Fairbanks Geothermal Energy Project

Project Officer: Eric Hass

Total Project Funding: $1,000,000

April 22, 2013

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Presenter – Bernie Karl

Chena Hot Springs Resort

Track 1

Relevance/Impact of Research

Fairbanks North Star Borough Project Goals

- –Provide base-load energy source for community
- –Decrease PM 2.5 and greenhouse gas emissions within Borough
- –Develop a better model of the reservoir

Chena Hot Springs Resort submitted a proposal that was selected in a competitive bidding process by the Fairbanks North Star Borough

- –Chena Hot Springs Resort submitted a proposal designed to increase the geothermal production from the reservoir
- –Proposal addressed issues with water re-injection
- –Proposal issues with addressed cold water infiltration into production well as well as accessing warmer water

Relevance/Impact of Research

Project Description

- Deepen production well (TG8) from 1020ft to 2500ft
- Deepen re-injection well (#2) from 800ft to 2700ft
- Seeking higher temperature, previously 173°F, and larger volume of production water
- Seeking to re-inject larger volume into higher temperature fractures
- Update reservoir model after drilling is complete
- Information from project could contribute to the development of similar Interior Alaskan geothermal resources
- Project to increase low temperature geothermal capacity of Chena Hot Springs Resort
- Wells to provide information to update reservoir model of Chena Hot Springs Resort

