An Overview of Cleanup Projects in DEQ Northwest Region Voluntary Cleanup Program

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Oregon DEQ

State of Oregon
Department of
Environmental
Quality

NWR Voluntary Cleanup

- Approximately 200 active sites
- Region covers Portland metro area, extends west to coast
- Approximately 15 staff including geologists, hydrogeologists, engineers, and toxicologists
- Work as interdisciplinary teams on projects

Types of Cleanup Sites

Large sites typically current or active industrial, many situated on Willamette River

- Gas Plants
- Bulk Fuel Facilities
- Rail Yards
- Ship Construction and Dismantling
- Pesticide Manufacturers

Other Cleanup Sites

Medium to small sites, more varied

- Dry cleaners
- Gas Stations
- Landfills/Dumps
- Other small industrial (plating, misc. manufacturing, etc.)
- Mom & Pop operations

Typical Contaminants - Soil

- Petroleum Hydrocarbons (gas, diesel, lube oils)
- Volatile Organic Compounds (benzene, solvents including PCE and TCE)
- Semi-Volatile Organics (phenols, PAHs)
- Metals (lead, arsenic, chromium)
- Poly-Chlorinated Biphenyls (PCBs)
- Dioxins and Furans

Typical Contaminants - Groundwater

- Dry cleaning (PCE) or industrial solvents (TCE, 1,1,1-TCA)

- Petroleum components including BTEX and Polynuclear Aromatic Hydrocarbons (PAHs)

CLEANUP GOALS

- Cleanup to risk-based concentrations, currently defined as one-in-a-million (1 x 10-6) risk
- Requires identification of potentially exposed human and ecological “receptors”
- In past, focused on human risk based on exposure to groundwater or soil. More emphasis now on ecological receptors, particularly in water (sediments)

Types of Cleanup Actions

Passive

- No Action – contaminants don't pose significant risk to humans or critters
- Monitoring – ensure stable situation does not change. Common for groundwater

Active

- Dig and Haul
- Containment (capping)
- Various in-place ("in-situ") treatments

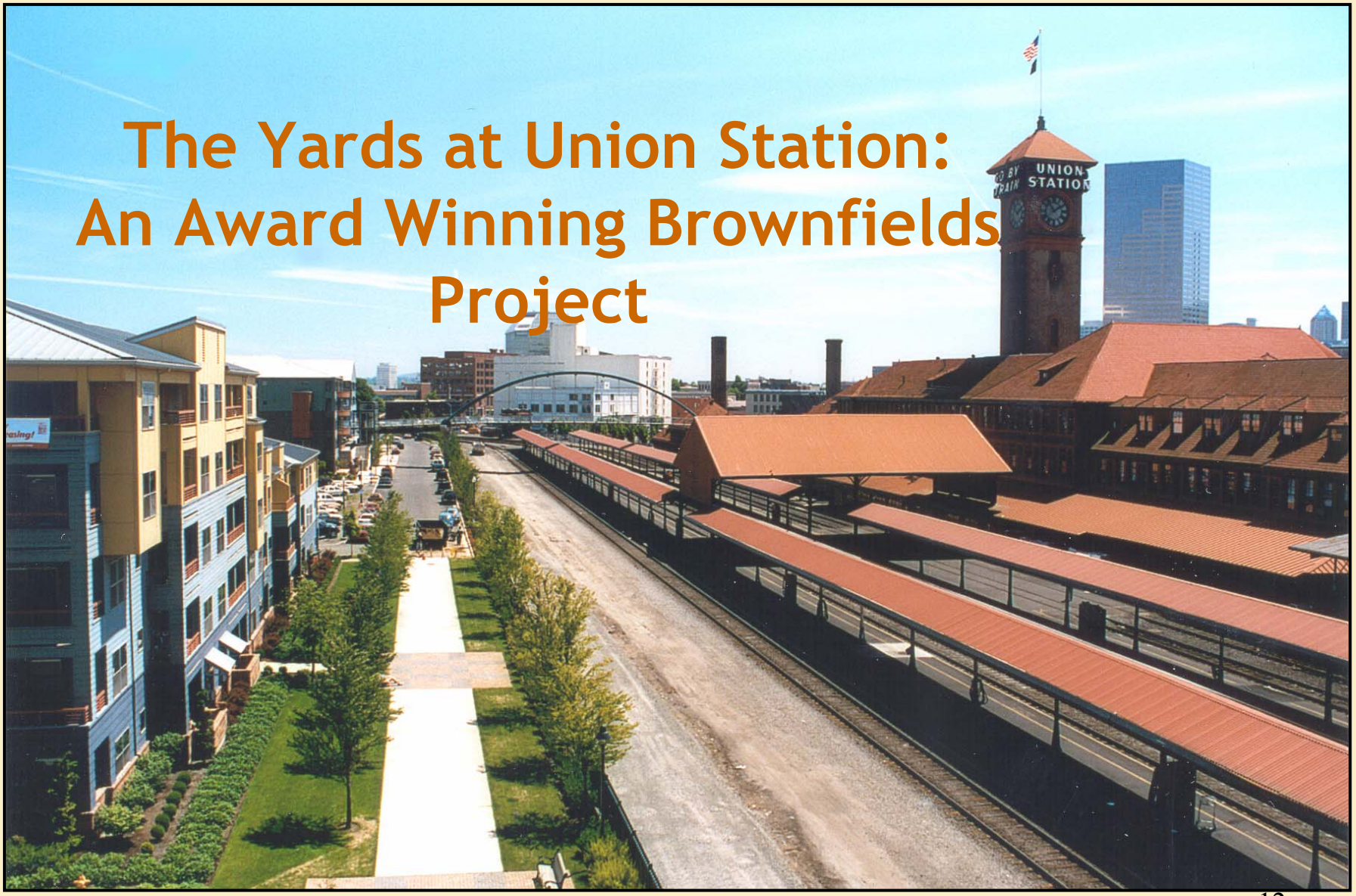
In-Situ Treatments

- Chemical – injection of chemicals to destroy contaminants or alter their physical properties to allow treatment or removal
- Thermal – application of heat to destroy or liberate contaminants
- Biological – Injection of bugs (typically bacteria) and/or nutrients to stimulate biodegradation

Cleanup Project Examples

- Union Station – Excavation and capping (simple)
- Cadet Mfg. – In-Situ Chemical Oxidation (intermediate)
- ICN – Electrical Resistive Heating (complex)

The Yards at Union Station: An Award Winning Brownfields Project



Site History

- Wetlands and small lake prior to 1890, later filled with 3 million yards of material
- Operated as rail yard from late 1800s to 1970s
- Purchased by City of Portland for redevelopment in 1987

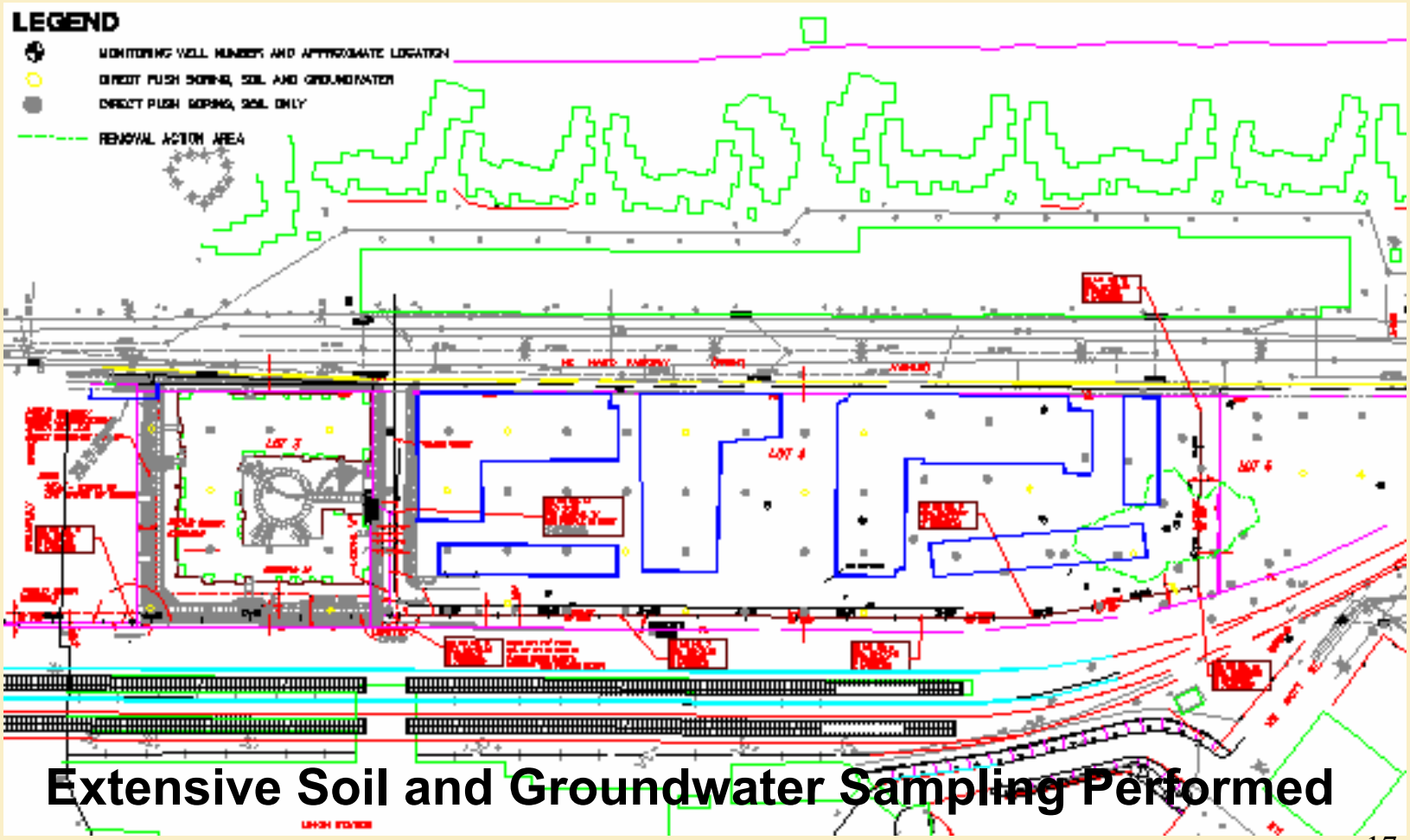
Union Station Yards - Circa 1912

Union Station Yards - Circa 1988

Discovery of Environmental Problems

- During geotechnical exploration, borings encountered crude oil in soil and groundwater in southern site
- Discovery of oil led to further assessment, which resulted in the discovery of site-wide contamination

