APPENDIX 17-D

Alpha Geoscience Report

HYDROGEOLOGY OF THE GREAT FLATS AQUIFER IN THE VICINITY OF THE GLENVILLE ENERGY PARK SITE

Prepared for:

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December 2001

ALPHA GEOSCIENCE

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Geology
Hydrology
Remediation
Water Supply

Hydrogeology of the Great Flats Aquifer in the Vicinity of the Glenville Energy Park Site

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ERRATA SHEET

The proposed water usage referenced in this report for the proposed Glenville Energy Plant is 2.4 MGD (average) and 4.0 MGD (maximum). The maximum water usage by the proposed Glenville Energy Plant was adjusted to 4.1 million gallons per day (MGD), at the time this report was in production, to account for a design modification (i.e., the addition of foggers on the gas turbines). The average daily pumping rate at the Schenectady well field with the Glenville Energy Plant in operation would be 15.1 MGD (average) and 16.8 MGD (maximum). These values are based on the revised maximum water use, and an average daily pumping rate of 12.7 MGD at the Schenectady well field from July 1997 through June 2001. It is the opinion of Alpha Geoscience that the additional 0.1 MGD for the maximum water usage is not significant with respect to the proposed pumping rates, and that the hydrogeologic analysis and conclusions contained in this report are not altered by this proposed additional water usage.

ABSTRACT

Alpha Geoscience conducted a hydrogeologic evaluation of a portion of the Great Flats aquifer in Schenectady County. The purpose of the evaluation was to determine the potential affects, if any, of the Glenville Energy Park (GEP) project on the quality was and quantity of water in the aquifer. The Great Flats aquifer is a designated sole source water supply for the City of Schenectady, the Towns of Glenville and Rotterdam, the Village of Scotia, and the Hamlet of Rotterdam Junction. A combined withdrawal of groundwater by these communities is approximately 20.4 million gallons per day. The City of Schenectady well field has a permitted capacity of 35 million gallons per day and has been pumping at an average rate of approximately 12.7 MGD for the 4 year period from July 1997 through June 2001. The proposed water usage by the GEP is 2.4 million gallons per day with a peak of 4.0 million gallons per day that will be obtained from the City of Schenectady well field on Rice Road in the Town of Rotterdam.

This hydrogeologic evaluation was performed by compiling, reviewing, and evaluating the available geologic and hydrogeologic information within the area of study (Plate 1). The available information was systematically organized and evaluated to characterize the geologic and hydrogeologic conditions within the study area. The potential impacts of the proposed water usage by the GEP were then evaluated, based on these conditions.

The geologic evaluation identified five primary geologic units including, in ascending order, bedrock, glacial till, outwash sand and gravel, glaciolacustrine sand, silt and clay, and alluvial sand and silt. The outwash sand and gravel that filled the Mohawk River Valley as the glaciers receded comprises the Great Flats aquifer from which the municipalities obtain water.

The aquifer primarily receives recharge from precipitation directly to the valley surface and from runoff onto the ground surface from the upland adjacent to the Mohawk River Valley. Additional recharge is derived from the bedrock and glacial till below the aquifer. The primary discharge zone for the aquifer is the Mohawk River. However, the aquifer is recharged by the river where flow is induced from the river to the aquifer by pumping at the Glenville, Schenectady, and Rotterdam well fields. This recharge to groundwater by the river is a reversal of the normal relationship between the Mohawk River and the aquifer. The ability of the Mohawk River to sustain the Schenectady, Rotterdam, and Glenville well fields prevents those systems from being susceptible to drought conditions.

The water level in the Mohawk River is controlled by canal locks that are used for navigational purposes. The water level in portions of the aquifer adjacent to the river are dependent on the river level, which varies between navigational and non-navigational seasons. Portions of the aquifer that are not located adjacent to the Mohawk River are not affected by river levels and exhibit normal seasonal cycles.

The Schenectady, Rotterdam, and Glenville well fields are not susceptible to summer drought conditions due to their proximity to the Mohawk River, however they are susceptible to brief periods of dry, cold weather in late January and early February. During such conditions of reduced contribution by the Mohawk River, the well fields will remove greater volumes of water from storage in the aquifer resulting in an expansion of the cone of drawdown at each well field. A pumping test at a rate of 29.8 million gallons per day at the Schenectady/Rotterdam well field during such conditions indicated that the cone of drawdown extended slightly to the north side of the Mohawk River. Pumping tests at the Schenectady/Rotterdam well field conducted during less severe climatic conditions with pumping rates ranging from 8 million gallons per day to 18.28 million gallons per day did not induce drawdown on the north side of the river. These pumping test results indicate that the water supplied by the Mohawk River to the Schenectady/ Rotterdam well field limits the cone of drawdown north of the well field, except during periods of severe climatic conditions and very high pumping rates.

An average pumping rate of 15.1 million gallons per day at the Schenectady well field with the GEP in operation is not expected to result in an expansion of the cone of drawdown to the north due to the high contribution of water from the Mohawk River to the well field. The analysis presented in this report uses the recent average pumping rate for the City of Schenectady, although flow rates are known to vary over short periods of time depending on demand. The short-term variations in the well field pumping rate have very little effect on the cone of drawdown because of the very high aquifer transmissivity and the hydraulic connection between the well field and the Mohawk River. Use of the average pumping rate is therefore, the proper method for assessing potential impacts of the proposed increased pumping rate on the cone of drawdown and groundwater flow directions.

Groundwater flow directions in the aquifer will not be altered by the proposed increased pumping at the Schenectady well field. Similarly, groundwater availability to private well users will not be affected by the increased pumping rate because the cone of drawdown for the City of Schenectady and Town of Rotterdam well fields will not change substantially because of the high permeability of the aquifer and the hydraulic connection between the well fields and the Mohawk River.

Comparison of groundwater contour maps for the navigational and non-navigational seasons show that there is little seasonal change in groundwater levels or groundwater flow directions, except near Lock 8. Damming of water at Lock 8 during the navigational season results in a 14.5 foot difference in surface water elevation from the upstream to the downstream side of the lock, which is open during the non-navigational season. This condition creates seasonal changes in the groundwater gradient and the groundwater flow direction in the area north of the lock (south to southeast of the GEP site). The groundwater contour maps and groundwater level measurements show that the groundwater gradient and groundwater flow direction at the GEP site are not affected by the seasonal changes in the Mohawk River level or the pumping at the municipal well fields. The depth to groundwater beneath the proposed GEP site is approximately 60 to 70 feet below ground surface. Furthermore, the results of a well survey indicate that there are no private well users that would be affected by an increased pumping rate at the Schenectady well field.

Information on groundwater quality was reviewed to evaluate whether the proposed additional pumping at the Schenectady/Rotterdam well fields would alter areas of known groundwater contamination. Investigations have identified and delineated a plume of trichloroethene (TCE) and related compounds in the groundwater at, and near the GEP site. A persistent groundwater divide exists south and southeast of the GEP site. Groundwater west of the groundwater divide generally flows to the southwest toward the Mohawk River. The TCE plume and most of the GEP site area lie west of the ground water divide. The investigations show that the likely source of the TCE is northeast of the GEP site. The hydrogeologic evaluation shows that the TCE plume will not be altered by the additional pumping at the Schenectady well field because the groundwater gradient and groundwater flow direction beneath the GEP site would be unaffected by the increased pumping.

The proposed additional pumping of 2.4 million gallons per day (4.0 million gallons per day maximum) at the Schenectady well field for the GEP project can be implemented without adverse impacts. The hydrogeologic evaluation shows that the increased pumping rate will not affect the groundwater flow direction or the groundwater quality of private well users, or of other municipal well fields. Analysis of historical pumping records and well field pumping tests shows that the Schenectady well field has sufficient capacity to easily support the additional demand of 2.4 million gallons per day (4.0 million gallons per day maximum). Existing plumes of contamination in the aquifer will not be altered because the proposed additional pumping at the Schenectady well field will not change groundwater gradients or flow directions.

1.0 INTRODUCTION

This report presents the results of a hydrogeological evaluation of the site and area surrounding the proposed Glenville Energy Park (GEP) (the project). The GEP is a proposed gas fired electrical generating facility that will be located in the Scotia-Glenville Industrial Park (Figure 1). The study area, shown on Plate 1, includes the proposed GEP site, most of the Great Flats aquifer, and four municipal well fields. The hydrogeological evaluation and report were prepared by Alpha Geoscience (Alpha) for Earth Tech, Inc. as part of its environmental impact assessments and submissions for the Article X permit application on behalf of the GEP.

The primary focus of this hydrogeological evaluation is on the potential affects of the GEP on the quality and quantity of water in the Great Flats Aquifer in Schenectady County. The Great Flats Aquifer is a sand and gravel deposit that underlies much of the Mohawk Valley in the area between Pattersonville and Glenridge (Figure 2) and is a sole source water supply for the City of Schenectady, the Towns of Glenville and Rotterdam, the Village of Scotia, and the Hamlet of Rotterdam Junction. The Town of Glenville also serves neighboring water districts in the Towns of Clifton Park, Charlton and Ballston. These communities withdraw a combined total average of 20.4 million gallons per day (MGD) from the aquifer. The proposed GEP project lies near the geographic center of the aquifer (Figure 2). This hydrogeologic evaluation assumes that the GEP project will increase the average withdrawal from the aquifer by an average of 2.4 MGD with a peak of 4.0 MGD, which would increase the combined pumpage from the aquifer for all the community water systems to a total of 22.2 MGD (23.8 MGD maximum). The City of Schenectady will supply GEP's water from its well field off Rice Road in the Town of Rotterdam. The average pumping rate at the Schenectady well field for a four year period from July 1997 through June 2001 is 12.7 MGD. The anticipated water usage of 2.4 MGD (4.0 MGD maximum) used for this hydrogeologic evaluation is the maximum anticipated volume for the GEP.

1.1 Objectives

The primary objectives of the evaluation were to determine whether the Schenectady well field has sufficient capacity to provide 2.4 MGD (4.0 MGD maximum) to GEP, and to evaluate the potential impacts of the project on the quantity and quality of the water resources available in the aquifer. The tasks that were undertaken to achieve the objectives of the assessment include the following:

- Defining the vertical and lateral extent of the hydrogeologic unit that comprises the Great Flats Aquifer and defining the nature and locations of the aquifer boundaries, recharge areas, and discharge areas.
- Defining the groundwater flow paths and patterns within the Great Flats Aquifer.
- Evaluating the historical extent of the cone of drawdown and zone of recharge of the Schenectady well field during both the navigation and non-navigation periods for the Mohawk River and Canal System.
- Assessing whether there will be any changes to the cone of drawdown and zone of recharge at the City of Schenectady well field as the result of the GEP.
- Assessing whether any changes in drawdown by increased demand at the City of Schenectady well field will impact the availability of water to other municipal and private water supplies relying on the aquifer.
- Assessing whether groundwater flow patterns will be changed in the Great Flats Aquifer by the additional pumpage at the Schenectady well field and,
- Assessing whether such changes will have an affect on the movement of contaminants that have been identified in the aquifer.

- Assessing the risks to the municipal well fields from a potential release of chemicals at the GEP site.

1.2 Methods

The objectives of this hydrogeologic evaluation were met through the review and analysis of existing information. Extensive quantities of hydrogeologic information have been developed from previous investigations of the Great Flats Aquifer and the site area. This information includes published reports, consulting reports to the municipalities that rely on the aquifer, well field data collected by the municipalities and subsurface data collected at or adjacent to the GEP site. The available information was used in the following tasks to meet the project objectives:

- Identify and obtain data and reports that pertain to well field production rates, historical pumping tests at the municipal well fields, geologic logs and records for wells throughout the Great Flats Aquifer, precipitation and temperature data, historical water quality, and reports describing the hydrogeology of the Great Flats Aquifer and related geologic units. This task also included a survey of residential wells.

- Review the data and reports.

- Catalogue reports and tabulate data.

- Construct geologic cross sections that show the three-dimensional characteristics of the subsurface and show the relationship of the GEP site to the municipal well fields.

- Construct geologic maps to show the vertical and lateral extent of the permeable water-bearing units that comprise the Great Flats Aquifer and the lower permeability units that define the vertical and lateral boundaries of the aquifer.

- Construct groundwater contour maps that show the direction of groundwater flow and discharge areas for the Great Flats Aquifer unit under two distinct conditions that include:
  1. The navigation season when the dams at the locks are closed during the operation of the Mohawk canal system.
  2. The non-navigation period when the dams are open and the canal system is not operating.

- Construct a map of relative infiltration rates to the Great Flats Aquifer.

- Quantify the monthly and the daily maximum and minimum production rates at each municipal well field, assess the projected change due to the GEP demand, and determine whether the demand will be within the proven and permitted yield of the City of Schenectady well field.

- Compare historical pumping tests with climatological data to assess whether the extra GEP demand can be met during prolonged dry periods.

- Identify known contaminant plumes and assess whether there will be any changes in groundwater and contaminant flow within the aquifer by the additional demand at the City of Schenectady well field.

2.0 COMPILATION AND REVIEW OF EXISTING REPORTS AND DATA

Several previous investigators collected data and interpreted the geologic and hydrogeologic conditions of the Great Flats Aquifer and adjacent areas. The objective of this phase of the GEP investigation was to develop an understanding of the aquifer dynamics by reviewing historical interpretations, developing a current database that includes historical and recently acquired data, and developing new hydrogeologic interpretations that reflect the updated database. This section of the report discusses the various report/data sources and briefly describes how they were applied.

2.1 Reports

Published information, in the form of reports and maps that address various aspects of the Great Flats Aquifer, was available in the existing libraries at Alpha Geoscience and Earth Tech, Inc. These corporate files also contained a few unpublished consulting reports that contained hydrogeologic information. Copies of several additional reports, primarily in the form of unpublished consulting reports, were also obtained from the Schenectady County Intermunicipal Watershed Rules and Regulations Board (Watershed Board). The reports from the Watershed Board included aquifer studies commissioned by the Watershed Board and also reports of other investigations in the aquifer by various developers and industries such as General Electric (GE), and Rotterdam Square Mall. A recent report prepared for the Watershed Board by Spectra Environmental Group Inc. (Spectra, February 2001), entitled Great Flats Aquifer Evaluation, was also reviewed.

The stated goal of the Spectra (2001) report was to synthesize existing information from previous reports and investigations, and to develop an understanding of the hydrostratigraphic complex that comprises the Great Flats Aquifer and its environs. The study area covered by the Spectra report included the Great Flats Aquifer from Hoffman's and Pattersonville to the west, to the City of Schenectady to the east. The Spectra report is in agreement with the substantive interpretations and conclusions of this report prepared by Alpha. The Spectra report however, provides a geomorphic and historical categorization of the Great Flats Aquifer, whereas the aquifer definition used for this study is broader and more inclusive, as described in Sections 3.1 and 3.4. Alpha's aquifer definition is based on the hydrogeologic characteristics of the sediments in the Mohawk river valley.

Additional documents were identified during the initial review and obtained if available. A summary of the available documents is presented in Appendix A. Information from the Canal Corporation, the New York State Department of Transportation (NYSDOT), and others was not available in report format. These sources of additional data are described below.

The reports provided information regarding key hydrogeologic aspects of the aquifer such as the distribution of the permeable sand and gravel unit that comprises the aquifer, vertical and lateral aquifer boundaries, potential yield of the aquifer, recharge areas, discharge areas, and general piezometric (i.e, water level) conditions. These historical interpretations provided the initial basis for the interpretations provided herein that were updated after obtaining additional data.

2.2 Sources of Additional Data

A variety of sources of additional information and data were available that were not contained in reports or published literature. These sources of information and data included, but were not limited to, soil borings from highway construction (ie., NYSDOT), investigations at the Main Plant site of GE, a landfill investigation in Glenville, municipal well field evaluations, and various investigations in or adjacent to the Scotia-Glenville Industrial Park. All of the borings and wells for which a location could be determined are shown on Plate 1. Detailed stratigraphic information for the borings/wells is presented in Appendix B.

The historical pumping test records were reviewed to assess the adequacy of previous testing for characterizing the ability of the aquifer and the City of Schenectady well field to meet the additional GEP demand. These historical pumping test records were also reviewed to evaluate the utility of the existing data for assessing the affects of the GEP pumping on groundwater flow patterns during the navigation and non-navigation periods.

Climatological data, consisting of monthly average temperature and precipitation, were also compiled and presented in Appendix C. These data were obtained from the weather station at the Albany airport and at Schenectady for the period 1960 through the present. These data were used to evaluate weather conditions during each of the pumping tests and the trends in production at the municipal well fields. The period of 1960 through the present was selected to include the extended period of drought that occurred from 1962 through 1964.

Groundwater data were evaluated to determine groundwater flow directions at the GEP site and in the study area. This information was used to determine whether increased pumping at the Schenectady well field to accommodate the GEP project would alter groundwater flow directions or change the direction or rate of groundwater flow in areas with known groundwater contamination. Groundwater elevation data for a range of dates covering both navigational and non-navigational conditions are presented in Tables 4.1 and 4.2. Groundwater gradients in the vicinity of the GEP site are summarized in Table 4.3. Groundwater contour maps for the various measurement dates are presented in Appendix D.

Monthly well field production rate data were obtained directly from the various municipalities that rely on the Great Flats Aquifer. The data are tabulated and summarized in Appendix E. These data were used to evaluate production trends and assess whether the City of Schenectady and neighboring Rotterdam well fields will be able to sustain the GEP demands within permitted capacities and can sustain additional demands from regional growth. The climatological data were compared with the production data to distinguish weather-related effects from the changes in production due to population and industry.

Water quality data were also collected directly from the City of Schenectady and the Town of Rotterdam for their respective well fields. These data are used to assess water quality issues and the potential impacts of the GEP project on contaminants in the aquifer. Personnel from the Town of Glenville and Village of Scotia water departments provided verbal summaries of the well field water quality information. Groundwater quality issues at other contaminated sites have been researched and documented by Earth Tech. Summaries for each of these sites are presented in Appendix F.

3.0 GEOLOGY

The GEP site and surrounding area lie within the Mohawk River valley in Schenectady County, New York. The region is relatively low lying with elevations ranging from 200 to 1,100 feet above mean sea level (amsl) and is part of the Hudson-Mohawk Lowlands Physiographic Province. The Adirondack Highlands lie to the north and the Appalachian Uplands Physiographic Province is to the south.

The bedrock surface in the Mohawk River Valley within the site area was eroded to an elevation of 50 feet or lower (relative to mean sea level) by repeated glacial advances. Subsequent glacial and Mohawk River deposits accumulated to maximum thickness of up to 250 feet. These deposits consist of a variety of materials that vary in their hydrogeologic characteristics.

3.1 Stratigraphy of the Geologic Units

Alpha compiled and reviewed stratigraphic information from available sources, as described in Section 2.0, to assess the sequence of unconsolidated stratigraphic units within the Mohawk River valley. Plate 2 presents a tabulation for 490 borings/wells in the study area. Stratigraphic information is available for 464 of these borings/wells. A detailed listing of the stratigraphic information for the borings/wells presented on Plate 2 is presented in Appendix B. Table 3.1 presents a list of 540 borings/wells that were identified in the study area, regardless of whether a location or stratigraphic information was available.

Alpha categorized the granular, unconsolidated material in the Mohawk River Valley according to the ability of these materials to transmit groundwater. This hydrologic categorization is useful and necessary to evaluate potential changes in groundwater flow patterns due to variations in pumping at well fields and seasonal changes in the level of the Mohawk River. Materials that readily transmit groundwater, including sand, gravel, and cobble zones, are considered aquifer materials for purposes of this report, due to their ability to store and transmit groundwater in quantities sufficient to supply large capacity water wells. Alpha has not subdivided the aquifer materials on the basis of depositional time frame (i.e., glacial history) because such subdivision has little bearing on the overall characterization of the aquifer. Detailed descriptions and categorization of the aquifer materials according to their depositional history can be found in the report prepared by Spectra (2001). Spectra has distinguished between sand and gravel within the Mohawk River Valley as separate units based on depositional history and grain size. Alpha has categorized sand and gravel units that are in hydraulic connection within the Mohawk River Valley as the same aquifer.

The unconsolidated materials logged in each boring are comprised of glacially-derived sediments and more recent alluvial deposits. The glacial sediments were deposited primarily during the last (Wisconsinan) ice age when continental glaciers advanced through the region depositing a layer of glacial till comprised of a heterogeneous mixture of clay, silt, sand, gravel, and boulders. As the glaciers retreated, sediments were deposited by glacial streams, lakes, and wind. Glacial deposits are generally thinner in the uplands and thicker in the valleys. Brief descriptions of the primary geologic and hydrogeologic units within the Mohawk River Valley, in ascending order, are as follows:

Bedrock: Glaciers eroded and scoured the bedrock surface which is primarily shale and interbedded siltstone of the Schenectady Formation, although the GEP site is mapped as being underlain by gray shales of the Canajoharie Formation.

Glacial Till: The dense glacial till unit is an unsorted diamict of clay, silt, sand, gravel, and boulders deposited above the bedrock. The glacial till has a relatively low hydraulic conductivity due to its clay and silt content and degree of compaction.

