NOTICE FOR PROFESSIONAL SERVICE

2017-PROF-1

ADDENDUM NO. 1

June 23, 2016

TO ALL PROSPECTIVE PARTIES:

The following changes in **bold** shall be made and incorporated as part of 2017-PROF-1.

1. Under F.2 PUBLIC WORKS- WASTEWATER DIVISION – LĪHU'E WASTEWATER TREATMENT PLANT PROCESS IMPROVEMENTS.

    a) **Attached** document titled "Līhu'e Wastewater Treatment Plant Tricking Filter/Solids Contact Condition Assessment".

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Assistant Chief Procurement Officer

Līhu'e Wastewater Treatment Plant
Trickling Filter/Solids Contact
Condition Assessment

Prepared for
County of Kaua'i, Department of Public Works
Wastewater Management Division
Līhu'e, Hawaii
September 22, 2014

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Technical Memorandum

Prepared for: County of Kaua'i, Department of Public Works
Wastewater Management Division

Project Title: Līhu'e Wastewater Treatment Plant
Biotower and Clarifier Startup and Optimization Engineering Services Project

Project No.: 143064.040

Technical Memorandum

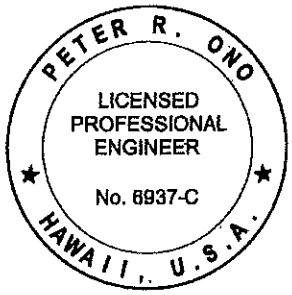
Subject: Trickling Filter/Solids Contact Condition Assessment

Date: September 22, 2014

To: Edward Tschupp, Chief, Wastewater Management Division

From: Peter Ono, Project Manager

Copy to: Jason Kagimoto, Wastewater Management Divisio



Peter R. Ono, P.E.
Brown and Caldwell

This work was prepared by me or under my supervision.

Limitations:

This document was prepared solely for the County of Kaua'i in accordance with professional standards at the time the services were performed and in accordance with the contract between the County of Kaua'i and Brown and Caldwell dated June 29, 2012. This document is governed by the specific scope of work authorized by the County of Kaua'i; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by the County of Kaua'i and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Section 1: Introduction

As part of the Līhu'e Wastewater Treatment Plant (WWTP) Biotower and Clarifier Startup and Optimization Engineering Services Project, a condition assessment was performed on the secondary treatment process at the Līhu'e WWTP. The condition assessment consisted of evaluating the mechanical, structural, and electrical assets.

1.1 Objective

Since actual flows to the plant have been roughly half of the design flow, the County of Kaua'i (County) has only operated one of the two parallel secondary treatment trains (i.e. Train 2) for approximately 10 years. The objective of the condition assessment was to evaluate the mechanical, structural, and electrical assets on both secondary treatment trains. The condition assessment will identify the necessary repairs to bring the first treatment train online and help to determine the condition of the assets on the second treatment train, which is currently in service. Each asset was assessed and a prioritized list of work items was developed as part of this assessment.

1.2 Background

The Līhu'e WWTP was originally constructed as an activated sludge secondary treatment process. In the mid-1990s, the plant was upgraded to a trickling filter/solids contact (TF/SC) process with two treatment trains. The following assets/equipment were constructed/installed:

- Trickling filter pumping station (i.e. biofilter pumping station)
- Three trickling filter pumps (i.e. biofilter circulation pumps)
- Two trickling filters (i.e. biofilters)
- Two aeration basins were converted to aerated solids contact tanks
- A secondary clarifier
- The existing secondary clarifier was modified
- Five return secondary sludge (RSS) pumps – two RSS Pumping Stations each with 2 pumps (Station1) and 3 pumps (Station 2)
- Two waste secondary sludge (WSS) pumps

See Figure 1-1 below for the site plan of the Līhu'e WWTP.

The Līhu'e WWTP has a rated capacity of 2.5 million gallons per day (mgd) on an average daily flow basis. However, the actual flow to the plant over the past several years has typically been between 1.0 and 1.2 mgd. As a result, the County has been operating the plant using only the second treatment train for approximately 10 years. It is anticipated that community growth and development will increase flows to the plant in the future and the other treatment train will be needed. As a result, the County has contracted Brown and Caldwell to evaluate the condition of the existing mechanical, structural, and electrical assets and identify the appropriate tasks that should be performed in order to provide a fully operational secondary treatment process.

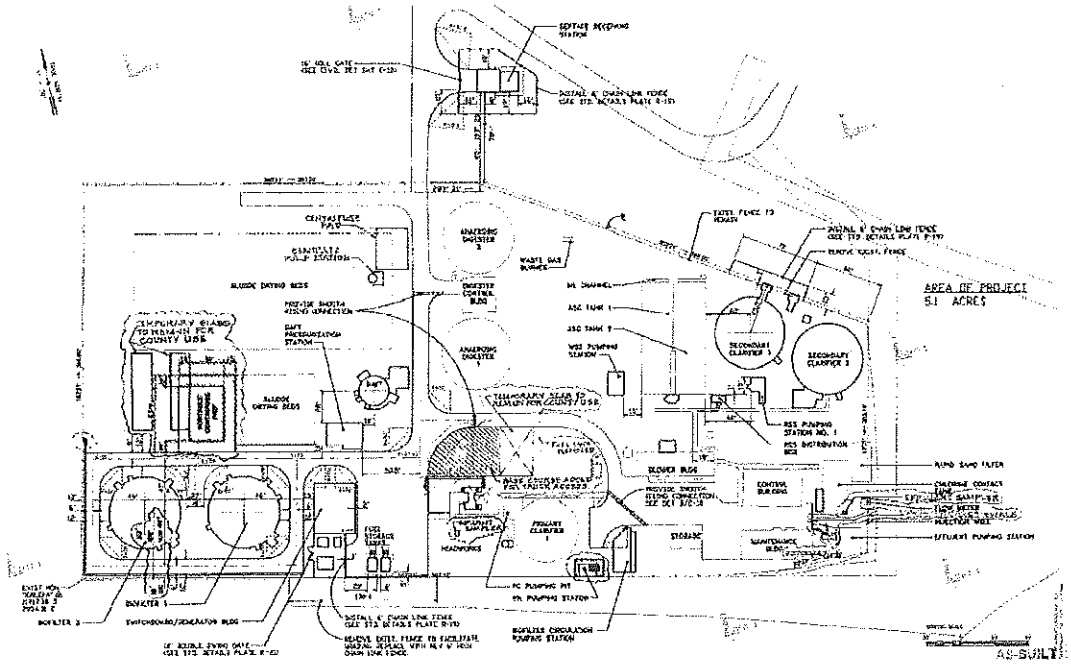

Figure 1-1. Lihu'e WWTP Site Map

Section 2: Mechanical Process Equipment Condition Assessment

A condition assessment was performed on the following mechanical process equipment to determine the likelihood of failure:

- Biofilter Circulation Pump 1
- Biofilter Circulation Pump 3
- Biofilter Circulation Pump 6
- Biofilter 1
- Biofilter 2
- Aerated Solids Contact Tank 1
- Aerated Solids Contact Tank 2
- Blower 1
- Blower 2
- Secondary Clarifier 1
- Secondary Clarifier 2
- RSS Pump 1 (RSS Pumping Station 1)
- RSS Pump 2 (RSS Pumping Station 1)
- RSS Pump 1 (RSS Pumping Station 2)
- RSS Pump 2 (RSS Pumping Station 2)
- RSS Pump 3 (RSS Pumping Station 2)
- WSS Pump 1
- WSS Pump 2

The condition assessment followed prescriptive criteria and utilized a numerical rating system. This approach is presented in detail below.

2.1 Mechanical Process Equipment Condition Assessment Approach

The objective of the mechanical process equipment condition assessment was to develop an effective system that rates and prioritizes each asset. The following sections summarize the criteria used to evaluate each asset and the associated rating system.

2.1.1 Assessment Criteria and Condition Assessment Ratings

Each asset was evaluated by observing the condition and operating state; determining the asset age and usage; and collecting and reviewing maintenance data. Each asset was given a condition assessment rating based on a 10-point cumulative score made up of eight criteria, shown in Table 2-1 below. The condition assessment rating (i.e. cumulative score) was determined for each asset and can be categorized as: good (10.0 to 8.0), fair (7.9 to 5.0), and poor (4.9 to 0.0) as shown in Appendix A.

Table 2-1. Condition Assessment Ratings

Criteria	Points
Facility Condition	0.5
Asset Condition	1.5
Asset Leaks	0.5
Operating Environment	2.0
Asset Age and Run Time	1.5
Corrective Maintenance	2.0
Preventative Maintenance	1.0
Equipment Rotation	1.0
Total	10.0

Facility Condition

The condition of the facility where the asset is located was visually assessed. This can help to determine the type of environment that the asset is exposed to and what type of housekeeping measures are in place. The condition of the asset can be directly related to the condition of the facility. For example, a noticeable contrast between the visual condition of the facility and the asset can indicate whether the asset(s) and/or the facility need to be further evaluated.

Asset Condition

The condition of each asset was assessed and rated based on its visual appearance. This helped to identify any visual defects (e.g. corrosion, cracks, missing pieces, etc.) on the asset and/or the asset's supports (e.g. pump pad).

Asset Leaks

Active leaks or stains (e.g. oil, water, sludge, fuel, etc.) helped to identify issues with an asset, such as a damaged bearing/seal, which can lead to more severe problems. The presence and severity of leaks provided information about the condition of the bearings/seals, causes of corrosion, and the overall condition of the asset.

Operating Environment

Whenever possible, each asset was evaluated while operating. Factors such as temperature, noise, ventilation, and vibration were obtained. Temperature was measured using a digital laser sensor device. Noise and vibration were measured by ear and feel, respectively. Ventilation was assessed by observing the available open space, windows, ventilation fans, and proper air circulation to help prevent the asset from overheating.

Assets that could not be operated due to being out of service (i.e. could not be brought on-line for further evaluation) or associated with an out of service asset (e.g. RSS pumps) were given zero points.

Asset Age and Run Time

Generally, the asset age and run time is used to determine the age and usage of each asset, respectively. Lower condition assessment ratings are given to older assets and/or assets with higher run times. Typically, run time data is collected with the intent of obtaining better insight on the overall use of each asset and the relative use compared to redundant assets. This will help determine if assets are being alternated and can provide a possible explanation why a specific asset needs more corrective maintenance compared to a redundant asset that has fewer hours of use. However, run time meters do not exist and as a result, run time data is not available at the Līhu'e WWTP. Only the age of the asset, which was determined from interviewing County plant operators, was used to provide a score for this criterion. If run time data is desired by the County in the future, run time meters can be installed to provide a local display and/or start/stop inputs to the plant control system can be used to record the equipment runtimes via the plant control system.

Corrective Maintenance

Corrective maintenance data for the Līhu'e WWTP was provided by the County for the last five years. This data helped to quantify the amount of corrective maintenance activities performed for each asset. Corrective maintenance includes responding to issues or problems, making repairs, and replacements. If 10 or more corrective maintenance activities were performed over the last 5 years, the resulting score would be zero. If there were fewer than 10 corrective maintenance activities performed for a given asset, the score was determined by interpolation.

The County was only able to provide data that was logged and stored within their work order software, MPET, which was started on October 15, 2008. This data consisted of only five corrective maintenance records over the last five years. Based on interviews with County plant operators, it is likely that no corrective maintenance activities were performed on assets associated with the first treatment train because they were not operated in the last 10 years. As a result, assets that were identified as not being operated during this time span were given zero points.

Preventative Maintenance

Preventative maintenance data was provided by the County for the last five years. This data was reviewed to determine whether or not a preventative maintenance program was in place and being performed. A properly executed preventative maintenance program can help to extend the life of an asset. If an asset had a preventative maintenance program in place and showed active maintenance being performed, the asset was given the full rating score of one. If the asset had little or poor preventative maintenance activity, the asset was given a score of 0.5. If the asset did not have an active program, the asset was given a rating score of zero. A score of zero was also applied to assets that had no preventative maintenance data available.

Similar to the corrective maintenance data, the County was only able to provide data that was logged and stored within their work order software, MPET, which was started on October 15, 2008. Only some of the assets on the second treatment train had a preventative maintenance program in place. As a result, the majority of the assets were given a rating score of zero.

Equipment Rotation

In order to assess whether equipment is being rotated (i.e. alternated) on a regular basis, interviews with County plant operators were performed. This was done because no run time data was available and preventative maintenance data could not be used to determine if assets were being rotated properly (including rotating redundant assets between lead and lag operation). However, for most of the assets assessed, the assets are not rotated (i.e. interviews revealed that assets that only serve the first treatment train have not been used in approximately 10 years).

If the asset is being rotated properly, it was given the full score of one. If the asset was run continuously but had sufficient redundancy (i.e. the asset has a backup if the asset went out of service), the asset was given a score of 0.5. If the asset was run continuously without sufficient redundancy, the asset was given a score of zero.

2.2 Mechanical Process Equipment Condition Assessment

The condition assessment consisted of data collection, facility site visits, and interviews with County plant operators. These activities are described below.