Relevance/Impact of Research

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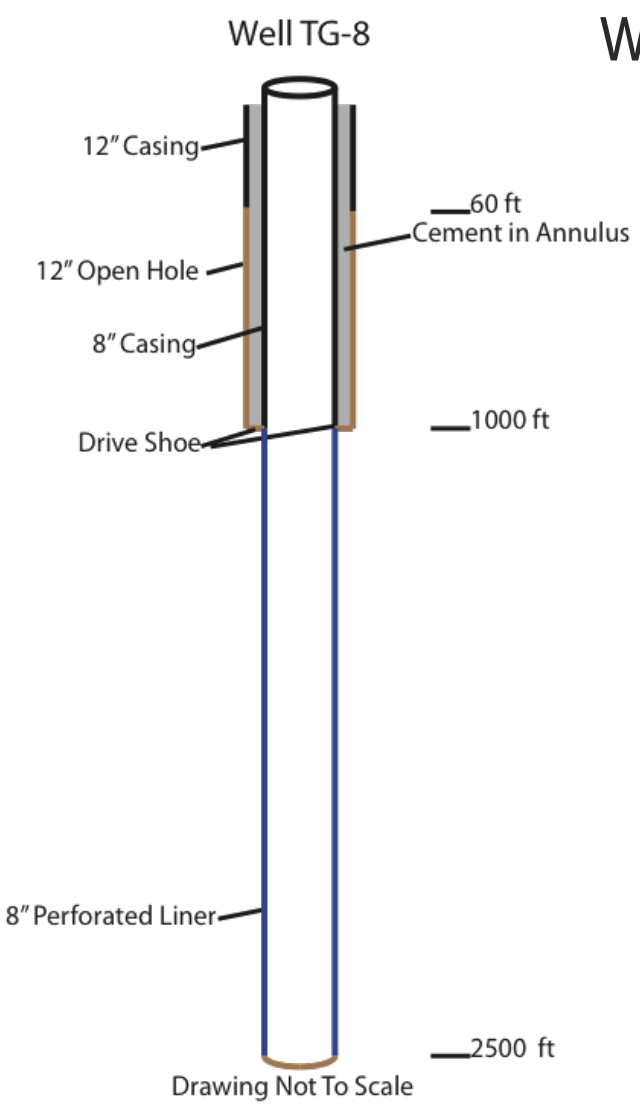
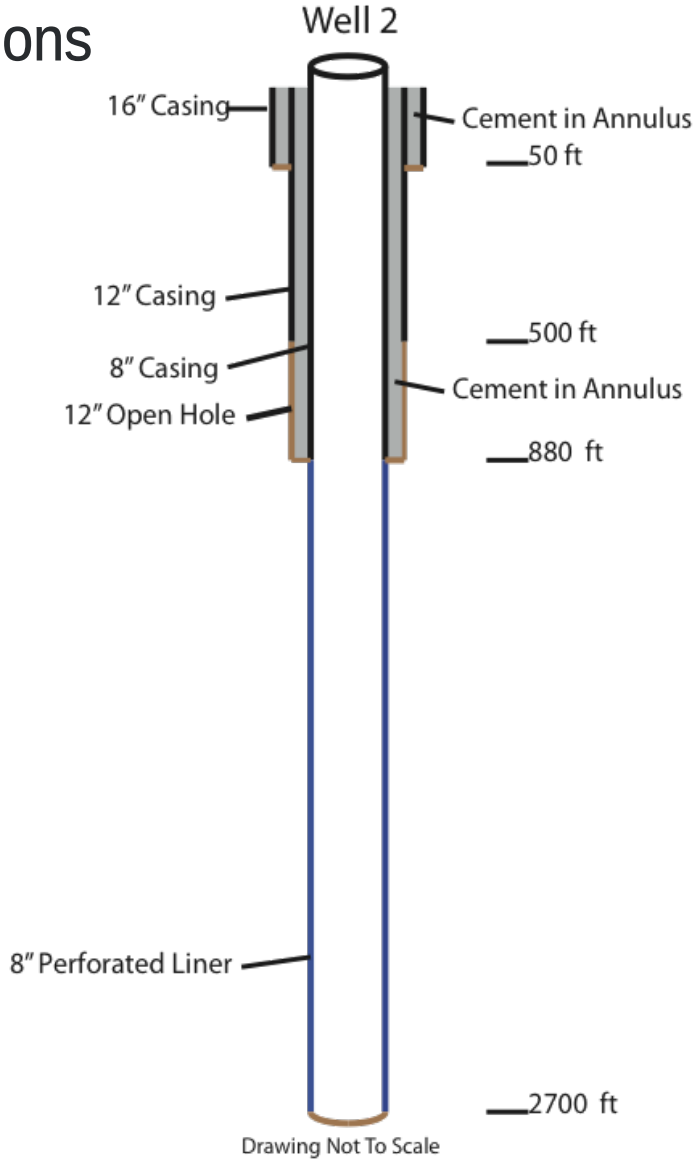
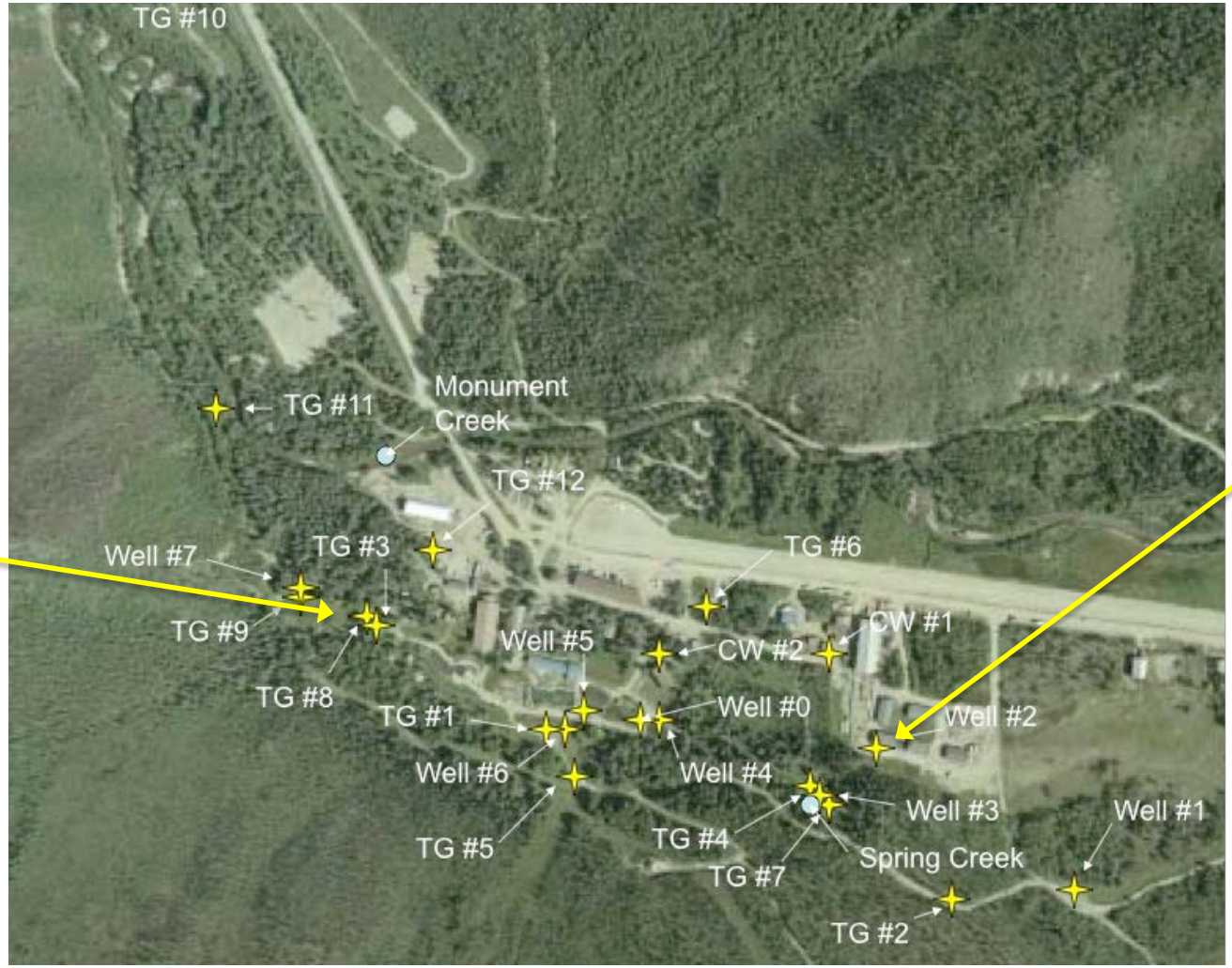
Well Illustrations