Outwash Sand and Gravel: Sand and gravel were deposited in the valley as the ancestral Mohawk River carried large volumes of sediment from the recently glaciated landscape. Sand and gravel filled much of the valley, ultimately creating the Great Flats Aquifer. The outwash sand and gravel contains very little fine grained sediment, making it highly permeable and an excellent aquifer material.

Glaciolacustrine Sand, Silt and Clay: Lakes were formed in the valley following retreat of glacial ice from the area. Sediment transported into these lakes settled to the bottom forming layers of fine sand, silt and clay. Sediment deposited in glaciolacustrine settings are typically interbedded layers of silt, sand and clay or a homogeneous mixture of grain sizes. Glaciolacustrine sediments are generally finer grained then outwash deposits and typically possess a much lower permeability than outwash sand and gravel deposits.

Alluvial Sand and Silt: Sediments in this category have been deposited in relatively recent geologic time by the Mohawk River and its tributaries. They consist of layers of sand, silt, and clay overlying the glacial deposits. The permeability of the alluvial deposits, which is dependent on the percentage and type of fine grained sediment that is present, controls the rate of infiltration of precipitation that recharges the underlying aquifer.

3.2 Bedrock

Bedrock in the area is comprised primarily of shale with interbedded siltstone of the Schenectady Formation and gray to black, slightly calcareous shales of the Canajoharie Shale formation, which underlies the GEP site. The bedrock dips gently to the west and southwest and contains two principal sets of nearly vertical joints oriented approximately northeast and northwest (Simpson, 1952)

Alpha used data from available borings (Appendix B and Plate 2) to determine the depth to bedrock. Plate 3 is a contour map developed from the available boring data showing the elevation of the surface of the bedrock. The bedrock valley beneath the Mohawk River is narrower to the west and broadens to the east beneath the Village of Scotia, as shown on Plate 3. The elevation of the bedrock surface at the base of the valley is less than 50 feet above mean sea level (amsl) and increases to approximately 250 to 300 feet amsl along the flanks of the valley, and to greater than 400 feet amsl in the surrounding uplands. Occasional irregularities appear to be present in the bedrock surface as indicated by the closed, circular contour lines.

3.3 Glacial Till

Glacial till is generally found overlying the bedrock throughout the aquifer region and ranges in thickness from a few feet along steep valley walls, to as much as 100 feet in some parts of the Mohawk River valley. Alpha used data from available borings (Appendix B and Plate 2) to determine the depth to glacial till. Plate 4 is a contour map developed from the available boring data showing the elevation of the surface of the glacial till. The top of the glacial till contour map shows a similar pattern to the top of bedrock map with a narrower valley to the west and broadening eastward. The elevation of the till surface ranges from less than 100 feet amsl in the valley to approximately 220 to 300 feet amsl along the flanks of the valley. The till is absent in localized areas due to either non-deposition or erosion subsequent to deposition.

3.4 Outwash Sand and Gravel

The Great Flats Aquifer is mainly comprised of the outwash sand and gravel unit, which consists of stratified and well sorted material, ranging in size from silty sand to gravel with occasional, localized clay lenses. The sand and gravel unit generally varies in composition west to east, with a larger sand component in the western section and increased gravel content to the east. Clay pockets are more prevalent in the areas around the Schenectady and Rotterdam well fields, which are close to a facies change between the outwash sand and gravel and the glaciolacustrine sediments. The outwash unit grades to a fine grained deposit (non aquifer material) to the south and southeast of the Schenectady/Rotterdam well field.

The aquifer defined by Alpha for this report includes all granular, unconsolidated materials (i.e., sand, gravel and cobbles) in the Mohawk River Valley that are in hydraulic connection, regardless of whether or not the materials were deposited during the same glacial or deglacial episode. This is a practical definition that has been applied by previous researchers (Brown, 1982, Brown, et al., 1981; Winslow, 1965; Simpson 1952) and that is necessary for evaluation of groundwater movement through the subsurface. All granular materials that are in hydraulic connection must be considered as a single hydrologic unit because pumping from any point within a hydrologic unit has the potential to affect groundwater flow in that unit. Spectra (2001) has restricted the definition of the Great Flats Aquifer to the Scotia Gravel deposit. This restricted definition of the aquifer was not used by Alpha because it does not include permeable, granular materials that are in hydraulic connection with the Scotia Gravel and that are potentially affected by pumping from the Scotia Gravel.

The aquifer thickness map (Plate 5) was constructed using available boring log data (Appendix B and Plate 2) and shows the relative thickness of the outwash sand and gravel unit. Alpha included all non-aquifer material (i.e., clay or silt pockets) contained within the outwash layer in calculating the total outwash unit thickness. The top of the outwash sand and gravel was defined as the change from overlying finer material to coarse-grained sand or sand and gravel units. The aquifer material is generally thinner on the valley flanks and thickens towards the center of the valley along a northwest to southeast trend. The sand and gravel also thickens from west to east with a maximum thickness of greater than 200 feet in the region beneath and southeastward of the GEP site.

The aquifer boundary was determined using available boring log data and is based on several criteria. The most distinctive boundaries occur in those regions where the aquifer material pinches out against bedrock slopes or grades to glaciolacustrine materials. Areas on the north side of the valley have an aquifer boundary marked by a change from outwash sand and gravel to kame and deltaic material, where there is an abrupt increase in elevation. South of the Schenectady well field, the aquifer boundary is marked at the bottom of a sand and gravel terrace (ie., kame). This kame deposit had previously been mapped by Brown et al. (1981) as part of the aquifer.

The aquifer boundary mapping by Alpha (Plate 5) differs from some previous mapping for several reasons. The aquifer boundary is mapped differently than Brown, et al. (1981) due to a difference in interpretation regarding which sediments are characterized as aquifer material. Mapping by Brown et al. (1981) included sand and gravel and other permeable deposits as aquifer material that exist at higher elevations and beyond the lateral extent of the outwash sand and gravel. Alpha used only moderately to highly permeable material that was deposited as outwash sand and gravel within the valley in classifying the aquifer. The resulting difference between the aquifer boundary as mapped by Brown et al. (1981) as compared to Alpha (Plate 5), is that the boundary mapped by Alpha is not as wide and does not extend up the sidewalls of the river valley.

3.5 Distribution of Geologic Units

Geologic cross sections showing the stratigraphy in the valley are presented on Plates 6, 7, and 8, and their locations are shown on Plate 1. The locations were selected to depict the subsurface conditions and relationships between the proposed GEP site and the municipal well fields. The section locations were also restricted to areas containing reliable stratigraphic information. The stratigraphy on portions of the cross sections is inferred from the top of bedrock contour map, the top of glacial till contour map, and the aquifer thickness map (Plates 3, 4, and 5), respectively in cases where there are few borings for stratigraphic control. Cross sections A-A' and B-B' (Plate 6) are oriented generally perpendicular to the long axis of the valley. Cross sections C-C' and D-D' (Plate 7) are oriented generally parallel to the long axis of the valley. Cross sections E-E' and F-F'(Plate 8) were constructed to show greater detail of the subsurface conditions in the immediate vicinity of the Schenectady and Rotterdam well fields.

The configuration of the bedrock valley is evident on cross sections A-A' and B-B'(Plate 6). The nearly ubiquitous extent of the glacial till that overlies the bedrock is apparent on all the cross sections. The localized area where glacial till is apparently absent above bedrock highs is shown on cross sections A-A' (Plate 6) and C-C'(Plate 7). The thickness and the extent of the outwash sand and gravel, which constitutes the Great Flats Aquifer, is evident on all of the cross sections. The thinning and interfingering of the outwash sand and gravel with glaciolacustrine silt, sand, and clay layers in the vicinity of the Schenectady and Rotterdam well fields are shown on cross sections C-C', E-E' and F-F' (Plates 7 and 8).

4.0 HYDROGEOLOGY

4.1 Extent and Location of the Great Flats Aquifer

The Great Flats Aquifer, which underlies the GEP site, is an unconfined water table aquifer contained within the glacial outwash deposit extending beneath most of the Mohawk River valley from Pattersonville on the upstream end to Glenridge at the downstream limit (Figure 2). The lateral extent and thickness are described in section 3.4 and are shown on the aquifer thickness map (Plate 5) and cross sections (Plates 6, 7 and 8).

4.2 Aquifer Recharge and Discharge

The Great Flats Aquifer receives recharge from precipitation to the land surface above the aquifer. This recharge either percolates directly into the aquifer unit where the outwash sand and gravel is exposed at land surface, or infiltrates down through less permeable units where the aquifer is overlain by alluvial deposits. The aquifer also receives recharge from runoff onto the surface from the uplands adjacent to the Mohawk River valley. Additional recharge is derived from the bedrock and glacial till where they underlie the aquifer.

The Water Infiltration Potential Map (Plate 9) displays the infiltration potential of the material at the ground surface. The aquifer boundary shown on Plate 9 is the boundary interpreted by Alpha, as described in Section 3.4. The infiltration potential zone delineations on Plate 9 are based on the infiltration potential zone map by Brown et al. (1981). The infiltration zones shown on the map are as follows:

- Zone 1: Very Low Infiltration Potential:
  Surface water and precipitation in these areas will infiltrate the soil very slowly when thoroughly wetted; includes mainly clayey soils, soils with a high water table, and soils that are shallow over nearly impervious material. Much of the water will be lost to surface runoff and uptake by vegetation (i.e., evapotranspiration) before it enters the subsurface, or will create ponded or swampy areas. Surface water in these areas is not likely to reach the water table.

- Zone 2: Low Infiltration Potential:
  Surface water and precipitation in these areas will infiltrate the subsurface slowly when thoroughly wetted; includes mainly silty soils, and soils having a moderately high water table. Surface water will eventually penetrate the underlying soil. Much of the surface water may be lost to evapotranspiration and surface runoff, especially during periods of high precipitation when the soil becomes saturated. Ponding and swampy areas are less prevalent, and surface water is more likely to reach the water table than in areas with very low infiltration potential.

- Zone 3: Moderate Infiltration Potential:
  Surface water and precipitation will infiltrate the subsurface at a moderate rate when thoroughly wetted; includes mainly deep soils with silty and sandy textures that are relatively well drained. Much of the surface water that enters the subsurface and migrates below the root zone will eventually reach the water table.

- Zone 4: High Infiltration Potential:
  Surface water and precipitation will infiltrate rapidly even when thoroughly wetted; includes mainly deep, well drained sand, gravel, cobbles and boulders that are well drained with little or no standing water. Streams flowing across these areas may entirely infiltrate the subsurface

before reaching another surface water body. Water that enters the subsurface and migrates below the root zone will eventually reach the water table.

The ground surface above the central portion of the aquifer generally exhibits a moderate to high water infiltration potential, while areas along the valley flanks have discontinuous pockets of low to very low infiltration rates. The GEP site is located over an area of high infiltration potential. The length of time for water infiltrating the subsurface to reach the water table is primarily dependant on the soil permeability and the depth to the water table. Although the soil permeability at the GEP site is high, the depth to groundwater is approximately 60 to 70 feet. The large separation between the water table and land surface has helped sustain the quality of the Great Flats Aquifer through natural filtration and providing time to respond to contaminant releases before they reach the water table.

The primary discharge zone for the Great Flats Aquifer system is the Mohawk River (Simpson, 1952; Winslow, 1965; Brown et al., 1981; Malcolm Pirnie, 1989; and O'Brien, 1970). Discharge also occurs locally at the municipal well fields where water is withdrawn by pumping. However, where the Mohawk River flows near the Glenville, Schenectady and Rotterdam well fields, the pumping at the well fields causes water from the river to recharge the aquifer (Brown et al, 1981; Malcolm Pirnie, 1989; O'Brien, 1970; Simpson, 1952; Winslow, 1965).

4.3 Depth to Water: Navigation and Non-Navigation Seasons

The depth to water in most water table aquifers in New York State varies throughout the year, and the groundwater level is generally lowest in summer and highest in the late fall and early spring. However, the water table along many sections of the Mohawk River are highest from around April 1st through December 1st and lowest throughout the winter. This phenomenon is due to the dams at the locks, which are closed during the navigation season (generally April through November) and are open when boats are not allowed through the canal system (non-navigation season from December through March). The closure of the dams creates a higher, controlled river level with a pool level of approximately 226 feet amsl above Lock 8 and a pool level of approximately 211.5 feet amsl below Lock 8. Winslow (1965) reported a level of 225.82 above Lock 8 and 211.22 below the lock. The Mohawk River level drops and develops a normal gradient after opening the dams. Malcolm Pirnie (1989) reported river levels of 216.9 feet amsl adjacent to the Glenville well field, 215.21 feet amsl above Lock 8, and 214.6 feet amsl below Lock 8 for the non-navigation season.

4.4 Surface Water/Groundwater Relationship

The maintenance of nearly constant river levels during the navigation season sustains a consistent water level in the aquifer adjacent to the Mohawk River even during droughts. This maintenance of the Great Flats Aquifer along the Mohawk River is very important to the Glenville, Rotterdam, and Schenectady well fields, which are adjacent to the Mohawk River. The Mohawk River is the prime source of recharge to the portion of the aquifer tapped by these wells. Winslow (1965) was able to determine, by temperature measurements, that 90 percent of the water being pumped by the Schenectady and Rotterdam well fields is derived from percolation to the aquifer from the Mohawk River during the navigation season.

The ability of the Mohawk River to sustain the Schenectady, Rotterdam, and Glenville well fields prevents those systems from being susceptible to drought conditions. The flow of the Mohawk River has been monitored since 1919 at Cohoes (Eissler, 1978). The average flow at Cohoes was reported by Winslow (1965) to be 5,647 cubic feet per second (3649 MGD). The calculated minimum 7-day average stream flow that can be expected to occur every 10 years (MA7Q10) is 760 cubic feet per second (491 MGD (Eissler, 1978)), which is 25 times greater than the combined average of 19.8 MGD for the Scotia, Glenville, Schenectady, and Rotterdam well fields. The combined average pumping rate of 19.8 MGD is equivalent to 30.6 cubic feet per second of flow, which is 4 percent of the calculated minimum 7-day average stream flow. The 491 MGD low flow for the Mohawk River is also more than 4 times greater than the 100 MGD that Winslow predicted to be the sustainable yield of the Great Flats Aquifer.

Portions of the Great Flats Aquifer that are not located adjacent to the Mohawk River will not be significantly affected by river levels; therefore, the water levels will exhibit normal seasonal cycles. These portions of the aquifer will experience reduced water levels during drought periods because they are not readily recharged by water from the river. The Scotia well field is in a portion of the aquifer that is not directly influenced by recharge from the Mohawk River and is therefore affected by drought conditions.

Although the three well fields near the Mohawk River (Schenectady, Rotterdam, and Glenville) are not susceptible to summer drought conditions, they are susceptible to brief periods of dry, cold weather in late January and early February. Malcolm Pirnie (1989) calculated that the Mohawk River's contribution to the Schenectady and Rotterdam well fields decreased to 72 percent during a pumping test in February 1988, when the river level was at its seasonal low (non-navigational period) and the water temperatures had decreased to approximately 32° Fahrenheit. This loss of recharge is due to a reduction in hydraulic head (reduced water level in the Mohawk River), a reduced cross sectional area of the Mohawk River that is covered with water, and a 50 percent reduction in hydraulic conductivity that is due to the greater viscosity of the cold river water relative to conditions during the summer. The net effect of the reduced contribution by the Mohawk River is an increased withdrawal of water from storage in the aquifer (Winslow, 1965). This increased draw from storage results in an expansion of the cone of drawdown.

Winslow (1965) concluded that the Schenectady well field could sustain a pumping rate of 30 MGD for up to 180 days of continuous dry weather with water temperatures sustained at 32° Fahrenheit. Despite these unrealistic and unsustainable climatic conditions (the cold season is much shorter than 180 days and is often punctuated by periods of warmer weather as demonstrated by climatic data (Appendix C)), the Schenectady well field is easily able to supply more water than the present demand plus the anticipated demand with the GEP in operation (i.e., 15.1 MGD). Water levels in the aquifer also recover rapidly in the spring with warmer temperatures and the return of the navigational controls on the level of the Mohawk River.

4.5 GROUNDWATER FLOW AND GROUNDWATER DIVIDE

Groundwater in aquifer systems, including the Great Flats Aquifer, flows from the recharge areas to the discharge areas. The direction of groundwater flow and the gradient of flow can be evaluated by contour maps of the elevation of the water table. The groundwater flow direction is oriented perpendicular to the contours and flows from higher hydraulic head (higher water table elevation) to lower hydraulic head (lower water table elevation). The direction of flow can change as the result of seasonal variations (i.e., navigation vs. non-navigation) and changes in pumping at the well fields. In the absence of pumping at the well fields, groundwater flow is toward the Mohawk River.

Groundwater contour maps were generated for the non-navigation and navigation periods specific to the immediate GEP site area and also for the Great Flats Aquifer within the area represented by Plate 1. Two representative site specific groundwater contour maps (Figures 3 and 4) were generated based on water levels measured in January 15, 2001 (non-navigational period) and July 18, 2000 (navigational period) by Earth Tech, in existing site wells and monitoring wells installed by Parsons Engineering and Science, Inc., the NYSDEC, and Earth Tech as part of an investigation of trichloroethene in the groundwater in the area (Section 7.0). The contour maps for the study area (Plates 10 and 11) are conceptual interpretations that are based on a compilation of water levels measured on different dates and interpolation in the intervening areas where no data are available. The most apparent difference between the navigational and non-navigational groundwater contour maps is the variation in the groundwater flow direction northwest of Lock 8 due to the change in the river level at the Lock during the navigational season.

Inferred groundwater flow directions have been identified at the GEP site area by evaluating the groundwater elevation contour maps (Appendix D) that were developed from water depth measurements in monitoring wells at the GEP site and surrounding area. Groundwater flow arrows constructed perpendicular to the groundwater elevation contours illustrate the inferred groundwater flow directions and indicate that groundwater flow is typically toward the Mohawk River.

Review of Plates 10 and 11 indicates that groundwater flow follows two major paths that diverge from a central groundwater divide. The groundwater divide is created by the tendency for groundwater to flow to the nearest point of discharge, which is the Mohawk River channel. Some groundwater becomes diverted due to the sinuosity of the river channel, thereby creating a flow divergence (i.e., groundwater divide). Groundwater in the western part of the GEP site area generally flows to the southwest toward the Mohawk River channel north of Daly's Island. The TCE plume and most of the GEP site area lie west of the ground water divide. The river channel in this area, during the non-navigational season, is relatively wider and closer to the site than the downstream reach that coincides with the location of the flow divide. The lower river level downstream of Lock 8 during the navigational period draws groundwater to this part of the river and enhances the groundwater divide.

Groundwater in the eastern part of the study area typically flows toward the south to the area just downstream of the Lock 8 dam (Figure 3 and Figure 4). Winslow has documented that the Mohawk River bottom just downstream of the dam is subject to scour and may represent an area ofpreferred groundwater discharge to the river. This condition, in conjunction with the difference in the water level across Lock 8 during the navigation season,draws water from the aquifer to the point of discharge (Lock 8) and enhances the groundwater divide that exists southeast of the GEP site.

The northeast-southwest trending flow divide that separates the two local flow regimes in the GEP site area is generally aligned in the zone between monitoring wells MW-99-16 and PMW-2 (Figures 3 and 4). Although the monitoring well spacing is sufficient to indicate the presence of the divide, more monitoring wells would be necessary to better define its location. The location of the divide is significant when considering potential source areas for groundwater contaminants known to be migrating beneath the GEP Site area.

The contour maps suggest that the location of the divide may be controlled by various natural and man-made characteristics of the Mohawk River floodplain and channel. These characteristics include: the surface topography, a natural bend in the Mohawk River, the presence of the Lock 8 dam, the Mohawk River level, the relative location of the Mohawk River shoreline, and the relative permeability of the Mohawk River bottom and bank. All of these characteristics may affect the location of the groundwater divide, and change with time. These changes may alter the pattern of groundwater discharge to the Mohawk River, and cause a slight shift in the location, width and magnitude of the divide.

The Mohawk River level changes as a result of man-made structures (locks) that control the navigational pool stage, and through natural variations related to climate, seasonal changes in runoff, and storm events. The relative location of the river shoreline shifts in response to the river levels. River bottom permeability may change in response to river level fluctuations that affect the relative percentage of exposed permeable river bank, and to sediment deposition and scour. The location of the groundwater divide through time is thus best characterized as a zone, rather than as a discrete line.

Review of the groundwater contour maps for the GEP site area (Appendix D) indicates that the groundwater divide shifted from November 1999 to June 2001over an area approximately 400 feet wide along NYS Route 5 to 800 feet wide northeast of the GEP site. The shift in the groundwater divide is a normal occurrence due to fluctuations in the groundwater table. Based on a review of the groundwater quality data, it is apparent that the TCE plume remains on the western side of the groundwater divide where groundwater flows southwest toward the Mohawk River, north of Daly's island.

4.5.1 GEP Site Groundwater Contour Map - Non-Navigation

Water levels during non-navigational periods were measured by NYSDEC during February 1997 (Table 4.1) and by Earth Tech on December 8, 1999; November 31 and December 22, 2000; and January 15, February 28, and March 20, 2001 (Table 4.2). Groundwater contour maps for each of these dates were prepared by Earth Tech and are presented in Appendix D. The Canal Corporation reports that the lock panels were raised at Lock 8 on December 2, 1999 and November 27, 2000 to begin the non-navigation season(s).

