

Appendix E

Engineering Report & Technical
Specifications for a Sewer Main
Extension to Serve Dockside

ENGINEERING REPORT
& TECHNICAL
SPECIFICATIONS

FOR A

SEWER MAIN EXTENSION

TO SERVE

DOCKSIDE

DOCK ROAD AND NYS RTE 9W

**TOWN OF MARLBOROUGH
ULSTER COUNTY, NEW YORK**

PREPARED BY



JUNE 2011

REVISED SEPTEMBER 2011

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1.0 INTRODUCTION

Engineering Properties, P.C. is pleased to submit this Engineers Report for a sewer main extension and sewer district extension to serve the project known as Dockside. The project site consists of several parcels of land totaling ± 27.2 acres. The proposed project scope includes the construction of 137 townhomes and a clubhouse in a neighborhood style development.

All buildings will be connected to new public water mains and sewer mains to be installed by the project sponsor. The project is within the Town of Marlborough and will receive sewer service via connection to the existing Town of Marlborough Sewer Improvement Area.

2.0 SITE DESCRIPTION

The project site consists of three parcels identified as Town of Marlborough tax lots, Section 108.4 Block 3 Lot 13, 14.2 and 29.1; containing ± 27.2 acres. Dock Road will serve as the main access to the site which is located south of the property. Dock Road will also be the location of the proposed sewer service connections to the existing 10" sewer main. To the west of the property is NYS Route 9W and several small commercial properties. Immediately north of the site is the Marlboro School District Middle School and to east is a marina. A USGS map indicating the site location can be found in Appendix A.

The site was a former sand and gravel mine which has been reclaimed and is currently undeveloped. The site consists of overgrown fields and brush. Topography on the project site is flat to gentle sloping in the center of the site where the floor of the mine was located with steep slopes around the perimeter. The base of the former mine site generally slopes from west to east with a low point in the developed area of 70 feet. From this area, the site slopes steeply up to the north towards the school and steeply down to the south towards dock road.

The highest elevation of the developed portion of the site above the sewer main is approximately 139 feet above mean sea level located in the area of buildings #2 and #3.

The lowest elevation directly above the proposed sewer main is approximately 91 feet above mean sea level and is found at the east portion of site in front of building #9.

3.0 EXISTING SANITARY SEWER SYSTEM DESCRIPTION

The project site is located partially within the service area of the Town of Marlborough Sewer Improvement Area (SIA) which is serviced by the Town of Marlborough Wastewater Treatment Plant (TMWTP) located on Dock Road directly south of the site. The plant treats the wastewater at the site and discharges treated effluent to the Hudson River just east of the site. The plant has a full design capacity of 175,000 gallons per day (GPD) and based on the last twelve months of record the plant is treating a monthly average flow of between 71,000 GPD and 208,000 GPD with average flow of 112,300 GPD. Based on this information, there is an available capacity of 62,700 GPD remaining for new development within the existing SIA.

In review of the *Engineers Report – Capacity and Performance Evaluation, Marlboro Wastewater Treatment Facility*, prepared by Brinnier and Larios, P.C. May 2007; the plant available capacity was reported to be 38,280 GPD in 2007. It was also noted that this capacity was reserved for approved projects and vacant land within the existing SIA which includes the applicant's lands on the western side of the site. As currently proposed, approximately 38 units and the clubhouse are located within the SIA, with the remaining 99 units located outside the SIA. A new sewer district formation will be required to provide service to the units outside the current SIA.

All units of the proposed Dockside sewage system will connect to the existing 10 inch gravity sewer mains located within Dock Road at the intersection of the project entry drive. This main continues down Dock Road and then discharges at the TMWTP located just off of Dock Road.

4.0 PROPOSED SANITARY SEWER SYSTEM

4.1 PROPOSED WASTEWATER FLOWS

As previously mentioned, the development of the Dockside project is designed for a total of 137 townhomes. Based on NYSDEC accepted standards, it is anticipated that each 3-bedroom townhome will discharge approximately 320 gallons per day of wastewater. The proposed wastewater flow for this project has been calculated as shown below:

TABLE 1: PROPOSED SEWER DEMAND

UNIT TYPE	# OF UNITS/USERS	DESIGN AVERAGE DAILY DEMAND/UNIT (GPD)	PROBABLE AVERAGE DAILY DEMAND/UNIT (GPD)	DESIGN AVERAGE DAILY DEMAND (GPD)	PROBABLE AVERAGE DAILY DEMAND (GPD)
3-Bedroom	137	320	240	43,840	32,880
Clubhouse Pool	50	50	50	400	400
Clubhouse	50	50	50	800	800
		TOTAL		45,040	34,080

Based on this analysis, the total design wastewater demand for the project is approximately 45,040 gallons per day (GPD). Of this demand, it is estimated that 13,360 GPD will be generated by uses located within the existing SIA and 31,680 GPD will be generated by uses located outside of the existing SIA. It should be noted that probable demand or the actual flows to the plant will likely be significantly less. It is estimated that actual flows will be approximately 34,080 GPD.

In review of the existing plant there is sufficient capacity to service the units located within the SIA but in consideration of other potential users within and outside of the SIA, additional treatment capacity will need to be added to the plant to service the proposed units outside of the existing SIA. It is our understanding that the Town is considering expanding the service area of the

plant to include this site as well as other areas of the Town. This expansion will include an upgrade in capacity of the plant to 350,000 GPD and the formation of a new sewer district which will include this parcel. With the new sewer district and the expanded capacity, the Town treatment plant will be capable of servicing the proposed units outside of the existing SIA.

As an alternative to municipal sewage disposal for the units located outside the SIA, the applicant is proposing to construct a “modular” wastewater treatment plant on the Town property adjacent to the existing Town plant. This alternative would only be pursued if Town has not extended the sewer district to service the remaining units at the time of preliminary site plan approval of the project. At that time a plan will be developed for the plant and appropriate approvals pursued by the applicant.

Whether connected to the TMWTP or to the “modular” wastewater treatment plant, a portion of the average daily flow, (114 units x 320 gpd/unit) 36,480 GPD will discharge to an onsite pump station. Peak hourly flow for this portion of the project will be 101.3 gallons per minute (GPM) or 4.0 times the average daily demand.

4.2 PROPOSED PROJECT COLLECTION SYSTEM

Wastewater from the project will be collected in a proposed gravity sewer main system within the proposed development consisting of sanitary manholes and 8” PVC SDR-35 gravity sewer mains, which will meet or exceed minimum slope requirements, and an on-site sewer pump station. A total of 17 sewer manholes and 2,489 l.f. of gravity sewer main is proposed to collect the wastewater. A small portion of this collection system will discharge by gravity to the existing Town sewer mains while the larger portion of the collection system will discharge to the onsite pump station. This proposed on-site sewer pump station will consist of a concrete wet well which will store the wastewater between pump run cycles (approximately every 30 min).. This wastewater will be ejected from the station

by a Smith & Loveless factory built automatic pumping station. The pump station will have two (2) 5 horsepower pumps that will be capable of pumping 101.3 GPM against a total dynamic head of 58 ft. This is the greater of the peak flow of 101.3 GPM and the minimum flow of 78.3 GPM necessary to attain the minimum scour velocity in the force-main (see Pump Station Hydraulic Calculations in Appendix C). The pump station is not large enough to be able to provide 24 hours of wastewater storage for the entire project therefore, a gas powered electrical stand-by generator will be installed to provide emergency backup electrical power to operate the sewer pump station in the event of a power interruption.

The effluent collected at the sewer pump station from the proposed 114 units will be pumped through $\pm 1,100$ feet of a 4" PVC SDR-26 sewer force main to a proposed sewer manhole located within the gravity portion of the project. At this location, the sewage will then be conveyed through the Town's sewage collection system and eventually discharged to the TMWTP.

All new sewer mains will be designed and constructed in accordance with the Technical Specifications found in Appendix D, as well as all Town of Marlborough and New York State Department of Environmental Conservation requirements. All improvements will be constructed within existing Town of Marlborough road right-of-ways or on lands of the proposed project. The mains and pump station will be dedicated to the Town for future operation and maintenance. Easement for access to and maintenance of the sewer mains will be granted to the Town of Marlborough within lands owned by the project sponsor.

5.0 CONCLUSION

As proposed, the sewage collection system will meet or exceed all local and state design requirements.

APPENDIX A LOCATION MAP

Drawing Name: Z:\989.01 - Dockside @ Marlborough.dwg\SketchPlan3.dwg Date Printed: Jun 15, 2011, 2:55pm



LOCATION MAP

DOCKSIDE @ MARLBOROUGH
DOCK ROAD
TOWN OF MARLBOROUGH
ULSTER COUNTY, NEW YORK

DATE:
06/02/11

SCALE:
1"=1000'

JOB #
989.01

SHEET #
F-1

ENGINEERING PROPERTIES
Achieving Successful Results with Innovative Designs

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APPENDIX B
SEWER DISTRICT
EXTENSION
DOCUMENTS

ENGINEERING REPORT
Capacity and Performance Evaluation
Marlboro Wastewater Treatment Facility

Marlboro Sewer Improvement Area
Town of Marlborough
Ulster County, New York

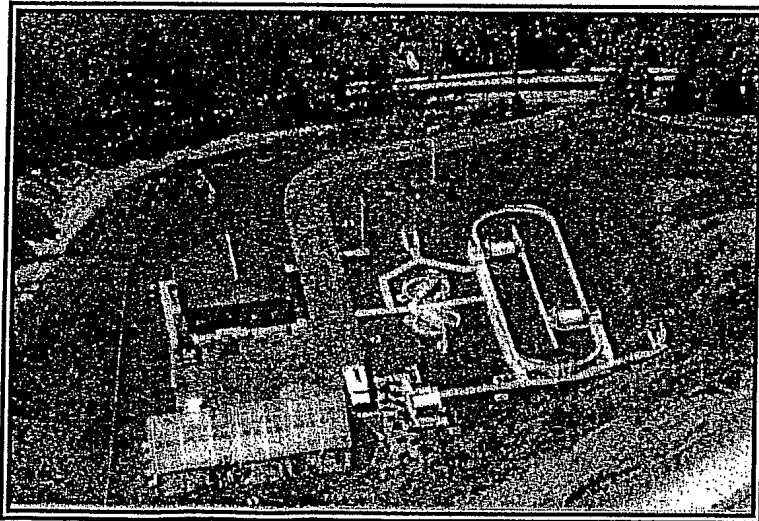
FINAL REPORT - MAY 2007

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I. BACKGROUND & SUMMARY OF RECENT OPERATING HISTORY

A. BACKGROUND

The establishment and construction of the Marlboro Sewer Improvement Area occurred in 1980-82. This project included the installation of a wastewater collection system throughout the Hamlet of Marlboro and the construction of a wastewater treatment facility on Dock Road. The project was funded largely (75%) by USEPA Clean Water Act funds, with the balance of funding coming from a Sewer Improvement Area(SIA) bond issue. In addition, a small portion of the treatment facility (12.5%) was funded by a state grant. Extensions were constructed in 1990-1992 for Jackson Avenue and a portion of Western Avenue. A later extension was constructed on Prospect Street. An extension was also granted for the Pine View Corners Development (Diorio Property) in 2004. This project is currently under construction.

The Marlboro Sewer Improvement Area includes approximately 316 residential users, 53 commercial users and 12 institutional users.

The Marlboro Sewer Improvement Area has a taxable assessment of \$101,816,185. and a current tax rate of \$0.611 per \$1000. of assessed value and a use rate of \$ 4.33 per 1000 gallons. The MSIA has a \$120,000. balance in serial bonds due to be retired in 2010, and a bond anticipation note of \$ 398,750 (retirement date to be verified).

