US EPA ARCHIVE DOCUMENT

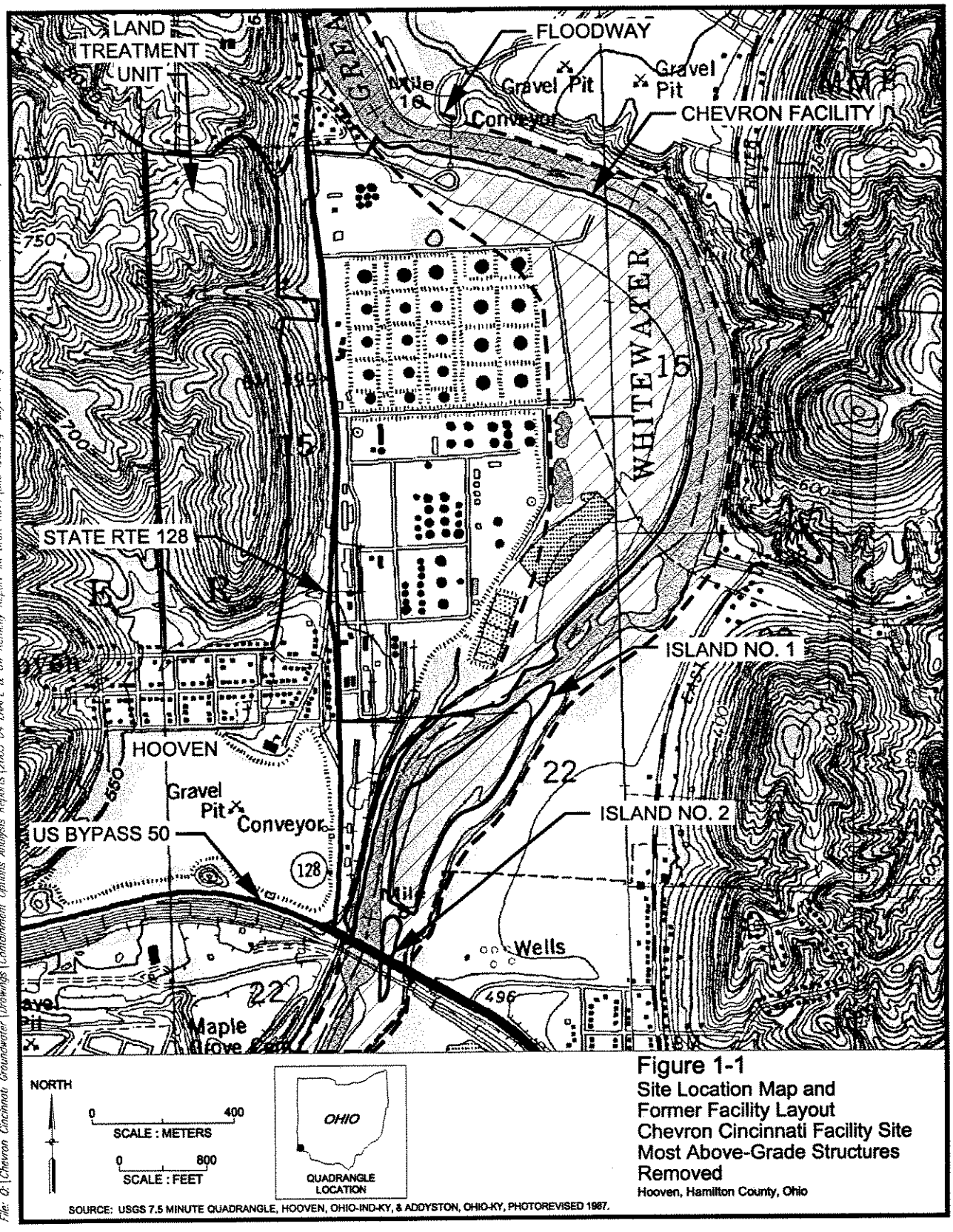
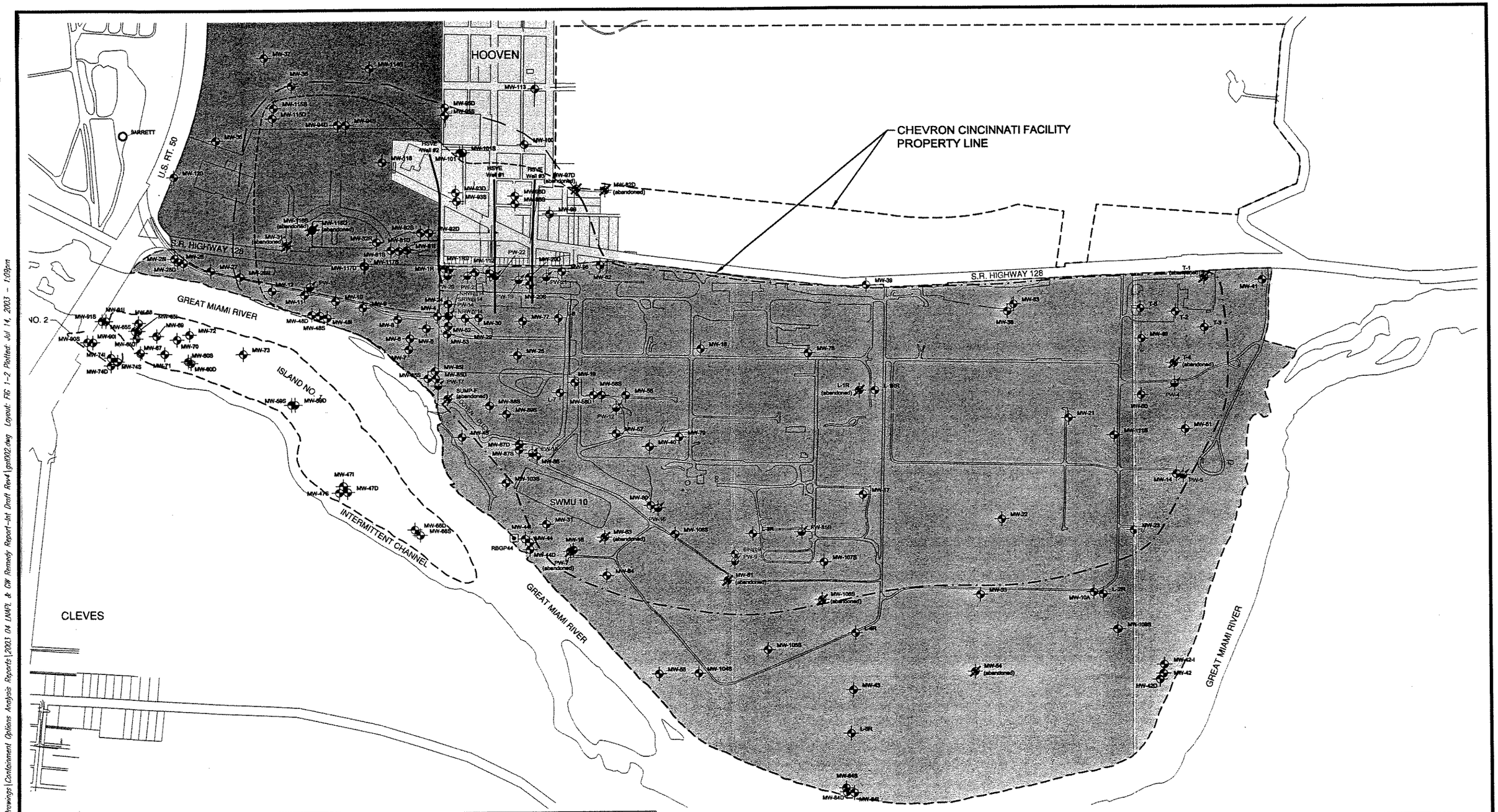


Figure 1-1
Site Location Map and
Former Facility Layout
Chevron Cincinnati Facility Site
Most Above-Grade Structures
Removed
Hooven, Hamilton County, Ohio

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\site loc.dwg Layout: fig 1-1 Plotted: Jul 14, 2003 - 1:07pm

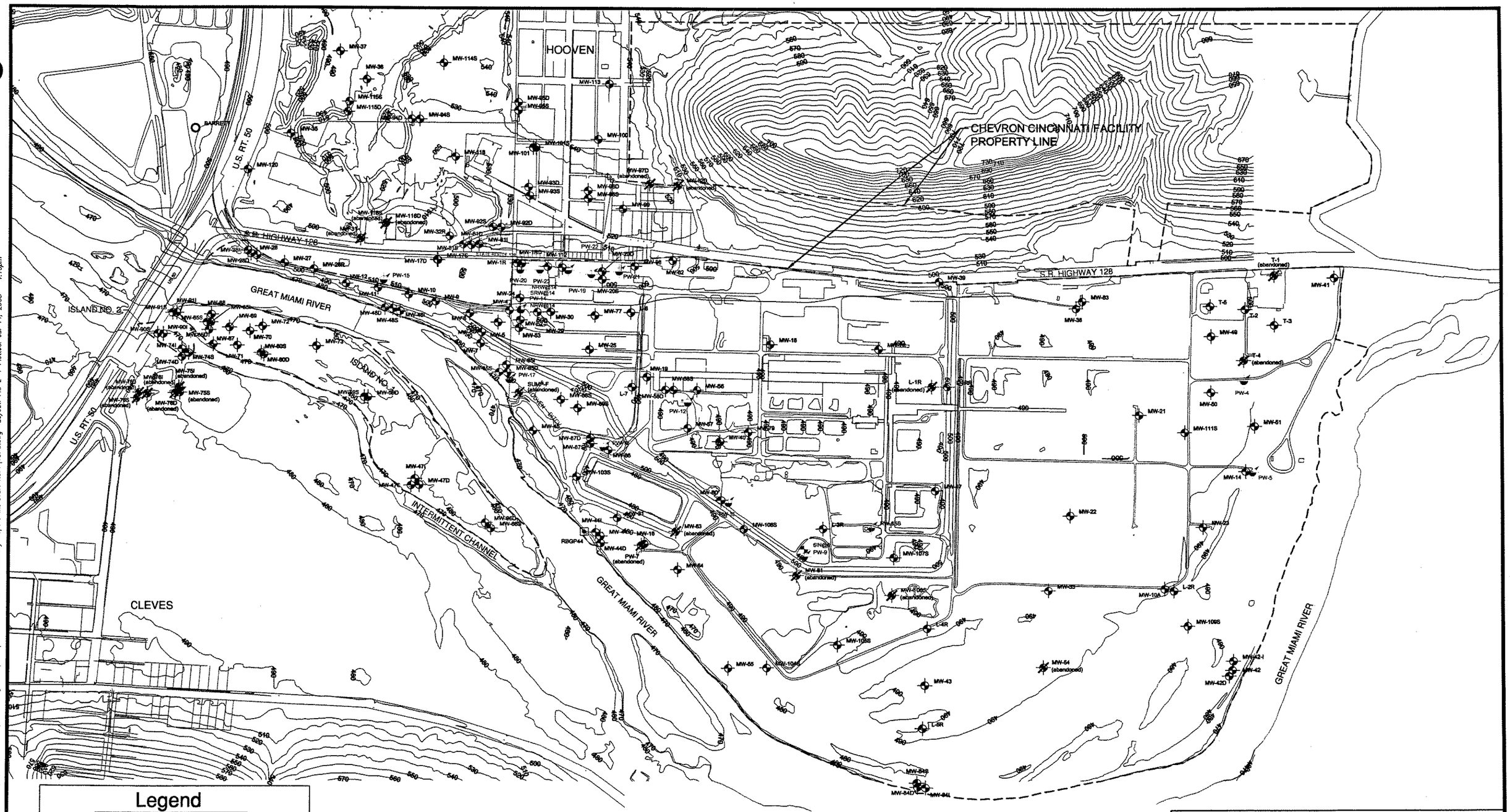


Facility Diagram
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 1-2

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\gsf302.dwg Layout: FIG 1-2 Plotted: Jul 14, 2003 - 1:09pm



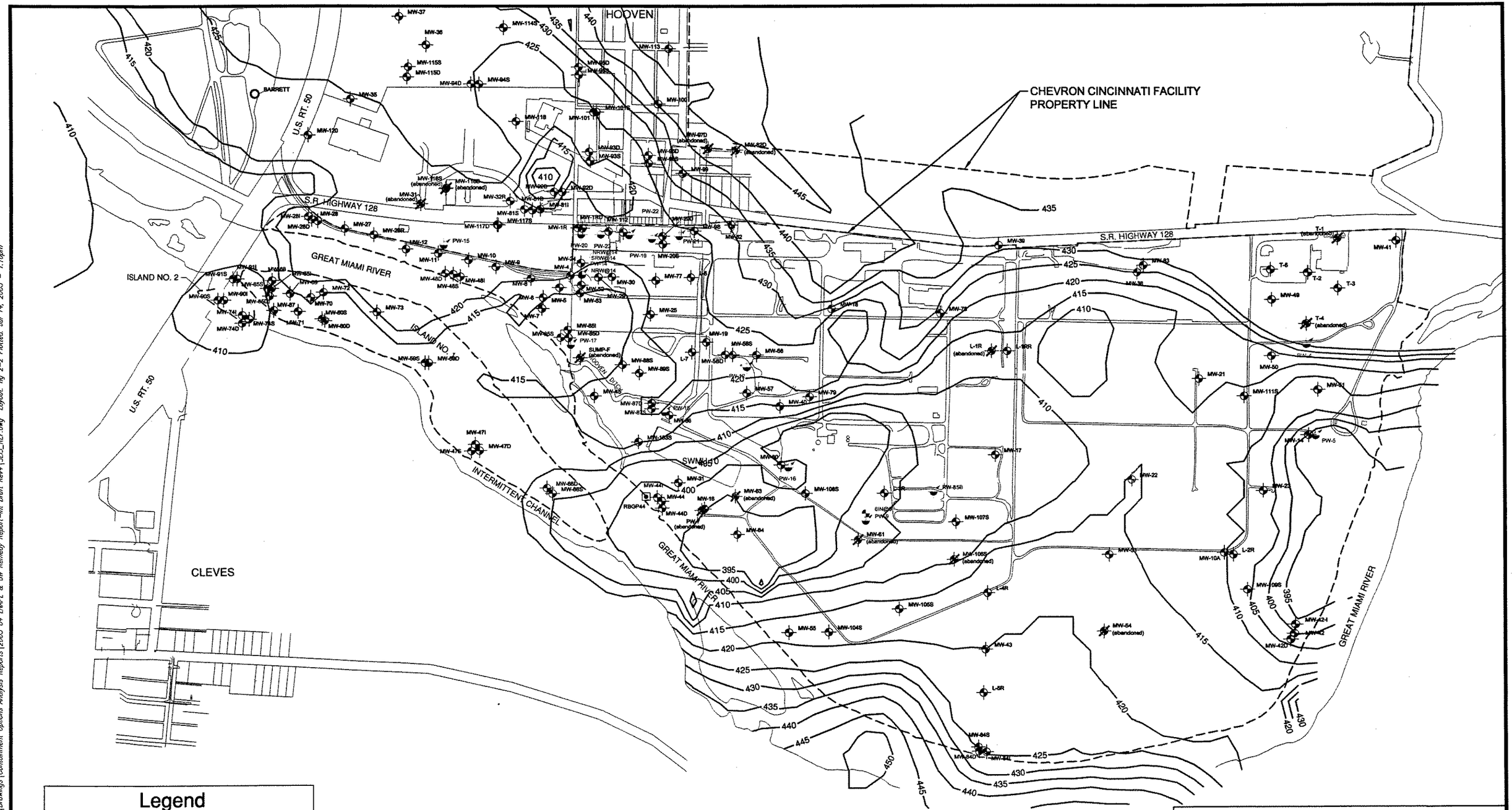
Source of Topography:
Hamilton County CAGIS System, State Plane Coordinates, Illinois East Zone, NAD83.

Topographic Site Map
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 2-1

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev1\FIG2-1.dwg Layout: FIG 2-1 Plotted: Jul 14, 2003 - 1:10pm



File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev1\SEIS_REF.dwg Layout: fig 2-2 Plotted: Jul 14, 2003 - 1:10pm

HOOVEN

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

U.S. RT. 50

INTERMITTENT CHANNEL

SWMU 10

CLEVES

Legend

- Monitoring Well
- Chevron Production/Recovery Well
- Monitoring Well (Abandoned)
- Transmissivity Contour (ft^2/day)
- Chevron Cincinnati Facility Boundary

300 0 150 300 600

SCALE IN FEET

Transmissivity of the Alluvial Aquifer
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 2-3

File: C:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev\alluv_aquifer.dwg Layout: fig 2-3 Plotted: Jul 14, 2003 - 1:11pm

HOOVEN

CLEVES

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

S.R. HIGHWAY 128

U.S. RT. 50

BARRETT

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

INTERMITTENT CHANNEL

Legend

- MW-85D — Monitoring Well
- PW-17 — Chevron Production/Recovery Well
- 467.5 — Potentiometric Surface Contour (ft. MSL)
- Chevron Cincinnati Facility Boundary

300 0 150 300 600
SCALE IN FEET

Water Table Contour Map
March 31, 1999; Typical High Water Table
CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 2-4

File: G:\Chevron Cincinnati\Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev1\F-0398.dwg Layout: fig 2-4 Plotted: Jul 14, 2003 - 1:11pm

HOOVEN

CLEVES

BARRETT

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

S.R. HIGHWAY 128

U.S. RT. 50

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

INTERMITTENT CHANNEL

HOOVEN DITCH

462.0
462.5
463.0
463.5
464.0
464.5
465.0
465.5
466.0
466.5
467.0
467.5
468.0
460.5
461.0
461.5

Legend

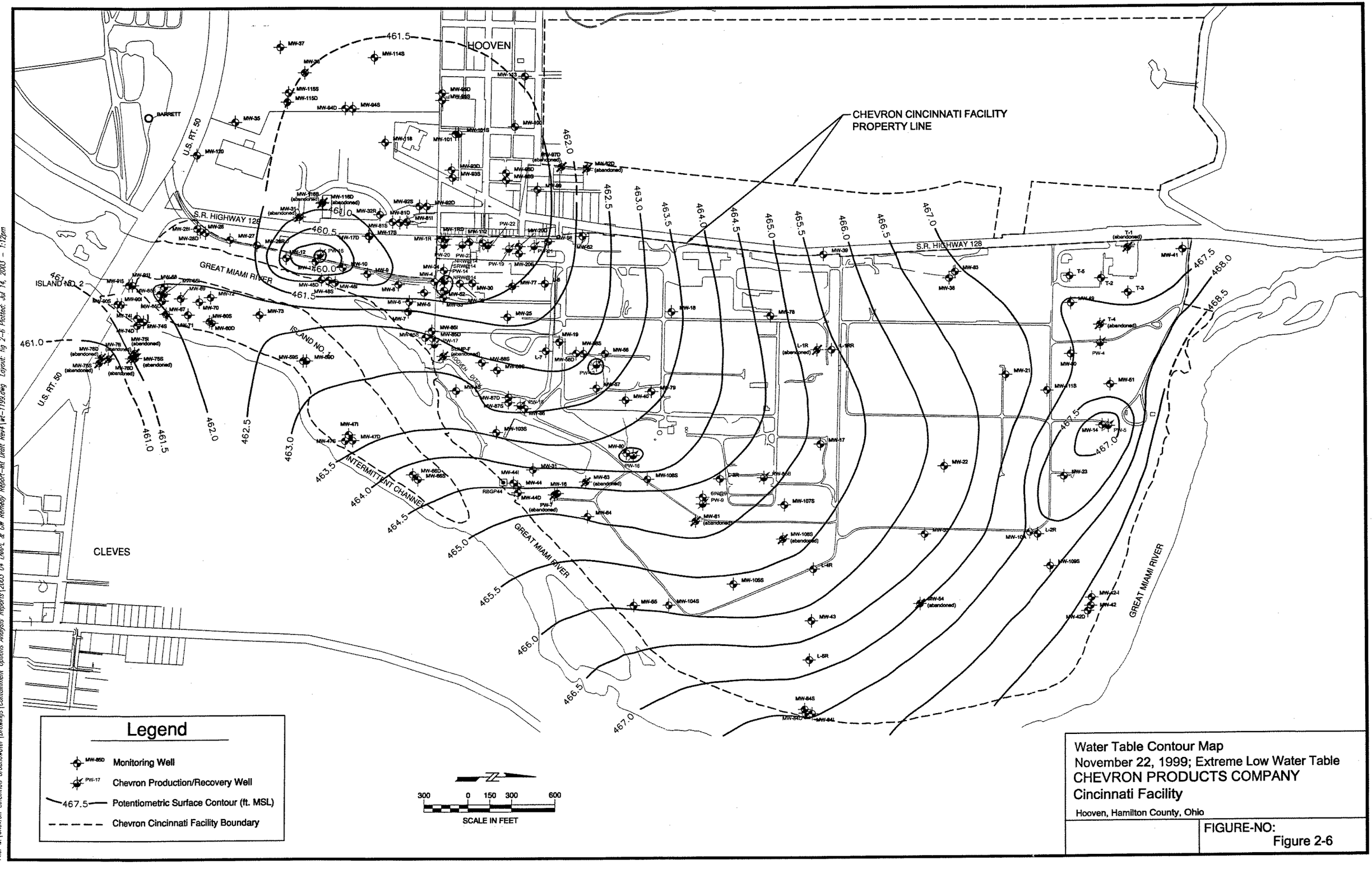
- MW-85D — Monitoring Well
- PW-17 — Chevron Production/Recovery Well
- 467.5 — Potentiometric Surface Contour (ft. MSL)
- Chevron Cincinnati Facility Boundary

300 0 150 300 600
SCALE IN FEET

Water Table Contour Map
September 24, 1999; Typical Low Water Table
CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 2-5

File: G:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analyses Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\wt-0909.dwg Layout: fig 2-5 Plotted: Jul 14, 2003 - 1:12pm



File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev1\wt-1199.dwg Layout: fig 2-6 Plotted: Jul 14, 2003 - 1:12pm

Figure 2-7: LNAPL Spill Schematic

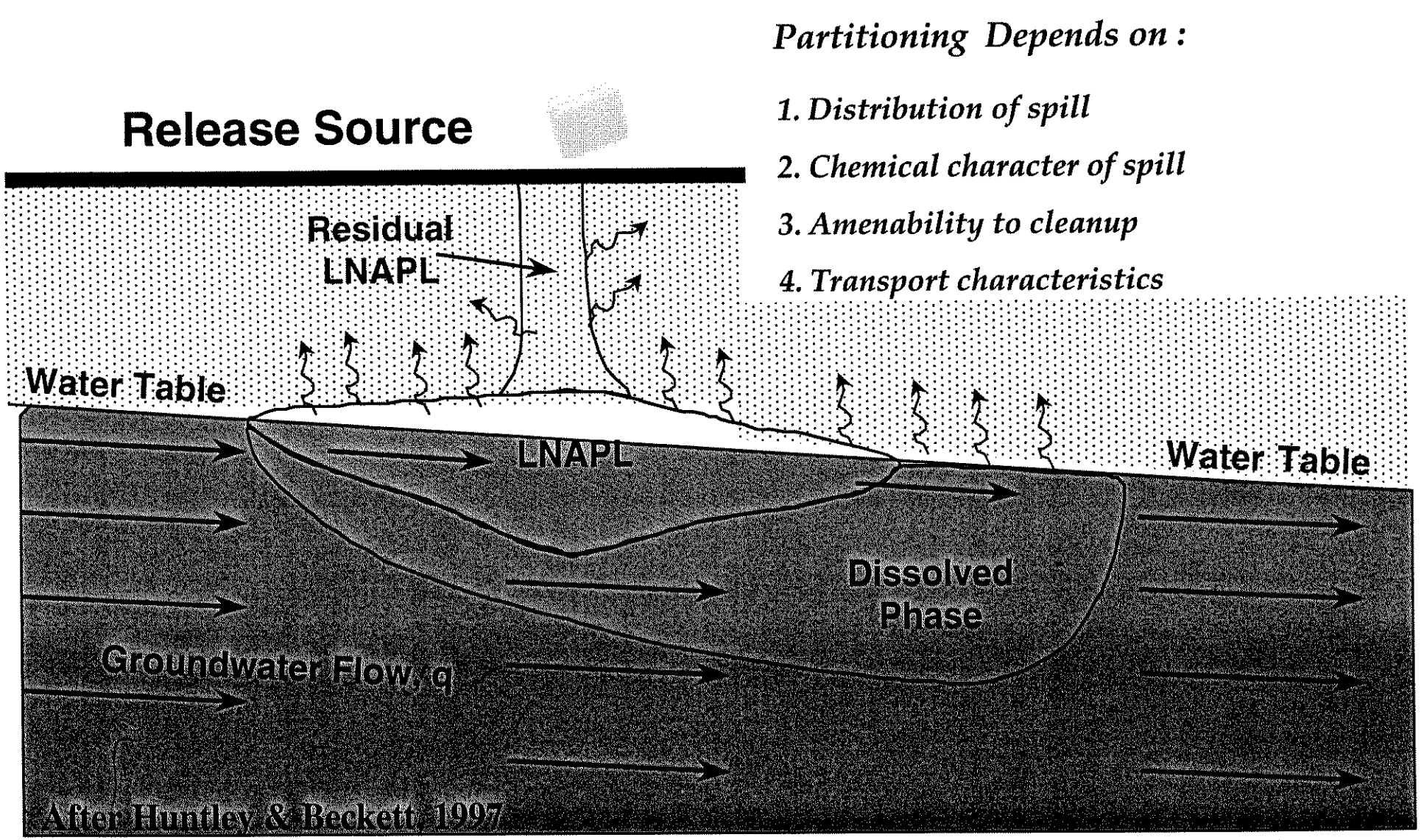
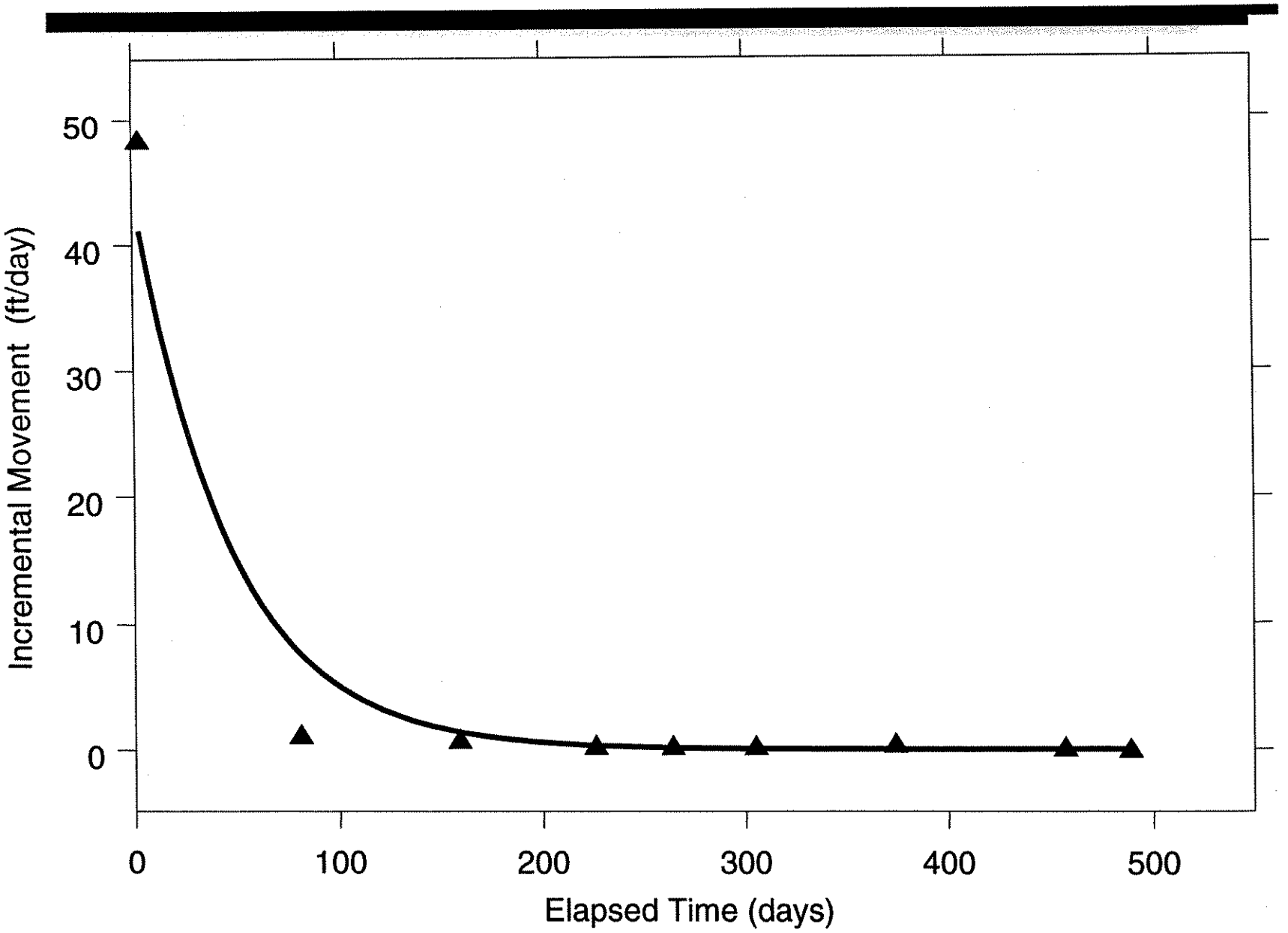
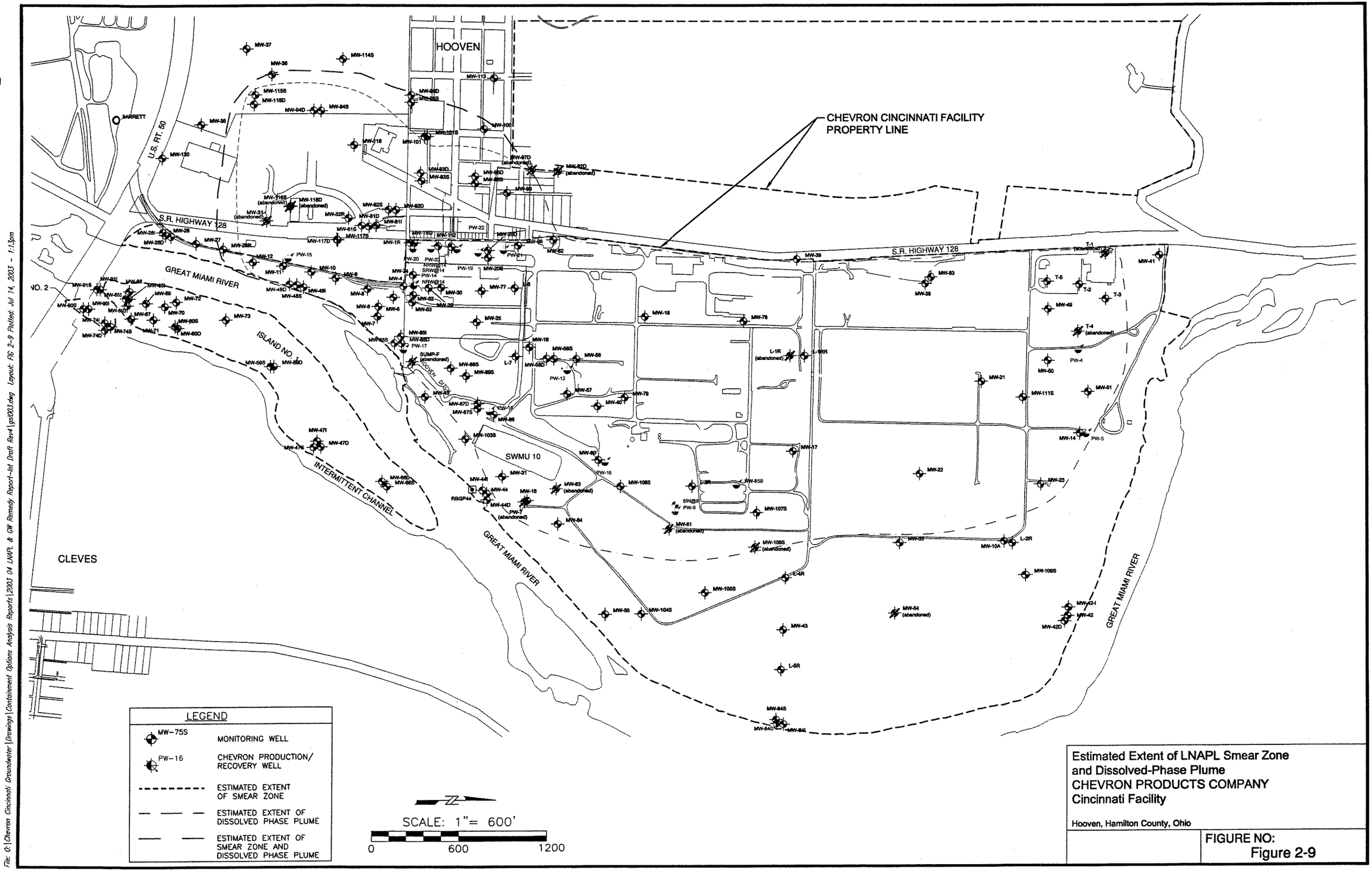


