

**LEGACY RIDGE
RESIDENTIAL DEVELOPMENT
HIGHLAND MILLS, NEW YORK**

**PRELIMINARY ENGINEERING REPORT
Legacy Ridge Water System**

July 2005

Last Revised January 2006

HDR

LMS

One Blue Hill Plaza
Pearl River, New York 10965

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE #</u>
1.0 INTRODUCTION	1
2.0 PROJECT DESCRIPTION	1
3.0 WATER SUPPLY AND DEMAND REQUIREMENTS	3
4.0 POTABLE WATER SUPPLY WELLS	3
5.0 WATER TREATMENT	4
6.0 STORAGE CAPACITY	5
7.0 WATER SYSTEM ANALYSIS	6

APPENDICES

- APPENDIX 1 – LEGACY RIDGE WATER CONCEPT PLANS**
- APPENDIX 2 – WATER DEMAND CALCULATIONS**
- APPENDIX 3 – STANDPIPE DETAILS AND SPECIFICATION**
- APPENDIX 4 – WATER BOOSTER STATION DETAILS AND SPECIFICATION**
- APPENDIX 5 – LEGACY RIDGE WATER SYSTEM SCHEMATIC**
- APPENDIX 6 – USGS QUADRANGLE MAP**
- APPENDIX 7 – PRESSURE REDUCING STATION DETAILS &
SPECIFICATIONS**
- APPENDIX 8 – WATER QUALITY DATA**

1.0 INTRODUCTION

This report has been prepared by HDR-LMS on behalf of the Project Sponsor for the residential development known as Legacy Ridge at Highland Mills. The report pertains to the water works improvements that are necessary to serve the proposed residential development known as Legacy Ridge. Legacy Ridge is located on both sides of Trout Brook Road (NY County Route 9) between Smith Clove Road and NY County Route 32. The properties are identified on the Town of Woodbury Tax maps as 3-1-11 and 3-1-12.5 in Highland Mills, Orange County, NY. Parcel 3-1-11 is the northernmost parcel and will be utilized for water supply, water storage, parking, and possible water treatment and otherwise to remain as permanent open space to be dedicated to the town. Parcel 3-1-12.5 will be primarily utilized for housing and water storage.

A site map showing Legacy Ridge site boundaries and topography is included in Appendix 6 of this report. The topography on the Legacy Ridge site ranges between approximate elevations 980 and 340. The area to be developed ranges between elevations 810 and 370. The proposed Legacy Ridge development will be serviced with central water provided by the Town of Woodbury Consolidated Water District (WCWD). Improvements must be made to accommodate Legacy Ridge prior to connecting to the WCWD. Such improvements include, but are not necessarily limited to, the following:

- A new, sufficient on-site water storage capacity to meet the projected consumptive uses and fire demands of Legacy Ridge
- A new water source capable of yielding the average daily water demand of Legacy Ridge community
- A new on-site water distribution system designed and constructed in accordance with both state and local regulations and specifications.

The following report identifies the characteristics and requirements of the proposed Legacy Ridge water distribution system and how the improvements will affect the existing WCWD.

2.0 PROJECT DESCRIPTION

The Legacy Ridge water system will serve a 287-unit housing community consisting of four bedroom single-family homes and a community recreation center. The site layout is based on a proposed R-2A with Conservation Cluster Zoning. The proposed Legacy Ridge water system will connect to the existing WCWD and will reduce the existing system's vulnerability by increasing available storage capacity and water supply. A looped system is preferable to help balance the piping network and reduce friction losses.

The Town of Woodbury requires a minimum pressure of 45 psi at street grade under average flow conditions and 20 psi at street grade during fire flow conditions. HDR-LMS will perform a water model analysis in order to determine the sizing of new water mains to meet the required pressures. The topography on the Legacy Ridge site ranges

between elevation 810 and 370, requiring three zones for water distribution. These zones are identified as High, Intermediate, and Low and are designed at a hydraulic grade level of 975.00, 861.25, and 725.00, respectively. Each zone will connect to the WCWD at specific points in the existing system. A description of each zone is included in Section 6.0 of this report.

