

ENGINEERING REPORT
&
TECHNICAL
SPECIFICATIONS

FOR A

**WATER MAIN EXTENSION
TO SERVE
Britain Woods Residential
Development**

**LITTLE BRITAIN ROAD/NYS ROUTE 207
TOWN/CITY OF NEWBURGH
ORANGE COUNTY, NEW YORK**

PREPARED BY



71 Clinton Street
Montgomery, NY 12549

**September 2023
February 2026**

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1.0 INTRODUCTION

Engineering & Properties, P.C. is pleased to submit this Engineer's Report for a water main extension to serve the project known as Britain Woods Residential Development.

The project site encompasses 47.95 acres of land consisting of six tax parcels, identified as Town of Newburgh tax lots 97-1-32.1, 32.2, 32.3, 40.1 and City of Newburgh tax lots 41-1-2 & 3. The proposed project includes the construction of 11 multi-family residential apartment buildings, a clubhouse with a pool, and a pool equipment storage/dog wash/restroom structure. Private roadways will be constructed to provide access to the development from Little Britain Road/NYS Route 207. All buildings will be served by new off-site Town water and sewer main extensions that will be installed by the project sponsor.

The project is located within the Town of Newburgh Consolidated Water District and will receive water via a proposed connection to the existing 8" diameter water main located on the north side NYS Route 207. All on-site water system improvements will be privately owned and operated by the property owner.

2.0 SITE DESCRIPTION

The proposed project site is located in the Town and City of Newburgh, Orange County, New York as shown on the Project Location Map in Appendix A. The 47.95 acres project site is located on the north side of Little Britain Road/NYS Route 207 between Old Little Britain Road to the west and Wisner Avenue to the east.

The site will have two entrances from Little Britain Road/NYS Route 207 on either side of the project site. The development is across the street from the Laborers' International Union Local 17 Training Academy to the south. To the east are numerous commercial and industrial uses and to the north and west are residential communities.

Seven of the proposed multi-family residential buildings will be two-stories in height with 22 apartment units consisting of 10 one-bedroom units and 12 two-bedroom units. Four buildings will have three-stories with “walk-out” ground floor and 26 apartment units consisting of 10 one-bedroom units and 16 two-bedroom units. In all, there will be a total of 110 one-bedroom units and 148 two-bedroom units, for a combined total of 258 apartments and 406 bedrooms. The site will also have a clubhouse with pool, private access roads and private water and sewer infrastructure that will be served by public main extension to the site.

3.0 EXISTING WATER SYSTEM DESCRIPTION

The project site is located in the Town of Newburgh Consolidated Water District No. 1. Currently, there is a 8-inch diameter water main located along the north side of Little Britain Road/NYS Route 207. The nearest location of this water main is 900 feet west of the project site. Additionally, the City of Newburgh operates two water mains that traverse the Site through an existing 20-foot-wide utility easement that runs parallel to NYS Route 207. The depths of these mains are noted to be as 4 feet.

According to information provided in the Annual Water Quality Report for the reporting year 2022, the Consolidated Water District utilizes two sources of water. Chadwick Lake Filter Plant is supplied by the Chadwick Lake Reservoir and has the capacity to treat 3.2 million gallons of water per day (MGD). The Delaware Aqueduct Filter Plant’s supply is taken from the New York City Department of Environmental Protection’s (DEP) Delaware Aqueduct, which is comprised of four large reservoirs in the Catskill region. Raw water from the Aqueduct station 5A tap, located near the Town of Marlborough, is filtered and chlorinated by the Town of Newburgh in a water filter plant located on the Aqueduct tap. Due to the available chlorine contact time, the total water treatment capacity from the Delaware Aqueduct is limited to a raw water taking of 3.1 MGD. Combined, these sources can safely yield approximately 6.3 MGD.

The water system serves around 23,300 customers through 6,763 service connections. The total amount of water produced in 2022 was 953 million gallons. The daily average of water treated and pumped into the distribution system was 2.8 MGD. The Town's Water Supply Supervisor indicated that the existing Town's water peak flow is 5.0 MGD on a hot summer day. Using the current max day demand of 5.0 MGD, there is approximately 1.30 MGD available for future use.

Fire flow characteristics based on a field test performed on May 9th, 2023 by representatives from Engineering & Surveying Properties, PC and the town water department at a hydrant, located on the north side of 488 Little Britain Road, indicate that normal operating static pressure at the hydrant was 81 psi, at an approximate hydrant elevation of 273 feet, with a residual pressure of 48 psi, at a flow of 1,000 gpm. See Appendix B for the Hydrant Flow Test Data.

4.0 PROPOSED WATER SYSTEM

The project sponsor proposes to construct approximately 1,766 linear feet of 12" diameter class 52 cement lined ductile iron pipe water main and 4,116 linear feet of 8" diameter class 52 cement lined ductile iron pipe water main to service the project as shown on Proposed Water System Layout in Appendix A. All new mains shall have hydrants and valves spaced as needed and will be designed and constructed in accordance with the Town of Newburgh and Orange County Department of Health requirements (see specifications in Appendix D). Refer to the plans of the proposed water system improvements. All improvements will be constructed within the existing road right-of-way or on land controlled by the applicant. The section of main within the NYS Route 207 right-of-way will be owned and maintained by the Town of Newburgh while the on-site improvements will be owned and maintained by the property owner.

