Chatham WPCF Septage Evaluation Report

Town of Chatham, Massachusetts

January 2013

WATER | ENERGY & RESOURCES | ENVIRONMENT | PROPERTY & BUILDINGS | TRANSPORTATION

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1 Introduction

The recent Phase 1 upgrade to the Chatham WPCF with construction completed in 2012 included a new Septage Receiving Building to house a new septage receiving station with a capacity to handle septage at 300 gpm. The receiving station is designed for rock, screening and grit removal.

Currently the Chatham WPCF only receives septage from within Chatham. The amount of septage that the WPCF receives from Chatham is expected to decrease over time as more properties will be connected to the collection system.

The purpose of this report is to estimate how much septage the Town can receive. The WPCF upgrade is divided into two phases, with Phase 1 providing an upgrade to handle flows that are expected to be added within the next 20 years. This report focuses on the septage planning and handling for Phase 1.

This report will discuss the following topics:

- References
- Assumptions
- Existing wastewater and septage quantities
- Background and evaluation
- Costs and impact on treatment processes if additional septage is accepted
- Evaluation of alternate sludge disposal options
- Conclusion

2 References

- WEF Manual of Practice No. 24: Septage Handling.
- WEF Manual of Practice No. 8: Design of Municipal Wastewater Treatment Plants, Fifth Edition.
- Preliminary Design Memorandum M-9A: Basis of Design – Sludge Processes (See Attachment No. 1) by Stearns & Wheler, LLC.
- Draft Preliminary Design Memorandum M-1B: Flows and Loadings (See Attachment No. 2) by Stearns & Wheler, LLC.

3 Assumptions

3.1 Typical Septage Characteristics

Based on the Manual of Practice No. 24, select characteristics of typical septage are presented in Table 3-1. The suggested design values as used in this evaluation are shown in Table 3-1.

Table 3-1 Select Septage Characteristics

Parameter	Average (mg/L)	Suggested Design Value (mg/L)
Total Solids (TS)	34,100	40,000
Total Volatile Solids (TVS)	23,100	25,000
Total Suspended Solids (TSS)	12,900	15,000
Volatile Suspended Solids (VSS)	9,000	10,000
Biochemical Oxygen Demand (BOD)	6,500	7,000
Total Kjeldahl Nitrogen (TKN)	590	700
Ammonia-N	97	150
Total Phosphorus	210	250
Alkalinity	970	1,000
Oil and Grease	5,600	8,000
pH	--	6.0

3.2 Septage Truck Size

Septage trucks that have historically unloaded septage at the Chatham WPCF are usually 2,000 to 4,000-gallon trucks. For the purposes of this evaluation, it was assumed that a typical septage truck is 3,000 gallons.

3.3 Characteristics of Septage from a 3,000-Gallon Septage Truck

The select characteristics of a 3,000-gallon truck of septage are presented in Table 3-2.

Table 3-2 Select Septage Characteristics of A 3,000-Gallon Truck of Septage

Parameter	Suggested Design Value (mg/L)	Suggested Design Value (lbs)
Total Solids (TS)	40,000	1,001 (dry lbs)
Total Volatile Solids (TVS)	25,000	626 (dry lbs)
Total Suspended Solids (TSS)	15,000	375 (dry lbs)
Volatile Suspended Solids (VSS)	10,000	250 (dry lbs)
Biochemical Oxygen Demand (BOD)	7,000	175
Total Kjeldahl Nitrogen (TKN)	700	18
Ammonia-N	150	4
Total Phosphorus	250	6
Alkalinity	1,000	25

4 Existing Wastewater and Septage Quantities

4.1 Wastewater Flows Under Startup, Phase 1 and Phase 2 Conditions

Table 4-1 shows the design wastewater flows, not including recycle flows, per the Draft Preliminary Design Memorandum M-1B.

Table 4-1 Design Wastewater Flows (Excluding Recycle Flows)

Condition	Startup Flow (mgd)	Phase 1 Flow (mgd)	Phase 2 Flow (mgd)
Minimum Month	0.08	N/A	0.8
Summer Average	N/A	1.8	2.7
Maximum Month	N/A	2.1	3.1
Peak Hour	N/A	3.5	5.1

Table 4-2 shows the design wastewater flows including recycle flows.

Table 4-2 Design Wastewater Flows (Including Recycle Flows)

Condition	Startup Flow (mgd)	Phase 1 Flow (mgd)	Phase 2 Flow (mgd)
Minimum Month	0.08	N/A	N/A
Summer Average	N/A	2.12	3.09
Maximum Month	N/A	2.45	3.56
Peak Hour	N/A	3.88	5.56

4.2 Septage Flows Under Startup, Phase 1 and Phase 2 Conditions

Per the Preliminary Design Memorandum M-9A, tables 4-3 through 4-5 indicate the estimated septage quantities that the Chatham WPCF will receive at startup, Phase 1 and Phase 2 of the upgrade. Per Memo M-9A, startup flows were based on current flows. The Phase 1 flows were estimated at 30% of the current flows and the Phase 2 flows were estimated at 10% of the current flows. The amount of septage that Chatham receives will decrease over time as more parts of the Town will be sewered.

Table 4-3 Estimated Septage and Grease Quantities at Startup

Condition	Septage & Grease Quantities (gpd)	Equivalent Number of 3,000-Gallon Trucks Per Day
Minimum Month	225	0.08
Average	1,325	0.44
Summer Average	2,044	0.68
Maximum Month	2,525	0.84

Table 4-4 Estimated Septage and Grease Quantities at the end of Phase 1

Condition	Septage & Grease Quantities (gpd)	Equivalent Number of 3,000-Gallon Trucks Per Day
Minimum Month	68	0.02
Average	398	0.13
Summer Average	613	0.20
Maximum Month	758	0.25

Table 4-5 Estimated Septage and Grease Quantities at the end of Phase 2

Condition	Septage & Grease Quantities (gpd)	Equivalent Number of 3,000-Gallon Trucks Per Day
Minimum Month	23	0.008
Average	133	0.04
Summer Average	204	0.07
Maximum Month	253	0.08

Figure 4-1 shows the quantity of septage and grease relative to the wastewater flows from startup through Phase 2. The septage and grease flows are so small at any time relative to wastewater flows that they are barely visible in the figure. See Figure 4-2 for the projected change in septage and grease quantities over time.

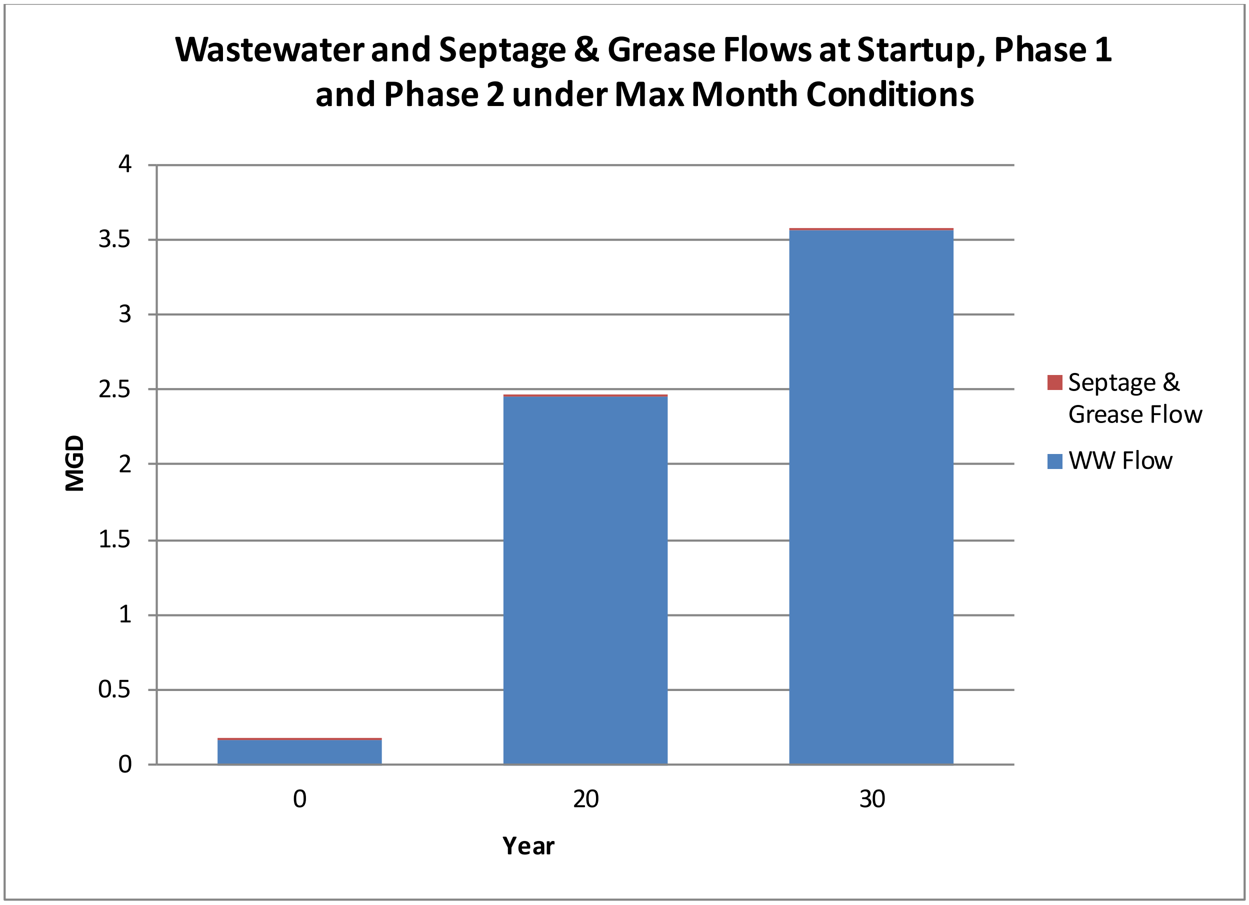

Figure 4-1 Septage and Grease Quantities Relative to Wastewater Flows

Figure 4-2 shows the changes in septage and grease quantities over time. Year 0 represents startup. Year 20 represents the end of Phase 1. Year 30 represents the end of Phase 2.

