North Indian Bend Wash Superfund Site

Final Feasibility Study Addendum

FSA Purpose

- Provide EPA with data and analyses to support selection of Final Remedy
- Fulfill the requirements of Supplemental Study and Five-year Review
  - Evaluate capture and remediation of zones of contamination
  - Analyze impact of recharge/reinjection on remediation
  - Evaluate sufficiency of monitoring network

FSA Process

1/1997: PCs annotated outline → 3/1997: EPA Scope of Work → 4/1997: PCs Work Plan

Develop model and initial Remedial Alternatives

3/1999: PCs Draft FSA → Summer 1999: Agency comments → 3/2000: PCs response to agency comments

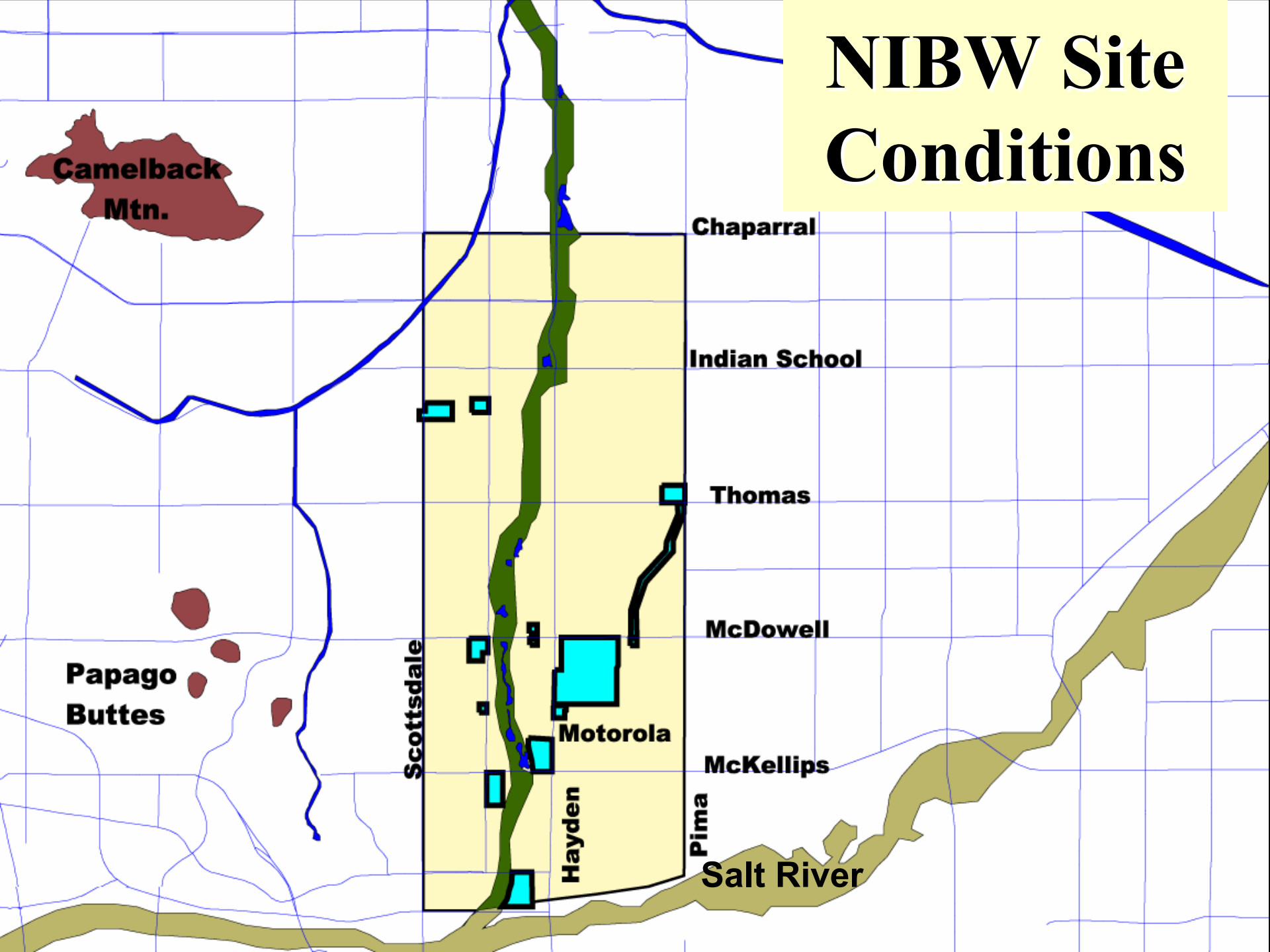
Incorporate modifications/updates and develop additional Remedial Alternatives

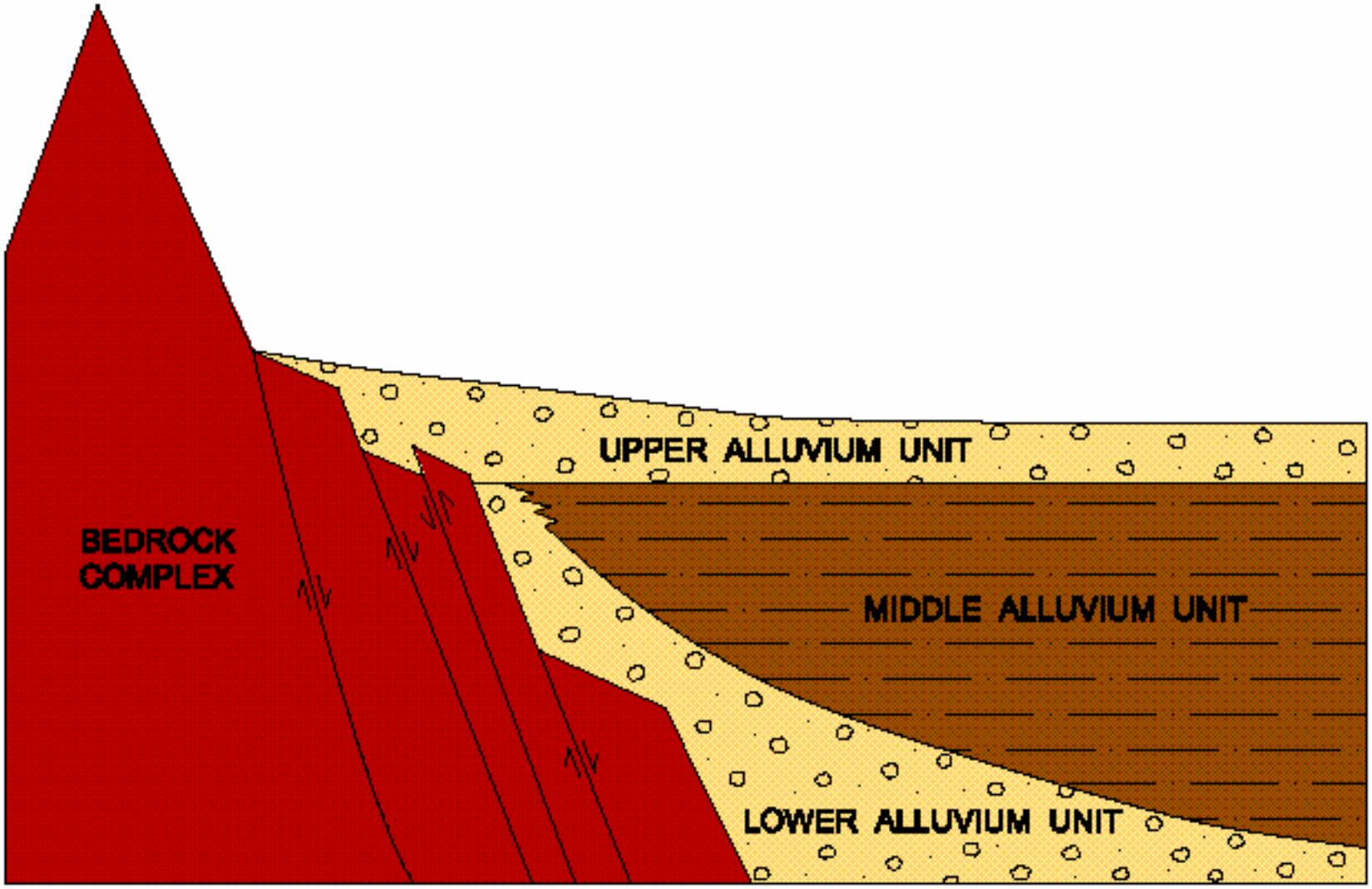
11/2000: PCs Final FSA

Document Organization

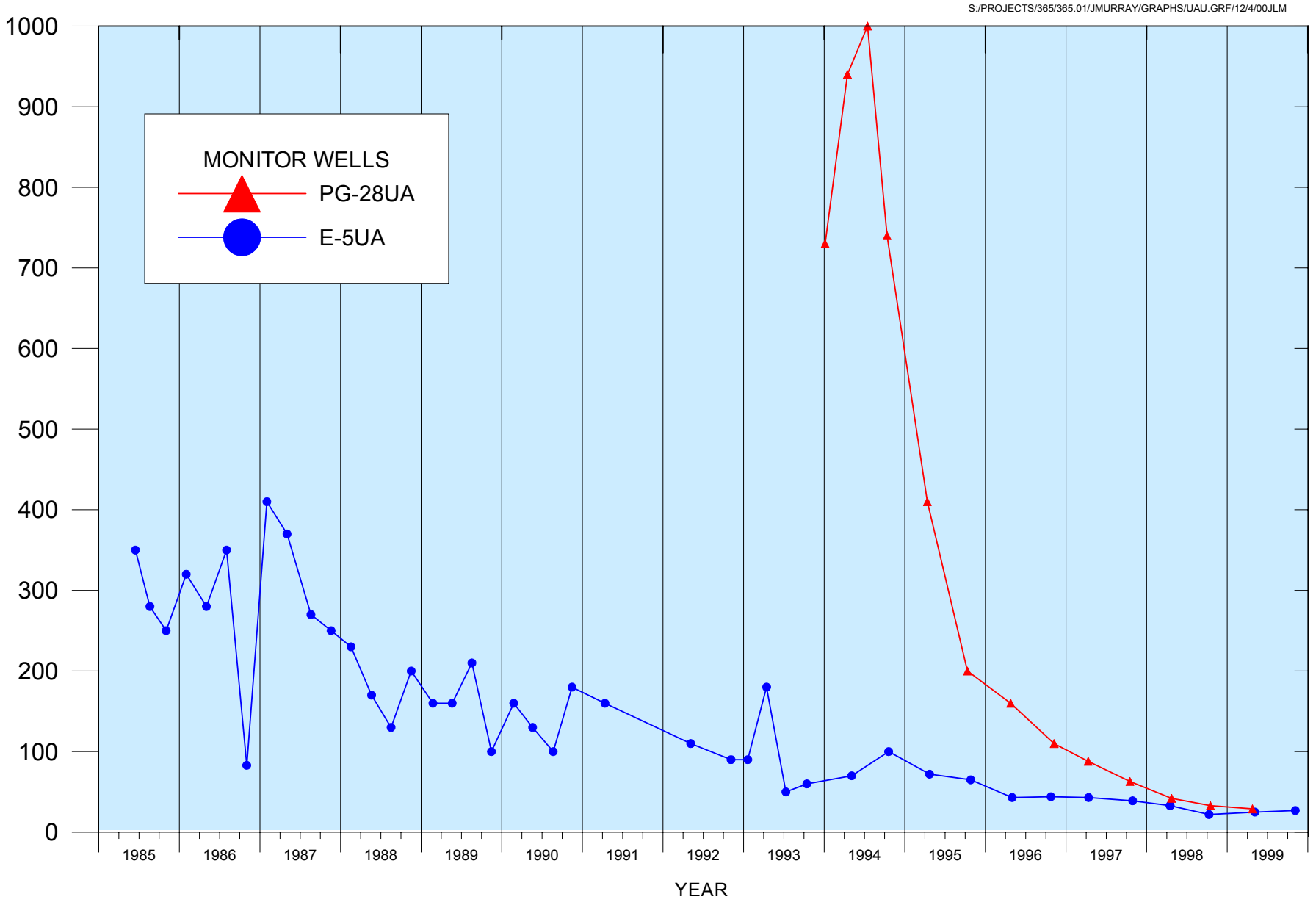
- Site conditions and previous investigations
- Groundwater monitoring
- Groundwater extraction and treatment
- Source control programs
- Analysis of Remedial Alternatives
- Appendices
  - Raw data
  - Methodology descriptions
  - Details for Remedial Actions
  - Details for Remedial Alternatives
  - Updated Site data

