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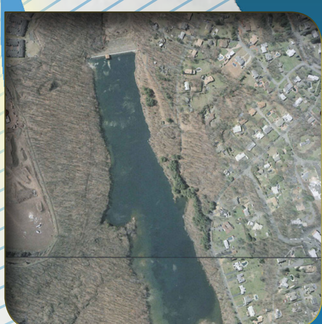

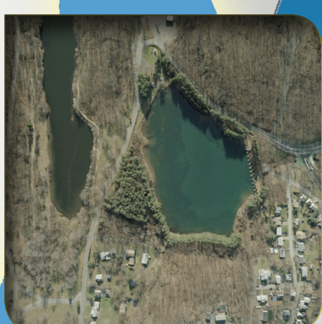

Passaic Valley Water Commission

Water Storage Improvements Feasibility Study

Passaic Valley Water Commission
1525 Main Avenue, Clifton, NJ 07011

Draft: September 9, 2010
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Prepared By:

T·Y·LIN INTERNATIONAL | MEDINA

In Association With:

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I. Executive Summary

I. EXECUTIVE SUMMARY

Passaic Valley Water Commission (PVWC) is a publically owned water purveyor located within the northern New Jersey water supply region. PVWC has three uncovered, finished water reservoirs, including Great Notch, New Street and Levine Reservoirs. The Great Notch and New Street Reservoirs are both located in Woodland Park, with Levine Reservoir being located in the City of Paterson.

These reservoirs are presently not in conformance with current applicable NJDEP and USEPA regulations for finished water storage. In March of 2009, the New Jersey Department of Environmental Protection (NJDEP) issued an Administrative Consent Order (ACO) to PVWC. The NJDEP provided PVWC with a schedule that required producing a feasibility study for addressing the regulatory requirements of the existing uncovered finished water reservoirs. This study is a part of the ACO requirements.

This feasibility study was initiated with a detailed review of PVWC's existing open reservoirs and distribution system. All relevant reports, maps, flow data, studies, and documents prepared by or for PVWC were reviewed. Reservoir sites and associated facilities were field investigated, along with meetings held with PVWC personnel to discuss standard operating and maintenance procedures. Following the completion of this review, Technical Memorandum #1 has been prepared and included herein.

Once the detailed review of the PVWC system was completed, it was then critical to set the criteria necessary in developing the various alternatives available to the PVWC. Review of power outage, existing plant and pump station power systems, backup power, reliability, emergency interconnections with other utilities, ability to transfer water during emergencies for each reservoir, and verification of previous emergency reserve, fire reserve, and demand equalization for the entire system were all part of setting the criteria phase of the project. This also included establishing the minimum storage requirements for PVWC operations. The treatment plant operations and capabilities, including reliability and redundancy, and back-up power capabilities were all reviewed and analyzed, as well.

Boundary, Topographic and Bathymetric surveys were performed for Great Notch, New Street and Levine Reservoirs. Boundary surveys of the Commission-owned properties have been prepared for each reservoir. New aerial photography was performed in order to prepare topographic and planimetric mapping of the three (3) reservoirs. A bathymetric survey of the three (3) reservoirs was also performed in order to map the bottom of the reservoirs. The bathymetric contours were then merged with the land survey and topographic information to provide a complete set of accurate topographic drawings for each reservoir. This information was critical in developing the various alternatives for each reservoir site, including the calculation of storm water runoff, and determining construction cost opinions.

A Phase 1A Cultural Resource Survey was performed for the three (3) reservoirs by Richard Grubb & Associates (RGA), a subconsultant to TYLIN Medina. In reference to the Great Notch Reservoir, a Phase IB cultural resources survey is recommended for terrestrial archaeological resources. In addition, drowned or submerged archaeological resources could be present in the Great Notch Reservoir. The potential for impacts on such resources should be considered in project planning. Should former upland surfaces be exposed and impacted by the undertaking, a Phase IB cultural resources survey is recommended to determine the presence or absence of archaeological resources. An intensive-level survey of the Great Notch Reservoir is recommended to assess the National Register eligibility of the reservoir. If the reservoir is determined eligible, then the effects of the alternatives on the Great Notch Reservoir will need to be assessed.

Prior to the construction of the New Street Reservoir, the original topography in the APE-Archaeology appears to have included upland areas containing level, well drained soils and it is possible that drowned or submerged archaeological resources could be present within the current reservoir footprint. The potential for impacts on such resources should be considered in project planning. Should former upland surfaces be exposed and impacted by the undertaking, a Phase IB cultural resources survey is recommended to determine the presence or absence of archaeological resources. A review of National Register files at the HPO revealed one property previously determined eligible for the National Register in the APE-Architecture, Garret Mountain Park (SHPO Opinion: 10/26/1979; DOE: 1/30/1980). The alternative under consideration in the feasibility study will have no adverse effect on Garret Mountain Park, provided that the vegetative buffer between the reservoir and the park is enhanced through planting of additional trees along Mountain Avenue. An intensive-level survey of the New Street Reservoir will likely be required by the HPO to assess the National Register eligibility of the 85-year-old reservoir. If the New Street Reservoir is determined eligible for the National Register, then the effects on the project will need to be assessed.

In reference to the Levine Reservoir, background research revealed that the APE-Architecture lies within the Great Falls/Society for Useful Manufactures (SUM) Historic District, which is both listed on the State and National Registers of Historic Places and as a National Historic Landmark (SR 5/27/1971; NR 4/17/1970; Addendum SR 10/15/1974, NR 1/8/1975; NHL 5/11/1976). It is the opinion of RGA that the circa 1885 Levine Reservoir contributes to the significance of the Great Falls/SUM Historic District. As a result, consultation with the HPO to minimize project effects on the historic district through context-sensitive design and/or enhancing vegetative buffers on the property is recommended. Recordation of the reservoir to Historic American Engineer Record standards may also be required prior to construction.

In this study, a detailed and structured decision analysis process was utilized to identify, evaluate and select the preferred alternative. All aspects of this decision were identified, including the decision makers and the criteria to be used. Alternatives, such as reservoir covers and liners, new storage facilities at the reservoirs, treatment of the reservoirs, addition of standby power, and a combination of these alternatives were all reviewed and analyzed. As a result, eight (8) alternatives were developed through various workshop meetings with the PVWC project team.

The evaluation criteria utilized for each of the eight (8) alternatives in the feasibility study included reliability, regulatory acceptance, water quality, and constructability. The alternatives were then ranked based on the ratings that were assigned to the criteria attached to the alternatives.

A Preliminary Budget Analysis was then performed using preliminary costs developed for each of the options. A total cost for each alternative was developed and based on the criteria rankings, in combination with the relative costs, the alternatives were then reduced down to two alternatives.

The final selection process involved a hard look at the advantages and disadvantages along with the cost opinions where Alternative 7 became the final selected alternative. The total life cycle cost opinion for Alternative 7 is $116,600,000 in net present value.

The following is a listing of the major components of Alternative 7:

1. Great Notch Reservoir
   a.) Two (2) – 20 mg prestressed concrete storage tanks, 365 feet in diameter, High WSEL = 447.5 feet, Low WSEL = 422 feet
   b.) Demolition of existing dam
   c.) Access road
   d.) Miscellaneous piping modifications
   e.) Appropriate stormwater facilities

2. New Street Reservoir
   a.) Two (2) – 15 mg prestressed concrete storage tanks, 255 feet in diameter, High WSEL = 330 feet, Low WSEL = 290 feet
   b.) Demolition of existing dam
   c.) Access Road
   d.) Miscellaneous piping modifications
   e.) Appropriate stormwater facilities

3. Levine Reservoir
   a.) Two (2) – 2.5 mg prestressed concrete storage tanks, 160 feet in diameter, High WSEL = 192 feet, Low WSEL = 175 feet
   b.) Access drive with parking area
   c.) Reservoir isolation wall
   d.) Miscellaneous piping modifications
   e.) Appropriate stormwater facilities

4. Back-up Power at the Little Falls Water Treatment Plant
   a.) Four (4) 2,500 kW generators
   b.) New generator and switchgear building

5. Great Notch Pump Station
   a.) Add a third pump to existing station (12 mgd total firm capacity)

6. New Street Pump Station
   a.) Two (2) Horizontal split case pumps (8 mgd total firm capacity)

7. New Verona Tank
   a.) 1 - 2 mg tank, 40'H X 92' Diameter) - Matches existing tank

8. Miscellaneous systemwide upgrades

A complete project schedule has been prepared and included at the end of this Executive Summary. The schedule lists all facets of the project, from the NJDEP approval of the feasibility study, through conceptual design, final design, permitting, NJEIT funding process, the bidding of the individual project components, including the construction duration. This schedule is also in line with the scheduling contained in the rate impact analysis performed on the selected alternative and provided herein.

It must be noted that the adherence to this schedule will be dependant on numerous factors that are beyond the control of the Passaic Valley Water Commission. Factors such as construction sequencing, coordination with the City of Newark's Cedar Grove Reservoir project schedule, public interests, regional water supply issues, weather conditions, and permitting issues may or may not affect the outlined schedule.

In regards to stormwater and environmental impacts of the selected alternative, a permit coordination meeting with the NJDEP was held on August 11, 2010, where permits and stormwater management measures were discussed. NJDEP will require that all stormwater measures adhere to the upcoming revised regulations. Additional input from local municipalities will need to be pursued where local review and approval of the proposed stormwater measures will be necessary.

NJDEP is requiring that all post-development conditions adhere to the NJ Stormwater Management Rule N.J.A.C. 7:8. Stormwater Management Measures should be implemented to address stormwater runoff quality and quantity. NJDEP will not require groundwater recharge due to existing reservoir bottom conditions (bedrock).

NJDEP permits and applications presently expected to be obtained are Flood Hazard Area Applicability for Levine Reservoir, Letter of Interpretation (Verification) for all three reservoir projects, Flood Hazard Area Individual Permit for New Street and Great Notch Reservoirs. Individual Wetlands permits for New Street and Great Notch Reservoirs. Dam Construction Permit (Removal) for New Street and Great Notch Reservoirs. Historic Preservation Office permit for Levine Reservoir.

New Jersey Flood Hazard Area regulations have jurisdiction over all streams that drain over 50 acres. Any modification of a channel or construction within a floodplain will require a permit. Any modification of freshwater wetlands, including the destruction of wetlands that occurs when a lake is drained due to dam removal, will require a wetlands permit issued by the NJDEP Bureau of Land Use.

In relation to the Newark/Great Notch Alternative, other options are being considered concurrently with this study to explore shared projects with the City of Newark and other purveyors which may or may not have any impacts on the selected alternative.

Public involvement pertaining to the selected alternative will be addressed once this feasibility study has been approved by the NJDEP and during the conceptual design phase of this project.

II. Introduction

II. INTRODUCTION

Passaic Valley Water Commission's (PVWC) three uncovered, finished reservoirs, namely Great Notch, New Street and Levine, are presently not in conformance with current NJDEP and USEPA applicable regulations for finished water storage. As a result, PVWC has entered into an Administrative Consent Order (ACO) with the NJDEP to prepare this feasibility study within the deadlines specified.

In order to meet these deadlines, it was necessary to carefully and strategically plan each task required to be performed as part of this study. It was also necessary to plan out, schedule and hold several meetings and workshops with the PVWC project team to assure that all of their requirements and needs are being met in the development and evaluation of various alternatives that will meet the ACO. The tasks mentioned above included the following with a brief description of each:

- **Task 1 – Information Review:** this task included a detailed review of PVWC's existing open reservoirs and distribution system. All relevant reports, maps, flow data, studies, and documents prepared by or for PVWC were reviewed. Reservoir sites and associated facilities were field investigated, along with meetings performed with PVWC personnel to discuss standard operating procedures. Reservoir capacity and physical configuration were reviewed and analyzed. Typical flow patterns and daily storage variations associated with each reservoir were determined and evaluated. WaterGems Model was utilized to understand how the system operates. A review of reservoir and distribution system water quality, including total coliform, chlorine residual, disinfectant by-products (DBPs), and all other pertinent data available from the reservoirs or in close proximity to the reservoirs was also performed.

- **Task 2 – Setting Criteria:** involved a detailed review of the USEPA requirements, as well as NJDEP requirements relating to uncovered reservoirs, as well as all other regulations that may be impacted by the uncovered reservoirs and potential alternatives. Power outage review and a review existing plant and pump station power systems, backup power, and reliability. Emergency interconnections with other utilities and the ability to transfer water during emergencies for each reservoir were determined and evaluated. A review and verification of previous emergency reserve, fire reserve, and demand equalization for the entire system, by gradient, and for wholesale customers. This also included establishing the minimum storage requirements for PVWC operations. The treatment plant operations and capabilities, including reliability and redundancy, and back-up power capabilities were reviewed and analyzed.

- **Task 3 – Site Mapping:** a boundary, topographic, including aerial photography, and bathymetric surveys were required for the three (3) reservoirs. This new mapping was utilized throughout the feasibility study to conceptually determine the location of the various proposed alternatives, perform runoff analysis calculations and for the development of the Engineer's Opinion of Probable Cost for the selected alternative.

- **Task 4 – Alternatives:** this task involved the development and refinement of various alternatives. Criteria for evaluating the alternatives were also developed, clearly defined,

  weighted, and ranked according to uncertainty, risk, and engineering judgment. A workshop process which included all decision makers was used to rank each alternative according to the criteria selected previously. Each alternative was ranked based on a weighted evaluation criteria, costs excluded. Preliminary Budget Costs were then applied to each alternative. An elimination process took place where various alternatives were eliminated based on the weighted evaluation criteria and costs. Also part of the is task is public involvement which will be addressed after the feasibility study has been finalized.

- **Task 5 – Financing:** identify potential federal, state, and private funding options for the recommended alternative. The team will also prepare an analysis describing the projected impact on retail and wholesale billing rates based on the recommended alternative and the most likely funding option.
- **Task 6 - Newark/Great Notch Alternative:** other options are being considered concurrently with this study to explore shared projects with the City of Newark and other purveyors which may or may not have any impacts on the recommended alternative.

Miscellaneous information was presented to the PVWC project team throughout various stages of the project, including the meetings and workshops referenced above, where their review and input was necessary to properly evaluate the recommended alternatives.

This feasibility study, as presented herein, is a culmination of the work performed under these tasks.

A. Purpose

The purpose of this feasibility study is to provide our evaluation of PVWC's three uncovered, finished water reservoirs. The evaluation will address the concerns of the PVWC regarding meeting finished water quality goals, maintaining the largest volume of water storage, and security.

The finished water quality goals include those mandated by the Long Term 2 Enhanced Surface Water Treatment Rule, along with the requirements of the Safe Drinking Water Act, such as the Lead and Copper Rule, Stage 2 Disinfectant/Disinfection Byproduct Rule, Total Coliform Rule, etc.

B. NJDEP ACO

As mentioned previously, the PVWC entered into and ACO with the NJDEP in March 2009. A copy of the ACO has been included for reference in Appendix A.

In summary, PVWC was required to submit a scope of work for this feasibility which was eventually approved by the NJDEP. The feasibility study was to examine, at a minimum, the elimination of the existing uncovered finished water storage facilities and/or covering of the uncovered finished water storage facilities.

Under the ACO, PVWC agreed to meet with the NJDEP three (3) times during the ACO. These meetings were to be scheduled at the 30%, 80% and 100% completion periods. It should be noted that the 30% meeting was held on April 1, 2010, the 80% was held on July 15, 2010, and the 100% was held on ______________________.

PVWC also agreed to execute an amendment to this ACO which would include the design and construction of the recommended alternative in order for PVWC to achieve compliance with current applicable regulations.

C. Deadlines

Under the current ACO, the feasibility study is due to the NJDEP by September 9, 2010.

III. Description of PVWC System

III. DESCRIPTION OF PVWC SYSTEM

Passaic Valley Water Commission is a publically owned water purveyor located within the northern New Jersey water supply region. The PVWC is owned by the cities of Paterson, Passaic, and Clifton. It serves 22 wholesale customers in the counties of Passaic, Bergen, Essex, Hudson and Morris. Approximately 38 percent of PVWC's production was consumed by wholesale customers from 2007 to 2009. The PVWC supplies water to a population of nearly 800,000 people with a demand averaging approximately 80 million gallons per day (MGD).

PVWC operates and maintains the water distribution systems for the municipalities of Paterson, Passaic, Clifton, Prospect Park, Lodi, and North Arlington. The 22 wholesale customers mentioned above, include the following:

Bloomingdale	North Caldwell
Cedar Grove	Nutley
Elmwood Park	Ringwood
Fairfield	Riverdale
Fair Lawn	Southeast Morris County MUA
Garfield	Totowa
Haledon	Verona
Harrison	Wallington
Lincoln Park	Wanaque
Lyndhurst	West Caldwell
NJ American Water Company	Woodland Park

A. Source Water

PVWC has three different sources of raw water supply which include the Passaic River Intake, Pompton River intake (via the Wanaque South Pipeline), Point View Reservoir (via discharge to the Pompton River/Passaic River), and Point View Reservoir (via the Wanaque South Aqueduct and Wanaque South Pipeline).

1. **Passaic River Intake**: the Passaic River Intake is the main source of supply for the Little Falls Water Treatment Plant (LFWTP). The LFWTP is owned and operated by the PVWC. The maximum capacity of the intake is 125 mgd, but a maximum allocation of 75 mgd can be withdrawn from the combined sources of the Passaic River (Passaic River Intake) and Pompton River (Wanaque South Pump Station).

   Pompton River: the Wanaque South Pump Station can pump Pompton River water to the canal arch at a rate of up to 60 mgd. This source of water has been used in the past when the water quality in the Pompton has been better than the Passaic River. PVWC owns two of the pumps in this pump station. The pump station is part of the North Jersey District Water Supply Commission. Withdrawal from the Pompton River does not have a passing flow requirement.

2. **Point View Reservoir:** PVWC owns the Point View Reservoir which holds 10,450 acre-ft (3.4 billion gallons) of raw water although its normal storage is 8,590 acre feet (2.8 billion gallons). It has a normal surface area of 465 acres. The safe yield of the raw water system supplying the Little Falls Plant is 75 mgd and one component of that yield is the Point View Reservoir storage capacity.

PVWC also obtains finished water from the North Jersey District Water Supply Commission System. Water from these two (2) finished water sources is then pumped to the distribution system with six (6) pressure zones, nine (9) booster pumping stations, three (3) reservoirs, and three (3) water storage tanks.

B. Reservoirs

PVWC has three uncovered finished water reservoirs. The largest (178.5 million gallons) reservoir is the Great Notch which floats off of the highest gradient (427 Gradient). The second largest reservoir (52.4 million gallons) is the New Street Reservoir which floats off of the main system gradient (300 Gradient). The smallest reservoir (19.2 million gallons) is the Levine Reservoir (former called the Grand Street Reservoir) which floats off of the industrial gradient (180 Gradient). These three reservoirs, as well as the City of Newark's Cedar Grove Reservoir, are shown in Appendix B – Technical Memorandum #1.

1. **Great Notch Reservoir:** located in Woodland Park, the primary purpose of the Great Notch Reservoir is to supply the water distribution system in the event that the Little Falls WTP is out of service. The reservoir also supplies the Valley Heights (through Woodland Park), NJ American portion of Woodland Park, Woodland Park, and Valley Road Service areas (HGL = 426).

Great Notch Reservoir

The Great Notch Reservoir is connected to the 330 Gradient by two 48-inch pipelines which are connected to the 51-inch transmission main providing water from the Little Falls WTP. One of the 48-inch pipelines is used for the inlet to the reservoir and one of the 48-inch pipelines is used for the outlet. The Great Notch Pumping Station pumps water from the 51-inch into the 48-inch reservoir inlet pipe. The two 48-inch pipelines enter the gate house which is located at the dam. The incoming water flows from a 48-inch to a 36-inch pipeline which runs along the bottom of the reservoir and discharges in the center. There is a check valve on the 36-inch inlet pipeline to prevent the backflow of water and create flow patterns that assist with turnover of the reservoir. Water also flows into and out of the reservoir via the slide gates in the gate house. There is no screening of the water that is withdrawn from the gate house.

Normally, the Great Notch Reservoir is maintained at a constant level and does not provide any significant flow equalization. Emergency situations are when the Great Notch Reservoir is utilized. The Great Notch Reservoir is very difficult to fill due to the size of the reservoir and the 12 mgd Great Notch Pump Station, (6mgd firm capacity) that gets its suction from the 330 Gradient.

During an emergency situation (when the pressure in the 330 Gradient is too low), there are two 16-inch pressure regulating valves located on the 48-inch reservoir outlet pipeline which will open and supply water to the 51-inch transmission main. This allows PVWC to provide water to the 330 Gradient during an emergency situation.

2. **New Street Reservoir:** the primary purpose of the New Street Reservoir, which is also located in Woodland Park, is to provide storage for the 300 Gradient (and indirectly the 330 Gradient). The New Street Reservoir was originally called the Garret Mountain Reservoir. The New Street Reservoir was constructed circa 1925. The reservoir covers approximately 11 acres, and stores 52.4 million gallons. The New Street Dam is a concrete arch dam that exhibits signs of spalling and deterioration. The reservoir bottom is unlined permeable earth. Berms have been constructed around the New Street Reservoir to partially divert surface runoff from flowing into the reservoir.

New Street Reservoir

The New Street Reservoir is the heart of the distribution system because it is located in the pressure zone with the most demand and has the largest diurnal volume fluctuations of all of the finished water reservoirs. It is the reservoir that serves the largest percentage of the system demands (over 70 percent of the system demands). The New Street Reservoir supplies the owner cities of Clifton, Passaic, and Paterson. During peak demand periods, flow into the New Street gradient can be supplemented from the Great Falls, Eastside, and Botany Pumping Stations which draw water from the 180 Gradient and pump it into the 300 Gradient.

During a power outage, water from the New Street Reservoir flows back to the Main Pump Station and is used to pump water to the 36-inch Morris County and 24-inch Verona transmission mains using the Totowa, Verona and Airport Pumps.

3. **Levine Reservoir:** the primary purpose of the Levine Reservoir is to supply the 300/330 Gradient with emergency and fire flow storage (via the East Side, Botany and Great Falls Pump Stations) and to supply the 180 Gradient with equalization, fire flow, and emergency storage. Located in the City of Paterson, it was originally known as the Stony Road Reservoir and later as the Grand Street Reservoir before its name was recently changed to the Levine Reservoir. This reservoir historically served an industrial area, but many of the industrial facilities are no longer in this zone. As such, the demand has been significantly reduced in the 180 Gradient.

Levine Reservoir

The Levine Reservoir provides equalization storage to the 180 Gradient and provides suction to the Botany Pump Station. The Botany Pump Station is operated to assist with low pressure areas in the 300 Gradient. During power outages at the WTP or fire flow conditions in the 300 Gradient, the East Side and Great Falls Pump Stations boost water from the 180 Gradient to the 300 Gradient. The Levine Reservoir has a re-chlorination facility. The purpose of this facility is to re-chlorinate water which has been stored in the Levine Reservoir before it re-enters the distribution system.

PVWC also owns and operates three (3) elevated water storage tanks: 1). Colonial Village area in Paterson 2). Prospect Park and 3). Lodi.

C. Finished Water

PVWC is a part owner in the North Jersey District Water Supply Commission (NJDWSC) which accounts for an average daily flow of 35 mgd and a peak of 52 mgd of the 210 mgd Wanaque Filter Plant production. PVWC pays 34 percent of the NJDWSC annual budget. The annual operating budget for North Jersey is approximately $10 million. North Jersey also supplies water to Newark, Montclair, and other smaller users. The Wanaque Filter Plant utilizes raw water from the Wanaque Reservoir, and the Pompton and Ramapo Rivers.

The Wanaque WTP process consists of conventional treatment with polyaluminum chloride coagulation, dual media filtration and the addition and distribution of free chlorine. PVWC, and several upstream PVWC customers (Wanaque, Ringwood, Riverdale, Bloomingdale, and Lincoln Park) receive water from the NJDWSC through either one of two 74-inch Wanaque Aqueducts.

PVWC can withdraw from the Wanaque Aquaduct an average flowrate of 35.5 mgd, 42 mgd on a monthly basis, and 52.5 mgd peak day flowrate at the LFWTP.

Riverdale, Bloomingdale, Lincoln Park, Ringwood, and Wanaque Borough are all the utilities which withdraw from the Wanaque Aqueduct upstream of the LFWTP interconnections.

D. Little Falls Water Treatment Plant

The Little Falls Water Treatment Plant (LFWTP) has an overall finished water capacity of 110 mgd and a firm capacity of 85 mgd. The expansion to the water treatment plant was completed in 2004 and increased the capacity to its current levels.

In regards to existing backup power, the LFWTP and Main Pump Station are fed from two different power sources, but they originate from the same substation. According to PSE&G, they cannot supply a second feed from a separate substation. One of the two power feeds is located overhead and this is the primary power feed. The second line is an overhead line until it is on the plant site where it is buried. PVWC currently pays about $0.13/kWhr for power and uses approximately 40,740,000 kW-hrs per year. There is no backup power for water treatment plant production.

E. Main Pump Station

Water flows by gravity from the LFWTP to the Main Pump Station. The Main Pump station was constructed over 100 years ago. The Main Pump Station consists of the following pump systems:

- Industrial Pumps
- Transfer Pumps
- Wanaque Pumps
- Totowa Pumps
- Verona Pumps
- Airport Pumps
- Morris County Pumps

The Main Pump Station receives finished water from the LFWTP and/or from the Wanaque Aqueduct except during power outages where backflow from New Street and Wanaque goes to the

180 gradient. The pumps from the Main Pump Station discharge into the following different gradients:

- Industrial Gradient (180 Gradient)
- 330 Gradient (serves the 300/330 Gradients)
- Verona Gradient (673 Gradient)
- Morris County Gradient (602 Gradient)
- Totowa Gradient (460 Gradient) @ Main Pumping Station

The piping and pumping configuration of the Main Pump Station allows for a significant amount of flexibility. In addition, the plant piping can be configured such that the Wanaque North Supply Line can flow to the plant clearwells as well.

In regards to backup power located at the Main Pump Station, power can be provided to the Verona Pumps (two pumps), Totowa Pumps (four pumps), and the Airport Pumps (two pumps).

The backup generator is a 1500 kW diesel generator. There is also a 400 amp portable generator which can power a 250 HP pump. It is typically used at the Eastside or Botany Pump Stations, but the generator was sized based on the largest remote facility pump (Great Falls – 250 hp). PVWC also has a 100 kW portable generator which can be used at many locations.

F. Power Outage Review

An understanding of the potential for a power outage to the LFWTP and the Main Pump Station is critical to understand the overall system and determining the required distribution system storage requirements. The following describes the historical power outages that have occurred over the past year and the longest power outage in recent history.

The following is a list of power outages from 2009:

- February 7, 2009 – 11 a.m. outage for approximately 2 hours
- March 9, 2009 – 7 p.m. outage for approximately 1.5 hours
- March 16, 2009 – 3 a.m. outage for approximately 1 hour
- April 2, 2009 – 11 a.m. outage for approximately 1 hour
- May 7, 2009 – 5 a.m. outage for approximately 4 hours
- May 29, 2009 – 6 a.m. outage for approximately 1 hour
- June 23, 2009 – 8 a.m. outage for approximately 1 hour
- December 13, 2009 – 12 a.m. outage for approximately 1 hour
- March 13-14, 2010 - 4 p.m. (March 13) to 9 p.m. (March 14)

In addition to these outages, a regional power outage occurred on August 14, 2003. The following is a summary of the events associated with the outage:

- The outage occurred at 4:11 p.m. on August 14, 2003.
- Power at the Little Falls Water Treatment Plant was only momentary, but PSE&G noted that there were concerns about power quality and that interruptions in service could occur at any time. PSE&G was also concerned with power draw of large horsepower motors so the plant was offline until the evening of August 15.

- Prior to the outage, the production was 94 mgd (56 mgd from the plant and 38 mgd from Wanaque). The total storage in the system at the time of the outage was 230 million gallons.
- Immediately after the power kicked out, the backup power for the Verona Pumps kicked on and the Verona Pumps served the Morris County Connection and Verona portions of the distribution system. The source of supply for these pumps was from backflow from the New Street Reservoir.
- Power returned to the pump stations in the 180 Gradient (Botany, Eastside and Great Falls) at 11:30 p.m. on August 14. Wanaque water was fed into the 180 Gradient by gravity. The Botany, Eastside, and Great Falls Pump Stations were used to transfer water from the 180 Gradient to the 300 Gradient.
- Prior to the return of the remote pump stations, the three main reservoirs dropped a total of 24.4 million gallons, which on a daily basis was equivalent to 80.2 million gallons.
- From 11:30 p.m. on August 14 to 6 p.m. on August 15, the plant and Main Pump Station (besides the pumps already discussed) were not operated. Over this time period, the reservoir storage, Wanaque supply, and Chittenden Road (Newark interconnection was opened at 2 p.m. on August 15) sources supplied 73.3 million gallons over the 18 hour 30-minute time frame. This is equivalent to 95.1 mgd.
- Over the 25 hour 48 minute shutdown, 97.7 million gallons of water were delivered to customers.
- 50.9 million gallons of water was released from the Commission's three finished water reservoirs.

G. Distribution System

The Main Pump Station transfers water from the Wanaque North Aqueduct and the effluent from the Little Falls Water Treatment into the distribution system. The distribution system consists of approximately 600 miles of piping with pipe sizes ranging from 6 inches to 51 inches in diameter. The majority of the distribution system is cast iron. The remaining piping consists mostly of ductile iron with a small percentage of concrete, steel, and transite. The distribution system consists of six major pressure gradients with the following average flowrates:

- 180 feet – 10 mgd
- 300 feet – 15 to 20 mgd (a significant amount of 180 Gradient is transferred to 300 Gradient)
- 330 feet – 30 to 35 mgd
- 427 feet – 3 mgd
- 610 feet – 4 to 6 mgd
- 673 feet – 10 mgd

There are 5 main distribution system lines that extend from the Main Pump Station:

- 51-inch Low Pressure Line (180 Gradient)
- 51-inch High Pressure Line (340 and 426 Gradients)
- 42-inch High Pressure Line (340 Gradient)
- 24-inch Verona Line (673 Gradient)
- 36-inch Morris County (610 Gradient)

H. Hydropower Generation

The Hydropower system consists of four 750 kVA, 600 kW hydroelectric generators. The hydroelectric generators are vertical shaft hydroturbines with direct-connected, rotating exciters. Hydropower Units No. 1 thru No. 3 are fixed-blade units. Hydropower Unit No. 4 is a variable pitch blade Kaplan unit.

In order for PVWC to operate the hydropower units, 85 cfs (50 mgd) needs to be passing over the dam. The minimum flowrate required to sustain rated output of the three fixed blades units is 180 mgd per unit. The minimum flowrate required to sustain output of the variable pitch blade is 120 mgd. The minimum flowrate needed to sustain operation of the entire hydropower facility

would be approximately 710 mgd (660 mgd for the hydropower and 50 mgd going over the dam). The hydropower generation system has synchronous generators, so it does not require its reactive power from the power grid if the proper equipment is in place. The combined electric generation capacity of the hydropower units is up to 2400 kW (3,000 kVA). The hydropower generators used to power the Great Notch Pump Station. This has since been disconnected.

I. Emergency Interconnections

PVWC has a large number of emergency interconnects with nearby utilities. All emergency interconnections are connections in both directions. **Figure 1.30** as contained in Appendix B, is a map showing all of the potential areas that PVWC can serve through emergency interconnections.

1. **Newark (Great Notch Crossovers):** PVWC can get water by gravity from the Cedar Grove Reservoir (Newark) via the Pequannock Aqueducts (Hydraulic Grade Line of 405 feet). Approximately 10 mgd can be provided by gravity into the 330 Gradient 51-inch transmission main from Newark, but only if the Great Notch Reservoir can be isolated.

2. **Newark (Joralemon Street/Belleville Reservoir):** PVWC can get water from Newark's Pequannock Aqueducts (Hydraulic Grade Line of 405 feet) via the Joralemon Street/Belleville Reservoir interconnection into the 51-inch 330 Gradient. This interconnection allows 20 mgd from Newark to PVWC, but it is in uncertain operating condition

3. **United Water:** PVWC can accept 10 mgd from United Water. United Water can supply water to the far end of the 300 Gradient. This Lodi connection allows PVWC to use a former wholesale connection to interconnect with United Water. PVWC can also supply up to 15 mgd to United Water through this interconnection. PVWC currently has a project on the capital improvements plan to upgrade this interconnection with United Water.

4. **North Jersey:** North Jersey can supply up to 52.5 mgd of finished water to PVWC. Although this is the maximum allowable allocation from North Jersey, PVWC staff has denoted that 60 mgd of hydraulic capacity is available. The 2000 Master Plan noted that 67 mgd of Wanaque flow is hydraulically possible.

5. **Chittenden Road Pump Station:** The Chittenden Road Pump Station provides a gravity interconnection from Newark's Pequannock Aqueducts (hydraulic gradient of 405 feet). This gravity line can supply up to 25 mgd from Newark into the 51-inch transmission main (330

Gradient). PVWC can pump 20 mgd of flow to Newark through this interconnection as well. The Chittenden Road Pump Station has three pumps and a bypass around the pump station which allows a significant amount of flexibility for interconnection. The following are the possible interconnection scenarios:

- Newark to Jersey City
- PVWC to Jersey City
- Newark and PVWC to Jersey City
- Newark to PVWC
- Jersey City to Newark
- Jersey City to PVWC
- Jersey City to PVWC to Newark
- PVWC to Newark

The Chittenden Road Pump Station provides a 15-mgd pumped interconnection from the City of Jersey City Aqueduct into the 51-inch 330 Gradient. PVWC can use the same pumped interconnection to supply the City of Jersey City with 25 mgd. The Chittenden Road Pump Station does not have backup power.

6. **Kearny:** Kearny can provide emergency interconnection water to the far end of the 330 Gradient (51-inch). They can feed Harrison, Lyndhurst, North Arlington, and potentially Nutley. They can feed about 5 or 6 mgd.

Further and more specific details of the PVWC System are contained in Appendix B – Technical Memorandum #1 – Information Review. This memorandum is a result of the work performed under Task 1 – Information Review of the feasibility study, and more clearly defines and outlines the PVWC System.

IV. Site Mapping

IV. SITE MAPPING

Boundary, topographic and bathymetric surveys were performed for 3 reservoirs belonging to Passaic Valley Water Commission. The reservoirs are Great Notch Reservoir, New Street Reservoir and Levine Reservoir, located in Woodland Park and the City of Paterson respectively, all in Passaic County, NJ.

All mapping is prepared in the horizontal datum of North American Datum 1983 (NAD 83), vertical datum is in the North American Vertical Datum of 1988 (NAVD 88).

A. Boundary Survey

Boundary surveys relevant to the Great Notch, New Street, and Levine Reservoirs were performed corresponding to the following lots owned by the Passaic Valley Water Commission:

1. Woodland Park, Passaic County
   - Block 113, Lot 3 and 3.04
   - Block 114, Lot 1
   - Block 46, Lot 1
   - Block 47, Lot 1
2. City of Paterson, Passaic County
   - Block 4802, Lot 28

Research was performed to obtain available record title information from the PVWC. Additional research was also conducted at the Passaic County Hall of Records to obtain supplemental record data such as record deeds, filed maps and recited record easements. The resultant boundary survey is based on documents provided to and obtained by TYLIN Medina, and is subject to the findings of the full title report.

Field reconnaissance to recover cited physical monumentation and visible planimetric features was also performed along with global positioning satellite survey (G.P.S.) to establish primary horizontal and vertical control stations that were utilized for subsequent field surveys.

Boundary surveys of the Commission owned properties have been prepared for each reservoir and have been included in Appendix C – Reservoir Boundary Surveys. All survey plats have been prepared in accordance with applicable State statues.

B. Topographic Survey

An aerial mapping subconsultant (Robinson Aerial Surveys Inc.) to prepare topographic and planimetric mapping of the parcels listed under the Boundary Survey effort. New aerial photography was performed in the Fall of 2009.

The aerial ground control targets required for the aerial mapping were set and established by TYLIN Medina. Approximately 16 ground control points were required for the aerial mapping. The aerial mapping has been produced at a scale of 1″ = 30′ with a 2′ contour interval. Supplemental survey in areas designated as obscured on the aerial mapping were also performed.

Record utility maps from public and private utilities known to serve the areas being surveyed were requested. Utilities have been mapped based on the record maps received, visible surface hardware and pipe sizes and invert elevations for sanitary and storm structures.

Copies of the aerial maps for the three (3) reservoirs have been included in Appendix D – Reservoir Aerial Photos.

C. Bathymetric Survey

A bathymetric survey of the three (3) reservoirs was performed by subconsultant (ASI Survey, Inc.) to map the bottom of the reservoirs. The bathymetric survey was performed from a watercraft powered by an electric motor. The craft was manned by a two (2) person field crew.

Bathymetric survey data was acquired through Survey Grade Echo Sounding equipment designed for shallow water bathymetry. The unit was mounted on the watercraft and interfaced with a GPS unit to provide horizontal and vertical locations for the individual survey lines. The unit utilized dual frequency soundings to provide data for the top of sediment as well as the hard reservoir bed. The bathymetric contours were then merged with the land survey and topographic information to provide a complete set of accurate topographic drawings for each reservoir.

Appendix E – Reservoir Bathymetric Survey Data has been included herewith showing low frequency data, high frequency data and differential data for each of the three (3) reservoirs. The low frequency drawings will show the sediment levels of each of the reservoirs, the high frequency data will show the reservoir bottom, with the differential mapping indicating the difference between the two (2) frequencies. Appendix E also includes mapping where the bathymetric information has been merged with the topographic information.

V. Setting Criteria

V. SETTING CRITERIA

A. Level of Service

1. Introduction

Passaic Valley Water Commission (PVWC) provides public water utility service for an equivalent population of more than 800,000, including retail customers in the owner cities of Clifton, Passaic, and Paterson, as well as Prospect Park, Lodi, North Arlington, and portions of Woodland Park and West Milford. In addition, PVWC is a major wholesale supplier of water. It has contracted with 25 towns and public water suppliers to provide all or part of the water supply needs of the communities served by these utilities. Approximately 38 percent of PVWC's production was consumed by wholesale customers (2007 to 2008).

Passaic Valley Water Commission (PVWC) has four different sources of raw water supply which include the Passaic River Intake, Pompton River intake (via the Wanaque South Pipeline), Point View Reservoir (via discharge to the Pompton River/Passaic River), and Point View Reservoir (via the Wanaque South Aqueduct and Wanaque South Pipeline).

PVWC operates the Little Falls Water Treatment Plant (LFWTP) which has an overall finished water capacity of 110 mgd and a firm capacity of 85 mgd.

Water flows by gravity from the LFWTP to the Main Pump Station. The Main Pump station was constructed over 100 years ago. The Main Pump Station consists of the following pump systems:

- Industrial Pumps
- Transfer Pumps
- Wanaque Pumps
- Totowa Pumps
- Verona Pumps
- Airport Pumps
- Morris County Pumps

The Main Pump Station receives finished water from either the efluent of the LFWTP or from the Wanaque Aqueduct.

The Main Pump Station transfers water from the Wanaque North Aqueduct and the finished water from the Little Falls Water Treatment into the distribution system.

There are 5 main distribution system lines that extend from the Main Pump Station:

- 51-inch Low Pressure Line (180 Gradient)
- 51-inch High Pressure Line (330 and 427 Gradients)
- 42-inch High Pressure Line (330 Gradient)
- 24-inch Verona Line (673 Gradient)
- 36-inch Morris County (610 Gradient)

PVWC has three uncovered finished water reservoirs. The largest (178.5 million gallons) reservoir is the Great Notch which floats off of the highest gradient (427 Gradient). The second largest reservoir (52.4 million gallons) is the New Street Reservoir which floats off of the main system gradient (300 Gradient). The smallest reservoir (19.2 million gallons) is the Levine Reservoir (formerly called the Grand Street Reservoir) which floats off of the industrial gradient (180 Gradient). All three of these larger storage reservoirs are uncovered. PVWC owns the top half of the volume of the Verona Tank and uses it for providing equalization to the 673 Gradient. The Verona Tank is a 2-million gallon tank.

An overall schematic of the distribution system is shown in **Figure 5.1**.

2. New Jersey Department of Environmental Protection Requirements

The Long-Term 2 Enhanced Surface Water Treatment Rule (LT2ESWTR) requires that all utilities, by April 1, 2009, provide one of the two options for any uncovered finished water reservoirs:

- Cover any uncovered finished water storage facilities.
- Treat the discharge from the uncovered finished water storage facility to the distribution system to achieve at least 4.0-log virus, 3.0-log Giardia lamblia, and 2.0-log Cryptosporidium inactivation and/or removal using a state-approved protocol.

In March of 2009, the New Jersey Department of Environmental Protection (NJDEP) issued an Administrative Consent Order (ACO) to the PVWC. It acknowledged that PVWC would not be able to meet the LT2ESWTR requirements by April 1, 2009. NJDEP provided PVWC with a schedule that required producing a feasibility study for addressing the regulatory requirements of the existing uncovered finished water reservoirs. This report is a part of the ACO requirements.

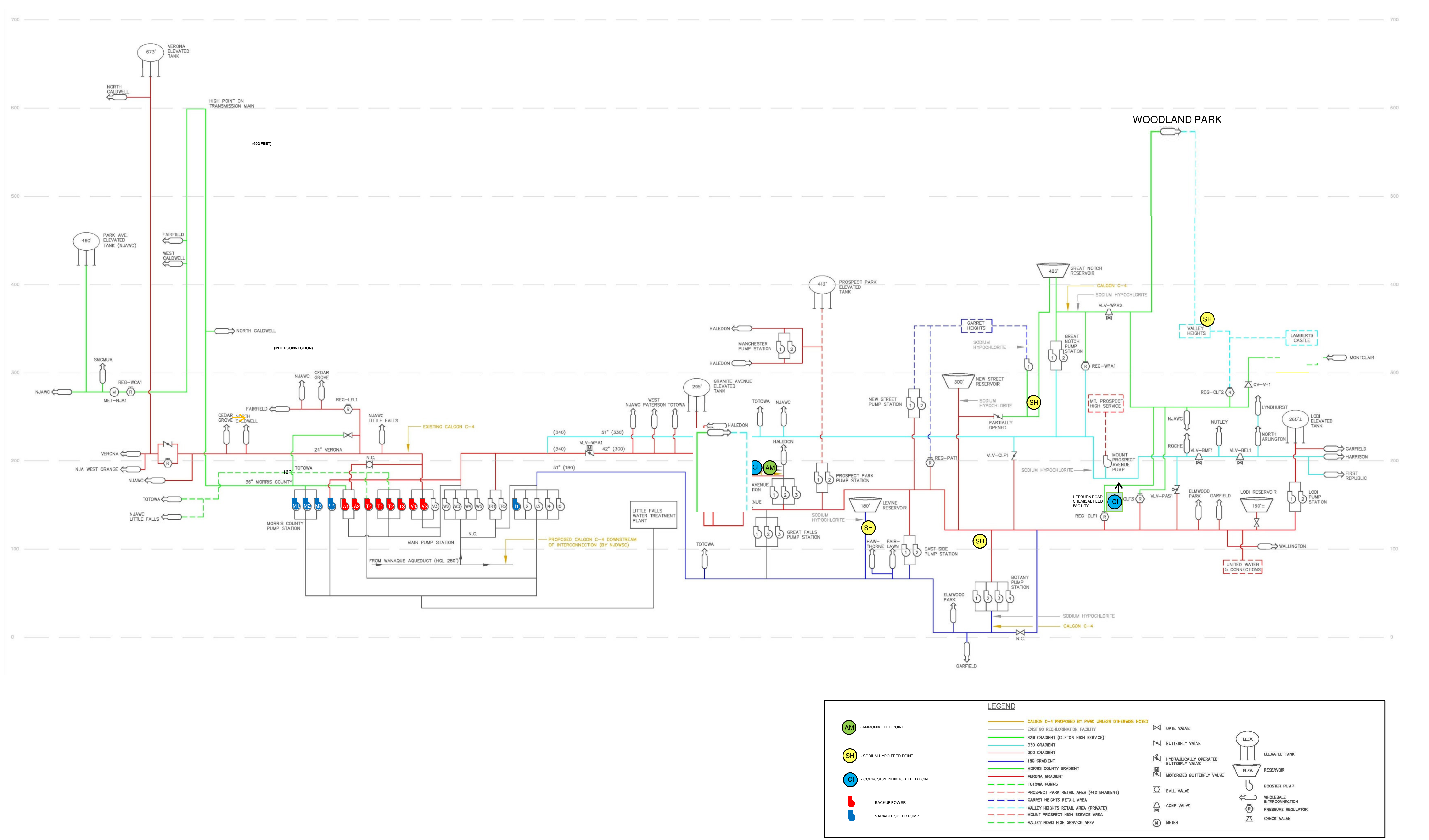


			Figure 5.1 Distribution System Schematic
REV	DATE	BY	DESCRIPTION

DESIGNED
DRAWN
CHECKED
DATE

DISCIPLINE ENGINEER

PROJECT ENGINEER

PARTNER

FILENAME:

T·Y·LIN INTERNATIONAL | MEDINA

PASSAIC VALLEY WATER COMMISSION

Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

SCALE
NA

JOB NO.
8378A.00

DRAWING NO.

SHEET NO.

OF

In addition to the ACO and LT2ESWTR, PVWC must meet the NJDEP requirements for distribution system storage. As a public community water supply system, PVWC is required to meet regulations adopted and administered by the NJDEP. There are two key regulations that are applicable to this study. Under the New Jersey Safe Drinking Water Act, Subchapter 11, "Standards for the Construction of Public Community Water Systems," the requirement for distribution system storage is defined. Specifically, N.J.A.C. 7:10-11.11, "Distribution storage requirements," states:

"Suppliers of water shall provide finished water storage as required pursuant to N.J.A.C. 7:19-6.7 and as follows:

1. Each public community water system shall provide storage for finished water as an integral part of its distribution system whether the water system has its own source(s) of water or buys water from another public community water system."

The minimum volume of storage in a system is defined in Subchapter 6 of the Water Supply Management Act Regulations - 7:19-6.7 – "System pressure and storage". The requirements state the following:

"With respect to the total capacity of system storage, the following minimum requirements apply to all systems. The Department may modify these requirements provided adequate justifying data is submitted which will demonstrate that service will not be disrupted during extended periods of system stress."

