Municipal Aquifer Report

Town of Pleasant Valley

Dutchess County, New York

May 2007

Prepared for:

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EXECUTIVE SUMMARY

The Town Board of the Town of Pleasant Valley retained The Chazen Companies (TCC) to review groundwater relationships in the Town and make water resource planning recommendations.

Bedrock aquifers underlie all parts of Pleasant Valley. Some sand and gravel aquifers lie in lower valley areas. Aquifers are recharged through soils throughout the Town. The resulting groundwater migrates slowly toward streams, unless intercepted by wells for human uses or depleted by vegetation. Examination of low-flow Wappinger Creek stream gauging data suggests that current groundwater demands by human use may be reducing stream flows. Nitrate concentrations in the Wappinger Creek also increase through the Town, suggesting that concentrated septic system discharges are present in some aquifer areas and are entering the creek.

Land to the east and west of the central Wappinger Creek corridor is generally covered by clayey soil allowing between 6.8 inches and 13.3 inches of aquifer recharge per year. Such soils cover the majority of the town and this recharge supplies the majority of replenishable groundwater withdrawn from wells throughout the Town. Sand and gravel deposits near streams allow higher aquifer recharge rates. This recharge contributes to stream flows during extended droughts and can sometimes support high capacity community water system wells installed in such sand and gravel areas.

The aquifer analysis summarized in this report finds that overall there is ample available groundwater to support continuing development in Pleasant Valley, but impacts to streams and some locally-recognized problem areas indicate that Pleasant Valley should consider implementing a Town water resource management strategy. Aspects of that program could include the following:

1. Use zoning or SEQRA processes so that minimum average parcel sizes in rural areas developed with individual septic systems and individual wells average at least 3 acres. This will ensure sustainable uses of individual domestic wells and provide adequate dilution of septic system wastes returned to aquifers. Analysis of the Town has identified some areas where existing parcels are smaller than recommended for the sustainable provision of potable water (Figure 13). In these areas, installation of small sewage treatment districts or central water systems may be warranted. Wherever central wells are used to replace existing individual wells, no net change in overall aquifer resources is expected, but the quality of water provided to the individual parcels would be expected to improve.

2. Consider adopting an aquifer overlay ordinance which provides townwide protection of all aquifers, and which provides additional protection for special aquifer areas including the wellhead recharge areas for any higher-yield community wells or particular sand and gravel aquifer areas likely to be tapped in the future. A model ordinance previously prepared with funding from the Dutchess County Water and Wastewater Authority is found in Appendix A of this report and could be modified for use in Pleasant Valley. An aquifer overlay map would be needed to accompany an aquifer protection ordinance.

3. Pumping tests for new community wells, public water supply wells and wells in specially designated areas, should be reviewed by the Town Planning Board as part of SEQRA analysis. Pumping tests should include simultaneous and longer testing for sites proposing significant numbers of individual wells. In some instances, off-site monitoring of existing wells or streams/wetlands may be warranted based on site-specific concerns. These measures will help ensure careful assessment of potential off-site well or stream/wetland impacts associated with the use of new wells.

4. Road salt practices in the Town should be examined to manage salt accumulation in areas near existing wells. Where wells lie near roads, snow aprons or low-salt areas may be warranted at ends of cul-de-sacs or bottoms of hills where accumulations of salty snow often accumulate and melt.

5. Various surfacewater management programs also benefit groundwater conservation and management strategies. Pleasant Valley should encourage the use of disconnected impervious surfaces, stormwater detention and infiltration techniques, and protection of natural vegetation around water bodies to offset development impacts which can both reduce groundwater recharge and increase stormwater runoff impacts. Such approaches can include infiltration and other Best Management Practices within the stormwater program. A town planning policy should be considered, stating that site development should seek to maintain pre-development runoff characteristics to both ensure adequate aquifer recharge and minimize stormwater flooding and surface water quality impacts.

1.0 INTRODUCTION

The Town Board of the Town of Pleasant Valley retained The Chazen Companies to prepare a municipal aquifer report. This report includes an aquifer map, evaluations of groundwater recharge and groundwater flow relationships, a discussion of well yields and yield capacities, and a series of water resource planning recommendations. To prepare this report, The Chazen Companies has relied on prior aquifer studies completed by our own staff as well as reports prepared by others. In addition, The Chazen Companies visited sections of Pleasant Valley to field check geologic formations, watershed areas, and to photo-document the different hydrogeologic terrains in the Town.

Sections 2.0 through 4.0 of this report provide, respectively, Town geographic characteristics which influence groundwater relationships, aquifer characteristics, and groundwater resource planning recommendations. Various Figures, Tables, and one Plate accompany this report.

Appendix A contains a copy of a model aquifer protection ordinance developed first by The Chazen Companies for the Towns of Dover, Amenia, Pawling and North East. The ordinance was recently refined for specific use in the Town of Amenia. This model could be adapted for use in Pleasant Valley, providing modest protection for aquifers throughout the Town and more aggressive protection for any present or future public water system wellfield recharge areas.

Many of the planning strategies recommended in this report are consistent with regional aquifer management recommendations outlined in Dutchess County's 1997 Water Supply Protection Strategy.

2.0 PLEASANT VALLEY HYDRO-GEOGRAPHY

Many geographic factors influence groundwater resources in Pleasant Valley. The following sections summarize some of these influences.

2.1 Setting and Population, Water and Sewer Service

Pleasant Valley covers approximately 33 square miles in the central region of Dutchess County, NY. The Town is bordered by Poughkeepsie, LaGrange, Hyde Park, and Washington. The population of Pleasant Valley was approximately 9,100 in 2000 according to available 2000 census data. Between 2000 and 2005, approximately 225 building permits were issued in Pleasant Valley according to Dutchess County website data, suggesting that the Town's population in 2007 is approximately 9,700 if we apply the County's average household population rate of 2.6 persons to the number of new home building permits.

Areas of highest residential and commercial density are found along NYS Route 44, particularly near and south of the Pleasant Valley central hamlet, and near the hamlets of Washington Hollow and Salt Point. The residential population of Pleasant Valley is otherwise distributed somewhat broadly throughout the Town. Larger-lot residential parcels and active or former agricultural lands extend across much of the western half of Pleasant Valley where rolling hills and deep soils are prevalent. The eastern half of the Town is more rugged and so includes many wooded lots as well as the Rockefeller University Research Center and the Taconic Hereford Multiple Use area.

Currently, all residents of Pleasant Valley rely on groundwater as their sole supply of potable water. Most of this water is withdrawn from individual domestic wells on individual residential parcels. Some newer subdivisions have centralized community water supply wells.

No regionally-significant wastewater treatment systems exist in Pleasant Valley. Both individual wells and septic systems continue to be used throughout the Town including within the hamlet of Pleasant Valley.

2.2 Topography

The topography of Pleasant Valley lies primarily between the elevations of 200 to 400 feet above mean sea level. Many hilltops crest over 500 feet and a few peaks rise to over 700 feet in the Tyrrell-Hereford Multiple Use area.

Much of the central and western portion of the Town consists of rolling hills. Land becomes more fragmented by ravines and ridges in the eastern half of the Town. Throughout the Town, most hills and ridges are aligned in a general north-to-south orientation, reflecting underlying bedrock ridges and the alignment of hills by historic southward direction of glacier movement across Dutchess County. These trends are evident on Figure 1.

The Wappinger Creek transects Pleasant Valley, flowing from northeast to southwest across the Town. The watershed of the Wappinger Creek collects water from upstream Towns of Milan, Clinton, Washington, Pine Plains and Stanford. The watershed narrows as it flows through Pleasant Valley and flows southward as a narrow watershed corridor through parts of the Towns of Poughkeepsie, LaGrange and Wappinger before discharging to the Hudson River.

Where the Wappinger Creek flows through Pleasant Valley, it follows a swath of topographically distinct land containing the creek and a ridgeline west of the creek. From north to south this zone extends under the hamlet of Salt Point, hilled areas extending southeast, homes along Hurley Road, the Dutchess Quarry aggregate operation, the hamlet of Pleasant Valley, and the residential neighborhoods of Clark and Timothy Heights. The zone is approximately one third of a mile wide, although widening somewhat near Sherow Road. This ridge is visible on Figure 1 and mapped approximately on Plate 1.

Numerous tributary streams enter the main stem of the Wappinger Creek as it flows through Pleasant Valley. The larger tributaries include the Little Wappinger Creek, which flows into Pleasant Valley from the Town of Clinton near the hamlet of Salt Point (Figure 3a), the Drake Brook which enters the Wappinger Creek near Traver Road and collects water from southeastern Pleasant Valley and parts of LaGrange (Figure 3b), and the Great Spring Brook, which collects water from much of eastern Pleasant Valley and enters the Wappinger Creek near North Avenue and Sherow Road (Figures 3c and 3d). Portions of these watersheds within Pleasant Valley are shown on Plate 1.

2.3 Geology

Geologic formations in Pleasant Valley include bedrock formations and overlying sediment formations.

Bedrock formations in Pleasant Valley consist primarily of shale, with mixed inliers of greywacke (silty sandstone), quartzite or siltstone. In the eastern half of the Town, complex depositional environments including pre-lithification soft-sediment slides and compressive and low-angle bedrock thrust-fault tectonic events have left a diverse mix of formations with many sedimentary beds oriented in vertical positions. Greater proportions of erosion-resistant rock types including chert and quartzite, and greywacke are found in eastern Pleasant Valley. Some of these eastern formations have also experienced low-level metamorphic alteration (Bence & McLelland, 1976), transforming original shale formations into slate or phyllite in some areas (Figure 4a). The varied and complex rock characteristics in the eastern part of Pleasant Valley contribute to the rugged landscape found throughout this part of the Town.

In western portions of the Town, the shale and greywacke have been less deformed by depositional and tectonic activities, so landscapes are more rolling and exhibit fewer vertically-upended ridgelines or deep ravines (Figure 4b).

The ridgeline along the west bank of the Wappinger Creek consists of carbonate bedrock (Figure 2). Carbonate rocks consist of calcium carbonate (forming limestone) or magnesium-enriched calcium carbonate (forming dolomite). When subjected to tectonic stress, both dolomite and limestone formations break in a brittle manner, leaving open cracks and fracture planes (Figure 5a). The carbonate rocks found in Pleasant Valley are older than the shale-based formations to their east and west. The boundaries separating the carbonate and shale-type bedrock formations consist of presently-inactive high-angle fault zones along which carbonate was moved upward relative to the adjacent rock formations. Where shale and phyllite/slate are geologically stressed, they tend to deform in a more ductile manner, folding and bending but leaving overall fewer open fractures (Figure 5b).

Sedimentary deposits overlie all bedrock formations in Pleasant Valley except in areas with bare rock exposure. Most sediments were deposited by glacial activity that ended in Pleasant Valley as recently as 16,000 years ago. A wide range of soil types have formed in these sediment deposits, reflecting the diversity of the underlying parent sediments or bedrock.

Glacial till is the dominant sediment deposit found on hillsides and hilltops. Glacial till usually contains a wide range of chaotically-sorted sediment sizes, with random boulders in a mix of clay and silt material. These sediments were transported by glacier ice, and either compressed as sediment debris under the ice, or left as a random mantle of debris draped over melting ice. Areas with thick and thin glacial till throughout the town are shown on Figure 7b. Thicker glacial till supports the generally rolling topography found in western Pleasant Valley (Figure 4b).

Glacial outwash deposits follow the narrow valley of the Wappinger Creek, particularly near Salt Point. In some areas, these sand and gravel mines have been subject to aggregate mining (Figure 8a).

Figure 7a was created by The Chazen Companies by matching Soil Service text descriptions of parent rock materials with each soil type mapped in Pleasant Valley. Considerable detail is provided by this map beyond detail available from Figure 7b. Soils now developed in the uppermost horizons of these surficial geology deposits significantly reflect the composition of the parent glacial.

2.4 Water Requirements, Consumption and Wastewater Generation

Residents on individual wells use between 80 to 100 gallons per day (gpd). Residents receiving water from central water supplies, who pay for their water, are generally more conservative in their water use and require only 60 to 80 gpd. Water uses normally peak in summer due to increased seasonal outdoor water uses.

As outlined in Section 2.1, approximately 9,700 people reside in Pleasant Valley, most using water from individual well systems. Using the estimates above, the population of Pleasant Valley withdraws a maximum of 970,000 gallons per day from aquifers.

Of these extracted gallons, each resident is estimated to "consume" 20 gallons of water per day (gpd), while generating up to 80 gallons of wastewater. This sums to 194,000 gpd of residential water consumption and 776,000 gpd of residential wastewater discharges. The consumed portion includes water dissipated by perspiration, steam from cooking, evaporation from watering of plants, washing of cars, and during drying actions by dishwashers and clothes driers, among other losses.

Wastewater released to septic systems can recharge aquifers or travel laterally along clay layers directly to nearby water bodies. During summer, 30 to 50 percent of wastewater released to septic leaching fields is drawn upward by evaporation or root transpiration. Using the 30 percent estimate, approximately 550,000 gpd of residential wastewater replenishes groundwater resources in Pleasant Valley.

Prior investigations have estimated that non-residential uses of water in most communities add an additional 50 percent (Goodkind & Odea, 1970). Using this estimate, combined groundwater use and consumption estimates for Pleasant Valley are:

- Total Groundwater withdrawn from aquifers: 1,500,000 gallons daily
- Wintertime water returned to Groundwater via Septic Systems: 1,200,000 gallons daily
- Summertime water returned to Groundwater via Septic Systems: 825,000 gallons daily

Based on these figures, water consumption in Pleasant Valley will consist of 300,000 daily gallons in winter (208 gallons per minute) and 675,000 daily gallons in summer (470 gallons per minute).

2.5 Land Use

Land uses influence rates of surface water runoff, evaporation or plant transpiration (evapotranspiration) losses, and aquifer recharge. Farmland, forested lands and low-density residential land are dominant land uses in Pleasant Valley. Concentrated residential and commercial use areas, including the hamlet of Pleasant Valley, are generally clustered along transportation corridors.

Various investigators have evaluated hydrologic changes associated with land use changes. Black (1968) documented slow increases in flow volume in the Wappinger Creek as large parts of the Wappinger Creek watershed have converted over the last century from active farms to brush and scrub forest. Black ruled out spreading urbanization as the source of the stream flow increases because he observed no changes in peak runoff flows, so he instead attributed the increased flow volume in the Wappinger Creek to delayed spring-time melting of snow under the increasingly wooded watershed canopy.

Precipitation data indicate that the mean annual precipitation in Pleasant Valley is between approximately 39 and 40 inches per year and that typical evaporation and plant transpiration rates in Pleasant Valley are between 20 and 21 inches (Randall, 1996), leaving approximately 19 inches of precipitation available each year to recharge aquifers or flow as overland runoff to streams. Recharge rates are addressed in following sections.

Soil Conservation Service programs, such as the TR-55 program, can be used to evaluate how land uses influence changes in runoff rates. In general, increased runoff decreases groundwater recharge. Analysis completed by Chazen (2006b) in the Wappinger Creek watershed concluded that runoff changes related to vegetation or impervious cover can be pronounced during heavy rain events but are insignificant during modest rainfalls unless runoff is conveyed directly to streams over impervious surfaces. Approximately 80% of annual precipitation is currently delivered by rainfalls of less than 1.5 inches per day (Chazen, 2006b). When analyzing runoff coefficients associated with such rain events, runoff values only increase markedly where connected impervious surfaces exceed approximately 30 percent of land surfaces. Such high impervious surfaces in Pleasant Valley occur almost exclusively in the hamlet center. Most current land uses elsewhere in Pleasant Valley, therefore do not significantly influence runoff rates during rainfall events less than 1.5 inches, and therefore cause little to no changes to prevailing rates of groundwater recharge. The use of discontinuous impervious surfaces (e.g.

roof drains flowing onto lawns) rather than continuous impervious surfaces (road gutter systems directed to a common surfacewater discharge) can nonetheless minimize runoff increases otherwise frequently associated with impervious surfaces, and help groundwater recharge.

It is worth noting that although future regional climate patterns are not fully understood, many investigators believe future weather may include more severe storms and longer periods without rain, with overall warmer temperatures. Such projections could increase overall evapotranspiration losses and increase the number of storm events where large runoff fractions occur. These trends could lead to a long-term expectation of reduced groundwater recharge and amplify the value of and need for municipal groundwater resource planning strategies.

Vegetation transpires large quantities of water to the atmosphere due to transpiration processes. Hardwood deciduous riparian forest in temperate climates can have evapotranspiration rates as high as 118 cm (46.5 inches) per year (Peterjohn and Correll, 1986). Since this occurs entirely during an eight month growing season, we can estimate peak summertime evapotranspiration losses at approximately 0.2 inches per day from riparian vegetation, which are those plants with root systems most likely to be in direct hydraulic contact with the watertable. Significant vegetation lies throughout the Great Spring Brook watershed, suggesting that up to hundreds of gallons per minute of water in this watershed are being consumed during the growing season by vegetation, reducing volumes of groundwater which might otherwise discharge to the stream and enhance its summer-time flow levels.

During extended drought periods, plant evapotranspiration losses in hillside and upland areas tend to decrease as soil water capacity becomes depleted; however, most plant activity in valleys continues during extended drought systems where root systems can reach shallow groundwater resources. Many wetlands lie in riparian settings and so benefit from groundwater discharges coming from upland recharge areas. These provide primarily flood control, surface water quality filtering, and ecological habitat benefits. Some upland wetlands, particularly those which are in enclosed basins or in poorly drained areas, can allow slow upland groundwater recharge through leaky bottoms and so beneficially assist groundwater resources.

2.6 Streams in Pleasant Valley

Stream flow data in Pleasant Valley are available from published reports, from data collected by the Dutchess County Environmental Management Council, and from stream flow data collected by The Chazen Companies for the Dutchess County Water & Wastewater Authority. Stream flow records are relevant to groundwater resource planning analyses because dry-season flows help identify rates of groundwater discharge from, or flow out of, watersheds. Impacts of routine water consumption by vegetation and human populations are very small during most seasons, but can come to represent meaningful shares of stream flow during dry periods.

During September and October 1997 low flow periods, stream flow data collected through efforts of the Dutchess County Environmental Management Council identified a decrease in stream flow exceeding 2,000 gpm in the Wappinger Creek somewhere between the bridge crossing at County Route 13 and the Pleasant Valley Town Hall. Causes of the stream flow reduction were not identified.

Stream gauging was also conducted by The Chazen Companies for the Dutchess County Water and Wastewater Authority (Chazen, 2003) during low flow periods in November of 2001, August of 2002 and September of 2002. This gauging work did not identify flow reductions near Pleasant Valley as severe as those noted by DCEMC, but flow gains in the Town were only minor during two of the gauging events and a small reduction in flow was recorded during the driest September 2002 data collection period.

Gauging efforts by DCEMC and The Chazen Companies both suggest that stream flow gain is either low or even lost as the Wappinger Creek flows through Pleasant Valley. Gain consistent with regional rates would reasonably be expected since the sub-watersheds of both the Great Spring Creek and the Drake Brook have their outfalls in the Town. Therefore it does appear that existing water consumption occurring within the Town is currently intercepting sufficient groundwater share to influence flow of the Wappinger Creek. Fuller discussion of stream flow records is found in Appendix B.

Nitrate concentrations and rates of nitrate gain in the Wappinger Creek recorded by the Dutchess County Environmental Management Council also increase in Pleasant Valley, measured along the reach between Town Hall and the next downstream sampling station at DeGarmo Road (Table 2). On the basis of land uses adjoining the Wappinger Creek in this area, the most likely source of these nitrate increases may be related to wastewater discharges from septic systems. Total phosphorous concentrations do not change as significantly in the Wappinger Creek in Pleasant Valley and there is only a low-level unexplained recurrence of low phosphorous levels in samples collected during winter and early summer months near the Town hall. Irregular peaks in phosphate gain may be related either to wastewater issues or to sediment entry into the creek.

3.0 GROUND WATER RESOURCES

Aquifers provide water for all residential and commercial activity in Pleasant Valley. Precipitation is the sole source of groundwater recharge to these geologic formations. Recharge enters the subsurface through the soil layer and replenishes all geologic formations in Pleasant Valley.

Once precipitation reaches the watertable, the groundwater then migrates in the aquifer through pore spaces or fractures toward lower elevation areas, and finally re-emerges at grade in springs or in streambeds as stream baseflow. Any wells installed along the groundwater flow-path between recharge areas and groundwater discharge areas can extract available water resources. Water removed by wells will not reach the stream unless portions are returned to the landscape via septic systems or wastewater treatment plants.

In general, directions of groundwater flow mimic overlay flow pathways, moving from higher elevation areas to lower areas, within each subwatershed area. Plate 1 shows sub-watersheds and estimated directions of groundwater flow in Pleasant Valley.

