Section 16

Emergency Storage

Within the Plant 1 site, there is an existing earthen basin with a volume of approximately 5 million gallons (Mgal) that is available for use as an emergency storage basin, but is currently not being used. This basin was originally an aerated lagoon, prior to the construction of the oxidation ditch at Plant 1. When the oxidation ditch was constructed, the aerated lagoon was converted to a waste sludge holding basin. The waste sludge holding basin was subsequently abandoned when new sludge handling facilities were constructed at Plant 2. The earthen basin is recognized as an emergency storage basin in the NPDES permit and can be used as such by using portable pumping equipment for filling and draining. In this section, permanent pumping and conveyance facilities and other improvements for use of the emergency storage basin are considered.

16.1 Routing Influent Wastewater to the Emergency Storage Basin

In Section 9, the option of reactivating Pump Station W as a backup to the Influent Pump Station is considered. As discussed in that section, there is existing discharge piping from Pump Station W to the emergency storage basin. Therefore, the improvements to Pump Station W and ancillary facilities described in Section 9 will allow Pump Station W to be used to divert influent wastewater from the 12-inch gravity sewer entering the Plant 1 site to the emergency storage basin.

In addition to the 12-inch gravity sewer entering the Plant 1 site, there is a 12-inch forcemain from Pump Station F. Flow from this forcemain currently can be routed either directly to the headworks of Plant 1 or to the Influent Pump Station for subsequent pumping to Plant 1 and/or to Plant 2. To allow this flow also to be routed to the emergency storage basin, additional piping would be required, for which there are several options, including the following: 1) connect the forcemain from Pump Station F to the Pump Station W sump, 2) connect the forcemain from Pump Station F directly to the discharge piping from Pump Station W, and 3) provide an outlet from the forcemain from the Influent Pump Station to Plant 2 into the emergency storage basin. Since it is considered highly unlikely that it would ever be desirable to completely shutdown Plants 1 and 2 at the same time and divert 100 percent of all influent wastewater to the emergency storage basin, it is probably not necessary to provide for diversion of the Pump Station F flow to the emergency storage basin. If Plant 1 were shutdown while Plant 2 remained in operation, the flow from Pump Station F could be routed to Plant 2 through the Influent Pump Station. For this Master Plan, it is assumed that piping to allow diversion of the Pump Station F flow to emergency storage will not be provided. If desired, the District could reconsider this option at a later date.

16.2 Draining the Emergency Storage Basin after Use

To drain the emergency storage basin after use, it is recommended that a self priming pump with a capacity of about 2 Mgal/d be provided at the top of storage basin berm. The suction line from the pump would extend down the berm to a concrete intake sump recessed into the storage basin floor. The discharge from the return pump would be routed to the Influent Pump Station for subsequent pumping to Plant 1 and/or Plant 2. A maximum return rate of about 2 Mgal/d is considered adequate, since the total flow to Plants 1 and 2 during return pumping operations would be the influent wastewater flow and the return flow, combined. Of course, this capacity can be verified at the time of design and final pump selection. In any case, the return pump would be provided with a variable frequency drive and flow meter so that the return pumping rate could be set at any desirable flow between the minimum and maximum allowable pump flows.

16.3 Aesthetic and Environmental Considerations

The storage of raw sewage in an earthen basin, if not properly limited and controlled, can result in unacceptable odors and can raise concerns of groundwater degradation. However, it is believed that these issues are acceptably mitigated based on limited use of the storage basin during relatively cold wet weather conditions.

Normally, all wastewater can be processed through Plants 1 and 2. If there should be a major failure in either Plant during dry weather flow conditions, it is likely that the other plant could take the entire flow temporarily while the problem is resolved. In that case, there would be no need for diversion to emergency storage. If there were a major failure at the Influent Pump Station, Pump Station W could be used as a backup as described in Section 9, again not resulting in the use of emergency storage. It is expected that the emergency storage basin, if used at all, would only be used for short durations to get by unexpected emergency peak wet weather conditions, combined with major equipment failures in Plant 1 or Plant 2 (both at the same time would be highly unlikely). The relatively cold and dilute sewage that would be stored temporarily in the emergency storage basin should not result in significant odors, provided the basin is emptied within a few days.

If it should ever be desirable to use the emergency storage basin to hold raw sewage on more than a temporary and emergency basis, consideration would have to be given to providing aeration equipment to prevent odors.

The concern regarding potential groundwater degradation is not considered to be significant. It is noted that this basin was used continuously for many years to treat raw sewage or to hold sewage sludge, without groundwater degradation being an issue. Therefore, the short duration use for emergency storage should certainly not be an issue. Additionally, use of this basin for emergency storage use is already recognized in the NPDES permit.

16.4 Recommended Improvements and Costs

The improvements recommended for use of the emergency storage basin include the re-activation of Pump Station W as described in Section 9 and the installation of a return pump system and piping as described in this section. Additionally, the basin bottom should be graded for drainage to a concrete sump at the intake of the return pump. A cost estimate for the improvements, not including the improvements to Pump Station W, is presented in Table 16-1. Costs for the improvements to Pump Station W are covered in Section 9 with regard to using Pump Station W as a backup to the Influent Pump Station.

Table 16-1
Cost Estimate for Emergency Storage Improvements

Item	Cost, $1000s (a)
Re-Grade Basin Bottom and Provide Concrete Pump Intake Sump	30
Self Priming Return Pump System	35
Piping and Valves	30
Misc. Site Improvements	10
Electical and Instrumentation	30
Subtotal 1	135
Contingencies @ 20% of Subtotal 1	27
Subtotal 2	162
General Conditions, Overhead and Profit @ 20% of Subtotal 2	32
Total Construction Cost	194
Engineering, Admin. and Environmental @ 25%	49
Total Capital Cost	243

(a) First quarter 2011 cost level. ENR 20-Cities CCI = 9,000.

Section 17
Wetlands Treatment Potential

The purpose of this section is to discuss the potential of designed wetlands to provide cost effective wastewater treatment to the Town of Discovery Bay.

17.1 Wetlands as Wastewater Treatment Processes

"Wetlands" is a term used widely with relatively poor definition. The most basic definition would be land that is wet on a frequent to continuous basis. As used, herein, a wetlands is land that is generally saturated with water, which supports stands of aquatic plants (submerged, emergent, and/or floating) tolerant of having their roots continuously immersed in water. The free water surface of a wetlands may be above or below the soil surface, i.e., there may be standing water in a wetlands, or the water surface may be below the surface of the soil, sand, or gravel substrate of the wetlands. Various physical, chemical, and biological aspects of wetlands have the potential to facilitate treatment of wastewater in a myriad of ways. These aspects include:

- Huge amounts of physical structure (substrate, plant roots, plant stems) on which bacteria and other microbes can grow.
- Diverse micro-ecologies (aerobic, anoxic, and anaerobic) fostering diverse microbial populations capable of providing a wide range of biological wastewater treatment functions.
- A wide range of physical/chemical conditions and micro-sites capable of facilitating a wide range of physical/chemical treatment processes such as sedimentation, chelation, adsorption, ion exchange, precipitation, oxidation and reduction.

It is significant to note that the foregoing mechanisms are essentially the same physical, chemical, and biological processes used in most conventional wastewater treatment processes. In this regard, the main differences between conventional wastewater treatment and wetlands wastewater treatment are:

- Conventional wastewater treatment typically uses concrete and steel reactors, power, and chemicals to create the physical, chemical, and biological conditions facilitating wastewater treatment, whereas wetlands provide these conditions in a more natural setting.
- The process conditions and performance in conventional systems are more amenable to manipulation and control than they are within a wetlands.
- To create natural wetlands settings that facilitate reliable wastewater treatment, substantially more land is required than for conventional wastewater treatment processes.

Wetlands of interest to this Master Plan are designed treatment wetlands (DTWs). DTWs are designed by qualified specialists to optimize one or more of the foregoing treatment mechanisms for specific wastewater treatment purposes. As an example, a DTW may be designed to remove one or more classes of water contaminants: organics, nitrogen compounds, pathogens, metals, refractory organics, colloids, etc. No one type of DTW removes all classes of contaminants efficiently. DTWs are designed for specific wastewater treatment purposes in specific climatic settings, just like conventional wastewater treatment processes.

17.2 Discovery Bay Wetlands Treatment Demonstration Project

In 2007, Discovery Bay implemented a DTW demonstration project to remove metals, specifically copper, utilizing the expertise of Alex Horne Associates (DTW specialists) and the University of California, Berkeley (Prof. David Sedlak). The result was four pilot-scale DTWs designed to remove metals, and a fifth experimental POP (Phyto-chemically enhanced Oxidative Photodegradation) cell designed to remove pharmaceuticals. Results reported through 2009 for the DTWs were good as shown in Table 17-1.

Table 17-1
Reported Results from Discovery Bay DTWs [(a)]

Contaminant	Final Concentration Range, µg/L	Removal Range, %
Copper:		
Total	2.4 to 4.4	70 to 85
Soluble	<1	>90
Zinc:		
Total	10 to 15	50 to 68
Soluble	7 to 11	63 to 77

(a) Source: Report on the Wetlands Project at Discovery Bay, Alex Horne, October 2009.

Due to funding limitations and successful implementation of alternative copper compliance strategies, the DTWs are not in operation at this time. Reportedly the DTW cattails and bulrushes died-off seriously in 2010, presumably as a result of excessive water depths on the rhizomes of these plants during their winter dormancy period. Re-growth is thought to be likely such that the pilot-scale DTWs should be available for further research and/or demonstration, as warranted.

17.3 Potential Uses of DTWs at Discovery Bay

Potential uses of DTWs at Discovery Bay could be driven by regulatory, economic, and/or public perception factors. Regulatory factors could be numeric effluent limitations on specific contaminants (such as copper or salinity, today, and possibly specific pharmaceuticals in the future), or narrative objectives (e.g., the non-numeric principles of minimizing water quality degradation to the extent feasible under the State Anti-Degradation Policy [State Board Resolution No. 68-16], or reducing the general toxicity or biostimulation potentials of wastewaters discharged to surface waters). Economic factors may favor DTWs over more energy intensive conventional treatment as power becomes an increasingly scarce resource. The people of Discovery Bay may desire the multi-purpose benefits of many DTWs: wastewater treatment, wildlife habitat, and aesthetic enjoyment.

The most realistic potential uses of DTWs at Discovery Bay are as supplemental advanced wastewater treatment processes to the town's existing conventional treatment processes. The specific benefits today would be narrative in nature:

1. Reducing effluent metals concentrations as an anti-degradation measure under Resolution No. 68-16 regardless of the issue of compliance with numeric effluent limitations on metals.
2. Reducing pharmaceutical concentrations in the Town's effluent discharged to the Delta, again, under Resolution No. 68-16 and the principles of environmental stewardship, because pharmaceuticals, in general, are not regulated numerically in effluent discharges to surface waters at this time.
3. Providing the people of Discovery Bay with an aesthetic wetlands setting to enjoy.

The most pressing effluent water quality problem for Discovery Bay, currently, is salinity. The first step in addressing this issue is differentiating EC (electrical conductivity, which includes organic acids) from TDS (total dissolved solids, which includes dissolved organics) from FDS (fixed dissolved solids, the best general measure of actual effluent salinity). DTWs impact these different "indicators" of salinity in different ways. Regarding FDS, DTWs are known to lose water to the atmosphere by vegetative evapotranspiration (ET) which generally concentrates FDS in the remaining water. However, it is conceivable that DTWs could be designed to remove more salts (e.g., by precipitation and plant uptake) than they concentrate by ET, thereby reducing effluent salinity. This possible use of DTWs could be investigated by Discovery Bay by modifying the existing demonstration project facilities. Technologies like the POP cell may offer the greatest potential because of the high pH conditions that such systems can create, which will precipitate some salts form solution.

17.4 Current Regulatory Drivers Relative to DTWs

As noted above, the two main regulatory drivers, today, for continued interest in DTWs at Discovery Bay are effluent salinity limitations and the narrative requirements of the State Anti-Degradation Policy with particular regards to metals (such as copper and zinc) and refractory organics (such as pharmaceuticals, flame retardants, pesticides, and other man-made organic compounds). The efficacy of DTWs for reducing effluent salinity is a matter for research. However, it is known that DTWs remove metals and refractory organics. In the current regulatory setting, DTW treatment would be required by the State only if determined to be cost effective under the State Anti-Degradation Policy. If in the future more restrictive numeric effluent limitations are placed on effluent metals and/or refractory organics, then DTWs may be economically viable alternatives to more conventional treatment technologies for achieving compliance with more restrictive limitations.

17.5 Recommendations

There is no question that DTWs have the potential to treat municipal wastewaters, particularly to provide advanced treatment of effluents produced by conventional secondary and tertiary treatment processes, such as are currently used or may be used in the future in Discovery Bay. In this regard, DTWs have the potential to reduce Discovery Bay's contributions to the overall degradation of the Delta. The cost effectiveness of this reduction in degradation would have to be determined, probably as part of an anti-degradation analysis, if required by the State under Resolution No. 68-16.

Currently the most pressing wastewater problem for Discovery Bay is effluent salinity. Salinity reduction is not an established capability of DTWs. Discovery Bay may wish to consider retaining qualified DTW specialists to research this capability as an alternative or supplement to the more conventional effluent salinity mitigation measures of 1) source control, 2) partial RO (reverse osmosis) treatment at the wastewater treatment plant, or 3) switching the Discovery Bay potable water supply from groundwater to surface water.

Future effluent limitations on metals and /or refractory organics may be more restrictive. In that case, Discovery Bay may wish to reconsider DTWs as a treatment process to comply with more restrictive effluent limitations as well as the anti-degradation requirements of the State.

Because there are credible roles for DTWs in Discovery Bay's situation and setting, the demonstration DTWs should be retained for possible future use, unless the real estate is critically needed for other uses. One approach that should be considered by Discovery Bay is whether full-scale DTWs can be integrated into overall community land use planning to create aesthetic public space, provide habitat, and improve effluent water quality.

Section 18

Solids Handling

All of the solids handling facilities for both WWTP No. 1 and No. 2 are located at plant No. 2. In this section, the existing facilities are described, known operating issues are considered, capacities are evaluated, and recommended improvements are discussed.

18.1 Description of Existing Facilities

The solids handling facilities consist of waste activated sludge (WAS) pumping systems at each plant, a small aerobic digester (0.69 million gallons), two sludge lagoons (5.75 million gallons each), a belt press dewatering facility, and two active solar sludge dryers. Solids from the secondary process at each plant are pumped as WAS to Plant No. 2 for processing. The WAS pumps for each plant can pump to the small aerobic digester, directly to one of the two sludge lagoons located at Plant No. 2, or directly to the dewatering facilities. When there is capacity to receive material into the active solar dryers, WAS is normally pumped to the aerobic digester for a short duration to get some volatile solids reduction and to allow some thickening and then is pumped to the belt press where it is dewatered and then loaded into the active solar dryers with a self-unloading truck. The active solar dryers dry the sludge to 75% to 80% solids to reduce volume and kill pathogens. The sludge is then stockpiled and land applied periodically on the Town property south of Plant No. 2

The final sludge product out of the active solar dryers meets Class A Exceptional Quality limits under EPA 503 regulations. As a result, the sludge is exempt from the California Statewide General Order on Sludge Disposal when land applied at less than 10 dry tons per acre per year. As such, the Town currently land applies the dried sludge on the Town agricultural property immediately south of Plant No. 2 without permit.

The aerobic digester is not large enough for complete volatile solids destruction under EPA 503 Class B Criteria, but is primarily used to create a homogenous sludge consistency prior to feeding the belt press. There is a decant system in place in the aerobic digester that allows some thickening of the sludge prior to being sent to dewatering. Sludge in the digester is approximately 1% solids prior to dewatering. There is also an overflow from the aerobic digester to the sludge lagoons. The aerobic digester is aerated and mixed with four 25 horsepower aerators.

The dewatering system consists of a single 1.5 meter mono-belt belt press with a polymer system and progressing cavity sludge feed pump. The feed pump pulls sludge through a combination 8-inch and 6-inch sludge line from the aerobic digester. Dewatered sludge cake is normally 12% to 16% solids and is transferred by auger directly into a self-unloading truck. The maximum capacity of the existing dewatering press is 100 gpm or 900 dry lbs per hour. Based on the 1% normal feed rate, the throughput through the press at 100 gpm is approximately 500 dry lbs per hour. When in operation, the dewatering equipment runs two shifts a day to fill the self-unloading truck, a morning shift and an afternoon shift. Total run time is approximately 8 hrs. A timer shuts off the belt press after about 4 hours of operation. Operators unload the truck first thing in the morning and once in the afternoon. It currently takes approximately 2 to 3 weeks to fill one chamber with the existing dewatering equipment.

The active solar dryers consist of two chambers, each 40 feet wide by 204 feet long. Each dryer holds about 190 wet tons of sludge at the beginning of each drying cycle. Sludge is loaded into the dryers with the self-unloading truck. A mechanical mole turns the sludge inside the dryers while the sludge is drying. Once the sludge is dry, the sludge is pushed to the back of the dryers for temporary sludge storage and then moved outside for longer term storage before land application on the Town property. The drying time is cyclical with the seasons with a complete cycle taking 2 weeks in the middle of summer and up to 12 weeks during the winter months.

The Town has a floating dredge that can be moved to either of the two sludge lagoons at Plant No. 2. The intent of the dredge is to pump sludge from the lagoon to the aerobic digester or directly to the belt press. During testing, it was found that the sludge consistency when pumped directly to the belt press varied so greatly it was not possible to run the belt press properly. Therefore, sludge is pumped to the aerobic digester for mixing consistency and to allow decanting prior to dewatering.

There is a solar powered "Solar Bee" mixer in each sludge lagoon to maintain a fresh water cap on top of the sludge. These mixers replaced the existing brush aerators as an energy savings measure and have operated well since they have been installed.

18.2 Existing Operational Issues

There are three key operational issues with the solids handling facilities.

1) Mechanical aerators in the aerobic digester are a constant maintenance item.

2) The dewatering capacity is limited and does not allow maximum use of the active solar dryers due to excessive dryer loading times.

3) Sludge Lagoons at Plant No. 2 are almost full and significant amounts of sludge must be removed in the near future.

18.2.1 Mechanical Aerators

Operation of the aerobic digester has both the benefit of feeding a very consistent sludge feed to the belt press and also reduces the volatile solids of the sludge prior to the belt press and placement in the dryers. The one operational issue with the aerobic digester is that the surface aerators require considerable maintenance. One of the aerators is routinely out of service. The aerators are held in place with a cable system, so removing an aerator for service is a time consuming task. However, given the nature of construction of the aerobic digester, there is no real alternative to the existing aerators that can be economically placed in service. Therefore no change to the existing aerators is recommended as part of the master plan.

18.2.2 Dewatering Capacity

During winter months when both dryers are full, sludge is wasted directly to the sludge lagoons and no dewatering takes place. During summer months, dewatering takes place continuously. However, in the summer months, the dryers can dry faster than the belt press can fill them. As a result, the maximum solids throughput through the dryer is not achieved. The specific capacity issues are address under Section 18.3.

18.2.3 Sludge Lagoons

At the time of construction of Plant No. 2, all of the sludge in Lagoon No. 1 at Plant No. 1 was pumped into the lagoons at Plant No. 2, to allow the Plant No. 1 lagoon to be converted to an emergency storage basin. In addition, wasting to the lagoons during winter months when the dryers are full or when the belt press is out of service has added additional sludge to the lagoons. Because of limited capacity of the dewatering system during summer months, no sludge from either lagoon at Plant No. 2 has been removed since their construction. Several sludge studies have been conducted by the Solar Bee Company as part of operational testing of the solar mixers in the lagoons, the last of which was conducted in January 2007. At that time, the sludge studies showed Lagoon No. 1 at Plant No. 2 was essentially full of sludge and Lagoon No. 2 at Plant No. 2 was about a quarter full of sludge. The depth of sludge in Lagoon No. 1 is now clearly visible and the lagoon appears full. The depth of sludge in Lagoon No. 2 is not visible and has not been measured since 2007. This problem is most easily addressed by either contracting to have solids removed from the lagoons or building at least Phase 1 of the solids handling improvements discussed later in this section (includes two belt presses and one active solar dryer).

A secondary benefit of the sludge lagoons is the degradation of sludge placed into them through a slow anaerobic process that naturally occurs in the lagoons as part of their operation. Placing sludge into the lagoons for a minimum of a year can reduce the total volume of sludge as much as 30%. Therefore continued operation of the lagoons as a means to absorb variable loading to the active solar dryers and to further reduce the total amount of sludge fed to the dryers is desirable going forward.

18.3 Existing Capacity and Future Requirements

Solids balance calculations were developed to determine solids production amounts for existing and future buildout conditions, which are shown in Table 18-1. The amount of solids produced is dependent on the influent BOD and TSS loading to the plant.

The capacity of the active solar dryers and the number of solar dryers required for the different options are also shown in Table 18-1. The operation of the aerobic digester and sludge lagoons reduces the volatile solids feed to the dryers by approximately 30% and the total number of dryers required is based on this reduced quantity of sludge. This process also reduces the odor potential of the dryers due to the lower volatility of the sludge.

Table 18-1
Summary of Solids Production

Parameter	Existing	Future Buildout
Flow, Mgal/d		
Average Annual Flow (AAF)	1.80	2.37
Average Constituent Concentrations, mg/L		
BOD	200	200
TSS	200	200
TKN	40	40
Solids Wasting (WAS)		
Average Annual, lb/d	3,300	4,300
Maximimum Month, lb/d	4,400	5,800
Volatile Solids (VSS), %	80%	80%
Aerobic Digester and Sludge Lagoon Operation		
VSS detruciton, % (a)	30%	30%
Average Annual TSS Remaining, lb/d	2,500	3,300
Active Solar Dryers		
Annual Capacity per Dryer, lb/d (b)	950	950
Number of Dryers Required	2.6	3.5
Number of Dryers Recommended to Build	3.0	4.0

(a) VSS destruction based on 9 Day HRT in Aerobic Digester and one 1 year sludge storage in existing sludge lagoons.
(b) Capacity at 16% solids feed.

18.3.1 Aerobic Digester

The capacity of the aerobic digester is approximately 9 days of HRT. This is sufficient to help reduce the volatile solids, but is not adequate to meet EPA 503 requirements for Class B sludge stabilization. The primary purpose of the aerobic digester is to reduce some of the volatile solids and to provide a uniform mixture of sludge for consistent operation of the belt press. As such, there is no strict requirement to increase the size of the aerobic digester for any of the operating scenarios. Expansion of the aerobic digester is therefore not recommended as part of the Master Plan.

18.3.2 Sludge Lagoons

The existing sludge lagoons were designed to store 12 months worth of sludge in each lagoon and allow stabilization of the sludge prior to disposal. Each lagoon was intended to be emptied while the alternate lagoon was filled. Based on current operation, the lagoons are utilized as an overflow for WAS when dewatering and processing through the active solar dryers cannot take place. The existing lagoons are large enough for operation under either operating scenario. It is recommended that the facility operation be modified to send sludge into the sludge lagoons prior to dewatering and processing through the active solar dryers. This will allow further stabilization and reduce the total volume of materials processed and disposed of. Sludge should be allowed to sit in the lagoons for a minimum of 12 months and then pumped out with the dredge to the dewatering and sludge drying systems. WAS can be placed into the lagoons either before or after the aerobic digester. If odors become an issue with the operation due to high VSS loading to the lagoons, the sludge should go through the aerobic digester first and then into the sludge lagoons. Operating the aerobic digester and lagoon system together in this manner will yield a minimum 30% reduction in volatile solids and 24% reduction in total solids for drying and disposal. No further changes to the sludge lagoons are recommended as part of the Master Plan.

18.3.3 Dewatering

The existing dewatering facility consists of a single belt press with an adjacent depressed truck loading area. The belt press discharges to an inclined conveyor which discharges into the adjacent truck. Because of the batch loading process of the active solar dryers and the seasonal nature of the process, peak yearly throughput for the dryers is achieved when they are loaded in 1 week or less during the summer months. This is required to achieve the drying throughput indicated in Table 18-1. Therefore, the sizing of the dewatering system is more dependent on the loading time of the dryer than on the amount of daily sludge produced. If proper loading times are not achieved, the actual dryer capacity can be as much as 50% less than that shown in Table 18-1.

One dryer is initially filled with approximately 190 wet tons of sludge. At 16% solids, this is equivalent to 60,800 dry lbs of solids. The existing belt press can process 500 dry lbs/hr at a 1% solids feed concentration and normally runs approximately 8 hours per day. There is no dewatering on the weekends. This results in 122 hours or 15 working days of operation to fill the dryer. This cycle is too long to hold the rated throughput capacity of the dryers. Adding 2 more belt presses will move the fill time to 5 working days. It also will allow more redundancy if one belt press is out of service. Currently no dewatering can occur when the existing belt press is out of service and because the press peak usage time is during the summer months, mechanical issues that do develop with the existing press tend to occur during peak summer loading times for the dryers.

It is recommended that two new 1.7 meter Aeromod belt presses (similar to the existing press) be added to the existing facility to maximize the throughput of both the existing solar dryers and the new dryers recommended for construction. The original facility was planned to allow mirroring another belt press system on a similar concrete pad with metal cover on the opposite side of the truck loading station. It is recommended that the facility be located as planned. It has been confirmed that two belt presses rotated 90 degrees to the existing press with a simple cake pump system feeding the same truck can fit in the planned location. This is, therefore, the recommendation.

18.3.4 Active Solar Dryers

Table 18-1 indicates the average annual active solar dryer throughput for Discovery Bay. This throughput is valid if the dryers can be fed in approximately 1 week as discussed in the dewatering section of this plan. As indicated in Table 18-1, 2.6 active solar dryers are needed to handle existing loads and four are needed at buildout. Since the Town currently has only 2 dryers, capacity is inadequate and the solids that are not being processed are filling the sludge lagoons. Accordingly, the third active solar dryer is needed now. The fourth dryer is theoretically required when the average annual influent flow to the plant exceeds about 2.0 Mgal/d. However, the timing of the fourth dryer should be confirmed based on experience, as described below.

18.4 Recommended Improvements

Based on the evaluations presented in this Section, the following phased solids handling improvement program is recommended:

> Phase 1: Add two belt presses and one active solar dryer. Continually monitor plant solids production and operation of the dewatering and drying facilities to confirm the time when a fourth dryer will be needed.
>
> Phase 2: Build the fourth active solar dryer when needed.

If financing the total cost of Phase 1 is an issue, then the belt press facility should be built first and the sludge lagoons can continue to store sludge while financing is arranged for the construction of the solar dryer. However, if the third active solar dryer is substantially deferred, then both the third and fourth dryers should be built as one project.

Proceeding with Phase 1 (including the active solar dryer) now will allow the District to keep up with current solids production going forward and also to begin making progress on removing solids from storage. Some cost efficiency and faster progress in processing stored solids could be realized if the fourth active solar dryer were constructed at the same time as the Phase 1 improvements. However, since dryers are not difficult to construct and are easily staged, the two-phase program is reasonable and allows the cost of the fourth dryer to be deferred until it is actually needed based on operational experience.

In addition to proceeding with the improvements indicated above, it is recommended that the existing sludge storage lagoons and dredge system be operated so as to optimize reduction of total solids prior to dewatering, thereby reducing the amount of solids to be dewatered, dried, and disposed of.

Table 18-2
Cost Estimate for Solids Handling Phase 1 Improvements

Item	Cost, $ [(a)]
Dewatering Building Improvements (2 Presses)	844,000
1 New Solar Dryer	1,150,000
Civil	140,000
Electrical and Instrumentation	450,000
Subtotal 1	2,584,000
Contingencies @ 20% of Subtotal 1	517,000
Subtotal 2	3,101,000
General Condition, Overhead and Profit @ 20% of Subtotal 2	620,000
Total Construction Cost	3,721,000
Engineering, Admin, and Environmental @ 25%	930,000
Total Capital Cost	4,651,000

(a) First quarter 2011 cost level. ENR 20-Cities CCI = 9,000.

Table 18-3
Cost Estimate for Solids Handling Phase 2 Improvements

Item	Cost, $ [(a)]
1New Solar Dryer	900,000
Civil	30,000
Electrical and Instrumentation	200,000
Subtotal 1	1,130,000
Contingencies @ 20% of Subtotal 1	226,000
Subtotal 2	1,356,000
General Condition, Overhead and Profit @ 20% of Subtotal 2	271,000
Total Construction Cost	1,627,000
Engineering, Admin, and Environmental @ 25%	407,000
Total Capital Cost	2,034,000

(a) First quarter 2011 cost level. ENR 20-Cities CCI = 9,000.

