Ciba-Geigy Toms River Site, Evaluation of Groundwater Extraction and Recharge System (GERS) Optimization

Marek Ostrowski, Brown and Caldwell

Jeff Caputi, Brown and Caldwell

Charles Meyn, Brown and Caldwell

Stephen Havlik, BASF Corporation

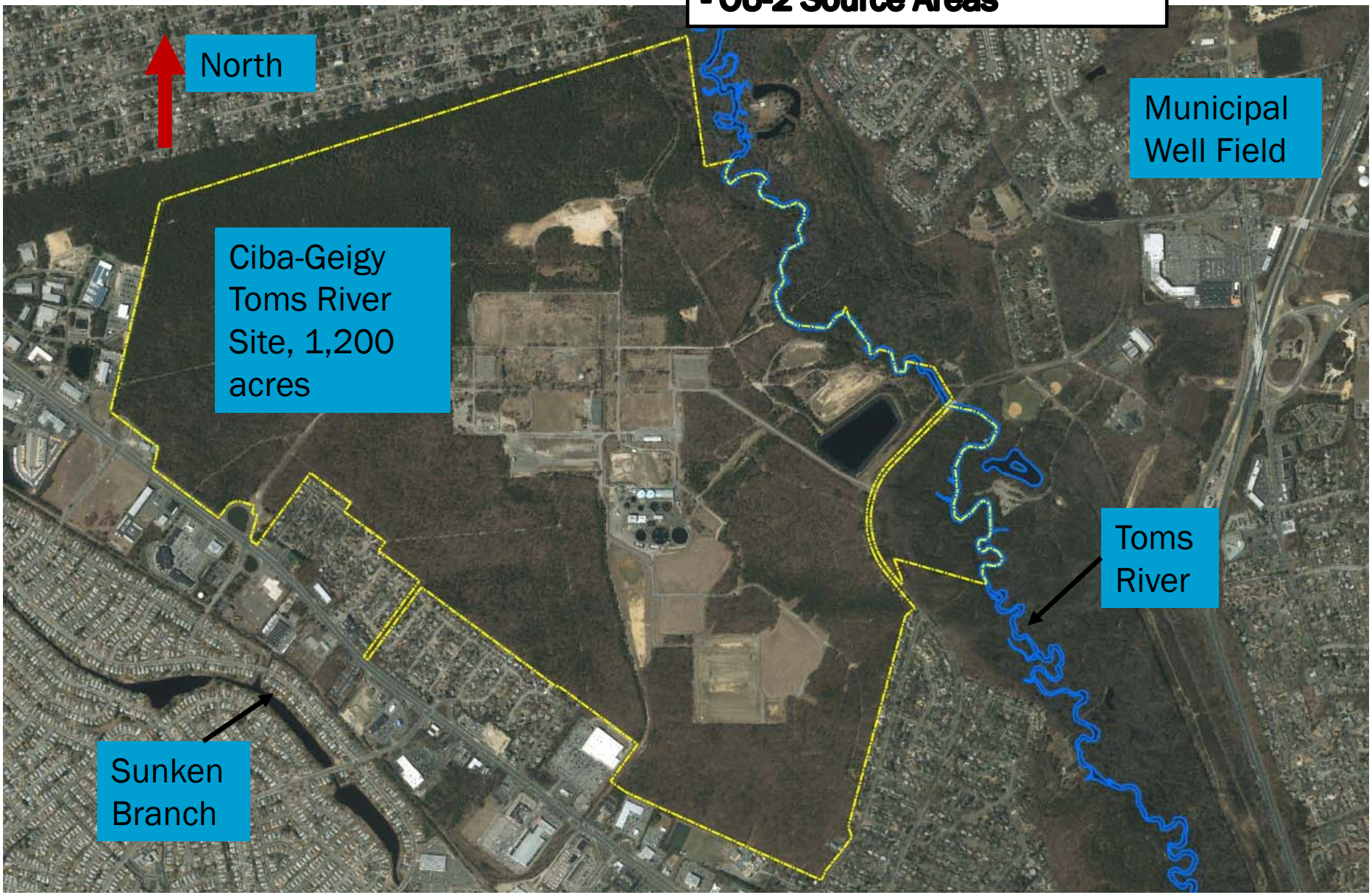
Brown AND Caldwell

- Site Background
- GERS Objectives, History and Current Operation
- Optimization Evaluation
- Summary and Recommendations
- Post-Implementation Benefits and Lessons Learned