Exploration Plan



Extensive Soil and Groundwater Sampling Performed

Crude Oil Release

Crude Oil in Soil and Groundwater

- Area Affected - 5,000 square feet of property.
- Corrective Action - Approximately 3,000 cubic yards of oil-containing soil removed.

Crude Oil Soil Remediation

Site-Wide Soil Contamination

Lead, Arsenic and Fuel Hydrocarbons in Soil

- Area Affected - Entire 6.1 acre site.
- Corrective Action - Surface capping and institutional controls.

Surface Capping

Cap Construction

- Fabric “demarcation” layer over contaminated soil throughout site
- Fabric covered with combination of soil, buildings and road
- Yearly cap inspection required
- Cap maintenance required “forever”

Phase A Housing

- Project groundbreaking March 1997. Project completed in March 1998.
- Consists of 158 units of housing. Half of units reserved for persons earning <50% of median income, and half reserved for persons earning <60% of median income.
- Phase A Housing currently near 100% occupancy.

Phase A Housing

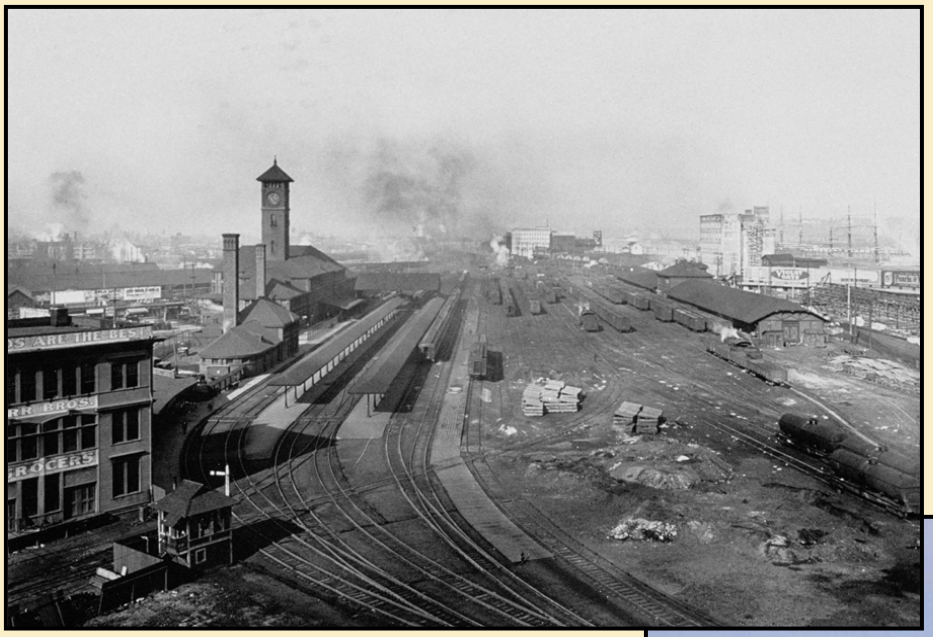
Phase B Housing

- Project groundbreaking September 1998. Project completed in January 2000.
- Consists of 321 units of housing. Forty percent of units reserved for persons earning <60% of median income, and the balance of units are market rate.
- Phase B Housing currently near 100% occupancy.

Phase B Housing

Cost-Sharing Arrangements

- Site owner able to negotiate and execute cost recovery agreement with prior owner (railroad).
- Out-of-pocket cost to current owner (City of Portland) for environmental assessment and remediation was $300,000.
- Total project cost $2,650,000.


ROGERS


UNION STATION

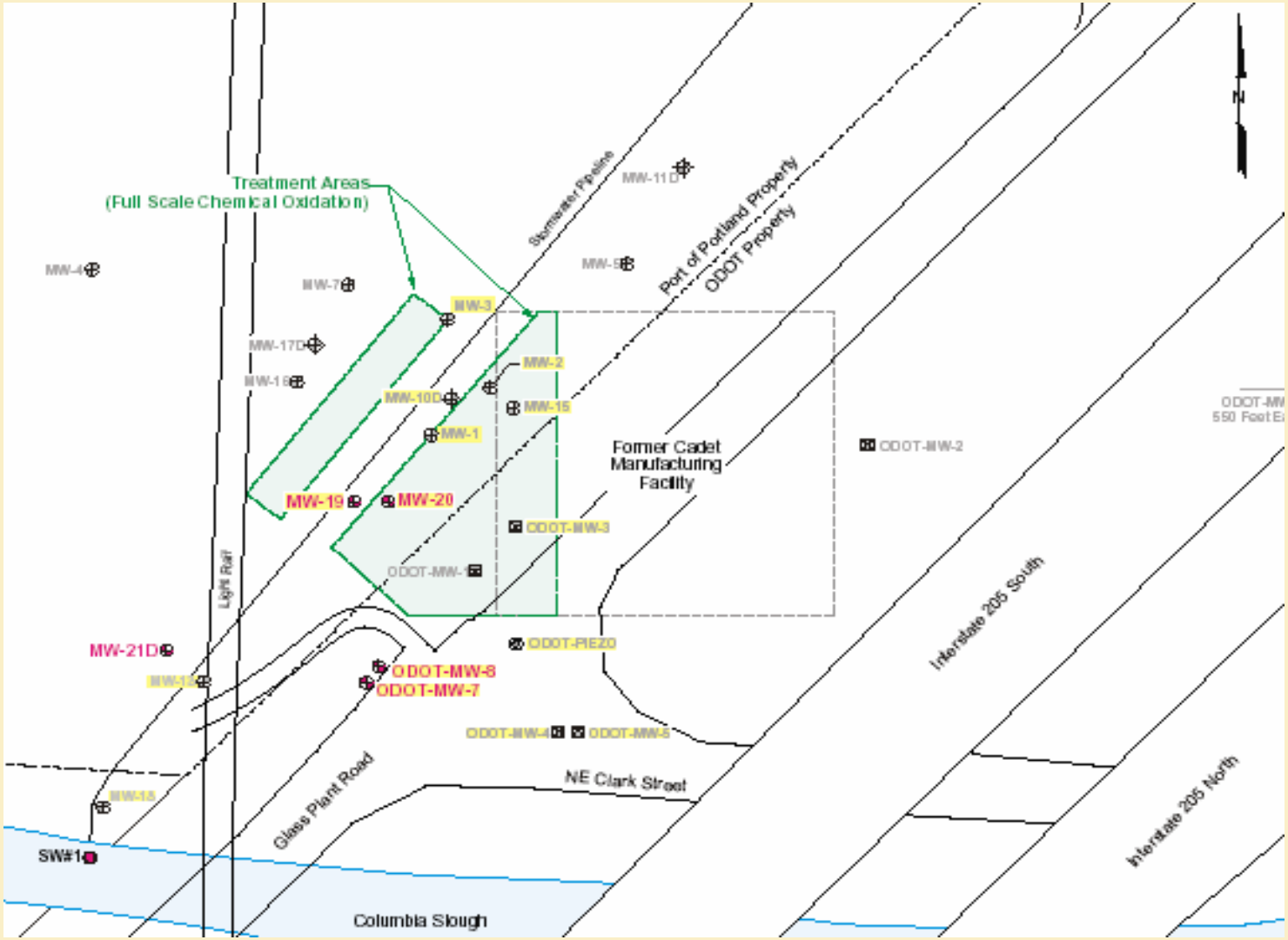
Cadet Manufacturing – A Non Award-Winning Cleanup Currently in Progress