4.1 PROPOSED DEMAND

Based on a bedroom count of 406 and a proposed demand of 110 gallons per day per bedroom and the additional usage for the clubhouse amenities, water demand is expected to be 52,932 gallons per day (36.75 GPM). The maximum daily demand is projected to be 2 times the average day 105,864 gallons per day.

Table 1 – Estimated Water Demand			
Type of Use	# of Units	Demand Rate (gpd)	Average Daily Demand (gpd)
Apartments			
1-bedroom	110 units	110	12,100
2-bedroom	148 units	220	32,560
Clubhouse			
Lounge & Multi-Purpose Room (Banquet Hall use)	86 seats	10	860
Office	2 Employees	15	30
Fitness Center (Health Club use)	60 People	20	1,200
Swimming Pool	150 Swimmers	10	1,500
Dog Wash	1 Station	500	500
20% Reduction for water saving fixtures			-818
Landscaping Irrigation	1 Lump Sum	5,000	5,000
Total Demand:			52,932

4.2 PROPOSED PRESSURES

Based on the Hydrant Flow Data found in Appendix B, domestic water pressures were analyzed for the new water main. Pressures in the new main range from a high of 91.55 psi in the water system low point located at the hydrant between building 10 and 11 to a minimum pressure of 65.76 psi at

the high point of the site located at the water service connection point for building 1. Based on this analysis the minimum recommended pressure of 35 psi can be met at ground elevation for all portions of the main.

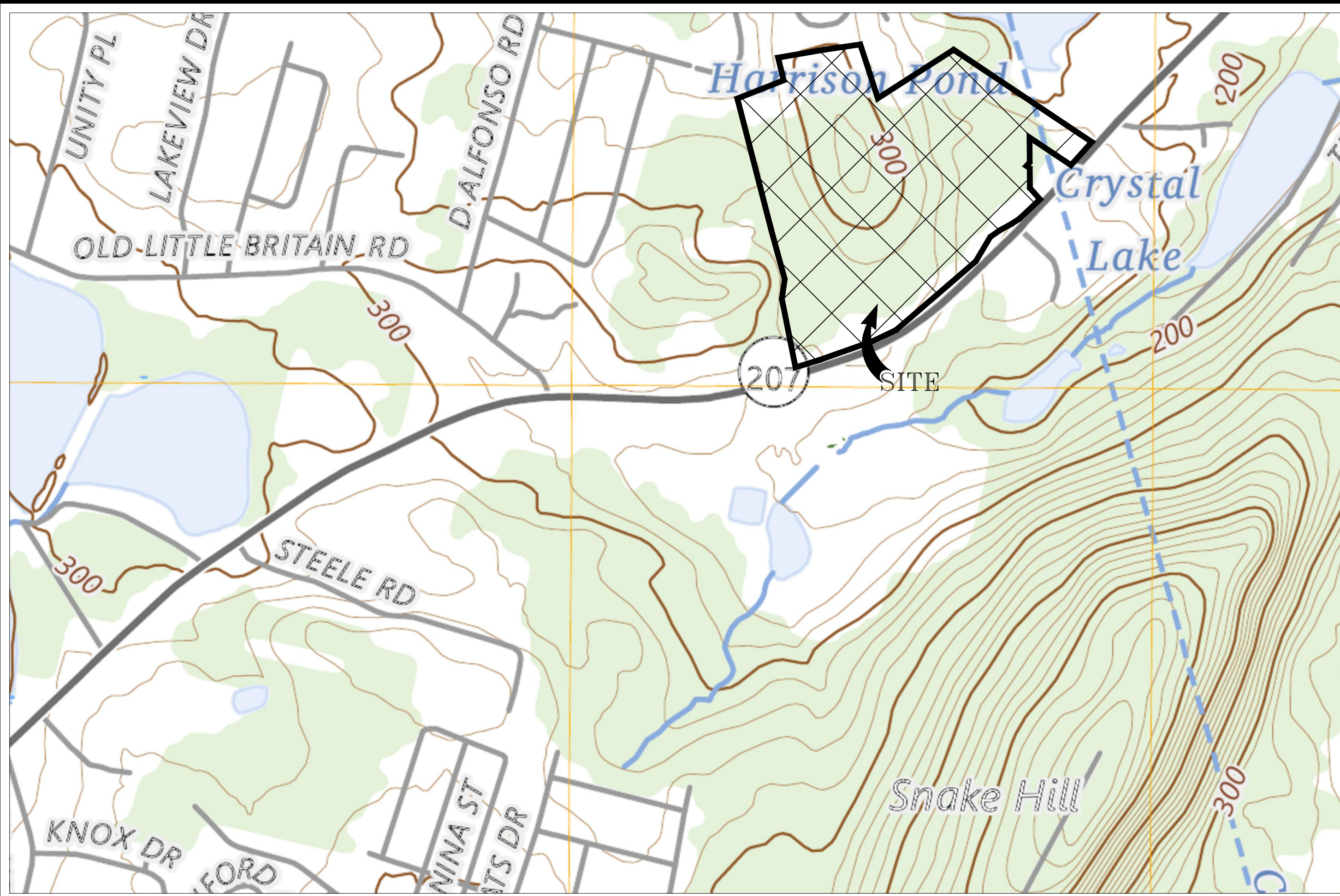
When analyzing fire flow, the minimum available fire flow for the system is 1,141.74 gpm at the water service connection point for building 3, maintaining a pressure of 20 psi based on calculations performed utilizing the WaterCAD program (See Appendix C for Pressure and Flow Calculations). As the buildings will be sprinkled in accordance with NFPA 13, a needed fire flow is not calculated, and hydrant demands of 500 gpm are met.