2.2.1 Historical Data Collection

Historical data collection helped to determine background information on the assets included in the condition assessment and was also used as a guide during the field investigation. Data collected is discussed below.

- Record drawings were provided by the County. These drawings were used to create the master asset list and identify which assets were included in the condition assessment. The drawings also helped to determine the overall treatment process, asset locations, and identification numbers.

- Maintenance records were also provided electronically in Microsoft Excel format by the County on March 19, 2013. The records consisted of all of the Līhu'e WWTP's corrective maintenance and preventative maintenance records. As stated earlier, these records were used in the assessment to determine the number of repair, replacement, and installation work orders per asset and to determine if each asset has an active preventative maintenance program.

It should be noted that March 29, 2013 was considered the cut-off date for incorporating historical data into the assessment.

2.2.2 Field Investigation

The field investigation was performed on January 9, 2013, February 7, 2013, and June 25, 2013, and consisted of visual and physical assessments of the mechanical assets and their respective facilities based on the assessment approach previously outlined. Photographs were also taken to document the conditions observed.

When possible, assets were observed while in operation. County plant operators were asked to turn on assets that were not running to analyze the operating and physical condition. In cases where the asset was out of service and could not be brought on-line for further evaluation (e.g. Secondary Clarifier 1), Brown and Caldwell did not ask the County plant operators to operate the asset.

2.2.3 Interviews

Interviews were critical in obtaining valuable information and knowledge of each asset that may not have been otherwise apparent during the historical data collection and field investigation. Interviews were performed with County plant operators on the same days as the field investigation. Each asset was discussed to determine the asset's operational status, installation/replacement date, rotational strategies, and other critical information. The information gathered from the interviews helped to fine tune the condition assessment ratings for each asset.

2.3 Mechanical Condition Assessment Findings, Results, and Recommendations

Eighteen assets were identified as being part of the secondary treatment process. These assets were assessed during the mechanical condition assessment and the key findings, results, and recommendations are provided below.

2.3.1 Biofilter Circulation Pumps 1, 3, and 6

There are three vertical turbine pumps at the Biofilter Pumping Station which can be used to pump primary treated wastewater over the two biofilters (although Biofilter 1 has not been used in approximately 10 years and is likely inoperable in its current state). The Biofilter Pumping Station was designed for six pumps, thus, the identification numbers are based upon the location each pump was installed. Biofilter Circulation Pumps 1 and 6 were installed during the mid-1990s plant upgrade, whereas Biofilter Circulation Pump 3 was replaced approximately one year ago. As a result, the County plant operators most often use Biofilter Circulation Pump 3. The pumps are located outdoors and are exposed to the weather. Biofilter Circulation Pump 6 could not be operated during the condition assessment. Based on a visual assessment, it seems that modifications to the seal water system have been made. The seal water system, which prevents the circulation pump from running without positive indication of seal water flow, could be the reason the pump is inoperable. Although Biofilter Circulation Pump 6 could not be operated, only one biofilter circulation pump is required under normal flow conditions. As a result, sufficient redundancy is available.

Based on the results of the condition assessment, Biofilter Circulation Pumps 1, 3, and 6 received condition assessment ratings of 7.4, 9.0, and 5.2; according to Section 2.1.1, they are in fair, good, and fair condition, respectively. See Attachment A for the detailed condition assessment.

It is recommended that Biofilter Circulation Pumps 1 and 6 be replaced primarily due to their age. However, based on the condition assessment rating of 7.4, Biofilter Circulation Pump 1 is not a high priority. For Biofilter Circulation Pump 6, the seal water system should be investigated to determine if it is the reason the pump is currently inoperable. Biofilter Circulation Pump 6 should be repaired (and reassessed after it is operational) so that another redundant pump is available for use. Finally, it is recommended that an active preventative maintenance program be implemented which includes rotating the pumps regularly.

2.3.2 Biofilter 1

Biofilter 1 is one of two biofilters constructed as part of the mid-1990s plant upgrade. It is not covered and is exposed to the weather. According to County plant operators, it has not been used for approximately 10 years. It is equipped with a motor, drive, and variable frequency drive (VFD) to control the speed of the distributor. However, the motor is currently inoperable. The biofilter may be able to operate hydraulically without the motor and drive; however, this was not verified. Based on interviews with County plant operators, three tension bars and some of the nozzles on the distributor arm were removed to replace parts on Biofilter 2.

The media within Biofilter 1 appears to be in adequate condition. The top layer of the media was checked in several areas to confirm it was not brittle and the vertical distance between the distributor arm and the media was consistent along the full length of the arm (i.e. there do not appear to be any localized media failures). However, it should be noted that the biofilter was offline and there was no biological mass on the media. Also, there were areas where the media did not tightly fit with adjacent media, resulting in a gap.

Based on the results of the condition assessment, Biofilter 1 received a condition assessment rating of 1.4; according to Section 2.1.1, it is in poor condition. See Attachment A for the detailed condition assessment.

For the purposes of this report, it is assumed that mechanically varying the speed of the distributor arm is desired. As a result, it is recommended that the motor and drive be replaced along with the tension bars and nozzles that were removed to replace parts on Biofilter 2. Also, since the biofilter has not been operated for 10 years, the bearing should also be replaced as a precautionary measure before any long-term planned use. It is also recommended that an active preventative maintenance program be implemented.

Biofilter 1 should be brought online prior to it being necessary for long-term planned use. A test run, for roughly a couple of months, should be performed to assess the biofilter in operation with a biological mass on the media. Although the media seemed adequate, it was not subjected to typical operating conditions and this will allow for any unforeseen issues with the media to be addressed.

In addition to this condition assessment, a performance assessment was conducted on the Līhu'e WWTP, which showed that pH decreases through the secondary process. This is not unusual and is most likely caused by nitrification occurring in the secondary process as a result of low biofilter BOD loading. As a result, the current level of nitrification should be determined before Biofilter 1 is brought online due to concerns related to further pH depression and alkalinity consumption. The process (upstream and downstream of the secondary process) should be sampled weekly for alkalinity, ammonia, and nitrate to determine the level of nitrification. If the biofilter effluent is fully nitrified then Biofilter 1 can be brought online as described in the previous paragraph and run concurrently with Biofilter 2; however, if the wastewater is only partially nitrified then nitrification will increase with the second biofilter on-line, and result in a lower pH. If this is the case, then biofilm growth on Biofilter 1 is not recommended and both biofilters should not be run concurrently. Instead, Biofilter 1 should operate as long and often enough to simply ensure the mechanisms operate properly. An operating scheme that is limited to one hour a day, once per week to test the operation

of the mechanisms should be considered. The operating duration and frequency can be increased as long as biofilm growth is prevented.

2.3.3 Biofilter 2

Biofilter 2 was also constructed in the mid-1990s and, similar to Biofilter 1, is not covered and is exposed to the weather. It is the only biofilter that has been online in the past 10 years. It is also equipped with a motor, drive, and VFD. However, the motor has failed and has been removed. As a result, the biofilter operates hydraulically and adjustments to the speed of the distributor arm is accomplished by varying the amount of open nozzles on the distributor arm.

The media within Biofilter 2 appears to be in adequate condition without any localized failures. This is based on the consistent vertical distance between the distributor arm and the media along the full length of the arm. However, there were areas where the media did not tightly fit with adjacent media, resulting in a gap.

Based on the results of the condition assessment, Biofilter 2 received a condition assessment rating of 5.1; according to Section 2.1.1, it is in fair condition. See Attachment A for the detailed condition assessment.

For the purposes of this report, it is assumed that mechanically varying the speed of the distributor arm is desired. As a result, it is recommended that the motor and drive be replaced. It is also recommended that an active preventative maintenance program be implemented.

2.3.4 Aerated Solids Contact Tank 1

The two aerated solids contact tanks were constructed as part of the initial construction of the Līhu'e WWTP in the 1970s. This tank was originally constructed as an activated sludge aeration basin that was retrofitted to an aerated solids contact tank during the plant upgrade in the mid-1990s. Aerated Solids Contact Tank 1 consists of coarse-bubble diffusers and wooden baffles that separate the tank along its length.

Similar to Biofilter 1, the tank has not been used for approximately 10 years based on interviews with County plant operators. The tank, which is currently drained, is exposed to the weather, and, as a result, piping within the tank is corroded and the wooden baffles within the tank have rotted and are failing (it is recommended that the wooden baffles are always submerged, even when the tank is not in use).

The coarse bubble diffusers are connected to two blowers located in the adjacent Blower Building. The County plant operators stated that the air header piping serving the two tanks leaks. Air bubbles can be seen at the flanges of the piping during heavy rain events when water ponds around the air header piping.

Based on the results of the condition assessment, Aerated Solids Contact Tank 1 received a condition assessment rating of 1.7; according to Section 2.1.1, it is in poor condition. See Attachment A for the detailed condition assessment.

It is recommended that the County evaluate the air system and solids contact process in order to determine if fine bubble diffusers would be more efficient. Additionally, the leaking flange on the air header piping should be properly sealed along with replacing the piping and wooden baffles within the tank (the wooden baffles should be submerged after being replaced, even if the tank is not in use). After the tank is brought online, it is recommended that an active preventative maintenance program be implemented.

2.3.5 Aerated Solids Contact Tank 2

Similar to Aerated Solids Contact Tank 1, this tank was also originally constructed as an activated sludge aeration basin that was retrofitted to an aerated solids contact tank during the plant upgrade in the mid-1990s. According to County plant operators, the tank is identical to Aerated Solids Contact Tank 1 and consists of coarse bubble diffusers (similarly connected to two blowers located in the Blower Building) and

wooden baffles that separate the tank along its length. Since this tank was online during the assessment and is the only tank that has been online in the past 10 years, it could not be drained. As a result, the condition assessment was limited to items that were above the water line in the tank.

Similar to the other tank, it is exposed to the weather and, as a result, exposed piping and the support railings are corroded. According to County plant operators, the diffuser arms require a hydraulic jack or crane in order to raise them above the water surface and perform maintenance. Since a hydraulic jack is not available and obtaining a crane requires a big effort, the diffusers have not had any preventative or corrective maintenance performed on them. The only preventative maintenance performed by the County plant operators has been to grease the diffuser arms once a month from an access point above the water surface in the tank. Although the coarse bubble diffuser heads could not be observed, the pattern created by the diffusers does not seem to be uniform throughout the tank.

Based on the results of the condition assessment, Aerated Solids Contact Tank 2 received a condition assessment rating of 5.9; according to Section 2.1.1, it is in fair condition. See Attachment A for the detailed condition assessment.

It is recommended that the County evaluate the air system and solids contact process in order to determine if fine bubble diffusers would be more efficient. The piping and wooden baffles (although the condition could not be visually assessed) within the tank should be replaced. The active preventative maintenance program should also be maintained.

2.3.6 Blowers 1 and 2

The blowers were both installed in the 1970s as part of the original activated sludge treatment process and are located in the Blower Building. However, they are not identical. The casing on Blower 1 is smaller and may be the reason County plant operators stated that it provides less oxygen than Blower 2 (even though they have the same horsepower). Blower 1 is operational but is not used because it does not provide enough oxygen to meet effluent requirements. As a result, Blower 2 is constantly in operation.

Based on the results of the condition assessment, Blowers 1 and 2 received condition assessment ratings of 3.7 and 5.6; according to Section 2.1.1, they are in poor and fair condition, respectively. See Attachment A for the detailed condition assessment.

It is recommended that both blowers be replaced because they are beyond their useful life. The blowers should be sized based on the findings of the air system and solids contact process evaluation recommended for Aerated Solids Contact Tanks 1 and 2. The blowers should also have an active preventative maintenance program in place which includes alternating the blowers regularly (after they are replaced).

2.3.7 Secondary Clarifier 1

Secondary Clarifier 1 was constructed as part of the mid-1990s plant upgrade and is exposed to the weather. Although it is the newer of the two clarifiers (Secondary Clarifier 2 was constructed during the original plant construction in the 1970s and modified during the mid 1990s plant upgrade), it is inoperable. Key issues with Secondary Clarifier 1 include the following:

- The motor has been removed
- The drive, inlet tub, energy dissipating inlets (EDIs), flocculating center well, and structural support for the center column are corroded
- The baffle on the launder is warped
- Some of the skimmer blades are missing
- The concrete coating has failed in numerous locations

According to County plant operators, parts were taken from Secondary Clarifier 1 as needed to keep Secondary Clarifier 2 in operation.

Based on the results of the condition assessment, Secondary Clarifier 1 received a condition assessment rating of 1.3; according to Section 2.1.1, it is in poor condition. See Attachment A for the detailed condition assessment.

It is recommended that a new motor and drive unit (due to its age) be installed, the identified metal parts be either rehabilitated or replaced, the baffle on the launder and the skimmer blades be replaced, and the concrete coating be rehabilitated. An active preventative maintenance program should also be implemented.

