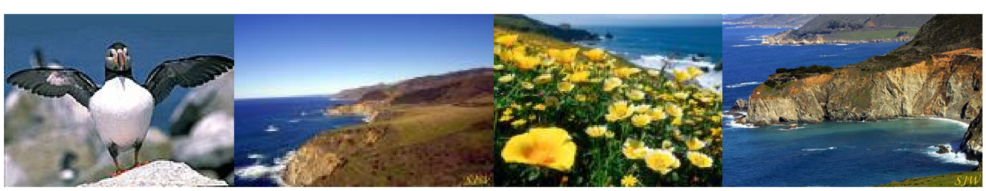
NUTE ENGINEERING
Civil & Sanitary Consultants
907 Mission Avenue
San Rafael, CA 94901

Fort Bragg Municipal Improvement District No. 1
Wastewater Treatment Facility Study

EXECUTIVE SUMMARY



FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

EXECUTIVE SUMMARY

The Fort Bragg Municipal Improvement District No. 1 was formed in 1969 and encompasses the City of Fort Bragg plus lands to the north and south, which are not within the City limits. Figure 1 shows the Fort Bragg city limits and its Sphere of Influence (SOI), which may eventually need sewer service through the District. The greater Fort Bragg area extends beyond the District limits and includes low density development which is served by septic tanks.

The downtown portion of the City of Fort Bragg as well as Noyo Harbor contains residential and commercial development. The MacKerricher State Park is served by contract and is outside the District. Areas outside the City and District continue to develop and it can be expected that some of these areas may seek sewer service through the District.

The former Georgia Pacific (G-P) Plant site, located just west of downtown Fort Bragg, is now closed and the buildings are being removed. It is expected that this land will eventually be developed and require sewer service.

The Fort Bragg wastewater facilities consist of a sewer system, six pump stations, a wastewater treatment plant and an outfall pipeline, which extends 690 feet into the Pacific Ocean. The original wastewater facilities were completed in 1971. A number of upgrades to the treatment plant have been constructed in the intervening years.

There are about 26.5 miles of sewers within the District, ranging in size from 6” to 30” in diameter. The first sewers were constructed in the late 1800’s. A large proportion of the sewers still in use are older vitrified clay pipe, notoriously subject to leaks through broken pipes and defective joints caused by intruding roots, seismic activity, differential settling as well as from external damage.

LAND USE

Zoning and land use within the District is regulated by both the City of Fort Bragg and Mendocino County. Existing land uses include residential, lodging, commercial and industrial. As land beyond the present District boundaries tries to develop with densities which cannot be supported by septic systems there will be pressure to extend the District boundaries and provide sewer service to these areas.

A major factor affecting future growth in Fort Bragg is the potential development of the G-P site within the City. With the loss of the G-P lumber mill and the decrease in fishing activity in Noyo Harbor the land uses in the area have become more oriented toward seasonal tourists and retirees. Future land uses are expected to continue this trend.

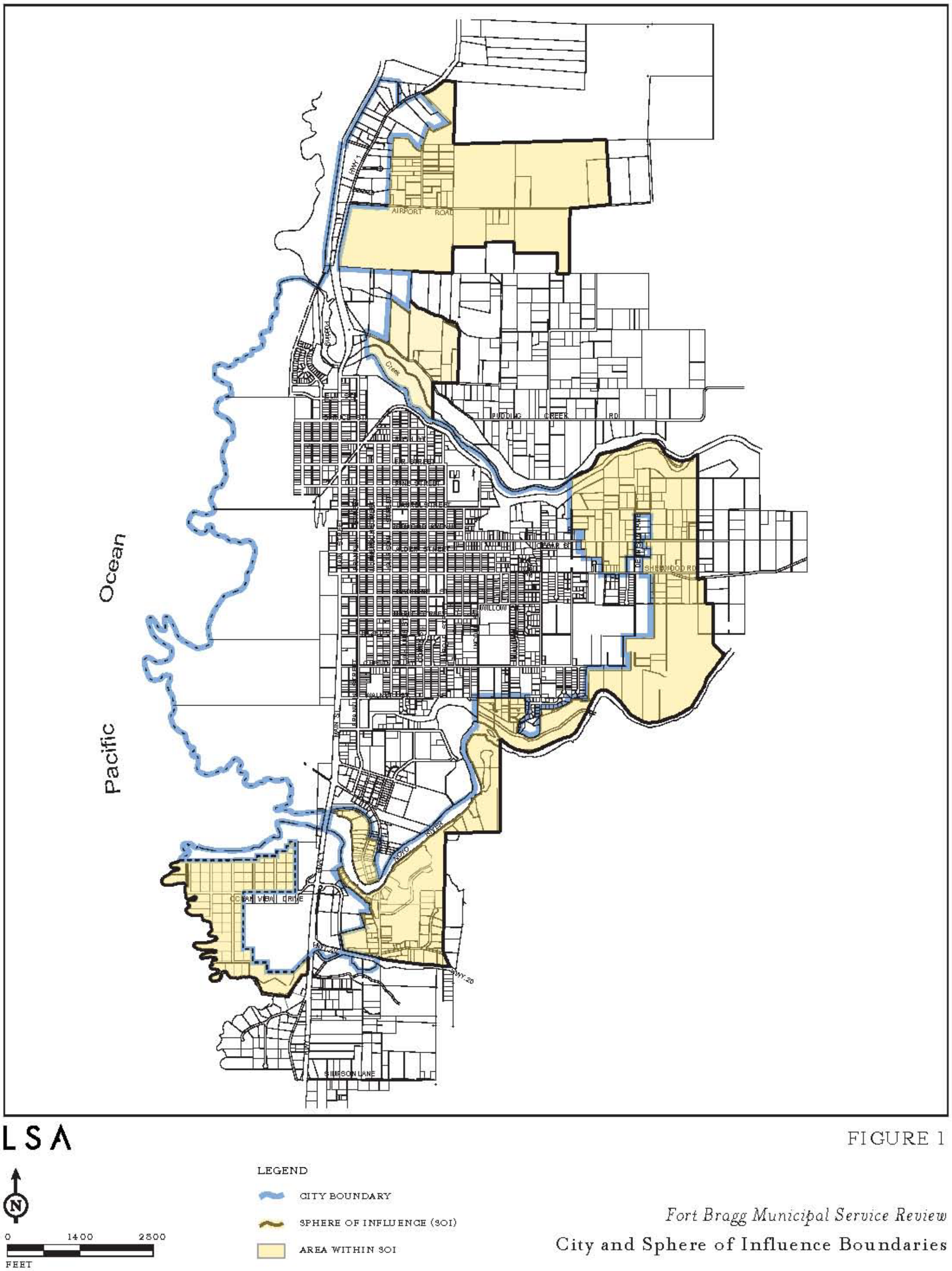


FIGURE 1

Fort Bragg Municipal Service Review

City and Sphere of Influence Boundaries

SOURCE: CITY OF FORT BRAGG, 2004

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The Municipal Service Review, Draft Report, July 2006 prepared by LSA et al provided projections of the land use in Fort Bragg and its Sphere of Influence areas for both the near term and long term buildout, with and without development on the G-P property. These land use projections are summarized in Table 1.

TABLE 1
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT
LAND USE PROJECTIONS

Use	Estimated 2006	Near Term 2011	Long Term Buildout without G-P	Total Long Term Buildout with G-P
Residential Units	2,967	3,741	4,314	4,914
Commercial Office, sq.ft.	1,556,735	1,673,335	1,839,768	2,234,343
Industrial, sq.ft.	3,000	478,115	905,987	1,105,987
Lodging, rooms	1,415	1,715	1,715	1,915
Entertainment/Performing Arts, sq.ft.				15,000
Marine Research Facility, sq.ft.				200,000
Open Space				100

Source: LSA, City of Fort Bragg Municipal Services Review, Draft Report, July 2006

WASTEWATER FLOWS

Based on the LSA Study the District's average dry weather flow (ADWF) at the treatment plant should be around 0.9 million gallons per day (mgd). The actual measured dry weather flow during the summer months is around 0.7 mgd which may reflect the water conservation practices in the City.

If in the future the water supply becomes less limiting, people may change their habits and the per capita water use may increase. Thus in terms of planning the future capacity needs of the wastewater treatment plant the higher unit wastewater flows should be used.

The wastewater flows for the total long term buildout including development of the G-P lands based on the LSA land use projections is expected to be around 1.5 mgd, which is the design flow recommended for the upgraded wastewater treatment plant.

INFILTRATION/INFLOW

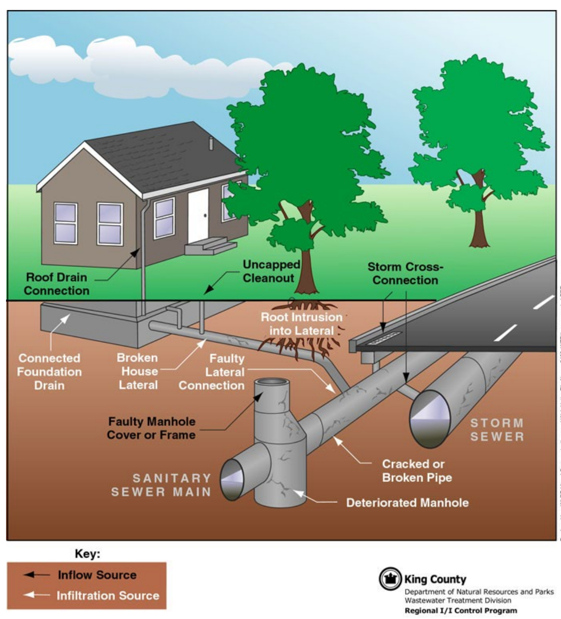
During wet weather the wastewater flows can increase dramatically. This is due to rainwater and groundwater entering the sewers through drainage connections and defects in sewer pipes and pipe joints. This extraneous water is termed Infiltration/Inflow (I/I) and causes high sewage flows at the treatment plant during wet weather. The mechanisms by which I/I can enter a sanitary sewer system is shown in Figure 2 and includes the following:

- **Infiltration**. Infiltration is groundwater which enters the sewer through holes, breaks, joint failures, improper connections, and other openings. These defects may be attributable to the age of the material, or exacerbated by defects in the sewer pipes caused by tree root intrusion, accidental damage by others digging, land movement or subsidence, seismic activity, etc.

- **Inflow**. Inflow is surface water that directly enters the sanitary sewer system from yard, roof and foundation or footing drains, from cross-connections with storm drains, downspouts, and through holes in manhole covers.

- **Rainfall Dependent I/I or RDI/I**. During high intensity rainfall water percolates through the ground and enters defective shallow sewers or laterals. These shallow sewers, when defective, act as underdrains and take on water at a rapid rate during intense storms when surface soils have been fully saturated.

FIGURE 2 – SOURCES OF INFILTRATION AND INFLOW



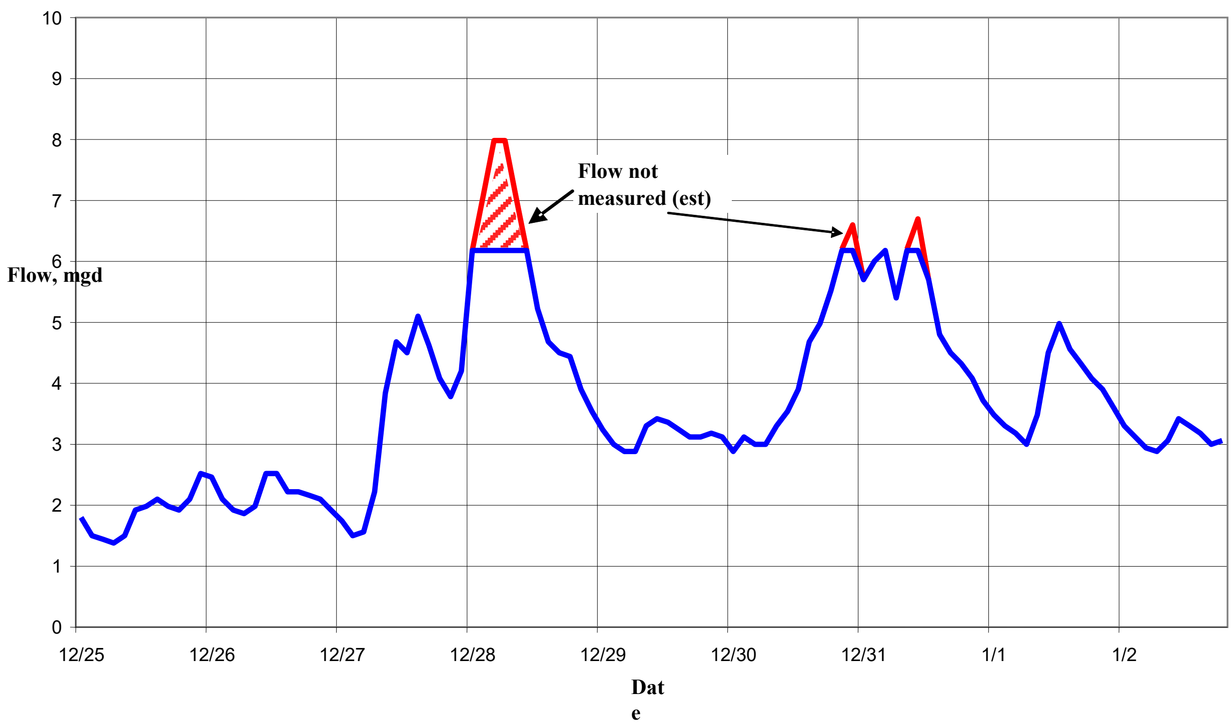
Source: King County Dept. of Natural Resources and Parks, Washington

It is possible to reduce I/I in a sewer system through sewer rehabilitation programs. Where direct connections of storm drains to the sanitary sewer system can be found it is often relatively easy and inexpensive to disconnect these illegal connections. Reducing the level of infiltration and rainfall dependent I/I becomes more challenging. The City has been pursuing a program of replacing and rehabilitating sewer mains in the older parts of town. However, if private sewer laterals are not rehabilitated they can remain a significant source of I/I. This is a particularly problem since the ground water, which formerly entered a rehabilitated sewer main, may transfer to defects in the connecting private sewer laterals resulting in is very small net reduction of I/I.

PROJECTED PEAK WET WEATHER FLOW

The flow meter at the treatment plant during the December 28, 2005 storm recorded peak daily flow of over 5 mgd. Figure 2 shows the measured sewage flow between December 25, 2005 and January 2, 2006. For several hours the flow meter scale was exceeded and the actual peak flow experienced is estimated at 8 mgd. Using this data it is recommended that for the projected buildout the treatment plant be designed to accommodate a peak flow of 9.8 mgd.

Figure 3
FT BRAGG MEASURED SEWAGE FLOW
DECEMBER 25, 2005 THROUGH JANUARY 2, 2006



DESIGN CRITERIA

The existing and projected design criteria for upgraded wastewater facilities based on land use and the LSA projections are as follows:

TABLE 2 - PROJECTED WASTEWATER FLOWS

Design Criteria	Existing	Projected Buildout
Average Dry Weather Flow, mgd	0.9	1.5
Peak Monthly Flow, mgd	2.2	3.3
Peak Daily Wet Weather Flow, mgd	5.0	6.2
Peak Instream Wet Weather Flow, mgd	8.0	9.8

WASTE DISCHARGE REQUIREMENTS

Discharge from the Fort Bragg wastewater treatment plant is regulated by the Water Quality Control Board (RWQCB), North Coast Region. The basic policy for establishing waste discharge requirements for the Fort Bragg treatment plant is the State Ocean Plan, which establishes water quality objectives for the protection of the beneficial uses of the ocean waters. The RWQCB uses the Ocean Plan and other guidance from the federal Environmental Protection Agency (EPA) to develop specific discharge requirements which are incorporated in Fort Bragg's NPDES permit. The NPDES permit must be renewed every five years, at which time new requirements may be incorporated. Because of the Federal "anti-backsliding" policy once discharge requirements are established in a permit it is very difficult to get them relaxed.

In the 2004 NPDES permit reissuance, Fort Bragg was successful in obtaining a relaxation of the effluent limit for total coliform bacteria from a water recycling limit to the most restrictive Ocean Plan limit for protection of shellfish. The RWQCB declined to consider relaxation of a number of other effluent limits, which were allowed in the Ocean Plan and Federal regulations for trickling filter plants. Consequently the effluent requirements in Fort Bragg's NPDES permit are more stringent than the minimum requirements set forth in the Ocean Plan.

The Ocean Plan includes a policy that compels consideration of the least toxic, most safe alternatives for disinfection. The Ocean Plan states that "Disinfection procedures that do not increase effluent toxicity and that constitute the least environmental and human hazard should be used." Therefore this wastewater treatment facility study includes an evaluation of UV disinfection as an alternative to the more traditional but risky chlorination and dechlorination.

Enforcement of violations to the NPDES permit has become more aggressive in recent years with mandatory minimum penalties of $3,000 for each violation. This automatic enforcement mechanism underscores the need to incorporate reliability and redundancy in the design of treatment and pumping facilities.

Blending, the bypassing of any wastewater around secondary treatment processes is a new regulatory topic which will be heavily scrutinized in all NPDES permits in California as their permits come up for reissuance. At the present time blending is practiced at the Fort Bragg treatment plant during high wet weather flows. Future treatment plant improvements need to consider methods and processes which will eliminate or reduce the need for blending.

In the next NPDES permit cycle it is expected that the RWQCB will put greater emphasis on source control and Pollutant Minimization Plans. Source control will require removal or treatment of waste products at their source before they get to the treatment plant. Source control will be an effort to control discharges of “emerging contaminants” such as antibiotics, pharmaceuticals, endocrine disrupting chemicals, etc. so they do not reach the aquatic ecosystem.

The treatment facility must either file for coverage under a statewide general industrial NPDES permit for its stormwater runoff or construct facilities to direct the stormwater back to the treatment plant for treatment. Pollutants from paved areas or from spills of sludge or chemicals could harm the aquatic ecosystem if not controlled. Routing storm water to the headworks affords the District flexibility and control in case of a spill, and removes the regulatory burdens of filing annual reports, fees, and conducting monitoring of storm water from the plant site.

EXISTING WASTEWATER TREATMENT PLANT

The original Fort Bragg wastewater treatment plant was completed in November 1971 and consisted of a single clarifier and single biofilter process, effluent chlorination and separate sludge digestion. In 1977 the treatment plant was upgraded with the installation of a secondary clarifier, secondary biofilter, sludge thickener, dechlorination facilities and a septage receiving station. This project also included construction of an ocean outfall and separation of combined sewers in the northern part of the city. In 1988 a grit chamber and a sludge filter press were added to the plant. The sludge filter press provides dewatering of the digested sludge so it can be disposed of at a landfill site. In 2004, construction of a second anaerobic sludge digester was completed. Installation of a headworks screen is scheduled for 2007.

The plant is now 35 years old and is showing signs of normal aging and deterioration. The salt air along with the hydrogen sulfides from the wastewater has led to significant corrosion and deterioration.

A number of replacements, upgrades and improvements are recommended for the existing treatment plant. These improvements, listed below, are necessary to keep the plant functioning over the near term as well as the long term. Most of these improvements will be incorporated in the recommended treatment plant upgrade project.

- Cleaning out and repairing the primary digester and replacing the mechanism in the sludge thickener.

- Elimination of the use of gaseous chemicals for disinfection and dechlorination.
- Replacement of old equipment in the two clarifiers and various pumps and piping.
- Replacement of corroded equipment and materials which is adversely affecting the plant operation.
- Replacement of old electrical equipment and controls for which replacement parts are no longer available.
- Installation of SCADA and telemetry system for the treatment plant and pump stations.
- Installation of a pump station to runoff from the plant site back to the treatment process.

The basic improvements to the existing treatment plant are estimated to cost $ 5,100,000.

WASTEWATER TREATMENT PLANT UPGRADE NEEDS

Fort Bragg is expected to grow in population, which means that there will be a need for additional treatment plant capacity. Some of this growth is expected to come from development on the adjacent Georgia-Pacific (G-P) property. In addition the discharge requirements have become more restrictive and the state is pursuing more aggressive enforcement for discharge violations.

The existing treatment plant has enjoyed relative isolation from the public. With the closing of the G-P mill it is very likely that the use of the surrounding land will change and the treatment plant will no longer be as isolated. The securing of a buffer between the plant and any new development will become very important if the plant is to remain at the existing site. The treatment plant will need to be upgraded to serve the additional growth, assure control of odors and eliminate the chlorine hazard.

The City sewer system is subject to intrusion of extraneous water during rainfall events. This extraneous water is evidenced as high sewage flows at the treatment plant. During storm events the existing plant process blends biologically treated effluent with effluent which has only received primary treatment. The Federal EPA and State are now implementing rules that will restrict the blending of excess flows at treatment plants. Additional treatment will be required at the plant if the blending practice is to be minimized or eliminated

Based on an analysis of the Federal and State water quality control policies and the District's current NPDES permit, except for blending, major changes in the effluent limitations are not expected in the next permit renewal cycle. In developing improvements for the Fort Bragg wastewater treatment facilities the following objectives need to be addressed:

- **<u>Secondary Treatment Requirements</u>** – Effluent limit of 30 mg/l for BOD and TSS on a monthly average basis.
- **<u>85% Removal of BOD and TSS</u>** – Achievement of 85% removal of BOD and TSS on a monthly average basis.
- **<u>Disinfection</u>** – Effluent limit of 70 MPN/100 ml monthly median and no more than 10% of samples to exceed 230 MPN/100 ml. Consider non-chlorine disinfection processes per Ocean Plan policy.
- **<u>Minimization of Blending</u>** – Phase out of blending at high flows to the extent practicable. Conduct infeasibility analysis to justify blending during peak wet weather events.
- **<u>Reliability and Redundancy</u>** – Improve reliability and redundancy of the treatment processes.
- **<u>Storm Water Containment</u>** – Route runoff from the treatment plant site back to the treatment process.

ALTERNATIVES ANALYSIS

In order to determine the best long range program for upgrading the wastewater treatment plant six alternative treatment processes were evaluated. These alternatives along with their estimated capital costs including the applicable costs to modernize the existing treatment plat as listed above are as follows:

<u>ALTERNATIVE A-1</u> - Upgrade the existing trickling filters, add a new secondary clarifier and continue to use chemicals to meet the effluent requirements. Effluent will be conventionally disinfected through the use of solutions of sodium hypochlorite and sodium bisulfite for dechlorination.

Estimated Capital Cost $12,790,000

<u>ALTERNATIVE A-2</u> - Upgrade the existing trickling filters and followed by effluent filters and ultraviolet disinfection.

Estimated Capital Cost $12,400,000

<u>ALTERNATIVE B</u> - Upgrade the existing treatment plant by installing an activated sludge process.

Estimated Capital Cost $17,960,000

<u>ALTERNATIVE C</u> - Upgrade the existing treatment plant using a dual system consisting of a trickling filter followed by an activated sludge process.

Estimated Capital Cost $15,920,000

<u>ALTERNATIVE D</u> - Upgrade the existing treatment plant by installing a membrane biologic reactor process.

Estimated Capital Cost $20,200,000

<u>ALTERNATIVE E</u> – Construct a totally new treatment facility using the oxidation ditch process at a site located on the old G-P haul road above the Noyo River.

Estimated Capital Cost $34,700,000

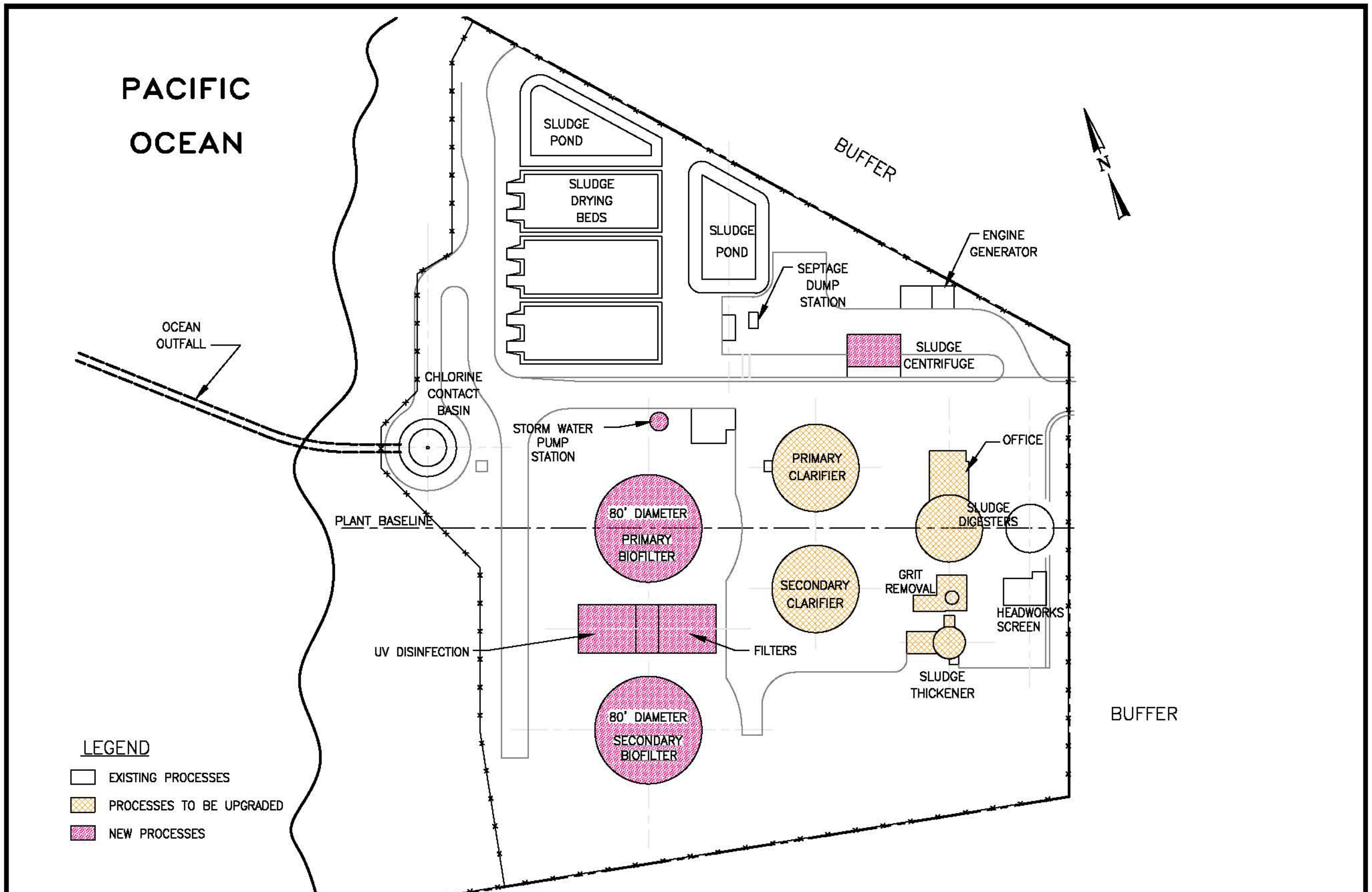
In summary the most economical project from a cost standpoint is Alternative A-2, which involves upgrading the existing treatment plant using the existing trickling filter process but adding effluent filters and UV disinfection. Sludge will be dewatered by a new sludge centrifuge and the dewatered sludge will continue to be transported to a landfill for disposal. The layout of the recommended plant improvements is shown in Figure 4.

Alternative A-2 is the most economical because it is able to build on the existing plant infrastructure such as piping and structures and reduces the facilities which would otherwise need to be demolished to make way for a new process.

The analysis of alternatives also revealed the following:

- The most economical method of disinfecting the effluent is with UV light rather than with chlorine chemicals and dechlorinating chemicals, which can add toxicity to the effluent.

- Relocating the treatment plant to a site along the former G-P haul road is estimated to cost some $34 million, which is some two and one half times the estimated cost of the lower cost alternatives.



FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1

RECOMMENDED TREATMENT PLANT IMPROVEMENTS

FIGURE 4

- The alternative of drying the sludge to attempt to produce a Class A sludge which could be sold or given away to the public has a high capital and operating cost and is more expensive overall than the present practice of hauling the sludge to a landfill for disposal.

If the treatment plant is to remain at its existing site it is very important that adequate buffer be acquired around the plant to minimize aesthetic and odor objections from the public.

The elimination of gaseous chemicals for disinfection and dechlorination is a public safety issue and should be addressed as soon as possible. The treatment plant is upwind of the town and an accident or spill of one of these gaseous chemicals could be very damaging.

OTHER FACILITY IMPROVEMENT NEEDS

In addition to upgrading and modernizing the District's treatment plant the pump stations and some transport facilities need to be improved. Of the District's six wastewater pump stations, four were constructed in the 1970's and much of the equipment has reached the end of its useful service life and replacement parts for some of the equipment, particularly electrical equipment, are no longer available.

