APPENDIX H – WATER AND WATERWATER INFORMATION

H-1 Correspondence with Connecticut Water Company
H-2 Correspondence Regarding Wastewater Interconnection
H-3 Hydrogeologic Water Evaluation

APPENDIX H-1 – CORRESPONDENCE WITH CONNECTICUT WATER COMPANY

Connecticut Water Company
93 West Main Street
Clinton, CT 06413-1600

Office: 860.669.8636
Fax: 860.669.9326
Customer Service: 800.286.5700

July 29, 2016

Mark Mirabito, Chief Operating Officer
NTE Energy
24 Cathedral Place Suite 300
Saint Augustine, FL 32084

Re: Proposed Killingly Energy Center
180/189 Lake Road, Killingly

Dear Mr. Mirabito:

We have reviewed the proposed development described as the Killingly Energy Center (KEC) and have determined there will be an adequate supply of water to support the process water needs of the KEC provided certain infrastructure improvements are made. Those water needs are described in your letter of July 21, 2016 and include an average daily demand of up to 50,000 gpd, increasing to a maximum of 100,000 gpd as ambient air temperature increases. Additionally, when operating on distillate, water use has the potential to peak at 400,000 gpd. It is understood such peaking occurrences would be rare and the frequency and duration of any draft greater than 100,000 gpd limited to (1) the unavailability of natural gas; (2) on-site oil storage capacity, which was represented to be a maximum one million gallons; and any limitations contained in an applicable permit or authorization, including but not limited to any CT Siting Council Order or state or federal air emissions permit.

A water main extension from existing distribution facilities in Plainfield will be required, as will a properly engineered booster station to ensure sufficient water is available to serve the project. Depending on the specific flow needs of the project, improvements to the existing water storage tank in the Killingly Industrial Park may be necessary and will require further review. An agreement defining the terms and conditions for the various improvements will need to be executed, and all costs associated with the improvements will be borne by the developer. Finally, as we discussed, a take or pay agreement will be necessary in the event the project needs to demonstrate that a specific quantity of water will be available.

Because supply availability of any system is finite, an annual review of Connecticut Water's ability to serve the project will need to be conducted on the one year anniversary date of this letter and every year thereafter until the project is complete.

If you have any questions, please feel free to contact me at 860.664.6059 or Craig Patla at 860.664.6140.

Very truly yours,

David L. Radka
Director of Water Resources & Planning

Cc: C. Patla
J. Casagrande

Killingly Energy Center
an NTE Energy Project

7/21/2016

Mr. David Radka
Connecticut Water Company
93 West Main Street
Clinton, CT 06413

Dear Dave,

It was a pleasure meeting with you and Craig on Tuesday morning to discuss your system or our Killingly Energy Center (KEC) project. Thanks for taking the time to meet with us and confirming Connecticut Water Company's (CT Water) interest and ability to provide KEC's process water needs. KEC will be located at 180/189 Lake Road in Killingly. As discussed, KEC's actual water requirements will typically be up to 50,000 gpd, increasing to 100,000 gpd when ambient air temperatures are warmer and the facility is using evaporative cooling. On rare occasions, KEC will require up to 400,000 gpd for emissions control when operating on ultra-low sulfur distillate (ULSD).

Since the plant may be operational 24/7, the average flow rates listed above are representative of the typical instantaneous water requirement at any point during the day, with differences accounting for the mode of operation (e.g. evaporating cooling, ULSD firing). Although unlikely in operation, for purposes of financing, we will need to show the banks that we have a commitment for 400,000 gpd.

As we continue our design and permitting efforts, and as we discussed Tuesday, we request that you provide us with an "ability to serve" letter, for the supply of water in the quantity and at the location defined above. We request your letter to support our Siting Council application which we are hopeful to submit by the end of July. Please let us know what, if any, additional information regarding the project's water requirements you require. I can be contacted at 201.230.5759 or via e-mail at mmirabito@nteenergy.com. Thank you.

Sincerely yours,

Mark Mirabito
NTE Connecticut, LLC

APPENDIX H-2 – CORRESPONDENCE REGARDING WASTEWATER INTERCONNECTION

Suez
Joseph Couture
Assistant Chief Operator
31 Wauregan Road
Danielson CT 06239
Phone 860-779-5392
Fax 860-779-3018
Joseph.Couture@suez-na.com

August 11, 2016
Mr. Marl Mirabito
NTE Connecticut, LLC
24 Cathedral Place
Suite 300
St. Augustine, FL 32084

Subject: **Proposed Killingly Energy Center (KEC)**

Dear Mr. Mirabito,

Suez has reviewed the correspondence you have to provided us with the Town of Killingly. Suez has determined that there is sufficient capacity in the Killingly Wastewater Collection System to handle the flow from the proposed KEC project. However, with the age of the pump station this flow will be directed to, both the Town of Killingly and Suez believe an engineering study should be completed to evaluate what additional burden, if any, these increased flows will have on this pump station.

Both the Town of Killingly and Suez understand that the majority of the wastewater associated with this project will be related to the blowdown from the heat recovery steam generator and evaporative cooler, as well as minimal sanitary wastewater. It is our understanding that the range of flows will be between 30,000 GPD to 45,000 GPD, but may have an infrequent discharge as high as 90,000 GPD.

Please be advised that before any construction shall begin on the sewer, a permit must be received at this office. This will allow us to inspect the lateral connection. A copy of the as-built should be filed at both the Killingly Town Hall and at my office, addressed above.

Should you need additional information, please feel free to contact me.

Regards,

TS 10:50 August 12, 2016

Joseph Couture
Assistant Chief Operator

Cc: Dave Capacchione, ToK Town Engineer
File

Wastewater Discharge Characteristics
Preliminary Estimate
Killingly Energy Center

CONSTITUENT	Concentration (mg/l)	
	Average	Maximum
Sodium	25.6	54.4
Calcium	19.0	39.9
Magnesium	3.2	6.8
Ammonia as N	0.1	0.2
Barium	0.02	0.04
Chloride	44.8	107.7
Nitrate	1.3	3.5
Nitrite	ND	ND
Sulfate	11.8	31.3
Phosphate	4.0	6.0
Fluoride	0.4	1.1
Turbidity	5.0	20.0
pH (S.U.)	7.0	7.5
Total Residual Chlorine	0.1	0.2
Aluminum	ND	ND
Iron (total)	0.05	0.14
Manganese (total)	0.01	0.02
Copper (total)	0.10	0.27
Antimony	ND	ND
Arsenic	ND	ND
Beryllium	ND	ND
Cadmium	ND	ND
Chromium	ND	ND
Lead	ND	ND
Mercury	ND	ND
Nickel	ND	ND
Selenium	ND	ND
Silver	ND	ND
Thallium	ND	ND

APPENDIX H-3 – HYDROGEOLOGIC WATER EVALUATION

Hydrogeologic Water Evaluation

Killingly Energy Center

July 2016

Prepared for:

NTE Connecticut, LLC
24 Cathedral Place, Suite 300
Saint Augustine, FL 32084

Prepared by:

Tetra Tech, Inc.
2 Lan Drive, Suite 210
Westford, MA 01886

Killingly Energy Center
an NTE Energy Project

EXECUTIVE SUMMARY

The Killingly Energy Center (KEC) has been purposefully designed by NTE Connecticut, LLC (NTE) as an air-cooled system to aggressively reduce water demands by 95 percent over a wet-cooled configuration. As a result, the water demands of KEC are extremely low for a combined cycle electric generating facility (50,000 to 100,000 gallons per day [gpd]), with the highest demand (400,000 gpd) occurring only for emissions control under limited times when the use of ultra-low sulfur distillate (USLD) is required as back-up fuel.