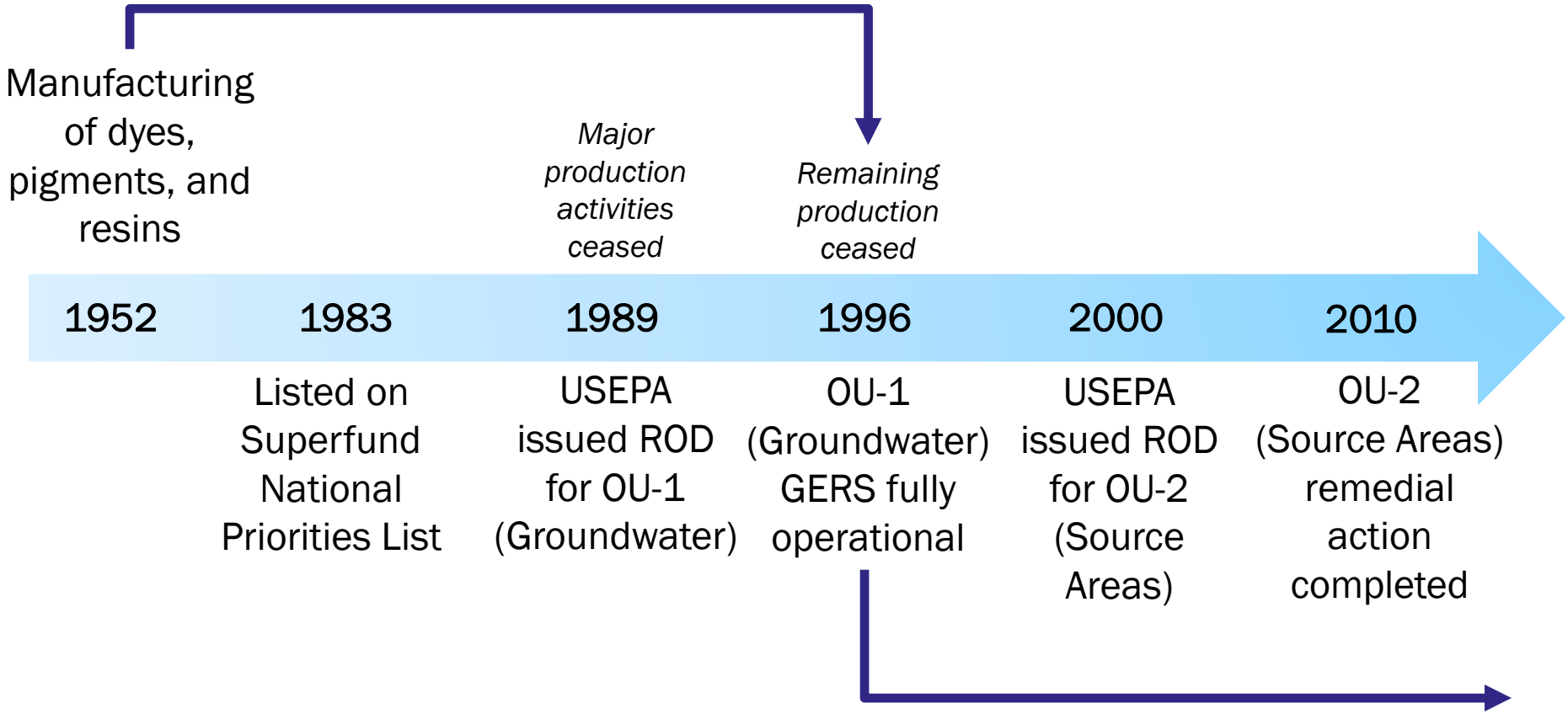
Brown AND Caldwell

Toms River Site

Two Operable Units:
- OU-1 Groundwater
- OU-2 Source Areas



Toms River Site

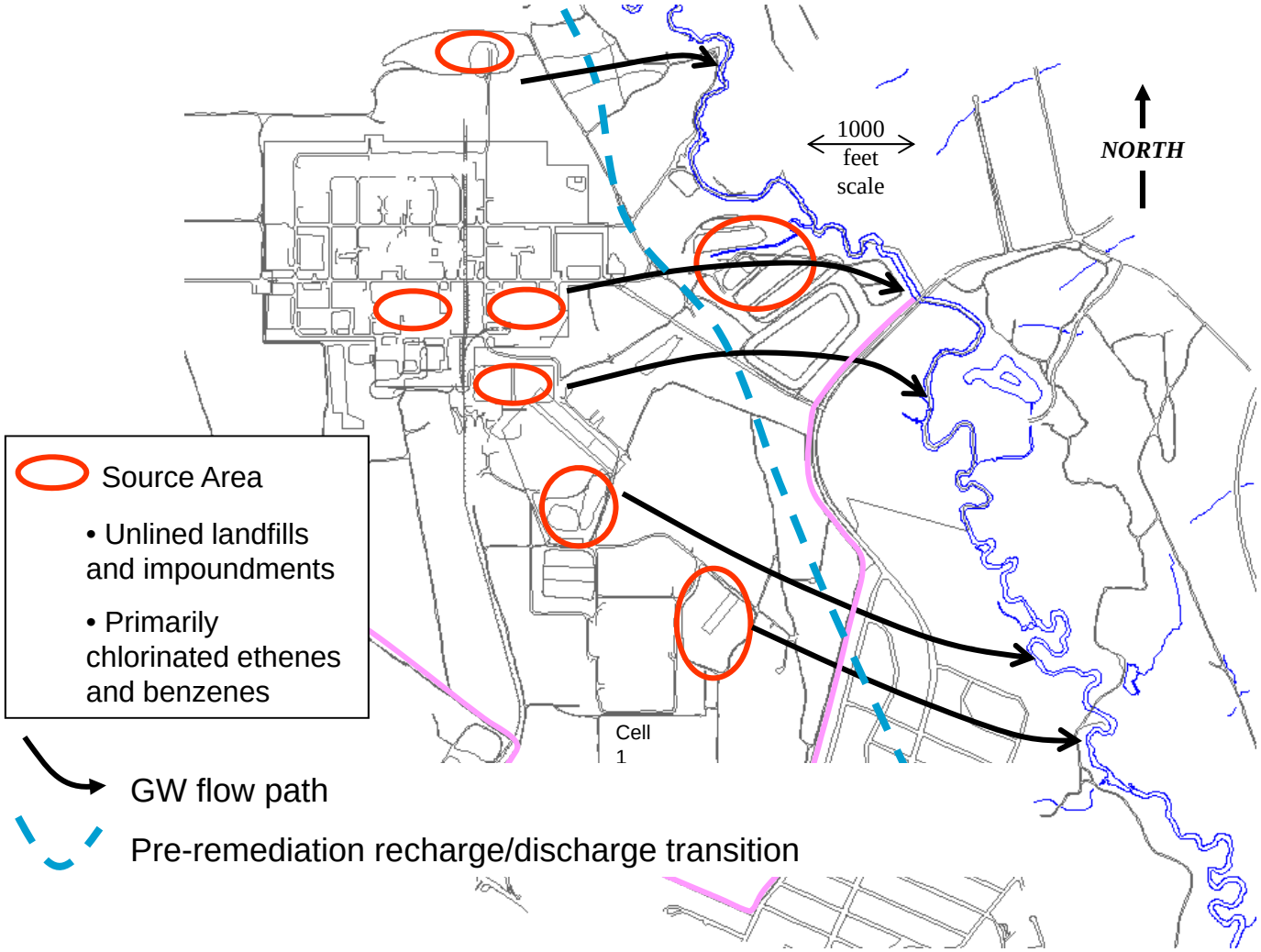


Wildlife Habitat Council Certification

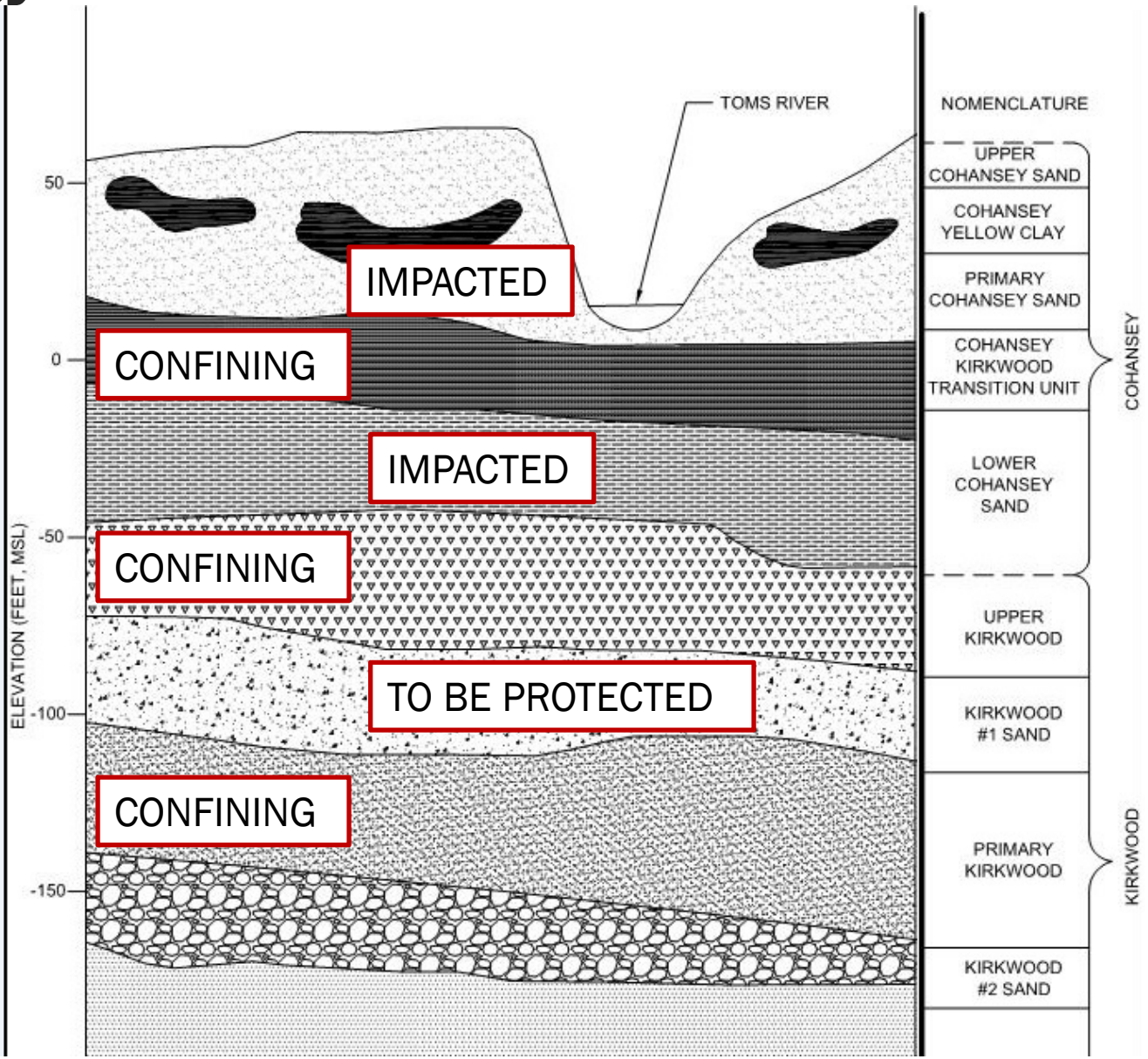
- 24 acres of grassland
- Large part is forested

Community Outreach

Source Areas and Original Flow Pattern



Geology


TOMS RIVER
NOMENCLATURE
IMPACTED
CONFINING
IMPACTED
CONFINING
TO BE PROTECTED
CONFINING
ELEVATION (FEET, MSL)
50
0
-50
-100
-150
UPPER COHANSEY SAND
COHANSEY YELLOW CLAY
PRIMARY COHANSEY SAND
COHANSEY KIRKWOOD TRANSITION UNIT
LOWER COHANSEY SAND
UPPER KIRKWOOD
KIRKWOOD #1 SAND
PRIMARY KIRKWOOD
KIRKWOOD #2 SAND
COHANSEY
KIRKWOOD