The regulations also include the following table:

Table 5.1

NJDEP Water Storage Requirements Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

	Type of System	Minimum Storage as a Function of Average Day Demand
i.	**Single, prime source, no interconnection(s), no auxiliary power at water source.**	100 percent
ii.	**Single, prime source, no interconnection(s), auxiliary power provided at water source***	80 percent
iii.	**Single, prime source with interconnection(s)****	50 percent
iv.	**Multiple source, no interconnection(s), no auxiliary power at water source**	80 percent
v.	**Multiple sources, no interconnection(s), auxiliary power provided at water source***	50 percent
vi.	**Multiple sources, with interconnection(s)**	50 percent
vii.	**Multiple sources, interconnection(s)**, auxiliary power provided at water source***	30 percent
viii.	**Same as vii. above, and distributing more than an average of 50 million gallons per day**	20 percent

- **Auxiliary power must be able to supply at least 50 per cent of average production.**

** **Combined interconnection(s) must be able to supply at least 50 per cent of average production; contract commitment from supplier is required.**

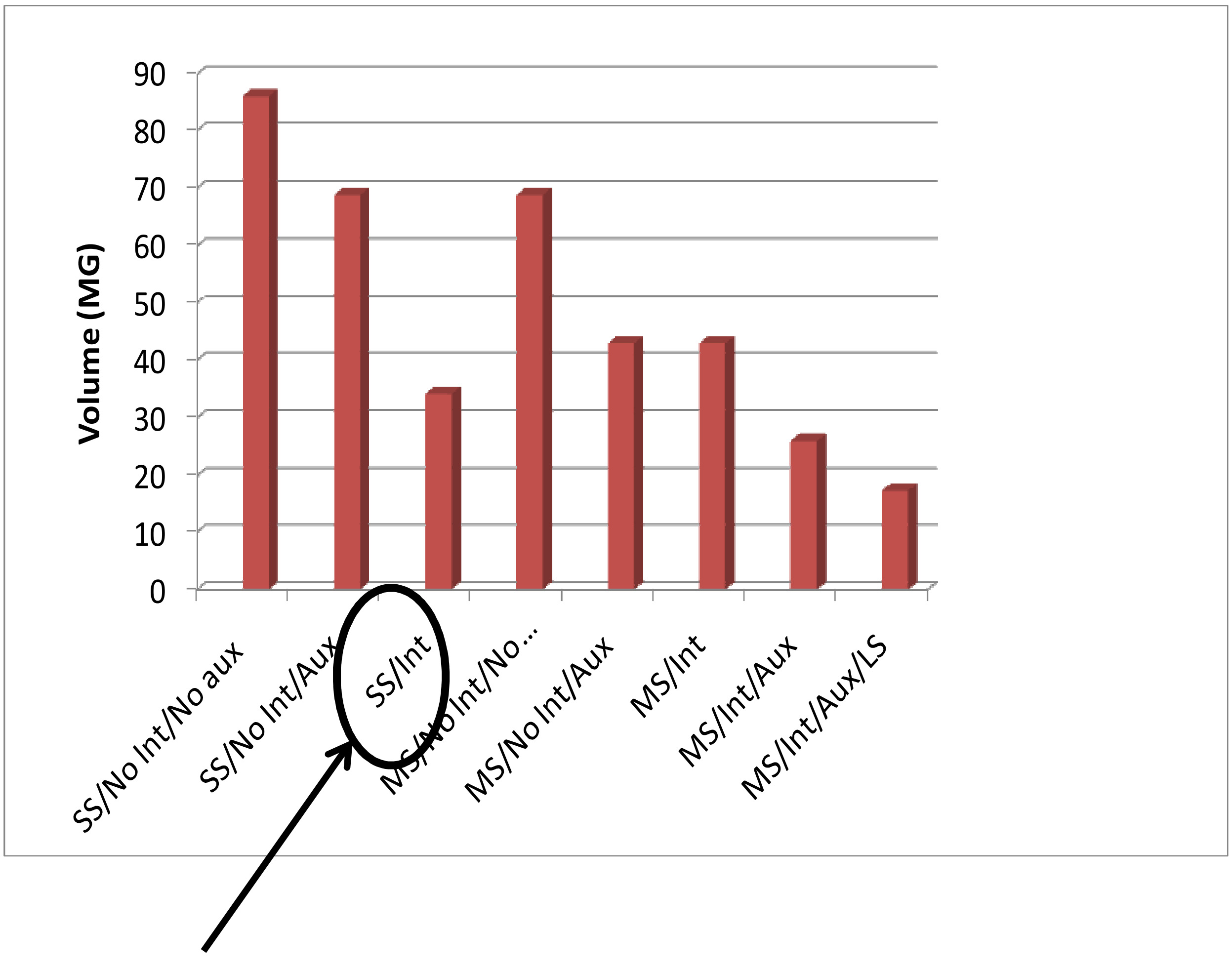
The average daily demand in PVWC's distribution system, including wholesale customers, is approximately 86 mgd. PVWC is considered by NJDEP as a Type iii system due to its multiple sources (LFWTP and North Wanaque), as well as interconnections (Newark and Jersey City). **Figure 5.2** shows the storage values that PVWC would need to have to meet the NJDEP storage requirements for all of the different classifications.

Based on the NJDEP requirements for storage and being classified as a Type iii system, the amount of storage required would be 34 MG. Based on the demands in the system the following would be the required storage by gradient:

- 180 Gradient – 1.8 MG
- 300 Gradient – 16.2 MG
- 330 Gradient – 14.4 MG
- 427 Gradient – 1.6 MG

3. Existing Diurnal Curves

Although the NJDEP requirements establish a minimum amount of system storage, a calculation needs to be done to determine the overall system storage requirements based on the system dynamics. The storage calculations for a system include four separate components:



Current PVWC Classification

Figure 5.2
Actual Storage Requirements Based on NJDEP Classification Types
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

- Equalization
- Fire Flow
- Emergency Storage
- Minimize operator attention requirements (less storage requires more operator attention to maintain the target pressure range unless pumping systems are automated)

The following is the selected approach for storage estimation: Maximum Day Criteria is considered for the individual storage components needed for equalization, fire demand, and emergency reserve versus the available water supply production facilities. The water production and storage must be considered together, since an increase in production may decrease the amount of water storage required.

A diurnal curve is required to establish the equalization storage required in the distribution system. To establish an overall distribution system diurnal curve, a number of days were selected based on high total system demand and large variances in reservoir volumes. The days selected for analysis were as follows:

- December 2, 2008
- January 30, 2009
- May 29, 2009
- July 20, 2009
- August 22, 2009

In addition to these dates, the team also utilized the diurnal curve from the distribution system model that was provided by PVWC. The PVWC operations staff gathered all of the charts from each day and provided them to the team for analysis. The charts were analyzed and data was recorded on an hourly basis into separate spreadsheets for each day. The overall diurnal curve was established by calculating the hourly amount of water transferred into the system through the 51-inch Low Pressure Line (180 Gradient), 51-inch High Pressure Line (300/330 and 427 Gradients) and the 42-inch High Pressure Line (300/330 Gradient) and subtracting or adding the differences in volume of the Great Notch, New Street, and Levine Reservoirs. The mass balance indicates how much demand occurred in the distribution system and the hourly demand was divided by the average day demand to provide a normalized demand curve.

The following are the assumptions for flow percentages for different gradients utilized in the demand curve analysis:

- 180 Gradient – 4.2% (3.4 mgd on a 81 mgd day),**
- 300 Gradient – 37.7% (30.5 mgd on a 81 mgd day),**
- 330 Gradient – 33.5% (27.1 mgd on a 81 mgd day),**
- 427 Gradient – 3.7% (3 mgd on a 81 mgd day),*
- High pressure gradient – 21% (17 mgd on a 81 mgd day),**
- Model Flowrate = 105 mgd.

  * Based on the assumption that 3 mgd flows through Great Notch and 3 mgd goes to 427 Gradient

  ** Based on August 22, 2009 data (and verified with May 29, 2009 data)

Figure 5.3 shows the diurnal curve for the distribution system model, as well as diurnal curves for December 2, 2008 and July 20, 2009. This diurnal curve only includes the 180, 300, 330 and 427 Gradients. The initial assumption was that the 460 and 673 Gradients did not have diurnal curves and the storage requirements for these zones were considered separately.

The amount of storage required for equalization is an integration which includes determining the area above the 1.0 value. This is equivalent to determining the amount of volume required when the hourly demand exceeds the average daily demand. The volume should only include the period of time where the hourly demand exceeds the average daily demand. Where the curve drops below 1.0 determines the end of the volume integration (unless it was only one or two points and increased above 1.0 immediately after). This overall volume requirement was divided by the average daily demand to determine the % volume of storage required based on the daily flowrate. This allows the data gathered to be extrapolated to higher flow days to determine their storage volume requirements.

Figure 5.4 shows the percent of storage required for the dates analyzed. **Figure 5.5** also shows the amount of storage required for each respective day. Except for the May 29, 2009, all of the remaining dates including the model require about 6 to 7 percent of the daily flowrate. This volume was equivalent to 3 to 6 million gallons of storage except for May 29, 2009, which required approximately 8 million gallons of equalization storage.

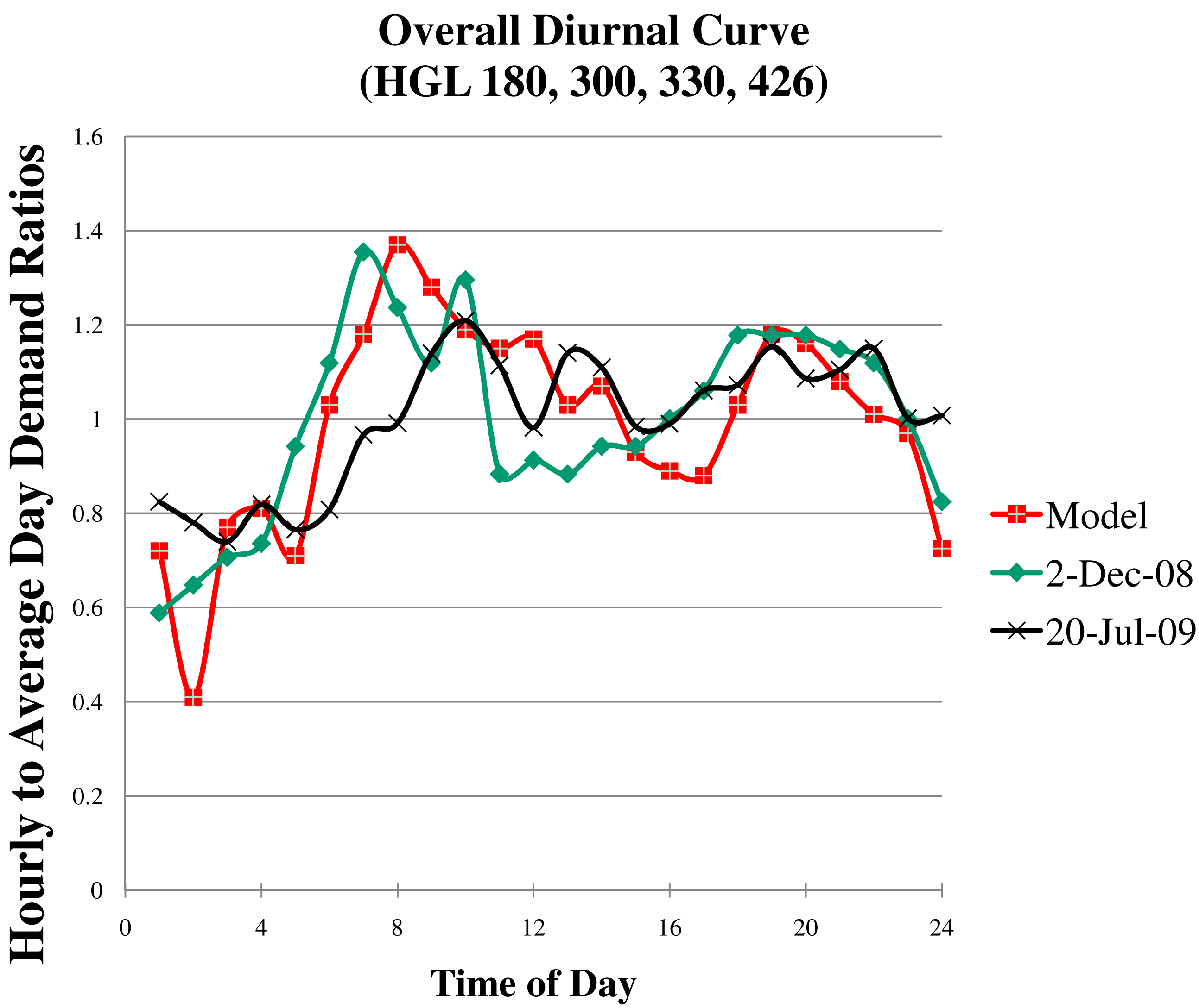


Figure 5.3
Overall System Diurnal Curve
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

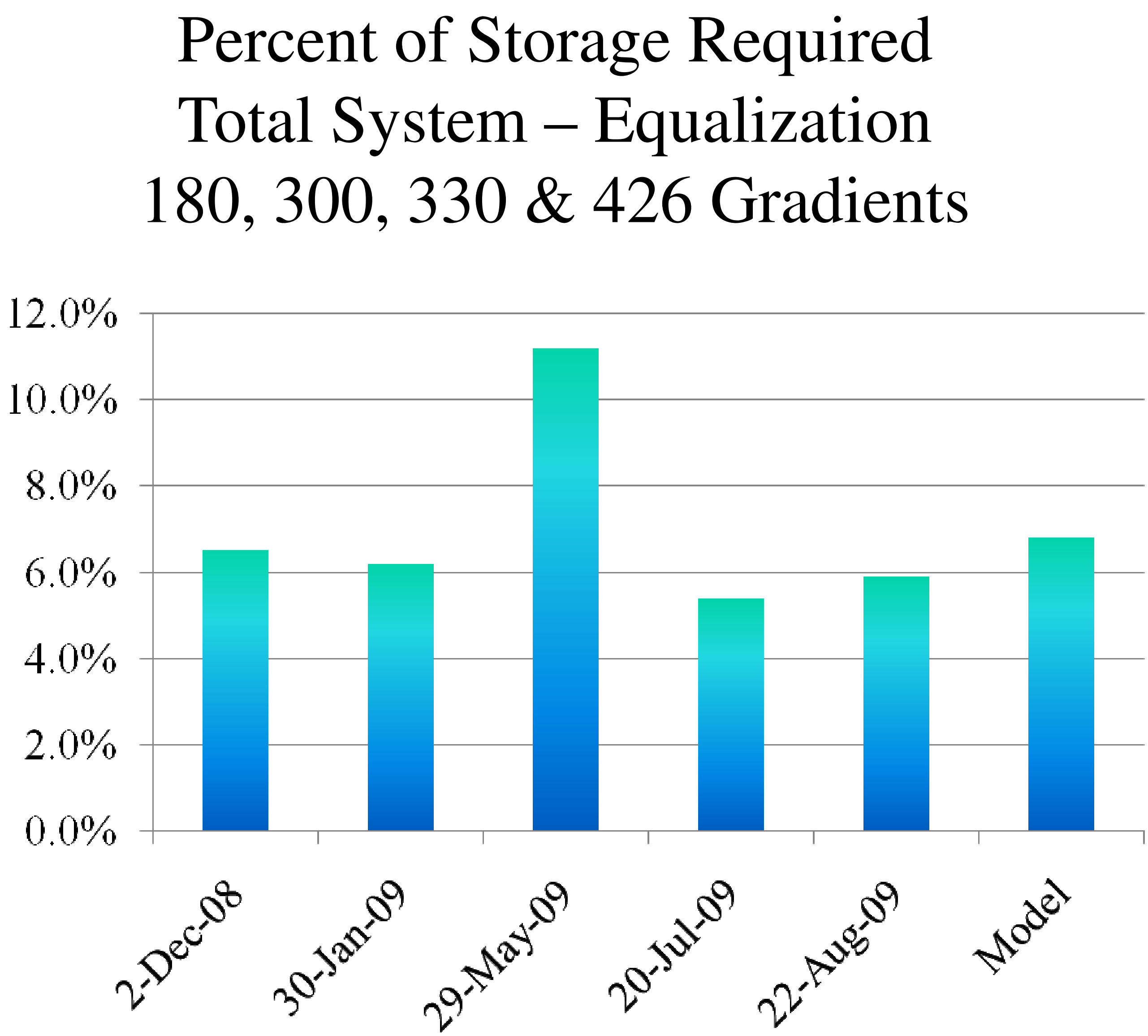


Figure 5.4
Percent Storage Requirements – Total System
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

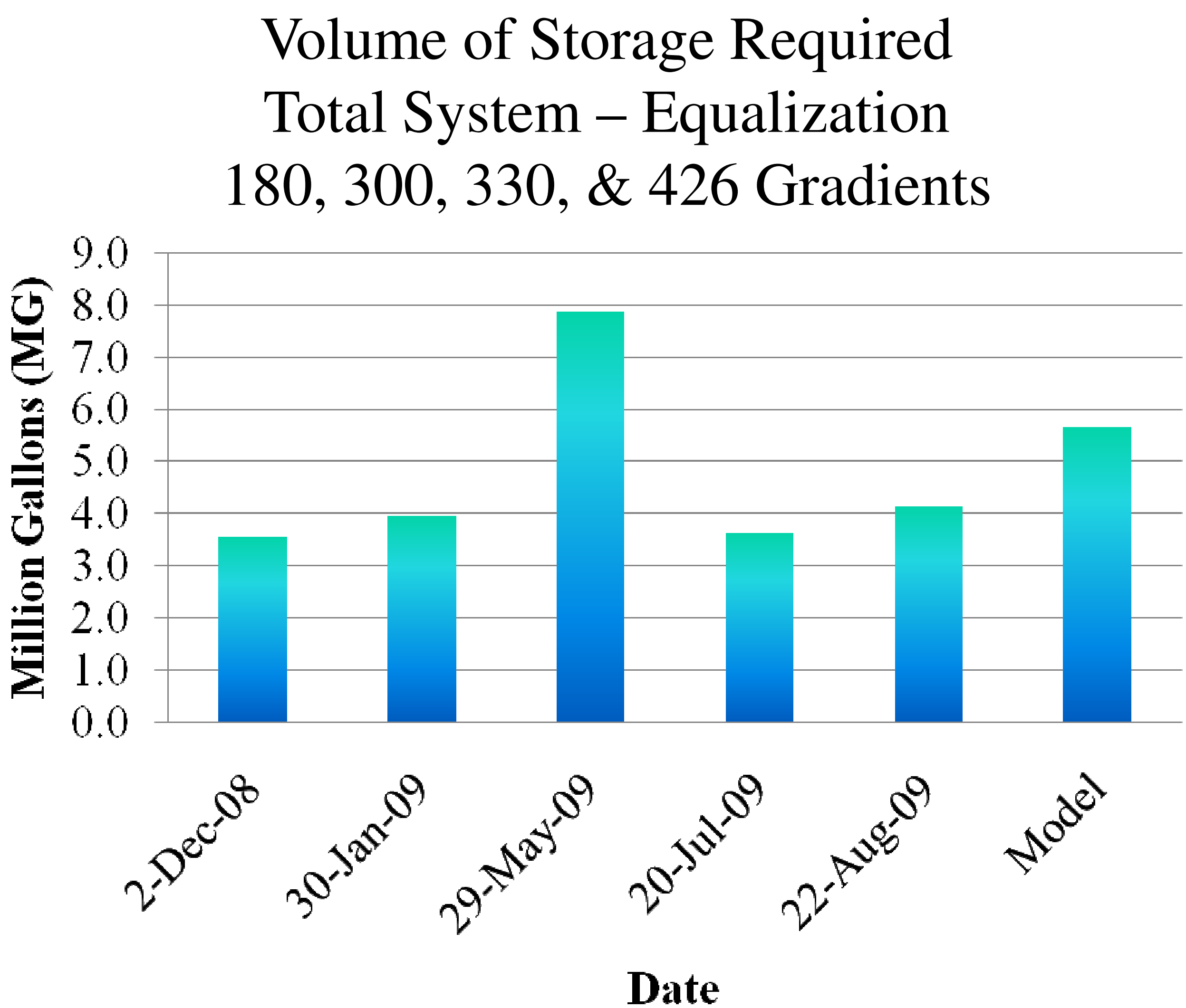


Figure 5.5
Storage Volume Requirements – Total System
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

The diurnal curve analysis was completed for each individual gradient as well.

a) **Existing 180 Gradient Equalization Requirements**
The diurnal curve for the 180 Gradient was calculated using the same methodology discussed for the overall diurnal curve. **Figure 5.6** shows the volume of storage required for each of these days. Even though the percentage is elevated, the overall volume requirement is approximately 2 million gallons due to the low demands in this portion of the system.

b) **Existing 300 Gradient Equalization Requirements**
The diurnal curve for the 300 Gradient was calculated using the same methodology discussed for the overall diurnal curve. The percent of daily flow for the 300 Gradient is approximately 15 percent during the summer months. **Figure 5.7** shows the volume of storage required for each of these days. The summer month storage requirements were approximately 6 million gallons in the summer months, although one of the winter dates required 8 million gallons of storage.

c) **Existing 330 Gradient Equalization Requirements**
The diurnal curve for the 330 Gradient was calculated using the same methodology discussed for the overall diurnal curve. The percent of daily flow for the 330 Gradient is approximately 7 percent for all of the dates analyzed. **Figure 5.8** shows the volume of storage required for each of these days. The storage requirements ranged from 1 to 2.5 million gallons of storage.

d) **Existing 427 Gradient Equalization Requirements**
Due to the lack of flow monitoring in this portion of the distribution system, no diurnal curve could be established. For analysis purposes, a minimum storage requirement of 3 million gallons was utilized. This is based on the operation of the Great Notch Pump Station at 6 mgd with an assumed 3 mgd flowing through the Great Notch Reservoir and to New Street Reservoir and 3 mgd being utilized by the 427 Gradient.

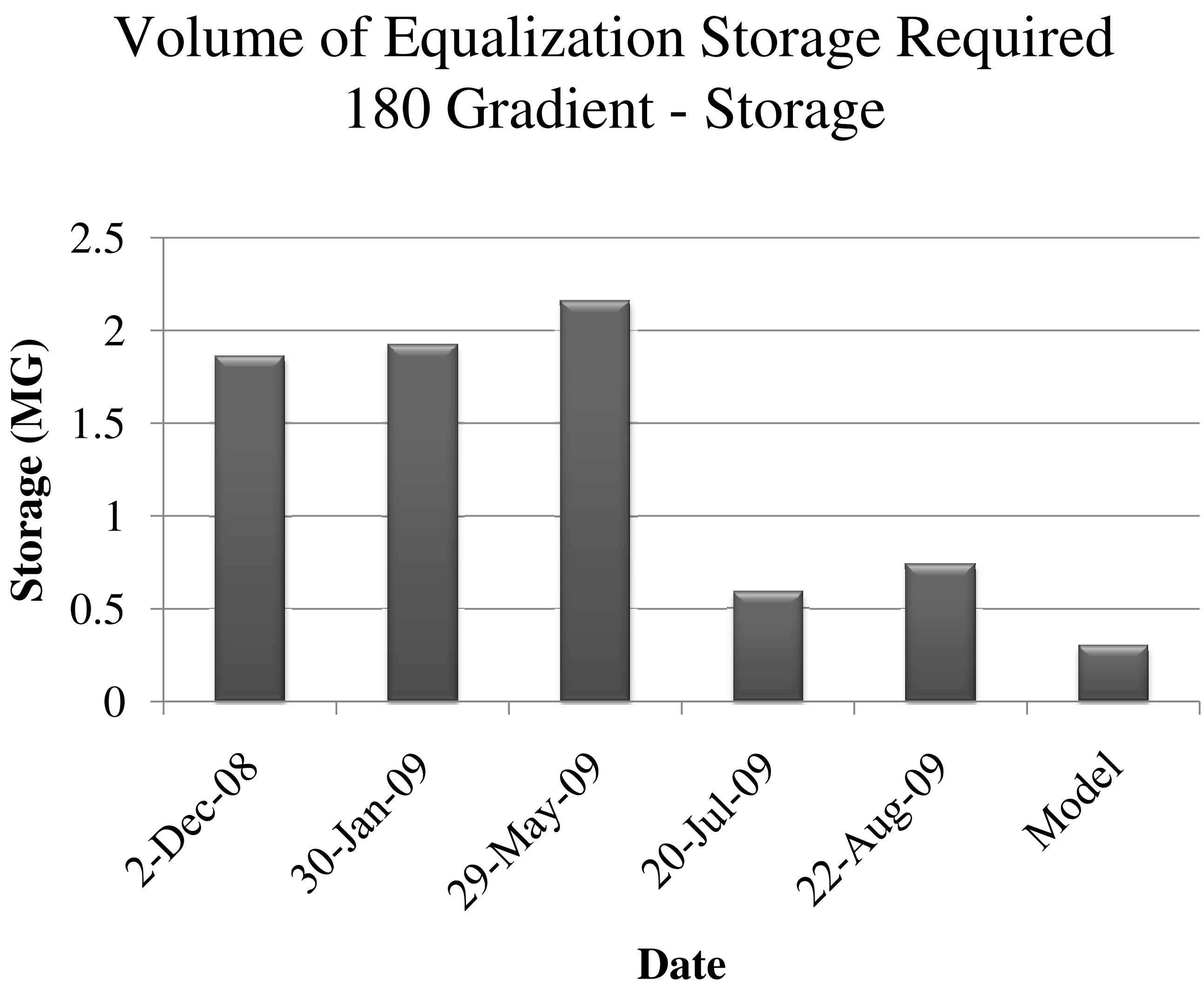


Figure 5.6
Volume Storage Requirements – 180 Gradient
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

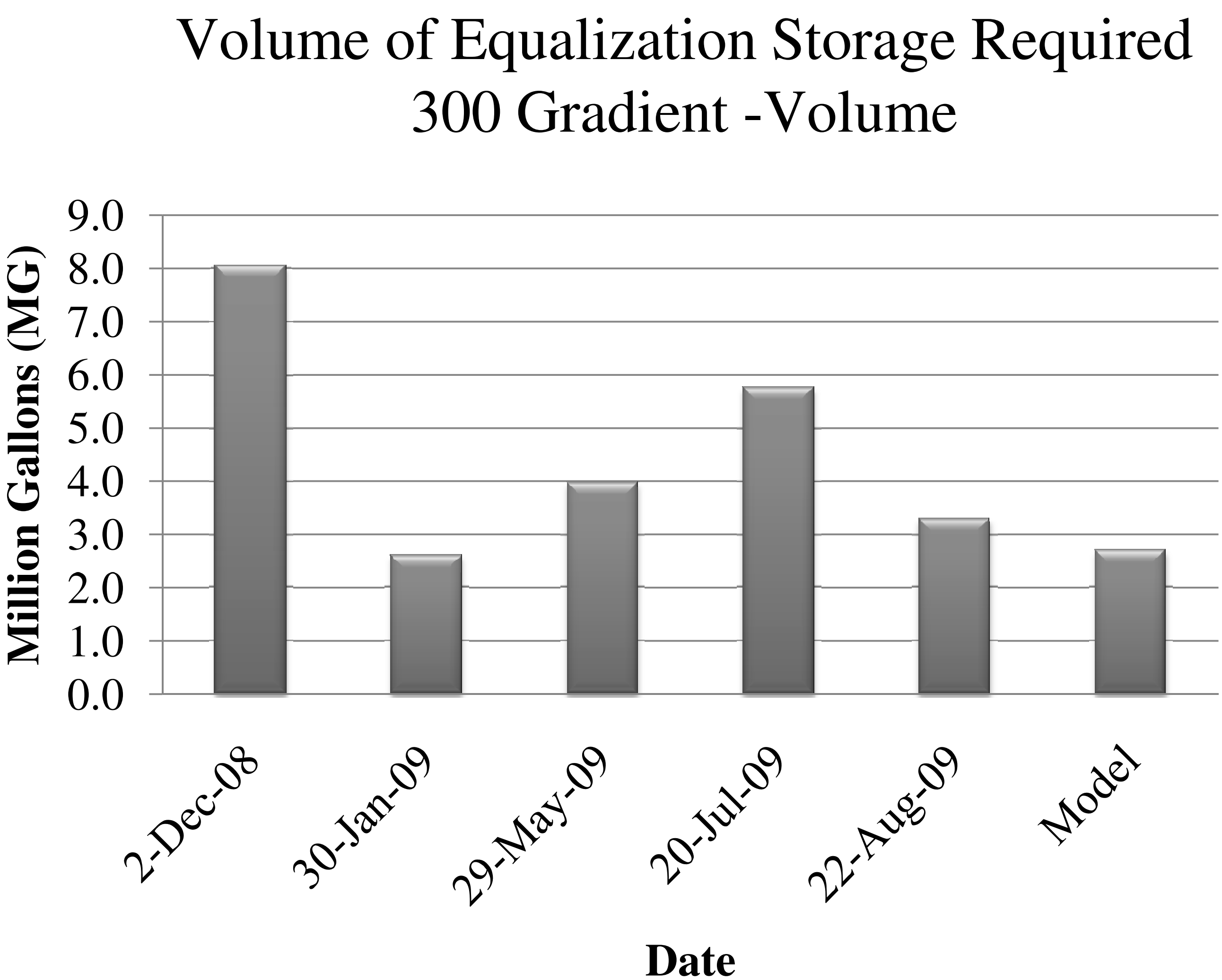


Figure 5.7
Storage Volume Requirements – 300 Gradient
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

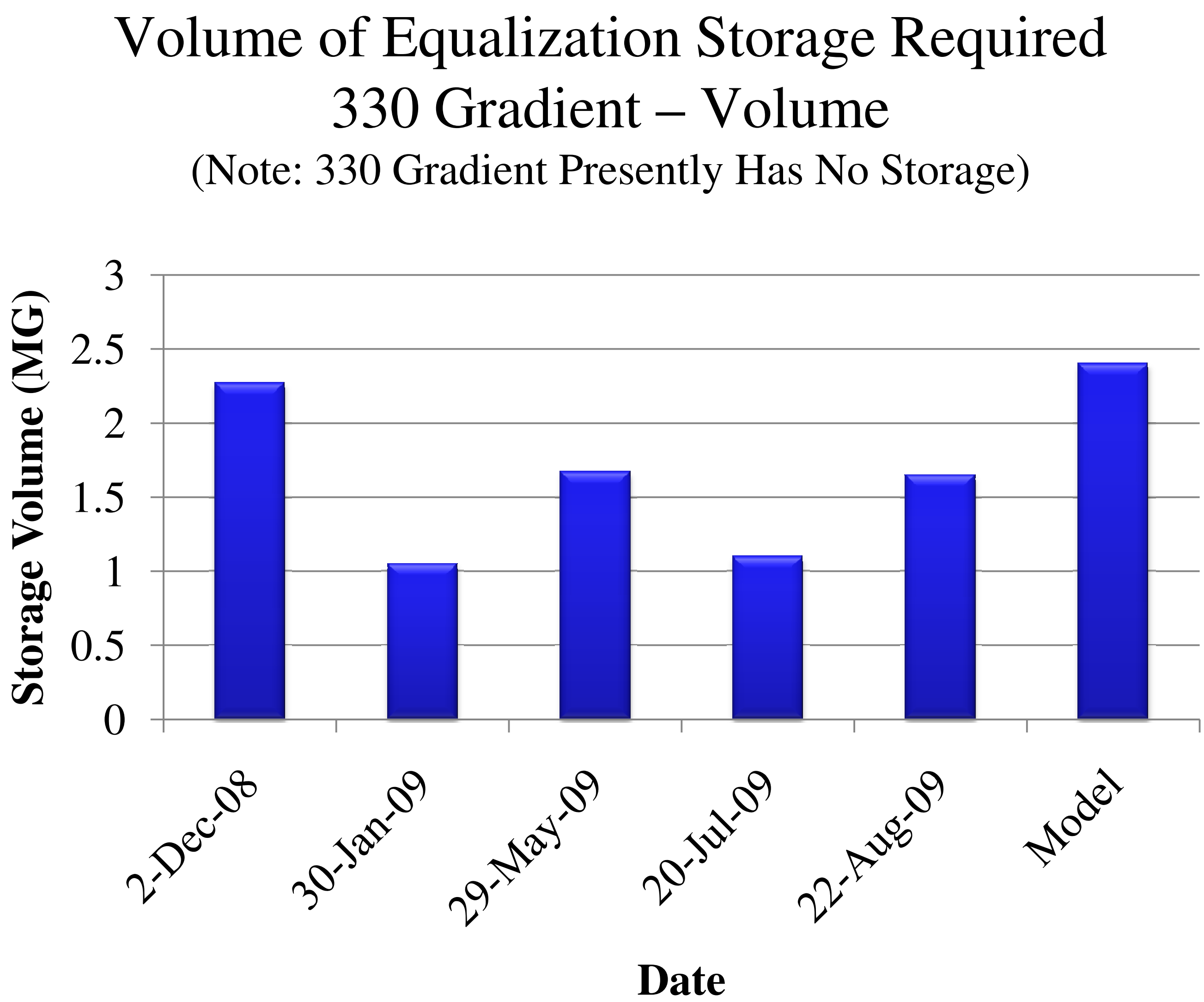


Figure 5.8 Volume Storage Requirements – 330 Gradient
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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Figure 5.9
Storage Volume Requirements – High Pressure Gradient
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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The maximum historical day demand for the system was 134 mgd. Based on the previously established flow assumptions for the system, the following is the breakdown of demand for each gradient:

- 180 Gradient Demand – 5.6 mgd.
- 300 Gradient Demand – 50.5 mgd.
- 330 Gradient Demand – 44.9 mgd.
- 427 Gradient Demand – 5.0 mgd (included in 330).
- High Pressure Gradient Demand – 28 mgd.

The percentage of the demand required for equalization storage for each of the gradients is as follows based on the previously established percentages for each system:

- 180 Gradient – 30 percent.
- 300 Gradient – 15 percent.
- 330 Gradient – 7 percent.
- High Pressure Gradient – 5 percent

If the overall system is analyzed, the percentage required for equalization is 8 percent. This value will be lower than the sum of the storage required for each individual gradient, but the value is used as a back check for the analysis.

Multiplying the demand times the percentage required for storage provides the estimated storage volume for each gradient on the 134 mgd maximum demand day:

- 180 Gradient – 1.7 MG.
- 300 Gradient - 7.6 MG.
- 330 Gradient – 3.5 MG (includes 427 Gradient).
- High Pressure Gradient – 1.4 MG

Back checking the overall system storage requirements results in a storage volume for equalization of 8.5 million gallons. Based on this analysis the minimum overall storage required for the distribution system equalization for the maximum demand day is 14.2 million gallons.

4. Fire Flow

Fire flow requirements are usually determined by the local fire department. However, codes, such as the 2003 International Building Code (IBC), often serve as guidelines. Minimum required fire flow rates and flow durations are specified in the IBC for building area according to construction type.

For one- and two-family dwellings, the Fire Code is specific for the minimum required fire flow as follows:

- < 3,600 square foot fire area = 1,000 gpm for 2 hours duration
- >3,600 square foot fire area = 1,500 gpm or higher for 2 hours duration (refer to International Fire Code - IFC Appendix B, Table B105.1)

Depending on the type of use, construction, and fire area, the required fire flow and duration ranges from 1,500 gpm for 2 hours to 8,000 gpm for 4 hours.

It is assumed that a major fire will not occur during the peak hour demand condition since the chance of this happening is minimal. But rather, it is more likely that a fire could occur under maximum day demand conditions. Consequently, this condition will be used for storage requirement considerations.

To assess the requirements of the system storage the fire flow and duration guidelines shown in **Table 5.2** will be used.

Table 5.2

Fire Flow Criteria / Guidelines Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

	Flow	**Duration**
Single Family Residential	1,000-1,500 gpm	2 hours
Multi-family Residential	1,500-2,500 gpm	2 hours
Commercial:		
Low Risk (retail)	3,000-4,000 gpm	3 hours
High Risk (mall, school, etc.)	6,000-8,000 gpm	4 hours
Industrial:		
Low Risk (manufacturing)	4,000-6,000 gpm	4 hours
High Risk (warehousing)	8,000-10,000 gpm	4 hours
Special purpose facilities	Criteria established on case-by-case basis – consult Fire Marshall	–

Fire flow duration for determining zone storage requirements is determined by the local fire department, but generally ranges from 4 to 10 hours for multiple fire occurrences within a pressure zone. Given these guidelines, required storage capacities can be calculated for different fire conditions. The variables in establishing fire storage volume are determining the type of fire and the number of multiple occurrences.

For planning purposes, population is normally used to calculate the required fire storage for specific pressure zones. Fire demand rates and storage volumes are determined using criteria established by the American Insurance Association (AIA) according to the following equation:

$$G = 1{,}020\sqrt{P}\left(1 - 0.01\sqrt{P}\right)$$

Where:

G = fire demand rate, gal/min.

P = population in thousands

Table 5.3 summarizes these calculations.

Table 5.3				
Required Fire Flow and Fire Reserve Storage (1) Water Storage Improvements Feasibility Study *Passaic Valley Water Commission, Clifton, NJ*				
Pressure Zone Population	**Fire Flow**		**Duration (hr)**	**Fire Reserve Storage (MG)**
	gal/min	**mgd**		
1,000	1,000	1.4	4	0.3
2,000	1,500	2.2	6	0.6
4,000	2,000	2.9	8	1.0
10,000	3,000	4.3	10	1.8
17,000	4,000	5.8	10	2.4
28,000	5,000	7.2	10	3.0
40,000	6,000	8.6	10	3.6
56,000	7,000	10.0	10	4.2
80,000	8,000	11.5	10	4.8
96,000	9,000	13.0	10	5.4
125,000	10,000	14.4	10	6.0
200,000	12,400	17.8	10	7.4
225,000	13,000	18.7	10	7.8
425,000	16,700	24.0	10	10
Notes: (1) Based on AIA guidelines.				

Using these guidelines, fire storage will be determined for each pressure zone and an assessment made regarding multiple fire capability within a pressure zone or service area.

Based on this table, the following are the fire flow storage requirements based on the population in each gradient:

- 180 Gradient – 3.0 MG (based on an equivalent population of 25,000)
- 300/330 Gradient – 10 MG (based on an equivalent population of 426,200)
- 427 Gradient – 3.0 MG (based on an equivalent population of 22,200)
- High Pressure Gradient – This value is accommodated by each wholesale customer in this area

5. 2003 Power Outage Review

The plant and the pump station do have dual service feeds from Public Service Energy and Gas Company (PSE&G), although they are from the same substation. An understanding of the potential for a power outage to the LFWTP and the Main Pump Station is critical to understand the overall system and determining the required distribution system storage requirements. The following describes the historical power outages that have occurred in 2009 and the longest power outage in recent history.

The following is a list of power outages from 2009:

- February 7, 2009 – 11 a.m. outage for approximately 2 hours
- March 9, 2009 – 7 p.m. outage for approximately 1.5 hours
- March 16, 2009 – 3 a.m. outage for approximately 1 hour
- April 2, 2009 – 11 a.m. outage for approximately 1 hour
- May 7, 2009 – 5 a.m. outage for approximately 4 hours
- May 29, 2009 – 6 a.m. outage for approximately 1 hour
- June 23, 2009 – 8 a.m. outage for approximately 1 hour
- December 13, 2009 – 12 a.m. outage for approximately 1 hour

In addition to these outages, a regional power outage occurred on August 14, 2003. The following is a summary of the events associated with the outage:

- The outage occurred at 4:11 p.m. on August 14, 2003.
- Power loss at the Little Falls Water Treatment Plant was only momentary, but PSE&G noted that there were concerns about power quality and that interruptions in service could occur at any time. PSE&G was also concerned with power draw of large horsepower motors so the plant was offline until the evening of August 15
- Prior to the outage, the production was 94 mgd (56 mgd from the plant and 38 mgd from Wanaque). The total storage in the system at the time of the outage was 230 million gallons.
- Immediately after the power kicked out, the backup power for the Verona Pumps kicked on and the Verona Pumps served the Morris County Connection and Verona portions of the distribution system. The source of supply for these pumps was from backflow from the New Street Reservoir.
- Power returned to the pump stations in the 180 Gradient (Botany, Eastside and Great Falls) at 11:30 p.m. on August 14. Wanaque water was fed into the 180 Gradient by gravity. The Botany, Eastside, and Great Falls Pump Stations were used to transfer water from the 180 Gradient to the 300 Gradient.
- Prior to the return of the remote pump stations, the three main reservoirs dropped a total of 24.4 million gallons, which on a daily basis was equivalent to 80.2 million gallons.
- From 11:30 p.m. on August 14 to 6 p.m. on August 15, the plant and Main Pump Station (besides the pumps already discussed) were not operated. Over this time period, the reservoir storage, Wanaque supply, and Chittenden Road (Newark interconnection was opened at 2 p.m. on August 15) sources supplied 73.3 million gallons over the 18-hour 30-minute time frame. This is equivalent to 95.1 mgd.

- Over the 25-hour 48-minute shutdown, 97.7 million gallons of water were delivered to customers.
- 50.9 million gallons of water was released from the Commission's three finished water reservoirs.

The following is a summary of the projected water requirements based on the emergency event:

- 180 Gradient – 2.1 MG
- 300 Gradient – 19.2 MG
- 330 Gradient – 17 MG
- 427 Gradient – 1.9 MG
- High Pressure Gradient – This value is accommodated by each wholesale customer in this area

6. Equalization, Fire Flow and Emergency Storage Review

The amount of storage associated with equalization, fire flow and storage is summarized in the following table:

Table 5.4

Required Storage Based on Calculated Values Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

Gradient	Equalization Storage (MG)	Fire Flow Storage (MG)	Emergency Storage (MG)	Total Calculated Storage (MG)	NJDEP Requirements (MG)
180	1.7	3.0	2.1	6.8	1.8
300	7.6	10	19.2	36.8	16.2
330	3.5	*	17	20.5	14.4
427	NA	3.0	1.9	4.9	1.6
High Pressure	1.4	NA	NA	1.4	NA
Combined Storage	14.2	18	40.2	70.4	34

Notes:
Assumes that reserve fire flow would only be required for one zone since these zones are combined.

7. Backup Power

Although the backup power that PVWC has is not enough to reduce the distribution system storage required by NJDEP (50 percent of average day capacity) to change the distribution system storage requirements, the existing backup power available is important for the overall analysis.

a) Source Water

The headgates at the Passaic River Intake have backup power via the 2400-volt generator set and the trailer-mounted 480-volt station loop generator.

The Wanaque South Pump Station does not have an emergency power source and has only one electrical feed from Public Service Electric and Gas Company (PSE&G).

The Jackson Avenue facility does not have emergency power backup and has only one electrical feed from Jersey Central Power and Light (JCP&L). The Wanaque South Pump Station has an emergency generator backup for minor electrical requirements, but not for the pumps.

b) <u>Finished Water</u>

The North Jersey source of supply is reliable even during a power outage because it flows by gravity from the Wanaque WTP to PVWC. Due to the gravity flow conditions to all end users, North Jersey has a low power demand and has backup power capacity to run the full capacity of the water treatment plant.

During a power outage at the Main Pump Station and the LFWTP, 25 to 30 mgd of gravity flow is available from the Wanaque North Aqueduct. This occurs by opening the 36-inch diameter gate valve which bypasses the Industrial Pumps and Wanaque North flows by gravity to the 180 Gradient. From the 180 Gradient, water is pumped up to the 300 Gradient using the Botany, East Side or Great Falls Pump Stations (during a power outage the mobile generator can be used to run one pump at one of these stations).

This 400-amp portable generator can power a 250-HP pump. It is typically used at the Eastside or Botany Pump Stations, but the generator was sized based on the largest remote facility pump (Great Falls – 250 hp). PVWC also has a 100-kW portable generator which can be used at many locations.

It is anticipated that PVWC could get as much as 67 mgd from North Jersey (Wanaque North) in an emergency situation if the Main Pump Station was operational.

c) <u>LFWTP</u>

The LFWTP and Main Pump Station are fed from two different power sources, but they originate from the same substation. According to PSE&G, they cannot supply a second feed from a separate substation (even if PVWC were willing to pay for it). One of the two power feeds is located overhead and this is the primary power feed. The second line is an overhead line until it is on the plant site where it is buried. PVWC currently pays about $0.13/kWhr for power and uses approximately 40,740,000 kW-hrs per year.

There is no backup power for water treatment plant production. There is a question if the hydropower can feed back to the WTP in an emergency power loss situation. There are issues associated with the reliability of the electrical system located on the plant side of the transformers (one single feed to the LFWTP/Main Pump Station). PVWC has some funding available to improve the reliability of this portion of the electrical system.

d) <u>Main Pump Station</u>

Backup power, located at the Main Pump Station, can provide power to the following pumps:

- Verona Pumps (two pumps)
- Totowa Pumps (four pumps)
- Airport Pumps (two pumps)

The backup generator is a 1500-kW diesel generator. The third Verona pump is connected to the backup generator, but operation of this pump during an outage causes the generator to trip out.

The Verona transfer system is automatic and contains a PLC for transferring to or from the utility source, as well as load shed circuits. The system was modified to provide power to the Airport pumps. Transfer of power to the Airport Pumps is manual.

8. Interconnections

PVWC has a large number of emergency interconnects with nearby utilities. All emergency interconnections are connections in both directions. **Figure 5.10** is a map showing all of the potential areas that PVWC can serve through emergency interconnections.

a) Newark (Great Notch Crossovers)
PVWC can get water by gravity from the Cedar Grove Reservoir (Newark) via the Pequannock Aqueducts (Hydraulic Grade Line of 405 feet). Approximately 10 mgd can be provided by gravity into the 330 Gradient 51-inch transmission main from Newark, but only if the Great Notch Reservoir can be isolated.

b) Newark (Joralemon Street/Belleville Reservoir)
PVWC can get water from Newark's Pequannock Aqueducts (Hydraulic Grade Line of 405 feet) via the Joralemon Street/Belleville Reservoir interconnection into the 51-inch 330 Gradient. This interconnection allows 20 mgd from Newark to PVWC, but it is in uncertain operating condition.

c) United Water
PVWC can accept 10 mgd from United Water. United Water can supply water to the far end of the 330 Gradient. This Lodi connection allows PVWC to use a former wholesale connection to interconnect with United Water. PVWC can also supply up to 15 mgd to United Water through this interconnection. PVWC currently has a project on the capital improvements plan to upgrade this interconnection with United Water.

d) Jersey City
The Chittenden Road Pump Station provides a 15-mgd pumped interconnection from the City of Jersey City Aqueduct into the 51-inch 330 Gradient. PVWC can use the same pumped interconnection to gravity supply the City of Jersey City with 25 mgd. The Chittenden Road Pump Station does not have backup power.

e) North Jersey
As discussed in Section 4.1, North Jersey can supply up to 52.5 mgd of finished water (contractually) to PVWC. Although this is the maximum allowable allocation from North Jersey, PVWC staff has denoted that 60 mgd of hydraulic capacity is available. The 2000 Master Plan noted that 67 mgd of Wanaque flow is hydraulically possible.

