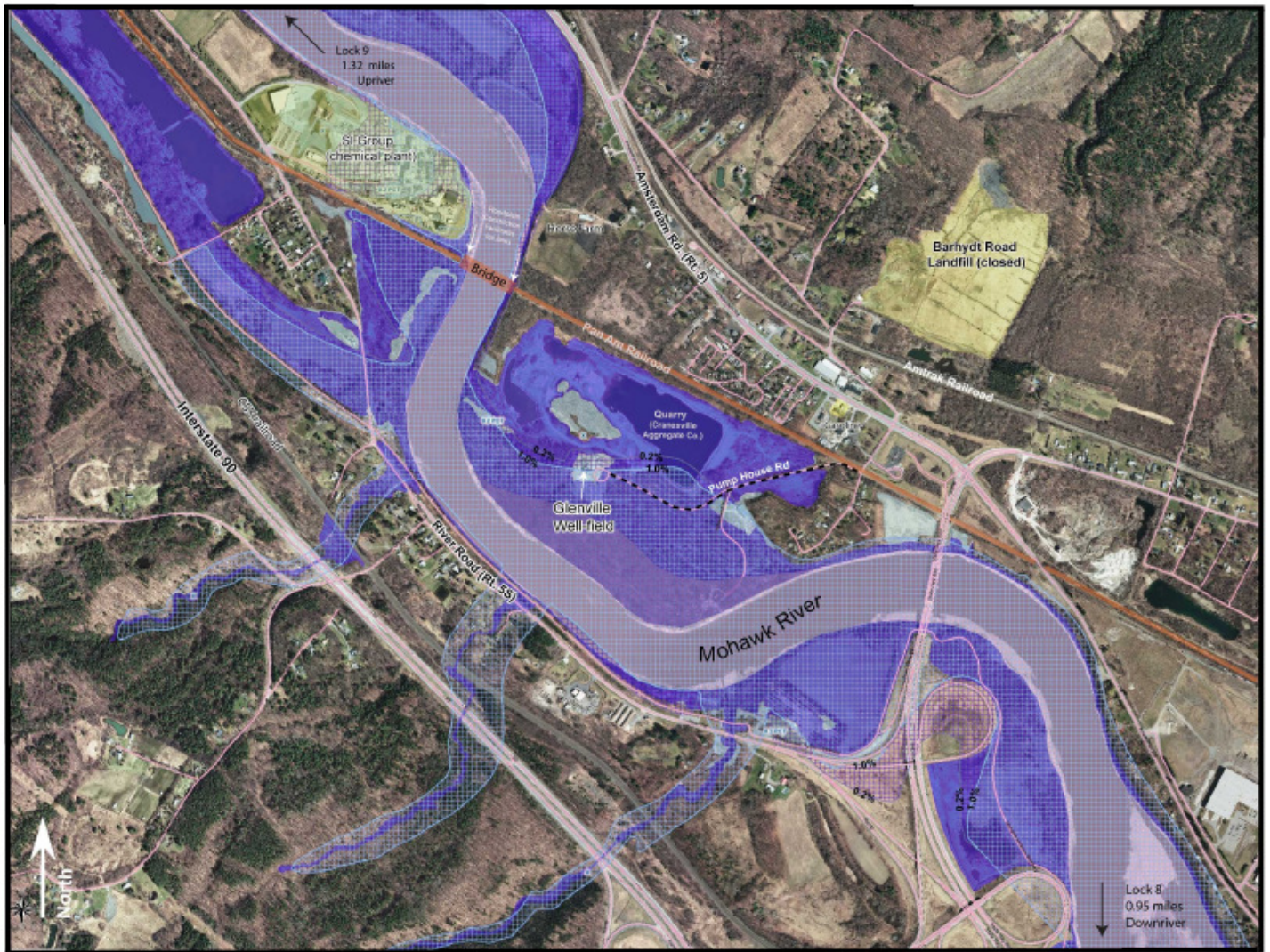




TOWN OF GLENVILLE

ADVISORY REPORT ON PROTECTION OF THE GLENVILLE WELL-FIELD



GLENVILLE WELL-FIELD PROTECTION COMMITTEE

FEBRUARY, 2013

11" x 17" flood zone map inserted here

Advisory Report
on
Protection of the Well-field of the Town of Glenville,
Schenectady County, New York

*Men really know not what good water's worth;
If you had been in Turkey or in Spain,
Or with a famishe'd boat's crew had your berth
Or in the desert the camel's bell,
You'd wish yourself where Truth is - in a well.*

Don Juan, Canto II. St. 84, Byron

Final Report

Glenville Well-field Protection Committee

February, 2013

Following several organizational meetings in 2011, the Town of Glenville appointed, in early January of 2012, the Glenville Well-field Protection Committee (GWPC), to provide guidance on protection of the Glenville well-field with its water treatment plant (WTP), sited on the Mohawk River flood plain within a residential and industrial area. This report emerges from those meetings and the analysis of reports, and other data relevant to the overall goal of protecting the Town's supply of clean and abundant drinking water from the Schenectady (sole source) Aquifer, one of America's finest.

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Cover photo:
Flood zones and key features in the vicinity of the Town of Glenville Well-field.

Executive Summary

The Glenville water supply system draws from its well-field, situated near the western end of the Great Flats Aquifer. It is the sole-source of water for some 16,000 residents in the town of Glenville NY. Its location on the floodplain of the Mohawk River with nearby industrial, and transportation activities, as well as human occupation, makes it susceptible to impairment by a number of potential and unpredictable threats. Over the past year, the Glenville Well-field Protection Committee (GWPC, “Committee” in this report) has investigated the range of these threats, and we have come to conclusions and recommendations that we present in this report. We have examined the water treatment plant (WTP) as it is situated adjacent to the Mohawk River in its surrounding flood plain, its design and operation, recent serious flooding, human activity, past and present, including the operation of the adjacent gravel pit, and other potential threats. We all agree that the continuous supply of high quality potable water to the citizens of Glenville is of utmost importance, and it is in everyone’s best interest to do what can be done to protect this precious resource.

We have identified and addressed six principal areas of concern.

1) **Flood mitigation**

Because the WTP, access road, and well-heads sit on the 100-year flood plain, there is particular concern that mitigation efforts address key vulnerable points in the system. Direct and indirect impacts from flooding have and will continue to result in a compromised infrastructure and potential loss in water quality and quantity. To avoid loss of service due to flooding, we strongly recommend the immediate installation of an earthen dike surrounding the WTP, raising the two outdoor wellheads, and raising the grade of the access road to provide secure vehicular access to the plant.

2) **Post-event restart of facilities**

In the event of catastrophic loss of the facilities (flood, contamination, power interruption, or natural disaster resulting in infrastructure loss), the system will need to be returned to service as quickly as possible. Therefore we recommend that existing emergency planning, procedures, and protocols be reviewed and updated as appropriate, to ensure that this can be achieved. To minimize restart time and cost, we should prepare an inventory of the critical equipment likely to be damaged; verify and establish sources of replacements or repair; and identify the various contractors, agencies and workers needed to accomplish the restoration of service on a 24hr./7day basis.

3) **Interconnect with adjacent systems**

The larger and more interconnected a water supply system is, the more likely it will be able to accommodate an interruption in any of its parts. There are a number of systems adjacent to the Glenville system that draw from the Great Flats Aquifer, and other sources. We are already connected in some places, and have on occasion helped each other overcome problems. However, for various technical reasons, these

interconnections would not be adequate to sustain service to Glenville residents in the event of a complete loss of our plant. We recommend that efforts be made to organize an inter-governmental group that would commission an engineering study of the regional water supply system. Such a study would provide the technical basis for planning and installation of emergency interconnections, stockpiling of emergency materials, and agreements on metering and payments.

