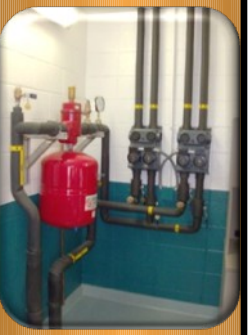


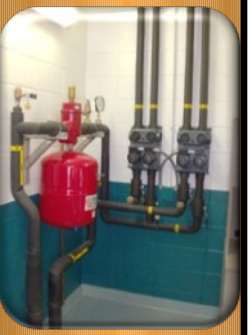
Geothermal (Heat Pump) Systems for Heating and Cooling

WWOA Annual Conference

October 21, 2010

Douglas Nelson, PE

Greg Moser, Utilities Superintendant



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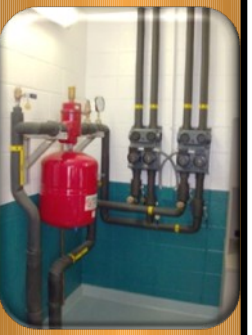
Outline

- Introductions
- Overview of Geothermal Heat Pumps
  - Air Source
  - Ground Source
    - Open
    - Closed-horizontal
    - Closed-Vertical
  - System Components
- Why Geothermal?
  - General Advantages
  - Why in Slinger?
- Results



Introduction

- Greg and Doug
- **ge·o·ther·mal**

  [jee-oh-thur-muhl]
  - adjective
  - of or pertaining to the internal heat of the earth.

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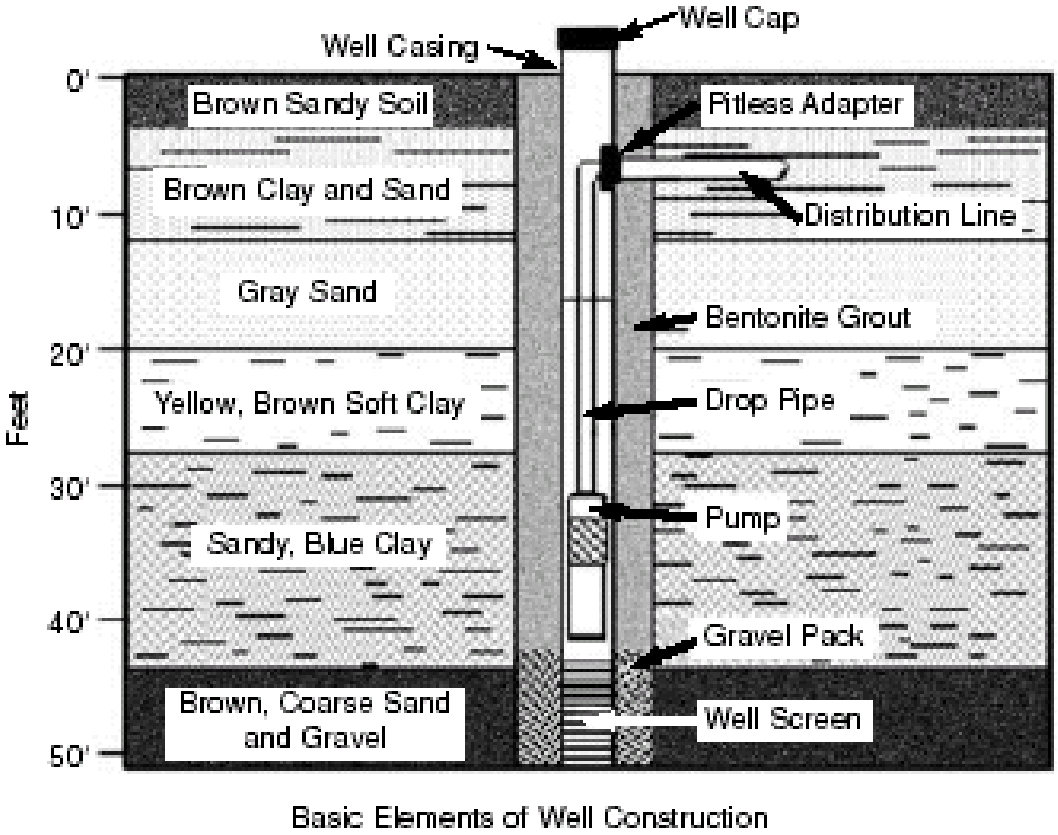
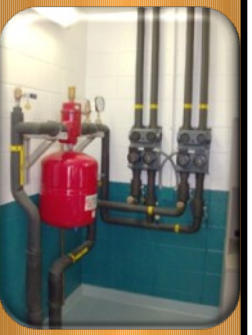
Overview



Basic Elements of Well Construction



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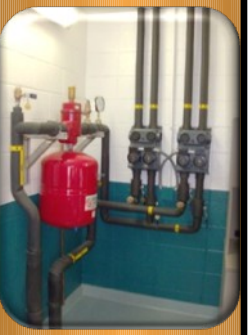

