Sludge is withdrawn from the sludge hoppers through the telescoping valves on a daily basis during winter operation and twice daily during the summer (due to the higher production rates). Staff report that this frequency prevents impaction of sludge in the hopper and clogging of the telescoping valve. Operation of the eight valves can take 1 to 2 hours per day depending on the sludge accumulated. While the telescoping valves were found to be in good working condition, the impaction problem is an indication that the valves may be undersized and/or that the design of the hoppers is not effective.

The City should continue with annual inspections and replace worn components as needed. Alternative sludge collection systems should be considered with the next major plant expansion project. These items should be scheduled into a replacement program (P-6).

3.5 FILTRATION SYSTEM

3.5.1 Overview

Filtration is the final polishing step which is designed to remove any coagulated particles and contaminants that are not removed during sedimentation/clarification process. Filtration removes contaminants by surface straining and by attraction of the contaminants to the media grain surfaces within the depth of the filter bed which occurs by variety of physical-chemical mechanisms.

Clarified water flows from the sedimentation through an effluent flume and channel and is dispersed to the filters through a 30-inch cast iron header where the flow splits into one of four (4) rapid sand filter units. Treated water enters a filter gullet from which it flows onto the filter bed. The filter bed consists of granular activated carbon and sand media. The original underdrains consisted of standard Leopold tile blocks. In 1993, they were upgraded to a scalloped stainless steel slotted type system. Filtered water is collected in a concrete diffuser

6.5.5 Pretreatment Concrete Repairs

A number of issues were identified which should be addressed to maintain the structural integrity of the mixing, flocculation and sedimentation basins. One of the primary concerns is the condition of the concrete. Our inspection found the concrete to be in good condition for a structure of this age; however numerous repairs are warranted to maintain and extend the structure's useful life. In addition, it is suggested that inspection and repairs to the rapid mixers, flocculators and sludge collection equipment be made in conjunction with the concrete repair as the work will require dewatering of the basins.

Items specific to this recommendation include:

a. Item No. S-20 thru S-28. Concrete repairs to mixing, flocculation and sedimentation basins.
b. Item No. S-29. Pressure wash interior walls of floc basins and re-inspect.
c. Item No. P-4. Clean, inspect and repair rapid mixer and flocculator blades.
d. Item No. P-6. Monitor the integrity of the sludge collection system gears and axles for the chain and flight system.
e. Item No. P-30. Inspect sludge hoppers for short-circuiting.

6.5.5.1 Recommendations

Of primary concern is the degradation of the concrete. The majority of the spalling and concrete cracking is minor in nature and will not immediately impact system reliability; however the more prominent concrete and control joint failures should be addressed as soon as possible. Major cracking at the joints on the interior of the sedimentation basins extends between adjacent basins which prevents the basins from being completely dewatered. These conditions will only worsen if left unattended. The rapid mix and flocculator paddles and turbines should be cleaned and overhauled coincident with the repairs to ensure efficient mixing and to reduce failures of the equipment. The estimated cost to complete this work is $140,000.

6.5.6 Sedimentation and Filtration Expansion

Expansion of the sedimentation and filtration processes will be required to meet future conditions. Our assessment validated that these processes are in fact limited hydraulically to 10 MGD and that as production rates approach this threshold, each process will require expansion in order to maintain treatment goals. If flows continue to increase as projected, a new mixing/sedimentation train and filter will be required by 2015.

Items specific to this recommendation include:

a. Item No. P-29. Add sedimentation basin to meet projected demands.
b. Item No. P-32. Add filter to meet projected demands.

