NARPM 2008

National Association of Remedial Project Managers

18th Annual Training Conference

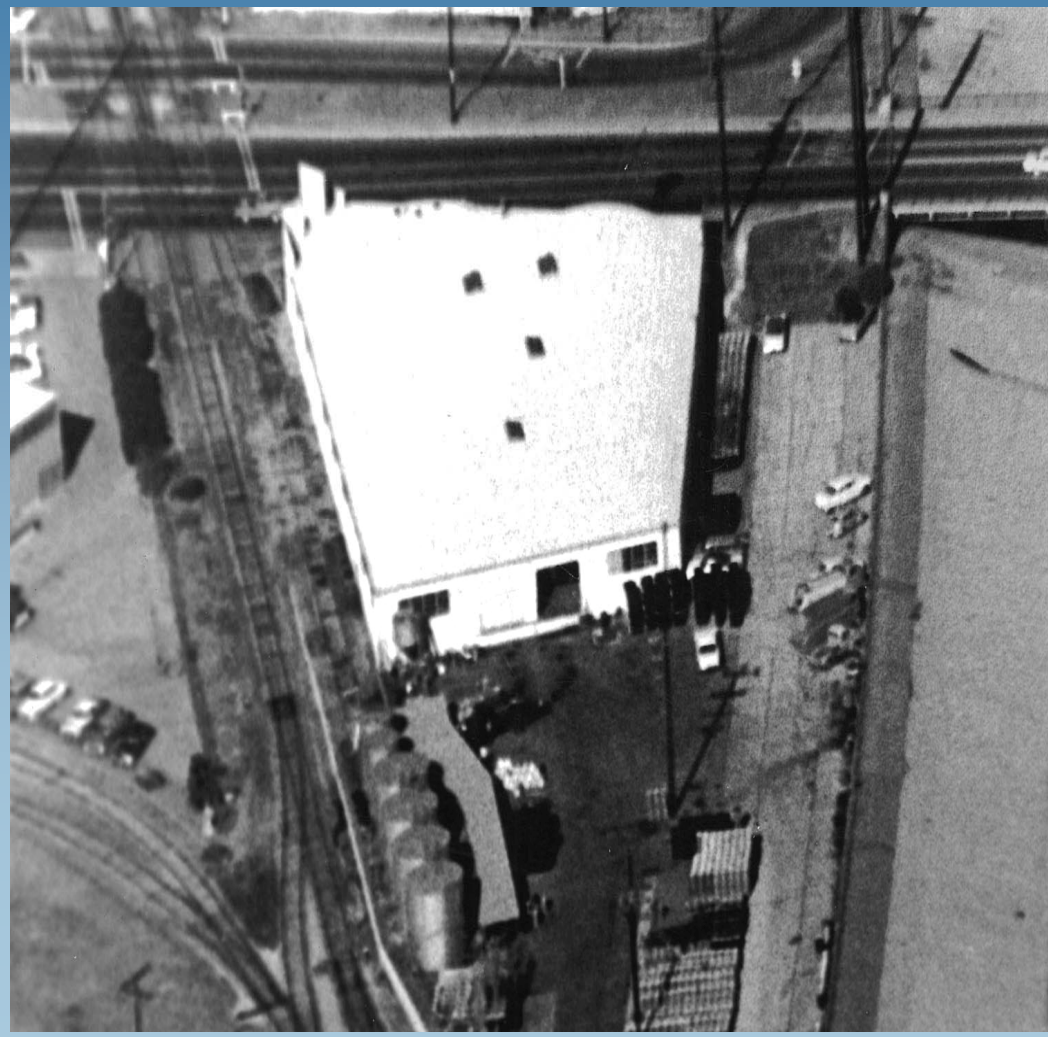
July 7 – 11, 2008

DNAPL Source Zone Treatment

Pemaco Superfund Site

Pemaco Superfund Site

- Maywood, California, 1.4 acres
- Former custom chemical blender 1950-1991, on site storage of drums, UST, AST
- Chlorinated solvent (TCE) soil and groundwater contamination
- 2005 ROD: Electrical Resistance Heating (ERH)
- Enhanced In Situ Bioremediation: polish for source zone/stand alone for dissolved phase plume
- Maywood Riverfront Park