2.3.8 Secondary Clarifier 2

Secondary Clarifier 2 was originally constructed during the 1970s. It was later modified (e.g. the depth of the clarifier was increased) at the time of the mid-1990s plant upgrade. Since this clarifier was online during the assessment and is the only clarifier that has been online in the past 10 years, it could not be drained. As a result, the condition assessment was limited to items that are above the water line. According to County plant operators, parts were taken from Secondary Clarifier 1 in order to replace parts that failed on Secondary Clarifier 2.

Similar to Secondary Clarifier 1, it is exposed to the weather. As a result, the motor and drive, along with all of the other exposed metal parts (e.g. skimmer arm and center column) are corroded. According to interviews with County plant operators, the motor currently in operation was installed approximately 5 years ago and has been operating adequately.

Based on the results of the condition assessment, Secondary Clarifier 2 received a condition assessment rating of 7.3; according to Section 2.1.1, it is in fair condition. See Attachment A for the detailed condition assessment.

It is recommended that a new drive unit (due to its age) be installed and the corroded metal parts be either rehabilitated or replaced. Also, an active preventative maintenance program should be maintained.

2.3.9 RSS Pumps 1 and 2 (RSS Pumping Station 1)

RSS Pumps 1 and 2 were both installed during the mid-1990s and are not covered, leaving them exposed to the weather. These vertical turbine pumps are dedicated to Secondary Clarifier 1 and, as a result, have not been operated in approximately 10 years. The County plant operators attempted to bump both pumps; however, both pump shafts were frozen.

Based on the results of the condition assessment, RSS Pumps 1 and 2 received condition assessment ratings of 2.3; according to Section 2.1.1, they are in poor condition. See Attachment A for the detailed condition assessment.

It is recommended that both pumps and motors be replaced and a roof be installed over the pumps, similar to RSS Pumping Station 2 and WSS Pumps 1 and 2, for protection from the weather. After the pumps are brought online, it is recommended that an active preventative maintenance program be implemented which includes rotating the pumps regularly.

2.3.10 RSS Pumps 1, 2, and 3 (RSS Pumping Station 2)

RSS Pumps 1, 2, and 3 were recently installed in 2009, 2009, and 2012, respectively. These chopper pumps have a roof over them, which minimize their exposure to weather. These pumps are dedicated to Secondary Clarifier 2 and are operated frequently. According to County plant operators, the operating procedure is to run either RSS Pumps 1 and 2 or RSS Pump 3. RSS Pumps 1 and 2 were observed while operating. However, RSS Pump 3 could not be started. The County plant operators mentioned that RSS Pump 3 operates adequately and usually does not have any issues being started. According to the County plant operators, these pumps are rotated regularly.

Based on the results of the condition assessment, RSS Pumps 1, 2, and 3 received condition assessment ratings of 8.5, 8.5, and 8.3, respectively; according to Section 2.1.1, they are all in good condition. See Attachment A for the detailed condition assessment.

It is recommended that the pumps continue to be rotated regularly while maintaining an active preventative maintenance program.

2.3.11 WSS Pumps 1 and 2

WSS Pumps 1 and 2 were installed as part of the mid-1990s plant upgrade and have a roof over them, which minimize their exposure to weather. These pumps serve either secondary clarifier and have been in operation. Both pumps were initially provided with VFDs. According to County plant operators, the VFD for WSS Pump 1 burned out twice; WSS Pump 1 currently only operates at constant speed via the across-the-line starters. Currently, WSS Pump 1 has no redundancy as WSS Pump 2 is inoperable.

Based on the results of the condition assessment, WSS Pumps 1 and 2 received condition assessment ratings of 6.1 and 2.6 (note that the VFDs are included in the Electrical Condition Assessment); according to Section 2.1.1, they are in fair and poor condition, respectively. See Attachment A for the detailed condition assessment.

It is recommended that both WSS pumps and motors be replaced. However, based on the condition assessment rating, WSS Pump 1 is not a high priority (it is recommended to be replaced primarily due to its age). It is also recommended that both pumps have an active preventative maintenance program which includes rotating the pumps regularly.

2.4 Criticality of Mechanical Assets

The condition assessment helped to determine the likelihood of failure for a given asset. However, because the recommendations may not all be addressed simultaneously, the recommendations were prioritized. As a result, the consequence of failure needs to be considered as part of the condition assessment. An asset criticality was established based on the consequence of failure for each of the mechanical assets.

Each asset has different levels of importance for the overall operation of the Līhu'e WWTP. If failure of an asset can result in a permit violation, it has a greater consequence of failure than the failure of an asset that causes a localized operational problem. The criteria that were used to determine the criticality of each asset is provided below:

- External spill – This criterion applies if the asset's failure could cause a wastewater spill outside of the Līhu'e WWTP's property line.
- Internal spill – This criterion applies if the asset's failure could cause a wastewater spill within the Līhu'e WWTP's property line. For example, failure of the biofilter circulation pumps could cause a spill at the Biofilter Pumping Station.
- Poor effluent quality – This criterion applies to assets whose failure could cause poor effluent that could affect the ability to produce R-1 quality effluent and/or meet the effluent characteristics identified in the Lihue WWTP's Underground Injection Control Permit (No. UK-1213).
- Operational problems – This criterion applies if the asset's failure could result in increased operational attention or work. For example, the failed biofilter motor results in increased attention by the County plant operators in order to adjust the distributor arm speed (i.e. varying the amount of open nozzles on the distributor arm).
- Health and safety – This criterion applies if the asset's failure could cause a threat to public or employee health and safety. This criterion applies automatically for any equipment failure that would cause an external spill.

A numerical point value of "1" was applied to each of these criteria as they apply to the failure of a specific asset. The number of points for each asset type was totaled. The total was then multiplied by a redundancy factor to obtain a criticality score.

The redundancy factor is a value of "1" or "2". If there is sufficient redundancy for an asset (i.e. the asset has a back-up or the treatment process or flow is not affected if the asset were to go out of service), a value of "1" was applied. If there is insufficient redundancy, a value of "2" was applied.

The asset criticality assessment table is presented below in Table 2-2.

Table 2-2. Asset Criticality

Asset	Asset ID	External Spill	Internal Spill	Poor Effluent Quality	Operational Problems	Health and Safety	Redundancy	Criticality Score	Effect of Failure
Biofilter Circulation Pump 1	P 20201		1	1	1	1	1	4	Primary effluent cannot be pumped to the biofilters
Biofilter Circulation Pump 3	P 20203		1	1	1	1	1	4	Primary effluent cannot be pumped to the biofilters
Biofilter Circulation Pump 6	P 20206		1	1	1	1	1	4	Primary effluent cannot be pumped to the biofilters
Biofilter 1	BF 1			1	1		2	4	Speed of drive cannot be adjusted by VFD (this assumes biofilter can be operated hydraulically). Increased effort required to adjust speed of distributor arm hydraulically to promote sloughing of biological growth on media.
Biofilter 2	BF 2			1	1		2	4	Speed of drive cannot be adjusted by VFD (this assumes biofilter can be operated hydraulically). Increased effort required to adjust speed of distributor arm hydraulically to promote sloughing of biological growth on media.
Aerated Solids Contact Tank 1				1	1		1	2	Effluent TSS may be too high
Aerated Solids Contact Tank 2				1	1		1	2	Effluent TSS may be too high (this assumes diffusers are functional, not field verified)
Blower 1				1	1		2	4	Effluent TSS may be too high
Blower 2				1	1		2	4	Effluent TSS may be too high
Secondary Clarifier 1	SC 1			1	1		2	4	Scum and sludge will overflow into launder
Secondary Clarifier 2	SC 2			1	1		2	4	Scum and sludge will overflow into launder
RSS Pump 1	P 25121			1	1		2	4	Sludge will not be removed from Secondary Clarifier 1
RSS Pump 2	P 25122			1	1		2	4	Sludge will not be removed from Secondary Clarifier 1
RSS Pump 1	P 25921			1	1		1	2	Sludge will not be removed from Secondary Clarifier 2
RSS Pump 2	P 25922			1	1		1	2	Sludge will not be removed from Secondary Clarifier 2
RSS Pump 3	P 25923			1	1		1	2	Sludge will not be removed from Secondary Clarifier 2
WSS Pump 1	P 25951			1	1		2	4	Sludge residence time and mixed liquor suspended solids concentration cannot be maintained
WSS Pump 2	P 25952			1	1		2	4	Sludge residence time and mixed liquor suspended solids concentration cannot be maintained

2.5 Mechanical Condition Assessment Prioritization and Recommendations

Risk is the product of the likelihood of failure and the consequence of failure. As previously stated, the likelihood of failure relates to the condition of an asset and the consequence of failure relates to the criticality of an asset. The condition assessment and criticality analysis provided a score for the risk associated with each asset that was assessed. This is the basis for prioritizing the recommendations identified in Section 2.3.

2.5.1 Asset Risk Prioritization

A risk score was calculated for each asset using a two-step process. First, the condition assessment score was subtracted from the total cumulative score of 10 to obtain a "remaining score". The risk score was then determined by multiplying the remaining score and the criticality score. The larger the total risk score, the higher the priority.

Based on the total risk score, each asset was ranked from highest to lowest. The result is a prioritization for the assets. The asset risk prioritization table is presented in Table 2-3, below.

Table 2-3. Asset Risk Prioritization

Asset	Asset ID	Condition Assessment Score	Remaining Score	Criticality	Risk Score
Secondary Clarifier 1	SC 1	1.3	8.7	4	34.8
Biofilter 1	BF 1	1.4	8.6	4	34.4
RSS Pump 1 (RSS PS 1)	P 25121	2.3	7.7	4	30.8
RSS Pump 2 (RSS PS 1)	P 25122	2.3	7.7	4	30.8
WSS Pump 2	P 25952	2.6	7.4	4	29.6
Blower 1		3.7	6.3	4	25.2
Biofilter 2	BF 2	5.1	4.9	4	19.6
Biofilter Circulation Pump 6	P 20206	5.2	4.8	4	19.2
Blower 2		5.6	4.4	4	17.6
Aerated Solids Contact Tank 1		1.7	8.3	2	16.6
WSS Pump 1	P 25951	6.1	3.9	4	15.6
Secondary Clarifier 2	SC 2	7.3	2.7	4	10.8
Biofilter Circulation Pump 1	P 20201	7.4	2.6	4	10.4
Aerated Solids Contact Tank 2		5.9	4.1	2	8.2
Biofilter Circulation Pump 3	P 20203	9.0	1.0	4	4.0
RSS Pump 3 (RSS PS 2)	P 25923	8.3	1.7	2	3.4
RSS Pump 1 (RSS PS 2)	P 25921	8.5	1.5	2	3.0
RSS Pump 2 (RSS PS 2)	P 25922	8.5	1.5	2	3.0

2.5.2 Prioritized Mechanical Condition Assessment Recommendations

Combining the recommendations from the mechanical condition assessment and the asset risk prioritization, Table 2-4 identifies the recommended work listed in order of priority.

Table 2-4. Prioritized Mechanical Condition Assessment Recommendations

Asset	Asset ID	Recommendations
Secondary Clarifier 1	SC 1	• Install new motor and drive unit • Rehabilitate/replace drive, inlet tub, EDIs, flocculating center well, and structural support for center column • Replace warped baffle and missing skimmer blades • Rehabilitate concrete coating on interior walls of clarifier
Biofilter 1	BF 1	• If mechanically varying speed of distributor arm desired, replace motor and drive • Replace tension bars and nozzles removed to replace parts on Biofilter 2 • Replace distributor arm bearing • Bring Biofilter 1 online prior to long-term planned use. Test run for roughly several months so media can be fully loaded. • Prior to bringing Biofilter 1 online, determine current level of nitrification
RSS Pump 1 (RSS PS 1)	P 25121	• Replace pump and motor • Install roof to protect pumps from weather
RSS Pump 2 (RSS PS 1)	P 25122	• Replace pump and motor • Install roof to protect pumps from weather
WSS Pump 2	P 25952	• Replace pump and motor
Blower 1		• Replace blower (size blower based on air system and solids contact process evaluation recommended for Aerated Solids Contact Tanks 1 and 2)
Biofilter 2	BF 2	• If mechanically varying speed of distributor arm desired, replace motor and drive
Biofilter Circulation Pump 6	P 20206	• Investigate if seal water system is reason pump inoperable. May allow replacement to be delayed. • Otherwise, replace pump and motor
Blower 2		• Replace blower (size blower based on air system and solids contact process evaluation recommended for Aerated Solids Contact Tanks 1 and 2)
Aerated Solids Contact Tank 1		• Evaluate air system and solids contact process • Properly seal leaking flange on air header piping • Replace piping and wood baffles within tank
WSS Pump 1	P 25951	• Replace pump and motor
Secondary Clarifier 2	SC 2	• Install new drive unit • Rehabilitate or replace corroded metal parts
Biofilter Circulation Pump 1	P 20201	• Replace pump and motor
Aerated Solid Contact Tank 2		• Evaluate air system and solids contact process • Replace piping and wood baffles within tank
Biofilter Circulation Pump 3	P 20203	• No repairs/replacements recommended
RSS Pump 3 (RSS PS 2)	P 25923	• No repairs/replacements recommended
RSS Pump 1 (RSS PS 2)	P 25921	• No repairs/replacements recommended
RSS Pump 2 (RSS PS 2)	P 25922	• No repairs/replacements recommended

In addition to the recommendations identified in Table 2-4, preventative maintenance programs should be implemented as recommended for each asset in Section 2.3. Currently, only five assets (Secondary Clarifier 2, Aerated Solids Contact Tank 2 and RSS Pumps 1, 2, and 3, located at RSS PS 2) have a preventative maintenance program in place. Proper preventative maintenance programs will reduce operational problems, improve asset performance, and prolong asset life.