CADET MANUFACTURING BACKGROUND

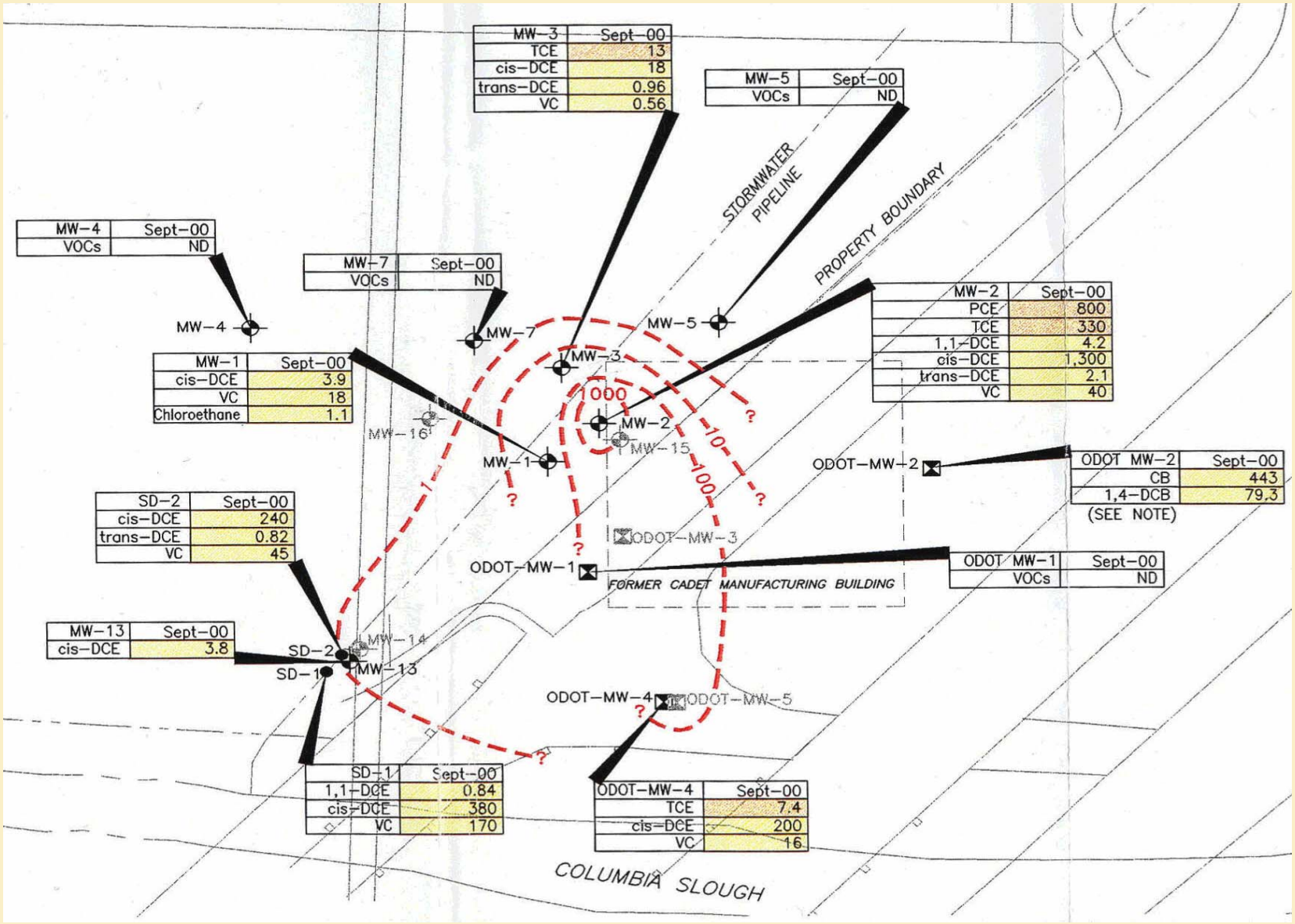
- Heater manufacturing in late 1960s and early 1970s
- Small operation (less than 5 acres)
- Use and release of solvents including TCE for metal degreasing
- Site vacant since 1970s. Contamination discovered in late 1990s during sewer line install through property
- Voluntary Cleanup investigation started in 1998, included intensive negotiations with bankrupt Cadet insurers to get money for cleanup
- $2.5 million settlement in 2001.

SETTLEMENT NEGOTIATIONS

CADET SITE MAP



CADET GROUNDWATER CONTAMINATION



ENVIRONMENTAL ISSUES

- **High VOC (PCE, TCE, DCE, VC) groundwater contamination (6200 ppb PCE, 2300 ppb TCE)**
- **Site adjacent to City of Portland backup wellfield**
- **Drinking water aquifer present at 50’ below ground surface**
- **Site groundwater discharges to Columbia River channel (Columbia Slough)**

REGIONAL GEOLOGIC CROSS-SECTION

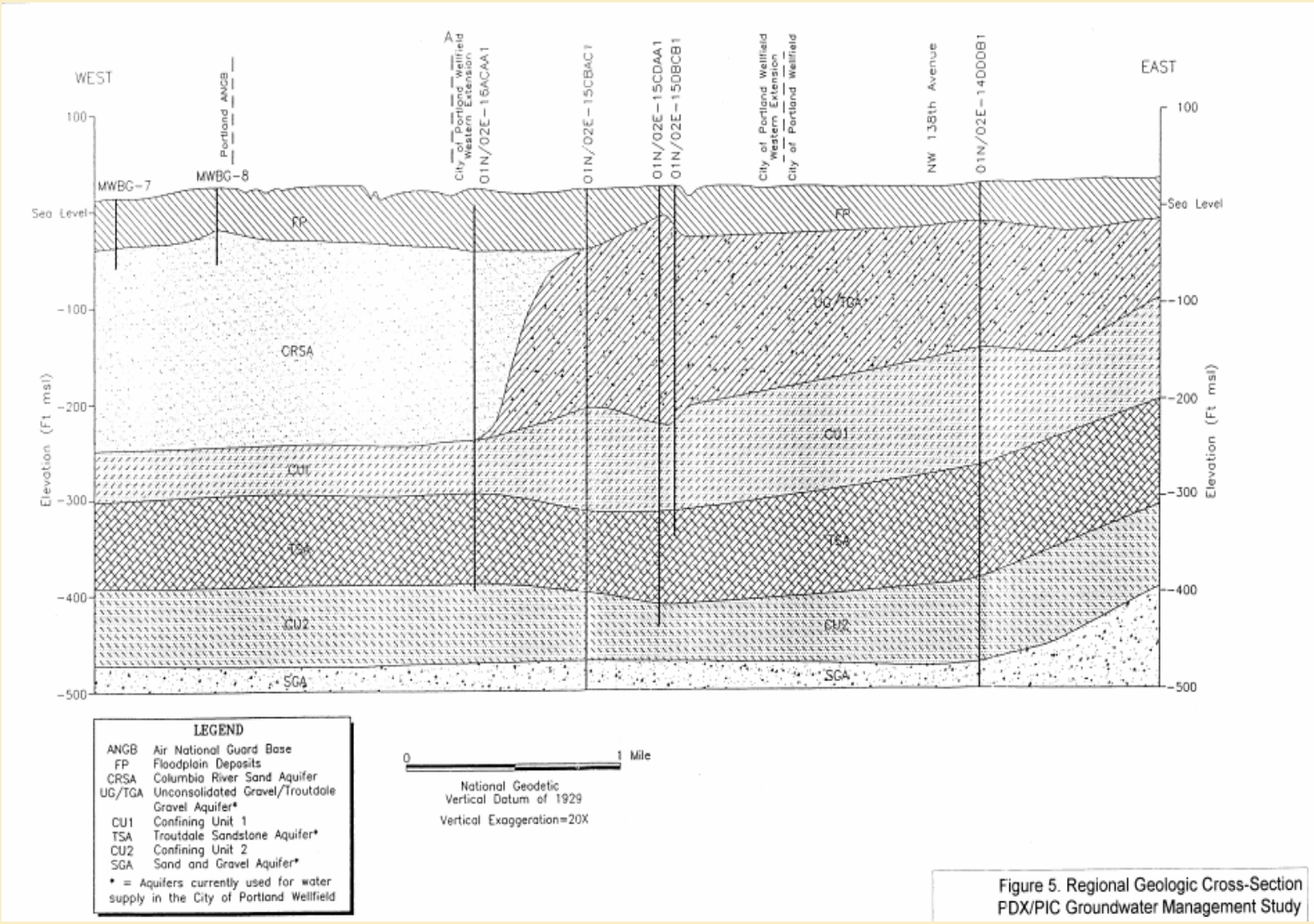
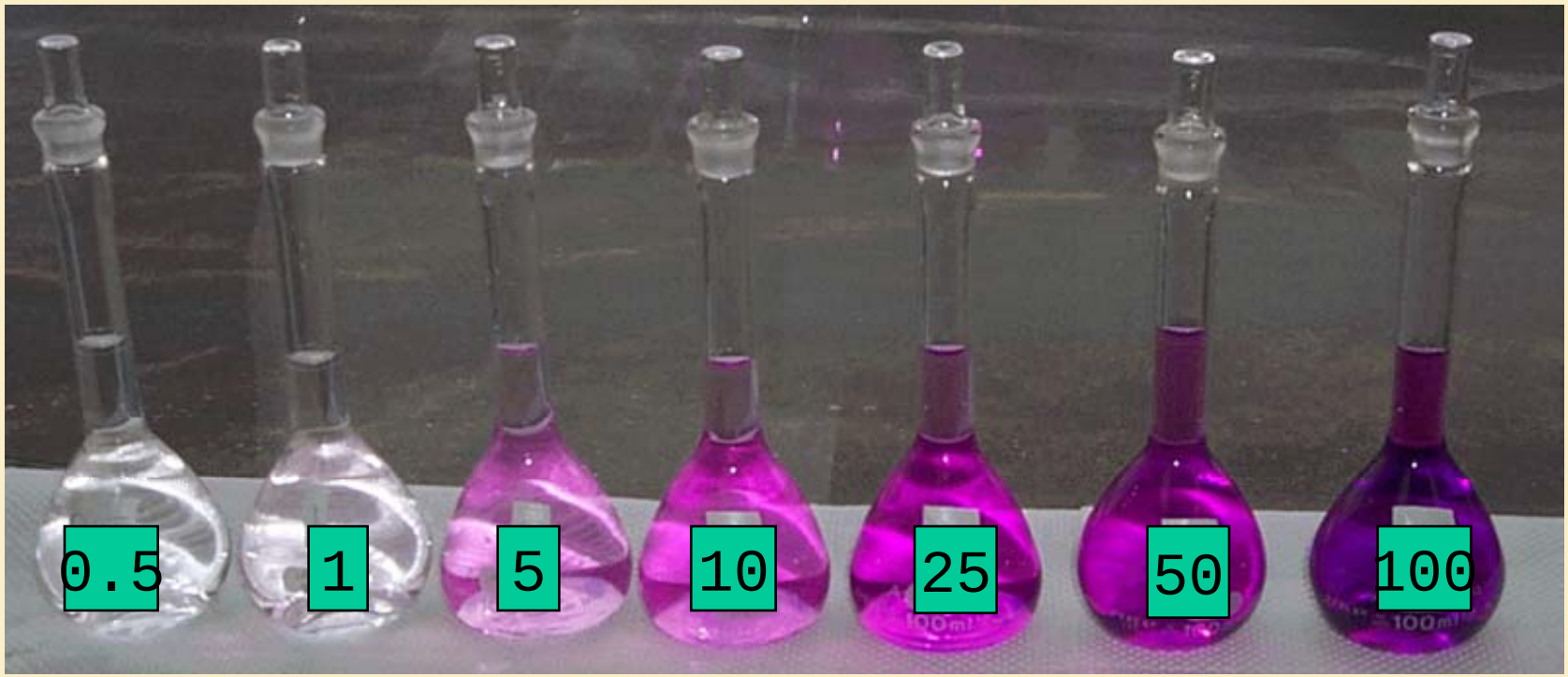