NIBW Site Conditions

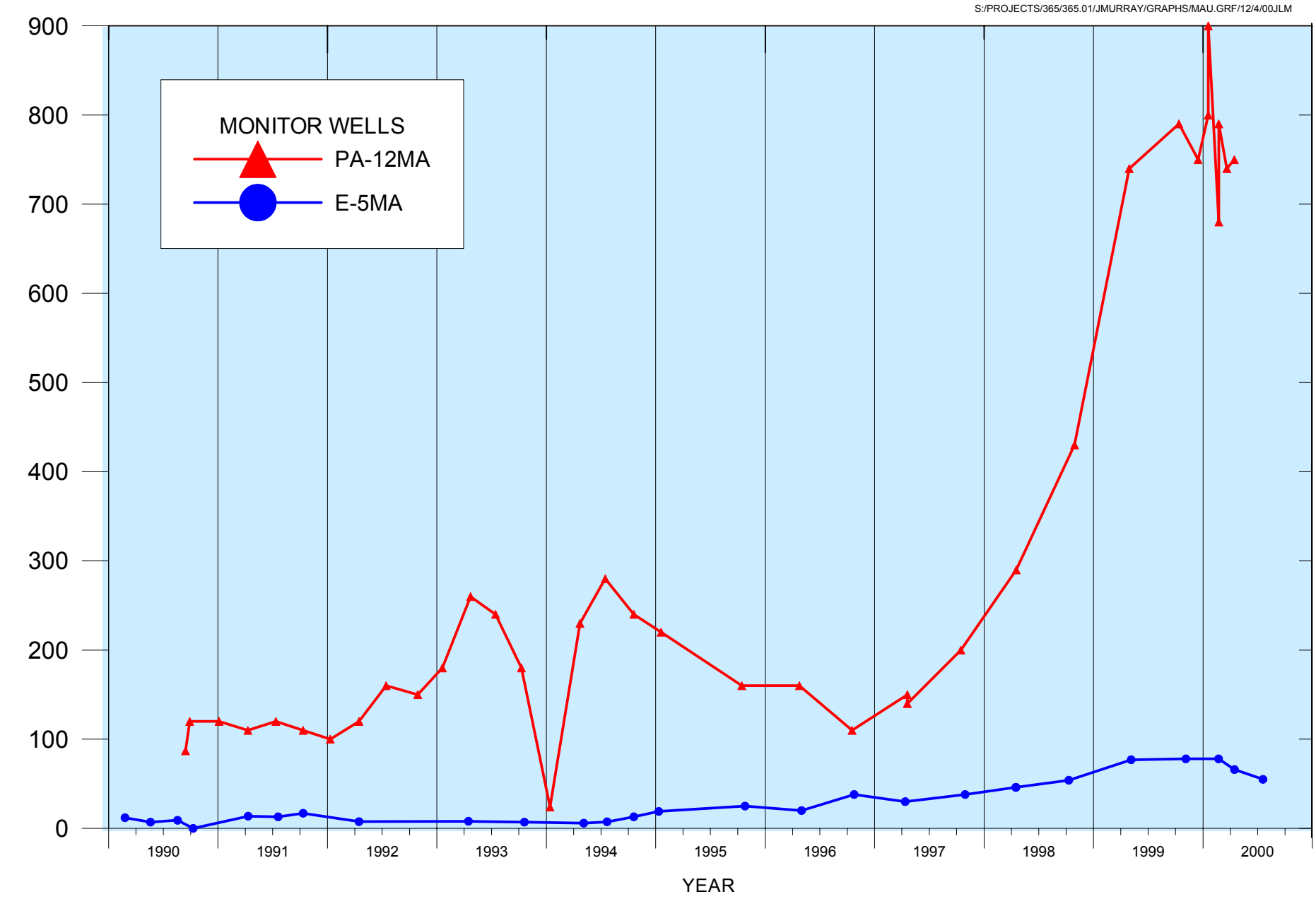




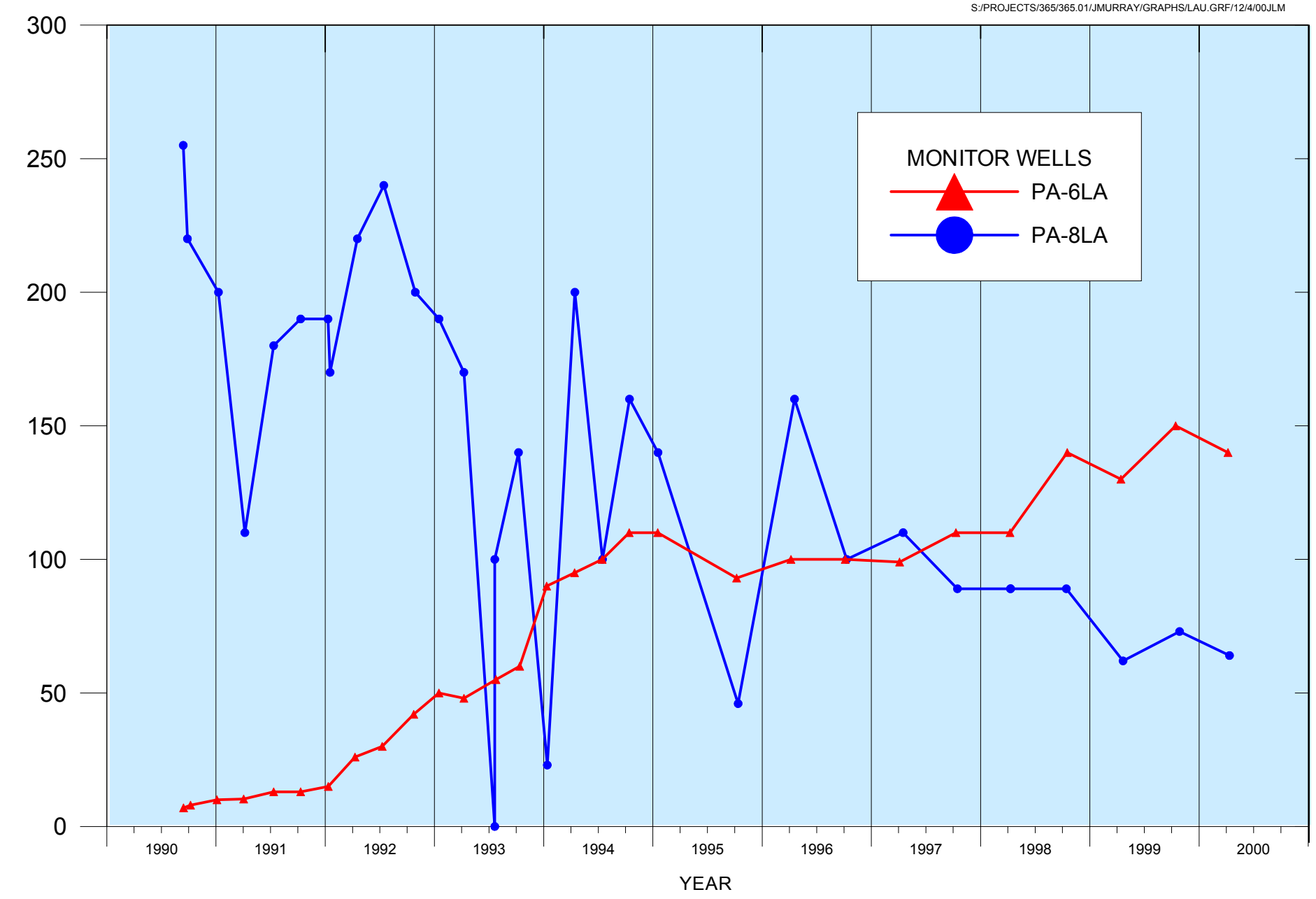
SCHEMATIC HYDROGEOLOGIC SECTION



TCE CONCENTRATION GRAPH FOR UAU MONITOR WELLS



TCE CONCENTRATION GRAPH FOR MAU MONITOR WELLS



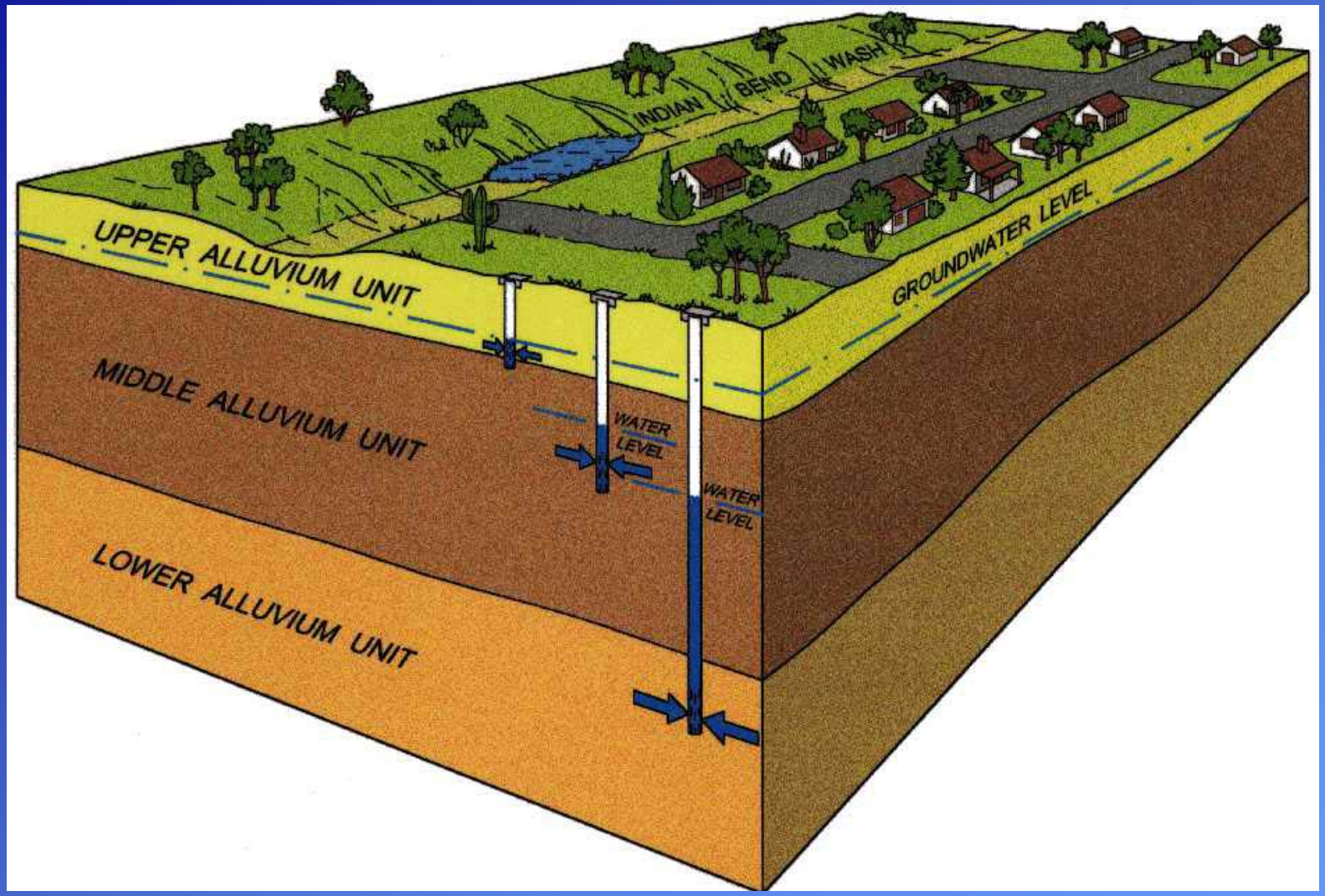
TCE CONCENTRATION GRAPH FOR LAU MONITOR WELLS

TCE Mass in Pounds (4/1998)

Hydrogeologic Unit	Estimated Dissolved Mass	FSA Model Dissolved Mass
Upper	736	1,000
Upper Middle	24,741	41,000
Lower Middle	791	2,000
Lower	32,273	21,500
Total	**58,541**	**65,500**

TCE Mass Flux in Pounds per Year

Time Period	OU Wells	PCX-1	Area 7	Area 12
5/97 - 4/98	3,334	---	---	---
5/98 - 4/99	3,333	432	2,007	1,066
5/99 - 4/00	3,151			
Total	**13,323 pounds**			



Groundwater Monitoring

Groundwater Monitoring Programs

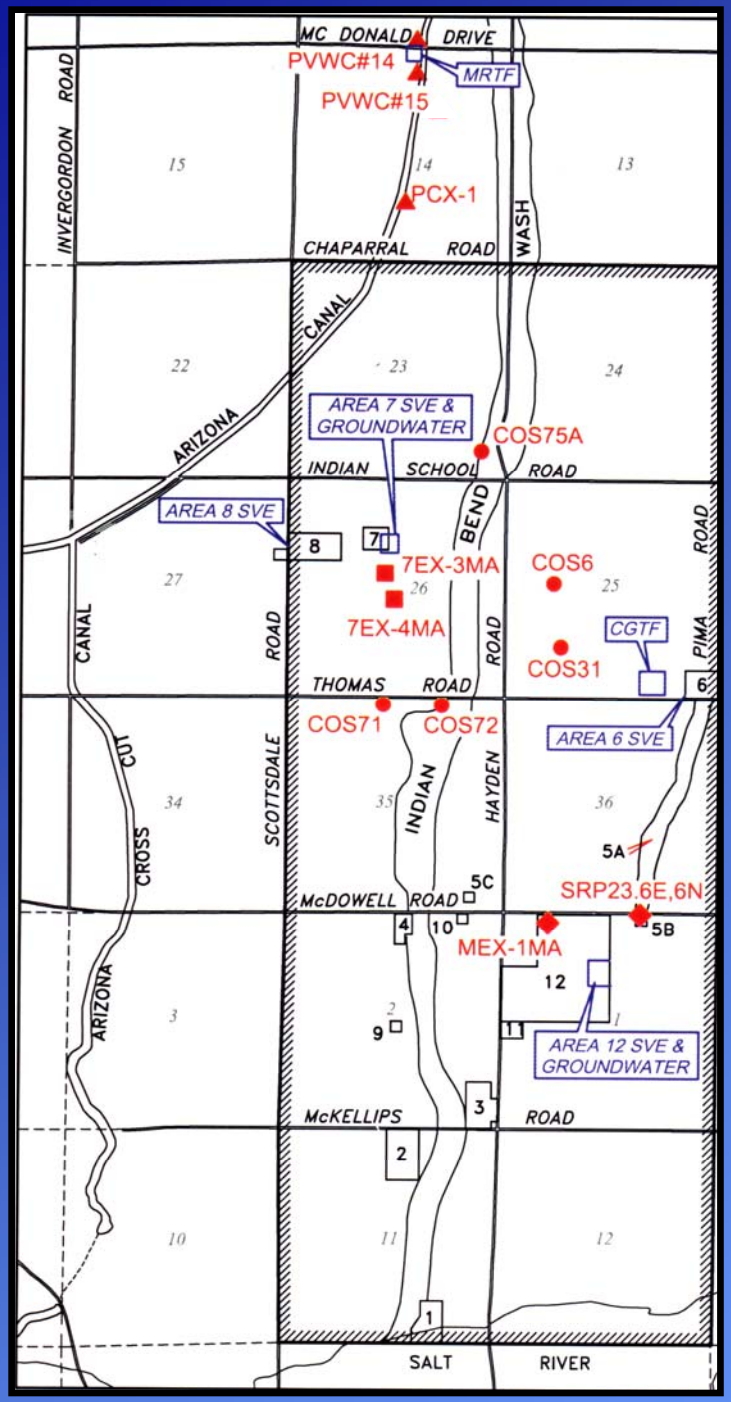
- OU I & II
  - Installation, quarterly water levels, and semi-annual sampling for about 130 monitor wells
  - Semi-annual sampling at 7 production wells
  - Pumpage reporting
- Voluntary
  - Installation, quarterly water levels, and quarterly sampling for about 25 monitor wells
  - Increased sampling frequency at selected wells
  - Continuous water level recording at selected wells
  - Periodic fluid-movement and depth sampling

Groundwater Monitoring Objectives

- Identify zones of contamination in MAU and LAU requiring remediation
- Identify zone of hydraulic capture resulting from operation of OU I extraction wells
- Evaluate rate of mass reduction in UAU due to migration to underlying units
- Identify locations where mass is migrating to from UAU

Groundwater Monitoring Performance & Effectiveness

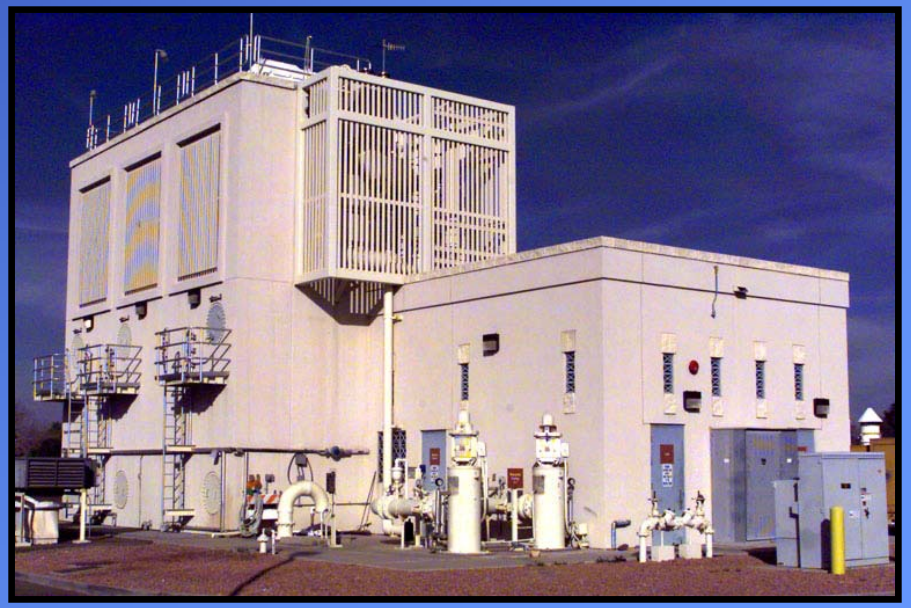
- Based on program objectives….
  - Monitoring network is complete
  - Monitoring frequency is sufficient
  - Range of monitoring data collected is comprehensive



Groundwater Extraction and Treatment

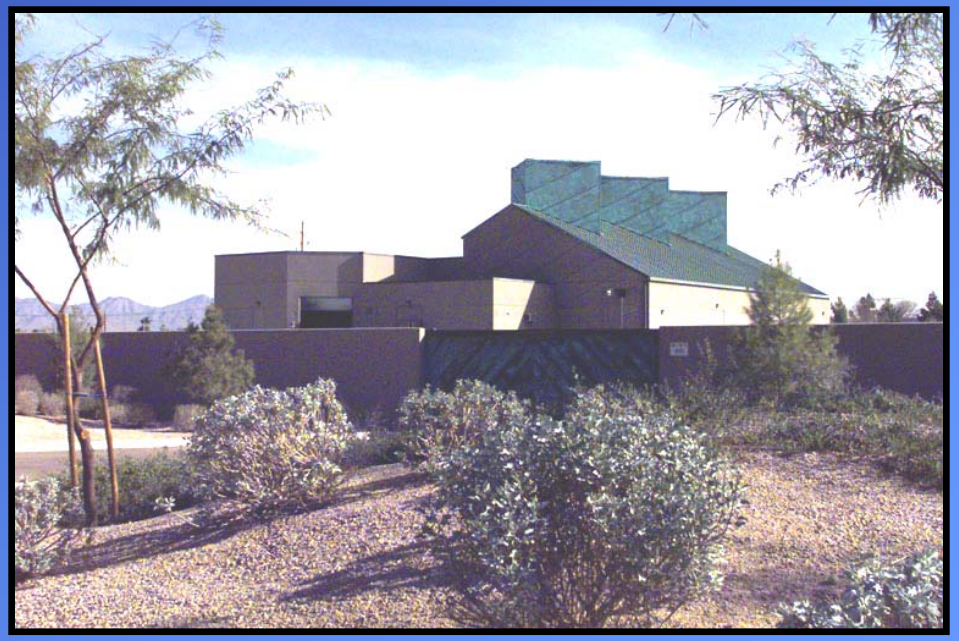
Groundwater Extraction and Treatment Requirements

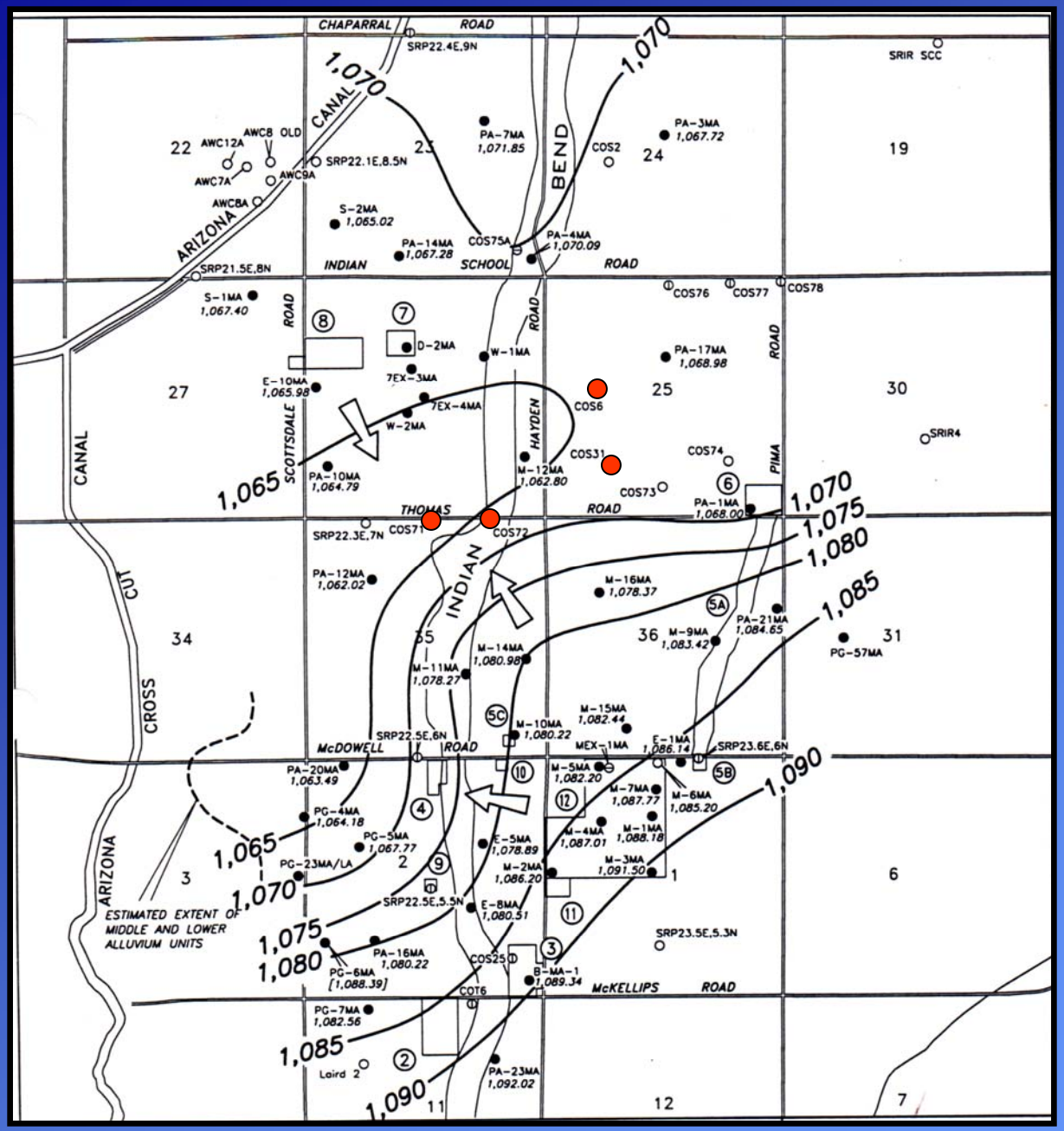
- Extract from MAU and LAU at 4 existing municipal wells at average annual rate of 75% of capacity (6,300 gpm)
- Treat using air stripping with air emissions controls
- Monitor fate and migration of TCE in UAU



