

A. INTRODUCTION

This chapter describes existing groundwater resources at the project site, and their potential for use as a domestic water supply for the proposed project. Potential impacts to groundwater resources are also discussed in this chapter. Information on groundwater resources was obtained from a preliminary water-supply evaluation conducted by Mid Atlantic Geosciences LLC, consisting of a subsurface geophysical investigation and pump tests of wells drilled onsite. In addition, Schoor DePalma Engineering, Inc. provided water demand calculations and an assessment of alternative sources of water. Full reports are located in Appendix B.

B. EXISTING CONDITIONS**BEDROCK GEOLOGY**

The USGS Hudson River Basin subsurface geology map indicates that the project site overlies layered sedimentary bedrock units, composed primarily of shale and limestone. As shown in Figure 3.6-1, the two main bedrock types underlying the project site are:

On – Matinsburg Formation. This formation underlies most of the project site and is a dark gray shale. Groundwater occurs in fractures, joints and along bedding planes, although fractures in this unit are generally few and mostly closed. Well yields in this unit within Orange County are reported to range from 3 to 225 gallons per minute (gpm).

OeW – Wappinger Group. This formation is found in the southeast corner of the project site, and consists of a dark gray to gray-black sequence of limestone and dolomite units. Groundwater occurs in joints and along bedding planes. Large openings in this rock formation exist due to the high solubility of carbonate rocks. These openings are often widened further by dissolution, which allows for significant storage of groundwater. Thus, well yields within this formation can be significantly higher than in the Martinsburg Formation. Well yields for the Wappinger Group in Orange County range from 20-285 gpm with a mean of 100 gpm and a median of 80 gpm.

Figure 1, found in Appendix G, Hydrogeologic Technical Report, presents a map of the study parcel and surrounding region showing surrounding watersheds, fault zones and regional fracture-trace patterns. There are no mapped gravel deposits within the project area. The fault zone mapped onsite strikes northeast-southwest, paralleling the typical trend of bedrock contacts and other fault zones in this section of the Valley and Ridge province.

GROUNDWATER RESOURCES

Water supply to the bedrock aquifer system below the project site is derived primarily from rain and snowmelt. The aquifers on the site are the carbonate and shale bedrock aquifers described above. All upland areas within the contributing watersheds can be considered recharge areas.

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Some wetland areas might also recharge the aquifers. Annual precipitation throughout the Hudson River Basin ranges from 10 to 40 inches per year with half of the annual precipitation falling between mid-February and mid-May, and some 10 inches of water may be stored in the Catskill Mountains snow pack as late as March. Within Orange County, groundwater recharge is approximately 0.398 mgd per square mile or 8.3 inches per year. Seasonal water table fluctuations typically exhibit a range of 5 to 6 feet from seasonal high to seasonal low in similar sites in New York and northern New Jersey.

As discussed in the Hydrogeologic Technical Report, Appendix G, under normal precipitation conditions, recharge to the bedrock aquifer is estimated to be 10.5 million gallons per day (MGD) over 26.4 square miles of the major drainage basin encompassing the site. This equates to a normal recharge rate of 0.398 MGD per square mile or 8.3 inches per year. Under 30-year drought conditions, recharge to the bedrock aquifer is estimated to be 7.14 MGD, which equates to a drought recharge rate of 0.270 MGD per square mile or 5.7 inches per year. Other than domestic wells, there are no known water withdrawals from the aquifer within the contributing watershed areas. A water budget analysis and discussion of how the recharge estimates apply to the watershed and to the property boundary is provided in Section 6.0 of the Hydrogeologic Technical Report contained in Appendix G.

The groundwater recharge figures described above represent estimates of recharge capacity in the region. The hydraulic characteristics of the project site's bedrock aquifer must be determined by a site-specific investigation. Therefore, a geophysical survey was conducted at the project site by Mid-Atlantic Geosciences LLC using very-low frequency electromagnetic (VLF) and two-dimension-resistivity (2DR) techniques. This investigation identified geophysical anomalies (water bearing fractures) used to guide the placement of test wells.

To confirm expected bedrock well yields, a preliminary pump test was conducted at the project site in December, 2004. The well and aquifer testing was completed as described in the Hydrogeologic Technical Report (Appendix G); prior to testing, a testing plan was submitted for review by both the NYDEC and the Orange County Health Department. Wells were drilled within the fractured bedrock zone between the Wappinger and Martinsburg bedrock formations — a location suspected of producing high yielding wells. Supplemental pump testing in March, 2005 concentrated on the most promising wells, specifically PW2, TW1 and TW4. Table 3.6-1 summarizes the results of pump tests and the location of wells is shown in Figure 3.6-1. The complete Hydrogeologic Technical Report prepared by Mid-Atlantic Geosciences, LLC is contained in Appendix G.

