100 Crossways Park West, Suite 415
Woodbury, New York 11797
tel: +1 516 496-8400
fax: +1 516 496-8864

September 30, 2009

Mr. Thomas Fox, P.G., Vice President
Dvirka & Bartilucci Consulting Engineers
330 Crossways Park Drive
Woodbury, New York 11797

Subject: National Grid Glenwood Landing Former Gas Plant Site
Groundwater Modeling Results

Dear Mr. Fox:

This letter report summarizes the groundwater flow and contaminant transport modeling completed by Camp Dresser & McKee (CDM) in support of Dvirka and Bartilucci (D&B)'s efforts to verify groundwater flow patterns and to evaluate the potential location of the source area(s) of observed tetrachloroethene (PCE) contamination in the vicinity of National Grid's Glenwood Landing former gas plant site.

Summary of Findings

Consistent with the observed data, the model shows that groundwater in the area of the National Grid Glenwood Landing site flows from east to west, discharging to Hempstead Harbor in the vicinity of the site. To the east of the National Grid site, in the vicinity of the suspected upgradient source areas, a downward vertical gradient exists. In the vicinity of the National Grid site, a strong upward vertical gradient was observed as groundwater discharges to Hempstead Harbor. The model successfully represents the observed downward vertical gradient in the suspected upgradient source area, and the observed upward vertical gradient in the shallow aquifer at the National Grid Glenwood Landing site.

Based on the observed and simulated flow field, the source area of the observed chlorinated volatile organic compounds (CVOCs) groundwater contamination is not located at the National Grid Glenwood Landing site, but could reasonably be located at one or more of the upgradient sites considered during this modeling exercise, as contamination introduced upgradient of the site would travel westward to discharge at the Harbor near the National Grid site. The model shows that contamination from a hypothetical on-site source would remain in the shallow groundwater and migrate horizontally westward to discharge to the Harbor, consistent with the upward vertical gradient observed at the site. Due to the observed upward vertical gradient, the contamination observed at the National Grid site at depth would not have originated on-site. Similarly, the contamination observed to the north and

south of the National Grid site would not have originated on-site, because any hypothetical groundwater contamination originating at the National Grid site would migrate directly west to discharge to Hempstead Harbor.

However, contamination introduced to the aquifer at the water table and at depth in the area of the suspected upgradient sources provides an understanding of both the contamination observed at depth at the 1A Parcel of the National Grid site, as well as the contamination observed north and south of the National Grid site along Shore Road.

These findings are explained and illustrated in greater detail in the following pages. Please note that all referenced figures are provided at the end of this letter.

Task 1 – Flow Field Simulation

As part of Nassau County's comprehensive groundwater management program, Nassau County Department of Public Works (NCDPW) worked with CDM to develop and calibrate a regional groundwater flow model. Since the 1980s when the model was first developed, the County has successfully used the modeling tool for a wide variety of applications. In 2003, as part of the Source Water Assessment Program (SWAP) completed for the New York State Department of Health (NYSDOH) in association with NCDPW and the Nassau County Department of Health (NCDH), the model was updated to include additional discretization and new hydrogeologic information, and the calibration was verified against more recent datasets. This model was used as the basis for delineating the source water area for all 365 public supply wells in Nassau County. The regional model has also been used to provide the framework for a number of local models developed to evaluate contaminant migration and remedial alternatives at Nassau County sites with documented contaminant releases.

The existing calibrated transient regional model developed to represent groundwater flow within Nassau County was used to provide the framework for evaluation of the volatile organic compound (VOC) contamination observed at depth at the National Grid Glenwood Landing site, including potential migration of chlorinated VOC contamination toward the National Grid site from suspected upgradient source areas. Discretization of the regional model's existing finite element grid was refined in the vicinity of Glenwood Landing/Glen Head to better represent the local groundwater flow field. Model hydraulic properties, recharge, and return flows were interpolated onto the refined model grid from the regional model. Boundary conditions and hydrogeologic properties were adopted directly from the regional model. Minor modifications were made to the distribution of hydraulic conductivity values assigned to the top two model layers north and east of the site, to better represent a slight northerly component of the groundwater gradient observed in December 2005 at the Glen Head groundwater plume and Trans Technology sites. Water supply pumping,

recharge, and return flow estimates compiled from historical water supply pumping and precipitation records and used in the regional model were incorporated into the local model.

Further modifications were made to the model structure in the vicinity of the shoreline near the Glenwood Landing site, to move the regional model representation of the shoreline slightly to the west to better match its actual location. The model refinements included:

- Reassignment of boundary conditions;
- Adjustment of model materials to be consistent with the revised shoreline representation; and
- Adjustment of model elevations representing land surface near the shoreline using a USGS digital elevation model (DEM); this also improved the match between the model and reported ground surface elevations at on-site well locations.

Model elevations, stratigraphy, and hydraulic properties in the local model area were compared with available on-site and off-site boring log information in the Glenwood Landing/Glen Head area, as well as data from the latest USGS report for Oyster Bay, NY (USGS Water-Resources Investigations Report 03-4288), which was published subsequent to the development of the regional model. Existing model representation of a low conductivity area near the Glenwood Landing site was found to be in general agreement with silt and clay layers observed in boring logs recorded at golf course wells N-4462 and N-9800 drilled in the vicinity of the site; however, the clays and silts were less pronounced in the boring logs for on-site wells at the same depth interval, suggesting heterogeneity in the local hydrogeology.

The model was run in transient mode for the period from 1960 to 2009 using a monthly time step. The transient simulation was used to compare model-computed heads with measured head data available for this time period in the USGS NWIS database. Additionally, the transient simulation was used to test whether particle tracks representing the migration of hypothetical contaminant sources would follow similar or different paths if contaminant releases had occurred at different times. Because it was found that particle tracks started at different times followed very similar pathways from the suspected upgradient source area to discharge to Hempstead Harbor, the particle tracking results presented in this memorandum were based on a steady state flow simulation for computational efficiency. The steady state simulation was developed using average 1998 – 2005 pumping and recharge rates.

Comparison of Model-Simulated Heads and Locally Observed Water Levels

Sources of local head data included:

- Water level data available for USGS wells in the site vicinity from the USGS NWIS on-line database. Nearby well locations are shown in Figure 1.

- Synoptic groundwater elevations from the Glen Head groundwater plume and Trans Technology site monitoring wells (Figure 2) collected December 7 and December 13, 2005, and documented in Table 3-1, Site Characterization Report, NYSDEC Glen Head GW Plume, February 2007.

- Synoptic water level measurements obtained June 14, 2006 from the National Grid Glenwood Landing Former Gas Plant Site monitoring wells at low tide, mid-tide, and high tide, as documented in the Groundwater Investigation Findings Reported, June 2008. Mid-tide water levels (Figure 2) were used for comparison to model results.

The regional model was successful in depicting the observed groundwater flow field. Figure 3 provides a comparison between the heads observed at the Glenwood Landing site and the upgradient Trans Technology and Glen Head Cleaners sites, and the model-simulated heads. The symbols depict the difference between the observed and model-simulated values. A comparison of transient model heads and time-history data for nearby USGS wells is shown on Figure 4.

Groundwater generally flows from east to west in the study area and at the National Grid site, as shown in plan view on Figures 5 and 6, respectively. Figure 6 shows the maximum VOC concentrations measured at the geoprobe locations, along with the model-simulated flow vectors. Figure 6 shows that contamination detected at the National Grid site, and in geoprobes to the north and south, originated to the east of the site. Consistent with the observed piezometric head data, groundwater is simulated to flow from east to west to discharge at the coast. Groundwater recharged to the aquifer system to the east and upgradient of the National Grid site, travels vertically down through the aquifer before turning west and then vertically upward to discharge to Hempstead Harbor, as shown in cross-section on Figures 7 and 8. No north-south components of flow from the National Grid site were observed or simulated.

Observations and Conclusions

- Figure 3 shows that there is generally good agreement between measured and model-simulated piezometric heads at the National Grid site and in the upgradient source areas. On average, simulated steady state water levels are 0.36 ft lower than observed values with a standard deviation of 1.0 feet.

- Simulated piezometric heads at the wells at the Glenwood Landing site are in good agreement with measured mid-tide values. Measured heads in the shallow wells are

approximately 5 to 10 feet lower than those measured in the deeper "MWD" wells at the Glenwood Landing site, indicating a strong upward gradient. The model simulates a vertical head difference of approximately 8 feet between the deeper and shallow zones. The difference between simulated and measured heads at the on-site wells is within the tidal range observed in the deeper wells.

- The simulated groundwater table is close to ground surface near the "seep" located approximately 2,000 feet north of the Glenwood Landing site.

- Water levels measured in the shallow wells are noted to exhibit a weaker tidal influence (approximately 0.5 ft) than the deeper wells (up to 3 ft). Reported heads in nearby wells screened in similar depth intervals differ from one another by approximately 2 to 3 feet or more. This may be related to the transient tidal fluctuations or may reflect the steep upward vertical gradients near the coast.

- The observed groundwater gradient between the Trans Technology and Glen Head Cleaners sites and Hempstead Harbor (Figure 5) is approximately 50 ft/6000 ft, or 0.0083 ft/ft. Observed and simulated groundwater gradients in the shallow aquifer are generally in good agreement across the area of interest.

- The transient simulated heads generally agree reasonably well with the measured heads at the USGS wells. In particular, the transient model accurately simulates the long-term water level record at wells N-1153, near the Trans Technology site, for which the longest and most complete data record is available.

The regional model groundwater flow model successfully represented observed piezometric heads and groundwater gradients in the Glenwood Landing area, and was used as the basis for the assessment of potential contaminant transport pathways (Task 2) described below.

Task 2 – Particle Tracking Simulations

The simulated steady state groundwater flow field was used as the basis for particle tracking simulations using the transport model DYNTRACK. As previously shown on Figures 5 through 8, groundwater flows from east to west, and discharges to Hempstead Harbor in the vicinity of the National Grid site. A downward vertical gradient is evident to the east, in the vicinity of the suspected upgradient source areas. At the National Grid site, a strong upward vertical gradient has been measured.