Figure 5. Regional Geologic Cross-Section
PDX/PIC Groundwater Management Study

INTERIM REMEDIAL MEASURE

- **Based on presence of solvents and location in wellfield, DEQ determined that immediate action was necessary**
- **Evaluation of wide variety of emergency treatment options performed**
- **Chemical treatment with sodium permanganate selected**
- **Chemical oxidation is an innovative, cost-effective and fast cleanup technology**
- **Lab and field testing performed to determine if treatment will work, how much chemical to use and at what concentration**

PERMANGANATE CONCENTRATIONS



Permanganate Concentration, milligrams $KMnO_4$ / Liter = ppm

Conversion Factors:

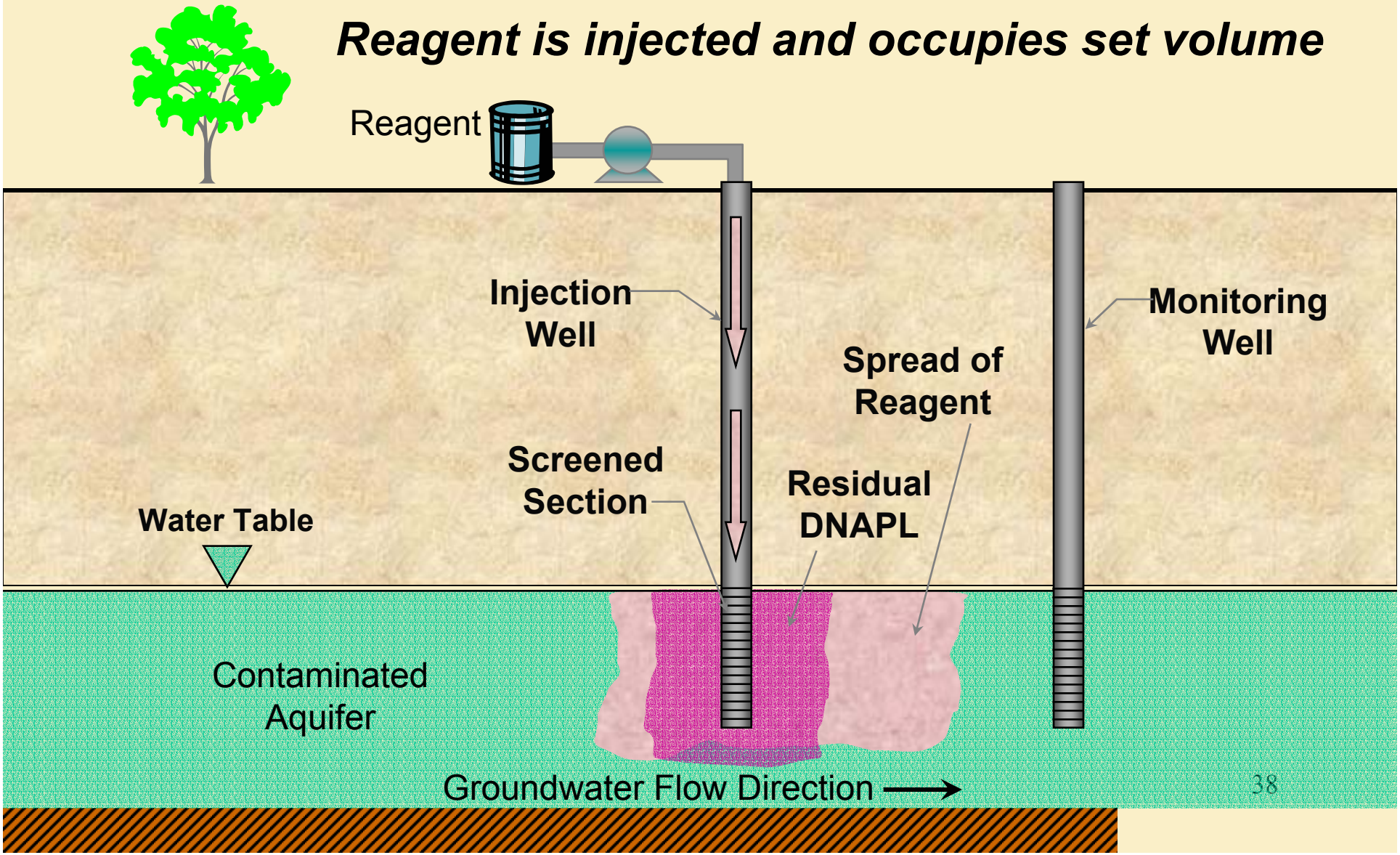
(milligrams $KMnO_4$ / Liter) x (0.8978) = (milligrams $NaMnO_4$ / Liter)

(milligrams $KMnO_4$ / Liter) x (0.7516) = (milligrams MnO_4^- / Liter)

Note: ppm x 10,000 = %

IN-SITU CHEMICAL OXIDATION INJECTION PROCESS

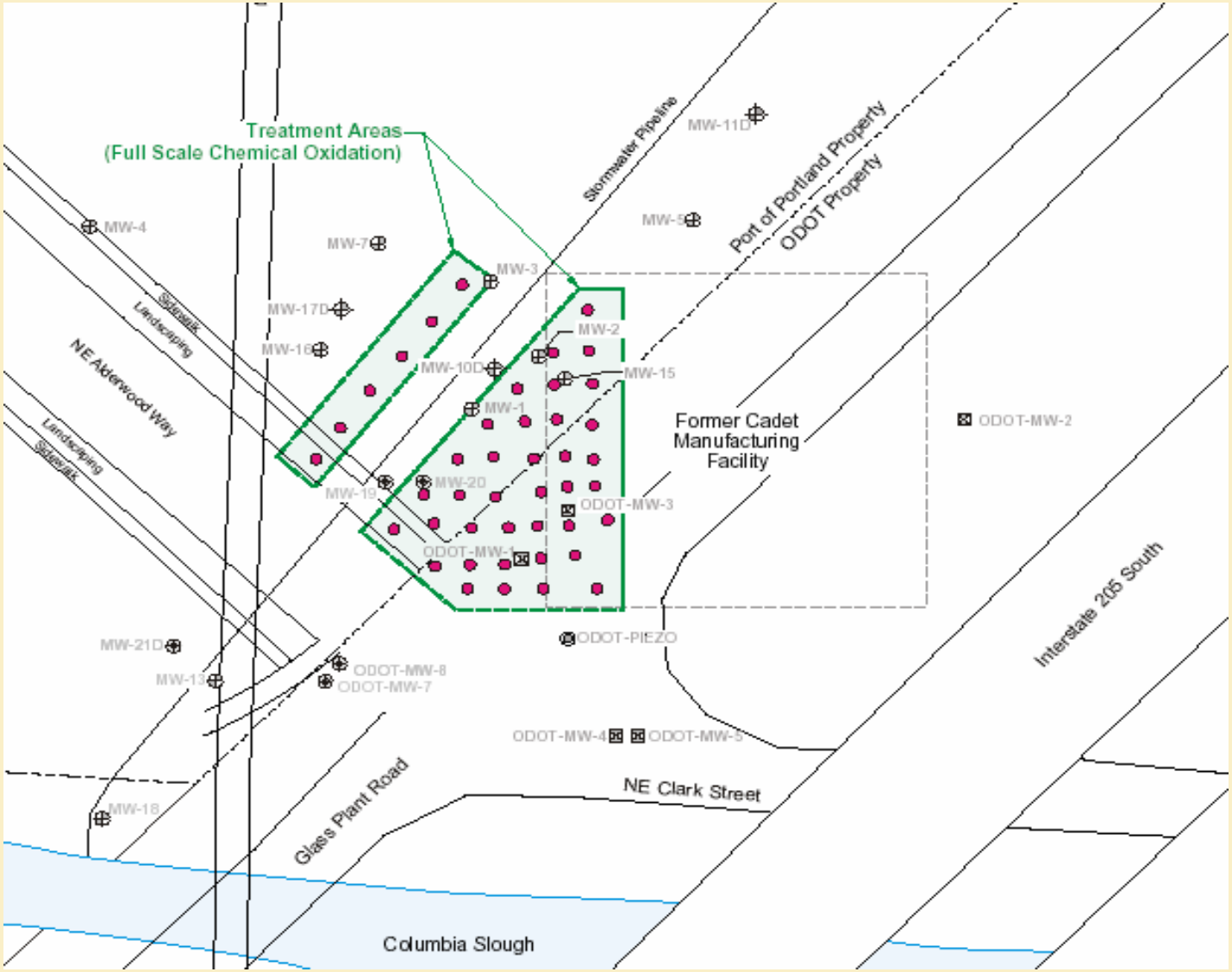
Reagent is injected and occupies set volume



