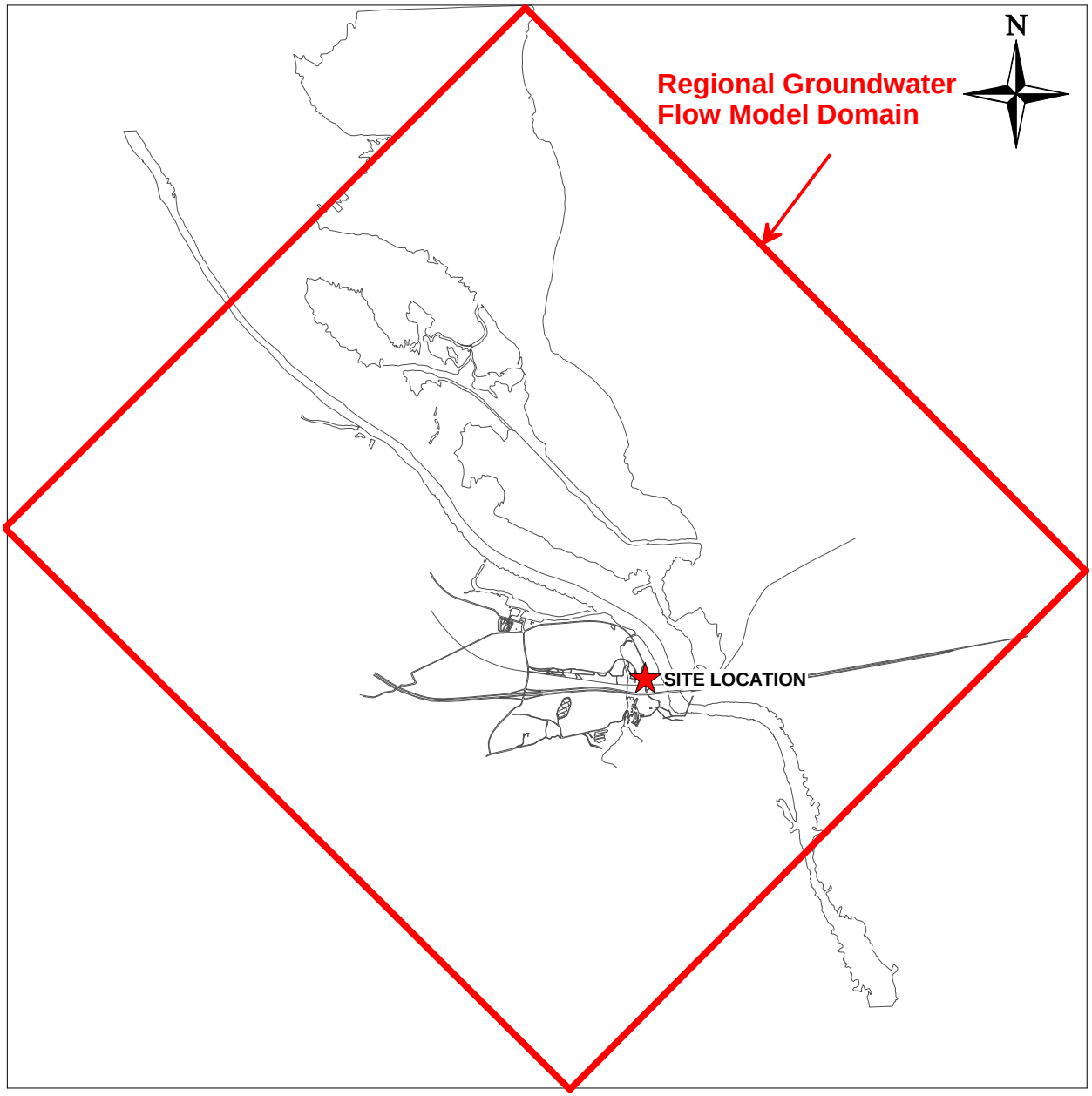

Scale in Feet

0 8,000 16,000

PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

REGIONAL MODEL DOMAIN EXTENTS

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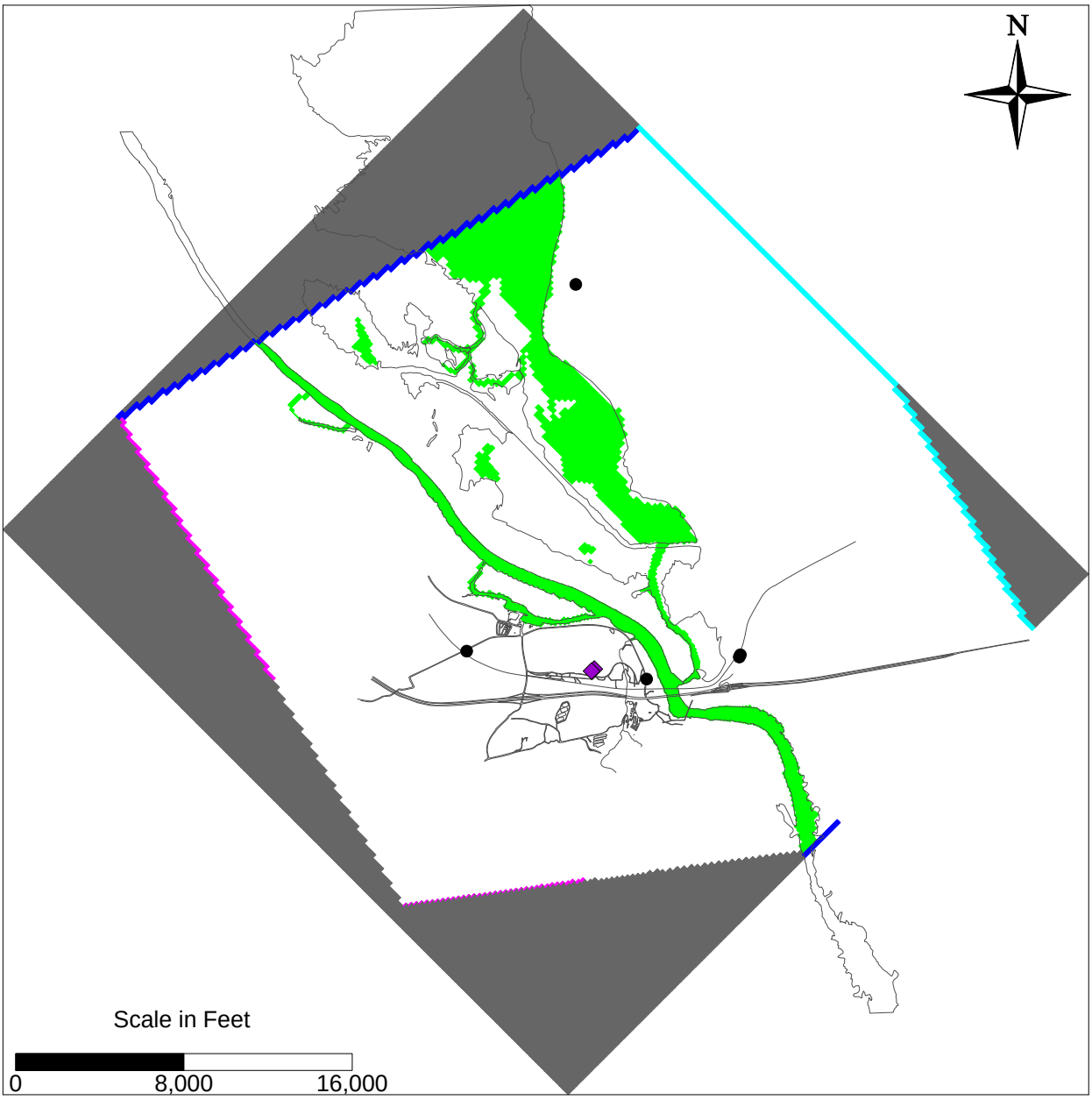
FIGURE
1-1



LEGEND

- Constant Flux Boundary Cell
- Constant Head Boundary Cell
- General Head Boundary Cell
- River Boundary Cell
- No Flow Boundary Cell
- Extraction Wells
- Injection Wells

*This figure shows a composite of the boundary conditions in each layer.

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

MODEL BOUNDARY CONDITIONS

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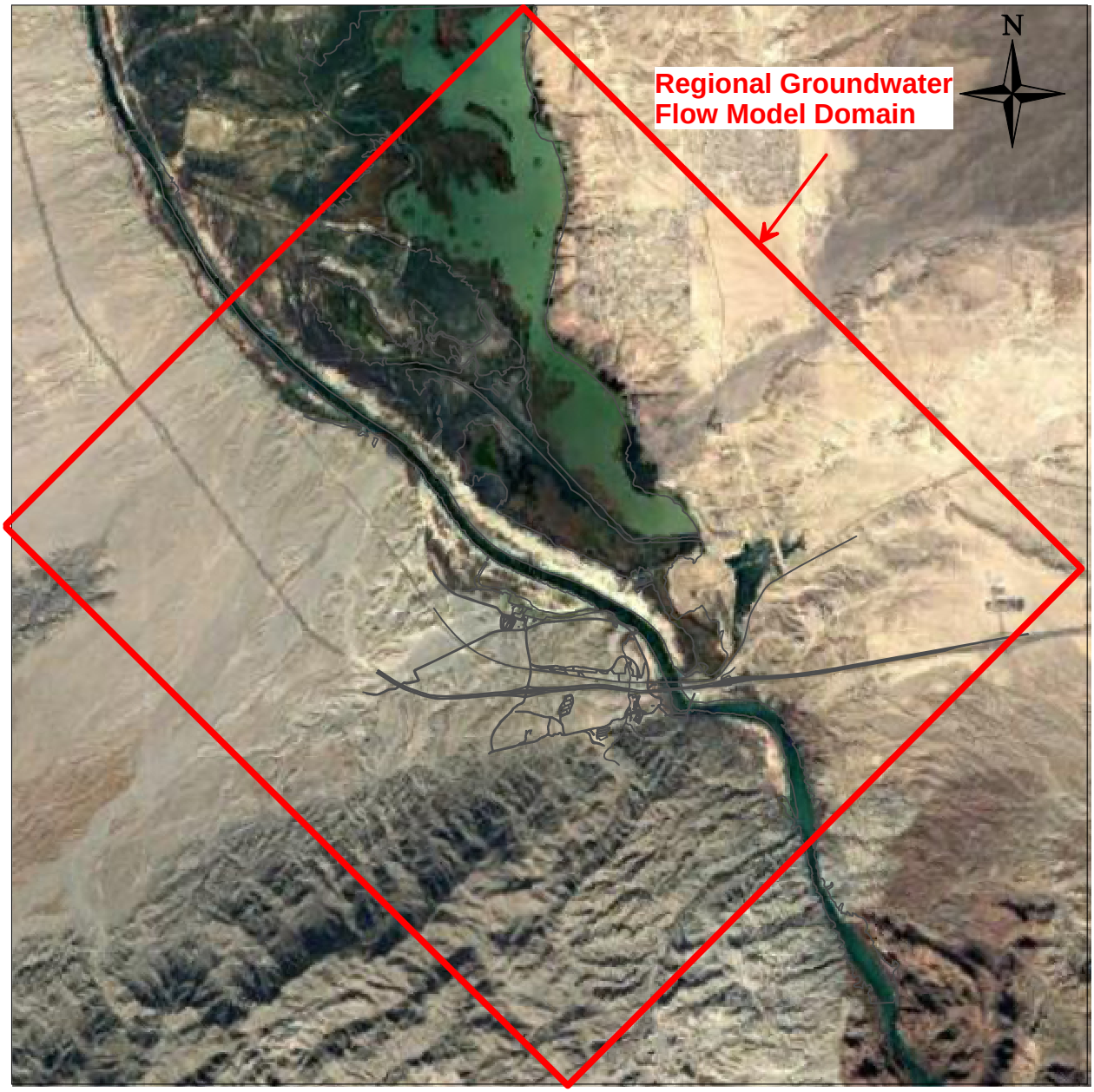
FIGURE
2.1-1



Scale in Feet

0 8,000 16,000

Satellite imagery from Google Earth dated January 14, 2015.

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

JANUARY 2015 SATELLITE IMAGERY

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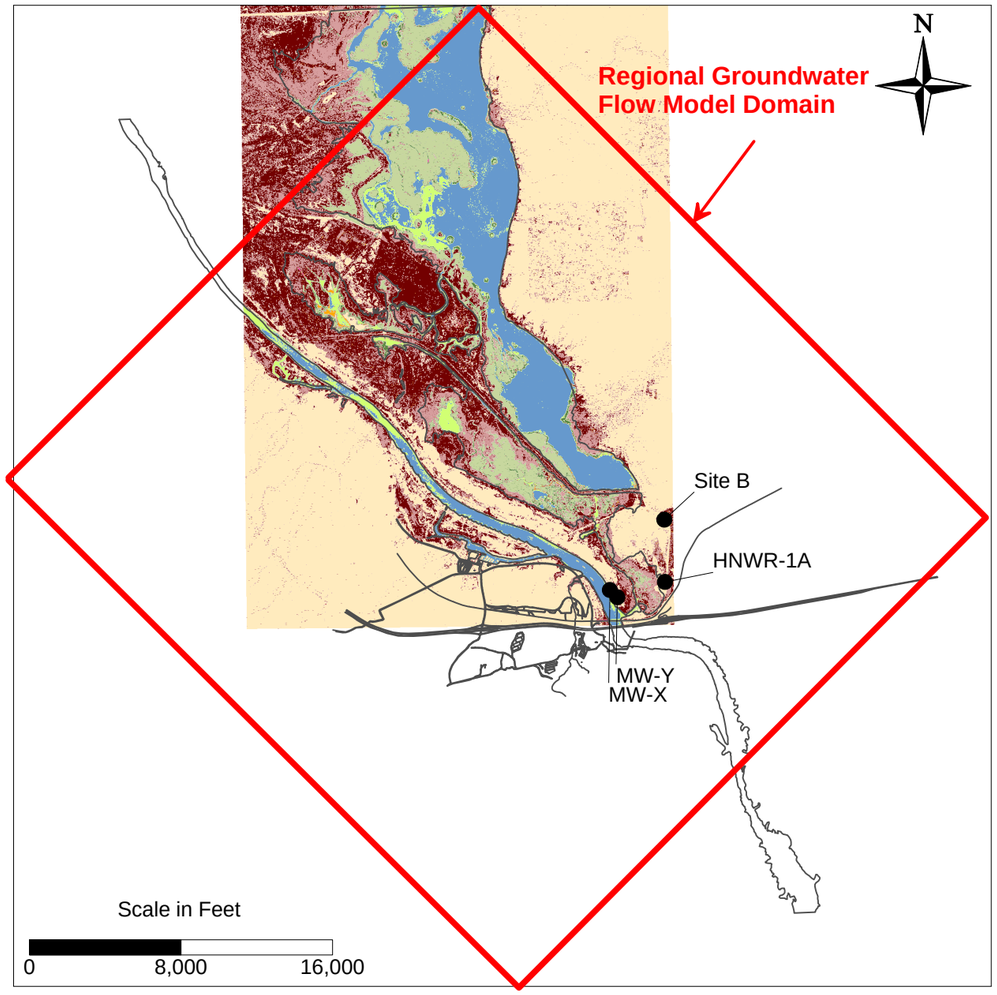
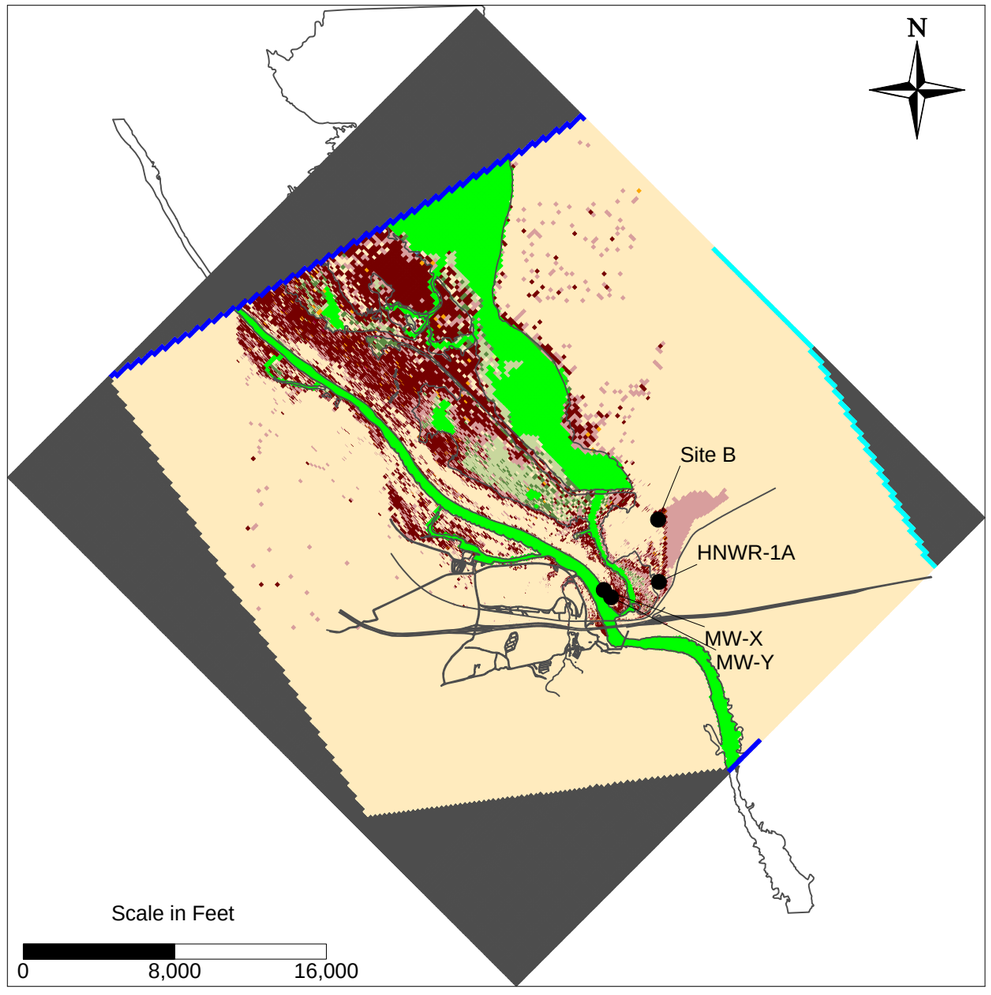
FIGURE
2.2-1

USGS LANDCOVER SURVEY



REGIONAL GROUNDWATER MODEL



LEGEND

- Constant Head Boundary Cell
- River Boundary Cell
- No Flow Boundary Cell
- General Head Boundary
- Open Water
- Submerged Aquatic Vegetation (SAV)
- Cattail
- Bulrush
- Bare Ground
- Tamarix
- Arrowweed
- Phragmites
- Mesquite

Description	ET Value (in/yr)	Extinction Depth (ft)
open water	0	10
SAV	0	10
cattail	68.05	10
bulrush	68.05	10
bare ground	3.72	10
tamarix	36.24	30
arrowweed	25.68	10
phragmites	68.05	10
Mesquite	42.35	30

U.S. Geological Survey. 2016. Development of a Decision Support Tool for Water and Resource Mangement Using Biotic, Abiotic, and Hydrological Assessments of Topock Marsh, Arizona. Report 2016-1065.

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED AND OBSERVED
EVAPOTRANSPIRATION MAPS

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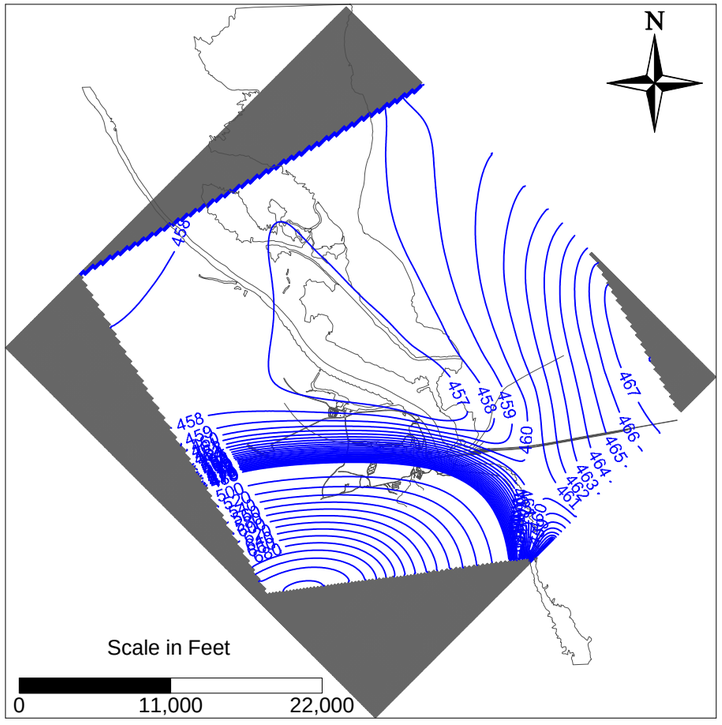
FIGURE
2.2-2

K_h:K_v = 10:1



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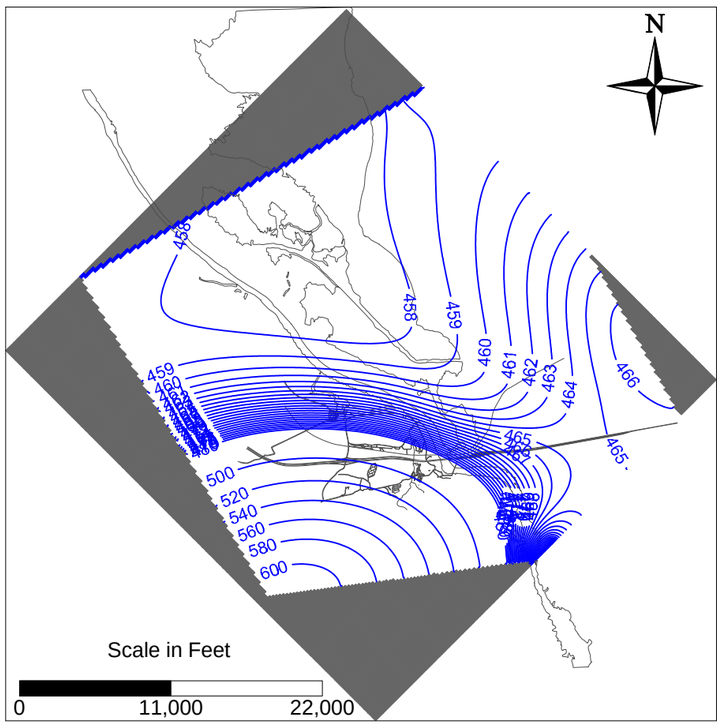

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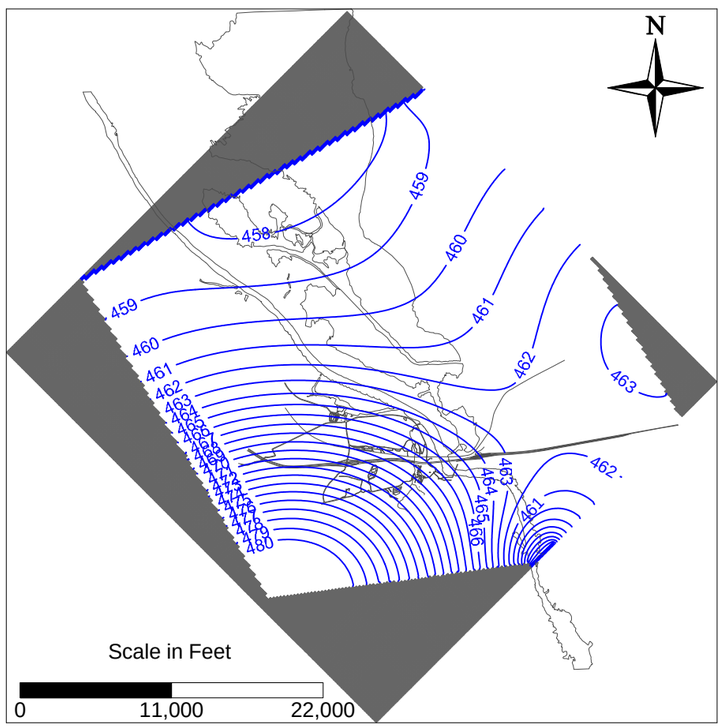

LEGEND

- Constant Head Boundary Cell
- No Flow Boundary Cell
- 457 — Simulated Groundwater Levels (ft NAVD 88)

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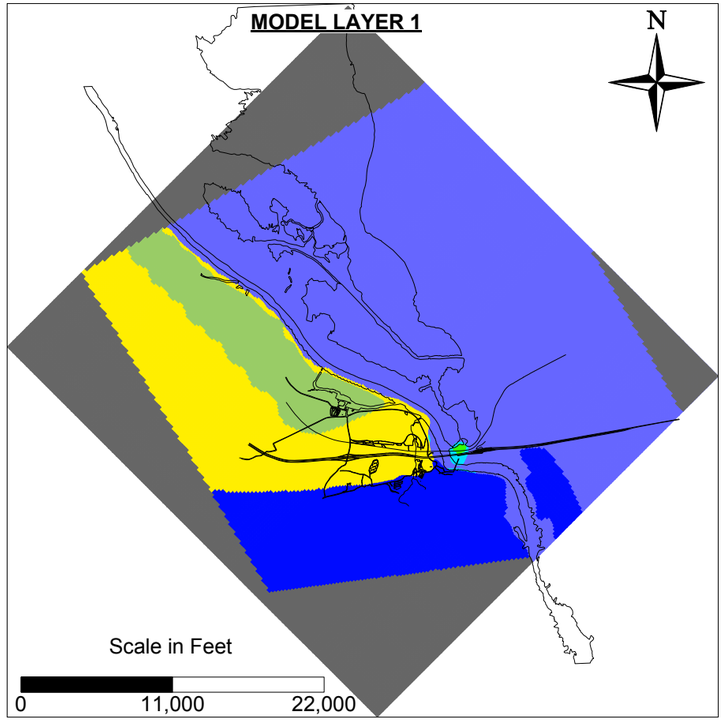
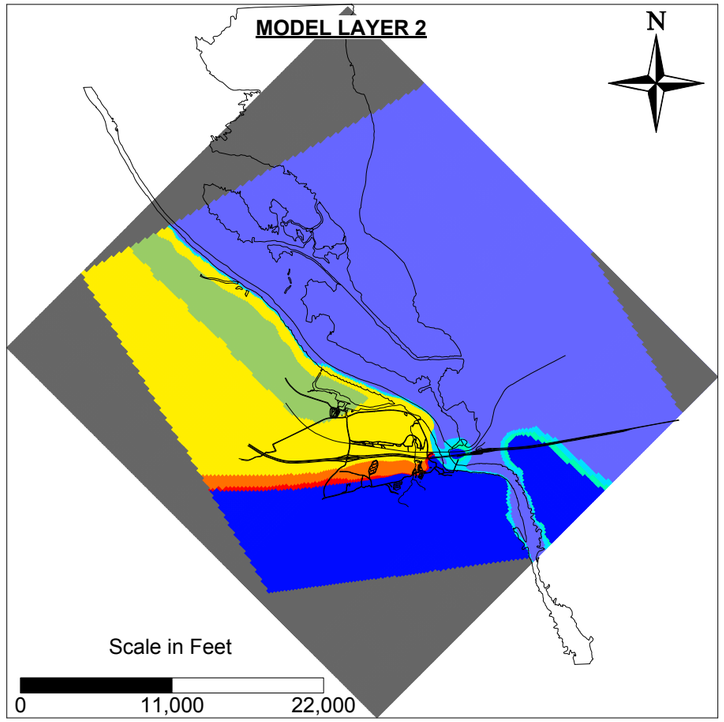
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

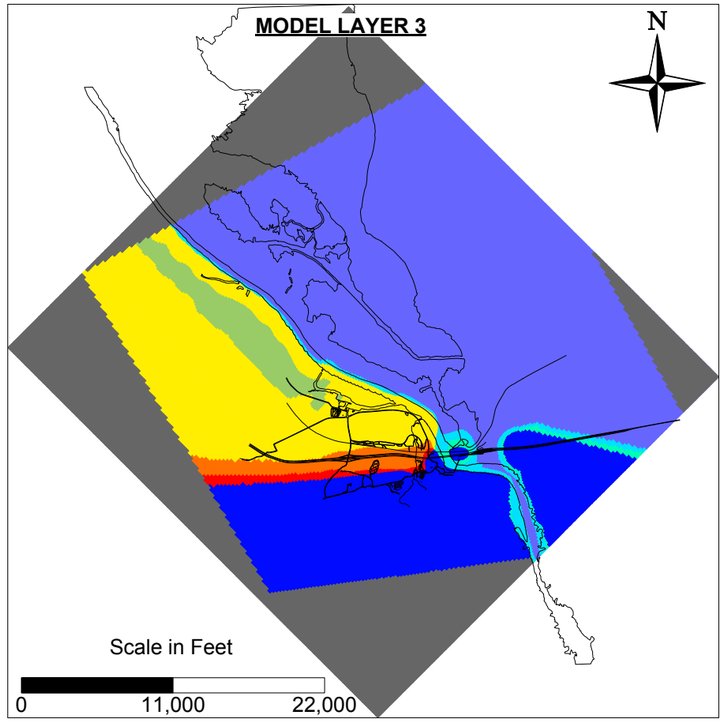
SIMULATED WATER LEVELS IN THE BEDROCK (LAYER 10) FOR DIFFERENT VERTICAL ANISOTROPIES

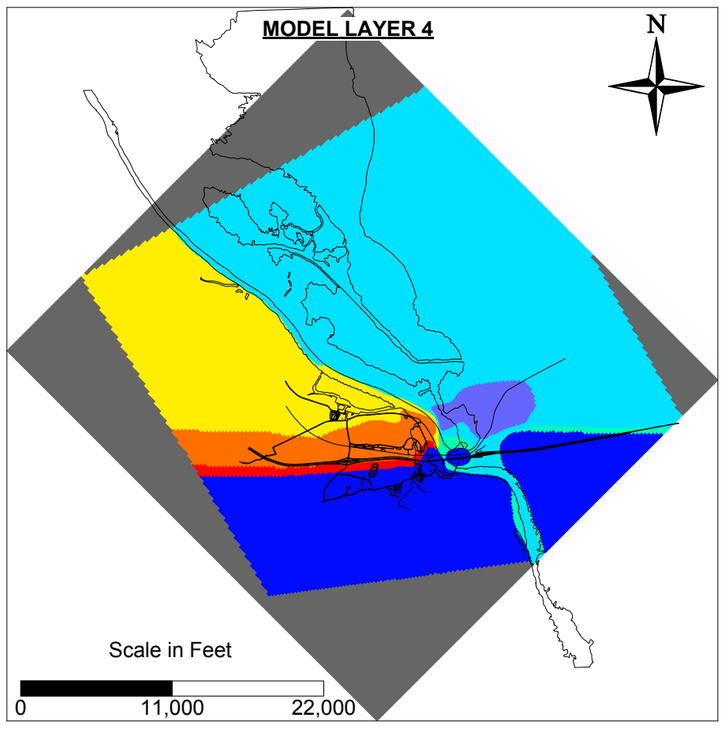
ARCADIS Design & Consultancy for natural and built assets

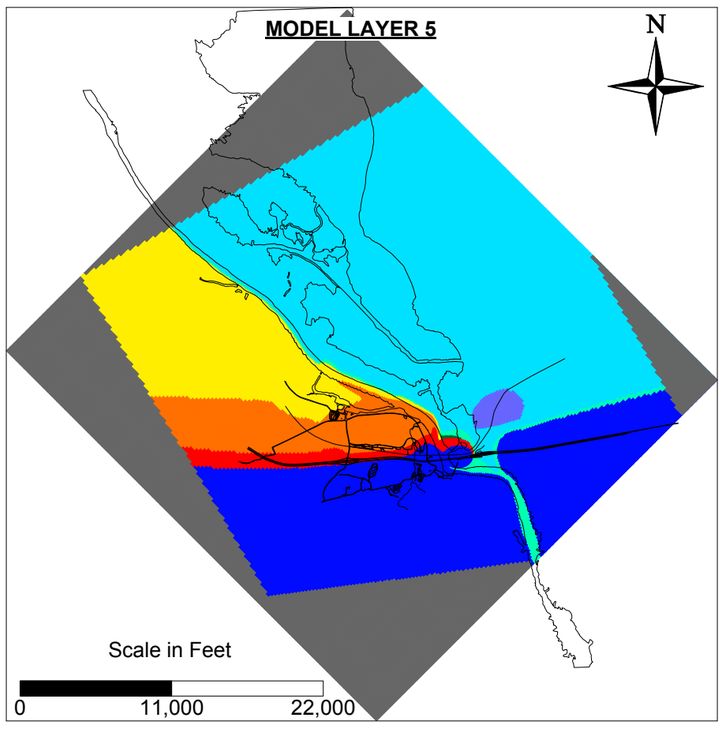
FIGURE
2.5-1











LEGEND

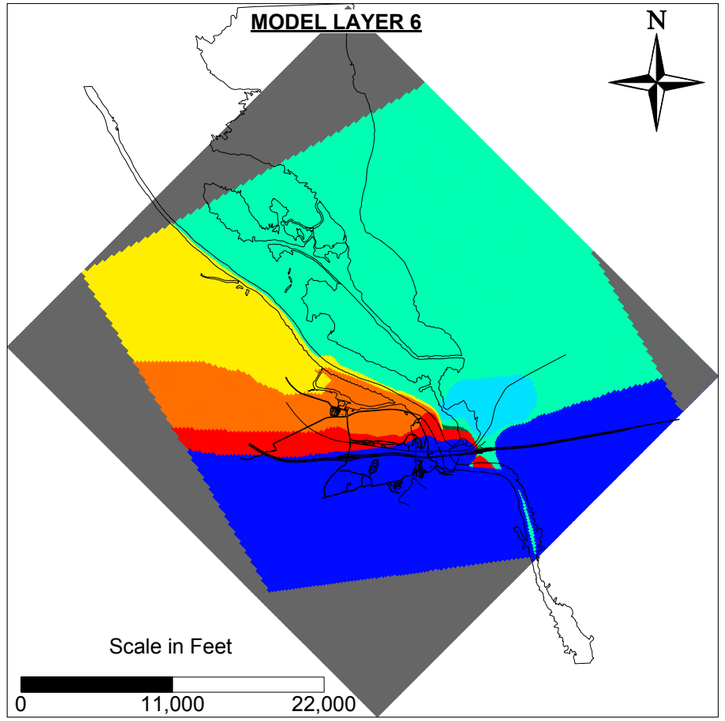
- Bedrock
- Qr3
- Qr2
- Qr1
- Qr0
- Qoa
- Tb
- Toa
- Toa1
- Toa0
- No Flow Cell

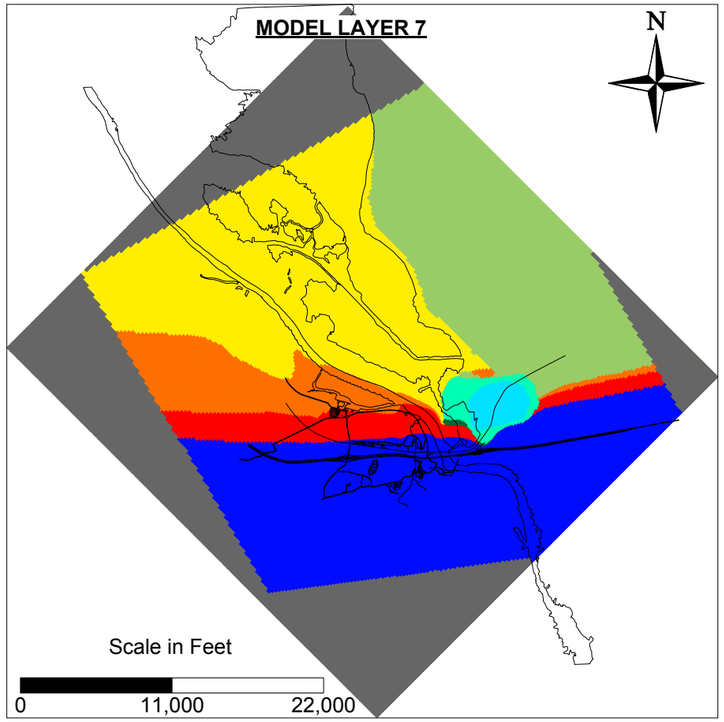
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

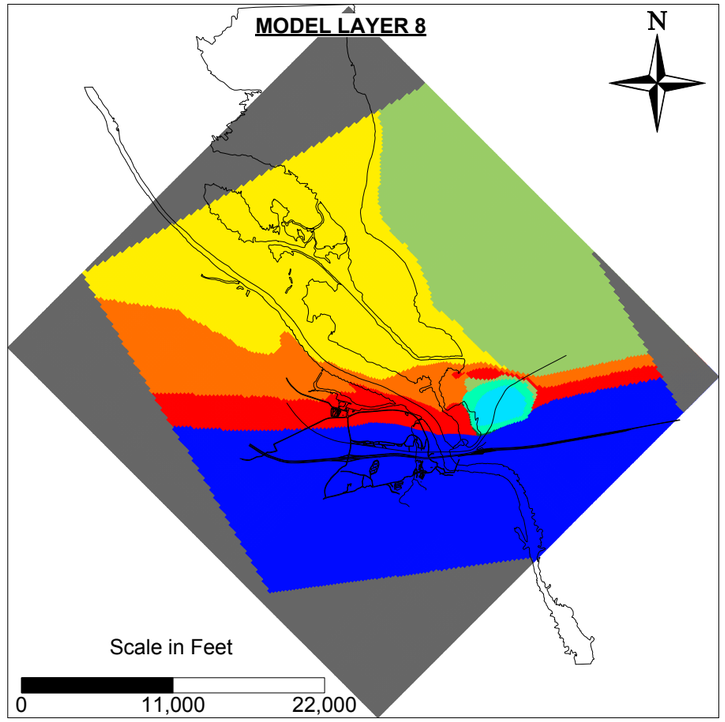
HYDROSTRATIGRAPHIC UNITS MODEL LAYERS 1-5