Scientific/Technical Approach

Production Well
TG-8



Re-injection Well
Well #2

TG – Temperature Gradient
CW – Cold Water

Scientific/Technical Approach

- Elected to re-drill wells that previous reservoir model indicated a high probability of reaching warmer reservoir
- TG-8 was the warmest well at 167°F and well temperature would increase when pumping water into nearby wells
- Well 2 is on the opposite side of the reservoir from production wells making it ideal location to re-inject water leaving the power plant
- Currently re-inject through well 1 and well TG-7, both wells are in cooler formations than re-injection water
- Temperature of well 2 didn't level off at greater depths indicating a potential to access higher temperatures
- Deeper re-injection well would allow a higher volume of water to enter a warmer fracture
- Had to plan around drilling in cold temperatures, also used temporary enclosures to extend drilling into winter
- Chena Hot Springs Resort is hospitality driven so drilling occurred during hours to result in minimal guest disturbance
- Use of water hammer with button bit to replace drilling with try-cone bit that only achieved 1ft/hr

Accomplishments, Results and Progress

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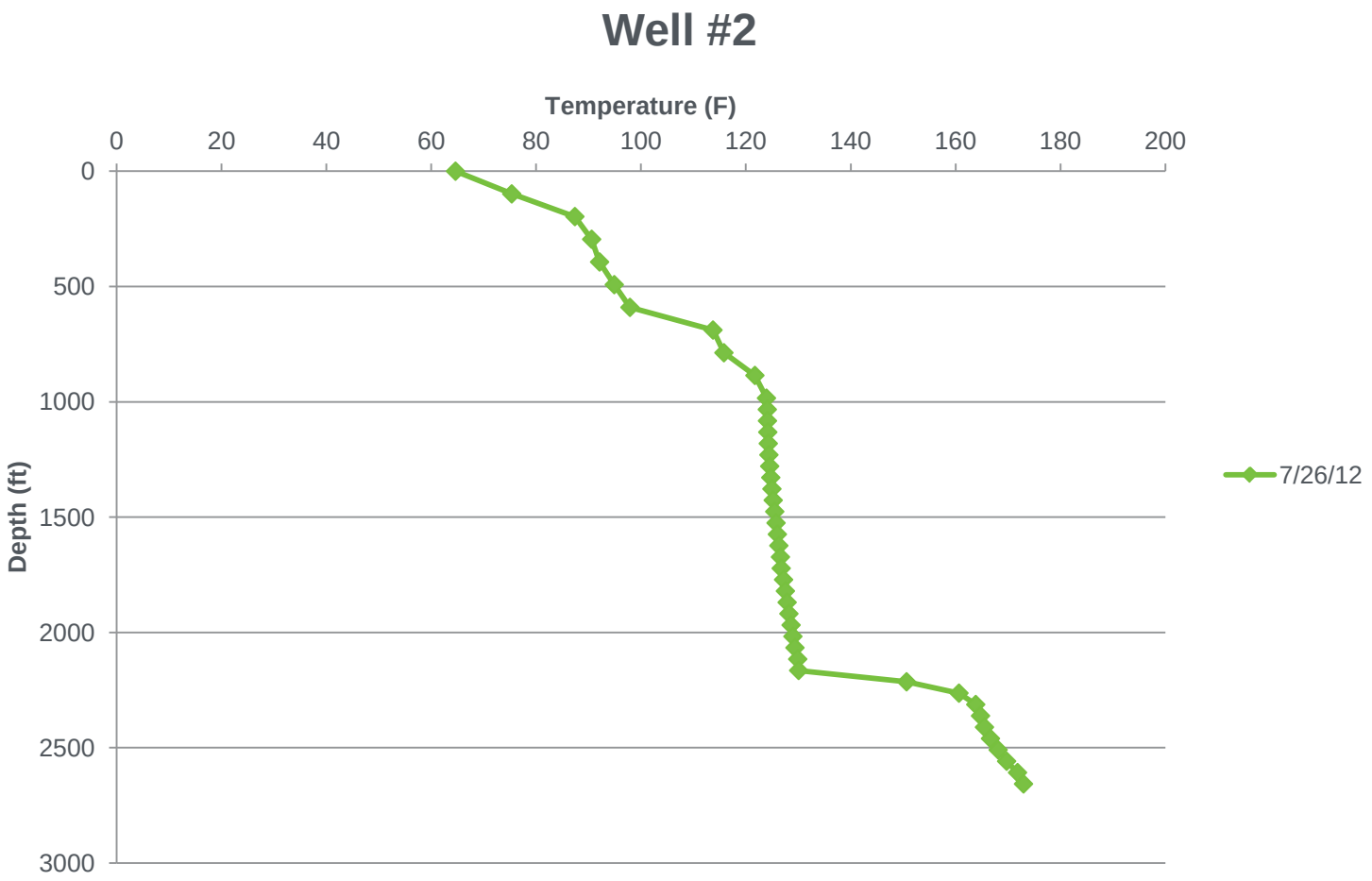
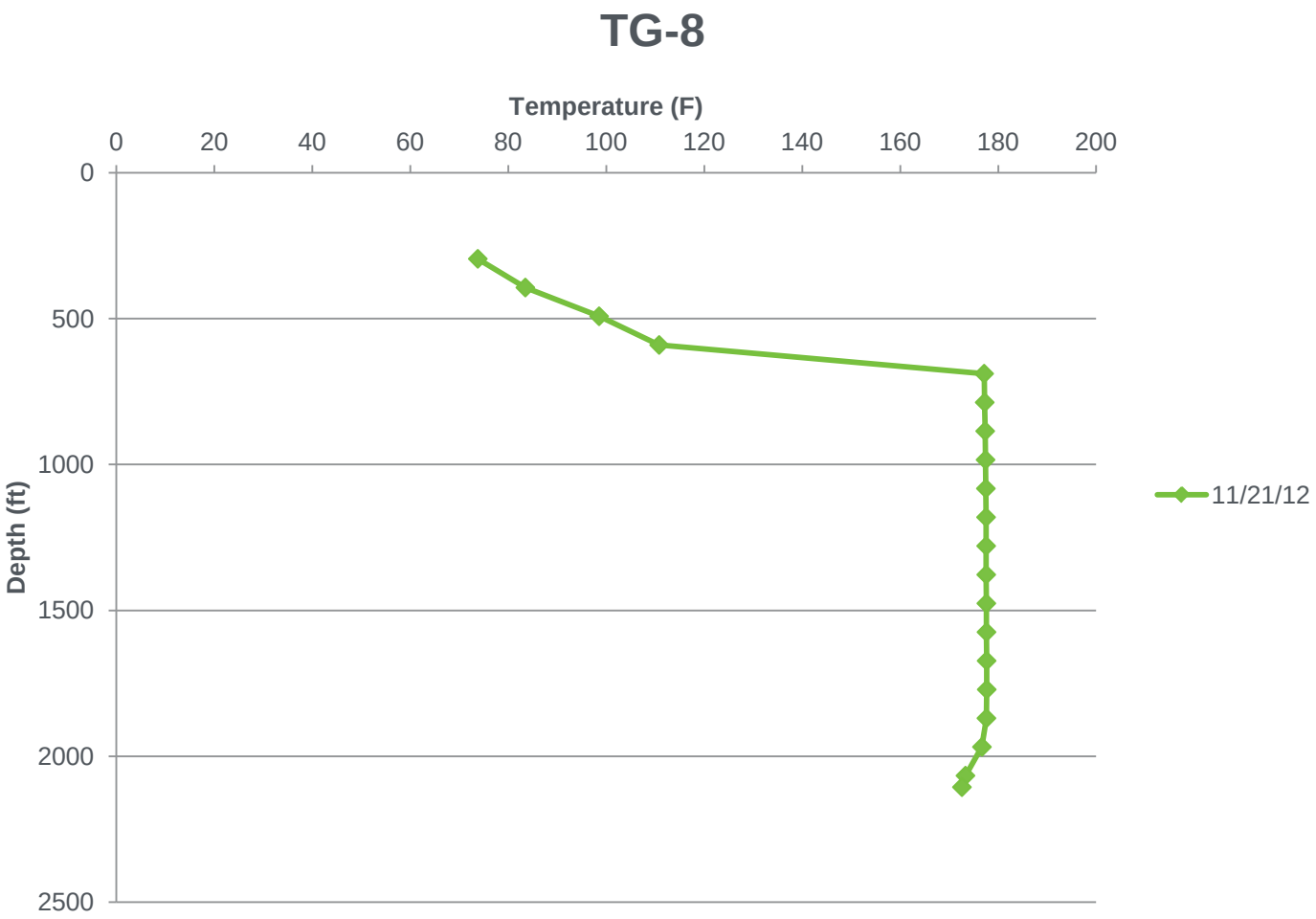
- Accomplishments/Progress to date.
  - Completed drilling 2700ft re-injection well
    - Well is cased and cemented
    - 173°F water at 2700ft
  - Completed drilling 2500ft production well
    - >177°F water temperature from 800-1900ft
    - Well will be cased and cemented by the end of March
    - Flow tested well at 550gpm with 20ft draw down
  - Greatest challenge was extreme cold temperatures during drilling
  - Install flow meters during spring
  - Complete reservoir model by May 2013