The existing Skyline and Summit/Overlook portions of the WCWD benefit most from the proposed connections. The Skyline water system is currently pressurized by the Birchwood Water Booster Station located near the Birchwood Ave/Skyline Dr intersection. This booster station draws from the Summit/Overlook system. The 100,000 gallon Skyline Tank located off Summit Drive provides fire storage for the Skyline system located south of the Riegel Rd/Skyline Dr intersection. This portion of the Skyline system is referred to as the Skyline Low Zone. The upper lying area of the Skyline system (north of the Riegel Rd/Skyline Dr intersection) is not fully provided with fire protection due to the lack of pressure provided by the Skyline Tank. This portion of the system is referred to in this report as the Skyline High Zone.

The Summit/Overlook is pressurized by the Addams St well field, Summit Ave Tanks #1 and #2 and the Overlook Tank. This system operates at a maximum hydraulic grade of 725.00 and covers the largest area within the WCWD. The following provides a description of the connection points and how they benefit the existing system. An approximate location of each connection point is shown on Appendix 1 of this report.

Connection Point #1 – The Legacy High Zone (HGL = 975.00) will be extended in the southwest corner of the site to the Skyline Drive High Zone. This will provide the Skyline High Zone with adequate fire protection as well as gravity feed system. The Skyline Low Zone must be disconnected from the Skyline High Zone to avoid an undesirable increase in pressure caused by this connection. The exact location of the water main extension and the location of the connection point to the existing WCWD are yet to be determined.

Connection Point #2 – The Legacy Intermediate Zone will connect directly to the Skyline Drive Tank (HGL = 861.25). This will provide the Legacy Intermediate Zone with the necessary storage for consumptive use. Fire storage will be provided by LR Tank #1. An additional 2,600 L.F. water main extension will be necessary to connect the Skyline Drive Low Zone to the Skyline Tank. This extension is required in order to separate the Skyline High and Low Zones

Connection Point #3 - A proposed water main will be extended from the Legacy Ridge Low Zone to the Summit Avenue system. The water main extension will exit the southeast corner of the Legacy Ridge site and will travel south along N.Y. County Rout 9 and connect to the existing water main along Hamilton Avenue. The water main extension will be pressurized by the proposed LR Tank #2 (overflow elevation 725.00), the Legacy Ridge Supply Wells, and the Summit/Overlook system.

3.0 WATER DEMAND AND SUPPLY REQUIREMENTS

The Legacy Ridge residential development has demand requirements for both consumptive and fire flow usage. Consumptive usage is the day-to-day water usage that can be estimated using the *New York State Department of Environmental Conservation's Design Standards for Wastewater Treatment Works* © 1988. This type of demand is often referred to as the average daily demand (ADD). Water demand for fire flow (a.k.a. emergency) usage is referred to as Needed Fire Flow (NFF) and is calculated using methodology presented in the *Guide For Determination of Needed Fire Flow* © ISO Properties, Inc., 2001.

Water systems are typically designed to provide adequate firm capacity to meet or exceed the maximum daily demand (MDD). "Firm capacity" is defined as the amount of water that can be supplied to a particular water system with the highest yielding well out of service. The Town of Woodbury (Town) has indicated that firm capacity is provided by the existing WCWD and is not a concern for new water supply. Therefore, since firm capacity is achieved elsewhere in the WCWD, MDD is not used to calculate new source requirements. At a minimum, a new water supply source equating to the MDD of Legacy Ridge must be supplied to meet the consumptive usage. The existing WCWD water supply coupled with the new water source must be capable of meeting the MDD of Legacy Ridge with the largest well out of service.

A summary of the Legacy Ridge system water demands and storage requirements are summarized in Table 1. Water demand calculations are provided in Appendix 2 of this report.