Predictive maintenance tools should also be considered. Predictive maintenance is being increasingly used in the wastewater field to identify maintenance of an asset when needed. These tools provide an early warning of current and existing operational abnormalities associated with an asset. Abnormal conditions can often be corrected before they create wear and tear that shortens the life of the asset. Vibration analysis, alignment checks, temperature checks, and oil analysis are some of the more commonly used tools. These analyses/checks can be performed in-house with the proper equipment and training or by outside contractors.

Section 3: Structural Condition Assessment

The structural condition assessment was performed by MKE Associates LLC. The condition assessment write-up provided in this report highlights the key items described in the full report. The full report can be found in Attachment B.

3.1 Structural Condition Assessment Approach

The approach of the structural condition assessment was to perform a visual walkthrough to assess the general condition of the following assets:

- Biofilter 1
- Biofilter 2
- Aerated Solids Contact Tank 1
- Aerated Solids Contact Tank 2
- Secondary Clarifier 1
- Secondary Clarifier 2
- RSS Pumping Station 2 Canopy

The assessment was limited to only those portions of the structures that were readily accessible and observable. No destructive or non-destructive material testing was performed. The observations noted and recommendations made herein, where applicable, are intended to restore the original functional capacity of each structure. It is not intended to upgrade the structures to current code requirements, which is beyond the scope of the work.

3.2 Structural Condition Assessment

3.2.1 Biofilter 1

In general, Biofilter 1, which was built in the mid 1990s, appears to be in fair to good condition with some minor discrepancies. Some minor hairline cracks were located randomly throughout the precast wall panels at each column. The cracks appear to be non-structural shrinkage cracks and are limited to only the exterior cement wash coating over the structural elements. Scratching off the cement wash coating layer, the cracks do not appear in the structural elements.

At the south-east quadrant of the biofilter, one concrete column contained minor concrete spalls at the base that exposed the embedded reinforcing steel. The rebar appears to be in good condition with no noticeable signs of advanced corrosion. After sounding this location with a small hammer, the spalling appears to be localized and limited only to that portion surrounding the exposed rebar. The concrete cover in this location is less than one inch and may not provide adequate protection for long-term durability.

The metal access ladder connection to the interior face of the concrete wall is not properly bolted/attached (i.e. the ladder connection and the concrete wall are not flush). No other signs of significant structural distress were noted and no apparent signs of foundation settlement were observed.

3.2.2 Biofilter 2

Biofilter 2 was built in the mid 1990s and is basically identical in structural framing to Biofilter 1. It was in service during the assessment and as a result, the assessment was limited to only the portions of the asset that was readily accessible and observable. Biofilter 2 is in the same general overall condition as Biofilter 1. The non-structural shrinkage cracks in the columns and wall panels and the exposed rebar at the column bases (2 locations) identified in Biofilter 1 are prevalent in Biofilter 2. One metal guardrail post near the gate at the top of the biofilter is missing an anchor bolt.

3.2.3 Aerated Solids Contact Tank 1

Aerated Solids Contact Tank 1 was constructed in the 1970s and appears to be in fair condition with minor to moderate deterioration of the ancillary structure elements. The steel railing all around the tank is in fair to poor condition with some moderate corrosion at the joints. The coating of the railing has mostly failed and is peeling off the substrate. Some minor holes were cut out of the steel grating leaving the grating unsupported at small sections. Various steel angles and plates supporting the wood baffles and elevated walkways exhibit signs of minor corrosion. Finally, there are various random narrow shrinkage cracks and concrete spalls located throughout the top of the concrete tank.

3.2.4 Aerated Solids Contact Tank 2

Aerated Solids Contact Tank 2 is part of the same subgrade rectangular tank as Aerated Solids Contact Tank 1 which was built in the 1970s. Aerated Solids Contact Tank 2 was in service during the assessment and as a result, the assessment was limited to only the portions of the asset that was readily accessible and observable. The tank appears to be in similar condition as Aerated Solids Contact Tank 1, though with slightly more deterioration. The steel railing all around the existing tank is in poor condition with some moderate to severe corrosion at the post bases. Some of the railing posts along the center walkway were missing. Also, similar to Aerated Solids Contact Tank 1, steel bar grates were cut and minor spalls and cracks were present at the top of the concrete walls.

3.2.5 Secondary Clarifier 1

Secondary Clarifier 1 was built in the mid 1990s and in general, appears to be in fair to good condition with minor discrepancies. At the northeast quadrant, a section of a slab on grade landing platform has been undermined. The cause of the undermining is unclear, though flow from an outlet pipe may have led to the erosion and undermining.

The steel beams supporting the FRP walkway appear to be in good condition. At the ends of the beams, a gap exists between the beam bottom and the supporting concrete wall. In addition, the FRP grating is the original grating installed during the construction of the tank and it may be near the end of its useful life due to exposure to ultraviolet rays from sunlight.

3.2.6 Secondary Clarifier 2

Secondary Clarifier 2 was built in the 1970s that consisted of reinforced concrete walls supported by shallow continuous footings with a 12 inch slab on grade. The depth of the structure was increased by 7 feet in the mid 1990s. The clarifier was in service during the assessment and as a result, the assessment was limited to only the portions of the asset that was readily accessible and observable. In general, the structure appears to be in fair condition with moderate discrepancies.

Numerous vertical cracks with widths averaging 0.03-inches and spalls occur at the steel railing post locations. The cracks and spalls are likely due to corrosion of the steel post bases but could be compounded by several factors, including:

- The clarifier walls are only 8-inches thick at the top (ACI 350 recommends a minimum wall thickness of 12-inches for concrete structures in contact with liquids).
- The post base sleeve reduces the concrete cover on either side of the post to thin sections.
- At these locations, there are no horizontal reinforcing steel to limit cracking.

3.2.7 RSS Pumping Station 2 Canopy

RSS Pumping Station 2 is covered by an open canopy structure consisting of steel beams, pipe columns, and a metal roof. The original date of construction is assumed to be in the mid 1990s. In general, the structure framing appears to be in fair condition with mostly minor to moderate isolated corrosion of the steel beams. The most severe corrosion is located at the top flange of the steel beam below the roof gutter, which has caused section loss of the top flange. This may be caused by a leak in the gutter.

3.3 Structural Condition Assessment Recommendations

Based on the structural condition assessment performed, the structural assets seem to be in relatively good condition overall. The following sections provide a list of recommended structural repairs.

3.3.1 Biofilter 1

The following structural repairs are recommended for Biofilter 1:

- Repair the spall at the base of the concrete column to provide long-term durability. The repair should include removing the loose and deteriorated concrete, cleaning the rebar to bare metal, and patching with a patching compound in accordance with the recommendations of the International Concrete Repair Institute (ICRI).
- Reset the ladder connection to provide full contact with the concrete wall and full nut engagement.

3.3.2 Biofilter 2

The following structural repairs are recommended for Biofilter 2:

- Repair the spalls at the base of the concrete columns to provide long-term durability. The repair should include removing the loose and deteriorated concrete, cleaning the rebar to bare metal, and patching with a patching compound in accordance with the recommendations of the ICRI.
- Install missing anchor bolt at base of metal guardrail post.

3.3.3 Aerated Solids Contact Tank 1

The following structural repairs are recommended for Aerated Solids Contact Tank 1:

- Replace steel railing.
- Reinforce holes (i.e. weld bars to span holes) through steel grating to provide complete load path to supporting beams.
- Clean steel brackets and angles and recoat with protective zinc-rich coating.

3.3.4 Aerated Solids Contact Tank 2

The following structural repairs are recommended for Aerated Solids Contact Tank 2:

- Replace steel railing.
- Reinforce holes (i.e. weld bars to span holes) through steel grating to provide complete load path to supporting beams.
- Epoxy inject minor shrinkage cracks and patch minor spalls in accordance with ICRI recommendations.

3.3.5 Secondary Clarifier 1

The following structural repairs are recommended for Secondary Clarifier 1:

- Verify the source of erosion/undermining and redirect water as required. Backfill the undermined slab on grade to provide bearing support.
- Fill the gap beneath the steel beams with non-shrink grout to provide bearing support.
- Replace the entire FRP grating with new FRP grating.

3.3.6 Secondary Clarifier 2

The following structural repairs are recommended for Secondary Clarifier 2:

- Epoxy inject cracks and patch spalls in accordance with ICRI recommendations.
- Modify railing post base connection to remove embedded portion.
- Replace the FRP grating with new FRP grating.

3.3.7 RSS Pumping Station 2 Canopy

The following structural repairs are recommended for RSS Pumping Station 2 Canopy:

- Clean and repaint the structural steel framing
- Repair the gutter

Section 4: Electrical Condition Assessment

4.1 Electrical Condition Assessment Approach

The approach of the electrical condition assessment was to perform a walkthrough to assess the general condition of electrical and instrumentation devices associated with the following process elements:

- Biofilter Circulation Pumps 1, 3 and 6
- Biofilter 1
- Biofilter 2
- Aerated Solids Contact Tank 1
- Aerated Solids Contact Tank 2
- Blowers 1 and 2
- Secondary Clarifier 1
- Secondary Clarifier 2
- RSS Pumps 1 and 2 (RSS Pumping Station 1)
- RSS Pumps 1, 2, and 3 (RSS Pumping Station 2)
- WSS Pumps 1 and 2
- Main Electrical Building

The assessment was limited to a visual inspection of the electrical components of each process system. Examination of the internal components of the control panels, motor control center (MCC) buckets, VFDs, and hand stations were limited to non-energized equipment. The observations noted and recommendations made herein, where applicable, are intended to restore the original function of each process system.

4.2 Electrical Condition Assessment Findings and Recommendations

4.2.1 Biofilter Circulation Pumps 1, 3, and 6

The biofilter circulation pumps are fed via the MCCs located in the main electrical building, which were installed in the mid 1990s. Each circulation pump is driven via an across-the-line constant-speed starter. Based on interviews with County plant operators and visual inspections, starters are currently functional and do not warrant replacement.

Hand stations for each of the circulation pumps are located adjacent to each pump and do not exhibit signs of corrosion or degradation. These hand stations are currently not functional and should be replaced. There are also remotely mounted flow displays located in the general vicinity of these circulation pump hand stations.

4.2.2 Biofilter 1

The biofilter speed motor control is fed via the MCC located in the main electrical building which was installed in mid 1990s. The drive motor for the biofilter has the option to be driven via a constant-speed across-the-line starter or a VFD. The existing across-the-line starter appeared to be in adequate condition. The existing VFD is a Danfoss VLT type drive installed/attached to the exterior of the MCC and appears to have been installed after the original MCC installation in the mid 1990s. Per communications with Eaton, installation of a 3rd party VFD (Danfoss type VFD as shown in Figure 4-1) on the front face of the MCC will void the UL listing of the MCC. Additionally, installation instructions from Eaton specifically prohibit installation of devices other than selector switches and pilot devices to the front face of the MCC bucket door, as the MCC dead front type construction is not designed for this application. These VFDs should be replaced with VFDs installed within the MCC and manufactured by Eaton or replaced with VFDs installed external to the MCC line-up. Where VFDs are installed outside of the MCC line, any manufacturer could be used as a replacement.

Figure 4-1. Biofilter Starter (Top) and Danfoss VFD (Bottom)

A control panel (PNL 21101) is installed at the top of Biofilter 1 containing remote flow indicators and an adjustable potentiometer intended for manual speed control of the biofilter drive motor. It was evident from inspection that water has been intruding into the control panel for some time, rendering the elements located within nonfunctional. The flow transmitters associated with the flow indicators are installed at the base of Biofilter 1 and are also inoperable. It is recommended that these be replaced if flow indication is desired.

4.2.3 Biofilter 2

Biofilter 2 drive unit is fed via the MCC located in the main electrical building, similar to Biofilter 1. The drive motor for the biofilter has the option to be driven via a constant-speed across-the-line starter or a VFD. The existing across-the-line starter appeared to be in adequate condition. The existing VFD is a Westinghouse type drive and it is currently unknown if the VFD is operational as the motor for Biofilter 2 has been removed and the VFD has been locked out/tagged out. It is assumed that the Westinghouse VFD should be replaced, as interviews with plant staff indicate that these types of Westinghouse VFDs have failed due to overheating in the past.