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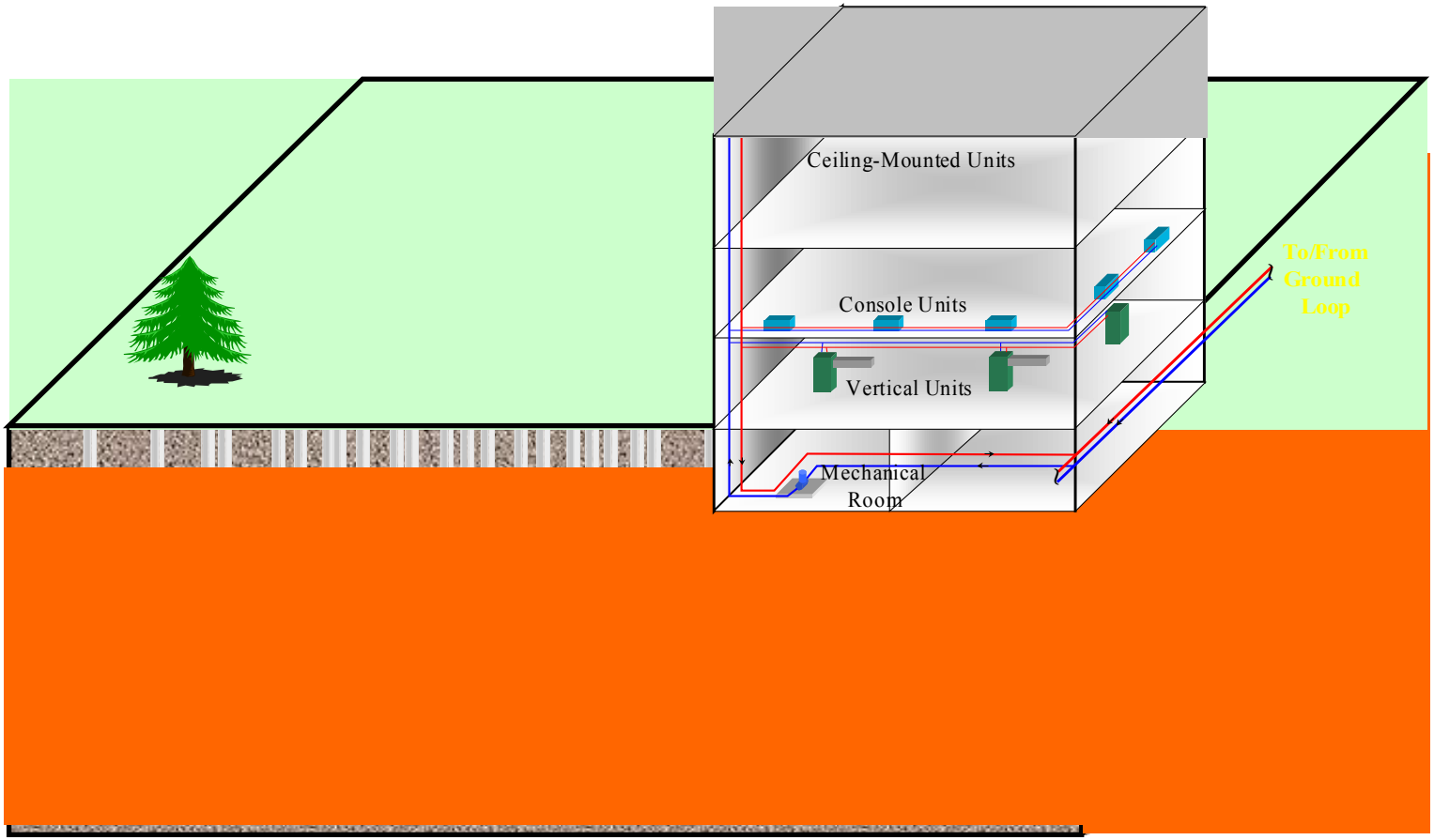
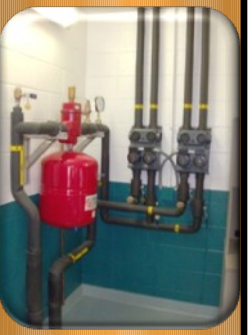
Types of Heat Pumps

- Air Source

Types of Heat Pumps

- Ground Source





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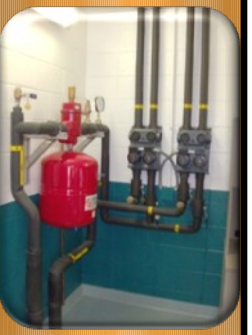
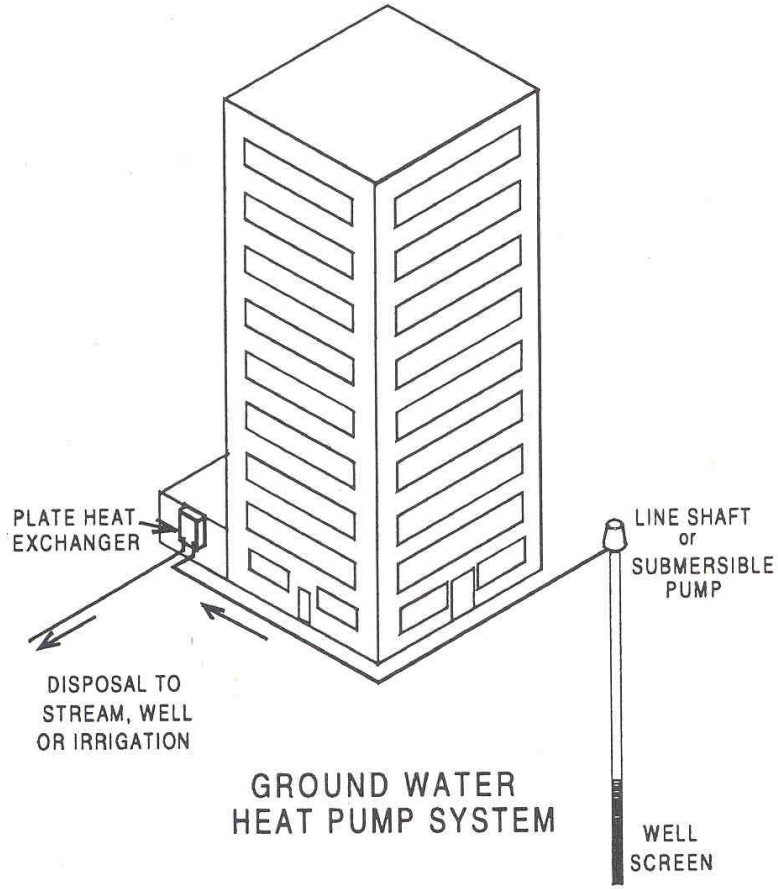
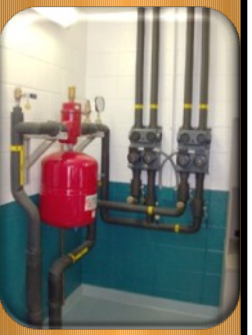