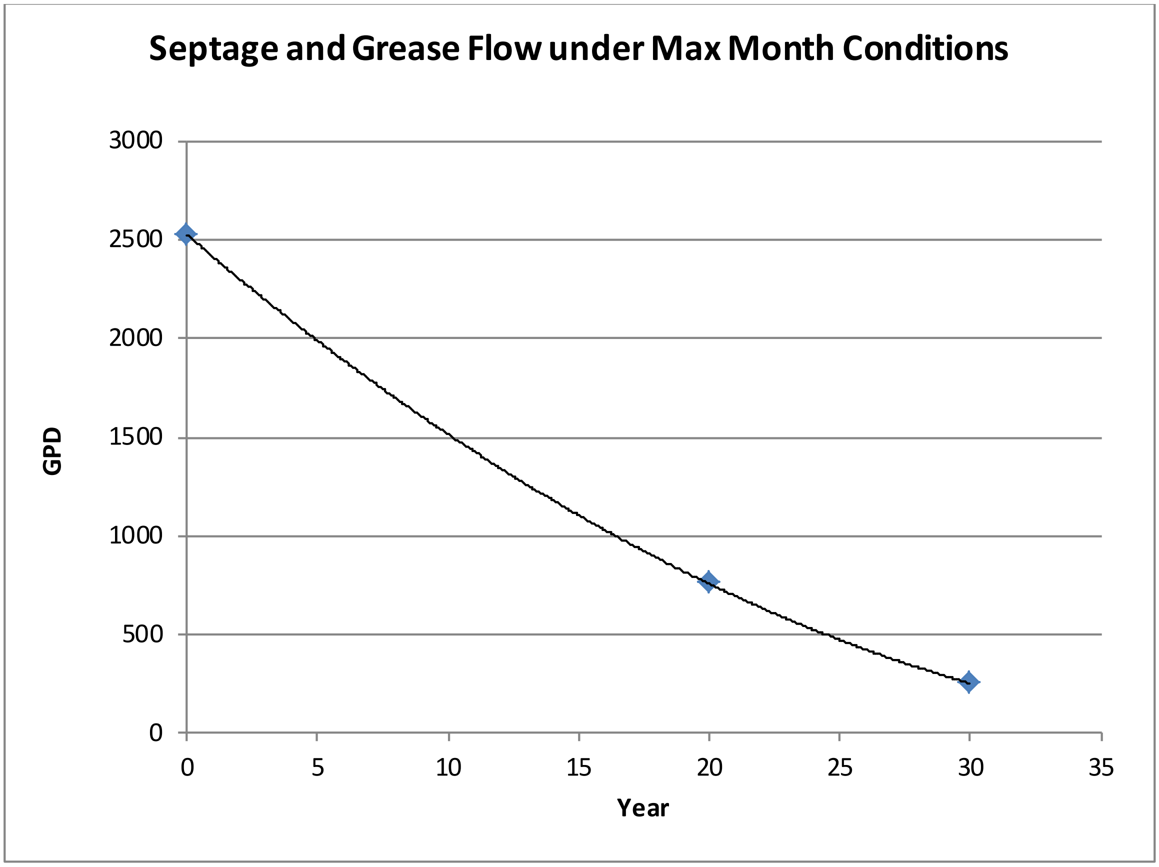

Figure 4-2 Septage and Grease Quantities Under Maximum Month Conditions

5 Background and Evaluation

5.1 Introduction

In order to determine the amount of septage that the newly upgraded WPCF can receive and treat, several factors were considered. These factors are as follows:

- Sludge storage capacity
- Septage receiving station capacity
- Dewatering capacity
- Treatment capacity
    - Nitrogen removal capabilities
    - BOD removal capabilities

The most limiting factor will determine the amount of septage that can be taken in by the WPCF.

It should be noted that only the maximum month condition is considered in this evaluation because this will determine the minimum amount of septage that may be added.

5.2 Existing Septage and Sludge Operations

Once septage is unloaded at the Septage Receiving Building, it passes through rock removal prior to entering the septage receiving station for screenings and grit removal. The screened and degritted septage then flows to Septage Holding Tank No. 5 adjacent to the Septage Receiving Building. The Septage Pump (formerly called Grit Pump) located in the Pump Room of the Sludge Processing Building pumps the septage from Septage Holding Tank No. 5 to one of the sludge holding tanks. In the sludge holding tanks, septage is mixed with the waste activated sludge and scum from the clarifiers prior to dewatering. The Sludge Feed Pumps (Penn Valley Pumps) in the Pump Room of the Sludge Processing Building transfer the sludge from the sludge holding tanks to the belt filter press in the Sludge Dewatering Building for dewatering. Although the Sludge Feed Pumps (Penn Valley Pumps) may be used to pump septage from Septage Holding Tank No. 5 directly to the belt filter presses, the Town has indicated that this operation should be avoided to reduce wear on the pumps and the Sludge Feed Pumps should be dedicated to pumping sludge from the sludge holding tanks to the belt filter presses.

5.3 Existing Septage and Future Sludge Storage Capacities

According to the Preliminary Design Memorandum M-9A, the Chatham WPCF currently has two 105,000-gallon sludge holding tanks and one 42,000-gallon septage holding tank (Septage Holding Tank No. 5). As part of the Phase 2 upgrade, two additional 105,000-gallon sludge holding tanks will be available by converting the abandoned MLE tanks to sludge holding tanks. The sludge storage tanks are intended to provide a minimum of 3-day storage under maximum month conditions at both Phase 1 and Phase 2.

Figure 5-1 shows the maximum 3-day sludge production over time with the excess sludge storage capacities under Phase 1 and Phase 2. In the first 20 years up to Phase 1, the excess sludge storage capacities drops from approximately 58,000 gpd (or 19 loads of septage) down to about 4,000 gpd (or 1 load of septage).

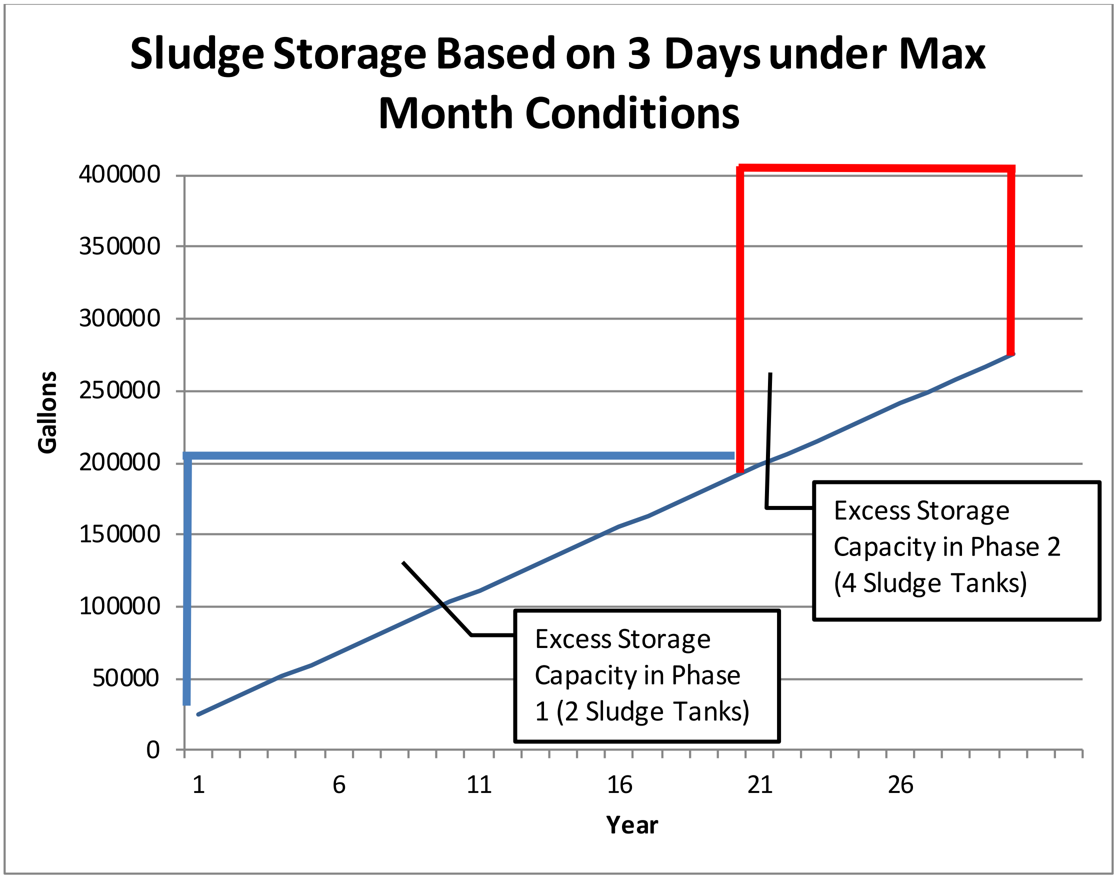

Figure 5-1 Sludge Storage Based on Three Days Under Maximum Month Conditions

5.4 Existing Septage Receiving Station Capacities

The septage receiving station has a capacity to handle septage at a rate of 300 gpm. Septage trucks that unload septage at the Chatham WPCF are normally 2,000 to 4,000-gallon trucks. For purposes of this evaluation, it was assumed that a typical septage truck was 3,000 gallons. It is estimated that it will take a 3,000-gallon truck approximately 10 minutes to unload a full truck load of septage when unloading at the maximum rate, plus another 10 minutes for paper work and cleanup. A minimum of 20 minutes is the "in-and-out time" for a 3,000-gallon septage truck to unload its contents.

Given the time to unload septage and the physical limitations of the septage receiving station, the Chatham WPCF can handle at most three 3,000-gallon septage trucks per hour, which equates to 24 3,000-gallon truck loads per an 8-hour day.

It should also be noted that the receiving facilities have no equivalent installed backup. If the septage receiving station fails, septage would have to be discharged untreated to Septage Holding Tank No. 5. If the septage pump fails, the sludge feed pumps (Penn Valley Pumps) may be used as a backup, but certainly not for long-term use.

5.5 Existing Sludge Pumping and Dewatering Capacities

There are two sludge feed pumps (Penn Valley Pumps) located in the Pump Room of the Sludge Processing Building that pump sludge (and sludge mixed with septage) from the sludge holding tanks to the belt filter press. Each pump has a VFD and has a capacity of 165 gpm @ 115 feet TDH. Upstream of the pumps is an inline grinder with 300 gpm capacity that grinds up the sludge prior to pumping and dewatering.

The Chatham WPCF has two 1-m belt filter presses (BFPs) located in the Sludge Dewatering Building. One of these units was installed as part of the recent WPCF upgrade while the other unit is over 20 years old and is considered to be a backup unit only. Since the older BFP has exceeded its life expectancy, this septage evaluation does not consider the use of this unit.

The new BFP has a minimum hydraulic loading rate of 60 gpm and solids loading rate of 600 dry pounds of solids per hour. The design operating plan was to operate the BFP 5 days a week, 6 hours a day. Figure 5-2 illustrates the sludge production and indicates the excess capacity of the existing belt filter press. The excess dewatering capacity decreases from approximately 310 lbs/hour (1.8 trucks per press day) in the first year down to zero in less than 8 years under maximum month conditions.