A range of water supply options has been considered, and NTE has selected the use of the existing Connecticut Water Company (CWC) system as the most favorable option. Use of CWC's water system will not impact Alexander Lake, as the wellfields anticipated to be used are located downgradient, and Alexander Lake is not within the zone of contribution for those wellfields; in fact, the major wellfields are separated from Alexander Lake by groundwater divides.

The CWC Killingly Industrial Park (KIP) Wellfield is located north of Alexander Lake and within the same watershed. The Connecticut Department of Energy and Environmental Protection (DEEP) has a robust and thoughtful program regulating water resource availability and quality, including a Diversion Act program that is protective of both surface and groundwater resources. This program considers environmental and resource consequences in evaluating and issuing permits for use of groundwater and surface water. The KIP Wellfield has a very modest withdrawal limit (70,000 gpd) within its diversion permit. The KIP Wellfield has not been activated since 2013 and, based on conversations with CWC, KEC's water demand on the CWC system will not result in increased use of this wellfield. Therefore, no impact to Alexander Lake will result from KEC's water use.

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
°F	degrees Fahrenheit
amsl	above mean sea level
cfs	cubic feet per second
CME	CME Associates, Inc.
CWC	Connecticut Water Company
DEEP	Department of Energy and Environmental Protection
gpd	gallons per day
KEC	Killingly Energy Center
KIP	Killingly Industrial Park
KWPCA	Killingly Water Pollution Control Authority
MGD	million gallons per day
MW	megawatts
NO_x	nitrogen oxides
NTE	NTE Connecticut, LLC
PBH	Phillip B. Hopkins
PDW	Plainfield Division Wellfield
ULSD	ultra-low sulfur distillate
USGS	United States Geological Survey

1.0 INTRODUCTION

NTE Connecticut, LLC (NTE) has carefully researched and integrated strategies to reduce the demand for water associated with the Killingly Energy Center (KEC), a proposed combined cycle electric generating facility in Killingly, Connecticut. KEC intends to utilize the existing Connecticut Water Company (CWC) system to meet its water use requirements. By using this existing system, KEC's water demands can be met without causing adverse impacts to the community or the environment, including the water level and water quality of Alexander Lake. The following sections provide:

- A description of KEC water needs under various operating scenarios;
- A discussion regarding the CWC system from which KEC intends to meet its water supply needs;
- An evaluation of the potential for impact to the local aquifer associated with CWC well use;
- Review of alternative water sources considered for KEC; and
- Conclusions regarding the anticipated impacts of KEC's proposed water use on the community and environment.

2.0 PROJECT WATER NEEDS

KEC will utilize a single combustion turbine generator in combined cycle mode, in a 1x1x1 configuration, which means it will have one combustion turbine generator, one heat recovery steam generator, and one steam turbine generator working in conjunction to generate approximately 550 megawatts (MW) of clean and efficient electricity, enough to meet the energy needs of approximately 500,000 homes.

KEC will be fueled primarily with natural gas, with limited firing of ultra-low sulfur distillate (ULSD) as the backup fuel. Although KEC is requesting authorization from the Connecticut Department of Energy and Environmental Protection (DEEP) to utilize ULSD for up to 720 hours per year, actual use is expected to occur on the order of once every two to three years. Water requirements for KEC will vary depending upon the fuel type and rate at which it is consumed at any given time, operating characteristics, and ambient temperature.

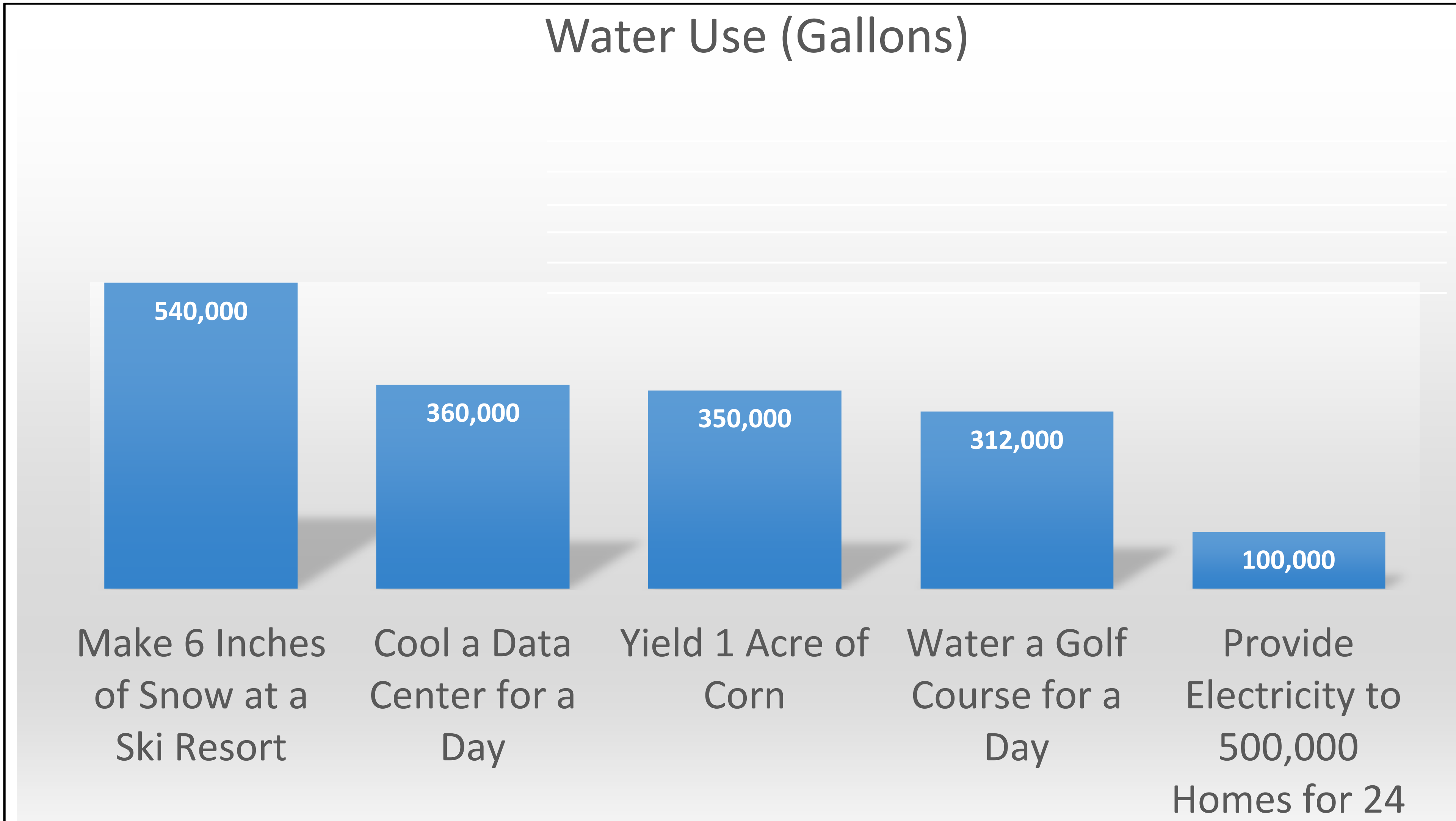
Similarly sized energy generation facilities that utilize wet cooling can require on the order of 4 to 5 million gallons per day (MGD). NTE has selected the use of advanced air cooling technology for KEC. This was done to reduce water demand by over 95 percent. Water needs for KEC's typical operation will be primarily associated with the use of ultra-purified water in the heat recovery steam generator. Although it is a closed-cycle process in which water will be recirculated and recycled through the system, the need to retain water purity in the system means that periodic discharges (or blowdown) of the recycled water and addition of new water (make-up water) is necessary.