Section 19
SCADA System

19.1 Introduction

This memorandum presents a review of the current Town of Discovery Bay Community Services District (TDBCSD) SCADA[1] assets and a review of a previous proposal by others to upgrade the SCADA system. Based on these reviews, revised recommendations for SCADA system improvements are developed. This effort is being performed as part of the Wastewater Master Plan Project.

19.2 Present SCADA System

The current SCADA system monitors and controls all water and wastewater systems owned by TDBCSD, including the water treatment plants, water wells, wastewater treatment facilities, lift stations and other facilities. The system includes approximately eleven Modicon2 Compact Programmable Logic Controllers (PLCs) that are nearing obsolescence, as well as 23 newer Modicon Momentum PLCs as remote PLCs throughout the District. The remote PLCs communicate utilizing serial Modbus RTU 3 protocol via a MDS 98104 radio / modem to the Master RTU at Wastewater Treatment Plant 1 (WWTP 1). In some cases there are subnets that allow smaller systems, which share data within their group. The subsystem information is packed together by the master PLC of the group and this data is passed to the Master RTU at WWTP 1.

Following is a simplified explanation of the different RTUs and their functions:

- **WWTP 1** – This site includes the Master Data Concentrator RTU with SCADA PC, which is the master communication unit for all serial radio to and from all remote sites. Additionally, at WWTP 1, there are several RTUs that perform various plant functions and report back to the Master Data Concentrator RTU. The SCADA PC then gets its information from the Master Data Concentrator. There are several Allen Bradley PLCs that are in vendor provided packages throughout the plant. The PLC families include the MicroLogix, SLC500 and CompactLogix.
- **WWTP 2** – This site has several Modicon based RTUs that feed into a central RTU that collects the data and then sends it to the WWTP 1 Master Data Concentrator RTU.

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1 SCADA – Supervisory Control And Data Acquisition. The SCADA system includes a personal computer (PC), network communication channels (in this case radio telemetry) and PLCs at the remote sites.

2 Modicon produced the first PLC in the world. Modicon is now owned by Schneider Electric and is second in US market share for PLCs behind Allen Bradley. For more information see www.modicon.com

3 Modbus RTU is an open protocol developed by Modicon and then released for use by all manufacturers. It is the de facto industry standard for serial communications.

4 MDS 9810 – Microwave Data Systems model 9810 radio modem was the industry standard for serial spread spectrum unlicensed radio communications. MDS was acquired by GE. The radio/modem is still available for purchase at their online site.

- **Lift Station RTUs** – There are approximately 16 lift station sites, most of which have Modicon based RTUs. There are some Original Equipment Manufacturer (OEM) RTUs such as LS-F that have a LS-150 controller that communicates via Modbus RTU serial communications.
- **Newport Drive WTP** – This subsystem has a master RTU that communicates via high speed proprietary (MB+) network to all onsite RTUs. There is one offsite RTU that is linked via a serial wireless radio network to the Master RTU at this site. The site's data is collected and packed so it can be sent to the Master Data Concentrator at WWTP 1.
- **Willow Lakes WTP** – This subsystem has a master RTU that communicates via high speed proprietary (MB+) network to all onsite RTUs. There are two offsite RTUs that are linked via a serial wireless radio network to the Master RTU at this site. The site's data is collected and packed so it can be sent to the Master Data Concentrator at WWTP 1.

19.3 Site Visit

A site visit was performed on Friday, November 19, 2010 by Bill Cassity, PE, of Stantec. The tour was conducted by Virgil Koehne, Town of Discovery Bay Community Services District Manager. During this site visit various installations were observed to judge the state of the SCADA system assets. The sample of sites visited was representative of the various types of sites and age of installation. All sites visited were generally clean, maintained and appeared to be in good working order.

19.4 SCADA System Upgrade Alternatives

Veolia Water reviewed the existing SCADA system and presented four proposed upgrade projects in a letter to Virgil Koehne, District Manager, dated February 10, 2009. Project 3 in that letter includes proposed improvements to SCADA facilities at the remote lift stations. Further explanation of the Project 3 recommendations was provided in a memorandum from Veolia to Gregory Harris, District Engineer, dated March 2, 2009. All of the proposed projects are discussed below, followed by recommendation of an alternative course of action that encompasses all the listed projects and recommendations. Additionally, memorandums by Telstar, dated September 14, 2009 and December 23, 2010 on radio telemetry system improvements and Ethernet connectivity are discussed.

19.4.1. Veolia Project 1 - Install Redundant Alarming Capability to Master RSView32 PC

Stantec reviewed this proposal and agree that an independent alarming capability as noted by Veolia is justified and should be pursued. This project was completed in 2010 using a Mission RTU110 with an AllenBradley MicroLogix 1100 PLC.

19.4.2. Veolia Project 2 - Provide WWTP #1 to WWTP #2 Integrated Network Services

Stantec reviewed this proposal and agree that a basic 2.4 or 5.6 GHZ point to point secured Ethernet link using an industrial grade radio and directional antennas would be justified and add reliability to the overall operation of the SCADA system.

19.4.3. Veolia Project 3 - Improvements to Lift Stations A through S

Stantec reviewed the proposed upgrade of the current SCADA system from a Modicon based system to an Allen Bradley based system via a migration path that will begin with all the lift stations. The following statements from the Veolia documents referenced above are believed to indicate Veolia's main reasons for the proposed upgrade. Comments or responses are provided for each statement.

"The controllers in place are provided with some sequencing capability but it is a reactive firmware and cannot be changed readily by the users to adapt to mitigation requirements, special circumstances, and most notably through remote command."

Comment / Response: *The existing controllers, like the AB ML1100, are programmable. They can be reprogrammed as required for the site requirements. In some cases it may be necessary to add in output modules or other wiring. The software to reprogram the Modicon PLC is readily available for purchase. ProWorx32 is an example of development software for the Modicon PLCs.*

"The current communication to the facilities from the master polling radio at WWTP 1 is specifically unidirectional and only reads information from the facility and has no programmatical capability to direct the station functions."

Comment / Response: *The existing Modicon controllers can be reprogrammed along with SCADA development software to allow bidirectional controls including remote manual operation of the pumps and other equipment at each station. In some of the older stations the controllers at these stations are manufacturer's proprietary units that are not easily reconfigured or expanded. These units should be replaced when they fail or if desired functionality is required.*

"The now nearly obsolete Modicon Micro 612 PLCs are not functioning as programmable logic controllers. They are simply providing a dumb RTU capability where the field PLC receives inputs from status and alarm points and the input image is read at the plant by the Modicon Compact data accumulator PLC."

Comment / Response: *The Compact is officially at its end of life*[5]*. Obsolescence alone should not be the sole reason to replace an entire control system immediately. Modicon is in the process of finalizing a legacy migration path that will not require rewiring the panel and field wiring. This would result in a major cost savings compared to rewiring and retesting all panels with Allen Bradley PLCs. Additionally, some of the obsolete PLCs could be migrated over and their parts held as spares to extend remaining system life of the remaining obsolete PLCs. This would allow a migration to the newer platform to occur over several years or as a full capital project at one time, whichever is in the District's best financial and operational interests.*

"The PLC controller paradigm will assure a much higher degree of mitigation of abnormal conditions, an enhanced ability to respond to commands to change modes of operations such as alternation, fixed lead/lag, and manual override. Additional PLC capabilities include the ability to monitor and adapt safe operation modes upon failure or illogical operation of pilot devices such as float switches, level transducers, or other field devices or instruments. Local data capture including, but not limited to:

- *Current Level*
  - *Maximum Level*
  - *Minimum Level*
  - *Average Level*
  - *Assurance Level is within known functional parameters (signal integrity for level)*
- *Pump Daily and accumulated Life Run Hours*
- *Calculated minutes per run cycle*
- *Daily start count."*

Comment / Response: *The controller paradigm noted above may be incorporated into the current hardware without a complete rewire or replacement of the backpanels. A separate hardware float backup system is typically employed to operate the station in the event of a PLC or level transmitter failure.*

"The new master polling radio shall be responsible for the remote lift stations above and shall the proposed configuration shall use a SLC 500 processor which is natively compatible with RSView32 to provide all tag data bi-directionally between facilities. The existing tags shall simply be decoupled from the Modicon Compact and the existing radio shall have the converted station removed from the polling list."

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[5] *The following are excerpted from an email by Ho Cho of Group Schneider to William P. Cassity of Stantec, dated November 30, 2010: "The Compact has been on the official end of life product for awhile. Though customers have been happy with the longevity of Compacts, they are slowing being migrated over to our M340 platform. Although, we don't currently have an import feature from 984LL to Unity for Compact & Micro, we are planning to release Unity 6.0 in late Q4 of next year where they can import their existing 984LL program to Unity. It will look and feel like 984LL but it will be on our Unity platform. Currently, as a service offering from Schneider, we'll convert the Compact program to Unity now. Also, we came up with M340 connector specifically designed for Compact which allow the customer to keep their field wiring in place without rewiring the control panel. In addition, 4 slot M340 rack fits (bit small footprint) very nicely to an existing Micro 612."*

Comment / Response: *All necessary data paths are existing including the non-native data path to the RSView SCADA package. The proposed solution of using another manufacturer's PLC (native or non-native) will require reworking the existing graphics, tagging and proving out all screens again, verses adding to the existing screen system. This will be a very labor intensive effort that will be duplicating the existing SCADA screens in many respects. If the current SCADA screens are unworkable or deficient, this may be a reasonable request, but otherwise this will be a duplication of the labor and costs already incurred and paid for by the District under a previous capital projects.*

"The ML1100 PLC also has a Real Time Clock (RTC) capability so that actual operational hours are used within the logical programming to reduce unnecessary call out and useless overtime where no work is necessary, but a minor alarm is present, but the station is performing all duties."

Comment / Response: *While a RTC is a nice feature, it can drift from the master SCADA clock. It is not difficult to program a near real-time clock that is resynchronized to the master RTU / SCADA periodically, if this functionality is required. Additionally, the idea of stopping alarms from calling out an operator can also be performed using existing features on most autodialers or via a minor alarm disable command from a master PLC to the remote PLCs.*

"For each specific station in this specific group, electrical components and control wiring modifications to varying degrees are also proposed. Depending on the location, new magnetic starters, protective devices, interposing control components, and peripherals as required to provide a complete control system function are included as required for the individual locations. "

Comment / Response: *This approach may be incorporated into the current hardware in a more cost effective manner. The proposed AB MicroLogix 1100 is very capable and is one of the hardware platforms Stantec typically utilizes in new small scale SCADA applications. However to replace (throw out) all the existing hardware does not seem to be in the best interests of the District. Most experienced control technicians and engineers are quite capable of programming in AB, Modicon and many other platforms simultaneously. All programmers have their favorites, but most programmers can adapt as required. If needed, contract operations firms that work with District facilities could train their personnel as required to support this work or hire a third party to support the PLCs, such as Telstar or others.*

19.4.4. Veolia Project 4 – Analysis, Enhancement, and Optimization of Lift Stations

Stantec reviewed the proposed project to make software enhancements including bidirectional controls of 4 stations. This proposal seems a more cost effective approach to enhancements of the all Modicon PLC systems that exist at TDBCSD than the approach of Project 3 that would replace the Modicon with Allen Bradley PLCs.

19.4.5. Alternative to the Veolia Project 3 & 4 Proposals – Utilize the Existing Modicon Backbone with Enhancements

After reviewing the existing system and Veolia Projects 3 and 4, it is felt that the most cost effective way to achieve the recommended upgrades is to utilize the existing hardware platform and add or modify the existing programs for the features desired. This approach is similar to that suggested by Veolia in their Project 4 proposal. The Master Data Concentrator at WWTP 1 could also be moved to WWTP 2 with a new hot standby radio and a new Modicon PLC could serve as the new Master as outlined in Project 3 but utilizing an AB SLC500. This would allow moving the SCADA PC to the main operating plant and allow the old PLC to continue operating as before. The existing system could be reprogrammed to allow part time polling, with the new Master Data Concentrator at WWTP 2 having additional time to poll its remote RTUs. In this way the system could have two masters that collect data from the sites independently. This would smooth the transition as sites could be switched from the old polling master (at WWTP 1) to the new polling master (at WWTP-2). For added reliability, the old polling master could be configured as a backup master with the ability to poll the existing information in the event of a failure of the new polling master at WWTP-2.

19.4.6. Telstar Memo of September 14, 2009 - Radio Telemetry System Improvements - Survey Results and Recommendations

Stantec reviewed the memo from Telstar. The idea of repairing or recalibrating the existing radios as well as adding a repeater to the existing network appears to have merit and would increase the reliability of the overall communications system throughput. Telstar also mentioned the idea of changing the radios to an Ethernet based system. While this would allow for online programming and an overall faster channel throughput, the idea of programming online is typically not advisable for a remote site such as a lift station or WTP. Programming changes should be performed at the site and tested with an adequate test procedure. Programming over the airwaves is not always conducive to understanding the process and the program change impacts. Additionally, if a program or program change is properly vetted and tested upon installation, there should be little need for additional changes or correction. The value in making a large capital expenditure for a minor increase in data rate throughput should be revisited.

19.4.7. Telstar Memo of December 23, 2010 - WWTP Ethernet Connectivity Recommendations

Stantec reviewed the memo from Telstar concerning proposed recommendations for connecting the WWTP 2 site to the internet. The memo discussed the methods of connecting both plants (WWTP 1 & 2) as well as connecting to the Internet. The discussion of fiber optics included costs that seem very low in regards to trenching or overhead and crossing a highway. The simpler and less costly method appears to be the 4.9GHZ radio link with new poles at WWTP 1 and 2. Additionally a link could be added at Lift Station H. The Ethernet could then connect to the local ISP at that point and allow Internet connectivity over a secure licensed frequency to WWTP 2 as well. These paths should be fully vetted with a radio path study at the proposed height or higher using a boom truck or other methods to ensure adequate fade margins are available for each link. The idea of making the tower suitable for both 4.9GHZ for Ethernet and the older 902-928 MHZ spread spectrum use is a good idea and should be pursued. It is suggested the total installations costs should be revisited after the radio path study confirms this idea has validity. Another option would be to consider installing a higher monopole tower at WWTP 2 and then leasing back antenna space to communications providers. This alternative could also act as a revenue source that could offset the installation costs.

19.4.8. Executive Summary

The existing SCADA system has served the Town of Discovery Bay Community Services District for many years and should continue to do so for the foreseeable future. Many of the PLCs that are installed are officially obsolete[6] but will still be usable for many years into the future. The overall SCADA system appears to have offered superior service and reliability during this time based on the lack of problems noted by the operations staff. For the reasons stated above, there is no compelling reason to switch from a Modicon brand based system to another brand. In light of the overriding cost impact of performing the proposed conversion to another PLC manufacturer, this seems to be an excessive fiscal demand on the District that could be easily overcome by training of the appropriate support personnel on Modicon PLCs.

The following is Stantec's recommended alternative approach:

> Add a new redundant radio[7] master RTU with a Modicon Unity based Programmable Automation Controller (PAC)[8] at WWTP 2 as the new Master Data Concentrator. This will allow for a more orderly conversion and allow SCADA to be moved to WWTP 2, where most operators are based from. The programs in WWTP 1 PLC could be modified to act as a backup radio master that would poll the RTUs if the new master at WWTP 2 was down and periodically to verify the backup system's integrity. This alternative approach also has the added benefit of simpler support in that all the PLCs in the field will still be by a single manufacturer as opposed to Veolia's Project 3 and 4 approaches which would result in changing some of the field RTUs to Allen Bradley and leaving some of the field RTUs as Modicon PLCs. This would complicate service issues and require service personnel to know and understand both Allen Bradley and Modicon verses understanding only Modicon in the remote stations.

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6 *Obsolete – For industrial electronics typically means the manufacturer will no longer offer full support. There may be third party repairs or other means such as selective conversion of some RTUs and using the PLC parts to keep other older RTU systems running well into the future. This can extend system life with no real danger to system integrity.*

7 *A redundant radio is available from GE / MDS for the 9810 series. It is a warm standby radio system that will prevent a loss of a single master radio from causing a communications outage.*

8 *The Unity based Programmable Automation Controller (PAC) is the next generation of PLC. PACs have all the features of PLCs but have more features including dynamic text based tagging verses addressed based tagging for PLCs. The Unity PAC mentioned is the same approximate size as the older Compact PLCs.*

Add the features desired to update the programs at each RTU including runtimes, number of starts, average run times and associated alarms as well as adding an analog level based control to RTUs that do not have them. The addition of remote PLC control at some of the older lift stations may require additional output cards and may or not be feasible with the older PLCs. This should be discussed further as to whether the remote control is necessary or beneficial at this point or is a " nice to have" feature. These features could then be ported over into the new Modicon Unity PACs as conversions are made. The SCADA software will also have to be updated for display and control enhancements. This item is similar to Veolia Proposed Projects 3 and 4, except it covers all RTUs and does not require any hardware updates or changing PLC manufacturers. This should result in a material savings of $38,548.21.[9] The cost of the software should be approximately the same as that of the Veolia project costs.

Add a separate backup float / alarm system with appropriate intrinsic barriers to allow the lift stations to continue operations in auto if the level transmitter or PLC became inoperable.

Start a SCADA Replacement Design Project that will investigate the replacement of the obsolete 612 PLCs with a legacy migration plan to replace the PLCs in an orderly fashion starting at the most critical PLCs to the least critical. This will allow the District to schedule a multi-year capital plan, or if funds become available, accelerate the upgrade of more sites, as desired.

The cost of these modifications listed in this alternative would also have to be done in the Veolia proposals except this proposal will not require the same level of additional hardware and wiring costs as well as longer station downtimes. It is expected the cost of this alternative project (items 1-4) would be around $350,000 as compared to $500,000 if this work was performed as described in the Veolia Proposed Project methodologies. This cost is based on extrapolating out the costs of Veolia Projects 1 through 4 to cover all lift stations instead of the 15 of the 34 specifically mentioned in their proposal. This number would have to be verified when a final scope of services was identified in a manner the project could be responded to by several competing firms.

9 *Materials savings stated is based on the Telstar / Veolia Project 3 estimate.*

Section 20

Summary of Recommended Improvements

In the previous sections of this report, various portions of the Town of Discovery Bay wastewater facilities are evaluated and specific recommendations for improvements are made. In this section, the recommended improvements and costs are summarized and information is given as to when the improvements should be made and/or what conditions would trigger the need for the improvements.

Before presenting the recommended improvements, however, it is important to review the flow and load basis of the evaluations and recommendations.

20.1 Flow and Load Basis of Evaluations and Recommendations

All facilities for the treatment of wastewater must be designed based on a specific set of wastewater flows and loads. The flows and loads that are the basis of all analyses and recommendations of this Master Plan are developed in Section 5. Generally, for a Master Plan or wastewater treatment plant design, multiple years of data are analyzed in order to establish a clear understanding of average flows and loads and the degree of variability in flows and loads that can be expected throughout the year and over multiple years, with extremes in seasonal conditions. The sizes, capacities, and costs of wastewater facilities are determined mostly based on peak flows and loads, while the average cost of operation is based mostly on average flows and loads.

For this Master Plan, multiple years of wastewater flow data were evaluated. However, reliable long-term influent wastewater strength data (i.e., BOD and TSS concentrations) were not available due to sampling problems. As a result, the wastewater strength upon which this Master Plan is based was determined from two intensive two-week monitoring programs, the results of which were substantially different from each other, combined with consideration of typical per capita BOD contributions and the population of the District. Peak BOD loads to the plant are estimated based on typical peaking factors from other areas. For a more complete discussion of this topic, the reader is referred to Section 5 and the technical memorandums referenced in that section and included herewith as Appendices A and C.

While it is believed that the wastewater strength criteria adopted for use in this Master Plan are reasonably conservative and appropriate, uncertainties remain. Continuing efforts should be made to build a long-term reliable database of plant influent characteristics. As the database is developed over time, the recommendations of this Master Plan can be reviewed.

20.2 Recommended Improvements

A list of all the recommended improvements developed in this Master Plan is presented in Table 20-1. For each improvement, a reference is given to the Master Plan section where that improvement is discussed in more detail, a budgetary cost is given, and the timing or condition that would trigger the need for the improvement is indicated. Costs are indicated in five separate columns to distinguish those improvements that should be undertaken immediately, those that are critical and should be completed as soon as possible, those that are certain or likely to be required (but not immediate or critical), those that are reasonably possible, and those that are unlikely to be required.

20.3 Plant Layout

A proposed site plan with all recommended future improvements shown is presented in Figure 20-1. Note that all possible improvements developed in the Master Plan are shown, even those unlikely to be constructed (such as reverse osmosis facilities).

Table 20-1
Recommended Improvements

Item	Description	Rept. Sect.	Reason for Improvement	Trigger for Implementation	Possible Timing (a)			Budgetary Cost, $ (b)				
					Begin Design	Begin Const.	Begin Operation	Immediate Improvements	Critical Improvements	Other Certain or Likely Improvements	Reasonably Possible or Optional Improvements	Unlikely Improvements
1	Influent Pump Station Modifications, Upgrade	9	Mitigate Ragging, Increase Capacity, Change Flow Splitting	Desired for Improved Reliability. Needed with Plant Expansion	2012	2013	2014		1,044,000			
2	Re-Activate Pump Station W	9	Backup to Influent Pump Station and Use for Emergency Storage	Desired to Facilitate Influent PS Mod's. Needed if Emergency Storage is to be Provided.	2012	2012	2012	378,000				
3	Emergency Storage Facilities	16	Facilitate Possible Emergency Full or Partial Plant Shutdown	Desired for Overall Reliability. Provide When Funds Available.	TBD	TBD	TBD	243,000				
4	Splitter Box, Oxidation Ditch, Clarifier, and RAS Pumps at Plant 2 and Standby Aerators for Existing Oxidation Ditches	11	Facilitate Taking an Oxidation Ditch Out of Service and Plant Expansion	Splitter Box, Oxidation Ditch, and Standby Aerators Needed Now for Reliability. Clarifier and RAS Pumps Needed Before Average Annual Flow Exceeds 2.0 Mgal/d.	2012	2013	2014		6,050,000			
5	Secondary Effluent Pump Station Modifications	12	Increase Pumping Head to Filters	Needed with Effluent Filters	TBD	TBD	TBD				250,000	
6	Secondary Effluent Equalization (c)	13	Limit Peak Flows to Filters, UV and Export Pump Station	When Peak Flows to UV Cannot be Trimmed to Sludge Lagoons or When Filters Required	TBD	TBD	TBD			680,000		
7	Effluent Filtration (c)	13	UV Performance or More Strigent Requirements or Reclamation	Upon Determination of Need	TBD	TBD	TBD				4,614,000	
8	Revise UV Disinfection Weirs	14	Flow Split to UV Channels	Desired Now	2011	2012	2012	10,000				
9	Conduct UV Disinfection Viral Bioassay Tests	14	Verify Existing Capacity	Desired Now	2011	2012	2012	50,000				
10	Upgrade UV Disinfection	14	Plant Expansion or More Stringent Total Coliform Limits	When Peak Day Flow Exceeds Peak Flow Capacity of UV Disinfection System (d)	TBD	TBD	TBD			1,200,000		
11	Reverse Osmosis Facilities	15	Reduce Effluent Salinity, Last Resort	If Required by Regulation - Very Unlikely	TBD	TBD	TBD					15,700,000
12	Add Pump to Export Pump Station	7	Plant Expansion	When Peak Day Flow Exceeds 4.0 Mgal/d (e)	TBD	TBD	TBD			100,000		
13	Solids Improvements, Phase 1: One New Solar Dryers and 2 Belt Presses	18	Correct Current Capacity Deficiency	Needed Now to Process Stored Sludge and Prevent Further Storage	2011	2012	2012	4,651,000				
14	Solids Improvements, Phase 2: One New Solar Dryer	18	Plant Expansion	To Be Determined Based on Operational Experience with Phase 1 Solids Improvements	TBD	TBD	TBD			2,034,000		
15	Collection System Pump Station Improvements	4	Needed for Reliable Performance	When Funds Available	Various (f)	Various (f)	Various (f)		100,000	550,000		
16	SCADA Improvements	19	Improved Monitoring and Control	When Funds Available	Various (f)	Various (f)	Various (f)		100,000	250,000		
	Total							5,332,000	7,294,000	4,814,000	4,864,000	15,700,000

(a) Approximate timing recommendations, where applicable. TBD = To Be Determined.
(b) Total capital cost, including construction, contingencies, engineering, administration and environmental documentation, as applicable. First quarter 2011 cost level. ENR 20-Cities CCI = 9,000.
(c) Total cost of $5,294,000 for equalization and filtration broken down to $680,000 for flow equalization and $4,614,000 for filters. Filter cost includes coagulation and flocculation.
(d) Peak flow capacity of UV disinfection system to be verified by viral bioassay testing. Capacity estimated at 3.4 to 4.1 Mgal/d. Existing peak day flow is 3.6 Mgal/d.
(e) Subject to confirmation of reliable capacity of Export Pump Station and possible increased capacity with pump over-speeding.
(f) Project can be phased over multiple years, based on priorities and available funding, to be determined by the District.

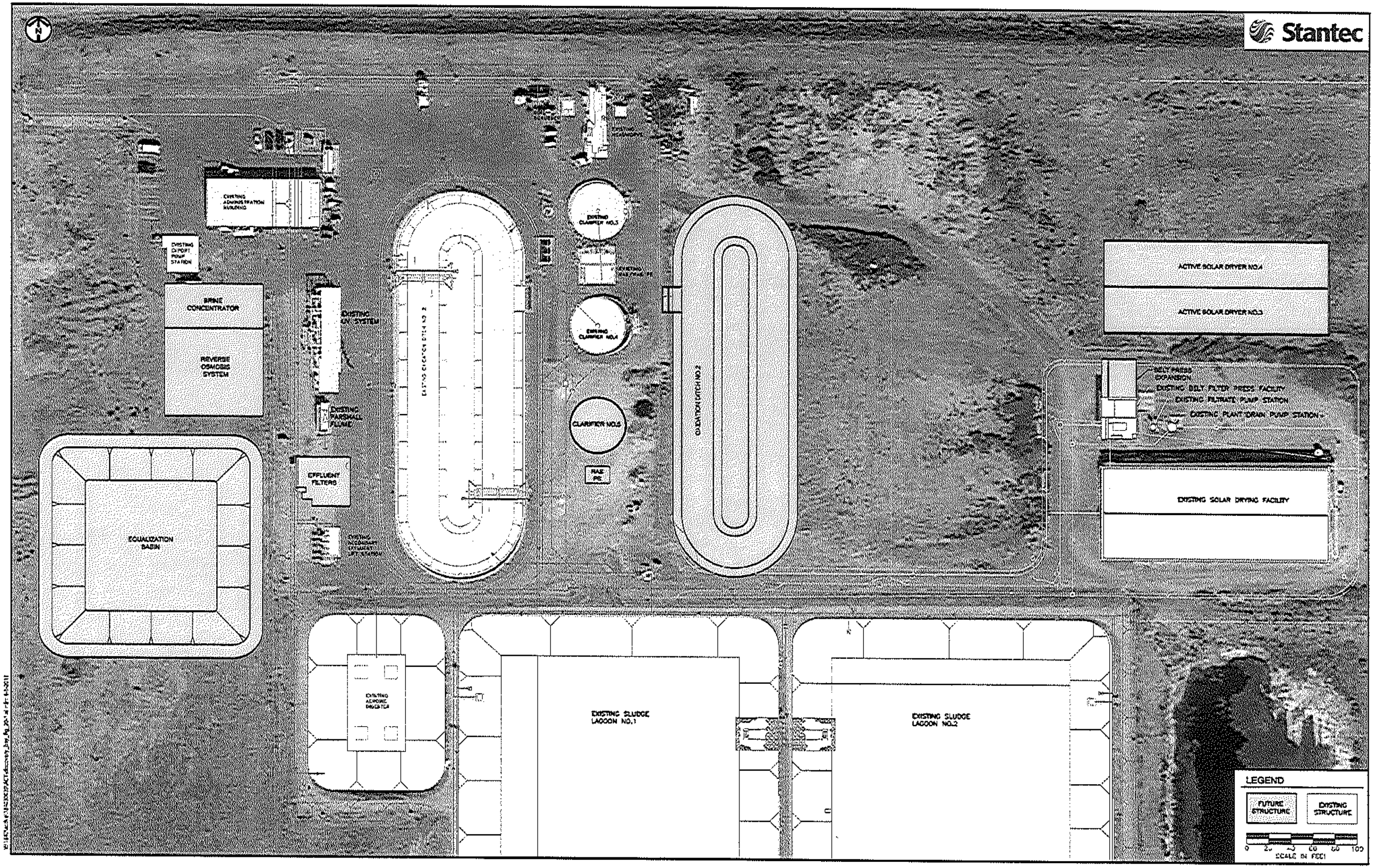


Figure 20-1
Site Plan Plant 2

Appendix A

Technical Memorandum No. 1 – Design Flows and Loads
June 2008

Appendix A

Town of Discovery Bay Community Services District Technical Memorandum No. 1

Design Flows and Loads

Prepared By: Jeffrey R. Hauser, P.E.