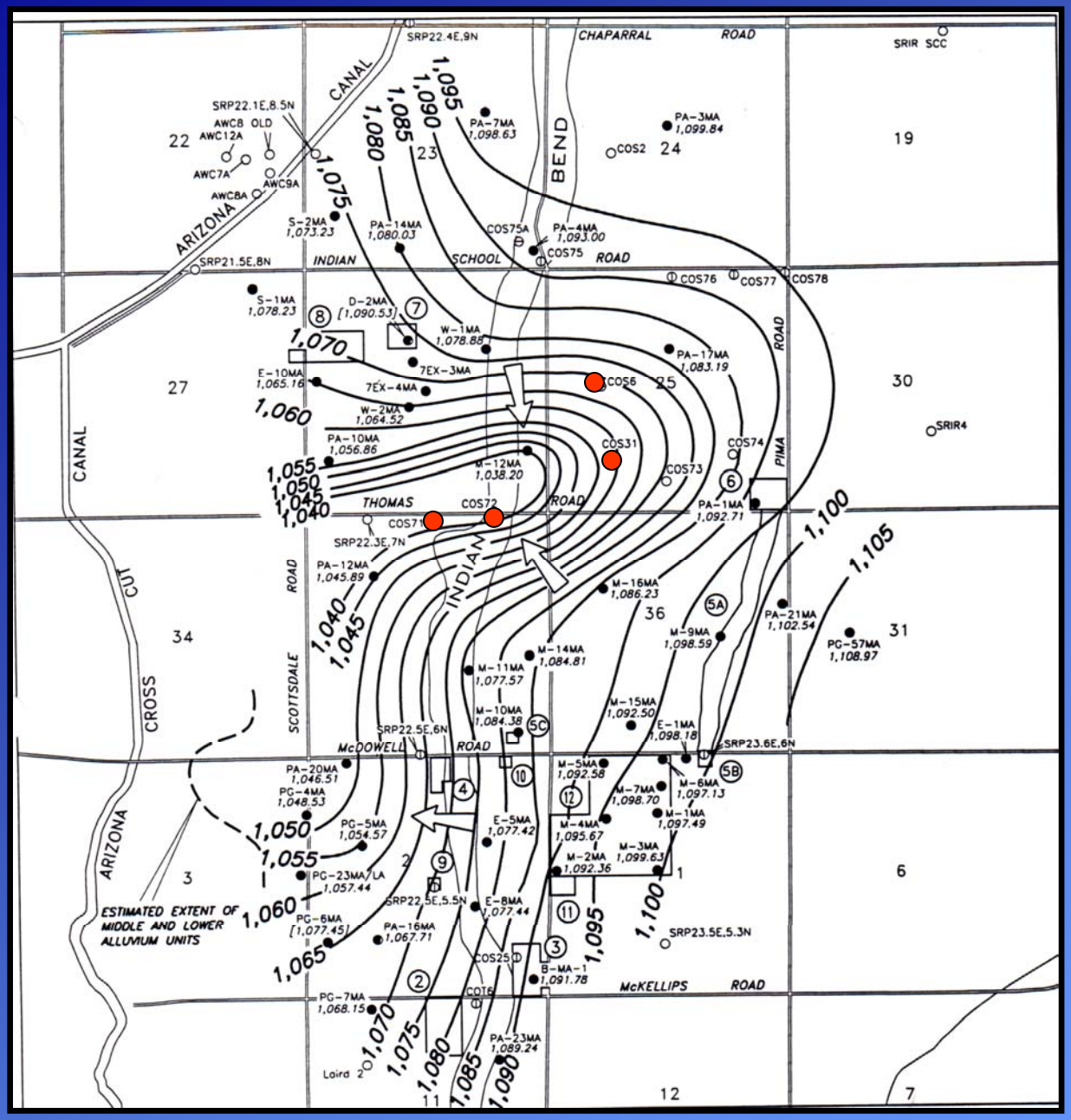
Groundwater Extraction and Treatment Enhancements

- Add treatment at well COS6
- Replace COS75 with COS75A (enhanced LAU)
- Install PCX-1
- Construct MRTF for treatment of 3 northern wells
- Implement Area 7 and 12 source control programs
- Implement CGTF upgrades