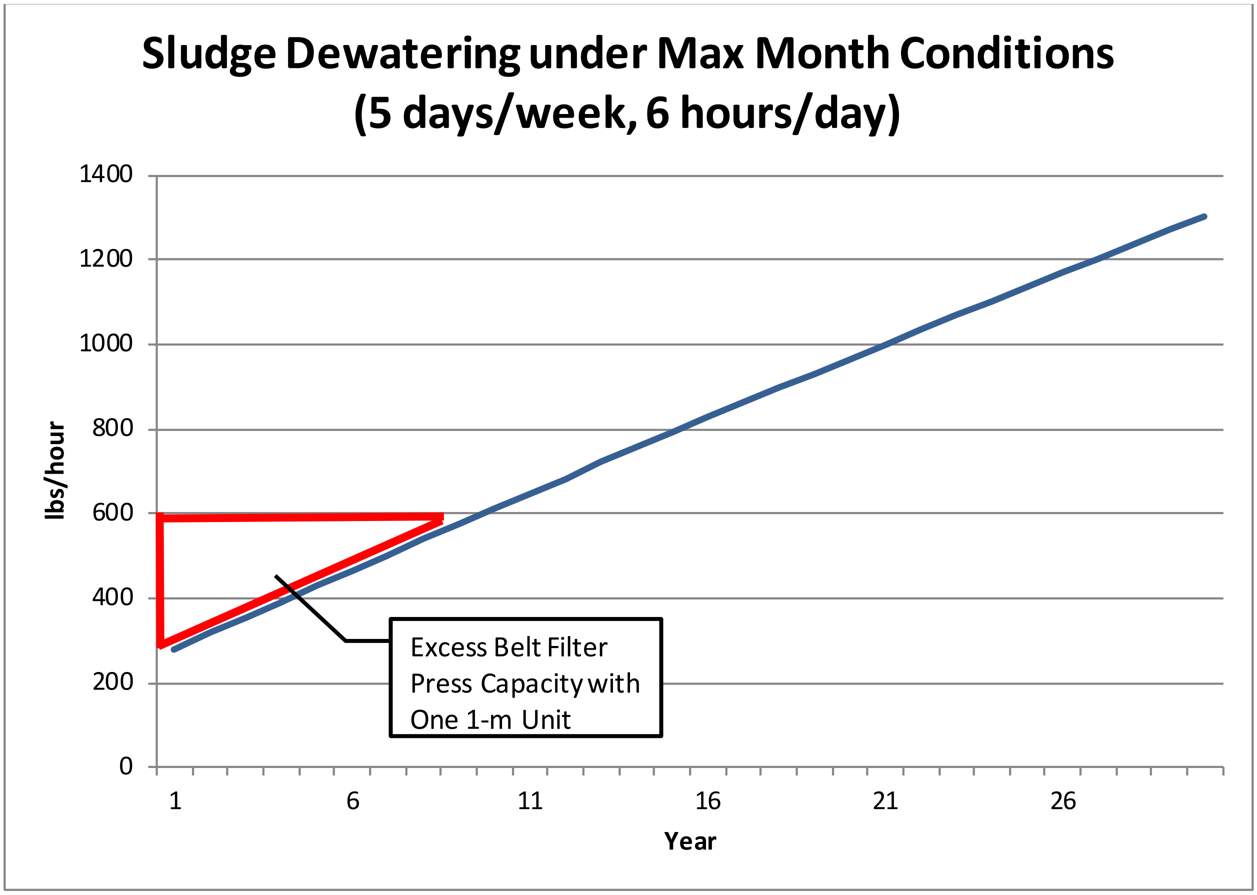

Figure 5-2 Belt Filter Press Capacities Under Maximum Month Conditions

5.6 Existing Treatment Capacities

Figure 5-3 shows the projected flow from startup through Phase 2 with the excess liquid treatment capacities. Since the only part of the septage that will make it to the main treatment process will be via the sludge tank decant and BFP filtrate, the excess treatment plant capacity will only be affected by the amount of liquid being recycled if extra septage were to be taken in.

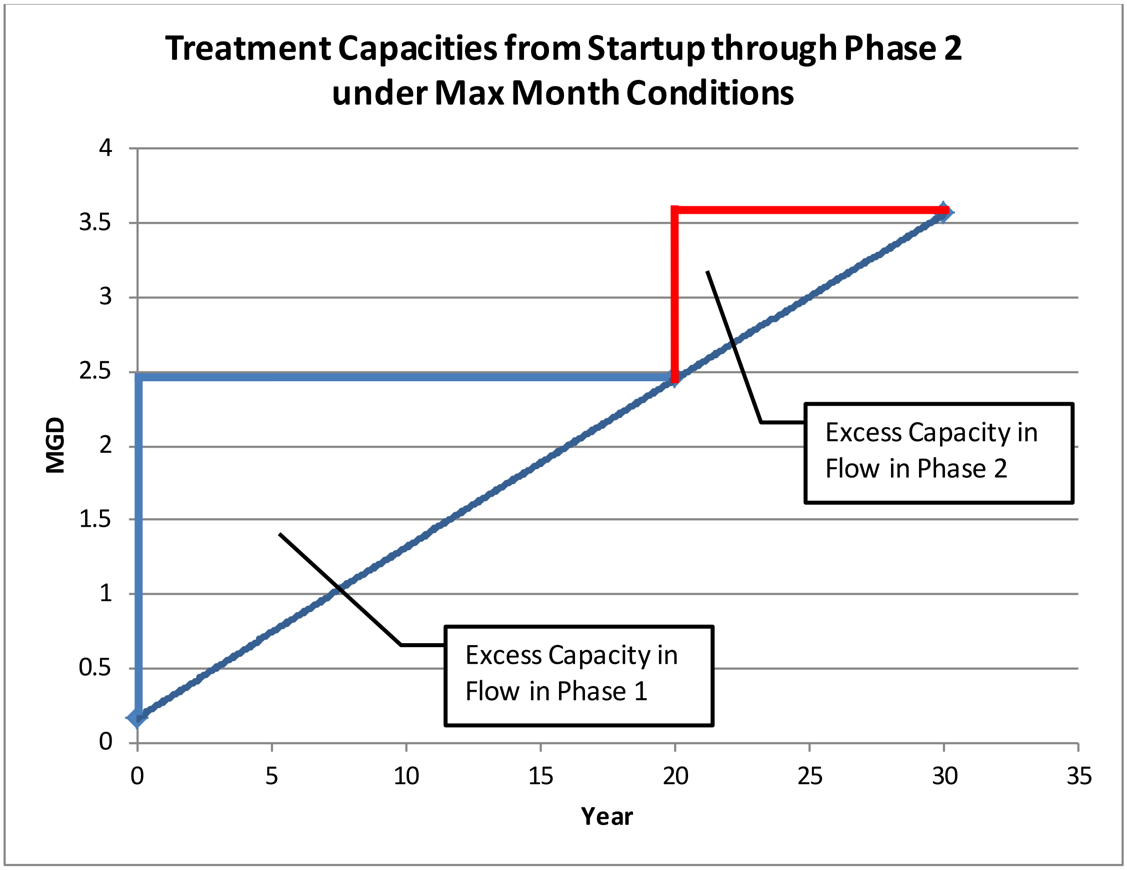

Figure 5-3 Treatment Capacities Under Maximum Month Conditions

5.7 Nitrogen Removal Capacities

Chatham's discharge permit consists of two effluent nitrogen discharge limits – 3 mg/L (based on 9,132 lbs per year at annual average flow of 1 mgd) and 10 mg/L (maximum daily limit). Taking in extra septage while meeting the discharge permit requirements poses some challenges for the existing processes. Refractory TKN is one of the components of the effluent total nitrogen that poses the biggest concern because it is not easy to remove. If the effluent has to meet 3 mg/L of total nitrogen in the effluent at all times, the refractory TKN plays a more significant role in meeting the discharge permit requirements.

Figure 5-4 shows the comparison of the typical composition of effluent total nitrogen of 3 mg/L to the plant data obtained from August 2012 (for example). For the month of August 2012, the average effluent TKN was 2.4 mg/L, minimum was 1.8 mg/L, and maximum was 3.5 mg/L. The effluent TN of 3 mg/L is for the annual average flow of 1 mgd and the effluent refractory TKN at Chatham can be higher than typical values even without septage. If the Town's goal is to maintain an effluent TN of 3 mg/L or less, any additional refractory TKN will make it more difficult to achieve the goal of 3 mg/L TN. However, if the Town is only interested in meeting the load limit of 9,132 lbs per year at the annual average flow of 1 mgd, then the refractory TKN is less of a concern, since the current effluent TN converts to only 1,643 lbs per year under current summer average flow of 0.18 mgd at 3 mg/L TN.

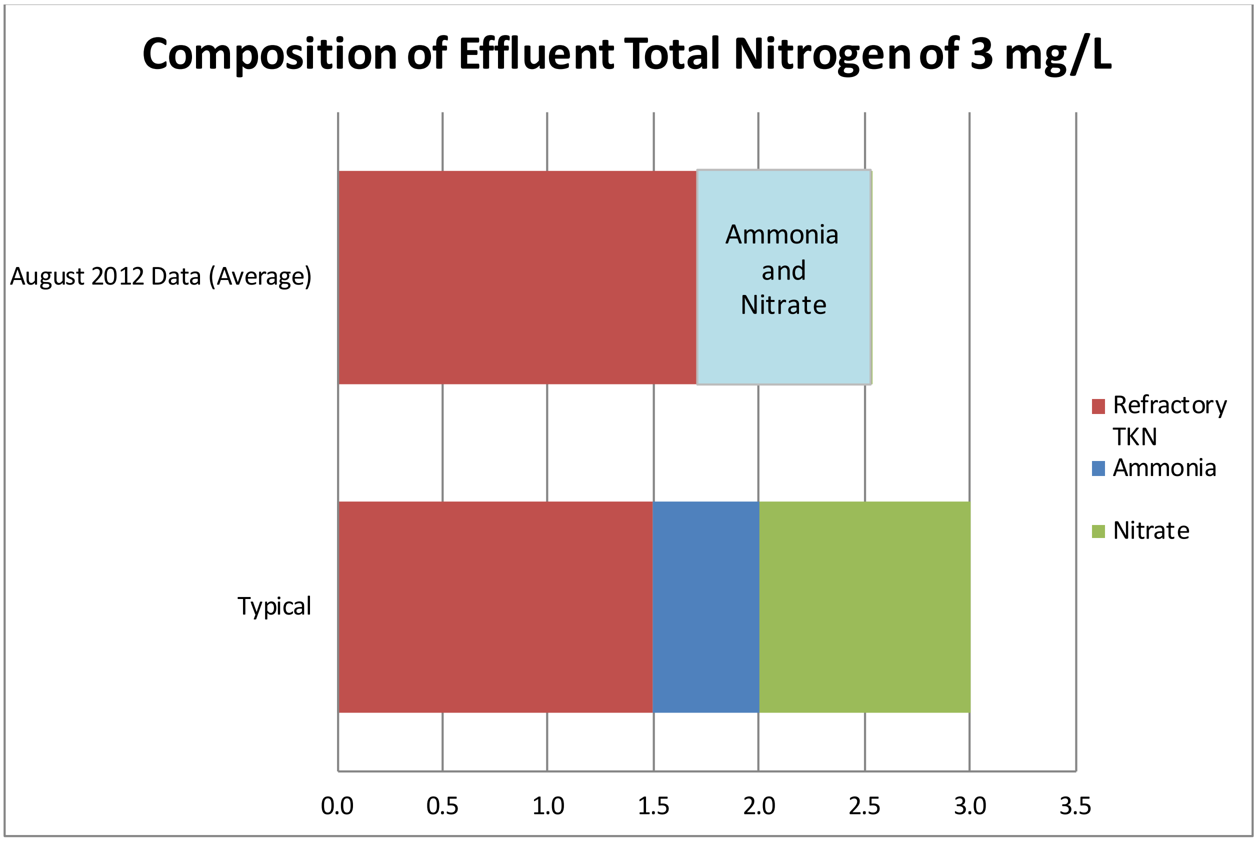

Figure 5-4 Composition of Effluent Total Nitrogen of 3 mg/L vs. August 2012 Plant Data

Figure 5-5 shows the design TKN in wastewater projected over startup through Phase 2 with the excess TKN capacities. For the first 20 years, the excess TKN capacities available at the Chatham WPCF decreases from approximately 660 lbs per day (which equates to 38 trucks per day) down to zero under maximum month conditions.

