7.0 WATER SUPPLY

Section 2 describes the quantity of water required, the primary and back-up water supply sources, treatment process description, and planned discharges for the RCEC and AWT Plant. This section presents a discussion of the water quality of these streams and the treatment of waste streams prior to discharge.

7.1 WATER QUALITY

The water quality of the secondary effluent from the Hayward WPCF and of the back-up secondary effluent supply from USD/EBDA is shown on Table 7-1. City of Hayward potable water quality is also shown. The City of Hayward WPCF is currently planning significant plant upgrades over the next 5 years that are designed to improve the quality of the secondary effluent. Therefore, the quality of the influent to the AWT plant is expected to improve within a few years of its commissioning. However, the treatment system described in Section 2.3 of this AFC will be designed to treat the AWT plant secondary effluent of the current quality to the levels required for use at the power plant and to treat waste streams to meet existing requirements for discharge.

7.2 WATER TREATMENT

The proposed AWT plant described in Section 2.3 will produce water suitable for use as cooling tower makeup and as feedwater for the power cycle makeup water treatment system. The AWT plant layout is shown in Figure 2.3-1. Anticipated product quality for key parameters is summarized in Table 7-2.

7.3 WASTEWATER COLLECTION, TREATMENT, AND DISPOSAL

The expected wastewater streams from the RCEC and AWT plant sites include the following:

- Combined Liquid Streams from Copper Removal/Treatment, Solids Clarification and Microfilter Backwash
- Cooling Tower Blowdown
- Sanitary Wastewater
- Plant Drainage
- AWT Plant Stormwater Drainage

The average and peak flow rates for these streams are presented in Section 2. Pipelines for each of these discharges are shown on Figure 2.3-2. Each waste stream will be monitored prior to discharge to the existing sewer to assure that it meets appropriate discharge limits. A description of each of these streams, and any treatment performed prior to discharge, is given below. Figure 7-1 is a process flow chart that describes the water treatment system. Figure 7-2 diagrams the microfiltration reverse osmosis (MF/RO) system.

7.3.1 Liquid Streams from Copper Removal/Treatment and Solids Clarification

Wastewater influent into the Hayward WPCF contains concentrations of copper ranging from 24 ug/L to 140 ug/L, with an average of 65 ug/L. In addition to the Hayward contribution, the EBDA pipeline receives effluents from five other dischargers (Oro Loma/Castro Valley Sanitary Districts, City of San Leandro, USD, Livermore-Amador Valley Water Management Agency, which includes the City of

Livermore, and Dublin-San Ramon Services District). The current EBDA permit limit for copper is an interim daily maximum limit of 23 ug/L, for which the point of compliance is the EBDA outfall. The average copper concentration at the EBDA outfall, which represents the blended effluent of all of the EBDA dischargers, is 13 ug/L.

Operations at the AWT plant will result in a concentrated wastestream rejected from the Reverse Osmosis process (RO concentrate) containing concentrations of copper above 23 ug/L. A second stream, generated from backwashing the Microfiltration system ahead of the Reverse Osmosis process, will contain copper concentrations identical to the Hayward secondary effluent concentrations, approximately 23.5 ug/L.

To ensure achievement of EBDA concentration permit limits, a copper treatment process has been incorporated into the AWT plant, which will significantly reduce the total mass loadings of copper ultimately discharged into the EBDA pipeline and San Francisco Bay. Copper treatment will involve pH adjustment with clarification and precipitation of copper. Lime will be added to raise the pH of the streams, ferric chloride ($FeCl_3$) will be added as a clarifying agent, and sodium sulfide (Na_2S) will be added to aid in copper precipitation. The chemical dosages are projected at approximately 1000 mg/l lime, 30 mg/l ferric chloride, and 4.5 mg/l sodium sulfide. Preliminary lab testing of this copper treatment process has been successful in achieving significant reduction in copper concentrations.

Following copper treatment and solids clarification, the resulting waste stream will be discharged to the Hayward WPCF secondary effluent 48-inch discharge line, upstream of the WPCF's chlorination facility. Water quality characterization of the Hayward effluent with the AWT plant and the RCEC Plant discharges compared to the EBDA limits is shown in Table 7-3. All copper removal and solids clarification facilities will be designed and operated so that the contribution of the Hayward WPCF's effluent to the EBDA pipeline meets EBDA permit limit targets, of which copper and suspended solids are understood to be the most critical.