5.0 CONCLUSION

From the above information, it is concluded that the proposed water mains will meet code requirements and that the Town of Newburgh water system has sufficient capacity to handle the projected water demand.

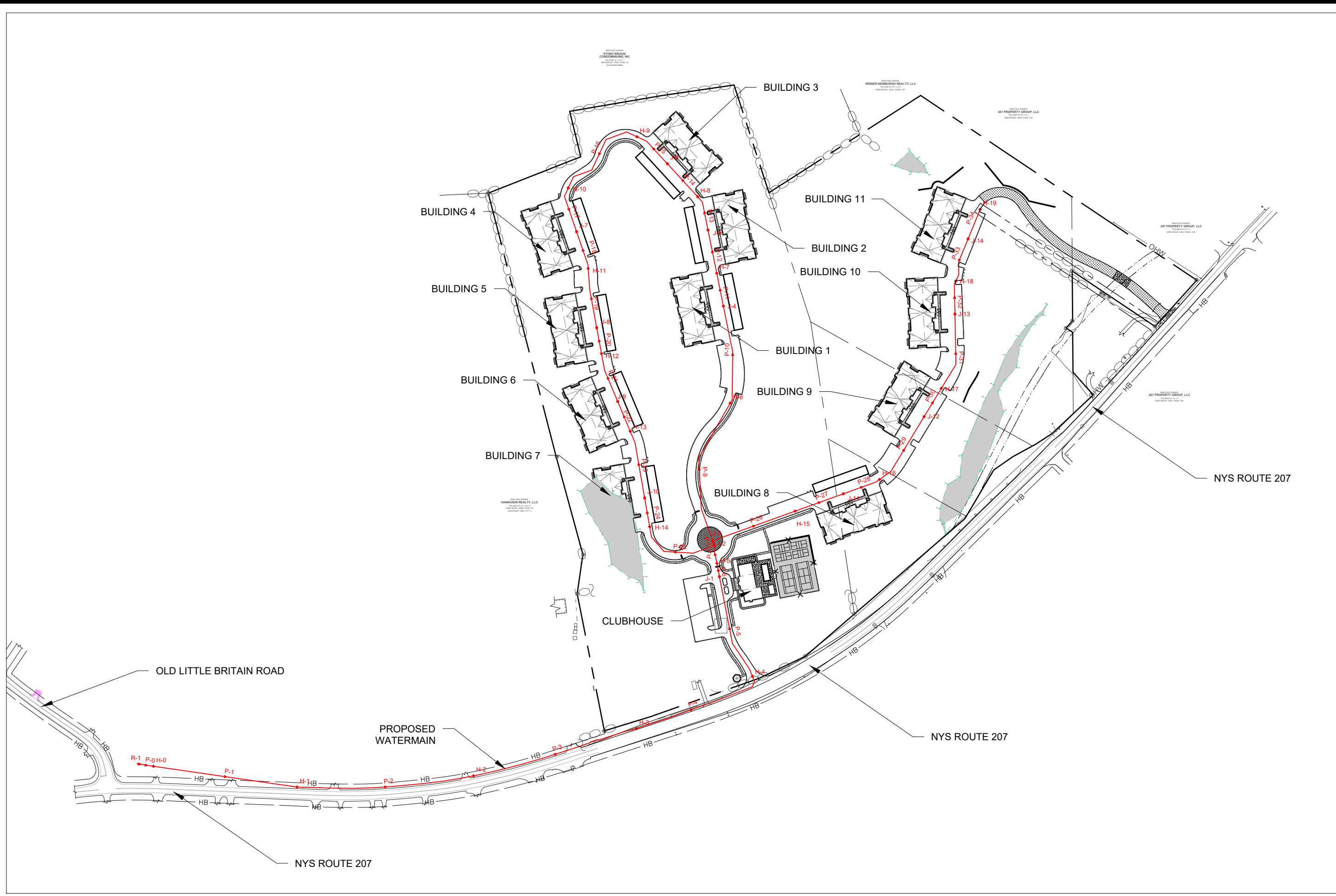
APPENDIX A

FIGURES



LOCATION MAP	BRITAIN WOODS NEW YORK STATE ROUTE 207 T/C OF NEWBURGH ORANGE COUNTY, NEW YORK	DATE: 09/21/2023	JOB # 1146.01	MONTGOMERY OFFICE 71 CLINTON STREET MONTGOMERY, NY 12549 Ph: (845) 457-7727 WWW.EP-PC.COM
		SCALE: 1" = 500'	SHEET # F-1	ENGINEERING & SURVEYING PROPERTIES Achieving Successful Results with Innovative Designs