The water levels measured by Earth Tech on January 15, 2001 were used to prepare a representative groundwater contour map for the non-navigational period (Figure 3). The contour map indicates that water levels were approximately 67 feet below the land surface at the GEP site and that groundwater was flowing toward the Mohawk River (to the southwest) across the GEP site and adjacent property. Although the water level in the Mohawk River was not measured on the January 15, 2001 date, the level was likely in the range of 215 to 218 feet above mean sea level, or approximately 10 feet lower than it would be when the panels at Lock 8 are in place. The groundwater contour maps for the non-navigation period display a groundwater divide that crosses the Industrial Park property in a northeast to southwest trend in the vicinity of the 400 block, east of the GEP site. The maps also display a southwesterly flow across the GEP site toward the Mohawk River west of the divide and more southerly flow east of the divide (Figure 3).

The groundwater gradient is generally greatest during the non-navigational period due to the lower river level. Groundwater gradients and groundwater flow rates gradually decrease after panels at the locks are installed and the river level gradually rises to navigational levels. The gradual rise in the river level results in a transitional period during which groundwater gradients and flow rates adjust to the navigational river level.

The horizontal groundwater gradient was calculated for each of the data sets by selecting the furthest upgradient and downgradient wells along the flowpath that provided the largest groundwater elevation change. The elevation change was then divided by the distance between the two selected wells to calculate the groundwater gradient. The horizontal gradients are relatively low during both the navigational and non-navigational periods. The gradient values for the non-navigational period range from 0.0069 to 0.0095 as shown on Table 4.3. A gradient of 0.003 existed on December 8, 1999 during the transitional period from the navigational to the non-navigational season. The relatively low horizontal groundwater gradients are indicative of the high aquifer transmissivity, which is the ease with which groundwater flows through the aquifer.

4.5.2 GEP Site Groundwater Contour Map - Navigation

Water level measurements collected by Earth Tech on July 18, 2000 were used to prepare a representative groundwater contour map for the navigation period (Figure 4). Earth Tech also measured water levels on September 28, November 8, 1999; June 8, July 7, July 18, August 1, September 18, October 20, 2000; and April 18, May 22, and June 21, 2001 (Table 4.2). Groundwater contour maps for each of these dates were prepared by Earth Tech and are presented in Appendix D. The Canal Corporation reports that the navigational period on the Mohawk River begins when the panels at the locks are installed on the river during the first two weeks of April each year.

The July 18, 2000 data indicate that the water table was approximately 63 feet below the land surface at the GEP site. A contour map of the July 18, 2000 water level elevations (Figure 4) indicates that groundwater flow beneath the site was to the southwest toward the Mohawk River. The flow direction in July 2000 is very similar to that shown for the non-navigational period (January 2001, Figure 3), and the results confirm that the Mohawk River is the local discharge zone for groundwater passing beneath the site.

The navigational period groundwater contour maps (Figure 4 and Appendix D) indicate a southwesterly flow across the GEP site west of the groundwater divide. The axis of the divide is slightly further west than the divide shown on the non-navigational groundwater contour maps. Groundwater on the southeast side of the divide flows to the south toward the dam at Lock 8. The flow direction to the south is the direct result of the Mohawk River level drop of approximately 10 feet that exists at the dam during the navigation season. The data also indicate that the Mohawk River in the vicinity of Lock 8 is the discharge zone for the groundwater near the southeast side of the GEP site.

The groundwater gradient is lowest during the navigational period due to the higher river level upstream of Lock 8. Groundwater gradients and groundwater flow rates gradually increase after the panels are raised at the locks and the river level gradually decreases to non-navigational levels. The gradual lowering of the river level results in a transitional period during which groundwater gradients and flow rates adjust to the non-navigational river level.

The horizontal groundwater gradient values in the vicinity of the GEP site for the navigation period are generally less than the non-navigational gradients as would be expected, and range from 0.0014 to 0.0062 as shown on Table 4.3. A gradient of 0.0096 existed on April 18, 2001 during the transitional period from the non-navigational to the navigational season.

4.5.3 Conceptual Groundwater Contour Map - Non-Navigation

A groundwater contour map was generated for the maximum extent of the aquifer within the expanded site area (Plate 10). This conceptual map was developed by placing groundwater contours onto the map within areas where historical data are available for various dates. The intervening areas were contoured by applying observed gradients and the interpreted relationships between recharge areas, discharge areas, and withdrawal at well fields. The map is considered conceptual due to the interpretation of contours in the intervening areas where water level measurements are not available and because data were collected over a wide range of dates.

The areas shown on Plate 10 where water level measurements are available for the non-navigation period include the GEP site contours (Figure 3), the Mohawk River levels, and the drawdown cones at the municipal well fields. The water level data collected from pumping tests of the Rotterdam, Schenectady, and Glenville well fields in 1988 were also included on the map (Malcom Pirnie, 1989). The data from these tests were selected because all three well fields were pumped at high rates for the longest period of time (72 hours) tested (see Section 5.4), and the tests were performed during the non-navigation period. These tests were conducted when the Mohawk River levels were at their lowest and the cold temperatures reduced the ability of the Mohawk River water to move (hydraulic conductivity) down into the aquifer (recharge). The Schenectady/Rotterdam test was conducted in February when hydraulic conductivity was likely reduced by nearly 50 percent relative to warm summer conditions (Winslow, 1965). The reduced water levels and colder temperatures in early February can result in greater aquifer drawdowns due to pumping at the Schenectady, Rotterdam, and Glenville well fields than during any other time of the year.

Malcolm Pirnie (1989) also measured the Mohawk River levels during the 1988 tests at the Schenectady/Rotterdam and Glenville well fields. The February 1988 pumping test at the Schenectady/Rotterdam well field was conducted at a rate of 29.8 MGD. The March 1988 pumping test at the Glenville well field was conducted at a rate of 2.1 MGD. The levels were 216.99 feet amsl adjacent to the Glenville well field, 215.21 feet (amsl) above the open dam at Lock 8, and 214.6 feet amsl below Lock 8. These three data points were used to establish a general surface water gradient for the section of the Mohawk River shown on Plate 10.

Additional generalized water level data were obtained from the GE landfill investigation area (Woodward-Clyde, 1989), the Glenville Landfill investigation (Dunn, 1988), the Scotia well field (Dunn, 1986), and the region as a whole (Brown, et al., 1981). Interpretations were also made from approximate surface water elevations of Collins Lake, sand and gravel quarries, and wetland areas that were obtained from topographic maps.

The contours on Plate 10 show that groundwater generally flows from the recharge areas toward the discharge areas. The recharge areas consist of most of the land surface above the aquifer and the upland areas bordering the aquifer. Discharge occurs primarily to the Mohawk River with localized discharge to the municipal well fields (Glenville, Schenectady/Rotterdam, and Scotia) and Collins Lake. The general directions of groundwater flow are indicated on Plate 10.

The groundwater contours represent lines of equal elevation of the surface of the water table. The groundwater flow direction is generally perpendicular to the contour lines at any given point or area. The circular contours at each well field show that groundwater flow near the well fields is toward the pumping wells. The groundwater contours near the Schenectady and Rotterdam well fields show that these two well fields create a single depression in the water table due to their proximity to one another. The area of drawdown at the Schenectady and Rotterdam well fields shown on Plate 10 is based on the February 1988 pumping test rate of 29.8 MGD. The extent of drawdown of the water table at the Schenectady, Rotterdam, Scotia, and Glenville well fields is shown on Plate 10 by the circular contours and, to a lesser extent, by the curvature in the contours immediately adjacent to the circular contours.

The groundwater contours indicate the influences of pumping at the municipal well fields are localized and do not influence each other (except for the adjacent Schenectady/Rotterdam well fields), or the groundwater flow beneath the GEP site. The combined pumping test rate effects plotted for a withdrawal of 29.8 MGD at the Schenectady/Rotterdam well fields (Malcolm Pirnie, 1989) suggests that drawdown extends beneath the Mohawk River and under the north bank as evidenced by the curvature shown in the 212 and 213 foot contour lines around the Schenectady/Rotterdam well fields. This combined pumping test is 13.3 MGD higher than the average combined daily demand of 16.5 MGD for Schenectady/Rotterdam well fields, and 10.9 MGD greater than the average projected demand of 18.9 MGD (20.5 MGD maximum) from the Schenectady/Rotterdam well fields when the GEP is operational.

The relatively minor changes in the contour lines shown on Plate 10 beyond the vicinity of the well fields during the 29.8 MGD pumping test that was conducted by Malcolm Pirnie, when river recharge was low and the aquifer drawdown was greatest, indicate that groundwater flow directions beneath the GEP site will not be altered by increased GEP demand at the Schenectady well field. Similarly, the contours on Plate 10 indicate that there would be essentially no changes in water levels or groundwater flow direction at or near any wells beyond the limited zone of influence of the Schenectady/Rotterdam well field.

4.5.4 Conceptual Groundwater Contour Map: Navigation

A groundwater contour map was generated to represent the navigation period when the Mohawk River levels are raised by closing the dams at the locks (Plate 11). This conceptual map was developed by placing groundwater contours onto the map within areas where historical data are available for various dates. The intervening areas were contoured by applying observed gradients and the interpreted relationships between recharge areas, discharge areas, and withdrawal at the well fields. The map is considered conceptual due to the interpretation of contours in the intervening areas where water level measurements are not available and the fact that much of the data represent a wide range of dates.

The areas for which water level measurements are available for the navigation period consisted of the GEP site contours (Figure 4), Mohawk River levels, and the drawdown cones at the Scotia, Schenectady, and Rotterdam well fields. The Schenectady/Rotterdam data were obtained from a pumping test on August 3, 1960 described by Winslow (1965). Winslow also provided water levels for the pool level above Lock 8 (225.82 feet amsl) and below the dam (211.22 feet amsl). The pumping test data from Malcolm Pirnie (1989) were used to represent the drawdown at the Scotia well field. No data were available for the Glenville well field; consequently, the relative shape of the drawdown for the Glenville well field was inferred from the non-navigation pumping test pattern shown on Plate 10, but the contour elevations were changed to reflect a higher river level.

The water table information was supplemented by general water level data from the Glenville Landfill investigation (Dunn, 1988), the General Electric – Main Plant landfill areas (Woodward-Clyde, 1989), and the Scotia well field (Dunn, 1986). General information for the entire region was derived from Brown et al. (1981). Additional interpretations were made from approximate surface water elevations interpreted from topographic maps showing Collins Lake, wetland areas, and sand and gravel quarries.

The contours on Plate 11 show that groundwater generally flows from the recharge areas toward the discharge areas. The recharge areas consist of most of the land surface above the aquifer and the upland areas bordering the aquifer. Discharge occurs primarily to the Mohawk River with localized discharge to the municipal well fields (Glenville, Schenectady, Rotterdam, and Scotia) and Collins Lake. The general directions of groundwater flow are indicated on Plate 11.

The groundwater contours show lines of equal elevation of the surface of the water table. The groundwater flow direction is generally perpendicular to the contour lines at any given point or area. The circular contours at each well field show that groundwater flow near the well fields is toward the pumping wells. The groundwater contours near the Schenectady and Rotterdam well fields show that these two well fields create a single depression in the water table due to their proximity to one another. The area of drawdown at the Schenectady and Rotterdam well fields shown on Plate 11 is based on the August 1960 pumping test rate of 18.28 MGD. The extent of drawdown of the water table at each well field is shown on Plate 11 by the circular contours around each well field and, to a lesser extent, by the curvature in the contours immediately adjacent to the circular contours.

The groundwater contours indicate that the municipal well influences are localized and do not influence each other (except for the adjacent Schenectady/Rotterdam well fields), and groundwater flow beneath the GEP site. Similarly, the contours on Plate 11 indicate that there would be essentially no changes in water levels or groundwater flow directions at or near any wells beyond the limited zone of influence of the Schenectady/Rotterdam well field. Groundwater in deeper portions of the aquifer north of the Mohawk River likely flows to the Schenectady/Rotterdam pumping wells, although the cone of drawdown from these wells does not likely extend north of the Mohawk River. The extent of drawdown near the Schenectady/Rotterdam well field is approximately equal to the 211 foot contour line shown on Plate 11. The close spacing of the groundwater contours in the vicinity of Lock 8 show the dramatic affect on groundwater flow around Lock 8 as the result of the 14.5 foot drop in hydraulic head from the upper to the lower pool. The pattern of the contours around Lock 8 created by the different river elevation on either side of the Lock gives the appearance that the groundwater flow north and northwest of Lock 8 is influenced by pumping at the Schenectady/Rotterdam well field. This drop in the river level across the Lock enhances the groundwater divide that diverts water east of the GEP in a flow direction toward the south to southeast. Groundwater west of the groundwater divide generally flows to the southwest toward the Mohawk River. The TCE plume and most of the GEP site area lie west of the groundwater divide. Groundwater southeast of the divide generally flows to the south toward the dam at Lock 8. Although the groundwater contours and the resulting flow may appear to be influenced by the pumping wells, the shape of the contours and the groundwater flow direction in the vicinity of Lock 8 is due to the change in the river level at the lock, and not due to the pumping at the Schenectady/Rotterdam well fields. The relationship between the ground water flow direction and the Mohawk River level is demonstrated by the groundwater flow map (Figure 4), which shows the effect of Lock 8 during the navigation season, regardless of the pumping at the Schenectady and Rotterdam well fields.

4.6 Summary

Comparison of Plates 10 and 11 reveals that the cone of influence from pumping at the Schenectady and Rotterdam well fields is larger during non-navigational periods (Plate 10) than during navigational periods (Plate 11). The groundwater contours for the navigational period show that pumping at the Schenectady and Rotterdam well fields does not influence the groundwater flow direction on the north side of the Mohawk River. The groundwater flow direction in the area southeast of the GEP site is south to southeast under normal, navigational season conditions.

The groundwater flow direction is strongly influenced by the change in river elevation at Lock 8. The extension of the cone of drawdown from the Schenectady and Rotterdam well fields to the north side of the Mohawk River during the non-navigational period is evident on Plate 10 by the deflection of the groundwater flow direction beneath the Village of Scotia, compared to the flow directions shown on Plate 11 during the navigational period and a pumping rate of 18.28 MGD at the Schenectady/Rotterdam well fields. The cone of drawdown from the Schenectady and Rotterdam well field shown on Plate 10 is from pumping 29.8 MGD during the non-navigational period. The current combined pumping rate of the Schenectady and Rotterdam well field is 16.5 MGD and the proposed combined pumping rate with the GEP plant in operation is 18.9 MGD (20.5 MGD maximum).

The groundwater maps shown in Figure 3 and 4 and in Plates 10 and 11 were compared to evaluate changes in groundwater flow patterns and to identify the reasons for such changes. The groundwater flow conditions shown on Figure 3, as compared to Figure 4, and on Plate 10, as compared to Plate 11, are similar, but the different climatic and pumping test conditions reflected on these drawings cause slight differences in the groundwater flow within the cone of drawdown of the well fields. The variations in the orientation of the groundwater contours within the various dates reflect these localized changes in the groundwater flow direction.

Comparison of the groundwater contours on Plates 10 and 11 also demonstrates that large variations in pumping rates result in relatively minor expansion to the cone of drawdown, and essentially no change in the direction of groundwater flow in the aquifer. The only differences groundwater flow directions between Plates 10 and 11 are due to seasonal variation in the river level, despite a difference of 11.52 MGD in the pumping rate reflected by these plates. The conditions on Plate 10 are for a non-navigational (low) river level and high pumping rates at the well fields. The conditions on Plate 11 represent conditions that include navigational river levels and normal pumping rates at the well fields. These plates are useful for comparing extreme or "worst case" conditions (Plate 10) to normal aquifer conditions (Plate 11).

The cone of drawdown from pumping at the Scotia well field is larger during the navigational period than during the non-navigational period due to increased water demand during the summer months. The Scotia well field does not benefit from recharge from the Mohawk River because of its distance from the river. It is likely that the water in the sand and gravel quarries around the Scotia well field provide significant recharge to the aquifer and inhibit the expansion of the cone of drawdown.

The groundwater flow direction in the vicinity of the Glenville well field does not appear to change considerably between navigational and non-navigational periods. The reason for the minimal change is because the majority of the water pumped at the Glenville well field is derived from the Mohawk River during both the navigational and non-navigational periods.

The groundwater flow direction at the proposed GEP site is to the southwest toward the Mohawk River during both the navigational and non-navigational periods. The groundwater flow direction at the GEP site is unaffected by pumping at the municipal well fields. The groundwater contours on Plate 10 for the non-navigational period show that the groundwater flow direction at the GEP site is unaffected by pumping at the Schenectady and Rotterdam well fields at a combined pumping rate of 29.8 MGD during the non-navigational period when the least amount of recharge is occurring from the river to the aquifer.

5.0 GROUNDWATER USAGE AND TESTING OF THE GREAT FLATS AQUIFER

A substantial amount of information is available regarding the use of groundwater from the aquifer by commercial, industrial, residential and municipal entities and from testing that has been performed to determine aquifer characteristics. Alpha compiled and evaluated information from residences, commercial and industrial establishments, and municipalities to evaluate aquifer conditions and potential impacts to existing groundwater users.

Communities, including Rotterdam Junction, Glenville, Scotia, Rotterdam, Schenectady and Niskayuna, rely on the Great Flats Aquifer for their municipal water. Four of these community systems (Schenectady, Rotterdam, Scotia and Glenville) are within the study area for the GEP hydrogeologic evaluation, which is represented by the area on Plate 1. The water production records for each of these systems were reviewed to assess average production rates, maximum and minimum yields, and long-term production trends. Pumping test records from published and unpublished reports were reviewed to assess drawdown characteristics in and near the well fields. Review of the available records was performed to evaluate the historical operation of the well fields and groundwater usage by the communities. This evaluation was necessary to determine the impacts, if any, of pumping an additional 2.4 MGD (4.0 MGD maximum) for the GEP project.

Inquiries were conducted to determine the presence of private residential and commercial/industrial groundwater users to evaluate potential impacts to such users, if any, from the proposed additional pumping at the Schenectady well field. A residential well survey was conducted to obtain information on the aquifer and to identify residential groundwater users. Additionally, municipal water department personnel were interviewed to identify wells utilizing the aquifer for domestic water supply.

5.1 Groundwater Usage

Alpha contacted personnel at the City of Schenectady, the Town of Rotterdam, the Town of Glenville, and Village of Scotia to identify groundwater users within the municipalities who obtain groundwater from private wells. Representatives of the Village of Scotia confirmed that they are unaware of any private wells utilizing groundwater from the aquifer. Town of Glenville officials identified Adirondack Beverages, Inc. as a commercial groundwater user with a well on the east side of Corporations Park, and two residential private wells located southwest and southeast of the proposed GEP site, respectively. The two residential private wells were also identified during the residential well survey described below. Information was requested directly from Adirondack Beverages, Inc. regarding the well location, pumping rate, and pumping water levels for their wells(s). Adirondack Beverages, Inc. declined to provide the information necessary to assess potential impacts.

Town of Rotterdam Water Department personnel indicated that the town requires permits for residents who utilize a private well and who are also connected to the municipal water supply system. The town water department provided a list to Alpha of residents to whom permits have been issued. No residents with permits were identified on either of the two roads (Rice Road and Schermerhorn Road) in Rotterdam that overlie the aquifer. The town does not maintain a list of residents that may be using only a private well for water supply.

The portion of the aquifer in the study area that lies within the City of Schenectady is occupied by industry. Therefore, there are no private wells within the aquifer in the study area within the City of Schenectady.

If there are unknown private groundwater wells within the cone of influence of the Schenectady/Rotterdam well field, the additional water pumped for the GEP would not be expected to create adverse affects on such wells. No changes in the groundwater flow direction will occur due to the increased pumping for the GEP, as described in Section 4.5. The increased pumping would cause a slight increase in drawdown of the water table; however, the increased drawdown would be less than the variation in the water table elevation caused by seasonal control of the Mohawk River that is apparent by comparing the groundwater contours shown on Plates 10 and 11 in the vicinity of the Schenectady/Rotterdam well fields. Such changes in elevation of the water table would therefore not affect the quantity of water available to private wells due to the very high permeability of the aquifer.

5.2 Residential Well Survey

A well survey was conducted by Alpha personnel to obtain information from residential wells located in close proximity to the proposed GEP site. The following information was requested as part of the survey.

- available stratigraphic information.
- groundwater levels, periods of well dryness, and water quality data.
- identification of wells in the area still being used by residents, or dates when the residents switched to public water.

The survey was conducted over a several week period beginning with a letter sent to area residents stating the intent of the survey. Follow-up telephone calls were made to residents beginning one to two weeks following the receipt of the letters. At least three attempts were made to contact each of the residents regarding the survey, with messages being left whenever possible.

