CITY OF FRESNO, CALIFORNIA
DEPARTMENT OF PUBLIC UTILITIES
WASTEWATER MANAGEMENT DIVISION

ENGINEERING REPORT FOR THE PRODUCTION, DISTRIBUTION AND USE OF RECYCLED WATER

SEPTEMBER 18, 2015

Prepared Under the Direction of:

Mr. Kevin Norgaard
Chief of Technical Services

Prepared by:

Blair, Church & Flynn Consulting Engineers
A California Corporation
451 Clovis Avenue, Suite 200
Clovis, CA 93612
(559) 326-1400 ph
(559) 326-1500 fax
bcf-engr.com

REGISTERED PROFESSIONAL ENGINEER
KARL E. KIENOW
No. 51,615
CIVIL
STATE OF CALIFORNIA

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LIST OF RELEVANT INTERNET-ACCESSIBLE DOCUMENTS

Construction Plans for Recycled Water Transmission Main Project SW1A
https://dl.dropboxusercontent.com/u/79172/215138_RWTM_SW1A_Plans.pdf

Construction Plans for Recycled Water Transmission Main Project SW1B
https://dl.dropboxusercontent.com/u/79172/215138_RWTM_SW1B_Plans.pdf

Industrial Pretreatment Program
https://dl.dropboxusercontent.com/u/79172/Industrial%20Pretreatment%20Program%202009.pdf

Recycled Water Master Plan
http://www.fresno.gov/NR/rdonlyres/7B22E4E4-29CF-4C10-B3BE-F32C141CBB4B/0/RecycledWaterMasterPlan2013.pdf

Recycled Water Ordinance
http://www.fresno.gov/NR/rdonlyres/7AB20689-3E0B-4C1C-A01B-67BF9D0B8305/0/RecycledWaterOrdinance.pdf

Recycled Water-Related Statutes
http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Documents/Lawbook/RWstatutes2014-05-01a.pdf

Recycled Water-Related Regulations
http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/lawbook/RWregulations_20150716.pdf

Recycled Water User Map for Initial Contacts
https://dl.dropboxusercontent.com/u/79172/Fresno%20RecWat%20User%20Map.pdf

TTDF Design Report
https://dl.dropboxusercontent.com/u/79172/TTDF%20Schematic%
20Design%20Final%20Tech%20Memo.pdf

TTDF Construction Drawings
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Plans.pdf

TTDF Construction Specifications Volume I
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Specs%20Vol1.pdf

TTDF Construction Specifications Volume II
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Specs%20Vol2.pdf

TTDF Construction Specifications Volume III
https://dl.dropboxusercontent.com/u/79172/TTDF%20Conformed%20Specs%20Vol3.pdf

ACRONYMS AND ABBREVIATIONS

AFY	Acre-Feet per Year
BOD	Biochemical Oxygen Demand
CRWQCB	California Regional Water Quality Control Board, Central Valley Region
CFS	Cubic Feet per Second
Clovis ST/WRF	Clovis Sewage Treatment / Water Reuse Facility
FID	Fresno Irrigation District
FMFCD	Fresno Metropolitan Flood Control District
FSE	Fine Screen Effluent
GFD	Gallons per Square Foot per Day
GPM	Gallons per Minute
GRRP	Groundwater Replenishment Reuse Projects
KVA	Kilovolt-Amp
KW	Kilowatt
MGD	Million Gallons per Day
MVA	Megavolt-Amp
MW	Megawatt
NFWRF	North Fresno Wastewater Reclamation Facility
OIS	Operator Interface Station
PGE	Pacific Gas & Electric Company
RAS	Return Activated Sludge
RWPA	Recycled Water Project Area
RWRF	Fresno / Clovis Regional Wastewater Reclamation Facility
RWTM	Recycled Water Transmission Main
SCADA	Supervisory Control and Data Acquisition
TSS	Total Suspended Solids
TTDF	Tertiary Treatment and Disinfection Facility
TTRW	Tertiary Treated Recycled Water
UV	Ultra-Violet
WAS	Waste Activated Sludge
WDRs	Waste Discharge Requirements

DEFINITIONS

1974 Agreement: The 1974 agreement between the City of Fresno and FID to establish a groundwater reclamation system consisting of on-site extraction wells at the RWRF and piping that delivers extracted groundwater to FID's Dry Creek and Houghton Canals.

1976 Agreement: The 1976 agreement between the City of Fresno and FID that provides for the agencies to use FID's distribution system to satisfy their respective water supply rights, and to work together to protect and preserve the groundwater basin.

Guidelines: The California Department of Water Resources March 2001 “Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water”

Master Plan: The City of Fresno's 2010 "Recycled Water Master Plan"

Metro Plan Update: The City of Fresno's 2011 "Metropolitan Water Resources Management Plan Update, Phase 2"

Recycled Water Ordinance: The City of Fresno Recycled Water Ordinance, adopted July 17, 2014 as Ordinance 2014-32

Rules and Regulations: The City of Fresno "Rules and Regulations of Recycled Water Use"

TTDF Design Report: "Tertiary Treatment and Disinfection Facility Technical Memorandum", August 2011

TTDF Construction Plans: "Drawings for the Construction of Tertiary Treatment and Disinfection Facility - Phase I", Conformed Drawings, September 19, 2013

TTDF Construction Specifications: "Fresno-Clovis Regional Wastewater Reclamation Facility, Tertiary Treatment And Disinfection Facility, Specifications", Conformed, Volumes I - III, September 2013,

Waste Discharge Requirements: California Regional Water Quality Control Board, Central Valley Region, "Order No. 5-01-254, Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County", 19 October 2001

1.0 INTRODUCTION

The City of Fresno is located in the County of Fresno, in California's Central Valley, approximately 220 miles north of Los Angeles and 180 miles south of Sacramento. In partnership with the City of Clovis, the City owns and operates the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF), which receives and treats the majority of wastewater generated within the Cities of Fresno and Clovis and some unincorporated areas of Fresno County. The RWRF site is located in the area generally bounded by Jensen, Chateau Fresno, Central, and Cornelia Avenues, and its on-site Administration Office building is located at Lat 36°42'14.63" N, Long 119°53'33.50" W. The RWRF is currently operated under California Regional Water Quality Control Board, Central Valley Region, "Order No. 5-01-254, Waste Discharge Requirements for Cities of Fresno and Clovis Wastewater Treatment Facility, Fresno County", dated 19 October 2001 (Waste Discharge Requirements).

The City also owns and operates the North Fresno Wastewater Reclamation Facility (NFWRF), which receives and treats wastewater generated within a small area of the City generally bounded by Copper, Friant, and Willow Avenues. The NFWRF is located on the north side of Copper Avenue, between Cedar and Maple Avenues, at Lat 36°53'46.35" N, Long 119°45'8.01" W. Recycled water produced by the NFWRF is used for irrigation of a golf course at Copper River Country Club, which is situated within the area served by the NFWRF.

The City of Clovis owns the Clovis Sewage Treatment / Water Reuse Facility (Clovis ST/WRF), which is operated under contract by CH2M Hill. The Clovis ST/WRF is located at the northeast corner of Ashlan and Loma Vista Avenues, at Lat 36°47'39.77" N, Long 119°36'50.71" W. The Clovis ST/WRF receives and treats wastewater generated within certain areas of the City of Clovis that are not tributary to the RWRF, and currently has an average daily flow capacity of 2.8 MGD. Recycled water produced by the Clovis ST/WRF is used for landscape irrigation in certain areas of the City of Clovis, and for agricultural irrigation via limited elements of the Fresno Irrigation District distribution system.

Figure 1-1 provides a location map showing the approximate locations of the RWRF, NFWRF and Clovis ST/WRF facilities.

The City of Fresno's 2011 Metropolitan Water Resources Management Plan Update (Metro Plan Update), Phase 2, recommended that the City incorporate tertiary-treated recycled water into its future water supply portfolio to meet non-potable demands in new development areas and existing parts of the City, to offset potable water demands. The Metro Plan Update called for the use of up to 25,000 AFY, approximately equivalent to an average of 22.3 MGD, of tertiary-treated recycled water by 2025. The City's 2010 Recycled Water Master Plan (Master Plan), although completed prior to the Metro Plan Update, Phase 2, incorporated the same Metro Plan Update recommendation taken from a draft edition, as a minimum. The Recycled Water Master Plan implementation recommendations included the construction of a tertiary-treated recycled water production facility at the RWRF, and a network of recycled water transmission and distribution pipelines to convey recycled water to use areas.

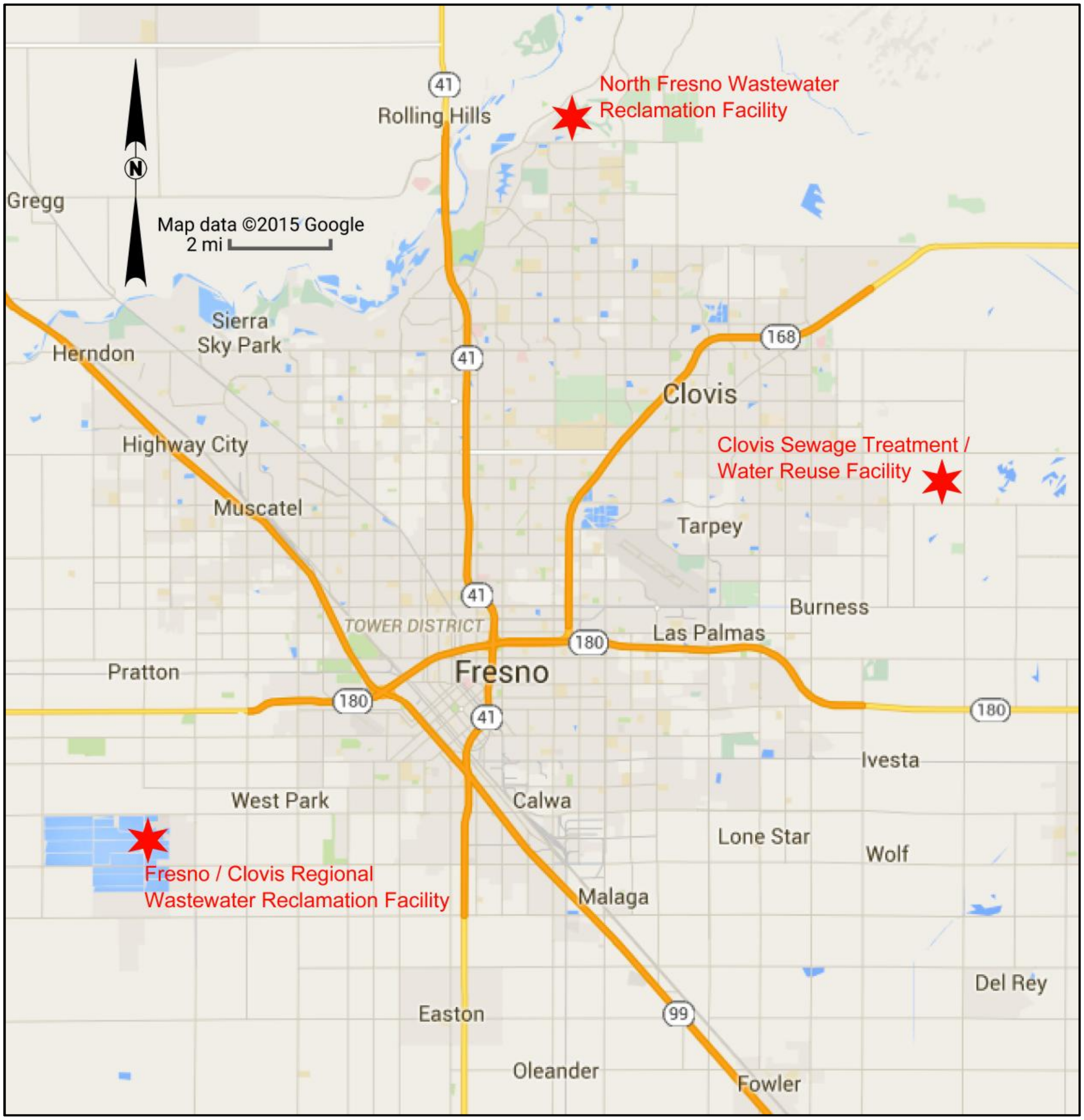

FIGURE 1-1
LOCATION MAP

The City of Fresno is currently constructing a Tertiary Treatment and Disinfection Facility (TTDF) at the RWRF. It will be a Phase 1 facility having an initial recycled water production capacity of 5 MGD. Subsequent Phase 2 and Phase 3 expansions are planned to provide additional capacity of 10 MGD and 15 MGD, respectively, to result in a Phase 3 capacity of 30 MGD. The TTDF will receive primary effluent from one of the existing RWRF treatment trains, and will produce disinfected tertiary-treated recycled water. A recycled water transmission and distribution pipeline network is planned to convey recycled water from the TTDF to recycled water use areas in the City of Fresno. Figure 1-2 provides an overview of the planned distribution system, taken from the Master Plan.

As generally described in the Master Plan, the City's objectives for its planning and development of a recycled water production and distribution system are:

- Protect and improve groundwater quality by reducing the use of the RWRF percolation ponds that are currently used for effluent disposal.
- Increase the use of recycled water through urban reuse, groundwater recharge and agricultural reuse to help meet increasing water demands in the region.
- Offset potable water use, enhancing the sustainability of the City's water supply.

This Engineering Report for the Production, Distribution, and Use of Recycled Water describes the City of Fresno's planned recycled water production and distribution facilities, and describes how those facilities and the planned uses of recycled water will comply with the State of California Water Recycling Criteria, which are contained in Sections 60301 through 60355, inclusive, of the California Code of Regulations, Title 22, Division 4. The format and content of this report conform to the March 2001 "Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water" (Guidelines).

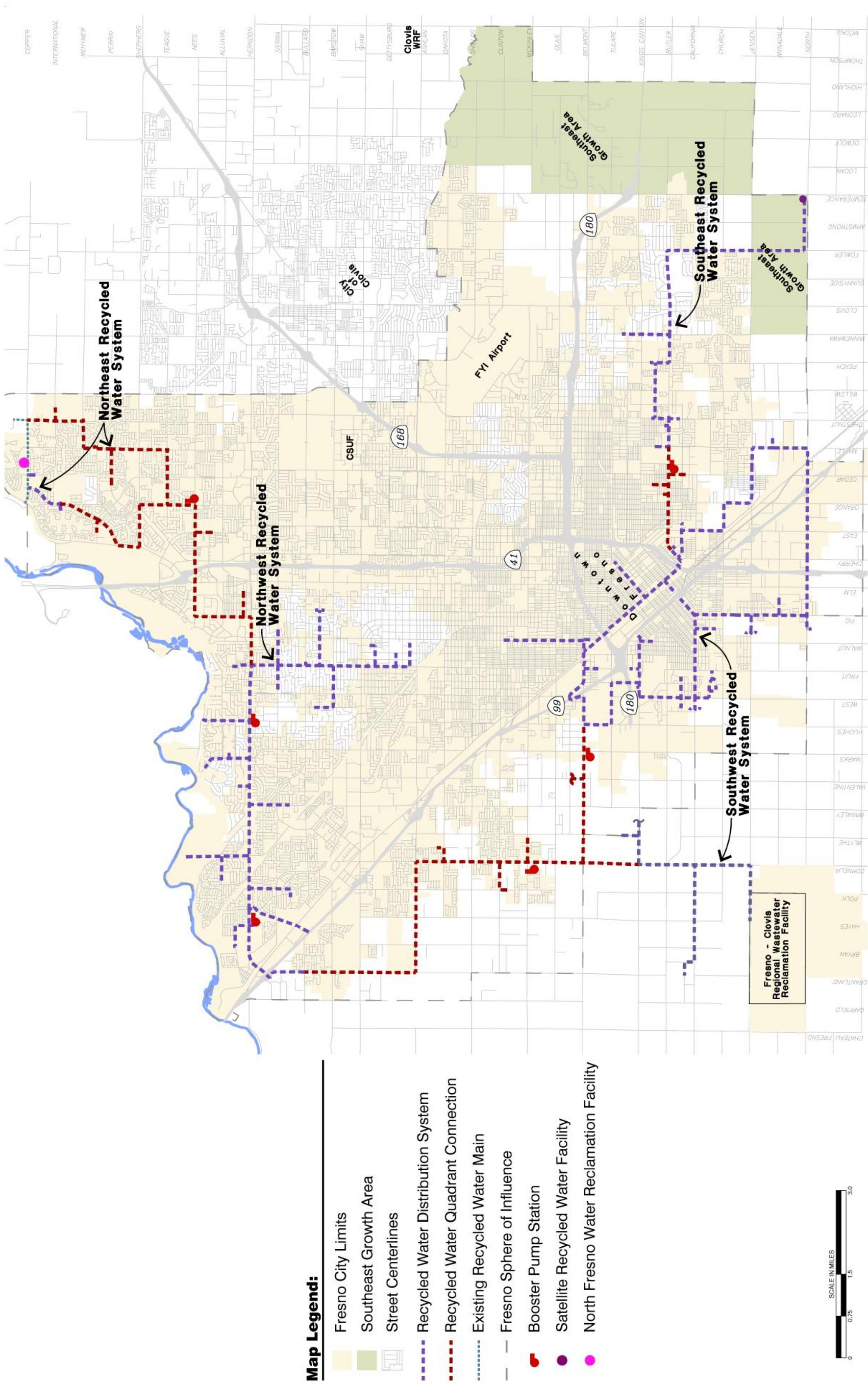

FIGURE 1-2
OVERVIEW OF PLANNED DISTRIBUTION SYSTEM

2.0 RECYCLED WATER PROJECT

2.1 General

The City of Fresno, Department of Public Utilities, Wastewater Management Division, is the lead agency and project sponsor for this project, and is ultimately responsible for the design, construction, operation and maintenance of the recycled water production and distribution facilities. Although the City of Fresno owns and operates the RWRF, in partnership with the City of Clovis, the City of Clovis has no ownership in or responsibility for the City of Fresno's planned recycled water production and distribution facilities.

Other agencies that have, or could potentially have, an interest in the City's production, distribution and use of recycled water are Fresno Irrigation District (FID) and Fresno Metropolitan Flood Control District (FMFCD).

2.1.1 Fresno Irrigation District

In 1974, the City entered into an exchange agreement (1974 Agreement) with Fresno Irrigation District (FID) to establish a groundwater reclamation system consisting of on-site extraction wells at the RWRF and piping that delivers extracted groundwater to FID's Dry Creek and Houghton Canals. The extracted ground water typically mixes with a variable amount of surface water prior to use on crops, including fodder, fiber, and food for human consumption (e.g., almonds, beans, peaches, raisins, and wine grapes, etc.). The extracted groundwater is discharged to the canals during the growing season for agricultural use on the western side of FID's service area. Each canal can convey up to 200 cubic feet per second (CFS). There are currently no regulatory restrictions on the use of extracted groundwater.

The 1974 Agreement stipulates the following:

- The City must discharge a minimum of 100,000 AF of extracted groundwater to FID during any ten-year period.
- The City may discharge a maximum of 30,000 AF of extracted groundwater to FID in any given year.
- For every acre-foot of extracted groundwater the City discharges to FID, the City is entitled to receive 0.46 acre-foot of surface water from FID.
- Any increase in the discharge of extracted groundwater to FID beyond that stipulated in the 1974 agreement is subject to FID approval.
- The City cannot extract groundwater from beneath the RWRF in volumes that will cause the groundwater level to drop below levels observed in the previous year.

The City has not historically used its full entitlement of surface water under the 1974 Agreement due to lack of demand and adequate facilities, such as groundwater recharge basins or surface water treatment facilities.

The City and FID also entered into a separate cooperative agreement dated 1976 (1976 Agreement), that provides for the agencies to use FID's distribution system to satisfy their respective water supply rights, and to work together to protect and preserve the groundwater basin. The 1976 Agreement also stipulates that the City will retain its treated effluent within the boundaries of FID unless written consent to do otherwise is obtained.

The City currently owns, operates and maintains the facilities that deliver extracted groundwater to the FID system, up to the point of delivery. FID currently owns, operates and maintains all elements of the FID system that distribute the extracted water, beyond the point of delivery. There are currently no plans to change responsibility for ownership, operation and maintenance of the respective facilities.

Relative to agricultural alternatives that involve FID, the Master Plan recommends expansion of agricultural exchange via increased delivery of extracted groundwater, and / or the addition of delivery of tertiary-treated recycled water, to expand such agricultural exchange beyond the current limitation of 30,000 AFY. Expansion beyond the current limitation, and / or the addition of tertiary-treated recycled water to the agricultural exchange program, would require modification of the 1974 Agreement. The City and FID are not yet working to modify the 1974 Agreement. Neither the TTDF currently under construction, nor the planned recycled water transmission and distribution pipeline network, include elements that are specifically intended to expand the agricultural exchange program beyond the current limitation, or provide for the addition of tertiary-treated recycled water to the program.

2.1.2 Fresno Metropolitan Flood Control District

The Master Plan recommends that Groundwater Replenishment Reuse Projects (GRRPs) be implemented to the extent practical in the southwest, northwest and southeast quadrants of the City. The Master Plan identifies numerous potential GRRP sites that are generally situated near or adjacent to FMFCD basin sites, since storm water runoff or surface water in the FMFCD system could be used for groundwater recharge on its own, and could also serve as diluent water for the GRRPs if tertiary-treated recycled water is used in the GRRPs. The Master Plan also identifies three tentative locations for regional groundwater recharge areas, or "super-recharge basins".

If development of any of the GRRPs affects FMFCD basins or other facilities, the City would have to enter into related agreements with FMFCD, whether or not the GRRP incorporates the use of tertiary-treated recycled water. The City and FMFCD are not yet working to develop such agreements. Neither the TTDF currently under construction, nor the planned recycled water transmission and distribution pipeline network, include elements that are specifically intended to supply TTRW to potential GRRP sites.

2.2 Rules and Regulations

The City of Fresno Recycled Water Ordinance was adopted July 17, 2014 as Ordinance 2014-32, and it is appended to this report as Appendix A. The Recycled Water Ordinance specifies that the City will establish Recycled Water Rules and Regulations to govern the operation of the City's recycled water system and the use of recycled water, and to implement the policies and requirements of the Recycled Water Ordinance, the California Code of Regulations Titles 17 and 22; and other State and local rules and regulations related to the use of recycled water. The Rules and Regulations have been prepared by the City, and they are appended as Appendix B.

The City will ensure that all parties involved in the distribution and use of its recycled water perform their activities in accordance with the Rules and Regulations, which have been developed by the City's Public Utilities Department (Public Utilities). The following documents support the Rules and Regulations:

- This Engineering Report
- TTDF Engineering Report
- Recycled Water Ordinance
- Recycled Water User Agreements

The Rules and Regulations cover design, construction, operation and maintenance for recycled water distribution systems and use areas, together with control measures to be implemented for use areas. They include a cross-connection control program, and provisions for inspection by City personnel. The Rules and Regulations are intended to meet or exceed all of the requirements of applicable State statutes and regulations, including but not limited to those compiled in the 25 June 2015 edition of the State Water Resources Control Board "*Recycled Water-Related Statutes and Regulations",* which was formerly referred to as "The Purple Book".

The Recycled Water Ordinance specifies that the Director of the City of Fresno Department of Public Utilities (Director), and / or City employees to whom such responsibility is delegated by the Director, shall administer, implement, and enforce the provisions of the ordinance. The Director also bears responsibility for enforcement of the Rules and Regulations. As of the date of this report, Thomas C. Esqueda is the Director of the City of Fresno Department of Public Utilities.

2.3 Producer, Distributor and Users of Recycled Water

2.3.1 Producer and Distributor

The City of Fresno, Department of Public Utilities, Wastewater Management Division, is the lead agency and project sponsor for this project, and is ultimately responsible for the design, construction, operation and maintenance of the recycled water production and distribution facilities. Although the City of Fresno owns and operates the RWRF in partnership with the City of Clovis, the City of Clovis has no ownership in or responsibility for the City of Fresno's planned recycled water production and distribution facilities. The City of Fresno will be the sole producer and distributor of recycled water.

2.3.2 Recycled Water Users

The Master Plan contains recommendations for three different categories of recycled water use opportunities, namely: Urban Reuse Opportunities, Agricultural Reuse and Exchange Opportunities, and Groundwater Reuse Recharge Opportunities.

As described earlier in this report, the City and FID are not yet working to modify the 1974 Agreement. Neither the TTDF currently under construction, nor the planned recycled water transmission and distribution pipeline network, include elements that are specifically intended to expand the agricultural exchange program beyond the current limitation, or provide for the addition of TTRW to the program. With respect to the use of TTRW, agricultural reuse and exchange involving FID is considered a long term opportunity, and it is not currently planned as a Phase 1 recycled water use.

GRRP opportunities are also considered long term recycled water use opportunities, and are not currently planned as a Phase 1 recycled water use.

The urban reuse opportunities recommended by the Master Plan are considered to be both near term and long term recycled water use opportunities, and it is expected that most or all of the Phase 1 recycled water uses will be in the urban reuse category. Urban reuse provides an opportunity to implement recycled water projects that directly offset potable water use and are highly visible to the community. The types of urban recycled water uses recommended in the Master Plan generally include landscape irrigation and industrial uses. Some examples of the types of users for which recycled water landscape irrigation is planned are listed below.

- Parks
- Golf courses and country clubs
- Homeowners association common areas
- Cemeteries
- Airports
- State highway rights-of-way
- Schools and college campuses
- Municipal facilities such as courthouses and city hall
- Water feature impoundments such as Lake Van Ness and Woodward Lake
- Fairgrounds

Similarly, some examples of industrial uses for which recycled water use is planned are given in the following bulleted list.

- Heating and cooling
- Industrial laundries
- Commercial vehicle washing
- Dust control
- Fire protection
- Sanitary, such as toilet flushing at industrial sites
- Process water (except for food processors)

- Cleanup/wash down water (except for food processors)
- Boiler Feed

The Recycled Water Ordinance requires recycled water use under certain circumstances, where recycled water service is available, as summarized in the following paragraphs.

a) The City may require all customers who connect to the potable water system to use recycled water for all approved uses, including but not limited to dual plumbing for commercial buildings and single family residential irrigation.
b) Existing commercial properties, existing industrial properties, existing apartments and condominiums, and all homeowners associations are required to use recycled water for landscape irrigation.
c) New commercial projects, new industrial projects, new institutional and governmental projects, and new apartments and condominiums are required to be dual plumbed to provide for internal use of recycled water, and are required to use recycled water for landscape irrigation.
d) New single family residential home projects are required to provide for landscape irrigation with recycled water.

All properties within the Recycled Water Project Area (RWPA), as it is defined in the Recycled Water Ordinance, that host land uses for which recycled water use is recommended by the Master Plan, or is required by the Recycled Water Ordinance, are potential recycled water use areas, and the owners or tenants of such properties are potential recycled water users.

The Rules and Regulations require that no recycled water shall be used on any property or use area not owned or controlled by the City unless a non-transferrable User Agreement has been executed between the City and the recycled water user. User Agreements will contain contractually binding terms requiring conformance with the Rules and Regulations and all applicable local, state and federal regulations, including Title 17 and 22 of the California Code of Regulations. Users will be responsible for constructing and maintaining their own on-site recycled water systems for their use area. Appendix C contains a user agreement template that will serve as the foundation for the individual User Agreements for each recycled water user.

The City of Fresno has begun making initial contacts with potential recycled water users to advise them of the forthcoming availability of recycled water, and to begin making necessary arrangements for them to become recycled water users. Initial contacts are being made with potential users sited within one-half mile of the planned recycled water transmission main system. Figure 2-1 is a highly reduced scale map graphically identifying the target area for initial contacts, and the locations of potential recycled water use areas. A full scale version of the map may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

The City of Fresno also plans to install recycled water hydrants along the recycled water transmission main system. The recycled water hydrants could be used to provide TTRW for fire suppression activities, and for construction water uses such as dust control and moisture conditioning for soil compaction.

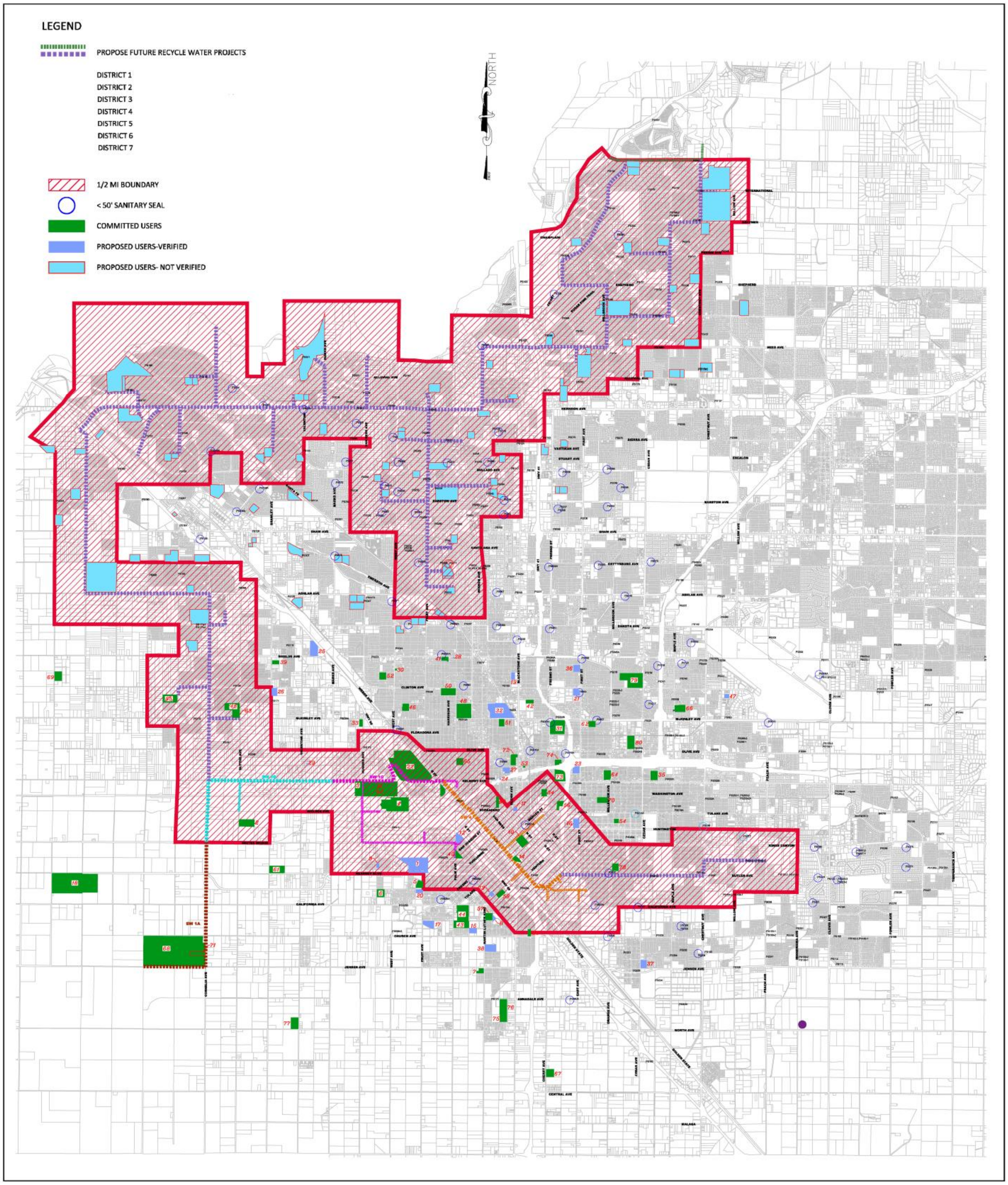

FIGURE 2-1
RECYCLED WATER USER MAP FOR INITIAL CONTACTS

2.4 Raw Wastewater

The raw wastewater entering the RWRF, for the last 12-month period ending 30 June 2015, has been characterized by the wastewater chemistry shown in Table 2-1, based on an analysis of data provided by the City. The data provided by the City consisted of laboratory analysis results for 24-hour composite samples.

TABLE 2-1
WASTEWATER CHARACTERISTICS
JULY 1 2014 THROUGH JUNE 30 2015

Property	Minimum	Maximum	Median	95th Percentile
Biochemical Oxygen Demand (BOD, mg/l)	219	598	336	450
Total Suspended Solids (TSS, mg/l)	182	546	294	368
Electrical Conductivity (EC, µmhos/cm)	778	1369	1051	1236
Ammonia Nitrogen (NH3-N, mg/l)	21	52	32	38
Total Dissolved Solids (TDS, mg/l)	430	964	605	779
Total Volatile Dissolved Solids (TVDS, mg/l)	108	448	192	285

The wastewater entering the RWRF is ordinary municipal wastewater generated within the majority of the wastewater collection system service areas of the Cities of Fresno and Clovis. The City of Fresno reports that wastewater generated by 46 industrial customers in calendar year 2014 accounted for the flow, BOD and TSS proportions, relative to the total flow received at the RWRF, shown in Table 2-2.

TABLE 2-2
INDUSTRIAL CUSTOMER CONTRIBUTIONS
JANUARY 1 2014 THROUGH DECEMBER 31 2014

Property	Total RWRF	Industrial Contribution	Industrial Percentage
Wastewater Flow (Million Gallons)	21,537	2,946	13.68%
Biochemical Oxygen Demand (BOD, Pounds)	62,489,056	21,655,376	34.65%
Total Suspended Solids (TSS, Pounds)	54,152,862	10,378,756	19.17%

The City has developed and rigorously implements an Industrial Pretreatment Program, as required by the Clean Water Act of 1977 (PL 95-217). The program sets forth uniform requirements for the discharge of certain industrial wastewater flows into the wastewater collection system and the RWRF, and enables the City as operator of the RWRF to comply with applicable local, state and federal laws relative to industrial wastewaters. The objectives of the program are to:

- Prevent the introduction of pollutants which will interfere with the operation of the RWRF, including interference with the use or disposal of municipal sludge.
- Prevent the introduction of pollutants which will pass through into the RWRF treatment facilities or otherwise be incompatible with the treatment facilities.
- Improve opportunities to recycle and reclaim wastewater and related sludges.
- Provide for equitable distribution of the cost of the Pretreatment Program among users.

The City of Fresno Industrial Pretreatment Program may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

2.5 Treatment Processes

2.5.1 Existing RWRF Facilities

The existing RWRF is currently rated for an annual monthly average daily discharge flow of 80 MGD and a maximum monthly average daily discharge flow of 88 MGD. The annual monthly average daily discharge flow is currently reported to be approximately 60 MGD.

Wastewater is received at the RWRF headworks, which includes an influent pump station, bar screens, grit removal tanks, and grit processing equipment. After the preliminary treatment at the headworks, the wastewater is provided with primary treatment by six clarifiers. The primary effluent from these clarifiers is distributed to three secondary treatment trains, referred to as Trains A, B and C. Figure 2-2 provides a schematic illustration of the three RWRF treatment trains.

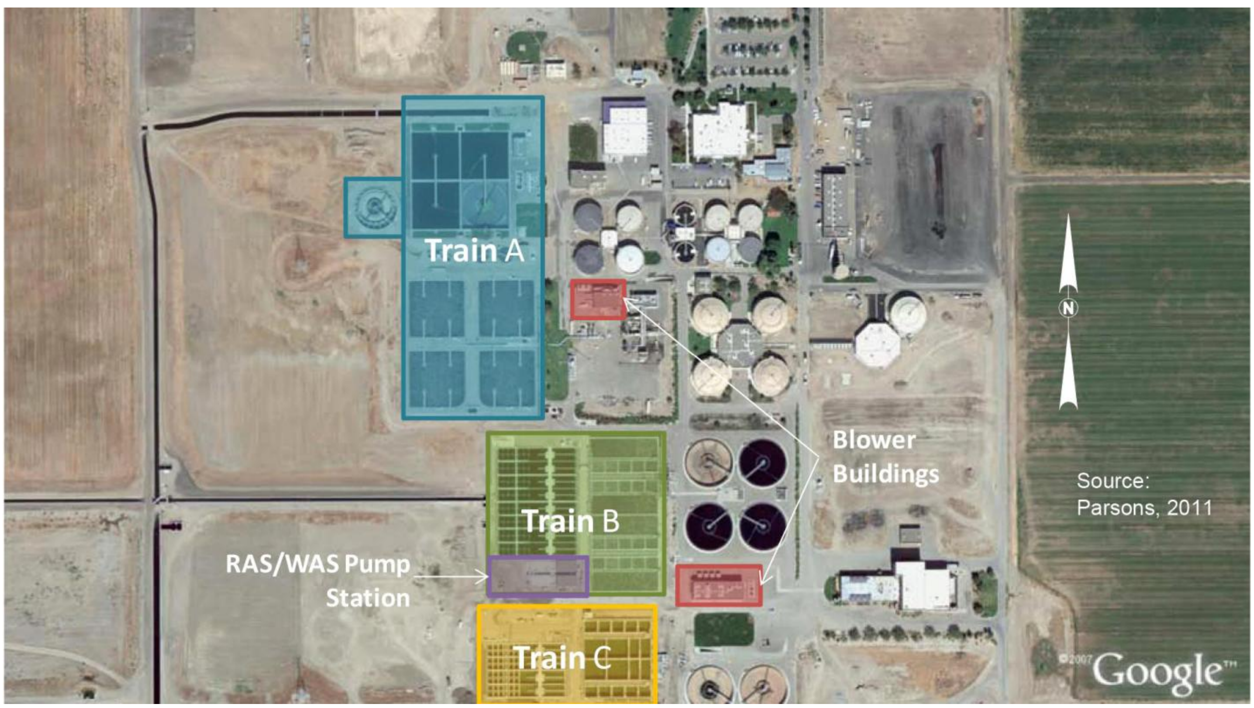

FIGURE 2-2
EXISTING RWRF TREATMENT TRAINS

Train A is the oldest of the three treatment trains, and it reportedly has several operational and maintenance issues as identified in the TTDF Engineering Report. Train B is the next oldest of the three treatment trains, and it consists of four rectangular aeration basins and eight rectangular secondary clarifiers. Train C is the newest of the three treatments trains. It consists of two rectangular aeration basins and four rectangular secondary clarifiers. The undisinfected secondary effluent from the RWRF treatment trains flows into two canals on the site, by which it is conveyed to the RWRF percolation basins.