Associated with the copper removal process, solids will be generated which will be handled onsite, prior to ultimate disposal in a landfill. From the reactor clarifier where the copper removal process will occur, the solids will be processed through gravity thickeners, conditioning, and plate and frame presses for dewatering to achieve 50 percent solids quality. The filtrate from the dewatering process will be conveyed to the post-treatment facilities. After dewatering, the resulting sludge will be transported off-site for ultimate disposal. The dominant species in the residual sludge will result from the lime dosage, described above, and will be calcium carbonate. Ferric hydroxide will be present to a much lesser extent. Other constituents of the sludge will result from incidental removal from the concentrate stream. The most notable constituent of concern that is removed from the concentrate in the treatment scheme is copper. The projected concentration of copper in the waste sludge resulting from this treatment is less than 100 mg/kg. The TTLC concentration of concern is listed as 2500 mg/kg. Therefore, it is unlikely that there will be any restrictions with respect to disposal of this sludge from a hazardous waste standpoint.

Table 7-1. Summary of average water quality characteristics for potential sources of project water.

Water quality parameter †	Hayward secondary effluent (primary source)	Union Sanitary District effluent (secondary source)	Hayward potable water supply	Drinking Water Standard
Turbidity	17 (11-33)	—	0.3 (0.2-0.6)	1-5 ntu
Color	—	—	2	15 Pt-Co units
Odor Threshold	—	—	1	3 units
pH	7.8	7.8	8.8	6.0 – 9.0 units
Total Alkalinity	255	—	60	no standard (mg/l)
Bicarbonate	—	—	—	no standard (mg/l)
Total Dissolved Solids	564	910	128	1,500 mg/l
BOD	17	9	ND	no standard (mg/l)
TOC	32	—	ND	no standard (mg/l)
Phosphate	4	—	ND	no standard (mg/l)
Total Nitrogen	28	—	ND	no standard (mg/l)
Nitrate as NO_3	6.0	—	ND	45 mg/l
Fluoride	2.2	—	0.1	2 mg/l
Chloride	153	—	12	500 mg/l
Hardness	160	250	63	200 mg/l
Arsenic	0.0017	0.0088	ND	0.05 mg/l
Calcium	33	52	11	no standard (mg/l)
Magnesium	14	33	6	no standard (mg/l)
Manganese	0.06	—	ND	0.05 mg/l
Sodium	133	—	13	350 mg/l
Potassium	16	—	0.9	no standard (mg/l)
Silica	13	17	6	no standard (mg/l)
Silver	0.002	0.0033	ND	0.1 mg/l
Sulfate	44	97	13	500 mg/l
Cadmium	0.0006	0.0006	ND	0.005 mg/l
Chromium	0.0051	0.0022	ND	0.05 mg/l
Copper*	0.024	0.018	0.058	1.3 mg/l
Cyanide	< 0.003	—	ND	0.2 mg/l
Iron	1.4	—	< 0.1	0.30 mg/l
Lead*	0.0022	0.0125	0.004	0.015 mg/l
Mercury	0.00005	—	ND	0.002 mg/l
Nickel	0.012	0.0085	ND	0.1 mg/l
Boron	0.5	—	ND	no standard (mg/l)
Selenium	0.0012	0.0242	ND	0.05 mg/l
Thallium	—	—	ND	0.002 mg/l
Zinc	0.073	0.038	ND	5.0 mg/l

† units of measure for each analyte are given in the last column
ND = analyte not detected
* Lead and copper values from City of Hayward tap water. 90th percentile value for copper is 0.08 mg/L

Table 7-2. Circulating water quality.