3.1 Bedrock Aquifers

With only limited areas of deep sand and gravel deposits, bedrock aquifers become an important source of water to Pleasant Valley. Generally, bedrock formations support lower average well yields than do sand and gravel aquifers because of lower overall porosity and more limited interconnectedness in the bedrock fractures and joints. Bedrock aquifers in Pleasant Valley have no inherent porosity. Faults, fractures and other joints therefore provide the only subsurface open areas available for groundwater storage and transmission.

Various investigators have evaluated typical short-term aquifer yields from domestic wells installed in the bedrock formations underlying Pleasant Valley. Gerber (1982) estimates that median ground water yields for shale aquifers are between 10 to 15 gpm and median ground water yields for carbonate aquifers are approximately 13 gpm. Simmons (1961) estimates that the average yields of shale aquifers is about 14 to 29 gpm and average yields for carbonate aquifers is about 11 to 36 gpm. As a general rule, yields from carbonate wells are somewhat higher than yields from shale-based aquifers since fractures in carbonate rock tend to remain open over time, as shown in Figure 5a, and can sometimes become further widened as slightly acidic waters move through the carbonate fractures.

On the basis of these factors, Figure 9 provides a simplified bedrock aquifer map for Pleasant Valley, consolidating the carbonate and non-carbonate formations into two general capacity categories. These boundaries are also approximated on Plate 1 on the basis of Figure 9, field observations by The Chazen Companies, and Fisher & Warthin (1976).

The typical well yield estimates summarized in the paragraph above are drawn from well driller's estimates. Such estimates are generally provided after brief flow tests immediately following drilling of each new well; as such, they describe the short-term rather than long-term yield from wells. These yield estimates should not be over-interpreted to predict well yields which could be sustained for extended, continuous pumping periods. Fractures near some wells may be poorly connected with surrounding fractures; where this conditions exists, fractures may become dewatered during extended pumping, such that long-term yields may differ from short term yields.

The long-term reliability of wells is conditionally related to the degree to which local fractures are interconnected, and to rates of groundwater entering these fractures as recharge through overlying soils. Optimal places to drill higher-capacity bedrock wells would be in areas with reasonably high recharge rates (see section 3.3) and areas with extensive interconnected fractures, such as those tentatively mapped on Figure 6. Wells on smaller parcels are usually sited on the basis of convenience or to meet health department separation distances from septic systems and so usually tap only small fractures. Such wells are usually suitable to meet homeowner yield demands but may not support higher yields.

3.2 Surficial Aquifers

Surficial aquifers consist of porous sediments such as sand and gravel and are normally found in valleys where pore-spaces can remain saturated with groundwater throughout the year. Where sediments are found above the watertable, sediments are not referred to or recognized as aquifers.

Outwash deposits found along the Wappingers Creek and in other valleys in Pleasant Valley may be surficial aquifers if sediments are deep enough to support wells. Exploratory work to develop high-capacity wells near the hamlet of Pleasant Valley has reportedly taken place at Bower Park and on lands somewhere west of Timothy Heights (Horsley Witten Hegemann, 1992). Reports describing these efforts were not available to The Chazen Companies for review. Two new wells installed approximately 58 feet deep into sand and gravel deposits near West Road reportedly support yields of over 366 gpm although pumping tests were conducted for only 24 hours (Friedman, 2003, for Brookside Meadows public water supply; Tim Miller Associates, 2003, for Brookside Meadows DEIS).

Surficial aquifers often serve as conduits for groundwater movement moving out of bedrock aquifers toward valley streams. Groundwater recharged in upland settings migrates downward through bedrock aquifer fractures, into valley sediments, and from there to streams. This relationship between upland groundwater and valley groundwater often enhances the reliability and yield of wells installed in surficial aquifers.

The low yield-per-square mile of the Drake Brook and Great Spring Brook (Table 1) suggests that storage capacity within surficial aquifers in these basins is somewhat limited, and that although some deeper sediments have been identified in the Great Spring Brook, the remaining available water budget for water consumption in this watershed may be limited if preservation of streamflow is a community objective. Most of the Hydrologic Group A soils in the Town lie near streams, such that although they allow high rates of groundwater recharge, this water may quite rapidly flow to the streams. Accordingly, only limited areas on Plate 1 are identified as potential sustainably, higher-yield surficial aquifers.

3.3 Soils and Aquifer Recharge

Soils substantially control rates of surface water entry, or recharge, into underlying aquifers. Soil mapping conducted by the Soil Conservation Service has assigned a Hydrologic Soil Group (HSG) rank to every soil. Recent investigations by Brandes et al (2005) suggest that the distributions of Hydrogeologic Soil Groups in watersheds correlate closely with recharge rates into underlying aquifers. The distribution of Hydrologic Soil Groups in Pleasant Valley is shown on Figure 10.

Hydrologic Soil Group A and A/D soils allow high infiltration rates and consist chiefly of deep, well- to excessively-drained sand or gravel. HSG A soils in Pleasant Valley are found along the Wappingers Creek, the East Branch of the Wappingers Creek and many of the smaller valleys (Figures 10 and 11b). Some of these soils have been managed as sand and gravel mines. Few to no HSG A soils are found on hillsides or hilltops, and most lie within short distances of streams or wetlands in valley settings.

Hydrologic Soil Group B soils have more moderate infiltration rates than HSG A soils. These soils generally have moderately-fine to moderately-coarse textures. HSG B soils are found on many of the rolling hills in western Pleasant Valley. Many of these hills appear to be drumlin-type hills, consisting primarily of glacial till. Soils in HSG B are also found in valley areas, including the valley followed by North Road north of Dutchess Quarry and in portions of the valley area near Wigsten and West Roads (Figures 10 and 11a).

Hydrologic Soil Group C and C/D soils have low infiltration rates and consist chiefly of soils with sufficient silt to substantially impede aquifer recharge. These soils have moderately-fine to fine textures and are found in areas with soils derived from glacial till. Some of the higher hills in western Pleasant Valley are covered with glacial till containing enough silt to fall in HSG C. Essentially all higher-elevation soils in eastern Pleasant Valley fall in HSG C (Figures 10 and 11a). Nearly 63 percent of Pleasant Valley is covered by Hydrologic Soil Group C or C/D soils.

Hydrologic Soil Group D soils have the lowest infiltration rates of any natural soils, and consist primarily of clay. Except for limited pockets in a few valley settings, there are few HSG D soils in Pleasant Valley (Figures 10 and 11b). Most HSG D soils lie in valley settings coincident either with current wetlands or in areas of glacial-era temporary lakes which became filled with glacial-era clay deposits.

A recent study in Dutchess County calibrated estimated aquifer recharge rates using Hydrologic Soil Groups (Chazen, 2006a). Aquifer recharge rates in the Wappinger Creek watershed were estimated at

- 18.2 inches/year through HSG A and A/D soils,
- 13.3 inches/year through HSG B soils,
- 6.8 inches/year through HSG C and C/D soils, and
- 3.8 inches/year through HSG D soils.

Using these aquifer recharge values, total estimated aquifer recharge entering aquifers throughout Pleasant Valley averages 14 million gallons per day, with average daily recharge occurring at rates of

- 1,354 gpd per acre through HSG A,
- 990 gpd per acre through HSG B soils,
- 505 gpd per acre through HSG C soils, and
- 283 gpd per acre through HSG D.

During drought years, average daily rates may decline by as much as 30 percent.

Groundwater flows supporting streams and riparian wetlands come both from the aquifer recharge flows described above, and from more transient groundwater movement, or interflow, which enters the subsurface but follows root channels, clay seams, or buried bedrock surfaces rather than penetrating deeply enough to reach aquifer formations. Interflow contributions to streams generally dwindle within a few weeks after major rains but are estimated to add an additional 35 percent of baseflow to streams in Pleasant Valley (Chazen, 2006b).

Such “interflow” represents an important portion of stream flow for a week or two following rainfall events; as this contribution eventually drains completely, baseflow from the underlying surficial and bedrock aquifers is relied upon to maintain continuing stream flow through longer droughts. The close proximity of most HSG

A soils to major steams means that although significant quantities of water recharges aquifers and interflow through these soils, this recharge is likely to reach streams soon after precipitation events. It is recharge entering the aquifer system furthest from streams which reaches streams longest after precipitation events. This is the recharge which is critical for the support of dry season stream flows and of any wells installed between the points of recharge and the streams. The majority of areas most distant from streams are on hillsides or other upland areas covered by HSG B or C soils.

Considering both aquifer recharge and interflow recharge together, approximate total groundwater recharge through soils in Pleasant Valley is estimated as follows

- 25.0 inches per year through HSG A and A/D soils,
- 18.2 inches per year through HSG B soils,
- 9.3 inches per year through HSG C and C/D soils, and
- 5.2 inches/year through HSG D soils.

3.4 Groundwater Flow

Plate 1 shows the estimated elevation of the watertable, or upper groundwater surface, of aquifers throughout Pleasant Valley. The estimates are based on evidence from observed perennial streams, ponds, and available well log records. In general, groundwater fills pore spaces and fractures within 20 to 30 feet below ground level in most areas, and nears the ground surface in the vicinity of streams, ponds, and streamside (reparian) wetlands (Figure 8b).

Groundwater moves toward lower elevations in the same manner as surfacewater, albeit far more slowly due to the intricacies of the pore and fracture pathways. Thus, groundwater flow moves from points of higher elevation to points of lower elevation, and then it discharges to valley stream systems. Flow arrows shown on Plate 1 show estimated general directions of groundwater flow, which can be used for general flow analysis. This map may be used to estimate recharge areas for particular wells, stream segments, or wetlands by inspecting lands upgradient (up-arrow, or uphill) from areas of interest. The map may also be used to identify areas downgradient (down-arrow) from any land uses of concern.

Plate 1 also shows discrete subwatersheds within Pleasant Valley. Although bedrock aquifers are continuous across the Town, groundwater recharged in one subwatershed cannot move through the subsurface to other subwatersheds. Plate 1 makes evident the importance of considering the sustainability of groundwater uses in each subwatershed.

3.5 Groundwater Quality

For the most part, groundwater quality in Pleasant Valley meets potable standards defined by the NYS Department of Health.

3.5.1 Natural Groundwater Quality

Natural concentrations of dissolved iron, manganese, elevated radiologicals (e.g. radon) and occasional hardness are mentioned as common natural water quality defects in Pleasant Valley bedrock aquifers. Iron and manganese are largely aesthetic concerns. Studies have noted that manganese often accompanies elevated iron (Miller, 1991). Hardness can lead to calcification of water pipes but is not considered a health hazard. Differences in total dissolved solids reflect tendencies of various formations to influence groundwater quality. Groundwater in carbonate formations is, for example, generally higher in dissolved solids than other rocks. Deeper wells also tend to have higher degrees of mineralization largely because the greater residence time of groundwater cycling through deeper fractures.

Groundwater in carbonate formations such as the dolomite along the Wappinger Creek may have higher sulfate, hardness, and total dissolved solids than other formations. Unconsolidated deposits may exhibit elevated total dissolved solids and hardness but have few other native defects; such formations will, however, be more susceptible to land use contaminants due to their proximity to grade. In some cases, mineral deposition in wells can lead to decreased yields over time which do not signal aquifer depletion, but rather indicate that the well may need to be rehabilitated or redrilled.

3.5.2 Introduced Contaminants

Typical groundwater quality impacts associated with various land uses include the following:

- Residential Development. Where septic systems are situated close to one another, groundwater quality may be over-loaded with discharges of nitrate, personal-use chemical discharges such as caffeine, pharmaceutical or hormone treatment residues, bacteria, and viruses. Wells or surfacewater bodies near such areas may be negatively affected as groundwater flows into these waters unless adequate recharge or open water movement is available to process or dilute these discharges. Groundwater quality in residential areas can also be impacted by homeowner releases of household chemicals and/or over-application of lawn fertilizers or pest control chemicals.

- Commercial and Industrial Uses. Groundwater quality can be affected by releases of petroleum, solvents, pesticides/herbicides, and dissolved metals. Risks of groundwater contamination associated with road deicing chemicals (salt) tend to be higher in commercial centers because de-icing efforts are often more intensive and paved coverage tends to increase.

- Agricultural. Groundwater quality can be impacted by agricultural activities where nutrient or fertilizer/pesticide management programs are not carefully monitored.

- Discrete areas of groundwater contamination (e.g. spill sites) are known to exist in Pleasant Valley, but were not the focus of this investigation.

<u>Salt</u>

Virtually all year-round roads in Pleasant Valley represent sources of potential salt contamination to groundwater quality. A USGS study completed in Putnam and Westchester Counties documented that chloride concentrations in streams were highest in watersheds with the most roads, closely relating road mileage to salt concentrations in the streams (Heisig, 2000). Chloride concentrations in the streams sampled by USGS ranged from approximately 5 to nearly 200 mg/l (parts per million). These samples were collected in summer when water in the streams normally comes from the local aquifers rather than from overland flow.

Road salt contamination tends to most severely impact aquifers where flat topography, and where inadequate curbing or other road runoff management allows excessive infiltration of salty snowmelt into the ground. Salt contamination of aquifers also can occur at ends of cul-de-sacs where melting and salty snow piles may accumulate, or near any uncovered salt-storage piles.

Homeowner complaints of road salt contamination often peak in winter. Where seasonal variation in salt complaints occur, road salting may be the suspected source of salt since road salting is heaviest during winter and spring months. Rates of road salting have generally increased in all northeastern States over the past three decades as public expectations for winter road drivability have evolved. No regional well sampling program has documented the full extent of road salt impact on groundwater quality.

Water softeners release salt to groundwater when regeneration wastes are discharged to septic systems. Several of the watersheds studied by Heisig (2000) were fully sewered and yet contained salt in their streams. This suggests road salt, rather than water softening salts was the dominant source of sodium chloride in those streams (Heisig, personal communication). Nonetheless, where softeners are extensively used, Heisig indicates that use of up to 700 or even 1,000 pounds of salt per year (equal to as many as 25 forty pound bags per year) is not unusual. Heavy softener use is most likely in areas with hard water coming from carbonate aquifers or areas with elevated iron in bedrock aquifers. Where wells are impacted by use of water softener salts, complaints are usually received from individual sites rather than over broad areas. Sampling guidance developed by the NYS Department of Transportation can be used to help distinguish between road salt and water softener salt contamination. Sodium concentrations in drinking water exceeding 20 mg/l are not recommended for those on severely restricted sodium diets, and water containing over 270 mg/l should not be used by people on moderately restricted sodium diets, according to NYS Department of Health regulations.

<u>Septic Systems – Nutrients</u>

Individual septic systems are used throughout Pleasant Valley since few wastewater treatment plants exist in the town. As reviewed above, wastewater releases primarily to subsurface systems may peak at 1,200,000 gpd in winter and fall to 825,000 gpd in summer. Wastewater constituent concentrations in such summer returns are, however, likely to be enriched since approximately the same waste load is expected to be discharged during all seasons, resulting in somewhat constant seasonal wastewater constituent loading to aquifers.

Wastewater constituents include nitrogen compounds. These typically convert to nitrate in aquifers. Nitrate does not decay much in aquifers and has a drinking water standard of 10 mg/l. The average person releases approximately 10 pounds of nitrogen waste per year (NJDEP, 2002). Where septic systems are too close together, groundwater quality can be locally degraded. To ensure that groundwater concentrations of nitrate do not routinely exceed 10 mg/l, a planning target of approximately 5 mg/l has been adopted by various communities, ensuring that most water quality, varying around the target of 5 mg/l remain reliably below the drinking water standard of 10 mg/l.

Stream sampling for nitrate was conducted by the Dutchess County Environmental Management Council during the 1990's. As reviewed previously, nitrate concentrations in the Wappinger Creek were found to generally increase down-watershed (Table 2) with gains in nitrate, as recorded in pounds per day per quarter mile of stream segment in the Wappinger Creek, occurring in the vicinity of the hamlet of Pleasant Valley. The contribution of nitrate from overland runoff versus groundwater baseflow is unknown. The most common sources of nitrate come from agricultural uses, domestic fertilizer uses, and from septic system releases. Pathways for nitrogen fertilizers to enter streams can be either from overland flow in stormwater flushes or by groundwater migration, whereas nitrogen from septic systems can only be conveyed by groundwater.

Sanitary wastewater contains phosphate as well as nitrogen wastes. The average person releases approximately 3 pounds of total phosphorous wastes each year (USEPA, 1980). Phosphorous in surfacewater can degrade lake or stream quality due to water over-nutrification. Phosphorous discharged by septic systems bonds to soils, with a saturation front moving outward as soil bonding sites are sequentially exhausted, resulting in an advancing phosphorous plume downgradient from septic systems, eventually reaching aquifer discharge locations in streams, wetlands or lakes. Phosphorous is not regulated as a drinking water contaminant although phosphorous is a significant contaminant in surface water bodies.

A recent NYCDEP study (NYCDEP, 2000) demonstrated that phosphorous readily travels more than 100 feet from septic systems toward streams or other open waters. Studies elsewhere indicate that phosphorous plumes therefore advance approximately 3 feet per year (Dr. William Harman, University of Binghamton, personal communication). At such rates, new homes situated 300 feet from streams might expect phosphorous to reach the stream after approximately 10 years. The NYCDEP (2000) study conclusively documents a wide range of capabilities in different soil types to hold phosphorous, explaining why rates of plume migration will vary widely.

Septic Systems – Bacteria and Viruses

Bacteria and viruses are often assumed to die off or be sufficiently filtered within a few hundred feet of a point of release at a septic system. A NYCDEP septic system study, however, documented several cases where coliform migrated at least 100 feet from septic system leaching fields (NYCDEP, 2000). The NYS Department of Health requires stipulated separation distances between wells and septic systems to limit bacterial or viral transmission to wells.

During 2002, 2003 and 2005, Smith Environmental Laboratory (Smith lab) tallied monthly e-coli detections and the Dutchess County Department of Health (DCDOH) laboratory tallied weekly e-coli and total coliform detections in Northern Dutchess including Pleasant Valley. Analysis of this data, showed that in dry summer months the percentage of wells containing e-coli could be up to 10%. This data, along with well data from the monitoring network set up by the DCWWA show a potential relationship between e-coli well failures and wells experiencing no effective recharge for a period of 30 to 50 days associated with minimal precipitation and high evapo-transpiration loses (TCC, 2006).

E-coli coliform inhabits intestinal tracts, so is a potential indicator of waste transmission between septic systems and wells. The increase in *e*-coli detections during dry periods suggests that wells may occasionally draw water from distant locations including from near septic system leaching fields during dry months. The

Dutchess County data suggest that wells and streams may be affected by coliform from septic systems, including some wells being at least seasonally affected by *e*-coli contamination.

Septic Systems – Pharmaceuticals and other Compounds

Recent research indicates that a wide range of lifestyle chemicals are being released to wastewater systems (USGS, 2002) including septic systems. Chemicals include caffeine and medicines such as steroids, nonprescription drugs such as ibuprofen and acetaminophen, detergent byproducts and plasticizer chemicals from many flexible plastic containers. Few of these chemicals decay when released to septic systems; many have been found in watershed streams where septic systems are the only likely source of wastewater release (P. Phillips, USGS, 2003, personal communication). The relationship between septic system discharges and contaminant presence in streams suggests these chemicals migrate through aquifers from the septic systems to the streams and so may also be withdrawn from aquifers by wells.

No local studies confirming the presence of such life-style chemicals in groundwater are known to be occurring in the region. Sewage treatment plants are also not presently required to analyze or treat wastewater for these chemicals so few wastewater treatment data are available. No drinking water standards yet exist for most of these chemicals, although standards may be anticipated in coming years. Presently, dilution in stream flow or dilution in aquifers by other recharge appears to be the most readily available management approach for these chemicals.

3.6 Future Water Supply Areas

All geologic formations in Pleasant Valley have a history of providing adequate groundwater supplies to support domestic wells. In general, the selection of locations for domestic wells can proceed on the basis of convenience and appropriate separation distances betweens wells and other site features.

Candidate locations for future higher-capacity wells have not been mapped as part of this investigation since site specific investigation would be a required part of such efforts. Any investigations leading to installation of wells which will produce more than 50 gallons per minute should likely focus either in areas with known sand and gravel deposits or in areas where larger concentrations of fractures can be identified in bedrock formations.

Sand and gravel deposits in Pleasant Valley lie primarily along the Wappinger Creek, along the southern tributary of the Great Spring Creek extending behind Timothy Heights, and in the basin traversed by North Avenue. These areas are shown as major valley sediment aquifer areas on Plate 1. Water supply exploration in these sediments would include soil borings to more fully characterize the depth and sediment distribution, the design and installation of test wells, and well testing.