As the pump stations are upgraded the latest reliability and safety standards should be incorporated into the project to protect the environment and public health from accidental sewage spills. These design standards include:

- Provide peak flow pumping capacity with any one pump out of operation.

- Locate all electrical equipment above grade and above expected flood levels.

- Provide standby source of power for the pumps, lighting and instrumentation systems.

- Use corrosion resistant materials because of the close proximity to the ocean and salt air.

- Provide SCADA controls which are telemetered to a master terminal unit at the treatment plant. SCADA provides remote monitoring and control of the pumping equipment and is highly useful in improving operational reliability.

Improvements to the pump stations is estimated to cost $3,950,000 and trunk sewer and force main improvements are estimate to cost $1,540,000.

In the short term it is recommended that the District purchase portable engine generator sets to provide standby power to the pump stations which are not already equipped with engine generator sets. Two portable engine generator sets are estimated to cost about $80,000 each. The District should also budget each year for the upgrade of equipment and electrical components until the major pump station projects can be implemented.

RECOMMENDED IMPROVEMENT PROGRAM

The recommended program for the Districts wastewater treatment and pumping facilities consists of the following project elements:

Wastewater Treatment Plant Improvements – Plant modernization with upgrade trickling filters followed by effluent filters and UV disinfection.

Estimated Project Cost $12,400,000

Pump Station Improvements – Upgrade and improvements to the six sewage pump stations.

Estimated Project Cost $3,950,000

Trunk Sewer and Force Main Improvements – Replacement of two critical pipelines in the District sewer system.

Estimated Project Cost $1,540,000

Total Estimated Wastewater Program Costs $17,890,000

POTENTIAL FUNDING SOURCES

In the 1970's and 1980's Congress funded grants for the construction of wastewater treatment plants, pump stations and interceptors under the "Clean Water Grant Program". For a number of years the grant share was as high as 87.5%, with a 12.5% local share.

Many agencies, including Fort Bragg, took advantage of these grants. The original treatment plant and pump stations received grant financing. As a part of this grant program all recipients were required to implement a Revenue Program, which established a system of sewer service charges. This was supposed to be a one-time grant program, after which agencies were supposed to be self supporting.

The Clean Water Grant Program also restricted the level of funding to only those facilities to serve the then existing population, with an allowance for a small amount of growth. If an agency wanted to construct larger capacity facilities or larger pipelines they had to fund these larger facilities from local funds. Most agencies elected to construct only the minimum facilities that would be eligible for grant funds.

The Clean Water Grant Program was phased out in the late 1980's and the SWRCB established the State Revolving Fund (SRF), which provides public agencies with low interest loan money to fund improvements to their wastewater facilities. Now some 30 years later many agencies, including Fort Bragg, find themselves with rapidly deteriorating facilities or without backup equipment because the initial grant program would not fund them. With the relatively recent emphasis by regulators on "reliability," duplicate equipment, duplicate pumps and parallel force mains are highly desirable and almost mandated. The other problem is that the system of sewer service charges developed in the Revenue Program may not have been sufficient to replace the facilities which are now reaching their economic life and are in need of replacement.

Large projects will usually need to be funded by grants or some kind of debt financing or a combination of both. Municipal agencies such as Fort Bragg can usually obtain bond financing or even commercial financing at market rates. However, low interest loans and some grants may be available.

There are some funding sources available for major projects to grade and modernize wastewater facilities. California has set up a State Revolving Fund (SRF) Loan Program, which provides low interest loans for qualifying wastewater facilities. The application process for an SRF loan is lengthy and the project cost may grow due to the addition of more studies and requirements to implement projects to reduce infiltration/inflow in the sewer system.

Some other funding sources are available for agencies which qualify under specific criteria and sometimes funding sources are authorized by a ballot proposition and then the funds get used up and they disappear. Possible sources of grant funds include the following:

- USDA Water and Waste Disposal loans and grants for populations less than 10,000
- Clean Beaches Initiative
- Small Communities Wastewater Grant Program
- Proposition 84 passed by voters in November 2006

It takes some time for these programs to be set up and it is important to keep abreast of the possibilities of securing grants from one or more of these sources.

CONCLUSIONS

Based on the studied summarized in the report the following conclusions are presented.

1. With the future development of the Georgia Pacific property the wastewater flows which will ultimately need to be handled are projected to approach 1.5 million gallons per day.

2. The Fort Bragg sewer system is old and because of broken pipes and defects the sewer system takes on extraneous surface and ground water which must be handled at the pump stations and treatment plant.

3. Waste discharge requirements in Fort Bragg's present NPDES are more stringent that the minimum requirements of the Ocean Plan but it is highly unlikely that the RWQCB will consider any relaxations to these limits.

4. The RWQCB is mandated to enforce violations of the NPDES permit and will assess mandatory minimum penalties of $3,000 for each violation.

5. Future treatment plant improvements consider methods and processes which will eliminate or reduce the need for blending of partially treated flows during wet weather.

6. The regulators are putting more emphasis on reliability and redundancy which means that treatment plant improvements and upgrades should be designed in so far as economically possible with standby and duplicate systems.

7. Some of the equipment in the Fort Bragg wastewater treatment plant and pump stations is now more than 35 years old and is in need of replacement and upgrade.

RECOMMENDATIONS

It is recommended that the District adopt Alternative A-2, which involves upgrading the existing treatment plant using the existing trickling filter process but adding effluent filters and UV disinfection and installing a new sludge centrifuge for sludge dewatering. It is also recommended that the District's pump stations and certain transport pipelines also be upgraded. This wastewater program is estimated to cost $17,890,000.

In undertaking this wastewater improvement program the following additional recommendations are presented:

1. The dry weather design flow for the upgraded wastewater treatment plant should be increased form 1.0 mgd to 1.5 mgd .

2. The City should continue its efforts to reduce infiltration/inflow into the sewer system through the ongoing sewer rehabilitation program.

3. The District should acquire a buffer around the existing treatment plant site to assure its isolation from the public.

4. In order to undertake a program of this magnitude it will be necessary to develop a detailed financing plan to determine the best financing mechanism and to set the appropriate charges for existing and new system users.

5. In order to finance this program the District should pursue possible grant funds and specifically undertake the application process for a State Revolving Fund Loan.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1

TECHNICAL MEMORANDUM NO. 1
PROJECTION OF LONG RANGE NEEDS

In order to develop the design characteristics for the needed wastewater treatment plant improvements it is necessary to project the growth needs of the District and the amount and characteristics of wastewater that must be treated. Projections of future development are based on the City of Fort Bragg Municipal Services Review prepared by LSA et al. The Draft Report, dated July 2006 projected the growth and development of the City and its Sphere of Influence (SOI) for the near term and for long term build out including development of the Georgia Pacific site.

DISTRICT SERVICE AREA

The Fort Bragg Municipal Improvement District was formed in 1969 and encompassed the City of Fort Bragg plus the north and south sides of Noyo Harbor, which are not within the City. Since its formation, lands to the north and south have been annexed to the District. Figure 1-1 shows the Fort Bragg city limits and its SOI, which may eventually need sewer service through the District.

The downtown portion of the City of Fort Bragg between Pudding Creek and Noyo harbor contains residential and commercial development. The Noyo Harbor area is developed with restaurants, commercial, fishery and industrial establishments.

In 1973 the MacKerricher State Park in Cleone connected to the Pudding Creek pump station. The MacKerricher State Park is served by contract and is outside the District and the Fort Bragg SOI. Areas outside the City and District continue to develop and it can be expected that these areas will seek sewer service through the District.

The former Georgia Pacific (GP) Plant site, located just west of downtown Fort Bragg, is now closed and the buildings are being removed. It is expected that this land will eventually be developed and require sewer service.

LAND USE

Sewer service is provided within the boundaries of the Fort Bragg Municipal District No.1, which includes all land within the City of Fort Bragg city limits as well as Noyo Harbor and some land north of Pudding Creek. The greater Fort Bragg area extends beyond the District limits and includes low density development which is served by septic tanks.

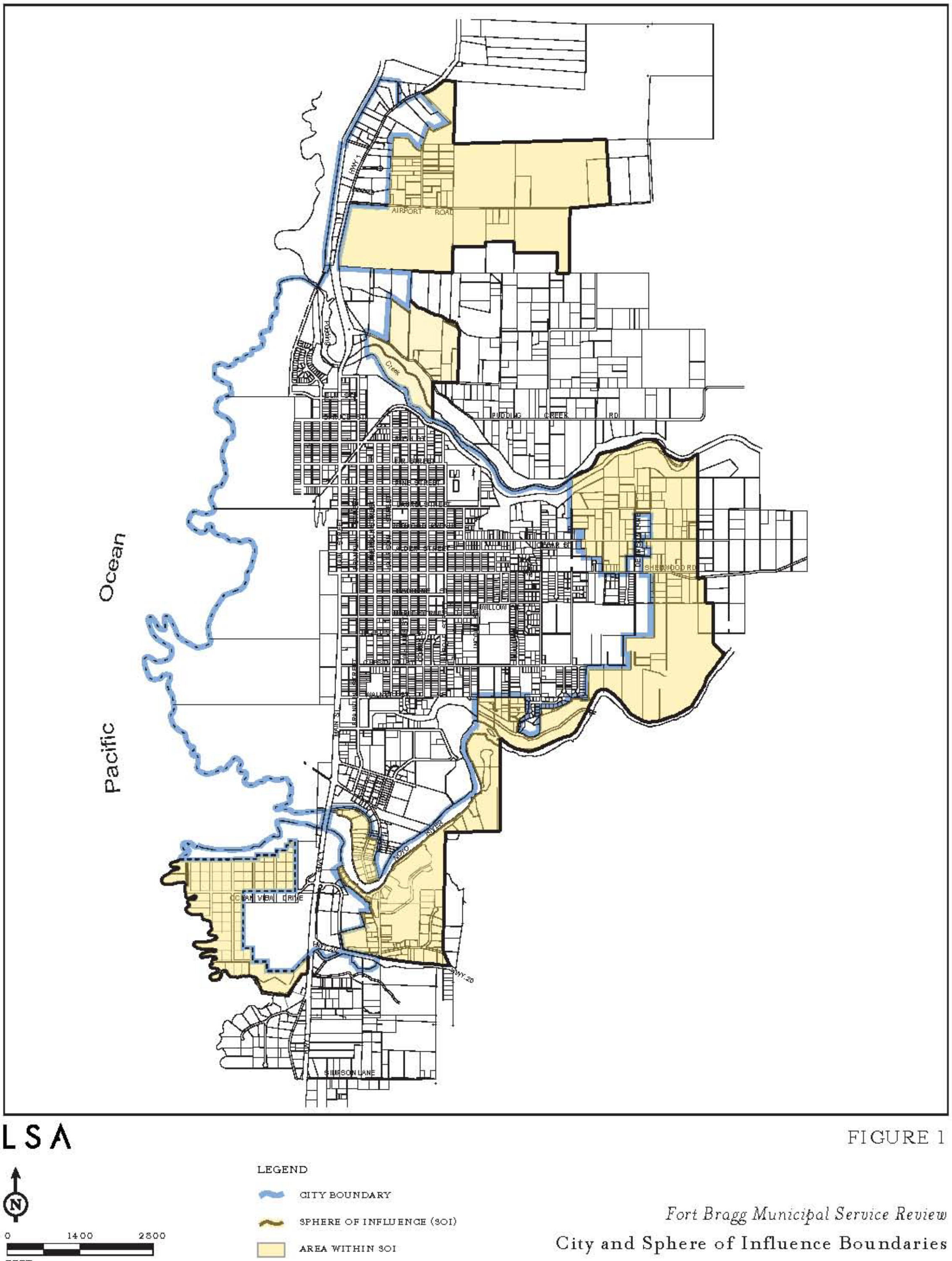


FIGURE 1

Fort Bragg Municipal Service Review
City and Sphere of Influence Boundaries

SOURCE: CITY OF FORT BRAGG, 2004

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Zoning and land use within the District is regulated by both the City of Fort Bragg and Mendocino County. Existing land uses within the District includes residential, lodging, commercial and industrial. As land beyond the present District boundaries tries to develop with densities which cannot be supported by septic systems there will be pressure to extend the District boundaries and provide sewer service to these areas.

A major factor affecting future growth in Fort Bragg is the potential development of the GP site within the City. With the loss of the GP lumber mill and the decrease in fishing activity in Noyo Harbor the land uses in the area have become more oriented toward seasonal tourists and retirees. Future land uses are expected to continue this trend.

The Municipal Service Review, Draft Report, July 2006 prepared by LSA et al provided projections of the land use in Fort Bragg and its SOI areas for both the near term and long term buildout, with and without development on the GP property. These land use projections are summarized in Table 1-1.

TABLE 1-1
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT
LAND USE PROJECTIONS

Use	Estimated 2006	Near Term 2011	Long Term Buildout without GP	Total Long Term Buildout with GP
Residential Units	2,967	3,741	4,314	4,914
Commercial Office, sq.ft.	1,556,735	1,673,335	1,839,768	2,234,343
Industrial, sq.ft.	3,000	478,115	905,987	1,105,987
Lodging, rooms	1,415	1,715	1,715	1,915
Entertainment/Performing Arts, sq.ft.				15,000
Marine Research Facility, sq.ft.				200,000
Open Space				100

Source: LSA, City of Fort Bragg Municipal Services Review, Draft Report, July 2006

WASTEWATER FLOW PROJECTIONS

Projections of the existing wastewater flows based on the LSA land use projections for 2006 are given in Table 1-2.

TABLE 1-2

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT
WASTEWATER FLOW PROJECTIONS FOR 2006

Use	2006 Land Use Projections*	Estimated Unit Wastewater Flows	2006 Projected Wastewater Flows
Residential Units	2,967	200 gpd	593,400
Commercial Office, sq.ft.	1,556,735	30 gpd/250 sq.ft.	186,808
Industrial, sq.ft.	3,000	30 gpd/1000 sq.ft.	90
Lodging, rooms	1,415	70 gpd	99,050
MacKerricher State Park, gpd	9,000		9,000
TOTAL PROJECTED WASTEWATER FLOW			888,348

*Source: LSA, City of Fort Bragg Municipal Services Review, Draft Report, July 2006

The calculation in Table 1-2 projects the 2006 average dry weather flow (ADWF) at the treatment plant should be around 0.9 million gallons per day (mgd). The actual measured dry weather flow for June July and August are around 0.7 mgd. Later in the season as the tourist numbers decrease and before the rains the plant flows may drop to around 0.6 mgd.

Because of limitations on its domestic water supply the City of Fort Bragg has been promoting the practice of water conservation. These measures have effectively reduced the per capita consumption of water. However, if in the future the water supply becomes less limiting people may change their habits and the per capita water use may increase. Thus in terms of planning the future capacity needs of the wastewater treatment plant the higher unit wastewater flows should be used.

The wastewater flows for the total long term buildout including development of the GP lands are projected in Table 1-3 using conventional unit wastewater flow rates and the LSA land use projections. For the purpose of sizing an expanded treatment plant it is recommended that an ADWF of 1.5 mgd be used.

TABLE 1-3
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT

WASTEWATER FLOW PROJECTIONS

Use	Total Long Term Buildout with GP	Estimated Unit Wastewater Flows	Projected Wastewater Flows
Residential Units	4,914	200 gpd	982,800
Commercial Office, sq.ft.	2,234,343	30 gpd/250 sq.ft.	268,121
Industrial, sq.ft.	1,105,987	30 gpd/1000 sq.ft.	33,180
Lodging, rooms	1,915	70 gpd	134,050
Entertainment/Performing Arts, sq.ft.	15,000	3 gpd/seat	3,000
Marine Research Facility, sq.ft.	200,000	30 gpd/1000sq.ft.	6,000
Open Space	100	0	0
MacKerricher State Beach, gpd			9,000
TOTAL PROJECTED WASTEWATER FLOW AS BUILD OUT			1,436,151

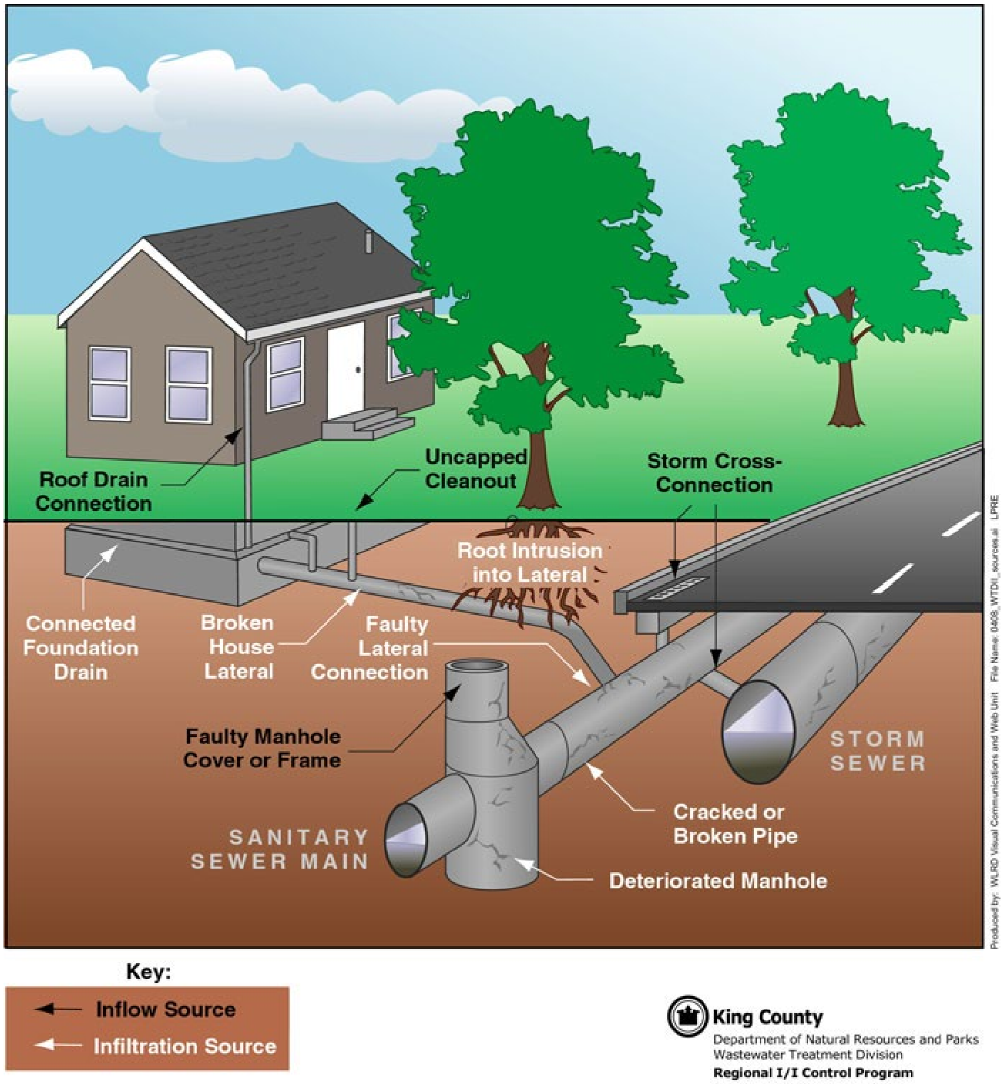
WET WEATHER FLOWS

During wet weather the wastewater flows can increase dramatically. This is due to rainwater and groundwater entering the sewers through drainage connections and defects in the sewer pipe and joints. This extraneous water is termed Infiltration/Inflow (I/I) and causes high sewage flows at the treatment plant during wet weather.

There are a number of mechanisms by which I/I can enter a sanitary sewer system. Figure 1-2 is a diagram illustrating the types of defects in the sewer system through which I/I can enter the sewers. The three components of I/I are described below.

Infiltration. Infiltration is groundwater which enters the sewer system (sewer mains, manholes, or upper and lower sewer laterals) through holes, breaks, joint failures, improper connections, and other openings. These defects may be attributable to the age of the material, or exacerbated by defects in the sewer pipes caused by tree root intrusion, accidental damage by others digging, land movement or subsidence, seismic activity, etc. Infiltration quantities often exhibit seasonal variation in response to groundwater levels.

FIGURE 1-2 – SOURCES OF INFILTRATION AND INFLOW



Source: King County Dept. of Natural Resources and Parks, Washington

Storm events can trigger a rise in groundwater levels and increase infiltration flows. The highest infiltration flows are observed following significant storm events or following prolonged periods of precipitation. Since infiltration is related to the total amount of piping and appurtenances in the ground it is usually expressed in terms of the total land area being served, or in terms of the lengths and diameters of sewer pipe.

Inflow. Inflow is surface water that directly enters the sanitary sewer system from yard, roof and foundation or footing drains, from cross-connections with storm drains, downspouts, and through holes in manhole covers. Peak inflow can occur during heavy rainfalls when storm sewer systems are surcharged or flooded, resulting in a direct cross-connection to the sanitary sewer system. Inflow occurs during and immediately

after storm events. Inflow is rarely measured in the field, and is grouped with infiltration as I/I by comparing dry weather sewer flows with wet weather sewer flows at the same locations.

Rainfall Dependent I/I or RDI/I. When rainfall is particularly intense and surface soils are saturated, the line that separates infiltration and inflow becomes blurred. Rainwater during high intensity rainfall that percolates through the ground and enters defective shallow sewers or laterals is also known as Rainfall Dependent I/I (RDI/I). These shallow sewers, when defective, act as underdrains and take on water at a rapid rate during intense storms when surface soils have been fully saturated.

RDI/I attributable to rainwater percolating into shallow defective sewers has been incorrectly categorized in some studies as inflow, because it follows a similar pattern of rising quickly immediately after intense rainfall. In these cases the mechanism of this rapid response is not cross-connections with storm drains or flooding of manholes (inflow), but rather, RDI/I enters the sewer system through sewer defects in mains and laterals that are relatively shallow.

FORT BRAGG SEWER SYSTEM

There are about 140,000 linear feet (26.5 miles) of sewers within the Fort Bragg Municipal Improvement District No. 1. The sewers range in size from 6" to 30" in diameter. The first sewers were constructed in the late 1800's. Most of the sewers still in use are the older vitrified clay pipe sewers, notoriously subject to leaks through defective joints, from intruding roots, from seismic activity, differential settling, and from external damage.

Some of the original sewers in the north part of town were constructed to carry both storm water and sanitary sewage, known as combined sewers. As part of the 1977 Sewerage Improvement Project, the most obvious combined sewers were converted to separate sanitary sewers by constructing new storm drains. The District sewer system is now technically considered a separate sewer system although it is still subject to high rates of I/I.

I/I ESTIMATE FOR THE FORT BRAGG SEWER SYSTEM

To estimate the peak wet weather flows which must be handled, effluent flow data from the Fort Bragg Treatment Plant was analyzed between October 2003 and March 2006. Four values were determined.

- Average dry weather flow (ADWF) was calculated as the average flow from the dry season months of July, August and September, when no rain was reported.

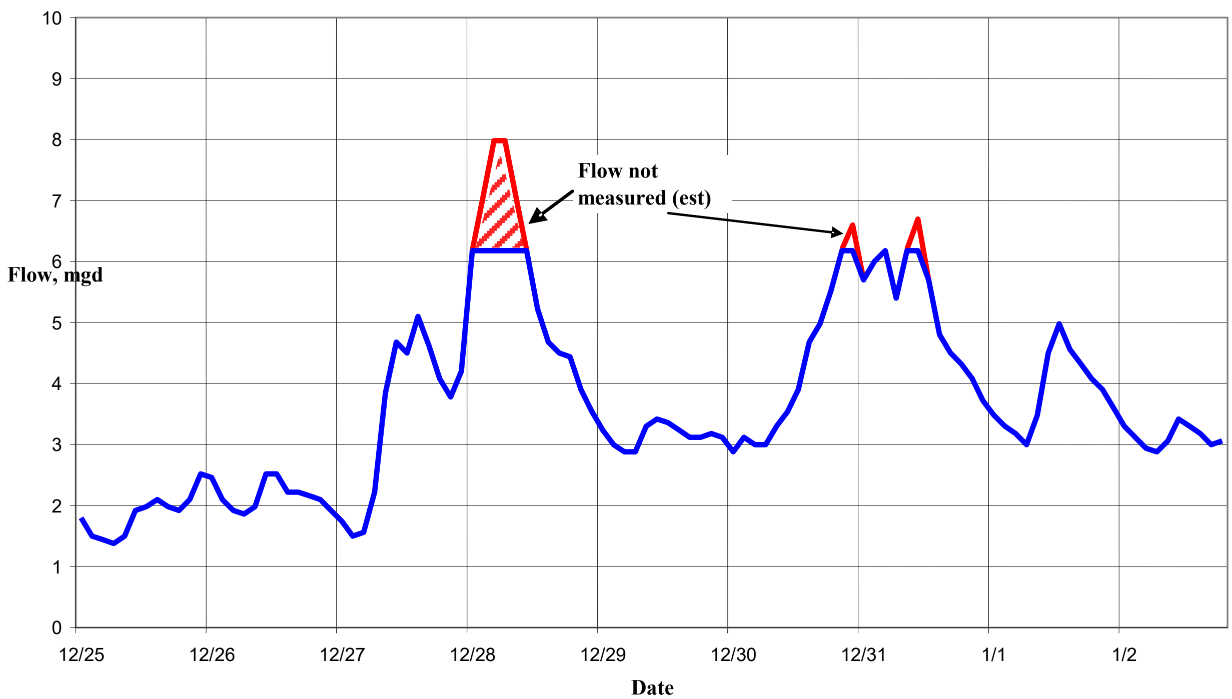
- Base wet weather flow, representing the average dry weather flow plus the infiltration component, was calculated as an average of daily reported plant flow between January and April for days when no rain was reported for the previous five days. In this calculation the base flow is not artificially raised due to storm-related inflow or RDI/I.

- The peak daily wet weather flow (PDWWF) flow of 5.06 mgd was recorded on December 28, 2005 during the series of New Years storms of 2005-2006. A daily flow of 4.9 mgd was recorded 3 days later on December 31, 2005. These recorded flows are an average over a 24 hour period. On both days for several hours the scale of the chart on which the measured flow was exceeded, which means the PDWWF does not represent the actual peak flow through the plant.

- The instantaneous peak wet weather flow (PWWF) is an estimate of the peak flow through the plant base on the flow charts.

Figure 1-3 shows the wastewater flows between December 25, 2005 and January 2, 2006. On December 28, 2005 the flow charts show that the flows exceeded the meter capacity over a 5 hour period. The peak flow rate during this storm event is estimated at 8 mgd.

Figure 1-3
FT BRAGG MEASURED SEWAGE FLOW
DECEMBER 25, 2005 THROUGH JANUARY 2, 2006



CALCULATION OF I/I COMPONENTS

The following is a calculation of the infiltration, inflow and RDI/I components of I/I at the Fort Bragg Plant.

Infiltration – The infiltration component is the base flow during the wet weather season, as defined above, minus the average dry weather flow. The logic is that seasonally high groundwater creates a steady state increase in flows above summer conditions, due to defects in the sanitary sewer system. The above approach of only averaging effluent flows during dry periods well within the wet season, beyond December, yielded a value of 1.13 mgd taken over the last three wet seasons. The average dry weather flow of the past two years is 0.65 mgd.

The infiltration component of I/I is therefore:

Base Wet Weather Flow (2004-2006):	1.13 mgd
Average Dry Weather Flow (2004-2005)	- 0.65 mgd
INFILTRATION (estimated)	~0.5 mgd

Assuming that the majority of the sewers in Fort Bragg are more than 40 years old the infiltration is likely to be widespread throughout the system. If the entire sewer system were replaced with new pipe only 0.5 mgd of infiltration would be eliminated. However, replacement of older sewers and laterals will have the benefit of reducing the RDI/I, which is a much larger component of the wet weather flows as shown below.