**Table 3.6-1
Pump Tests**

Well	Transmissivity	Well Depth	Rate of Pump Test	Specific Capacity	Proposed Usage
TW1	235 sf/day	500 ft	50	0.58 GPM/ft	Backup Supply
PW2	100 sf/day	500 ft	140	1.2 GPM/ft	Primary Supply
TW4	100 sf/day	500 ft	90	0.72 GPM/ft	Backup Supply
OW3	235 sf/day	500 ft	85	1.8 GPM/ft	Irrigation

Sources: Hydrogeologic Technical Report, Prepared by Mid-Atlantic Geosciences, LLC, January 2004

Results of groundwater pump testing confirm the ability of the primary well PW2 to provide 140 GPM, slightly more than two times the average daily demand. Wells TW1 and TW4 demonstrated a combined capacity of 140 GPM, sufficient as a backup source. Lastly, well OW3 demonstrated a capacity of 85 GPM.

Water levels in the deep, bedrock test wells are representative of the potentiometric surface of the aquifer, not the water table. The potentiometric surface of the aquifer is typically 7 to 16 feet below grade, except at Well TW4, where flowing artesian conditions were observed. However, shallow water table piezometers provide measurements of the depth to the water table near the wetland areas of the site. Near the wetland areas, depth to the water table was measured at the piezometers to be approximately 1.4 to 7.4 feet below land surface.

Mid-Atlantic Geosciences, LLC (MAG), consultants for the proposed project, discussed the 6-hour stabilized drawdown requirement with the regulatory officials prior to completion of the aquifer tests. The bedrock aquifer responds as a highly confined system; therefore, it was realized that complete stabilization would not occur within a reasonable time frame. To clarify this item, MAG consulted with James Garry at the NYDEC. Mr. Garry agreed that the 6-hours of stabilized drawdown was not an appropriate standard for a confined aquifer and that the NYDEC is no longer using that standard. Instead, he stated that the NYDEC accepts a six-month drawdown projection at the tested rate that demonstrates that the well can sustain the tested rate for that period of time. Subsequently, MAG consulted with Edward Simms at the Orange County Health Department. Mr. Simms indicated that he would defer to the NYDEC and would accept their alternative standard. The drawdown projections demonstrate that the tested rates are sustainable. The six-month drawdown projections manual and water-level recorder data, along with the digital data on CD, are contained in Appendix G, Hydrogeologic Technical Report.

With respect to well water quality, the wells were sampled for all parameters specified in the New York State Department of Health (NYSDOH) Sanitary Code, Part 5, Subpart 5-1, including radon and MPA analysis. Laboratory results for water quality parameters from each well are provided in Appendix G. During both tests, water samples were collected from the pumping wells after approximately 72 hours of pumping. The samples were collected and analyzed by Severn Trent Laboratories for primary and secondary drinking water standards. Tables 3 and 4 in Appendix G summarize the results. Results indicate that water quality for all three wells meets all primary and secondary drinking water standards regulated by the NYSDOH.

In accordance with the Public Water Supply Wellhead Protection Guidelines issued by the Orange County Department of Health, each wellhead will be protected. Each will have a properly secured well seal, a pitless adapter, and will be constructed in accordance with public community well standards. Each finished wellhead will be at least three feet above the 100-year flood elevation. The water purveyor will own (or control by easement) a 200' radius surrounding each well within which activities will be restricted as per the protection guidelines. None of the proposed public supply wells are located within either 100 feet or 200 feet of surface waters or designated wetland areas. Figure 3.6-2 shows the 100 foot and 200 foot wellhead protection area around the proposed wells.

All additional details regarding the onsite pump tests can be found in the Hydrogeologic Technical Report, Appendix G. Pumping durations are shown in Figures 11 and 12 of the report. Recovery responses for the observation wells at the end of the PW2 test are illustrated in Figure

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13 of the report. Construction details of the piezometers are also provided in the report, and the discharge location for the onsite pumping wells is shown on Figure 2 of the report. Well completion reports are included in the report for the proposed public supply wells PW2, TW1 and TW4.