Higher-flow wells installed elsewhere in Pleasant Valley would likely occur in fractured bedrock. Where larger fractures exist and extend to the land surface, the fractures can be susceptible to accelerated weathering and erosion. Linear landscape features which cross-cut otherwise uninterrupted ridges and valleys are often clues to the locations of such fractures. The Chazen Companies have identified various linear features in Pleasant Valley (Figure 6), some of which may represent fracture traces. Many north-to-south linear features evident on Figure 6 are not marked as potential fracture traces because field investigation would be required to distinguish between those associated with fractures versus those formed as simple weathered depressions between rock ridges. Exploration for higher-capacity wells in areas with potential high-yield fractures includes drilling candidate bedrock wells and determining available yields via pumping tests.

Evaluations of the long-term reliability of any new higher-capacity wells should include development of a water balance considering volumes of available groundwater recharge, the demand of the new wells, and consideration of any potential drawdown impacts on pre-existing wells and stream flow depletion which might be caused by use of the new well, particularly if wastewater is not returned locally to offset extracted water volumes.

4.0 GROUNDWATER RESOURCE MANAGEMENT

4.1 Groundwater Summary

Aquifers represent the sole source of water for the current population of Pleasant Valley. There has been recurring discussion of development of a central water supply system for the hamlet of Pleasant Valley. One possible source of water is a connection to Poughkeepsie's water supply, but the most frequently discussed source of water would be groundwater wells within Pleasant Valley.

Sand and gravel aquifers may provide groundwater for future central water supply wells. The most extensive sand and gravel areas lie along the Wappinger Creek north of the hamlet of Pleasant Valley, with other potential sources of sand and gravel situated near the Wappinger Creek in the Great Spring Brook sub-watershed. Smaller sand and gravel deposits which may lie below the watertable and thus provide opportunities for groundwater well installations may exist in valley areas with Hydrologic Soil Group A soils on Figure 11b.

Under these regionally limited surficial deposits, there is a regionally-continuous fractured bedrock aquifer capable of supporting individual well yields, and potentially capable of supporting higher yields where wells intercept several intersecting fractures. Groundwater within the town-wide bedrock aquifer moves locally toward nearby streams, supporting these surface water resources during dry periods and supporting current wells.

Groundwater in the Town is recharged by precipitation infiltrating through overlying soils. Most groundwater recharge occurs at annual average rates of approximately 18.2 inches per year through Hydrologic Soil Group A and A/D soils, 13.3 inches per year through HSG B soils and 6.8 inches per year through HSG C and C/D soils, which all together cover over 90 percent of the Town.

A characteristic of aquifers in Pleasant Valley is the segmenting of groundwater resources into many small watershed areas in the Town. Groundwater in each of the resulting small watershed areas is isolated from groundwater in adjacent areas, and only mixes when converging in the discharging streams. Well depletion in one area cannot, therefore, be mitigated by groundwater available in other watershed areas although the same general bedrock aquifer underlies the entire Town.

Town-wide average daily aquifer recharge is estimated to substantially exceed current demand; however, local areas of groundwater over-use may exist, either because of pumping which exceeds local recharge rates, or because septic systems are installed so close together that local groundwater quality is degraded.

4.2 Available Yield

A functional approach to managing available yield in the Town of Pleasant Valley should involve a twofold strategy:

- Require preparation of a water recharge budget and careful analysis of off-site drawdown impacts for any larger new wells proposed in the Town
- Ensure that residential parcels developed with individual wells and septic systems meet minimum parcel size criteria to support wells and to adequately dilute septic system wastewater discharges (see section 4.3). This management approach ensures that residential uses only intercept a fraction of total groundwater recharge, thus also preserving dry-season stream flows.

Communities in the Harlem Valley have discussed additional planning objectives seeking to balance water consumption by residential/commercial populations against the need to preserve stream flows. The 1999 Harlem Valley aquifer report identified a planning objective of limiting water consumption to half of the drought-stream stream flow (7Q10) flow. By this planning objective, water consumption in the watersheds of the Drake Brook and Great Spring Brook watershed would need to be limited to using not more than 35 gallons per minute and 25 gallons per minute, respectively, for any new uses occurring since the stream gauging standard period of 1931 though 1960. At a per-capita daily water consumption rate of 20 gallons per day (0.014 gpm), total population growth within these largely residential watersheds from 1960 on could be limited by this planning objective not to exceed approximately 4,320 persons or 1,660 homes, excluding any allocation of water for significant commercial/business water needs in these two watersheds. It is unknown how many homes have already been built in these two watersheds since approximately 1960.

Water demand within the Pleasant Valley hamlet and along the Route 44/Wappinger Creek corridor does not draw water from the Drake Brook or Great Spring Brook watersheds, and instead draws water primarily from subwatershed aquifer areas immediately along the Wappinger Creek. This concentration of uses focused in small subwatershed areas along the Wappinger Creek may explain why flow reductions have been observed during some recent stream gauging sessions. There has been discussion of installation of central wells in the Pleasant Valley hamlet. If this occurs, it is expected to impose little to no net regional water budget impact since the project would simply replace use of many existing individual wells; with centralized wells.

4.3 Minimum Parcel Sizes

Where individual wells and traditional septic systems are likely to be in long-term use, average parcel sizes should be large enough that on-site recharge can both sustain well use and provide adequate dilution for wastewater discharges. Nitrate loading analysis has been provided to predict where wastewater constituents may be overloading aquifers, either now or in the future.

To help identify minimum sustainable parcel sizes where wells and septic systems the Dutchess County Water & Wastewater Authority recently funded an analysis of aquifer loading rates based on a variation of New Jersey's septic system minimum density calculation (Chazen, 2006a). The study identifies minimum average recommended parcel sizes for Pleasant Valley. The nitrate loading calculation formula is shown below.

$$A = (4.4186HM / CqR) + Isc$$

Where

A = recommended minimum acres per system, in acres (e.g. parcel size)
H = persons per system
M = pounds of nitrate-nitrogen per person per year
Cq = Nitrate-nitrogen target average groundwater concentration, in mg/L
R = Annual Recharge Rate, in inches
Isc = Impervious surface cover, in acres

This formula can allow flexibility for evaluating unique projects, but may also be used with default values for broad planning purposes. The recommended default values are:

H = 2.6 persons per household, representing regional typical occupancy levels
M = 10 pounds of nitrate-nitrogen.
Cq = 5 mg/l, equal to half the nitrate drinking water standard so that, as results average around this goal, most outcomes will remain below the standard.
Isc = 0.1 acres, to address driveways, roofs and other impervious surfaces.
R = use annual average recharge rates addressed elsewhere in this report for each of the four Hydrologic Soils Groups.

Using the recommended formula, minimum average parcel sizes suggested in Pleasant Valley for areas using individual wells and traditional septic systems are as follows:

For areas with Hydrologic Soil Group A:	1.3 acres per system
For areas with Hydrologic Soil Group B:	1.8 acres per system
For areas with Hydrologic Soil Group C:	3.3 acres per system
For areas with Hydrologic Soil Group D:	5.9 acres per system

Figure 12 shows areas in Pleasant Valley where existing parcels underlain by each of the four Hydrologic Soil Groups are below the parcel sizes referenced above. Figure 13 consolidates the undersized parcels into a single presentation format. Where single parcels or small groups of parcels are identified, it is unlikely that well water quality is at risk since adjoining larger parcels are likely to be providing compensatory recharge, preserving overall local groundwater quality. However, several larger clusters of under-sized parcels exist. In these areas, some decrease in groundwater quality may be expected and water quality nitrate concentrations may be nearing or even exceeding the drinking water standard for nitrate of 10 mg/l.

The Town may wish to ensure that rural area average parcel sizes average at least 3 acres to ensure that the extensive areas with Hydrologic Soil Groups B and C in eastern and western parts of the Town can function sustainably using individual wells and septic systems.

Additional sources of nitrate in aquifers do exist but are not included in this density model. For example, properly applied lawn fertilizers are fully utilized by site vegetation and will not contribute to elevated regional groundwater nitrate concentrations. Moreover, lawn fertilizer is not used at all homes, and is applied at ground surface rather than being released below ground level as are septic system discharges. Accordingly, nitrate from lawn fertilization can be readily addressed or mitigated by modified practices and community best management practice education and so need not be included in the calculations above.

4.4 Aquifer Protection

Most residents and businesses in Pleasant Valley use wells which are individually owned and for which no routine sampling is required. Since all geologic formations in Pleasant Valley are used for water supply purposes, this study recommends adoption of an aquifer overlay protection ordinance to provide a measure of groundwater quality protection in the community.

A model aquifer ordinance potentially suitable for adopting in Pleasant Valley is included in Appendix A. The ordinance was developed by Dover, Amenia, North East and Pawling with assistance from the Dutchess County Water & Wastewater Authority. It has received legal review to verify municipal authority on addressed topics. The latest version of this model, provided in Appendix A, is currently under consideration for adoption in the Town of Amenia and could be readily adapted for use in Pleasant Valley.

Briefly, the advantages of our recommended application of this aquifer protection model include:

1. Some measure of aquifer protection is provided for all lands in the Town.

2. The model provides both groundwater quality and groundwater capacity protection. Proposed activities requiring more water than that recharged on the individual site is accorded a higher level of SEQRA review.
3. The highest level of aquifer protection could be reserved for wellhead protection areas for community wells. More flexible aquifer protection is recommended for all other areas, or the Town could provide the higher level of protection for priority sand and gravel aquifers.

An aquifer overlay map for the Town of Pleasant Valley would be needed which encloses the complete Town and identifies wellhead protection areas for community water system wells such as the Valley Dale water system wells or for any wells developed for use in a hamlet water supply water district. The entire town would lie within the Regional Aquifer overlay district and receive a general level of aquifer protection. Recharge areas for any community water systems wellfields would receive a higher level of aquifer protection due to greater number of households and businesses dependent on continuing well water quality. As more public water supplies are developed, more wellhead protection areas can be delineated and added to this map.

If an aquifer protection ordinance is to be adopted, the first portion of Section B1 of the model ordinance in Appendix A text could be revised as follows:

> 1. The Aquifer Overlay (AQO) District encompasses the entire Town of Pleasant Valley and includes two types of aquifers: the town wide Regional Aquifer (RA) offers groundwater protection to bedrock or surficial aquifers throughout the Town. Particular Regional Aquifer Wellhead Protection (RAWP) areas warranting enhanced aquifer protection are delineated where community water system well fields are installed within the RA.

If these application and aquifer protection concepts are accepted by the Town, the rest of the model ordinance would need to be changed to match the terminology suggested above.

4.5 Pumping Test Protocols

Where wells are installed for new community water supplies, testing of wells must conform with protocols required by the NYS Department of Environmental Conservation. Wells intended for such uses are normally required to undergo testing for at least 72 hours at pumping rates equal to twice the average estimated daily demand rate.

The 72-hour test protocol used for most community water systems is appropriately conservative since it is normally conducted at twice the average proposed project daily water demand, and so is likely to successfully identify groundwater shortages in a project area. During project scheduling and SEQRA scoping for such projects, the Town Planning Board should be encouraged to ensure that the following additional test and review components are met:

1. Off-site monitoring in any adjacent existing wells, streams and/or wetlands.
2. Analysis and comparison of proposed water consumption (extraction less wastewater returns) to best estimates of local drought-flow level (e.g. 7Q10) in nearby watershed streams.
3. Flow tests should be a minimum of 72 hours long, and should be extended if necessary until water levels in test wells and monitored on-site and off-site wells stabilize.
4. The report including test results should include well drawdown projections showing how low water levels will fall during extended dry periods of up to 180 days.

Present testing protocols for non-community wells are reasonably conservative, but Applicants should be asked as part of SEQRA analysis to provide a water budget comparing onsite recharge to water uses. This will help predict whether off-site drawdown impacts should be anticipated and/or assessed.

Where subdivisions of approximately 10 or more parcels are proposed using individual wells and septic systems <u>and</u> where average parcel sizes smaller than those recommended in Section 4.3 are allowed by zoning, some specific analysis may be warranted as part of project SEQRA reviews. The County Department of Health currently requires pre-installation and testing of 20% (1 in 5) of proposed wells on such subdivisions. Applicants usually test the wells sequentially rather than concurrently, and each test usually last less than one day. By means of a local ordinance or a strongly recommended guidance administered by the Planning Board, testing of pre-drilled individual wells could be improved by requiring simultaneous tests, extending at least to 24 hours, and potentially to as long as 72-hours if particularly-sensitive on-site or off-site conditions are identified by the reviewing board. The discharge rate for testing of each pre-drilled well should be a minimum of 5 gallons per minute (gpm).

4.6 Road De-Icing

Salt is a regionally-recognized groundwater contaminant. Chloride contamination in wells has been documented in many some towns. Road salt is a primary source of salt in groundwater. Water softener salt discharges can also contaminate wells.

Subdivisions with individual wells should include impervious snow accumulation areas for ends of roads or other areas likely to accumulate particularly large snow volumes. In addition to ends of cul-de-sacs, snow accumulation or salt runoff accumulation can occur in wells found at the bottom of hills or immediately downhill from intensively managed road margins.

Impervious snow accumulation areas connected to runoff-control conveyances may be warranted in some areas to ensure that undissolved salt does not accumulate in soils and dissolve throughout the year near any domestic wells. Select areas may be identified as particularly vulnerable to salt contamination of groundwater resources and wells, warranting designated "no salt" road segments. Infiltration practices introducing road runoff directly into aquifers should be discouraged.

Protocols developed by the NYS Department of Transportation can be used to help distinguish between road salt and water softener contamination in wells.

4.7 Stormwater Management

Various surfacewater management programs also benefit groundwater conservation and management strategies. Pleasant Valley should encourage the use of disconnected impervious surfaces, stormwater detention and infiltration techniques, and protection of natural vegetation around water bodies to offset development impacts which can both reduce groundwater recharge and increase stormwater runoff impacts. Such approaches can include infiltration and other Best Management Practices within the stormwater program. A town planning policy should be considered, stating that site development should seek to maintain pre-development runoff characteristics to both ensure adequate aquifer recharge and minimize stormwater flooding and surface water quality impacts.

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Tables

Table 1 - Stream Flow
Wappinger Creek and Tributary Flows - USGS Data
Percent Freqency Analysis

	Watershed size	Frequency for which flow is equal or exceeded, in million gallons per day per square mile					
Location	square miles	10%	30%	50%	70%	90%	7Q10
East Branch of Wapp Creek at Clinton Corners	33.3	1.82	0.89	0.52	0.27	0.107	0.042
Main Stem of Wapp Creek at Clinton Corners	92.4	2.21	1	0.54	0.23	0.091	0.034
Little Wapp Creek at Salt Point	32.9	1.89	0.82	0.42	0.17	0.042	0.007
Great Spring Brook near Sherow Rd.	15.7	2.02	0.82	0.41	0.13	0.02	0.005
Drake Brook upstream of old Mill Dam	5.5*		1.76	0.83	0.23	0.02	0.013
Drake Brook Tributary, entering Drake Brk below dam	7*			0.1	0.07	0.037	0.014
Wap Creek below Pleasant Valley at Red Oaks Mill	181	2.12	0.99	0.54	0.22	0.078	0.027

	Watershed size	Frequency for which flow is equal or exceeded, in gallons per minute					
Location	square miles	10%	30%	50%	70%	90%	7Q10
East Branch of Wapp Creek at Clinton Corners	33.3	42,636	21,093	12,118	6,283	2,468	942
Main Stem of Wapp Creek at Clinton Corners	92.4	139,128	62,832	33,660	14,810	5,835	2,154
Little Wapp Creek at Salt Point	32.9	42,187	18,401	9,425	3,815	942	157
Great Spring Brook near Sherow Rd.	15.7	21,991	8,976	4,488	1,481	224	49
Drake Brook upstream of old Mill Dam	5.5*		6,732	3,142	898	67	0
Drake Brook Tributary, entering Drake Brook below old dam	7*			494	336	180	67
Wap Creek below Pleasant Valley at Red Oaks Mill	181	269,280	125,664	71,359	27,825	9,425	3,411

Data Source: Ayer & Pauszek, 1986. Period of Record adjusted to 1931-1960.
Data conversion to gallons per minute by: The Chazen Companies
Example: 70% column means this flow or a greater flow is observed 70 percent of days and lower flow is observed 30% of days.
7Q10 means the 7-day average low flow observed during a statistical 1-in-10 year drought.
*Watershed areas for the Drake Brook have been revised by TCC and yield/square mile factors in uppermost table changed accordingly.

Table 2 - Stream Flow and Water Quality Data - DCEMC Data
Wappinger Creek near Pleasant Valley

	Stream Flow in GPM					
Relation to ROM frequency data:	>Q90	Q90	<Q90	Q30	>Q30	Q30
Season:	early summer	summer	late summer	autumn	winter	winter
Date:	Jun-97	Sep-97	Oct-97	Nov-97	Jan-98	Feb-98
Stream Location						
Wapp Crk at CR 13	10,582	6,624	6,081	53,811	86,977	50,535
Wapp Crk at Hurley Rd.	10,897	6,799	3,994	55,319	104,844	60,229
Wapp Crk at Town Hall	15,636	4,488	2,989	113,250	124,802	66,777
Wapp Crk at DeGarmo Rd	18,715	10,735	5,552	122,926	136,108	65,233
Wapp Crk at Red Oaks Mill (ROM)	17,054	8,078	6,734	125,664	184,457	127,459

	Nitrate Concentration, mg/l					
Date:	Jun-97	Sep-97	Oct-97	Nov-97	Jan-98	Feb-98
Stream Location						
Wapp Crk at CR 13	2.91	0.36	0.24	0.08	0.51	0.43
Wapp Crk at Hurley Rd.	3.08	0.54	0.38	0.07	0.46	0.38
Wapp Crk at Town Hall	3.18	0.43	0.30	0.08	0.47	0.32
Wapp Crk at DeGarmo Rd	3.22	0.37	0.50	0.17	0.54	0.43
Wapp Crk at Red Oaks Mill (ROM)	3.16	0.20	0.27	0.09	0.54	0.39

	Nitrate Gain relative to next upstream station, Kg/Day per 1/4 mile					
Date:	Jun-97	Sep-97	Oct-97	Nov-97	Jan-98	Feb-98
Stream Location						
Wapp Crk at CR 13	--	--	--	--	--	--
Wapp Crk at Hurley Rd.	1.20	0.60	0.00	-0.10	1.60	0.50
Wapp Crk at Town Hall	5.10	-0.50	-0.20	1.60	3.50	-0.50
Wapp Crk at DeGarmo Rd	3.40	0.60	0.60	3.50	4.70	2.10
Wapp Crk at Red Oaks Mill (ROM)	--	--	--	--	--	--

	Phosphate Concentration, mg/l					
Date:	Jun-97	Sep-97	Oct-97	Nov-97	Jan-98	Feb-98
Stream Location						
Wapp Crk at CR 13	0.013	0.110	0.043	0.060	0.021	0.030
Wapp Crk at Hurley Rd.	0.034	0.066	0.040	0.037	0.032	0.022
Wapp Crk at Town Hall	0.007	0.069	0.038	0.044	0.018	0.190
Wapp Crk at DeGarmo Rd	0.011	0.078	0.037	0.040	0.023	0.023
Wapp Crk at Red Oaks Mill (ROM)	0.016	0.115	0.044	0.032	0.000	0.031

	Phosphate Gain relative to next upstream station, Kg/Day per 1/4 mile					
Date:	Jun-97	Sep-97	Oct-97	Nov-97	Jan-98	Feb-98
Stream Location						
Wapp Crk at CR 13	--	--	--	--	--	--
Wapp Crk at Hurley Rd.	0.10	-0.10	0.00	-0.50	0.41	-0.10
Wapp Crk at Town Hall	-0.10	0.00	0.00	0.90	-0.17	0.00
Wapp Crk at DeGarmo Rd	0.00	0.20	0.00	0.00	0.30	0.10
Wapp Crk at Red Oaks Mill (ROM)	--	--	--	--	--	--

Data Source: Records of Dutchess County Environmental Management Council Wappinger Creek Program
Data formatted by: The Chazen Companies
Data shading added by The Chazen Companies for emphasis and discussed in report text.