Approximately 50,000 gallons per day (gpd) may be required for blowdown and for all plant uses on an average operating day. In periods of higher ambient temperatures (above 59 degrees Fahrenheit [°F]), KEC will use evaporative cooling of the combustion air to enhance efficiency and energy output; when in use, the evaporative cooler will use up to an additional 50,000 gpd, depending on ambient temperature. These are relatively small volumes compared to typical industrial users in Connecticut. The context for KEC's anticipated water demand is illustrated in Figure 1.

Additional water use will be required for emissions control during extremely limited times when natural gas is unavailable and use of ULSD is necessary for electric grid reliability. When using ULSD, water is injected into the combustion turbine to reduce nitrogen oxide (NO_X) levels, whereas during natural gas firing, dry-low NO_X combustion is used; dry-low NO_X combustion is not available for ULSD firing. Water injection for NO_x control during ULSD firing will increase the total water demand up to 400,000 gpd of water. However, ULSD use would only occur during extremely limited times when natural gas is not available, and at no time would occur for more than 720 hours over a given year.

Therefore, while average water use of KEC would be on the order of up to 50,000 gpd in the winter and up to 100,000 gpd in the summer, the maximum use (reflecting ULSD use) could be up to 400,000 gpd for those limited occasions when back-up fuel is required. As previously stated, the frequency of these occasions is expected to be on the order of once every two to three years.

KEC will have an extremely low water demand for a facility of its type and magnitude, with its water requirements reduced by over 95 percent compared to a more conventional wet-cooled project configuration.



4 Audubon International estimates that the average American course uses 312,000 gallons per day.

http://www.nashuatelegraph.com/newsstatenewengland/910832-227/ski-areas-invest-in-snowmaking-to-survive.html

http://www.killington.com/site/mountain/mountain-info/snowmaking_snowfall

http://www.datacenterknowledge.com/archives/2012/08/14/data-center-water-use-moves-to-center-stage/

Killingly Energy Center
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Figure 1

Context for KEC Anticipated Water Use

3.0 DESCRIPTION OF THE LOCAL CONNECTICUT WATER SYSTEM

CWC currently serves the Town of Killingly, including the existing Lake Road Generating facility (an electric generating facility with three units) and others within the Killingly Industrial Park (KIP). CWC supplies 90,000 customers, or approximately 300,000 individuals, for residential, commercial, industrial, and municipal purposes in 56 Connecticut communities. As of March 2014, CWC had 18 surface water supplies and 221 groundwater supply wells. Residential and commercial residents of the Town of Killingly are served by the Crystal Water Division, a portion of the larger CWC system that was acquired from Crystal Water Company in 1999. Additional detail is provided below to describe specific wells of interest within the existing CWC system that serves the Town of Killingly.

3.1 EXISTING WELLS AND USAGE

The Crystal Water Division system wellfield closest to the KEC site is the KIP Wellfield. The wellfields that CWC has identified as likely to meet KEC's needs, listed in order of proximity to KEC, are: the Phillip B. Hopkins (PBH) Wellfield; the Brooklyn Wellfield; and the Plainfield Division Wellfield (PDW). The locations of these four wellfields are shown on Figure 2. Information describing each wellfield is provided below.

3.1.1 KIP Wellfield

The KIP Wellfield consists of two wells located between Lake Road and Shore Road in Killingly (see Figure 2). KIP Well #1 and KIP Well #2 are located approximately 500 feet and 250 feet from the northern shore of Alexander Lake, respectively. The subsurface material in the area consists of gravels underlain by fine to medium sands with occasional lenses of silt up to 150 feet in thickness. In accordance with its existing water diversion permit issued by DEEP, the total volume DEEP has authorized CWC to extract under permit number DIV-200301917 from the combined wellfield is up to 70,000 gpd.

Although authorized to withdraw up to 70,000 gpd, based upon a review of annual water use reports provided by CWC, the wellfield has not pumped any water since September 2, 2013. Even in 2013, well usage was extremely low, with the well pumped for a total of only 21 days during that calendar year. Daily withdrawal rates during that time ranged from 1,000 gpd to just less than 70,000 gpd.

3.1.2 PBH Wellfield

The PBH Wellfield is located off of Route 12 and immediately east of the Five Mile River, as shown on Figure 2. This location is across the Five Mile River from the KEC site and Alexander Lake, approximately 2.7 miles southeast of the KEC site and 1.7 miles southeast of Alexander Lake. The wellfield is located about 200 feet east of the Five Mile River. The subsurface materials in this area consist of fine to medium sand underlain by fine to coarse sand with gravel. The deposits are mapped as undifferentiated stratified drift; mostly stream deposits. A thin veneer of flood plain alluvium overlies the stratified drift. Under static conditions, groundwater flow would be in a generally northeast to southwest direction. Recharge to the wellfield is derived from storage in the unconsolidated deposits, and induced from Five Mile River and several small tributary streams.