A survey form was produced by Alpha to record information regarding the residential wells. The information requested included identification of wells currently or historically used for water supply, the number of known wells on the property, the well depth, well log data, static water levels, water yield, and type of material in which the well was completed. Residents were also questioned regarding known problems with the wells, including loss of yield, water quality issues, as well as water quality analysis records. Residents in certain areas were asked if they would give permission for future sampling of their wells for water quality analysis. The individual data forms completed by Alpha personnel are not included in this report for purposes of maintaining confidentiality.

A total of twenty-eight residential properties were included in the well survey, including the two residential groundwater users identified by Town of Glenville Water Department personnel. Twenty residents responded to the survey. Of those, ten residents responded with limited information regarding wells on their properties. No information was obtained from the remaining ten respondents. Wells that could be identified by location were plotted on Plate 1 using the prefix RW. The stratigraphic, water level and water quality information provided by some residents was of limited use in comparison to other, more detailed information sources compiled by Alpha; therefore, the residential well data were not used in the hydrogeologic evaluation.

No impacts to the water levels, groundwater flow direction, or available groundwater quantity would occur at these residential wells because they are located beyond the zone of influence of the municipal well fields, as described in Section 4.5. Changes in the groundwater flow direction occur in the vicinity of the residential wells located southeast of the GEP site due to seasonal changes in the river level at Lock 8, as described in Section 4.5, and as shown on Plates 10 and 11. These changes in groundwater flow direction are not attributable to pumping at the Schenectady/Rotterdam well fields.

5.3 Municipal Well Field Records

Alpha personnel contacted officials for the City of Schenectady, Town of Glenville, Village of Scotia, and Town of Rotterdam regarding the current and historical operations at their respective well fields. Documentation regarding the well field development, production, water quality demographics, and operation and maintenance was provided to Alpha in written records and verbally. The information compiled by Alpha from each municipality is presented in the following sections. The Town of Rotterdam is divided into Districts 3 and 5. The well field for District 5 is within the Great Flats Aquifer as described in Section 5.3.4. The water source for District 3 is also within the Great Flats aquifer, but is beyond the limits of the study area for this report. Therefore, information and analysis for the Town of Rotterdam in this report is limited to District 5.

5.3.1 City of Schenectady

The City of Schenectady municipal well field is located on Rice Road in Rotterdam, as shown on Plate 1. A total of fourteen wells have been installed at the well field since 1941. The wells include ten installed in the 1940s, two in the 1950s, and two in the 1960s. Twelve of the fourteen wells are currently active or on standby for emergency use, and the remaining two have been abandoned and are not part of the existing system. The overall capacity of the well field has varied over the years and is influenced by the frequency of maintenance and rehabilitation procedures to keep the wells operating at maximum efficiency. Schenectady implemented a routine well maintenance and monitoring program in the mid-1980s. This program has significantly increased the yield of a few wells and has returned some wells to active status.

5.3.1.1 Records Summary

Alpha personnel met with representatives of Schenectady's Water Department to review historical records of well field production, water quality, and testing results for the period 1960 to the present. The water department has maintained records of the monthly production (gallons) and daily average production (gallons) for the period 1960 to 1967, monthly production and actual daily production for most of the months for the year 1969, and monthly and actual daily production for the period 1971 through 1978. The data from 1978 to the present, which is recorded on a computerized spreadsheet, includes monthly production, daily production, daily peak production and daily minimum production. Schenectady has also computerized its water quality testing records from 1990 to the present.

5.3.1.2 Water Production and Usage

The City of Schenectady well field has a permitted capacity of 35 million gallons per day (MGD). Pumping tests are performed periodically on individual wells to evaluate current capacity and determine if rehabilitation is necessary. Well capacities, which were determined based on the results of the pumping tests performed on wells in 1999 and 2000, are presented in Table 5.1.

The Schenectady municipal water system primarily serves residential customers, with the remainder of the production serving government, institutional, and industrial use. The system currently serves an estimated population of 65,000, not including usage outside of the municipality. The current population is substantially lower than the peak population documented from 1904 to 1967. The maximum population (estimated) during this period was 112,690 in the years 1943 and 1944 (City of Schenectady, 1960-1967). Schenectady also supplies water to Niskayuna for residential and other uses. Table 5.2 presents a summary of water usage by customers using high volumes of water. Approximately 2.9 MGD of water from the Schenectady well field is used by a combination of municipal, institutional, industrial, government and commercial customers and approximately 10.3 MGD of water is used for residential customers.

Production records for monthly total, daily average, daily peak and daily minimum usage are presented in Appendix E for the years 1968 through June 2001. Monthly total values only were available for intermittent years from 1960 through 1978. Representatives of Schenectady's Water Department provided a description of monthly water production based on the historical record. The month of June typically has the highest production while the months of January, February, and March have the lowest production.

Graphs presented in Appendix E were reviewed to compare current well field production to historical levels. The graphs show that well field production began to decline in 1995. The data indicate that the daily average production from 1960 through 1995 ranged from approximately 13 MGD to 26 MGD with a peak daily production of 28 MGD occurring on February 16, 1995. The average daily production from 1960 through 1995 was 17.4 MGD. The daily rates began to decline in 1995. The daily average production ranged from approximately 10 MGD to 19 MGD for 1996 through June 2001 and the average daily production of 12.7 MGD for July 1997 through June 2001 is an indication of the current representative water usage.

The average production data indicate that the GEP's average demand of 2.4 MGD (4.0 MGD maximum) would increase the production for the City of Schenectady to an average of 15.1 MGD (16.7 MGD maximum), which is below the historical average (pre-1996) of 17.4 MGD.

The analysis presented in this report uses the recent average pumping rate for the City of Schenectady, although flow rates are known to vary over short periods of time depending on demand. The short-term variations in the well field pumping rate have very little effect on the cone of drawdown because of the very high aquifer transmissivity and the hydraulic connection between the well field and the Mohawk River. Use of the average pumping rate is therefore, appropriate for assessing potential impacts of the proposed increased pumping rate on the cone of drawdown and groundwater flow directions.

5.3.2 Town of Glenville

The Town of Glenville well field is located on Pump House Road, off Van Buren Lane, Glenville (Plate 1). The well field was completed in 1966, and currently has four production wells.

5.3.2.1 Records Summary

Alpha personnel reviewed monthly production, monthly average production, yearly total production, and the total plant output for the period February 1966 through August 2001. Daily production and daily average production were also reviewed for the period January 1995 through August 2001. These data are tabulated in Appendix E.

5.3.2.2 Water Production and Usage

The Town of Glenville well field has a permitted capacity of 5.7 MGD. The current maximum output is 4.2 MGD based on pump capacity. The months of May through August generally have the highest production, while the months of December and January have the lowest production. Review of well field records from 1966 through August 2001 showed that maximum daily production of 4.2 MGD was recorded on a total of six days during the period June through August 1997. A minimum daily average production of 0.14 MGD is recorded for the month of February 1966.

Graphs presented in Appendix E were reviewed to compare current well field production to historical levels. The graphs show that well production generally increased from 1966 to 1984, leveled off until 1990, then decreased slightly to a stabilized daily average rate of approximately 2.0 MGD that has persisted through August 2001.

5.3.3 Village of Scotia

The Village of Scotia well field is located on Vley Road, Scotia. The well field began operation circa 1931 with two production wells. Two additional production wells were added in the 1970's and 1980's.

5.3.3.1 Records Summary

The existing well field records include data on production rates for 1931, 1940, 1950, January 1960 to March 1967, and January 1993 through August 2001.

5.3.3.2 Water Production and Usage

The Village of Scotia well field has a permitted capacity of 2.0 MGD. The months of June through August have the highest production, while the months of December through February have the lowest. A maximum daily average production in the 1993 to 2001 time period of 1.7 MGD was recorded in June 1999, and a minimum average daily production of 1.0 MGD was recorded in October and December 2000.

The production data indicate that the well field produced an average of about 0.86 MGD from 1931 through the early 1960s. The rate had increased to around 1.0 MGD by 1962 and to 1.5 MGD by 1965. The current average rate, which has remained close to the 1965 rate is approximately 1.3 MGD. Graphs presented in Appendix E were reviewed to compare current well field production to historical rates. The graphs show that well field production has been relatively stable since 1973.

5.3.4 Town of Rotterdam (District #5)

The Town of Rotterdam is divided into Districts 3 and 5. The well field for District 5 is within the Great Flats Aquifer as described in Section 5.3.4. The water source for District 3 is also within the Great Flats aquifer, but is beyond the limits of the study area for this report. Therefore, information and analysis for the Town of Rotterdam in this report is limited to District 5. The well field for the Town of Rotterdam's Water District #5 is located on Rice Road. Rotterdam's District #5 well field is approximately 1,000 feet northeast of the Schenectady well field (Plate 1). Construction of the District #5 water system was completed in 1953. The current system consists of four production wells that are connected to a distribution system that includes elevated storage tanks and a standpipe.

5.3.4.1 Records Summary

Monthly production and daily average production are available for the period 1994 to September 2001. Rotterdam also provided the results of quarterly water quality monitoring of volatile organic compounds (VOCs) from 1992 to the present.

5.3.4.2 Water Production and Usage

The Rotterdam District #5 well field has a permitted capacity of 10 MGD. Rotterdam performed pumping tests on the production wells in February and April, 2000. Well capacities of 1,100 gpm, 2,000 gpm, 1,800 gpm, and 2,100 gpm were measured at production wells 1, 2, 3 and 4, respectively. The current total well field capacity is 10 MGD based on the test results.

The Rotterdam District #5 water system currently serves an estimated population of 26,000 people. The population served by District #5 has been relatively stable since 1983 when the estimated population was 26,310. Rotterdam supplies water to residential, commercial, industrial, and institutional users. Residential water usage exceeds the combined water usage for commercial, industrial, and institutional purposes.

Representatives of Rotterdam's Water Department provided a description of monthly water production based on the historical record. The months of June, July, and August have the highest production while the months of January, February, and March have the lowest production. The average daily production for 1997 through September 2001 is 3.8 MGD. Review of well field records from 1994 to present showed that a maximum daily production of 9.1 MGD was recorded on June 24, 1999. The lowest production was recorded in February 1994 when the average daily production was 2.4 MGD.

Graphs presented in Appendix E were reviewed to compare current well field production to production levels recorded since 1994. The graphs show that well field production has been relatively stable during this period. Review of the records from 1955 to 1982 showed that water production was increasing during this period. Water consumption was approximately 1.2 MGD in 1955 and 2.6 MGD in 1982 (Frasier, 1983).

5.4 Aquifer Pumping Tests

The drawdown characteristics and aquifer parameters such as transmissivity, hydraulic conductivity, and yield were determined from pumping tests that have been performed periodically at the municipal well fields. These pumping tests (Table 5.3) included six in the Schenectady/Rotterdam well fields, two in the Glenville well field and two in the Scotia well field. Additionally, tests have typically been conducted on individual wells shortly after installation and development; however, the results of these tests were not readily available.

5.4.1 Schenectady/Rotterdam Well Fields

The Schenectady/Rotterdam well fields, which consist of two separate systems, are typically treated as a single well field for pumping test purposes because the well fields are separated by approximately 1000 feet and their resulting drawdown cones combine to form a single, large cone of drawdown. The pumping rates shown on Table 5.3 for the Schenectady/Rotterdam well fields mostly represent rates from the Schenectady wells; however, the 1952 test data were only for Rotterdam, and the 1988 test rate of 29.8 MGD was derived by pumping the Rotterdam system at 10 MGD and the Schenectady system at 19.8 MGD.

The Schenectady/Rotterdam well fields were first tested during the navigation season on October 1946 by the United States Geological Survey (USGS). This was a limited test that involved pumping the wells for 17 hours at a combined rate of 16 MGD. No water level measurements were collected from the Mohawk River and only a few wells were monitored for water level; consequently, no evaluation of drawdown effects could be assessed (Simpson, 1952).

The second test was conducted on January 10-12, 1947, during the non-navigation period. This test also involved pumping at a combined rate of 16 MGD for 17 hours. The January test was considered to produce more useful data than the October test, due to relatively stable water levels in the Mohawk River. The general findings were that the outwash sand and gravel deposits that make up the Great Flats Aquifer are some of the most transmissive in the United States. Furthermore, the Schenectady well field receives most of its recharge from the Mohawk River, and the Mohawk River is able to sustain an infiltration rate of 100 MGD or greater 99.9 percent of the time (Simpson, 1952).

A pumping test was conducted for two wells in the Rotterdam well field in July 1952 (Winslow, 1965). Two wells in the Rotterdam field (249-359-92 and 249-359-93) were pumped for 24 hours at a combined total rate of 8 MGD while the water levels were monitored. No rates were recorded for the Schenectady well field, though it is likely that the Schenectady system was being pumped throughout the test duration. This test indicated that there is some local variability in the hydrologic characteristics of the aquifer that appears to be related to the presence of layers of low permeability silt and clay, which are described in Sections 3.4 and 3.5. This variability is of little consequence with respect to the availability of groundwater due to the high permeability of the aquifer, and the hydraulic connection to the Mohawk River.

Pumping tests were conducted on August 3, and again on December 29, 1960 by the USGS (Winslow, 1965). The objectives of the tests were to assess the extent of drawdown around the Schenectady well field and assess the affect of river stage (navigation vs. non-navigation) on the recharge/drawdown cone from the Schenectady well field. These tests involved holding the ongoing production of the Schenectady well field at a constant rate for 14 hours. The August pumping test was conducted at a rate of 18.28 MGD, and the December pumping test was conducted at a rate of 15.3 MGD. The wells at the Rotterdam well field were not operating throughout either test. Water levels were measured in monitoring wells, the Mohawk River above the dam at Lock 8, and the Mohawk River below the dam. The measurements were taken twice during the 2-hour period after the wells had been pumping for 12 hours.

The drawdown measurements for the navigation period derived from water levels measured in the aquifer during the August 3, 1960 test indicated that the cone of drawdown did not extend to the north side of the Mohawk River while pumping the Schenectady wells at a rate of 18.28 MGD (Winslow, 1965), as described in Section 4.5 (Plate 11). The fact that the drawdown did not extend north of the Mohawk River was attributed to the effects of infiltration to the aquifer from the Mohawk River. The test rate of 18.28 MGD is substantially lower than the 29.8 MGD August 1988 pumping test rate (Plate 10) and is higher than the current average of 12.7 MGD and the proposed average rate of 15.1 MGD (16.7 MGD maximum) that would occur during GEP operations. The drawdown created by pumping at the well fields is discussed more fully in Section 4.5.4.

The December 29, 1960 pumping test, conducted at the rate of 15.3 MGD, also indicated that the drawdown did not extend to the north side of the Mohawk River based on the water levels measured in the aquifer during the test; however, Winslow (1965) predicted that the drawdown would extend to the north side of the Mohawk River toward the end of the non-navigation season based on the water levels measured during the pumping tests, as described in Section 4.5. The potential for expansion of the cone toward the end of the navigation season is greatest when the Mohawk River is low following a period of cold, dry weather. The low water levels reduce the hydraulic head in the Mohawk River and reduce the river bed surface area across which the water can infiltrate. The cold water temperature also reduces infiltration by significantly decreasing the hydraulic conductivity of the aquifer at the base of the Mohawk River. Hydraulic conductivity can be 50 percent less for 32° F water than the hydraulic conductivity for 80°F water (Winslow, 1965). Winslow (1965) interpreted that the Schenectady well field could not sustain a pumping rate of 29.8 MGD for more than 180 days of continuous, dry, cold weather. However, such extreme weather conditions do not persist in the northeast for periods of 180 days as evidenced by review of climatic data (Appendix C).

The potential drawdown effects during late non-navigation conditions were evaluated by Malcolm Pirnie (1989) in February 1988 (Table 5.3). Malcolm Pirnie conducted a 72-hour test at a combined rate of 29.8

MGD. This combined rate consisted of 10 MGD for Rotterdam and 19.8 MGD from Schenectady, which exceeds the average demand of 15.1 MGD (16.7 MGD maximum) that is anticipated from the Schenectady well field during GEP operations.

The 1988 Rotterdam/Schenectady test began by ceasing all pumping in the two well fields to allow recovery of the aquifer to static levels. Pumps were then turned on in stages until the targeted pumping rate was achieved. The targeted rate of 29.8 MGD was held constant and the water levels in monitoring wells, pumping wells and the Mohawk River were monitored throughout the test. The results of the test indicated that the cone of drawdown did extend to the north side of the Mohawk River; although this drawdown effect stabilized before the end of the test, indicating that the maximum extent of influence was achieved for the 29.8 MGD pumping rate. The drawdown derived by the February 1988 test is discussed more fully in Section 4.5.3.

5.4.2 Glenville Well Field

The Glenville well field was tested on at least two different occasions (Table 5.3). The first test was conducted in April 1965 for a period of 72 hours at a rate of 3.9 MGD (Malcolm Pirnie, 1989). The water levels of the Mohawk River and in monitoring wells were measured throughout the test. The test, which was conducted during the navigation season, indicated that the Mohawk River, which borders the well field to the west, south, and east, is the primary source of recharge. The cone of drawdown was effectively prevented from expanding by the Mohawk River and the valley margin to the north. A second test was conducted by Malcolm Pirnie for 72 hours at a rate of 2.1 MGD in March of 1988 (non-navigation season) (Malcolm Pirnie, 1989). Water levels were recorded in the Mohawk River, pumping wells, and monitoring wells throughout the test. The resulting cone of drawdown was again confined by recharge from the Mohawk River and is described in Section 4.5.3.

5.4.3 Scotia Well Field

Existing information indicates that the Scotia well field was tested twice (Table 5.3). The well field was tested following installation of a new well in 1986 (Dunn, 1986) and again in 1988 for the Great Flats Aquifer study by Malcolm Pirnie (1989).

The 1986 test consisted of pumping well No. 3 at a rate of 1.7 MGD for 24 hours starting on April 19th, 1986. The water levels were measured in production wells and monitoring wells within the municipal property that contains the well field. Water levels were allowed to recover to a static condition before the test and were monitored throughout the test duration. The hydrogeologic investigation and pumping test by Dunn (1986) demonstrated that the portion of the Great Flats Aquifer that supplies the Scotia well field is recharged by direct infiltration to the land surface and leakage from adjacent alluvial deposits. These local sources of recharge are not sufficient to maintain the well field yield on their own. Water levels measured during the pumping test show that the additional aquifer demand is maintained by withdrawal of storage from adjacent portions of the aquifer. This withdrawal causes the cone of drawdown to expand outward beyond the well field until a sufficient recharge area of the aquifer is tapped to sustain the well field. Under normal conditions, it was determined that the cone would expand to the adjacent open gravel pits to the south, southeast and west where mining activities have extended below the water table. The water in the sand and gravel quarries generally supplies sufficient recharge to inhibit expansion of the cone of drawdown southward beyond the quarries. In the unlikely event that the quarries become dry, for example during prolonged drought conditions, the cone of drawdown could extend southward beyond the quarries.

The Malcolm Pirnie pumping test was conducted over a 72-hour period from August 30 through September 2, 1988 (Malcolm Pirnie, 1989). This test was apparently conducted after an extended dry period (Malcolm Pirnie, 1989); however, the rainfall record from Schenectady is incomplete for the eight months preceding the test dates. The Albany weather data indicate that March through July accumulated a deficit of 4.8 inches of precipitation while August was above normal. The well field was shut down prior to the test and the water levels were allowed to recover. A recharge event (3-inch rainfall) occurred 2 days before the test (Malcolm Pirnie, 1989). The effects of this recharge event were evident by a rise in the water level in one of the observation wells. The test was conducted by pumping production well No. 3 at a rate of 1.7 MGD. Drawdown was measured in the well field from the pumping well, monitoring wells, the idle production wells, and an adjacent stream (Malcolm Pirnie, 1989). The data were used to plot a water level contour map showing the cone of drawdown around the well field. The water levels indicated that the drawdown did not expand beyond the adjacent sand and gravel quarries. The resulting cone of drawdown is described in Section 4.5.4.

5.5 Summary

Information on groundwater usage and aquifer testing was compiled and evaluated to better understand the aquifer characteristics and production capability. Information was obtained from residences, commercial and industrial establishments, municipalities, and available reports.

This analysis showed that there are relatively few private entities that utilize the groundwater from the aquifer, as would be expected due to the availability of water from the local municipalities. The identified private groundwater users include two residents along the south side of Route 5 near the proposed GEP site, and Adirondack Beverages, Inc.

Review of available municipal well field records provides an understanding of the current average water production rates and the historical water production rates for each municipal well field. The City of Schenectady well field is permitted at a capacity of 35.0 MGD and has an average daily production rate of 12.7 MGD for the period 1997 through June 2001. The Glenville well field has a permitted capacity of 5.7 MGD and has a daily average production of 2.0 MGD for the period of 1990 through August 2001. The Village of Scotia well field has a permitted capacity of 2.0 MGD and an average daily rate of 1.3 MGD for the period of 1973 through September 2001. The Town of Rotterdam water district number 5 well field has a permitted capacity of 10 MGD and an average daily production rate of 3.8 MGD for the period of 1997 through September 2001.