2.5.2 New TTDF Facilities

Primary effluent destined for treatment at the new TTDF will be diverted from Train C at a point immediately upstream of the Train C aeration basins by connection to an existing pipe stub in the primary effluent piping. The primary effluent will be treated by fine screening at a new fine screen facility situated near the point of diversion. Fine screen effluent (FSE) will be conveyed to the TTDF by a gravity flow FSE pipeline that crosses one of the secondary effluent canals (Canal B) in an inverted siphon configuration.

The TTDF will receive and treat the FSE and produce TTRW using membrane bioreactor (MBR) processes. The TTDF will be all new construction, with bioreactors (pre-aeration basins), membrane tanks and a blower building all having common walls to minimize concrete and piping costs. In the course of the treatment process, flow will progress through two parallel bioreactors that provide both anoxic and oxic zones, and then through the membrane cassette facilities in the membrane tanks. Membrane permeate will be disinfected by an in-pipe ultra-violet (UV) disinfection system to produce TTRW, meeting Title 22 recycled water quality criteria. Train A Aeration Basin No. 4 will be converted to provide covered recycled water storage.

The initial phase of the TTDF will have a constant flow capacity of 5 MGD, but will be laid out so as to provide for future expansion to have an ultimate design capacity of 30 MGD.

The existing 24 inch diameter aeration air line serving Train A Aeration Basin No. 4 will be used and extended to deliver process air to the bioreactors. Electrical power for the TTDF will be supplied from an existing 12 kV electrical building, located east of the Train A secondary clarifiers, through existing and new extended conduits.

Figure 2-3 provides a TTDF schematic site plan, and Figure 2-4 provides a TTDF schematic line diagram, both taken from the TTDF Design Report.

The most significant key elements of manufactured components of the TTDF are the fine screen equipment, the MBR membranes, and the UV disinfection system. The fine screen equipment will be ROTAMAT Rotary Drum Fine Screens RPPS-PRO, Model RPPS-PRO 1600/2, manufacture by Huber Technology. The MBR membrane facilities will be LEAPmbr, incorporating ZeeWeed hollow fiber membranes, manufactured by GE Water & Process Technologies. The UV disinfection systems will be TrojanUVFit Model 72AL75 UV disinfection system, manufactured by Trojan Technologies.

Chemicals that will be routinely used at the TTDF include sodium hypochlorite (12.5% solution) and citric acid (50% solution) for MBR maintenance and recovery cleans. The chemicals will be stored at an outdoor 30' by 20' containment area that consists of a concrete slab with perimeter containment walls 1' 2" high. Sodium hypochlorite will be stored in two 250 gallon totes, and citric acid will be stored in one 250 gallon tote. The totes will be supported on individual steel tote support frames. Chemical

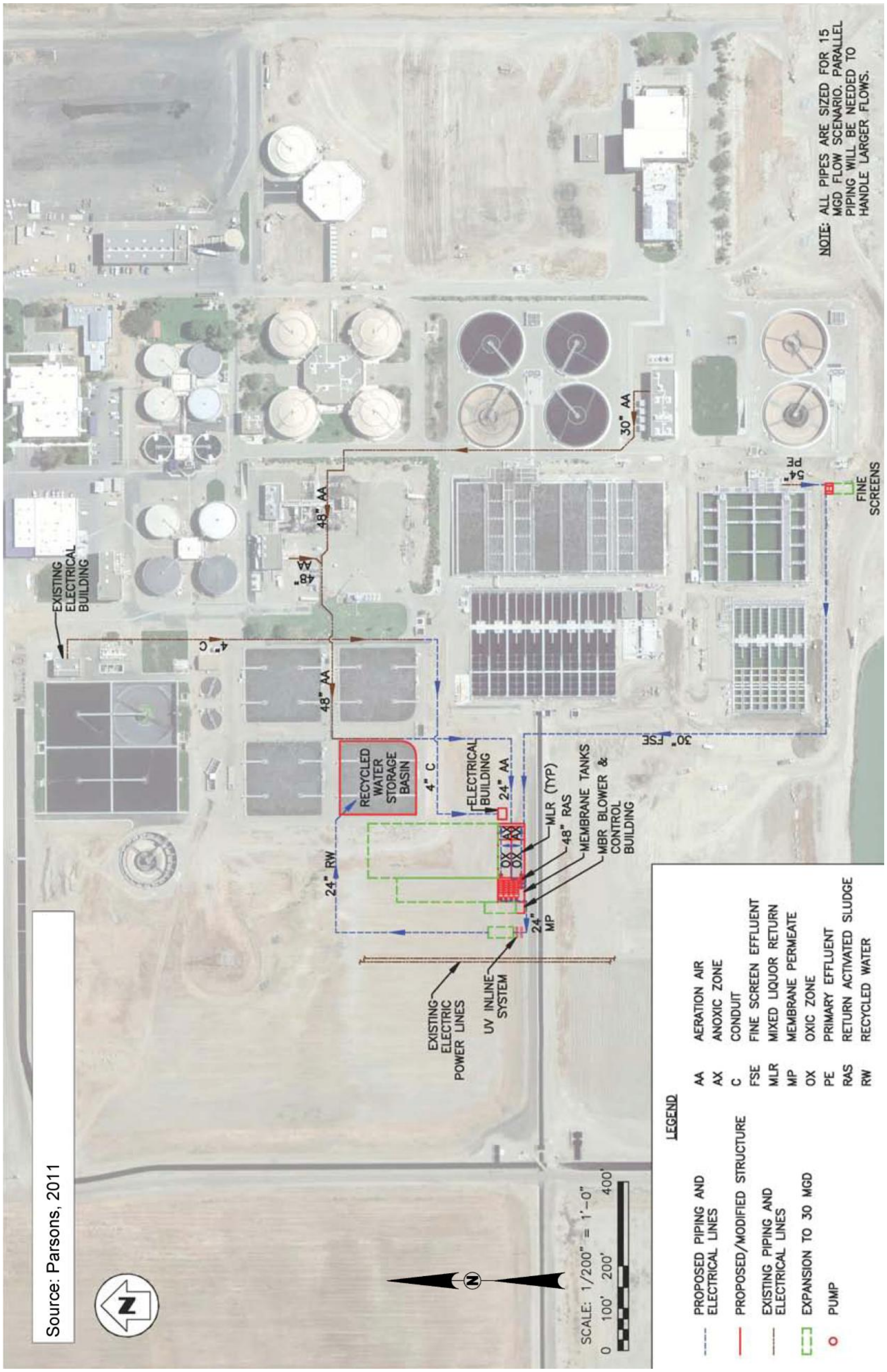

FIGURE 2-3
TTDF SCHEMATIC SITE PLAN

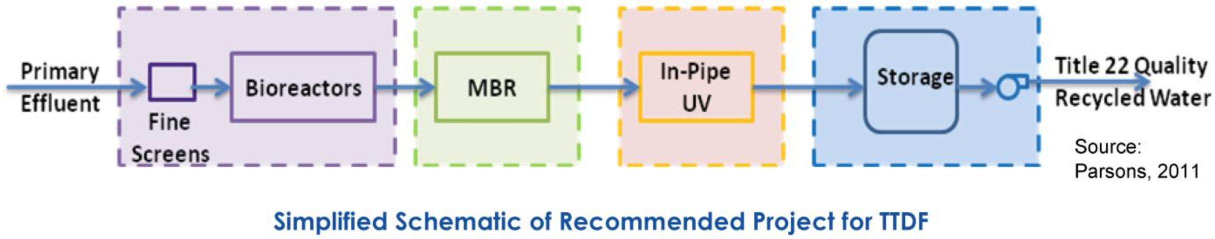

FIGURE 2-4
TTDF SCHEMATIC LINE DIAGRAM

metering pumps sited within the containment areas will inject the chemicals into the backpulse pumps discharge header for MBR maintenance and recovery cleans. It is estimated that annual chemical consumption will be 4,000 gallons per year for sodium hypochlorite, and 750 gallons per year for citric acid. The TTDF Design Report, Section 16 - Recommended Project Description in particular, provides a description of the TTDF, including a detailed list of major process equipment and planned chemical use. The TTDF Design Report is included as Appendix D, and may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents. TTDF Construction Drawings may also be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

2.5.3 Operation and Maintenance Manuals

Under the provisions of the construction contract for the TTDF, the construction contractor is responsible for obtaining from the various vendors and suppliers and providing the operation and maintenance (O&M) manuals for all of the key elements of the TTDF. The TTDF design engineer, Parsons Corporation (Parsons) will prepare an overall Process O&M Manual for the TTDF, which will incorporate all of the O&M documentation and will be produced in an electronic format that will be accessible and usable online by computer and other electronic devices, such as iPads and similar tablets.

In a separate but related effort, Carollo Engineers (Carollo), under a contract with the City is assembling all of the existing O&M manuals for the RWRF, exclusive of the TTDF. The existing O&M manuals currently exist only in printed hard copy form. Carollo will combine the existing documentation in an electronic format that will provide similar online accessibility as for the Parsons Process O&M Manual for the TTDF. Although the Parsons Process O&M Manual for the TTDF and the Carollo combined O&M manual for the RWRF will be separate electronic documents, they will both be accessible for plant operators via the same secure online portal.

2.6 Plant Reliability Features

The TTDF Design Report, Section 15 - Selected MBR Alternatives Analysis, and Section 16 - Recommended Project Description in particular, provides a description of the key elements of the TTDF process equipment and their reliability features. The following paragraphs provide a summary of process equipment reliability features described in the TTDF Design Report.

2.6.1 Fine Screens

Fine screens will be in-channel perforated-plate drum screens. Two fine screens will be installed with one of the units as standby, thereby providing a fully redundant standby primary treatment unit process. Each screen would be capable of handling 5 MGD of flow to provide redundancy. The units will be installed in concrete channels equipped with isolation gates to allow for maintenance without interfering with fine screen and TTDF operation. Each fine screen will be equipped with an integrated washer/compactor for cleaning and concentrating the screenings prior to disposal off site.

The fine screens will be provided with alarms to indicate high differential water level (between upstream and downstream surfaces), high upstream water level, motor overload, low oil level, and emergency stop actuated conditions.

2.6.2 Bioreactors (Pre-Aeration Basins)

Two bioreactors will be constructed, each having a flow capacity of 5 MGD to provide system redundancy, thereby providing multiple biological treatment units capable of producing oxidized wastewater with one unit not in operation. Each bioreactor will be divided into several anoxic and oxic zones, with the first quarter of each bioreactor dedicated to the anoxic zone. Baffles would be placed in the bioreactors to separate the anoxic and oxic zones to minimize back-mixing as the flow passes through in a plug flow regime. Additional baffling would be used to divide each anoxic and oxic zone into 3 compartments to minimize back-mixing. The plug flow conditions increase the efficiency of biological treatment, optimizing carbonaceous matter removal, nitrification and denitrification. Submersible mixers will provide mixing in the anoxic zones. One submersible mixer will be provided in each anoxic zone compartment, for a total of six mixers, with one additional mixer provided as a shelf spare.

2.6.3 Aeration System

Air will be introduced into the oxic zones in the bioreactors through fine bubble diffusers. Aeration will be tapered so that approximately 70% of the oxygen is provided in the first half of the oxic zone to satisfy the high oxygen demand. The required air will be supplied to the oxic zones by the existing RWRF blowers. The blowers are of single-stage centrifugal type and have enough capacity to serve the biological needs of the MBR process as well as the remaining plant. There are five duty blowers with one standby blower. The existing 24 inch diameter air pipeline of RWRF Train A Aeration Basin No. 4 will be used and extended to supply air to the bioreactors, since that basin will be de-commissioned and converted to provide recycled water storage.

2.6.4 Mixed Liquor Return and Sludge Recirculation Pumps

Two recirculation lines will be provided in the MBR system, namely the mixed liquor return and sludge recirculation lines. The mixed liquor return system transfers mixed liquor from the tail end of the oxic zone back to the head of the anoxic zone at an adjustable rate up to four times the average flow. This system transfers nitrates resulting from nitrification back to the anoxic zone for denitrification as the oxygen molecules associated with nitrates are used by the biomass. The sludge recirculation system transfers sludge from the membrane tanks to the head of the oxic zone, also at an adjustable rate up to four times the average flow. The recirculation system prevents the solids concentration in the membrane tanks from increasing excessively and plugging the membranes, as permeate is removed from the mixed liquor. Excess sludge will be wasted from the MBR system from the sludge recirculation line.

There will be two duty pumps with one shelf spare pump for the mixed liquor return pumps, one duty pump with one standby pump for the sludge recirculation pumps, and one duty pump with one standby pump for the waste activated sludge (WAS) pumps.

2.6.5 MBR Membrane System

The MBR membrane system will consist of four independent MBR tanks, with each tank containing six installed hollow fiber membrane cassettes with spare room for installation of an additional cassette. The system will be configured to allow isolation of a tank for maintenance and cleaning. Permeate pumps would draw the MBR membrane system effluent through the membranes, directing it to the TTDF disinfection system.

The total membrane surface area for the four tanks is 417,360 square feet, which provides for a treatment capacity of 5.0 MGD for the design flux rate of 12 gallons/square foot/day (GFD), and for the maximum flux rate of 16 GFD when one tank is out of service. The MBR membrane system facilities will include alarms to signal the production of TTDF effluent that does not meet the quality requirements for disinfected TTRW. The MBR membrane system thus provides alarm systems and multiple MBR tank units capable of treating the entire flow with one unit not in operation.

Key mechanical elements of the MBR membrane system include air scouring blowers, permeate pumps, backpulse pumps, and instrument air compressors. There will be two duty blowers and one standby blower for the air scouring blowers. There will be four duty pumps and one shelf spare pump for the permeate pumps. There will be one duty pump and one standby pump for the backpulse pump. And finally, there will one duty air compressor and one standby air compressor for the instrument air compressor.

2.6.6 Disinfection

Membrane permeate will be disinfected by an in-pipe ultra-violet (UV) disinfection system to produce TTRW, meeting Title 22 recycled water quality criteria. The UV disinfection systems will be TrojanUVFit Model 72AL75 UV disinfection system, manufactured by Trojan Technologies. There will be four reactor trains, with each train having two reactors. Three of the UV disinfection trains will be in service at any given time, with the fourth train being on standby. Each reactor will have a flow treatment capacity of 1.0 MGD, providing an in-service total treatment capacity of 6.0 MGD for the design flow of 5.0 MGD. The standby train with its two standby reactors will provide 2.0 MGD of standby capacity. The UV disinfection system provides multiple UV disinfection units capable of treating the entire flow with one unit out of service, and also provides two standby units.

2.6.7 Alarm Provisions

The TTDF will include a new Supervisory Control and Data Acquisition (SCADA) system with an Operator Interface Station (OIS) in the Control Building. The TTDF will also include many alarm systems that will communicate with facility operators via the SCADA OIS. The OIS will include alarm management screens to display process and control system alarms.

The contents of the alarm management screen will be arranged in a tabular fashion, and entries in the alarm table will be color coded following the same color conventions as used in the existing RWRF SCADA system. The following information, as applicable, will be conveyed in the alarm table: date and time of the alarm, database point designation, type of alarm, value, PLC number and alarm description. The alarm management screen will provide a means for acknowledging alarms either individually or by page or globally.

If audible alarms are enabled at the intended site, a means will be provided for silencing audible alarms which is at all times accessible or visible to the operator. At physical locations where there is more than one OIS, the operator will not be required to silence the alarm on more than one OIS.

Alarms are categorized by four types listed in order of priority from highest to lowest.

a) Major alarm is the highest priority. A major alarm is caused by an abnormal process or equipment condition. A condition which is potentially dangerous to personnel or equipment or violates public health regulatory limits is classified as a major alarm. A major alarm is usually characterized as being a High-High alarm, hardwired alarm, or remote safety shutdown alarm.
b) Minor alarm is the next highest priority. A minor alarm is caused by an abnormal process or equipment condition. A condition which is not considered mission critical is classified as a minor alarm. A minor alarm may be a precursor to a major alarm.
c) Event alarm is the next to lowest priority. An event alarm is generated by operator action such as changing the control mode.
d) Informational alarm is the lowest priority. An informational alarm provides a means of conveying important process information to the operator. Informational alarms usually take the form of messages.

Table 2-3 provides a very brief summary of alarms that will be provided for key elements of the TTDF process equipment. It is based on information contained in Section 13370 – Programmable Controllers and Panel Instruments in the TTDF Construction Specifications.

TABLE 2-3 ALARM PROVISIONS FOR SELECTED KEY ELEMENTS OF THE TTDF PROCESS EQUIPMENT	
Process Equipment Item	**Alarm Description**
Fine Screens	Common Alarm
Fine Screens	High Differential Level
Fine Screens	High Upstream Level
Fine Screens	Emergency Stop Actuated
Fine Screens	Grease Pump No. 1 Reservoir Low Level
Aeration Basins	RAS Influent Valve Fail
Aeration Basins	Influent Channel Agitation Air Valve Fail
Aeration Basins	ML Channel Agitation Air Valve Fail
Aeration Basins	Anoxic Mixer Fail
Aeration Basins	Anoxic Mixer High Winding Temperature
Aeration Basins	Anoxic Mixer Seal Leak
Aeration Basins	Oxic Zone Aeration Valve Fail
Aeration Basins	Mixed Liquor Pump Fail
Membrane Basins	Agitation Air Valve Fail
Membrane Basins	Membrane Basin Low Level
Membrane Basins	Membrane Basin Low-Low Level
Membrane Basins	Infeed Slide Gate Fail
Membrane Pump Gallery	Permeate Pump Fail
Membrane Pump Gallery	Permeate Pump High Winding Temperature
Membrane Pump Gallery	Backpulse Pump Fail
Membrane Pump Gallery	Backpulse Pump High Winding Temperature
Membrane Pump Gallery	Backpulse Pumps High Discharge Pressure
Membrane Pump Gallery	Sump Pump Common Alarm
Membrane Pump Gallery	Sump Pump Seal Leak
Membrane Pump Gallery	Sump High-High Level
Membrane Pump Gallery	Floor High Level
Permeate Collector	Permeate Collector Low Level
Permeate Collector	Permeate Collector Low-Low Level
Permeate Collector	Permeate Collector High Turbidity
RAS Pump Station	RAS Pump Fail
RAS Pump Station	RAS Pump High Winding Temperature
RAS Pump Station	RAS Pump High Discharge Pressure
RAS Pump Station	RAS Pump Station Low-Low Level
WAS Pump Station	WAS Pump Fail
WAS Pump Station	WAS Pump High Winding Temperature
WAS Pump Station	WAS Pump Seal Leak
WAS Pump Station	WAS Pump Station Low-Low Level
UV Train	Discharge Valve Fail
UV Reactor	High Water Temperature
UV Reactor	Low UV Intensity
UV Reactor	Ground Fault

TABLE 2-3 ALARM PROVISIONS FOR SELECTED KEY ELEMENTS OF THE TTDF PROCESS EQUIPMENT	
Process Equipment Item	**Alarm Description**
UV Reactor	Low Priority Alarm
UV Reactor	High Priority Alarm
UV Reactor	Critical Instrument Failure
UV Reactor	UV Dose Failure
Drain Pump Station	Drain Pump Fail
Drain Pump Station	Drain Pump High Winding Temperature
Drain Pump Station	Drain Pump Seal Leak
Drain Pump Station	Drain Pump Station Low Level
Drain Pump Station	Drain Pump Station High Level
Valve Vault	Valve Vault Sump Pump Common Alarm
Valve Vault	Valve Vault Sump High-High Level

2.6.8 Facility Hours and Staffing

As for the existing RWRF facilities, the TTDF facilities will be staffed around the clock, 24 hours every day, by certified plant operators. All alarm indicators will be received by plant operators in the facility Control Building via the SCADA system and its OIS interfaces. The Control Building is continuously staffed by RWRF personnel.

2.6.9 Electrical Power Supply

The primary source of electrical power supply for the RWRF, provided by Pacific Gas & Electric Company (PGE) is one 70 KV high voltage power line supplying power via one City-owned 10 MVA power transformer with a secondary voltage of 12 KV. The secondary side of the transformer is connected to two main circuit breakers for the main 12 KV service switchgear, which is equipped with a normally open tie circuit breaker. This switchgear is rated at 12 KV, 2000A, 500 MVA short circuit capacity with Bus “A” and Bus “B” separated by the normally open tie circuit breaker.

A backup source of electrical power supply from PGE exists in the form of a 12 KV line that provides a capacity of 5 MVA for emergency use. This backup line originates at a different PGE substation than the primary source line, and it is considered highly unlikely that both sources would be out of service at the same time. This backup line is tied to the main 12KV service switchgear through a normally open circuit breaker with a "Kirk Key" trapped key interlock, operated manually.

The RWRF also has three backup generators, one of which is a propane fired system that generates 25 KW. The other two backup generators are diesel fired systems that produce 350 KW and 1600 KW, respectively. The total power generation capacity of these three backup generators is thus 1975 KW, or 1975 KVA. Combined with the backup PGE line, this results in a total backup power supply capacity of 6975 KVA.

The RWRF also has a natural gas fired turbine generator that can produce up to 9.25 MW, equivalent to 9250 KVA. This generator system is not currently configured to provide power to the overall RWRF electrical system, and so it is not available as a near-term backup source of electrical power for the RWRF and the TTDF. However, the City is working to implement the necessary improvements to allow this generator to serve as a backup source of electrical power.

The City reports that the RWRF summer peak electrical power demand is approximately 6500 KVA, and that the estimated peak power demand for the TTDF is approximately 1250 KVA, for a combined total of 7750 KVA. It is evident that the primary power supply provides sufficient capacity for the anticipated combined demand of the RWRF and the TTDF. However, until the natural gas fired turbine generator can be configured to serve as a general service backup generator, the backup power supply capacity of 6975 KVA does not provide sufficient electrical power for the combined demands of the RWRF and the TTDF. The City reports that until such time as the natural gas fired turbine generator can be configured to serve as a general service backup generator, plant operators will shut down non-essential electrical loads facility-wide if necessary for temporary operation under emergency backup power supply conditions.

2.7 Supplemental Water Supply

The City will operate the TTDF and manage its recycled water users such that the recycled water supply can meet recycled water demand at all times. However, if the TTDF becomes unable to produce sufficient recycled water on a short-term basis to meet recycled water demand, supplemental water may be required to meet the recycled water user needs.

Supplemental water could be provided by the following sources.

1) Stored Recycled Water. The covered recycled water storage basin, a converted RWRF Train A aeration basin, will provide 2.7 million gallons of recycled water storage, or approximately 54% of one day's recycled water production capacity of the TTDF. Stored recycled water may be used to provide continued recycled water service for limited periods in the event of a short-term emergency situation resulting in TTDF inability to produce TTRW.
2) Raw Water. Raw water consists of untreated surface water provided by FID. Raw water would not be introduced into and conveyed by the recycled water distribution system, but would be delivered by other conveyance systems, generally the FID pipeline and canal system and private irrigation water pipelines. Thus, utility of this source of supplemental water would be limited to those users who have access to such other systems, and would be subject to supply availability.
3) Potable Water Distribution System. The City's potable water distribution system could serve as a temporary source of supplemental water for recycled water users. This would require an approved temporary disconnection from the City's recycled water distribution system, followed by the establishment of an approved temporary connection to the City's potable water distribution system.

4) Private Wells. Some recycled water users will have onsite private wells that have been or are being used for irrigation water supply and/or potable water supply, and could be relied on as a temporary source of supplemental water. As for potable water, the use of this supplemental source would require an approved temporary disconnection from the City's recycled water distribution system, followed by the establishment of an approved temporary connection to the private well system.

5) Reclamation Wells. In the future, the City hopes to be able to use groundwater produced from aquifers beneath the RWRF percolation ponds, disinfected if necessary, as a supplemental water source for the recycled water system. The City estimates that it will be at least two years from the date of this report before the use of this groundwater as a supplemental water supply could be implemented Water quality testing to verify suitability of the groundwater would be done prior to approval of such use, and necessary infrastructure would have to be constructed.

The only supplemental water source of those listed above that has potentially lower general quality than the recycled water itself is the raw (untreated) surface water. In cases where raw water is used as a supplemental source, the City will confirm with the affected users that the raw water quality is adequate for their particular application, which is ordinarily expected to be the case.

Since most recycled water users will have formerly relied on raw water, potable water, or private wells for the same uses for which recycled water is subsequently used, it is expected that the supply and delivery infrastructure for those supplemental water supply sources would generally be adequate for those same uses on a temporary basis.

Cross-connection of any recycled water distribution system, whether the City's recycled water distribution system or any individual user's on-site recycled water system, with any potable water distribution system is prohibited, even as a supplemental water source in the event of a shutdown or failure at the TTDF. The Rules and Regulations contain specific requirements for disconnecting on-site recycled water systems from the recycled water distribution system before making a temporary connection to a potable water distribution system.

2.8 Monitoring and Reporting

The Waste Discharge Requirements (WDRs) for the RWRF include a Monitoring and Reporting Program (MRP) that specifies required monitoring and reporting for RWRF operations. Primary effluent destined for treatment at the new TTDF will be diverted from RWRF Train C at a point immediately upstream of the Train C aeration basins by connection to an existing pipe stub in the primary effluent piping. The diversion point is downstream of the RWRF headworks, and therefore downstream of the influent composite sampling location designated in the WDRs. Influent monitoring and reporting for the TTDF will therefore be done as an integral part of the influent monitoring and reporting done for the RWRF under the provisions of the MRP.

Monitoring and reporting for disinfected TTRW produced by the TTDF will also be done as specified in the MRP for effluent discharge monitoring. This will involve the introduction of a new effluent composite sampling location at the TTDF discharge, in addition to those currently designated in the WDRs. The new sampling location must be established with concurrence of CRWQCB staff, and a description of the new sampling location must be submitted to the Board and attached to the WDRs.

In addition to the effluent discharge monitoring and reporting required by the WDRs, disinfected TTRW will also be tested for total coliform bacteria and turbidity, as required by Title 22 CCR Section 60321.

The disinfected TTRW will be sampled at least once daily for total coliform bacteria. The samples will be taken from the disinfected TTRW at the new designated effluent composite sampling location, and will be analyzed by the RWRF laboratory.

Disinfected TTRW will also be continuously sampled for turbidity using a continuous turbidity meter and recorder at the new effluent composite sampling location. In the event of failure of the continuous turbidity meter and recorder, grab samples taken at the same location at a minimum frequency of 1.2-hours may be substituted for a period of up to 24-hours.

All monitoring results will be reported as specified in the WDRs, including the additional total coliform bacteria and turbidity monitoring for the TTDF.

2.9 Contingency Plan

For the purposes of this report, "off-spec effluent" is TTDF effluent that does not meet the quality requirements for disinfected TTRW, or partially treated or untreated wastewater that somehow passes through the TTDF. In the event of any circumstance that could result, or does result, in the discharge of off-spec effluent from the TTDF, effluent pumping from the TTDF permeate pumps to the covered recycled water storage basin would be halted, so as to preserve the quality of stored TTRW so that it may be used to provide continued recycled water service while the cause of the problem is investigated and remedied.

In the event that off-spec effluent is delivered into the covered recycled water storage basin, pumping from the recycled water pump station would be halted, so as to prevent the introduction of off-spec effluent into the recycled water distribution system. Provided that the off-spec effluent in storage is of an equivalent or higher quality than the undisinfected secondary effluent produced by the RWRF, the off-spec effluent would be pumped or allowed to overflow via the overflow pipeline to Canal B, which is part of the canal system that delivers undisinfected secondary effluent from the RWRF treatment facilities to the percolation basins. The TTDF facilities will include a dedicated pipeline for pumped conveyance of off-spec effluent under such conditions.

If off-spec effluent in the covered recycled water storage basin is not of an equivalent or higher quality than the undisinfected secondary effluent produced by the RWRF, the off-spec effluent would be pumped from the storage basin via temporary pipelines and returned to the primary effluent stream of

RWRF Train C. The recycled water storage basin would be flushed clean and disinfected prior to returning the basin to normal recycled water storage duty.

Since the supply of primary effluent for treatment by the TTDF is a diversion from the primary effluent stream of RWRF Train C, the supply can be stopped by simply stopping the diversion. This can be done by operation of a pneumatically operated valve located in a valve vault adjacent to the fine screens. When the diversion is stopped, the primary effluent that would otherwise be diverted to and treated by the TTDF is instead retained and treated in RWRF Train C.

3.0 TRANSMISSION AND DISTRIBUTION SYSTEMS

Chapter 1 of this report provides a brief description of the Master Plan, and its recommendations for recycled water production, transmission and distribution facilities that are now in the early stages of implementation. Figure 1-2 provides an overview of the planned distribution system, taken from the Master Plan. The initial phase of implementation of the planned distribution system includes the design and construction of certain elements of the recycled water transmission mains referred to as the Southwest Quadrant, together with a related recycled water booster pump station. Figure 3-1 shows the Southwest Quadrant recycled water transmission main and booster pump station projects.

The City is expected to soon award a construction contract for the Southwest Quadrant Project SW1A, and is currently soliciting bid proposals for the construction of Project SW1B. The construction plans for Projects SW1A and SW1B may be viewed at the URL addresses provided in the List Of Relevant Internet-Accessible Documents.

Projects SW1C, SW1D, SW4, and SWPS1 are currently under engineering design, at various levels of design completion. The City reportedly is planning to soon issue a Request for Qualifications for engineering design of the Northwest Quadrant and Northeast Quadrant recycled water transmission mains.

The hydraulic design for the recycled water transmission main system is based on a minimum operating pressure of 40 PSI, and a maximum pressure variation between low operating pressure and high operating pressure of 20 PSI.

Pipe materials for the recycled water transmission mains will be cement mortar lined and coated steel pipe (CMLCSP) or cement mortar lined and tape coated steel pipe with a mortar rock shield (CMLTCSP) for pipes 24 inches and larger in diameter. Pipes smaller than 24 inches in diameter will be poly-vinyl chloride pipe (PVC) or ductile iron pipe (DIP).

The City of Fresno has developed and adopted Standard Specifications and Standard Drawings for recycled water facilities. The Standard Specifications include construction specifications as well as design criteria. The Standard Specifications and Standard Drawings are appended to this report as Appendix E. The Standard Specifications and Standard Drawings apply to all construction of recycled water facilities within the City of Fresno.

With respect to pipe materials, the Standard Specifications and Standard Drawings currently include provisions for PVC and DIP pipe materials. The City of Fresno is also in the process of developing additional standard specification and standard drawing content to include the CMLCSP and CMLTCSP pipe materials, which is expected to be added to the Standard Specifications and Standard Drawings after it is adopted by the City.

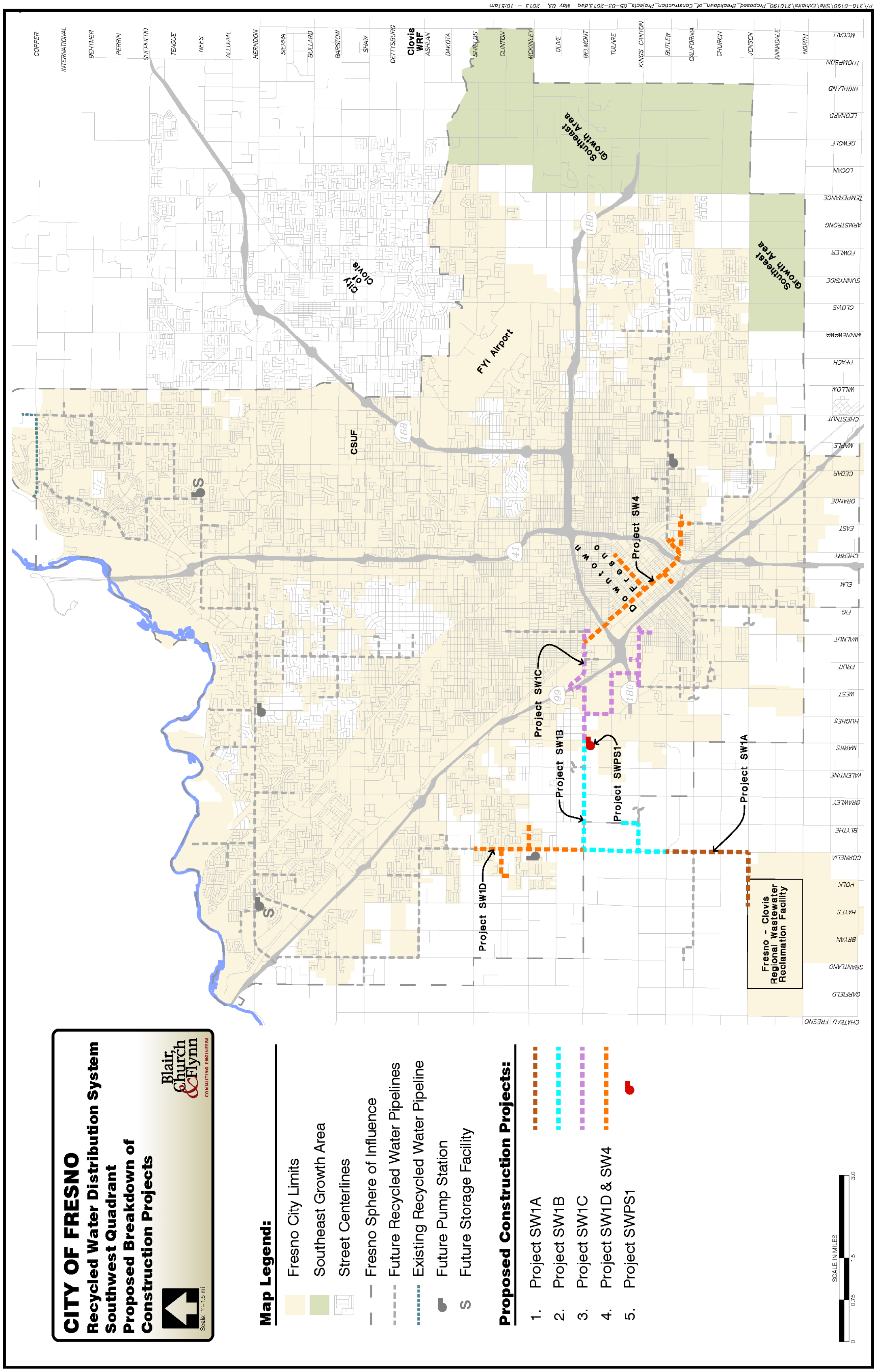

FIGURE 3-1
SOUTHWEST QUADRANT RECYCLED WATER TRANSMISSION MAIN PROJECTS

4.0 RECYCLED WATER USE AREAS

Subchapter 2.3 of this report provides a brief discussion of planned and/or required recycled water uses, restated in part here for the reader's ease of reference. All properties within the Recycled Water Project Area (RWPA), as it is defined in the Recycled Water Ordinance, that host land uses for which recycled water use is recommended by the Master Plan, or is required by the Recycled Water Ordinance, are potential recycled water use areas, and the owners or tenants of such properties are potential recycled water users.

The Rules and Regulations require that no recycled water shall be used on any property or use area not owned or controlled by the City unless a non-transferrable User Agreement has been executed between the City and the recycled water user. User Agreements will contain contractually binding terms requiring conformance with the Rules and Regulations and all applicable local, state and federal regulations, including Title 17 and 22 of the California Code of Regulations. Users will be responsible for constructing and maintaining their own on-site recycled water systems for their use area. Appendix C contains a user agreement template that will serve as the foundation for the individual User Agreements for each recycled water user.

The City of Fresno has begun making initial contacts with potential recycled water users to advise them of the forthcoming availability of recycled water, and to begin making necessary arrangements for them to become recycled water users. Initial contacts are being made with potential users sited within one-half mile of the planned recycled water transmission main system. Figure 2-1 is a highly reduced scale map graphically identifying the target area for initial contacts, and the locations of potential recycled water use areas. A full scale version of the map may be viewed at the URL address provided in the List Of Relevant Internet-Accessible Documents.

The City is in the process of retaining a recycled water use area consultant (RWUA Consultant) that will work with potential recycled water users and the City to set up recycled water use areas in conformance with the Recycled Water Ordinance, the Rules and Regulations, the Recycled Water User Agreement, and all applicable local, state and federal regulations. The City will pay the cost of the RWUA Consultant. The recycled water user will be responsible for implementing all onsite improvements, beyond the point of connection to the City's recycled water service, that may be necessary to retrofit or equip the use area for recycled water use. The recycled water user will also be responsible for elimination of any cross connections discovered in the course of the cross connection control survey.

Each recycled water user must designate a Recycled Water Site Supervisor to be responsible for the onsite recycled water system at each use area under their control. The Recycled Water Site Supervisor is required to be responsible for proper installation, operation, and maintenance of the recycled water system, compliance with the Rules and Regulations, prevention of potential hazards, and preservation of the onsite recycled water system plans in “as built” form. Additional specific responsibilities of the Recycled Water Site Supervisor are provided in the Rules and Regulations.

Upon completion of the RWTM facilities that will deliver TTRW to the Roeding Park area, the City plans to implement recycled water use at Roeding Park, including Chaffee Zoo and Rotary Storyland and

Playland, as the first of the City's own recycled water use areas. A feasibility study has been conducted, and the City is currently making arrangements to retain an engineering and landscape architecture consultant for the design of improvements necessary to retrofit or equip the use area for recycled water use.