In 1991, the sludge de-watering process at the plant was modified to include a plate and frame press.

The wastewater treatment facility includes an entrance channel, comminutor, oxidation ditch with dual rotors (27.5 inch diameter), and secondary clarifiers. Sludge is returned to the oxidation ditch by screw pumps and de-watered with a plate and frame press. A small operations building with a laboratory is included on the site.

Currently, there is no disinfection process at the facility, but a disinfection requirement is being added to the SDPES permit by NYSDEC and will be effective in 2009.

B. RECENT OPERATION HISTORY

The wastewater treatment facility was designed for an average daily flow of 175,000 gallons per day, and has a permit (SPDES Permit # NY0109720) to discharge to the Lattintown Creek, a tributary of the Hudson River. The facility utilizes the Oxidation Ditch process. Operating data for the years 2003-2005 was evaluated to determine wastewater characteristics. This data is summarized as follows:

Table 1- Flow and Influent Characteristics

Year	Total Daily Flow (MGD)	BOD Influent (mg/l)	SS Influent (mg/l)
2003	0.109	202	147
2004	0.114	277	193
2005	0.125	213	133
Average	0.116	231	158

Table 2 - Organic Loading and Effluent
(lbs/day)

Year	BOD removal (%)	Influent BOD loading-actual	Influent BOD loading-design capacity	Effluent BOD loading-actual	Effluent BOD loading-allowed
2003	97.44%	183.6	302	4.7	43
2004	98.46%	262.0	302	4.1	43
2005	97.92%	221.4	302	4.6	43
Average		222.3		4.5	

Table 3 - Suspended Solids Loading and Effluent
(lbs/day)

Year	SS Removal (%)	Influent SS loading-actual	Influent SS loading-design capacity	Effluent SS loading-actual	Effluent SS loading-allowed
2003	93.6	133.6	355	8.5	43
2004	95.1	183.5	355	9.0	43
2005	94.0	191.0	355	11.5	43
Average		169.4		9.7	

C. ANALYSIS OF OPERATING DATA

In evaluating available plant hydraulic capacity, it is best to utilize a conservative approach. For example, any month in which the flow exceeds 175,000 gallons per day would constitute a violation of the SPDES permit. Therefore, the highest six months of each year are considered and used as a base flow for the calculation of available hydraulic capacity.

Table 4- Highest Six Months Flow Average

Year	Highest Six Months Flow (average-gpd)
2003	136,000
2004	128,500
2005	145,670
Average	136,720

The calculated remaining hydraulic capacity is derived as follows:

SPDES Permit and Design Flow: 175,000 gallons per day
 Less Highest Flow Periods of 2003-2005: -136,720 gallons per day
 Remaining Capacity (175,000 - 136,720) = 38,280 gallons per day

With respect to organic loading, and capacity, the average influent values over the past three years are utilized and factored by the highest flow periods (above) to derive a conservative mass loading of BOD5 and Suspended Solids.

Existing Suspended Solids Concentration (2003-2005): 158 mg/l
 Existing BOD5 Concentration (2003-2005): 231 mg/l

Mass Loading Suspended Solids: .137 MGD x 8.34 x 158 = 180.5 lbs/day
 Mass Loading BOD5: .137 MGD x 8.34 x 231 = 264 lbs/day

Remaining Capacity Suspended Solids = Design Capacity - Actual Loading
 (conservative approach) = 355 lbs/day - 180.5 lbs/day
 = 174.5 lbs/day

Remaining Capacity BOD5 = Design Capacity - Actual Loading
 (conservative approach) = 302 lbs/day - 264 lbs/day
 = 38 lbs/day

With respect to current treatment removal efficiencies, a three year performance summary is as follows:

Year	BOD removal	SS Removal
2003	97.44%	93.62%
2004	98.46%	95.06%
2005	97.92%	94.00%
Average	97.94%	94.23%

II. FUTURE GROWTH AND FLOW PROJECTIONS

The present flow and organic loadings are contributed from properties in the Hamlet of Marlboro Sewer Improvement Area, including extensions on Jackson Avenue, Western Avenue and Prospect Street, which were installed in 1990-1992.

Future flows will be generated from two sources:

1. Vacant lands from within the SIA which become developed.
2. Lands outside of the SIA which request service.
3. Other lands outside of the SIA which may logically request service in the future.

The Town Board has received numerous requests for sewer service on lands adjacent to or near the Sewer Improvement Area (SIA).

In order to assess *potential* future flows and loadings at the facility, projections are being made in this report. It is important to emphasize that these are potential future flows and that sewer district extensions or municipal agreements for sewer service are made by the Town Board after evaluation of numerous factors, including: environmental impacts, financial impacts, and other community impacts.

Table 5 - Approved Projects in Marlboro (not yet built or occupied)

Project	Location	No. Units	Bedrooms	Flow (gpd)	BODs (lbs/day)	SS (lbs/day)
NNA Development	Dragotta Rd	4	16	2,160	4.14	4.14
Pine View Corners	Highland Ave	36	72	8,640	16.56	16.56
Prime Development	Orchard St	8	24	2,880	5.52	5.52
Prospect St Development	Prospect St	4	12	1,440	2.76	2.76
TOTAL		52	124	15,120	29	29

1. Hydraulic loading based on 120 gpd/bedroom as per NYSDEC Hydraulic Loading rate guidelines
2. Biological loading based on 230 mg/l BOD and Suspended Solids

In addition to the above, the Town estimates that there is potential for approximately 53 homes and 2 businesses to be located on vacant lands within the Marlboro Sewer Improvement Area. This would equate to the following flows and loadings:

Table 6 - Projection of Flows from Vacant Lands within the Marlboro SIA

Vacant Land	Lots	Bedrooms	Flow	BOD5	SS
Residential	53	159	19,080	36.6	36.6
Business	2	n.a.	3,000	6	6
Total			22,080	42.6	42.6

Table 7- Pending Request and Projects Outside of the Marlboro SIA

Project	Location	No. Units	Bedrooms	Flow (gpd)	BODs (lbs/day)	SS (lbs/day)
Bayside (1)	9W/Purdy Ave	99	198 (2)	23,760 (2)	45.6	45.6
Ginsberg	Dock Rd	137	411	49,320	94.7	94.7
NNA Development	Grand St	44	92	15,840	30.4	30.4
Stoutridge Winery (3)	Prospect St			2,100	4	4
TOTAL		280	701	91,020	174.7	174.7

(1) A small portion of the Bayside project/property is situated in the boundary of the Marlboro SIA

(2) Bayside request may rise to 297 bedrooms and 35,640 gpd.

(3) Stoutridge Winery request has been deferred. It is our understanding that an on-site system is being installed.

Table 8 - Future Flow Projections and Organic Loadings

Area	Existing Flow (gpd)	Future Flow 2026 (gpd)	Existing BOD loading (lbs/day)	Future BOD loading (lbs/day)
Marlboro Sewer Improvement Area (1)	136,720	173,920	264	335.6
Table 7 Extensions - Proposed (2)	0	91,020	0	174.7
Other Potential Extensions (3)	0			
Total		264,940	264	510.3

(1) Existing Six Month Highest Flow Average + Table 5 + Table 6

(2) Requests for Extension and Pending Projects

(3) Possible Future Extensions West (Marlboro High School) and North (9W Corridor) are not included at this time

III. WASTEWATER FLOWS AND CHARACTERISTICS

A. HYDRAULIC LOADINGS

1. DESIGN AVERAGE FLOW (DAF)

Projected Marlboro SIA (2026):

	<u>Existing</u>	<u>Proposed</u>
Marlboro SIA:	136,700	173,920
Pending Extensions:	<u>0</u>	<u>91,020</u>
Total	136,700	264,940

$$\underline{\text{DAF} = 265,000 \text{ G.P.D. (184 GPM)}}$$

2. DESIGN PEAK HOURLY FLOW (DPHF)

Using the DAF of 265,000 GPD, along with a 100 gallons per capita per day value for new collection systems (GLUMRB, Page 10-4), the resultant population equivalent is 2650 persons. Using Figure 1 (GLUMRB, Page 10-5), the desired ratio of design peak hourly flow to design average flow is 3.5. Accordingly, the Design Peak Hourly Flow (DPHF) is 927,500 GPD (265,000 GPD x 3.5).

$$\underline{\text{DPHF} = 927,500 \text{ G.P.D. (644 GPM)}}$$

B. ORGANIC LOADINGS

1. DESIGN ORGANIC LOADING

The design organic loading is provided in Table 8, as a total of existing and proposed loading.

$$\underline{\text{Design Organic Loading} = 510.3 \text{ \#/day BOD}_5}$$

2. DESIGN AVERAGE BOD₅

Using the DAF and the Design Organic Loading values from above, the Design Average BOD₅ is calculated at 231 mg/l (510.3 #/day / 8.34 / .265 MGD)

$$\underline{\text{Design Average BOD}_5 = 231 \text{ mg/l}}$$

C. SOLIDS LOADINGS

1. DESIGN SOLIDS LOADING

The design solids loading is provided in Tables 5 through 7 , and is a total of existing and potential solids loading.

Design Solids Loading = 426.8 #/day Solids

2. DESIGN AVERAGE SUSPENDED SOLIDS

Using the DAF and the Design Solids Loading values from above, the Design Average Suspended Solids was calculated at 193 mg/l (426.8 #/day / 8.34 / .265 MGD).

Design Average Suspended Solids = 193 mg/l

IV. MAJOR PLANT PROCESS ASSESSMENTS

In this section, the theoretical treatment capacity of each major component will be determined. A brief discussion comparing the calculated capacity and the design values then follows.

Generally, the existing WWTP consists of: influent channel/bar screen(manual) & comminutor, 175,000 gallon oxidation ditch with dual rotor aeration, two(2) secondary clarifiers -17 ft diameter each with 12 ft SWD, , two (2) sludge recirculation pumps-screw type, cascade aeration device, and sludge dewatering facilities.

A. OXIDATION DITCH (EXTENDED AERATION PROCESS)

The WWTP is equipped with extended aeration facilities of the oxidation ditch type, whose function it is to reduce the organic content of the wastewater via microbiological activity to meet effluent BOD₅ limits.

Total volume under aeration is 175,000 gallons or 23,400 cubic feet. Side water depth of the ditch is 6 feet, and there are two large rotor aerators, each inches in diameter.

1. ORGANIC LOADING BASIS

A. Existing Organic Loading

From Section I.C, the existing organic loading of the facility is 264 lbs BOD/day.

B. Proposed Organic Loading

From Table 8, the projected total design year loading of the facility is 510.3 lbs BOD/day.

C. Allowed Organic Loading

Extended aeration basins are allowed to be loaded up to 15 #/day BOD₅ per 1000 cubic feet under aeration at average BOD₅ loading (GLUMRB, Page 90-7).

Allowed Organic Loading = 15#/day x 23,400 cu ft/1000 cu ft
= 351 # BOD/day

D. Discussion

The allowed organic loading of the aeration basin is 351 #BOD/day. The proposed organic loading of the aeration basin 510.3 lbs BOD/day. **Additional aeration volume will be required once the loading increases from its present value of 264 #BOD/day to 351 #BOD/day.**

2. FOOD / MASS (F / M) RATIO

A. Existing F/M Ratio

At the existing loading of 264 # BOD/day and with the design Mixed Liquor Suspended Solids (MLSS) at 4,000 mg/l (3,000 - 5,000 mg/l as required by GLUMRB, Page 90-7), and further assuming the ratio of Mixed Liquor Volatile Suspended Solids (MLVSS) to MLSS is 0.8 (Metcalf & Eddy, Page 480), the MLVSS will approximate 3,200 mg/l (4,000 mg/l x 0.8).