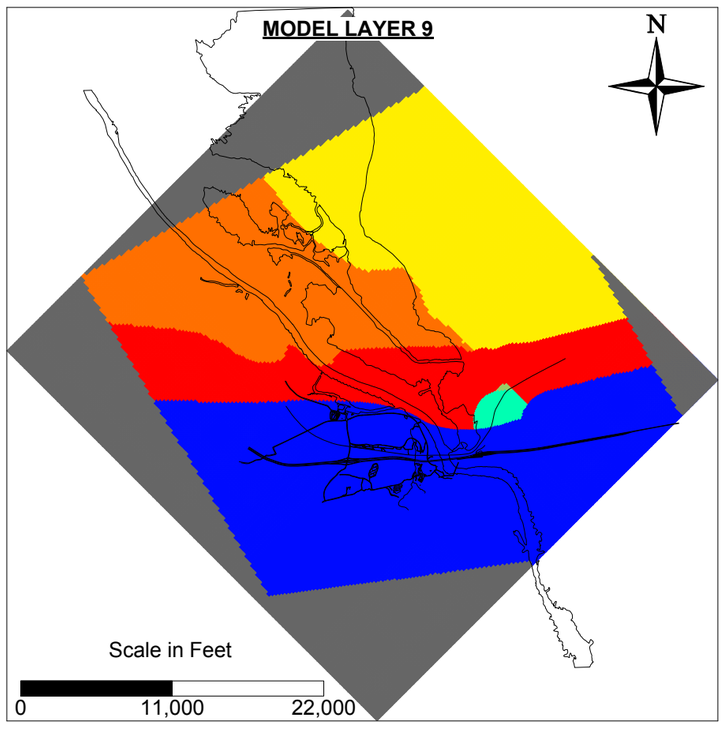
ARCADIS Design & Consultancy for natural and built assets

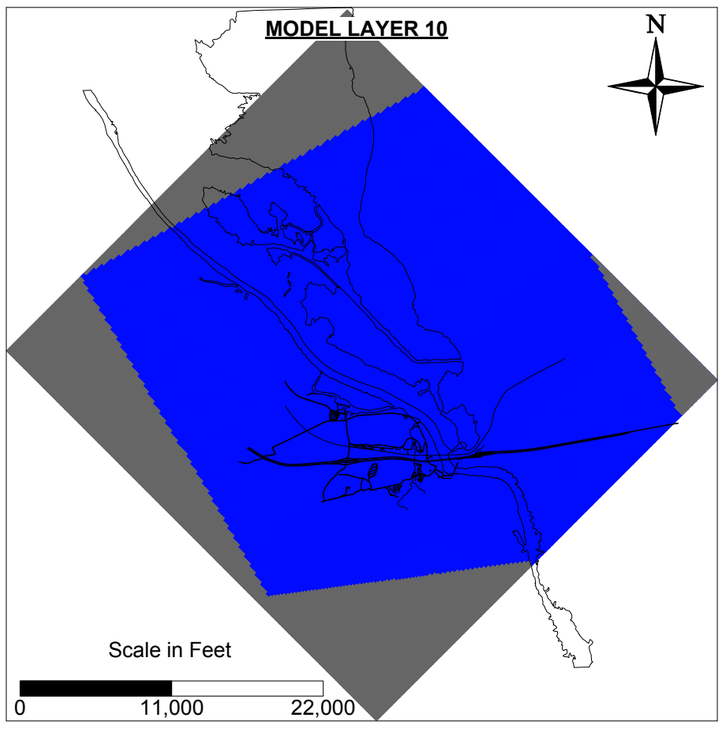
FIGURE
2.6-1











LEGEND

- Bedrock
- Qr3
- Qr2
- Qr1
- Qr0
- Qoa
- Tb
- Toa
- Toa1
- Toa0
- No Flow Cell

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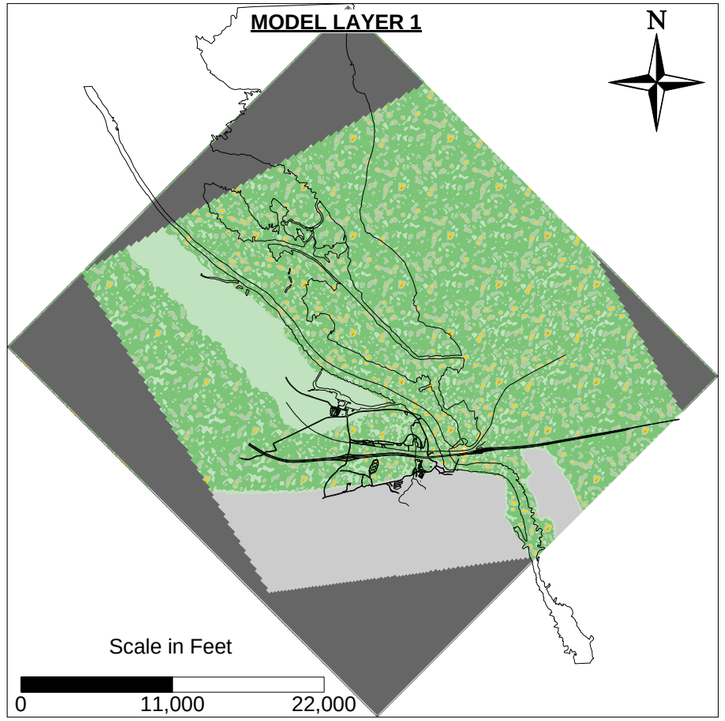
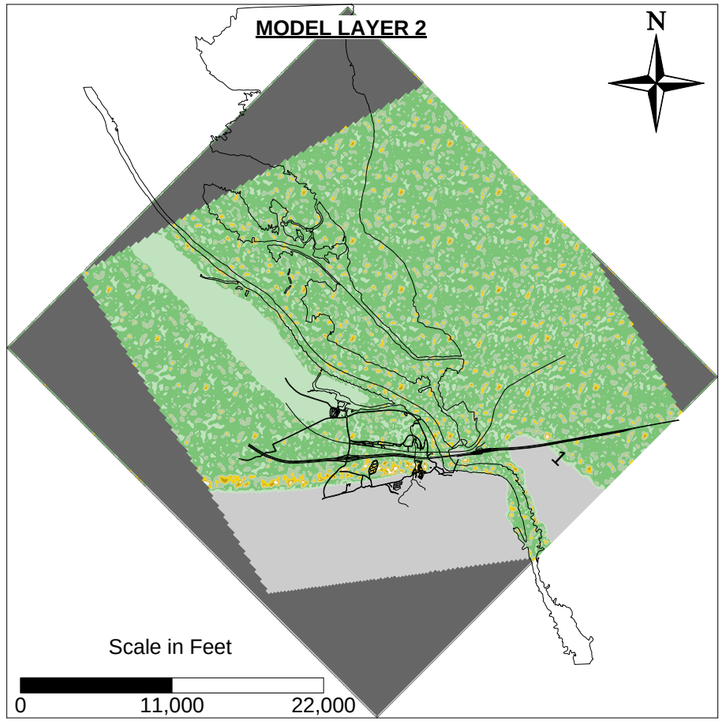
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

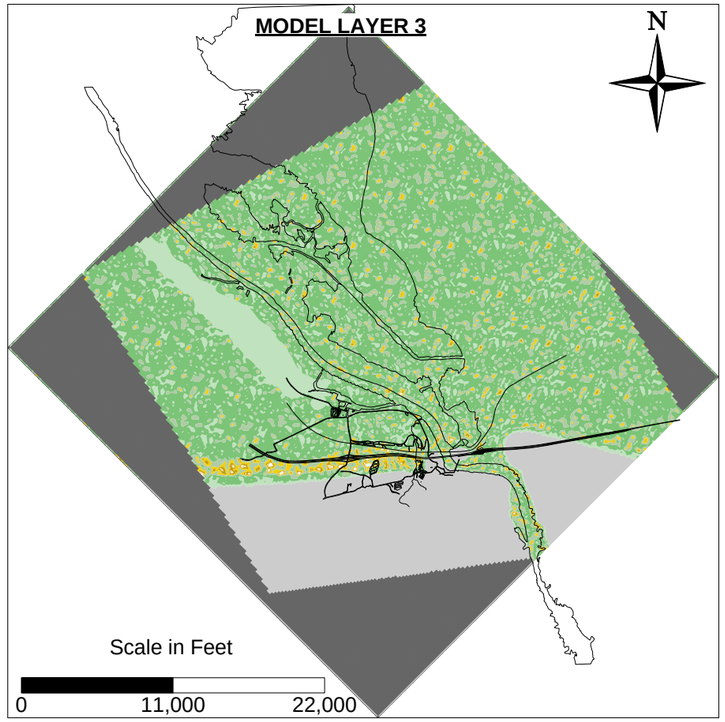
HYDROSTRATIGRAPHIC UNITS MODEL LAYERS 6-10

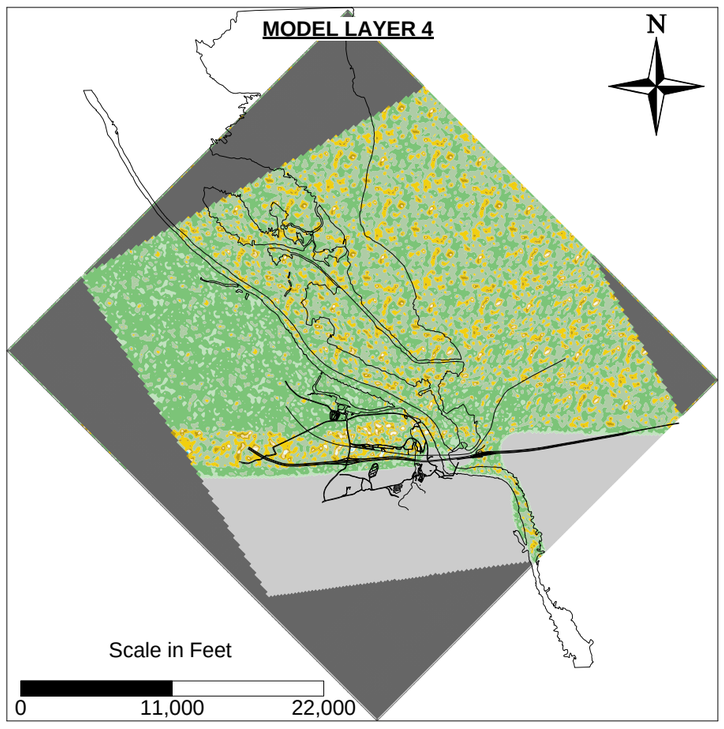
ARCADIS Design & Consultancy for natural and built assets

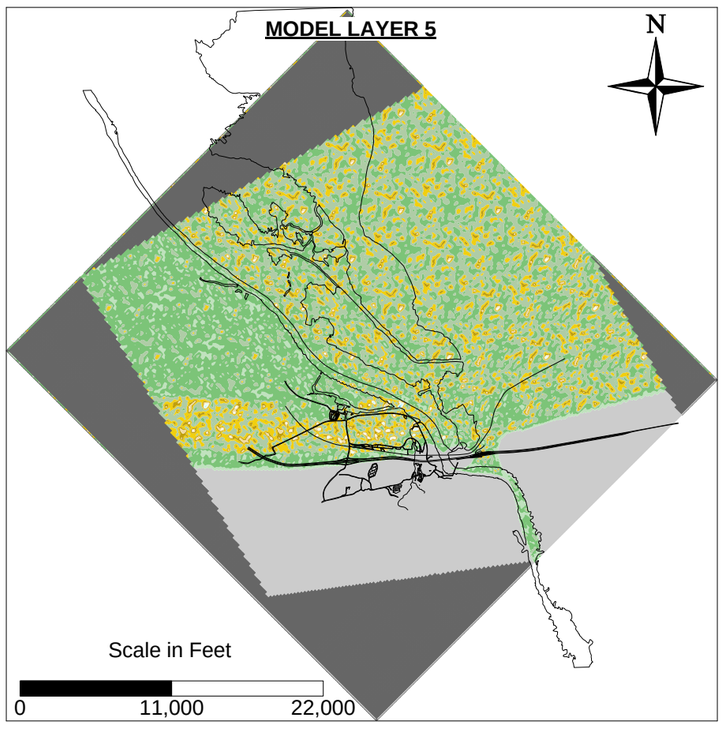
FIGURE
2.6-2





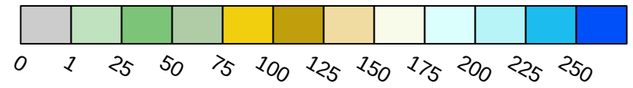






LEGEND

Horizontal Hydraulic Conductivity (ft/day)



No Flow Boundary Cell

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NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

HYDRAULIC CONDUCTIVITY MODEL LAYERS 1-5

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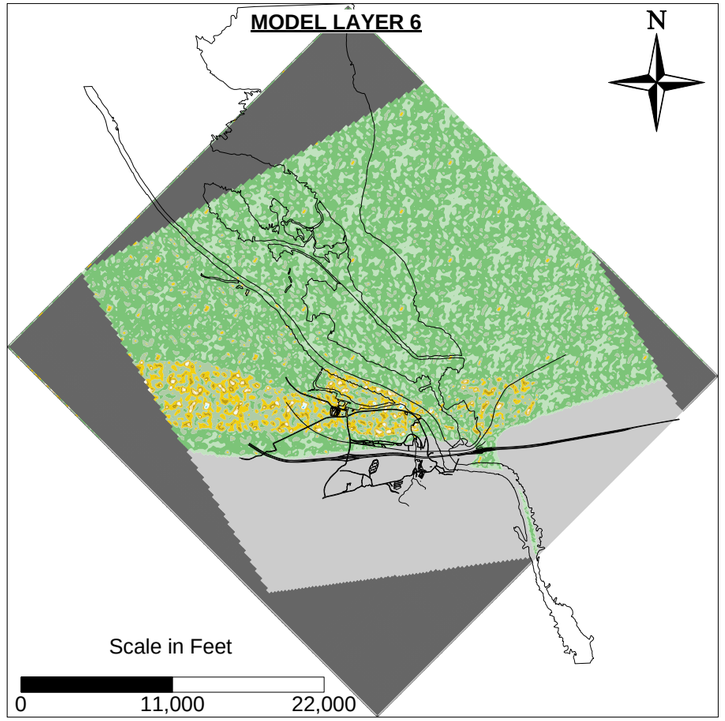
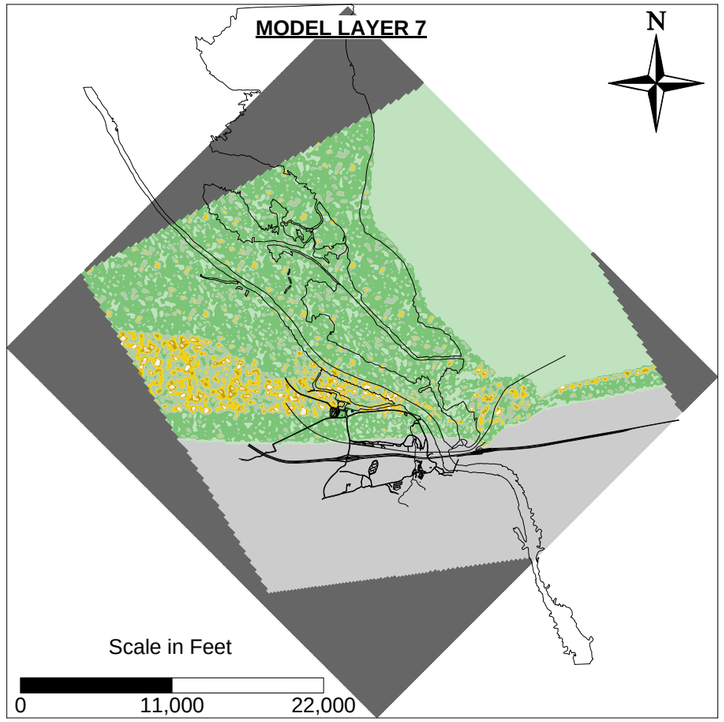
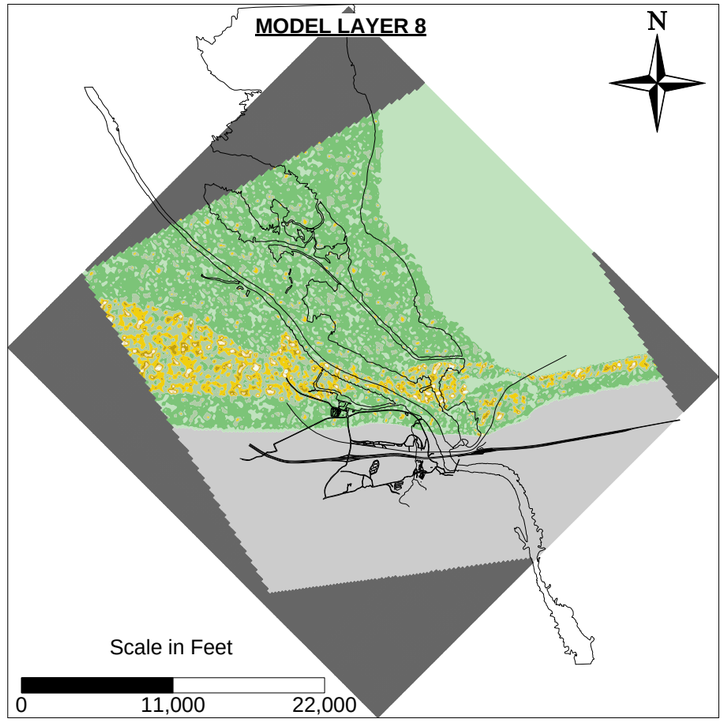
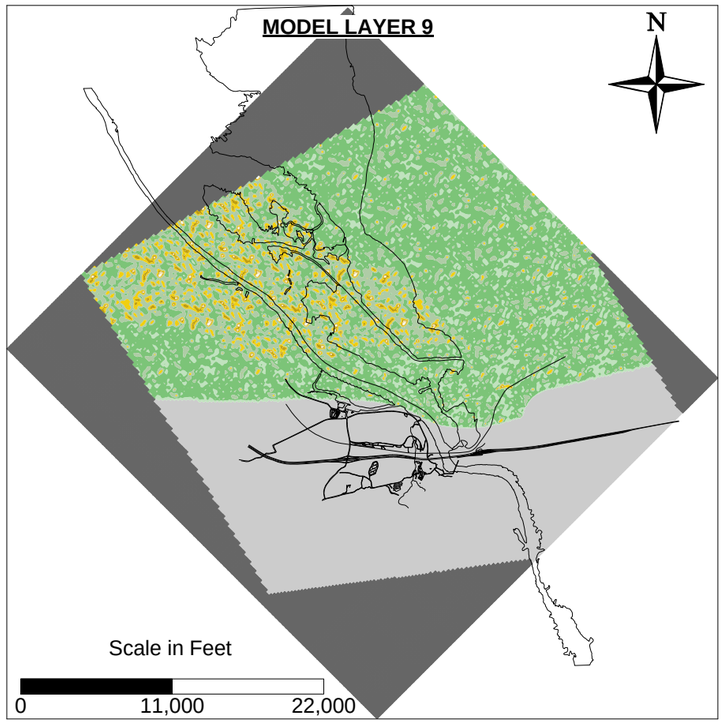
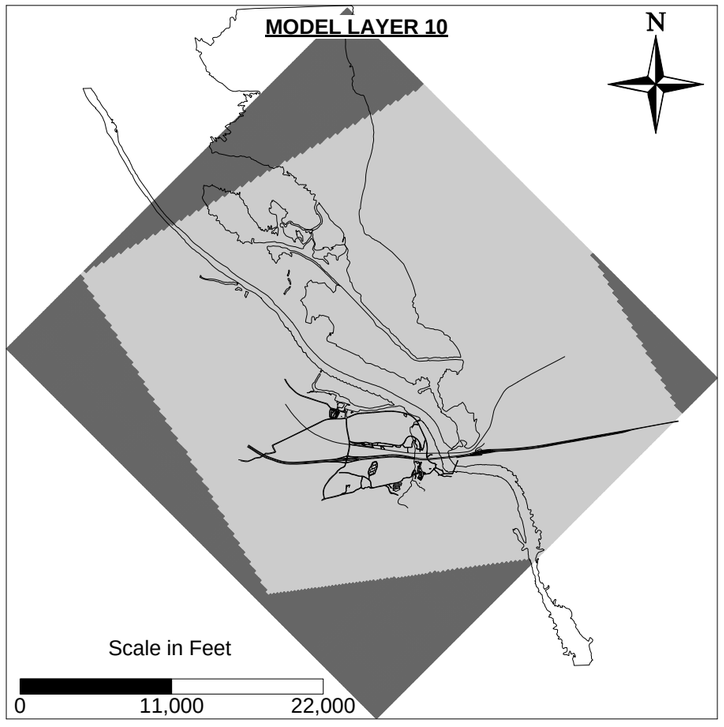
FIGURE
2.6-3





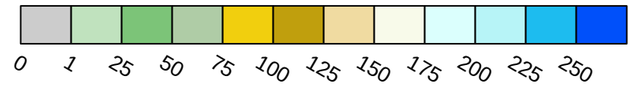






LEGEND

Horizontal Hydraulic Conductivity (ft/day)



No Flow Boundary Cell

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NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

HYDRAULIC CONDUCTIVITY MODEL LAYERS 6-10

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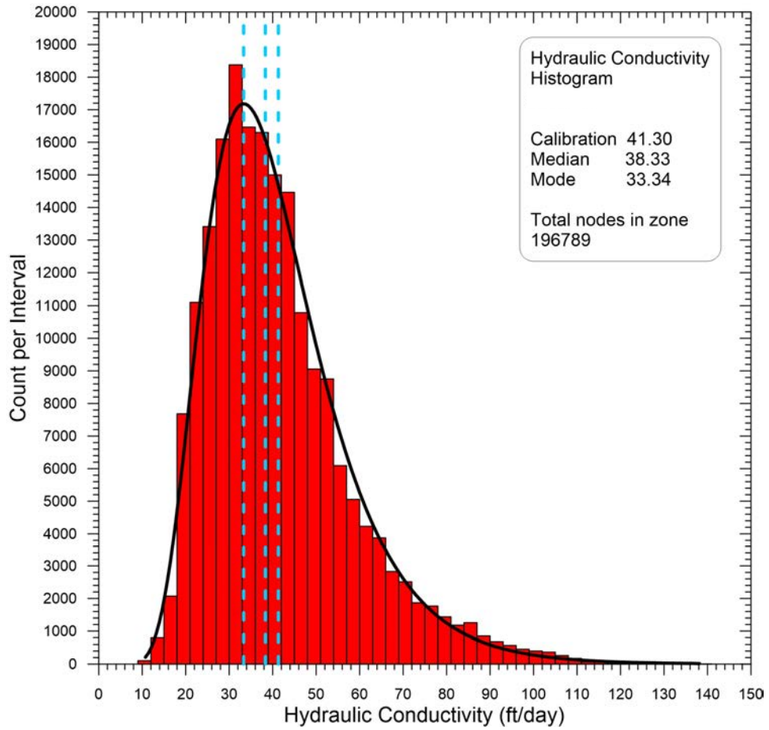
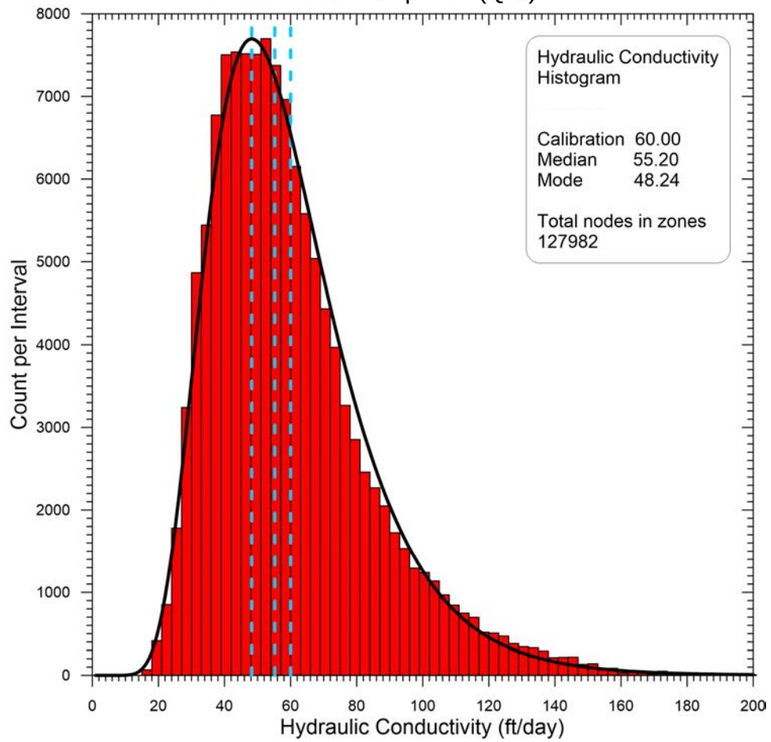
FIGURE
2.6-4

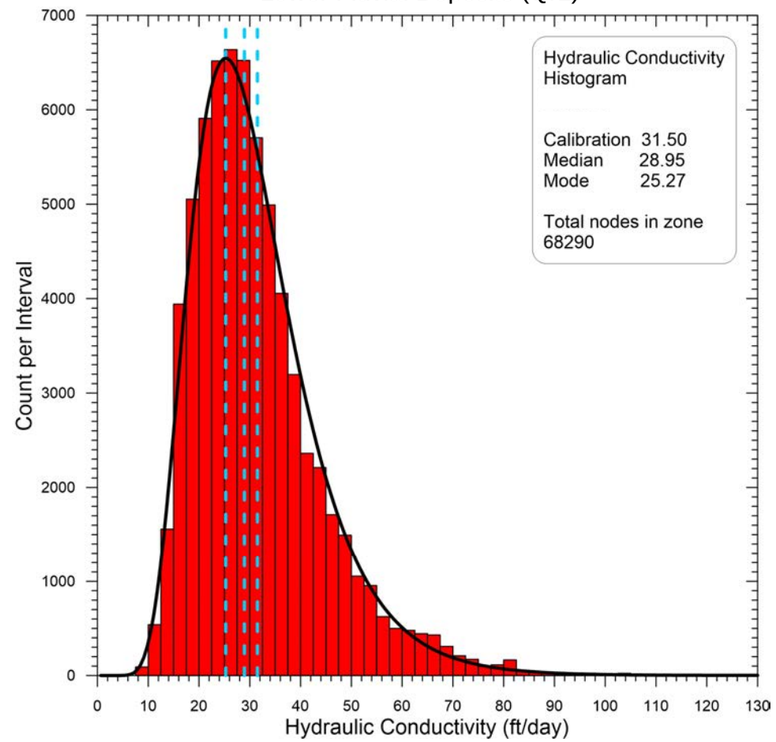
Upper Fluvial Sand and Silt (Qr3)



Middle Fluvial Deposits (Qr2)



Lower Fluvial Deposits (Qr1)



The mode is the peak of the fitted log-normal distribution. The vertical lines on each graph from left to right are the mode, median, and calibrated value, respectively consistent with a positively skewed log-normal distribution. The calibration value is also the mean or average of the data.

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HYDRAULIC CONDUCTIVITY HISTOGRAMS FOR Qr3, Qr2, AND Qr1

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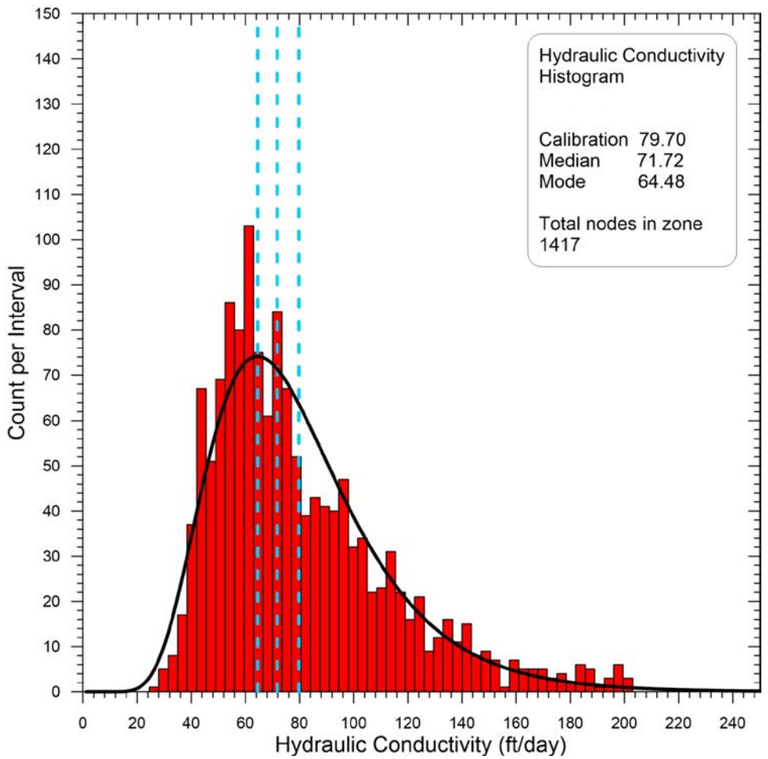
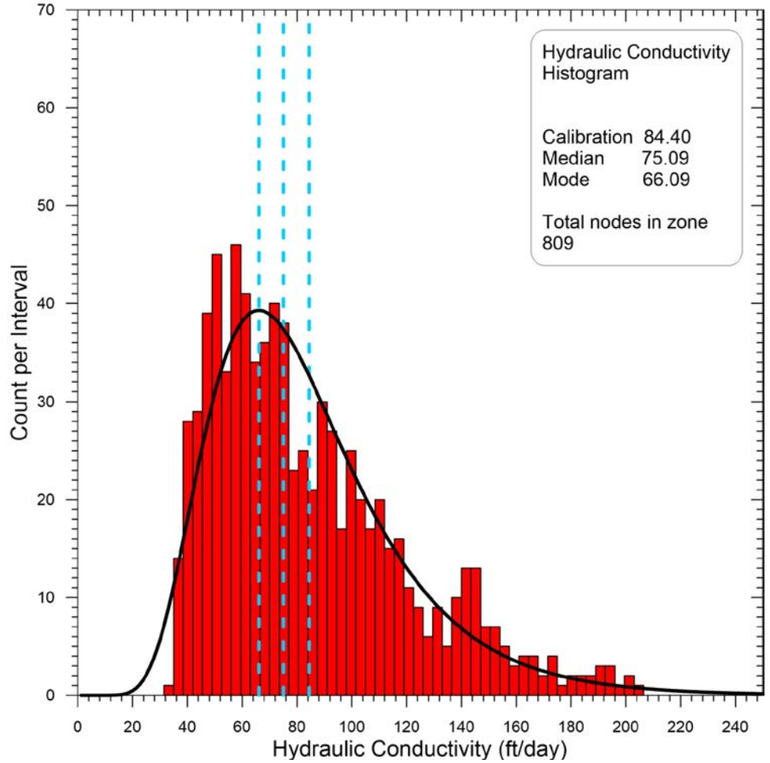
FIGURE
2.6-5

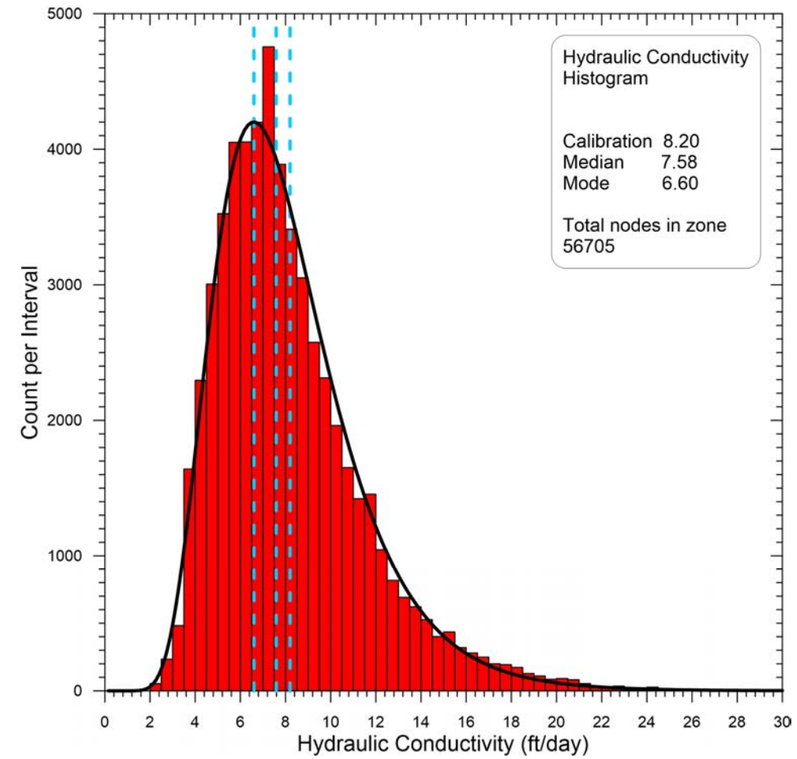
Colorado River Channel Fill (Qr0)



Older Quaternary Alluvium (Qoa)



Bouse Formation (Tb)



The mode is the peak of the fitted log-normal distribution. The vertical lines on each graph from left to right are the mode, median, and calibrated value, respectively consistent with a positively skewed log-normal distribution. The calibration value is also the mean or average of the data.

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HYDRAULIC CONDUCTIVITY HISTOGRAMS FOR Qr0, Qoa, AND Tb

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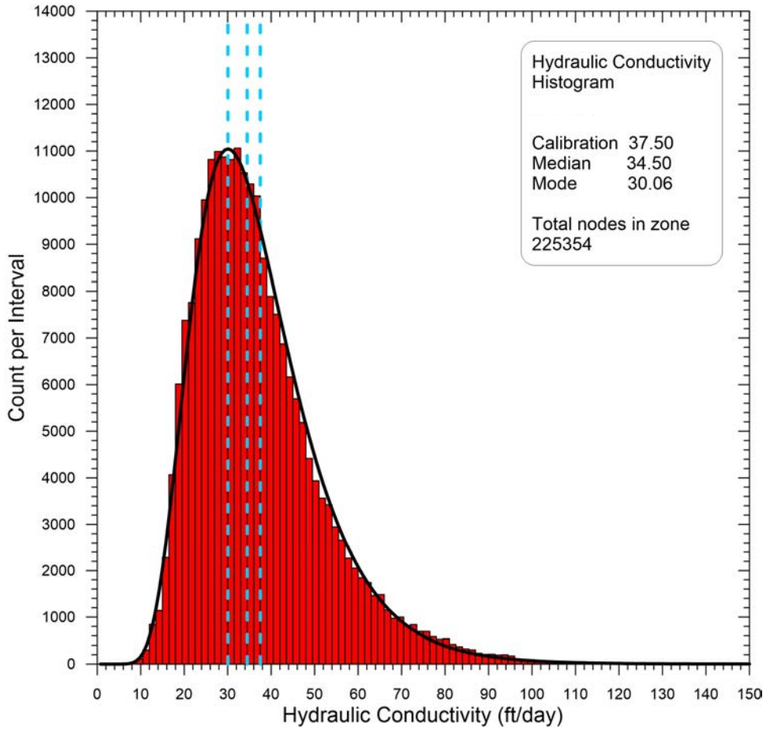
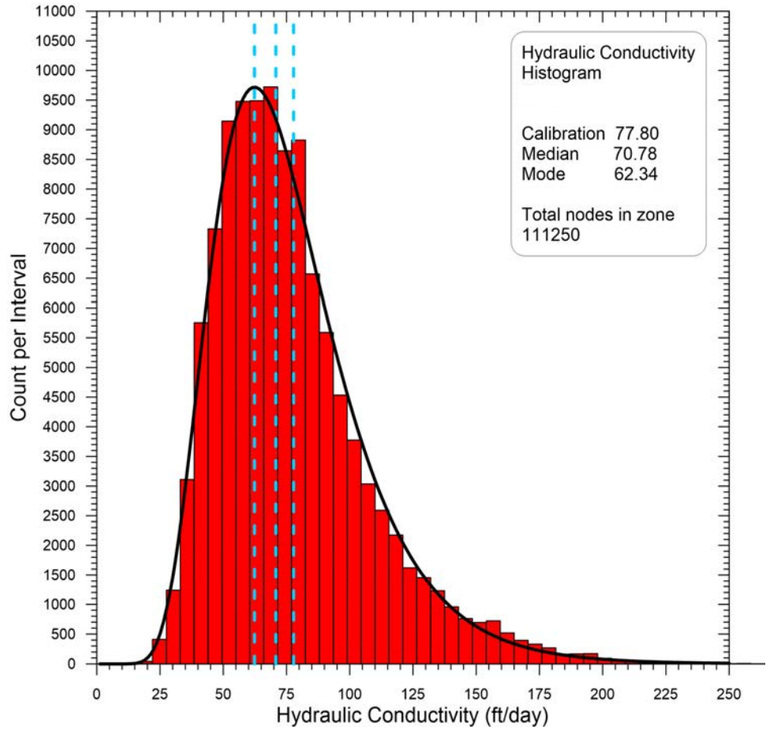
FIGURE
2.6-6

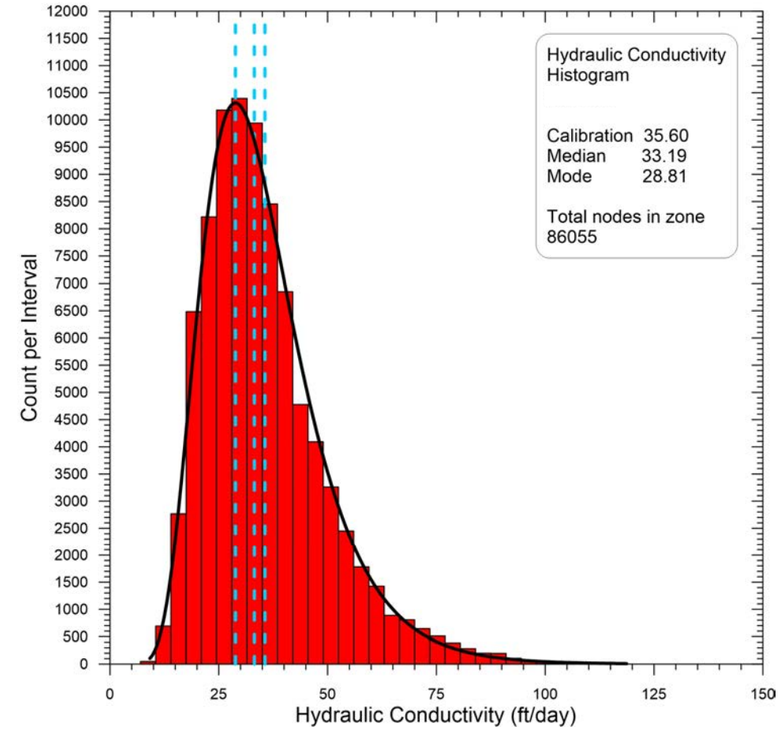
Tertiary Alluvium - Upper (Toa2)



Tertiary Alluvium - Lower (Toa1)



Basal Alluvium (Toa0)



The mode is the peak of the fitted log-normal distribution. The vertical lines on each graph from left to right are the mode, median, and calibrated value, respectively consistent with a positively skewed log-normal distribution. The calibration value is also the mean or average of the data.