4) **Recharge monitoring and aquifer quality**

Contamination from activity in adjacent areas with hydrologic connection to the well-field is an ever-present critical concern. In order to detect contamination plumes approaching our wells in time for appropriate action, we recommend a program of test monitoring of the aquifer at various distances from our plant. This monitoring would assess potential surface contamination, changes driven by adjacent gravel mining, and deep hydrologic connection to potential contaminants.

5) **Education and protection of the resource**

A key facet of water protection is a well-informed citizenry. Thus the committee is interested in furthering the education of the Glenville community – including its leaders – about our water supply and potential threats to that supply. We recommend an effort be made, directed at all citizens, to raise the level of public awareness regarding the source and vulnerability of their water supply and to build a well-managed archive of information on our water supply in the context of the Mohawk River watershed.

6) **Regional planning**

Regional planning and cooperation with adjacent municipal authorities can be an important factor in insuring uninterrupted flow of water for the Town of Glenville. Thus we encourage working cooperatively with other agencies and authorities who can effect change with regard to aquifer contamination and who may be partners in funding opportunities that would address the key water quality issues that affect other systems with a similar setting (Niskayuna, Schenectady, Rotterdam, and Scotia).



Town of Glenville Water Treatment Plant

Introduction

This is a time of global climatic change, and the State of New York is in the early stages of assessing critical infrastructure and how to better prepare that infrastructure for what may be a continuation of damaging storms, floods and extreme weather events. Planning and preparation at the local level is going to be an important part of the overall New York State assessment and approach. Glenville's well-field is an essential resource for some 16,000 people and it faces potential degradation, or loss. It is particularly vulnerable because it sits on the floodplain of the Mohawk River, and it is situated in and adjacent to an area with potential surface and sub-surface contamination.

Natural disasters of 2011-2012 will cost the nation more than \$70 billion. Most of this damage has been directly related to hurricanes and storms Irene, Lee, Sandy, and other un-named storms, which have resulted in the loss of lives and many homes and priceless possessions. Hundreds of businesses and industrial facilities have been devastated. In the lead-up to Hurricane Sandy, we saw the first hints of change at the local and state levels: at long last NYS government and its various agencies, local and state-wide, are awaking to the need for improved, expedited coordination and action toward dealing with the consequences of global climatic change.

Flooding during the passage of tropical storms Irene and Lee in the fall of 2011 caused damage to the water treatment plant (WTP) and came within a few vertical feet of incapacitating the facility, as well as isolating the plant and damaging its access road. Hurricane Sandy could have again had serious impact on the Mohawk watershed if its route had varied only slightly. Additional storms of such destructive magnitude seem destined for our region and we must work for mitigation.

Potential water-quality risks are real and diverse: Extraction of gravel from an adjacent quarry that is currently permitted to surround the WTP; the proximity of some 140 un-sewered homes and businesses including one gasoline station; a railroad right-of-way with rails borne on thousands of ties laden with wood preservatives; the closed Barhydt Road Landfill; a major chemical plant (SI Group) across the Mohawk River from the WTP; and an adjacent horse farm. The presence of these risks signal the need for extreme vigilance regarding pollution, decline in yield capacity and the alteration of pH, temperature, oxygen levels, water viscosity and other parameters, including the ill-defined risk of pharmaceutical pollution.

The challenge for improving this situation has several primary components that are interwoven but all related to our overall goal of a continuous and uninterrupted supply of clean drinking water for the Town of Glenville. These components include addressing flooding of the WTP; deterioration of water quality and quantity in the source aquifer; restart and interconnection to adjacent water supplies for recovery from potential loss; and formulating longer-term strategy and goals.

Formation and Operation of the Glenville Well-field Protection Committee

In January 2012, the Glenville Town Board formally appointed the Glenville Well-field Protection Committee (henceforth the Committee) with advisory authority (informally meeting for several months in late 2011). Since inception, the Committee has investigated natural events and societal practices that have the potential to impact Glenville's well-field and water treatment plant (WTP) in the future. See the appendix for a description of the WTP. To address these potential impacts and to protect our water supply, the Committee is offering recommendations to Town leaders on steps that should be taken to assure that residents of Glenville have a safe, uninterrupted supply of high-quality water.

From the first meeting of the Committee, monthly meetings have been open to interested citizens. A variety of individuals have attended, some invited, others as 'walk-ins'. At these meetings both detailed and broad aspects of the flooding matters were discovered, discussed, and a body of information (textual, cartographic and photographic) was accumulated. This information will help frame future actions appropriate to insure the integrity of Glenville's water supply system.

We have focused on a variety of potential threats to our well-field, including those from both the surface and from deeper difficult-to-observe threats to the aquifer. Perhaps the most significant potential risk to Glenville's well-field includes several potential sources of surface contamination. One significant source of concern are high-intensity storm events that cause severe flooding along the main stem of the Mohawk River adjacent to Glenville. In the last few years, there have been several flood events that have raised concern about the integrity of the Glenville water supply system. The events include high water in 2006 due to heavy rainfall in the upper part of the Mohawk watershed; brief flooding in 2010 resulting from an ice jam, which inundated the pump-house road; and recently, severe flooding caused by both Tropical Storms Irene and Lee. In addition to these severe storm event floods, activities associated with industrial, commercial, and residential practices have been reviewed for their potential impacts to the well-field.

This report presents what the Committee has learned and makes recommendations in six general areas for the security and integrity of Glenville's water supply system. As a system, each part of the water supply is closely linked to the other and thus overlapping of content naturally occurs.

- 1) **Flood mitigation.** Direct and indirect threats from flooding that would result in contamination of wells, and compromised infrastructure.
- 2) **Post-event restart of facilities.** Streamlining procedures and being prepared with details.
- 3) **Interconnection to adjacent systems.** Assessing the possibilities and merits of coordinating with neighboring systems.

4) **Recharge monitoring and Aquifer quality.** Developing long-term monitoring to establish a factual basis for evaluation of contamination and other influences (deep and shallow) from adjacent areas with hydrologic connection to the well-field.

5) **Education for protection of the resource.** Education of the Glenville community about our water supply and potential threats to this resource and establishment of a well-curated collection of materials documenting the history of our water-supply system.

6) **Regional planning.** Regional planning and cooperation with adjacent municipal authorities as an important factor in insuring uninterrupted flow of water for the Town of Glenville. This step should include working with federal, state and regional agencies concerned with aquifer quality.

Detailed Guidance on Committee Recommendations

1. Flood Mitigation: flooding and surface contamination

Recent flooding in the Mohawk watershed should be evaluated in the context of a changing hydrologic system. It would be wise to consider how our future planning considers change already recognized in the basin (Garver and Cockburn, 2011, 2012). Hydrologic data suggest that important changes have occurred in NY State in the past few decades and it is important to understand what these changes mean in different sectors of the State (Hayhoe, et al., 2006; Frumhoff et al., 2007; Shaw et al., 2011; Rosenzweig et al., 2011). The recently released ClimAid study (Rosenzweig et al., 2011, and see Shaw et al., 2011) notes that the annual average precipitation in NY State has been increasing by nearly 1 cm per decade since 1900 and there has been an increase in the frequency of heavy rainfall that is especially pronounced in the Northeast (Shaw et al., 2011; see also Burns et al., 2007; DeGaetano, 2009; USGRCP, 2009).

Flooding in 2006, 2010, and 2011 has raised concerns about the integrity of the WTP because surface flooding can overtop wellheads, which results in expensive and time-consuming cleaning of the system. Although the plant operation was not interrupted by either the January 2010 ice-jam event, nor by 2011 Tropical Storms Irene and Lee, the plant did sustain damage and there is concern that the plant is vulnerable to more extreme floods. Thus we are concerned that residents of Glenville could be exposed to severe inconvenience of a compromised water supply from surface contamination and WTP shut-down during floods. Under present circumstances risk of a shut-down due to flooding is relatively high. Time and extent of this threat cannot be determined precisely because future weather and water flow for the Mohawk watershed are difficult or impossible to know with certainty but we do our best to evaluate the risks and to recommend prudent responses.