A control panel (PNL 21201) is installed at the top of Biofilter 2 containing remote flow indicators and an adjustable potentiometer intended for manual speed control of the biofilter drive motor. It was evident from inspection that the internal components of the control panel have been severely corroded. Also, water has been intruding into the control panel for some time, rendering the elements located within nonfunctional. The flow transmitters associated with the flow indicators are installed at the base of Biofilter 2 and are also inoperable. It is recommended that these be replaced if flow indication is desired.

4.2.4 Aerated Solids Contact Tank 1

There were no notable electrical elements directly associated with Aerated Solids Contact Tank 1.

4.2.5 Aerated Solids Contact Tank 2

There were no notable electrical elements directly associated with Aerated Solids Contact Tank 2.

4.2.6 Blowers 1 and 2

The blower control panel and associated starter and surge protection elements are located adjacent to Blower 1 and 2 motors. This Cutler Hammer control system was installed as part of the original plant construction in 1970. Based on input from Cutler Hammer (now EATON), although replacement parts may be available for this reduced voltage starter, some of the devices located within are legacy products and are no longer supported. Of the interior components inspected, there was a fair amount of noticeable heating on the contactors, corrosion, and other minor signs of degradation. While this device may not be at the end of its service life, based on the control panel being a legacy product, it is recommended that it be replaced.

4.2.7 Secondary Clarifier 1

The across-the-line, constant-speed starter associated with this drive mechanism did not exhibit signs of degradation. However, the over-torque device located adjacent to the drive motor did exhibit signs of corrosion. It is recommended that the over-torque device be replaced in kind.

4.2.8 Secondary Clarifier 2

Secondary Clarifier 2 is currently driven via an across-the-line starter located within the main electrical building MCC. The existing starter and ancillary components did not exhibit signs of corrosion and degradation.

4.2.9 RSS Pumps 1 and 2 (RSS Pumping Station 1)

Both RSS Pumps 1 and 2 are driven via VFDs and across-the-line starters located in the main electrical building. However, these process elements have not been run in 10 years. The VFDs are legacy products and are no longer supported by the manufacturer, which severely restricts the availability of replacement parts. It is recommended that both VFDs be replaced with a newer model, Eaton SVX series or equivalent.

Hand stations located near the RSS pumps are ON/OFF type selector switches. With the replacement of the VFDs, consideration should be given to replacing the hand stations with Local/Off/Remote selector switches and speed potentiometers to enable remote speed settings by a County plant operator.

4.2.10 RSS Pumps 1, 2 and 3 (RSS Pumping Station 2)

RSS Pumps 1, 2 and 3 VFDs are located outdoors within a NEMA 4X stainless steel enclosure. These Siemens Micromaster 430 VFDs exhibit only minor signs of corrosion on the exterior of the enclosure, while interior electrical components do not show signs of degradation.

4.2.11 WSS Pumps 1 and 2

Both WSS Pumps 1 and 2 are driven via VFDs and across-the-line starters located in the main electrical building. Similar to the RSS Pumps' VFDs at RSS Pumping Station 1, these VFDs are legacy products and are no longer supported by the manufacturer. County plant operators indicated that variable speed operation may not be desired for the WSS pumps as the current operation runs a WSS pump for ten minutes out of each hour to achieve the desired process functionality. However, for the purposes of this assessment, it is assumed that variable speed operation may still be required and replacement of these VFDs in kind is recommended. It is also recommended that both VFDs be replaced with a newer model, Eaton SVX series or equivalent.

Hand stations located near the WSS pumps are ON/OFF type selector switches. With the replacement of the VFDs, where variable speed operation is required, consideration should be given to replacing the hand stations with Local/Off/Remote selector switches and speed potentiometers to enable remote speed settings by a County plant operator.

4.2.12 Main Electrical Building

The existing main electrical building was constructed as part of the mid 1990s upgrade. The space in which the majority of the electrical equipment exists is a non-conditioned space. Interviews with County plant operators and other County of Kauai staff indicate that a large number of Westinghouse VFDs have been replaced prior to the end of their useful service life possibly due to overheating issues. At the time of the site inspections it was noted that the electrical room was warm, possibly 80 degrees, and that additional research is required to determine if the space is getting hot enough to warrant conditioning the electrical room. For the purposes of this report, it is assumed that air conditioning is warranted and a new air conditioning unit be installed along with the required insulation to meet The International Energy Conservation Code.

Section 5: Summary of the Trickling Filter/Solids Contact Condition Assessment

The mechanical, structural, and electrical condition assessments all found issues that should be addressed. Since not all of the issues can be addressed simultaneously, the issues have been prioritized. Based on the types of recommendations provided for each assessment, the recommended approach is to prioritize all of the issues based on the risk score determined for the mechanical assets in Section 2.5.1. The mechanical assets are the biggest concern because:

- The majority of the assets are the original assets installed
- Some of the assets have not been operated for 10 years
- Very few assets have an active preventative maintenance program in place

Table 5-1 identifies the suggested approach to addressing all of the mechanical, electrical, and structural recommendations based upon the condition assessment performed.

Table 5-1. Prioritized Mechanical, Electrical, and Structural Recommendations

Asset	Asset ID	Mech.	Struct.	Elect.	Recommended Repair/Replacement
Secondary Clarifier 1	SC 1	■			• Install new motor and drive unit • Rehabilitate/replace drive, inlet tub, EDIs, flocculating center well, and structural support for center column • Replace warped baffle and missing skimmer blades • Rehabilitate concrete coating on interior walls of clarifier
			■		• Verify source of undermining and redirect water. Backfill slab on grade. • Fill gap beneath steel beams with non-shrink grout • Replace FRP grating
				■	• Replace over-torque device
Biofilter 1	BF 1	■			• If mechanically varying speed of distributor arm desired replace motor and drive • Replace tension bars and nozzles removed to replace parts on Biofilter 2 • Replace distributor arm bearing • Bring Biofilter 1 online prior to long-term planned use. Test run for roughly several months so media can be fully loaded. • Prior to bringing Biofilter 1 online, determine current level of nitrification
			■		• Repair concrete spall at base of concrete column • Reset ladder connection
				■	• Replace VFD with compatible VFD listed for installation within MCC • If flow indication desired replace control panel, flow indicators, and flow transmitters
RSS Pump 1 (RSS PS 1)	P 25121	■			• Replace pump and motor • Install roof to protect pumps from weather
				■	• Replace VFD (consider replacing hand station with Local/Off/Remote selector switches and speed potentiometers)
RSS Pump 2 (RSS PS 1)	P 25122	■			• Replace pump and motor • Install roof to protect pumps from weather
				■	• Replace VFD (consider replacing hand station with Local/Off/Remote selector switches and speed potentiometers)
WSS Pump 2	P 25952	■			• Replace pump and motor
				■	• Assuming variable speed required, replace VFDs (consider replacing hand station with Local/Off/Remote selector switches and speed potentiometers)
Blower 1		■			• Replace blower (size blower based on air system and solids contact process evaluation recommended for Aerated Solids Contact Tanks 1 and 2)
				■	• Replace control panel
Biofilter 2	BF 2	■			• If mechanically varying speed of distributor arm desired replace motor and drive
			■		• Repair concrete spalls at base of concrete columns • Install missing anchor bolt at base of metal guardrail post
				■	• Replace VFD with compatible VFD listed for installation within MCC • If flow indication desired replace control panel, flow indicators, and flow transmitters

Table 5-1. Prioritized Mechanical, Electrical, and Structural Recommendations (continued)

Asset	Asset ID	Mech.	Struct.	Elect.	Recommended Repair/Replacement
Biofilter Circulation Pump 6	P 20206	■			• Investigate if seal water system is reason pump is inoperable. This may allow for replacement to be delayed. • Otherwise, replace pump and motor
				■	• Replace remote flow indicator
Blower 2		■			• Replace blower (size blower based on air system and solids contact process evaluation recommended for Aerated Solids Contact Tanks 1 and 2)
				■	• Replace control panel
Aerated Solids Contact Tank 1		■			• Evaluate air system and solids contact process • Properly seal leaking flange on air header piping • Replace piping and wood baffles within tank
			■		• Replace steel railing • Reinforce holes through steel grating • Clean steel brackets and angles and recoat with protective zinc-rich coating
WSS Pump 1	P 25951	■			• Replace pump and motor
				■	• Assuming variable speed required, replace VFDs (consider replacing hand station with Local/Off/Remote selector switches and speed potentiometers)
Secondary Clarifier 2	SC 2	■			• Install new drive unit • Rehabilitate or replace corroded metal parts
			■		• Epoxy inject cracks and patch spalls • Modify railing post base connection • Replace FRP grating
Biofilter Circulation Pump 1	P 20201	■			• Replace pump and motor
				■	• Replace remote flow indicator
Aerated Solids Contact Tank 2		■			• Evaluate air system and solids contact process • Replace piping and wood baffles within tank
			■		• Replace steel railing • Reinforce holes through steel grating • Epoxy inject minor shrinkage cracks and patch minor spalls
Biofilter Circulation Pump 3	P 20203			■	• Replace remote flow indicator
Main Electrical Building	N/A			■	• Install new air conditioning unit to condition the main electrical room
RSS Pumping Station 2 Canopy			■		• Clean and repaint structural steel framing • Repair gutter

Section 6: Construction Cost Estimate

In accordance with the Association for the Advancement of Cost Engineering International (AACEI) criteria, a class 4 design construction cost estimate has been provided for the recommendations identified in Table 5-1. A class 4 estimate is defined as a Planning Level or Design Technical Feasibility Estimate and has an expected accuracy range of approximately -30 percent to +50 percent depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. It should be noted that in unusual circumstances, ranges could exceed those shown.

The total construction cost estimate, itemized in Table 6-1 below, for the recommendations identified as part of this condition assessment is approximately $2.1 M.

Table 6-1. Construction Cost Estimate for Trickling Filter/Solids Contact Condition Assessment Recommendations

Asset	Asset ID	Construction Cost Estimate		
		Mech.	Struct.	Elect.
Secondary Clarifier 1	SC 1	$349,000	$20k	$12k
Biofilter 1	BF 1	$79,000	$5k	$76k
RSS Pump 1 (RSS PS 1)	P 25121	$81,000		$19k
RSS Pump 2 (RSS PS 1)	P 25122	$81,000		$19k
WSS Pump 2	P 25952	$36,000		$19k
Blower 1		$198,000		$13k
Biofilter 2	BF 2	$26,000	$10k	$76k
Biofilter Circulation Pump 6	P 20206	$50,000		$20k
Blower 2		$198,000		$13k
Aerated Solids Contact Tank 1		$66,000	$80k	
WSS Pump 1	P 25951	$36,000		$19k
Secondary Clarifier 2	SC 2	$122,000	$130k	
Biofilter Circulation Pump 1	P 20201	$50,000		$20k
Aerated Solids Contact Tank 2		$65,000	$80k	
Biofilter Circulation Pump 3	P 20203			$20k
Main Electrical Building	N/A			$29k
RSS Pumping Station 2 Canopy			$20k	
Subtotal		$1,437,000	$345,000	$355,000
Total		$2,137,000		