Figure 2-8. Incremental LNAPL Movement Observed (Texas Sweet Crude Spill)





Estimated Extent of LNAPL Smear Zone and Dissolved-Phase Plume
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 2-9

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\gsl003.dwg Layout: FIG 2-9 Plotted: Jul 14, 2003 - 1:13pm

HOOVEN

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

BARRETT

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

INTERMITTENT CHANNEL

CLEVES

LEGEND

- MW-81D — MONITORING WELL
- PW-12 — RECOVERY WELL
- MW-116S — MONITORING WELL (ABANDONED)
- 6 — LNAPL SMEAR ZONE THICKNESS CONTOUR (ft.)

NOTE:
Smear Zone thickness at northern end of site is based on limited ROST data

400 0 200 400 800
SCALE IN FEET

Estimated LNAPL Smear Zone Thickness

CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 2-10

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & CW Remedy Report-Int Draft Rev1\hopl001.dwg Layout: FIG 2-10 Plotted: Jul 14, 2003 - 1:14pm

HOOVEN

BARRETT

CLEVES

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 1

INTERMITTENT CHANNEL

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

0.1 0.3 0.5 0.7 0.9

LEGEND

- MW-92D — MONITORING WELL
- MW-116D (abandoned) — MONITORING WELL (abandoned)
- PW-20 — CHEVRON PRODUCTION/ RECOVERY WELL
- 0.1 — OBSERVABLE LNAPL ISOPACH CONTOUR (ft.)
- CHEVRON CINCINNATI FACILITY PROPERTY LINE

SCALE: 1"= 600'

0 600 1200

Observable LNAPL Thickness
November 1999, Extreme Low Water Table
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

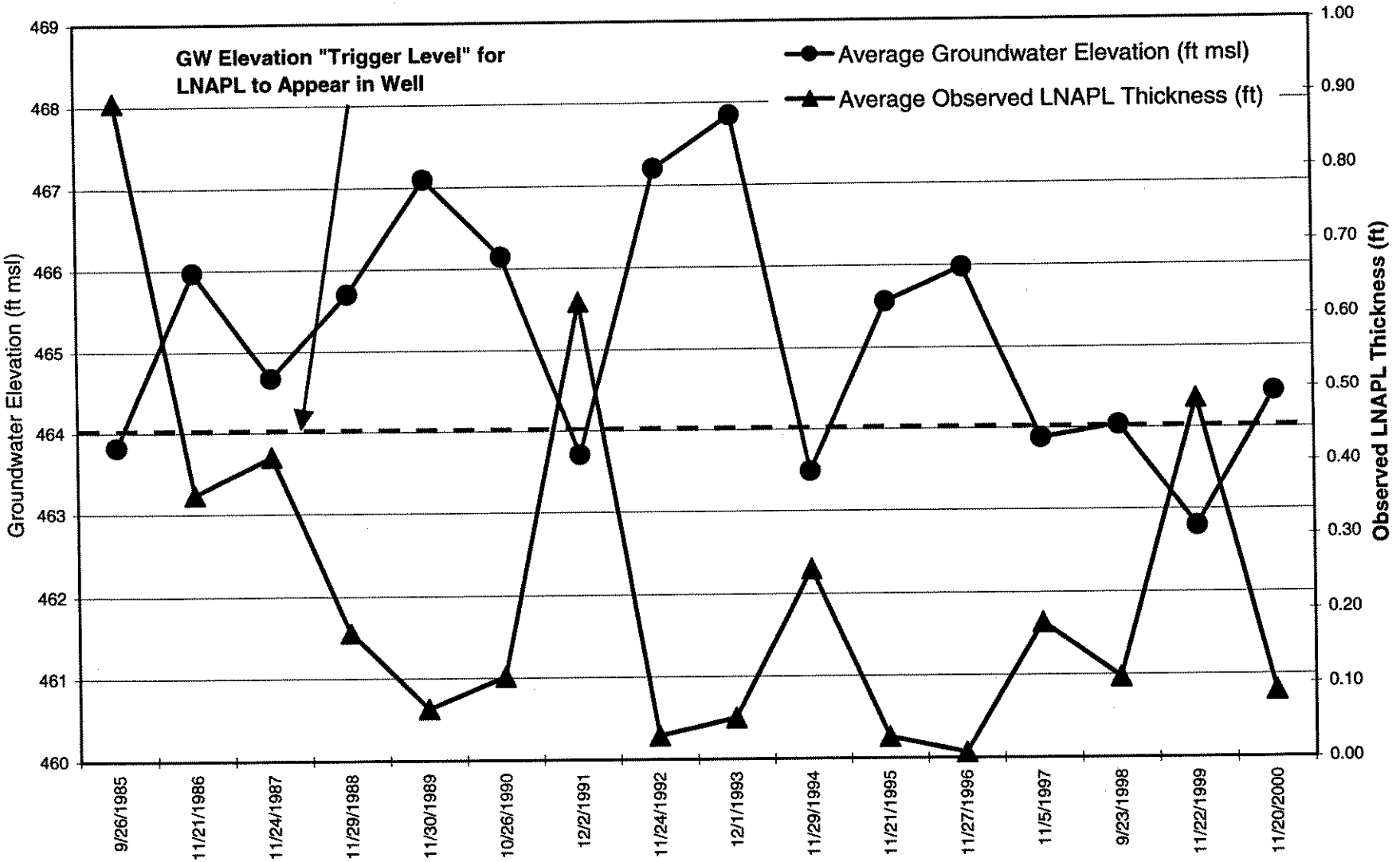
Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 2-11

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\mapt_low_1199.dwg Layout: FIG 2-11 Plotted: Jul 14, 2003 - 1:15pm

Figure 2-12: Average Hydrograph Trends, Compiled MW-1 through MW-25

Groundwater Elevation vs. Observed LNAPL Thickness



S.R. HIGHWAY 128

LIF 15A

MW-26R

MW-117S

MW-117D

MW-1R

MW-1RD

MW-112

PW-20

PW-23

PW-22

PW-19

MW-200

MW-206

PW-21

MW-98

ASTW

MW-32

PW-15

MW-12

MW-11

MW-10

MW-9

ROST MW-1

LIF 05A

LIF 04A

MW-24

MW-48S

MW-48D

MW-48I

MW-4

PW-14
SRW@14
NRW@14

MW-30

MW-29

MW-77

L-6

ASTM

MW-8

MW-52

MW-53

MW-5

DD1

MW-6

MW-7

MW-73

ASTE

MW-16

LIF 08

DD11

MW-25

LIF 16

DD2

MW-85I

DD3

MW-85S

MW-85D

PW-17

DD12

MW-18

DD4
SUMP-F
(abandoned)

DD8

DD6

DD7

DD13

HOOVEN DITCH

MW-58D

MW-58S

MW-56

PW-12

DD5

MW-89S

DD14

HOOVEN DITCH

DD9

DD10

DD16

MW-67

LIF 10

MW-79

DD17

MW-87D

MW-87S

DD18

PW-18

MW-86

MW-40

A

A'

DD15

DD19

GREAT MIAMI RIVER

MW-103S

MW-80

PW-16

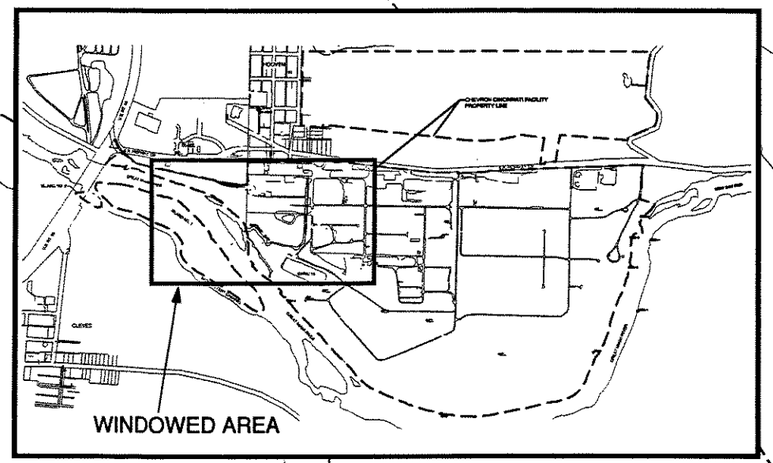
ISLAND No. 1

MW-47I

MW-47S

MW-47D

MW-31



LEGEND

MW-75S	MONITORING WELL
PW-9	CHEVRON PRODUCTION/ RECOVERY WELL
DD19	ROST/CPT LOCATION
A —— A'	CROSS SECTION LINE
– – –	CHEVRON CINCINNATI FACILITY BOUNDARY

SCALE: 1"= 200'

0 200 400

N

Hooven Ditch Boring Log and ROST Locations

CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 2-13

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\hooven ditch.dwg Layout: FIG 2-13 Plotted: Jul 14, 2003 - 1:15pm

Figure 2-14: Hooven Ditch Geologic Cross Section

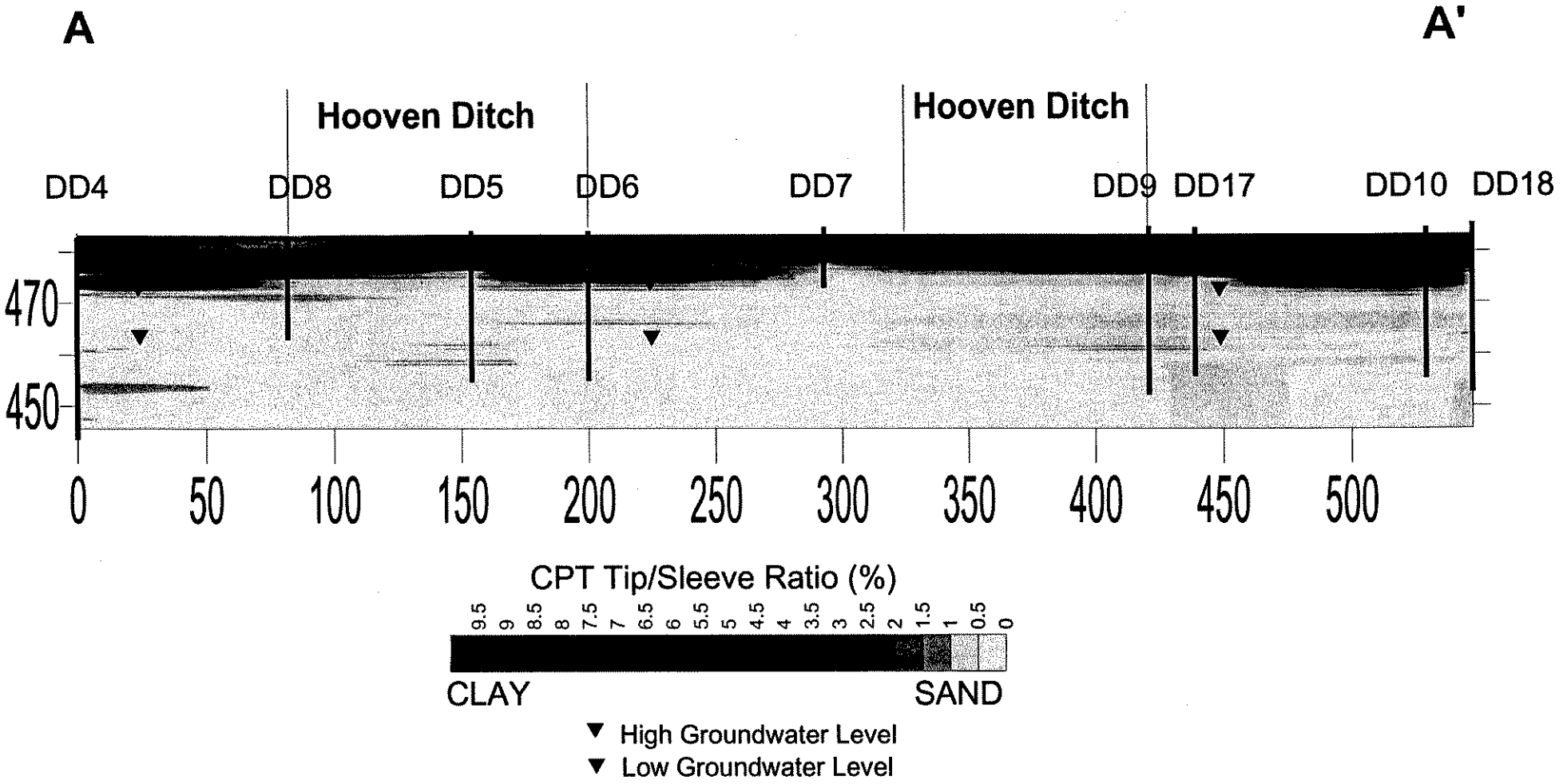


Figure 2-15: Hooven Ditch Geologic Cross Section with LIF Intensity

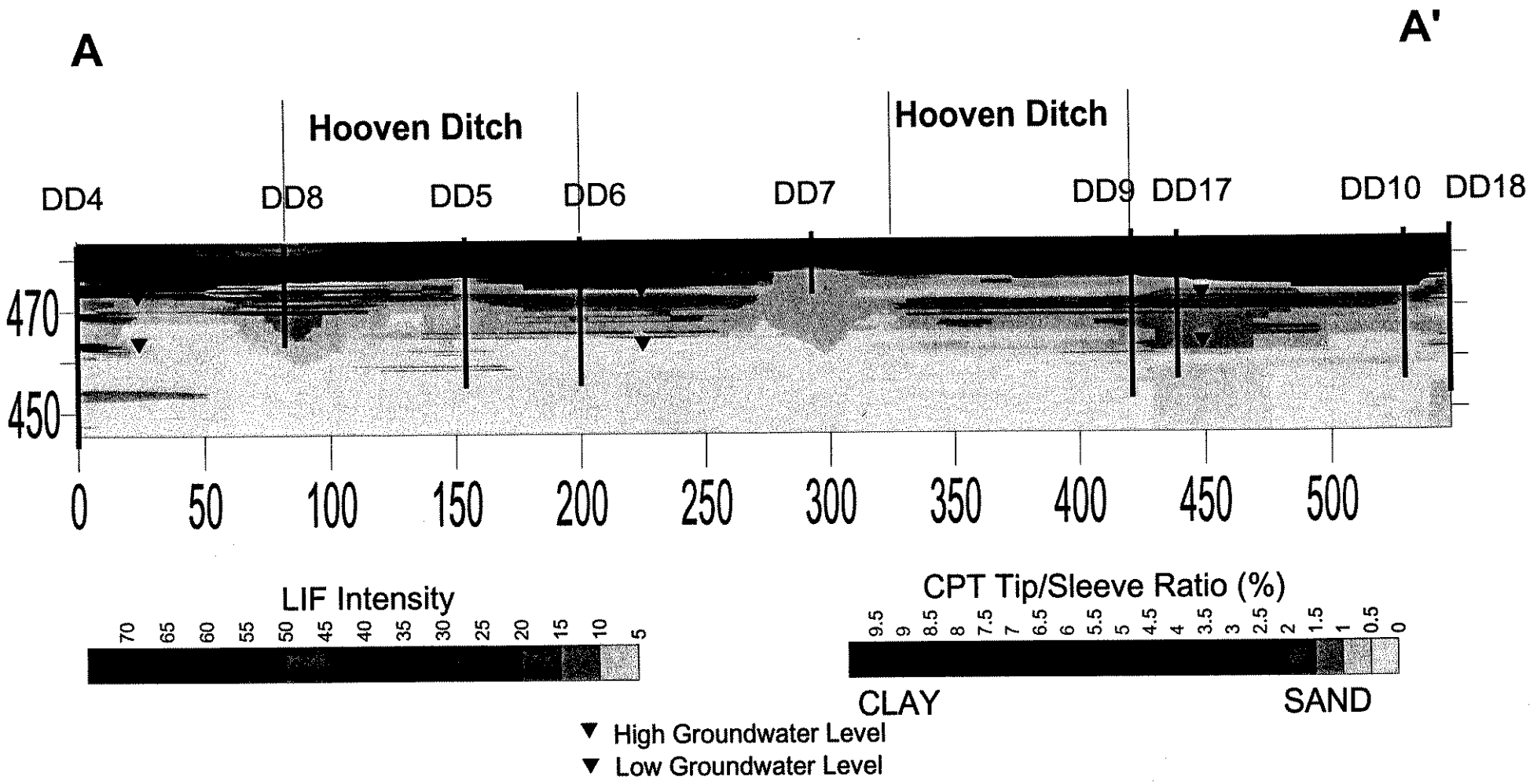


Figure 2-16: Cumulative and Yearly LNAPL Recovery History

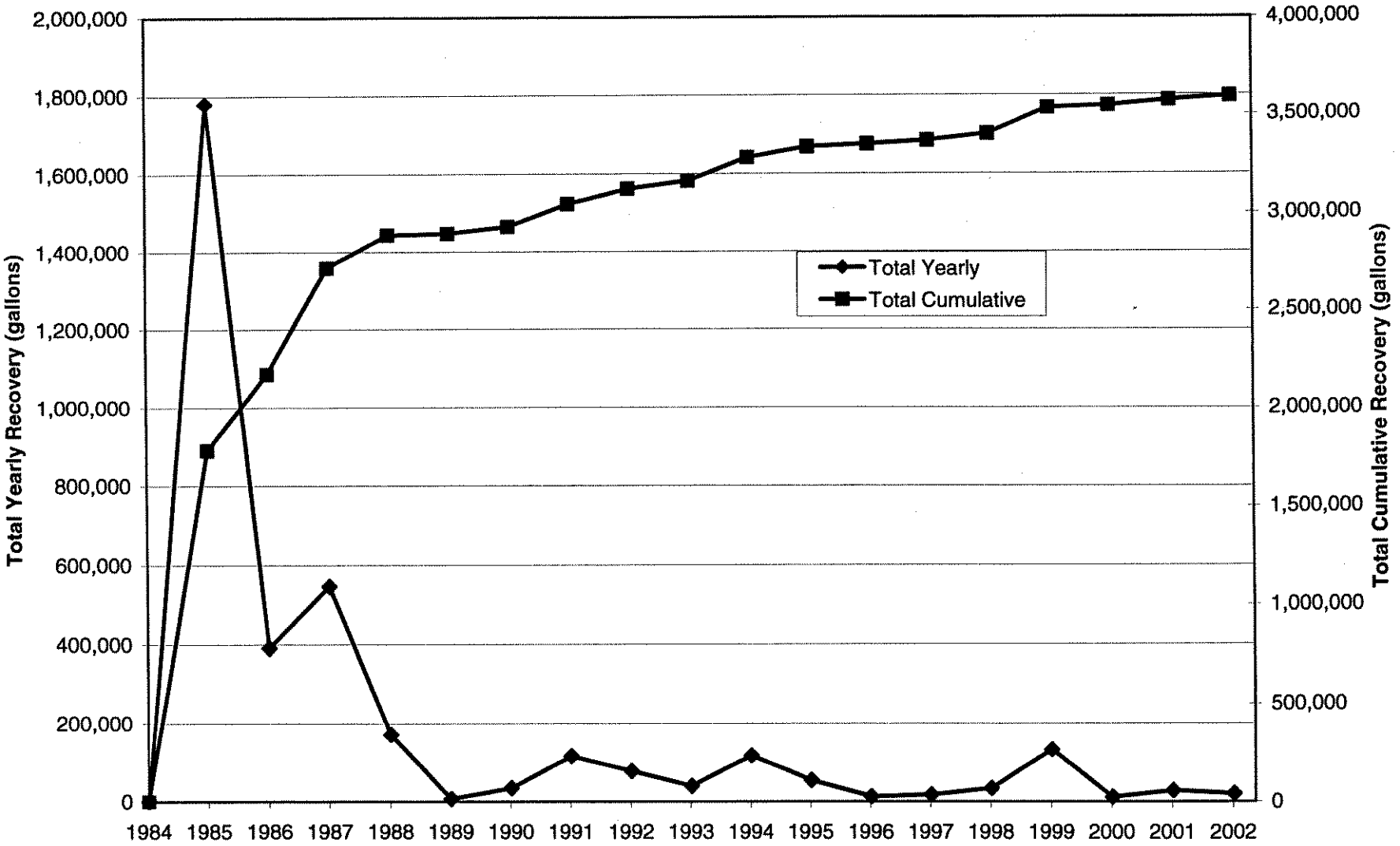


Figure 2-17: Estimated Cumulative LNAPL Volume Removed by Hooven HSVE Well 1

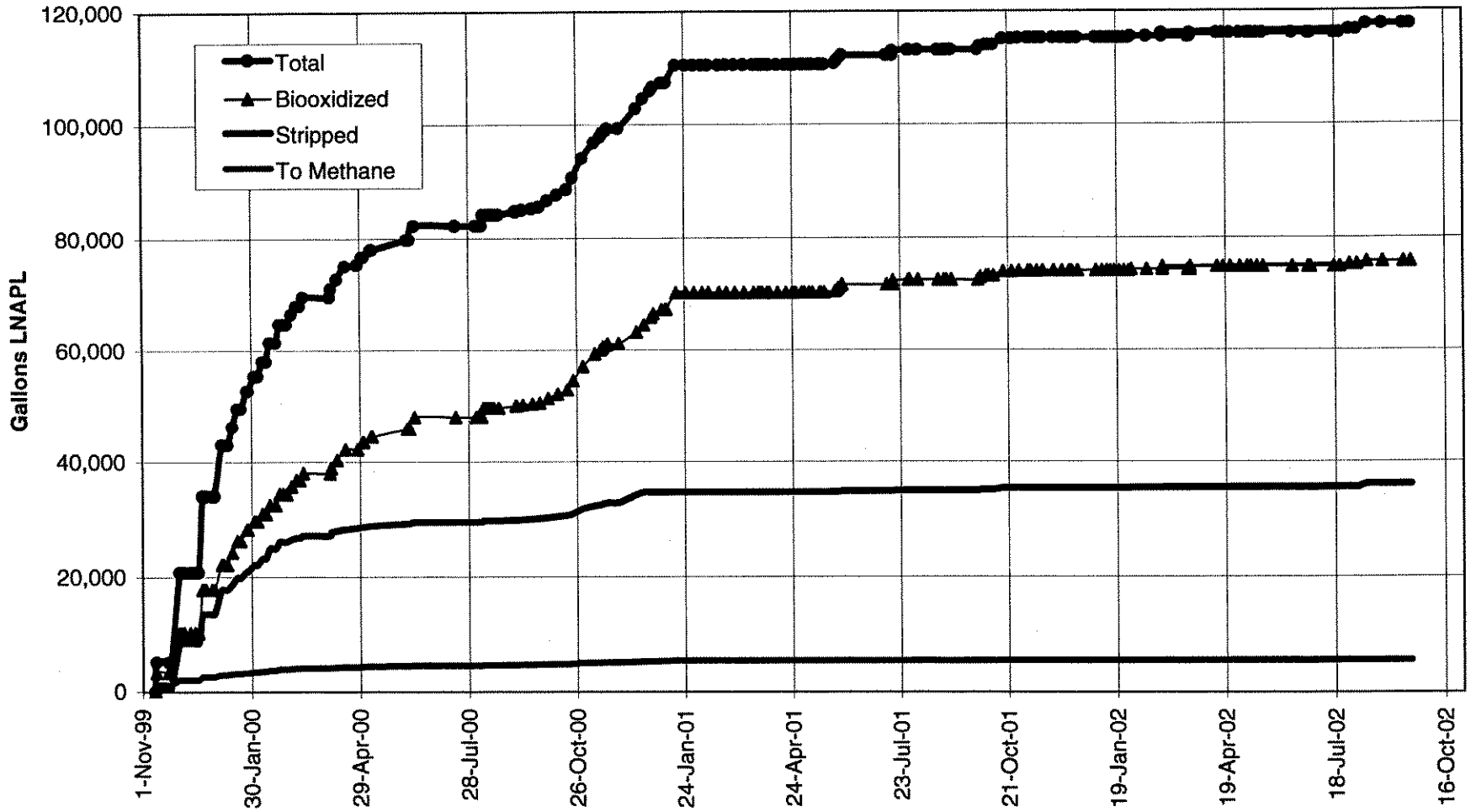
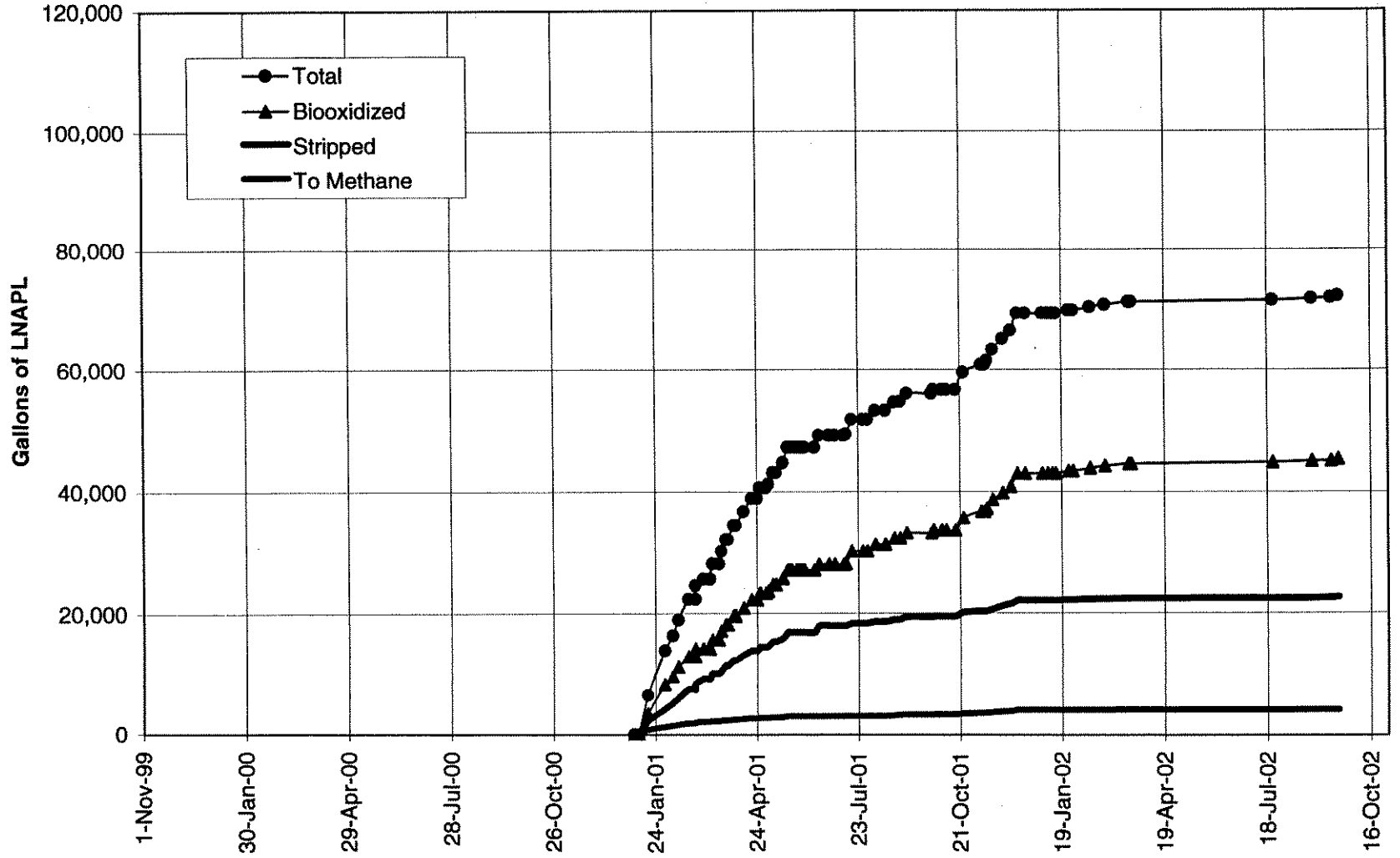