The existing MLVSS, therefore, is about 3,656 #/day [(0.137 MGD) x (3,200 mg/l) x (8.34)].

The resultant F / M Ratio, therefore, is about 0.07 # BOD₅ per day per # MLVSS [(264 #/day) / (3,656 #/day)].

B. Proposed F / M Ratio

From Section III.A.1. above, the proposed DAF is 265,000 GPD, and from Table 7, the proposed design organic loading is 510.3 #/day BOD₅.

Establishing the design Mixed Liquor Suspended Solids (MLSS) at 4,000 mg/l (3,000 - 5,000 mg/l as required by GLUMRB, Page 90-7), and further assuming the ratio of Mixed Liquor Volatile Suspended Solids (MLVSS) to MLSS is 0.8 (Metcalf & Eddy, Page 480), the MLVSS will approximate 3,200 mg/l (4,000 mg/l x 0.8).

The proposed MLVSS, therefore, is about 7,072 #/day [(0.265 MGD) x (3,200 mg/l) x (8.34)].

The resultant proposed F / M Ratio, therefore, is about 0.07 # BOD₅ per day per # MLVSS [(510.3 #/day) / (7072 #/day)].

C. Allowed F / M Ratio

For extended aeration, GLUMRB specifies the permissible F / M

Ratio at 0.05 - 0.10 # BOD₅ per day per # MLVSS (Page 90-7).

D. Discussion

Since the proposed F / M Ratio range compares favorably with the recommended F / M Ratio range, the proposed design MLSS of 4,000 mg/l is considered satisfactory for the proposed application.

B. FINAL CLARIFICATION

The WWTP is currently equipped with two-final settling tanks (clarifiers) whose function is to provide adequate quiescent storage capacity to promote separation of settleable solids from the liquid portion of the wastewater, and to provide thickening of the settled solids prior to digestion.

Each clarifier tank is 17' in diameter with a side-water depth (SWD) of 12'. The surface area of each tank is about 227 Square Feet (SF), and each clarifier has approximately 106 l.f. of weir length.

For final settling tanks, both the surface overflow rate and the solids loading rate are calculated to assure proper unit sizing.

1. SURFACE OVERFLOW RATE (SOR)

a. Existing SOR

The existing DPHF is .525 MGD (525,000 GPD).

Total final settling tank surface area is 454 SF (2 @ 227 SF).

The resultant proposed SOR at DPHF, therefore, is 1156 GPD/SF (525,000 GPD / 454 SF).

b. Allowed SOR

For the extended aeration process, GLUMRB allows a final settling tank SOR at DPHF of up to 1,000 GPD/SF (Page 70-3).

Therefore, the final clarifiers are approximately 15% over GLUMRB standards at current loading levels. This is due to a change in design standards which has occurred.

c. Proposed SOR

To meet GLUMRB Standards for the proposed DPHF of 927,500 G.P.D., a SOR of 1000 G.P.D./SF is required.

Req'd Surface Area = 927,500 G.P.D./1000 G.P.D./SF=927.5 Sq. Ft.

Existing Surface Area = 454 Sq. Ft.

Add'l Surface Area Req'd = 927.5 Sq. Ft. - 454 Sq. Ft. = 473.5 Sq. Ft.

Circular Clarifier, 25 diameter = 490 Sq. Ft.

d. Discussion

It is required that additional surface area be installed to meet both present and future conditions. A new circular clarifier, 25 ft diameter with 12 ft SWD will meet both future and present requirements.

2. PEAK SOLIDS LOADING RATE (PSLR)

a. Proposed PSLR

GLUMRB specifies that the PSLR shall be computed based on the DMDF plus the design maximum return sludge rate, and the design MLSS under aeration.

The proposed DMDF is .265 MGD (265,000 GPD), and from Section III.B.2.a above, the proposed design MLSS under aeration is 4,000 mg/l.

Assuming a design maximum return sludge rate of 100% (.265 MGD), the resultant total flow is .530 MGD.

Peak Solids, therefore, are computed at 17,680 # / day [(0.530 MGD) x (4,000 mg/l) x (8.34)].

Total final settling tank surface proposed is 944 Sq. Ft.

Therefore, the proposed PSLR, is about 18# / day / SF [(17,680 #/day) / (994 SF)].

b. Allowed PSLR

GLUMRB allows a final settling tank PSLR of up to 35 #/day/SF (Page 70-3).

c. Discussion

The proposed PSLR falls within established PSLR guidelines.

3. WEIR LOADING RATE (WLR)

a. Proposed WLR

From Section III.A.3 above, the proposed DPHF is .9275 MGD (927,500 GPD).

Total final settling tank weir length proposed (150 lf) and existing (212 lf) is 362 linear feet. The resultant proposed WLR at DPHF, therefore, is 2562 GPD/FT (927,500 GPD /362 FT).

b. Allowed WLR

For final settling tanks with a plant capacity of less than 1 MGD, the allowed WLR at DPHF is 20,000 GPD/FT. (GLUMRB Page 70-4).

c. Discussion

The proposed WLR falls within established WLR guidelines.

C. EFFLUENT DISINFECTION

The WWTP is currently not equipped with effluent disinfection facilities. While the current SPDES Permit does not require effluent disinfection, the Town has been notified by NYSDEC that there will be a disinfection requirement effective in 2009.

Design and installation of an effluent disinfection system will be required independent of a plant expansion. The cost of this will be borne by the Marlboro Sewer Improvement Area and any extensions thereof. Alternatives are chlorination and ultra-violet disinfection.

D. SLUDGE DIGESTION / STORAGE

Currently, substantial Sludge Digestion is accomplished within the oxidation ditch. A separate, aerated sludge holding tank is needed to facilitate sludge wasting and complete digestion. Sludge cannot be effectively stored in the clarifiers without negatively impacting suspended solids removal, especially during peak flow events.

1. VOLUME (POPULATION EQUIVALENT BASIS)

a. Proposed Population Equivalent

From Section III.A.3 above, the proposed Population Equivalent is 2650.

b. Allowed Population Equivalent

GLUMRB requires a digester volume of 3.0 cubic feet (CF) per

Population Equivalent (GLUMRB, Page 80-10). An additional 25% is recommended where supernatant separation is performed in the tank.

An aerated sludge holding tank/decant tank is proposed as follows:

Volume Req'd = 3.0 cu. ft. x 2650 P.E. x 1.25 = 9940
Volume = l x w x h

Tank Dimensions: 20 ft wide x 42 ft length x 12 ft SWD
(To be split into two basins)

Tank Volume: 10,080 cu. ft.

c. Discussion

An aerated sludge holding tank is required to facilitate complete digestion and proper sludge storage prior to dewatering.

2. AIR REQUIREMENTS

a. Required Air Supply

GLUMRB specifies that the aerobic sludge digestion process shall be provided with at least 30 cubic feet of air per minute per 1,000 cubic feet of tank volume (GLUMRB, Page 80-11).

Using the digester volume of 10,080 CF, the resultant air requirement for the aerobic sludge digestion process is 302 cfm (30 cfm air / 1,000 CF x 10,080 CF).

b. Discussion

From above, the aerobic digester requires 302 cfm of air. Two blowers, each capable of supplying the required 302 cfm will be provided.

E. SLUDGE DEWATERING

Currently, the plate and frame press is operated on 5-6 cycles per week. At the design flow of 265,000 gallons per day (2026), it is anticipated that the plate and frame press would operate 10-12 cycles per week. While GLUMRB recommends two units for mechanical sludge dewatering, it is recommended that storage and duplicate spare parts be used to meet this goal. Additionally, drying beds are available for emergency use/storage.

F. SUMMARY OF IMPROVEMENTS and COST

It is recommended that the following improvements be made at the Marlboro WWTF to accommodate an expansion to 265,000 gallons per day and to address other required improvements at the facility.

1. Installation of a 90,000 gallons per day EA Aerotor Plant to provide aeration and clarification of the additional sanitary flow anticipated over the next twenty years.
2. Modifications to the entrance channel to improve hydraulics and to accommodate the additional sanitary flow.
3. Installation of an aerated sludge holding tank to store and concentrate sludge prior to dewatering. This is both an operational enhancement and an expansion component. This improvement will also make it more efficient to deliver sludge from the Milton WWTF.
4. Installation of effluent disinfection, by chlorination or ultraviolet disinfection, to meet requirements recently imposed through the SPDES permit.
5. Site piping modifications to accommodate the expansion and to facilitate the sludge processing changes.

A preliminary opinion of probable cost is provided in Table 9 (below). An alternative to expand the facility by 100% (to a design flow of 355,000 gallons per day) is provided in Table 10.

**Table 9 - Probable Cost of WWTF Improvements
Expansion to 265,000 GPD and Other Improvements**

Item	Description	Total Cost
Add Combined Oxidation Ditch and Secondary Clarifier -Lakeside	90,000 GPD Treatment Unit 52 ft O.D. EA Aerator Process	\$720,000
Add Aerated Sludge Holding Tank & Decant System	Utilize existing space in drying bed to meet GLUMRB requirements for 2 devices	\$350,000
Entrance Channel Modifications & Additions		\$140,000
Other Plant Improvements not related to Expansion		
Site Piping Modifications & Additions		\$120,000
Splitter Box after Entrance Channel	2:1 Diversion of Influent	\$40,000
Effluent Disinfection -allowance	Required by SPDES permit	\$160,000
Electrical Construction		\$220,000
Sub-Total		\$1,750,000
Contingencies	10 % of above	\$175,000
Total Construction		\$1,925,000
Design Allowance	8% allowance	\$154,000
Inspection Allowance	6.5 % allowance	\$125,000
Legal & Administration Allowance	2% allowance	\$38,500
Total Project Cost		\$2,242,500
<i>Portion Allocated to Expansion</i>		<i>\$1,695,730</i>
<i>Portion Allocated to SIA</i>		<i>\$546,770</i>

Items Related to Existing SIA:

- 67% of Aerated Sludge Holding Tank & Decant (\$234,500)
- 67% of Effluent Disinfection (\$ 107,200)
- 25% of Electrical (\$55,000)
- 25% of Site Piping Modifications (\$30,000)
- 24.4 % of contingencies and all other costs

**Table 10 - Probable Cost of WWTF Improvements
Expansion to 350,000 GPD and Other Improvements**

Item	Description	Total Cost
Add Combined Oxidation Ditch and Secondary Clarifier -Lakeside	180,000 GPD Treatment Unit 52 ft O.D. EA Aerator Process	\$1,000,000
Add Aerated Sludge Holding Tank & Decant System	Utilize existing space in drying bed to meet GLUMBR requirements for 2 devices	\$470,000
Entrance Channel Modifications & Additions		\$170,000
Other Plant Improvements not related to Expansion		
Site Piping Modifications & Additions		\$160,000
Splitter Box after Entrance Channel	1:1 Diversion of Influent	\$40,000
Effluent Disinfection -allowance	Required by SPDES permit	\$220,000
Electrical Construction		\$280,000
Sub-Total		\$2,340,000
Contingencies	10 % of above	\$234,000
Total Construction		\$2,574,000
Design Allowance	8% allowance	\$205,920
Inspection Allowance	6.5 % allowance	\$165,000
Legal & Administration Allowance	2% allowance	\$51,480
Total Project Cost		\$2,996,400
<i>Portion Allocated to Expansion</i>		<i>\$2,410,120</i>
<i>Portion Allocated to SIA</i>		<i>\$586,280</i>

Items Related to Existing SIA:

50% of Aerated Sludge Holding Tank & Decant (\$235,000)
50% of Effluent Disinfection (\$ 110,000)
25% of Electrical (\$70,000)
25% of Site Piping Modifications (\$40,000)
20% of all other costs

V. SUMMARY AND RECOMMENDATIONS

1. The establishment and construction of the Marlboro Sewer Improvement Area occurred in 1980-82. This project included the installation of a wastewater collection system throughout the Hamlet of Marlboro and the construction of a wastewater treatment facility on Dock Road.
2. The Marlboro Sewer Improvement Area includes approximately 316 residential users, 53 commercial users and 12 institutional users. The Marlboro Sewer Improvement Area has a taxable assessment of \$101,816,185. and a current tax rate of \$0.611 per \$1000 of assessed value and a use rate of \$ 4.33 per 1000 gallons. The Hamlet of Marlboro SIA has a \$120,000. balance in serial bonds due to be retired in 2010, and a bond anticipation note of \$ 398,750 (retirement date to be verified).
3. A review of Marlboro Wastewater Treatment Facility (WWTF) loadings and performance for the years 2003-2005 indicate excellent treatment efficiencies, averaging 97.94% BOD removal and 94.23% Suspended Solids removal. The average daily flow at the WWTF is 116,000 gallons per day.
4. A conservation analysis of plant flows and loadings was performed to determine safe additional capacity. This yielded a safe additional flow capacity of 38,280 gallons per day, a safe BOD capacity of 38 lbs/day and a safe suspended solids capacity of 174.5 lbs/day.
5. A review of future growth and flow projections, both inside and outside of the Marlboro Sewer Improvement Area (SIA) was conducted. This included a review of: approved projects, vacant land with the SIA, and pending requests/projects outside of the SIA. The result of this review is the following:
 - An estimated 15,120 gallons per day capacity requirement for approved projects
 - An estimated 22,080 gallons per day capacity requirement for vacant lands in the SIA
 - An estimated 91,020 gallons per day capacity requirement for pending requests/projects outside of the Hamlet of Marlboro SIA.

The total, projected flow capacity requirement, using conservative hydraulic loading factors, is 264,940 gallons per day (see Table 8). The current capacity is 175,000 gallons per day.

6. For additional users from outside the boundaries of the Marlboro Sewer Improvement Area to be approved for connection, a financial plan for the expansion of the WWTF must be developed. A preliminary engineering assessment was performed on each plant component under the proposed future loading condition, and it is recommended that the SIA incorporate the same process (oxidation ditch) into an expansion. A modular EA Aerotor Plant would include additional aeration capacity and

clarification to accommodate an expansion of capacity.

7. A preliminary opinion of cost was developed (see Table 9) for expansion of the Marlboro WWTF from 175,000 gallons per day to 265,000 gallons per day. The total cost of the capital project is estimated to be \$ 2,242,500., with \$ 1,695,730. attributed to expansion of the capacity to 265,000 gallons per day.

8. For service to properties and projects outside of the SIA, it is recommended that a capital charge be instituted for entry into the Sewer Improvement Area, and that the subject project/property be extended into the Sewer Improvement Area for future assessment purposes. A preliminary charge is derived as follows:

$$\begin{aligned} \text{Capacity Expansion Charge} &= \text{Capacity Expansion Cost} \div \text{Capacity Increase} \\ \text{(per gallon)} & \\ \text{Capacity Expansion Charge} &= \$ 1,695,730 \div 90,000 \text{ gallons} \\ \text{(per gallons)} & \\ \text{Capacity Expansion Charge} &= \$ 18.84 \end{aligned}$$

9. A larger expansion plan was reviewed since it is felt that a more extensive expansion of sewer service (i.e., northerly along the Route 9W corridor and Westerly) may be feasible in the future. A preliminary opinion of cost was developed (see Table 10) for expansion of the Marlboro WWTF from 175,000 gallons per day to 350,000 gallons per day. The total cost of the capital project is estimated to be \$ 2,996,400., with \$ 2,410,120. attributed to expansion of the capacity to 350,000 gallons per day, and the balance, \$ 586,280., being SIA related improvements.

The capital assessment charge related to expansion in this larger expansion alternative is calculated as follows:

$$\begin{aligned} \text{Capacity Expansion Charge} &= \$ 2,410,120 \div 175,000 \text{ gallons} \\ \text{(per gallon)} & \\ \text{Capacity Expansion Charge} &= \$ 13.80 \end{aligned}$$

10. It is recommended that the Town establish a capital project to expand the wastewater facilities plant in the Hamlet of Marlboro from 175,000 gallons per day to 265,000 gallons per day, and that a capacity expansion charge of \$ 18.84 per gallon of design flow be established for projects situated outside of the Hamlet of Marlboro Improvement Area.

11. It is also recommended that a 20% discount of design flow be utilized for projects which exclusively serve senior citizens. For such projects, a design flow of 100 gallons per day per bedroom can be utilized instead of 120 gallons per day per bedroom.

12. Should the Town Board feel that there is a likelihood of other sewer service extensions to the north and west, the larger expansion (to 350,000 gallons per day) should be adopted. This expansion has a lower unit cost (per gallon). Under this scenario, the establishment of a new District around all future service areas should be considered to reduce the financial risk to the Marlboro Sewer Improvement Area.

REFERENCES

1. **Great Lakes-Upper Mississippi River Board of State Public Health and Environmental Managers (GLUMRB), Recommended Standards for Wastewater Facilities - 1990 Edition, Health Education Services, Albany, NY, 1990.**
2. **Metcalf & Eddy, Inc., Wastewater Engineering: Treatment, Disposal, Reuse, McGraw-Hill, Inc., New York, 1979.**
3. **Wastewater Facilities Plan, Town of Marlborough, April 1979 by Brinnier and Larios, P.C.**
4. **Design Standards for Wastewater Treatment Works, NYSDEC, 1988**

*Engineering Report
Capacity and Performance Evaluation*

*Marlboro Sewer Improvement Area
Town of Marlborough*

APPENDIX A

**Monthly Operating Summary & Reports
(2003-2005)**

*Engineering Report
Capacity and Performance Evaluation*

*Marlboro Sewer Improvement Area
Town of Marlborough*

APPENDIX B

Lakeside EA Aerotor Process Technical Information

NOTES:

1* 1989 EXTENSION

2* 1992 EXTENSION

MARLBOROUGH

Central Sch

Marlboro

Riverside Cem

Dragotta

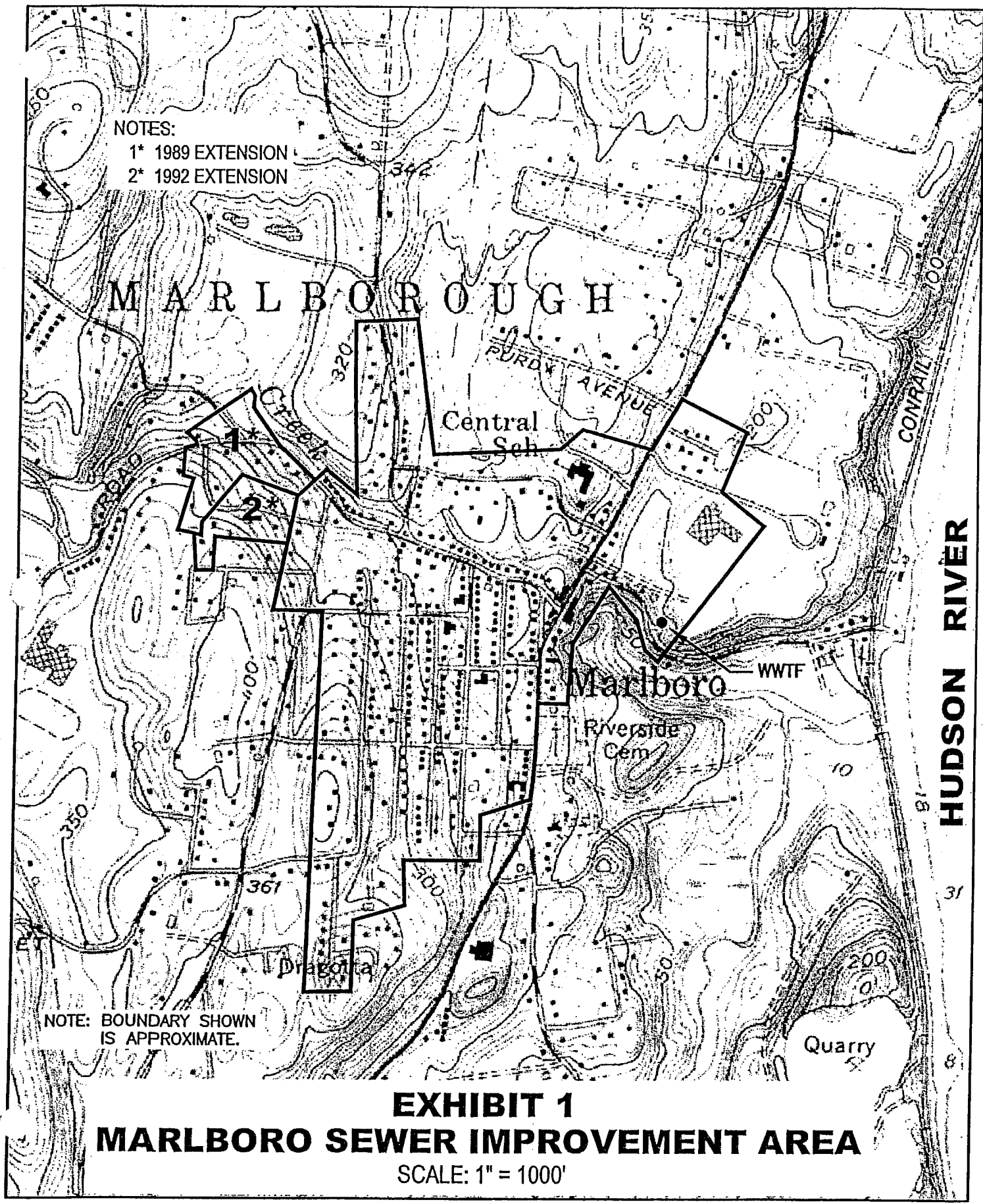
Quarry

NOTE: BOUNDARY SHOWN IS APPROXIMATE.

HUDSON RIVER

EXHIBIT 1 MARLBORO SEWER IMPROVEMENT AREA

SCALE: 1" = 1000'



NOTES:

1* 1989 EXTENSION

2* 1992 EXTENSION

STOUTRIDGE WINERY
2,100 GPD

PROSPECT ST.
DEVELOPMENT
4 UNITS
1,440 GPD

BAYSIDE
99 UNITS
23,760 GPD

MARLBOROUGH

Central
Sch.