GERS Objectives, History and Current Operation

Brown AND Caldwell

GERS Background/Objectives

1989 ROD for OU-1 (Groundwater)

Objectives/Goals

- Protect water quality in the Toms River
- Protect water quality in the Kirkwood aquifer (well field)
- Mass Removal (to the extent practicable)

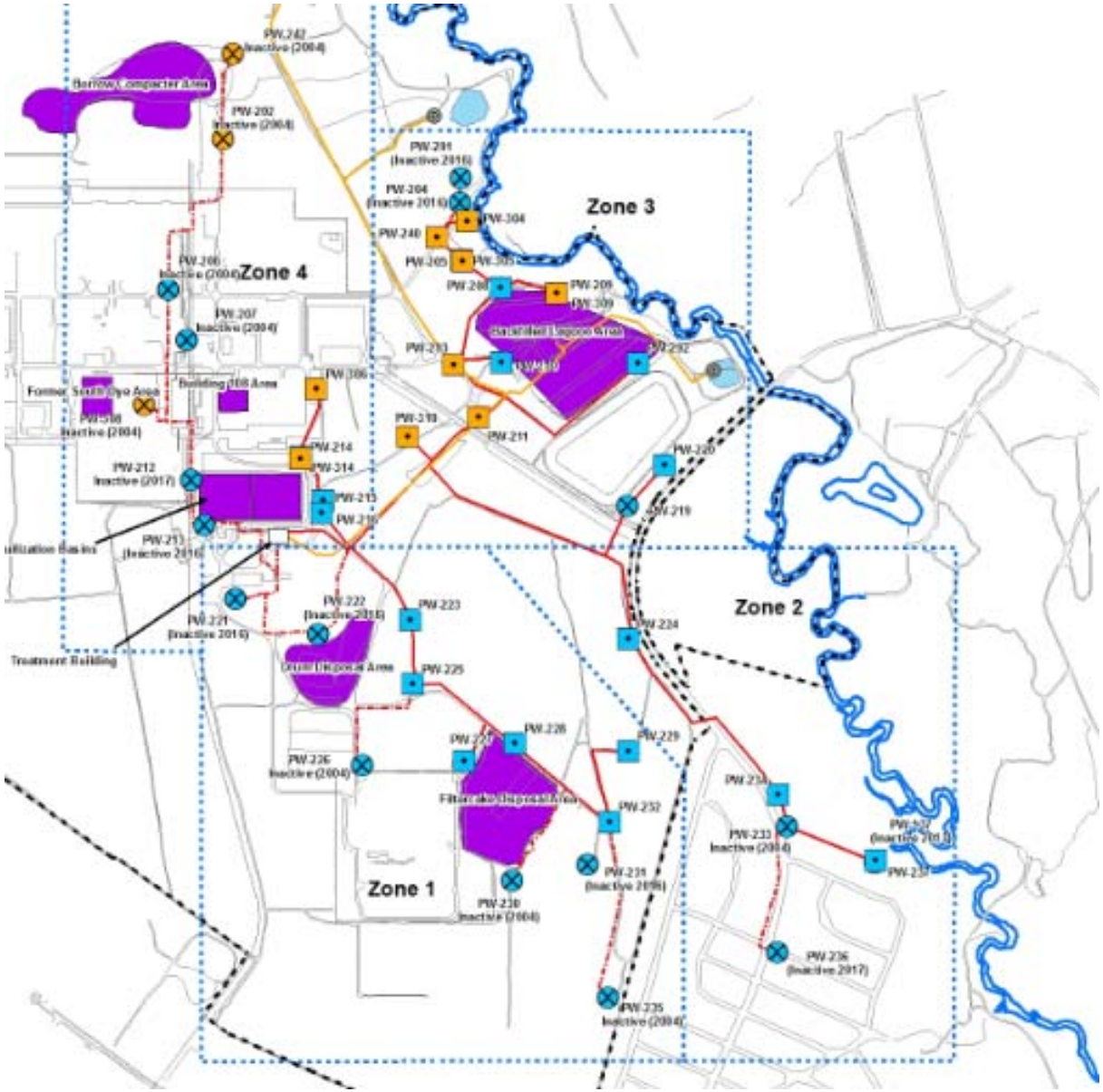
Groundwater Extraction and Recharge System (GERS)

- Capture/contain plume (440 acres in 1996 – current size 280 acres)
- 43 extraction wells
- 10,000 linear feet of piping
- 2,700 gpm treatment system
- 7 acres of recharge basins

2010 ROD for OU-2 (Sources) includes GERS optimization

GERS Map

- GERS on line in 1996
- Originally 43 wells
- In 2003-2004, 9 wells idled and 3 wells installed
- Pre-optimization GERS included 37 active wells: 28 screened in the PCOH and 9 screened in the LCOH

