City and County of San Francisco 2030 Sewer System Master Plan

TASK 600 TECHNICAL MEMORANDUM NO. 602 CONFIGURATION ANALYSIS

FINAL DRAFT



CITY AND COUNTY OF SAN FRANCISCO 2030 SEWER SYSTEM MASTER PLAN

TASK 600

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CONFIGURATION ANALYSIS

Please note this memo was created in February of 2007 and was not updated. It was determined by the SFPUC and the consultants that it was important to capture the information at the time of development so the reviewers could see the progression of information and decisions made at the time of the memo development. Please also note that the word 'alternative' was used instead of 'configurations' for the memos reflecting the existing wording at the time it was written. In the Summary Report, the term was updated to 'configuration' so as not to confuse the CEQA review process. The configurations mentioned herein may have changed or been eliminated and are not considered full CEQA alternatives.

1.0 PURPOSE AND OBJECTIVES

The Draft Project Memorandum titled Sewer System Master Plan Project Alternatives submitted by SFPUC on January 3, 2007 summarized the four treatment and disposal alternatives for the SFPUC Sewer System Master Plan. The purpose of this memorandum is to identify the treatment plant footprint requirements for the alternatives and present the associated capital costs for liquid treatment improvement and upgrades. Discussion on solids treatment is provided in Technical Memoranda 607 and 608. General assumptions about appropriate treatment process selections and treatment process criteria used in the footprint analyses for liquid processing facilities are presented in Appendix A.

2.0 ALTERNATIVES DESCRIPTIONS

There are four treatment alternatives in the Master Plan. In this section each alternative is summarized with a brief description of the capacity and level of treatment at each of the SFPUC treatment facilities and associated outfalls.

2.1 Alternative 1

Alternative 1 has two sub options called Option A and Option B. In this alternative, all the Southeast Water Pollution Control Plant (SEP) flows, both wet and dry, are treated at an improved SEP to eliminate odors and replace old infrastructure. In Option A, visual impacts are reduced and in Option B, these impacts are virtually eliminated. Dry-weather flows at SEP receive secondary treatment, and wet-weather flows receive primary and secondary treatment, depending on the actual flows. All SEP effluent is discharged to the Bay through Southeast Bay Outfall (SBO), which will be rehabilitated for a capacity of 250 mgd to eliminate a secondary discharge to Islais Creek. The North Point Facility (NPF) will provide primary treatment for wet-weather flows from the north shore area and from the Channel Transport Box system and discharge effluent through the North Point Outfall (NPO), which

will be upgraded from a capacity of 150 mgd to 240 mgd. All west side flows (wet and dry) are treated at Oceanside Water Pollution Control Plant (OSP) and discharged to the ocean through the Southwest Ocean Outfall (SWOO). The flows discharged of SWOO will be increased to 300 mgd in order to reduce combined system discharges (CSDs) on the Westside. Dry-weather flows receive secondary treatment, and wet-weather flows receive primary and secondary treatment, depending on the actual flows. A bayside biosolids center (BBC) will be constructed adjacent on the bay side.

2.2 Alternative 2

Alternative 2 has two sub options called Options A and B. In Option A, the average dryweather flows (ADWF) to SEP are reduced by diverting 10 mgd to OSP. In Option B the ADWF are further reduced by diverting an additional 18.3 mgd (26 mgd maximum) to North Point Plant (NPP). All the remaining SEP flows, both wet and dry, are treated at an improved SEP to eliminate odors and replace old infrastructure. In Option A visual impacts are reduced and in Option B these impacts are virtually eliminated. Dry-weather flows at SEP receive secondary treatment, and wet-weather flows receive primary and secondary treatment, depending on the actual flows. All SEP effluent is discharged to the Bay through SBO, which will be rehabilitated for a capacity of 250 mgd to eliminate a secondary discharge to Islais Creek. The NPF will provide primary treatment for wet-weather flows from the north shore area and from the Channel Transport Box system and discharge effluent through NPO, which will be upgraded from a capacity of 150 mgd to 266 mgd. In Option B dry-weather flows from North Shore Drainage receive secondary treatment at the upgraded all-weather North Point Plant (NPP) with up to 240 mgd of wet-weather flows exceeding the secondary capacity of 26 mgd receiving primary treatment and disinfection only. All westside flows (wet and dry) plus the 10-mgd bayside dry-weather flow diverted from Cayuga Subdrainage are treated at OSP and discharged to the ocean through SWOO. The flows discharged of SWOO will be increased to 300 mgd in order to reduce CSDs on the west side. Dry-weather flows receive secondary treatment, and wet-weather flows receive primary and secondary treatment, depending on the actual flows. Sludge from SEP and NPP will be treated at BBC that will be constructed on the bay side.

2.3 Alternative 3

In this alternative, all bayside dry-weather flows are transported to the OSP site for treatment at a new all-weather facility, New Oceanside Plant (NOSP), and discharge through SWOO. The existing OSP continues to treat westside flows; all dry-weather flows receive secondary treatment and wet-weather flows receive primary and secondary treatment, depending on the actual flows. The flows discharged through SWOO will be increased to 450 mgd, in part to reduce CSDs on the west side. All solids generated from bayside wastewater are treated at the OSP site as well. The SEP will become a wetweather facility, Southeast Facility (SEF), that will treat up to 250 mgd of bayside wetweather flows through primary treatment and disinfection, which increases the outflow from

the Islais Transport system by 150 mgd, and discharge to the Bay through SBO, which will be upgraded to a capacity of 250 mgd to eliminate discharges to Islais Creek. SEF will undergo numerous upgrades for wet weather treatment, as well as mitigation for odor, noise, and visual impacts. All north shore wet-weather flows will continue to be treated through primary quality at NPF and discharged to the Bay through NPO, which will be upgraded and increased in capacity to 240 mgd. Solids from NPF will be routed to SEF and then to the OSP site for treatment. A plant inter-tie will be constructed to pump flows from the Bayside to the Westside.

2.4 Alternative 4

Alternative 4 includes relocating SEP from its current location. Instead of improving SEP at its existing location, a new plant could be located at a new Bayside site, to treat both wet and dry-weather flows, that eliminates odors, noise, and visual impacts. The Pier 92/94 and Hunter's Point sites were evaluated as potential locations for SEP. Dry-weather flows will receive secondary treatment, and wet-weather flows up to 250 mgd will receive primary (100 mgd) and secondary treatment (150 mgd). All effluent is discharged to the Bay through either SBO or a new Bay outfall. If SBO is used, it will be upgraded for a capacity of 250 mgd to eliminate discharges to Islais Creek. NPF will provide primary treatment for wet-weather flows from the north shore area and from the Channel Transport Box system and discharge effluent to the Bay through the NPO, which will be upgraded for a capacity of 240 mgd. All westside flows (wet and dry) are treated at OSP and discharged to the ocean through SWOO. Dry-weather flows receive secondary treatment, and wet-weather flows receive primary and secondary treatment, depending on the actual flows. Flows through SWOO will be increased to 300 mgd to reduce CSDs on the Westside. The BBC will be constructed adjacent to the relocated SEP.

3.0 FOOTPRINT REQUIREMENTS

This section identifies footprint requirements for SEP, OSP and NPF for all alternatives described in Section 2.0.

3.1 Southeast Plant

3.1.1 Flows and Loads

This section summarizes the flows and loads and design criteria for SEP used for all alternatives. Values of flows and loads reported in the following summary tables are adapted from the Memorandum titled Wastewater Flow and Load Projections submitted by SFPUC on September 1, 2006 and revised on January 3, 2007.

Table 1 lists the projected influent flows and loads used to size treatment units at the SEP for all alternatives.

Table 1 Projected Influent Flows and Loads for SEP 2030 Sewer System Master Plan City and County of San Francisco

Parameter	Alternatives 1 and 4	Alternative 2	Alternative 3
Average Dry Weather Flow (mgd)	79.3	51.0	n/a
Peak Hour Dry Weather Flow (mgd)	106.2	70.5	n/a
Maximum Primary Treatment Capacity* (mgd)	250	250	250
Maximum Secondary Treatment Capacity (mgd)	150	150	n/a
Average Influent BOD Loading (lb/d)	186,000	120,000	n/a
Max Month Influent BOD Loading (lb/d)	225,000	143,000	n/a
Max Week Influent BOD Loading (lb/d)	243,000	154,000	n/a
Max Day Influent BOD Loading (lb/d)	328,000	204,000	n/a
Average Influent TSS Loading (lb/d)	198,000	128,000	n/a
Max Month Influent TSS Loading (lb/d)	280,000	176,000	n/a
Max Week Influent TSS Loading (lb/d)	335,000	209,000	n/a
Max Day Influent TSS Loading (lb/d)	773,000	594,000	n/a
Average Influent TKN Loading (lb/d)	33,800	21,900	n/a

(1) In Alternatives 1, 2 and 4 100 mgd receives primary only treatment with disinfection n/a: not available

Design criteria used to size units at SEP is summarized in the document titled Unit Sizing Criteria Assumptions, revised on September 5, 2006. Measures were taken to allocate space for treatment of two future potential contaminants. For the analysis, it was assumed

that ammonia removal and tertiary filtration would satisfy space requirements necessary for potential future contaminants.