GINSBERG
137 UNITS
49,320 GPD

WWTF

Marlboro

Riverside
Cem

PINE VIEW CORNERS
36 UNITS
8,640 GPD

PRIME DEVELOPMENT
8 UNITS
2,880 GPD

NNA DEVELOPMENT
4 UNITS
2,160 GPD

NNA DEVELOPMENT
44 UNITS
15,840 GPD

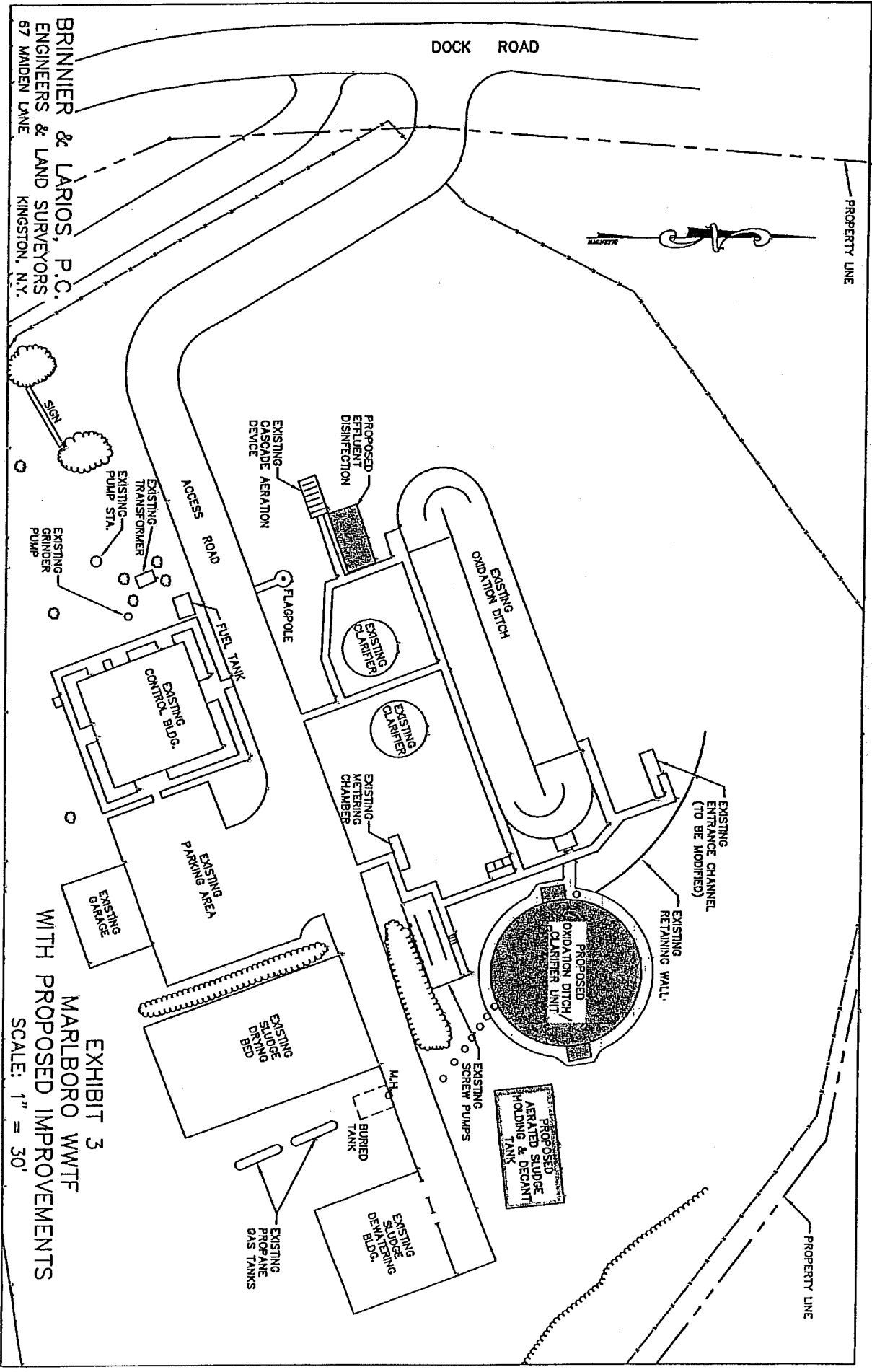
NOTE: BOUNDARY SHOWN
IS APPROXIMATE.

Quarry

EXHIBIT 2 - FUTURE FLOW AREAS MARLBORO SEWER IMPROVEMENT AREA

SCALE: 1" = 1000'

HUDSON RIVER



BRINNIER & LARIOS, P.C.
 ENGINEERS & LAND SURVEYORS
 67 MADEN LANE
 KINGSTON, N.Y.

EXHIBIT 3
 MARLBORO WWTf
 WITH PROPOSED IMPROVEMENTS
 SCALE: 1" = 30'

APPENDIX C
PUMP STATION
CALCULATIONS

**PUMP STATION
HYDRAULICS WORKSHEET**

WO. NO. 989.01	DATE 06/14/11	REVISED	SHEET 1	OF 2
--------------------------	-------------------------	---------	-------------------	----------------

PROJECT TITLE Dockside		LOCATION Town of Marlborough
CALCULATED BY RW	APPROVED BY JS	REF DRAWING(S)

DESIGN FLOW:

Determine Avg. Daily Flow:

# of Units:	114	Units
Bedrooms / Unit:	3	Bedrooms
Flow / Unit:	320	Gallons per Day (GPD)
Total Average Daily Flow =	36,480	Gallons per Day (GPD)
Peak Hourly Flow (Peaking Factor of 4.0) =	101.3	Gallons per Minute (GPM)

REQUIRED SCOUR FLOW:

Required Scour Velocity (V)	2.0 ft/sec	*Note: If Scour Flow is less than Peak Hourly Flow, use Peak Hourly Flow to determine Total Dynamic Head.
Force Main Diameter (D)	4.0 inches	
Forcemain Material	Schd. 26 - PVC	
Hazen-Williams Constant ©	130	
Cross Sectional Area (A)	12.6 in ² { A = π * (D / 2) ² }	
Required Scour Flow (Q)	78.3 GPM	{ Q = (A) / 144 * (V) * 7.4805 * 60 } *less than 101.3GPM
Friction Head Loss (h _f)	hf = 10.44 * (L) * (Q) ^{1.85} / (C) ^{1.85} * (D) ^{4.8655} = 77.3	

PUMP SELECTION:

STATION	Pump Elevation	Max F.M. Elevation	Static Head	F.M. Length	Minor Loss. 10%	Total Adj. Length	Friction Head Loss	Total Dyn. Head (h _T)	Pump Model
			(ft)	(ft)	(ft)	(L, ft)	101 GPM	101 GPM	
1	82.00	131.00	49.0	1080	108.0	1188.0	9.2	58.2	4C3B

Pump is to be Smith & Loveless Wet Well Mounted Pump, Model(s) as specified above.

WET WELL SIZING:

Design Holding Period (min)	30.0
Required Volume (gal)	760.0
Inside Dia. (ft)	6.0
Required Min Depth b/w Pump Off to Pump On	3.6

BUOYANCY CALCULATION:

Outside Dia. (ft)	7.333	Volume of Concrete (ft ³)				Water Displaced	
		Lid	Ring	Base	Total	Depth to Ground Water (ft)	1.0
Inside Dia. (ft)	6.000	24.16	139.59	42.23	205.98	Finish Grade to Top Lid (ft)	-1.0
Lid Thickness (ft)	0.667	Weight of Concrete (#)				Volume (ft ³)	408.3
Top Opening Area (ft ²)	6.000	Lid	Ring	Base	Total	Weight (#)	25,475.02
Height of Wet Well (ft)	10.000	3,623.31	20,938.19	6,334.97	30,896.47	#'s of Concrete > Water?	YES
Base Thickness (ft)	1.000						



Smith & Loveless Inc.



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Project Info | Pump Selection | **Technical Data** | Pump Curve | Drawings | Rep Worksheet | WW Elevations | Calculations

Customer / Project Info

Location: Marlboro, NY Date: 6/15/2011 4:58:12 PM
 Project Name: Marlboro PS WW Diam: 6 Inquiry #:
 Customer: Type: Classic Engineer: Engineering Properties
 Rep: Hydra Numatic Sales Co Pumps: Duplex Prepared by: Michael P. Whelan

Type of Pumps: 4B3B Number of Pumps: 2
 Suction Pipe Size: 4 WW Diameter: 6
 Discharge Valve Size: 4 Electrical Service Data: Phase: 3 Cycle: 60 Volts: 230 *
 Common Discharge Pipe Size: 4
 120 Volt Single Phase Available: No 120 V Single Phase Transformer Required: 3 KVA
 Wiring Diagram: Control Panel Data Type: NEMA 1

PUMP DATA

Design Characteristics (GPM@TDH)

Pump Model

Impeller Diameter

Rotation

Mechanical Seal Size

Static Suction Lift

Pump Serial Number

Motor Serial Number (Code Letter)

MOTOR DATA

Motor Horsepower

Motor RPM

MOTOR CONTROL EQUIPMENT

Circuit Breaker Trip Rating

Magnetic Starter

O.L. Coil Number

PUMP 1 PUMP 2 PUMP 3 PUMP 4

101.0@58.:	101.0@58.:	XXXXXX	XXXXXX
4B3B	4B3B	XXXXXX	XXXXXX
11.25	11.25	XXXXXX	XXXXXX
CCW	CW	XXXXXX	XXXXXX
1.875	1.875	XXXXXX	XXXXXX
20 FT.	20 FT.	XXXXXX	XXXXXX
5	5	XXXXXX	XXXXXX
1170	1170	XXXXXX	XXXXXX
30 Amps	4L202E	4L202E	XXXXXX
NEMA 1	4L421B	4L421B	XXXXXX

Sensor Type: Float Switch *

CONTROL SYSTEM:

Relay Logic *

S&L Part Number

High Level Actuation

Low Level Actuation

INDICATION: Local and Remote

Pumps Off	Low Level	Second Level	High Level	Low Level Alarm	High Level Alarm
4L291A	4L291A	XXXXXX	4L291A	XXXXXX	4L291A
XXXXXX	2	XXXXXX	2.5	XXXXXX	3
1.5	XXXXXX	XXXXXX	XXXXXX	XXXXXX	XXXXXX

Standard Equipment

Relay Logic Controls, Automatic Alternator, Vacuum Priming System with SONIC START® STREAMLINE™, Prime Mode Selector-Constant or On-Demand Control, Circuit Breakers, Ventilating Fan & Heater with Thermostats, Spare S&L Mechanical Seal & Volute Gaskets, Duplex GFI Protected Convenience Outlet, Station Operating Instructions, Pump Failure via Multi-Sensors Switches, High Water Alarm, Individual Running Time Meters



Smith & Loveless Inc.