Drawing Name: Z:\1146.01 - Britain Woods\1146.01 - Site Plan.dwg Date Printed: Feb 10, 2026, 9:00am



PROPOSED WATER SYSTEM LAYOUT	BRITAIN WOODS NEW YORK STATE ROUTE 207 T/C OF NEWBURGH ORANGE COUNTY, NEW YORK		DATE: 09/21/2023 REV 02/10/2026 SCALE: 1" = 250'	JOB # 1146.01 SHEET # 3.7A	MONTGOMERY OFFICE 71 CLINTON STREET MONTGOMERY, NY 12549 Ph: (845) 457-7727 WWW.EP-PC.COM
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APPENDIX B
HYDRANT FLOW
DATA

HYDRANT FLOW TESTING RESULTS

WO. NO. 1146.01	DATE 09/21/23	SHEET 1 OF 1
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PROJECT TITLE Britain Woods	MUNICIPALITY (C/V/T) T/C of Newburgh	LOCATION New York State Route 207
PERFORMED BY ZS & JH	WATER DISTRICT Town of Newburgh Water District	REF DRAWING(S)

HYDRANT TEST DATA

Hydrant Test #: 1 Date: 05/09/23 Time: 9:22 AM
 PM

Residual Hydrant Location: 488 Little Britain Road

Residual Hydrant Elevation: 273.0 feet Vertical Datum: NAVD88

Flowing Hydrant Location: 480 Little Britain Road

Flowing Hydrant Elevation: 276.0 feet Vertical Datum: NAVD88

Aprox. Distance between Hydrants: 410 ± feet

Existing Water Main Size: 6" 8" 10" 12" _____

RESULTS

Residual Hyd. Static Pressure (P_S): 81 PSI = 186.9 Feet of Static Head

Residual Hyd. Flow Pressure (P_T): 48 PSI = 110.8 Feet of Static Head

Flow Hydrant Measured Flow (Q_T): 1,000 GPM

Calculated Flow @ 20psi: 1,393 GPM = $Q_T \times [(P_S - 20) / (P_S - P_T)]^{0.54}$

HYDRANT TEST DATA

Hydrant Test #: _____ Date: _____ Time: _____ AM
 PM

Residual Hydrant Location: _____

Residual Hydrant Elevation: _____ feet Vertical Datum: _____

Flowing Hydrant Location: _____

Flowing Hydrant Elevation: _____ feet Vertical Datum: _____

Aprox. Distance between Hydrants: _____ ± feet

Existing Water Main Size: 6" 8" 10" 12" _____

RESULTS

Residual Hyd. Static Pressure (P_S): _____ PSI = _____ Feet of Static Head

Residual Hyd. Flow Pressure (P_T): _____ PSI = _____ Feet of Static Head

Flow Hydrant Measured Flow (Q_T): _____ GPM

Calculated Flow @ 20psi: _____ GPM = $Q_T \times [(P_S - 20) / (P_S - P_T)]^{0.54}$

APPENDIX C
PRESSURE AND FLOW
CALCULATIONS

**WATERCAD TABLE OF
PIPE INFORMATION**

WO. NO. 1146.01	DATE 9/22/2023	REVISED 02/09/26	SHEET 3	OF 6
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PROJECT TITLE Britain Woods		LOCATION T/C of Newburgh
CALCULATED BY ZS	APPROVED BY RW	REF DRAWING(S)

Label	Start Node	Stop Node	Diameter (inches)	Pipe Material	Hazen-Williams C	Has Check Valve?	Length (feet)
P-2	H-1	H-2	12	Ductile Iron	120	False	501
P-3	H-2	H-3	12	Ductile Iron	120	False	481
P-4	H-3	H-4	12	Ductile Iron	120	False	380
P-5	H-4	J-1	12	Ductile Iron	120	False	301
P-6	J-1	H-5	12	Ductile Iron	120	False	38
P-7	H-5	J-2	12	Ductile Iron	120	False	52
P-8	J-2	J-3	12	Ductile Iron	120	False	14
P-9	J-3	H-6	8	Ductile Iron	120	False	418
P-10	H-6	J-4	8	Ductile Iron	120	False	278
P-11	J-4	H-7	8	Ductile Iron	120	False	95
P-12	H-7	J-5	8	Ductile Iron	120	False	125
P-13	J-5	H-8	8	Ductile Iron	120	False	100
P-14	H-8	J-6	8	Ductile Iron	120	False	127
P-15	J-6	H-9	8	Ductile Iron	120	False	116
P-16	H-9	H-10	8	Ductile Iron	120	False	280
P-17	H-10	J-7	8	Ductile Iron	120	False	132
P-18	J-7	H-11	8	Ductile Iron	120	False	109
P-19	H-11	J-8	8	Ductile Iron	120	False	169
P-20	J-8	H-12	8	Ductile Iron	120	False	74
P-21	H-12	J-9	8	Ductile Iron	120	False	143
P-22	J-9	H-13	8	Ductile Iron	120	False	92
P-23	H-13	J-10	8	Ductile Iron	120	False	193
P-24	J-10	H-14	8	Ductile Iron	120	False	82
P-25	H-14	J-2	8	Ductile Iron	120	False	230
P-26	J-3	H-15	8	Ductile Iron	120	False	248
P-27	H-15	J-11	8	Ductile Iron	120	False	145
P-28	J-11	H-16	8	Ductile Iron	120	False	110
P-29	H-16	J-12	8	Ductile Iron	120	False	220
P-30	J-12	H-17	8	Ductile Iron	120	False	94
P-31	H-17	J-13	8	Ductile Iron	120	False	222