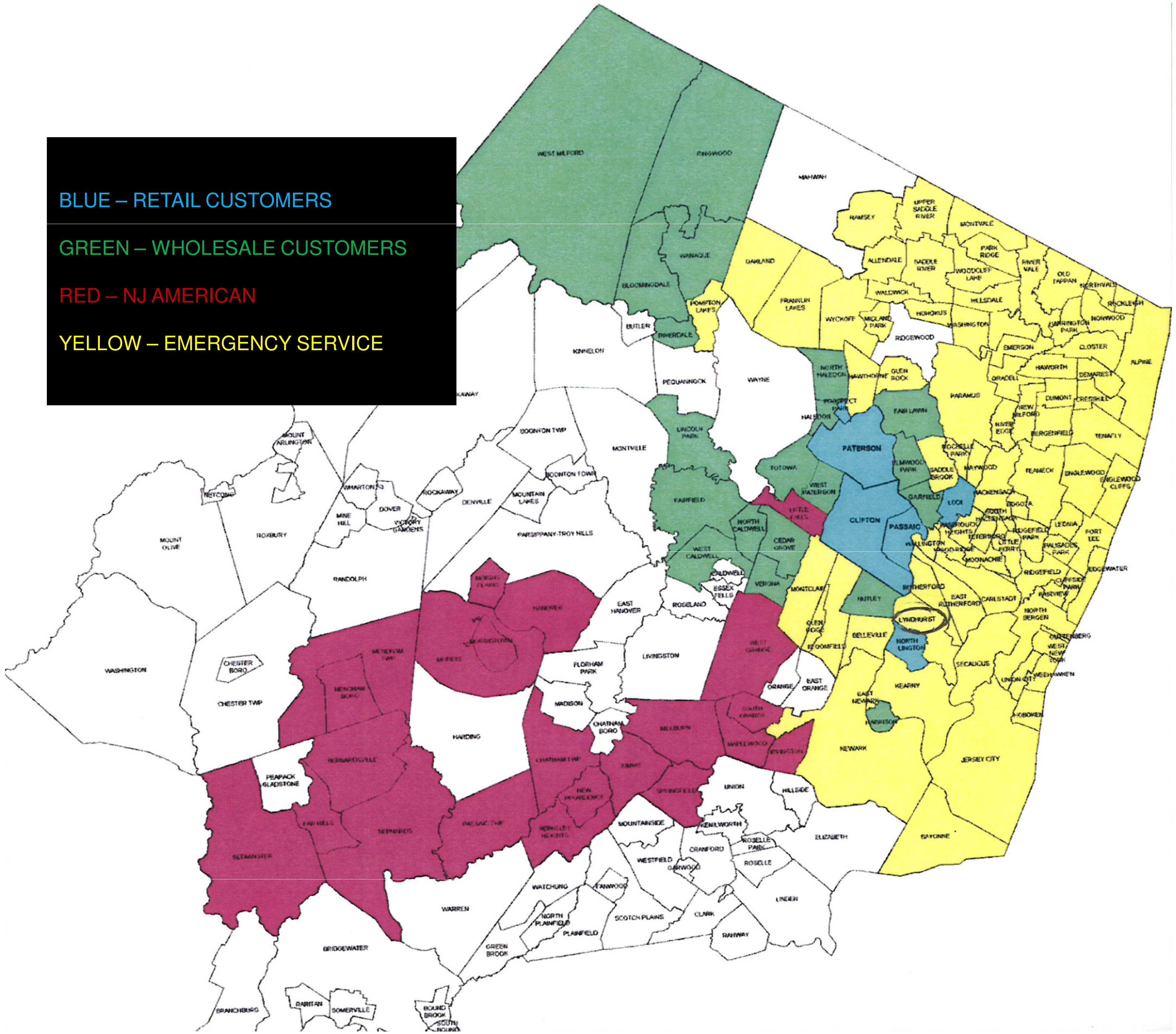

Figure 5.10 – PVWC Interconnections

REV	DATE	BY	DESCRIPTION

DESIGNED
DRAWN
CHECKED
DATE
DISCIPLINE ENGINEER
PROJECT ENGINEER
PARTNER

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PASSAIC VALLEY WATER COMM.

PASSAIC VALLEY WATER COMMISSION
MUNICIPALITIES POTENTIALLY RECEIVING PVWC WATER
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

SCALE
NA

JOB NO.
8378A.00
DRAWING NO.
SHEET NO.
OF

FILENAME:

f) Chittenden Road Pump Station

The Chittenden Road Pump Station provides a gravity interconnection from Newark's Pequannock Aqueducts (hydraulic gradient of 405 feet). This gravity line can supply up to 25 mgd from Newark into the 51-inch transmission main (330 Gradient). PVWC can pump 20 mgd of flow to Newark through this interconnection as well.

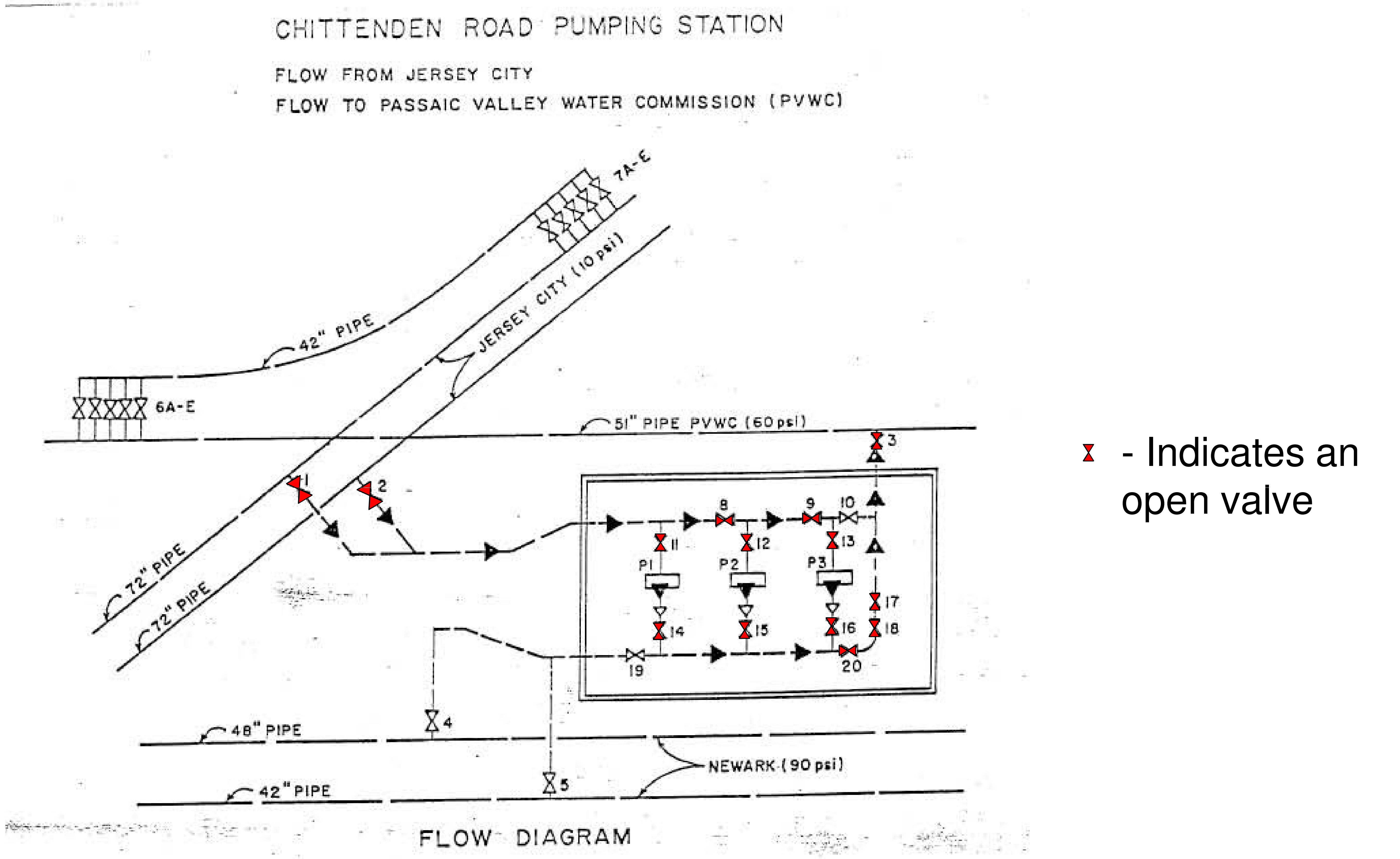
The Chittenden Road Pump Station has three pumps and a bypass around the pump station which allows a significant amount of flexibility for interconnection. The following are the possible interconnection scenarios:

- Newark to Jersey City
- PVWC to Jersey City
- Newark and PVWC to Jersey City
- Newark to PVWC
- Jersey City to Newark
- Jersey City to PVWC
- Jersey City to PVWC to Newark
- PVWC to Newark

Figure 5.11 shows the schematic of the pump station that allows flow from Jersey City to PVWC and **Figure 5.12** shows the schematic of the pump station that shows flow from Newark to PVWC.

g) Kearny

Kearny can provide emergency interconnection water to the far end of the 330 Gradient (51-inch). They can feed Harrison, Lyndhurst, North Arlington, and potentially Nutley. They can feed about 5 or 6 mgd.



REV	DATE	BY	DESCRIPTION
			Figure 5.11 Jersey City/PVWC Interconnection

DESIGNED
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DISCIPLINE ENGINEER
PROJECT ENGINEER
PARTNER

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Water Storage Improvements Feasibility Study
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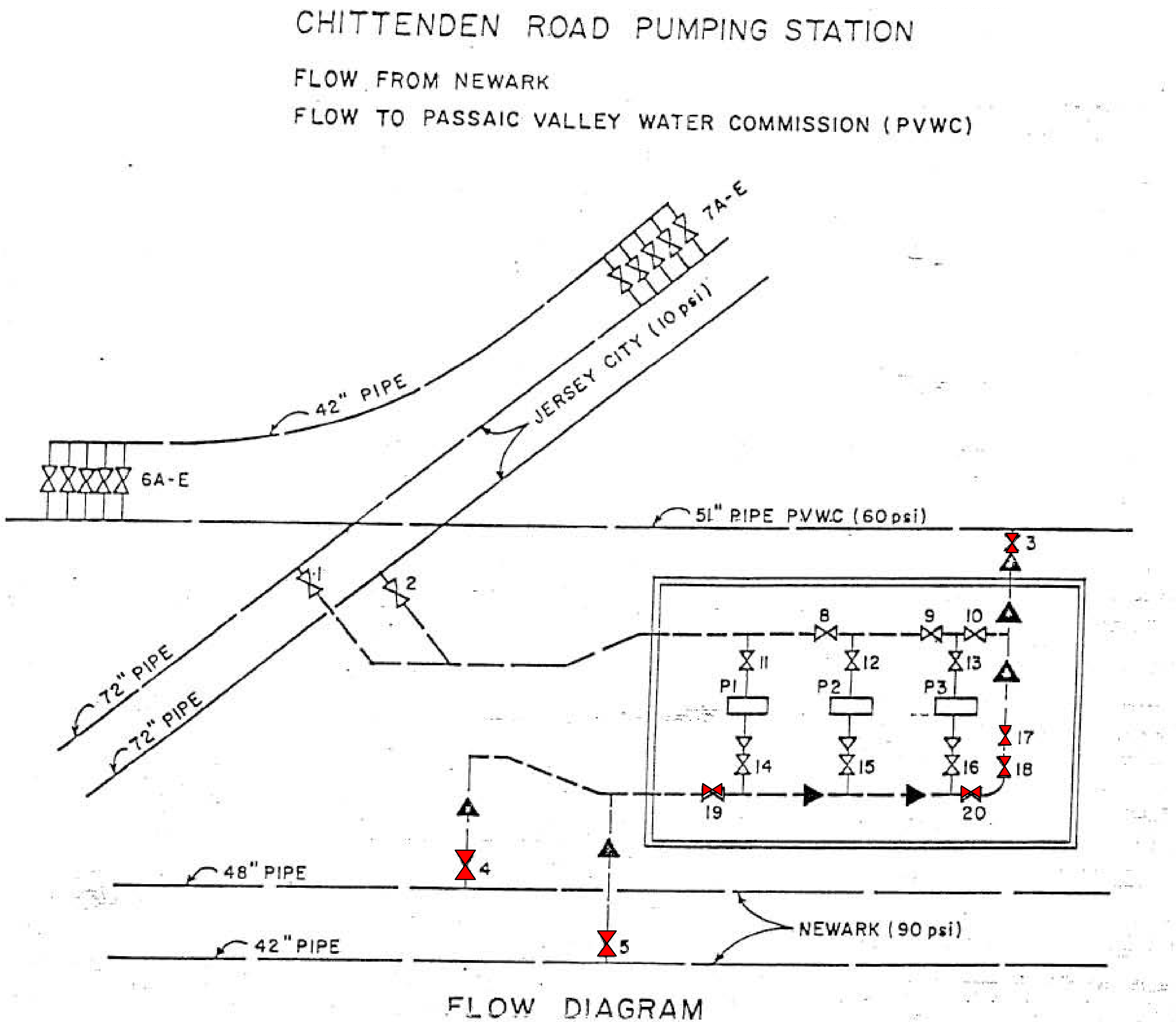

- Indicates an open valve

			Figure 5.12 Newark/PVWC Interconnection	DESIGNED	DISCIPLINE ENGINEER	PROJECT ENGINEER	PARTNER
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				CHECKED			
				DATE			
REV	DATE	BY	DESCRIPTION				

FILENAME:

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Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

SCALE
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JOB NO.
8378A.00

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B. Define Level of Service

The Level of Service (LOS) is defined as the amount of water that can be delivered to the customers during the Design Emergency Event (DEE) before imposing restrictions. The process for establishing the LOS includes the following steps:

- Identify potential DEE.
- Define failure modes for system components for potential DEEs.
- Define non-storage capacity replacement options for flow and duration for potential DEEs.
- Select critical DEE.
- Define what we mean by LOS (flow and time) and Restricted Level of Service (RLOS).
- Discuss/Select a LOS (RLOS) for the DEE.
- Identify/Select alternative combinations of 'tools' (back up power, emergency storage, etc.) to meet the LOS and the RLOS for the selected DEE.

C. Restricted Level of Service

The RLOS is the amount of water that can be delivered to the customers of PVWC under restrictive use after the original timeframe of the DEE. The RLOS is the amount of water that can be delivered for an indefinite timeframe if the DEE was extended beyond the originally anticipated timeframe.

D. Design Emergency Events

The design emergency event is an event which impacts the ability of PVWC to pump, treat, or distribute water to its customers. The design emergency event can include catastrophic failure of major system infrastructure or regional issues such as a major power outage. The duration of emergency events to be considered are on the order of hours and days, consistent with finished water storage volumes. The following assumptions are considered for all potential emergency events:

- The Wanaque North supply is assumed available during the DEE.
- Main breaks are not considered emergency events for the DEE analysis.
- Acts of terrorism or intentional acts of sabotage are not considered.

The following write-ups discuss a number of potential DEEs.

1. Main Pump Station Failure

The Main Pump Station is located at the LFWTP site. The Main Pump Station receives finished water from either the effluent of the LFWTP or from the Wanaque North Aqueduct. The entire water treatment flow and all of the Wanaque Aqueduct flow passes through the Main Pump Station.

There are three potential ways that the Main Pump Station could fail:

- Flood – The Main Pump Station is located at the lowest elevation on the plant site and is adjacent to the Passaic River. Although the pump station has never flooded, there is a possibility of flooding and the pump station has been close to flooding in the past.

- Mechanical – All of the pumps are mounted on the main operating floor and the gallery below has all of the suction and discharge piping associated with the pumps. The condition of the riveted steel piping located below the main level is unknown and is a concern due to its age. A major piping break in this area could flood the lower level and completely shutdown the entire pump station.
- Electrical – There is always a possibility that power to the Main Pump Station could be lost due to loss of a transformer, substation or electrical gear.

The probability of failure of the Main Pump Station was assigned a medium risk factor due to the age of the pump station and piping, age of the electrical equipment and the elevation of the pump station, and its potential for flooding.

The duration of a failure at the Main Pump Station was assigned an extended outage factor. The loss of the Main Pump Station due to flooding would be considerable because the floodwaters would need to recede, the basement level would need to be pumped out, the electrical equipment would need to be dried out and potentially replaced. This process would take a period of weeks. In addition, a mechanical or electrical failure would also take a period of weeks due to repair or electrical equipment replacement.

If failure of the Main Pump Station occurred, approximately 25 mgd from the Wanaque North supply could be provided to the 180 Gradient by gravity. The water from the 180 Gradient could be pumped to the 300/330 Gradient utilizing the 180 Gradient Pump Stations. In addition, PVWC could get as much as 70 mgd from existing interconnections. This would provide as much as 95 mgd. This could occur for an indefinite period of time.

2. Source Water Failure

PVWC has three different sources of raw water supply which include the Passaic River Intake, Pompton River intake (via the Wanaque South Pipeline), Point View Reservoir (via discharge to the Pompton River/Passaic River), and Point View Reservoir (via the Wanaque South Aqueduct and Wanaque South Pipeline).

The loss of source water could occur in three different modes of failure:

- Chemical spill on Pompton – A large volume of contaminant could be dumped or spilled into the Pompton River. This event would require PVWC to shutdown the Pompton River Intake. A large spill on the Pompton will also impact the Passaic River as well.
- Chemical spill on Passaic – A large volume of contaminant could be dumped or spilled into the Passaic River. This event would require PVWC to shutdown the Passaic River Intake.
- Pump Station Failures – The Wanaque South Pump Station can pump Pompton River water to the canal arch and into the treatment plant. PVWC owns two of the pumps in this pump station. There could be a failure of this pump station. In addition, a failure of the Passaic River intake could occur either by damage to the traveling screens or by failure of the low-lift pump stations which transfers water from the raw water pump station wet well into the LFWTP.
- The probability of failure of the source water was assigned a low risk factor due to the low probability of a spill into both of the water sources, the potential for failure of the

Wanaque South Pump Station, and the low probability of screen or raw water pump station failure (considering the extra capacity of these pumps).

- The duration of a source water failure was assigned a short outage factor. Any type of chemical spill on either of the sources would flow past the intake reasonable quickly. In addition, any pump station failures could be addressed with backup units or source water flexibility.
- If failure of the source water supply occurred, approximately 35.5 mgd (or more) from the Wanaque North supply could be provided to the distribution system. In addition, PVWC could get as much as 70 mgd from existing interconnections. This would provide more than 100 mgd. This could occur for an indefinite period of time.

3. Water Treatment Plant Failure

The LFWTP has an overall finished water capacity of 110 mgd and a firm capacity of 85 mgd. The loss of LFWTP could occur in three different modes of failure:

- Mechanical – The LFWTP process consists of a large number of mechanical systems including the raw water pumps, ballasted flocculation system, ozone contactor, filters, solids handling system, backwash system, and chemical feed systems. A catastrophic failure of any of these system could result in an overall plant shutdown.
- Electrical – There is always a possibility that power to the LFWTP could be lost due to loss of a transformer, substation, or electrical gear.
- Process – The loss of the LFWTP could occur due to a process problem which could result in unacceptable water quality. This could include source water quality and treatability problems, loss of chemicals, inability to supply ozone to the system, loss of sand for the ballasted flocculation process, and SCADA system failure.

The probability of failure of the entire LFWTP was assigned a low risk factor due to the available redundancy of the existing treatment process, the high level of automation, and the presence of onsite operations and maintenance personnel.

The duration of a failure at the LFWTP was assigned an extended outage factor. A mechanical or electrical failure significant enough to take the entire LFWTP out of service would also take a period of weeks due to replace or repair.

If failure of the LFWTP occurred, approximately 35.5 mgd (or more) from the Wanaque North supply could be provided to the distribution system. In addition, PVWC could get as much as 70 mgd from existing interconnections. This would provide as much as 100 mgd. This could occur for an indefinite period of time.

4. Backup Power Failure

Failure of the backup power system is not a part of the normal operation of the PVWC system and was only considered as a part of other failure scenarios.

5. Interconnection Failure

Failure to rely on interconnections is not a part of the normal operation of the PVWC system and was only considered as a part of other failure scenarios.

6. Regional Power Failure

As discussed previously, a regional power failure has occurred in the past and its impact on the PVWC system was significant. This potential DEE has such a large impact because it includes a loss of all PVWC external power as well as interconnection utility power (other interconnection utilities would be without power also). This results in the complete loss of the use of the LFWTP, loss of the Main Pump Station (except for pumping to the High Pressure Gradient), loss of the 180 Gradient Pump Stations (except for about 12 mgd of capacity) and the loss of all interconnections.

The probability of failure of the regional power system was assigned a low risk factor due to the recent occurrence of a regional power failure (2003) and the improvements that have been made to the grid since this time.

The duration of a failure of the regional power system was assigned a outage of less than 24 hours. This was based on the 2003 outage which was approximately a 24 hour outage although portions of the system power returned much quickly than this.

If failure of the regional power grid occurred, approximately 25 mgd from the Wanaque North supply could be provided to the 180 Gradient by gravity. There is only backup power for 12 mgd of pumping capacity from the 180 Gradient into the 300/330 Gradient. There would be no way to get water above the 300 Gradient or to the High Pressure Gradient without utilizing emergency storage volume located at either the New Street Reservoir or the Great Notch Reservoir. If storage is available at the New Street Reservoir, the emergency generator for the High Pressure Gradient could supply water to this portion of the system.

7. Emergency Event Definition

Based on the above analysis, the regional power outage was selected at the emergency event definition. It was selected for the following reasons:

- It was the most limiting scenario of all of the plausible scenarios analyzed.
- It has happened in the past.
- It does not rely on interconnections.
- The duration is this event has been reasonable for the purposes of establishing an emergency event (this event is approximately 24 hours).

A workshop was held at PVWC at January 8, 2010 to discuss the design emergency event definition. It was decided that the design emergency event should include the following assumptions:

- Total outside power is off-line for 24 hours.
- No finished water is available from system interconnections.
- All pumping and/or treatment that would be relied up requires back-up power for duration of outage.

- Wanaque North supply is available.

Based on the previous regional power outage, the amount of storage volume that was needed (50.9 million gallons) and the demands during the summer months, a LOS flowrate of 100 mgd was established. The LOS definition is defined as the flowrate necessary to supply all of PVWC customer cities as well as their wholesale customers. The Restricted Level of Service is defined as the flowrate required to supply only the PVWC customer cities (Passaic, Clifton, and Paterson). The customer cities account for approximately 50 percent of the total system demands. This would be equivalent to a flowrate of 50 mgd.

A number of different LOS and RLOS options were discussed which included:

- 100 mgd for 24 hours = 100 MG LOS
- 100 mgd for 12 hours LOS with 50 MGD RLOS after 12 hours = 75 MG
- 100 mgd for 8 hours LOS with 50 MGD RLOS for 16 hours = 67 MG

Based on the reliance of wholesale customers on PVWC and the limited availability of other water suppliers to provide additional water to these wholesale customers, the 100 mgd for 24-hour LOS was selected without a RLOS (except past the 24 DEE).

This eliminates the notification process that would be required to the wholesale customers if an RLOS was implemented for a portion of the DEE.

VI. Alternative Development and Refinement

VI. Alternatives Development & Refinement

A. Goals of the Feasibility Study

The primary goal of the Water Storage Improvements Feasibility Study is to meet the stringent requirements of NJDEP on schedule, as defined in the ACO, and with a preferred alternative that will provide the most cost effective, reliable solution for PVWC.

B. Options Available to Meet ACO & LOS

There are a variety of potential ways of meeting LOS requirements of 100 mgd for a 24-hour period. This list includes the following individual options:

- Treatment at the current storage reservoirs
- Cover and line existing reservoirs
- New storage tanks in the system
- Back-up power at the LFWTP
- On-site storage tanks at the LFWTP
- Back-up power at the main pump station
- Combinations

The goal of the selected alternatives include minimizing life cycle costs, eliminating existing water quality challenges (inability to use phosphorus-based of corrosion inhibitors, extended water age, maintaining chlorine residual) and staying within the proposed boundary conditions. The boundary conditions that have been established include:

- Working within the constraints of the existing distribution system (existing gradients). Original discussions included gradient consolidation, but this was eliminated from consideration due to the hydraulic of the systems and site limitations.
- Providing a minimum of 34 million gallons of storage in the system (NJDEP requirements).
- If backup power for 34 mgd of capacity was provided, then the system storage could be reduced to 17 million gallons (NJDEP requirements).
- Provide 100 million gallons of emergency supply over a 24-hour period and the equalization storage requirements established previously for each gradient.
- If backup power is relied upon for any portion of the supply during the DEE, consideration should be given to startup time and the time required to establish operational stabilization.
- Assistance of other utilities with regional reliability storage (additional storage for regional reliability).

These boundary conditions bracket the range of the potential options and are used to examine the proposed alternative possibilities.

C. Level of Service Options

1. Introduction

As discussed previously, the options that could meet the LOS include the following list:

- Treatment at the current storage reservoirs
- Cover and line existing reservoirs
- New storage tanks in the system
- Back-up power at the LFWTP
- On-site storage tanks at the LFWTP
- Back-up power at the main pump station
- Combinations

These options were first examined independently to determine what would be required for each individual option to meet the LOS and establish a high level cost opinion for these options. Once this preliminary evaluation was complete, the team sat down in a workshop setting eliminating high cost options and established alternatives for meeting the LOS that were one or potentially a combination of viable options.

2. Options for Meeting Level of Service Requirements

a) Treatment at Reservoirs

In order to keep an uncovered finished water reservoir, the utility is required to treat the discharge from the uncovered finished water storage facility prior to entering the distribution system. This treatment process must achieve at least 4.0-log virus, 3.0-log *Giardia lamblia,* and *2.0-log Cryptosporidium inactivation and/or removal using a state-approved protocol.* One of the methods that could be used to achieve this level of treatment is by the addition of filtration technology. This could be achieved utilizing either dual media filtration or membrane filtration. Dual media filtration would require additional contact time for virus inactivation and membrane filtration could potentially get all of the required treatment using only the membranes. This option would need to be able to supply peak hour demand for the distribution system. Although the LOS is 100 mgd, this system would need to provide 140 mgd of treatment capacity in order to meet peak hourly flowrates. This option was eliminated from further consideration due to the following reasons:

- Must treat the entire LOS peak flow (140 mgd peak hour).
- Remote operations and time intensive membrane cleaning requirements (would require more operations and maintenance).
- The membrane plant capacity would be higher than the current LFWTP.
- The membrane facility would require back-up power.
- Open reservoir(s) would not allow the use of a phosphorus-based corrosion inhibitor. Staying below lead action levels would remain challenging.
- Capital Cost is $1.50/GAL = $210M.
- The membrane facility would most likely be located at the Great Reservoir Site and would include additional pumping costs to get the entire storage volume up to the Great Notch Site.
- The NJDEP regulations state that surface water or ground water under the direct influence of surface water (which the water be will classified as once it enters an

uncovered reservoir) shall be treated for a minimum chlorine contact period of 30 minutes to produce a minimum free chlorine residual level. This would be difficult to achieve without the construction of a separate chlorine contact basin.

Figure 6.1 shows the cost curve for a membrane facility which results in a cost of approximately $210 million. Based on all of these factors, this option was eliminated during the alternatives workshop.

Another potential option for treatment at the uncovered reservoirs is the use of UV disinfection at the reservoir outlets. As discussed above this treatment process must achieve at least 4.0-log virus, 3.0-log *Giardia lamblia, and 2.0-log Cryptosporidium inactivation and/or removal using a state-approved protocol.* UV disinfection could easily achieve the *Giardia* and Cryptosporidium disinfection but the inactivation of viruses would result in high doses of UV. This option would need to be able to supply peak hour demand for the distribution system. Although the LOS is 100 mgd, this system would need to provide 140 mgd of treatment capacity in order to meet peak hourly flowrates. This option was eliminate from further consideration due to the following reasons:

- Must treat the entire LOS peak flow (140 MGD peak hour).
- Remote operation and sleeve cleaning requirements (would require more operations and maintenance). The UV facility would require back-up power.
- Open reservoir(s) would not allow the use of a phosphorus-based corrosion inhibitor. Staying below lead action levels would remain challenging.
- Capital Cost is $0.40/GAL = $40M. This is for Giardia and Cryptosporidium inactivation only (virus inactivation would be significantly higher – up to 4 times higher). These capital costs are from the 2006 AWWARF study that examined the use of UV for treatment of the uncovered finished water at PVWC.
- The UV facility would most likely be located at the Great Reservoir Site and would include additional pumping costs to get the storage volume up to the Great Notch site.
- The NJDEP regulations state that surface water or ground water under the direct influence of surface water (which the water will classified as once it enters an uncovered reservoir) shall be treated for a minimum chlorine contact period of 30 minutes to produce a minimum free chlorine residual level. This would be difficult to achieve without the construction of a chlorine contact basin. This contact basin would also be required for virus inactivation.
- NJDEP requires filtration when the water has significant occurrences of insect, or other macroorganisms, algae, or large diameter pathogens such as Giardia lamblia, Cryptosporidium, or fecal coliform. This could occur with the use of an open reservoir.

Membrane Treatment Plant Cost Curve (from Cost Estimating Manual for Water Treatment Facilities – McGivney, Kawamura 2008)

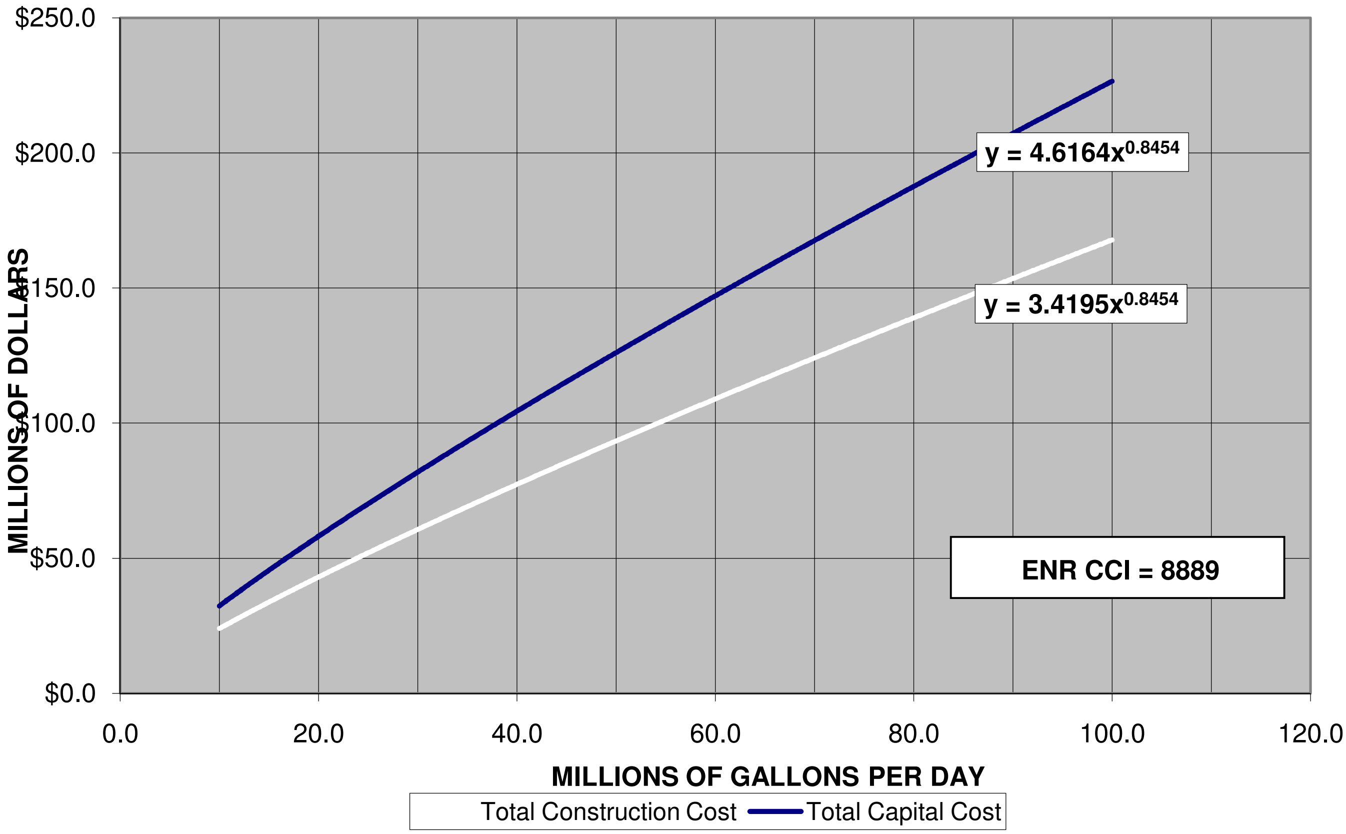

Figure 6.1
Membrane Treatment Plant Cost Curve
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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b) Reservoir Covers and Liners

One of the potential options for addressing the uncovered reservoir regulations is by covering and lining the existing reservoirs. Covers have been installed to minimize or eliminate contamination in uncovered reservoirs. Reservoir covers minimize the impact of animal wastes, human activities such as swimming, and airborne contaminates. Covers also minimize algae formation and reduce chlorine residual degradation. Liners prevent infiltration of external water from other sources and minimize the potential effects of the material located on the bottom of the unlined reservoir. This option would have the following requirements, advantages and disadvantages:

- New Street Reservoir would require a dam upgrade.
- Improvements would need to be made the Great Notch pump station to allow the Great Notch Reservoir to refill quicker. This would require a larger sized pump station to allow this storage volume to turnover and refill. **Figure 6.2** shows the cost curve for a pump station which would be approximately $5 million dollars (75 mgd firm capacity). The Great Notch Reservoir would require a dam to split the reservoir storage volume in half to allow half of the reservoir to be removed from service for cover and liner repair and replacement.
- Provides the largest volume of storage within the existing sites for all options.
- The costs for reservoir covering and lining would be about $0.38/gallon for the project and about $0.18/gallon for the materials.
- Water age would still be a potential problem. The storage would most likely need to drain to a lower gradient in order to keep the Great Notch Reservoir turned over. This would waste a significant amount of energy. Baffling could assist with reservoir turnover, but would not completely solve the problem.

Pump Station Cost Curve
(from Cost Estimating Manual for Water Treatment Facilities – McGivney, Kawamura 2008)

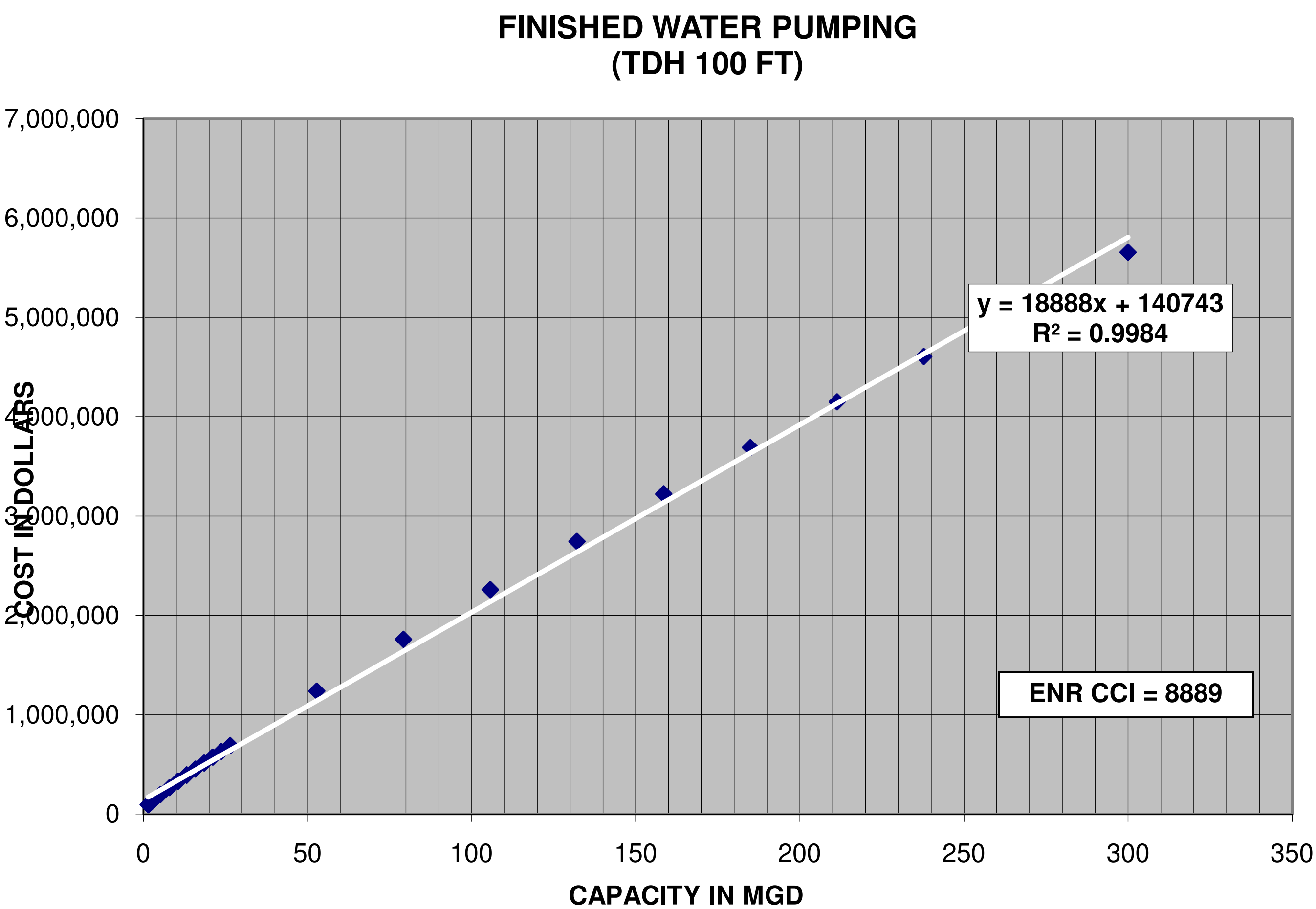

Figure 6.2
Pump Station Cost Curve
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

c) **New Storage Tanks**

One of the most appealing options for addressing the uncovered reservoirs is the construction of ground storage tanks. These tanks are typically prestressed concrete, steel, or cast-in-place concrete. They provide a physical structure to hold the storage volume and can be sized to distribute the water at the correct hydraulic grade line. Multiple tanks can be installed in order to allow for flexibility in operation and to allow maintenance in tanks. The storage tank structures have the following requirements, advantages and disadvantages.

- Eliminates need for New Street Dam upgrade. This option also potential eliminates all dam structures for PVWC. This would result in a reduction in permitting requirements and dam maintenance.
- Provides storage volume at the correct hydraulic grade lines.
- Provides the ability to install multiple tanks to supply some redundancy to remove tanks from service for maintenance.
- Provides the ability to baffle and control the inlet and outlet conditions of the tank to minimize the potential for short-circuiting and reduce the water age.
- Eliminates the disadvantages of open reservoirs such as in the ability to utilize a phosphorus based corrosion inhibitor and minimizes chlorine reduction due to sunlight and other external contaminants.
- Provides the ability to install storage in the gradient where the storage is required.
- The ability to utilize different tank technologies to fit the site constraints.
- A reasonable cost-effective manner to provide storage volume. The cost of tank storage ranges from as low as $0.29/gallon for large steel tanks (not including tank recoating) to $0.60/gallon for large cast-in-place concrete tanks (see **Figures 6.3** through **6.5**).

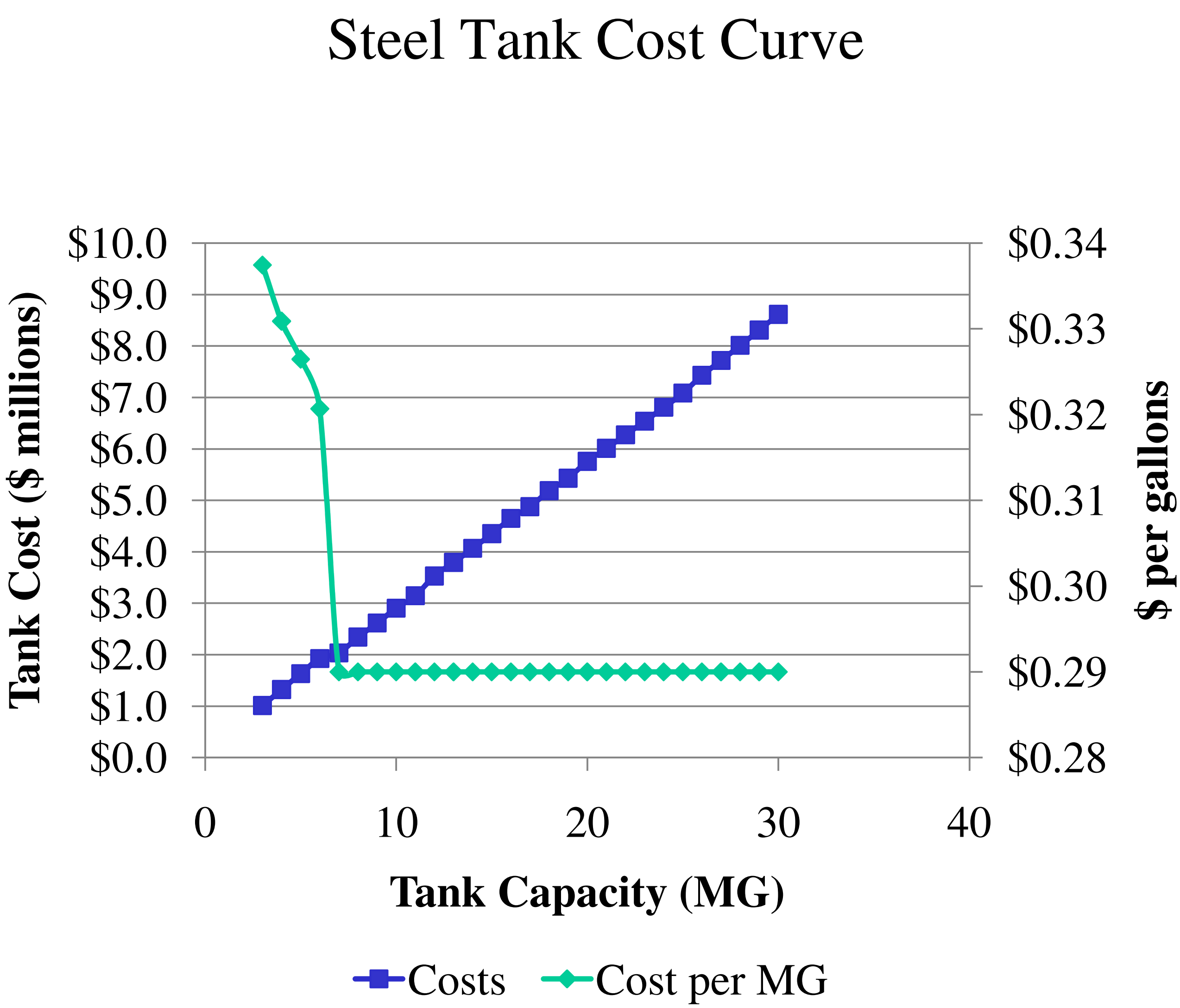

Figure 6.3
Steel Tank Cost Curve
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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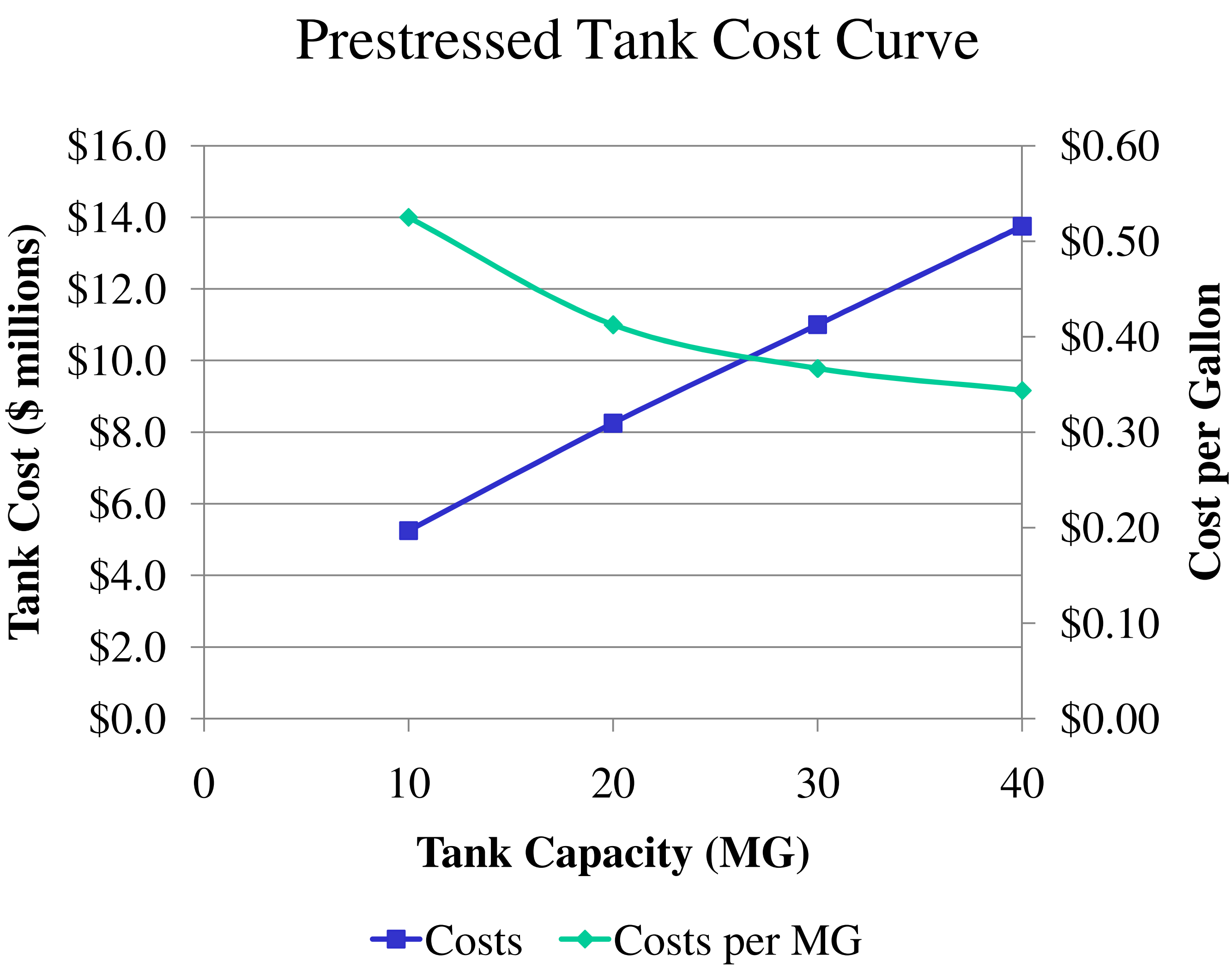

Figure 6.4
Prestressed Tank Cost Curve
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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Cast-in-place Concrete Tank Cost Curve (from Cost Estimating Manual for Water Treatment Facilities – McGivney, Kawamura 2008)

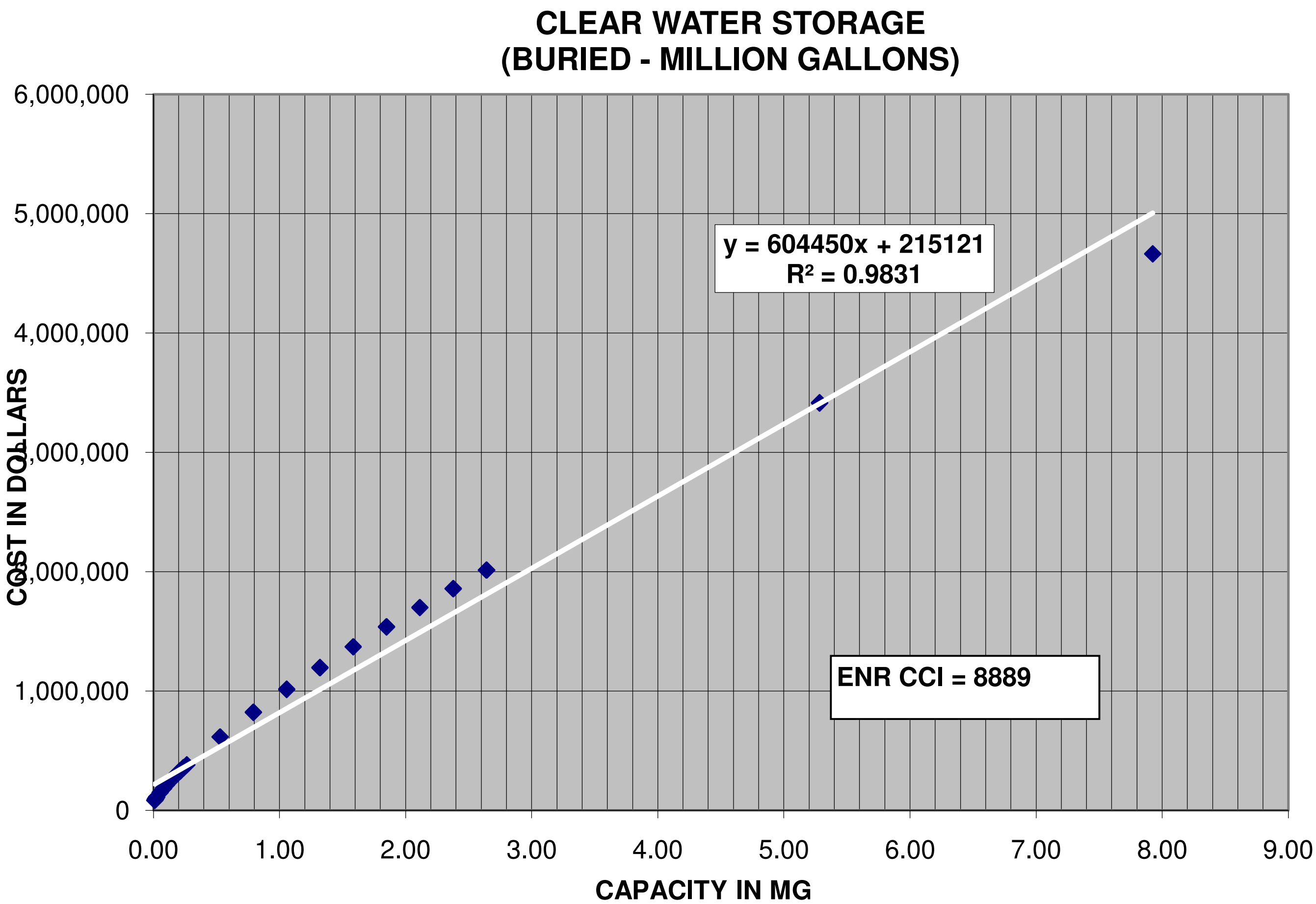

Figure 6.5
Cast-in-place Concrete Tank Cost Curve
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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d) Backup Power at the LFWTP and Main Pump Station

The use of backup power at the LFWTP and/or at the Main Pump Station is a very cost-effective method for supplying the water necessary during the DEE. The backup power would use diesel generators (potentially supplemented with natural gas) to convert diesel fuel to electric energy. This would occur on the LFWTP site and potentially supply electricity to the LFWTP and/or the Main Pump Station. The energy would allow the facilities to continue to operate through a power outage event such as that defined by the DEE. The backup power has the following requirements, advantages and disadvantages:

- The backup power system is a mechanical system which must be maintained and can failure during an emergency event.
- The backup power system requires diesel fuel whose delivery could be interrupted during a DEE.
- The budgetary cost for backup power is approximately $2 million dollars per megawatt of power.
- The existing diesel storage currently located on the plant site would provide enough diesel to make it through the DEE (0.08 gphr of diesel per kW).
- The following table shows the emergency power capacity requirements for different LFWTP capacities and different Main Pump Station capacities.