Backward Particle Tracks

The model was run in a back-track mode from 12 on-site and off-site groundwater probe locations, at the depths where chlorinated VOCs were encountered. The depth intervals with the highest observed total VOC concentrations were used as the starting locations for the back-tracks. In general, the highest levels of contamination were observed deeper than the screened intervals of the shallow monitoring wells and shallow probes.

The model was run 'backwards' in time to track the average path of the observed contamination back to the location where a dissolved contaminant would have been introduced at the water table. The pathways of the simulated "backtracks" are shown in plan view in Figure 9. The tracks confirm that the general direction of groundwater flow is westwards toward the National Grid Glenwood Landing site. Figure 9 clearly shows that the VOCs measured at depth at the National Grid site could not have originated from an on-site source, but could have been released at one or more of the suspected upgradient source areas.

Forward Tracks and Particle Clouds

Figure 10 illustrates steady-state model results using forward particle tracking representing the average path of hypothetical groundwater contamination from the following potential upgradient source locations: Trans Technology, Glen Head Cleaners, Soundview Cleaners, Fresh and Clean Laundry, and Professional Touch Cleaners. Initial particle tracking simulations using the transient flow field showed very little variation in the pathways between particles released from the sites at 5-year intervals from 1960 to 2002. In each case, particles were introduced to the model flow field at the water table and run forward in time. Figure 10 shows that hypothetical contamination introduced at the water table at each of the potential upgradient source locations travels from east to west, to discharge to Hempstead Harbor in the vicinity of the National Grid site.

Contaminant transport simulations incorporating dispersion were also run to generate particle clouds that illustrate the migration of contamination from a hypothetical source area on the National Grid site, contaminant migration from the suspected upgradient source area at the water table and contaminant migration from the suspected upgradient source area at depth, from a dense non-aqueous phase liquid (DNAPL) source.

Figures 11 and 12, which illustrate the results of the particle cloud simulations originating from a hypothetical source at the National Grid site in plan and cross-sectional view respectively, show that if contamination was introduced at the site, it would immediately travel west to Hempstead Harbor and discharge. If particles representing hypothetical contamination are introduced to the flow field at the National Grid site, they do not travel

vertically down, nor to the north or south, and hence, the National Grid site is not the source of the observed contamination at depth or off-site.

Figures 13 and 14 illustrate the migration of contamination introduced at the water table at the suspected upgradient source areas in plan view and cross-section, respectively. These figures confirm that contamination potentially originating somewhere in the suspected upgradient source area would travel west to discharge to Hempstead Harbor. Figures 15 and 16 show the migration of contamination introduced at depth from the suspected upgradient source area (e.g., DNAPL source) in plan view and cross-section, respectively. The model simulations confirm that the observed groundwater contamination in the vicinity of the National Grid site could have originated from the suspected upgradient source area.

Observations and Conclusions

- Groundwater flows from east to west; groundwater from all upgradient suspected CVOC source areas flows to the west, discharging to Hempstead Harbor in the vicinity of the National Grid site. Upgradient of the National Grid site in the vicinity of the suspected source areas, a downward vertical gradient exists. In the vicinity of the National Grid site, a strong vertically upward gradient was observed as groundwater discharges to Hempstead Harbor. Consistent with the observed/simulated flow fields, the contaminant transport simulations do not reflect either a northerly or southerly component of flow that could explain migration to the off-site geoprobe locations from hypothetical contamination introduced at the National Grid site.

- The existing model represents the observed downward vertical gradient in the suspected upgradient source area, and the observed upward vertical gradient in the shallow aquifer at the National Grid Glenwood Landing site.

- The plan view and cross-section particle track simulations indicate that the source area of the observed VOC groundwater contamination is not at the National Grid Glenwood Landing site, but could reasonably be one or more of the upgradient sites considered during this modeling exercise, as contamination introduced upgradient of the site would travel westward to discharge at the Harbor near the National Grid site.

- The particle cloud simulation illustrating the migration of contamination from a hypothetical on-site source at the National Grid Glenwood Landing site (orange particles) does not reproduce the contamination observed at depth at the 1A Parcel of the National Grid site. The model shows that contamination from such a hypothetical on-site source would remain in the shallow groundwater and migrate horizontally westward toward the Harbor, consistent with the upward vertical gradient observed at the site.

- The particle cloud simulation illustrating the migration of contamination from a hypothetical on-site source at the National Grid Glenwood Landing site (orange particles) does not reproduce the contamination observed north and south of the site along Shore Road. As noted above, and shown on Figures 11 and 12, contamination from such a hypothetical on-site source would migrate directly west towards the Harbor.

- The particle cloud simulation illustrating the migration of contamination introduced to the aquifer at the water table and at depth at the suspected upgradient source areas (blue particles) could explain both the contamination observed at depth at the 1A Parcel of the National Grid site, as well as the shallow contamination observed north and south of the National Grid site along Shore Road, as shown on Figures 15 and 16.

We hope that this modeling evaluation is useful to you, in synthesizing available information and presenting the flow field and contaminant transport in the National Grid Glenwood Landing site study area. If you have any questions or comments, please do not hesitate to call me at (516) 496-8400.