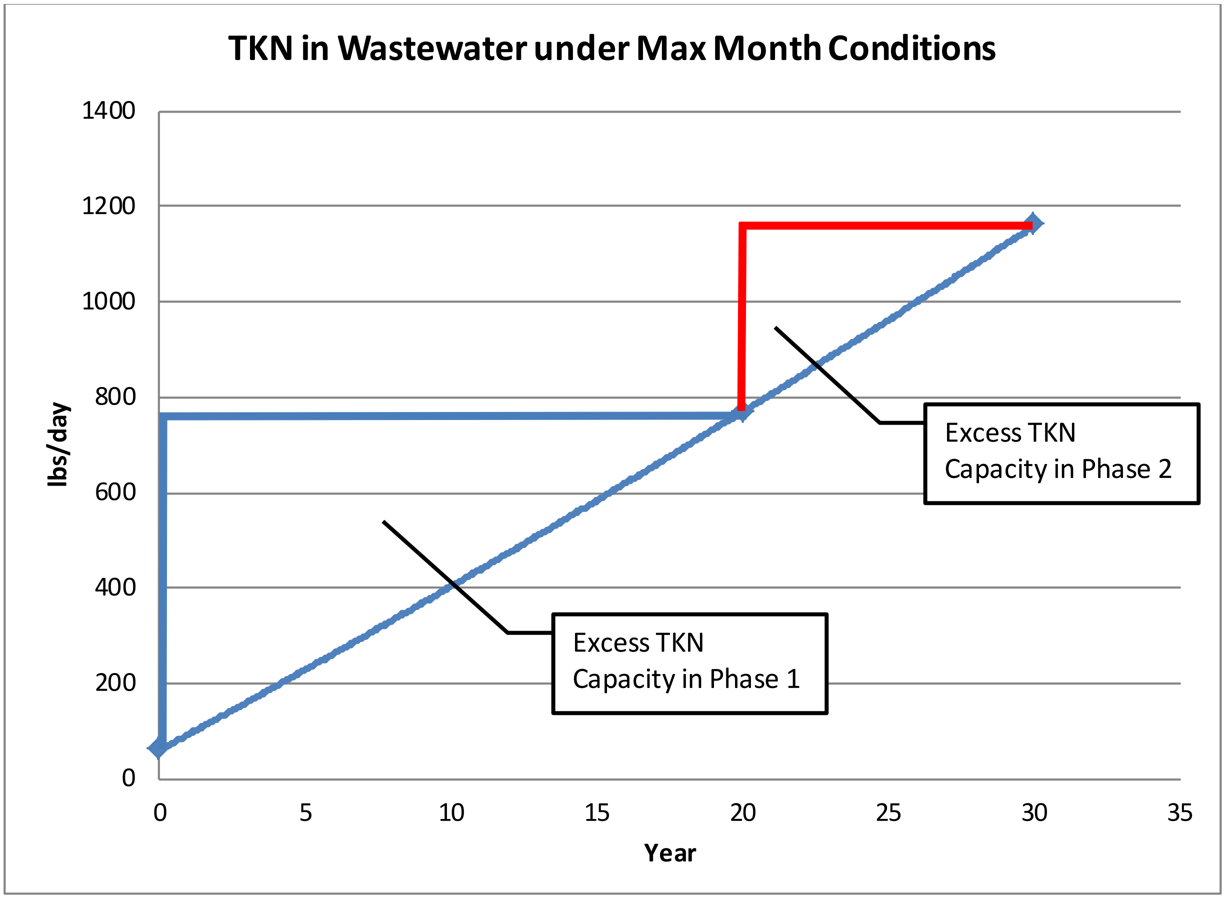

Figure 5-5 TKN in Wastewater Under Maximum Month Conditions

5.8 Biochemical Oxygen Demand (BOD)

BOD is one of the parameters listed in the discharge permit and since septage contains a higher level of BOD than normal wastewater, the BOD in the filtrate being sent to the liquid stream treatment will have to be removed by the liquid stream processes, especially the secondary treatment process. Typical BFP filtrate from normal sludge processing contains BOD in the range of 50 – 500 mg/L per MOP-8. An assumption is taken in the calculations that a BOD of 500 mg/L would be expected in the filtrate from the dewatering of septage due to the nature of higher BOD contents in septage. Figure 5-6 shows the design BOD in wastewater projected over startup through Phase 2 with the excess BOD capacities. For the first 20 years, the excess BOD capacities available at the Chatham WPCF decreases from approximately 4,400 lbs per day (which equates to 359 trucks per day) down to zero under maximum month conditions.

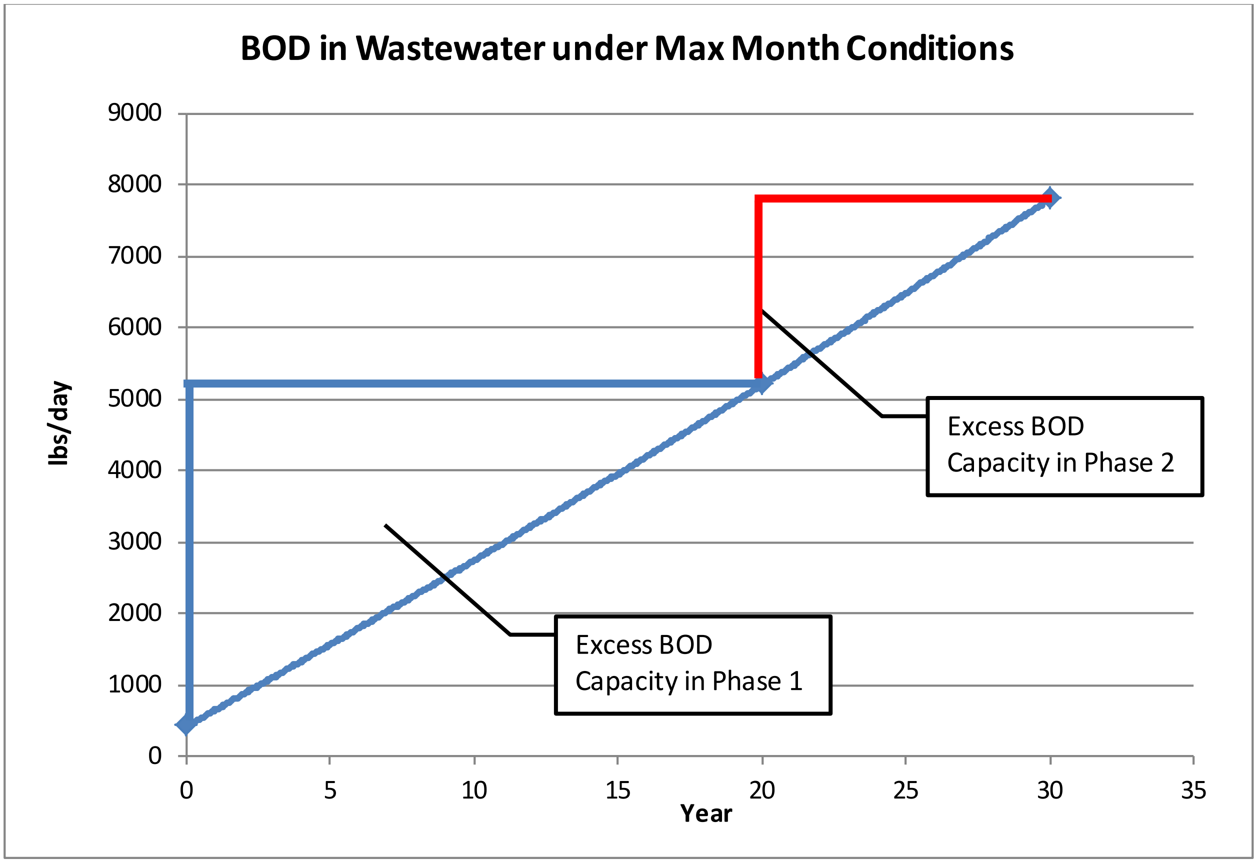

Figure 5-6 BOD in Wastewater Under Maximum Month Conditions

5.9 Summary of Existing WPCF Capabilities to Accept Additional Septage

Table 5-1 provides a summary of various processes with the excess capacities for the first 20 years expressed in the number of additional 3,000-gallon septage trucks that the Chatham WPCF can receive each day without violating the discharge permit.

Table 5-1 Theoretical Maximum Number of Additional 3,000-Gallon Septage Trucks Per Day Under Maximum Month Conditions

Parameters	Number of Additional Trucks***		
	Startup	Year 10	Year 20
Physical Limitation of Septage Receiving Station	24	24	24
Sludge Storage	6	3	0
Sludge Dewatering	1.5*	3* & **	0* & **
Plant Capacity (Added Filtrate Only)	787	365	0
Effluent Total Nitrogen Limit (based on achieving 3 mg/L under all conditions)	0	0	0
Plant TKN Loading (based on achieving 9,132 lbs per year effluent TN under all conditions)	38****	17****	0****
Plant BOD Loading (Added Filtrate Only)	359	169	0

* Number of additional trucks is calculated based on the BFP operating 5 d/wk, 6 hr/d.

** Based on a 2-m belt filter press. Assume that at least one of the existing 1-m BFP will be replaced with a new 2-m BFP on or before Year 7, when the existing 1-m BFP runs out of capacity.

*** All values are rounded down.

**** Assumes all septage TKN ends up in filtrate under the worst case scenario.

The most limiting factor in the Table 5-1 will dictate the additional load that can be taken in by the WPCF.

If the Town has a goal to meet the effluent TN of 3 mg/L, it is not recommended that any more septage trucks be allowed to discharge due to the high refractory TKN in septage and the sporadic high levels of TKN currently being seen in the WPCF effluent.

If the Town has a goal to meet the effluent TN load of 9,132 lbs per year under the annual average flow of 1 mgd, although the plant has some additional TKN and BOD capacity, the additional number of septage trucks that can be accepted is limited to 1.5 per press day at startup by the sludge dewatering process, based on the assumptions at the beginning of the report. However, this one additional truck would place the BFP very close to its design condition and would further run the risk of reduced BFP performance. Thus, accepting as few as one additional truck per day would not be recommended. However, accepting an additional truck once or twice a week may be acceptable.

6 Costs and Impact on Treatment Processes if Additional Septage is Accepted

The following are impacts to the Chatham WPCF identified if additional septage is accepted:

- Hauling of Dewatered Sludge – The cost of hauling dewatered sludge poses the biggest impact if additional septage is accepted. Currently the Town pays approximately $110 per wet ton of dewatered sludge to be hauled from the Chatham WPCF to the Yarmouth facility, at an approximate cost of about $29,000 per year (based on approximately 5 tons per press and 52 presses per year).
- Sodium hydroxide—will consume more due to the slightly acidic nature of typical septage, but this quantity is seen as insignificant.

- Methanol—will consume more but insignificant.
- Polymer—will consume more but not expecting to have significant impact on additional costs.
- More aeration will be required at the reactor, but insignificant on an individual septage truck basis.
- More air will be needed in the sludge holding tanks due to an increase in storage level. Air is needed to keep the solids in suspension. A small increase in aeration requirement is expected.
- More labor to attend the discharge of septage and empty screenings, grit, rocks and dewatered sludge.
- More operation of equipment that leads to more maintenance and electricity, such as pumps, BFP, septage receiving station, etc.
- Not expecting significant impact on clarifiers, filters and UV disinfection since they are independent of septage.
- Penn Valley Pumps—although the Penn Valley pumps can be used to transfer septage from Tank No. 5 to the BFP temporarily, Town indicated that these pumps should be dedicated to sludge.

The cost of additional septage based on solids disposal to the Yarmouth facility is approximately $0.12 per gallon ($368 for a 3,000-gallon septage truck) based on the rate the Town of Chatham paid for August 2012. Other costs are mostly small and may add approximately $0.01 per gallon ($30 for a 3,000-gallon septage truck).

7 Evaluation of Alternate Sludge Disposal Options

Currently the dewatered sludge generated by the Chatham WPCF is sent to the Yarmouth facility for disposal by WeCare Organics, LLC.