Table 3 - Stream Flow - DCWWA Data collected by The Chazen Companies
Flow Data and Yield-per-Acre Analysis

Watersheds	Site #	Waterway Name and Gaging Location	Contributing Area Upstream of Gaging Site	November 6-8, 2001				August 12-14, 2002				September 24-26, 2002				1931-1960	
				Streamflow			Groundwater Yield per Acre	Streamflow			Groundwater Yield per Acre	Streamflow			Groundwater Yield per Acre	Groundwater Yield per Acre	
																Q90*	7Q10*
			acres	cfs	gpm	gal / day	gal / day / acre	cfs	gpm	gal / day	gal / day / acre	cfs	gpm	gal / day	gal / day / acre	gal / day / acre	gal / day / acre
Ten Mile River	1	Ten Mile: USGS Gaging Station at Connecticut Border (Old Forge Road)	**131,562**	22.95	10301	14,832,934	**113**	27.74	12448	17,925,552	**136**	19.22	8624	12,418,947	**94**	**169**	**61**
	4	Ten Mile in Dover Plains (Ten Mile River Drive)	**90,950**	16.30	7316	10,534,938	**116**	17.26	7745	11,152,169	**123**	13.85	6216	8,951,466	**98**	na	na
	6	Webatuk Creek at Leedsville Road	**35,574**	4.35	1952	2,811,471	**79**	4.33	1941	2,795,313	**79**	3.59	1609	2,317,040	**65**	na	na
	2	Swamp River: @ Route 6 (Old Post Road)	**31,490**	5.05	2267	3,263,892	**104**	3.98	1784	2,569,103	**82**	2.27	1017	1,463,904	**46**	**135**	**33**
	5	Amenia Brook at Wassaic (Across from Fire Station)	**7,135**	1.70	763	1,098,736	**154**	1.93	866	1,247,388	**175**	1.43	640	920,999	**129**	**136**	**59**
Fishkill Creek	7	Fishkill Creek at Beacon (Bridge Street, Old USGS Station)	**126,125**	16.85	7563	10,890,411	**86**	26.73	11995	17,272,774	**137**	13.54	6075	8,747,876	**69**	**128**	**31**
	8	Sprout Creek near Fishkill (Mountainview Road)	**38,855**	2.90	1302	1,874,314	**48**	3.56	1598	2,300,882	**59**	4.04	1811	2,607,882	**67**	na	na
	9	Sprout Creek near La Grange (Bridge on Route 376)	**36,320**	3.30	1481	2,132,840	**59**	5.66	2538	3,654,912	**101**	5.10	2287	3,292,976	**91**	**77**	**5**
	10	Fishkill Creek at E. Fishkill/Beekman Line (Phillips Road)	**31,769**	5.60	2513	3,619,365	**114**	7.52	3375	4,860,290	**153**	4.01	1800	2,591,724	**82**	na	na
	11	Fishkill Creek at Beekman/Unionvale Line (Route 55)	**10,096**	2.45	1100	1,583,472	**157**	4.75	2130	3,066,766	**304**	3.00	1344	1,935,714	**192**	na	na
Wappingers Creek	13	Wappingers Creek at Red Oaks Mill (USGS Gaging Station)	**109,232**	15.65	7024	10,114,833	**93**	17.17	7706	11,097,232	**102**	12.03	5397	7,771,940	**71**	**124**	**45**
		USGS Data for Wappingers Creek at Red Oaks Mills	**109,232**	14.00	6284	9,048,413	**83**	14.00	6284	9,048,413	**83**	12.00	5386	7,755,782	**71**	na	na
	14	Wappingers Creek at Pleasant Valley (Route 44 behind Town Hall)	**99,610**	14.65	6575	9,468,518	**95**	13.37	5999	8,638,003	**87**	7.27	3263	4,698,712	**47**	na	na
	15	Upper Wappingers Creek @ Town of Clinton Line (Park at Hibernia Rd)	**36,397**	5.95	2671	3,845,575	**106**	3.67	1647	2,371,977	**65**	3.37	1511	2,175,174	**60**	**133****	**48****
	17	East Branch Wappingers Creek (Hibernia Road Bridge)	**21,618**	3.15	1414	2,035,893	**94**	3.32	1490	2,145,766	**99**	3.48	1561	2,247,884	**104**	**164**	**63**
	16	Little Wappingers Creek (Salt Point Turnpike @ Salt Point Dam)	**20,557**	0.85	382	549,368	**27**	0.71	319	458,884	**22**	0.69	309	444,245	**22**	na	na
Crum Elbow	18	Crum Elbow Creek (Bridge crossing at Route 41)	**12,556**	0.70	314	452,421	**36**	0.66	296	426,568	**34**	0.54	240	346,037	**28**	**98**	**8**
Sawkill	19	Sawkill Creek at Red Hook (Route 9)	**12,515**	1.60	718	1,034,104	**83**	3.24	1452	2,090,830	**167**	1.89	846	1,218,304	**97**	**238**	**129**
Landsman Kill	20	Landsman Kill Creek (Downtown Rhinebeck)	**6,826**	4.50	2020	2,908,418	**426**	1.07	480	691,557	**101**	0.58	261	375,800	**55**	**95**	**0**

* Q90 is the 90% exceedence value for groundwater yield, based on the period of record from 1931-1960. 7Q10 is the lowest seven day average yield that occurs every 10 years. Q90 and 7Q10 values for stream discharge (Ayer and Pauszek, 1968) were used to c
** Calculated by subtracting value for East Branch Wappingers from value just downstream of confluence point.
na - no statistical data available for this location

Reproduced from Chazen, 2003, County-wide Groundwater Monitoring Program; 2002 Annual Report

Figures

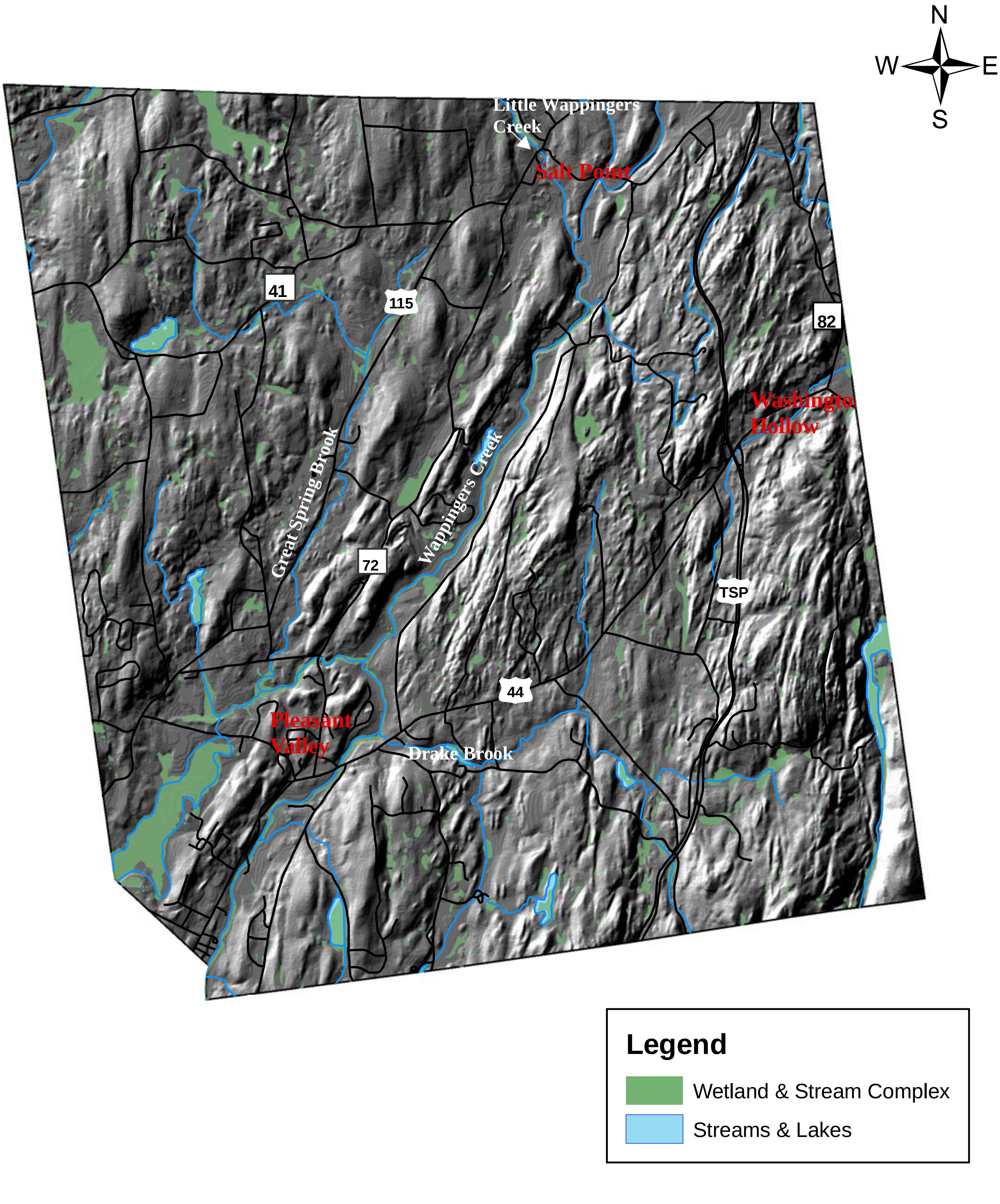

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FIGURE1: HILLSHADE SITE REFERENCE MAP

Town of Pleasant Valley, Dutchess County, New York

Source: TCC GIS Database for Dutchess County

Date:
May 2007

Scale:
1 in equals 5,000 ft

Project #:
40603.00

Legend

Western Section

- Oag: Greywacke & Shale
- On: Shale & Siltstone
- Otm: varying large clasts in a silty matrix

Central Valley

- Ocw: Dolomite and Limestone with minor Shale
- Oba: Limestone

Eastern Section

- Cn: Shale & Quartzite
- Cg: Shale, Limestone & Conglomerate
- Osf: Shale & Siltstone
- Omi: Shale & Chert

Greywacke: Sandstone with a silt/clay matrix

Low-level metamorphism observed in the eastern Pleasant Valley

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FIGURE 2- BEDROCK GEOLOGY

Town of Pleasant Valley, Dutchess County, New York

Sources: Bedrock Geology from NYSGS Bedrock Geology Map, Lower Hudson Sheet, Dated 1970, Reprinted 1995;

Date:
May 2007

Scale:
1 in equals 5,000 ft

Project #:
40603.00

Figure 3A:
Little Wappingers Creek near Salt Point

Figure 3B:
Convergence of two Drake Brook tributaries in ragged landscape near Mill Lane

Figure 3C:
Great Spring Brook near North Ave.

Figure 3D:
Southern tributary of the Great Spring Brook at West Road

Figure 4A:
Metamorphically altered shale near Masten Road and Taconic Parkway.

Figure 4B
Rolling Landscapes in eastern Pleasant Valley. View South from Fox Run Road.

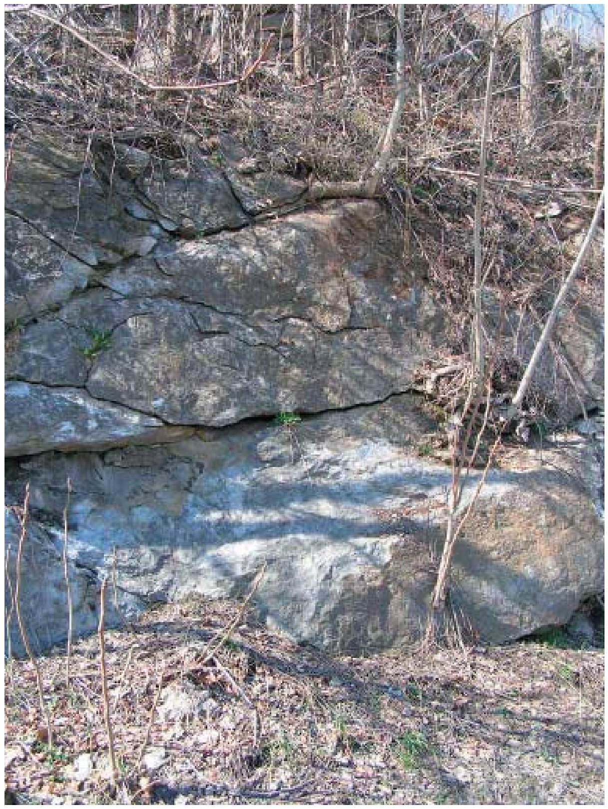
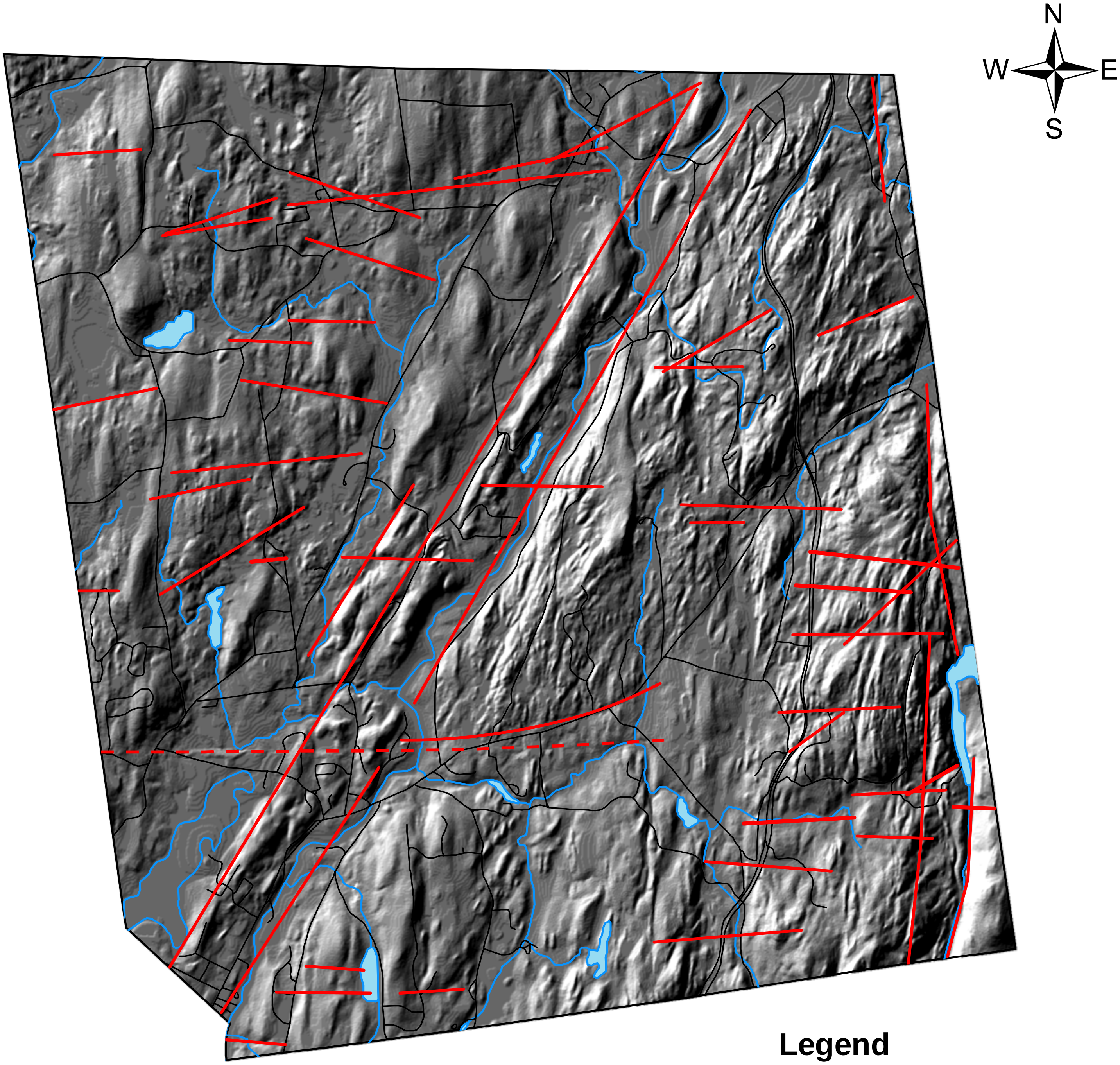


Figure 5A

Dolomite near Pleasant Valley Town Hall with Fractures.

Figure 5B:

Shale with Deformation but few fractures along South Aveanue.



Legend

- Roads
- Rivers
- Lakes & Ponds
- Linear Features

NOTE: The linear features identified on this map suggest, but do not guarantee, the existence of underlying water-bearing fractures or fracture systems. Fractured bedrock zones may also underlie prominent, north-to-south valley alignments.

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FIGURE 6: PRELIMINARY FRACTURE TRACE MAP

Town of Pleasant Valley, Dutchess County, New York

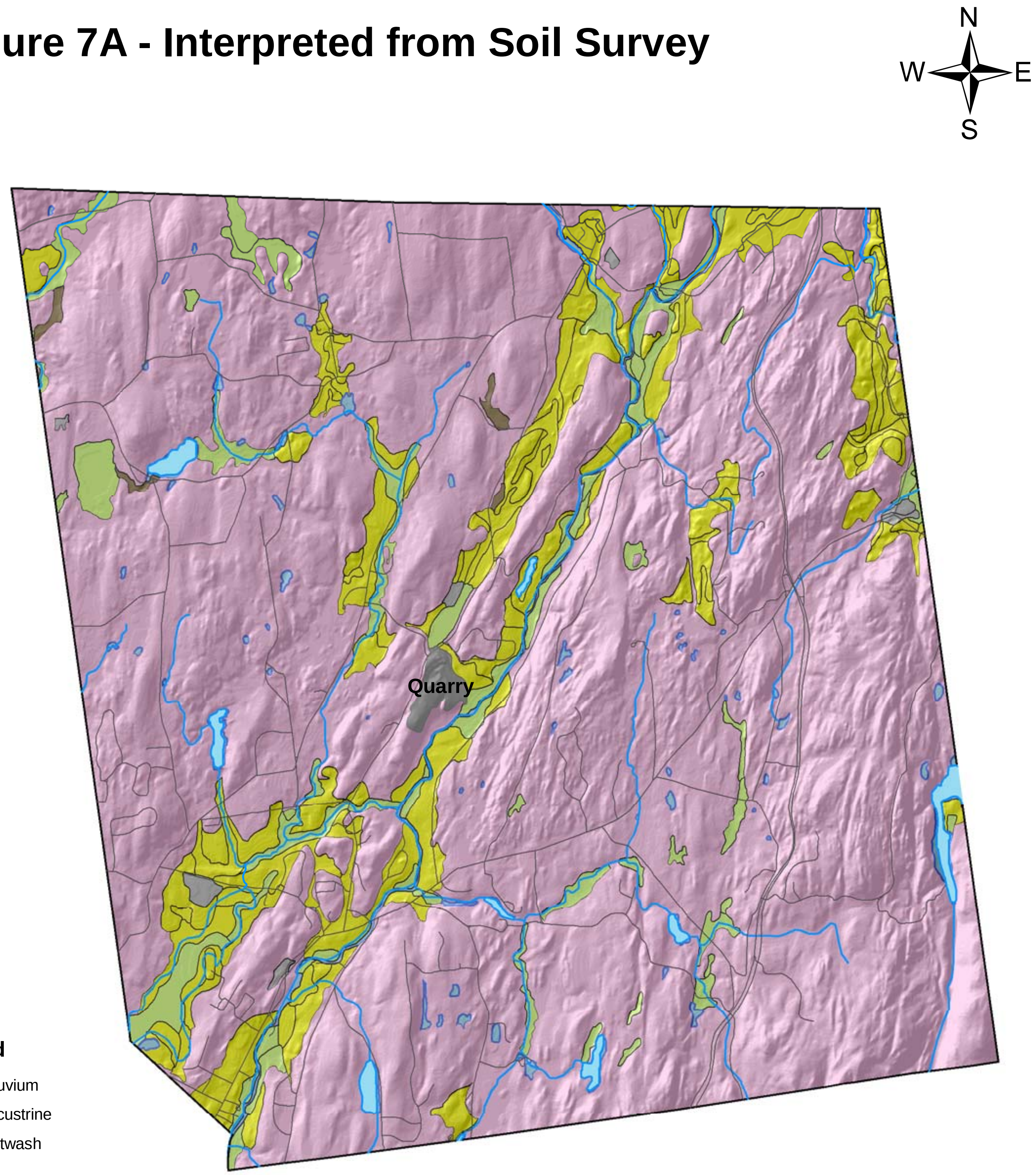
Source: Linear features mapped by The Chazen Companies, 2007.