Table 1 - Summary of Water System Demands & Storage Requirements	
Average Daily Demand =	97.2 gpm
Maximum Daily Demand =	157.9 gpm
Needed Fire Flow (2-hr duration) =	1000.0 gpm
Total System Demand =	1,157.9 gpm
Minimum Storage Required =	260,000 gallons
Storage Provided =	510,000 gallons

4.0 POTABLE WATER SUPPLY WELLS

Three new groundwater supply wells (TW-01, TW-02 and TW-04), will provide additional source capacity to the WCWD. One additional well (TW-03) was also installed but subsequently abandoned due to elevated turbidity levels. The three wells are located in the northeast portion of the WCWD near the NY County Route 34 (a.k.a. Trout Brook Road) and NY County Route 32 intersection. The new supply wells are completed in the underlying sand and gravel aquifer associated with Woodbury Creek. The three wells were installed between June and November 2005 by Hayward Baker Inc. using a dual rotary drilling rig to minimize the disturbance to the formation and facilitate the

installation of the large diameter outer casing and screen. Each of the wells were completed with 10 feet of high capacity stainless steel screen, TW-01 and TW-04 were fitted with 50 slot screen while TW-03 was fitted with a 60 slot screen based on grain size analysis of the aquifer material. The completion depths of the wells were 42.5, 47.7, and 49 feet from the top of the well casing for TW-01 to TW-04 respectively. All construction materials and installation procedures for both wells meet NYSDOH requirements for water supply wells.

Individual 72-hour pump tests were conducted on each of the test wells and drawdown and recovery data was collected from the existing groundwater and surface water monitoring points in the area. In addition, groundwater samples were collected for analysis as required for approval of new public water systems by New York State Department of Health (NYSDOH).

During each of the 72-hour pump tests that were conducted on the test wells the pumping rate was maintained at a constant rate for an uninterrupted period of at least 72-hours. TW-01 was tested at a constant rate of 210 gpm with a maximum stabilized drawdown of 11.57 feet. At the end of the 72-hour test the specific capacity of this well was calculated to be 18 gpm/ft of drawdown. TW-02 was tested at a constant rate of 119 gpm and the maximum stabilized drawdown was 18.01 which results in a specific capacity of 6.6 gpm/ft of drawdown. The pumping rate at TW-04 was 39 gpm with a stabilized drawdown of 12.99 ft and a specific capacity of 3.0 gpm/ft of drawdown. On completion of each of the 72-hour pump tests the recovery data indicates that the aquifer water levels recovered back to the approximate pre-test levels.

Based on the monitoring data collected at the other groundwater monitoring points the noted drawdowns on-site and off-site were minimal. The noted water level changes indicate that once the wells are placed into production it is not anticipated that any of the off-site residential wells will experience significant water level impacts.

The estimated long term safe yields and recommended pumping rates for TW-01, TW-02, and TW-04 are 290, 120, and 34 gpm respectively, based on the aquifer testing data. The total combined yield of the three test wells is 444 gpm (639,360 gallons/day) which is in excess of the anticipated daily demand for WP3 and the Legacy Ridge development. Currently, the WCWD provides approximately 900,000 gallons per day to the 10,000 residents it serves. With the addition of the two new wells the system capacity would be increased by 71% (639,360 gallons per day). This large increase in capacity would provide flexibility in operation and maintenance and decrease the vulnerability of the system should one (or more) of the existing wells fail or become contaminated.

5.0 WATER TREATMENT

A full set of water quality samples were collected near the end of the 72-hour tests and the samples were analyzed by a NYSDOH certified laboratory to insure the proposed supply meets all water quality standards for public supply. The results indicate the water

is of excellent quality and exhibits very low concentrations of iron and manganese. Preliminary analytical results TW-01 is summarized in Appendix 8.

All treatment will occur at the groundwater source. Raw water from the proposed supply well(s) will be disinfected in accordance with the *Recommended Standards for Water Works* © 2003 (a.k.a. Ten States Standards) and local requirements. Disinfection will occur at a centralized well house located in close proximity to the supply wells. Sufficient contact time shall be allowed prior to all private connections. The water system improvements will have no impact on existing water treatment.

6.0 STORAGE CAPACITY

The sizing of the Legacy Ridge water storage tanks does not take into consideration off-site demands. Off-site demands, if any, must be documented by the Town of Woodbury in order to determine additional storage capacity requirements for off-site homes.