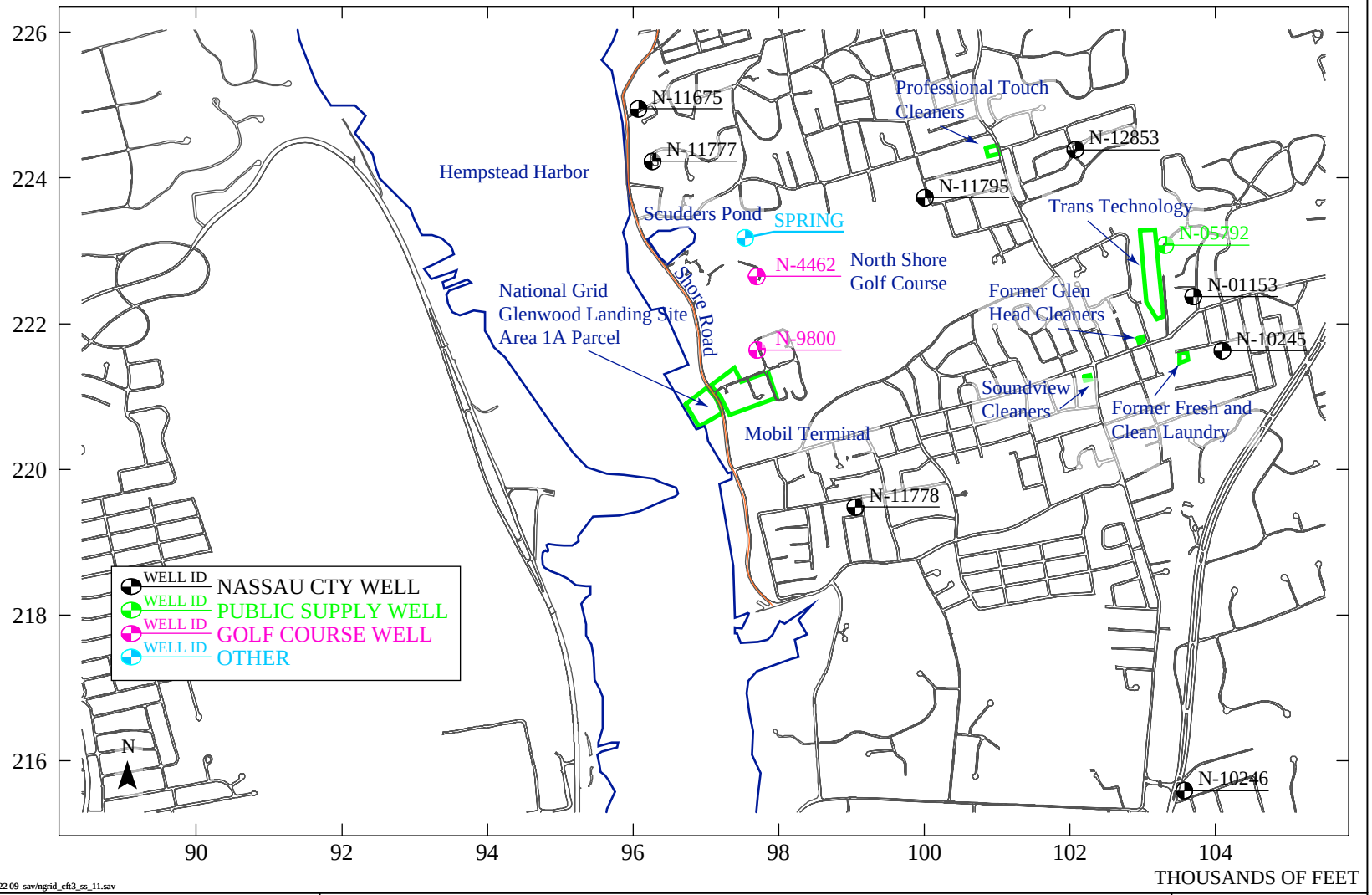
Very truly yours,

Mary Anne Taylor

Mary Anne Taylor, P.E.
Associate
Camp Dresser & McKee

cc: R. Fitzgerald
K. Kelly

Figures

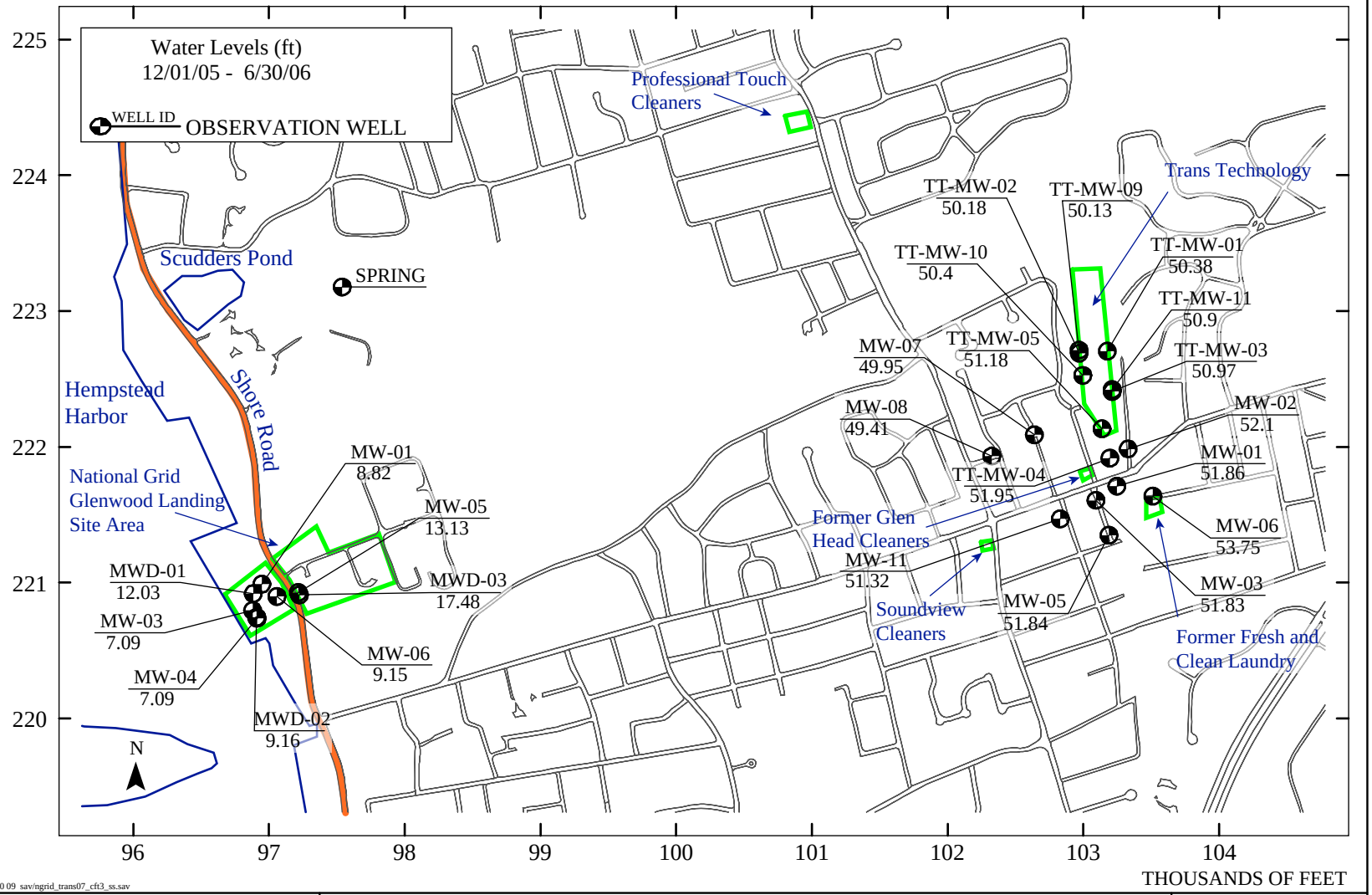


CDM

USGS Monitored Well Locations in Site Vicinity

National Grid, Glenwood Landing Site

Figure
1

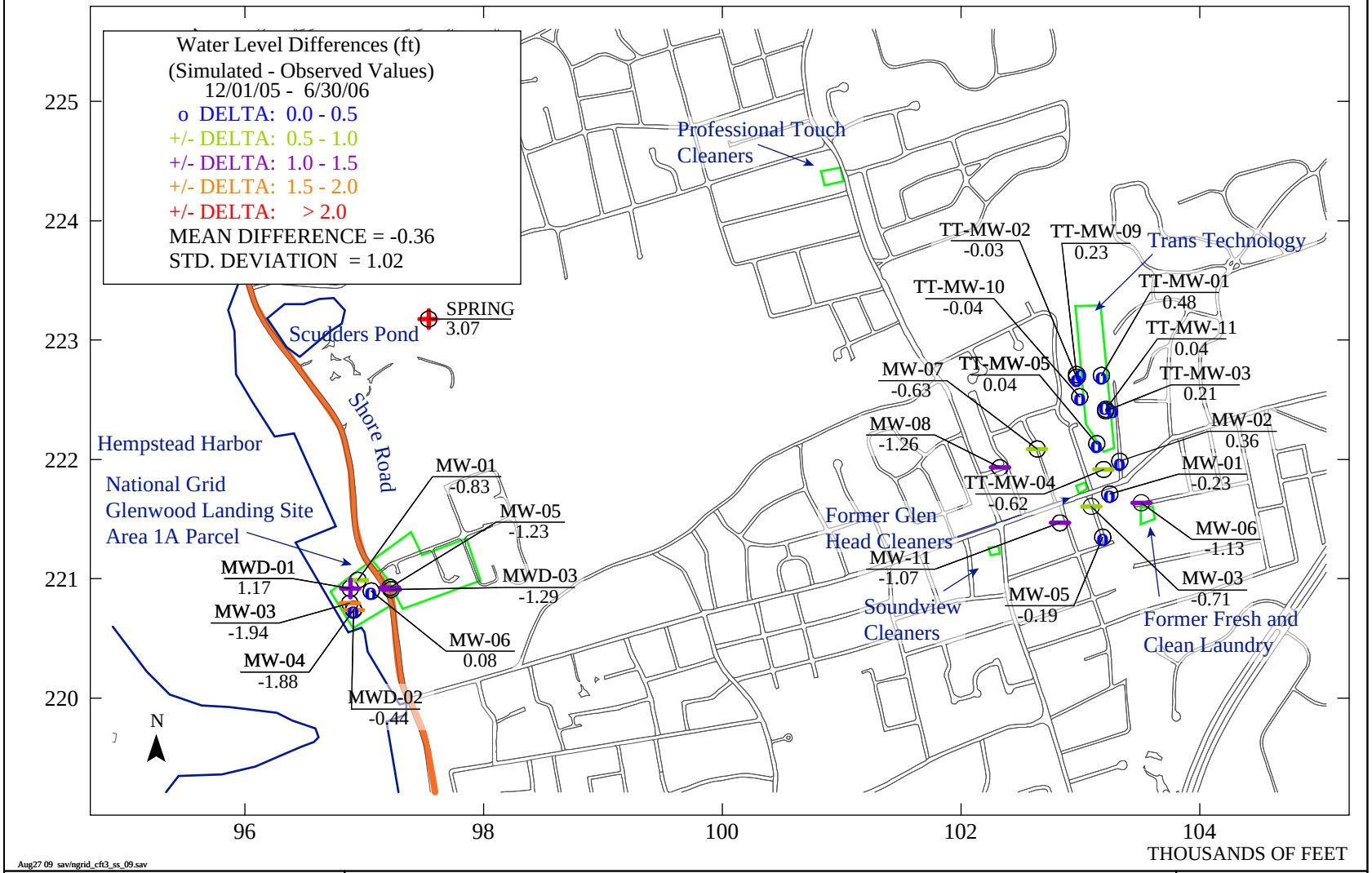


CDM

Observed Water Level Data

National Grid, Glenwood Landing Site

Figure 2

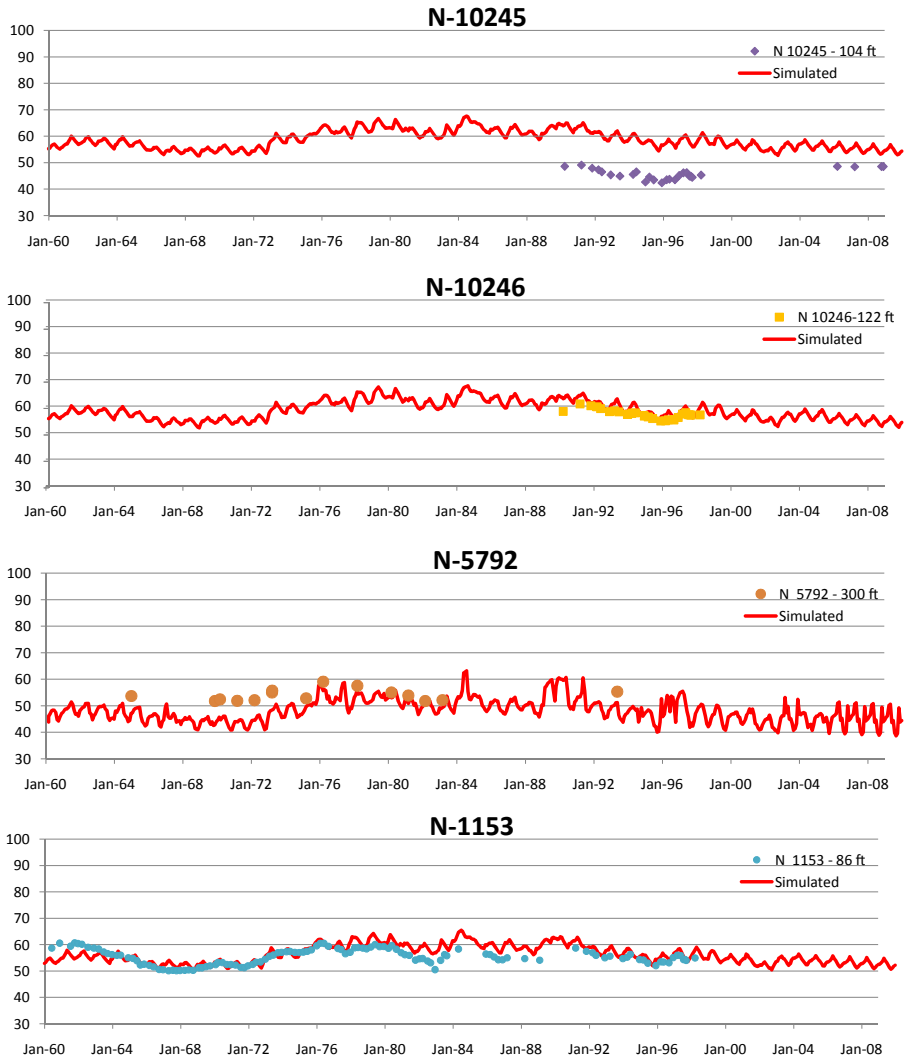


CDM

Comparison of Observed and Simulated Water Levels
Steady-State Model, Mid-Tide Site Values