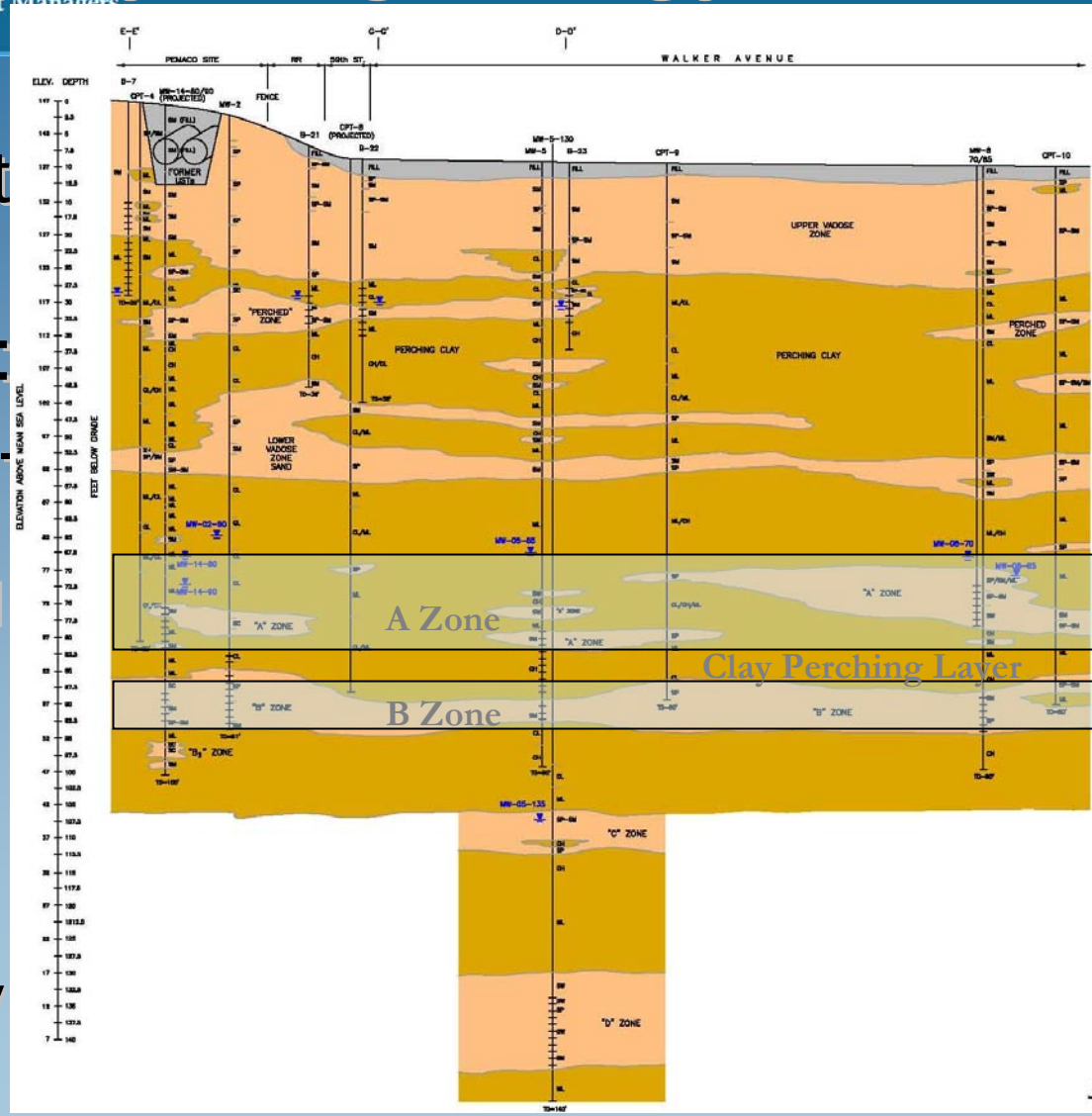
Activities to Date

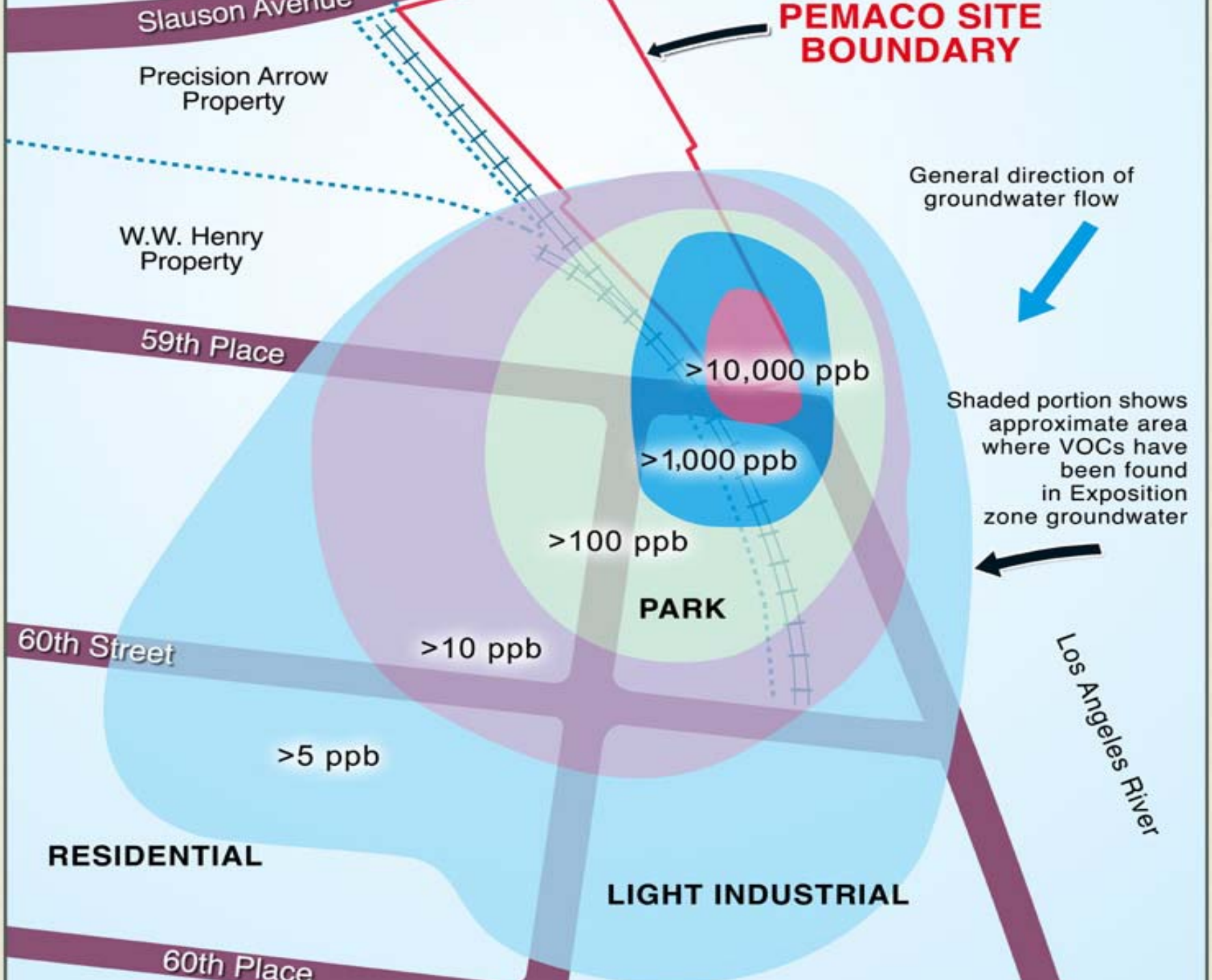
- 1997-EPA removed 29 underground storage tanks
- 1998- 1999 EPA installed a soil vapor extraction system and treated 144, 400 lbs of soil
- 2003- Remedial Investigation/Feasibility Study
- 2004-Public Comment
- 2005- ROD including public comments signed
- 2005- Construction on remedy began
    - Vapor and groundwater well installation
- 2006-7 ERH well installation and turn on P&T System
- 2007 EISB Pilot Studies & ERH