Contaminant	Units	RO Permeate (To Cooling Tower)	Cooling Tower Blowdown at 100 Cycles
Alkalinity-Bicarbonate	mg/L	11.000	301.400
Alkalinity-Carbonate	mg/L	0.000	8.500
Alkalinity-P-BaCl2	mg/L	0.000	0.000
Alkalinity-Phenol	mg/L	0.000	8.500
Alkalinity-Total	mg/L	11.000	309.900
Aluminum	mg/L	0.000	0.000
Ammonia*	mg/L	2.000	200.000
Arsenic	mg/L	0.000	0.000
Biochemical Oxygen Demand	mg/L	0.300	< 1.0
Boron	mg/L	0.420	42.000
Bromide	mg/L	0.000	0.000
Cadmium	mg/L	0.000	0.000
Chloride	mg/L	5.000	839.830
Chromium	mg/L	0.000	0.000
Copper	mg/L	0.0001	0.010
Cyanide	mg/L	0.00019	0.019
Fluoride	mg/L	0.000	0.000
Hardness-Calcium	mg/L	0.100	10.000
Hardness-Magnesium	mg/L	0.100	10.000
Hydrogen Sulfide	mg/L	0.000	0.000
Iron	mg/L	0.000	1.000
Lead	mg/L	0.000	0.000
Manganese	mg/L	0.000	0.000
Mercury	mg/L	0.000	0.000
Nickel	mg/L	0.0001	0.010
Nitrate as NO_3	mg/L	1.000	100.000
Nitrite as NO_2	mg/L	0.300	30.000
Nitrogen-Total	mg/L	2.700	270.000
pH	s.u.	5.200	8.060
Phosphate	mg/L	0.000	15.000
Potassium	mg/L	1.000	100.000
Selenium	mg/L	0.000	0.000
Silica	mg/L	0.400	40.000
Silver	mg/L	0.000	0.000
Sodium	mg/L	4.000	400.000
Sulfate	mg/L	1.000	100.000
Total Dissolved Solids	mg/L	20.000	2461.000
Total Organic Carbon	mg/L	1.000	1.000
Total Suspended Solids	mg/L	0.000	10.000
Temperature	Degrees F	64	100
Zinc	mg/L	0.0004	0.040