National Grid, Glenwood Landing Site

Figure 3

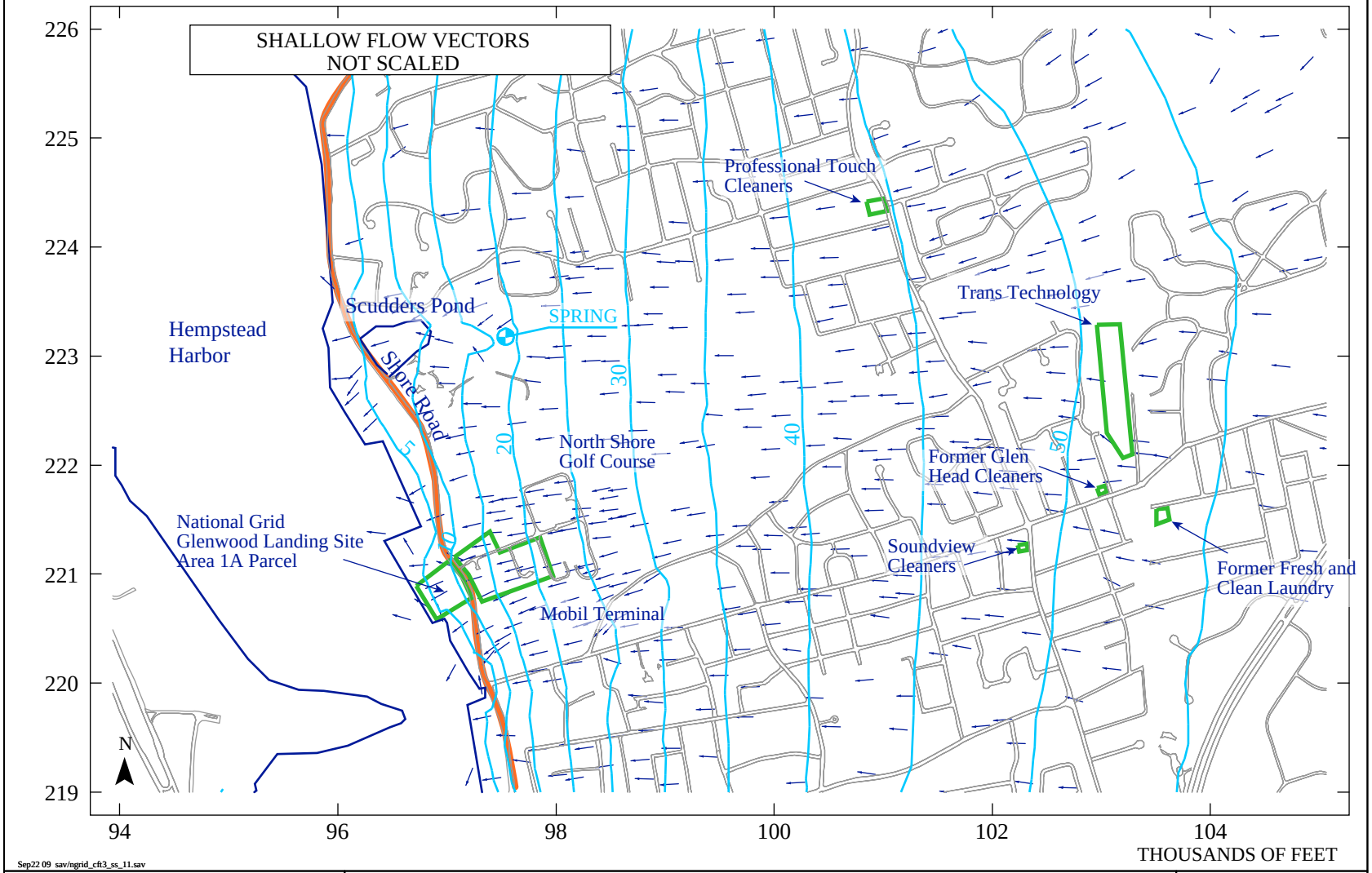


CDM

Comparison of Transient Model Heads and Time-History Data for USGS Wells
Well Depths Indicated in Graph Labels

National Grid, Glenwood Landing Site

Figure
4

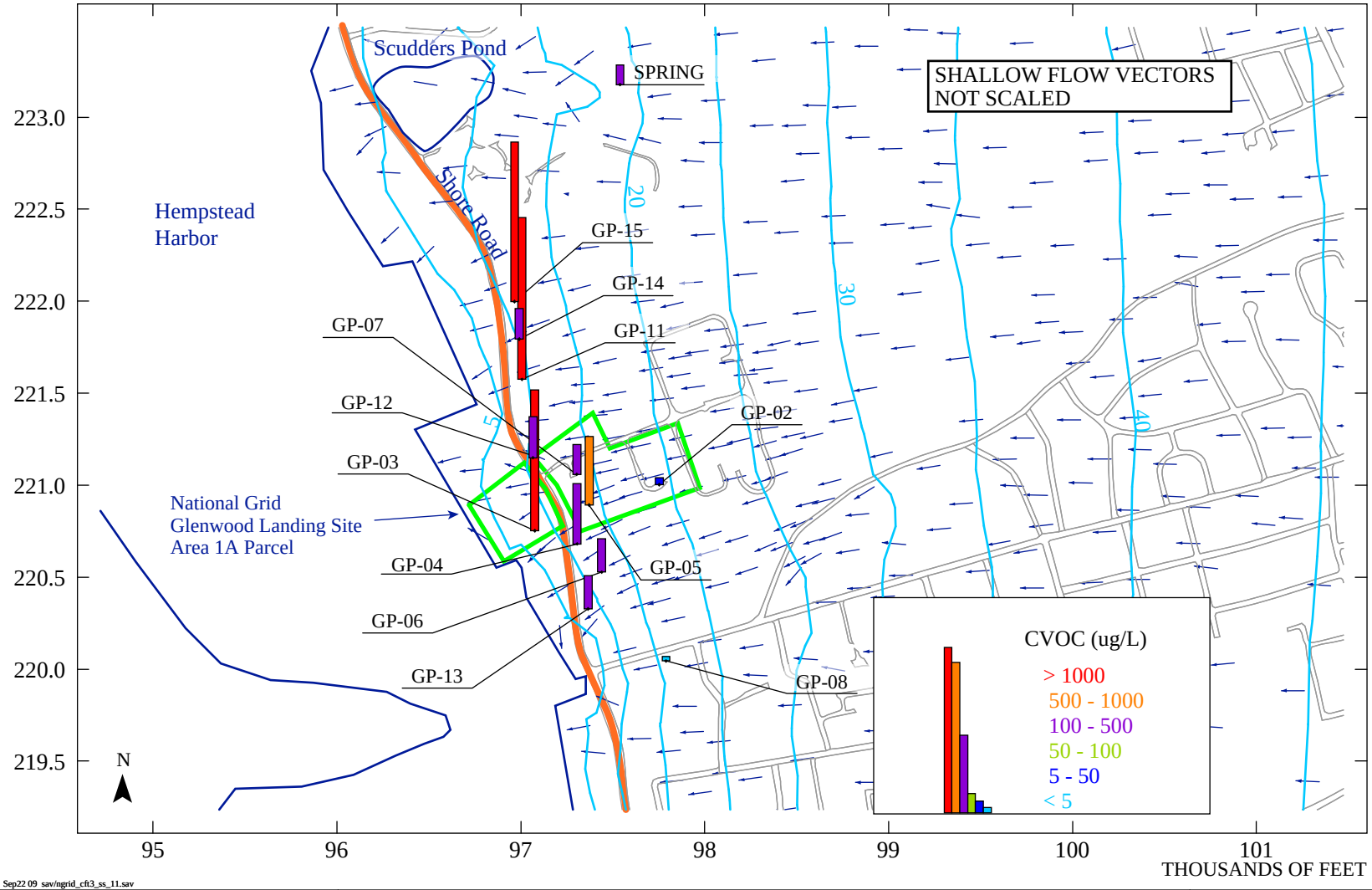


CDM

Regional Plan View with Water Table Contours and Flow Vectors
Head Contours and Shallow Flow Vectors - Not Scaled

National Grid, Glenwood Landing Site

Figure
5



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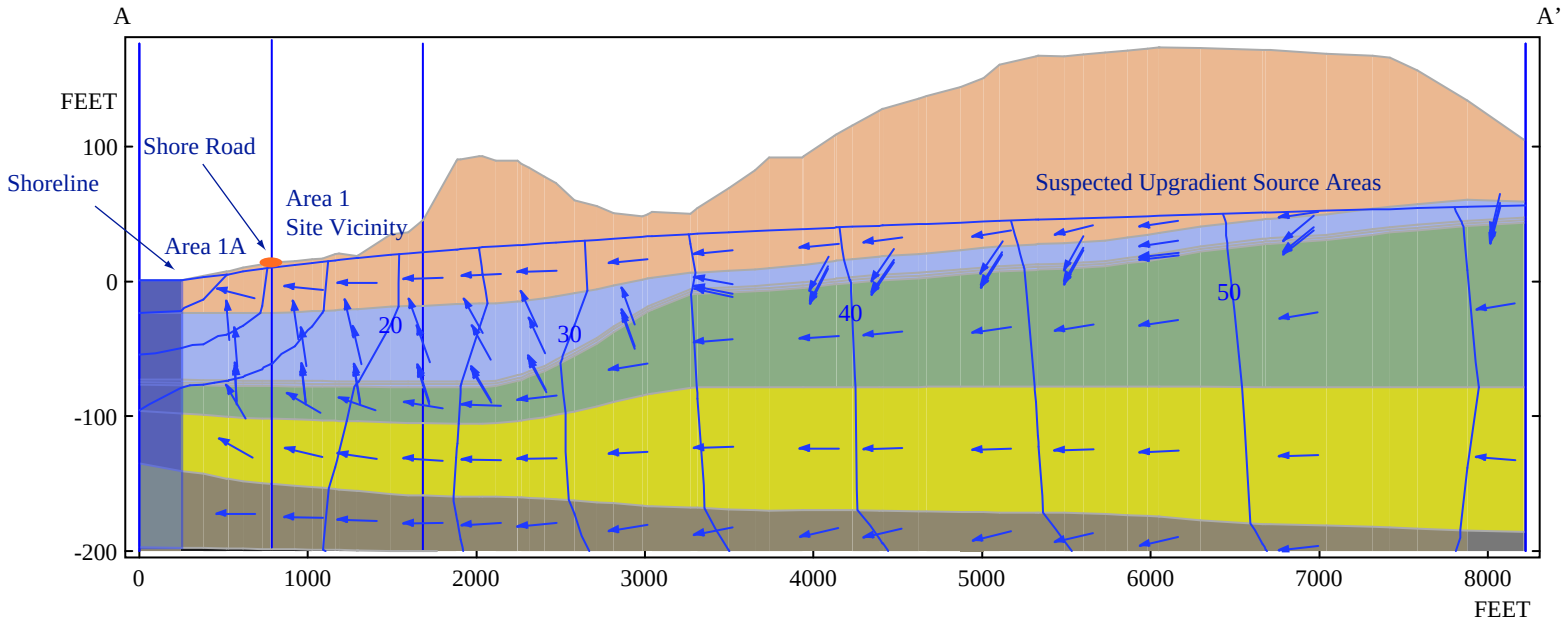
CDM