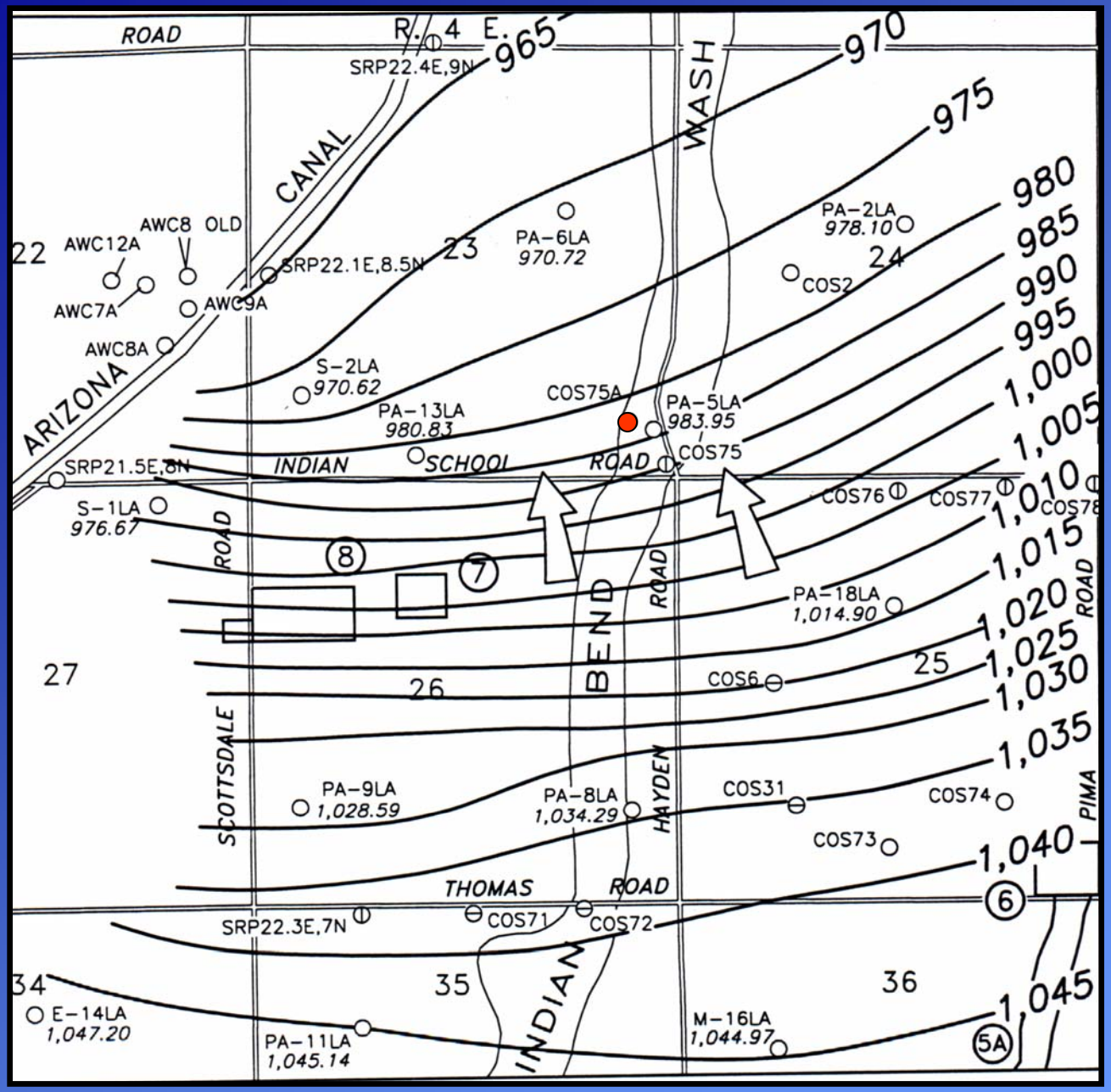




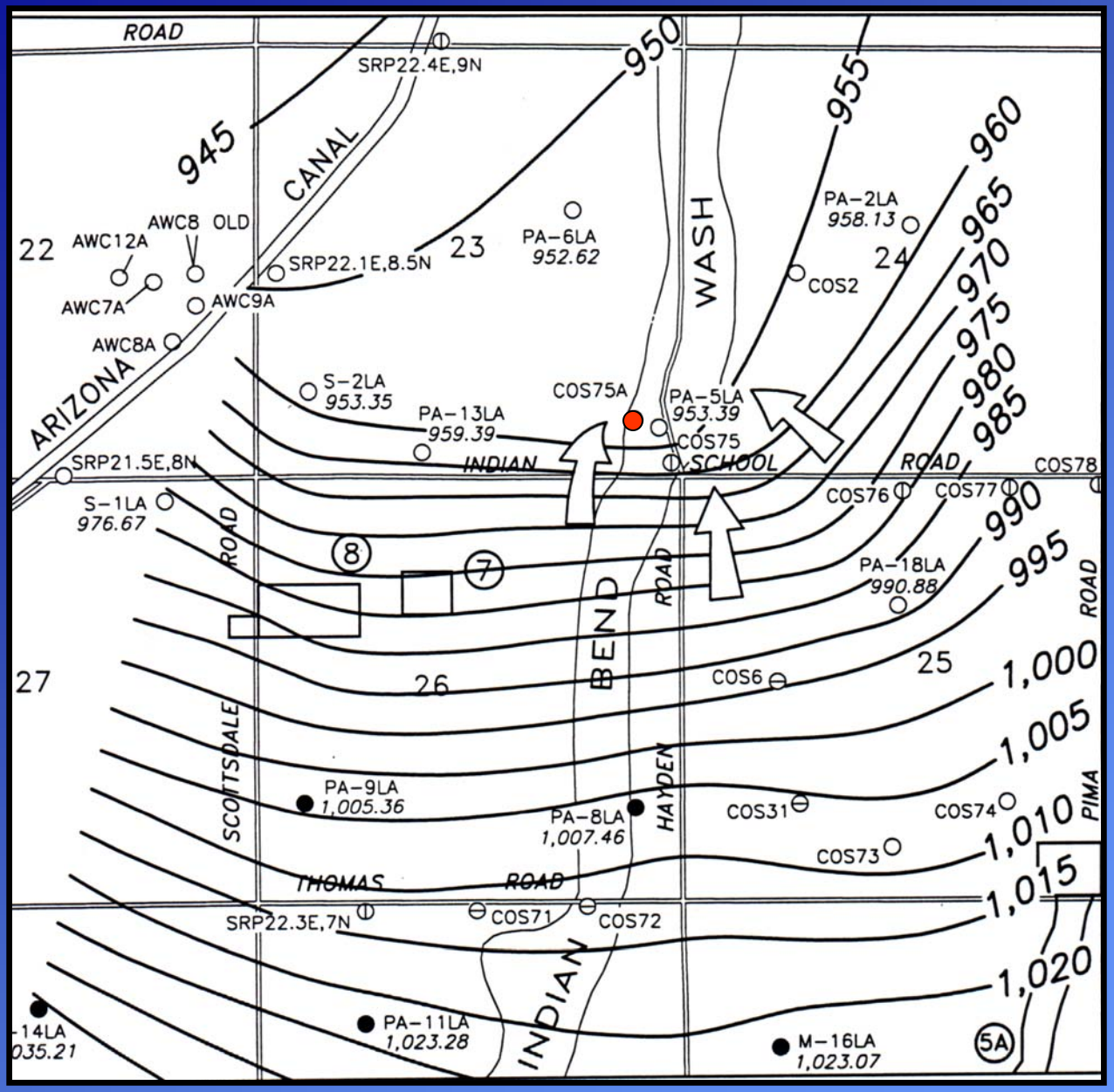
October 1993 Before CGTF



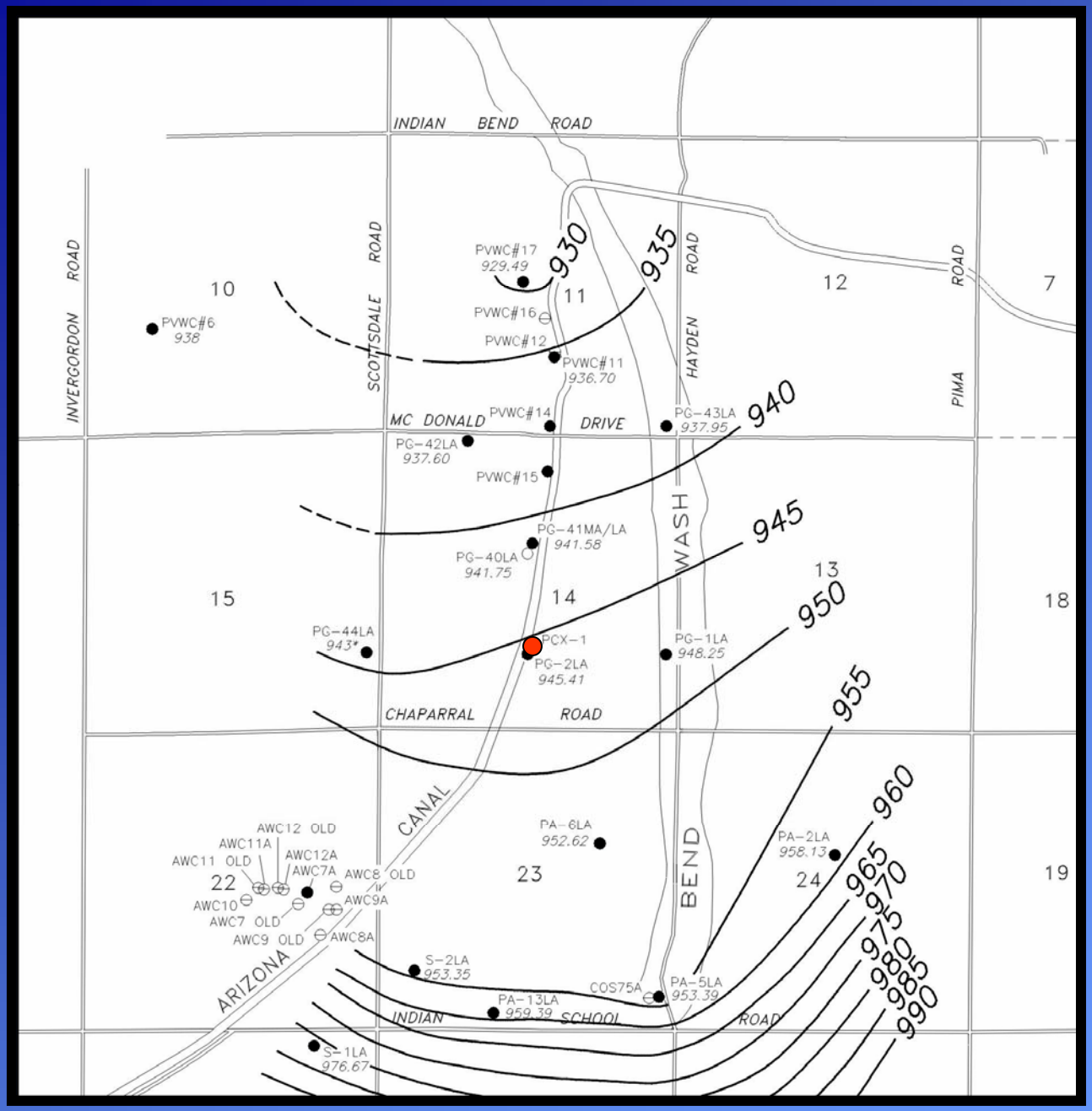
October 1998
After CGTF



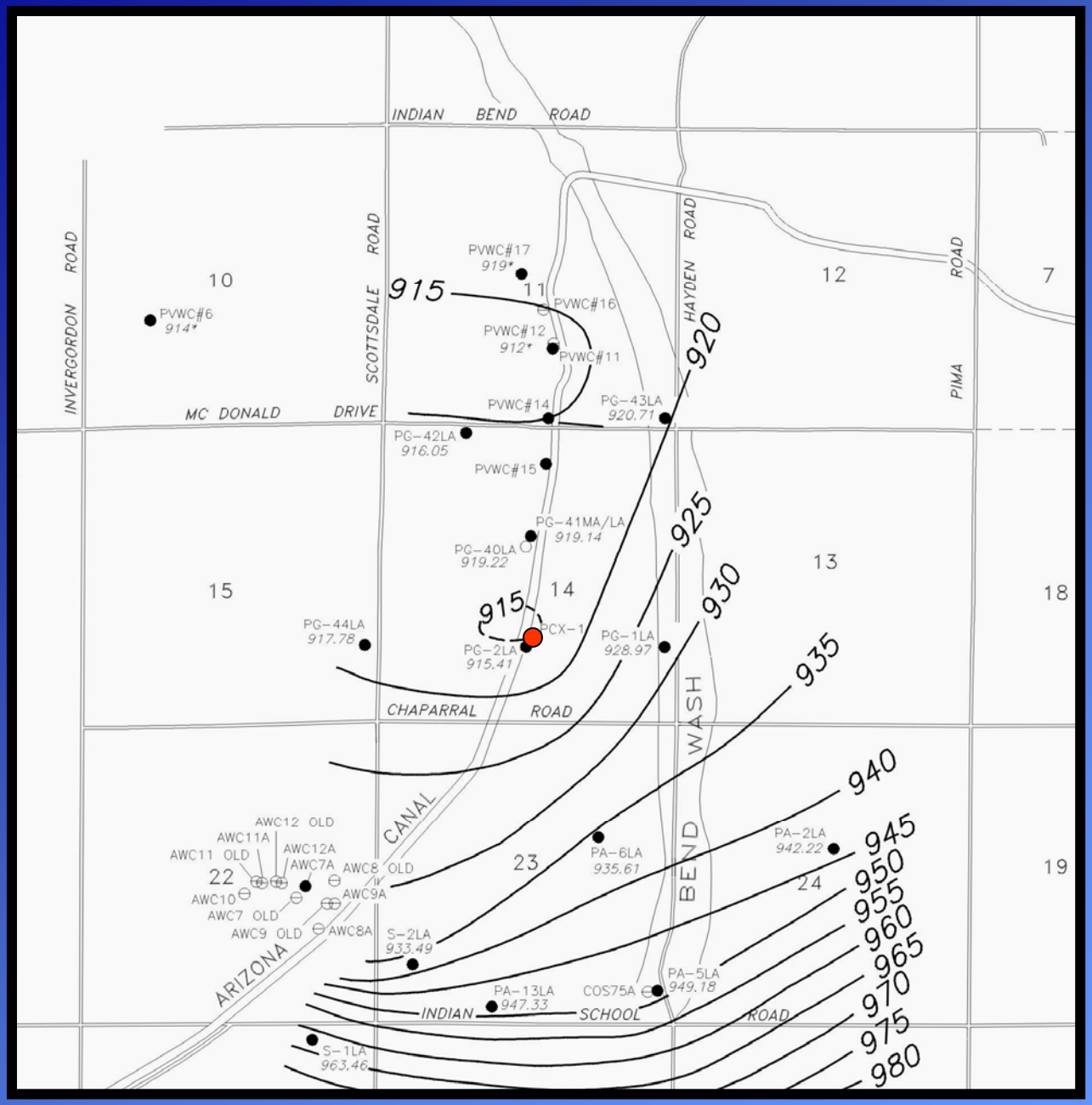
April 1995 Before COS75A



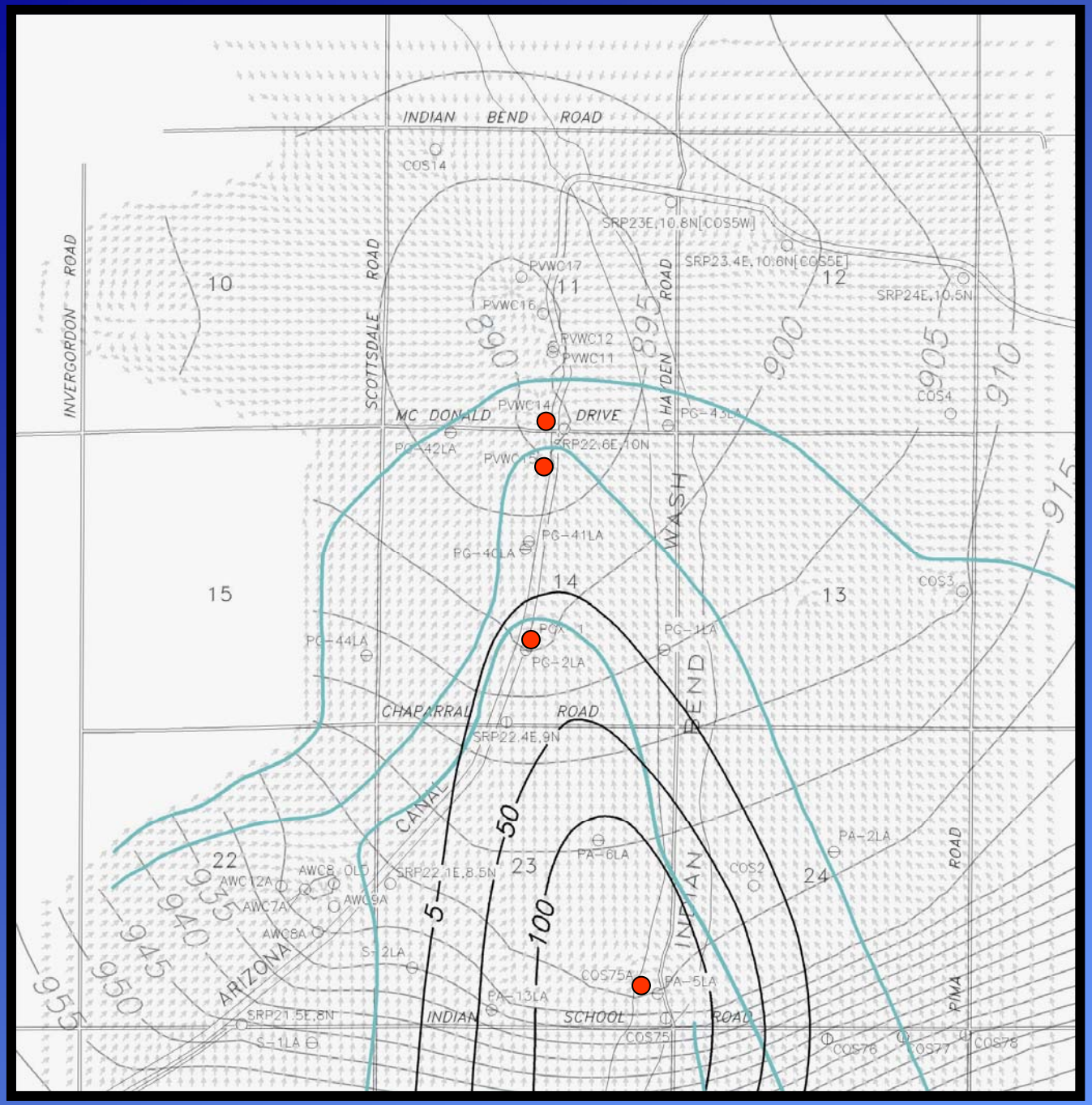
April 1997 After COS75A



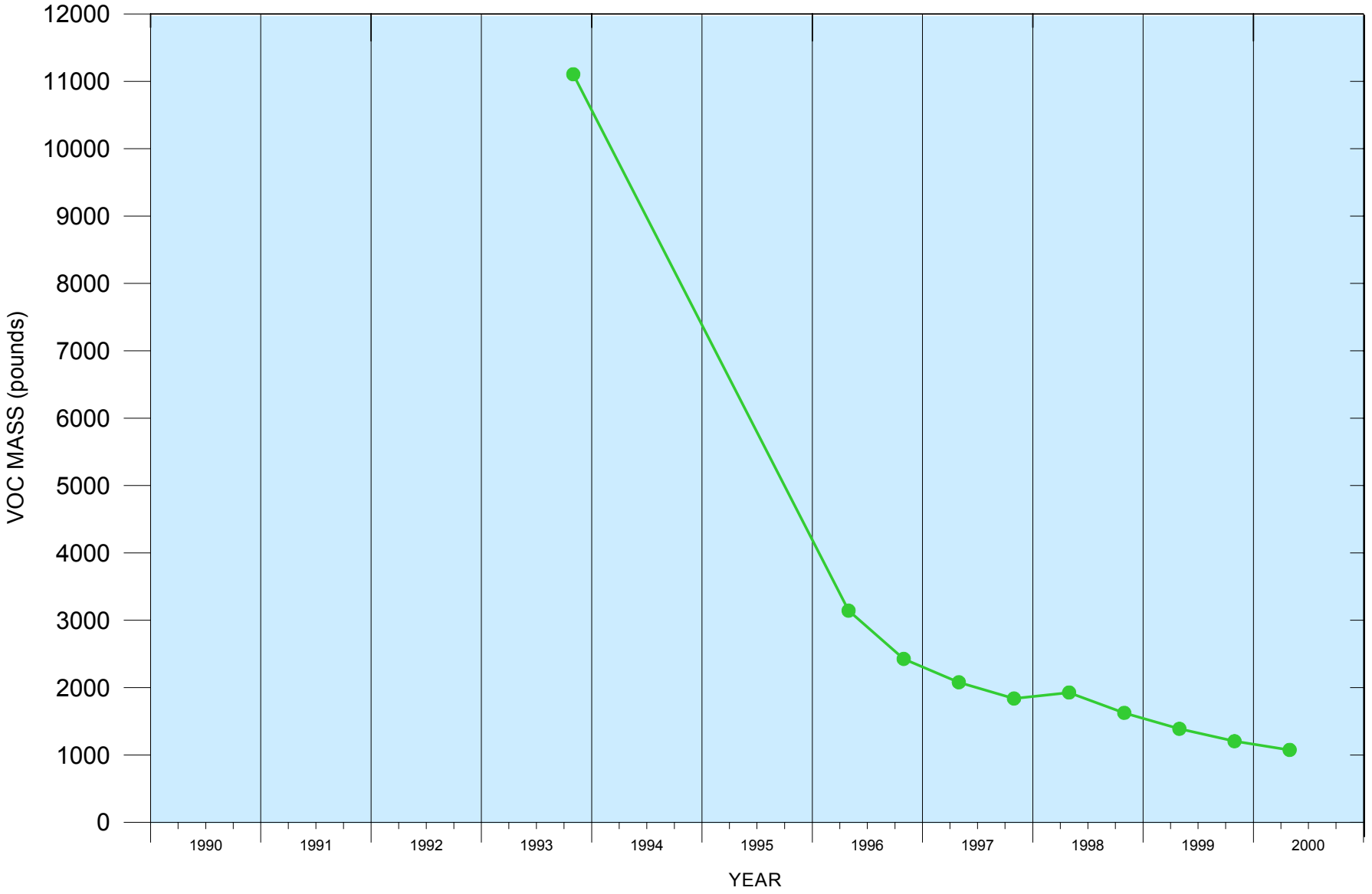
April 1997
Before PCX-1



April 1999
After PCX-1



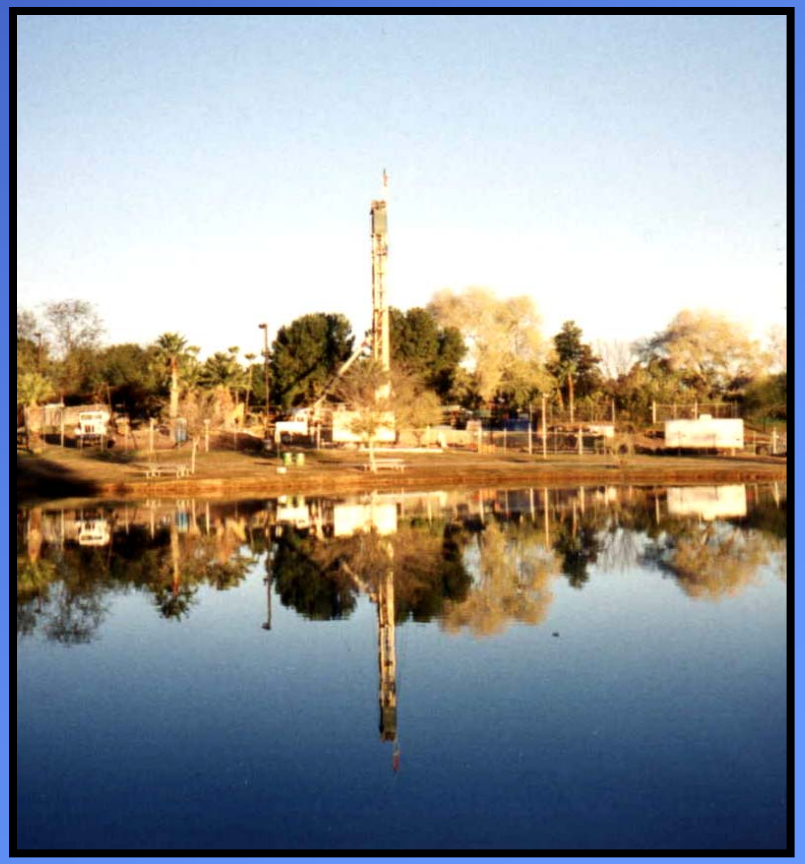
Estimated Hydraulic Capture FSA Model



VOC Mass Reduction in UAU Over Time

Performance & Effectiveness Evaluation for Extraction

- 90% reduction in UAU mass
- Hydraulic containment of zones contamination in MAU and LAU
- Clean or small concentrations in peripheral wells
- Enhanced MAU mass removal at source areas



Performance & Effectiveness Evaluation for Treatment

- CGTF consistently producing water to meet VOC standards
- Upgrades to CGTF provide additional assurances
- MRTF producing water with no detectable VOCs
- Source areas programs prevent high concentrations from reaching CGTF or MRTF

Water Resources Management Issues

- **Quantity Issues**
  - Many users and providers competing for groundwater supply
  - State directive for conservation and beneficial use of groundwater
  - Potential threat of land subsidence in response to over-pumping

Water Resources Management Issues

- **Quality Issues**
  - Degraded inorganic water quality exists in UAU and parts of MAU and LAU
  - Concern with enhanced migration and spreading of poor water quality

Integrating Remediation with Groundwater Resource Management

- Partner with groundwater users
- Utilize existing wells, infrastructure, and groundwater pumping
- Coordinate groundwater extraction for optimum plume management
- Build-in versatility of treatment systems to meet needs of water users and their demands
- Manage other water resource issues
  - Wide-spread groundwater depletion and inorganic impacts

COS Pump and Treat System

- Expanded pump and treatment capacity to meet demands
- Conducted detailed evaluation of fluid flow and contaminant distribution in production wells
- Replaced existing well for enhanced LAU mass capture
- Prioritized well pumping/increased monitoring frequency
- Upgraded treatment system to facilitate use of priority wells and assure safe drinking water
- Aided evaluation of nitrate and hardness impacts

Paradise Valley Initiative

- Public/private partnership
- Phased construction decision process
- Detailed hydrogeologic characterization tied to remedial design
- Construction on accelerated schedule
- Active community participation

Salt River Project Agreement

- Provided water supply via NIBW and M52 remedy to replace impacted wells
  - NIBW Pump and Treat Systems (4,000 gpm)
  - OU-2 Pump and Treat System (~ 5,400 gpm)
- Prioritize well use to achieve better capture/minimize impacts to clean wells
- Achieves reduced pumping in NIBW and reliable end use at M52

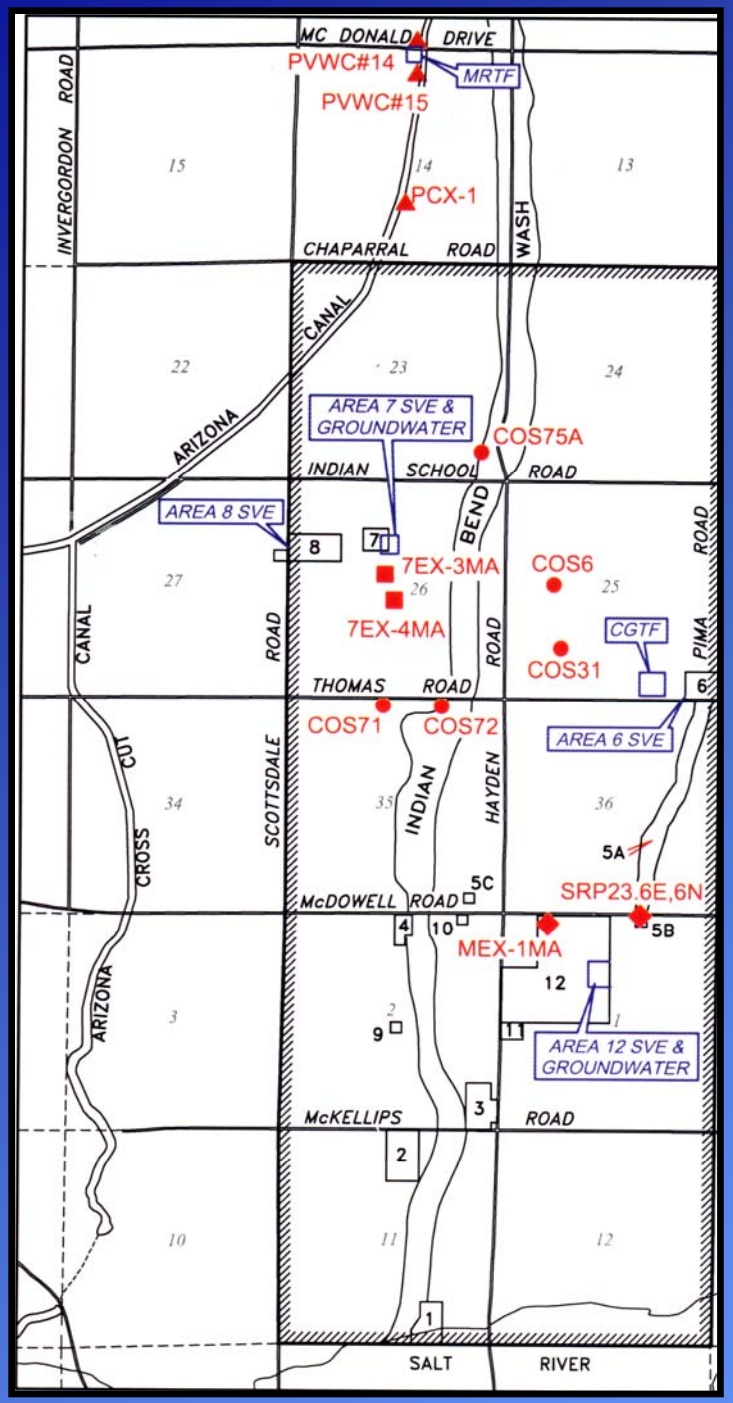
NIBW Plume Management

- Focused/consistent groundwater extraction for greatest mass capture
- Optimize use of treatment system to meet variable demands
- Reduced pumpage of clean wells outside the plume to minimize impacts and assure containment
- Allows conjunctive use of surface water to reduce groundwater pumpage of basin