TREATMENT DESIGN

- Concentration - 200 g/L $NaMnO_4$ in water solution
- 43 injection points, spaced 15' radially, in high contamination areas
- Injection interval depths every 5'
- Inject 200 gallons of $NaMnO_4$ per injection interval, total 800 to 1,000 gallons per location
- 57,300 pounds of sodium permanganate
- Permanganate health and safety issues.
- Only one manufacturer – delivered by tanker from Illinois
- Injections completed February 2003

CHEMICAL OXIDATION TREATMENT AREAS



FUTURE CADET ACTIVITIES

- Cost of Phase 1 treatment $450,000 including $320,000 for chemicals
- Preliminary results mixed – good results in upper unit, not so good lower
- Delivery of chemical to treatment area is critical, difficult in fine-grained soil
- Based on results, treatment will likely be needed, will consider tretment to stimulate natural biologic breakdown (anaerobic bacteria)

Case Summary:
Electrical Resistance Heating

ICN Pharmaceuticals, Inc.

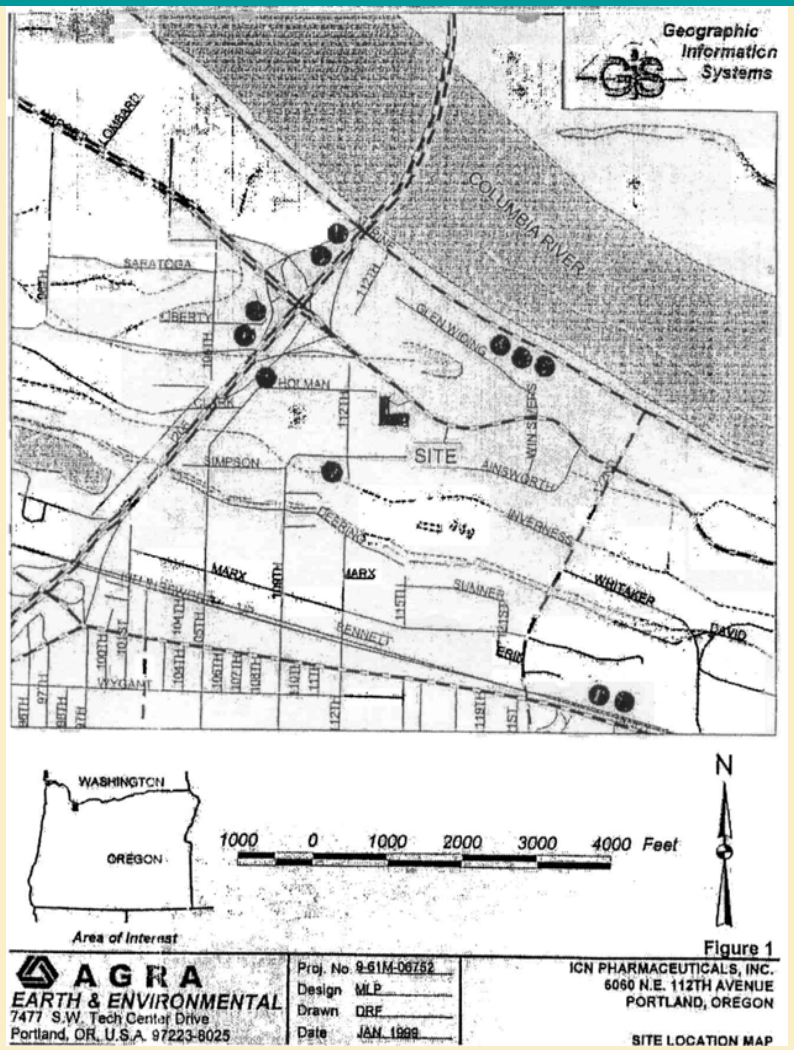
Portland, Oregon

DEQ
State of Oregon
Department of
Environmental
Quality

Site Background

- ICN Pharmaceuticals, Inc. joined DEQ's Voluntary Cleanup Program in 1992
- Former clinical laboratory: 1960-1980
- Primary contaminants: chlorinated solvents (TCE and daughter compounds) as well as benzene and toluene
- Former dry well considered source of groundwater contamination - suspected DNAPLs present
- Site located in Portland Wellfield, many nearby wells

Site Proximity to City Wells

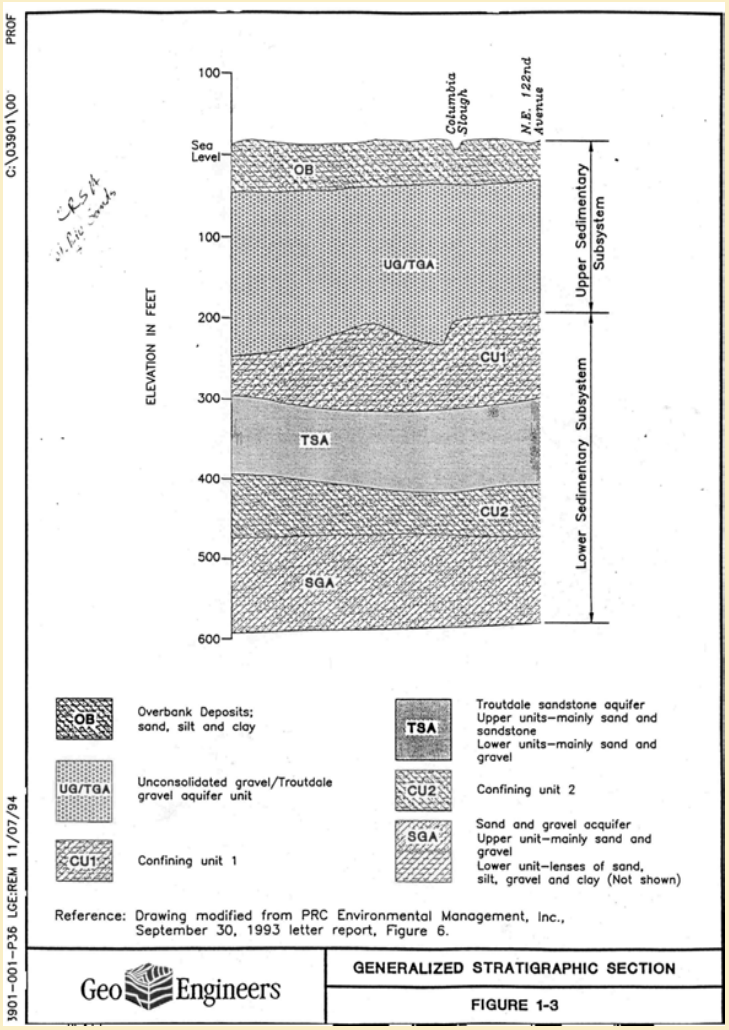


Site Geology

- Fine-grained “Overbank Deposits” to 60 ft bgs

- Gravels (Troutdale Gravels) from 60 to 220 feet bgs represent uppermost drinking water aquiferandTroutdale Gravel Aquifer consisting of unconsolidated and cemented gravels (approx. 175 ft thick)