Plan View of Local Area Flow Field
Head Contours and Shallow Flow Vectors - Not Scaled
Maximum CVOC Concentrations Observed at Probe Locations
National Grid, Glenwood Landing Site

Figure
6



— 5-FT HEAD CONTOURS

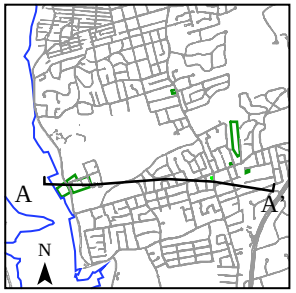
FLOW VECTORS
NOT SCALED

CROSS-SECTION A - A'
Hydraulic Conductivity Assignments (ft/day)

- Kx 100 Kz 1.0
- Kx 5.0 Kz 0.5
- Kx 80 Kz 2.0
- Kx 110 Kz 1.1
- Kx 1.0 Kz 0.005

PROJECTED 500 FT

CROSS SECTION A-A'



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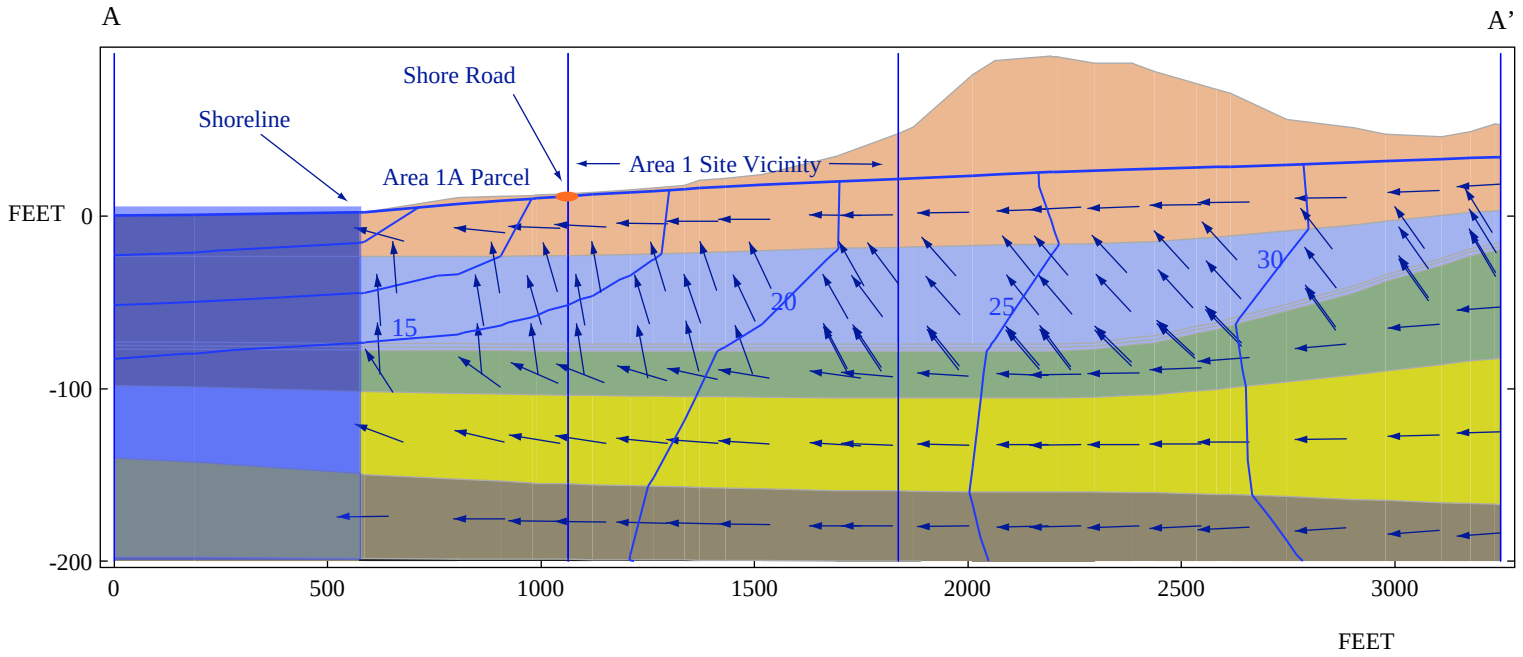
CDM

Cross-Section and Flow Vectors
Regional View

National Grid, Glenwood Landing Site

Figure
7



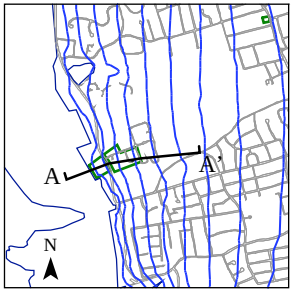
FLOW VECTORS
NOT SCALED

— 5-FT HEAD CONTOURS

CROSS-SECTION A - A'
Hydraulic Conductivity Assignments (ft/day)

- Kx 100. Kz 1.0
- Kx 5.0 Kz 0.5
- Kx 80. Kz 2.0
- Kx 110. Kz 1.1
- Kx 1.0 Kz 0.005

CROSS SECTION A-A'



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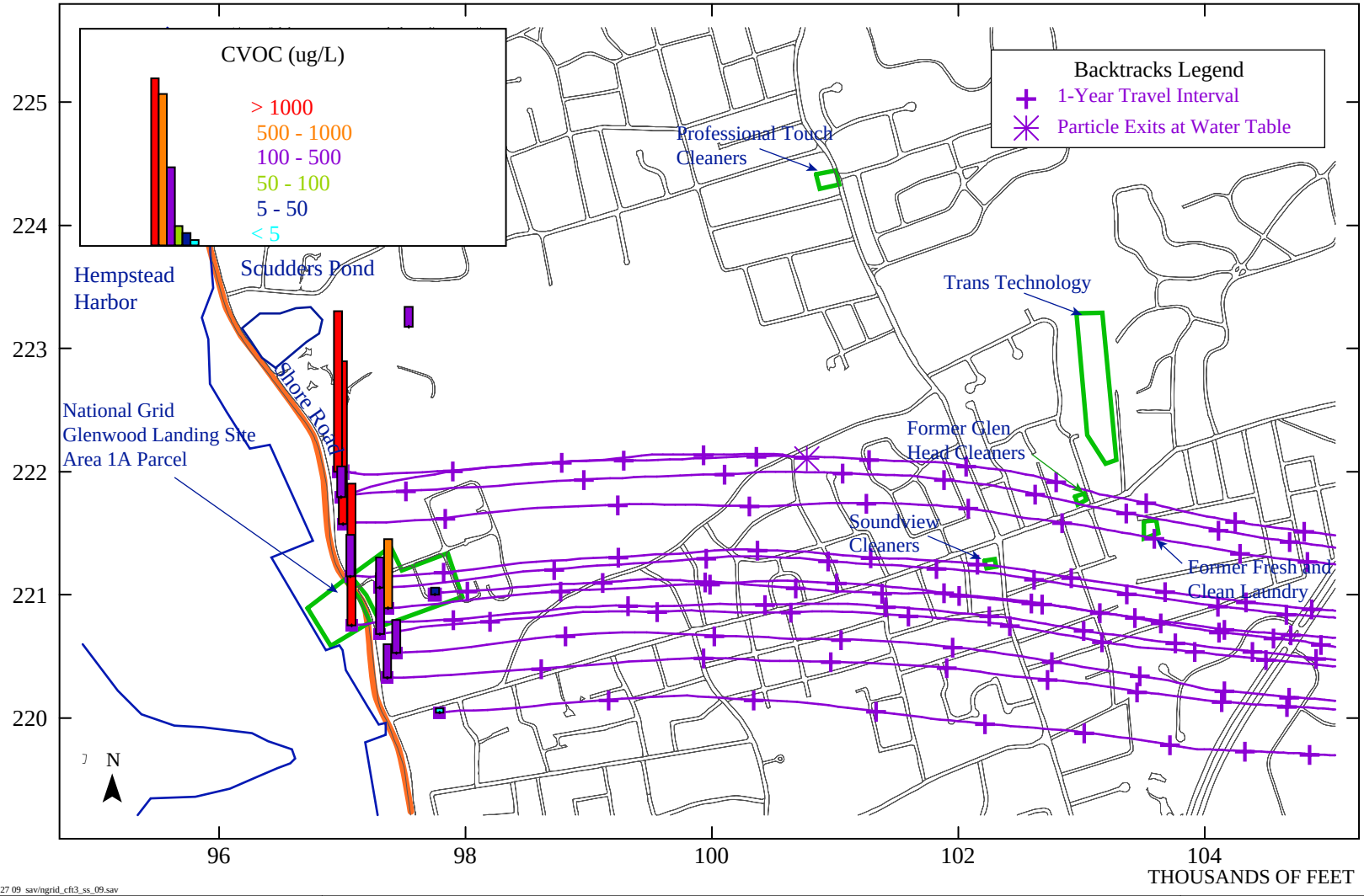
CDM