WATERCAD CALCULATED

Fire Flow Results

WO. NO. 1146.01	DATE 9/22/2023	REVISED 02/09/26	SHEET 5	OF 6
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PROJECT TITLE Britain Woods		LOCATION T/C of Newburgh		
CALCULATED BY ZS	APPROVED BY RW	REF DRAWING(S)		

Node	P (psi)	FFN (gpm)	PFN (psi)	FFA (gpm)	PFA (psi)	LSP (psi)	LPN
H-0	80.81	500.00	72.15	1,273.41	35.05	20.00	J-5
H-1	79.51	500.00	70.69	1,260.42	33.75	20.00	J-5
H-2	84.18	500.00	75.15	1,245.06	38.41	20.00	J-5
H-3	87.72	500.00	78.50	1,230.79	41.96	20.00	J-5
H-4	85.01	500.00	75.65	1,219.83	39.25	20.00	J-5
H-5	81.38	500.00	71.88	1,210.27	35.62	20.00	J-5
H-6	68.08	500.00	57.96	1,171.56	22.00	20.00	J-4
H-7	66.09	500.00	55.71	1,152.46	20.13	20.04	J-5
H-8	66.15	500.00	55.67	1,147.72	20.11	20.04	J-6
H-9	66.38	500.00	55.86	1,146.19	20.23	20.04	J-6
H-10	76.75	500.00	66.23	1,157.31	29.80	20.00	J-6
H-11	76.98	500.00	66.51	1,166.13	29.64	20.00	J-6
H-12	77.03	500.00	66.67	1,175.05	29.55	20.00	J-6
H-13	77.03	500.00	66.84	1,184.02	29.68	20.00	J-6
H-14	77.27	500.00	67.36	1,195.79	30.48	20.00	J-6
H-15	87.29	500.00	77.12	1,208.51	38.25	20.00	J-4
H-16	87.95	500.00	77.11	1,208.51	35.55	20.00	J-4
H-17	90.34	500.00	78.68	1,208.51	33.81	20.00	J-4
H-18	91.55	500.00	79.07	1,208.52	30.88	20.00	J-4
H-19	91.45	500.00	78.42	1,208.52	27.96	20.00	J-4
J-1	81.24	502.42	71.76	1,211.34	35.48	20.00	J-5
J-2	80.85	500.00	71.33	1,208.82	35.08	20.00	J-5
J-3	80.72	500.00	71.20	1,208.51	34.96	20.00	J-4
J-4	65.76	502.60	55.43	1,152.74	20.02	20.40	J-5
J-5	65.76	502.60	55.32	1,145.76	20.02	20.53	J-6

- P = Static Pressure of Node Analyzed (psi)**
- FFN = Total Fire Flow Needed (gpm)**
- PFN = Pressure of Node Analyzed at Fire Flow Needed (psi)**
- FFA = Total Fire Flow Available (gpm)**
- PFA = Pressure of Node Analyzed at Fire Flow Available (psi)**
- LSP = Lowest System Pressure at Fire Flow Available (psi)**
- LPN = Lowest Pressure Node at Fire Flow Available**

APPENDIX D
TECHNICAL
SPECIFICATIONS

SECTION 02660

WATER SYSTEM

PART 1.0 - GENERAL

1.01 SUMMARY

- A. The Contractor shall supply all labor, tools, materials, and equipment to construct, test and disinfect the watermains as described in these specifications and the accompanying drawings. All references to the standards, specifications, regulations, etc., are meant to be their last revisions. The contractor shall comply with the latest regulations, requirements and specifications of the New York State Department of Health, the "Recommended Standards for Water Works", 2018 publication and all appropriate AWWA Specifications, latest revision.

1.02 PROJECT RECORD DOCUMENTS

- A. Accurately record the actual locations of all subsurface utilities, structures and obstructions encountered during construction. Provide an as-built survey of the water main and water service locations prior to final payment.

PART 2.0 - PRODUCTS

2.01 PIPE

All pipe shall be class 52 double cement lined ductile iron pipe with exterior bituminous coating and shall meet the requirements of AWWA C104 and AWWA C151, latest revisions. Pipe shall be supplied in the longest available lengths which will provide for required horizontal and vertical deflections, but shall not exceed 20 feet. Pipe shall be push-on or mechanical joint as required. All fittings and appurtenances shall be cast iron. Pipe lengths must be 5' at all connections to fittings and 20 feet at all crossings with storm and sanitary sewers and laterals.

Joints shall be the integral wall bell and spigot type using Elastometric Gasket Joints meeting the requirements of ASTM F-477. All pipes shall be wiped clean and lubricated prior to insertion.