Figure 5 is a graph of the Schenectady well field production compared to the proposed average well field pumping rate of 15.1 MGD (16.7 MGD maximum). The graph in Figure 5 shows that the well field has historically produced volumes of water at rates greater than 15.1 MGD and 16.7 MGD over considerable periods of time. In particular, the well field produced greater than an average daily rate of 15.1 MGD nearly continuously for an 103 month period from February 1987 through August 1995. Daily average production was slightly below 15.1 MGD for only 9 months and was greater than 16.7 MGD for 49 months during this period. These aggregate production rates are substantially below the permitted capacity of 35 MGD for the City of Schenectady well field, the 29.5 MGD pumping test rate (Section 5.4), and the total well field capacity of 41.5 MGD. Review of the historical production data shows that the well field has produced water at rates greater than the proposed 15.1 MGD daily average and 16.7 maximum daily rates for extended periods, and that no adverse impacts on the volume of water available from the Schenectady well field occurred in the past or is expected from the proposed additional pumping for the GEP project.

Pumping tests have been conducted at each of the municipal well fields to evaluate the well field capacity. Pumping rates for tests conducted at the Schenectady/Rotterdam well fields have ranged from 8.0 MGD to 29.8 MGD. The following conclusions have been derived from the pumping tests conducted at the Schenectady/Rotterdam well fields:

- The outwash sand and gravel deposit that makes up the Great Flats Aquifer is highly transmissive.

- Water levels measured during pumping tests at rates of 18.28 MGD and 15.3 MGD at the Schenectady/Rotterdam well fields indicate that the drawdown from the well pumping did not extend to the north side of the Mohawk River during the navigation and non-navigation periods, respectively.

- Water levels measured during a pumping test at a rate of 29.8 MGD during the non-navigation season indicated that drawdown was evident on the north side of the Mohawk River.

The results of pumping tests at the Glenville Well Field indicate that the Mohawk River is the primary source of recharge to the aquifer and that the cone of influence from the Glenville Well Field is effectively prevented from expanding due to the recharge by the river.

Pumping tests conducted at the Scotia well field indicate that the primary sources of recharge are direct infiltration to the land surface, leakage from adjacent alluvial deposits, and infiltration from water in the nearby sand and gravel quarries. The recharge from the water in the sand and gravel quarries inhibits expansion of the cone of drawdown to the south.

The water levels, groundwater flow direction, and available groundwater quantity of private well users would not be adversely impacted by increased pumping at the Schenectady/Rotterdam well field because such private wells are located beyond the zone of influence of the well fields, as described in Section 5.0. Similarly, other municipal well fields would not be adversely impacted by the increased pumping at the Schenectady/Rotterdam well field because the zone of influence for the Scotia and Glenville well fields are beyond the zone of influence of the Schenectady/Rotterdam well fields, as described in Section 4.5.

6.0 EVALUATION OF CLIMATE AND RIVER FLOW ON THE AQUIFER

The Great Flats Aquifer is a dynamic water table system that is in equilibrium with recharge from precipitation and the Mohawk River and discharge to municipal wells and the Mohawk River. The equilibrium between recharge and discharge to the aquifer maintains sufficient levels in the aquifer to support the current average municipal demand of 19.8 MGD from the aquifer while maintaining a substantial base flow in the Mohawk River. The various contributing factors to the recharge/discharge equilibrium fluctuate seasonally and also during extremes in temperature and precipitation. For example, long, hot dry periods reduce the quantities of recharge to the aquifer that is normally contributed by precipitation. A reduction of precipitation will lower the level of the water table, particularly in areas near the aquifer boundary (Plate 5). The Scotia well field is in an area that is susceptible to drops in the water table from extended dry periods.

The portion of the water table that borders the Mohawk River is not susceptible to summer droughts. This phenomenon is particularly important to the well fields at Rotterdam Junction, Glenville, Rotterdam and Schenectady, which are supported by recharge (induced infiltration) from the Mohawk River. The Mohawk River is a navigation waterway with canals and locks that are used to maintain a consistent water level and continuous flow in the Mohawk River. The water level above Lock 8 is maintained at approximately 226 feet above mean sea level (amsl) and the pool above Lock 7 is maintained at approximately 211.5 feet amsl (Winslow, 1965). The sustained water elevations and flow in the river act to maintain the water level in the aquifer and recharges the aquifer where water table drawdown is occurring at adjacent well fields, as described in Sections 4.3 and 4.4.

Although the aquifer adjacent to the Mohawk River is not affected by droughts during the navigation season (approximately April 1st to December 1st), winter conditions, especially long periods of cold, dry weather, can reduce the amount of river water available for recharge to the aquifer. Recharge from the Mohawk River to the aquifer is reduced when river levels and the wetted surface area of the Mohawk River bottom is reduced by opening the dams during the non-navigation season. This recharge to the aquifer is further reduced by a lack of flood events (snow melt/rain) during dry winters and extended cold periods that can reduce hydraulic conductivity at the base of the Mohawk River by as much as 50 percent.

Climatological data were assessed to determine whether previous testing and analyses of the Great Flats Aquifer addressed the ability of the aquifer to sustain withdrawals of groundwater. The historical river data were also reviewed to determine whether the Mohawk River flow is sustained at levels that will replenish the aquifer during extended dry periods.

6.1 Climate

Historical records of monthly precipitation and temperature data were obtained from the National Oceanic and Atmospheric Administration (NOAA) observation stations at the Albany Airport and Schenectady for the period from 1960 to the present. Records as far back as 1960 were reviewed in order to include the years of known drought in the early 1960's. The Schenectady data for this period are incomplete; consequently, the Albany temperature and precipitation data were used where the data for Schenectady were unavailable. The normal temperatures and precipitation data for Albany are tabulated on Table 6.1. Precipitation and temperature data from 1960 to the present are tabulated in Appendix C for both Schenectady and Albany. All of the data were obtained from NOAA through the Regional Climatic Data Center at Cornell University, Ithaca, New York.

The precipitation data indicate that yearly precipitation for Schenectady is 34.51 inches per year, and for Albany is normally 36.17 inches per year. Schenectady has an average precipitation of 15.31 inches, and

Albany has an average of 16.63 inches, falling during the period from May through September. The average monthly temperature for Schenectady is 48.48°F, and Albany is 47.36°F. The average temperature for the coldest winter months of December through February is 25.5°F at Schenectady and 23.53°F at Albany. The total combined precipitation for those same three months is 7.51 inches at Schenectady and 7.56 inches at Albany.

A review of the precipitation data for Schenectady and Albany indicate that the years 1962 (28.44 inches at Schenectady) 1963 (29.03 inches at Schenectady) and 1964 (22.45 inches at Schenectady) were the three driest years in the Schenectady and Albany area since 1960. These three years, had precipitation totals for May through September at Schenectady of 10.61 inches (1962), 13.33 inches (1963) and 7.97 inches in 1964. These values are lower than any other reportedly dry year such as 1995, which actually had a slightly below normal total precipitation for the year of 31.07 inches and a total of 10.31 inches.

A review of the temperature data indicate that winter temperatures (December through February) during the dry years of 1962 through 1964 were close to normal with the years 1963 and 1964 being slightly below average and 1962 being slightly above average. These were important years, since they were driest during the period of 1960 through the present. Infiltration from the Mohawk River into the aquifer is reduced due to the colder winter temperatures that prevail during the non-navigation season. These were also the years that Winslow (1965) used as a basis for estimating the affects of the non-navigation season on recharge. The non-navigation pumping test conducted by Malcolm Pirnie at the Schenectady/Rotterdam well fields in February of 1988 corresponded to average December through February temperatures of 25.13°F (Albany data) which were slightly above the normal of 23.53°F.

The Glenville well field, which is also sustained by river infiltration, was tested in April 1965 and March of 1988 by Malcolm Pirnie. These tests were conducted during periods of near normal temperatures. The 1965 test was most likely conducted under controlled river levels associated with the navigation season, while the 1988 test was conducted during a period when precipitation amounts were below normal, although the Mohawk River would have been receiving runoff from high precipitation that occurred during February of that year.

The Scotia well field pumping tests, which are not influenced by river infiltration and the effects of temperature, were conducted in April 1986 by Dunn Geoscience and September 1988 by Malcolm Pirnie. The 1986 test was conducted after a winter of slightly above normal precipitation. The 1988 test however, did occur during a mild, short term drought with a total precipitation of 29.95 inches, which is 6.22 inches below normal. Five of the months that preceded the test were characterized by below normal precipitation.

6.2 MOHAWK RIVER FLOW

The Mohawk River is a critical element in sustaining water levels in the Great Flats Aquifer and supporting the water supply demands in Schenectady County. River flows have been monitored in the Mohawk River at the Cohoes station continuously since 1915 (Eissler, 1978). Although this station is downstream from the site area, flows at that location are considered to be similar to flows in the area of Lock 8 in the vicinity of the GEP Site and the Schenectady well field (Winslow, 1965).

The historical data indicate that the Mohawk River has an average flow at the Cohoes station of 3688 MGD (5,706 cubic feet per second (cfs)) during the 83 year period from 1917 to 2000 (USGS, 2002). The lowest flow indicated up to 2000 was 14 MGD (23 cfs), which occurred on August 24, 1941; however, it was possible that the low flow on that date was the result of storage being accumulated at one of the locks. A ten-day average is a more representative flow rate since the averaging technique removes the daily effects of navigation controls. The lowest recorded 10-day average up to 2000 was 309 MGD

(477 cfs) recorded for the period August 15 through 24, 1941 (USGS, 2002). A low flow of 309 MGD is 16 times greater than the average daily demand of 19.8 MGD by all municipal well fields pumping from the Great Flats Aquifer. The 19.8 MGD average daily demand is approximately 6 percent of the low flow rate for the river. The low flow value is also approximately 14 times higher than the average demand of 22.2 MGD, which is anticipated for the entire Great Flats Aquifer with the addition of the average GEP use of groundwater. The 10-day low flow average of 309 MGD is lower than the low flow average calculated from the provisional data for the recent drought conditions during the Fall 2001, when the average was 391 MGD (605 cfs).

6.3 SUMMARY

A review of the climatological and river data indicates that climatic factors, as well as the level of water in the river, affect the availability of water in the aquifer. Normal variations in temperature and precipitation do not substantially affect the water level in the Mohawk River which recharges the aquifer in the vicinity of the Glenville well field and the Schenectady and Rotterdam well fields. Review of the available climatic and river data indicates the volume of flow in the Mohawk River is more than sufficient to provide adequate recharge to the aquifer, even during periods of drought. Water production rates from the Glenville well field and the Schenectady and Rotterdam well fields are relatively unaffected due to the availability of recharge from the river to the aquifer during periods of drought.

Water production rates at the Scotia well field can potentially be affected during periods of drought because the well field does not receive direct recharge from the river. As a result, the Scotia wells must draw additional water from storage in the aquifer during periods of drought which results in an expansion of the cone of drawdown of the well field. The water in the sand and gravel quarry around the Scotia well field provides direct recharge to the aquifer and reduces the expansion of the cone of drawdown of the well field during periods of drought.

7.0 GROUNDWATER QUALITY

The quality of the groundwater in the Great Flats Aquifer is an issue of importance due to local reliance upon the aquifer as a sole source of drinking water. Growth and development over the aquifer in the past has resulted in documented areas of contamination with the potential to affect groundwater quality. Examples of potential sources of contamination include landfills, underground storage tanks, improper waste management/disposal, and accidental releases of chemicals. Trichloroethene (TCE) has been detected in groundwater at various locations in the aquifer and has been identified as a particular contaminant of concern. The following sections describe the water quality testing performed at the municipal well fields and the occurrence of TCE in the Great Flats Aquifer.

7.1 Schenectady Well Field

Schenectady collects and analyzes water samples in accordance with the requirements of the New York State Department of Health (NYSDOH) Regulations for Public Water Systems (Subpart 5-1). The NYSDOH has determined, based on water quality data, that the Schenectady well field is not under the direct influence of surface water. Schenectady analyzes samples for several groups of parameters including, but not necessarily limited to, inorganics, organics, physical characteristics and microbiological contaminants. Representatives of Schenectady's Water Department provided a description of the water quality results for the most recent ten year period (1990 to present). They report that none of the NYSDOH Subpart 5-1 Maximum Contaminant Levels (MCLs) have been exceeded in this period.

Alpha reviewed the groundwater quality data to evaluate when TCE and other volatile organic compounds was detected in groundwater samples collected during this period. Schenectady has been required by the NYSDOH to sample more frequently for volatile organic compounds including TCE. Table 7.1 presents a summary of the TCE data for Schenectady and shows that TCE was detected at very low levels (1 part per billion (ppb) or less) in Schenectady wells 1 and 2 until the end of 1997. These levels are below the New York State drinking water standard of 5 ppb. TCE has not been detected in Schenectady's production wells since 1997. The NYSDOH has approved a reduced sampling schedule for TCE, based on these recent results.

7.2 Rotterdam Well Field

Rotterdam collects and analyzes water samples in accordance with the requirements of NYSDOH Regulations for Public Water Systems (Subpart 5-1). The NYSDOH has determined, based on water quality data, that the Rotterdam District #5 well field is not under the direct influence of surface water. Rotterdam routinely collects samples and has them analyzed for several groups of parameters including, but not necessarily limited to, inorganics, organics, physical characteristics, and microbiological contaminants. Representatives of Rotterdam's Water Department provided a summary of the groundwater quality results for the most recent eight year period (1992 to September 2001).

Alpha reviewed the groundwater quality data to evaluate when TCE and other volatile organic parameters were detected in groundwater samples collected during the period of 1992 to the present. Rotterdam has been required by the NYSDOH to sample more frequently for volatile organic compounds, including TCE. Table 7.2 presents a summary of TCE and volatile organic data for Rotterdam District #5. Review of the data shows that TCE has been detected in Rotterdam wells 1, 2, 3 and 4 at concentrations ranging from non-detectable to 1.3 ppb. Toluene was detected in the samples collected from wells 1 and 2 on November 29, 1994 at concentrations of 1.2 and 0.8 ppb, respectively. Tetrachloroethene was detected in the sample collected from well 2 on November 4, 1992 at a concentration of 0.92 ppb. The concentration of TCE, toluene, and tetrachloroethene detected in the wells are below their respective New York State Groundwater Standard of 5 ppb.

7.3 GEP Site and Surrounding Area

Many rounds of groundwater sampling have been conducted in the GEP site area since the VOCs were first discovered in nearby water wells. The NYSDOH and NYSDEC have collected groundwater samples from nearby residential water supply wells during eight separate sampling events. The NYSDOH, NYSDEC, and two consulting firms representing local property interests, have installed 25 groundwater monitoring wells at and adjacent to the GEP site, and collected groundwater samples during 17 separate sampling events. These sampling events have included some of the monitoring wells installed during NYSDEC's response to a local petroleum spill in the nearby 400 and 500 blocks of the Depot.

In addition to these investigative sampling events, local municipalities have sampled and tested their water supply wells on a regular basis during this time period as described in Sections 7.1 and 7.2. Collectively, these investigations have documented the nature and extent of TCE and other VOCs in the groundwater and identified their impacts to local water supplies, however the source(s) of VOCs remains unidentified. TCE and other VOCs detected in the water supply wells were below the New York State Drinking Water Standards.

Table 7.3 summarizes the sampling events for residential and monitoring wells. The locations of the sampled wells are shown on Figure 3. Detailed discussion of the nature and extent of groundwater contamination beneath and near the GEP site is documented in the Environmental Site Assessments prepared by Earth Tech for the GEP site.

7.4 Other Sites

Numerous commercial and industrial businesses have been established on the aquifer in the past. Operations associated with many such businesses prior to the establishment of current regulatory and engineering controls have resulted in the release of a variety of contaminants to the environment and into the groundwater.

Earth Tech has conducted extensive research to identify the various sites on the aquifer that have resulted in contamination of soil and/or groundwater. The summary for each site prepared by Earth Tech is presented in Appendix F. Each summary provides a description of the site conditions, lists the available reports, identifies the contaminants of concern, provides a brief environmental assessment, describes the relationship of each site to the proposed GEP Site, and provides conclusions. Earth Tech concludes that there is little chance that any of the identified sites have had an adverse environmental impact on the GEP Site.

7.5 Summary

Information on groundwater quality was reviewed to evaluate whether the proposed additional pumping at the Schenectady/Rotterdam well fields would alter areas of known groundwater contamination. Considerable investigation has been conducted, and is continuing, to determine the source of TCE at and near the proposed GEP site. The investigations completed to date provide a reasonable delineation of the TCE (and related compounds) contaminated groundwater. The results of the investigations show that the TCE is migrating to the southwest toward the Mohawk River, beneath the proposed GEP site. The groundwater flow analysis presented in Section 4.5 and on Figures 3 and 4, demonstrates that the groundwater flow direction beneath the GEP site will not be effected by the increased pumping at the

Schenectady well field and therefore, the TCE plume will not be altered by the proposed additional pumping at the Schenectady well field.

Analysis of water samples from the Schenectady and Rotterdam well fields in accordance with NYSDOH regulations has periodically detected TCE. The reported concentrations have been below the New York State Groundwater Standard of 5 ppb. TCE has not been detected in Schenectady's production wells since 1997. The proposed additional pumping at the Schenectady well field is not expected to affect the water quality from the wells because the groundwater flow directions will be unaffected by the additional pumping, as described in Section 4.5.

8.0 EVALUATION OF POTENTIAL IMPACTS

The proposed GEP project is expected to utilize approximately 2.4 MGD (4.0 MGD maximum) of groundwater from the Schenectady municipal well field. The objectives of this report are to determine whether the Schenectady well field has the capacity to meet the proposed additional water use and to evaluate the potential impacts that such additional pumping at the Schenectady well field may create. This report provides the basis to determine whether the Schenectady well field can supply the additional water demand, to evaluate whether the additional water usage at the Schenectady well field will impact other drinking water sources that utilize the aquifer, and to assess whether the additional pumping at the Schenectady well field will affect or alter the migration pathway of existing contamination plumes.

This hydrogeologic evaluation shows that the Schenectady municipal well field can adequately supply an additional 2.4 MGD (4.0 MGD maximum) for the proposed GEP project. The average daily production for the well field from 1997 through June 2001 was 12.7 MGD. The well field produced a peak daily rate of 28 MGD on February 16, 1995 and has sustained average daily pumping rates ranging from 10.6 MGD (November 1999) to 19.0 MGD (July 1997) since that time. The permitted capacity of the Schenectady municipal well field is 35 MGD. A combined pumping test for Schenectady and Rotterdam well fields conducted in February 1988, indicated that the well fields could support a pumping rate of at least 29.8 MGD. The anticipated average pumping rate for the Schenectady well field with the proposed GEP in operation is 15.1 MGD (16.7 MGD maximum).

This hydrogeologic evaluation has confirmed that the Great Flats Aquifer is capable of producing large volumes of groundwater. Winslow (1965) estimated that the aquifer could produce up to 100 MGD on a sustainable basis. The ability of the aquifer to sustain such high production rates is due to induced infiltration from the Mohawk River. Pumping wells in the aquifer that are located adjacent to Mohawk River induce high rates of infiltration from the Mohawk River. The ability of the Mohawk River to sustain the Schenectady, Rotterdam, and Glenville well fields prevents those systems from being susceptible to drought conditions. Portions of the Great Flats Aquifer that are not located adjacent to the Mohawk River are not significantly affected by river levels and will exhibit normal seasonal cycles. Winslow (1965) determined that 90 percent of the water pumped by the Schenectady and Rotterdam well fields during the navigation season is attributable to infiltration from the Mohawk River. The contribution of water to the well fields from the Mohawk River during the non-navigation season is estimated to be approximately 70 percent.

The sustained flow of water in the Mohawk River ensures that adequate recharge is available to the aquifer and the municipal well fields adjacent to the Mohawk River. Available stream flow data for the Mohawk River show that the minimum 7-day average stream flow that can be expected to occur every 10 years (760 cubic feet per second) is 25 times greater than the combined average pumping rate for the Glenville, Schenectady, and Rotterdam well fields (19.8 MGD, 30.6 cfs). Additionally, the low flow rate for the Mohawk River is more than 4 times greater than the predicted 100 MGD sustainable yield rate for the Great Flats Aquifer. The current combined pumping rate of 19.8 MGD for all municipalities is equivalent to 4 percent of the calculated minimum 7-day average stream flow value. These data demonstrate that the aquifer capacity far exceeds the combined water demand of the municipal well fields and the GEP project.

Review of climatic data indicate a period of drought during 1962, 1963, and 1964 with precipitation totals for the months of May through September of 10.61 inches, 13.33 inches and 7.97 inches, respectively, as compared to a normal average of 15.34 inches (at Schenectady) for these months. Records show that the Schenectady well field produced a daily average of 20.0 MGD in June 1964 during the worst of the drought. This rate is greater than the anticipated demand of 15.1 MGD from the Schenectady well field with the GEP in operation.