The FEMA-determined 100- and 500-year flood levels at the WTP are 239.9 ft. asl (above mean sea level) and 243.5 ft. asl, respectively (see Schenectady County Flood Insurance Study). During the Irene event, the high-water level at the plant was approximately 242.2 ft. above sea level (i.e., above the predicted 100-year flood level).

We have surveyed the site to better define how this flood elevation compares to the well-field property. Levels greater than 245 ft. asl would flood the pump-house, contaminate the clear wells, and deactivate the system. Flooding might also have secondary effects because there are vulnerable sectors at lower levels that include the access road, the power substation, the emergency generator, and ancillary buildings, and thus these potential flood-prone areas need to be carefully considered. **We thus recommend installation of a dike around the plant that would afford protection up to a level two feet above the predicted 500-year event (0.2% probability in any given year).**

Further, we experience inconvenience, loss of communication, and staff insecurity at the WTP when the pump-house road is flooded and the plant becomes accessible only by boat. Therefore, **we also recommend rebuilding the road to an elevation equal to that of the plant itself.** If a dike is built, and the road raised, in cooperation with the neighboring gravel quarry as owned by the Cranesville Aggregate Company (CAC), the result would allow vehicular access for both the WTP and the quarry.

We have consulted with local archaeologists familiar with the history of the site and find that the proposed changes would have minimal impact on the archaeological record, especially that of the important and adjacent Bent site (W. A. Ritchie and R. E. Funk, 1973).

A key concern is measuring and understanding water levels around the plant. As part of the effort to measure water levels at various points in and around the plant, we are installing water-elevation-gauge posts similar to the one at SI Group, our neighbor across the river to the southwest. These cylindrical, yellow, steel posts of eight-inch diameter bearing level markings are visible from the plant and the eastern part of Pump House Road. These will provide key reference markers during high-water events.

The severity of flooding can be affected by entities in the watershed (Garver and Cockburn, 2011, 2012). We have discussed actions that might be taken by the NYS Department of Environmental Conservation (DEC), NYS Canal Corporation, New York Power Authority (NYPA), and others. Immediate actions in the wake of Irene and Lee, underway and proposed, include clearing the river of deadwood, channel dredging, modifications to the lock and dam structure and operation, and planning and flood management for the entire 3,456 mi² watershed. At this time we find that the various state and federal agencies have been stimulated to improve coordination prior to, during, and following flood events and a centralized 'command center' may be in the offing. The expeditious management of movable dams prior to Hurricane Sandy (October, 2012) is illustrative. Toward the end of making our contribution to improved management of the system and protection of our Town's resources, **it is suggested that detailed letters of concern, reviewed by the Town attorney and Town engineers, be directed to the Canal Corporation, the DEC, DOH, and our congressional representatives. An aspect of this outreach might be to solicit greater rapport with such agencies during their planning and engineering efforts and to be in a more potent position when untoward events do occur.** Proactive measures such as movable dam design and installation, canal draining, channel dredging, opening the power plant gates at Vischer's

Ferry Dam, lowering NYPA's lower reservoir at Blenheim Gilboa, lowering the reservoir at the NYC Gilboa dam, and debris clearance from the flood plain would thus be fostered.

2. Post-event restart of facilities

In the event of catastrophic loss of the facilities (flood, contamination, power interruption, sabotage, or natural disaster), the system will need to be returned to service as quickly as possible. **Therefore we recommend that existing emergency planning, procedures and protocols be reviewed and updated as appropriate, to ensure that this can be achieved.** To minimize restart time and cost, this planning should include the following steps: prepare an inventory of critical equipment likely to be damaged, verify and establish sources of replacement or repair, and identify the various contractors, agencies and workers needed to accomplish the restoration of service on a 24/7 basis.

We also recommend completion of the Phase II water WTP upgrade (involving piping and valving) allowing any well to be pumped to either clear-well within the plant and from there to the distribution system. At present all wells can be routed to the original clear-well however only two wells may be directed to the new clear-well. In the event of a failure of the old clear-well sufficient capacity for high demand periods can not be assured without the ability to route water from the two wells within the original plant to the new clear-well.

3. Interconnection to neighboring systems

Backup plans for a complete or partial failure of the WTP and well-field are needed. This planning is necessitated by the fact that at present the Town is reliant on one source for its water and an extended outage of that source requires other potential sources of water be determined and implemented.

The Town water system normally has an approximate three-day supply of water "in the air", that is, water that has been pumped into storage tanks on Lolik Lane and Church Road. With rationing of water usage, that supply should suffice until alternative arrangements can be implemented.

Glenville, at present, has interconnections with Clifton Park and Ballston that are now served by the Saratoga County water system. In the past, Glenville sold water through these interconnections. We also have an interconnection with the Village of Scotia. Each of these sources could supply the Town with a limited quantity of water. The quantity is limited by the capacity of the interconnection pipes and by pressure differences.

Another potential backup source is the City of Schenectady, which has water mains near Freemans Bridge. This source could be implemented at low cost by piping water across the bridge deck with a "hydrant to hydrant" type connection. A more sophisticated interconnection could be engineered at a low cost. The City of Schenectady's water source is the same as Glenville's.

Several “abandoned” water wells in the Town of Glenville may exist and might serve and thus their status needs definition.

While none of the alternative arrangements has the ability to supply Glenville with all the water it needs, a combination of sources should serve until a permanent supply is restored.

It is recommended that all of the mentioned backup sources be examined for volume considerations as well as equipment needs. A detailed written plan must be developed, so that in the event of a Glenville water-source failure, implementation can proceed without delay. We must remember that the Glenville backup plan can “go both ways”. We can also serve the other communities if they have problems. It is recommended that written contracts be negotiated and developed so that at the time of a water failure by either party a phone call is all that is required to start the water flowing.

4. Recharge monitoring and aquifer quality

Contamination of areas with hydrologic connection to the well-field

There is an ever-present possibility of accidental and/or vandal-based pollution of the Great Flats Aquifer. The regulations, preventative measures, and emergency planning implemented in the recharge area apply to Glenville as well. We should encourage and participate in various initiatives defined as much as possible, and do what we can to increase public awareness of the nature of their water supply and the need to protect it. **The Town's concerns and actions must be addressed in the annual report on water supply that is sent to the consumers. Further, we should endorse state and federal efforts to establish a full watershed flood mitigation center to coordinate watershed-wide modeling and storm mitigation.**

The recharge area of the aquifer includes an area between the well-field and Route 5. Sources of local surface and groundwater contamination in this area include: leaking and spilling from diverse storage tanks (e. g. a gasoline station on Route 5 near the junction of Van Buren Lane), railroad accidents (many Pan Am Co. and CSX trains traverse the aquifer every day), highway accidents, upstream chemical and fuel releases, adjacent septic system percolation (some 140 residences and small businesses), horse farm effluent percolation, preservative leachate from railroad ties, floodwaters carried by the river, local run-off, and sabotage/illicit dumping. To date and to the best of the Committee’s knowledge, the plant has experienced no noticeable contamination from these sources but they remain an ever-present low probability threat.