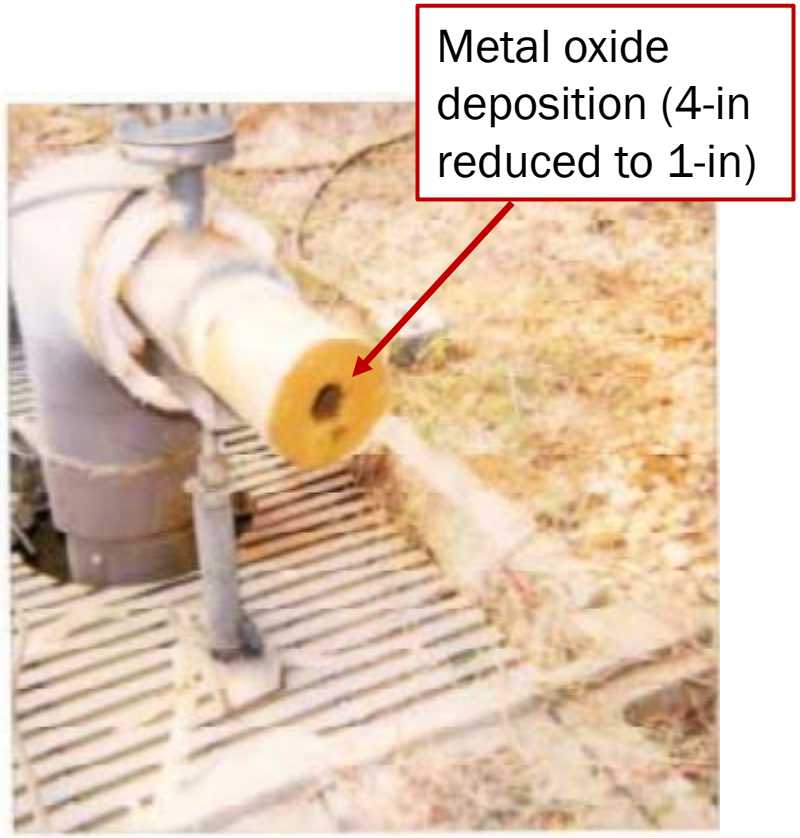


GERS Pre-optimization Operation

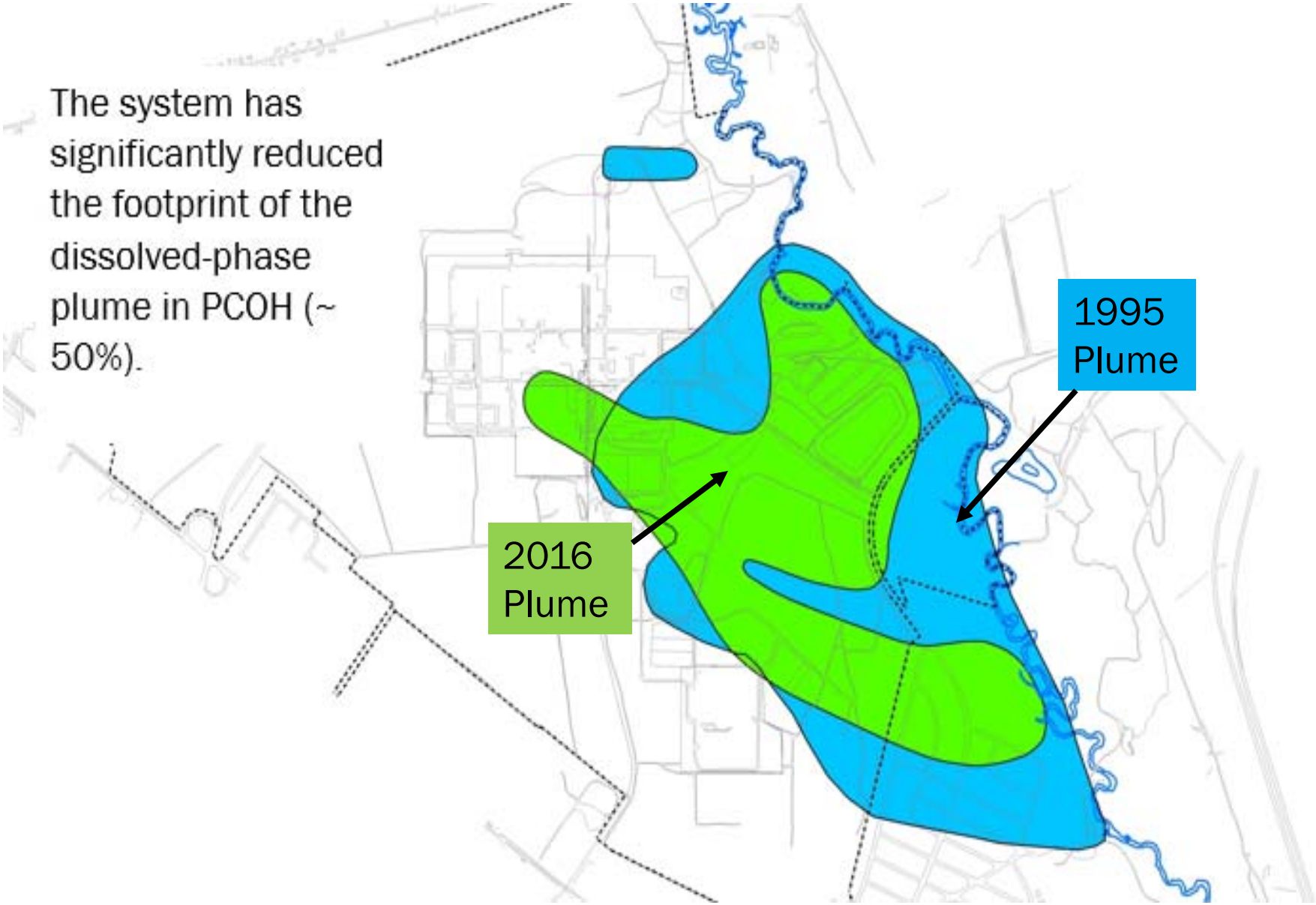
- Extraction Rate (Q): 1,200 gpm
- Mass removal: 3,000 lbs/yr
- Source Area Wells (1,000 to 10,000 ppb):
  - 50% of Q
  - >90% of mass
- Non-source Area Wells (<100 ppb):
  - 50% of Q
  - <10% of mass

Current GERS Operation

- Q impacted by clogging due to deposition of metal oxides (high iron)
- High annual maintenance:
  - Well redevelopment ~ 5 to 20
  - Pump replacement ~ 10 to 50
  - Pipe jetting



The system has significantly reduced the footprint of the dissolved-phase plume in PCOH (~ 50%).