Stratigraphic Cross-Section



Source Zone Description

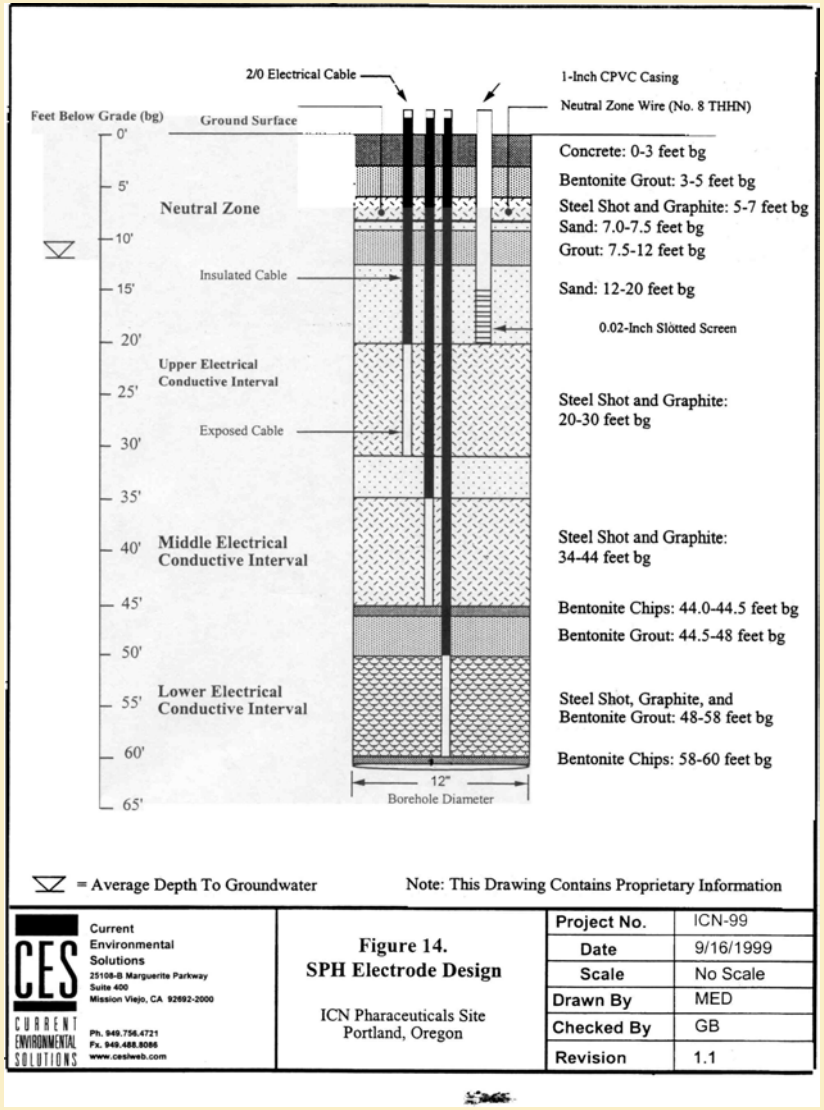
- Very high concentrations of solvents (to 250,000 ppb) including area of residual free product (DNAPL)
- Free product zone 120 by 80 ft oblong centered on former dry well
- Contamination extending to >100 feet below ground surface and drinking water aquifer
- Between 1992 and present, many of phases of soil and groundwater investigation completed including installation of 60+ wells, some as deep as 200 feet
- Nearly all contamination determined to have migrated to groundwater, mostly present in shallow silts

Remedial Approach

- Electrical resistive heating selected as interim action
- Operational strategy
  - Deliver electrical current to metal probes installed to 50 feet throughout site
  - Boil groundwater to 100C and vaporize contaminants
  - Collect vapors in vapor extraction system at surface
- Other treatment options not expected to work, too slow, or too expensive

Treatment System

- Initial system: 60 electrodes, 53 vapor extraction points, 13 pressure monitoring points, 8 thermocouple strings, and 950 kW transformer
- Later expanded to include 13 additional electrodes and 67 “electrode vents”, plus instrumentation
- SVE system recovers contaminants in multiple phases (steam/vapors/liquids) and separates into liquid and vapor streams for treatment and discharge



CES
CURRENT ENVIRONMENTAL SOLUTIONS
Current Environmental Solutions
25108-B Marguerite Parkway
Suite 400
Mission Viejo, CA 92692-2000
Ph. 949.756.4721
Fx. 949.488.8086
www.ceslweb.com

Figure 14.
SPH Electrode Design

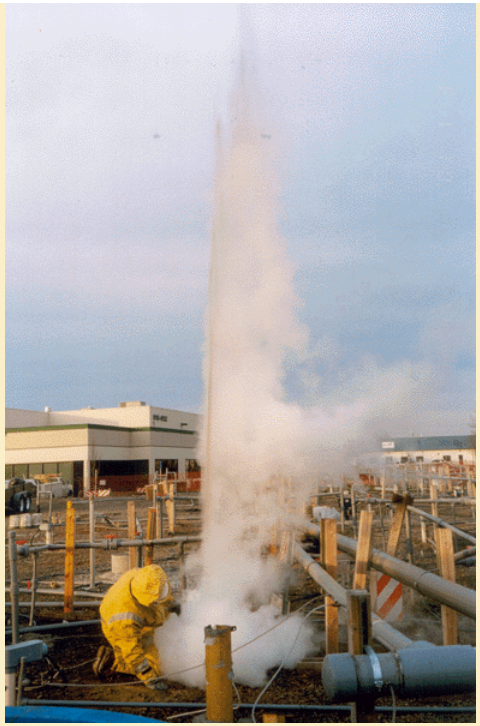
ICN Pharaceuticals Site
Portland, Oregon

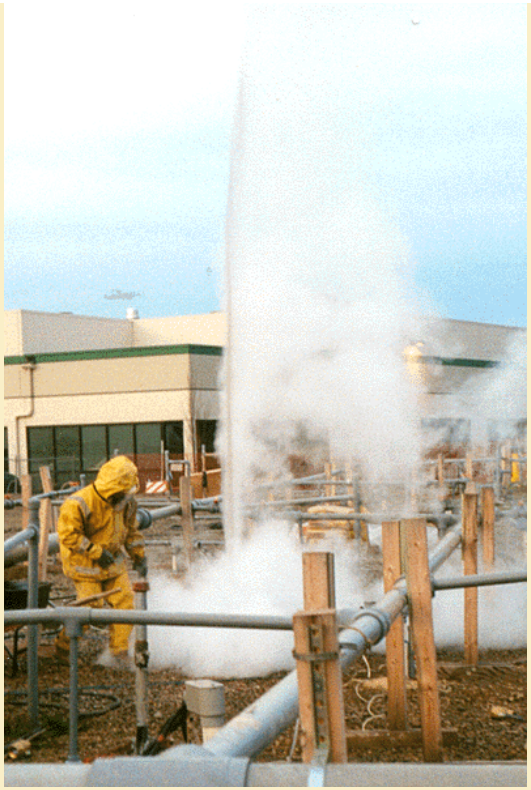
Project No.	ICN-99
Date	9/16/1999
Scale	No Scale
Drawn By	MED
Checked By	GB
Revision	1.1

