



Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

OCT 03 2014

Mr. Todd Mullins
Federal Facility Agreement Manager
Division of Waste Management
Kentucky Department for Environmental Protection
200 Fair Oaks Lane, 2nd Floor
Frankfort, Kentucky 40601

PPPO-02-2572921-14

Ms. Jennifer Tufts
Federal Facility Agreement Manager
Federal Facilities Branch
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Mullins and Ms. Tufts:

REMEDIAL GOALS MET FOR PHASE IIa OF THE INTERIM REMEDIAL ACTION FOR VOLATILE ORGANIC COMPOUND CONTAMINATION AT THE C-400 CLEANING BUILDING

With this letter, the U.S. Department of Energy (DOE) is formally transmitting information that supports DOE's position that the remedial goals for Phase IIa of the C-400 Interim Remedial Action (IRA) were achieved as of September 9, 2014. This information is being submitted to seek concurrence from the U.S. Environmental Protection Agency and the Kentucky Department for Environmental Protection that the remediation goals have been met, as discussed via conference call on September 19, 2014.

The Record of Decision for Interim Remedial Action for the Groundwater Operable Unit for the Volatile Organic Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant Paducah, Kentucky, DOE/OR/07-2150&D2/R2, identifies the remediation goals for the IRA. Section 2.9.3 presents goals specifically related to Phase IIa of the IRA, using electrical resistance heating in soils of both the Upper Continental Recharge System and the upper Regional Gravel Aquifer (RGA) in the C-400 southeast treatment area, as follows: Operate the electrical resistance heating system until 1) monitoring indicates that heating has stabilized in the subsurface and 2) recovery of trichloroethene (TCE), as measured in the recovered vapor, diminishes to a point at which further recovery is at a constant rate (i.e., recovery is asymptotic).

The Remedial Design Report, Certified for Construction Design Drawings and Technical Specifications Package, for the Groundwater Operable Unit for the Phase IIa Volatile Organic

Compound Contamination at the C-400 Cleaning Building at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-1272&D2/R1, identifies the following criteria for assessment of the two remediation goals.

Goal: Heating has stabilized in the subsurface.

1. “Temperatures in the soil above the potentiometric surface of the RGA (approximately 53 feet below ground surface at the C-400 Building) are at or above 90°C (194°F). The boiling point of free-phase TCE is 87°C (189°F) at sea level pressure conditions. Temperatures below the potentiometric surface of the RGA are at or above the boiling point of the free-phase TCE at the depth of treatment [e.g., approximately 87°C (189°F) at the potentiometric surface and approximately 93°C (199°F) at 60 feet below ground level]. The target temperatures at each depth interval will be verified by 90% of the digital temperature monitoring sensors installed at 3-foot intervals throughout the heated volume.”

Met: By mid-June 2014, more than 90% of the digital temperature monitoring sensors installed at each three-foot interval throughout the treatment zone exceeded the depth-specific target temperature (194°F–198°F). (See the summary of temperature with depth on Slide 5 of the enclosure.)

2. “The target temperatures...are maintained for the period of time necessary to achieve asymptosis, as defined below.”

Met: By mid-June 2014, target temperatures in the treatment zone were met (or exceeded) and sustained. Asymptosis in volatile organic compound (VOC) vapor recovery was achieved with the slope of the curve of VOC recovery approaching zero at a slow rate of change]. (See the graphical plots of average well field temperature and VOCs recovered on Slide 3 of the enclosure.)

Goal: Recovery of TCE, as measured in the recovered vapor, diminishes to a point at which further recovery is at a constant rate.

1. “Asymptotic conditions will be identified based on visual inspection of data plots showing TCE mass removal rate....”

Met: VOC mass recovery rates declined rapidly from a high of 125 gallons per week after system restart in January 2014 down to 24 gallons per week in late May 2014. Subsequent VOC mass recovery rates have remained 10 gallons per week or less. During and after pulsed operations, VOC mass recovery rates averaged 4 gallons per week for the 5 weeks ending 8/31/14 and continued at a constant rate of 2 gallons per week for the next 3 weeks ending 9/21/2014. This 2 gallon recovery in an individual week is less than 0.2% of the total of 1,121 gallons of VOCs removed during this Phase. Additionally, the rate of recovery of 2 gallons per week during the 3 weeks ending 9/21/2014 is less than 2% of the original rate of 125 gallons per week in January 2014. (See the plots of VOC gallons removed on Slides 6 and 7 of the enclosure.) The slope of the VOC recovery rate curve has approached zero at a slow rate of change, therefore, the curve is asymptotic.

2. "Asymptotic conditions will be identified based on visual inspection of data plots showing...TCE vapor concentration versus time for individual vapor recovery wells."

Met: The combined header vapor concentrations have decreased from an average of 14,385 parts per million vapor the week ending January 21, 2014, to approximately 14 parts per million vapor for the week ending September 21, 2014. (See the VOC concentration trends in the combined vapor header as shown on Slides 8, 9, and 17 of the enclosure.) Total VOC levels in the combined vapor header have remained consistently low for several weeks.

The VOC concentrations from individual vapor wells with the highest concentrations show similar asymptotic decreases. (See slides 11 through 16 of the enclosure for VOC concentration trends in the subset of vapor wells in the vicinity of the former TCE transfer pump and TCE storage tank, which are the six wells with highest measured VOC concentrations.) The slope of the VOC concentration versus time curves have approached zero at a slow rate of change for measurements at the combined header and for measurements in individual wells, therefore, the curves are asymptotic.

DOE requests an expedited review and concurrence that the remediation goals have been met in order to avoid unnecessary additional costs to the project, preferably prior to or no later than October 17, 2014. Once DOE receives concurrence, heating in the vicinity of C-400 will cease. As a best management practice, DOE will continue to operate the vapor extraction system for up to 30 days after the electrodes are de-energized or until the subsurface has cooled sufficiently to allow post-operation sampling activities.

If you have any questions, or require additional information, please contact David Dollins at (270) 441-6819.