Date:
May 2007

Scale:
1 in equals 5,000 ft

Project #:
40603.00

Figure 7A - Interpreted from Soil Survey

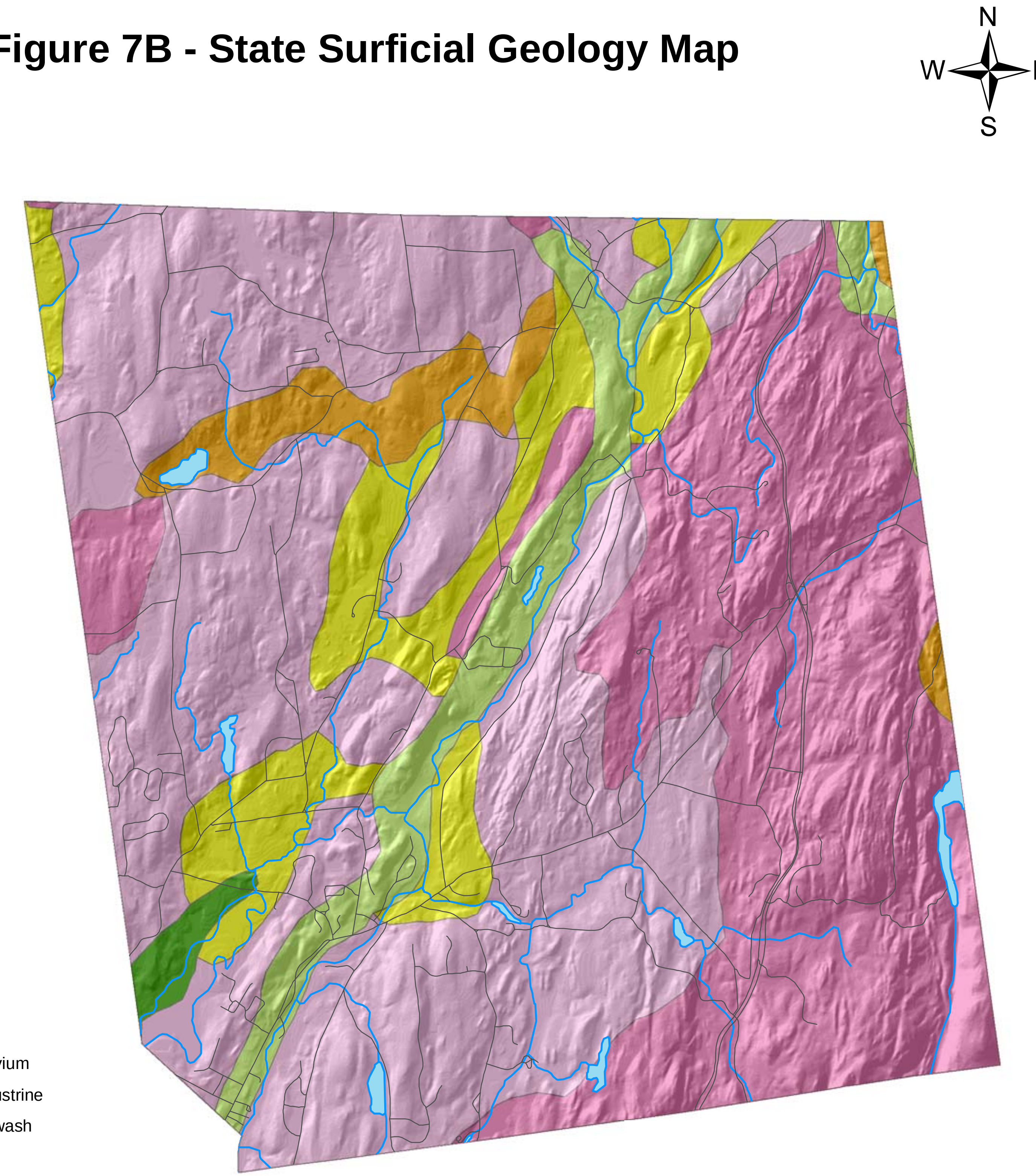


Legend

- Alluvium
- Lacustrine
- Outwash
- Till
- Undefined
- Water body

1 inch equals 5,000 feet

Figure 7B - State Surficial Geology Map



Legend

- Alluvium
- Lacustrine
- Outwash
- Till
- Undefined
- Water body
- Kame deposit
- Exposed rock or till less that 1 meter

1 inch equals 5,000 feet

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-

FIGURE 7A, 7B - SURFICIAL GEOLOGY MAPS

Town of Pleasant Valley, Dutchess County, New York

Sources: Figure 7A derived by TCC from USDS Soil Survey of Dutchess County. Figure 7B from NYSGS Surficial Geology Map, Lower Hudson Sheet, 1989.

Date: May 2007	
Scale: As Shown	
Project #: 40603.00	

Figure 8A
Rolling topography and gravel mine off North Ave near Salt Point.

Figure 8B
Wetlands near North Ave at Hurley Road.

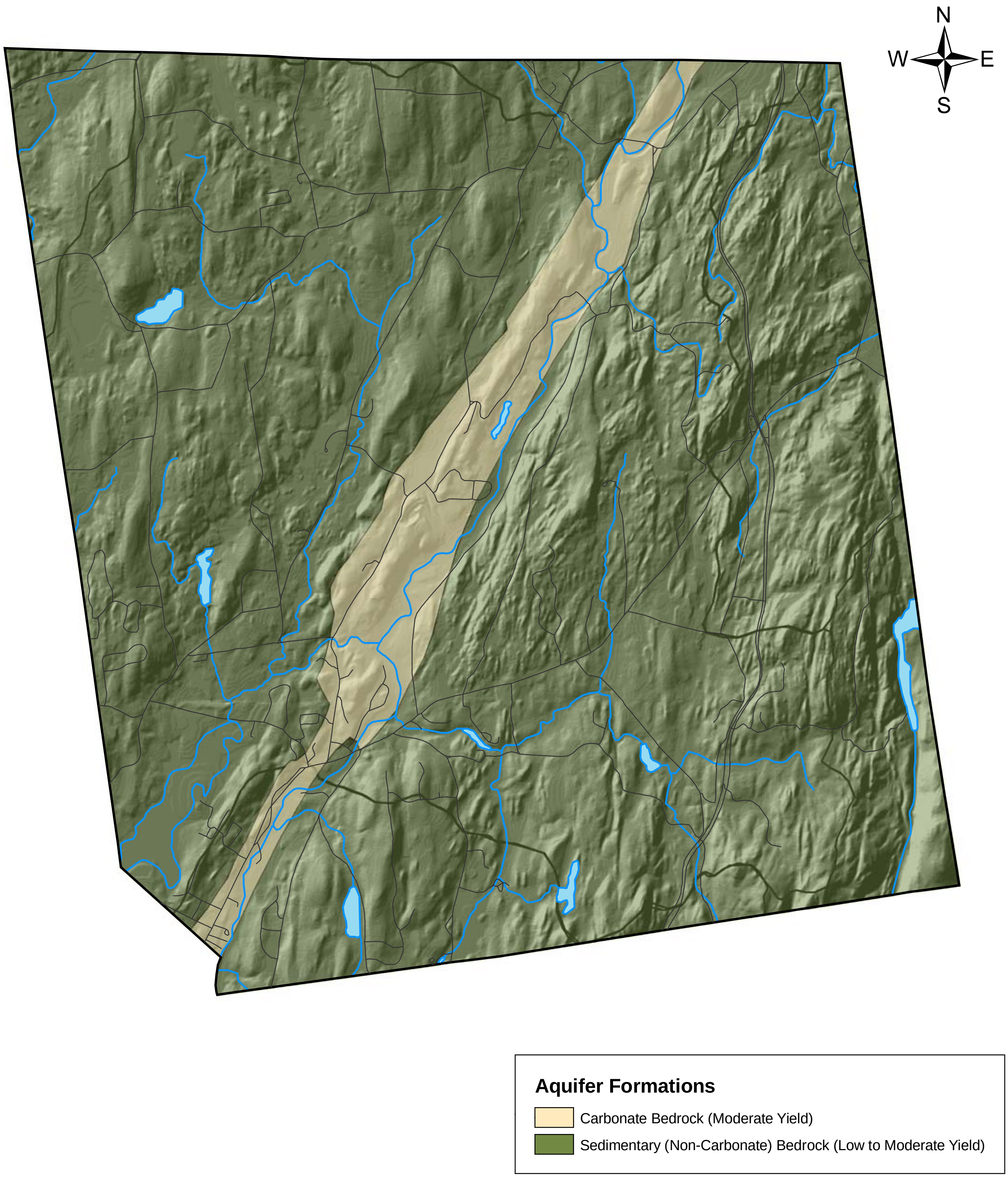

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FIGURE 9- HYDROGEOLOGIC BEDROCK

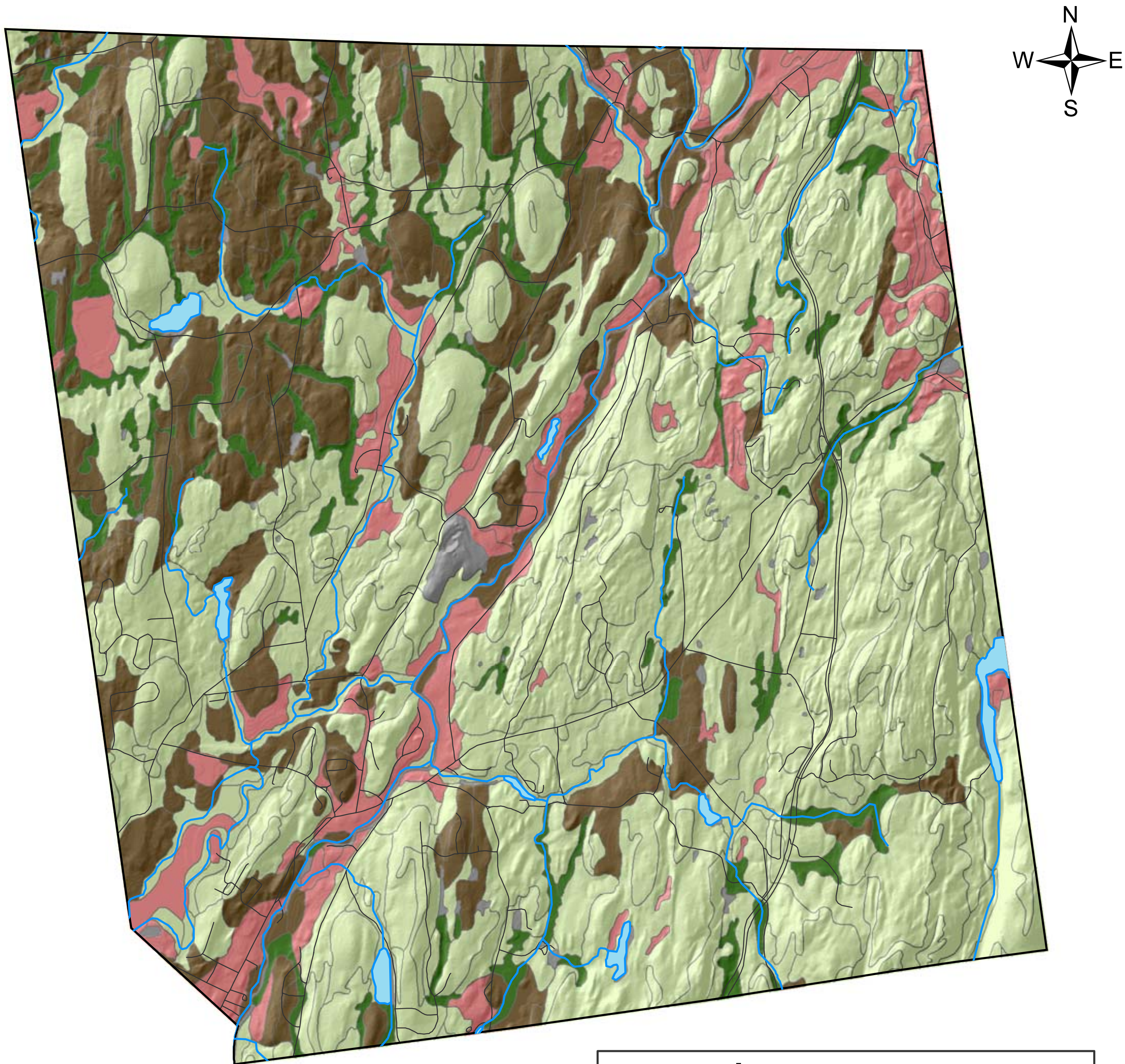
Town of Pleasant Valley, Dutchess County, New York

Source: Interpreted by TCC from NYSGS Bedrock Geology Map, Lower Hudson Sheet, Dated 1970, Reprinted 1995;

Date:
May 2007

Scale:
1 in equals 5,000 ft

Project #:
40603.00



Legend

- A and A/D (18.2 inches of recharge) (1,964 Total Acres)
- B (13.3 inches of recharge) (4,351 Total Acres)
- C andC/D (6.8 inches of recharge) (13,043Total Acres)
- D Soils (3.8 inches of recharge) (1,428 Total Acres)
- Undetermined

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FIGURE 10 - HYDROLOGIC SOIL GROUPS

Town of Pleasant Valley, Dutchess County, New York

United States Department of Agriculture Soil Survey for Dutchess County.

Date:
May 2007

Scale:
1 in equals 5,000 ft

Project #:
40603.00

Figure 11A: Upland Hydrologic Soil Groups

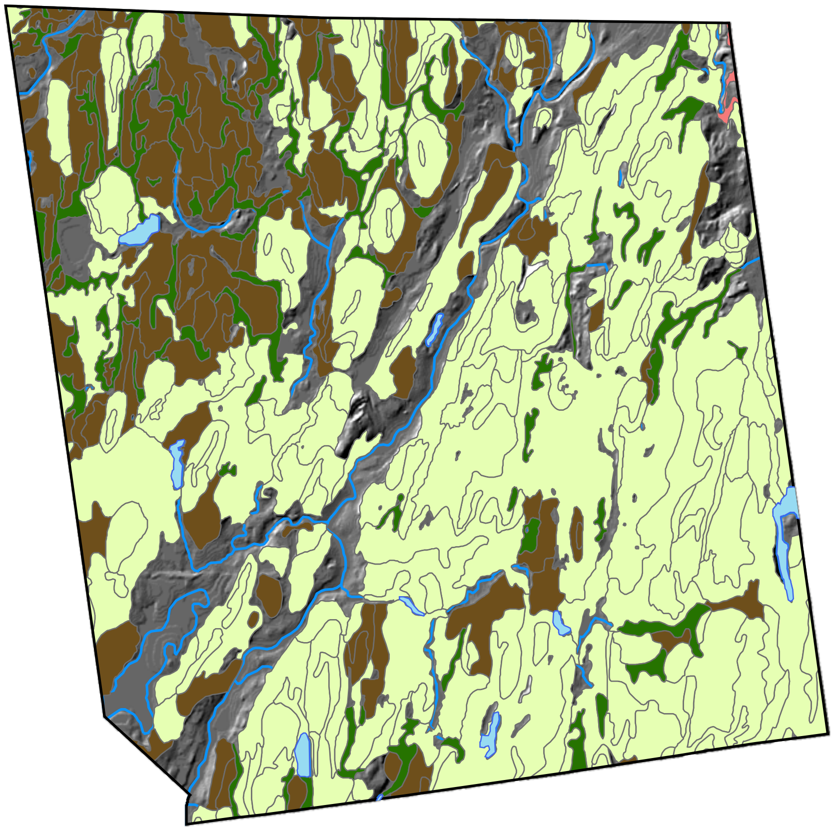
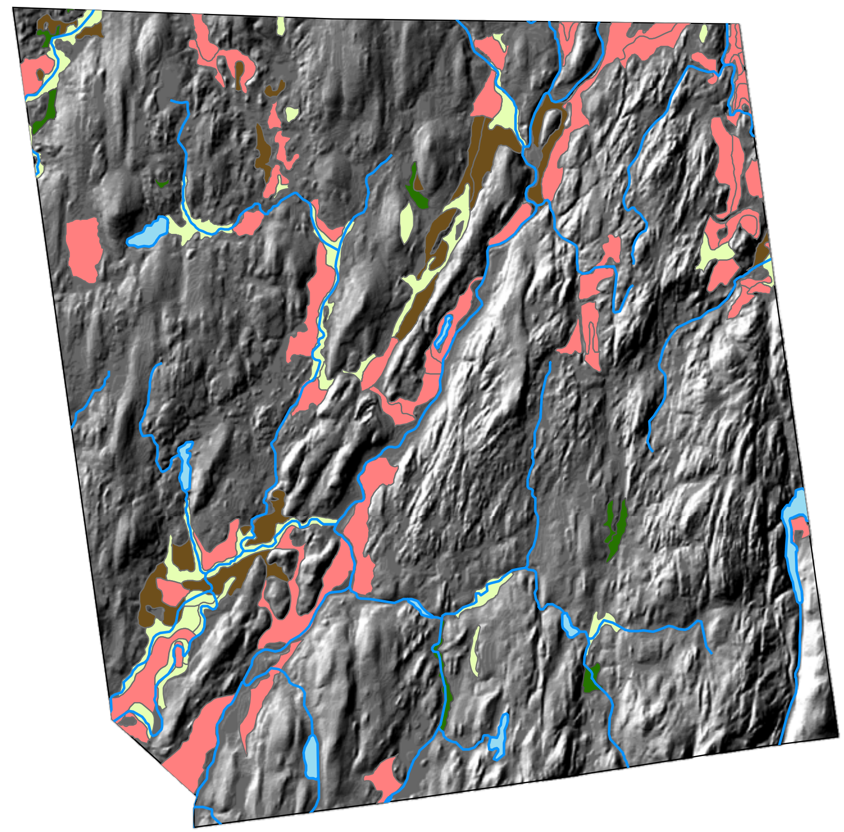


Figure 11B: Valley Hydrologic Soil Groups



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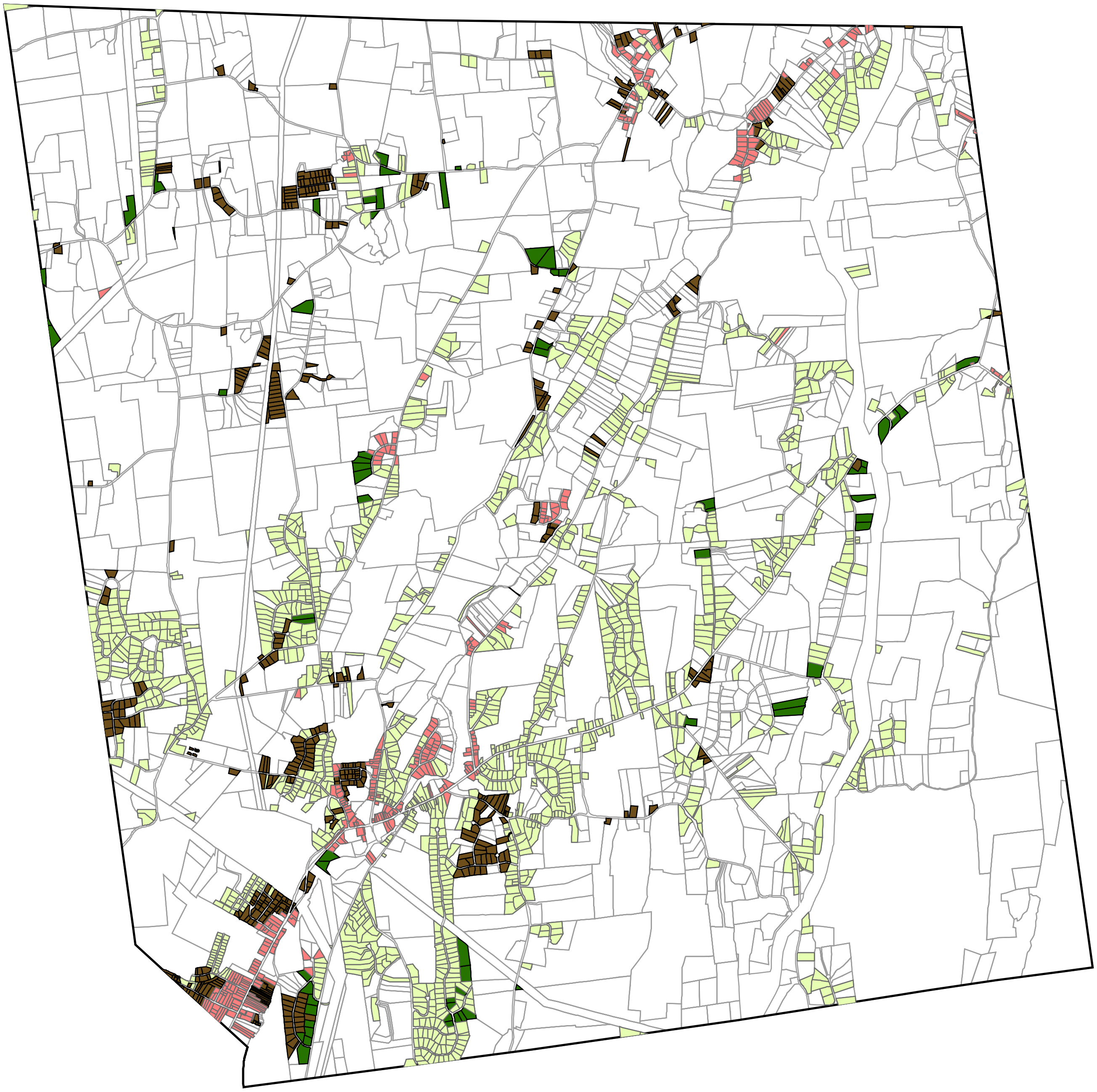
FIGURES 11A, B: HYDROLOGIC SOIL GROUPS IN UPLAND VS. VALLEY SETTING