Table 6.1

Emergency Generator Options Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

Option No.	Scenario	Generator Size	Estimated Costs
GO-1	75 mgd from Wanaque	Two – 1,750 KW (3,500 kW)	$7 million ($0.093/gallon)
GO-2	50 mgd from Wanaque – 28 mgd from WTP	Two – 2,500 kW (5,000 kW)	$10 million ($0.128/gallon)
GO-3	25 mgd from Wanaque – 56 mgd from WTP	Three – 1,750 kW (5,250 kW)	$10.5 million ($0.13/million)
GO-4	0 mgd from Wanaque – 84 mgd from WTP	Three – 2,500 kW (7,500 kW)	$15 million ($0.178/million)
GO-5	0 mgd from Wanaque – 112 mgd from WTP	Four – 2,250 kW (9,000 kW)	$18 million ($0.16/million)

e) Storage at WTP

Although additional storage at the LFWTP would meet some of the required storage there was no obvious location for significant storage available. This option was eliminated from consideration.

D. Decision Making Model Development

1. Decision Making Model Platform

Criterium Decision Plus (CDP) is a decision support tool that can help organize and communicate complex decision-making tasks while engaging decision makers in the process and allowing their values to be integrated in a quantitative manner. The software provides a way to identify and list the goals, objectives, evaluation criteria, planning parameters, metrics, and project alternatives in a hierarchy structure. The goal of any decision model is to provide a prioritization of project alternatives. In CDP, the prioritization is based on ratings (or data) entered for the metrics attached to the alternatives in the hierarchy. The model then assigns relative ratings to each of the criteria using a scale common to all criteria and prioritizes the alternatives.

a) Evaluation Process

The evaluation process diagram in **Figure 6.6** is adapted from the 2005 CDP Users Guide and is used for the scoring of the alternatives. CDP's evaluation process involves brainstorming the problem, building the hierarchy, assigning ratings, selecting uncertainty, reviewing and analyzing results, and recording and documenting the results. Each step is discussed in more detail below.

1. Brainstorm the Problem

CDP's first step in evaluating the alternatives is brainstorming and defining the goals, objectives, evaluation criteria, planning parameters, and metrics by which to measure the ability of the alternatives to meet them.

The goal of the project was defined as meeting the ACO and providing compliance with the LT2ESWTR.

The evaluation criteria for this project included the following criteria and their respective definitions:

Reliability, which is defined as requiring fewer assets to operate and maintain. More reliable is better. Reliability is broken down into the following subcategories:

- Operability: Defined as the simplicity of daily operations. The simpler the system is to operate the better.
- Level of Redundancy: Defined as the level of redundancy or the ability to continue to operate if a portion of the system is out of service. More redundancy is better.
- Maintainability: Defined as the level of maintenance required for a given alternative. Less maintenance is better.
- Distribution System Recovery: Defined as the relative amount of time that is required for the system to return to normal daily operations after an event. Faster recovery is better.
- Daily Operation Flexibility: Defined as the ability of the system to deal with daily changes. If the system is more limited this will result in more SCADA requirements and more operator training. More flexibility is better.
- Plant Recovery: Defined as the ability of the plant to come back online after a plant shutdown occurs. Faster plant recovery is better.

Regulatory Acceptance, which is defined as being acceptable to NJDEP, and EPA Region 2. The easier the selected alternative is to get accepted the better. Regulatory Acceptance is broken down into the following subcategories:

- Supports Regional Reliability: Defined as improving reliability and security from a regional perspective. More regional reliability is better
- Ability to Meet ACO Schedule: Defined as the timeframe required to implement the alternative. Alternatives may require long lead times to improve the system resulting in extended construction schedules and regional coordination. More time is worse.

Water Quality: Defined as the ability of an alternative to improve water quality and compliance with regulations. This only includes the ability to improve public health benefits beyond the regulatory minimum. Improved water quality is better.

Constructability: Defined as the level of complexity required to build the alternative. Less complexity is better.

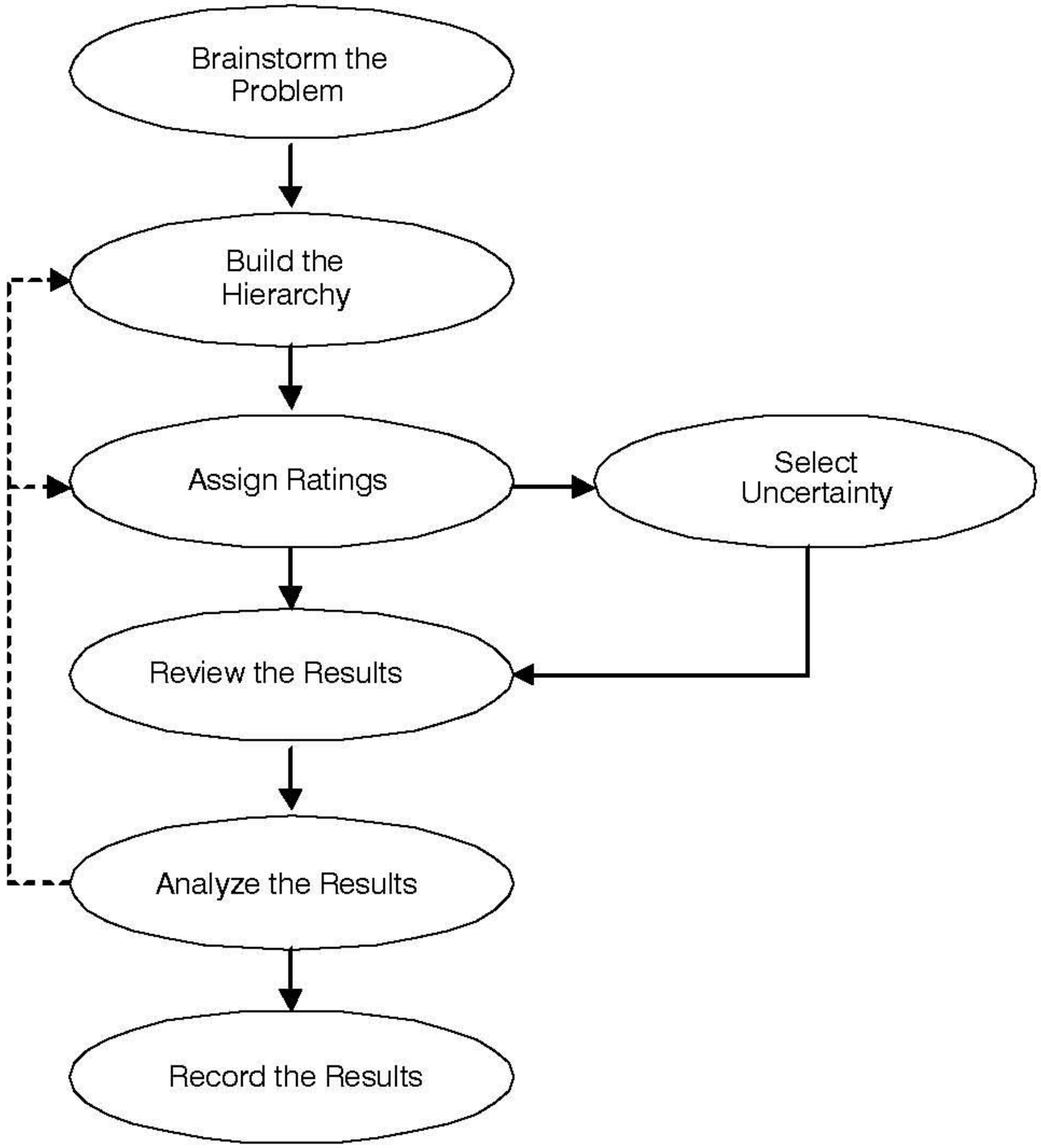

Figure 6.6
Criterium DecisionPlus Evaluation Process Diagram (2005)
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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2. **Build the Hierarchy**
   Brainstorming the problem is requisite in CDP to developing a logical decision structure (or hierarchy), and it imposes discipline in the decision-making process. The result is a hierarchy starting from the goal, including the objectives, evaluation criteria, planning parameters, and metrics leading to the alternatives as illustrated in **Figure 6.7**.

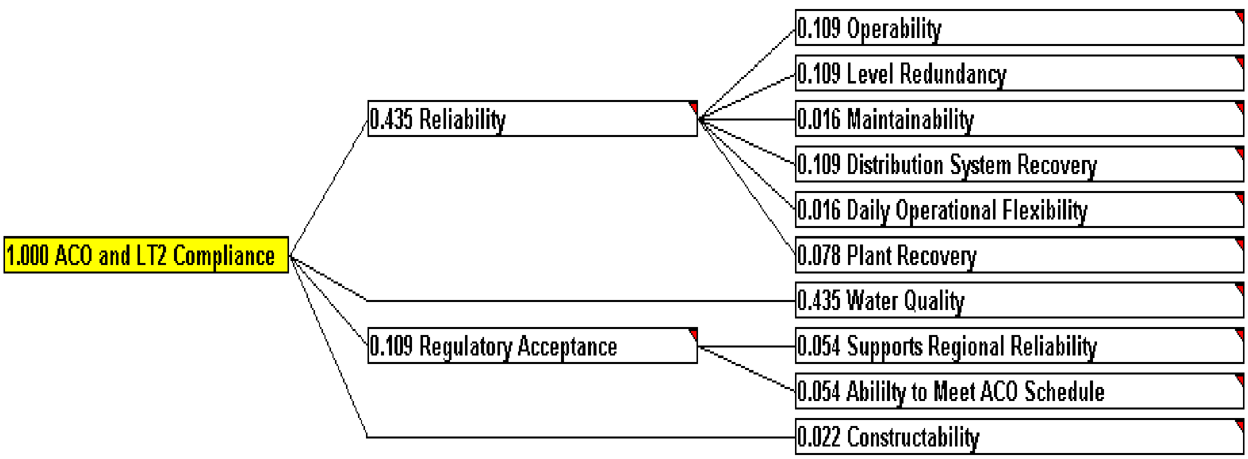

Figure 6.7
Criterium DecisionPlus Hierarchy with Connections
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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3. **Assign Ratings**

The next step is to assign ratings to the metrics. Assigning ratings can be accomplished two ways: the full pairwise comparison method and the direct rating method. Both approaches accomplish the same goal of scoring the alternatives and both take into consideration the goal, objectives, evaluation criteria, planning parameters, metrics, the alternatives, and the best available information. The rating on this project was established using the pairwise comparison. Once the ratings are assigned to the criteria attached to the alternatives in the hierarchy, the model assigns relative ratings to each of the criteria using a scale common to all criteria. The result is a prioritization of the alternatives.

Based on the pairwise comparison of the criteria, the following is the weighting of the each criteria, as well as subcriteria. For example, 43.5% of the alternative comparison should be based on the water quality considerations.

Reliability: 43.5%.

- Operability:10.9%.
- Level of Redundancy: 10.9%.
- Maintainability: 1.6%.
- Distribution System Recovery: 10.9%.
- Daily Operational Flexibility: 1.6%.
- Plant Recovery: 7.8%.

Water Quality: 43.5%.

Regulatory Acceptance: 10.9%.

- Supports Regional Reliability: 5.4%.
- Ability to Meet ACO Schedule: 5.4%.

The full pairwise comparison method means "comparing in pairs" and involves comparing each criterion within a rating set to the other criteria in that set as shown in **Figure 6.8**. Ratings are assigned with respect to and/or with special consideration of the common reference to the specific criteria.

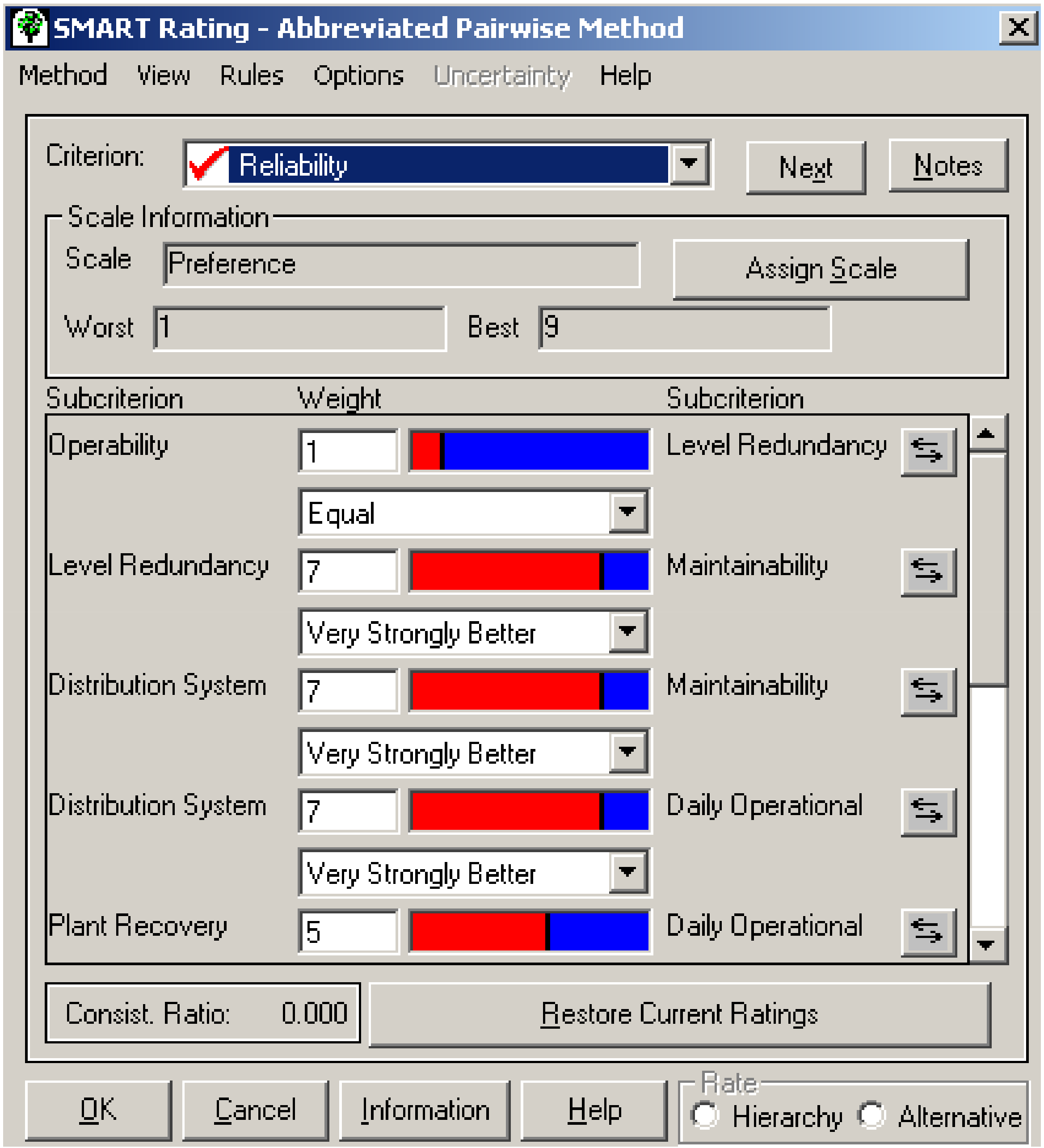

Figure 6.8
Criterium DecisionPlus Pairwise Comparison Method for Rating Criteria
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

A group of alternatives was established based on meeting the LOS of service established with the acceptable options established previously. These alternatives were developed in a workshop with PVWC and include the following:

Alternative 1 – Covers and liners for all of the existing uncovered reservoirs. New Street would require dam improvements. This would provide the following storage:

- Levine: 15.2 MG of reservoir storage.
- New Street: 37.5 MG of reservoir storage.
- Great Notch: 85 MG of reservoir storage (based on minimum historical water level).

Alternative 2 – Cover and line the Great Notch Reservoir and eliminate the New Street Reservoir and the Levine Reservoir. This alternative includes a new 75-mgd pump station at the Great Notch Reservoir. This would provide the following storage:

- Great Notch: 85 MG of reservoir storage (based on minimum historical water level).

Alternative 3 – Replace all of the reservoirs with storage tanks. This would provide the following storage:

- Levine: 13 MG of tank storage.
- New Street: 100 MG of tank storage.
- Great Notch: 13 MG of tank storage.

Alternative 4 – Replace all of the reservoirs with minimal tank storage and backup power. This would provide the following storage and backup power:

- Levine: 3 MG of tank storage.
- New Street: 23 MG of tank storage.
- Great Notch: 3 MG of tank storage.
- 75 mgd of backup power capacity (either the Main Pump Station or LFWTP).

Alternative 5 – Cover and line the Great Notch Reservoir and add tanks to New Street and Levine sites. This would provide the following storage:

- Great Notch: 85 MG of reservoir storage (based on minimum historical water level).
- Levine: 3 MG of tank storage.
- New Street: 23 MG of tank storage.

Alternative 6 – Cover and line the Great Notch Reservoir and provide backup power.

- Great Notch: 85 MG of reservoir storage (based on minimum historical water level).
- 75 mgd of backup power capacity (either the Main Pump Station or LFWTP).

Alternative 7 – Replace reservoirs with storage tanks and provide some backup power.

- Levine: 10 MG of tank storage.
- New Street: 50 MG of tank storage.
- Great Notch: 10 MG of tank storage.
- 35 mgd of backup power capacity (either the Main Pump Station or LFWTP).

Alternative 8 – Cover and line the Great Notch Reservoir and provide storage tanks at New Street and Levine Site, as well as backup power.

- Great Notch: 85 MG of storage (based on minimum historical water level).
- New Street: 23 MG of tank storage.
- Levine: 3 MG of tank storage.
- 28 mgd of backup power capacity (either the Main Pump Station or LFWTP).

The following were the scores of each alternative based on a pairwise comparison:

- Alternative 1: 0.457.
- Alternative 2: 0.148.
- Alternative 3: 0.822.
- Alternative 4: 0.578.
- Alternative 5: 0.527.
- Alternative 6: 0.333.
- Alternative 7: 0.739.
- Alternative 8: 0.665.

The following table compares the each of the alternatives to the NJDEP storage requirements, the calculated storage requirements, and the total volume of water that could be produced in a 24-hour period.

Table 6.2

Alternatives Storage Comparison Table Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

Alternative	Ability to Meet NJDEP Storage Requirements (43 MG)	Ability to Meet Calculated Storage Requirements (70 MG)	Total Storage Volume Available (MG)	Total Volume of Water Available in 24 hours (MG)
1	X	X	138**	138**
2	X	X	85**	85**
3	X	X	126	126
4	*		29	104
5	X	X	111**	111**
6	X	X	85**	160**
7	X	X	70	105
8	X	X	111**	139**

* Meets NJDEP requirements with the use of backup power
** Does not include volume reduction for bifurcated dam at Great Notch Reservoir

4. **Review and Analyze Results**
   Once the problem has been brainstormed, the hierarchy has been built, and the ratings have been assigned, CDP provides the alternative prioritization results. CDP has the ability to review and/or analyze the results with a variety of methods. Two common methods include testing the sensitivity of the scores of the project alternatives to changes in ratings of criterion or viewing how, and to what extent, the highest rated criteria contributed to the scores.

   To understand how and to what extent the highest rated criteria contributed to the scores of the alternatives; the "Contributions by Criteria" Window can be viewed. **Figure 6.9** shows an example of the results display, showing which objective made the largest contribution to the decision and which made the least. The CDP software also allows review of contributions by lower criteria (i.e., planning parameters or metrics) to the alternative scores.

   The sensitivity of the model was tested and the following lists the changes that would be required to change the highest ranked alternative:

   - Constructability would have to increase from an importance of 2.2% to 52%.
   - Regulatory Acceptance would have to increase from 11% to 43%.
   - Reliability/Operability changes would not change the decision.
   - Reliability/Distribution System Recovery would have to increase from an importance of 10.9% to 55%.
   - Water Quality would have to decrease from an importance of 43% to 11%.
   - Reliability/Plant Recovery would have to increase from an importance of 7.8% to 50%.
   - Reliability/Daily Operational Flexibility would not change the decision.
   - Reliability/Maintainability would not change the decision.
   - Reliability/Level of Redundancy would not change the decision.
   - Both Regulatory Acceptance categories would not have changed the decision.

   Based on this sensitivity analysis the model was considered robust due to the requirement for large criteria importance changes to impact the model.

5. **Record and Document the Results**
   Based on the results, an informed decision in selecting the alternative can be made. The CDP software provides the capacity to record and document the model results in a variety of ways.

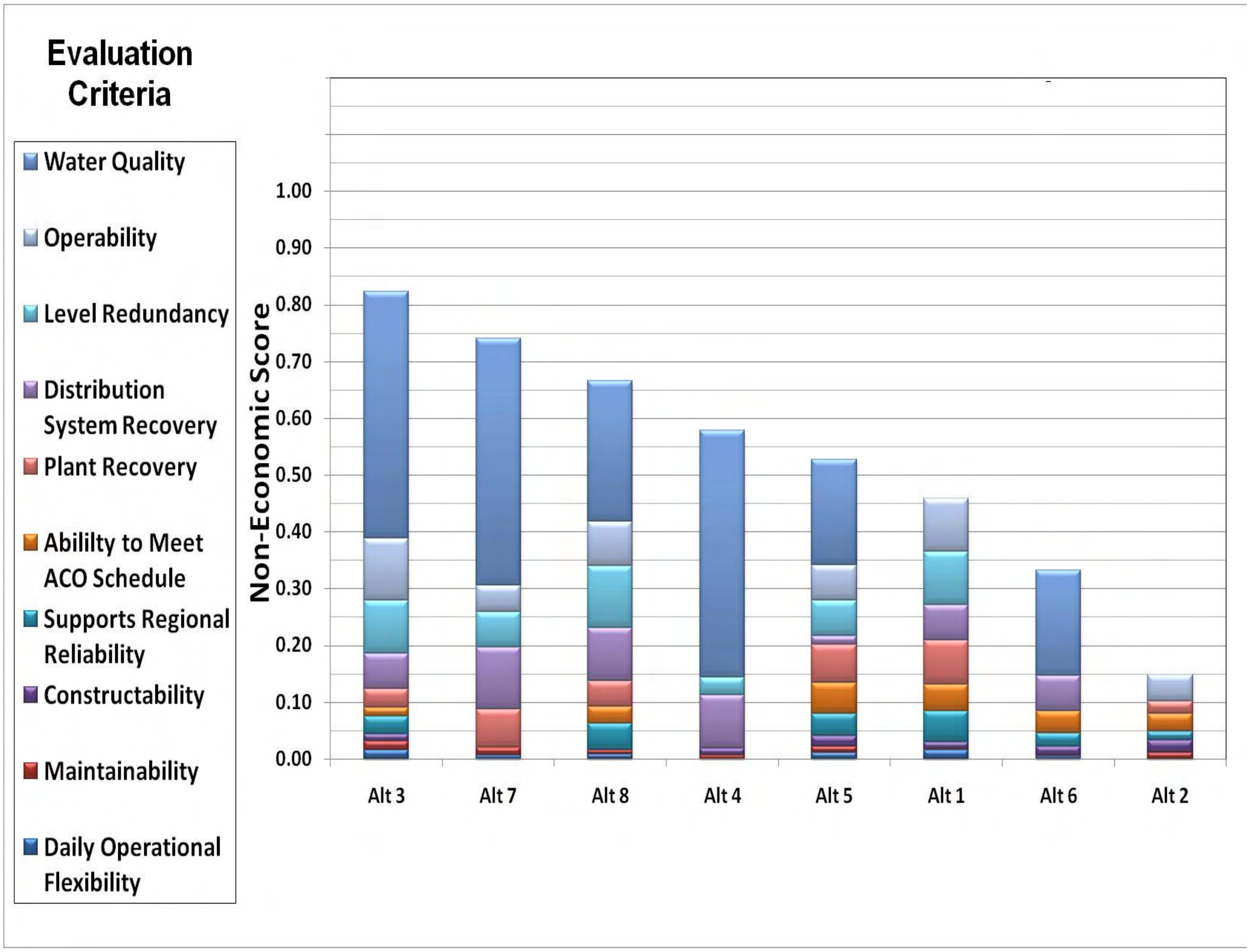

Figure 6.9

Criterium DecisionPlus Contributions by Objective

Water Storage Improvements Feasibility Study

Passaic Valley Water Commission (PVWC)

2. Preliminary Budget Analysis

Using the preliminary costs developed for each of the options, a total cost for each alternative was developed. This costs were utilize for comparison purposes only and do not reflect the overall costs of the project. Table 6.3 lists the budgetary comparison costs for each alternative.

Table 6.3

Relative Cost Comparison Table Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

Alternative	Cover and Liner Costs (millions)	Storage Tank Costs (millions)	Backup Power and Pump Station Costs (millions)	Total Relative Costs (millions)
1	$56	$0	$0	$56
2	$38	$0	$7.5	$45.5
3	$0	$76	$0	$76
4	$0	$17.4	$10.5*	$27.9
5	$38	$15.6	$0	$53.6
6	$38	$0	$18	$56
7	$0	$42	$10.5*	$52.5
8	$38	$15.6	$10.5*	$64.1

* **Due to the low incremental costs of the backup power, the size of the generators was increased to provide a minimum of 81 mgd of capacity. This provides power to support operation of two treatment trains (56 mgd) at the LFWTP plus 25 mgd of pumping from the Wanaque North finished water supply.**

3. Final Alternatives Definitions

Figure 6.10 shows the alternatives scoring with the relative costs comparisons. Based on the rankings, in combination with the relative costs, it was decided that the alternative evaluation would continue with the following three final alternatives:

- Alternative 4
- Alternative 7
- Alternative 8

As the alternative developed, Alternative 7 developed further into the three separate alternatives (Alternatives 7A, 7B, and 7C). The following describes each of the three sub-alternatives:

<u>Alternative 7A</u> – Replace reservoirs with storage tanks and provide some backup power

- Levine: 5 MG of tank storage
- New Street: 50 MG of tank storage
- Great Notch: 20 MG of tank storage
- 81 mgd of backup power capacity (either the Main Pump Station or LFWTP)

Alternative 7B – Replace reservoirs with storage tanks and provide some backup power

- Levine: 5 MG of tank storage.
- New Street: 50 MG of tank storage.
- Great Notch: 50 MG of tank storage.
- 81 mgd of backup power capacity (either the Main Pump Station or LFWTP).

Alternative 7C – Replace reservoirs with storage tanks and provide some backup power

- Levine: 5 MG of tank storage.
- New Street: 30 MG of tank storage.
- Great Notch: 40 MG of tank storage.
- 81 mgd of backup power capacity (either the Main Pump Station or LFWTP).

As discussions progressed, it was decided that the original Alternative 7 did not have enough storage in the system. Alternative 7A provided the minimum storage required to meet the calculated storage volumes for each gradient. Alternative 7B included all of the required calculated storage volume plus an additional 30 MG for regional reliability. Alternative 7C included the minimum storage required to meet the calculated storage volumes with a shift in storage to the 427 Gradient to supply some additional regional reliability with minimal impact to water age.

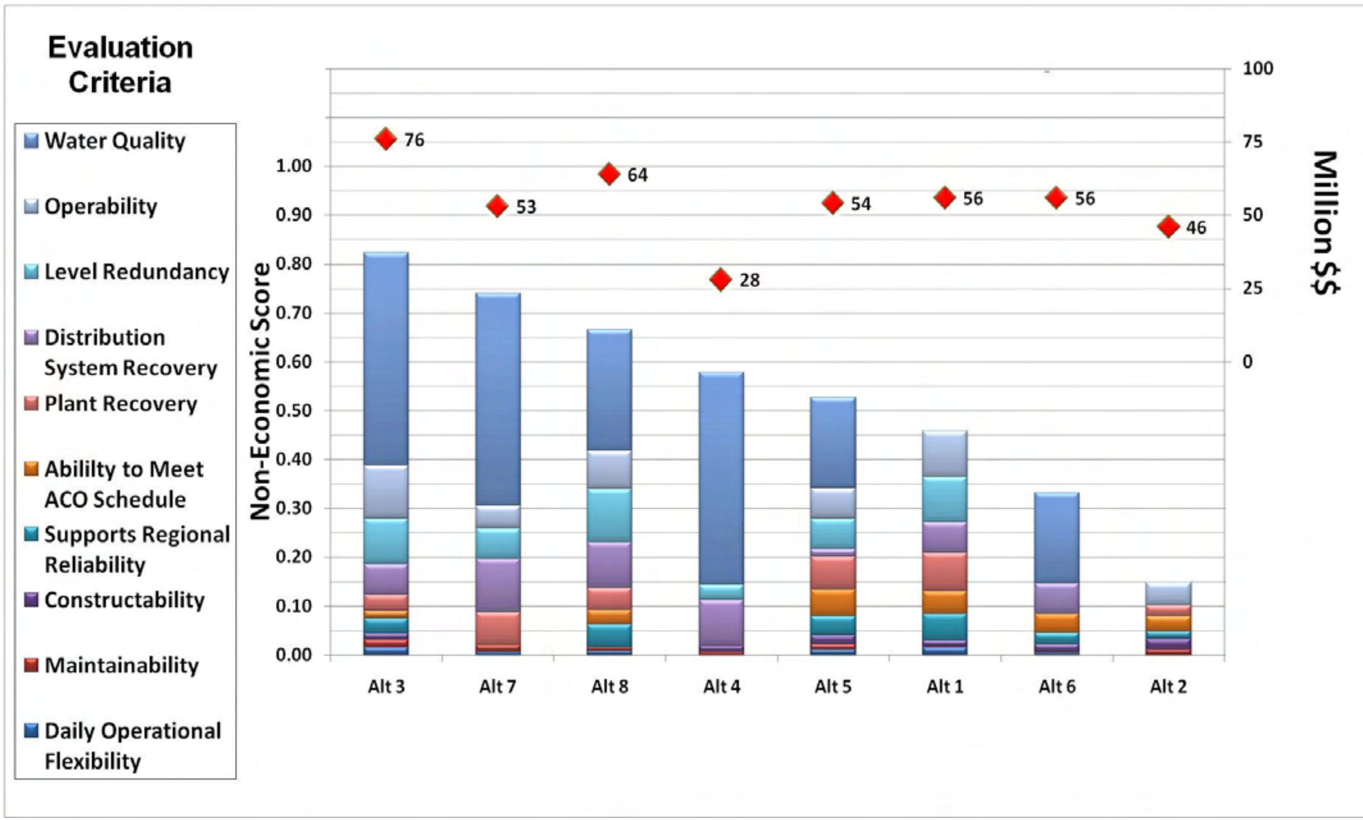

Figure 6.10
Alternatives Scoring with Relative Cost Comparisons
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

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Specifics on each of the Alternatives are discussed in the following sections including requirements for additional pumping capacity and additional storage at the Verona tank site.

4. Reservoir Alternative 4

This alternative eliminates the existing reservoirs and replaces them with minimal tank storage. Emergency back-up power would also be provided at the LFWTP. Specifics associated with this alternative are summarized below:

- Minimum storage was determined by regulations.
- Storage at Great Notch Reservoir would be 3 MG tank storage.
- Storage at New Street reservoir would be 23 MG tank storage.
- Storage at Levine Reservoir would be 5 MG tank storage.
- The emergency back-up power generators were sized to allow 81 mgd from the Main Pump Station and/or operate the LFWTP. The incremental cost to allow 25 mgd to be pumped from the Main Pump Station and operate the LFWTP at 56 mgd capacity was relatively small, so the generators were upsized to accommodate this flow condition.

It was assumed for each alternative where the addition of storage tanks was considered to replace the reservoir that pre-stressed concrete tanks would be constructed, with the exception of the Levine Tank. Due to the significant storage volume required, pre-stressed concrete is the most cost effective option and minimizes long-term corrosion and maintenance. The storage volumes and the number of tanks resulted in large diameter tanks. The overall height of the tanks was limited by aesthetic reasons in some options, as well as transportation (shipping) reasons for others. It was also assumed that two tanks would be provided for each prestressed tank option, with each tank sized for 50 percent of the total volume required. This was assumed so that sufficient reliability and redundancy is provided. One tank can remain in operation and serve the respective pressure zone while the other is isolated and maintenance performed. A complete system shutdown for routine maintenance, inspection, or disinfection is highly unlikely with two tanks.

a) Great Notch Reservoir

The lowest historical water level for the Great Notch Reservoir is 418 feet, while the minimum elevation to supply Garret Heights is 422 feet. The maximum hydraulic grade line (maximum water surface elevation) within the reservoir is 427 feet. It is also important to note that, that this reservoir has a drainage area of 146.5 acres. Any alternative developed for this area must include provisions for stormwater detention associated with eliminating this as a finished water reservoir.

1. Option 1 – Locate Tanks Downstream of Demolished Dam

The existing dam would be demolished and new stormwater ponds would then be constructed within the reservoir area to allow for detention of stormwater. The release of stormwater from the ponds would be controlled to maintain the existing hydrograph of the area. Pre-stressed concrete storage tanks would be located in the area downstream of the former dam and connect to the two 48-inch lines that currently serve the reservoir.

Advantages

- Demolition of the dam (constructed in 1900) would eliminate the extensive permitting requirements and maintenance associated with the dam.
- The new finished water storage tanks would be located near the existing 48-inch piping, so minimal piping work would be required for connection to the system.
- The new stormwater system and detention ponds could be constructed to return the stormwater flow to its natural path.
- The area where water is currently impounded may be re-vegetated.
- Access to the storage tanks would be provided by Reservoir Road.

Disadvantages

- Existing grade downstream of the dam is approximately elevation of 380 feet. Either significant compacted fill material would need to be imported to raise the bottom of the tank to a minimum elevation of 418 feet or, if the tank were located at existing grade, the volume of water stored below elevation 418 feet would not be useable towards the minimum storage requirements.
- From discussions with PVWC staff, it was understood that unsuitable subgrade material exists downstream of the existing dam and would significantly complicate the tank foundation design.
- Existing vegetation in the area would be removed to facilitate placement of the tanks.

2. **Option 2 – Locate Tanks Outside of Existing Reservoir Impoundment Area**

This option was considered, primarily because it would allow the Great Notch Reservoir to be converted from a potable water storage reservoir to a stormwater storage pond. Pre-stressed concrete storage tanks would be located in the area to the west of the mid-point of the reservoir on the hillside. New piping would be constructed to connect the new storage tanks to the existing 48-inch pipes to the potable water system.

Advantages

- Potable water storage system would be completely separated from the Great Notch Reservoir and dam structure.
- No new stormwater detention facilities would be required, as the existing reservoir would be converted to a large stormwater storage reservoir.
- No modifications within the dam would be required for the piping.
- Access to the new tanks would provided by Old Rifle Camp Road.

Disadvantages

- The dam permit would need to remain, along with all necessary inspections and requirements.
- Buried storage tanks would most likely be located in rock excavation resulting in higher construction costs.
- Not enough area for big tanks
- Elevations are too high
- Major piping modifications would be required

3. **Option 3 – Locate Tanks in North-East Corner of Existing Reservoir Area**

In this option, the new finished water storage tanks would be located within the footprint of the existing reservoir. An area in the northeast quadrant of the reservoir was selected as the existing grade elevations would allow a tank to be constructed at grade and provide the hydraulic elevations necessary to tie into the system. The existing dam would be demolished and a new stormwater control strategy will be implemented.

The new tanks would be connected to the existing 36-inch piping that passes through the dam. In addition, the existing 36-inch interconnect piping between Great Notch Reservoir and New Street Reservoir would be connected to the tanks, allowing water to flow by gravity to the New Street Reservoir tanks. The high water level in the new Great Notch Reservoir tanks would be 447.5 feet and the low water level would be 422 feet.

Figure 6.11 show Great Notch Reservoir Alternative 4, the proposed location for the two 1.5-MG pre-stressed concrete storage tanks (3 MG total) within the existing footprint of the reservoir. **Figure 6.12** shows the Great Notch Schematic Alternatives 4 and 7A, and **Figure 6.13** shows the Dam Facilities (Gate House) Alternatives 4 and 7A with additional modifications needed near the dam.

Advantages

- Potable water storage system would be completely separated from the Great Notch Reservoir and dam structure.
- Demolition of the dam (constructed in 1900) would eliminate the extensive permitting and maintenance associated with maintaining the dam.
- New tanks would be located in a cove of the existing reservoir footprint, mostly surrounded by a wooded area, which would minimize the aesthetic impacts of the tanks.
- New stormwater system and detention ponds could be constructed, if required, to return the stormwater flow to its natural path.
- Access to the new tanks would be provided by Rifle Camp Road.

Disadvantages

- New piping would need to be installed within the subgrade of the existing reservoir from the end of the existing piping approximately half the length of the reservoir to the location of the new tanks.

Option 3 was selected for this Great Notch Alternative 4.

KEY NOTES:

1. 100'-0" DIAMETER 1.5 MG STORAGE TANK, HIGH WSEL = 447.50. LOW WSEL = 422.0.
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. CONNECT NEW 36" PIPING TO EXISTING 36" PIPING, APPROXIMATE LOCATION FOR CONNECTION SHOWN.
4. MAX HGL = 427.0 OF EXISTING RESERVOIR.
5. CHECK VALVE VAULT.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD TO RIFLE CAMP ROAD.
8. EXISTING 36" INTERCONNECT BETWEEN NEW STREET RESERVOIR AND GREAT NOTCH RESERVOIR. DEMO EXISTING INLET AND CONNECT NEW PIPING.
9. 36" TANK INTERCONNECTION.
10. NEW STORMWATER POND ELEVATION.
11. DEMOLISH EXISTING DAM.
12. REGRADE AREA USING MATERIAL FROM DAM DEMOLITION.

LAST UPDATED: 07/22/2010 06:37 AM

LAST SAVED BY: jkeistler

PRELIMINARY NOT RELEASED FOR CONSTRUCTION

REV	DATE	BY	DESCRIPTION

DESIGNED CR
DRAWN SJ/TL
CHECKED
DATE March 2010

ENGINEER

PASSAIC VALLEY WATER COMMISSION

FIGURE 6.11

GREAT NOTCH RESERVOIR
ALTERNATIVE 4

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

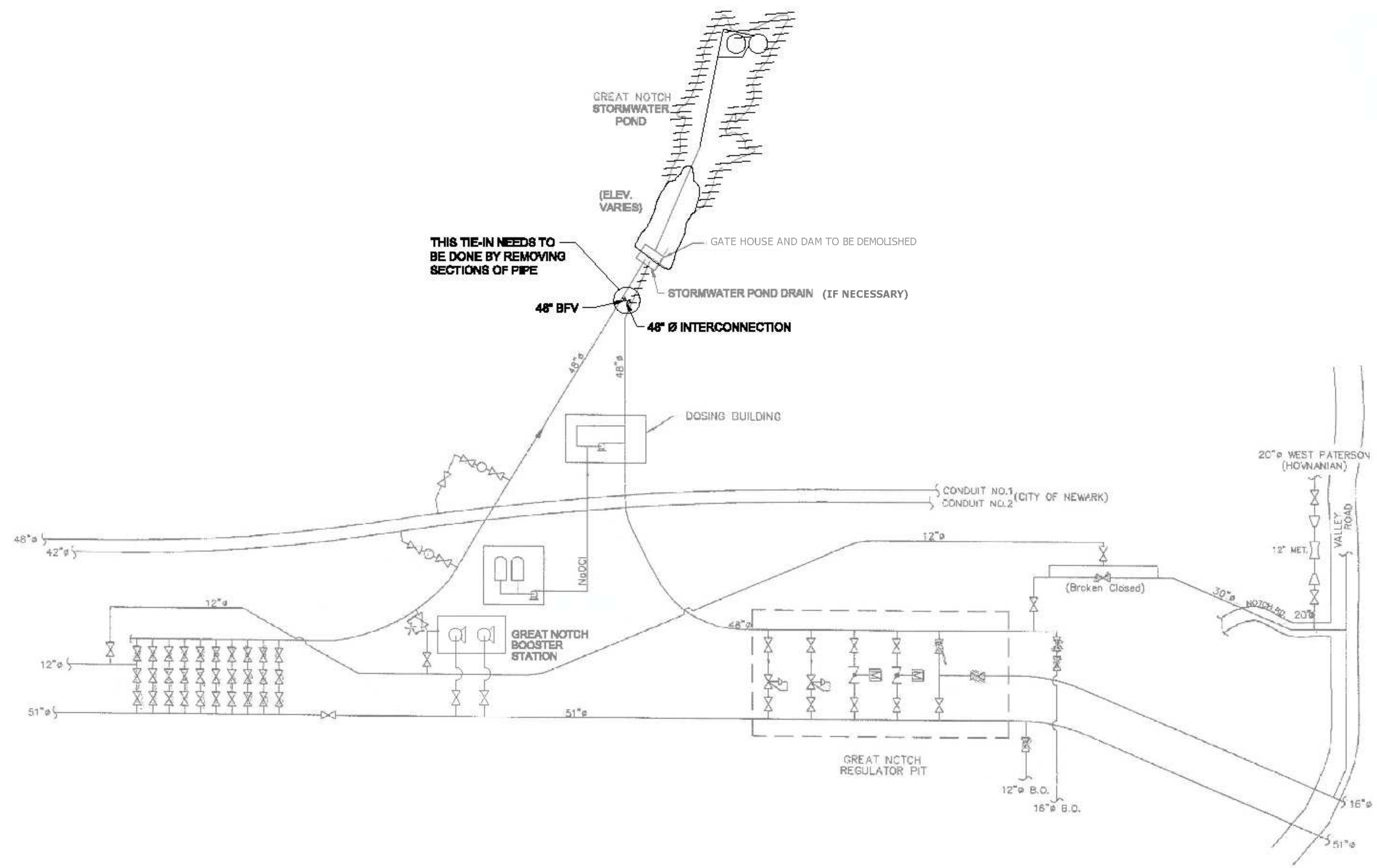
JOB NO. 8378A.00

DRAWING NO.