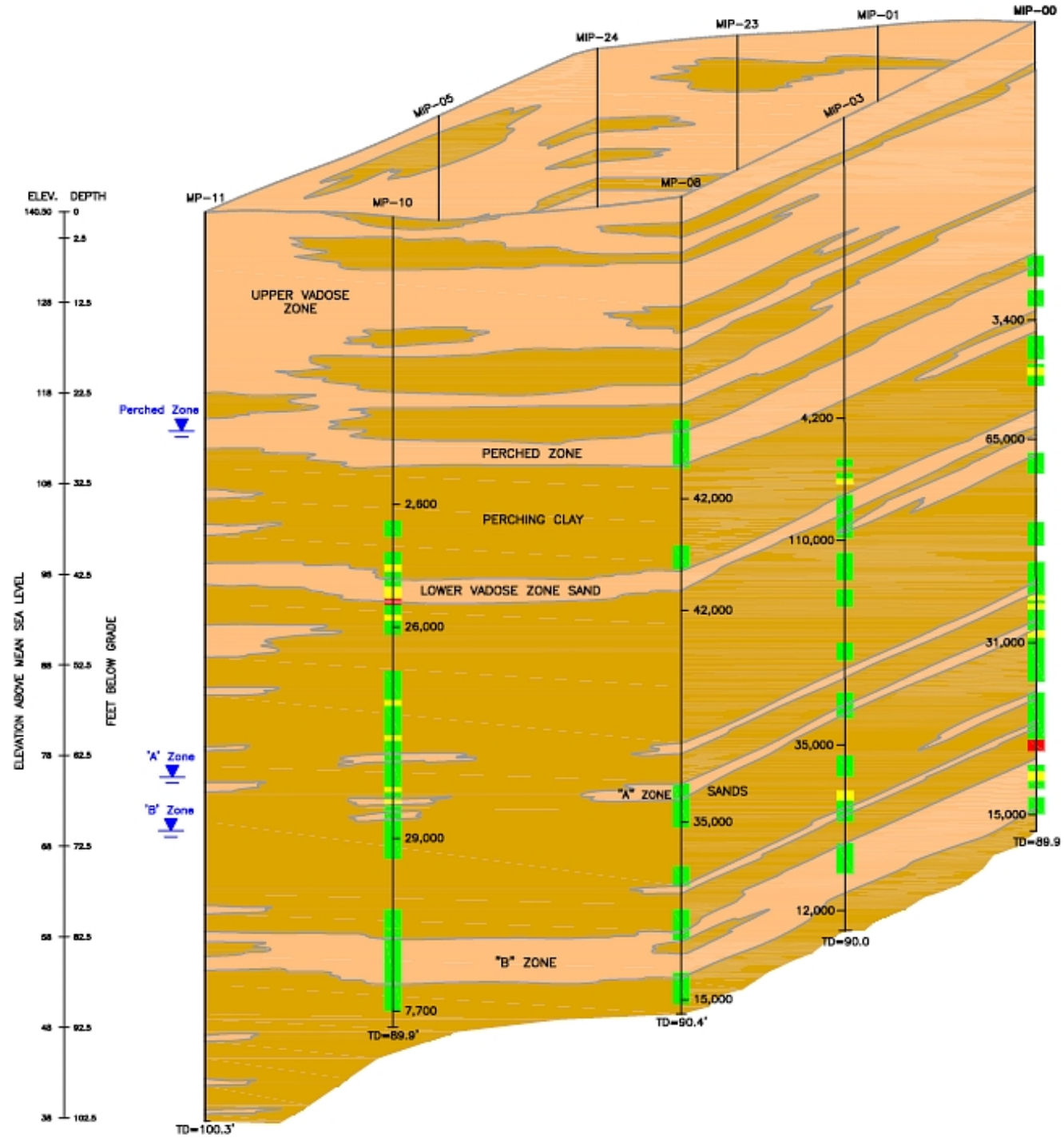

FORMER
PEMACO SITE
BOUNDARY
LOS ANGELES RIVER
SLAUSON AVENUE
MAYWOOD RIVERFRONT PARK
ALAMO AVENUE
ERH
AREA
59TH PLACE
PARK NATIVE
SOIL STOCKPILE
PARK CLEAN
SOIL STOCKPILE
PEMACO
TREATMENT
BUILDING
W. W. HENRY
COMPOUND
WALKER AVENUE
60TH STREET

Pemaco: Hydrogeology

- Groundwater transport primarily through two Exposition zones (EZ):
  - A (~60-70 ft bgs)- semi-discontinuous saturated, fine silty and poorly graded sand lenses.
  - B (~80-90 ft bgs)- continuous saturated fine poorly graded, silty sands.




Slauson Avenue
PEMACO SITE BOUNDARY
Precision Arrow Property
W.W. Henry Property
General direction of groundwater flow
59th Place
>10,000 ppb
>1,000 ppb
>100 ppb
Shaded portion shows approximate area where VOCs have been found in Exposition zone groundwater
PARK
60th Street
>10 ppb
Los Angeles River
>5 ppb
RESIDENTIAL
LIGHT INDUSTRIAL
60th Place



24 CPT/MIP locations yielded detailed source zone information to be used in RD

T N & Associates, Inc.
Engineering and Science

ERH Procurement

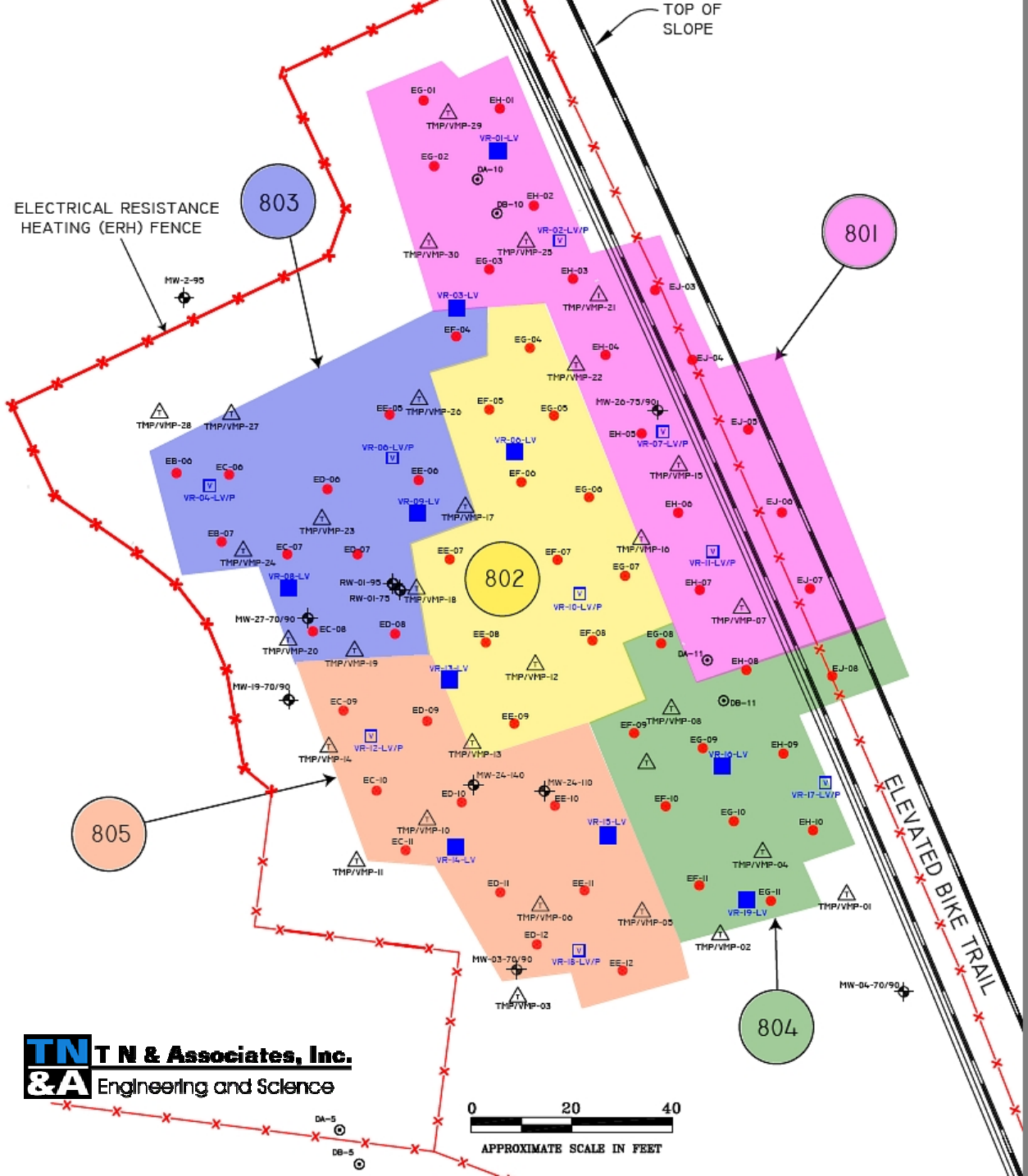
- Performance-based Contract (based on meeting specified temperature goals)
- RFP based on “Best Value” to the government (combination of technical merit and price
- Bidders given all site data and detailed proposal evaluation criteria