Inflow and RDI/I – The direct inflow and RDI/I can be estimated as the additional wet weather flow beyond the average dry weather flow and infiltration component as follows:

	PDWWF	**PWWF**
Wet Weather Flow (December 26, 2005)	5.06 mgd	8.0 mgd
Average Dry Weather Flow (2004-2005)	- 0.65 mgd	-0.65 mgd
Infiltration Component	- 0.48 mgd	-0.48 mgd
INFLOW AND RDI/I at PWWF (estimated)	3.93 mgd	6.78 mgd

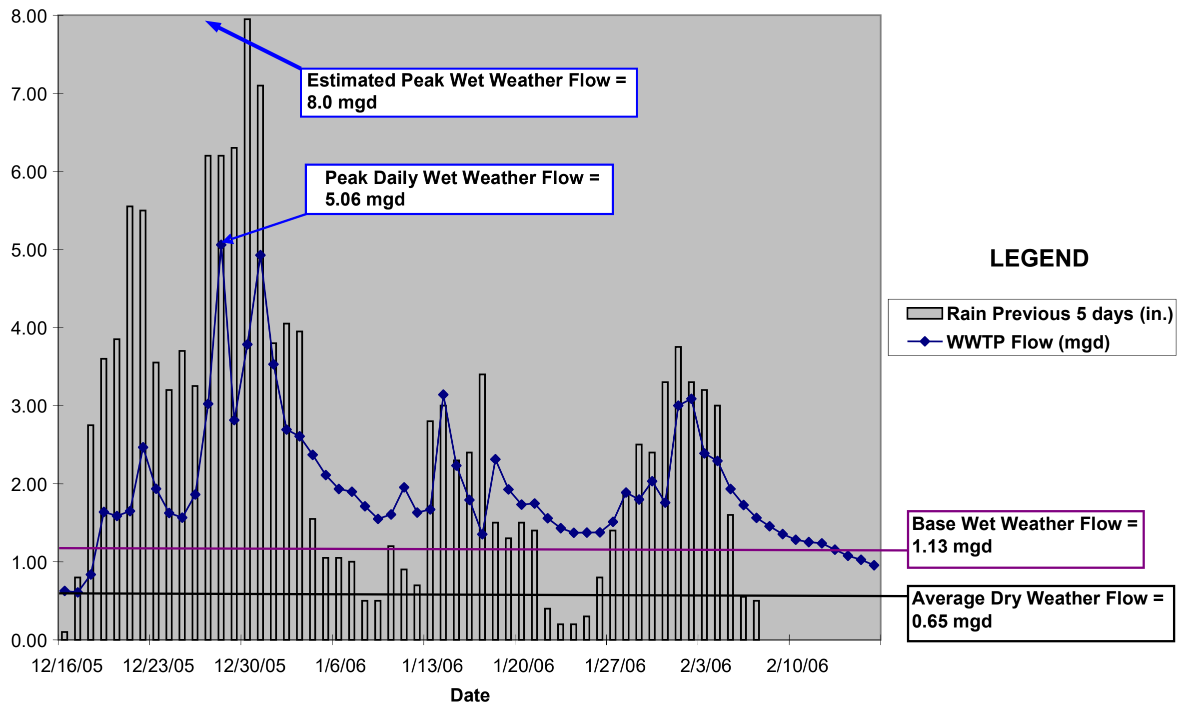
These values are graphically shown in Figure 1-4, below. The base wet weather flow conditions occurred in February 2006 when no rain had fallen for several days. The bars on the graph depicting rainfall include the total sum of rainfall of the calendar day plus the previous 4 days.

Inflow and RDI/I are evident in Figure 1-4 as the peak amount of flow minus the calculated base wet weather flow, which includes groundwater infiltration. The only way to separate the direct inflow component from the RDI/I is to identify the direct connections and make an estimate of their contribution.

An I/I estimate was made based on data from 1994 through 1999. The infiltration estimate from those data was higher at 1 mgd and the inflow estimate was also lower at 3.4 mgd. The PDDWF of that time period was about the same at 4.9 mgd (1996). In the intervening five years, the ADWF has not changed appreciably, but some sewer mains have been rehabilitated, which may have had some measurable benefit on reducing infiltration and RDI/I.

Flow measurements over the last 15 years show 5 mgd as the measured maximum daily flow. This value is about 7.7 times the ADWF. The estimated instantaneous peak flow rate of 8 mgd represents a peaking factor of over 12 times the ADWF. Recent field investigations have revealed interconnections between the trunk sewer coming into the plant and the storm drainage system of the old Georgia-Pacific mill site, which may be adding direct inflow or scalping some flows off of the highest peak wet weather influent flows.

Figure 1-4 – Estimated Infiltration/Inflow at Fort Bragg WWTP



I/I REDUCTION CHALLENGES

Before setting numeric goals for I/I reduction, it must be acknowledged that it is widely accepted that I/I source elimination programs have generally lacked effectiveness in reducing wet weather flows. There is also a level of imprecision inherent to characterizing what flows are extraneous to the collection system, the mechanism by which extraneous flows enter the collection system and effective approaches to

eliminating I/I. Some of the imprecision can be attributed to the phenomenon of "hydraulic transfer."

As groundwater levels near sewers rise both during significant storms and over the duration of the wet weather season, water will flow into the lowest available defective points in a sewer system. In some locations, this would be the sewer main, but if a sewer main has been rehabilitated or has minimal defects, the waters will rise and enter the nearest available defective point such as through sewer laterals or lateral connections to the mains, regardless if they are a private or public part of the system.

As sewers are rehabilitated using methods such as direct burial, pipebursting, slip-lining, cured-in-place pipes, pipe reaming or direct burial of new plastic pipe, groundwater will migrate to the next highest sewer defect and enter the system. This migration of infiltration is known as “hydraulic transfer” and can confound efforts to reduce I/I when a system is not holistically analyzed and rehabilitated. Money can be spent, pipes improved, and no measurable reduction in I/I flows realized. This outcome has plagued many sanitation agencies that have struggled to show I/I improvements to regulators and interested parties.

To avoid hydraulic transfer of I/I, a system-wide strategy must be employed that includes both the publicly owned sewer infrastructure and privately owned sewer laterals. A program that addresses only one or the other will have a reduced effectiveness in eliminating I/I. When only the public sewer main is replaced or rehabilitated and made reasonably watertight, very little reduction in I/I may be achieved because groundwater migrates to the next lowest defect in the system, which may likely be in the private laterals.

Similarly if only the private lateral is replaced or rehabilitated and made reasonably watertight very little reduction in I/I is achieved because the groundwater migrates to defects in the public sewer main. Rehabilitation of only the lower lateral or only the upper lateral will also achieve partial I/I reductions. In order to achieve maximum reduction in I/I and avoid compromising the ability of the sewer system to convey and treat sewage, both the public sewer main and private laterals must be replaced or rehabilitated in an area targeted for I/I reduction.

When the laterals and mains are rehabilitated together in an area, it is known as “comprehensive sewer rehabilitation.” Even with comprehensive rehabilitation, the effectiveness in reducing I/I is judged to be only 70% because of the realities of available construction techniques and future damage to the sewer over the long term. Some agencies are undertaking comprehensive sewer rehabilitation in which the sewer main and all the laterals are rehabilitated. These projects can cost up to $2,000,000 per mile of sewer main, which would cost over $50 million for the Fort Bragg sewer system.

FLOW PROJECTIONS FROM NEW DEVELOPMENT

Sewers constructed to serve new development should make use of newer technologies and as using PVC pipe. These sewers. including the house laterals, need to be inspected and tested and will be water tight. However, even with a totally new system defects can occur over the years due to ground movement, damaging sewer lines during excavations, etc.

For the purpose of designing new sewer systems and projecting wet weather flows from these systems it is recommended that the following peak factors be used:

PDWWF = 2.0 x ADWF
PWWF = 3.0 x ADWF

WASTEWATER CHARACTERISTICS

In addition to wastewater flows, the principal characteristics related to wastewater treatment and disposal are the amounts of organic and suspended material in the sewage. To a lesser degree the settleable solids and grease content are characteristics which should be considered in treatment plant design.

Biochemical oxygen demand (BOD) is defined as the weight of oxygen required to oxidize the organic matter in a waste. The BOD represents a measure of the amount of suspended and dissolved organic matter present in the waste.

The influent BOD values for a typical residential community with a normal compliment of commercial and light industrial users ranges from 250 to 350 mg/l. At the Fort Bragg treatment plant the influent BOD values which have been measured are often much higher than would be anticipated from a 50 percentile of 340 mg/l to a 90 percentile of 558 mg/l as shown in Table 1- 4 below.

There are two values of BOD which are important in designing the necessary treatment units.

- The BOD loading is the BOD concentration multiplied by the flow rate for that day converted to pounds per day. The BOD loading is one of the main criteria for the design of the biologic treatment system. At Fort Bragg the BOD loading can reach 3,800 lbs/day 5% of the time. This is 75% more than the median value almost double the expected value from similar communities.

- The BOD concentration in the influent is important because pursuant to the NPDES permit it is necessary to achieve 85% removal in the final effluent.

During wet weather the incoming sewage at Fort Bragg is diluted by the I/I, which is essentially clean rainwater. During these high flows the BOD concen-

TABLE 1-4
FORT BRAGG MUNICIPAL UTILITY DISTRICT
INFLUENT FLOW, BOD AND TSS VALUES RANKED BY PERCENTILE

Percentile	Plant Daily Flow mgd	Peak Wet Weather Flow mgd	BOD Conc. mg/l	BOD Loading lbs/day	TSS Conc. mg/l	TSS Loading lbs/day
Minimum	0.46	1.13	32	337	40	500
1st	0.52	1.17	64	950	54	730
5th	0.56	1.25	99	1275	95	860
10th	0.58	1.28	138	1435	122	1010
20th	0.62	1.36	197	1623	154	1190
50th (Median)	0.72	1.62	340	2170	240	1615
80th	1.28	2.40	460	2850	360	2470
90th	1.65	2.89	558	3535	467	3052
95th	2.20	3.25	654	3800	540	3710
99th	3.00	5.42	804	6970	758	5318
Maximum	5.10	8.0*	1300	7500	1800	9728

* Estimated from storm of December 28, 2005

tration in the influent will drop to less than 100 about 5% of the time. This means that the concentration of BOD in the effluent must be 15 mg/l or less to meet the 85% removal requirement. In order to be on the conservative side the treatment facilities should be designed to produce an effluent with a BOD concentration of 10 mg/l or less during these high flows.

Total suspended solids (TSS) are the materials suspended in the sewage. Some of this material will settle when the transporting power of the water is decreased by reduction in velocity and is measured as settleable solids. If the suspended material is allowed to remain in the sewage for any considerable length of time, or if it is not removed before disposal to the receiving body of water, it will settle and decompose, resulting in odors and septic conditions causing a depletion of dissolved oxygen.

TSS are removed by the clarifiers. Stabilization of the BOD converts soluble organics to suspended solids which must also be removed. As with BOD there are two values of TSS which must be considered in the design of wastewater treatment plants.

- TSS loading is the concentration of TSS multiplied by the flow and converted to pounds per day. Clarifiers must be designed so that the rate of overflow allows the solids to settle out to remove of TSS. The sludge thickener, digesters and sludge dewatering system must have the capacity to digest these solids. From

Table 1-4 the median TSS is 240 mg/l, which is about normal for domestic sewage.

- The TSS concentration in the influent is similar to that of BOD in that pursuant to the NPDES permit it is necessary to achieve 85% removal in the final effluent. During wet weather the incoming sewage at Fort Bragg is diluted by I/I, which is essentially clean rainwater. During these high flows the TSS concentration in the influent will drop to less than 100 about 5% of the time. This means that the concentration of TSS in the effluent must be 15 mg/l or less to meet the 85% removal requirement. As with the BOD in order to be on the conservative side the treatment facilities should be designed to produce an effluent with a TSS concentration of 10 mg/l during these high flows.

It should be noted that in Table 1-1 the projected wastewater flow for the existing development in the District based on conventional unit flow rates was 0.89 mgd, whereas the measured flow rate at the plant is 0.65 mgd. This amounts to 73% of the expected flow and may indicate that a fairly high rate of water conservation is taking place. If the unit flow rates are less than normal then the concentration of organics and solids will be correspondingly higher. When this apparent phenomenon is taken into account the 50 percentile of BOD becomes 255 mg/l, which is more reasonable. However, by the same reasoning the 50 percentile TSS concentration becomes 160 mg/l, which is relatively low. The fact remains that the existing loadings of both BOD and TSS are high and the concentrations are low at high flows.

SUMMARY OF PROJECTED DESIGN CRITERIA

The purpose of this section has been to establish a basis for the design for upgrading the Fort Bragg wastewater treatment plant.

As summarized above the Fort Bragg area is expected to continue to grow resulting in an increase in the sewage flows received at the wastewater treatment plant. With the increase in flows there will be an increase in the organics and solid material which must be treated. There is also a need to provide treatment to meet the requirement of the NPDES permit, specifically there is a need to comply with the 85% removal requirement.

Table 1-5 summarizes the wastewater characteristics in terms of concentrations in milligrams per liter (mg/l) and the loadings in terms of pounds per day at the projected dry weather design flow of 1.5 mgd.

TABLE 1-5
FORT BRAGG MUNICIPAL UTILITY DISTRICT
WASTEWATER TREATMENT PLANT DESIGN CRITERIA

Characteristic	Existing	Projected Future	Total

Wastewater Flow			
ADWF, mgd	0.89	0.61	1.50
PDWWF, mgd	5.0	1.2	6.2
PWWF, mgd	8.0	1.8	9.8
BOD (90th percentile)			
Concentration, mg/l	560	300	405
Loading, lbs/day	3,540	1,530	5,070
TSS (90th percentile)			
Concentration, mg/l	470	300	366
Loading, lbs/day	3,050	1,530	4,580

References:

LSA, Economic Planning Systems Inc., Winzler and Kelly Consulting Engineers, and Baseline Environmental Consulting; City of Fort Bragg Municipal Services Review, Draft Report, July 2006.

Mendocino County General Plan Update, Community Planning Areas Workshop Materials, Fort Bragg, July/August 2005.

FORT BRAGG MUNICIPAL UTILITY DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 2
REVIEW OF WASTEWATER DISCHARGE REQUIREMENTS

The Fort Bragg Municipal Utility District wastewater treatment facility is regulated by NPDES Permit No. CA0023078 (Order No. R1-2004-0009) reissued March 24, 2004 by the Regional Water Quality Control Board (RWQCB), North Coast Region (see Appendix A). In California, federal NPDES permits are equivalent to State waste discharge requirements as defined in the California Water Code. Effluent limits in the NPDES permit are based on both water quality objectives in the California Ocean Plan, which is State regulation, and technology-based limits for secondary treatment defined in Federal regulations. The NPDES permit must be renewed every five years, at which time the RWQCB can incorporate additional requirements or provisions, which tend to be more restrictive over time.

The purpose of TM 2 is to review the existing requirements and effluent limits as set forth in the current NPDES permit and identify possible future discharge requirements which may affect the level of treatment needed in the future. This review included a review of relevant State and Federal policies and meeting with the staff of the RWQCB in Santa Rosa. The project alternatives are developed in recognition of the need to comply with current and future projected waste discharge requirements and receiving water limitations.

OCEAN PLAN

In 1972 the State Water Resources Control Board (SWRCB) first adopted the Water Quality Control Plan for Ocean Waters of California, generally known as the "Ocean Plan". The Ocean Plan is a State regulation that implements the California Water Code for the State's Ocean waters, which extend three miles from the shoreline. The Ocean Plan establishes beneficial uses for all ocean waters in California and water quality objectives to protect those uses. It also includes a program of implementation to achieve these objectives and to protect areas of special biological significance. Ocean discharges such as Fort Bragg's are regulated under the Ocean Plan's program of implementation.

Applicable Policies for Treatment and Disposal. The Ocean Plan states that waste discharges to the ocean must be designed and operated in a manner that will maintain the indigenous marine life and a health and diverse marine community. It also requires that discharges that may contain pathogenic organisms or viruses should be discharged a sufficient distance from shellfishing or water-contact sports areas to maintain applicable bacterial standards without disinfection. This condition can not be met in

Fort Bragg, where construction of an ocean outfall to such distances, and its maintenance, would be cost-prohibitive.

Disinfection Requirements. In Fort Bragg, the nearest shoreline is about 500 feet south of the discharge outfall, a reasonable distance for shellfishing and water-contact recreation only if combined with disinfection. Until now, the area was isolated from the general population by the private property of Georgia-Pacific, which restricted access. In the future, this area is expected to be used frequently by the public. RWQCB staff has indicated unwillingness to recommend relaxation of pathogen indicator limits because of the anticipated increase in public water contact recreation and shellfishing in the ocean in the vicinity of the Fort Bragg's treatment plant.

In situations such as Fort Bragg's, the Ocean Plan specifies that reliable disinfection in conjunction with a reasonable separation of the discharge point from the area of use must be provided. The Ocean Plan states that "Disinfection procedures that do not increase effluent toxicity and that constitute the least environmental and human hazard should be used."

These general Ocean Plan requirements compel consideration of alternative disinfection technologies that minimize effluent toxicity and human health hazards. If such alternatives are not considered there is a risk that a wastewater treatment facility study would get sent back by the RWQCB for revision. Traditional disinfection technology using sodium hypochlorite is allowable under the Ocean Plan, since it is safely used statewide and de-toxified using sodium bisulfite. However, where shown to be feasible on specific wastewaters, UV disinfection has lower toxicity risk and is safer to use than chlorine chemicals. As such, the Ocean Plan policy essentially compels that any renovation of a treatment plant such as the Fort Bragg WWTF consider UV disinfection because it has no effluent toxicity risk and compared to chlorine it has lower health risk to treatment plant workers. In Fort Bragg's case there are even additional risks to human health and water quality from the transportation of the chlorine-based disinfection chemicals on narrow, winding roads.

Effluent Limitations. For discharges governed by the Ocean Plan, effluent limitations are established in NPDES permits such that the concentrations set forth as water quality objectives are not exceeded in the receiving water upon completion of initial dilution. The RWQCB may establish more restrictive water quality objectives and effluent limitations than those set forth in the Ocean Plan as necessary for the protection of beneficial uses of ocean waters. In Fort Bragg's 2004 permit reissuance, the RWQCB did exercise this discretion by handing down more stringent TSS, TSS and BOD removal, and bacteriological effluent limits than the Ocean Plan requires.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 3 WASTEWATER TREATMENT PLANT EVALUATION

The purpose of this Technical Memorandum (TM) is to evaluate the existing wastewater treatment plant processes for the purpose of identifying immediate operational needs and maintenance priorities as well as needed capital improvement projects. For this task each unit process was inspected with the help of the District staff and evaluated for its operational condition, age and current performance. The following summarizes the findings with an evaluation of maintenance and performance issues along with recommendations for addressing outstanding needs.

It should be noted that the improvements recorded in this TM only address the deferred maintenance and replacement of old equipment to bring the plant up to current design and operational standards. These recommended improvements do not address capacity increases necessary to meet future growth needs. Alternatives for major upgrades to the treatment plant for the purpose of obtaining greater capacity are evaluated in TM 4. Improvements recorded in this TM will be incorporated into those alternatives which will utilize all or a portion of the exiting treatment plant processes.

ESTIMATED COSTS

Cost estimates are based on an ENR Construction Cost index of 9,100 representing costs in early 2007.

HISTORY OF THE WASTEWATER TREATMENT PLANT

In response to waste discharge requirements adopted by the North Coast Regional Water Quality Control Board on July 20, 1967, the City of Fort Bragg formed Municipal Improvement District No. 1, planned and implemented a Regional Sewage Disposal Project. The original wastewater treatment plant was completed in November 1971 and consisted of a single clarifier and single biofilter process followed by effluent disinfection with separate sludge digestion. This first stage plant operated on the flow sheet commonly known as the “Petaluma” flow sheet and was designed to remove approximately 60 per cent of the biochemical oxygen demand (BOD) and suspended solids from approximately 1.0 million gallons per day of wastewater.

In 1977 the treatment plant was upgraded with the installation of a secondary clarifier, secondary biofilter, sludge thickener, dechlorination facilities and a septage receiving station. This project also included construction of an ocean outfall and separation of combined sewers in the northern part of the city. The installation of the second trickling filter and second clarifier was dictated by the need to meet secondary treatment standards.

In 1988 a grit chamber and a sludge filter press were added to the plant. The sludge filter press provides dewatering of the digested sludge so it can be disposed of at a landfill site. In 2004, construction was completed on a second anaerobic sludge digester.

The plant is now 35 years old and is showing signs of normal aging and deterioration. The salt air along with the hydrogen sulfides from the wastewater has led to significant corrosion and deterioration.

PERFORMANCE OF THE EXISTING TREATMENT PLANT

The District's NPDES permit limits the mean daily dry weather flow to the plant to 1.0 mgd. This is based on achieving an effluent BOD and TSS of 30 mg/l each. The influent BOD measured at Fort Bragg is often higher than that for domestic wastewater, which has increased the organic loading on the trickling filters. In order to meet discharge requirements it has become necessary to add chemicals in the secondary clarifier on a routine basis. The performance of the secondary clarifier is considered to be a limiting factor in meeting effluent requirements.

WASTEWATER TREATMENT PLANT PROCESSES

The Fort Bragg wastewater treatment plant utilizes two sludge trickling filter process with separate anaerobic sludge digestion. Treated effluent is disinfected with gaseous chlorine and then dechlorinated with gaseous sulfur dioxide. Digested sludge is dewatered by means of a belt filter press and transported to a land disposal site. The plant is designed to meet Federal secondary treatment standards with an effluent BOD and TSS of 30 mg/l each.

The layout of the Fort Bragg treatment plant is set forth in Figure 3-1 and the design characteristics are given in Table 3-1. The treatment plant process consists of the following which are described in detail below:

- Headworks Screen
- Grit Removal
- Primary Clarification
- Primary Biofilter and Recirculation Pumps
- Secondary Biofilter and Recirculation Pumps
- Disinfection and Dechlorination
- Ocean Outfall
- Sludge Thickener
- Primary and Secondary Sludge Digestion
- Sludge Pump Room
- Sludge Belt Filter Press

- Sludge Drying Bed
- Plant Auxiliary Power Generator

- SCADA
- Storm Water Containment

HEADWORKS SCREEN

Removal of rags and non-treatable items prior to the grit chamber and the treatment plant equipment is a high priority. A project to install a headworks screen is currently under design and will be constructed in 2007. The headworks screen will be located in a new concrete structure and will directly screen the incoming wastewater. Head loss across the screen is monitored and once a pre-specified headloss is reached the screening will be removed from the screen and be discharged to a washing press. The washing press will wash out the fecal matter and compact the screenings prior to discharge into a dumpster. The washed screenings will be taken to a landfill.

Because of budget constraints only one headworks screen is being installed at the present time. A second channel is being installed and it is recommended that a second screen be installed in the near future.

Recommendation – Install a second headworks screen.

GRIT REMOVAL

The existing plant headworks structure was constructed in 1988 and receives the raw wastewater from a 30" diameter trunk sewer crossing the Georgia Pacific (GP) property. The structure is reinforced concrete with a concrete deck which allows the operator to service the grit chamber and the two comminutors from the deck level. A manually cleaned bar screen has been provided in a third channel to screen flows which may bypass the comminutors during periods of high flows. A single monorail is placed above the comminutor to allow for removal of these units. However, there is no hoist permanently mounted to the monorail. The headworks is not currently covered or enclosed so any odors are free to escape into the air.

The grit chamber is a Jones & Atwood cyclonic type separator mixed by an electric motor and gear drive. The grit in the chamber is periodically agitated using plant compressed air. The grit falls to the bottom and the separated grit is pumped via two Wemco slurry pumps directly to the grit classifier and washer.

Following the grit chamber the wastewater passes through an electric motor driven comminutor. The purpose of the comminutor is to shred and chop rags and other debris such as plastics, prior to the wastewater entering the primary clarifier.

Plant operators report that the grit chamber generally perform as designed. However, because the comminutors are located after the grit chamber, rags are generally removed with the grit and foul the slurry pumps and the grit classifier. In addition, while the comminutors are intended to cut up the rags they do not remove the rag remnants from the waste stream. These remnants often recombine to foul pumps and valves downstream of the headworks.

The underflow of the grit chamber, which contains the grit is pumped through a grit cyclone and classifier. The grit from the headworks grit chamber is pumped via two Wemco slurry pumps to the grit cyclone and the grit is discharged to a classifier. The grit cyclone and classifier were installed in 1979, and are located on a raised concrete platform adjacent to the sludge thickener. Their role is to separate and wash the grit which has been removed from the waste stream by the grit chamber so it can be disposed of separately. The grit cyclone and classifier are not housed in a building and is primarily made of painted mild steel and is mounted on a concrete deck with no roof and is suffering from a high level of corrosion. These units have reached their life expectancy and should be replaced.

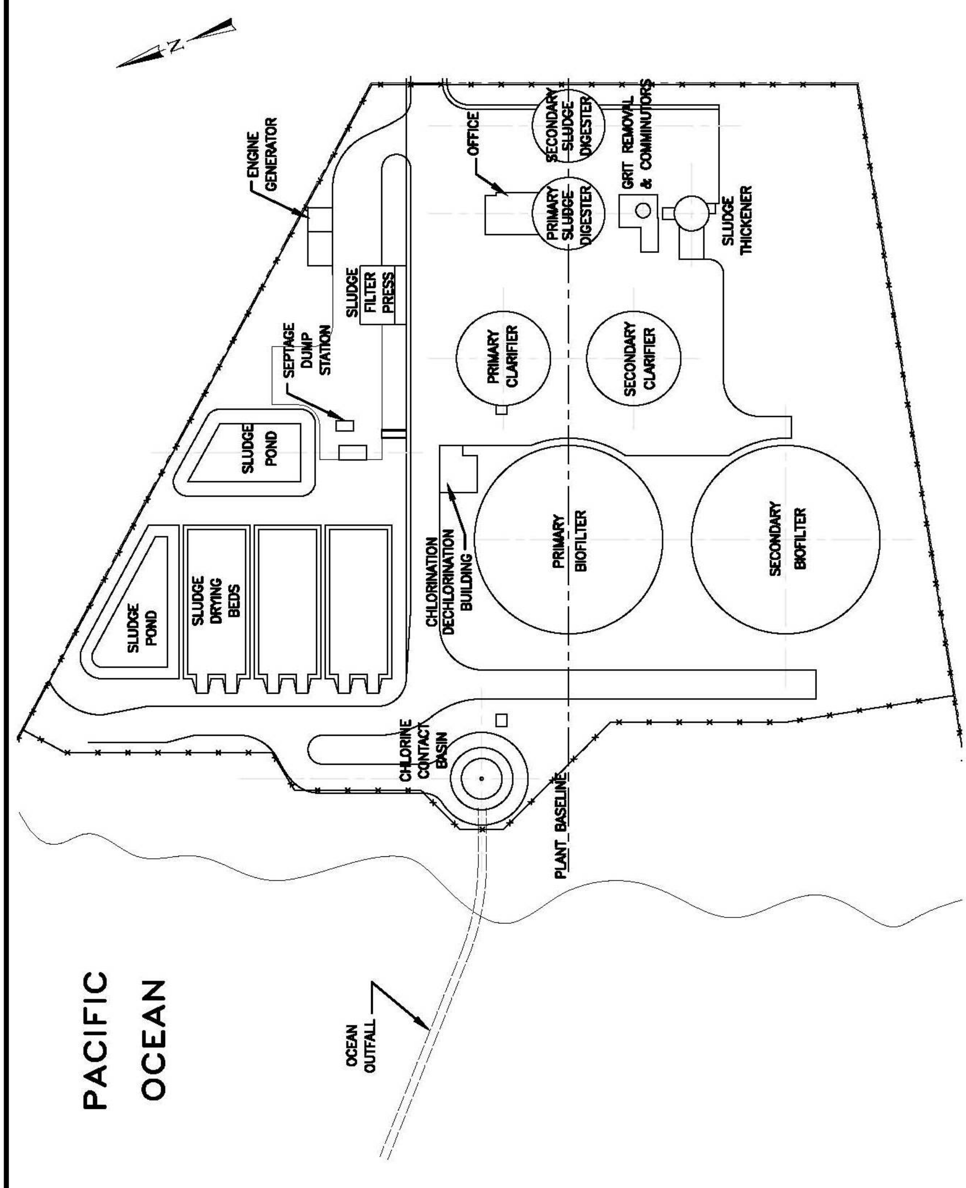
The galvanized steel handrails around this equipment are also showing their age and exposure, along with the electrical conduits and switches. The elevated concrete deck and concrete stair are still in good condition. Much of the painted ductile iron piping is exposed and needs to be repainted. In addition, due to the age of the piping and the abrasiveness of the grit which is transported through the piping, an assessment of the existing pipe wall thickness should be conducted.

<u>Evaluation</u> - The headworks and grit chamber is operationally in good condition and a change of process is not recommended. The removal of rags prior to this process with a headworks screen will improve the maintenance requirements of the grit chamber and the grit pumping. The existing grit chamber is designed with an air purge cycle to break up the build up of grit at the bottom of the chamber. This air is provided by two plant air compressors. These twenty year old compressors need to be replaced with more effluent compressors to reduce the electrical energy costs.

The two grit slurry pumps and the grit classifier/washer have been in service for nearly 30 years and have reached their useful life. These units should be replaced. Wemco grit slurry pumps are still being manufactured and replacement units can easily be acquired and installed.

There are several grit classifiers and washers on the market that are similar in operation and would fit on the existing elevated deck.