Take Home Messages

- Groundwater Resource Management must drive the remedy
- Long-term aquifer sustainability is crucial
- Key challenges unrelated to TCE impact
  - Water resources: groundwater overdraft
  - Water quality: arsenic, nitrate, hardness, & salinity
- NIBW Stakeholder Process:

Coordination ➡ Cooperation ➡ Collaboration



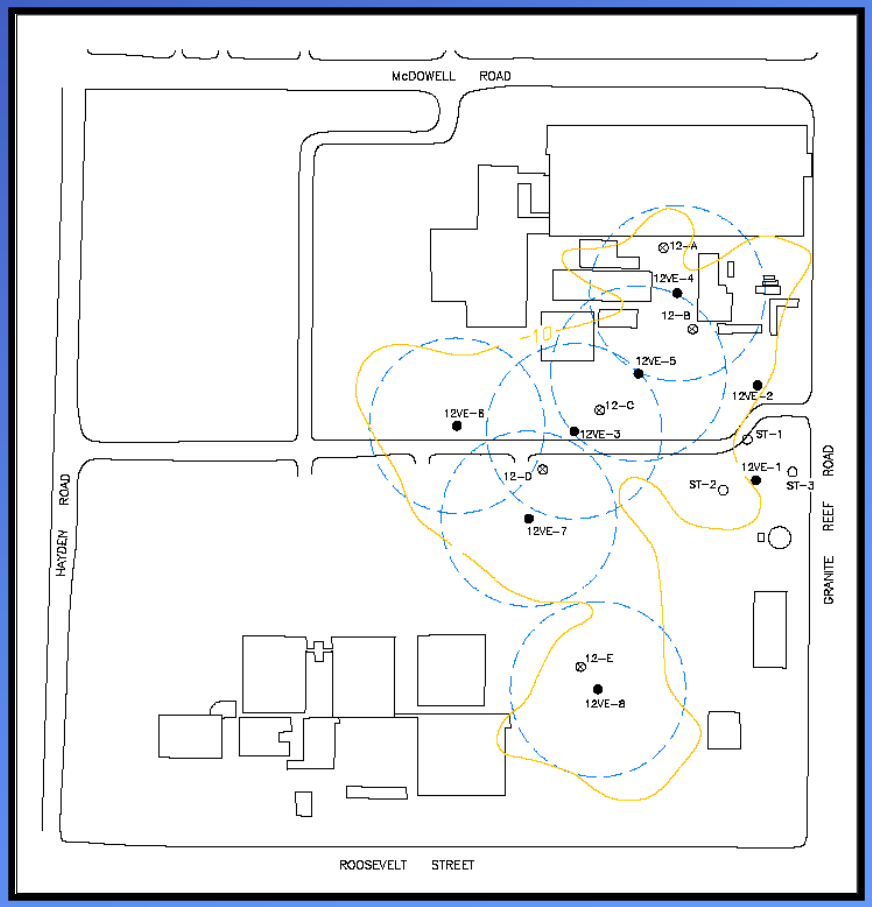
Source Control

Areas 6, 7, and 8

- Area 6
  - Voluntary SVE
- Area 7 SVE
  - SVE
  - Voluntary UAU GWET
  - Voluntary MAU GWET
- Area 8 SVE

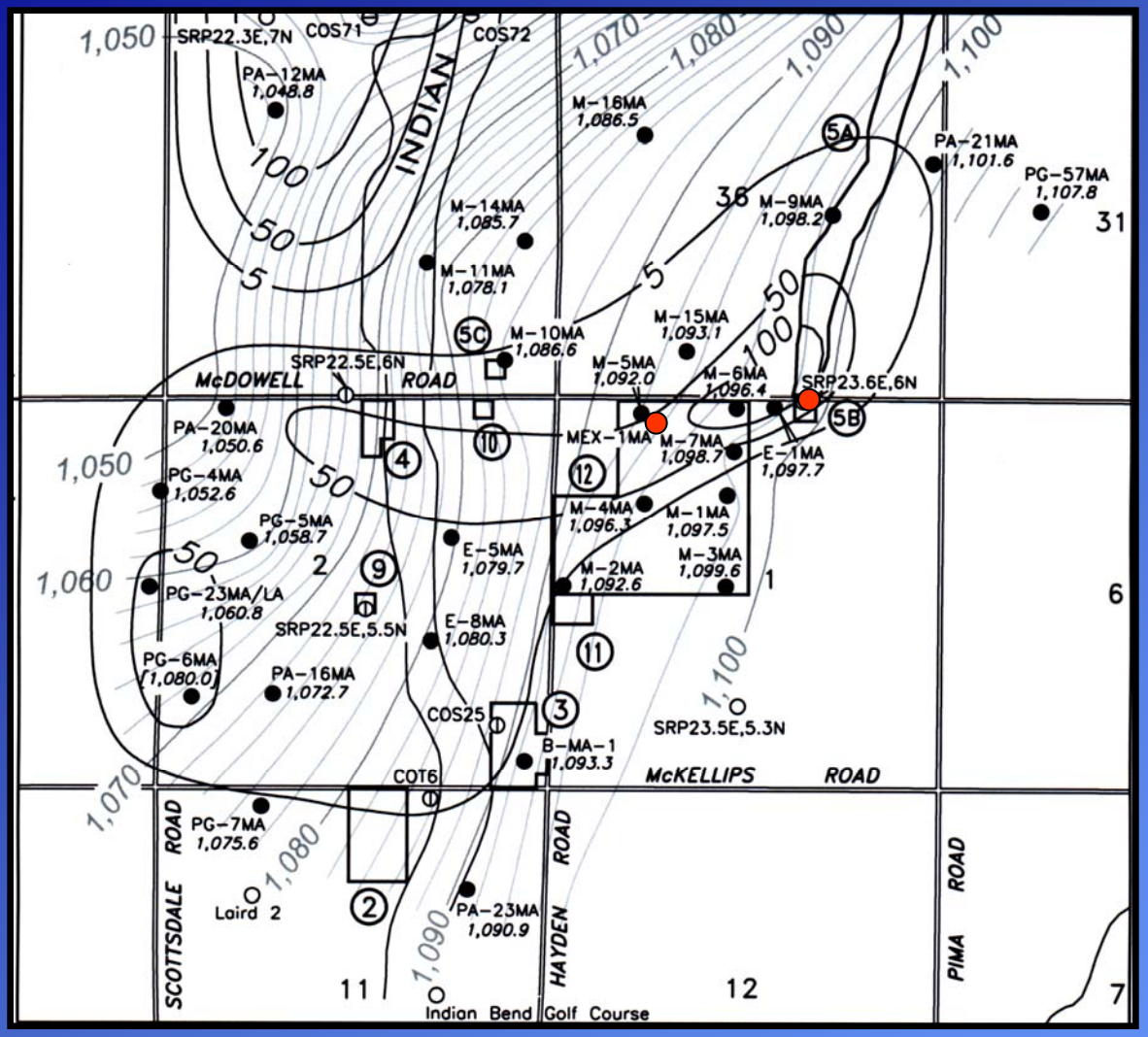
Area 12 Vadose Zone

- SVE from 12/96 through 6/98
- Removed about 1,000 pounds of VOCs
- Letter of Determination from EPA to discontinue operations in 8/00
- Decommissioning in progress

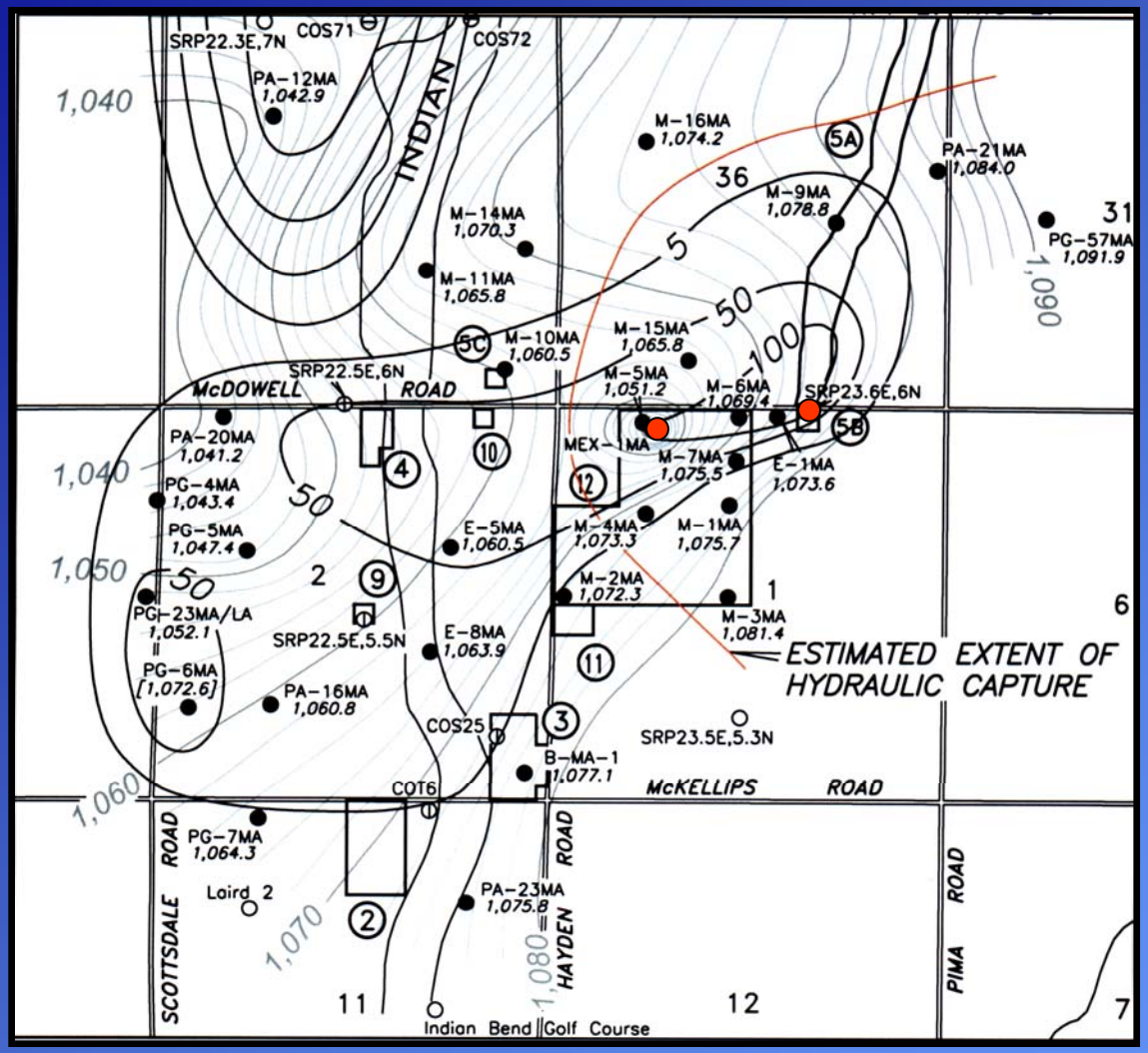


Area 12 MAU Groundwater

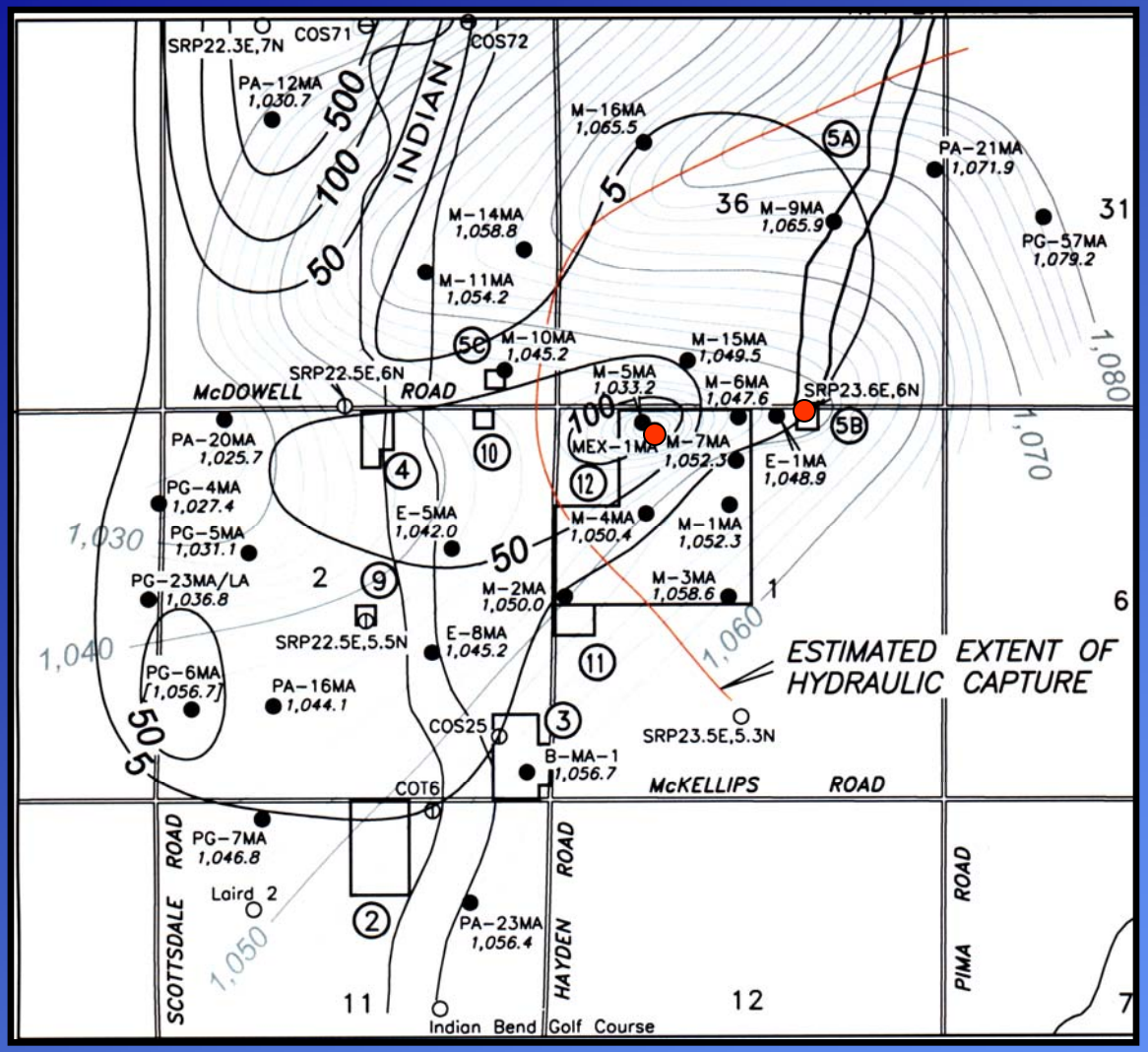
- Voluntary program
- Extraction at 2 wells
- Average rate of 1,000 gpm annually in accordance with SRP demand



Area 12 MAU Groundwater before GWET June 1998



Area 12 MAU Groundwater after GWET July 1999



Area 12 MAU Groundwater after GWET July 2000

North Indian Bend Wash Superfund Site

Analysis of Remedial Alternatives

Background

- **Required Remedy did not achieve containment of northern LAU**
- **PCs with EPA review developed Enhanced Remedy**
  - COS75A, PCX-1, and MRTF for northern LAU
  - Source Control GWET for UAU and MAU
- **Remedial Actions are enhancements to Enhanced Remedy**
- **Remedial Alternatives are combinations of Remedial Actions**