Dewatered sludge from Edgartown is shipped off island in containers to New Bedford where Synagro picks it up and takes it to their facility in Woonsocket RI. Synagro has indicated verbally that they are willing to haul and dispose of dewatered sludge from the Chatham WPCF.

Both Falmouth and Hyannis thicken sludge, so their alternatives for disposal would not be applicable.

The following are dewatered sludge hauling and disposal options for the Town of Chatham to consider if the Yarmouth facility closes down in the near future:

- WeCare Organics, LLC
- RMI
- Synagro

Based on the information provided by WeCare Organics, LLC, the cost of hauling and disposing of dewatered sludge from Chatham to Soil Preparation, Inc. in Plymouth, ME would be approximately $120 per wet ton based on a dump-trailer containing approximately 30 wet tons per load. The dump-trailer can be rented from WeCare Organics, LLC for approximately $1,500 per month or the Town of Chatham can provide its own.

8 Conclusion and Recommendations

Based on the above analysis, the conclusion is that if the Town's goal is to achieve 3 mg/L of effluent total nitrogen under the annual average flow of 1 mgd, no additional septage should be accepted. However, if the Town's goal is to achieve the effluent TN load limit of 9,132 lbs per year under the annual average flow of 1 mgd, it is recommended that the Chatham WPCF accept no more than 1 additional septage truck per day. In this case, should the Town decide to accept additional septage, it should be recognized that the plant would run the risk of not meeting the target dewatered sludge concentration from the belt filter press dewatering equipment. Moreover, there is no redundancy for the septage receiving facility. The facility could accept a limited amount of additional septage, but it was not designed to serve as a regional septage receiving facility.

Attachment 1

Preliminary Design Memorandum M-9A

STEARNS & WHELER LLC
Environmental Engineers & Scientists

PRELIMINARY DESIGN MEMORANDUM M-9A

From: Karen Wong

Date: April 21, 2006 (Revised April 7, 2009)

Subject: Chatham, MA Preliminary Design
Basis of Design – Sludge Processes

Purpose of Memo

The purpose of this memo is to provide the Basis of Design for the sludge treatment and handling processes for the upgrade to the Chatham, MA WWTF.

Codes and Standards

The following design guidelines and standards have been adopted for this project:

- TR-16: Guides for the Design of Wastewater Treatment Works, 1998 Edition

Background

The Chatham WWTF has an existing sludge and septage treatment system. The following paragraphs describe each of the existing sludge and septage treatment/handling processes.

Septage Receiving and Handling

The Chatham WWTF currently receives and treats septage from haulers located in and around Chatham. The WWTF tracks the number of septage loads discharged into the system, the volume of septage and the average pH. The quantities are averaged using data collected from 2002 to 2005 and are summarized in Table 1.

TABLE 1

CURRENT SEPTAGE QUANTITIES (FROM 2002 TO 2005 DATA)

CONDITION	SEPTAGE QUANTITIES (GPD)
Minimum Month	200
Average	1025
Summer Average	1694
Maximum Month	2075

Septage is discharged directly from the haulers' tank trucks to the septage holding tank through a 6-inch pipe, a rock trap and a coarse bar rack. The septage holding tank has a capacity of 4500 gallons and is located below the septage degritting room. The rocks and screenings are manually raked off of the bar rack following each discharge by a hauler and disposed of in a covered container. The overflow from the septage holding tank flows to the adjacent trap grease holding tank. A recessed impeller centrifugal grit pump transfers the septage to the septage degritting room.

The grit pump moves septage through a teacup solids classifier and the grit settles out in the bottom of the cyclone. The teacup must be blown down once every half-hour with effluent water to remove grit. The fluidized grit flows into a decanter, which allows the supernatant to drain. Periodically, the decanter is drained through a screened opening, and the decanter is tipped to the front to empty grit into a bobcat wheel loader. The grit is then delivered to a roll-off container, covered with lime, and taken to a lined landfill.

Typically, the degritted septage then flows to aeration tank No. 2, where it is held and aerated. Occasionally, the aeration is turned off and the supernatant is decanted to the MLE process. The diffuser is a 4-inch perforated PVC pipe located at the bottom of aeration tank No. 2. A positive displacement blower supplies air for aeration and it is located in a small shed adjacent to the aeration tank.

The degritted and settled septage is then pumped through the teacup to aeration tank No. 1 by the grit pump where the material is aerated and settled. A surface aerator is periodically used for aerating and mixing in tank No. 1. When the total solids concentration reaches 0.8 to 1%, it is typically ready for dewatering.

Trap Grease Receiving and Handling

In addition to septage, the Chatham WWTF receives and treats non petroleum trap grease. Table 2 provides a summary of grease quantities that Chatham is currently receiving and treating. Septage haulers discharge trap grease directly into a 1,100 cubic foot trap grease holding tank through a 6-inch pipe. The trap grease holding tank is located immediately west of the septage holding tank below the teacup classifier. The 6-inch trap grease pipe is adjacent to the septage discharge pipe. Periodically, contents in the trap grease holding tank are discharged into Tank No. 5, which has a capacity of 42,000 gallons and is located south of the septage degritting room. Tank No. 5 was originally designed as a sludge storage tank.

TABLE 2

CURRENT GREASE QUANTITIES (FROM 2002 TO 2005 DATA)

CONDITION	GREASE QUANTITIES (GPD)
Minimum Month	25
Average	300
Summer Average	350
Maximum Month	450

The grease is mixed in Tank No. 5 and treated with potassium permanganate prior to being discharged into aeration tank No. 2 with septage and waste sludge. Solids from aeration tank No. 2 are pumped to the belt filter presses located in the Dewatering Building for dewatering.

Waste Activated Sludge Storage

The Town originally has four aeration tanks; two of them (No. 3 and No. 4) were converted to MLE tanks with baffle walls and slide gates within each tank in 1996 and the other two (No. 1 and No. 2) were used as septage, sludge and trap grease pretreatment. The dimensions of each tank are 37 ft x 37 ft x 10.2 ft side water depth, with the storage volume of each tank being 14,000 cubic feet (105,000 gallons). Each aeration tank has a drain located at the center of the tank.

Return Activated Sludge (RAS) from the secondary clarifiers is recycled back to the aeration tanks while Waste Activated Sludge (WAS) is pumped from the secondary clarifiers to either Tank No. 5 where WAS is blended with trap grease or to Tank Nos. 1 and 2 for temporary storage.

Sludge Dewatering and Pumping

Belt filter presses are used to dewater sludge in the Chatham WWTF. There are two existing BFPs located at the existing Solids Dewatering Building. Each press has a one-meter belt and has a capacity of feeding sludge with 2.6% solids at 100 gpm. Typically only one BFP is used during the dewatering process and sludge is dewatered one day a week. Each dewatering process requires 6 to 8 hours of the BFP operations. There are also one grinder and two positive displacement rotary lobe type sludge feed pumps associated with the sludge dewatering process and they are located in the existing Control Building.

When solids concentration in Tank Nos. 1 and 2 reaches 0.8 to 1%, sludge will be fed to the BFP through a grinder, which is rated for 200 gpm at 0.75% solids, then through the sludge feed pump at 100 gpm. Currently one belt filter press is fed by one sludge feed pump. The belt filter press filtrate is collected in a sump with two recycle pumps and is pumped back to the WAS stream entering the sludge holding tanks.

Polymer is directly fed to the BFP and is metered by a chemical feed system. The chemical feed system is located in the Dewatering Building. It consists of two liquid polymer storage drums and two polymer feed systems.

Dewatered Sludge Disposal

Dewatered sludge is discharged into a hopper and transported to the Yarmouth Septage Treatment Facility for disposal.

Options

General

The recommended sludge processes for the upgrade to the Chatham WWTP include the following facilities and processes:

- Reuse of the existing septage and grease receiving and handling
- Waste Activated Sludge Storage
- Waste Activated Sludge Dewatering
- Polymer Feed
- Dewatered Sludge Storage, Conveying and Disposal

Primary sludge treatment is not required due to selection of the oxidation ditch biological treatment process. All other processes, equipment, sizing, and description of each process are provided below.

Septage and Grease Receiving and Handling

Pre-engineered septage receiving units are available from various manufacturers – Lakeside, Parkson and Huber, but the Town has indicated they are not interested in such systems because Chatham will not receive septage from other towns, therefore less septage will be received in the future.

The following tables 3 through 5 indicate the estimated septage quantities that the Chatham WWTF will receive at startup, Phase 1 and Phase 2 of the upgrade. The estimated septage quantities at startup, Phase 1 and Phase 2 were obtained from the 2002 to 2005 Chatham WWTF data, 30% of startup, and 10% of startup, respectively. The amount of septage that Chatham receives will decrease over time as more parts of the Town will be sewered.

TABLE 3

ESTIMATED SEPTAGE AND GREASE QUANTITIES AT STARTUP

CONDITION	SEPTAGE & GREASE QUANTITIES (GPD)
Minimum Month	225
Average	1,325
Summer Average	2,044
Maximum Month	2,525

TABLE 4

ESTIMATED SEPTAGE AND GREASE QUANTITIES AT THE END OF PHASE 1

CONDITION	SEPTAGE & GREASE QUANTITIES (GPD)
Minimum Month	68
Average	398
Summer Average	613
Maximum Month	758

TABLE 5

ESTIMATED SEPTAGE AND GREASE QUANTITIES AT THE END OF PHASE 2

CONDITION	SEPTAGE & GREASE QUANTITIES (GPD)
Minimum Month	23
Average	133
Summer Average	204
Maximum Month	253

Waste Activated Sludge Storage

Design criteria for the waste activated sludge storage system is as follows:

- Minimum 3-days storage at maximum month conditions to accommodate 3-day weekend in summer.
- WAS flowrates from modeling and manufacturers.

- Per WEF MOP, sludge mixing requires 20 – 40 cfm/1000 CF of tank volume (use 30 cfm/1000CF).

The waste activated sludge storage system will accept WAS from the WAS pumps, reactor scum from the Orbal oxidation ditch and secondary scum from the secondary clarifiers. During normal operation, activated sludge will be wasted from the RAS suction header, and metered before discharge to the existing tanks which have been converted WAS Holding Tanks. The WAS pumps will be placed in the basement of the RAS/WAS Building. There will be one main WAS line running from the WAS pump to outside of the WAS Holding Tanks and branches to each of the tanks. The tanks will require an aeration system to keep the tank completely mixed and aerobic. A submersible decant pump will be provided to each WAS Holding Tank for sludge decanting and tank dewatering. The decant pumps will pump the flow to the recycle flow pump station.

The Town has four tanks available for sludge storage. Table 6 indicates the amount of storage associated with the volume for Phase 1 and Table 7 is for Phase 2. As can be seen from the table, if three tanks will be needed for Phase 2, there would be 4 days of storage at summer average conditions and 3 days of storage at maximum month conditions, which meets the design criteria set above. Three tanks will also allow enough storage capacity for long weekends, even under maximum month conditions. However, two tanks will be enough during Phase 1 to meet the design criteria.