Three wells currently operate at this location that have been registered by DEEP. PBH Well #2 (Registration No. 3400-001-PWS-GR) is registered to withdraw 1.81 MGD, and is a 70-foot deep 24 x 18 inch gravel-packed well that was constructed in 1981. PBH Well #3 (Registration No. 3400-02-PWS-GR) is registered to withdraw 1.2 MGD, and is a 74-foot deep 24 x 18 inch gravel packed well that was constructed in 1982. PBH Well #4 was installed as a back-up well in 2012, and is a 24 x 18 inch gravel-packed well that is 63 feet deep; no additional registered volume is associated with this back-up well. PBH Well #1 was never developed. The average pumping rate demonstrated from the PBH Wellfield during pump tests was 800,000 gpd (Whitman & Howard 1995). A water treatment plant was constructed at the PBH Wellfield in 2006 in order to add chlorine and remove iron and manganese.

The PBH Wellfield is interconnected via piping to the Brooklyn Wellfield.

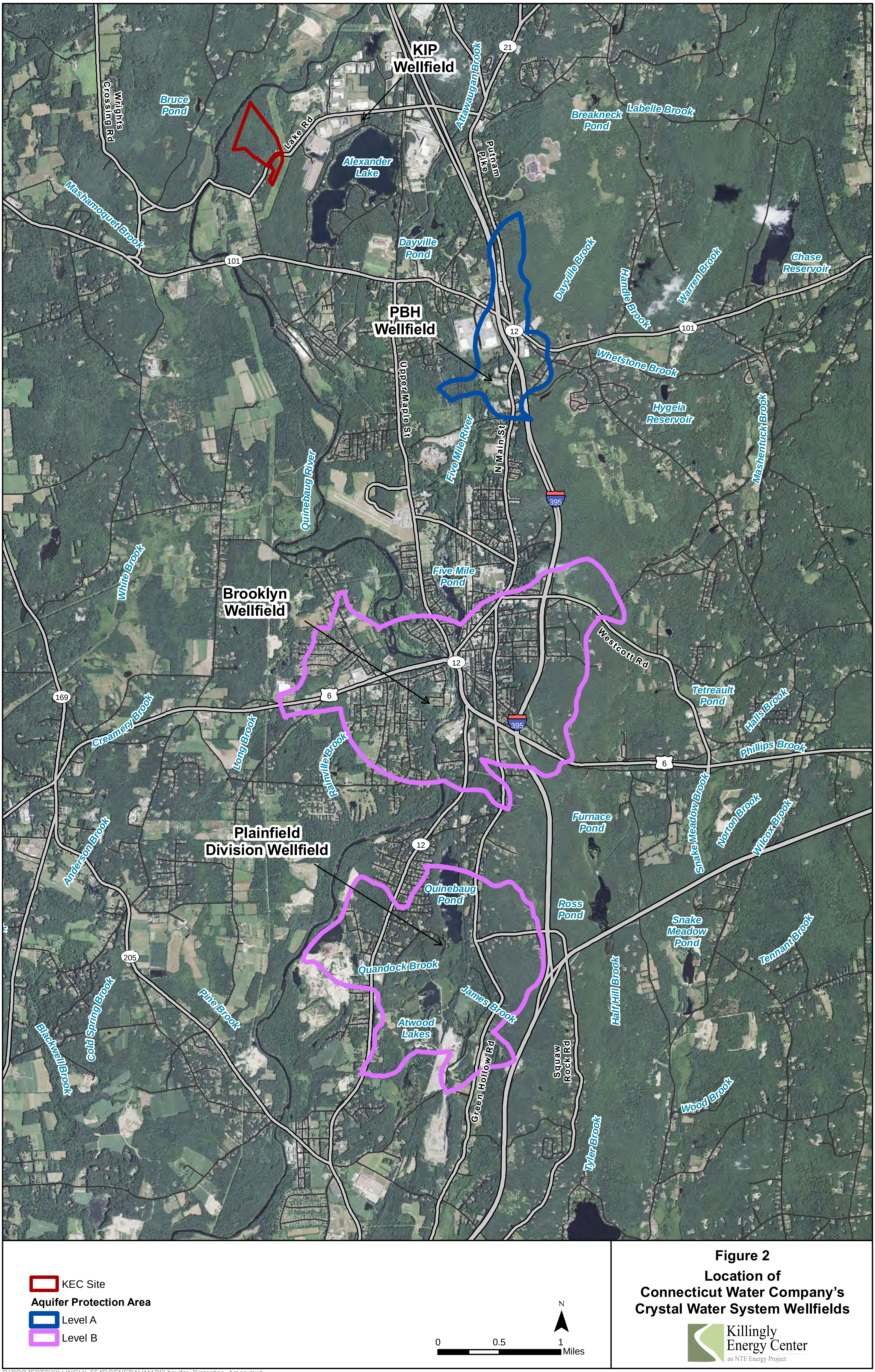

Figure 2
Location of Connecticut Water Company's Crystal Water System Wellfields

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3.1.3 Brooklyn Wellfield

The Brooklyn Wellfield is located at the end of Quebec Square in Brooklyn, south of the Quinebaug River, as shown on Figure 2. Its location, on the western side of the Quinebaug River, is across the Quinebaug River from the KEC site and Alexander Lake, at a distance of approximately 4.4 miles and 3.8 miles, respectively. This area is characterized by extensive glacio-fluvial deposits. The materials in this area consist of fine to coarse sand and gravel overlain by fine silty sand with clay. Static groundwater flow at this location would be in a roughly northwest to southeast direction. Recharge to the wellfield would be from aquifer storage and precipitation, as well as induced from the Quinebaug River.

The Brooklyn Wellfield consists of three wells registered by DEEP that draw from a sand and gravel aquifer. Brooklyn Well #1 (Registration No. 3700-002-PWS-GR) is registered to withdraw 410,000 gpd, and is a 41-foot deep, 18 x 10-inch diameter gravel-packed well that was constructed in 1953. Brooklyn Well #2 (Registration No. 3700-003-PWS-GR) is registered to withdraw 470,000 gpd, and is a 50-foot deep 18 x 10-inch diameter gravel-packed well that was constructed in 1958. Brooklyn Well #3 (Registration No. 3700-004-PWS-GR) is registered to withdraw 480,000 gpd, and is a 69-foot deep 18 x 10-inch gravel packed well. Although Brooklyn Well #3 was constructed in 1961, it was not activated until 1982.

3.1.4 Plainfield Division Wellfield

The PDW is located at the end of Taos Drive in Killingly, southwest of Quinebaug Pond, as shown on Figure 2. No interconnecting piping currently exists between the Brooklyn Wellfield and the PDW. The PDW is approximately 6.47 miles from the KEC site and 5.87 miles from the southern shore of Alexander Lake. It is located within a narrow pre-glacial valley that has been filled with moderate to high permeability glacio-fluvial sands, gravels, silts and clays. These sediments, which range from about 25 to 55 feet in thickness, were deposited by meltwater streams during a period of glacial retreat. Overlying these deposits are a series of ice contact deposits including kames, eskers, and possibly deltaic deposits. The valley is flanked to the east and northwest by till uplands. The PWD appears to be located within the deepest part of the pre-glacial channel, as evidenced by topography and test well/production well logs from this location. Under static conditions, groundwater flow in the area of the PWD is generally from north to south.