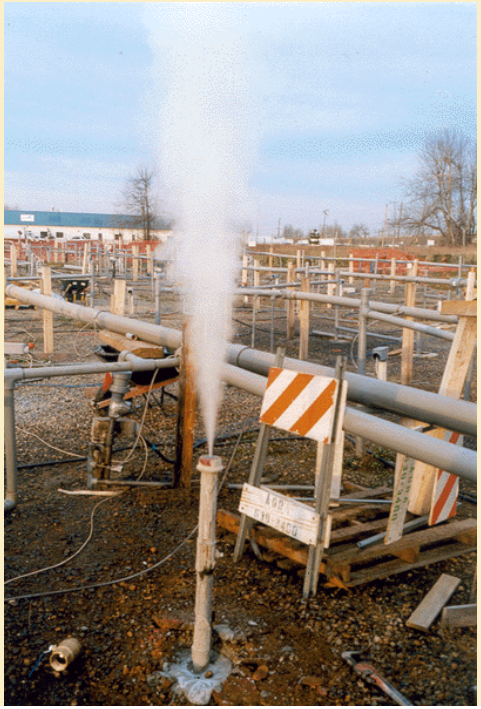

'00 5 4

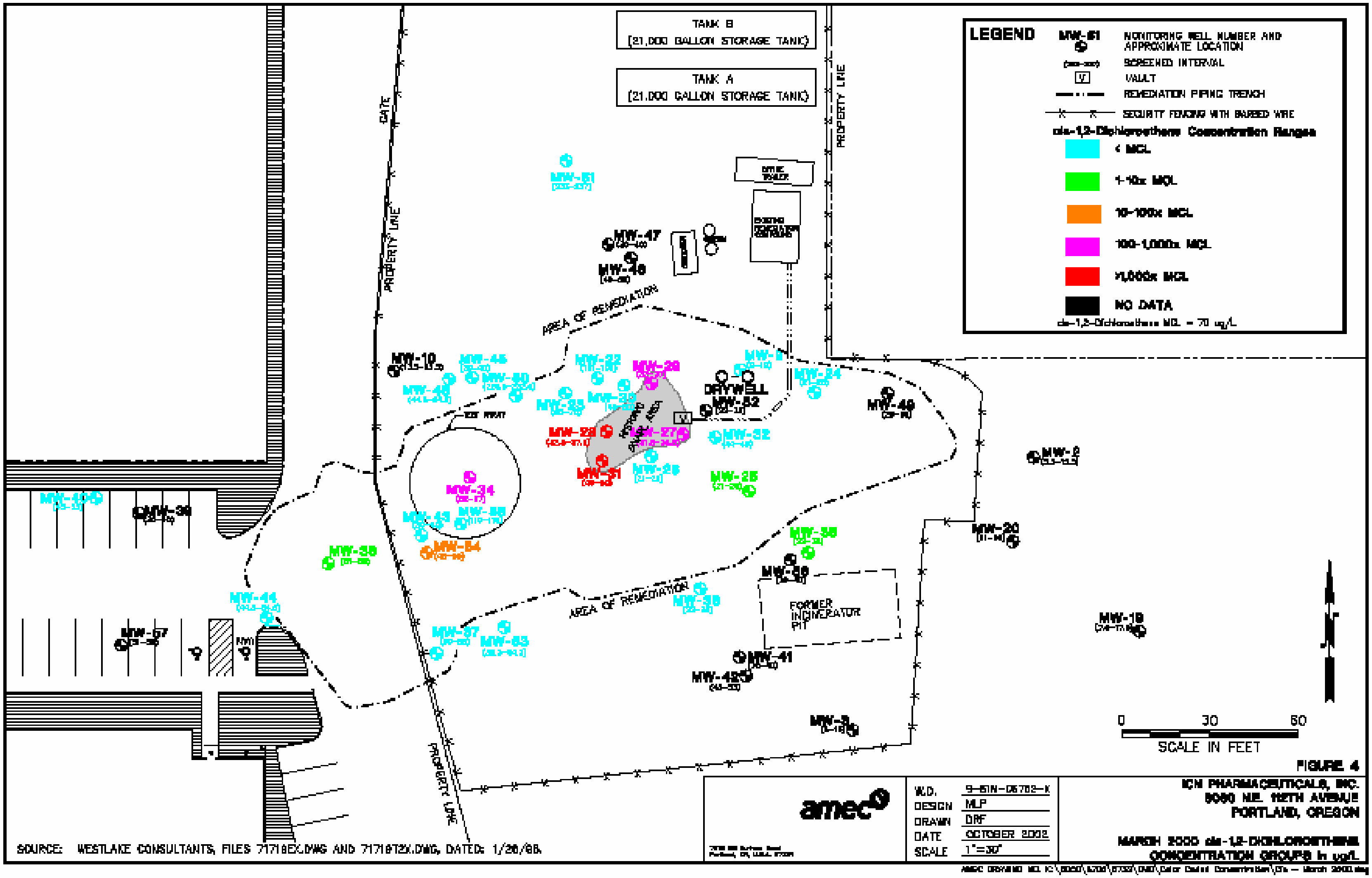
Problems

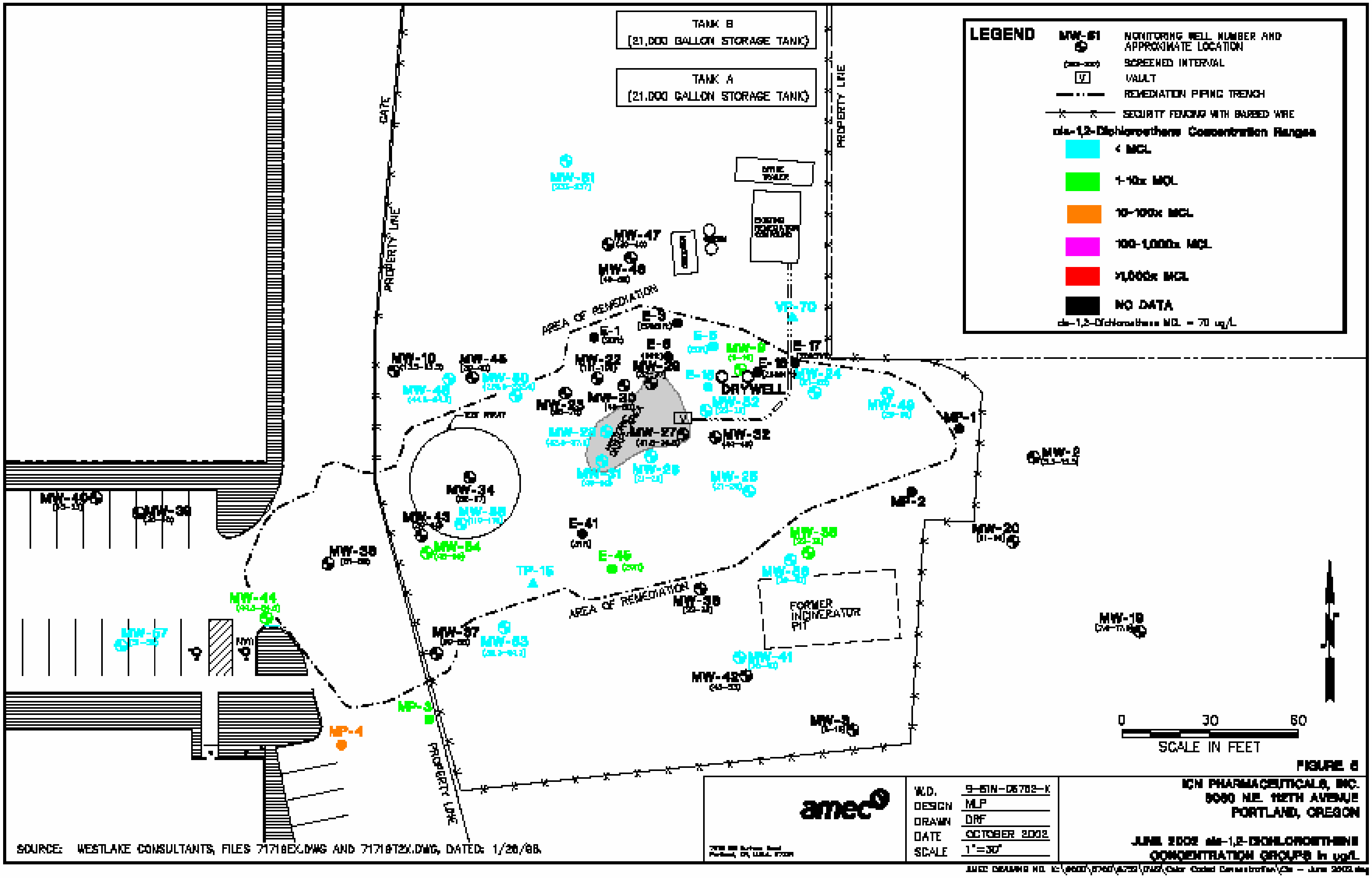
- Movement of steam in subsurface erratic, short-circuiting to surface
- Sampling of very hot water for groundwater monitoring dangerous/difficult
- Failure (melting) of monitoring well casing despite use of heat-resistant inserts
- Work completed during energy shortage. Electricity costs very high