TABLE 6

WAS SLUDGE STORAGE DESIGN CRITERIA (PHASE 1)

CONDITION	PERCENT SOLIDS	SLUDGE VOLUME (GPD)	STORAGE – 1 TANK (DAYS)	STORAGE – 2 TANKS (DAYS)	STORAGE – 3 TANKS (DAYS)	STORAGE – 4 TANKS (DAYS)
Average (Spring/Fall)	0.8%	39,000	2.6	5.2	7.8	10.4
Average (Summer)	0.8%	51,000	2.0	4.0	6.0	8.0
Max Month	0.8%	65,300	1.6	3.1	4.7	6.2

TABLE 7

WAS SLUDGE STORAGE DESIGN CRITERIA (PHASE 2)

CONDITION	PERCENT SOLIDS	SLUDGE VOLUME (GPD)	STORAGE – 1 TANK (DAYS)	STORAGE – 2 TANKS (DAYS)	STORAGE – 3 TANKS (DAYS)	STORAGE – 4 TANKS (DAYS)
Average (Spring/Fall)	0.8%	38,900	2.6	5.2	7.8	10.5
Average (Summer)	0.8%	75,800	1.3	2.7	4.0	5.4
Max Month	0.8%	95,400	1.1	2.1	3.2	4.3

Mixing is required in the WAS storage tanks to keep solids in suspension and to deliver a consistent slurry to the belt filter presses. A coarse bubble aeration process with positive displacement blowers is recommended. For WAS mixing, a rate of 30 cfm/1000 CF was used to size the blowers. This rate is within the guidelines of TR-16, and is a common design criterion for Stearns and Wheler in similar applications. This results in a blower capacity of 1,250 scfm for a total of three tanks. Pressure rise across the blower will be approximately 7 psi. Three positive displacement blowers (two operational, one standby) are proposed for this application. Blowers will be located in the Chemical and Blower Building. All blowers will be provided with sound attenuating enclosures for noise reduction.

There are two types of positive displacement blowers – bi-lobe and tri-lobe. The advantages and disadvantages of each type of blower are presented below:

Bi-lobe blowers: lower initial costs and less efficient than tri-lobe blowers, longer history, without pulsation dampening features.

Tri-lobe blowers: higher initial costs and more efficient than bi-lobe blowers, newer technology, with pulsation dampening features.

Because they are quieter and more efficient and only slightly more costly, tri lobe blowers are recommended.

<u>Waste Activated Sludge Dewatering</u>

Design criteria for the waste activated sludge dewatering process are as follows:

- Feed solids concentrations of 0.8%
- Phase 2 WAS solids loading rate: 5,020 lbs/d (summer average) and 6,320 lbs/d (maximum month)
- WAS solids loading rate at Phase 2 minimum month conditions is expected to be 1,540 lbs/d
- Belt filter press dewatered solids concentration of 16% solids.
- Belt filter press operates 5 days a week, 6 hours a day.

The WAS dewatering process utilizes two belt filter presses (BFP) that will be located in the existing Sludge Dewatering Building. One BFP will be operational and one will be standby. Feed pumps will pump from the WAS Holding Tanks to the BFP. Dewatered sludge will be conveyed to a dumpster.

The existing 4-inch feed pump suction lines will be reused for Phase 1 but larger pipes will be needed for Phase 2 because the velocity inside the pipes will be getting too high.

Various assumptions can be used as to the frequency of operation of the BFP, which influences the sizing of the unit. Table 8 summarizes the scenarios for Phase 1 only. Table 9 summarizes the scenarios for Phase 2.

TABLE 8

BELT FILTER PRESS FLOWRATES AS FUNCTION OF OPERATIONAL SCENARIO (PHASE 1)

SCENARIO	PERCENT SOLIDS	5 DAYS @ 8HRS/DAY	5 DAYS @ 6HRS/DAY	6 DAYS @ 8HRS/DAY	6 DAYS @ 6HRS/DAY
Min Month	0.8%	50 gpm	**60 gpm**	40 gpm	50 gpm
Summer Average	0.8%	150 gpm	**200 gpm**	120 gpm	170 gpm
Max Month	0.8%	190 gpm	**250 gpm**	160 gpm	210 gpm

TABLE 9

BELT FILTER PRESS FLOWRATES AS FUNCTION OF OPERATIONAL SCENARIO (PHASE 2)

SCENARIO	PERCENT SOLIDS	5 DAYS @ 8HRS/DAY	5 DAYS @ 6HRS/DAY	6 DAYS @ 8HRS/DAY	6 DAYS @ 6HRS/DAY
Min Month	0.8%	70 gpm	**90 gpm**	60 gpm	80 gpm
Summer Average	0.8%	220 gpm	**300 gpm**	180 gpm	250 gpm
Max Month	0.8%	280 gpm	**370 gpm**	230 gpm	310 gpm

A typical 1-meter BFP should be able to handle 200 gpm of WAS with 1% solids, 130 gpm with 1.5% solids and 90 gpm with 2.5% solids. During Phase 1, one of the existing BFP will be enough to handle 1% sludge at all conditions. For Phase 2, both of the existing BFPs will be needed to handle the maximum month and summer average conditions shown in Table 9 and one BFP will be needed during minimum month conditions. A 5-day, 6-hr/day operation was the basis for the design criteria.

Because the Town desires spare belt filter presses, the existing BFPs cannot be reused due to their insufficient capacities at Phase 2. Thus, they will be replaced with two new 2.0-meter units. The two new 2.0-meter BFPs will be located in the existing Sludge Dewatering Building. The BFPs will have redundant sludge feed pumps (progressive cavity) that will pump WAS from the WAS Holding Tanks to the BFPs. The sludge feed pumps will be VFD-controlled and located at the existing Control Building. Two polymer feed systems will be installed in the Sludge Dewatering Building to condition the WAS prior to thickening. Two plant water booster pumps will be needed to supply high pressure water to the BFPs and they will also be located in the Sludge Dewatering Building.

Polymer System

The existing polymer system will be reused only in Phase 1. New polymer systems will be installed in Phase 2.

There are two types of polymers – dry and emulsion. Dry polymers are less costly than emulsion polymers but the dry polymer feed systems are more expensive. Emulsion polymers cost more than dry polymers because of the water content, but the polymer system is less labor intensive and the capital cost for the system is lower than the dry polymer system.

The preliminary design will allow enough space for either type of system to be installed.

Dewatered Sludge Storage and Disposal

Chatham WWTF has two existing bins to hold dewatered sludge located at the immediate end of each belt filter press. Each bin has a capacity of about 8 CY. Table 10 demonstrates the time needed to fill an existing dewatered sludge holding bin during Phase 1 and Phase 2, based on the belt filter presses operating 5 days a week and 6 hours a day. According to Table 10, the existing bin has a large enough capacity only under minimum month conditions during Phase 1. If the existing bins are used, emptying the bin as frequent as every hour will be required during Phase 2 of the project under maximum month conditions, which is not reasonable. Therefore, the existing bins cannot be reused and new storage devices will be required.

TABLE 10

TIME REQUIRED TO FILL AN EXISTING DEWATERED SLUDGE HOLDING BIN (PHASE 1 AND PHASE 2)

	PHASE 1		PHASE 2	
Conditions	Dewatered Sludge Production (gpd)	Time to Fill Existing Bin (hrs)	Dewatered Sludge Production (gpd)	Time to Fill Existing Bin (hrs)
Minimum Month	960	6.7	1,450	4.4
Summer Average	3,150	2.0	4,720	1.4
Maximum Month	4,030	1.6	5,940	1.1

Only one of the two existing bins will be reused during the Phase 1 upgrade due to the larger dimensions of the new belt filter press. A conveyor will be installed to transport dewatered sludge from the new belt filter press to the existing storage bin. The other existing bin could be used as a standby unit. However, as part of the Phase 2 upgrade, it is recommended that the Truckway of the Sludge Dewatering Building be modified in order to accommodate the new dewatered sludge holding dumpster. A conveyor will be installed to transport dewatered sludge from the belt filter presses to the new dumpster. A belt conveyor or screw conveyor can be used, but belt conveyors often perform better with lower percent solids sludge (less than 20% cake) as they do not tend to “ball” the sludge while conveying. It is recommended that two dumpsters be available for plant use – one active and one standby unit which will be in transit at least part of the time. See attached Figure 9A.

Other Technologies

Various other technologies were evaluated – the US Filter Cannibal Process, lime stabilization and In-vessel composting.

Cannibal Solids Reduction Process

The Cannibal solids reduction process is a relatively new technology offered by US Filter/Envirex Products. It makes claims to reduce biological sludge yield by up to 85%. The marketing literature indicates there are approximately 30 installations and operations in the United States within the past 5 years.

The process begins with all return activated sludge from the secondary clarifiers passing through a patented solids separation module (SSM), where trash, grit and other inert materials are removed. The SSM consists of one rotary drum screen, one surge tank, one in-line cyclone manifold, one cyclone feed pump, and one screening compactor. The solids from the SSM are collected in a dumpster and can be disposed of in a landfill. After the SSM, the majority of the flow returns back to the aeration tanks, that is, the Orbal reactor for Chatham, and a small portion goes to a patented interchange bioreactor, which is also called the Cannibal tank. The environment inside the bioreactor allows the aerobic mixed liquor to become facultative such that the aerobic bacteria are selectively destroyed and the low yield facultative bacteria utilize the remains and byproducts of the aerobic bacteria. The mixed liquor is then recycled back to the main treatment process by means of a decanter. When the facultative bacteria from the bioreactor stream meet the aerobic bacteria in the aeration tank, the facultative bacteria cannot survive and will be broken down. A steady state balance between the selection and destruction process is maintained such that there is no net gain of biological solids. Diffusers and mixer are installed inside the bioreactor for mixing and aeration purposes. The bioreactor requires an occasional purge to remove any build-up of inert and fine materials that made their way through the SSM. The amount of solids/sludge from such purge is estimated to be 0.1 lbs TSS/lb BOD.

In addition to the bioreactor/Cannibal tank, the Cannibal process also requires an anoxic contact zone where preliminarily treated raw wastewater, the interchange mixed liquor from the bioreactor/Cannibal tank and the screened RAS combined and one hour of retention time is recommended.

The operation of the Cannibal solids reduction process is automated by use of the SmartCannibal™ Control System, which monitors the ORP and pH in the bioreactor and automatically controls the rate and time of aeration and mixing to ensure optimum solids destruction. The SmartCannibal™ Control System can also be customized to regulate the mass flow through the SSM and bioreactor as a function of the plant loading.

For the Chatham WWTF, the Cannibal Solids Reduction Process would be designed to handle the Phase 1 annual average flow of 1.2 mgd. The process requires two bioreactors which can be accommodated by converting two of the existing aeration tanks. The estimated screenings production at 30% solids is 450 dry lbs per day and the estimated purged biological sludge is 40 dry tons per year.

The advantages of the Cannibal Solids Reduction Process are mainly the O&M cost savings and less labor intensive sludge processing. The manufacturer claims that the Cannibal process will decrease the secondary sludge production by up to 85%; with that the investments in sludge dewatering equipment and disposal can be reduced or even eliminated. US Filter, the manufacturer of the Cannibal Solids Reduction Process, prepared a preliminary cost saving analysis, estimating a saving of $60,000 annually at startup and $119,000 annually at 1.2 mgd design flow. This cost analysis takes into consideration the sludge handling and disposal, power, and chemical costs. A process flow diagram of the Cannibal Solids Reduction Process is included.

Including a building for the SSM, it is estimated that the Cannibal process would cost at least $2.5 million dollars to construct plus additional costs for an anoxic contact zone and for engineering. The annual savings of $15,000 at startup and as much as $180,000 per year at the end of Phase I do not result in enough of a savings to offset the capital costs. In Workshop No. 3, this system was discussed with the Town and they indicated that they were not interested in considering it further.