There are two DEEP-registered wells in the PDW, with a third unregistered well available as a back-up supply. PDW #1 (Registration No. 3700-005-PWS-GR) is registered to withdraw 590,000 gpd and is a 41-foot deep, 8-inch diameter naturally developed well that was constructed in 1961. This source is the lead supply well for the PDW service area (D.L. Maher 1990b). PDW #2 (Registration No. 3700-006-PWS-GR) is registered to withdraw 467,000 gpd, and is a 39-foot deep naturally developed well that was constructed in 1962, and redeveloped in July of 1989 to enhance yield. The backup well, PWD #3, is a 52-foot deep naturally developed well that was constructed in 1989 and has a pumping capacity of 200,000 gpd.

3.2 WELLFIELD HYDROGEOLOGIC CONTEXT

Figure 3 provides the geologic context of the four wellfields described above, and shows (to the extent delineated) each well's "aquifer protection area," as delineated through the Level A and Level B Mapping Processes. Aquifer protection areas are delineated by DEEP for active public water supply wells in stratified drift that serve more than 1,000 people, in accordance with Sections 22a- 354c and 22a-354z of the Connecticut General Statutes. Level B Mapping delineates a preliminary aquifer protection area, providing a conservative estimate of the land area from which the well draws its water (likely larger than the actual recharge area).

Level B delineation is a very conservative process that first determines the initial setback area at each well. The extent of this setback area is based on a graphical relationship between transmissivity and pumping rate. For a single well, the maximum pumping rate is used; for a wellfield, the combined maximum pumping rate (along with transmissivity) determines the initial setback area. Use of the maximum pumping rate, rather than an average rate based on actual usage data, results in the delineation of a very conservative initial setback area. Once the initial setback area is determined, a recharge area is identified – up to a distance determined by basin groundwater divides – with the potential for geologic deposits (including till) to contribute flow to that setback area. This recharge area includes all areas where precipitation would drain directly into the initial setback area, without first discharging to a surface water course. Finally, the indirect recharge areas are identified, which would include all of the land hydraulically up-gradient of the wellfield to the drainage divide. For this reason, Level B areas are generally quite large.

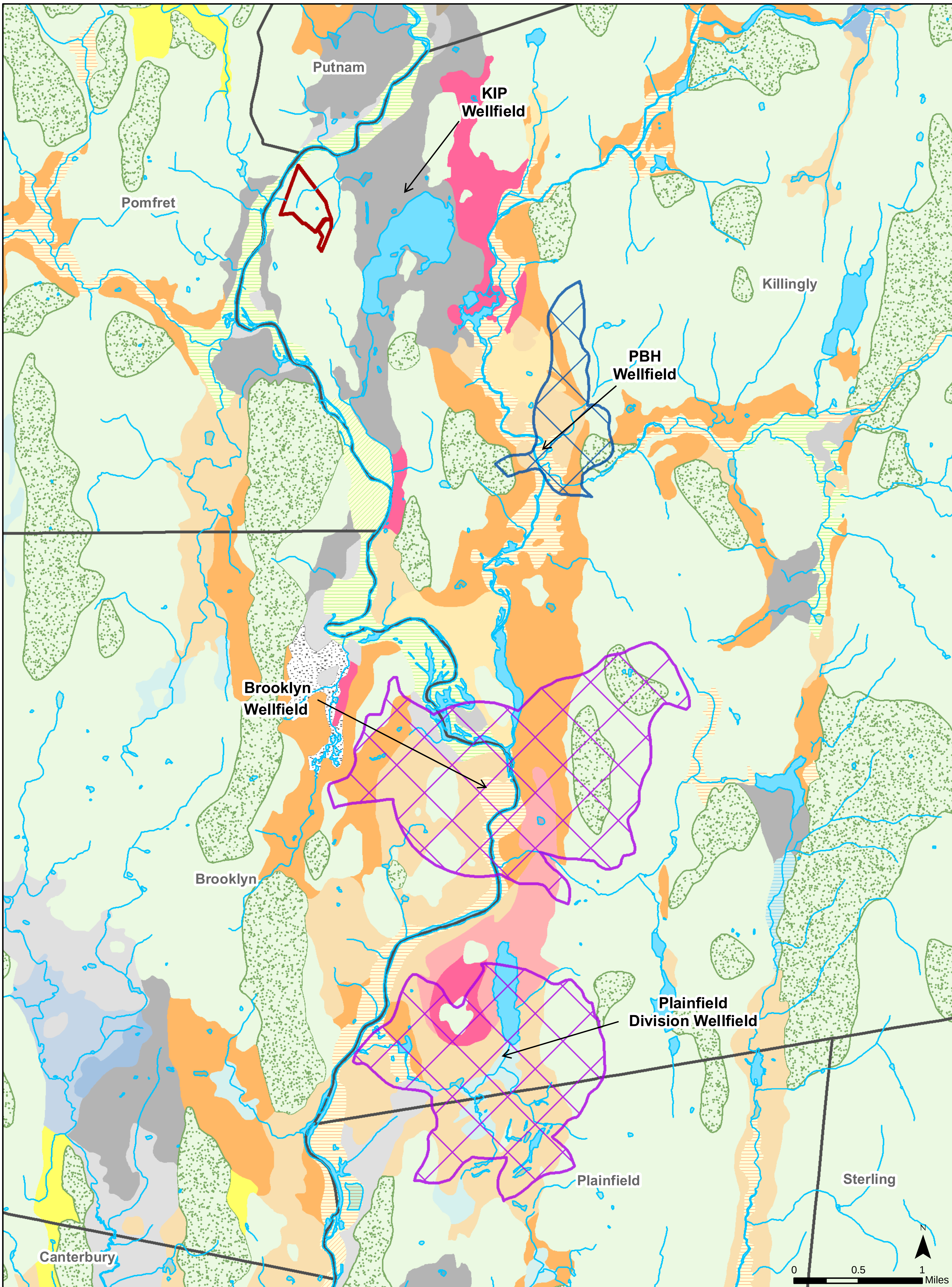
Level A Mapping delineates the generally smaller final aquifer protection area (based on additional, detailed site-specific pump tests), which becomes the regulatory boundary for land use controls designed to protect the well from contamination. As Level A Mapping is completed for a given wellfield and approved by DEEP, it replaces the Level B Mapping. As shown on Figures 2 and 3, Level B and A mapping has been completed for the PBH Wellfield; and Level B mapping has been completed for the Brookfield Wellfield and the PDW.