Types of Heat Pumps

- Open Loop (Ground Water Source)








Types of Heat Pumps

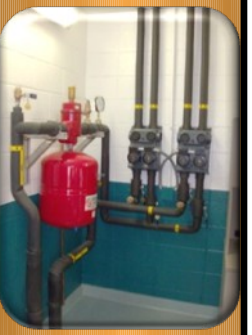
- Horizontal Loop

Trenching

Bedding

Slinky

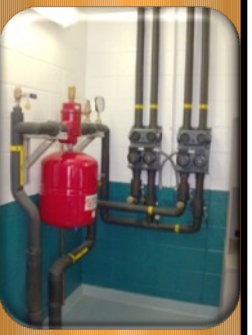





Types of Heat Pumps

- Pond Loops





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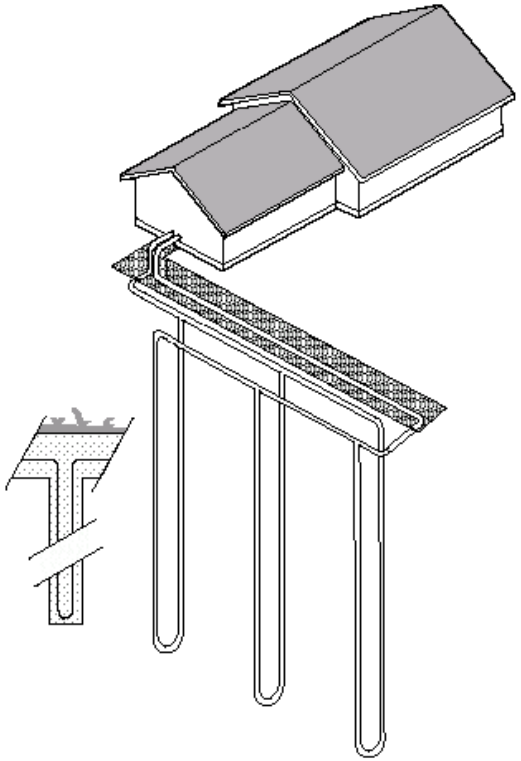
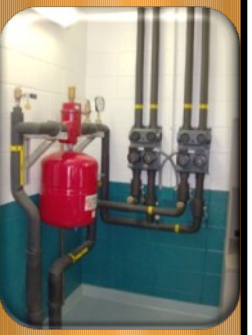
Types of Heat Pumps

- Vertical Loops



Types of Heat Pumps

- Vertical Loops



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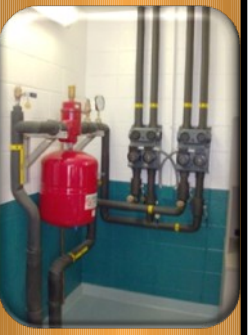

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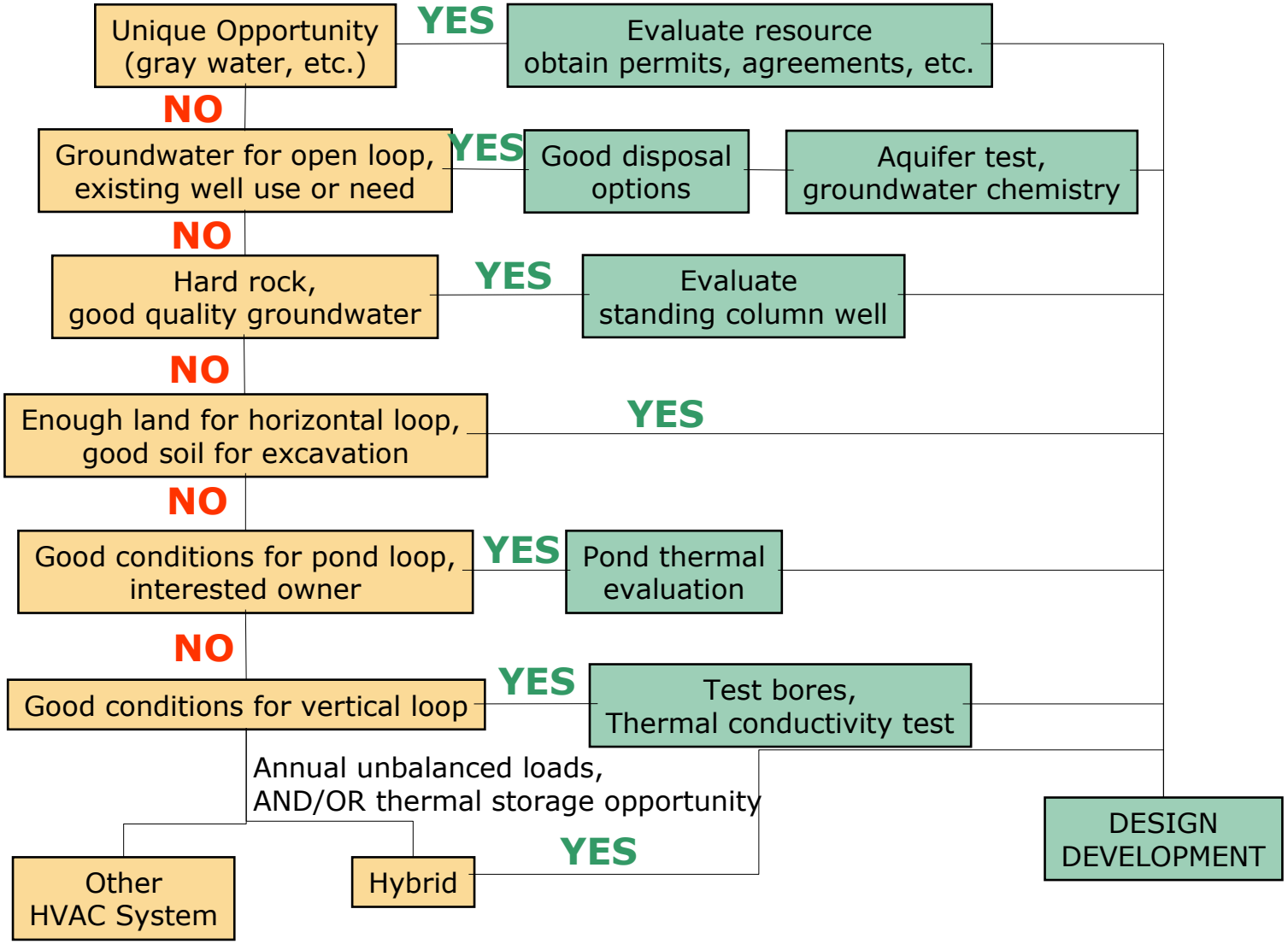
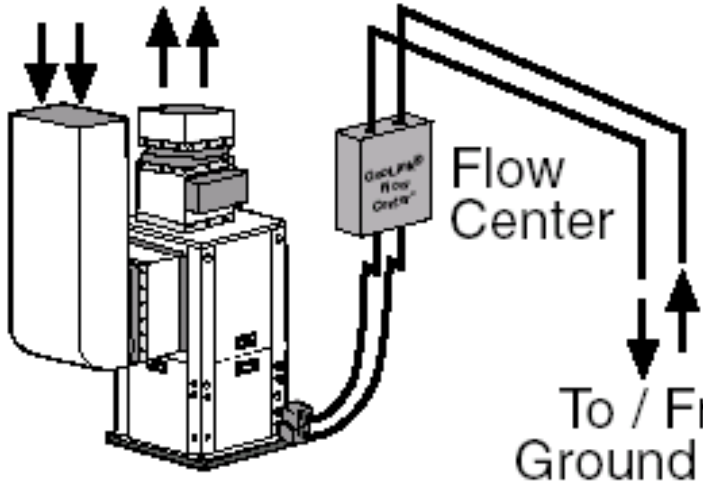
Types of Heat Pumps