APPENDIX A
RECYCLED WATER ORDINANCE

ORDINANCE NO. ___________

AN ORDINANCE OF THE CITY OF FRESNO, CALIFORNIA, ADDING ARTICLE 9 OF CHAPTER 6 OF THE FRESNO MUNICIPAL CODE RELATING TO THE USE OF RECYCLED WATER FOR PLUMBING AND LANDSCAPE IRRIGATION

WHEREAS, the people of the State of California have a primary interest in the development of facilities to reuse water containing waste to supplement existing surface and underground water supplies and to assist in meeting the future water requirements of the State (California Water Code, Section 13510);

WHEREAS, conservation of all available water resources requires the maximum reuse of wastewater for beneficial uses of water (Water Code Section 461);

WHEREAS, continued use of potable water for irrigation of greenbelt areas and other non-potable uses may be an unreasonable use of such water where recycled water is available;

WHEREAS, the State Water Resources Control Board adopted Resolution No. 2009-0011, which intends to establish requirements to increase the use of recycled water in California;

WHEREAS, the State Water Resources Control Board adopted an Order, which creates General Waste Discharge Requirements for Landscape Irrigation Uses of Municipal Recycled Water (General Permit); and

WHEREAS, the City of Fresno Urban Water Management Plan (Resolution No. 2008-207, August 19, 2008) identifies the City's need to develop 25,000 acre-feet per year of recycled water by 2025 to offset potable water use in order to help meet future water supply needs for the Fresno Metropolitan area;

THE COUNCIL OF THE CITY OF FRESNO DOES ORDAIN AS FOLLOWS:

SECTION 1. Article 9 is added to Chapter 6 of the Fresno Municipal Code to read:

ARTICLE 9

RECYCLED WATER ORDINANCE

SECTION 6-901. TITLE. This section shall be known as the "Recycled Water Ordinance" of the City of Fresno and may be so cited.

SECTION 6-902. PURPOSE AND INTENT. The purpose and intent is to provide recycled water to all service areas in the City identified in the Recycled Water Master Plan (Plan) (currently under development) and subsequent additions, revisions or updates of the Plan. It is the intent of the City that existing owners of property and future development, identified in the Master Plan as being potential users within areas designated for recycled water use, qualify for a recycled water use agreement from the City in accordance with this Recycled Water Ordinance.

It is also the intent of the City that such recycled water be used in a manner and for types of uses that are in compliance with any and all applicable Federal, State and local statues, ordinances, regulations and other requirements.

SECTION 6-903 DEFINITIONS.

(a) “Approved use” means the uses defined by State law as being approved for use of tertiary treated recycled water.

(b) "Cross-connection" means any unapproved and/or unprotected connection between a potable water system and a nonpotable system. No cross connections are allowed between recycled water and potable water systems.

(c) “Customer”, “Consumer”, or “User” means a person or entity having a connection to the recycled water system or potable water system owned and operated by the City.

(d) “Dual plumbed system” means a system that utilizes separate piping systems for recycled water and potable water within a facility and where the recycled water is used for either of the following:

a. To serve plumbing outlets (excluding fire suppression systems) within a building, or

b. Outdoor landscaping irrigation at individual residences.

(e) “On-site recycled water system" means facilities under the control of the owner, normally downstream of the recycled water meter.

(f) "Potable water" means water which conforms to the Federal, State and local standards for human consumption.

(g) "Recycled water" means non-potable tertiary treated water which, as a result of treatment of wastewater, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource.

(h) "Recycled water distribution system" means recycled water pipelines, transmission mains, pump stations, storage reservoirs, and appurtenances acquired or constructed and owned by the City, and used for the conveyance of recycled water between the wastewater treatment plant and the recycled water service connections.

(i) "Recycled water project area" means those geographical areas identified in the Fresno Recycled Water Master Plan and designated by the City to which the City will provide recycled water service where it is expected to be available. Customers within the Recycled Water Project Area are eligible for recycled water service for approved uses when it becomes available.

(j) "Recycled water service connection" means the point of connection (POC) of the user/customer's recycled water line with the recycled water service line of the City, which shall normally be the downstream end of the recycled water meter tailpiece.

(k) "Rules and regulations" means the Rules and Regulations for Recycled Water Use and Distribution within the City of Fresno.

(l) "Use area" means an area of recycled water use with defined boundaries. A use area may contain one or more facilities.

SECTION 6-904. ADMINISTRATION. The Director of the Department of Public Utilities (Director) shall administer, implement, and enforce the provisions of this section. Any powers granted to or duties imposed upon the Director may be delegated by the Director to persons in the employ of the City.

The Director will develop and enforce rules and regulations necessary to the administration of this section. The Director may amend such rules and regulations from time to time as conditions require. These rules and regulations shall be consistent with the general policy established herein by the City.

SECTION 6-905. USER AGREEMENT. Recycled water shall not be delivered, used, or discharged upon any property or use area not owned or controlled by the City unless a user agreement has been established.

The City will issue to each recycled water customer a user agreement for each site or combination of sites, which grants permission to use recycled water and requires the customer to use recycled water in accordance with the rules, regulations and standards of the City's Recycled Water Rules and Regulations and all applicable State and local rules and regulations, including Titles 17 and 22 of the California Code of Regulations (CCR), as may be amended from time to time.

SECTION 6-906. APPLICATION PROCESS FOR USER AGREEMENT. Applicants shall file applications for recycled water use with the Department of Public Utilities. The application shall contain such information as required by the

Department of Public Utilities. The application shall be reviewed for conformance with the requirements in this section, the Recycled Water Master Plan and all other applicable statutes. Upon determination that a property shall be served with recycled water, or adoption of a condition for development approval requiring use of recycled water, and approval of the application, the owner of the property may become a user by entering into a user agreement that complies with the regulations and such other requirements deemed necessary by the Department of Public Utilities.

SECTION 6-907. RECYCLED WATER SERVICE ELIGIBILITY. All areas served by potable water service within the Recycled Water Project Area are eligible for recycled water service connections for approved uses when recycled water becomes available.

However, the Director, or his or her designee, may determine that currently, connection to the recycled water system is not economically or operationally feasible because of distance from an available recycled water source or other such condition as the Director, or his or her designee, deems appropriate. This determination can change as the system is expanded or revised in the future and will be considered at that time.

SECTION 6-908. REQUIREMENT TO USE RECYCLED WATER. The City reserves the right to require all customers who connect (or desire to connect) to the City potable water system on or after January 1, 2015 to use recycled water in-lieu of potable water for all approved uses, including, but not limited to, dual plumbing requirements for commercial buildings and single family residential irrigation.

Upon application by a developer, owner or water customer for a tentative map, subdivision map, land use permit, or other development project, the Director shall review the Master Plan and make a preliminary determination whether the current or proposed use of the subject property require it to be served with recycled water or to include facilities designed to accommodate the use of recycled water in the future, due to its location within an existing or proposed Recycled Water Project Area. Based upon such determination, an agreement for such use may be required as a condition of approval of any such application, in addition to any other conditions of approval or service.

a. Requirement for Commercial Properties in Recycled Water Project Area.

Existing Commercial: Existing commercial properties in the Recycled Water Project Area are required to use recycled water for landscape irrigation. Owners of existing commercial properties shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

New Commercial: Projects involving new commercial subdivision of land for which a tentative map or parcel map is required and are located within the Recycled Water Project Area, shall be conditioned to be dual plumbed to provide for the internal use of recycled water and to provide for the use of recycled water for landscape irrigation. The point of connection to the recycled water distribution system shall be coordinated between the customer and the City. The Director will determine requirements for recycled water plumbing. These requirements and the use of recycled water will become conditions of approval.

b. Requirement for Industrial Projects in the Recycled Water Project Area.

Existing Industrial: Existing industrial properties in the Recycled Water Project Area are required to use recycled water for landscaping. Owners of existing industrial properties shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

New Industrial: New industrial projects which require a City permit and which are located within the Recycled Water Project Area are required to provide dual plumbing for internal uses of recycled water and to provide for the use of recycled water for landscape irrigation. Such projects must also provide a feasibility study analyzing the possibility of using recycled water for industrial processes and cooling. The Director will determine requirements for recycled water plumbing. The feasibility study and, if applicable, any City requirements for the use of recycled water will become conditions of approval.

c. Requirement for Institutional and Governmental Use in the Recycled Water Project Area.

New Institutional and Governmental Projects: New institutional and governmental projects which are located within the Recycled Water Project Area are required to be dual plumbed to provide for the internal use of recycled water and to provide for the use of recycled water for landscape irrigation. The Director will determine requirements for recycled water plumbing. These requirements and the use of recycled water will become conditions of approval.

d. Requirement for Residential Uses in the Recycled Water Project Area.

New Apartments and Condominiums: Apartment and Condominium projects involving new commercial subdivisions of land for which a tentative map or parcel map is required and are located within the Recycled Water Project Area, shall be conditioned to be dual plumbed to provide for the internal use of recycled water and to provide for the use of recycled water for landscape irrigation in common areas. The point of connection to the recycled water distribution system shall be coordinated between the customer and the City. The Director will determine requirements for recycled water plumbing. These requirements and the use of recycled water will become conditions of approval.

New Single Family Residential Homes: Single family residential home projects involving new residential subdivisions of land for which a tentative map or parcel map is required and are located within the Recycled Water Project Area, shall be conditioned to provide for landscape irrigation with recycled water. The point of connection to the recycled water distribution system shall be coordinated between the customer and the City. These requirements and the use of recycled water will become conditions of approval.

Existing Apartments and Condominiums: Existing apartment and condominiums are required to use recycled water for landscape irrigation in common areas. Owners of existing apartment and condominium properties shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

Home Owner Associations: Home Owner Associations are required to use recycled water for landscape irrigation in common areas. Home Owner Associations shall connect to the recycled water system or must provide a feasibility study to apply for an exception to this Recycled Water Ordinance.

SECTION 6-909. VOLUNTARY USE INSIDE AND OUTSIDE OF THE RECYCLED WATER PROJECT AREA.

a. Existing Commercial Properties in the Recycled Water Project Area.

Existing Commercial Properties: Existing commercial properties that are in the Recycled Water Project Area shall consider using recycled water for internal dual plumbing, internal cooling towers and evaporative coolers.

b. Commercial Properties Outside of the Recycled Water Project Area.

New and Remodeled Commercial Properties: New and remodeled commercial properties that are located outside of the Recycled Water Project Area shall consider the feasibility of providing for internal dual plumbing and providing for the use of recycled water for landscape irrigation, as recycled water may be extended beyond the Recycled Water Project Area.

c. Existing Industrial Properties in the Recycled Water Project Area.

Existing Industrial Properties: Existing industrial properties in the Recycled Water Project Area shall consider the feasibility of using recycled water for internal dual plumbing.

d. Existing and New Institutional and Governmental Use.

Existing Institutional and Governmental Properties: Existing institutional and governmental properties in the Recycled Water Project Area shall consider the feasibility of using recycled water for internal dual plumbing and landscape irrigation.

New Institutional and Governmental Properties Outside of Recycled Water Project Area: New institutional and governmental properties that are located outside of the Recycled Water Project Area shall consider the feasibility of using recycled water for internal dual plumbing and landscape irrigation, as recycled water is expected to be extended beyond the Recycled Water Project Area.

e. Residential Uses Outside of Recycled Water Project Area

Remodeled Apartments and Condominiums: Remodeled apartment and condominium properties shall consider the feasibility of dual plumbing to provide for the internal use of recycled water and using recycled water for landscape irrigation in common areas.

Existing Apartments and Condominiums: Existing apartment and condominiums shall consider the feasibility of using recycled water for landscape irrigation in common areas.

Home Owner Associations: Home Owner Associations are encouraged to consider the feasibility of using recycled water for landscape irrigation in common areas.

These statements apply to residential uses outside of the Recycled Water Project Area as recycled water may be extended beyond the current Recycled Water Project Area.

f. Industrial Projects; Inside and Outside of Recycled Water Project Area.

All existing and new industrial projects shall consider the feasibility of providing for the use of recycled water for industrial processes and cooling and dual plumbing.

SECTION 6-910. EXISTING POTABLE WATER SERVICE: VOLUNTARY RETROFITS. Existing potable water customers in the Recycled Water Project Area may be provided with the opportunity by the City to retrofit their system to accept recycled water, such as existing commercial properties and existing institutional and governmental properties.

SECTION 6-911. CONSTRUCTION AND DUST CONTROL ACTIVITIES. Any person applying for a construction permit for a project that includes dust control activities is required to use recycled water for those activities within the Recycled Water Project Area.

SECTION 6-912. RECYCLED WATER RULES AND REGULATIONS. The City will at all times have Recycled Water Rules and Regulations which will be prepared, maintained and updated by the Director, or his or her designee.

The purpose of the Recycled Water Rules and Regulations is to detail the requirements of the City's recycled water system, namely: this section; the California Code of Regulations Titles 17 and 22; and other State and local rules and regulations related to the use of recycled water as they may be adopted or changed from time to time.

SECTION 6-913. SANCTIONS. Any owner and or operator who violates this Recycled Water Ordinance may, for each day of violation, or portion thereof, be subject to penalties in accordance with Chapter 1, Article 3 of the City Municipal Code.

SECTION 6-914. ENFORCEMENT. Any person, firm, corporation, association, or agency found to be violating any provisions of this section or the terms and conditions of the user agreement, permit or any applicable Federal, State, County, or City statute, regulation, resolution, ordinance or other requirement may be subject to termination of the recycled water service without notice.

SECTION 9-915. CONFLICTING PROVISIONS. In the event of any conflict, between the provisions of the most current version of the Uniform Plumbing Code, and the provisions of this Section, the provisions of this Section shall apply.

SECTION 9-916. SEVERABILITY. If any section, subsection, provision or part of this Recycled Water Ordinance, or its application to any person or circumstance, is held to be unconstitutional or otherwise invalid, the remainder of this Recycled Water Ordinance, and the application of such provision to other person or circumstances, shall not be affected thereby and shall remain in full force and effect and, to that end, the provisions of this Recycled Water Ordinance are severable.

SECTION 2. This ordinance shall become effective and in full force and effect at 12:01 a.m. on the thirty-first day after its final passage.

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STATE OF CALIFORNIA)
COUNTY OF FRESNO) ss.
CITY OF FRESNO)

I, YVONNE SPENCE, City Clerk of the City of Fresno, certify that the foregoing ordinance was adopted by the Council of the City of Fresno, at a regular meeting held on the _________ day of _____________, 2014.

AYES :
NOES :
ABSENT :
ABSTAIN :

Mayor Approval: ________________________________, 2014
Mayor Approval/No Return: ________________________, 2014
Mayor Veto: ____________________________________, 2014
Council Override Vote: ___________________________, 2014

YVONNE SPENCE, CMC
City Clerk

BY:_________________________
Deputy

APPROVED AS TO FORM:
CITY ATTORNEY'S OFFICE

BY:___________________________
Brandon M. Collet, Deputy Date

BMC:prn [64611prn/ord] 05-19-14

APPENDIX B
RULES AND REGULATIONS

Rules and Regulations of Recycled Water Use

DEPARTMENT OF
PUBLIC UTILITIES
Providing Life's Essential Services

Wastewater Management Division
5607 W. Jensen Ave
Fresno, CA 93706

Contents

1. Introduction

The City of Fresno owns and operates a Recycled Water Distribution System (Distribution System) providing Recycled Water for approved uses to Recycled Water Customers (Customer) within the Recycled Water Project Area. This document contains the City of Fresno's Rules and Regulations governing the design, construction and use of Recycled Water (Rules and Regulations). These Rules and Regulations aim to provide Customers with necessary information to comply with relevant codes, laws, statutes and regulations concerning the use of Recycled Water.

1.1. Authority and Sources

The Rules and Regulations are prepared and administered by the Department of Public Utilities Wastewater Management Division, and may be updated from time to time. The Rules and Regulations apply to all Customers and distributors of Recycled Water and shall govern the design, construction and use of both the Distribution System operated by the City and On-Site Recycled Water Systems operated by Customers. Since codes, laws, statutes and regulations can change without prior approval or knowledge, the City of Fresno does not assume any liability for errors in this document. It is the responsibility of the Customer to check with the City of Fresno before initiating any changes to their On-Site Recycled Water System. It is the intent of these Rules and Regulations to be consistent with the following criteria:

(a) California Code of Regulations, Title 22, Division 4, Chapter 3 (Water Recycling Criteria).

(b) California Code of Regulations, Title 17, Division 1, Chapter 5 Group 4, Article 1and 2 (General and Protection of Water System).

(c) The State Water Resources Control Board (SWRCB) and its Division of Drinking Water (DDW) Guidelines for Use of Recycled Water, and Guidelines for Use of Recycled Water for Construction Purposes.

(d) American Water Works Association (AWWA) California/Nevada section, Guidelines for the Distribution of Non-Potable Water and Guidelines for Retrofitting to Recycled Water or alternate measures that are acceptable to the DDW.

(e) Applicable regulations by the Regional Water Quality Control Board (RWQCB).

(f) City of Fresno Municipal Code, Chapter 6, Article 3, Sewage and Water Disposal and Article 9, Recycled Water Ordinance.

Interested parties may contact the Wastewater Management Division for copies of documents referenced in these Rules and Regulations.

1.2. Scope and Severability

If any section, subsection, clause or phrase of these Rules and Regulations is determined to be invalid, the remaining portions of these Rules and Regulations shall remain in effect. If there is any conflict between the provisions of these Rules and Regulations and the provisions of any of the referenced documents, the most stringent guidelines will control.

1.3 Planning for Recycled Water Use

The Rules and Regulations outlined in this document provide Recycled Water Customers with information for design, installation, operation and maintenance of an On-Site Recycled Water System. This section provides general information about the City of Fresno's Recycled Water program.

Eligibility to Use Recycled Water.

(a) The Department of Public Utilities shall review the Recycled Water Master Plan and make a preliminary determination whether the current or proposed use of the property requires service with Recycled Water, or facilities designed to accommodate the use of Recycled Water in the future. This determination is based in part on the property's location within the existing or proposed Recycled Water Project Area.[1]

(b) The City of Fresno's Recycled Water Ordinance requires all new construction, existing and future commercial/ industrial facilities to use Recycled Water for landscape irrigation, if available in the Recycled Water Project Area.

(c) Existing sites using Potable Water for irrigation may convert to Recycled Water with approval of the City.

(d) All Recycled Water systems shall be metered separately from the Potable Water supply and must have no Cross Connection to the Potable Water supply.

1.4. Protection of Public Health and the Environment

The use of Recycled Water shall not result in contamination or pollution of any surface water body nor create a hazard that is injurious to public health. The City of Fresno, Fresno County Department of Health, and the DDW may take measures to ensure that a Customer's On-Site Recycled Water System adequately protects public health and the environment. Conditions which may lead to unacceptable public health and environmental hazards include, but are not limited, to:

(a) Cross connections with the potable system or any other water system;

(b) Improper tagging, marking or signage;

(c) Unapproved uses of Recycled Water; and

(d) Recycled Water runoff to a surface water body.

1.5. Approved Uses of Recycled Water

Tertiary disinfected Recycled Water may be used for landscape and agricultural irrigation, impoundments, commercial laundries, cooling towers and other Approved Uses as identified in Title 22, Division 4, Chapter 3, Article 3 Recycled Water Criteria. Moreover, statutes delineating permissible uses of Recycled Water at locations such as

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[1] Fresno Municipal Code, Chapter 6, Article 9, Section 6-908

cemeteries and car washes are identified in the Health and Safety Code, Division 8, Part 1, Chapter 4.5 and the Water Code Division 6, Part 2.12 § 10950 – § 10953, respectively.

1.6. Violation of Rules and Regulations

The City may terminate Recycled Water service to a Customer who uses, transports, or stores Recycled Water in violation of these Rules and Regulations. No Customer will create or threaten to create conditions of pollution, contamination, and nuisance or violate discharge requirements prescribed by the RWQCB. Enforcement actions may be initiated against any Customer resulting in potential termination of Recycled Water service. In addition, no person at any time shall tamper with City property except to shut off water to protect public health or prevent damage to property or the environment. Only authorized City personnel may operate City facilities.

The City shall investigate all reports of non-compliance with any provision of these Rules and Regulations and/or the User Agreement to determine the validity and seriousness of the violation. Determinations regarding the seriousness will be based upon the violation's magnitude and duration; effect on public health, the environment, City property or assets, or the operation of the Distribution System; effect on the City's compliance with the Rules and Regulations of the regulatory agencies with which it must in turn comply; and the history and good faith of the Customer.

1.7. Notice of Violation

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Unless the violation is an emergency, as determined by the City, the Customer will receive a written notice of violation describing:

(a) The nature of the violation;
(b) Requirements for submittal of a corrective action plan;
(c) A reasonable time limit for the satisfactory mitigation of the violation; and
(d) A date for a follow-up inspection.

The Customer may file a notice of appeal within 15 calendar days after notice of violation is received, following the guidelines for filing a notice of appeal and the City shall implement duty of enforcement procedures as defined in Fresno Municipal Code, Chapter 1, Article 4.

For emergencies that result in cross connection of recycled water with potable water, refer to Part 10. Cross Connection, Section 10.3 Emergency Preparedness and Section 10.4 Emergency Cross Connection Procedures.

1.8. User Agreements

Recycled Water shall not be delivered, used, or discharged upon any property or Use Area not owned or controlled by the City unless a non-transferrable User Agreement has been executed between the City and Customer permitting the Customer to receive Recycled Water service.

The site-specific User Agreement will identify the Recycled Water's Use Area, an estimate of the quantity (including seasonal schedule) of Recycled Water to be used, and permitted uses of Recycled Water. User Agreements delineate contractually binding terms associated with these Rules and Regulations. Once executed, the User

Agreement permits use of Recycled Water in accordance with the terms of the User Agreement, these Rules and Regulations, and all applicable local, State and federal regulations, including Title 17 and 22 of the California Code of Regulations, as may be amended from time to time. If an On-Site Recycled Water System is found to be in violation of a City of Fresno Ordinance, the corresponding User Agreement and/or these Rules and Regulations, the City shall implement provisions of Section 1.7. of these Rules and Regulations.

1.8.1. User Agreement Renewal

Upon expiration of the existing User Agreement, customer shall enter into a new agreement for continuation of recycled water services. The new agreement may have additional regulatory requirements, costs, or rates not specified on the original agreement. In the case of change of property ownership and if the new owner desires to continue the recycled water service, a new Recycled Water User Agreement with the new owner will be processed reflecting changes in regulatory requirements, costs or rates not previously specified, if any.

1.9. Conditions Precluding Delivery of Recycled Water

The City has sole discretion and flexibility in scheduling, distributing and prioritizing Recycled Water deliveries, particularly under conditions of insufficient recycled water supply, maintenance of City's treatment or distribution systems, acts of a third party, or order of a Regulatory Agency.

2. Definitions

Whenever the following terms (or pronouns are used in their place) occur in these Rules and Regulations, they will be identified with capitalized initials and their meaning shall be interpreted as follows:

"**Air Gap**" is a physical separation from the free-flowing discharge end of a water supply pipeline and an open or non-pressure receiving vessel. It is generally regarded as the most protective method of backflow prevention. An approved air gap must be at least twice the diameter of the water supply pipeline, measured vertically from the flood rim of the Customer's receiving vessel to the supply pipe from the service connection. In no case shall the air-gap separation be less than one inch.

"**Applicant**" is a potential user requesting Recycled Water services from the City.

"**Approved Uses**" means uses defined by California Code of Regulations, Title 22, Division 4 Environmental Health, Chapter 3 Water Recycling Criteria, Article 3 Uses of Recycled Water.

"**As-Built**" means engineering drawings that depict completed facilities, as constructed or modified.

"**Backflow**" is a condition that results in the flow of water, mixtures or substances into a potable water system from a source other than an approved water supply.

"**City**" means City of Fresno, California.

"**Contamination**" means an impairment of the City's potable water quality resulting from the introduction of sewage, industrial fluids, waste liquids, compounds or other materials to a degree which creates an actual hazard to public health through poisoning or spread of disease.

“**Cross Connection**” is the unprotected and/or unapproved actual or potential connection between a potable and non-potable water supply. By-pass arrangements, jumper connections, removable sections, swivel or changeover devices through which backflow could occur, shall be considered to be Cross Connections.

“**Cross Connection Control Specialist**” is an individual trained in cross-connection control, establishment of a procedure or system for testing backflow preventers, and maintenance of records of locations, tests, and repairs of backflow preventers.

“**Customer**”, “Consumer” or “User” means a person or entity who is the contracted recipient of Recycled Water services owned and operated by the City of Fresno.

Division of Drinking Water (“**DDW**”) is a division of the State Water Resources Control Board, formerly California Department of Public Health (CDPH).

“**Dual Plumbing**” means a system that utilizes separate piping systems for Recycled Water and potable water within a facility and where the Recycled Water is used for either of the following: (a) to serve plumbing outlets (excluding fire suppression systems) within buildings or (b) outdoor landscaping irrigation at individual residences.

“**Easement**” means a recorded document in which the land owner gives the City permanent rights to construct and maintain Recycled Water mains and/or facilities across private property.

“**Impoundment**” is a lined structure or a body of water with a lined structure containing Recycled Water, which is used for aesthetic, recreational or irrigation purposes.

“**On-Site Recycled Water System**” means facilities under the control of the property owner, extending from the Recycled Water service connection to the Use Area being serviced with Recycled Water. This includes any on-site distribution plumbing, irrigation systems, industrial processes, impoundments or other approved facilities.

“**Overspray**” means the spray of Recycled Water outside the irrigation area.

“**Pantone**” A color standard system referenced in the American Water Works Association California-Nevada Section Guidelines for Distribution of non-potable water.

“**Ponding**” means the unauthorized retention of Recycled Water in a Use Area for a period following the cessation of approved Recycled Water use activity.

“**Potable Water**” means water which meets the federal, state and local standards for human consumption and is approved for human consumption.

“**Record Drawings**” are the Customer’s plans and specifications for the proposed Use Area required by the City’s application for Recycled Water Service.

“**Recycled Water**” means non-potable tertiary disinfected water, which as a result of treatment of wastewater is suitable for a direct beneficial use or controlled use that would otherwise not occur, and is therefore considered a valuable resource.

“**Recycled Water Distribution System**” means Recycled Water pipelines, transmission mains, pump stations, storage reservoirs, and appurtenances acquired, constructed and owned by the City and used for the conveyance of Recycled Water between the wastewater treatment plant and the Recycled Water service connections.

“**Recycled Water Project Area**” means those geographical areas identified in the City’s Recycled Water Master Plan where the City expects Recycled Water service to be available. Customers within the Recycled Water Project Area are eligible for Recycled Water service for approved uses when it becomes available.

“**Recycled Water Service Connection**” means the point of connection (POC) of the Customer’s Recycled Water line with the Recycled Water service line of the City, which shall normally be the downstream end of the Recycled Water meter tailpiece.

“**Recycled Water Site Supervisor**” or “Site Supervisor” is the Customer’s liaison with the City regarding Recycled Water matters. This person must have the authority to enforce these Rules and Regulations, be responsible for the operation and maintenance of the On-Site Recycled Water System, must prevent potential violations and submit a Use Area Monitoring Report.

“**Reduced Pressure Principle Backflow Prevention Device**” is a type of backflow prevention device, usually installed near a water meter, which prevents backflow by a combination of two check valves, an automatically operated differential relief valve between the two check valves and a tightly closing shut-off valve on each side of the check valve assembly.

“**Regulatory Agency**” refers to those public agencies legally constituted to protect public health and water quality, and whose rules govern the use of Recycled Water, such as DDW, RWQCB and the Fresno County Department of Public Health.

“**Rules and Regulations**” means the Rules and Regulations for Recycled Water use, distribution and transport within the City of Fresno.

“**Runoff**” means Recycled Water that drains outside the approved Use Area.

“**RWQCB**” means Regional Water Quality Control Board, a subdivision of the State Water Resources Control Board.

“**RWRF**”, Fresno-Clovis Regional Wastewater Reclamation Facility.

“**SWRCB**”, State Water Resources Control Board

“**Use Area**” means an area of Recycled Water use with defined boundaries. A Use Area may contain one or more facilities.

“**Water Recycling Criteria**” - the State of California’s set of requirements for the implementation of Recycled Water programs as detailed in the California Code of Regulations, Title 22, Division 4, Chapter 3.

3. General City Responsibilities

The City shall be responsible for all aspects of the treatment, distribution system and quality of Recycled Water. City responsibilities shall include:

(a) Observe and permit installation, connection, and disconnection of Recycled Water service, including, piping, valves and other appurtenances required to connect the City's Recycled Water Distribution System to an On-Site Recycled Water System. The service includes a Recycled Water Meter(s) to measure Recycled Water consumption at the Use Area.

(b)). Ensure users follow the City of Fresno Public Works Standard Specifications, Section 33, Recycled Water Facilities Design Criteria and Section 34, Recycled Water Facilities. [2]

(c) Manage and supervise remergency and non-emergency conversions from a Recycled Water supply at a Use Area back to a Potable Water system and viceversa. This can happen if delivery of recycled water is precluded for reasons beyond the reasonable control of the City including, but not limited to insufficient recycled water supply, maintenance of City's treatment or distribution systems, acts of a third party, or an order from a Regulatory Agency..

(d) Conduct the initial and final inspections of the Use Area as part of the Customer's process for utilizing recycled water.

(e) Monitor the Customer's Recycled Water management practices.

(f) Collect fees from Customers Recycled Water use and related services, as designated in the Master Fee Schedule, when such fees are developed.

(g) Agents of the City, RWQCB, or DDW may enter and inspect the Use Area during reasonable hours, upon providing credentials and with 24 hours advance notice or such notice as required by law, for the purposes of verifying that Customer is complying with these Rules and Regulations and to protect public health and the environment.

(h) The City shall not be responsible for abatement of Cross Connections within a Customer's premises.

4. General Customer Responsibilities

Recycled Water Customers must comply with and enforce all aspects of these Rules and Regulations upon accepting Recycled Water service and finalizing the User Agreement. Customer responsibilities include but are not limited to the following:

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[2] City of Fresno Public Works Standard Specifications, Addendum No. 4, Resolution No.70-36, Sections 33. Updated version approved January 2013.

(a) Understanding that all Approved Uses of Recycled Water for the permitted Use Area are exclusively for non-potable uses as identified in Title 22, Division 4, Chapter 3, Article 3. Water Recycling Criteria

(b) Obtaining all permits necessary to install, operate and maintain the On-Site Recycled Water System.

(c) Granting the City an easement for construction of the Recycled Water Service Connection if the City decides to make provisions for delivery of Recycled Water to the proposed Use Area.

(d) Paying for, furnishing, installing, operating and maintaining all facilities necessary for conveyance of Recycled Water from the point of connection (beginning at a flow control valve adjacent to, and following the water meter assembly) to the On-Site Recycled Water System, in a manner consistent with these Rules and Regulations and without harming or damaging any person or property.

(e) Identifying and labeling all facilities associated with the On-Site Recycled Water System according to the type of water in each system.

(f) Paying to install, connect and/or disconnect from the Recycled Water Service Connection in a manner ensuring no Recycled Water enters the Potable Water system.

(g) Paying for, and furnishing, all necessary modifications to the On-Site Recycled Water System such as sprinkler changes, quick-coupler modifications or installations, modifications to prevent unauthorized discharges and additional requirements related to new or expanded systems (see Section 6).

(h) Providing the City a written notification, in a timely manner, specifying any material change or proposed change in the character of the use of Recycled Water.

(i) Ensuring all materials used in operating and maintaining the On-Site Recycled Water System are approved/recommended for Recycled Water use.

(j) Adhering to Use Area management practices as described in Section 7.

(k) Submitting an Annual Self Inspection Report (Exhibit B); arranging and paying for a third party Cross Connection inspection once every four years using the Cross Connection Control Test Procedures outlined in Exhibit C.

(l) Designating a Recycled Water Site Supervisor who is responsible for the On-Site Recycled Water System at each Use Area under their control (see Section 5).

5. Site Supervisor Responsibilities

The Recycled Water Site Supervisor is responsible for the On-Site Recycled Water System at each Use Area under their control. The Site Supervisor is responsible for proper installation, operation, and maintenance of the irrigation system; compliance with these Rules and Regulations, prevention of potential hazards and preservation of the Recycled Water distribution system plans in “as built” form. Specific responsibilities include but are not limited to the following:

(a) Avoiding Cross Connections when installing, operating and maintaining pipelines, equipment and appurtenances associated with On-Site Recycled Water Systems.

(b) Attending all Cross Connection tests.

(c) Knowing and understanding the provisions of Title 17 and the Water Recycling Criteria relating to the safe use of Recycled Water; understanding basic concepts of backflow and Cross Connection prevention, system testing and related emergency procedures.

(d) Maintaining a copy of these Rules and Regulations, irrigation system layout map and a Recycled Water system operations manual at the Use Area. These documents shall be available to operating personnel at all times.

(e) Ensuring Recycled Water signs are fully legible and displayed at all irrigation sites, particularly areas with greater visibility and public use.

(f) Training Use Area personnel on the Approved Uses of Recycled Water.

(g) Providing the City with updated contact information of the supervisor and/or a designee to ensure operational and maintenance issues receive prompt attention.

(h) Conducting a required annual self-inspection of the Use Area and submitting a monitoring report to the City (see Appendix A).

(i) Coordinating a Cross Connection test by a third party every four years and ensuring the City receives documentation following the test.

(j) Establishing and maintaining a record of all inspections, modifications, maintenance, employee trainings, permit documents, and communications with the City and other Regulatory Agencies.

(k) Reporting all violations and emergencies to the appropriate Regulatory Agency.

5.1. Changing the Recycled Water Site Supervisor

The Customer must immediately notify the City of any personnel changes relating to the Recycled Water Site Supervisor position. In the event of any change, the new Site Supervisor must attend a Recycled Water Site Supervisor Certification Workshop within 90 days of the position change. Failure to attend this workshop may result in termination of Recycled Water service.

5.2. Recycled Water Site Supervisor Training

The Site Supervisor must attend a Supervisor Certification Workshop as recommended by the DDW and provided by the City, within the first 120 days of receiving Recycled

Water service. Failure to attend the Site Supervisor Certification Workshop may result in the termination of Recycled Water service.

6. Facility Requirements

This section specifies the Rules and Regulations governing the design, installation and inspection of new and existing Recycled Water irrigation systems. Additionally, this section also covers the required Rules and Regulations governing design requirements at the service connection and on-site requirements for piping depth, separation requirements, vertical separation at crossings, pipe class specifications and depth of cover consistent with Title 22, Division 4, Chapter 16, Article 4 § 64572.

6.1. Design Requirements at the Service Connection

Each Recycled Water Service Connection will be equipped with a valve on both sides of, and adjacent to, the meter assembly. The valve on the inlet side of the meter assembly will be owned and maintained by the City and shall be used by the City to control the water supply through the meter assembly. The valve on the outlet side of the meter assembly will be owned and maintained by the Customer and shall be used by the Customer to control the flow of Recycled Water to the Use Area. City ownership and maintenance responsibilities of the service connection include the meter assembly and terminate at, and does not include, the valve on the Customer's side of the meter assembly.

(a) Air gap

If conveyance of Recycled Water is carried out with existing plumbing, Potable Water service will be disconnected from the On-Site Recycled Water System and an above-ground air gap will be installed. The air gap will be spaced so that a Reduced Pressure Principle Backflow Prevention Device may be installed by the City in the future.

(b) Future Connections

In the event of potential Recycled Water service interruption or failure, Customers may connect the On-Site Recycled Water System to the previous Potable Water supply provided that (a) Recycled Water supply is disconnected from the On-Site Recycled Water System and (b) a Potable Water service point is configured to allow for future connections.

6.2. Required Temporary Connection to Potable Water Service

Each On-Site Recycled Water System must pass a Cross Connection test prior to receiving Recycled Water. To facilitate this, the On-Site facility must be supplied with water via a temporary supply pipe to an on-site Potable Water system up to and during the Cross Connection test. After passing the test, the temporary supply connection must be removed and the system connected to the Recycled Water meter. On-Site Recycled Water Systems with no Potable Water within the Use Area, such as some streetscapes and medians, do not need to conduct a Cross Connection test and therefore do not need a temporary Potable Water source.

6.3. Conversion of Facilities

(a) Conversion from Potable to Recycled Water Use

No existing Potable Water facility shall be converted to, or incorporated into, a Recycled Water facility without proper testing and approval by the City. With the exception of pipe identification and pipe separation, On-site Recycled Water Systems for which the existing buried piping system is converted from Potable Water to Recycled Water must meet the same requirements as new facilities. However, any new buried piping added to existing piping at a converted Use Area must meet the identification and separation requirements for new systems. In addition, any existing piping uncovered for any reason during construction must be marked according to new pipe identification requirements to the extent feasible. Prior to the conversion of an existing Potable Water system to Recycled Water use, the Customer shall, at a minimum, submit Record Drawings and a report outlining the measures necessary to bring the system into full compliance to the City for review and approval.

(b) <u>Conversion from Recycled to Potable Water Use</u>

If the City determines it is necessary to convert Recycled Water facilities to Potable Water use, it shall be the responsibility of the Customer, at the Customer's cost and expense, to implement the following, as determined by the City:

(i) Notify DDW of the intention to return to Potable Water use.

(ii) Arrange to have the City disconnect and plug the Use Area Recycled Water Service Connection in a manner approved by the City.

(iii) Shock the On-site Recycled Water System to be converted with 50 ppm of chlorine for 24 hours.

(iv) Measure the chlorine residual after 24 hours. If a residual greater than 25 ppm is maintained, then continue to the next step. If the residual is below 25 ppm, then re-chlorinate by returning to the previous step until the chlorine residual can be maintained above 25 ppm.

(v) Flush the On-site Recycled Water System with Potable Water and perform a standard bacteriological test. The final test results must be acceptable to the City before supplying the former On-site Recycled Water System with Potable Water.

(vi) Install and test approved backflow prevention assemblies on all Potable Water meter connections as required by Cross Connection requirements.

(vii) Remove all Recycled Water quick-couplers.

(viii) Notify all Use Area personnel of the change.

(ix) Remove all Recycled Water warning labels/signs from the On-site Recycled Water System and the Use Area.

(x) Notify DDW both prior to and upon completion of conversion back to Potable Water.

6.4. Recycled Water Piping Requirements

Construction of Recycled Water mains, facilities and appurtenances within the Recycled Water Project Area shall comply with design requirements as identified in the City's Standard Specifications.[3] The specifications also include identification requirements for piping, valve boxes, quick couplers, sprinkler heads, signage boards and specifications for pipe sizing, depth, materials, identification tags and service assemblies. The "California Waterworks Standards" set forth minimum separation requirements for Recycled Water and water main lines. Refer to Title 22 California Code of Regulations § 64572 for specific horizontal and vertical separation distances between potable and recycled water lines.