Figure 2-18: Estimated Cumulative LNAPL Volume Removed by Hooven HSVE Well 3



HOOVEN

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

BARRETT

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

INTERMITTENT CHANNEL

CLEVES

0.0055
0.0045
0.0035
0.0025
0.0015
0.0005
0.0

LEGEND

- MW-92D — MONITORING WELL
- MW-118D (abandoned) — MONITORING WELL (abandoned)
- PW-20 — CHEVRON PRODUCTION/ RECOVERY WELL
- MW-96S — LNAPL SAMPLE LOCATIONS
- 0.002 — BENZENE MOLE FRACTION
- CHEVRON CINCINNATI FACILITY PROPERTY LINE

NOTE:
Benzene Mole Fraction Data Taken From CRTC 1997, A.D. Little 1999 and Quanterra 1999 LNAPL Sample Lab Data.

SCALE: 1"= 600'

0 600 1200

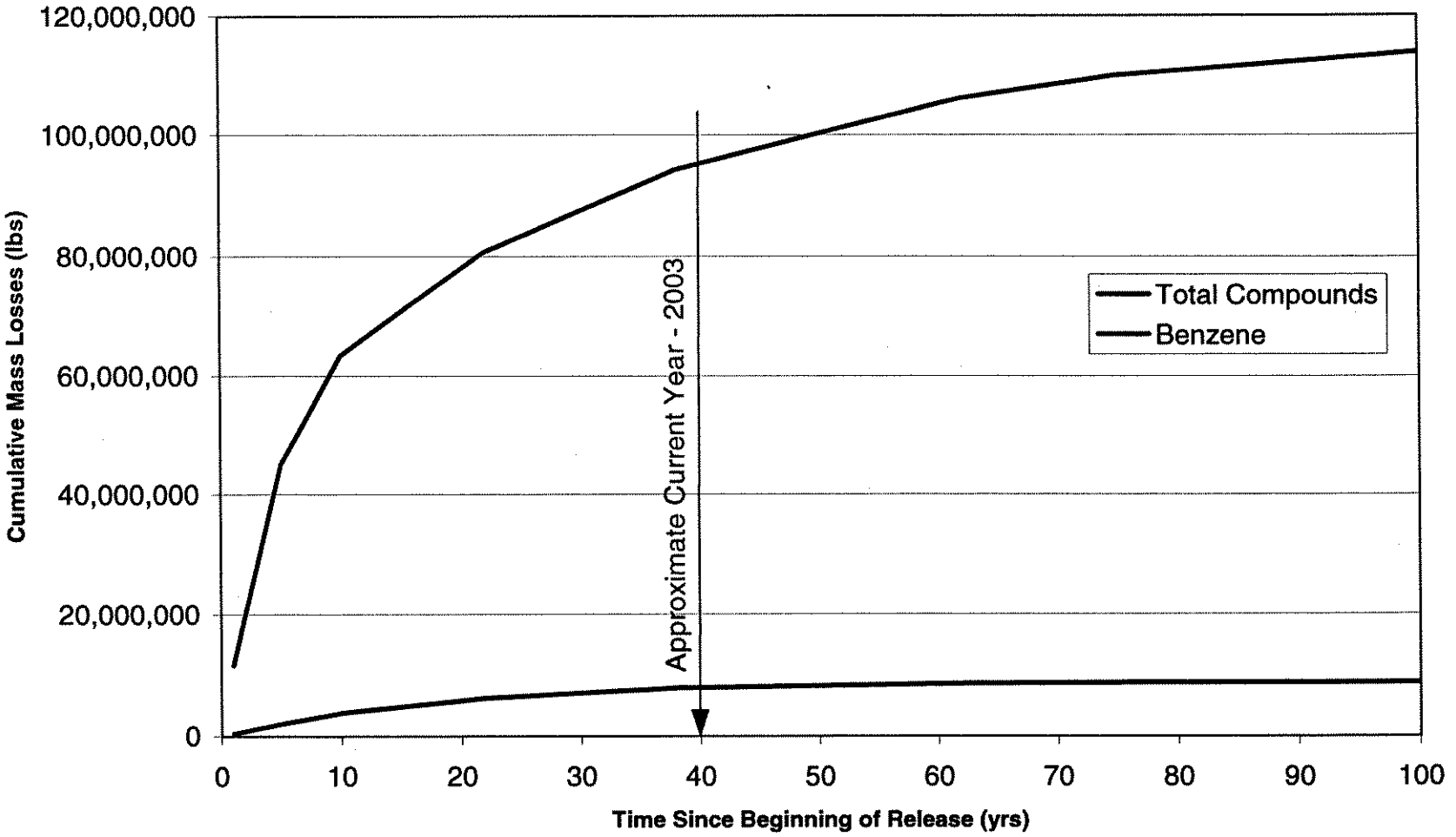
Interpreted Benzene Mole Fraction Distribution, from LNAPL Samples
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 2-19

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-ht Draft Rev4\ben_from_LNAPL.dwg Layout: FIG 2-19 Plotted: Jul 14, 2003 - 1:21pm

Figure 2-20: Cumulative Natural Mass Loss Estimates



HOOVEN

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

HOOVEN DITCH

SWMU 10

INTERMITTENT CHANNEL

CLEVES

LEGEND

- MW-55 — Existing Monitoring Well to be Sampled
- PROD_16 — Existing Production Well to be Sampled
- MV-81S, 23 — Concentration of Total Arsenic Detected during Phase II RFI (ug/L)
- MW-96S, (<10) — Concentration of Total Arsenic Detected during Phase I RFI or subsequent Hooven Investigation (ug/L)
- 20 — Arsenic concentration Isopleth (dashed where uncertain)

SCALE: 1"= 600'

0 600 1200

Arsenic in Groundwater Isopleth Map
(from CMS)
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 2-21

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\Arsenic_in_GW.dwg Layout: fig 2-21 Plotted: Jul 14, 2003 - 1:22pm

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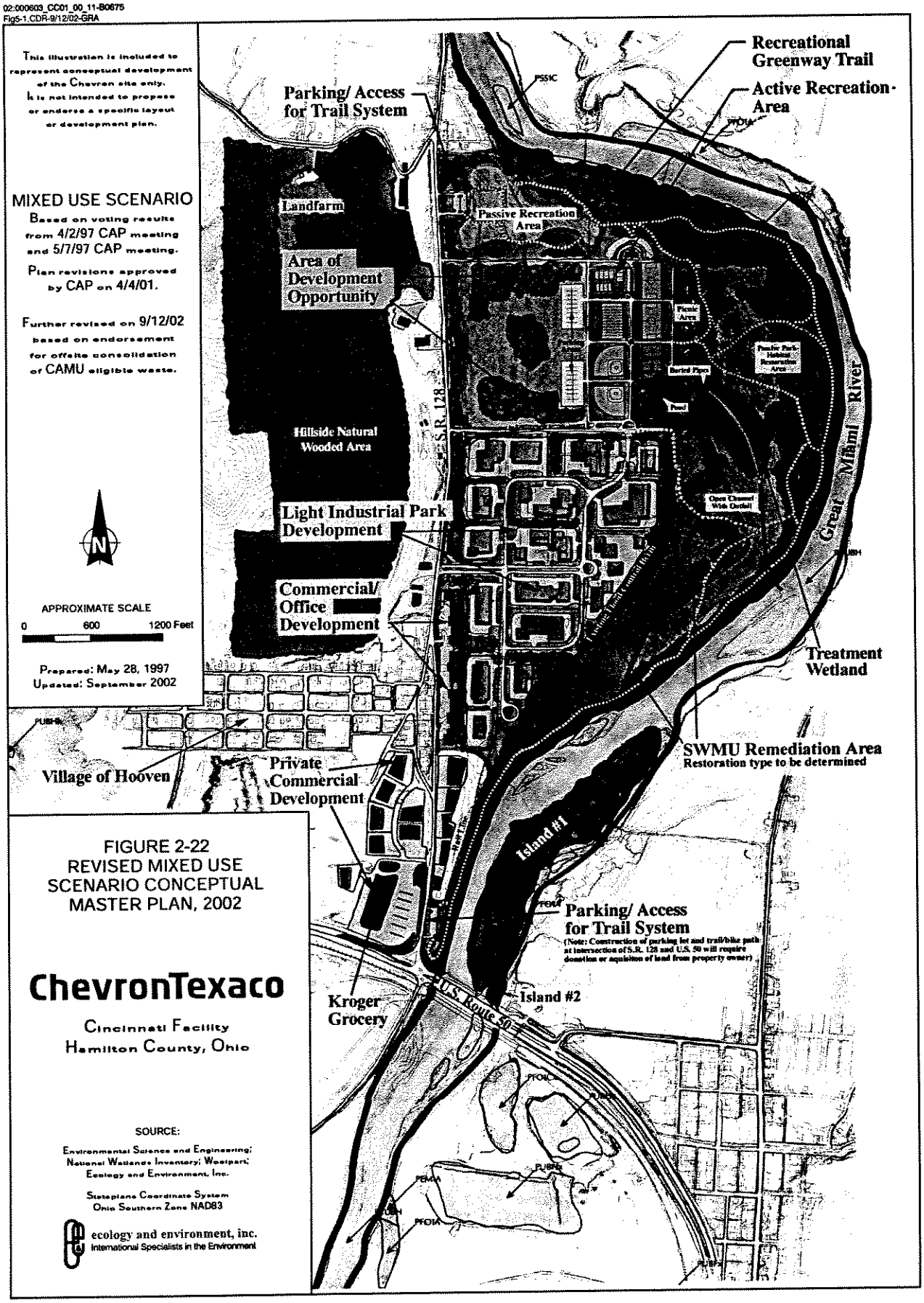
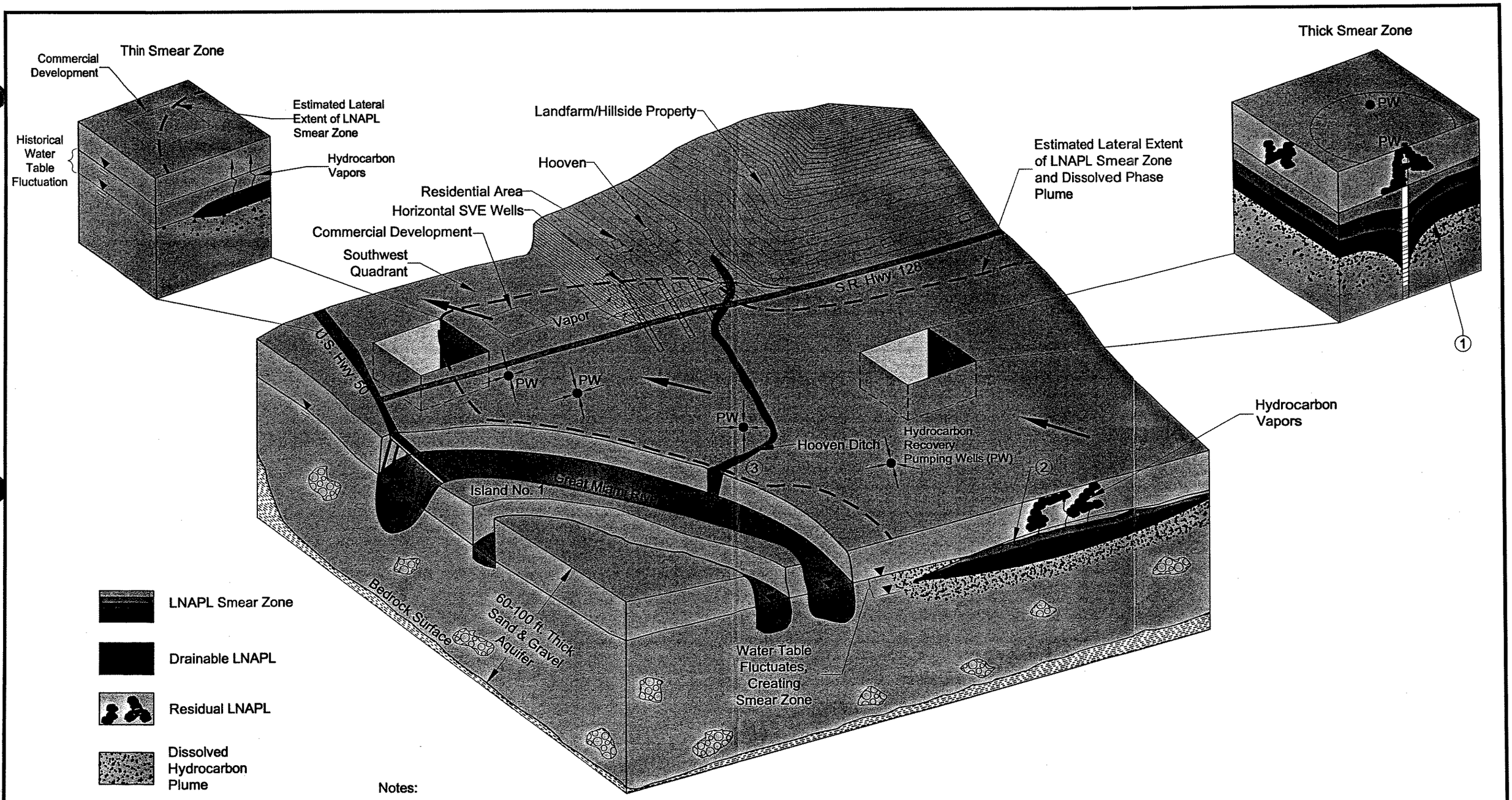
Fig5-1.CDR-9/12/02-GRA





LNAPL Smear Zone

Drainable LNAPL

Residual LNAPL

Dissolved Hydrocarbon Plume

Natural Direction of Groundwater Flow

Local Groundwater Flow

Estimated Lateral Extent of LNAPL Smear Zone and Dissolved Phase Plume

Notes:

1. Groundwater Pumping Creates Inward Hydraulic Gradient.
2. Liquid Hydrocarbon Plume Varies With Water Table.
3. One Time Occurrence Hydrocarbon to Surface During High Water Table
4. Figure Is Not To Scale

Current Conceptual Site Model
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

SCALE:		FIGURE-NO:
Not To Scale		Figure 2-23

File: C:\Chevron Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft\Site Conceptual Model.dwg Layout: FIG 2-23 Plotted: Jul 14, 2003 - 1:23pm

HOOVEN

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

BARRETT

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

HOOVEN DITCH

INTERMITTENT CHANNEL

CLEVES

464 464.5 465 465.5 466 466.5 467 467.5 468 468.5 469 469.5 470 470.5 471 471.5 472

Legend

- MW-86D — Monitoring Well
- PW-17 — Chevron Production/Recovery Well
- 467.5 — Potentiometric Surface Contour (ft MSL) Simulated by MODFLOW-SURFACT
- Chevron Cincinnati Facility Boundary
- Estimated Barrier Location for Model Simulations

300 0 150 300 600
SCALE IN FEET

SOURCE OF TOPOGRAPHY HAMILTON COUNTY CAGIS SYSTEM
STATE PLANE COORDINATES OHIO SOUTHERN ZONE, NAD83

Natural Hydraulic Gradients
Simulated Potentiometric Surface Map
(No Pumping, High Water Table)
CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 3-1

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\not_htd_grnat_high.dwg Layout: fig 3-1 PlotDate: Jul 14, 2003 - 1:24pm

HOOVEN

CLEVES

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

S.R. HIGHWAY 128

U.S. RT. 50

BARRETT

ISLAND NO. 2

ISLAND NO. 1

GREAT MIAMI RIVER

INTERMITTENT CHANNEL

462 462.5 463 463.5 464 464.5 465 465.5 466 466.5 467 467.5 468 468.5 469

Legend

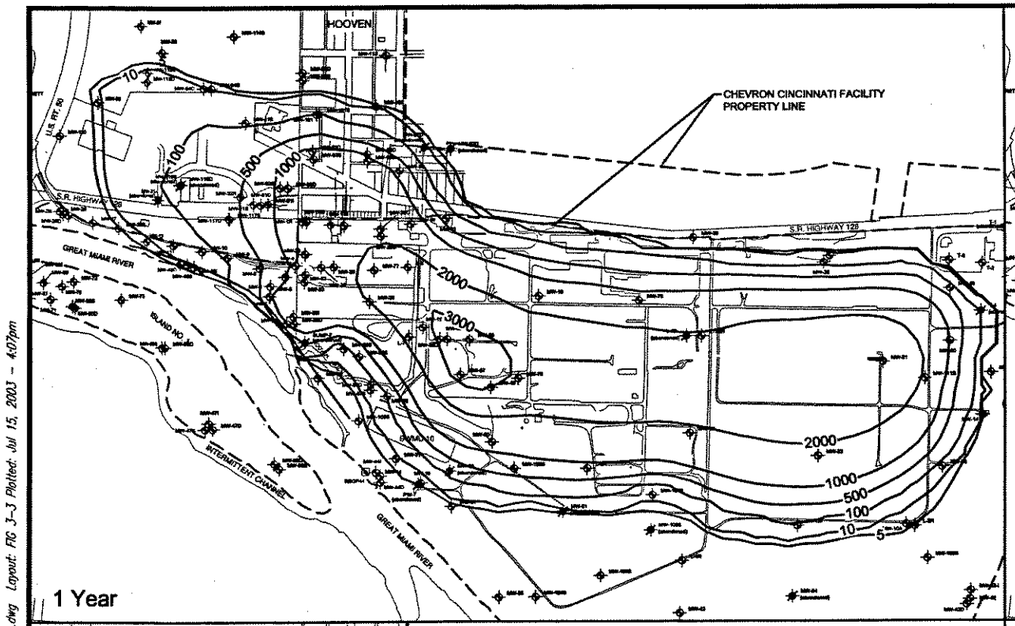
- MW-85D — Monitoring Well
- PW-17 — Chevron Production/Recovery Well
- 467.5 — Potentiometric Surface Contour (ft MSL) Simulated by MODFLOW-SURFACT
- Chevron Cincinnati Facility Boundary
- Estimated Barrier Location for Model Simulations

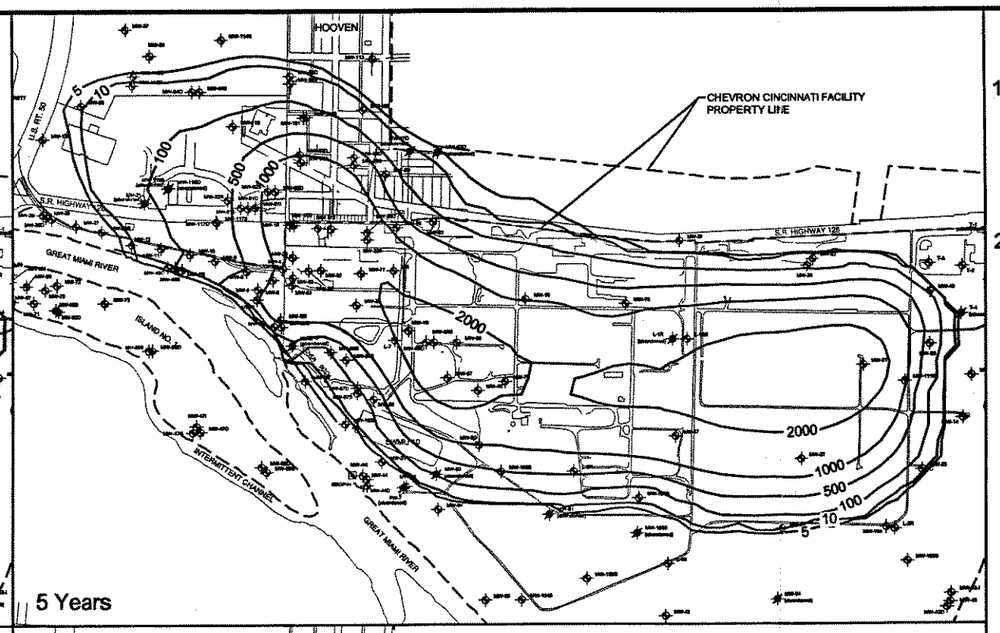
300 0 150 300 600
SCALE IN FEET

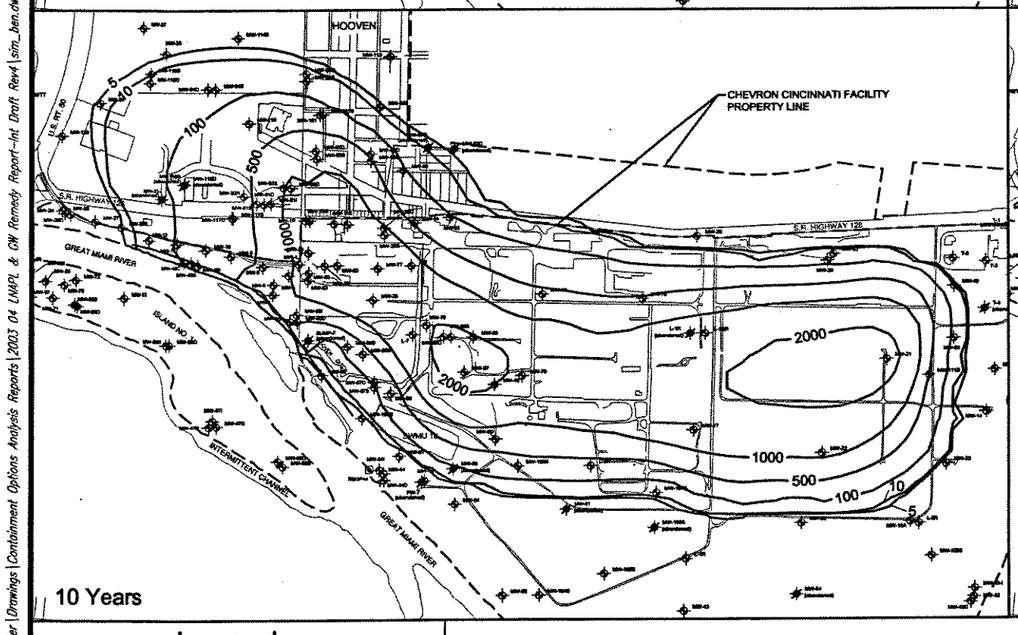
Natural Hydraulic Gradients
Simulated Potentiometric Surface Map
(No Pumping, Low Water Table)
CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

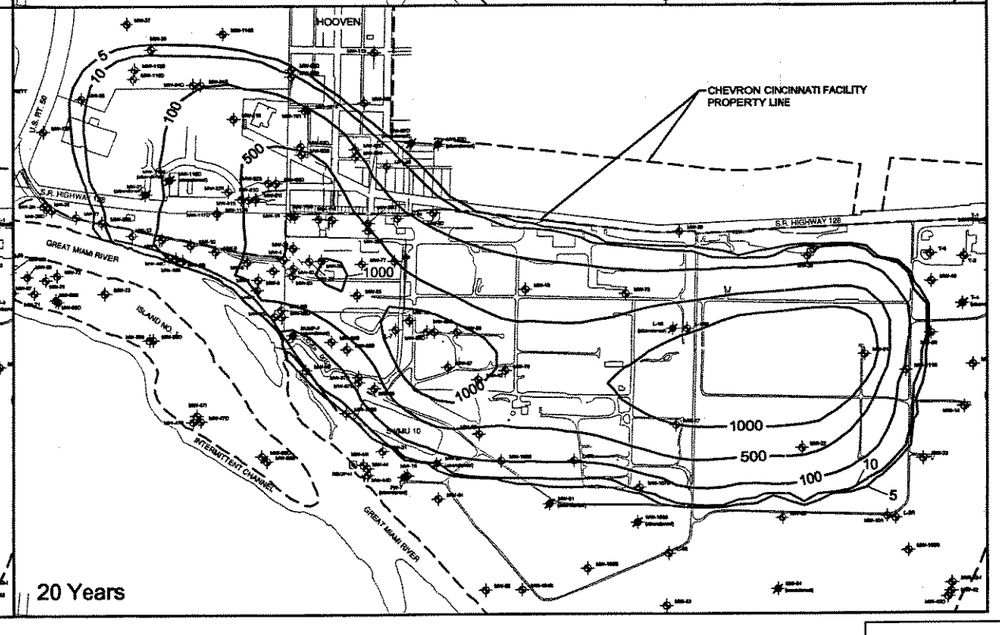
FIGURE-NO:
Figure 3-2

File: G:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft\New\nat_hyd_Grad_low.dwg Layout: fig 3-2 Plotted: Jul 14, 2003 - 1:24pm









Notes:

1. Groundwater flow simulated by MODFLOW-SURFACT (estimated low water table at ambient conditions as shown in Figure 3-2).
2. LNAPL source is modeled according to configuration of smear zone as shown in Figure 2-8.