Decision Tree



System Components



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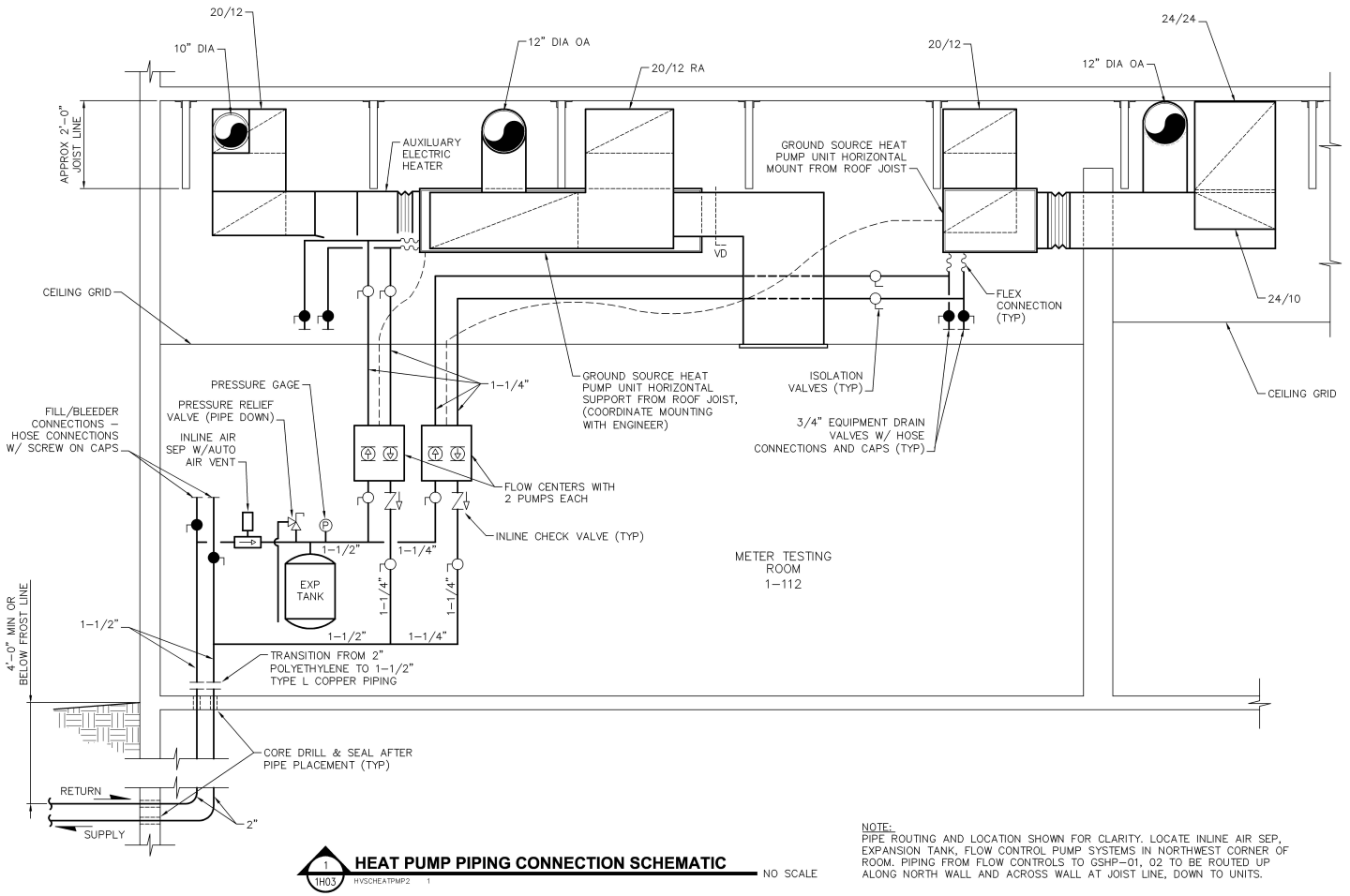
Interior Piping



1 1H03 **HEAT PUMP PIPING CONNECTION SCHEMATIC** NO SCALE
HVSCHEATPMP2 1

NOTE:
PIPE ROUTING AND LOCATION SHOWN FOR CLARITY. LOCATE INLINE AIR SEP, EXPANSION TANK, FLOW CONTROL PUMP SYSTEMS IN NORTHWEST CORNER OF ROOM. PIPING FROM FLOW CONTROLS TO GSHP-01, 02 TO BE ROUTED UP ALONG NORTH WALL AND ACROSS WALL AT JOIST LINE, DOWN TO UNITS.