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HYDRAULIC CONDUCTIVITY HISTOGRAMS FOR Toa2, Toa1, AND Toa0

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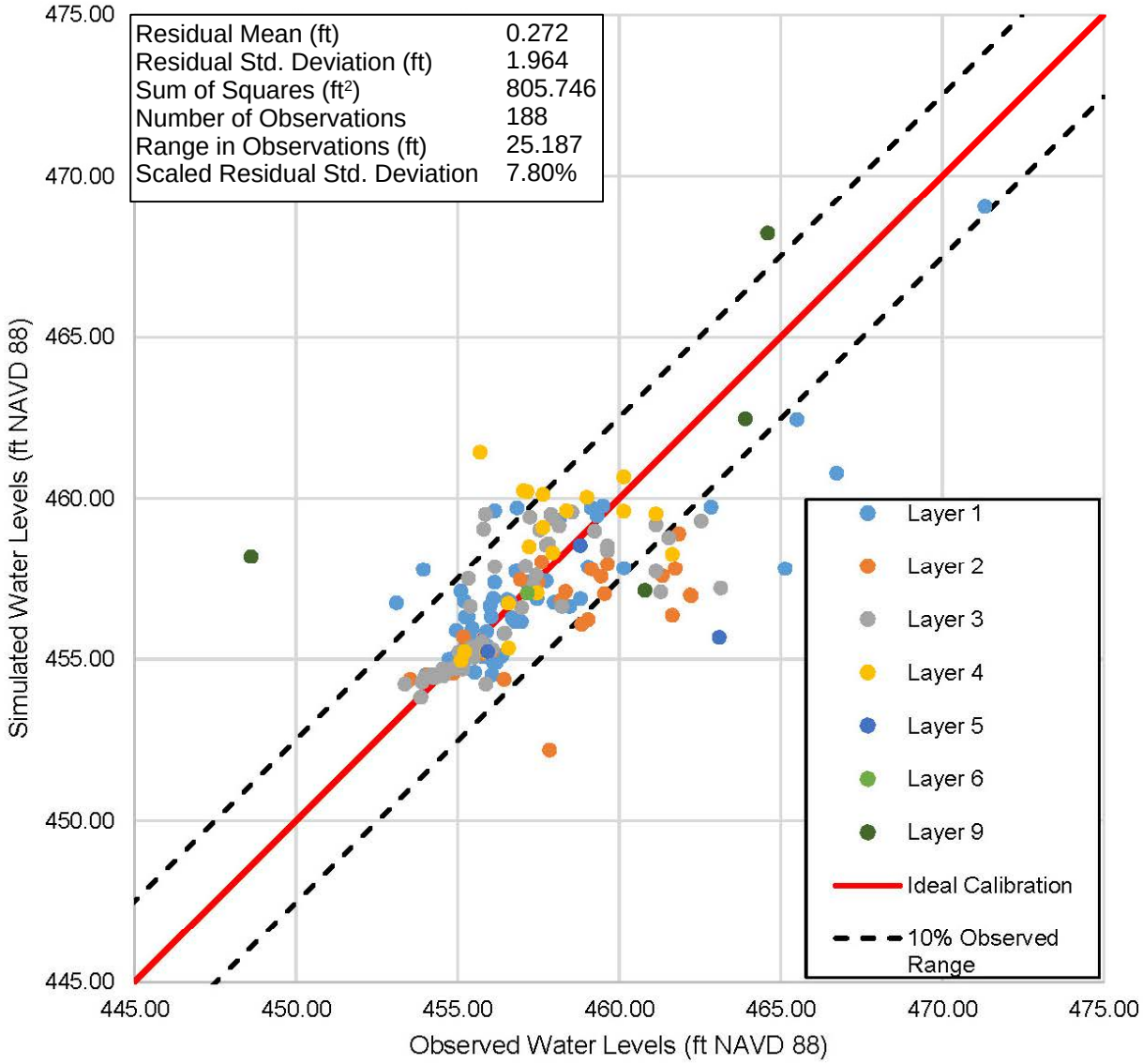
FIGURE
2.6-7



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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED VS. OBSERVED WATER LEVELS SITE AND REGIONAL TARGETS

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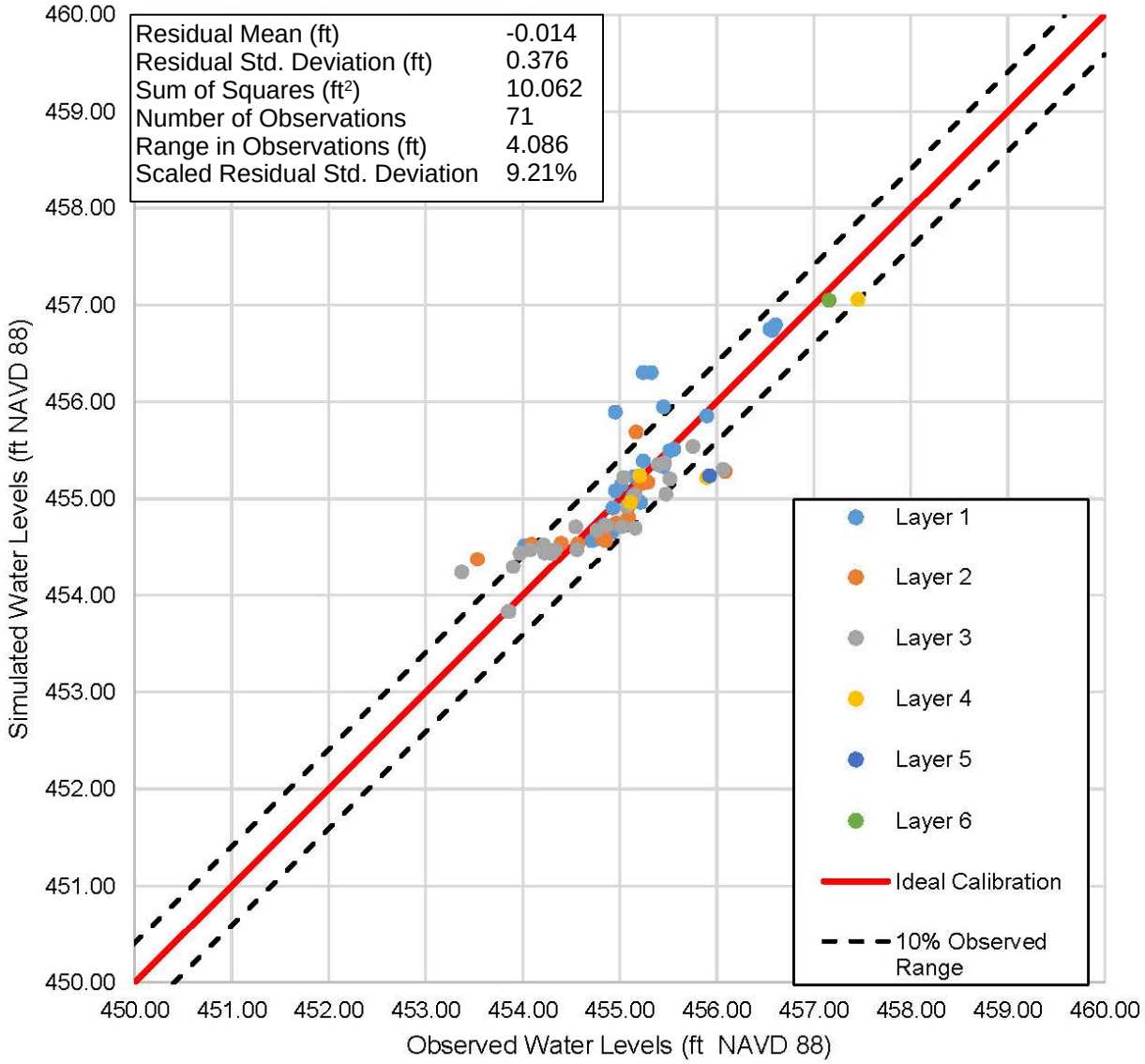
FIGURE
2.7-1

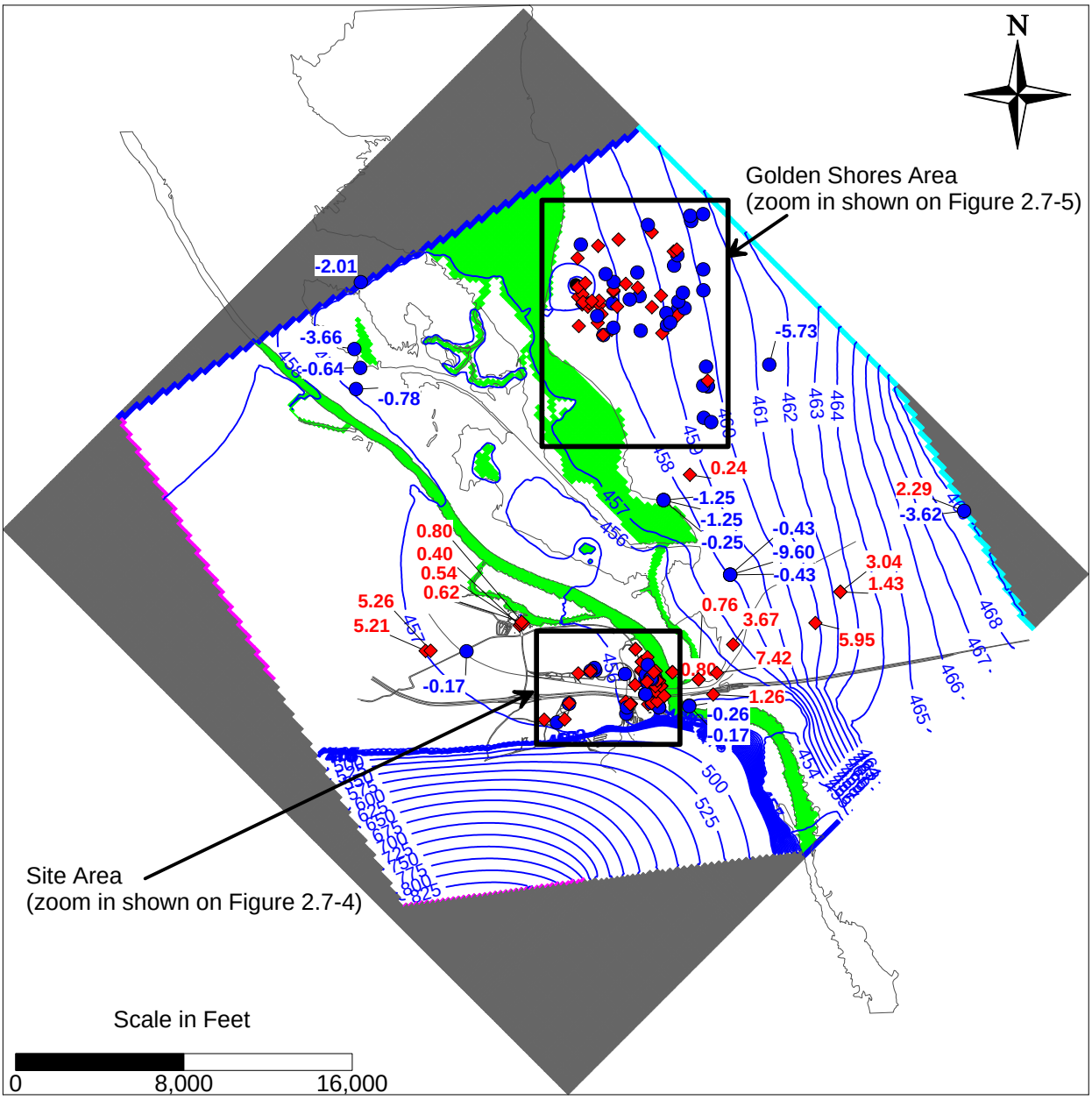


PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED VS. OBSERVED WATER LEVELS SITE TARGETS

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2.7-2



LEGEND

- Constant Flux Boundary Cell
- Constant Head Boundary Cell
- General Head Boundary Cell
- River Boundary Cell
- No Flow Boundary Cell
- Extraction Wells
- 457 Simulated Groundwater Levels (ft NAVD 88)

0.10 -0.10 Residual (ft)
(Residual = Observed Water Level - Simulated Water Level)

Zoom-In Locations
(Additional detail shown on Figures 2.7-4 and 2.7-5).

*Boundary conditions and simulated water levels are shown for layer 1 only. Residuals and target locations are shown for all layers.

PG&E
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NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

REGIONAL SIMULATED WATER LEVELS AND RESIDUALS

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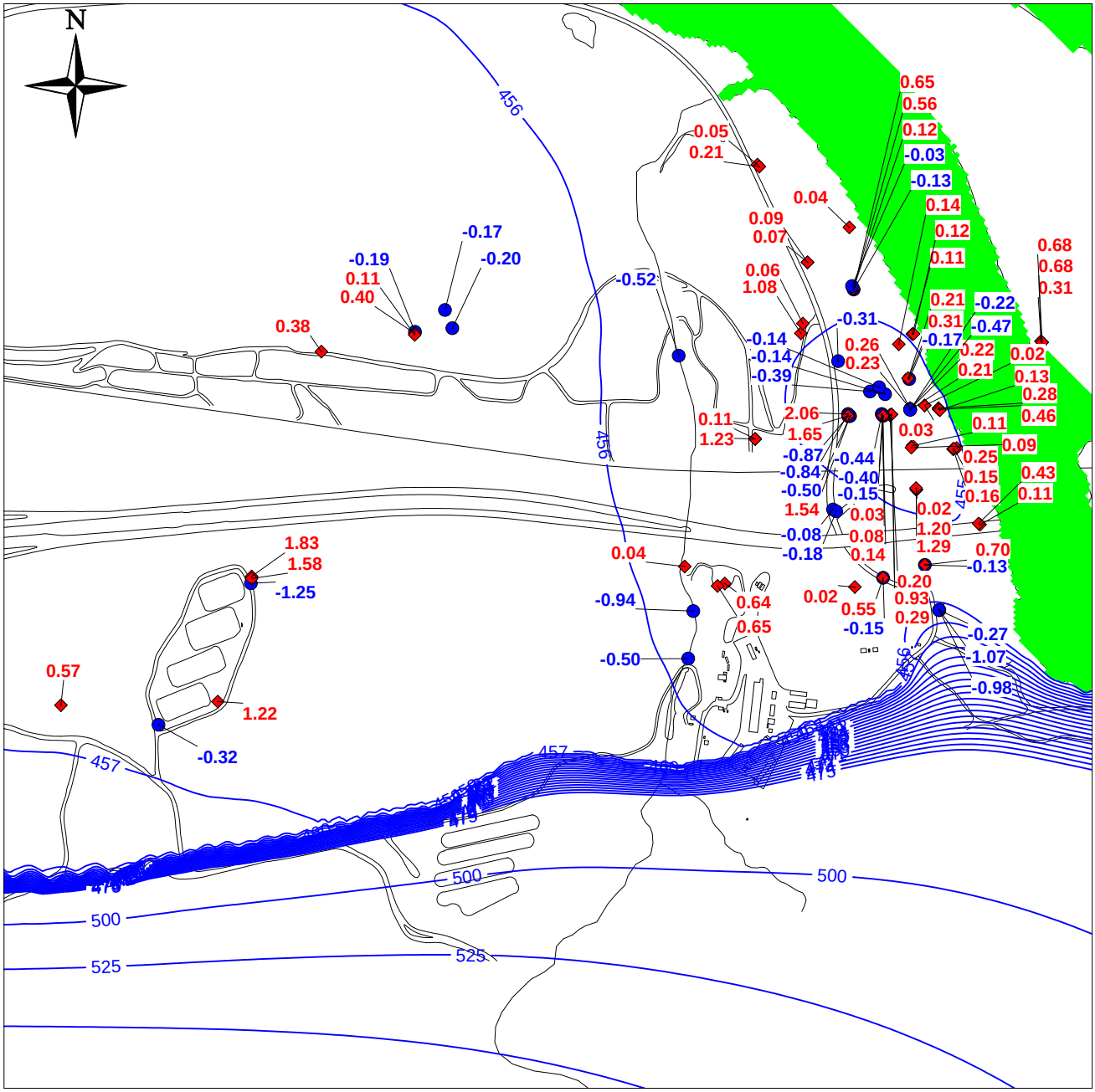
FIGURE
2.7-3



Scale in Feet

0 1,000 2,000

LEGEND

River Boundary Cell

457 Simulated Groundwater Levels (ft msl)

0.10 -0.10 Residual (ft)
(Residual = Observed Water Level - Simulated Water Level)

*Boundary conditions and simulated water levels are shown for layer 1 only. Residuals and target locations are shown for all layers.

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SITE SIMULATED WATER LEVELS AND RESIDUALS

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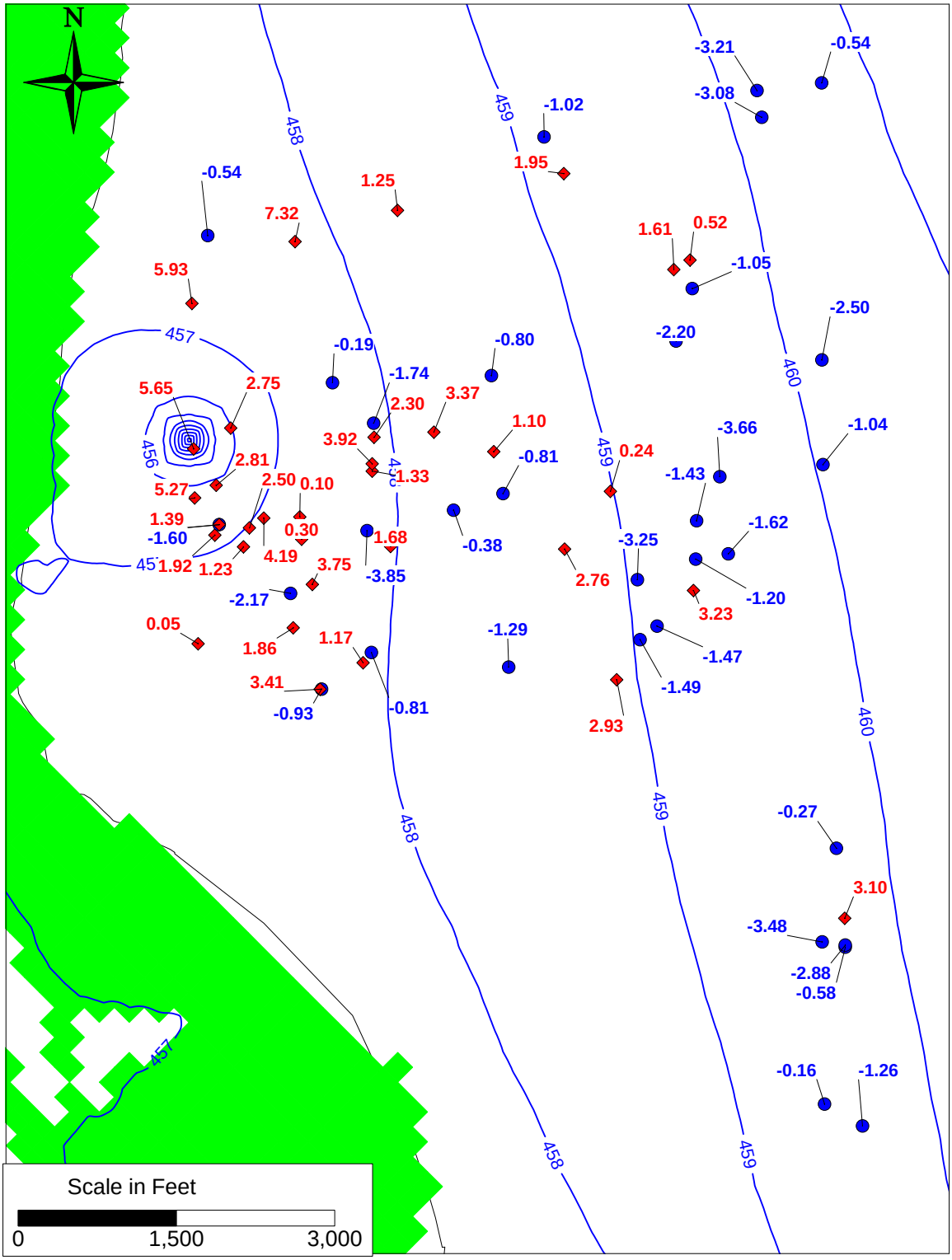
FIGURE 2.7-4



LEGEND

River Boundary Cell

—457— Simulated Groundwater Levels (ft msl)

0.10 -0.10 Residual (ft)
(Residual = Observed Water Level - Simulated Water Level)

*Boundary conditions and simulated water levels are shown for layer 1 only. Residuals and target locations are shown for all layers.

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

GOLDEN SHORES SIMULATED WATER LEVELS AND RESIDUALS

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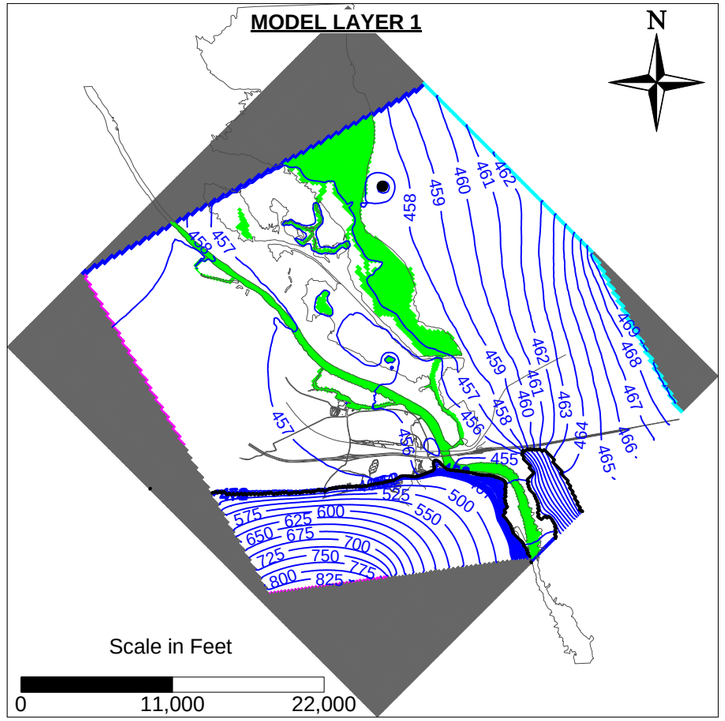
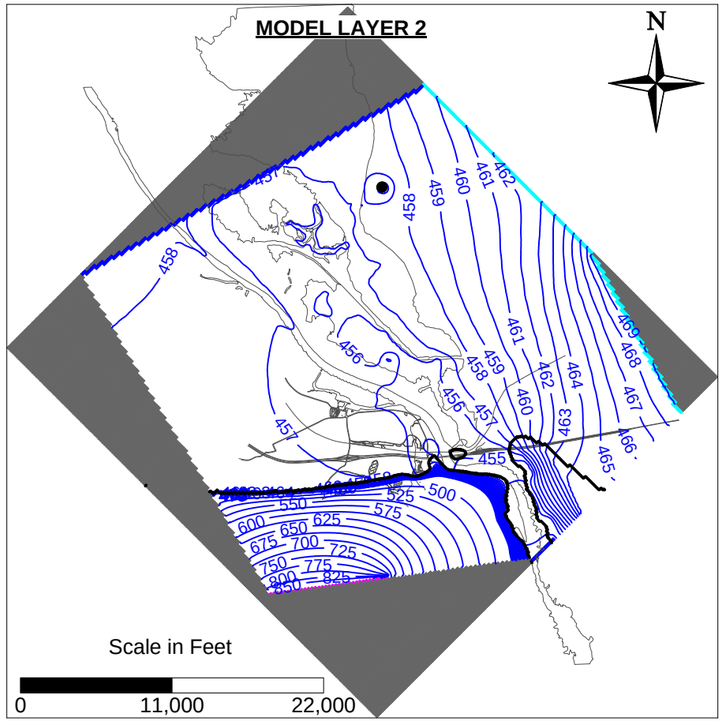
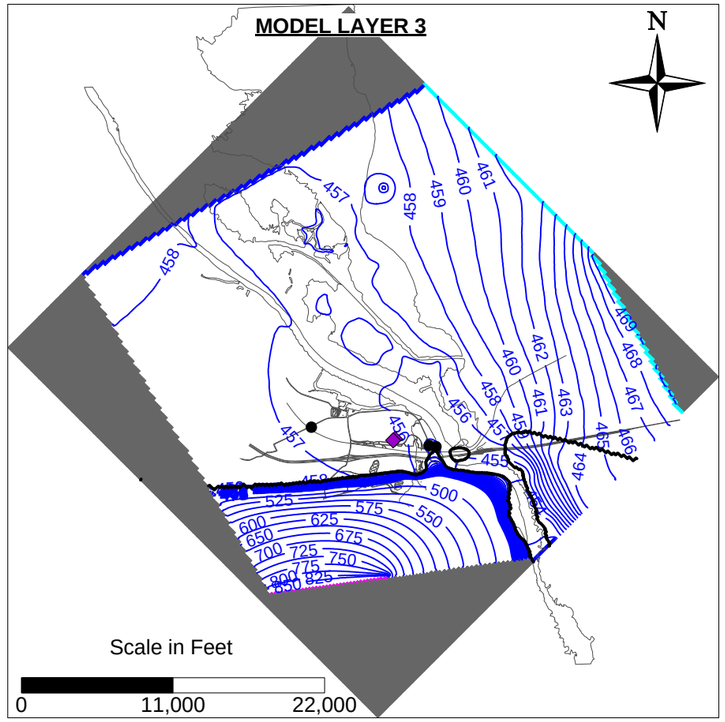
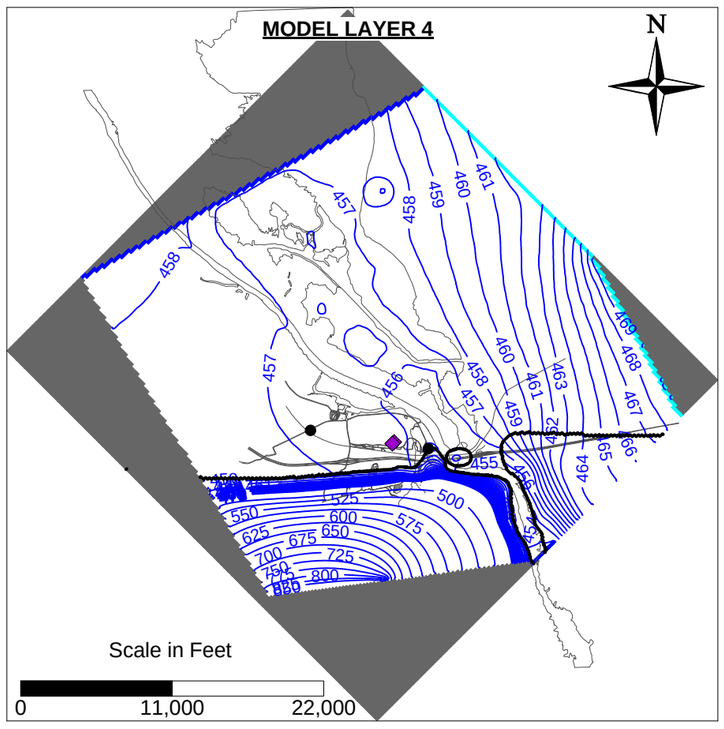
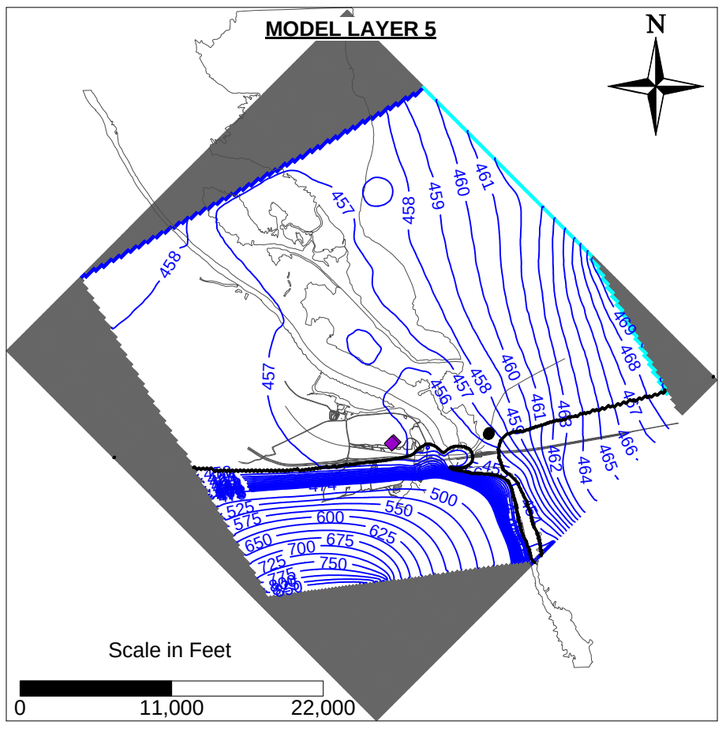
FIGURE
2.7-5











LEGEND

- Constant Flux Boundary Cell
- Constant Head Boundary Cell
- General Head Boundary Cell
- River Boundary Cell
- No Flow Boundary Cell
- Extraction Wells
- Injection Wells
- 457 Simulated Groundwater Levels (ft NAVD 88)
- Bedrock Contact

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

REGIONAL SIMULATED WATER LEVELS MODEL LAYERS 1-5

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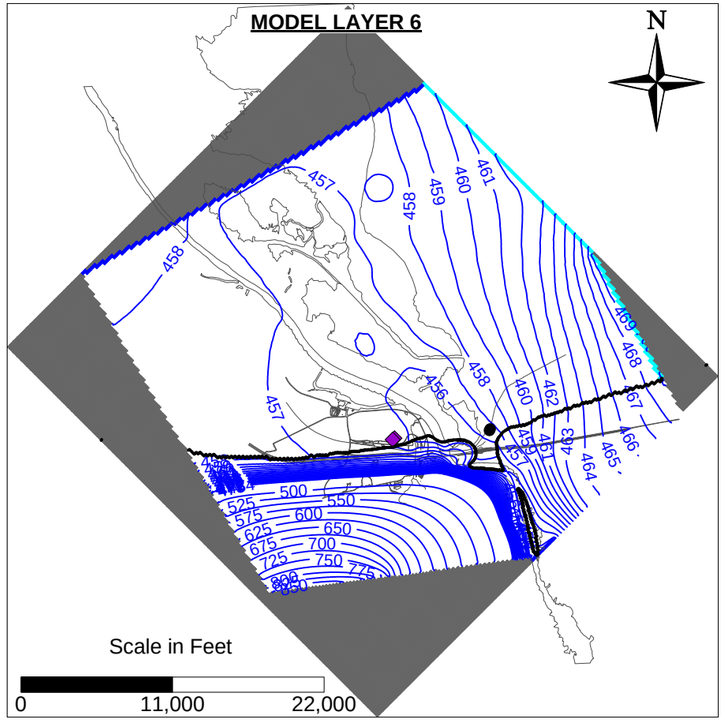
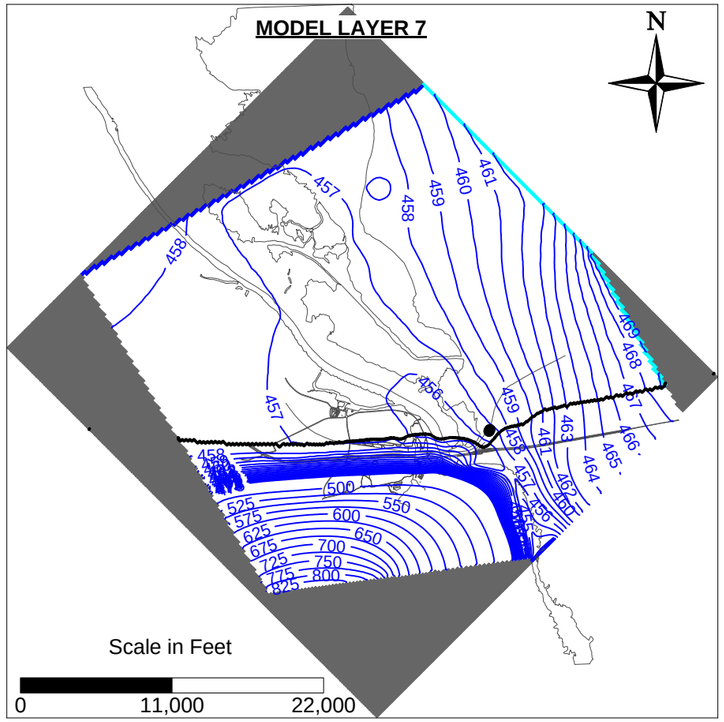
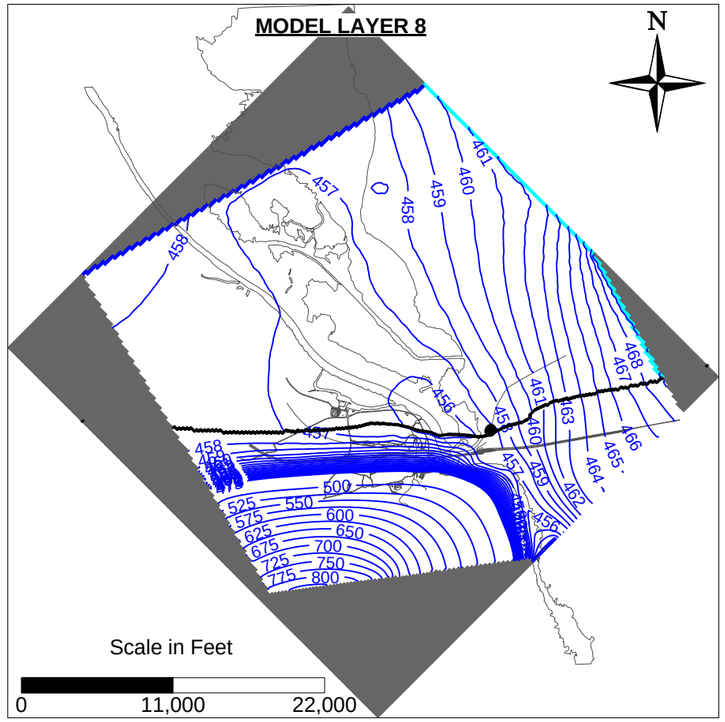
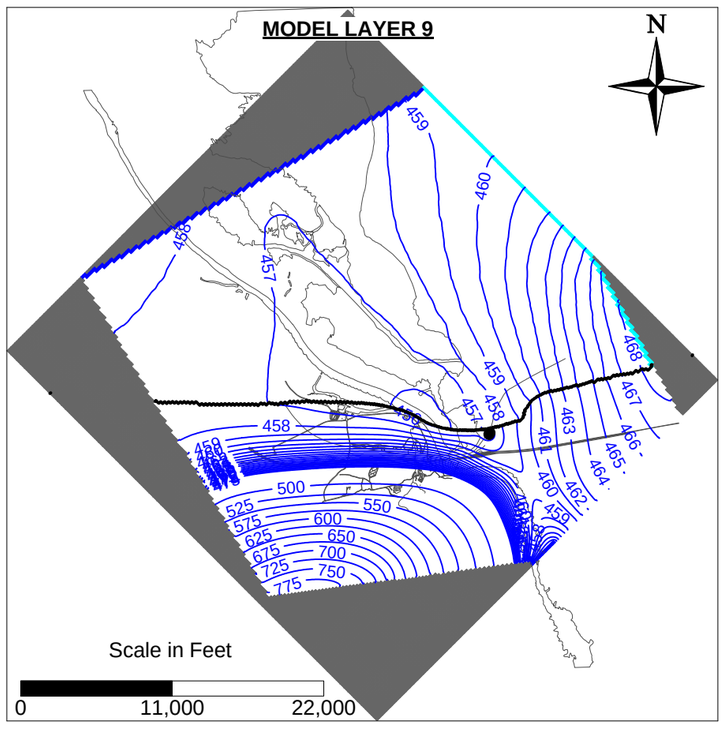
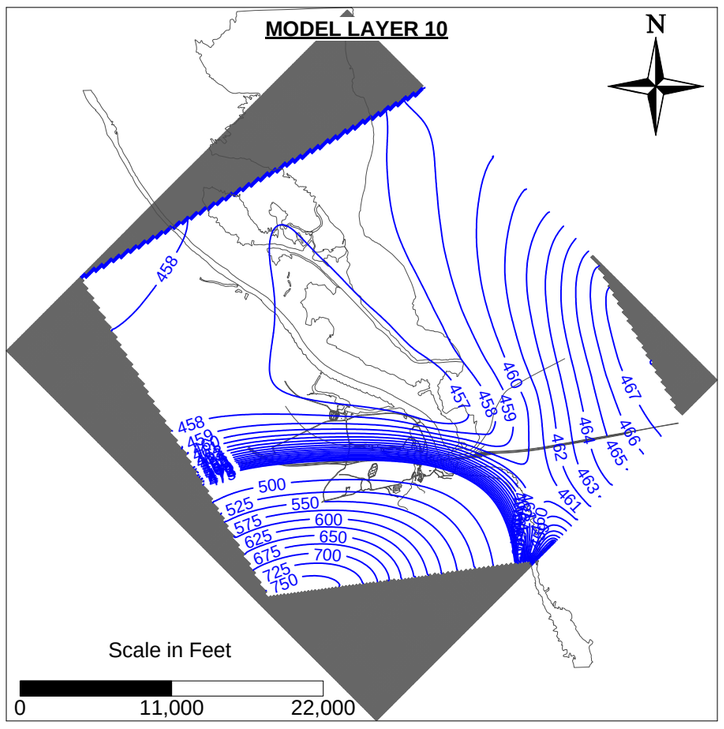
FIGURE
2.7-6











LEGEND

- Constant Head Boundary Cell
- General Head Boundary Cell
- No Flow Boundary Cell
- Extraction Wells
- Injection Wells
- 457 Simulated Groundwater Levels (ft NAVD 88)
- Bedrock Contact