All four Crystal Water Division Wellfields are located in the same classic glacial valley aquifer, formed from running or stagnant meltwaters as the glaciers retreated 13,000 years ago. In the areas immediately east of KEC, the valley is approximately 1 mile wide and mimics the north-south orientation of the underlying bedrock of the Quinebaug Formation. Based on numerous borings collected by the United States Geological Survey (USGS) in the 1960s, including some located within the KIP, this valley slopes from the eastern and western hillsides to the center, where the elevation is 100 feet above mean sea level (amsl).

This valley is filled in some places with 150 feet of stratified (well sorted) sands, gravels and silts. The sands and gravels would be associated with former meltwater streams, while the silts would be associated with former glacial lakes. As the glacier retreated, large ice blocks were left behind. Streams and lakes moved the stratified material around and sometimes over those ice blocks. When the ice melted these areas became indentations, which filled with water to become ponds if they intersected with the water table (often referred to as “kettle” ponds).

Alexander Lake is very large kettle pond, approximately 200 acres in size, with an average depth of approximately 24 feet and a maximum depth of 53 feet. The boring logs for wells within the KIP indicate that, at various times throughout pre-history, the Alexander Lake Ice Block acted as a dam, allowing glacial ponds to form depositing silt (low energy environment) and, at other times, sand and pebble gravel deposits (high energy environment) probably in the form of braided streams. More recently, alluvium (sand, silt and organic matter) was deposited in the floodplains of rivers and streams. These deposits may be up to 25 feet thick along the banks. USGS mapping indicates that the wetland/stream/small pond system south of the lake may be underlain by alluvium and, in the distant past, water may have flowed south from the pond.

Surface water in this glacial valley flows generally from north to south through the Quinebaug River and Five Mile River systems. Alexander Lake is not connected to either of these systems, and located at higher elevations then these surface water bodies. Like most glacial valley aquifer systems, groundwater flows from higher bedrock/till hills both east and west and discharges to these river systems, as shown in the Level A mapping for the PBH Wellfield discussed below. It would be expected that these systems would have a southern component of flow based on the hydraulic head changes of the rivers.



KEC Site
Surface Waters
Town Boundary

Aquifer Protection Area

Level A
Level B

Surficial Geology

Glacial Ice-laid Deposits
- Thin Till
- Thick Till

Glacial Meltwater Deposits
- Fines (very fine sand, silt, and clay)
- Gravel
- Sand and Gravel
- Sand
- Gravel overlying Sand
- Sand and Gravel overlying Sand
- Sand overlying Sand and Gravel
- Sand and Gravel overlying Sand overlying Fines
- Sand and Gravel overlying Fines
- Sand overlying Fines
- Fines overlying Sand and Gravel
- Fines overlying Sand

Postglacial Deposits
- Alluvium overlying undifferentiated Coarse Deposits
- Alluvium overlying Sand
- Alluvium overlying Fines
- Alluvium overlying undifferentiated Coarse Deposits overlying Fine Deposits
- Swamp deposits
- Swamp deposits overlying Fines
- Artificial Fill

Figure 3

Geologic Context of Connecticut Water Company's Crystal Water System Wellfields

Killingly Energy Center
an NTE Energy Project

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4.0 EVALUATION OF POTENTIAL EFFECT ON THE LOCAL AQUIFER

Despite the relatively small volume of proposed water use associated with KEC (accommodated with the existing CWC permitted resources) and the characteristics of the existing water system and geologic context (as shown in Figure 3), an assessment of the potential effect of KEC's water use has been conducted.

4.1 KIP WELLFIELD

The KIP Wellfield is located within the Alexander Lake watershed. As noted above, historical records indicate that the KIP wellfield has not recently been in use. KEC's water needs will not require increased use of this wellfield. However, this section assesses a hypothetical impact on Alexander Lake if the wellfield were to be used.

Based on data provided by CME Associates, Inc. (CME) in *Alexander's Lake Watershed Plan* (CME 2011) prepared on behalf of the Alexander Lake Homeowners Association, the watershed to Alexander Lake appears to be delineated based on surficial topography. The size of the watershed was calculated in that report as 586 acres.

Lake water levels typically fluctuate somewhat throughout the year. CWC monitors lake levels on a weekly basis as a condition of its KIP Wellfield permit (even when not operating the wellfield). During the last three years, the water level in Alexander Lake has fluctuated each year by approximately 1.5 feet, with higher levels typically correlating with significant rainfall and/or snow melt. For example, in 2013, the highest lake level was recorded between June and August due to higher than normal rainfall in June, while 2014 and 2015 lake levels were highest at the end of April and beginning of May, when snow melt combined with rainfall to increase contributions to the lake.

A simple mass balance calculation can be used to provide perspective on the recharge that influences Alexander Lake water levels. Recharge to the watershed by precipitation under average conditions is conservatively estimated to be 22 inches per year (Whitman & Howard 1995), accounting for precipitation and evapotranspiration rates. Actual fluctuation in lake levels would, of course, be dependent on actual rates of precipitation and evapotranspiration. Use of this average case results in calculation of an average annual recharge for the lake of 46.7 million cubic feet per year, or 349 million gallons per year (calculated by multiplying the area of the watershed, as identified in the CME report, by the rate of recharge). Note that, because the watershed delineation appears not to have been defined using the full range of appropriate parameters, its size may be understated, which would result in calculated effect that overstates what would actually occur. Although additional recharge to the watershed previously came from septic system discharge associated with homes located around the lake, the connection of these homes to the sewer system in the 1990s removed that constant source of recharge.

Hypothetically, if the KIP Wellfield were used at its fully permitted volume of 70,000 gpd every day during those times when KEC will be authorized to use ULSD for the maximum of 30 days (which is expected to considerably overstate the potential for actual ULSD use), the withdrawal would be 2.1 million gallons per year. This volume represents 0.6 percent of the total average annual watershed recharge. This volume would not result in changes in Alexander Lake water levels that would be discernable from its normal water level fluctuations associated with precipitation and evapotranspiration. As previously noted, historical records indicate this wellfield is not currently in use, and CWC has indicated that KEC will not require increased use of the KIP Wellfield.

4.2 PBH WELLFIELD

The PBH Wellfield is an anticipated source of water to meet KEC's needs, and is the closest wellfield to the KEC site and to Alexander Lake within the Crystal Water Division that is currently in use.

As discussed in Section 3.1.2, DEEP has established two levels of modeling and mapping of the location in aquifers of wellfield areas, zones of contribution and recharge areas. The PBH Wellfield has been mapped to Level A, which means that the area identified as supplying water to the wellfield is based on hydrogeological data of aquifer geometry, hydraulic characteristics and connection to surface water features, groundwater level data and surface water discharge information for model calibration and pump test data for model verification.