Sincerely,



Jennifer Woodard
Federal Facility Agreement Manager
Portsmouth/Paducah Project Office

Enclosure:

C-400 Phase IIA System Review Presentation

e-copy w/enclosure:

brian.begley@ky.gov, KDEP/Frankfort
craig.jones@lataky.com, LATA/Kevil
darla.bowen@lataky.com, LATA/Kevil
dave.dollins@lex.doe.gov, PPPO/PAD
gaye.brewer@ky.gov, KDEP/PAD
jennifer.woodard@lex.doe.gov, PPPO/PAD
kim.knerr@lex.doe.gov, PPPO/PAD
latacorrespondence@lataky.com, LATA/Kevil
leo.williamson@ky.gov, KDEP/Frankfort
mark.duff@lataky.com, LATA/Kevil
mike.guffey@ky.gov, KDEP/Frankfort
myrna.redfield@lataky.com, LATA/Kevil
pad.dmc@swiftstaley.com, SST/Kevil
paula.spear@lataky.com, LATA/Kevil
reinhard.knerr@lex.doe.gov, PPPO/PAD
richard.bonczek@lex.doe.gov, PPPO/LEX
rob.seifert@lex.doe.gov, PPPO/PAD
stephaniec.brock@ky.gov, KYRHB/Frankfort
todd.mullins@ky.gov, KDEP/Frankfort
tufts.jennifer@epa.gov, EPA/Atlanta



C-400 Phase IIa System Review

9/21/2014

System Performance Relative to Remedial Goals

Temperature

VOCs Removed

Vapor Concentration

Summary of Operations (through 9/21/2014)



Operations

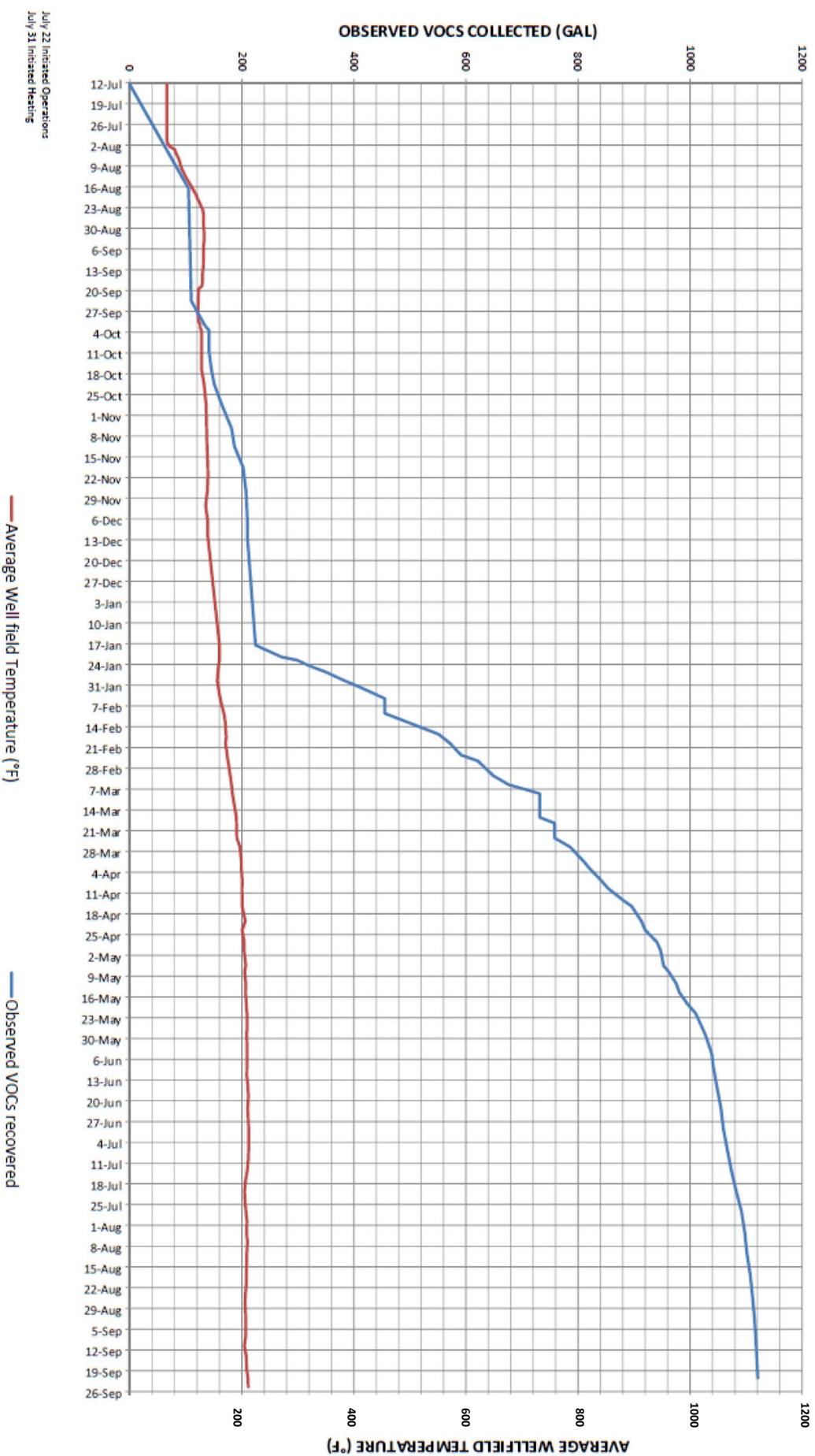
- ❑ Began heating system operation 7/30/2013
- ❑ Began pulsing 7/28/2014: completed pulsing 9/9/2014
- ❑ Approximately 1,121 gallons of VOCs captured by carbon system as of 9/21/2014
- ❑ Mass removal weeks ending 9/7/2014–9/21/2014 \approx 2 gallons per week
- ❑ Mass removal rate averaged \approx 7 gallons per week from 6/1/2014–7/27/2014 (9 weeks)
- ❑ Mass removal rate averaged \approx 4 gallons per week from 8/4/2014–8/31/2014 (5 weeks)

Temperature in Treatment Zone (20–60' bgs)

- ❑ Achieved target temperature for the treatment zone on average in mid–March
- ❑ Achieved target temperature at each 3' depth interval in mid–June
- ❑ Continue to achieve average target temperatures at each depth;
- ❑ Pulsing and other operational changes cause some digiTAMs to show temperatures below targets, especially shallow and deep
- ❑ Average treatment zone temperature (9/7/2014): 207°F
 - Shallow Average (21–33' bgs): 203°F
 - Middle Average (33–51' bgs): 209°F
 - Deep Average (51–60' bgs): 209°F

System VOC Removal and Temperatures (through 9/21/2014)

C-400 PHASE IIA OBSERVED VOLATILE ORGANICS COLLECTED/TEMPERATURE TRENDS



Timeline (through end of pulsing, 9/9/2014)