Original Planned Milestone/ Technical Accomplishment	Actual Milestone/Technical Accomplishment	Date Completed
Complete 2700ft re-injection well	Well completed as planned	11/2012
Complete 2500ft production well	Well drilled, casing cemented in by 3/31/12	
Refine reservoir model	Modeling can commence 4/1/12	

Temperature Profile of Re-injection Well



Temperature Profile of Production Well



Future Directions

- Complete Production well
  - Cement in casing
  - Install well pump
  - Tie in well to existing resort piping
- Complete update to reservoir model
  - Install flow meters for production wells
  - Assess energy being drawn from reservoir
  - Measure flows being produced and re-injected into each well
- Increase electrical production capacities depending on well performances
  - Recently purchased Kaishan screw expander ORC to be installed
  - Reduce the use of diesel to generate electricity, thereby decreasing PM 2.5 and greenhouse gas emissions
  - Provide possible base-load energy source for community

Milestone	Status & Expected Completion Date
Cement in casing for production well	Expected to be completed by 3/31/13
Complete reservoir modeling	To be completed by 5/31/13

Summary

- Deepened production well to 2500ft and successfully increased the temperature of the well from 172°F to 177°F
- Large zone (~1000ft) of high temperature water likely resulting in increase production volume
- Deepened re-injection well to 2700ft with a bottom temperature of 173°F
- Increase water flow to be directly re-injected into geothermal reservoir
- Reservoir model to be completed by project end date of 5-31-13
- Expected increase in low temperature geothermal capacity of power plant at Chena Hot Springs Resort
- Results of new production and re-injection wells will likely lead to higher electrical generation capacity
- 20ft/hr drilling by use of water hammer was effective method of drilling with water instead of drilling mud

Project Management

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- Project date was extended from 12/31/12 to 5/31/13 due to cold weather delays

Timeline:

Planned Start Date	Planned End Date	Actual Start Date	Current End Date
9/1/11	12/31/12	9/1/11	5/31/13

Budget:

Federal Share	Cost Share	Planned Expenses to Date	Actual Expenses to Date	Value of Work Completed to Date	Funding needed to Complete Work
$1,000,000	$1,000,000	$1,553,886	$1,553,886	$1,553,886	$446,114

- Fairbanks North Star Borough is project contractor
  - ~$90,000 allocated towards project management
  - Majority of funds used for direct drilling and material costs
  - Small portion allocated towards completing reservoir model
- Chena Hot Springs Resort is primary sub-contractor
- Arctic Drilling contracted to do construction work on both wells
- Project extended to 5/31/13 and is on schedule to meet end date