Attachment A: Detailed Mechanical Condition Assessment

Asset	Insp. Date	Insp. By	Location	Component	Component ID	Manuf.	Model	Serial Number	Year Inst.	Operating State	Design Flow / Output	hp	Phase	Voltage	Hz	Amps	kW	Drive Type	Fuel Type	Misc. Comments	Pts	Sc
Biofilter Circulation Pump 1	1/9/2013	JK	Biofilter Circulation Pumping Station	Pump	P 20,01	Fairbanks Morse	VTSH - Vertical Turbine Solids Handling		~1995	On		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A	Pump works, however, not used often. Pump 3 approximately 1 yr old and used predominantly.	0.5	0.4
				Motor		GE Motors	Energy Saver	XJP1424H450 1C	~1995	On	1,770 RPM	30	3	460		34.5		Constant	Electric			
Biofilter Circulation Pump 3	1/9/2013	JK	Biofilter Circulation Pumping Station	Pump	P 20303				~2012	On		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A	No nameplate on pump. Pump used almost all the time since the newest.	0.5	0.4
				Motor		Rotec Motor Corporation	Contra-Duty		~2012	On	1,775 RPM	30	3	460	60	35		Constant	Electric			
Biofilter Circulation Pump 5	1/9/2013	JK	Biofilter Circulation Pumping Station	Pump	P 20305	Fairbanks Morse	VTSH - Vertical Turbine Solids Handling	K4C2-062028-2	~1998	Off		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A		0.5	0.4
				Motor		GE Motors	Energy Saver	XJP1424H901A	~1995	Inoperable	1,770 RPM	30	3	460		34.5		Constant	Electric	Operator said motor not working due to electrical problem. They think easy fix that their electrician can repair.		
Biofilter 1	1/9/2013	JK	Biofilter 1	Motor	BF 1	SEW-Eurodrive, Inc. USA			~1995	Inoperable	1,700 RPM	0.5			60			Variable	Electric	Operator said they like ability to change speeds of distributor arm mechanically.	0.5	0.3
				Drive		SEW-Eurodrive, Inc. USA		66035452594.84.002	~1995	Inoperable								Variable	Electric			
				Arm					~1995	Inoperable	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Variable	Electric			
				Media					~1995	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Biofilter 2	6/25/2013	JK	Biofilter 2	Motor	BF 2				~1995	N/A								Variable	Electric	Motor failed and removed. Operator said they like ability to change speeds of distributor arm mechanically.	0.5	0.2
				Drive					~1995	N/A								Variable	Electric			
				Arm					~1995	On	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Variable	Electric			
				Media					~1995	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Aerated Solids Contact Tank 1	1/9/2013	JK	Aerated Solids Contact Tank 1						1970s/ ~1995	Off	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Equipped with coarse-bubble diffusers.	0.5	0.3
Aerated Solids Contact Tank 2	6/25/2013	JK	Aerated Solids Contact Tank 2						1970s/ ~1995	On	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Equipped with coarse-bubble diffusers.	0.5	0.3
Blower 1	1/9/2013	JK	Blower Building	Blower		Hoffman	Centrifugal Blower 3826EA	26849	1970s	Off		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A		0.5	0.3
				Motor		Toshiba	B1002VLG3UM	90604559	1970s	Off	3,540 RPM	100		230/460	60	230/115		Constant	Electric			
Blower 2	1/9/2013	JK	Blower Building	Blower		Hoffman	Centrifugal Blower 7410BH	0379972	1970s	On		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A		0.5	0.3
				Motor		General Electric	SK365AL125	XP492003	1970s	On	3,555 RPM	100	3	460	60			Constant	Electric			
Secondary Clarifier 1	1/9/2013	JK	Secondary Clarifier 1	Motor	SC 1	N/A	N/A	N/A	N/A	Inoperable	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		0.5	0.2
				Drive		Westech		4482A	~1995	Inoperable								Constant	Electric			
				General		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
Secondary Clarifier 2	6/25/2013	JK	Secondary Clarifier 2	Motor	SC 2	Sterling Electric	T-MTR3124	J31335	~2008	On											0.5	0.3
				Drive		Westech			~1995	On												
				General		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A			
RSS Pump 1	1/9/2013	JK	RSS Pumping Station 1	Pump	P 25121	Fairbanks Morse	VTSH - Vertical Turbine Solids Handling		~1995	Off/Inoperable?		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A	Pump associated with SC 1.	0.5	0.4
				Motor		GE Motors	Energy Saver		~1995	Off/Inoperable?	700 RPM		3	460		9.1		Constant	Electric			
RSS Pump 2	1/9/2013	JK	RSS Pumping Station 1	Pump	P 25122	Fairbanks Morse	VTSH - Vertical Turbine Solids Handling		~1995	Off/Inoperable?		N/A	N/A	N/A	N/A	N/A	N/A	Constant	N/A	Pump associated with SC 1.	0.5	0.4
				Motor		GE Motors	Energy Saver		~1995	Off/Inoperable?	700 RPM		3	460	60	9.1		Constant	Electric			
RSS Pump 1	6/25/2013	JK	RSS Pump Station 2	Pump	P 25921	Vaughan	PF418CS	966048	2009	On	200 GPM							N/A	N/A	Pump associated with SC 2.	0.5	0.3
				Motor		Reliance Electric		B473912-010	2009	On		7.5		230/460		19.2/9.6		Variable	Electric			
RSS Pump 2	6/25/2013	JK	RSS Pump Station 2	Pump	P 25922	Vaughan	PF418CS	96604A	2009	On	200 GPM							N/A	N/A	Pump associated with SC 2.	0.5	0.3
				Motor		Reliance Electric		B473912-010	2009	On	1,170 RPM	7.5				19.2/9.6		Variable	Electric			
RSS Pump 3	6/25/2013	JK	RSS Pump Station 2	Pump	P 25923	Vaughan	PE8710CS	112348	2012	Off	2,000 GPM							N/A	N/A	Pump associated with SC 2. Could not read motor nameplate. Operators could not turn on.	0.5	0.3
				Motor														Variable	Electric			
WSS Pump 1	1/9/2013	JK	WSS Pumping Station	Pump	P 25951	Gorman Rupp	T3A3-B	1054494	~1995	On		N/A	N/A	N/A	N/A	N/A	N/A	Variable	N/A	Pump associated with SC 1 and 2.	0.5	0.4
				Motor		Reliance Electric			~1995	On	1,760 RPM	7.5	3	230/460	60	18.9		Variable	Electric			
WSS Pump 2	1/9/2013	JK	WSS Pumping Station	Pump	P 25952	Gorman Rupp			~1995	Off		N/A	N/A	N/A	N/A	N/A	N/A	Variable	N/A	Pump associated with SC 1 and 2.	0.5	0.4
				Motor		Reliance Electric			~1995	Off	1,760 RPM	7.5	3	230/460	60	18.9		Variable	Electric			

Cr 1. Visual condition of the facility				Cr 2. Visual condition of equipment, base and structure				Cr 3. Leaks from system (water, oil & etc.)				Cr 4. Operating environment (Temp/ventilation, noise and vibrations)					
Observation	Photos	Pts	Sc	Observation	Photos	Pts	Sc	Observation	Photos	Pts	Sc	Observation	Pts	Sc
Facility in good condition but exposed to weather. Well ventilated. Concrete is in good condition. Good housekeeping.	1, 5, 6	1.5	1.2	In good condition. Corrosion in area of shaft and seal water. Minimal corrosion otherwise. Paint in good condition. Clean. Base in fair condition, minimal corrosion, slightly worn down.	2-4, 7-10	0.5	0.2	Seal on pump shaft looks to be disconnected.	11	2	1.5	Temp: 158 degrees F. Noise and vibration good. Running smoothly. Good ventilation (outdoors).	1.5	0.8
Facility in good condition but exposed to weather. Well ventilated. Concrete is in good condition. Good housekeeping.	1, 5, 6	1.5	1.4	In good condition. Minimal corrosion. Paint in good condition. Clean. Base is chipped in one corner but in otherwise good condition.	12-16	0.5	0.5	No apparent leaks.	18	2	1.9	Temp: 132 degrees F. Noise and vibration good. Running smoothly. Good ventilation (outdoors).	1.5	1.3
Facility in good condition but exposed to weather. Well ventilated. Concrete is in good condition. Good housekeeping.	1, 5, 6	1.5	1.2	In good condition. Minimal corrosion. Paint in fair condition. Slight corrosion on the pump base.	20-26	0.5	0.5	No apparent leaks.	27	2	0	Currently not operational. Could be due to seal water system.	1.5	0.8
Biofilter in good condition overall but exposed to weather. Coating on interior walls in fair condition.	28-30	1.5	0.5	Motor and drive inoperable. However, Operators stated that distributor arm can still rotate hydraulically (not verified). Three tension bars and some nozzles from distributor arm taken for other biofilter. There are some areas where media not tightly fitting. Vertical gap between distribution arm and media seems to remain constant. Media seems snug at wall. Media does not seem brittle from UV damage.	35-46, 49-52	0.5	0	No apparent leaks. However, biofilter not used for approximately 10 years. Biofilter currently inoperable.	N/A	2	0	Currently not operational.	1.5	0.0
Biofilter in good condition overall but exposed to weather. Coating on interior walls cracking and spalling.	149-152	1.5	0.7	Motor has been removed. The distributor arm and structural support for motor is corroded. Media seems to be in good condition. Vertical gap between distribution arm and media seems to remain constant. Media seems snug at the wall.	148-152	0.5	0.4	No apparent leaks. However, couldn't inspect closely.	N/A	2	1.2	Temp: N/A. Noise is good. Vibration seems minimal. Distributor arm seems to be operating well. However, operating hydraulically since motor failed and removed.	1.5	0.6
Facility in fair condition but exposed to weather. Concrete in good condition.	47-48	1.5	0.6	Air header piping leaks (when heavy rain puddles around piping can see air bubbles). Railings and piping corroded. Wood that divides the tank is falling apart.	53-87	0.5	0.2	Air header piping leaks (when heavy rain puddles around piping can see air bubbles).		2	0	Could possibly bring online but haven't used in approximately 10 years.	1.5	0.6
Facility in fair condition but exposed to weather. Concrete in fair condition.	153-156	1.5	0.6	Air header piping leaks (common piping with ASCT 1). Railings and piping corroded. Railing bent in one section. Couldn't assess below water surface.	153-163	0.5	0.2	Air header piping leaks (when heavy rain puddles around piping can see air bubbles).		2	1.2	Air leaks from piping. Also, pattern of bubbles not consistent between two sides of tank. Can't bring up diffusers without rinsing since hydraulic lift not available.	1.5	0.6
Walls in facility have been repaired. Poor ventilation. Oil and dirty. Used for storage.	88-90	1.5	0.9	Unit is dirty with corrosion on the blower. Electrical conduit detached. Motor and base in fair condition. Base sits on concrete above pad, which is cracking.	97-105	0.5	0.2	Seems to be leaking oil. Visible oil stains.	99	2	0	Do not use since does not provide enough DO. Blower has same hp as Blower 2 but may not provide enough DO due to size of casing.	1.5	0.3
Walls in facility have been repaired. Poor ventilation. Oil and dirty. Used for storage.	88-90	1.5	1.2	Unit is dirty but in fair condition. Base is in good condition. No concrete pad.	91-96	0.5	0.3	Potential leaks. Visible oil stains.	92, 93	2	1.5	Temp: 158 degrees F. Minimal vibration. Very loud. Running smoothly. Poor ventilation (indoors with minimal windows).	1.5	0.3
Facility looks old and corroded. Exposed to weather.	166, 167	1.5	0.5	Motor has been removed. Drive is corroded. Baffle is warped (may be due to missing screws). Missing skimmer blades on one side. Inner tub and energy dissipating inlets (EDI) are corroded through in some areas. Floodsiding center wall is corroded. Some corrosion on foundation. Structural support for center column corroded. Concrete coating failed in numerous locations.	108-120	0.5	0	No noticeable leaks. However, motor removed.	N/A	2	0	Inoperable. Motor removed.	1.5	0.0
Facility looks old and corroded. Exposed to weather. Interior living is old and weathered.	164-166	1.5	0.8	Motor and drive is exposed to weather and is corroded. Additionally, all metal parts are experiencing corrosion. The skimmer arm and the support structure for the center column is also corroded.	167-183	0.5	0.5	No noticeable leaks.	N/A	2	1.7	Temp: good. Ventilation: good, open to environment. Noise and vibration good. Skimmer arm operates smoothly.	1.5	1.2
Area in good condition but exposed to weather. Clean. Good housekeeping.	121-123	1.5	1.3	Motor and drive in good condition. Minimal corrosion. Paint in good condition. Base in good condition.	123-131	0.5	0	No noticeable leaks. However, pump not used for approximately 10 years. SC 1 currently inoperable.	N/A	2	0	Pump not operated for approximately 10 years since SC 1 inoperable. Attempted to bump pump but pump shaft frozen.	1.5	0.0
Area in good condition but exposed to weather. Clean. Good housekeeping.	121-123	1.5	1.3	Motor and drive in good condition. Minimal corrosion. Paint in good condition. Base in good condition.	124-127, 131	0.5	0	No noticeable leaks. However, pump not used for approximately 10 years. SC 1 currently inoperable.	N/A	2	0	Pump not operated for approximately 10 years since SC 1 inoperable. Attempted to bump pump but pump shaft frozen.	1.5	0.0
Area covered but dirty. Wind and rain still get in since sides not enclosed.	198-205	1.5	1.3	Motor and pump in good condition. Minimal corrosion. Paint in good condition. Base in good condition.	184-188	0.5	0.4	Small oil stain.	N/A	2	1.8	Temperature: good. Ventilation: good, open to environment. Noise and vibration good.	1.5	1.4
Area covered but dirty. Wind and rain still get in since sides not enclosed.	198-205	1.5	1.3	Motor and pump in good condition. Minimal corrosion. Paint in good condition. Base in good condition.	189-193	0.5	0.4	Small oil stain.	N/A	2	1.8	Temperature: good. Ventilation: good, open to environment. Noise and vibration good.	1.5	1.4
Area covered but dirty. Wind and rain still get in since sides not enclosed.	198-205	1.5	1.3	Motor and pump in good condition. Minimal corrosion. Paint in good condition. Base in good condition.	194-197	0.5	0.4	Small oil stain.	N/A	2	1.8	Could not assess while operating. However, pump and motor is new and Operators said it operates fine.	1.5	1.4
Area in good condition but exposed to weather from sides (no walls). Clean. Good housekeeping.	132	1.5	1.1	Corrosion on pump and motor. Base and pad in good condition. Old.	139-147	0.5	0.2	Oil leak.	144	2	1.8	Temp: 81 degrees F. Noise and vibration good. Good ventilation. VFD burnt out, operated at constant speed.	1.5	0.6
Area in good condition but exposed to weather from sides (no walls). Clean. Good housekeeping.	132	1.5	1.1	Corrosion on pump and motor. Base and pad in good condition. Old.	133-138	0.5	0.5	No noticeable leaks.	N/A	2	0	Pump is inoperable.	1.5	0.6