ERH Procurement

- Technical evaluation team from USEPA, US ACOE, and TN&A
- Awarded to Thermal Remediation Services (TRS)
- Structured subcontract with “milestone” payments based on performance criteria

Performance Criteria

- 85% of electrodes achieving temperature of 87 degrees C
- 85% of electrodes achieving temperature of 110 degrees C
- Not to exceed 3,144,000 kWh total

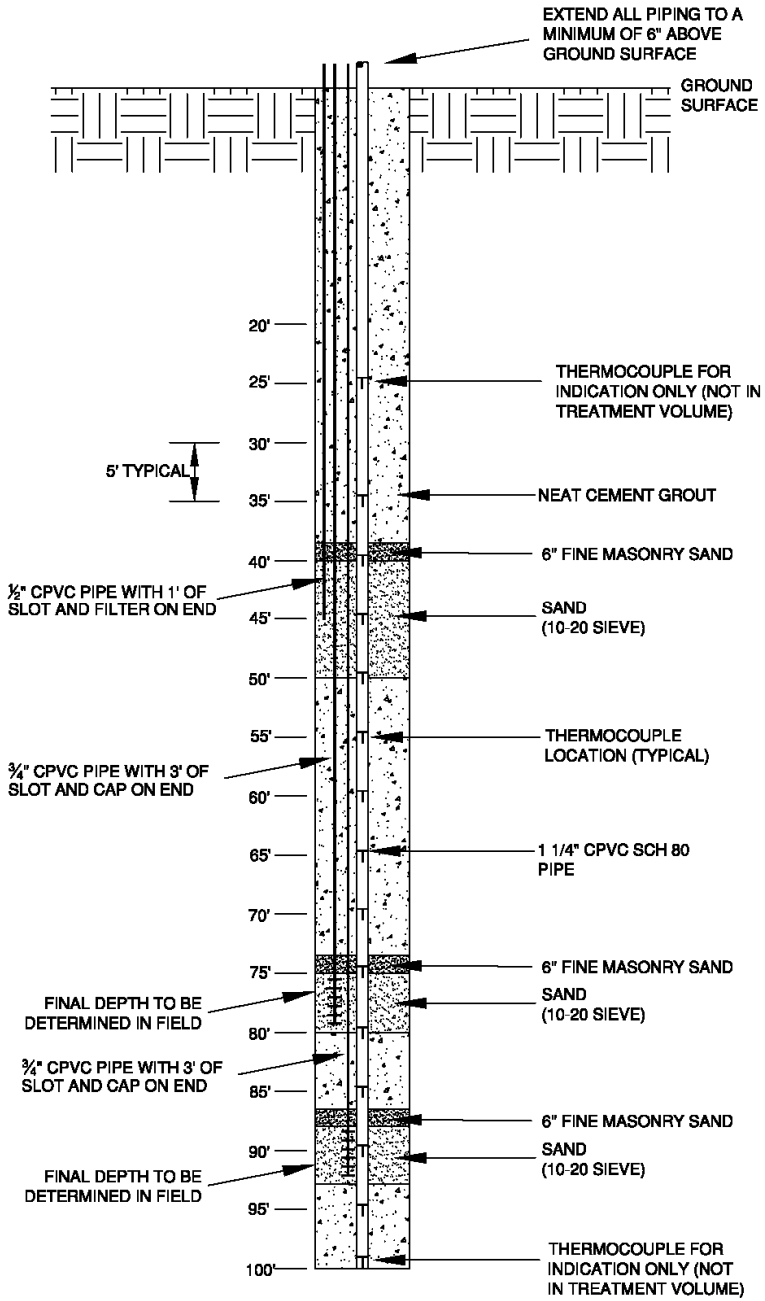


ERH Design / Implementation at Pemaco

- 58 co-located electrode and extraction wells
- Dual electrode configuration to heat interval between 35 ft and 95 ft bgs
- 14 additional SVE locations; 3 GW pumping wells
- 30 temperature monitoring locations, each with 20 thermocouples (every 5 ft, to 100 ft bgs)

Heating began in September 2007

TMP (TYPICAL OF 14)




HOT
Vapor entering bldg

Vapor treatment train

Flameless Thermal Oxidizer

Vapor conditioning package


CT-201
Chiller


B-102


T-404

Well Field Soil Vapor Monitoring

- Samples collected from 30 vapor monitoring probes
- 23 perched extraction wells
- 9 co-located perched zone recovery VR wells
- 32 exposition extraction wells

Sampling Frequency Vapors

- PID daily of the influent and effluent of each carbon vessel
- Weekly summa canister sampling of the vapor to atmosphere.
- 5 days per week of the influent vapor being treated