Reviewed By: Gregory Harris, P.E.

Date: June 24, 2008

1.1 Purpose

The purpose of this technical memorandum (TM) is to analyze historical data and develop design flows and loads for expansion of the Town of Discovery Bay Community Services District (TDBCSD) Wastewater Treatment Plant. The remainder of this TM is organized into the following major sections:

- Analysis of Historical Flows
- Analysis of Historical Constituent Concentrations and Loads
- Intensive Monitoring Data and Analysis
- Existing Wastewater Characteristics to be Used for Design
- Estimate of Future Users Flows and Loads
- Summary of Existing and Future Flows and Loads

1.2 Analysis of Historical Flows

Historical daily influent and effluent flows recorded for the period from January 2004 through July 2007 are presented in Figure 1-1. From the figure, it is clear that influent and effluent flow recordings are frequently in disagreement. Influent flows are determined by summing the flows from several meters and are believed to be suspect. Effluent flows are from a single meter that has been calibrated from time to time and are believed to be much more accurate. Therefore, effluent flows are used in this TM to estimate influent flows. Generally, the two should be about the same; however, effluent flows can be slightly lower than influent flows when sludge is wasted to the lagoons (this is relatively insignificant) and substantially higher than influent flows when the sludge lagoons are decanted back to the plant. The trendline shown in Figure 1-1 for effluent flows is believed to provide a good representation of average annual influent flows. As indicated, the average annual flow has increased by about 20% over the period shown.

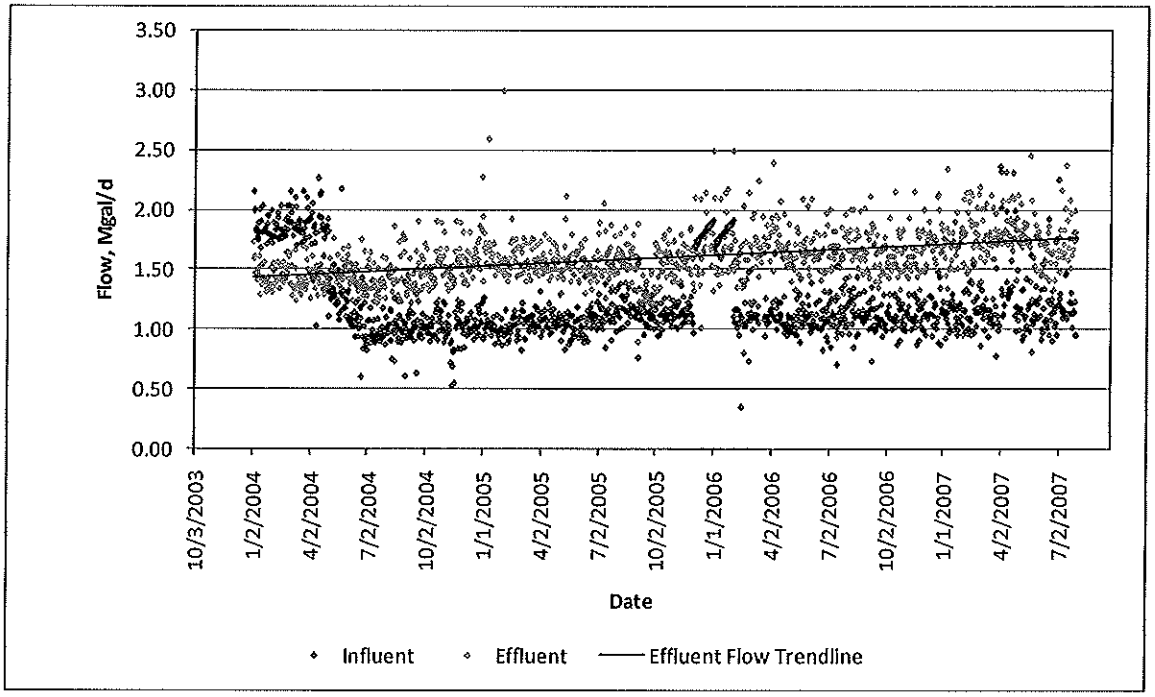


Figure 1-1 Recorded Historical Influent and Effluent Flows

For wastewater treatment plant design, it is important to determine peak flows as compared to average annual flows. In Figure 1-2, the daily effluent flow and the 30-day rolling average of daily effluent flows are shown as ratios to the corresponding average annual flow. From the data shown in Figure 1-2, the following peaking factors are believed to be appropriate:

- Average Day Maximum Monthly Flow (ADMMF) / Average Annual Flow (AAF) = 1.1

- Peak Day Flow (PDF) / Average Annual Flow (AAF) = 2.0

It is also important to determine maximum hourly flows, such as would occur during a peak storm event. Since actual plant data for such peak flow events are not available, it is estimated that the peak flow occurring on the peak day would be 1.5 times the average flow on that day. Since the average flow on the peak day is 2.0 times the AAF, the peak hour peaking factor is estimated as follows:

- Peak Hour Flow (PHF) / Average Annual Flow (AAF) = 3.0

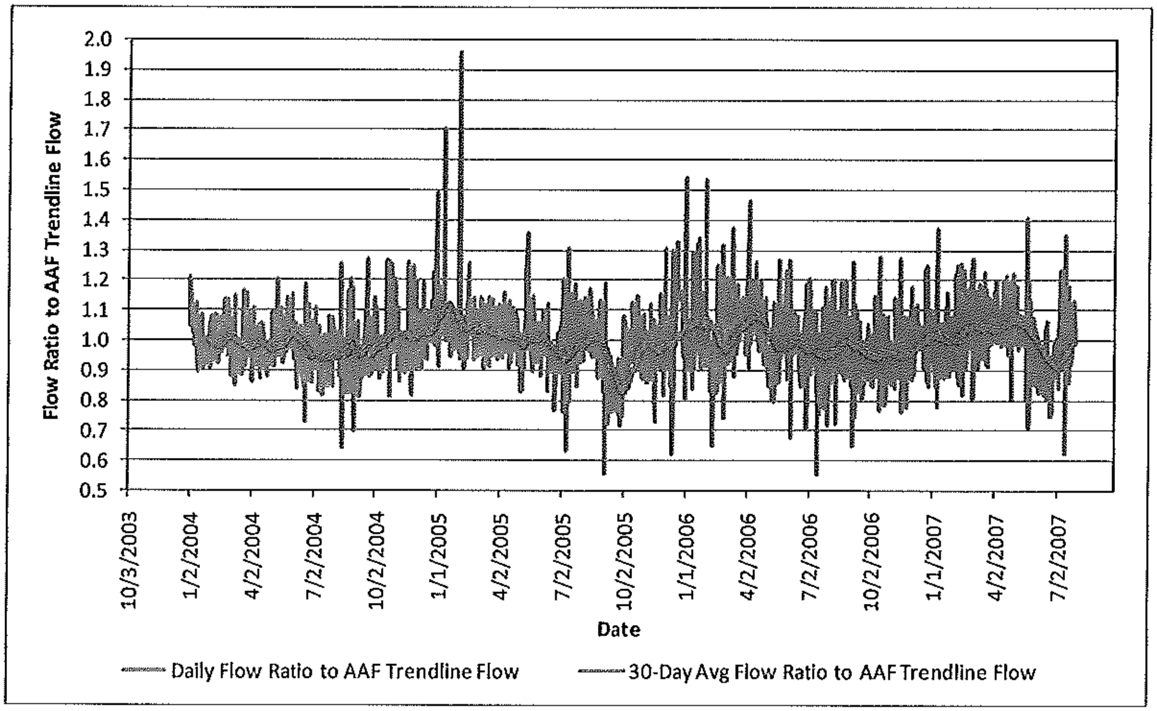


Figure 1-2 Daily and 30-Day Average Flow Ratios to AAF Trendline Flow

1.3 ANALYSIS OF HISTORICAL CONSTITUENT CONCENTRATIONS AND LOADS

Influent samples are taken once per week and analyzed for biochemical oxygen demand (BOD_5 or simply BOD) and total suspended solids (TSS). Recorded influent BOD and TSS concentrations are shown in Figures 1-3 and 1-4, respectively. In Figure 1-5, the TSS/BOD ratios for all sampling events are shown. There are various problems associated with the data shown in these figures as noted below:

1. Influent BODs have exhibited several patterns that individually or together are unlikely:

    a. Early in 2004, extremely high and unrealistic values were recorded.
    b. From mid-2004 through the end of 2005 the data were highly variable.
    c. Throughout 2006, the data were fairly stable and low.
    d. For 2007, intermediate values and variability are indicated.

2. Influent TSS have exhibited several patterns that individually or together are unlikely:

    a. Early in 2004, extremely high and unrealistic values were recorded.
    b. From mid-2004 through the mid-2005, relatively low values with moderate variability were recorded.
    c. Unusually high values were seen late in 2004 and in 2007.
    d. Relatively low and stable values were seen in 2006.

3. The ratio of influent TSS to BOD for municipal wastewater would generally be expected to be near 1.0. In contrast, the actual data show unrealistic patterns with extended periods substantially above 1.0 and extended periods substantially below 1.0.

Considering the unrealistic patterns described above, the plant influent BOD and TSS data are believed to be unreliable. It is believed that erroneous data have resulted at least partly from the fact that the sampler intake was generally not in a well mixed location that would allow representative sampling. Because of these problems, typical influent characteristic concentrations will have to be estimated based on limited intensive monitoring, as discussed in the following section. Variability in influent characteristics will have to be estimated based on typical values for other municipal wastewater treatment plants.

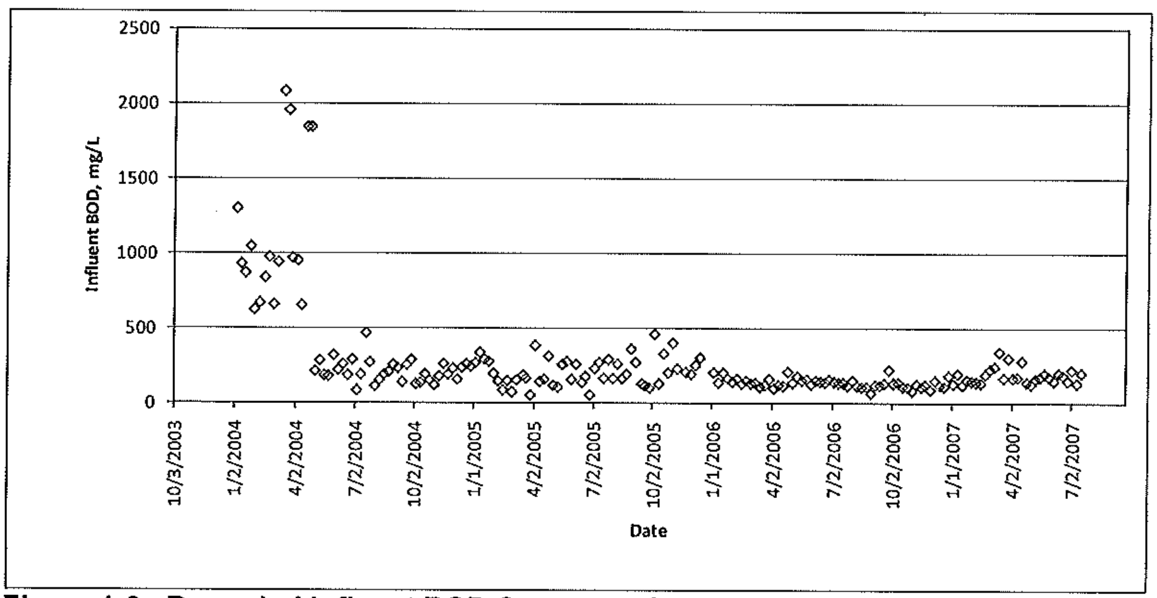


Figure 1-3 Recorded Influent BOD Concentrations

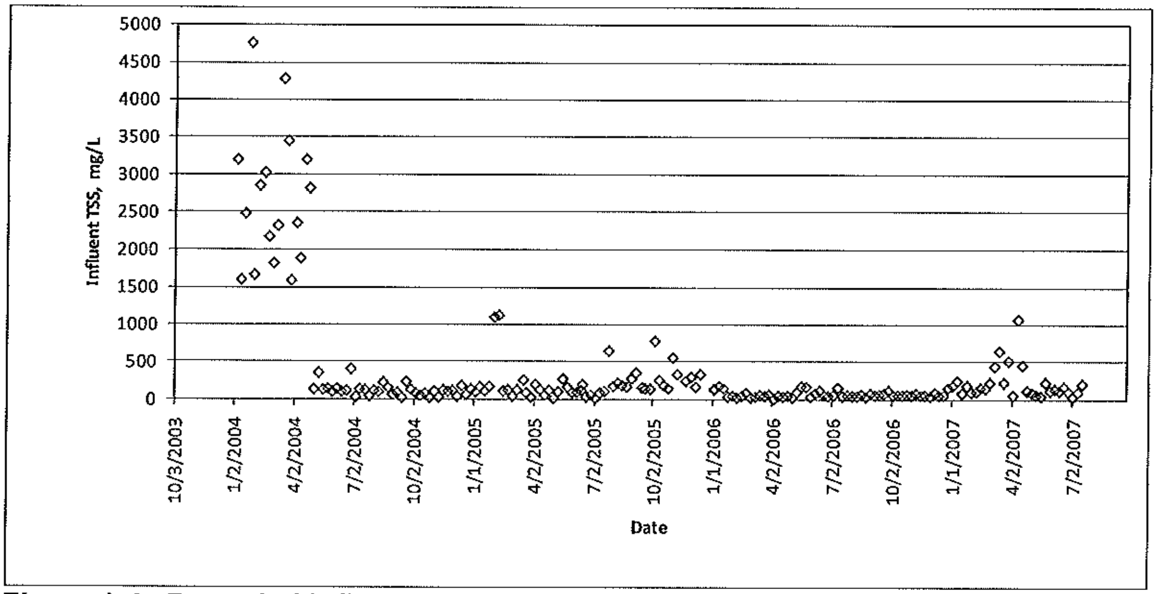


Figure 1-4 Recorded Influent TSS Concentrations

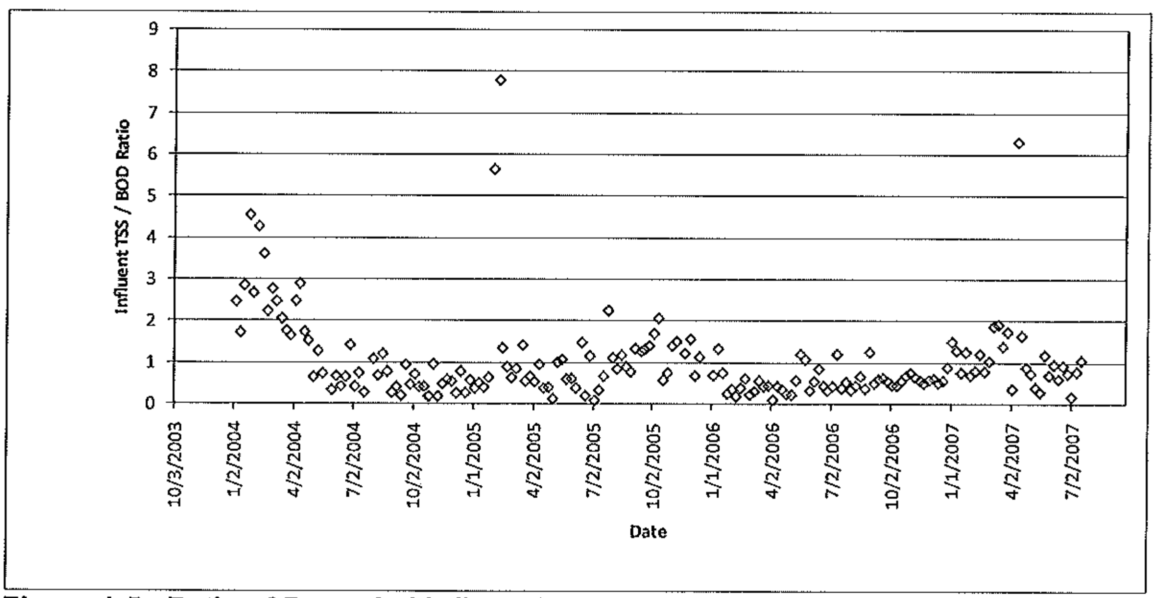


Figure 1-5 Ratio of Recorded Influent TSS / BOD

1.4 INTENSIVE MONITORING DATA AND ANALYSIS

To allow an assessment of key influent wastewater characteristics, a two-week intensive monitoring campaign was conducted in December 2007 to support preparation of this TM. For this campaign, the influent sample location was relocated from a poorly mixed channel to the well-mixed zone after the hydraulic jump of the influent Parshall flume. Daily influent and effluent composite samples were taken and analyzed for a range of analytes. The analytes are listed and the monitoring results are indicated for influent and effluent samples in Tables 1-1 and 1-2, respectively. Influent characteristics calculated from the influent and effluent data are shown in Table 1-3. Additional samples were taken of mixed liquor, sludge dewatering return flows and sludge lagoon supernatant, resulting in the data shown in Table 1-4. A key to the symbols used in Tables 1-1 through 1-4 and in this discussion is given in Table 1-5. Key results related to influent characteristics are discussed in the following paragraphs. The data given in Table 1-4 regarding the mixed liquor and return flows, were collected for consideration in process design. No specific evaluations are presented herein.

As shown in Tables 1-1 through 1-3, some of the data are highlighted because they are either outliers or unlikely values and average results are given both including and excluding these values. Reasons for highlighting are briefly discussed below:

1. In Table 1-1 (Influent Data), results are highlighted when they are substantially different from the other results in the series. These outliers were determined as data values more than two standard deviations from the mean.
2. In Table 1-2 (Effluent Data), ND results for COD, ffCOD, mfCOD, and BOD are highlighted because such values are unlikely. Wastewater treatment plant effluent would be expected to include detectable amounts of these constituents.
3. In Table 1-2 (Effluent Data), the high values for COD, BOD, mfBOD and mfTKN recorded on December 14, 2007 are highlighted because they are substantially higher than other data in the same series.
4. In Table 1-3 (Calculated Influent Characteristics), the following are explanations for highlighting:

    a. The TSS/BOD ratio would be expected to be near 1.0 (+/- about 0.2 or so). Unusually high values are believed to be erroneous.
    b. The COD/BOD ratio would be expected to be near 2.0 (+/- about 0.3 or so). Values substantially outside of this range are highlighted.
    c. For each of the following parameters, one unusually high or low value, as compared to other values in the series, is highlighted: gfCOD/COD, mfCOD/COD, ffCOD/COD, gfBOD/BOD, TKN/COD, TKN/BOD, N_{us}, PCOD/COD, F_{cv}, F_{bs}, F_{na}, and F_{nus}.

d. X_{sc} and Coll. COD/COD values are highlighted when zero or negative. Zero values are highly unlikely and negative values are impossible. Such values result from variable or erroneous influent or effluent data that were used to calculate these parameters.

From the data given in Tables 1-1 and 1-3, the following key observations can be made about the influent wastewater characteristics:

1. With an average BOD, excluding highlighted values, of 238 mg/L, the wastewater would generally be considered a medium strength municipal wastewater.

2. The average TSS/BOD ratio, excluding highlighted values, of 1.32 is substantially higher than expected for typical municipal wastewater (about 1.0). The reason for these high values is not known. When the TSS/BOD ratio is high, the possibility of higher than normal sludge yields (pounds sludge solids per pound of BOD removed) is indicated. This will have to be considered during process design. Data from future sampling events should be used to provide a further check of this ratio.

3. The average TKN/BOD ratio, excluding highlighted values, of 0.13 is low as compared to typical municipal wastewater. A value closer to 0.2 would be expected. A low TKN/BOD ratio means that denitrification can be accomplished more easily and reliably than with a higher ratio. Given the relatively short duration of the intensive monitoring effort, it would be prudent to use a value higher than 0.13 for plant design. A value of 0.17 is suggested for preliminary design. Data from future sampling events should be used to provide a further check of this ratio.

4. The average COD/BOD ratio, excluding highlighted values, of 1.94 is within the range of typically expected values. However, the data were highly variable with ratio values both substantially below and above expected values. Therefore, these results are uncertain. COD/BOD ratios substantially different than 2.0, if consistent, would have implications regarding sludge yields and/or possible toxic or inhibitory substances in the wastewater.

5. The average ratio of particulate COD to VSS (ratio indicated as F_{cv}), excluding highlighted values, of 0.82 is very low compared to a typical value (BioWin default) of 1.6. This is considered to be unlikely and there is no apparent explanation.

6. The average ratio of readily biodegradable COD (RBCOD) to total COD (ratio indicated as F_{bs}), excluding highlighted values, of 0.29 is substantially higher than would be expected (BioWin default = 0.16). A high value of this ratio would improve the performance of denitrification in anoxic basins upstream from aeration basins. Given the relatively short duration of the intensive monitoring effort, it would be prudent to consider the impact of a value lower than 0.29 for plant design.

Table 1-1 Influent Data from Intensive Monitoring Effort

Date	Effluent Flow, Mgal/d	TSS, mg/L	VSS, mg/L	COD, mg/L	gfCOD, mg/L	ffCOD, mg/L	mfCOD, mg/L	BOD, mg/L	BOD Load, lb/d	gfBOD, mg/L	TKN, mg/L	gfTKN, mg/L	NH3-N, mg/L	NO3-N, mg/L	TP, mg/L	gfTP, mg/L	Alkalinity (CaCO3), mg/L	pH	TDS, mg/L
Thursday, December 06, 2007	1.66	236	203	470	115	108	103	180	2492	33	30	30	28	ND	5.3	3.3	455	7.76	1580
Friday, December 07, 2007	1.71	372	244	230	89	77	77	240	3423	64	26	23	21	ND	5.4	3.1	437	7.59	1450
Saturday, December 08, 2007	2.00	286	251	290	110	120	110	210	3503	82	28	25	21	ND	3.4	0.37	475	7.26	1370
Sunday, December 09, 2007	1.51	548	362	630	200	130	230	370	4660	120	28	28	28	ND	6.5	3.9	469	7.05	1210
Monday, December 10, 2007	1.61	514	367	570	230	220	240	560	7519	190	29	23	22	ND	6.3	4.4	459	7.18	1150
Tuesday, December 11, 2007	1.44	340	333	570	190	170	190	230	2762	84	24	23	23	ND	5.2	3.7	454	7.66	1400
Wednesday, December 12, 2007	1.52	398	367	260	190	190	170	260	3296	75	25	24	21	ND	5.2	3.8	462	7.63	1280
Thursday, December 13, 2007	1.64	528	476	360	160	180	150	230	3146	72	26	24	21	ND	6.3	3.2	447	7.53	1380
Friday, December 14, 2007	1.67	725	516	590	150	150	140	210	2925	78	33	24	21	ND	4.9	3.2	452	7.72	1290
Saturday, December 15, 2007	1.61	386	264	430	140	140	130	240	3223	61	35	28	22	ND	5.2	3.1	457	7.55	1410
Sunday, December 16, 2007	1.61	112	100	250	110	130	130	140	1880	42	41	35	31	ND	5.2	4.0	464	7.75	1540
Monday, December 17, 2007	1.72	402	390	530	250	160	230	310	4447	150	39	27	21	ND	6.6	3.9	450	7.36	1150
Tuesday, December 18, 2007	1.64	317	302	380	160	94	150	240	3283	83	35	23	22	ND	3.9	3.2	458	7.41	1340
Wednesday, December 19, 2007	1.66	204	185	290	150	90	140	9.9	137	7.6	30	23	20	ND	5.1	3.9	445	7.61	1190
Average	1.643	382	311	418	160	140	156	245	3335	82	31	26	23	ND	5.3	3.4	456	7.5	1339
Standard Deviation	0.124	153	109	137	46	40	48	117	1562	44.9	5.1	3.4	3.3		0.9	0.9	9.5	0.21	130
Average Excluding Marked Outliers (a)	1.615	356	311	418	160	134	156	238	3253	73	30	25	22	ND	5.5	3.6	456	7.54	1339

(a) Outliers determined as values greater than 2.0 standard deviations from the mean are highlighted with pink color.

Table 1-2 Effluent Data from Intensive Monitoring Effort

Date	TSS, mg/L	COD, mg/L	ffCOD, mg/L	mfCOD, mg/L	BOD, mg/L	mfBOD, mg/L	mfTKN, mg/L	NH3-N, mg/L	NO3-N, mg/L	NO2-N, mg/L	TP, mg/L	Alkalinity (CaCO3), mg/L	pH	TDS, mg/L	UV Transmit-tance (Measure in-line 1/day)
Thursday, December 06, 2007	5.67	22	ND	ND	ND	ND	1.2	ND	20	ND	3.8	271	7.9	1200	73%
Friday, December 07, 2007	7.0	26	ND	ND	ND	ND	1.4	0.24	20	ND	3.5	266	8.03	1190	71%
Saturday, December 08, 2007	7.0	ND	ND	ND	ND	ND	1.1	ND	20	ND	3.6	268	7.89	1200	72%
Sunday, December 09, 2007	6.0	ND	ND	ND	ND	ND	1.2	ND	20	ND	3.6	268	7.92	1200	74%
Monday, December 10, 2007	30.7	52	28	19	ND	ND	1.2	0.29	19	ND	3.2	273	7.8	1190	72%
Tuesday, December 11, 2007	9.67	57	ND	14	ND	ND	1.2	ND	18	ND	2.8	272	8.0	1220	72%
Wednesday, December 12, 2007	8.67	56	37	28	ND	ND	1.1	0.26	19	ND	3.5	274	8.26	1200	72%
Thursday, December 13, 2007	6.67	24	25	18	ND	ND	1.1	ND	19	ND	3.0	266	8.04	1200	72%
Friday, December 14, 2007	36.0	150	60	42	78	24	3.4	ND	19	ND	3.2	274	8.06	1220	74%
Saturday, December 15, 2007	8.0	26	15	13	5.2	ND	1.5	ND	19	ND	3.2	271	8.07	1160	72%
Sunday, December 16, 2007	14.0	42	35	18	5.6	ND	1.6	0.41	18	ND	3.0	273	8.1	1200	70%
Monday, December 17, 2007	10.0	42	19	25	5.5	ND	ND	ND	17	ND	3.1	269	8.09	1210	72%
Tuesday, December 18, 2007	12.7	21	19	24	5.5	ND	1.1	ND	16	ND	2.8	276	7.85	1170	72%
Wednesday, December 19, 2007	7.67	21	19	22	4.7	ND	0.98	ND	16	ND	3.1	267	8.17	1170	72%
Average (b)	12.1	38.5	18.4	15.9	7.5	1.7	1.3	0.1	18.6	0.0	3.2	271	8.0	1195	72%
Average Excluding Highlighted Values (a)	12.1	35.4	28.6	22.3	5.3	ND	1.3	0.1	18.6	0.0	3.2	271	8.0	1195	72%

(a) Values considered to be unlikely and outlier values are highlighted in pink.
(b) ND values assumed to be zero when calculating a numerical average.