Place detectable identification tape above pipe 12" or less below ground level, or immediately under pavement. The detectable identification tape shall be made of polyethylene with a 1 mil metallic foil core, highly resistant to alkalis, acids or other destructive chemical compounds likely to be encountered in soils. The tape shall have black letters "CAUTION BURIED WATER LINE BELOW" printed on blue background. Tape shall be at least 3" wide, manufactured by Reef Industries, Inc. (TERRA TAPE), Linguard, Inc. or approved equal.

2.02 FITTINGS

Fittings shall be cast iron with mechanical joints. Fittings shall be pressure rated at 250 psi, and shall conform to AWWA C110, latest revision, specifications. Mechanical joint rubber gaskets shall

conform to AWWA C-111, latest revision, standards. Tie rodding should be provided with retainer glands for all fittings as necessary to restrict pipe displacement.

2.03 VALVES

Valves shall be Mueller Resilient Wedge Gate Valves Model # A-2360 as manufactured by Mueller Company. Valves shall meet all applicable requirements of ANSI/AWWA C509, latest revision, and be pressure rated to 250 psi working pressure and 500 psi static test pressure.

2.04 HYDRANT

All hydrants shall be dry-barrel Mueller Centurion hydrants. Hydrants shall conform to AWWA C502, latest revision. All hydrants shall be pressure rated to 250 psi working pressure 400 psi static pressure and shall have a main valve opening of five (5) inches in accordance with Town of Newburgh requirements.

PART 3.0 - EXCAVATION AND PIPE INSTALLATION

3.01 BEDDING

The Contractor shall use clean sand for bedding of the water mains. The sand must be free of stones and placed evenly and carefully around and over the pipe in six (6) inch maximum layers. Each layer shall be thoroughly and carefully compacted until one (1) foot of cover exists over the pipe. Each layer shall be compacted by approved mechanical tamping machines to not less than 90% of the maximum dry density as defined by ASTM D1557, latest issue for that soil.

3.02 LAYING PIPE

The Contractor shall notify the Underground Facilities Protection Organization of New York at 1-800-962-7962 and any other involved utility companies not affiliated with UFPO, prior to any excavation. Pipes that require cutting shall be cut with a pipe saw, wheelcutter or hydraulic cutter as deemed acceptable by the engineer. All pipes shall be backfilled prior to the end of the working day in order to minimize safety hazards. All open ends of pipe shall be plugged and sealed watertight. Blocking and wedging are not permitted for pipe stabilization. Clean sand shall be used to make the bottom of trench uniform. Pipe deflections are permitted to 80% of the maximum allowable limit of 5 degrees for design purposes. All piping must have double line indicators to measure maximum deflections limits in the field. All pipes shall be laid in accordance with AWWA C600, latest revision, for ductile iron pipe. All pipes, fittings and valves shall be carefully handled to avoid damage and, while they are suspended over the trench, before lowering, they shall be rung and inspected for defects. Before the pipe is laid, all lumps, blisters, excess coal tar, dirt, oil, grease and moisture shall be removed from inside the pipe. After pipe is laid, care shall be taken to avoid the entrance of dirt or water from the trench by use of tight bulkheads. Under no conditions may pipe be installed with standing groundwater in the trenches.

The pipe shall be laid to conform to lines and grades shown on the plans, or as directed by the engineer. The pipe shall have a minimum cover of 4'-0" unless noted otherwise on the drawings. Each bell and spigot shall be cleaned thoroughly. Each pipe and special fitting shall be firmly

supported on good foundations. Mechanical and rubber gasket pipe joints shall be fabricated and used in strict accordance with manufacturer's instructions. Where bolts are used, they shall be drawn up evenly with a torque wrench.

3.03 PIPE RESTRAINTS

All pipe fittings shall be restrained to the new watermain on both sides using retainer glands in accordance with AWWA C111, latest revision. The retainer gland shall be tightly fastened to the pipeline via clamp fittings designed to break off at the required torque. The unit shall be securely fastened to the fitting using nuts and bolts as required. The gland shall be secured to the fitting first before being tightly fastened to the pipeline. Refer to the design plans for more detail.

3.04 WATER MAIN, STORM SEWER & SANITARY SEWER CROSSING SEPARATIONS

Separate water and sewer lines at least 10' horizontally edge to edge.

At street intersections, or at other locations where water and sewer lines must cross, including sanitary sewer laterals and house connection potable water services, provide a minimum vertical distance of 18" between the outside of the water main and the outside of the sewer. One full length of water pipe shall be centered on sewer crossings so joints are equidistant and as far as possible from the sewer.

When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the reviewer's authority must specifically approve any variance from these requirements. As a minimum, concrete encasement must be provided and approved on a case-by-case basis by the engineer. Provide adequate support for both pipes to eliminate any possibility of settling.

PART 4.0 - INSPECTION AND TESTING

4.01 GENERAL

The Contractor shall supply all necessary materials, equipment and labor to test the piping as described below, including pump, piping, valves and labor. The engineer will supply the test gauge or else calibrate the contractor's gauge before and after the tests. All pressure tests must be done in the engineer's presence under his direction. The testing of watermains shall be done in accordance with Section 5 of AWWA Standard C-600-17, latest revision.