Remedial Action Objectives for Final Remedy Selection

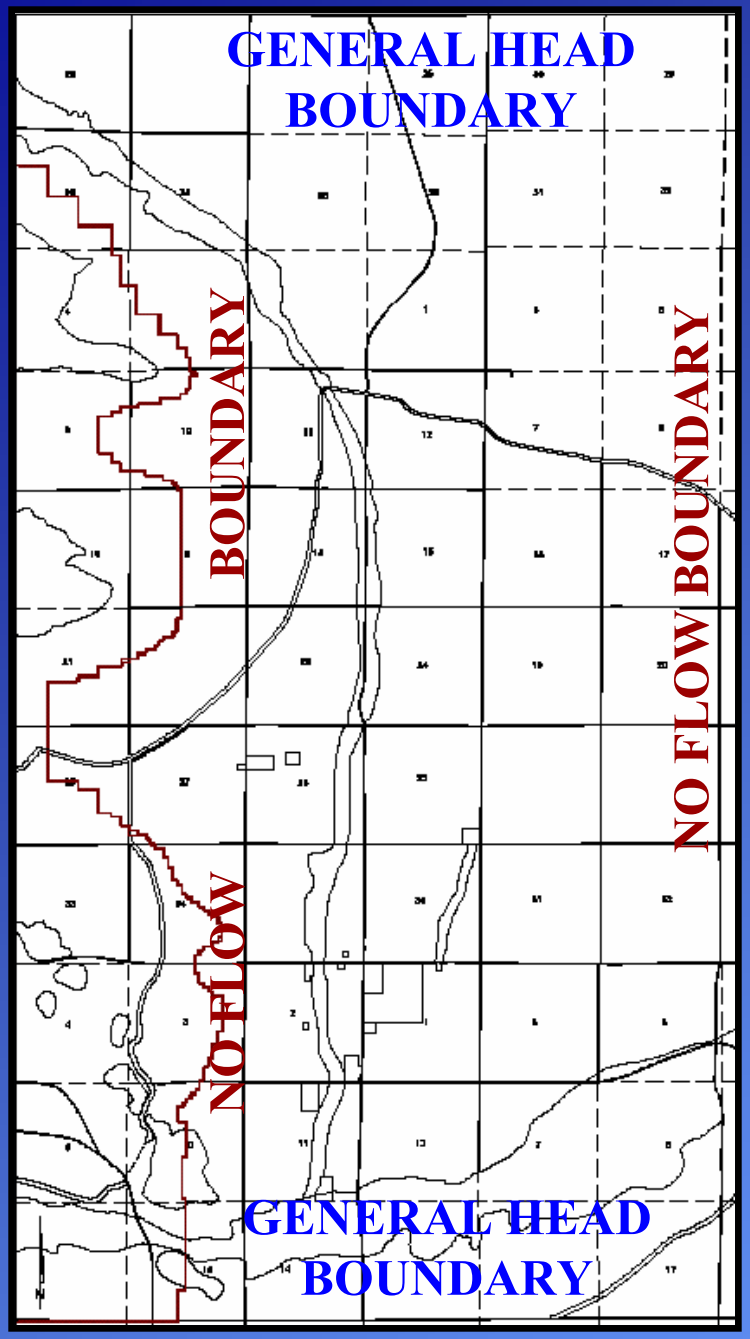
- **Protect human health and environment by…**
  - **preventing exposure to contaminated groundwater**
  - **limiting impact of VOCs on unaffected wells**

Remedial Action Objectives for Final Remedy Selection (cont)

- Provide long-term management of zones of contamination to improve aquifer's suitability for potable use
- Provide potable water source for COS, using existing facilities to extent possible
- Mitigate impact of vadose zone contamination on UAU groundwater

FSA Flow and Transport Model

Developed at EPA request as comparative tool for evaluating relative performance of remedial actions



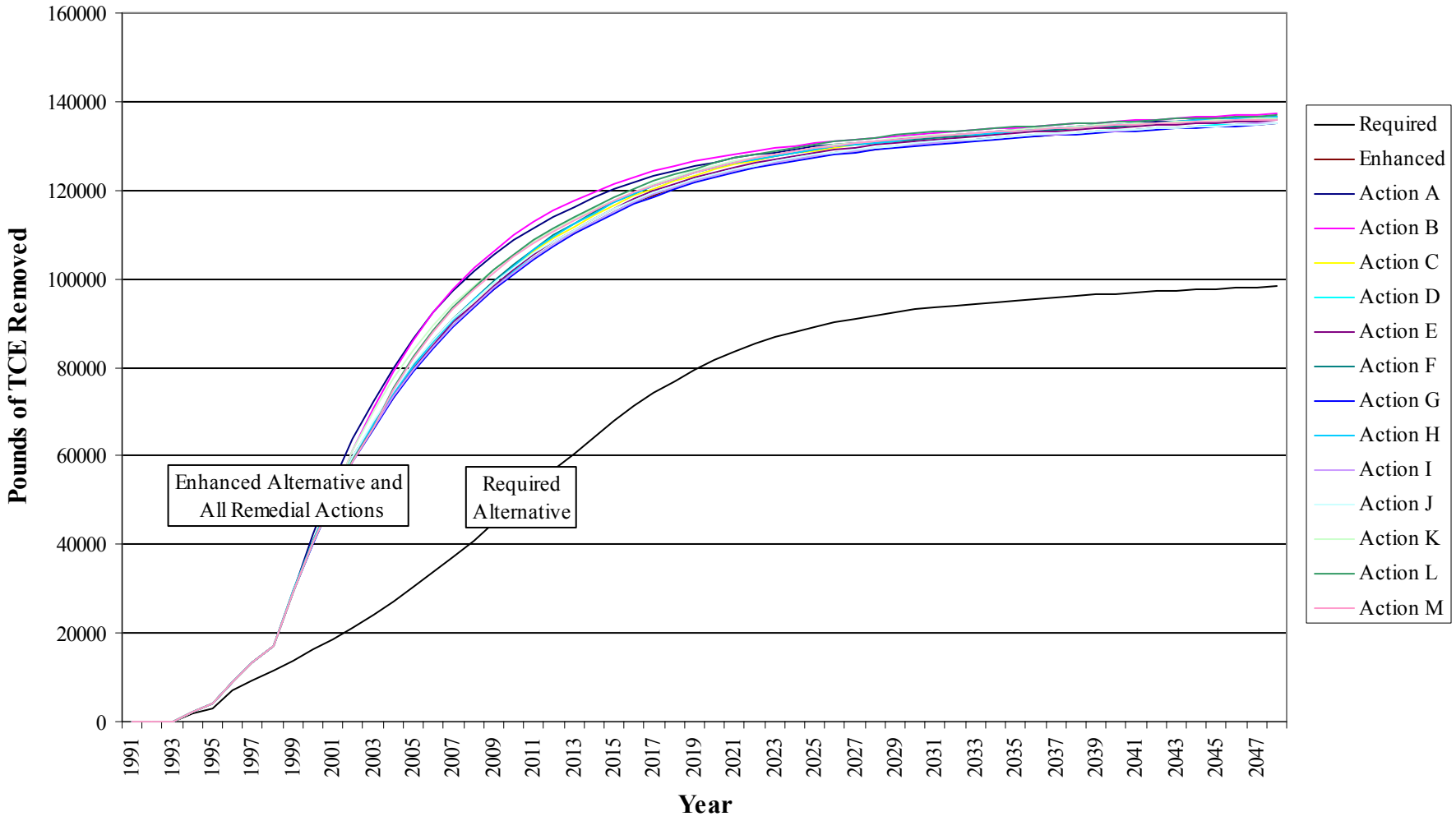
FSA Model Development

- 66-square mile domain
- 10 layers representing UAU, MAU, and LAU
- Calibrated to 1990-1996 water level & water quality data
- Site data used to estimate and distribute of input parameters
- Developed future pumping rates through discussions with providers

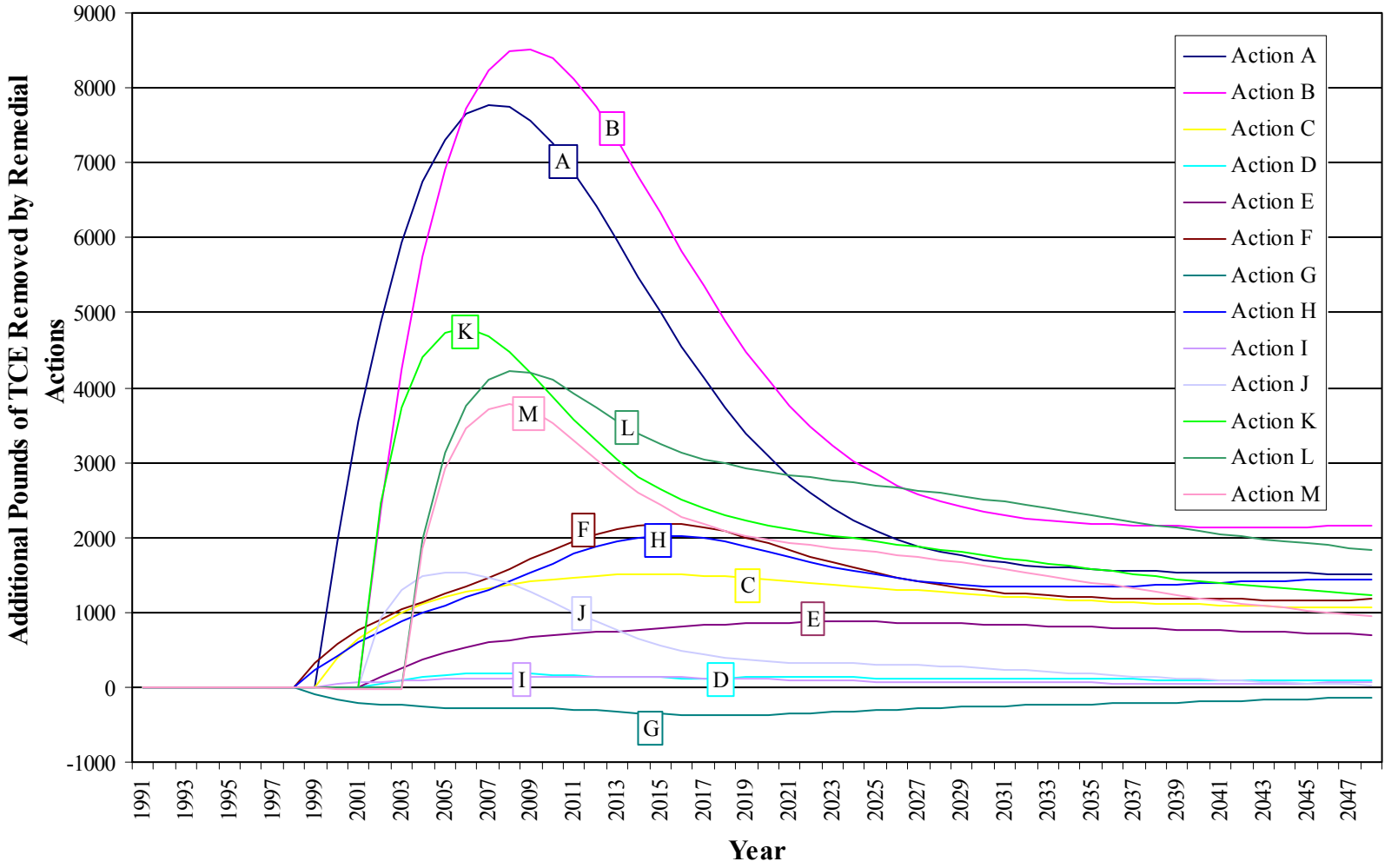
14 Remedial Actions

- A - 1 additional MAU well near Area 7
- B - 2 additional MAU wells near Area 7
- C - Increased extraction rate at Area 12
- D - 1 well near Southwest Margin
- E - Extraction at Miller/McDowell well
- F - Increase CGTF pumping to 8,000 gpm
- G - Decrease CGTF pumping to 5,000 gpm
- H - Focused CGTF pumping
- I - Extraction at PG-40/41
- J - 1 additional LAU well
- K - 3 additional LAU wells
- L - 3 additional LAU wells with reinjection
- M - 3 additional LAU wells with partial reinjection
- N - Air sparging at Area 7

Cumulative Pounds of TCE Removed for Remedial Actions



Cumulative Difference in TCE Removed Compared with Enhanced Remedy



6 Remedial Alternatives

- 1- Required Remedy
- 2 - Enhanced Remedy
- 3 - Action A, plus increased CGTF to 6,600 gpm, focused pumping with spare equipment at COS71 and COS75A, and CGTF upgrades
- 4 - Action A and Action J
- 5 - Action A, plus increased CGTF to 6,600 gpm, focused pumping using higher capacity pumps and VFDs at COS71 and COS75A, and CGTF upgrades
- 5RR - Alternative 5 with recharge/reinjection of all water into UAU and LAU
- 6 - Action B, Action C, and Action K

National Contingency Plan (NCP)

- **Threshold Criteria**
  - Protection of human health and environment
  - Compliance with ARARs
- **Primary Balancing Criteria**
  - Long-term effectiveness and permanence
  - Reduction of toxicity, mobility, volume
  - Short-term effectiveness
  - Implementability
  - Cost
- **Modifying Criteria**
  - State acceptance
  - Community acceptance

Results of NCP Evaluation

Differences between the Remedial Alternatives mainly with respect to…

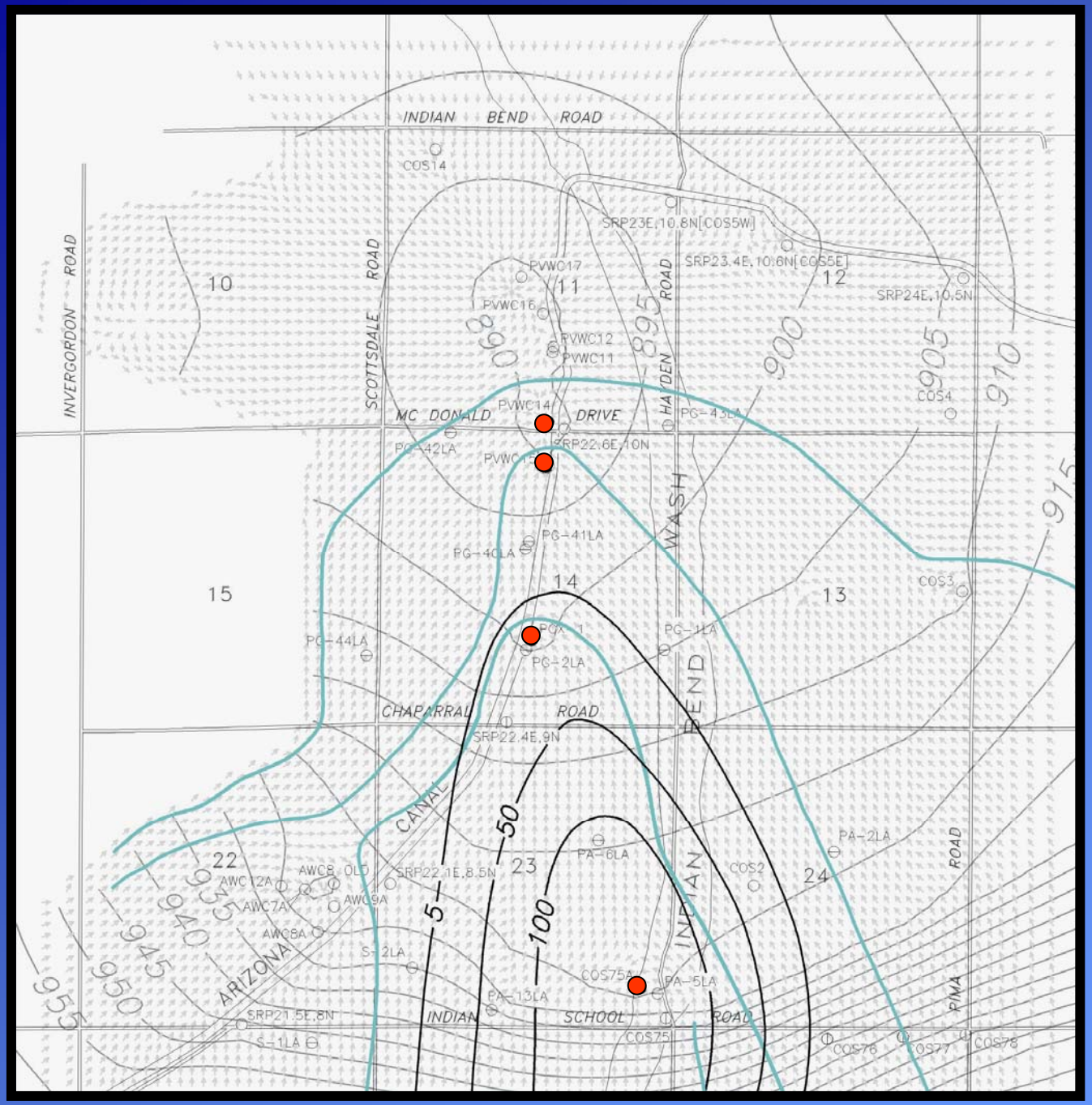
Reduction in toxicity, mobility, volume of contamination

Implementability

Cost

Reduction in Toxicity, Mobility, & Volume

- Evaluated based on differences in…
  - hydraulic capture
  - balance of pumping between MAU and LAU
  - mass removal
  - distribution of TCE concentrations (plumes)
  - plume area
  - wellhead TCE concentrations