Cross-Section Through Site Area

National Grid, Glenwood Landing Site

Figure
8



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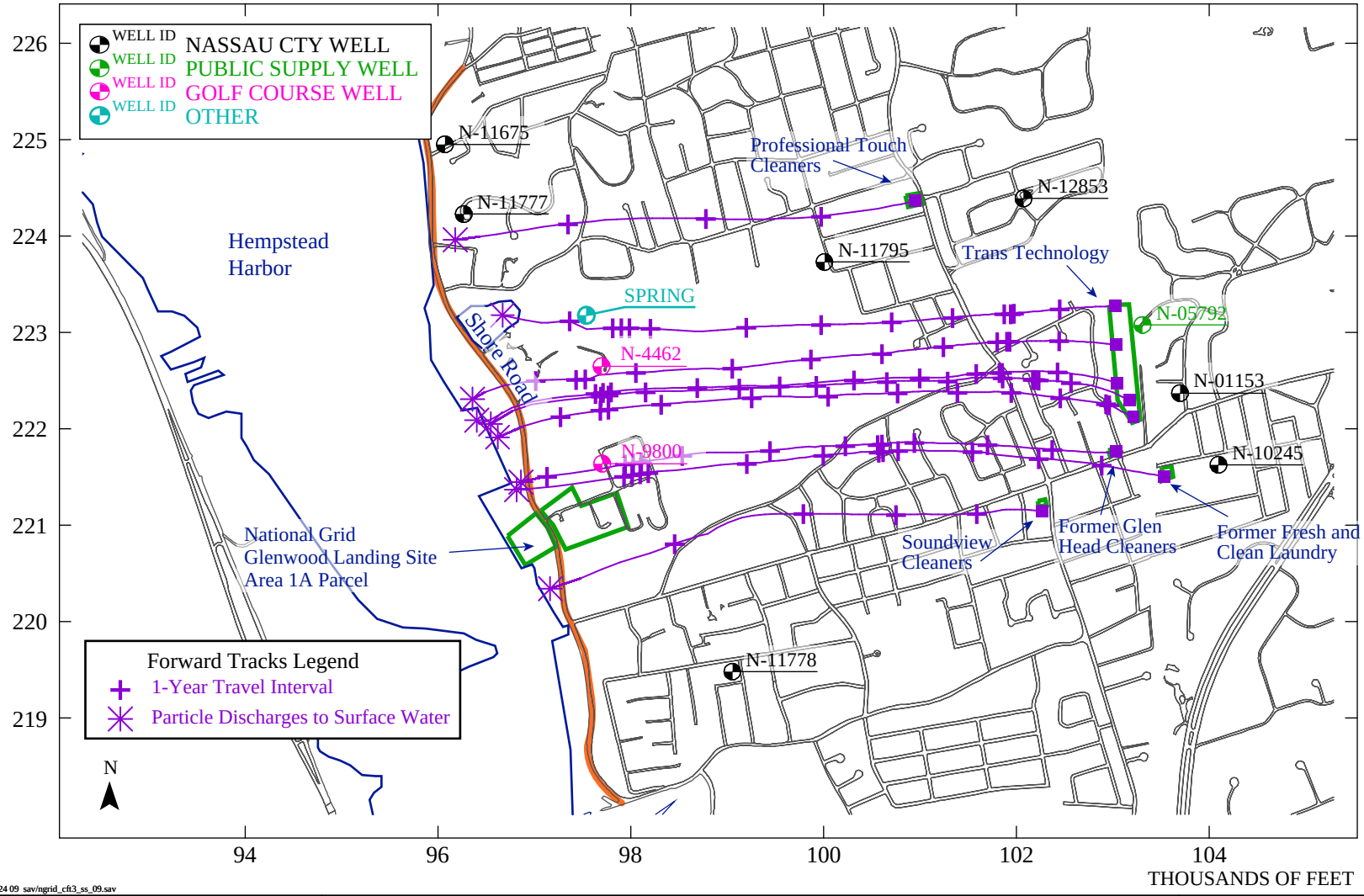
CDM

Backtracks from Maximum CVOC Concentrations at Probe Locations
Tick Marks at 1-Year Intervals

National Grid, Glenwood Landing Site

Figure 9



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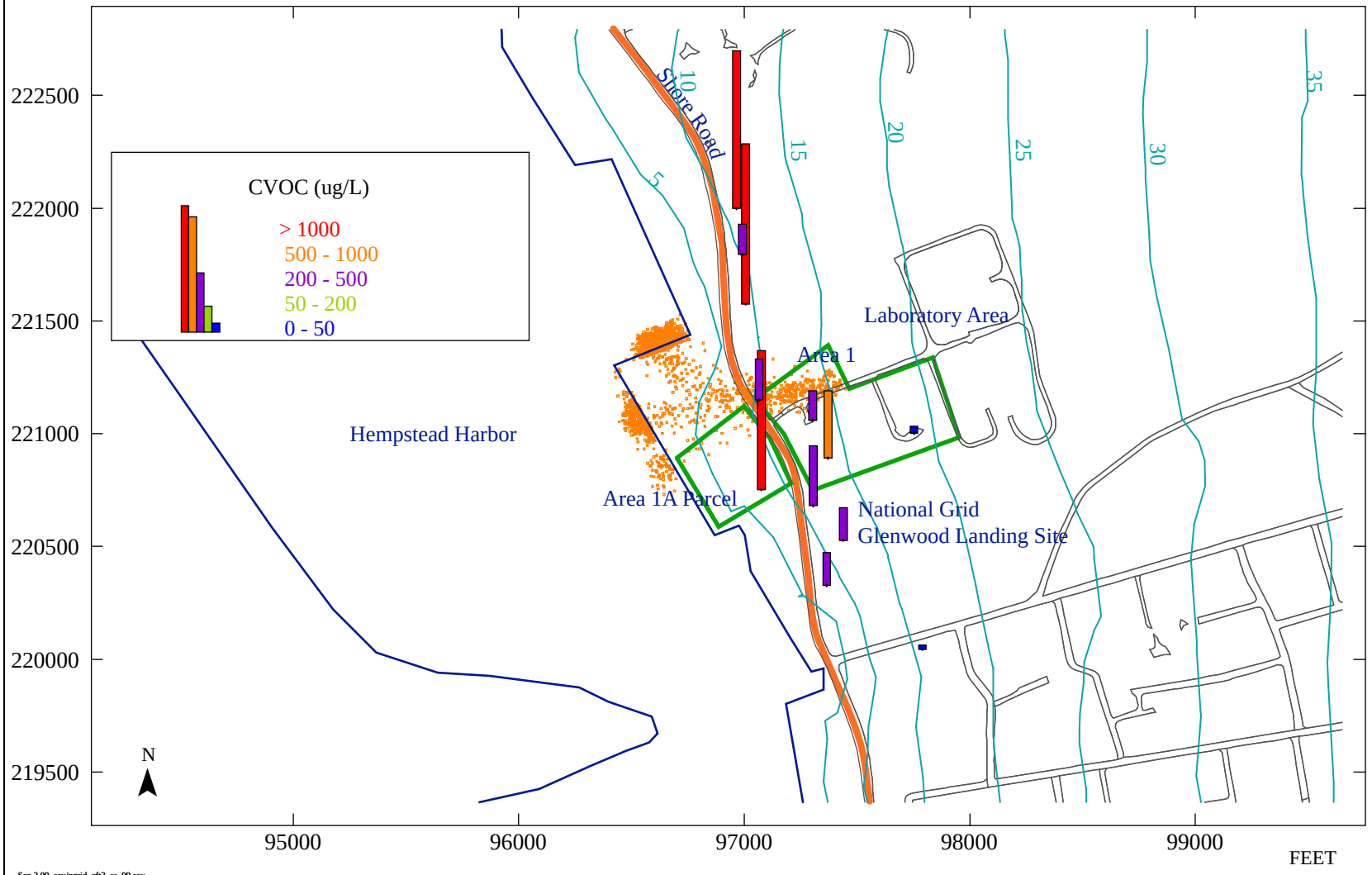
CDM

Forward Particle Tracks
Simulated Contaminant Transport
Particles Introduced in 1960 from Suspected Upgradient Source Areas
National Grid, Glenwood Landing Site