The quality of raw water drawn by the WTP is periodically tested for key indicators to detect variation from established baselines, but it is clear to the Committee that we need to improve our baseline monitoring. This monitoring should focus on several parameters that are not currently routine: turbidity, pH, water level, temperature, and indicator chemicals. **A scientifically-based monitoring protocol which would collect test data at various distances from our wells should be developed and implemented. This**

protocol would utilize all available existing test wells as well as some critically located new wells, especially wells up-gradient from our well points (as defined in Appendix I). Some 30% of the ‘feed’ to our WTP is from the north and northeast – the direction of major potential pollution (see meeting minutes covering the presentation by Jason Pelton). Pharmaceutical pollution is now also emerging as an issue but we sense that it is premature to initiate specific studies and make further commentary. **Finally, we should consider the merits of extending Glenville’s wastewater collection system to the residential area between Route 5 and our well-field, and north of Route 5.**

There is also a concern that there may be a deep hydrologic connection to adjacent areas. We know that the well-field sits in well-sorted river gravels, and routine pumping is known to have far-reaching effects that have been well-recorded in the measured cone of depression. However, in the tests done to delineate the cone of depression, no wells on the south side of the Mohawk River were evaluated; hence the area affected by water withdrawal has been inferred to not extend to the south side of the Mohawk. This inference is not supported by data but deep connection of the aquifer upgradient (to the south and west) cannot be ruled out, especially in periods of low flow in the river and high withdrawal rates from the well-field. Hence there is a concern that there may be a poorly understood hydrologic connection between the well-field and the SI Group plant directly across the Mohawk River. **The SI Group plant has been through an active and aggressive plan with the NYSDEC to manage contamination directly below the plant but plumes of contamination beyond this site need assessment.**

Clear and direct connections have been established through the aquifer below the Mohawk River between the Schenectady well-field and Maalwyck Park (and Glenville Business and Technology Park) where a down-gradient, migrating plume of trichloroethylene (TCE) has been identified. Regardless, **we find insufficient data to confirm the existence of a deep connection between the Glenville well-field and the lingering contamination at the SI Group site in Rotterdam Junction.**

Potential Impacts of the adjacent gravel quarry

The WTP is surrounded by lands owned and operated as a gravel pit by CAC which is permitted by The Region 4 NYSDEC. Our well-field thus becomes increasingly vulnerable as the area of the quarry expands. Although it is impossible to know exactly what might happen, there is the potential for contaminants to enter the wells as gravel extraction approaches the supply wells. This growth in quarry operations increases the extent of ponded, exposed water directly adjacent to the well-field. We suspect that movement of contaminants will be accelerated and augmented as open water replaces the gravel that is the main component of the aquifer. Even casual inspection indicates that floating surface matter can move hundred of meters in hours with little degradation whereas percolating material moving through the aquifer moves much more slowly and with much degradation and natural filtering. In addition, we suspect that the accumulated organic matter and sediments in the adjacent gravel pit may initiate detrimental chemical and transmissivity (the rate which groundwater flows through an aquifer) changes in the water supply. It is possible that eutrophication (as supported by plant nutrients released

in sewage) of the ponded waters will occur, and in this case, the resulting primary production will occur primarily in planktonic form including dangerous *Cyanobacteriaceae*, because of the seasonal variation in water level that prevents the growth of vascular plants. Eutrophication may also cause a loss of oxygen from the deeper water, and the floor of the pond, change in pH of the sediment and out-gassing and transport of bottom material for potential entry to the shore substrate.

We now know that CAC uses the gravel mined in this pit to supply the nearby concrete batch plant, and thus it is likely that the rate of extraction would correlate with concrete sales. There is no evidence at present that they are selling the gravel directly for purposes such as road building and paving. Therefore the rate of expansion of the pit is moderate, as concrete sales are relatively modest. Nevertheless, it is important to know more about the water column in the adjacent gravel pit, including the chemical and biological character of the vertical water column and sediments in the pit. Plant nutrient levels, pH, temperature, and oxygen levels are especially important. These data will provide a basis to detect and react to any problematic changes and to be well prepared to provide guidance for the renewal of CAC's mining permit in 2014. We have requested permission from CAC to begin such studies, but we have been denied access to this property. We have also requested guidance on such matters from Region 4 NYSDEC but, again, our request was unsuccessful, perhaps because of post-flood complexity and a litigious atmosphere at the time of our request. **We thus urge that every effort be made to gain access to the quarry lands and waters of CAC for routine, long-term annual monitoring, as a prudent action, necessary to respond to emerging threats to water quality in a manner that assures the safe supply to nearly 16,000 residents and the many businesses and industries of the Town, and potentially many more in the future.** Early fall is a priority time for such sampling because thermal stratification of the ponds would be the most highly developed.

This matter is urgent because the permitting process is about to come under review. **A detailed plan for dialogue with Region IV of the NYSDEC and CAC regarding renewal of the mining permit for the CAC is strongly urged. We should seek to make access to the quarry for monitoring of the grounds and waters of the quarry a requirement for permit renewal.** Continued mining of the region between the WTP and the Mohawk River will also open the WTP 'peninsula' to serious erosion and other influences of the river.

An attractive alternative would be acquisition and retirement of the portion of the site as yet unexcavated, which would eliminate this sort of threat. Cooperation with CAC toward the establishment of an educational and memorial parkland affirming the importance of both water and mineral resources would be an act of great significance. We must remember that the Cushing family, some of the first to quarry this flood plain for gravel, donated the site of the WTP to the Town.

5. Education and protection of the resource: outreach, and education

We should continue to record, collect, organize, study, and archive data

concerning the watershed as a whole so that we can best understand the factors that can affect the well-field, including flooding, ice jamming, land use, topography, weather and climate. We should interact with and seek guidance from those agencies that have the means to study and mitigate flooding of the Town of Glenville's riparian plain. These agencies include the NYS Canal Corporation, New York Power Authority, US Army Corps of Engineers, US Coast and Geodetic Survey, Federal Emergency Management Administration, NYS Department of Environmental Conservation, NYS Department of Health, National Weather Service-NOAA, Schenectady County Conservation District, and SI Group.

Toward these ends we have procured and have archived with Mr. Kevin Corcoran a copy of the current DEC mining permit for the adjacent operation of the CAC gravel quarry, pertinent articles from the *Daily* and *Sunday Gazette* from recent years, printed proceedings of related conferences, various hydro-geological studies of the site, maps of the site, annotated photographs of flooding and adjacent features such as the Pan Am RR, the gravel pit, and, perhaps, most important of all, the minutes of the meetings conducted by the GWPC as available through the Town's Planning Department. **It is suggested that the many *Gazette* articles related to flooding and water management for the Mohawk watershed be assembled in chronological order in scrap-book style as a memoir of recent flooding and as a guide to the complexity of events following serious flooding. Further is it suggested that the final version of this report be made available on the web; be presented, in "distilled form", at the forthcoming Mohawk Watershed Symposium to be held at Union College and on educational kiosks - as currently funded - placed at key localities in the Town.**

We continue to urge all members of the Glenville Town Board to visit the access road and the water treatment plant, to view the surroundings of the well field, i.e. quarry, residence-business community, railroad, river, etc., and that the status of Glenville's water supply be included in the annual State of the Town Report presented by the Town Supervisor. Aerial images of the site are also available on *Google Earth*. Proceedings of Union College's Annual Mohawk Watershed Symposia, as organized by Professors John Garver and J. M. H. Cockburn (see Glenville file) are a seminal resource. Professor Garver's contributions on Mohawk River hydrology to Google (Wikipedia) are another.

6. Regional planning. Regional planning and the cooperation of adjacent municipal authorities may be an important factor in insuring an uninterrupted flow of water for the Town of Glenville. **Thus we encourage working with agencies and authorities who can affect change with regard to aquifer contamination and who may be able to partner in funding opportunities to address key water quality issues that affect other systems with a similar setting (Niskayuna, Schenectady, Rotterdam, and Scotia).**



Damage and debris at Lock 10 following Tropical Storm Irene in August, 2011

Summary of the Details on Proposed Actions

1. Establish additional long-term monitoring sites to gather baseline data to assess key indicator chemicals. This effort should include developing a better understanding of the direction of groundwater flow and possible connections across the Mohawk River.
2. Determine elevations at key points around the WTP to facilitate flood mitigation efforts and real-time monitoring during flood events.
3. Complete installation of gauged posts to monitor flood levels and electronic means of communication.
4. Examine flood vulnerability of the power substation and emergency generator, including fuel capacity and duration.
5. Examine WTP to determine if there are any unrecognized failure points related to lightning strikes, hail, wind, fire and river-bank erosion that could undercut power pylons to curtail power supply to the WTP.