Table 1-3
Influent Characteristics Calculated from Influent and Effluent Data from Intensive Monitoring Effort

Date	VSS/ TSS	Xiss, mg/L	TSS/ BOD	COD/ BOD	gfCOD/ COD	ffCOD/ COD	mfCOD/ COD	gfBOD/ BOD	TKN/ COD	TKN/ BOD	gfTKN/ TKN	Nus= Eff mfTKN -Eff NH3-N -0.4, mg/L	Coll. COD= Xsc= gfCOD -ffCOD, mg/L	Coll. COD/ COD	PCOD= COD -gfCOD, mg/L	PCOD/ COD	Fcv= PCOD/ VSS	RBCOD= Inf ffCOD- Eff ffCOD, mg/L	Fbs= RBCOD/ COD	Fus= Eff ffCOD/ Inf COD	Fna= NH3-N/ TKN	Fnus= Nus/ TKN
Thursday, December 06, 2007	0.86	33	1.31	2.61	0.24	0.23	0.22	0.18	0.06	0.17	1.00	0.80	7	0.01	355	0.76	1.75	108	0.23	0.00	0.93	0.03
Friday, December 07, 2007	0.66	128	1.55	0.96	0.39	0.33	0.33	0.27	0.11	0.11	0.88	0.76	12	0.05	141	0.61	0.58	77	0.33	0.00	0.81	0.03
Saturday, December 08, 2007	0.88	35	1.36	1.38	0.38	0.41	0.38	0.39	0.10	0.13	0.89	0.70	-10	-0.03	180	0.62	0.72	120	0.41	0.00	0.75	0.03
Sunday, December 09, 2007	0.66	186	1.48	1.70	0.32	0.21	0.37	0.32	0.04	0.08	1.00	0.80	70	0.11	430	0.68	1.19	130	0.21	0.00	1.00	0.03
Monday, December 10, 2007	0.71	147	0.92	1.02	0.40	0.39	0.42	0.34	0.05	0.05	0.79	0.51	10	0.02	340	0.60	0.93	192	0.34	0.05	0.76	0.02
Tuesday, December 11, 2007	0.98	7	1.48	2.48	0.33	0.30	0.33	0.37	0.04	0.10	0.96	0.80	20	0.04	380	0.67	1.14	170	0.30	0.00	0.96	0.03
Wednesday, December 12, 2007	0.92	31	1.53	1.00	0.73	0.73	0.65	0.29	0.10	0.10	0.96	0.44	0	0.00	70	0.27	0.19	153	0.59	0.14	0.84	0.02
Thursday, December 13, 2007	0.90	52	2.30	1.57	0.44	0.50	0.42	0.31	0.07	0.11	0.92	0.70	-20	-0.06	200	0.56	0.42	155	0.43	0.07	0.81	0.03
Friday, December 14, 2007	0.71	209	3.45	2.81	0.25	0.25	0.24	0.37	0.06	0.16	0.73	3.00	0	0.00	440	0.75	0.85	90	0.15	0.10	0.64	0.09
Saturday, December 15, 2007	0.72	102	1.53	1.79	0.33	0.33	0.30	0.25	0.08	0.15	0.80	1.10	0	0.00	290	0.67	1.10	125	0.29	0.03	0.63	0.03
Sunday, December 16, 2007	0.89	12	0.80	1.79	0.44	0.52	0.52	0.30	0.16	0.29	0.85	0.79	-20	-0.08	140	0.56	1.40	95	0.38	0.14	0.76	0.02
Monday, December 17, 2007	0.97	12	1.30	1.71	0.47	0.30	0.43	0.48	0.07	0.13	0.69		90	0.17	280	0.53	0.72	141	0.27	0.04	0.54	0.00
Tuesday, December 18, 2007	0.95	15	1.32	1.58	0.42	0.25	0.39	0.35	0.09	0.15	0.66	0.70	66	0.17	220	0.58	0.73	75	0.20	0.05	0.63	0.02
Wednesday, December 19, 2007	0.91	19	20.61	29.29	0.52	0.31	0.48	0.77	0.10	3.03	0.77	0.58	60	0.21	140	0.48	0.76	71	0.24	0.07	0.67	0.02
Average	0.84	71	2.92	3.69	0.41	0.36	0.39	0.36	0.08	0.34	0.85	0.90	20.4	0.04	258	0.59	0.89	122	0.31	0.05	0.77	0.03
Average Excluding Highlighted Values (a)	0.84	71	1.32	1.94	0.38	0.33	0.37	0.33	0.08	0.13	0.85	0.72	41.9	0.10	258	0.62	0.82	122	0.29	0.05	0.75	0.02
Typical for Municipal Wastewater (b)	0.76		1.1	2.26					0.09	0.21											0.625	
BioWin Default (c)	0.81		0.98	2.03					0.08	0.16				0.16		0.49	1.60		0.16	0.05	0.66	0.02

(a) Values considered to be unlikely and outlier values are highlighted in pink.
(b) Based on data for medium strength domestic wastewater as listed in Table 3-15 of "Wastewater Engineering" by Metcalf and Eddy (Fourth Edition).
(c) BioWin default based on "COD Influent" values taken from BioWin 3 process simulation software by Envirosim Associates.

Table 1-4
Mixed Liquor and Return Flow Data from Intensive Monitoring Effort

Date	Time of Day	TSS, mg/L	VSS, mg/L	COD, mg/L	BOD, mg/L	gfCOD, mg/L	gfTKN, mg/L	NH3-N, mg/L	NO3-N, mg/L	gfTP, mg/L	Alkalinity (CaCO3), mg/L	pH	TDS, mg/L
Mixed Liquor													
Monday, December 10, 2007		1060	853	950			4.5			7.6			
Thursday, December 13, 2007		960	878	960			3.7			6.5			
Monday, December 17, 2007		1180	980	940			10			9.9			
Thursday, December 20, 2007		1090	1050	970			7.2			9.5			
Average		1073	940	955			6.4			8.4			
Belt Press Filtrate with Washwater													
Monday, December 10, 2007		20	17.7	ND	14	ND	2.5	0.74	21	4.1	253	7.77	1030
Thursday, December 13, 2007		88	73	39	12	11	1.9	0.31	19	5.3	210	7.95	1070
Monday, December 17, 2007		22	20	64	17	30	4.3	2.2	16	5.1	264	7.84	1100
Thursday, December 20, 2007		64	54	41	20	32	2.1	ND	32	6.4	207	8.04	1120
Average		49	41	48	16	24	2.7	1.08	22	5.2	234	7.90	1080
Lagoon Decant													
Thursday, December 20, 2007	10:00 AM	43.3	32	94	54	49	6.4	4.4	5.2	5.1	397	8.34	1240
Thursday, December 20, 2007	12:30 AM	46.1	32.5	83	43	27	7.8	5.2	3.5	6.5	427	8.19	1520
Average		44.7	32.3	89	49	38	7.1	4.8	4.4	5.8	412	8.27	1380

Table 1-5
Key to Wastewater Characteristic Symbols

BOD	=	Biochemical oxygen demand (5-day)
COD	=	Chemical oxygen demand (total), mg/L
F_{bs}	=	Fraction of total COD that is readily biodegradable (soluble and biodegradable)
F_{cv}	=	Ratio of particulate COD divided by VSS
F_{na}		Fraction of TKN that is ammonia-N
F_{nus}		Fraction of TKN that is soluble and unbiodegradable
F_{us}	=	Fraction of total COD that is soluble and unbiodegradable
ffCOD	=	COD after flocculation and membrane filtration (colloids removed), mg/L
gfBOD	=	BOD of glass fiber filter (1.2 µ) filtrate, mg/L
gfCOD	=	COD of glass fiber filter (1.2 µ) filtrate, mg/L
gfTKN	=	TKN of glass fiber filter (1.2 µ) filtrate, mg/L
mfBOD	=	BOD of membrane filter (0.45 µ) filtrate, mg/L
mfCOD	=	COD of membrane filter (0.45 µ) filtrate, mg/L
mfTKN	=	TKN of membrane filter (0.45 µ) filtrate, mg/L
MLSS	=	Mixed liquor suspended solids
MLVSS	=	Mixed liquor volatile suspended solids
N_{US}	=	Unbiodegradable soluble organic nitrogen
NH_3-N	=	Ammonia nitrogen, mg/L
NO_2-N	=	Nitrite nitrogen, mg/L
NO_3-N	=	Nitrate nitrogen, mg/L
PCOD	=	Particulate COD
RBCOD	=	Readily biodegradable COD
TKN	=	Total Kjeldahl Nitrogen
TSS	=	Total suspended solids
VSS	=	Volatile suspended solids
X_{ISS}	=	Inert (nonvolatile) suspended solids
X_{SC}	=	Colloidal COD

1.5 EXISTING WASTEWATER CHARACTERISTICS TO BE USED FOR DESIGN

Based on the data presented in the foregoing sections, the following are suggested to represent the characteristics of the existing wastewater for design purposes. These characteristics must be combined with expected flows and loads from future growth to obtain the final wastewater characteristics for design.

1. Average annual BOD concentration occurring with average annual flow = 240 mg/L.
2. Ratio of TSS to BOD: 1.3 (this value is higher than that for typical domestic sewage and should be re-evaluated based on future monitoring data).
3. Ratio of TKN to BOD: 0.17 (this value may be conservatively high and should be re-evaluated based on future monitoring data).
4. Average Day Maximum Monthly Load (ADMML) = 1.3 x average annual load (AAL).
5. Peak Day Load (PDL) = 2.0 x average annual load (AAL).

Since the BOD concentration given above will have a direct impact on the sizing of wastewater treatment facilities, and since the intensive monitoring effort completed for this study was only two weeks in duration, additional influent sampling data should be used to confirm or revise this value. Lacking a long-term database, consideration should be given in design to the impacts of possible higher values and such considerations should be evaluated in establishing appropriate design safety factors.

As a rough check of the suggested average design value of 240 mg/L for BOD, the apparent per capita BOD contribution can be calculated. At a current AAF of about 1.8 Mgal/d, the concentration of 240 mg/L would result in an average daily BOD load to the wastewater treatment plant of about 3,600 lb/d. The current population in the service area can be estimated based on the number of residential connections (5,348) and an average of 2.8 people per residence (from 2000 census data), giving a total population of about 15,000. Therefore, the apparent per capita BOD load is 0.24 lb/d. This is a very reasonable value. For example, the "Recommended Standards for Wastewater Facilities" developed by the Great Lakes – Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (commonly referred to as the Ten States Standards) recommends a design value of 0.22 lb/d for communities with garbage grinders. Therefore, it is believed that an average BOD concentration of 240 mg/L is a reasonable design value.

The ADMML and PDL factors given above can be applied to BOD, TSS, and TKN. These values are based on typical data for other municipal wastewater treatment plants. Currently, adequate data are not available for the TDBCSD WWTP to establish site-specific values.

1.6 ESTIMATE OF FUTURE USERS FLOWS AND LOADS

It is currently anticipated that an additional 3,000 to 4,000 dwelling units will be constructed within the service area of TDBCSD. At a typical average annual flow per dwelling unit of 330 gallons per day, this would result in an incremental flow of about 1 to 1.3 Mgal/d. Allowing for some commercial development also, the District and the developer have agreed to plan for a future average annual flow increment of 1.5 Mgal/d. It is presumed that the wastewater characteristics and flow peaking factors after addition of these future flows will remain unchanged from existing values.

1.7 SUMMARY OF EXISTING AND FUTURE FLOWS AND LOADS

Based on the information developed in this Technical Memorandum, design influent flows and loads for the TDBCSD WWTP are summarized in Table 1-6.

Table 1-6

Summary of Existing and Future Flows and Loads

Parameter	Existing	Future Increment	Future Total
Flow, Mgal/d			
Average Annual Flow (AAF)	1.80	1.50	3.30
Average Day Maximum Monthly Flow (ADMMF)	1.98	1.65	3.63
Peak Day Flow (PDF)	3.60	3.00	6.60
Peak Hour Flow (PHF) (a)	5.40	4.50	9.90
Average Constituent Concentrations (b), mg/L			
BOD	240	240	240
TSS (c)	312	312	312
TKN (d)	41	41	41
Average Annual Load (AAL)			
BOD	3,603	3,002	6,605
TSS (c)	4,684	3,903	8,587
TKN (d)	615	513	1,128
Average Day Maximum Monthly Load (ADMML)			
BOD	4,684	3,903	8,587
TSS (c)	6,089	5,074	11,163
TKN (d)	800	667	1,467

(a) Allowance at 3 x AAF. Confirm with future monitoring.

(b) AAF combined with AAL.

(c) Based on 1.3 x BOD. May be high. Confirm with future monitoring.

(d) Based on 0.17 x BOD. May be high. Confirm with future monitoring.

Table 1-X
Design Flows and Loads Summary

To be completed

Appendix B

Technical Memorandum – SCADA System Review
March 2011

Stantec

Appendix B

Town of Discovery Bay Community Services District Technical Memorandum

SCADA System Review

Prepared By:	William P. Cassity, PE
Reviewed By:	Eric Samuelson, PE Jeffrey R. Hauser, PE
Date:	March 24, 2011

INTRODUCTION

This memorandum presents a review of the current Town of Discovery Bay Community Services District (TDBCSD) SCADA[1] assets and a review of a previous proposal by others to upgrade the SCADA system. Based on these reviews, revised recommendations for SCADA system improvements are developed. This effort is being performed as part of the Wastewater Master Plan Project.

PRESENT SCADA SYSTEM

The current SCADA system monitors and controls all water and wastewater systems owned by TDBCSD, including the water treatment plants, water wells, wastewater treatment facilities, lift stations and other facilities. The system includes approximately eleven Modicon[2] Compact Programmable Logic Controllers (PLCs) that are nearing obsolescence, as well as 23 newer Modicon Momentum PLCs as remote PLCs throughout the District. The remote PLCs communicate utilizing serial Modbus RTU [3] protocol via a MDS 9810[4] radio / modem to the Master RTU at Wastewater Treatment Plant 1 (WWTP 1). In some cases there are subnets that allow smaller systems, which share data within their group. The subsystem information is packed together by the master PLC of the group and this data is passed to the Master RTU at WWTP 1.

Following is a simplified explanation of the different RTUs and their functions:

1 SCADA – Supervisory Control And Data Acquisition. The SCADA system includes a personal computer (PC), network communication channels (in this case radio telemetry) and PLCs at the remote sites.

2 Modicon produced the first PLC in the world. Modicon is now owned by Schneider Electric and is second in US market share for PLCs behind Allen Bradley. For more information see www.modicon.com

3 Modbus RTU is an open protocol developed by Modicon and then released for use by all manufacturers. It is the de facto industry standard for serial communications.

4 MDS 9810 – Microwave Data Systems model 9810 radio modem was the industry standard for serial spread spectrum unlicensed radio communications. MDS was acquired by GE. The radio/modem is still available for purchase at their online site.

- **WWTP 1** – This site includes the Master Data Concentrator RTU with SCADA PC, which is the master communication unit for all serial radio to and from all remote sites. Additionally, at WWTP 1, there are several RTUs that perform various plant functions and report back to the Master Data Concentrator RTU. The SCADA PC then gets its information from the Master Data Concentrator. There are several Allen Bradley PLCs that are in vendor provided packages throughout the plant. The PLC families include the MicroLogix, SLC500 and CompactLogix.
- **WWTP 2** – This site has several Modicon based RTUs that feed into a central RTU that collects the data and then sends it to the WWTP 1 Master Data Concentrator RTU.
- **Lift Station RTUs** – There are approximately 16 lift station sites, most of which have Modicon based RTUs. There are some Original Equipment Manufacturer (OEM) RTUs such as LS-F that have a LS-150 controller that communicates via Modbus RTU serial communications.
- **Newport Drive WTP** – This subsystem has a master RTU that communicates via high speed proprietary (MB+) network to all onsite RTUs. There is one offsite RTU that is linked via a serial wireless radio network to the Master RTU at this site. The site's data is collected and packed so it can be sent to the Master Data Concentrator at WWTP 1.
- **Willow Lakes WTP** – This subsystem has a master RTU that communicates via high speed proprietary (MB+) network to all onsite RTUs. There are two offsite RTUs that are linked via a serial wireless radio network to the Master RTU at this site. The site's data is collected and packed so it can be sent to the Master Data Concentrator at WWTP 1.

SITE VISIT

A site visit was performed on Friday, November 19th by Bill Cassity, PE, of Stantec. The tour was conducted by Virgil Koehne, Town of Discovery Bay Community Services District Manager. During this site visit various installations were observed to judge the state of the SCADA system assets. The sample of sites visited was representative of the various types of sites and age of installation. All sites visited were generally clean, maintained and appeared to be in good working order.

SCADA SYSTEM UPGRADE ALTERNATIVES

Veolia Water reviewed the existing SCADA system and presented four proposed upgrade projects in a letter to Virgil Koehne, District Manager, dated February 10, 2009. Project 3 in that letter includes proposed improvements to SCADA facilities at the remote lift stations. Further explanation of the Project 3 recommendations was provided in a memorandum from Veolia to Gregory Harris, District Engineer, dated March 2, 2009. All of the proposed projects are discussed below, followed by recommendation of an alternative course of action that encompasses all the listed projects and recommendations. Additionally, memorandums by Telstar, dated September 14, 2009 and December 23, 2010 on radio telemetry system improvements and Ethernet connectivity are discussed.

Veolia Project 1 - Install Redundant Alarming Capability to Master RSView32 PC

Stantec reviewed this proposal and agree that an independent alarming capability as noted by Veolia is justified and should be pursued. This project was completed in 2010 using a Mission RTU110 with an AllenBradley MicroLogix 1100 PLC.

Veolia Project 2 - Provide WWTP #1 to WWTP #2 Integrated Network Services

Stantec reviewed this proposal and agree that a basic 2.4 or 5.6 GHZ point to point secured Ethernet link using an industrial grade radio and directional antennas would be justified and add reliability to the overall operation of the SCADA system.

Veolia Project 3 - Improvements to Lift Stations A through S

Stantec reviewed the proposed upgrade of the current SCADA system from a Modicon based system to an Allen Bradley based system via a migration path that will begin with all the lift stations. The following statements from the Veolia documents referenced above are believed to indicate Veolia's main reasons for the proposed upgrade. Comments or responses are provided for each statement.

1. "The controllers in place are provided with some sequencing capability but it is a reactive firmware and cannot be changed readily by the users to adapt to mitigation requirements, special circumstances, and most notably through remote command."

   Comment / Response: *The existing controllers, like the AB ML1100, are programmable. They can be reprogrammed as required for the site requirements. In some cases it may be necessary to add in output modules or other wiring. The software to reprogram the Modicon PLC is readily available for purchase. ProWorx32 is an example of development software for the Modicon PLCs.*

2. "The current communication to the facilities from the master polling radio at WWTP 1 is specifically unidirectional and only reads information from the facility and has no programmatical capability to direct the station functions."

   Comment / Response: *The existing Modicon controllers can be reprogrammed along with SCADA development software to allow bidirectional controls including remote manual operation of the pumps and other equipment at each station. In some of the older stations the controllers at these stations are manufacturers proprietary units that are not easily reconfigured or expanded. These units should be replaced when they fail or if desired functionality is required.*

3. "The now nearly obsolete Modicon Micro 612 PLCs are not functioning as programmable logic controllers. They are simply providing a dumb RTU capability where the field PLC receives inputs from status and alarm points and the input image is read at the plant by the Modicon Compact data accumulator PLC."

   Comment / Response: *The Compact is officially at its end of life*[5]*. Obsolescence alone should not be the sole reason to replace an entire control system immediately. Modicon is in the process of finalizing a legacy migration path that will not require rewiring the panel and field wiring. This would result in a major cost savings compared to rewiring and retesting all panels with Allen Bradley PLCs. Additionally, some of the obsolete PLCs could be migrated over and their parts held as spares to extend remaining system life of the remaining obsolete PLCs. This would allow a migration to the newer platform to occur over several years or as a full capital project at one time, whichever is in the District's best financial and operational interests.*

4. "The PLC controller paradigm will assure a much higher degree of mitigation of abnormal conditions, an enhanced ability to respond to commands to change modes of operations such as alternation, fixed

[5] The following are excerpted from an email by Ho Cho of Group Schneider to William P. Cassity of Stantec, dated November 30, 2010: "The Compact has been on the official end of life product for awhile. Though customers have been happy with the longevity of Compacts, they are slowing being migrated over to our M340 platform. Although, we don't current have an import feature from 984LL to Unity for Compact & Micro, we are planning to release Unity 6.0 in late Q4 of next year where they can import their existing 984LL program to Unity. It will look and feel like 984LL but it will be on our Unity platform. Currently, as a service offering from Schneider, we'll convert the Compact program to Unity now. Also, we came up with M340 connector specifically designed for Compact which allow the customer to keep their field wiring in place without rewiring the control panel. In addition, 4 slot M340 rack fits (bit small footprint) very nicely to an existing Micro 612."

lead/lag, and manual override. Additional PLC capabilities include the ability to monitor and adapt safe operation modes upon failure or illogical operation of pilot devices such as float switches, level transducers, or other field devices or instruments. Local data capture including, but not limited to:

Current Level
Maximum Level
Minimum Level
Average Level
Assurance Level is within known functional parameters (signal integrity for level)
Pump Daily and accumulated Life Run Hours
Calculated minutes per run cycle
Daily start count."

Comment / Response: *The controller paradigm noted above may be incorporated into the current hardware without a complete rewire or replacement of the backpanels. A separate hardware float backup system is typically employed to operate the station in the event of a PLC or level transmitter failure.*

5. "The new master polling radio shall be responsible for the remote lift stations above and shall the proposed configuration shall use a SLC 500 processor which is natively compatible with RSView32 to provide all tag data bi-directionally between facilities. The existing tags shall simply be decoupled from the Modicon Compact and the existing radio shall have the converted station removed from the polling list."

   Comment / Response: *All necessary data paths are existing including the non-native data path to the RSView SCADA package. The proposed solution of using another manufacturer's PLC (native or non-native) will require reworking the existing graphics, tagging and proving out all screens again, verses adding to the existing screen system. This will be a very labor intensive effort that will be duplicating the existing SCADA screens in many respects. If the current SCADA screens are unworkable or deficient, this may be a reasonable request, but otherwise this will be a duplication of the labor and costs already incurred and paid for by the District under a previous capital projects.*

6. "The ML1100 PLC also has a Real Time Clock (RTC) capability so that actual operational hours are used within the logical programming to reduce unnecessary call out and useless overtime where no work is necessary, but a minor alarm is present, but the station is performing all duties. "
   Comment / Response: *While a RTC is a nice feature, it can drift from the master SCADA clock. It is not difficult to program a near real-time clock that is resynchronized to the master RTU / SCADA periodically, if this functionality is required. Additionally, the idea of stopping alarms from calling out an operator can also be performed using existing features on most autodialers or via a minor alarm disable command from a master PLC to the remote PLCs.*

7. "For each specific station in this specific group, electrical components and control wiring modifications to varying degrees are also proposed. Depending on the location, new magnetic starters, protective devices, interposing control components, and peripherals as required to provide a complete control system function are included as required for the individual locations. "

   Comment / Response: *This approach may be incorporated into the current hardware in a more cost effective manner. The proposed AB MicroLogix 1100 is very capable and is one of the hardware platforms Stantec typically utilizes in new small scale SCADA applications. However to replace (throw out) all the existing hardware does not seem to be in the best interests of the District. Most experienced control technicians and engineers are quite capable of programming in AB, Modicon and many other platforms simultaneously. All programmers have their favorites, but most programmers can adapt as required. If needed, contract operations firms that work with District facilities could train their personnel as required to support this work or hire a third party to support the PLCs, such as Telstar or others.*

Veolia Project 4 – Analysis, Enhancement, and Optimization of Lift Stations

Stantec reviewed the proposed project to make software enhancements including bidirectional controls of 4 stations. This proposal seems a more cost effective approach to enhancements of the all Modicon PLC systems that exist at TDBCSD than the approach of Project 3 that would replace the Modicon with Allen Bradley PLCs.

Alternative to the Veolia Project 3 & 4 Proposals – Utilize the Existing Modicon Backbone with Enhancements

After reviewing the existing system and Veolia Projects 3 and 4, it is felt that the most cost effective way to achieve the recommended upgrades is to utilize the existing hardware platform and add or modify the existing programs for the features desired. This approach is similar to that suggested by Veolia in their Project 4 proposal. The Master Data Concentrator at WWTP 1 could also be moved to WWTP 2 with a new hot standby radio and a new Modicon PLC could serve as the new Master as outlined in Project 3 but utilizing an AB SLC500. This would allow moving the SCADA PC to the main operating plant and allow the old PLC to continue operating as before. The existing system could be reprogrammed to allow part time polling, with the new Master Data Concentrator at WWTP 2 having additional time to poll its remote RTUs. In this way the system could have two masters that collect data from the sites independently. This would smooth the transition as sites could be switched from the old polling master (at WWTP 1) to the new polling master (at WWTP-2). For added reliability, the old polling master could be configured as a backup master with the ability to poll the existing information in the event of a failure of the new polling master at WWTP-2.

Telstar Memo of September 14, 2009 - Radio Telemetry System Improvements - Survey Results and Recommendations

Stantec reviewed the memo from Telstar. The idea of repairing or recalibrating the existing radios as well as adding a repeater to the existing network appears to have merit and would increase the reliability of the overall communications system throughput. Telstar also mentioned the idea of changing the radios to an Ethernet based system. While this would allow for online programming and an overall faster channel throughput, the idea of programming online is typically not advisable for a remote site such as a lift station or WTP. Programming changes should be performed at the site and tested with an adequate test procedure. Programming over the airwaves is not always conducive to understanding the process and the program change impacts. Additionally, if a program or program change is properly vetted and tested upon installation, there should be little need for additional changes or correction. The value in making a large capital expenditure for a minor increase in data rate throughput should be revisited.

Telstar Memo of December 23, 2010 - WWTP Ethernet Connectivity Recommendations

Stantec reviewed the memo from Telstar concerning proposed recommendations for connecting the WWTP 2 site to the internet. The memo discussed the methods of connecting both plants (WWTP 1 & 2) as well as connecting to the Internet. The discussion of fiber optics included costs that seem very low in regards to trenching or overhead and crossing a highway. The simpler and less costly method appears to be the 4.9GHZ radio link with new poles at WWTP 1 and 2. Additionally a link could be added at Lift Station H. The Ethernet could then connect to the local ISP at that point and allow Internet connectivity over a secure licensed frequency to WWTP 2 as well. These paths should be fully vetted with a radio path study at the proposed height or higher using a boom truck or other methods to ensure adequate fade margins are available for each link. The idea of making the tower suitable for both 4.9GHZ for Ethernet and the older 902-928 MHZ spread spectrum use is a good idea and should be pursued. It is suggested the total installations costs should be revisited after the radio path study confirms this idea has validity. Another option would be to consider installing a higher monopole tower at WWTP 2 and then leasing back antenna space to communications providers. This alternative could also act as a revenue source that could offset the installation costs.

Executive Summary

The existing SCADA system has served the Town of Discovery Bay Community Services District for many years and should continue to do so for the foreseeable future. Many of the PLCs that are installed are officially obsolete[6] but will still be usable for many years into the future. The overall SCADA system appears to have offered superior service and reliability during this time based on the lack of problems noted by the operations staff. For the reasons stated above, there is no compelling reason to switch from a Modicon brand based system to another brand. In light of the overriding cost impact of performing the proposed conversion to another PLC manufacturer, this seems to be an excessive fiscal demand on the District that could be easily overcome by training of the appropriate support personnel on Modicon PLCs.

The following is Stantec's recommended alternative approach:

1. Add a new redundant radio[7] master RTU with a Modicon Unity based Programmable Automation Controller (PAC)[8] at WWTP 2 as the new Master Data Concentrator. This will allow for a more orderly conversion and allow SCADA to be moved to WWTP 2, where most operators are based from. The programs in WWTP 1 PLC could be modified to act as a backup radio master that would poll the RTUs if the new master at WWTP 2 was down and periodically to verify the backup system's integrity. This alternative approach also has the added benefit of simpler support in that all the PLCs in the field will still be by a single manufacturer as opposed to Veolia's Project 3 and 4 approaches which would result in changing some of the field RTUs to Allen Bradley and leaving some of the field RTUs as Modicon PLCs. This would complicate service issues and require service personnel to know and understand both Allen Bradley and Modicon verses understanding only Modicon in the remote stations.

2. Add the features desired to update the programs at each RTU including runtimes, number of starts, average run times and associated alarms as well as adding an analog level based control to RTUs that do not have them. The addition of remote PLC control at some of the older lift stations may require additional output cards and may or not be feasible with the older PLCs. This should be discussed further as to whether the remote control is necessary or beneficial at this point or is a " nice to have" feature. These features could then be ported over into the new Modicon Unity PACs as conversions are made. The SCADA software will also have to be updated for display and control enhancements. This item is similar to Veolia Proposed Projects 3 and 4, except it covers all RTUs and does not require any hardware updates or changing PLC manufacturers. This should result in a material savings

6 Obsolete – For industrial electronics typically means the manufacturer will no longer offer full support. There may be third party repairs or other means such as selective conversion of some RTUs and using the PLC parts to keep other older RTU systems running well into the future. This can extend system life with no real danger to system integrity.

7 A redundant radio is available from GE / MDS for the 9810 series. It is a warm standby radio system that will prevent a loss of a single master radio from causing a communications outage.

8 The Unity based Programmable Automation Controller (PAC) is the next generation of PLC. PACs have all the features of PLCs but have more features including dynamic text based tagging verses addressed based tagging for PLCs. The Unity PAC mentioned is the same approximate size as the older Compact PLCs. Group Schneider has also recently released a product called

of $38,548.21.[9] The cost of the software should be approximately the same as that of the Veolia project costs.