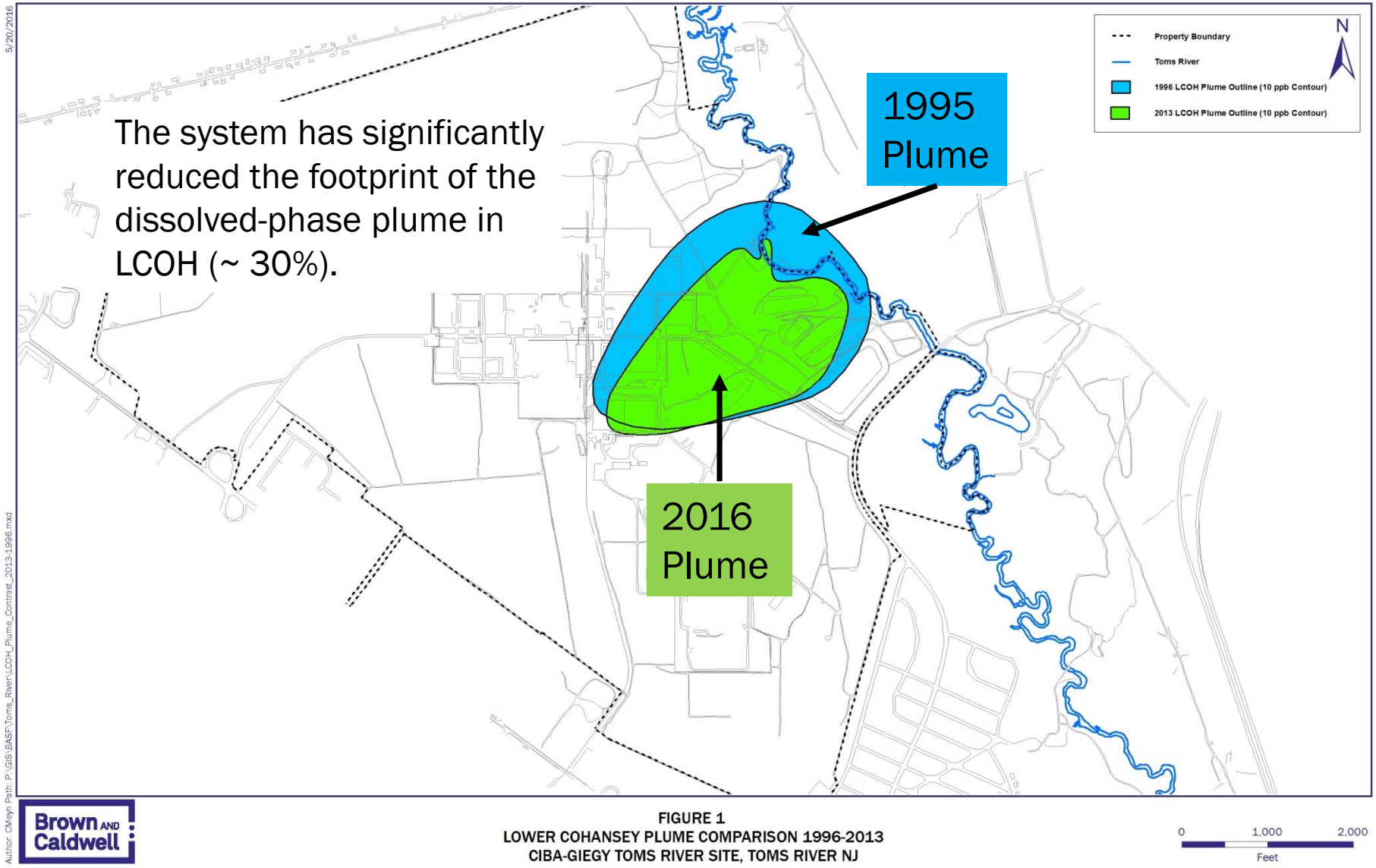


FIGURE 1
LOWER COHANSEY PLUME COMPARISON 1996-2013
CIBA-GIEGY TOMS RIVER SITE, TOMS RIVER NJ

Optimization Evaluation

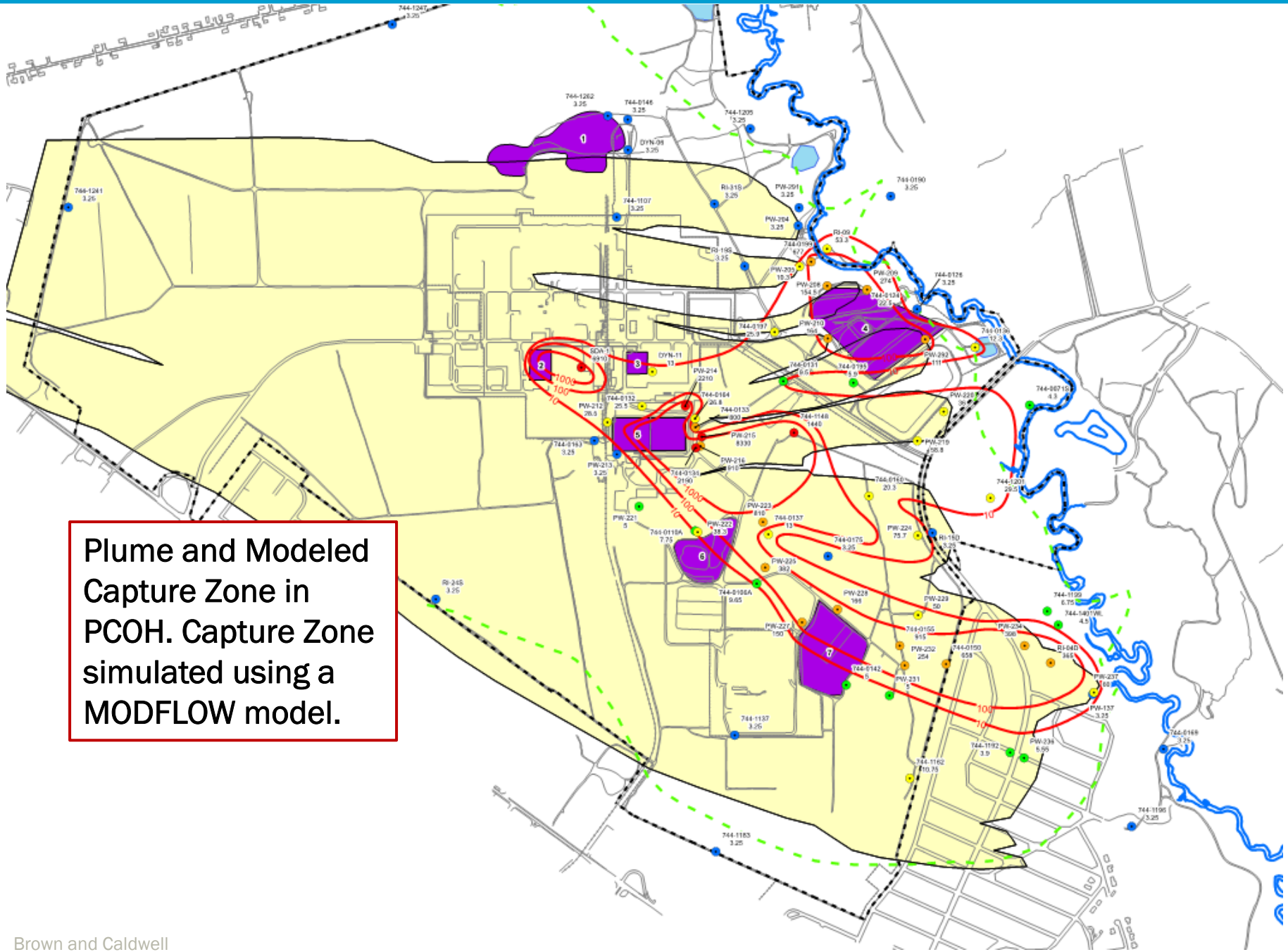
Brown AND Caldwell

Basis and Objectives of GERS Optimization

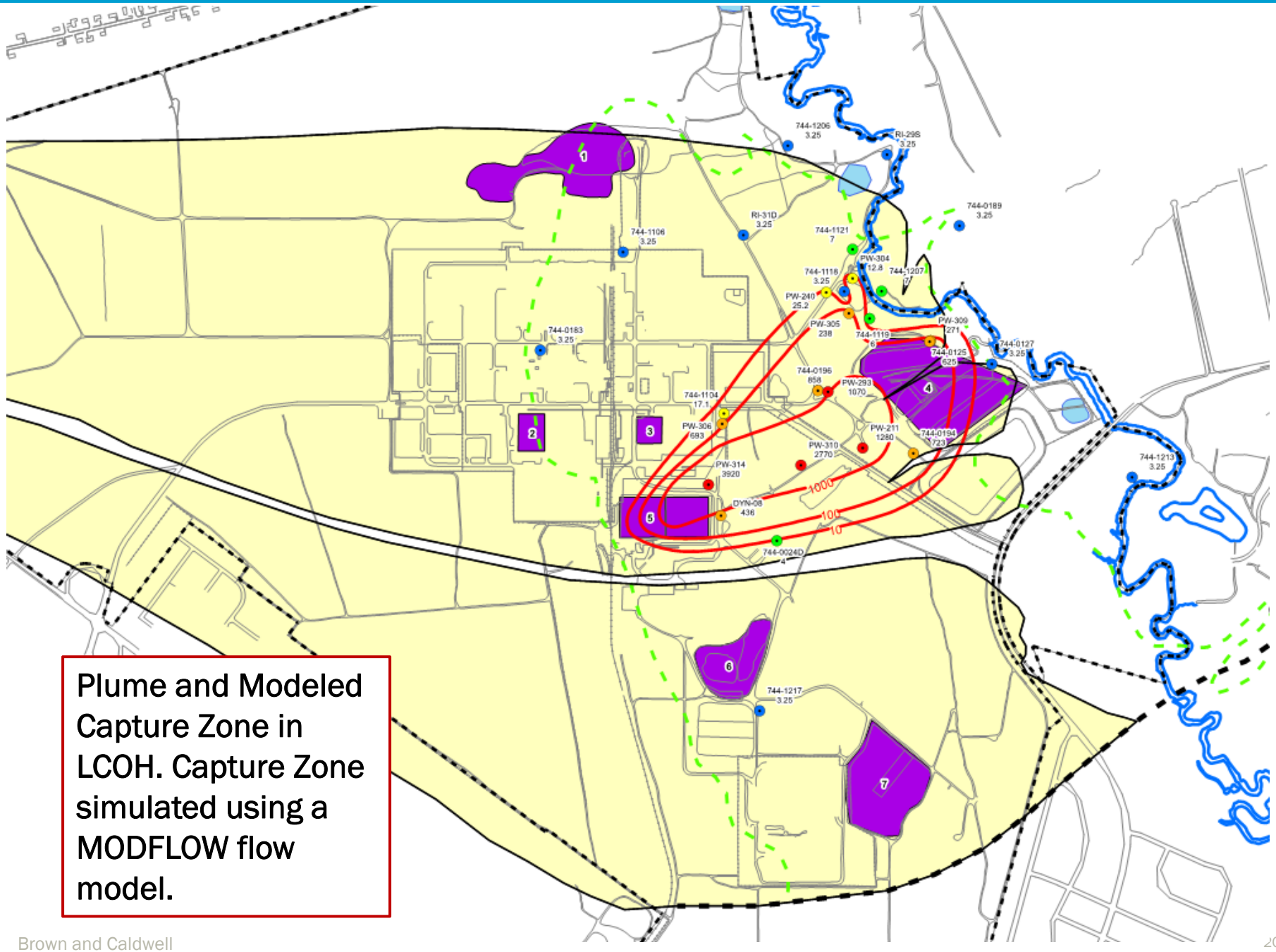
- Plumes have decreased in size, so the system can be adjusted to the new conditions.
- GERS optimization is a requirement of the OU-2 ROD.
- GERS needs to continue satisfying the applicable regulatory requirements.
- Phased approach to GERS optimization:
  - Short-term: Identify/eliminate unnecessary wells (completed)
  - Longer-term: Increase mass removal and improve capture (ongoing)