B. FUTURE WITHOUT THE PROPOSED PROJECT

In the future without the proposed project, use of the project site's groundwater resources is not expected to change appreciably. However, there are two developments that may be built in the immediate vicinity of the project site which would use groundwater supplies. The first project is the Hamptonburgh Business Center consisting of approximately 120,000 square feet of flex space. Approximately fifty-percent of the square footage of this site is proposed to be completed by 2008. This development is located approximately 1,000 feet east of the proposed Four Seasons at Hamptonburgh project site, near the junction of Neelytown and Eager Roads. Based on assumptions in the Pyramid Industrial Park FGEIS (see below) it can be expected that this development would generate 10,000 gallons per day (gpd) in water demand.

The second development, Pyramid Industrial Park, is to be located on property adjacent to the project site north of Eager Road. This project proposes to develop approximately 1,270,000 square feet of flex space, fifty-percent of which is expected to be developed by 2008. The July 2001 FGEIS completed for the Pyramid Industrial Park estimates total water consumption to be approximately 18,000 gpd. Pump tests of an existing onsite well on the Pyramid Industrial Park Property shows negligible drawdown at 20 gpm. Therefore, it was concluded that this development will have a negligible impact on the aquifer. As discussed in Chapter 3.8: Infrastructure and Utilities, the Four Seasons at Hamptonburgh development would provide capacity to store and treat an additional 18,000 gpd of water supplied by sources from the Pyramid Industrial Park to accommodate the future water demand from that project. The wells developed on the Four Seasons project site have been shown to be capable of serving the needs of the Four Seasons project alone and therefore would not be capable of providing water supply to offsite projects now or in the future.

C. POTENTIAL IMPACTS OF THE PROPOSED PROJECT

WATER DEMAND

Based on the development of 300 units of housing and using the maximum-month average day demand of 130 gpd per bedroom, the total potable water demand using three bedrooms per household for 68 attached town home units and two bedrooms per household for the remaining 232 single family units is given below in Table 3.6-2.

**Table 3.6-2
Water Demand**

Development Component	Water usage (gpd)
(130 gpd/bedroom) x (2 bedrooms/unit) x (232 units)	60,320
(130 gpd/bedroom) x (3 bedrooms/unit) x (68 units)	26,520

6,000 sf Clubhouse @ 0.1 gpd/sf	600
TOTAL	87,440
Irrigation Demand (400 gpd/unit)	120,000
GRAND TOTAL	207,440

It is intended that irrigation demand will be met through the potable supply system when extra capacity is available. It is expected that this demand would occur for about six months of the year (April through September). The additional irrigation well (OW3), separate from the potable system, was developed to supply up to 122,400 gpd if necessary. It is not expected that this well will be used for irrigation because all water needs for the proposed project can be met by the three wells serving the potable system.

POTENTIAL EFFECTS TO GROUNDWATER RESOURCES

As discussed above, three proposed public supply wells (PW2, TW1 and TW4) have been installed on the site to provide a firm capacity of 140 gallons per minute (201,600 gpd) or slightly more than twice the average daily demand. Irrigation demand is estimated to be approximately 400 gpd per unit (120,000 gpd) during peak periods. It is intended that irrigation demand will be met primarily through the potable supply system when extra capacity is available. In addition, a proposed irrigation well (OW3) separate from the potable system has been developed to supply up to 122,400 gpd.

Regarding well operations, testing showed no hydraulic connection interference between the primary well PW2 and the two backup wells (TW1 and TW4). Only well TW1 showed a projected drop in water level when pumped simultaneously with the irrigation well OW3. Therefore, it is recognized that use of the irrigation well would need to be limited if both of the backup wells are necessary for extended durations at full capacity. However, with backup well TW4 able to meet approximately 1.3 times the average daily demand (70 GPM) on its own, the need to use well TW1 is expected to be infrequent.

In order to gauge the potential effects of utilizing onsite groundwater to satisfy the proposed project's potable and irrigation demand, nearby domestic wells and water levels in onsite wetlands were monitored during pump testing. Although the Scoping Document required that the pump test and off-site well monitoring program be submitted to the Town prior to execution, the plan and program were submitted to the Orange County Department of Health, from which approval was obtained (See appendix I for Pump Test Plan and related correspondence).

Shallow water-table piezometers were installed at locations identified as P1, P2 and P3 in Figure 3.6-1. In addition, the surface water stage of the onsite pond was monitored via a stilling-well location identified as S1. Water levels were also measured at two of the closest domestic wells offsite, approximately 1900 and 2600 feet from the primary well PW2. No domestic wells are located within 1500 feet of the proposed public supply wells.