Town of Pleasant Valley, Dutchess County, NY

Source: Topographic separation prepared by TCC

Drawn:	CMW
Date:	May 2007
Scale:	Not to Scale
Project:	40603.00
Figure:	3



Legend

- Parcels 1.3 Acres or Smaller with A or A/D Hydrologic Soil as the Dominant Type
- Parcels 1.8 Acres or Smaller with B Hydrologic Soil as the Dominant type
- Parcels 3.3 Acres or Smaller with C or C/D Hydrologic Soil as the Dominant Type
- Parcels 5.9 Acres or Smaller with D Hydrologic Soil as the Dominant Type

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FIGURE 12 - EXISTING PARCELS SMALLER THAN RECOMMENDED SUSTAINABLE WELL AND SEPTIC SYSTEM FOR USE, BY SOIL TYPE

Town of Pleasant Valley, Dutchess County, New York

United States Department of Agriculture Soil Survey for Dutchess County.
Dutchess County Real Property Parcel Dataset

Date:
May 2007

Scale:
1 in equals 5,000 ft

Project #:
40603.00

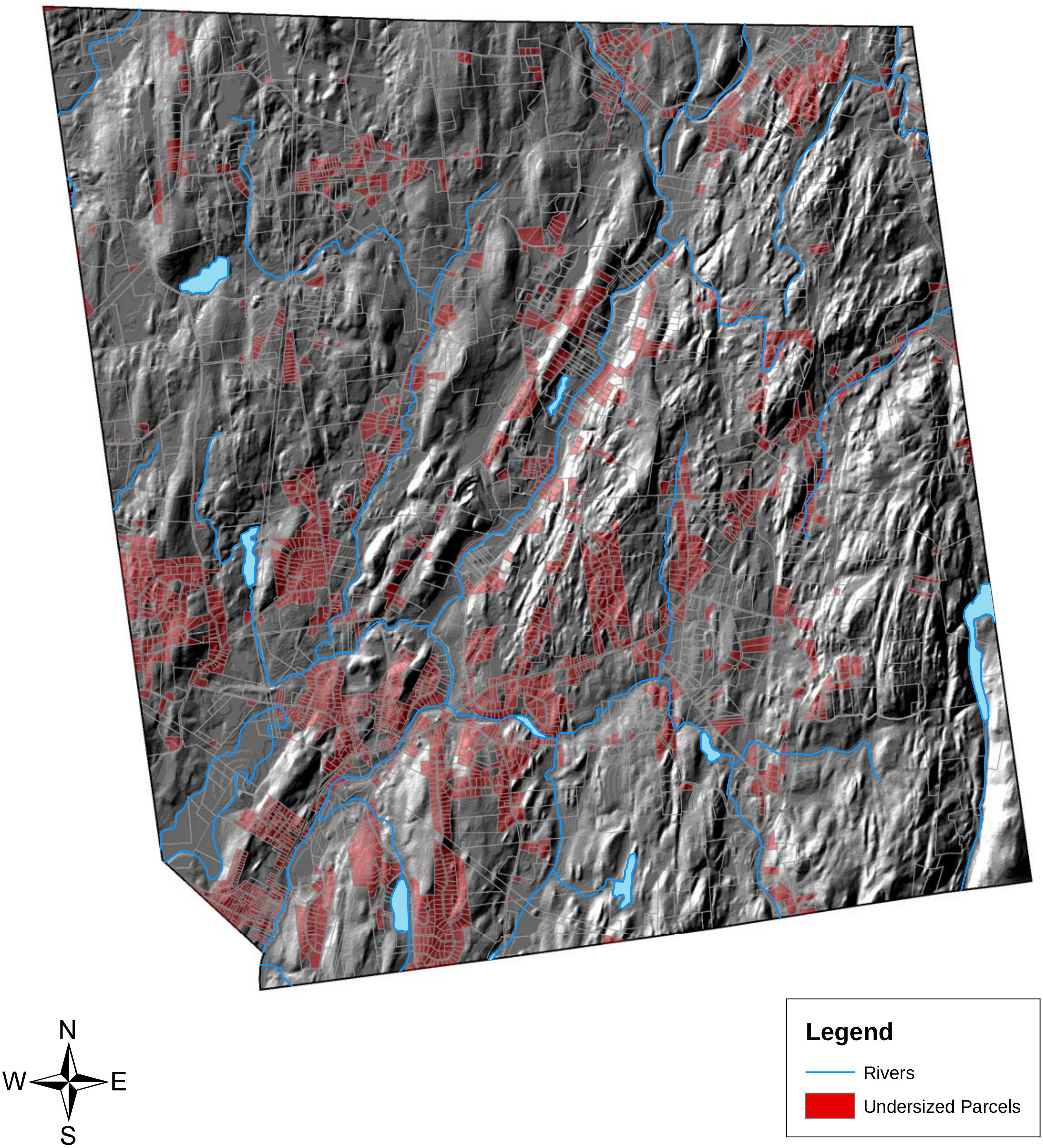

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FIGURE 13 - EXISTING PARCELS SMALLER THAN RECOMMENDED FOR SUSTAINABLE WELL AND SEPTIC SYSTEM USE, SUMMARY

Town of Pleasant Valley, Dutchess County, New York

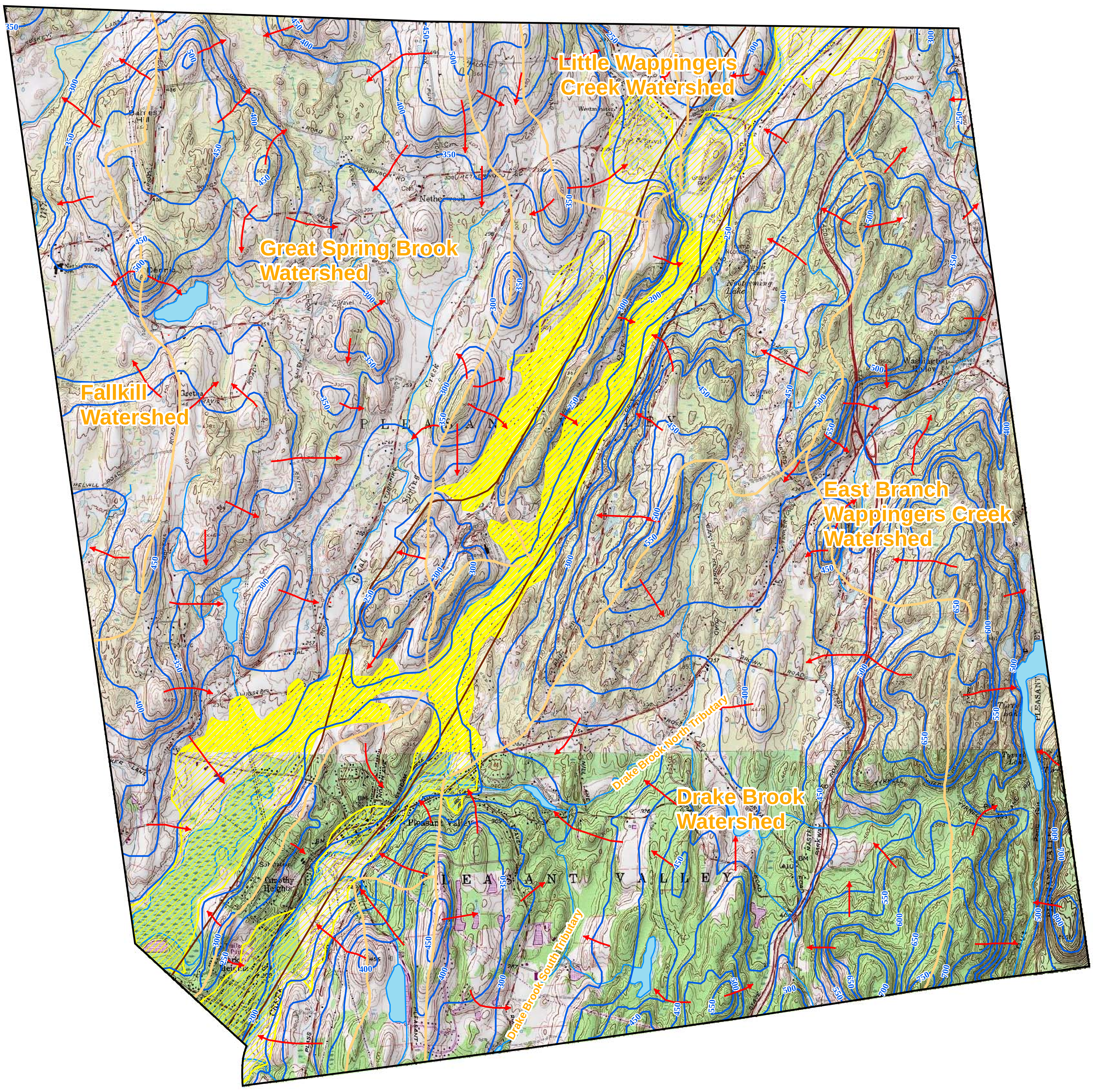
United States Department of Agriculture Soil Survey for Dutchess County.
Dutchess County Real Property Parcel Dataset

Date:
May 2007

Scale:
Not To Scale

Project #:
40603.00

Plate



Legend

- Estimated directions of groundwater flow
- Water table contour lines, with approximate elevations
- Watershed Boundaries
- Major Valley Sediment Aquifers based on NYS Museum, Fisher and Warthin (1976), and TCC observation
- Carbonate Bedrock Aquifer along Wappingers Creek corridor in central Pleasant Valley
- Town-wide bedrock aquifer, including carbonate bedrock aquifer

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PLATE 1- GROUNDWATER FLOW MAP

Town of Pleasant Valley

Dutchess County, New York

USGS Topographic Map of the Salt Point, NY Quadrangle 7.5 minute series
Dated 1963.

Date:
May 2007

Scale:
1 in equals 2,000 ft

Project #:
40603.00

Appendix A

Model Aquifer Ordinance Potentially Applicable for Town of Pleasant Valley

The following draft Aquifer Overlay Ordinance for the Town of Amenia, NY was initially drafted under auspices of the Dutchess County Water & Wastewater Authority by the law firm of Rapport Meyers Rodenhausen, LLP and The Chazen Companies, and subsequently modified by Amenia's planner Mr. Joel Russell.

Amenia's draft ordinance would need to be modified slightly to reflect aquifer conditions found in Pleasant Valley. A potential revision to §121-15(B)(1) follows:

> 1. The Aquifer Overlay (AQO) District encompasses the entire Town of Pleasant Valley and includes two types of aquifers: the town wide Regional Aquifer (RA) offers groundwater protection to bedrock or surficial aquifers throughout the Town. Particular Regional Aquifer Wellhead Protection (RAWP) areas warranting enhanced aquifer protection are delineated where community water system wellfields are installed within the RA.

Following changes to the Amenia model ordinance would be required throughout the model ordinance.

Aquifer recharge rates occurring in Pleasant Valley would need to be inserted in §121-15F.

§121-15 AQUIFER OVERLAY DISTRICT (AQO)

A. Legislative Findings, Intent, and Purpose

The Aquifer Overlay AQO District has been created to protect the health and welfare of residents of the Town of Amenia by minimizing the potential for contamination and depletion of the Harlem Valley's aquifer system. The entire Town of Amenia contains an aquifer system that has been divided into four categories described in Subsection B. This aquifer system provides drinking water to public water systems and private wells and also provides groundwater and surface water that is essential to the maintenance of healthy aquatic and terrestrial ecosystems. The Town has determined that a limiting factor on the carrying capacity of the land is its capability to provide water in sufficient quality and quantity so that water use by some users does not adversely affect other users. Another limiting factor on the carrying capacity of the land is its ability to absorb wastewater without adversely affecting the quality or quantity of groundwater and surface water necessary for water supplies and other needs of the natural and human environment. The purpose of these regulations is to protect the Town's groundwater aquifer system, to provide the most protective standards to those areas of the aquifer at greatest risk of contamination, and to manage development so that groundwater supplies are not depleted or degraded.

B. Delineation and Regulatory Effect of District

1. The Aquifer Overlay (AQO) District encompasses the entire Town of Amenia and includes two basic types of aquifers: the Valley Bottom Aquifer, containing significant amounts of groundwater located in areas that are generally more developed, and the Upland Aquifer, containing lesser quantities of groundwater and less development (see definitions in subsection C below). The AQO district consists of three aquifer zones, two in the Valley Bottom Aquifer and one in the Upland Aquifer. These zones are designated as the Priority Valley Bottom Aquifer (PVBA), which is the aquifer area most susceptible to contamination that would affect public water supplies, the Buffered Valley Bottom Aquifer (BVBA), which is less susceptible than the PVBA because it is in an area serviced by public water systems, and the Upland Aquifer (UA) which consists of areas not covered by the Valley Bottom Aquifer zones. These zones are delineated on the Aquifer Overlay District Map. There is also provision in this §121-15 for an Upland Wellhead Protection Area (UWP), which has not been mapped at this time because the Upland Aquifer area does not presently contain any settlements with an intensity of development that would require additional groundwater protection. The UWP category has been established in this Chapter for possible future mapping in the event that more intensive development occurs within the UA zone , resulting in the need to protect public water supply wellheads within this area. The official Aquifer Overlay District Map can be found at the Town offices. A photo-reduction of this map is attached to this chapter for reference purposes. The Aquifer Overlay AQO District map and any amendments to it must be prepared or approved by a hydrogeologist working for the Town.
2. The official Aquifer Overlay District Map shall be used to determine the boundaries of zones within the AQO District. In case of a question or dispute as to the exact location of a boundary on a specific parcel of land, the Town may retain a qualified hydrogeologist at an applicant's expense to make such a determination in the field based upon the criteria in this § 121-15. An applicant may challenge the Town's determination by retaining a qualified hydrogeologist to make such determination independently based upon the criteria in this § 121-15. In the event of such a challenge, the Town's hydrogeologist shall review the report of the applicant's hydrogeologist at the applicant's expense and shall make the final determination as to the location of the specific boundary. Any such boundary delineation shall not, by itself, effect a change in the AQO District Map. The AQO District Map may only be changed by action of the Town Board as provided in Subsection 121-15H.
3. Within the Aquifer Overlay District, all of the underlying land use district rules shall remain in effect except as specifically modified by this § 121-15. In case of a conflict between this §121-15 and the underlying use regulations, the more restrictive shall control. Nothing in this § 121-15 shall be construed to allow uses that are not permitted by the underlying land use district.

C. Definitions

For purposes of this § 121-15, the following definitions shall apply:

Action: A project or physical activity as defined in the SEQR Regulations of the NYS Department of Environmental Conservation, 6NYCRR Part 617 , including all actions subject to SEQR that are covered by this Chapter, as well as subdivision applications and other actions requiring local government approval under SEQR.

Aquifer: A consolidated or unconsolidated geologic formation, group of formations or part of a formation capable of yielding a significant or economically useful amount of groundwater to wells, springs or infiltration galleries.

Aquifer Overlay AQO District Map: The Town's overlay map showing Aquifer Overlay District zones.

Buffered Valley Bottom Aquifer BVBA: Areas delineated as Buffered Valley Bottom Aquifer BVBA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, BVBA areas consist of regions within the Valley Bottom Aquifer VBA served by community water systems, where the sources of water supply for the community water system and for any other wells would not be substantially threatened by a contaminant release occurring within the BVBA. No portion of the BVBA may lie hydrogeologically upgradient of any wells, including wells used by the community water system.

Community Water System: A public Water System regulated by the New York State Department of Health that serves at least five service connections used by year-round residents or regularly serves at least 25 year-round residents.

Conditionally Exempt Small Quantity Generators: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites generating or storing less than 100 kilograms per month and 1000 kilograms of listed and /or characteristic wastes, respectively, and generating and storing less than 1 kilogram per month and 1 kilogram of acutely hazardous waste, respectively.

Consumption of Water: The net loss of water from a watershed through evaporation and transpiration processes caused by any human activities and associated land uses, other than open space uses, including evaporative losses from septic system leaching lines. The definition of Consumption of Water includes the use of water in diluting wastewater discharges so that groundwater quality at the property line downgradient from the discharge will be 50% or less of the New York State Department of Environmental Conservation's Title 10 Part 703 Groundwater (GA) Water Standards, i.e. the DEC's groundwater contamination standards.

Discharge: Any intentional or unintentional action or omission resulting in the releasing, spilling, leaking, pumping, pouring, emitting, emptying, or dumping of substances or materials into the waters of the State or onto lands from which the discharged substances or materials might flow or drain into said waters, or into waters outside the jurisdiction of the State, when damage may result to the lands, waters, or natural resources within the jurisdiction of the State.

Generator of Hazardous Waste: Any person or site whose act or process produces hazardous waste.

Groundwater: Water contained in interconnected pores and fractures in the saturated zone in an unconfined aquifer or confined aquifer.

Hazardous Substance: Any substance, including any petroleum by-product, which may cause harm to humans or the environment when improperly managed. A complete list of all hazardous substances except for petroleum by-products can be found in 6 NYCRR Part 597.2(b) Tables 1 and 2 and amendments thereto.

Hazardous Waste: See 6 NYCRR Part 371 and amendments thereto for the identification and listing of hazardous wastes.

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Major Oil Storage Facilities; Facilities with a storage capacity of 400,000 gallons or more of petroleum.

Natural Recharge: The normal rate at which precipitation enters the subsurface to replenish groundwater in aquifers, without interruption or augmentation by human actions or landscape modifications.
Non-point discharge: Discharges of pollutants not subject to SPDES (State Pollutant Discharge Elimination System) permit requirements.
Pesticide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, and any substances intended to for use as a plant regulator, defoliant or desiccant, and being those substances defined as pesticides pursuant to Environmental Conservation Law § 33-0101 et seq. and amendments thereto.
Petroleum: Oil or petroleum of any kind and in any form including but not limited to oil, petroleum fuel oil, oil sludge, oil refuse, oil mixed with other waste, crude oil, gasoline and kerosene, as defined in 6 NYCRR Part 597.1(7) and amendments thereto.
Point Source Discharge: Pollutants discharged from a point source as defined in Environmental Conservation Law § 17-0105 and amendments thereto.
Priority Valley Bottom Aquifer PVBA: The area delineated as the Priority Valley Bottom Aquifer PVBA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the PVBA consists of all areas within the Valley Bottom Aquifer VBA which are not included in Buffered Valley Bottom Aquifer BVBA areas.
Pollutant: Any material or byproduct determined or suspected to be hazardous to human health or the environment.
Radioactive Material: Any material that emits radiation.
Small Quantity Generator: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites not meeting Conditionally Exempt Small Quantity Generator status but which generate and store less than 1000 kilograms per month and 6000 kilograms of listed and /or characteristic wastes, respectively, and generating and storing less than 1 kilograms per month and 1 kilogram of acutely hazardous waste, respectively.
Solid Waste: Generally refers to all putrescible and non-putrescible materials or substances, except domestic sewage, sewage treated through a publicly owned treatment works, or irrigation return flows, that is discarded or rejected as being spent or otherwise worthless, including but not limited to garbage, refuse, industrial and commercial waste, sludges from air or water treatment facilities, rubbish, tires, ashes, contained gaseous material, incinerator residue, construction and demolition debris and discarded automobiles, as defined in 6 NYCRR Part 360-1.2(a) and amendments thereto.
State Pollutant Discharge Elimination System ("SPDES"): The system established pursuant to Article 17 Title 8 of Environmental Conservation Law for issuance of permits authorizing discharges to the waters of the state of New York.
Upland Aquifer UA: The area delineated as Upland Aquifer UA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the UA consists of all areas on the Aquifer Overlay AQO District Map not included in the Valley Bottom Aquifer VBA or in Upland Wellhead Protection UWP areas.
Upland Wellhead Protection UWP areas: Areas delineated or to be delineated in the future as Upland Wellhead Protection UWP areas on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, UWP areas consist of wellhead protection areas for community water system wells not located within the Valley Bottom Aquifer VBA. At a minimum, wellhead protection areas enclose all lands situated within 60-days travel time (seepage velocity) from the community water system's wells, and enclose sufficient land that average annual Natural Recharge in the UWP area matches the average water demand of the community water system.
Valley Bottom Aquifer VBA: The area delineated as the Valley Bottom Aquifer VBA on the Aquifer Overlay AQO District Map. As defined by a hydrogeologist working for the Town, the VBA consists of the following areas:

1. All locations where outcrops of the Stockbridge Formation, as generally defined by New York State Museum Geologic Maps, are present at grade;
2. All locations where the Stockbridge Formation is the first bedrock formation found under unconsolidated soil materials;
3. All overburden soils (sand, gravel, clay, till, etc.) overlying the Stockbridge Formation;

4. All locations which do not overlie the Stockbridge Formation but where moderately to highly permeably overburden soils (K >10^{-5} cm/sec), including stratified silt, sand, and/or gravel are hydraulically connected to, and are substantially contiguous to, the Stockbridge Formation.