Legend

- MW-100 Monitoring Well
- Simulated Benzene Isopleths (ppb)
- Chevron Cincinnati Facility Boundary
- Estimated Barrier Location for Model Simulations

N

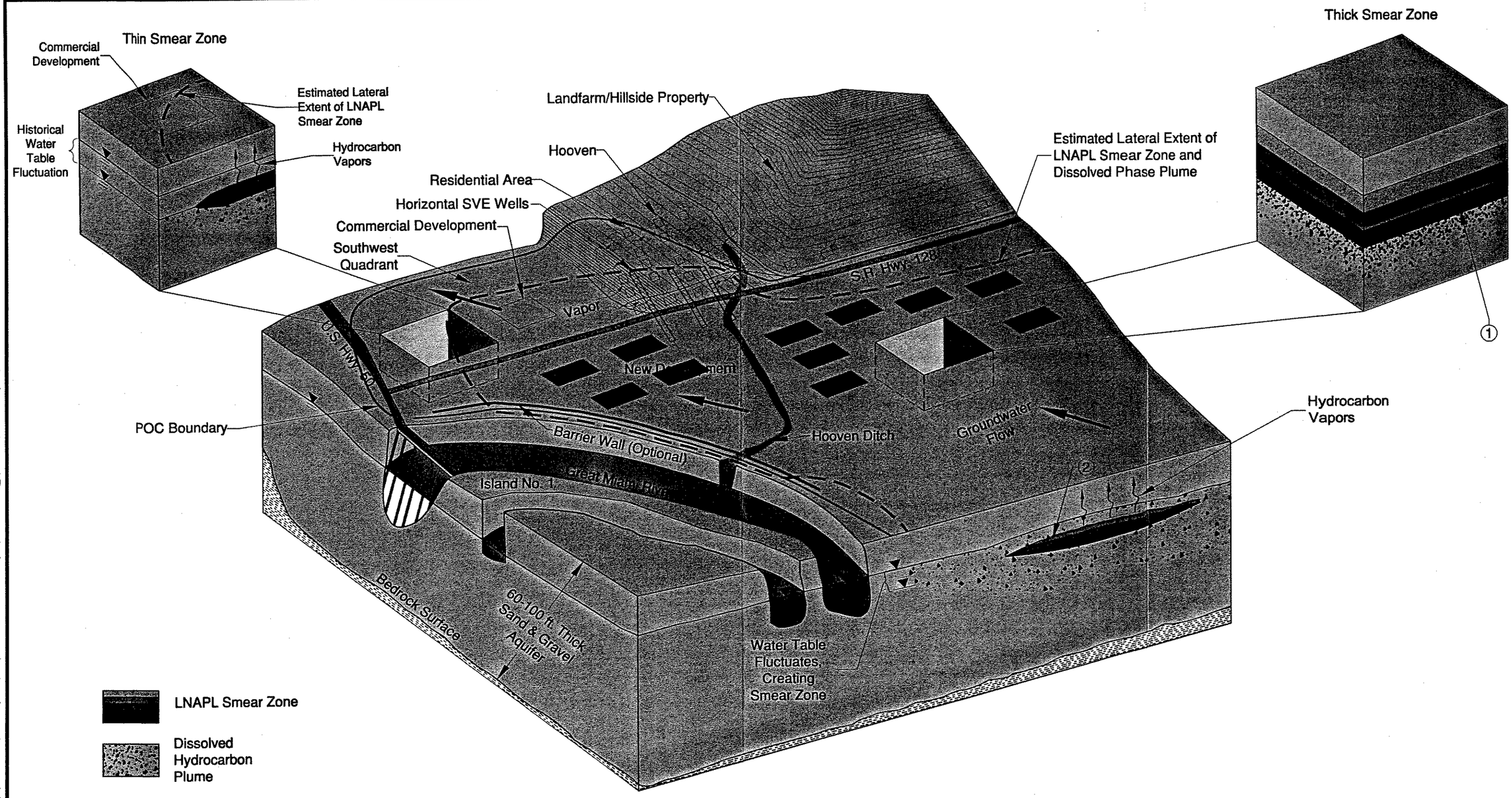
300 0 150 300 600

SCALE IN FEET

Simulated Benzene Isopleths
for 0.3% Degradation Rate
CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 3-3

File: G:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\sim_ben.dwg Layout: FIG 3-3 Plotted: Jul 15, 2003 - 4:07pm



Notes:

(1) Natural Hydraulic Gradients Restored

(2) Liquid Hydrocarbon Plume Varies With Water Table.

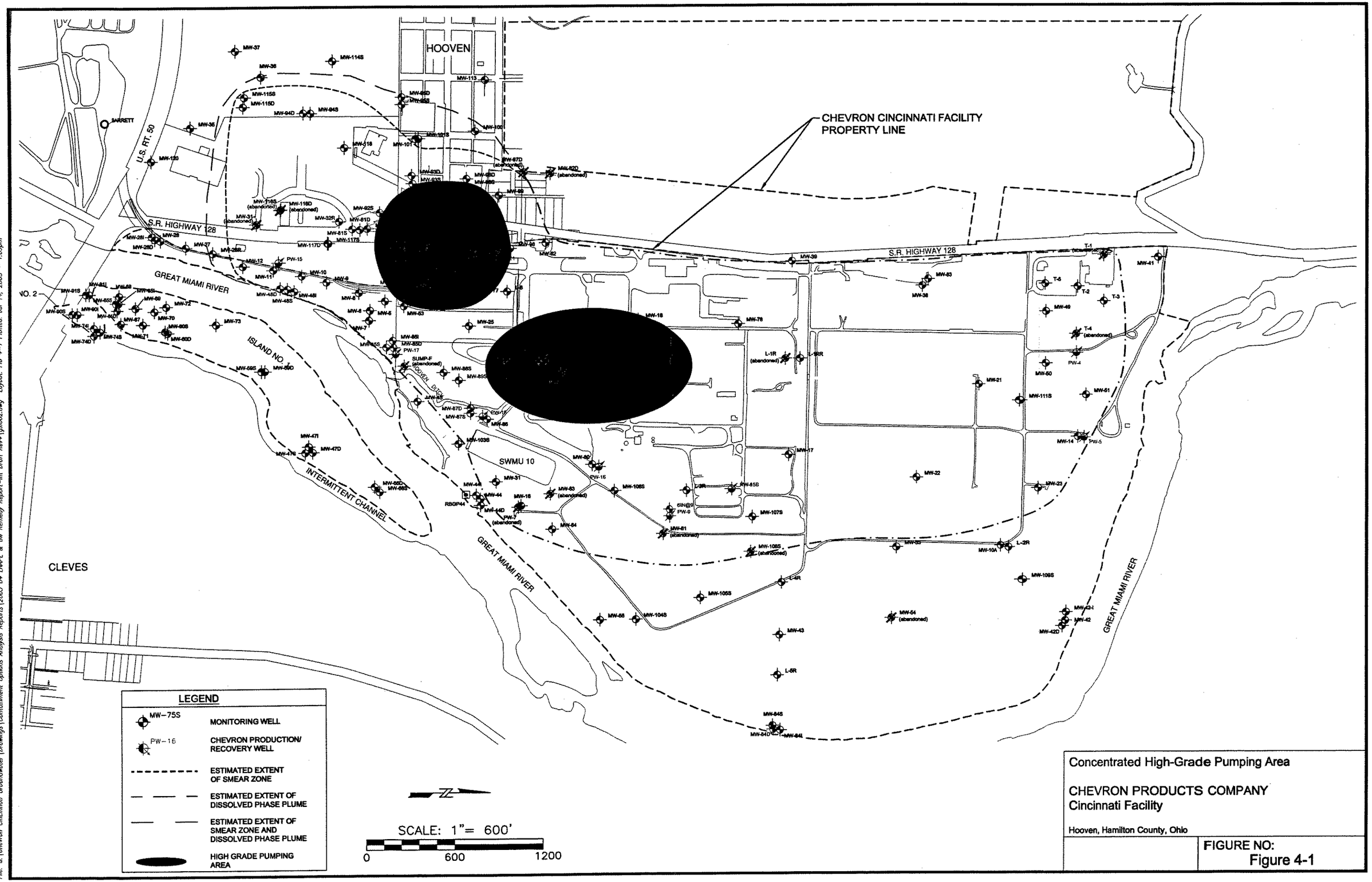
(3) Figure Is Not To Scale

Future Conceptual Site Model (50-100 Years)
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 3-4

File: Q:\Chevron Cincinnati\Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft\Site Conceptual Model.dwg Layout: FIG 3-4 Plotted: Jul 14, 2003 - 1:23pm



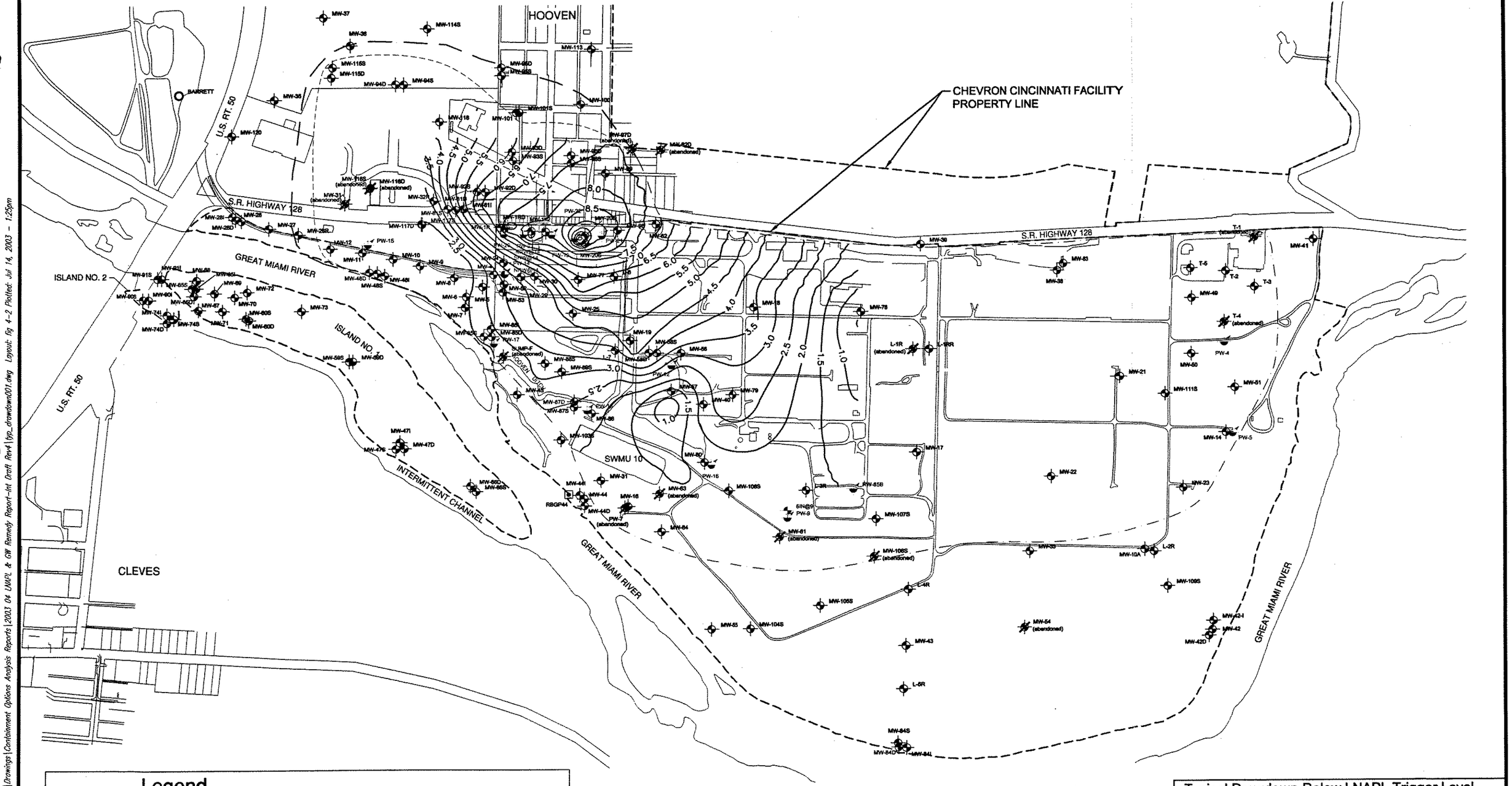
Concentrated High-Grade Pumping Area

CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 4-1

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\gs1002.dwg Layout: FIG 4-1 Plotted: Jul 14, 2003 - 1:09pm



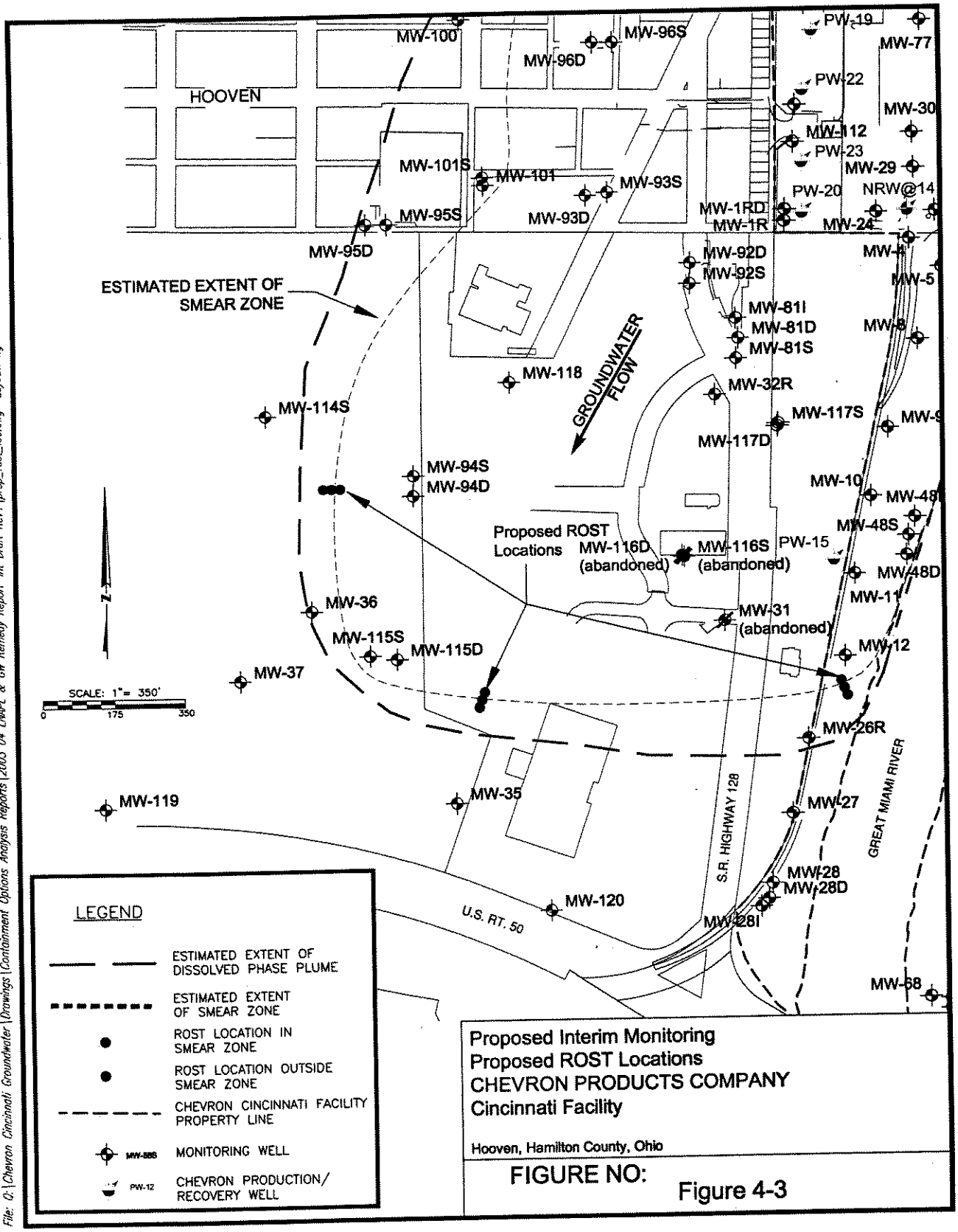
Legend

- MW-85D — Monitoring Well
- PW-17 — Chevron Production/Recovery Well
- 467.5 — Potentiometric Surface Contour (ft MSL) Simulated by MODFLOW-SURFACT
- Chevron Cincinnati Facility Boundary
- ESTIMATED EXTENT OF SMEAR ZONE
- ESTIMATED EXTENT OF DISSOLVED PHASE PLUME
- ESTIMATED EXTENT OF SMEAR ZONE AND DISSOLVED PHASE PLUME

Typical Drawdown Below LNAPL Trigger Level
From High-Grade
Pumping During Low Water Table (at 30 Days)
CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 4-2

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 Q4 LNAPL & GW Remedy Report-Int Draft Rev4\typ_drawdown001.dwg Layout: fig 4-2 Plotted: Jul 14, 2003 - 1:25pm

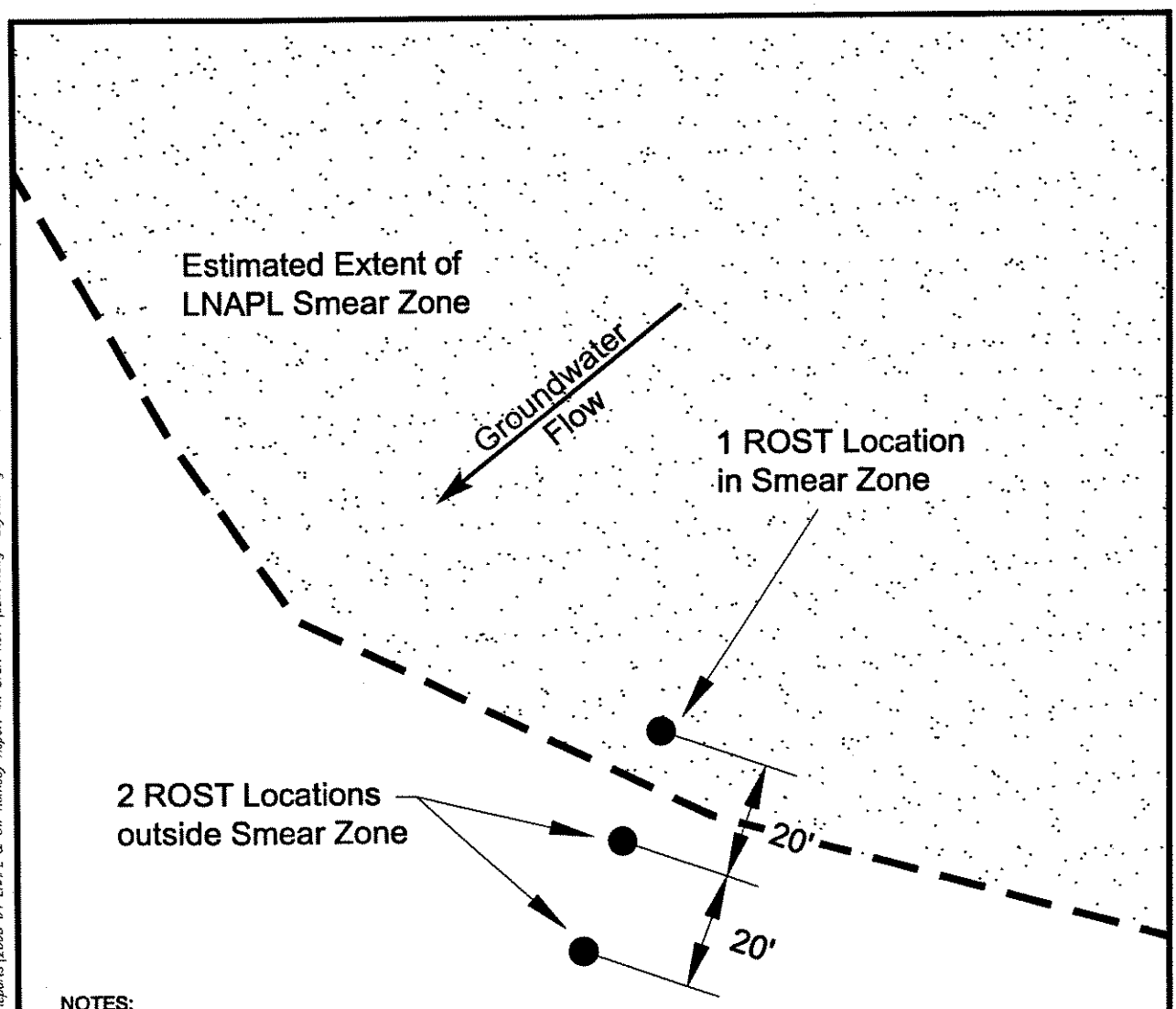


Proposed Interim Monitoring
Proposed ROST Locations
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO: Figure 4-3

File: G:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\prop_rost_loc.dwg Layout: fig 4-3 Plotted: Jul 14, 2003 - 1:26pm



NOTES:

1. The 2 clean ROST locations outside the smear zone will be sampled annually for the first 6 years then biannually for the next 10 years.

2. If the LNAPL smear zone is detected in the second outer clean ROST location, then the response actions will be initiated.

LEGEND

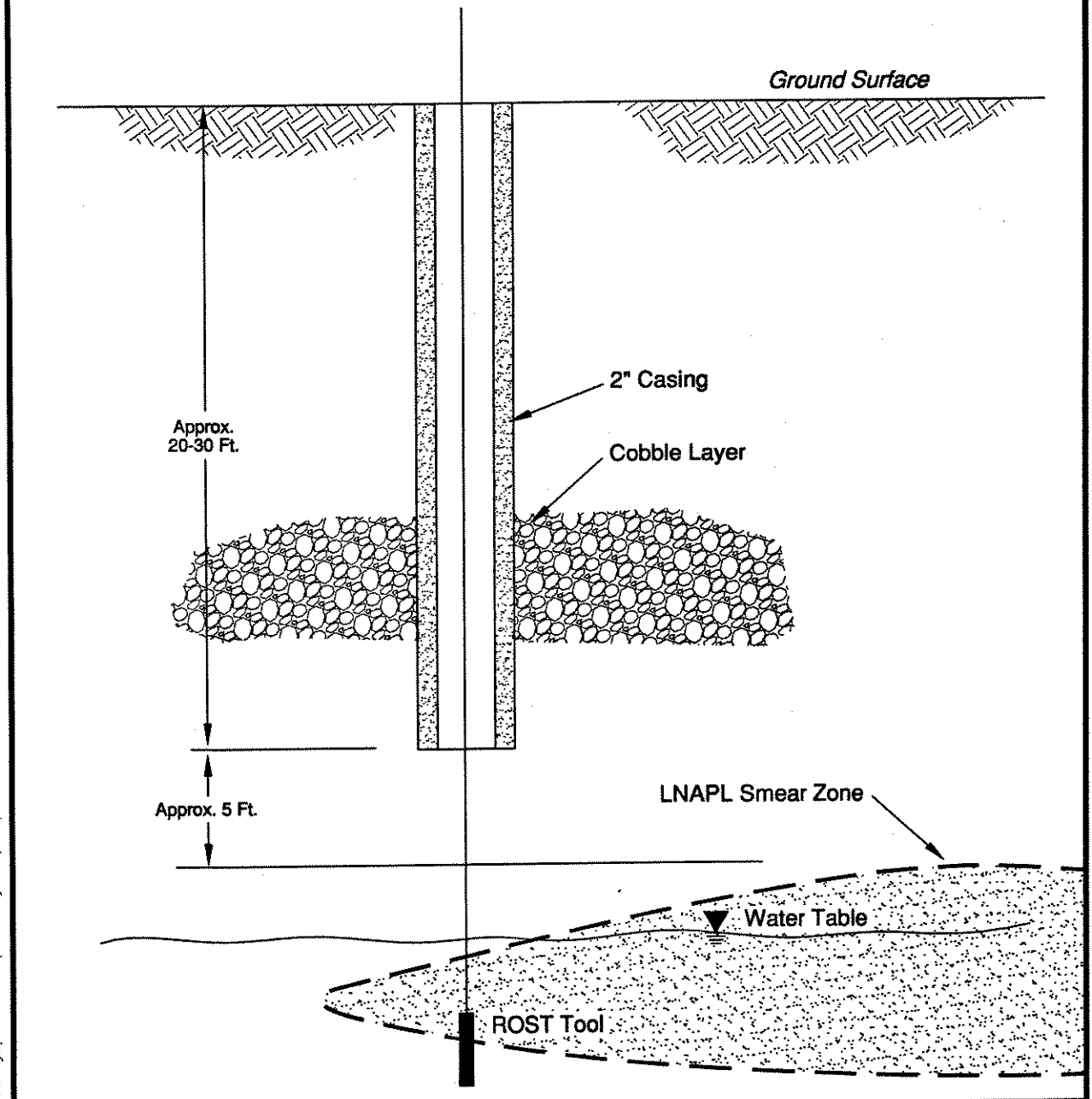
ESTIMATED EXTENT OF SMEAR ZONE

Conceptual Determination of Smear Zone Edge
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 4-4

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev1\szf001.dwg Layout: fig 4-4 Plotted: Jul 14, 2003 - 1:27pm



NOTES:

Annual ROST testing can be done using the same casing hole each year.

