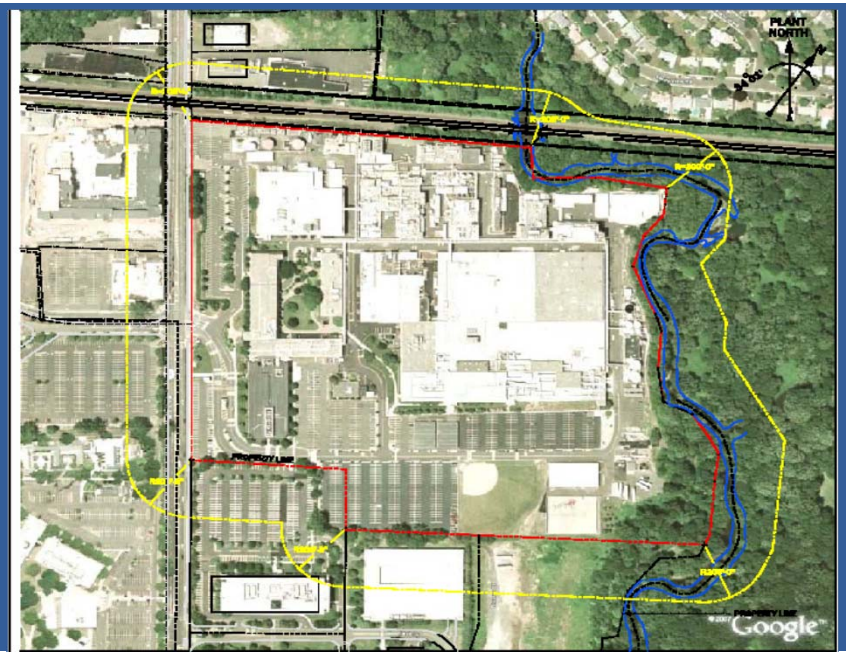
Application of Multiple Remedial Techniques and Approaches at a Former Pharmaceutical Manufacturing Facility



David J. Russell P.E., BCEE, LSRP

AECOM

Cause, Discovery, Progression of Action

Sixty-Acre Pharmaceutical R&D and Pilot Plant Facility (25 Buildings, 1 Million SF)

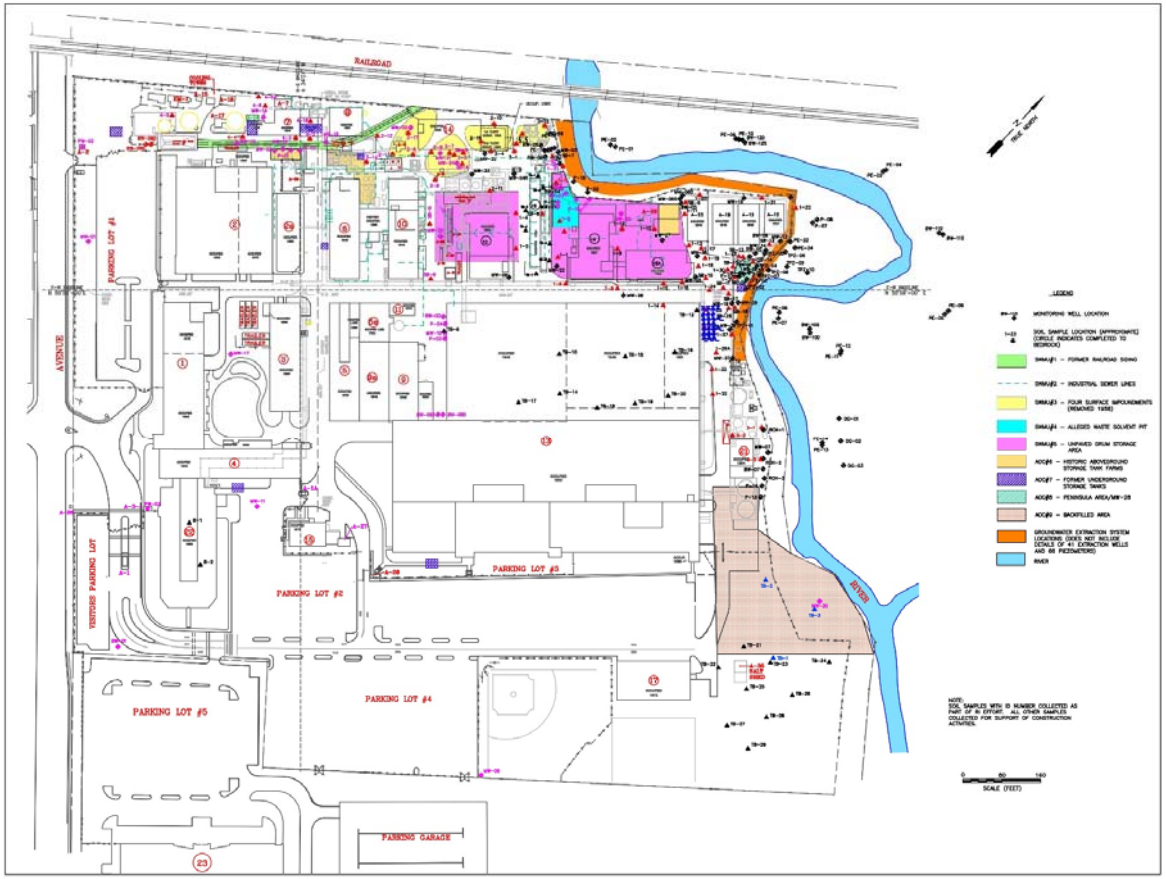
Extensive Environmental Investigations for 30 Years, Active Remediation for 27 Years