3.1.2 **Preliminary Treatment**

3.1.2.1 Alternatives 1 and 2

For Options A and B, the preliminary treatment requirements are the same but the location of buildings differs. Currently, preliminary treatment is performed in Buildings 011 and 012. Building 011 is the older of the two buildings and consists of five mechanical bar screens (0.75-inch opening) and 5 grit tanks (65 mesh grit). The SEP lift station is also located in Building 011. Building 012 consists of four climber bar screens (0.5-inch opening) and four Pista vortex grit units. For both options, it is assumed that the preliminary treatment equipment in Building 011 will be decommissioned and removed. For Option A the lift station pumps will be replaced and sump rebuilt. In Option B Building 011 will be demolished and the lift station will be relocated closer to the headworks buildings.

Building 012 is rated for a peak wet weather flow (PWWF) of 180 mgd with all units in service. The design criteria require one mechanical bar screen and one grit chamber out of service during PWWF, which would reduce the existing capacity to 135 mgd. The PWWF of 250 mgd can be achieved with the addition of three new mechanical bar screens (45 mgd each) and four additional grit chambers. Currently, the screens and grit chambers in Building 012 are coupled such that each grit chamber has a dedicated screen upstream. To provide flexibility in operation for the future preliminary treatment equipment, it is recommended that there be a common channel connecting screen effluent to downstream grit chambers. Additionally, since four grit chambers are required four bar screens should be installed for maximum flexibility.

For Options A and B, it is assumed that the additional preliminary treatment equipment will occupy a footprint similar to the existing Building 012. In Option A Building 011 will be retained as a structure and the lift station will be refurbished in place. In Option B, Building 011 will be demolished and the influent lift station relocated, creating space for improved visual mitigation.

3.1.2.2 Alternative 3

Preliminary treatment is currently performed in Buildings 011 and 012. Building 011 is the older of the two buildings and consists of five mechanical bar screens (0.75-inch opening) and five grit tanks (65 mesh grit). The SEP lift station is also located in Building 011. Building 012 consists of four climber bar screens (0.5-inch opening) and four Pista vortex grit units. For Alternative 3, it is assumed that the preliminary treatment equipment in Building 011 will be decommissioned; the lift station will be rebuilt closer to 012.

The preliminary treatment equipment in Building 012 is rated for a peak wet weather flow (PWWF) of 180 mgd with all units in service. The design criteria require one mechanical bar

screen and one grit chamber out of service during PWWF, which would reduce the existing capacity to 135 mgd. The PWWF of 250 mgd can be achieved with the addition of three new mechanical bar screens (45 mgd each) and four additional grit chambers. Currently, the screens and grit chambers in Building 012 are coupled such that each grit chamber has a dedicated screen upstream. To provide flexibility in operation for the future preliminary treatment equipment, it is recommended that there be a common channel connecting screen effluent to downstream grit chambers. Additionally, since four grit chambers are required four bar screens should be installed for maximum flexibility.

It is assumed that the additional preliminary treatment equipment will occupy a footprint similar to the existing preliminary treatment Building 012. In addition, preliminary treatment Building 011 will be demolished and the influent lift station relocated, creating space for improved visual mitigation.

3.1.2.3 Alternative 4

Screening will be performed with 8 bar screens (4-ft width) each with a treatment capacity of 35.7 mgd. Grit removal will be performed with five aerated grit tanks that will be an extension of primary clarifiers (41 ft x 40 ft, each).

3.1.3 **Primary Treatment**

3.1.3.1 Alternatives 1 and 2

For Options A and B, the primary treatment options are the same. The SEP has two sets of primary clarifiers, Buildings 040/041 and Building 042. Primary treatment Buildings 040/041 house the older set of primary clarifiers currently used for wet weather only treatment. There is sufficient capacity in Buildings 040/041 and 042 for future flows. All primary clarifiers would be rehabilitated. Those in Buildings 040/041 will be recoated and new mechanisms will be installed. Clarifiers in Building 042 will only need recoating.

If future regulations require an MBR or other technology, Building 040/041 can be demolished to make space available. With just Building 042 in service, conventional primary treatment (peak surface overflow rate [SOR] of 4,000 gpd/sf) is not possible at peak flow. Two additional clarifiers are needed to accommodate peak flows. Construction of an MBR will eliminate the need for the HPO process and two additional primary clarifiers can be constructed in that space. Chemically enhanced primary treatment (CEPT) with an SOR of 5,000 gpd/sf can be used as an interim solution during construction of the two additional primary clarifiers.

For Options A and B, it is assumed that all clarifiers will remain in service and will be rehabilitated. If future regulations call for an MBR, Buildings 040/041 must be demolished and two new primary clarifiers built where the HPO system exists. CEPT will only be used as an interim solution during construction.

3.1.3.2 Alternative 3

The SEP has two sets of primary clarifiers, Buildings 040/041 and Building 042. Buildings 040/041 house the older set of primary clarifiers currently used for wet weather only treatment. in Using the clarifiers in Buildings 040/041 and 042, there is sufficient capacity for future flows. All primary clarifiers would be rehabilitated by replacing the clarifier mechanisms and recoating the basins.

It is assumed that all primary clarifiers will remain in service and will be rehabilitated.

3.1.3.3 Alternative 4

It was assumed that conventional primary clarification would be used which will require eight primary clarifiers (225 ft x 40 ft, each).

3.1.4 Secondary Treatment

The General Assumptions Memo assumed that for SEP the existing HPO process (Building 200) represents the most compact technology where only secondary treatment must be met. For a mitigated SEP, the existing HPO process will be retained. As such, ammonia removal (i.e., nitrification) will not be possible due to the one-day solids retention time (SRT) and suppressed pH values. The existing aeration basins will be recoated and the cryogenic oxygen plant will need to be replaced with one of equivalent capacity.

3.1.4.1 Alternatives 1 and 2

For Alternative 1 and 2, the HPO plant will treat the peak day load after primary clarification (with CEPT). To satisfy design criteria, the existing plant would operate at a reduced SRT of 0.44 days during peak day loading, which is lower than the design value (one day). For the calculations, it was assumed that the peak day BOD load occurs on a day where the peak hour flow does not exceed 150 mgd, so that all the flow is treated through secondary treatment. Our rationale for letting the calculated SRT drop below the design objective is that the peak day projected BOD loadings were based on existing loading conditions, with no growth accounted for, since they primarily reflect the washout of the storage boxes during storm events. On the basis that the SEP is currently treating these loads successfully, it is assumed that the existing HPO plant has sufficient capacity for Alternative 1.

For Option A the existing secondary clarifiers will be rehabilitated but the footprint will not be reduced. In Option B these clarifiers will be replaced with more efficient flocculator clarifiers, capable of a higher SOR (1,700 gpd/sf at peak versus 830 gpd/sf at peak for the existing clarifiers). As a result, the number of secondary clarifiers can be reduced from the existing sixteen to nine. The outer seven clarifiers (numbers 1, 2, 3, 4, 8, 12 and 16) will be demolished to provide space for visual mitigation. The conversion of the remaining clarifiers to flocculator clarifiers will require a side water depth of 20 feet and the existing clarifier mechanisms will be replaced to optimize performance.

It is assumed that the existing HPO process (Building 200) can provide sufficient capacity for future loads and will be retained. All clarifiers will remain in service under Option A. For Option B It is assumed that clarifiers 1, 2, 3, 4, 8, 12 and 16 can be demolished and the remaining nine clarifiers will be converted to flocculator clarifiers. This will create space for extensive visual mitigation.

3.1.4.2 Alternative 3

Alternative 3 will not have secondary treatment.

3.1.4.3 Alternative 4

Footprint requirements described here for Alternative 4 are applicable to both secondary and advanced treatment processes. The MBR process will operate at a 10-d SRT which means that it will produce a completely nitrified effluent. In addition, the application of a membrane (either microfilter or ultrafilter) means that additional filtration necessary for future contaminants, will not be necessary. The MBR process will require eight aeration basins (including tanks containing membranes) measuring 254 ft by 51 ft, each. Additional space must be allocated for additional screening of MBR influent to remove debris that may damage membranes.

3.1.5 Advanced Treatment

3.1.5.1 Alternatives 1 and 2

If future regulations require higher levels of treatment the existing HPO plant can be replaced with a MBR process. There is not sufficient space to retrofit the existing HPO aeration basins; the MBRs will be installed where Buildings 040/041 are located currently. The MBR will require ten aeration basins (245 ft x 40 ft, each) as well as additional space allocated for ancillary equipment (i.e., permeate pumps, chemical cleaning equipment, screening facility).

An MBR can be constructed where Building 040/041 is currently, consisting of ten aeration basins (245 ft x 40 ft, each) and space for ancillary equipment.

3.1.5.2 Alternative 3

Alternative 3 will not have advanced treatment.

3.1.5.3 Alternative 4

MBR process will serve as both secondary and advanced treatment for alternative 4.

3.1.6 <u>Disinfection</u>

3.1.6.1 Alternatives 1 and 2

Secondary Effluent Disinfection

For both Options A and B, it was assumed that UV disinfection would be used for disinfection of secondary effluent. The UV system was sized assuming a transmissivity of 50 percent for both options (MBR effluent may have a higher transmissivity than tertiary filter effluent) and a minimum design dose of 35 mJ. The UV system would consist of 2,592 lamps arranged in 6 channels, two banks per channel. Each channel will have dimensions of 30 ft by 5.5 ft by 4.8 ft (LXWXD).