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

REGIONAL SIMULATED WATER LEVELS MODEL LAYERS 6-10

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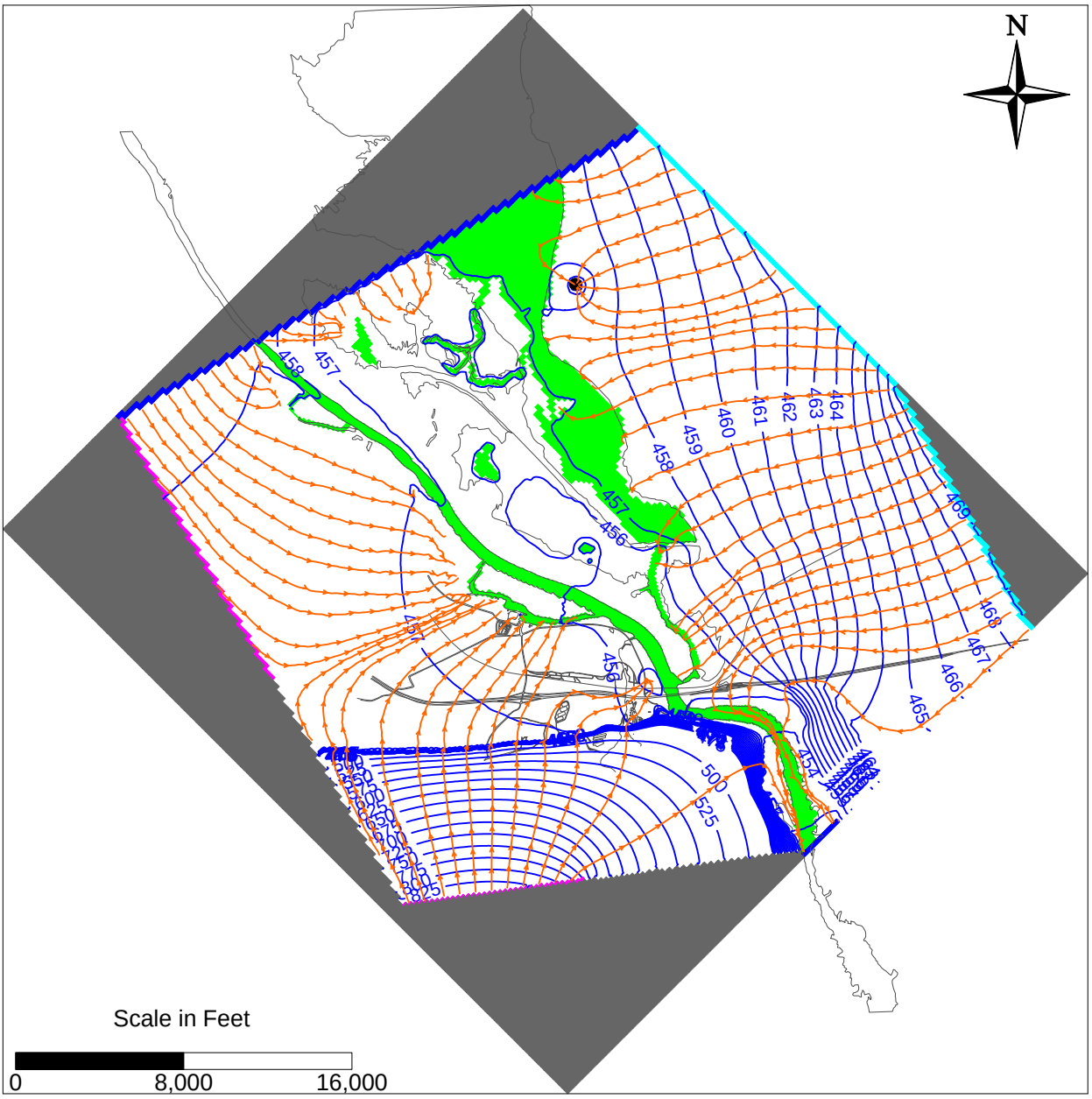
FIGURE
2.7-7



LEGEND

- Constant Flux Boundary Cell
- Constant Head Boundary Cell
- General Head Boundary Cell
- River Boundary Cell
- No Flow Boundary Cell
- Extraction Wells
- Simulated Groundwater Particle Pathline
  *Arrows are shown every 1,000 feet

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

REGIONAL SIMULATED GROUNDWATER FLOW AND PATHLINES

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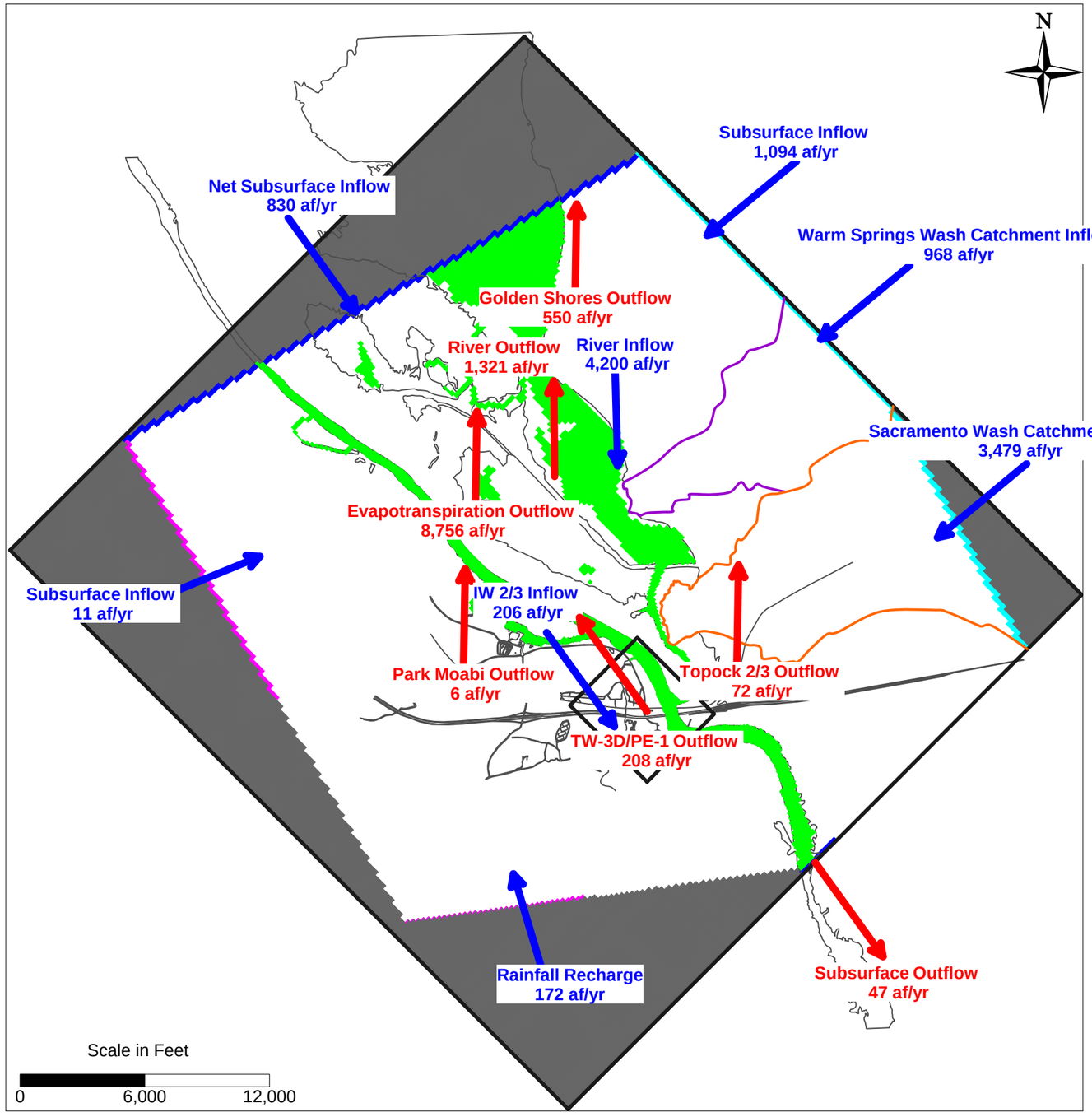
FIGURE
2.7-8



LEGEND

- Constant Flux Boundary Cell
- Constant Head Boundary Cell
- General Head Boundary Cell
- River Boundary Cell
- No Flow Boundary Cell
- Sacramento Wash Catchment
- Warm Springs Wash Catchment
- Inflow
- Outflow

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED INFLOW/OUTFLOW

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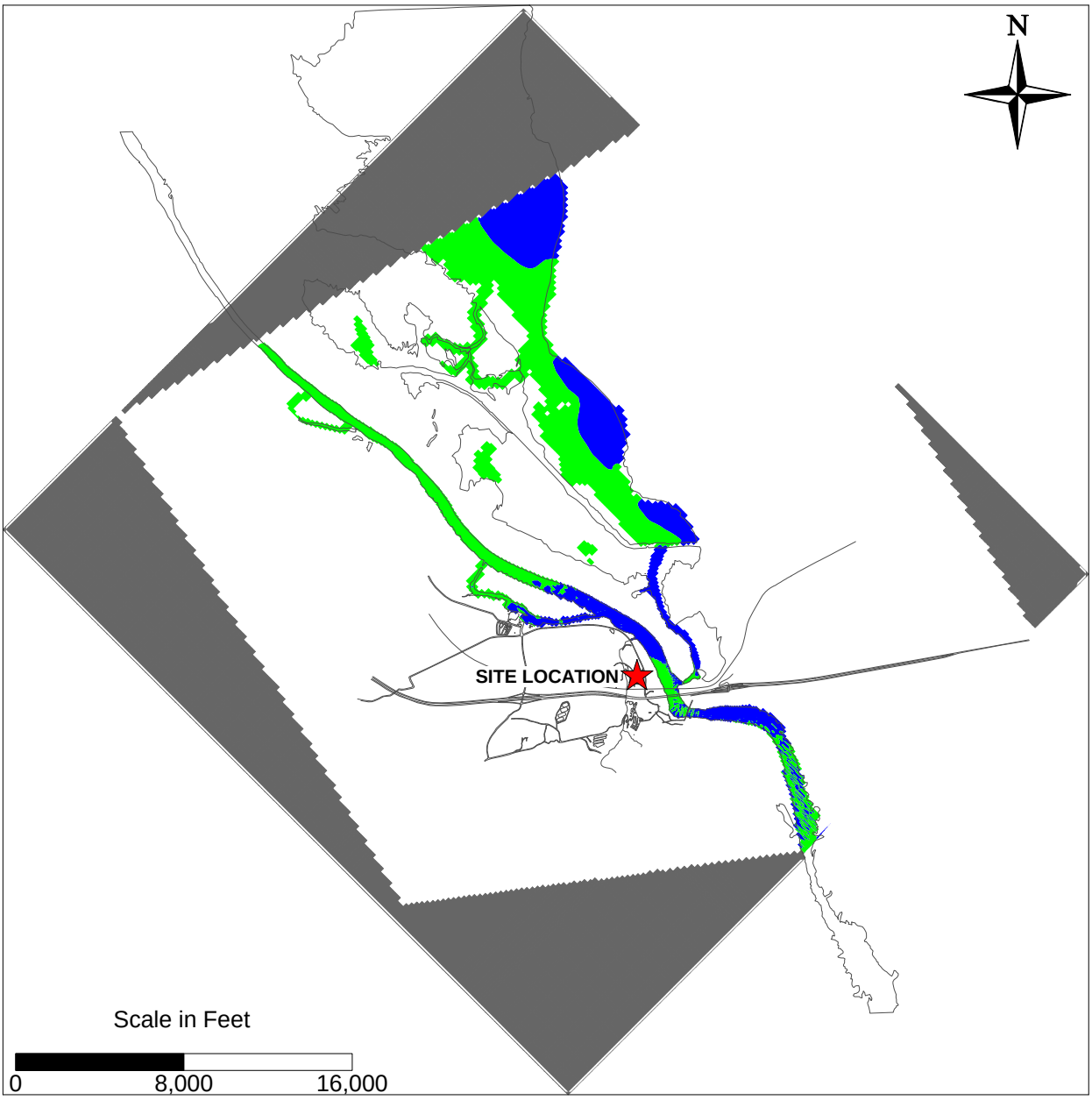
FIGURE
2.7-9



LEGEND

- Positive River Flux
- Negative River Flux
- No Flow Boundary Cell

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED GROUNDWATER-SURFACE WATER INTERACTION

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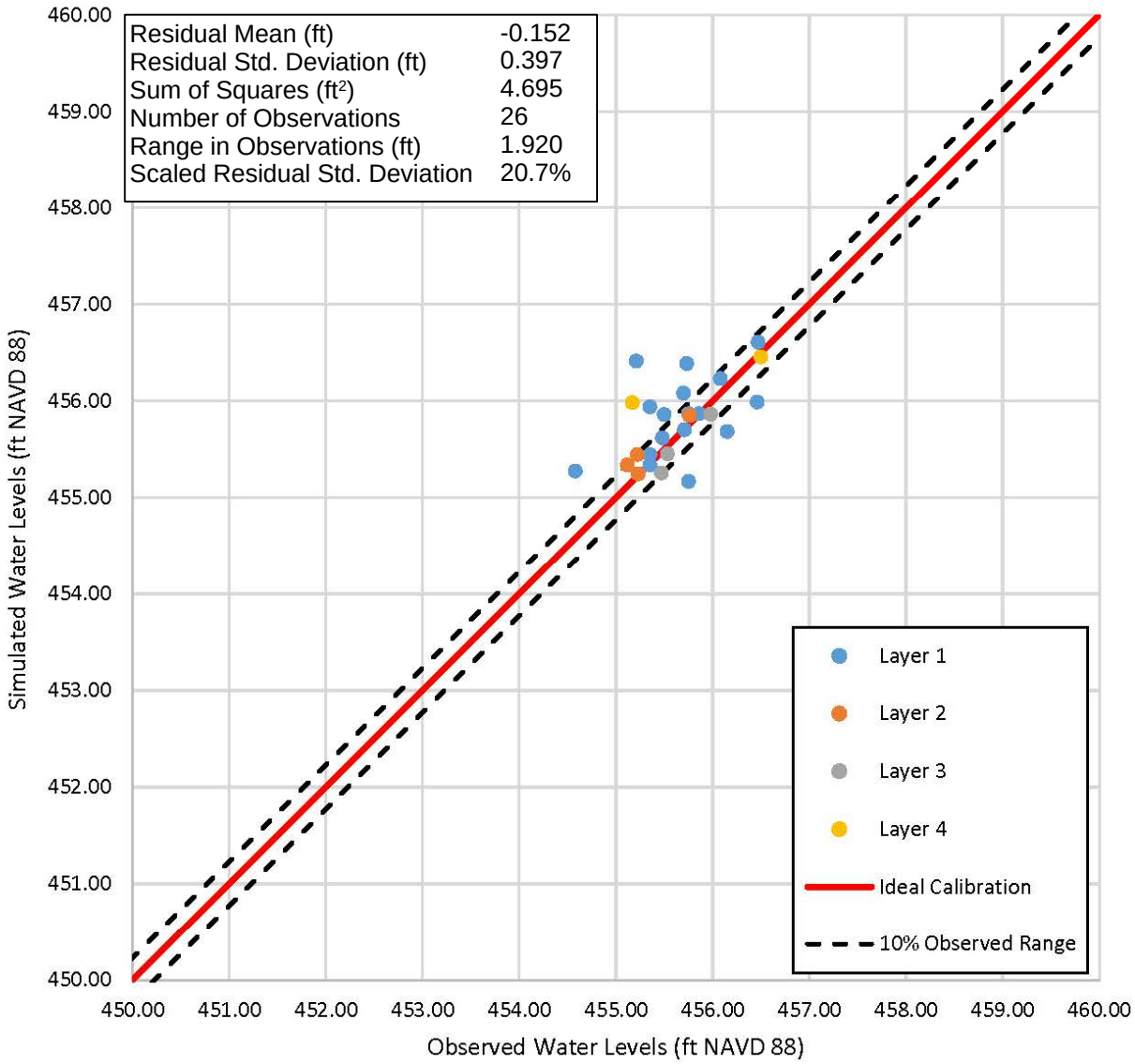
FIGURE
2.7-10



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NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED VS. OBSERVED WATER LEVELS PRE IM-3 CONDITIONS

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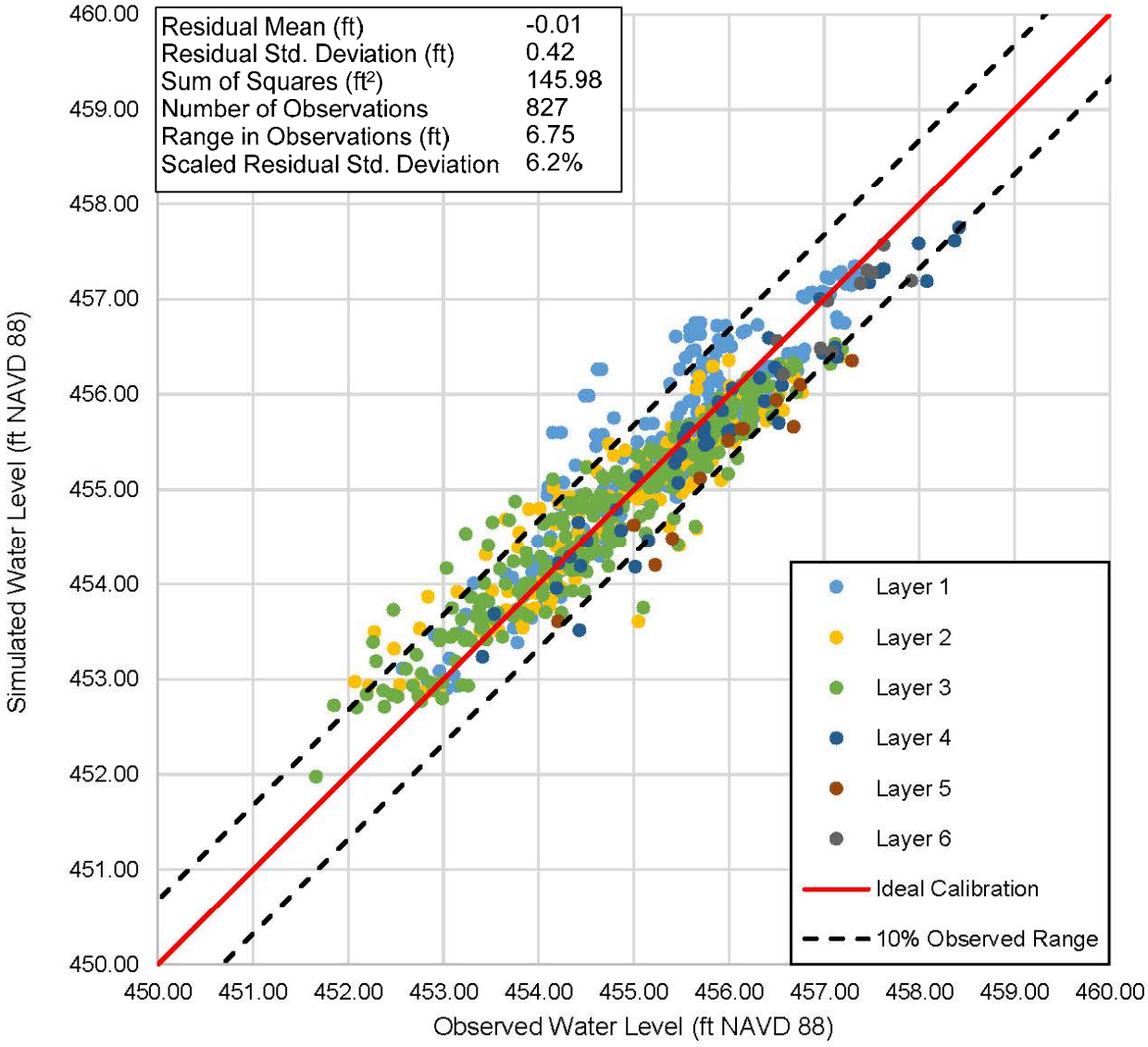
FIGURE
2.7-11



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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED VS. OBSERVED WATER LEVELS TRANSIENT CALIBRATION

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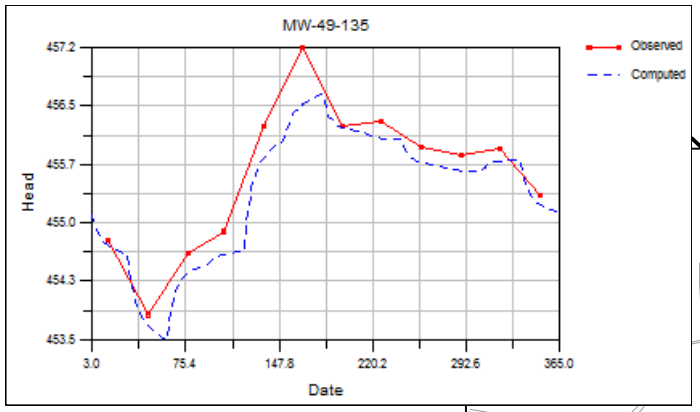
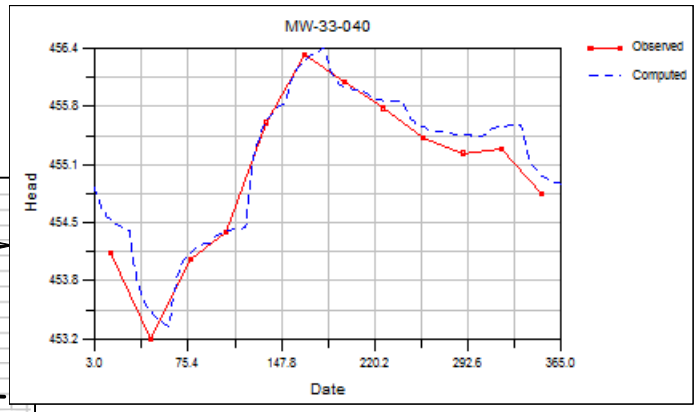
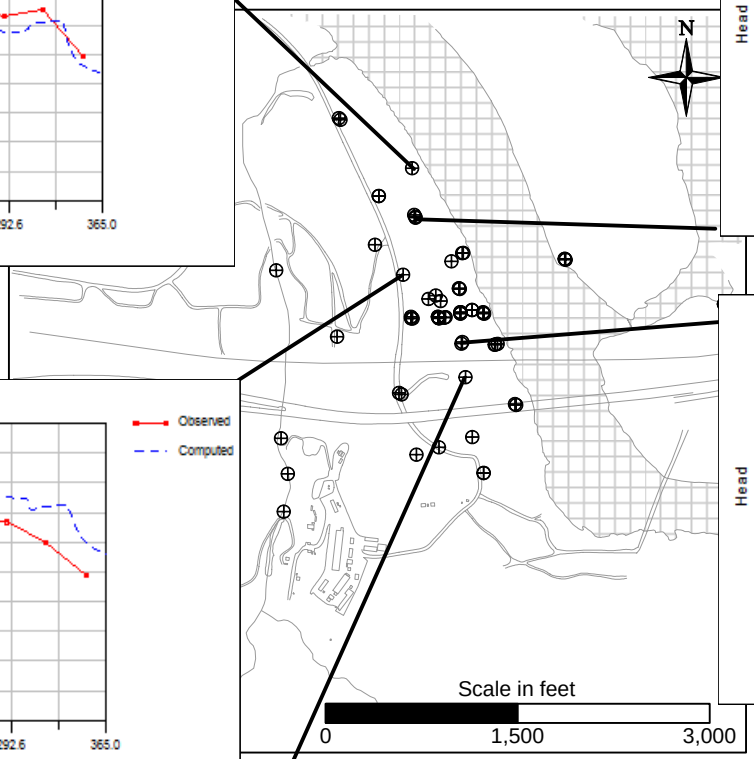
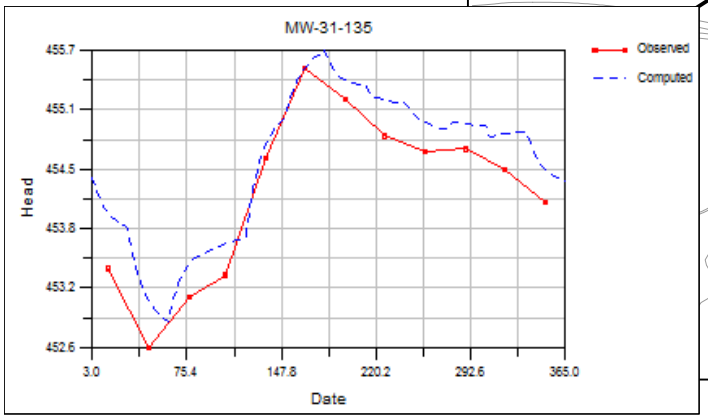
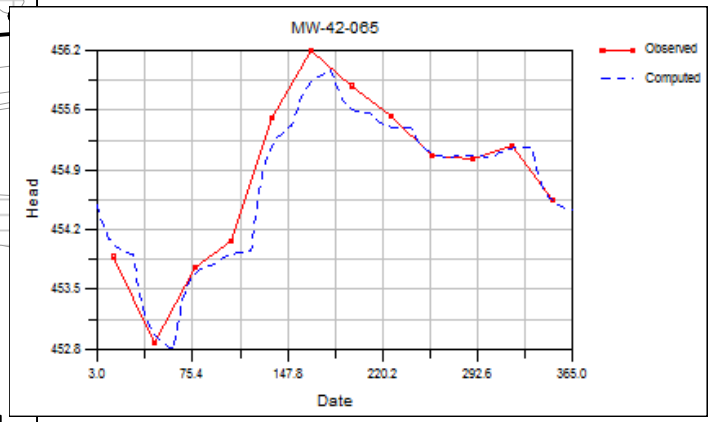
FIGURE
2.7-12

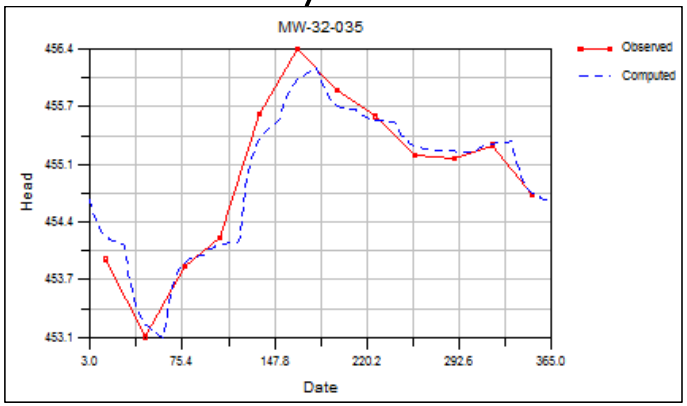












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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

FLOODPLAIN TRANSIENT HYDROGRAPHS

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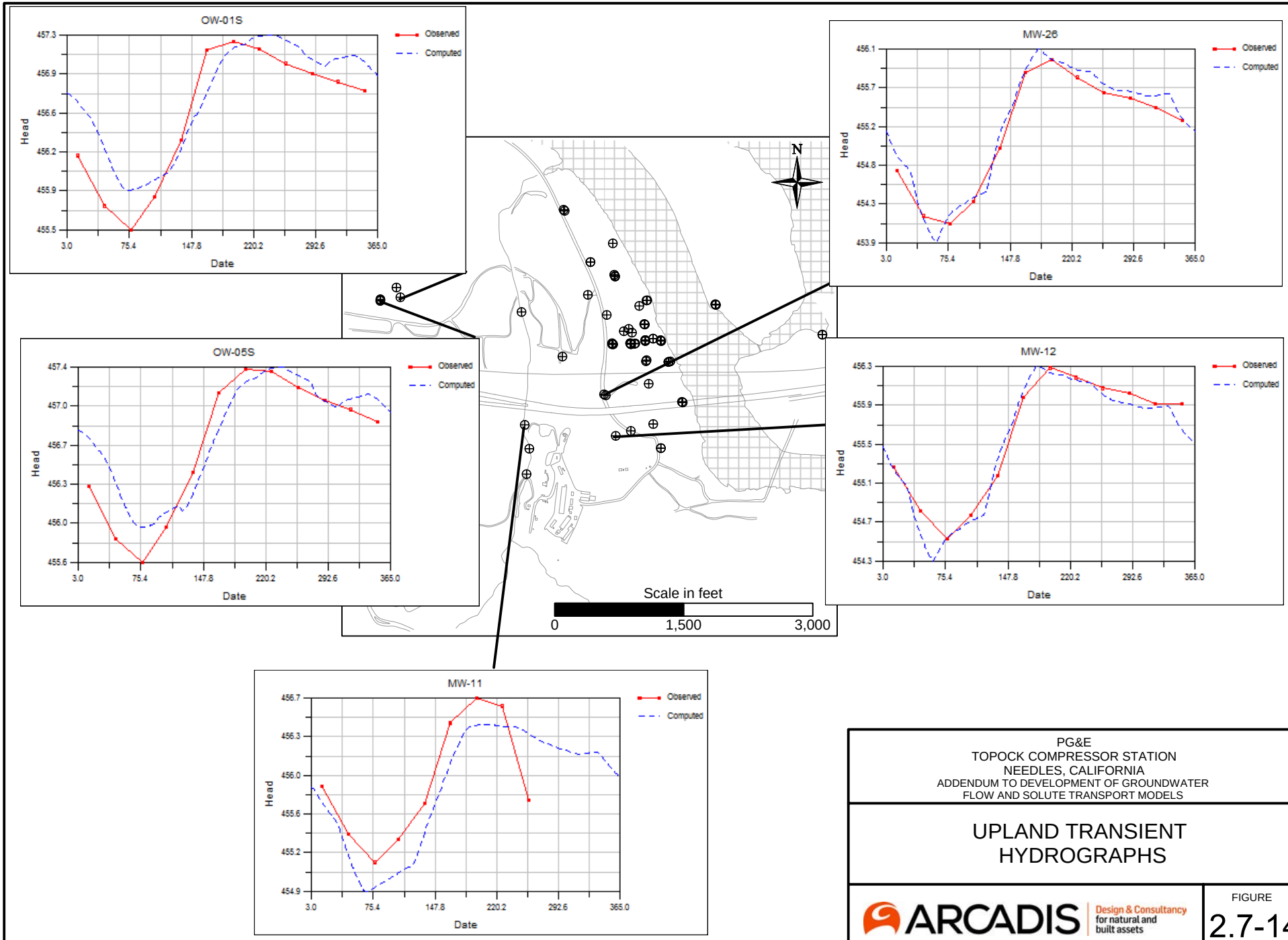
FIGURE
2.7-13



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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

UPLAND TRANSIENT HYDROGRAPHS

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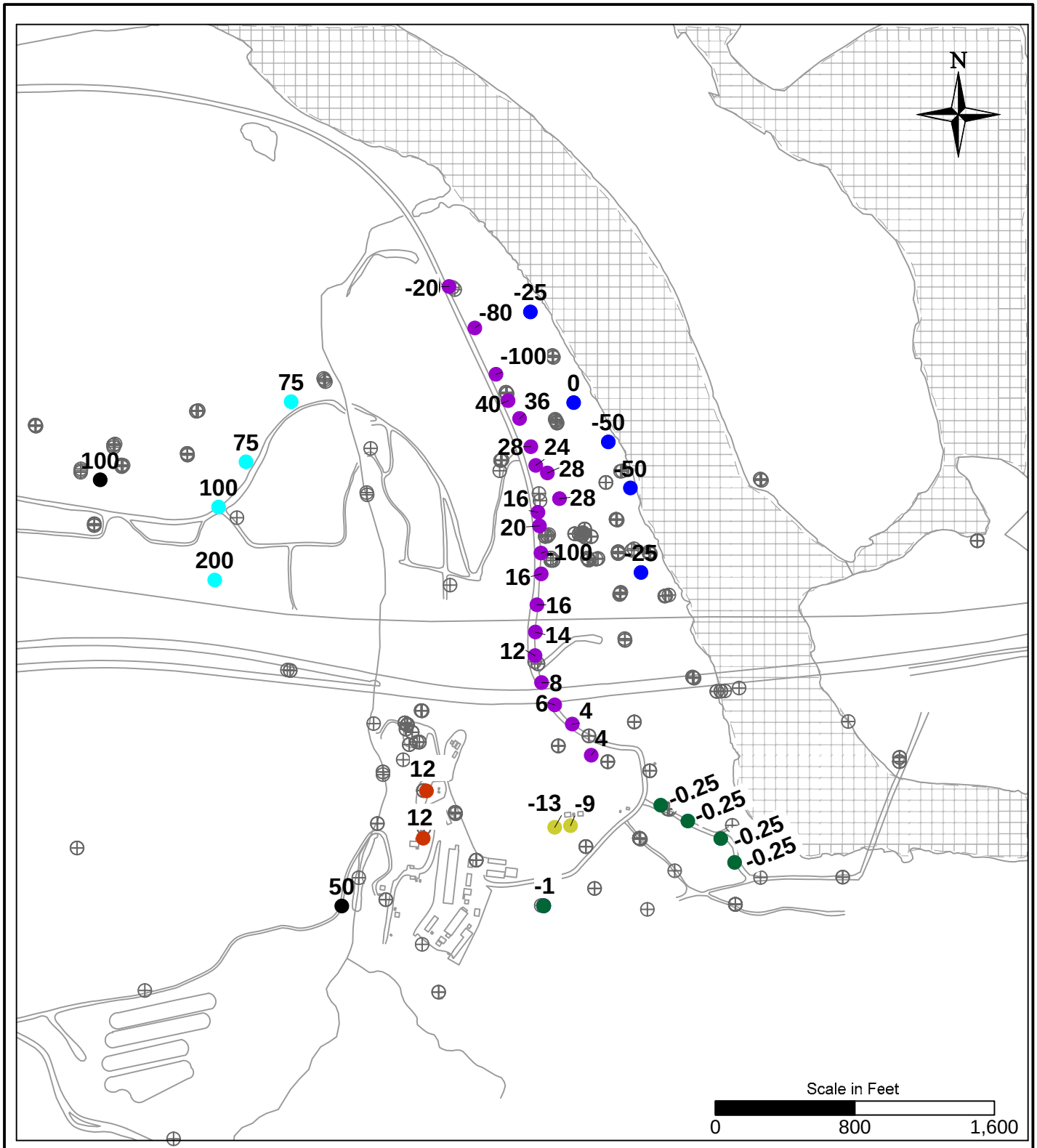
FIGURE
2.7-14



LEGEND

- NTH IRZ WELL LOCATIONS
- COMPRESSOR STATION INJECTION
- IRL INJECTION WELLS
- FRESHWATER INJECTION
- EAST RAVINE EXTRACTION WELLS
- RIVERBANK EXTRACTION WELLS
- TRANSWESTERN BENCH EXTRACTION WELLS
- MONITORING WELLS

Active Rates in GPM

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER
FLOW AND SOLUTE TRANSPORT MODELS

REMEDIATION DESIGN WELL LOCATIONS

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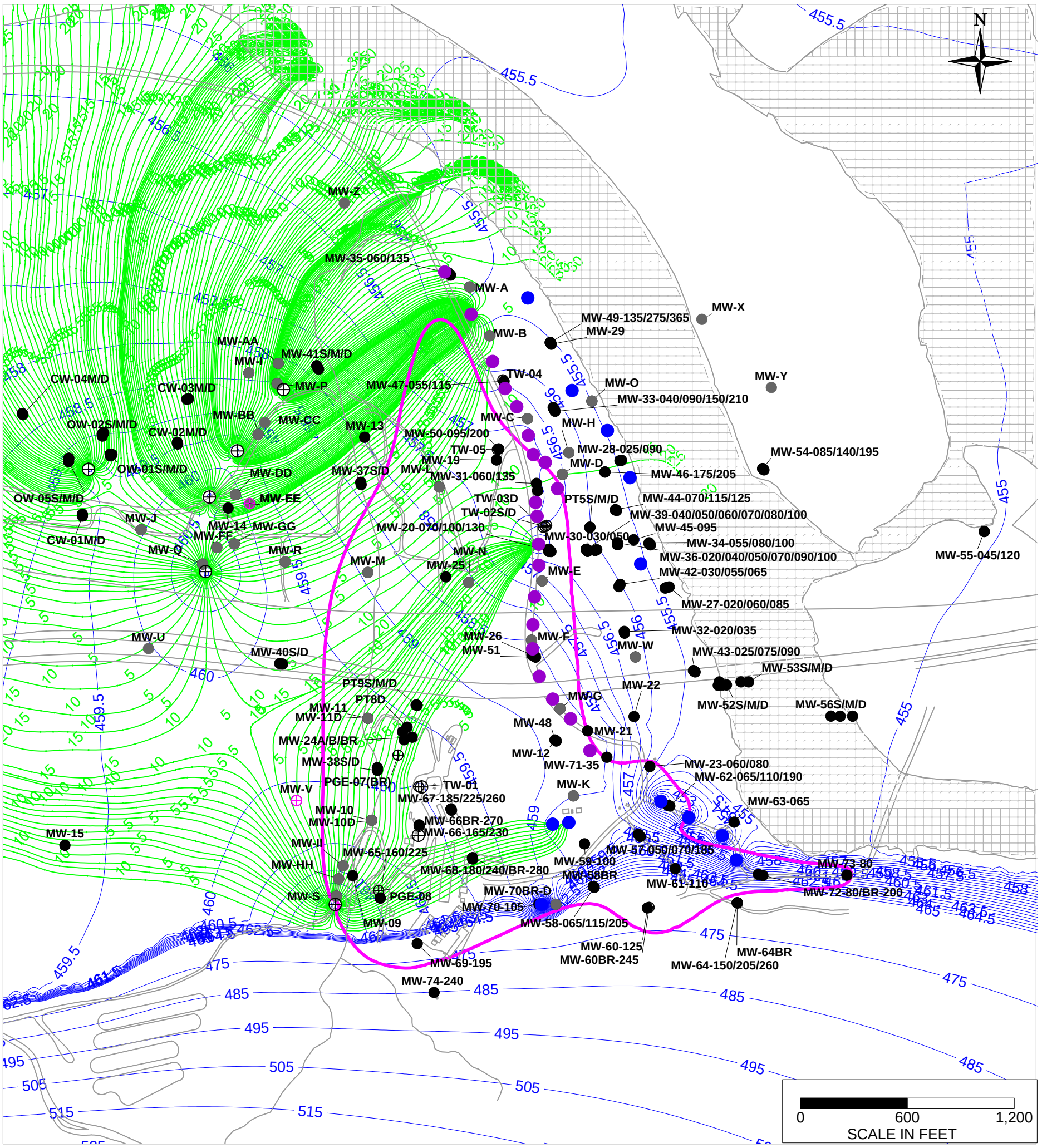
FIGURE
3-1