Date	Event
7/22/2013	System operating
7/30/2013	Heating initiated
7/30/2013- 1/13/2014	Shakedown, operation, troubleshoot/repair operational, mechanical, and weather-related issues; ~220 gallons VOCs removed through 1/13/2014
1/14/2014	Full system restart (94% uptime since 1/14/2014 restart)
1/20/2014	1 st week of operation after restart yields 125 gals of VOCs removed; combined header concentration 1st-week after restart average of 14,395 ppmv
<i>mid-March</i>	<i>Average temperature in treatment zone exceeds target</i>
week of 6/1/2014	First of nine weeks that average ~7 gallons per week VOC removal
<i>mid-June</i>	<i>90%+ digiTAMs exceed respective depth-specific targets in treatment zone</i>
7/28/2014	Initiated pulsing
week of 8/4/2014	First of five weeks that average ~4 gallons per week VOC removal
9/9/2014	Pulsing complete; Total of 1,117 gallons VOCs recovered (2 gallons recovery week ending 9/7/2014 [$<0.2\%$ of total]); Weeks ending 8/4/2014-8/31/2014, weekly average recovery of 4 gallons VOCs; Week ending 9/7/2014 combined header concentrations ~15 ppmv (~0.1% of first week vapor header concentrations)

System Performance vs. Target Temperatures

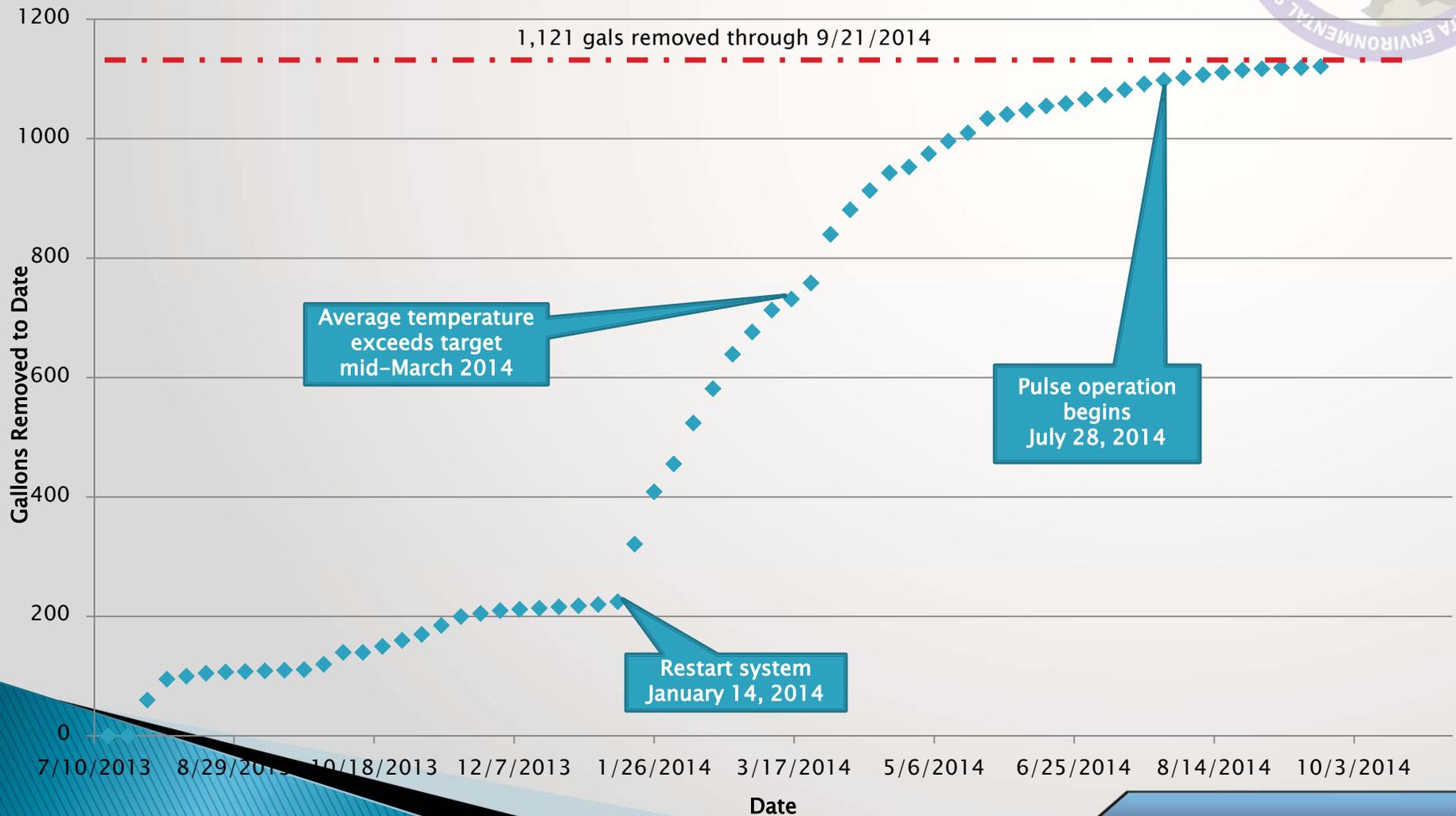
July 6, 2014 (prior to pulsing)