7. On-Site Recycled Water Systems

The following requirements shall be met for new On-Site Recycled Water System facilities. Before Recycled Water is delivered to a Use Area, the site shall be assessed and retrofitted, as necessary, by the Customer in order to meet the requirements of this subsection. Customers shall furnish, install, operate, and maintain all On-site Recycled Water Systems and appurtenances necessary to convey water from the valve immediately following the meter assembly to the approved Use Area in a manner that does not harm or damage any person or property. Refer to Sections 5 and 6 for general City and Customer responsibilities regarding On-Site Recycled Water Systems. Plans, specifications and drawings of On-Site Recycled Water Systems shall be submitted to and approved by the City prior to construction.

7.1. Signage

All Use Areas that are accessible to the public shall be posted with conspicuous signs, not smaller than 4 inches by 8 inches in area and showing an international symbol for Non-Potable Water. The lettering on the signs must be a minimum of ½ inch in height and must be back or white on a purple background (See figure 1 for an acceptable symbol). The signs must read "Recycled Water—Do Not Drink" in English, Spanish ("Agua Reciclada—No Beber") or any additional language that may be needed to reach the population or workers in the area using recycled water The User will be responsible for posting signs in all Use Areas visible to the public (such as site entrances), and at all valves, control boxes, and similar features. Use Areas that are prone to vandalism may place Recycled Water signage at higher elevations to avoid tagging, theft, and property damage.

Recycled Water signage may also be posted at any points where after-market clip-on purple rings are used for head identification of pop-up sprinklers, rotary sprinklers and shrub riser sprinklers.

7.2. Irrigation Requirements

Operation of all On-Site Recycled Water Systems shall comply with the Use Area irrigation requirements defined in Title 22 Code of Regulations, Division 4, Chapter 3, Article 4, § 60310.

[3] City of Fresno Public Works Standard Specifications, Addendum No. 4, Resolution No.70-36, Sections 33 and 34. Updated version approved January 2013.

8. Department of Transportation

In cooperation with the City, the California Department of Transportation (Caltrans) shall permit the City to place transmission lines for Recycled Water in freeway rights-of-way to promote the beneficial use of Recycled Water so long as transmission does not unreasonably interfere with use of the freeway or unreasonably increase any hazard to vehicles on the freeway. Caltrans shall require the use of Recycled Water for irrigation of freeway landscaping as identified in Streets and Highways Code, Division 1, Chapter 1, Article 1, § 92.3.

9. Recycled Water Fill Stations

Residential and commercial Customers may collect bulk supply of recycled water at City-designated areas to offset potable water uses by agreeing to the terms and conditions of the user agreement for fill station Customers (Exhibit E). Residential Customers may collect up to 300 gallons per load and commercial users may collect 300 gallons or more per load.

10. Cross Connection

IMPORTANT: No physical connection shall be made or allowed between any Recycled Water system and any potable water system.

10.1. General City Responsibilities

(a) The City shall implement a Cross Connection control program as required by all provisions of Title 17, Division 1, Chapter 5, Group 4, Article 1, § 7584.

(b) The Cross Connection control program may be implemented directly by the City or by means of a contract with the local health agency, or with another agency approved by the health agency.

(c) The Cross Connection control program shall include the provision of at least one Cross Connection Control Specialist trained in cross-connection control to carry out the cross-connection program, the establishment of a procedure or system for testing backflow preventers, and the maintenance of records of locations, tests, and repairs of backflow preventers.

(d) The City is not responsible for abatement of Cross Connections which may exist within a Customer's Use Area.

(e) The City shall evaluate the degree of potential health hazard to the public water supply that may be created as a result of special conditions existing in a Use Area as identified in Title 17, Division 1, Chapter 5, Group 4, Article 1, § 7585.

10.2. General Customer Responsibilities

(a) The Customer must pass a Cross Connection test before connecting the On-Site Recycled Water System to the Distribution System at any Use Area that uses both recycled and potable water.

(b) The following elements are required for a Cross Connection test. See Exhibit C for specific Cross Connection Testing Procedure.

(i) The Customer must notify the City at least 48 hours prior to the test so that a City representative is present.

(ii) The test must be done once every four years under the supervision of the City and performed by an AWWA-certified Cross Connection Control Specialist.

(iii) The Recycled Water Site Supervisor must be present at the test.

(iv) A written report documenting test results must be submitted by the Cross Connection Control Specialist to the Recycled Water Site Supervisor and the City following test completion.

10.3. Emergency Preparedness

In case of earthquake, flood, fire, major freeze, nearby construction, or other incident that could damage the Recycled Water or Potable Water systems, the Site Supervisor must inspect all Potable Water systems and the On-site Recycled Water System for damage as soon as it is safe to do so. If either system appears damaged, both systems should be shut off at their points of connection. The Site Supervisor must immediately contact the City for further instruction.

To prevent contamination, damage, or a public health hazard, the Customer may make emergency modifications or repairs without the prior approval of the City. As soon as possible after the modification, but within 24 hours, the Customer must notify the City of the emergency modifications and file a written report within three days.

10.4. Emergency Cross Connection Procedures

In the event that a Cross Connection occurs or is identified, the following emergency Cross Connection response plan shall be implemented:

(a) The Customer must notify the City by telephone immediately. This notification must be followed by a written notice within 24 hours that includes an explanation of the nature of the Cross Connection, date and time discovered, and the contact information of the person reporting the Cross Connection if different from the Recycled Water Site Supervisor.

(b) The City will notify DDW and other Regulatory Agencies, as appropriate, of the reported Cross Connection.

(c) Customer must immediately shut down the Recycled Water supply to the On-site Recycled Water System.

(d) Customer must keep Potable Water systems pressurized and post "Contaminated Water – Do Not Drink or Apply to Food" signs at all Potable Water fixtures and outlets.

(e) Customer must provide bottled water for employees until the Potable Water system is deemed safe to drink.

(f) After DDW has provided final approval, the City will reestablish the Recycled Water service and inform the Customer to remove “Contaminated Water – Do Not Drink or Apply to Food” signage at Potable Water fixtures and outlets.

11. Backflow Prevention

Customers shall be responsible for ensuring that all Potable Water services into Use Areas are fitted with a Reduced Pressure Principal Backflow Prevention Device if one does not already exist. The backflow prevention device must be located as close as practical to the downstream side of every Potable Water meter. Backflow prevention devices must be properly maintained and tested by the User at least annually. Backflow protection is usually not necessary on Recycled Water irrigation systems as Recycled Water is non-potable. However, the City may require certain sites to install backflow prevention devices at the service connection if it is determined that a potential on-site backflow hazard exists; this protects the quality of Recycled Water in the Distribution System. Examples include:

(a) Irrigation systems that are installed with direct injection chemical fertilizer capability; and
(b) Irrigation sites where Recycled Water impoundment may cause a backflow hazard.

Refer to Title 17, Division 1, Chapter 5, Group 4, Article 2, § 7601 - § 7605 for requirements on construction and type of backflow preventers, feasible locations, and type of protection required.

12. Obtaining Recycled Water Service

12.1. Request for Service

Potential customers requesting recycled water service shall contact the Department of Public Utilities who will determine if the customer’s proposed area is in an area where Recycled Water is or will be available. If in the area where Recycled Water is or will be available, Customer will be provided an “Application for the use of Recycled Water” form (Exhibit A) which should be filled out and returned to the City for process. Prior to receiving Recycled Water service, any proposed use of Recycled Water not listed on Title 22, Uses of Recycled Water, will be required to be approved by DDW.

12.2. Proposed Site Assessment and Inspection

Upon receipt of Application and before the On-Site Recycled Water System is connected to the Distribution System, the proposed Use Area will be inspected and an assessment will be made by the City for locations of potential Ponding, Runoff, Overspray, and other concerns. The City will indicate how the On-site Recycled Water System needs be designed in order to address potential violations of these Rules and Regulations.

12.3. Design Approval

Prior to constructing or modifying On-Site Recycled Water Systems, draft Record Drawings prepared by the Customer must be approved by the City. The Customer must meet all applicable design requirements for the Use Area to comply with these Rules and Regulations. The Customer shall submit to the City plans for the On-Site Recycled Water System utilizing City Standard format. No work shall begin by the Customer until plans and necessary permits have been approved and issued by the City.

12.5. Acceptance Inspection

(a) Construction Inspection. The City will inspect Use Areas undergoing construction to incorporate On-Site Recycled Water Systems and appurtenances in conformance with the approved Record Drawings and applicable regulations. It is the responsibility of the Customer to notify the City of all planning and construction phases so that inspections can be scheduled.

(b) Cross Connection Test. Any Use Area where both Recycled and Potable Water are present shall pass a Cross Connection test prior to connecting the On-Site Recycled Water System to the Distribution System. Refer to section 11 and Appendix B for all Cross Connection requirements.

(c) Final Inspection and Approval to Receive Recycled Water. The City will perform a final inspection to ensure all requirements have been met prior to establishing Recycled Water service. This inspection may be coordinated with the Cross Connection test. The inspector will check to see that the proper equipment was used and that all required tags, labels, and signs are in place. The City must grant final approval before Recycled Water may be supplied to the Use Area. Final approval will be granted when construction has been completed in accordance with approved Record Drawings, all Cross Connection tests have been performed, a final on-site inspection has been conducted, and all requirements have been met satisfactorily. After the User Agreement is finalized by the City and all applicable fees have been paid, the City will finalize the installation of the service connection with the service meter assembly. Upon request, DDW will be provided with a copy of all test and inspection reports as well as notification that Recycled Water service has started. For the lifetime of the On-site Recycled Water System, the City will periodically inspect the Use Area to ensure compliance with all applicable Rules and Regulations.

12.6. Coverage Test

Customers are responsible for minimizing Overspray, Runoff, and Ponding from their On-site Recycled Water System. The City will conduct an inspection of the On-site Recycled Water System; the Customer must contact the City to schedule a coverage test walk-through of the system. The Recycled Water Site Supervisor must be in attendance. All modifications to the system are the responsibility of the Customer, and the Customer must pay all costs associated with such modifications.

12.7. Metering

All Recycled Water use shall be metered, and all Recycled Water used on any Use Area where a meter is installed must pass through said meter. Users shall be held responsible, and charged, for all Recycled Water passing through the meter(s), unless otherwise specified by the City.

12.8. Record Drawings

Customers must provide Record Drawings of the On-Site Recycled Water System to the City within 90 days of receiving Recycled Water. Record Drawings must indicate any and all changes in the work involving departures from the original contract drawings, including those involving both constant pressure and intermittent-pressure lines and appurtenances. Changes must be approved by the City before the Customer implements the changes in the construction contract. Exhibit D provides a list of required information when submitting Record Drawings12.9. Fees and Charges

The Customer shall pay all fees and charges for the use of recycled water and other related charges based upon the actual use of recycled water by the Customer, in the amount designated in the City's Master Fee Schedule when such a fee is developed.

12.10. Disputed Recycled Water Bills

Any dispute over the accuracy of a Recycled Water bills shall be governed byFresno Municipal Code (FMC) Article 1 – Billing and Collection Procedures for Municipal Utility Services, Section 6-104 (h)

12.11. Non-Registering Recycled Water Meter

When a meter is found to be out of order, the charge for Recycled Water will be governed FMC Article 1 – Billing and Collection Procedures for Municipal Utility Services, Section 6-104 (j)

13. Service Termination

13.1. Turn-off at User's Request

A Customer may request that service be discontinued, either temporarily or permanently, by giving at least 30 days' advance notice to the City. The User assumes full responsibility for all meter and usage charges incurred from the effective date of service until User notifies the City to discontinue service.

13.2. Turn-off by the City

The City may discontinue a Customer's service for any of the following reasons:

(a) Non-Payment of Bills. Service may be discontinued for nonpayment of any water charges by a User, subject to the terms of the User Agreement.

(b) Non-Compliance. Service may be discontinued for non-compliance with the terms and conditions of the User Agreement or these Rules and Regulations, as specified in the User Agreement.

(c) Water Quality. Service may be discontinued if, at any point in the City's Distribution System, the Recycled Water does not meet the quality requirements of the City or a Regulatory Agency. Service would, in such case, be restored at such time as Recycled Water again meets the quality requirements or at such time as the City supplements the Recycled Water system with water from other sources.

(d) Non-Compliance with Regulations. Service may be suspended or terminated in the manner provided herein at any time the Customer's operations do not conform to these Rules and Regulations as determined by the City in its sole discretion. Where safety of water supply or public health is endangered, or Regulatory Agency regulations have been violated, service may be suspended immediately without notice. Otherwise, all defects noted shall be corrected within the period of time specified by the City.

(e) Waste of Water. In order to protect against serious and negligent waste or misuse of Recycled Water, the City may provide notice of such waste and suspend service if such wasteful practices are not remedied after notice to such effect has been given to the Customer.

(f) Unauthorized Use of Recycled Water. When the City has discovered an unauthorized use, the service may be suspended without notice.

13.3. Re-Establishment of Service

The City shall have the right to refuse to re-establish service following termination of service for violation of these Rules and Regulations or the terms of a User Agreement. If a Customer desires to re-establish service following the termination of Recycled Water service, the City may renew the original User Agreement, with modified terms and conditions to achieve compliance with these Rules and Regulations or terms of the User Agreement. . Any restoration of recycled water service to the Use Area that is desired by the Customer shall be the responsibility of the Customer and shall be at no cost to the City.

Exhibit A

APPLICATION FOR USE OF RECYCLED WATER

1. Customer Name:
2. Address:
3. Use Area Property Manager:
4. Property Manager Email:
5. Property Manager Telephone number:
6. Name of Recycled Water Site Supervisor:
7. Recycled Water Site Supervisor Telephone number:
8. Complete the following information for the Use Area:

Use Area APN:
Use Area Address:
Total Irrigated Area (Acres):
Estimated Recycled Water Demand:
Method of irrigation:
Type of plant material present:
Type of Recycled Water use: ☐Landscape Irrigation
☐Agricultural Irrigation
☐Impoundments
☐Other:
Public access to the Use Area is: ☐Unrestricted ☐Restricted
Number of outdoor drinking fountains in the Use Area:
Number of outdoor eating areas in the Use Area:
Number of domestic wells in the Use Area:
Number of impoundments in the Use Area (if any, briefly describe):

For City of Fresno Use Only:

9. Check list of items required for obtaining Recycled Water service:

☐ The Customer and the City have determined that the Use Area is eligible to be served with Recycled Water.

- ☐ The Customer has submitted Exhibit A – Application for the Use of Recycled Water. Application received on:
- ☐ The City has reviewed the application.
- ☐ The City has assessed the Customer's on-site irrigation system and provided a description of required improvements.
  Assessment performed on:
- ☐ The City has approved the plans and retrofit/construction schedule prior to retrofit/construction.
- ☐ The Customer has constructed/retrofitted the On-Site Recycled Water System.
- ☐ The City has reimbursed the Customer for required improvements as recommended by the on-site assessment.
- ☐ The Customer has submitted "as-built" drawings to the City for record, including all remaining information requested by Exhibit B.
- ☐ The City has performed the final on-site inspection and approval, as specified in Exhibit C.
- ☐ The Customer has signed a Recycled Water User Agreement.
- ☐ The City initiates Recycled Water service. Date:
- ☐ The City confirms service to DDW.
- ☐ The City documents Recycled Water Site Supervisor training.

10. Description of on-site assessment and required improvements:

Exhibit B

USE AREA MONITORING REPORT

City of FRESNO
Department of Public Utilities

Wastewater Management Division
5607 W. Jensen Ave
Fresno, CA 93706-9458
559-621-5100—FAX 559-498-1700
www.fresno.gov

PART 1 - ANNUAL INSPECTION

1. **Site Name**:

2. **Site Address**:

3. Indicate regular hours of irrigation system operation:
   From: Choose an item. **To**: Choose an item.

If you answer yes to any question from 4 to 11 list the corrective action in each case.

4. Is there evidence of runoff Recycled Water from the site? Show affected area(s) on a sketch. Fax sketch to (559) 498-1700, Attn: Reclamation Coordinator.

   ☐**Yes** ☐**No**
   Corrective Action:

5. Is odor of wastewater origin emanating from the irrigation site? If present, indicate apparent sources, characterization, and direction of travel.

   ☐**Yes** ☐**No**
   Corrective Action:

6. Is there evidence of ponding of Recycled Water, and evidence of mosquitoes breeding within the irrigation area due to ponding?

   ☐**Yes** ☐**No**
   Corrective Action:

7. Are warning signs, tags, stickers and above-ground pipe markings properly posted to to inform the public that Recycled Water is being used for irrigation, which is not suitable for drinking?

☐**Yes** ☐**No**
Corrective Action:

8. Is there evidence of plugged, broken, or otherwise faulty drip irrigation system emitters, valves, or sprinklers?

☐**Yes** ☐**No**
If yes, indicate which apply:

☐Pop-up repair	Date: Click here to enter a date.
☐Rotor repair	Date: Click here to enter a date.
☐Nozzle replacement	Date: Click here to enter a date.
☐Lateral repair	Date: Click here to enter a date.
☐Main-line repair	Date: Click here to enter a date.
☐Quick coupler repair	Date: Click here to enter a date.
☐Other	Date: Click here to enter a date.

9. Are the irrigation controls working properly?

☐**Yes** ☐**No**
Corrective Action:

10. Is there evidence of direct spraying of Recycled Water on drinking water fountains, passing vehicles, buildings, and food facilities?

☐**Yes** ☐**No**
Corrective Action:

11. Has there been any construction or have there been any modifications done on the property within the last six months? If yes, please explain.

☐**Yes** ☐**No**
Explanation:

PART II - RECYCLED WATER SITE SUPERVISOR SIGN OFF

I, ____________________, certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, and accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and/or disconnection of Recycled Water service."

☐ By checking this box, I have read and agree to the statement above.

Name of Recycled Water Site Supervisor:

Date: Click here to enter a date.

PART III – CHANGE OF ON-SITE SUPERVISOR, OWNERSHIP OR MANAGEMENT

If the on-site supervisor, property ownership or management has changed since the last inspection, fill out the following change of information:

New Owner/Management:

Address:
Street Name

City: **State**: **Zip**:

Email: **Phone**:

New On-Site Supervisor:

Address:
Street Name

City: **State**: **Zip**:

Email: **Phone**:

PART IV – SAVE, PRINT AND SUBMIT

Save, Print and Submit form:

Attn: Reclamation Coordinator
Fresno-Clovis Regional Reclamation Facility
5607 W. Jensen Ave
Fresno, CA 93706

Or fax to: (559) 498-1700, Attn: Reclamation Coordinator

Exhibit C

CROSS CONNECTION TEST PROCEDURE

The following is the required methodology for conducting Cross Connection control tests in Use Areas having both Recycled Water and Potable Water service. An AWWA-certified Cross Connection Control Specialist must perform the test using equipment dedicated for use with Recycled Water. Backflow testing equipment used for Recycled Water must not be reused on Potable Water systems.

Cross Connection Control Test Part 1

The Potable Water system shall be activated and pressurized. The On-Site Recycled Water System shall be shut down at its point of connection to the Distribution System and depressurized – this is usually done by manually bleeding a control valve or quick-coupling valve located in the lowest elevation of the On-Site Recycled Water System.

(a) The Cross Connection Control Specialist will specify the amount of time that the Potable Water system shall remain pressurized while the On-Site Recycled Water System is depressurized. The size and complexity of the Potable Water and On-Site Recycled Water System will determine the minimum amount of time the On-Site Recycled Water System is to remain depressurized.

(b) All On-Site Recycled Water System control valves, quick-coupling valves, irrigation systems and impoundment inlets shall be tested and surveyed for flow. If the On-Site Recycled Water System is shut down at its point of connection to the Distribution System, then continuous flow from any part of the On-Site Recycled Water System indicates a Cross Connection.

(c) All water fixtures using Potable Water (hose bibs, faucets, drinking fountains, urinals, decorative fountains) shall be tested and surveyed for flow. No flow from Potable Water outlets indicates that it may be connected to the On-Site Recycled Water System and therefore constitutes a Cross Connection to be remedied.

(d) Use Areas where no Cross Connections have been identified may proceed to part 2 of this test. If any Cross Connections are discovered, they must be disconnected and the Use Area must be re-inspected by an AWWA-certified Cross Connection Specialist per these procedures, beginning with Part 1 of the Cross Connection Control Test.

Cross Connection Control Test Part 2

(a) The Potable Water system shall be shut down at its point of connection (usually the City-controlled valve immediately preceding the meter assembly) and depressurized. For multistory buildings, the Cross Connection Control Specialist will determine the amount of pressure to be reduced and monitored with a gauge installed at a low point of elevation in the Potable Water System.

(b) The On-Site Recycled Water System shall then be activated and pressurized.

(c) The Cross Connection Control Specialist shall specify the minimum amount of time to pressurize the On-Site Recycled Water System while the Potable Water system is depressurized (or in the case of multistory buildings remains in a state of reduced pressure). The minimum amount of time the Potable Water system is to remain depressurized shall be determined by the Cross Connection Control Specialist.

(d) All water fixtures using Potable Water (hose bibs, faucets, drinking fountains, urinals, decorative fountains) shall be tested and surveyed for flow. If the Potable Water System has been shut down at its point of connection, then continuous flow from any part of the Potable Water system indicates a Cross Connection. Potable Water fixtures in multistory buildings may be inspected in combination with a pressure gauge, or the pressure gauge may be used instead of testing all fixtures. If the Potable Water system has truly been shut down at its point of connection, an increase in pressure viewed at the gauge over a period of time specified by the Cross Connection Control Specialist indicates a Cross Connection with the Recycled Water System.

(e) All On-Site Recycled Water System control valves, quick-coupling valves, and any other approved Use Area facilities (such as supply lines to impoundments) shall be tested and surveyed for flow. No flow from any On-Site Recycled Water System control valve, quick-coupling valve or Recycled Water fixture indicates a likely connection with the Potable Water system, and therefore constitutes a Cross Connection to be remedied.

(f) If no Cross Connections are identified, then the Potable Water system shall be re-pressurized. If any Cross Connections are discovered, the On-Site Recycled Water System must be re-inspected by a Cross Connection Control Specialist according to these procedures, beginning with part 1 of the Cross Connection Control Test.

(g) The Cross Connection Control Specialist performing the foregoing tests must report the results and return it to the Department of Public Utilities, Wastewater Management Division.

Exhibit D

REQUIRED INFORMATION FOR RECORD DRAWINGS

Customers shall submit draft Record Drawings during the process for obtaining Recycled Water service and then provide final as-built Record Drawings upon completion of all modifications to the On-Site Recycled Water System(s) and Potable Water System(s). Applicants shall submit drawings of each Use Area on 8½" x 11", 11" x 17" or 24" x 36" sheets of paper which shall include a signature line for the Department of Public Utilities approval.

Sheet 1

☐ Location and vicinity map including surrounding land use and adjacent streets demarking the Recycled Water Use Area.

Sheet 2

☐ Specific Potable Water irrigation use areas (if applicable).
☐ Location of Potable Water main lines, ancillary lines, gate valves, controllers, drinking fountains, and supply facility.
☐ Location and size of Potable Water service connections.
☐ Location and size of existing and future Recycled Water service connections.
☐ Location of all On-Site Recycled Water System distribution lines, gate valves, master valves, pressure regulating valves, and other associated facilities. Exception: Although it may not be possible to show the location of all water pipelines for existing irrigation systems converting to Recycled Water, all locations where future Recycled Water piping must be separated from the Potable water piping must be clearly indicated on the plans.
☐ Location of any other piping network piping, gate valves, strainers, controllers, and supply facilities, specifically all backflow prevention devices for Potable Water systems.
☐ Where applicable, indicate that the separation between Potable and Recycled Water lines meets minimum requirements. Also show sleeving and other cross-connection prevention measures where applicable.
☐ Areas of public access on the Use Area.
☐ Location of domestic wells on or within 100 ft. of the Use Area.
☐ Location of any lakes, ponds, reservoirs, or other impoundments located within the Use Area or within 100 feet of the Use Area, and indicate the type of water source.
☐ Location of Recycled Water signage on the Use Area.
☐ Location of foundations, buildings, structures, and public facilities with either Recycled or Potable Water service. Public facilities include, but are not limited to

drinking fountains, outdoor eating areas, restrooms, snack bars, swimming pools,
wading pools, decorative fountains and showers. Include the pipelines feeding all
of these facilities.

☐ Any other features known or considered to be important to the on-site use of Recycled Water.

☐ Depiction of any other applicable On-Site Recycled Water System components as required by the Rules and Regulations.

☐ Include the Standard Notes specified by the City.

<u>Sheet 3</u> (if applicable)

☐ Construction details of any domestic well within 100 feet of the Use Area.

Exhibit E
FILL STATION APPLICATION FORM

City of FRESNO
Department of Public Utilities

Wastewater Management Division
5607 W. Jensen Ave
Fresno, CA 93706-9458
559-621-5100—FAX 559-498-1700
www.fresno.gov

DEPARTMENT OF PUBLIC UTILITIES
Providing Life's Essential Services

Recycled Water Use Application and Agreement for Fill Station Customers

Customer Information:

Customer Name:

Customer Street Address:

City:

Zip Code:

Customer Phone:

Your Water Provider:

Phone:

Email:

Type of Customer: Residential (up to 300 gallons per load)
Commercial (300 gallons and more per load)

Vehicle Information

Please provide the following information for all vehicles collecting recycled water:

1. Vehicle A License Plate Number:

Does Vehicle A have valid insurance and registration?

What is the automobile insurance expiration date for Vehicle A?

2. Vehicle B License Plate Number:

Does Vehicle B have valid insurance and registration?

What is the automobile insurance expiration date for Vehicle B?

3. Vehicle C License Plate Number:

Does Vehicle C have valid insurance and registration?

What is the automobile insurance expiration date for Vehicle C?

Recycled Water Use Information

From the list below, select all applicable uses of Recycled water:

☐ Dust control

☐ Irrigation of trees, landscaping and gardens

☐ Vehicle Washing

☐ Soil compaction

☐ Washing of hard surfaces such as paths, walls, windows

☐ Other:

Specify the street address, City and zip code where recycled water will be used:

Location A:

Location B:

Location C:

Frequently Asked Questions about Recycled Water

1. What is the Recycled Water Fill Station Program?

The "Recycled Water Fill Station" program is a pilot initiative to provide recycled water from the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) for commercial and residential Customers to offset the use of drinking water for non-drinking uses.

2. What is recycled water and is it safe?

Recycled water is wastewater which as a result of treatment and disinfection is suitable for a beneficial use and is therefore considered a valuable resource. The ultra violet disinfection process uses high energy ultraviolet light to inactivate pathogens and other microorganisms. It must meet strict standards of the Division of Drinking Water (DDW)

3. What can I use recycled water for?

Recycled water can be used for watering trees, lawns and gardens. It can also be used for dust control, soil compaction, washing vehicles and hard surfaces such as paths, walls and windows.

4. What is recycled water <u>NOT</u> suitable for?

It is not suitable for drinking, cooking or use in the kitchen, bathing or showering, filling swimming pools or spas, children's water toys and connecting it to the household domestic (drinking water) plumbing or irrigation system.

5. Do water use restrictions (conservation) apply to recycled water?

No. Water use restrictions do not apply to recycled water. However, it is a valuable resource and should not be wasted.

6. How much will recycled water cost me?

The Customer shall pay all fees and charges for the use of recycled water and other related charges based upon the actual use of recycled water by the Customer in an amount to be designated in the City's Master Fee Schedule.

7. How much recycled water can I pick up at a time?

Commercial Customers may collect 300 gallons or more per load and residential Customers may collect up to 300 gallons per load. **The City of Fresno is not liable for any damages to you or your vehicle(s) due to your participation in the recycled water fill station program.**

8. Where and when can I use the Recycled Water Fill Station?

Designated areas for recycled water fill stations will be approved by the City's Director of Public Utilities.

Rules and Regulations of Recycled Water Use

1. DO NOT DRINK recycled water.

2. Recycled water **shall not** be put into any piping or storage facility that has any connection to an on-site drinking water supply.

3. Commercial distributor's vehicles used for bulk collection, transportation and distribution of recycled water must have containers with capabilities of 300 gallons or greater.

4. Designated vehicles must have water tight valves and fittings, must not leak, and tanks must be cleaned of contaminants prior to use.

5. Hauling vehicles may be self-propelled or towed vehicles having an attached water tank, with or without pumps, hoses and accessory equipment for filling or distribution of recycled water. Use of convertible trucks, dump trucks, or flat-bed trucks with detachable tanks is allowed if the tanks are securely attached.

6. Vehicles without a tank or detached tank are not approved for collecting recycled water.

7. A truck or tank that has contained material from a septic tank or cesspool shall not be used to convey recycled water.

8. Customers are required to label both sides of their water tanks with the words "**Recycled Water/Do not drink**" in letters of at least 4 inches in height. Labeling must be permanently attached to or painted on the vehicle and must be fully legible and visible at all times.

9. Recycled water shall be used and/or applied promptly. No storage of recycled water on-site at a residential property.

10. Recycled water shall not be discharged to the street gutter or storm drain system. If you have leftover recycled water and want to dispose of it, either discharge it to a landscaped area or to the sanitary sewer system via an on-site cleanout.

11. After handling recycled water, remember to apply hand sanitizer or wash hands with soap and drinking water, especially before eating or smoking.

12. The City may conduct site visits to ensure your proper use of recycled water and to ensure the health and safety of your family and the public.

Procedure to Obtain Recycled Water

1. Read and understand the conditions of this Use Application/Agreement. Download and save the form to your Desktop. Type in your responses, Save, Print, and mail a signed form to the following address:

Attn: Reclamation Coordinator
Fresno Clovis Regional Wastewater Reclamation Facility
5607 W. Jensen Ave
Fresno, CA 93706

A hard copy of the form can be mailed to you by calling (559) 621-5134.

2. Approved applicants will receive a brief one-on-one training on use requirements of recycled water. Customers will be provided a badge to access the gate into the fill station site and activate the water supply. A City representative will direct participating Customers to the fill station located inside the RWRF.

3. The badge holder is the primary party held accountable for accessing the fill station site. If the badge is misplaced or damaged, the primary badge holder shall pay $25.00 to the Wastewater Management Division for a new badge.

4. All water tanks and containers are required to be labeled with the words "**Non-potable water/Do not drink**".

5. Access to the commercial and residential recycled water fill station is based on a first-come basis.

6. Haulers must ensure that tanks are sealed and secured for transport prior to leaving the facility.

Certification Statement/Signature Section

☐ By checking this box, myself, and if applicable, my organization's officers, owners, personnel, employees, agents, contractors, invitees or volunteers agree to hold harmless the City of Fresno from any and all claims, lawsuits, demands, liability, monetary loss, property damage and/or injury arising out of our organization's connection with the collection, transportation and distribution of recycled water.

☐ By checking this box, I assert that the information provided in this application is true and accurate to the best of my knowledge, and represent that I have read, understand, and agree to comply with the City's Rules and Regulations for recycled water. Failure to comply with the conditions of this agreement may lead to termination of this agreement and the ability to obtain recycled water from the commercial/residential fill station.

Name:

Customer's Signature

Date

Figure 1

NON-POTABLE DO NOT DRINK ACCEPTABLE FIGURE

APPENDIX C
RECYCLED WATER USER AGREEMENT

AGREEMENT
CITY OF FRESNO, CALIFORNIA
RECYCLED WATER SERVICES

THIS AGREEMENT is made and entered into effective the [Day of the month, e.g., 1st] day of Choose an item. [Year], by and between the CITY OF FRESNO, a California municipal corporation (hereinafter referred to as “CITY”, and [Customer's Name], [Legal identity], located at [address] (hereinafter referred to as “CUSTOMER”).

RECITALS

WHEREAS, CITY produces and distributes recycled water of satisfactory quality for use in irrigating landscaped areas and impoundment areas with unrestricted public access; and

WHEREAS, CUSTOMER owns and operates certain landscaped areas and/or impoundment areas that CUSTOMER desires to irrigate/supply with recycled water distributed by CITY; and

WHEREAS, CITY and CUSTOMER will conserve potable water by using recycled water for agricultural or landscape irrigation and/or impoundment water supply; and

WHEREAS, CUSTOMER acknowledges that this Agreement is subject to the requirements of Fresno Municipal Code Section Chapter 6, Article 9, Recycled Water Ordinance; and

WHEREAS, this Agreement will be administered for CITY by its Director of Public Utilities (hereinafter referred to as “Administrator”) or his/her designee.

AGREEMENT

NOW, THEREFORE, in consideration of the foregoing and of the covenants, conditions, and premises, hereinafter contained to be kept by the respective parties, it is mutually agreed as follows:

1. <u>Term of Agreement</u>. This Agreement shall be effective from the date first set forth above (“Effective date”) and shall continue in full force and effect through [Day of the month, e.g., 1st] day of Choose an item., [Year], subject to any earlier termination in accordance with this Agreement.

2. <u>Recycled Water Use Area</u>. CUSTOMER shall use recycled water supplied by CITY on approximately [Number of acres] acres within the permitted use area. The location of the use area is described in the attached Exhibit A as submitted with the “Application for the Use of Recycled Water”. CITY understands that the CUSTOMER has the right to add or subtract from the total use area as operations plans dictate, provided that all potential use areas are disclosed in this Agreement.

3. City Ordinance. CUSTOMER has read and agrees to the terms stated in CITY Ordinance 2014-32 (hereinafter, “Recycled Water Ordinance”), attached as Exhibit D and incorporated herein.

4. Rules and Regulations. CUSTOMER has read and agrees to the terms of the CITY’s Recycled Water Use Rules and Regulations governing the use, distribution and transport of recycled water (hereinafter, “CITY’s Rules and Regulations”), which are attached as Exhibit E and incorporated herein.

5. No Representation Regarding Water Service, Pressure, or Volume for any Portion of the Recycled Water Pipeline. CITY does not make any representation, warranty or guarantee of any kind or nature and hereby specifically disclaims any kind of representation, warranty or guarantee that any portion of the recycled water system described or the recycled water system as a whole will yield any specific volume of water or provide any specific water pressure to CUSTOMER under static or demand scenarios or for any use by CUSTOMER and its tenants, lessees, purchasers, successors or assigns. CUSTOMER assumes full responsibility for the adequacy of volume of water and water pressure beyond the Point of Connection (“POC”) as defined in the CITY’s Rules and Regulations.

6. Maintenance and Repair. CUSTOMER shall be responsible for operation, maintenance, repair, and replacement of all portions of the recycled water system beyond the POC. Under no circumstances shall CITY be required or accountable to maintain, repair or replace CUSTOMER’s recycled water system unless and until CITY may, at its sole discretion and option, accept dedication of the water system, or any portion thereof in increments or otherwise, at some future date. CUSTOMER's obligation to maintain, repair and replace its recycled water system shall include, without limitation, any operation and maintenance, repair, replacement or modification of the recycled water system as may be required by CITY. Should CUSTOMER fail to operate, maintain, repair and replace its portion of recycled water pipeline as needed for proper operation of the public portions of the recycled water pipeline, the CITY shall have the right, but not the obligation, to stop providing water.

7. Priorities for Delivery of Recycled Water.

(a) The CITY reserves the right to control and schedule recycled water distribution as necessary to maintain an acceptable working pressure; protect public health; construct, maintain and operate other CITY facilities; and manage availability of recycled water supply.

(b) Delivery of recycled water may at times be precluded for reasons beyond the reasonable control of the CITY including, but not limited to insufficient recycled water supply, maintenance of CITY’s treatment or distribution systems, acts of a third party, or order of a regulatory agency.

(c) If recycled water supply is interrupted for any reason, including but not limited to those outlined in (b), first priority for recycled water service shall be given to potable water rate payers of the CITY to meet all anticipated municipal needs of the CITY.

(d) If recycled water delivery is interrupted for more than 48 hours, the CITY may connect the CUSTOMER'S back-up water supply. If the CUSTOMER does not have a backup supply and was originally connected to the CITY potable water system, CITY may reconnect CUSTOMER'S on-site recycled water system to the CITY potable water system subject to the terms of the Rules and Regulations. The CUSTOMER agrees to return to recycled water use as soon as the CITY is able to resume recycled water delivery. CUSTOMER shall pay for the full cost of water used from the alternate supply.

8. Receipt and Application of Recycled Water.

(a) CUSTOMER agrees to use recycled water for uses stated in Exhibit A of this Agreement, as submitted on the "Application for the Use of Recycled Water," except for portions of the use area where application of recycled water may be prohibited by any law, statute, rule, regulations or guidelines governing the use of recycled water.

(b) CUSTOMER understands that the CITY will inspect and assess the use area before the On-Site Recycled Water System is connected to the Distribution System. The CITY will indicate how the On-site Recycled Water System needs be designed in order to minimize/eliminate potential violations of the Rules and Regulations. Furthermore, CUSTOMER understands that this Agreement shall become valid upon passing a Final On-Site Inspection by the CITY (Exhibit -C).

(c) CUSTOMER agrees that any agreement it may have with a third party for the management of the use area shall not in any way relieve CUSTOMER of the requirements, terms and conditions of this Agreement. CUSTOMER shall be responsible to the CITY for the safe use of recycled water by CUSTOMER and any third party.

(d) The CITY shall not be liable for any damage related to CUSTOMER's recycled water infrastructure, use, and distribution, including damage resulting from inadequate capacity, defective plumbing, broken or faulty services, or any conditions beyond the control of the CITY. Furthermore, CUSTOMER accepts such conditions of pressure, as provided by the distribution system at the location of its service connection, and holds the CITY harmless from any and all liability, damage, losses, costs, fees or expenses, arising from low pressure or high pressure conditions, or from interruptions of service.

(e) CUSTOMER understands and accounts for the nutrient contribution of recycled water when irrigating crops, green spaces, freeway medians, parks, school yards and cemeteries. CUSTOMER agrees that the CITY will not be liable for damage to vegetation resulting from the application of recycled water.

9. Recycled Water Use Requirements. CUSTOMER agrees to abide by all use requirements identified in the CITY's Rules and Regulations, the Recycled Water Ordinance, California Code of Regulations Title 17 and 22 relating to the use of recycled water, and all laws, statutes or guidelines governing recycled water use. Approved uses of recycled water for the CUSTOMER's use area shall be limited to those described in Exhibit A of this Agreement and as specified on the "Application for the Use of Recycled Water".