The concrete headworks structure appears to be in good condition but should be repainted. The structure and unit processes are enclosed by an aluminum handrail system that is in good condition despite the corrosive salt air. The fiberglass grates covering the concrete channels are also in good condition. However, the mild steel parts including the monorail steel beam, electrical conduits and electric motor housings have not been painted for sometime and are showing a high degree of corrosion. Some of the conduits need to be replaced.



FT. BRAGG MUNICIPAL IMPROVEMENT DISTRICT
EXISTING WASTEWATER TREATMENT PLANT LAYOUT

FIGURE 3-1

TABLE 3-1 FORT BRAGG WASTEWATER TREATMENT PLANT DESIGN CHARACTERISTICS

Basis of Design	
Design Population	10,000
Design Flow:	
Average Dry Weather Flwo (ADWF), mgd	1
Peak Wet Weather Flow (PWWF), mgd	1,700
Biochemical Oxygen Demand, lbs/day	1,700
Suspended Solids, lbs/day	
Liquid Treatment	
Headworks:	
Grit Chamber	1
Volume, cf	300
Bar Screens	1
Comminutors	2
Primary Clarifier	1
Primary Recirculation Pumps	2
Low Speed, gpm	1,700
High Speed, gpm	3,000
Primary Biofilter	1
Diameter, ft	80
Depth of Rock Media, ft	3
Volume of Media, cu yds	560
BOD Loading, lbs/cy	2
Secondary Recirculation Pumps	2
Low Speed, gpm	1,700
High Speed, gpm	3,000
Secondary Biofilter	1
Diameter, ft	100
Depth of Plastic Media, ft	4
Volume of Media, cu yds	1,164
BOD Loading, lbs/cy	0.5
Secondary Clarifier	1
Diameter, ft	65
Side Wall Depth, ft	10
Surface Area, sq ft	3,320
Volume, gal	249,000
Overflow Rate @ ADWF/PWWF, no recirc, gal/sq ft/day	301/2,110
Detention Time @ ADWF/PWWF, no recirc, hrs	6.0/0.85
Chlorinators	2
Maximum Feed Rate, lbs/hr	2,000
Sulfur Dioxide Feeder	1
Maximum Feed Rate, lbs/hr	450
Chlorine Contact Chamber	1
Volume, gal	41,300
Ocean Outfall	
Diameter, in	24
Length from High Water Line, ft	690
Any Depth Below MSL, ft	28
Initial Dilution	50:1
Solids Treatment	
Grit Removal Equipment:	
Grit Separator Capacity, gpm	205
Grit Classifier	1
Sludge Thickener	1
Diameter, ft	24
Side Wall Depth, ft	10
Volume, gal	452
Volatile Solids Loading, lbs/cf/day	33,900
Primary Sludge Digester	1
Diameter, ft	50
Side Wall Depth, ft	22
Volume, gal	324,000
Volatile Solids Loading, lbs/cf/day	0.025
Secondary Sludge Digester	1
Diameter, ft	35
Side Wall Depth, ft	20
Volume, gal	144,320
Sludge Recirculation Pump	1
Capacity, gpm	2,000
Sludge Heat Exchanger	1
Transfer Capacity, BTU/hr	580,000
Sludge Filter Press	1
Belt Width, meters	1.5
Maximum Feed Rate, gpm	7

Corrosion at the wastewater plant is an ongoing issue due to the persistent presence of hydrogen sulfide gas and the influence of corrosive salt spray from the ocean. These factors have combined to take a toll on much of the plant's painted steel and iron facilities. Visual evidence of severely corroded electrical conduits, corroded process piping and machinery abound. Damaged conduits are a worker safety issue and should be replaced. A complete assessment of the existing condition of the pipelines should be undertaken followed by cleaning and sandblasting and painting of the exposed pipelines.

Recommendations – In order to improve the operation of the plant headworks and grit classifier and washer the following improvements are recommended:

- Install screening upstream of the plant headworks to remove rags prior to the grit chamber.
- Once the screening is installed remove the comminutors, which do not perform any useful function.
- Replace the existing air compressors needed for the grit chamber.
- Replace the two Wemco slurry pumps.
- Replace the cyclone and grit classifier.
- Replace grit piping where pipe and fittings are found to be thin and worn.
- Replace corroded conduits in the headworks area.
- Replace corroded metal work including the handrails around the grit classifier.

PRIMARY CLARIFICATION

The suspended matter in the raw sewage is removed by sedimentation and flotation in the primary clarifier. The primary clarifier is 65 feet in diameter with a 7 foot side wall depth. The clarifier utilizes a skimmer to gather the floating material so it can be removed and pumped to the digester. The settled sludge is raked to the center of the clarifier where it is pumped to the sludge thickener. This unit was designed and built in 1970 and, according to operations staff, has never been taken out of service for fear of possible permit violation. Therefore, the entire underwater portion of the clarifier mechanism has not been inspected for over 30 years.

Evaluation - The primary clarifier is considered a shallow clarifier by today's design standards which recommend clarifier depths of 10 to 14 feet. Deeper clarifiers allow for better settling of the suspended solids. Improvements to the settling characteristics for shallow clarifiers can be made by installing a new raking mechanism. A new clarifier mechanism can ensure that the wastewater is distributed evenly within the clarifier and that the accumulated sludge can be removed efficiently without disruption. The clarifier mechanism should have spiral sludge scrapers and a large feed well hydraulically designed to facilitate channel flocculation if necessary. Also, density current baffles will be installed along the wall below the overflow weir to prevent carryover of solids from the tank bottom over the weir to the effluent.

Many agencies with clarifiers of this vintage are replacing the clarifier mechanism with more modern ones with the ability to collect sludge more efficiently and which are better suited for chemical flocculation if it becomes necessary. Mechanisms fabricated from stainless steel are available but they are about double the cost of the conventional galvanized steel mechanisms. Most of the clarifier mechanism is under water and not usually subject to corrosion. Considering that the existing conventional steel clarifier mechanisms at the Fort Bragg plant have lasted over 35 years replacement with a stainless steel mechanism is not considered warranted. However, it is recommended that the walkway portion of the mechanism, which is exposed to the air be fabricated out of stainless steel to resist corrosion.

Recommendations – In order to improve the operation of the primary clarifier the following improvements are recommended:

- Install a new galvanized steel clarifier mechanism with spiral rakes and a center well which improves flocculation together with a stainless steel walkway.

PRIMARY BIOFILTER

The primary biofilter is a biologic filter consisting of graded rock stacked to a depth of 3 feet on redwood grillage. The primary biofilter is 80 feet in diameter and is designed to be enlarged to a diameter of 130 feet. The overflow from the primary clarifier is pumped through a distributor, which rotates above the rock bed. Sewage passes through the rocks where bacteria and micro-organisms attached to rocks stabilize the organic matter in the sewage as it passes by. From the primary biofilter the partially treated sewage flows on to the secondary biofilter.

The primary biofilter rock media has been stacked upon redwood grillage which has now been in service for over 30 years. This grillage appears to be in relatively good condition, however it is likely that the grillage is approaching its useful life. The distributor mechanism, which was replaced in 1998, appears to be in good operational condition, although the paint job has weathered considerably. This mechanism has a mechanical seal.

Evaluation – The biofilter is not a fussy treatment process, however, any project to upgrade the existing treatment plant should include the replacement if the rock media and redwood grillage with plastic media and plastic supports. At that time the District should also inspect the distributor mechanism for wear and corrosion damage and be repaired or replaced as necessary.

Rock media is heavy and cannot be stacked higher than about three feet. However if the rock is replaced with plastic media it can be stacked higher requiring a smaller diameter to achieve the same amount of treatment. If plastic media is used in an upgraded biofilter media it is recommended that a concrete wall be constructed around the periphery with appropriate ventilation holes. The diameter of the reconstructed biofilter can be reduced by using a deeper media depth. This will make additional space available between the primary and secondary biofilters.

Recommendations – For the foreseeable future the condition of the redwood grillage should be monitored for possible failure in the primary biofilter.

SECONDARY BIOFILTER AND RECIRCULATION PUMPS

The secondary biofilter is 90 feet in diameter and provision has been made to expand the diameter to 130 feet. The rock media in this biofilter was removed in 1997 because the redwood support grillage was collapsing. The rock media was replaced with four feet of plastic media supported on plastic supports. The advantage of the plastic media is that it has a greater surface area for the attachment of bacteria and organisms which treat the sewage. The thickness of this biological growth layer on plastic media does not tend to be as great as on rocks. This thinner layer is actually beneficial to the treatment process because smaller amounts of this layer are constantly sloughing off and it does not tend to become anaerobic.

Evaluation – The secondary biofilter appears to be functioning as designed. However, operators have discovered some loose media in the effluent diversion box. Possibly left there during construction or one or more of the perforated plastic netting which enclose the loose media have ruptured. The condition of the existing plastic media and media enclosures should be evaluated to make sure the media is adequately contained. The valves and air release valve on the recirculation pumps are original and now unreliable and should be replaced.

If the secondary biofilter is retained in the upgraded treatment plant it is recommended that a concrete wall be constructed around the periphery with appropriate ventilation holes. If necessary additional plastic media can be added to provide a deeper media depth. This will provide additional treatment and make additional space available between the primary and secondary biofilters. These improvements will be evaluated in TM 4 for the alternatives involving continued use of the trickling filter process.

Recommendations – For the foreseeable future the secondary biofilter should be monitored for possible loss of plastic media.

BIOFILTER RECIRCULATION PUMPS

Wastewater is circulated over the primary and secondary biofilters by means of recirculation pumps. There are four pumps total, two for each biofilter together with associated valves. The pumps are vertical propeller pumps which extend into the pump pit below. The motors sit above the deck and are exposed to the salt air. Wooden sheds have been constructed over the motors to protect them from the rain and corrosion. These pumps and motors are getting old and unreliable and are in need of replacement.

Operators report that some of the existing valves on the discharge of these pumps have not been exercised for fear of damage. Also the existing air release valves do not appear to be working. These valves should be replaced.

Depending on which long term treatment alternative is selected these pumps may need to be replaced with new higher head pumps or they may not be needed altogether. However, the existing pumps and valves will need to be kept in operation as long as the existing trickling filter process is in operation and an appropriate budget, say $50,000 should be established for this replacement.

Recommendation – It is recommended that a $50,000 budget be established for replacement of the pumps and valves as necessary but that these replacements be delayed until the decision has been made about the future treatment process to be used in the upgraded plant.

SECONDARY CLARIFICATION AND CHEMICAL FEED SYSTEM

The flow from the secondary biofilter enters the secondary clarifier where the light biologic humus material which sloughs from the biofilters is settled out. The secondary clarifier was constructed in 1977 and is 65 feet in diameter with a 10 foot side wall depth. This clarifier is deeper than the primary clarifier which improves its performance.

The District adds flocculating chemicals to the influent to the secondary clarifier. This has improved settling of the suspended solids and BOD removal. The staff have constructed a small wooden shed to protect the small chemical feed pump and provide the operators with some weather protection.

Like the primary clarifier this unit has never been taken out of service for inspection. Staff has no idea of the condition of the clarifier mechanism.

Evaluation – As with the primary clarifier it is recommended that the clarifier mechanism be replaced with a new galvanized steel mechanism with spiral rakes and a center well which improves chemical flocculation. The walkway should be fabricated out of stainless steel to resist corrosion.

The chemical feed system constructed by the operators is very useful in meeting the NPDES permit requirements. However, the use of chemicals is a significant plant operating cost. The chemical feed pump is manually controlled but has the capability to be continuous flow paced if provided with a flowmeter signal. The chemical feed system needs to be upgraded with a standby pump paced by a flow control signal from the effluent flow meter.

Recommendations - The following improvements are recommended for the secondary clarifier and chemical feed equipment:

- Install a new galvanized steel clarifier mechanism with spiral rakes and a center well which improves flocculation together with a stainless steel walkway.

- Upgrade the chemical feed system and install a flow signal from the plant flowmeter to pace the chemical feed pump to better control the use of expensive chemicals.

DISINFECTION AND DECHLORINATION

Prior to discharge the treated effluent is disinfected with gaseous chlorine which is injected into the effluent after the biologic treatment process. The chlorine remains in contact with the effluent for a suitable time to achieve the necessary "kill" of coliform organisms in the chlorine contact chamber.

The chlorine contact chamber consists of the outfall pipe from the secondary clarifier to the chlorine contact basin and the chlorine contact basin which is 40 feet in diameter by 6 feet deep with sides sloping 1:1. Flow enters the basin tangentially and overflows a circular weir in the center, thus producing a circular mixing motion to the entire contents of the basin. The total volume of the chlorine contact basin is 41,300 gallons, which provides a detention time for the treated effluent of over an hour at a flow rate of 1.0 mgd. High winter wastewater flows stress the hydraulic capacity of the chlorine contact chamber and serve to reduce the disinfection contact time of contact chamber.

Chlorine is toxic to marine organisms so after the chlorine contact basin gaseous sulfur dioxide is injected into the flow to remove the residual chlorine. The reaction is instantaneous so no additional contact chlorine is necessary. The plant staff has recently upgraded the chlorination system by installing two new chlorinators, a chlorine sensor in the tank storage area, and a new chlorine residual monitor.

The chlorine gas at and sulfur dioxide gas are delivered to the plant in one ton cylinders. The monorail and hoist at the chemical bulk tank storage area has not been serviced because the local service contractor does not believe it is properly capacity rated.

Evaluation – Storage of hazardous chemicals such as gaseous chlorine and sulfur dioxide requires careful planning and operation to avoid potential risks from an accidental chemical release. Such planning includes frequent operator training and up to date risk management plans as part of the requirements for city and county permitting. With the prevailing winds from the west a chlorine gas leak would directly threaten city residents. Safety considerations and future development of the Georgia-Pacific property will require higher safeguards for the chemical storage at the treatment plant and could dictate the elimination of gaseous chemical use.

The benefits of continuing to use gaseous chemicals for chlorination and dechlorination need to be evaluated against the current and future risks and regulatory requirements. Other safer technologies exist such the use of sodium hypochlorite for disinfection and sodium bisulfite for dechlorination. Both of these chemicals are toxic but being in a solution form they will not threaten people. However, they must be transported to the treatment plant from the Bay Area and a spill could threaten fish. Disinfection by ultraviolet light is now a proven technology and does not require use of any chemicals.

Recommendations – It is highly recommended that in the short term the District switch to the use of aqueous solutions of chlorination and dechlorination chemicals to reduce the hazard to the public. This requires double contained storage tanks and chemical feed pumps. This conversion is relatively inexpensive and would provide "peace of mind" in the event there is a leak of one of the toxic gasses.

In the long term with any expansion of plant capacity the size of the chlorine contact chamber will become limiting and additional chlorine contact tankage will need to be added. This should be evaluated against use of ultraviolet light for disinfection.

OCEAN OUTFALL

A 24" diameter ocean outfall was installed as a part of the 1977 sewage disposal project and extends 690 feet into the ocean just westerly of the plant site termination at an average depth of 28 feet. The outfall pipe is welded steel, cement–lined and coated, and is encased in concrete through the breaker zone. The effluent is discharged by gravity from the chlorine contact chamber through a series of diffusers. The calculated average initial dilution is 50:1.

During the 1999 permit review process an underwater video of the outfall diffuser was taken. Marine life was attached directly to the outfall pipe and diffusers which indicates minimal toxicity of the effluent as it is discharged to the ocean environment.

In this video the diffuser ports appeared to be in good condition except for missing nozzle flaps. The purpose of the flaps were to minimize entrance of sand through the diffuser piping. The outfall pipe is believed to be in good condition.

Recommendation – Inspect the outfall and repair the diffusers where necessary.

SLUDGE THICKENER

Sludge from the primary clarifier is pumped to the sludge thickener. In the sludge thickener, rotating mechanism stirs and sweeps the settled and thickened sludge to the center of the basin to be pumped to the digester.

The current thickener mechanism has been in place since 1977 and the mechanism has deteriorated to a point that it is questionable as to how long it will continue to operate. The sludge thickener mechanism has tilted and the influent pipe has ruptured. The efficiency and the performance of this essential treatment unit is now compromised, and the mechanism should be replaced as soon as possible.

In addition the steel beam structure which supports the center column catwalk is severely corroded and needs replacement. Electrical conduits and junction boxes are also in severe stage of corrosion. The mechanism drive motor has been recently replaced.

Evaluation – The thickener operation efficiency and reliability have been significantly compromised by the damaged mechanism. Problems such as this increase electrical operating costs over time. Poorly thickened sludge reduces the storage and digestion capacity of the sludge digesters.

Recommendations – Replace the sludge thickener mechanism with a stainless steel mechanism. The thickener can be taken out of service for a limited time by increasing the sludge detention in the primary clarifier and pumping the sludge from the primary clarifier directly to the sludge digester.

PRIMARY AND SECONDARY SLUDGE DIGESTERS

The Fort Bragg treatment plant uses two anaerobic sludge digesters. The primary digester was constructed in 1970 with the original plant. The secondary digester was placed into operation in 2005. The purpose of the sludge digesters is to stabilize the solids which are removed from the treatment process prior to final disposal. During the stabilization process methane gas is produced, which can be used for heating or power production.

Sludge in the primary digester is heated and mixed with an external mixing pump. A gas fired boiler heats hot water which in turn heats the sludge through one of two types of heat exchangers, a jacket water heat exchanger or a spiral heat exchanger. Currently, the jacket water heat exchanger is used for sludge heating. Operations staff have not been using the spiral heat exchanger due to frequent fouling with rags. Once the headworks screen is installed this fouling should not be a serious problem.

The secondary digester can also be heated and mixed although under normal operations it serves as a holding tank for the sludge from the primary digester. With the installation of the secondary digester, the primary digester can now be taken out of service for a short period of time to inspect and repair as necessary.

Evaluation – During its 37 year life the primary digester has never been taken out of service to clean it and evaluate its condition. It is very likely that the primary digester has now accumulated a large build up of trapped inert materials, grit, sand and plastics. The concrete in the ceiling and upper walls may be severely corroded from sulfur in the gas. The ceiling will very likely need structural repair. Also the foam insulation on the walls and roof needs to be repaired.

In order to clean the primary digester all sludge handling operations will need to be transferred to the secondary digester. Once it is drained and cleaned, the interior of the structure must be inspected for defects or damage. The cleaning and repair plan needs to be expedited in order to minimize the time the digester is out of operation. Repair costs of the digester will not be known until the sludge is removed and the inside of the digester can be inspected. In the future the digesters should be cleaned out at least every ten years in order to maintain capacity for active sludge digestion and repair structural problems that may develop.

Additional improvements necessary include replacement of the gas relief valves and flame arrestors on the primary digester. The digester waste gas burner automatic igniter system does not work. Operators must ignite this burner manually, which is a safety issue.

Recommendations - The following improvements are recommended for the sludge digesters:

- Clean the primary digester.
- Repair and recoat the inside of the primary digester.
- Replace the flame arrestors and gas relief valves.
- Replace the waste gas burner
- Repair the foam insulation on the primary digester.

SLUDGE PUMP ROOM

Most of the pumps and piping and components located in the sludge pump room, located below the control room, are greater than 30 years old and may require replacement. The slurry pumps, which are driven by compressed air should be replaced with centrifugal sludge pumps. The gas fired boiler should be replaced with a more efficient unit.

Recommendation – It is recommended that the boiler sludge pumps and piping in the sludge pump room be replaced as necessary.

SLUDGE BELT FILTER PRESS

A sludge filter press and building were added at the plant in 1988. The purpose of the sludge belt filter press is to dewater the sludge after digestion in the sludge digesters. Prior to entering the filter press the sludge is conditioned with a chemical polymer. The belt filter press uses a permeable membrane belt to “squeeze” the water from the sludge. The water which is squeezed out of the sludge is returned to the treatment process for further treatment. The solids content of the dewatered sludge “cake” averages 20% solids. According to the staff, operation of the belt filter press requires two people.

After dewatering the sludge “cake” produced by the filter press is stored in the sludge drying beds until it can be trucked out of the Fort Bragg area for final disposal. Since the cake directly from the filter press contains 20% solids and 80% water it would be beneficial if the water content could be further reduced so less water needs to be hauled to the disposal site, which at the present time is the Redwood landfill in Marin County.

The belt filter press and building are now approaching 20 years of use and there are signs of wear and corrosion associated with the high humidity and corrosive exposure.

Evaluation – In the short term the building housing the sludge belt filter press needs to be repainted to inhibit corrosion. For the long term alternative methods of sludge dewatering methods have been investigated in TM 5 and should be incorporated into the major treatment plant capacity upgrade.

Recommendation: It is recommended that the building housing the sludge belt filter press be repaired and repainted.

SLUDGE DRYING BEDS

The sludge drying beds consist of three 4,000 square foot drying areas with a drainage collection system down the center. Sludge from the belt filter press stockpiled in the drying beds is periodically turned to enhance drying. It is intended that more of the moisture be evaporated to decrease the sludge volume prior to trucking. However, the high moisture content in the ocean air, cool temperatures and rain are not very conducive to good evaporation and drying. Even after storage in the sludge drying bed the sludge still has a moisture content of 70% to 80%. In the summer when the sludge is as dry as it is going to get the sludge is trucked to the Redwood Landfill for final disposal.

Evaluation – The sludge drying beds are performing as anticipated and require little maintenance. However the operators report that they regularly exceed the sludge storage capacity provided by the drying beds. Staff reports that they have trouble reducing the moisture content of the stored filter press sludge cake to a low enough level to be accepted at the sludge final disposal site without further drying. Considering the fact that the drying beds are uncovered and subject to rain and cool breezes from the ocean the sludge generated during the winter cannot be adequately dewatered so it can be trucked out for final disposal.

In the short term it will probably be possible to make use of the existing sludge beds. The underdrain pipes should be replaced to improve the draining ability of the sludge beds. In the long term increased plant capacity will require improved sludge handling and storage.

Recommendation: It is recommended that the underdrains of the sludge drying beds be replaced.

SEPTAGE DISPOSAL STATION AND SLUDGE LAGOON

The septage disposal area was constructed in 1988 and consists of a concrete septage disposal vaults and a manually cleaned bar screen. The operators can choose to pump the septage directly to the sludge thickener or let it flow by gravity to the sludge lagoons.

Evaluation – The septage disposal system is in good repair but would benefit by repainting of the pipework and iron hardware. The operators report that the sludge lagoons are nearly full and should be cleaned. Because the lagoons are now full septage is no longer accepted at the plant.

Recommendations: The following improvements are recommended for the septage dump station and the sludge lagoon:

- Repaint the piping in the septage dump station.
- Clean out the sludge lagoon.

PLANT AUXILIARY POWER GENERATOR

The treatment plant auxiliary electric power is provided by a 350 KVA diesel fired engine generator located within a masonry block building. The generator is well protected from the elements and is operated on weekly basis to ensure reliability. Diesel fuel is stored adjacent to the generator building in an above ground double contained diesel storage tank.

Evaluation – The generator and diesel storage tank are in adequate condition. Continual efforts need to be made to protect the steel piping which protrude from the storage tank from corrosion by repainting.

Recommendation: The existing standby engine generator set and diesel storage tank appears to be adequate at this time. If the electrical power needs change as plant upgrades are made, the generator size may need to be increased.

ELECTRICAL EQUIPMENT AND CONTROL SYSTEMS

Much of the plant's electrical equipment and control systems are now over thirty years old and replacement parts are simply not available. This equipment needs to be replaced in order to keep the plant operating. Replacement of the electrical equipment will need to be done in phases in order to keep the existing equipment operating. The main electrical motor control center is located in the control room and is the oldest in the plant. Once the laboratory is relocated to the new building a new motor control center can be installed along the north wall of the room while keeping the existing equipment in operation. Once the new equipment is installed the existing panels can be removed and any new electrical equipment can be installed in its place.

The other two auxiliary motor controls should also be replaced. Installation of telemetry and SCADA controls at the plant is addressed in TM 7.

Recommendation: Replace the existing electrical equipment and motor control centers at the treatment plant.

SCADA IMPROVEMENTS

SCADA is an acronym for ***s**upervisory **c**ontrol **a**nd **d**ata **a**cquisition*, a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and waste control, energy, oil and gas refining and transportation. A SCADA system gathers information, such as where a leak on a pipeline has occurred, transfers the information back to a central site, alerting the home station that the leak has occurred, carrying out necessary analysis and control, such as determining if the leak is critical, and displaying the information in a logical and organized fashion. SCADA systems can be relatively simple, such as one that monitors environmental conditions of a small office building, or incredibly complex, such as a system that monitors all the activity in a nuclear power plant or the activity of a municipal water or wastewater system. SCADA systems were first used in the 1960s and since then have become much more sophisticated.

SCADA systems include hardware and software components. The hardware gathers and feeds data into a computer that has SCADA software installed. The computer then processes this data and presents it in a timely manner. SCADA also records and logs all events into a file stored on a hard disk or sends them to a printer. SCADA warns when conditions become hazardous by sounding alarms.

At the present time the Fort Bragg treatment and pump stations do not have any SCADA systems. In the event of an equipment malfunction operations personnel are only alerted through a telephone alarm system. In recent years the fines for any leaks or spills have become very high and the regulators and the public expect immediate response and cleanup of any overflows or spills. With SCADA controls the operation of the equipment at the treatment plant and pump stations can be monitored remotely on a personal computer with internet access.

Recommendation – It is recommended that SCADA controls be installed at the treatment plant to monitor the plant equipment as well as the pump stations.

STORMWATER CONTAINMENT

At the Fort Bragg treatment plant rainfall falling on the plant site finds its way to storm drains which discharge directly to the ocean. This also means that any spills of sewage or sludge or a chemical tank spill will be discharged directly to the ocean.

In wastewater treatment upgrades, it is common to route the storm water runoff from treatment plant process areas back to the treatment plant. This provides containment of surface flows from the plant, and treats any spills or incidental vehicular and atmospheric pollutants that fall on paved areas. Today the most compelling reason for treating this local storm water may be the exemption from a regulatory program. Federal regulations specify, as of March 10, 2003, that wastewater treatment plants with a design flow of 1.0 MGD or greater are considered industrial activities that must file for coverage under a statewide general NPDES permit. Facilities that route drainage to the headworks are exempt, removing a recurring regulatory requirement and associated fees, monitoring, reporting and other paperwork.

Renovation or relocation of the Fort Bragg treatment plant presents an opportunity to collect and treat all runoff from the process areas, loading/unloading areas, and sludge handling areas. This scheme implements a strategy of containment throughout the plant that provides a reliable back-up in case of process equipment malfunction, process overflows, operator error, or other spill events. Although this runoff would be relatively clean most of the time, it would not contribute a significant flow to the influent, particularly if the treatment plant design minimizes the impervious paved and roofed areas to the extent practicable. Routing the runoff back to the plant process simplifies cleanup activities in case of any type of spill, for instance eliminating many reporting requirements required under the statewide storm water permit.

Recommendation – It is recommended that stormwater from the plant site be routed back to the treatment plant for treatment. This will require reconfiguration of several of the plant storm drains and installation of a pump station which will pump the stormwater back to the treatment plant.

UTILITIES

Utilities serving the wastewater treatment plant include electric power, supplied by PG&E and domestic water supplied by the City. There is no natural gas service but rather propane is purchased and stored in an aboveground tank. Excess digester gas can be used to heat the boiler, which heats the digester.

The domestic water is supplied by a 4” pipeline more than a half mile long running through an easement across the G-P property from the vicinity of Chestnut and Main Streets. The domestic water is used in the lab and for the bathrooms. The only fire protection is single 4” wharf hydrant located next to the secondary digester. In the future a larger water line should be extended to the plant and a one or more larger fire hydrants should be provided together with the appropriate detector check valve.

When the G-P property develops and new utilities are installed there may be an opportunity to connect to a larger water line and natural gas service may become available.

Recommendation – When the G-P property develops upgrade the water and gas utility services to the treatment plant.

RECOMMENDED TREATMENT PLANT IMPROVEMENTS

Based on the studies summarized in this Technical Memorandum a number of replacements, upgrades and improvements are recommended for the existing treatment plant. These improvements are necessary to keep the plant functioning over the near term as well as the long term. The recommended treatment plant improvements together with their estimated costs are summarized below. The alternatives evaluated in TM 4 will include some of these improvements for alternatives which make use of some or all of the existing treatment plant process.

SUMMARY

The purpose of this TM has been to evaluate the existing Fort Bragg wastewater treatment plant for the purpose of recommending improvements necessary to address deferred maintenance, replace old equipment and bring the plant up to current design and operational standards. The major upgrade needs of the existing treatment plant fall into the following categories:

Headworks Screen	180,000
Headworks and Grit Removal Improvements	260,000
Primary Clarifier Improvements	280,000
Replace Recirculation Pumps and Valves	50,000
Secondary Clarifier and Chemical Feed System Improvements	340,000
Disinfection and Decholorination Improvements	200,000
Ocean Outfall	40,000
Sludge Thickener Mechanism Replacement	180,000
Primary Sludge Digester Cleaning and Repair	540,000
Sludge Pump Room and Pump and Piping Replacement	160,000
Sludge Filter Press Building	50,000
Sludge Drying Beds, Replace Underdrains	20,000
Septage Dump Station and Sludge Lagoon	60,000
Electrical Equipment Replacement	610,000
SCADA Controls	390,000
Stormwater Containment	400,000
Estimated Construction Cost	3,760,000
Contingencies and Incidentals	1,340,000
TOTAL ESTIMATED PROJECT COST	5,100,000

- Cleaning out and repairing the primary digester and replacing the mechanism in the sludge thickener.
- Elimination of the use of gaseous chemicals for disinfection and dechlorination.
- Replacement of old equipment in the two clarifiers and various pumps and piping.