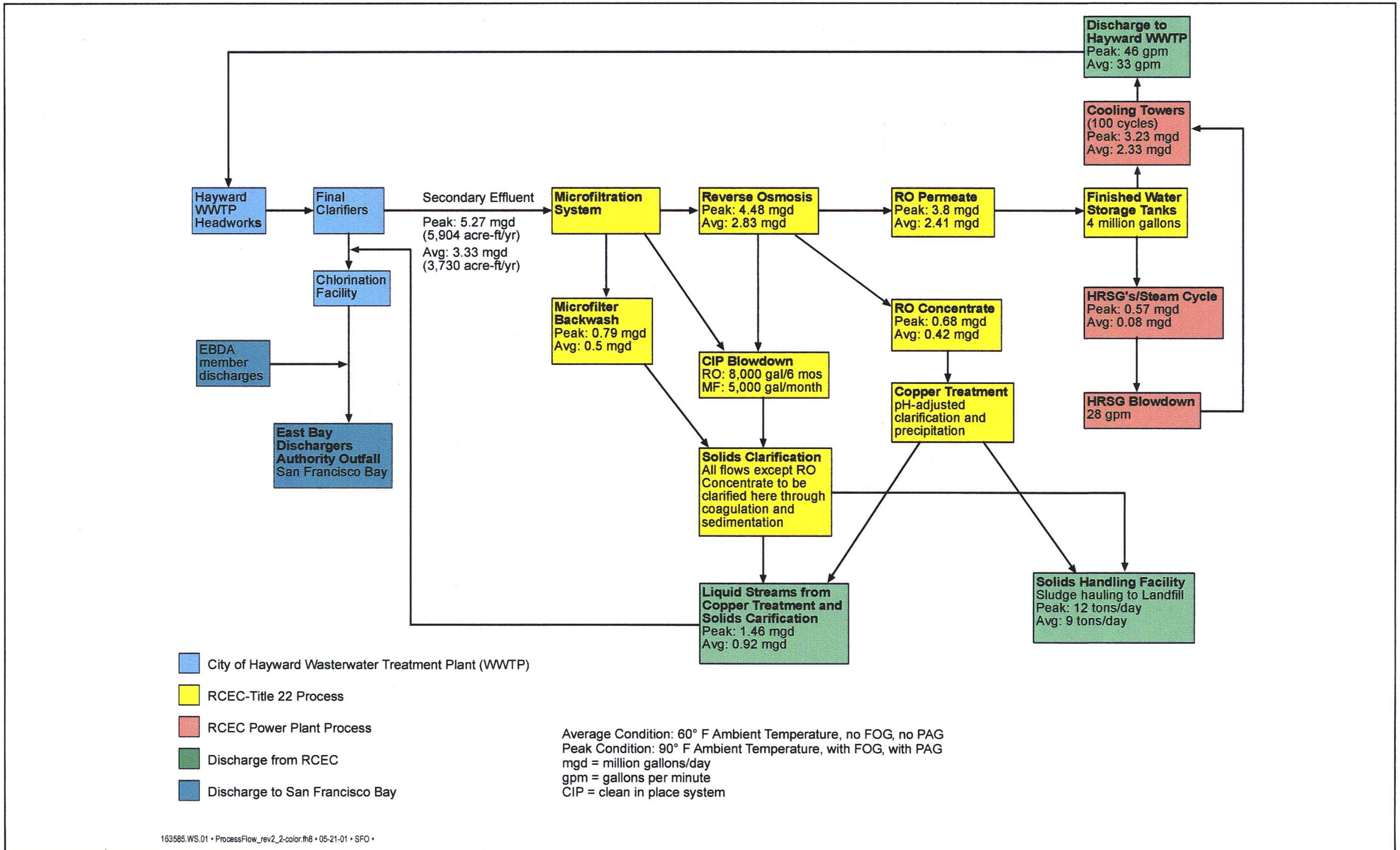
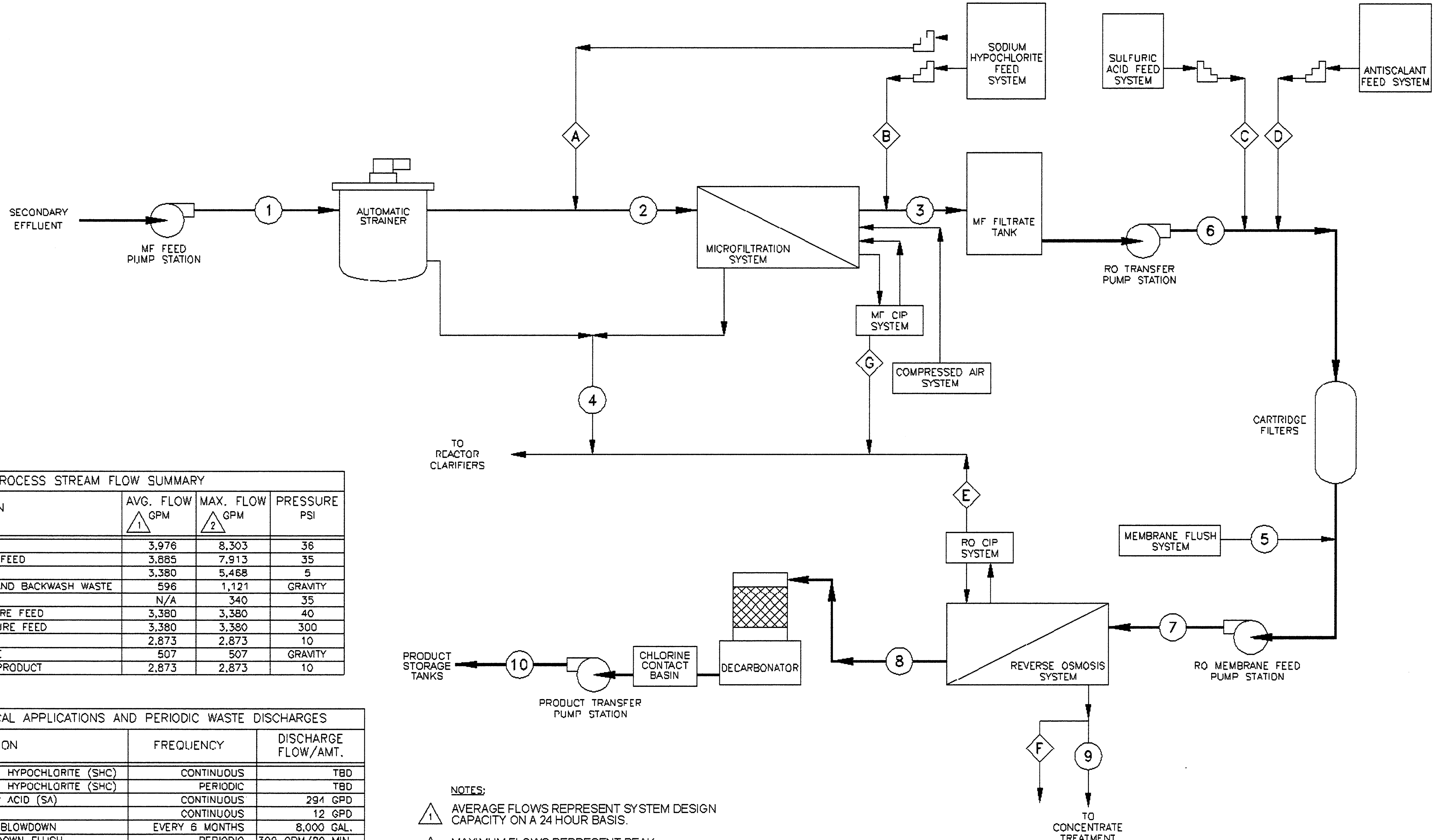


Figure 7-1. Process flow schematic showing operation of the facility.