SHEET NO.

OF

PROJECT NO: FILENAME: great notch reservoir alt 4.dwg PLOT TIME: $TIME$



SCALE: NA

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FIGURE 6.12

GREAT NOTCH SCHEMATIC
ALTERNATIVES 4 & 7A

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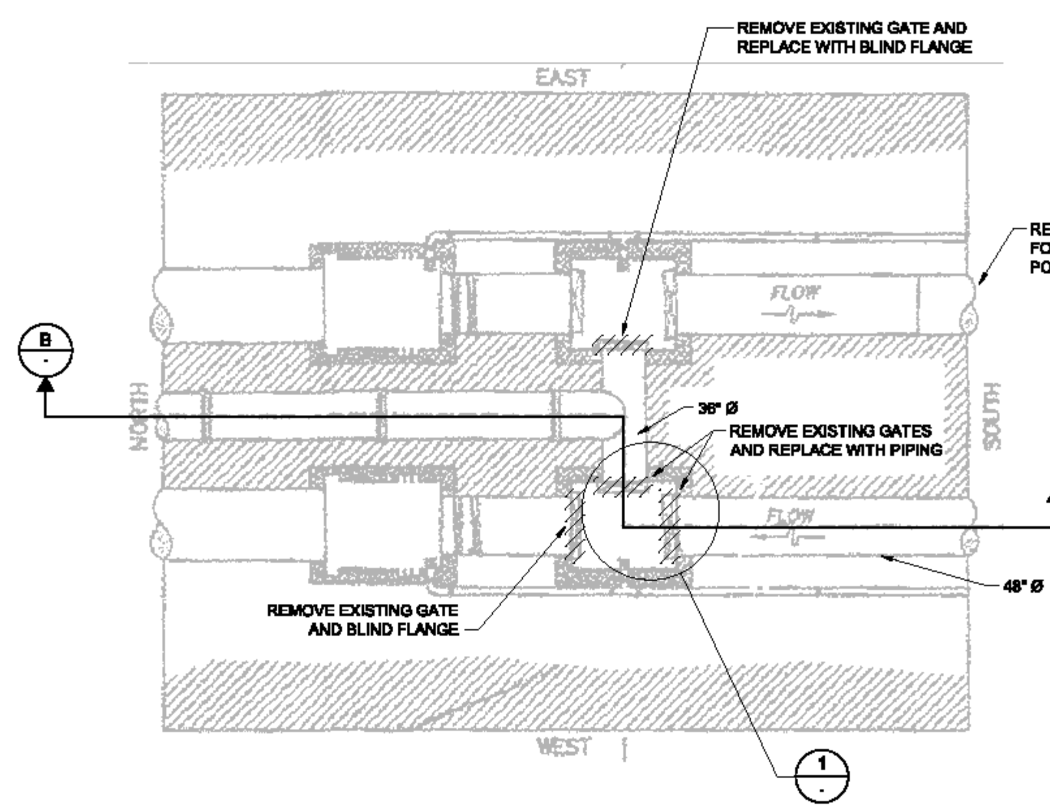
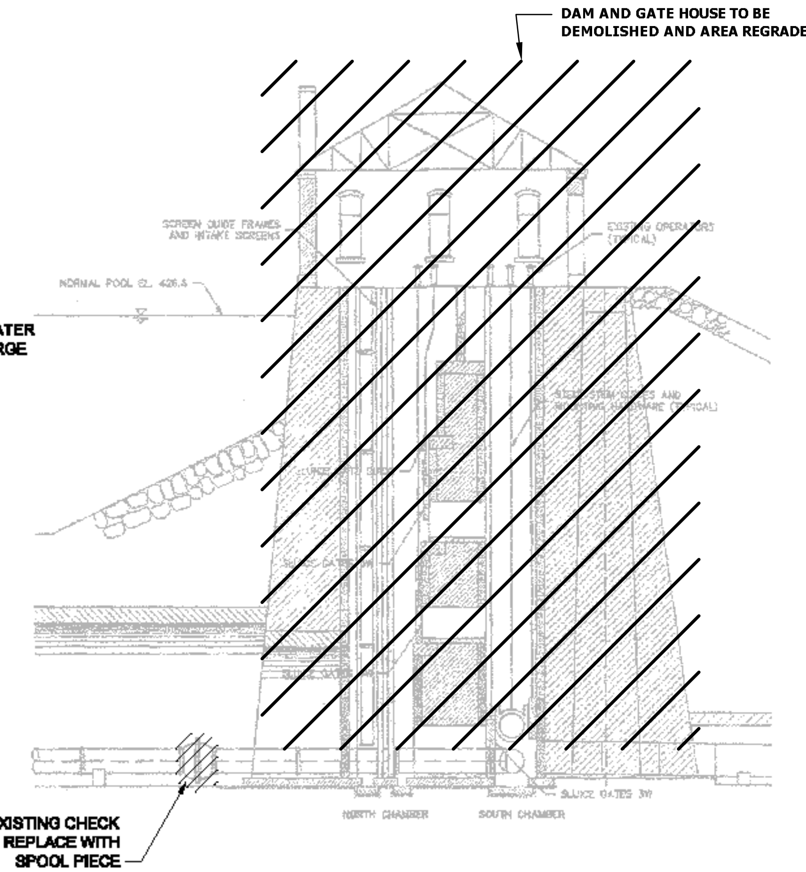
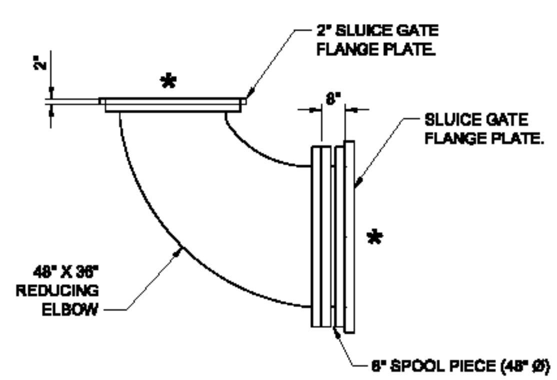


A PLAN OF GATE HOUSE
SCALE: NA



B SECTION THROUGH CHAMBER LOOKING EAST
SCALE: NA



1 DETAIL
SCALE: 3/8" = 1'-0"

* ASSUMES THAT EXISTING GATE CONNECTIONS ARE FLANGED.

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FIGURE 6.13

DAM FACILITIES (GATE HOUSE)
ALTERNATES 4 & 7A

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PROJECT NO:
FILENAME: DAM Facilities (Gate House and Spillway) Alternatives 4 & 7A.dwg

b) New Street Reservoir

The lowest historical water level for the New Street Reservoir was 288 feet. The maximum hydraulic grade line (maximum water surface elevation) within the reservoir is 300 feet. It is also important to note that this reservoir has a drainage area of 14.1 acres. Any alternative developed for this area must include provisions for stormwater facilities associated with eliminating this as a finished water reservoir.

1. **<u>Option 1 – Locate Tanks at an Elevation High Enough to Consolidate the</u> 300 and 330 Gradients (Within Existing Reservoir Footprint)**

   This option considered locating the tanks at elevations sufficient to consolidate the 300 and 330 Gradients by serving both. Both tanks would be installed within the existing reservoir footprint. In order to do this, and get the tanks to an elevation to sufficiently serve the 330 Gradient, significant compacted fill material would need to be imported to raise the bottom of the tank to a minimum elevation of 330 feet or, if the tank were located at existing grade, the volume of water stored below elevation 288 feet would not be useable towards the minimum storage requirement.

   Existing piping would be modified to connect the New Street Tanks with the Great Notch Tanks and Levine Tank. This would allow water to flow by gravity from the Great Notch Tanks to the New Street Tanks, and from the New Street Tanks to the Levine Tank.

   Advantages

   - The 300 and 330 Gradients could be consolidated through the use of these two tanks.
   - The New Street dam could be demolished and new stormwater facilities constructed in the area of the existing reservoir.
   - The existing stormwater features could be modified to tie back into the natural flow path.

   Disadvantages

   - Both tanks would require extensive screening to fit aesthetically within the site. (Two tanks that are 40 feet high would not blend in with the surroundings).
   - Importing the significant compacted fill would be costly and would drastically change the grade of the existing site contours.
   - There would not be much land available for other uses after the tanks and the necessary stormwater facilities are installed.

2. **<u>Option 2 – Locate Tanks Within Existing Reservoir Footprint and Function at Similar Hydraulic Elevations</u>**

   This option considered locating the tanks at elevations to match the operating hydraulic elevations of the existing reservoir. Both tanks would be installed within the existing reservoir footprint. The height of the tanks would be limited to 30 feet, so the top of the tanks would not be higher than the current high water operating level of the New Street Reservoir for aesthetic reasons. Piping would be installed to connect the New Street Tanks with the Great Notch Tanks and Levine Tank. This would allow water to flow by gravity from the Great Notch Tanks to the New Street Tanks, and from the New Street Tanks to the Levine Tank.

Advantages

- Both tanks would fit aesthetically within the site. (Two tanks that are 30 feet high would be installed mostly below grade and the top would be no higher than the existing high water operating level of the reservoir).
- The New Street dam could be demolished and new stormwater facilities constructed in the area of the existing reservoir.
- The existing stormwater features could be modified to tie back into the natural flow path.

Disadvantages

- The 330 Gradient would need to operate as it currently does, as consolidation of the 300 and 330 Gradients is not possible with this alternative.
- Low water levels in the tanks could not serve the 300 gradient, thereby resulting in unusable storage.
- There would not be much land available for other uses after the tanks and the necessary stormwater facilities are installed.
- This option would require significant rock excavation.

3. **Option 3 – Locate Tanks at an Elevation High Enough to Build on Existing Grade**

This option considered locating the tanks at elevations sufficient to consolidate the 300 and 330 Gradient by serving both. The high water surface elevation for both tanks would be 330 feet. The low water surface elevation for both tanks would be 290 feet. The tanks in this alternative would be approximately 222 feet in diameter and 40 feet high. Both tanks would be installed by cutting into the hill at the north end of the reservoir and constructing the tanks so the tanks would be "benched" into the hillside. Pre-stressed concrete storage tanks were selected for this alternative. Piping would be installed to connect the New Street Tanks with the Great Notch Tanks and Levine Tank. This would allow water to flow by gravity from the Great Notch Tanks to the New Street Tanks, and from the New Street Tanks to the Levine Tank.

The existing reservoir would be filled and regraded as necessary to accommodate stormwater detention ponds and site drainage improvements. There may be enough land area left over to accommodate other uses.

Figure 6.14 shows New Street Reservoir Alternatives 4 and 8, the proposed location for the two 11.5-MG pre-stressed concrete storage tanks (23 MG total) at the north end of the reservoir. **Figure 6.15** shows New Street Reservoir Alternatives 4 and 8 and profile a ground surface profile cut through the center of the tanks.

Advantages

- The New Street dam could be demolished and new stormwater facilities constructed as required in the area of the existing reservoir.
- There would be land available for other uses after the tanks and the necessary stormwater facilities are installed.
- The existing stormwater features could be modified to tie back into the natural flow path.
- Does not require significant fill material

.

Disadvantages

- Both tanks would require screening to fit aesthetically within the site. (Two tanks that are 40 feet high would not blend in with the surroundings unless vegetation was planted along the adjacent road).

Option 3 was selected for the New Street Alternative 4.

KEY NOTES:

1. 11.5 MG STORAGE TANK, HIGH WSEL = 330. LOW WSEL = 290.0.
2. LIMITS OF SURVEY, PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. EXISTING MANHOLE. TIE IN AND EXTEND EXISTING 42" PIPING TO NEW RESERVOIRS.
4. DEMOLISH EXISTING DAM.
5. CHECK VALVE VAULT.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD.
8. EXTEND EXISTING ACCESS DRIVE FROM MOUNTAIN AVE. TO NEW WATER STORAGE TANKS.
9. FILL EXISTING RESERVOIR AND REGRADE AS NECESSARY FOR STORMWATER AND SITE DRAINAGE IMPROVEMENTS.

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FIGURE 6.14

NEW STREET RESERVOIR
ALTERNATIVES 4 & 8

VERIFY SCALES
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0 1"
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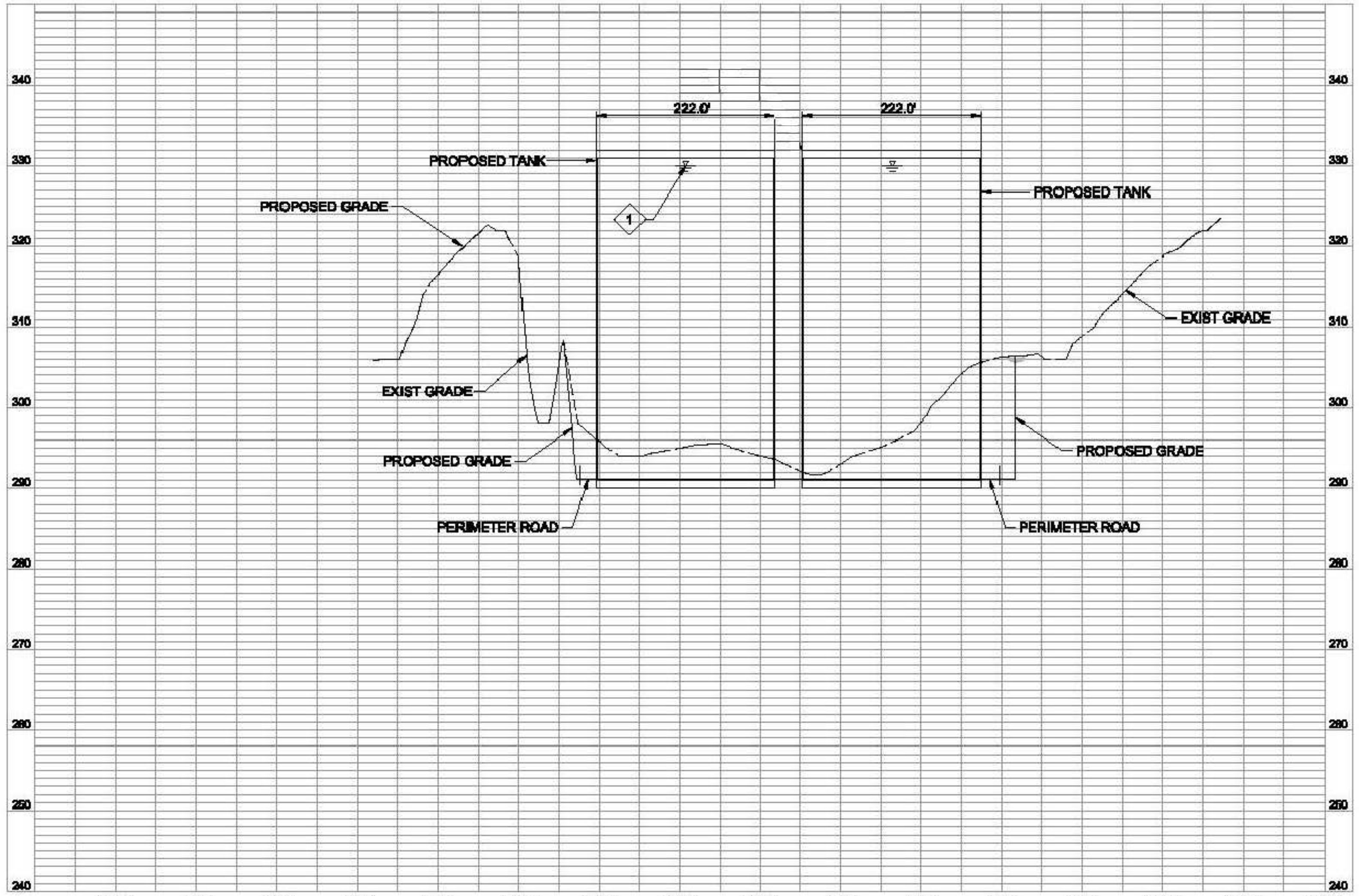
PROJECT NO: 8376A00 FILENAME: new street reservoir alt 4&8.dwg PLOT TIME: $TIME$

KEY NOTES:

(1) 11.5 MG STORAGE TANK, HIGH WSEL = 330.



Hortz scale 1" = 100'
Vert Scale 1" = 10'

PROFILE (1 / FIG 6.14)

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PROJECT NO:

FILENAME: NEW STREET SITE SECTION 5C.dwg PLOT TIME: $TIME$

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FIGURE 6.15

NEW STREET RESERVOIR
ALTERNATIVE 4 & 8 PROFILE

VERIFY SCALES
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OF

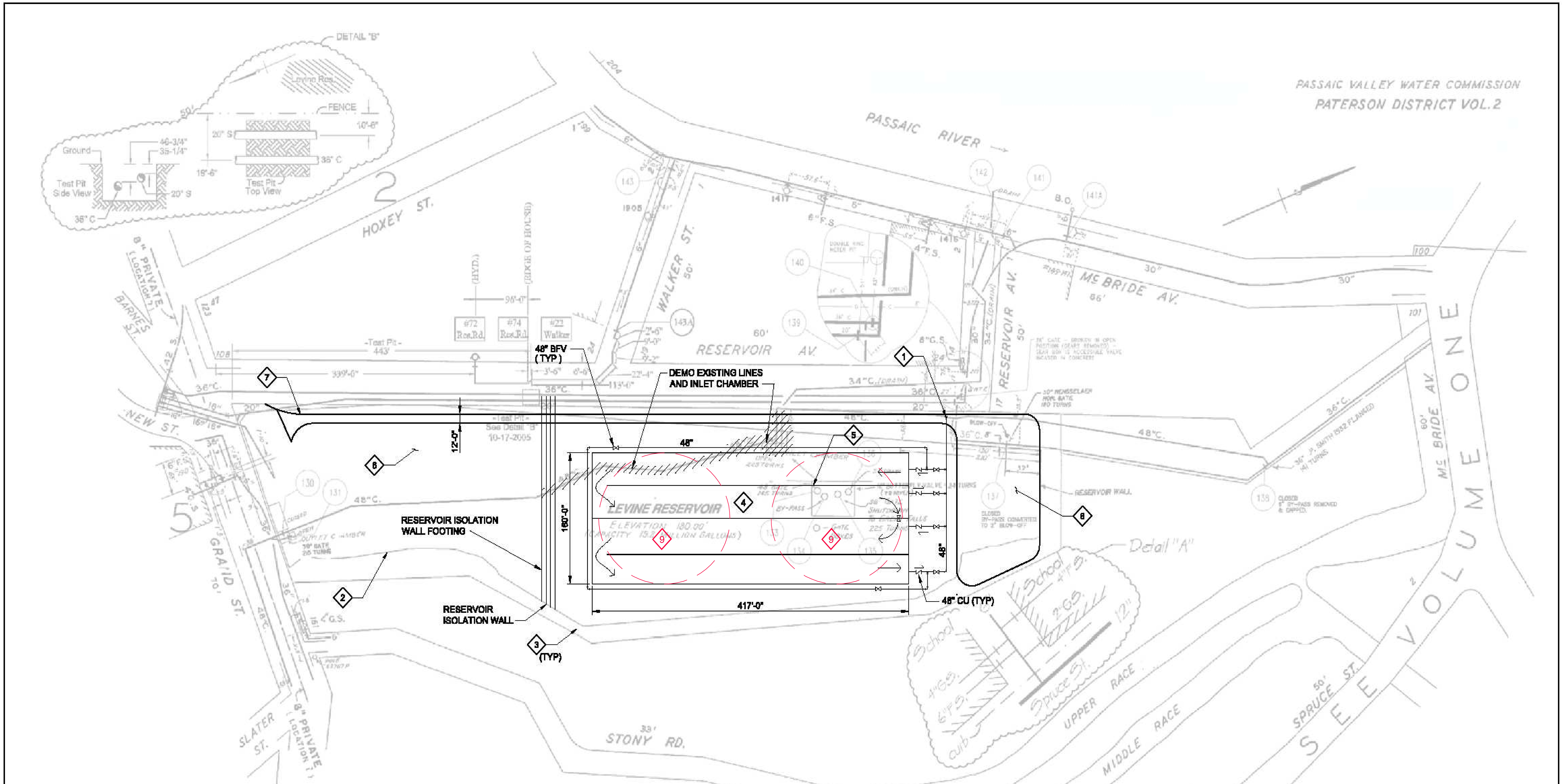
c) **Levine Reservoir**

The lowest historical water level for the Levine Reservoir was 168 feet. The maximum hydraulic grade line (maximum water surface elevation) within the reservoir is 180 feet. It is also important to note that this reservoir has no external drainage area. Therefore, only storm drainage internal to the reservoir footprint would need to be accommodated.

In this alternative, an isolation wall would be installed to separate the north and south halves of the existing reservoir. The south half of the reservoir would be disconnected from the potable water system, but remain filled with water or backfilled for aesthetic purposes.

Two (2) new 2.5 mg prestressed concrete tanks would be constructed within the footprint of the north half of the reservoir. The high water surface elevation for the tanks would be 192 feet. The low water surface elevation for the tanks would be 175 feet. The tanks in this alternative would be approximately 160 feet in diameter by 17 feet high. The new tanks would be connected to the existing 48-inch piping that runs underneath the reservoir. Piping would be installed to connect the Levine Tank to the New Street Tanks. This would allow water to flow by gravity from the New Street tanks to the Levine tank. Due to the site constraints (geometry of the reservoir), there was only one option for the Levine Tank.

Figure 6.16 shows the proposed location for the 5-MG cast-in-place concrete storage tank in the north half of Levine Reservoir.



KEY NOTES:

1. CONNECT NEW 48" PIPING TO EXISTING 48" PIPING, APPROXIMATE LOCATION FOR CONNECTION SHOWN.
2. MAX HGL = 180.0 OF EXISTING RESERVOIR.
3. AREA FROM EDGE OF ISOLATION WALL AND EDGE OF EXISTING RESERVOIR TO NEW STORAGE TANK TO BE BACKFILLED AND LANDSCAPED.
4. 5 MG STORAGE TANK, HIGH WSEL = 180.0. LOW WSEL = 170.0.
5. WATER STORAGE TANK BAFFLING.
6. REMAINING EXISTING RESERVOIR TO BE FILLED WITH WATER FOR AESTHETIC PURPOSES, BUT DISCONNECT FROM THE POTABLE WATER SYSTEM.
7. CONSTRUCT NEW ROAD AT EXISTING SITE ENTRANCE.
8. CONSTRUCT NEW PACKING AREA OVER BACKFILLED PORTION OF RESERVOIR.
9. 2-2.5 MG TANKS, 160' IN DIAMETER, HIGH WSEL=192.0', LOW WSEL=175.0' ARE ALSO BEING CONSIDERED BY THE PVWC

SCALE: NA

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FIGURE 6.16
LEVINE RESERVOIR

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OF

PROJECT NO: 8376A00 FILENAME: Levine Reservoir Figure 16.dwg PLOT TIME: $TIME$

5. Reservoir Alternative 7 (A, B, and C)

- Minimum storage was determined by operational needs and regulations.
- Storage at Great Notch Reservoir Site would be 20 MG for Alternative 7A, 50 MG for Alternative 7B, and 40 MG for Alternative 7C.
- Storage at New Street Reservoir Site would be 50 MG for Alternatives 7A and 7B, and 30 MG for Alternative 7C.
- Storage at Levine Reservoir Site would be 5 MG.
- The emergency back-up power generators were sized to allow 35 mgd from the Main Pump Station and/or operate the LFWTP. The incremental cost to allow 25 mgd to be pumped from the Main Pump Station and operate the LFWTP at 56 mgd capacity was relatively small, so the generators were upsized to accommodate this flow condition.

a) Great Notch Reservoir

The operating conditions, hydraulic requirements, and site considerations are similar to those described previously for Alternative 4.

1. Option 1 – Locate Tanks Downstream of Demolished Dam

This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, except the size of the pre-stressed concrete tanks. They are 10 MG each for a total storage volume of 20 MG for Alternative 7A, 25 MG each for a total storage volume of 50 MG for Alternative 7B, and 20 MG each for a total storage volume of 40 MG for Alternative 7C.

2. Option 2 – Locate Tanks Outside of Existing Reservoir Impoundment Area

This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, except the size of the pre-stressed concrete tanks. They are 10 MG each for a total storage volume of 20 MG for Alternative 7A, 25 MG each for a total storage volume of 50 MG for Alternative 7B, and 20 MG each for a total storage volume of 40 MG for Alternative 7C.

3. Option 3 – Locate Tanks in North-East Corner of Existing Reservoir Area

Option 3 is similar to Alternative 4 and was selected as the chosen site location for all Alternative 7 versions (7A, 7B, and 7C). The following discusses the selected options.

Alternative 7A

This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, except the pre-stressed concrete tanks are 10 MG each for a total storage volume of 20 MG. **Figure 6.17** with the Great Notch Reservoir Alternative 7A shows the proposed location for the two 10-MG pre-stressed concrete storage tanks (20 MG total) within the existing footprint of the reservoir. **Figure 6.12** with the Great Notch Schematic for Alternatives 4 and 7A, and **Figure 6.13** with the Dam Facilities (Gate House) Alternatives 4 and 7A show additional modifications needed near the dam.

Alternative 7B

This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, with some exceptions. The pre-stressed concrete tanks are 25 MG each for a total storage volume of 50 MG. In addition, the new tanks would be connected to both the existing 36-inch piping that passes through the dam and new 36-inch piping that would be installed parallel to the existing piping.

A new Great Notch Pump Station would be added adjacent to the existing Great Notch Pump Station. In addition, a new Reverse Pump Energy Recovery Facility would be installed to recover the majority of energy associated with transferring water to the lower gradients.

Figure 6.18 shows Great Notch Reservoir Alternative 7B, the proposed location for the two 25-MG pre-stressed concrete storage tanks (50 MG total) within the existing footprint of the reservoir. **Figure 6.19** shows a schematic of the new Great Notch Pump Station and Reverse Pump Energy Recovery Facility. **Figure 6.20** shows additional modifications needed near the dam. **Figure 6.21** shows the proposed layout for the new Great Notch Pump Station.

KEY NOTES:

1. 260'-0" DIAMETER 10 MG STORAGE TANK, HIGH WSEL = 447.50. LOW WSEL = 422.0
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. CONNECT NEW 36" PIPING TO EXISTING 36" PIPING, APPROXIMATE LOCATION FOR CONNECTION SHOWN.
4. MAX HGL = 427.0 OF EXISTING RESERVOIR.
5. CHECK VALVE VAULT.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD TO RIFLE CAMP ROAD.
8. EXISTING 36" INTERCONNECT BETWEEN NEW STREET RESERVOIR AND GREAT NOTCH RESERVOIR. DEMO EXISTING INLET AND CONNECT NEW PIPING.
9. 36" TANK INTERCONNECTION.
10. NEW STORMWATER POND ELEVATION.
11. DEMOLISH EXISTING DAM.
12. REGRADE AREA USING MATERIALS FROM DAM DEMOLITION.

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FIGURE 6.17

GREAT NOTCH RESERVOIR
ALTERNATIVE 7A

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KEY NOTES:

1. 410'-0" DIAMETER 25 MG STORAGE TANK, HIGH WSEL = 447.50. LOW WSEL = 422.0.
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. CONNECT NEW 36" PIPING TO EXISTING 36" PIPING, APPROXIMATE LOCATION FOR CONNECTION SHOWN.
4. MAX HGL = 427.0 OF EXISTING RESERVOIR.
5. NEW STORMWATER POND ELEVATION.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD TO RIFLE CAMP ROAD.
8. EXISTING 36" INTERCONNECT BETWEEN NEW STREET RESERVOIR AND GREAT NOTCH RESERVOIR. DEMO EXISTING INLET AND CONNECT NEW PIPING.
9. 36" TANK INTERCONNECTION.
10. DEMOLISH EXISTING DAM.
11. REGRADE AREA USING MATERIAL FROM DAM DEMOLITION.

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FIGURE 6.18

GREAT NOTCH RESERVOIR ALTERNATIVE 7B

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PROJECT NO: 8378A00 FILENAME: great notch reservoir alt 7B.dwg PLOT TIME: $TIME$

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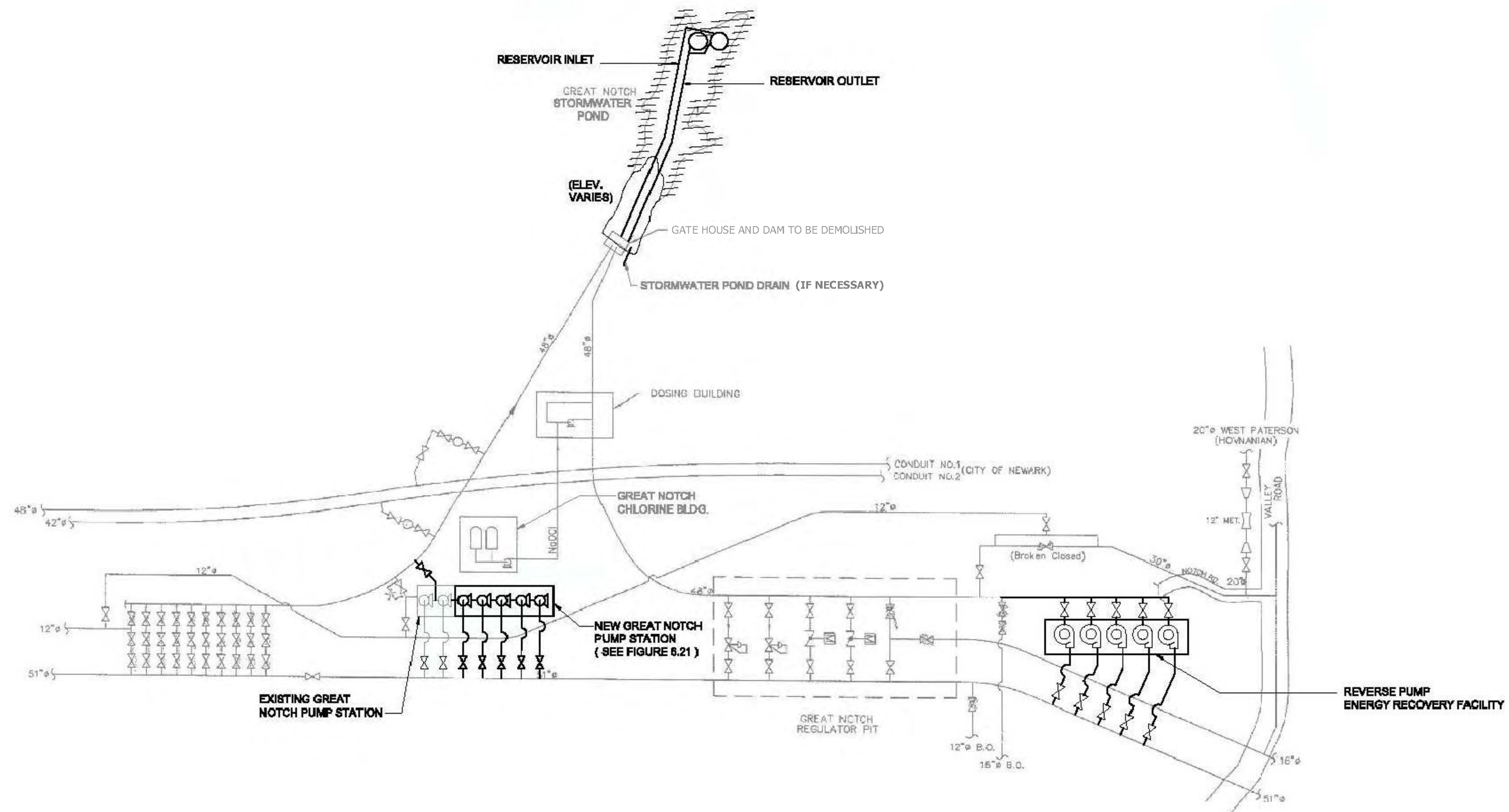

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PROJECT NO: FILENAME: Great notch schematic alt 7b and 8.dwgPLOT TIME: $TIME$

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FIGURE 6.19

GREAT NOTCH SCHEMATIC
ALTERNATIVE 7B AND 8

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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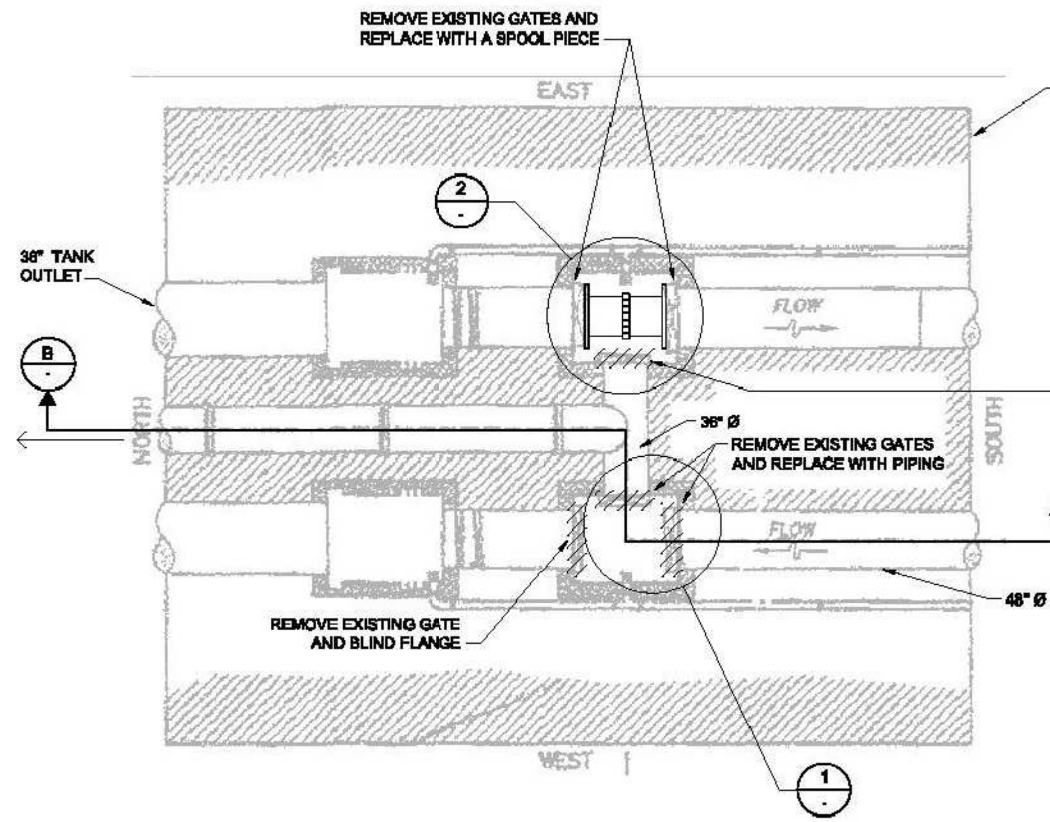
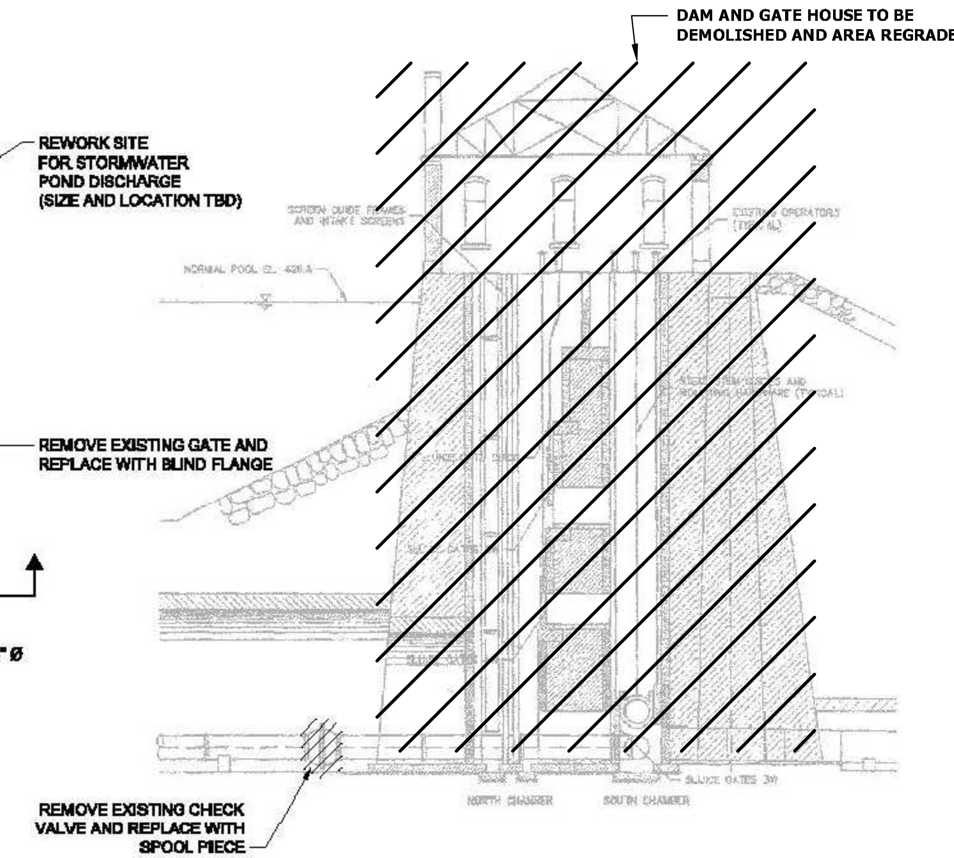
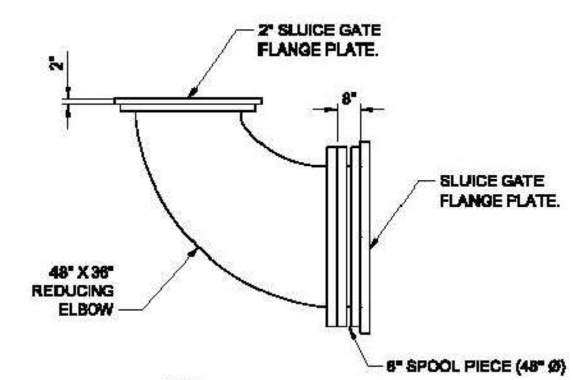


A PLAN OF GATE HOUSE
SCALE: NA



B SECTION THROUGH CHAMBER LOOKING EAST
SCALE: NA



1 DETAIL
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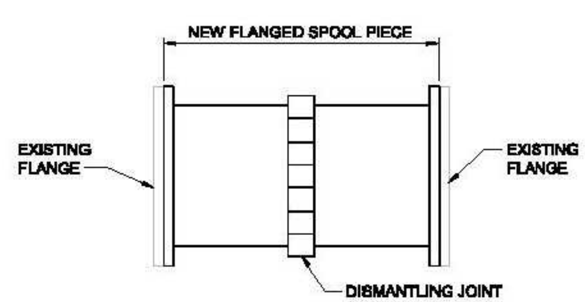

2 DETAIL
SCALE: NA

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FIGURE 6.20

DAM FACILITIES (GATE HOUSE)
ALTERNATES 7B, 7C, & 8

VERIFY SCALES
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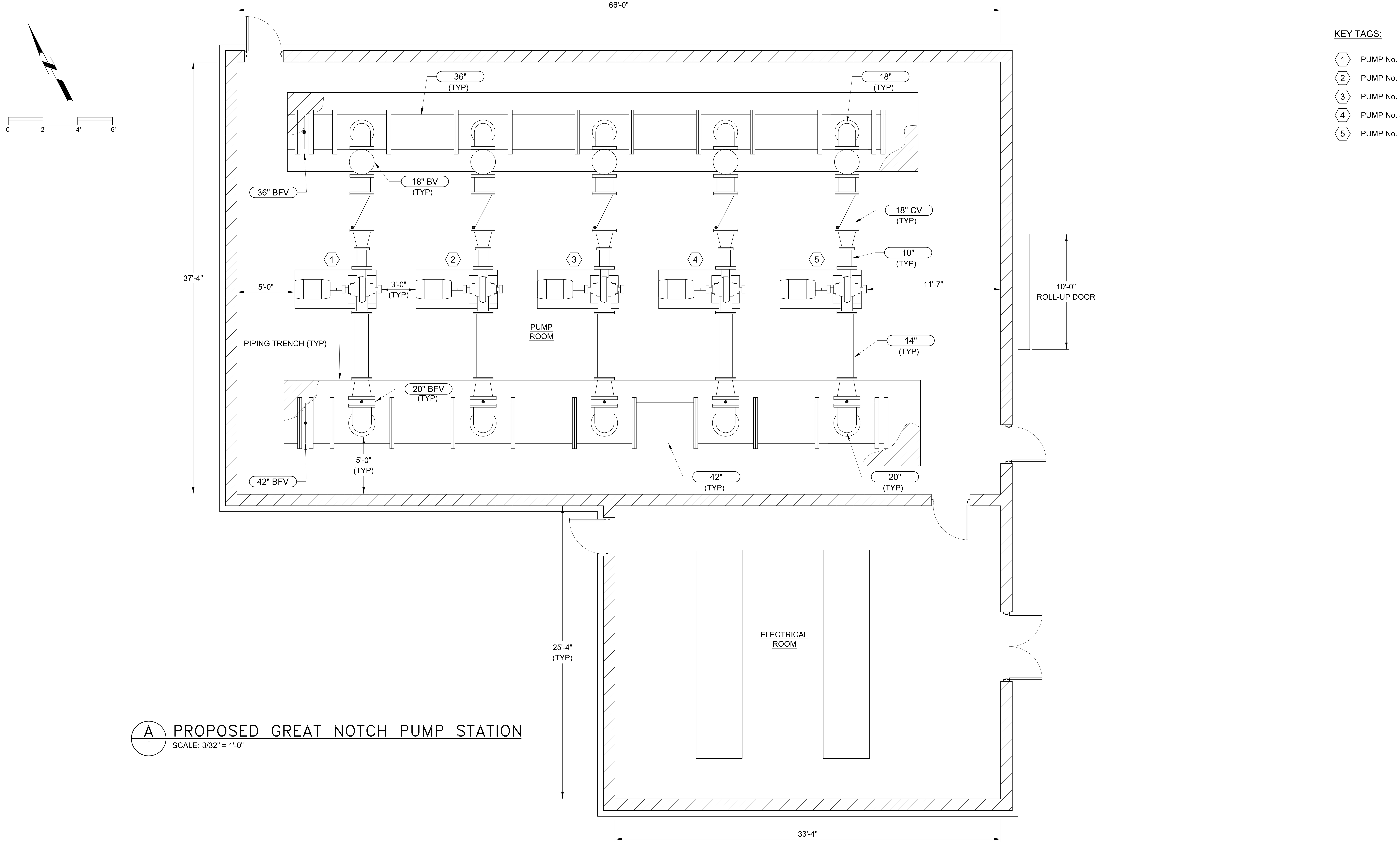
PROJECT NO: 8378A00
FILENAME: DAM Facilities (Gate House and Spillway) .dwg



A PROPOSED GREAT NOTCH PUMP STATION

SCALE: 3/32" = 1'-0"

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FIGURE 6.21

PROPOSED GREAT NOTCH PUMP STATION

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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OF

PROJECT NO:

FILENAME: Proposed Great Notch Pump Station.dwg

PLOT TIME: $TIME$

Alternative 7C
This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, with some exceptions. The pre-stressed concrete tanks are 20 MG each for a total storage volume of 40 MG. In addition, the new tanks would be connected to both the existing 36-inch piping that passes through the dam and new 36-inch piping that would be installed parallel to the existing piping.

The Great Notch Tanks would be connected by new piping to the New Street Tanks and New Street Pump Station. Water would be able to flow in both directions between the Great Notch Tanks and the New Tanks.

Figure 6.22 shows Great Notch Reservoir Alternative 7C, the proposed location for the two 20-MG pre-stressed concrete storage tanks (40 MG total) within the existing footprint of the reservoir. **Figure 6.23** shows the Alternative 7C schematic of the new Great Notch Pump Station and New Street Pump Station. **Figure 6.20** shows additional modifications needed near the dam for Alternatives 7B, 7C, and 8.

b) New Street Reservoir
The operating conditions, hydraulic requirements, and site considerations are similar to those described previously for Alternative 4.

1. **Option 1 – Locate Tanks at an Elevation High Enough to Consolidate the 300 and 330 Gradients (Within Existing Reservoir Footprint)**
   This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, except the pre-stressed concrete tanks are 25 MG each for a total storage volume of 50 MG for Alternatives 7A and 7B, and 15 MG each for a total storage volume of 30 MG for Alternative 7C.

2. **Option 2 – Locate Tanks Within Existing Reservoir Footprint and Function at Similar Hydraulic Elevations**
   This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, except the pre-stressed concrete tanks are 25 MG each for a total storage volume of 50 MG for Alternatives 7A and 7B, and 15 MG each for a total storage volume of 30 MG for Alternative 7C.

3. **Option 3 – Locate Tanks at an Elevation High Enough to Build on Existing Grade**
   This option (including the advantages and disadvantages) is similar to the one described in Alternative 4, except the pre-stressed concrete tanks are 25 MG each for a total storage volume of 50 MG for Alternatives 7A and 7B, and 15 MG each for a total storage volume of 30 MG for Alternative 7C.