3. Add a separate backup float / alarm system with appropriate intrinsic barriers to allow the lift stations to continue operations in auto if the level transmitter or PLC became inoperable.

4. Start a SCADA Replacement Design Project that will investigate the replacement of the obsolete 612 PLCs with a legacy migration plan to replace the PLCs in an orderly fashion starting at the most critical PLCs to the least critical. This will allow the District to schedule a multi-year capital plan, or if funds become available, accelerate the upgrade of more sites, as desired.

5. The cost of these modifications listed in this alternative would also have to be done in the Veolia proposals except this proposal will not require the same level of additional hardware and wiring costs as well as longer station downtimes. It is expected the cost of this alternative project (items 1-4) would be around $350,000 as compared to $500,000 if this work was performed as described in the Veolia Proposed Project methodologies. This cost is based on extrapolating out the costs of Veolia Projects 1 through 4 to cover all lift stations instead of the 15 of the 34 specifically mentioned in their proposal. This number would have to be verified when a final scope of services was identified in a manner the project could be responded to by several competing firms.

9 Materials savings stated is based on the Telstar / Veolia Project 3 estimate.

VEOLIA
WATER

February 10, 2009

Mr. Virgil Koehne
General Manager
Discovery Bay Community Services District
1800 Willow Lake Road
Discovery Bay, CA 94505

Dear Virgil:

As you know, Veolia has been asked by Discovery Bay to develop a comprehensive proposal for enhancing existing SCADA and communications systems located at the wastewater treatment plants and lift stations.

During the last few weeks at Discovery Bay, Veolia's operations and technical services departments have become much more comfortable with their understanding of these systems. This knowledge combined with our experience upgrading and operating similar systems at plants throughout the western United States, has lead to our development of four distinct projects.

Veolia recommends that they all be completed promptly in order to enhance sewer system reliability, help ensure regulatory compliance and reduce wear and tear on staff caused by frequent false alarms. We recognize, however, that budget constraints may not allow for this and have listed them in priority order as follows:

RECOMMENDED SCADA AND COMMUNICATION UPGRADES FOR DISCOVERY BAY CSD WASTEWATER SYSTEM		
Project #	**Description**	**Cost**
1	Installation of redundant alarming	$5,725.00
2	Integrate communications between WWTPs #1 and #2	$2,000.00 to $7,500.00 depending on option selected
3	Convert older lift stations from Modicon to Allen-Bradley controls	$79,720.00 to $91,600.00 depending on option selected
4	Analysis and optimization of new lift stations	$37,950.00

Veolia West Operating Services, Inc.
2300 Contra Costa Blvd., #350
Pleasant Hill, CA 94523
Tel 925-681-2304

All project proposals are inclusive of equipment and labor required to complete the work as described in the detailed scope documents attached hereto. Labor is charged at $85.00 an hour, which is a very favorable rate compared to the $95.00 to $125.00 most SCADA and communications contractors would invoice. However, should the analysis described in Project #4 provide additional information regarding SCADA and communication needs at the newer lift stations, a follow-on proposal will be offered for your consideration.

We look forward to discussing this information at your earliest opportunity. In the meantime, should you have any questions or require additional information, please feel free to contact Kip Edgley or me.

Sincerely,

James L. Good
Vice President
Area Manager, Northern California

Attachments

Cc: Gregory Harris, Herwit Engineers
Kip Edgley, Veolia Water
Gerald Smart, Veolia Water
Chris McAuliffe, Veolia Water
Chuck Fenton, Veolia Water

VEOLIA WATER

SCADA and Communications Improvements Proposal for Discovery Bay

Projects described in this document listed in recommended priority:

#1 - Install Redundant Alarming Capability to Master RSView32 PC

#2 - Provide WWTP #1 to WWTP #2 Integrated Network Services

#3 – Conversion of Older Lift Stations from Modicon Monitoring to Allen-Bradley Integrated Control for Lift Stations A, C, D, E, F, G, H, J, R, and S.

#4 – Analysis, Enhancement, and Optimization of Lift Stations Newport, Lakeshore, The Lakes, Village #4, and Bixler School for improving reliability, alarming, mitigation, and optimization of equipment performance. This task improves communication to provide bi-directional programming as needed for optimizing PLC/SCADA communications.

<u>Project #1 Justification:</u>
Veolia Water standards for SCADA automation require redundant alarming systems if the sole system in place is based on Microsoft PC operating systems. The failure rate of Microsoft-based systems is too high to allow for reliable monitoring.

<u>Project #1 General Scope:</u>
Mission System Cellular RTUs will be installed at the existing Master PLC and the RSView32. The Master shall be reprogrammed to interface to the RTU for various failure modes and critical alarms allowing the Mission System to callout in backup to the existing ScadaTec telephone/modem based system. The Mission System is comprised of an RTU that is provided with 8 Discrete No-Voltage inputs and can accept two analog inputs as well. Each input is configurable for different alarming needs and the Mission System servers handle all monitoring, call out, and documentation of events through a recurring fee-based monitoring service. The cost of the RTU includes the first year of monitoring and provides the user with web-based internet access to check status of the unit.

<u>Project #2 Justification:</u>
Veolia Water and the Town of Discovery Bay recognize that the two WWTPs need to be integrated as a single network. The existing wireless access points used in the Cisco-based video system may provide short term use, but SCADA and other plant networking needs to be separate from the City's video network. Listed below are several options to implement this upgrade, including estimated cost:

1. Inexpensive Wireless 2.4GHZ system between plants. This is a low cost option that allows the communication between plants by way of distributed Ethernet. It is not intended to be the core of a town wide distributed Ethernet expansion.
   - Estimated cost: $2,000.00
2. Expensive, but very expandable system at 5.6GHZ that can support eventual conversion to Ethernet communications to remotes. This is intended to provide the core for an

eventual city wide distribution of Ethernet to support all facilities currently under the management contract.
- Estimated cost: $7,500.00

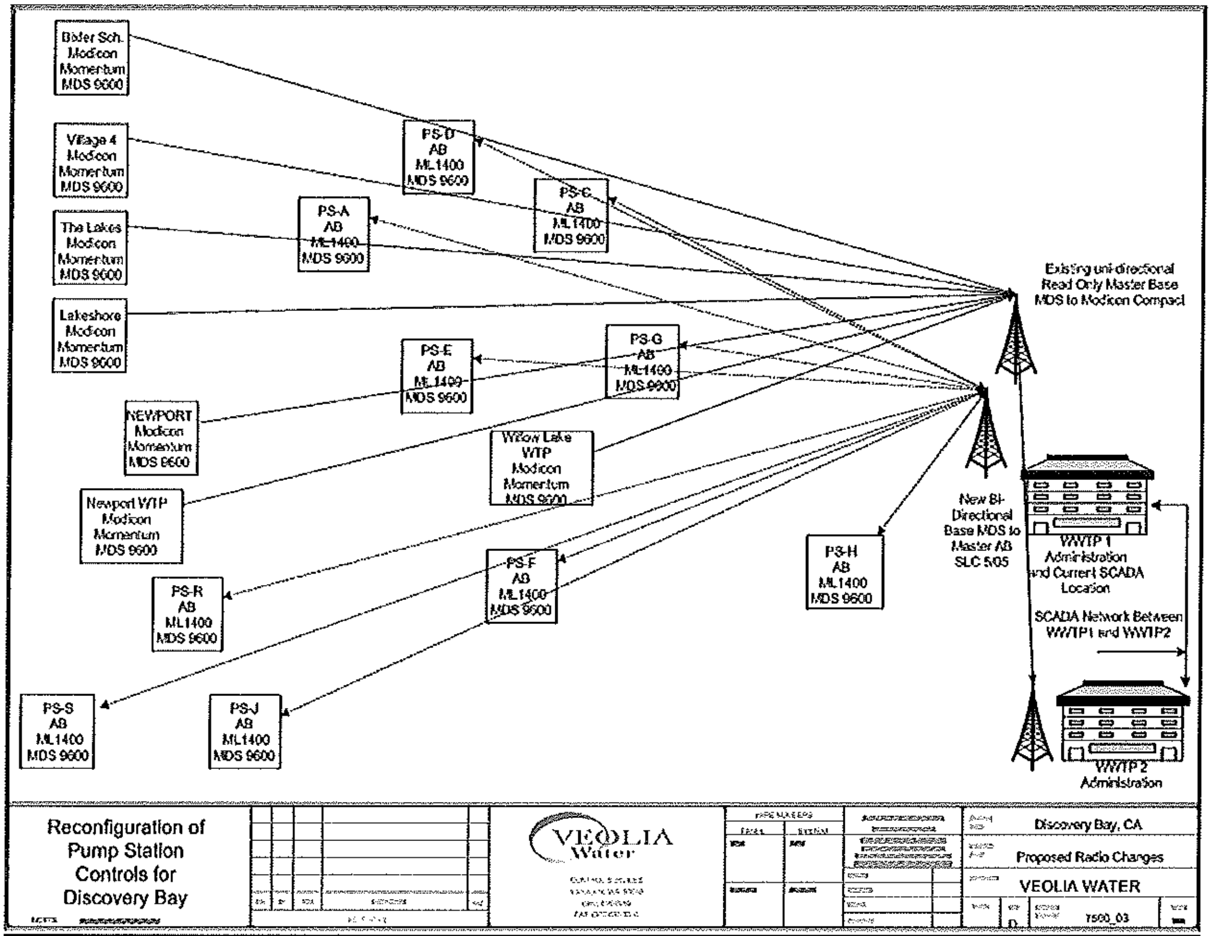
3. Physical extension of fiber optics-based system between plants. This is the Town's preferred option.
   - Estimated cost: Cannot be provided until engineering and contractor bidding completed.

No further discussions on Project #2 are provided in this document, pending Town's decision concerning preferred approach.

Project #3 Justification:
VWNA-West LLC has long supported and implemented an Allen-Bradley/Rockwell Standard for PLC integration. Allen-Bradley/Rockwell Technology is comprehensively supported through corporate technical resources which are also augmented by regional resources. The existing Modicon model for the above referenced Lift Stations involves an older model PLC that does not control the facility operations and needs to be modified to accept bi-directional control.

Project #3 General Scope:
The scope will provide for installation of a new Allen-Bradley PLC (SLC 5/05) in WWTP #1 or #2 SCADA location to serve as new polling master. The existing polling master shall be left in service, but as each station is modified, that station's remote radios shall be disassociated with the parent radio and assigned to the new polling master. The new polling master shall provide bi-directional control and data pass. The individual stations shall be provided with a MicroLogix ML1400 PLC which will be used to provide intelligent and integrated control for the individual station. Selected stations shall be provided with small operator interfaces so that data can be accessed from other stations in the operation as well as provide simple control set point capability. All stations shall be documented, all programming shall include complete annotation, and new control and power control drawings shall be provided for each station. All programming within the Master SLC 5/05 and associated enhanced graphics within RSView32 shall be provided in a manner meeting VWNA Best Practices. Equipment installed under the Task #1 scope shall include 10 remote stations, the mastering station, and the mastering radio communications.

Project #3 Conversion Diagram



Project #4 Justification:
This task provides the analysis, and subsequent changes to programs, controls, equipment configurations, instrumentation, and pilot devices as required to accomplish the most efficient and reliable operations possible for the identified facilities. Newer stations are provided with adequate PLC equipment, but inconsistent equipment conditions, programming, pump control equipment, and no dedicated mitigation philosophy is impeding optimization and reliability. The first priority under this task will be to develop the knowledge, as well as the actions necessary to accomplish definitive and demonstrable improvements.

Project #4 General Scope:
Utilizing Modicon PLC programming software and copies of the existing program provided by Telstar, VWNA shall work with Telstar to completely evaluate the efficacy of the existing programming. The overall facility performance shall be reviewed for alternations, real time compensations, alarm generation, status information, and the applicability of adding bi-directional control through the existing Modicon radio links. RSView32 shall be enhanced to provide additional functionality and enhanced graphical representation as required to achieve optimized functionality. VWNA shall provide all RSView32 programming, and Telstar and VWNA shall jointly provide graphical modifications to Magelis Operator Interfaces and Modicon Momentum PLC's.

Additional evaluation will include, but not be limited to: programming and utilization of adjustable frequency drives, field instrumentation calibration and integration, and motor control components. Scope shall not include installation, decommissioning, or significant modifications of power distribution components.

VEOLIA WATER

TASKS TO BE PERFORMED – Listed by Projects in Numerical Order

Project #1 – Mission System RTU; tasks to be performed:

1. Physically install RTU at Master PLC location
2. Physically install antenna to exterior unless cell strength allows inside antenna configuration
3. Physically connect up to four outputs from Modicon Compact Master PLC to Discrete Inputs #1 through #4. #5 through #8 shall be reserved for connection to proposed SLC 5/05 Bi-Directional Master PLC.
4. Analog inputs shall be dedicated to one per Master PLC.
5. Configuration of Mission RTU shall include coordination with Telstar to achieve necessary programming changes to interface with Mission Systems. VWNA Technical Services shall direct and coordinate Telstar services to accomplish a complete installation.
6. VWNA and Telstar shall provide a complete test of the total system and assure proper operation. Veolia Water NA and Discovery Bay shall be the only entities accessing the Mission website. Veolia Water requests that the Discovery Bay users with access be identified to assure authorized users are known.
7. VWNA shall, if Project #1 is approved, complete all interface for all channels of the Mission RTU, including providing an RSView32 interface for alarm control. VWNA shall provide all programming services and installation for this task. Main WWTP #1 (or possible #2 depending on SCADA location)

Project #3 – Tasks to be performed:

At WWTP #1 or #2 depending on location of SCADA:

1. Install a new Polling Master MDS 9810 Serial Radio, Antenna, and Cable to support the above referenced Lift Stations. The new Master provides the ability to implement the new controllers without disruption to the existing systems as the polling master currently in use will continue to support other communications.
2. Install a new AB SLC 5/05 Data Accumulator PLC at the same location as the MDS 9810 Master. This PLC shall be used to communicate directly by Ethernet to RSView32 and will be used to receive SCADA commands, transmit commands to the target Lift Station Controller which will also send data back relevant to the current control and status of the target location. The AB SLC 5/05 will be used initially as a data accumulator and will not provide local I/O except for interface to a secondary alarm system controller.
3. Provide all SLC 5/05 programming as required to function as a multi-station data controller and accumulator to be used in addition to the existing MDS 9810 master radio.
4. Modify the RSView32 interface as required to adapt to the enhanced data and control provided by this proposed system improvement.
5. Enhance RSView32 as previously discussed with client and engineer to optimize use and informational content of HMI application.
6. Provide complete documentation for all new programming per VWNA Best Practices for Automation and Integration.

Station A:

1. Completely replace the existing control enclosure for the motor controls.
2. Provide new magnetic starters, complete with new overload relays, for both pumps.
3. Provide new H-O-A switches and all other necessary control peripherals. Budgeted peripherals that are not used will be returned and itemized to the stocks on hand for inventory of maintenance parts.
4. Provision and interconnection of TimeMark Phase Loss Detectors. Existing phase loss devices shall be removed.
5. Install new level control for redundancy to existing level transducer. Existing Level Transducer will be connected to the AB PLC for main control. Level switches shall provide input to the PLC as well as drive relay bypass control. Either a two stage or two physical switch complement will be used in a "best fit" for this and other stations.
6. Installation and programming of an AB MicroLogix ML1400 PLC. This PLC shall interface with the existing MDS 9810 radio, but provide future capability for connectivity to a distributed Ethernet communication scheme through Native Ethernet communication capability built into the PLC.
7. Provision of an APC SmartUPS for assuring power integrity to the PLC, 24VDC power supply, 12 VDC power supply for the radio, and other peripherals with a minimum uptime allowing for communication of power failure to the main PLC at WWTP #1.
8. Provision, programming, and configuration for a 2711-C600M component class PanelView if this option is selected. This low cost interface is to allow field modifications to be made to settings, access to runtimes, levels, flows, and other pertinent operating conditions. This is an option for each station.
9. All other services to clean up existing controls, integrate the new controlling PLC, decommission the existing pump controller, and to clean up all control wiring as required.
10. Document new controls, PLC program, and PanelView
11. Provide any training as required for new controls.
12. Provide Control Drawings for new configuration including communication, configuration, and I/O.

Station C:
All services as specified in A above except for the replacement of the motor control enclosure.

Station D:
All services as specified in A above except for the replacement of the motor control enclosure.

Station E:
All services as specified in A above except for replacement of the motor control enclosure and magnetic starters. The panel and power components were deemed to be in acceptable condition and shall not be replaced. However, all associated wiring shall be cleaned up and documentation services shall apply.

Station F:
This station has a damaged power distribution and motor control panel. This panel is scheduled for replacement with a newly constructed motor control power panel that will be installed by others. Services provided will include

1. Provision and interconnection of TimeMark Phase Loss Detectors if not available in new power panel.

2. Install new level control for redundancy to existing level transducer. Existing Level Transducer will be connected to the AB PLC for main control. Level switches shall provide input to the PLC as well as drive relay bypass control.
3. Installation and programming of an AB MicroLogix ML1400 PLC. This PLC shall interface with the existing MDS 9810 radio, but provide future capability for connectivity to a distributed Ethernet communication scheme.
4. Provision of an APC SmartUPS for assuring power integrity to the PLC, 24VDC power supply, 12 VDC power supply for the radio, and other peripherals with a minimum uptime allowing for communication of power failure to the main PLC at WWTP #1.
5. Provision, programming, and configuration for a 2711-C600M component class PanelView if this option is selected. This low cost interface is to allow field modifications to be made to settings, access to runtimes, levels, flows, and other pertinent operating conditions.
6. All other services to integrate the new controlling PLC, decommission the existing pump controller, and to clean up all control wiring as required. The new motor control panel does not replace the existing pump controller.
7. Document new controls, PLC program, and PanelView
8. Provide any training as required for new controls.
9. Provide Control Drawings for new configuration including communication, configuration, and I/O.
10. Coordinate PLC installation with new panel implementation.

Station G:

1. Installation and programming of an AB MicroLogix ML1400 PLC. This PLC shall interface with the existing MDS 9810 radio, but provide future capability for connectivity to a distributed Ethernet communication scheme.
2. Installation of a new enclosure on the side panel of the existing for housing the UPS.
3. Provision and interconnection of relays to detect loss of either phase of single-phase pump supply voltage. Existing phase loss devices shall be evaluated for function and removed if not working properly.
4. Install new level control for redundancy to existing level transducer. Existing Level Transducer will be connected to the AB PLC for main control. Level switches shall provide input to the PLC as well as drive relay bypass control.
5. Provision of an APC SmartUPS for assuring power integrity to the PLC, 24VDC power supply, 12 VDC power supply for the radio, and other peripherals with a minimum uptime allowing for communication of power failure to the main PLC at WWTP #1.
6. Cleaning and organization of controls, single-phase capacitor assemblies, cleaning of motor controller panel area, and labeling of wires as required for documentation.
7. Document new controls, PLC program, and PanelView
8. Provide any training as required for new controls.
9. Provide Control Drawings for new configuration including communication, configuration, and I/O.

Station H:

1. Installation and programming of an AB MicroLogix ML1400 PLC. This PLC shall interface with the existing MDS 9810 radio, but provide future capability for connectivity to a distributed Ethernet communication scheme.
2. Provision and interconnection of relays to detect loss of either phase of single-phase pump supply voltage. Existing phase loss devices shall be evaluated for function and removed if not working properly.

3. Install new level transducer. Existing Tesco Controller (Liquitronic) shall be decommissioned. Level Transducer will be connected to the AB PLC for main control.
4. Level switches shall be installed to provide input to the PLC as well as drive relay bypass control.
5. Provision of an APC SmartUPS for assuring power integrity to the PLC, 24VDC power supply, 12 VDC power supply for the radio, and other peripherals with a minimum uptime allowing for communication of power failure to the main PLC at WWTP #1.
6. Cleaning and organization of controls, single-phase capacitor assemblies, cleaning of motor controller panel area, and labeling of wires as required for documentation.
7. Document new controls, PLC program, and PanelView
8. Provide any training as required for new controls.
9. Provide Control Drawings for new configuration including communication, configuration, and I/O.

Station J:

1. Installation and programming of an AB MicroLogix ML1400 PLC. This PLC shall interface with the existing MDS 9810 radio, but provide future capability for connectivity to a distributed Ethernet communication scheme.
2. Provision and interconnection of TimeMark 2644 Phase Loss Monitors to detect loss of either phase integrity for 3 phase 240 VAC supply. Existing phase loss devices shall be evaluated for function and removed if not working properly.
3. Install new level transducer. Existing Tesco Controller (Liquitronic) shall be decommissioned. Level Transducer will be connected to the AB PLC for main control.
4. Level switches shall be installed to provide input to the PLC as well as drive relay bypass control.
5. Provision of an APC SmartUPS for assuring power integrity to the PLC, 24VDC power supply, 12 VDC power supply for the radio, and other peripherals with a minimum uptime allowing for communication of power failure to the main PLC at WWTP #1.
6. Cleaning and organization of controls, single-phase capacitor assemblies, cleaning of motor controller panel area, and labeling of wires as required for documentation.
7. Document new controls, PLC program, and PanelView
8. Provide any training as required for new controls.
9. Provide Control Drawings for new configuration including communication, configuration, and I/O.

Station R:

1. Installation and programming of an AB MicroLogix ML1400 PLC. This PLC shall interface with the existing MDS 9810 radio, but provide future capability for connectivity to a distributed Ethernet communication scheme.
2. Provision and interconnection of relays to detect loss of either phase of single-phase pump supply voltage. Existing phase loss devices shall be evaluated for function and removed if not working properly.
3. Install new level transducer. Existing Tesco Controller (Liquitronic) shall be decommissioned. Level Transducer will be connected to the AB PLC for main control.
4. Level switches shall be installed to provide input to the PLC as well as drive relay bypass control.
5. Provision of an APC SmartUPS for assuring power integrity to the PLC, 24VDC power supply, 12 VDC power supply for the radio, and other peripherals with a minimum uptime allowing for communication of power failure to the main PLC at WWTP #1.
6. Cleaning and organization of controls, single-phase capacitor assemblies, cleaning of motor controller panel area, and labeling of wires as required for documentation.

7. Document new controls, PLC program, and PanelView
8. Provide any training as required for new controls.
9. Provide Control Drawings for new configuration including communication, configuration, and I/O.

Station S:
All services as specified in Station E. The panel and power components were deemed to be in acceptable condition and shall not be replaced. However, all associated wiring shall be cleaned up and documentation services shall apply.

Project #4 – Newer Lift Station Enhancements
Tasks to be performed:

Bixler School:
This facility is very new and only requires a thorough evaluation on the program content and function of the existing controller to PLC. Enhancements are estimated to be minor and communications are reasonably solid.

Newport PS; the following will be performed:

1. Evaluation of the Modicon Momentum program for function, annotation, and optimization
2. Evaluation and assessment of the programming and control of pump speed control
3. Assess, improve, modify, or otherwise affect the programming of the Magelis operator interface to improve operational information and controls access.
4. Evaluate and implement bi-directional controls for set points and other functions needed by operations to meet normal VWNA control standards.
5. Evaluate and assure field instrumentation is fully functional, calibrated, and integrated properly into the PLC.
6. Direct Telstar in PLC modifications required to accomplish master PLC changes.

Lakeshore PS; the following will be performed:
1. Evaluation of the Modicon Momentum program for function, annotation, and optimization
2. Evaluation and assessment of the programming and control of pump speed control and assure all displays and AFD's are operating correctly.
3. Provide analysis to optimize pumping control paradigm
4. Assess, improve, modify, or otherwise affect the programming of the Magelis operator interface to improve operational information and controls access.
5. Evaluate and implement bi-directional controls for set points and other functions needed by operations to meet normal VWNA control standards.
6. Evaluate and assure field instrumentation is fully functional, calibrated, and integrated properly into the PLC.
7. Direct Telstar in PLC modifications required to accomplish master PLC changes.

The Lakes PS; the following will be performed:
1. Evaluation of the Modicon Momentum program for function, annotation, and optimization
2. Evaluation and assessment of the programming and control of pump speed control and assure all displays and AFD's are operating correctly.
3. Correct the panel mounted flow indicator mounting problem or replace as required.
4. Evaluation and assessment of the programming and control of pump speed control

5. Assess requirement for the programming of the Magelis operator interface to improve operational information and controls access. The current Magelis has no user program installed or programmed.
6. Evaluate and implement bi-directional controls for set points and other functions needed by operations to meet normal VWNA control standards.
7. Evaluate and assure field instrumentation is fully functional, calibrated, and integrated properly into the PLC.
8. Direct Telstar in PLC modifications required to accomplish master PLC changes.

Village #4 PS; the following will be performed:

1. Evaluation of the Modicon Momentum program for function, annotation, and optimization
2. Evaluation and assessment of the programming and control of pump speed control and assure all displays and AFD's are operating correctly.
3. Provide analysis to optimize pumping control paradigm
4. Assess, improve, modify, or otherwise affect the programming of the Magelis operator interface to improve operational information and controls access.
5. Evaluate and implement bi-directional controls for set points and other functions needed by operations to meet normal VWNA control standards.
6. Evaluate and assure field instrumentation is fully functional, calibrated, and integrated properly into the PLC. Direct Telstar in PLC modifications required to accomplish master PLC changes

Additional Needs for Project #4:

The current software licensed to the Town of Discovery Bay for programming Modicon PLC's and Magelis Operator Interfaces is obsolete, out of support, and not applicable for current use. The options of replacement are FastTrack SoftWorx or Schneider / Square D software. Costs for the software are:

1. Schneider Option at VWNA Cost: $7,600.24 – Quote received from Graybar Electric
2. FastTrack SoftWorx Cost: $4,400.00 – Quote received from FastTrack Softworx and includes the Schneider option for Magelis OI Software.

Either will work and the recommendation for the software is the lower cost FastTrack SoftWorx package.