Performance Relative to ROD Requirements

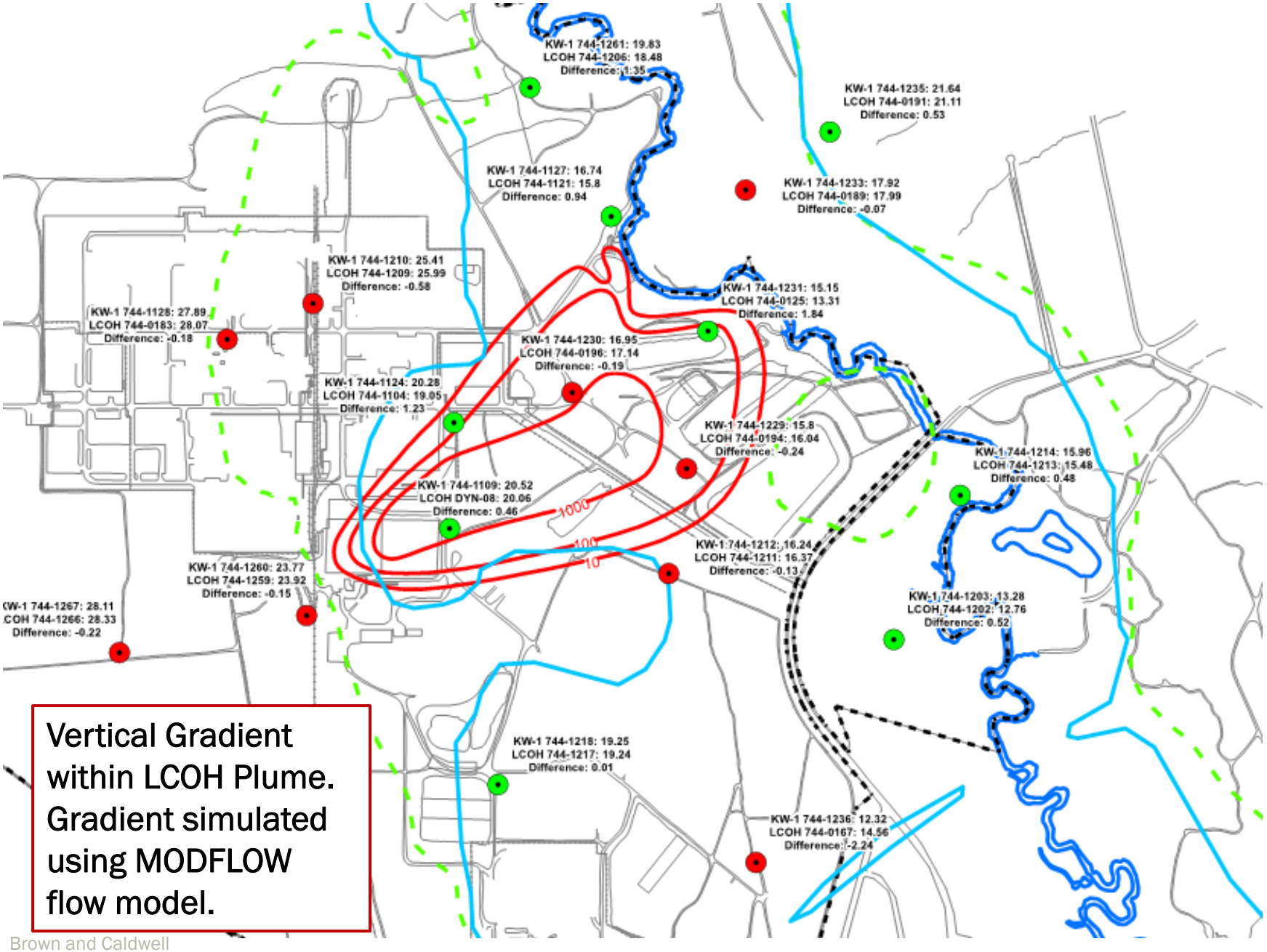
- Water Quality in Toms River
  - Capture zone in Cohansey covers majority of the plume
  - No Site impact on Toms River
- Water Quality in Kirkwood
  - Variable upward/downward gradient in the LCOH plume area
  - No Site impacts in Kirkwood
- Cohansey Restoration
  - Initially, plume size decreased from 440 ac to 280 acres
  - Concentrations have been stable for over 10 yrs



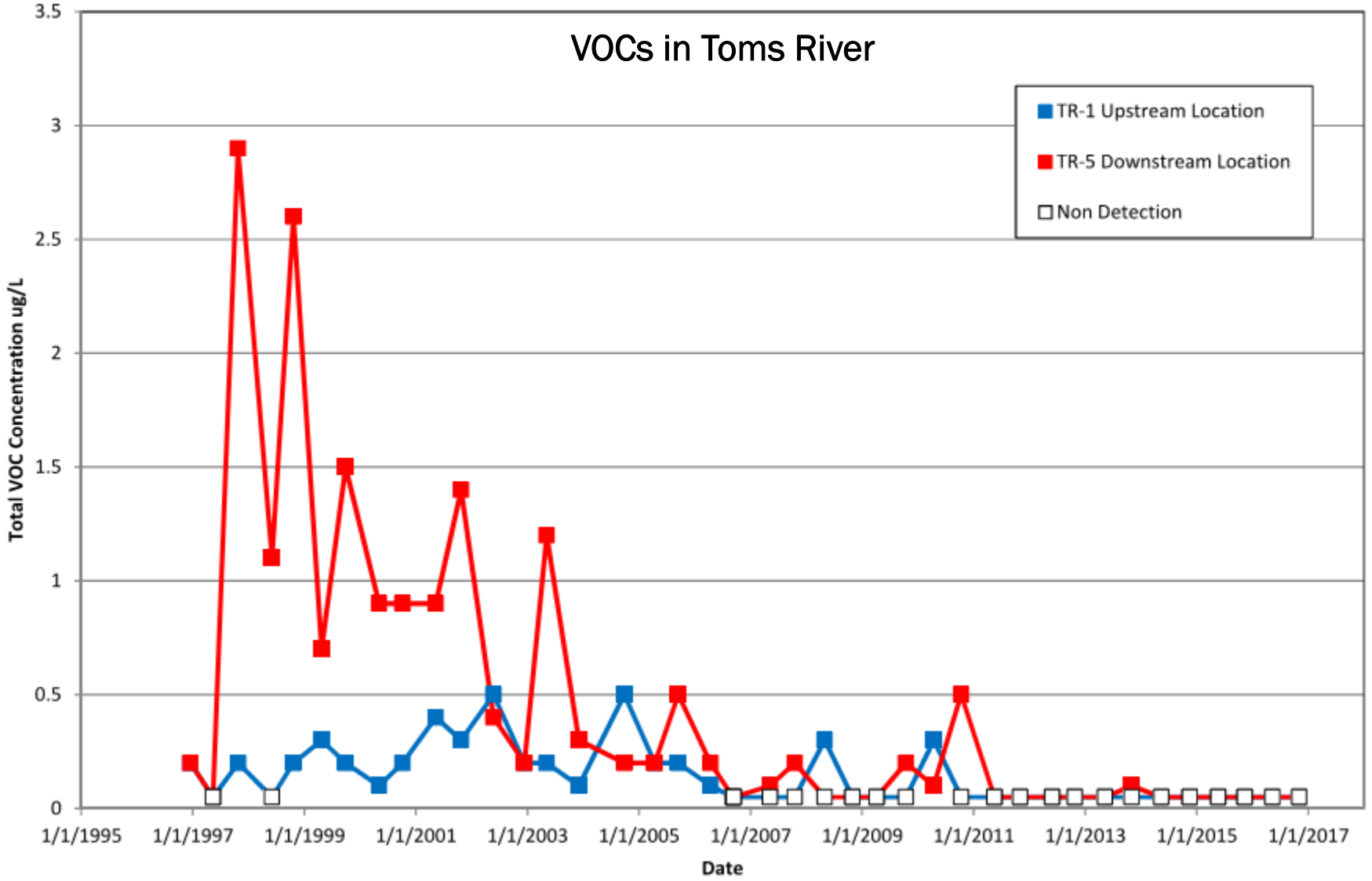
Plume and Modeled Capture Zone in PCOH. Capture Zone simulated using a MODFLOW model.



Plume and Modeled Capture Zone in LCOH. Capture Zone simulated using a MODFLOW flow model.



Vertical Gradient within LCOH Plume. Gradient simulated using MODFLOW flow model.


VOCs in Toms River
TR-1 Upstream Location
TR-5 Downstream Location
Non Detection
Total VOC Concentration ug/L
3.5
3
2.5
2
1.5
1
0.5
0
1/1/1995
1/1/1997
1/1/1999
1/1/2001
1/1/2003
1/1/2005
1/1/2007
1/1/2009
1/1/2011
1/1/2013
1/1/2015
1/1/2017
Date