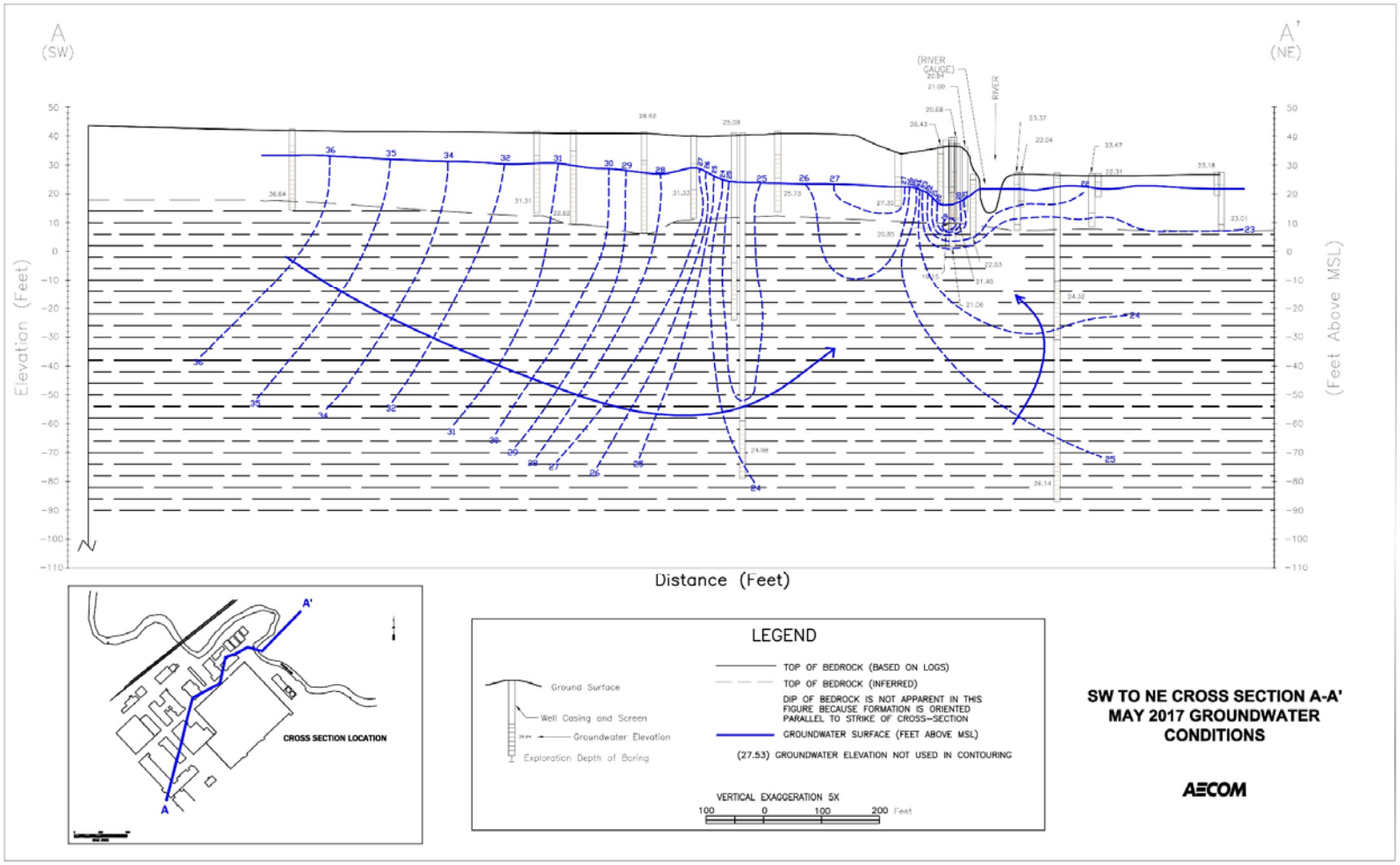
1938	Initially 30 Acres Developed, Railroad Spur Constructed
1940s	Four Wastewater Surface Impoundments Constructed
1950s - 1980s	Additional Buildings Constructed, USTs Closed/Removed
1961	Additional 30 Acres Purchased to Southeast
1984	**Environmental Investigations Initiated**
1985	Initial ACO with NJDEP
1990s	WWTP Constructed, more USTs Closed/Removed
1991	NJPDES – DGW Permit Issued
1994	**Groundwater Extraction System (GWES) Installed/Operational and Second ACO with NJDEP**
1994	Discontinued use of last USTs. All other USTs removed prior to 1988
1997	Reduction in Site Production Well Pumping Regime
1998	USEPA Issues Draft HSWA Permit for Site