The VBA includes the Priority Valley Bottom Aquifer PVBA and Buffered Valley Bottom Aquifer BVBA areas.
Wastewater: Aqueous-carried solid or hazardous waste.
Watershed: That land area that includes the entire drainage area contributing water to the Town water supply and which includes the Aquifer Protection Overlay District.
Water Supply: The groundwater resources of the Town of Amenia, or the groundwater resources used for a particular well or community water system.
Well: Any present or future artificial excavation used as a source of public or private water supply which derives water from the interstices of the rocks or soils which it penetrates including bored wells, drilled wells, driven wells, infiltration galleries, and trenches with perforated piping, but excluding ditches or tunnels, used to convey groundwater to the surface.

D. General Provisions of the Aquifer Overlay District

1. The manufacture, use, storage, or discharge of any products, materials or by-products subject to these regulations, such as wastewater, solid waste, hazardous substances, or any pollutant, must conform to the requirements of these regulations.
2. Usage of Water for proposed actions within the Aquifer Overlay AQO District shall be examined pursuant to SEQRA in accordance with the methodology set forth in Subsections F and G of this § 121-15.
3. In addition to the list of Statewide Type I Actions contained in § 617.4(b) of 6 NYCRR, all proposed actions resulting in discharges exceeding standards provided in 6 NYCRR Part 703.6(e) and amendments thereto (groundwater contamination standards), and all proposed actions where Water Consumption exceeds Natural Recharge, as defined in Subsections F and G herein, shall be designated as Type I Actions under the Implementing Regulations of the State Environmental Quality Review Act (6 NYCRR Part 617), unless the action is listed as a Type II action under such regulations.
4. Installation of any underground fuel tank or tanks, whose combined capacity is less than 1,100 gallons, is prohibited in the Aquifer Overlay AQO District.
5. This Section 121-15 shall not apply to customary agricultural practices conducted in conformity with applicable rules of the New York State Department of Environmental Conservation and the New York State Department of Agriculture and Markets which are in conformance with a whole farm management plan approved by the Dutchess County Soil and Water Conservation District.
6. This Section 121-15 shall not apply to any single-family, two-family, or multi-family residential use of land containing five or fewer dwelling units, or to any home occupation unless such residential use or home occupation includes one of the activities listed in subsection E below.

E. Use and Permit Requirements in the Aquifer Overlay District

In accordance with Article IX of this chapter, the Planning Board shall review and act upon Special Permit applications within the Aquifer Overlay AQO District. If the uses listed below are regulated by any state federal agency, the definitions of such uses and all applicable regulations under state and federal law shall apply.

1. Special Permits within the Priority Valley Bottom Aquifer PVBA and Upland Wellhead Protection UWP areas. The following uses, if permitted in the underlying land use district, shall require the issuance of a Special Permit within the Priority Valley Bottom Aquifer PVBA and the Upland Wellhead Protection UWP areas:
   a. Photo labs;
   b. Auto repair facilities and truck terminals, including engine repair and machine shops;
   c. Furniture stripper/painter, metal works, wood preservers;
   d. Printers and the use of printing presses;
   e. Conditionally Exempt or Small Quantity Generators of Hazardous Waste.

f. Solid waste management facilities not involving burial, including incinerators, composting facilities, liquid storage, regulated medical waste, transfer stations, recyclables handling & recovery facilities, waste tire storage facilities, used oil, C&D processing facilities, each as defined in 6 NYCRR Part 360, and junk or salvage yards in general.

g. Salt storage facilities.

h. Uses where Water Consumption exceeds Natural Recharge.

i. Cemeteries, including pet cemeteries

j. Veterinary hospitals and offices

k Funeral parlors.

l. Storage or disposal of manure, fertilizers, pesticides/herbicides. No special permit shall be required where such storage or disposal is conducted pursuant to a *Whole Farm Management Plan* developed in association with the Dutchess County Soil & Water Conservation District.

2. Special Permits within the Buffered Valley Bottom Aquifer BVBA areas and the Upland Aquifer UA. The following uses, if permitted in the underlying land use district, shall require the issuance of a Special Permit within the Buffered Valley Bottom Aquifer BVBA and Upland Aquifer UA:

   a. Gasoline service stations;

   b. Major Oil Storage Facilities;

   c. Junkyards and automobile cemeteries.

   d. Salt storage facilities.

   e. Conditionally Exempt, Small Quantity, or Large Quantity Generators of Hazardous Waste.

   f. Disposal of any hazardous waste, as defined in 6 NYCRR Part 371, by burial.

   g. Land application of septage, sludge, or human excreta, including land application facilities defined in 6 NYCRR Part 360-4.

   h. Cemeteries, including pet cemeteries

   i. Veterinary hospitals and offices

   j. Funeral parlors.

   k. Storage or disposal of manure, fertilizers, pesticides/herbicides. No special permit shall be required where such storage or disposal is conducted pursuant to a *Whole Farm Management Plan* developed in association with the Dutchess County Soil & Water Conservation District.

3. Application Requirements: In addition to the Special Permit application requirements set forth in Article IX, applicants proposing actions listed in subsections (1) and (2) above that are located within the Aquifer Overlay AQO District shall identify the following as part of their applications:

   a. The source of water to be used;

   b. The quantity of water required;

   c. Water use minimization measures to be implemented;

   d. Water recycling measures to be implemented;

   e. Wastewater discharge measures;

   f. Grading and/or storm water control measures to enhance on-site recharge of surface water;

   g. Point Source or Non-Point Discharges;

   h. A complete list of any Hazardous Substances to be used on site along with quantity to be used and stored on site; and

   i. A description of Hazardous Substance storage or handling facilities and procedures.

4. Special Conditions for proposed uses within the Priority Valley Bottom Aquifer PVBA and Upland Wellhead Protection UWP areas requiring a Special Permit:

   a. Storage of chloride salts is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

   b. Generators of Hazardous Waste shall provide the Town with copies of all applicable permits provided by State and/or Federal regulators and copies of all annual, incident, and remediation-related reports.

   c. Any projects where Water Consumption exceeds the Natural Recharge, as defined in Subsections F and G herein, shall demonstrate through SEQRA how such impact will be mitigated through, for example, compensatory recharge equal to the identified recharge deficit through a combination of artificial on-site or off-site recharge, or provision of compensatory natural recharge areas elsewhere in the Town.

5. Special Conditions for proposed uses within the Buffered Valley Bottom Aquifer BVBA areas and the Upland Aquifer UA areas requiring a Special Permit:

   a. Gasoline service station operators shall provide the Town with copies of all applicable permits provided by State and/or Federal regulators and copies of all annual, incident, and remediation-related reports.

   b. Junkyard operators shall drain fuels, lubricants, and coolants from all cars stored on site to properly permitted above-ground holding tanks, provide to the Town copies of all applicable permits provided by State and/or Federal regulators and copies of all annual and incident reports, provide the Town with an annual summary of numbers of vehicles on site and total gallons of various classes of fluids drained from vehicles and disposal manifests or other documentation of disposition of such fluids.

   c. Storage of chloride salts is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

   d. Storage of coal and/or cinders is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

   e. Generators of Hazardous Waste shall provide the Town with copies of all applicable permits provided by State and Federal regulators and copies of all annual, incident, and remediation-related reports.

   f. Any projects where Water Consumption exceeds the Natural Recharge, as defined in subsections F and G herein, shall demonstrate through SEQRA how such impact will be mitigated through, for example, compensatory recharge equal to the identified recharge deficit through a combination of artificial on-site or off-site recharge, or provision of compensatory natural recharge areas elsewhere in the Town .

6. Prohibited uses within the Priority Valley Bottom Aquifer District PVBA and Upland Wellhead Protection UWP areas:

   a. Municipal, private and C&D landfills as defined in 6 NYCRR Part 360-2 and 6 NYCRR Part 360-7.

   b. Land application of septage, sludge, or human excreta, including land application facilities as defined in 6 NYCRR Part 360-4.

   c. Disposal, by burial, of any hazardous waste, as defined in 6 NYCRR Part 371

   d. Large Quantity Generators of Hazardous Waste.

   e. Gas stations and Major Oil Storage Facilities.

   f. On-site dry cleaning.

   g. Junkyards and Junked car lots.

7. Prohibited uses within the Buffered Valley Bottom Aquifer BVBA and Upland Aquifer UA: Land application of septage, sludge, or human excreta, including land application facilities defined in 6 NYCRR Part 360-4.3.

8. General Non-Degradation Standard: No special permit shall be granted unless the applicant can show that the proposed action will not degrade the quality of the groundwater in a manner that poses a potential danger to public health or safety. Compliance with applicable standards, requirements, and permit conditions imposed by federal, state, or county agencies shall be deemed to constitute compliance with this standard.

F. Determination of a Parcel's Natural Recharge

The natural recharge rate for a parcel shall be determined by identifying the soil types on the property, classifying them by hydrologic soil groups (A through D), applying the recharge rates of 20.2 inches per year through HSG A and A/D soils, 14.7 inches/year per year through HSG B soils, 7.6 inches/year through HSG C and C/D soils, and 4.2 inches/year through HSG D soils, and multiplying the recharge rate(s) by the number of acres in the parcel for each soil group

G. Consumption of Water

Water consumption is the net loss of liquid phase water through site activities, plus the water needed to dilute wastewater and other discharges to a concentration equal to 50% of the NYS Title 6 Part 703 Groundwater Standard.

The following table establishes the method to calculate water consumption:

Use	Gallons per day	Multiplied by Dilution factor	Consumption/day
Irrigated Lands (non-agricultural)	Irrigated Acres x 4,000[(1)]	x 1	= ____________
Uses with Surface Water Discharge	Site activity use x 0.2	x 1	= ____________
Residential Uses with Subsurface Water Discharge[(2)]	70 gpd/capita	x 6	= ____________
Nonresidential Uses with Subsurface Water Discharge[(2)]	Daily Use	x 6	= ____________

(1) Applicable for vegetation requiring 1 inch/week irrigation. May be adjusted for vegetation with other water requirements.
(2) Calculate use per NYSDEC intermediate wastewater disposal guide. Discharge must not exceed NYSDEC Title 10, Part 703 effluent limits.

H. Map Changes

1. New Buffered Valley Bottom Aquifer BVBA and expanded Buffered Valley Bottom Aquifer BVBA areas may be established by the Town's Hydrogeologist at the request of the Town, or proposed to the Town by groups of site owners where a new Community Water System source regulated by the NYS Department of Health is proposed, and where the Town's Hydrogeologist concludes or agrees that the water source for the Community Water System and any private wells within or hydraulically downgradient from the new or expanded Buffered Valley Bottom Aquifer BVBA would not be threatened by a Pollutant Discharge originating anywhere within the Buffered Valley Bottom Aquifer BVBA.
2. New Buffered Valley Bottom Aquifer BVBA shall be regional in nature and no single project, or single parcel Buffered Valley Bottom Aquifer BVBA may be proposed.
3. New Upland Wellhead Protection UWP areas, or expanded Upland Wellhead Protection UWP areas, must be defined for the water sources for any existing and future proposed Community Water Systems within the Upland Aquifer UA by their owners, and must be reviewed and approved by the Town's hydrogeologist.
4. The Aquifer Overlay District Map may be modified to reflect new or more accurate geological or hydrological information, provided that the Town's hydrogeologist reviews and approves any such modification.
5. Any new areas or revisions of boundaries made pursuant to this Subsection H shall be placed on the Aquifer Overlay District Map pursuant to the zoning map amendment process in Article X.

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I. Reporting of Discharges

Any person or organization responsible for any discharge of a Hazardous Substance, Solid Waste, Hazardous Waste, petroleum product, or radioactive material shall notify the Town Clerk of such discharge within 24 hours of the time of discovery of the discharge. This notification does not alter other applicable reporting requirements under existing law and applies to all uses and structures, whether conforming or non-conforming in any respect.

J. Non-conforming Uses, Structures, and Lots

See Article VI of this Chapter. For any non-conformity which requires a special permit to expand or change, all requirements of this § 121-15 shall apply to such expansion or change.

Model Aquifer Ordinance Potentially Applicable for Town of Pleasant Valley

The following draft Aquifer Overlay Ordinance for the Town of Amenia, NY was initially drafted under auspices of the Dutchess County Water & Wastewater Authority by the law firm of Rapport Meyers Rodenhausen, LLP and The Chazen Companies, and subsequently modified by Amenia's planner Mr. Joel Russell.

Amenia's draft ordinance would need to be modified slightly to reflect aquifer conditions found in Pleasant Valley. A potential revision to §121-15(B)(1) follows:

> 1. The Aquifer Overlay (AQO) District encompasses the entire Town of Pleasant Valley and includes two types of aquifers: the town wide Regional Aquifer (RA) offers groundwater protection to bedrock or surficial aquifers throughout the Town. Particular Regional Aquifer Wellhead Protection (RAWP) areas warranting enhanced aquifer protection are delineated where community water system wellfields are installed within the RA.

Following changes to the Amenia model ordinance would be required throughout the model ordinance.

Aquifer recharge rates occurring in Pleasant Valley would need to be inserted in §121-15F.

§121-15 AQUIFER OVERLAY DISTRICT (AQO)

A. Legislative Findings, Intent, and Purpose

The Aquifer Overlay AQO District has been created to protect the health and welfare of residents of the Town of Amenia by minimizing the potential for contamination and depletion of the Harlem Valley's aquifer system. The entire Town of Amenia contains an aquifer system that has been divided into four categories described in Subsection B. This aquifer system provides drinking water to public water systems and private wells and also provides groundwater and surface water that is essential to the maintenance of healthy aquatic and terrestrial ecosystems. The Town has determined that a limiting factor on the carrying capacity of the land is its capability to provide water in sufficient quality and quantity so that water use by some users does not adversely affect other users. Another limiting factor on the carrying capacity of the land is its ability to absorb wastewater without adversely affecting the quality or quantity of groundwater and surface water necessary for water supplies and other needs of the natural and human environment. The purpose of these regulations is to protect the Town's groundwater aquifer system, to provide the most protective standards to those areas of the aquifer at greatest risk of contamination, and to manage development so that groundwater supplies are not depleted or degraded.

B. Delineation and Regulatory Effect of District

1. The Aquifer Overlay (AQO) District encompasses the entire Town of Amenia and includes two basic types of aquifers: the Valley Bottom Aquifer, containing significant amounts of groundwater located in areas that are generally more developed, and the Upland Aquifer, containing lesser quantities of groundwater and less development (see definitions in subsection C below). The AQO district consists of three aquifer zones, two in the Valley Bottom Aquifer and one in the Upland Aquifer. These zones are designated as the Priority Valley Bottom Aquifer (PVBA), which is the aquifer area most susceptible to contamination that would affect public water supplies, the Buffered Valley Bottom Aquifer (BVBA), which is less susceptible than the PVBA because it is in an area serviced by public water systems, and the Upland Aquifer (UA) which consists of areas not covered by the Valley Bottom Aquifer zones. These zones are delineated on the Aquifer Overlay District Map. There is also provision in this §121-15 for an Upland Wellhead Protection Area (UWP), which has not been mapped at this time because the Upland Aquifer area does not presently contain any settlements with an intensity of development that would require additional groundwater protection. The UWP category has been established in this Chapter for possible future mapping in the event that more intensive development occurs within the UA zone , resulting in the need to protect public water supply wellheads within this area. The official Aquifer Overlay District Map can be found at the Town offices. A photo-reduction of this map is attached to this chapter for reference purposes. The Aquifer Overlay AQO District map and any amendments to it must be prepared or approved by a hydrogeologist working for the Town.
2. The official Aquifer Overlay District Map shall be used to determine the boundaries of zones within the AQO District. In case of a question or dispute as to the exact location of a boundary on a specific parcel of land, the Town may retain a qualified hydrogeologist at an applicant's expense to make such a determination in the field based upon the criteria in this § 121-15. An applicant may challenge the Town's determination by retaining a qualified hydrogeologist to make such determination independently based upon the criteria in this § 121-15. In the event of such a challenge, the Town's hydrogeologist shall review the report of the applicant's hydrogeologist at the applicant's expense and shall make the final determination as to the location of the specific boundary. Any such boundary delineation shall not, by itself, effect a change in the AQO District Map. The AQO District Map may only be changed by action of the Town Board as provided in Subsection 121-15H.
3. Within the Aquifer Overlay District, all of the underlying land use district rules shall remain in effect except as specifically modified by this § 121-15. In case of a conflict between this §121-15 and the underlying use regulations, the more restrictive shall control. Nothing in this § 121-15 shall be construed to allow uses that are not permitted by the underlying land use district.

C. Definitions

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Aquifer Overlay AQO District Map: The Town's overlay map showing Aquifer Overlay District zones.

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Community Water System: A public Water System regulated by the New York State Department of Health that serves at least five service connections used by year-round residents or regularly serves at least 25 year-round residents.

Conditionally Exempt Small Quantity Generators: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites generating or storing less than 100 kilograms per month and 1000 kilograms of listed and /or characteristic wastes, respectively, and generating and storing less than 1 kilogram per month and 1 kilogram of acutely hazardous waste, respectively.

Consumption of Water: The net loss of water from a watershed through evaporation and transpiration processes caused by any human activities and associated land uses, other than open space uses, including evaporative losses from septic system leaching lines. The definition of Consumption of Water includes the use of water in diluting wastewater discharges so that groundwater quality at the property line downgradient from the discharge will be 50% or less of the New York State Department of Environmental Conservation's Title 10 Part 703 Groundwater (GA) Water Standards, i.e. the DEC's groundwater contamination standards.

Discharge: Any intentional or unintentional action or omission resulting in the releasing, spilling, leaking, pumping, pouring, emitting, emptying, or dumping of substances or materials into the waters of the State or onto lands from which the discharged substances or materials might flow or drain into said waters, or into waters outside the jurisdiction of the State, when damage may result to the lands, waters, or natural resources within the jurisdiction of the State.

Generator of Hazardous Waste: Any person or site whose act or process produces hazardous waste.

Groundwater: Water contained in interconnected pores and fractures in the saturated zone in an unconfined aquifer or confined aquifer.

Hazardous Substance: Any substance, including any petroleum by-product, which may cause harm to humans or the environment when improperly managed. A complete list of all hazardous substances except for petroleum by-products can be found in 6 NYCRR Part 597.2(b) Tables 1 and 2 and amendments thereto.

Hazardous Waste: See 6 NYCRR Part 371 and amendments thereto for the identification and listing of hazardous wastes.

Herbicide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any weed, and being those substances defined as herbicides pursuant to Environmental Conservation Law § 33-0101, and amendments thereto.

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Major Oil Storage Facilities; Facilities with a storage capacity of 400,000 gallons or more of petroleum.

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Non-point discharge: Discharges of pollutants not subject to SPDES (State Pollutant Discharge Elimination System) permit requirements.

Pesticide: Any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest, and any substances intended to for use as a plant regulator, defoliant or desiccant, and being those substances defined as pesticides pursuant to Environmental Conservation Law § 33-0101 et seq. and amendments thereto.

Petroleum: Oil or petroleum of any kind and in any form including but not limited to oil, petroleum fuel oil, oil sludge, oil refuse, oil mixed with other waste, crude oil, gasoline and kerosene, as defined in 6 NYCRR Part 597.1(7) and amendments thereto.

Point Source Discharge: Pollutants discharged from a point source as defined in Environmental Conservation Law § 17-0105 and amendments thereto.

Priority Valley Bottom Aquifer PVBA: The area delineated as the Priority Valley Bottom Aquifer PVBA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the PVBA consists of all areas within the Valley Bottom Aquifer VBA which are not included in Buffered Valley Bottom Aquifer BVBA areas.

Pollutant: Any material or byproduct determined or suspected to be hazardous to human health or the environment.

Radioactive Material: Any material that emits radiation.

Small Quantity Generator: As defined by the Resource Conservation and Recovery Act and amendments thereto, sites not meeting Conditionally Exempt Small Quantity Generator status but which generate and store less than 1000 kilograms per month and 6000 kilograms of listed and /or characteristic wastes, respectively, and generating and storing less than 1 kilograms per month and 1 kilogram of acutely hazardous waste, respectively.