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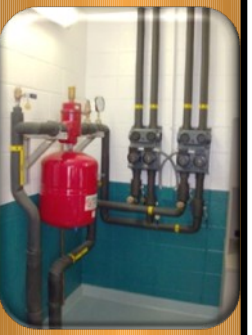
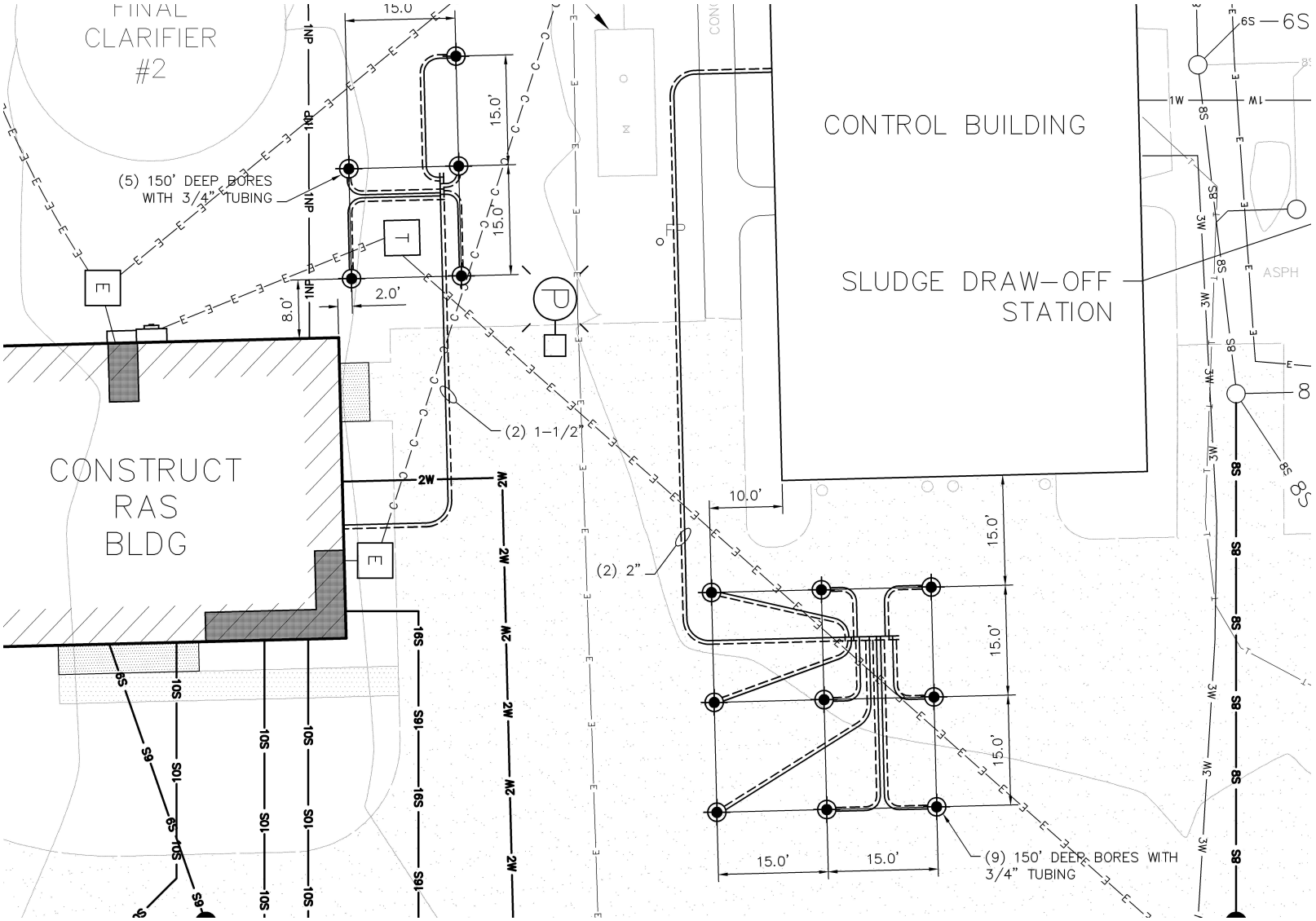
W239 N1906 Ridgeview Parkway • Waukesha, WI 53188-1020
(262) 542-5783 • Fax: (262) 542-5863 • www.ruekert-mielke.com

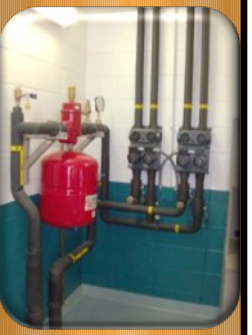
SLINGER WWTF UPGRADE
CONTROL BUILDING
HVAC PUMP PIPING CONNECTION SCHEMATIC
VILLAGE OF SLINGER
WASHINGTON COUNTY, WISCONSIN