Project Timeline

May 2000	Submitted Comprehensive Site Conditions Report (CSCR) to NJDEP/EPA Region II
May 2001	Commenced "Residual Contamination Areas" (RCAs) Remediation Pilot Testing
July 2001	Meeting with NJDEP and EPA – Bedrock Contamination Issues Raised by Agencies
October 2001	NJDEP Conditional Acceptance of CSCR
March 2003	Extended RCA Pilot Testing
November 2004	Full-Scale RCA Remediation Program Initiated
November 2007 and July 2008	Vapor Intrusion Assessments Conducted
October 2008	VP-51 Investigation Conducted
June 2009	VP-51 Area added to RCA Remediation Program
June 2010	NJDEP Approval of Vapor Intrusion Assessment
July 2010	Plant Closure
Ongoing	Continued GWES GW Monitoring Program, RCA Remediation Program & RI Activities

SWMUs and Groundwater Extraction System (GWES)




A
(SW)
A'
(NE)
Elevation (Feet)
(Feet Above MSL)
Distance (Feet)
(RIVER GAUGE)
RIVER
CROSS SECTION LOCATION
LEGEND
Ground Surface
Well Casing and Screen
Groundwater Elevation
Exploration Depth of Boring
TOP OF BEDROCK (BASED ON LOGS)
TOP OF BEDROCK (INFERRED)
DIP OF BEDROCK IS NOT APPARENT IN THIS FIGURE BECAUSE FORMATION IS ORIENTED PARALLEL TO STRIKE OF CROSS-SECTION
GROUNDWATER SURFACE (FEET ABOVE MSL)
(27.53) GROUNDWATER ELEVATION NOT USED IN CONTOURING
VERTICAL EXAGGERATION 5X
100 0 100 200 Feet
SW TO NE CROSS SECTION A-A'
MAY 2017 GROUNDWATER CONDITIONS
AECOM