Sampling Water

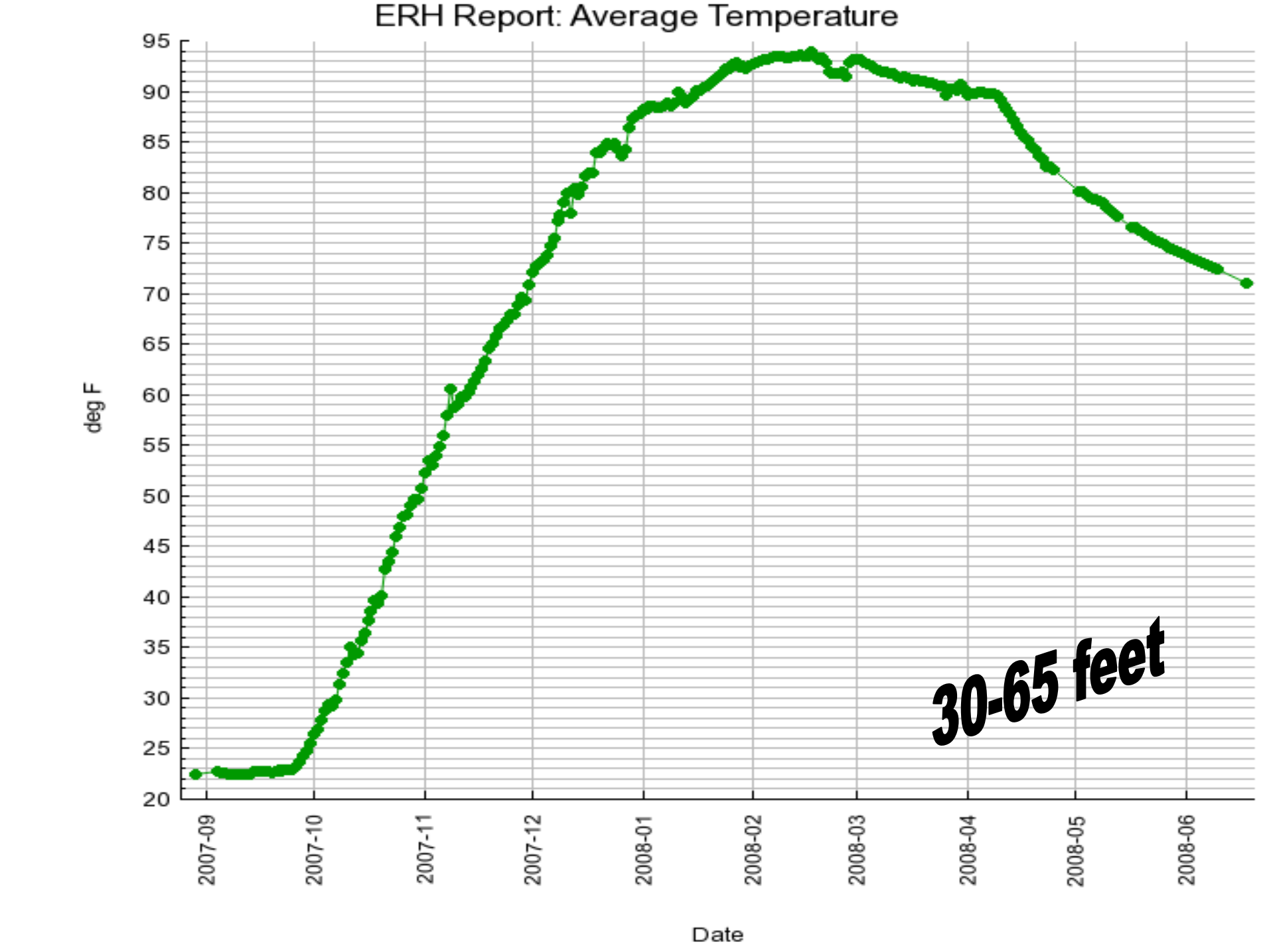
- Weekly sampling of water after carbon treatment but prior to release into the sewer line.
- Weekly manifold sampling of contaminated water prior to being treated.