Primary Effluent Disinfection

The disinfection requirements for Options A and B will be the same. Disinfection of primary effluent will be performed during PWWF events where the 150-mgd capacity of the secondary treatment processes is exceeded. At PWWF (250 mgd), 100 mgd will be bypassed around the secondary processes and will be disinfected using liquid sodium hypochlorite. In Option A disinfection will be performed using a the existing chlorine contact channel. In Option B a new channel will be constructed to improve mitigation efforts by limiting odor potential at the plant perimeter. Dechlorination is assumed to be accomplished with sodium metabisulfite.

3.1.6.2 Alternative 3

Disinfection will be performed on all flows through SEF. At PWWF, 250 mgd of primary effluent will be disinfected using liquid sodium hypochlorite. Disinfection will be performed using a new effluent channel that will pass through the current secondary clarifier area. This will improve mitigation efforts by limiting odor potential at the plant perimeter. Dechlorination is assumed to be accomplished with sodium metabisulfite.

3.1.6.3 Alternative 4

Primary Effluent Disinfection

Disinfection of primary effluent will be performed during peak wet weather flow (PWWF) events where the 150-mgd capacity of the secondary treatment processes is exceeded. At PWWF (250 mgd), 100 mgd will be by-passed around the secondary processes and will be disinfected using liquid sodium hypochlorite. Disinfection will be performed using 9-ft wide channel (10-ft deep). The total channel length is 516 ft. Dechlorination is assumed to be accomplished with sodium metabisulfite.

Secondary Effluent Disinfection

It was assumed that UV disinfection would be used for disinfection of secondary effluent. The UV system was sized assuming a transmissivity of 50 percent and a minimum design

dose of 35 mJ. The UV system would consist of 2,592 lamps arranged in 6 channels, two banks per channel. Each channel will have dimensions of 30 ft by 5.5 ft by 4.8 ft (LXWXD).

4.0 OCEANSIDE PLANT

4.1.1 Flows and Loads

Table 2 lists the projected influent flows and loads used to size treatment units at the OSP for all alternatives. Note that for Alternative 3, the existing OSP will only treat westside wastewater flows and the dry-weather bayside flow will be treated at the NOSP, described in the next section.

Table 2 Projected Influent Flows and Loads for OSP 2030 Sewer System Master Plan City and County of San Francisco			
Parameter	Alternative 1, 3 and 4	Alternative 2	
Average Dry Weather Flow (mgd)	15.3	25.3	
Peak Hour Dry Weather Flow (mgd)	24.3	40.2	
Maximum Primary Treatment Capacity (mgd)	65	65	
Maximum Secondary Treatment Capacity (mgd)	43	43	
Average Influent BOD Loading (lb/d)	39,900	67,100	
Max Month Influent BOD Loading (lb/d)	46,700	80,600	
Max Week Influent BOD Loading (lb/d)	59,100	96,100	
Max Day Influent BOD Loading (lb/d)	82,500	134,000	
Average Influent TSS Loading (lb/d)	42,4000	71,400	
Max Month Influent TSS Loading (lb/d)	51,200	94,100	
Max Week Influent TSS Loading (lb/d)	66,800	119,000	
Max Day Influent TSS Loading (lb/d)	122,000	202,000	
Average Influent TKN Loading (lb/d)	6,720	11,700	

4.1.2 Preliminary Treatment

For all alternatives including both Option A and B in Alternative 1 and 2, the grit handling facility will be expanded to provide relieve for "grit events" encountered during wet weather.

The grit facility was originally designed so that two vortex tanks could handle 440 cf/day of grit, the estimated quantity generated from flushing of Westside T/S Box. Assuming a bulk density of 100 lb/cuft this design load is about 144,000 ppd and the design capacity of each vortex tank is about 72,000 ppd. Recent observations estimate that between 300,000 and 400,000 ppd of grit could enter the plant during grit events. It is therefore recommended that two new vortex tanks of the same size and capacity be installed for a total of five tanks. Currently the bar screens and grit tanks are paired into three separate trains (one screen to one grit tank). Since no additional screen is needed, the facility shall be modified so that the flow from one screen can go to any grit tank.

4.1.3 **Primary Treatment**

The maximum primary treatment capacity will remain the same as the original design capacity for all alternatives. There are five primary clarifiers at OSP. With one tank offline, the peak wet-weather flow of 65 mgd results in a surface overflow rate of 2,040 gpd/ft2, which is well within the design criteria.

4.1.4 Secondary Treatment

4.1.4.1 Alternatives 1, 3 and 4

In these alternatives, the OSP will continue to treat wastewater flows generated from westside drainages only. As projected for year 2030, the BOD loads will have a moderate increase from the original design loads. The average BOD would be about 15% higher, the maximum month 2% higher, while the maximum day load would remain essentially the same. These loading conditions are within the design capacity of the existing secondary treatment facility.

4.1.4.2 Alternative 2

In Alternative 2, BOD loading to the secondary system will be significantly increased with the addition of diverted bayside flow. BioWIN simulations indicate that two aeration trains are able to handle the average load at 1-day SRT. For maximum month and maximum week conditions, three trains will need to be in service, and a more aggressive SRT can be used during max week load to keep the MLSS at acceptable level. The existing seven secondary clarifiers will be able to handle the increased loads based on clarifier stress test results1.

The existing oxygen generation system has three PSA units with a total production capacity of 30 tons/day, and the liquid oxygen storage system can supplement the oxygen supply at a maximum vaporization rate of 34 tons per day. Based on current oxygen demands and projected loads of Alternative 2, the existing PSA system has sufficient capacity for up to

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¹ The OSP subsequently converted the aeration tanks to an anaerobic selector system. The sludge settling property was greatly improved, with SVI reduced from around 300 mL/g (at the time of stress

the maximum month condition. Under max-week and max-day loads, supplemental supplies from the LOX system will be sufficient to meet the demands.

4.1.5 <u>Disinfection</u>

4.1.5.1 Alternatives 1 and 4

Currently there are no microbial discharge standards for OSP effluents. Alternatives 1 and 4 will retain the existing flow scheme, and are not expected to trigger new disinfection requirements.

4.1.5.2 Alternatives 2 and 3

It is assumed that disinfection will be required for OSP effluents due to increased ocean discharges in Alternatives 2 and 3. A UV disinfection system will be constructed for secondary effluent disinfection. Assuming a transmissivity of 50% and a minimum design dose of 35mJ/cm2, the UV system will be of low-pressure, high-intensity configuration with three channels and a total of 1080 lamps.

The primary effluent that bypasses secondary treatment during wet weather will be disinfected in the existing chlorine contact channel.

4.1.6 Solids Handling

For all alternatives except Option A of Alternative 1, the solids stabilization process will be upgraded to meet Class A requirements, in order to ensure continued beneficial biosolids reuse. This will be achieved with a thermal hydrolysis pretreatment process. For a description of the process refer to the technical memorandum San Francisco Long-Term Biosolids Management Plan. The system will consist of two process trains, with two pulper tanks, three reactors and one flash tank per train. The capacity of each reactor will be 48,000 lb of solids per day. The process upgrade will also include sludge pre-dewatering and high pressure steam generation. The proposed facility capacity will be sufficient for the higher solids loads in Alternative 2, and the pretreatment will allow the digesters to handle the increased solids loads at much higher feed concentrations.

5.0 NEW OCEANSIDE PLANT

In Alternative 3, all bayside dry-weather flow will be transported to the OSP site for treatment and discharge. It is possible that a consolidated new plant will be constructed that will treat both bayside and westside flows. As a conservative measure, it is assumed that the transported bayside flow will not be blended with the westside flows and will be treated at a separate plant, the NOSP. This plant will be constructed in the area between the existing OSP and Armory Road.

test) to about 150 mL/g. This further ensures the clarifiers' ability to handle the loading conditions under Alternative 2.

5.1.1 Flows and Loads

Table 3 lists the projected influent flows and loads used to size treatment units at the NOSP.

Table 3 Projected Influent Flows and Loads for NOSP 2030 Sewer System Master Plan City and County of San Francisco		
Parameter	Alternative 3	
Average Dry Weather Flow (mgd)	79.3	
Peak Hour Dry Weather Flow (mgd)	106.2	
Maximum Primary Treatment Capacity (mgd)	150	
Maximum Secondary Treatment Capacity (mgd) 150		
Average Influent BOD Loading (lb/d)	186,000	
Max Month Influent BOD Loading (lb/d)	225,000	
Max Week Influent BOD Loading (lb/d)	243,000	
Max Day Influent BOD Loading (lb/d)	328,000	
Average Influent TSS Loading (lb/d)	198,000	
Max Month Influent TSS Loading (lb/d)	280,000	
Max Week Influent TSS Loading (lb/d)	335,000	
Max Day Influent TSS Loading (lb/d)	773,000	
Average Influent TKN Loading (lb/d)	33,800	

5.1.2 **Preliminary Treatment**

The preliminary treatment facility will include three bar screens with 3/8-in openings and 5-ft width, and four vortex grit tanks with 24-ft diameter. The facility will be similar in size to the existing dry-weather headworks (Building 012) at SEP.

5.1.3 Primary Treatment

The primary treatment facility will consist of seven conventional primary clarifiers (180 ft x 39 ft each).