4.02 TESTING

Two tests shall be required at the discretion of the Engineer. The first shall be a hydrostatic pressure test only. This shall be done when a section of line has been completed. The line shall be partially backfilled and braced against movement during the test. All air must be bled out of the section. A one inch (1") tap shall be provided for the required service connection. Taps may be made by means of a tapped coupling left at proper location or by cutting with an approved tapping machine, or by use of service saddles approved by the engineer. Taps shall be of the thread type to accept a standard corporation stops as specified herein.

Taps and corporation stops should be located at least 1'0" from pipe ends. Corporation stops shall be as specified on the approved plans.

The contractor may elect to perform one hydrostatic pressure test at the completion of all improvements. However, the Contractor shall bear the responsibility of locating any underground leaks and making the necessary repairs. The hydrostatic test shall be of at least two hours in duration. Test pressure at the point of testing shall be as indicated by the Engineer, and in general, shall be one and a half times the actual working pressure or 150 PSI, whichever is greater applied at the lowest point of the section to be tested. A correction shall be made for the difference in elevation between this point and the test gauge. With the required pressure on the line, the entire run shall be examined for evidence of leakage. Any leaks discovered shall be corrected and the test repeated until the engineer is satisfied that the line is tight. The test pressure shall not vary by more than 5 psi for the duration of the test.

After the above work is completed and the line is completely backfilled, a leakage test of two hour duration shall be made at the same pressure as the pressure test measured at the lowest portion of the test section and corrected for test gauge height. No pipe installation will be accepted unless and until the leakage is less than the amounts allowed in AWWA Standard C-600-17, Section 5.2, and Table 6. Allowable leakage is determined by the following formula:

$$* \quad L = \frac{SD (P)^{0.5}}{148,000}$$

Where L is leakage in gph, S is the length of pipe tested in feet, D is the nominal diameter of the pipe in inches and P is the average test pressure during the test in psi. The hydrostatic pressure test and leakage test may be conducted simultaneously if deemed acceptable by the engineer.

4.03 DISINFECTION OF MAINS

All new work shall be disinfected by the contractor. Disinfection shall be performed in an approved manner in accordance with the American Water Works Association's Standard for Disinfecting Water Mains, Designation C651-14 except that the "Tablet Method" described in Section 4.3 of C-651-14 shall not be used.

4.04 PREVENTATIVE MEASURES DURING CONSTRUCTION

Keeping Pipe Clean and Dry: Precautions shall be taken to protect pipe interiors, fittings and valves against contamination. Pipe delivered for construction shall be strung so as to minimize entrance of foreign material. When pipelaying is not in progress, as, for example, at the close of the day's work, all openings in the pipeline shall be closed by water tight plugs. Joints of all pipes in the trench shall be completed before work is stopped. If water accumulates in the trench, the plugs shall remain in place until the trench is dry.

If dirt that, in the opinion of the engineer or job superintendent, will not be removed by the flushing operation enters the pipe, the interior of the pipe shall be cleaned and swabbed as necessary, with a 5 percent hypochlorite disinfecting solution.

4.05 PRELIMINARY FLUSHING

The main shall be flushed prior to disinfection. The flushing velocity shall not be less than 3.0 ft/sec. The rate of flow required to produce this velocity in various diameters is shown in Table I. No site for flushing should be chosen unless it has been determined that drainage is adequate.

TABLE I
Required Openings to Flush Pipelines*
(40 psi Residual Pressure)

<u>Pipe Size (in.)</u>	<u>Flow Required to Produce 3.0 fps Velocity (gpm)</u>	<u>Orifice Size (in.)</u>	<u>Hydrant Number</u>	<u>Outlet Nozzles (Size in.)</u>
4	120	15/16	1	2-1/2
6	260	1-3/8	1	2-1/2
8	470	1-7/8	1	2-1/2
10	730	2-5/16	1	2-1/2
12	1,060	2-13/16	1	2-1/2

4.06 FORM OF CHLORINE DISINFECTION

The most common form of chlorine used in the disinfecting solutions are liquid chlorine (gas at atmosphere pressure), calcium hypochlorite granules, and sodium hypochlorite solutions.

- A. Liquid Chlorine: shall be used only when suitable equipment is available and only under the direct supervision of a person familiar with the physiological, chemical and physical properties of this element and who is properly trained and equipped to handle any emergency that may arise. Introduction of chlorine gas directly from the supply cylinder is unsafe and shall not be permitted.

The preferred equipment consists of a solution feed chlorinator in combination with booster pump for injecting the chlorine/water mixture into the main to be disinfected. Direct feed chlorinators are not recommended because their use is limited to situations where the water pressure is lower than the chlorine cylinder pressure.

- B. Calcium Hypochlorite: contains 70 percent available chlorine by weight. It is either granular or tabular in form. The tablets, 6-9 to the ounce, are designed to dissolve slowly in water.

A chlorine-water solution is prepared by dissolving the granules in water in the proportion requisite for the desired concentration.

- C. Sodium hypochlorite: is supplied in strengths from 5.25 to 16 percent available chlorine. It is packaged in liquid form in glass, rubber or plastic containers ranging in size from one quart bottles to five gallon carboys. It may also be purchased in bulk for delivery by tank truck.

A chlorine-water solution is prepared by adding hypochlorite to water. Product deterioration must be considered when computing the quantity of sodium hypochlorite required for the desired concentration.