Existing data have been used to develop groundwater contour maps for both the site and the study area for the non-navigation and navigation seasons. Review and evaluation of the groundwater flow pathways show that the cones of drawdown for the Glenville, Scotia, and combined Schenectady /Rotterdam well fields are distinct and separate from one another. Each well field operates independently and without interference from one another. The ability of the Schenectady/Rotterdam well fields to operate without influencing the Glenville or Scotia well fields is due to the contribution of infiltration from the Mohawk River. The February 1988 pumping test conducted at a rate of 29.8 MGD during the non-navigation period resulted in an expansion and stabilization of the cone at drawdown for the Schenectady and Rotterdam well fields to the north side of the Mohawk River. It is Alpha's opinion, based on analysis of historical pumping tests, that increasing the pumping rate at the Schenectady/Rotterdam well field by 2.4 MGD (4.0 MGD maximum) to accommodate the proposed GEP project will not result in a substantial expansion of the cone of drawdown for the well fields. Most of the water from increased pumping would be derived from infiltration from the Mohawk River.

No changes in groundwater flow paths are anticipated in response to an increase in the pumping rate at the Schenectady/Rotterdam well field as discussed in Section 4.4. Accordingly, the increased pumping rate is not expected to alter the migration pathway of known contamination plumes in the aquifer.

The TCE plume that extends across the GEP site has been defined by various investigations and is not in an area that is influenced by pumping at the municipal well fields. The TCE migrates through the groundwater according to the direction of flow, which varies due to normal seasonal factors, including the navigation and non-navigation water levels in the Mohawk River. The maximum width of the TCE plume is approximately 600 to 700 feet beneath the GEP site, based on groundwater quality data from February 1997 through June 2001, and the distribution of existing wells. Review of groundwater contour maps (Appendix D) and groundwater quality data indicates that the TCE plume remains on the western side of the groundwater divide where groundwater flows southwest to the Mohawk River, north of Daly's island. The migration pathway of the TCE will not be altered by the proposed increased pumping at the Schenectady/Rotterdam well field to accommodate the GEP project.

The cone of drawdown of the Schenectady/Rotterdam well field will not expand substantially due to the increased pumping rate of 2.4 MGD (4.0 MGD maximum) because most of the additional groundwater to support the increased pumping is derived from infiltration from the Mohawk River. A higher pumping rate will not draw contamination to the well field because the cone of drawdown for the well field is not expected to change substantially due to the proposed increased pumping rate.

The migration pathways for existing contaminant plumes located beyond the influence of pumping of the Schenectady/Rotterdam well field will not change because the cone of drawdown at the well field is not expected to change. As described in Appendix F, the various known contaminated sites, as regulated by the New York State Department of Environmental Conservation, continue to be monitored to detect changes in groundwater gradients or contaminant concentrations.

9.0 CONCLUSIONS

This hydrogeological evaluation was conducted to characterize the geologic and hydrogeologic conditions of the Great Flats Aquifer. The primary focus of this hydrogeological evaluation was on the potential affects of the proposed GEP project on the quality and quantity of water in the Great Flats Aquifer in Schenectady County. The anticipated GEP project water usage of 2.4 MGD (4.0 MGD maximum) used for this hydrogeologic evaluation is the maximum anticipated volume for the GEP. Actual water usage may be less, depending on final design.

The following conclusions have been developed based on the extensive compilation, review and evaluation of the available information:

- Bedrock in the area is comprised primarily of shale with interbedded siltstone of the Schenectady Formation and gray to black, slightly calcareous shales of the Canajoharie Shale formation, which underlies the GEP site. The elevation of the bedrock surface at the base of the valley is less than 50 feet above mean sea level (amsl) and increases to approximately 250 to 300 feet amsl along the flanks of the valley, and to greater than 400 feet amsl in the surrounding uplands.

- Glacial till is generally found overlying the bedrock throughout the aquifer region and ranges in thickness from a few feet along steep valley walls, to as much as 100 feet in some parts of the Mohawk River valley. The elevation of the till surface ranges from less than 100 feet amsl in the valley to approximately 220 to 300 feet amsl along the flanks of the valley.

- The Great Flats Aquifer is mainly comprised of the outwash sand and gravel unit, which consists of stratified and well sorted material, ranging in size from silty sand to gravel with occasional, localized clay lenses. The aquifer consists of all granular, unconsolidated materials in the Mohawk River Valley that are hydraulically connected, consistent with characterization of the aquifer by previous researchers. Definition of the Great Flats Aquifer was not limited or restricted to deposits of a certain geomorphic feature or glacial/deglacial event.

- The aquifer material is generally thinner on the valley flanks and thickens towards the valley floor along a northwest to southeast trend. The sand and gravel thickens from west to east with a maximum thickness of greater than 200 feet in the region beneath and southeast of the GEP site.

- The aquifer boundary mapping by Alpha differs from some previous mapping for several reasons. The aquifer boundary is mapped differently than Brown, et al. (1981) due to a difference in interpretation regarding sediments that are in hydraulic connection with the saturated aquifer materials in the Mohawk River Valley. The resulting difference between the aquifer boundary as mapped by Brown et al. (1981) as compared to Alpha, is that the boundary mapped by Alpha is not as wide and does not extend up the sidewalls of the river valley.

- The Great Flats Aquifer receives recharge from precipitation to the land surface above the aquifer. The aquifer also receives recharge from runoff onto the surface from the uplands adjacent to the Mohawk River valley and from below from the bedrock and glacial till below the aquifer.

- The primary discharge zone for the Great Flats Aquifer system is the Mohawk River. Discharge also occurs locally at the Glenville, Schenectady and Rotterdam municipal well fields where water is withdrawn by pumping. However, where the Mohawk River flows near the well fields, the pumping at the well fields causes water from the river to recharge the aquifer.

- The water table along many sections of the Mohawk River is highest from around April 1st through December 1st and lowest throughout the winter due to the dams at the locks, which are closed during the navigation season (generally April through November) and are open when boats are not allowed through the canal system (non-navigation season from December through March)

- The ability of the Mohawk River to sustain the Schenectady, Rotterdam and Glenville well fields prevents those systems from being susceptible to drought conditions. Portions of the Great Flats Aquifer that are not located adjacent to the Mohawk River are not significantly affected by river levels and will exhibit normal seasonal cycles.

- The Schenectady, Rotterdam, and Glenville well fields are not susceptible to summer drought conditions due to their proximity to the Mohawk River. However, they are susceptible to brief periods of dry, cold weather in late January and early February when the water contribution from the river is diminished. The net effect of the reduced contribution by the Mohawk River is an increased withdrawal of water from storage in the aquifer resulting in an expansion of the cone of drawdown. Water levels in the aquifer recover rapidly in the spring with the onset of warmer temperatures and the increase in the water level in the Mohawk River as the result of navigational controls.

- Comparison of groundwater contour maps for the navigational and non-navigational seasons reveals that the cone of drawdown from pumping at the Schenectady and Rotterdam well fields is larger during non-navigational periods than during navigational periods. The groundwater contours for the navigational period show that pumping Schenectady and Rotterdam well field does not influence the groundwater flow direction on the north side of the Mohawk River.

- The groundwater flow direction in the area southeast of the GEP site is south to southeast under normal, navigational season conditions, but is strongly influenced by the change in river elevation at Lock 8.

- In contrast to the area east and southeast of the site, the groundwater flow direction at the proposed GEP site is to the southwest toward the Mohawk River during both the navigational and non-navigational periods. The groundwater flow direction at the GEP site is unaffected by pumping at the municipal well fields.

- The City of Schenectady well field is permitted at a capacity of 35.0 MGD and has an average daily production rate of 12.7 MGD for the period of July 1997 through June 2001. The anticipated production rate for the Schenectady well field with the GEP in operation is 15.1 MGD (16.7 MGD maximum). The well field has historically produced volumes of water at rates greater than 15.1 MGD nearly continuously for a 103 month period from February 1987 through August 1995. Daily average production was slightly below 15.1 MGD for only 9 months and was greater than 16.7 MGD for 49 months during this period. No adverse impact on the volume of water available from the Schenectady well field is expected from the proposed additional pumping for the GEP project, based on the review of the historical production data.

- The water levels, groundwater flow direction, and available groundwater quantity of private well users would not be adversely impacted by increased pumping at the Schenectady/Rotterdam well field because such private wells are located beyond the cone of drawdown of the well fields.

Similarly, other municipal well fields would not be adversely impacted by the increased pumping at the Schenectady/Rotterdam well field because the cone of drawdown for the Scotia and Glenville well fields are beyond the cone of drawdown of the Schenectady/Rotterdam well fields.

- A pumping test at a rate of 29.8 million gallons per day at the Schenectady/Rotterdam well field during severe climatic conditions indicated that the cone of drawdown extended slightly to the north side of the Mohawk River. Pumping tests at the Schenectady/Rotterdam well field conducted during less severe conditions with pumping rates ranging from 8 million gallons per day to 18.28 million gallons per day did not exhibit drawdown on the north side of the river. These pumping test results indicate that the water supplied by the Mohawk River to the Schenectady/ Rotterdam well field limits the cone of drawdown north of the well field except during extreme climatic conditions at very high pumping rates.

- Investigations have identified and delineated a plume of TCE and related compounds in the groundwater at, and near the GEP site. The investigations show that TCE is migrating beneath the GEP site to the southwest toward the Mohawk River, and that the likely source of the TCE is northeast of the GEP site. The hydrogeologic evaluation shows that the direction and rate of migration of the TCE plume will not be altered by the proposed additional pumping at the Schenectady/Rotterdam well fields because the groundwater gradient and groundwater flow direction beneath the GEP site is unaffected by the increased pumping.

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GLOSSARY OF TERMS

Alluvial
Pertaining to or caused by the action of rivers or streams for example, alluvial sediment is sediment that is transported by a river or stream and deposited on the flood plain of the river or stream.

Aquifer
A geologic formation, group of formations, or part of a formation that contains sufficient saturated permeable material to yield usable quantities of groundwater to wells or springs.

Cone of Drawdown (Depression)
A depression of the water table that is formed around a well when water is pumped from the aquifer by the well. The depression is shaped like an inverted cone.

Contaminant Plume
A body of contaminated groundwater originating from a specific source and moving within the aquifer.

Contour Line
A line on a map connecting points of equal value, such as elevation, depth, or concentration.

Daily Average Production
The total amount of water produced from a well, during a period of time divided by the number of days in that period.

Daily Peak Production
The highest amount of water produced from a well in a period of one day during a particular span of days, months or years.

Discharge
The removal or emergence of groundwater from an aquifer.

Drawdown
The lowering of the water table as the result of pumping from a well.

(Geologic) Cross Section
A two dimensional view of a vertical section of the earth.

Glacial Till
A mixture of clay, silt, sand, gravel and boulders that has been deposited by a glacier.

Glaciolacustrine
Pertaining to sediments that are derived from, or deposited in glacial lakes.

Groundwater
The water that lies beneath the ground surface that fills the cracks, crevices, and pore space of rocks and sediment.

Hydraulic Conductivity
The rate of flow of water through a specified area under a specified hydraulic gradient (see Hydraulic Gradient and Hydraulic Head)

Hydraulic Gradient
The rate of change of hydraulic head or water pressure over a given horizontal distance (see Hydraulic Head).

Hydraulic Head
The pressure of a fluid on a given area, at a given point, caused by the height of the fluid surface above the point of measurement.

Kame
A steep-sided accumulation of sand and gravel deposited against the ice of a glacier.

Navigation Season
The time period between April and November that the lock system on the Mohawk River is operated, resulting in controlled, relatively elevated river levels.

Non-Navigation Season
The time period between December and March, that the lock system on the Mohawk River is out of operation, resulting in normal, uncontrolled river levels.

Outwash
Material deposited by sediment-laden meltwater from a glacier.

Permeability
The capacity of geologic materials to transmit fluid.

Permitted Capacity
The amount of water that a well field is allowed to remove from an aquifer, as stated in a permit, and normally expressed in volume over given time.

Piezometric surface
The surface defined by the levels to which groundwater will rise in wells that are installed in the same aquifer.

Production Well
A well designed and constructed to produce large quantities of water.

Pumping Test
A test that is conducted to determine aquifer or well characteristics by pumping water at a specified rate, and observing the affect on water levels in the aquifer or well, respectively.

Recharge
The addition of water to an aquifer.

Sole Source Aquifer
Those aquifers that are designated by the United States Environmental Protection Agency as the sole or principal source of drinking water for a community, under provisions of the Federal Safe Drinking Water Act.

Stratigraphy
The study of the different layers (strata) of rocks and sediment, especially their sequence in time, the character of the rocks and sediment, and the correlation of the layers between different localities.

Transmissivity
The rate at which water is transmitted through a specified width of an aquifer under a unit hydraulic gradient.

Water Table
The plane below which materials are saturated with groundwater, and above which, materials are unsaturated.

Well Field Capacity
The total amount of water a well field can produce, based on aquifer characteristics, well characteristics and related water distribution system infrastructure.

Yield
The volume of water capable of being produced by a pumping well over a given time period.

TABLES

Table 3.1

Summary of Study Area Borings/Wells
Glenville Energy Park

Well/Boring Number	Information Key	Well/Boring Number	Information Key
890: DH 6S	1	DEC-MW7	1
890: DH 7S	1	DEC-MW8	1
890: DH 8S	1	DEC-MW9	1
890: DH 9S	1	DEC-MW10	1
890: DH 10S	1	DEC-MW11	1
890: DH 11S	1	DEC-MW12	1
890: DH 12S	1	DEC-MW13	1
890: DH 29S	1	GEP-MW-99-14	1
890: DH 24S	1	GEP-MW-99-15	1
890: DH 39S	1	GEP-MW-99-16	1
890: DH 34S	1	ESS: SN1	1
890: DN-B-11	1	ESS: SN4	1
890: DN-B-8	1	ESS: SN5	1
890: DA-B-4	1	ESS: SN6	2
890: DN-B-2	1	ESS: SN7	1
890: DA-B-28	1	ESS: SN8	1
890: DA-B-17	1	ESS: SN9	1
890: DN-B-15	1	ESS: SN75	2
890: DH D	1	ESS: SN77	2
890: DH 17 F	1	ESS: SN78	1
890: DH 18 F	1	ESS: SN79	2
890: DH 19 F	1	ESS: SN80	2
890: DH 20 F	1	ESS: SN81	2
CR: FH-B-1	1	ESS: SN83	2
CR: FH-B-2	1	ESS: SN85	2
Navy-1	3	ESS: SN149	1
Navy-2	3	ESS: SN152	1
CP: WW-1	3	ESS: SN153	1
DEC-MW1	3	ESS: SN154	2
DEC-MW2	1	ESS: SN190	2
DEC-MW3	1	ESS: SN191	1
DEC-MW4	1	ESS: SN192	2
DEC-MW5	1	ESS: SN193	2
DEC-MW6	1	ESS: SN220	1

Table 3.1 (continued)

Well/Boring Number	Information Key	Well/Boring Number	Information Key
ESS:SN221	1	GE: BCP-M11B	3
ESS: SN222	1	GE: BCP-M13	1
ESS: SN223	1	GE: BCP-M14	1
GE-P1	1	GE: BCP-M15	1
GE: B7	1	GE: 301I	1
GE: B8	1	GE: 302D	1
GE: B113-1	2	GE: 302S	1
GE: B113-2	2	GE: LandFill B1	1
GE: B113-3	2	GE: LandFill B1A	1
GE: B113-4	2	GE: LandFill B2	1
GE: B113-5	2	GE: LandFill B3	1
GE: B113-6	2	GE: LandFill B4	1
GE: B113-7	2	GE: LandFill B5	1
GE: B113-8	2	GE: TFarm-2D	1
GE: B113-9	2	GE: TFarm-5A	1
GE: B113-10	2	GE: TFarm-6B-87-1	1
GE: B113-11	2	GE: TFarm-8C	1
GE: B259-1	1	GE: TFarm-9	1
GE: B259-5	1	GE: TFarm-13	1
GE: B259-7	1	GE: TFarm-11B	1
GE: B259-9	1	GE-T87-A	1
GE: B259-13	1	GE-T87-3	1
GE: B259-15	1	GE-1	1
GE: B262-G1	1	GE-1A	1
GE: B262-G2	1	GE-2	1
GE: B262G-3	1	GE-3	1
GE: B262-G4	1	GE-6	1
GE: B262-G5	1	GE-7	1
GE: B262-G6	1	GE-9	1
GE: B262-G7	1	GE-10	1
GE: B262-G8	1	GE-11	1
GE: B262-G9	1	GE-12	1
GE: BCP-B9	1	GE-13	1
GE: BCP-B10	1	GE-15	1
GE: BCP-M1	1	GE-16	1
GE: BCP-M3	1	GE-23	1
GE: BCP-M9	1	GE-24	1
GE: BCP-M11	3	GE-25	1
GE: BCP-M11A	3	GE-26	1

Table 3.1 (continued)

Well/Boring Number	Information Key	Well/Boring Number	Information Key
GE-27	1	RSM: B-202	1
GE-28	1	RSM: B-202A	1
GE-29	1	RSM: B-203	1
GE-30	1	RSM: B-204	1
GE-31	1	RSM: B-205	1
GE-32	1	RSM: B-206	1
GE-33	1	RSM: B-207	1
GE-34	1	RSM: B-207A	1
GE-35	1	RSM: B-208	1
GE-71	1	RSM: B-209	1
GE-72	3	RSM: B-210	1
GE-207	1	RSM: B-211	1
GE-208	1	RSM: B-212	1
GE-203D	1	RSM: B-213	1
GE-213D	1	RSM: B-214	1
GE-214D	1	RSM: B-215	1
GE-220	1	RSM: B-215A	1
GE-221	1	RSM:B-215B	1
GE-301	1	RSM: B-216	1
GL: DGC-1A	1	RSM: B-301	1
GL: DGC-1D	1	RSM: B-302	1
GL: DGC-2D	1	RSM: B-302A	1
GL: DGC-2S	1	RSM: B-303	1
GL: DGC-3D	1	RSM: B-304	1
GL: DGC-3S	1	RSM: B-305	1
GL: DGC-4D	1	RSM: B-306	1
GL: DGC-4S	1	RSM: B-306A	1
GL: DGC-5D	1	RSM: B-307	1
GL: DGC-5S	1	RSM: B-307A	1
RSM: B-101	1	RSM: B-308	1
RSM: B-101A	1	RSM: B-309	1
RSM: B-102	1	RSM: B-309A	1
RSM: B-103	1	RSM: B-310	1
RSM: B-105	1	RSM: B-311	1
RSM: B-106	1	RSM: B-401	2
RSM: B-107	1	RSM: B-403	2
RSM: B-108	1	RSM: B-404	2
RSM: B-201	1	RSM: B-404A	2
RSM: B-201A	1	RSM: B-405	2

Table 3.1 (continued)

Well/Boring Number	Information Key	Well/Boring Number	Information Key
RSM: B-405A	2	SWF: MW12	1
RSM: B-406	2	SWF: MW13	1
RSM: B-407	2	SWF: MW14	1
RSM: B-408	2	Old Well #2	2
RSM: B-409	2	SCW: MW 2	1
RSM: B-410	2	SCW: MW 4	1
RSM: B-411	2	SCW: MW 5	1
RSM: B-412	2	SCW: MW6	1
RSM: B-413	2	SCW: MW7	1
RSM: B-414	2	SCW: MW8	1
RSM: B-415	2	SCW: MW9	1
RSM:B-416	2	SCW: MW10	1
RSM:B-416A	2	SCW: MW11	1
RSM: B-417	2	SCW: MW12	1
RSM: B-418	2	248-358-1	1
RSM: B-418A	2	248-358-2	1
RSM: B-1	1	248-358-3	1
RSM: B-3	1	248-358-4	1
RSM: B-4	1	248-358-5	1
RSM: B-5	1	248-358-6	1
RSM: B-6	1	248-359-4	1
RSM: B-7	2	248-359-6	1
RSM: B-8	2	248-359-7	1
SWF: MW1	1	248-359-8	1
SWF: MW2	1	248-359-9	1
SWF: MW3	1	249-358-1	1
SWF: MW4S	1	249-358-2	1
SWF: MW4D	1	249-358-3	1
SWF: MW5	1	249-358-4	1
SWF: MW6	1	249-358-5	1
SWF- MW7	2	249-358-6	1
SWF- MW7A-1	2	249-358-50	1
SWF- MW7A-2	2	249-358-51	1
SWF- MW7A-3	2	249-358-67	1
SWF- MW7A-4	2	249-358-71	1
SWF- MW8	1	249-358-103	1
SWF- MW9	1	249-358-104	1
SWF: MW10	1	249-358-105	1
SWF: MW11	1	249-359-1	1

Table 3.1 (continued)

Well/Boring Number	Information Key	Well/Boring Number	Information Key
249-359-2	1	249-359-49	1
249-359-3	1	249-359-52	1
249-359-6	1	249-359-53	1
249-359-4	1	249-359-55	1
249-359-5	1	249-359-56	1
249-359-8	1	249-359-57	1
249-359-9	1	249-359-58	1
249-359-10	1	249-359-59	1
249-359-11	1	249-359-60	1
249-359-12	1	249-359-61	1
249-359-13	1	249-359-62	1
249-359-14	1	249-359-63	1
249-359-15	1	249-359-64	1
249-359-16	1	249-359-66	1
249-359-18	1	249-359-68	1
249-359-19	1	249-359-69	1
249-359-20	1	249-359-70	1
249-359-21	1	249-359-72	1
249-359-22	1	249-359-75	1
249-359-23	1	249-359-76	1
249-359-24	1	249-359-77	1
249-359-25	1	249-359-78	1
249-359-26	1	249-359-79	1
249-359-29	1	249-359-80	1
249-359-30	1	249-359-81	1
249-359-31	1	249-359-82	1
249-359-32	1	249-359-83	1
249-359-33	1	249-359-84	1
249-359-34	1	249-359-85	1
249-359-35	1	249-359-86	1
249-359-36	1	249-359-87	1
249-359-38	1	249-359-88	1
249-359-41	1	249-359-89	1
249-359-42	1	249-359-90	1
249-359-43	1	249-359-91	1
249-359-44	1	249-359-92	1
249-359-45	1	249-359-93	1
249-359-46	1	249-359-95	1
249-359-47	1	249-359-96	1
249-359-48	1	249-359-97	1