Two (2) proposed on-site storage tanks and the existing Skyline Tank will supplement water to the Legacy Ridge water system. The tanks are identified as LR Tank #1 and LR Tank #2. Refer to Appendix 1 for a location of both tanks. A specification and a detail of a typical storage tank are included in Appendix 3 of this report. The tanks will be installed at different elevations in order to keep on-site pressures within the range of 45-100 psi under average daily flow conditions. According to the Ten States Standards, pressures within the system should stay within the range of 35-80 psi; however, the design must also meet the local requirements of a minimum 45 psi under average flow conditions. All homes receiving a pressure greater than 90 psi should be provided with private pressure reducing valves. High pressure zones within Legacy Ridge will be identified upon completion of a water model analysis. Homes located within the high pressure zones will be provided with individual pressure reducing valves.

Three (3) pressure zones have been identified in the proposed Legacy Ridge Water System. The table below offers an outline of the characteristics of each pressure zone.

Zone	Maximum Elevation	Minimum Elevation	Storage Tank Pressurization	Pump Pressurization
High	860	745	LR Tank #1	LR Booster Station
Intermediate	745	610	Skyline Tank	LR Booster Station
Low	610	390	LR Tank #2	LR Supply Wells

LR Tank #1 will be located in the northwest portion of parcel 3-1-11. LR Tank #1 is sized to provide storage for a 2-hour fire event and one day of average daily flow to the 18 homes of the Legacy Ridge High Zones. LR Tank #1 measures 42' diameter x 28' sidewall height and stores approximately 300,000 gallons of potable water. The required storage capacity of this tank was vastly oversized to provide additional storage capacity and improve the WCWD reliability. The overflow elevation will be situated at elevation 975.00, as requested by the Town of Woodbury. According to the Town of Woodbury,

placing the tank at such an elevated position will provide the Skyline High Zone with fire flow. An investigation must be performed on the homes within the Skyline High Zone to confirm that the fire demand for the system does not exceed the storage capacity provided. Another benefit of placing the tank at elevation 975 is that it provides relief for the Birchwood Booster Station. A water model analysis must be performed to specifically determine the affects of the LR Tank #1 on the Skyline Drive system. High and low pressure areas should be identified to confirm that the improvements to the existing system are designed in accordance with the 10 State Standards.

LR Tank #1 will receive potable water from the LR Water Booster Station. The LR Water Booster station is located near LR Tank #2 and is equipped with two sets of pumps. One pump set transfers water from the Legacy Ridge Low Zone to the Legacy Ridge High Zone. The second set of pumps transfers water from the Legacy Ridge Low Zone to the Legacy Ridge Intermediate Zone. A specification and a detail of a typical water booster station are included in Appendix 4 of this report.

The LR Tank #2 will receive potable water from the supply wells. LR Tank #2 will be located in the southwest corner of parcel 3-1-12.5 in the open space behind subdivided lot 79. LR Tank #2 is sized to storage for a 2-hour fire event and one day of average daily flow to the 194 homes of the Legacy Ridge Low Zone. LR Tank #2 measures 45' diameter x 19' sidewall height and stores approximately 210,000 gallons of potable water. At the request of the Town of Woodbury, the LR Tank #2 overflow elevation will be situated at 725 and will float off the Summit/Overlook system.

A pressure reducing station will be provided at the Skyline Tank to provide sacrificial relief from LR Tank #1. This valve will only open under an emergency condition. A water model analysis will determine the specifics of each pressure reducing station. Details of a typical pressure reducing station are provided in Appendix 7. The pressure reducing station can be provided with redundancy to protect the system when valve failure occurs.

7.0 WATER SYSTEM ANALYSIS

A water model analysis will be performed on the Legacy Ridge system to confirm that the proposed design conforms to state and local regulations under all operating conditions. Specifically, the model analysis will determine the following:

- Adequate system pressure under all conditions in accordance with state and local regulations
- Water storage tank sizing and location
- Water main sizing and location
- Fire pump and transfer pump sizing
- Areas requiring pressure reduction and/or pressure boosting
- Pressure reducing valve operation

Due to the lack of off-site information, assumptions may be required to run the model analysis. Assumptions should gain Town approval prior to finalizing the model analysis.