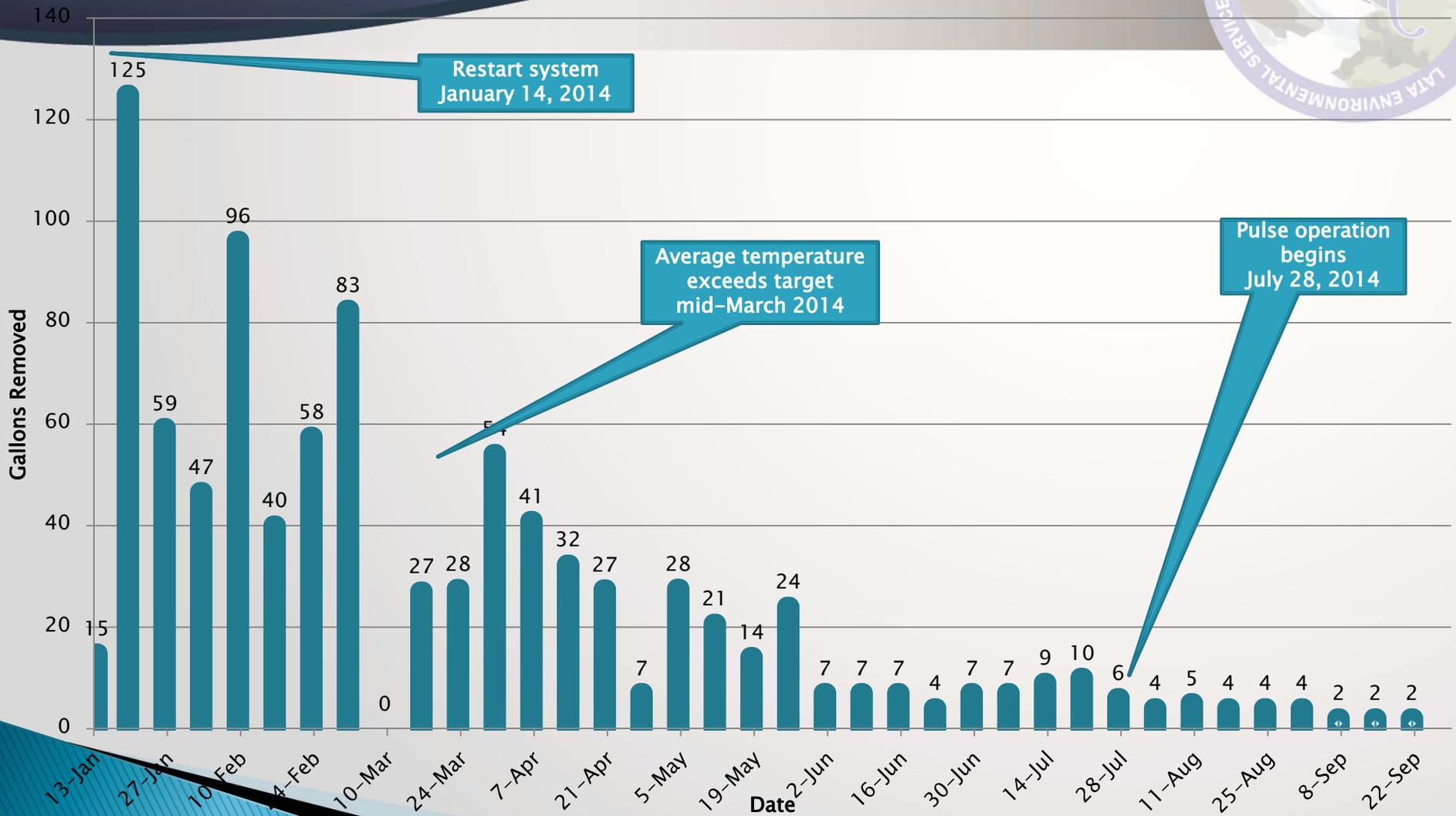
- ❑ Average temperature in treatment zone (20–60' bgs) exceeds goal
- ❑ 90+% of digiTAMs at each level exceed respective goal from 20–60' bgs

Depth Zone	Depth (ft bgs)	Target Temperature (°F)	Average Temperature at Depth (°F)	%> Target	Criterion
Shallow	21-24	194	209	97%	Above potentiometric surface
Shallow	24-27	194	210	97%	Above potentiometric surface
Shallow	27-30	194	211	100%	Above potentiometric surface
Shallow	30-33	194	211	100%	Above potentiometric surface
Medium	33-36	194	211	100%	Above potentiometric surface
Medium	36-39	194	212	100%	Above potentiometric surface
Medium	39-42	194	212	100%	Above potentiometric surface
Medium	42-45	194	213	100%	Above potentiometric surface
Medium	45-48	194	213	100%	Above potentiometric surface
Medium	48-51	194	214	100%	Above potentiometric surface
Deep	51-54	189-194	215	100%	~At potentiometric surface
Deep	54-57	196	217	100%	Below potentiometric surface
Deep	57-60	198	211	90%	Below potentiometric surface

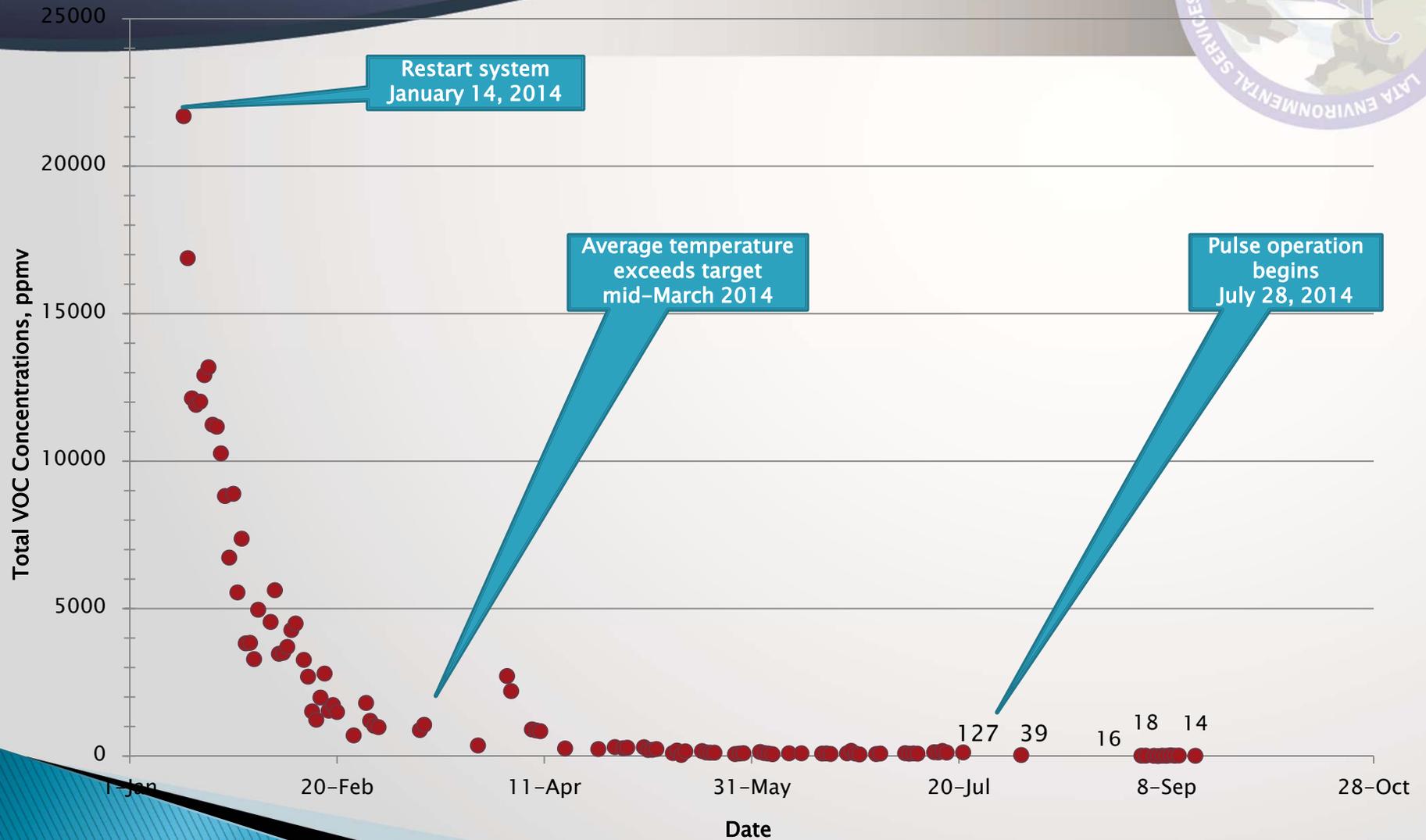
System Performance - VOC (TCE and Breakdown Products) Cumulative Gallons Removed