The Level B mapping of the PBH Wellfield was completed in 1990. This conservative delineation included the identification of the regional watershed divides. There is a clear watershed divide west and northwest of the PBH Wellfield and Alexander Lake in a similar location to the one delineated in the CME (2011) report.

The Level A mapping of the PBH Wellfield was completed in 1995 and approved by DEEP. The delineation included the installation of additional subsurface test borings, seepage analysis to evaluate the contribution of water from the Five Mile River, a long-term pumping test to determine aquifer characteristics and impacts to surface water bodies. This information was used to construct groundwater flow maps and then used in a numerical groundwater model (MODFLOW) to determine the maximum extent of the recharge area to the PBH Wellfield.

The results of the pumping test indicated a contribution to the PBH Wellfield from sand and gravel with a hydraulic conductivity of 250 feet per day and a hydraulic conductivity of more silty material to the north of 50 feet per day. Significant induced infiltration from the Five Mile River, located 200 feet to the west of the PBH Wellfield, was also noted. Groundwater flow based on observation of 39 monitoring wells is from the east in the direction of the river. The numerical simulation of the zone of contribution, calibrated to the pumping test and induced infiltration results, is shown on Figures 2 and 3.

The PBH Wellfield (and delineated Level A area) is east of the Five Mile River, on the opposite side of the Five Mile River from the KEC site and Alexander Lake and in a separate watershed. The closest edge of the predicted zone of contribution and recharge area for the PBH Wellfield is approximately 1 mile southeast of the eastern shore of Alexander Lake. Based on this Level A mapping, it is clear that there is no geologic, hydrogeologic or hydraulic connection between the PBH Wellfield and Alexander Lake. Pumping of water from this location will not impact water levels or water quality in Alexander Lake.

4.3 BROOKLYN WELLFIELD

As shown on Figures 2 and 3, the Brooklyn Wellfield has been mapped by DEEP to Level B. Standards for mapping zones of contribution and recharge area for Level B are based on existing geologic mapping of known aquifer characteristics, limited field verification, the location of the wellfield, and maximum pumping rates, as discussed in Section 3.1.2. For this reason, Level B mapping areas are generally conservatively larger than the Level A areas, in order to encompass any area considered to have the potential to contribute to recharge.

The determination of aquifer transmissivity for the Brooklyn Wellfield was made by using a variety of analytical techniques and calculations. Based on the calculated transmissivity in the D.L. Maher report (1990a) – 6,000 cubic feet per day per foot – and the combined maximum pumping rate determined at the time based on specific capacities of 785 gallons per minute for Brooklyn Wells #1, #2, and #3, the resulting setback radius was defined as 3,600 feet. This value is a conservative delineation, as it is based on the maximum combined pumping rate and not on actual or projected usage (Maher 1990a). The direct and indirect recharge areas were then calculated on this basis, resulting in the Level B area for the Brooklyn Wellfield shown on Figures 2 and 3.

Like the PBH Wellfield, the Brooklyn Wellfield is located in a separate watershed from Alexander Lake.

The Brooklyn Wellfield (and the full delineated Level B area) is located south of a large meander of the Quinebaug River, on the opposite side of the Quinebaug River from the KEC site and Alexander Lake. The closest edge of the predicted zone of contribution and recharge area for the Brooklyn Wellfield is approximately 3 miles south of the southern shore of Alexander Lake and in a different watershed. Based on this Level B mapping, it is clear that there is no geologic, hydrogeologic or hydraulic connection between the Brooklyn Wellfield and Alexander Lake. Pumping of water from this location will not impact water levels or water quality in Alexander Lake.

4.4 PLAINFIELD DIVISION WELLFIELD

As previously noted, the PDW is not currently connected to the wellfields that currently serve the Town of Killingly, (although the wellfield is located in Killingly). However, one strategy under consideration is the potential interconnection of this additional wellfield to the Brooklyn/PBH system, in order to create a more robust network of supply sources throughout the region. The PDW, like the Brooklyn Wellfield, has been mapped by DEEP to Level B, utilizing the same tools and analysis to establish a conservative recharge area and zone of contribution around the well. The PDW and its delineated Level B area are also located south of a large meander of the Quinebaug River, and have the same hydrogeologic separation from the KEC site and Alexander Lake as does the Brooklyn Wellfield.

The determination of aquifer transmissivity for the PDW was made by using a variety of analytical techniques and calculations. Based on the calculated transmissivity in the D.L. Maher report (1990a) of 6,500 cubic feet per day per foot, and the combined maximum pumping rates for the three wells based on specific capacities of 905 gallons per minute, the required setback radius is 3,800 feet. This value is a conservative delineation, based on the maximum combined pumping rate and not on the actual or projected usage (D.L. Maher 1990a); only two of the wells are currently operated. The direct and indirect recharge areas were then calculated to define the Level B area for the PDW shown on Figures 2 and 3.

Like the PBH and Brooklyn Wellfield, the PDW is located in a separate watershed from Alexander Lake and, in fact, is two watersheds away.

The edge of the predicted zone of contribution and recharge area for the PDW is over 5 miles south of the southern shore of Alexander Lake and in a separate watershed. Based on this Level B mapping, it is clear that there is no geologic, hydrogeologic or hydraulic connection between the PDW and Alexander Lake. Pumping of water from this location will not impact water levels or water quality in Alexander Lake.

5.0 ALTERNATIVE WATER SUPPLIES CONSIDERED

Even though local public water supplies are available to supply KEC water requirements, NTE considered the potential availability and suitability of alternate water sources to reduce or offset the use of public water from CWC. This included the potential use of recycled wastewater from nearby dischargers, as well as developing its own surface water or groundwater source, as outlined below.

5.1 POTENTIAL USE OF RECYCLED WASTEWATER

Recycled wastewater from nearby publicly owned treatment works or other large industrial uses has been considered for water use at KEC where sufficient flow is consistently available and water quality can support a reasonable water treatment system (because KEC's water must be cleaner than potable water quality for most of its uses). Three facilities were identified in the vicinity of the KEC site that were considered as potential sources of treated effluent: the Killingly Water Pollution Control Authority (KWPCA); the Putnam Wastewater Treatment Plant; and the Frito-Lay facility. Note that use of any one of these options would have the potential to require a DEEP Diversion Permit. In addition, because each of these options would rely upon an independent facility that could be subject to outages or other operational issues, it is likely that a back-up water connection with CWC would still be required. Each potential recycled wastewater option considered is further addressed below.

5.1.1 Killingly Water Pollution Control Authority

The KWPCA discharges into the Quinebaug River south of KEC. This facility, operated by Suez, has a treatment capacity of 8 MGD, with an average daily flow into the treatment plant of 3 MGD. With flows of this volume, it was determined that this facility could be considered as a potential source of treated effluent.