- Replacement of corroded equipment and materials which is adversely affecting the plant operation.
- Replacement of old electrical equipment and controls for which replacement parts are no longer available.
- Installation of SCADA improvements at the treatment plant.
- Installation of a pump station to direct storm water from the plant site back to the treatment process.

The elimination of gaseous chemicals for disinfection and dechlorination is a public safety issue and should be addressed as soon as possible. The treatment plant is upwind of the town and an accident or spill of one of these gaseous chemicals could be very damaging.

The estimated cost of the improvements to bring the treatment plant up to current standards is $4,850,000. The treatment plant upgrade alternative analysis summarized in TM 4 incorporated these improvements into the alternatives involving retaining the plant at its present site.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO.1
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 4
WASTEWATER TREATMENT PLANT UPGRADE ALTERNATIVES

The Fort Bragg wastewater treatment plant is some thirty-seven years old and over the years has undergone several expansion projects and improvements. The most recent improvement project, completed in 2005, consisted of the construction of a new secondary digester at a cost of around $1 million. Installation of a headworks screen is scheduled for 2007. The rest of the plant is showing its age and there is a need for further improvements and upgrades, including replacement and/or rehabilitation of process equipment and electrical components as described in TM 3.

Fort Bragg is expected to grow in population, which means that there will be a need for additional treatment plant capacity. Some of this growth is expected to come from development on the adjacent Georgia-Pacific (G-P) property.

The existing treatment plant has enjoyed relative isolation from the public. With the closing of the G-P mill it is very likely that the use of the surrounding land will change and the treatment plant will no longer be as isolated. The securing of a buffer between the plant and any new development will become very important if the plant is to remain at the existing site. The treatment plant will need to be upgraded to serve the additional growth, assure control of odors and eliminate the chlorine hazard.

The City sewer system is subject to intrusion of extraneous water during rainfall events. This extraneous water is evidenced as high sewage flows at the treatment plant. During storm events the existing treatment plant process blends biologically treated effluent with effluent which has only received primary treatment. The Federal EPA and State are now implementing rules that will restrict the blending of excess flows at treatment plants. Additional treatment will be required at the plant if the blending practice is to be minimized or eliminated

TREATMENT OBJECTIVES

In addition to meeting the anticipated growth needs the Fort Bragg wastewater treatment plant must meet the following waste discharge requirement objectives:

Secondary treatment – The Federal EPA has established a minimum secondary treatment standard for all wastewater treatment plants. This standard requires a minimum effluent quality of 30 mg/l Biochemical Oxygen Demand (BOD) and 30 mg/l of total suspended solids (TSS) on a calendar month basis. Without the addition of chemical flocculants the existing plant would not be able to meet the treatment levels necessary to comply with the current NPDES permit.

85% removal of BOD and TSS – This requirement was also established by the EPA and requires that for any calendar month the treatment plant achieve 85% removal of both BOD and TSS. When it rains the sewage becomes diluted with rainwater and groundwater from high I/I and the incoming BOD and TSS values are low. This means that during the high flow periods, when the treatment units are stressed hydraulically the BOD and TSS in the effluent must be kept very low. In other words the best treatment must be reserved for the high flows which occur during the winter months.

Disinfection – As described in TM 2 the District's disinfection requirement will very likely remain at 70 MPN/100 ml monthly median with 240 MPN/100 ml maximum.

Alternatives to chlorination – At the present time Fort Bragg uses gaseous chlorine for disinfection and gaseous sulfur dioxide for dechlorination. Both of these chemicals are very toxic and could endanger the plant personnel as well as the public. With the prevailing winds from the ocean chlorine from a spill could be blown into town with disastrous consequences. Alternatives to the use of gaseous chlorine and sulfur dioxide include using aqueous solutions such as sodium hypochlorite (bleach) or use of ultraviolet light (UV). Use of UV light for disinfection would eliminate use of all toxic chemicals. Consideration of UV disinfection is encouraged by the Ocean Plan.

Wet Weather Flow Treatment - One of the main considerations in designing upgrades to the Fort Bragg wastewater treatment plant or a new plant are the wet weather flows, which occur during rainfalls. These flows come from the high rates of I/I into the sewer system through defects in the older pipes. As discussed in TM 1 the achievement of a significant reduction or I/I is very expensive and time consuming. For the foreseeable future the Fort Bragg pump stations and treatment facility must be designed to accommodate and treat the high peak flows.

Elimination of Blending – When high wet weather flows occur the existing Fort Bragg treatment plant blends effluent from the primary clarifier with effluent from the secondary clarifier which has passed through the biologic treatment process. Because the BOD and TSS in these extraneous flows are low the blended flow is able to meet effluent requirements. This treatment method was approved by the EPA and State when the District received grants for construction of the original treatment plant processed in 1970 and 1977. The EPA and State are now discouraging the bypassing of treatment units and the blending of flow streams within the treatment plant, even though the final effluent meets the specified effluent quality. The blending strategy is used by many plants in the US and is particularly useful in treating peak flows during wet weather.

Reliability and Redundancy – The EPA and State are emphasizing reliability and redundancy of equipment and processes at treatment plants and pump stations. Thus, where possible the design of these facilities should incorporate duplicate or standby equipment. This allows a unit to be taken out of operation for repair but it also adds to the overall construction cost.

Stormwater Containment – The EPA and State are encouraging treatment plants to direct drainage water from the plant site back to the treatment process. The reason for this is to prevent any spills from the treatment process or chemical spills from entering the receiving waters through the drainage system. By directing drainage water back through the treatment process spills would be contained and treated. A stormwater containment system is recommended in TM 3.

BASIS FOR DEFINING TREATMENT ALTERNATIVES

Six alternatives for the treatment plant upgrade have been considered. These alternatives range from the continued use of the current trickling filter treatment process, construction of a new activated sludge process, an membrane biologic reactor (MBR) process and an oxidation ditch at a new site. Treatment of wet weather flows is a major concern and alternative treatment processes, which minimize blending are evaluated. Compliance with new and possible future discharge requirements have been considered in the definition of the various alternatives.

The alternatives also include the possibility of constructing a totally new treatment plant at a new more remote site. Any treatment plant at Fort Bragg will very likely need to use the existing ocean outfall for effluent disposal. The construction of a new outfall at a different location has not been considered since it would be very expensive and require new studies and permits. Establishing a different method of effluent disposal such as through reclamation, land disposal or disposal to local waterways would also be problematic and expensive because of the permitting requirements and high cost of land. The high flows during wet weather are a serious constraint to any type of disposal which would not rely on an ocean outfall.

Estimates of the capital costs have been made for all alternatives so appropriate decisions can be made. These cost estimates are allocated between existing and new users in TM 8.

DESIGN CRITERIA

The design criteria for the upgraded treatment plant is based on meeting future treatment needs as set forth in TM 1 and complying with the requirements of the NPDES permit as described in TM 2.

The design criteria for the upgraded treatment plant and the required effluent characteristics are given in Table 4-1 below.

TABLE 4-1
TREATMENT PLANT UPGRADE DESIGN CRITERIA

Parameter	Units	Influent	Effluent(1)

ADWF	mgd	1.5	
Peak Monthly Flow	mgd	3.3	
PDWWF	mgd	6.2	
PWWF	mgd	9.8	
BOD	mg/l	380	30
	lbs/day	4,171	
	removal		85%
TSS	mg/l	310	30
	lbs/day	3,725	
	removal		85%

(1) Monthly Average

ALTERNATIVE TREATMENT PROCESSES

There are several processes in common usage for municipal wastewater treatment. Each process has its advantages and disadvantages as discussed below and summarized in Table 4-2.

Trickling Filter (Biofilter) Process - The trickling filter process, also referred to as the biofilter process, involves distributing the wastewater over a stack of rocks or plastic media with a large amount of surface area. Bacteria and microorganisms attach themselves to the media as a biologically active film and metabolize the soluble organic matter from the wastewater as it passes by. The wastewater is not in contact with the biologic film on the rocks very long, however the removal of the organic matter from the flow occurs very rapidly. Oxygen for the biologic process is provided from either natural or forced ventilation. The biologic film, which has consumed the organic matter from the wastewater is constantly sloughing off and must be settled out in the secondary clarifier.

The trickling filter process is used at the existing Fort Bragg treatment plant and has performed well over the years. The primary biofilter contains rock media and the secondary biofilter contains plastic media. The plastic media has about double the surface area to support the biologic film than does the rock media. Because of the higher than normal BOD loading at the Fort Bragg treatment plant chemicals are presently added to the secondary clarifier to aid in the sedimentation process of the final effluent.

Table 4-2 goes here

The main advantages of the trickling filter process are that it is easy to control and economical to operate. Since the biologic films are attached and the flow over the trickling filter is kept relatively constant the active biologic films are not prone to being washed out under high flow conditions.

The main disadvantage of the trickling filter process is that it produces a medium quality secondary effluent with BOD and TSS in the range of 20 to 30 mg/l range. Because of this effluent quality it may be difficult to comply with the 85% BOD and TSS removal requirement during high wet weather flows and either chemical treatment or a subsequent filtration process will be necessary. Also the effluent is relatively turbid and needs to be filtered if it is going to be disinfected with UV light.

Activated Sludge Process – The activated sludge process treats wastewater by means of bacteria and microorganisms which are dispersed throughout the fluid and not attached to anything. Air is added to provide oxygen to the bacteria and microorganism which are consuming the organic matter in the wastewater. The bacteria and microorganisms form a floc which must be settled out in a secondary clarifier. A portion of the settled floc is returned to the incoming flow to continue the treatment and a portion is pumped to the digester for stabilization and disposal.

The main advantage of the activated sludge process is that it produces a high quality effluent with BOD and TSS in the range of 10 to 20 mg/l. The effluent usually has a low turbidity. Activated sludge treatment plants require less land than do trickling filter plants, which is the reason that this is the preferred process of larger cities. Some plants aerate with pure oxygen to accelerate the biologic process and to reduce the size of the tanks needed.

For a small plant one disadvantage of the activated sludge process is that it is expensive to operate because of the need to use blowers to provide air for the process. Also the process is prone to upset with shock organic loads or high flows. The microorganisms providing the treatment do not respond to a rapid addition of organic loading or rapid increase in flows, which can wash out the floc from the secondary clarifier. The washed out floc ends up in the effluent and will cause a violation of discharge requirements.

Dual Trickling Filter/Activated Sludge Process – A dual trickling filter/activated sludge process combines the advantages of both processes. The trickling filter provides pre-treatment of shock organic loads before the wastewater flows on to the activated sludge process. However the biologic floc in the activated sludge process can still be prone to washout during high flows.

Membrane Biologic Reactor (MBR) – The MBR system uses an activated sludge process followed by ultrafiltration membranes to separate the treated effluent from the floc instead of depending on sedimentation to remove the floc. The MBR process produces a very high quality, low turbidity effluent which can easily be disinfected with UV light. The high quality effluent meets the California Title 22 requirements for recycling for landscape irrigation and other public contact uses.

The MBR process is very "high-tech" with lots of equipment and has a very high capital and O&M cost. Also, the MBR cannot process large variations in flows so additional standby units would be necessary unless the peak flows can be equalized in ponds and brought back to the MBR for treatment when the peak flows have subsided. The effluent quality from an MBR system is much higher than needed for an ocean outfall discharge.

Oxidation Ditch – An oxidation ditch is a relatively low tech, extended aeration activated sludge treatment process which makes use of an aeration basin in the form of a ditch where the wastewater is aerated. The incoming flow must be screened before entering the oxidation ditch to remove plastics and inorganic matter. The biologic floc is settled out in a clarifier and the waste floc is either dried or dewatered.

The oxidation ditch system is a relatively economical system but requires more land than either the trickling filter or activated sludge systems. It is usually used in rural communities with average flows of less than 1 mgd. If the Fort Bragg treatment plant is to be relocated to a new site away form town with a large available land area an oxidation ditch would be a good choice for the treatment process.

SECONDARY SEDIMENTATION ALTERNATIVES

The upgraded wastewater treatment plant will need better secondary sedimentation. This can be provided by either adding a new secondary clarifier and connecting the two existing clarifiers to primary clarifiers or by adding effluent filters. The Mt. View Sanitary District treatment plant in Contra Costa County, with an average flow of 2.5 mgd has successfully used effluent filters to provide secondary sedimentation and effluent polishing. The two sedimentation alternatives are described below:

New Secondary Clarifier – The two existing clarifiers are both 65 feet in diameter; the primary clarifier is 7 feet deep and the secondary clarifier is 10 feet deep. Chemical flocculants are now required to be added to the secondary clarifier to meet the discharge requirements. Both of these clarifiers become overloaded during high wet weather flows. As a basic improvement to the treatment plant additional sedimentation capacity needs to be added.

One strategy in providing for additional sedimentation capacity would be to operate the two 65 foot diameter clarifiers in parallel as primary clarifiers and add a new secondary.

Clarifiers are designed on the basis of the surface overflow rates in terms of gallons per day per square foot (gpd/sf) and detention time. Detention time is related to volume, which is the surface area times the depth. The settling efficiency is also related to both surface area and depth. Two 65 foot diameter clarifiers are equivalent in surface area to a 92 foot diameter clarifier. The estimated cost of a new clarifier 92 feet in diameter by 14 feet deep is given below:

Site grading and excavation	$180,000
Concrete	1,300,000
Clarifier mechanism and installation	400,000
Handrail and metalwork	40,000
Piping	80,000
Sludge pumps	100,000
Electrical work	80,000
Total Estimated Construction Cost	$2,180,000

Effluent Filters – Effluent filters can be used to provide both secondary sedimentation and effluent polishing for a trickling filter plant. During dry weather the two existing clarifiers could be used as primary and secondary clarifiers and the effluent filters would be used to polish the effluent. During wet weather when the flows become high the two existing clarifiers would both be used as primary clarifiers and the effluent filters would serve as the secondary sedimentation as well as effluent polishing. With filters following the trickling filters the effluent could be disinfected with UV light. The effluent filters would be the continuously backwashing upflow filters similar to the Parkson Dynasand filters. This treatment strategy has been successfully used for the last 12 years at the Mt. View Sanitary District treatment plant in Contra Costa County.

The estimated construction cost for effluent filters is given below:

Excavation	$60,000
Concrete	860,000
Filter Modules	480,000
Pumps	120,000
Compressors	40,000
Grating and Metalwork	80,000
Piping	80,000
Electrical	50,000
Total Estimated Construction Cost	1,770,000

DISINFECTION ALTERNATIVES

The treated effluent from the Fort Bragg wastewater treatment plant must be disinfected prior to discharge to the Pacific Ocean to protect the beneficial uses. The controlling beneficial use is protection of shellfish for human consumption. In order to protect this beneficial use the discharge requirements specify that the effluent must be disinfected to a coliform count of 70 MPN/100 ml median and 230 MPN/100 ml maximum. If the effluent is disinfected with a chlorine compound the residual chlorine must be removed with the addition of a dechlorinating compound such as sulfur dioxide or sodium bisulfite. Even though the residual chlorine is removed the addition of all these chemicals does leave some residual toxicity that ends up in the environment. Effluent can also be disinfected with ultraviolet light, which avoids any use of chemicals.

There are basically three alternatives for disinfection at wastewater treatment plants:

- Injection of chlorine gas for disinfection followed by injection of sulfur dioxide gas for dechlorination.
- Injection of a sodium hypochlorite solution for disinfection followed by sodium bisulfite solution for dechlorination.
- Disinfection with ultraviolet (UV) light

Disinfection with chlorine gas – In TM 3 the alternative of continued use of gaseous chlorine and sulfur dioxide was rejected as a viable alternative because of the potential for an accident in handling these two gases. Such a serious accident could threaten plant personnel as well as city residents. The economics of this alternative have not been investigated further.

Disinfection with sodium hypochlorite and dechlorination with sodium bisulfite – Sodium hypochlorite is more costly than chlorine gas because it only comes in a 12.5% solution, so much of the transportation cost goes to transporting the water. Also sodium hypochlorite degrades to 8% within a month so it is not economical to store too much chemical. Sodium bisulfite is a 25% solution and does not degrade very quickly.

Residual ammonia in the effluent makes the chlorine more toxic. Sometimes if the treatment process is too efficient in nitrifying the effluent ammonia must be added to provide the necessary toxicity.

In using either gaseous chlorine or a chlorine compound as a disinfecting agent, sufficient retention time must be provided so that the chlorine can remain in contact with the effluent long enough to achieve the desired bacterial kill. The desired contact time is 30 to 60 minutes at average flow and 20 minute at peak flows.

The existing chlorine contact chamber at the wastewater treatment plant has a volume sufficient to provide 72 minutes of contact for 1.0 mgd and 18 minutes of contact at a flow of 4.0 mgd. In order to provide sufficient contact at the projected average dry weather flow of 1.5 mgd and an instantaneous peak flow of 9.8 mgd it will be necessary to provide additional contact chamber volume.

After the chlorine contact chamber the residual chlorine is removed with gaseous sulfur dioxide or sodium bisulfite. This reaction is instantaneous and does not require a contact chamber.

These two chemicals are solutions which must be delivered to Fort Bragg form the Bay Area. There is always the possibility of an accident in which the solution would spill and enter a stream and kill salmon and other aquatic organisms.

UV Disinfection – Installation of UV disinfection facilities at the Fort Bragg treatment plant would allow compliance with the disinfection requirements without the use of toxic chlorine and sulfur compounds. The trade off is that UV disinfection relies on electric power rather than chemicals.

The ability to disinfect with UV light depends on the light transmittance through the effluent and the size of particles in the effluent. Effluents from trickling filter plants are rather turbid and have relatively low transmittance. In order to meet disinfection requirements with a trickling filter plant effluent filters would need to be installed. Activated sludge treatment plants and MBR plants produce a less turbid effluent and would not require effluent filters.

In 1998 and 1999 two tests were run on the Fort Bragg effluent, which showed that the transmittance of the trickling filter effluent was 62% and UV disinfection was feasible.

Evaluation of Disinfection Alternatives – The capital cost, O&M cost and total present worth of the two disinfection alternatives is summarized in Table 4-3. In brief summary the alternative to provide effluent disinfection with sodium hypochlorite has an estimated capital cost of $1,380,000 versus $1,670,000 for UV disinfection, a 21% difference. However, the annual O&M cost for disinfection with sodium hypochlorite is estimated to be $103,000 versus $46,740 for UV disinfection, which is less than half the annual cost. On an overall present worth basis the UV disinfection is about 16% less expensive.

On the basis of this economic evaluation and considering that disinfection with UV light is much less risky to the public and to the environment than using toxic chemicals we recommend that UV disinfection be installed in the upgraded treatment plant. These costs will be incorporated in the alternatives analysis.

TABLE 4-3
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
ESTIMATED COSTS OF DISINFECTION ALTERNATIVES

DISINFECTION WITH SODIUM HYPOCHLORITE AND DECHLORINATION WITH SODIUM BISULFITE				
Capital Cost		Operation and Maintenance Cost		
Chemical Feed Equipment	$60,000	Sodium Hypochlorite	68,000 gal/yr @ $0.80/gal	$54,600
Storage Tanks	$100,000	Sodium Bisulfite	26,000 gal/yr @ $0.80/gal	$21,000
Piping	$40,000	Power		$2,000
Chlorine Contact Chamber	$820,000	Labor	260 hrs/yr @ $90/hr	$23,400
Subtotal Construction Cost	$1,020,000	Replacement Costs		$2,000
Contingencies and Incidentals	$360,000	TOTAL ESTIMATED ANNUAL O&M COSTS		$103,000
TOTAL ESTIMATED CAPITAL COST	$1,380,000			
		TOTAL PRESENT WORTH - 20 yrs @ 6%		$2,561,410
DISINFECTION WITH ULTRAVIOLET LIGHT				
Capital Cost		Operation and Maintenance Cost		
Excavation	$60,000	Power	250,000 KW/yr @ $0.13	$32,500
Concrete Structure	$180,000	Lamp Replacement	144 lamps/yr @ $50	$7,200
UV Equipment	$820,000	Ballast Replacement	14 /yr @ $150	$2,100
Handrails and Metalwork	$20,000	Pump and Fan Replacement		$250
Piping	$80,000	Labor	52 hrs/yr @ $90/hr	$4,690
Electrical	$80,000	TOTAL ESTIMATED ANNUAL O&M COSTS		$46,740
Subtotal Construction Cost	$1,240,000			
Contingencies and Incidentals	$430,000			
TOTAL ESTIMATED CAPITAL COST	$1,670,000			
		TOTAL PRESENT WORTH - 20 yrs @ 6%		$2,206,108

ALTERNATIVE TREATMENT PLANT IMPROVEMENT PROJECTS

The following alternatives for the Fort Bragg treatment plant have been evaluated, including estimates of capital costs and O&M costs. Five alternatives involve upgrading the existing treatment plant at the existing site which is surrounded by the former G-P properties.

ALTERNATIVE A-1 - Upgrade the existing trickling filters, add a new secondary clarifier and continue to use chemicals to meet the effluent BOD and TSS requirements. Effluent will be conventionally disinfected using solutions of sodium hypochlorite for chlorination and sodium bisulfite for dechlorination.

ALTERNATIVE A-2 - Upgrade the existing trickling filters and followed by effluent filters and ultraviolet disinfection.

ALTERNATIVE B - Upgrade the existing treatment plant by installing an activated sludge process.

ALTERNATIVE C - Upgrade the existing treatment plant using a dual system consisting of a trickling filter followed by an activated sludge process.

ALTERNATIVE D - Upgrade the existing treatment plant by installing a membrane biologic reactor process.

ALTERNATIVE E – Construct a totally new treatment facility using the oxidation ditch process at a site located on the old G-P haul road above the Noyo River.

The six treatment plant improvement alternatives are described below. The estimated project element costs for each alternative are detailed in Appendix B and summarized in Table 4-4.

ALTERNATIVE A-1 – UPGRADE TRICKLING FILTER WITH CONVENTIONAL DISINFECTION

Alternative A-1 involves continued use of an upgraded trickling filter process followed by chlorination for disinfection. The rock media in the trickling filters will be replaced with an 80 foot diameter by 10 foot deep bed of plastic media in the two trickling filters. A new secondary clarifier will be constructed. The center column of each trickling filter will be raised and the existing distributor mechanisms will be remounted on the raised center columns. The two existing clarifiers will be converted to primary clarifiers and a new 92 foot diameter by 14 foot deep secondary clarifier will be constructed. Equipment will be provided for adding flocculating chemicals to the secondary clarifier effluent to allow achievement of the 85% BOD and TSS removal during peak wet weather flows. Sodium hypochlorite will be used for effluent disinfection and sodium bisulfite will be used for dechlorination and a new chlorine contact chamber will be constructed. The Alternative A-1 improvements consist of the following:

- Improvements to the existing treatment plant recommended in TM 3
- Replace the rock media in the two trickling filters with 80 foot diameter by 10 foot deep bed of plastic media and construct a block wall around the two filters.
- Construct a new 92 foot diameter by 14 foot deep secondary clarifier.
- Install chemical feed equipment to allow addition of chemical flocculating chemicals to the secondary clarifier effluent.
- Construct a new chlorine contact basin.

In order to keep the existing treatment plant in operation one trickling filter will be taken out of service while the other is reconstructed. Chemical flocculants will have to be added in the primary clarifier during this time in order to maintain the necessary level of treatment.

ALTERNATIVE A-2 – UPGRADE TRICKLING FILTER WITH FILTERS AND UV DISINFECTION

Alternative A-2 involves continued use of the trickling filter process with replacement of the rock media in the two trickling filters with an 80 foot diameter by 10 foot deep bed of plastic media and construction of effluent filters and UV disinfection. The trickling filters produce a relatively turbid effluent so effluent filters are recommended to allow disinfection with ultraviolet light. In this alternative it is proposed that new effluent filters be constructed instead of a new secondary clarifier. During dry weather the two existing clarifiers would be operated as primary and secondary clarifiers. During wet weather both clarifiers would be operated as primary clarifiers and the effluent filter would serve in the place as a secondary clarifier. The effluent filters will operate all the time and reduce the turbidity of the effluent so it can be disinfected with UV light. This is the flow sheet and operational procedure successfully used at the Mt. View Sanitary District in Contra Costa County.

The Alternative A-2 improvements consist of the following:

- Improvements to the existing treatment plant recommended in TM 3
- Replace the rock media in the two trickling filters with an 80 foot diameter by 10' deep bed of plastic media and construct a block wall around the two filters.
- Construct continuous backwashing upflow effluent filters.
- Construct UV disinfection

In order to provide secondary treatment during construction it is recommended that the effluent filters and UV disinfection be constructed and put into operation before reconstruction of the trickling filters.

ALTERNATIVE B – ACTIVATED SLUDGE PROCESS

Alternative B involves replacement of the trickling filter process with an activated sludge process. Both trickling filters would be abandoned and the activated sludge tanks would be constructed in the location of the existing secondary trickling filter. The two existing clarifiers will be converted to primary clarifiers and a new 92 foot diameter by 14 foot deep secondary clarifier will be constructed.

The Alternative B improvements consist of the following:

- Improvements to the solids handling processes in the existing treatment plant recommended in TM 3.

- Construct the aeration tanks and blower building for the activated sludge process.
- Construct a new 92 foot diameter by 14 foot deep secondary clarifier.
- Construct either a new chlorine contact chamber or UV disinfection

ALTERNATIVE C – DUAL TRICKLING FILTER AND ACTIVATED SLUDGE PROCESS

Alternative C involves construction of a dual trickling filter - activated sludge process. The primary trickling filter will be reconstructed as a 80 foot diameter filter with a block wall and with 6 feet of plastic media. Aeration tanks for the activated sludge process will be constructed in the location of the existing secondary trickling filter. The two existing clarifiers will be converted to primary clarifiers and a new 92 foot diameter by 14 foot deep secondary clarifier will be constructed.

The Alternative C improvements consist of the following:

- Improvements to the solids handling processes in the existing treatment plant recommended in TM 3
- Reconstruct the primary trickling filters as an 80 foot diameter filter with 6 feet of plastic media.
- Demolish the other trickling filter to make room for the aeration tanks.
- Construct the aeration tanks and blower building for the activated sludge process.
- Construct a new 92 foot diameter by 14 foot deep secondary clarifier.
- Construct either a new chlorine contact chamber or UV disinfection

ALTERNATIVE D – MEMBRANE BIOLOGIC REACTOR

Membrane bioreactors (MBRs) are a relatively new wastewater treatment technology which produces exceptional effluent quality compared to conventional treatment process trains. MBR technology combines membrane separation processes with biological treatment of wastewater. Its advantages over conventional activated sludge treatment include high quality wastewater effluent that can be recycled, reduced sludge to be disposed of, and a smaller footprint that allows for much smaller plants to treat the same amount of wastewater.

MBRs are quite simply an activated sludge process in which the conventional secondary clarifier is replaced by a membrane separation process (either microfiltration or ultrafiltration). The MBR can be operated either with or without primary clarification, but always requires fine screening (3 mm or smaller) to protect the membranes from abrasive and stringy waste components (hair in particular). Due to the presence of an absolute barrier for suspended solids, MBRs are able to maintain very high solids concentrations (8,000 to 20,000 mg/L) and solids retention times which allows for smaller aeration basins and high BOD removals. Effluent suspended solids are typically near the detection limit and turbidities are typically less than 0.2 NTU.

At Fort Bragg an MBR process could potentially produce an effluent of much higher quality than is necessary for an ocean discharge. The quality of the effluent would meet Title 22 and be suitable for landscape irrigation or other potential reuse. Despite the very high quality effluent from an MBR process it is doubtful that the District could secure permission to discharge the effluent into one of the coastal streams because most local streams are used as a domestic water source.

If a MBR process were constructed at the existing treatment plant site the headworks, primary clarifiers and sludge digestion system would remain in service. The trickling filters would be removed and the activated sludge tanks and membranes would be installed in new structures.

ALTERNATIVE E – OXIDATION DITCH AT NEW SITE

Alternative E involves constructing a totally new treatment plant at a new site located along the old G-P haul road above the Noyo River. It is assumed that sufficient land will be available to allow use of the oxidation ditch treatment process.