DESIGNED BY: MR (IBC)
DRAFTED BY: JRW
CHECKED BY:
DATE: AUGUST, 2007
FILE NO. 1892050.200
BID SET
SHEET NO. 1H03

Exterior piping and Wells

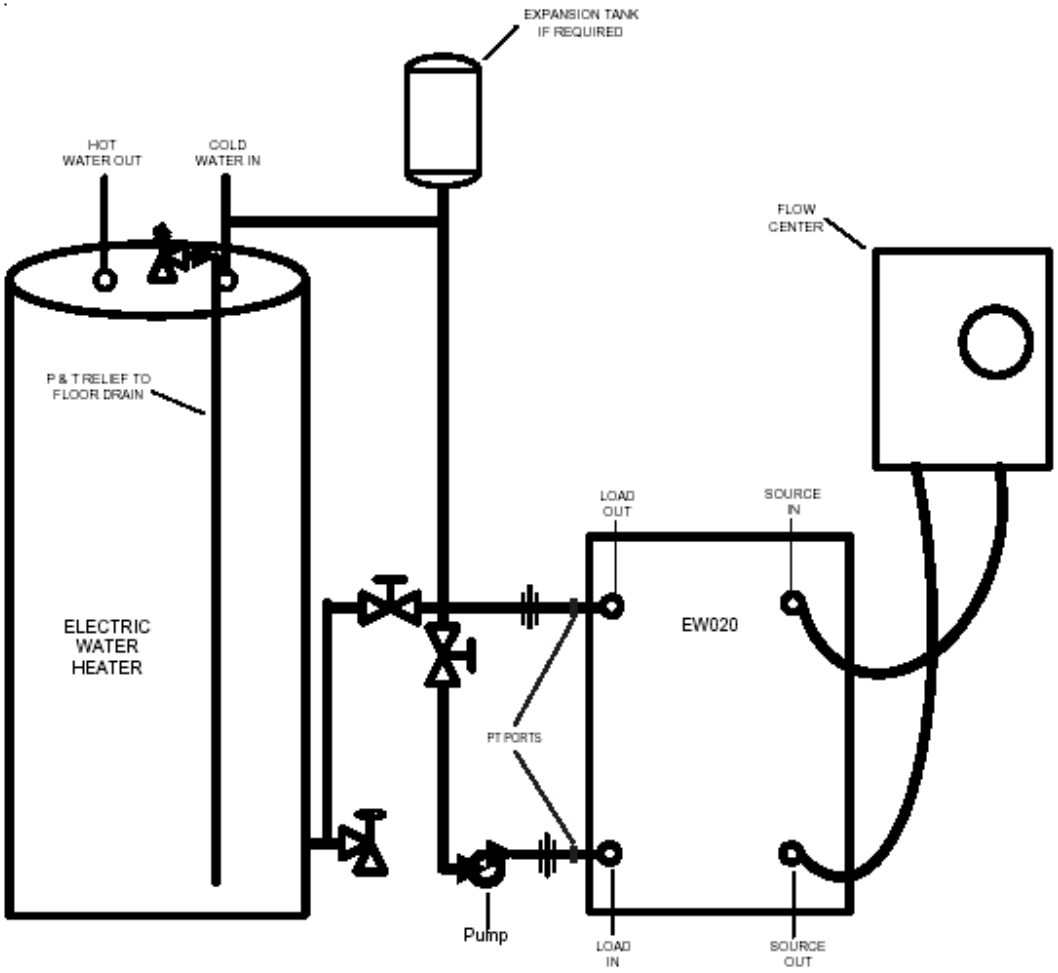




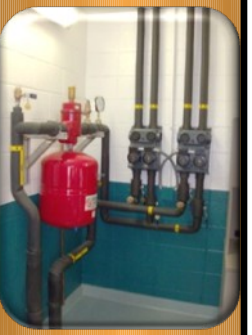


System Components

Water Heating



Why Geothermal?



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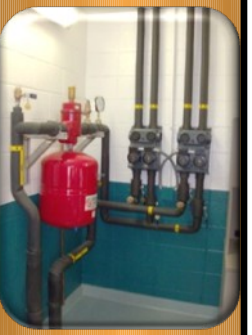

General Advantages

- Efficiency
  - 4x for electric resistance
  - 3x for propane
  - 2x for ASHP
  - 2x for fuel oil
  - 2x for natural gas

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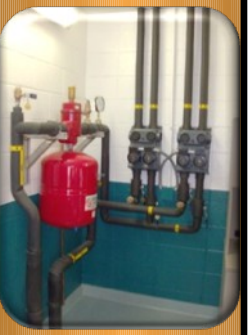
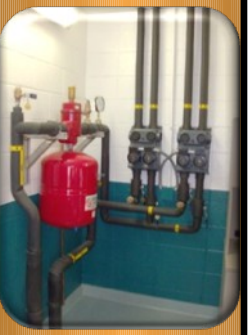


General Advantages

- Economics
  - High Energy Savings
  - (Offset by Higher Constructed Cost)
  - Grants-$125-175/Ton Rebate



General Advantages

- Well Proven Technology
  - 20 years on specific systems
  - Dairy Farms—50 years
  - Digester Heat Exchangers
- Heating AND Cooling
- Carbon Credits

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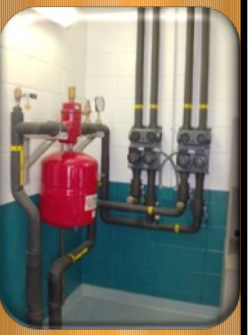

Why in Slinger?

- Attitude of Sustainability
- Existing Electric Heat
- No Natural Gas

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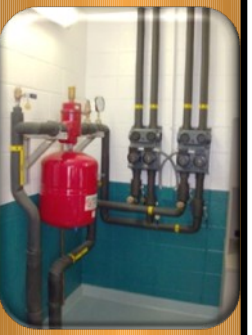
Results



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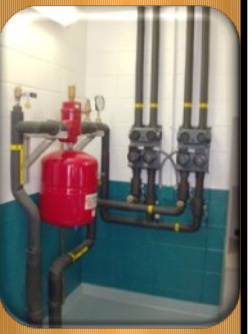