10. Recycled Water Site Supervisor. CUSTOMER shall designate an individual as its Recycled Water Site Supervisor ("Site Supervisor"), who shall be the CUSTOMER's coordinator and direct liaison with the CITY regarding recycled water matters. CUSTOMER agrees that the Site Supervisor shall be responsible for all duties identified in CITY's Rules and Regulations. The Site Supervisor is required to attend a certification course provided by the City on the accepted uses and regulatory restrictions for the use of Recycled Water. The Site Supervisor is also responsible for training operators or recycled water in the Use Area.

11. On-Site Recycled Water System Modifications. CUSTOMER understands and agrees that any modifications to its On-Site Recycled Water System, as defined in the Recycled Water Ordinance, must comply with the CITY's Rules and Regulations relating to recycled water and failure to do may result in termination of recycled water service.

12. Notification of Public. CUSTOMER shall provide adequate notification, as required by the Division of Drinking Water (DDW) to employees and the general public that recycled water is being applied within the designated use area.

13.

Record Drawings. Upon completion of all modifications to CUSTOMER'S on-site recycled water system and potable water system, CUSTOMER shall provide the CITY with record drawings containing specific information as identified in Exhibit B of this agreement.

14. Fees and Charges. CUSTOMER shall pay all fees and charges for the use of recycled water and other related charges based upon the actual use of recycled water by the CUSTOMER, in an amount designated in the CITY's Master Fee Schedule when such a fee is developed. The CITY shall provide recycled water at no cost until June 30, 2019. As an incentive, CUSTOMERS may receive a one-time reimbursement of up to $5,000 at the sole discretion of the Director of Public Utilities or his or her designee for on-site improvements needed to utilize recycled water.

15. Indemnification. To the furthest extent allowed by law, CUSTOMER shall indemnify, hold harmless and defend CITY and each of its officers, officials, employees, agents and volunteers from any and all loss, liability, fines, penalties, forfeitures, costs and damages (whether in contract, tort or strict liability, including but not limited to personal injury, death at any time, and property damage) incurred by CITY, CUSTOMER or any other person, and from any and all claims, demands, liabilities, damages and actions in law or equity (including attorney's fees and litigation expenses), arising or alleged to have arisen directly or indirectly out of the performance of this Agreement and the performance of any or all work to be done in and upon the street rights-of-way or within CUSTOMER's property boundary, and premises adjacent thereto, pursuant to this Agreement, or arising or alleged to have arisen directly or indirectly in any way related to the construction, installation and operation of the recycled water supply pipeline or its appurtenances by anyone occupying any portion of CUSTOMER's property including, without limitation, any such claims, causes of action, damages, liabilities, fees, costs, expenses, and attorney fees arising from water quality compliance, a lack of volume of water, inadequate fire flow, lack of water pressure in, from or delivered to the recycled water supply pipeline, or lack of flow capacity in the recycled water supply pipeline. CUSTOMER's obligations under the preceding sentence shall apply regardless of whether CITY or any of its officers, officials, boards, employees, agents or volunteers are passively negligent, but shall not apply to any loss, liability, fines, penalties, forfeitures, costs or damages caused by the active or sole negligence, or the willful misconduct, of CITY or any of its officers, officials, employees, agents or volunteers.

16. General Terms.

(a) Governing Law and Venue. This Agreement shall be governed by, and construed and enforced in accordance with the laws of the State of California, and venue for purposes of filing any action regarding the enforcement or interpretation of this Agreement shall be Fresno County, California.

(b) Severability. The provisions of this Agreement are severable. The invalidity or unenforceability of any one provision in this Agreement shall not affect the other provisions.

(c) Binding. Once this Agreement is signed by all parties, it shall be binding upon all parties and each parties' respective heirs, successors, lessees, sub lessees, assigns, transferees, agents, servants, employees and representatives.

(d) No Third Party Beneficiaries. The rights, interests, duties and obligations defined within this Agreement are intended for the specific parties hereto as identified in the preamble of this Agreement. Notwithstanding anything stated to the contrary in this Agreement, it is not intended that any rights or interests in this Agreement benefit or flow to the interest of any third parties.

(e) Extent of Agreement. Each party acknowledges that they have read and fully understand the contents of this Agreement. This Agreement represents the entire and integrated agreement between the parties with respect to the subject matter hereof and supersedes all prior negotiations, representations or agreements, either written or oral.

17. Monitoring and Reporting. CUSTOMER agrees to comply with the monitoring and reporting requirements as identified in the CITY's Rules and Regulations.

18. Headings. The section headings in the Agreement are for convenience and reference only and shall not be construed or held in any way to explain, modify or add to the interpretation or meaning of the provisions of this Agreement.

19. Exhibits. Each exhibit and attachment referenced in this Agreement is, by the reference, incorporated into and made part of this Agreement.

20. Notices. Any notice required or intended to be given to either party under the terms of this Agreement shall be in writing and shall be deemed to be duly given if delivered personally, transmitted by facsimile followed by phone confirmation of receipt, or sent by United States registered or certified mail, with postage prepaid, return receipt requested, addressed to the party to which notice is to be given at the party's address set forth on the signature page of this Agreement.

21. Attorney's Fees. If a party is required to commence any proceeding or legal action to enforce or interpret any term, covenant or condition of this MOU, the prevailing party in such proceeding or action shall be entitled to recover from the other party its/their reasonable attorney's fees and legal expenses.

22. Termination. Upon any breach of this Agreement by CUSTOMER, CITY may (a) exercise any right, remedy (in contract, law or equity), or privilege which may be available to it under applicable laws of the State of California or any other applicable law; (b) proceed by appropriate court action to enforce the terms of the Agreement and/or recover all direct, indirect, consequential, economic, and incidental damages for the breach of the Agreement.

The CITY may terminate this Agreement immediately following any of the reasons listed in Section 13.2 of the CITY's Rules and Regulations for recycled water use.

IN WITNESS WHEREOF, the parties have executed this Agreement at Fresno, California, the day and year first above written.

[Name of Company] [legal entity] By: ____________________________ Name: __________________________ (Type or print written signature.)	CITY OF FRESNO, a California municipal corporation By:______________________________ Thomas C. Esqueda, Director Department of Public Utilities Dated:____________________________

Addresses: CUSTOMER: [Company Name] Attention: [Title] [Street Address] [City, State, Zip Code] Phone: Fax:	 CITY: City of Fresno Attention: Conrad Braganza Wastewater Reclamation Coordinator 5607 W. Jensen Ave. Fresno, CA 93706 Phone: (559) 621-5134 Fax: (559) 498-1700

Attachments:

1. Exhibit A – Application for the Use of Recycled Water
2. Exhibit B – Required Information for Record Drawings
3. Exhibit C – Final On-Site Inspection and Approval
4. Exhibit D – Recycled Water Ordinance
5. Exhibit E – CITY's Recycled Water Use Rules and Regulations

Exhibit A
APPLICATION FOR THE USE OF RECYCLED WATER

1. Customer Name:
2. Address:
3. Use Area Property Manager:
4. Property Manager Email:
5. Property Manager Telephone number:
6. Name of Recycled Water Site Supervisor:
7. Recycled Water Site Supervisor Telephone number:
8. Complete the following information for the Use Area:

   Use Area APN:
   Use Area Address:
   Total Irrigated Area (Acres):
   Estimated Recycled Water Demand:
   Method of irrigation:
   Type of plant material present:
   Type of Recycled Water use: ☐Landscape Irrigation
   ☐Agricultural Irrigation
   ☐Impoundments
   ☐Other:
   Public access to the Use Area is: ☐Unrestricted ☐Restricted
   Number of outdoor drinking fountains in the Use Area:
   Number of outdoor eating areas in the Use Area:
   Number of domestic wells in the Use Area:
   Number of impoundments in the Use Area (if any, briefly describe):

For City of Fresno Use Only:

9. Check list of items required for obtaining Recycled Water service:

   ☐ The Customer and the City have determined that the Use Area is eligible to be served with Recycled Water.
   ☐ The Customer has submitted Exhibit A – Application for the Use of Recycled Water. Application received on:
   ☐ The City has reviewed the application.

☐ The City has assessed the Customer’s on-site irrigation system and provided a description of required improvements.
Assessment performed on:

☐ The City has approved the plans and retrofit/construction schedule prior to retrofit/construction.

☐ The Customer has constructed/retrofitted the On-Site Recycled Water System.

☐ The City has reimbursed the Customer for required improvements as recommended by the on-site assessment.

☐ The Customer has submitted “as-built” drawings to the City for record, including all remaining information requested by Exhibit B.

☐ The City has performed the final on-site inspection and approval, as specified in Exhibit C.

☐ The Customer has signed a Recycled Water User Agreement.

☐ The City initiates Recycled Water service. Date:

☐ The City confirms service to DDW.

☐ The City documents Recycled Water Site Supervisor training.

10. Description of on-site assessment and required improvements:

Exhibit B

REQUIRED INFORMATION FOR RECORD DRAWING

Customers shall submit draft Record Drawings during the process for obtaining Recycled Water service and then provide final as-built Record Drawings upon completion of all modifications to the On-Site Recycled Water System(s) and Potable Water System(s). Applicants shall submit drawings of each Use Area on 8½” x 11”, 11” x 17” or 24” x 36” sheets of paper which shall include a signature line for the Department of Public Utilities approval.

Sheet 1

- ☐ Location and vicinity map including surrounding land use and adjacent streets demarking the Recycled Water Use Area.

Sheet 2

- ☐ Specific Potable Water irrigation use areas (if applicable).
- ☐ Location of Potable Water main lines, ancillary lines, gate valves, controllers, drinking fountains, and supply facility.
- ☐ Location and size of Potable Water service connections.
- ☐ Location and size of existing and future Recycled Water service connections.
- ☐ Location of all On-Site Recycled Water System distribution lines, gate valves, master valves, pressure regulating valves, and other associated facilities. Exception: Although it may not be possible to show the location of all water pipelines for existing irrigation systems converting to Recycled Water, all locations where future Recycled Water piping must be separated from the Potable water piping must be clearly indicated on the plans.
- ☐ Location of any other piping network piping, gate valves, strainers, controllers, and supply facilities, specifically all backflow prevention devices for Potable Water systems.
- ☐ Where applicable, indicate that the separation between Potable and Recycled Water lines meets minimum requirements. Also show sleeving and other cross-connection prevention measures where applicable.
- ☐ Areas of public access on the Use Area.
- ☐ Location of domestic wells on or within 100 ft. of the Use Area.
- ☐ Location of any lakes, ponds, reservoirs, or other impoundments located within the Use Area or within 100 feet of the Use Area, and indicate the type of water source.
- ☐ Location of Recycled Water signage on the Use Area.
- ☐ Location of foundations, buildings, structures, and public facilities with either Recycled or Potable Water service. Public facilities include, but are not limited to drinking fountains, outdoor eating areas, restrooms, snack bars, swimming pools, wading pools, decorative fountains and showers. Include the pipelines feeding all

of these facilities.

☐ Any other features known or considered to be important to the on-site use of Recycled Water.

☐ Depiction of any other applicable On-Site Recycled Water System components as required by the Rules and Regulations.

☐ Include the Standard Notes specified by the City.

Sheet 3 (if applicable)

☐ Construction details of any domestic well within 100 feet of the Use Area.

Exhibit C

FINAL ON-SITE INSPECTION AND APPROVAL

1. Customer Name:
2. Complete the following information for the Use Area:

   Use Area APN:

   Use Area Address:

   Requested date of service:

   Recycled Water service initiated on (TBD):

   Number of service connections:

   Specify the back-up water supply source:

   Has the Cross Connection Test been waived?[1] ☐Yes ☐No

   Date of Cross Connection Test:

   Briefly describe any upgrades to the Use Area:

   How many domestic wells are present within 50 ft. of the Use Area or within 100 ft. of any impoundment?

   Describe the level and method of backflow protection at the Use Area:

   Is Recycled Water signage displayed in visible and public areas? ☐Yes ☐No

   Special requirements and conditions:

3. **Final Inspection by the City**:

   I have inspected the On-Site Recycled Water System(s) governed by this User Agreement and attest that the construction and operation of this system are in accordance with the City's Rules and Regulations governing recycled water use.

   Inspector Name:

   Inspector Signature: ________________________________

   Date:

[1] Customers may request a waiver of the Cross Connection test if no potable water piping is present in the Use Area.

Exhibit D

RECYCLED WATER ORDINANCE

Exhibit E

RECYCLED WATER RULES AND REGULATIONS

APPENDIX D
TTDF DESIGN REPORT

City of Fresno

Fresno-Clovis Regional Wastewater Reclamation Facility

Tertiary Treatment and Disinfection Facility Technical Memorandum
(Part One—Schematic Design Phase)

August 2011

PARSONS

TABLE OF CONTENTS

TECHNICAL MEMORANDUM (PART ONE – SCHEMATIC DESIGN PHASE)

LIST OF TABLES

LIST OF TABLES (CONTD…)

LIST OF FIGURES

LIST OF FIGURES (CONTD…)

EXECUTIVE SUMMARY

BACKGROUND

New Water Source – Recycled Water

The City of Fresno (City) has embarked on development of a new water source – recycled water, to offset potable water use and improve ground water quality. The City prepared a Recycled Water Master Plan (July 2010) to assess potential uses and demand for recycled water.

The City's ultimate goal is to recycle 25,000 acre feet/year or more of recycled water by 2025. The recycled water goal includes direct non-potable use of State of California Title 22 quality recycled water for landscape irrigation as well as for groundwater recharge. The City anticipated that the project would be developed in three logical phases and decided to construct a 5 to 10 mgd first phase Tertiary Treatment and Disinfection Facility (TTDF) at their Fresno-Clovis Regional Water Reclamation Facility (RWRF).

During the master planning efforts, although the City had decided on the approximate capacity of the TTDF, the tertiary treatment technology, system layout and location of the facilities were not finalized. These tasks have been performed as part of the pre-design and are summarized in this technical memorandum (TM). Therefore, this pre-design TM, in addition to developing the design basis, focuses on evaluation and selection of a filtration technology out of eight (8) proven California Department of Public Health (CDPH) approved technologies, a disinfection technology between UV irradiation and ozonation, and a recycled water storage system from several options.

Nitrogen Removal and Effluent Electrical Conductivity (EC)

The RWRF's discharge currently has a limit for electrical conductivity (EC) of 500 micro mhos/cm + EC of the source water. Meeting this limit is a challenge and may require various measures including source water treatment or replacement, expensive systems to remove salts in wastewater, industrial source control and/or public education on waste minimization. The various alternatives presented, including Membrane Bio Reactor (MBR), may not be effective removing all salts from the final effluent. However, MBR technology could help reduce EC levels through its reliable nitrification/denitrification (NDN) capability. Parsons estimates that effluent EC can be reduced by about 150 micro mhos/cm through NDN in the MBR permeate, as ammonia is converted to nitrogen gas and escapes into the atmosphere.

During the past few years, the RWRF has experienced a reduction of the effluent EC through an incidental NDN process that reduced ammonia to nitrogen gas. The reduction in the effluent was estimated between 8% to 9.5% of the total EC influent, enough to maintain compliance with the Waste Discharge Requirements (WDR) discharge limit.

North Fresno Wastewater Reclamation Facility, operated by the City, was issued a WDR/NPDES permit on December 10, 2009 by the Central Valley Regional Water Quality Control Board (RWQCB) with a Total Nitrogen (TN) limit of 10 mg/L for the recycled water used for golf course irrigation. It is expected that the proposed TTDF at the RWRF will also have a similar TN limit for irrigation water. This means that it will be short sighted to design the TTDF with no consideration for nitrogen removal.

Aging Train A Infrastructure

Train A facilities, reportedly, are old, of obsolete design and are difficult to operate and maintain. Further, nitrogen removal cannot be achieved reliably with the current configuration of the aeration basins in Train A. Discussions with the City's operations staff indicated that the ceramic disc diffusers installed in the aerations basins need replacement/cleaning and it may not be possible to restore them to their original state due to their age. Further, the aeration pipe grids that connect the diffusers are old and unique to the type of diffusers currently installed. The secondary clarifiers in Train A are in need of central column and scraper mechanism replacement. Based on the above extensive repair/replacement needs related to Train A infrastructure coupled with the long age of the equipment, it appears that replacement of Train A facilities in the near future would be a prudent measure, if the intention is to continue to use Train A for the long term.

MBR - A Clear Choice for Holistic Solution

Considering the regulatory requirements discussed earlier and long age of Train A facilities, a decision was made to consider the MBR process as a potential alternative to conventional tertiary filtration technologies. The MBR system followed by ultraviolet disinfection offers a multi faceted solution and provides the following four key benefits.

- Excellent Filtration – Produces the highest quality recycled water with effluent turbidity consistently less than 0.2 NTU. The MBR permeate is superior in quality compared to effluent from any conventional tertiary filtration process and exceeds Title 22 standards for recycled water.
- Simultaneous Nitrification and Denitrification (NDN) – Provides effluent that meets the expected permit limits, specifically Total Nitrogen (TN) of less than 10 mg/L, without significant infrastructure addition.
- Reduction in EC – Due to its NDN capability, a measurable reduction in EC can be achieved by using MBR process.
- Future Capacity Replacement – Provides a means for reliable, phased capacity replacement of aging infrastructure at Train A, with one of the most advanced and state-of-the-art membrane filtration technologies that will consistently and reliably meet current and future discharge regulations. This would avoid substantial costs associated with replacing and/or upgrading of Train A facilities in the near future, if tertiary filters were used in lieu of an MBR system.

Based on the above considerations, MBR will be more cost effective compared to conventional filtration systems, when considering its ability to produce high quality effluent with nitrogen removal and avoided cost of future upgrades/replacement of Train A facilities for nitrogen removal.

The scope of this TM evolved around the City's recycled water goals and associated electrical power supply options. Although a major part of this TM focuses on evaluation and selection of a conventional filtration technology, Sections following Workshop No.1 (Sections 8 through 13) compare conventional tertiary filtration systems with MBR system.

During Workshop No. 2 (Section 14), the decision was made in favor of MBR process due to the key benefits discussed above. Therefore, the last Section (Section 15) of this TM, which serves as a standalone section with MBR as the system of choice, has been printed on color paper to differentiate it from the rest of the report.

The proposed TTDF needs to become an integral part of the RWRF for its operation, reliability and compliance with the near term and future regulatory requirements. Further, the SCADA system of the proposed TTDF should fully integrate with the existing RWRF SCADA system for smooth and reliable operation.

COMMUNICATION AND DECISION WORKSHOPS

Since the inception of this project, Parsons maintained regular interaction and discussions with the City's staff throughout the development of this TM. The feedback received from the City's staff helped Parsons immensely to understand the plant's operational and maintenance constraints as well as City's preferences and to incorporate them into the TM. Two full-day technical Workshops were conducted at the RWRF to review and discuss the progress of this TM development. The first Workshop was held on 11/4/2010 while the second one was conducted on 2/3/2011.

Sections 3 through 7 present the work completed prior to Workshop No.1. This includes a comparison of eight conventional filtration system alternatives, three disinfection system alternatives/variations, and three storage alternatives. Features of operation, pros and cons, reliability, expandability to 30 mgd, capital, O&M and life cycle costs were compared and discussed. Section 8 summarizes the discussions and decisions made during Workshop No.1.

The following are the key collective decisions made during Workshop No.1.

1. Nova filtration system will be the preferred conventional filtration technology, if filtration is considered over MBR process.
2. In-pipe UV disinfection will be used for all alternatives
3. Depending on the physical configuration of the alternative, either pre-stressed concrete tanks or converted Train A aeration basins will be used as storage tanks for recycled water.

4. Due to aging infrastructure at Train A, only Train A will be considered for retrofitting into MBR system.

Moving forward, three Plans were identified for further development.

- Plan A – Conversion of Train A facilities into a 12 mgd MBR with 1.23 peaking factor. This plan includes conversion of one secondary clarifier into aeration basin for MBR; building new tank(s) to house membranes; constructing new housing for in-pipe UV reactors and conversion of one aeration basin into recycled water storage

- Plan B – 5 mgd constant flow conventional filtration (Nova disc filter) system for Train B. This plan includes feed from Canal B at a constant flow rate, Nova disk filters for filtration, construction of new housing for in-pipe UV reactors, and building new pre-stressed concrete tank (5 MG) for recycled water storage

- Plan C – 12 mgd constant flow conventional filtration (Nova disk filter) system for Train B.

These Plans are discussed in detail in Sections 9, 10 and 11. Section 11 presents a comparison of Plan A with Plan C. Section 12 describes the power source options for TTDF with both conventional filtration and MBR system for a 12 mgd facility expandable to an ultimate capacity of 30 mgd. The Section includes a duct bank and cable routing plan for the two alternative systems. These routing plans were developed after a thorough review of the Plant's record drawings and in close coordination with City's electrical engineers. Utilization of existing conduits was maximized to the extent possible in both the alternatives.

During Workshop No. 2, in addition to the option of converting Train A facilities into MBR, the City expressed their interest to explore the option of having MBR designed and built as a separate stand-alone system with all new structures.

As a result of the discussion during Workshop No.2, the following two MBR alternatives are selected over the conventional tertiary filtration alternatives for further development and City's review and final decision.

1. Converting Train A into MBR – (5 mgd constant flow; no peaking factor) – This is similar to Plan A as discussed in Section 9 of this report, except that the capacity will be 5 mgd constant flow instead of 12 mgd with peaking factor.

2. Constructing a separate standalone MBR system with all new tanks – (5 mgd constant flow; no peaking factor)

Sections 14 and 15 summarize the latest developments, subsequent to Workshop No.2. Section 14 sets the stage for a new project direction provided by the City during Workshop No.2. and steers the discussion into Section 15, which compares the two MBR alternatives noted above. Figures 15-1 and 15-2 present the preliminary layouts for the two alternatives.

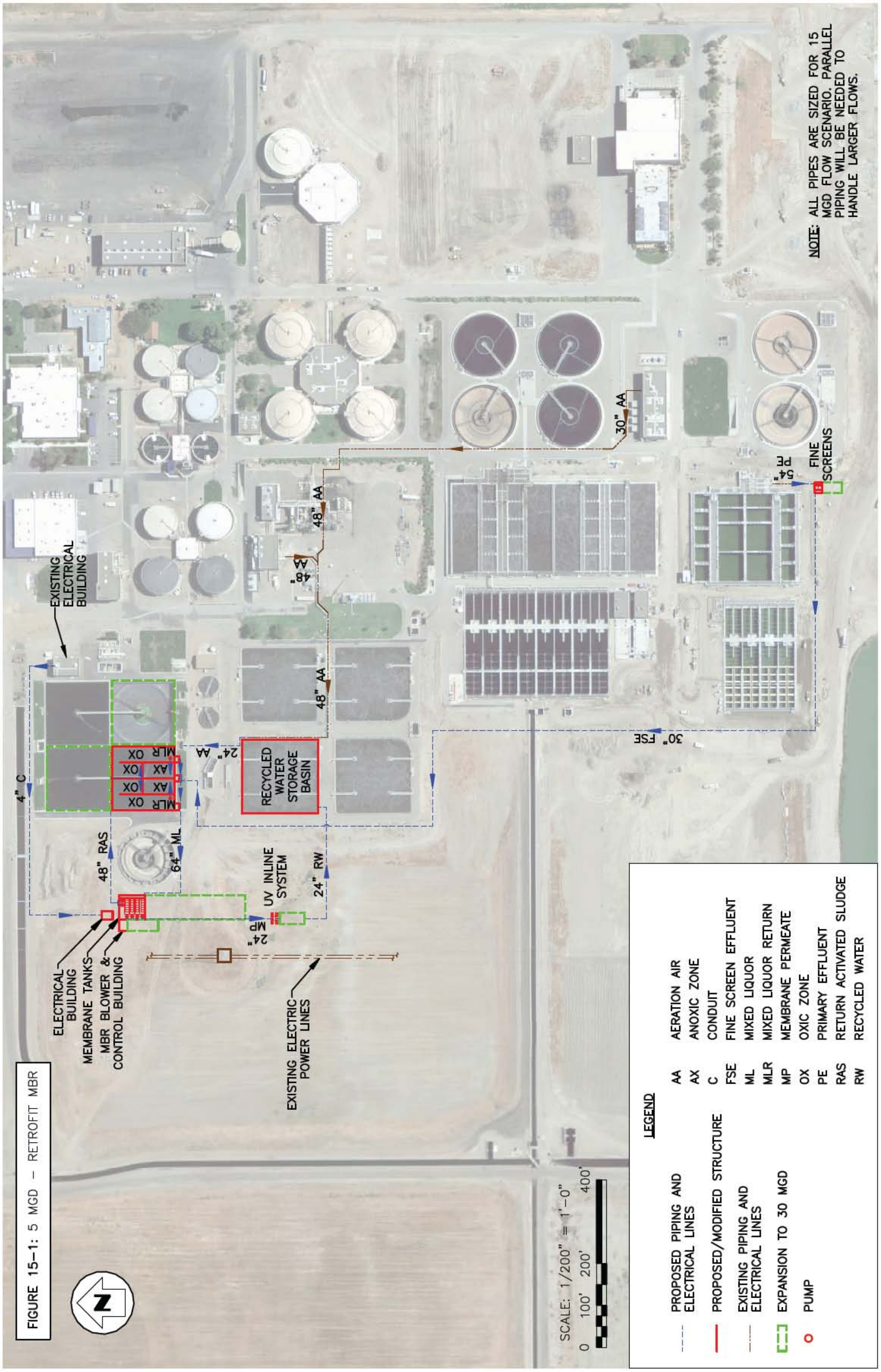

FIGURE 15-1: 5 MGD – RETROFIT MBR

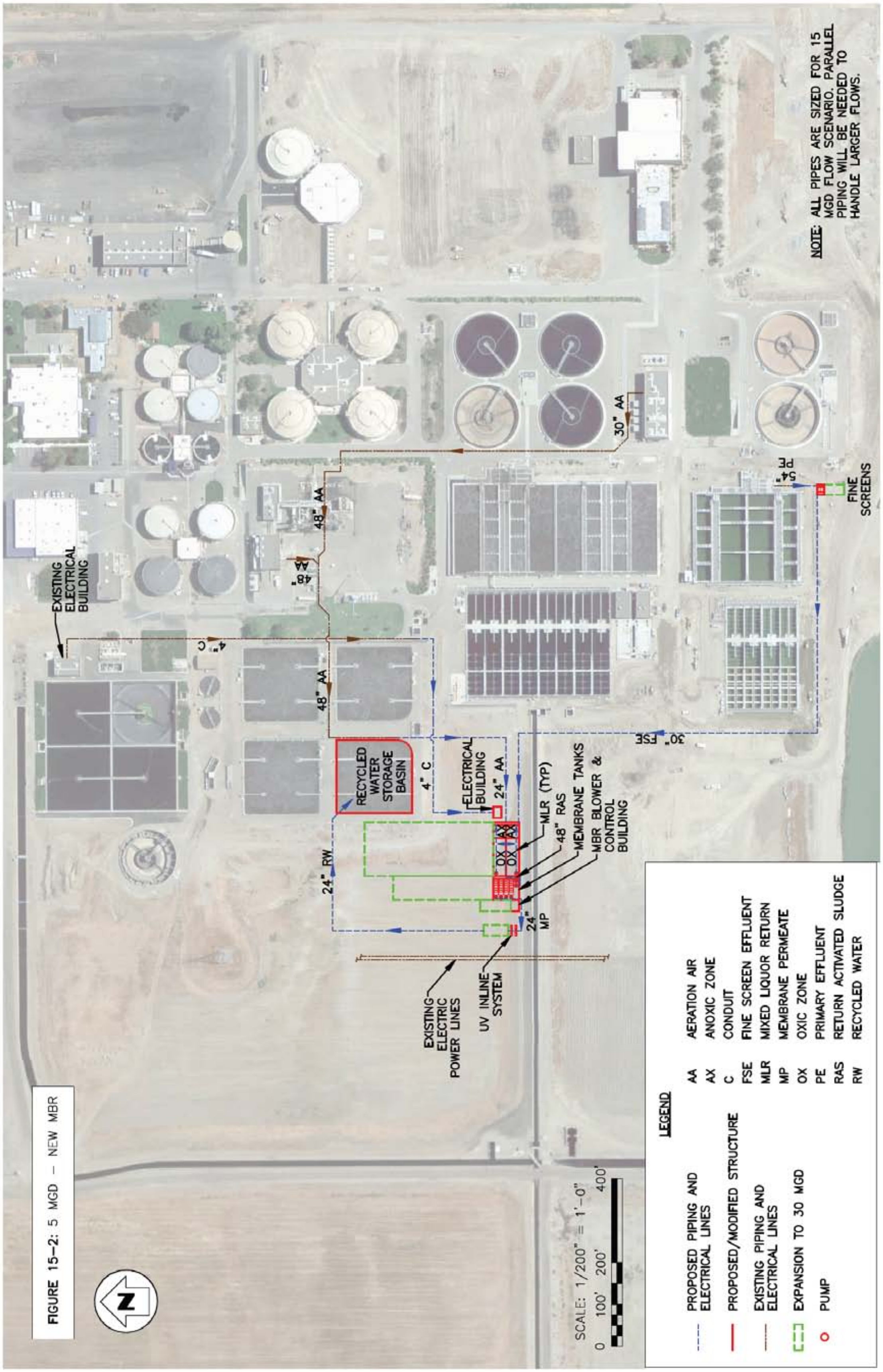

FIGURE 15-2: 5 MGD – NEW MBR

IN-PIPE UV FOR DISINFECTION

During Workshop No.1, the City chose in-pipe UV disinfection as opposed to an open channel UV system. One of the major drivers was the positive feedback received from the staff at neighboring Clovis Water Reuse Facility in operating and maintaining their in-pipe UV system. Therefore, for the purpose of this TM, 1-mgd capacity in-pipe UV reactors were considered. The 1 MGD rating for each reactor is based upon high quality membrane permeate feed such as from the MBR system. Four reactor trains (3 operating + one standby) will be required to disinfect 5 mgd of flow and each train will accommodate two reactors. There are several larger in-pipe reactors currently available from other manufacturers that may be more economical for the present project and will be evaluated during detailed design.

CONVERSION OF AERATION BASIN (TRAIN A) FOR RECYCLED WATER STORAGE

It was determined that the aeration basins at Train A, with sloping walls could be retrofitted into recycled water storage tanks. According to the City's staff, at least one of the units in Train A is typically out of service and hence conversion of one aeration basin into recycled water storage tank will not negatively impact the current plant operations. Further, due to the proximity of the proposed MBR facilities to Train A, conversion of one of the aeration basins into a storage tank would be a prudent choice.

PRELIMINARY COSTS

Preliminary costs were developed for two alternatives described earlier - retrofitting the existing facilities in Train A for aeration basins of MBR system or using completely new structures for this purpose. The costs estimated are according to Class 4 level per AACE (Association for the Advancement of Cost Engineering) guidelines. At this point in the design process, these costs are preliminary and should be used only for comparative purposes. The costs were estimated using several resources. Quotes from the manufacturers, information available from similar projects performed by Parsons, including construction in the Central Valley, were used to determine these costs.

Avoided Cost of Future Upgrades/Replacement of Train A

As disused earlier, a credit could be given to compensate for the cost of replacing and upgrading Train A in the near future, which would occur under conventional filtration alternatives but not under MBR alternatives. To estimate this credit, \$3-\$4 per gal of wastewater treated was used as the cost basis, which would translate into \$15-\$20 million of avoided future capital investment for a 5 mgd system. For the purposes of cost comparison, \$18 million is considered as avoided capital replacement cost. Note that the estimated avoided cost is based on constructing new basins to remove nitrogen but without new aeration blowers.

Table ES-1: MBR Alternatives Capital Cost (5 mgd) [a]

Parameter	Capital Cost ($ Million)	
	Retrofit MBR	New MBR
MBR Equipment and Structures Cost	8.4	8.7
MBR Total Capital Cost [b]	24.5	24.4
UV Disinfection Total Capital Cost [b]	5.3	5.3
Storage (Aeration Basin No. 3 or 4) Total Capital Cost [b]	3.1	3.1
Total Capital Cost	**32.9**	**32.8**
Train A Capacity Replacement (Avoided Cost) [c]	(18)	(18)
Net Effective Capital Cost	**14.9**	**14.8**

[a] For detailed cost analysis see Appendix A.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] Near future replacement cost of Train A facilities equivalent to 5 mgd capacity

DISCUSSION AND CONCLUSION

It is evident from the data presented in Table ES-1 above that the two MBR alternatives compared are very close to each other from a cost standpoint. The capital cost difference between the two alternatives is insignificant and is within the margin of error of our estimates. The concrete savings realized by retrofitting existing structures is balanced by less extensive piping required by using new structures.

However, using all new structures offers a more flexible and compact design. By properly planning the new facilities, they can be built in a monolithic construction with common walls, which would make it easier to build and more efficient to operate. The future expansion of tertiary facilities would follow the same compact pattern. Also, the design would not need to be tailored based on the constraints of existing facilities, but based on the best design practices. For example, deeper new aeration basins compared to the retrofitted basins would allow for a more efficient aeration system.

Further, a separate standalone MBR system will be easier to construct and will also provide some redundant treatment facilities associated with that particular train in the interim and for several years until the City decides to totally decommission that train due to its obsolescence.

Based on the above discussion, Parsons recommends using all new structures for constructing the MBR system, as it would be a more prudent and reliable approach to achieve filtration, nitrogen removal and future capacity replacement for Train A.

SECTION 1 - INTRODUCTION AND OBJECTIVE

1.1 BACKGROUND

The City of Fresno (City) mainly relies on groundwater as the primary drinking water resource where the groundwater level is approximately 300 feet below ground surface. To conserve valuable drinking water resources, the City plans to use tertiary treated recycled water for landscape irrigation as well as for commercial and industrial uses. Also the City plans to maximize the recharge of groundwater with high quality recycled water. The City's goal is to recycle 25,000 acre feet/year or more of recycled water by 2025. Therefore, the City is embarking upon new projects to design and construct a tertiary treatment and disinfection facility (TTDF) at the City of Fresno-Clovis Regional Water Reclamation Facility (RWRF) and new recycled water distribution system including pipelines, pump stations and storage reservoirs. The new recycled water distribution system will deliver disinfected tertiary recycled water to potential recycled water use sites according to the City's Recycled Water Master Plan that is currently being prepared.

The size of the new TTDF will have an initial capacity of 5 to 10 million gallons a day (mgd) in response to the immediate recycled water demand identified in the Recycled Water Master Plan; however it will ultimately expand to 30 mgd over the years to accommodate more users. The City's initial plan was to expand the TTDF in phases: the first phase (Phase I) would have a capacity of 5 mgd, the second phase (Phase II) would have a capacity of 10 mgd for a total of 15 mgd, and the third phase (Phase III) would have a capacity of 15 mgd for a total of 30 mgd. The City is now considering a Phase I capacity of 5 to 10 mgd, depending on the system selection and associated economics. If the Phase I is constructed for a capacity greater than 5 mgd, the capacity of subsequent phases will be adjusted accordingly. A phased expansion approach is prudent for several reasons:

- Recycled water demand will be low initially, but will increase over the years.
- It will minimize initial capital outlay.
- This approach takes advantage of emerging technologies in the area of recycled water production as new technologies emerge and are developed and optimized over the years, e.g., ultraviolet (UV) disinfection, ozonation, membrane filtration and so forth.
- Public acceptance of recycled water and hence the demand for that water will increase over the years.

The proposed TTDF needs to become an integral part of the RWRF for its operation, reliability and compliance with the near term and future regulatory requirements. Train A, the oldest treatment train at RWRF, is dated and has operational issues and therefore is a candidate for replacement in the near future with a more reliable and state-of-the-art treatment system. Furhter, the SCADA system of the proposed TTDF should fully integrate with the existing RWRF SCADA system for smooth and reliable operation.

1.2 SCOPE AND OBJECTIVES

Key objectives of this project include:

- Design and construct the first phase of the TTDF to match the demand of 5 to 10 mgd.
- Consider proven, cost effective and state-of-the-art technologies for upgradability and expandability in the future to a capacity of 30 mgd.
- Develop phased site master plan for ultimate 30 mgd capacity.
- Design treatment facilities that meet Title 22 irrigation and groundwater recharge requirements and could be retrofitted in the future to meet more stringent effluent quality requirements, if needed, in a cost effective manner, such as nitrogen removal.
- Consider facilities that present desired flexibility and redundancy as required for California Department of Public Health (CDPH) Title 22 criteria.
- Design facilities which are easier to operate.
- Consider full integration of TTDF control system (SCADA, etc.,) with the existing facilities at RWRF's control system.

More specifically, the following eight types of commonly used filters will be evaluated for tertiary filtration:

- Dual media gravity filters
- Deep bed mono-media gravity filters
- Continuous backwash filters
- Traveling bridge filters
- Fuzzy Filters™
- Cloth media disk filters
- Nova Ultrascreen® filters
- Microfilters

In addition to the alternatives above, membrane bioreactors (MBR), which replace secondary clarifiers and provide filtration at the same time, will also be evaluated.

The filtered effluent in all cases will be disinfected to meet the State of California Title 22 requirements for unrestricted reuse. Both UV disinfection and ozone will be evaluated for this purpose. Disinfection by gaseous or liquid chlorine (NaOCl) was not considered at the suggestion of the City, due to extensive operation and maintenance requirements associated with chlorine storage, handling and pumping and due to its potential to form toxic disinfection by products (DBP). A storage tank, 5 million gallons (MG) capacity, will be provided for storage of the final effluent/recycled water before it can be pumped though the recycled water distribution system.

SECTION 2 - EXISITNG RELEVANT TREATMENT FACILITIES

2.1 EXISTING FACILITIES AT THE CITY OF FRESNO CLOVIS REGIONAL WATER RECLAMATION FACILITY (RWRF)

The existing RWRF located at 5607 W. Jenson Avenue in Fresno, is designed for a capacity of 80 mgd average annual flow while the current plant flow is about 64 mgd. The wastewater entering the plant is received at the headworks, which includes an influent pump station, bar screens, grit removal tanks, and grit processing equipment. After the preliminary treatment at the headworks, the wastewater is provided with primary treatment by six clarifiers. The primary effluent from these clarifiers is distributed to three trains of secondary treatment facilities (Trains A, B and C). See Figure 2-1 below.