PROCESS STREAM FLOW SUMMARY				
STREAM	DESCRIPTION	AVG. FLOW (1) GPM	MAX. FLOW (2) GPM	PRESSURE PSI
1	MF FEED	3,976	8,303	36
2	MF PRETREATED FEED	3,885	7,913	35
3	MF FILTRATE	3,380	5,468	5
4	MF SCREENING AND BACKWASH WASTE	596	1,121	GRAVITY
5	RO FLUSH FEED	N/A	340	35
6	RO LOW PRESSURE FEED	3,380	3,380	40
7	RO HIGH PRESSURE FEED	3,380	3,380	300
8	RO PERMEATE	2,873	2,873	10
9	RO CONCENTRATE	507	507	GRAVITY
10	DECARBONATED PRODUCT	2,873	2,873	10

SUMMARY OF CHEMICAL APPLICATIONS AND PERIODIC WASTE DISCHARGES			
STREAM	DESCRIPTION	FREQUENCY	DISCHARGE FLOW/AMT.
A	12.5% SODIUM HYPOCHLORITE (SHC)	CONTINUOUS	TBD
B	12.5% SODIUM HYPOCHLORITE (SHC)	PERIODIC	TBD
C	93% SULFURIC ACID (SA)	CONTINUOUS	294 GPD
D	ANTISCALANT	CONTINUOUS	12 GPD
E	PERIODIC CIP BLOWDOWN	EVERY 6 MONTHS	8,000 GAL.
F	SYSTEM SHUTDOWN FLUSH	PERIODIC	300 GPM/20 MIN.
G	PERIODIC CIP BLOWDOWN	EVERY MONTH	5,000 GAL.

NOTES:

(1) AVERAGE FLOWS REPRESENT SYSTEM DESIGN CAPACITY ON A 24 HOUR BASIS.

(2) MAXIMUM FLOWS REPRESENT PEAK INSTANTANEOUS FLOW CONDITIONS.

CHLORINE CONATCT BASIN NOT INCLUDED IN SPI DESIGN

Figure 7-2

MF/RO Process Flow Diagram
RUSSELL CITY ENERGY CENTER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Source: CH2M Hill

Table 7-3. Predicted water quality characteristics for project wastewater.

Constituent	Hayward + RCEC Wastewater Discharge		EBDA Discharge Limit*	
Turbidity	2.0	ntu	NA	
pH	7-8	units	6-9	
Total Dissolved Solids	852	mg/l	NA	
Total Suspended Solids	22.8	mg/l	30 ‡	mg/l
BOD	22.3	mg/l	25 ‡	mg/l
Hardness	168	mg/l	NA	
Calcium (total)	38	mg/l	NA	
Magnesium (total)	13	mg/l	NA	
Manganese	0.1	mg/l	NA	
Sodium (total)	123	mg/l	NA	
Potassium	23	mg/l	NA	
Total Alkalinity	255	mg/l	NA	
Silica	13	mg/l	NA	
Sulfate	113	mg/l	NA	
Chloride	172	mg/l	NA	
Copper (total)	0.023	mg/l	0.023	mg/l
Cadmium	0.3	mg/l	NA	
Chromium (total)	2.7	mg/l	NA	
Cyanide (total)	0.0043	mg/l	0.021	mg/l
Iron (total)	1.9	mg/l	NA	
Lead (total)	0.0024	mg/l	0.056	mg/l
Mercury (total)	0.00007	mg/l	0.00021	mg/l
Nickel (total)	0.016	mg/l	0.021	mg/l
Nitrate	5.6	mg/l	NA	
Fluoride	3.2	mg/l	NA	
Arsenic	0.9	mg/l	NA	
Boron	0.5	mg/l	NA	
Selenium (total)	0.0017	mg/l	0.050	mg/l
Silver (total)	0.0025	mg/l	0.023	mg/l
Zinc (total)	0.073	mg/l	0.58	mg/l

*EBDA discharge limits for settleable matter, benzo(a)anthracene, bis(2-Ethylbexyl) Phthalate, Chrysene, Dibenzo(a,h)anthracene, and Indeno(1,2,3-cd)pyrene also exist and will be met in the combined Hayward + RCEC discharge.