Figure
10

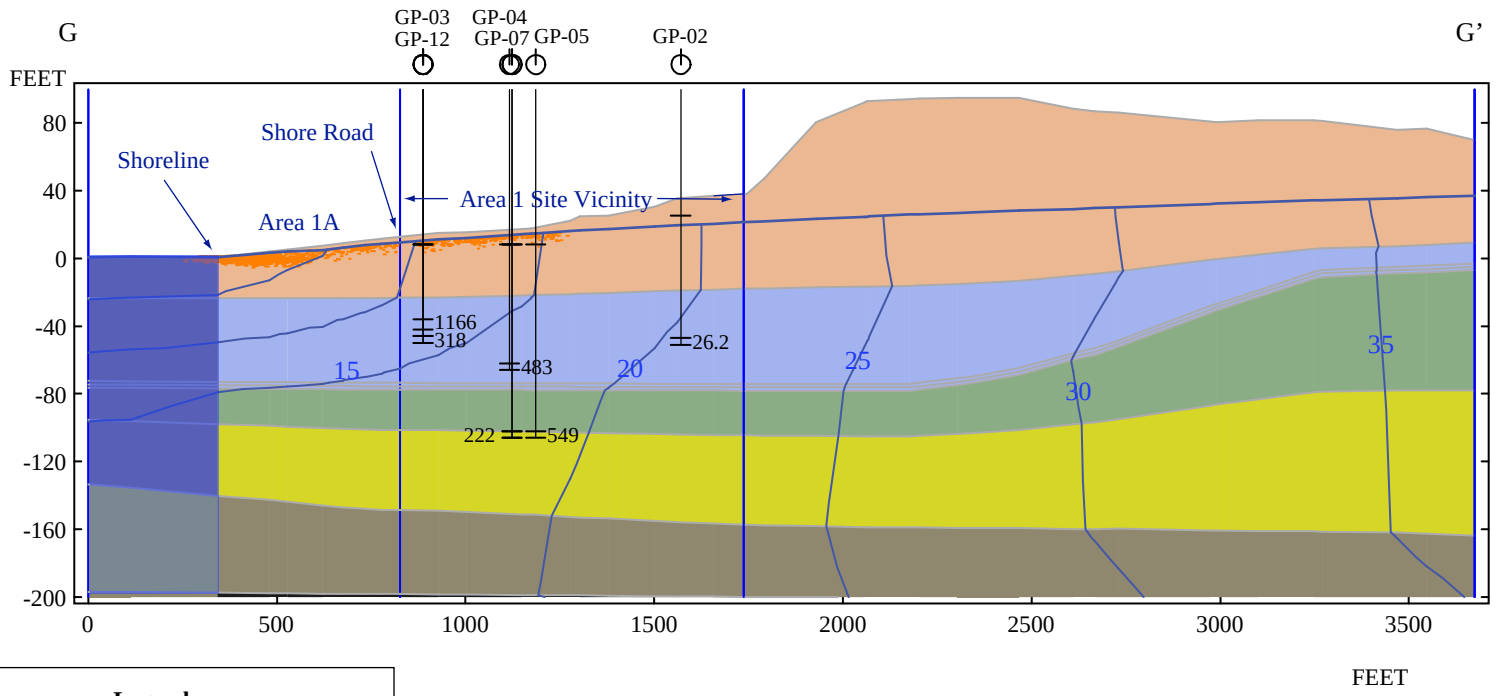


CDM

Particle Clouds Illustrating Transport
From a Hypothetical Area 1 Source

National Grid, Glenwood Landing Site

Figure
11



Legend

Hypothetical Area 1 Source

5-FT HEAD CONTOURS

CROSS-SECTION G - G'
Hydraulic Conductivity Assignments (ft/day)

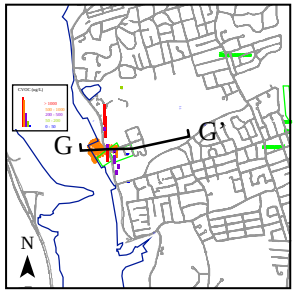
- Kx 100. Kz 1.0
- Kx 5.0 Kz 0.5
- Kx 80. Kz 2.0
- Kx 110. Kz 1.1
- Kx 1.0 Kz 0.005

Observed
CVOC Concentrations
(ug/L)

- OBSERVATION WELL
- GROUND SURFACE
- TOP OF SCREEN
- BOTTOM OF SCREEN

PROJECTED 500 FT

CROSS SECTION G-G'



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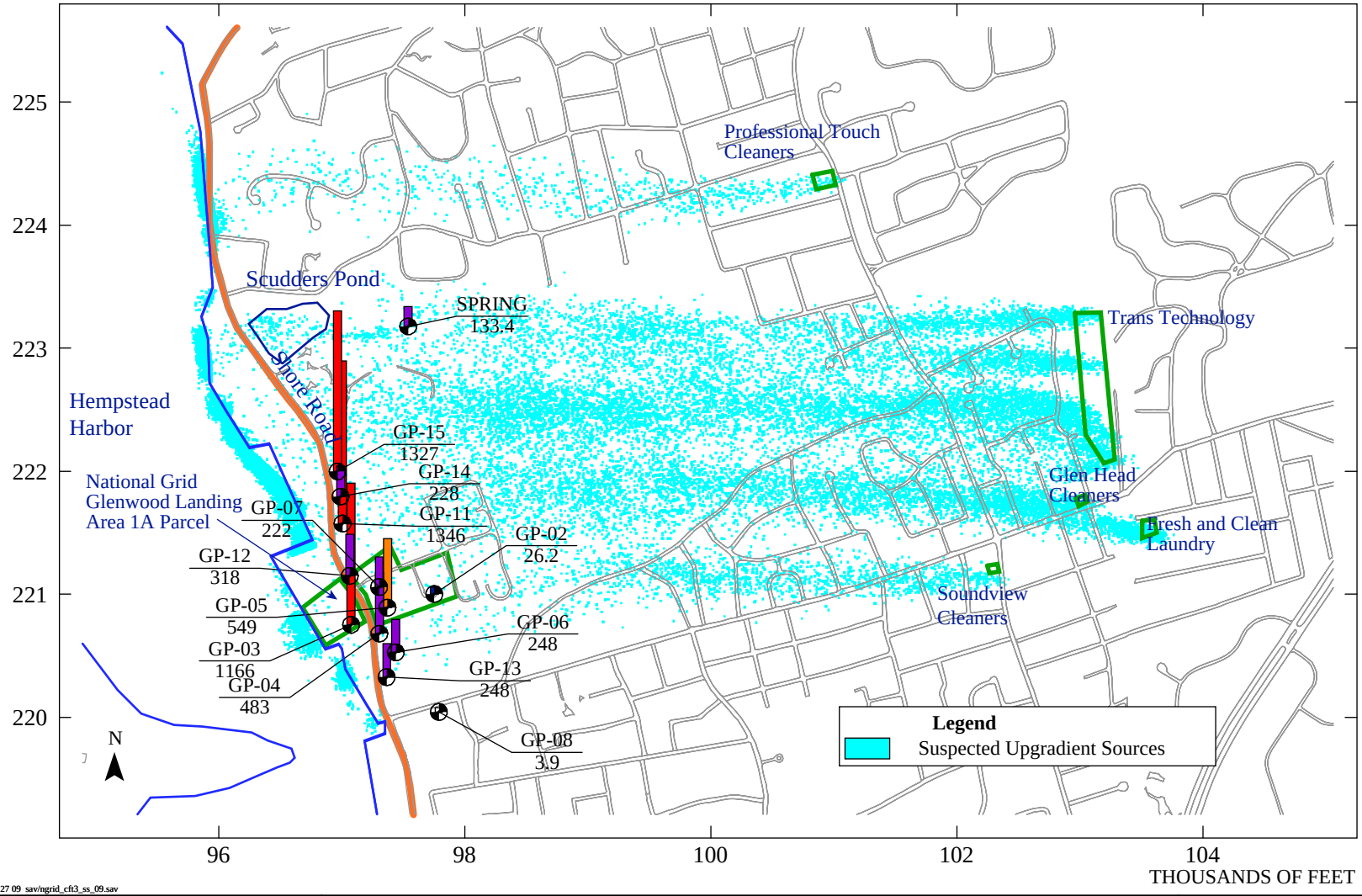
Cross-Section through Area 1 Site Vicinity

National Grid, Glenwood Landing Site

Figure
12

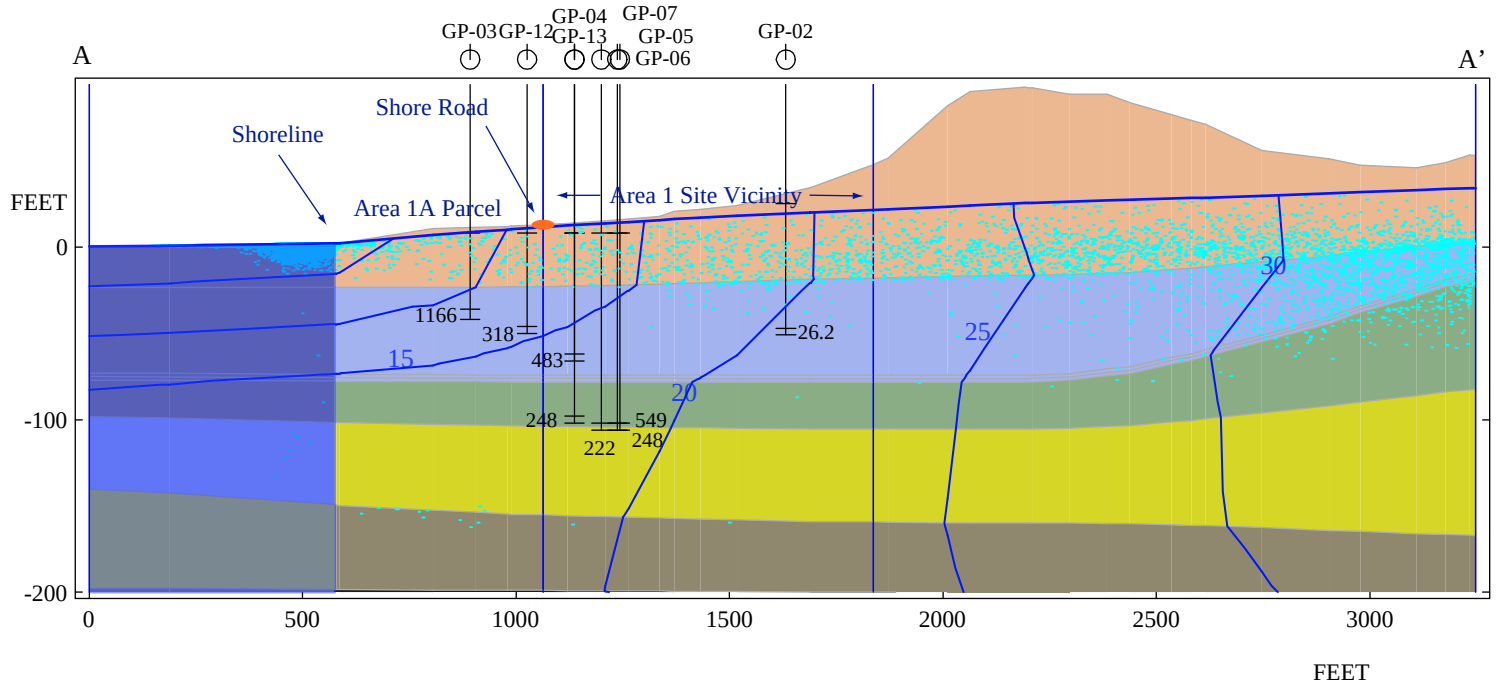


CDM

Particle Clouds Illustrating Transport
from Suspected Upgradient CVOC Source Areas