6. Equip WTP to better monitor key water quality parameters, including pH, water temperature, water level, turbidity, and oxygen at one or more of the four wells.
7. Review and update emergency plans including:
 - i. Plans and methods to communicate with users in the event service is interrupted or curtailed.
 - ii. Movement of vehicles and portable equipment to safe areas in advance of rising water.
 - iii. Movement of important documents, maps, plans, photographs and equipment to safe locations.
 - iv. Cutting power to systems and devices that could be immersed.
 - v. Altering electrically powered access gate at the WTP to allow entry by authorized personnel during power outage.
 - vi. Plan for emergency procurement of replacement equipment and materials.
 - vii. Plan to expedite contractor assistance in restoring plant service.
 - viii. Make sure procedures for securing WTP in an emergency are effective.
 - ix. Create checklists where appropriate.
 - x. Clearly define responsibilities of people involved and build 24-hour teamwork toward assuring the safety and well being of both personnel and facilities.
 - xi. Make sure plan is in clear concise language, and make sure key agencies have access to it.
8. Review status of insurance for the WTP and access road. The next serious flood will probably do great damage to the access road because of flow enhancement by past erosion on the north side of the road caused by the floods of storms Irene and Lee.
9. Review capacity and capacity reportage of the wells, two of which are nearly fifty years old.
10. Consider how to respond to serious drought; the arrival of commercial interests proposing high-volume consumption of water, (e.g. water bottling, tower cooling) and the demographic consequences of growing water shortages in the southwestern U.S.
11. Consider the status of our current connections with other systems and the merit of adding or planning for emergency connections with the Schenectady-Niskayuna-Rotterdam system. The long-term implications of such connections should be included in this study.
12. Consider the merits of completion of the berm/dike along the south side of the Pan Am railroad right-of-way toward containing derailed railroad cars containing dangerous chemicals.
13. Review the means of metering of water distribution for the Town toward fostering more efficient monitoring and water use. Niskayuna's experience with drive-by radio-meter reading has been good.

14. Contract with a firm with technical expertise in the hydrology, geology and biology of water supply aquifers to evaluate the implications of extensive and expanding ponded water surrounding the WTP in terms of 1) annual temperature regime and viscosity change; 2) attraction of waterfowl that are vectors of various bacterial forms including *Salmonella* spp. and *Escherichia* spp. (Nearby Collins Lake has had to close its swimming program for a period of time because of bacterial levels fostered by large numbers of Canada geese); 3) the influx of colder winter water and warmer summer waters that may induce calcium and magnesium carbonate deposition at the wells points; 4) the 2014 renewal of the mining permit for CAC.

15. Direct detailed letters of specific concern, as reviewed by our Town attorney, to each agency that might play a role in the protection of our well-field. This would include The Canal Corporation, Region IV NYSDEC, Central offices of NYSDEC, NYPA, FEMA, Army Corps of Engineers and NYSDOH. Example issues include Lock 8 being modified to potentially cause flood damage and the potential for sediments from being deposited during flooding which may reduce permeability of the aquifer and add deleterious materials to water entering the aquifer.

16. Take actions to stimulate greater interest in the nature, importance, and vulnerability of the Glenville water supply through increased content in the annual report on Glenville's water service; construction of educational kiosks in our town parks; outreach to the K-12 education system and local colleges and universities for education; participation in symposia, and research; occasional news releases to local newspapers from town officers (e.g. annual State of the Town Report) regarding matters of concern; publication of an appropriate version of this report on the web; joint meetings with the managers of the other regional water-supply systems; and the hosting of the public at our WTP once or twice a year. We suspect that the great majority of Glenville residents who rely on this key water resource do not know the location of the WTP. The best defense against vandalism and terrorism is a well-informed public. Finally, special educational attention should be given to the residents and proprietors of the un-sewered community located north of the well-fields regarding proper disposal of chemicals.

17. Initiate long-term planning and oversight regarding the use of lands surrounding the WTP including adjacent flood plain, railroad right-of-way, horse farm, and array of homes and small businesses located between Route 5 and the railroad right-of-way north of the WTP. The Glenville Environmental Conservation Commission (GECC) could be the key agency in this regard. The Town may also want to seek input from the Schenectady Inter-municipal Watershed Board and to stimulate its interest in the current challenges facing the Glenville (and regional) water supply. Fall-back plans should be conceived and considered, should it become necessary to treat our source as "surface water", or to remove some unwanted contaminant. Acquisition of a 'fall-back site' for a new facility might also be considered, possibly in cooperation with the Village of Scotia. The village owns nearby lands that might serve. We should make rough estimates of the costs of various options, including addition of filtration, to guide decision-making, should the need arise.

18. Investigate funding sources to execute the various suggestions offered including the examination of water rates and the management and dedication of this income from user fees.

Conclusion

Mitigation efforts will pay handsome rewards, but planning takes time, as does gathering knowledge of potential threats. In the event of emergency, we must not find ourselves saying “If only we had done this, that or the other, we could have saved ourselves grief.”

Special appreciation is extended to the many representatives of the agencies who have attended our meetings and have given us guidance in our proceedings. It has not been an easy task garnering such assistance because of the litigious atmosphere of the present. And, you are reminded that, one of the most central of agencies to our interests, NYSDEC Region IV, the permitting office for the adjacent gravel quarry, was unable to meet with us but it is hoped that such a meeting will be arranged in the near future.

Special thanks are extended to Mr. Kevin Corcoran, Town Planner, who has provided a lasting record of our meetings, and Mr. Jamie MacFarland, Director of Operations, who provided guidance on the operation of the Committee, including facilitation of our meetings with other groups and agencies. The minutes of the meetings are available in the offices of the Glenville Town Planner. Thanks are also extended to Roger Harrison, Glenville WTP operator, and Thomas Coppola, Glenville Commissioner of Public Works, for their many tutorials on the WTP and water distribution system.

Key References

Burns, D.A., Klaus, J. and McHale, M. R., 2007. Recent climate trends and implications for water resources in the Catskill mountain region, New York, USA. *Journal of Hydrology* (336): 155-170.

Changnon, Stanley A. 2008. Characteristics of severe Atlantic hurricanes in the United States: 1949–2006. *Natural Hazards* 48, no. 3: 329-33.

Cockburn, J.M.H., and Garver, J.I., 2012. Rethinking forecasted impacts of gradual climate change in the Mohawk Watershed and other northeastern watersheds: Extreme events versus gradual change. In Cockburn, J.M.H, and Garver, J.I. (eds) *Mohawk Watershed Symposium 2012*, Union College Schenectady NY, 16 March 2012, p. 8-9.

Cockburn, J.M.H., Garver, J.I., and Kern, A., 2009, Current trends and future possibilities: monitoring for the future and how watershed dynamics may be affected by global climate change. In: Cockburn, J.M.H. and Garver, J.I., *Proceedings from the 2009 Mohawk Watershed Symposium*, Union College, Schenectady NY, p. 14-18.