6.5.6.1 Related Improvements

A number of related improvements were identified which should be considered in any major work on the mixing, sedimentation and filtration systems. These include the following:

a. Item No. A-1. Repair the brick walls at the Filter Room Window Wells.
b. Item No. A-10. Replace windows and repair flashing in the Filter Room Window Wells.
c. Item No. A-12. Replace Filter Room window glass.
d. Item No. A-14. Replace the roof decks at Filter Room Window Wells.
e. Item No. S-14. Add guard rails around filters.
f. Item No. S-19. Replace rusted pipe stanchions in pipe gallery.
g. Item No. E-3. Replace MCC #3.
h. Item No. P-5. Provide protection for mixing motors on top of the pretreatment works.
i. Item No. P-7. Monitor and inspect filter underdrain system; repair as needed.
j. Item No. P-9. Replace filter control valves, actuators and flow meters as needed.
k. Item No. P-27. Modify filtered water chemical injection points.
l. Item No. P-31. Upgrade sedimentation sludge collection and disposal process.
m. Item No. P-32. Add filter-to-waste piping.

components, rebalancing of the impellers and shaft, replacement of bushings and upgrade of the existing stuffing box to a mechanical seal. There was significant wear on the impeller and impeller bowls, but Frederick flow was able to rebuild both components. Following completion of service, the pump was re-installed and placed back in service.

Based on the condition of Raw Water Pump #3, Raw Water Pumps #1 and #2 should be overhauled or completely replaced (P-3). Based on the conditions observed with Raw Water Pump #3, it is our opinion that these pumps are moderately/highly subject to mechanical failure. The loss of one or more of the pumps could significantly limit production capacity and could interrupt service to the system.

3.3 RAPID MIX AND FLOCCULATION SYSTEM

3.3.1 Overview

Aluminum sulfate (alum) and sodium hydroxide (caustic soda) are added to the raw water in the piping header in the Raw Water Pump Room. Aluminum sulfate is used as a coagulant and caustic soda is added for pH adjustment. The water is discharged from the raw water pumps into a 24-inch pipe where it flows to the influent flume. The influent flume distributes flow over four rapid mix and flocculation treatment trains. Each treatment train consists of an inactive carbon contact chamber, a rapid mix basin and two flocculation basins. The rapid mix basin is designed to disperse the aluminum sulfate and caustic soda throughout the raw water and promotes the initial process of coagulation of the suspended contaminants in the water. The rapid mix chamber includes a dual 4-blade turbine style mixer to induce mixing.

Following the rapid mix process, coagulated water passes from the rapid mix chambers to each flocculation basin through 3-foot by 3.5-foot ports; the coagulated water exits the second basin through a 17-foot by 2-foot port located at the bottom of the basin. All of these ports are staggered to reduce short circuiting and promote contact time. Water in the flocculation basin is mixed at a slower rate to promote the interaction of particles to create large settable particles called "floc". Each basin is equipped with a flat blade turbine style mixer to induce mixing within the chamber. The rapid mix and flocculation systems are detailed in Table 3-2.

TABLE 3-2

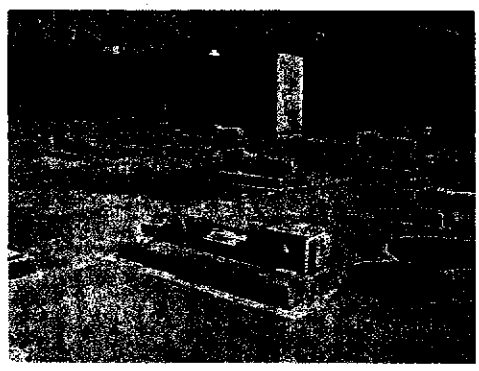
RAPID MIX AND FLOCCULATION SYSTEM DETAILS

Rapid Mix System	
Purpose	Mix raw water with chemicals
Location	Pretreatment works
Basin Dimensions	6' wide x 6' long x 15' deep
Type	Right-angle drive
Invert	EL 198.5
Paddle Details	dual 4-blade turbine style
Manufacturer	Lightning
Model	72-Q-3
Number	4
Design Condition	0-1,670 RPM
Motor Horsepower	3 hp
Motor Starter Type	Variable Frequency drives
Flocculation System	
Purpose	Increase floc size
Location	Pretreatment works
Basin Dimensions	17' wide x 17' long x 15' deep
Type	Right-angle drive
Invert	EL 187.0
Paddle Details	flat blade turbine style
Manufacturer	Lightning
Model	72-Q-2
Number	8
Design Condition	0-1,670 RPM
Motor Horsepower	2 hp
Motor Starter Type	Variable Frequency drives