5.1.4 Secondary Treatment

Preliminary footprint analysis indicated that accommodating an activated sludge facility in the available area would be challenging, and would require aggressive design approaches such as stacked clarifiers. As a conservative measure, it is assumed that an MBR facility will be constructed for secondary treatment. Activated sludge processes may be

reconsidered if the plant layout could be optimized by utilizing the entire site area for a consolidated plant, instead of a separate NOSP for bayside flows.

The MBR process will operate at a 10-d SRT and will require eight aeration basins (including tanks containing membranes) measuring 254 ft by 51 ft, each. Additional space must be allocated for additional screening of MBR influent to remove debris that may damage membranes.

5.1.5 <u>Disinfection</u>

Secondary effluent disinfection will be achieved using high-output low-pressure ultraviolet (UV) system. The UV system will consist of five channels with a total of 1,980 lamps.

6.0 NORTH POINT FACILITY

6.1.1 Flows and Loads

Table 4 lists the projected influent flows and loads used to size treatment units at the NPF for all alternatives.

Table 4 Projected Influent Flows and Loads for NPF 2030 Sewer System Master Plan City and County of San Francisco		
Parameter	Alternatives 1, 3 and 4	Alternative 2
Average Dry Weather Flow (mgd)	n/a	18.4
Peak Hour Dry Weather Flow (mgd)	n/a	25.7
Maximum Primary Treatment Capacity (mgd)	240	266
Maximum Secondary Treatment Capacity (mgd)	n/a	26
Average Influent BOD Loading (lb/d)	n/a	38,500
Max Month Influent BOD Loading (lb/d)	n/a	48,000
Max Week Influent BOD Loading (lb/d)	n/a	52,300
Max Day Influent BOD Loading (lb/d)	n/a	73,000
Average Influent TSS Loading (lb/d)	n/a	41,000
Max Month Influent TSS Loading (lb/d)	n/a	60,700
Max Week Influent TSS Loading (lb/d)	n/a	74,000
Max Day Influent TSS Loading (lb/d)	n/a	179,000
Average Influent TKN Loading (lb/d)	n/a	7,020
Note: n/a - not applicable		

6.1.2 **Preliminary Treatment**

6.1.2.1 Alternatives 1, 3 and 4

In Option A of Alternative 1, two fine bar screens will be added for a total of four screens to handle the increased flow capacity to 240 mgd. The screens will be with 3/8-in openings and 4.5-ft channel width.

The NPF currently does not operate a grit handling process, and grit is allowed to enter and settle in the primary clarifiers. In Option B of Alternative 1, a new grit handling facility will be constructed in addition to the new bar screens. The facility will consist of six aerated grit tanks (75 ft x 18 ft each). The new facility would be located on the south side of NPF. Alternatively, the grit handling improvement may be a modification of the primary clarifiers that would enable more effective grit capture and retrieval.

The preliminary treatment improvements in Alternatives 3, 4 will be the same as Option B of Alternative 1.

6.1.2.2 Alternative 2

The preliminary treatment improvements for the wet-weather facility in Alternative 2 will be the same as Options A and B, respectively, of Alternative 1. In addition, a preliminary treatment facility will be constructed on the south side for dry-weather flows. The facility will include two bar screens with 3/8-in openings and 4.5-ft channel width, and three vortex grit tanks with 22-ft diameter.

6.1.3 Primary Treatment

6.1.3.1 Alternatives 1, 3 and 4

The existing six primary clarifiers will be rehabilitated. The clarifiers are currently without sludge blanket collection mechanisms, and the sludge is manually flushed out of the tanks after each wet-weather operating session. The clarifiers will be refurbished with new sludge collection mechanisms. However, a sludge handling strategy must be developed if sludge were collected continuously during wet-weather operation (that is, when sludge pumping to the Channel T/S Box is not allowed). The scum collection system will also be upgraded to improve operating efficiency.

6.1.3.2 Alternative 2

The primary treatment improvements for the wet-weather facility in Alternative 2 will be the same as Alternatives 1, 3 and 4. In addition, a new primary treatment facility will be constructed on the south side for dry-weather flows. The facility will consist of four conventional primary clarifiers, 150 ft x 20 ft each.

6.1.4 Secondary Treatment

Secondary treatment will only be required for the dry-weather flows in Alternative 2. To accommodate a facility on the south side of the plant, conventional activated sludge processes would not be possible. It is assumed that an MBR facility will be constructed. The facility will consist of seven basins with a total aeration volume of 320,000 cf. The MBR process will include an anoxic zone prior to aerobic zone, and will operate at 10-day SRT.

The MBR will also meet the advanced treatment requirements by producing a completely nitrified and filtered effluent.

6.1.5 Disinfection

6.1.5.1 Alternatives 1, 3 and 4

Disinfection of primary effluent will continue to be achieved with sodium hypochlorite chlorination and sodium bisulfite dechlorination. A new chlorine contact channel will be constructed on the south side for the increased flow capacity. The channel will be 15-ft wide and a total length of 760 ft, arranged in a serpentine configuration, and a sidewater depth of 10 ft.

6.1.5.2 Alternative 2

A new chlorine contact channel for the wet-weather facility in Alternative 2 will be of the same size as in Alternatives 1, 3 and 4. Since the south side of the plant will be occupied by dry-weather facilities, the contact channel will be located on the Seawall Triangle east of the north side (across Kearny Street).

In addition, the MBR effluent will be disinfected with a UV system. The system will be of low-pressure, high-intensity configuration consisting of two channels with a total of 648 lamps.

6.1.6 Solids Handling for Alternative 2

The NPP upgrade in Alternative 2 will not include a solids stabilization facility, and the solids generated from primary and secondary processes will still need to be treated at the centralized Biosolids Center for treatment. It would not be preferable to continue pumping the solids via North Shore Force Main to Channel T/S Box and allowing it to be mixed with influent flows to the SEP. A strategy needs to be developed for the effective transport of North Point solids to the Biosolids Center. One option would be to revive the old sludge pipe that used to serve this function when North Point was an all-weather plant.

7.0 SUMMARY OF ASSOCIATED COSTS

This section presents estimated capital costs. The capital costs for all alternatives are summarized in Tables 5 through 12.

The capital costs were estimated at a level that can be used to prepare planning level cost scopes and evaluate alternative schemes. The estimate was prepared using quantity take-offs, vendor quotes, and equipment pricing furnished by the design team or by the estimator. The estimate includes direct labor costs, including a shift differential if applicable, and anticipated productivity adjustments to labor, and equipment. Where possible, estimates for work anticipated to be performed by specialty subcontractors were used. A detailed description of the cost estimating procedure for the capital costs can be found in the SFPUC Wastewater Treatment Plants Master Plan Conceptual Design Estimates Basis of Estimate of Probable Construction Cost submitted by Brown and Caldwell on January 8, 2007.

Table 5 Summary of Capital Costs for Alternative 1 2030 Sewer System Master Plan City and County of San Francisco		
Facility	Alternative 1A Total Expenditure (2006 dollars)	Alternative 1B Total Expenditure (2006 dollars)
SEP		
Demolition, Site Prep	79,577,206	80,765,050
Site Work, Yard Piping	30,814,467	37,462,639
Electrical/Instrumentation	44,510,969	85,244,222
Influent Pump Station	5,528,255	12,564,805
Headworks	19,433,584	19,433,878
Primary Clarifiers	5,229,209	4,932,776
HPO & Secondary Clarifiers Upgrades	79,849,224	108,046,836
Chlorine Disinfection	n/a	6,582,586
UV Disinfection	11,289,903	22,868,538
Odor Control	36,167,430	35,315,389
Architectural Mitigation	21,080,428	71,057,887
Administration Building	n/a	80,782,182
Maintenance Building	n/a	3,592,464
Total SEP Capital Costs	333,480,675	568,649,252

Table 5	Summary of Capital Costs for Alternative 1
	2030 Sewer System Master Plan
	City and County of San Francisco

Facility	Alternative 1A Total Expenditure (2006 dollars)	Alternative 1B Total Expenditure (2006 dollars)
NPF		,
Land Acquisition, Site Prep	28,204,062	28,204,062
Site Work, Yard Piping	13,445,866	14,386,632
Electrical, Instrumentation	8,493,677	15,176,242
Pretreatment	n/a	24,596,360
Primary Clarifiers	5,062,858	5,062,858
Chemical Facilities	5,577,709	5,577,709
Chlorine Contact Process	11,056,064	11,056,064
Total NPF Capital Costs	71,840,236	104,059,927
OSP		
Site Work, Yard Piping	2,455,774	4,075,402
Electrical, Instrumentation	2,298,788	15,866,762
Preliminary Treatment	9,659,408	9,659,408
Solids Pretreatment	n/a	54,100,774
Architectural Mitigation	3,264,631	16,334,934
Total OSP Capital Costs	17,678,601	100,037,280
BBC		
Total BBC Capital Costs	636,949,239	703,644,185
Outfalls ⁽¹⁾		
SEP Outfall	278,809,579	278,809,579
NPF Outfall	237,813,717	237,813,717
Total Treatment Plant Costs	1,576,572,047	1,993,013,940

⁽¹⁾ These costs include construction of a new 9-ft diameter outfall for each location. At SEP the old outfall risers will be demolished and at North Point the whole outfall will be demolished.