KEY NOTES:

1. 365'-0" DIAMETER 20 MG STORAGE TANK, HIGH WSEL = 447.50. LOW WSEL = 422.0.
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. CONNECT NEW 36" PIPING TO EXISTING 36" PIPING, APPROXIMATE LOCATION FOR CONNECTION SHOWN.
4. MAX HGL = 427.0 OF EXISTING RESERVOIR.
5. NEW STORMWATER POND ELEVATION.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD TO RIFLE CAMP ROAD.
8. EXISTING 36" INTERCONNECT BETWEEN NEW STREET RESERVIOR AND GREAT NOTCH RESERVOIR. DEMO EXISTING INLET AND CONNECT NEW PIPING.
9. 36" TANK INTERCONNECTION.
10. DEMOLISH EXISTING DAM.
11. REGRADE AREA USING MATERIAL FROM DAM DEMOLITION.

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FIGURE 6.22

GREAT NOTCH RESERVOIR
ALTERNATIVE 7C

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8378A.00
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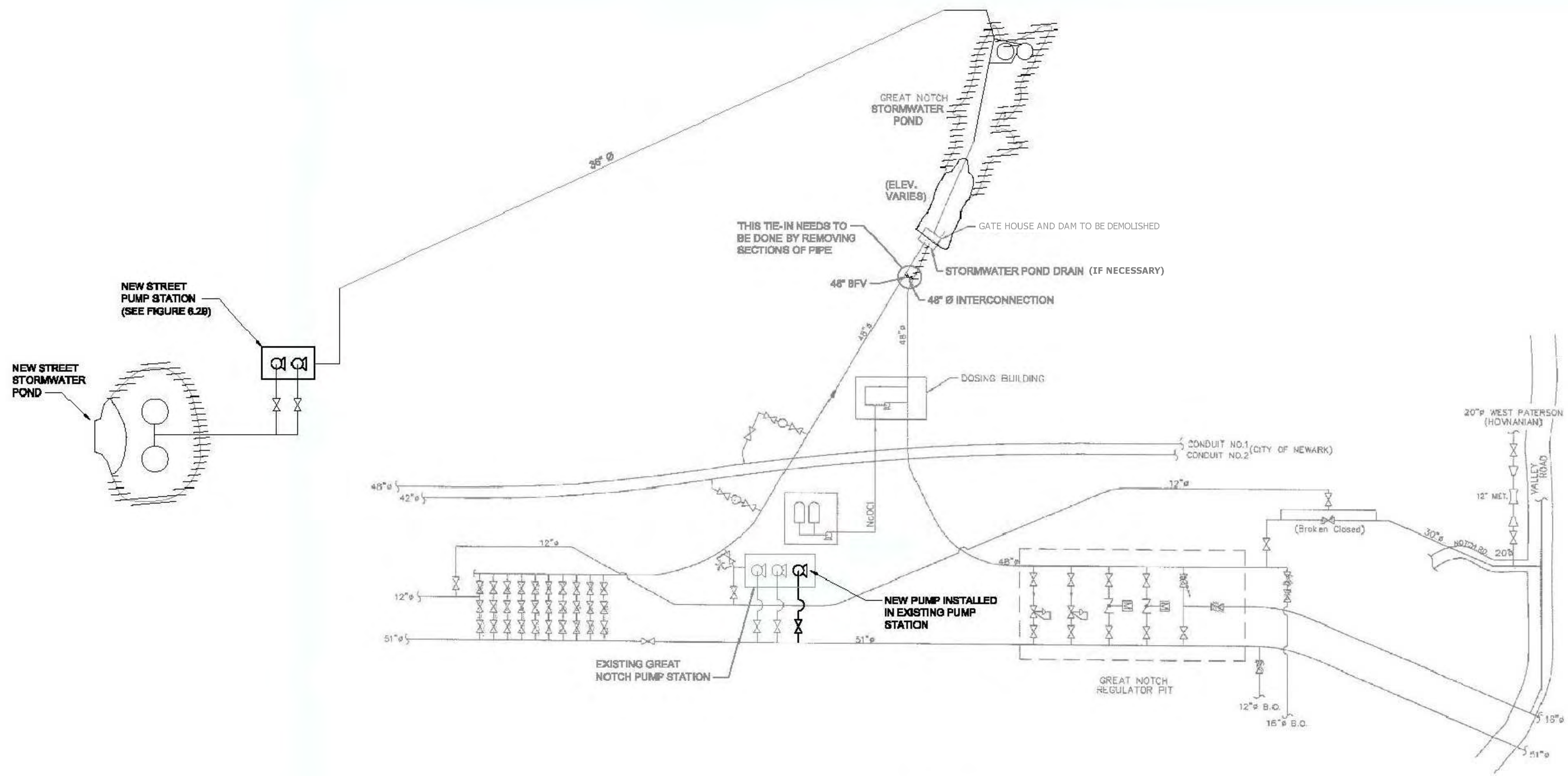
SHEET NO.
OF

PROJECT NO: 8378A00 FILENAME: great notch reservoir alt 7C Fig 21.dwg PLOT TIME: $TIME$



SCALE: NA

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FIGURE 6.23

GREAT NOTCH SCHEMATIC
ALTERNATIVE 7C

VERIFY SCALES
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DRAWING NO.
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OF

PROJECT NO: 8376A00 FILENAME: Great notch schematic alt 7 Fig 24.dwg PLOT TIME: $TIME$

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LAST SAVED BY: jbaider

In addition, Alternative 7C includes a New Street Pump Station that would be constructed with piping connecting the New Street Tanks to the Great Notch Tanks. The pump station would provide the ability for water to flow in both directions between the New Street Tanks and the Great Notch Tanks. New piping would also be installed to connect the New Street Tanks to the Levine Tank, allowing gravity flow of water to the Levine Tank.

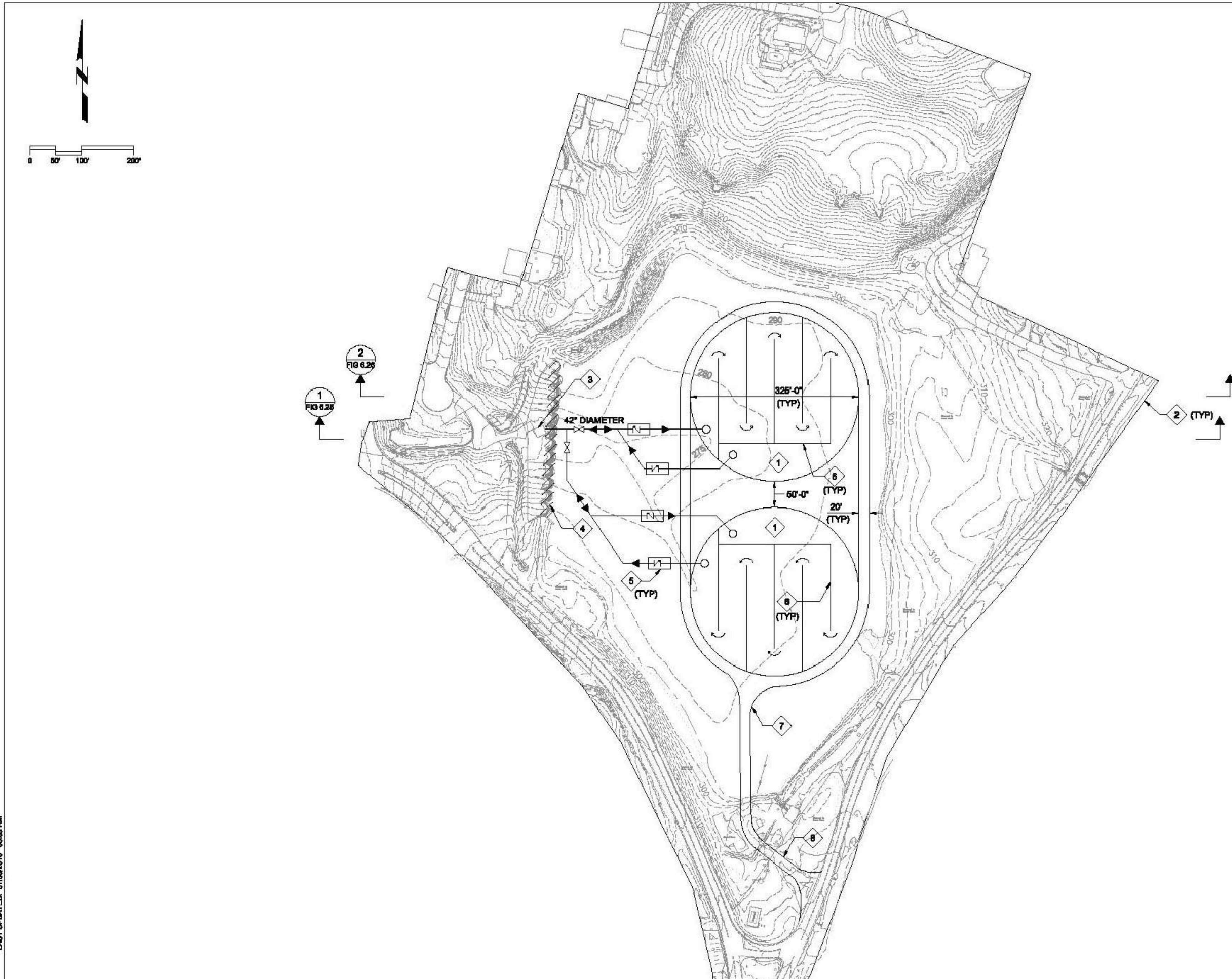
Option 3 was selected for all Alternative 7 options.

Figure 6.24 shows New Street Reservoir Alternatives 7A and 7B with the proposed location for the two 25 MG pre-stressed concrete storage tanks (50 MG total) within the existing foot print of the reservoir. **Figure 6.25** shows New Street Reservoir Alternatives 7A and 7B Profile 1. **Figure 6.26** shows New Street Reservoir Alternatives 7A and 7B Profile 2 with a ground surface profile cut through different locations of the tanks.

Figure 6.27 shows New Street Reservoir Alternative 7C, the proposed location for the two 15-MG pre-stressed concrete storage tanks (30 MG total) within the existing footprint of the reservoir. **Figure 6.28** shows the New Street Reservoir Alternative 7C Profile with a ground surface profile cut through the center of the tanks. **Figure 6.23** shows a schematic of how the New Street Pump Station connects to the Great Notch Tanks and piping (Alternative 7C). **Figure 6.29** shows the proposed layout for the New Street Pump Station (Alternative 7C).

c) Levine Reservoir

The modifications to Levine Reservoir Site for this alternative are identical to those described previously for Alternative 4.



KEY NOTES:

1. 25 MG STORAGE TANK, HIGH WSEL = 330
   LOW WSEL = 290.
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. EXISTING MANHOLE. TIE IN AND EXTEND EXISTING 42" PIPING TO NEW RESERVOIRS.
4. DEMOLISH EXISTING DAM.
5. CHECK VALVE VAULT.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD.
8. EXTEND EXISTING ACCESS DRIVE FROM MOUNTAIN AVE. TO NEW WATER STORAGE TANKS.
9. FILL EXISTING RESERVOIR AND REGRADE AS NECESSARY FOR STORMWATER AND SITE DRAINAGE IMPROVEMENTS.

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FIGURE 6.24

NEW STREET RESERVOIR
ALTERNATIVE 7A & 7B

VERIFY SCALES
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OF

PROJECT NO: 8376A00 FILENAME: new street reservoir alt 7.dwg PLOT TIME: $TIME$

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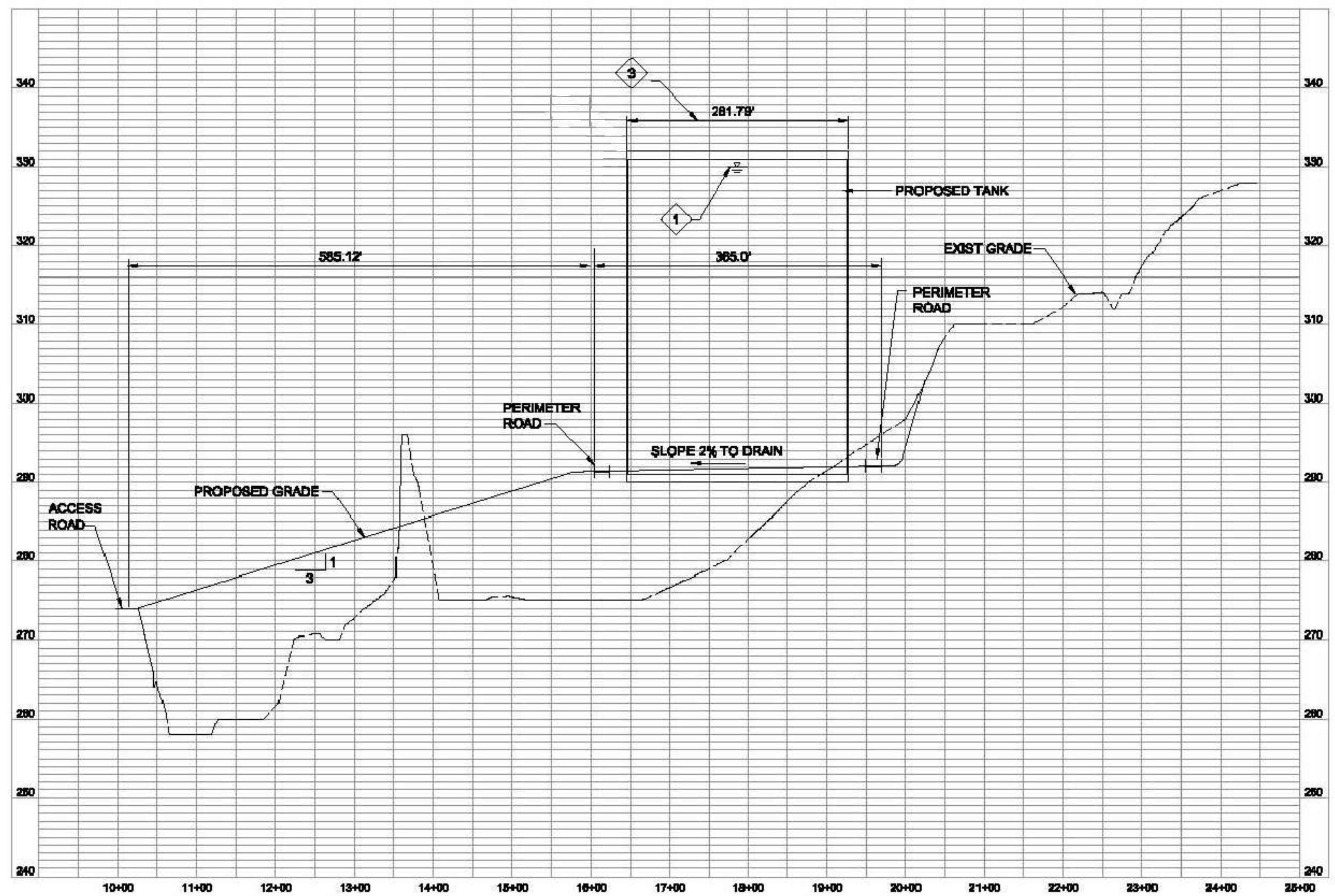
KEY NOTES:

1. 25 MG STORAGE TANK, HIGH WSEL = 330.

3. SECTION DOES NOT PASS THROUGH CENTER OF THE TANK (325' Ø TANK)



Hortz scale 1" = 100'
Vert Scale 1" = 10'

PROFILE (1 / FIG 6.24)

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PROJECT NO: 6376A00 FILENAME: NEW STREET SITE SECTION 5A.dwg PLOT TIME: $TIME$

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FIGURE 6.25

NEW STREET RESERVOIR
ALTERNATIVE 7A & 7B PROFILE 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 6376A.00

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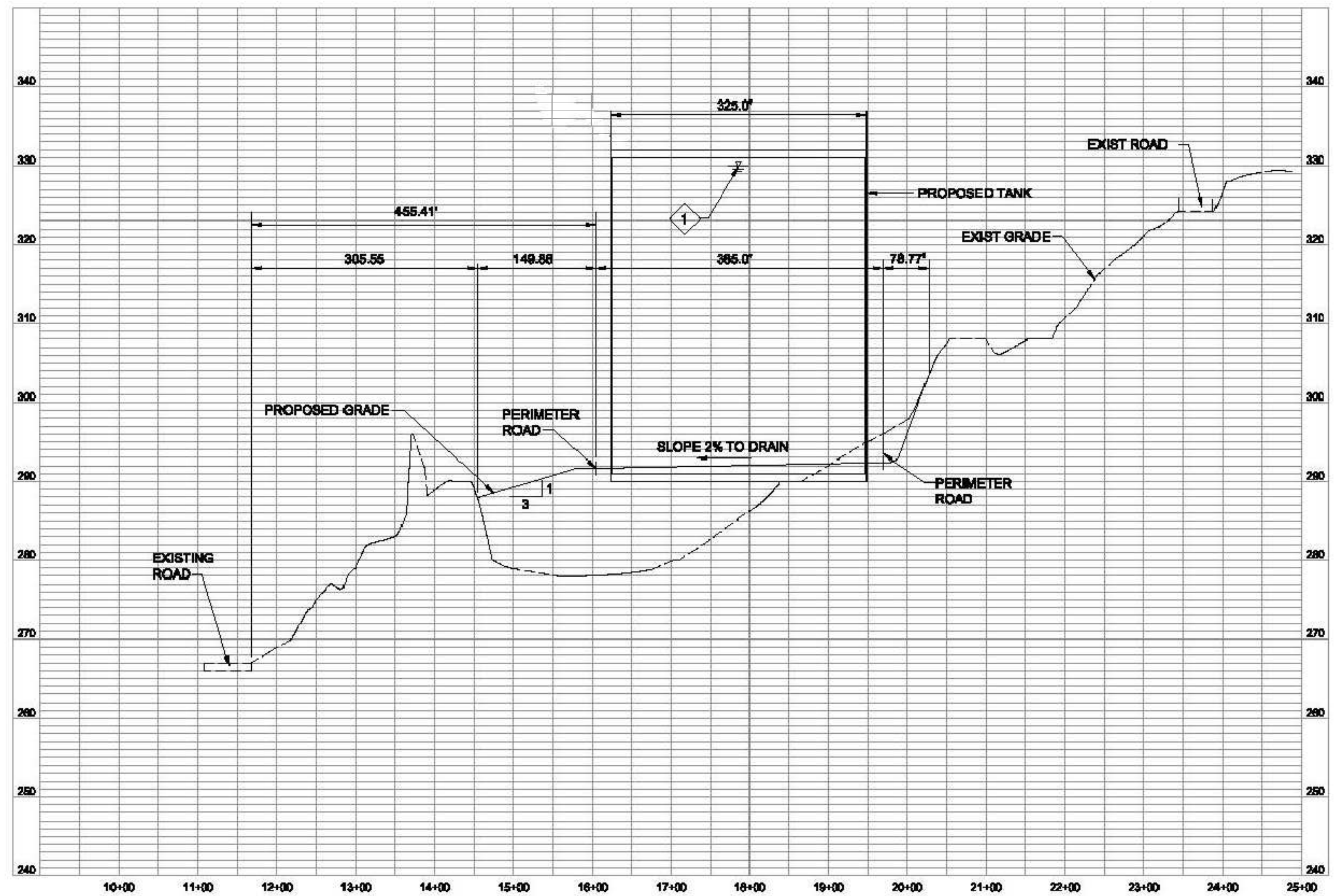
SHEET NO.
OF

KEY NOTES:

1. 25 MG STORAGE TANK, HIGH WSEL = 330.



Hortz scale 1" = 100'
Vert Scale 1" = 10'

PROFILE 2 FIG 6.24

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FIGURE 6.26

NEW STREET RESERVOIR
ALTERNATIVE 7A & 7B PROFILE 2

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 6376A.00
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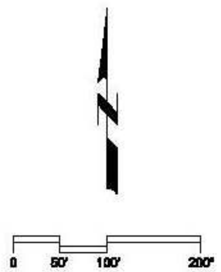
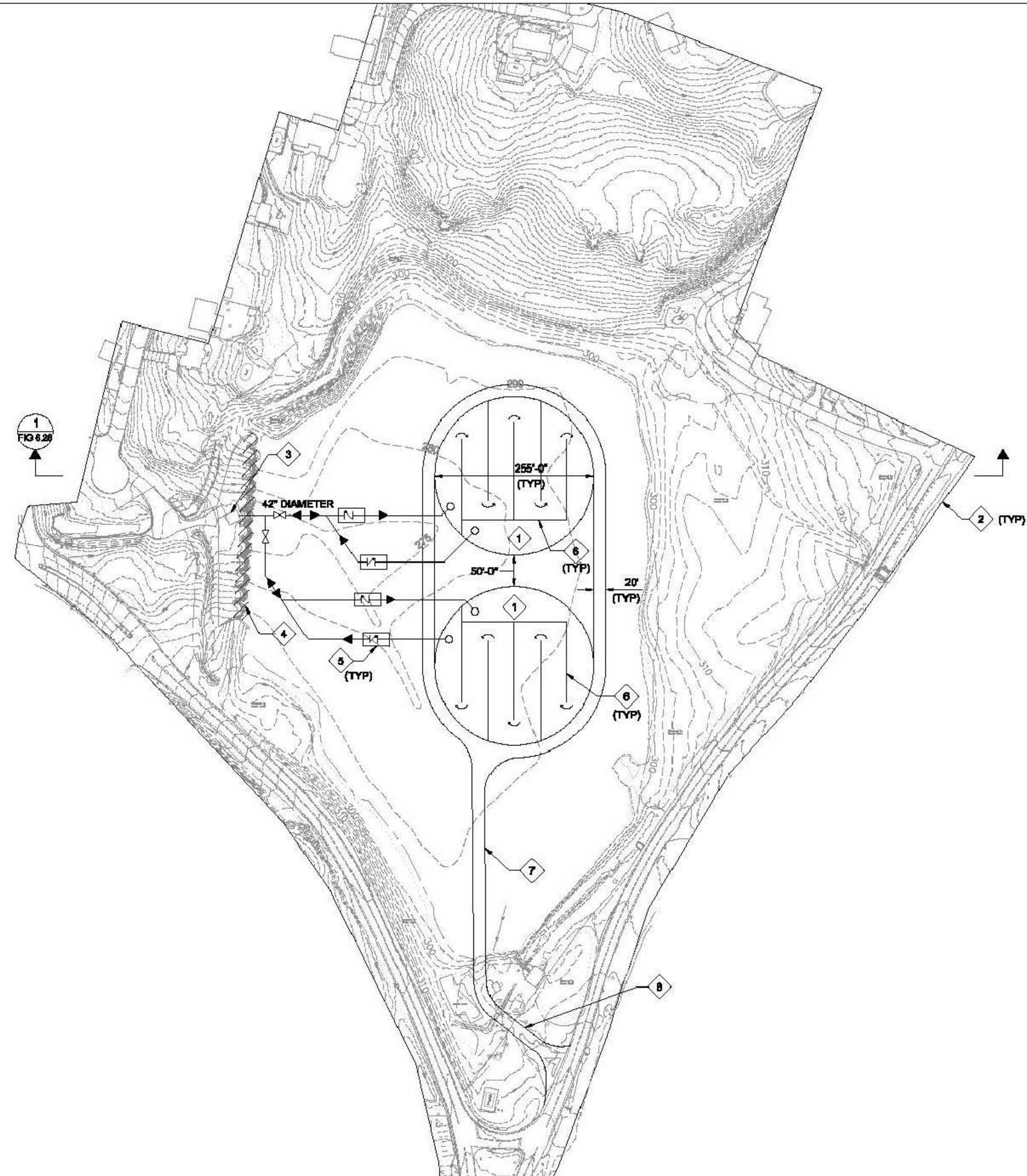
SHEET NO.
OF

PROJECT NO: 6376A00 FILENAME: NEW STREET SITE SECTION 5B.dwg PLOT TIME: $TIME$





KEY NOTES:

1. 15 MG STORAGE TANK, HIGH WSEL = 330
   LOW WSEL = 290.
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. EXISTING MANHOLE. TIE IN AND EXTEND EXISTING 42" PIPING TO NEW RESERVOIRS.
4. DEMOLISH EXISTING DAM,
5. CHECK VALVE VAULT.
6. WATER STORAGE TANK BAFFLING.
7. ACCESS ROAD.
8. EXTEND EXISTING ACCESS DRIVE FROM MOUNTAIN AVE. TO NEW WATER STORAGE TANKS.

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FIGURE 6.27

NEW STREET RESERVOIR
ALTERNATIVE 7C

VERIFY SCALES
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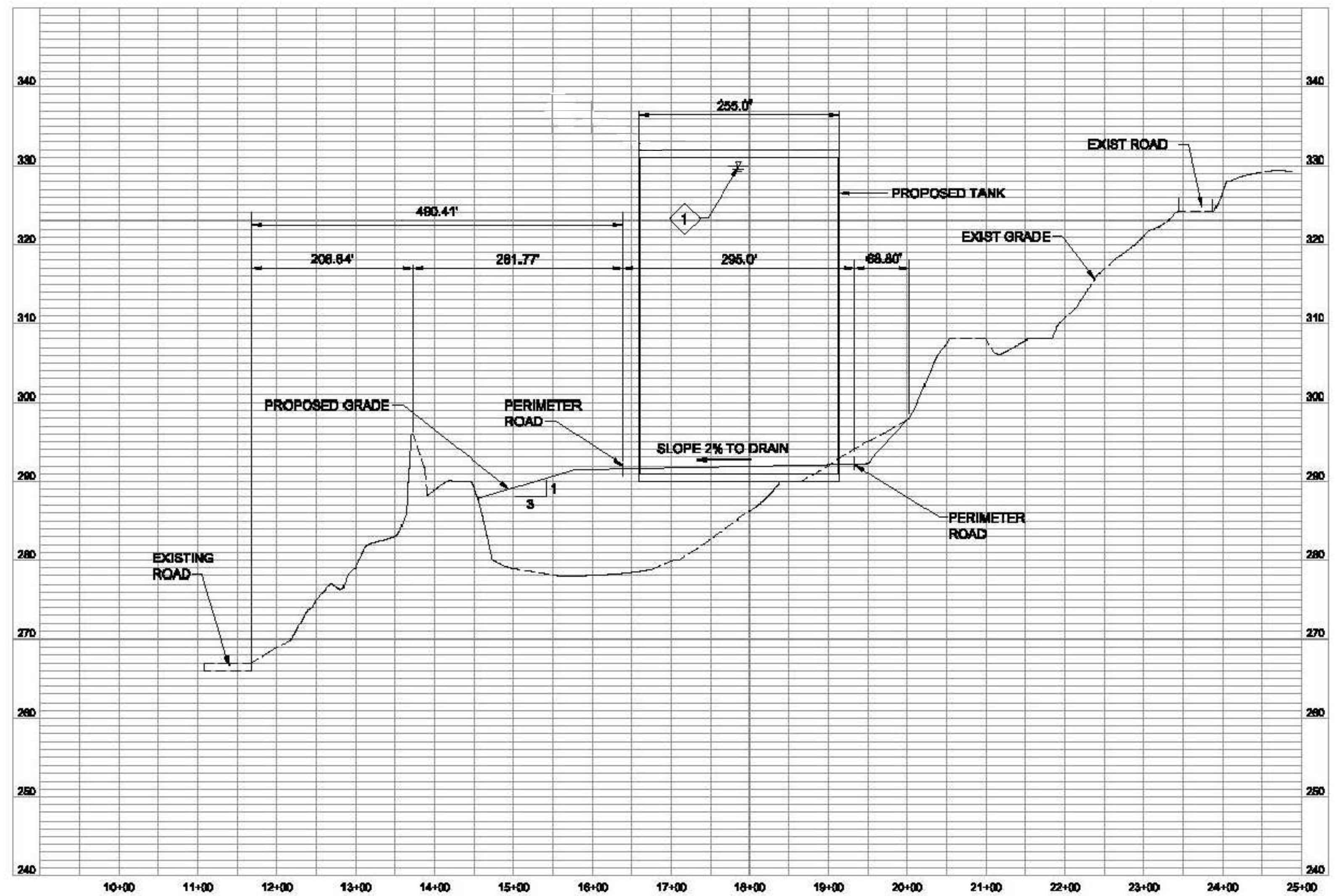
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 6376A.00
DRAWING NO.
SHEET NO. OF

PROJECT NO: FILENAME: new street reservoir alt 7C.dwg PLOT TIME: $TIME$

KEY NOTES:

1. 25 MG STORAGE TANK, HIGH WSEL = 330.



Hortz scale 1" = 100'
Vert Scale 1" = 10'

PROFILE 1 / FIG 6.27

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FIGURE 6.28

NEW STREET RESERVOIR
ALTERNATIVE 7C PROFILE

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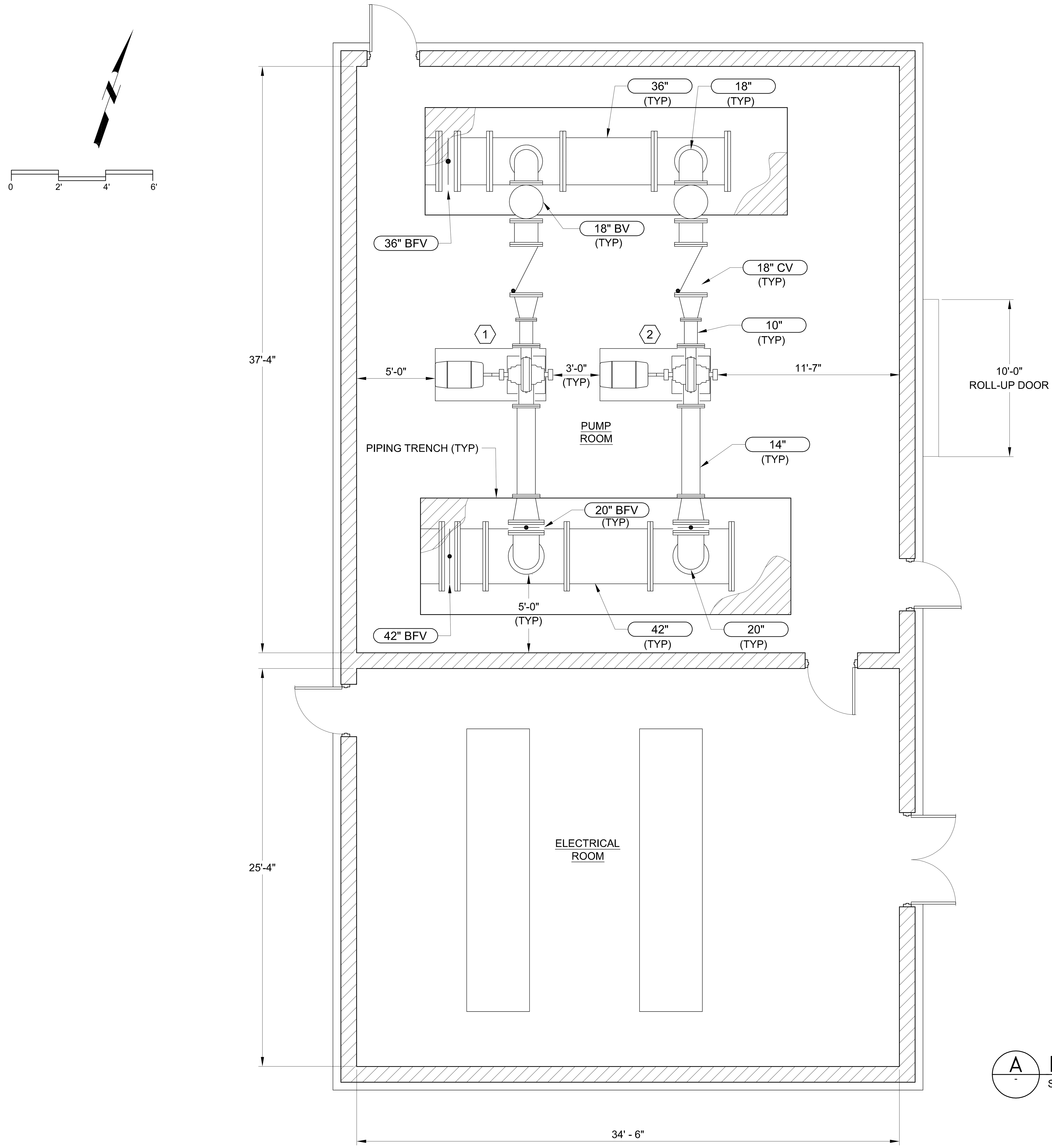
JOB NO. 6376A.00 | DRAWING NO. | SHEET NO. | OF

PROJECT NO: 6376A00 FILENAME: NEW STREET SITE SECTION 6D.dwg PLOT TIME: $TIME$

KEY TAGS:

1 PUMP No. 1 (8 mgd.)

2 PUMP No. 2 (8 mgd.)



A PROPOSED NEW STREET PUMP STATION

SCALE: 3/32" = 1'-0"

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FIGURE 6.29

PROPOSED NEW STREET PUMP STATION
ALTERNATIVE 7C

VERIFY SCALES
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0 1"
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PROJECT NO: FILENAME: Proposed New Street Pump Station.dwg PLOT TIME: $TIME$

6. Reservoir Alternative 8

This alternative eliminates the existing New Street and Levine reservoirs and replaces them with tank storage sufficient for minimal operational needs. The Great Notch Reservoir would remain and would be covered and lined. Emergency back-up power would also be provided at the LFWTP. Specifics associated with this alternative are summarized below:

- Minimum storage was determined by operational needs and/or regulations.
- Storage at Great Notch Reservoir would be 85 MG.
- Storage at New Street Reservoir Site would be 23 MG (tanks).
- Storage at Levine Reservoir Site would be 5 MG (tanks).
- The emergency back-up power generators were sized to allow 75 mgd from the Main Pump Station and/or operate one train at the LFWTP. The incremental cost to allow 25 mgd to be pumped from the Main Pump Station and operate the LFWTP at 56 mgd capacity was relatively small, so the generators were upsized to accommodate this flow condition.

a) Great Notch Reservoir

The operating conditions, hydraulic requirements, and site considerations are similar to those described previously for Alternative 4.

In this alternative, the Great Notch Reservoir would be divided into north and south sections by an earthen dam. Each section would have a reinforced polypropylene liner and cover. The existing 36-inch piping that passes through the dam would be extended, and a new 36-inch pipeline and dam penetration would be installed to facilitate filling and draining each section of the reservoir. Additional 36-inch piping would be installed throughout the reservoir to accommodate operational flexibility for filling, draining, and equalization purposes. The existing 36-inch piping that connects Great Notch Reservoir to New Street Reservoir would also be extended to allow water to flow by gravity from each section of the Great Notch Reservoir to the New Street Tanks.

A new Great Notch Pump Station would be added adjacent to the existing Great Notch Pump Station. A new Reverse Pump Energy Recovery Facility would also be installed. For stormwater that accumulates on the new reservoir cover, a stormwater collection and pumping system would be built that would convey the flows downstream of the dam.

Great Notch Reservoir Alternative 8 (**Figure 6.30**) shows the proposed location for the new lined and covered reservoir sections, baffling, and dividing dam. **Figure 6.19** shows a schematic of the new Great Notch Pump Station and Reverse Pump Energy Recovery Facility (Alternatives 7B and 8). **Figure 6.20** shows additional modifications needed near the dam (Alternatives 7B, 7C, and 8). **Figure 6.21** shows the proposed layout for the new Great Notch Pump Station.

KEY NOTES:

1. STORMWATER PUMP STATION
2. LIMITS OF SURVEY. PROPERTY BOUNDARY NOT YET IDENTIFIED.
3. CONNECT NEW 36" PIPING TO EXISTING 36" PIPING, APPROXIMATE LOCATION FOR CONNECTION SHOWN.
4. MAX HGL = 427.0 OF EXISTING RESERVOIR.
5. STORMWATER COLLECTION PIPING FROM COVER.
6. STORMWATER PUMP STATION DISCHARGE TO SPILLWAY.
7. ACCESS ROAD TO RIFLE CAMP ROAD.
8. EXISTING 36" INTERCONNECT BETWEEN NEW STREET RESERVOIR AND GREAT NOTCH RESERVOIR. DEMO EXISTING INLET AND CONNECT NEW PIPING.
9. EDGE OF COVER AND LINER
10. DIVIDING DAM, ACCESS ROAD, AND VALVE ACCESS AREA.
11. CONNECTING BOTH RESERVOIR CELLS PIPING.
12. VALVE ACCESS ROAD
13. ACCESS AND AIR RELEASE HATCH ON COVER.
14. RESERVOIR BAFFLING

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FIGURE 6.30

GREAT NOTCH RESERVOIR
ALTERNATIVE 8

VERIFY SCALES
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PROJECT NO: FILENAME: great notch reservoir alt 8.dwg PLOT TIME: $TIME$

b) New Street Reservoir

The operating conditions, hydraulic requirements, and site considerations are identical to those described previously for Alternative 4.

1. **<u>Option 1 – Locate Tanks at an Elevation High Enough to Consolidate the 300 and 330 Gradients (Within Existing Reservoir Footprint)</u>**

   This option (including the advantages and disadvantages) is identical to the one described in Alternative 4.

2. **<u>Option 2 – Locate Tanks at an Elevation High Enough to Consolidate the 300 and 330 Gradients</u>**

   This option (including the advantages and disadvantages) is identical to the one described in Alternative 4.

3. **<u>Option 3 – Locate Tanks at an Elevation High Enough to Building on Existing Grade</u>**

   This option (including the advantages and disadvantages) is identical to the one described in Alternative 4.

   Option 3 was selected for Alternative 8.

   Figure 6.14 shows New Street Reservoir Alternatives 4 and 8 with the proposed location for the two 11.5-MG pre-stressed concrete storage tanks (23 MG total) at the north end of the reservoir. The New Street Reservoir Alternatives 4 and 8 Profile shows a ground surface profile cut through the center of the tanks (**Figure 6.15**).

c) Levine Reservoir

The modifications to Levine Reservoir for this alternative are identical to those described previously for Alternative 4.

7. Emergency Backup Power

For all reservoir alternatives, diesel fuel powered emergency generators would be provided. Table 6.1 identified five different Generator Options (GO) that were evaluated. The individual engine generator sizes were determined based on the electrical loads desired to be in operation. Fuel consumption was based on the assumption that 0.08 gallons were used for every kW generated. A detailed load analysis will be included in Conceptual Design.

It was decided that GO-2/GO-3 would be used for all reservoir alternatives. This would provide up to 56 mgd from the LFWTP and 25 mgd from Wanaque North pumped into the distribution system. Therefore, two 2,500 kW generator units would run in parallel to provide emergency back-up power for each alternative (after refinement it was determined that a generator size of 2,500 kW would provide the required power).

In order to provide PVWC with sufficient reliability and redundancy to operate during the emergency design condition (a 24-hour power outage event), an N+2 redundancy scheme would be used. The “N” refers to the number of duty units needed to be in service during the design condition and the “+2” refers to the number of standby units. Therefore, in the N+2 condition, two complete standby units would be provided. This level of redundancy was considered necessary due to the power outage events that occurred in early 2010. During these events, PVWC encountered failures of the backup power generators from the

High Pressure Gradient that prevented them from operating. In some cases, the failures were so significant that emergency repairs could not be made in time to place the generators back into service during the outage.

The loads in each of these scenarios account for operation of the ozone generation system, which contributes a significant load within the system. Studies are underway to determine if this electrical load can be eliminated by utilizing chlorine in place of ozone as a primary disinfectant during the emergency design condition. If this load were eliminated, additional redundancy beyond N+2 would be provided.

Each generator option was developed assuming that power would be generated at 2,400 Volts in a delta configuration. Generating power at this voltage would not require the use of step-down transformers. However, new switchgear would be added to connect to the existing plant system.

The generator facility would include switchgear to connect all generators to a common generator bus, with a main circuit breaker to connect the entire generator system to existing switchgear panel "A." A new circuit breaker would be added to switchgear "A" to receive the generator power. This will allow standby power to be distributed to the Main Pump Station and LFWTP, as well as all other parts of the plant that are connected to switchgear "A," while utilizing existing grounding and protection systems. This will allow most plant areas to have building power for lights and other basic electrical needs during a utility power outage. In the unlikely event that the available generators are not sufficient to power the needed pumps as well as these facility loads, the system can be configured to automatically disconnect some plant areas, or to generate an alarm when generator capacity Is not sufficient to start the next pump so that an operator can manually disconnect less important loads prior to starting the last pump.

The automatic transfer systems for the existing Verona standby generator and at the operations building generator will sense voltage from the new standby power system as utility power. If these generators are to be retained, control modifications should be made to ensure these generators continue to power their respective loads through the duration of a utility power outage.

Each engine generator would be provided with its own control panel, synchronizing equipment, and operator interface. This equipment would all be located in a separate room to keep operators away from potential arc flash dangers when switching or monitoring the system.

Each engine generator would have batteries mounted to the skid to provide the necessary power to start the engine under blackout conditions. The manufacturer's standard battery sizing of three starts would be utilized for the battery for each engine generator. Wall mount chargers would ensure that the batteries are fully charged at all times and available to start the units upon a loss of power at the plant.

Additional fuel pumps and piping would be added to the existing on-site diesel fuel storage tank to serve the engine generators. No day tanks would be provided for the generators. A pumped loop system would be utilized with redundant piping to ensure a continuous supply of diesel fuel is available. Return fuel oil, from the excess pressure leaving the engine, would be conveyed back to the bulk diesel fuel storage tank. The volume of the existing storage tank should be sufficient to prevent the fuel from exceeding recommended temperature limits.

a) **Generator Enclosure Building**

1. **Stand-Alone Enclosure Option**

   In lieu of providing the engine generators in a building, stand-alone skid mounted units housed within sound attenuating enclosures were considered. The advantages and disadvantages of this option are listed below:

   Advantages

   - Low capital cost. Each unit would be mounted on a slab on grade sized independently for each unit. The switchgear would be housed in a prefabricated electrical enclosure, also placed on a slab on grade.
   - Sound attenuation would be provided integral to each unit enclosure.
   - Space could be allocated on-site for the addition of similar skid mounted engine generators in the future without the need to provide empty space within a building.

   Disadvantages

   - Space within the enclosure for maintenance is limited, which may increase the difficulty of routine maintenance.
   - Lighting is limited within the enclosure, which may increase the difficulty of routine maintenance at night or under blackout conditions.
   - Minimal heating would be provided within the enclosure. When the engines are running, the enclosure would be very warm. When the engines are off, temperatures within the enclosure may be as low as 50 degrees Fahrenheit.

2. **Generator and Switchgear Building Option**

   A building was sized to accommodate four 2,500-kW engine generator units along with a separate control room and a separate room for electrical equipment. This option assumes the engine generators would be provided as an integral skid-mounted unit with the radiator attached to the unit. Transition ductwork for each unit would be provided to convey radiator exhaust to a louver mounted in the exterior wall of the building. This would allow the exhaust airflow to be provided by the unit, rather than adding large HVAC ventilation units to the building. Small exhaust fans would be provided for ventilation when the units are not running. Large inlet louvers would be provided so sufficient airflow can pass into the building when the engine generator units are in operation. Smaller inlet louvers would be provided for airflow when the units are not in operation.

3. **Generator and Switchgear Building with Local Fuel Pump Station**

   A local fuel pump station for the generators would include adding a fuel transfer pump room to the Generator and Switchgear Building. The fuel pumps would be housed in this room and allow for access and control within the same building as the engine generators.

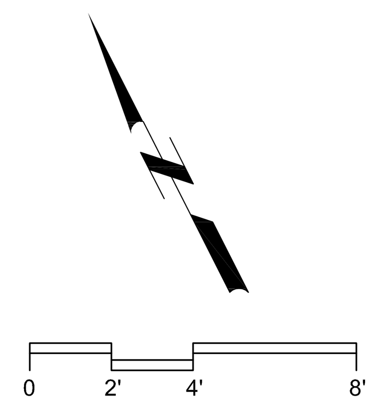
   Advantages

   - The generators, electrical switchgear, fuel pumps, and controls would all be in the same building.
   - There would be adequate lighting, heating, and space for routine maintenance and operation of the engine generators.

Disadvantages

- Providing a building for all of the generators, electrical switchgear, fuel pumps, and controls would be a higher capital cost.
- The layout of the building does not provide room for future engine generators.

Figure 6.31 shows a plan view of the building layout Generator and Switchgear Building Plan for Reservoir Alternatives 4, 7 and 8 with the Local Fuel Pump Station. **Figure 6.32** shows a section of the Generator and Switchgear Building Reservoir Alternatives 4, 7, and 8. **Figure 6.33** shows a schematic of the emergency generator's fuel supply.



KEY NOTES:

1. 2,500 kW SKID MOUNTED ENGINE GENERATOR UNIT.
2. TRANSITION DUCT FROM SKID MOUNTED RADIATOR TO EXHAUST LOUVER.
3. 12'-0" WIDE x 14'-8" HIGH MOTOR OPERATED EXHAUST LOUVER.