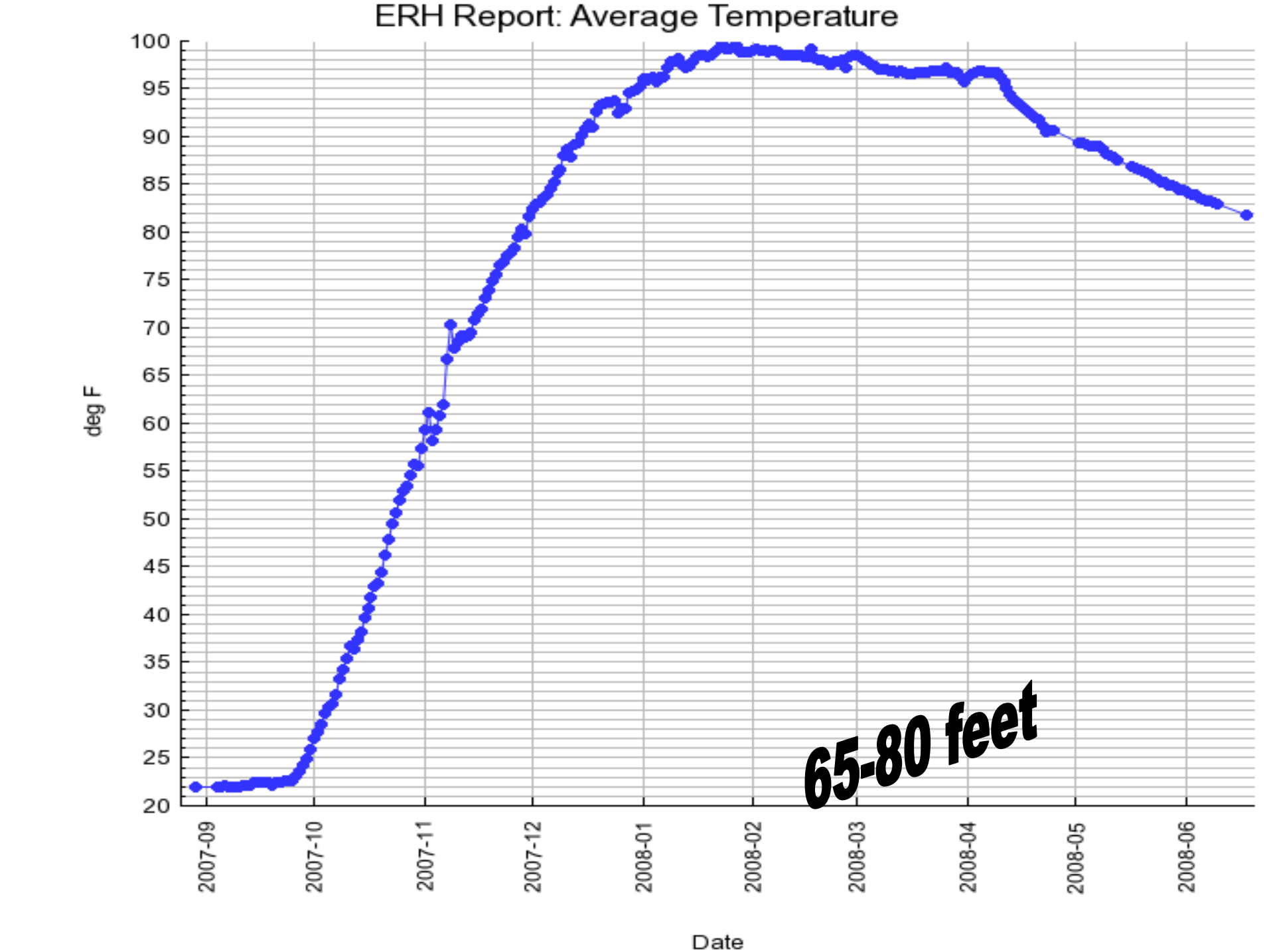
Estimate of Energy usage

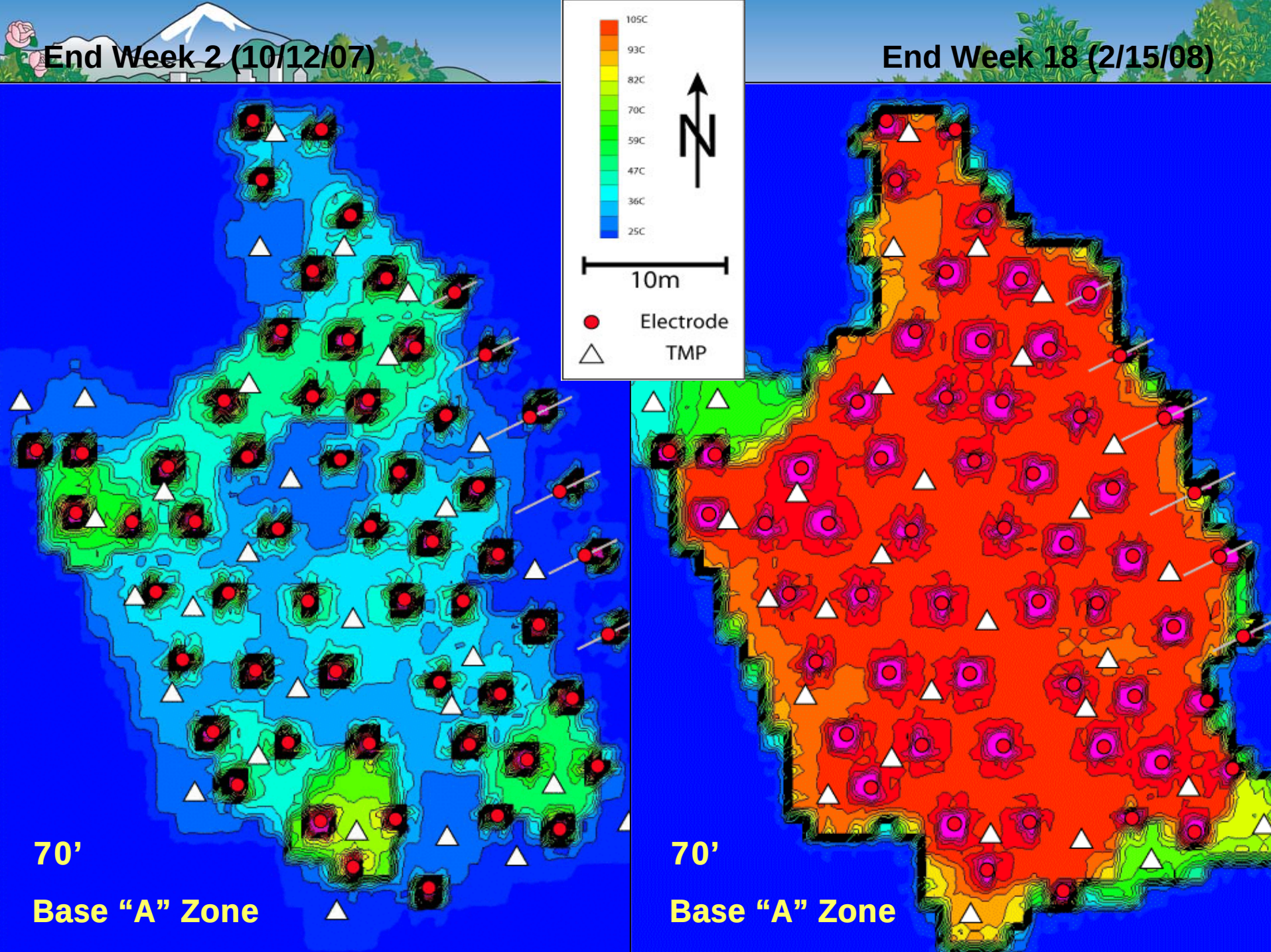
- 3.44 million kW-hr to remove 90% of mass or 103 days of heating
- 6.4 million kW-hr to reach MCLs/ARARs or 205 days of heating