Biosolids Handling

According to USEPA Part 503 regulations, biosolids are classified as Class A and Class B. The main difference between the two classes is the degree of pathogen and vector attraction reduction potential that occurs in the biosolids treatment process. Typically, aerobic and anaerobic digestion, air drying and lime stabilization are methods of producing Class B biosolids. Based on the EPA guidelines, composting, heat drying, heat treatment, autothermal thermophilic aerobic digestion, beta ray irradiation, gamma ray irradiation, pasteurization, and alkaline pasteurization are all capable of producing Class A biosolids.

The major advantages of Class A over Class B biosolids are as follows:

- Fewer restrictions on final biosolids disposal locations.
- Less documentation required on biosolids handling.
- Greater public acceptance of final products.
- Better public perception of treatment process.
- Lower cost/liability for ultimate disposal.

Although the Town indicated in Workshop No. 2 that they would like to maintain their current sludge handling and disposal practices, such as sending dewatered sludge to the Yarmouth Septage Treatment Facility, the following two treatment methods are presented for the Town's future consideration.

In-Vessel Composting (Class A)

In-vessel composting is one of the composting methods for which the process occurs in an enclosed container or vessel. There are two main types of in-vessel composting systems: plug flow and dynamic (also called agitated bed). The advantages of in-vessel composting include: easier to contain odor, faster throughput, less labor requirements and smaller footprint compared to other manual composting methods. The disadvantage is that numerous mechanical and clogging problems associated with the equipment. The quality of the final product is of high quality that can be used for landscaping and distributed to the general public.

Moisture content in the dewatered sludge has significant impact on the compost mix. The higher the moisture content, that is the lower solids concentration of dewatered sludge, the larger the equipment and materials handling systems are required.

Major process equipment includes:

- Mixers
- Discharge/feed screws
- Elevators
- Hydraulic power units
- Blowers
- Leveling screws
- Air scrubbers
- System breakers

Based on the costs received from Fairfield Service Company, the installed costs of an in-vessel composting system could be as high as $7,000,000 for a system designed to handle the Phase II sludge quantities. The footprint of this facility would be approximately 60 feet by 140 feet. There are other less expensive technologies that could be evaluated if the Town wanted to pursue this option further.

<u>Lime Stabilization (Class B)</u>

Lime is added to untreated sludge in the lime stabilization process. It can be added prior to or after sludge dewatering, but the latter is favored because dry lime can be used and there are no special requirements for dewatering. If lime is added after sludge dewatering, which is called lime post-treatment, it is important to ensure that mixing is adequate. Quicklime is preferred over regular lime since quicklime reacts with water to produce the exothermic reaction that raises the mixture temperature to over 50^{o}C, which is a high enough temperature to inactivate worm eggs.

A lime post-treatment system typically consists of a dry lime feed system, dewatered sludge cake conveyor and a lime-sludge mixer. A dosing device transports from a lime silo the appropriate amount of quicklime to dewatered sludge and the two kinds of solids are well-mixed in a mixer. The mixture will then be conveyed to a container by a belt conveyor. The lime silo will be sized for one month storage of quicklime.

Assuming the dewatered sludge temperature to be approximately 20^{o}C and the lime-sludge mixture to be approximately 50^{o}C, the theoretical quicklime dosage required to raise the lime-sludge mixture by 30^{o}C would be 0.63 lb CaO/lb of sludge solids. The dosage under various conditions in Phase 1 and Phase 2 are summarized in Table 11.

TABLE 11

QUICKLIME DOSAGE FOR LIME POST-TREATMENT STABILIZATION IN PHASE 1 AND PHASE 2

	PHASE 1			PHASE 2		
Conditions	**Dewatered Sludge (lb solids/day)**	**Quicklime Dosage (lb CaO/day)**	**Quicklime Dosage (ton/month)**	**Dewatered Sludge (lb solids/day)**	**Quicklime Dosage (ton/day)**	**Quicklime Dosage (ton CaO/month)**
Minimum Month	960	610	9	1,450	910	14
Summer Average	3,150	1,990	31	4,720	2,980	46
Maximum Month	4,030	2,550	40	5,940	3,760	58

Major process equipment includes:

- Lime Silo with Rotary Valve
- Dosing Device/Conveyor
- Dewatered Sludge Conveyor from BFP to Lime-Sludge Mixer
- Lime-Sludge Mixer
- Belt Conveyor to from Lime-Sludge Mixer to Dumpster

Based on the costs received from US Filter Zimpro Products, the installed costs for the lime post-treatment stabilization would be approximately $500,000 for a system designed to handle the Phase II sludge quantities. The lime system would be located in the area of the Sludge Dewatering Building with the silo being outside.

Process/Equipment Description and Design Criteria

Design criteria for the recommended improvements are as follows:

<u>WAS Storage System:</u>

Decisions made in Workshop No. 2:

- The Town indicated that they would like to reuse the existing aeration tanks for waste activated sludge storage. Two of the existing aeration tanks will be converted into waste sludge holding tanks in Phase 1 and the rest will be converted in Phase 2.
- The Town preferred removable coarse bubble diffused aeration system for tank mixing and easier tank cleaning.

Major process equipment includes:

- Odor control covers for all of the WAS Holding Tanks (possibly as part of Phase II).

- Blowers

No. of Units:	Total of 3 units 2 installed in Phase 1 (1 operational and 1 standby) The third blower will be installed in Phase 2
Application:	WAS Holding Tanks mixing
Type:	Tri-lobe, positive displacement
Blower Capacity:	1250 scfm @ 7 psi
Operation:	On demand

- Aeration System

No. of Units:	3 (1 grid for each WAS Holding Tank)
Type:	Removable coarse bubble diffusers

- Decant Pumps

No. of Units:	3 (1 for each WAS Holding Tank)
Application:	For decanting sludge and dewatering WAS Holding Tanks
Type:	Submersible
Pump Capacity:	150 gpm
Operation:	On demand

<u>WAS Dewatering Process:</u>

Decisions made in Workshop No. 2:

- The Town indicated that Penn Valley double disc pumps are preferred for BFP feed pumping.
- The Town would like to have one belt filter press replaced in Phase 1 with a 2 m unit and the other replaced in Phase 2 with a 2 m unit.

Major process equipment includes:

- Belt Filter Press Feed Pumps

No. of Units:	2 (1 operational, 1 standby)
Type:	Double Disc Pump, VFD-controlled
Pump Capacity:	370 gpm
Operation:	5 days/week and 6 hours/day

- Belt Filter Press

No. of Units:	2 (1 installed in Phase 1, 1 installed in Phase 2)
Belt Width:	2.0-meter
Drive Motor:	3 HP
Operation:	5 days/week and 6 hours/day

- Water Booster Pumps
  No. of Units: 2 (1 installed in Phase 1, 1 installed in Phase 2)
  Pump Capacity: 90 gpm @ 120 psi
  Operation: 5 days/week and 6 hours/day

- Hydraulic Power Units
  No. of Units: 2 (1 installed in Phase 1, 1 installed in Phase 2)
  Manufacturer: by belt filter press manufacturer
  Operation: 5 days/week and 6 hours/day

- Polymer Feed Systems (Phase 2)
  No. of Units: 2
  Polymer Type: Dry or Emulsion
  Operation: 5 days/week and 6 hours/day

<u>Dewatered Sludge Storage and Conveying System</u>

Major process equipment includes:

- Conveyor (Phase 1)
  No. of Units: 1
  Type: Belt conveyor
  Approx. Length: 18 feet
  Operation: When belt filter press is operating

- Dumpster (Phase 2)
  No. of Units: 2
  Type: Leveling Roll-Out Container
  Length: 16 feet
  Width: 7 feet 10 inches
  Height: 5 feet

- Conveyor (Phase 2)
  No. of Units: 1
  Type: Belt conveyor
  Approx. Length: 50 feet
  Operation: When belt filter press is operating

Demolition and Maintenance of Plant Operations

Various equipment in the existing Dewatering Room will be demolished over time.

Results of Value Engineering

A value engineering study was conducted in September 2007 by Lewis and Zimmerman Associates, Inc. and engineers from Camp, Dresser and McKee (CDM). The team formulated cost savings or optimization suggestions, indexed by process. Stearns & Wheler's response to each is listed below.

SP-2: The VE team recommended downsizing the belt filter press. S&W and the Town agree that the replacement of the existing 1.0 m press with a new 1.0 m press in lieu of a 2.0 m press is an acceptable alternative.

SP-4: The VE team suggested the use of self-leveling bin and eliminate sludge conveyor. The Town requested a modification to this option and has requested the use of an existing container until Phase 2. With the replacement of one BFP with a new 1.0 m press, the second existing bin can be used and therefore there is no need to purchase a new self leveling bin or sludge conveyor.

CF-3/CF-4: The VE team recommended the combination of the Chemical & Blower Building and the RAS/WAS Building into one structure. The Town requested that S&W look at pre-engineered vs. concrete measuring unit (CMU) for chemical feed building ONLY. S&W identified that the reuse of the existing control building was reviewed and the proposed blowers for the sludge holding tanks would not fit well into that structure, without extensive renovations to accommodate noise consideration piping and structural support for equipment.

Decisions for Final Design

- One of the existing BFP will be replaced with a new 1.0 m BFP. The design criteria for the new BFP require that the structural base of the unit can fit into the existing BFP footprint of 147" length by 75.5" width. The overall dimensions of the press, excluding the discharge chute, are required to be within 17' long by 8.5' wide by 9' high in order for the complete BFP to fit within the available existing building space along with required space for maintenance and repair work. The new BFP must have a minimum hydraulic capacity of 75 gpm and a minimum solids handling capacity of 500 lbs dry solids/hr.
- The existing dewatered sludge holding bins will be reused. The dewatered sludge conveyor will be eliminated. If the Ashbrook Standard Deck BFP model is installed, it will remain on a raised foundation structure in order to discharge into the existing bins. If the BDP model 2VP is installed it will be lowered, as the discharge chute is at approximately 7' in height and does not require additional elevation to discharge into the existing bins.
- Existing Odor Control Area in the Sludge Dewatering Building will be cleared and demolished. The new BFP polymer feed system, hydraulic power unit, and washwater booster pump will be installed in that area.
- The waste sludge blowers will be located in the Process Building.
- Telescoping valves will be used in the WAS Holding Tanks in lieu of using decant pumps.
- A dewatering pump will be provided in the basement of the Sludge Processing Building to drain water from Sludge Holding Tanks 3 and 4.
- Fixed coarse bubble diffusers will be installed in Sludge Holding Tanks 1 and 2. Fixed diffusers will be used in lieu of retrievable diffusers due to similar required maintenance efforts and intensive removal efforts associated with the retrievable type. The fixed coarse

bubble diffusers will be wall mounted instead of floor mounted in order to ease tank cleaning efforts.

Attachment 2

Draft Preliminary Design Memorandum M-1B

STEARNS & WHELER LLC
Environmental Engineers & Scientists

DRAFT PRELIMINARY DESIGN MEMORANDUM M-1B

From: J. Jefferson Gregg, P.E.

Date: April 21, 2006

Re: Chatham, MA Preliminary Design
Flows and Loadings

Purpose of Memo

The purpose of this memorandum is to summarize the development of wastewater flows and loadings for the Town of Chatham (Town) to be used in the preliminary design of wastewater facilities.

Average Wastewater Flows Development

To remain consistent with the facilities planning process to date and the Massachusetts Estuaries Project Efforts, the Town's existing water consumption data has been used as the basis for the future Wastewater Treatment WWTF design flows and loadings.

The following is a summary of the Town's water data analysis and how it is being applied to this project:

1. 2002-2003 Water data (provided by the Town – summer to summer, and used as part of the Massachusetts Estuaries Project (MEP)). Currently approximately 90 percent of the Town is on public water.