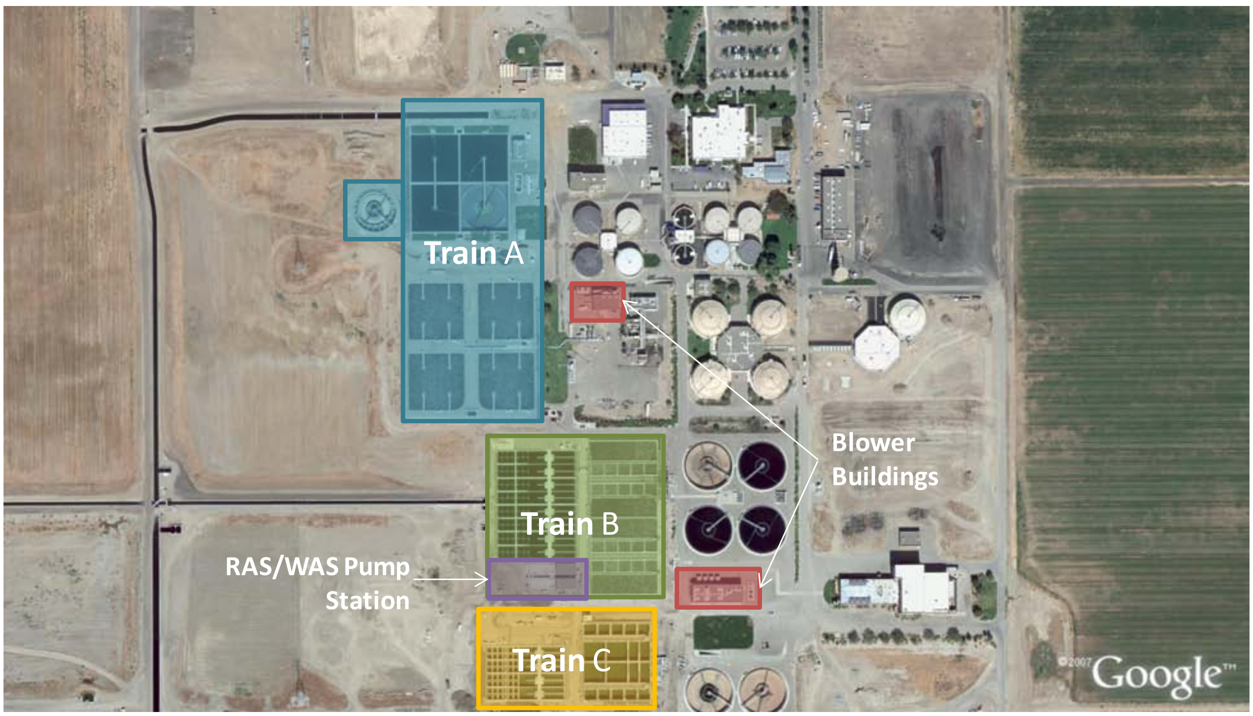

Figure 2-1: Relevant Facilities

Train A is the oldest one. It consists of four square aeration basins and four square secondary clarifiers. Train A has several operational and maintenance issues as summarized in Section 14 of this TM. Train B is the next oldest one. It consists of four rectangular aeration basins and eight rectangular secondary clarifiers. This train is located between trains A and C. Train C is the newest train. It consists of two rectangular aeration basins and four rectangular secondary clarifiers. The effluent from the plant flows into two canals on the site and finally from there to percolation ponds. The RWRF is in compliance with all the current regulatory requirements, except for Electrical Conductivity (EC) and occasionally other constituents such as chlorides, manganese and arsenic. Relevant design information for the three trains is provided in Table 2-1 with a brief schematic shown in Figure 2-2.

Table 2-1: Existing Relevant Facilities - Major Design Information[1]

Parameter	Units	Train A	Train B	Train C	Total
Rated Average Flow [2]	mgd	-	-	-	80
Rated Max Month Flow [2]	mgd	-	-	-	88
Aeration Basins, Blowers, and Air Supply System					
Number	-	4	4	2	10
Volume, Each	MG	2.7	2.6	2.7	26.6
Side Water Depth (SWD)	ft	16	17	17	-
Mixed Liquor Suspended Solids (MLSS)	mg/L	2,500 - 3,000	2,500 - 3,000	2,500 - 3,000	-
Solids Retention Time (SRT)	days	4 - 5	4 - 5	4 - 5	-
Blower Type	-	Single-stage centrifugal (Turblex)			-
Blower No.	-	6 (Located in Two Buildings)			-
Bower Capacity, Each	scfm	27,000			162,000
Diffuser Type	-	Ceramic Dome	Ceramic Plate	Membrane	-
Secondary Clarifiers					
Number	-	4[3]	8	4	16[3]
Volume, Each	MG	2.36	0.93	0.93	20.6
SWD	ft	14	13	13	-

[1]Values obtained from 2006 conformed drawings. SRT was obtained from Water Environment & Technology (WE&T) paper, June 2009
[2]Per Waste Discharge Report (WDR) Order No. 5-01-254 - See Appendix C)

[3]Train A circular secondary clarifier (clarifier no.5) is not included.

Even though the current discharge permit only requires Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) removal (40 mg/L BOD and 40 mg/L TSS in the effluent), the operations staff has been able to achieve some nitrification and denitrification by dissolved oxygen (DO) control at strategic locations and maintaining a higher (4-5 days) SRT in the aeration basins.[1]

[1]"How Low is Too Low?" Schuyler, Ronald G et.al., WE&T Journal, June 2009

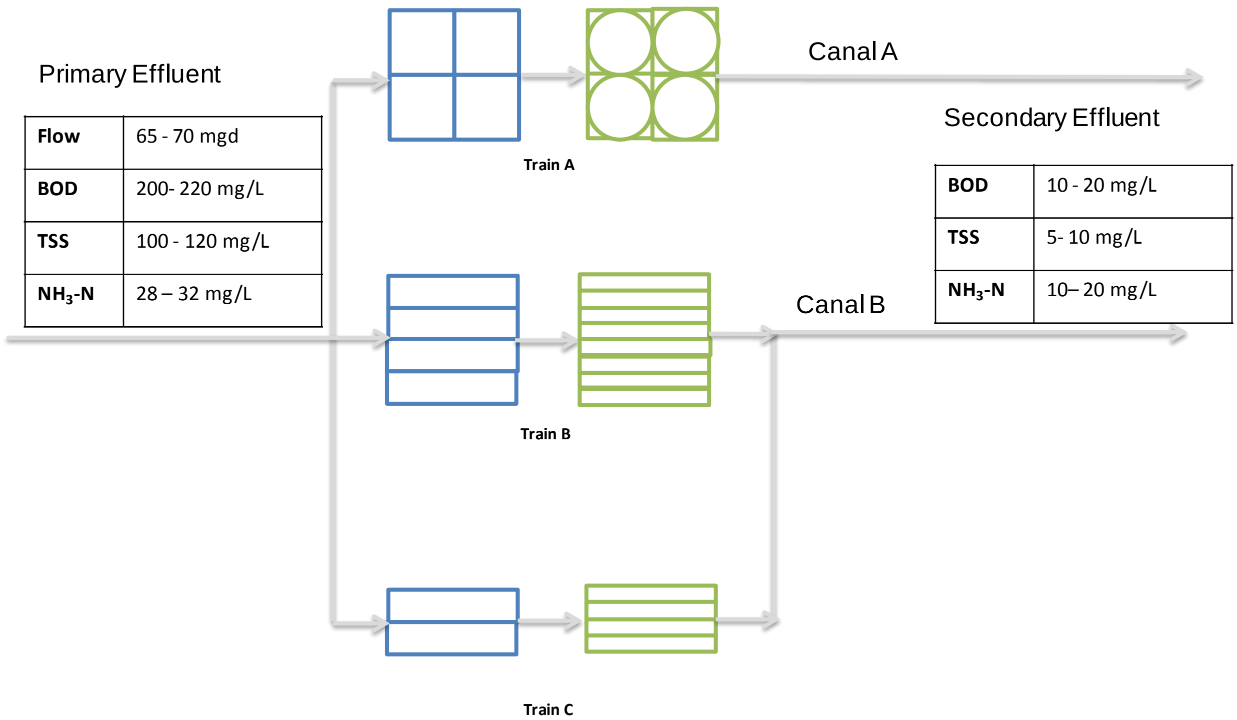

Figure 2-2: Existing Relevant Facilities - Current Operation

Train A, as pointed out above, is the oldest and is of obsolete design. The aeration basins are square shaped with sloping side walls. The mixed liquor is difficult to mix and aerate, the design is inefficient and does not allow plug flow regime (nearly essential to achieve high efficiency in a biological reactor), and operation and maintenance is less than optimum with sloping "gunited" walls. Further, based on Parsons' discussions with City's operations staff, Train A has immediate need for significant repairs/replacements (See Section 14 for details).

Trains B and C, however, are of newer construction and are well designed and operated. They have concrete walls and employ plug flow in reactors. The associated secondary clarifiers are also of proper design in terms of detention time, surface settling rates and other important criteria.

Therefore, the City believes and Parsons concurs, that in the current TTDF project, if any existing facilities should be upgraded and/or modified for reuse, they should be of Train A.

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PRE-WORKSHOP NO.1 ANALYSIS (SECTION 3 - SECTION 7)

SECTION 3 - PLANNED TERTIARY TREATMENT AND DISINFECTION FACILITY (TTDF)

3.1 GENERAL

As described in the previous Sections of this Technical Memorandum (TM), the City plans to construct a 5 to 10 mgd TTDF at the RWRF under first phase. This facility will consist of a 5 to 10 mgd filter feed pump station, a new conventional filtration system, a disinfection system, and a 5 million gallon (MG) storage tank along with post-chlorination and recycled water distribution pump station. The recycled water treated at the TTDF will be used for unrestricted landscape irrigation. The City, in the future, may also use the recycled water for ground water recharge, which requires removal of nitrogen to comply with the CDPH guidelines for recycled water recharge. The TTDF will be located in an open area north of Canal "B." During the Schematic Design Phase, a preliminary layout of 5 to 10 mgd TTDF expandable to ultimate capacity of 30 mgd will be prepared. Figure 3-1 below shows the planned TTDF in the overall RWRF treatment scheme. A simplified schematic of the TTDF and its unit processes is shown in Figure 3-2.

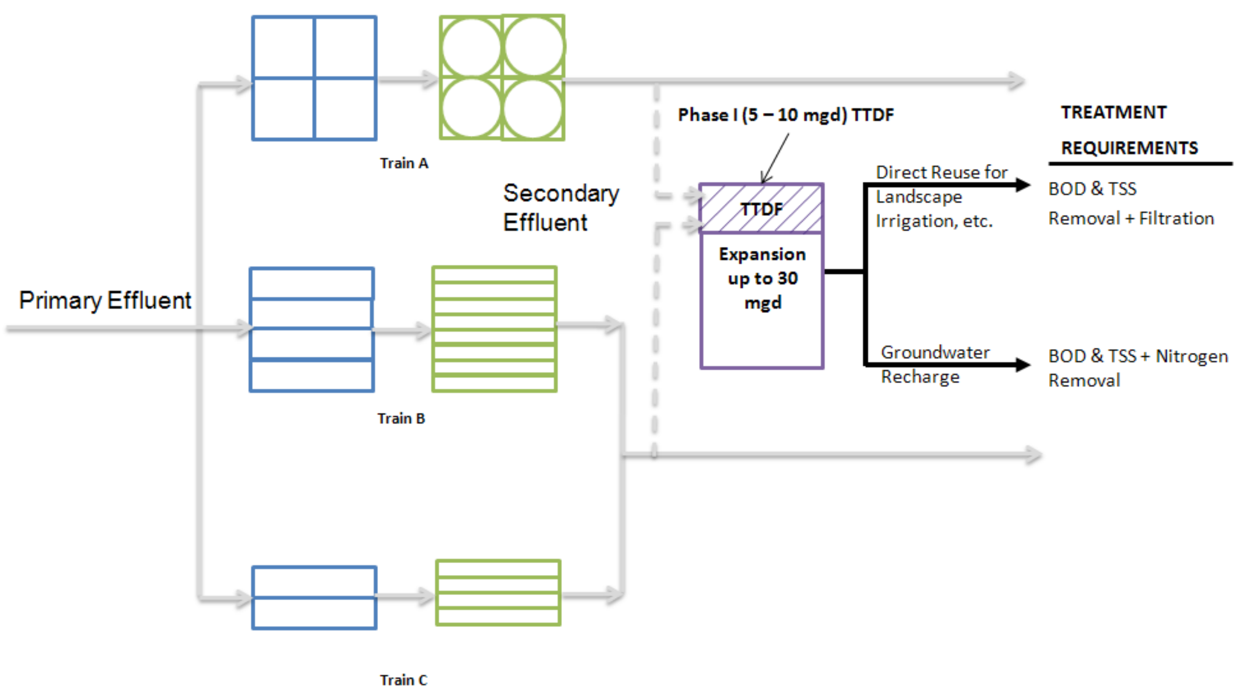

Figure 3-1: Planned TTDF

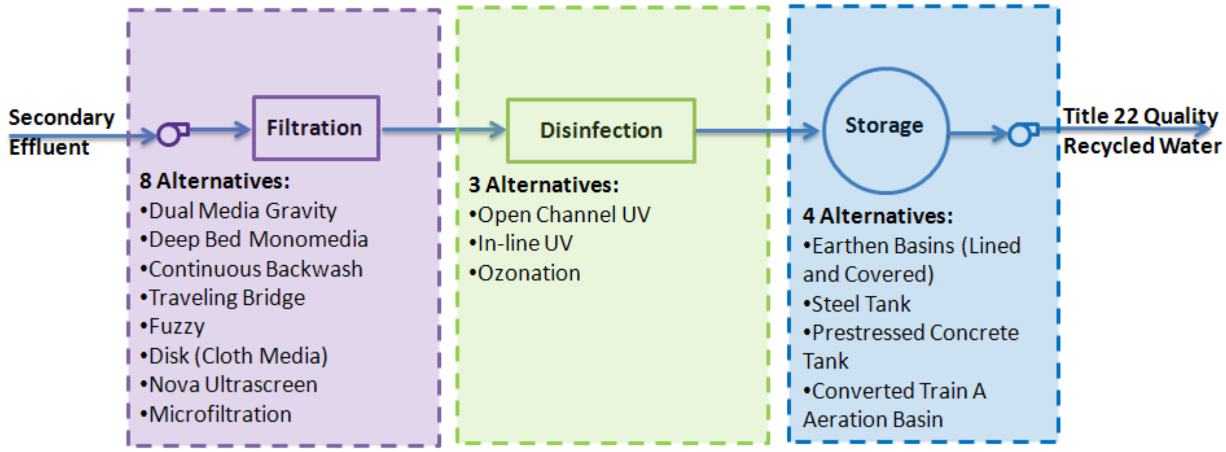

Figure 3-2: Simplified Schematic of the TTDF

A detailed analysis of the alternative technologies considered for evaluation for filtration, disinfection and storage systems is presented in Sections 4, 5 and 6, respectively, of this TM.

3.2 FILTER FEED PUMP STATION

A new filter feed pump station will be located adjacent to the existing effluent junction box to feed the secondary effluent to the proposed filters. The pump station will be sized to accommodate a total of four (4) vertical turbine pumps: two (one duty and one standby) will be installed for 5 mgd capacity and two more will be installed for next 10 mgd expansion of the TTDF. Space will be left for expansion of the pump station to 30 mgd.

3.3 FILTRATION

The following eight CDPH approved conventional filtration technologies will be evaluated to select the preferred filtration technology:

- Dual Media Gravity Filters
- Deep Bed Monomedia Filters
- Continuous Backwash Filters
- Traveling Bridge Filters
- Fuzzy Filters
- Disk (Cloth Media) Filters
- NOVA Ultrascreen Filters
- Microfiltration

In addition to the alternatives above, MBR, which replaces secondary clarifiers and provides filtration at the same time, will also be evaluated as an alternative to conventional filtration.

3.4 DISINFECTION

To select the most viable technology for the TTDF, proven disinfection technologies including

UV radiation (open channel and in-pipe) and ozonation will be evaluated. Only low-pressure high-intensity UV lamps will be considered for both open channel and in-pipe UV disinfection. Ozonation alternative will only consider the use of liquid oxygen for ozone generation. Section 5 of this TM provides a detailed analysis of disinfection system alternatives.

3.5 STORAGE

The proposed TTDF will include a 5 MG recycled water storage tank. The storage tank will have a recycled water distribution pump station. The following four alternatives for the storage tank construction will be evaluated to select the most viable alternative:

- Earthen Basins (lined and covered)
- Steel Tank
- Concrete Tank
- Conversion of an existing aeration basin from train A (capacity will be limited to 2.7 MG) – only for MBR option

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SECTION 4 - FILTRATION SYSTEM ALTERNATIVES ANALYSIS

4.1 BACKGROUND

As noted in Section 1, the City's goal is to produce 25,000 acre-ft/year of recycled water by 2025. This Section of the TM presents the eight filtration alternatives that were evaluated for the TTDF.

As described earlier, the existing facilities at the RWRF are designed to treat an average wastewater flow of 80 mgd. The existing RWRF produces secondary effluent that is well within the permitted BOD and TSS limits, as indicated in Table 4-1 below.

Table 4-1: Secondary Effluent Permitted Quality and Currently Achieved Quality

Parameter	Units	WDR Permit Limit[1] (Monthly Average)	Currently Achieving
BOD_5	mg/L	40	10 - 20
TSS	mg/L	40	5 - 10

[1]WDR Order No. 5-01-254 (See Appendix C)

To comply with CDPH standards for unrestricted reuse (Title 22) of wastewater effluent, the secondary effluent must be coagulated (although this requirement can be waived - see below), filtered, and disinfected. By removing a majority of the suspended solids and turbidity, filtration enhances the effectiveness of the downstream disinfection process.

Per Title 22 standards, when media filtration is used, the filtered effluent turbidity must not exceed a daily average of 2 Nephelometric Turbidity Units (NTU), 5 NTU more than 5% of the time within a 24 hour period, and 10 NTU at any time. These turbidity maxima were developed based on the Pomona Virus Study conducted by the County Sanitation Districts of Los Angeles County (CSDLAC, 1977), which correlated the turbidity values with successful disinfection as measured by total coliforms (less than 2.2 per 100 ml for Title 22 tertiary effluent) and viruses. When membrane filtration is used, the filtered effluent turbidity must not exceed 0.2 NTU more than 5% of the time within a 24 hour period, and 0.5 NTU at any time. Table 4-2 below summarizes Title 22 tertiary effluent criteria.

Table 4-2: Tertiary Effluent (Title 22) Criteria

Parameter	Units	Value
Turbidity for Media Filtration	NTU	≤2 Daily Average, ≤5 95% of the time within a 24 hour period, ≤10 at all times
Turbidity for Membrane Filtration	NTU	≤0.2 NTU 95% of the time within a 24 hour period, ≤0.5 NTU at all times
Filter Loading Rate	gpm/ft^2	2 – 30

Title 22 standards state that coagulation may be waived if the filter effluent does not exceed 2 NTU, the filter influent is continuously measured, the filter influent turbidity does not exceed 5 NTU, and automatically activated chemical addition or diversion facilities are provided in the event filter influent turbidity exceeds 5 NTU. The current secondary effluent quality data suggests that the RWRF meets the filter influent criteria for waiving the coagulation requirement. To enhance reliability and provide a prudent design, automatically actuated coagulation will be provided in the event filter influent turbidity exceeds 5 NTU.

There are several CDPH approved filtration technologies which generally fall into the following eight categories:

- Dual media gravity filters
- Deep bed monomedia filters
- Continuous backwash filters
- Traveling bridge filters
- Fuzzy filters
- Cloth media filters
- Nova Ultrascreen filters
- Microfilters

Each of these categories of filters has a specific maximum allowable filtration rate approved by the CDPH. The approved rates are based on pilot tests conducted (typically by an independent testing agency) on these filters using secondary effluent from an actual wastewater treatment plant and measurement and verification of performance in these tests.

Operational reliability is an important criterion for recycled water systems and there are several options for meeting Title 22 reliability requirements, including (reproduced from California Code of Regulations, Title 22, Chapter 3, Article 10, Section 60351) :

- Alarm and multiple filter units capable of treating the entire flow with one unit not in operation.
- Alarm, short-term retention or disposal provisions and standby replacement equipment.
- Alarm and long-term storage or disposal provisions.
- Automatically actuated long-term storage or disposal provisions.
- Alarm and standby filtration unit process.

For the purposes of filtration system alternative analysis in this TM, multiple filter units capable of treating the entire flow with one unit not in operation were considered. However, it should be noted that the RWRF does currently have long term disposal provisions under its existing WDR Order No. 5-01-254.

This TM presents the features of operation, advantages and disadvantages, design criteria, preliminary layout drawings, and preliminary construction, O&M, and 20 year life-cycle cost estimates for each of the eight filtration technologies. The evaluations consider a filtration capacity of 5 mgd constant flow (enough to satisfy near-term recycled water demand identified in the City's Recycled Water Master Plan).

4.2 FILTRATION SYSTEM ALTERNATIVES

4.2.1 Dual Media Gravity Filters

Features of Operation

Dual media filters are custom designed filters employing anthracite (typically 18-inches depth) and sand (typically 12-inches depth) media. The anthracite medium layer is above the sand medium layer. The sand medium is supported by a layer of gravel (in order to prevent plugging of underdrain nozzles/orifices and to distribute the backwash water evenly across the filter) which, in turn, is supported by the filter underdrain system. Many underdrain systems, however, are now capable of supporting the media directly, without the need of a gravel layer. Solids are removed by a variety of mechanisms including straining, sedimentation, impaction, interception, and adhesion (removal mechanisms that are common to all granular media depth filters). Figure 4-1 below presents a simplified schematic of a granular media depth filter.

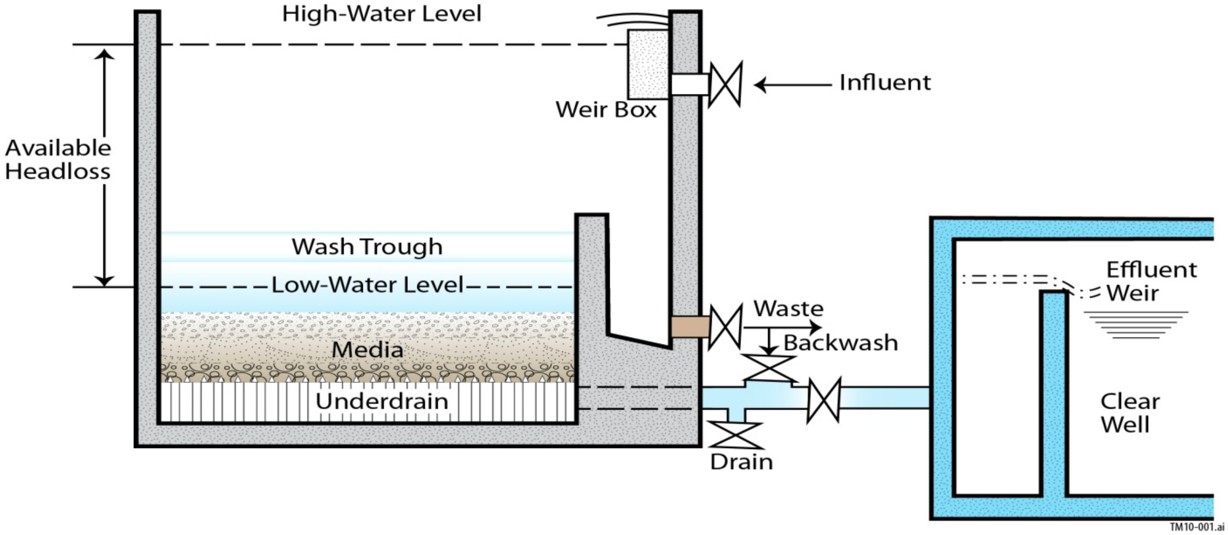

Figure 4-1: Simplified Schematic of a Granular Media Depth Filter

Over time, the solids accumulate within the voids of the filter bed, increasing the headloss across the filter. After the headloss exceeds a certain allowable level or after the filtered turbidity exceeds the allowable level, the filter must be backwashed in order to remove the accumulated solids. In the majority of operating filtration systems, headloss is used as the criteria for backwashing. The backwashing sequence in these filters is automatic and programmable so that backwashing occurs first with air only (approximately 3 minutes, but to be preselected), then air and water (approximately 5 minutes, but to be preselected), and then water only (approximately 10 minutes, but to be preselected). Two backwash pumps (one duty and one standby) and two air scour blowers (one duty and one standby), sized for backwashing one filter cell at a time, are provided. The backwash velocity is enough to fluidize the bed while avoiding media loss. In other words, the backwash velocity is controlled such that height of the fluidized bed does not exceed the level of the wash trough. The backwash waste is collected in the wash trough and is sent to a backwash waste storage tank. From the backwash waste storage tank, the backwash waste is pumped at a controlled rate back to the headworks via return pumps. The length of a filter run (i.e. the time between filter cell backwashes) is conservatively 24 hours; however, the length of a filter run will depend upon the filter influent quality. Influent with higher turbidity would require more frequent backwashes and vice versa. The typical headloss through the filter is 2 (clean bed) - 10 (dirty bed) feet. The backwash waste production rate varies depending upon the filter influent quality, typically ranging between 5 - 15% of the filter influent flow rate.

Advantages and disadvantages of dual media gravity filters are summarized in Table 4-3 and the design criteria are summarized in Table 4-4. A preliminary layout for the dual media gravity filters at the TTDF is presented in Figure 4-2. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd and 15 mgd systems and two redundant filter cells are planned for the 30 mgd system. Preliminary construction, O&M, and 20 year life-cycle cost estimates for dual media filters are presented in Table 4-5.

Advantages and Disadvantages

Table 4-3: Dual Media Filter Advantages and Disadvantages

Advantages	Disadvantages
Dual media filters are proven, with many long-operating installations.	Backwashes produce a large, instantaneous flow of backwash waste - which requires storage. The backwash waste storage tank is large (sized for two backwashes), adding to capital costs.
Dual media filters are, by virtue of their ample storage capacity, less susceptible to upsets and breakthrough than other filtration technologies that do not employ depth filtration.	Backwashing requires that a filter cell be taken off-line.
Dual media filters are non-proprietary (both in terms of design and materials e.g. media) and can be competitively bid.	Concrete and piping requirements are high.
	Expansion of the filter requires the construction of additional filter cells.
	Operating issues, such as loss of media and destratification of media, will occur over time.
	Chlorine dosing is recommended for algae control.

Design Criteria

Table 4-4: Dual Media Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	5
Number of Filter Cells	4
Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)	16 x 16 x 15.5
Total Filtration Area, ft^2	1,024
Filtration Rate with One Filter Backwashing, gpm/ft^2	4.5
Backwash	
Type	Air-water (Air, Air & Water, Water)
Rate, Air and Water Cycle	
Air, scfm/ft^2	3 to 5
Water, gpm/ft^2	8 to 9
Rate, Water Cycle Only, gpm/ft^2	16 to 18
Underdrain Type	False Bottom with Nozzles or Underdrain Blocks
Backwash Waste Storage Tank Capacity	2 Backwashes
Headloss Through Filter, ft (Operating)	10

Preliminary Layout

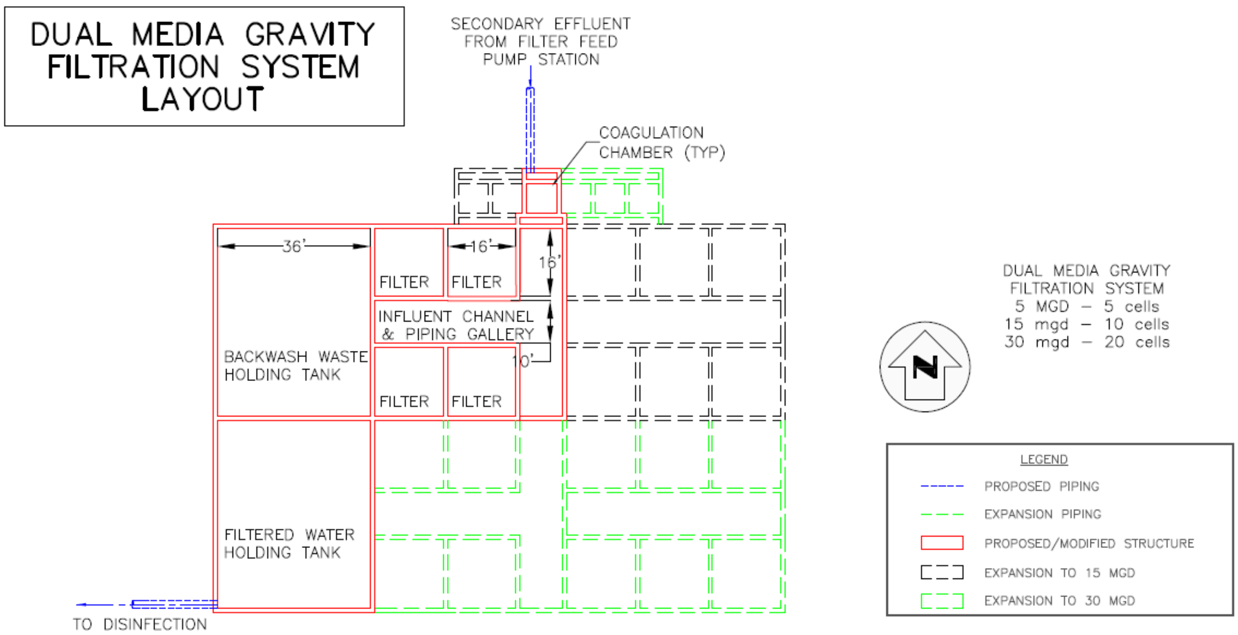

Figure 4-2: Preliminary Layout of 5 mgd Dual Media Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-5: Dual Media Filter Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,600,000
Total Capital Cost[a]	4,300,000
Total Annual O&M Cost[b]	90,000
20-Year Life Cycle Cost [c]	5,900,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

4.2.2 Deep Bed Monomedia Filters

Features of Operation

The features of operation for deep bed monomedia filters are essentially identical to dual media gravity filters, with the only major difference being the media - deep bed monomedia filters employ a single medium (typically anthracite with a depth of 48-inches). The length of a filter run, the operating headloss across the filter bed, and the backwash waste production rate for deep bed monomedia filters are essentially the same as for dual media gravity filters (refer to Section 4.2.1).

Advantages and disadvantages of deep bed monomedia filters are summarized in Table 4-6 and the design criteria are summarized in Table 4-7. A preliminary layout for the deep bed monomedia filters at the TTDF is presented in Figure 4-3. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd and 15 mgd systems and two redundant filter cells are planned for the 30 mgd system. Preliminary construction, O&M, and 20 year life-cycle cost estimates for deep bed monomedia filters are presented in Table 4-8 below.

Advantages and Disadvantages

Table 4-6: Deep Bed Monomedia Filter Advantages and Disadvantages

Advantages	Disadvantages
Deep bed monomedia filters are proven, with many long-operating installations.	Backwashes produce a large, instantaneous flow of backwash waste - which requires storage. The backwash waste storage tank is large (sized for two backwashes), adding to capital costs.
Deep bed monomedia filters are, by virtue of their ample storage capacity, less susceptible to upsets and breakthrough than other filtration technologies, including dual media gravity filters.	Backwashing requires that a filter cell be taken off-line.
Deep bed monomedia filters are non-proprietary (both in terms of design and materials e.g. media) and can be competitively bid.	Concrete and piping requirements are high.
Deep bed monomedia filters use a single medium, avoiding the problems with destratification of media experienced with multimedia filters.	Expansion of the filter requires the construction of additional filter cells.
	Operating issues, such as loss of media, occur over time.
	Chlorine dosing is recommended for algae control.

Design Criteria

Table 4-7: Deep Bed Monomedia Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	5
Number of Filter Cells	4
Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)	16 x 16 x 17
Total Filtration Area, ft^2	1,024
Filtration Rate with One Filter Backwashing, gpm/ft^2	4.5
Backwash	
Type	Air-water (Air, Air & Water, Water)
Rate, Air and Water Cycle	
Air, scfm/ft^2	3 to 5
Water, gpm/ft^2	8 to 9
Rate, Water Cycle Only, gpm/ft^2	16 to 18
Underdrain Type	False Bottom with Nozzles or Underdrain Blocks
Backwash Waste Storage Tank Capacity	2 Backwashes
Headloss Through Filter, ft (Operating)	10

Preliminary Layout

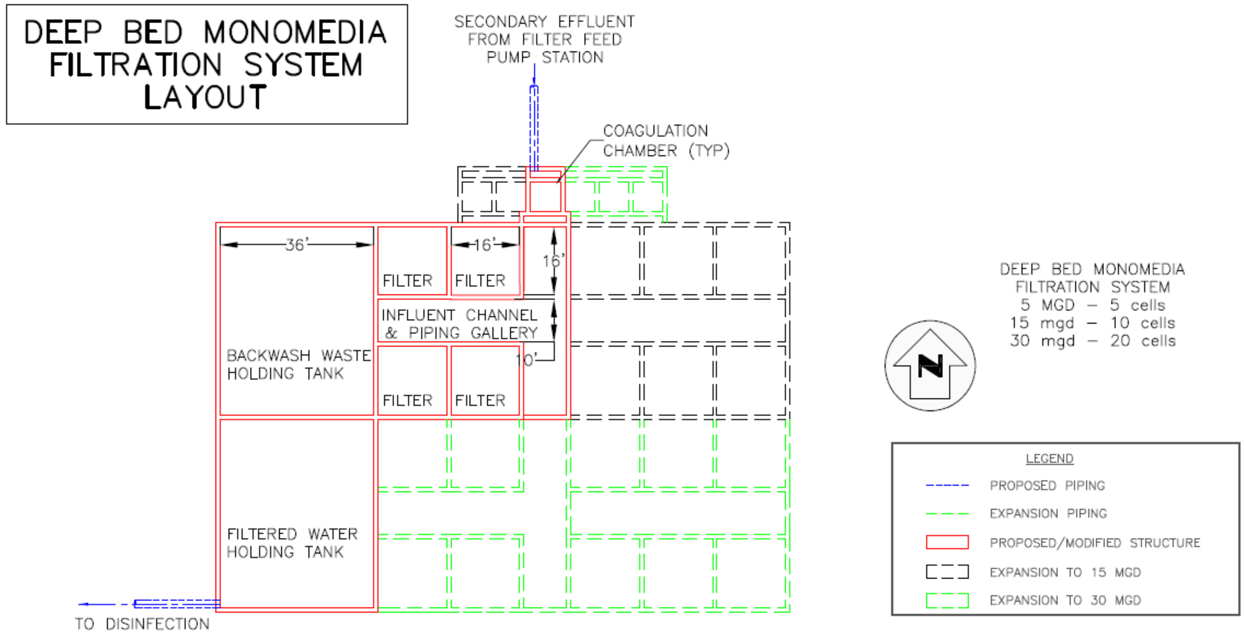

Figure 4-3: Preliminary Layout of 5 mgd Deep Bed Monomedia Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-8: Deep Bed Monomedia Filter Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,600,000
Total Capital Cost[a]	4,400,000
Total Annual O&M Cost[b]	90,000
20-Year Life Cycle Cost [c]	6,000,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

4.2.3 Continuous Backwash Filters

Features of Operation

Continuous backwash filters, marketed under various names such as DynaSand, SuperSand, and TechnaSand, are deep bed granular media filters that are similar to the granular media filters discussed above in that solids are removed by straining, sedimentation, impaction, interception, and adhesion. However, there are a several major differences: the filter bed is continuously backwashed via an airlift pump and the filter operates as an up-flow filter rather than a down-flow filter. The filters are supplied in modules, either as packaged units (for low flow applications) or for installation in concrete basins (for high flow applications). Due to the continuous filter bed cleaning system, this type of filter requires a low operating head (about 3 feet). It also produces a continuous low rate of waste backwash flow to eliminate the need for flow equalization of the waste backwash before return to the main treatment plant. The backwash waste production rate is approximately 5% of the filter influent flow rate.

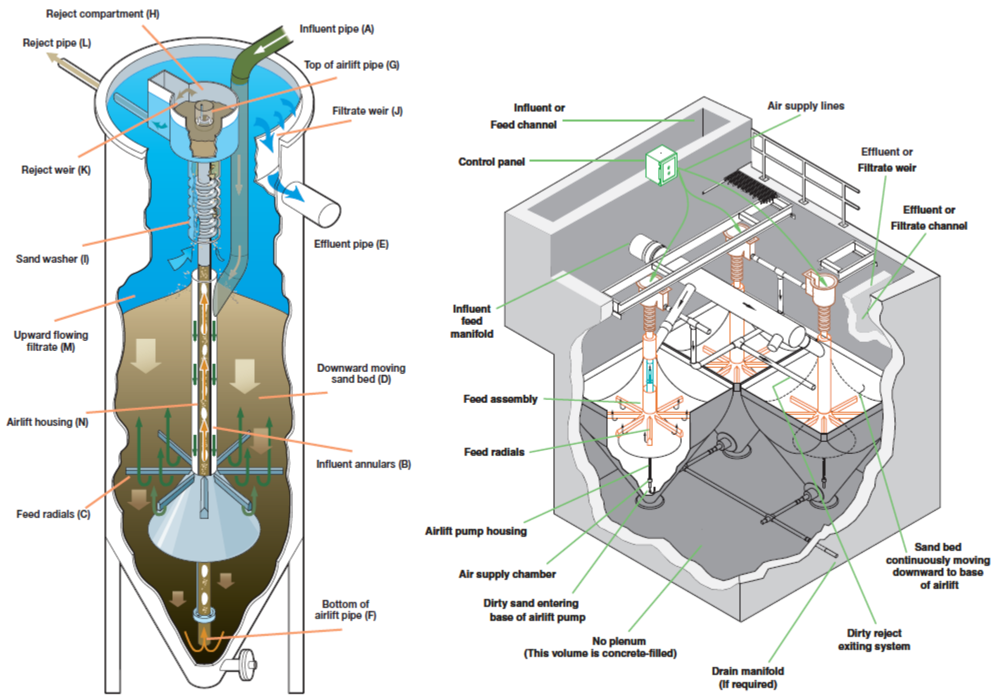

Figure 4-4: Continuous Backwash Filter (Figure from DynaSand®)

As shown in Figure 4-4 above, sand containing captured solids is drawn though an airlift pipe and into a reject compartment. The sand is scoured within the airlift pipe, cleaning the sand before it is collected in the reject compartment. The scoured solids, which are less dense than the sand media, flow over the reject weir and into the reject pipe. The clean sand then returns to the filter bed though a sand washer, in which any remaining solids are removed and carried back into the reject compartment by a small amount of filtrate. Figure 4-4 above shows filter cells arranged in 2 x 2 configuration. For the TTDF, a 4 x 1 module configuration is planned.