DISCOVERY BAY LIFT STATION ENHANCEMENTS - Price Summary

Project #1 - Installation of Redundant Alarming

	Labor	Materials	Notes
Mission RTU		$ 2,659.00	Mission 800 RTU and first year monitoring
Telstar Services	$ 1,800.00		Estimate from Paul as an approx. for interface programming to RTU
VWNA Installation	$ 1,000.00		Installation and interface analysis to direct Telstar and provision of RSView32 modifications
Totals	**$ 2,800.00**	**$ 2,659.00**	
Materials Handling Fee	**$ 265.90**		
Total for Project #1	**$ 5,724.90**		

Project #2 - Integrate Communication Between WWTPs #1 and #2

Option #1	$ 2,000.00	Low Cost WAP's	Includes labor, Boom Lift Rental, Materials, and Configuration
Option #2	$ 7,500.00	Full Cost Radio	Includes labor, Boom Lift Rental, Materials, and Configuration
Option #3	N/A	TBD	Scope is not VWNA

Project #3 - Convert Older Lift Stations from Modicon to Allen-Bradley Controls

	Labor	Materials	Contingency
Station A	$ 3,040.00	$ 4,801.51	$ 784.15
Station C	$ 2,630.00	$ 3,176.21	$ 580.62
Station D	$ 2,630.00	$ 3,176.21	$ 580.62
Station E	$ 3,040.00	$ 3,996.51	$ 703.65
Station F	$ 2,630.00	$ 2,493.71	$ 512.37
Station G	$ 2,630.00	$ 3,212.60	$ 584.26
Station H	$ 2,630.00	$ 2,787.60	$ 541.76
Station J	$ 3,040.00	$ 3,189.71	$ 622.97
Station R	$ 2,630.00	$ 3,387.90	$ 601.79
Station S	$ 2,630.00	$ 2,239.71	$ 486.97
Main Plant	$ 2,890.00	$ 6,086.51	$ 897.65
Totals	**$ 30,420.00**	**$ 38,548.21**	**$ 6,896.82**
Materials Handling Fee	**$ 3,854.82**		
Total for Project #3	**$ 79,719.85**		
Adder for Ultrasonic Option	**$ 11,880.00**		
Total with Ultrasonic	**$ 91,599.85**		

Project #4 - Analysis and Optimization of New Lift Stations

	Labor	Materials	Software

			Material allowance is for instrument repair, or additional components if necessary. Labor is VWNA + Telstar, but ratio of total
Bixler School PS	$ 3,000.00	$ 500.00		is not yet known. Estimate only
Village #4 PS	$ 7,500.00	$ 1,000.00		See note above
Lakeshore PS	$ 6,200.00	$ 1,000.00		See note above
The Lakes PS	$ 6,200.00	$ 1,000.00		See note above
Newport PS	$ 5,700.00	$ 1,000.00		See note above
				Includes PLC and Magelis Software to be used by technicians on VWNA and on completion installed on SCADA PC, or
Softwater for Modicon			$ 4,400.00	dedicated technician laptop
Totals	**$ 28,600.00**	**$ 4,500.00**	**$ 4,400.00**	
Materials Handling Fee	**$ 450.00**			
Total for Project #4	**$ 37,950.00**			

DISCOVERY BAY LIFT STATION ENHANCEMENTS - Project #3 Detail

STATION A

240 VAC 3 Phase 2 - Pumps (5 HP Each)

2	NEMA Starters (Alt. Bid IEC) w/OLR	$	215.00	$	430.00
2	H-O-A selector	$	25.00	$	50.00
1	30 x 36 x 10 NEMA 4X SS Cabinet	$	1,025.00	$	1,025.00
1	backpanel for above	$	100.00	$	100.00
2	Fuse Blocks	$	30.00	$	60.00
10	FRN Dual Element (for 5 HP)	$	4.25	$	42.50
2	TimeMark 2644 (240 VAC)	$	160.00	$	320.00
4	(2 to 10) AMP DIN CB (Amps TBD)	$	17.91	$	71.63
50	Terminals	$	0.56	$	27.86
6	End Barriers	$	0.42	$	2.54
6	End Stops	$	0.90	$	5.41
20	HLT Relays (voltage TBD)	$	10.26	$	205.27
1	DIN Rail Chunk	$	4.25	$	4.25
1	ML1400/24VDC Sink - 120 VAC PS	$	575.00	$	575.00
1	1762-IF4	$	252.75	$	252.75
1	SUA-500 VA Smart UPS	$	525.00	$	525.00
1	2711C-T6M	$	600.30	$	600.30
2	Level Switch	$	127.00	$	254.00
	Material Total			**$**	**4,551.51**

STATION C

240 VAC 3 Phase 2 - Pumps (5 HP Each)

2	NEMA Starters (Alt. Bid IEC) w/OLR	$	215.00	$	430.00
2	H-O-A selector	$	25.00	$	50.00
1	26 x 32 backpanel	$	100.00	$	100.00
2	Fuse Blocks	$	30.00	$	60.00
10	FRN Dual Element (for 5 HP)	$	4.25	$	42.50
2	TimeMark 2644 (240 VAC)	$	160.00	$	320.00
4	(2 to 10) AMP DIN CB (Amps TBD)	$	17.91	$	71.63
50	Terminals	$	0.56	$	27.86
6	End Barriers	$	0.42	$	2.54
6	End Stops	$	0.90	$	5.41
20	HLT Relays (voltage TBD)	$	10.26	$	205.27
1	DIN Rail Chunk	$	4.25	$	4.25
1	ML1400/24VDC Sink - 120 VAC PS	$	575.00	$	575.00
1	1762-IF4	$	252.75	$	252.75
1	SUA-500 VA Smart UPS	$	525.00	$	525.00
0	2711C-T6M	$	600.30	$	-
2	Level Switch	$	127.00	$	254.00
	Material Total			**$**	**2,926.21**

STATION D

240 VAC 3 Phase 2 - Pumps (5 HP Each)

2	NEMA Starters (Alt. Bid IEC) w/OLR	$	215.00	$	430.00
2	H-O-A selector	$	25.00	$	50.00
1	26 x 32 backpanel	$	100.00	$	100.00

		2 Fuse Blocks	$	30.00	$	60.00
		10 FRN Dual Element (for 5 HP)	$	4.25	$	42.50
		2 TimeMark 2644 (240 VAC)	$	160.00	$	320.00
		4 (2 to 10) AMP DIN CB (Amps TBD)	$	17.91	$	71.63
		50 Terminals	$	0.56	$	27.86
		6 End Barriers	$	0.42	$	2.54
		6 End Stops	$	0.90	$	5.41
		20 HLT Relays (voltage TBD)	$	10.26	$	205.27
		1 DIN Rail Chunk	$	4.25	$	4.25
		1 ML1400/24VDC Sink - 120 VAC PS	$	575.00	$	575.00
		1 1762-IF4	$	252.75	$	252.75
		1 SUA-500 VA Smart UPS	$	525.00	$	525.00
		0 2711C-T6M	$	600.30	$	-
		2 Level Switch	$	127.00	$	254.00
		Material Total			**$**	**2,926.21**
STATION E						
240 VAC	3 Phase	2 - Pumps (15 HP Each)				
		2 NEMA Starters (Alt. Bid IEC) w/OLR	$	375.00	$	750.00
		2 H-O-A selector	$	25.00	$	50.00
		2 Fuse Blocks	$	30.00	$	60.00
		10 FRN Dual Element (for 15 HP)	$	4.25	$	42.50
		2 TimeMark 2644 (240 VAC)	$	160.00	$	320.00
		4 (2 to 10) AMP DIN CB (Amps TBD)	$	17.91	$	71.63
		50 Terminals	$	0.56	$	27.86
		6 End Barriers	$	0.42	$	2.54
		6 End Stops	$	0.90	$	5.41
		20 HLT Relays (voltage TBD)	$	10.26	$	205.27
		1 DIN Rail Chunk	$	4.25	$	4.25
		1 ML1400/24VDC Sink - 120 VAC PS	$	575.00	$	575.00
		1 1762-IF4	$	252.75	$	252.75
		1 SUA-500 VA Smart UPS	$	525.00	$	525.00
		1 2711C-T6M	$	600.30	$	600.30
		2 Level Switch	$	127.00	$	254.00
		Material Total			**$**	**3,746.51**
STATION F						
240 VAC	3 Phase					
		2 TimeMark 2644 (240 VAC)	$	160.00	$	320.00
		4 (2 to 10) AMP DIN CB (Amps TBD)	$	17.91	$	71.63
		50 Terminals	$	0.56	$	27.86
		6 End Barriers	$	0.42	$	2.54
		6 End Stops	$	0.90	$	5.41
		20 HLT Relays (voltage TBD)	$	10.26	$	205.27
		1 DIN Rail Chunk	$	4.25	$	4.25
		1 ML1400/24VDC Sink - 120 VAC PS	$	575.00	$	575.00
		1 1762-IF4	$	252.75	$	252.75
		1 SUA-500 VA Smart UPS	$	525.00	$	525.00
		0 2711C-T6M	$	600.30	$	-
		2 Level Switch	$	127.00	$	254.00
		Material Total			**$**	**2,243.71**
STATION G						
240 VAC	1 Phase					
		1 NEMA 4X 24 x 24 x 8 enclosure and BP	$	425.00	$	425.00

	4 (2 to 10) AMP DIN CB (Amps TBD)	$ 17.91	$	71.63
	50 Terminals	$ 0.56	$	27.86
	6 End Barriers	$ 0.42	$	2.54
	6 End Stops	$ 0.90	$	5.41
	12 HLT Relays (voltage TBD)	$ 10.26	$	123.16
	1 DIN Rail Chunk	$ 4.25	$	4.25
	1 ML1400/24VDC Sink - 120 VAC PS	$ 575.00	$	575.00
	1 1762-IF4	$ 252.75	$	252.75
	1 SUA-500 VA Smart UPS	$ 525.00	$	525.00
	1 KPSI 750 Level Transducer	$ 950.00	$	950.00
	Material Total		**$**	**2,962.60**
STATION H				
240 VAC	1 Phase			
	4 (2 to 10) AMP DIN CB (Amps TBD)	$ 17.91	$	71.63
	50 Terminals	$ 0.56	$	27.86
	6 End Barriers	$ 0.42	$	2.54
	6 End Stops	$ 0.90	$	5.41
	12 HLT Relays (voltage TBD)	$ 10.26	$	123.16
	1 DIN Rail Chunk	$ 4.25	$	4.25
	1 ML1400/24VDC Sink - 120 VAC PS	$ 575.00	$	575.00
	1 1762-IF4	$ 252.75	$	252.75
	1 SUA-500 VA Smart UPS	$ 525.00	$	525.00
	0 2711C-T6M	$ 600.30	$	-
	1 KPSI 750 Level Transducer	$ 950.00	$	950.00
	Material Total		**$**	**2,537.60**
STATION J				
240 VAC	3 Phase			
	2 TimeMark 2644 (240 VAC)	$ 160.00	$	320.00
	4 (2 to 10) AMP DIN CB (Amps TBD)	$ 17.91	$	71.63
	50 Terminals	$ 0.56	$	27.86
	6 End Barriers	$ 0.42	$	2.54
	6 End Stops	$ 0.90	$	5.41
	20 HLT Relays (voltage TBD)	$ 10.26	$	205.27
	1 DIN Rail Chunk	$ 4.25	$	4.25
	1 ML1400/24VDC Sink - 120 VAC PS	$ 575.00	$	575.00
	1 1762-IF4	$ 252.75	$	252.75
	1 SUA-500 VA Smart UPS	$ 525.00	$	525.00
	0 2711C-T6M	$ 600.30	$	-
	1 KPSI 750 Level Transducer	$ 950.00	$	950.00
	Material Total		**$**	**2,939.71**
STATION R				
240 VAC	1 Phase			
	4 (2 to 10) AMP DIN CB (Amps TBD)	$ 17.91	$	71.63
	50 Terminals	$ 0.56	$	27.86
	6 End Barriers	$ 0.42	$	2.54
	6 End Stops	$ 0.90	$	5.41
	12 HLT Relays (voltage TBD)	$ 10.26	$	123.16
	1 DIN Rail Chunk	$ 4.25	$	4.25
	1 ML1400/24VDC Sink - 120 VAC PS	$ 575.00	$	575.00
	1 1762-IF4	$ 252.75	$	252.75
	1 SUA-500 VA Smart UPS	$ 525.00	$	525.00
	1 2711C-T6M	$ 600.30	$	600.30

	1	KPSI 750 Level Transducer	$ 950.00	$	950.00
		Material Total		**$**	**3,137.90**
STATION S					
240 VAC 3 Phase					
	2	TimeMark 2644 (240 VAC)	$ 160.00	$	320.00
	4	(2 to 10) AMP DIN CB (Amps TBD)	$ 17.91	$	71.63
	50	Terminals	$ 0.56	$	27.86
	6	End Barriers	$ 0.42	$	2.54
	6	End Stops	$ 0.90	$	5.41
	20	HLT Relays (voltage TBD)	$ 10.26	$	205.27
	1	DIN Rail Chunk	$ 4.25	$	4.25
	1	ML1400/24VDC Sink - 120 VAC PS	$ 575.00	$	575.00
	1	1762-IF4	$ 252.75	$	252.75
	1	SUA-500 VA Smart UPS	$ 525.00	$	525.00
	0	2711C-T6M	$ 600.30	$	-
		Material Total		**$**	**1,989.71**
MAIN PLANT					
	1	MDS 9810 (includes Antenna and Cable)	$ 1,877.00	$	1,877.00
	1	AB SLC 552	$ 2,167.00	$	2,167.00
	1	AB 1746-A4	$ 146.95	$	146.95
	1	AB 1746-P1	$ 195.85	$	195.85
	1	AB 1746-OX8	$ 218.45	$	218.45
	1	Hammond NEMA1 Enclosure	$ 195.61	$	195.61
	1	2711C-T10M	$ 1,185.00	$	1,185.00
		Material Total		**$**	**5,985.86**

	MCC/Other Materials	PLC Material	PanelView Material	Level Material	Programming	Installation
Station A	$ 2,344.46	$ 1,352.75	$ 600.30	$ 254.00	$ 1,000.00	$ 1,360.00
Station C	$ 1,319.46	$ 1,352.75	$ -	$ 254.00	$ 820.00	$ 1,130.00
Station D	$ 1,319.46	$ 1,352.75	$ -	$ 254.00	$ 820.00	$ 1,130.00
Station E	$ 1,539.46	$ 1,352.75	$ 600.30	$ 254.00	$ 1,000.00	$ 1,360.00
Station F	$ 636.96	$ 1,352.75	$ -	$ 254.00	$ 820.00	$ 1,130.00
Station G	$ 659.85	$ 1,352.75	$ -	$ 950.00	$ 820.00	$ 1,130.00
Station H	$ 234.85	$ 1,352.75	$ -	$ 950.00	$ 820.00	$ 1,130.00
Station J	$ 636.96	$ 1,352.75	$ -	$ 950.00	$ 1,000.00	$ 1,360.00
Station R	$ 234.85	$ 1,352.75	$ 600.30	$ 950.00	$ 820.00	$ 1,130.00
Station S	$ 636.96	$ 1,352.75	$ -		$ 820.00	$ 1,130.00
Main Plant	$ 1,877.65	$ 2,923.86	$ 1,185.00		$ 2,040.00	$ 850.00

	Materials	Labor	Contingency
Station A	$ 4,801.51	$ 3,040.00	$ 784.15
Station C	$ 3,176.21	$ 2,630.00	$ 580.62
Station D	$ 3,176.21	$ 2,630.00	$ 580.62
Station E	$ 3,996.51	$ 3,040.00	$ 703.65
Station F	$ 2,493.71	$ 2,630.00	$ 512.37
Station G	$ 3,212.60	$ 2,630.00	$ 584.26
Station H	$ 2,787.60	$ 2,630.00	$ 541.76
Station J	$ 3,189.71	$ 3,040.00	$ 622.97
Station R	$ 3,387.90	$ 2,630.00	$ 601.79
Station S	$ 2,239.71	$ 2,630.00	$ 486.97
Main Plant	$ 6,086.51	$ 2,890.00	$ 897.65
Sub Totals	**$ 38,548.21**	**$ 30,420.00**	**$ 6,896.82**
Total	**$ 75,865.03**		
Optional Total	**$ 87,745.03**		

Documentation	Construction Materials *	Labor and Materials	Contingency	Extended	with Ultrasonic Option
$ 680.00	$ 250.00	$ 7,841.51	$ 784.15	$ 8,625.66	$ 10,066.66
$ 680.00	$ 250.00	$ 5,806.21	$ 580.62	$ 6,386.83	$ 7,827.83
$ 680.00	$ 250.00	$ 5,806.21	$ 580.62	$ 6,386.83	$ 7,827.83
$ 680.00	$ 250.00	$ 7,036.51	$ 703.65	$ 7,740.16	$ 9,181.16
$ 680.00	$ 250.00	$ 5,123.71	$ 512.37	$ 5,636.08	$ 7,077.08
$ 680.00	$ 250.00	$ 5,842.60	$ 584.26	$ 6,426.86	$ 7,171.86
$ 680.00	$ 250.00	$ 5,417.60	$ 541.76	$ 5,959.36	$ 6,704.36
$ 680.00	$ 250.00	$ 6,229.71	$ 622.97	$ 6,852.68	$ 7,597.68
$ 680.00	$ 250.00	$ 6,017.90	$ 601.79	$ 6,619.69	$ 7,364.69
$ 680.00	$ 250.00	$ 4,869.71	$ 486.97	$ 5,356.68	$ 7,051.68
$ -	$ 100.00	$ 8,976.51	$ 897.65	$ 9,874.16	$ 9,874.16
				$ 75,865.03	**$ 87,745.03**

* This category includes items such as conduits, fittings, conductors, wire ties, etc. as required as required at each location. These costs will be tracked and only invoiced if incurred.

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CONTROL SYSTEM INTEGRATION • INSTRUMENTATION SALES & SERVICE
SCADA • PLC/HMI • Telemetry • Calibration • Maintenance

September 14, 2009

Virgil Koehne
Town of Discovery Bay
1800 Willow Lake Rd.
Discovery Bay, CA 94505

Subj: Radio Telemetry System Improvements - Survey Results and Recommendations
Ref: Telstar SR19583

Dear Virgil:

Last year Telstar had prepared a proposal to relocate the SCADA PC, polling master PLC, and master radio from WWTP1 to WWTP2. On August 21, I performed a radio path survey at selected telemetry sites within the Town to validate the concept of using WWTP2 as the master polling site, determine what options would be available to improve the weak communication paths, and where possible perform repairs to the system to make immediate radio communication improvements.

Attached to this memo is a the survey log. The survey results are explained in this memo, and a list of options for improving the system is also presented.

SURVEY RESULTS EXPLAINED – Reference Attachment

1. Columns C and D compare signal strengths achieved over a one year period with WWTP1 as the master polling station, using the existing master antenna and mast.
    a. At LS-A and LS-E, the radio was replaced with a repaired unit, and the RSSI (received signal strength indication) improved dramatically.
    b. Over the one year time span, RSSI at all sites (except the ones mentioned above) was the same or worse, and at LS-C, LS-G, and Lakeshore LS much worse.
    c. LS-J radio has low transmit power and should be replaced. The radio path has many houses and trees which results in poor data transmission performance.
2. Columns J and K indicate the correct direction to point at WWTP1 and the actual direction the antenna is pointing respectively, in degrees magnetic. In many cases there is a significant difference in the two columns. The directional Yagi antennas used at the remote stations have an approximate horizontal window of ±15 degrees. So correcting antenna misalignments would help improve RSSI. However in some cases there are houses or trees directly in the path and the antennas are rotated off axis to attempt to alleviate the path problem.
3. Columns H, I provide reference information about the antennas.

4. Column P indicates the RSSI values achieved in September of last year, using WWTP2 as the master polling station, using a 6dB omni-directional antenna 30' above ground level. At the remote stations, the existing antennas and masts were used, without changing the configured azimuth. I did this test as a quick "what if" scenario so it's results can be considered "worst case". If WWTP2 becomes the master polling station, then the antennas at the remote stations should be physically aligned at WWTP2.
5. Column O is similar to column P with the following differences in testing: 1) A 6dB omni-directional antenna was mounted 70 feet above ground at WWTP2. 2) At the remote stations a separate 10dB Yagi antenna was used at the height indicated in the log.
6. Column Q is the same as column P except Willow Lake WTP was used as the master radio.

SUGGESTIONS FOR RECONFIGURING THE SYSTEM TO IMPROVE RADIO PATHS

Depending on the time horizon, there are several options available. Currently, the RSView screens are viewed remotely using a remote access software called VNC (PCAnywhere is also used) via a wireless Ethernet link that is part of the video surveillance system. This access method was intended only as a stop gap measure for expedience and not intended for long term use. Ultimately it makes sense to relocate the SCADA PC, master polling PLC, and master radio from WWTP1 to WWTP2 simply because WWTP2 is where the personnel are that consume the data provided by the SCADA system. Relocating the system would eliminate the need for the Ethernet link between the two plants, eliminating a critical point of failure.

List of Options:

1. *Relocate Master station from WWTP1 to WWTP2*

   At WWTP2: install 70' antenna tower, relocate SCADA PC, polling master PLC, master radio, antenna to be high gain sector type antenna (90° beamwidth, results in superior coverage). This option results in the most efficient transfer of data, and simplest overall system configuration. The disadvantage is the cost of the new tower and the labor to implement the new polling method. Also, while almost every remote station would have a better communication path than at present, there are one or two remote stations that still would not have a clear path. Which brings us to option 2...

2. *Install repeater station at Willow Lake WTP*

   To implement this, one new radio and antenna would be added at Willow Lake, no other materials required. I have investigated this site and determined that the conduit for the antenna feedline is full, no room for another coax. Therefore all the radios would be relocated to the base of the tank, inside a small new enclosure, this will also improve signal strength due to the shorter feedlines required. The serial data lines would be extended from the PLC to the new radio enclosure, using the conduit presently used for the antenna feedlines.

   The advantages are that only one radio and antenna are added to the system. The only changes to the system would be realigning some of the remote station antennas to point at Willow Lake, so the implementation of this option could be done rapidly, one or two days. Option 1 above need not be implemented in order to implement this option. The repeater antenna would be mounted on top of the tank, so a tower is not needed.

Another advantage of this option is that several of the remote stations nearby have excellent signal strength to Willow Lake, stations that would otherwise have trouble communicating with WWTP1 or WWTP2.

The cost to implement this repeater is very low, approximately $4500 including parts and labor.

The downside is that a repeater station is another point of failure and several of the remote stations still do not have a clear path to Willow Lake so they would continue to have path issues (unless option 1 is also implemented and/or we mounted the antenna at Willow Lake 50'-80' high).

3. *No changes*
   Make no changes to radios other than repairing defective 9810s (LS-J), raising antenna masts, increasing antenna gains. This is not the lowest cost option, and will result in periodic communication failures and the resulting consequences.

4. *Change antenna polarization from vertical to horizontal*
   This is a simple change to make, the master antenna is changed to a model with horizontal polarization (material cost ~$1500), and the remote station antennas are simply rotated 90° axially. This will result in somewhat improved signal strength and also eliminate much interference, as most interference is vertically polarized.

Suggested configuration if options 1 & 2 are implemented:

Site	Suggested configuration
WWTP Plant 1	Convert to remote station, master at WWTP2. Relocate polling master PLC to WWTP2.
WWTP Plant 2	Change radio to master. Modify PLC program to be polling master.
Lift Station A	Use Willow Lake as repeater.
Lift Station C	Use Willow Lake as repeater.
Lift Station D	Use Willow Lake as repeater.
Lift Station E	Use either Willow Lake as repeater or WWTP2 70' as master.
Lift Station F	Use Willow Lake as repeater.
Lift Station G	Use Willow Lake as repeater.
Lift Station H	Use WWTP2 70' as master.
Lift Station J	Use WWTP2 70' as master, raise station antenna to 20', use higher gain antenna.
Lift Station S	Use WWTP2 70' as master, use higher gain antenna.
Lakeshore Lift Station (Village 2)	Use WWTP2 70' as master.
The Lakes Lift Station	Use either Willow Lake as repeater or WWTP2 70' as master.

(Village 3)	
Newport Drive WTP PLC 10	Use WWTP2 70' as master, raise antenna, use higher gain antenna.
West Village 4	Use Willow Lake as repeater.
Bixler School LS	Use either Willow Lake as repeater or WWTP2 70' as master.

OTHER OPTIONS

1. *TransNET*

The 9810 radio is still available from MDS, though its technology is about 15 years old. Due to the age of the Discovery Bay SCADA system, some of the radios are in need of repair, some have low transmit power, one radio's diagnostic port has failed. Some of the 9810s in use are some of the earliest units made by MDS, the ones with the black labels are no longer repairable, only 9810s with silver labels are still repairable.

The next generation of serial radio from MDS is the TransNET. The TransNET is also a 900 MHz frequency hopping spread spectrum serial radio (FHSS) like the 9810, but uses newer compression and error checking algorithms to squeeze more bandwidth into the same radio spectrum, up to 115K Baud (TransNET) versus 19,200 Baud (9810). The result is more dependable performance. The TransNET is slightly less expensive at $995 each, replacement 9810s are $1180 each.

The TransNET is not compatible with the 9810, the two models won't communicate with each other. So remote stations with TransNET radios would need to communicate with a TransNET master radio.

An option to consider would be similar to option 2 above, however the new master radio at the repeater station would be a TransNET instead of 9810. Remote stations that would communicate with this site would also need to have TransNET radios installed. The advantage to this option is more reliable communication to the remote stations. The downside is a higher installation cost as the 9810 radios at the remote stations would need to be replaced with TransNETs. Only the stations communicating with the repeater would be affected though.

2. *Other Types of Radios*

So far, I have only discussed serial radios. There are many other types of radios that could be used in this system, the list is beyond the scope of this memo. However, a common desire of many new telemetry systems is to use Ethernet capable radios. These provide many advantages. Kip Edgley has expressed a desire to modernize the SCADA system with new PLCs and radios so that online PLC editing could be performed. This would be possible with Ethernet radios. (Depending on the model of PLC used, this may also be possible using serial radios.)

Ethernet radios are available in many bands including UHF, 900 MHz, 2.4GHz, 4.9GHz, and others. Some of the considerations when selecting an Ethernet radio include: security features, frequency band, unit cost, installation costs, signal strength requirements, etc.

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I hope this memo proves useful to you and has helped clarify some of the options open to you for improving the quality of the radio communications for your SCADA system.

If you have any questions, please do not hesitate to contact me.

Best Regards,

Paul Berson
Sr. Project Manager, ext. 180

Attachment

	A	C	D	H	I	J	K	O	P	Q	R	S
1		MDS 9810 RADIO CONFIGURATION & PERFORMANCE DATA						MISC. TESTS			NOTES	
2		RSSI (dBm)/SNR (to WWTP1, using existing mast/antenna)						RSSI TESTS TO ... (dBm @ local mast Ht.)				
3	Site	8/21/2009	9/5/2008	Antenna Gain (dBd)	Antenna Height (ft above ground)	Correct Azimuth to WWTP1 (deg Magnetic)	Current Antenna Azimuth (deg Magnetic)	WWTP2 70' high master	WWTP2 30' high master	Willow Lakes WTP - 40' high master	Suggestions for existing equipment 1 - Use a higher gain antenna. 2 - Raise antenna higher. 3 - Repair radio. 4 - Antenna needs weather seal. 5 - Panel interior needs cleaning. 6 - Correct antenna azimuth.	Misc. Notes
4												
5	WWTP Plant 1		NA/20			-	-					
6	WWTP Plant 2		-58/30									
7	Lift Station A	-96	-103/22	7	12	127	118	-91 @ 24'	-105	-92	1245	Ham xmitter in path to WWTP1. Bad Battery. On 8-21-09 replaced existing radio (S/N 823618) with Telstar used radio (S/N: 97497). Old unit had low TX power.
8	Lift Station C	-111[4]	-105/20	7	12	147	125[1]	-94 @ 24'	-95	-87	145	Faces large house. Bad Battery.
9	Lift Station D	-96	-96/26	7	20	141	125		-92	-88	45	
10	Lift Station E	-96	-120/11	7	12	129	160[2]	-87 @ 12'	-120	-94	245	Bad battery.
11	Lift Station F		-87/27	2	12						45	
12	Lift Station G	-110	-106/22	7	12	145	200[2]	-87 @ 24'	-93	-67	1345	Antenna buried in Palm tree. Low TX power. Installed radio from LS-A (S/N: 823618), because LS-G radio had bad diagnostics port.
13	Lift Station H		-75/27	3	10						45	
14	Lift Station J	-111	-111/16	7	10	64	70	-88 @ 24'	-120	-108	245	Many obstructions close to station.
15	Lift Station R		-87/30								45	
16	Lift Station S	-98	-96/24	7	25	68	55		-93	-102	45	
17	Lakeshore Lift Station (Village 2)	-112	-108/21	10	25	112	135	-86 @ 24'	-114	-91	46	
18	Newport Drive Lift Station		-83/25								45	
19	The Lakes Lift Station (Village 3)	-105	-99/24	10	25	124	110	-84 @ 24'	-100	-85	46	
20	Newport Drive WTP PLC 10	-98	-98/12	7	18	89	90	-82 @ 24'	-106	-103	24	
21	Newport Drive WTP PLC 11		NA/23									
22	Willow Lakes WTP PLC 10		-91/27									
23	Willow Lakes WTP PLC 11		NA/26									
24	Well 1B		-81/25									
25	Well 2		-53/28									
26	Well 5		-75/26									
27	West Village 4	-105	-104/19	10	16	129	135	-110 @ 24'	-112	-87	2	Antenna needs drip loop.
28	Bixler School LS	-99	-99/13-24	7	16	131	135	-83 @ 24'		-86		
29	Golf Course Valve Station		-68/25								4	Antenna needs drip loop and weather seal.
30												
31												
32	Footnotes:											
33	1. Antenna is rotated so as to avoid a Palm tree in the path.											
34	2. Antenna is rotated so as to avoid a house in the path.											
35	3. -											
36	4. -96dB to WWTP1 @ 24' high away from Palm Tree in path.											

December 23, 2010

Virgil Koehne
Town of Discovery Bay
1800 Willow Lake Rd.
Discovery Bay, CA 94505

Subj: WWTP Ethernet Connectivity Recommendations
Ref: Telstar SR21316

Dear Virgil:

There are two issues that we discussed, Internet Connectivity in general, and Ethernet communication between Plant 1 and Plant 2. This memo documents some of the problems and possible solutions.

Internet Connectivity

My understanding is that Plant 2 has been experiencing problems getting on to the Internet. Plant 2 uses a wireless Ethernet link to connect to the local ISP (Internet Service Provider), Spectral. That wireless link is experiencing interference from an unknown source somewhere in the radio path. They have experimented with different equipment to try to overcome the interference but to no avail.

One possible solution that has been proposed is to use the Marina site as a repeater, since that path from the ISP to the Marina is working, and Plant 2 has a line of sight path to the Marina. I do not know if this has been tested yet. One advantage of this plan is the low cost of its implementation. One disadvantage is that there is no guarantee that those radio paths will be interference free for any length of time. Radio interference in the Wifi band is a fact of life, and there is little recourse you would have to stop the interferer.