2. Ninety percent reduction applied to convert water use to wastewater generation (facilities plan, and MEP). This 90% reduction is based on an analysis of the wastewater flows to the existing Chatham WWTF.

3. Calculated average water use per parcel for those parcels without known irrigation systems, as identified by Town.

4. Actual water data was used where available, if no water data was available the following approach was used:

   a. Average water use for single family home was estimated to be 120 gpd/parcel (rounded to two significant figures). Estimations based on the parcel by parcel analysis.
   b. For non-single family homes, estimated water use assigned to these parcels was based on the average water use of parcels with the same state class code (similar property type).
   c. Build-out parcels (future) were assigned 120 gpd/parcel.

5. Build-out projections based on the approach established as part of the facilities planning effort and accepted by the Town and Cape Cod Commission (CCC).

6. Existing developed-properties wastewater flow compared to projected build-out flow, and the higher of the two values used.

7. Additional build-out criteria used, as agreed upon with the Town:

- Residential properties are redeveloped to full extent based on current zoning.
- Commercial and Industrial, vacant-developable land is converted to residential.
- All other existing uses remain the same.
- Maps were reviewed with the Town and site specific modifications were made.

Wastewater Flows and Peaking Factors

Table 1 presents the average flows seen at the existing Chatham wastewater treatment facility, generated from the existing collection system.

TABLE 1

EXISTING WWTF FLOWS (2002-2005)

CONDITION	FLOW (MGD)
Average Flow	0.10
Minimum Month Flow	0.07
Maximum Month Flow	0.16

Water use and wastewater flow peaking factors were evaluated and compared to TR-16. The peaking factors considered for the preliminary design are presented in Table 2. As part of the evaluation, both the wastewater flows recorded at the existing WWTF and the drinking water well pumping records were evaluated for the following reasons:

- The limited size of the existing collection system may not be representative of the Town demographics.
- Existing WWTF peaking factors may represent a more year round population and might not be representative of the entire Town (if sewered).
- Town water supply well pumping records are more likely to show the seasonal impacts of the entire Town.
- Well pumping records also reflect higher peak pumping rates in the summer because of additional uses like car washing, lawn irrigation, etc, and therefore would require downward adjustments to the wastewater estimate.
- Well pumping does not equate to 100% wastewater generation, and therefore should not be considered as the sole means of estimating peaking factors.

Therefore, peaking factors falling between those seen at the WWTF and from the well pumping records were considered as a reasonable approximation of those for a Townwide system and were compared to estimated TR-16 values, for validation purposes. The peak day and peak hour estimates were well within the range recommended by TR-16. TR-16 does not have estimates for summer average, minimum month or maximum month flows.

TABLE 2

PEAKING FACTORS

CONDITION	EXISTING WWTF (1)	TR-16 (5)	PROPOSED
Minimum Month	0.7		0.5
Summer Average (2)	1.3		1.6
Maximum Month (3)	1.6		1.9
Peak Day (4)	1.8	2.1	2.2
Peak Hour		3.4	3.4

Notes:
1. Based on 2002 through 2005 data
2. Three month average (June, July, and August) divided by average annual
3. Maximum month divided by average annual
4. Peak day divided by average annual
5. TR-16 estimates based on average annual flow of 1.5 mgd

Summer average flows during the years 2002 through 2005 were evaluated for June through August, June through September and July through September. The highest average summer flow occurred during the June through August period, although all three periods yielded similar results.

Table 3 presents the Townwide wastewater flow estimates. Existing average annual flow and build-out flows are based on the previously agreed upon approach. Peaking factors are then applied to calculate the remaining build-out flows. Build-out is considered the design conditions for this project.

TABLE 3

TOWN-WIDE FLOW ESTIMATES
(not including I/I)

CONDITION	FLOW (MGD)
Existing (2003) Average Annual Flow (1)	1.0
Build-out (BO) Average Annual Flow	1.3
BO Summer Average Flow	2.1
BO Minimum Month Flow	0.86
BO Maximum Month Flow	2.5
BO Peak Day Flow	2.9
BO Peak Hourly Flow	4.5

Note:
1. Calculated flow based on 2002-2003 water data and existing Town wide land use and units based on 2004 Town assessors data.

The future Chatham collection system will be a new system over very significant areas of Town. The new gravity PVC sewers and manhole joints and covers will be gasketed. Portions of the Town will be low pressure sewers. All new connections will be wye-connections with new laterals to the house, and no roof leaders or sump pumps and/or foundation drain connections will be allowed under any condition. In addition, public education programs should be employed to prevent illegal connections. Because of this, inflow is expected to be negligible.

Table 4 summarizes the projected Infiltration and Inflow (I/I) estimates for the collection system. The "startup" condition is based on the existing collection system and an infiltration rate of 500 gpd/in-mile (based on TR-16). I/I was calculated based on the preliminary sewer layouts developed at the time of this memorandum, and based on 8-inch diameter pipe, and using an I/I rate of 500 gpd/in-mile. I/I for laterals is based on 500 gpd/in-mile for approximately 5,100 4-inch connections each approximately 80 feet long. Estimated length based on Town-wide average distance of building to property line based on GIS information. Although 500 gpd/in-mile is on the high end of the TR-16 range for just infiltration, for this preliminary design it will be used to represent infiltration and inflow.

TABLE 4

INFILTRATION / INFLOW ESTIMATE

CONDITION	FLOW (GPD)
Existing Collection System	20,000
Preliminary Gravity Sewer Layout	350,000
Laterals (All Phases)	160,000
Total	530,000

The proposed sewer areas presented in Table 4 are based on future areas of Town to be sewered as presented in a memorandum to the Town dated June 7, 2005 and entitled Wastewater System Implementation Capital Improvement Planning Items.

Once the proposed sewer layouts are finalized, the estimated I/I values will be adjusted. At this time, the lengths of pressure sewers and gravity sewers have not been finalized. I/I values are not peaked and represent the condition of maximum I/I occurring under any flow condition.

Table 5 presents the proposed WWTF design flows, which are the total of the Townwide flows under build-out conditions presented in Table 3 and the I/I flows presented in Table 4.

TABLE 5

TOTAL PROPOSED WWTF DESIGN FLOWS [(1)]

CONDITION	FLOW (MGD)
Startup Minimum Month Flow	0.08
Average Annual Flow	1.9
Average Summer Design Flow	2.7
Minimum Month Design Flow	1.2
Maximum Month Design Flow	3.1
Peak Day Design Flow	3.5
Peak Hourly Design Flow	5.1

Note:
1. Includes I/I

Maximum month flows and loadings will be critical for meeting any effluent nitrogen limit. Peak flows are also critical for process design and hydraulic considerations and effluent disposal. Also, with continued reconstruction of homes in Chatham, it is quite possible that a higher proportion of year-round residents may eventually reside in Town. However, such projections are not available at the time of this technical memorandum, so for planning purposes the present distribution of seasonal and year-round properties (outside of the projected growth due to Build-out) would remain the same in the future. To minimize the impact of future conversion of seasonal to year round homes, the facility will also consider a summer average flow rate and loading, which would account for the majority of the potential residential sewer users in the future. However the fact that the facility will be designed around maximum month and peak day conditions will address this increase in flow and loading.

Development of Loadings

Table 6 presents TR-16 factors for loading variability.

TABLE 6

TR-16 LOADING FACTORS

CONDITION	MAXIMUM MONTH	PEAK DAY
BOD	1.14	1.8
TSS	1.3	2.1

Table 7 presents the existing loadings for the Chatham WWTF (2002-2005).

TABLE 7

EXISTING WWTF FLOWS AND LOADINGS (2002-2005)

CONDITION	AVERAGE	MINIMUM MONTH	MAXIMUM MONTH
Flow, mgd	0.1	0.08	0.16
BOD_5, lb/day	180	70	420
TSS, lb/day	180	80	300
TKN, lb/day	30	10	60
Ammonia, lb/day	20	< 10	40

Note:
Flows and loadings represent a 4 year average (through October 2005)
Rounded to two significant figures

Table 8 presents the flows and loads for the entire WWTF (Phase 1 and 2). Loadings were based on concentrations currently seen at the existing WWTF, increased with build-out estimates, and TR-16 factors were applied for Maximum Month and Peak Day conditions for TSS, and BOD.

TABLE 8

WWTF DESIGN FLOWS AND LOADINGS

CONDITION	STARTUP (3)	AVERAGE ANNUAL	DESIGN SUMMER AVERAGE	MINIMUM MONTH	MAXIMUM MONTH	PEAK DAY	PEAK HOUR (2)
Flow, mgd	0.08	1.9	2.7	1.2	3.1	3.5	5.1
BOD_5, lb/day (1)	100	3,200	6,200	1,400	7,400	8,500	-
TSS, lb/day (1)	160	3,400	5,900	2,200	7,000	8,100	-
TKN, lb/day	20	600	900	200	1,100	1,300	-
Ammonia, lb/day	10	400	600	100	800	900	-

Notes:
1. BOD and TSS loadings for Maximum Month and Peak Day adjusted based on recommended Loading Factors listed in Table 8.
2. Peak Hour loadings not calculated.
3. Start-up loadings based on 2005 data.

For design purposes, seasonal correlations were developed showing under what temperature conditions the facility might see its maximum loading conditions. This impacts the sizing of the facility.

TABLE 9

SEASONAL CORRELATION OF FLOWS AND LOADS

SEASON	DESIGN FLOW	DESIGN LOAD	DESIGN AVERAGE MONTHLY TEMPERATURE (DEGREES C)
Dec-Feb	Use Min. Month	Use Min. Month	7
March-May	Use Average Design Flow	Use Average Design Flow	10
June-Aug	Use Max Month	Use Max Month	20
Sept-Nov	Use Average Design Flow	Use Average Design Flow	16

WWTF Phasing

Preliminary design of the WWTF is based on two phases, based on a preliminary division of the Town to address potential sewering options. Phase I flows would cover portions of the Town located generally south of Route 28, and Phase II would encompass the remaining areas of Town.

Table 10 summarizes the approximate flow split.

TABLE 10

PHASED WWTF DESIGN FLOWS [(1)]

CONDITION	PHASE I FLOWS (MGD)	PHASE II FLOWS (MGD)
Startup Minimum Month Flow	0.08	0.8
Average Annual Flow	1.3	1.9
Average Summer Design Flow	1.8	2.7
Minimum Month Design Flow	0.8	1.2
Maximum Month Design Flow	2.1	3.1
Peak Day Design Flow	2.3	3.5
Peak Hourly Design Flow	3.5	5.1

Note:

1. Includes I/I

Other Flow Considerations

1. Future Harwich Sewer Extensions:

The Town is currently in discussions with the Town of Harwich regarding the possible extension of any proposed collection system into Harwich. This would require an inter-municipal agreement between the two Towns establishing the quantity of flow and other requirements. No flow estimate is available at this time, and the ultimate ability of Chatham to extend sewers into Harwich will be dependant on the effluent disposal capacity of the Town of Chatham.

2. Septage:

As identified in the 1999 Needs Assessment Report (Table 5-8), "Septage and grease are treated in the sludge holding tanks and the decant liquid and belt filter press filtrate from these flows have minimal contributions to the wastewater treatment process." Therefore for this analysis concentrations from septage are considered to have minimal impact on the new WWTF. Also, the Town of Chatham only receives septage from the Town, therefore as more of the Town is sewered, an even smaller portion of the wastewater flow stream will originate from this source. However, the septage will be considered in the sludge processing and disposal calculations.