‡ Monthly average concentration

Approximately 9 tons/day (average) to 12 tons/day of sludge will be generated, requiring one to two truckloads per day. All lime storage, copper treatment, and solids handling facilities are shown in Figure 2.3-1.

7.3.2 Cooling Tower Blowdown

Circulating (or cooling) water system blowdown will consist of AWT plant RO product water that has been concentrated between 50 to 100 cycles and residues of the chemicals added to the circulating water. These chemicals will control scaling and biofouling of the cooling tower and corrosion of the circulating water piping and condenser tubes. Cooling water treatment will require the addition of a pH control agent (acid or caustic), a mineral scale dispersant (i.e. polyacrylate polymer), a corrosion inhibitor (phosphate based), and a biocide (i.e. bleach or equivalent). MSDS information for representative chemicals used are included in Appendix 7-B. As cooling tower makeup water will be very low in TDS, soda ash or some other form of buffering may also be required during operation at lower cycles.

This waste stream will be discharged via a separate pipeline to the existing 8" sanitary sewer along Enterprise Avenue, as shown on Figure 2.3-2. This stream will have a separate monitoring point, prior to entering the sewer, to assure it meets appropriate discharge limits. The volume of this relatively minor waste stream is expected to be 33 gpm under average conditions and 46 gpm under peak conditions. In order to determine the worst case impact of operation, varying assumptions were used for flow balance determination and for cooling tower blowdown quality. Flows were determined assuming operation at 50 cycles of concentration, as greater flowrates results at the lower cycles of operation. Cooling tower blowdown was determined for operation at 100 cycles of concentration, to project the highest concentrations in the discharge. The water quality characterization of this wastewater stream is shown on Table 7-2.

Due to the use of cooling towers with the lowest achievable drift (0.0005%), the amount of TDS discharged to the atmosphere is very low. The drift quality is equivalent to the blowdown quality, therefore, the concentration of TDS in the drift is expected to be a maximum of 2,461 mg/L at a flowrate of approximately 0.69 gpm, or equivalent to 20 lb/day.

7.3.3 Sanitary Wastewater

Sanitary wastewater from sinks, toilets and other sanitary facilities will be collected and discharged to the existing sanitary sewer, shown on Figure 2.3-2. An average flow of 2 gpm is expected to be discharged.

7.3.4 Plant Drainage

Miscellaneous general plant drainage will consist of area washdown, sample drainage, equipment leakage, and drainage from facility equipment areas. Water from these areas will be collected in systems of floor drains, sumps, and pipes within the RCEC and AWT Plant and discharged to the existing 8" sanitary pipeline along Enterprise Avenue, as shown on Figure 2.3-2. These streams will have separate monitoring points, prior to entering the sewer, to assure they meet appropriate discharge limits. Drains that could contain oil or grease will be routed through an oil/water separator. An average flow of 53 gpm and peak flow of 66 gpm is projected.

7.3.5 Stormwater from AWT Plant

Stormwater from the AWT plant will be collected and discharged via a separate pipeline, as shown on Figure 2.3-2. A maximum flow of approximately 2.6 (4.0 cfs) based on 25-year, 24-hour storm volume is projected for the site assuming all impervious surfaces.

7.4 BENEFITS OF MF/RO COMBINED WITH COPPER REMOVAL

The use of MF/RO and copper treatment to treat the secondary effluent for the RCEC will result in several environmental benefits. These include, most importantly: 1) reduced discharge from the cooling tower and HRSG blowdown, and 2) significant reduction in mass loadings of copper discharged to San Francisco Bay.

Reduced discharge—The higher quality of water available for cooling tower operations will allow much greater cycling of water than would otherwise be possible. If conventional Title 22 treatment were used for treatment of typical Hayward WPCF secondary effluent, cycling of cooling water would be limited to 3 to 5 cycles due to the higher level of impurities in typical recycled secondary effluent. Use of MF/RO technology results in significantly lower impurities, including lower TDS levels; therefore, the water is able to be cycled up to100 times before blowing down any impurities. (Average cycling in the RCEC's circulating water system will likely be about 50 times.)

Reduced copper mass loadings—The planned copper removal process will reduce mass loadings of copper from the Hayward WPCF by 12 kg/month (from 36 kg/month to 24 kg/month) during peak power plant operation. This is a reduction of approximately 33 percent. The effect of the mass reduction on the total copper discharged to the San Francisco bay (i.e. including the mass loadings from the other five EBDA members) is a reduction from 159 kg/month of copper to 147 kg/month, a reduction of 8 percent.

Russell City Energy Center AFC

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