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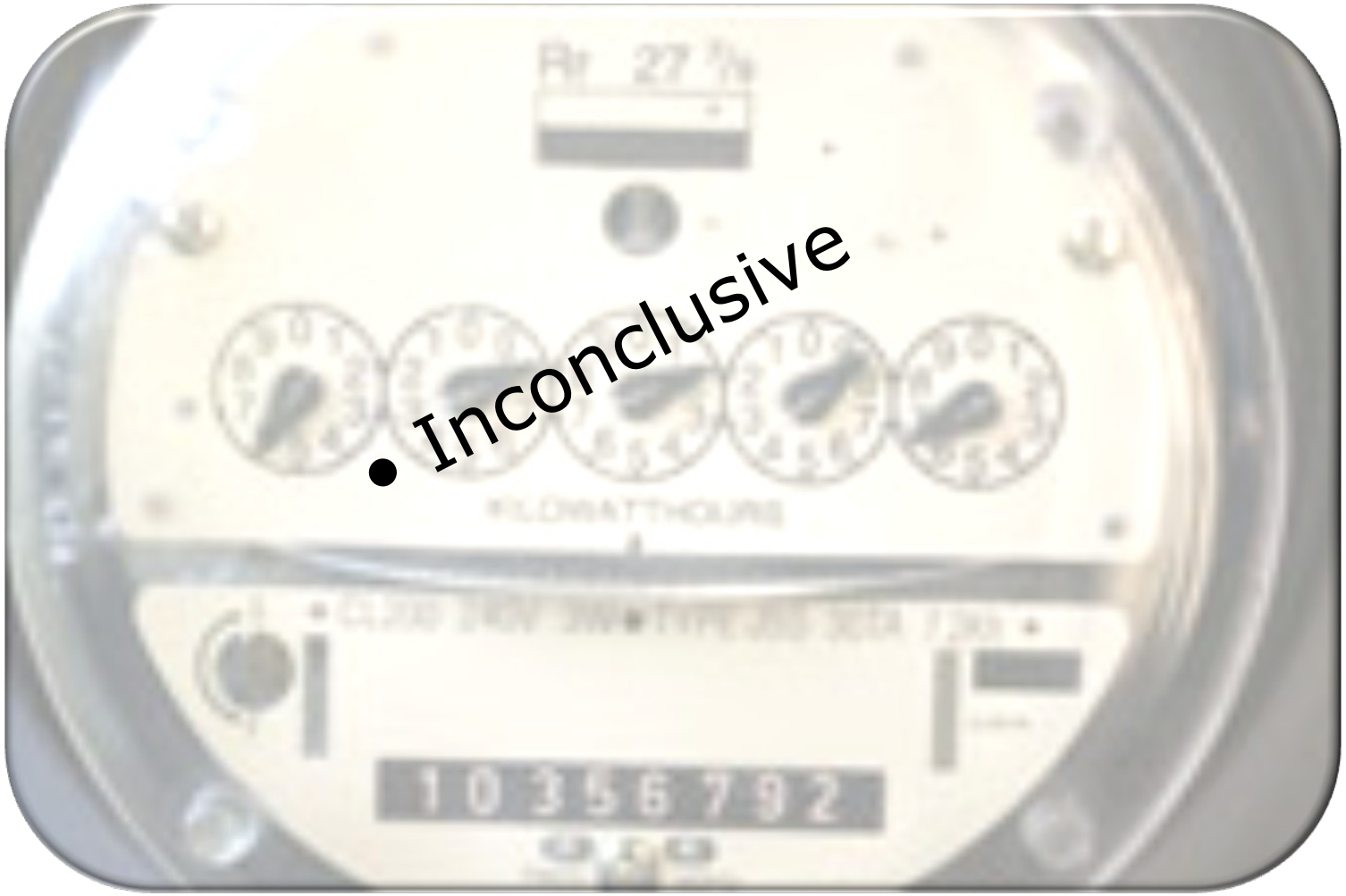
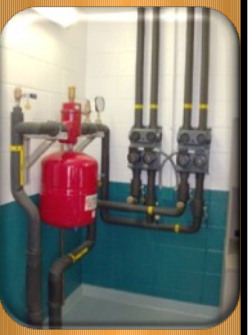
Electrical Advantage

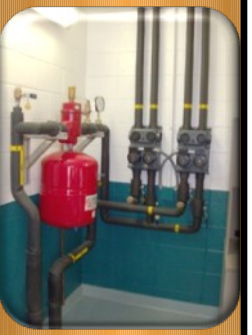


- Inconclusive



Electrical Advantage

- Helps to Meet WPPI Alternative Energy Requirements.

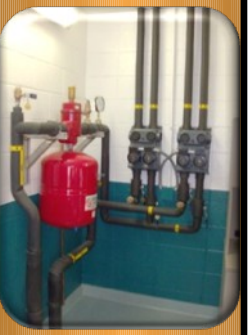


Questions?

Douglas Nelson, PE
Ruekert-Mielke, Inc
(262) 542-5733
Dnelson@ruekert-mielke.com

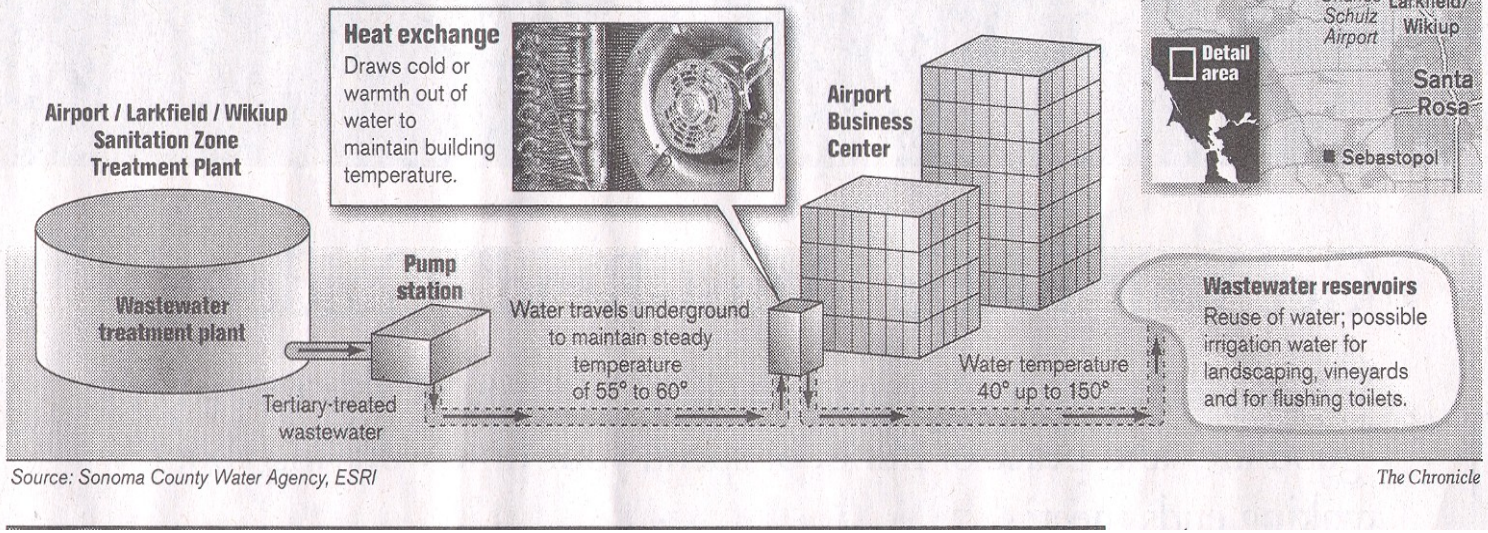
Greg Moser
Slinger Wastewater Utility
(262) 644-8615
gmoser@vi.slinger.wi.gov