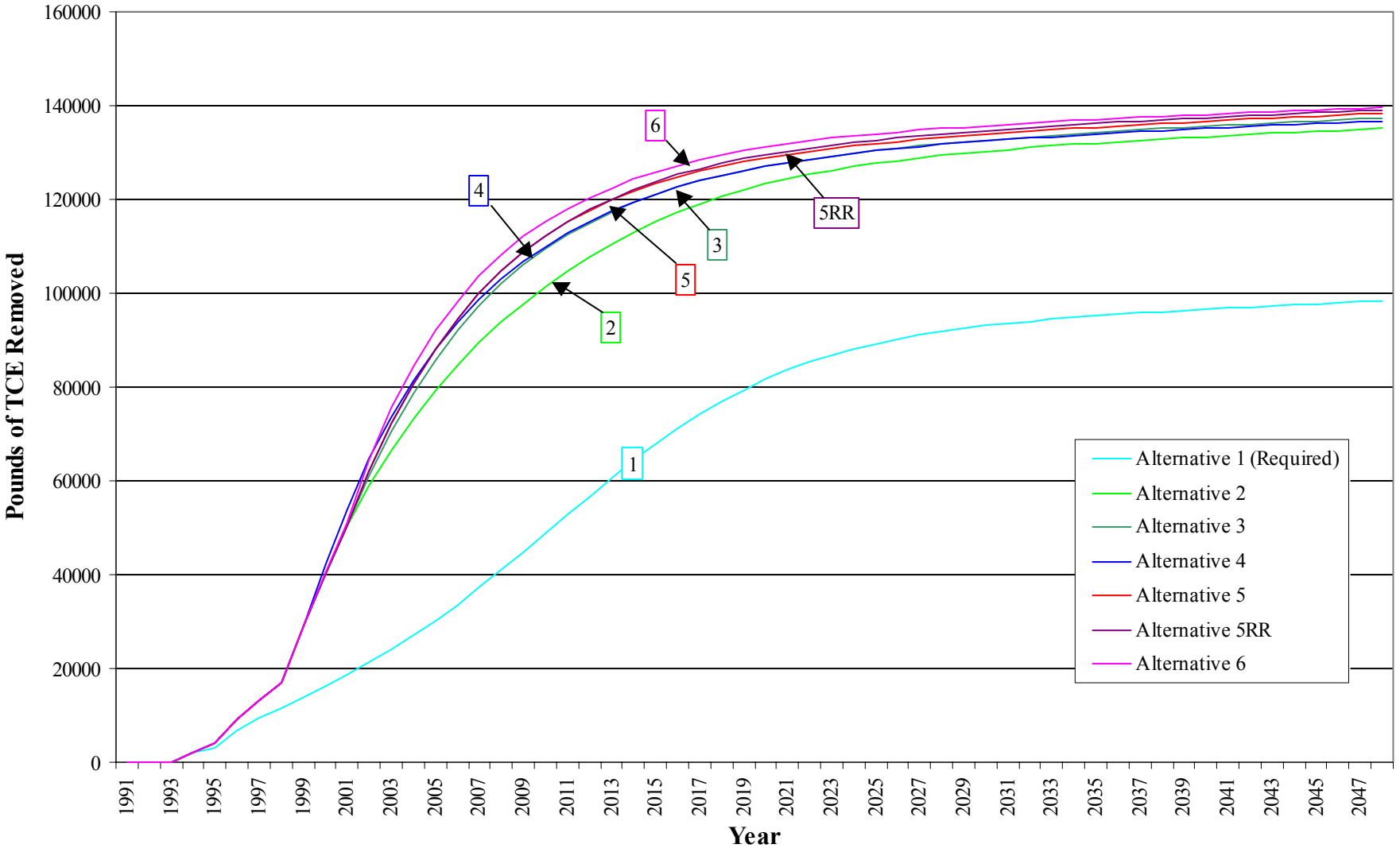


Estimated Hydraulic Capture FSA Model

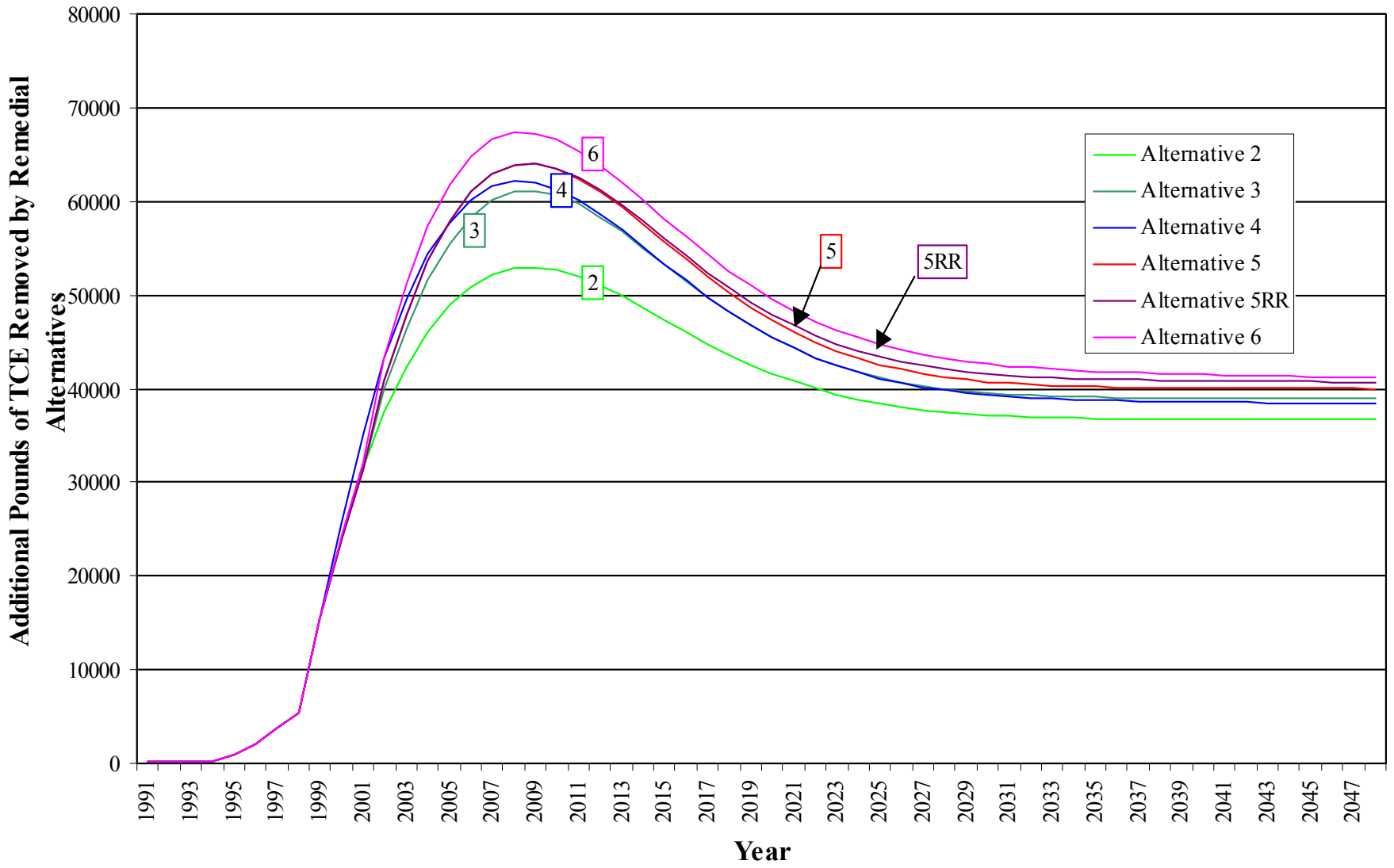
Balance of Pumping

Hydrogeologic Unit	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6
Middle	59%	47%	46%	35%	40%	34%
Lower	41%	53%	54%	65%	60%	66%

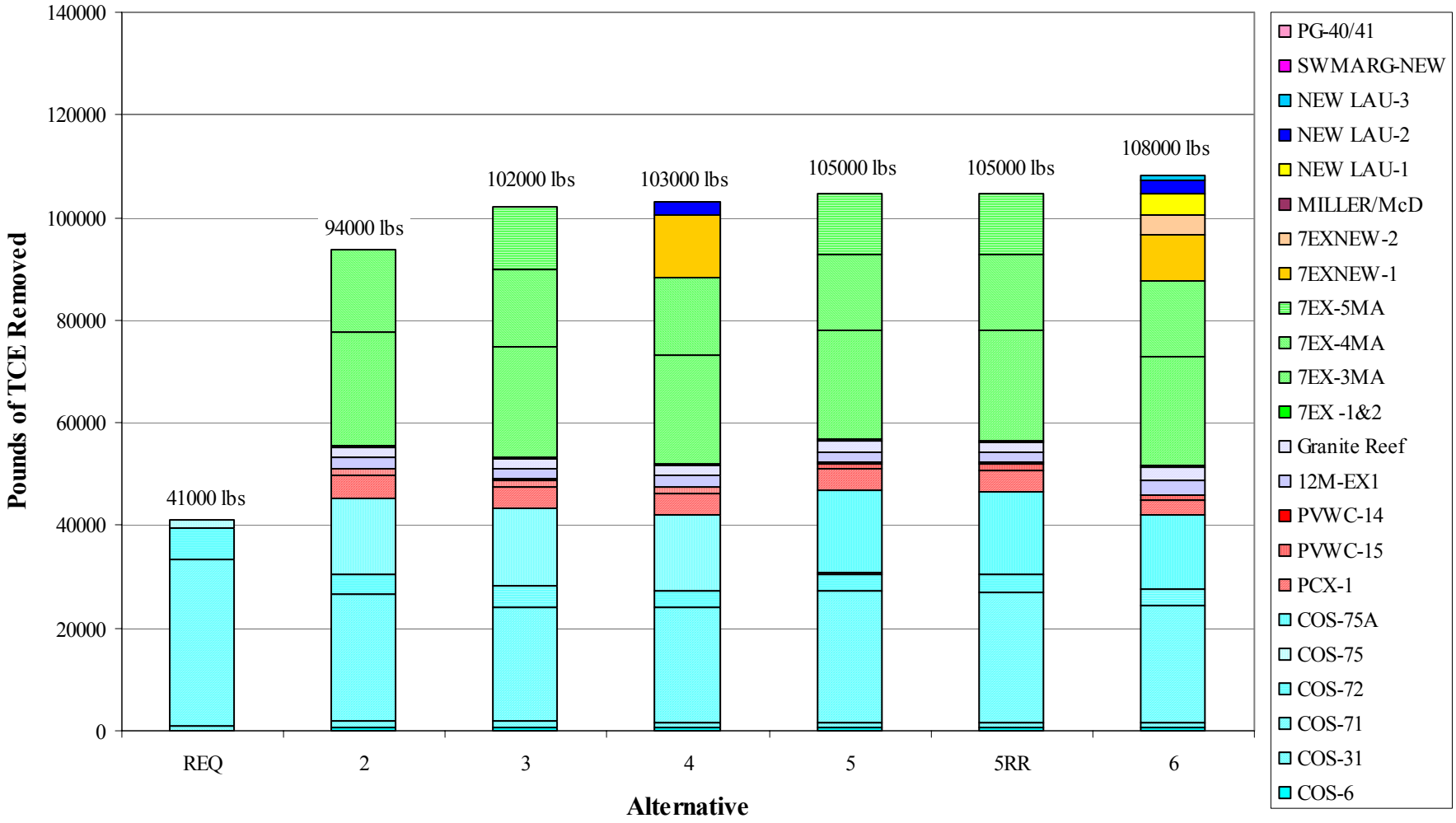
Cumulative Pounds of TCE Removed for Remedial Alternatives



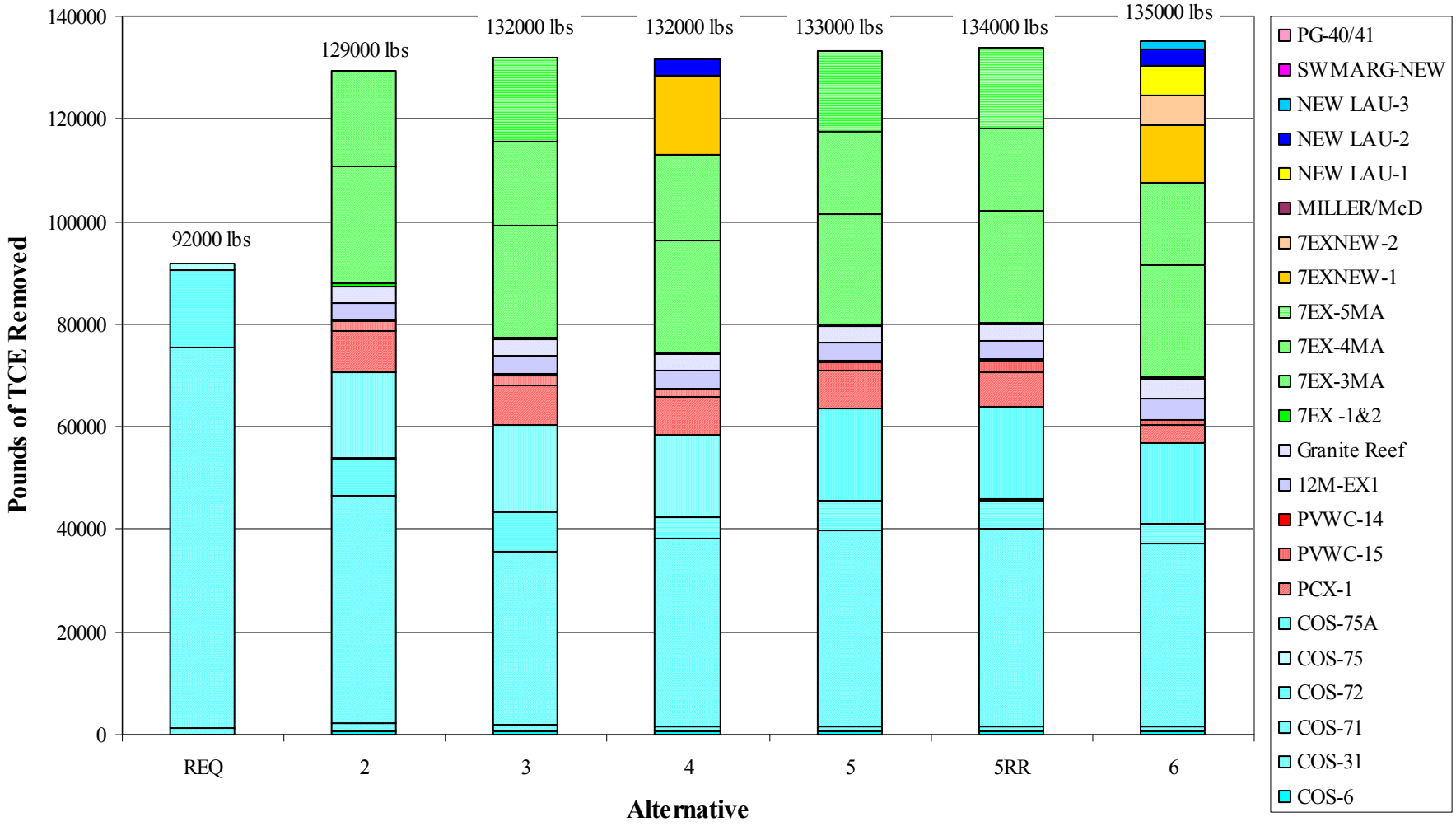
Cumulative Difference in TCE Removed Compared with Required Remedy



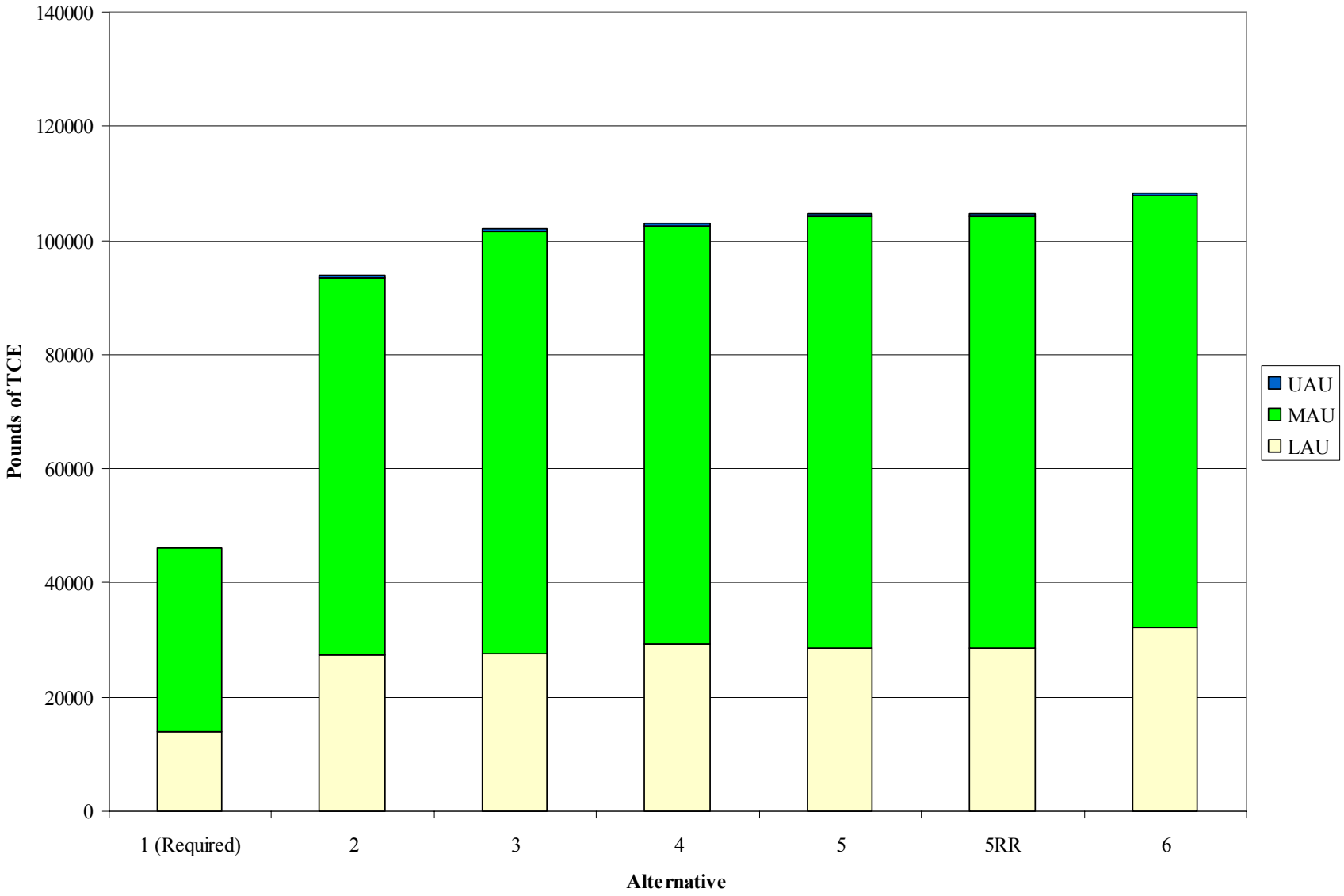
TCE Mass Removed by Remedial Alternatives (2008)