Table 6 Summary of Capital Costs for Alternative 1 Future and Optional Projects 2030 Sewer System Master Plan City and County of San Francisco				
Facility	Alternative 1A Total Expenditure (2006 dollars)	Alternative 1B Total Expenditure (2006 dollars)		
SEP				
MBR Demonstration Project	52,224,003	52,224,003		
MBR Facility	395,609,527	426,101,804		
Demolition of Wet Weather Primaries	2,325,153	2,325,153		
Total SEP Future Capital Costs	450,158,683	480,650,960		
NPF – Increase capacity to 240 mgd				
Site Work, Yard Piping	49,975	4,255,661		
Electrical, Instrumentation	142,680	3,003,797		
Pretreatment	1,037,625	23,524,997		
Total NPF Future Capital Costs	1,230,280	30,784,455		
BBC	1			
Biosolids Drying	134,300,694	139,324,620		
Total BBC Future Capital Costs	134,300,694	139,324,620		
Total Treatment Plant Costs	585,689,657	650,760,035		

Table 7 Summary of Capital (2030 Sewer System I) City and County of S		
Facility	Alternative 2A Total Expenditure (2006 dollars)	Alternative 2B Total Expenditure (2006 dollars)
SEP		
Demolition, Site Prep	79,577,206	80,765,050
Site Work, Yard Piping	30,868,423	38,072,100
Electrical/Instrumentation	44,525,105	69,808,240
Influent Pump Station	5,528,255	12,564,805
Headworks	19,433,584	20,227,752
Primary Clarifiers	5,229,209	3,999,588
HPO & Secondary Clarifiers Upgrades	79,849,224	67,356,029
Chlorine Disinfection	n/a	6,637,059
UV Disinfection	11,289,903	22,771,871
Odor Control	36,167,430	36,779,093
Architectural Mitigation	21,087,159	61,667,866
Administration Building	n/a	78,027,736
Maintenance Building	n/a	3,629,625
Total SEP Capital Costs	333,555,498	502,306,814
NPF		
Land Acquisition, Site Prep	28,204,062	28,204,062
Site Work, Yard Piping	13,445,866	14,386,632
Electrical, Instrumentation	8,493,677	15,176,242
Pretreatment	n/a	24,596,360
Primary Clarifiers	5,062,858	5,062,858
Chemical Facilities	5,577,709	5,577,709
Chlorine Contact Process	11,056,064	11,056,064
Total NPF Capital Costs	71,840,236	104,059,927

2030 Sewer System Ma	Summary of Capital Costs for Alternative 2 2030 Sewer System Master Plan City and County of San Francisco		
Facility	Alternative 2A Total Expenditure (2006 dollars)	Alternative 2B Total Expenditure (2006 dollars)	
NPP			
Land Acquisition, Site Prep	n/a	25,433,273	
Site Work, Yard Piping	n/a	6,232,495	
Electrical, Instrumentation	n/a	69,053,757	
Pretreatment	n/a	28,549,992	
Primary Clarifiers	n/a	17,484,128	
MBR	n/a	194,417,602	
UV Disinfection	n/a	7,410,456	
Odor Control	n/a	33,882,929	
Chemical Facility	n/a	3,577,420	
Architectural Mitigation	n/a	61,794,076	
Total NPP Capital Costs	n/a	447,836,128	
OSP			
Site Work, Yard Piping	4,830,052	4,830,052	
Electrical, Instrumentation	18,209,547	18,209,547	
Preliminary Treatment	9,659,408	9,659,408	
UV Disinfection	8,981,558	8,981,558	
Solids Pretreatment	54,100,774	54,100,774	
Architectural Mitigation	16,408,051	16,408,051	
Total OSP Capital Costs	112,189,390	112,189,390	
BBC			
Total BBC Capital Costs	636,949,239	703,644,185	
Outfalls ¹			
SEP Outfall	278,809,579	278,809,579	
NPF Outfall	237,813,717	237,813,717	
Total Treatment Plant Costs	1,671,157,659	2,386,659,740	

⁽¹⁾ These costs include construction of a new 9-ft diameter outfall for each location. At SEP the old outfall risers will be demolished and at North Point the whole outfall will be demolished.

Projects 2030 Sewer System Ma	Summary of Capital Costs for Alternative 2 Future and Optional Projects 2030 Sewer System Master Plan City and County of San Francisco		
Facility	Alternative 2A Total Expenditure (2006 dollars)	Alternative 2B Total Expenditure (2006 dollars)	
SEP	•		
MBR Demonstration Project	52,224,003	52,224,003	
MBR Facility	395,609,527	366,327,604	
Demolition of Wet Weather Primaries	2,325,153	2,325,153	
Total SEP Future Capital Costs	450,158,683	420,876,760	
NPF – Increase capacity to 240 mgd			
Site Work, Yard Piping	49,975	4,255,661	
Electrical, Instrumentation	142,680	3,003,797	
Pretreatment	1,037,625	23,524,997	
Total NPF Future Capital Costs	1,230,280	30,784,455	
BBC		I	
Biosolids Drying	139,324,620	139,324,620	
Total BBC Future Capital Costs	139,324,620	139,324,620	
Total Treatment Plant Costs	590,713,583	650,760,035	

Table 9 Summary of Capital Costs for Alternative 3 2030 Sewer System Master Plan City and County of San Francisco						
Facility	Alternative 3 Total Expenditure (2006 dollars)					
SEP						
Demolition, Site Prep	110,231,360					
Site Work, Yard Piping	35,341,589					
Electrical/Instrumentation	40,185,502					
Influent Pump Station	12,567,736					
Headworks	20,227,049					
Primary Clarifiers	62,469,638					
Chlorine Disinfection	10,657,918					
Odor Control	26,321,446					
Architectural Mitigation	35,488,556					
Maintenance Building	3,592,464					
Total SEP Capital Costs	357,083,258					
NPF						
Land Acquisition, Site Prep	28,204,062					
Site Work, Yard Piping	14,386,632					
Electrical, Instrumentation	15,176,242					
Pretreatment	24,596,360					
Primary Clarifiers	5,062,858					
Chemical Facilities	5,577,709					
Chlorine Contact Process	11,056,064					
Total NPF Capital Costs	104,059,927					
New OSP	I					
Land Acquisition, Site Prep	15,597,590					
Lease for Armory	25,000,000					
Site Work, Yard Piping	39,441,346					
Electrical, Instrumentation	95,321,078					
Preliminary Treatment	17,698,621					
Primary Clarification	37,958,837					
MBR	242,770,106					
Chlorine Disinfection	17,340,123					

Table 9	Summary of Capital Costs 2030 Sewer System Maste City and County of San Fr	r Plan				
	Facility	Alternative 3 Total Expenditure (2006 dollars)				
Odor C	control	39,589,612				
Chemic	cal Facility	6,072,466				
Archite	ctural Mitigation	85,026,805				
Total N	lew OSP Capital Costs	621,816,584				
Existing O	SP					
Site Wo	ork, Yard Piping	4,830,052				
Electric	cal, Instrumentation	18,209,547				
Prelimi	nary Treatment	9,659,408				
UV Dis	infection	8,981,558				
Solids	Pretreatment	54,100,774				
Archite	ctural Mitigation	16,408,051				
Total E	xisting OSP Capital Costs	112,189,390				
WBC		'				
Total W	/BC Capital Costs	541,337,957				
Outfalls ⁽¹⁾		,				
SEP O	utfall	278,809,579				
NPF O	utfall	237,813,717				
Total Treatment Plant Costs 1,993,013,940						
Materia						

⁽¹⁾ These costs include construction of a new 9-ft diameter outfall for each location. At SEP the old outfall risers will be demolished and at North Point the whole outfall will be demolished.

Table 10 Summary of Capital Costs for Alternative 3 Future and Optional Projects 2030 Sewer System Master Plan City and County of San Francisco							
Facility Alternative 3 Total Expenditure (2006 dollars)							
SEP							
MBR Demonstration Project	52,224,003						
Total SEP Future Capital Costs	52,224,003						
NPF – Increase capacity to 240 mgd							
Site Work, Yard Piping	4,255,661						
Electrical, Instrumentation	3,003,797						
Pretreatment	23,524,997						
Total NPF Future Capital Costs	30,784,455						
WBC							
Biosolids Drying	32,000,851						
Total WBC Future Capital Costs	32,000,851						
Total Future Treatment Plant Costs 115,009,309							

Table 11 Summary of Capital Costs for Alternative 4 2030 Sewer System Master Plan City and County of San Francisco					
Facility	Alternative 4 Total Expenditure (2006 dollars)				
Existing SEP					
Demolition, Site Prep	140,883,188				
Total Existing SEP Capital Costs	140,883,188				
New SEP	·				
Land Acquisition, Site Prep	165,948,772				
Site Work, Yard Piping	6,321,187				
Electrical/Instrumentation	122,733,021				
Influent Pump Station	12,567,736				
Headworks	50,383,312				
Primary Clarifiers	57,860,807				
MBR	246,690,061				
Chlorine Disinfection	5,504,196				
UV Disinfection	19,308,949				
Odor Control	33,115,600				
Architectural Mitigation	36,576,486				
Administration Building	80,451,588				
Maintenance Building	3,629,645				
Total SEP Capital Costs	841,091,360				
NPF					
Land Acquisition, Site Prep	28,204,062				
Site Work, Yard Piping	14,386,632				
Electrical, Instrumentation	15,176,242				
Pretreatment	24,596,360				
Primary Clarifiers	5,062,858				
Chemical Facilities	5,577,709				
Chlorine Contact Process	11,056,064				
Total NPF Capital Costs	104,059,927				

Table 11 Summary of Capital Costs for Alternative 4 2030 Sewer System Master Plan City and County of San Francisco						
	Facility	Alternative 4 Total Expenditure (2006 dollars)				
OSP						
Site Wo	rk, Yard Piping	4,075,402				
Electrica	al, Instrumentation	15,866,762				
Prelimin	ary Treatment	9,659,408				
Solids P	Pretreatment	54,100,774				
Architec	tural Mitigation	16,334,934				
Total OS	SP Capital Costs	100,037,280				
BBC						
Total BE	BC Capital Costs	564,091,920				
Outfalls ⁽¹⁾						
SEP Ou	tfall	278,809,579				
NPF Ou	tfall	237,813,717				
Total Tr	eatment Plant Costs	1,993,013,940				
Notos		1				

⁽¹⁾ These costs include construction of a new 9-ft diameter outfall for each location. At SEP the old outfall risers will be demolished and at North Point the whole outfall will be demolished.