APPENDIX 1

LEGACY RIDGE WATER CONCEPT PLANS

APPENDIX 2

WATER DEMAND CALCULATIONS

APPENDIX 2 - WATER DEMAND CALCULATIONS

Project: Legacy Ridge Residential Development
Location: Highland Mills, Orange County, NY
Date: January 19, 2006
LMS Project #: 0997-004

1. Calculate Average Daily Flow (ADD) for WP3 Development

TABLE 1 - DETERMINATION OF AVERAGE DAILY DEMAND			
TYPE OF FACILITY	No. of Units	Unit Demand (gpd) ¹	Projected Flowrate (gpd)
Four-bdrm single family home	287	475	136,325
Community Recreation Center ²	1	N/A	3,675

AVERAGE DAILY DEMAND = 140,000 GPD
 97.2 GPM

¹ Values for unit demand (gpd) were obtained from the New York State Department of Environmental Conservation's *Design Standard For Wastewater Treatment Works, 1988*

² The architectural design of the recreation centers has not been completed. The demand for these facilities was calculated by assuming both facilities will include a pool, a gym, and a community area.

2. Calculate Maximum Daily Demand (MDD)

The Maximum Daily Demand is calculated by multiplying the Average Daily Demand by a factor of 1.624. The MDD factor of 1.624 was determined based on historic data from the Town of Woodbury (1.452 MGD MDD/0.894 MGD ADD).

MDD = ADD x 2.0
 MDD = 140,000 GPD x 1.624
 MDD = 227,360 GPD
 MDD = 157.9 gpm

3. Calculate Needed Fire Flow (NFF)

The following table offers a means of determining needed fire flow for one and two family dwellings that do not exceed two stories in height. The table is referenced in AWWA M31, American Water Works Association Manual of Water Supply Practices, Distribution System Requirements for Fire Protection, (c) 1998

Table 1-5 Needed Fire Flow for one- and two-family dwellings

Distance Between Buildings (ft)	Needed Fire Flow (gpm)
More than 100	500
31-100	750
11-30	1000
Less than 11	1500

The minimum distance separation between homes on Legacy Ridge is 30 feet. Therefore, the Needed Fire Flow is 1000 gpm for a two hour duration. The fire flow for the Recreation Center may be greater than 1000 gpm. The NFF for the Recreation Center will be determined once the building specifications and details are complete.

4. Calculate Total System Demand (TSD)

The total system demand is the MDD plus NFF.

TSD = MDD + NFF
 TSD = 157.9 gpm + 1000 gpm
 TSD = 1,157.9 gpm

5. Description of Pressure Zone Characteristics

The pressure zones were determined following the completion of a preliminary analysis of the Legacy Ridge water system. The water system was designed to maintain a minimum 45 psi at street grade under average flow conditions.

TABLE 1 - PRESSURE ZONE DESCRIPTION				
ZONE	# of Four Bedroom Single Family Homes	# of Recreation Centers	Average Daily Demand	Maximum Daily Demand
High	18		5.94	9.64
Intermediate	75		24.74	40.18
Low	194	1	66.55	108.07
TOTALS	287	1	97.2	157.9

6. Determine the Required Storage Capacity

According to Table 1 of AWWA M31, American Water Works Association Manual of Water Supply Practices, Distribution System Requirements for Fire Protection, (c) 1998, a fire flow of 2,500 gpm or less must be maintained for a two (2) hour duration. The required volume in storage is calculated as follows:

Volume required for Fire Protection = 1000 gpm x 120 min =	120,000 (+) gal.
Volume required for Average Daily Demand =	<u>140,000 (+) gal.</u>
Minimum Required Storage Volume =	260,000 gal.

7. Calculate Storage Requirements for WP3 Tank #1 and WP3 Tank #2

Given:

LR Tank #1 provides ADD and NFF storage for 18 homes in the High Zones and NFF for the 75 homes in the Intermediate Zone in the Legacy Ridge development. Tank #1 is designed 130% beyond the required storage capacity to reduce the system's vulnerability and to provide the WPCWS will additional storage capacity.

The existing Skyline Drive Tank provides 100,000 gallons worth of storage capacity. This tank supplies ADD to 75 homes (35,625 gallons) in the Intermediate Zone. The remaining 64,375 gallons of storage capacity is available fo the Skyline Drive system that is located north of the Skyline Drive/Reigel Road intersection.