The identified treatment plant site is at an elevation of 300, which will require a construction of high head pumping system to carry the raw sewage to the plant. A raw sewage pump station would be constructed at the site of the existing treatment plant or at a suitable site on the main trunk sewer leading to the treatment plant. The force main system would run along Cypress Street, then along the haul road along the Noyo River crossing to the south side and then running up the hill to the plant site. In this reach the Noyo river is mostly a confined estuary and any sewage spill would have a very detrimental effect on water quality. Also the upstream portion of the Noyo river is used for the City water supply so any discharge of sewage into the river could create the suspicion of a health hazard. For maximum reliability we recommend that two parallel raw sewage force mains be installed along with the effluent pipeline, making a total of three pipelines. An outfall pipeline would need to be constructed from the treatment plant so the treated effluent can be discharged through the existing ocean outfall. The existing treatment plant would be abandoned.

It is assumed that the new site would provide ample land for a low tech treatment plant such as an oxidation ditch. The oxidation ditch treatment system would consist of two parallel channels with aerators. A sludge digester would be installed to stabilize the resulting sludge.

Even though the oxidation ditch is an economical treatment process the pumping and three mile long transport system to the new plant site makes this alternative very expensive. In addition, there would be the risk that if one of the pipelines were to break the wastewater would flow into the Noyo River and Noyo Harbor which could potentially cause a great deal of environmental damage.

Alternative E improvements consist of the following elements:

- Construct raw sewage pump station
- Construct parallel raw sewage pipelines to new plant site
- Construct oxidation ditch treatment plant
- Construct outfall pipeline to existing ocean outfall
- Abandon existing treatment plant

EVALUATION OF ALTERNATIVES

The estimated capital costs of the six alternatives described above is given in Table 4-4. Included in this table are the estimated costs of improvements to the existing treatment plant recommended in TM 3 which would be incorporated in each of the alternatives. Based on this evaluation the following conclusions are presented;

- Alternative E, the relocation of the treatment plant to a new site some three miles away along the G-P haul road is much more expensive than any of the alternatives involving upgrading the existing treatment plant at its present site. At an estimated $34 million relocating the treatment plant is some two and one half times more expensive than Alternatives A-1 and A-2.
- The lowest cost alternatives are Alternatives A-1 and A-2 which involve upgrading the existing trickling filter treatment process.

TABLE 4-4
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
TREATMENT PLANT UPGRADE ALTERNATIVES
ESTIMATED COSTS

	ALTERNATIVE A-1	ALTERNATIVE A-2	ALTERNATIVE B	ALTERNATIVE C	ALTERNATIVE D	ALT
Process	Biofilters with Chemical Addition	Biofilters, Effluent Filter and UV Disinfection	Activated Sludge	Dual Process Biiofilter and Activated Sludge	Membrane Biologic Reactor	Oxidati
Improvements to the Existing Treatment Plant						
Headworks Screen	$180,000	$180,000	$180,000	$180,000	$180,000	
Grit Removal	$260,000	$260,000	$260,000	$260,000	$260,000	
Primary Clarifier	$280,000	$280,000	$280,000	$280,000	$280,000	
Recirculation Pumps and Valves	$50,000	$50,000	$50,000	$50,000	$50,000	
Secondary Clarifier and Chemical Feed System	$340,000	$340,000	$340,000	$340,000	$340,000	
Disinfection and Dechlorination System Improvements	$200,000					
Ocean Outfall	$40,000	$40,000	$40,000	$40,000	$40,000	
Sludge Thickener Mechansim	$180,000	$180,000	$180,000	$180,000	$180,000	
Primary Digester Cleaning and Repair	$540,000	$540,000	$540,000	$540,000	$540,000	
Sludge Pump Room Replacements	$160,000	$160,000	$160,000	$160,000	$160,000	
Septage Dump Station and Sludge Lagoon	$60,000	$60,000	$60,000	$60,000		
Electrical Equipment Replacement	$610,000	$610,000	$610,000	$610,000	$480,000	
SCADA Controls	$390,000	$390,000	$390,000	$390,000	$200,000	
Stormwater Containment	$400,000	$400,000	$400,000	$400,000	$400,000	
New Treatment Processes						
Trickling Filter Improvements	$1,810,000	$1,710,000		$550,000		
Activated Sludge Process			$5,010,000	$3,060,000		
Membrane Biologic Reactor					$9,500,000	
Oxidation Ditch						
Secondary Clarifier(s)	$2,180,000		$2,180,000	$2,180,000		
Effluent Filters		$1,770,000				
Chlorine Contact Chamber	$820,000					
UV Disinfection		$1,240,000	$1,240,000	$1,240,000	$1,240,000	
Sludge Dewatering	$475,000	$475,000	$475,000	$475,000	$475,000	
Odor Control	$500,000	$500,000	$500,000	$500,000	$250,000	
Pumping and Pipelines						
Demolitions			$400,000	$300,000	$400,000	
Subtotal Estimated Construction Cost	$9,475,000	$9,185,000	$13,295,000	$11,795,000	$14,975,000	
Contingencies and Incidentals	$3,315,000	$3,215,000	$4,655,000	$4,125,000	$5,225,000	
TOTAL ESTIMATED PROJECT COST	$12,790,000	$12,400,000	$17,950,000	$15,920,000	$20,200,000	

Alternative A-2, which involves UV disinfection has about the same capital cost as Alternative A-1, which uses sodium hypochlorite for effluent disinfection. As show in Table 4-3 UV disinfection has the lowest present worth cost and eliminates the use of toxic chemicals.

- Comparing Alternatives B, C and D the lowest cost is Alternative C, the dual process alternative, which retains one of the trickling filters. However Alternative C is some 36% more expensive than Alternatives A-1 and A-2.

Based on this evaluation of treatment alternatives it is recommended that the District adopt Alternative A-2 involving upgrading the two existing trickling filters and installing effluent filters and UV disinfection. The estimated capital cost of this alternative is $12,400,000.

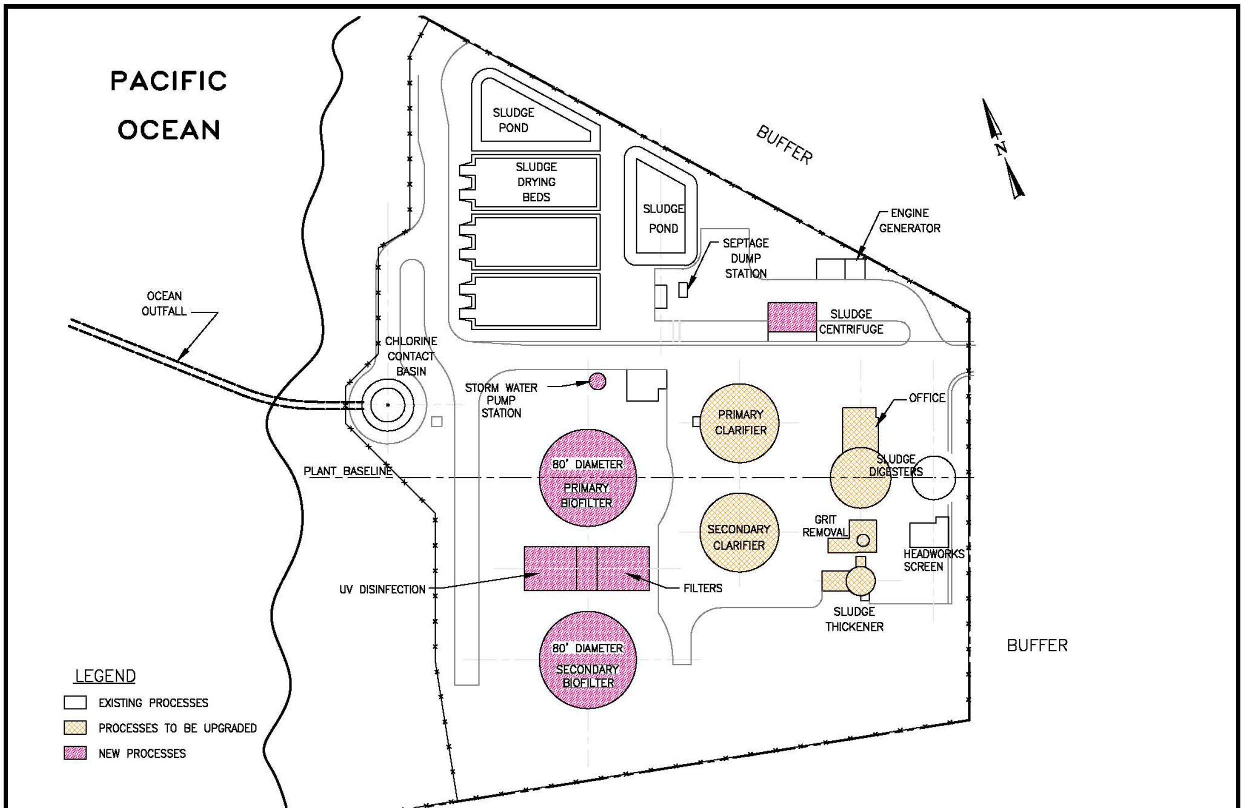
The layout of Alternative A-2 is shown in Figure 4-1. This alternative is most economical because it is able to build on the existing plant infrastructure such as the piping and structures and minimize the facilities that would otherwise need to be demolished to make way for a new process.

ODOR CONTROL

Wastewater treatment plants can generate odors which can be objectionable to the public. With its isolation possible odors from the existing Fort Bragg plant were never a concern. As the plant becomes less isolated control of odors will become more important.

Certain processes are more prone to generating odors than others. Usually the processes near the plant headworks and the sludge handling facilities generate the most odors. There are ways to control odors form these processes by adding chemicals and installing coverings and ventilating the air through scrubbers. Some of these control methods can become expensive.

The degree of odor control necessary becomes a function of how close the plant is to the public and whether or not the public has become sensitized to the odors. The worst situation is where a treatment plant is close to residences. As discussed below in order to limit the aesthetic and potential odor control problem at the plant is to have an adequate buffer between the plant and any public areas. For the purpose of the analysis of alternatives a “place holder” cost of $500,000 has been added to the alternatives involving retaining the treatment plant at the existing site for as yet undefined odor control improvements.



FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
RECOMMENDED TREATMENT PLANT IMPROVEMENTS

FIGURE 4-1

PLANT ISOLATION

With the departure of G-P the Fort Bragg treatment plant, which overlooks the ocean, is now surrounded by vacant land, which has a high potential for development to residential uses. Wastewater treatment plants require a certain amount of isolation. Treatment plants which become surrounded by residential and commercial development often become subject to citizen complaints and lawsuits. Where plants are too close to residences it is necessary to install expensive odor control equipment and other aesthetic features to make it a “good neighbor”. If the treatment plant remains at its present site it will be very important to acquire more land which will act as a buffer from the public.

SUMMARY

The purpose of this TM has been to evaluate alternatives for upgrading the Fort Bragg treatment facilities. Based on this analysis the following conclusions and recommendations are made:

- The most economical method of disinfecting the effluent is with UV light rather than with chlorine chemicals, which can add toxicity to the effluent.

- Relocating the treatment plant to a site along the former G-P haul road is estimated to cost some $34 million, which is two and one half times the estimated cost of the lower cost alternatives.

- It is recommended that the District upgrade its existing trickling filters and install effluent filters and UV disinfection. The estimated cost of this project is $12,400.000.

If the treatment plant is to remain at its existing site it is very important that adequate buffer be acquired around the plant to minimize aesthetic and odor objections from the public.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO 5
EVALUATION OF ALTERNATIVE SOLIDS HANDLING PROCESSES

It is one of the functions of a wastewater treatment plant to remove solids from the wastewater flow. In typical domestic sewage the solids consist of grit, rags, paper, plastics, fecal matter, etc. As the wastewater is treated additional biologic solids are generated as the microorganisms stabilize the soluble organic matter.

At the Fort Bragg wastewater treatment plant these solids are removed by several processes. At the plant headworks rags, plastics and some paper will be removed by the headworks screen. The heavier grit, consisting of sand, coffee grounds, seeds, etc. is removed in the grit chamber. Fecal matter and biologic solids are collected in the primary sedimentation tank (primary clarifier) then pumped to the sludge thickener and then to the sludge digester. In the sludge digester the solids are digested anaerobically (in the absence of oxygen) during which time methane gas is produced.

At the present time the digested sludge is periodically drawn out and then run through a belt filter press, which concentrates the sludge to about 15% solids. This sludge "cake" is stored in the sludge drying beds in an attempt to concentrate the solids further so they can be hauled to a landfill site for final disposal. Several times a year these solids are transported to the Redwood Landfill in Marin County, which only accepts concentrations of 20% or higher.

The existing belt filter press is almost 20 years old and is requiring increasingly frequent maintenance. Also the prefab metal building which houses the belt filter press is becoming corroded and will need to be repaired and repainted. The sludge drying beds are uncovered, so the deposited solids are slow to dry because of the long rainy winters and moist foggy weather. In the summer after the rains, the sludge in the drying beds is turned over mechanically with a tractor by the operations staff to try to improve drying.

The sludge produced at Fort Bragg is classified as a Class B sludge, which must be hauled to a Class III landfill site or other permitted sites, which have strict monitoring and record keeping. The District is attempting to have a local site permitted to accept dewatered sludge, however the permits have not been issued for various reasons.

If Fort Bragg were to produce a Class A sludge then it could theoretically be used in agriculture and even sold or given away to the public. Class A sludge is basically sterilized and is considered safe for public use.

The purpose of this TM is to investigate alternative solids dewatering and handling processes including those processes that can produce a Class A sludge.

REQUIREMENTS FOR CLASS A AND CLASS B SLUDGES

Over the years regulations have changed to encourage beneficial reuse of biosolids. These regulations are the "Standards for the use or disposal of sewage sludge," Title 40 Code of Federal Regulations Part 503 (40 CFR 503) set criteria for the quality of the biosolids in terms of heavy metal content and destruction of pathogens and control of vectors to protect public health.

As defined in these regulations Class A biosolids have undergone treatment processes which have reduced the pathogens to below current detectable levels and are considered safe for public use and may be used for fertilizer. Class A sludge must also meet stringent requirements of heavy metals, PCBs and other toxic constituents. Processes that can produce Class A biosolids include composting, heat drying, heat treatment, thermophilic aerobic digestion, beta or gamma ray irradiation and pasteurization. Processes to reduce pathogens have no effect on heavy metals and other pollutants that may be in the sewage sludge.

Class B biosolids are solids which have undergone less rigorous treatment with reduction pathogens to levels that are considered unlikely to pose a threat to public health and the environment under specific use conditions. Biosolids that meet the Class B treatment and pollutant criteria must undergo either aerobic or anaerobic digestion for a set period of time at a minimum temperature. These biosolids can only be applied to land with formal site permit restrictions and strict record keeping such as a Class III landfill. Class B biosolids cannot be sold or given away to the public in bags or other containers or applied on lawns or home gardens.

The Mendocino Community Services District elected to dry their biosolids. The agency was pressed for available land area for sludge drying beds and was concerned that odors would affect the adjacent residential areas. They used to have a belt filter press and hauled a 10 yard transfer to a Bay Area landfill once per week. The Regional Board has not yet granted permission to dispose of their Class A biosolids locally as a soil amendment. The District currently disposes of their dry biosolids at a Bay Area landfill, but the volume is much less than before.

SLUDGE DISPOSAL QUANTITIES

The Ft. Bragg treatment process currently produces about 100 tons of dry biosolids annually from a average dry weather wastewater flow of 0.72 million gallons per day (mgd). At the projected design flow of 1.5 mgd there will be a larger quantity of biosolids which will need to be disposed of.

At the present time digested sludge is dewatered through a belt filter press and with the aid of polymers to about 12% to 15% solids. This dewatered sludge is then transferred to one of three uncovered sludge drying beds where it is stored. With the aid of seasonal dry weather and repeated mixing with a loader bucket the stored sludge reaches a solids content of about 24%. Several times a year the District contracts with a company to load the sludge into trucks for final disposal at the Redwood Landfill in Novato, CA. The average cost per ton to load, transport and ultimate disposal is about $90 per ton.

The sludge quantities and costs of the existing filter press operation and disposal at the Redwood Landfill are summarized in Table 5-1. At the present time with the necessity to transport the sludge to the Redwood Landfill in Marin County the sludge dewatering and disposal operation is costing the District over $130,000 annually.

SLUDGE DEWATERING EQUIPMENT OPTIONS

After digestion the sludge is in a liquid form, consisting of only about 2.5% solids, which means that it is 97.5% water. In this form the sludge is very voluminous and it would be very expensive to transport it anywhere for disposal because it is mostly water. In order to handle the sludge before it can be disposed of it must be concentrated. The higher the concentration of solids the less voluminous it is to transport. Three conventional dewatering methods are discussed below.

Belt Filter Press – Fort Bragg currently uses a belt filter press to dewater its anaerobically digested sludge. A belt filter press literally squeezes the water out of the sludge. A typical belt-filter press system consists of sludge feed pumps, polymer feed equipment, belt-filter press and a sludge cake conveying system. Conditioned sludge is first introduced on a gravity drainage section where it is allowed to thicken to remove the free water. Following gravity drainage, pressure is applied in a low pressure section, where the sludge is squeezed between opposing porous cloth belts. The low pressure section is followed by a high-pressure section where the sludge is subjected to shearing forces as the belts pass through a series of rollers releasing additional quantities of water from the sludge. The dewatered sludge is discharged through a chute in the side of the building where it forms a pile on the concrete slab below. Operations staff uses a loader to scoop up the sludge and deposit it into one of the three sludge drying beds. Belt filter presses can dewater digested sludge to a concentration of around 15% solids.

Sludge Centrifuge – Another type of dewatering equipment in common usage at wastewater treatment plants is the sludge centrifuge. In a typical centrifuge the digested sludge is fed into a rapidly rotating bowl which separates the solids from the liquid. The sludge is removed via an internal rotating conveyor, and the liquid centrate is recycled back to the treatment plant headworks. In general the sludge centrifuge will produce a sludge cake with a solid content of 24% to 28%, which is dryer than that produced by a belt filter press. A sludge centrifuge has a connected power requirement of about 50 horsepower (hp), whereas a belt filter press only requires around 25 hp.

Table 5-1
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
EXISTING SLUDGE FILTER PRESS OPERATIONS

Average Dry Weather Flow	0.72 mgd
Dry Solids Concentrations	
Digested Sludge to Filter Press	2.0% to 2.5%
Filter Press Cake	12% to 15%
Sludge Stored in Drying Bed	Approx 24%
Quantity of Sludge Dewatered	
Filter Press Feed Rate	55 gpm
Operation Duration	6 hrs/week
Volume Dewatered	20,000 gal/week
Dry Solids Weight of Dewatered Sludge (@2.5%)	2.08 dry tons/week
Annual Dry Solids Weight of Dewatered Sludge	108.5 dry tons
Sludge for Disposal	
Weight of Sludge for Transport (24% solids)	452 wet tons/year
Operation and Maintenance	
Labor Hours @16 man-hours/week	832 hrs/yr
Polymer Usage @10 gals/day	520 gals/yr
Polymer Usage @ 8.6 lbs/gal	4,472 lbs/yr
Connected Horsepower	17.25 hp
KWH per 6 hr day	103.5 kwh/day
KWH per year	5,382 kwh/yr
Annual Operation and Maintenance Costs	
Labor – 16 hrs/week x 52 weeks @ $90/hr	$74,880
Polymer – 4,772 lbs/yr @ $1.20/lb	5,726
Power – 5,382 kwh @ $0.12	646
Repairs – Estimated	10,000
Transportation and Disposal	40,056
TOTAL ANNUAL O&M COSTS	$131,308

Sludge Drying Beds – The Fort Bragg wastewater treatment plant has three open air paved sludge drying beds. Each bed has a drain pipe below a layer of gravel running down the center of the bed. In warmer climates liquid digested sludge can be dewatered in the sludge drying beds, providing there is enough room. However, the wet climate at Fort Bragg precludes efficient sludge drying.

The current use of these beds is to store sludge cake from the belt filter press. Further drying of the sludge is inhibited because the beds are located next to the ocean and are subject to the prevailing cool temperatures and high moisture content of the prevailing ocean fog and wind. In addition, each time it rains, the sludge beds fill up with rain water which must evaporate before the sludge can start to dry again. However, it has been found that with some effort including turning of the sludge it does eventually dry to a solids content of around 24%. This solids content is high enough to allow disposal at the Redwood Landfill in Marin County.

As long as the sludge drying beds remain uncovered it doesn't matter whether the solids content is 15% from a belt filter press or 20% or more from a more efficient centrifuge. With either solids content entering the uncovered sludge drying bed after a year of storage it will probably end up around 24% solids. As a contrast, in warmer parts of California, stored sludge can be concentrated to a solids content of up to 85%, at which point the wind might start to blow it away.

SLUDGE DRYING EQUIPMENT

While mechanical sludge dewatering equipment can reduce sludge volume to 15% to 24%, a substantial amount of water still remains in the sludge cake. Modern sludge drying equipment can dehydrate the sludge to a dry granular form at 90% solids. The resulting sludge is very dry and can qualify as a Class A sludge.

Convection rotary dryers can be used for drying both raw primary sludge and anaerobically digested sludge. In a rotary dryer sludge is fed into a slightly sloped cylindrical steel vessel. The sludge feed is often mixed with previously dried sludge to achieve an initial lower moisture content and alleviate sticking of the sludge to the cylinder.

This type of drying system converts biosolids (sludge) into a high quality, beneficial and theoretically re-usable Class"A" product that is 75 to 100 percent dry solids. The biosolids processed through the dryer system are virtually pathogen free. When in operation, the dryer is sealed and limited air enters into the drying area. Using indirect heat, and operating under a negative pressure, reduces the chance of combustion that exists when biosolids come in contact with the heat source (as occurs with direct drying systems).

COMPOSTING

Composting can be a low-tech and low capital method of producing Class A biosolids. Composting relies on available land area and adding a bulking agent such as tree trimmings. The end product is usually a Class A, humus-like material without detectable levels of pathogens. This composted sludge can be applied as a soil conditioner and fertilizer to gardens, food and feed crops, and rangelands.

The three commonly employed composting methods are aerated static pile, windrow, and in-vessel. The windrow method would be the most applicable to the Fort Bragg operation. In the windrow method, dewatered wastewater solids are mixed with bulking agent and piled in long rows. The piles are mechanically turned to increase the amount of oxygen. This periodic mixing is essential to move outer surfaces of material inward so they are subjected to the higher temperatures deeper in the pile. Windrow composting will take up a relatively large covered area so the sludge does not get rained on in order for it to be effective at Fort Bragg.

COMPARISON OF SLUDGE DISPOSAL ALTERNATIVES

The existing sludge dewatering and disposal procedure using a belt filter press and sludge drying bed storage is currently accomplishing the job. However, as the plant flows increase the storage capacity of the sludge drying beds will become limiting and there will be a need to employ a more formal sludge dewatering and disposal system. Also, when the G-P property develops there will be a need to control odors by limiting the use of the open air sludge drying beds.

The existing belt filter press will need to be replaced soon and the decision will need to be made whether or not to purchase another belt filter press or a sludge centrifuge. By far the largest cost is the transportation of the sludge to Marin County for final disposal. If a local sludge disposal site were developed then these transportation costs could be much less. If the District were to produce a Class A sludge it is conceivable that it could be sold or given away to the public or at the least trucked to some local farm. In order to evaluate the economics of alternative sludge disposal methods for the projected increased wastewater flow the following six alternatives have been evaluated.

Alternative 1 – Sludge Filter Press – Install a new sludge filter press in the existing building. The dewatered sludge will be around 15% solids, which is lower than the 20% required for disposal directly to the Redwood Landfill. The sludge cake from the belt filter press will have to be stored in the existing sludge drying beds so the solids content can be increased to around 24% prior to disposal as evaluated in Alternative 5.

Alternative 2 – Sludge Centrifuge – Install a sludge centrifuge in the existing filter press building. The building and piping will require modification to accommodate the centrifuge. A sludge centrifuge can produce a sludge cake with an average solids content of around 24%, which could be disposed of directly to the Redwood landfill.

Alternative 3 – Dryer Preceded by a Belt Filter Press – Install a sludge dryer preceded by a belt filter press. A new building will be required to house the dryer equipment and store the sludge so it does remains dry prior to final disposal or reuse. In this alternative it is assumed that a Class A sludge would be produced and that the transportation and disposal costs will be zero.

Alternative 4 – Dryer Preceded by a Sludge Centrifuge – Install a sludge dryer preceded by a sludge centrifuge, which produces a dryer cake than the belt filter press. A new building will be required to house the dryer equipment and store the sludge so it does remains dry prior to final disposal or reuse. In this alternative it is assumed that a Class A sludge would be produced and that the transportation and disposal costs will be zero.

Alternative 5 – Sludge Drying Bed with Belt Filter Press – Continue the present method of storing the dewatered sludge from a belt filter press in the existing sludge drying bed until it reaches a solids content of around 24% and then dispose of it to the Redwood Landfill.

Alternative 6 – Sludge Composting – Construct a metal building over the existing sludge drying beds and pave them so dewatered sludge from a belt filter press or centrifuge could be composted. In this alternative it is assumed that the bulking agent will be provided from tree trimmings or other sources at no cost and that transportation and disposal costs will be zero.

The design parameters including volume of sludge produced, estimated capital, energy and disposal costs and total present worth for the six alternative sludge dewatering and disposal methods are summarized in Table 5-2.

The total present worth represents the amount of money which, together with accrued interest, would pay for all costs associated with the alternative over the life of the project. The interest rate was taken as 6 percent over a 20 year planning period. In reviewing Table 5-2 the following conclusions can be made:

- Alternative 5 has the lowest present worth cost. In this alternative the digested sludge is dewatered with a belt filter press and stored in the existing sludge drying beds until it has reached a solids concentration of around 24%, and then trucked to the Redwood Landfill for final disposal. This is essentially the current sludge disposal method. Alternative 5 includes replacement of the existing belt filter press, which is reaching its useful economic life. However, as the plant flows increase the storage capacity of the three uncovered sludge drying beds may not be sufficient and this method is no longer considered viable.

TABLE 5-2
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT No. 1
SLUDGE DEWATERING AND DISPOSAL ALTERNATIVES - FUTURE ADWF = 1.5 MGD

Alternative		Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 6
Characteristic	Units	Belt Filter Press	Centrifuge	Dryer Preceeded by Belt Filter Press	Dryer preceeded by Centrifuge	Sludge Drying Bed w/ Belt Filter Press	Sludge Drying Bed w/ Centrifuge	Composting with Belt Filter Press
Sludge Classification		Class B	Class B	Class A	Class A	Class B	Class B	Class A
Disposal Method		Landfill	Landfill	Sell or Landfill	Sell or Landfill	Landfill	Landfill	Sell or Landfill
Sludge to Unit	% solids	2.0% to 2.5%	2.0% to 2.5%	15%	17% to 22%	15%	20%	15%
Dewatered Cake	% solids	15%	24%	90%	90%	Approx 24% in summer	Approx 24% in summer	
Sludge for Disposal	% solids	15%	24%	90%	90%			
Connected Horsepower		23 hp	50 hp	46 hp	73 hp	23 hp	50 hp	27 hp
Annual Sludge Production	dry tons/year	344	344	344	344	344	344	344
Annual Sludge For Disposal	wet tons/year	2293	1430	380	380	1430	1430	
Estimated Costs								
Estimated Capital Cost								
Dewatering Equipment		$280,000	$275,000	$280,000	$275,000	$280,000	$275,000	$280,000
Drying Equipment				$350,000	$350,000			$50,000
Installation		$75,000	$100,000	$150,000	$150,000	$75,000	$100,000	$75,000
Building		$50,000	$100,000	$350,000	$400,000	$50,000	$100,000	$750,000
Subtotal		$405,000	$475,000	$1,130,000	$1,175,000	$405,000	$475,000	$1,155,000
Contingencies and Incidentals		$142,000	$165,000	$396,000	$410,000	$142,000	$165,000	$405,000
TOTAL ESTIMATED CAPITAL COST		$547,000	$640,000	$1,526,000	$1,585,000	$547,000	$640,000	$1,560,000
Estimated Annual O&M Cost								
Labor		$74,880	$74,880	$100,000	$100,000	$74,880	$74,880	$131,040
Polymer		$9,930	$15,000	$9,930	$15,000	$9,930	$15,000	$9,930
Energy		$860	$3,260	$71,724	$53,220	$860	$3,260	$2,000
Repairs (2)		$5,600	$5,500	$12,600	$12,500	$5,600	$5,500	$6,600
Transportation and Disposal Cost (3)		(4)	$128,700	$0	$0	$128,700	$128,700	$0
TOTAL ESTIMATED O&M COST			$227,340	$194,254	$180,720	$219,970	$227,340	$149,570
TOTAL PRESENT WORTH - 20 yrs @ 6%		(4)	$3,247,590	$3,754,093	$3,657,858	$3,070,056	$3,247,590	$3,275,568

(1) Assumes that dewatered sludge is stored in the existing sludge drying beds until the solids content reaches 24%.
(2) Repari costs are estimated at 2% of equipment capital cost
(3) Disposal costs: Landfill charge plus transportation = $90/wet ton
(4) Dewatered sludge from sludge filter press is only 15% solids and requires more drying before it can be taken to Redwood Landfill

- Alternatives 3 and 4, involving a sludge dryer which would produce a Class A sludge, preceded by either the belt filter press or the sludge centrifuge have the highest present worth costs even if the sludge can be given away. In these two alternatives it may be difficult to obtain certification of the Class A sludge and giving away the sludge to the public or otherwise disposing of it may have additional costs not included in this analysis.