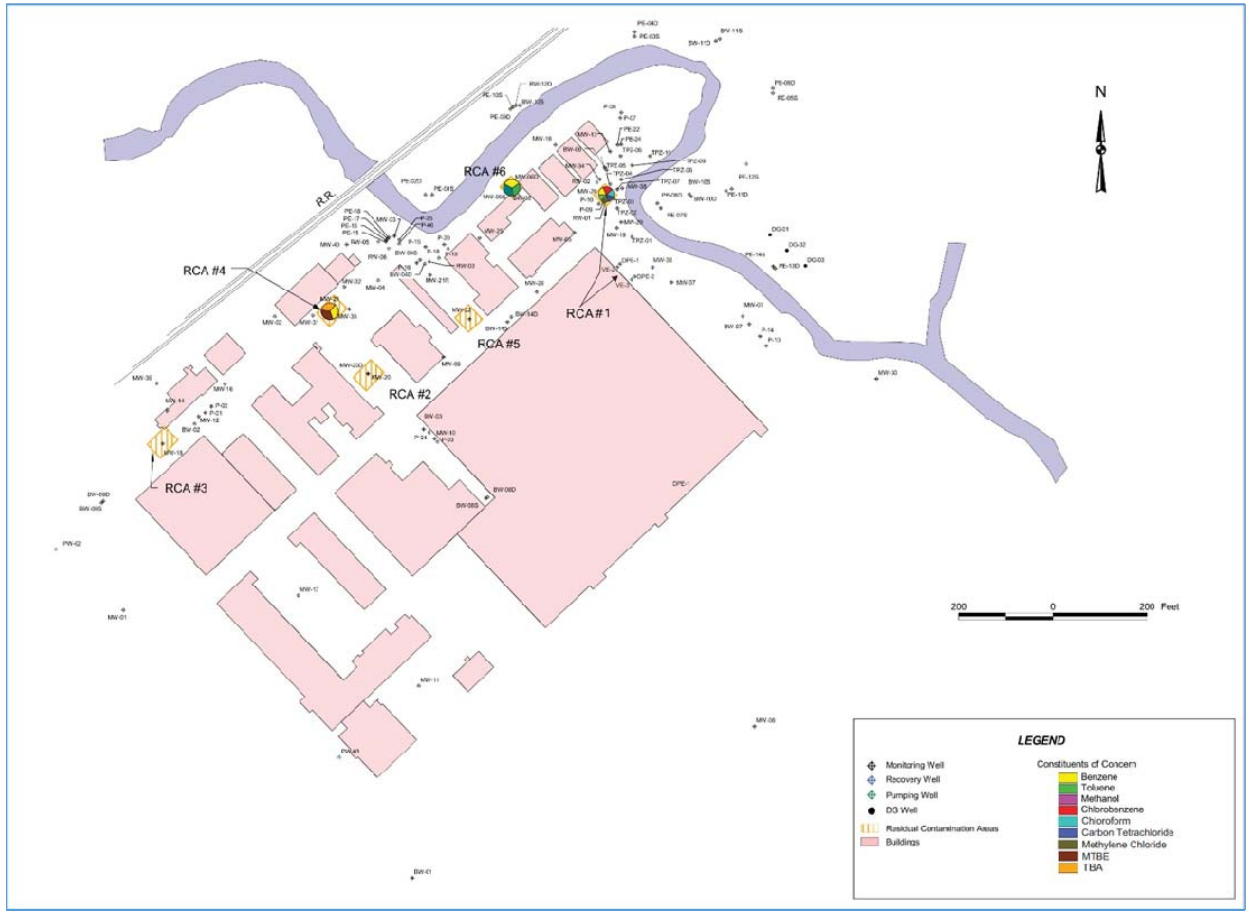
Project Closure Strategy

- CSCR - Comprehensive Site Conditions Report
- Develop Cost Effective Site-Wide Remedial Strategy to Bring Site to Closure
- Obtain NJDEP/USEPA Acceptance of Proposed Strategy
- Implement Site-Wide Remedial Strategy
- Monitor Effectiveness and Update Strategy As Needed

ACO Compliance Strategy

- Maintain and Monitor Hydraulic Control with Groundwater Extraction System (GWES)
- Address Confirmed Site-Related Constituents that Contribute to GW Contamination:
  - Benzene
  - Toluene
  - Carbon Tetrachloride
  - 1,4-Dioxane
  - Chloroform
  - Methanol
  - Methylene Chloride
  - Chlorobenzene
- Remedial Objectives and Technologies Developed for Residual Contamination Areas (RCAs) to Reduce Concentrations to Allow Natural Attenuation of GW and Eventual Shut Down of GWES

Residual Contamination Areas (RCAs)



Cost-Benefit Analysis Conclusion

- Cost Savings realized if GWES operating period is reduced at least 15 years to a 25-year operational period
- Pilot Testing conducted to confirm feasibility and cost savings of more aggressive RCA remedial strategy
- Impact of GWES upgrades/replacement could easily accelerate cost of “status quo” and RCA Return on Investment

RCA Pilot Study

Conducted Pilot-Testing of Four Remedial Technologies to Remediate RCAs:

- Soil-Vapor Extraction
- Dual-Phase Extraction
- Air Sparging
- Enhanced Bioremediation (Biosparging)

