alteration  
 Blueschist Pervasive Alteration  
 Clay Weakly Hornfelsic  
 Lithic Graywacke Strongly Hornfelsic  
 Argillaceous Graywacke

**SYMBOLS**  
 Wireline Log Casing Shoe  
 Mud Motor and Venturi  
 Deviation Survey Core Interval  
 No Recovery

**REMARKS**  
 All depths  
 KB = 28'  
 Steam Entries  
 Water Entries  
 4669' 3rd 05th  
 6588' 4th 13th  
 8258' 10th 21st  
 9285' 14th 08th  
 9311' 10th 08th  
 9336' 8th 16th  
 9483' 26th 16th  
 10073' 14th 08th  
 10970' 5th 05th  
 11967' 4th 4th

**SECONDARY MINERALS**  
 Q = Quartz  
 C = Calcite  
 F = Ferrous  
 E = Epithermal  
 P = Pyrite  
 M = Magnetite  
 Ch = Chlorite  
 A = Actinolite  
 T = Tourmaline