- FEMA, 18 December, 2013. 44 CFR §9.8 Executive Order 11988 and 11990 New York State Thruway Authority / New York State Canal Corporation Erie Canal: Re. Floodplain mitigation project, Mohawk River, N. Y. (cc. office of the Glenville Town Planner)
- Frumhoff, P.C., McCarthy, J. J., Melillo, J. M., Moser, S. C., and Wuebbles, D. J.. 2007, *Confronting Climate Change in the US Northeast: Science, Impacts and Solutions*. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).
- Garver, John. 27 December, 2013. Letter to FEMA Environmental Planning and Historic Preservation re. 44 CFR §9.8 Executive Orders 11988 and 11990 NYS Thruway Authority / New York State Canal Corporation Erie Canal (cc. office of the Glenville Town Planner).
- Garver, J.I., and Cockburn, J.M.H., 2011, Changes in the Hydrology of the Mohawk Watershed and implications for watershed management, In Cockburn, J.M.H, and Garver, J.I. (eds) Mohawk Watershed Symposium 2011, Union College Schenectady NY, 18 March 2011, p. 16-21.
- Garver, J.I., and Cockburn, J.M.H., 2012. Change in the Mohawk Watershed and vulnerability to Infrastructure. In Cockburn, J.M.H, and Garver, J.I. (eds) Mohawk Watershed Symposium 2012, Union College Schenectady NY, 16 March 2012, p. 12-16.
- Hayhoe, K., C.P., Wake, Huntington, T.G., Luo, L., Schwartz, M.D., Sheffield, Wood, J., E., Anderson, B., Bradbury, J., DeGaetano, A., Troy, T.J. and Wolfe, D.. 2006. Past and future changes in climate and hydrological indicators in the US Northeast. *Climate Dynamics* v. 28, n. 4: p. 381-407.
- Ritchie, W. A., and Funk, E. R. 1973. *Aboriginal Settlement Patterns in the Northeast*. New York State Museum Memoir 20, New York State Museum. 378 pp.
- Rosenzweig, C., Solecki, W., DeGaetano, A., O'Grady, M., Hassol, S., Grabhorn, P. (Eds.). *Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation*. Technical Report. New York State Energy Research and Development Authority (NYSERDA), Albany, New York. www.nyserda.ny.gov.
- Shaw, S., Schneider, R., McDonald, A., Riha, S., Tryhorn, L., Leichenko, R., Vancura, P., Frei, A., Montz, B., 2011, Water Resources (Ch. 4), In Rosenzweig, C., Solecki, W., DeGaetano, A., O'Grady, M., Hassol, S., Grabhorn, P. (Eds.). *Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation*. Technical Report. New York State Energy Research and Development Authority (NYSERDA), Albany, New York. www.nyserda.ny.gov.
- Suro, T.P., Firda, G.D. and Szabo, C.O. 2009, Flood of June 26–29, 2006, Mohawk, Delaware, and Susquehanna River Basins, New York: U.S. Geological Survey Open-File Report 2009–1063, 354 p.
- Vermette, S. 2007. Storms of tropical origin: a climatology for New York State, USA (1851-2005). *Natural Hazards* 42, no. 1: 91-103.

Web Sources Regarding Mohawk River Flow

Mohawk River flow:

[http:// waterdata.usgs.gov/ny/nwis/uv?site no=01357500&format=gif&period=31](http://waterdata.usgs.gov/ny/nwis/uv?site no=01357500&format=gif&period=31)

Schoharie Creek flow at Burtonville:

[http:// waterdata.usgs.gov/ny/nwis/uv?site no=01351500&PARAMeter cd=00065.00060](http://waterdata.usgs.gov/ny/nwis/uv?site no=01351500&PARAMeter cd=00065.00060)

Mohawk River flow at Freeman's Bridge:

[http:// waterdata.usgs.gov/ny/nwis/uv?site no=01354500&PARAMeter cd=00065.00060](http://waterdata.usgs.gov/ny/nwis/uv?site no=01354500&PARAMeter cd=00065.00060)

Gauging stations on the Mohawk River system:

[http:// waterdata.usgs.gov/ny/nwis//current/?type=flow.](http://waterdata.usgs.gov/ny/nwis//current/?type=flow)

Members of the GWPC

Phil Adams, (Vice-chair), Civil Engineer, Retired

John Garver, Wold Professor of Geology, Union College

Carl George (Chair), Professor of Biology, Emeritus, Union College

Stephen Hammond, P. E., Civil-Environmental Engineer

Jason Pelton, Schenectady County Planning Department Groundwater Management
Planner, and employee of NYSDEC

Jacqueline Smith, Associate Professor of Geology, The College of Saint Rose

Cal Welch, Deputy Chair, Glenville Environmental Conservation Commission

Officers and Engineers of the Town of Glenville

Thomas Coppola, Commissioner of Public Works

Kevin Corcoran (Secretary), Town Planner

Roger Harrison, Water Treatment Plant Operator

Mark Lindsay Kestner, P.E., Vice President, Kestner Engineering

James MacFarland, Director of Operations

Glenville Town Board Liaison

Gina Wierzbowski, Councilwoman and liaison to the GWPC

Cranesville Aggregate Co. Liaison

Kim Mosher, EHS Director

Appendix I:

Glenville Water Treatment Plant (WTP) Vital Statistics

Location: 42° 51' 10.16"N x 74° 01' 03.39"W; c. 4 acres acquired in 1965
Well intakes c. 50' deep using EPA designated Schenectady Sole-source Aquifer
On line 1967 indoor Well 1 (cap. 700 gpm) and indoor Well 2 (cap. 1,500 gpm)
Well 3 outdoor on-line 1969 (cap. 1,500 gpm)
Well 4 outdoor on-line c. 1985 (cap. 2,100 gpm)
Total minimum capacity 5,800 gpm
Yield for 2011: 1,717,890 gal.
Current annual yield, October 1, 2011 through September 2012: 1,952,838 gal.
Current yield as percent of capacity using conservative total capacity of four wells at
6,000 gpm = 6.2% (but crises may result in a much greater percent).
Electrically grounded fencing with electrically powered entrance gate
Auxiliary diesel power with three-day fuel storage
Adjacent workshop and storage structure
Providing chlorination but not fluoridation or hardness control
Routine chemical monitoring in accord with NYSDOH regulation
Access via Van Buren Lane to Pump House Rd. off Route 5, just west of junction of I-890

Distances apart (in feet) for various features in the vicinity
(e.g. Mohawk River to East Outdoor Well)

	East Outdoor Well	West Outdoor Well	Indoor Wells (2)
River	640	605	895
Gravel pit	660	750	465
SI Group	2850	2655	2455
Horse farm	2080	1915	1670
Gas station	2450	2655	2450
Railroad	1370	1385	1110
Residences	1450	1500	1210
Landfill	3170	3310	3080

Appendix II:

Maps and Photos



Glenville Water Treatment Plant from Pump House Road



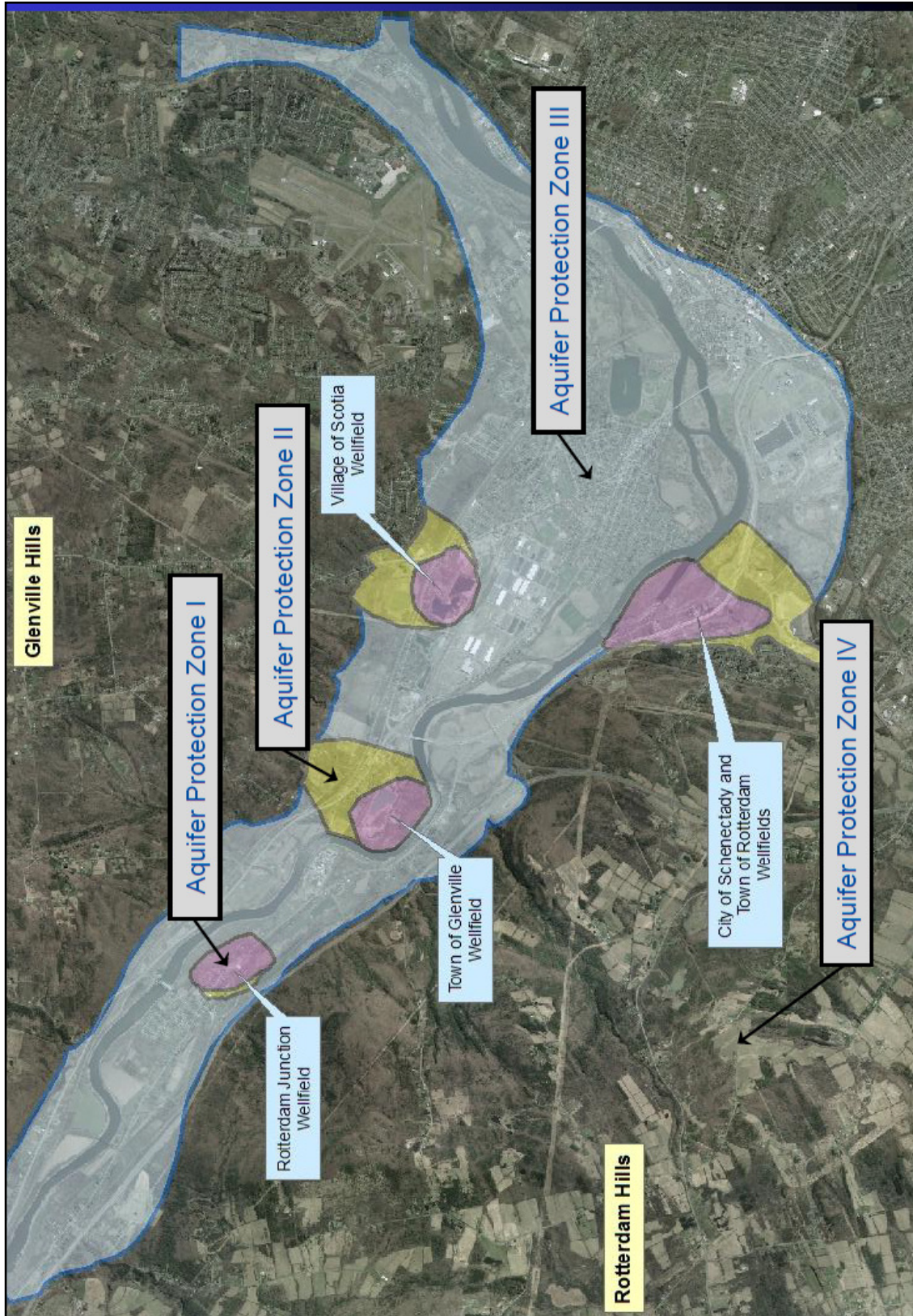
Committee members tour the inside of the Water Treatment Plant



Gravel pit adjacent to the Glenville well-field



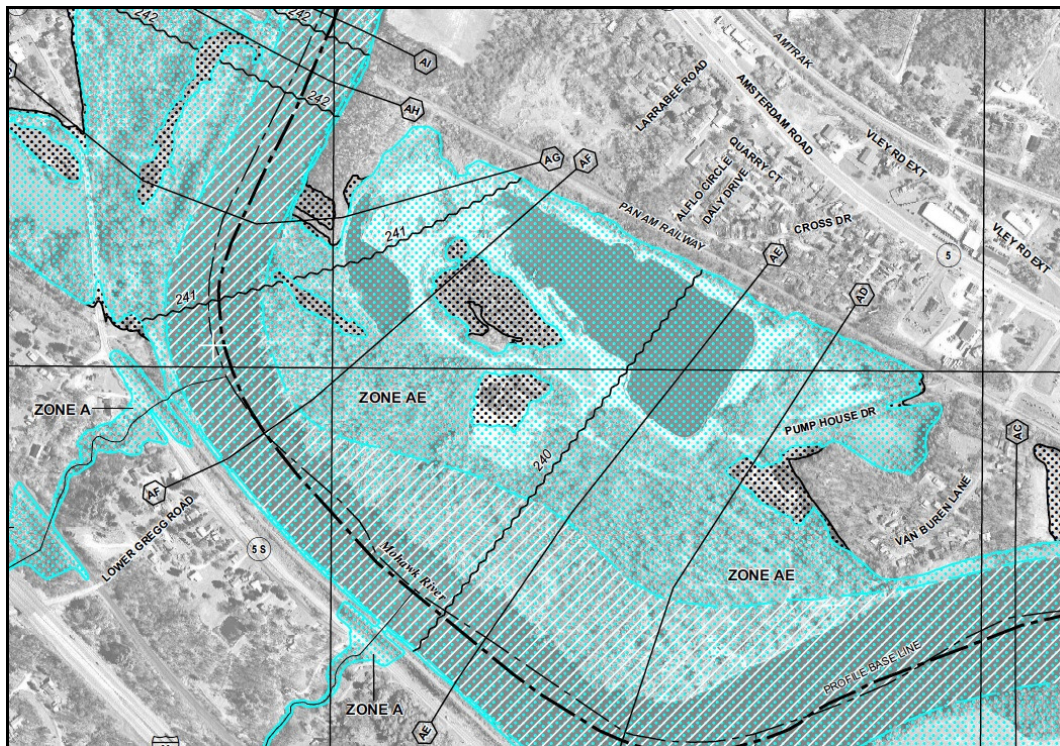
Committee members observe one of the two outside production wells



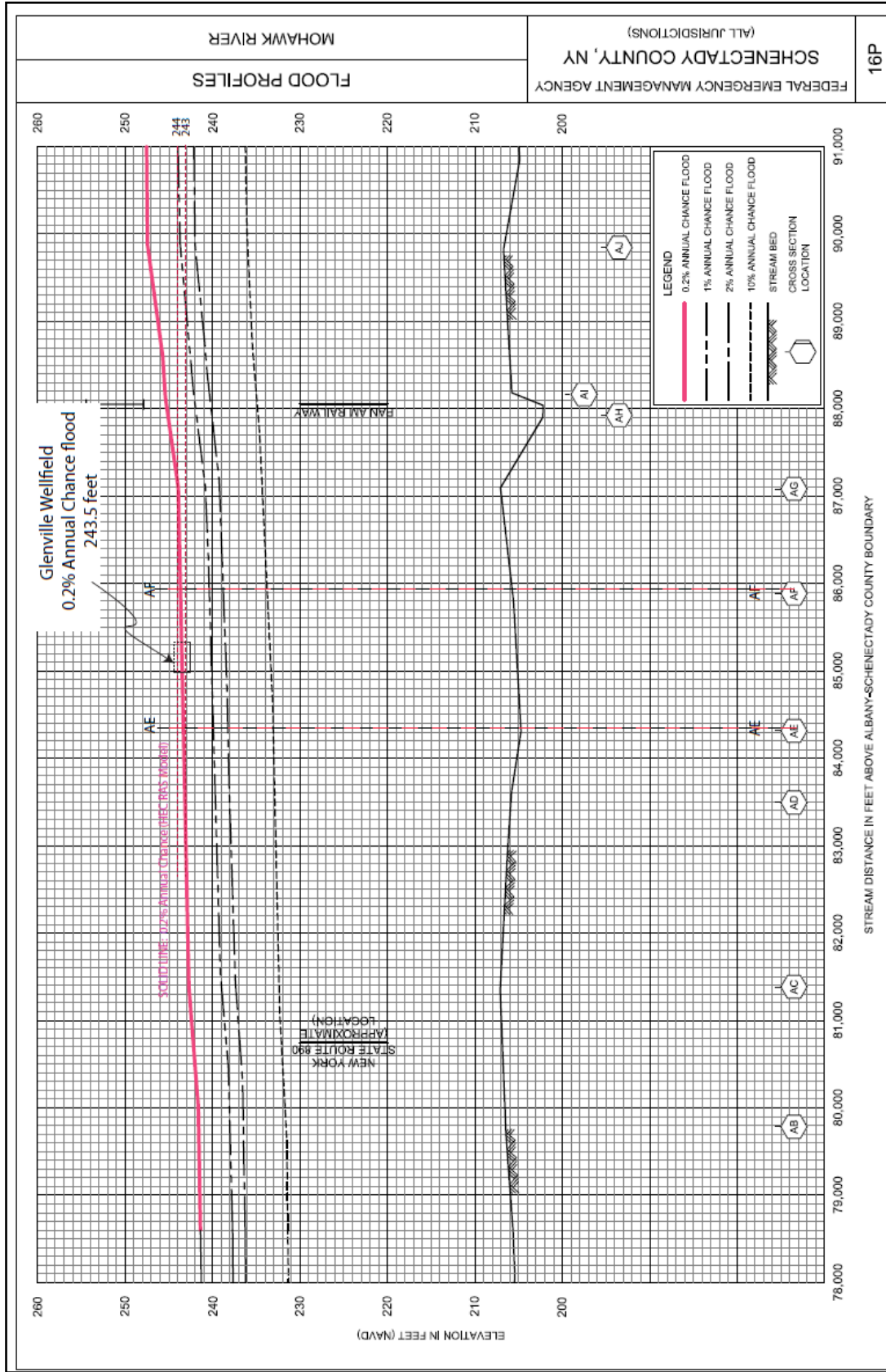
Great Flats Aquifer well-fields and recharge zones