Table 12 Summary of Capital Costs for Alternative 4 Future and Optional Projects 2030 Sewer System Master Plan City and County of San Francisco							
Facility Alternative 4 Total Expenditu (2006 dollars)							
New SEP	,						
MBR Demonstration Project	52,224,003						
Total SEP Future Capital Costs	52,224,003						
NPF – Increase capacity to 240 mgd							
Site Work, Yard Piping	4,255,661						
Electrical, Instrumentation	3,003,797						
Pretreatment	23,524,997						
Total NPF Future Capital Costs	30,784,455						
BBC							
Biosolids Drying 38,516,764							
Total BBC Future Capital Costs	38,516,764						
Total Treatment Plant Costs	121,525,222						

APPENDIX A – GENERAL ASSUMPTIONS AND CRITERIA FOR TREATMENT ALTERNATIVE FOOTPRINT ANALYSES



PROJECT MEMORANDUM

Project Name: SFPUC Sewer Master Plan Date: May 23, 2006

Client: City and County of San Francisco Project Number: 128680

Prepared By: Lloyd Slezak, Brown and Caldwell Denny Parker, Brown and Caldwell

Subject: General Assumptions and Criteria for Treatment Alternative Footprint Analyses

Purpose and Objectives

The purpose of this memo is to summarize general assumptions and criteria for the development of interim deliverables for the Wastewater Master Plan aimed at estimating the potential land area requirements and layouts for the wastewater treatment plants required under the various system alternatives. These "Footprint Analyses" are required at both existing treatment sites and potential new treatment sites. Brown and Caldwell and SFPUC staff each have independent assignments for such footprint analyses, however it is important that the independent assignments recognize and adhere to a common set of general assumptions about flows and loads, routing of combined wastewater through primary only and primary plus secondary treatment processes, appropriate treatment process selections, and treatment process criteria. The purpose of this memorandum is to record the agreed assumptions and criteria that will underlie various footprint analyses¹.

Footprint Analyses Required

Oceanside Treatment

- OS 1. Treatment facilities necessary to accommodate treatment of dry weather and wet weather flows (not including CSOs) from the Bayside sewerage area at the Oceanside Treatment Plant (OSP). Bayside wet weather flows that currently are processed and discharged at the North Point Facility are not assumed to be transported to OSP in this analysis.
- OS 2. Treatment facilities necessary to accommodate treatment of all dry weather flows from the Bayside sewerage area at the Oceanside Treatment Plant.
- OS 3. Treatment facilities necessary to accommodate treatment of dry weather and wet weather flows (not including CSOs) from a partial diversion of flows from the Bayside sewerage area at the Oceanside Treatment Plant. The amount of diversion will be matched with the existing capacity of the Oceanside Treatment Plant and use of the (expanded) wet weather pumps in Westside Pump Station for decanting of excess flows during wet weather without impacting the Westside CSD practice. This treatment scenario is associated with the Cayuga Tunnel concept.

¹This memo covers liquid processing facilities. Solids processing facilities will be covered in another document.

Bayside Treatment

- BA 1. Treatment facilities required to treat all Bayside flows that are currently routed to the Southeast Plant with footprint reductions achieved through replacement of existing facilities with more optimally sized and aggressively loaded treatment processes.
- BA 2. Treatment facilities required to treat all Bayside flows that are currently routed to the Southeast Plant at a new "green field" central location.
- BA 3. Treatment facilities required to treat the North Shore drainage area (North Shore Pump Station) dry weather flows at new secondary treatment facilities located at the North Point Wet Weather Treatment Facility. Also includes expansion of wet weather treatment capacity from 150 mgd to 240 MGD (or higher) depending on CSO system evaluation.
- BA 4. Treatment facilities required to treat the Channel drainage area (Channel Pump Station flows minus the North Shore Pumping Station flows) dry weather flows at new secondary treatment facilities at some location near the Channel Pump Station.
- BA 5. Treatment facilities required to treat the portion of dry weather flows remaining at Southeast plant after diversions to the new treatment facilities at North Point and Channel Pump Station area are completed (see BA 3 and BA 4).
- BA 6. Treatment facilities for wet weather flows (not including CSOs) at a reconfigured Southeast Plant resulting from diversion of Bayside sewerage area dry weather flows to the Oceanside Plant.
- BA 7. Treatment facilities required to treat the portion of dry weather flows remaining at Southeast plant after partial diversions of Bayside sewerage area flows to the Oceanside plant with implementation of the Cayuga Tunnel concept.



Flow and Load Assumptions

SFPUC staff developed the flow and load analysis shown in the table below.

of 1 oo stall developed the low and load analysis shown in the table below.																	
		Flow, MGD				BOD, ppd			TSS, ppd				TKN, ppd				
Condition	Option Label	ADWF	DW Peak Hour	Secondary Capacity	Total Capacity	ADWL	Max Month	Max Week	Max Day	ADWL	Max Month	Max Week	Max Day	2nd Max Day	ADWL	Max Month	Max Week
Existing OSP	-	15.3	24.3	43	65	39,900	46,700	59,100	82,500	42,400	51,200	66,800	122,000		6,720	7,870	9,970
Existing SEP	BA-1, BA-2	79.4	106.2	150	250	186,000	225,000	243,000	328,000	198,000	280,000	335,000	773,000	536,000	33,800	41,000	44,300
All SEP Flow to OSP	OS-1	94.6	130.5	193	315	226,000	272,000	302,000	410,000	240,000	331,000	402,000	890,000	658,000	40,600	48,900	54,200
Bayside Dry Weather Flow to OSP ^a	OS-2	94.6	130.5	130 ^b	171 °	226,000	272,000	302,000	410,000	240,000	331,000	402,000	890,000	658,000	40,600	48,900	54,200
Cayuga Flow to OSP	OS-3	To be determined															
SEP Flows at NP	BA-3	18.4	25.7	36	150+ (250) ^d	38,600	48,000	52,300	73,000	41,000	60,800	74,100	179,000	122,000	7,030	8,750	9,500
SEP Flows at New Channel	BS-4	30.8	43.0	61	50+ ^d	73,300	91,300	99,500	138,000	78,000	116,000	141,000	341,000	233,000	13,400	16,600	18,100
Reduced SEP Flows	BA-5	30.2	37.5	53	200+ ^d	73,800	85,700	91,100	117,000	78,500	103,000	120,000	252,000	181,000	13,500	15,600	16,600
SEP Wet Weather Only	BA-6	0	0	0	100+ ^d					To be det	ermined						
SEP After Cayuga Diversion	BA-7	To be de	etermined														

Notes:

Major Assumptions:

- 1. ADWF flow and loads are based on population and water demand projections for 2030, and a wastewater:water ratio of 0.95
- 2. Bay water intrusion is allocated as: North Shore--0.5 MGD; Channel--0.5 MGD; Islais Creek + Sunnydale--1 MGD
- 3. North Shore, Channel, Islais Creek and Sunnydale Drainages have the same peaking characteristics as total SEP flow
- 4. Peaking factors are derived from historical records:
- * 1995 Southeast Plant data
- * 2004 Oceanside Plant data
- 5. Outside wastewater sources: (to be revised when more reliable projections are available)
- * North San Mateo Co. and Presidio flows are assumed to remain at their current levels
- * Bayshore and Brisbane flows are at their maximum limits (5 and 6.7 MGD). They are not applied with peaking factors
- 6. BOD and TKN follow the same peaking characteristics as COD

^a Peak loads are the same as "All SEP Flows to OSP," since SEP peak conditions occur at less than 150 MGD flow.

^b Citywide peak (hourly) dry weather flow

^c Existing OSP capacity (65 MGD) + Bayside dry-weather peak flow

^d Additional primary capacities to be determined by CSO system evaluation



Preliminary and Primary Treatment Process Assumptions

Assumptions regarding the need for preliminary and primary treatment in various footprint analyses are driven by the plant that is being analyzed.

North Point Wet Weather Treatment Facility

The North Point Plant is a former primary treatment plant that has been converted to a wet weather treatment facility. Scenarios anticipate that the existing facilities for wet weather treatment should remain and that any secondary treatment at the site be provided with a new parallel treatment process. New preliminary and primary treatment processes should be included with new secondary treatment and disinfection processes for the new North Point Plant facilities.