A second possible solution would be to find a location that Comcast or AT&T services with broadband internet and relay the data from this location to either Plant 1 or Plant 2. Cherry Hills Drive runs along the west side of Plant 1 and the homes on this street do have broadband Internet access. It may be possible to get AT&T or Comcast to provide broadband to Plant 1 or even to the Golf Course Valve Station, by running the signal in an underground conduit to the nearest access point. [Note: I contacted AT&T about this and the representative I spoke to could not say definitely since I did not have an exact street address to give him on Cherry Hills Drive, but he thought it should be possible. They gave me the number of their local Engineering Office (925) 823-7341 who would confirm if it is possible. I left a message with the Engineering office.]

Plant to Plant Ethernet Connectivity

At this time, the SCADA PC is located at Plant 1, because master PLC and master radio are here. All of the remote stations, (wells, water treatment plants, lift station, etc.) communicate with Plant 1 via unlicensed frequency hopping spread spectrum radios. However, the operations staff is located at Plant 2. In order for the operations staff to have visibility of the SCADA information, a remote connection is made from a desktop PC at Plant 2 to the SCADA PC at Plant 1 over a wireless Ethernet link, using Cisco Aironet Wifi radios. This wireless link is independent of the Wifi link used for Internet access, however it uses the same radio band. The Aironet radios were provided as part of the video surveillance system and were never intended for interplant networking purposes, only for relaying video images back to the Town Offices. The Aironet radios were used for the sake of expediency as a stop gap measure, since the offices at Plant 2 had just been built and the new RSView SCADA system had just been installed, replacing the obsolete Factorylink SCADA system which was unreliable, and there was no other available means to network the two plants together.

Means by which the two plants can be networked include fiber optic cable, copper wire, and wireless. Fiber optic will permit the greatest possible bandwidth but would require the installation of approximately 3000 feet of cable, terminations, and media adapters. This would cost between $5000-$10,000 to install. Copper wire is slightly less expensive, with slightly lower performance. Fiber or copper would provide a long term, secure link between the two plants. A wireless link will provide lower bandwidth and is less secure than fiber and copper, but is significantly less expensive to install. Equipment costs are approximately $500 per site, and installation labor is minimal, ~$750 per site. You must ensure that there is a line of sight path between the antennas with absolutely no objects in the way. This may require installation of tall masts. A 40' mast for Plant 2 would cost approximately $3000 plus installation. [Note: A side benefit to installing a mast here is that it could also be used for the SCADA system radio, in case you later decide to move the master station from Plant 1 to Plant 2. Something to think about. We had provided a quote to you to do this about two years ago.]

Recommendations

Since this project is for a municipality, you are allowed to use the 4.9GHz Public Safety band. The advantage of this band is that use is restricted to public safety agencies. Generally this covers all government entities, private companies sponsored by a government entity (such as private ambulance services) and any organization with critical infrastructure (power companies, pipelines, etc.). Also, channel assignments are handled by a local frequency coordinator, therefore if anyone interferes with your signal, you have legal recourse to get them to stop. The cost of the license is minimal, ~$500 including frequency coordination labor.

You could consider installing a 4.9GHz radio at Plant 2 and another at your ISP, this might solve the Internet connectivity problem. Then install a third radio at Plant 1 to solve the plant networking problem. Alternatively, you could have AT&T or Comcast install broadband Internet access at Plant 1, and then just a pair of 4.9GHz radios, one at each plant, would solve both problems at once.

Following are two figures. Figure 1 is a satellite image showing the locations of the SCADA related stations. Figure 2 is an image indicating the path of a fiber or cable between Plant 1 and Plant 2. The path length is approximately 2800 feet.

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Figure 1 - Discovery Bay SCADA Sites

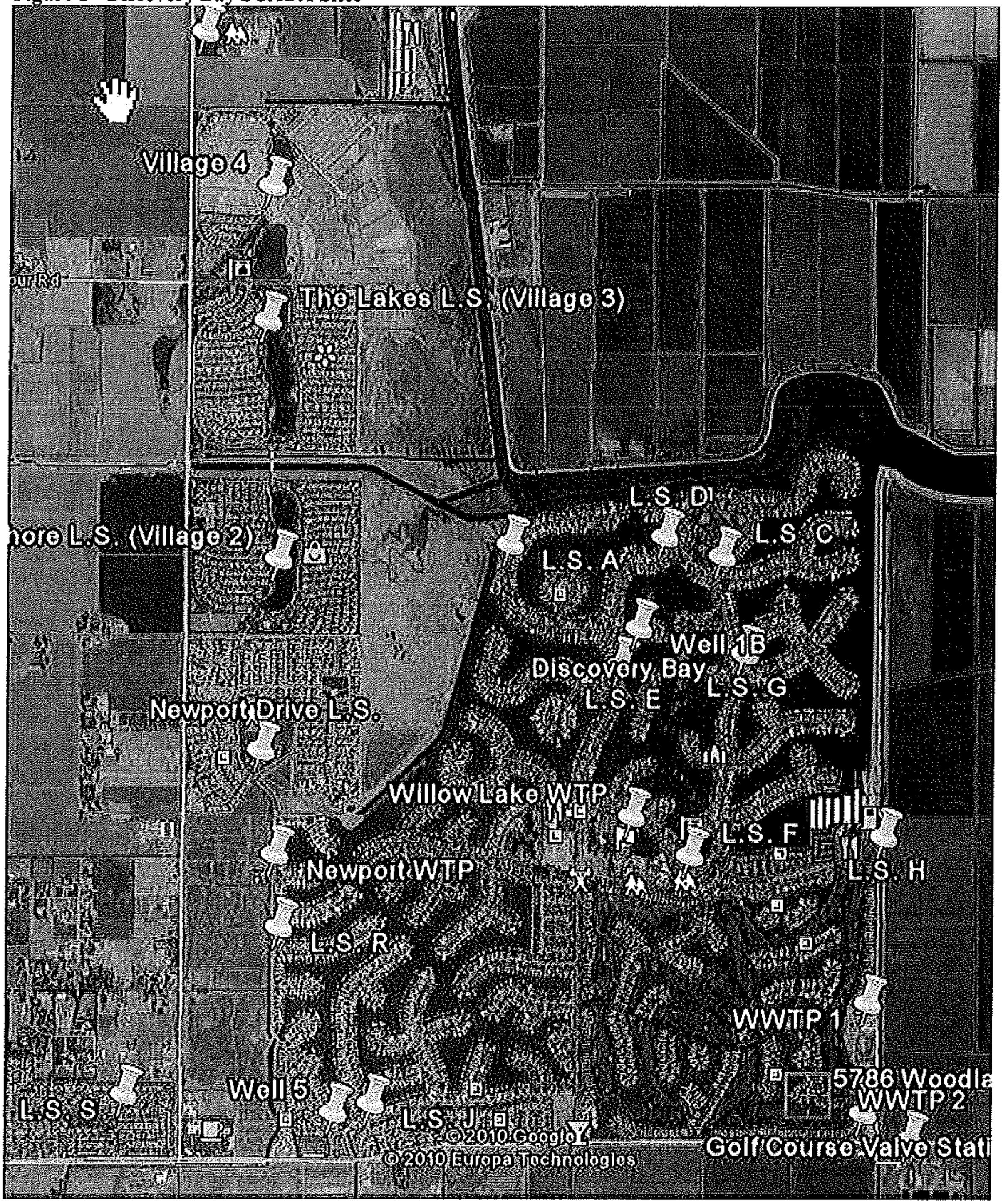

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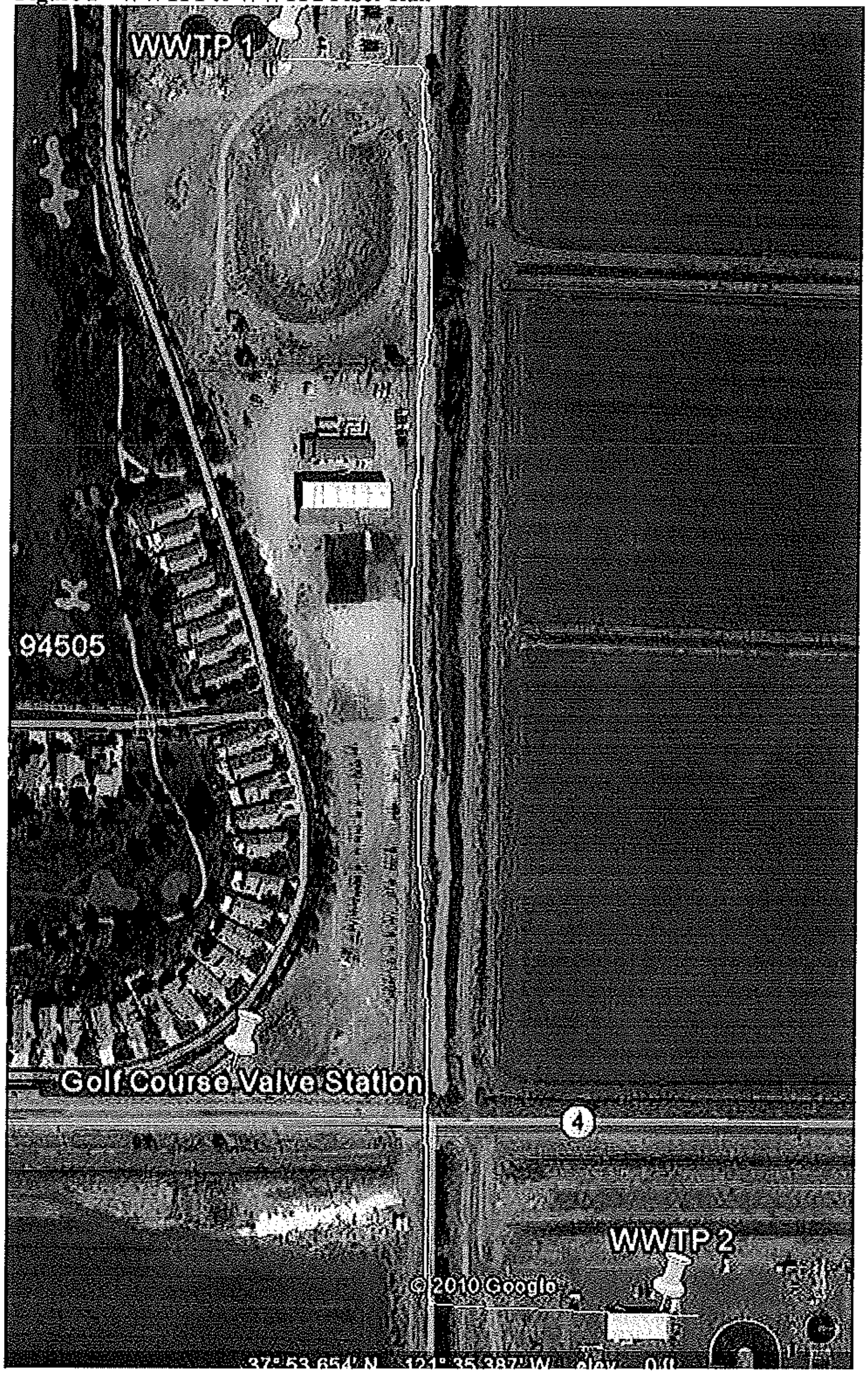
Figure 2 - WWTP1 to WWTP2 Fiber Run



Appendix C

Technical Memorandum No. 2 – Special Influent Monitoring, July 2011

Stantec

Appendix C

Town of Discovery Bay Community Services District
Technical Memorandum No. 2

Discovery Bay WWTP Special Influent Monitoring, July 2011

Prepared By: Jeffrey R. Hauser, P.E.

Reviewed By: Steven L. Beck, P.E.
Gregory Harris, P.E.

Date: September 12, 2011

1.0 BACKGROUND AND PURPOSE

A draft of the Discovery Bay Wastewater Treatment Plant Master Plan was completed in March, 2011. Because of inconsistent and questionable historical plant data, the draft Master Plan was based on existing wastewater characteristics primarily developed in a special monitoring effort conducted in December 2007 and discussed in Technical Memorandum 1. Before proceeding to finalize the Master Plan, however, it was decided to complete a second special influent monitoring effort in July 2011. The purpose of this memorandum is to present and evaluate the results of that second special monitoring effort, which was completed from July 7 through July 20, 2011.

2.0 SAMPLING METHODS

Prior to the sampling effort, a pumped mixing system was installed in each plant headworks to keep the areas both upstream and downstream of the influent screen well-mixed. Pump suction was from downstream of the screen and discharge was both upstream and downstream. To maintain a pool at the sampling location and to prevent back-mixing of RAS into the area downstream from the screen, a short (approximately 8 inches high) stop plate was to be installed downstream from each screen and upstream from the point of addition of RAS. However, a steel screen support angle mounted inside the channel was in the way and prevented the installation of the stop plate in the Plant 2 headworks. Therefore, the pumped mixing system was not operated in the Plant 2 headworks. Although it had been planned to take samples from downstream of each screen to eliminate the issue of rag accumulation on the sample intake strainer, a phenomenon that has historically impaired proper sampling and has resulted in questionable data, this was not possible at Plant 2 because of the inability to install the stop plate. Therefore, except as otherwise noted, all samples from both plants were taken upstream from the respective screens. To prevent rag accumulation on the sample intake strainer, plant operators installed the sample intake tube and strainer within a vertical perforated pipe in each of the headworks channels. The vertical pipes were 6-inch and 3-inch diameter for Plants 1 and 2, respectively. Perforations were approximately 1-inch diameter and were spaced several inches apart both vertically and horizontally (around the circumference of the pipe).

The flow in the headworks at each plant is intermittent, based on cycling of the plant influent pumps. The pump cycle times are variable with influent flow. When observed at about 10:30 AM on August 17, 2011, pump on and off times were about 3 minutes each for the pumps serving Plant 2.

Based on field observations by Stantec and Herwit on August 17, 2011, the sampling locations in both plants were well-mixed while the influent pumps were operating. In Plant 1, with the pumped mixing system, the sampling location remained well-mixed, even when the influent pumps were not operating. At Plant 2, however, the sampling location was not well mixed when the influent pumps were not in operation. However, as discussed below, this is not believed to have significantly impacted the samples.

With flow proportional sampling, an automatic sampling sequence can be initiated only when the influent pumps are on. However, since a sample sequence includes purge and sample draw times and can last for approximately one minute, it is likely that some sampling events were started while the plant influent pumps were running, but were completed after the pumps had stopped. With the mixed pool at the sample location in Plant 1, this phenomenon would not be of concern, as the sample tube would always be submerged in well-mixed sewage, whether the influent pumps were running or not. At Plant 2, however, when the influent pumps stopped running, there was no significant mixing at the sample location and the water level dropped, possibly below the sampler intake tube. It is believed that this did not significantly impact the 24-hour composite sample characteristics for the following reasons:

1. The probability of drawing substantial sample volumes while the influent pumps were not running is low.
2. To the extent sampling events did extend into times when the influent pumps were not running, the sample sequences would have been completed very soon after the influent pumps stopped and before significant settling of suspended solids could have occurred.
3. If the water level did drop below the sample intake tube when the influent pumps were off, no samples would have been drawn at such times.

At Plant 1, return flows from an experimental wetlands system are pumped into the headworks at a location that was immediately downstream from the sample intake point. With the pumped mixing system, the wetlands return flow could have resulted in dilution of the plant influent sample if the wetlands return pumps happened to be operating during a sample event that continued after the plant influent pumps had stopped. Because the probability of such occurrences is believed to be low, it is likely that 24-hour composite samples would not have been significantly affected. If the wetlands return pumps were operating at the same time as the plant influent pumps, the high velocity in the headworks channel would have likely prevented back-mixing of the wetlands return flow to the sample intake location.

Twenty-four-hour flow-proportional composite influent samples were taken daily at each plant from July 7 through July 20, 2011. On July 19 and 20, samples were taken both upstream and downstream of the screen at Plant 1. In addition to influent sampling, grab samples were taken of the mixed liquor in the Plant 1 oxidation ditch on four occasions (July 11, 18, 19, and 20).

3.0 MONITORING RESULTS AND DISCUSSION

The influent constituents that were monitored for and the results are shown in Table 1. Also shown in Table 1 are ratios of Plant 2 concentrations to Plant 1 concentrations for the constituents monitored for Plant 2. Ratios of different constituent concentrations within each plant are shown in Table 2. Influent COD, BOD, TSS, and TKN constituent concentrations for Plants 1 and 2 are shown graphically in Figures 1 and 2, respectively. In Figures 3 through 6, the results for Plant 1 are compared to the results for Plant 2 for COD, BOD, TSS, and TKN, respectively. In Figures 7 through 10, respectively, the following constituent ratios are shown for both plants: COD/BOD, TSS/BOD, TKN/BOD, and VSS/TSS.

Key observations from the results are presented below:

1. During the sampling period, the influent wastewater for both plants was relatively low in strength. For example, the average influent BOD was only 146 and 168 mg/L, respectively, for Plants 1 and 2. This compares to an average of 238 mg/L determined in a similar monitoring effort in December 2007. TSS values were 145 and 158 mg/L for Plants 1 and 2, respectively, compared to 356 mg/L in December 2007.
2. Although there was significant variability, average constituent ratios for both plants were in-line with typical values for domestic sewage, which are as follows: COD/BOD = 2.0, TSS/BOD = 1.0, TKN/BOD = 0.20, VSS/TSS = 0.90, NH3-N/TKN = 0.7.
3. The influent to Plant 2 was generally about 15% to 30% higher in strength than that to Plant 1.

As noted under Item 1, above, the July 2011 monitoring results indicate a lower strength wastewater than the December 2007 results. Plant effluent flows were similar during both monitoring periods (average of 1.61 Mgal/d and 1.57 Mgal/d for the 2007 and 2011 monitoring periods, respectively), so differences in dilution with I/I is not believed to be a factor. For the December 2007 monitoring effort, high TSS values (including 4 of 14 results above 500 mg/L) and high ratios of TSS/BOD (including 12 of 14 results above 1.3) were troubling. Such results can occur when the sample intake is on the floor and the sampling location is not well-mixed, leading to excessive intake of solids that tend to settle on the floor. This would increase both the BOD and TSS, but the TSS would increase more, leading to high TSS/BOD ratios. For the current monitoring effort (July 2011), care was generally taken to sample from well-mixed locations several inches above the floor. Excessively high TSS values were not seen in the July 2011 monitoring effort and the TSS/BOD ratios were, on average, in-line with expectations.

Constituent ratios for COD/BOD and TKN/BOD were also more consistent and in-line with expectations in July 2011 than in December 2007. In these regards, the 2011 monitoring results would seem to be more reliable than those in 2007. However, the overriding issue with the July 2011 data is that the indicated wastewater strength is too low to be credible based on the District population, as discussed later in this document.

In comparing the results for samples before and after the screen in the Plant 1 headworks on July 19 and 20, no statistically significant difference is noted. This is not surprising for two reasons: 1) the screens remove rags and large solids that would not be expected to significantly change sample characteristics, and 2) the pumped mixing system resulted in blending of the wastewater from before and after the screen.

3.1 Flows and BOD Loads

Plant flow data for the monitoring period are shown in Table 3. The flow data are dated from July 6 through July 19, which is one day prior to the sample dates shown in Table 1. This is because a 24-hour composite sample completed in the morning on a given date is most representative of the plant influent on the previous date.

Influent flows to each plant were monitored using a magnetic flow meter at the influent pump station and the flume in that plant's headworks. In general, the flumes seemed to indicate slightly higher flows than the magnetic flow meters. The combined plant effluent flow is measured using a flume. The flow readings from the effluent flume were substantially higher than the sum of the influent flows to the two plants. For example, the average flow for the monitoring period was 1.574 Mgal/d based on the effluent flow meter and 1.307 Mgal/d based on the sum of averaged influent flume and magnetic flow meter results for the two plants.

The averaged influent flume and magnetic flow meter values indicated in Table 3 were used together with the respective plant influent BOD concentration data to calculate influent BOD loads to the two plants, as shown in Table 4. Also shown in the table are the total flows and BOD loads for both plants based on the influent flow meters and the combined average influent BOD concentration (calculated from the total flow and total load). Finally, in Table 4, the BOD loads that would be implied by using the effluent flows combined with the total averaged influent BOD concentrations are shown. As indicated in the table, the BOD loads calculated based on influent flows and those based on effluent flows result in per capita BOD loads of about 0.13 and 0.16 lb/d, respectively (based on a District population of 13,352 from the 2010 census). These per capita BOD loads are considered to be too low to be credible. For communities with garbage grinders, the 10 States Standards recommends an average design BOD load of 0.22 lb/d per person. Based on studies in other communities in California, this is believed to be a realistic criterion.

3.2 Consideration of Plant Sludge Yield as a Check on Influent BOD Loads

The amount of waste activated sludge (WAS) produced in the secondary treatment system should be roughly proportional to the influent BOD load. For example, with reactor temperatures around 20 °C and operating mean cell residence times near 15 days, the sludge yield would be expected to be around 0.75 to 0.95 pounds of total sludge solids per pound of influent BOD load. Therefore, long-term sludge production data, if available and reliable, can be used as a rough back check on influent BOD load.

Although WAS flows are monitored and recorded in each plant, these flows must be combined with WAS solids concentrations to determine the mass of sludge solids produced. Unfortunately, reliable data on WAS concentrations are not available. When WAS quantities were determined for plant monitoring records, it was presumed that the WAS concentration was equal to the then most recently determined return activated sludge (RAS) concentration. However, this would be true only if the ratio of the clarifier underflow to the total clarifier influent flow (i.e., [RAS + WAS] / [Q + RAS + WAS]) was constant while wasting was in progress and if this ratio and the oxidation ditch mixed liquor solids concentration were the same at the time of wasting as at the time of the most recent RAS sampling. This cannot be presumed. Therefore, the WAS mass production data is unreliable, which was confirmed by plant operations staff.

As part of this investigation, an attempt was made to estimate sludge yield based on a mass balance for phosphorus. Since phosphorus is conserved within a wastewater treatment plant, the total amount of phosphorus in the waste sludge plus net accumulation in the oxidation ditch should be equal to the influent total phosphorus minus the effluent total phosphorus. If the amount of phosphorus that should be in the sludge is determined in this manner, then the total sludge yield can be determined based on the ratio of total phosphorus to total solids (TP/TSS) in the oxidation ditch mixed liquor.

Influent and effluent total phosphorus concentrations and the amount of phosphorus removed in Plant 1 (as concentrations and loads) are shown in Table 5. As shown, in the table, the apparent phosphorus removal from the liquid stream was erratic, ranging from -1.7 to 4.8 lb/d. Negative values would indicate phosphorus was being released into the liquid stream from solids in the oxidation ditch. Although such releases could theoretically occur if the plant was accomplishing enhanced biological phosphorus removal and the ditch was allowed to go partially anaerobic or if there was a substantial decrease in pH resulting in the dissolution of particulate phosphorus, it is unlikely that either of these phenomena were occurring, so the apparent zero and negative removals are questioned. From the morning of July 11 to the morning of July 20 (dates corresponding with mixed liquor data discussed below), the total amount of phosphorus removed from the liquid stream was 10.4 lb (based on removals indicated for the nine days from the sample ending July 12 through the sample ending on July 20).

Mixed liquor monitoring results for Plant 1 are shown in Table 6. The variability in mixed liquor phosphorus concentrations indicated in the table is questionable. In particular, it is highly unlikely that the phosphorus concentration could change from 15 to 13 to 16 mg/L from July 18 to July 20. However, based on the data, there was a net accumulation of total phosphorus in Oxidation Ditch 1 of 8.3 lbs from July 11 through July 20. Adding this to the phosphorus removed from the liquid stream during the same period (10.4 lbs, from above), a total of 18.7 lbs of phosphorus was apparently incorporated in sludge solids over the nine days, or 2.08 lb/d. At an average beginning and ending sludge solids phosphorus content of 0.726 percent, this would indicate an apparent average sludge production of 287 lb/d. During the same period, the apparent influent BOD load to Plant 1 (from Table 4, based on averaged influent flow meter readings) was 572 lb/d, indicating an apparent sludge yield of 0.50 lb TSS per lb of BOD. This sludge yield is too low to be credible. The sludge production should be at least 50% greater even for the apparent low influent BOD load, and higher yet if the actual influent BOD load is greater than indicated in Table 4. More data over a longer period of time would be needed to have confidence in the results.

Based on all of the above, reliable sludge production data are not available to be used as a check on the influent BOD load.

3.3 INVESTIGATION OF POSSIBLE INFLUENT SAMPLING ISSUES

As previously noted, it had been planned to take influent samples downstream from the screen in each plant, where rag accumulation on the sample intake strainer would not be a problem. A pumped mixing system was to be operated in each of the headworks to make sure that wastewater upstream and downstream of the screen was well-mixed at all times. Unfortunately, due to the inability to install the required stop plate in the Plant 2 headworks, the planned sampling program was altered and all samples were taken upstream of the respective screens in both plants. Rag accumulation on the sample intake in each plant was prevented by installing the sample tube and strainer in a perforated pipe. Although it would not be expected that the perforated pipe could have impacted the sample characteristics, it was desired to verify this expectation.

Another possible issue with the July 2011 sampling methodology is that the sample strainer and tubing could have supported attached biological growth that would have changed sample characteristics. For example, it has been noted elsewhere that, unless the sample tube and strainer are frequently cleaned and disinfected or replaced, readily biodegradable BOD can be taken up by the attached biological growths on the tube and strainer. In this regard, significant biological growth was noted on the sample strainer at Plant 1 during the August 17 site visit by author of this memorandum. In discussing this potential issue with plant operations staff, it was determined that the sample tube and strainer are cleaned or replaced only once per quarter.

To investigate the two potential issues indicated above, on August 26, 2011, three one-hour manually composited samples were taken during the same periods as three one-hour automatic sampler composites. Each manual composite sample was developed by taking equal grab sample volumes during each influent pump operation cycle and then mixing all of the grab samples together. From the monitoring results shown in Table 7, no particular pattern or tendency for the manual composite sample to be different from the automatic sampler composite sample is noted. Therefore, it does not appear that the sample tube and strainer location in a perforated pipe or biological growths on the sample tube and/or strainer substantially impacted sampling results.

3.4 SUMMARY AND RECOMMENDATIONS

The July 2011 special monitoring results indicate a very low strength wastewater with BOD and TSS concentrations generally in the range of 100 to 200 mg/L. However, the low strength is questioned for the following reasons:

1. Influent BOD and TSS concentrations in the range of 100 to 200 mg/L are highly unusual for relatively modern communities in California (and elsewhere). For example, long-term average concentrations in the Cities of Brentwood, Lathrop, and Manteca are about 350 mg/L, 325 mg/L and 325 mg/L, respectively (based on previous studies completed by the author of this memorandum).
2. When combined with wastewater flow rates, the apparent low influent strength for Discovery Bay would indicate BOD loads around 0.13 lb/d per capita, which is too low to be credible. The average per capita loading established in the 10 States Standards for communities with garbage grinders is 0.22 lb/d per capita, which has been found to be a reasonable criterion for agencies in California.

A hypothetical partial explanation for low influent BOD and TSS concentrations could be dilution of the sewage with groundwater entering the collection system (infiltration). However, this would not explain the low influent BOD and TSS loads entering the plant. Hypothetical explanations for the low loads could include the following:

1. The actual population in Discovery Bay could have been reduced since the 2010 census due to poor economic conditions and home mortgage foreclosures.
2. Many of the residents of Discovery Bay go outside of the community for work or school, resulting in partial displacement of wastewater loads that would otherwise be expected within the community.

At this time, the hypothetical explanations given above have not been investigated, but it is considered unlikely that these hypotheses could adequately explain the apparent low influent wastewater loads. Unless and until an adequate explanation for loads as low as those seen in the July 2011 special monitoring effort can be developed, planning and design for the Discovery Bay WWTP should be based on more typical and conservative criteria.