Cr 5. Age of unit and run time		Cr 6. Corrective maintenance activities (Last 5 years)			Cr 7. Preventative maintenance activities (Last 5 years)			Cr 8. Equipment rotation (Exercise Program)			Possible Points	Condition Assessment Rating	Criticality Score	Total Rating
Observation	Photos	Pts	Sc	Observation	Pts	Sc	Observation	Pts	Sc	Observation				
Age: ~17 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	1	Preventative maintenance program in place with active maintenance being performed. Grease motors once a month (based on Operator interview).	1	0.5	Rotate equipment but not on a regular basis. Pump 3 is mainly used since it's the newest (~1 year old).	10	7.4	4	19.4
Age: ~ 1 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	1	Preventative maintenance program in place with active maintenance being performed. Grease motors once a month (based on Operator interview).	1	0.5	Rotate equipment but not on a regular basis. Pump 3 is mainly used since it's the newest (~1 year old).	10	9	4	4.6
Age: ~17 years old. No runtime data available.	N/A	2	1.5	Three corrective maintenance activities performed.	1	1	Preventative maintenance program in place with active maintenance being performed. Grease motors once a month (based on Operator interview).	1	0	Rotate equipment but not on a regular basis. Pump 3 is mainly used since it's the newest (~1 year old). However, can't rotate to this pump currently because it is not operational.	10	5.2	4	19.2
Age: ~17 years old. No runtime data available.	N/A	2	0	Have not used biofilter in approximately 10 years.	1	0	Have not used biofilter in approximately 10 years.	1	0	Biofilter is not mechanically operational. The biofilter has not been operated for approximately 10 years.	10	1.4	4	34.4
Age: ~17 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0	No preventative maintenance performed.	1	0	Biofilter has not been rotated for approximately 10 years.	10	5.1	4	19.6
Age: ~17 years old.	N/A	2	0	Have not used solids contact tank in approximately 10 years.	1	0	Have not used solids contact tank in approximately 10 years.	1	0	Solids contact tank has not been used for approximately 10 years.	10	1.7	2	16.6
Age: ~17 years old.	N/A	2	2	No corrective maintenance performed.	1	1	Preventative maintenance program in place with active maintenance being performed. Grease diffuser arms once a month (based on Operator interview).	1	0	Solids contact tank has not been rotated for approximately 10 years.	10	5.8	2	8.2
Age: ~35-40 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0	No preventative maintenance performed.	1	0	Don't use this blower because it does not provide enough DO.	10	3.7	4	25.2
Age: ~35-40 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0	No preventative maintenance performed.	1	0	Only use this blower. Do not use the other one because it does not provide enough DO. No backup.	10	5.6	4	17.6
Age: ~17 years old. No runtime data available.	N/A	2	0	Have not used clarifier in approximately 10 years.	1	0	Have not used clarifier in approximately 10 years.	1	0	Can't use this clarifier because the motor has been removed. Also, other parts have been taken from this clarifier to keep the other clarifier in operation.	10	1.3	4	34.8
Age: ~5 years old. No runtime data available.	N/A	2	1.5	No corrective maintenance activities performed.	1	1	Preventative maintenance program in place with active maintenance being performed.	1	0	Secondary clarifier has not been rotated for approximately 10 years.	10	7.3	4	10.8
Age: ~17 years old. No runtime data available.	N/A	2	0	Have not used pump in approximately 10 years since Secondary Clarifier 1 is currently inoperable.	1	0	Have not used pump in approximately 10 years since Secondary Clarifier 1 is currently inoperable.	1	0	Have not used pump in approximately 10 years since Secondary Clarifier 1 is currently inoperable.	10	2.3	4	30.8
Age: ~17 years old. No runtime data available.	N/A	2	0	Have not used pump in approximately 10 years since Secondary Clarifier 1 is currently inoperable.	1	0	Have not used pump in approximately 10 years since Secondary Clarifier 1 is currently inoperable.	1	0	Have not used pump in approximately 10 years since Secondary Clarifier 1 is currently inoperable.	10	2.3	4	30.8
Age: ~ 4 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0.5	Preventative maintenance program in place with semi-active maintenance being performed.	1	0.8	Operators said that they rotate the pumps (Pump 1 and 2, and Pump 3).	10	8.5	2	3.0
Age: ~ 4 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0.5	Preventative maintenance program in place with semi-active maintenance being performed.	1	0.8	Operators said that they rotate the pumps (Pump 1 and 2, and Pump 3).	10	8.5	2	3.0
Age: ~ 1 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0.5	Preventative maintenance program in place with semi-active maintenance being performed.	1	0.8	Operators said that they rotate the pumps (Pump 1 and 2, and Pump 3).	10	8.3	2	3.4
Age: ~17 years old. No runtime data available.	N/A	2	2	No corrective maintenance performed.	1	0	No preventative maintenance performed.	1	0	WSS Pump 2 is not operational. No backup.	10	8.1	4	19.6
Age: ~17 years old. No runtime data available.	N/A	2	0	WSS Pump 2 is not operational.	1	0	No preventative maintenance performed.	1	0	Pump is not operational. Only WSS Pump 1 is used.	10	2.6	4	29.6

Attachment B: Structural Condition Assessment Report

STRUCTURAL

GENERAL

Cursory walkthrough site visits were performed on January 9, 2013 and July 9, 2013 to assess the general condition of the various structures noted below. The assessment was limited to only those portions of the structures that were readily accessible and observable. Biofilter 2, Aerated Solids Contact Tank (ASC) Tank 2, and Secondary Clarifier 2 were all in service at the time of the latter site visit, so observations of conditions below the in-service water levels were not possible. No destructive or non-destructive material testing was performed. The observations noted and recommendations made herein, where applicable, are intended to restore the original functional capacity of each structure. It is not intended to upgrade the structures to current code requirements, which is beyond the scope of the work.

BIOFILTER 1

Biofilter 1 consists of precast reinforced concrete wall panels with a concrete top ring beam and concrete columns supported by reinforced concrete stem walls and shallow spread footings. The slab on grade is 12" thick. A concrete column located at the center of the tank supports the inlet pipe and rotary arm distributors. The structure was built in the mid 1990s.

In general, the structure appears to be in fair to good condition with some minor discrepancies. Some minor hairline cracks were located randomly throughout the precast wall panels and at each column. The cracks appear to be non-structural shrinkage cracks and limited to only the exterior cement-wash coating over the structural elements. After scratching off the cement-wash coating layer, the cracks do not appear in the structural elements (See Photos 1 & 2).

Photo 1- Typical Wall Panel and Columns

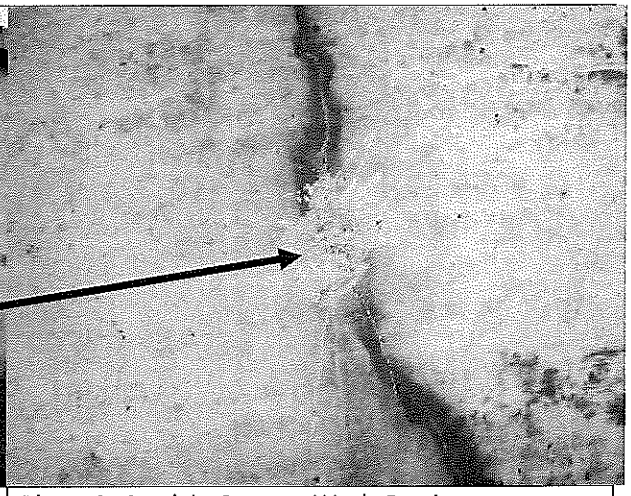

Photo 2- Crack in Cement-Wash Coating

At the south-east quadrant of the biofilter, one concrete column had some minor concrete spalls at the base that exposed the embedded reinforcing steel (See Photo 3). The rebars appear to be in good condition with no noticeable signs of advanced corrosion. After sounding this location with a small hammer, the spalling appears to be localized and limited only to that portion surrounding the exposed rebar. The concrete cover in this location is less than one inch, which is less than the original contract drawing requirements and may not provide adequate protection for long-term durability.

The metal access ladder connection to the interior face of the concrete wall is incomplete (See Photo 4). No other signs of significant structural distress were noted and no apparent signs of foundation settlement were observed.

Photo 3- Exposed Rebar at Column Base

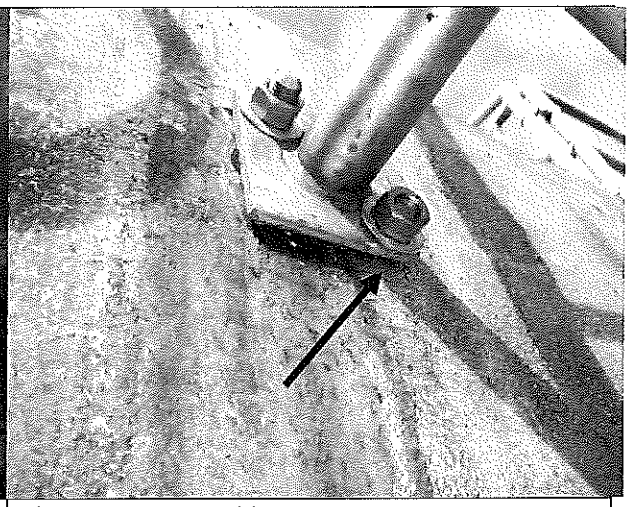

Photo 4- Access Ladder Connection

Biofilter 1 Recommendations and Opinion of Probable Construction Costs

- Repair base of concrete column spall for long-term durability. Remove loose and deteriorated concrete, clean rebar to bare metal, and patch with patching compound in accordance with the recommendations of the International Concrete Repair Institute (ICRI).
- Reset ladder connection to provide full contact with concrete wall and full nut engagement.
- Estimated Construction Cost: $ 5,000

BIOFILTER 2

Biofilter 2 is basically identical in structural framing to Biofilter 1 and the general overall condition is nearly the same. The non-structural shrinkage cracks in the columns and wall panels and the exposed rebar at the column bases (2 locations) (See Photo 5) identified in Biofilter 1 are prevalent in Biofilter 2. This would seem reasonable given that both structures were built at the same time.

One metal guardrail post near the gate at top of the Biofilter is missing an anchor bolt (See Photo 6).

Photo 5- Exposed Rebar at Column Base

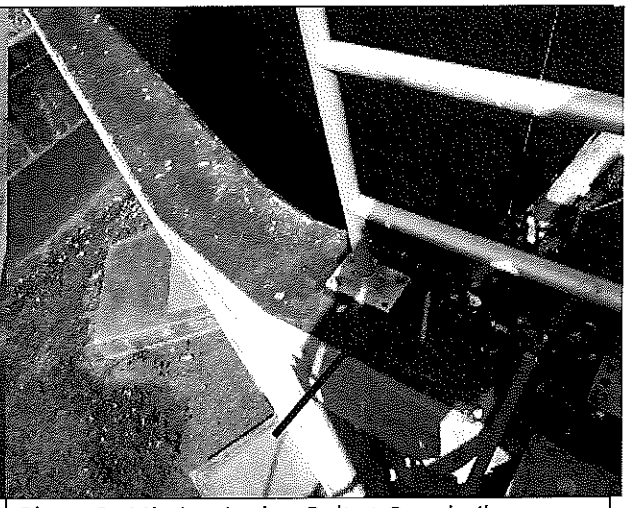

Photo 6- Missing Anchor Bolt at Guardrail

Biofilter 2 Recommendations and Opinion of Probable Construction Costs

- Repair bases of concrete column spalls for long-term durability. Remove loose and deteriorated concrete, clean rebar to bare metal, and patch with patching compound in accordance with the recommendations of the International Concrete Repair Institute (ICRI).
- Install missing anchor bolt at base of metal guardrail post.
- Estimated Construction Cost: $ 10,000

ASC TANK 1

ASC Tank 1 is one half of a subgrade rectangular tank consisting of concrete walls and slabs. An elevated steel grating walkway supported by concrete columns is located at the centerline of Tank 1. The original date of construction is in the 1970s. The tank appears to be in fair condition with some minor to moderate deterioration of the ancillary structural elements.

The steel railing all around the existing tank is in fair to poor condition with some moderate corrosion at the joints (See Photo 7). The coating of the railing has mostly failed and is peeling off the substrate. Some minor holes were cut out of the steel grating, leaving the grating unsupported at small sections (See Photo 8). Various steel angles and plates supporting the wood baffles and elevated walkways exhibit signs of minor corrosion (See Photos 9 & 10). The wood baffles, which separate the sections of the tank, are in poor condition, exhibiting signs of wood rot (See Photos 10 & 11). Finally, there are various random narrow shrinkage cracks and concrete spalls located throughout the top of the concrete tank (See Photo 12).