Pump ESP

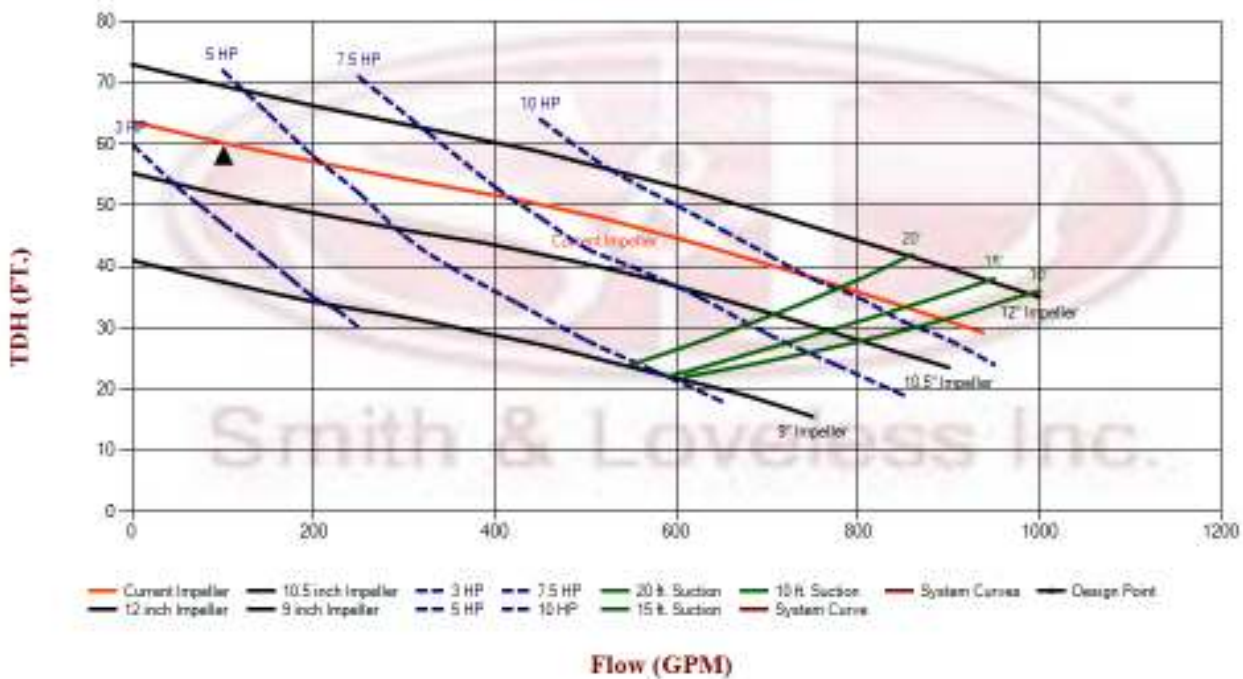
ELECTRONIC SELECTION PROGRAM

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Contact Us |
Help

Project Info
Pump Selection
Technical Data
Pump Curve
Drawings
Rep Worksheet
WW Elevations
Calculations

Customer / Project Info			
Location:	Marlboro, NY	Date:	6/15/2011 4:58:12 PM
Project Name:	Marlboro PS	WW Diam:	6
Customer:		Type:	Classic
Rep:	Hydra Numatic Sales Co	Pumps:	Duplex
		Inquiry #:	
		Engineer:	Engineering Properties
		Prepared by:	Michael P. Whelan

PUMP CURVES



Design Point: 101.0 GPM @ 58. Pump Model: 4B3B 1170 RPM Impeller Trim: 11.25 HP: 5 Hp Efficiency: 39.1%

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 answers@smithandloveless.com | smithandloveless.com
 PH: 913-888-5201 | FAX: 913-888-2173

APPENDIX D
TECHNICAL
SPECIFICATIONS

SECTION 02530

SANITARY SEWER SYSTEM

PART 1.00 - GENERAL

1.01 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the requirements of the Contract Documents.

1.02 WORK INCLUDED

- A. Work of this Section includes all labor, materials, equipment and services necessary to complete the Sanitary Sewer System as shown on the drawings and specified herein, including, but not limited to, the following:
 - 1. Installation of onsite sanitary sewers consisting of manholes, drop connections, pipe and all necessary and required accessory items and operations including connections to existing facilities.
 - 2. Alteration and/or reconstruction of existing structures including resetting existing and/or new castings to grade as required.
 - 3. Connection of building sanitary sewer service lines to the onsite sanitary sewer system.
 - 4. Installation of onsite sanitary sewer pump station and force main.
 - 5. Installation of sanitary sewer facilities within the Public R.O.W. including connections to existing sanitary sewer facilities.
 - 6. Cleaning, testing and repairing of sanitary sewer system.

1.03 RELATED WORK

- A. Section 02315 Trenching and Backfilling
- B. Section 02370 Erosion and Sediment Control
- C. Section 03305 Concrete (Site)
- D. Section 02510 Water Distribution System

1.04 QUALITY ASSURANCE

- A. The Contractor shall perform all his operations in accordance with the rules, regulations and ordinances of those governing bodies having jurisdiction.
- B. The installation of all sanitary sewer structures and pipe within the Public R.O.W. shall conform to the requirements of all agencies having jurisdiction.

- C. The requirements of the Department of Health and New York State Department of Environmental Conservation and/or any other agency having jurisdiction shall govern the horizontal and vertical separation of water lines from sanitary sewers.
- D. PVC Sewer Pipe
1. Polyvinyl chloride (PVC) gravity sewer and force main pipe shall be so installed as to not exceed a maximum deflection across the diameter of 5.0 percent. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
 2. Upon completion of a section of sewer, including placement and compaction of backfill, the Contractor shall measure the amount of deflection by pulling a specially designed gauge assembly through the completed section. The gauge assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Owner's Field Representative.
 3. Should the installed pipe fail to meet this requirement, the Contractor shall do all work to correct the problem, to the satisfaction of the Owner's Field Representative, without additional compensation.
- E. Leakage Tests
1. General Requirements
 - (a) The Contractor shall test the completed sewers, including manholes and laterals, for leakage by infiltration, exfiltration or low-pressure air exfiltration tests as specified herein. The tests will be conducted as approved by the Owner's Field Representative. The Contractor shall furnish all necessary equipment, materials and labor for performing the tests as specified. All sewer pressure pipe leak testing shall be performed in accordance with Part 4.0 of the "Water Distribution System, 02660" specifications.
 - (b) The Contractor shall notify the Owner's Field Representative at least 48 hours prior to the start of testing. Testing shall only be performed in the presence of the Owner's Field Representative.
 - (c) Sections of pipe tested for infiltration and exfiltration prior to completion of the Project shall be subject to additional leakage tests, if warranted in the opinion of the Owner's Field Representative, prior to acceptance of the Project.
 2. Infiltration and Exfiltration Testing
 - (a) The test length intervals for either type of leakage test shall be approved by the Owner's Field Representative, but in no event shall they exceed one thousand (1000) feet. In the case of sewers laid on steep grades, the length of line to be tested by exfiltration at any one time may be limited by the maximum allowable internal pressure on the pipe and joints at the lower end of the line.
 - (b) The test period, wherein the measurements are taken shall not be less than four (4) hours in either type of test.

(c) Depending on field conditions, the following tests for leakage shall be employed:

(1) Infiltration Test

The test may be used only when ground water levels are at least five (5) feet above the top of the pipe for the entire length of the section to be tested during the entire period of the test. Ground water levels may be measured in an open trench or in standpipes previously placed in backfilled trenches during the backfilling operations. When standpipes are installed in the backfill for ground water measurement, the lower ends of these shall be satisfactorily embedded in a mass of crushed stone or gravel to maintain free percolation and drainage. Infiltration through joints shall be measured by using a watertight weir or any other approved device for volumetric measurement installed at the lower end of the section under test.

(2) Exfiltration Test

This test consists of filling the pipe with water to provide a head of at least five (5) feet above the top of the pipe or five (5) feet above ground water, whichever is higher, at the highest point of the pipe line under test, and then measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test the line must remain filled with water for at least twenty four (24) hours prior to the taking of measurements. Exfiltration shall be measured by the drop of water level in a closed-end standpipe or in one of the sewer manholes available for convenient measuring.

When a standpipe and plug arrangement is used in the upper manhole of a line under test, there must be some positive method of releasing entrapped air in the sewer prior to taking measurements.

(3) Leakage Requirements

The total leakage of any section tested shall not exceed the rate of 50 gallons per day per mile per inch of nominal pipe diameter. For purposes of determining the maximum allowable leakage, manholes shall be considered as sections of 48 inch diameter pipe, five (5) feet long, and the equivalent leakage allowance shall be 2.25 gallons per manhole per 24 hours.

3. Low-Pressure Air Exfiltration Testing

- (a) The sewer mains and/or laterals shall be tested for leakage by the use of low-pressure air as specified hereinafter and as approved by the Owner's Field Representative. The test length shall not exceed one (1) interval of pipe between two (2) manholes. Air test procedures may be dangerous and the Contractor shall take all necessary precautions to prevent blowouts.
- (b) After the pipe has been backfilled and cleaned, pneumatic plugs shall be placed in the line at each manhole and inflated to 25 psi. Low-pressure air

shall be introduced into this sealed line until the internal air pressure reaches 4 psi greater than the average back pressure of any ground water that may be over the pipe. At least two (2) minutes shall be allowed for the air pressure to stabilize.

- (c) After the stabilization period (3.5 psi minimum pressure in the pipe), the portion of line being tested shall be acceptable if the time required in minutes for the pressure to decrease from 3.5 to 3.0 psi (greater than the average back pressure of any ground water that may be over the pipe) is not less than the time indicated in the following table:

Pipe Size (In.)	Time (Min.)
4	2-1/2
6	4
8	5
10	6-1/2
12	7-1/2

4. Correction of Defective Work

- (a) If leakage exceeds the specified amount, the Contractor shall at his own expense make the necessary repairs or replacements required to permanently reduce the leakage to within the specified limit, and the tests shall be repeated until the leakage requirement is met.
- (b) Any defects found in the system are to be repaired at the expense of the Contractor so as to conform strictly to the Specifications and to the satisfaction of the Owner's Field Representative. All repairs shown necessary by the tests are to be made, broken or cracked pipe replaced, all deposits removed, and sanitary sewer left true to line and grade and entirely clean, free from lumps of cement, protruding gaskets, bulkheads, etc., and ready for use before final acceptance by the Owner.

5. Compliance with Agency Requirements

- (a) In the event of conflict between the leakage test requirements specified herein with the leakage test requirements of agencies having jurisdiction over all or any portion of the sanitary sewers installed under this Contract, the more restrictive requirements shall govern.

F. Cleaning and Repair

1. The Contractor will be required to clean the entire newly constructed sanitary sewer system of all debris and obstructions. This shall include, but not be limited to removal of all formwork from structures, concrete and mortar droppings, construction debris and dirt. The system shall be thoroughly flushed clean and the Contractor shall furnish all necessary hose, pumps, pipe and other equipment that may be required for this purpose. No debris shall be flushed into existing sanitary sewers or streams; all debris shall be removed from the system.
2. After the system has been cleaned, the Contractor shall thoroughly inspect the system and all repairs shown to be necessary shall be promptly performed by the Contractor.

3. All work of cleaning and repair as specified herein shall be performed at the Contractor's expense and to the complete satisfaction of the Owner's Field Representative.

G. Final Inspection

1. Upon completion of the Work and before final acceptance by the Owner, the entire sanitary sewer system shall be subjected to a final inspection in the presence of the Site Engineer and/or Owner's Field Representative. The Work shall not be considered as complete until all requirements for line, grade, cleanliness, leakage tests and workmanship have been met.

1.05 SUBMITTALS

- A. The Contractor shall submit the following material designs for the type specified for review and approval prior to materials being delivered to the site:

1. Polyvinyl Chloride Pipe and Fittings
2. Elastomeric Gaskets
3. Brick
4. Concrete Block
5. Concrete and Mortar Mixes
6. Pumps
7. Generator
8. Automatic Transfer Switch

- B. Submit shop drawings of the following items for the type specified prior to materials being delivered to the site:

1. Precast Manholes
2. Manhole Frames and Covers
3. Ladder Rungs
4. Sanitary Pump Station
 - (a) Valve Vault
 - (b) Wet Well
 - (c) Control Systems and Control Box
 - (d) Access Lid

1.06 DELIVERY, STORAGE & HANDLING

A. Storage

1. Storage of pipe on the job shall be in accordance with the pipe manufacturer's recommendations, subject to the approval of the Owner's Field Representative.
 2. PVC pipe shall be stored at the site until installation in a manner, acceptable to the Owner's Field Representative, which will keep the pipe at ambient outdoor temperatures. Temporary shading shall be provided as required to meet this requirement. Simply covering the pipe or structures which allows temperature build-up when exposed to direct sunlight will not be permitted.
- B. All pipe shall be protected against impact, shock and free fall, and only equipment of sufficient capacity and proper design shall be used in the handling of the pipe.
- C. Pipe which is defective from any cause, including damage caused by handling, and determined by the Owner's Field Representative as unrepairable, shall be unacceptable for installation and shall be replaced at no cost to the Owner as directed by the Owner's Field Representative.
- D. Pipe that is damaged or disturbed through any cause prior to acceptance of the Work shall be repaired, realigned or replaced as directed by the Owner's Field Representative, at the Contractor's expense.