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 12 gpm
ER-2 = 0.25 gpm	TCS-2 = 12 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 1 - NTH IRZ ON

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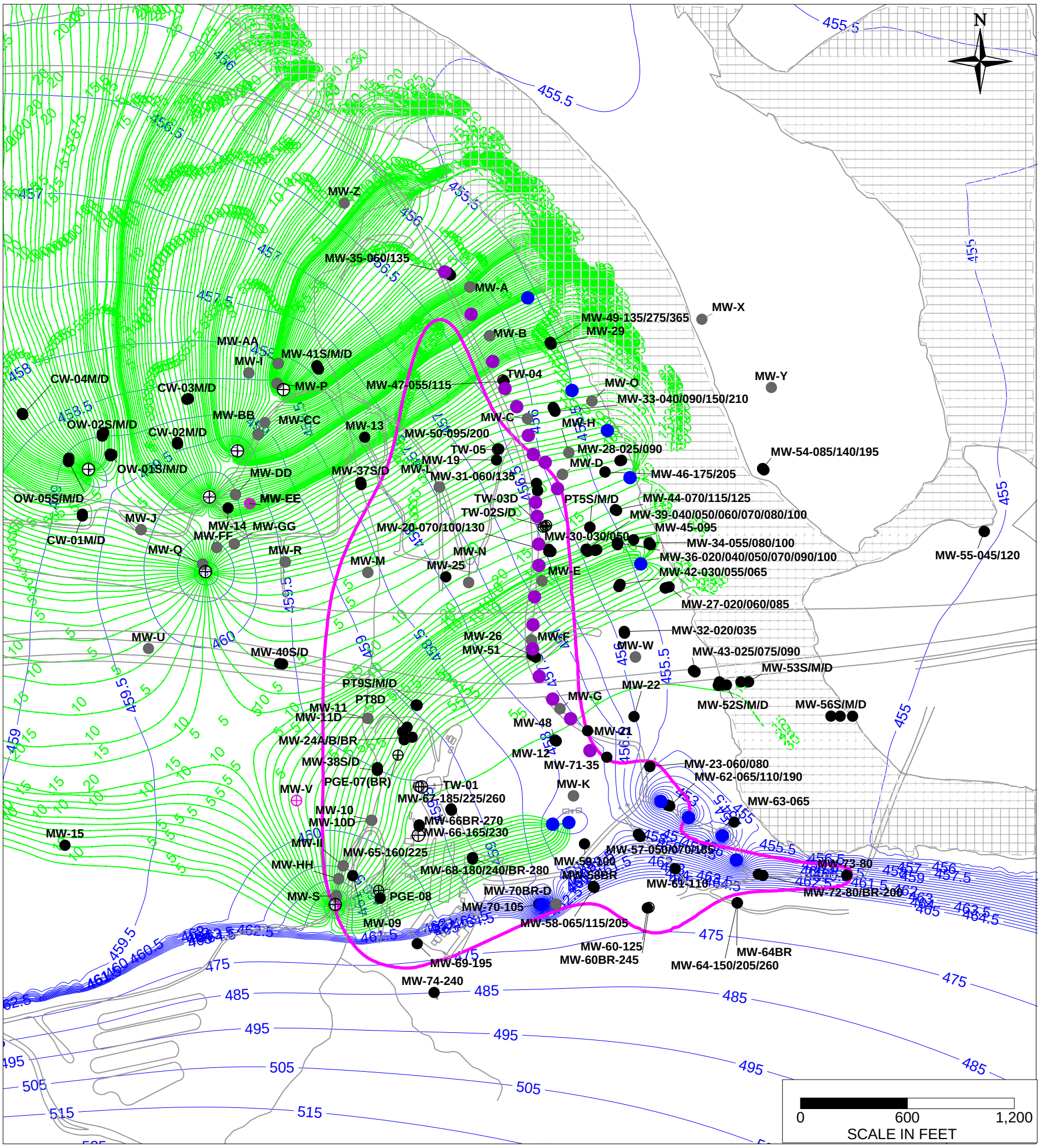
FIGURE 4-1



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS

- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.25 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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NEEDLES, CALIFORNIA
DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 1 - NTH IRZ OFF

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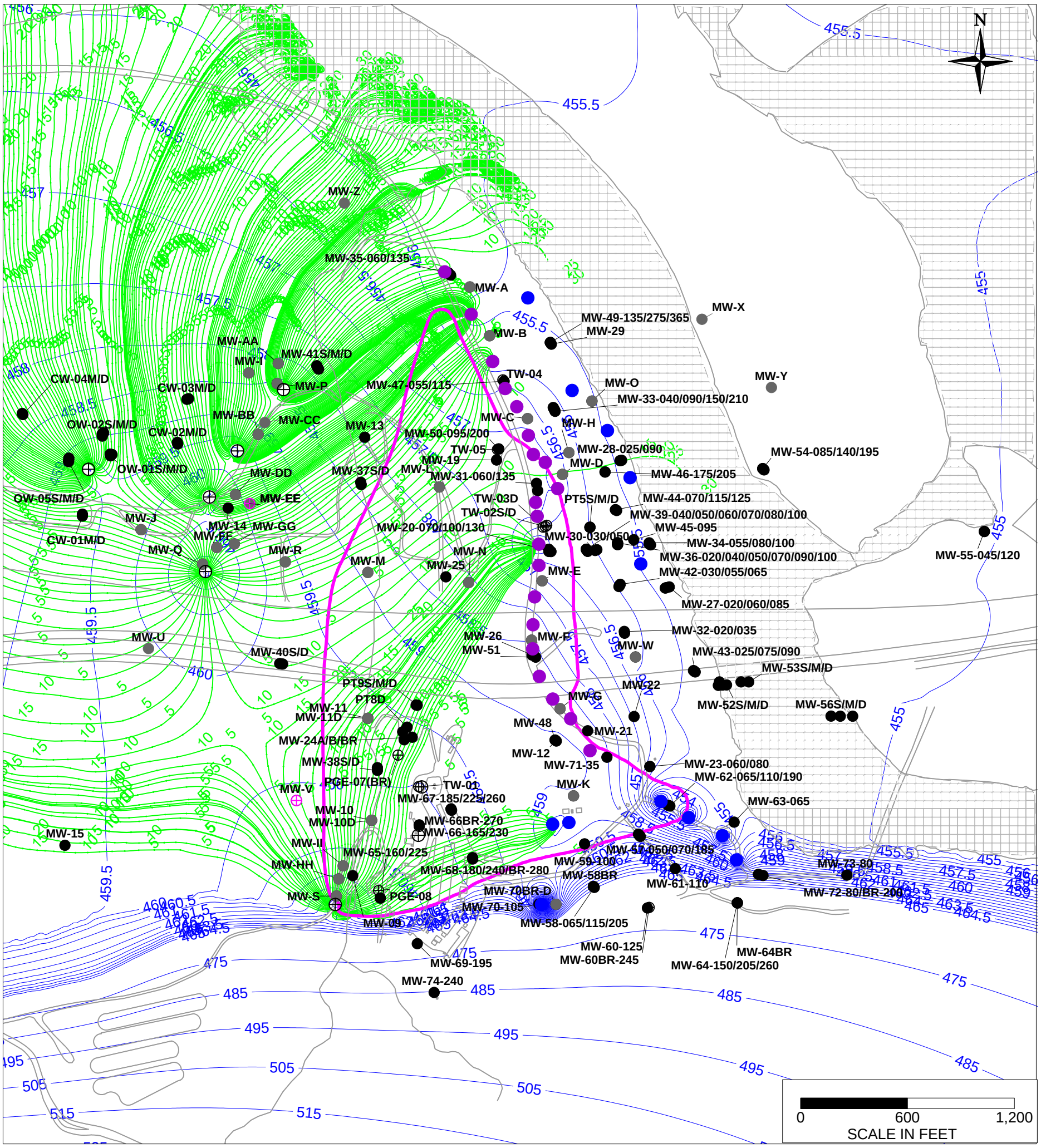
FIGURE 4-2



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 12 gpm
ER-2 = 0.25 gpm	TCS-2 = 12 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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NEEDLES, CALIFORNIA
DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 2 - NTH IRZ ON

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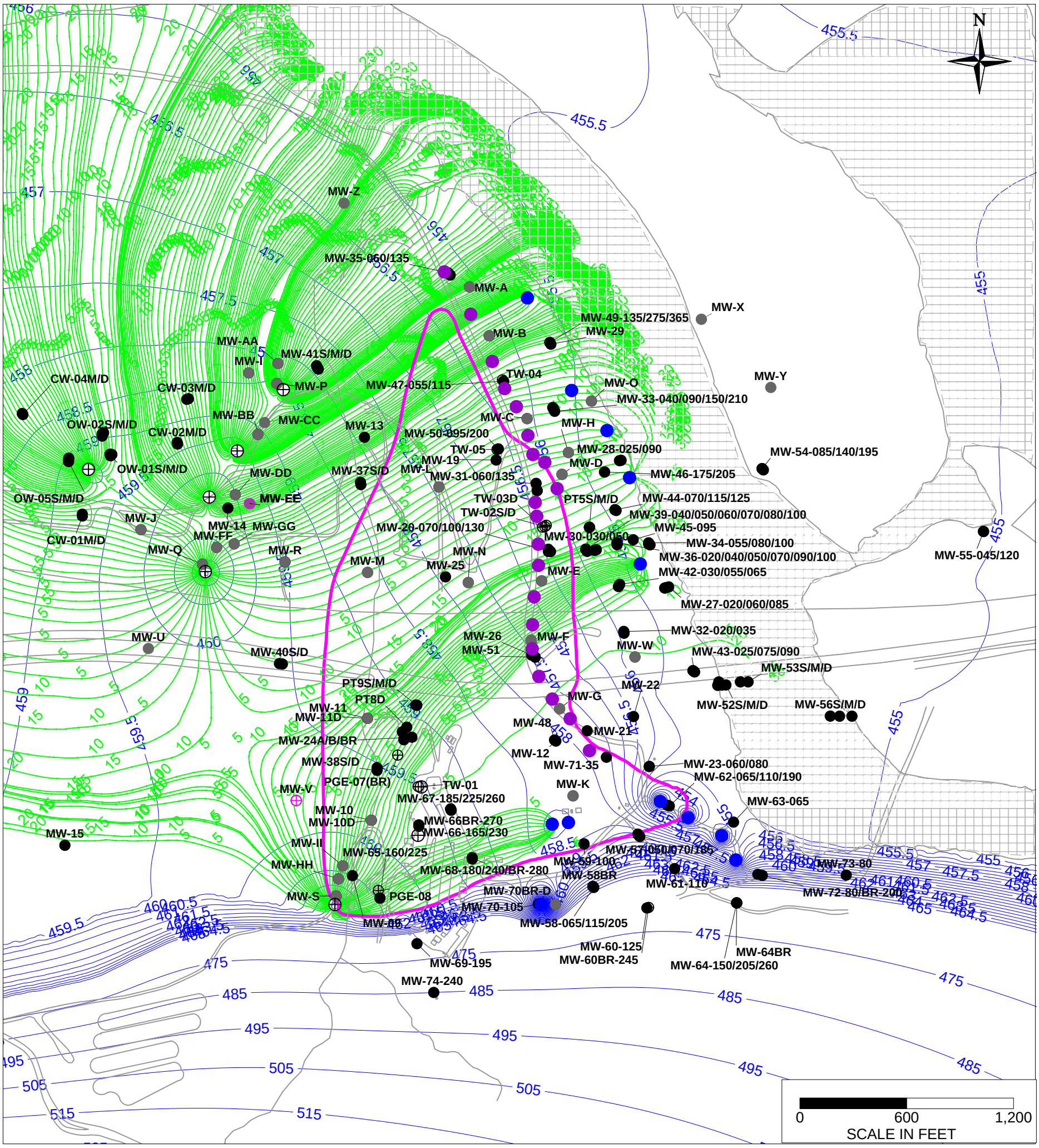
FIGURE 4-3



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.25 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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NEEDLES, CALIFORNIA
DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 2 - NTH IRZ OFF

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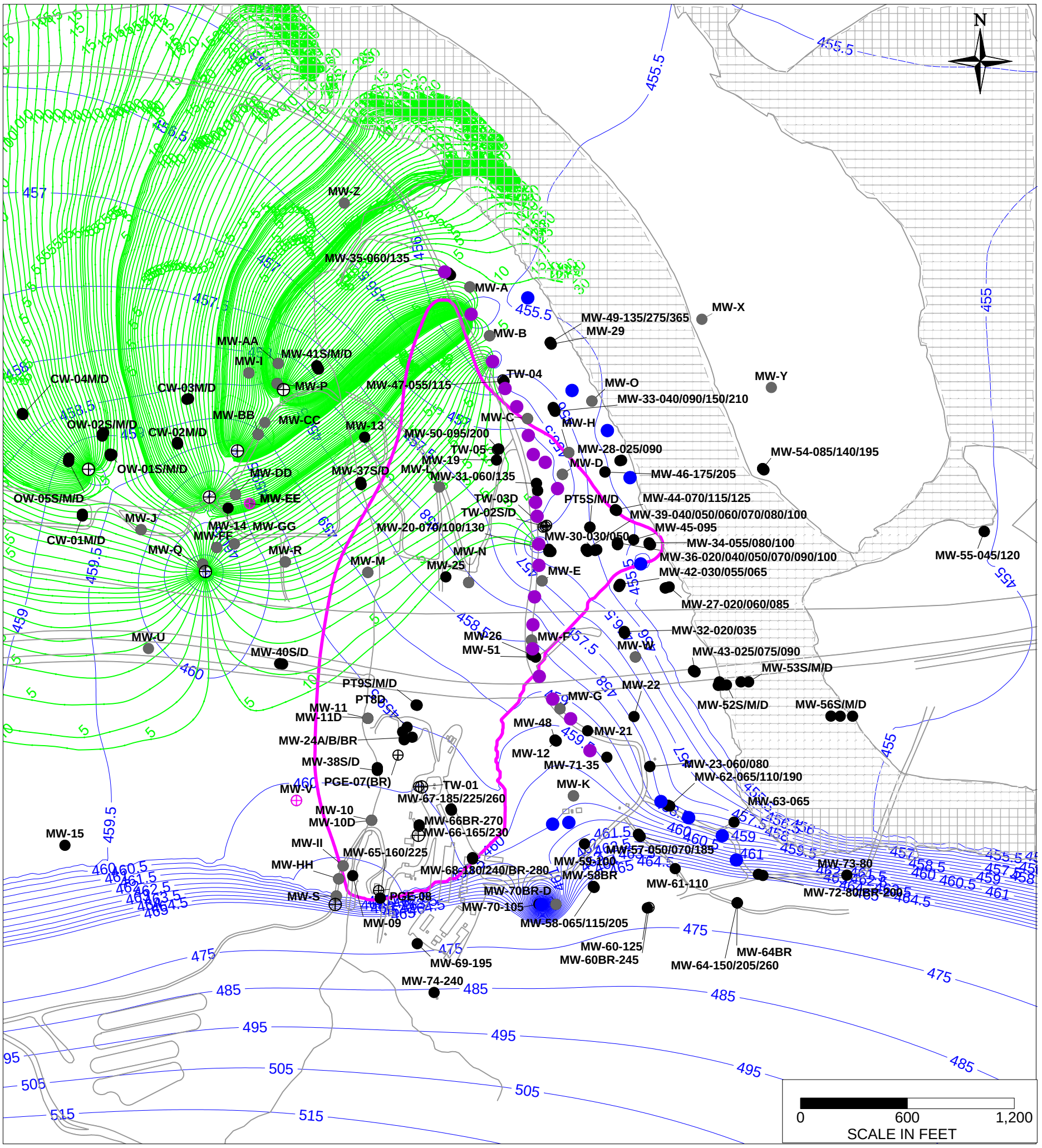
FIGURE 4-4



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- 460 — SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- 5 — SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 12 gpm
ER-2 = 0.25 gpm	TCS-2 = 12 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 3 - NTH IRZ ON

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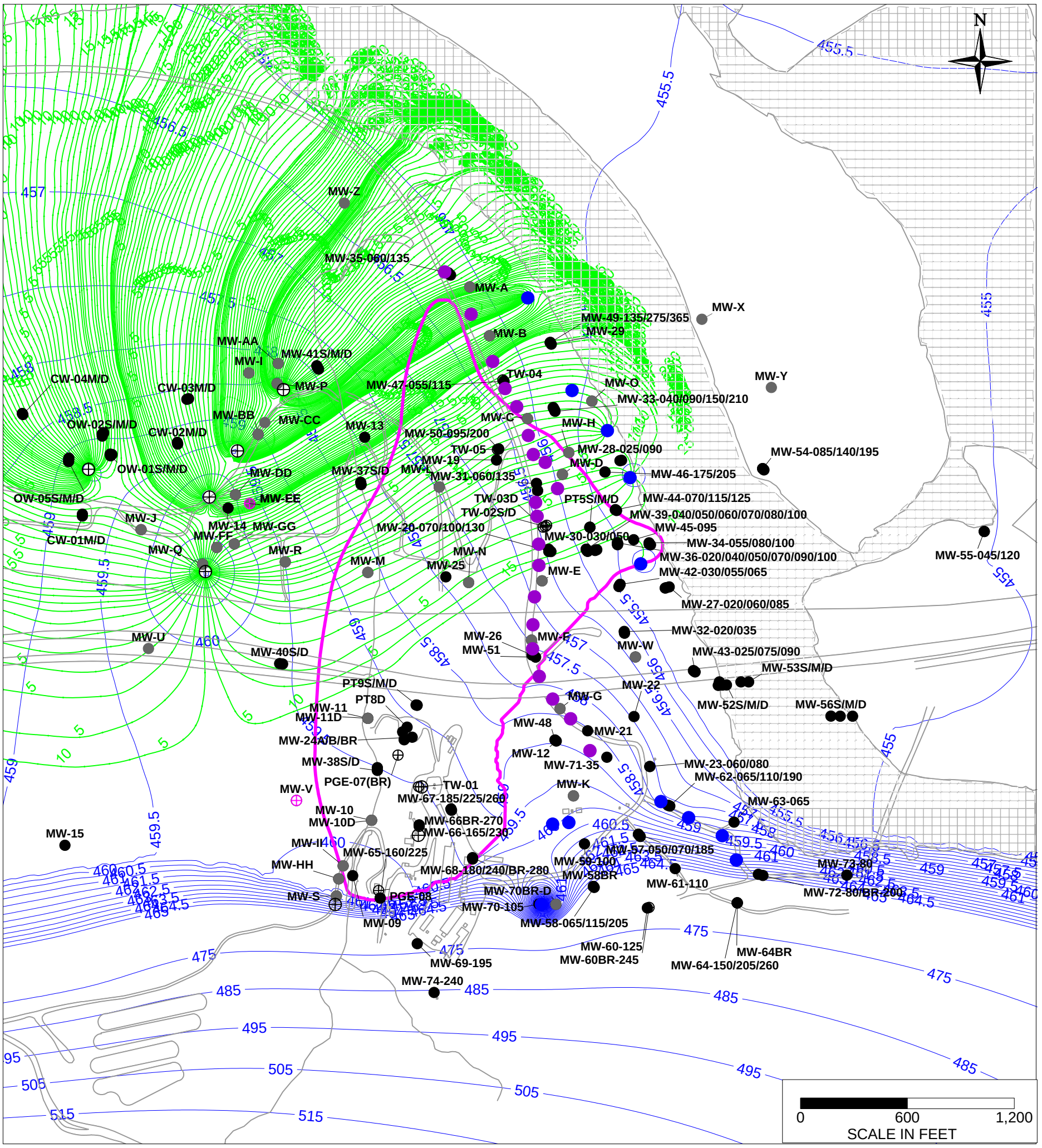
FIGURE 4-5



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- 460 — SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- 5 — SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.25 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 3 - NTH IRZ OFF

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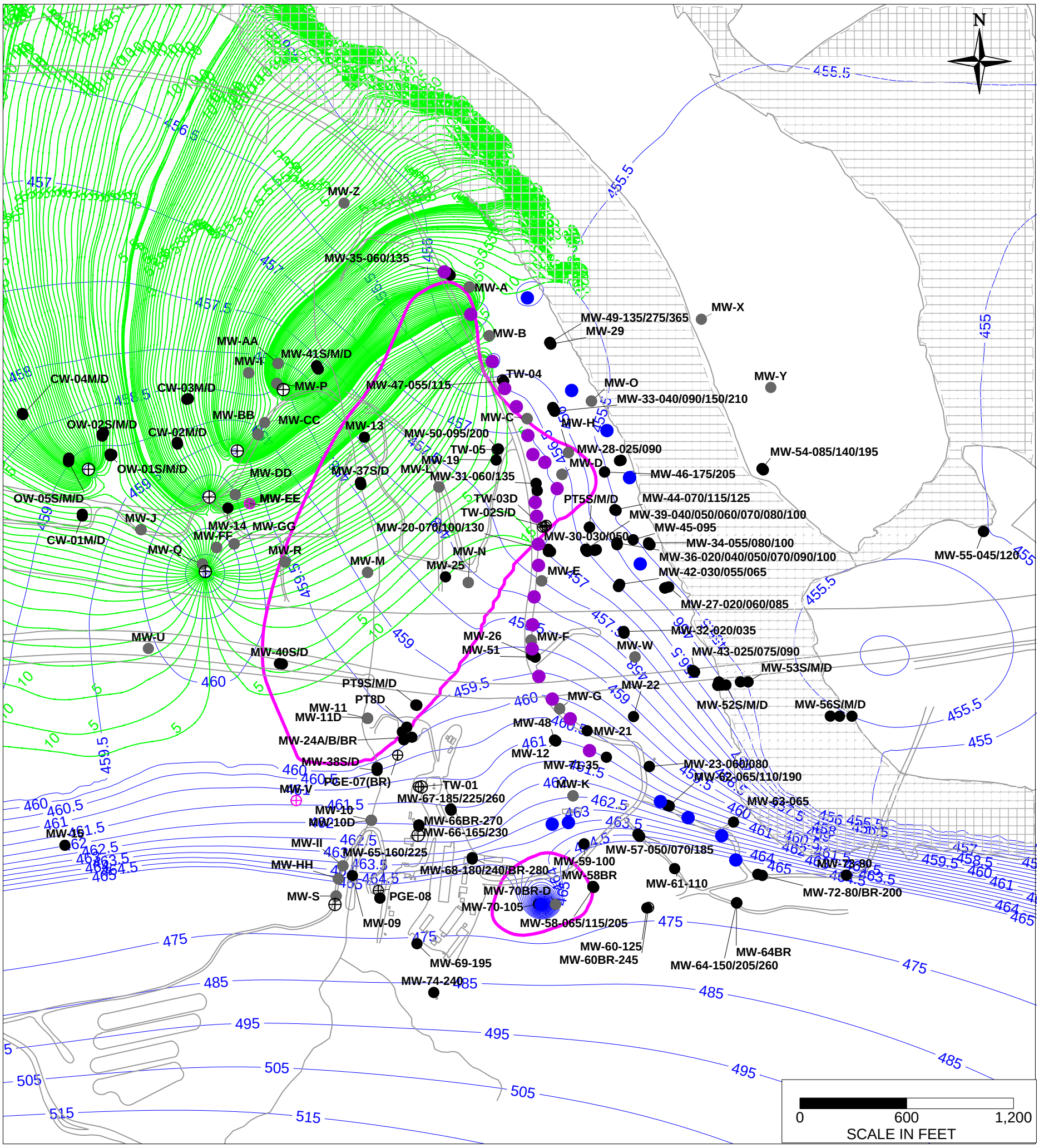
FIGURE 4-6



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 12 gpm
ER-2 = 0.25 gpm	TCS-2 = 12 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 4 - NTH IRZ ON

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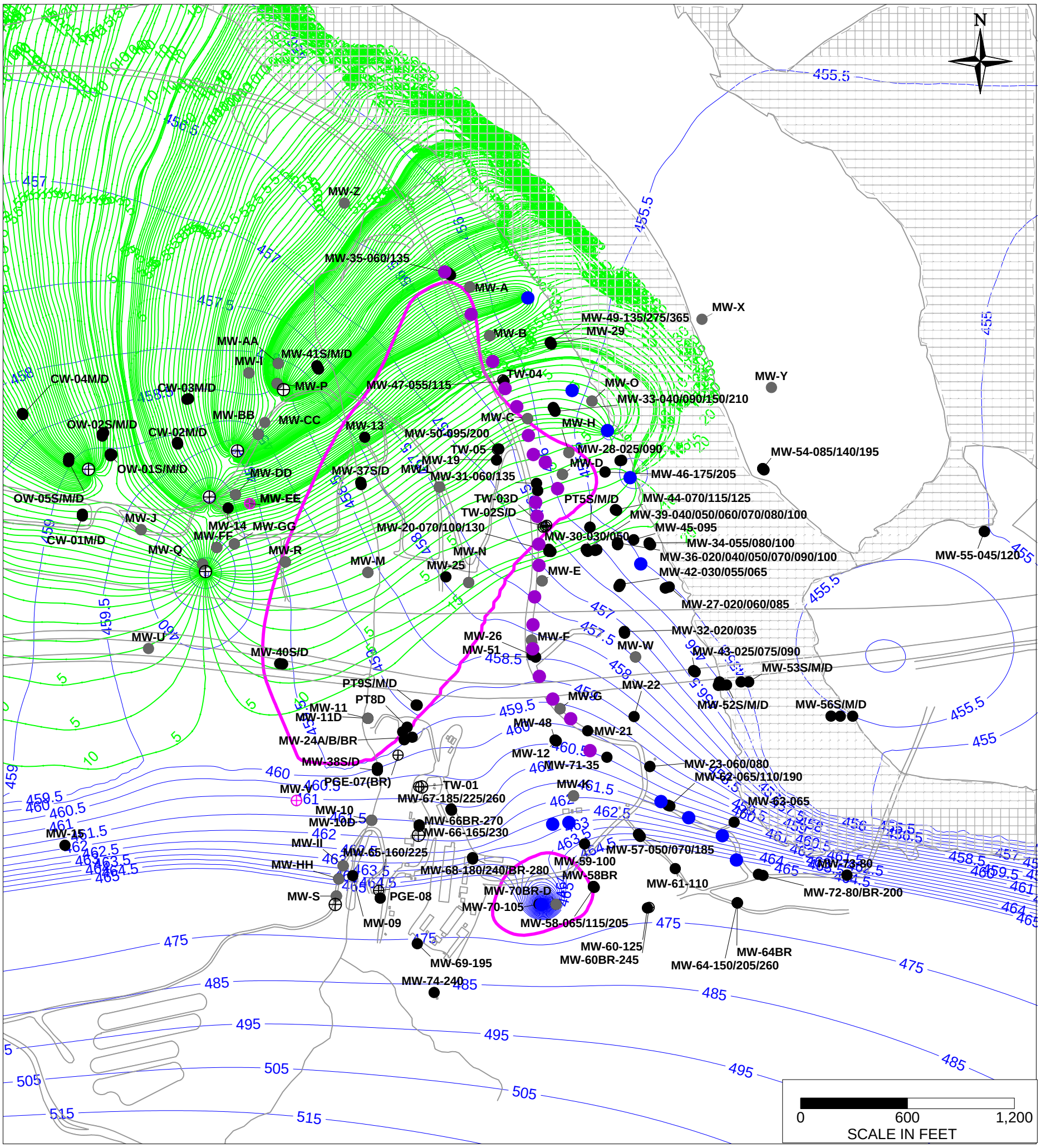
FIGURE 4-7



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.25 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 4 - NTH IRZ OFF

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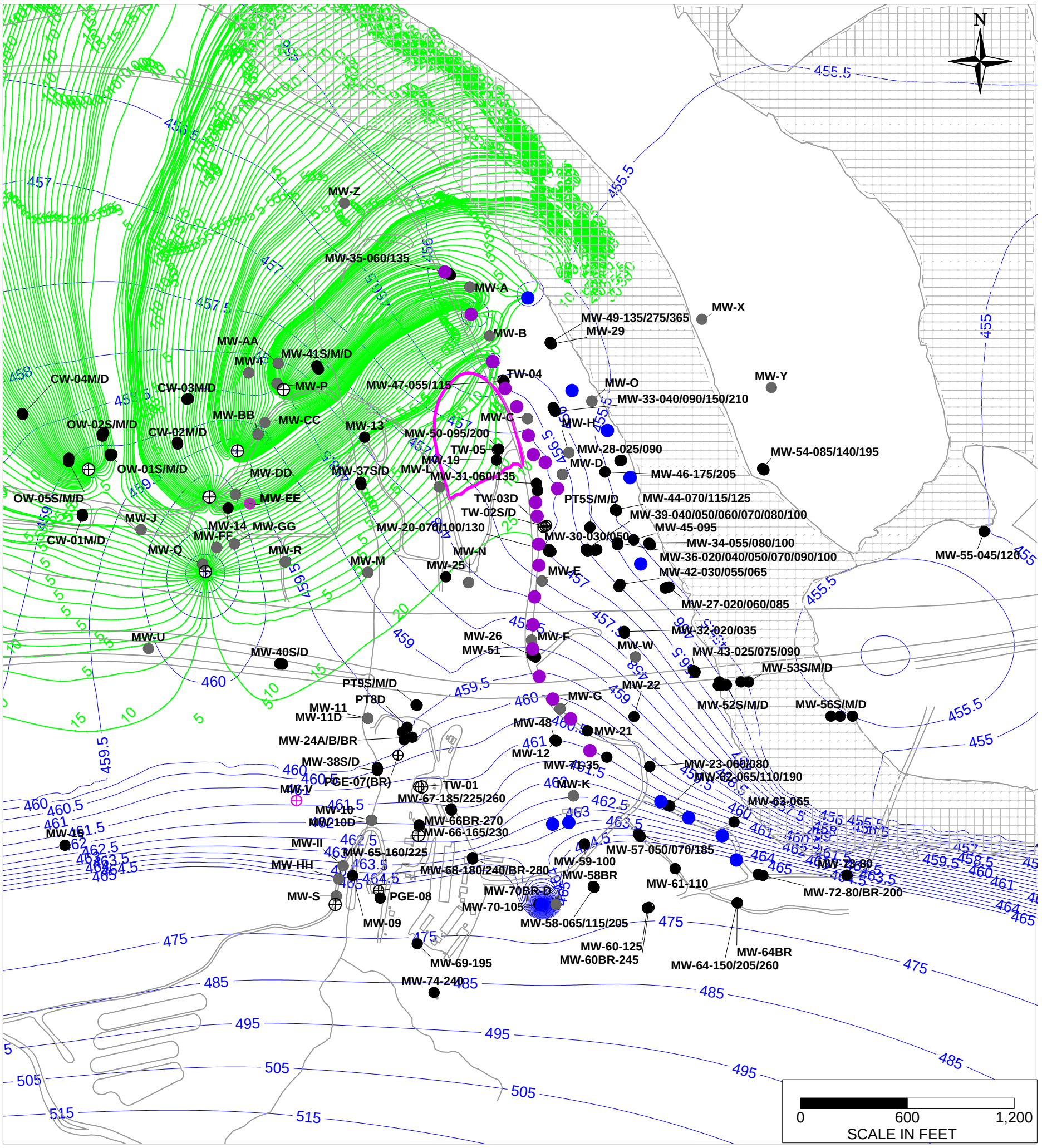
FIGURE 4-8



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (300 gpm)

EXTRACTION	INJECTION
NTH IRZ = 300 gpm	NTH IRZ = 300 gpm

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 12 gpm
ER-2 = 0.25 gpm	TCS-2 = 12 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED SUBSURFACE PATHLINES MODEL LAYER 5 - NTH IRZ ON

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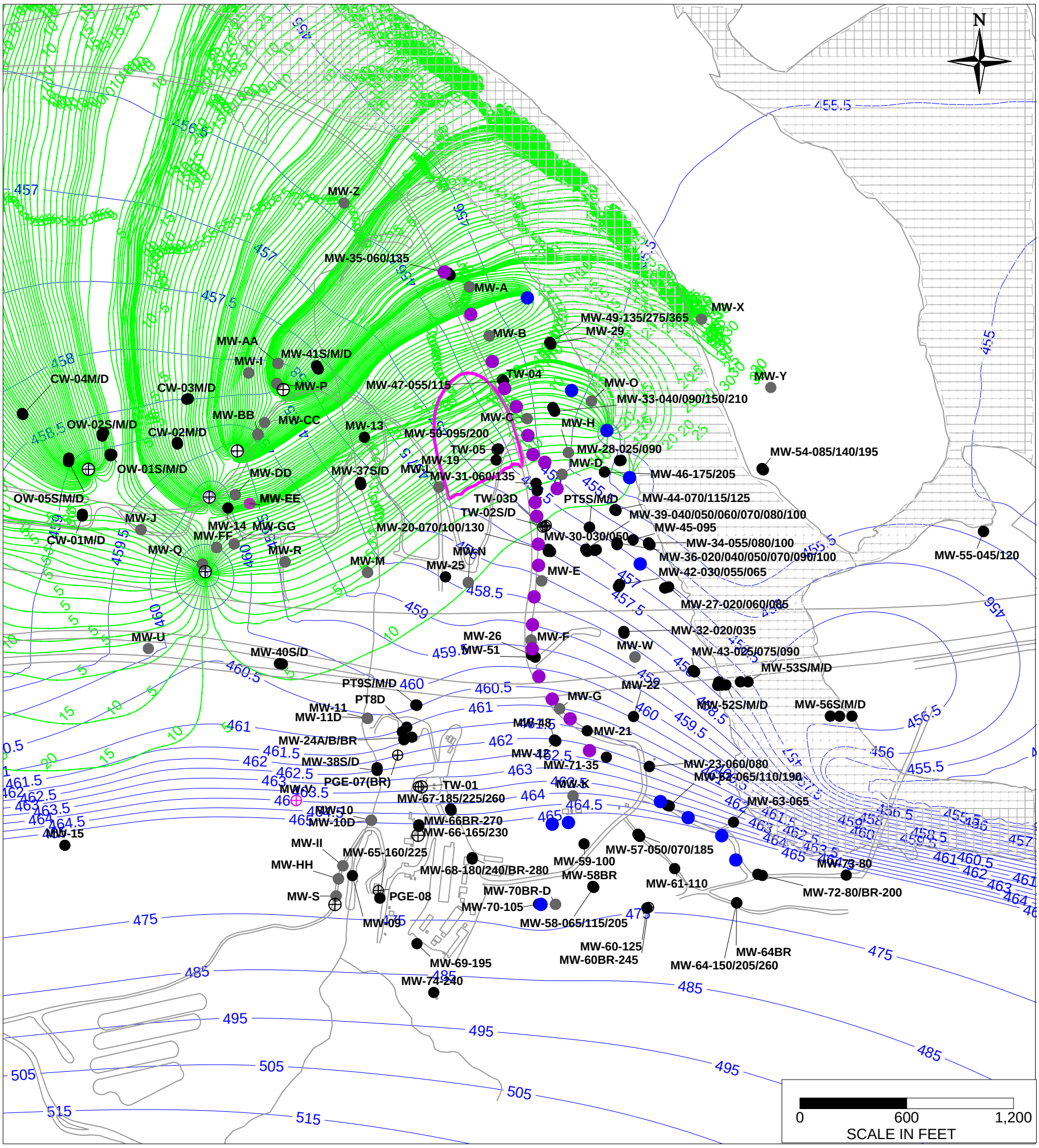
FIGURE 4-9



LEGEND

- IRZ WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- EXISTING MONITORING WELLS
- PROPOSED MONITORING WELLS
- FUTURE PROVISIONAL MONITORING WELLS
- –460– SIMULATED GROUNDWATER LEVELS (FT MSL)
- ESTIMATED DECEMBER 2015 HEXAVALENT CHROMIUM 32 ug/L CONTOUR
- –5– SIMULATED GROUNDWATER PARTICLE PATHLINE* (5 YEAR POSTINGS)

SIMULATED PUMPING RATES

NTH IRZ (OFF)

EXTRACTION	INJECTION
NTH IRZ = OFF	NTH IRZ = OFF

TCS LOOP (24 gpm)

EXTRACTION	INJECTION
ER-1 = 0.25 gpm	TCS-1 = 13.5 gpm
ER-2 = 0.25 gpm	TCS-2 = 13.5 gpm
ER-3 = 0.25 gpm	
ER-4 = 0.25 gpm	
ER-6 = 1.0 gpm	
TWB-1 = 13 gpm	
TWB-2 = 9 gpm	

IRL LOOP (150 gpm)

EXTRACTION	INJECTION
RB-1 = 25 gpm	IRL-1 = 75 gpm
RB-2 = OFF	IRL-2 = 75 gpm
RB-3 = 50 gpm	
RB-4 = 50 gpm	
RB-5 = 25 gpm	

FRESHWATER (450 gpm)

EXTRACTION	INJECTION
HNWR-1A = 450 gpm	FW-1 = 100 gpm
	FW-2 = 50 gpm
	IRL-3 = 100 gpm
	IRL-4 = 200 gpm

*Simulated particle pathlines depict simulated groundwater flow and are not representative of solute transport as they do not take into account mechanisms such as sorption, reduction, oxidation, degradation, etc.