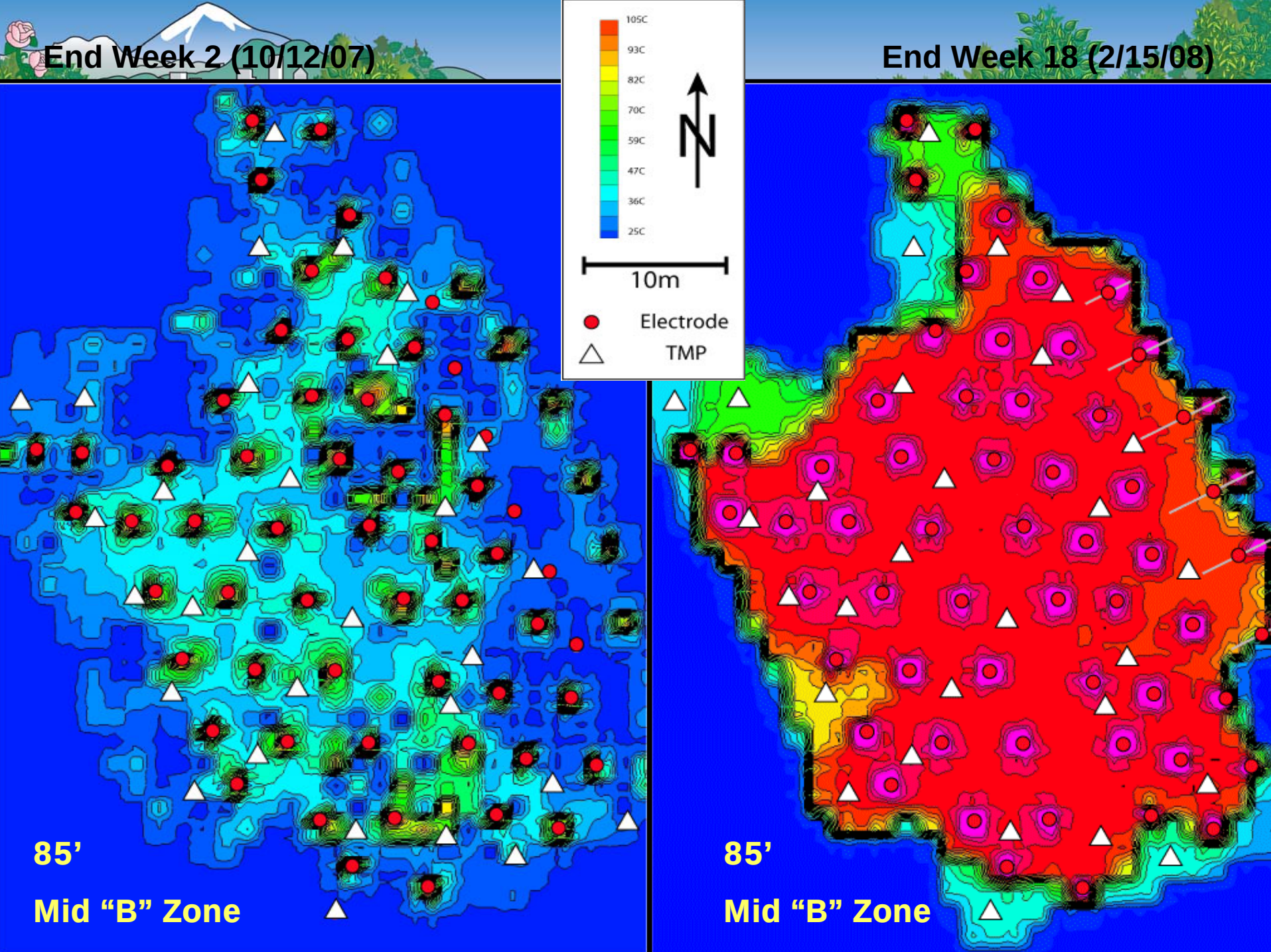
Actual Energy Usage

- 5,065,617 kWh used over 210 days of heating
- Energy cost = $550,812.83 or .092/kWh
- Average cost per day = $2,500
- Did not reach MCLs prior to turn off

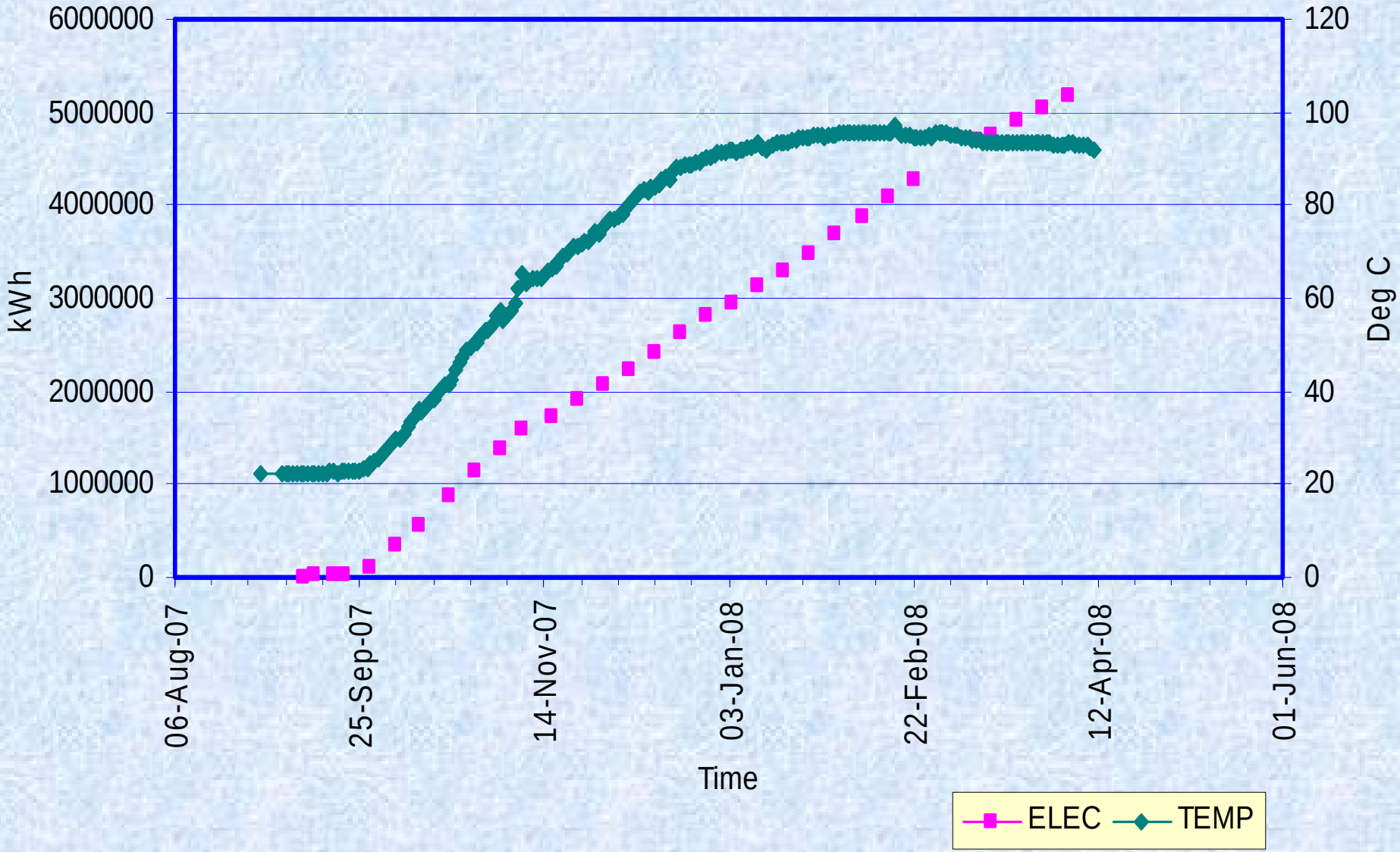

ERH Report: Average Temperature
deg F
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
2007-09
2007-10
2007-11
2007-12
2008-01
2008-02
2008-03
2008-04
2008-05
2008-06
Date
30-65 feet


ERH Report: Average Temperature
deg F
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
2007-09
2007-10
2007-11
2007-12
2008-01
2008-02
2008-03
2008-04
2008-05
2008-06
Date
65-80 feet