Solid Waste: Generally refers to all putrescible and non-putrescible materials or substances, except domestic sewage, sewage treated through a publicly owned treatment works, or irrigation return flows, that is discarded or rejected as being spent or otherwise worthless, including but not limited to garbage, refuse, industrial and commercial waste, sludges from air or water treatment facilities, rubbish, tires, ashes, contained gaseous material, incinerator residue, construction and demolition debris and discarded automobiles, as defined in 6 NYCRR Part 360-1.2(a) and amendments thereto.

State Pollutant Discharge Elimination System ("SPDES"): The system established pursuant to Article 17 Title 8 of Environmental Conservation Law for issuance of permits authorizing discharges to the waters of the state of New York.

Upland Aquifer UA: The area delineated as Upland Aquifer UA on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, the UA consists of all areas on the Aquifer Overlay AQO District Map not included in the Valley Bottom Aquifer VBA or in Upland Wellhead Protection UWP areas.

Upland Wellhead Protection UWP areas: Areas delineated or to be delineated in the future as Upland Wellhead Protection UWP areas on the Aquifer Overlay AQO District Map. As defined or approved by a hydrogeologist working for the Town, UWP areas consist of wellhead protection areas for community water system wells not located within the Valley Bottom Aquifer VBA. At a minimum, wellhead protection areas enclose all lands situated within 60-days travel time (seepage velocity) from the community water system's wells, and enclose sufficient land that average annual Natural Recharge in the UWP area matches the average water demand of the community water system.

Valley Bottom Aquifer VBA: The area delineated as the Valley Bottom Aquifer VBA on the Aquifer Overlay AQO District Map. As defined by a hydrogeologist working for the Town, the VBA consists of the following areas:

1. All locations where outcrops of the Stockbridge Formation, as generally defined by New York State Museum Geologic Maps, are present at grade;
2. All locations where the Stockbridge Formation is the first bedrock formation found under unconsolidated soil materials;
3. All overburden soils (sand, gravel, clay, till, etc.) overlying the Stockbridge Formation;

4. All locations which do not overlie the Stockbridge Formation but where moderately to highly permeably overburden soils (K >10^{-5} cm/sec), including stratified silt, sand, and/or gravel are hydraulically connected to, and are substantially contiguous to, the Stockbridge Formation.

The VBA includes the Priority Valley Bottom Aquifer PVBA and Buffered Valley Bottom Aquifer BVBA areas.

Wastewater: Aqueous-carried solid or hazardous waste.

Watershed: That land area that includes the entire drainage area contributing water to the Town water supply and which includes the Aquifer Protection Overlay District.

Water Supply: The groundwater resources of the Town of Amenia, or the groundwater resources used for a particular well or community water system.

Well: Any present or future artificial excavation used as a source of public or private water supply which derives water from the interstices of the rocks or soils which it penetrates including bored wells, drilled wells, driven wells, infiltration galleries, and trenches with perforated piping, but excluding ditches or tunnels, used to convey groundwater to the surface.

D. General Provisions of the Aquifer Overlay District

1. The manufacture, use, storage, or discharge of any products, materials or by-products subject to these regulations, such as wastewater, solid waste, hazardous substances, or any pollutant, must conform to the requirements of these regulations.
2. Usage of Water for proposed actions within the Aquifer Overlay AQO District shall be examined pursuant to SEQRA in accordance with the methodology set forth in Subsections F and G of this § 121-15.
3. In addition to the list of Statewide Type I Actions contained in § 617.4(b) of 6 NYCRR, all proposed actions resulting in discharges exceeding standards provided in 6 NYCRR Part 703.6(e) and amendments thereto (groundwater contamination standards), and all proposed actions where Water Consumption exceeds Natural Recharge, as defined in Subsections F and G herein, shall be designated as Type I Actions under the Implementing Regulations of the State Environmental Quality Review Act (6 NYCRR Part 617), unless the action is listed as a Type II action under such regulations.
4. Installation of any underground fuel tank or tanks, whose combined capacity is less than 1,100 gallons, is prohibited in the Aquifer Overlay AQO District.
5. This Section 121-15 shall not apply to customary agricultural practices conducted in conformity with applicable rules of the New York State Department of Environmental Conservation and the New York State Department of Agriculture and Markets which are in conformance with a whole farm management plan approved by the Dutchess County Soil and Water Conservation District.
6. This Section 121-15 shall not apply to any single-family, two-family, or multi-family residential use of land containing five or fewer dwelling units, or to any home occupation unless such residential use or home occupation includes one of the activities listed in subsection E below.

E. Use and Permit Requirements in the Aquifer Overlay District

In accordance with Article IX of this chapter, the Planning Board shall review and act upon Special Permit applications within the Aquifer Overlay AQO District. If the uses listed below are regulated by any state federal agency, the definitions of such uses and all applicable regulations under state and federal law shall apply.

1. Special Permits within the Priority Valley Bottom Aquifer PVBA and Upland Wellhead Protection UWP areas. The following uses, if permitted in the underlying land use district, shall require the issuance of a Special Permit within the Priority Valley Bottom Aquifer PVBA and the Upland Wellhead Protection UWP areas:
   a. Photo labs;
   b. Auto repair facilities and truck terminals, including engine repair and machine shops;
   c. Furniture stripper/painter, metal works, wood preservers;
   d. Printers and the use of printing presses;
   e. Conditionally Exempt or Small Quantity Generators of Hazardous Waste.

f. Solid waste management facilities not involving burial, including incinerators, composting facilities, liquid storage, regulated medical waste, transfer stations, recyclables handling & recovery facilities, waste tire storage facilities, used oil, C&D processing facilities, each as defined in 6 NYCRR Part 360, and junk or salvage yards in general.

g. Salt storage facilities.

h. Uses where Water Consumption exceeds Natural Recharge.

i. Cemeteries, including pet cemeteries

j. Veterinary hospitals and offices

k Funeral parlors.

l. Storage or disposal of manure, fertilizers, pesticides/herbicides. No special permit shall be required where such storage or disposal is conducted pursuant to a *Whole Farm Management Plan* developed in association with the Dutchess County Soil & Water Conservation District.

2. Special Permits within the Buffered Valley Bottom Aquifer BVBA areas and the Upland Aquifer UA. The following uses, if permitted in the underlying land use district, shall require the issuance of a Special Permit within the Buffered Valley Bottom Aquifer BVBA and Upland Aquifer UA:

a. Gasoline service stations;

b. Major Oil Storage Facilities;

c. Junkyards and automobile cemeteries.

d. Salt storage facilities.

e. Conditionally Exempt, Small Quantity, or Large Quantity Generators of Hazardous Waste.

f. Disposal of any hazardous waste, as defined in 6 NYCRR Part 371, by burial.

g. Land application of septage, sludge, or human excreta, including land application facilities defined in 6 NYCRR Part 360-4.

h. Cemeteries, including pet cemeteries

i. Veterinary hospitals and offices

j. Funeral parlors.

k. Storage or disposal of manure, fertilizers, pesticides/herbicides. No special permit shall be required where such storage or disposal is conducted pursuant to a *Whole Farm Management Plan* developed in association with the Dutchess County Soil & Water Conservation District.

3. Application Requirements: In addition to the Special Permit application requirements set forth in Article IX, applicants proposing actions listed in subsections (1) and (2) above that are located within the Aquifer Overlay AQO District shall identify the following as part of their applications:

a. The source of water to be used;

b. The quantity of water required;

c. Water use minimization measures to be implemented;

d. Water recycling measures to be implemented;

e. Wastewater discharge measures;

f. Grading and/or storm water control measures to enhance on-site recharge of surface water;

g. Point Source or Non-Point Discharges;

h. A complete list of any Hazardous Substances to be used on site along with quantity to be used and stored on site; and

i. A description of Hazardous Substance storage or handling facilities and procedures.

4. Special Conditions for proposed uses within the Priority Valley Bottom Aquifer PVBA and Upland Wellhead Protection UWP areas requiring a Special Permit:

a. Storage of chloride salts is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.

b. Generators of Hazardous Waste shall provide the Town with copies of all applicable permits provided by State and/or Federal regulators and copies of all annual, incident, and remediation-related reports.

c. Any projects where Water Consumption exceeds the Natural Recharge, as defined in Subsections F and G herein, shall demonstrate through SEQRA how such impact will be mitigated through, for example, compensatory recharge equal to the identified recharge deficit through a combination of artificial on-site or off-site recharge, or provision of compensatory natural recharge areas elsewhere in the Town.

5. Special Conditions for proposed uses within the Buffered Valley Bottom Aquifer BVBA areas and the Upland Aquifer UA areas requiring a Special Permit:
   a. Gasoline service station operators shall provide the Town with copies of all applicable permits provided by State and/or Federal regulators and copies of all annual, incident, and remediation-related reports.
   b. Junkyard operators shall drain fuels, lubricants, and coolants from all cars stored on site to properly permitted above-ground holding tanks, provide to the Town copies of all applicable permits provided by State and/or Federal regulators and copies of all annual and incident reports, provide the Town with an annual summary of numbers of vehicles on site and total gallons of various classes of fluids drained from vehicles and disposal manifests or other documentation of disposition of such fluids.
   c. Storage of chloride salts is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.
   d. Storage of coal and/or cinders is prohibited except in structures designed to minimize contact with precipitation and constructed on low permeability pads designed to control seepage and runoff.
   e. Generators of Hazardous Waste shall provide the Town with copies of all applicable permits provided by State and Federal regulators and copies of all annual, incident, and remediation-related reports.
   f. Any projects where Water Consumption exceeds the Natural Recharge, as defined in subsections F and G herein, shall demonstrate through SEQRA how such impact will be mitigated through, for example, compensatory recharge equal to the identified recharge deficit through a combination of artificial on-site or off-site recharge, or provision of compensatory natural recharge areas elsewhere in the Town .

6. Prohibited uses within the Priority Valley Bottom Aquifer District PVBA and Upland Wellhead Protection UWP areas:
   a. Municipal, private and C&D landfills as defined in 6 NYCRR Part 360-2 and 6 NYCRR Part 360-7.
   b. Land application of septage, sludge, or human excreta, including land application facilities as defined in 6 NYCRR Part 360-4.
   c. Disposal, by burial, of any hazardous waste, as defined in 6 NYCRR Part 371
   d. Large Quantity Generators of Hazardous Waste.
   e. Gas stations and Major Oil Storage Facilities.
   f. On-site dry cleaning.
   g. Junkyards and Junked car lots.

7. Prohibited uses within the Buffered Valley Bottom Aquifer BVBA and Upland Aquifer UA: Land application of septage, sludge, or human excreta, including land application facilities defined in 6 NYCRR Part 360-4.3.

8. General Non-Degradation Standard: No special permit shall be granted unless the applicant can show that the proposed action will not degrade the quality of the groundwater in a manner that poses a potential danger to public health or safety. Compliance with applicable standards, requirements, and permit conditions imposed by federal, state, or county agencies shall be deemed to constitute compliance with this standard.

F. Determination of a Parcel's Natural Recharge

The natural recharge rate for a parcel shall be determined by identifying the soil types on the property, classifying them by hydrologic soil groups (A through D), applying the recharge rates of 20.2 inches per year through HSG A and A/D soils, 14.7 inches/year per year through HSG B soils, 7.6 inches/year through HSG C and C/D soils, and 4.2 inches/year through HSG D soils, and multiplying the recharge rate(s) by the number of acres in the parcel for each soil group

G. Consumption of Water

Water consumption is the net loss of liquid phase water through site activities, plus the water needed to dilute wastewater and other discharges to a concentration equal to 50% of the NYS Title 6 Part 703 Groundwater Standard.

The following table establishes the method to calculate water consumption:

Use	Gallons per day	Multiplied by Dilution factor	Consumption/day
Irrigated Lands (non-agricultural)	Irrigated Acres x 4,000[(1)]	x 1	= ____________
Uses with Surface Water Discharge	Site activity use x 0.2	x 1	= ____________
Residential Uses with Subsurface Water Discharge[(2)]	70 gpd/capita	x 6	= ____________
Nonresidential Uses with Subsurface Water Discharge[(2)]	Daily Use	x 6	= ____________

(1) Applicable for vegetation requiring 1 inch/week irrigation. May be adjusted for vegetation with other water requirements.
(2) Calculate use per NYSDEC intermediate wastewater disposal guide. Discharge must not exceed NYSDEC Title 10, Part 703 effluent limits.

H. Map Changes

1. New Buffered Valley Bottom Aquifer BVBA and expanded Buffered Valley Bottom Aquifer BVBA areas may be established by the Town's Hydrogeologist at the request of the Town, or proposed to the Town by groups of site owners where a new Community Water System source regulated by the NYS Department of Health is proposed, and where the Town's Hydrogeologist concludes or agrees that the water source for the Community Water System and any private wells within or hydraulically downgradient from the new or expanded Buffered Valley Bottom Aquifer BVBA would not be threatened by a Pollutant Discharge originating anywhere within the Buffered Valley Bottom Aquifer BVBA.
2. New Buffered Valley Bottom Aquifer BVBA shall be regional in nature and no single project, or single parcel Buffered Valley Bottom Aquifer BVBA may be proposed.
3. New Upland Wellhead Protection UWP areas, or expanded Upland Wellhead Protection UWP areas, must be defined for the water sources for any existing and future proposed Community Water Systems within the Upland Aquifer UA by their owners, and must be reviewed and approved by the Town's hydrogeologist.
4. The Aquifer Overlay District Map may be modified to reflect new or more accurate geological or hydrological information, provided that the Town's hydrogeologist reviews and approves any such modification.
5. Any new areas or revisions of boundaries made pursuant to this Subsection H shall be placed on the Aquifer Overlay District Map pursuant to the zoning map amendment process in Article X.

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I. Reporting of Discharges

Any person or organization responsible for any discharge of a Hazardous Substance, Solid Waste, Hazardous Waste, petroleum product, or radioactive material shall notify the Town Clerk of such discharge within 24 hours of the time of discovery of the discharge. This notification does not alter other applicable reporting requirements under existing law and applies to all uses and structures, whether conforming or non-conforming in any respect.

J. Non-conforming Uses, Structures, and Lots

See Article VI of this Chapter. For any non-conformity which requires a special permit to expand or change, all requirements of this § 121-15 shall apply to such expansion or change.

Appendix B

Appendix B – Preliminary Evaluation of Stream Flow Statistics
The Chazen Companies.

Ayer and Pauszek (1968) examined stream flow records from a gauging network maintained historically in Dutchess County but for the most part currently deactivated within the watershed except for a remaining gauge at Red Oaks Mill. Consolidated stream flow records for the Wappinger Creek upstream and downstream from Pleasant Valley, as well as stream flow records for the Great Spring Creek watershed and the Drake Watersheds are discussed below and summarized on Table 1 in the main body of this report.

By combining the flows of the upper Wappinger Creek, the East Branch of the Wappinger Creek and the Little Wappinger Creek, we can estimate from Table 1 that median flow (exceeded 50% of the time) entering Pleasant Valley below the confluence of the Little Wappinger Creek at Salt Point is approximately 55,200 gallons per minute, stream flow falls to 9,245 gpm during the 90 percent event (flow exceeded 90% of the time) and falls to 3,253 gpm during the statistically-estimated 7-day average flow during a 1-in-10 year drought (based on 1931 to 1960 period of record).

The data also show that median flow (exceeded 50% of the time) of the Great Spring Brook entering the Wappinger Creek is approximately 4,488 gallons per minute, falling to 224 gpm during the 90 percent event (flow exceeded 90% of the time) and falling to 49 gpm during the statistically-estimated 7-day average flow during a 1-in-10 year drought (based on 1933 to 1961 period of record). The currently inactive gauging station where these data were collected remains on the Great Spring Brook near Sherow Road and North Road.

Flow in the Drake Brook is estimated by combining Table 1 flow data from the main stem and its tributary to identify that median flow is approximately 3,636 gpm, falling to 247 gpm during the 90 percent event, and falling to 67 gpm during the 7-day average flow during a 1-in-10 statistical drought.

Inspection of the low flow data on Table 1 indicates that yields-per-square mile are lower in the Great Spring Brook, Drake Book and Little Wappinger Creek watersheds than in the Upper Wappinger Creek Watershed, East Branch, and overall Wappinger Creek. This is believed to reflect the relatively limited volumes of thick sand and gravel in these three lower-flow tributaries, so rendering them less able to store large volumes of groundwater during wet periods for slow release during dry periods. The

Great Spring Brook also appears to have a significant number of large riparian wetlands which may be removing hundreds of gallons daily from this watershed and directly reducing summertime stream flows.

The former Dutchess County Environmental Management Council (DCEMC) maintained a Wappinger Creek stream monitoring program for several years. Data have been consolidated by The Chazen Companies in Table 2 of the main body of this report.

Stream gauging and creek water sampling were conducted by the Dutchess County Environmental Management Council (DCEMC) in the Wappinger Creek in 1997 and 1998. Select readily-available data from that program are presented on Table 2. Stream gauging conducted during September and October of 1997 most closely represents low-flow summertime conditions in the Wappinger Creek. Comparison with reference data from the Red Oaks Mill gauging site shows that flow during these two periods were somewhat consistent with flows within the lowest 10 percent of flows observed in the Wappinger Creek (e.g. flows exceeded 90 percent of the time).

The sampling stations used by DCEMC which are relevant to Pleasant Valley include the following:

- River Mile 8.01 – Wappinger Creek at Red Oaks Mill. This station is below Pleasant Valley and coincident with the current remaining Red Oaks Mill USGS gauging station.
- River Mile 12.28 – Wappinger Creek at DeGarmo Road. This station is the nearest downstream station to Pleasant Valley.
- River Mile 16.56 – Wappinger Creek behind Pleasant Valley Town Hall
- River Mile 20.88 – Wappinger Creek at Hurley Road bridge. This station is downstream of entry of the Little Wappinger Creek into the Wappinger Creek and at the upstream end of Hurley Road.
- River Mile 24.04 – Wappinger Creek at County Route 13. This is the nearest station upstream of Pleasant Valley. It is downstream of the entry point of the East Branch tributary to the Wappinger Creek and upstream of the entry point for the Little Wappinger Creek tributary.

During the September and October 1997 low flow periods, the data indicate that flow in the Wappinger Creek decreased somewhere between the creek crossing at County Route 13 and the Pleasant Valley Town Hall. This is an unexpected finding since tributary inflows from the Little Wappinger Creek, Great Spring Brook and Drake Brook all contribute to stream flow within this reach of the Wappinger Creek. The source of water reductions is unknown but appears to be in the order of 2,000 to 3,000 gallons per minute. As indicated in Section 2.4, average daily water consumption by the Town's entire residential and commercial population is not estimated to exceed 675,000 daily gallons in summer, equal to 470 gallons per minute. The reduction cannot be explained by consideration of wetland water uses since wetlands intercept water flowing to streams, but seldom remove water already in a stream. The source of the reduced flow of the Wappinger Creek in Pleasant Valley is therefore not understood at this time. The water requirements of any agricultural or aggregate operations are unknown but may contribute to stream flow reductions. The precision of the Dutchess County EMC stream gauging is not known, but the individuals involved in the gauging effort were generally properly trained so the data may be correct. The narrow confines of the Wappinger Creek in Pleasant Valley suggest it is unlikely that subsurface streamwater flow paths explain the apparent loss of Wappinger Creek flow in Pleasant Valley.

Samples of stream water collected by Dutchess County Environmental Management Council personnel were analyzed for nitrate and phosphate in laboratory facilities at Marist College and at the Institute of Ecosystem System studies. Concentrations of nitrate and phosphate entering streams are usually mitigated by biological activity, but persistent concentrations reflect likely higher concentrations of nitrate and phosphate in the groundwater entering stream baseflow.

Stream gauging conducted by TCC as part of the aquifer monitoring program established by Dutchess County Water and Wastewater Authority (Chazen, 2003) during low flow events in November 2001, August 2002 and September 2002 recorded flows of 6,675 gpm, 5,999 gpm and 3,263 at the Wappinger Creek at the Pleasant Valley Town Hall in November of 2001, August of 2002 and September of 2002, respectively. These were two years of significant drought and low creek flows, nearing stream flows which might be expected during the 1-in-10 year statistical drought. Estimating that the streamflows were supported fully and solely by groundwater discharges, groundwater yield per acre for November 2001 was 95 gal/day/acre, for was 87 gal/day/acre in August of 2002, and had dropped to 47 gal/day/acre by September of 2002. The data table from these gauging events is reproduced in Table 3 in the main body of this report and, unlike DCEMC data, did not identify substantial flow reductions as the Wappinger Creek passed through the hamlet of Pleasant Valley (Sum of Stations 15, 16 and 17 versus station 14 on Table 3) although flow gain was not substantial and minor flow reductions were noted during the driest September 2002 data round. No explanation is presently understood for absence of flow reductions in the Chazen data versus the flow reductions documented by the DCEMC data.

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