LEGEND

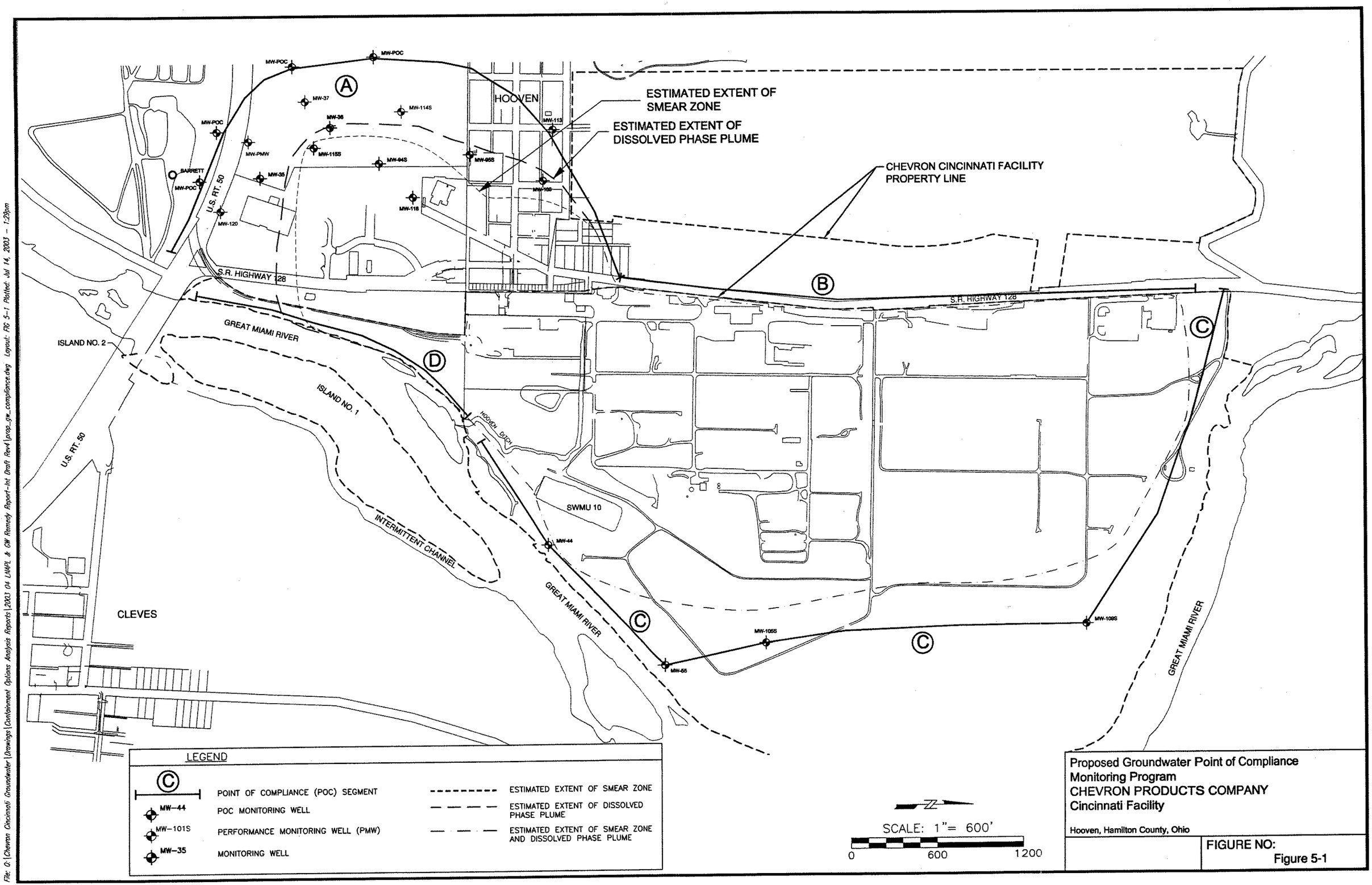
SMEAR ZONE

Conceptual Determination of Smear Zone Edge Using ROST Tool
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO: Figure 4-5

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\sz002.dwg Layout: fig 4-5 Plotted: Jul 14, 2003 - 1:28pm



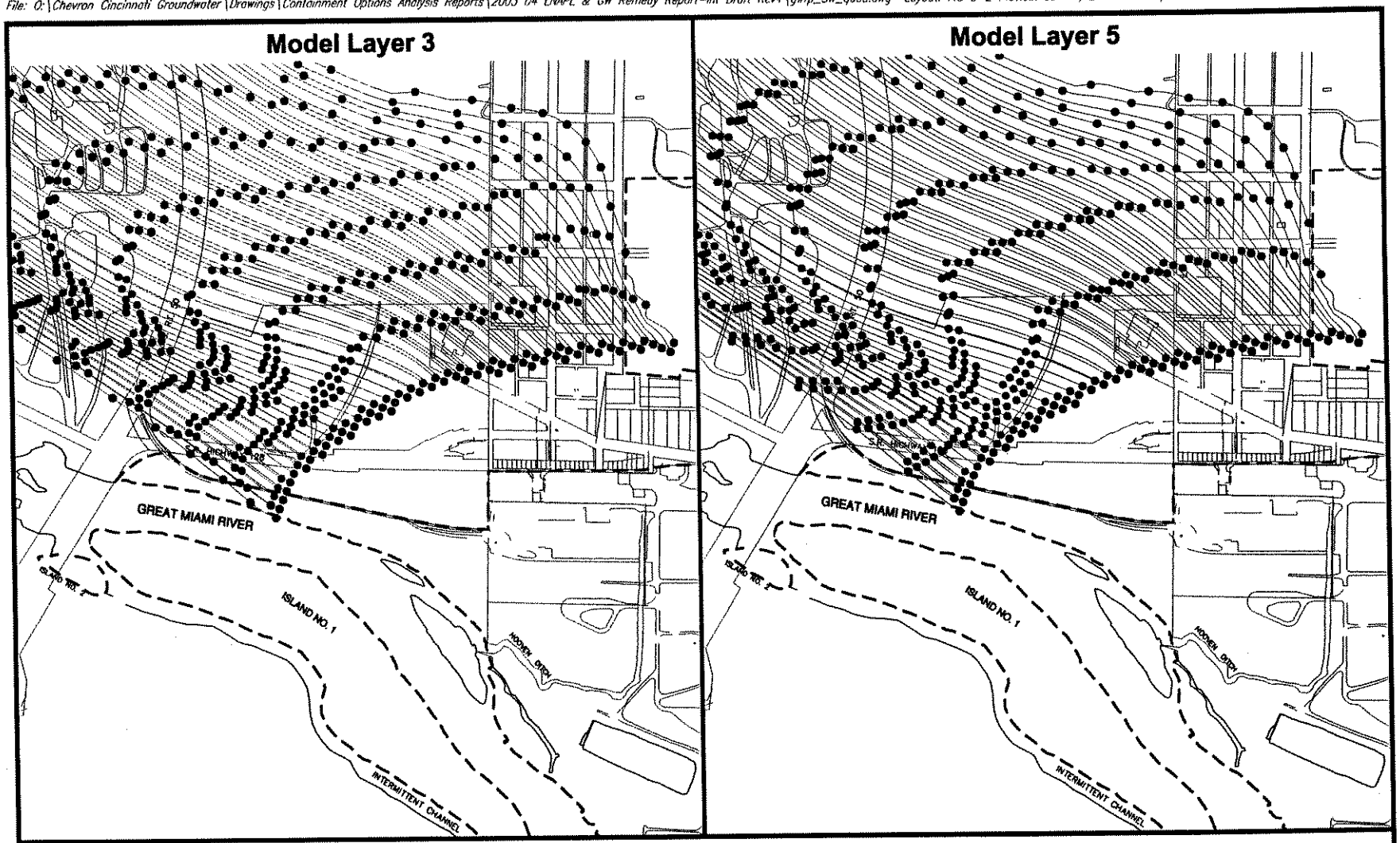
Proposed Groundwater Point of Compliance Monitoring Program
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure 5-1

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\prop_gw_compliance.dwg Layout: FIG 5-1 Plotted: Jul 14, 2003 - 1:29pm

File: O:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\gwfp_SW_quad.dwg Layout: FIG 5-2 Plotted: Jul 14, 2003 - 1:29pm



Groundwater Flowpaths and Particle Tracks in the Southwest Quadrant Area

CHEVRON PRODUCTS COMPANY

Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE-NO:
Figure 5-2

Figure A-1. Multiphase Simulation of Progressive LNAPL
Saturation Profiles During and After a Finite Release in a Simple Sandy Aquifer Setting

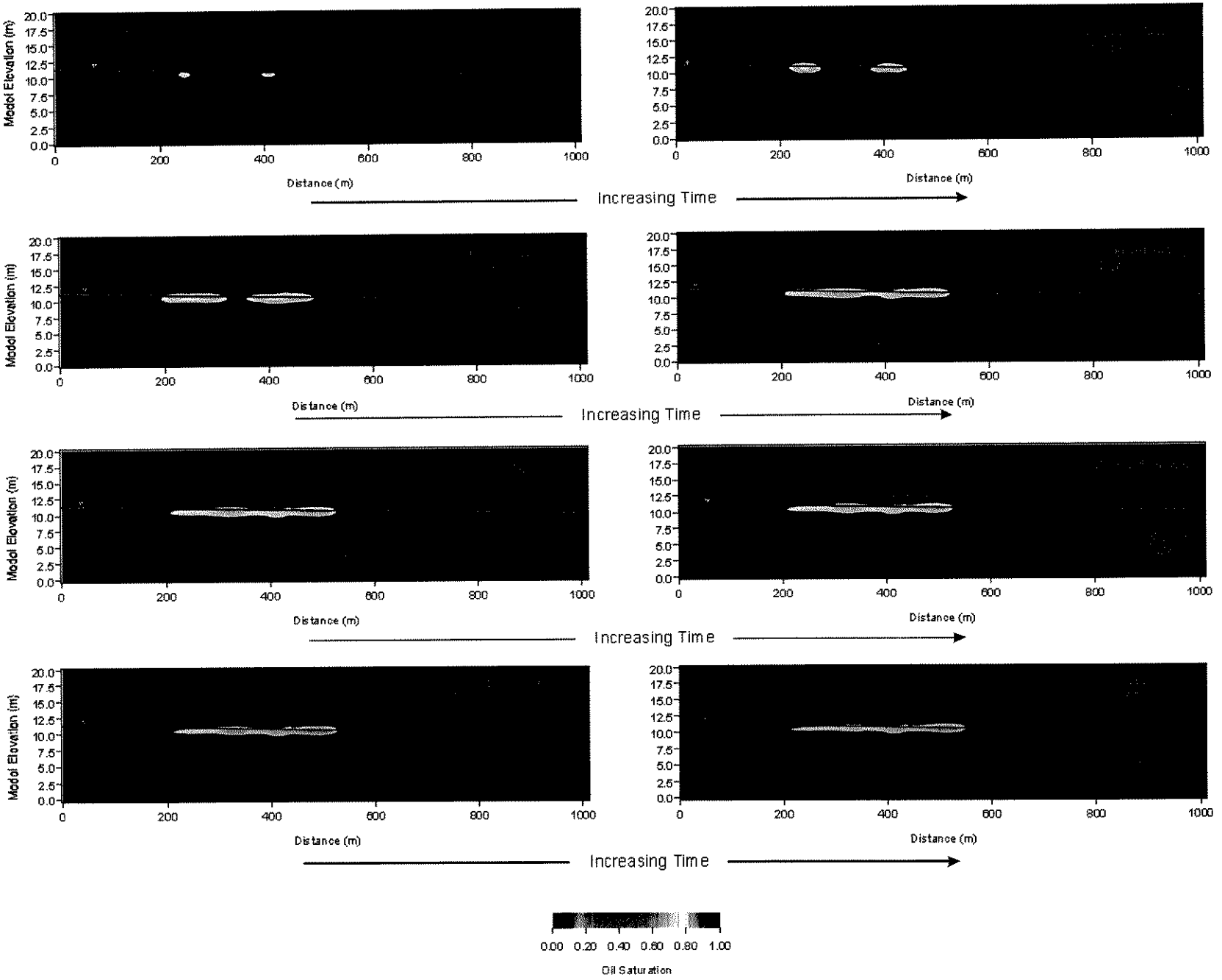


Figure A-2. Multiphase Simulation of Progressive LNAPL
Velocity Profiles During and After a Finite Release in a Simple Sandy Aquifer Setting

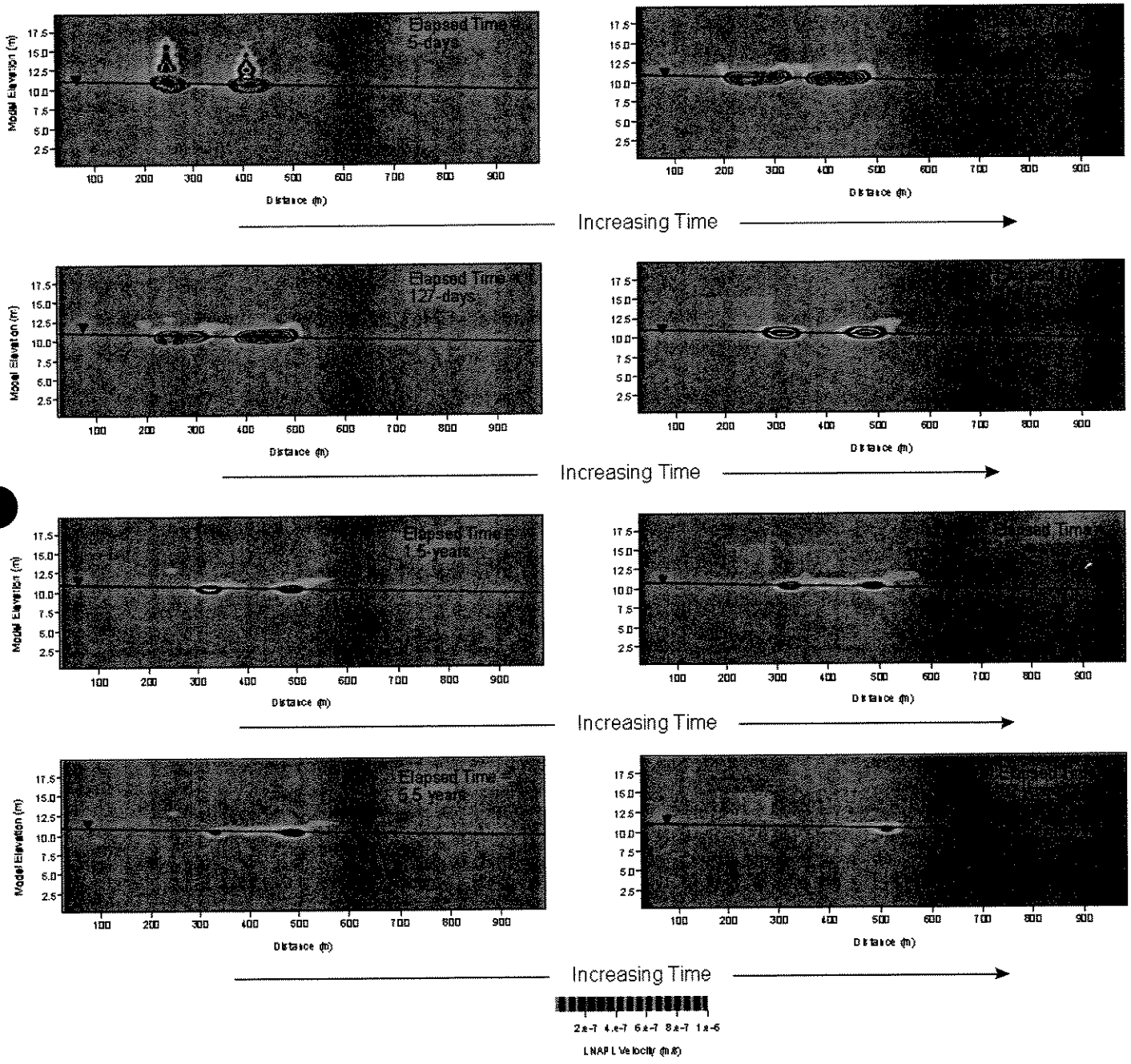


Figure A-3: Comparison of Seasonal Low Water Table to Hydrocarbon Recovery from Oldest Production Wells

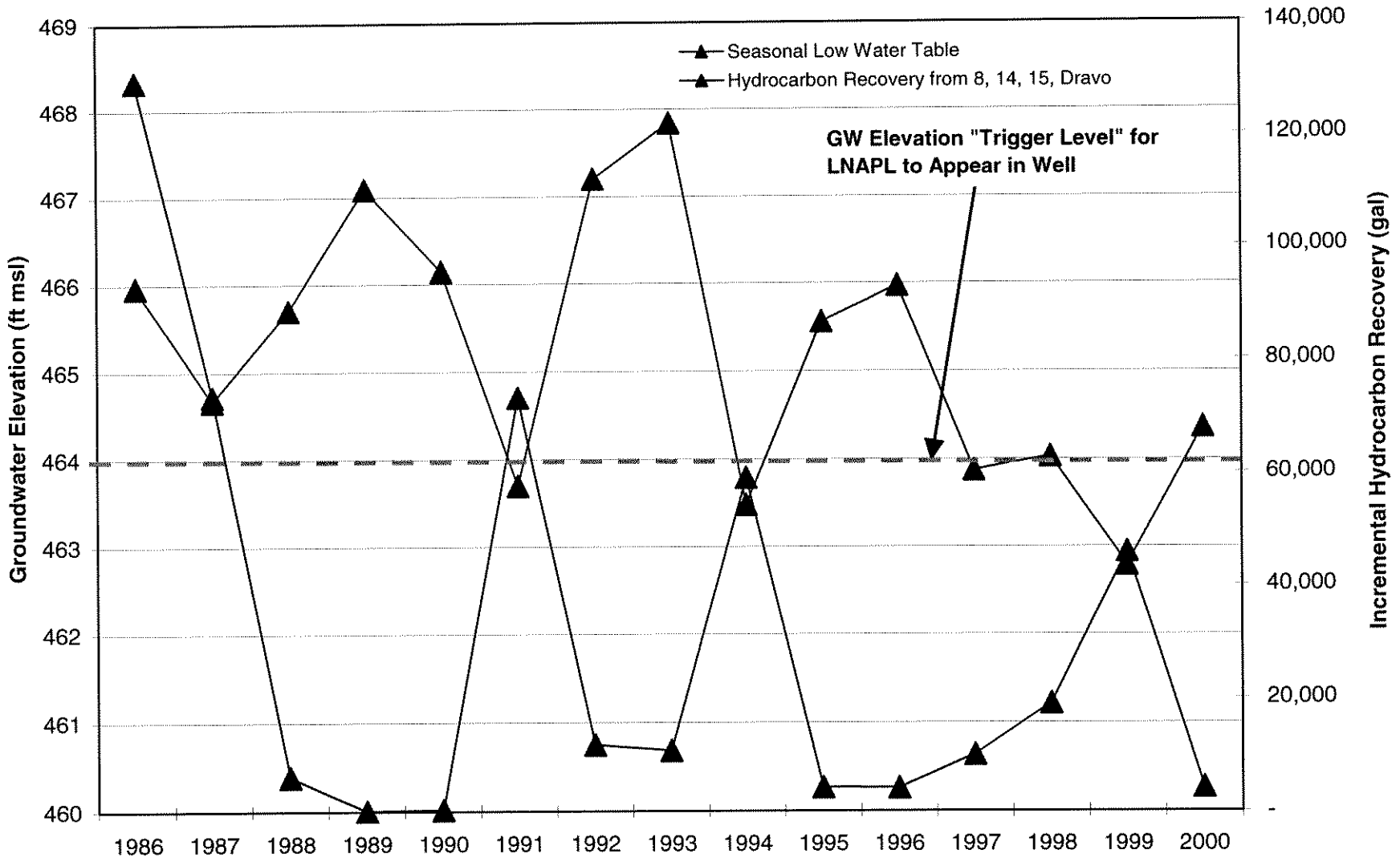
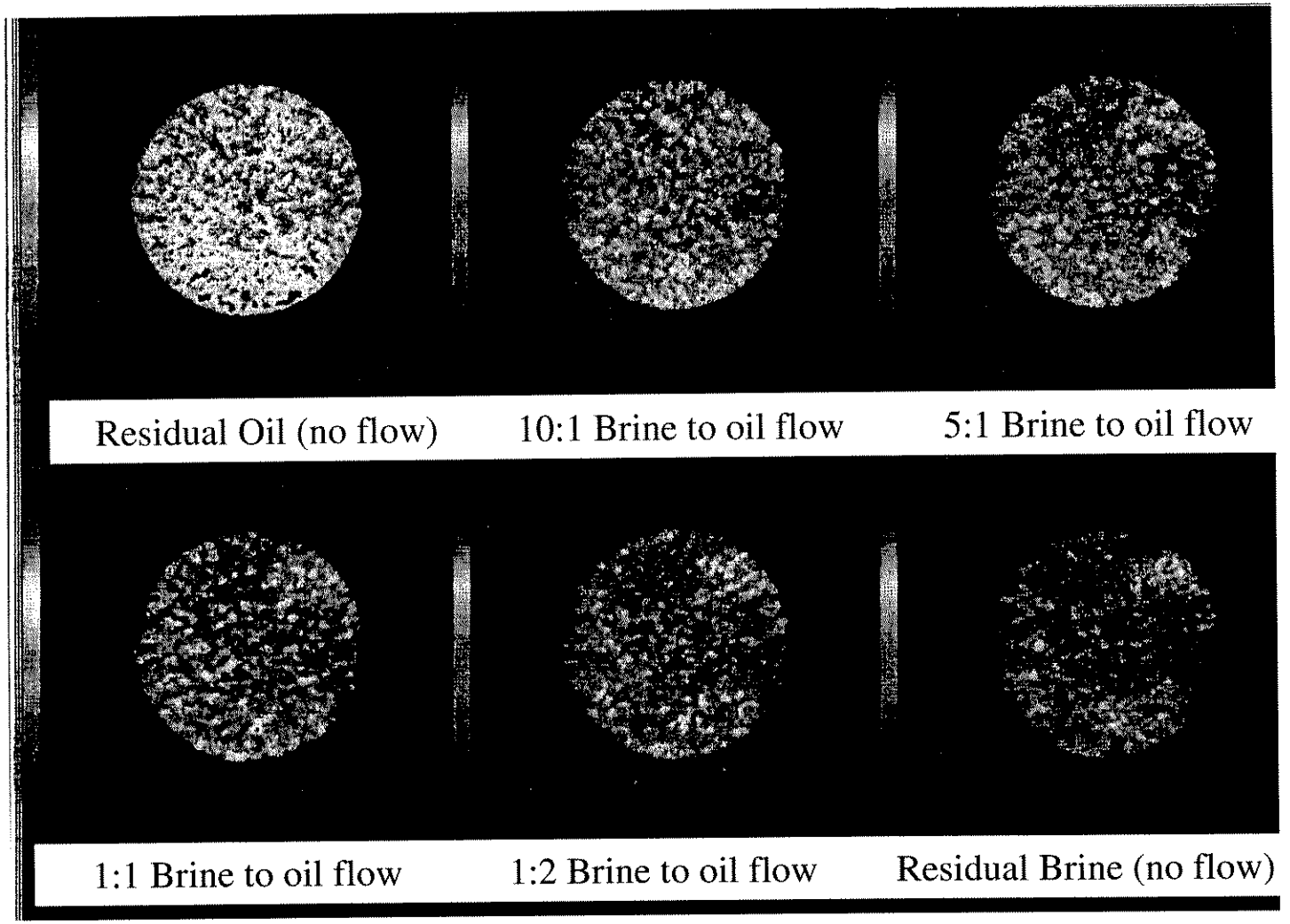