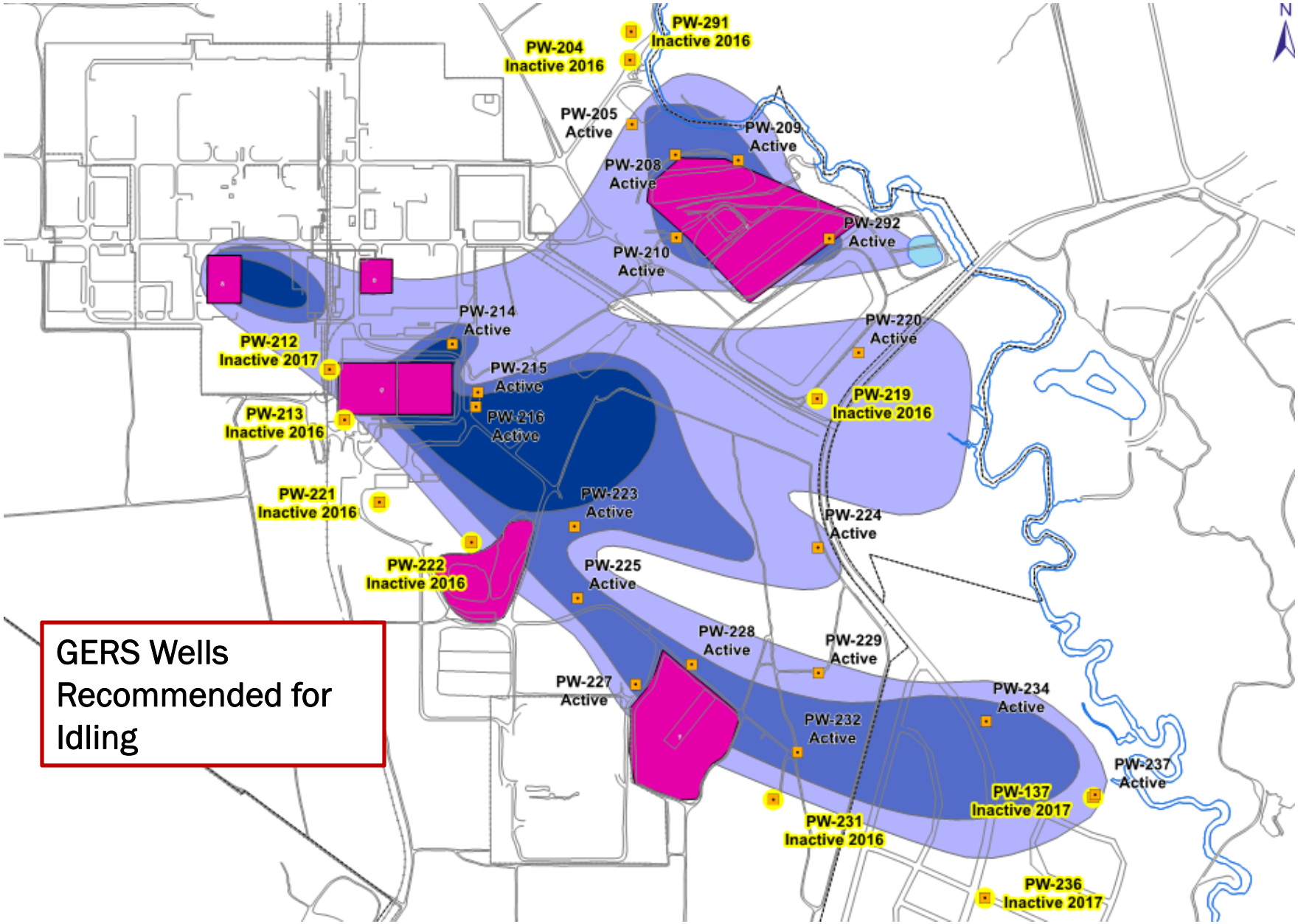
Method of Evaluation

- Based on ROD objectives and GERS characteristics.
- GERS wells evaluated based on:
  - Maintaining hydraulic containment in Cohansey
  - Location in source are vs. non-source area
  - Maintaining upward gradient (location within LCOH plume footprint)
  - Mass Removal
- GW modeling of potential reductions using the flow model utilized for annual analysis of capture.

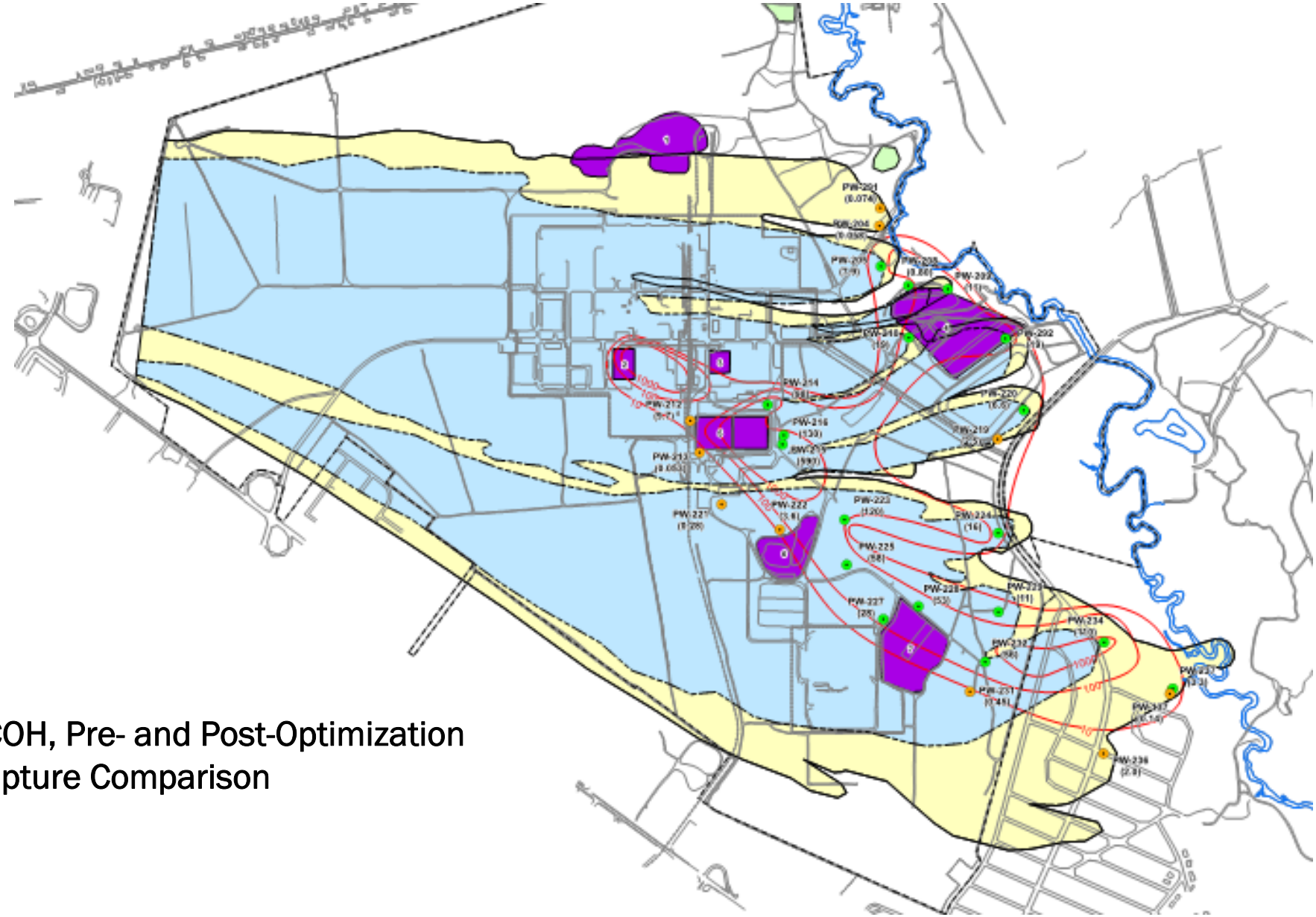
Method of Evaluation

Table 1
Evaluation of GERS Optimization
Ciba-Geigy Toms River Site, Toms River, New Jersey

Well (1)	Aquifer	O&M Zone	Well Group	Current Design (gpm)	Maximum Sustainable Rate (2) (gpm)	Location with Respect to Plume Core .	TCOC Mass Removal Rate (2) (lbs/yr)	In Footprint of LCOH Plume (Contributes to Upward. Grad.) (3) or Adjacent to the River .	GERS Wells Idled .
PW-137	PCOH	2	5	10	24	Downgradient	0.1	Yes (4)	X
PW-204	PCOH	3	3	30	20	Sidegradient	0.1	No	X
PW-205	PCOH	3	3	60	40	Within	7.9	Yes	
PW-208	PCOH	3	3	17	3	Downgradient	0.8	Yes	
PW-209	PCOH	3	3	10	9	Within	10.6	Yes	
PW-210	PCOH	3	2	44	18	Within	19.2	Yes	
PW-211	LCOH	3	2	68	56	Within	360.4	Yes	
PW-212	PCOH	4	2	40	36	Upgradient	9.7	No	X
PW-213	PCOH	4	6	19	17	Upgradient	0.1	No	X