A NEW GENERATOR AND SWITCHGEAR BUILDING

SCALE: 1/4" = 1'-0"

LAST UPDATED: 07/29/2010 07:02 PM

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FIGURE 6.31

GENERATOR AND SWITCHGEAR BUILDING PLAN FOR RESERVOIR ALTERNATIVES 4, 7 & 8 WITH LOCAL FUEL PUMP STATION

VERIFY SCALES

BAR IS ONE INCH ON ORIGINAL DRAWING

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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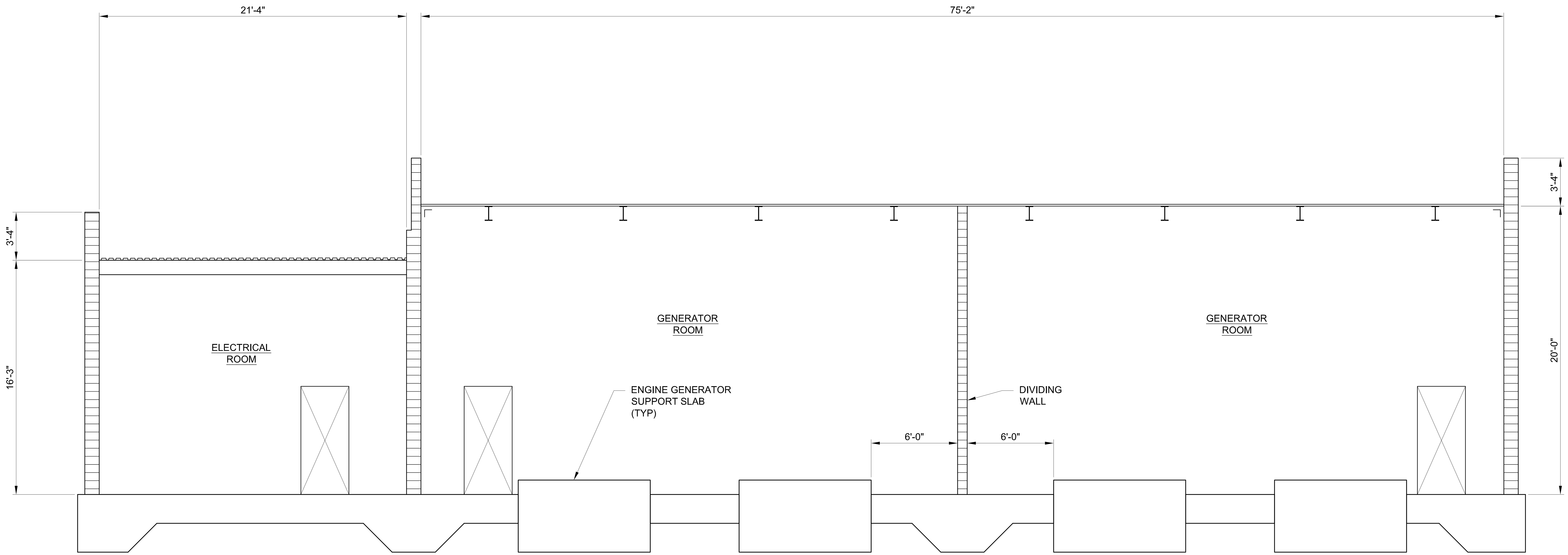
PROJECT NO:

FILENAME: Generator & Switchgear Bldg Plan for Reservoir Alts 4, 7, 8 with Remote Fuel Pump Station.dwg

PLOT TIME:



A SECTION
FIG 6.31
SCALE: 1/4" = 1'-0"
FIG 6.34

0 2' 4' 8'

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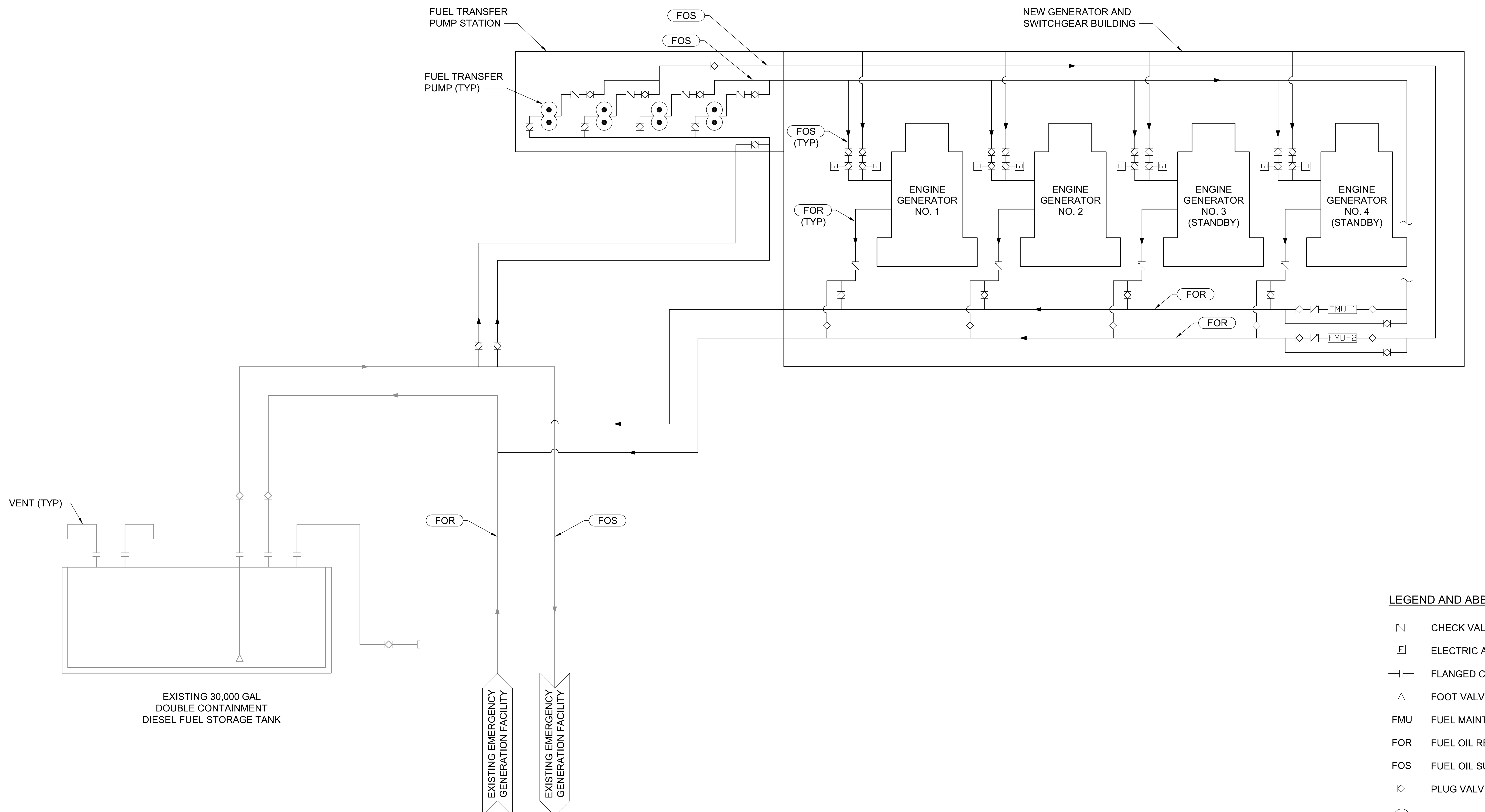
FIGURE 6.32

GENERATOR AND SWITCHGEAR BUILDING SECTION
FOR RESERVOIR ALTERNATIVES 4, 7 & 8

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8378A.00
DRAWING NO.
SHEET NO.
OF

PROJECT NO:
FILENAME: Generator Option 2 for 4,7 & 8 building section.dwg PLOT TIME: $TIME$



LEGEND AND ABBREVIATIONS:

(symbol)	CHECK VALVE
E	ELECTRIC ACTUATOR
(symbol)	FLANGED CONNECTION
△	FOOT VALVE
FMU	FUEL MAINTENANCE UNIT
FOR	FUEL OIL RETURN
FOS	FUEL OIL SUPPLY
(symbol)	PLUG VALVE
(symbol)	POSITIVE DISPLACEMENT ROTARY PUMP
(symbol)	QUICK CONNECT FITTING

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FIGURE 6.33

GENERATOR DIESEL FUEL STORAGE
& FEED SCHEMATIC
WITH LOCAL FUEL PUMP STATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8378A.00
DRAWING NO.
SHEET NO.
OF

PROJECT NO:
FILENAME: generator option 2 fuel oil storage & feed schematic.dwg
PLOT TIME: $TIME$

4. **Generator and Switchgear Building with Remote Fuel Pump Station**
A remote fuel pump station for the generators would include adding a fuel transfer pump station near the existing diesel fuel storage tanks (30,000 gallons total).

Advantages
- The generators, electrical switchgear, and controls would all be in the same building.
- There would be adequate lighting, heating, and space for routine maintenance and operation of the engine generators.
- The building footprint would be reduced by the size of the fuel transfer pump room.

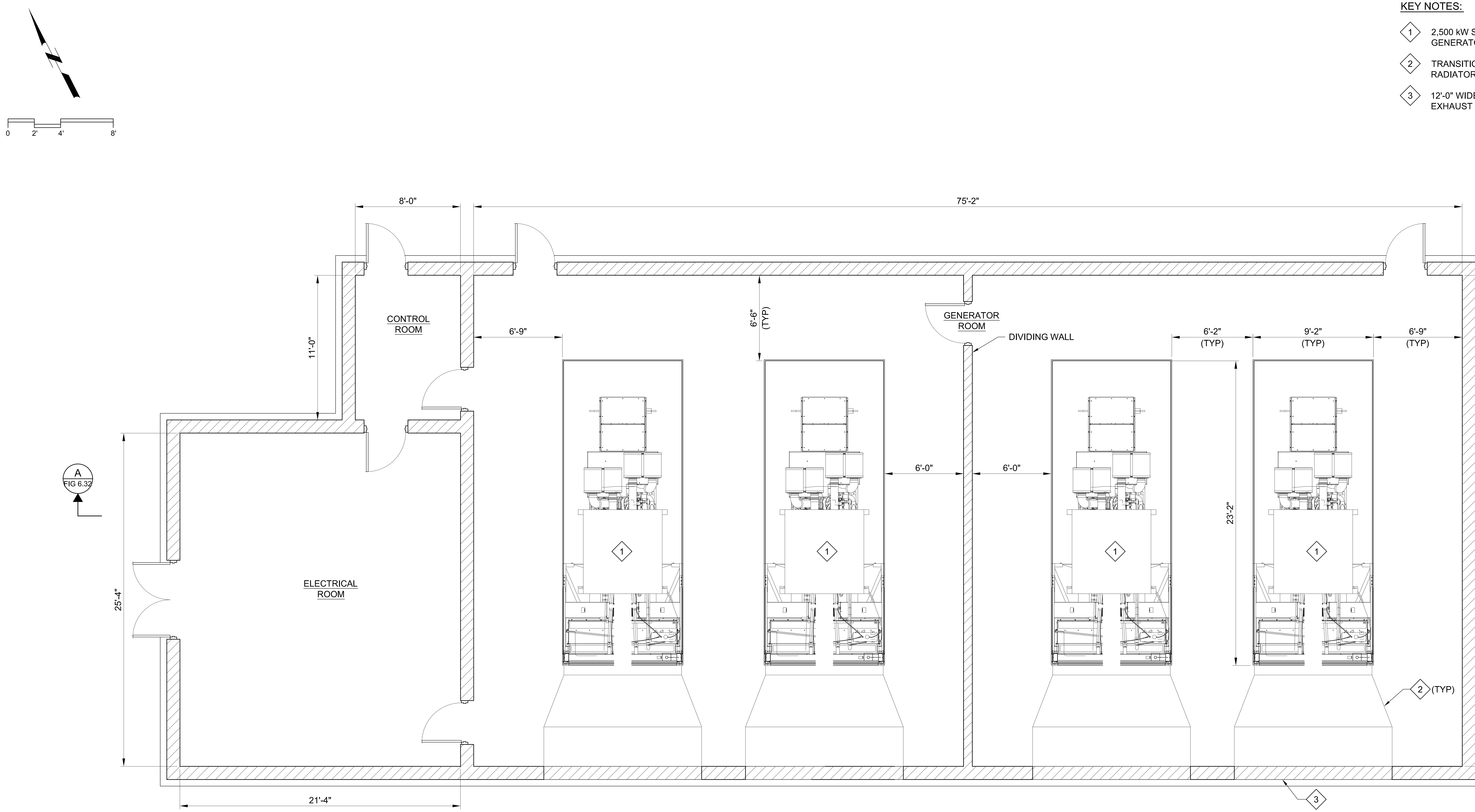
Disadvantages
- Providing a building for all of the generators, electrical switchgear, and controls would be a higher capital cost.
- The layout of the building does not provide room for additional future engine generators.

The option for the Generator and Switchgear Building with Remote Fuel Pump Station was selected.

Figure 6.34 shows a plan view of the building layout with the Generator and Switchgear Building Plan for Reservoir Alternatives 4, 7 and 8 with the Remote Fuel Pump Station. **Figure 6.32** shows the Generator Switchgear Building Section for Reservoir Alternatives 4, 7, and 8. **Figure 6.35** shows the Generator Diesel Fuel Storage and Feed Schematic with the Remote Fuel Pump Station for the emergency generator's fuel supply.

KEY NOTES:

1. 2,500 kW SKID MOUNTED ENGINE GENERATOR UNIT.
2. TRANSITION DUCT FROM SKID MOUNTED RADIATOR TO EXHAUST LOUVER.
3. 12'-0" WIDE x 14'-8" HIGH MOTOR OPERATED EXHAUST LOUVER.



A NEW GENERATOR AND SWITCHGEAR BUILDING

SCALE: 1/4" = 1'-0"

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DESIGNED CR | DRAWN SJ/TL | CHECKED | DATE March 2010 | ENGINEER

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FIGURE 6.34

GENERATOR AND SWITCHGEAR BUILDING PLAN FOR RESERVOIR ALTERNATIVES 4, 7 & 8 WITH REMOTE FUEL PUMP STATION

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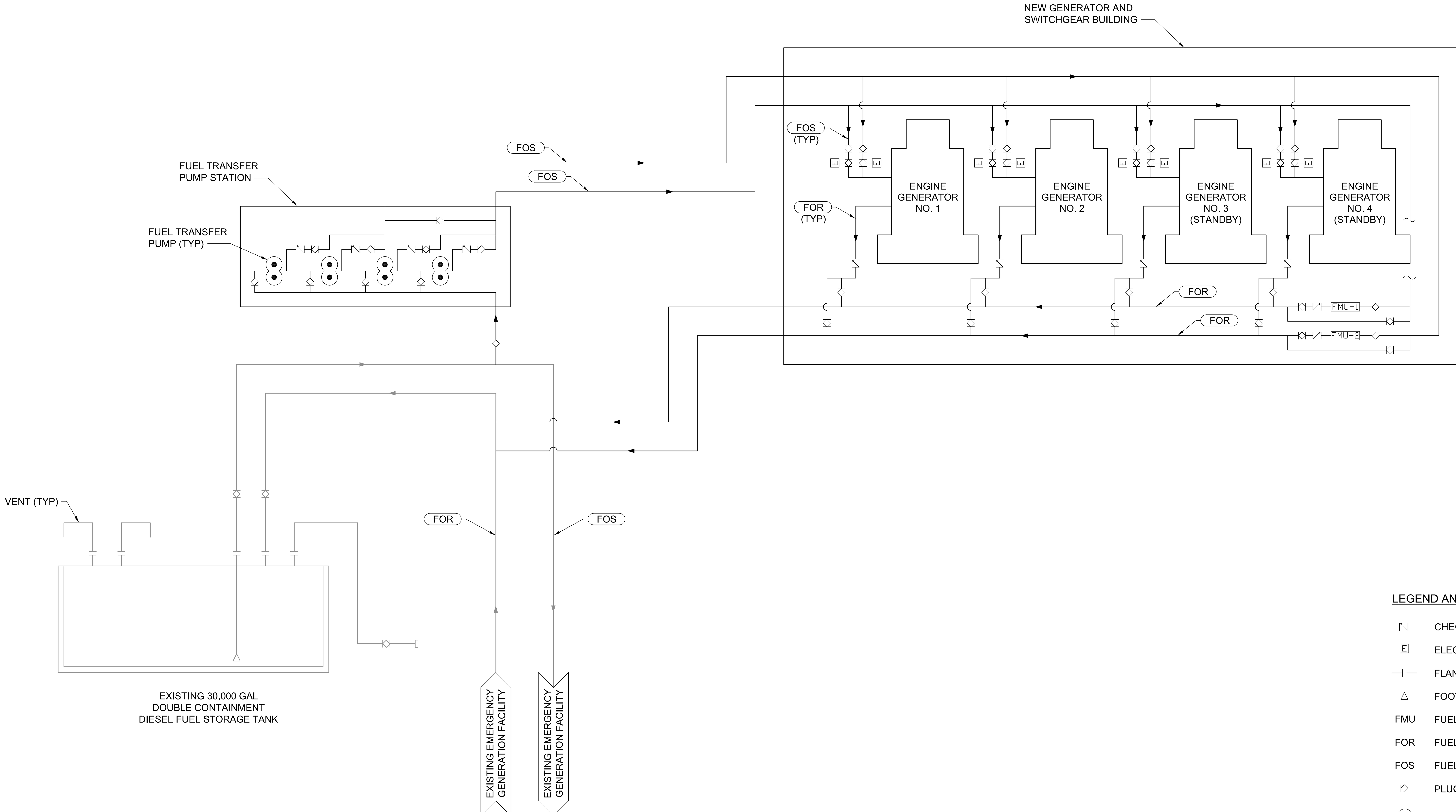
OF

PROJECT NO: FILENAME: Generator Option 2 for 7 & 8.dwg PLOT TIME: $TIME$



LEGEND AND ABBREVIATIONS:

- CHECK VALVE
- E ELECTRIC ACTUATOR
- FLANGED CONNECTION
- FOOT VALVE
- FMU FUEL MAINTENANCE UNIT
- FOR FUEL OIL RETURN
- FOS FUEL OIL SUPPLY
- PLUG VALVE
- POSITIVE DISPLACEMENT ROTARY PUMP
- QUICK CONNECT FITTING

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DATE April 2010
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FIGURE 6.35

GENERATOR DIESEL FUEL STORAGE & FEED SCHEMATIC WITH REMOTE FUEL PUMP STATION

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PROJECT NO: FILENAME: fuel oil storage & feed schematic.dwg PLOT TIME: $TIME$

b) Site Location for Generator and Switchgear Building

Two locations were considered to site the new engine generators.

1. **Boiler House Alternative**

   Demolition of the existing Boiler House was considered. This building is currently not in service and is in poor condition. A new Generator and Switchgear Building, or separate skid mounted engine generator units could be installed in this area following demolition of the existing structure.

   Advantages
   - The engine generators and new switchgear would be in close proximity to the existing plant electrical feed.
   - The new structure would be at a lower elevation than the existing onsite fuel storage tank, so pressures required for pumping would be minimal.
   - The Boiler House is not currently in service and the structure is in poor condition, so demolition is favorable.

   Disadvantages
   - The Boiler House was constructed on solid rock beneath the foundation. This would complicate installation of new underground utilities.
   - The footprint of the Boiler House does not provide sufficient space to construct a new Generator and Switchgear Building as well as a future pump station to replace the existing Main Pump Station.
   - Existing utilities are routed under the Boiler House that would significantly complicate the installation of new utilities and any rock removal.

2. **Lime Building Alternative**

   Demolition of the existing Lime Building was considered. This building is currently not in service although some minor electrical loads are powered out of this building. A new Generator and Switchgear Building, or separate skid mounted engine generator units may be installed in this area following demolition of the existing structure. This site was recommended as the location to install new engine generators in a previous report.

   Advantages
   - Sufficient space is available at and around the existing structure, so that following demolition, adequate space is available for the new facility.
   - An existing plant drive would be utilized for access, minor modifications would be necessary.
   - New fuel lines could be installed from the existing on-site diesel fuel storage tank to the new facility, and it is generally in close proximity.
   - This location is in close proximity to the existing generator building and High Pressure Gradient Pump Stations. An interconnect for power distribution would be in close proximity as well.
   - The emergency generator would be located at a higher elevation and minimize the flooding potential.

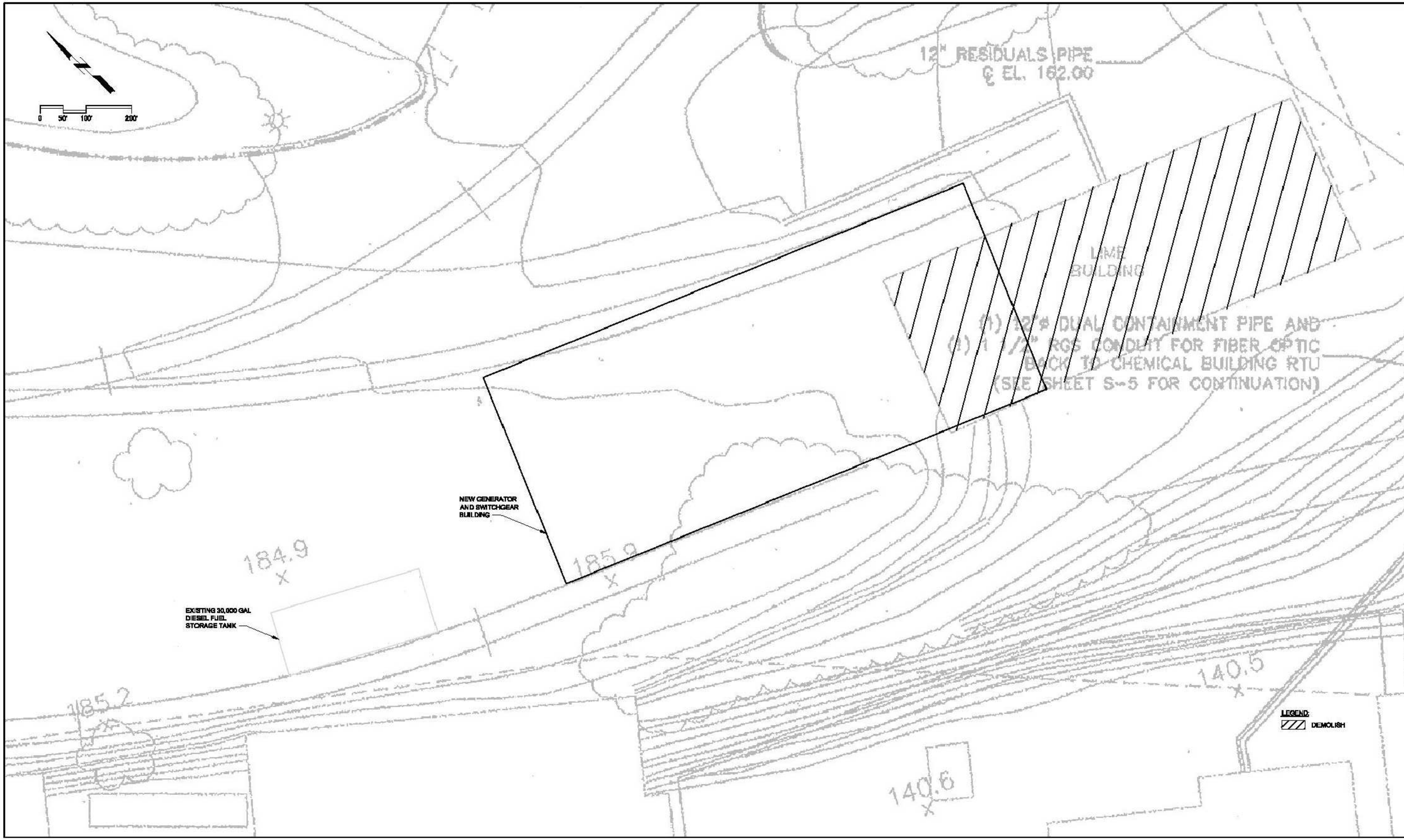
   Disadvantages
   - This site is elevated from the Boiler House, and as such, fuel pumping would require higher pressures.
   - Sound attenuation would be important as the new engine generators would be at a similar elevation to the rest of the plant (i.e., sound would be able to

travel further since the units and exhaust would not be located behind a hill).

- The existing lime building site location was selected as the chosen location for the emergency generator building.
- **Figure 6.36** shows where the building is located with relation to the existing diesel fuel storage tank for Reservoir Alternatives 4, 7 and 8 with the Local Fuel Pump Station.
- **Figure 6.37** for shows where the building is located with relation to the existing diesel fuel storage tank and Remote Fuel Pump Station for Reservoir Alternatives

c) **Fuel Storage**

The fuel consumption anticipated at full load for the 2,500 KW unit is 200 gallons/hour. This equates to a total volume of 9,600 gallons required for operation of two units continuously at full load for 24 hours. The existing 30,000-gallon diesel fuel storage tank has sufficient fuel storage volume available to operate the new and existing generators during the design 24-hour power outage without any additional deliveries.



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DATE: March 2010
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FIGURE 6.36

GENERATOR SITE PLAN
FOR RESERVOIR ALTERNATIVES 7 & 8
WITH LOCAL FUEL PUMP STATION

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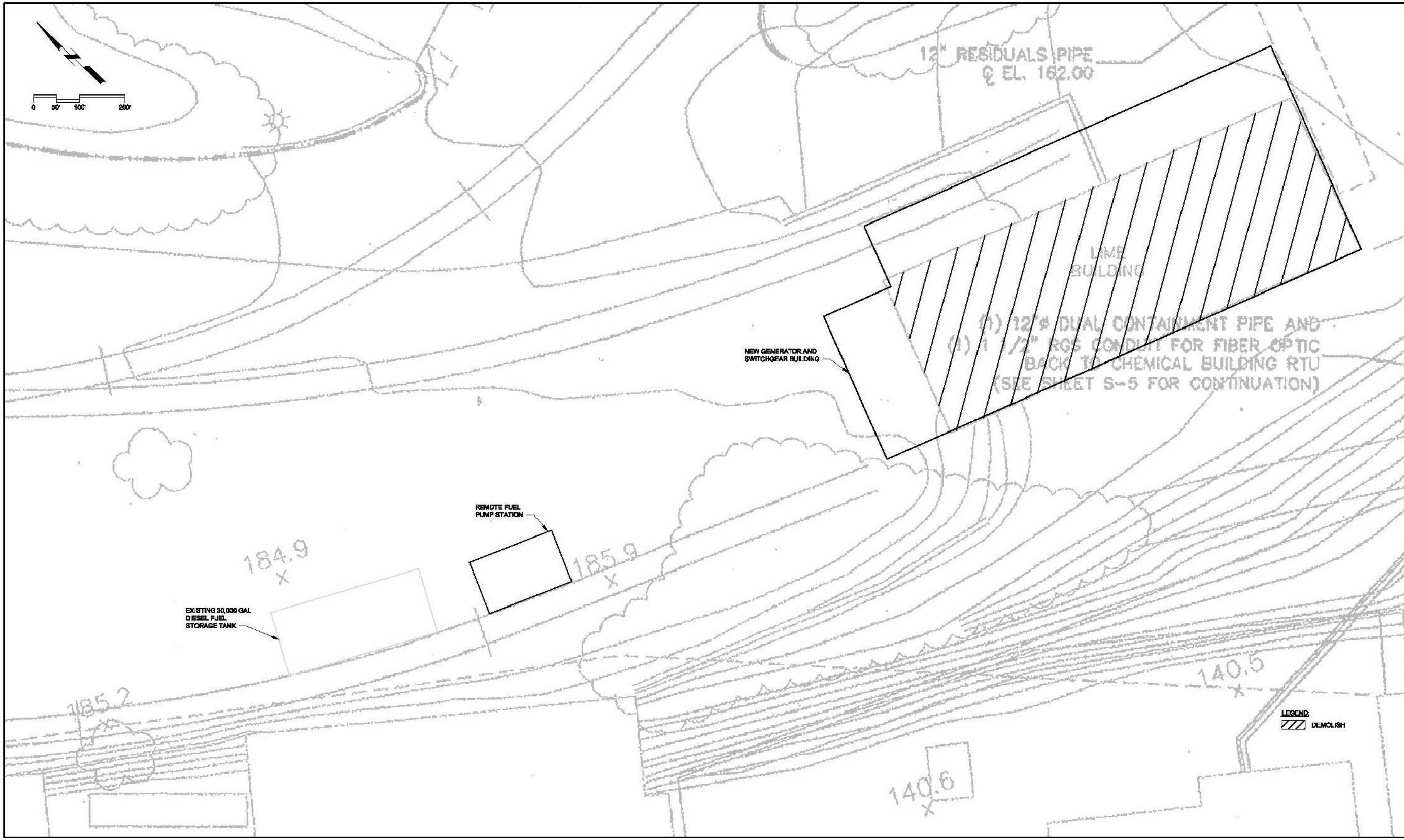
PROJECT NO:
FILENAME: generator option 2 site for 7&8 local fuel pump.dwg



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ENGINEER

PASSAIC VALLEY WATER COMMISSION

FIGURE 6.37

GENERATOR SITE PLAN
FOR RESERVOIR ALTERNATIVES 7 & 8
WITH REMOTE FUEL PUMP STATION

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PROJECT NO:

FILENAME: generator option 2 site for 7&8.dwg

PLOT TIME: $TIME$

8. Stormwater and Environmental Impacts of the Selected Alternative

Measures and requirements outlined in this section are a reflection of understanding with NJDEP through a Permitting Coordination Meeting that took place on August 11th, 2010 attended by PVWC, TYLI|Medina and various NJDEP Departments. This meeting involved the discussion of required permits and stormwater management measures needed for the selected alternative outlined in this report.

a.) Stormwater Impacts

NJDEP will require that all stormwater measures adhere to the upcoming revised stormwater regulations. Further input from local municipalities is to be pursued as stormwater measures will be subject to local review and approval.

1. <u>General</u>

Since more than one acre of disturbance is proposed for each of the three reservoirs, NJDEP is requiring that all post-development conditions adhere to the New Jersey Stormwater Management Rule N.J.A.C. 7:8. Stormwater Management Measures should be implemented to address stormwater runoff quality and quantity. NJDEP regards current reservoir configurations as an active wet pond providing, at minimum, 80% Total Suspended Solids (TSS) removal to its entire contributing drainage area. As such, post-development conditions will be required to achieve similar treatment standing for the entire drainage site. In order to properly assess existing stormwater runoff quantity, pre-development conditions should be considered based on a reservoir stage level set at crest of spillway. However, NJDEP is requesting that this spillway stage level presumption should be compared to a year's average of daily recorded maximum operation stage levels. If significant variance is observed, then consideration should be given to the stage level providing least amount of stormwater impact to downstream properties. NJDEP will not require groundwater recharge, as current reservoir bottom conditions (bed rock) are presumed to have no infiltration.

2. <u>Levine Reservoir</u>

The contributing drainage area for Levine Reservoir is 5.72 acres. This area is mainly finished water surface area (at 79%) and a mix of woodland and rock outcrop areas visible along the east end of reservoir. The drainage area boundary approximately follows top of reservoir wall to the north, west and south ends and along the high grounds to the east end. Excess flow from Levine currently drains through an outlet structure connected to a 34-inch concrete pipe system located within the inlet chamber at the west end. This pipe system runs along Reservoir Avenue, crosses McBride Avenue and outlets into the Passaic River. In the event of over-topping flow conditions, the reservoir wall would act as a spillway and resulting surface runoff would eventfully drain into the adjacent Passaic River. NJDEP does not have Levine classified as a dam. The selected alternative layout proposes the draining of Levine Reservoir and the installation of an isolation wall, water storage tanks, and a parking lot at the north end of reservoir (See Appendix F for reference). NJDEP requires the use, to the extent possible, of nonstructural conveyance systems such as vegetated filter strips and swales to address TSS removal and runoff collection from proposed parking lot and along the sides of the proposed storage tanks. Topsoil cover shall use natural vegetation (non treated lawn) to the extent possible to reduce nutrient loading. Collected runoff from the post-developed drainage area would be routed to a dry detention basin located within the impounded reservoir (south of isolation wall). This basin will be utilized to address TSS removal and to maintain or reduce stormwater runoff. Outlet flow from the basin would be conveyed to the existing outlet pipe system on Reservoir Ave.

3. **New Street Reservoir**

The contributing drainage area for the New Street Reservoir is 15.07 acres. This area is mainly finished water surface area (at 73%) and a mix of woodland and rock outcrop segments visible along the reservoir's perimeter. The drainage area boundary is approximately bordered by Slippery Rock Brook to the north, Mountain Avenue to the east and Rifle Camp Road (County Route 633) to the south and west ends. A dam and an outlet structure are located to the west end of the reservoir. The Dam sits at an approximate height of 30 feet and the outlet structure is attached to the dam's north end. The outlet contains a spillway that discharges excess flow from the reservoir into the adjacent Slippery Rock Brook. In the event of over-topping flow conditions, the top of dam will act as a secondary spillway and resulting surface runoff would eventfully drain into the adjacent Slippery Rock Brook. NJDEP classifies New Street dam as a high hazard dam.

The selected alternative layout proposes the removal of the New Street Dam and installation of two 255 feet diameter tanks and a service access road at the southeast end of the reservoir (See Appendix F for reference). NJDEP requires the use, to the extent possible, of nonstructural conveyance systems such as vegetated filter strips and swales to address TSS removal and runoff collection from the proposed service road and tank's roof top. NJDEP will no longer allow non TSS treatment of roof top runoff, as such; top of tank runoff will require water quality treatment. Collected runoff from the post-developed drainage area would be routed to a bioretention basin located within the impounded reservoir (just east of current dam location). This basin will be utilized to address TSS removal and to maintain or reduce stormwater runoff. Outlet flow from the basin would be conveyed to the adjacent Slippery Rock Brook, as per existing conditions. Consideration should be given to grading the impounded reservoir grounds in a manner to maintain current Flood Hazard overflow patterns contributed by Slippery Rock Brook. Topsoil cover shall use natural vegetation (non treated lawn) to the extent possible to reduce nutrient loading.

4. **Great Notch Reservoir**

The contributing drainage area for Great Notch Reservoir is 133.53 acres. The finished water surface area occupies only 23.5% of the total area. The remaining area is predominantly woodland park with scattered rock outcrops visible along the reservoir's perimeter. The drainage area boundary approximately follows along the same line of Third River's HUC-14 drainage area on east, north and west ends and borders an unnamed tributary (ditch) to the south end. A dam and an outlet structure are located to the southwest end of the reservoir. The Dam sits at an approximate height of 60 feet and the outlet structure is attached to the dam's east end. The outlet contains a spillway that discharges excess flow from the reservoir into the adjacent unnamed tributary leading to Third River. NJDEP classifies Great Notch dam as a high hazard dam.

The selected alternative layout proposes the installation of two 365 feet diameter tanks, service access road at the northwest end of the reservoir, the removal of the dam and construction of an outlet structure for control of stormwater (See Appendix F for reference). The tanks would be placed in a filled area of the reservoir that would be aligned parallel to Rifle Camp Road (County Route 663). The service road would be connected to Old Rifle Road, as opposed to the wooded wetland area as shown. NJDEP requires the use, to the extent possible, of nonstructural conveyance systems such as vegetated filter strips and swales to address TSS removal and runoff collection from the proposed service road and tank's roof top. NJDEP will no longer allow non TSS treatment of roof top runoff, as such; top of tank runoff will require water quality treatment. Collected runoff from the post-developed drainage area would be routed to the former lake area. Consideration should be given to grading the impounded reservoir grounds in a manner providing surface flow into the former lake area. Topsoil cover shall use natural vegetation (non treated lawn) to the extent possible to reduce nutrient loading. The former lake area would continue to serve as a wet pond structure providing TSS removal and maintaining or reducing stormwater runoff. Outlet flow from the basin would continue to be conveyed to the adjacent unnamed tributary.

b.) Environmental Impacts

1. <u>General</u>

New Jersey Flood Hazard Area (FHA) regulations have jurisdiction over all streams that drain over 50 acres. A permit is required for any modification of a channel or for construction within the floodplain. Wetland permits are issued by the NJDEP Bureau of Land Use, and are required for any modification of freshwater wetlands, including the destruction of wetlands that occurs when a lake is drained due to dam removal.

2. <u>Levine Reservoir</u>

Since Levine Reservoir has a total contributory area of 5.72 acres, it does not fall under the jurisdiction of the FHA regulations. Due to Levine Reservoir being a totally man-made structure that is not on a stream corridor, it would also not fall under the jurisdiction of the Bureau of Land Use Regulation. Therefore, representatives of NJDEP indicated that this project would not fall under NJDEP jurisdiction for FHA; additional reviews may be required by the local municipality. Therefore, it is recommended to file for a Jurisdictional Determination (J.D.) for both FHA and Land Use to determine that it does not fall under NJDEP jurisdiction.

Pending outcome of the jurisdictional determination, a letter of interpretation (line verification) may be required.

Levine Reservoir lies within the Great Falls of Paterson Historic District and is listed on the State Registry of Historic Places. Removing it may be considered an encroachment on the Historic District. An application, including a cultural resources survey, will need to be filed with the State Historic Commission, whose decision could include design revisions. If no federal funds are being used for this project, it may not be subject to Federal Section 106 review.

3. <u>New Street Reservoir</u>

New Street Reservoir is shown on both the New Jersey Flood Hazard Maps and the Federal Flood Insurance Rate Maps (FIRM) as being situated in the Slippery Rock Brook corridor. The waters of the reservoir are shown as part of the floodway for this brook. Construction in a floodway is generally prohibited. There is some dispute as to whether it is properly classified as floodway, as it is an artificial off-line water body. Therefore, there are two alternatives for proposed construction in the floodway:

Alternative 1

Apply to the NJDEP to revise the state flood map to remove the floodway designation from New Street Reservoir. This would involve preparing a complete new hydraulic study of the area, to show that the water surface area of the reservoir is not critical to the passage of flood waters from the brook and does not need to be a protected conveyance. This process would require a new topographic survey and would likely take one to two years (1-2 yrs.) for approval.

Alternative 2

Apply for a hardship exception to construct in a floodway. This would require a detailed explanation of the reasons for building in the floodway. Part of those reasons would include an explanation as to why the floodway designation is not appropriate. Done as part of the FHA Individual Permit, this process would not require additional time for the change of floodway designation. The state flood map would not be changed.

In either case, a FHA Individual Permit will be required, due to the dam removal and construction of the proposed storage tanks in the floodplain; this permit application must include a re-delineation of the flood waters, showing minimal impact on properties downstream of the reservoir property.

A Dam Removal Permit will also be required to decommission the dam. This permit process requires public notice. If there are any objectors, there must be a public hearing, at which time, the Director of NJDEP decides whether dam removal will be permitted. The Bureau of Land Use Regulation may defer to the Bureau of Dam Safety for the review of downstream impacts, rather than doing a separate FHA review.

A Wetlands Letter of Interpretation (Line Verification) will also be required to determine if there are wetlands which will be impacted by the proposed dam removal and tank construction. Should this be the case, a Wetlands Individual Permit (IP) will be needed. NJDEP representatives stressed that this type of project has not been reviewed before and, therefore, there are no General Permits under which the work could be done.

Due to the ACO, this project may be qualified to receive a hardship exception for flood hazard, dam removal and wetlands. In this case, the project will be evaluated

on the basis of keeping the environmental impacts to a minimum.

The New Street Reservoir property borders Garret Mountain Reservation, the primary recreational facility of the Passaic County Parks Department. The reservation includes some historical structures, namely Lambert Castle Museum and a portion of the Morris Canal, but the New Street Reservoir is not historical. However, it is the only remaining dam of its type in the state and some documentation may be required upon demolition. A cultural resources review will be part of the Dam Removal Permit review; this will necessitate filing of a cultural resources survey.

4. **Great Notch Reservoir:**
   The selected alternative proposes to remove the existing dam and construct two large storage tanks on the former lake bed. Since the reservoir is 30 acres, with a total drainage area of 130 acres, the permitting of this project would be more complicated than the other two sites. The NJDEP voiced concern over "losing the entire open water resource", including the associated wetlands. The 30-acre lake would be considered a substantial visual and environmental benefit to the surrounding properties. The full range of Dam Removal, Wetlands, and FHA Individual Permits would be required. Rather than building a concrete low-flow channel through the former lakebed, NJDEP would be looking for re-construction of the full natural stream channel and restoration of the overbank area to a natural condition. The indication is that the level of proof and the alternatives analysis will be more stringent for this site than for the other properties. Draining the reservoir may meet with public and municipal resistance, although the reservoir is not readily visible from adjacent areas.

   As part of the Wetlands Individual Permit, it is likely that wetlands mitigation will be required. This would likely involve construction of new wetlands to replace the existing, either on site or at another location.

   There are no above-ground may be required structures at this location. A complete cultural resources survey is recommended and an archeological investigation would likely be required during construction.

   A dam removal permit will be required to decommission the dam. This permit process requires public notice. The Bureau of Land Use Regulation may defer to the Bureau of Dam Safety for the review of downstream impacts, rather than applying for a separate FHS review.

The table below is a summary of required NJDEP verification and permit applications for all three (3) reservoirs, based on the selected alternative contained herein

Permits & Applications	Approximate Process Time	Reservoir		
		Levine	New Street	Great Notch
Flood Hazard Area Applicability	1 Month	X		
Letter of Interpretation (Verification)	1 Month	X	X	X
Flood Hazard Area Individual Permit	6+ Months		X	X
Individual Wetlands Permit	6+ Months		X	X
Dam Construction Permit (Removal)	6+ Months		X	X
Project Authorization Under the NJ Register of Historic Places Act (HPO Permit)	6+ Months	X		

9. Review Cultural Resources

A Phase 1A Cultural Resource Survey was performed for the three (3) reservoirs by Richard Grubb & Associates (RGA), a subconsultant to TYLIN Medina. The Phase IA Cultural Resources Survey consisted of background research, review of historic atlases and maps, a site visit, an assessment of the potential for significant historic and prehistoric archaeological resources, and an assessment of project effects on architectural historic properties. Reference should be made to Appendix G – Cultural Resource Survey Report for the entire reports prepared for each reservoir.

a) Great Notch Reservoir

Richard Grubb & Associates performed a Phase IA cultural resources survey for the Great Notch Reservoir in the Borough of Woodland Park, Passaic County, New Jersey as part of the feasibility study for the PVWC water storage improvement project.

Based on the topographic setting, the results of background research, and a site visit, the northern portion of the APE-Archaeology is considered to have a moderate to high potential to contain both prehistoric and historic cultural resources. Richard Grubb & Associates recommends that a Phase IB cultural resources survey be conducted in the location of the proposed access road, as well as in any areas where the proposed tank construction will affect intact well drained and undisturbed soil surfaces located beyond the limits of the existing reservoir. In addition, if the proposed modifications to the dam will impact the undisturbed, uplands located to the east of the dam this area should be subject to a Phase IB survey.

Drowned or submerged archaeological resources may also be present in what were formerly upland surfaces at the Great Notch Reservoir. As such, a Phase IB cultural resources survey is recommended to determine the presence or absence of archaeological resources where formerly upland landforms may be exposed or impacted. The latter area could be tested if the reservoir is drained prior to tank installation.

The historic architectural survey identified one architectural resource in the APE-Architecture more than 50 years of age: the Great Notch Reservoir Dam, constructed circa 1900. No historic properties previously listed on or determined eligible for the National Register will be affected by the alternatives under consideration in the feasibility study.

b) New Street Reservoir

Richard Grubb & Associates performed a Phase IA cultural resources survey for the New Street Reservoir in the Borough of Woodland Park, Passaic County, as part of the feasibility study for the PVWC water storage improvement project.

Based on the topographic setting, the results of background research, and a site visit, the

APE-Archaeology is considered to have a low potential to contain significant prehistoric or historic cultural resources in areas where terrestrial impacts are proposed. No additional archeological survey is recommended in those areas. It is possible that there were once well drained upland soils located in what is now the New Street Reservoir.

Drowned or submerged prehistoric archaeological resources could be present in these formerly upland surfaces. A Phase IB cultural resources survey is recommended to determine the presence or absence of archaeological resources where formerly upland landforms may be exposed or impacted. The latter area could be tested if the reservoir is drained prior to construction.

The historic architectural survey identified one architectural resource in the APE-Architecture more than 50 years of age: the New Street Reservoir Dam, constructed circa 1925. The alternatives being considered for the feasibility study will have no adverse effect on Garret Mountain Park, which has been previously determined eligible for the National Register. Increasing the vegetative buffer between the reservoir and the park will ensure the proposed alternatives will have no adverse effect on the park.

c) Levine Reservoir

Richard Grubb & Associates performed a Phase IA cultural resources survey for the Levine Reservoir in the City of Paterson, Passaic County, New Jersey as part of the feasibility study for the PVWC water storage improvement project.

Based on the topographic setting, the results of background research, and a site visit, the APE-Archaeology is considered to have very low potential to contain significant prehistoric and historic period archaeological resources. No further archaeological survey is recommended.

The historic architectural survey identified one property listed on the State and National Registers in the APE-Architecture, the Great Falls of Paterson/Society for Useful Manufactures Historic District. The district has also been designated a National Historic

Landmark. It is the opinion of RGA that the Levine Reservoir is a contributing resource to the historic district. The project will have an effect on the historic district; therefore, consultation with the HPO is recommended to avoid an adverse effect through context-sensitive design and enhancement of the vegetative buffer around the reservoir's north end. Documentation of the reservoir to Historic American Engineering Record standards may also be required by the HPO. Additionally, an Application for Project Authorization under the New Jersey Register of Historic Places Act is required because the project will utilize public funding for construction in a State Register-listed district.

Consultation with the HPO regarding the need for intensive-level survey of the building located to the south of the reservoir on the south side of Grand Street, formerly known as the Grand Street Pumping Station is also recommended. The building was previously recommended eligible for the National Register and has historical associations to the Levine Reservoir. If the building is determined eligible for the National Register, then the effects of the project on the building will be assessed.

10. Evaluate Constructability at Each Site

a) Great Notch Reservoir Site

Great Notch Reservoir Site is located in a heavily wooded area and has a shoreline perimeter of approximately 7,500 feet. The Great Notch Dam is an earthen dam with a concrete core. Approximately 120 acres of wooded land drain into the reservoir. The bottom and sides of the reservoir are earthen material and bedrock.

The reservoir would have to be drained and any unsuitable soil above bedrock removed from construction areas prior to improvements within the reservoir being built. Preliminary bathymetric surveys of the reservoir indicated that there is approximately 3 feet or less of material over the bedrock. A significant amount of structural fill material will be needed to bring the subgrade up to the tank slab elevation.

It is anticipated that only minimal rock removal would be necessary for construction of tanks within the reservoir. However, rock removal may be necessary for some portions of the new piping to be installed. Piping should be installed above the bedrock within an embankment or other non-trenching means where possible. A geotechnical study of the site should be conducted to provide tank subgrade and pipe trenching design recommendations.

It was assumed that the pre-stressed concrete tanks would be built on a membrane floor slab. This slab design is dependent on the suitability of the subgrade, with allowable settlement being a determining factor. If the geotechnical design recommendations indicate a structural floor slab is needed, the costs of the slab will increase significantly. This additional cost is not included in the estimates. Each tank will have a flat roof slab due to the size of the tanks and the aesthetic impacts of a domed roof.

Pre-stressed concrete tank manufacturers have indicated that a minimum of 10 feet of space around the tanks in all directions is needed for construction. The figures currently show 50 feet of space between the tanks in all alternatives.

The north and west sides of the reservoir have steep grades that would limit access. The reservoir could be accessed for construction by installing a new road at the northeast corner of the reservoir. This road, which was included in the cost estimate, would connect to Rifle Camp Road. There is sufficient room within the reservoir for contractor staging and laydown. In addition, the empty reservoir provides enough area to stockpile material from the demolition of the dam.

It is anticipated that Great Notch Reservoir will be the last reservoir site in the construction sequence. This will allow PVWC to take advantage of the significant amount of system storage there while construction is occurring at Levine and New Street Reservoirs.

b) New Street Reservoir Site

New Street Reservoir Site has a shoreline perimeter of approximately 3,000 feet. The New Street Dam is a concrete arch dam that exhibits signs of spalling and deterioration. The bottom and sides of the reservoir are earthen material and bedrock.

The reservoir would have to be drained and any unsuitable soil above bedrock removed from construction areas prior to improvements within the reservoir being built. Preliminary bathymetric surveys of the reservoir indicated that there is approximately 1 foot or less of soil over the bedrock. Depending on the location, a significant amount of structural fill material may be needed to bring the subgrade up to the tank slab elevation.