1.07 JOB CONDITIONS

- A. The Contractor shall exercise whatever precautions are necessary to protect existing conditions or other Work from damage.
- B. Excavation and Backfill
1. The provisions of Section 02315 of these Project Specifications shall govern all work under this Section.
- C. Connections to Existing Facilities
1. General Requirements

The Contractor shall make all required connections of the proposed sanitary sewer into existing sanitary sewer facilities, where and as shown on the Drawings and/or as approved by the Owner's Field Representative.
 2. Connections into existing sanitary sewer facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall be required to comply with all such requirements, including securing of all required permits, and paying the costs thereof. The cost of making the connections in accordance with the requirements of the Owner of the existing facility shall be included in the Contract Sum.

1.08 WARRANTY

- A. Sanitary Pump Station

1. All manufacturer warranties shall be turned over to the Owner.
2. The Contractor shall guarantee all work for a period of one (1) year.

PART 2.00 - PRODUCTS

2.01 MATERIALS DEFINITIONS

A. Sanitary Sewer Pipe, Fittings and Joints

1. Gravity Polyvinyl Chloride Pipe and Fittings (PVC)
 - (a) Pipe shall be Bell and Spigot, utilizing an elastomeric gasket, shall conform to "Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings," SDR-35, ASTM Specification D 3034, latest edition.
 - (b) The minimum "pipe stiffness" at 5% deflection shall be 46 psi for all sizes when tested in accordance with ASTM designation D-2412. Straight pipe shall be furnished in lengths of not more than 13 feet, and Y-branches shall be furnished in lengths of not more than 3 feet. Saddle Y-branches will not be allowed.
 - (c) Elastomeric gaskets shall be used for all pipe joints and shall conform to "Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals," ASTM Specification D 3212, latest edition. Joints for the polyvinyl chloride pipe shall be push-on bell and spigot joints using elastomeric ring gaskets. The gaskets shall be securely fixed into place in the bells so that they cannot be dislodged during joint assembly. The gaskets shall be of a composition and texture which is resistant to common ingredients of sewage and industrial wastes, including oils and groundwater, and which will endure permanently under the conditions of the proposed use.
 - (d) Lubricant, as recommended by the pipe manufacturer and approved by the Owner's Field Representative, shall be used for all pipe joints.
 - (e) All pipe delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to the above-mentioned ASTM specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Owner's Field Representative to apply such tests as he deems necessary.
2. Pressure Polyvinyl Chloride Pipe and Fittings (PVC)
 - (a) Polyvinyl Chloride Pipe shall conform in all respects to "Polyvinyl Chloride (PVC) Pressure Pipe, CL 150, 4 inch through 12 inch, for Water," AWWA Specifications C-900, latest revision, in 20-foot nominal lengths except as may otherwise be specified herein.
 - (b) PVC elastomeric gasket joints shall be in accordance with AWWA Specifications C-900 and referenced ASTM Specifications.

- (c) Lubricant, as recommended by the pipe manufacturer and approved by the Owner's Field Representative, shall be used for all pipe joints.
- (d) All pipe delivered to the job site shall be accompanied by test reports certifying that the pipe and fittings conform to the above-mentioned ASTM Specifications. In addition, the pipe shall be subject to thorough inspection and tests, the right being reserved for the Owner's Field Representative to apply such tests as he deems necessary.

B. Manholes

- 1. Brick shall conform to the "Specifications for Sewer and Manhole Brick (Made from Clay or Shale)," AASHTO Designation M-91, latest revision, Grade MS.
- 2. Precast Manholes
 - (a) Where called for on the Drawings or approved in writing by the Site Engineer, the Contractor may substitute precast manholes. Precast Reinforced Concrete Manhole Sections shall conform to the "Specifications for Precast Reinforced Concrete Manhole Sections," AASHTO Designation M-199, latest revision and ASTM- C478
 - (b) Prior to fabrication, the Contractor shall submit four (4) sets of plans of the proposed precast structures to the Owner's Field Representative for approval, along with design criteria and certification by the manufacturer that the structure will support the design load.
 - (c) The minimum compressive strength of the concrete used for all precast structures shall be 4,000 psi. Where steps are required in structures, steps shall be installed during the casting of the structures, aligned as specified herein. Joints in the structures shall be tongue and groove joints, formed in such a manner so that either a mortar or rubber seal can be applied.
 - (d) No precast manhole shall be fabricated or delivered to the job site until it has been approved by the Owner's Field Representative and/or Site Engineer. All structures shall have number and manufacturer's name on each section.
 - (e) Approval for the use of precast structures shall relieve the Owner and Site Engineer of any additional costs for modification of openings due to line or grade changes, deletion of structures, relocation of structures, or addition or deletion of lines to be connected into the structures, and such additional cost shall be at the Contractor's expense.
- 3. Manhole Frames and Covers
 - (a) Manhole Frames and Covers shall be gray cast iron castings Campbell Foundry Pattern Number 1007C or equal, conforming to the requirements of AASHTO Designation M-105, latest revisions, Class 30. The castings shall be true to pattern in form and dimensions as specified and shall be free from pouring faults, sponginess, cracks, blowholes and other defects that affect their strength and other characteristics for the intended use. All surfaces shall have a workmanlike finish.

- (b) All component parts shall fit together in a satisfactory manner and frames and covers shall be of non-rocking design so as to prevent rocking or rattling under traffic. Frames and covers that are warped or rocking, as determined by the Owner's Field Representative, will be rejected and shall be removed and replaced by the Contractor to the satisfaction of the Owner's Field Representative at no cost to the Owner.
 - (c) Unless otherwise specified, the word "SEWER" shall be integrally cast on the cover in raised letters and centered. Letter size shall be three (3) inches.
 - (d) All castings shall be coated with an asphalt paint which shall result in a smooth coating and not be tacky or brittle.
4. Concrete shall conform to the requirements for concrete as specified herein under Section 03305 Concrete (Site) of these Project Specifications.
5. Reinforcement shall be new billet stock deformed steel bars conforming to AASHTO Designation Grade 40. Steel wire fabric shall conform to AASHTO Designation M-55. Metal accessories, chairs, ties and other items necessary for proper placement of reinforcing, shall be provided. Reinforcement shall be free from scale, oil, ice and structural defects and shall be stored so as to prevent contact with the ground.
6. Mortar
- (a) Mortar shall be composed of one (1) part Portland cement and two (2) parts sand by volume. Hydrated lime, not to exceed four (4) pounds of lime to each bag of cement, may be added as approved by the Owner's Field Representative. Material requirements shall be as follows:
 - (1) Portland Cement shall conform to the requirements of AASHTO Designation M-85, Type II.
 - (2) Hydrated Lime shall conform to the requirements of ASTM C-6.
 - (3) Mortar Sand shall conform to the requirements of AASHTO Designation M-45, except that aggregate shall be no coarser than #8 sieve size.
 - (4) Water shall be clean and shall not contain any oil, acid, alkali, salts, vegetable matter, organic matter or other deleterious substances.
 - (b) Hand mixing of mortar will be permitted only when, in the opinion of the Owner's Field Representative, the amount of mortar to be used makes machine mixing undesirable. When hand mixing is used, the ingredients must first be thoroughly mixed dry in a tight box, after which the proper quantity of clean water shall be gradually added and then the materials shall be hoed or worked until a uniform mixture is secured. Admixtures may be added only with the prior written approval and in the presence of the Owner's Field Representative.
 - (c) No greater quantity of mortar is to be prepared than is required for immediate use and it shall be worked over constantly with hoe or shovel

until used. No Mortar shall be retempered and none shall be used more than one and one-half (1½) hours after mixing. All mortar containing cement which remains upon stopping work shall be discarded.

7. Steps for Manholes

This Specification covers the material requirements for steps for manholes.

1. General: The minimum design live load, for steps, appurtenances and fastenings, shall be a single concentrated load of 13.5 kN. The live loads imposed by persons occupying the steps shall be considered to be concentrated at such points as will cause the maximum stress in the Structural member being considered.

Steps shall be designed so a worker's foot cannot slide off the end. The minimum length of the rungs shall be 10 inches.

Whenever a combination of dissimilar types of metals are used in the manufacture of steps, appurtenances and fastenings, the materials shall be treated to prevent deleterious effects.

2. Materials: Manhole steps shall be fabricated from one of the following:

- (a) Ferrous Metal Steps: Are not permitted

- (b) Non-Ferrous Metal Steps: shall conform to the following requirements:

Aluminum Castings - Alloy 356-T6, 715-03.

Wrought Aluminum 6061-T6, 6005-T5, or 6351-T6, 715-04.

When aluminum steps are used, the portion of the step which will be in direct contact with cement concrete or concrete mortar, shall be coated with Zinc Chromate Primer conforming to the requirements of subsection 708-04 or shall be coated with bituminous material approved by the materials Bureau.

- (c) Reinforced Plastic. Steps shall consist of polypropylene or other plastic material meeting this specification. It may be extruded, cast, or molded into the standard size and shape manhole steps, having a steel core center for strength and completely covered by the plastic molding for corrosion protection. The plastic material shall have the following characteristics:

- (1) Resistance to Salt and Caustic Solutions. Resistance to the following solutions when submerged for 30 days:

10% Sodium Chloride
10% Hydrochloric Acid
10% Sodium Hydroxide
10% Sulfuric Acid

- (2) Flow Point. A flow point of 160°C or greater.

- (3) Flexibility. It shall remain flexible over a temperature range of -30°C to +120°C upon long aging.
- (4) Fire Resistance. It shall be non-burning, self-extinguishing, or very slow burning. The steel core shall be not less than 12 mm diameter and shall have the following physical characteristics:

Tensile Yield - Minimum - 275 MPa
Tensile Strength - Minimum - 482 MPa

The plastic step, when cast into a concrete block the proper depth, shall withstand a minimum load of 13.5 kN applied on 625 mm⁽²⁾ area in the center of the step without cracking or breaking the plastic coating, loosening the step in the concrete or permanently deforming the step.

PART 3.00 - EXECUTION

3.01 INSPECTION

- A. Examine the areas and conditions where the Sanitary Sewer System is to be installed and notify the Owner's Field Representative of conditions detrimental to the proper and timely completion of the Work. Do not proceed with the Work until unsatisfactory conditions have been corrected by the Contractor in a manner acceptable to the Owner's Field Representative.

3.02 INSTALLATION

A. General Requirements

1. The Contractor shall install all sanitary sewer structures and pipe in the locations as shown on the Drawings and/or as approved by the Owner's Field Representative. Pipe shall be of the type and sizes specified and shall be laid accurately to line and grade. Structures shall be accurately located and properly oriented.

B. Pipe Installation

1. Laying Pipe

- (a) Each length of pipe shall be laid with firm, full and even bearing throughout its entire length, in a trench prepared and maintained in accordance with Section 02315 of these Project Specifications. Pipe will be laid upgrade with bells upgrade unless otherwise approved by the Owner's Field Representative.
- (b) Every length of pipe shall be inspected and cleaned of all dirt and debris before being laid. The interior of the pipe and the jointing seal shall be free from sand, dirt and trash before installing in the line. Extreme care must be taken to keep the bells of the pipe free from dirt and rocks so that joints may be properly assembled without overstressing the bells. No pipe is to be trimmed or chipped to fit.