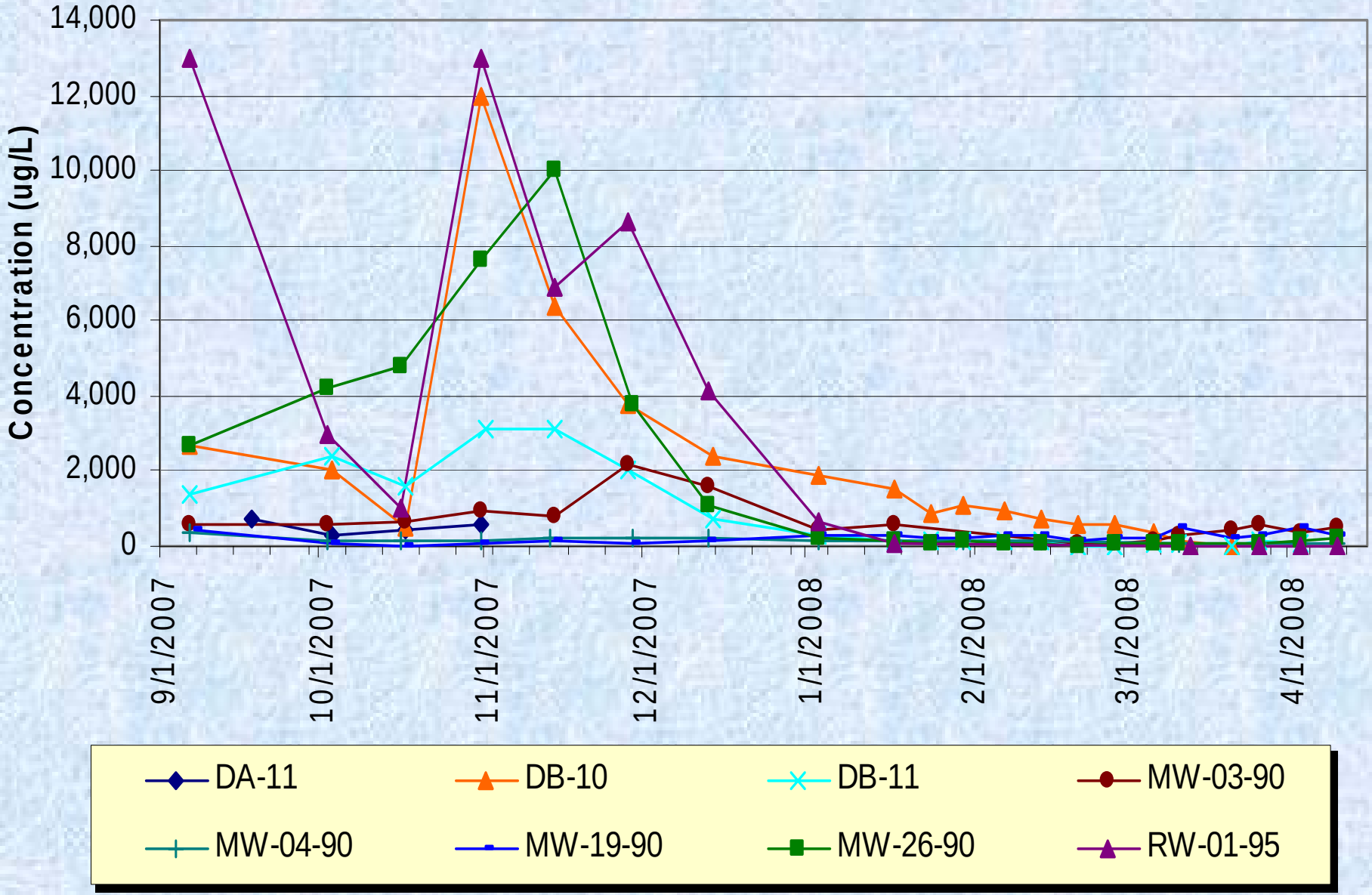

End Week 2 (10/12/07)
End Week 18 (2/15/08)
105C
93C
82C
70C
59C
47C
36C
25C
N
10m
Electrode
TMP
70’
Base “A” Zone
70’
Base “A” Zone


End Week 2 (10/12/07)
End Week 18 (2/15/08)
105C
93C
82C
70C
59C
47C
36C
25C
N
10m
Electrode
TMP
85’
Mid “B” Zone
85’
Mid “B” Zone

ERH Energy Consumption VS Temperature Increase



TCE in Select Ground Water Monitoring Wells



Groundwater Remedial Progress (after 6 months of heating and 2 months of subsequent monitoring)

Compound	Starting Avg. Concentration (ug/L)	Current Avg. Concentration (ug/L)
TCE	15,000	<100
cis-1,2 DCE	14,000	<50
VC	700	<10
Benzene	500	<10
Hexane	>10,000	~50

Treatment/Cost

- ERH Construction : $2,109,005
- Milestone Payments: $355,000
- 210 days of electricity: $550,813
- Total cost $3,014,818
- Cost of running the treatment plant averages $150,000/month

Lessons Learned

- Actual boiling temperatures within the aquifer can occur lower than specifications outlined in your contract
- Watch your concentrations of high LEL chemicals (LNAPL and DNAPL) Your high LNAPL can blow through your carbon (C6 and higher uses up your carbon like mad)

Lessons Learned

- Redirecting energy can be a good thing
- Caution: contractors redirecting energy to deeper depths can cause lost of conductivity in the aquifer …may not regain even with addition of water when redirection occurs at the higher temperatures

Lessons Learned

- Electrode spacing is extremely important they must be spaced equally
- Field implementation needs to follow the original design
- Make sure subsurface structures are incorporated into the electrode design

Lessons Learned

- Long electrodes work if installed close together
- Make sure contractors have installed enough vapor and groundwater recovery wells within the ERH zone.

Lessons Learned

- If monitoring wells within your ERH system dry up don't fret just turn them into vapor recovery wells.
- VMP are great things because we can determine what is actually occurring in the aquifer during heating…ie pressure or vacuum

Lessons Learned

- Most vendors can heat up the systems nicely. The challenge is in the recovery and treatment of your contaminants.
- Don’t forget to go back and check/recheck permit/release limitations as they change during heating.
- You need to have your TMP’s in the coldest part of your site

Lessons Learned

- During site assessment or additional sampling leave in a 2 inch PVC points that can be used for future temperature monitoring locations
- Mass determination at beginning can keep your vapor treatment costs lower if vapor treatment is included as part of the bid for heating. Need a real good site characterization.

Maywood Riverfront Park – Opened in April 2008!

Pemaco site

- THE END

Groundwater pumped from first tank through filters


T-101
H-202
H-201


B-102

PEMACO SUPERFUND SITE

- THE END