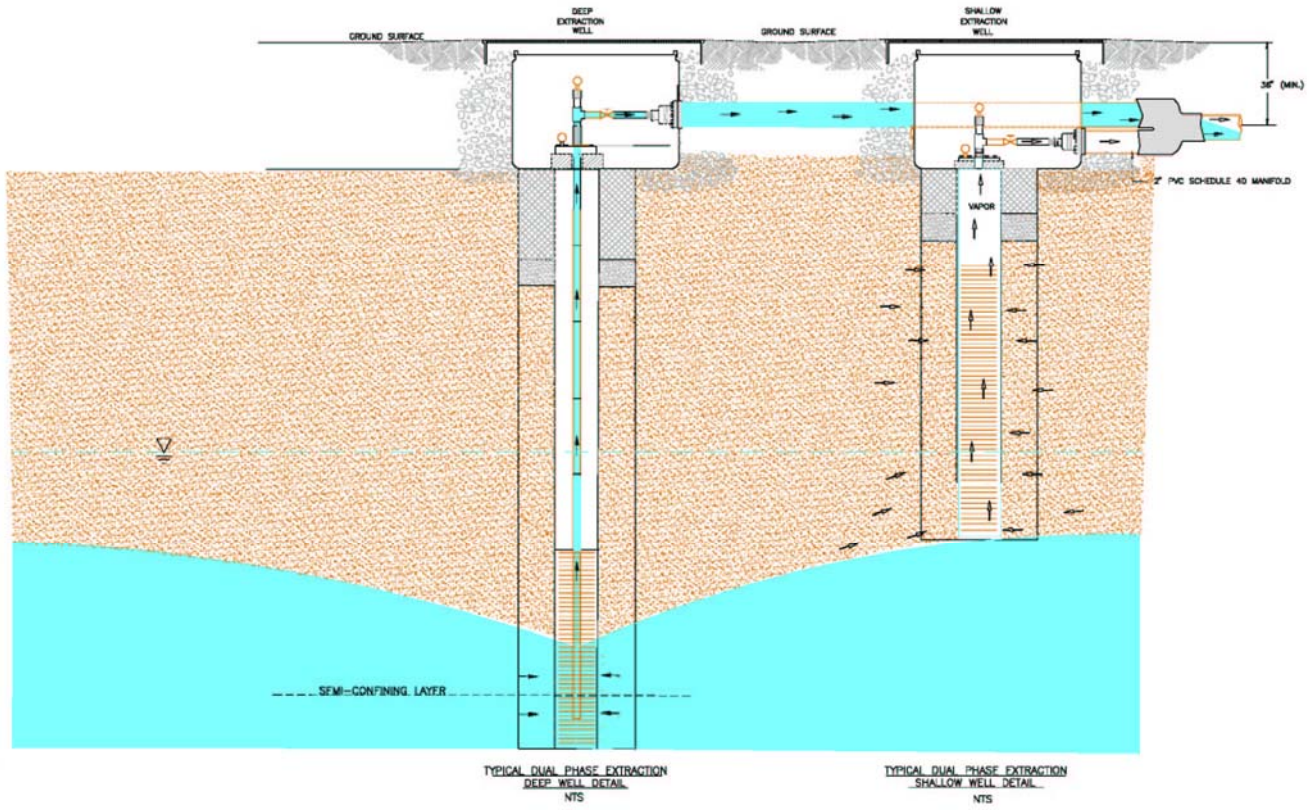
RCA Remediation Implementation

- High Vacuum DPE at RCAs with High Toluene and Benzene to Address Mass Removal
- Enhanced Biosparging at RCAs with Toluene, Methanol, MTBE and 1,4-Dioxane (Cometabolic Biodegradation)
- Enhanced Biosparging Following DPE to Address Reduced Levels of Benzene and Toluene

RCA Remedial Systems

RCA Remedial Systems

High Vacuum Dual-Phase Extraction Well Couplet Design



Site-Wide Remedial Strategy

- Maintain Existing GWES to provide Hydraulic Control in Compliance with ACO
- Implement RCA Remediation to Address RCAs Contribution to Groundwater
- Remediate RCAs to Remedial Objectives that Comply with Natural Attenuation Remedy
- Shutdown GWES and Implement Monitored Natural Attenuation of Groundwater with a Classification Exception Area (CEA)

Cessation of Operations

NJDEP Site Remediation Reform Act

- Combined New ISRA Case with existing ACO
- RCRA 2020 GPRA Site with LSRP, NJDEP and USEPA Oversight
- Due Diligence Assessment
- Closure of Two RCRA Hazardous Waste Storage Facilities
- Closure of Nine Spill USTs, Deed Notice/Engineering Control and Remedial Action Permits (RAPs)
- Continued Implementation of Remedial Actions

Property Sale

Brownfield Developers/University/Train Station

- Liability Transfer
- Developer Assumes Remedial Strategy
- Proposed Mixed-Use Development
  - Issues
    - Multiple Stakeholders RP/USEPA/NJDEP/Developer/College
    - Demolition
    - Financial Assurance – NJDEP/USEPA
    - Vapor Intrusion

Proposed Redevelopment

Ongoing Redevelopment

Ongoing Redevelopment




Summary and Lessons Learned

- Site-Wide Strategy Development
  - Comprehensive Site Conditions Report
  - RCA Remediation in Concert with Groundwater Extraction and Treatment System
  - Mobile Remediation Trailers Addressed Multiple RCAs Cost Effectively
- Look Beyond Status Quo to Meet Remedial Action Objectives
- Effective Implementation Resulted in Sale and Redevelopment of the Brownfields Property