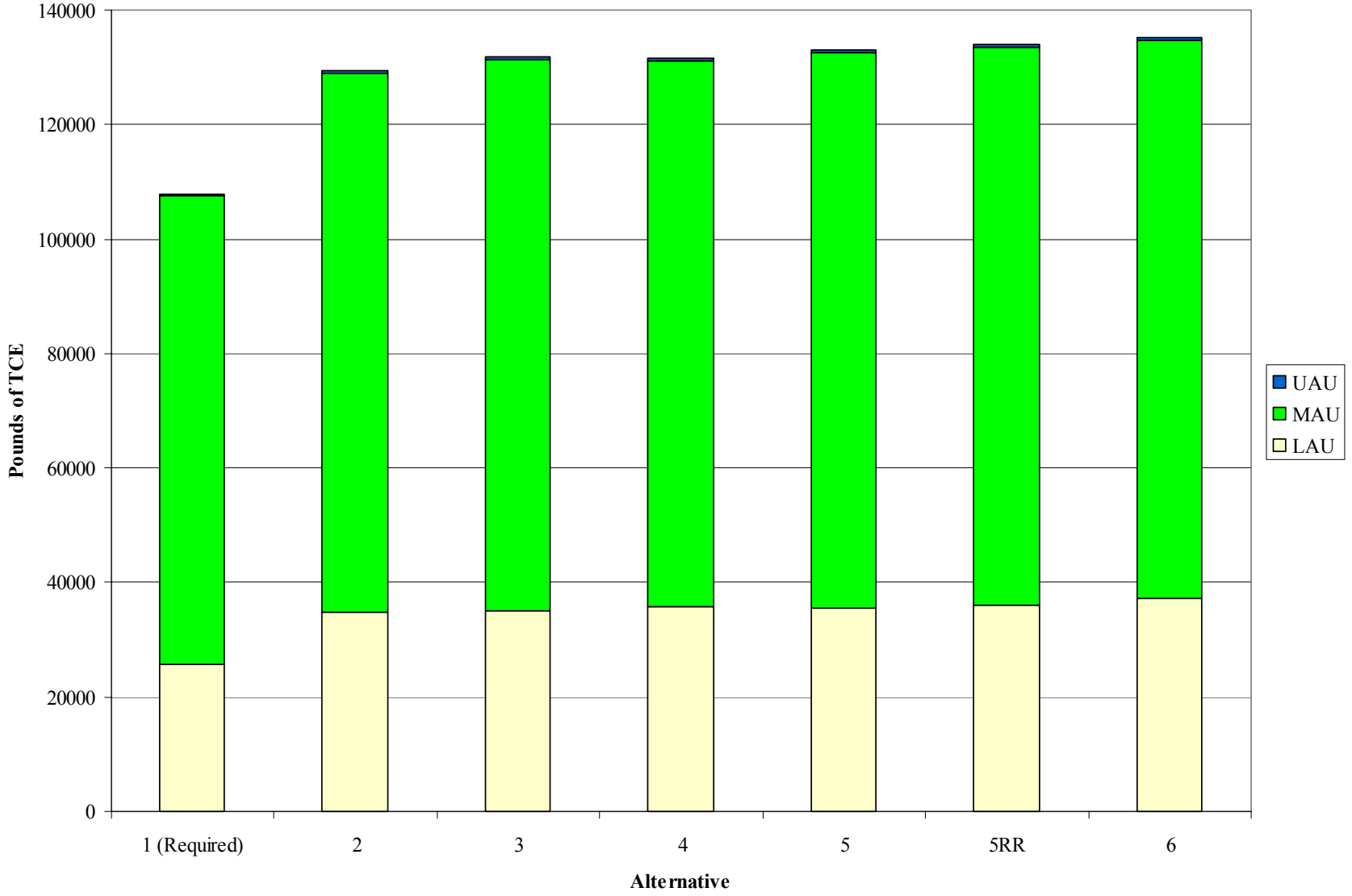
TCE Mass Removed by Remedial Alternatives (2028)



TCE Mass Removed by Remedial Alternatives by Unit (2008)

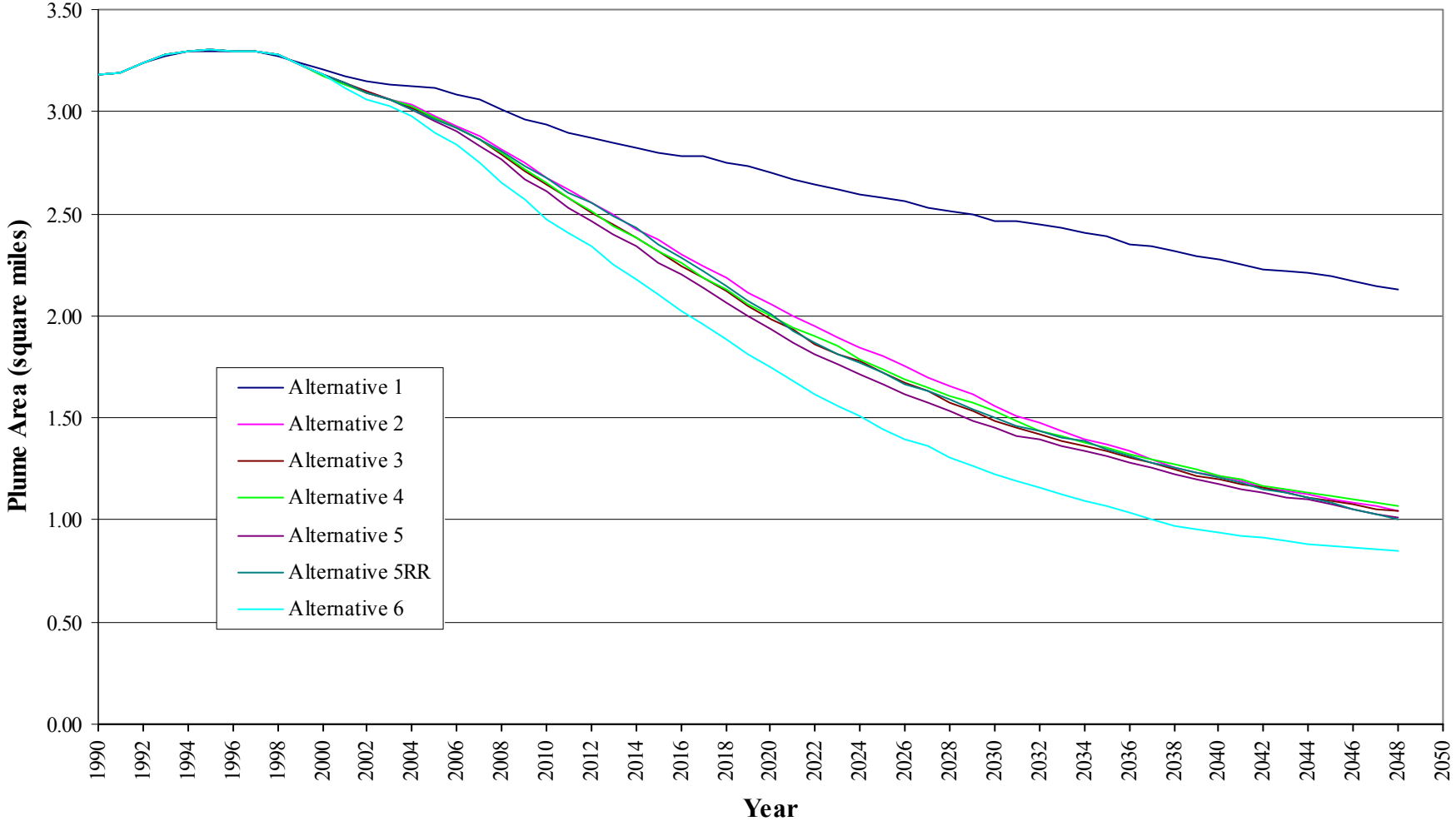


TCE Mass Removed by Remedial Alternatives by Unit (2028)



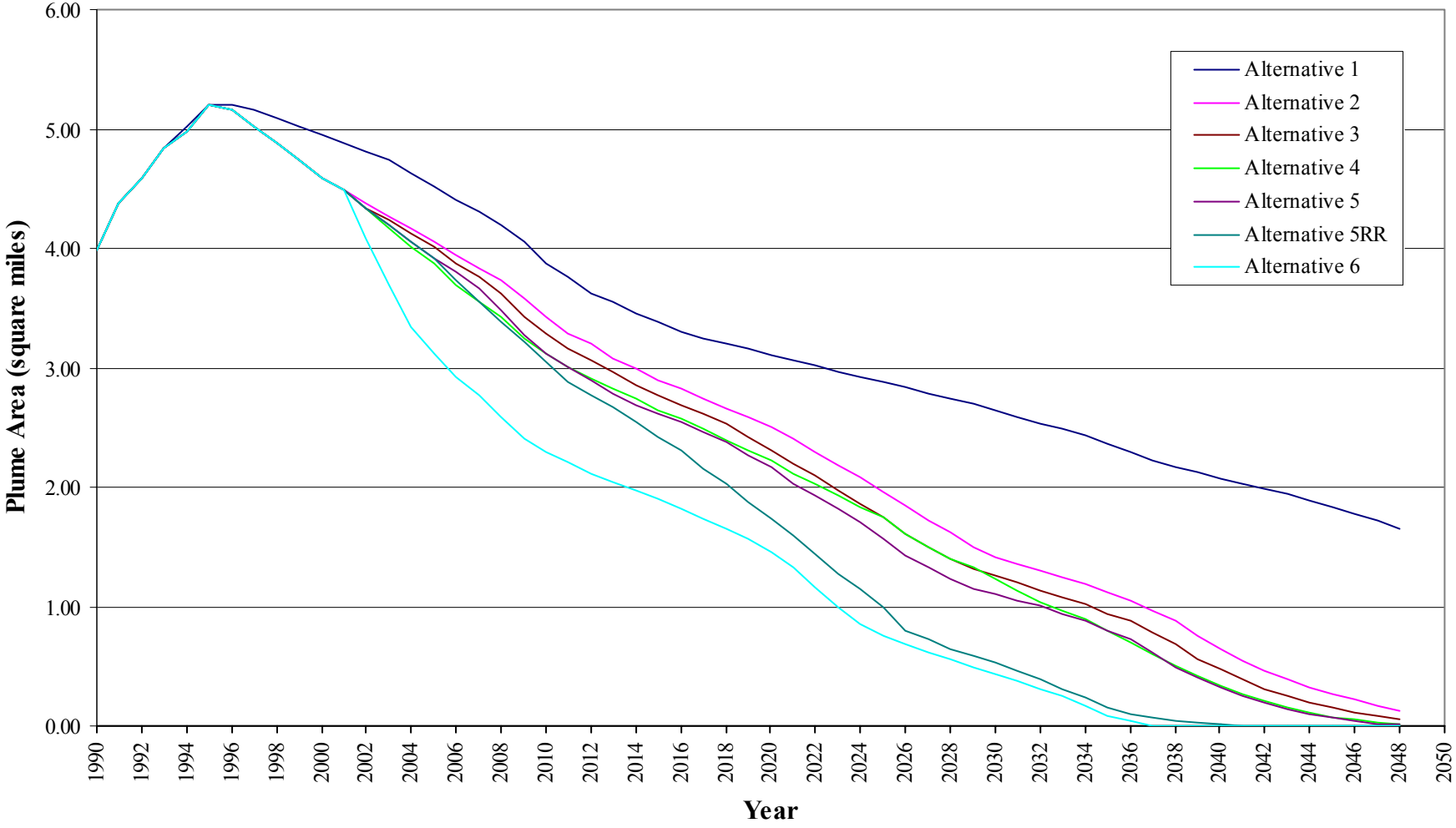
Plume Area

Layer 3 (MAU)

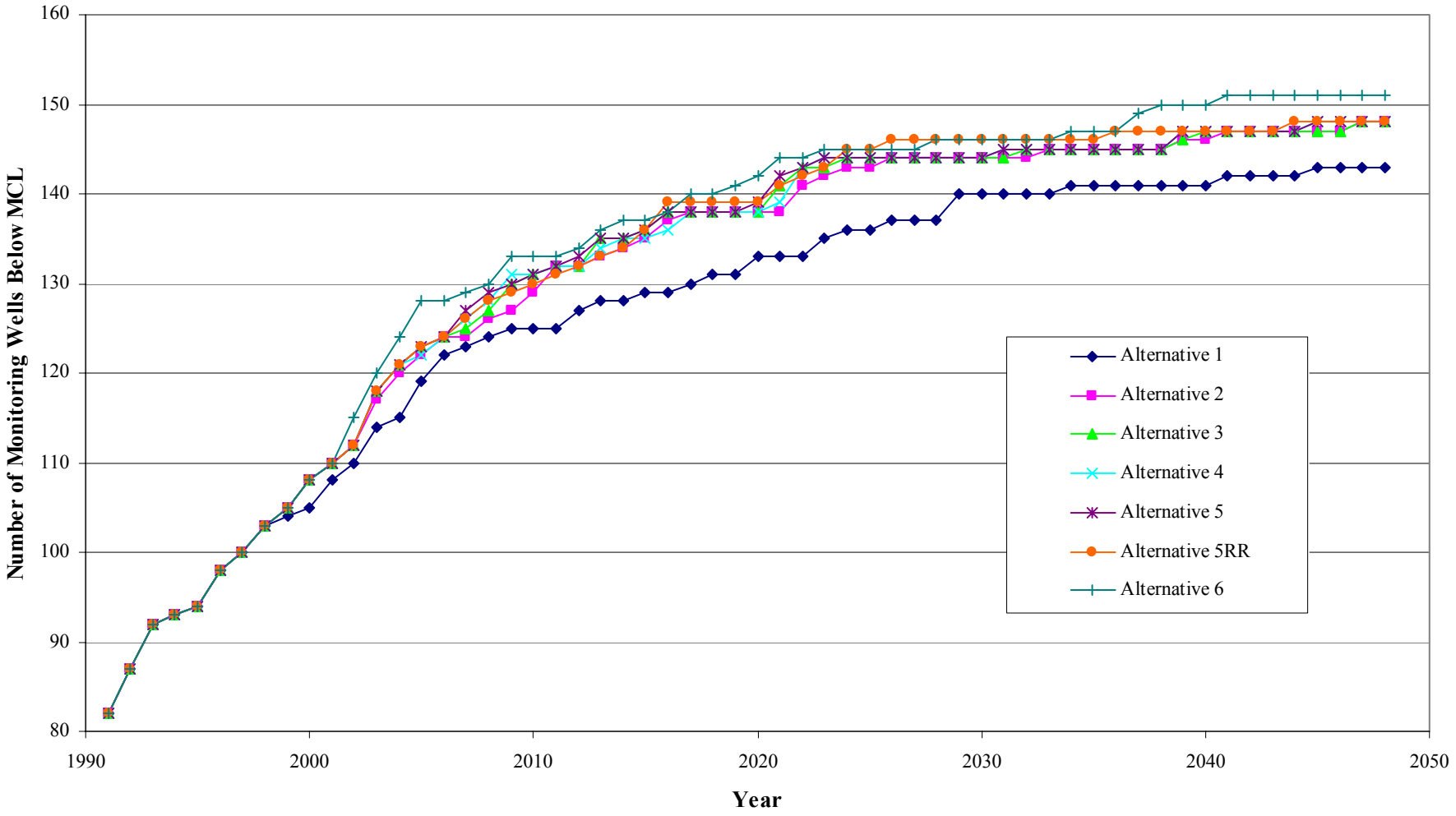


Plume Area

Layer 6 (LAU)



Number of Monitor Wells Below the MCL



Implementability

- Alt 1 - already implemented
- Alt 2 - already implemented
- Alt 3 - comparatively easy, in progress
- Alt 4 - moderately difficult
- Alt 5 - moderately difficult, technical feasibility concerns
- Alt 5RR - moderately difficult, technical feasibility concerns
- Alt 6 - difficult

Cost - Present Worth Analysis

- Alt 1 - $69.4 million
- Alt 2 - $128.2 million
- Alt 3 - $132.9 million
- Alt 4 - $134.2 million
- Alt 5 - $135.2 million
- Alt 5RR - $146.7 million
- Alt 6 - $171.1 million

North Indian Bend Wash Superfund Site

Summary of Remedial Alternatives Evaluation Process