High-lift pumps inside the Glenville Water Treatment Plant

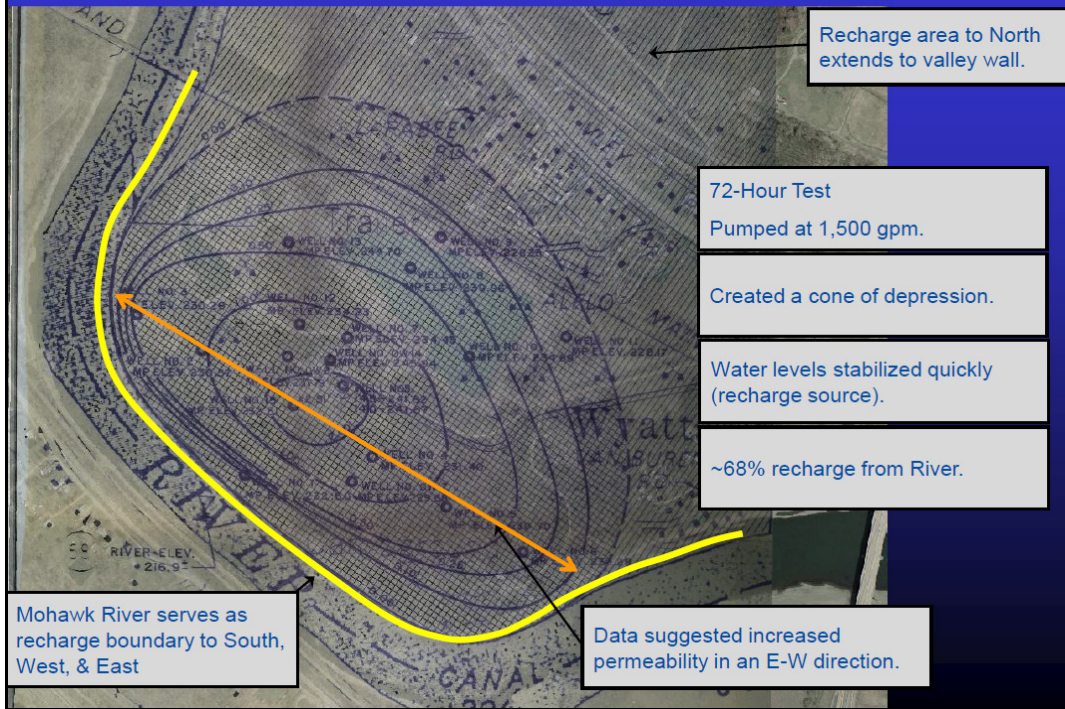


Flood Insurance Rate Map showing elevations and flood zones around the Glenville well-field



Flood elevations for the Glenville well-field

Ground Water Flow – 1988 Test



Ground water flow test results for the Glenville well-field

Variations in Summer -vs- Winter Recharge

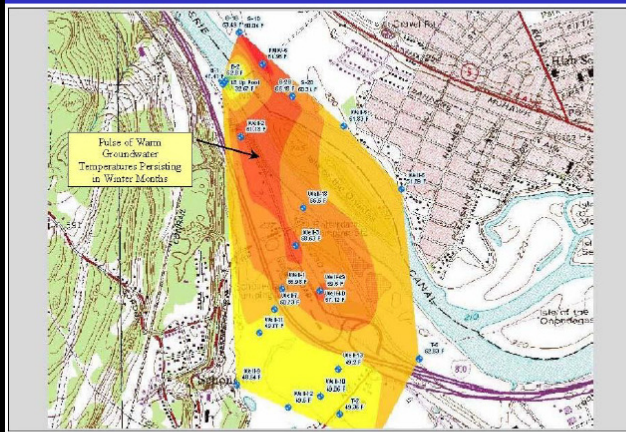


FIGURE 8
December 2010 Surface Water and Groundwater Temperatures

Schenectady County Well and Assessment Program
March 2012

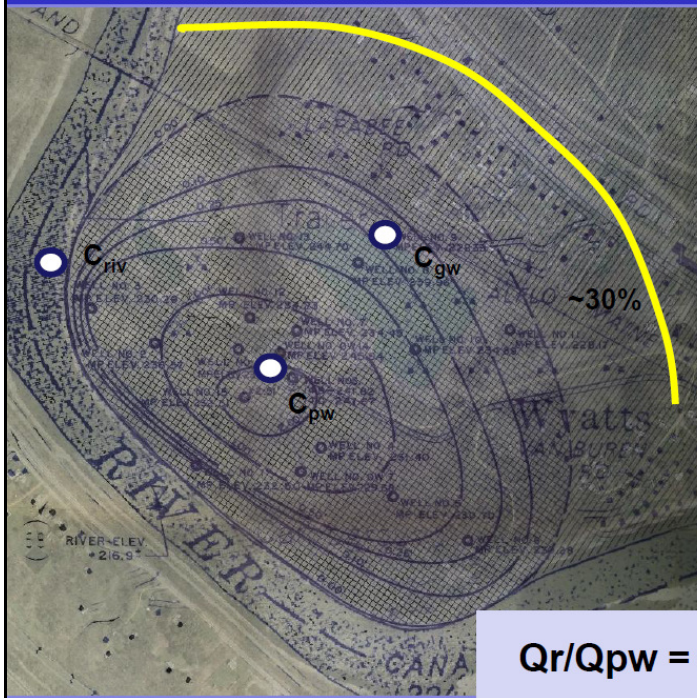
- Navigation –vs- Non-Navigation.
- About 5-6 feet difference in groundwater elevations.
- Aquifer testing completed during the non-navigation season.
- Expect increased river recharge during navigation season.

To Better Understand:

- Manual water level measurements.
- Temporal variations with pressure transducers equipped with data loggers.
- Temperature is also a good "indicator species" to assess recharge along with naturally occurring isotopes

Glenville well-field summer and winter recharge characteristics

Well Field Recharge



- 30% of recharge is not derived from the River.
- Is some variability, but not likely to change much with presence of a significant recharge boundary (Mohawk River).
- $Q_{avg} = 1.7$ mgd
- $Recharge_{river} = 1.2$ mgd
- $Recharge_{ug} = 0.5$ mgd
- Single Constituent Mass Balance Approach

$$Q_r/Q_{pw} = (C_{pw} - C_{gw}) / (C_{riv} - C_{gw})$$

Glenville well-field recharge rates

All images relating to this study are available on disc upon request to the Glenville Planning Department.

We are now faced with the fact, my friends, that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history, there is such a thing as being too late. Procrastination is still the thief of time...

Dr. Martin Luther King, Jr. speaking at Manhattan's Riverside Church
April, 1967, to end the war in Vietnam.



Flooding from the Mohawk River surrounds the Town of Glenville Well-field, following Tropical Storm Irene.

Times Union Photo by Will Waldron, August 29, 2011, used by permission.