Figure A-4: Micrographs of Changing Saturation under Different Flow Conditions

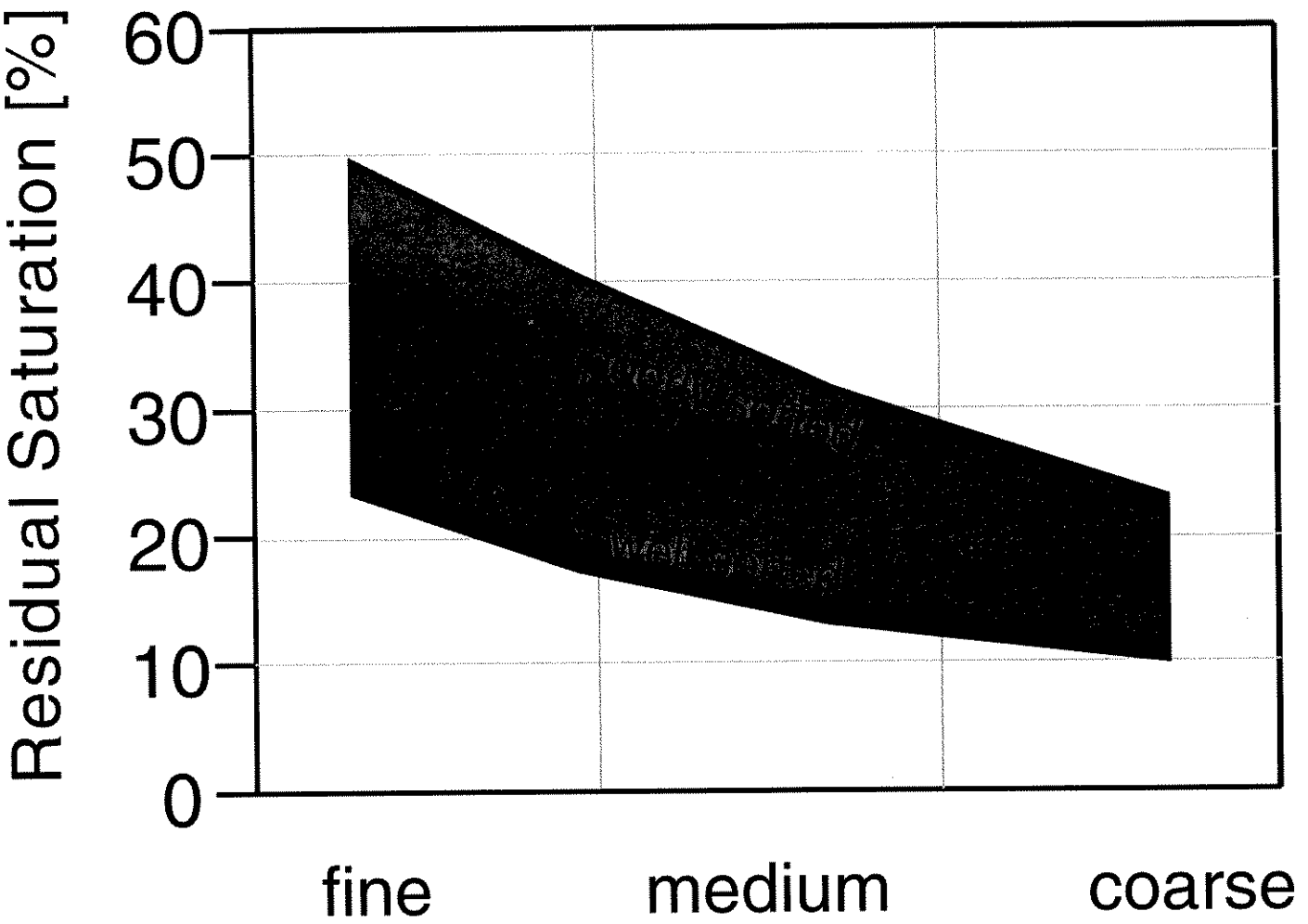


Courtesy of Terra Tek, Salt Lake City, UT

Oil = Blue

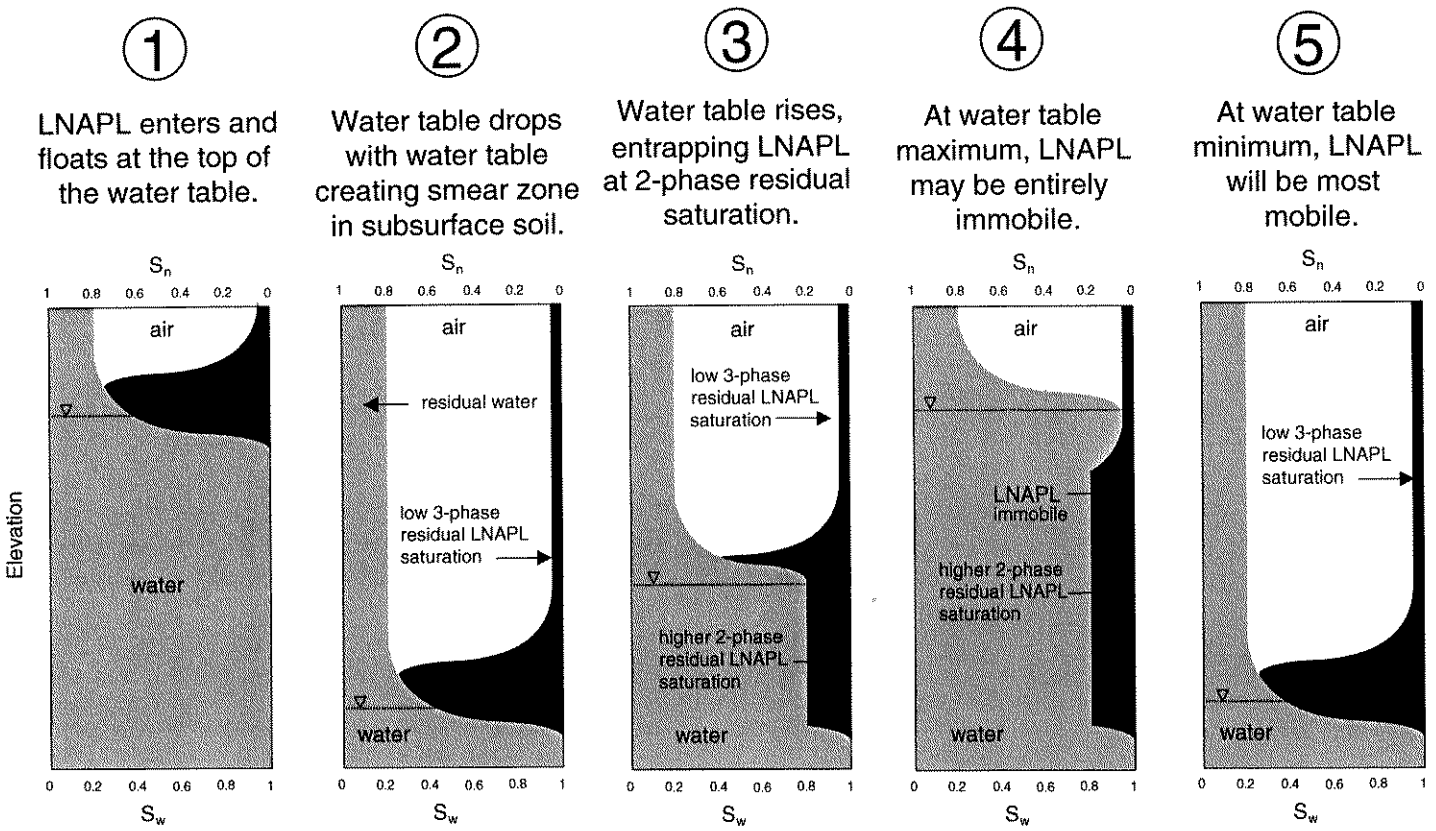
Brine = Red/yellow

Figure A-5: Residual LNAPL Saturation Range in Sands

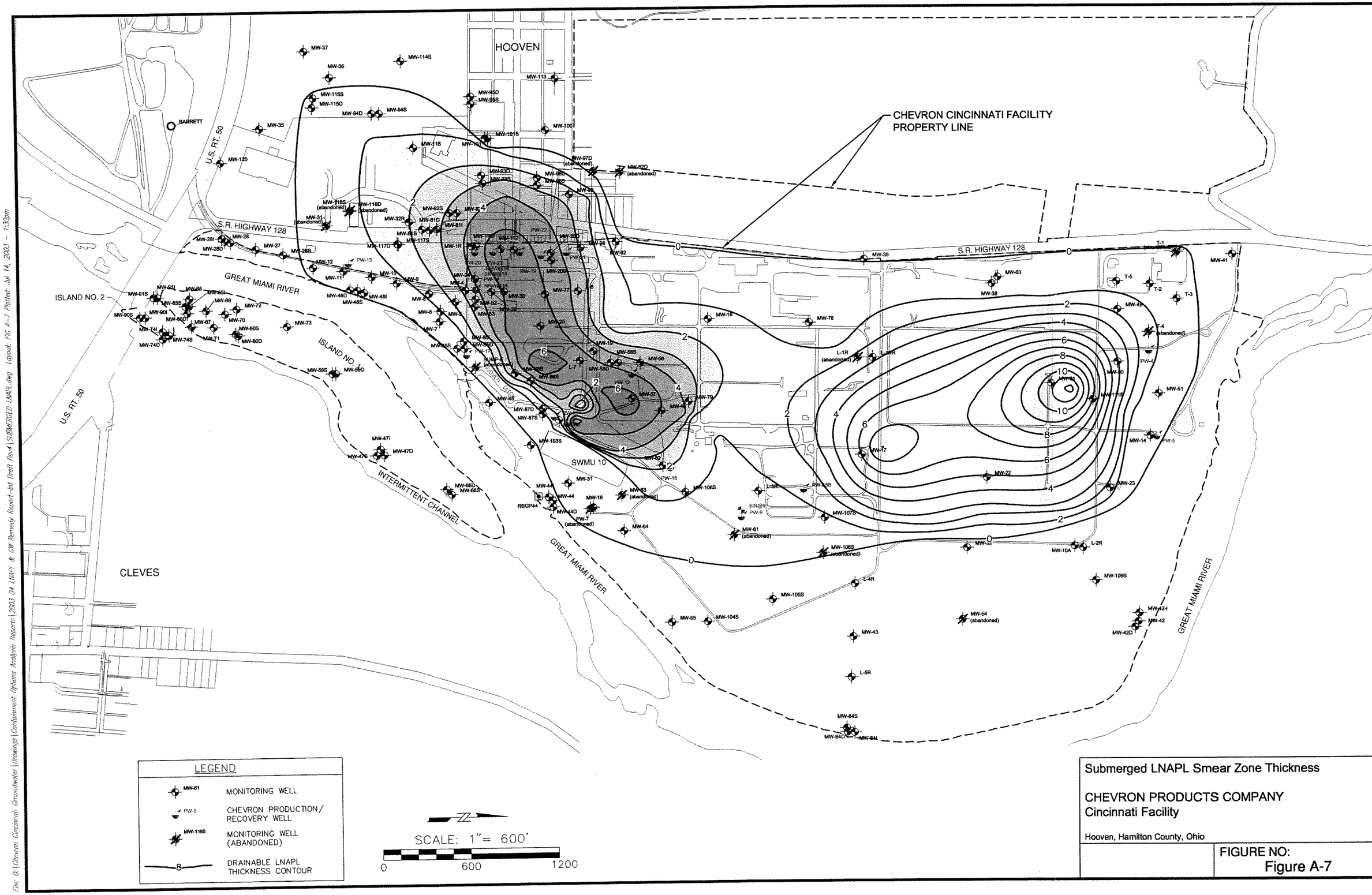


NGWA Conference Paper, Beckett

Figure A-6: Schematic of LNAPL Redistribution by a Fluctuating Water Table



Note: S_w = Saturation of water, S_n = Saturation of LNAPL



Submerged LNAPL Smear Zone Thickness

CHEVRON PRODUCTS COMPANY
Cincinnati Facility

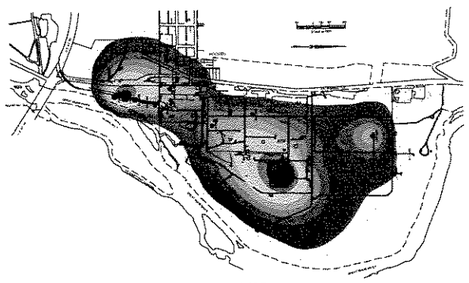
Hooven, Hamilton County, Ohio

FIGURE NO:
Figure A-7

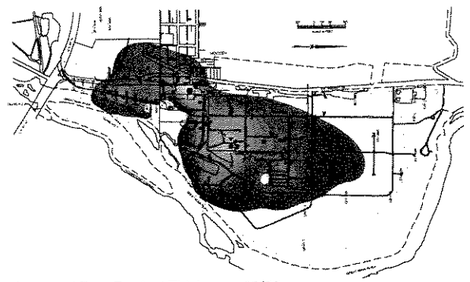
File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\SUBMERGED LNAPL.dwg Layout: FIG A-7 Plotted: Jul 14, 2003 - 1:30pm

Range of Observed Free Product Thickness (ft).
Interpolated on 50-ft centers by Kriging.

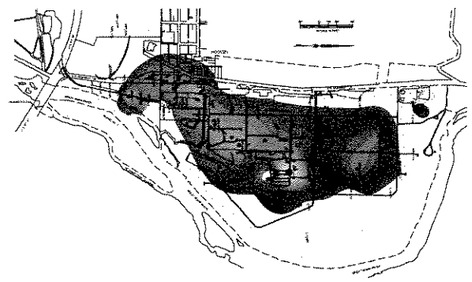
2.1
1.9
1.7
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1



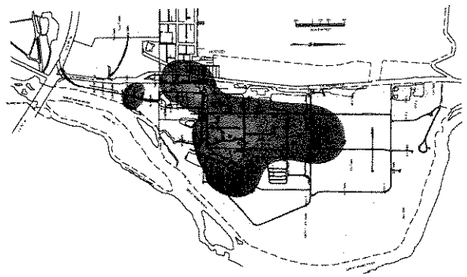
Observed Free Product Thickness, 9/85
Average Water Level = 463.82 ft MSL



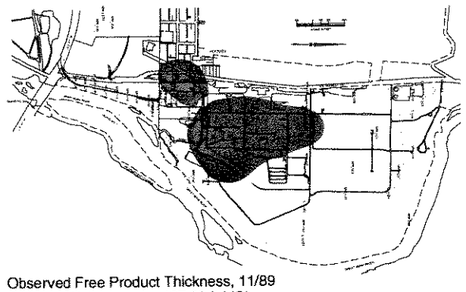
Observed Free Product Thickness, 11/86
Average Water Level = 465.97 ft MSL



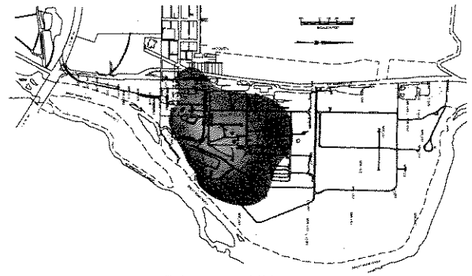
Observed Free Product Thickness, 11/87
Average Water Level = 464.67 ft MSL



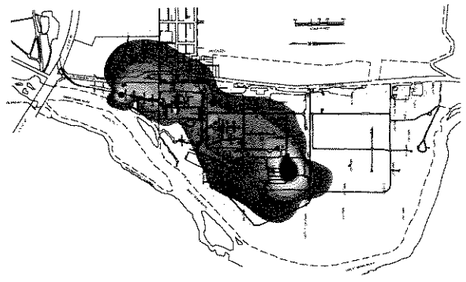
Observed Free Product Thickness, 11/88
Average Water Level = 465.70 ft MSL



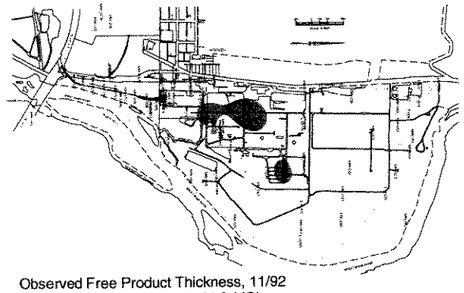
Observed Free Product Thickness, 11/89
Average Water Level = 467.09 ft MSL



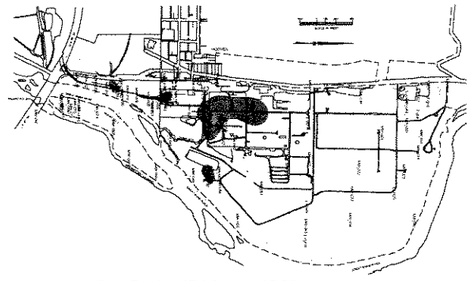
Observed Free Product Thickness, 10/90
Average Water Level = 466.14 ft MSL



Observed Free Product Thickness, 12/91
Average Water Level = 463.71 ft MSL



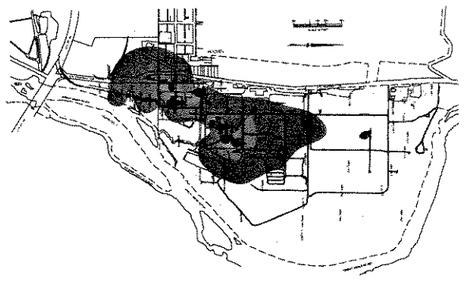
Observed Free Product Thickness, 11/92
Average Water Level = 467.21 ft MSL



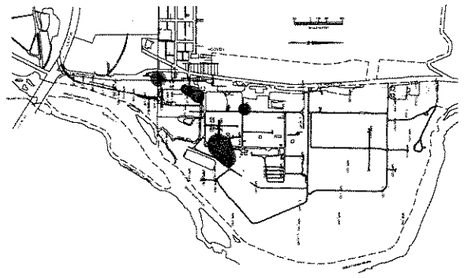
Observed Free Product Thickness, 12/93
Average Water Level = 467.84 ft MSL

Figure A-8
Free Product Time Series Maps 1985 - 1993

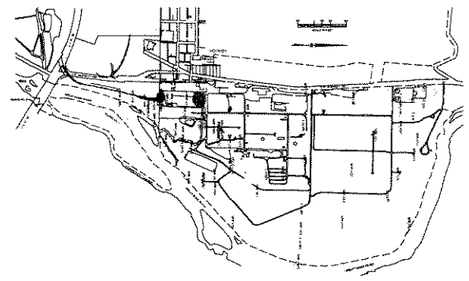
CHEVRON PRODUCTS COMPANY
Cincinnati Facillity
Hooven, Hamilton County, Ohio



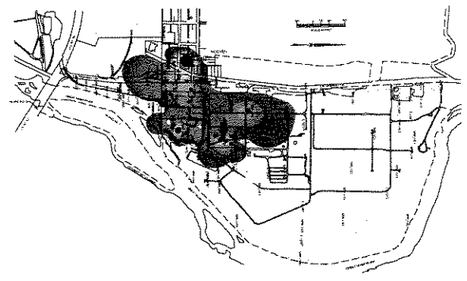
Observed Free Product Thickness, 11/94
Average Water Level = 463.49 ft MSL



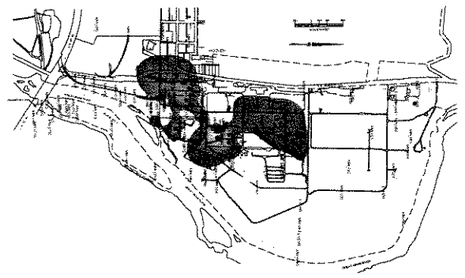
Observed Free Product Thickness, 11/95
Average Water Level = 465.56 ft MSL



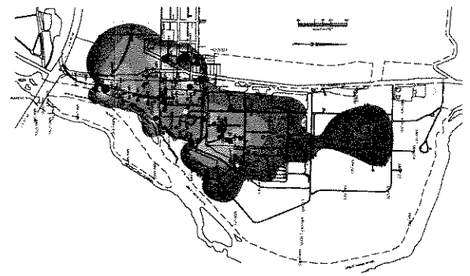
Observed Free Product Thickness, 11/96
Average Water Level = 465.97 ft MSL



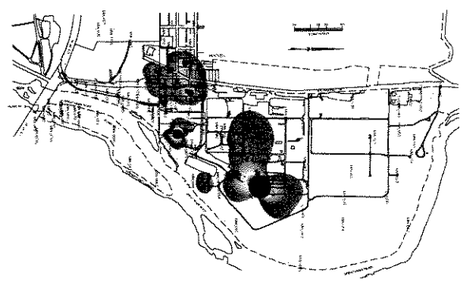
Observed Free Product Thickness, 11/97
Average Water Level = 463.88 ft MSL



Observed Free Product Thickness, 9/98
Average Water Level = 464.04 ft MSL



Observed Free Product Thickness, 11/99
Average Water Level = 462.80 ft MSL



Observed Free Product Thickness, 11/00
Average Water Level = 464.44 ft MSL

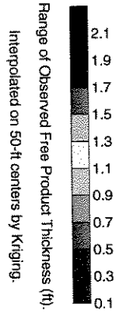
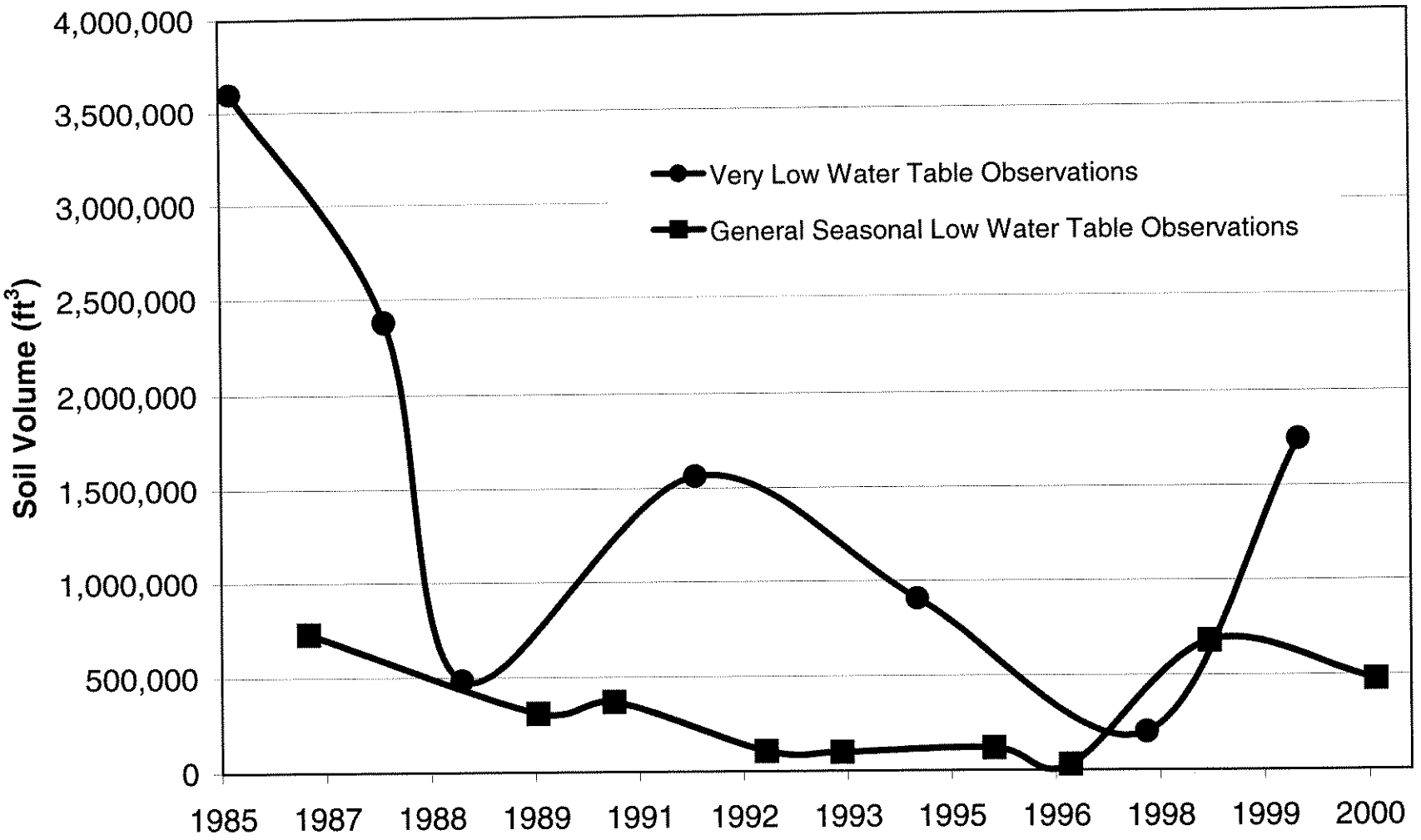
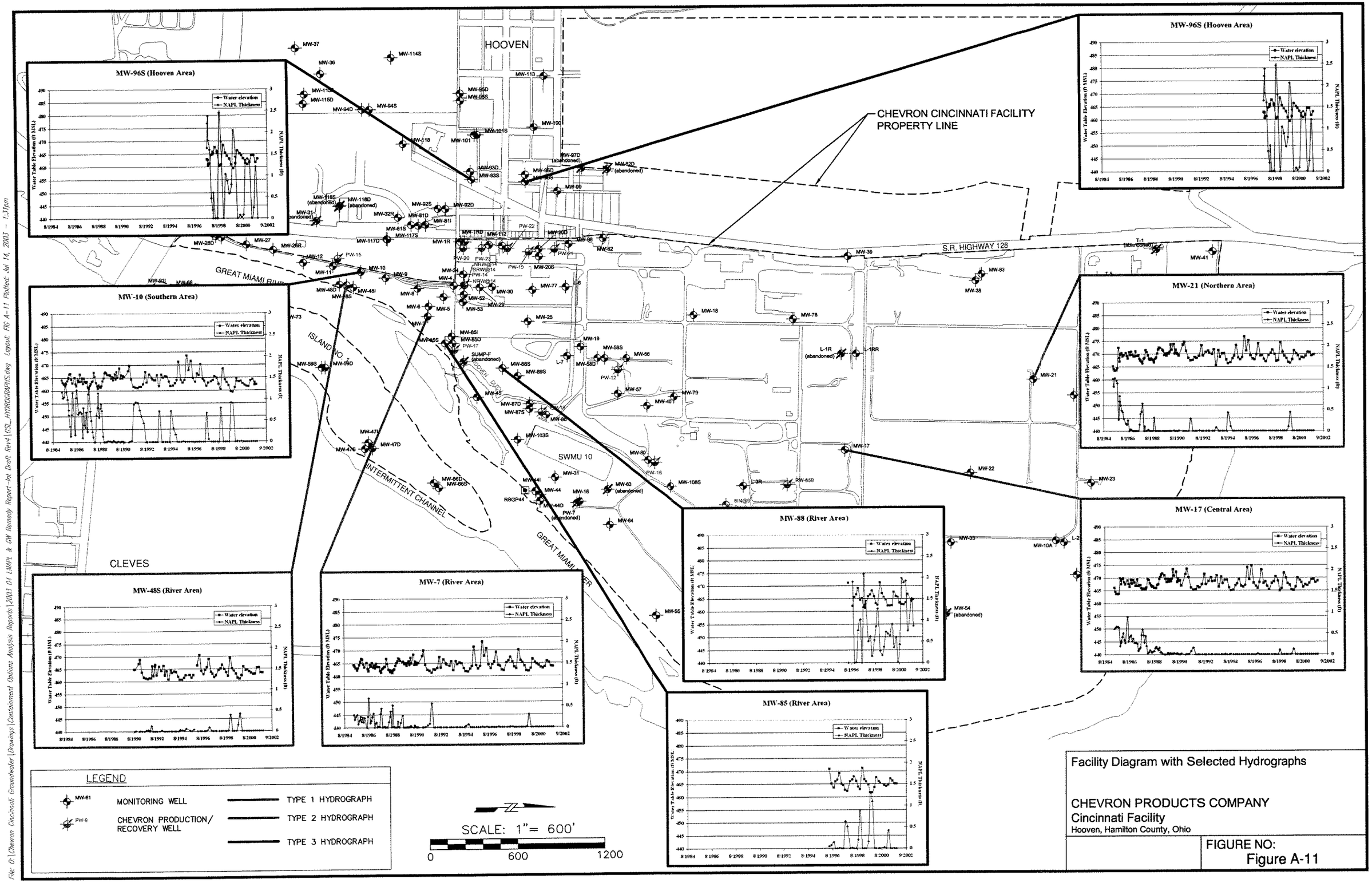


Figure A-9
Free Product Time Series Map 1994 - 2000

CHEVRON PRODUCTS COMPANY
Cincinnati Facillity
Hooven, Hamilton County, Ohio

Figure A-10: Observed LNAPL Plume Soil Volume for Low Water Table Conditions



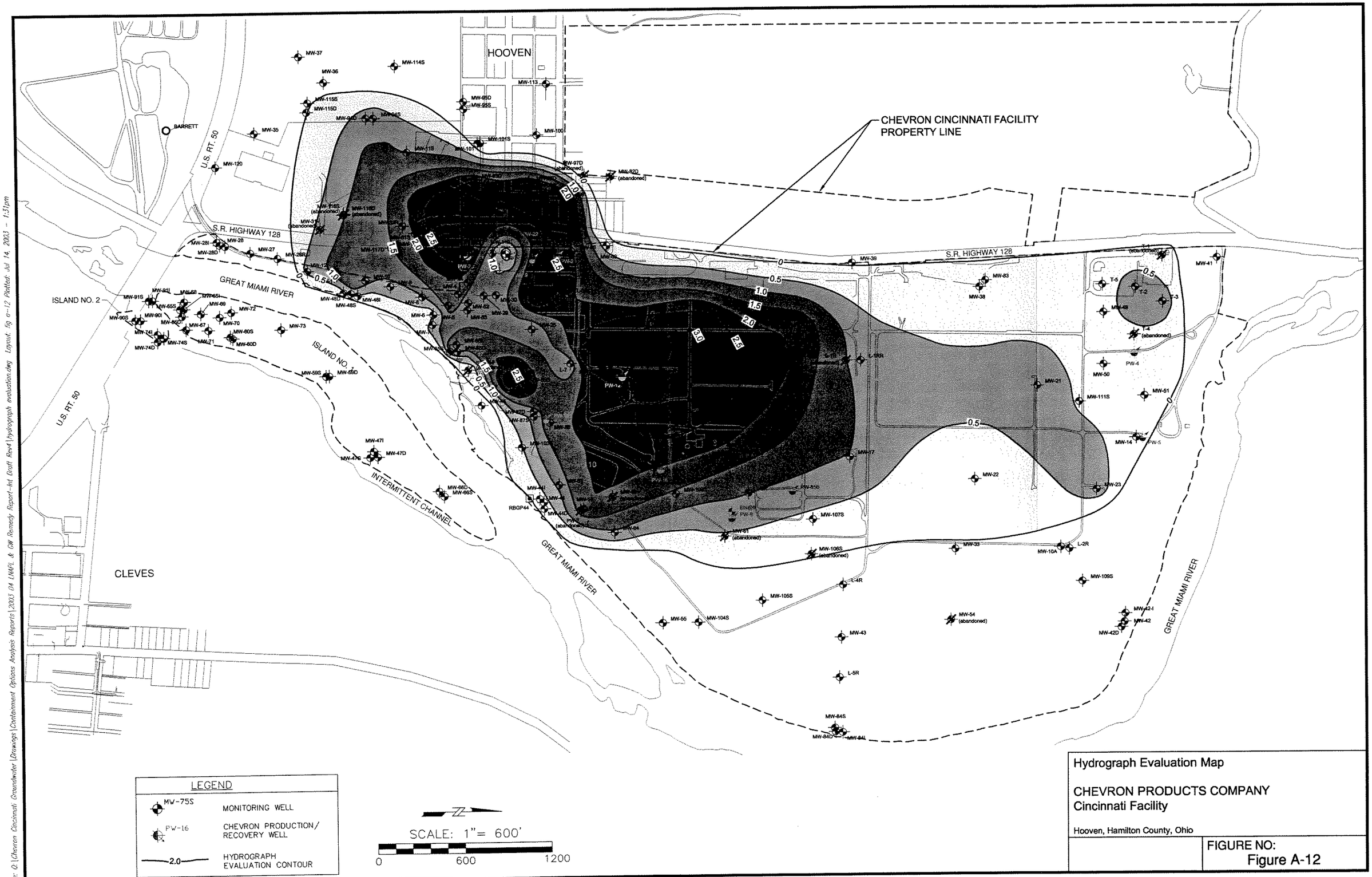


Facility Diagram with Selected Hydrographs

CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE NO:
Figure A-11

File: O:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\CSI_HYDROGRAPHS.dwg Layout: FIG A-11 Plotted: Jul 14, 2003 - 1:31pm



Hydrograph Evaluation Map

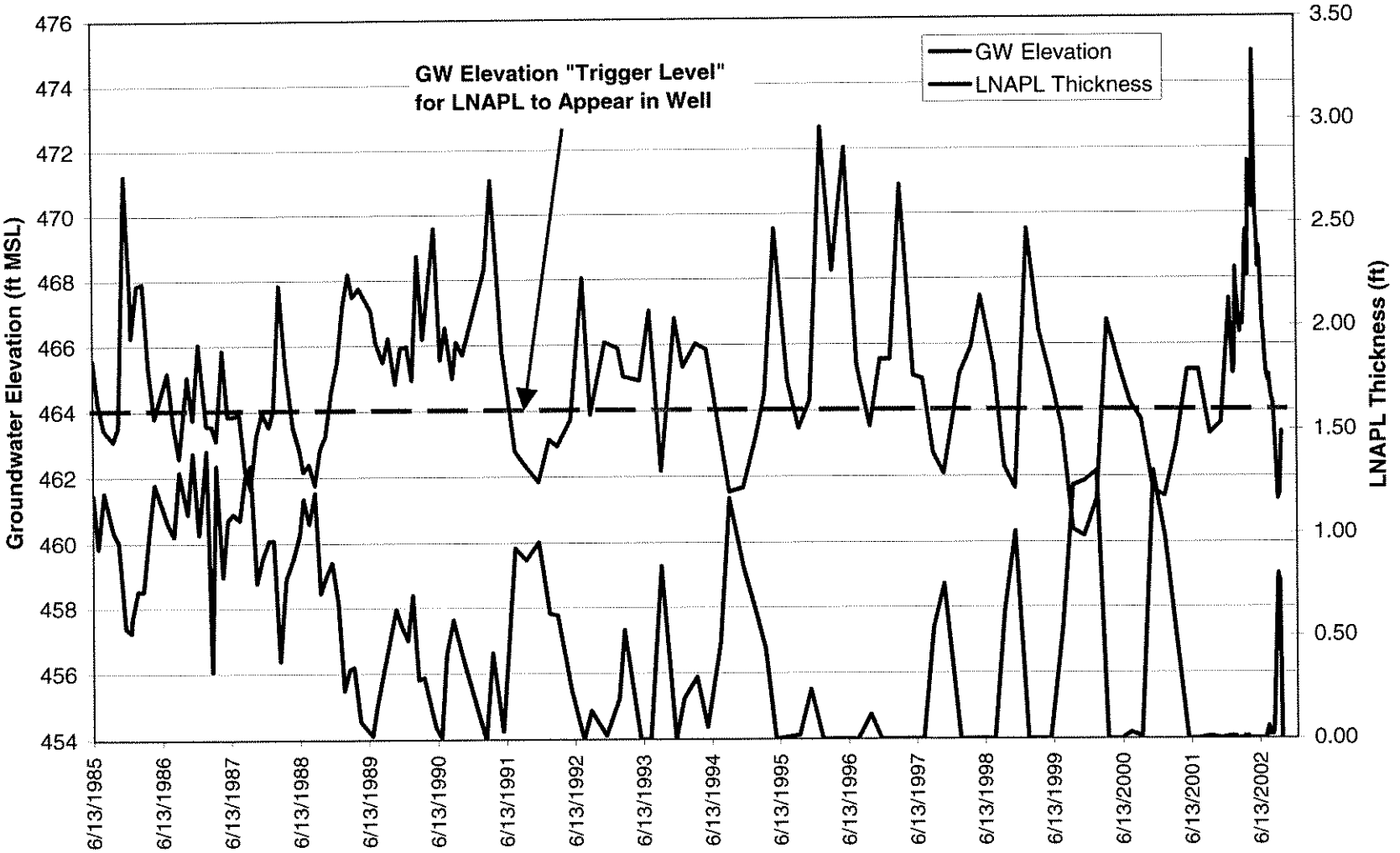
CHEVRON PRODUCTS COMPANY
Cincinnati Facility