Pump test results demonstrated confined conditions in the bedrock fracture systems supplying test wells and no discernable hydraulic impacts at the water table zone or at the central pond onsite. Therefore, adverse impacts to nearby wetland and surface-water resources are not anticipated. Because of the complexity of the two bedrock fracture systems reached by test wells, drawdown impacts at nearby domestic wells cannot be quantified. However, the aquifer

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tests demonstrated no measurable impact at two of the closest domestic wells offsite. Because there are relatively few domestic wells in the site vicinity, adverse impacts to nearby domestic wells are considered unlikely. A discussion of potential impacts from the proposed project's water needs is further discussed in Section 6.0 of the Hydrogeologic Technical Report, Appendix G.

A water availability analysis was prepared for the three sub-drainage areas that are likely to contribute to the proposed onsite water supply. This analysis, summarized in Table 3 of the Hydrogeologic Report (Appendix G) takes into account the existing community water supply systems, the proposed water supply systems, including this site and the adjacent Pyramid Industrial site, and existing domestic and commercial well diversions. For the total area of the three sub-drainage basins, the total average water use for existing and proposed diversions is estimated to be 372,850 GPD (0.373 MGD), and the total peak water use is estimated to be 630,700 GPD (0.631 MGD). Average ground-water recharge for this area is estimated to be 3.14 MGD under normal conditions and 2.13 MGD under drought conditions. Therefore, the total of the existing and proposed diversions represents 11.9 percent of the estimated average ground-water recharge and 17.5 percent of the estimated ground-water recharge under 30-year drought conditions. These calculations indicate that sufficient ground-water recharge is available to support both the existing and the proposed diversions within the defined area.

POTENTIAL EFFECTS TO SURROUNDING LAND USES

The proposed wells, including the primary potable production well and backup and irrigation well, are located at least 200 feet from the site property line. The land uses within a 200 feet radius of any well are consistent with the development of this project as a residential, age restricted community consisting of single family and attached homes with roadways, landscape and lawn areas and underground utilities. All areas outside the buildings shall be maintained and owned by the community's homeowner's association. All surface drainage from the developed areas is generally directed away from the wellheads and all runoff from the roadways is directed to stormwater management basins that have outlets downhill from wellheads, minimizing the opportunity for contamination from stormwater. There are no sanitary disposal systems within 200 feet of any wellhead.

POTENTIAL CONSTRUCTION IMPACTS

During construction, no blasting will be required within 800 feet of the proposed on-site wells. In addition, there is no record of any off-site wells within at least 1,000 feet of the area of the site where rock is expected to be encountered. Any blasting of rock on-site, if required, is proposed at a maximum depth of 20 feet, whereas the wells are at least 500 feet below the surface. Proper monitoring of the adjacent and on-site wells will be included in a blasting protocol that will be approved by the Town in advance of any blasting operation for this project. Therefore, no significant adverse impacts are expected due to construction impacts.

WATER SUPPLY ALTERNATIVES

SURFACE WATER SUPPLY - WALLKILL RIVER

Although not the preferred alternative, surface water from the Wallkill River can provide sufficient supply for the project's potable and irrigation water demand. Based on the lowest possible flow rate for the Wallkill River, as indicated by the United States Geological Survey

(USGS) stream flow monitoring database, the proposed project's water demand would remove about 1.7% of the Wallkill River's available surface water supply. This small amount would have negligible effects on the Wallkill River resource. Should highly treated wastewater be returned to the Wallkill River downstream of the potable water intake, it would account for approximately 90,100 gpd, and therefore replace 1.03% of the flow. Thus, were the Wallkill used as a surface water supply for the project, the project's wastewater recharge would decrease the net removal of water from the Wallkill River to 0.26% of its flow.

Membrane filtration would be required for treatment of surface water in order to meet the National Primary Drinking Water Regulations. An elevated water tank would be needed to hold 30% of the peak day flow plus fire flow for a total volume of 250,000 gallons.

SURFACE WATER SUPPLY – QUARRY

A stone quarry located immediately southeast of the project site is unlikely to be a viable water supply option for the project site. Of primary concern is that the Applicant does not own or control the quarry property and therefore has no rights to withdraw water from it. The utility would need to own and control land around the quarry to the extent that it could prevent any detrimental runoff entering the water supply. Should adequate water be available in the quarry, and were it available for project use, the water source would require treatment similar to using water from the Wallkill River, as discussed above. Furthermore, the reliable yield of the quarry is not known, and extensive hydrogeologic testing would be needed to determine the reliable yield. Surface water supplies are more prone to adverse impacts from drought. It would need to be determined if the quarry receives sufficient ground-water input to be a reliable supply during drought. The proposed ground-water source from deep bedrock fractures is considered a safer, more reliable, and more economical water supply.

MITIGATION

Pump tests demonstrate that there are sufficient groundwater supplies to meet the demands of the proposed project. Therefore, no mitigation is required.