4.07 APPLICATION

The hypochlorite solutions shall be applied to the watermain with a gasoline or electrically powered chemical feed pump designed for feeding the chlorine solutions. For small applications, the solutions may be fed with a hand pump, for example, a hydraulic test pump.

Feed line shall be of such material and strength as to withstand safely the maximum pressures that may be created by the pumps. All connections shall be checked for tightness before the hypo-chlorite solution is applied to the main.

4.08 METHODS OF CHLORINE APPLICATION

A. Continuous Feed Method - This method is suitable for general application. Water from the existing distribution system or other approved sources of supply shall be made to flow at a constant, measured rate into the newly-laid pipeline. The water shall receive a dose of chlorine, also fed at a constant, measured rate. The two rates shall be proportioned so that the chlorine concentration in the water in the pipe is maintained at a minimum of 25 mg/l available chlorine. To assure that this concentration is maintained, the chlorine residual should be measured at regular intervals in accordance with the procedures described in the current edition of Standard Methods of AWWA M12 - Simplified Procedures for Water Examination.

Table II gives the amount of chlorine residual required for each 100 foot of pipe in various diameters. Solutions of one percent chlorine may be prepared with sodium hypochlorite or calcium hypochlorite. The latter solution requires approximately 1 lb. of calcium hypochlorite in 8.5 gallons of water. If liquid laundry bleach with 5.25% Cl is used, then 4.25 gallons of water is to be mixed with 1 gallon of bleach to obtain 1 percent solution.

TABLE II
Chlorine Required to Produce 25 mg/1
Concentration in 100 ft. of pipe

Pipe Size (in.)	Volume of 100-ft. length (gallons)	100 Percent Chlorine (lb.)	1 Percent Chlorine Solutions (gal.)
4	65.3	.013	0.16
6	146.5	.030	0.36
8	261.0	.054	0.65
10	408.0	.085	1.02
12	588.7	.120	1.44

During the application of the chlorine, valves shall be manipulated to prevent the treatment dosage from flowing back into the line supplying the water. Chlorine application shall not cease until the entire main is filled with the chlorine solution. The chlorinated water shall be retained in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances. At the end of this 24 hour period, the treated water shall contain no less than 10 mg/l chlorine throughout the length of the main.

- B. Tablet Method - The "tablet method" as contained in Section 4.3 of American Water Works Association (AWWA) Standard C651-14 is not acceptable to the New York State Department of Health and shall not be used.

4.09 FINAL FLUSHING

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the main is no higher than that generally prevailing in the system, or less than 1 mg/l. Chlorine residual determination shall be made to ascertain that the heavily chlorinated water has been removed from the pipeline. The chlorinated shall not be discharged directly into an existing watercourse (i.e. pond, lake, stream, etc.) but rather to a suitable location where the water can percolate into the ground for treatment. If such a location is not available, then the wastewater shall be taken off-site to an approved wastewater treatment plant.

4.10 BACTERIOLOGIC TESTS

After final flushing and before watermain is placed in service, a series of samples shall be collected from the main and tested for bacteriologic quantity and shall show the absence of coliform organisms. If the number and frequency of samples is not prescribed by the public health authority having jurisdiction, at least two consecutive sets of acceptable samples, taken at 24 hours apart, shall be collected from the new main which is currently under disinfection procedures in accordance with AWWA C651-14, latest revision, Section 5.1. At least one set of samples shall be collected from every 1,200 ft of the new watermain, plus one set from the end of the line and at least one set from each branch.

Samples for bacteriologic analysis shall be collected in sterile bottles treated with sodium thiosulfate with the analyses performed by a NYSDOH approved lab facility. No hose or fire hydrant shall be used in collection of samples. A suggested samples tap consists of a standard corporation cock installed in the main with a copper tube gooseneck assembly. After samples have been collected the gooseneck assembly may be removed and retained for future use. All testing for bacteriological quality shall be done in accordance with "Standard Methods for the Examination of Water and Wastewater".

4.11 REPETITION OF PROCEDURE

If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated at the Contractors expense until satisfactory samples have been obtained. When the samples are satisfactory, the main may be placed in service.

4.12 PROCEDURE AFTER CUTTING INTO OR REPAIRING EXISTING MAINS

The procedure outlined in this section applies primarily when mains are wholly or partially dewatered. Leaks or breaks that are repaired with clamping devices while the main remains full of water under pressure require no disinfection.

- A. Trench Treatment - When an old line is opened, either by accident or by design, the excavation will likely be wet and badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from such pollution. Tablets have the advantage in such a situation because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
- B. Main Disinfection - Swabbing with Hypochlorite Solution: The interior of all pipe and fittings used in making the repair (particularly coupling and tapping sleeves) shall be swabbed with a 1 percent hypochlorite solution before they are installed.
- C. Flushing: Thorough flushing is the most practical means of removing contamination introduced during repairs. If valving and hydrant locations permit, flushing from both directions is recommended. Flushing shall be started as soon as the repairs are completed and continued until discolored water is eliminated.
- D. Sampling - Bacteriologic samples shall be taken after all repairs, in order to provide a record by which the effectiveness of the procedures used can be determined. If the direction of flow is unknown samples shall be taken on each side of the main break.

END OF SECTION