National Grid, Glenwood Landing Site

Figure
13



Legend

Hypothetical Upgradient Water Table Source

— 5-FT HEAD CONTOURS

CROSS-SECTION A - A'

Hydraulic Conductivity Assignments (ft/day)

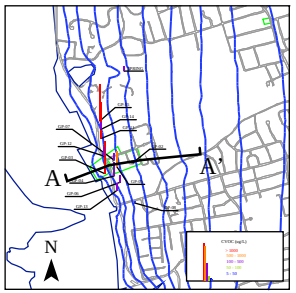
- Kx 100. Kz 1.0
- Kx 5.0 Kz 0.5
- Kx 80. Kz 2.0
- Kx 110. Kz 1.1
- Kx 1.0 Kz 0.005

CVOC (ug/L)

- OBSERVATION WELL
- GROUND SURFACE
- TOP OF SCREEN
- BOTTOM OF SCREEN

PROJECTED 800 FT

CROSS SECTION A-A'



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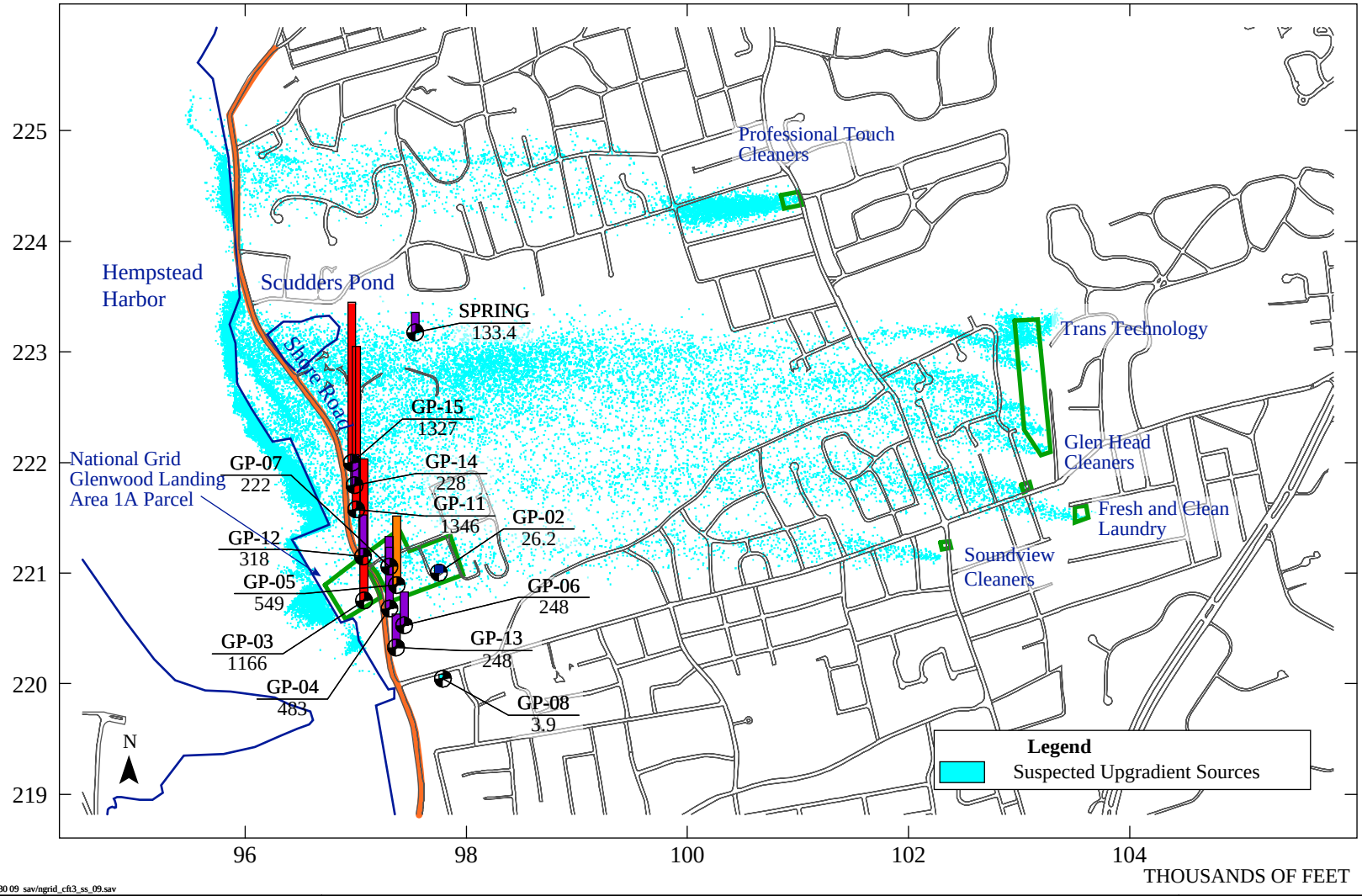
CDM

Cross-Section: Transport Simulation

Transport from a Suspected Upgradient Source Area at the Water Table

National Grid, Glenwood Landing Site

Figure 14



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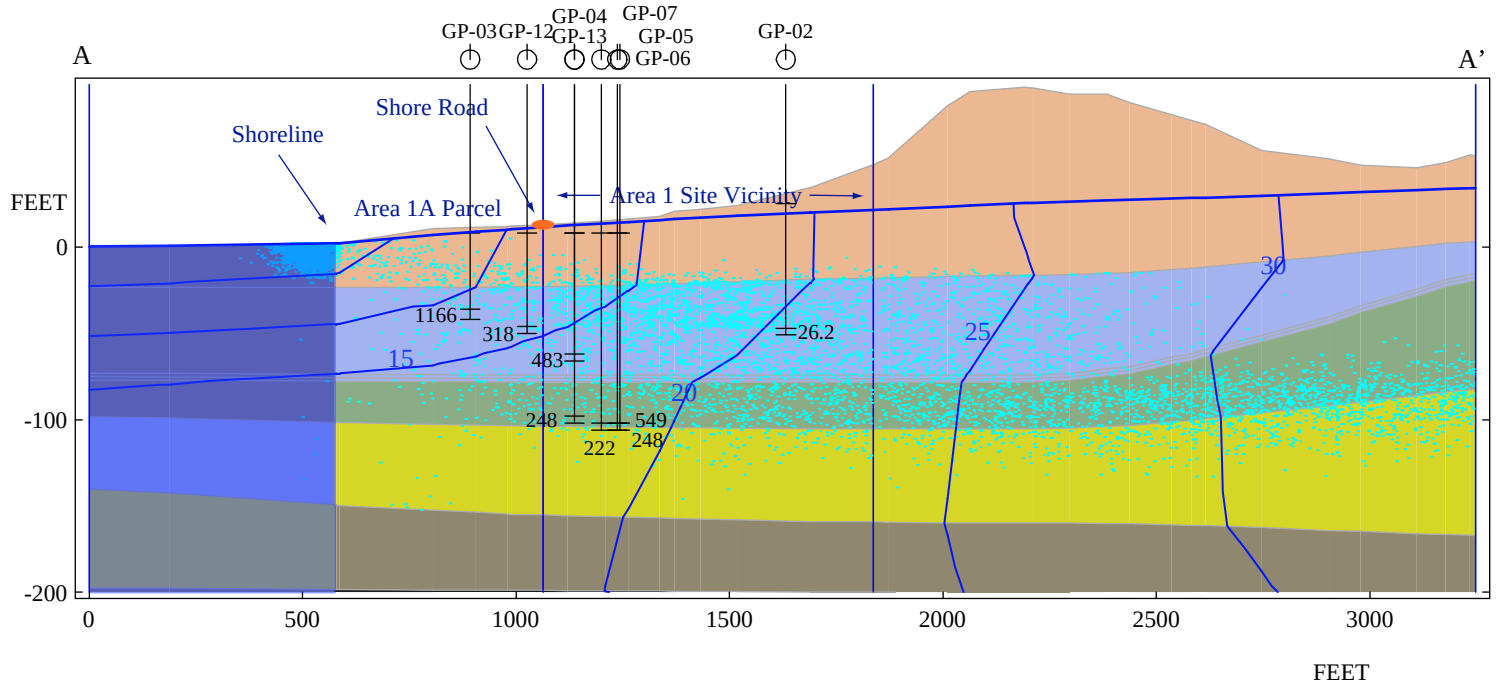
CDM

Particle Clouds Illustrating Transport
from a Hypothetical Upgradient DNAPL Source

National Grid, Glenwood Landing Site

Figure
15



Legend

Hypothetical Upgradient DNAPL Source

— 5-FT HEAD CONTOURS

CROSS-SECTION A - A'

Hydraulic Conductivity Assignments (ft/day)

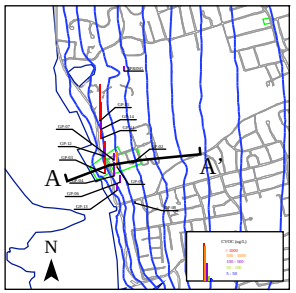
- Kx 100. Kz 1.0
- Kx 5.0 Kz 0.5
- Kx 80. Kz 2.0
- Kx 110. Kz 1.1
- Kx 1.0 Kz 0.005

CVOC (ug/L)

- OBSERVATION WELL
- GROUND SURFACE
- TOP OF SCREEN
- BOTTOM OF SCREEN

PROJECTED 800 FT

CROSS SECTION A-A'



Sep22 09 sav/ngrid_cft3_ss_11.sav

CDM

Cross-Section: Transport Simulation
Transport from a Hypothetical Upgradient DNAPL Source
National Grid, Glenwood Landing Site

Figure 16