Table 1
Influent and Effluent Monitoring Data

Sample	Plant 1 Influent, mg/L								P1 Eff, mg/L	Plant 2 Influent, mg/L						Ratio - Plant 2 / Plant 1					
Date	BOD	COD	TSS	VSS	TKN	NH3N	ALK	TP	TP	BOD	COD	TSS	VSS	TKN	NH3N	BOD	COD	TSS	VSS	TKN	NH3N
7/7/2011	160	320	163	152	28	23	466	3.5	3.2	170	360	178	159	32	25	1.06	1.13	1.09	1.05	1.14	1.09
7/8/2011	150	310	87	80.5	29	23	461	3.8	3.3	160	430	198	170	34	20	1.07	1.39	2.28	2.11	1.17	0.87
7/9/2011	170	350	142	132	30	20	471	3.9	3.5	160	390	124	110	32	21	0.94	1.11	0.87	0.83	1.07	1.05
7/10/2011	190	390	140	133	32	21	461	3.6	2.9	180	410	152	139	34	23	0.95	1.05	1.09	1.05	1.06	1.10
7/11/2011	140	340	153	139	30	16	448	3.6	3.1	180	440	154	138	35	20	1.29	1.29	1.01	0.99	1.17	1.25
7/12/2011	150	310	129	122	30	17	455	3.2	2.9	160	490	143	133	30	20	1.07	1.58	1.11	1.09	1.00	1.18
7/13/2011	130	300	167	152	25	18	442	3.2	3	170	370	156	140	31	25	1.31	1.23	0.93	0.92	1.24	1.39
7/14/2011	130	310	102	92	27	18	430	3.1	2.9	170	380	99	86	31	24	1.31	1.23	0.97	0.93	1.15	1.33
7/15/2011	140	310	105	96.5	24	15	424	2.9	2.9	190	350	122	107	31	24	1.36	1.13	1.16	1.11	1.29	1.60
7/16/2011	200	350	179	165	23	13	443	2.6	3	160	410	166	151	32	23	0.80	1.17	0.93	0.92	1.39	1.77
7/17/2011	100	190	186	176	26	18	431	2.7	2.7	200	360	179	159	31	23	2.00	1.89	0.96	0.90	1.19	1.28
7/18/2011	120	170	176	157	30	20	450	3.7	2.9	140	220	191	172	33	23	1.17	1.29	1.09	1.10	1.10	1.15
7/19/2011	120	260	156	142	34	19	455	3.9	2.9	150	380	196	182	32	21	1.25	1.46	1.26	1.28	0.94	1.11
7/20/2011	150	420	147	136	27	20	446	3.2	2.9												
Average	146	309	145	134	28	19	449	3.35	3.01	168	384	158	142	32	22	1.20	1.30	1.13	1.10	1.15	1.24
	Plant 1 Influent - After Screen																				
7/19/2011	120	400	138	128	29	16		3.5													
7/20/2011	150	450	179	165	28	19	446	3.3													

Table 2
Influent Constituent Ratios

Sample Date	Plant 1 Influent					Plant 2 Influent				
	COD/BOD	TSS/BOD	VSS/TSS	TKN/BOD	NH3/TKN	COD/BOD	TSS/BOD	VSS/TSS	TKN/BOD	NH3/TKN
7/7/2011	2.00	1.02	0.93	0.18	0.82	2.12	1.05	0.89	0.19	0.78
7/8/2011	2.07	0.58	0.93	0.19	0.79	2.69	1.24	0.86	0.21	0.59
7/9/2011	2.06	0.84	0.93	0.18	0.67	2.44	0.78	0.89	0.20	0.66
7/10/2011	2.05	0.74	0.95	0.17	0.66	2.28	0.84	0.91	0.19	0.68
7/11/2011	2.43	1.09	0.91	0.21	0.53	2.44	0.86	0.90	0.19	0.57
7/12/2011	2.07	0.86	0.95	0.20	0.57	3.06	0.89	0.93	0.19	0.67
7/13/2011	2.31	1.28	0.91	0.19	0.72	2.18	0.92	0.90	0.18	0.81
7/14/2011	2.38	0.78	0.90	0.21	0.67	2.24	0.58	0.87	0.18	0.77
7/15/2011	2.21	0.75	0.92	0.17	0.63	1.84	0.64	0.88	0.16	0.77
7/16/2011	1.75	0.90	0.92	0.12	0.57	2.56	1.04	0.91	0.20	0.72
7/17/2011	1.90	1.86	0.95	0.26	0.69	1.80	0.90	0.89	0.16	0.74
7/18/2011	1.42	1.47	0.89	0.25	0.67	1.57	1.36	0.90	0.24	0.70
7/19/2011	2.17	1.30	0.91	0.28	0.56	2.53	1.31	0.93	0.21	0.66
7/20/2011	2.80	0.98	0.93	0.18	0.74					
Average	2.12	1.03	0.92	0.20	0.66	2.29	0.95	0.90	0.19	0.70

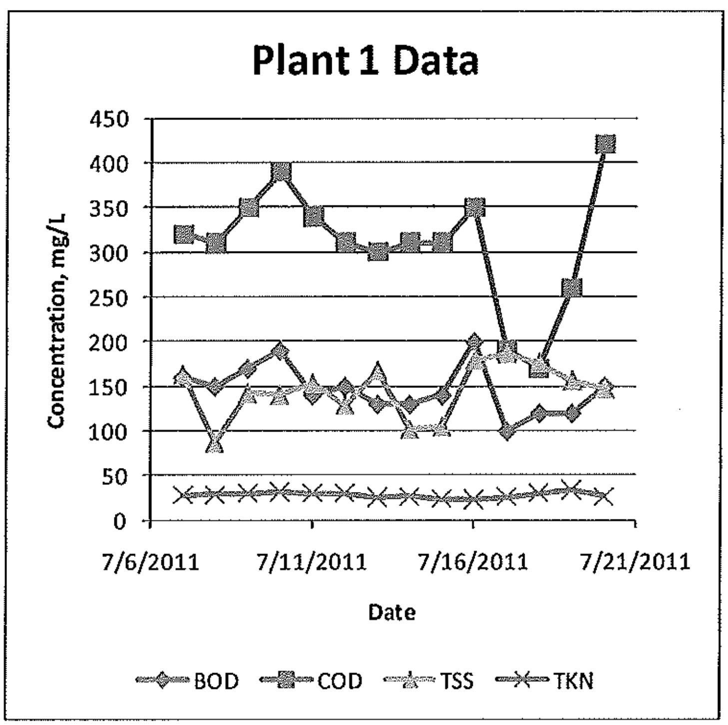


Figure 1
Plant 1 Monitoring Results

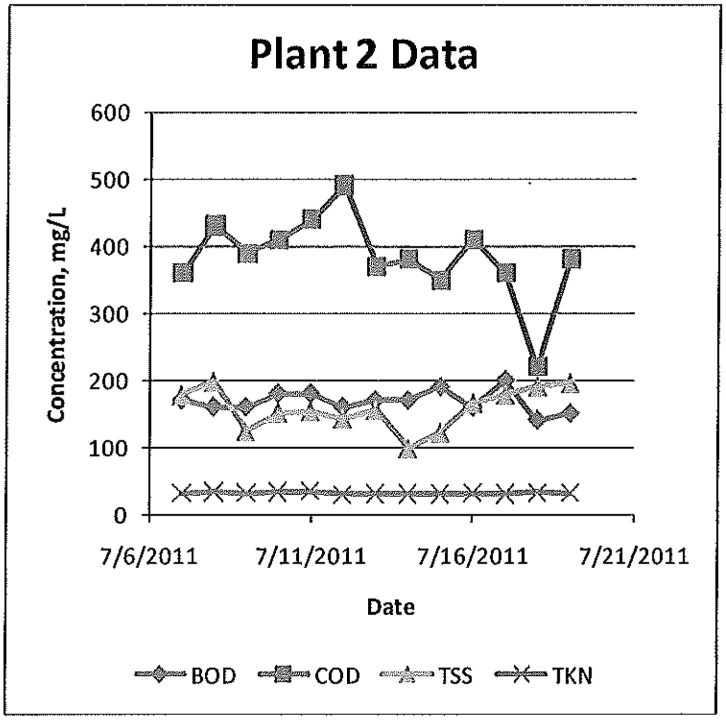


Figure 2
Plant 2 Monitoring Results

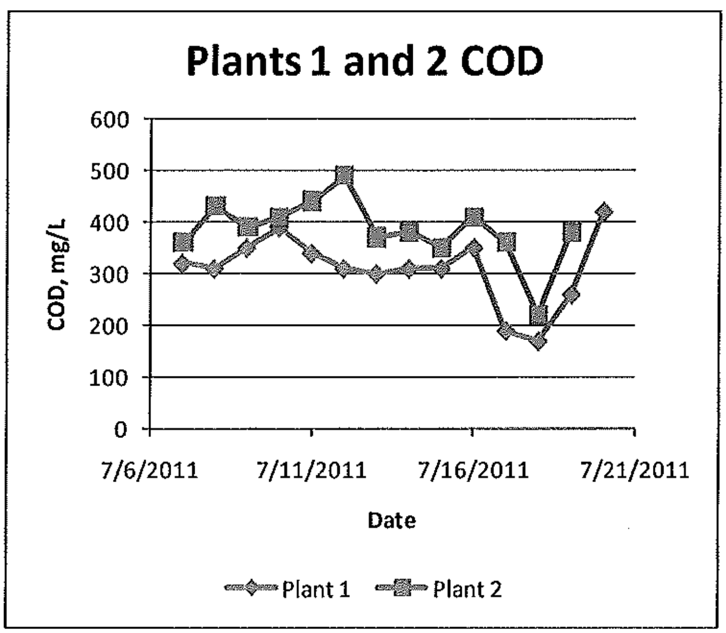


Figure 3
Plants 1 and 2 COD Results Comparison

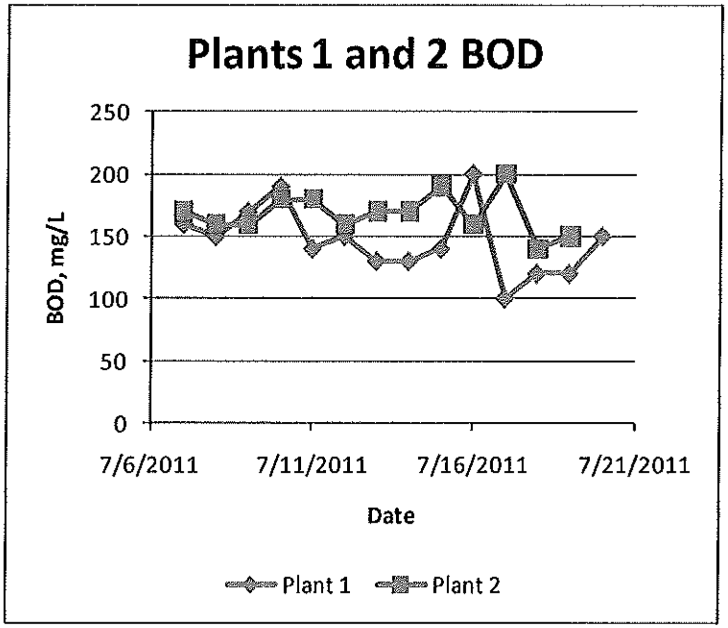


Figure 4
Plants 1 and 2 BOD Results Comparison

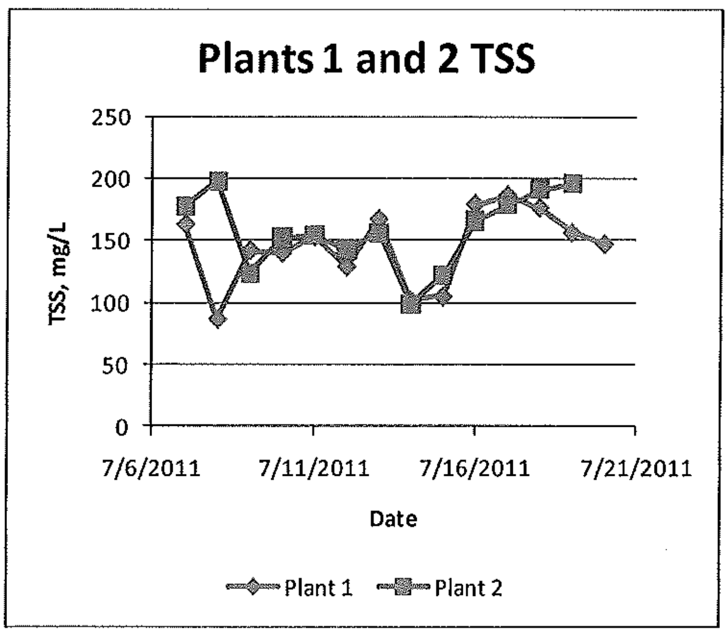


Figure 5
Plants 1 and 2 TSS Results Comparison

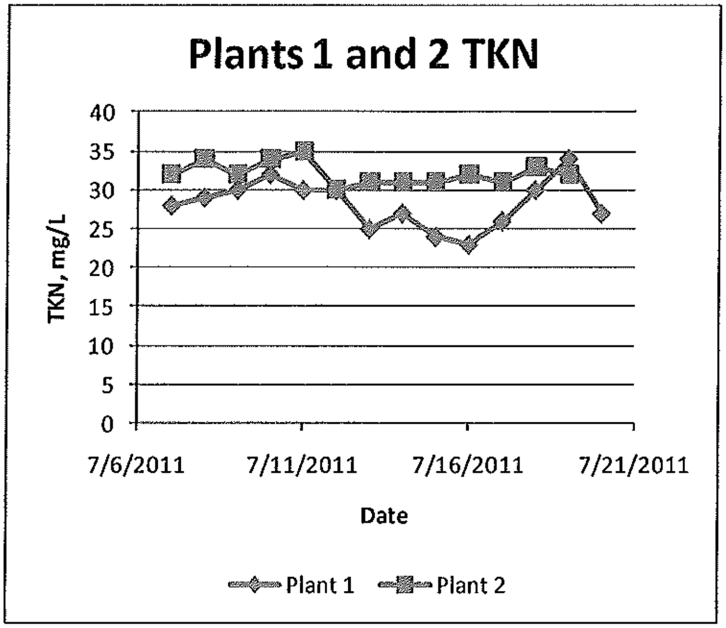


Figure 6
Plants 1 and 2 TKN Results Comparison

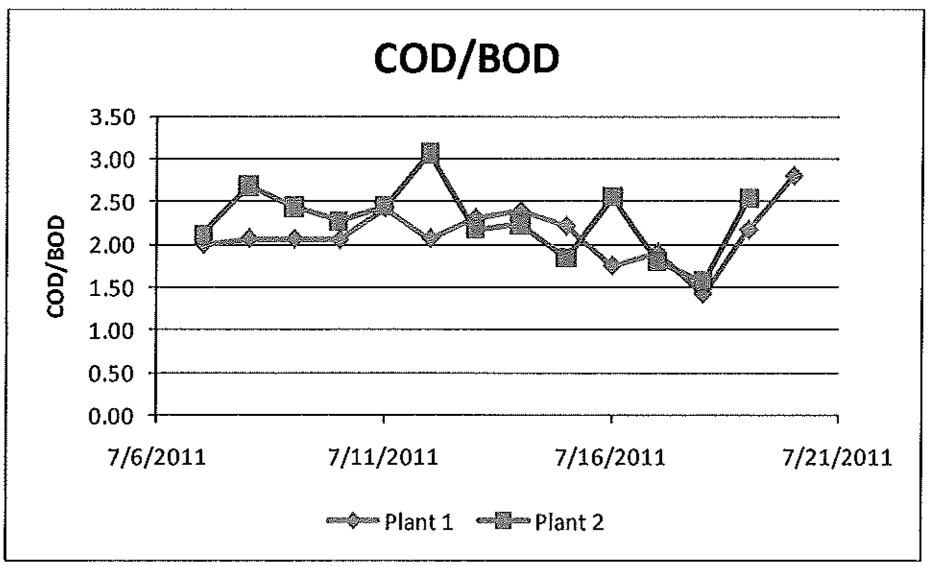


Figure 7
Plants 1 and 2 COD/BOD

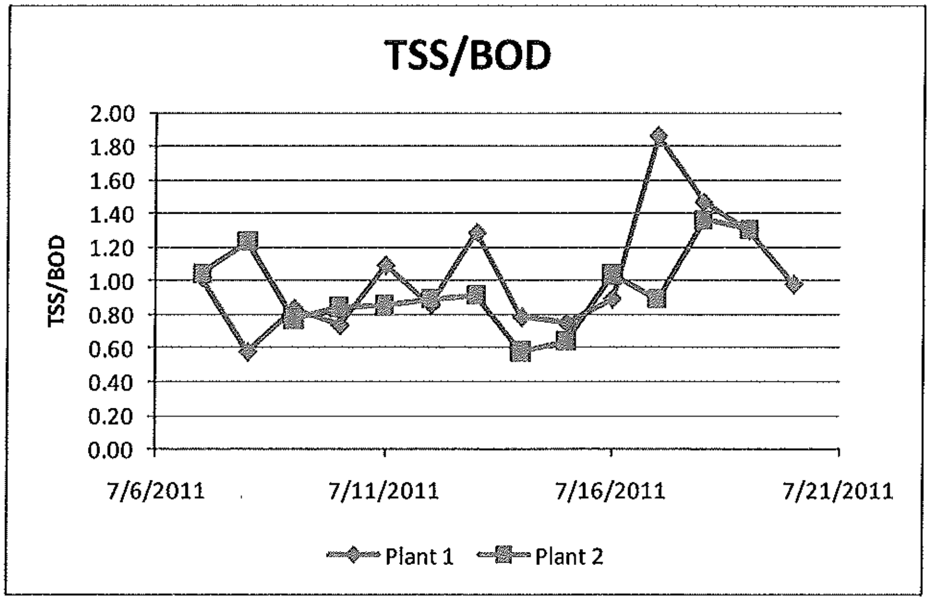


Figure 8
Plants 1 and 2 TSS/BOD

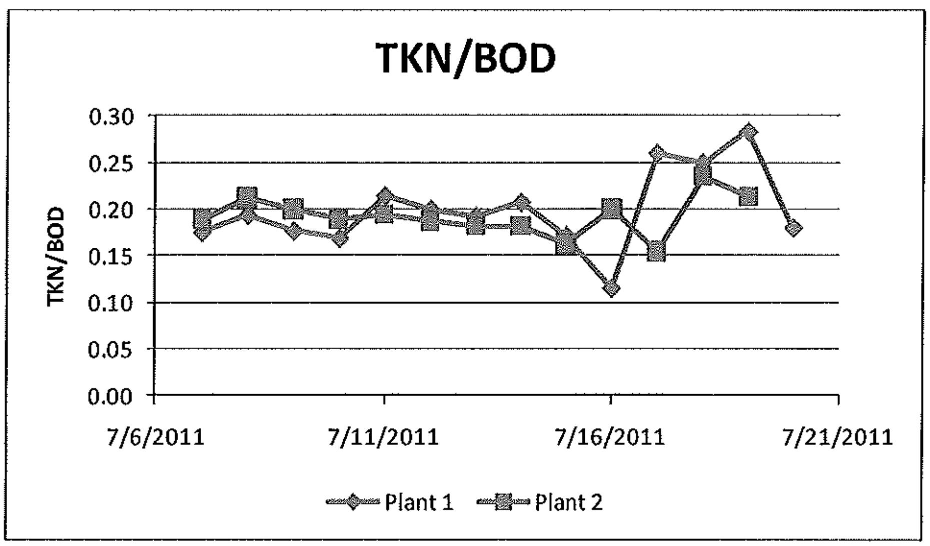


Figure 9
Plants 1 and 2 TKN/BOD

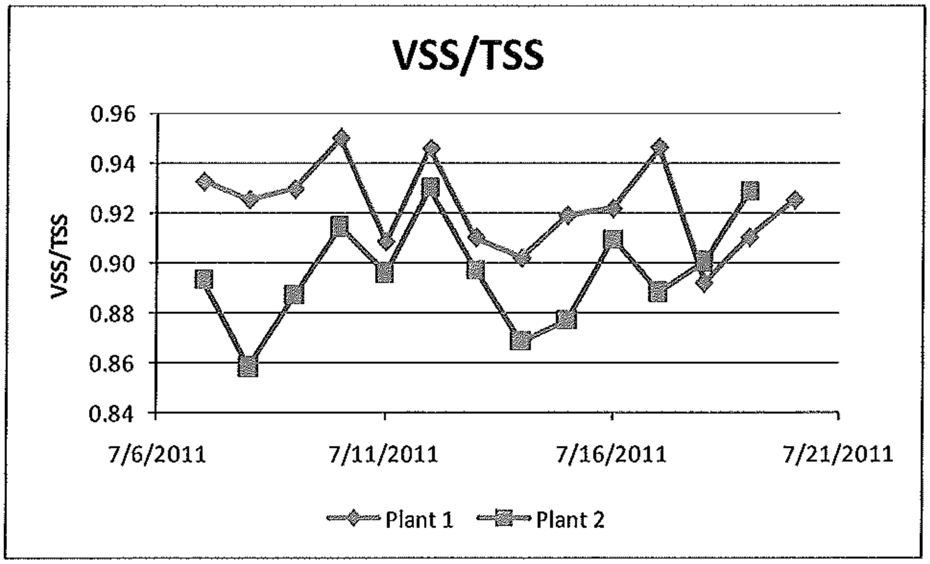


Figure 10
Plants 1 and 2 VSS/TSS

Table 3
Flow Data

Date	Effluent Flow, Mgal/d	Plant 1 Influent Flow			Plant 2 Influent Flow			Total Influent Flow		
		Flume Mgal/d	Mag. Mgal/d	Avg. Mgal/d	Flume Mgal/d	Mag. Mgal/d	Avg. Mgal/d	Flume Mgal/d	Mag. Mgal/d	Avg. Mgal/d
7/6/2011	1.470	0.700	0.622	0.661	0.631	0.530	0.580	1.331	1.152	1.241
7/7/2011	1.410	0.660	0.604	0.632	0.640	0.576	0.608	1.300	1.180	1.240
7/8/2011	1.640	0.630	0.581	0.606	0.777	0.713	0.745	1.407	1.294	1.351
7/9/2011	1.730	0.440	0.462	0.451	1.010	0.953	0.981	1.450	1.415	1.432
7/10/2011	1.650	0.540	0.445	0.492	0.938	0.827	0.882	1.478	1.272	1.375
7/11/2011	1.590	0.520	0.478	0.499	0.851	0.749	0.800	1.371	1.227	1.299
7/12/2011	1.470	0.500	0.455	0.478	0.837	0.778	0.807	1.337	1.233	1.285
7/13/2011	1.580	0.470	0.417	0.444	0.871	0.763	0.817	1.341	1.180	1.261
7/14/2011	1.510	0.440	0.424	0.432	0.872	0.767	0.820	1.312	1.191	1.252
7/15/2011	1.630	0.510	0.481	0.495	0.877	0.796	0.836	1.387	1.277	1.332
7/16/2011	1.750	0.540	0.489	0.515	0.987	0.892	0.940	1.527	1.381	1.454
7/17/2011	1.540	0.450	0.466	0.458	0.858	0.774	0.816	1.308	1.240	1.274
7/18/2011	1.560	0.620	0.521	0.571	0.701	0.643	0.672	1.321	1.164	1.242
7/19/2011	1.510	0.600	0.571	0.585	0.705	0.648	0.677	1.305	1.219	1.262
Average	1.574	0.544	0.501	0.523	0.825	0.743	0.784	1.370	1.245	1.307

Table 4
BOD Loads

Sample Date	Plant 1 - Influent Flow Basis: Influent Flow Mgal/d (a)	Plant 1: BOD Conc. mg/L	Plant 1: BOD Load lb/d	Plant 2 - Influent Flow Basis: Influent Flow Mgal/d (a)	Plant 2: BOD Conc. mg/L	Plant 2: BOD Load lb/d	Total - Influent Flow Basis: Influent Flow Mgal/d (a)	Total Infl.: BOD Conc. mg/L (b)	Total Infl.: BOD Load lb/d (b)	Total Infl.: Flow Per Cap. gal/d (c)	Total Infl.: BOD Per Cap. lb/d (c)	Total - Effluent Flow Basis: Effluent Flow Mgal/d (d)	Total Effl.: BOD Conc. mg/L (e)	Total Effl.: BOD Load lb/d (f)	Total Effl.: Flow Per Cap. gal/d (c)	Total Effl.: BOD Per Cap. lb/d (c)
7/7/2011	0.661	160	882	0.580	170	823	1.241	165	1705	93	0.128	1.470	165	2019	110	0.151
7/8/2011	0.632	150	791	0.608	160	811	1.240	155	1602	93	0.120	1.410	155	1822	106	0.136
7/9/2011	0.606	170	858	0.745	160	994	1.351	164	1853	101	0.139	1.640	164	2250	123	0.168
7/10/2011	0.451	190	715	0.981	180	1473	1.432	183	2188	107	0.164	1.730	183	2643	130	0.198
7/11/2011	0.492	140	575	0.882	180	1325	1.375	166	1900	103	0.142	1.650	166	2280	124	0.171
7/12/2011	0.499	150	624	0.800	160	1068	1.299	156	1692	97	0.127	1.590	156	2071	119	0.155
7/13/2011	0.478	130	518	0.807	170	1145	1.285	155	1663	96	0.125	1.470	155	1902	110	0.142
7/14/2011	0.444	130	481	0.817	170	1158	1.261	156	1639	94	0.123	1.580	156	2055	118	0.154
7/15/2011	0.432	140	504	0.820	190	1299	1.252	173	1803	94	0.135	1.510	173	2175	113	0.163
7/16/2011	0.495	200	826	0.836	160	1116	1.332	175	1943	100	0.146	1.630	175	2377	122	0.178
7/17/2011	0.515	100	429	0.940	200	1567	1.454	165	1996	109	0.150	1.750	165	2403	131	0.180
7/18/2011	0.458	120	458	0.816	140	953	1.274	133	1411	95	0.106	1.540	133	1706	115	0.128
7/19/2011	0.571	120	571	0.672	150	841	1.242	136	1412	93	0.106	1.560	136	1772	117	0.133
7/20/2011	0.585	150	732	0.677			1.262			95		1.510			113	
Average	0.523	146	640	0.784	168	1121	1.307	160	1754	98	0.131	1.574	160	2113	118	0.158

(a) Flows are average of influent magnetic flow meter and flume reading at each plant.
Flows shown are for day prior to sample date, because samples are 24-hour composites.
(b) Load is total load for both plants. Concentration is determined based on total flow and total load.
(c) Per capita values are based on District population of: 13,352
(d) Total effluent flow from both plants as measured at the effluent flow meter.
(e) BOD concentrations are the same as for the total influent flow based analysis.
(f) Load is calculated based on effluent flow and influent concentration.

Table 5
Plant 1 Phosphorus Removal

Sample Date	Inf. Flow Mgal/d	Inf. TP mg/L	Eff. TP mg/L	Delta TP mg/L	TP Rem. lb/d
7/7/2011	0.661	3.5	3.2	0.3	1.7
7/8/2011	0.632	3.8	3.3	0.5	2.6
7/9/2011	0.606	3.9	3.5	0.4	2.0
7/10/2011	0.451	3.6	2.9	0.7	2.6
7/11/2011	0.492	3.6	3.1	0.5	2.1
7/12/2011	0.499	3.2	2.9	0.3	1.2
7/13/2011	0.478	3.2	3	0.2	0.8
7/14/2011	0.444	3.1	2.9	0.2	0.7
7/15/2011	0.432	2.9	2.9	0	0.0
7/16/2011	0.495	2.6	3	-0.4	-1.7
7/17/2011	0.515	2.7	2.7	0	0.0
7/18/2011	0.458	3.7	2.9	0.8	3.1
7/19/2011	0.571	3.9	2.9	1	4.8
7/20/2011	0.585	3.2	2.9	0.3	1.5
Average	0.523	3.35	3.01	0.34	1.53

Table 6
Plant 1 Oxidation Ditch Mixed Liquor Data

Sample Date	Concentration, mg/L					Ratio				Total Mass in Ditch, lbs (a)	
	COD	TKN	TP	TSS	VSS	COD/VSS	VSS/TSS	TKN/TSS	TP/TSS	TP	TSS
7/11/2011	2700	150	15	2080	1640	1.65	0.79	0.072	0.0072	125.1	17347
7/18/2011	2800	120	15	1920	1500	1.87	0.78	0.063	0.0078	125.1	16013
7/19/2011	2800	120	13	2100	1640	1.71	0.78	0.057	0.0062	108.4	17514
7/20/2011	2900	140	16	2190	1680	1.73	0.77	0.064	0.0073	133.4	18265
Average	2800	133	14.8	2073	1615	1.74	0.78	0.064	0.0071		
Change in Mass from 7-11 to 7-20										8.3	917

(a) Based on oxidation ditch volume of 1.0 Mgal.

Table 7
Comparison of Manual and Automatic Sampler Composite Samples

Parameter	Time	Concentration, mg/L	
		Manual Composite	Automatic Sampler Composite
BOD	09:15-10:15	110	120
	11:00-12:00	150	150
	14:00-15:00	95	180
COD	09:15-10:15	300	320
	11:00-12:00	340	340
	14:00-15:00	480	410
TKN	09:15-10:15	42	---
	11:00-12:00	49	---
	14:00-15:00	43	---
TSS	09:15-10:15	102	109
	11:00-12:00	132	115
	14:00-15:00	118	111
VSS	09:15-10:15	90.5	---
	11:00-12:00	113	93
	14:00-15:00	114	99