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SIMULATED SUBSURFACE PATHLINES MODEL LAYER 5 - NTH IRZ OFF

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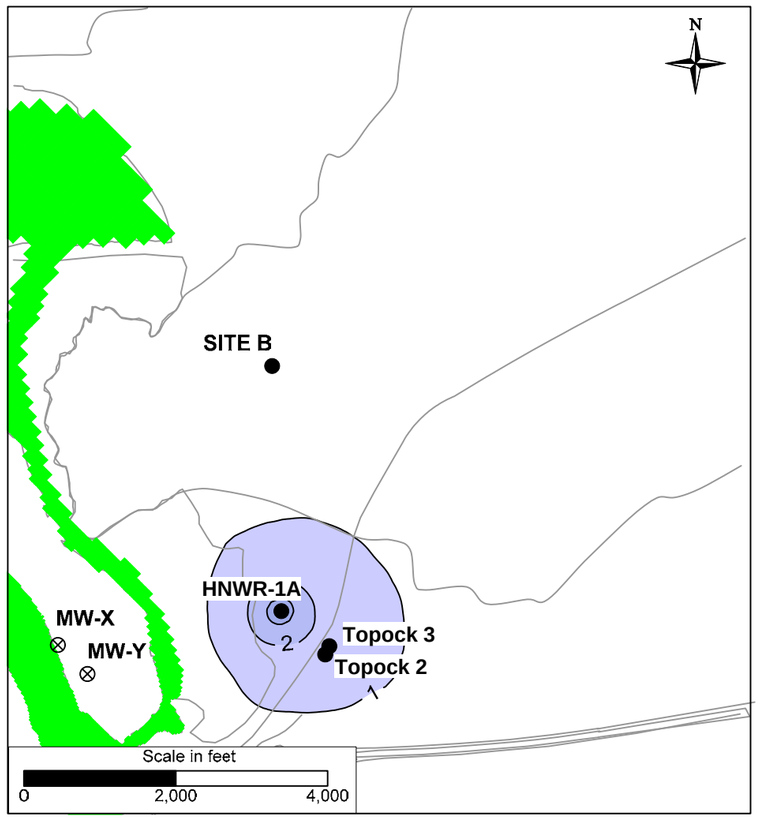
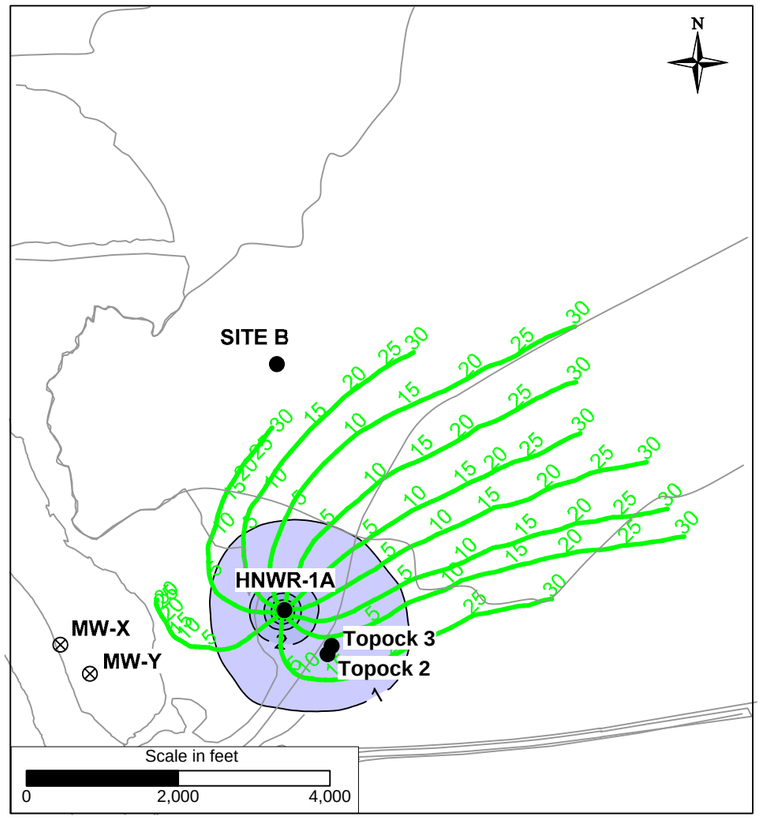
FIGURE 4-10

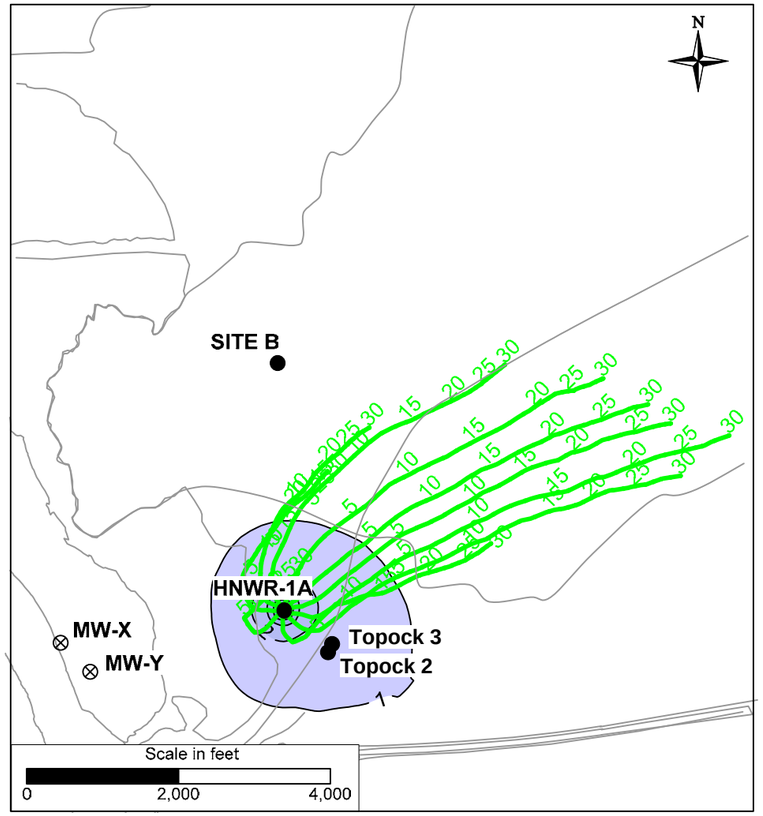
Model Layer 1



Model Layer 3



Model Layer 4



Legend

- River Cell
- Extraction Wells
- Monitoring Wells
- 5 — Simulated Groundwater Particle Pathlines (5 year postings)

Simulated Groundwater Drawdown (feet)

1 2 3 4 5 6 7 8 9 10

*Extraction Wells Topock 2 and 3 and monitoring wells MW-X and MW-Y are shown for reference.

**Particles for reverse particle tracking pathlines for well HNWR-1A were initialized in screened model layers 3 and 4

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ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

SIMULATED DRAWDOWN AND REVERSE PARTICLE TRACKING FOR HNWR-1A EXTRACTING AT 450 GPM

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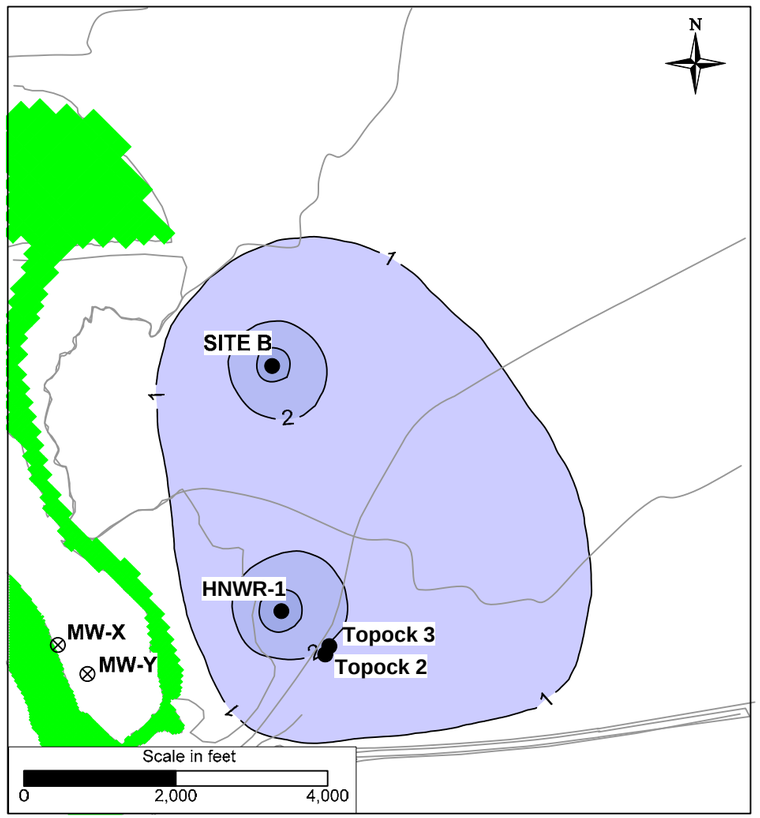
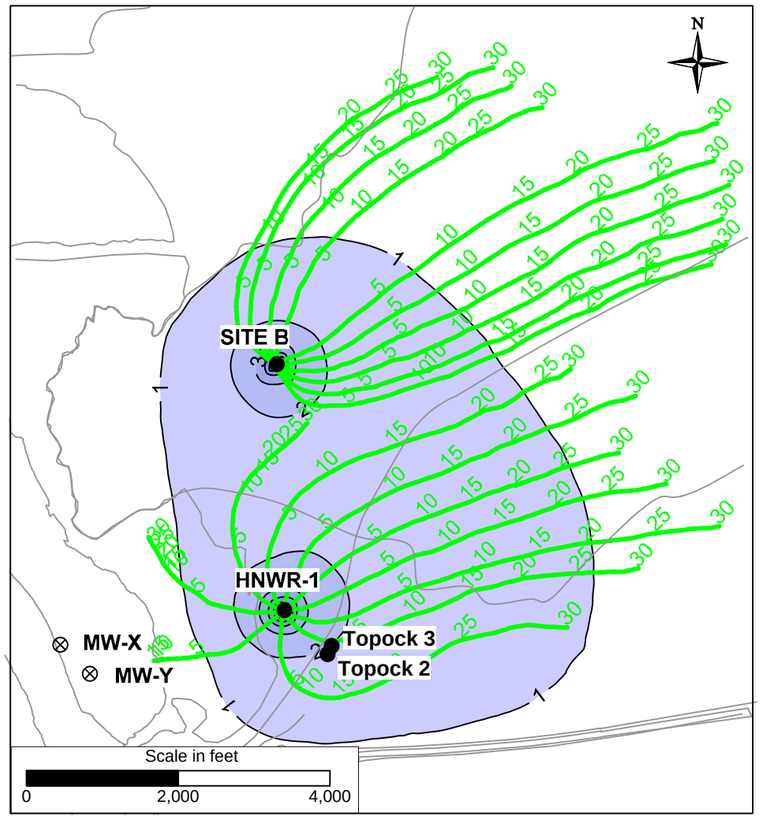
FIGURE
5.1-1

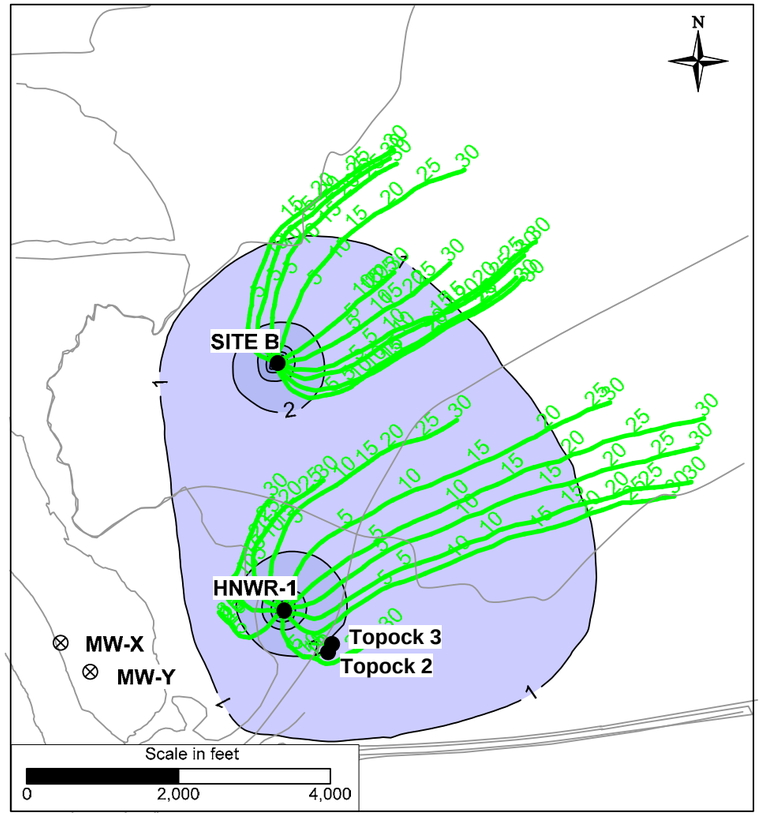
Model Layer 1



Model Layer 3



Model Layer 4



Legend

- River Cell
- Extraction Wells
- Monitoring Wells
- 5 — Simulated Groundwater Particle Pathlines (5 year postings)

Simulated Groundwater Drawdown (feet)

1 2 3 4 5 6 7 8 9 10

*Extraction Wells Topock 2 and 3 and monitoring wells MW-X and MW-Y are shown for reference.

**Particles for reverse particle tracking pathlines for well HNWR-1A and Site B were initialized in screened model layers 3 and 4

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SIMULATED DRAWDOWN AND REVERSE PARTICLE TRACKING FOR HNWR-1A AND SITE B EXTRACTING AT 450 GPM EACH

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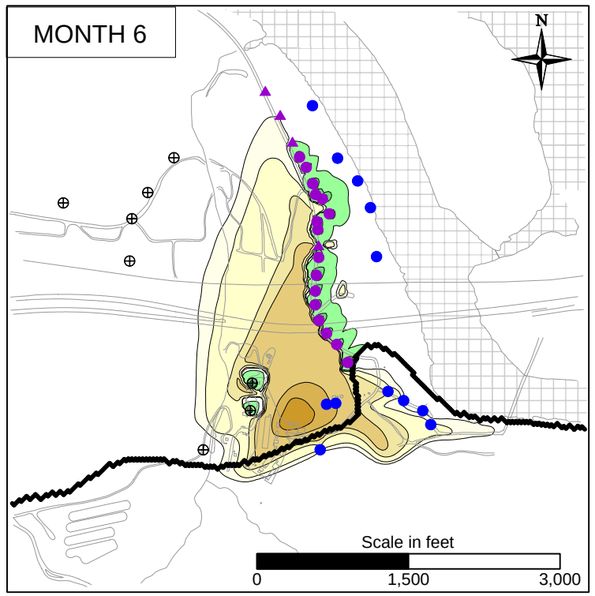
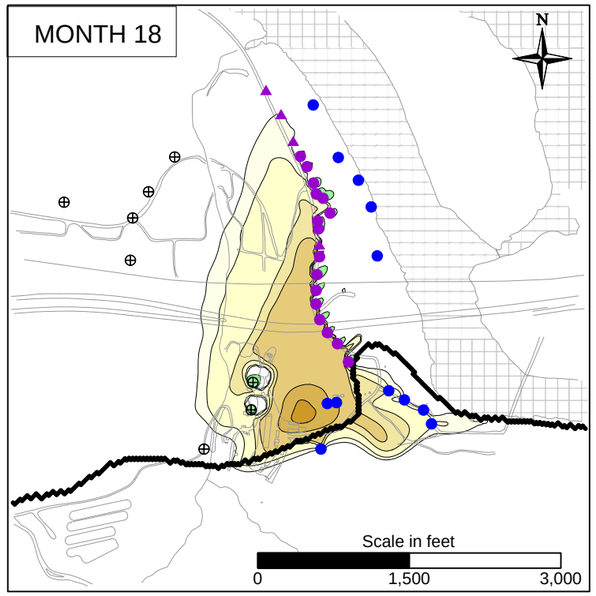
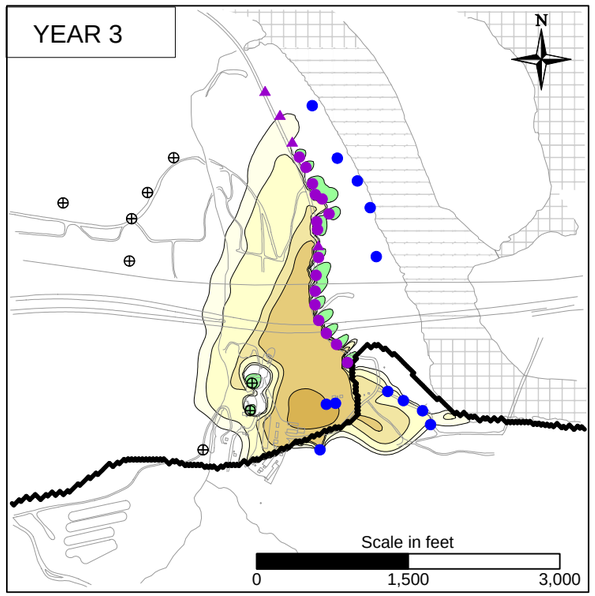
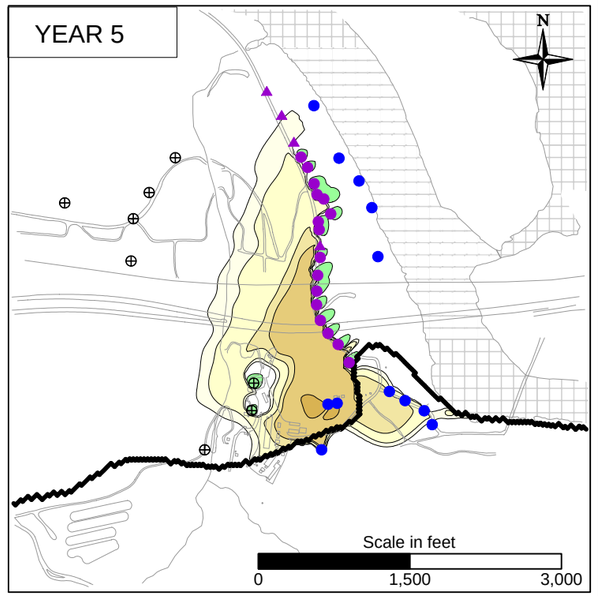
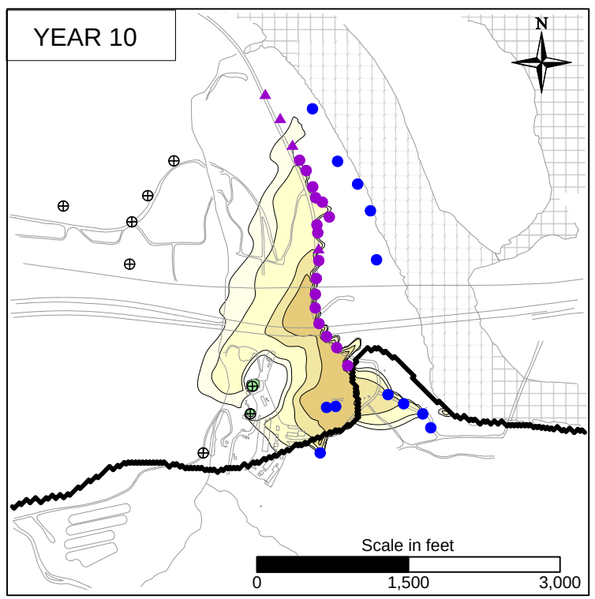
FIGURE
5.2-1

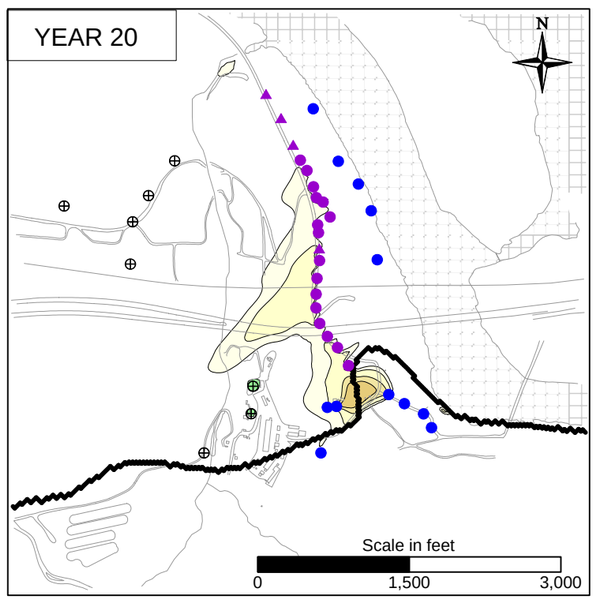


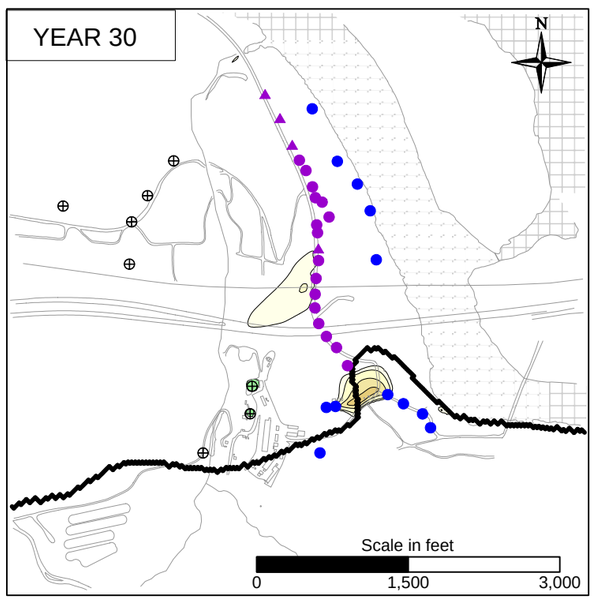












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

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SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 1 WITH 2013 INITIALIZED PLUMES

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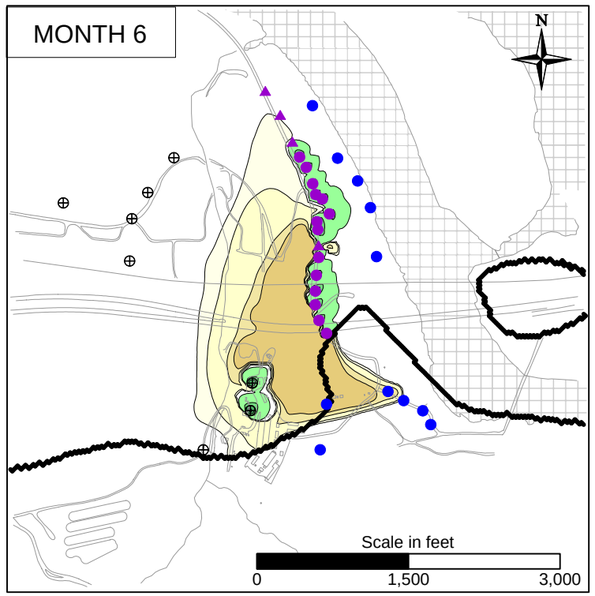
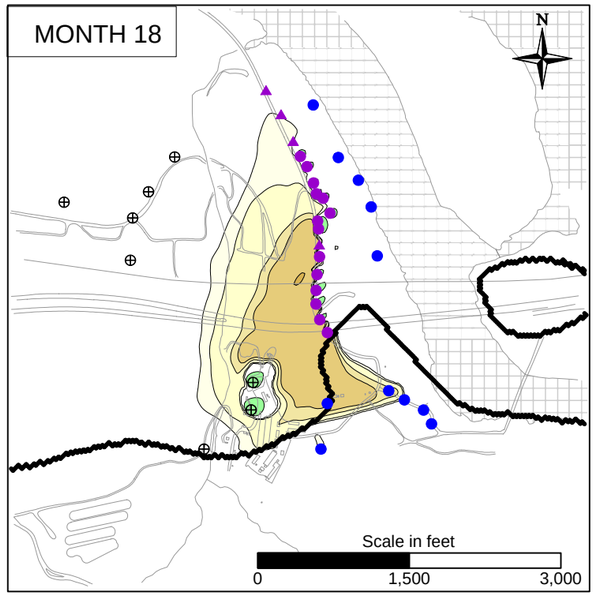
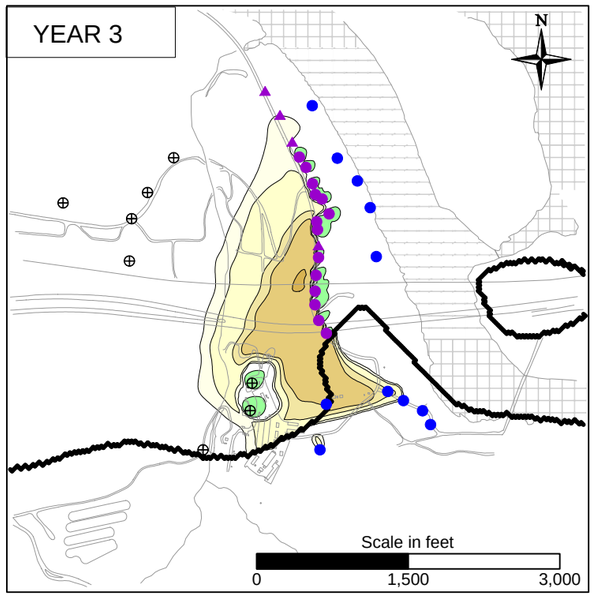
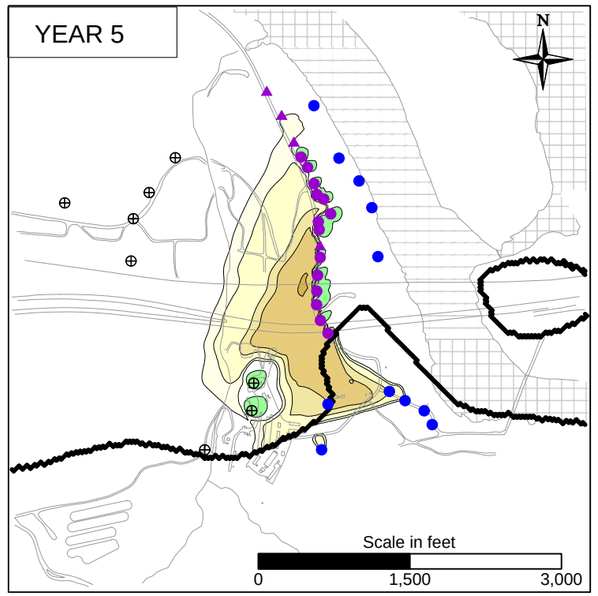
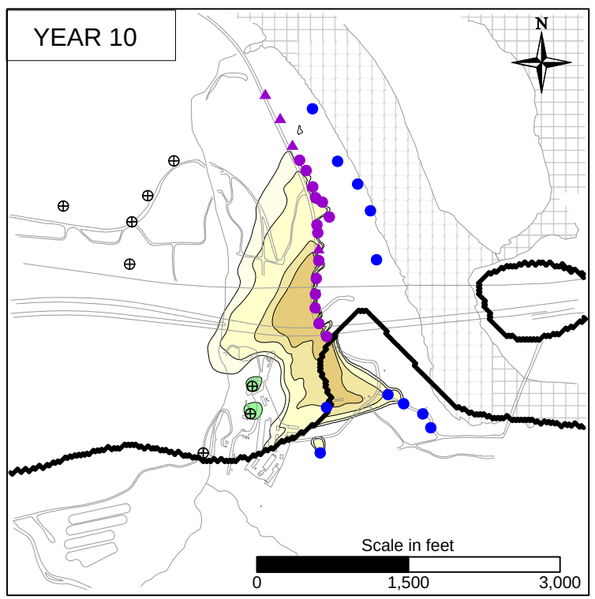
FIGURE
6.1-1

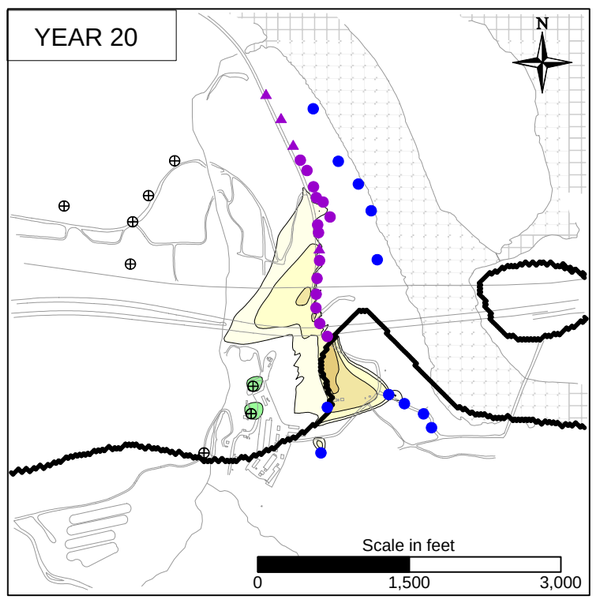


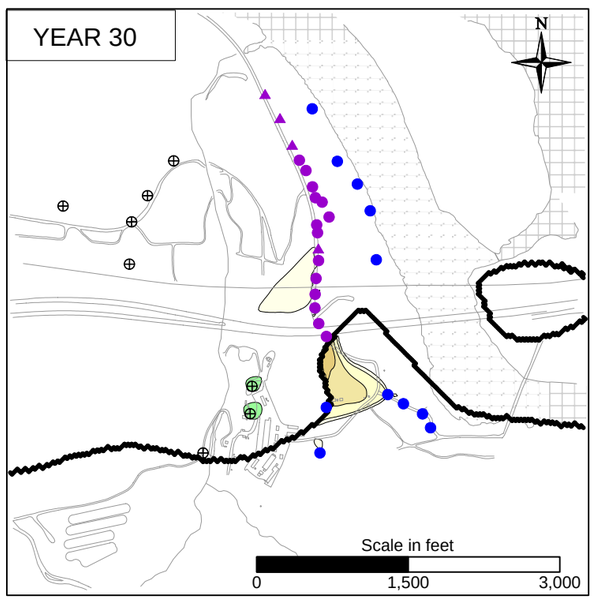












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

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SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 2 WITH 2013 INITIALIZED PLUMES

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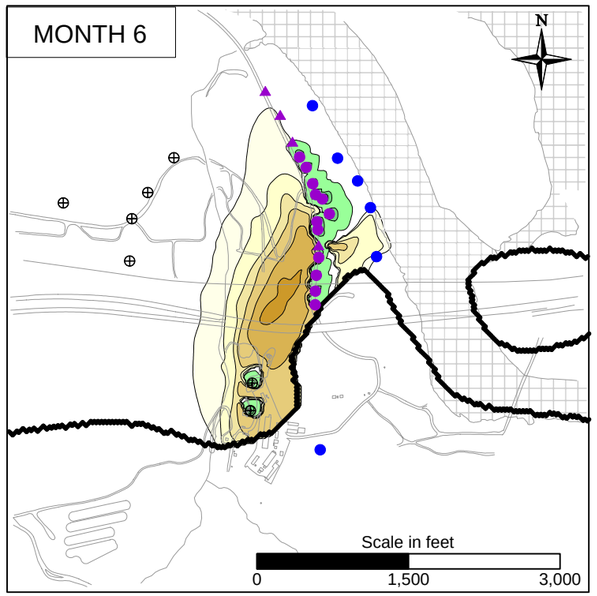
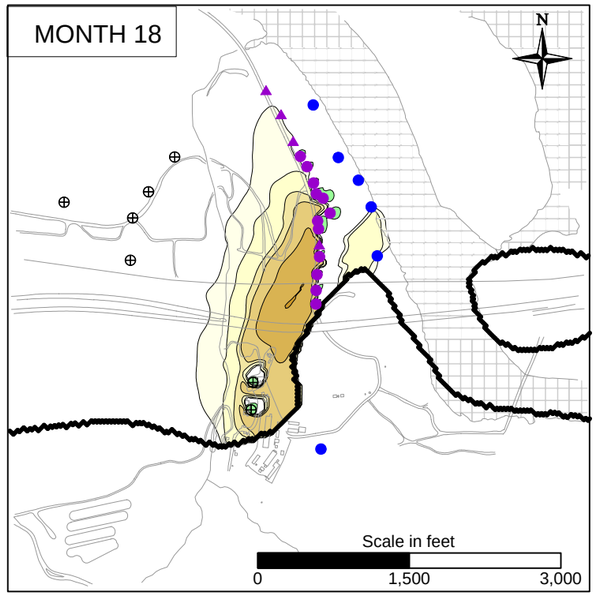
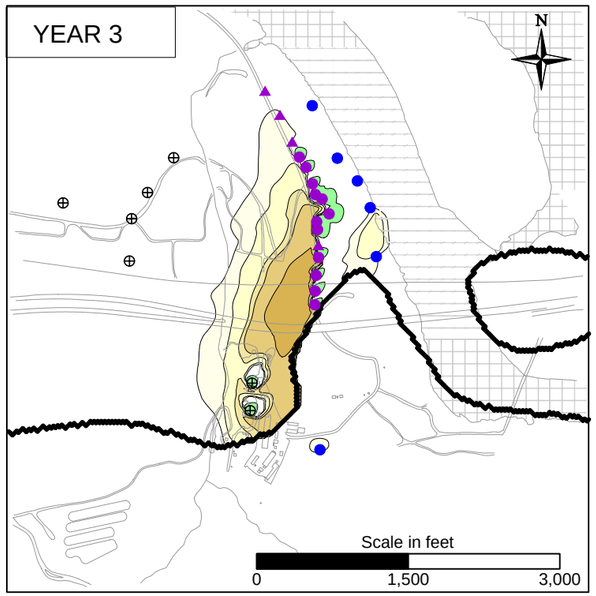
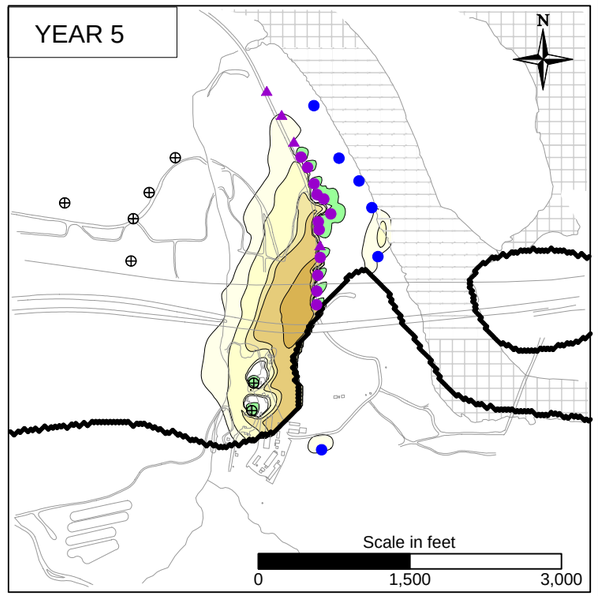
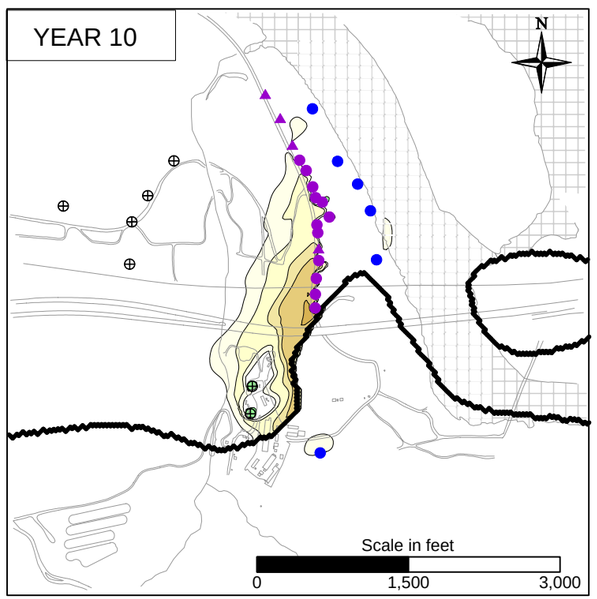
FIGURE
6.1-2

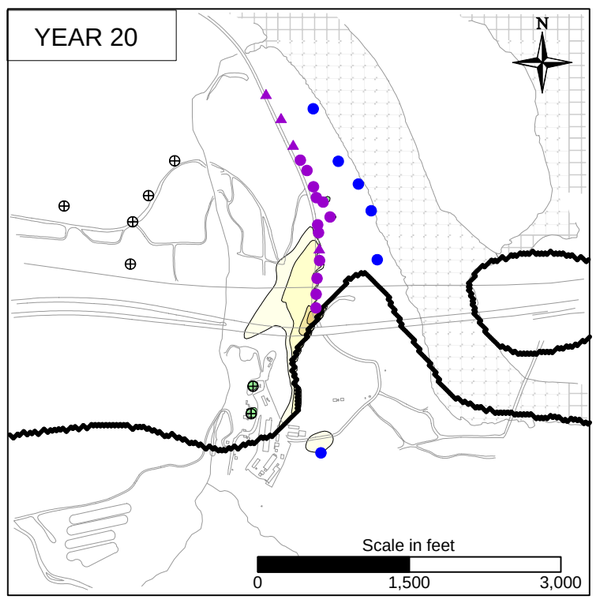


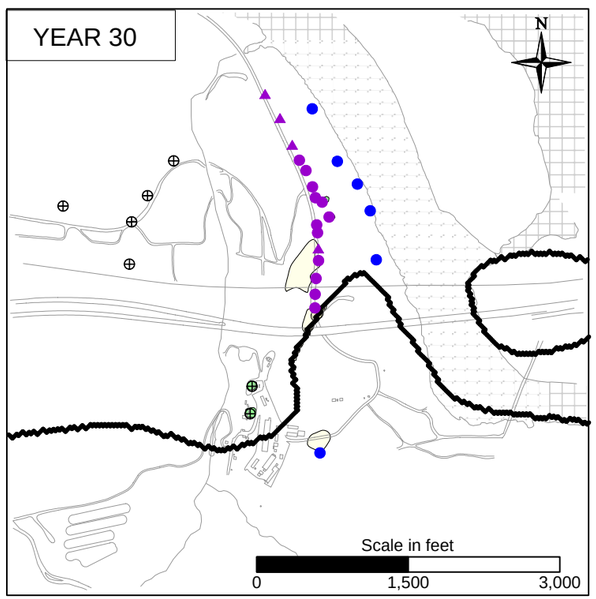












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

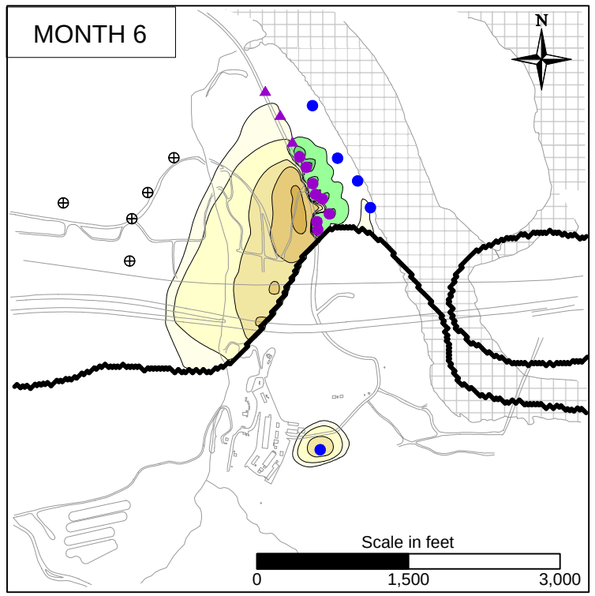
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