New Channel Plant

Any secondary treatment associated with a new plant near the Channel Pump Station would need to have associated preliminary and primary treatment processes.

Southeast Plant

Revised secondary treatment facilities at the Southeast Plant will take their flows from common preliminary and primary treatment facilities that handle wet weather flows designated for primary treatment only and flows that can be accommodated with the secondary treatment processes.

Oceanside Plant

Revised secondary treatment facilities at the Oceanside Plant will take their flows from common preliminary and primary treatment facilities that handle wet weather flows designated for primary treatment only and flows that can be accommodated with the secondary treatment processes. Grit handling facilities are currently overwhelmed at times, and the grit handling system will need an upgrade.

Representative Preliminary and Primary Treatment Technology Assumptions

Where required, preliminary treatment is assumed to include lift pumping, screening with mechanically cleaned bar screens, and grit removal with either aerated grit tanks or vortex type grit separation processes.

Primary treatment will generally be assumed as conventional primary sedimentation. Chemically Enhanced Primary Treatment may be considered in special instances (e.g. ahead of biological aerated filters or perhaps for increased primary performance in wet weather conditions).

Secondary Treatment –Representative Process Technology Assumptions

Suitable treatment locations in developed urban environments like that in San Francisco means that treatment technologies must be identified that fit within site constraints and that can be shielded or screened for aesthetic reasons. Therefore, for planning purposes, representative technologies must be identified that can be used as "place holders" for siting and environmental

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studies, recognizing that by the time of design, newer more attractive technologies may be identified and chosen for implementation.

Compact Secondary Treatment at New Sites

Treatment schemes BA-3 and 4 considers decentralizing treatment by providing new treatment facilities at or near the North Point plant and the Channel PS, thereby reducing the flows treated at the Southeast plant. Also, BA-2 considers relocating all flows now currently treated at the Southeast plant to a new treatment plant

For the new plants at or near North Point and Channel sites, or a completely new site, space constraints lead to the conclusion that the most compact treatment processes must be chosen, even though they will not have the lowest life cycle costs compared to the more conventional technologies such as employed currently at San Francisco's plants. Thus, the conventional technologies, such conventional activated sludge, high purity oxygen activated sludge, and the trickling filter/solids contact technologies were not considered for North Point or Channel sites or a completely new site (under BA-2)².

The assessment was that compact treatment technologies are currently developing or evolving at a rapid pace of development, with new variants appearing in the market place almost annually. Since the actual design of new wastewater treatment plants is likely a decade away, it was determined that only small number of representative technologies would be considered for the purposes of determining compact plant footprint. Several technologies were considered as follows:

- Deep shaft. This technology involves a vertical shaft (several hundred feet in depth) with a pipeline within the center shaft that allows reverse flow for aeration and circulatory flow. Aeration at high pressures results in supersaturation of dissolved gases which are released when the flow is brought to the surface. Post aeration must relieve the gasses to allow sedimentation. Because mixed liquor levels are very high, larger than normal secondary clarifiers must be employed, which reduces any space advantage of the process. Alternatively, smaller flotation tanks may be used for solids separation, but there have been problems with meeting secondary treatment requirements when using flotation as the designs have not been optimized for clarification. Therefore, the technology was not considered as the representative compact technology, but future developments in flotation separation could permit its reconsideration later.
- Deep Aeration Tanks. Aeration tanks can be built deeper (say 30 ft) compared to the shallow sidewater depth typically employed (for instance, the oxygen reactors at the Southeast plant are 15 ft deep). Fine bubble diffusion can be used to increase energy efficiency over existing technology. To prevent flotation of solids in downstream secondary clarifiers due to supersaturation of dissolved gasses, post aeration is typically provided in aerated channels distributing the mixed liquor to secondary clarifiers. These deeper aeration tanks can be followed either by flocculator clarifiers, which are typically loaded from 25 to 50 percent higher than conventional clarifiers because of their greater depth (20 vs. 15 in ft in current clarifiers), rapid sludge withdrawal and improved

² If, contrary to our expectations, a site is found that will accommodate conventional technologies, this assumption can be revisited during later planning.

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hydraulic features. Alternatively, rectangular secondary clarifiers can be stacked one atop the other and can be considered if there is insufficient room for flocculator clarifiers. They take somewhat less space than flocculator clarifiers, but have the disadvantages of greater difficulty of flow balancing as well as reduced ease of access for maintenance. The deep tank aeration technology option is considered a well developed and proven process.

- Membrane Bioreactor (MBR) technology. MBRs are activated sludge processes that use membranes for solids separation instead of secondary clarifiers. In modern designs, the membranes are placed in the aeration tanks. The membranes allow operation at high mixed liquor suspended solids levels (7,000 to 10,000 mg/L compared to 1,500 to 4,000 mg/L in conventional plants) and eliminate the need for space consuming secondary clarification. Thus, there typically is significant space savings, particularly when high degrees of treatment are required such as when ammonia oxidation (nitrification) must be maintained. MBRs have recently been employed for decentralized treatment plants in urban environments precisely because they are compact technologies that can be hidden in buildings that mimic neighboring buildings. In larger plants, such as those considered here, MBRs are typically preceded by primary sedimentation so as to reduce the organic loading on the biological process. The MBR process is the newest process in the compact technology array, with fewer large plants in operation (and for relatively shorter periods). It is still undergoing rapid technological change and development with remaining research questions. For instance, on site testing by the University of California and the SFPUC for the Water Environment Research Foundation (WERF) showed that s membrane separation rates decline during wet weather events in a combined sewer system due to increased production of colloidal proteins and carbohydrates. Research is ongoing to address these questions, and if the process were recommended to be a feature of the master plan, future demonstration or large pilot scale testing would be necessary to refine design parameters.
- Biological Aerated Filters (BAFs). BAFs are submerged fixed film biological reactors in which microorganisms, attached to the reactor media, reduce the carbonaceous (and where required, the nitrogenous) content of the incoming wastewater. The reactors also operate like filters, in that most of the influent suspended solids are trapped by the media, thus eliminating the need for separate secondary clarifiers. However, to meet secondary treatment requirements, it has been found that the BAF reactors have to be preceded by chemically enhanced primary treatment (CEPT) to reduce the influent BOD and SS loads. At least two of the BAF equipment providers have very large facilities in operation around the world (e.g. at 70 to 100 mgd), and others are starting to gain similar experience. As an example of a municipality in a similar situation to that for the City of San Francisco, planning for the City of San Diego's Point Loma plant site compared conventional to space saving technologies. If converted to full secondary, the Point Loma site would have to accommodate an average dry weather flow of 240 mgd. Layouts showed that in the land available, 240 mgd of BAF capacity could be fit on the Point Loma site, whereas only a reduced capacity could be processed by high purity oxygen activated sludge technology (150 mgd). There are concerns about application of BAF technologies for carbonaceous BOD removal in San Francisco. First, most BAF applications include nitrification and there are few BOD removal only applications around the world to develop wastewater specific design criteria. Second, the BAF technology requires CEPT as pretreatment, and the historical experience with CEPT at San Francisco plants has resulted in poor performance during wet weather events (so poor

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that CEPT had to be shut down during wet weather). Low alkalinity during storm events has made chemical addition with ferric chloride ineffective due to the lack of pH control. CEPT failure could not be tolerated during storm events. It may be possible to develop a pH control system could be successfully implemented that would deal with the rapid changes in alkalinity that can occur within minutes during wet weather events. Thus, the CEPT/BAF technology should be demonstrated with careful pilot or demonstration scale testing to show that it can perform effectively under the highly variable conditions prevalent during storm events. Thus, to qualify the CEPT/BAF technology for implementation later, demonstration or large pilot scale testing would be necessary to refine design parameters.

Thus, the three compact technologies identified for purposes of footprint analyses on compact urban sites are the deep tank aeration process, the CEPT/BAF process and the MBR process. Based on past experience, the life cycle cost of the various technologies can be ranked as follows: Deep tank aeration < CEPT/BAF < MBR. The space requirements follow in opposite order: MBR < CEPT/BAF < Deep tank aeration.

Considering state of development, life cycle cost, space requirements, and operational complexity, each site will be examined to establish the representative compact secondary treatment technology appropriate for that site. Where sufficient site is available, the deep tank process will be used. If the site is insufficient for the deep tank process, then the CEPT/BAF process will be configured for the site. Finally, if there is insufficient room for the CEPT/BAF process, then the MBR process will be designated as the representative compact secondary treatment process. Finally, any Bayside treatment site involved in an alternative that involves discharge to the Bay must include site area available for potential future implementation of Advanced Secondary treatment processes, as described in a later section.

Treatment at the Southeast Plant Site

For any alternative using the southeast plant site (e.g. BA-1), a reduction in land area used for treatment is desired, to allow an increase in buffer zones and other uses of the site. With redesign of the site, there is less pressure to go to extremes in compact technology, as the site is the largest of any considered. Therefore, making use of updated conventional technologies that consume less space would be the likely scenario with the lowest annual life cycle costs. Several different situations arise with the use of the site, ranging from primary only to continuation of use of the site for the current service area:

<u>Transfer of all secondary treatment to Oceanside, with only primary treatment at Southeast during wet weather (BA-6).</u> Under this scenario, it is assumed that conventional primary treatment will be employed for wet weather treatment at the Southeast site, as it now for current primary treatment. If only 150 mgd of primary treatment is provided, as is done currently, fewer primary clarifiers would need to be in service, since the flows now receiving secondary treatment, presumably would also receive primary treatment at the Oceanside site. It is assumed the newer primary clarifiers would be employed for this service. If a higher degree of CSO reduction is target in any system alternative, this assumption would have to be reassessed.