LR Tank #2 provides ADD and NFF storage for 194 homes in the Low Pressure Zones in the Legacy Ridge development

<i>Calculate Required Volume for Tank #1</i>		(+)	gal.	
Volume required for Fire Protection = 1000 gpm x 2 hours =		120,000	(+)	gal.
Volume Required for Average Daily Demand = 18 homes x 475 gpd/home =		<u>8,550</u>	gal.	
Required Volume for LR Tank #1 =		128,550		
130% Additional Storage Capacity		167,115		
LR Tank #1 Storage Capacity		295,665		

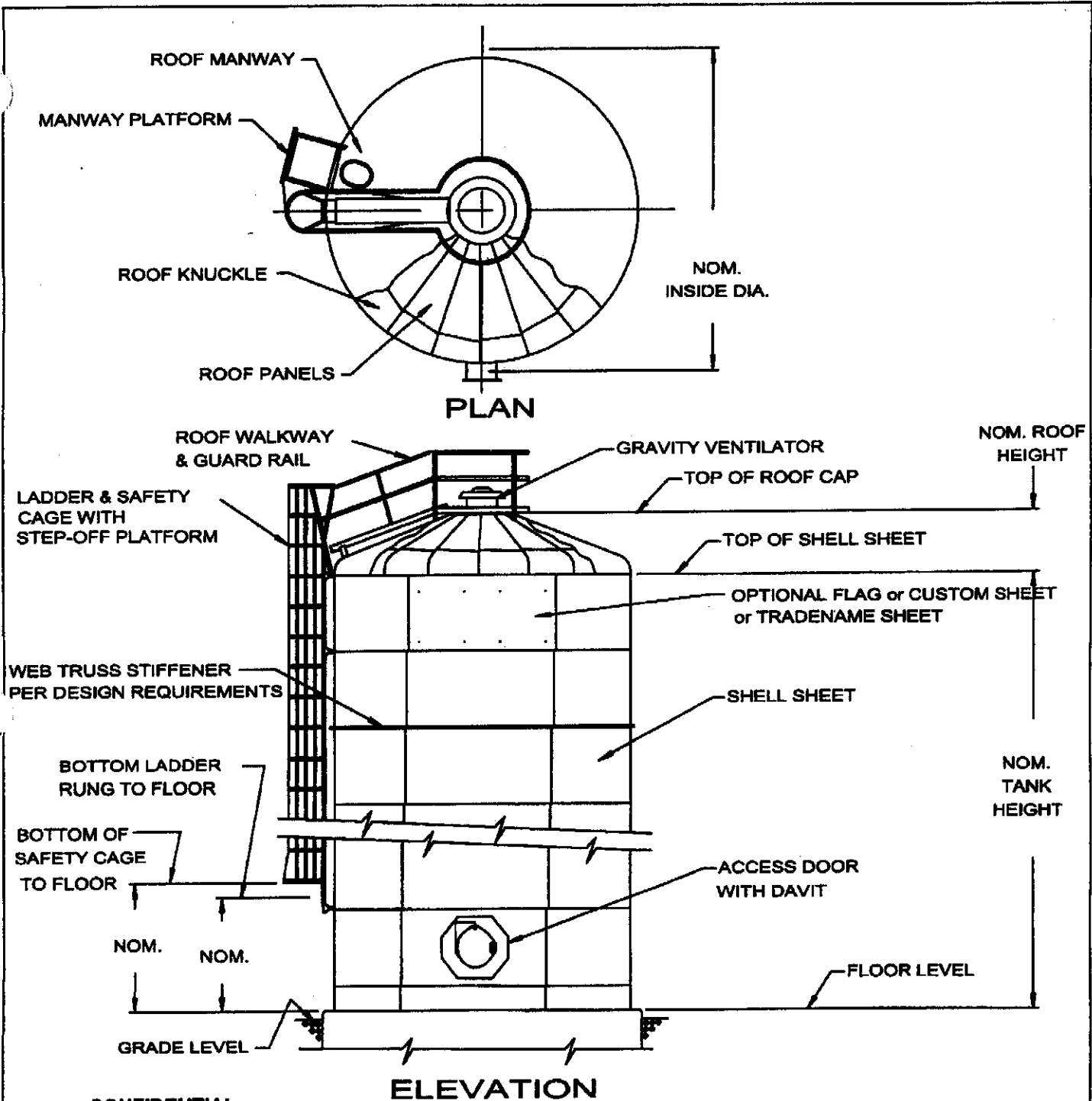
<i>Calculate Required Volume for Tank #2</i>		(+)	gal.	
Volume Required for Fire Protection = 1000 gpm x 120 min =		120,000	(+)	gal.
Volume Required for Average Daily Demand = 194 homes x 475 gpd/home =		<u>92,150</u>	gal.	
Required Volume for LR Tank #2 =		212,150		