Table 3.1 (continued)

Well/Boring Number	Information Key	Well/Boring Number	Information Key
249-359-98	1	249-359-141	1
249-359-99	1	249-359-142	1
249-359-100	1	249-400-1	1
249-359-101	1	250-357-1	1
249-359-102	1	250-357-2	1
249-359-106	1	250-357-3	1
249-359-107	1	250-357-4	1
249-359-108	1	250-357-6	1
249-359-109	1	250-359-1	1
249-359-110	1	250-359-2	1
249-359-111	1	250-359-3	1
249-359-112	1	250-359-4	1
249-359-113	1	250-359-5	1
249-359-114	1	250-359-6	1
249-359-115	1	250-359-7	1
249-359-116	1	250-400-1	1
249-359-117	1	250-400-2	1
249-359-118	1	250-400-3	1
249-359-119	1	250-400-4	1
249-359-120	1	250-400-5	1
249-359-121	1	250-400-6	1
249-359-122	1	250-400-7	1
249-359-123	1	250-400-8	1
249-359-124	1	250-400-9	1
249-359-125	1	250-400-10	1
249-359-126	1	250-400-11	1
249-359-127	1	250-400-12	1
249-359-128	1	250-401-1	1
249-359-129	1	250-401-2	1
249-359-130	1	251-358-1	1
249-359-131	1	251-358-2	1
249-359-132	1	251-358-6	1
249-359-133	1	251-358-8	1
249-359-134	1	251-358-9	1
249-359-135	1	251-358-10	1
249-359-136	1	251-359-1	1
249-359-137	1	251-359-2	1
249-359-138	1	251-359-3	1
249-359-139	1	251-359-4	1
249-359-140	1	251-359-5	1

Table 3.1 (continued)

Well/Boring Number	Information Key	Well/Boring Number	Information Key
251-359-6	1	L8: DAD-2	1
251-400-1	1	L8: DAD-3	1
251-400-2	1	L8: DAD-4	1
251-400-3	1	L8: DAW-5	1
251-400-4	1	L8: DAX-6	1
251-400-5	1	L8: DAX-7	1
251-400-6	1	SGH: TB-1	1
251-400-8	1	SGH: TB-2	1
251-400-9	1	SGH: TB-3	1
251-400-10	1	SGH: TB-4	1
251-400-11	1	SGH: TB-5	1
251-400-12	1	SGH: TB-6	1
251-400-13	1	SGH: TB-7	1
251-401-4	1	RW-1	3
251-401-5	1	RW-2	3
251-401-7	1	RW-3	3
251-401-11	1	RW-4	3
251-401-12	1	DLA-B1	1
251-401-20	1	DLA-B2	1
GWF-1	1	DLA-B3	1
GWF-2	1	DLA-B4	3
GWF-3	1	DLA-B5	3
GWF-4	1	DLA-B6	3
GWF-5	1	PMW-1	3
GWF-6	1	PMW-2	3
GWF-7	1	PMW-3	3
GWF-8	1	PMW-4	3
GWF-9	1	PMW-5	3
GWF-10	1	PMW-6	3
GWF-11	1	PMW-7	3
GWF-12	1	JLS B-1	3
GWF-13	1	JLS B-2	3
GWF-14D	1	JLS B-3	3
GWF-14S	1	JLS B-4	3
L8: DAD-8	1	JLS B-5	3
L8: DAD-9	1	GEP-1	3
L8: DND-10	1	GEP-2	3
L8: DND-11	1	GEP-3	3
L8: DAD-1	1	GEP-4	3

Table 3.1 (continued)

Information Key

(1) Stratigraphic and location information are available for the indicated boring/well.
(2) No location could be determined for the indicated boring/well.
(3) No stratigraphic information is available for the indicated well.

The prefix of each boring/well corresponds to the reference for the boring/well information as follows:

GL	See Dunn Geoscience Corp. (1988)
890,CR	See DOT Boring Logs (1960-1990's)
GWF,SWF,SCW	See Malcolm Pirnie, Inc. (1989)
ESS	See Simpson (1952)
GE	See Dames and Moore (1997, Appendix E)
RSM	See Dunn Geoscience Corp. (1977)
248, 249, 250, or 251	See Winslow (1965)
DEC	See Woodward (1999)
GEP-MW-	See Earth Tech (1999)
JLS	See Dunn Geoscience Corp. (1989)
PMW	Parsons Monitoring Wells (no logs available)
RW	Residential Wells (no logs available)
DLA-B1	Empire Soils (1990/1994)
CP	Corporations Park Water Well (no logs available)
NAVY	Scotia Depot Wells (no logs available)
SGH	See Scotia Glenville High School (1968)
GEP	Earth Tech Wells (2001)

Table 4.1

1997 Groundwater Elevation Data
Scotia-Glenville Industrial Park
Glenville, New York
Glenville Energy Park Project

Well I.D.	Measuring Point Elevation (feet)	Ground Elevation (feet)	WellCasing Stick-up (feet)	February 1997 Depth to Groundwater (feet)	February 1997 Groundwater Elevation (feet)
MW-1	293.20	290.74	2.46	71.89	221.31
MW-2	295.26	293.16	2.10	70.76	224.50
MW-3	289.37	290.05	-0.68	68.84	220.53
MW-4	291.74	289.58	2.16	72.92	218.82
MW-5	290.11	287.95	2.16	71.0	219.11
MW-6	288.58	286.28	2.30	69.12	219.46
MW-7	289.26	286.8	2.46	67.07	222.19
MW-8	296.13	293.23	2.90	74.88	221.25
MW-9	288.33	285.98	2.35	68.9	219.43
MW-10	293.15	290.94	2.21	63.64	229.51
MW-11	295.12	295.73	-0.61	67.9	227.22
MW-12	292.62	293.13	-0.51	69.54	223.08
MW-13	293.85	292.62	1.23	67.34	226.51

Note:
Groundwater elevations are in feet above mean sea level.
Groundwater levels were measured by NYSDEC.

Table 4.2
Summary of Groundwater Elevation Data
Scotia-Glenville Industrial Park
Glenville, New York
Glenville Energy Park

Well I.D.	Measuring Point Elevation (Top of PVC)	Navigational Period				Non-Navigational Period		Navigational Period					
		September 28, 1999		November 8, 1999		December 8, 1999		June 8, 2000		July 7, 2000		July 18, 2000	
		Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation
MW-1	293.20	67.75	225.45	66.94	226.26	67.82	225.38	---	NA	65.81	227.39	66.15	227.05
MW-2	295.26	68.99	226.27	68.57	226.69	68.75	226.51	---	NA	65.75	229.51	66.24	229.02
MW-3	289.37	63.84	225.53	63.12	226.25	63.70	225.67	---	NA	61.91	227.46	62.35	227.02
MW-4	291.74	66.82	224.92	65.58	226.16	67.26	224.48	---	NA	65.17	226.57	65.32	226.42
MW-5	290.11	65.05	225.06	63.92	226.19	65.28	224.83	63.61	226.50	63.31	226.80	63.52	226.59
MW-6	288.56	63.36	225.20	62.35	226.21	63.42	225.14	63.14	225.42	61.52	227.04	61.80	226.76
MW-7	289.26	63.69	225.57	63.18	226.08	63.35	225.91	62.76	226.50	61.44	227.82	61.52	227.74
MW-8	296.13	70.55	225.58	69.74	226.39	70.45	225.68	---	NA	68.04	228.09	68.41	227.72
MW-9	288.33	---	NA	62.12	226.21	63.24	225.09	---	NA	61.35	226.98	61.59	226.74
MW-10	293.18	66.01	227.17	65.45	227.73	65.36	227.82	---	NA	59.72	233.46	60.00	233.18
MW-11	295.10	68.38	226.72	67.85	227.25	67.82	227.28	64.48	230.62	63.23	231.87	63.42	231.68
MW-12	292.62	66.74	225.88	66.07	226.55	66.54	226.08	64.82	227.80	63.87	228.75	64.19	228.43
MW-13	293.91	67.46	226.45	66.95	226.96	66.99	226.92	64.67	229.24	63.28	230.63	63.39	230.52
MW-99-14	296.20	---	NA	68.72	227.48	68.64	227.56	65.06	231.14	63.58	232.62	63.63	232.57
MW-99-15	293.67	---	NA	66.47	227.20	66.40	227.27	63.38	230.29	61.85	231.82	61.85	231.82
MW-99-16	288.33	---	NA	62.45	225.88	62.43	225.90	61.54	226.79	59.78	228.55	59.52	228.81
B-1	287.14	---	NA	60.16	226.98	60.09	227.05	---	NA	---	NA	55.87	231.27
B-2	287.87	---	NA	61.41	226.46	61.38	226.49	---	NA	---	NA	57.45	230.42
B-3	287.05	---	NA	59.92	227.13	59.82	227.23	---	NA	---	NA	55.25	231.80
B-4	285.95	---	NA	---	NA	---	NA	---	NA	---	NA	55.40	230.55
B-5	284.97	---	NA	58.61	226.36	58.59	226.38	---	NA	---	NA	54.75	230.22
B-6	288.39	---	NA	62.26	226.13	62.27	226.12	---	NA	---	NA	58.71	229.68
WW-1	283.81	---	NA	---	NA	---	NA	---	NA	---	NA	---	NA
WW-2	288.04	---	NA	55.04	233.00	55.03	233.01	---	NA	---	NA	---	NA
PMW-1	302.20	---	---	---	---	---	---	---	---	---	---	67.71	234.49
PMW-2	300.77	---	---	---	---	---	---	---	---	---	---	66.51	234.26
PMW-3	299.20	---	---	---	---	---	---	---	---	---	---	64.69	234.51
PMW-6	232.20	---	---	---	---	---	---	---	---	---	---	18.00	214.20
PMW-7	234.48	---	---	---	---	---	---	---	---	---	---	12.65	221.83

Notes:
--- = Water level not collected during this event.
NA = Not Applicable
BMP = Below Measuring Point (top of inner PVC)
Non-Navigation season(s) began with the removal of locks at Lock 8 on December 2, 1999 and November 27, 2000.
Navigation season(s) began with the reinstallation of locks at Lock 8 during the first two weeks of April each year.

Table 4.2 (continued)
Summary of Groundwater Elevation Data
Scotia-Glenville Industrial Park
Glenville, New York
Glenville Energy Park

Well I.D.	Measuring Point Elevation (Top of PVC)	Navigational Period						Non-Navigational Period					
		August 1, 2000		September 18, 2000		October 20, 2000		November 31, 2000		December 22, 2000		January 15, 2001	
		Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation
MW-1	293.20	---	NA	64.46	228.74	66.77	226.43	68.83	224.37	72.27	220.93	70.56	222.64
MW-2	295.26	---	NA	65.30	229.96	67.33	227.93	68.07	227.19	71.59	223.67	70.54	224.72
MW-3	289.37	---	NA	62.93	226.44	65.11	224.26	68.28	221.09	69.00	220.37	69.53	219.84
MW-4	291.74	---	NA	63.77	227.97	65.98	225.76	70.96	220.78	73.01	218.73	71.81	219.93
MW-5	290.11	63.80	226.31	61.97	228.14	64.13	225.98	68.96	221.15	71.10	219.01	69.87	220.24
MW-6	288.56	62.03	226.53	60.08	228.48	63.04	225.52	66.79	221.77	69.56	219.00	67.86	220.70
MW-7	289.26	61.57	227.69	59.52	229.74	62.74	226.52	62.63	226.63	66.76	222.50	65.77	223.49
MW-8	296.13	---	NA	66.23	229.90	69.28	226.85	71.91	224.22	75.16	220.97	73.45	222.68
MW-9	288.33	---	NA	59.92	228.41	62.11	226.22	65.27	223.06	68.97	219.36	66.32	222.01
MW-10	293.18	---	NA	59.91	233.27	---	NA	62.59	230.59	65.19	227.99	63.71	229.47
MW-11	295.10	---	NA	59.89	235.21	65.56	229.54	67.77	227.33	---	NA	---	NA
MW-12	292.62	---	NA	---	NA	---	NA	---	NA	69.96	222.66	67.92	224.70
MW-13	293.91	63.47	230.44	62.37	231.54	65.49	228.42	65.30	228.61	67.91	226.00	67.05	226.86
MW-99-14	296.20	63.81	232.39	---	NA	---	NA	65.16	231.04	67.90	228.30	66.58	229.62
MW-99-15	293.67	61.95	231.72	59.98	233.69	63.61	230.06	62.51	231.16	65.89	227.78	64.56	229.11
MW-99-16	288.33	59.46	228.87	57.31	231.02	60.30	228.03	59.37	228.96	63.15	225.18	62.08	226.25
					0.00								
B-1	287.14	---	NA	56.31	230.83	56.84	230.30	58.25	228.89	58.15	228.99	59.69	227.45
B-2	287.87	---	NA	57.13	230.74	---	NA	58.80	229.07	---	NA	59.59	228.28
B-3	287.05	---	NA	55.60	231.45	56.15	230.90	57.57	229.48	57.48	229.57	58.57	228.48
B-4	285.95	---	NA	55.32	230.63	---	NA	56.94	229.01	56.78	229.17	57.74	228.21
B-5	284.97	---	NA	55.09	229.88	54.79	230.18	56.02	228.95	55.75	229.22	56.84	228.13
B-6	288.39	---	NA	58.17	230.22	58.14	230.25	59.73	228.66	59.42	228.97	60.59	227.80
WW-1	283.81	---	NA	---	NA	---	NA	---	NA	---	NA	---	NA
WW-2	288.04	---	NA	---	NA	---	NA	---	NA	---	NA	---	NA
PMW-1	302.20	68.02	234.18	67.10	235.10	70.56	231.64	69.39	232.81	71.86	230.34	70.06	232.14
PMW-2	300.77	66.71	234.06	64.24	236.53	68.87	231.90	66.45	234.32	70.15	230.62	66.96	233.81
PMW-3	299.20	65.06	234.14	63.54	235.66	67.77	231.43	66.68	232.52	69.26	229.94	66.78	232.42
PMW-6	232.20	18.60	213.60	16.45	215.75	18.46	213.74	19.81	212.39	---	NA	19.46	212.74
PMW-7	234.48	12.93	221.55	9.98	224.50	13.24	221.24	13.77	220.71	---	NA	14.48	220.00

Notes:
--- = Water level not collected during this event.
NA = Not Applicable
BMP = Below Measuring Point (top of inner PVC)
Non-Navigation season(s) began with the removal of locks at Lock 8 on December 2, 1999 and November 27, 2000.
Navigation season(s) began with the reinstallation of locks at Lock 8 during the first two weeks of April each year.

Table 4.2 (continued)
Summary of Groundwater Elevation Data
Scotia-Glenville Industrial Park
Glenville, New York
Glenville Energy Park

Well I.D.	Measuring Point Elevation (Top of PVC)	Non-Navigational Period				Navigational Period					
		February 28, 2001		March 20, 2001		April 18, 2001		May 22, 2001		June 21, 2001	
		Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation	Depth to Water (feet BMP)	Water Table Elevation
MW-1	293.20	---	NA	74.80	218.40	67.57	225.63	64.21	228.99	67.18	226.02
MW-2	295.26	73.44	221.82	72.79	222.47	68.09	227.17	65.33	229.93	67.20	228.06
MW-3	289.37	73.75	215.62	70.41	218.96	66.97	222.40	63.03	226.34	63.02	226.35
MW-4	291.74	74.21	217.53	73.95	217.79	69.71	222.03	63.65	228.09	66.20	225.54
MW-5	290.11	71.75	218.36	72.06	218.05	68.87	221.24	61.91	228.20	64.64	225.47
MW-6	288.56	70.55	218.01	70.21	218.35	65.55	223.01	60.10	228.46	62.77	225.79
MW-7	289.26	69.09	220.17	68.61	220.65	64.48	224.78	61.31	227.95	62.31	226.95
MW-8	296.13	76.71	219.42	76.24	219.89	71.00	225.13	66.41	229.72	69.39	226.74
MW-9	288.33	67.71	220.62	70.00	218.33	64.11	224.22	58.59	229.74	62.58	225.75
MW-10	293.18	67.36	225.82	66.66	226.52	61.31	231.87	59.91	233.27	61.98	231.20
MW-11	295.10	---	NA	---	NA	67.72	227.38	64.55	230.55	64.97	230.13
MW-12	292.62	---	NA	70.89	221.73	---	NA	---	NA	65.16	227.46
MW-13	293.91	69.95	223.96	69.31	224.60	65.92	227.99	63.30	230.61	64.69	229.22
MW-99-14	296.20	69.95	226.25	69.35	226.85	65.43	230.77	63.51	232.69	65.37	230.83
MW-99-15	293.67	68.02	225.65	67.41	226.26	63.21	230.46	61.21	232.46	63.46	230.21
MW-99-16	288.33	66.04	222.29	65.61	222.72	61.99	226.34	59.93	228.40	60.80	227.53
B-1	287.14	---	NA	---	NA	59.62	227.52	---	NA	57.28	229.86
B-2	287.87	---	NA	60.10	227.77	59.55	228.32	58.97	228.90	58.29	229.58
B-3	287.05	---	NA	59.08	227.97	58.36	228.69	57.33	229.72	56.58	230.47
B-4	285.95	---	NA	58.34	227.61	57.73	228.22	57.13	228.82	56.37	229.58
B-5	284.97	57.20	227.77	57.40	227.57	56.80	228.17	56.24	228.73	55.57	229.40
B-6	288.39	---	NA	60.99	227.40	60.51	227.88	60.04	228.35	59.41	228.98
WW-1	283.81	---	NA	---	NA	---	NA	---	NA	---	NA
WW-2	288.04	---	NA	---	NA	---	NA	---	NA	---	NA
PMW-1	302.20	73.15	229.05	73.20	229.00	68.70	233.50	67.66	234.54	69.74	232.46
PMW-2	300.77	71.34	229.43	71.41	229.36	66.11	234.66	65.05	235.72	68.44	232.33
PMW-3	299.20	71.24	227.96	70.60	228.60	65.23	233.97	64.02	235.18	66.75	232.45
PMW-6	232.20	21.73	210.47	23.12	209.08	15.81	216.39	15.71	216.49	18.71	213.49
PMW-7	234.48	17.66	216.82	18.31	216.17	11.87	222.61	9.76	224.72	12.67	221.81
GEP-1	294.98	---	NA	---	NA	---	NA	---	NA	65.35	229.63
GEP-2	296.02	---	NA	---	NA	---	NA	---	NA	65.56	230.46
GEP-3	292.97	---	NA	---	NA	---	NA	---	NA	62.82	230.15
GEP-4	295.62	---	NA	---	NA	---	NA	---	NA	65.39	230.23

Notes:
--- = Water level not collected during this event.
NA = Not Applicable
BMP = Below Measuring Point (top of inner PVC)
Non-Navigation season(s) began with the removal of locks at Lock 8 on December 2, 1999 and November 27, 2000.
Navigation season(s) began with the reinstallation of locks at Lock 8 during the first two weeks of April each year.

Table 4.3
Horizontal Groundwater Gradient Summary
Glenville Energy Park Project
Glenville, N.Y.

Date	Upgradient Well	Downgradient Well	Groundwater Elevation Change (ft)	Distance (ft)	Groundwater Gradient
Navigational Period					
September 28, 1999	MW-10	MW-4	2.25	1120	0.0020
November 8, 1999	MW-10	MW-4	1.57	1120	0.0014
June 8, 2000	MW-99-14	MW-6	5.72	980	0.0058
July 7, 2000	MW-10	MW-4	6.89	1120	0.0062
July 18, 2000	PMW-3	MW-5	7.92	1320	0.0060
August 1, 2000	PMW-3	MW-5	7.83	1320	0.0059
September 18, 2000	PMW-3	MW-5	7.52	1320	0.0057
October 20, 2000	PMW-3	MW-6	5.91	1310	0.0045
April 18, 2001	PMW-3	MW-5	12.73	1320	0.0096
May 22, 2001	PMW-3	MW-5	6.98	1320	0.0053
June 21, 2001	PMW-3	MW-6	6.66	1310	0.0051
Non-Navigational Period					
February 1997	MW-10	MW-4	10.69	1120	0.0095
December 8, 1999	MW-10	MW-4	3.34	1120	0.0030
November 31, 2000	PMW-3	MW-5	11.37	1320	0.0086
December 22, 2000	PMW-1	MW-5	11.33	1496	0.0076
January 15, 2001	PMW-1	MW-9	10.13	1420	0.0071
February 28, 2001	PMW-1	MW-4	11.52	1680	0.0069
March 20, 2001	PMW-1	MW-5	10.95	1496	0.0073

Notes:

1) Non-Naviation season(s) began with the removal of panels at Lock 8 on December 2, 1999 and November 27, 2000.
2) Navigation season(s) began with the reinstallation of panels at Lock 8 during the first two weeks of April each year.