System Performance - VOC (TCE and Breakdown Products) Gallons Removed per Week



System Performance - Vapor Header VOC Concentration (TCE and Breakdown Products)



Summary



Operations

- ❑ Began heating system operation 7/30/2013
- ❑ Began pulsing 7/28/2014: completed pulsing 9/9/2014
- ❑ Approximately 1,121 gallons of VOCs captured by carbon system as of 9/21/2014
- ❑ Mass removal per week has decreased to ~2 gallons (<0.2% of total removed)
- ❑ Mass removal has reached asymptotic conditions

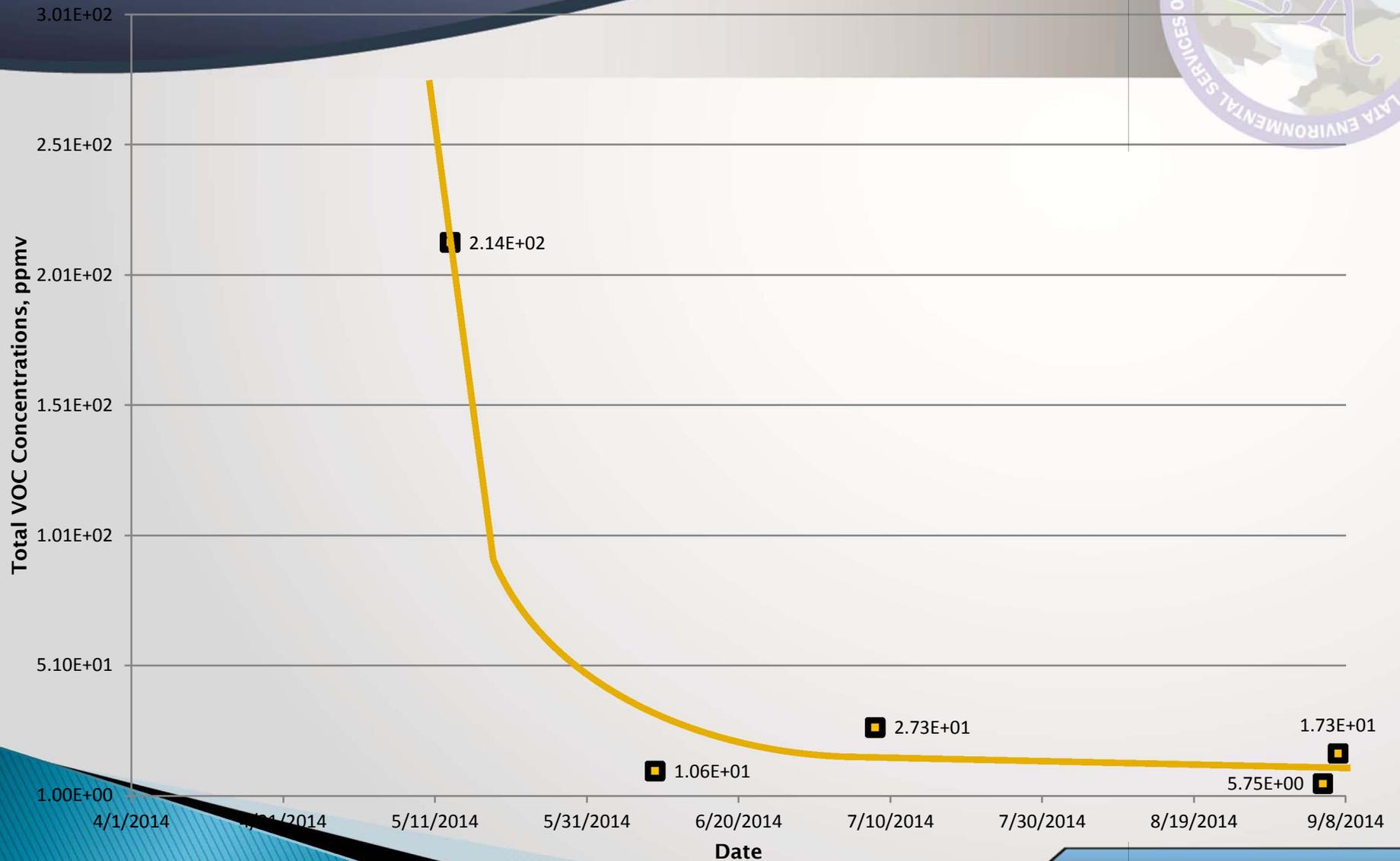
Temperature in Treatment Zone (20–60' bgs)

- ❑ Achieved target temperature on average in mid-March
- ❑ Achieved target temperature at each depth in mid-June
- ❑ Average temperatures exceeded goals at all elevations
- ❑ Temperatures sufficient to allow mass removal to reach asymptotic conditions