3.3.2 Equipment Evaluation

3.3.2.1 Rapid Mix System

For this report we were unable to inspect any of the paddles on the rapid mixer because the basins were not accessible at the time of our inspection. Staff reported that the paddles are covered with tuberculation but are otherwise in satisfactory condition. The paddles should be



cleaned and inspected for damage or missing paddles and replaced if their condition warrants (P-4). The motors that drive the rapid mixers are mounted on top of the rapid mix chamber and are exposed to the elements. The motors were replaced in 2006 and are regularly maintained.

3.3.2.2 Flocculation System

The flocculator paddles in both basins were found to be in fair condition. Each paddle and flocculator drive shaft was covered with a significant amount of tuberculation and many of the paddles appeared to be worn or corroded reducing the paddle surface area. This condition has likely reduced the mixing efficiency of the flocculators. The paddles should be cleaned, inspected and replaced where warranted (P-4). The motors were replaced and variable frequency drives were added in 2006. These units receive regularly scheduled maintenance.

The motor and gear boxes for the rapid mix and flocculation system are exposed to the elements; this appears to have had little impact on their operation and condition. However, staff reports that the units can be difficult to service during inclement weather. The City should consider alternatives for sheltering the equipment as part of a long-term improvement strategy (P-5).

3.4 SEDIMENTATION AND SLUDGE COLLECTION SYSTEM

3.4.1 Overview

Once a floc has been formed, the treated water flows from the flocculation basin to the sedimentation basins where the floc and contaminants are removed by gravity settling. The sedimentation basin consists of two levels; water enters the lower level of the basin and flows along the length of the basin. Once the water reaches the far end of the basin, the water flows up and then in the reverse direction on the upper level. All along the path of flow, the floc particles settle out onto the lower and upper floors of the basin. At the end of the sedimentation process, the clarified water exits the basins through a 2-inch effluent slot into an effluent flume.

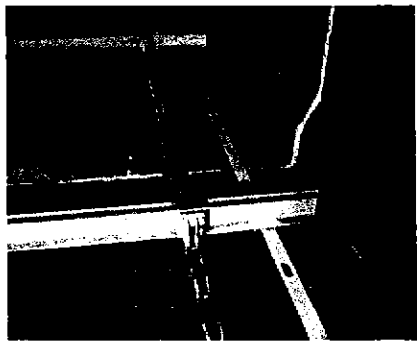
Settled sludge is collected from the upper and lower levels of the sedimentation basins by a chain and flight system where it is deposited into a sludge collection trough located at the far end of the basin. Each trough is split into two hoppers. Sludge is withdrawn from the hoppers through telescoping valves where it is discharged to the public sewer system. The equipment comprising the sedimentation and sludge collection system is detailed in Table 3-3.

TABLE 3-3

SEDIMENTATION AND SLUDGE COLLECTION SYSTEM DETAILS

Tankage	
Number	4
Dimensions (per tank)	115'-2" x 17'
Invert	EL 187.0
Detention Time	1.75 hours @ 10 MGD
Overflow Rate	700 gpd/sf
Horizontal Velocity	1.95 fpm
Sludge Collection & Disposal	
Type	Chain & flight
Manufacturer	Falk
Model	2KR25 20A5
Number	2
Year Installed	1974
Motor Horsepower	0.5 hp
Chain Speed	2 ft/min
Discharge	6" Telescoping valve

3.4.2 Sludge Collection Equipment Evaluation



Staff operates the sludge collection system in a continuous mode in order to reduce strain on the chain and flights which could result from excessive sludge build up. They report that intermittent operation has not performed satisfactorily and has been problematic. The flight and chains were recently upgraded and appear to be in good condition. The main sprocket and drive axels have tuberculation and surface corrosion on them.