- Alternative 6, sludge composting to produce a Class A sludge has a relatively high present worth cost even though the sludge is given away at no cost. Sludge composting requires construction of a rather large and expensive building and the periodic mixing of the sludge with the bulking agent will be labor intensive.

- In Alternatives 2 and 5, the largest item in the O&M cost is the disposal cost, which includes transportation to the Redwood Landfill in Marin County and their dumping fee. This cost is directly related to the solids content of the sludge. The dryer the sludge the less quantity that must be transported and disposed of. The weather in Fort Bragg is not conducive to drying sludge and possibly a building over the sludge drying bed would accelerate the drying.

- The present worth costs of a belt filter press versus sludge centrifuge in Alternatives 1 versus 2 and 3 versus 4 are very close. The sludge centrifuge produces a dryer sludge, 24% versus 15% for the belt filter press. This is not significant if the dewatered sludge is stored out in the rain for six months because both types of sludge will reach the same equilibrium solids content. If storage space for the dewatered sludge is limited then the sludge centrifuge is preferred since its solids content will be greater than 20% and it can be hauled directly to a landfill.

In summary the best and most economical alternative for the upgraded treatment plant is considered to be Alternative 2. This alternative involves installation of a new sludge centrifuge which can dewater the sludge to a solids content of greater than 20% and the hauling of the sludge directly to a landfill site without storage in the sludge drying beds.

SUMMARY

Wastewater sludge or biosolids are a necessary by-product of wastewater treatment. The solids handling facilities at the Fort Bragg treatment plant consist of a belt filter press and sludge drying beds, which produces a Class B sludge. At the present time the anaerobic sludge from the sludge digesters is dewatered by the belt filter press and stored in the sludge drying beds until it reaches a solids content of 20% or greater at which time it is transported to the Redwood Landfill in Marin County for final disposal. However, in the future as the wastewater flows increase the existing sludge drying beds will not be large enough to store the dewatered sludge through the wet season prior to final disposal in the summer.

Class A biosolids can be produced by installing a sludge dryer or by composting. Class A biosolids can potentially be turned into an asset for use by landscapers and the public as a soil amendment. In addition, drying can significantly reduce the volume of the biosolids produced. The economic analysis showed that attempting to produce a Class A sludge has the highest capital cost and highest present worth cost even if it can be given away and its disposal cost is zero. Additional considerations achieving the necessary approvals of the Class A treatment system may not be readily forthcoming and there could be some costs to organize a marketing program and arrange to sell or give Class A sludge away.

An economic evaluation of sludge disposal alternatives shows that the current method of sludge disposal, even with the costly trucking and disposal at the Redwood Landfill has the lowest present worth cost. If the dewatered sludge can be kept dry and its solids content can be increased the transportation and disposal cost will be less. The existing belt filter press is approaching its economic life and will soon need to be replaced.

For the upgraded treatment plant it is recommended that Fort Bragg replace its belt filter press with a centrifuge. The benefit to a sludge centrifuge is that it produces a 24% sludge cake and the dewatered sludge can be transported directly to the landfill without further storage and dewatering. The estimated cost of a sludge centrifuge installation is $640,000. This cost for the various treatment alternatives is included in TM 4.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 6
PUMP STATION IMPROVEMENT NEEDS

The Fort Bragg Municipal Improvement District No. 1 maintains six wastewater pump stations. The pump stations were constructed at various times starting in 1970. The City of Fort Bragg Department of Public Works maintains the sewer system and force mains.

The purpose of this Technical Memorandum (TM) is to evaluate the District's existing pump stations and recommend both short term and long term improvements and modernizations where necessary.

Four of the District's six pump stations were constructed in the 1970's and much of the equipment has reached the end of its useful service life. As a further complication replacement parts for some of the equipment, particularly electrical equipment, are no longer available.

Since the 1970's the regulations for water quality protection have been strengthened and the standards for pump station design, reliability and safety have become more restrictive. As the pump stations are upgraded the latest reliability and safety standards should be incorporated into the project.

COST ESTIMATES

Cost estimates are based on an ENR Construction cost index of 9,100 representing construction costs in early 2007.

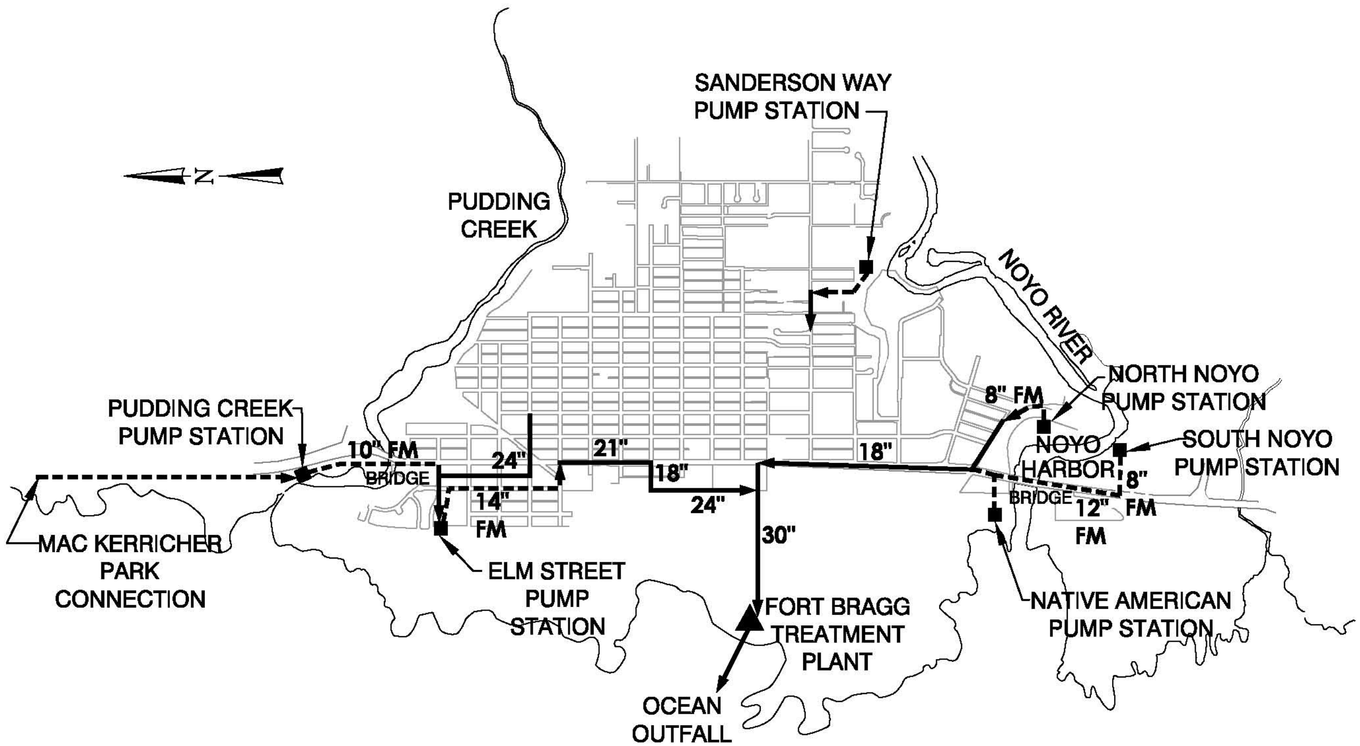
PUMP STATION DESCRIPTIONS AND UPGRADE NEEDS

The location of the District's pump stations is shown in Figure 6-1 and the characteristics of each pump station are listed in Table 6-1.

<u>Elm Street Pump Station</u>

The Elm Street pump station was constructed in 1970 and is located at the westerly end of Elm Street. This pump station was constructed with the District's original wastewater project and pumps the sewage from the north end of Fort Bragg through a 14" diameter force main to a gravity trunk sewer which flows to the wastewater treatment plant. The Elm Street pump station also re-pumps the wastewater received from the Pudding Creek pump station.

The Elm Street pump station contains two self priming Gorman Rupp pumps, a 55 KW gasoline powered standby engine generator set and an air gap fresh water pump housed inside a masonry block building. The communitor to grind up solids, which was installed with the original project, is no longer used and has been removed. The exist-



FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
PUMP STATIONS AND MAJOR INTERCEPTORS

Figure 6-1

TABLE 6-1
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
ESTIMATED COSTS OF PUMP STATION UPGRADES

Pump Station	Elm Street Pump Station	North Noyo Pump Station	South Noyo Pump Station	Pudding Creek Pump Station	Native American Pump Station	Sanderson Way Pump Station
Construction Date	1970	1970	1970	1975	1987	1989
Tributary Service Area	Fir St. to Pudding Creek west to	North side of Noyo Harbor	South Side of Noyo Harbor	North of Pudding Creek	Homes west of Highway 1 just north of the Noyo River Bridge	Homes along Sanderson Way
Type of Pump Station	Self Priming Pumps	Wet pit/dry pit Flush Clean	Wet pit/dry pit Flush Clean	Wet pit/dry pit Flush Clean	Submersible	Submersible
Number of Pumps	2	2	2	2	2	2
Pump Capacity, gpm@TDH	800 gpm @38 ft.	360 gpm @ 120 ft.	450 gpm @ 130 ft.	450 gpm @ 66 ft.	62 gpm	190 gpm
Motor Speed	1,150	1,750	1,750	1,150		
Motor Horsepower	15	20	20	15	1.5	5
Level Control System	Bubbler	Bubbler	Bubbler	Bubbler	Bubbler	Bubbler
Standby Power	YES	NO	NO	YES	NO	NO
KW Rating	55			55		
Engine Fuel	Gasoline			Gasoline		
Discharge Force Main, Diamter	14"	8"	8", 12"	10"	4"	4"

ing equipment and electrical switchboard appear to be the original equipment, for which replacement parts are basically impossible to obtain. Also being very close to the ocean, the salt air has caused extensive corrosion of the equipment, even inside the building.

This pump station is the largest in the District and if it were to fail and sewage were to bypass it will flow to Glass Beach, which is a popular public attraction. It is therefore very important that this station be as reliable as possible. This pump station needs a complete modernization and upgrade.

North Noyo and South Noyo Pump Stations

The North Noyo and South Noyo pump stations were constructed in 1970 and are essentially identical, serving the two sides of Noyo Harbor. Both pump stations are set against steep slopes. The discharge force mains run directly up the slope to a gravity sewer above. The static pumping head at each station is over 120 feet, which requires use of high head pumps.

These pump stations are the wet pit dry pit type with two dry pit pumps in each station. A masonry block building above the pump pit contains the electrical controls and an air gap fresh water system. There is no standby engine generator set at either station. This existing equipment and electrical switchboard appear to be the original equipment, for which replacement parts are basically impossible to obtain. The fencing around both pump station sites is corroded and too low to discourage vandalism. A new higher fence should be installed with barbed wire at the top. Both Noyo pump stations need complete modernizations and upgrades.

Pudding Creek Pump Station

The Pudding Creek Pump Station was constructed in 1975 and is located on the north side of Pudding Creek just west of Highway 1. This area is at the mouth of Pudding Creek and drifting beach sand accumulates against the pump station. There is public beach access past the pump station and a motel is located just to the north and above the pump station. Reliability and control of odors is very important at this site.

The Pudding Creek pump station is the wet pit dry pit type with two dry pit pumps. The building above the pump pit contains the electrical controls and a 55 KW gasoline powered engine generator set. As with the Elm Street pump station, this pump station is also very close to the ocean and the salt air has caused extensive corrosion of the equipment, even inside the building.

The large mound of sand which has drifted against the building partially blocks the louver for the radiator of the standby engine generator. Two masonry block wing walls have been constructed to contain the sand but periodic sand removal is necessary. The wing walls should be raised and lengthened to further protect the pump station. This pump station needs a complete modernization and upgrade.

Native American Pump Station

The Native American Pump Station was constructed in 1987 and is a submersible type pump station. This pump station is located west of Highway 1 along a projection of North Harbor Drive, on a private drive known as North Noyo Point Road and serves four single family homes. Sewage is pumped through a force main to the gravity sewer located on the east side of Highway 1. The floor levels of several homes are below the top elevation of the pump pit and on at least one occasion sewage has backed up into the homes. The laterals are now equipped with backflow valves to prevent backups, although these types of valves are not 100% reliable.

The tops of the pump pit and valve pit are level with the ground and can take on drainage water. It would be desirable to raise the level of the pump pit and valve pit, however this could aggravate the possibility of backup into the homes. If the pit levels are raised a manhole should be constructed in front of the pump station to act as a relief in the event the water rises and threatens the homes.

The submersible pumps at this station are hard piped to the discharge pipes, which makes them difficult to remove because the pipes have to be disassembled first. New submersible pumps and stainless steel rails should be installed to facilitate their easy removal. New hatch covers are also needed.

The electrical control panel located next to the pump station is corroded and needs to be replaced with a stainless steel cabinet. The components in the control panel also need to be replaced. The receptacle for plugging in a standby engine generator should be retained.

<u>Sanderson Way Pump Station</u>

The Sanderson Way pump station was constructed in 1989. This station is a submersible type pump station and is located in the backyard of #150 Sanderson Way and serves homes along Sanderson Way, which are too low to connect to the gravity sewer system without pumping.

The pump pit was equipped with galvanized rails for removal of the submersible pumps, which have now corroded out. These rails should be replaced with stainless steel rails, which is standard for sewage installations. A backflow preventer should also be installed to allow washdown with potable water.

Access to this pump station is sometimes blocked by the homeowner who parks a car in the driveway. This is an aggravation, particularly if the maintenance personnel are responding to an alarm. The access easements should be checked.

DESIGN CRITERIA

Existing sewage pump stations should incorporate current design criteria in any modifications or upgrades. Not only is there a need to protect the environment and public health from accidental sewage spills but also in recent years the State has adopted a more aggressive enforcement policy and assesses mandatory fines for any discharge of sewage to the environment.

Design criteria for sewage pump stations and force mains dictate that they should be conservatively designed and incorporate redundancy and reliability features. Ideally, standby pumping and emergency power should be provided at all pump stations, however, in some cases, this may be impractical. In order to assure maximum reliability of sewage pump stations the following design measures are recorded:

- Provide peak flow pumping capacity with any one pump out of operation.
- Locate all electrical equipment above grade and above expected flood levels.
- Provide standby source of power for the pumps, lighting and instrumentation systems.
- Provide adequately sized pump suction and discharge piping.
- Provide a minimum 2 ft/sec velocity and maximum 6-8 ft/sec velocity through the discharge force mains.
- Use corrosion resistant materials because of the close proximity to the ocean and salt air.
- Telemeter alarms from each pump station to a central alarm panel or directly to maintenance personnel.
- Provide SCADA controls where feasible.

In recent years there has been an increasing emphasis on reliability of sewage pump stations and confined space issues. A confined space is defined as a trench, pit or hole that is below grade or has limited ingress and egress. There have been serious accidents and deaths of workers who have entered confined spaces and were overcome by lack of oxygen or toxic gases such as hydrogen sulfide. In some cases workers above have noticed that the person in the confined space has passed out or is having difficulty and have entered the confined space to rescue him only to be overcome themselves.

As a result of these tragic accidents OSHA has promulgated rules which prohibit a single person from entering a confined space without assistance form other workers above. For example entrance of a sewer manhole now requires three persons: the person entering the manhole, who must be harnessed and roped to a winch above, a person above to operate the winch and a helper. Below grade pump stations also come under OSHA rules and require multiple persons just to go below grade to service the pumps.

Confined space issues now control pump station design to the extent that it is almost standard procedure to design newer sewage pump stations, except for the very large ones, as submersible type stations. The District's two minor pump stations are already submersible type stations.

PUMP STATION IMPROVEMENTS

The Districts four major pump stations are over 30 years old and very little, if any improvements have been made in the intervening years. The pumps and particularly the electrical control components at these pump stations have reached their useful life and replacement parts are becoming increasingly difficult to obtain. As a result all four of the 1970's era pump stations will need major upgrades to bring them up to modern design standards. The Districts two smaller stations will need relatively minor upgrades. The modernization and upgrade needs of each pump station is summarized in Table 6-2 and the estimated capital costs are summarized in Table 6-3.

Elm Street Pump Station

It is recommended that a new pump pit with a valve pit be installed outside the existing pump station. The new pump pit would be equipped with submersible pumps controlled by adjustable speed drives. It may be possible to incorporate a connection to the existing wet well for temporary storage of sewage during high flows or an extended power outage. A new diesel fueled engine generator set will be needed and can be housed in the existing building along with the electrical equipment. The air-gap water system will be replaced with a reduced pressure backflow preventer. The louvers and metal work will also need to be replaced. This modernization and upgrade is estimated to cost $1,000,000.

North Noyo and South Noyo Pump Stations

It is recommended that a new pump pit with a valve pit be installed in the driveway outside the existing pump stations. The new pump pits would be equipped with submersible pumps controlled by adjustable speed drives. It may be possible to incorporate a connection to the existing wet well for temporary storage of sewage during high flows or an extended power outage. New diesel fueled engine generator will be needed and since the buildings are very small they will need to be installed outdoors in a fiberglass enclosure. The louvers and metal work will also need to be replaced. This modernization and upgrade is estimated to cost $920,000 for each pump station.

TABLE 6-2
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
PUMP STATION IMPROVEMENT NEEDS

Pump Station	Elm Street Pump Station	North Noyo Pump Station	South Noyo Pump Station	Pudding Creek Pump Station	Native American Pump Station	Sanderson Way Pump Station
Peak Flow Pumping	Increase Pumping Capacity					
Flood Protection					Raise Pump Pit Elevation	
Pumps	Convert to Submersible	Convert to Submersible	Convert to Submersible	Convert to Submersible	Replace Pumps and rails	Replace Pump Rails
Piping and Valves	Replace	Replace	Replace	Replace		
Electrical Components	Replace	Replace	Replace	Replace	Replace	
Level Control System	Replace	Replace	Replace	Replace		
Alarms/Telemetering	Install New SCADA System	Install New SCADA System	Install New SCADA System	Install New SCADA System	Install New SCADA System	Install New SCADA System
Corrossion	Replace Corroded Metal	Replace Corroded Metal	Replace Corroded Metal	Replace Corroded Metal	Replace Corroded Metal	
Fresh Water Supply	Install Backflow Preventer	Install Backflow Preventer	Install Backflow Preventer	Install Backflow Preventer		Install Backflow Preventer
Odor Control						
Confined Space/OSHA	Eliminate Confined Space Entry	Eliminate Confined Space Entry	Eliminate Confined Space Entry	Eliminate Confined Space Entry		
Fencing	Needs New Fence	Needs New Fence	Needs New Fence			
Special Problems		Potential Flooding from River	Potential Flooding from River	Control Sand Dune Encroachment		

TABLE 6-3
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
ESTIMATED COSTS OF PUMP STATION UPGRADES

Pump Station	Elm Street Pump Station	North Noyo Pump Station	South Noyo Pump Station	Pudding Creek Pump Station	Native American Pump Station	Sanderson Way Pump Station
Temporary pumping	$25,000	$25,000	$25,000	$25,000		
Demolition	$20,000	$15,000	$15,000	$15,000		
Auxilllary pump pit	$80,000	$80,000	$80,000	$80,000		
Pump pit rehabilitation	$40,000	$40,000	$40,000	$40,000	$10,000	$20,000
Top slab with hatch cover	$40,000	$40,000	$40,000	$40,000		
Valve box with hatch cover	$60,000	$50,000	$50,000	$50,000	$20,000	
Pumps and piping	$90,000	$80,000	$80,000	$90,000	$30,000	
Painting	$20,000	$20,000	$20,000	$20,000		
Influent sewer connection	$30,000	$25,000	$25,000	$25,000		
Force main connection	$20,000	$20,000	$20,000	$20,000		
Engine generator set	$100,000	$100,000	$100,000	$100,000		
Electrical work	$92,000	$92,000	$92,000	$92,000	$20,000	
SCADA and alarms	$35,000	$35,000	$35,000	$35,000	$25,000	$25,000
Site work	$25,000	$25,000	$25,000	$45,000		
Miscellaneous	$25,000	$20,000	$20,000	$25,000	$20,000	$15,000
SUBTOTAL ESTIMATED CONSTRUCTION COST	$702,000	$667,000	$667,000	$702,000	$125,000	$60,000
Contingencies and Incidentals	$248,000	$233,000	$233,000	$248,000	$45,000	$20,000
TOTAL ESTIMATED PROJECT COST	$950,000	$900,000	$900,000	$950,000	$170,000	$80,000

Pudding Creek Pump Station

It is recommended that a new pump pit with a valve pit be installed outside the existing pump station. The new pump pit would be equipped with submersible pumps controlled by adjustable speed drives. It may be possible to incorporate a connection to the existing wet well for temporary storage of sewage during high flows or an extended power outage. A new diesel fueled engine generator will be needed and can be housed in the existing building along with the electrical equipment. The louvers and metal work will also need to be replaced and the decorative block vents will need to be sealed to keep out the salt air. This modernization and upgrade is estimated to cost $1,000,000.

Native American Pump Station

The Native American Pump Station only serves four homes and is only 20 years old. Improvements of the Native American Lift Station will involve raising the pump pit and valve pit, new hatch covers, new electrical panel and installation of SCADA and alarms. In addition, it will be necessary to make sure that check valves are installed on the laterals to homes which are lower than the pump station rim. These improvements are estimated to cost $170,000.

Sanderson Way Pump Station

The Sanderson Way Pump Station is less than 20 years old and the recommended improvements consist of replacing the pump rails with stainless steel rails and installation of a SCADA and alarm system. These improvements are estimated to cost $80,000.

SHORT TERM PUMP STATION IMPROVEMENTS

The pump station upgrade projects for the District's four major pump stations represent major expenditures consisting of a reconstruction of the pump station with new pumps, new engine generators, new electrical controls and components, etc. Upgrade projects to keep the pump stations running over the short term will also be necessary. These projects will consist of replacing pumps and electrical controls just to keep the pump stations running. As time goes by the interim improvements to keep the pump stations running will become more expensive and require a greater portion of the District's maintenance budget.

For the foreseeable future until the major pump station upgrade projects can be implemented the District should budget each year for replacement and upgrade of the equipment and electrical components in the existing pump stations.

In order to increase the reliability of the pump stations the District should consider purchasing some portable engine generator sets which could be parked at the pump stations. Portable engine generator sets this size will cost around $80,000 to $100,000 each.

TRUNK SEWER AND FORCE MAIN IMPROVEMENTS

There are two sections of trunk sewer and force mains through which the pump stations discharge, which need replacement in the near term.

Pudding Creek Force Main

The force main serving the Pudding Creek pump station runs south parallel to Highway 1, crosses Pudding Creek and discharges to a manhole at Elm Street. High flows in Pudding Creek have scoured the bottom and the force main floated to the creek surface for a period of time. The pipe has been re-anchored to the bottom of the creek but it has also experienced several breaks elsewhere along its alignment.

It is recommended that this force main be replaced in a new route along State Highway 1 and attached to the Pudding Creek bridge. The force main should also be extended to the gravity sewer on Fir Street so the sewage does not have to be repumped at the Elm Street pump station. Caltrans permits will be required for this project. The estimated cost of this force main replacement project is as follows:

12" Force Main	3780	LF @	250/LF	945,000
Bridge Crossing	300	LF @	400/LF	120,000
Subtotal				1,065,000
Contingencies and Incidentals				375,000
TOTAL ESTIMATED PROJECT COST				1,440,000

Trunk Sewer Downstream of Elm Street Pump Station

The Elm Street pump station discharges through a 14" diameter force main to a 21" diameter gravity sewer at Fir and Main Streets. Downstream there is a one block section of 18" sewer on Alder between Main Street and the G-P property, which restricts the flow. During periods of high flow this section causes surcharging which has been known to result in sewer overflows in the downtown area.

It is recommended that this 200 foot long section of gravity sewer main be replaced with a 24" diameter sewer main with sufficient capacity to convey the peak wet weather flows without surcharging. The estimated cost of this sewer replacement project is $100,000.

24" Sewer Main	200 LF @ 350/LF	70,000
2 Only Manholes		7,000
Subtotal		77,000
Contingencies and Incidentals		23,000
TOTAL ESTIMATED PROJECT COST		100,000

SUMMARY

The purpose of this TM is to evaluate the District's six pump stations and recommend improvements and upgrades to replace old equipment and bring the station up to modern design standards.

The recommended pump station improvements are listed in Table 6-2 and the estimated project costs are summarized in Table 6-3. The following is a summary of the estimated pump station upgrade project costs and the associated sewer system improvement project costs.

<u>Pump Station Improvements</u>	
Elm Street Pump Station	$950,000
North Noyo Pump Station	$900,000
South Noyo Pump Station	$900,000
Pudding Creek Pump Station	$950,000
Native American Pump Station	$170,000
Sanderson Way Pump Station	$ 80,000
TOTAL PUMP STATION IMPROVEMENTS	$3,950,000
<u>Trunk Sewer and Force Main Improvements</u>	
Pudding Creek Force Main Replacement	$1,440,000
Gravity Sewer on Elm between Main Street and the GP property	$100,000
TOTAL TRUNK SEWER AND FORCE MAIN IMPROVEMENTS	$1,540,000

In the short term it is recommended that the District purchase portable engine generator sets to provide standby power to the pump stations which are not already equipped with engine generator sets. Two portable engine generator sets are estimated to cost about $80,000 each. The District should also budget each year for the upgrade of equipment and electrical components until the major pump station projects can be implemented.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 7
ELECTRICAL, SCADA AND TELEMETRY EVALUATION

The Fort Bragg wastewater treatment and pumping facilities were first constructed in 1970 and some equipment is now 37 years old. Our surveys of the of the electrical equipment in the wastewater treatment plant and pumping stations reinforce previous evaluations, that the electrical systems are aging, spare parts are difficult to obtain because of obsolesce and the effects of the salt air environment are destroying the panels, conduits, wiring and all associated non-stainless steel components. The maintenance staff has done a commendable job in keeping the equipment operational given these conditions.

With aging equipment the probabilities of failure are much greater and could cause sewage spills and the resultant regulatory reactions and enforcement. While it is not possible to correct everything at once, a carefully executed plan could replace aging equipment with new and also allow upgrades as desired to improve operating efficiency.

SCADA AND TELEMETRY

SCADA is an acronym for ***supervisory control and data acquisition***, a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a plant or equipment in industries such as telecommunications, water and wastewater control, energy, oil and gas refining and transportation. A SCADA system gathers information, such as where a leak on a pipeline has occurred, transfers the information back to a central site, alerting the home station that the leak has occurred, carrying out necessary analysis and control, such as determining if the leak is critical, and displaying the information in a logical and organized fashion. SCADA systems can be relatively simple, such as one that monitors environmental conditions of a small office building, or incredibly complex, such as a system that monitors all the activity in a nuclear power plant or the activity of a municipal water or wastewater system. SCADA systems were first used in the 1960s and since then have become much more sophisticated.

SCADA systems include hardware and software components. The hardware gathers and feeds data into a computer that has SCADA software installed. The computer then processes this data and presents it in a timely manner. SCADA also records and logs all events into a file stored on a hard disk or sends them to a printer. SCADA warns when conditions become hazardous by sounding alarms.

At the present time the Fort Bragg treatment and pump stations do not have any SCADA systems. In the event of an equipment malfunction operations personnel are only alerted through a telephone alarm system. In recent years the state is assessing fines for any process upsets, leaks or spills and the regulators and the public expect immediate response to correct the problem and cleanup any overflows. With SCADA controls the operation of the equipment at the treatment plant and pump stations can be monitored remotely on a personal computer with internet access.

For maximum reliability and control all equipment in the wastewater treatment plant and remote pump stations should be on SCADA. A master terminal unit (MTU) would be located at the wastewater treatment plant and remote terminal units (RTU) would be located at the various pump stations.

The improvements necessary to update a SCADA system will consist of the following:

- Update the wastewater treatment plant controls for connection of a new SCADA RTU.
- Update Pump Station Controls for connection to new SCADA RTU's.
- Install new SCADA Master Terminal Unit (MTU) at the wastewater treatment plant.
- Install a new radio telemetry system to connect pumping stations with the MTU.