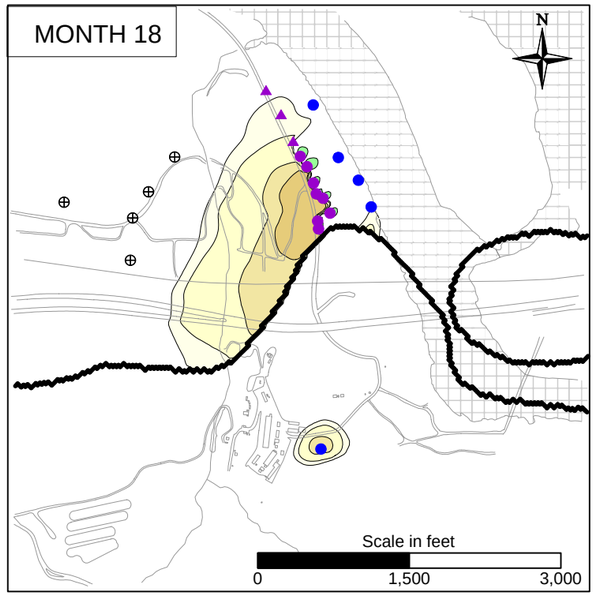
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

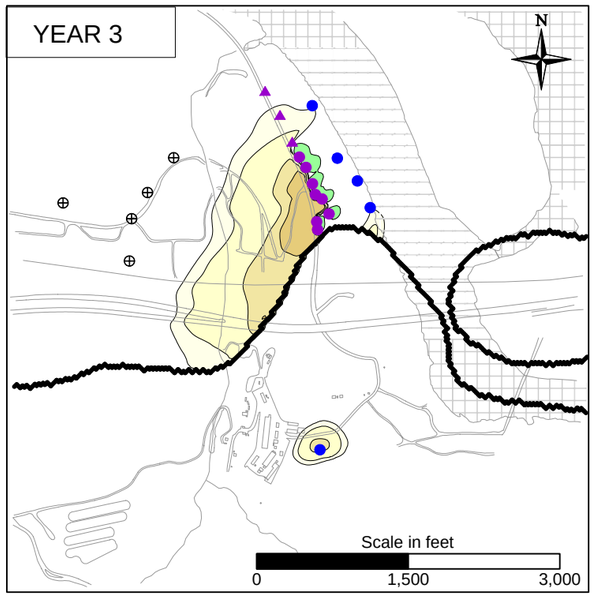
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 3 WITH 2013 INITIALIZED PLUMES

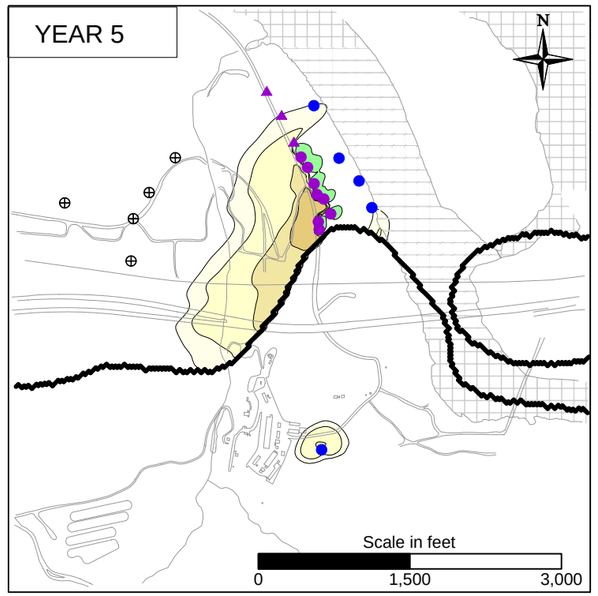
ARCADIS Design & Consultancy for natural and built assets

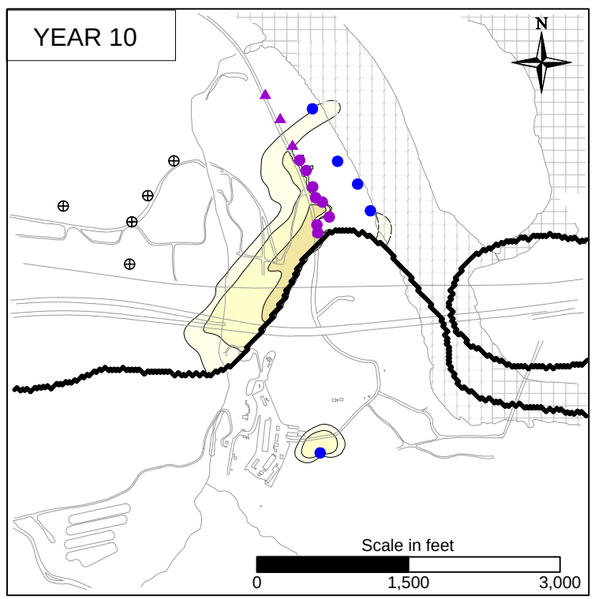
FIGURE
6.1-3

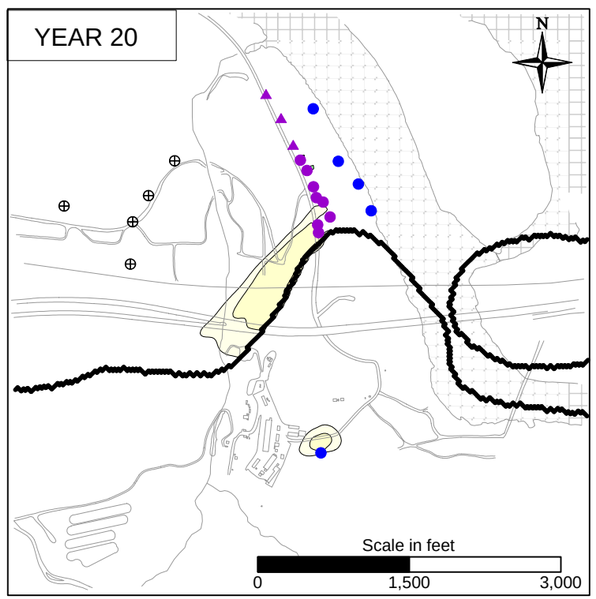


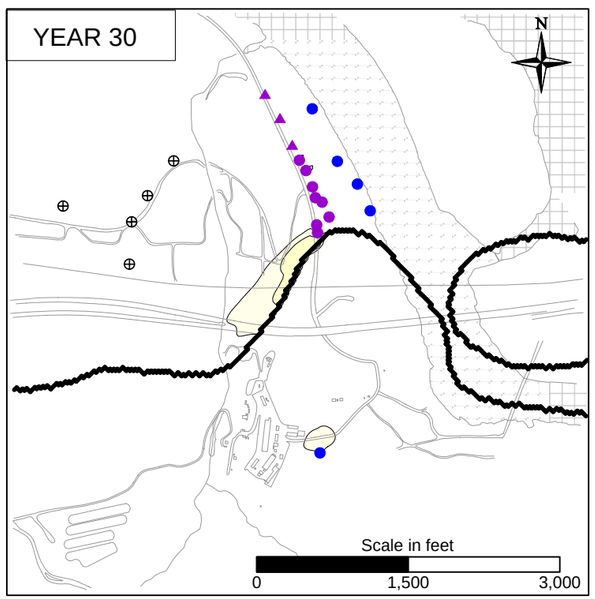












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

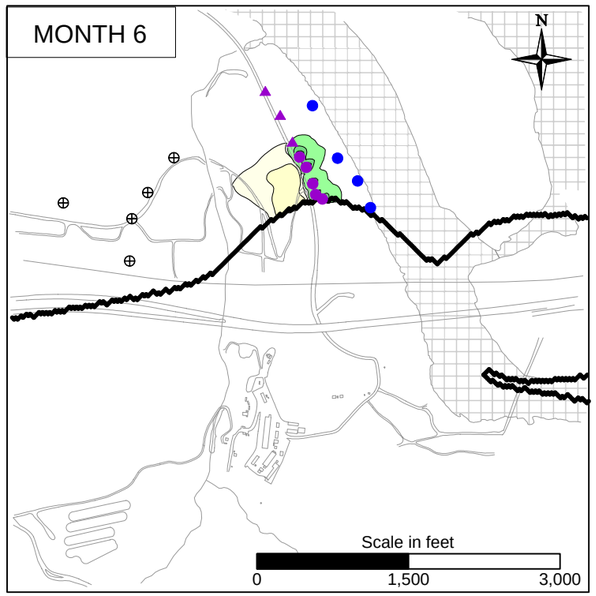
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

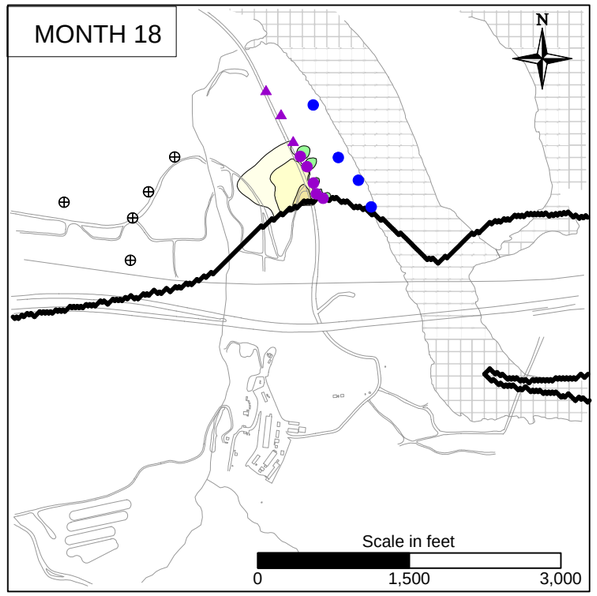
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

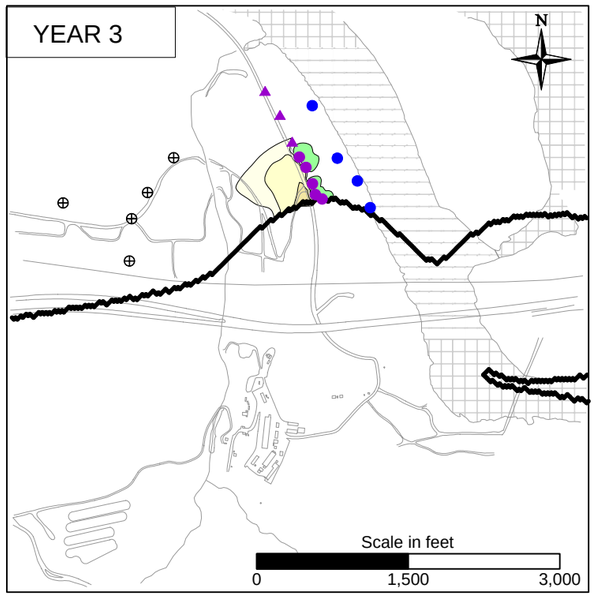
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 4 WITH 2013 INITIALIZED PLUMES

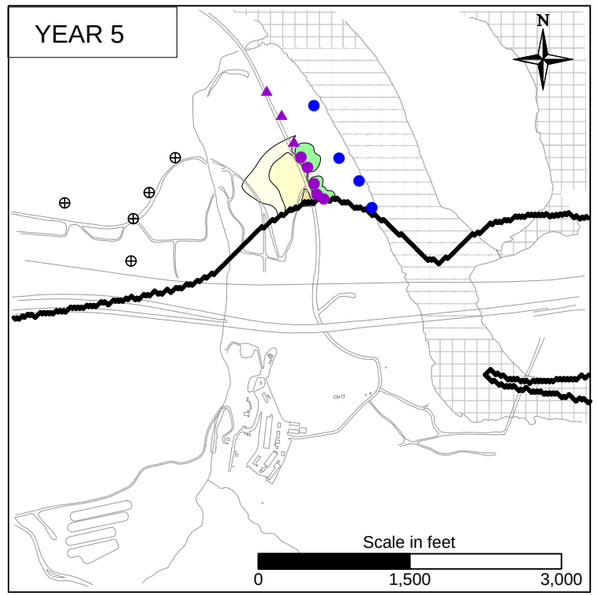
ARCADIS Design & Consultancy for natural and built assets

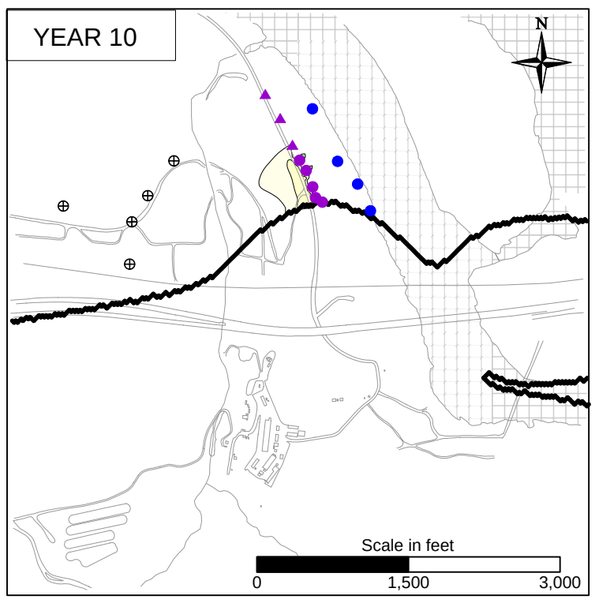
FIGURE
6.1-4

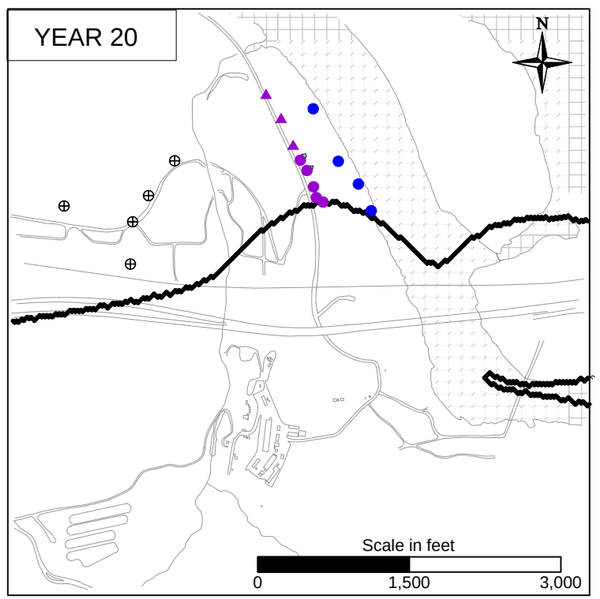


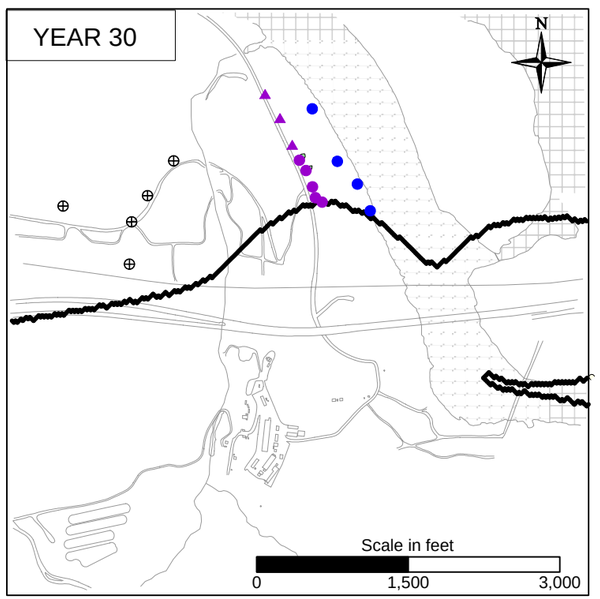












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

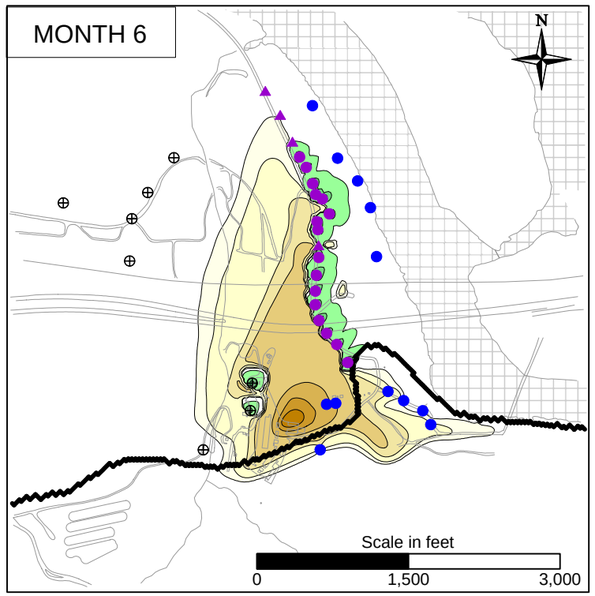
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

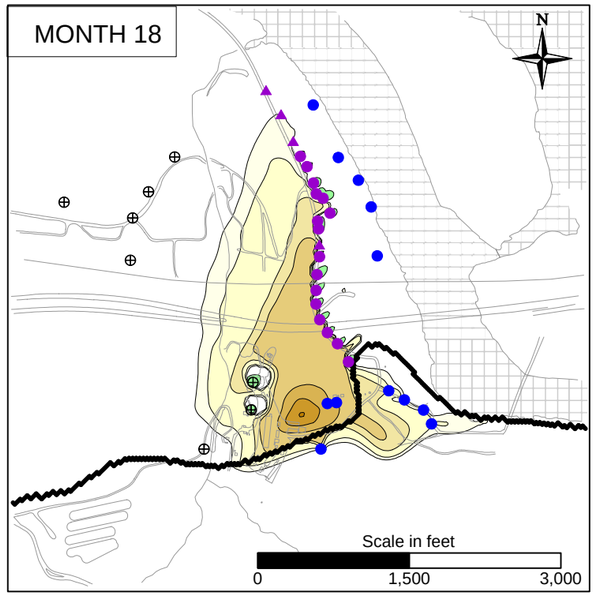
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

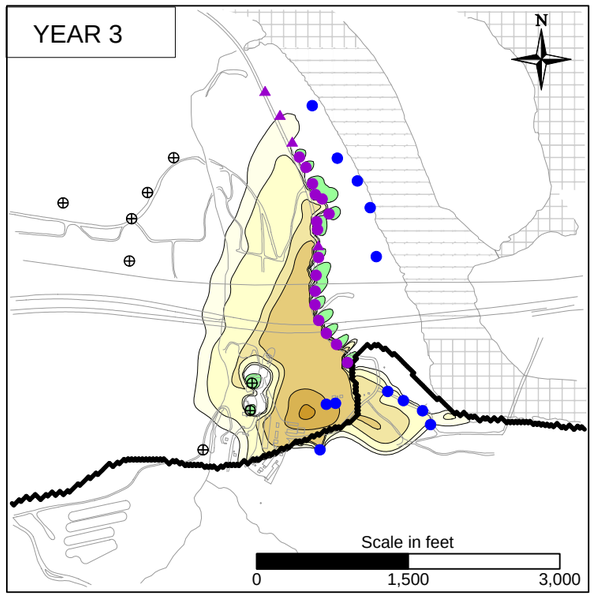
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 5 WITH 2013 INITIALIZED PLUMES

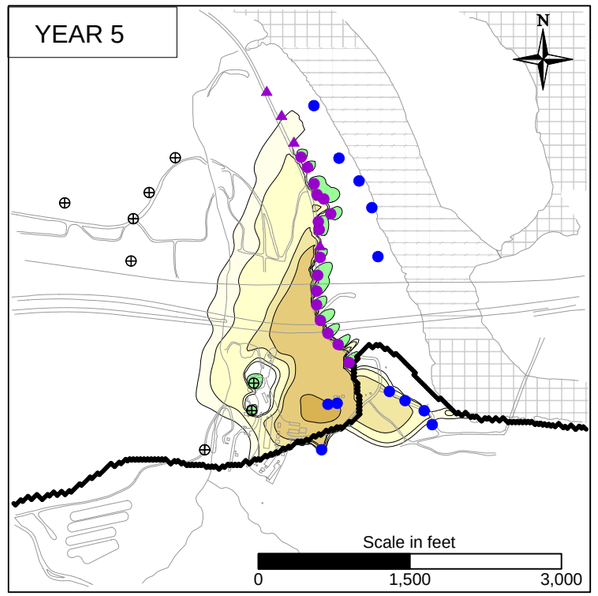
ARCADIS Design & Consultancy for natural and built assets

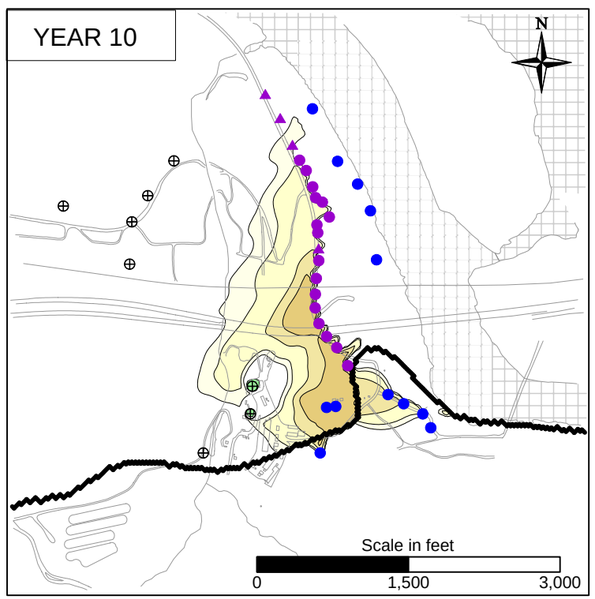
FIGURE
6.1-5

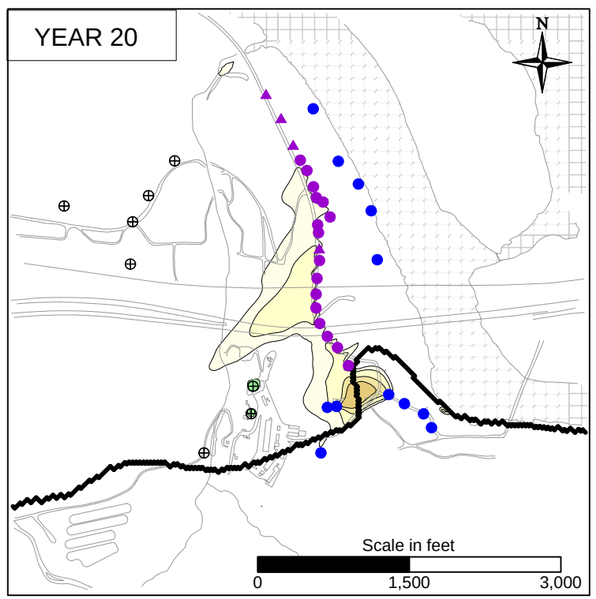


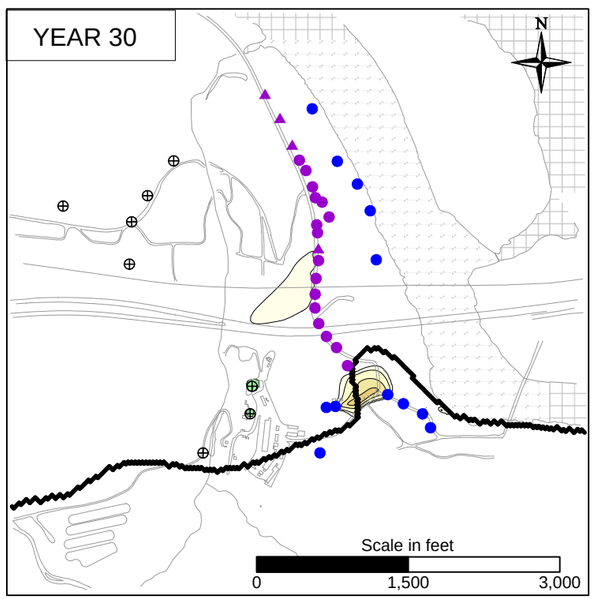












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

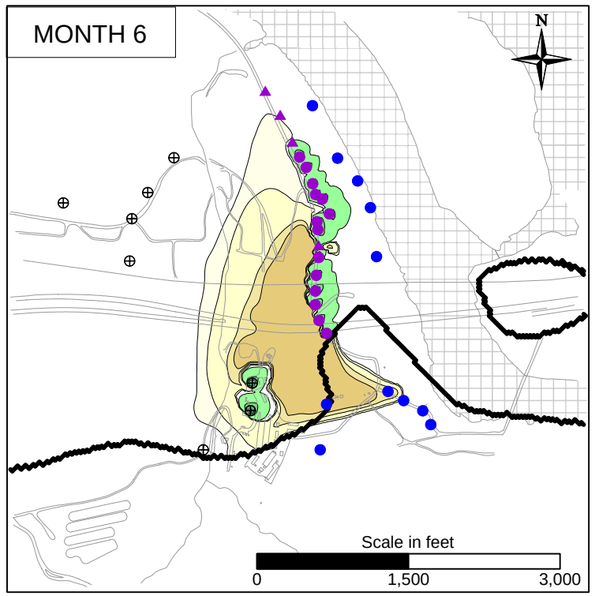
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

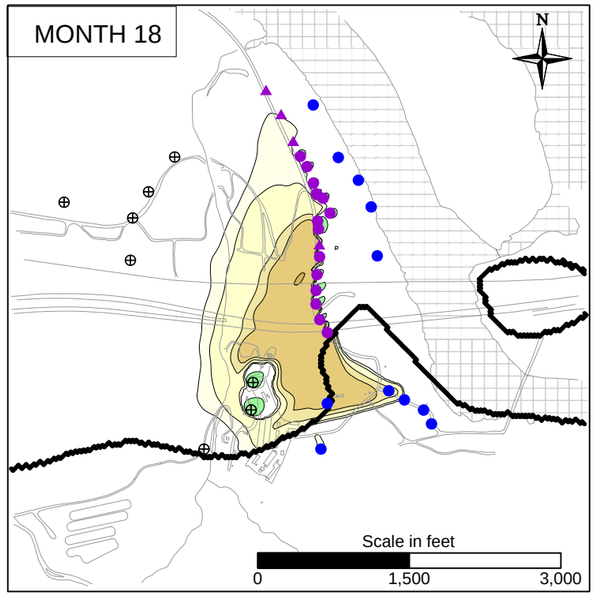
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

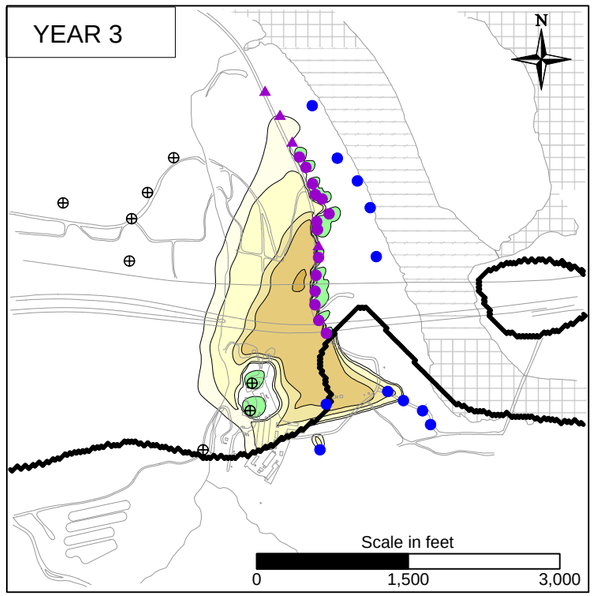
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 1 WITH 2015 INITIALIZED PLUMES

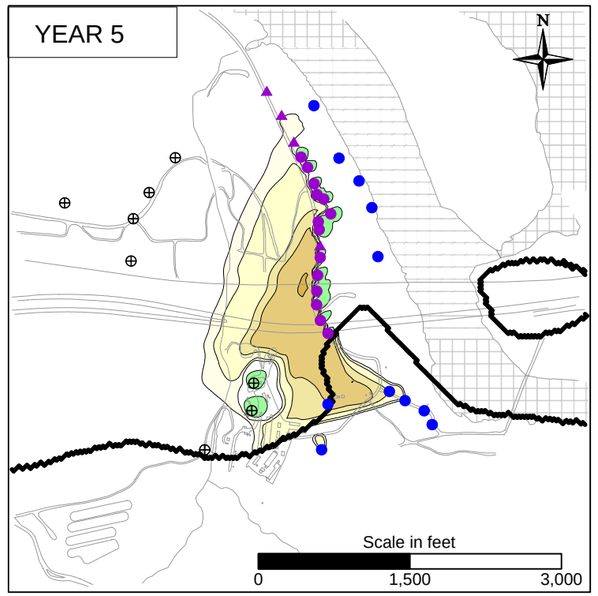
ARCADIS Design & Consultancy for natural and built assets

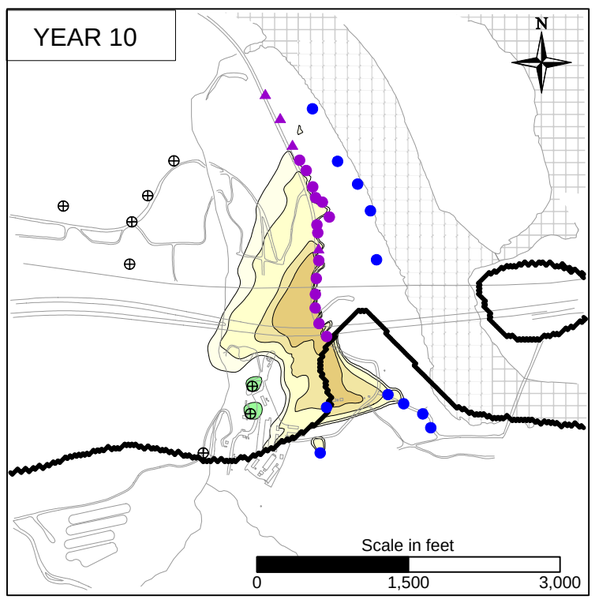
FIGURE
6.1-6

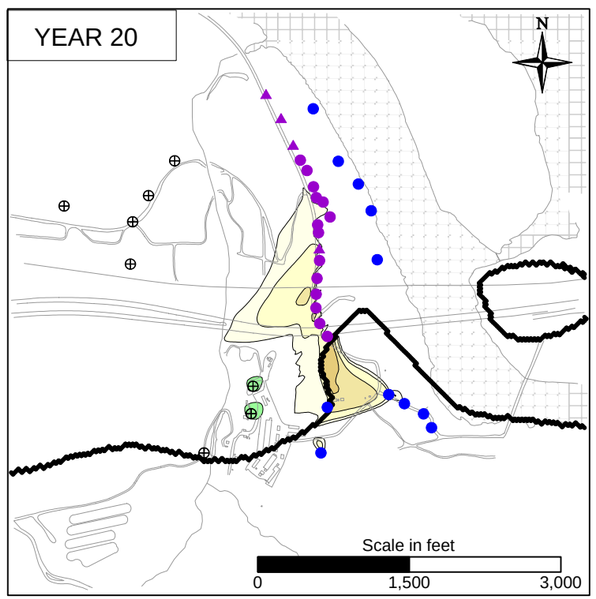


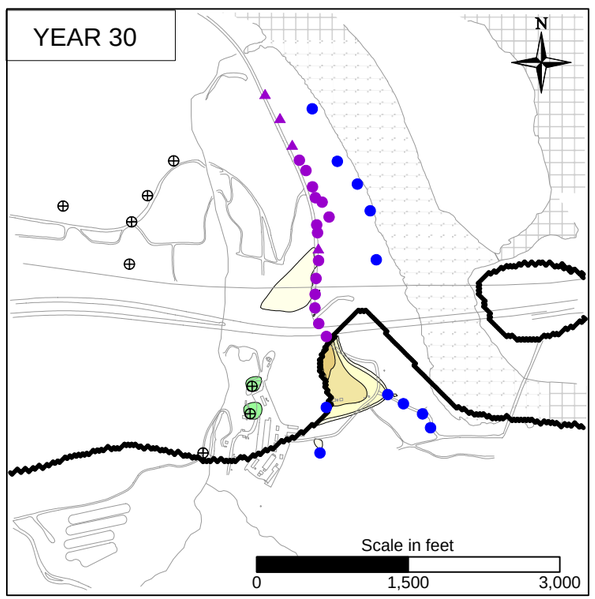












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

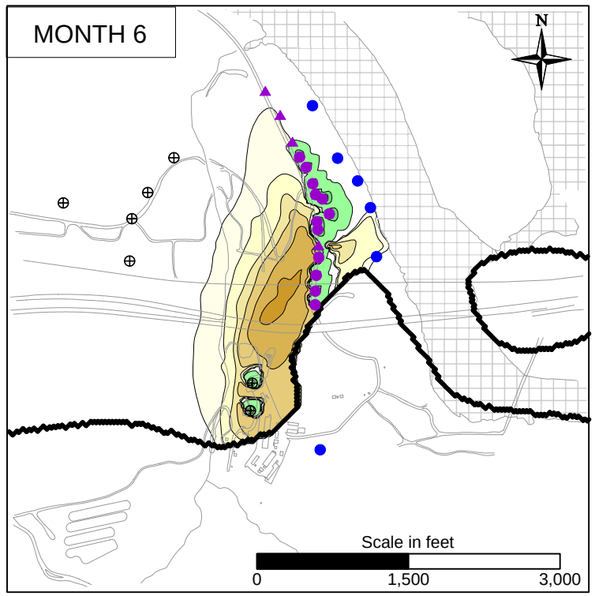
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

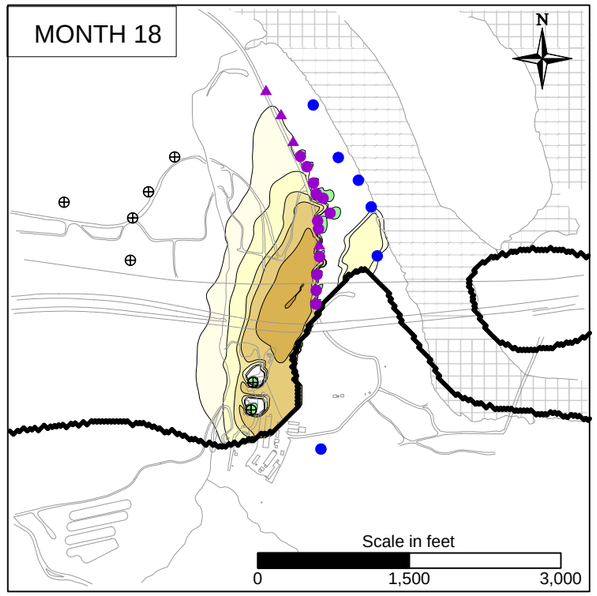
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

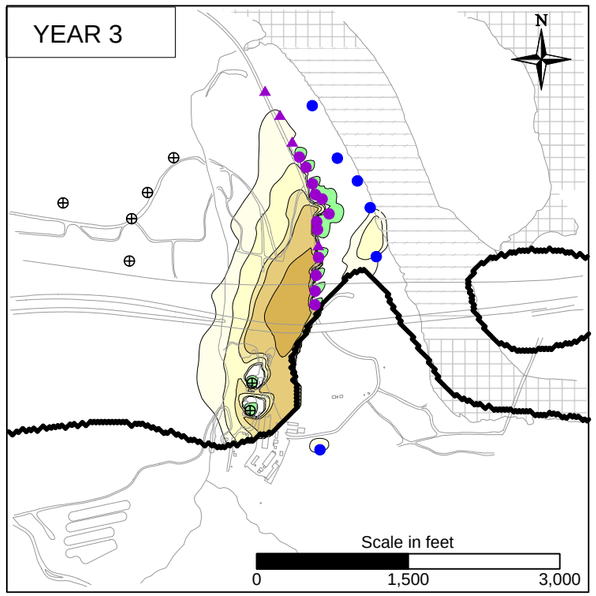
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 2 WITH 2015 INITIALIZED PLUMES

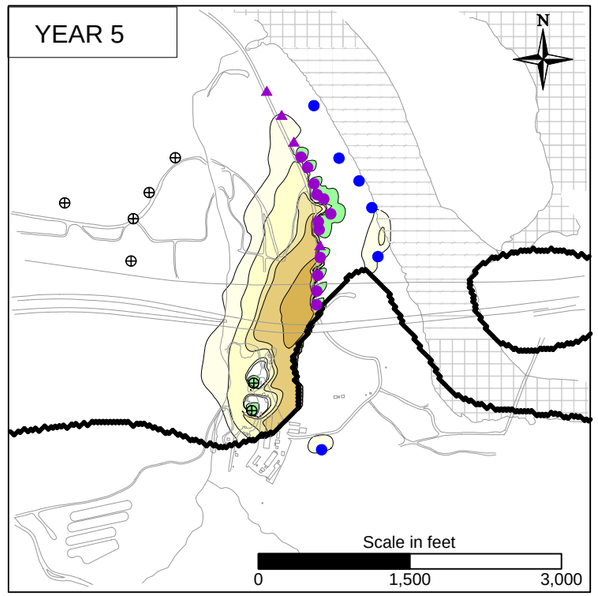
ARCADIS Design & Consultancy for natural and built assets