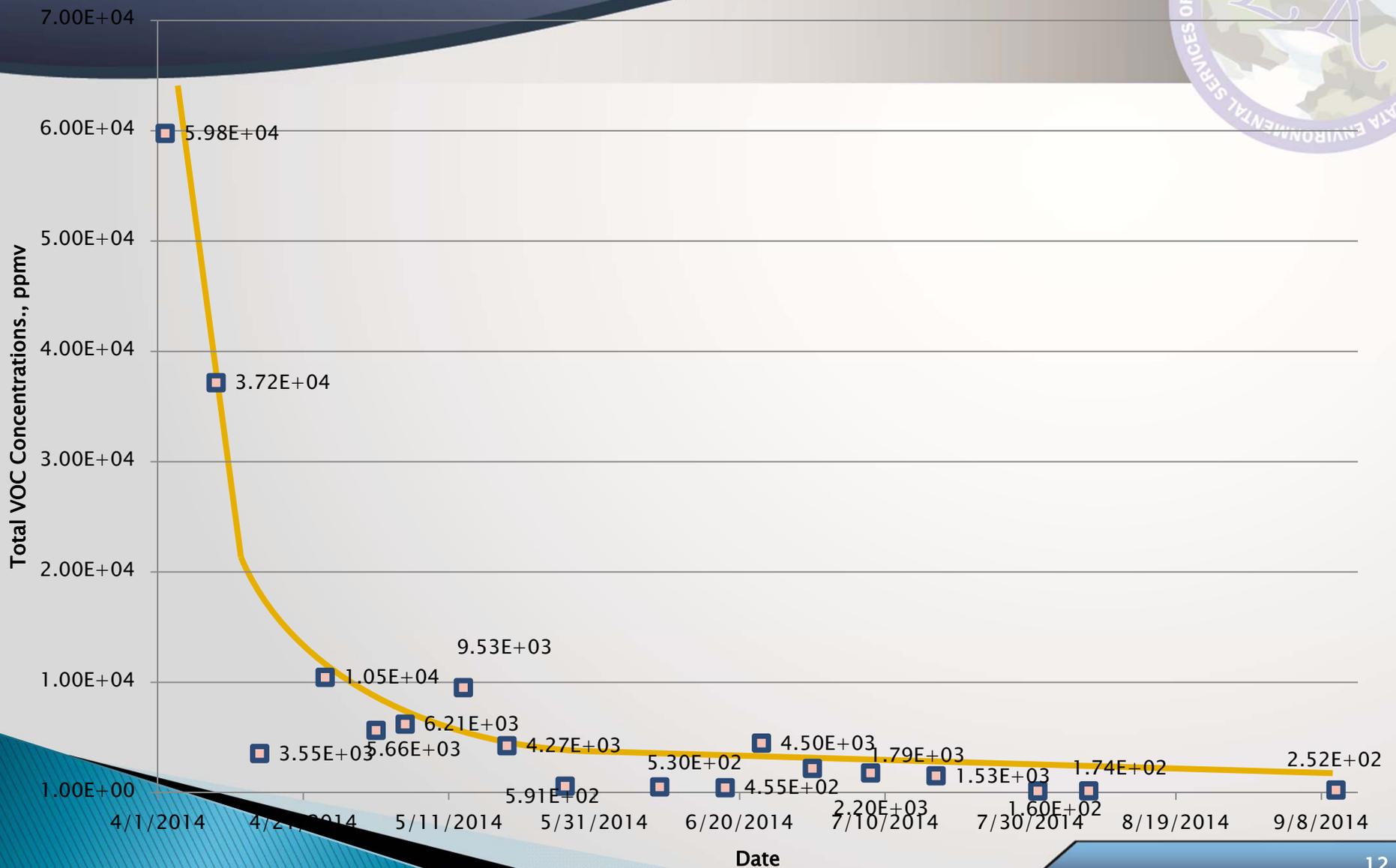
Vapor Concentrations

- ❑ Combined header vapor concentrations have decreased from a first week average (after restart) of 14,385 ppmv to ~15 ppmv
- ❑ Individual vapor wells with the highest concentrations have had concentrations decrease to a small percentage of their maximum concentrations

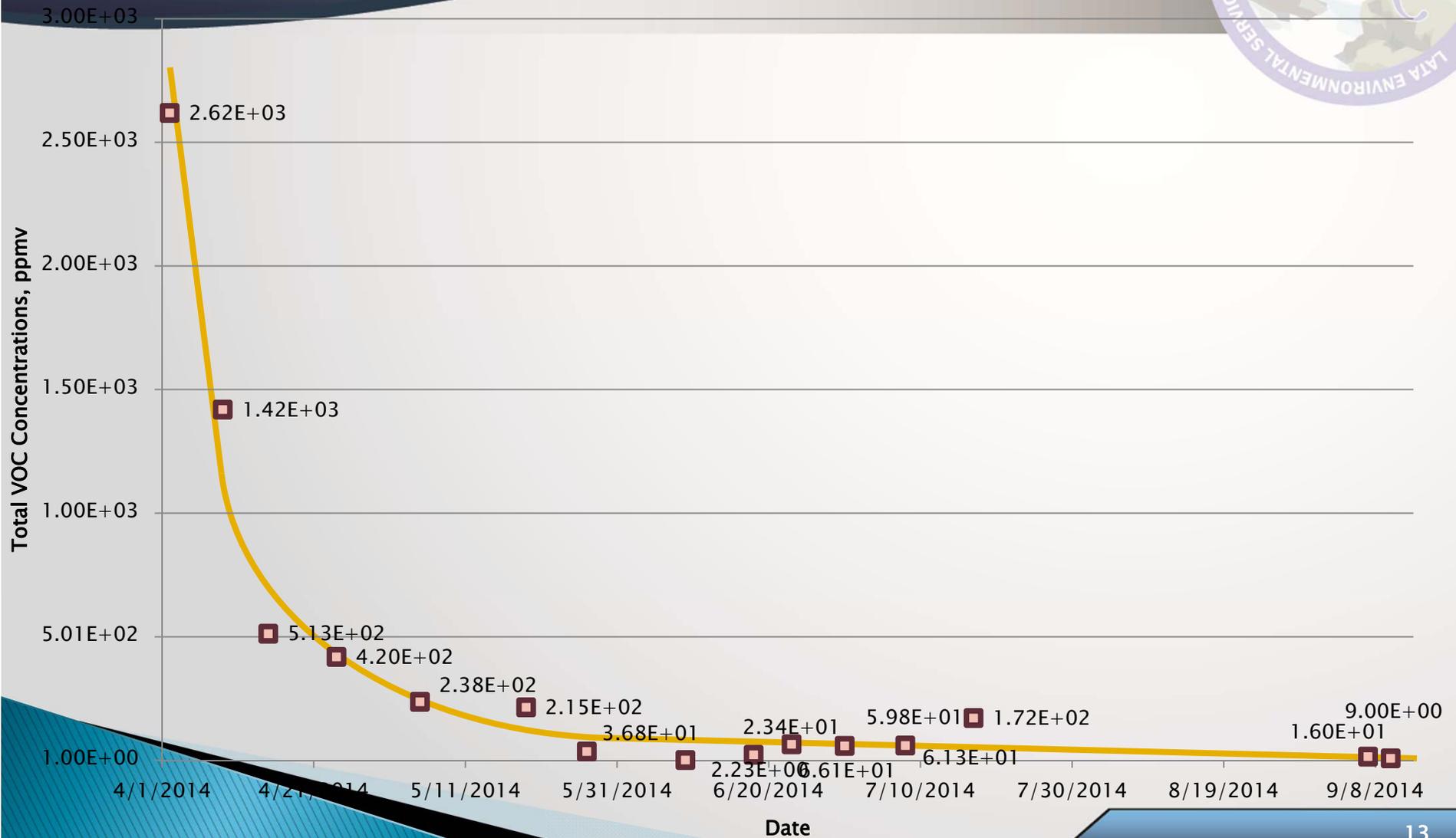
Individual Vapor Wells with Highest Concentrations vs. Time VX206, since 4/1/2014