Hooven, Hamilton County, Ohio

FIGURE NO:
Figure A-12

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\hydrograph evaluation.dwg Layout: fig a-12 Plotted: Jul 14, 2003 - 1:31pm

Figure A-13: Groundwater Elevation and LNAPL Thickness for MW-20S



HOOVEN

CLEVES

BARRETT

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

INTERMITTENT CHANNEL

461
460
460.5
461.5
462
462.5
463
463.5
464
464.5
465
466.5
467

LEGEND

- MW-61 — MONITORING WELL
- PW-9 — CHEVRON PRODUCTION/ RECOVERY WELL
- APPROXIMATE EXTENT OF LNAPL
- 466.5 — LNAPL ELEVATION CONTOURS (ft/msl)

SCALE: 1"= 600'

0 600 1200

Top of LNAPL Elevation Map
September 24, 1999

CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE NO:
Figure A-14

File: Q:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\LNAPL ELEV 092499.dwg Layout: FIG A-14 Plotted: Jul 14, 2003 - 1:32pm

HOOVEN

CLEVES

BARRETT

CHEVRON CINCINNATI FACILITY
PROPERTY LINE

U.S. RT. 50

S.R. HIGHWAY 128

GREAT MIAMI RIVER

ISLAND NO. 2

ISLAND NO. 1

INTERMITTENT CHANNEL

SWMU 10

461.5
461
460
462
462.5
463
463.5
464
464.5
465
466.5
467

LEGEND

- MW-61 — MONITORING WELL
- PW-8 — CHEVRON PRODUCTION/ RECOVERY WELL
- APPROXIMATE EXTENT OF LNAPL
- 466.5 — LNAPL ELEVATION CONTOURS (ft/msl)

SCALE: 1"= 600'

0 600 1200

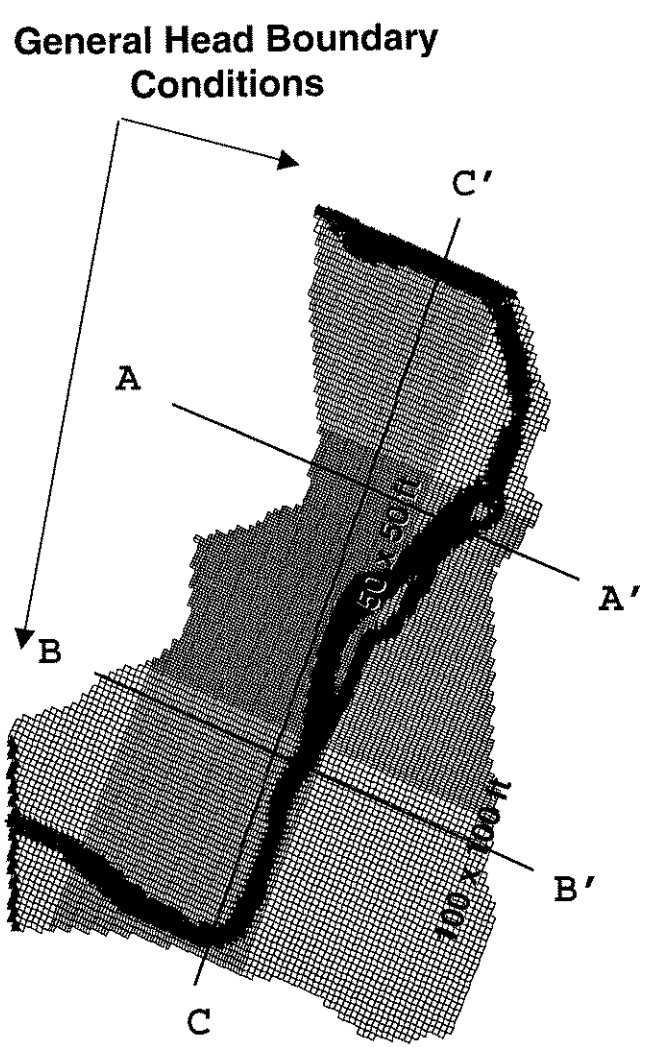
Top of LNAPL Elevation Map
November 24, 1999

CHEVRON PRODUCTS COMPANY
Cincinnati Facility
Hooven, Hamilton County, Ohio

FIGURE NO:
Figure A-15

File: O:\Chevron Cincinnati Groundwater\Drawings\Containment Options Analysis Reports\2003 04 LNAPL & GW Remedy Report-Int Draft Rev4\LNAPL ELEV 112499.dwg Layout: fig a-15 Plotted: Jul 14, 2003 - 1:33pm

Figure B-1: MODFLOW-SURFACT Model Grid and Cross Sections

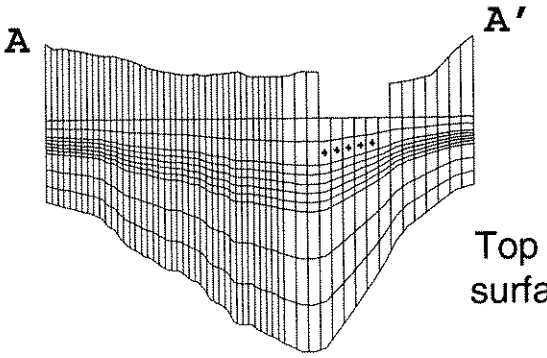


11 layers

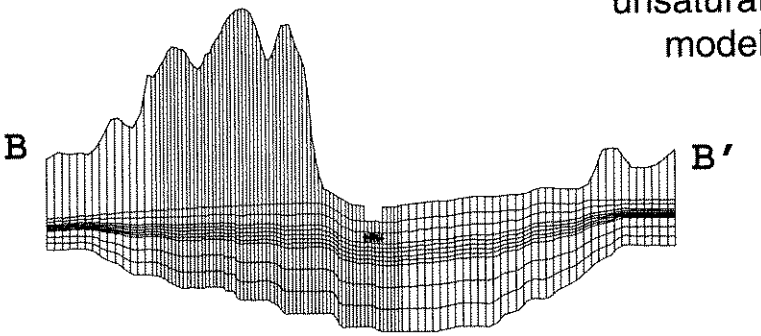
181 rows

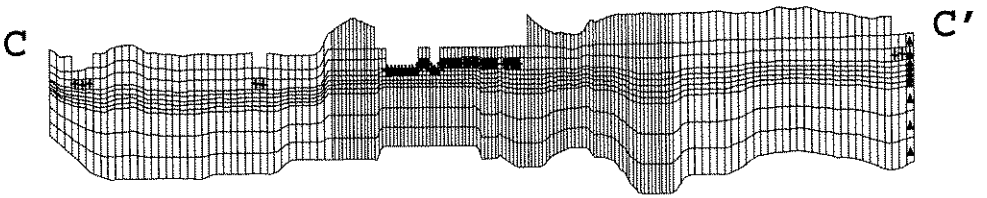
123 columns

244,893 grid cells



Top of model is land surface. Model layer 1 remains unsaturated for all model runs.





Z exaggeration = 20

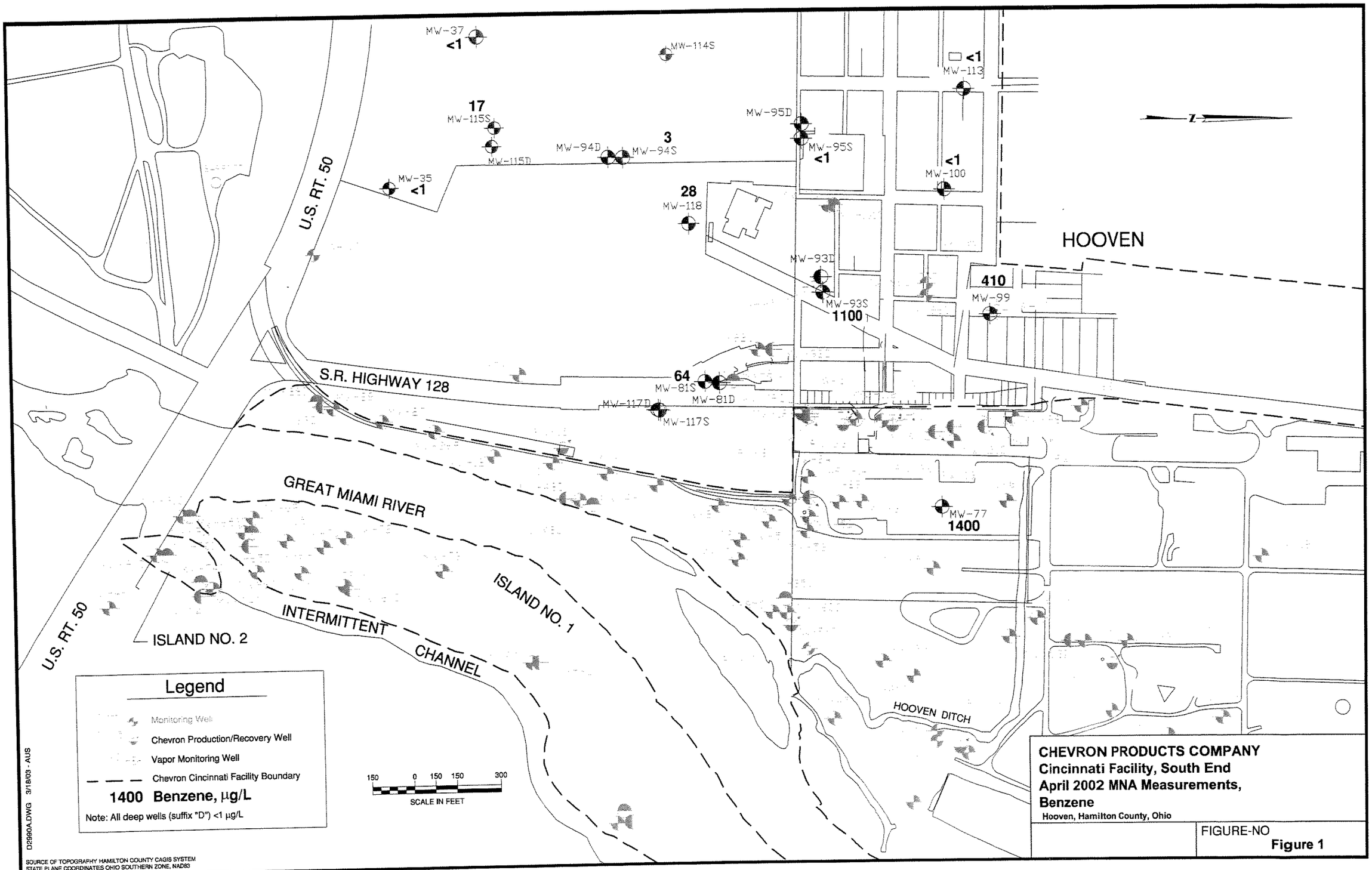
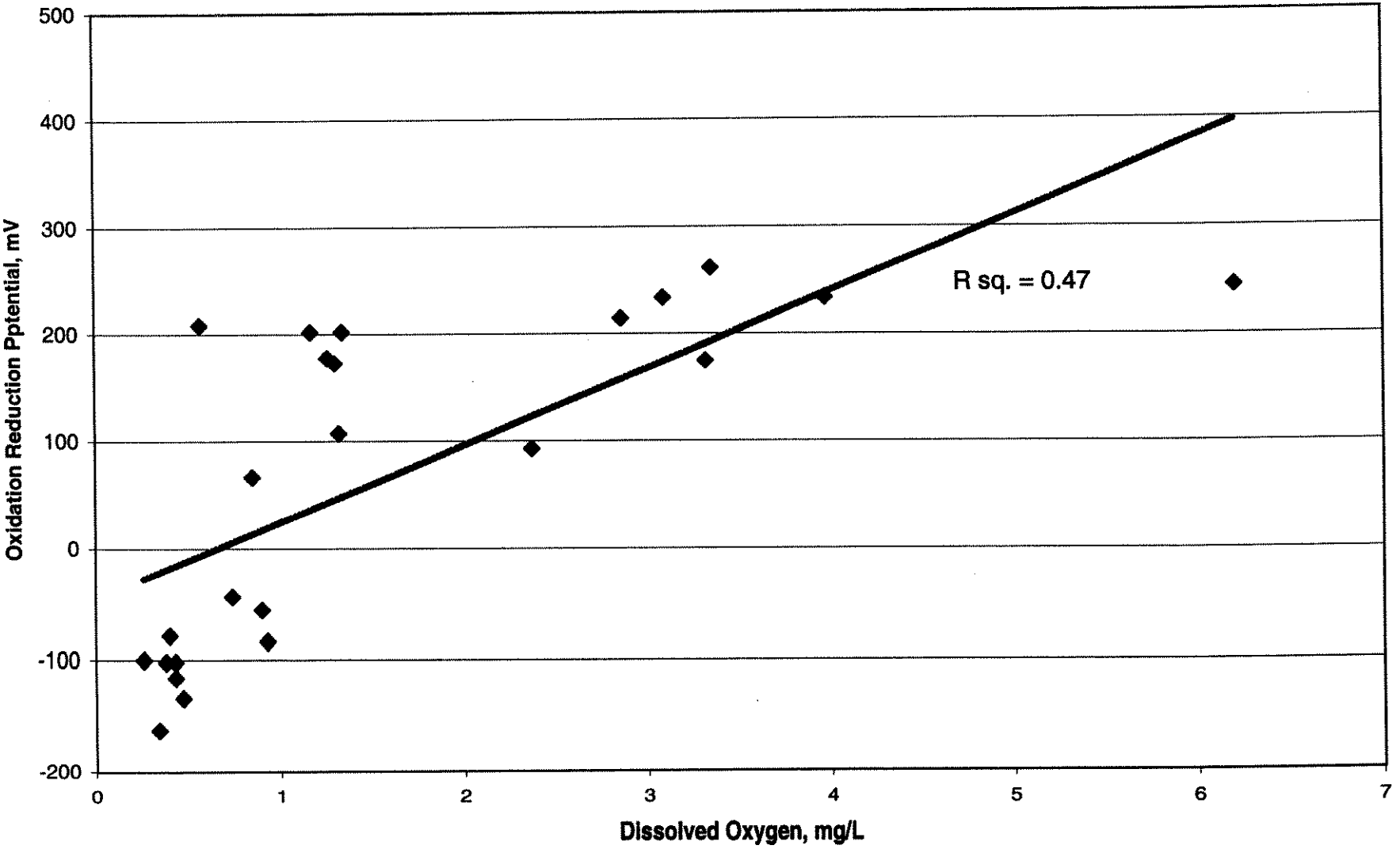

MW-37
<1
MW-114S
<1
MW-113
17
MW-115S
MW-115D
MW-94D
MW-94S
3
MW-95D
MW-95S
<1
<1
MW-100
MW-35
<1
28
MW-118
HOOVEN
MW-93D
MW-93S
1100
410
MW-99
U.S. RT. 50
S.R. HIGHWAY 128
64
MW-81S
MW-81D
MW-117D
MW-117S
GREAT MIAMI RIVER
MW-77
1400
ISLAND NO. 1
INTERMITTENT CHANNEL
ISLAND NO. 2
U.S. RT. 50
HOOVEN DITCH
Legend
Monitoring Well
Chevron Production/Recovery Well
Vapor Monitoring Well
Chevron Cincinnati Facility Boundary
1400 Benzene, µg/L
Note: All deep wells (suffix "D") <1 µg/L
150 0 150 150 300
SCALE IN FEET
D2990A.DWG 3/18/03 - AUS
SOURCE OF TOPOGRAPHY HAMILTON COUNTY CAGIS SYSTEM
STATE PLANE COORDINATES OHIO SOUTHERN ZONE, NAD83
CHEVRON PRODUCTS COMPANY
Cincinnati Facility, South End
April 2002 MNA Measurements,
Benzene
Hooven, Hamilton County, Ohio
FIGURE-NO
Figure 1

Figure 2: Minimum DO vs ORP, April 2002



MW-37
4.80/0.0

MW-114S
2.86/0.0

3.35/0.5
MW-113

0.71/1.5
MW-115S

3.97/0.0
MW-95D

1.50/0.0
MW-94D

0.74/2.5
MW-94S

MW-95S
3.09/0.0

MW-115D
0.56/1.5

2.37/0.0
MW-35

1.26/0.0
MW-100

0.93/NA
MW-118

U.S. RT. 50

HOOVEN

0.57/0.0
MW-93D

0.38/NA
MW-99

MW-93S
0.20/0.0

MW-81D
0.15/3.5

S.R. HIGHWAY 128

0.34/4.5
MW-81S

MW-117D
0.43/0.0

MW-117S
0.43/9.0

GREAT MIAMI RIVER

MW-77
0.26/NA

ISLAND NO. 1

INTERMITTENT CHANNEL

U.S. RT. 50

ISLAND NO. 2

HOOVEN DITCH

Legend

- Monitoring Well
- Chevron Production/Recovery Well
- Vapor Monitoring Well
- Chevron Cincinnati Facility Boundary
- 4.80/0.00 Dissolved Oxygen/ Ferrous Iron, mg/L

150 0 150 150 300
SCALE IN FEET

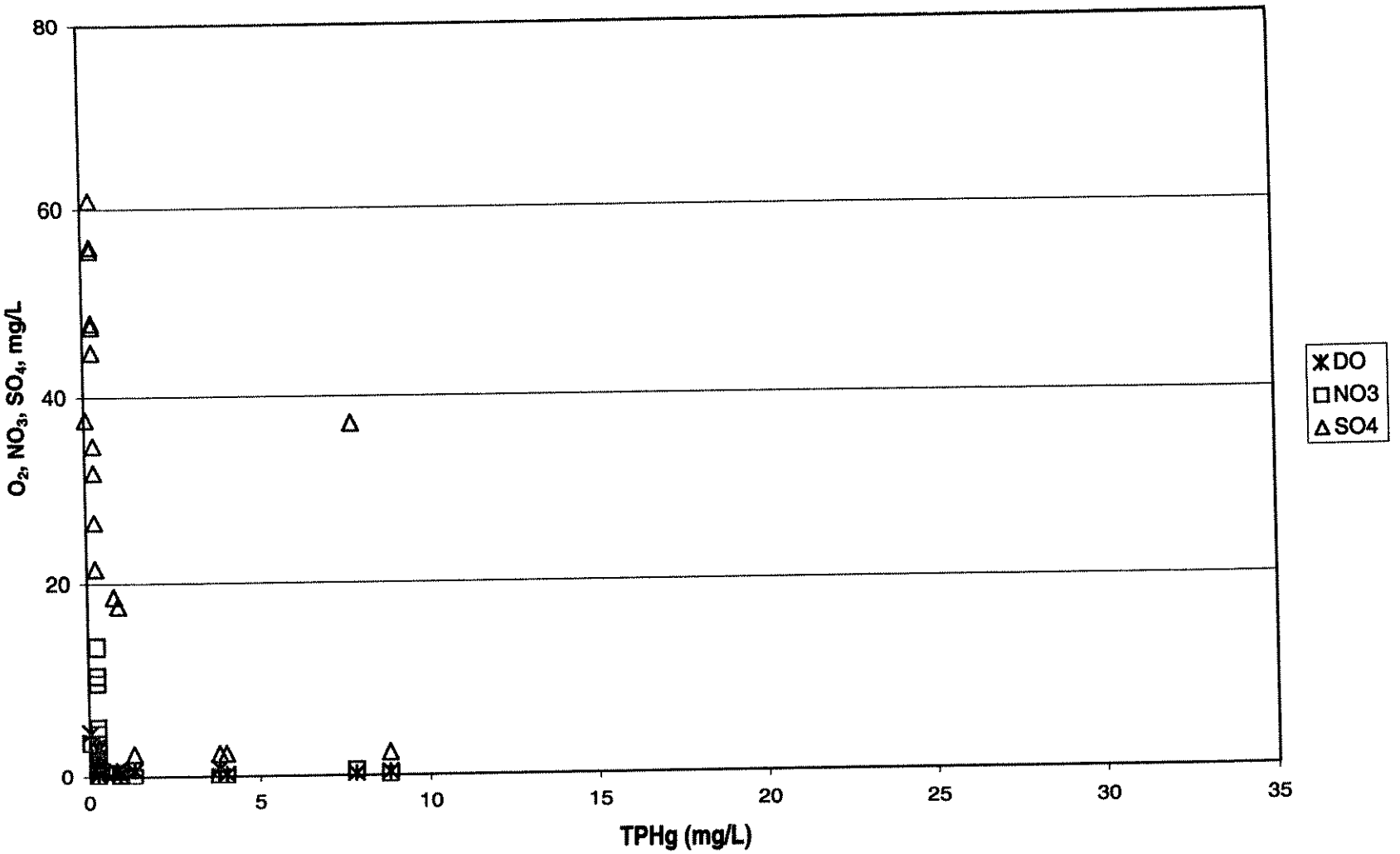
D29908.DWG 3/18/03 - AUS

SOURCE OF TOPOGRAPHY HAMILTON COUNTY CAGIS SYSTEM
STATE PLANE COORDINATES OHIO SOUTHERN ZONE, NAD83

CHEVRON PRODUCTS COMPANY
Cincinnati Facility, South End
April 2002 MNA Measurements,
Dissolved Oxygen/Ferrous Iron
Hooven, Hamilton County, Ohio

FIGURE-NO
Figure 3

Figure 4: TPHg versus Terminal Electron Acceptors (April 2002)



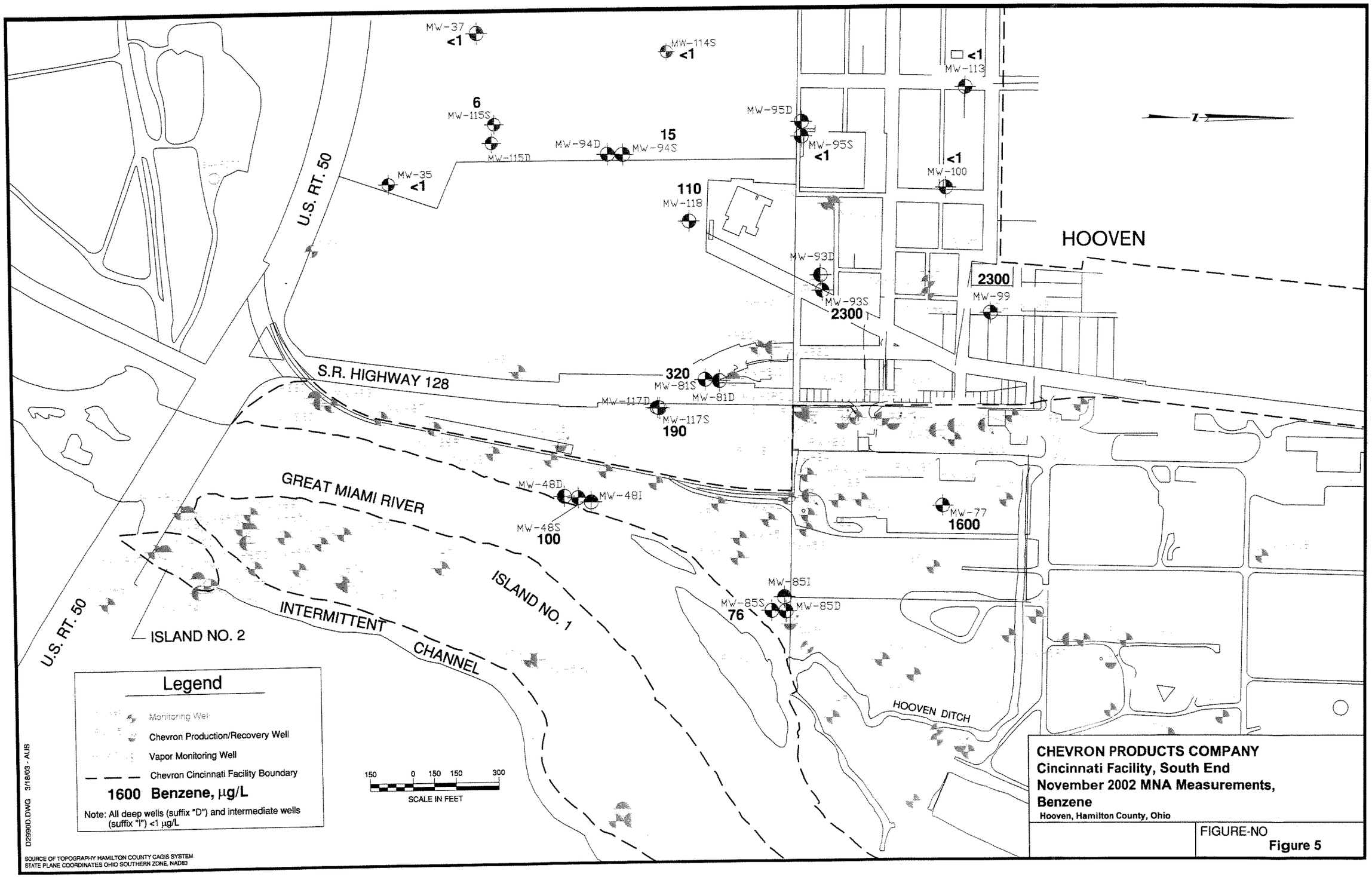
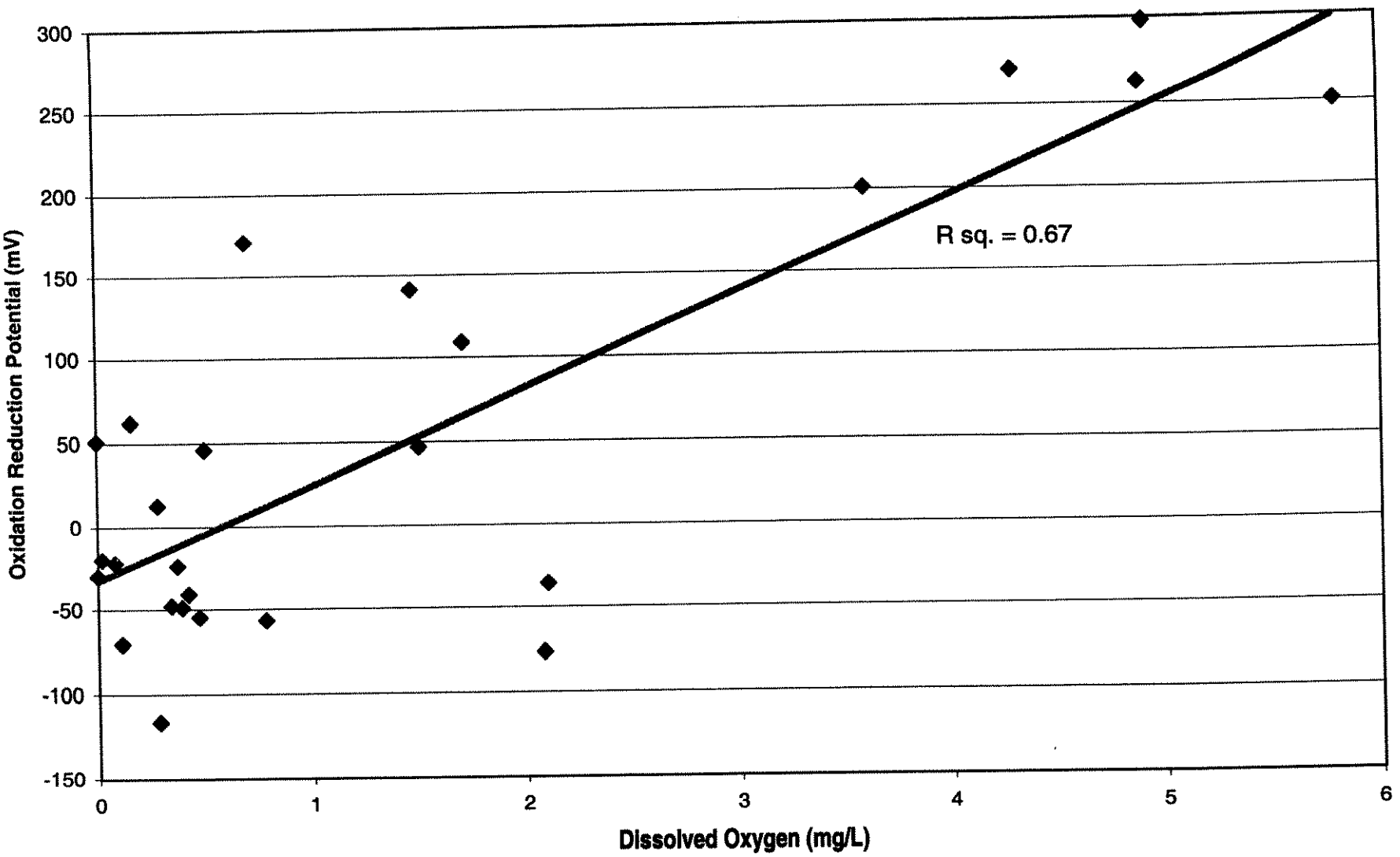