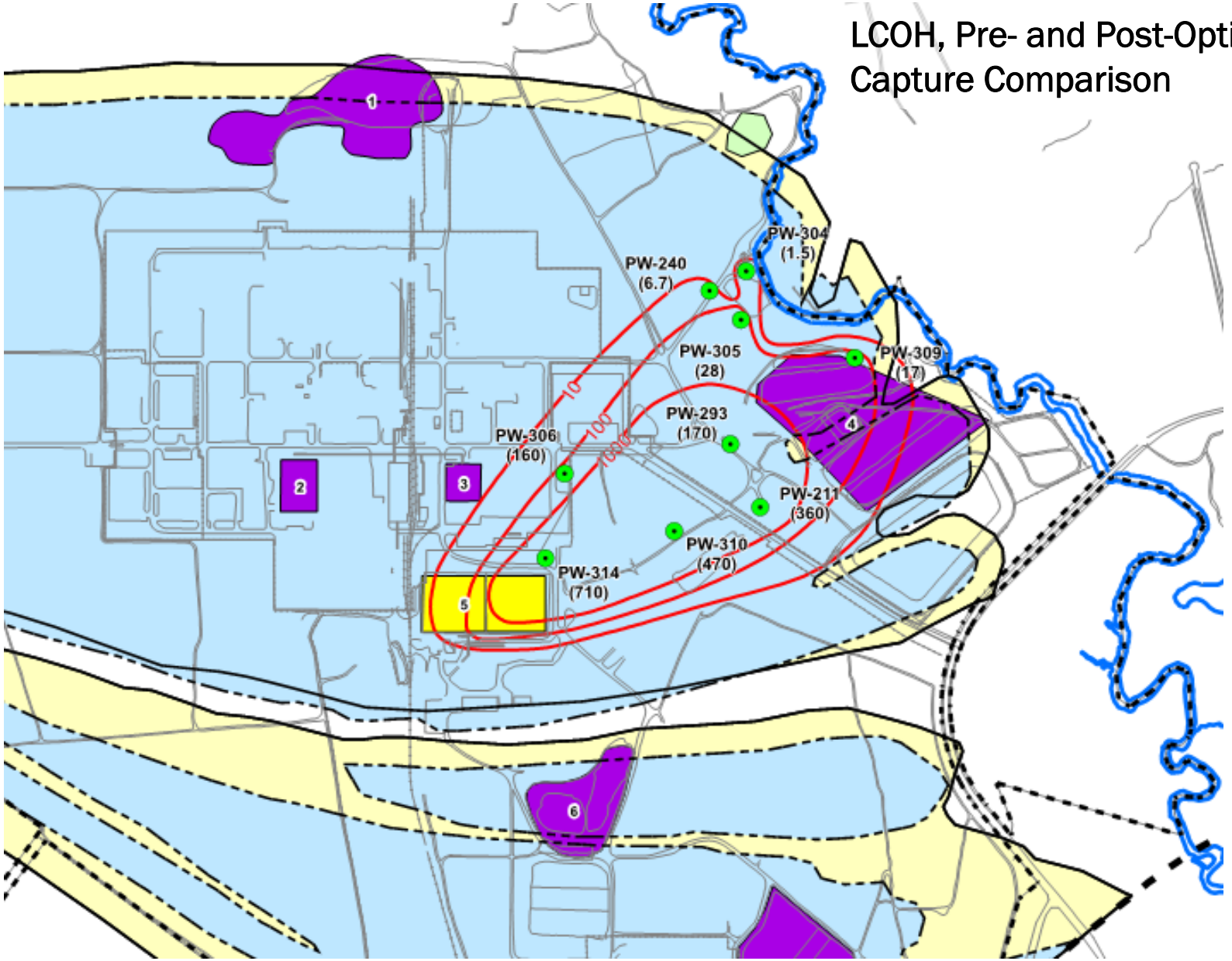


GERS Wells Recommended for Idling

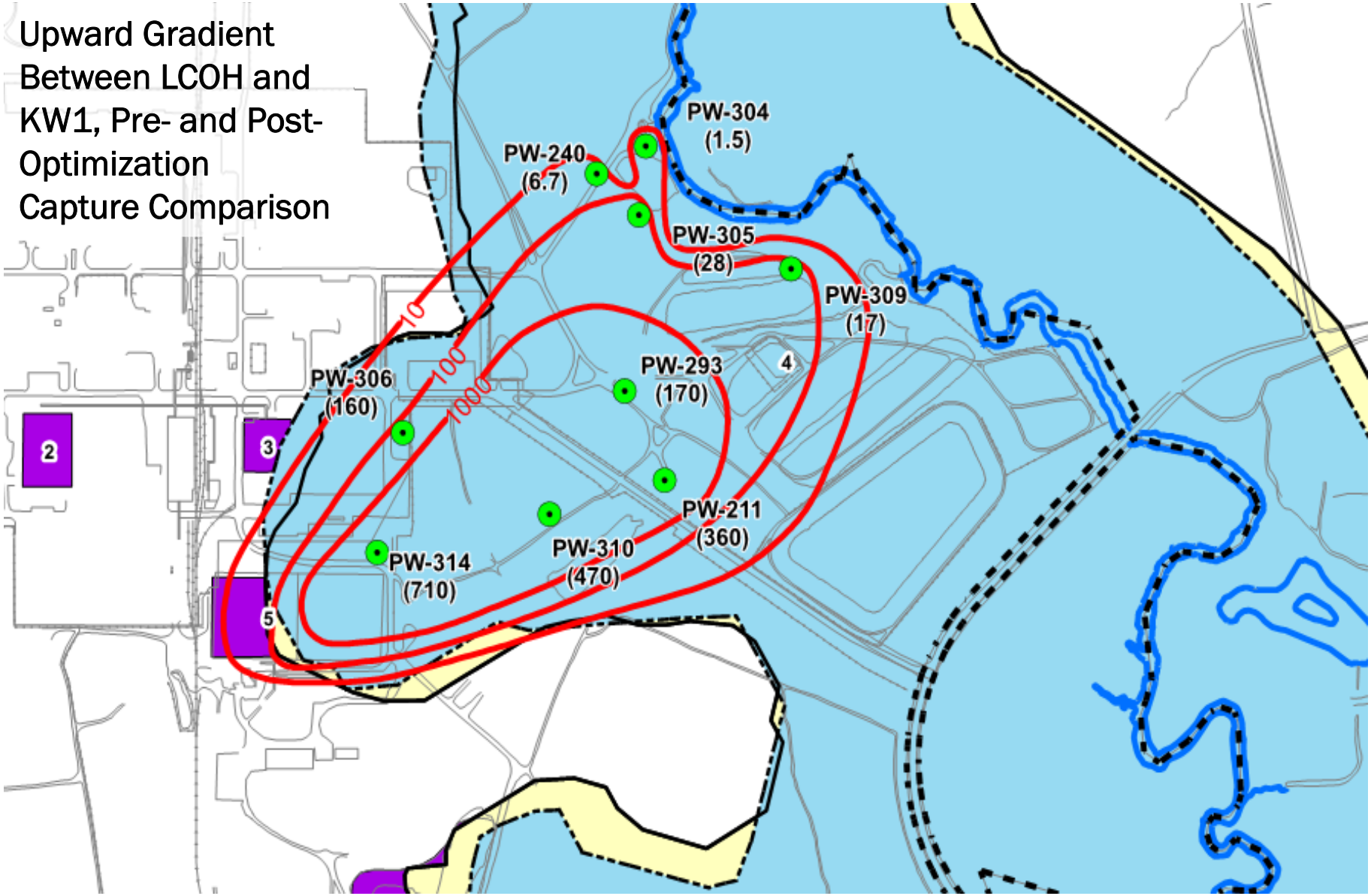


PCOH, Pre- and Post-Optimization Capture Comparison

LCOH, Pre- and Post-Optimization Capture Comparison



Upward Gradient Between LCOH and KW1, Pre- and Post-Optimization Capture Comparison



Summary and Recommendations

Brown AND Caldwell

Evaluation Summary

GERS Wells Eliminated	10 (27%)
Flow Reduction	300 gpm (~25%)
Impact on Capture	Negligible (Expand Monitoring)
Impact on Vertical Gradient	Negligible
Impact on Mass Removal	Negligible

Post-Implementation Benefits and Lessons Learned

Brown AND Caldwell

O&M

- Implemented in 2016/2017
- Reduced maintenance requirements.
- Lower GERS O&M costs.
- Free capacity for placing new extraction wells in areas where they can improve capture and mass recovery.
- Increased influent conc. did not affect treatment.
- Reduced flow rate impacted plant operations.
- Reduced flow contributes to deposits in pipes.

Thank you.
Questions?

Brown AND Caldwell


Brown AND
Caldwell