Advantages and disadvantages of continuous backwash filters are summarized in Table 4-9 and the design criteria are summarized in the Table 4-10. A preliminary layout for the continuous backwash filters at the TTDF is presented in Figure 4-5. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd and 15 mgd systems and two redundant filter cells are planned for the 30 mgd system. Preliminary construction, O&M, and 20 year life-cycle cost estimates are presented in Table 4-11.

Advantages and Disadvantages

Table 4-9: Continuous Backwash Filter Advantages and Disadvantages

Advantages	Disadvantages
Continuous backwash filters are proven, with many long-operating installations.	The design of continuous backwash filters is proprietary.
Continuous backwash filters are, by virtue of their ample storage capacity, less susceptible to upsets and breakthrough than other filtration technologies that do not employ depth filtration.	Expansion of the filter requires the construction of additional filter cells.
Continuous backwash filters have no moving parts. The only mechanical component of this type of filter is an air compressor to produce the air needed for the airlift pumps.	Air flow must be precisely controlled in order to prevent the loss of media.
Continuous backwashing eliminates the need for taking a filter off-line for cleaning, storing backwash water and filtered water, and backwash waste return pumps.	Internal parts of the filter cannot be accessed for maintenance without taking the filter offline and removing the media.

Design Criteria

Table 4-10: Continuous Backwash Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	5
Number of Filter Cells	5
Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)	28.3 x 7.1 x 16.2
Total Filtration Area, ft^2	1,000
Filtration Rate with One Filter Backwashing, gpm/ft^2	4.3
Backwash	
Type	Air
Rate, Air	
Air, scfm per module (scfm per ft^2)	2 - 3 (>150)
Headloss Through Filter, ft (Operating)	3

Preliminary Layout

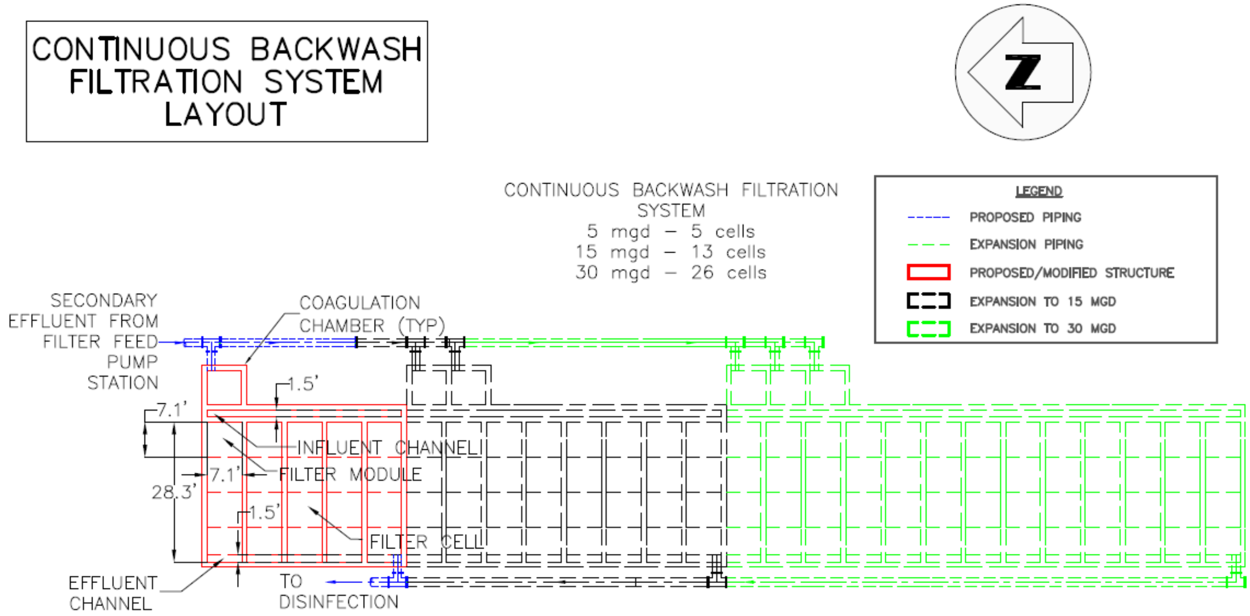

Figure 4-5: Preliminary Layout of 5 mgd Continuous Backwash Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-11: Continuous Backwash Filter Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,300,000
Total Capital Cost[a]	3,800,000
Total Annual O&M Cost[b]	105,000
20-Year Life Cycle Cost [c]	5,600,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

4.2.4 Traveling Bridge Filters

Features of Operation

Traveling bridge filters, marketed under various names such as ABW, AquaABF, and Gravisand, are shallow bed (typically 11-inches) granular media filters that are installed in a segmented bed arrangement. The backwash system is suspended from a bridge that moves across the bed. A pump takes filtered water from the effluent channel and directs it back into a segment of the filter bed, forcing the water back up through the filter bed, dislodging the particles removed from the wastewater. A second pump, attached to a hood that covers the segment being backwashed, draws the waste backwash water into the hood and discharges it into a trough for return to the head of the treatment plant.

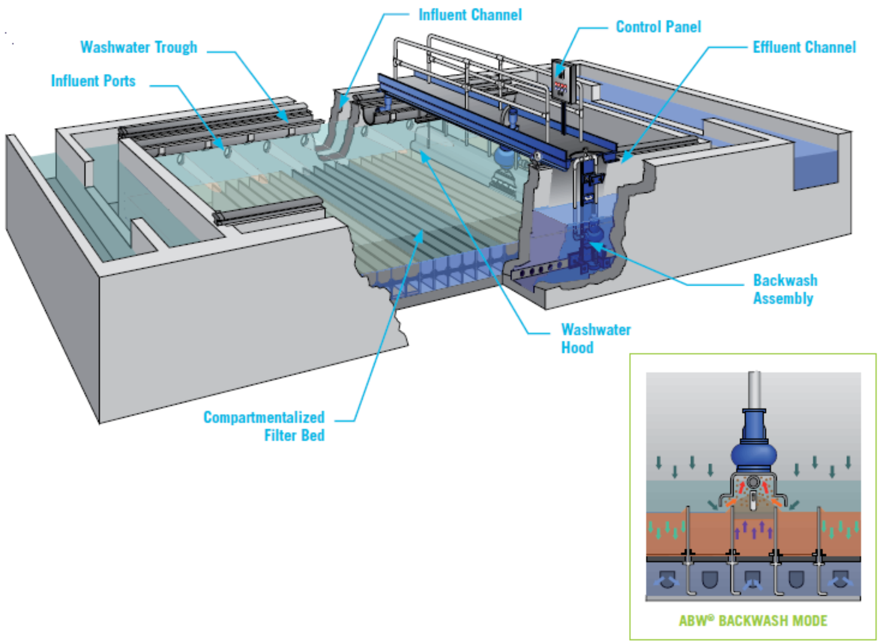

Figure 4-6: Traveling Bridge Filter (Figure from ABW®)

As with other filtration technologies, the backwash frequency and backwash waste production rate vary depending upon the filter influent quality; however, typically each filter is backwashed three times per day and the backwash waste production rate is typically 1 - 2% of the filter influent flow rate. The operating headloss across the filer is low, typically 2 - 12 inches of water. Typically, backwashing is initiated when a predetermined headloss across the filter bed is exceeded although the operator can choose to initiate backwashing after the filter effluent turbidity exceeds a predetermined set point.

Advantages and disadvantages of traveling bridge filters are summarized in Table 4-12 and design criteria are summarized in the Table 4-13. A preliminary layout for the traveling bridge filters at the TTDF is presented in Figure 4-7. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter cell is planned for the 5 mgd, 15 mgd, and

30 mgd systems. Preliminary construction, O&M, and 20 year life-cycle cost estimates for traveling bridge filters are presented in Table 4-14.

Advantages and Disadvantages

Table 4-12: Traveling Bridge Filter Advantages and Disadvantages

Advantages	Disadvantages
Traveling bridge filters are proven, with many long-operating installations.	The design of traveling bridge filters is proprietary.
The backwashing arrangement eliminates the need for taking a filter out-of-service for cleaning.	The CDPH approved filtration rate is low (≤2 gpm/ft^2), resulting in a large footprint.
Filter feed pump pressure requirements are lower due to the shallow filter bed depth.	Expansion of the filter requires the construction of additional filter cells.
	The backwash system bridge has many moving parts.
	The depth of the filter bed is shallow and the filter is more susceptible to upsets and breakthrough than deep bed filters.

Design Criteria

Table 4-13: Traveling Bridge Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	2
Number of Filter Cells	2
Dimensions of Each Cell, Length (ft) x Width (ft) x Depth (ft)	110 x 16 x 6.25
Total Filtration Area, ft^2	3,520
Filtration Rate with One Filter Offline, gpm/ft^2	1.97
Headloss Through Filter, ft (Operating)	1

Preliminary Layout

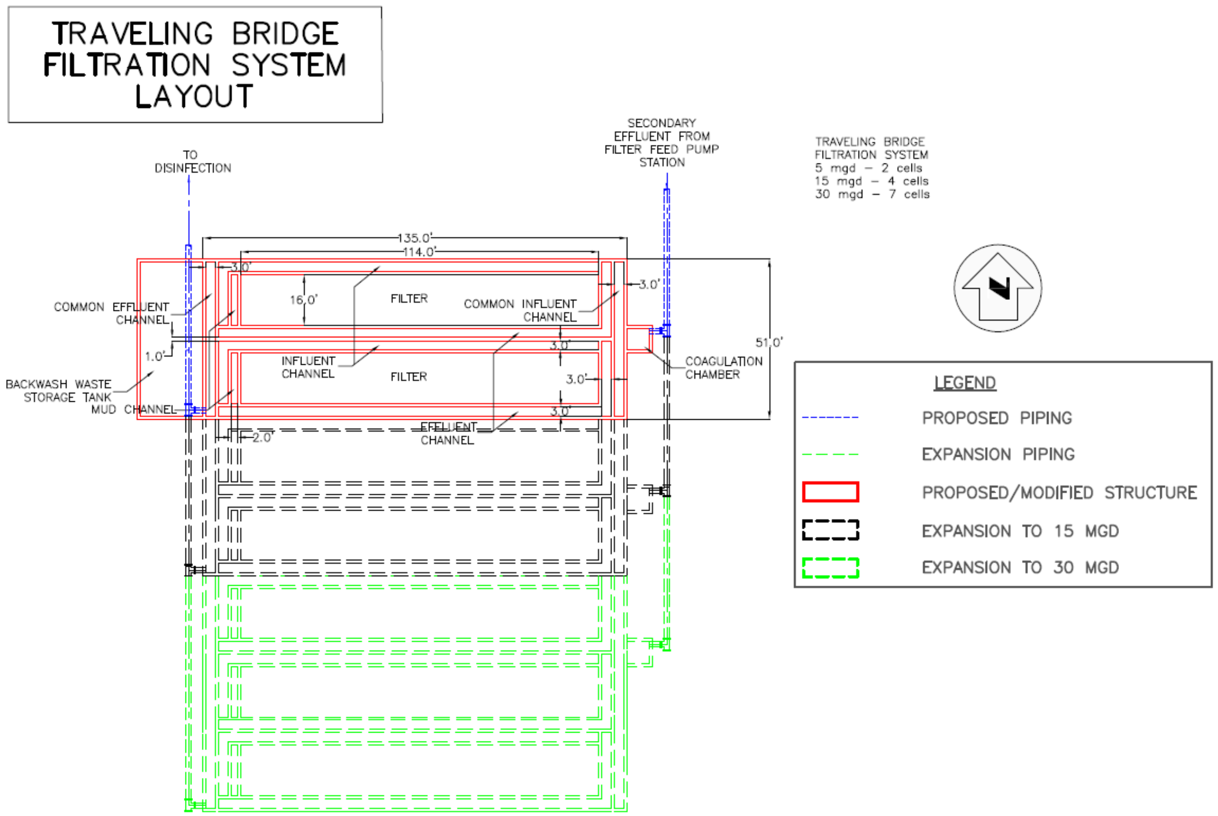

Figure 4-7: Preliminary Layout of 5 mgd Traveling Bridge Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-14: Traveling Bridge Filter Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,800,000
Total Capital Cost[a]	4,800,000
Total Annual O&M Cost[b]	80,000
20-Year Life Cycle Cost [c]	6,200,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

4.2.5 Fuzzy Filters

Features of Operation

Fuzzy filter is a proprietary filtration technology from Schreiber, LLC utilizing media consisting of highly porous (~90%) 1.25-inch diameter synthetic fiber spheres. The media is compressible, which allows the properties of the filter bed (including bed depth and porosity) to be controlled by the operator in response to changes in filter influent quality, amount of solids accumulated in the filter bed, and desired effluent quality. The high porosity allows the filter to be operated at a filtration rate well in excess of conventional incompressible granular media filters (30 gpm/ft2 as opposed to 5 gpm/ft2), which translates to a very compact footprint. The filters are supplied as modular, packaged units.

Figure 4-8: Fuzzy Filter (Figure from Schreiber, LLC)

The media is retained between two perforated plates as shown in Figure 4-8, of which the top plate is adjustable. During the "Filtration Cycle", the influent is filtered in an up-flow configuration - it is introduced at the bottom of the filter and withdrawn at the top of the filter. When the headloss across the filter reaches a predetermined set point or when the effluent turbidity exceeds a predetermined set point, the filter enters into the "Wash Cycle." Typically, backwashing is initiated every 24 hours or after the headloss across the filter exceeds a predetermined set point, whichever occurs sooner. In the "Wash Cycle," the adjustable plate automatically rises and the filter media is expanded using the flow velocity of filter influent water. "Washing air" is then introduced to scour the media and remove the captured solids. The dirty wash water is withdrawn from the top of the filter and returned to the plant. Before the filter is brought back into service, the adjustable plate comes back to its original position and the filter is flushed to waste ("Flush Cycle") for approximately one minute. The entire backwash cycle takes about 30 minutes. The backwash waste production rate is approximately 1 - 5% of the influent filter flow rate, depending upon the filter influent quality.

Advantages and disadvantages of fuzzy filters are summarized in Table 4-15 and the design criteria are summarized in the Table 4-16. A preliminary layout for the fuzzy filters at the TTDF is presented in Figure 4-9. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter unit is planned for the 5 mgd, 15 mgd, and 30 mgd systems.

Preliminary construction, O&M, and 20 year life-cycle cost estimates for fuzzy filters are presented in Table 4-17 below.

Advantages and Disadvantages

Table 4-15: Fuzzy Filter Advantages and Disadvantages

Advantages	Disadvantages
The CDPH approved filtration rate for Fuzzy Filters is high (≤30 gpm/ft^2), resulting in a compact footprint.	Fuzzy filters are proprietary and would need to be sole sourced from Schreiber, LLC.
The properties of the bed (porosity, depth, etc.) are adjustable and, thus, the filter is able to handle variations in influent quality.	The media is proprietary and media replacement is expensive.
Filters are supplied as easy to install skid mounted, packaged units.	There are only small (less than 1 mgd filtration capacity) installations in California.
	The history and number of Title 22 installations is limited.
	Backwashing requires the shutdown of the entire filter unit.

Design Criteria

Table 4-16: Fuzzy Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	30
Number of Filter Units	3
Dimensions of Each Filter Bed, Length (ft) x Width (ft)	7 x 7
Total Filtration Area, ft^2	147
Filtration Rate with One Filter Backwashing, gpm/ft^2	35.4
Headloss Through Filter, ft (Operating)	4

Preliminary Layout

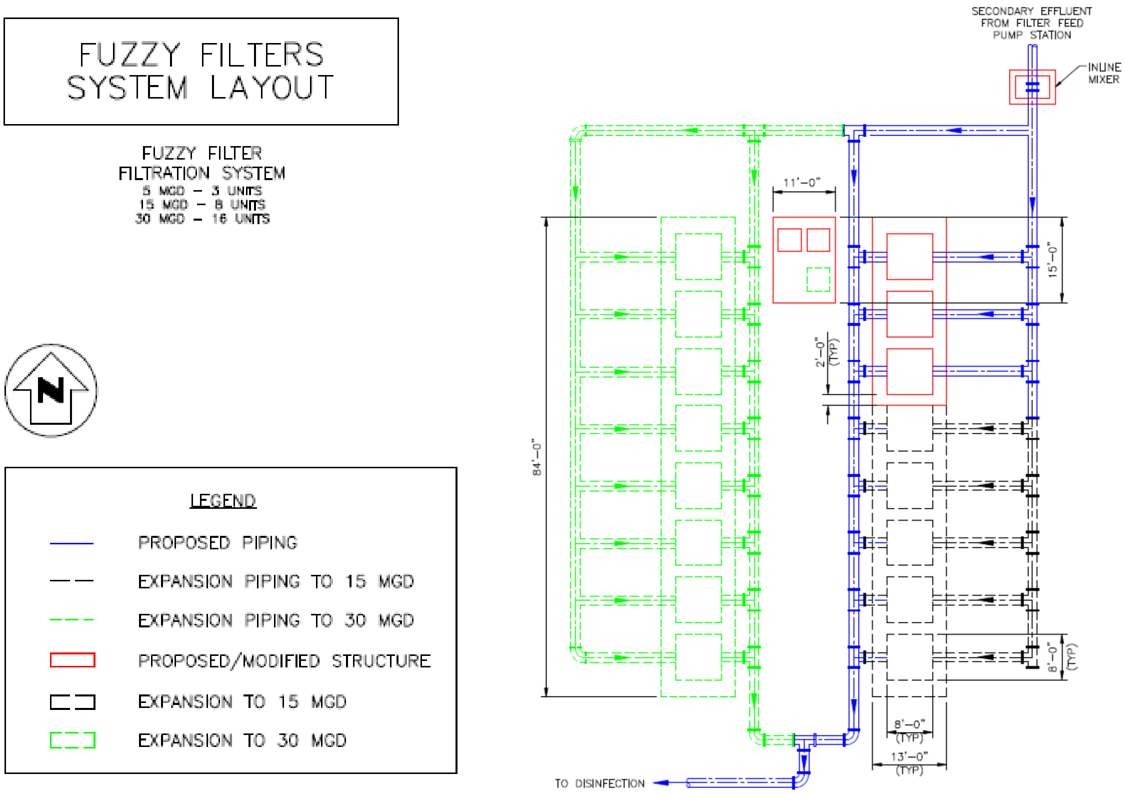

Figure 4-9: Preliminary Layout of 5 mgd Fuzzy Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-17: Fuzzy Filter Cost Summary(5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,350,000
Total Capital Cost[a]	4,100,000
Total Annual O&M Cost[b]	110,000
20-Year Life Cycle Cost [c]	6,000,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

4.2.6 Cloth Media Filters

Features of Operation

Cloth media filters are type of filters consisting of segmented disks of synthetic media. Unlike in deep bed granular media filtration, cloth media filters remove solids primarily by straining and, while the media does have depth, the “filter bed” is essentially two-dimensional. There are many proprietary products that fall into this category, including: AquaDisk from Aqua Aerobics, Hydrotech from Veolia, and Forty X from Siemens. Aqua Aerobics also supplies AquaDiamond, which operates on the same principles as AquaDisk; however, it is primarily used as a retrofit to traveling bridge filters.

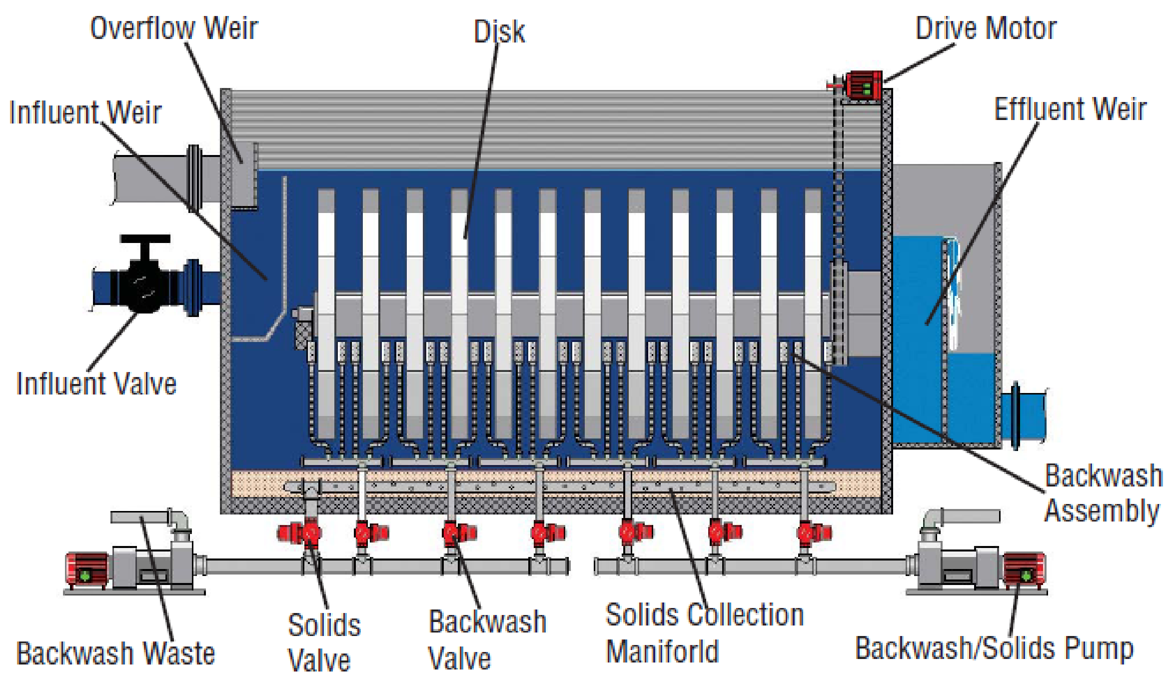

Figure 4-10: Cloth Media Filter (Figure from Aqua-Aerobic)

Depending upon the specific manufacturer, cloth media filters operate in both “inside-out” (filter influent is introduced within the center shaft of the disks, flows through the disk media, and filtered water is collected in the basin) and “outside-in” (filter influent is introduced in the basin, flows through the disk media, and filtered water is collected in the center shaft of the disks as shown in Figure 4-10) configurations. The description that follows describes a cloth media filter with an “out-to-in” configuration, such as AquaDisk. Inlet wastewater enters the basin, completely submerging the cloth media. Liquid passes through the cloth media. The filtered liquid enters the internal portion of the disk and is discharged through the center shaft. As the filter cloth collects solids on the outer surface, headloss across the media gradually increases and water level inside the tank rises to a set point elevation. At this point, the backwash cleaning system initiates backwash operation and cleans a set of two discs while the other discs in the tank continue filtration. During backwash, the disks undergoing backwash are rotated and a vacuum pump cleans the disk media. Influent will continue to be processed during the backwash cleaning cycle, allowing for continuous filtration. Heavier solids are allowed to settle to the bottom portion of the filter tank. These solids are then pumped on an intermittent basis. All components of the system are constructed from corrosion resistant materials designed for continuous operation.

The backwash waste production rate varies depending upon filter influent quality, but typically ranges from 5 - 10% of the filter influent flow rate. The number of backwashes per day also varies widely depending upon influent water quality. Typically, disks are backwashed every 30 to 40 minutes and the backwash duration for one 12 disk unit is 12 minutes.

Advantages and disadvantages of cloth media filters are summarized in Table 4-18 and the design criteria are summarized in the Table 4-19. A preliminary layout for the cloth media filters at the TTDF is presented in Figure 4-11. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter unit is planned for the 5 mgd, 15 mgd, and 30 mgd systems and that the structure that is planned for the 5 mgd system is sufficient for housing disks with a filtration capacity of up to 9 mgd. Preliminary construction, O&M, and 20 year life-cycle cost estimates for cloth media filters are presented in Table 4-20.

Advantages and Disadvantages

Table 4-18: Cloth Media Filter Advantages and Disadvantages

Advantages	Disadvantages
Filtration capacity can be increased without adding tanks. The cloth media filter considered for the TTDF is expandable to 9 mgd with just the addition of disks.	The design of cloth media filters is proprietary.
There are no moving parts during filtration.	The media for cloth media filters is proprietary and relatively expensive.
There is no downtime during backwashing (only a set of two disks are backwashed at a time).	There are pronounced spikes in effluent turbidity for ~5 minutes following backwash - more so than in conventional deep bed granular media filters.
Backwash volume requirements are low.	
The footprint is relatively small (since the disks allow for a high filter surface area per ft^2 of physical footprint).	
There is a good customer base in California with many Title 22 installations.	
The headloss across the filter is low.	
Media replacement is simple.	

Design Criteria

Table 4-19: Cloth Media Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	6
Number of Filter Units	3
Number of Disks per Unit	8
Total Filtration Area, ft^2	1291
Filtration Rate with One Filter Offline, gpm/ft^2	4.0
Headloss Through Filter, ft (Operating)	3

Preliminary Layout

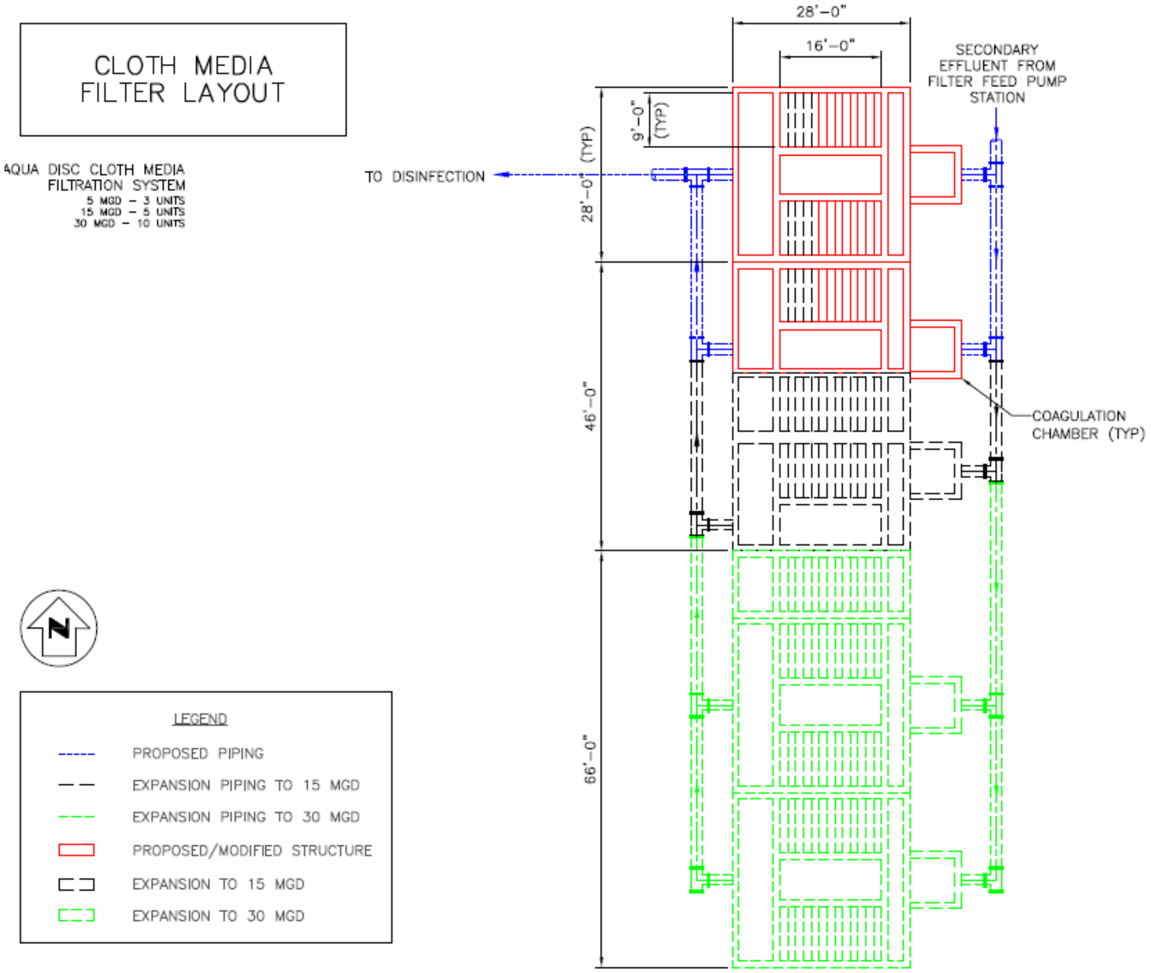

Figure 4-11: Preliminary Layout of 5 mgd Cloth Media Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-20: Cloth Media Filter Cost Summary (5 mgd Constant Flow[d])

Parameter	Cost ($)
Equipment and Structures Cost	1,400,000
Total Capital Cost [a]	4,100,000
Total Annual O&M Cost [b]	90,000
20-Year Life Cycle Cost [c]	5,700,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

[d]Concrete structure is capable of housing additional disks with a filtration capacity of 4 mgd i.e. the concrete structure is designed for a total filtration capacity of 9 mgd.

4.2.7 Nova Ultrascreen Filters

Features of Operation

The Nova Ultrascreen® filter is a proprietary filter from Nova Water Technologies that, like cloth media filters, utilizes segmented disks for filtration. The key difference between Nova Ultrascreen filters and cloth media filters is the filtration media - Nova Ultrascreen filters use precision woven stainless steel micronic screen mesh with precise perforation sizes depending upon the application. The media has no depth and the mechanism of solids removal is exclusively straining (i.e. operates as a surface filter). The filter operates in an “inside-out” configuration - the filter influent is directed to the inside of the disks, flows through the stainless steel mesh, and is collected in a clear well (see Figure 4-12 below). Nova Ultrascreen filters are supplied as modular, fully enclosed, packaged units constructed in full stainless steel.

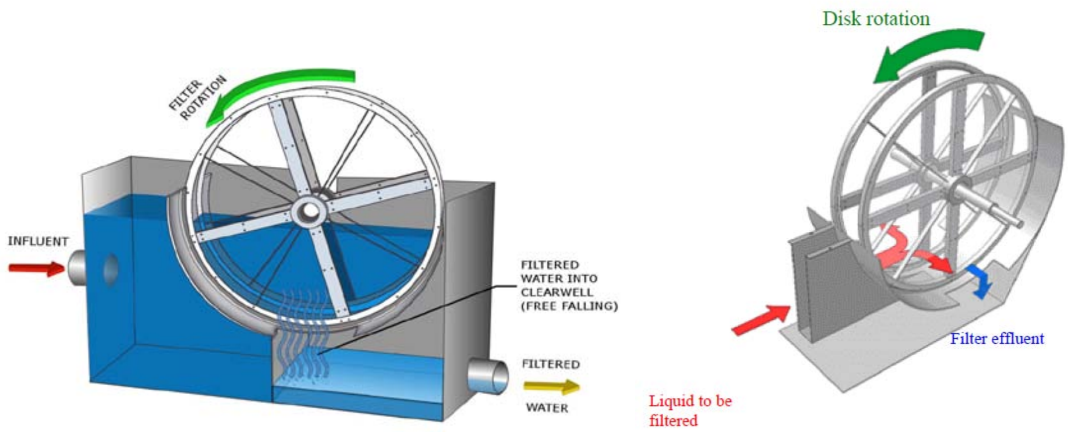

Figure 4-12: Nova Ultrascreen Filter (Figure from Nova Water Technologies)

The other major difference when compared to cloth media disc filters is that here the disks rotate continually during filtration in order to achieve "dynamic tangential filtration," a phenomenon that the supplier claims increases solids rejection and limits the build-up of solids on the screen. By continuously rotating the disks during filtration, the angle of approach taken by a particle will be less than 90^{o}, making the projected area of perforations in the media smaller than their rated size. Per the manufacturer, these filters are able to remove a target particle size of 10 microns with a mesh opening size of 20 microns due to "dynamic tangential filtration".

Nova Ultrascreen discs are partially submerged as shown in Figure 12. The backwash is initiated in a manner similar to cloth media disc filters upon the water level in the basin reaching a preset elevation. However, unlike the cloth media filters, the backwash is carried out via a set of backwash arms installed on both sides of the discs and fitted with nozzles. Per the manufacturer, the disks undergo "pulsed backwashing", which is a short burst of backwashes lasting 10-15 sec and occur quite frequently throughout the day. The number of backwashes per day varies widely depending on the quality of the influent. The filtration cycle continues during the backwash as the discs continually rotate. Upper half of the discs that are above the water level are backwashed while the lower half of the discs continue filtration. The backwash waste production rate also varies depending upon filter influent quality, but is typically less than 1% of the filter influent flow rate.

Advantages and disadvantages of Nova Ultrascreen filters are summarized in Table 4-21 and the design criteria are summarized in the Table 4-22. A preliminary layout for the Nova Ultrascreen filters at the TTDF is presented in Figure 4-13. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Note that one redundant filter unit is planned for the 5 mgd, 15 mgd, and 30 mgd systems. Preliminary construction, O&M, and 20 year life-cycle cost estimates for Nova Ultrascreen filters are presented in Table 4-23.

Advantages and Disadvantages

Table 4-21: Nova Ultrascreen Advantages and Disadvantages

Advantages	Disadvantages
The CDPH approved filtration rate for the Nova Ultrascreen filter is 16 gpm/ft^2, provided that the filter is coupled with a disinfection process that achieves a 5-log polio virus removal.	Nova Ultrascreen filters are proprietary and would need to be sole sourced from Nova Water Technologies.
Supplied as modular, packaged units that are easy to install.	The disks are continuously rotating, which could present reliability issues.
The filter occupies a small footprint.	Limited history of installations in operation (less than one year).
The media replacement is less frequent than for other non-granular media filters.	There are no operating municipal installations in California. All municipal installations are on the East Coast (total of eight installations, of which four are in Florida).
The disk rotation speed is variable, allowing the operator to adjust the speed based on the filter influent quality or the desired filtered water quality.	
The headloss across the filter is low.	
Effluent turbidity is relatively constant, even after a backwash.	

Design Criteria

Table 4-22: Nova Ultrascreen Filter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
CDPH Approved Filtration Rate, gpm/ft^2	16
Number of Filter Units	2
Number of Disks per Unit	10
Total Filtration Area, ft^2	444
Filtration Rate with One Filter Offline, gpm/ft^2	15.6
Headloss Through Filter, ft (Operating)	2.5

Preliminary Layout

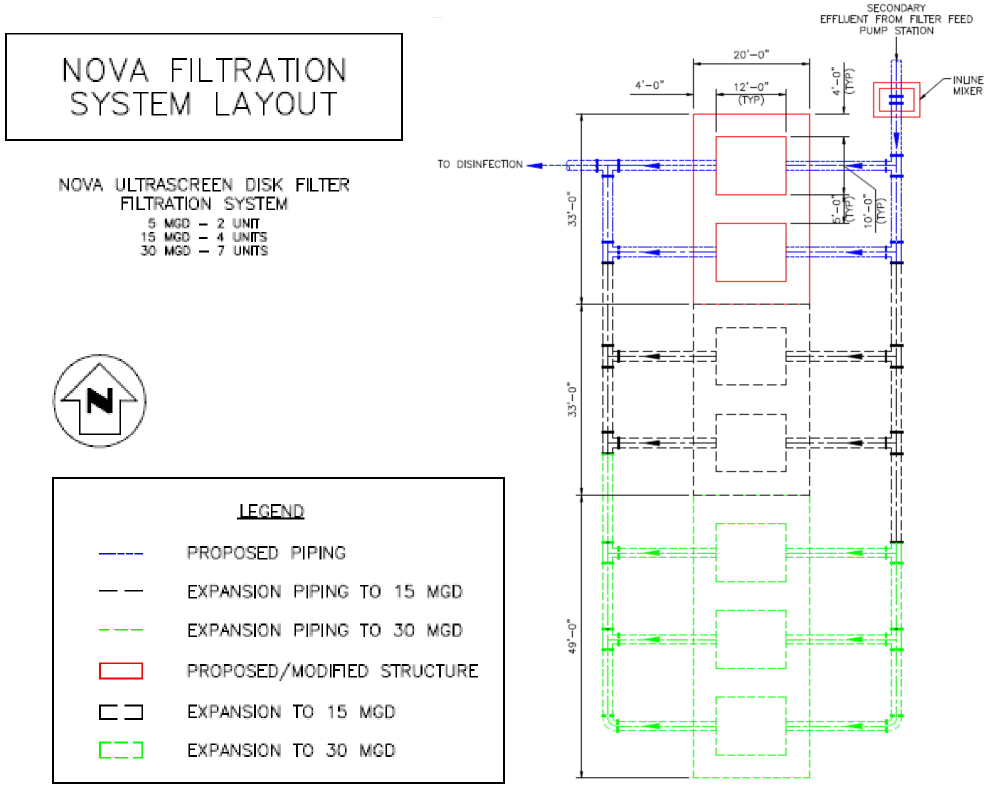

Figure 4-13: Preliminary Layout of 5 mgd Nova Ultrascreen Filter, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-23: Nova Ultrascreen Filter Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,200,000
Total Capital Cost[a]	3,500,000
Total Annual O&M Cost[b]	100,000
20-Year Life Cycle Cost [c]	5,300,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

4.2.8 Microfilters

Features of Operation

Microfilters use membrane filtration to separate micron-sized particles from the filter influent water. Like the Nova Ultrascreen, the solids removal mechanism used is straining - however, the membrane pore sizes are much smaller, typically close to 0.1 microns. The membrane material varies depending upon the supplier, but is usually natural or synthetic polymers. For example, Pall's Microza LGV microfilters are made of PVDF (polyvinylidene fluoride) membranes.