MW-37
<1
MW-114S
<1
<1
MW-113
6
MW-115S
MW-115D
MW-94D
15
MW-94S
MW-95D
MW-95S
<1
MW-35
<1
<1
MW-100
110
MW-118
HOOVEN
MW-93D
MW-93S
2300
2300
MW-99
U.S. RT. 50
S.R. HIGHWAY 128
320
MW-81S
MW-81D
MW-117D
MW-117S
190
GREAT MIAMI RIVER
MW-48D
MW-48I
MW-48S
100
MW-77
1600
MW-85I
MW-85S
76
MW-85D
ISLAND NO. 1
INTERMITTENT CHANNEL
ISLAND NO. 2
U.S. RT. 50
HOOVEN DITCH
Legend
Monitoring Well
Chevron Production/Recovery Well
Vapor Monitoring Well
Chevron Cincinnati Facility Boundary
1600 Benzene, µg/L
Note: All deep wells (suffix "D") and intermediate wells (suffix "I") <1 µg/L
150 0 150 150 300
SCALE IN FEET
D2990D.DWG 3/18/03 - AUS
SOURCE OF TOPOGRAPHY HAMILTON COUNTY CAGIS SYSTEM
STATE PLANE COORDINATES OHIO SOUTHERN ZONE, NAD83
CHEVRON PRODUCTS COMPANY
Cincinnati Facility, South End
November 2002 MNA Measurements,
Benzene
Hooven, Hamilton County, Ohio
FIGURE-NO
Figure 5

Figure 6: Minimum DO vs ORP, November 2002



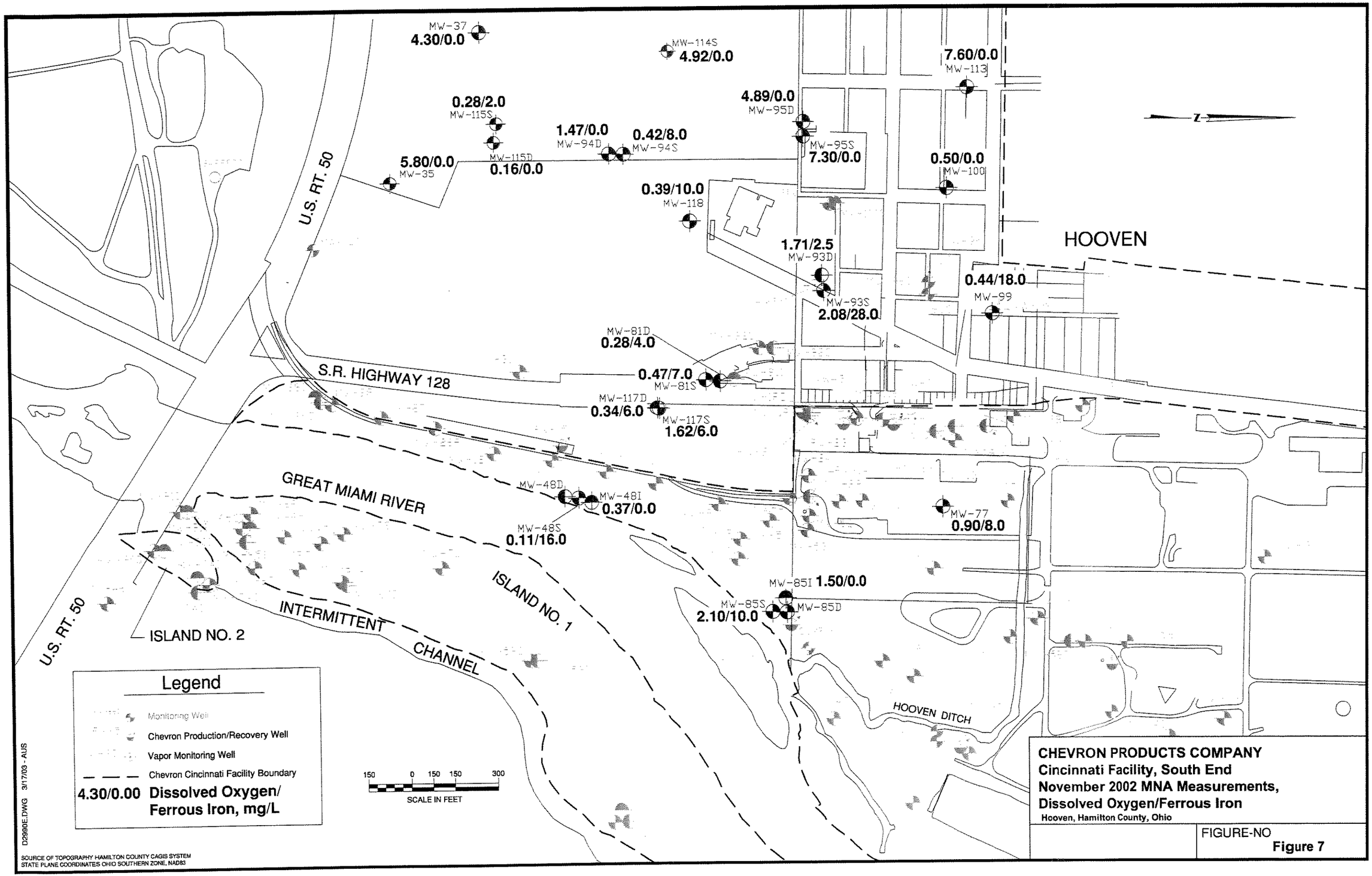
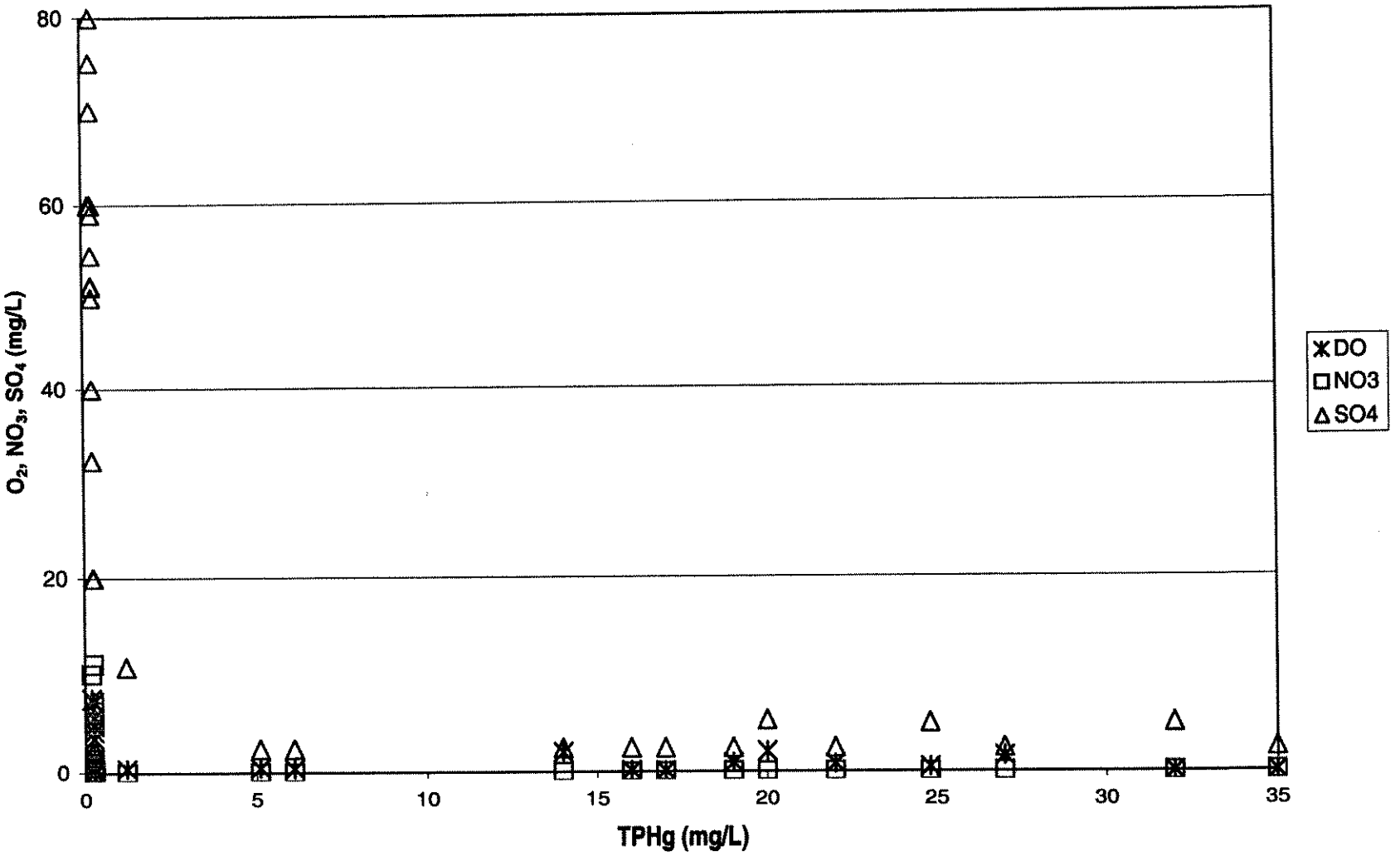
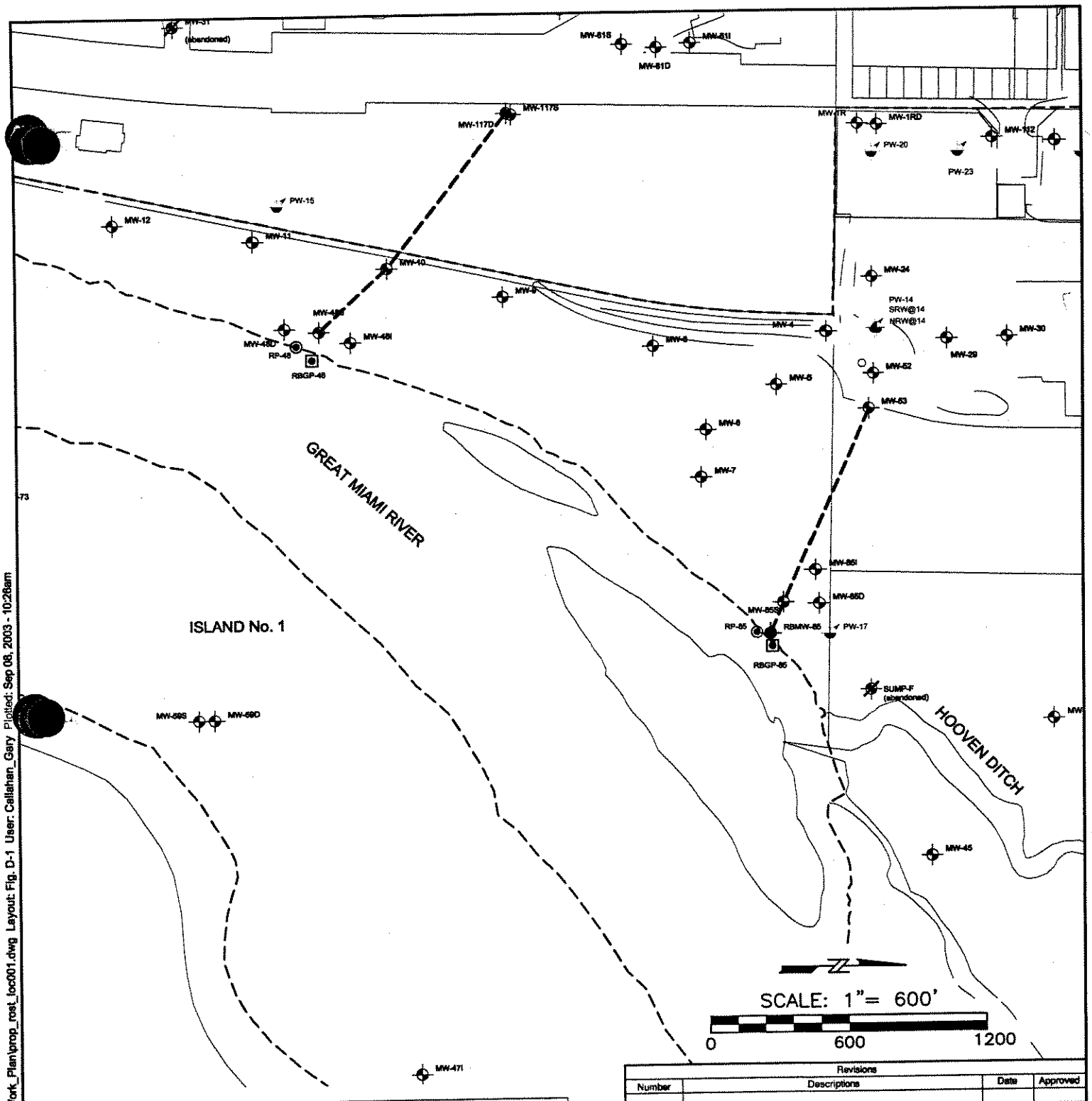

MW-37
4.30/0.0
MW-114S
4.92/0.0
7.60/0.0
MW-113
4.89/0.0
MW-95D
0.28/2.0
MW-115S
1.47/0.0
MW-94D
0.42/8.0
MW-94S
MW-95S
7.30/0.0
0.50/0.0
MW-100
5.80/0.0
MW-35
MW-115D
0.16/0.0
0.39/10.0
MW-118
U.S. RT. 50
HOOVEN
1.71/2.5
MW-93D
MW-93S
2.08/28.0
0.44/18.0
MW-99
MW-81D
0.28/4.0
S.R. HIGHWAY 128
0.47/7.0
MW-81S
MW-117D
0.34/6.0
MW-117S
1.62/6.0
GREAT MIAMI RIVER
MW-48D
MW-48I
0.37/0.0
MW-48S
0.11/16.0
MW-77
0.90/8.0
MW-85I 1.50/0.0
MW-85S
2.10/10.0
MW-85D
ISLAND NO. 1
INTERMITTENT CHANNEL
U.S. RT. 50
ISLAND NO. 2
HOOVEN DITCH
Legend
Monitoring Well
Chevron Production/Recovery Well
Vapor Monitoring Well
Chevron Cincinnati Facility Boundary
4.30/0.00 Dissolved Oxygen/ Ferrous Iron, mg/L
150 0 150 150 300
SCALE IN FEET
D2990E.DWG 3/17/03 - AUS
SOURCE OF TOPOGRAPHY HAMILTON COUNTY CAGIS SYSTEM
STATE PLANE COORDINATES OHIO SOUTHERN ZONE, NAD83
CHEVRON PRODUCTS COMPANY
Cincinnati Facility, South End
November 2002 MNA Measurements,
Dissolved Oxygen/Ferrous Iron
Hooven, Hamilton County, Ohio
FIGURE-NO
Figure 7

Figure 8: TPHg versus Terminal Electron Acceptors (November 2002)





LEGEND

- MW-10 — MONITORING WELL LOCATION
- RBMW-85 — RIVER BANK MONITORING WELL LOCATION
- RP-85 — RIVER BANK PIEZOMETER LOCATION
- RBGP-85 — RIVER BANK GAUGE POINT LOCATION
- PW-20 — CHEVRON PRODUCTION/ RECOVERY WELL LOCATION
- TRAVERSE

Revisions			
Number	Descriptions	Date	Approved

ChevronTexaco

URS

Designed by:	Chevron Cincinnati Facility		Hooven, Ohio
Drawn by:	**Figure D-1** **Proposed GMR Monitoring Network Traverses**		
Checked by:			
Reviewed by:	Scale:	Date: 9/08/03	Dwg No.:
Submitted by:	Contract No.: 80831603.130201	Drawing Code: prop_rost_loc001.dwg	

File: Q:\Chevron Cincinnati Groundwater\Drawings\GMR_Work_Plan\prop_rost_loc001.dwg Layout: Fig. D-1 User: Callahan_Gary Plotted: Sep 08, 2003 - 10:28am

Cleves & Miamitown Rd.

Avenue B

Production Well 14

Production Well 12

Production Well 9

Production Well 7

NRW

SRW

L-7

SWMU 10

DRAINAGE DITCH

APPROXIMATE EDGE OF SMEAR ZONE

ISLAND NO. 1

GREAT MIAMI RIVER

1R, 2, 4, 5, 8, 9, 19, 24, 25, 29, 30, 40, 44, 45, 52, 53, 56, 57, 58S, 58D, 63, 64, 80, 86, 87, 88, 89

B-1, B-2, B-3, B-4, B-6, B-7, B-8, B-9, B-10, B-11, B-12, B-13, B-14, B-15, B-16, B-17, B-18, B-19, B-20, B-21, B-22, B-23, B-24, B-1385

9 LHC

10.3+

6.8+

14.9

10.2 SHEEN

7+

6.5 LHC

10+ LHC

8+ LHC

10 SHEEN

4+ SHEEN

LEGEND

- Existing Monitor Well
- Existing Sump
- Layne Test Well
- Water Production Well
- Soil Boring Location
- 10+ — Smear Zone Thickness (feet) + = or Greater
- LHC — Liquid Hydrocarbon Product Identified in Soil Sample
- SHEEN — LHC Sheen Identified in Soil Sample

75 0 75 150
SCALE: 1"=150'

NOTE: BORING LOCATIONS APPROXIMATE

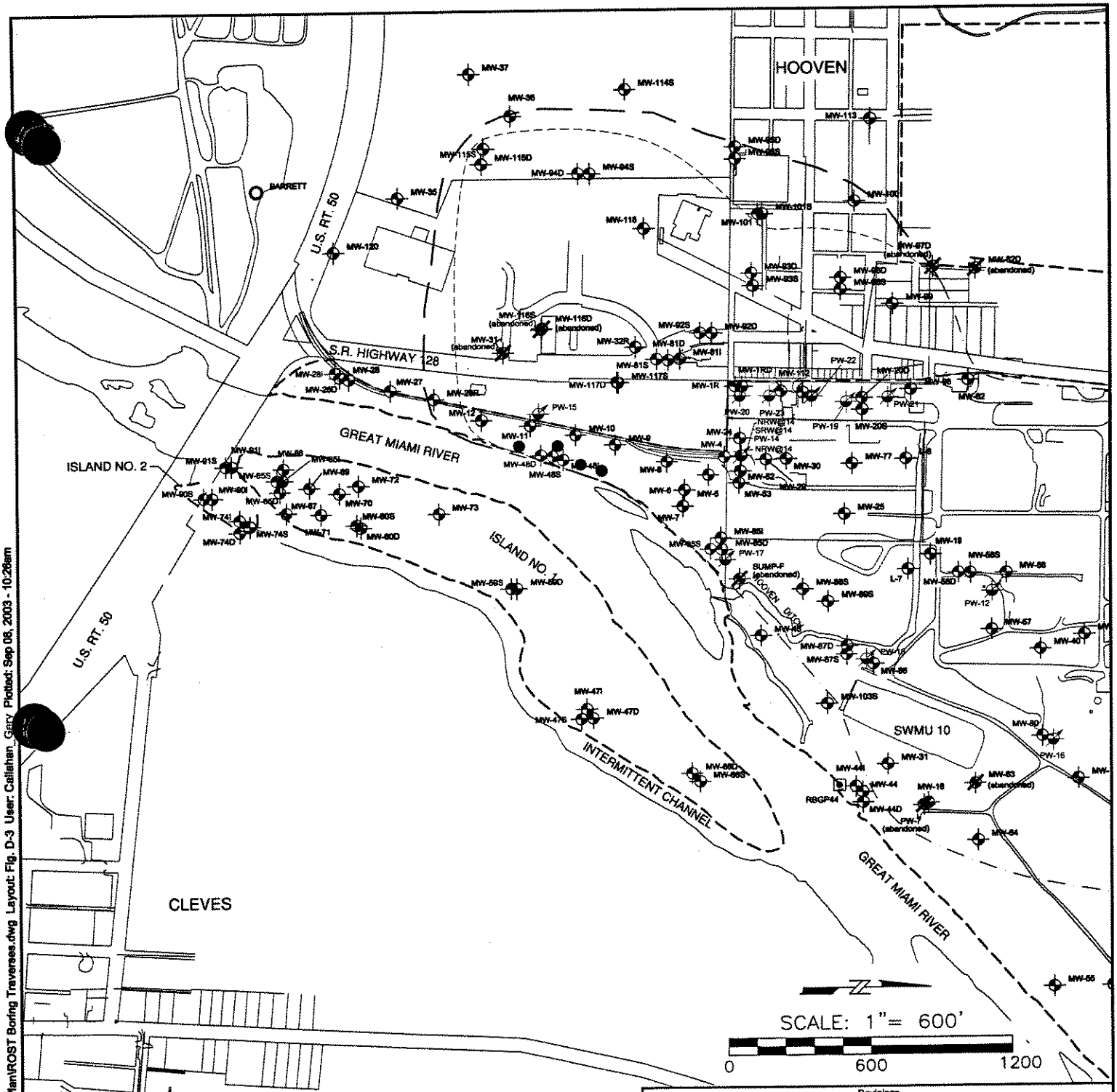
Revisions			
Number	Descriptions	Date	Approved

ChevronTexaco URS

Designed by:	Chevron Cincinnati Facility	Hooven, Ohio
Drawn by: gwc	**Figure D-2 Estimated Smear Zone Extent**	
Checked by:		
Reviewed by:	Scale:	Date: 9/08/03
Submitted by:	Contract No.: 80831603.130201	Drawing Code: 1996 Smear Zone Study CEC.dwg

Dwg No.:

File: O:\Chevron Cincinnati\Groundwater\Drawings\GMR_Work_Plan\1996 Smear Zone Study CEC.dwg Layout: Fig. D-2 User: Callie Gray Plotted: Sep 08, 2003 - 10:25am



LEGEND

- MW-48S — MONITORING WELL
- PW-16 — CHEVRON PRODUCTION/ RECOVERY WELL
- Proposed Intial ROST Borings
- ESTIMATED EXTENT OF SMEAR ZONE
- ESTIMATED EXTENT OF DISSOLVED PHASE PLUME
- ESTIMATED EXTENT OF SMEAR ZONE AND DISSOLVED PHASE PLUME

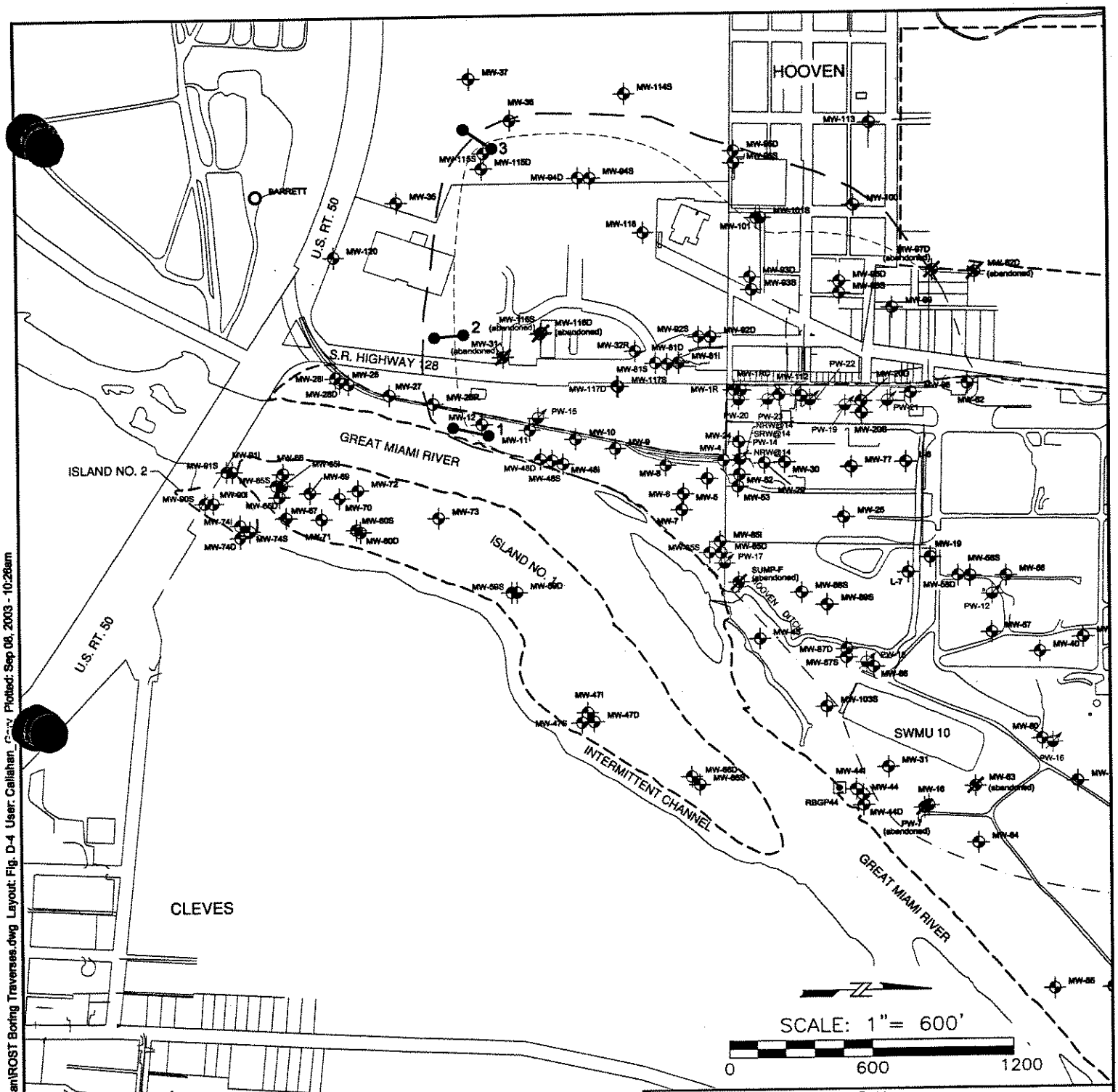
Revisions			
Number	Descriptions	Date	Approved

ChevronTexaco

URS

Designed by:	Chevron Cincinnati Facility		Hooven, Ohio
Drawn by:	**Figure D-3 Area 1 Proposed ROST Boring Locations**		
Checked by:			
Reviewed by:	Scale:	Date: 9/08/03	Dwg No.:
Submitted by:	Contract No.: 80831603.130201	Drawing Code: ROST Boring Traverses.dwg	

File: Q:\Chevron Cincinnati Groundwater\Drawings\GMR_Work_Plan\ROST Boring Traverses.dwg Layout: Fig. D-3 User: Callahan_Gary Plotted: Sep 08, 2003 - 10:26am



LEGEND

- MW-48S — MONITORING WELL
- PW-16 — CHEVRON PRODUCTION/ RECOVERY WELL
- 1 — TRAVERSE FOR ROST BORINGS
- ESTIMATED EXTENT OF SMEAR ZONE
- ESTIMATED EXTENT OF DISSOLVED PHASE PLUME
- ESTIMATED EXTENT OF SMEAR ZONE AND DISSOLVED PHASE PLUME

Revisions			
Number	Descriptions	Date	Approved

ChevronTexaco **URS**

Designed by:	Chevron Cincinnati Facility		Hooven, Ohio
Drawn by:	**Figure D-4 Area 2 Proposed ROST Boring Locations**		
Checked by:			
Reviewed by:	Scale:	Date: 9/08/03	Dwg No.:
Submitted by:	Contract No.: 80831603.130201	Drawing Code: ROST Boring Traverses.dwg	

File: Q:\Chevron Cincinnati Groundwater\Drawings\GMR_Work_Plan\ROST Boring Traverses.dwg Layout: Fig. D-4 User: Callahan Plotted: Sep 08, 2003 - 10:26am