Using Through-Put of WWTP for Heating/Cooling



Sonoma County Water Agency Demonstration Project

The Sonoma County Water Agency is studying the feasibility of a pilot project that would use recycled wastewater to heat and cool buildings as well as irrigate landscaping and vineyards. The network, which they believe would cut traditional natural gas and electricity use dramatically, would cost between $50 million and $70 million and be installed at the Airport Business Center over the next two years. Proponents are traveling to Washington this week to seek funding for the system.



Source: Sonoma County Water Agency, ESRI

The Chronicle

Using Waste Water as Energy Source

(SFO Chronicle -- 7 April 2008)

SONOMA'S POWER PLAY: Pilot program may test use of treated wastewater as a source of both alternative energy for local office park, irrigation for vineyards

Photos by Brant Ward / The Chronicle

Sonoma Supervisor Paul Kelley (left) and Clay Gregory of Jackson Family Wines tour a water treatment plant in Santa Rosa.

WASTE NOT, WANT NOT

By Kelly Zito
Chronicle Staff Writer

When most people think alternative energy, solar, wind or biofuels come to mind, Sonoma County officials want to add another source to the list: treated wastewater.

A pilot program taking root in a nondescript business park near the Charles M. Schulz Airport just north of Santa Rosa would use highly treated water pumped from a nearby plant to heat and cool buildings, with the additional promise of using the piped water to irrigate landscaping and vineyards.

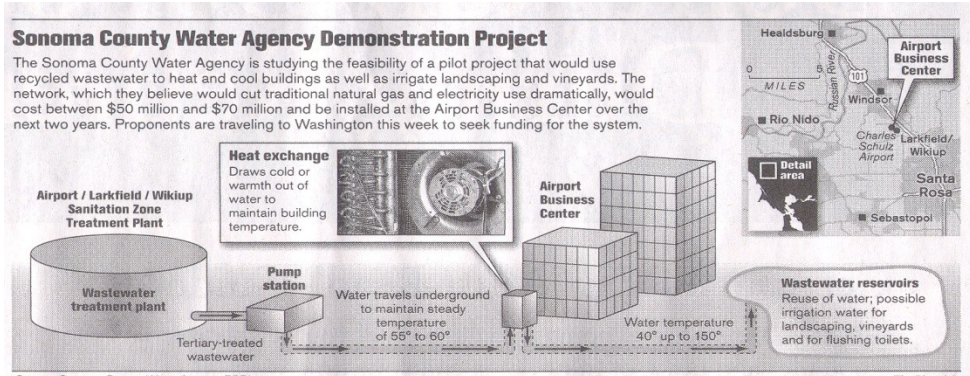
If the ambitious, expensive plan gets off the ground, environmental planners in similar-size cities around the country theoretically could use the template -- developed in part by scientists at the Los Alamos National Laboratory -- to slash power bills and better use every last drop of water.

"Recycled water is a new energy source," said Grant Davis, assistant general manager of the Sonoma County Water Agency. "Water and wastewater that you'd normally have to treat and dispose of will become the source for heating and cooling."

The project has gained steam in the past few months as Pacific Gas and Electric Co. and some of the biggest names in the wine business have signed on; in March, county supervisors approved $1 million for a feasibility study. The flurry of interest comes as more cities and businesses take a hard look at their contributions to greenhouse gas emissions and climate change, and national labs expand their research to include not just military security, but wa-

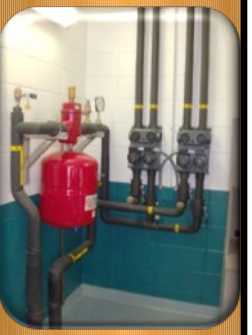
▸ WASTEWATER: Page A19

Large vertical filters clean the wastewater before it is used for irrigation or to produce energy.



Brant Ward / The Chronicle

Wastewater purified at a Santa Rosa wastewater treatment plant could soon become a source of energy.



Abridged answer to: "Why GSHP?"

Energy Cost Comparison

One Million BTU's / Snohomish CO. "2001")

Residential customers, as of 2-20-01

Electric furnace	100% Eff. / 7¢/kWh	**$ 28.13**
Propane	80% Eff. / $1.50 / Gal	**$ 27.34**
Elec. BaseBoard	100% Eff. / No Duct Loss	**$ 21.09**
Natural Gas	80% Eff. / $0.90 / Therm	$ **15.24**
#2 Fuel Oil	80% Eff. / $1.69 / Gal	**$ 15.19**
Elec. Heat Pump	200 – 300 % Eff.	**$ 14.06**
Geo Heat Pump	300 – 500 % Eff.	**$ 8.05**