INVENTORY OF ELECTRICAL UPGRADE NEEDS

An inventory was made of the electrical equipment in the wastewater treatment plant and pump stations. The following electrical equipment and components should be replaced and upgraded to current standards.

Wastewater Treatment Plant
- MCC's P1, 2, 3, & 4
- Various outdoor conduit and wiring runs
- Light fixtures and fittings in all buildings

Pump Stations
- Control Panels
- Standby Generators and Fuel Systems
- Outdoor and indoor conduit and wiring runs
- Lighting fixtures and fittings

WASTEWATER TREATMENT PLANT ELECTRICAL UPGRADES

The following are descriptions and estimated budget costs for the four electrical motor control centers (MCC) and wiring upgrade needs at the wastewater treatment plant.

MCC P1 – Control Building – The existing MCC P1 would be replaced with a new five stack unit with a control panel section in the control room area currently occupied by the laboratory area. (The laboratory is to be moved to its own building separate from the control building.) The control panel section would house the new SCADA RTU and would be connected to the SCADA MTU also located in the Control Room.

The existing MCC P1 would remain while the new MCC P1 is installed and powered via a new 480V, 3-phase feeder that will be run from the automatic transfer switch (ATS) in the standby generator room. When the new MCC is powered up, individual loads will be switched over from the existing MCC with new conduit and wiring in the pump room below both MCC's. This will minimize the outage time on the plant equipment and allow the plant to continue to operate during the cutover operation.

The estimated cost for the new MCC P1 is:

Material	$120,000
Installation	60,000
Conduit & Wiring	55,000
Misc	10,000
Total Estimate	$245,000

MCC P2 – Chlorination Building - The existing MCC P2 will be replaced with a new 316L stainless steel, two stack unit with a control section. The control section will house the various control, alarming and monitoring devices that will communicate with the SCADA RTU in MCC P1.

The estimated cost for the new MCC P2 will be:

Material	$40,000
Installation	8,000
Conduit & Wiring	12,000
Misc	5,000
Total Estimate	$65,000

MCC P3 – Sludge Thickener Equipment Room - The existing MCC P3 will be replaced with a new 316L stainless steel four stack unit with a control section. The control section will house the various control, alarming, and monitoring devices and will communicate with the SCADA RTU in MCC P1.
The estimated cost for the new MCC P3 will be:

Material	$100,000
Installation	35,000
Conduit & Wiring	30,000
Misc	10,000
Total Estimate	$175,000

MCC P4 Filter Press Building - The existing MCC will be replaced with a new 316L stainless steel, two stack unit with a control section. The control section will house the various control, alarming and monitoring devices and will communicate with the SCADA RTU in MCC P1.

The estimated cost for the new MCC P4 will be:

Material	$40,000
Installation	10,000
Conduit & Wiring	10,000
Misc	5,000
Total Estimate	$65,000

Yard Wiring and Conduits – Some of the wiring and conduits in the treatment plant are compromised by deteriorating insulation, which causes shorts and difficulty in maintaining electrical service to equipment. These conduits and wires should be replaced as necessary to maintain electrical service to equipment. The estimated cost for replacing yard wiring and conduits is estimated at $60,000.

Summary – The total estimated cost for electrical upgrades at the wastewater treatment plant is estimated as follows:

MCC P1	$245,000
MCC P2	65,000
MCC P3	175,000
MCC P4	65,000
Yard Wiring and Conduits	60,000
	$610,000

WASTEWATER TREATMENT PLANT SCADA

SCADA at the wastewater treatment plant should be set up to monitor and control the various existing process equipment and would be extended to monitor and control future equipment. The existing process equipment which should be monitored includes the following:

The treatment plant equipment which need to be monitored and controlled by a SCADA system are listed below:

Headworks screen (1 new, 1 future)
Influent flow meter (1 new)
Grit removal equipment (2 air compressors)
Primary clarifier (1)
Secondary clarifier (1)
Biofilter recirculation pumps (4)
Effluent flow meter
Chlorination system
Dechlorination system
Sludge filter press
Stormwater pumps (future)

As described above each new MCC will be equipped with its own RTU which will communicate with an MTU in the control room. Because of the distances between these various processes and the fact that space in the existing conduits for wiring is not generally available the most economical method of handling interplant communications will be by a local radio network. This will eliminate a considerable amount of trenching, conduit and wiring expense. The estimated cost for the SCADA monitoring of the above equipment and programming is estimated below:

SCADA equipment and programming	$300,000
Installation and wiring	75,000
In plant radio system	15,000
Total Estimated Cost	$390,000

PUMP STATION ELECTRICAL UPGRADE NEEDS

The following are descriptions and estimated budget costs for electrical upgrade needs at the pump stations. The electrical system upgrades for the pump stations will consist of installation of new 316L stainless steel, duplex pump control panels (MCCs) with either ultrasonic and/or pressure transducer level detectors. The stations with standby generators will also have ATS's in the control panel.

A typical estimated cost of replacing the MCC at the four major pump stations is given below:

Material	$55,000
Installation	18,000
Conduit & Wiring	12,000
Misc	7,000
Total Estimate	$92,000

Replacement of the electrical panel at the Native American pump station is estimated at $20,000. The Sanderson Way pump station does not need an electrical panel upgrade at this time.

Summary - The electrical upgrades at the District's pump stations is estimated as follows:

Elm Street Pump Station	$92,000
North Noyo Pump Station	$92,000
South Noyo Pump Station	$92,000
Pudding Creek Pump Station	$92,000
Native American Pump Station	$20,000
Total Estimated Cost	$388,000

PUMP STATION SCADA

For the six remote pump stations the SCADA RTU will consist of a Micro PLC with digital input/output (I/O) modules and analog I/O modules, ethernet port, radio modem, 24Vdc power supply, human machine interface (HMI) module, The SCADA RTU will communicate by radio to the MTU at the treatment plant. An uninterruptible power source (UPS) will be provided for backup power and surge protection together with associated control and timing relays. Operational software will be developed for the plant control and monitoring and communications between the RTU and the MTU. If desired the PLC can also communicate with a local dialer as a backup to the radio system.

A stand alone SCADA RTU unit for each pump station with its own 316L stainless steel cabinet will cost between $25,000.00 to $35,000.00 plus installation costs. These costs can be reduced if multiple identical units are purchased and the programming is the same for the PLC and HMI units.

SUMMARY

An evaluation of the electrical equipment in the wastewater treatment plant and pump stations has revealed a need for major upgrades. The existing motor control centers are original equipment and parts are no longer available. For most of the District's facilities it is judged that new equipment will be needed.

There is also a need for installation of a SCADA system, which is a computer system for gathering and analyzing real time data. SCADA systems are used to monitor and control a processes and equipment form remote locations and is highly useful in improving the operational reliability.

The estimated cost for the upgraded electrical equipment and SCADA equipment is given in Table 7-1 and summarized below.

Wastewater treatment plant	
Electrical upgrades	$610,000
SCADA	$390,000

Pump Stations	
Electrical upgrades	$388,000
SCADA	$190,000

These estimated upgrade costs will be included in the treatment plant improvement cost estimates in TM 3 and the pump station improvement costs in TM 6.

TABLE 7-1
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
ELECTRICAL AND SCADA UPGRADES
SUMMARY OF ESTIMATED COSTS

Facility	Electrical Upgrades	SCADA
Wastewater Treatment Plant		$390,000
Control Room MCC P1	$245,000	
Chlorination Room MCC P2	$65,000	
Thickener Building MCC P3	$175,000	
Filter Press Building MCC P4	$65,000	
Yard Wiring and Conduits	$60,000	
Treatment Plant Total	$610,000	$390,000
Pump Stations		
Elm Street	$92,000	$35,000
North Noyo	$92,000	$35,000
South Noyo	$92,000	$35,000
Pudding Creek	$92,000	$35,000
Native American	$20,000	$25,000
Sanderson Way		$25,000
Pump Station Total	$388,000	$190,000

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 8
PROGRAM COST ALLOCATION

The purpose of this Technical Memorandum is to allocate the costs of the recommended improvement program between existing and new users. This allocation is based on existing and projected future wastewater flow rates is not necessarily the allocation that would be used in a detailed financial study to set sewer rates.

RECOMMENDED IMPROVEMENT PROGRAM

The recommended program consists of the following project elements:

Wastewater Treatment Plant Improvements – Plant modernization with upgrade trickling filters followed by effluent filters and UV disinfection.
Estimated Project Cost $12,400,000

Pump Station Improvements – Upgrade and improvements to the six sewage pump stations.
Estimated Project Cost $3,950,000

Trunk Sewer and Force Main Improvements – Replacement of tow critical pipelines in the District sewer system.
Estimated Project Cost $1,540,000

TOTAL ESTIMATED WASTEWATER PROGRAM COSTS $17,890,000

COST ALLOCATION

The allocation of these project costs to existing and new users, based on wastewater flow is summarized in Table 8-1. The cost allocation of the recommended wastewater program costs on the basis of flow to the existing users is $10,614,700 and the cost allocated to new users is $7,275,300.

SUMMARY

In order to undertake a program of this magnitude it will be necessary to develop a detailed financing plan so the necessary capital funding can be secured. Depending on the financing plan a different cost allocation may be developed. Potential funding sources are discussed in TM 10.

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
WASTEWATER TREATMENT FACILITY STUDY

TM 9 - RELATIONSHIP OF RECOMMENDATIONS TO REGULATORY REQUIREMENTS

The purpose of TM 9 is to relate the recommendations of this study to present and future regulatory requirements. TM 2 analyzed the existing waste discharge requirements and expected future regulatory requirements for the District's ocean discharge. In TM 3 the existing wastewater treatment plant was evaluated in terms of its facility needs and ability to meet current regulatory requirements. TM 4 evaluated alternatives for upgrading the treatment plant to meet growth needs and expected future waste discharge requirements.

In addition to the regulatory requirements there is the need to upgrade the existing wastewater pumping and treatment facilities to replace aging equipment and address concerns of the public such as safety issues and odor control. With the potential for development of the G-P property these issues will be of concern. The more isolated the treatment plant is from future development the better.

CRITERIA

The relationship of the recommendations to regulatory and other considerations is based on the following criteria:

Replacement of Aging Equipment – The treatment plant and four of the pump stations are now more than 30 years old and equipment is aging and in need of replacement. In most cases replacement of aging equipment is an immediate need in order to keep the facilities functioning. If the equipment is allowed to wear out it will need to be replaced on a high priority basis rather than on a planned basis, which will usually be more expensive. In addition an equipment malfunction may lead to a discharge violation and a fine.

Existing Discharge Requirements – Compliance with existing waste discharge requirements is of prime importance. The following discharge requirements are considered the most important in terms of compliance:

- **Secondary Treatment** – The conventional definition of secondary treatment is that the effluent as discharged must have a BOD and TSS of 30 mg/l on a monthly average basis. The existing treatment plant sometimes has difficulty meeting this requirement. Chemicals are added to the secondary clarifier to assist in meeting these discharge limits. The recommended treatment plant improvements include processes and equipment which will improve compliance with secondary treatment requirements.

- **85% BOD/TSS Removal –** In the wet weather, during high flows, the existing wastewater treatment plant has difficulty meeting the 85% removal of BOD and TSS. Chemicals are added to the secondary clarifier to assist in meeting this requirement. However, one or more additional treatment process will be needed to be able to consistently meet this requirement. All of the plant upgrade alternatives which were evaluated have the objective of complying with this requirement.

- **Improved Disinfection** – The existing chlorine contact chamber at the treatment plant provides adequate detention for dry weather flows but is marginal at peak wet weather flows. Any treatment plant upgrade project must address provide a larger chlorine contact chamber to assure adequate coliform kill or convert to a disinfection process which uses ultraviolet light.

- **Site Stormwater Containment** – The District's NPDES permit requires that all rainwater which falls on the treatment plant site where it could become contaminated from chemical or wastewater spills be returned to the plant for treatment. This will require the construction of a pumping station and pipeline back to the plant headworks.

Anticipated Future Regulatory Requirements – Specific future regulatory requirements are difficult to identify, however over the years the discharge requirements for municipal wastewater treatment plants have generally become more stringent. Since the Fort Bragg plant discharges to the Pacific Ocean it may be less likely to be the subject of much more stringent requirements than a plant that discharges to a river or lake. The regulatory requirements which are considered to be important in planning future treatment plant upgrades are listed below.

- **Wet Weather Flow Treatment** – Regulations require that all wastewater flows receive biologic treatment at the treatment plant. This includes a prohibition of bypassing flows from the sewer system and adequate pumping at the pump stations.

- **Elimination of Blending** – New regulations are being developed that will basically prohibit the practice of blending of treated and partially treated flows within a treatment plant. This requirement requires larger treatment units to provide the necessary treatment.

- **Increased Reliability and Redundancy** – Regulations are becoming increasingly stringent in respect to providing reliability and redundancy of pumping and treatment equipment. Where possible duplicate equipment or processes should be provided.

Public Concerns – In addition to the discharge regulations there are certain public concerns that influence the design of pump station and treatment plant upgrade projects. These concerns include the following:

- **Elimination of Gaseous Chemicals** – The elimination of the use of gaseous chemicals for disinfection and dechlorination is a public safety issue. The prevailing winds from the Fort Bragg treatment plant blow toward the city and if there were a leak or accident with these chemicals there could be serious injuries. Elimination of these gaseous chemicals at the treatment plant should be a high priority.

- **Odor Control** – As the G-P property develops odor control will become an important issue. Some of the treatment processes may eventually need to be covered. Even with odor control the acquisition of a buffer of land between the treatment plant and development is very important. This buffer should be landscaped and made attractive so that the public is basically unaware of the existence of the treatment plant.

- **Isolation from Future Development** – Ideally a wastewater treatment plant should be well isolated from future development. This can be partially achieved with a buffer of land around the plant. Alternative E evaluated in TM 4 investigated the construction of a new treatment plant on G-P property along the former G-P haul road. This is some three miles from town and very isolated for now. It is also more than twice as expensive as other treatment plant upgrade alternatives.

EVALUATION

The relationship of the criteria listed above to the recommended plant upgrade project and the recommended pump station improvements is summarized in Table 9-1. As shown in this table all of the criteria will be addressed by the improvements. Since it is not recommended that the treatment plant be relocated to another site it will be necessary to acquire a buffer around the plant site to assure isolation.

SUMMARY

The purpose of this TM is to tie the recommended wastewater facility improvements to various regulatory and other requirements.

This evaluation has shown that the existing regulatory requirement and expected future regulatory requirements will be met by the recommended improvements.

TABLE 9-1
FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT NO. 1
RELATIONSHIP OF RECOMMENDED TREATMENT PLANT IMPROVEMENTS TO REGULATORY REQUIREMENTS

Process Improvement	Replacement of Aging Facilities and Equipment	Existing Regulatory Requirements				Anticipated Future Requirements			Public Concerns		
		Secondary Treatment	85% BOD/TSS Removal	Improved Disinfection	Stormwater Containment	Wet Weather Flow Treatment	Elimination of Blending	Increased reliability	Eliminate Gaseous Chemicals	Odor Control	Isolated from Future Development
Improvements to the Existing Treatment Plant											
Headworks Screen	X	X				X	X	X	X	X	
Grit Removal	X	X				X	X	X	X	X	
Primary Clarifier	X	X				X	X	X	X	X	
Recirculation Pumps and Valves	X	X				X	X	X	X	X	
Secondary Clarifier	X	X	X			X	X	X	X	X	
Ocean Outfall						X					
Sludge Thickener Mechanism	X							X			
Primary Digester Cleaning and Repair	X							X			
Sludge Pump Room Replacements	X							X			
Septage Dump Station and Sludge Lagoon	X							X			
Electrical Equipment Replacement	X							X			
SCADA Controls	X							X			
Stormwater Containment					X						
New Treatment Processes											(1)
Trickling Filter Improvements		X	X			X	X	X			
Effluent Filters		X	X	X			X	X			
UV Disinfection				X				X	X		
Sludge Dewatering	X										
Odor Control										X	
Pump Station Improvements											
Elm Street	X							X			
North Noyo	X							X			
South Noyo	X							X			
Pudding Creek	X							X			
Native American	X							X			
Sanderson Way	X							X			
Trunk Sewer and Force Main Improvements	X							X			

FORT BRAGG MUNICIPAL IMPROVEMENT DISTRICT
WASTEWATER TREATMENT FACILITY STUDY

TECHNICAL MEMORANDUM NO. 10
POTENTIAL FUNDING SOURCES

The Federal Clean Water Act (CWA), which was enacted by Congress in 1972, empowered the Environmental Protection Agency (EPA) to oversee protection of the nation's waterways. In California the Porter-Cologne Water Quality Control Act established that the State Water Resources Control Board (SWRCB) and its nine Regional Water Quality Control Boards (RWQCB). The SWRCB and RWQCBs are responsible for preparing specific plans for protecting water quality and issuing discharge permits consistent with the CWA.

In the 1970's and 1980's Congress funded grants for the construction of wastewater treatment plants, pump stations and interceptors. This grant program was administered by the EPA. In California the EPA delegated the grant administration to the SWRCB, which called the program the "Clean Water Grant Program". For a number of years the grant share was as high as 87.5%, with a 12.5% local share.

Many agencies, including Fort Bragg, took advantage of these grants. The original treatment plant and pump stations received grant financing. As a part of this grant program all recipients were required to implement a Revenue Program, which established a system of sewer service charges designed to assure proper funding of maintenance of the facilities built with grant funds and to provide a reserve for the replacement of structures and equipment as they wore out. This was supposed to be a one-time grant program, after which agencies were supposed to be self supporting.

The Clean Water Grant Program was phased out in the late 1980's and the SWRCB established the Revolving Loan Fund, which provides public agencies with low interest loan money to fund improvements to their wastewater facilities.

The Clean Water Grant Program restricted the level of funding to only those facilities to serve the then existing population, with an allowance for a small amount of growth. If an agency wanted to construct larger capacity facilities or large pipelines they had to fund these larger facilities from local funds. Most agencies elected to construct only the minimum facilities that would be eligible for grant funds.

Now some 30 years later many agencies, including Fort Bragg, find themselves with rapidly deteriorating facilities or without backup equipment because the initial grant program would not fund them. With the relatively recent emphasis by regulators on "reliability," duplicate equipment, duplicate pumps and parallel force mains are highly desirable and almost mandated. The other problem is that the system of sewer service charges developed in the Revenue Program may not have been sufficient to replace the facilities which are now reaching their economic life and are in need of replacement.
There are some funding sources available for major projects to grade and modernize wastewater facilities. The State Revolving Fund loan program is the main program but

there are some grants for which Fort Bragg may qualify. Some funding sources are for agencies which qualify under specific criteria and sometimes funding sources are authorized by a ballot proposition and then the funds get used up and they disappear.

LOCAL REVENUE SOURCES

Local revenues for the operation and maintenance as well as routine capital improvements for wastewater facilities are generally collected through ad valorum taxes, sewer service charges and sewer connection charges. Under Proposition 218 the establishment and raising of the sewer service charges and connection charges require a public hearing process.

Ad valorum taxes – Ad valorum taxes in California were reduced after the passage of Proposition 13 in 1978. Those agencies which had an established ad valorum tax prior to that date generally kept their apportionment.

Sewer Service Charges – Sewer service charges are now in popular use to fund both O&M costs and capital costs for wastewater agencies. The sewer service charge is based on water usage plus a strength factor for commercial establishments such as restaurants, which discharge wastewater with a higher strength than domestic sewage.

Connection Charges – Most wastewater agencies have established a connection charge for new users which helps fund replacements and their capital projects. Revenue from this source is dependent on growth of the area and if there is little growth there is little revenue.

LOCAL FUNDING

Many of the smaller projects can be funded on a pay-as-you-go basis from the sewer service charges. Larger projects require some type of debt financing such as through general obligation bonds, revenue bonds or certificates of participation. Some bond financing requires a vote, however certificates of participation are generally non-voted. Agencies can also obtain bank loans.

Commercial debt financing will be at the prevailing interest rate. Municipal bonds are tax free for the investors and therefore carry a lower interest rate than normal commercial loans. The interest rate is based on the credit rating of the borrower.

STATE REVOLVING FUND LOAN PROGRAM

The Federal Water Pollution Control Act (Clean Water Act or CWA), as amended in 1987, provides for establishment of a State Revolving Fund (SRF) loan program. The program is funded by federal grants, State funds, and Revenue Bonds. The purpose of the SRF loan program is to implement the CWA and various State laws by providing financial assistance for the construction of facilities or implementation of measures necessary to address water quality problems and to prevent pollution of the waters of the State.

The SRF Loan Program provides low-interest loan funding for construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, water reclamation facilities, as well as expanded use projects such as implementation of non-point source (NPS) projects or programs, development and implementation of estuary Comprehensive Conservation and Management Plans, and storm water treatment.

Eligible applicants include local public agencies and eligible project types include publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, and water reclamation facilities, as well as, non-point source pollution control projects. The available funding is $200 to $300 million annually. Loans have a 20 year term with an interest rate equal to one-half the most recent State General Obligation Bond Rate, typically 2.5% to 3.5%). Another benefit is that the loan repayment does not begin until a year after the project construction has been completed.

A number of wastewater agencies are taking advantage of the SRF loan program. The local Regional Water Quality Control Board must approve the project and include it in the State Revolving Fund Priority List. It takes approximately a year to prepare the necessary studies and environmental reviews necessary for the application process. The applicant's proposed project is carefully scrutinized by the SRF staff and must include infiltration/inflow studies. Because of this careful scrutiny the State may attach conditions which may result in a project larger and more costly than originally contemplated.

USDA WATER AND WASTE DISPOSAL LOANS AND GRANTS

The United States Department of Agriculture (USDA) Rural Utilities Service (RUS) provides the following types of financial and technical assistance for development of safe and affordable water supply systems and sewage and other forms of waste disposal facilities:

- Water and Waste Disposal Loans and Grants
- Emergency Community Water Assistance Grants
- Technical Assistance and Training Grants
- Solid Waste Management Grants

This type of assistance is available to public entities such as cities and special purpose districts with populations up to 10,000 people. Applicants must be unable to obtain needed funds from commercial sources at reasonable rates and terms and have the legal ability to repay the loans, pledge security for the loans and operate and maintain the facilities.

Loan and grant funds may be used for construction, repair, expansion and improvements to water supply and waste collection and treatment systems. The loan repayment period can be up to 40 years or the useful life of the facilities, whichever is shorter. The interest rate starts at 4.5 % and depends on the median household income. Grants may be provided when necessary to reduce the user cost to a reasonable level and can cover up to 75% of the eligible cost.

It appears that Fort Bragg and the Fort Bragg Municipal Improvement District may qualify for a USDA RUS grant or loan for wastewater improvement facility grants or loans. The long repayment period means that the agency may still be paying off the loan when new modernizations must be financed.

CALIFORNIA BOND MEASURES

In California, voters have approved ballot propositions authorizing millions of dollars in bonds to be issued for the general purpose of providing clean water. The ballot propositions have formed the basis of grant programs that fund a wide variety of projects ranging from major infrastructure improvements to staff support of nonprofit, local water education groups. These clean water grants are administered by the Division of Financial Assistance (DFA) of the SWRCB.

From the point of voter approval, it takes about 3 years until the point that SWRCB actually issues payment to local agencies and organizations that apply for, obtain approval for, and complete work for which grant funding has been authorized. The program that the DFA has set up has created a significant administrative burden for these grants, including submittals of water quality monitoring programs, quality assurance programs, quarterly project updates, pre- and post-project photographs and evaluation reports of the project when completed, including review of water quality information. The administrative burden for the application process is quite high as well, and there is a lot of competition for the money from a wide variety of sources.

Interestingly, Fort Bragg may actually have some competitive advantage on these clean water grants, due to its coastside location, proximity to heavily-used beaches that contribute to the State’s tourism, and the fact that it does not have a lot of competing North Coast communities and population. For these reasons, Fort Bragg should probably spend some effort applying for bond-related grant funding for its water quality improvement projects.

When distributing statewide dollars, the SWRCB is under some political and internal pressure to spread the wealth geographically as well as by population. In the grant approval process, SWRCB and its working groups of the Regional Boards and other agencies and organizations are mindful of distributing grant dollars equitably among the nine regions of the state. There are less potential projects in the North Coast region relative to other parts of the state, mostly owing to its relatively low population. If Fort Bragg has plans ready for implementation that can be shown to improve water quality or prevent water quality degradation, it may find itself well-positioned for funding due to its geographic location.

Communities in Southern California have received the lion's share of this funding due to the higher tourism and greater number of competing entities. One consequence of this funding asymmetry is that SWRCB and EPA are actively seeking good beach protection proposals from other parts of the state. So if there are good proposals from the northernmost part of the state they have a good probability of obtaining grant funding.

CLEAN BEACHES INITIATIVE

There are several grant programs administered by the DFA, with names such as Coastal Non-point Source, Integrated Watershed Management grants, etc. The active grant program for which Fort Bragg would most likely qualify and be competitive is the Clean Beaches Initiative (CBI), which has been augmented by the successive ballot propositions.

The SWRCB began the Clean Beaches Initiative Grant Program with the Budget Act of 2001. The Budget appropriated $32.298 million from Proposition 13 to implement 38 specific projects. The projects address postings and closures at California public beaches caused by bacterial contamination.

The Watershed, Clean Beaches, and Water Quality Act was signed into law on September 20, 2002. The Act appropriated an additional $46 million from Proposition 40 for additional CBI grants to help local agencies, non-profit organizations, and public agencies implement projects that protect and restore California's coastal water quality.

In November 2002, voters approved the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Proposition 50) authorizing the issuance of bonds to fund a variety of water quality improvement projects. The 2005/06 Budget Act appropriated $23 million of Proposition 50 funds for CBI projects.

SMALL COMMUNITY WASTEWATER GRANTS PROGRAM

The Small Community Wastewater Grant (SCWG) Program, funded by Proposition 40 and Proposition 50 at a $30 million level statewide, provides grant assistance from the DFA for the construction of publicly owned wastewater treatment and collection facilities. Fort Bragg qualifies for funding under the SWCG program because it is within the population limit of 20,000 and its annual median household income is below $37,994.

The SCWG Program Guidelines were adopted by the State Water Board on June 17, 2004. The current Competitive Projects List (CPL) was adopted on October 21, 2004. Fort Bragg's four projects applied for a total of $2,770,000, and all four projects were ranked on the CPL as Class B projects, eligible for funding. The DFA has indicated to Fort Bragg that they should continue to submit applications for planning, design and construction grants as these phases are developed and grant application filing deadlines are established.

The current CPL will be amended to include new potential projects to facilitate timely expenditure of SCWG funds. Projects on the current CPL continue to remain on the list. All projects will be evaluated to ensure they are properly classified as Class A (Existing or Potential Public Health Problems), B (Pollution Problems), or C (Other Projects), according to Section IV of the Guidelines. Per State Water Board Resolution No. 2004-0070, only projects in Class A and Class B will be eligible to compete for available funding.

PROPOSITION 84

In November 2006, voters approved the Water Quality, Safety and Supply, Flood Control, Natural Resource Protection and Park Improvements Act, known as Proposition 84. The State is now authorized to sell $5.4 billion in general obligation bonds for safe drinking water, water quality, water supply, flood control, natural resource protection, and park improvements.

Compared to previous voter-approved bond measures, Proposition 84 introduces a higher order-of-magnitude in funding and scope. The Clean Beaches Initiative will in all likelihood be augmented with funding from this new Act. Water quality projects such as Fort Bragg's will obviously qualify, but it may be 3 or 4 years before funding is available.

The scope of this bond is so broad, and the costs of some components such as flood control so high, that it is likely to be some time before the allocation formulas for wastewater, water supply, flood control and parks all get sorted out. Fort Bragg should continue to track the CBI for opportunities to tap into this significant source of infrastructure funding. If there are some on-the-shelf projects already designed and ready for bid Fort Bragg could act quickly to secure this funding.

SUMMARY

Large projects will usually need to be funded by grants or some kind of debt financing or a combination of both. Municipal agencies such as Fort Bragg can usually obtain bond financing or even commercial financing at market rates. However, in California low interest loans and some grants may be available.

The original Clean Water Grant program of the EPA has been discontinued and California has set up a State Revolving Fund Loan Program, which provides low interest loans for qualifying wastewater facilities. The application process for an SRF loan is lengthy and the project cost may grow due to the addition of more studies and requirements to implement projects to reduce infiltration/inflow in the sewer system.

Fort Bragg may qualify for USDA Water and Waste Disposal loans and grants because its population is less than 10,000.

Grants for wastewater facilities may become available through some of California's bond measures, the Clean Beaches Initiative and the recently passed Proposition 84. It takes some time for the programs to be set up and it is important to keep abreast of the possibilities of securing grants from one or more of these sources.