TABLE 5.1

City of Schenectady Municipal Water Supply
1999 - 2000 Production Well Summary
Glenville Energy Park Project

Well I.D.	Status	Yield (GPM)	Yield (MGD)	Remarks
1	Standby	1200	1728000	Emergency Use Only
2	Active	2510	3614400	
3	Active	2140	3081600	
4	Inactive/Abandoned	-		
5	Active	3280	4723200	
5A	Active	2510	3614400	
6	Active	2490	3585600	
7	Active	2680	3859200	
7A	Inactive/Abandoned	-		High Manganese
8	Active	2360	3398400	
9	Active	1725	2484000	
10	Active	2170	3124800	
11	Active	2860	4118400	
12	Active	2900	4176000	
	Total	**28,825**	**GPM**	**(41.5 MGD)**
	Daily Capacity	**41,508,000**	**gallons**	

Notes: GPM = gallons per minute
MGD = million gallons per day
Well yields measured during pumping tests conducted in 1999/2000 at 125 psi.
Values shown are average daily pumping rates.

TABLE 5.2
Schenectady Municipal Water Supply
High Volume Water Users
Glenville Energy Park Project

User/Customer*	Usage (gallons per day)
Municipal	847,478
Institutional	228,703
Industrial	1,450,324
Government	256,429
Commercial	136,659
TOTAL	**2,919,593**

* Does not include City of Schenectady Residential Usage.

Note: Municipal = Municipal Use Outside City of Schenectady.
Institutional = Hospitals, Colleges, Senior Care Facilities.
Industrial = Industrial and Manufacturing.
Government = City and County Government Facilities, Subsidized Housing.
Commercial = Business/ Corporation

Source: C.T. Male Associates, P.C. March 13, 1998
City of Schenectady Water Emergency Plan

TABLE 5.3

Summary of Historical Pumping Test Records
Glenville Energy Project

Schenectady/Rotterdam Well Fields

Test Date	*Production Rate	Duration	Information Source
Oct. 1946	16 MGD	17 hrs	Simpson, 1952
Jan. 1947	16 MGD	17hrs	Simpson, 1952
July 1952	8 MGD	24 hrs	Winslow, 1965
Aug. 1960	18.28 MGD	14 hrs	Winslow, 1965
Dec. 1960	15.3 MGD	14 hrs	Winslow, 1965
Feb. 1988	29.8 MGD	72 hrs	Malcolm Pirnie, 1988

Glenville Well Field

Test Date	*Production Rate	Duration	Information Source
April 1965	3.9 MGD	72 hrs	Malcolm Pirnie, 1989
March 1988	2.1 MGD	72 hrs	Malcolm Pirnie, 1989

Scotia Well Field

April 1986	1.7 MGD	24 hrs	Dunn, 1986
Sept. 1988	1.7 MGD	72 hrs	Malcolm Pirnie, 1989

* The pumping rates are generally for the Schenectady Well Field only, except for the July 1952 test, which was from the Rotterdam Well Field, and the February 1988 test, which represents a combined rate of 10 MGD from Rotterdam and 19.8 MGD from Schenectady.

MGD = Million Gallons per Day

Table 6.1

Monthly Precipitation and Temperature Normals
Albany International Airport and Schenectady County Airport
Glenville Energy Park

Month	Precipitation (inches)[1]		Temperature (degrees Fahrenheit)[1]	
	Albany[2]	Schenectady[3]	Albany[2]	Schenectady[3]
January	2.36	2.24	20.6	22.7
February	2.27	2.31	23.5	25.3
March	2.93	2.81	34.3	34.3
April	2.99	2.97	46.4	47.3
May	3.41	3.40	57.6	58.0
June	3.62	3.26	66.9	67.9
July	3.18	2.86	71.8	72.6
August	3.47	3.21	69.6	70.3
September	2.95	2.61	61.3	62.5
October	2.83	2.76	50.2	52.0
November	3.23	3.12	39.7	40.4
December	2.93	2.96	26.5	28.5
TOTAL	36.17	34.51		

1 Snowfall is converted to inches of liquid precipitation by the National Oceanic and Atmospheric Administration (NOAA).

2 The Albany data are based on a 30 year average from 1961 through 1990.

3 The Schenectady data are based on a 23 year average for the period from 1951 through 1973.

TABLE 7.1

Schenectady Municipal Water Supply
Trichloroethylene (TCE) Sampling Results; 1990 - 2001
Glenville Energy Park Project

Year	Quarter*	Well 1 TCE Concentration (ug/l)	Well 2 TCE Concentration (ug/l)
1990	1	0.5	0.4
1990	2	**	**
1990	3	0.7	0.8
1990	4	ND	0.6
1991	1	0.5	ND
1991	2	**	**
1991	3	0.9	0.5
1991	4	**	**
1992	1	**	**
1992	2	**	**
1992	3	**	**
1992	4	0.65	ND
1993	1	0.7	ND
1993	2	0.9	ND
1993	3	0.76	ND
1993	4	1.0	0.5
1994	1	**	**
1994	2	0.6	ND
1994	3	0.8	0.6
1994	4	0.9	ND
1995	1	0.6	ND
1995	2	0.6	ND
1995	3	1.0	ND
1995	4	**	**
1996	1	**	**
1996	2	**	**
1996	3	**	**
1996	4	**	**
1997	1	**	**
1997	2	**	**
1997	3	**	**
1997	4	**	0.5
1998	1	**	**
1998	2	**	**
1998	3	**	ND
1998	4	**	**
1999	1	**	ND
1999	2	**	**
1999	3	**	**
1999	4	**	**
2000	1	**	**
2000	2	**	**
2000	3	**	**
2000	4	**	ND
2001	1	**	**

Notes:
ND = Not detected at or above the detection limit.
ug/l = micrograms per liter (parts per billion).
The New York State Drinking Water Standard for TCE is 5 ug/l and is equivalent to the New York State Class GA Groundwater Standard.
* = Quarter 1 = January, February, March
Quarter 2 = April, May, June
Quarter 3 = July, August, September
Quarter 4 = October, November, December
** = Sample was collected from another production well. All results are ND.

TABLE 7.2

Rotterdam Municipal Water Supply
Trichloroethene (TCE) and Other Volatile Organic Sampling Results
1992 - July 2000
Glenville Energy Park

Date	Well 1 TCE Concentration (ug/l)	Well 1 Other Volatile Organics (ug/l)	Well 2 TCE Concentration (ug/l)	Well 2 Other Volatile Organics (ug/l)	Well 3 TCE Concentration (ug/l)	Well 3 Other Volatile Organics (ug/l)	Well 4 TCE Concentration (ug/l)	Well 4 Other Volatile Organics (ug/l)
May 12, 1992	0.57	ND	0.54	ND	0.78	ND	0.52	ND
August 19, 1992	0.66	ND	0.66	ND	ND	ND	ND	ND
November 4, 1992	1.1	ND	ND	0.92	0.65	ND	0.81	ND
February 23, 1993	1	ND	0.9	ND	ND	ND	ND	ND
May 18, 1993	0.8	ND	0.8	ND	1	ND	0.8	ND
May 18, 1993	ND	ND	ND	ND	NS	NS	NS	NS
August 31, 1993	0.7	ND	1.3	ND	0.6	ND	1.3	ND
December 1, 1993	0.8	ND	1.2	ND	0.8	ND	1.2	ND
December 22, 1993	ND	ND	ND	ND	NS	NS	NS	NS
February 16, 1994	0.9	ND	0.8	ND	0.9	ND	ND	ND
May 18, 1994	0.7	ND	0.6	ND	0.7	ND	ND	ND
August 31, 1994	0.8	ND	0.8	ND	0.7	ND	0.7	ND
November 29, 1994	1.1	1.2	1.2	0.8	0.7	ND	1.2	ND
March 1, 1995	0.8	ND	0.8	ND	0.9	ND	ND	ND
May 17, 1995	0.7	ND	0.8	ND	0.8	ND	ND	ND
August 9, 1995	1	ND	0.8	ND	1	ND	0.8	ND
November 15, 1995	1	ND	1	ND	0.8	ND	0.7	ND
February 28, 1996	ND	ND	ND	ND	ND	ND	ND	ND
May 7, 1996	NS	NS	ND	ND	ND	ND	ND	ND
June 12, 1996	ND	ND	NS	NS	NS	NS	NS	NS
August 20, 1996	0.71	ND	0.88	ND	0.9	ND	0.86	ND
November 27, 1996	ND	ND	ND	ND	0.86	ND	0.56	ND
March 11, 1998	ND	ND	ND	ND	ND	ND	ND	ND
June 3, 1998	ND	ND	ND	ND	ND	ND	ND	ND
September 1, 1998	ND	ND	0.69	ND	0.74	ND	0.84	ND
December 14, 1998	ND	ND	0.96	ND	ND	ND	ND	ND
March 18, 1999	0.74	ND	0.73	ND	ND	ND	ND	ND
June 3, 1999	0.58	ND	0.51	ND	0.83	ND	0.85	ND
September 13, 1999	0.75	ND	0.78	ND	0.74	ND	0.63	ND
November 3, 1999	0.59	ND	0.62	ND	0.63	ND	0.77	ND
February 10, 2000	0.6	ND	ND	ND	ND	ND	ND	ND
May 22, 2000	ND	ND	ND	ND	ND	ND	ND	ND
July 27, 2000	0.6	ND	ND	ND	ND	ND	ND	ND

ND = Not detected at or above the detection limits
NS = No Sample collected
ug/l = micrograms per liter (parts per billion)
Data for the TCE and other volatile organics per EPA method 502.2
Data for calendar year 1997 not available from the Town of Rotterdam
The New York State Drinking Water Standard for TCE is 5 ug/l and is equivalent to the New York State Class GA Groundwater Standard.
The 0.92 ug/l of "other volatile organics" on Nov. 4, 1992 was identified as tetrachloroethene
The 1.2 and 0.8 ug/l of "other volatile organics" on Nov. 29, 1994 was identified as toluene

TABLE 7.3

Summary of Groundwater Well Sampling Events
Glenville Energy Park (GEP), LLC
Glenville, New York

Sampling Date	Sampled by:	Wells Sampled for VOCs
April 9, 1991	NYSDOH	Residential [R-342, R-338, and R-350]
April 23, 1991	NYSDOH	Residential [R-338]
May 1, 1991	NYSDOH	Residential [R-104-R, R-100-R, R-102-R, L-8]
May 7, 1991	NYSDOH	Residential [four SW]
August 5, 1992	NYSDOH	Residential [R-337]
October 26, 1995	NYSDEC	B-1, B-2, B-3, B-6, IWW-1, IWW-2, A1, A2, and A3
October 1995	NYSDEC	MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, and MW-9
January 1996	NYSDEC	IWW-2
June 12, 1996	NYSDEC	B-1
January 23, 1997	NYSDEC	MW-11
January 23, 1997	NYSDEC	MW-11
January 30, 1997	NYSDOH	Residential [Rose]
February 1997	NYSDEC	MW-6, MW-7, MW-8, MW-10, MW-11, MW-12, MW-13
June 1997	NYSDEC	MW-6, MW-11, MW-13
September 28, 1999	Earth Tech* NYSDEC	MW-4, MW-5, MW-6, MW-7, MW-8, MW-10, MW-11, MW-12, and MW-13
November 8, 1999	Earth Tech* NYSDEC	MW-6, MW-7, MW-9, MW-11, MW-13, MW-99-14, MW-99-15, and MW-99-16
June 8, 2000	NYSDEC	MW-7, MW-11, MW-13, MW-99-14, MW-99-15, and MW-99-16
July 7, 2000	Earth Tech* NYSDEC	MW-5, MW-6, MW-7, MW-13, MW-99-14, MW-99-15, and MW-99-16
July 31, 2000	NYSDEC	MW-7, MW-13, MW-99-14, MW-99-15, PMW-1, PMW-2, PMW-3, PMW-6, and PMW-7
October 30, 2000	Parsons*	PMW-1, PMW-2, PMW-3, PMW-6, and PMW-7
November 2000	NYSDEC	MW-5, MW-6, MW-7, MW-8, MW-11, MW-12, MW-13, MW-99-14, MW-99-15, MW-99-16, PMW-1, PMW-2, PMW-3, PMW-6, PMW-7, B-1, and B-3
June 19/20, 2001	Earth Tech*	MW-6, MW-7, MW-13, MW-99-14, MW-99-15, MW-99-16, GEP-1, GEP-2, GEP-3, and GEP-4

* = Validated Groundwater Quality Results

FIGURES

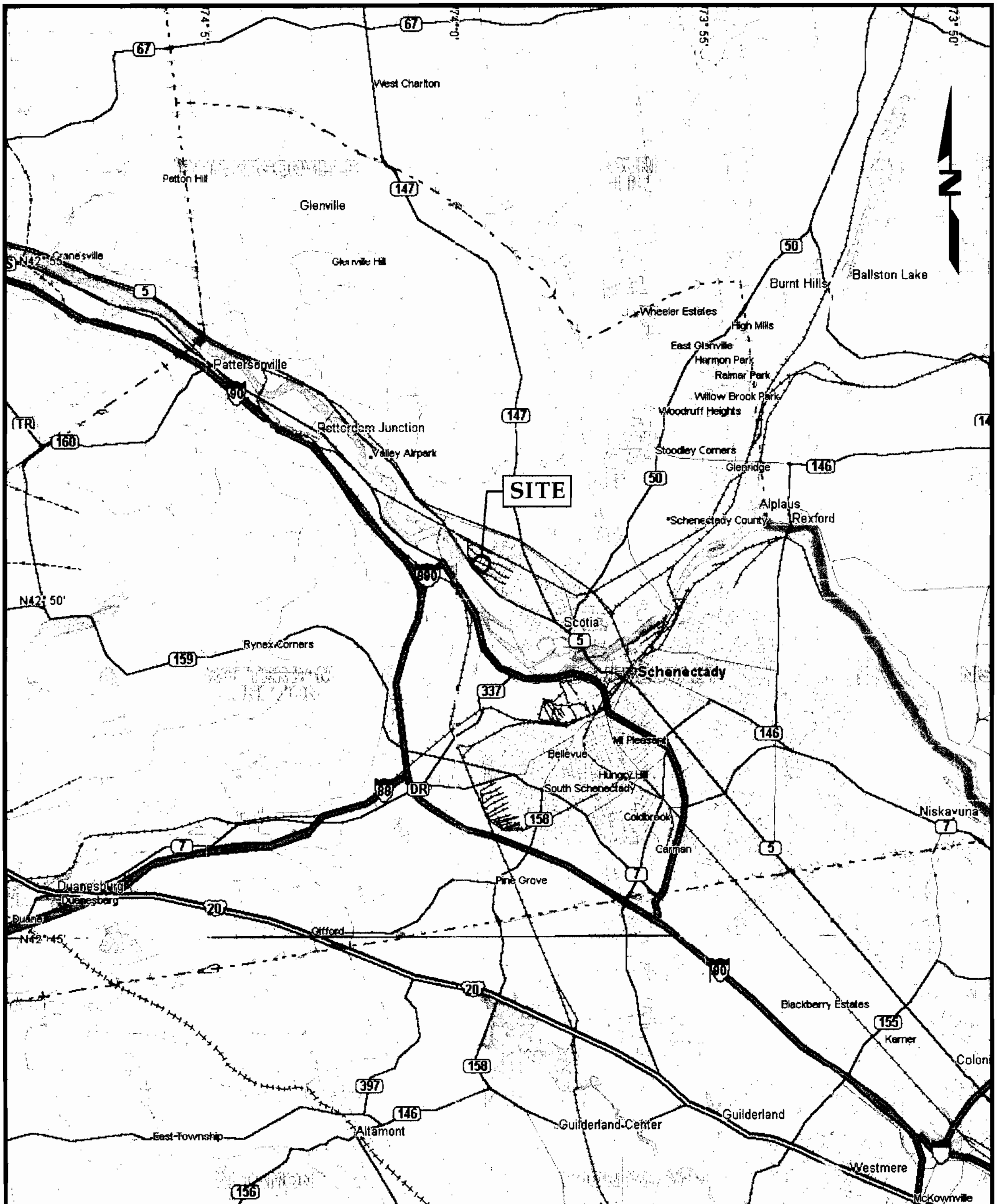
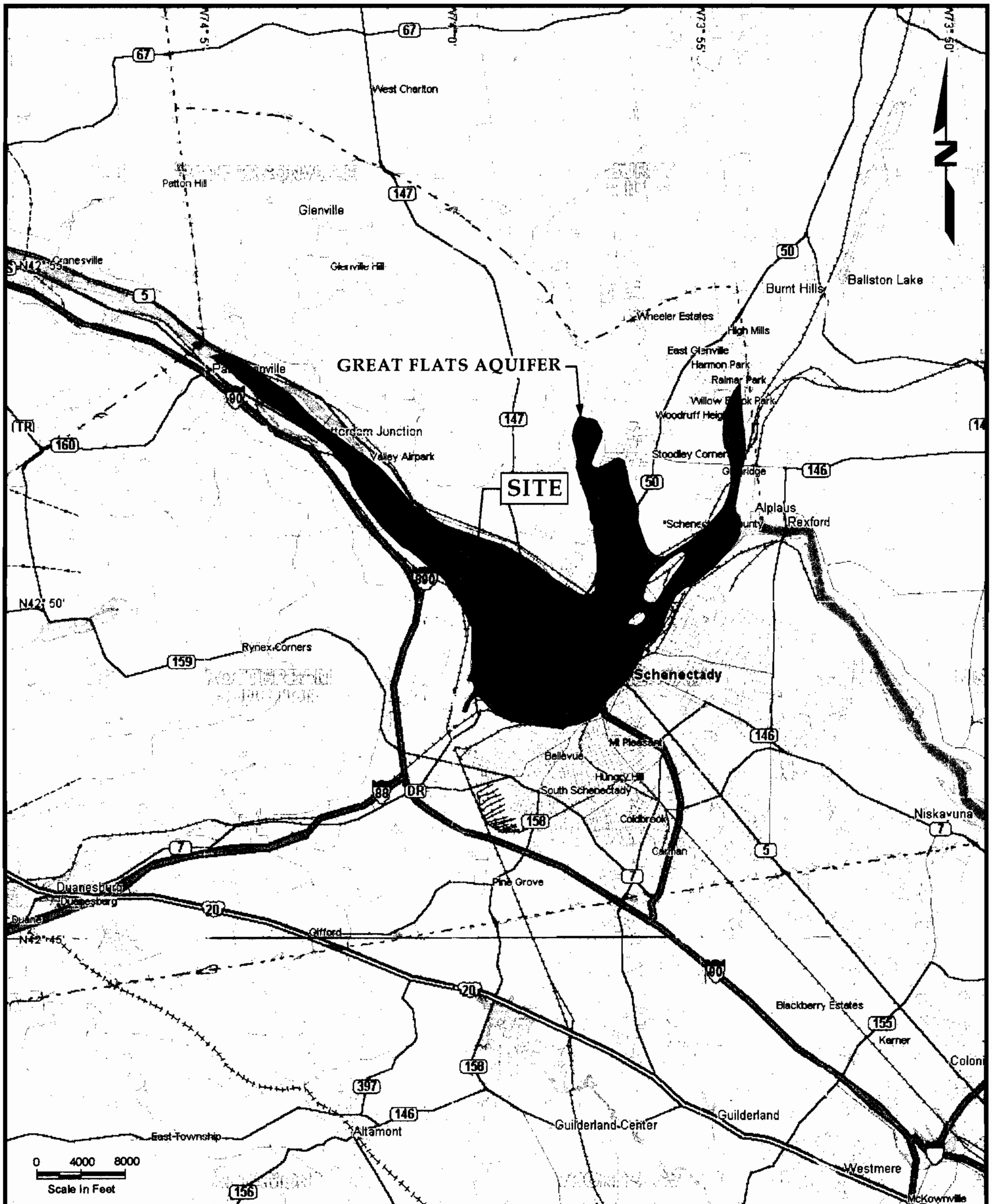


FIGURE 1
SITE LOCATION MAP

GLENVILLE ENERGY PARK
TOWN OF GLENVILLE, SCHENECTADY CO,, N.Y.

00137-09.CNV



MAP REFERENCE: MAP TITLED "GROUND-WATER SITUATION IN EASTERN SCHENECTADY COUNTY, N.Y. SHOWING SURFICIAL DEPOSITS, LOCATION OF WELLS, AND THE APPROXIMATE CONTOURS ON THE BEDROCK SURFACE". GEOLOGY BY J.D. WINSLOW, R.H. JOHNSTON AND L.J. CRAIN, 1962

FIGURE 2

MAP OF GREAT FLATS AQUIFER

GLENVILLE ENERGY PARK

TOWN OF GLENVILLE, SCHENECTADY CO,, N.Y.

00137-07.CNV