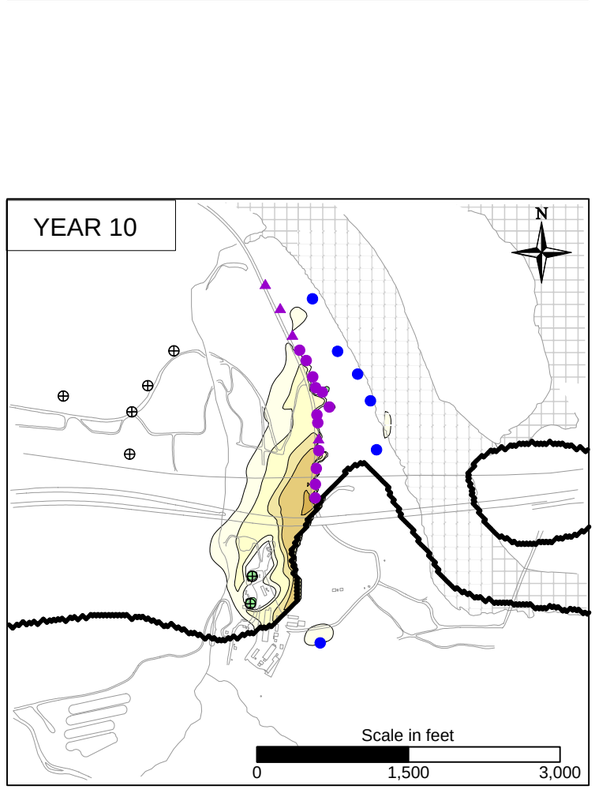
FIGURE
6.1-7

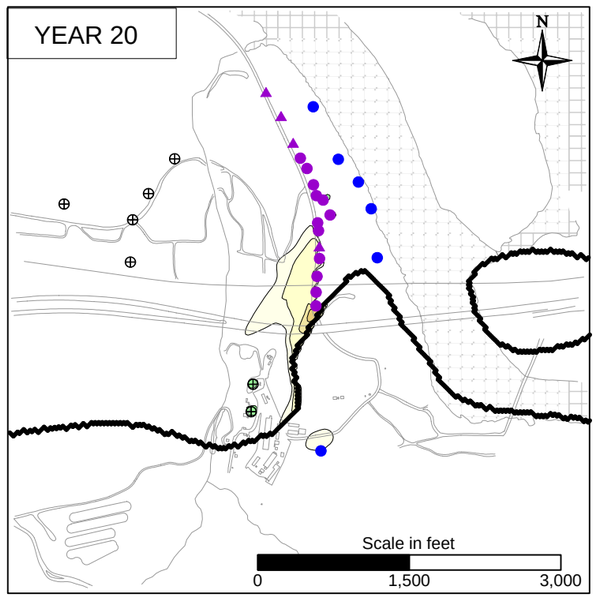


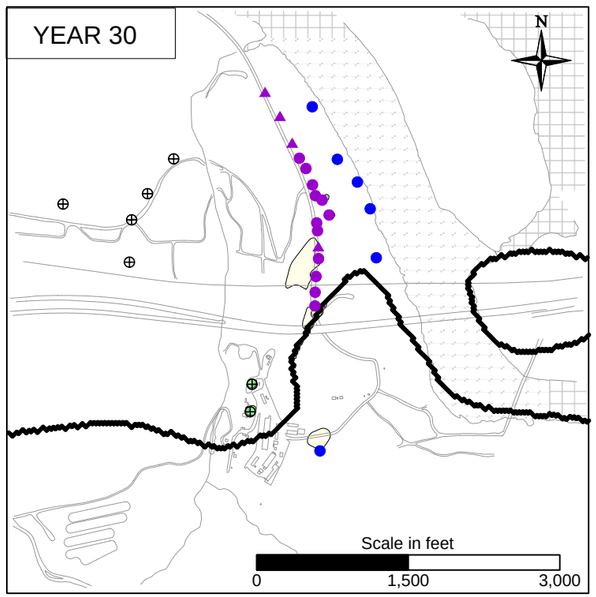












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

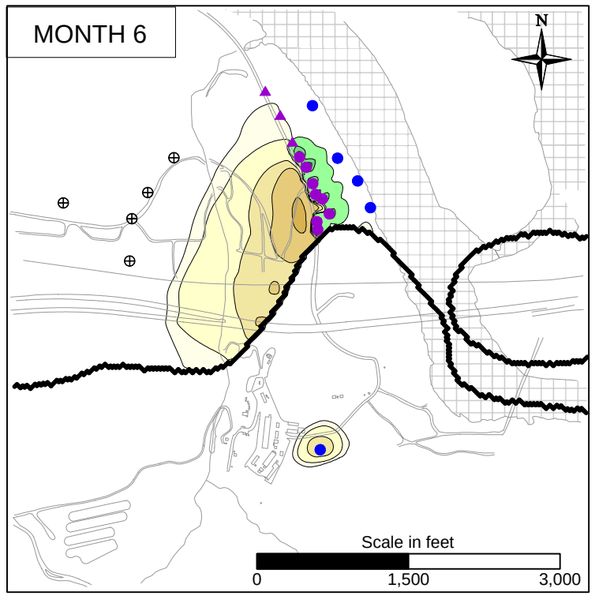
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

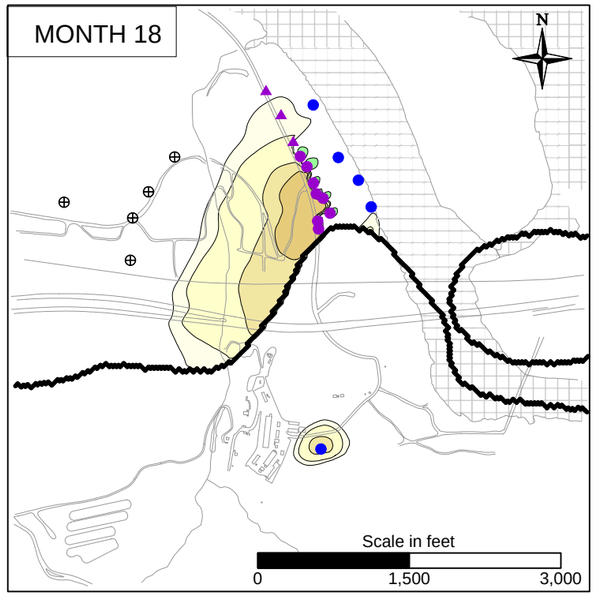
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

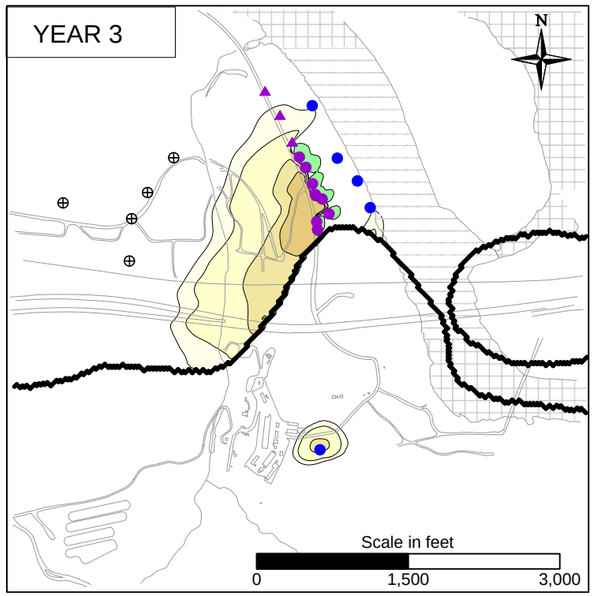
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 3 WITH 2015 INITIALIZED PLUMES

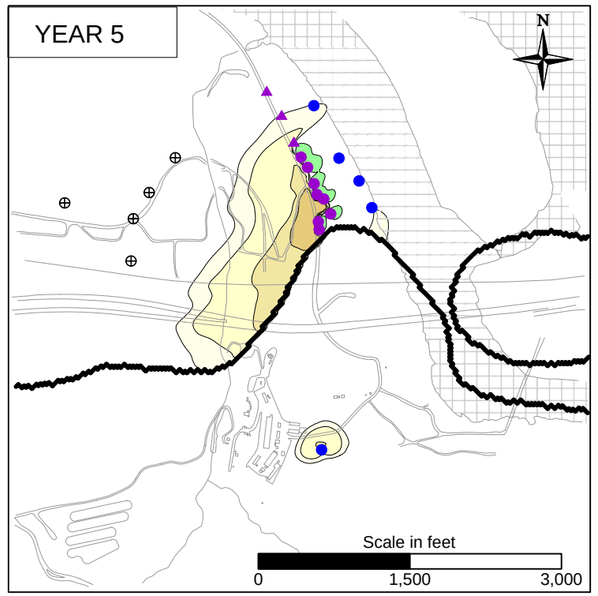
ARCADIS Design & Consultancy for natural and built assets

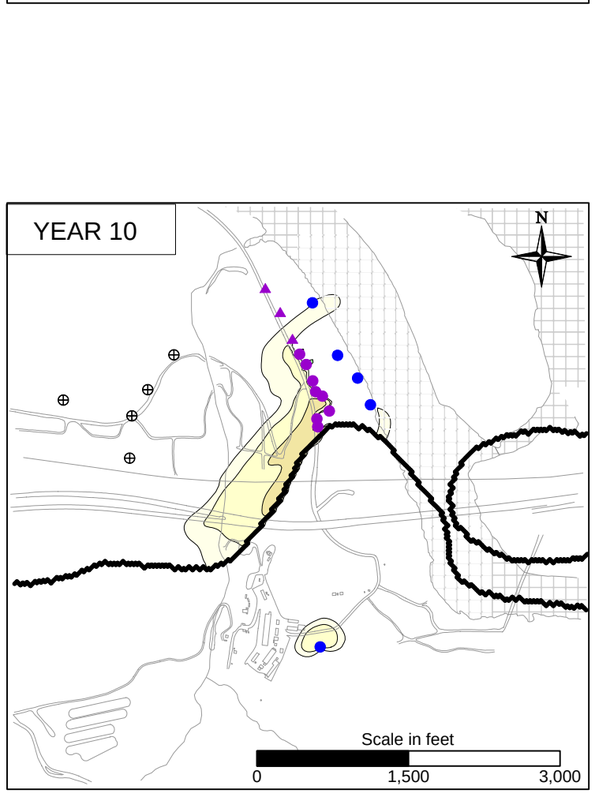
FIGURE
6.1-8

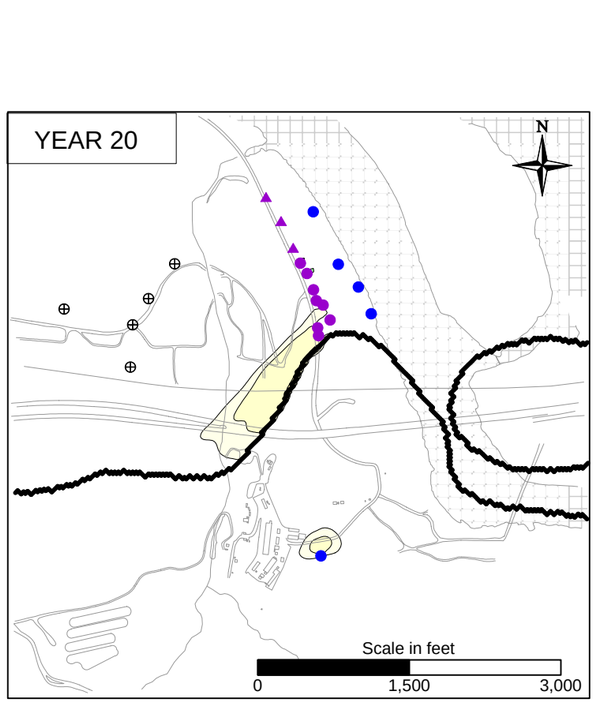


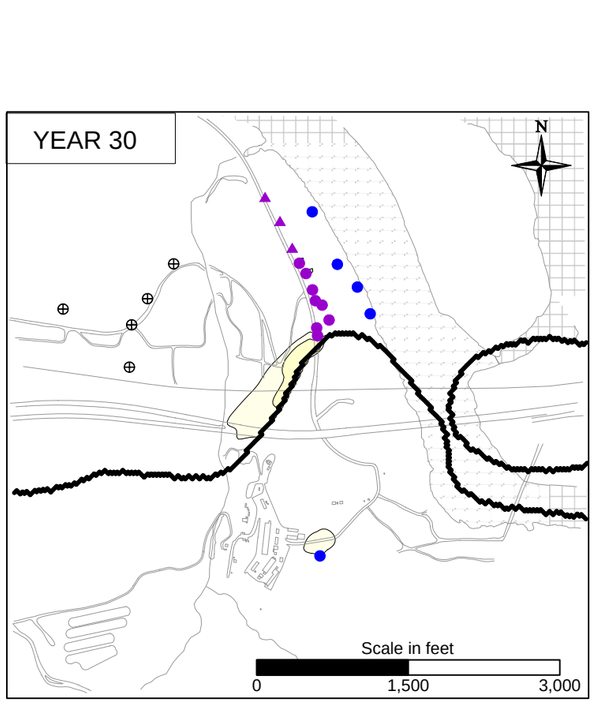












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

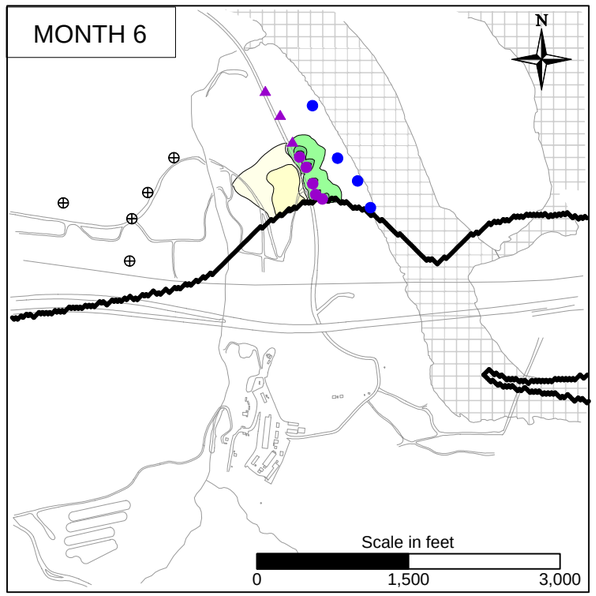
- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

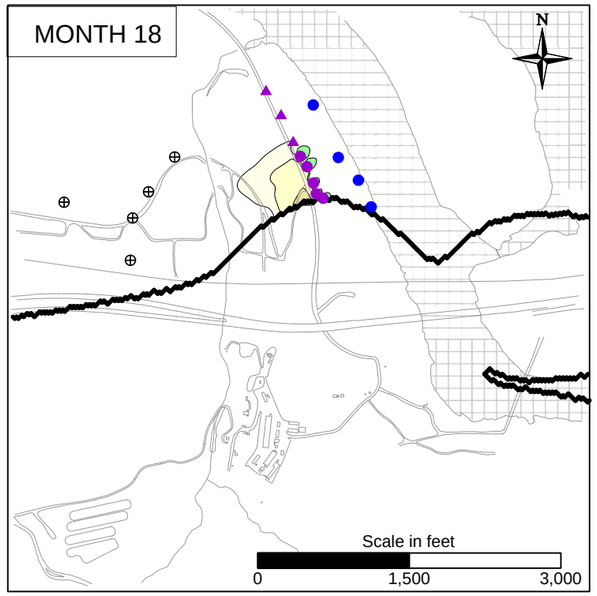
PG&E
TOPOCK COMPRESSOR STATION
NEEDLES, CALIFORNIA
ADDENDUM TO DEVELOPMENT OF GROUNDWATER FLOW AND SOLUTE TRANSPORT MODELS

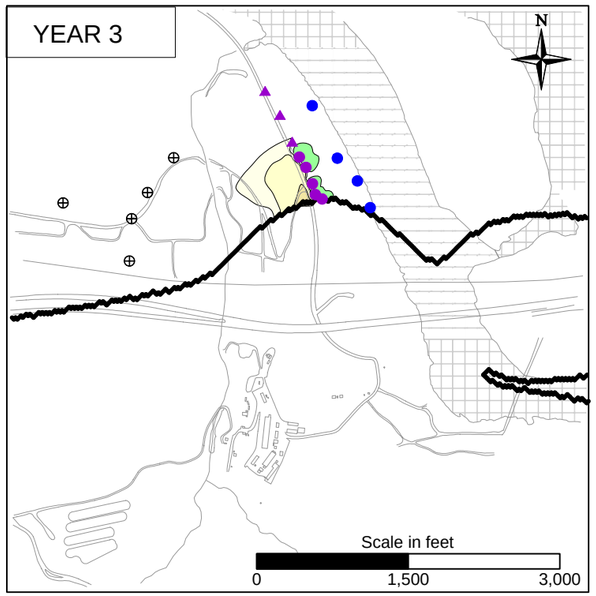
SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 4 WITH 2015 INITIALIZED PLUMES

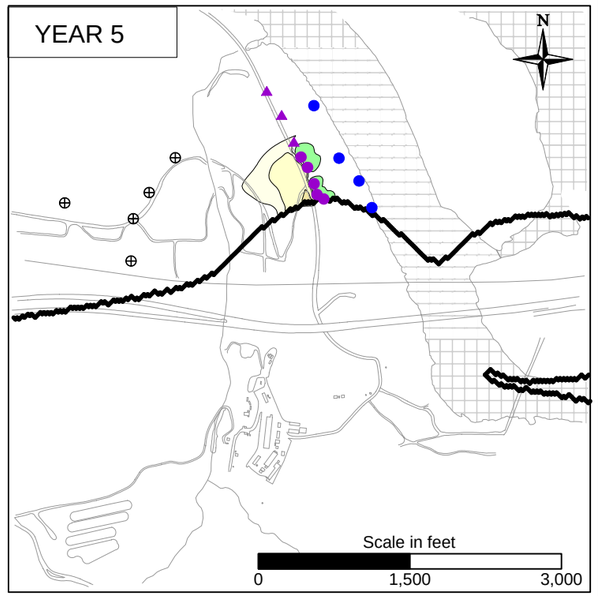
ARCADIS Design & Consultancy for natural and built assets

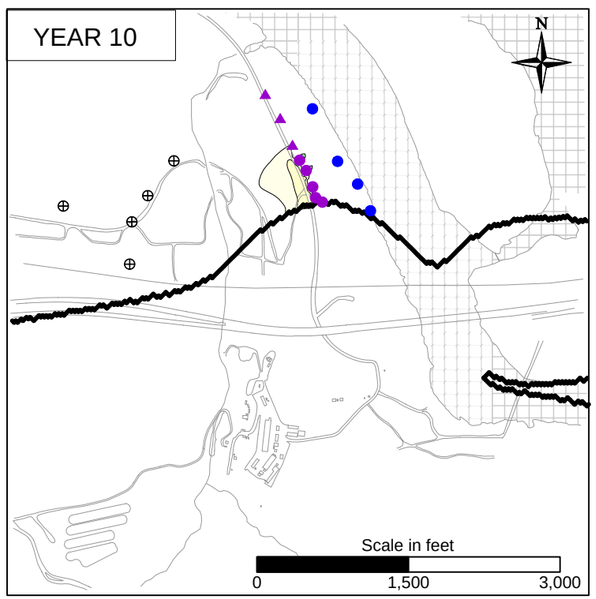
FIGURE
6.1-9

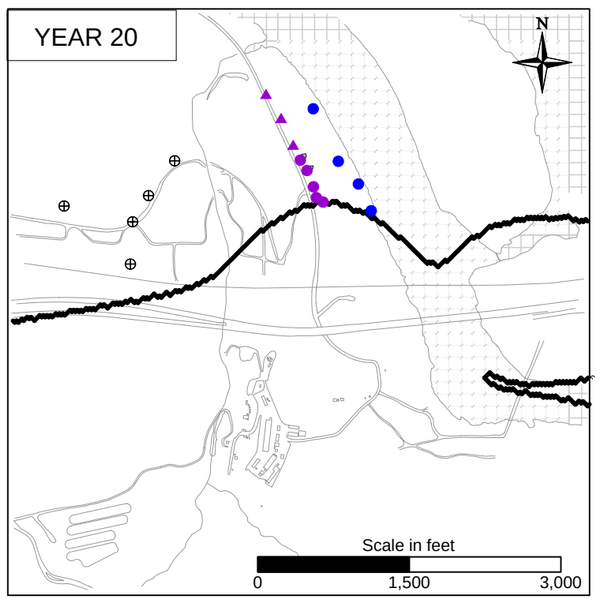


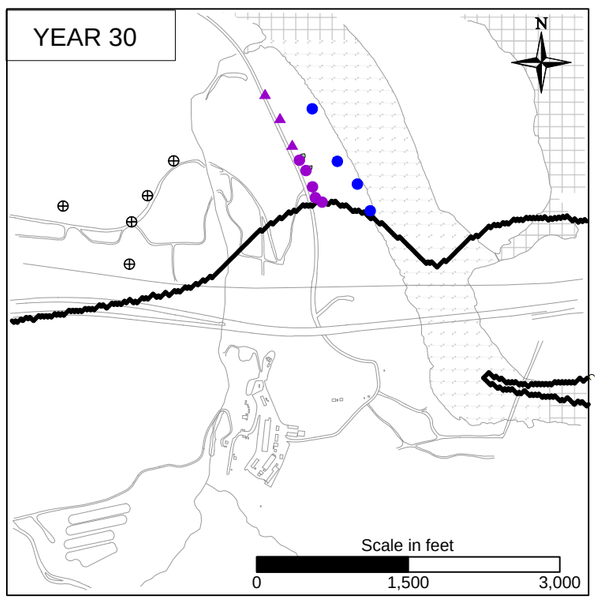












Chromium Concentration (ppb)

15,000
10,000
5,000
1,000
500
100
32

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS

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SIMULATED HEXAVALENT CHROMIUM TRANSPORT RESULTS IN MODEL LAYER 5 WITH 2015 INITIALIZED PLUMES

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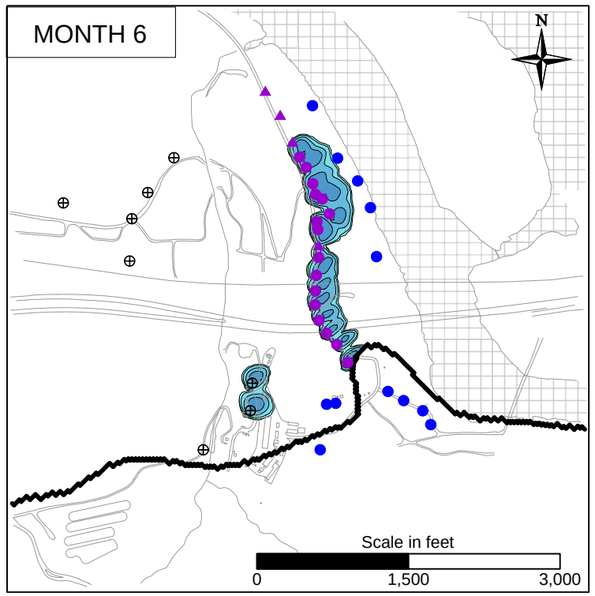
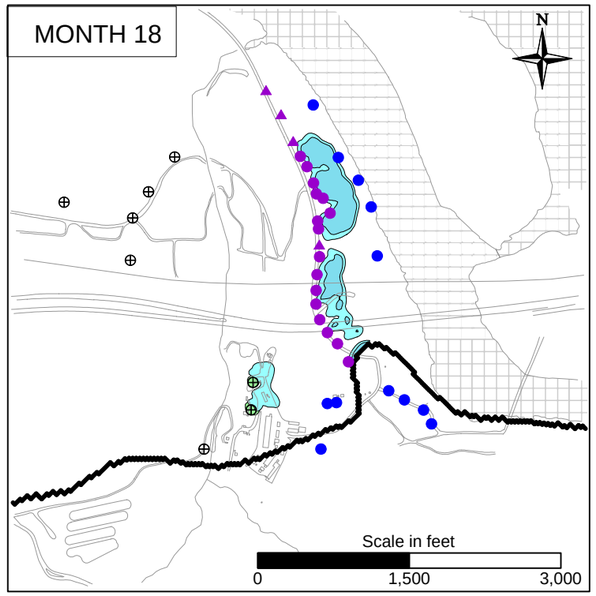
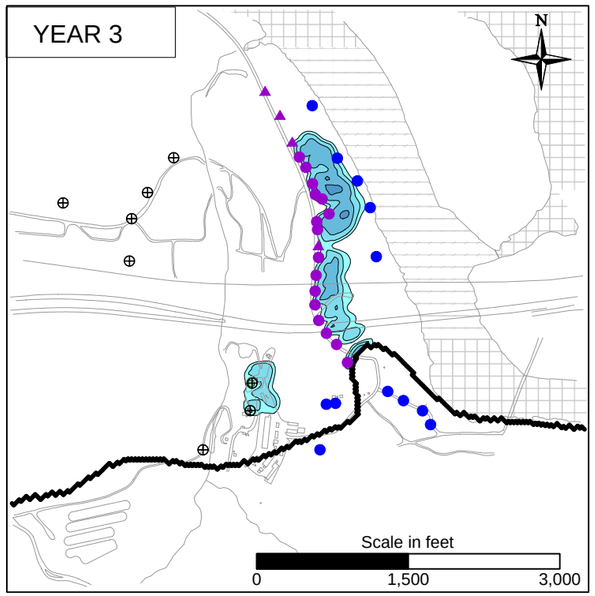
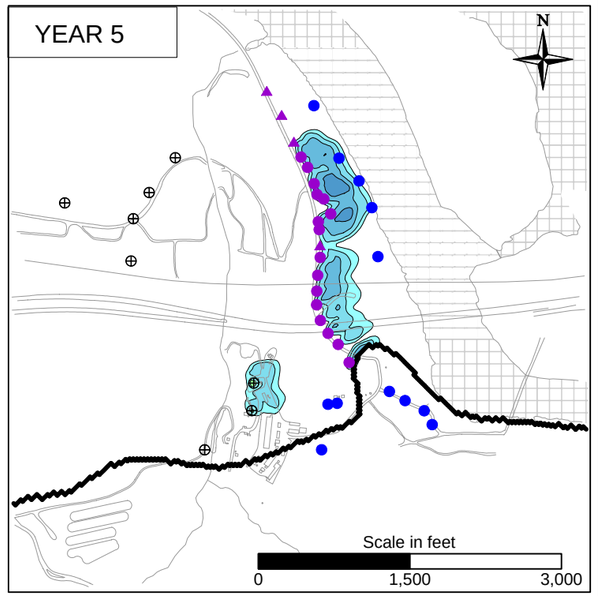
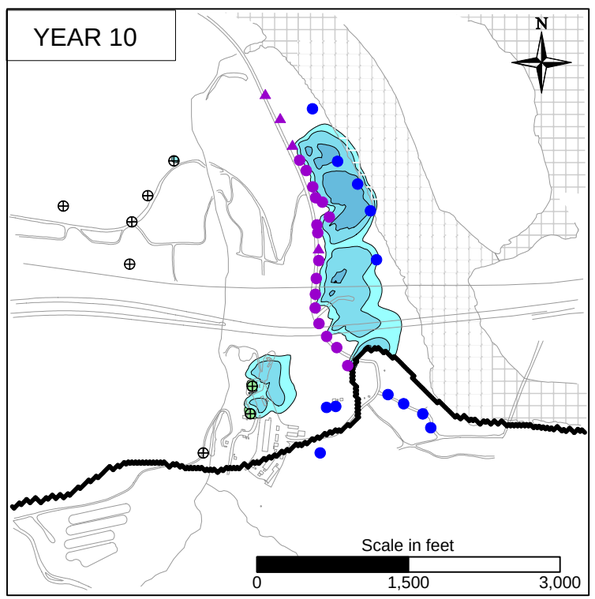
FIGURE
6.1-10

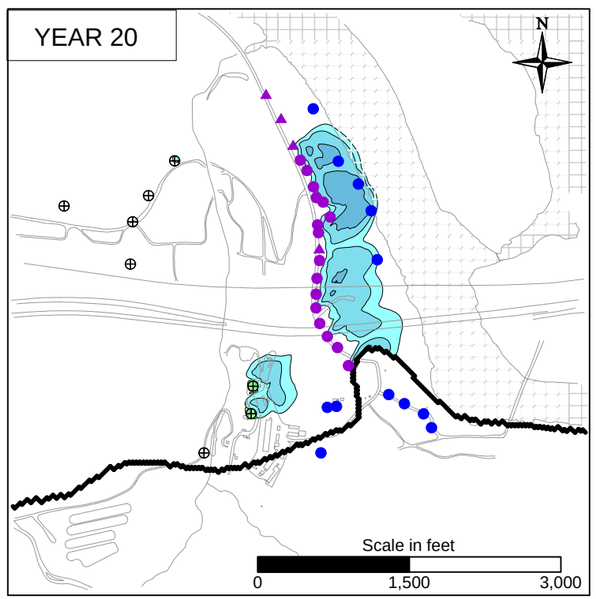


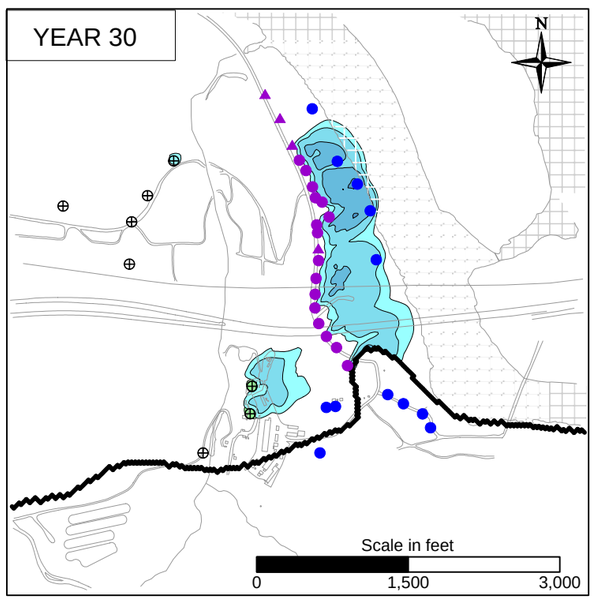












Manganese Concentration (ppm)

2
1
0.75
0.5
0.25
0.13

Carbon Concentration (ppm)

100
75
50
25
1

LEGEND

- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS IN MODEL LAYER 1

*Contours represent the maximum simulated manganese in all model layers.

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SIMULATED MANGANESE TRANSPORT RESULTS

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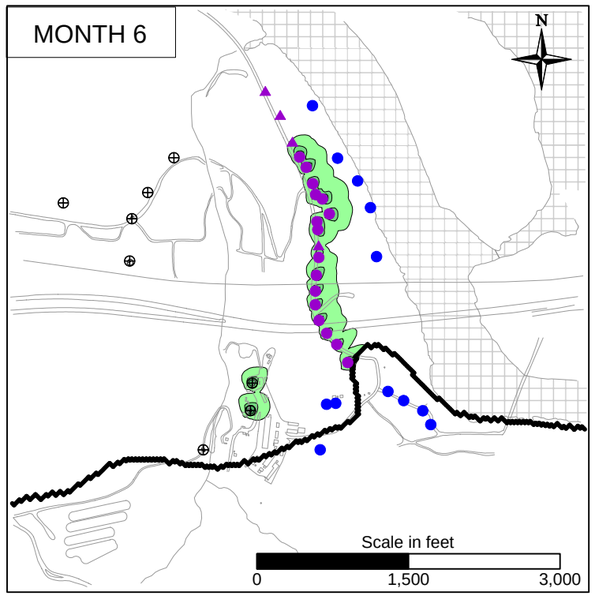
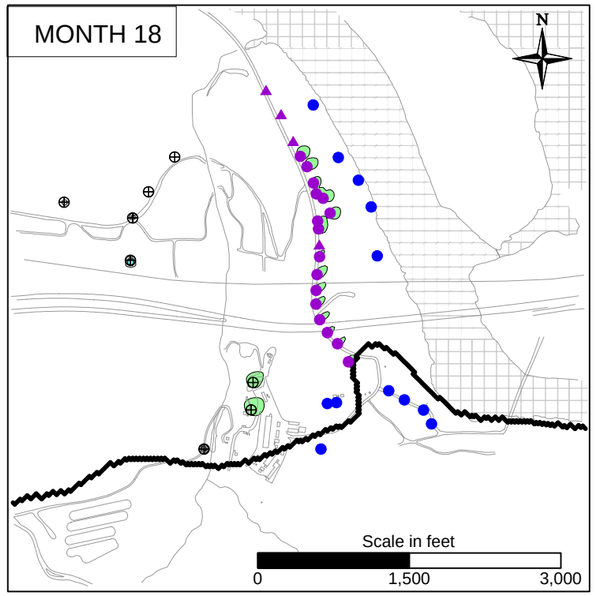
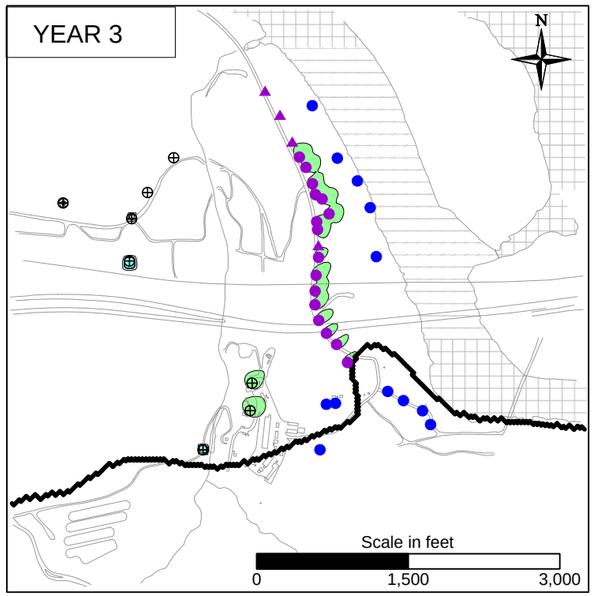
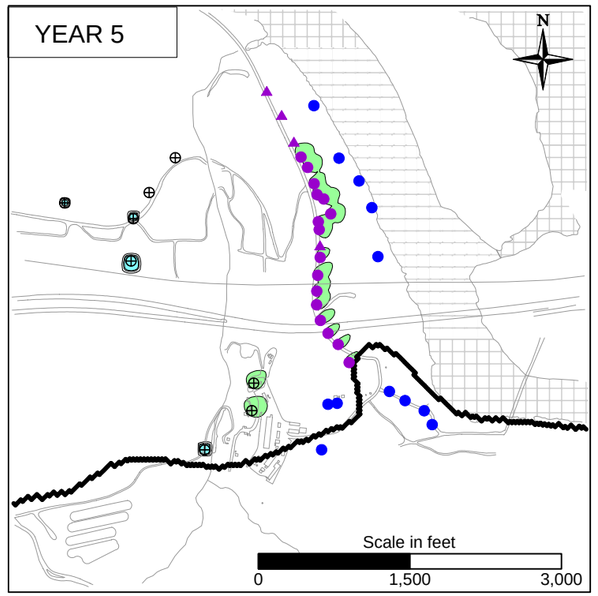
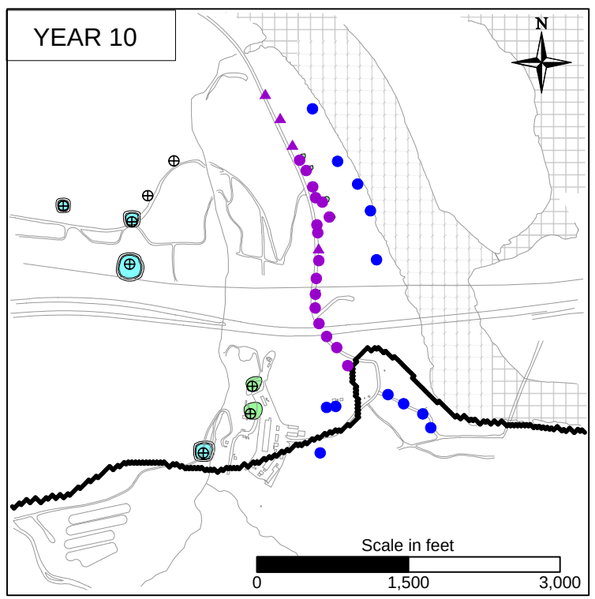
FIGURE
6.2-1

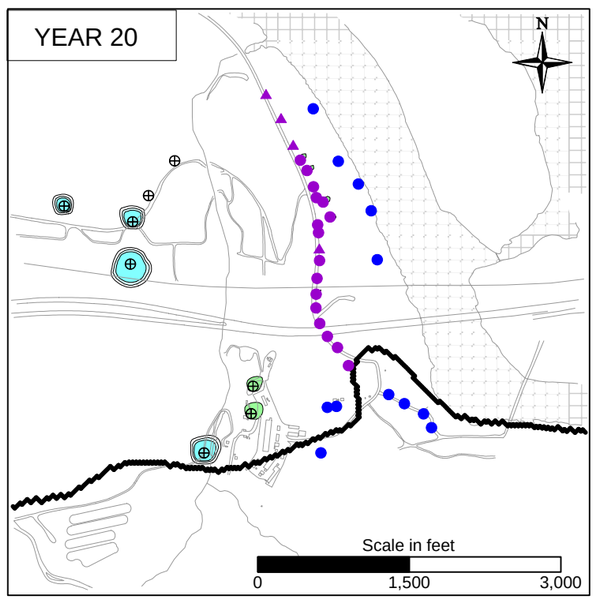


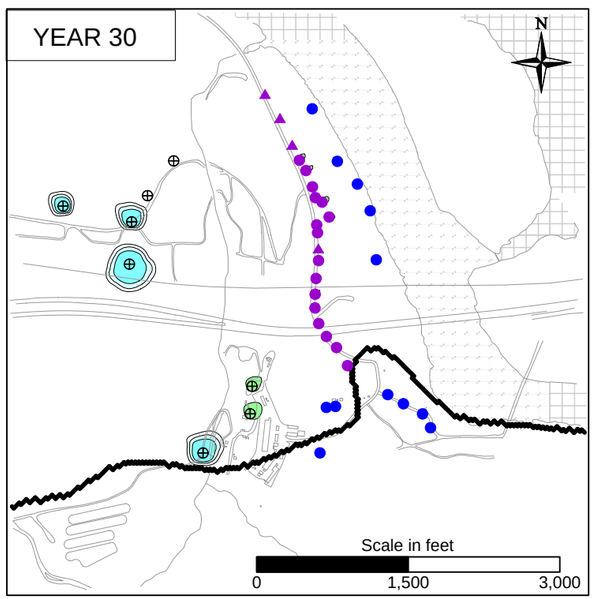












Arsenic Concentration (ppm)

0.015

0.012

0.01

0.005

Carbon Concentration (ppm)

100

75

50

25

1

LEGEND

- IRZ INJECTION WELLS
- IRZ EXTRACTION WELLS
- UPGRADIENT INJECTION WELLS
- EXTRACTION WELLS
- BEDROCK EXTENTS IN MODEL LAYER 1

*Contours represent the maximum simulated arsenic in all model layers.

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SIMULATED ARSENIC TRANSPORT RESULTS

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FIGURE
6.3-1