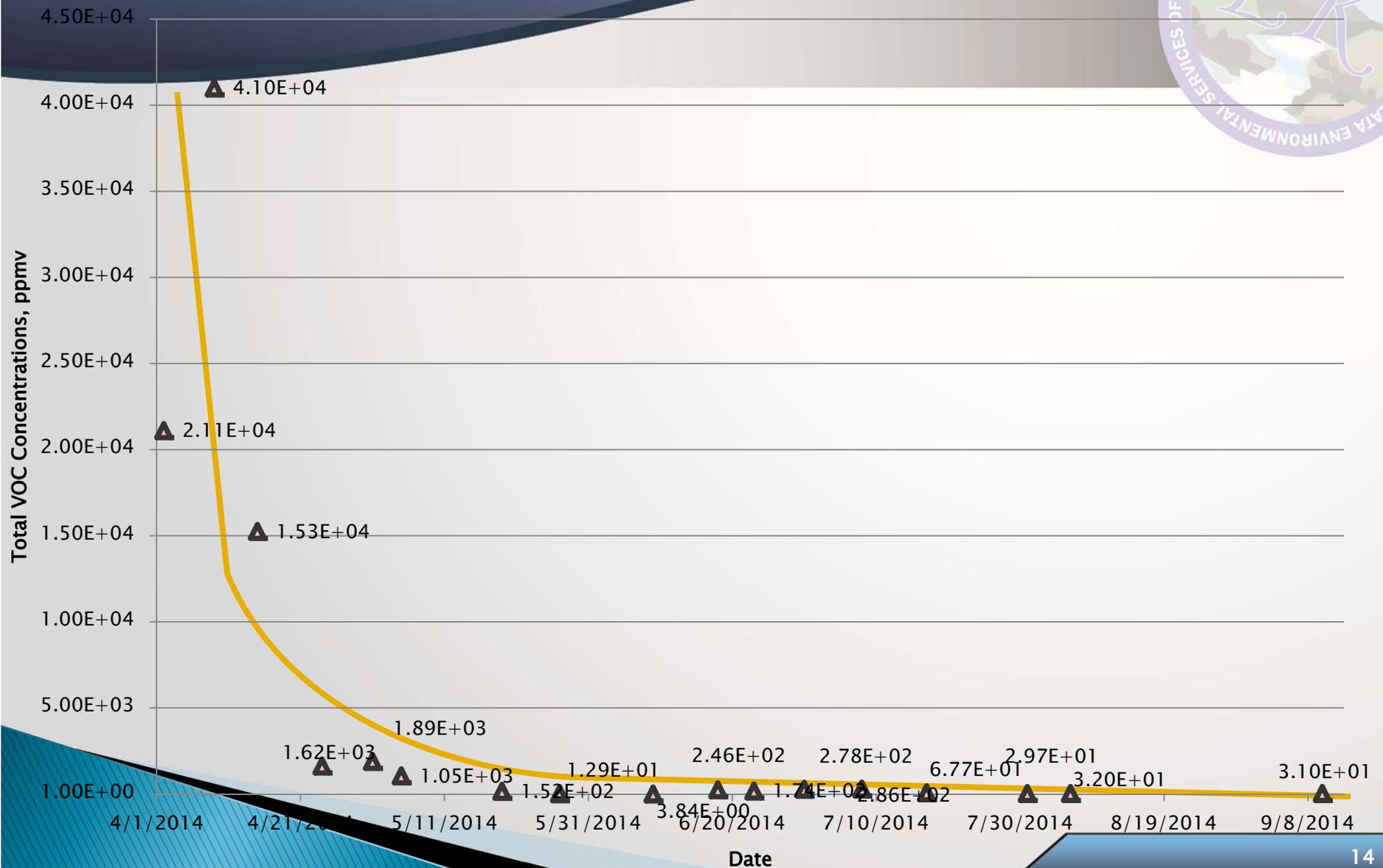
Individual Vapor Wells with Highest Concentrations vs. Time VX208, since 4/1/2014



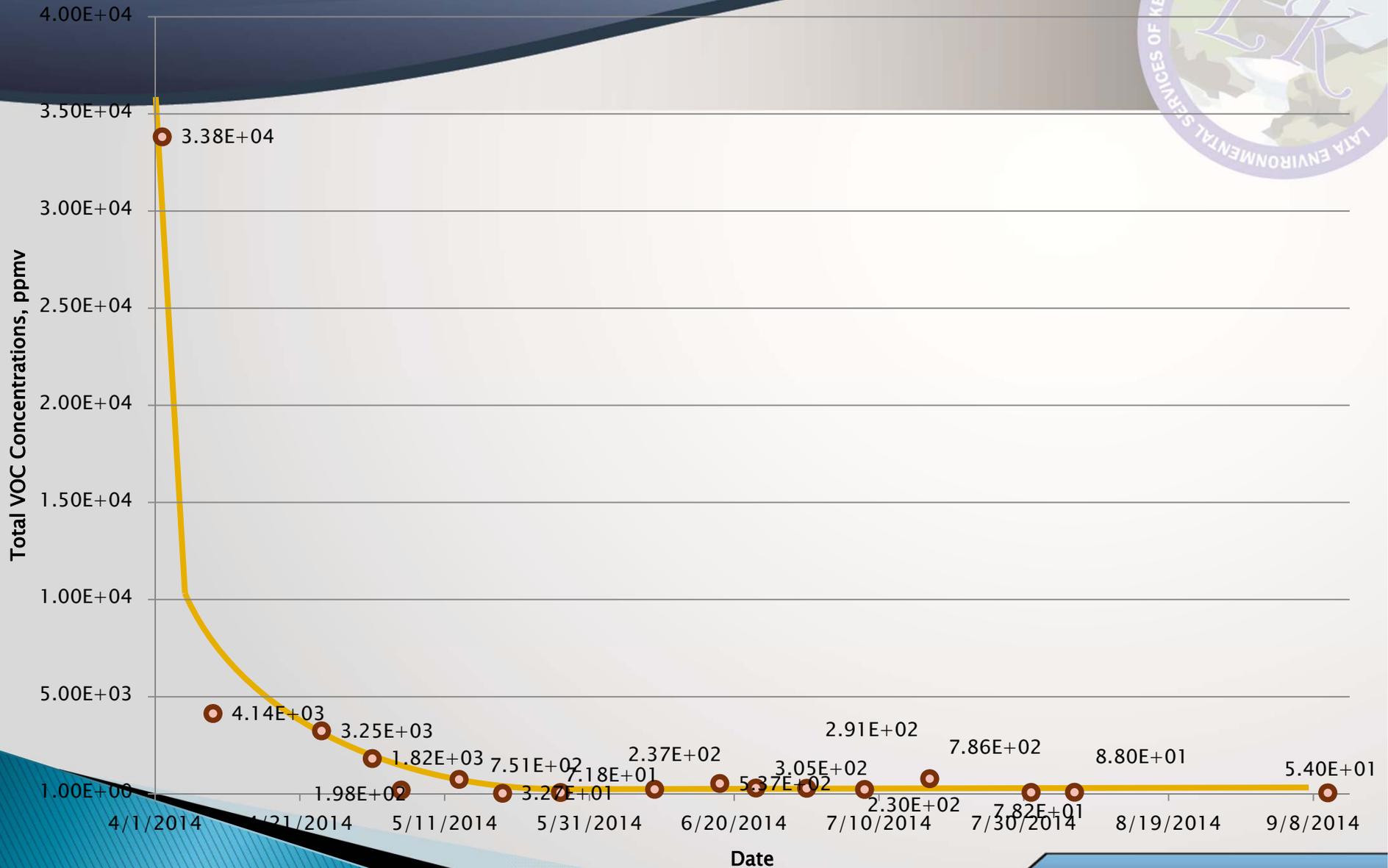
Individual Vapor Wells with Highest Concentrations vs. Time X215, since 4/1/2014