Photo 7- Corrosion at Joints of Railing

Photo 8- Holes Through Steel Grating

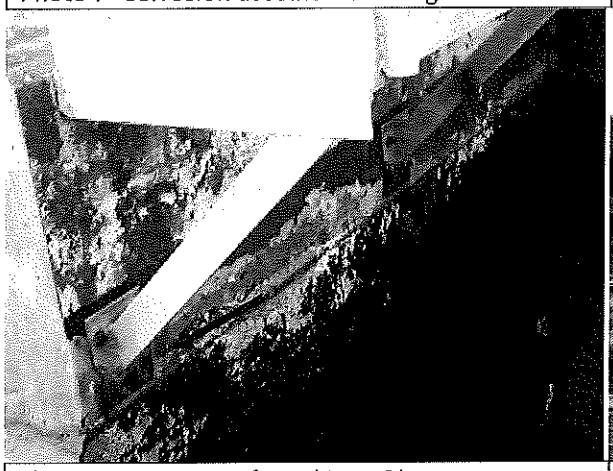

Photo 9- Corrosion of Steel Base Plates

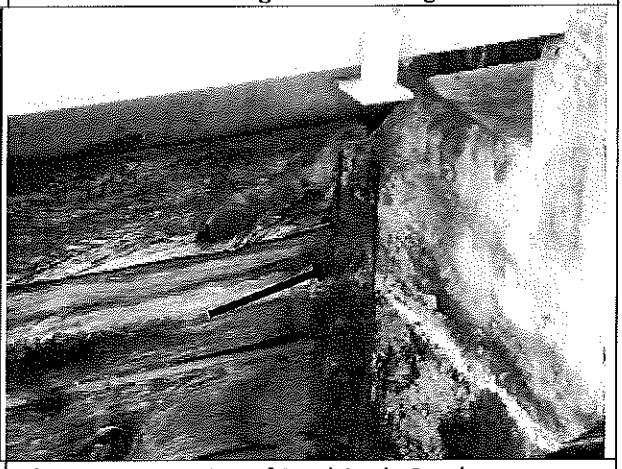

Photo 10- Corrosion of Steel Angle Brackets

Photo 11- Wood Rot of Baffles

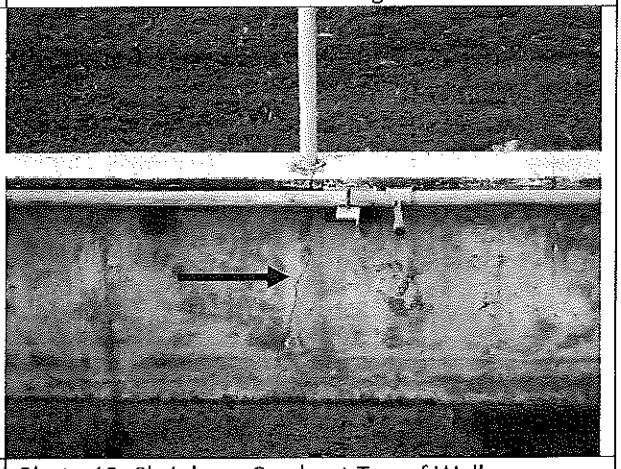

Photo 12- Shrinkage Cracks at Top of Walls

ASC Tank 1 Recommendations and Opinion of Probable Construction Costs

- Replace steel railing.
- Reinforce holes through steel grating to provide complete load path to supporting beams.
- Epoxy inject minor shrinkage cracks and patch minor spalls in accordance with ICRI recommendations

- Clean steel brackets and angles and recoat with protective zinc-rich coating.
- Replace wood baffles.
- Estimated Construction Cost: $ 80,000

ASC TANK 2

ASC Tank 2 is the second half of the same subgrade rectangular tank as ASC Tank 1. The tank appears to be in similar condition as ASC Tank 1, though slightly more deteriorated. While ASC Tanks 1 and 2 are essentially the same structure, the in-service use of Tank 2 throughout the years may have accelerated the deterioration of Tank 2 modestly more than Tank 1.

The steel railing all around the existing tank is in poor condition with some moderate to severe corrosion at the post bases (See Photo 13). Some of the railing posts along the center walkway were missing or intentionally removed (See Photo 14). And similar to ASC Tank 1, steel bar grates were cut and minor spalls and cracks were present at the top of the concrete walls.

Photo 13- Corrosion of Post Base Leading to Concrete Spall

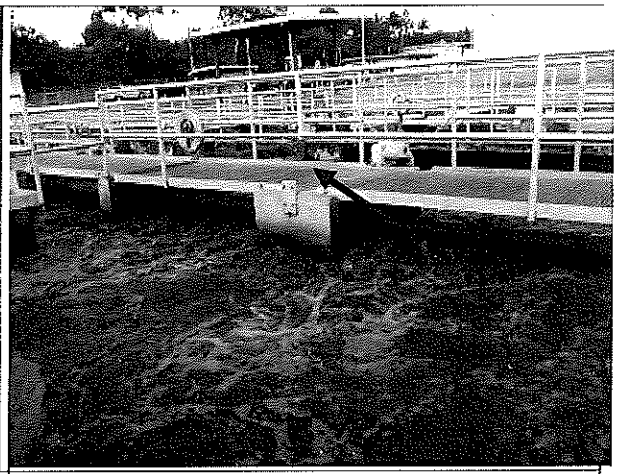

Photo 14- Missing Railing Post

ASC Tank 2 Recommendations and Opinion of Probable Construction Costs

- Replace steel railing.
- Reinforce holes through steel grating to provide complete load path to supporting beams.
- Epoxy inject minor shrinkage cracks and patch minor spalls in accordance with ICRI recommendations
- Estimated Construction Cost: $ 80,000

SECONDARY CLARIFIER 1

Secondary Clarifier 1 is a subgrade circular tank consisting of reinforced concrete walls supported by shallow continuous footings with a 12" slab on grade. The structure was built in the mid 1990s, similar to Biofilter 1. A fiber reinforced polymer (FRP) walkway grating supported by steel beams spans across the center of the tank.

In general, the structure appears to be in fair to good condition with minor discrepancies. At the northeast quadrant, a section of a slab on grade landing platform has been undermined (See Photo 16).

It is unclear the cause of the undermining, though an outlet pipe shown in the photo below may be the cause.

Photo 15- Overall View of Secondary Clarifier 1

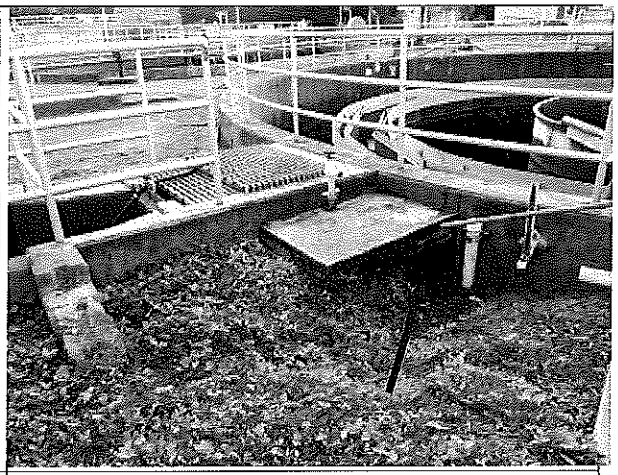

Photo 16- Slab on Grade Undermining

The steel beams supporting the FRP walkway appear to be in good condition. At the ends of the beams, a gap exists between the beam bottom and the supporting concrete wall (See Photo 17). In addition, the FRP grating is the original grating installed during construction of the tank and it may be near the end of its useful life due to exposure to UV rays.

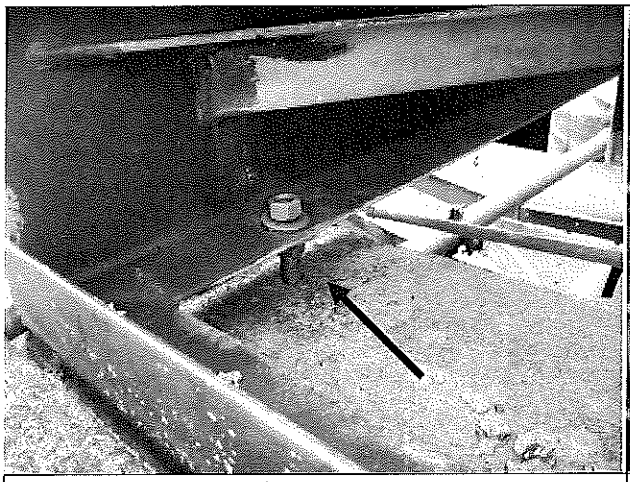

Photo 17- Gap Beneath Beams

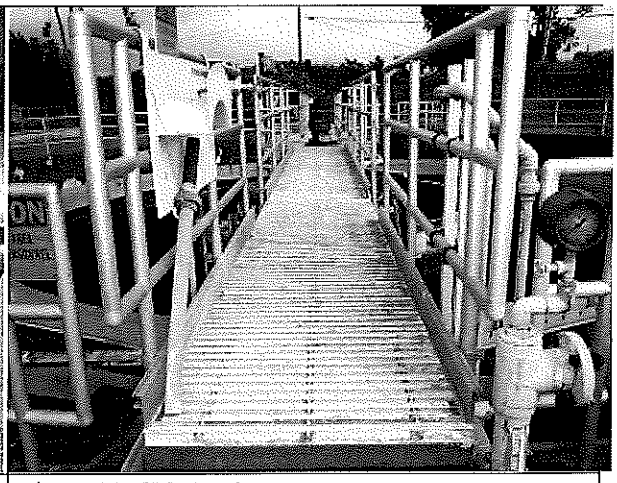

Photo 18- FRP Grating

Secondary Clarifier 1 Recommendations and Opinion of Probable Construction Costs

- Backfill the undermined slab on grade to provide bearing support. Verify source of undermining and redirect water as required.
- Infill the gap beneath the steel beams with non-shrink grout to provide bearing support.
- Replace the FRP grating with new FRP grating.
- Estimated Construction Cost: $ 20,000

SECONDARY CLARIFIER 2

Secondary Clarifier 2 is a subgrade circular tank consisting of reinforced concrete walls supported by shallow continuous footings with a 12" slab on grade. The original date of construction is in the 1970s. The original structure was deepened by 7 feet in the mid 1990s, when the biofilters were built. An FRP walkway grating supported by steel beams spans the center of the tank.

In general, the structure appears to be in fair condition with moderate discrepancies. Numerous vertical cracks with widths averaging 0.03 inches and spalls occur at the steel railing post locations (See Photos 19 & 20). The cracks and spalls are likely due to corrosion of the steel post bases, but could be compounded by several factors including: a) the clarifier walls are only 8 inches thick at the top, b) the post base sleeve reduces the concrete cover on either side of the post to thin sections, and c) there is no horizontal reinforcing steel at these locations to limit the cracking. ACI 350 recommends a minimum wall thickness of 12" for concrete structures in contact with liquids.

Photo 19- Concrete Spall at Railing Post Base

Photo 20- Vertical Crack at Top of Concrete Wall

Secondary Clarifier 2 Recommendations and Opinion of Probable Construction Costs

- Epoxy inject cracks and patch spalls in accordance with ICRI recommendations
- Modify railing post base connection to remove embedded portion.
- Replace the FRP grating with new FRP grating.
- Estimated Construction Cost: $ 130,000

RSS Pump Station 2 Canopy

An open canopy structure consisting of steel beams and pipe columns and metal roofing is located adjacent to Secondary Clarifier 2. It provides protection against weather for RSS Pump Station 2. The original date of construction is assumed to be the 1990s. In general, the structural framing appears to be in fair condition with mostly minor to moderate isolated corrosion of the steel beams. The most severe corrosion occurred at the top flange of the steel beam below the roof gutter, which resulted in some section loss of the top flange. (See Photo 22) There may be a leak in the gutter at this location which may be accelerating the steel corrosion.

Photo 21- Steel Canopy Structure

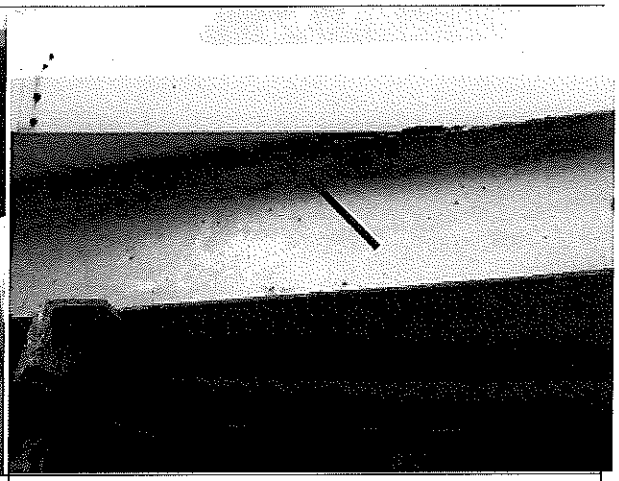

Photo 22- Moderate Corrosion at Top Flange

RSS 2 Pump Station Canopy Recommendations and Opinion of Probable Construction Costs

- Clean and repaint structural steel framing of canopy.
- Repair gutter.
- Estimated Construction Cost: $ 20,000