It is anticipated that only minimal rock removal would be necessary for construction of tanks within the reservoir for Alternative 7C. Alternatives 4 and 8 would require significant rock removal in order to "bench" the tanks into the hillside. In addition, rock removal may be necessary for some portions of the new piping to be installed. Piping should be installed above the bedrock within an embankment or other non-trenching means where possible. A geotechnical study of the site should be conducted to provide tank subgrade and pipe trenching design recommendations.

It was assumed that the pre-stressed concrete tanks would be built on a membrane floor slab. This slab design is dependent on the suitability of the subgrade, with allowable settlement being a determining factor. If the geotechnical design recommendations indicate a structural floor slab is needed, the costs of the slab will increase significantly. This additional cost is not included in the estimates. Each tank will have a flat roof slab due to the size of the tanks and the aesthetic impacts of a domed roof.

Pre-stressed concrete tank manufacturers have indicated that a minimum of 10 feet of space around the tanks in all directions is needed for construction. The figures currently show 50 feet of space between the tanks in all alternatives.

The site is easily accessible to the south from Mountain Avenue. There is sufficient room within the reservoir for contractor staging and laydown. In addition, the empty reservoir provides enough area to stockpile material from the demolition of the dam.

c) Levine Reservoir Site

The bottom and sides of Levine Reservoir are bedrock, and some of the reservoir walls appear to be constructed of concrete. The reservoir has a perimeter of 1,800 feet. In addition, preliminary indications are that the Levine Reservoir is located within Great Falls National Park.

The reservoir would have to be drained and any unsuitable soil above bedrock removed from construction areas prior to improvements within the reservoir being built. Preliminary bathymetric surveys of the reservoir indicated that there is approximately 3 feet or less of soil over the bedrock. Structural fill material will be needed to bring the subgrade up to the tank slab elevation for some parts of the reservoir.

Because of the v-shaped bottom of the reservoir, significant rock removal will be required for construction of the new tanks, piping, and reservoir isolation wall. A geotechnical study of the site should be conducted to provide tank subgrade, pipe trenching, and isolation wall design recommendations.

Levine Reservoir is the most constricted of the three sites and does not provide adequate area for contractor staging and laydown without significant temporary fill within the existing reservoir. In addition, PVWC does not own much land around the perimeter of the reservoir that could be used by the contractor. Temporary construction easements on adjacent land may be needed to accommodate construction activities. The site can be accessed to the south from Grand Street and Reservoir Avenue.

It is anticipated that Levine Reservoir would be the first reservoir removed from service during construction. One challenge while the reservoir is out of service will be maintaining 180 Gradient pressure. Maintaining the pressure can be accomplished by feeding the 180 Gradient from the 300/330 Gradient. Details of how this would be achieved will be developed during the preliminary design phase of the project.

d) Emergency Generators

The emergency generators would be constructed prior to any other improvement. Once online, the generators can supply power for backup capacity from the LFWTP and the Wanaque North supply. A critical component of the emergency generator construction will be relocating the electrical loads for the solids handling system from the Lime Building (to be demolished). A potential location for relocating the electrical loads is the new Generator and Switchgear Building, although this would require a temporary relocation during construction of the building.

e) New Street Pump Station

The New Street Pump Station would be constructed prior to the expansion of the Great Notch Pump Station to provide redundancy prior to removing the Great Notch Pump Station from service. It is anticipated that New Street Pump Station work will occur simultaneously or before the construction of New Street Reservoir improvements, but before Great Notch Reservoir construction activities begin.

f) Great Notch Pump Station Expansion

It is anticipated that construction of the Great Notch Pump Station Expansion would occur last in conjunction with the Great Notch Reservoir Improvements. The expansion of the pump station involves installing an additional pump, piping, appurtenances, and electrical equipment in the existing pump station building. Details of how this would be achieved will be developed during the preliminary design phase of the project.

E. Final Alternative Selection

As discussed above the final alternatives had been refined to the following:

- Alternative 7C
- Alternative 4
- Alternative 8

Alternative 4 was eliminated at the beginning of the final alternative selection workshop for the following reasons:

- It did not meet the calculated system storage requirements.
- Operations would have been extremely challenging because available storage would not meet equalization requirements and fire flow protection would have been sacrificed.
- PVWC would not have been able to provide any regional reliability.
- The system storage would not have been enough to supply the system during the 2003 power outage without relying on the backup power.
- The combination of storage (29 MG) and backup power capacity (81 mgd) would not meet the maximum day demand requirements (134 mgd).

In addition, Alternative 7C was selected over Alternatives 7A and 7B for the following reasons:

- Alternative 7B was approximately $40 million dollars more than Alternatives 7A and 7C. This $40 million in additional cost was directly attributed to regional reliability.
- Alternative 7B would cause water age challenges due to the large amount of storage located at the Great Notch Reservoir Site and the low demands in the 427 Gradient.
- Alternative 7A provided the correct amount of distribution system storage but the majority of storage was in a gradient that could not supply regional reliability.
- Alternative 7C provided storage in a hydraulic location where it could be used in any portion of PVWC's system (or regionally) during an emergency event.
- Alternative 7B would have required a significant turnover of water in the 427 Gradient storage (back feed to the 300/330 Gradient) which would result in operation of a power generation facility or loss of hydraulic energy.

To simplify the discussion; Alternative 7C is referred to as Alternative 7 for the final analysis.

F. Refined Cost Opinions

1. Cost Opinion Assumptions

The major assumptions that were made for the feasibility-level cost opinion are as follows:

- The life cycle of all alternatives was considered to be 50 years.
- For Alternative 8, the reservoir liner and cover were assumed to need replacement every 10 years over the 50-year life cycle.
- It was assumed that filling above the bedrock to the desired elevation with compacted structural backfill would provide an adequate base for any tanks.
- Internal baffling in the tanks/reservoir for water quality purposes was assumed for all alternatives.
- Appropriate landscaping was included with each alternative.
- Minimal SCADA improvements were included with each alternative.
- Minimal stormwater improvements were included with each alternative.
- All alternatives included modifications to existing piping to connect Great Notch Reservoir, New Street Reservoir, and Levine Reservoir.
- All alternatives included the demolition of the dam at New Street Reservoir.
- Alternative 7 included the demolition of the dam at Great Notch Reservoir.
- Demolition of the dam at Great Notch Reservoir assumed that the majority of the dam material could be reused to fill in portions of the existing reservoir site.
- The improvements at Levine Reservoir were the same for all alternatives.
- For Levine Reservoir, it was assumed that the remaining existing reservoir could drain to the nearby storm sewer system.
- All alternatives included a potable water hydrant and piping for tank washdown.
- Fencing was included around the tanks for each alternative. Alternative 8 also included fencing around the Great Notch Reservoir.
- No costs were included for potential issues with construction sequencing, constraints, or seasonal limitations.
- All manholes and valve vaults were assumed to be precast concrete.
- All tanks, except the Levine Reservoir tank, were assumed to be prestressed concrete tanks with a membrane floor.
- The cost opinion of a new Verona Tank was assumed to be $2 million for all alternatives.
- A contingency of 20 percent of the direct costs was included for all alternatives.
- Contractor overhead, profit, and risk were assumed to be 12 percent of direct costs.
- Escalation at midpoint of construction was assumed to be 6 percent of direct costs.
- Sales tax of 7 percent was assumed to be applicable to half of the direct costs.
- A bid market allowance of 2 percent of direct costs was assumed.
- Direct costs were estimated using cost curves from previous Carollo projects and the Computerized Carollo Cost Estimating System (CCES) Database.
- The cost estimate herein is based on our perception of current conditions at the project location. This estimate reflects our professional opinion of

accurate costs at this time and is subject to change as the project design matures. The Consultant has no control over variances in the cost of labor, materials, equipment; nor services provided by others, contractor's means and methods of executing the work or of determining prices, competitive bidding or market conditions, practices or bidding strategies. The Consultant cannot and does not warrant or guarantee that proposals, bids or actual construction costs will not vary from the costs presented as shown.

2. Cost Opinion Breakdowns and Equipment Requirements

Table 6.4 lists the cost opinions for Alternatives 7 and 8.

Table 6.4

Cost Opinions for Alternatives 7 and 8 Water Storage Improvements Feasibility Study
Passaic Valley Water Commission, Clifton, NJ

Alternative Component			Alternative 7		Alternative 8
Levine Reservoir		$	8,307,412	$	8,307,412
New Street Reservoir		$	23,108,144	$	16,057,885
Great Notch Reservoir		$	27,704,092	$	23,013,776
Back-up Power at LFWTP (10,000 KW, N+2)		$	5,240,100	$	5,240,100
Great Notch Pump Station		$	-	$	4,524,500
Reverse Pump Station		$	-	$	4,524,500
New Verona Tank		$	2,000,000	$	2,000,000
Other Systemwide Upgrades		$	-		
Total		$	66,359,748	$	63,668,173
Contingency	20%	$	13,271,950	$	12,733,635
Total with Contingency		$	79,631,698	$	76,401,808
Contractor Overhead Profit and Risk	12%	$	9,555,804	$	9,168,217
Escalation at Midpoint of Construction	6%	$	4,777,902	$	4,584,108
Sales Tax(if applicable) (based on 1/2 of total direct cost-.5 x 7%)	3.5%	$	2,787,109	$	2,674,063
Bid Market Allowance	2%	$	1,592,634	$	1,528,036
Division 1 Costs	0%	$	-	$	-
Sub-Total Bid Costs		**$**	**98,345,147**	**$**	**94,356,232**
Engineering and Program Management Costs	15%	$	13,378,125	$	12,835,504
Legal, Administrative, Public Outreach Costs	5%	$	4,459,375	$	4,278,501
Sub Total		**$**	**17,837,500**	**$**	**17,114,005**
Total Capital Costs		**$**	**116,182,647**	**$**	**111,470,237**
Delta O&M Costs- NPV		**$**	**428,571**	**$**	**55,785,224**

Alternative 7

The total life cycle cost opinion for Alternative 7 is $116,600,000 in net present value. This includes approximately $79,630,000 in direct costs, $17,837,500 in engineering/legal costs, and $429,000 in O&M costs.

Alternative 8
The total life cycle cost opinion for Alternative 8 is $167,300,000 in net present value. This includes approximately $76,400,000 in direct costs, $17,114,005 in engineering/legal costs, and $55,800,000 in O&M costs.

3. Operation and Maintenance Costs

The operations and maintenance costs are relative comparison between Alternative 7 and Alternative 8. The costs for Alternative 7 include additional power costs associated with pumping more storage to the 427 Gradient. The costs for Alternative 8 include additional costs associated with pumping more storage to the 427 Gradient, the labor associated with maintaining the cover on the Great Notch Reservoir and the costs for replacing the cover, liner and baffling material every 10 years.

4. Alternative Selection Model Update

The decision model was updated with the cost opinion (including operations and maintenance costs). **Figure 6.38** shows the final alternative rankings with cost opinion information.

5. Final Alternative Selection and Refinement

The final alternative selection was between Alternative 7 and Alternative 8. The following summarizes each of these alternatives:

Alternative 7 – Replace Reservoirs with Storage Tanks and provide some Backup Power.

- Levine: 5 MG of storage (two 2.5 mg prestressed tanks).
- New Street: 30 MG of storage (two 15-MG prestressed tanks).
- Great Notch: 40 MG of storage (two 20-MG prestressed tanks)
- 81 mgd of backup power capacity (either the Main Pump Station or LFWTP).
- Additional pumping capacity at the Great Notch Pump Station – additional 6-mgd pump.
- Addition of a new pump station at the New Street Tanks (to pump up to the Great Notch Tanks): 8-mgd firm capacity.
- Additional 2-MG tank at the existing Verona Tank site.

Alternative 8 – Cover and line the Great Notch Reservoir and provide Storage Tanks at New Street and Levine as well as Backup Power.

- Great Notch: 85 MG of storage (based on minimum historical water level) – cover and lining of the existing reservoir and includes a bifurcated dam.
- New Street: 23 MG of storage (two 11.5-MG pre-stressed tanks).
- Levine: 5 MG of storage (two 2.5 mg prestressed tanks).
- 81 mgd of backup power capacity (either the Main Pump Station or LFWTP).
- New 30-mgd Great Notch Pump Station.
- New Reverse Pump Power Generation Station.
- Additional 2-MG tank at the existing Verona Tank site.

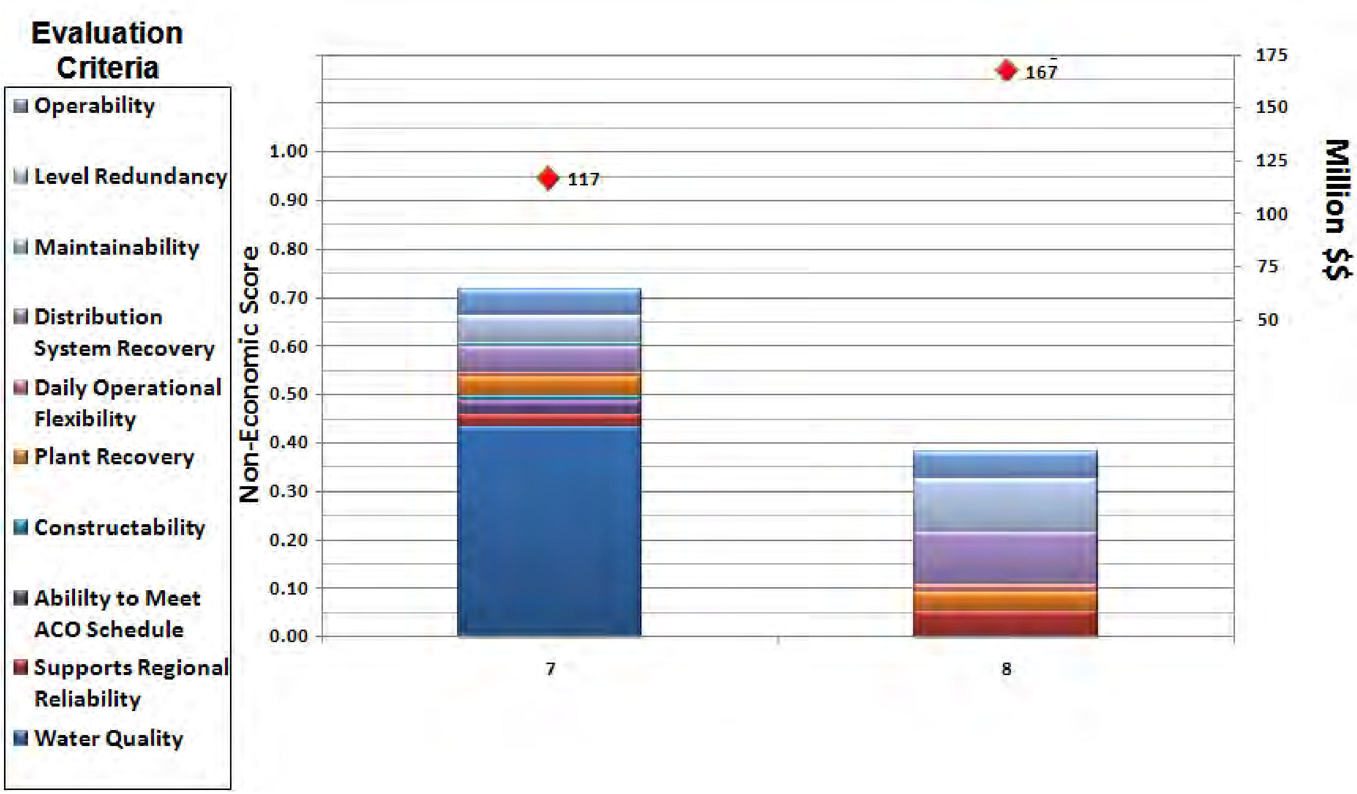

Figure 6.38 Final Alternative Ranking with Cost Opinion Information
Water Storage Improvements Feasibility Study
Passaic Valley Water Commission (PVWC)

Alternative 7 was the final selected alternative. It was selected for the following reasons:

- Total project costs of Alternative 8 were significantly higher than Alternative 7 (approximately $50 million).
- Alternative 8 would be significantly more challenging to operate due to the minimal equalization storage in the 300/330 Gradient and the operation of the reverse pump station.
- Alternative 8 would require more maintenance on the reservoir cover and liner system.
- Alternative 8 would have required dam maintenance and continued permitting.
- Alternative 7 provided pump station redundancy for transferring water from the 300/330 Gradient to the 427 Gradient.
- Construction sequencing for Alternative 8 would be more challenging due to the large amount of earthwork, the construction of the bifurcated dam and the challenges associated with lining and covering a reservoir of this size.
- During construction, PVWC would have to rely on the storage in New Street and Levine for Alternative 8 (total storage volume of 52.7 MG). Alternative 7 will rely on the storage volume in Great Notch (85 MG) during construction.

G. Public Involvement

The public involvement portion of the project will be addressed during the conceptual design phase of the project.

VII. Financing

VII. FINANCING

The purpose of this chapter is to present the potential federal, state and private funding sources that are available to the PVWC in implementing the selected alternative developed as part of this feasibility study, along with an analysis of the impact on retail and wholesale rates as a result of the selected alternative. The following contains each of the funding sources, with an explanation of each, corresponding web sites, contact people, time frames, and addresses.

A. Potential Funding Sources

1. New Jersey Environmental Infrastructure Financing Program (EIFP)

The New Jersey Environmental Infrastructure Financing Program (EIFP) http://www.njeit.org/loanprocess.htm is a partnership between the New Jersey Department of Environmental Protection (DEP) and the New Jersey Environmental Infrastructure Trust. The Legislative created the program to offer local governments and private water purveyors low-cost financing for construction of wastewater and drinking water infrastructure, landfill construction and closure, and stormwater and nonpoint source pollution management projects. Non point source projects may include open space acquisition and remedial action such as brownfields cleanup that produces a water quality improvement.

EIFP borrowers receive two loans:

i. **Zero Percent** interest loan from the NJDEP.
ii. **Market Rate** interest loan from the sale of the Trust's AAA rated tax-exempt bonds.

Some projects will receive 75 percent of the total loan from the NJDEP and 25 percent from the Trust, making their loans only one-quarter of the market rate. Projects that will qualify for the 75/25 financing:

- Projects serving a designated Urban Center or Urban Complex
- Combined sewer overflow projects
- Open space land acquisition projects

All other projects will receive 50 percent of the total loan from DEP and 50 percent from the Trust, making their loans one-half of the market rate.

How to Qualify:

- October 1 of each year is the deadline for submitting a commitment letter and planning documents to qualify for a loan award in November of the following year.
- Pre-award: Applicants may receive authorization to proceed with a project prior to the loan award.
- Short-term Financing for work prior to loan award is also available through the EIFP.

Application Deadline: On or about March 1st annually.

Notification Date: Early September of the same year.

Eligible Activities:
Eligible water project include those that ensure compliance with the Safe Drinking Water Act (SDWA) and protect public health. Some examples are:

- Treatment facilities that need to be upgraded or installed to ensure compliance the SDWA primary and secondary drinking water standards.
- Finished water storage facilities or pumping stations that need to be upgraded or installed to maintain compliance with SDWA.
- Transmission/distribution mains that need to be replaced, repaired or installed to prevent contamination caused by leaks in the pipe or to improve water pressure.
- Water meters that need to be installed or replaced.
- Redevelop well or construct new wells to meet the rules for required pumping capacity.
- Security such as fencing, lighting, motion detectors, and cameras.

Eligible Applicants:
Municipalities, counties, sewerage or utility authorities, joint meetings, improvement authorities or local government units constructing new or improving existing wastewater, stormwater or nonpoint source management facilities.

Qualifications Required for Consideration:
Eligibility is determined according to the ranking criteria of the Federal Priority System developed each year by the DEP. Each project is evaluated and point scores are assigned. Projects are certified for funding based on list rank, amount of available funds, and compliance with requirements and deadlines for planning, design and application.

Loan Limitations:
Eligible entities must:

- Request placement on Project Priority List
- Send in a commitment letter
- Satisfy the planning, design and application deadlines and requirements

Contact Person:
Dennis Hart, Executive Director, New Jersey Environmental Infrastructure Trust
Address:
3131 Princeton Pike, Bldg 6, Suite 201
Lawrenceville, NJ 08648

Mail:
P.O. Box 440
Trenton, NJ 08625

2. Drinking Water State Revolving Fund (DWSRF)

As part of the 1996 Safe Drinking Water Act (SDWA) Amendments, Congress established the Drinking Water State Revolving Fund (DWSRF) www.nj.gov/dep/watersupply/loanprog.htm program. The goal of the program is to provide States with a financing mechanism to ensure safe drinking water to the public. States use Federal capitalization grant money awarded to them to set up infrastructure funding accounts from which assistance is made available to public water systems. States can make loans to public water systems that have interest rates between 0 percent and market rate and standard repayment terms up to 20 years. Loan repayments to the state will provide a continuing long-term source of infrastructure financing.

Both publicly and privately owned community water systems and non-profit non-community water systems are eligible for funding under the DWSRF program. Eligible projects include installation and replacement of failing treatment facilities, eligible storage facilities and transmission and distribution systems. Projects to consolidate water supplies may also be eligible.

The DWSRF program prepares annual intended use plans (IUP). States must file capitalization grant application each year with the U.S. Environmental Protection Agency (USEPA) to secure an allotment of Federal funds needed to initialize and to continue the DWSRF at the State level. The IUP is a central component of the State's application to the USEPA. The IUP describes how the State intends to spend the Federal grant moneys, including eligible projects and non-project set aside expenditures.

DWSRF Agencies and Contacts

- Environmental Infrastructure Trust:
  Maryclaire D'Andrea
  Phone: (609) 219-8600 | Fax: (609) 219-8620
  Email: mdAndrea@njeit.org

- Department of Environmental Protection:
  Roger Tsao
  Phone: (609) 292-5550 | Fax: (609) 292-1654
  Email: roger.tsao@dep.state.nj.us
  www.epa.gov/safewater/dwsrf.html
  www.epa.gov/safewater/dwinfo.htm

3. Pollution Prevention Grant Programs

U.S. Department of Environmental Protection Pollution Prevention Grant Programs: Pollution Prevention (P2) and the Pollution Prevention Information Network (PPIN). Both programs were enacted under the Pollution Prevention Act of 1990. Under these grant programs, EPA supports projects that utilize pollution prevention techniques to reduce and/or eliminate pollution from air, water and/or land. In addition, the grant programs will seek to promote training in pollution prevention/source reduction techniques. For purpose of the grant programs, pollution prevention refers to any practice that reduces or eliminates pollutants.

Deadline for Applications: 45 days from post date.
Refer to www.epa.gov/p2/pubs/grants/ppis/ppis.htm for listings.

When Funds are Available: Grants are usually awarded between June and September.

Match Amount: Eligible applicants are required to provide at least 50% of the total project costs.

Proposal Submission Information: The application process is a two-step process involving a proposal package, followed by an application package (http://www.epa.gov/p2/pubs/grants/ppis/2010rfpp2grant.pdf). The applicant first submits a proposal to the Region. In order for the proposal to be reviewed, it must contain the following items:

- Cover Page
- Narrative Proposal
- SF 424 form
- Letters of Support
- Key Contact information

Eligible proposals that merit further consideration based on the evaluation criteria in will be contacted by the Region and asked to submit an application. Only those applicants who are asked to submit an application will be considered for a P2 grant or cooperative agreement. Application materials include additional federal forms and supporting documentation. An application should not be submitted at this time.

Contact Information:

- U.S. EPA Region 2 (NJ, NY, PR, U.S. Virgin Islands)

Mail code:
SPMMB, 290 Broadway 25th Floor, New York, NY 10007-1866
Contact person: Alex Peck
Phone: (212) 637-3758 | Fax: (212) 637-3771
Email: peck.alex@epa.gov

4. Homeland Security Grant Program (HSGP)

Program Overview:
The Homeland Security Grant Program (HSGP) suite consists of five sub-programs, namely the State Homeland Security Program (SHSP), Urban Areas Security Initiative (UASI), Operation Stonegarden (OPSG), Metropolitan Medical Response System (MMRS), and Citizen Corps Program (CCP).

State Homeland Security Program (SHSP)

Total Funding Available in FY 2010: $842 Million

Purpose: This core assistance program provides funds to build capabilities at the state and local levels and to implement the goals and objectives included in state homeland security strategies and initiatives in their State Preparedness Report. Consistent with the Implementing Recommendations of the 9/11 Act of 2007 (Public Law 110-53) (9/11 Act), states are required to ensure that at least 25 percent of SHSP appropriated funds are dedicated towards law enforcement terrorism prevention-oriented planning, organization, training, exercise, and equipment activities, including those activities which support the development and operation of fusion centers.

Eligible Applicants: The State Administrative Agency (SAA) is the only entity eligible to apply to FEMA for SHSP funds. Recipients include all 50 states, the District of Columbia, Puerto Rico, American Samoa, Guam, Northern Mariana Islands and the U.S. Virgin Islands.

Awards: Funds will be allocated based on three factors: minimum amounts as legislatively mandated, DHS' risk methodology, and effectiveness.

Program Awards and Funding Minimum: Each state will receive a minimum allocation under SHSP using the thresholds established in the 9/11 Act. All 50 states, the District of Columbia, and the Commonwealth of Puerto Rico will receive 0.36 percent of the total funds allocated for grants under Sections 2003 and 2004 of the Homeland Security Act of 2002 as amended by the 9/11 Act for SHSP and UASI programs. Four territories (American Samoa, Guam, Northern Mariana Islands and the U.S. Virgin Islands) will receive a minimum allocation of 0.08 percent of the total funds allocated for grants under Sections 2003 and 2004 of the Homeland Security Act of 2002 as amended by the 9/11 Act for SHSP and UASI programs.

Submission Dates and Times: Application submissions will be received by **11:59 p.m. EDT, April 19, 2010.** Only applications made through www.grants.gov will be accepted.

Address to Request Application Package: All applications for DHS grants will be filed using the common electronic "storefront" www.grants.gov.

Content and Form of Application: The on-line application must be completed and submitted using www.grants.gov after Central Contractor Registry (CCR) registration is confirmed. The on-line application includes the following required forms and submissions:

- For SHSP, UASI, MMRS, and CCP funds, an Investment Justification (IJ) Report from the Grants Reporting Tool
- For UASI funds, an overview of the UAWG structure and a list of members and their associated jurisdictions
- For OPSG funds, Operations Orders and Detailed Budget Summary from eligible local units of government at the county level and Federally recognized tribal governments within States and territories
- For OPSG funds, inventory of Operations Orders in FEMA-provided template
- Standard Form 424, Application for Federal Assistance
- Standard Form 424A, Budget Information

- Standard Form 424B, Assurances
- Standard Form 424C, Budget Information – Construction Form
- Standard Form 424D, Assurances – Construction
- Lobbying Form – Certification Regarding Lobbying (this form must be completed by all grant applicants)
- Standard Form LLL, Disclosure of Lobbying Activities (if the grantee has engaged or intends to engage in lobbying activities)
- Certification Regarding Debarment, Suspension, and Other Responsibility Matters
- Certification Regarding Drug-Free Workplace Requirements

Dun and Bradstreet Data Universal Numbering System (DUNS) number: The applicant must provide a DUNS number with their application. This number is a required field within www.grants.gov. Organizations should verify that they have a DUNS number, or take the steps necessary to obtain one, as soon as possible. Applicants can receive a DUNS number at no cost by calling the dedicated toll-free DUNS number request line at (866) 705-5711.

Valid CCR Registration: The application process also involves an updated and current registration by the applicant. Eligible applicants must confirm CCR registration at http://www.ccr.gov, as well as apply for funding through www.grants.gov .

IJ (SHSP, UASI, MMRS, and CCP): As part of the FY 2010 HSGP application process for SHSP, UASI, MMRS, and CCP funds, applicants must develop a formal IJ that addresses each Investment being proposed for funding. The IJ must demonstrate how proposed projects address gaps and deficiencies in current capabilities. The IJ must demonstrate the ability to provide enhancements consistent with the purpose of the program and guidance provided by FEMA. Applicants must ensure that the IJ is consistent with all applicable requirements outlined in this application kit.

UASI (Urban Area Security Initiative)

- For new Urban Areas, IJ technical assistance is available; please consult your SAA for requesting assistance services from FEMA.
- UASI jurisdictions may propose up to 15 Investments (including Multi-Applicant Investments that support regional initiatives) within their IJ.

SHSP (State Homeland Security Program)

- For SHSP funds, applicants may propose up to 15 Investments (including Multi-Applicant Investments that support regional initiatives) within their IJ.

MMRS (Metropolitan Medical Response System)

- States receiving MMRS grant funds are required to prepare one Investment that clearly identifies the support for the integration of local emergency management, health, and medical services for mass casualties using MMRS grant funds across all MMRS jurisdictions.

CCP (Citizen Corps Program)

- States and territories receiving CCP funds are required to prepare an Investment which outlines how funds will be used to facilitate both community and citizen preparedness and participation, and support the development and maintenance of an integrated emergency preparedness planning body of government and nongovernmental representatives.

Construction and Renovation (SHSP, UASI):
Use of HSGP funds for construction is generally prohibited except as outlined below. Such construction shall be strictly limited and allowable only when it is a necessary component of a security system at critical infrastructure facilities. OPSG, CCP, and MMRS funds may not be used for any type of construction. Project construction not exceeding $1,000,000 is allowable as deemed necessary. The following types of projects are considered to constitute construction or renovation and must be submitted to FEMA for compliance review under Federal environmental planning and historic preservation (EHP) laws and requirements prior to initiation of the project:

- Construction and renovation of guard facilities which are intended to provide enhanced security at grantee-designated critical infrastructure sites
- Renovation of and modifications, including the installation of security and communication equipment, to buildings and structures that are 50 years old or older
- Any other construction or renovation efforts that change or expand the footprint of a facility or structure, including security enhancements to improve perimeter security
- Physical security enhancements including, but not limited to:
  a) Lighting
  b) Fencing
  c) Closed-circuit television (CCTV) systems
  d) Motion detection systems
  e) Barriers, doors, gates, and related security enhancements

In order to draw down funds for construction and renovation costs under HSGP, grantees must provide to FEMA:

- A description of the asset or facility, asset location, whether the infrastructure is publicly or privately owned, and the construction or renovation project
- Certification that a facility vulnerability assessment has been conducted
- An outline addressing how the construction or renovation project will address the identified vulnerabilities from the assessment
- Consequences of not implementing the construction or renovation project
- Any additional information requested by FEMA to ensure compliance with Federal EHP requirements

For more information on FEMA's EHP requirements, SAAs should refer to FEMA's Information Bulletin #329, Environmental Planning and Historic Preservation Requirements for Grants, available at http://www.fema.gov/pdf/government/grant/bulletins/info329.pdf.

Additional information and resources can also be found at http://www.fema.gov/plan/ehp/ehp-applicanthelp.shtm.

5. Community Development Block Grants /Entitlement Grants

U.S. Department of Housing and Urban Development: Community Development Block Grant (CBDG) Entitlement Community Grants.
Deadline for Applications: For formula grants, no earlier than November 15 or no later than August 16 of the fiscal year of which the funds are allocated.
When funds are available: Grantees have program year start dates between January 1 and October 1.

The program provides annual grants on a formula basis to entitled cities and counties to develop viable urban communities by providing decent housing and a suitable living environment, and by expanding economic opportunities, principally for low- and moderate- income persons. The program is authorized under Title 1 of the Housing and Community Development Act of 1974, Public Law 93-383, as amended; 42 U.S.C.-5301 et seq.

HUD awards grants to entitlement community grantees to carry out a wide range of community development activities directed toward revitalizing neighborhoods, economic development, and providing improved community facilities and services.

Entitlement communities develop their own programs and funding priorities. However, grantees must give maximum feasible priority to activities which benefit low- and moderate- income persons. A grantee may also carry out activities which aid in the prevention or elimination of slums and blight. Additionally, grantees may fund activities when the grantee certifies that the activities meet other community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community where other financial resources are not available to meet such needs. CBDG funds may not be used for activities which do not meet these broad national objectives.

Eligible Grantees are as follows:

- principal cities of Metropolitan Statistical Areas (MSAs)
- other metropolitan cities with populations of at least 50,000
- qualified urban counties with populations of at least 200,000 (excluding the population of entitled cities) are entitled to receive annual grants

Eligible Activities:
CDBG funds may be used to activities which include, but are not limited to:

- acquisition of real property
- relocation and demolition
- rehabilitation of residential and non-residential structures
- construction of public facilities and improvements, such as water and sewer facilities, streets, neighborhood centers, and the conversion of school buildings for eligible purposes
- public services, within certain limits
- activities relating to energy conservation and renewable energy resources

- provision of assistance to profit-motivated businesses to carry out economic development and job creation/retention activities

Requirements:
To receive its annual CDBG entitlement grant, a grantee must develop and submit to HUD its Consolidated Plan http://www.hud.gov/offices/cpd/about/conplan/ , (which is a jurisdiction's comprehensive planning document and application for funding under the following Community Planning and Development formula grant programs: CDBG, HOME Investment Partnerships, Housing Opportunities for Persons with AIDS (HOPWA), and Emergency Shelter Grants (ESG). In its Consolidated Plan, the jurisdiction's Plan and its performance under the Plan. Also, the Consolidated Plan must include several required certifications, including that not less than 70% of the CDBG funds received, over a one, two, or three year period specified by the grantee, will be used for activities that benefit low- and moderate-income persons, and that the grantee will affirmatively further fair housing. HUD will approve a Consolidated Plan submission unless the Plan (or a portion of it) is inconsistent with the purposes of the National Affordable Housing Act or is substantially incomplete.
Following approval, the Department will make a full grant award unless the Secretary has made a determination that the grantee:

- Has failed to carry out its CDBG-assisted activities in a timely manner
- Has failed to carry out those activities and its certifications in accordance with the requirements and the primary objectives of Title I of the Housing and Community Development Act of 1974, as amended, and with other applicable laws
- Lacks a continuing capacity to carry out its CDBG-assisted activities in a timely manner

Contact Person:
Kathleen Naymola, Community Planning & Development (CPD) Field Office Director.
Field Office: Newark Field Office.
Correspondence Code: 2FD
Address:
One Newark Center
13th Floor
Newark, NJ 07102-5260

B. Rate Impact Analysis for the Selected Alternative

Revenue Requirement Analysis

The Passaic Valley Water Commission has adopted a Five-Year Budget that relates revenues, expenses, construction schedules and financings. The approved Five-Year Budget includes a preliminary forecast of the construction costs of the reservoir improvement project and the anticipated implementation schedule for the projects. This preliminary forecast was developed without the benefit of this feasibility analysis and the detailed construction cost estimates contained herein. The Five-Year Budget anticipates periodic rate adjustments of 5% each year effective January 1, 2011 and January 1, 2012 and 4% effective January 1, 2013. The debt service schedules in the approved Five Year Budget anticipate a maximum annual debt service of $6,705,547.54 associated with the reservoir improvements alone and this would have come due in the year 2026.

The capital cost of the selected alternative is presented in Table RRA-1. In this table, project contingencies and allowances have been reallocated to each individual construction project to facilitate the projection of financing needs and the outlay of construction expenditures. Engineering, legal and program management expenditures are treated as a distinct project in this analysis and these expenses will both anticipate and track construction costs through the life of the effort.

Table RRA-2 shows the anticipated construction schedule and expenditure outlay for the program. The actual implementation schedule will be the subject of further negotiation with the New Jersey Department of Environmental Protection and could change. The schedule shown in Table RRA-2 was developed taking into consideration the need to maintain water service and fire protection through the construction schedule. Essentially, this means that no more than one reservoir may be out of service at any point in time during the overall construction phase. Table RRA-3 shows the financing and debt service amounts associated with this construction and expenditure outlay schedule. The debt service calculations reflect the use of a 30-year issue for each project element to spread the annual debt service as much as possible and mitigate the impact on customer rates. Other options, including the NJEIT, may be available, but the initial analysis shows that the best option for keeping annual debt service as low as possible is to use the Commission's Revenue Bonds. New bonds would be issued periodically during the construction phase to anticipate construction expenditure outlays.

The Commission's approved Five-Year Budget was updated to reflect the construction expenditure schedule shown in Table RRA-2 and the debt service obligations shown in Table RRA-3. The rate adjustments in the approved budget were then adjusted to retain the same debt service coverage ratios that have been approved by the Commission. The assumption made in this analysis is that rate increases would be applied across all customer classes and to the fixed service charges collected by the Commission at the same rate. In other words, a 5% annual increase would be applied to the retail fixed service charge, the volumetric rates, and wholesale rates. Private fire service rates are projected to increase at greater annual adjustments to achieve parity with the indicated cost of providing service. After the completion of the detailed design and negotiation of the final project construction schedules with the New Jersey Department of Environmental Protection, it would be appropriate to revisit this assumption. A detailed cost of service allocation study could suggest a need to deviate from a uniform application of the rate increases across all service classes. Nevertheless, the across-the-board approach taken here is consistent with the projections made in the approved Five Year Budget.

The construction schedule derived in this evaluation indicates that all elements of the program cannot be completed concurrently as originally forecast in the approved Five Year Budget. This means that certain elements of the construction program and the associated financings will take place over an extended period of time. Because the annual debt service amounts projected in this evaluation track closely with the amounts anticipated in the current Five Year Budget, it is recommended that the rate increases already approved in the Five Year Budget be maintained at 5% each year effective January 1, 2011, January 1, 2012 and 4% effective January 1, 2013. This will help to build cash reserves and mitigate the impact of the larger construction expenditures that will follow. The impact of the delayed construction expenditures beyond 2013 can be assessed in the development of a new Five Year Budget, which will cover the 2011 through 2015 period. The construction program undertaken by the Commission in future years, particularly 2016 through 2018, can be adjusted to limit overall construction expenditures to levels that will mitigate the impact of rate increases beyond 2015. The maximum debt service payments required under the revised construction schedule is $6,628,000, an amount slightly less than that contemplated in the approved Five Year Plan. The maximum occurs in 2034, or eight year later than originally projected.

Table RRA-1: Construction Cost Allocation			
Item		**Cost Estimate**	**Reallocation of Contingencies and Allowances**
Levine Reservoir		$8,307,412	$12,312,000
New Street Reservoir		$23,108,144	$34,246,000
Notch Reservoir		$27,704,092	$41,057,000
Back-up Power at LFWTP (10,000 KW, N+2)		$5,240,100	$7,766,000
New Verona Tank		$2,000,000	$2,964,000
Total		$66,359,748	
Contingency	20%	$13,271,950	
Total with Contingency		$79,631,698	
CONTRACTOR OVERHEAD PROFIT AND RISK	12%	$9,555,804	
ESCALATION AT MIDPOINT OF CONSTRUCTION	6%	$4,777,902	
SALES TAX (If Applicable) – (based on 1/2 of total direct cost-.5 x 7%)	3.5%	$2,787,109	
BID MARKET ALLOWANCE	2%	$1,592,634	
Subtotal - Construction		$98,345,147	$98,345,000
ENGINEERING AND PROGRAM MANAGEMENT COSTS	15%	$13,378,125	
LEGAL, ADMINISTRATIVE, PUBLIC OUTREACH COSTS	5%	$4,459,375	
Subtotal Design and Program Management		$17,837,500	$17,838,000
TOTAL		$116,182,647	$116,183,000

Table RRA-2: CONSTRUCTION EXPENDITURE										
Item	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**		**Total**
Levine Reservoir	$0	$3,078,000	$6,156,000	$3,078,000	$0	$0	$0	$0	$0		$12,312,000
New Street Reservoir	$0	$0	$0	$0	$8,561,500	$17,123,000	$8,561,500	$0	$0		$34,246,000
Great Notch Reservoir	$0	$0	$0	$0	$0	$0	$10,264,250	$20,528,500	$10,264,250		$41,057,000
Back-up Power at LFWTP (10,000 KW, N+2)	$0	$3,883,000	$3,883,000	$0	$0	$0	$0	$0	$0		$7,766,000
New Verona Tank	$0	$0	$741,000	$2,223,000	$0	$0	$0	$0	$0		$2,964,000
Subtotal - Construction	$0	$6,961,000	$10,780,000	$5,301,000	$8,561,500	$17,123,000	$18,825,750	$20,528,500	$10,264,250		$98,345,000
Design and Program Management	$3,568,000	$1,010,000	$1,564,000	$769,000	$1,242,000	$2,485,000	$2,732,000	$2,979,000	$1,489,000		$17,838,000
Total	$3,568,000	$7,971,000	$12,344,000	$6,070,000	$9,803,500	$19,608,000	$21,557,750	$23,507,500	$11,753,250		$116,183,000

Table RRA-3 Projected Debt Service Payments									
	2012 Const	2013 Const	2014 Const	2015 Const	2016 Const	2017 Const	2018 Const	2019 Const	Total
2012	$353,612.50								$353,612.50
2013	$473,612.50	$542,000.00							$1,015,612.50
2014	$473,512.50	$727,000.00	$271,612.50						$1,472,125.00
2015	$473,512.50	$729,137.50	$366,612.50	$432,325.00					$2,001,587.50
2016	$473,312.50	$726,337.50	$362,575.00	$582,325.00	$854,862.50				$2,999,412.50
2017	$472,575.00	$728,337.50	$363,775.00	$580,950.00	$1,144,862.50	$938,987.50			$4,229,487.50
2018	$476,625.00	$729,412.50	$364,775.00	$579,750.00	$1,147,537.50	$1,258,987.50	$1,022,912.50		$5,580,000.00
2019	$475,250.00	$725,062.50	$365,312.50	$578,350.00	$1,145,337.50	$1,260,387.50	$1,372,912.50	$516,500.00	$6,439,112.50
2020	$472,500.00	$725,500.00	$365,637.50	$581,337.50	$1,147,737.50	$1,261,987.50	$1,373,037.50	$691,500.00	$6,619,237.50
2021	$474,500.00	$728,750.00	$365,750.00	$578,900.00	$1,148,712.50	$1,257,987.50	$1,373,437.50	$694,062.50	$6,622,100.00
2022	$476,000.00	$726,250.00	$364,750.00	$581,250.00	$1,149,050.00	$1,262,687.50	$1,373,237.50	$691,662.50	$6,624,887.50
2023	$477,000.00	$728,250.00	$363,500.00	$581,750.00	$1,148,750.00	$1,261,537.50	$1,371,450.00	$694,062.50	$6,626,300.00
2024	$472,500.00	$729,500.00	$362,000.00	$581,750.00	$1,145,000.00	$1,259,750.00	$1,374,025.00	$695,562.50	$6,620,087.50
2025	$472,750.00	$725,000.00	$365,250.00	$581,250.00	$1,145,500.00	$1,259,250.00	$1,370,750.00	$691,637.50	$6,611,387.50
2026	$477,500.00	$725,000.00	$363,000.00	$580,250.00	$1,150,000.00	$1,257,750.00	$1,373,500.00	$692,500.00	$6,619,500.00
2027	$476,500.00	$729,250.00	$365,500.00	$578,750.00	$1,148,250.00	$1,260,250.00	$1,375,000.00	$691,250.00	$6,624,750.00
2028	$475,000.00	$727,500.00	$362,500.00	$581,750.00	$1,145,500.00	$1,261,500.00	$1,370,250.00	$694,500.00	$6,618,500.00
2029	$473,000.00	$725,000.00	$364,250.00	$579,000.00	$1,146,750.00	$1,261,500.00	$1,374,500.00	$692,000.00	$6,616,000.00
2030	$475,500.00	$726,750.00	$365,500.00	$580,750.00	$1,146,750.00	$1,260,250.00	$1,372,250.00	$694,000.00	$6,621,750.00
2031	$477,250.00	$727,500.00	$366,250.00	$581,750.00	$1,145,500.00	$1,257,750.00	$1,373,750.00	$695,250.00	$6,625,000.00
2032	$473,250.00	$727,250.00	$366,500.00	$577,000.00	$1,148,000.00	$1,259,000.00	$1,373,750.00	$690,750.00	$6,615,500.00
2033	$473,750.00	$726,000.00	$366,250.00	$581,750.00	$1,149,000.00	$1,258,750.00	$1,372,250.00	$690,750.00	$6,618,500.00
2034	$473,500.00	$728,750.00	$365,500.00	$580,500.00	$1,148,500.00	$1,262,000.00	$1,374,250.00	$695,000.00	**$6,628,000.00**

2035	$477,500.00	$725,250.00	$364,250.00	$578,500.00	$1,146,500.00	$1,258,500.00	$1,374,500.00	$693,250.00	$6,618,250.00
2036	$475,500.00	$725,750.00	$362,500.00	$580,750.00	$1,148,000.00	$1,258,500.00	$1,373,000.00	$695,750.00	$6,619,750.00
2037	$472,750.00	$730,000.00	$365,250.00	$577,000.00	$1,147,750.00	$1,261,750.00	$1,369,750.00	$692,250.00	$6,616,500.00
2038	$474,250.00	$727,750.00	$362,250.00	$577,500.00	$1,145,750.00	$1,258,000.00	$1,369,750.00	$693,000.00	$6,608,250.00
2039	$474,750.00	$729,250.00	$363,750.00	$582,000.00	$1,147,000.00	$1,262,500.00	$1,372,750.00	$692,750.00	$6,624,750.00
2040	$474,250.00	$729,250.00	$364,500.00	$580,250.00	$1,146,250.00	$1,259,750.00	$1,373,500.00	$691,500.00	$6,619,250.00
2041	$477,750.00	$727,750.00	$364,500.00	$577,500.00	$1,148,500.00	$1,260,000.00	$1,372,000.00	$694,250.00	$6,622,250.00
2042		$729,750.00	$363,750.00	$578,750.00	$1,148,500.00	$1,263,000.00	$1,373,250.00	$695,750.00	$6,152,750.00
2043			$362,250.00	$578,750.00	$1,146,250.00	$1,258,500.00	$1,372,000.00	$691,000.00	$5,408,750.00
2044				$577,500.00	$1,146,750.00	$1,261,750.00	$1,373,250.00	$695,250.00	$5,054,500.00
2045					$1,149,750.00	$1,262,250.00	$1,371,750.00	$693,000.00	$4,476,750.00
2046						$1,260,000.00	$1,372,500.00	$694,500.00	$3,327,000.00
2047							$1,370,250.00	$694,500.00	$2,064,750.00
2048								$693,000.00	$693,000.00
Total	$14,119,262.50	$21,638,287.50	$10,839,800.00	$17,249,937.50	$34,126,600.00	$37,484,812.50	$40,829,512.50	$20,620,737.50	$196,908,950.00