Based upon an evaluation of preliminary water quality data provided by the KWPCA, the wastewater treatment facility appears to remove both conventional pollutants (biochemical oxygen demand and total suspended solids) as well as nutrients (phosphorus and nitrogen species) to very low concentrations in the treated effluent. However, the conductivity[1] of KWPCA's discharge is estimated to be four to six times higher than that in the CWC supply.

As would be the case with any municipal wastewater treatment plant, the KWPCA treated effluent would require further treatment at KEC to make it suitable for the intended water uses. The water would require pretreatment (e.g., microfiltration) and supplemental disinfection to support its use as service water, evaporative cooler makeup, and supply water to the makeup demineralizer system. The elevated conductivity of the treated effluent does not meet the requirements established for evaporative coolers; thus, a portion would have to be demineralized and blended with treated water that is not demineralized in order to meet makeup water quality guidelines. Such a blending arrangement increases operational complexity as well as the size of the membrane (reverse osmosis-based) demineralizer system. Since reverse osmosis systems typically operate at approximately 75 percent recovery when treating water with the expected salinity in the KWPCA effluent, this additional demineralized water demand would result in an associated increased demand for supply water and an associated increase in the volume of wastewater discharged. The high conductivity would also result in increased chemical usage, power requirements, and effort to operate the makeup demineralizer system.

The requirement for a pretreatment process (e.g., microfiltration) reduces the overall recovery of the treatment system, results in the increased demand for supply water and production of wastewater (e.g., microfiltration backwash) and increases chemical usage, operator attention and maintenance requirements. Even with suitable

[1] Conductivity is used to measure the concentration of dissolved solids that have been ionized in water.

pretreatment, it is expected that the reverse osmosis membranes would require more frequent cleaning, which results in increased wastewater production and effort to operate.

Significant infrastructure modifications would be necessary, including construction of a water supply pump station and chlorination facilities at the KWPCA wastewater treatment plant site, an approximately 6.5-mile treated effluent supply pipeline (including the procurement of all necessary rights-of-way), and a separate filtered/service water tank and pumping system at KEC.

Due to these issues, the use of KWPCA treated effluent was eliminated from further consideration as a source of water supply for KEC.

5.1.2 Putnam Wastewater Treatment Plant

The Town of Putnam has a wastewater treatment plant that discharges to the Quinebaug River north of KEC and is also operated by Suez. According to the Town of Putnam Water Pollution Control Authority, the wastewater treatment plant has a design capacity of 2.9 MGD; if flows approximate this volume, this facility could be considered as a potential source of treated effluent.

While representatives of the Putnam wastewater treatment plant were initially willing to consider potential use of its treated effluent for this purpose, subsequent communications have indicated that treated effluent from this facility may be reserved for other purposes. No further consideration of this source has, therefore, been undertaken. Note that, were this source further considered, all the issues noted for the KWPCA effluent would be expected to apply to this option as well.

5.1.3 Frito-Lay Facility

The Frito-Lay facility is located on the eastern shore of Alexander Lake, just over 1 mile from KEC. The manufacturing processes for each snack food Frito-Lay produces have different procedures and varying wastewater composition, depending upon the characteristics of the core ingredients. Because most of the products are fried, specific controls are designed into its discharge, including an oil/water separator, clarification and neutralization, prior to discharging its wastewater to the KWPCA. Discharge is on the order of 600,000 to 900,000 gpd, but varies by work schedule as well as product. Its current permit allows for discharge of up to 1.6 MGD. According to Frito-Lay, its discharges typically comprise approximately 30 percent of the flows being discharged to the KWPCA.

Although sufficient volumes appear to be available from this potential source, concerns included the variability of the discharge quality and the potential for oily waste even at low levels. Frito-Lay's discharge would require extensive treatment to render it suitable to use as supply water to KEC's makeup demineralizer system and evaporative cooler. The conductivity of Frito-Lay's discharge is an order of magnitude higher than that in the CWC supply, making it considerably more difficult to demineralize. In addition, the discharge from Frito-Lay has a significant biochemical oxygen demand loading that would require treatment utilizing biological processes. This type of treatment imposes complex and cumbersome operational requirements not typically encountered in facilities like KEC and results in increased maintenance requirements. This water source was, therefore, not selected for further consideration.

5.2 NEW SURFACE OR GROUNDWATER SUPPLY

Given the proximity to a significant water body (the Quinebaug River) and the possibility of groundwater well development (as demonstrated by other nearby well users), these options were briefly considered.

The Quinebaug River was considered to be the most robust and appropriate potential source of surface water in the vicinity of KEC, with average daily flows at the USGS gauging station in Putnam measured at 547 cubic feet per second (cfs), or over 350 MGD. The 7Q10[2] at that gauge was identified as 49 cfs (31.7 MGD). Although the Quinebaug River was identified as a potentially feasible water source, it was noted that the most recent Diversion Permit granted (in 2008 to Plainfield Renewable Energy, LLC for a maximum use of 893,000 gpd and annual average day withdrawal limit of 656,000 gpd) was extremely controversial. Permitting would also be required for the specific location and design of an intake structure. Given the low typical water needs of an air-cooled facility such KEC, as well as the cost and potential concerns associated with permitting and construction of an intake structure in the Quinebaug River, this alternative was not selected for further consideration.

The KEC site is not specifically located in an aquifer protection area as determined by DEEP. While surficial aquifer potential is mapped as low, water could be determined to be available from sandy/silt deposits more proximate to the Quinebaug River or from bedrock. However, this type of potential water supply may be limited or not available without intensive water supply exploration. In addition, given the proximity of Alexander Lake and the presence of other groundwater users in the vicinity, an on-site or near-site groundwater well was not selected for further consideration.

[2] 7Q10 is a low-flow planning statistic representing the lowest average river flow over a period of 7 days, with a recurrence interval of 10 years.

6.0 CONCLUSION

NTE has carefully considered a range of strategies for KEC that would minimize the water demand of the facility to the greatest extent possible, and selected a water source that would not impact the community or the environment. KEC incorporates advanced air cooling technology, eliminating the need for millions of gallons of water a day for cooling purposes. Under its typical natural gas-fueled operation, water needs will be very low for a facility of this type. During the limited hours that KEC will use ULSD, additional water is necessary to incorporate appropriate emissions control technologies.

Based upon a review of alternatives available, NTE has selected the use of the existing CWC water system to supply the KEC water needs. None of the wellfields that will be employed have the potential to impact the community, environment or water levels or quality in Alexander Lake as a result of KEC's use. The KIP Wellfield is within the Alexander Lake contributing watershed; however, its allowed withdrawal has been restricted by DEEP to a level determined allowable without adverse effect to the surroundings. Even with this limit in place, CWC has no intention of increasing use of the KIP Wellfield to meet KEC's water needs. The remaining wellfields are all downgradient of Alexander Lake, separated by groundwater divides, and not located within their zone of contribution. Therefore, no impact to Alexander Lake will result from KEC's water use.

7.0 REFERENCES

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