Retention of existing service area flows on site for secondary treatment with primary treatment also during wet weather (BA-1). For this alternative, it is assumed that high purity oxygen activated sludge would be retained as it is the most space effective conventional biological

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treatment process where only secondary treatment requirements must be met The cryogenic oxygen supply appears to be oversized and may be replaced with newer technology to increase energy efficiency. Most significantly, the secondary clarifiers would be replaced with deeper high rate flocculator clarifiers that can operate with higher surface overflow rates, so that the area devoted to secondary clarification can be reduced and the clarifiers can be more easily screened for aesthetic purposes. The target is to reduce the number of secondary clarifiers from 16 to 9; if it can be shown through on-site stress testing that the existing shallow secondary clarifiers can function at the needed capacity during peak wet weather flows, then the clarifiers would be modified rather than replaced with deeper flocculator clarifiers. Finally, by the end of the planning period, the high purity oxygen activated sludge plant would be at the end of its useful life (at fifty years old) and would need replacement with some form of compact treatment technology.

Retention of existing service area flows except for Cayuga diversion with primary treatment also during wet weather (BA-7). Flows would be reduced to the site to match flows diverted to the Oceanside plant under OS-3. The logic developed for alternative BA-1, applies here as well, excepting for appropriate reductions in the required facilities (for instance a secondary clarifier might be eliminated).

With Decentralization at North Point Plant and the Channel sites, treatment of reduced secondary flows at Southeast and Primary Treatment also during wet weather (BA-5). Under this scenario, both average dry weather flows and peak wet weather flows to the Southeast plant will be materially reduced. Area devoted to secondary treatment will be reduced simply due to the decrease in flows and loads. Therefore, a switch in technology to a more energy efficient deep tank activated sludge process was chosen as the future system rather than some other form of compact technology, as it would have a lower life cycle cost. High rate flocculator clarifiers would be employed for secondary clarifiers, again to reduce the site footprint. Conventional primary clarification would be employed ahead of the secondary process, using the newer primary clarifiers for dry and wet weather flow treatment.

Treatment at the Oceanside Plant

Several alternatives would transfer flows and loads to the Oceanside plant. Two approaches are taken.

<u>Use of Compact Treatment Technologies (OS-1 and OS-2)</u>. Here, it is assumed that all the secondary capacity (dry weather and wet weather secondary capacity for OS-1 and dry weather capacity for OS-2) will be transferred from the Southeast plant to the Oceanside site. The SFPUC intends to determine the maximum capacity that can be accommodated in the Oceanside Treatment Plant. As a first trial, the current oxygen activated sludge technology will be assessed to determine if it can fit on the sites adjacent to the current plant. If not, the compact secondary treatment technologies would be applied, using the same rationale as described earlier. Under OS-2, the reduction in wet weather secondary treatment capacity on the Bayside might be mitigated by providing a higher degree of treatment for wet weather discharges on the Bayside, such as adopting ballasted flocculation or advanced primary treatment rather than the current primary treatment approach.

<u>Maximization of Capacity using Conventional Technologies (OS-3).</u> For this alternative, the SFPUC intends to make estimates of the maximum treatment capacity that site can provide using existing treatment processes without dramatic design features (i.e. without process

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stacking or compact footprint process technologies). Transfer of a portion of the flows from the Southeast Plant service area with the Cayuga Tunnel Concept would provide the additional flows up to the capacity of the Oceanside plant.

Advanced Secondary Treatment –Representative Process Technology Assumptions

A basic planning assumption is that discharge to the ocean involves less risk and that increased degrees of treatment will be not required during the planning period, compared to discharge to the Bay. From the point of view of establishing plant footprints for each site, it is assumed that locating treatment at or adjacent to the Oceanside plant site with its high capacity ocean outfall, will only require secondary treatment in the future. However, for the alternatives where Bayside treatment plants would discharge to the Bay, there must be some allocation of space for advanced secondary treatment.

One approach would be to add space for a tertiary treatment process for every potential contaminant that might be identified in the future. For example, the assumption might be that the listed example unit processes might be required for each of the following potential contaminants:

- Ammonia: Tertiary BAFs for nitrification
- Cu: Chemical addition and clarification in an existing or new unit
- Hg: Tertiary filtration
- Nutrients (phosphorus): Chemical addition for phosphorus removal in the primary clarification step or in activated sludge aeration tanks where that technology is used
- Nutrients (nitrogen): Tertiary denitrification filter or BAF with methanol addition
- Emerging Pollutants of Concern (EPOC): Varies, for instance low rate activated sludge system (or fixed film system) that is nitrifying and therefore can accommodate slow growing organisms the degrade some of the EPOCs. Advanced oxidation processes (e.g combinations of UV, hydrogen peroxide or high intensity UV) could be used in lieu of disinfection to increase some EPOC removals.

If space were allocated for all of the listed contaminants, possibly four tertiary treatment structures might be added to the site (some of the contaminants can be co-treated in the same treatment unit). Even at four tertiary treatment steps, it is clear that even the existing Southeast plant site (the largest site available) lacks sufficient room to accommodate such extensive treatment. It is assumed that the same would be true at all other potentially available sites.

A more pragmatic approach in planning is to assume that there is not a very high risk that all of the listed contaminants will be regulated in the future and that only some of them will be. For the purposes of this discussion, it is assumed that two of the potential contaminants will be regulated. One of these contaminants is assumed to be handled by modification of an existing process (such as chemical addition to a primary clarifier) and will not require allocation of a significant amount of plant process space. It is assumed that the second contaminant will require a new tertiary treatment process. Therefore, only one additional space consuming tertiary process will be laid out on the alternatives with discharge to the Bay. A reasonable assumption is that the contaminant will require additional biological treatment. That biological

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treatment will be sized to accommodate nitrification (oxidation of ammonia nitrogen), on the following grounds:

- It is possible that ammonia could be regulated in the future for Bayside discharges, requiring its removal or oxidation.
- Some EPOC are resistant to biological degradation, but if the biological system is adjusted to a low overall growth rate, then slow growing microorganisms can be established that can oxidize some of them. When such removals occur, they have been correlated with operation at a low rate and coincident with the ability of the system to nitrify.

Thus, for cases where room is at a premium, tertiary BAFs are assumed for nitrification either directly for ammonia removal or for EPOC reduction. If room is so restricted that stacked nitrifying BAFs would be required, then tertiary nitrifying trickling filters would be employed instead. Where there is more room for expansion of the deep tank aeration compact treatment alternative, it is assumed that the activated sludge system aeration basin will be expanded to accommodate nitrification. For deep tank aeration with nitrification, means to accelerate the nitrification process will be assumed so as to reduce space requirements, such as ones employing either supplemental media for nitrification (a hybrid or integrated fixed film activated sludge process), or one with bioaugmentation whereby the activity of nitrifiers is enhanced. If an MBR was the process initially selected as the compact secondary treatment technology, then no additional provision for nitrification need be made, as the process is typically designed at loadings that will result in complete nitrification.

Disinfection Treatment Assumptions

SFPUC staff has indicated a preference to a shift to UV disinfection as its primary treatment process to eliminate the need for compliance with low chlorine residual requirements and for enhanced safety in terms of reduced chemical handling. UV would be applied for flows receiving secondary treatment, but and Sodium Hypochlorite disinfection would be continued to be used for flows receiving primary treatment only.

Equipment Redundancy Assumptions

Each type of secondary process deserves an analysis of equipment standby assumptions and process redundancy during detailed design. At this level of planning for site requirements, we are most concerned with the assumptions that cause treatment plant space to be consumed. The following table summarizes our assumptions.

Process or Major Equipment Item	Standby or Redundancy Criteria
Bar screens	Capacity for PWWF with at least one
	standby bar screen
Influent and Effluent Pumping	One standby pump at PWWF
Grit Removal	No standby at PWWF
Primary Sedimentation Tanks	No standby at PWWF, at least one standby at ADWF
Aerobic Reactors (Aeration tanks, BAFs	No standby at PWWF; at least one tank
etc.)	out of service during ADWF

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Secondary Clarifiers (High purity oxygen	No standby at PWWF, at least one standby
and conventional activated sludge)	at ADWF
Cryogenic supply (High purity oxygen	One standby at ADWF; use of liquid
activated sludge)	oxygen at peak hour load.
Blowers	One standby at peak day load
Disinfection	No standby at PWWF, at least one standby
	at ADWF

Low Impact Design Consideration

The City has adopted policies to minimize the use of natural resources and reduce the burden to the sewer system. As such, green roofs or photovoltaic power generation shall be considered in the planning of new facilities. In addition, permeable pavement, green strips and trees shall be used as much as possible to reduce stormwater flow.

Water Recycling

As a continuation of Waste Water Enterprise strategy, new facilities should be designed for reusing as much of the secondary effluent as possible.