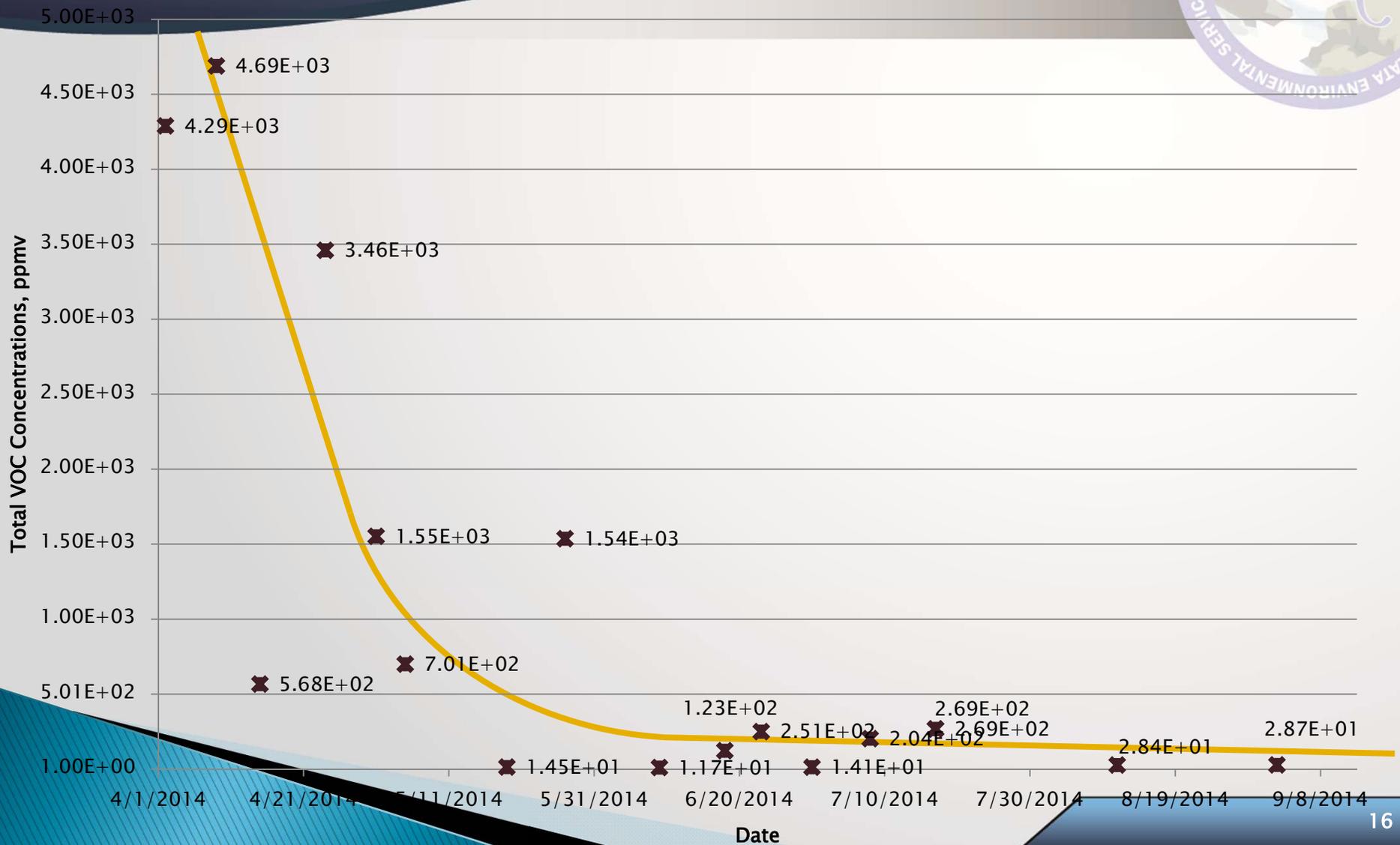
Individual Vapor Wells with Highest Concentrations vs. Time X216, since 4/1/2014



Individual Vapor Wells with Highest Concentrations vs. Time X217, since 4/1/2014



Individual Vapor Wells with Highest Concentrations vs. Time X218, since 4/1/2014



Discussion of Temperature Targets



- ❑ Temperature targets were set conservatively
 - ❑ Targets set 5°F > normal TCE boiling point ($189^{\circ}\text{F} + 5^{\circ}\text{F} = 194^{\circ}\text{F}$)
 - ❑ TCE-water azeotrope has lower normal boiling point (160°F)
 - ❑ TCE boiling point at -12" Hg estimated at 167°F
 - ❑ TCE-water azeotrope boiling point at -12" Hg estimated at 140°F

- ❑ Achieved temperatures sufficient to vaporize VOCs for recovery