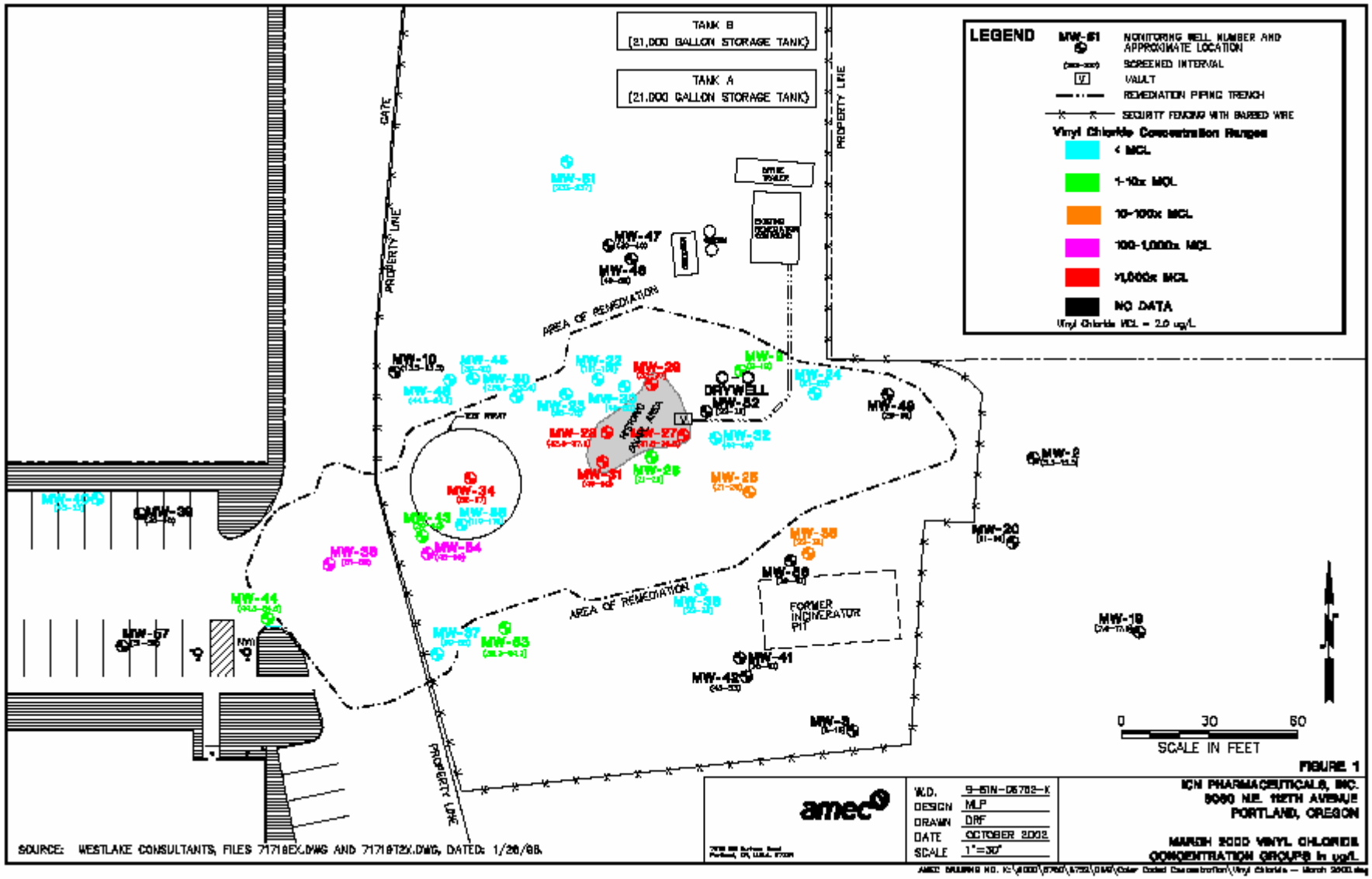


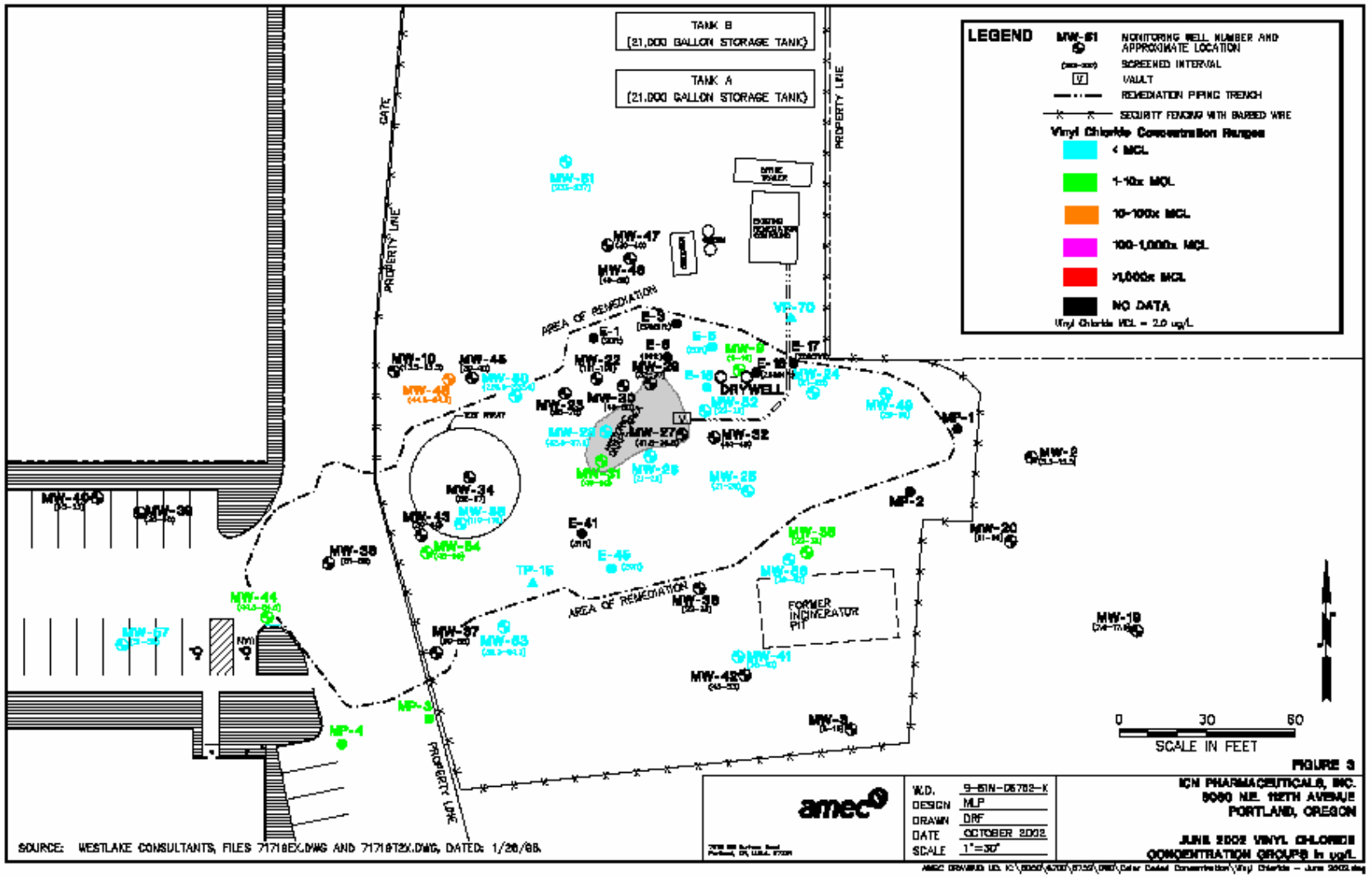





LEGEND
MW-61
MONITORING WELL NUMBER AND APPROXIMATE LOCATION
SCREENED INTERVAL
VAULT
REMEDIATION PIPING TRENCH
SECURITY FENCING WITH BARBED WIRE
cis-1,2-Dichloroethene Concentration Ranges
< MCL
1-10x MCL
10-100x MCL
100-1,000x MCL
>1,000x MCL
NO DATA
cis-1,2-Dichloroethene MCL = 70 ug/L
TANK B
(21,000 GALLON STORAGE TANK)
TANK A
(21,000 GALLON STORAGE TANK)
GATE
PROPERTY LINE
AREA OF REMEDIATION
DRYWELL
FORMER INCINERATOR PIT
MW-10
MW-45
MW-22
MW-29
MW-5
MW-24
MW-46
MW-50
MW-33
MW-30
MW-52
MW-49
MW-28
MW-27
MW-32
MW-6
MW-31
MW-26
MW-25
MW-34
MW-43
MW-55
MW-40
MW-39
MW-38
MW-54
MW-36
MW-20
MW-56
MW-44
MW-35
MW-47
MW-48
MW-51
MW-37
MW-53
MW-41
MW-42
MW-19
MW-3
0
30
60
SCALE IN FEET
FIGURE 4
amec
W.O. 9-61N-06702-K
DESIGN MLP
DRAWN DRF
DATE OCTOBER 2002
SCALE 1"=30'
ICN PHARMACEUTICALS, INC.
5050 N.E. 112TH AVENUE
PORTLAND, OREGON
MARCH 2000 cis-1,2-DICHLOROETHENE
CONCENTRATION GROUPS in ug/L
SOURCE: WESTLAKE CONSULTANTS, FILES 71718EX.DWG AND 71718T2X.DWG, DATED: 1/26/98.


LEGEND
MONITORING WELL NUMBER AND APPROXIMATE LOCATION
SCREENED INTERVAL
VAULT
REMEDIATION PIPING TRENCH
SECURITY FENCING WITH BARBED WIRE
cis-1,2-Dichloroethene Concentration Ranges
< MCL
1-10x MCL
10-100x MCL
100-1,000x MCL
>1,000x MCL
NO DATA
TANK B (21,000 GALLON STORAGE TANK)
TANK A (21,000 GALLON STORAGE TANK)
PROPERTY LINE
GATE
AREA OF REMEDIATION
DRYWELL
FORMER INCINERATOR PIT
SCALE IN FEET
FIGURE 6
ICN PHARMACEUTICALS, INC.
PORTLAND, OREGON
SOURCE: WESTLAKE CONSULTANTS, FILES 71718EX.DWG AND 71718T2X.DWG, DATED: 1/26/98.
amec
DESIGN MLP
DRAWN DRF
DATE OCTOBER 2002
SCALE 1"=30'


TANK B
(21,000 GALLON STORAGE TANK)
TANK A
(21,000 GALLON STORAGE TANK)
LEGEND
MW-51 MONITORING WELL NUMBER AND APPROXIMATE LOCATION
(xxx-xxx) SCREENED INTERVAL
V VAULT
REMEDIATION PIPING TRENCH
SECURITY FENCING WITH BARBED WIRE
Vinyl Chloride Concentration Ranges
< MCL
1-10x MCL
10-100x MCL
100-1,000x MCL
>1,000x MCL
NO DATA
Vinyl Chloride MCL = 2.0 ug/L
PROPERTY LINE
GATE
AREA OF REMEDIATION
DRYWELL
FORMER INCINERATOR PIT
0 30 60
SCALE IN FEET
SOURCE: WESTLAKE CONSULTANTS, FILES 71718EX.DWG AND 71718T2X.DWG, DATED: 1/26/88.
amec
W.O. 9-61N-05703-K
DESIGN MLP
DRAWN DRF
DATE OCTOBER 2002
SCALE 1"=30'
FIGURE 1
ICN PHARMACEUTICALS, INC.
9080 NE 112TH AVENUE
PORTLAND, OREGON
MARCH 2000 VINYL CHLORIDE
CONCENTRATION GROUPS in ug/L


TANK B
(21,000 GALLON STORAGE TANK)
TANK A
(21,000 GALLON STORAGE TANK)
PROPERTY LINE
GATE
AREA OF REMEDIATION
DRYWELL
FORMER INCINERATOR PIT
LEGEND
MW-51 MONITORING WELL NUMBER AND APPROXIMATE LOCATION
SCREENED INTERVAL
VAULT
REMEDIATION PIPING TRENCH
SECURITY FENCING WITH BARBED WIRE
Vinyl Chloride Concentration Ranges
< MCL
1-10x MCL
10-100x MCL
100-1,000x MCL
>1,000x MCL
NO DATA
Vinyl Chloride MCL = 2.0 ug/L
0 30 60
SCALE IN FEET
SOURCE: WESTLAKE CONSULTANTS, FILES 71718EX.DWG AND 71718T2X.DWG, DATED: 1/28/88.
amec
W.O. 9-81N-05782-K
DESIGN MLP
DRAWN DRF
DATE OCTOBER 2002
SCALE 1"=30'
ICN PHARMACEUTICALS, INC.
9080 N.E. 112TH AVENUE
PORTLAND, OREGON
JUNE 2002 VINYL CHLORIDE CONCENTRATION GROUPS in ug/L
FIGURE 3

Analysis

- Heating system operated for approximately one year, much longer than expected
- Currently using existing infrastructure to complete a “polishing” step to get rid of remaining contamination – biosparging
- Approx. 96 gallons of total VOCs recovered, much more eliminated by biodegradation enhanced by heat (thermophilic bacteria)
- Free product completely removed, one of first successful “in-situ” treatments of DNAPL in country
- Cost pretty high – probably $2+ million