- (c) No length of pipe shall be laid until the preceding lengths of pipe have been thoroughly embedded in place, so as to prevent movement or disturbance of the pipe.
- (d) Installation of polyvinyl chloride (PVC) sewer pipe shall be as follows:
 - (1) Each pipe unit shall be inspected before being installed. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from the ends of the pipe by more than 1/16 inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Any pipe unit or fitting discovered to be defective either before or after installation shall be removed and replaced with a sound unit.
 - (2) Polyvinyl chloride pipe shall be supported on a minimum of four (4) inches of compacted crushed stone, or as directed by the Owner's Field Representative. No pipe or fitting shall be permanently supported on saddles, blocking, or stones. Crushed stone shall be 3/4 inch in size or such other sized as may be approved. The gravel shall consist of clean, hard, and durable particles or fragments, free from dirt, vegetation, or other objectionable matter and free from an excess of soft, thin elongated, laminated or disintegrated pieces. The crushed stone shall be spread in layers of uniform thickness and shall be compacted to a minimum density of ninety-five (95) percent of the maximum density of the soil as determined by the Standard Proctor Test (AASHTO Designation T-99).
 - (3) Suitable bell holes shall be provided, so that after placement, only the barrel of the pipe receives bearing pressure from the supporting material.
 - (4) All joint surfaces shall be cleaned. Immediately before jointing the pipe, the bell or groove shall be lubricated in accordance with the manufacturer's recommendation. Each pipe unit shall then be carefully pushed into place without damage to pipe or gasket. Suitable devices shall be used to force the pipe units together so that they will fit with a minimum open recess inside and outside and have tightly sealed joints. Care shall be taken not to use such force as to wedge apart and split the bell or groove ends.
 - (5) Joints shall not be "pulled" or "cramped" unless permitted by the Owner's Field Representative.
 - (6) Where any two pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units and new gaskets.
 - (7) All premolded gasket joint polyvinyl chloride pipe of a particular manufacturer may be rejected if there are more than five unsatisfactory joint assembly operations or "bell breaks" in 100 consecutive joints, even though the pipe and joint conform to the appropriate ASTM Specifications as specified. If the pipe is unsatisfactory, as determined above, the Contractor shall, if

required, remove all pipe of that manufacturer of the same shipment from the Work and shall furnish pipe from another manufacturer which will conform to all of the requirements of these Project Specifications.

- (8) Open ends of pipe and branches shall be closed with polyvinyl chloride stoppers secured in place in an acceptable manner.
- (9) After each pipe has been properly bedded, enough crushed stone shall be placed between the pipe and the sides of the trench, and thoroughly compacted, to hold the pipe in correct alignment. Bell holes, provided for jointing, shall be filled with crushed stone and compacted. Then crushed stone shall be placed and compacted to a minimum of six (6) inches over the top of the pipe to complete the pipe bedding.
- (10) Polyvinyl Chloride (PVC) gravity sewer pipe shall be so installed as to not exceed a maximum deflection of 5%. Such deflection shall be computed by multiplying the amount of deflection (nominal diameter less minimum diameter when measured) by 100 and dividing by the nominal diameter of the pipe.
- (11) Upon completion of a section of sewer, including placement and compaction of backfill, the Contractor shall measure the amount of deflection by pulling a specially designed gauge assembly through the completed section. The gauge assembly shall be in accordance with the recommendations of the pipe manufacturer and be acceptable to the Owner's Field Representative.

2. Pipe Extension

- (a) Where existing pipe is to be extended, the same type of pipe shall be used unless otherwise specified or approved by the Owner's Field Representative.

3. Full Lengths of Pipe

- (a) Only full lengths of pipe are to be used in the installation except that partial lengths of pipe may be used at the entrance to structures where necessary to obtain a proper connection to the structure.

4. Pipe Entrances to Structures

- (a) All pipe entering structures shall be cut flush with the inside face of the structure, and the cut ends of the pipe surface of the structure shall be properly rounded and finished so that there will be no protrusion, ragged edges or imperfections that will impede the flow of water or affect the hydraulic characteristics of the installation. The method of cutting and finishing shall be subject to the approval of the Owner's Field Representative.

5. Bedding and Backfilling

- (a) The type of materials to be used in bedding and backfilling and the method of placement shall conform to the requirements of the Section 02315 of these Project Specifications and as shown on the Details of the Drawings.

6. Protection During Construction

- (a) The Contractor shall protect the installation of the pipe at all times during construction. Movement of construction equipment, vehicles and loads over and adjacent to any pipe shall be performed at the Contractor's risk.
- (b) At all times when pipe laying is not in progress, all open ends of pipes shall be closed by approved temporary water tight plugs. If water is in the trench when work is resumed, the plug shall not be removed until the trench has been pumped dry and all danger of water entering the pipe has been eliminated.

7. Tolerance

- (a) Pipe shall be laid accurately to the line and grade as shown on the Drawings and/or as approved by the Owner's Field Representative. Allowable tolerances shall be one-quarter (1/4) inch in grade and one-half (1/2) inch in line in any section of pipe between manholes. No adverse grades shall be allowed. Deviations from these tolerances shall be grounds for rejection of the line of pipe by the Owner's Field Representative. Any line which has been rejected shall be rebuilt to the correct line and grade by the Contractor at his own expense.

C. Pipe Joints

- 1. All joints are to be made watertight in accordance with the requirements specified herein.
- 2. Pipe shall be jointed in strict accordance with the Pipe manufacturer's instruction. Jointing of all pipe shall be done entirely in the trench.

D. Manholes

1. General Requirements

- (a) All manholes shall be built in accordance with the Details and in the locations shown on the Drawings and as specified herein.
- (b) Structures shall be constructed of precast Concrete. Structures will require Shop Drawing approval by the Owner's Field Representative and/or the Site Engineer.

2. Inverts

- (a) Smooth concrete invert channels shall be constructed in all manholes to insure a smooth flow of water through the structure.
- (b) The invert channels shall be carried up to the elevations shown on the Drawings and/or as approved by the Owner's Field Representative.

Channels shall slope smoothly and evenly from the entrance pipe to the outlet pipe.

- (c) Invert channels shall be built for future extensions where shown on the Drawings and/or where directed by the Owner's Field Representative.

3. Frames, Covers and Gratings

- (a) Frames, Covers and/or Gratings for manholes shall be of the type and size indicated on the Drawings. Frames shall be well bedded in mortar and shall be set accurately to the correct alignment and grade. In areas to be paved, frames shall be set by using four (4) points of reference, set ninety (90) degrees apart, to insure accurate setting to proposed pavement grade.

4. Ladder Rungs

- (a) Ladder rungs shall be installed in all manholes, spaced twelve (12) inches on center vertically and staggered. Rungs shall be set securely in place during the construction of the masonry wall.

5. Precast Manholes

- (a) Precast manholes shall be installed only after Shop Drawings have been approved.
- (b) The base unit of the precast structures shall be founded on an approved compacted subgrade. Should the base unit be a slab only, the first riser unit shall be set in a pad of 2½-inch minimum thick mortar or as recommended by the Manufacturer and approved by the Owner's Field Representative. Prior to setting subsequent manhole barrel sections, apply primer to tongue and groove ends and allow to set in accordance with manufacturer recommendations. Place "Ram-nek", or equivalent, plastic rope on tongue end. Lower next section into position, and remove excess material from interior of structure. Add additional material on exterior of joint, if necessary, for completely watertight joint.
- (c) The top grade of the precast concrete corbel section shall be set sufficiently below finished grade to permit a maximum of four (4) and a minimum of two (2) courses of eight (8) inch brick to be used as risers to adjust the grade of casting. Manhole frames shall be set on a grout pad as specified hereinabove.

6. Bitumastic Coating

- (a) The entire exterior surface of all manholes shall be coated with two (2) coats of an approved bitumastic material to produce a dry film thickness of 0.07 inches (70 mils) per coat.

E. Connections to Existing Facilities

- 1. The Contractor shall make all required connections of the proposed sanitary sewer to existing sanitary sewer facilities, where shown on the Drawings and/or as approved by the Owner's Field Representative.

2. Connections into existing sanitary sewer facilities shall be performed in accordance with the requirements of the Owner of the facility. The Contractor shall be required to comply with all such requirements, including securing of all required permits, and paying the costs thereof. The cost of making the connections in accordance with the requirements of the Owner of the existing facility shall be included in the Contract Sum.

F. Alterations and/or Reconstruction of Existing Structures

1. General Requirements

- (a) The Contractor shall alter and/or reconstruct existing structures where shown on the Drawings, and/or as approved by the Owner's Field Representative. In general, alterations shall be made with the same type of material used in the original construction unless otherwise indicated on the Drawings or approved by the Owner's Field Representative.

2. Adjustment to New Grade and Alignment

- (a) All castings on existing sanitary sewer structures, that are to remain, shall be adjusted to new grade and alignment. When such adjustment is required, the castings shall be carefully removed and the walls of the structure reconstructed as required. The castings shall be cleaned and reset in a firm mortar bed to the new grade and alignment. Existing castings which are broken, damaged or otherwise unfit for incorporation in the new work shall be replaced under the Contract Sum.

3. Removal of Portions of Walls of Existing Structures

- (a) In all cases of alteration and/or reconstruction of existing structures, existing walls shall be removed to a point where the existing walls will provide sound and adequate foundation for the construction of the new walls as approved by the Owner's Field Representative.

4. Damage to Existing Structure and/or Pipe

- (a) The Contractor shall exercise extreme care during such alteration and/or reconstruction so as not to damage any portions of the structure and/or pipe shown to remain. Any such damage shall be repaired to the satisfaction of the Owner's Field Representative.

5. Structures to be Cleaned

- (a) Upon completion of alteration and/or reconstruction of existing structures, all structures shall be cleaned of any accumulation of debris or foreign matter of any kind and shall be kept clean of such accumulation until final acceptance of the Work.

G. Relocation and/or Abandonment of Existing Facilities

1. The Contractor shall not abandon, disconnect, obstruct or in any other way interfere with the operation of an existing sewer facility until such time as adequate

permanent or temporary substitute facilities have been constructed and placed in operation.

H. Service Lines

1. General Requirements

- (a) The Contractor shall make all required connections of the building sanitary sewer service lines into the onsite sanitary sewer system where and as shown on the Drawings and/or as approved by the Owner's Field Representative. Work shall include making the service line connections into the onsite sanitary sewer system, furnishing and installing all service line pipe from the existing onsite sanitary sewer system to points located ten (10) feet outside of the proposed right-of-way lines and properly sealing the ends with watertight plugs. Service line extensions from these points into the building will be performed by others.

2. Coordination with Building Contractor

- (a) The Contractor will be required to coordinate his Work with the work of the Building Contractor to determine the exact location and elevation of the point of entry into the building. If the Building Contractor has installed his portion of the sanitary sewer service line, Work under this Contract shall also include final connection of the sanitary sewer service line five (5) feet outside the building line to the building service line at no additional cost to the Owner.

3. Connection into Onsite Sanitary Sewer System

- (a) Sanitary sewer service line connections to the pipe of the onsite sanitary sewer system shall be made with proper fittings supplied by the pipe manufacturer and as shown on the Drawings into existing manholes, new manholes, or the onsite mains in a manner satisfactory to the Owner's Field Representative.
- (b) The Contractor shall install 45 degree wye branches in the onsite sanitary sewer mains in all locations where building sewer service line connections are shown on the Drawings directly entering the onsite sewer main. Connections of the sanitary sewer service lines shall be made into the wye branches by means of 45 degree bends. The connections shall be made thoroughly watertight and Class A Concrete shall be placed under each connection to bear on undisturbed earth and firmly support the connection. All Work shall be performed to the satisfaction of the Owner's Field Representative.

END OF SECTION