8. Summary of Design Demands & Storage Requirements

Average Daily Demand =	97.2 gpm
Maximum Daily Demand =	157.9 gpm
Total System Demand =	1157.9 gpm
Required Storage Capacity =	260,000 gallons
LR Tank #1 Storage Capacity =	295,665 gallons
LR Tank #2 Storage Capacity =	212,150 gallons
Proposed Storage Capacity Provided =	507,815 gallons

APPENDIX 3

STANDPIPE DETAILS & SPECIFICATIONS



CONFIDENTIAL

THIS DRAWING IS THE PROPRIETARY PROPERTY OF
 NORTH EAST AQUASTORE, INC.
 PHILLIPSBURG, NJ
 AND SHALL NOT BE USED NOR REPRODUCED WITHOUT
 THE EXPRESS WRITTEN CONSENT OF THE COMPANY.

NEA COPYRIGHT 2000
 ALL RIGHTS RESERVED

NOT FOR CONSTRUCTION

*
TANK WITH CONCRETE FLOOR

07/19/00 RGG
 REV. 01, 02/01 - P22
 REV. 04, 08/01 - P10

SCALE: NONE

NORTH EAST AQUASTORE
 525 MEMORIAL PARKWAY
 PHILLIPSBURG, NJ 08827 (908) 454 - 8885

DWG. # NEASM 100A10

**Specification For Aquastore® Tank
Engineered Storage Products Co.
Glass Coated, Bolted Steel Potable Water Storage Tank**

1.0 GENERAL

1.1 Scope of Work

1.1.1 Furnish and erect a glass-coated, bolted-steel water storage tank, including tank structure and tank appurtenances as shown on the contract drawings and described herein.

1.1.2 All required labor, materials and equipment shall be included.

1.2 Qualifications of Tank supplier

1.2.1 The Engineer's selection of factory applied glass-fused-to-steel bolt together tank construction for this facility has been predicated upon the specific criteria, construction methods, and an optimum coating for resistance to internal and external tank corrosion. Deviations from the specified design, construction or coating details, will not be permitted. To assure the greatest ease and availability of tank and appurtenant components, and/or spare parts, preference shall be given to U.S. manufacture.

1.2.2 The bidder shall offer a new tank structure as supplied from a manufacturer specializing in the design, fabrication and erection of factory applied glass-fused-steel, bolted tanks. The manufacturer shall employ a staff of full time design engineers, own and operate its steel fabrication facility and glass coat the tank all at one plant location.

1.2.3 The tank shown on the contract drawing and specified herein is a model _____ WT/CF **Aquastore® Tank** as manufactured by **Engineered Storage Products Company** of DeKalb, Illinois. Local Dealer/Builder is **North East Aquastore®** of Phillipsburg, New Jersey. This design and coating system shall be the minimum acceptable level of quality for this project.

1.2.4 Alternate glass-fused-to-steel tank products, as provided by other manufacturers, will be considered for prior approval by the Engineer. Manufacturers lacking the experience requirement with installations in the United States, will be considered, if the manufacturer provides a satisfactory 5 year 100% Cash Bond in lieu of evidence of experience and long term operation in the United States.

1.2.4.1 Contractor(s) proposing to offer an alternate design shall submit to the Engineer a complete submittal package for the proposed alternate design at least 10 days prior to bid date. The package shall be complete and shall provide all information necessary to substantiate conformance with these plans and specifications in all details. Any and all deviations or exceptions shall be listed separately along with rationale for acceptance of same.

1.2.4.2 The Contractor(s) shall be solely _____ responsible for providing the required information all within the required time frame. It shall be the burden of the Contractor to convince the Engineer of the acceptability of the proposed alternate. Failure to