Microfilters can be arranged in horizontal or vertical configuration, depending on the influent quality and manufacturer. Microfilter modules are arranged in racks and are pre-engineered to suit various flow rates.

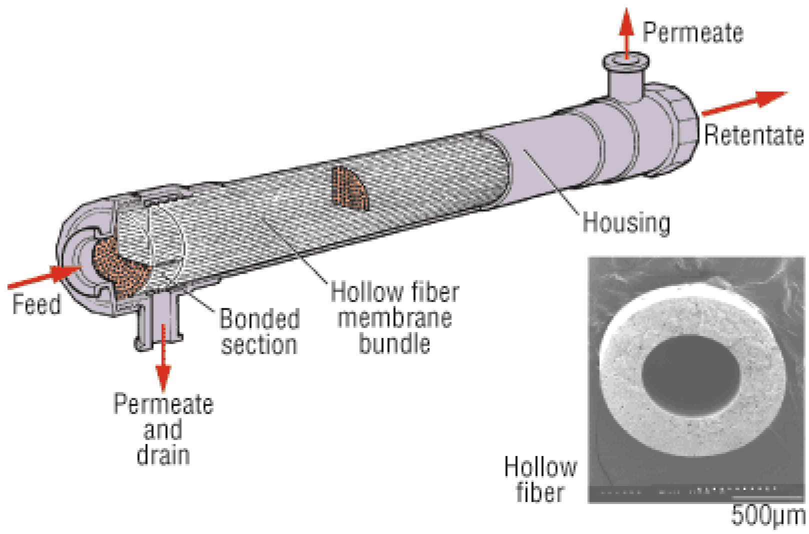

Figure 4-14: Microfilter Cross Section

Due to the small membrane pore sizes, the majority of solids and even some viruses are rejected and the quality of permeate produced is much higher than the quality of filtered water produced with media filtration technologies discussed earlier. Due to the high solids removal efficiency, the downstream disinfection efficiency is enhanced. If UV disinfection is used, the NWRI guidelines allow for a smaller UV system resulting in significant capital and operating cost savings when operating on microfilter permeate.

Advantages and disadvantages of microfilters are summarized in Table 4-24 and the design criteria are summarized in the Table 4-25. A preliminary layout for microfilters at the TTDF is presented in Figure 4-15. The footprint for 5 mgd, 15 mgd, and 30 mgd capacity is presented. Peliminary construction, O&M, and 20 year life-cycle cost estimates for microfilters are presented in Table 4-26.

Advantages and Disadvantages

Table 4-24: Microfilter Advantages and Disadvantages

Advantages	Disadvantages
Microfilters produce recycled water exceeding Title 22 requirements.	Microfilters have a higher capital cost when compared to media filters.
Microfilters remove most viruses, giardia, and crypto.	The influent pumping requirements increase the O&M costs when compared to media filters.
Available in modular, skid mounted units - lowering installation costs.	Membrane replacement is relatively expensive.
When coupled with a downstream UV disinfection system, substantial cost savings can be realized when compared to media filtration coupled with UV disinfection.	Microfilters are more O&M intensive than conventional media filters.

Design Criteria

Table 4-25: Microfilter Design Criteria

Parameter	Criteria
Design Flow, mgd	5
Flux Rate, gpd/ft^2	Not regulated[1]
Feed pressure, psi	20-30

[1] Flux rates are not regulated for Title 22 recycled water applications. The microfilter membranes used for Title 22 applications are similar to the ones approved for drinking water filtration applications, where the approved flux rates range from 75 – 120 gpd/sq.ft, depending on the manufacturer. However, based on current installations for Title 22 applications, the operating flux rates range from 30-50 gpd/sq.ft.

Preliminary Layout

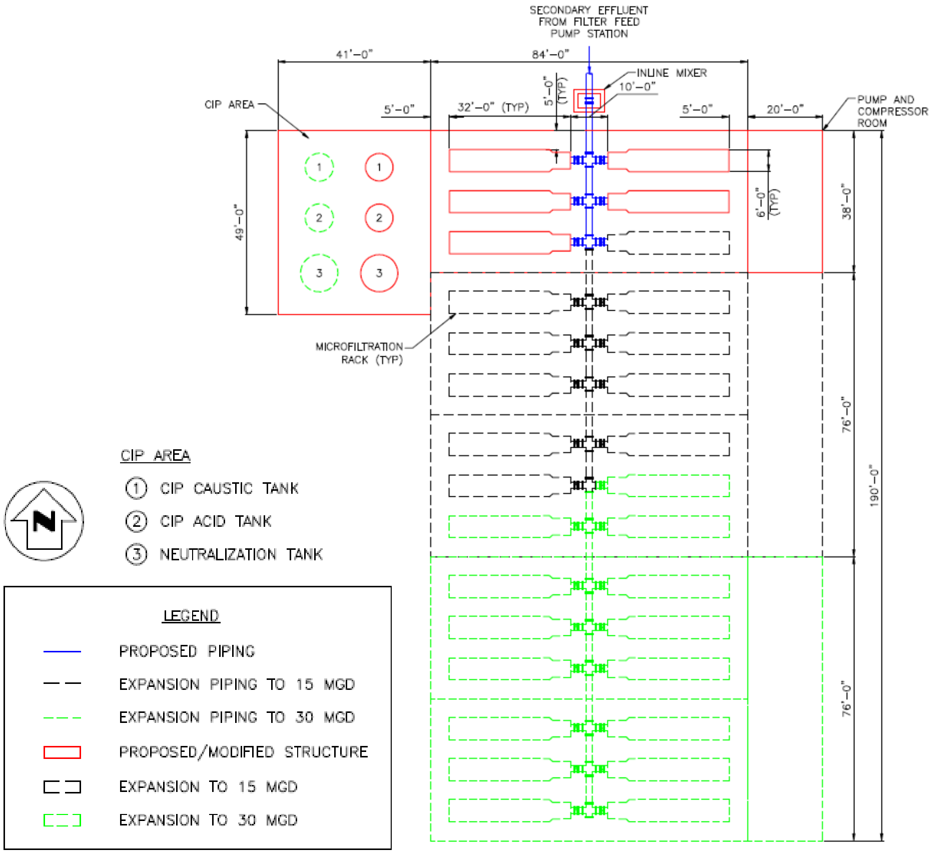

Figure 4-15: Preliminary Layout of 5 mgd Microfiltration System, with Future Footprint for Phased Expansion to 30 mgd

Cost Summary

Table 4-26: Microfilter Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	3,500,000
Total Capital Cost [a]	10,700,000
Capital Cost Credit for UV Disinfection [b]	(2,000,000)
Net Total Capital Cost	8,700,000
Total Annual O&M Cost [c]	400,000
Annual O&M Cost Credit for UV Disinfection	(100,000)
Net Total Annual O&M Cost	300,000
20-Year Life Cycle Cost [d]	14,200,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Credit due to higher UVT and lower UV dosage for microfilter permeate.
[c]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[d]At a 5% discount rate and a 4% escalation rate.

4.3 SUMMARY OF COSTS

Table 4-27 presents a summary of the construction, O&M, and 20-year life-cycle cost estimates for each of the eight filtration technologies evaluated. As can be seen below, Nova Ultrascreen filters are the lowest both in terms of capital cost (~$300,000 less than continuous backwash filters, the next lowest cost alternative) and 20-year life-cycle cost (~$400,000 less than cloth media filters, the next lowest cost alternative). See Appendix A for preliminary cost estimates.

Table 4-27: Summary of Costs of Each 5 mgd Constant Flow Filtration Alternative

Technology	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
Dual Media Gravity Filters	4.3	90	5.9
Deep Bed Monomedia Filters	4.4	90	6.0
Continuous Backwash Filters	3.8	105	5.6
Travelling Bridge Filters	4.8	80	6.2
Fuzzy Filters	4.1	110	6.0
Cloth Media Filters[1]	4.1	90	5.7
Nova Ultrascreen Filters	3.5	100	5.3
Microfilters[2]	8.7	300	14.2

[1]Concrete structure is designed for a filtration capacity of up to 9 mgd.
[2] Includes UV system credit.

SECTION 5 - DISINFECTION SYSTEM ALTERNATIVES ANALYSIS

5.1 BACKGROUND

Currently the RWRF does not disinfect the secondary treated effluent. The secondary effluent is discharged to percolation ponds through effluent canals A and B. As described earlier in this TM, in order to upgrade the discharge to California Title 22 standards for unrestricted reuse, the City has decided to construct a TTDF, which consists of filtration, disinfection and storage. This Section of the TM evaluates three alternatives for disinfection at the TTDF.

The two disinfection technologies evaluated are:

1. Ultraviolet (UV) Disinfection
    a. Open Channel UV Disinfection
    b. In-pipe UV Disinfection

2. Ozone Disinfection

The UV disinfection system considers low pressure, high intensity lamps, which are the result of progressive research and energy conservation measures over the years. The use of low pressure high intensity lamps results in a compact and more efficient UV disinfection system. Ozone disinfection, which is still considered an emerging technology for wastewater disinfection, considers generation of ozone from liquid oxygen. Ozone can also be generated from air, which however, may be cost prohibitive for a large plant such as TTDF.

5.2 UV DISINFECTION

UV disinfection utilizes ultra-violet portion of the light spectrum to render disease causing pathogens inactive. The UV lamps can be placed in several banks, in series, in an open channel system or may be placed inside a vessel (pipe) for an inline UV system. The design of UV system highly depends on the quality of water being disinfected. The UV system design criteria for tertiary-filter (media based) treated recycled water are more stringent than membrane treated recycled water, primarily due to the fact that the higher turbidity of former creates a shielding effect on pathogens thus reducing the effectiveness of UV light. According to National Water Research Institute (NWRI), May 2003 guidelines, the minimum UV transmittance for media filter effluent and membrane effluent shall be 55% and 65% at 254 nm, respectively. The minimum UV dose required for media filter effluent and membrane effluent are 100 mJ/cm2 and 80 mJ/cm2, respectively, under maximum flow. Besides the above criteria, end of lamp life and fouling factors are used in the design of UV system. The former addresses the loss in the output of UV lamps as they age and the latter compensates for the fouling of lamp sleeve. The values of these factors differ from manufacturer to manufacturer as approved by CDPH. To comply with CDPH standards for unrestricted reuse (Title 22) of wastewater effluent, the City will need to provide tertiary treatment (filtration) to reduce the effluent suspended solids to a turbidity level less than 2 NTU in case of media filtration and less than 0.2 NTU for membrane filtration prior to final disinfection. By removing a majority of the solids, the effectiveness of the downstream disinfection process is enhanced.

5.2.1 UV Design Criteria

According to NWRI guidelines, the UV disinfection system for TTDF should include the following two parameters and should be designed according to Table 5-1:

1. The UV system should be capable of 5 – log polio virus inactivation and total coliform not to exceed 2.2 MPN/ 100 ML
2. The UV system should include one standby bank per train or a separate standby train must be provided.

Table 5-1: UV Disinfection Design Criteria

Parameter	Units	Media Filtration	Membrane Filtration
Capacity	mgd	5	5
UV Transmittance	UVT	55%	65%
Design Dose (Maximum daily design flow of 5 mgd)	mJ/cm2	100	80

5.3 UV OPEN CHANNEL EQUIPMENT AND STRUCTURE

Features of Operation

In an open channel disinfection system, the UV lamps are placed in modules and several modules make up for a bank. These banks may be placed in series in a channel to provide required disinfection (refer to Figure 5-1). For the TTDF, two identical parallel channels will be constructed to house UV banks; the channels will be located north of the effluent canal B. The channels will initially house 3 banks each to accommodate 5 mgd filtered water flow through the facility. The channels will be designed to have extra room for adding more banks in the future to disinfect up to a total of 10 mgd flow in the same structure as shown in Figure 5-2. The design characteristics of the UV channels are shown in Table 3. Each UV channel will have a level control gate / weir at the discharge end to ensure the UV lamps are submerged consistently. The disinfected water will be either conveyed by gravity or pumped into storage for distribution.

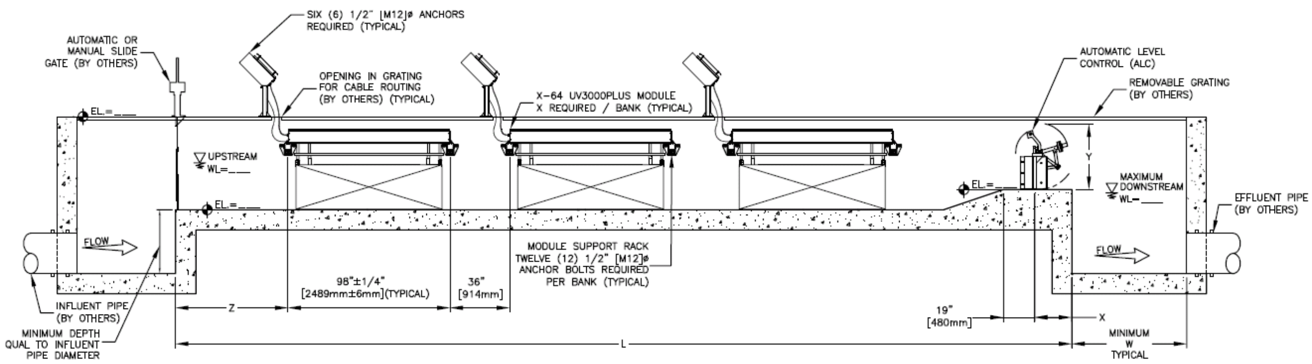

Figure 5-1: Simplified Schematic of a UV-Open Channel System

Advantages and Disadvantages

Advantages and Disadvantages are included in Table 5-2

Table 5-2: UV Disinfection Advantages and Disadvantages

Advantages	Disadvantages
Modular design - UV banks may be added to the same channel to increase capacity	Canopy/building may be required to protect the electronic ballasts from direct sunlight
Lamps are arranged in modules - each module can be taken out for maintenance without taking the bank offline.	Mechanical components like mechanical wiping system require more maintenance
Low head loss	Future compliance with EDC's and NDMA is expensive as it requires increasing the UV dose to 6-7 times by upgrading the facility by employing reverse osmosis and or increasing the number of UV banks.
Less process instrumentation and controls required when compared to other technologies considered for the project	
Extensive experience in wastewater disinfection	

Open Channel UV Design Characteristics

Key design criteria for open channel UV system are listed in Table 5-3 below.

Table 5-3: Design Characteristics of Open Channel UV System for Design Flow of 5 mgd

Parameter	Units	Design Value
Type of UV system	-	Low Pressure, High Intensity
Number of Channels	-	2
Length of channel	ft	62
Width of Channel	ft	4
Depth of Channel	ft	5.2
Total Number of Banks	-	6 (4 Duty, 2 Redundant)
Total Number UV lamps	-	528 (including redundancy)
Disinfection Capacity per Bank	mgd	1.25

Preliminary Layout

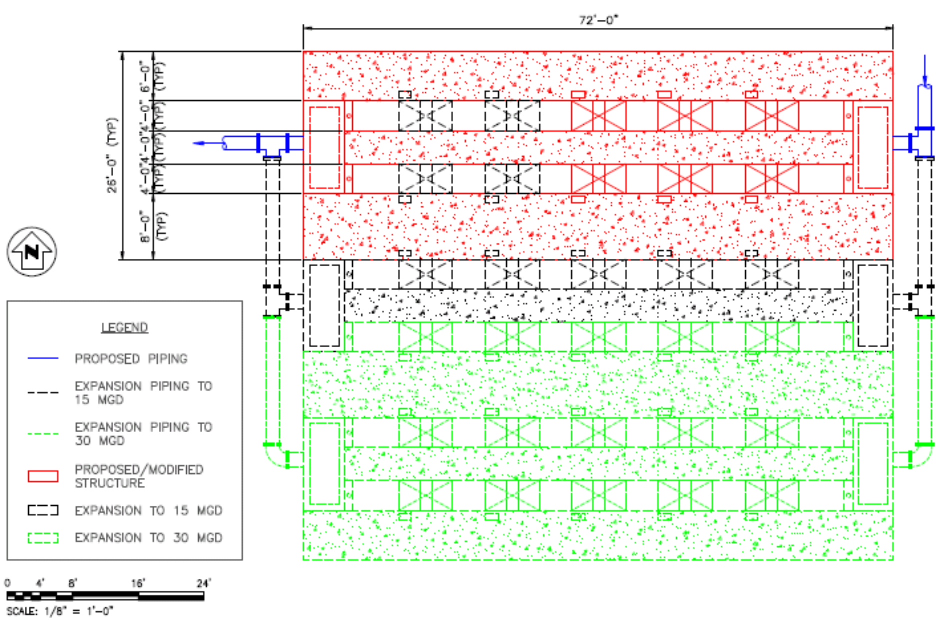

Figure 5-2: Preliminary Layout of 5 mgd UV Open Channel Disinfection System, with Future Footprint for Phased Expansion to 30 mgd

5.3.1 Expandability

The UV system layout is presented in Figure 5-2 above planned for 5 mgd, expandable to 15 mgd and ultimately to 30 mgd capacity. The initial expansion to 15 mgd shall be accomplished by providing additional banks (two banks each) in the existing two channels and constructing an additional identical channel with same number of banks. The ultimate 30 mgd expansion will require construction of three additional identical channels and populating them with equal number of banks.

5.3.2 Capital, O&M and Life Cycle Costs

The capital cost includes cost for 5 mgd UV equipment, concrete structure, canopy, distribution pipes and a building required to house the ballasts. Table 5-4 below presents preliminary capital, O&M and 20 year life cycle costs.

Table 5-4: Open Channel UV System Following Media Filtration Cost Summary (5 mgd Constant Flow[d])

Parameter	Cost ($)
Equipment and Structures Cost	1,450,000
Total Capital Cost [a]	4,500,000
Total Annual O&M Cost [b]	230,000
20-Year Life Cycle Cost [c]	8,700,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to mid point of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

[d]Concrete structure designed to house additional banks with a disinfection capacity of 5 mgd for a total disinfection capacity of 10 mgd.

5.4 UV IN-PIPE EQUIPMENT AND STRUCTURE

Features of Operation

UV in-pipe system consists of UV lamps that are housed in a stainless steel reactor. Each reactor has an inlet and an outlet and the flow can be controlled via a flow meter and a control valve. This system requires more instrumentation and control than the open channel UV systems. The capacity of each reactor considered (for workshop no. 1) is approximately 2.30 mgd for filtered water. For 5 mgd system four reactors (3 Duty + 1 Standby) would be necessary to reliably disinfect the required flow as shown in Figure 4. The reactors can be arranged in series or parallel depending on the manufacturer, site constraints and capacity of the facility. Several trains can be installed parallel to each other to provide require disinfection capacity.

Based upon Parsons' discussions with the in-pipe UV disinfection system manufacturers and CDPH, we understand that in-pipe UV disinfection systems are validated but are not approved for Title 22 unrestricted water reuse. It is our understanding that CDPH approves in-pipe UV disinfection systems on a case-by-case basis, only after a wastewater facility has installed the particular system under consideration.

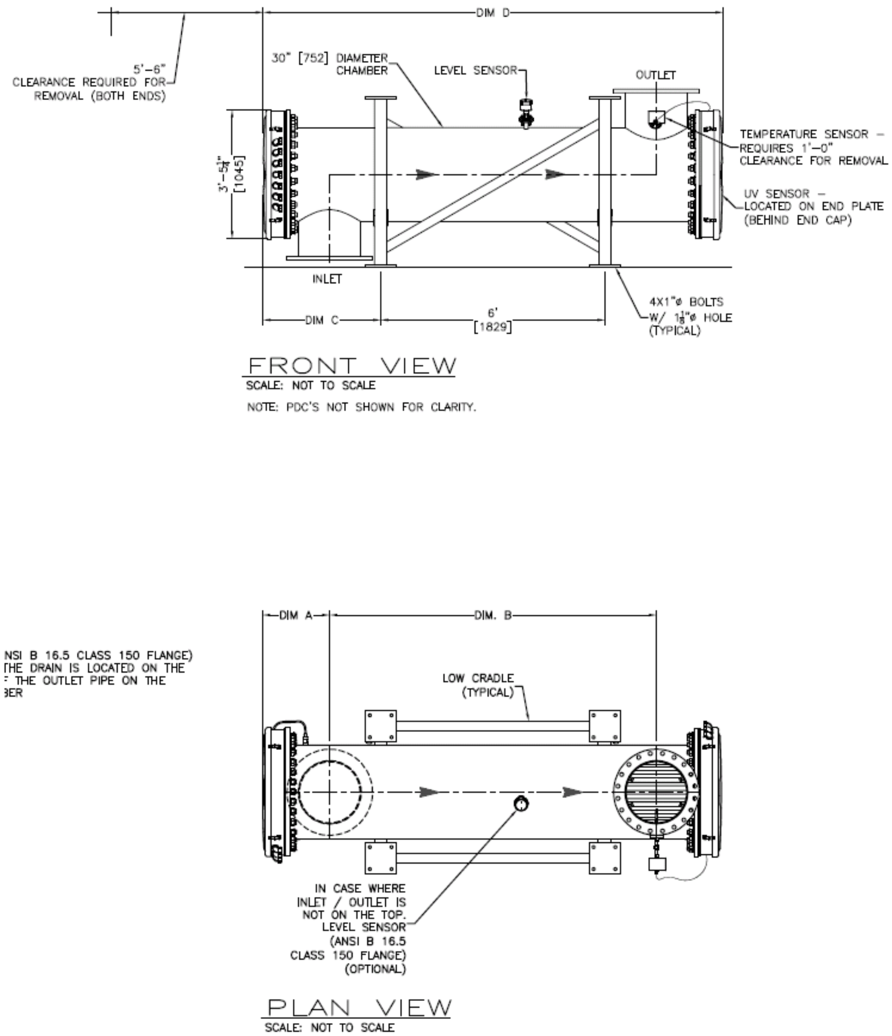

Figure 5-3: Simplified Schematic of an In-pipe UV Disinfection System

Advantages and Disadvantages

Table 5-5 below shows advantages and disadvantages for In-pipe UV disinfection system.

Table 5-5: In-pipe UV Disinfection System Advantages and Disadvantages

Advantages	Disadvantages
Modular design – UV inline system reactors are modular and can be places parallel or in series depending on design capacity	Lamps are enclosed in the reactor and it needs to be taken off line for servicing
Ease of expandability	More modulating valves required to control flow
Less civil and site work is required compared to other disinfection technologies considered in the project.	More process instrumentation and control required
Little to no site excavation required	CDPH approves the system on a case by case basis; CDPH has not given any blanket approved for inline systems.
Lamps are serviceable from the reactor end	

In-pipe UV Design Characteristics

Key design criteria for in-pipe UV system are listed in Table 5-6 below.

Table 5-6: Design Characteristics of In-pipe UV System for Design Flow of 5 mgd

Parameter	Units	Design Value
Type of UV system	-	Low Pressure, High Intensity
Number of Reactors	-	4
Length of Reactor	ft	13
Total number of lamps in each Reactor	-	144
Total Number UV lamps	-	576 (including redundancy)
Disinfection Capacity per Reactor	mgd	2.3

Preliminary Layout

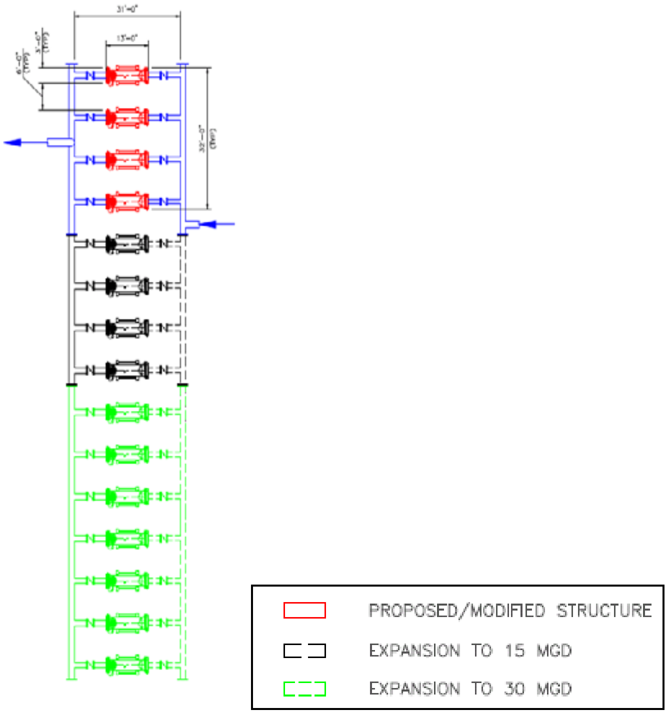

Figure 5-4: In-pipe UV Disinfection System

5.4.1 Expandability

The initial 5 to 15 mgd expansion of the facility will be accomplished by adding 4 additional reactors of the same capacity. Similarly expansion to 30 mgd will be accomplished by adding 7 additional reactors. However several automatic actuated control valves and flow meters will be required to ensure proper flow distribution and control to each reactor. This will lead to higher instrumentation and control costs and operational complexity compared to open channel UV system.

5.4.2 Capital, O&M and Life Cycle Costs

The capital cost includes cost for 5 mgd inline UV equipment, concrete pad, canopy, distribution pipes and a building required to house the ballasts. Table 5-7 below presents preliminary capital, O&M and 20 year life cycle costs.

Table 5-7: In-pipe UV Disinfection System following Media Filtration Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	1,460,000
Total Capital Cost [a]	4,800,000
Total Annual O&M Cost [b]	230,000
20-Year Life Cycle Cost [c]	8,900,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

5.5 OZONE DISINFECTION

Features of Operation

Ozone is a much stronger disinfectant than chlorine, UV and other common disinfectants. Unlike chlorine (or sodium hypochlorite) which diffuses through the cell wall of the microorganisms and disinfects, ozone oxidizes the cell wall causing the microbes to disintegrate. Ozone is a very strong oxidizing agent with 1.5 times the oxidizing potential of chlorine.

Ozone is produced from either air or oxygen. Typically, the concentration of ozone is about 3 % (maximum) when produced by air versus 10% when produced using oxygen. Therefore ozone generation using air could be cost prohibitory for smaller installations. For purposes of this evaluation, ozone generation system using liquid oxygen is considered. The system is designed for a dose of 10mg/L with a contact time of 15 minutes to be conservative and to keep a factor of safety for the system. Pilot testing is highly recommended to establish a design dose and contact time for ozone disinfection of recycled water specific to TTDF, which is an additional cost to the project.

Ozone Disinfection Equipments and Structure

Ozone disinfection system comprises a liquid oxygen tank that provides liquid oxygen to ozone generators via ambient vaporizers (used to eliminate moisture). Nitrogen gas is introduced in the ozone generators as a catalyst. The ozone is produced by several dielectrics in the generators and is introduced into the filtered water via coarse bubble diffusers in a contact basin. Excess ozone is collected and destroyed in the ozone destruct system as shown in schematic Figure 5-5. A preliminary layout for ozone disinfection system is included as Figure 5-6.

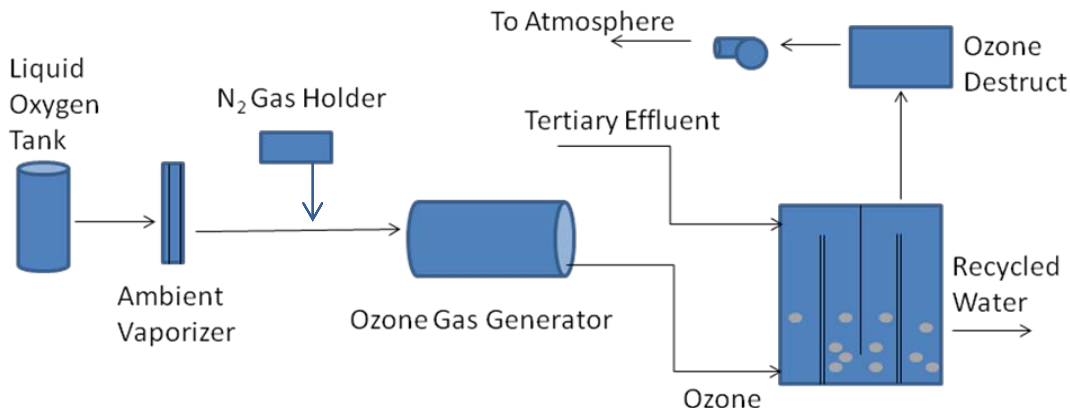

Figure 5-5: Schematic of Ozone Generation

Advantages and Disadvantages

Table 5-8 includes advantages and disadvantages for Ozone disinfection system.

Table 5-8: Ozone Disinfection System Advantages and Disadvantages

Advantages	Disadvantages
Skid mounted system	Dose and contact time are critical and must be decided carefully
Less civil and site work required for the equipment	Regular liquid oxygen supply is required
Compact design	Second and third phase expansion will require larger units than the one proposed for initial installation
More economical for future removal of Endocrine Disruptive Chemicals and NDMA etc.	More process instrumentation and controls required
	Extensive mechanical equipment required for the system
	High power consumption
	Limited experience in wastewater disinfection

Ozone Disinfection Equipments and Structure

The ozone disinfection system design criteria are summarized in the Table 5-9 below.

Table 5-9: Design Characteristics of Ozone Disinfection System for Design Flow of 5 mgd

Parameter	Units	Design Value
Ozone Dose	mg/L	10
Contact Time	Minutes	15

Preliminary Layout

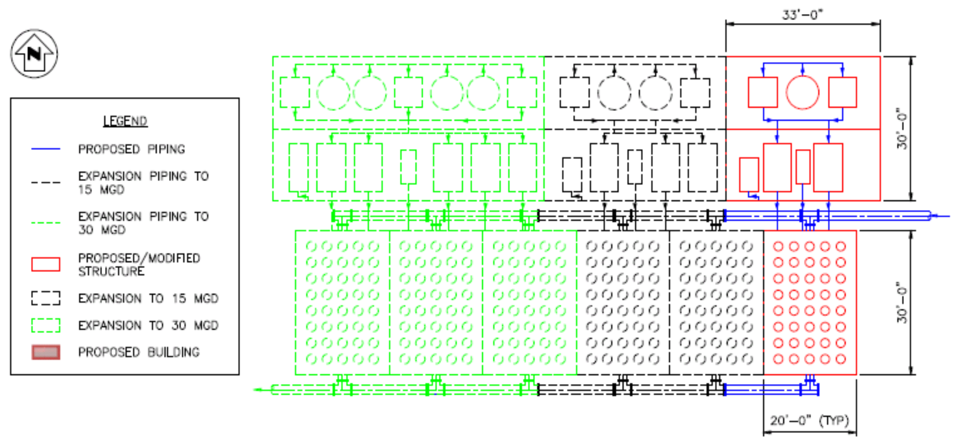

Figure 5-6: Ozone Disinfection System

5.5.1 Expandability

The Ozone system is skid mounted but may not be expandable as easily as UV disinfection systems. Increasing the capacity of the system may be accomplished by including more reactors of the same size or larger Ozone reactors and larger contact basins which need to be carefully designed. Alternatively, the larger Ozone Generators may be installed initially and similar Ozone generators may be added depending on the capacity of expansion.

5.5.2 Capital, O&M and Life Cycle Costs

The capital cost for the ozone disinfection system includes 5 mgd ozone equipment, concrete pad, distribution pipes and building required to house ozone reactors. Table 5-10 below presents preliminary capital, O&M and 20 year life cycle costs.

Table 5-10: Ozone Disinfection System Cost Summary (5 mgd Constant Flow)

Parameter	Cost ($)
Equipment and Structures Cost	2,200,000
Total Capital Cost [a]	6,600,000
Total Annual O&M Cost [b]	450,000
20-Year Life Cycle Cost [c]	14,800,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b]Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c]At a 5% discount rate and a 4% escalation rate.

5.6 SUMMARY OF COSTS

Table 5-11: Summary of Costs for Disinfection System Alternatives (5 mgd Constant Flow)

Technology	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
UV – Open Channel[1]	4.5	230	8.7
UV – In-pipe	4.8	230	8.9
Ozone	6.6	450	14.8

[1]Concrete structure designed to house banks with a total disinfection capacity of 10 mgd.

SECTION 6 - STORAGE SYSTEM ALTERNATIVES ANALYSIS

6.1 BACKGROUND

As pointed out in Section 1, the City's goal is to produce 25,000 acre-ft/year of recycled water by 2025. This TM will present the four storage alternatives that were evaluated for the TTDF.

The following four storage alternatives were considered:

- Earthen basins, lined and covered
- Steel tank
- Pre-stressed concrete tank
- Conversion of Train A aeration basin into a storage reservoir

The last option (the conversion of a Train A aeration basin into a storage tank) is only an option if the City decides to select MBR alternative. A detailed discussion of the MBR option is presented in Section 7.

6.2 STORAGE ALTERNATIVES

6.2.1 Earthen Basins, Lined and Covered

Description

Earthen basins are constructed by excavating and forming earthen berms with the excavated soil, resulting in basins that are partially above grade and partially below grade. In order to function as a storage reservoir, the basins must be lined (to prevent loss of recycled water via percolation) and covered (to prevent the loss of recycled water via evaporation and the contamination of recycled water). While there are many options for lining and covering earthen basins, the use of gunite lining and a hypalon membrane cover have been considered in the evaluation of this alternative. Gunite lining is proven, cost effective, easy to install, and has been used by the City in the past. Hypalon membrane covers, while more expensive than polypropylene or high density polyethylene (HDPE) membrane covers, are of a superior quality, and come with a standard 30-year material warranty.

Advantages and disadvantages of earthen basins are summarized in Table 6-1 and the design criteria are summarized in Table 6-2. A preliminary layout for the earthen basins at the TTDF is presented in Figure 6-1. Preliminary construction, O&M, and 20 year life-cycle cost estimates for the planned earthen storage basins at the TTDF are presented in Table 6-3. The typical life of storage structures is at least 50 years; however, a 20 year life-cycle cost analysis is presented for consistency.

Advantages and Disadvantages

Table 6-1: Earthen Basins Advantages and Disadvantages

Advantages	Disadvantages
Lined and covered earthen basins are typically less expensive than steel tanks or concrete tanks.	Periodic maintenance and replacement of floating membrane covers are required.
Earthen basins are easily constructed.	Membrane covers need to be removed to access the basin internals for maintenance.
Permits recycled water from the treatment system to flow by gravity into the storage	Leak detection is difficult.
Partitions within the basin allow for taking one cell offline for maintenance while keeping the others in operation.	Floating covers are prone to vandalism.
	Less conducive to water circulation, which may impact water quality.

Design Criteria

Table 6-2: Earthen Basins Design Criteria

Parameter	Criteria
Design Capacity, MG	5
Number of Basins	2
Dimensions of Each Basin, Length (ft) x Width (ft) x Depth (ft) (Free Board (ft))	255 x 180 x 10 (3)
Side Wall Slope (H:V)	3:1
Number of Distribution Pumps	2 (1 duty + 1 standby)
Distribution Pump Capacity, Each	3,500 gpm
Distribution Pump Discharge Head	230 feet
Distribution Pump Motor hp, Each	300 hp

Preliminary Layout

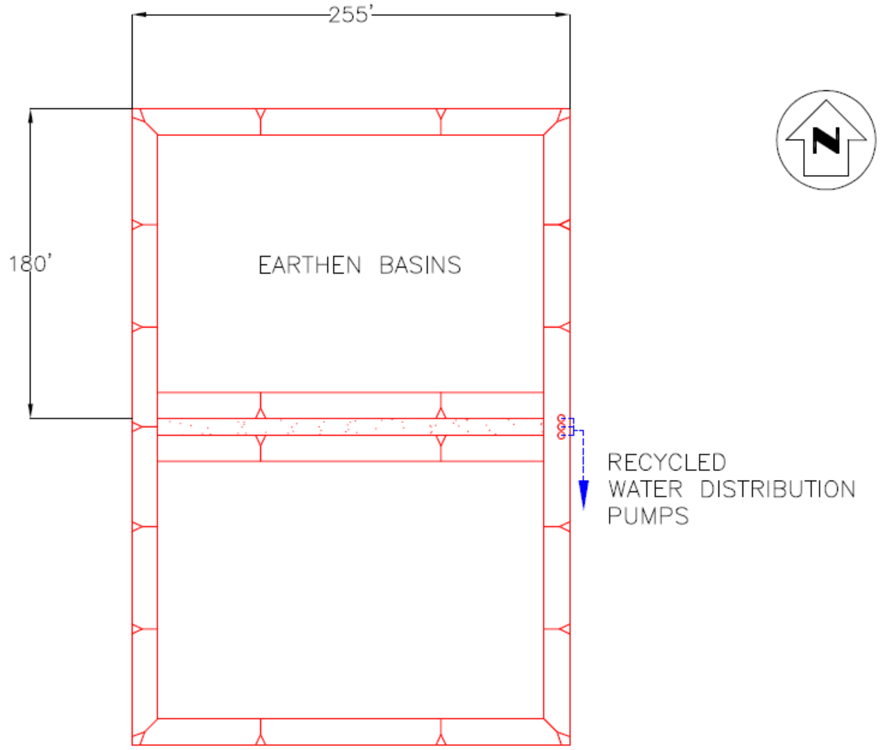

Figure 6-1: Preliminary Layout of 5 MG Earthen Basins

Cost Summary

Table 6-3: Earthen Basins and Recycled Water Pump Station Cost Summary

Parameter	Cost ($)
Total Capital Cost[a]	4,000,000
Total Annual O&M Cost[b]	310,000
20 Year Life-Cycle-Cost[c]	9,600,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

6.2.2 Steel Tank

Description

A single welded steel storage tank with a welded steel roof and a concrete ring wall foundation has been considered in the evaluation of this alternative. Advantages and disadvantages of steel tanks are summarized in Table 6-4 and the design criteria are summarized in Table 6-5. A preliminary layout for the steel tank at the TTDF is presented in Figure 6-2. Preliminary construction, O&M, and 50 year life-cycle cost estimates for the planned steel storage tank at the TTDF are presented in Table 6-6.

Advantages and Disadvantages

Table 6-4: Steel Tank Advantages and Disadvantages

Advantages	Disadvantages
Steel storage tanks are typically less expensive than concrete storage tanks.	Since steel storage tanks are installed above grade, pumping to the steel storage tank will be required - adding to O&M costs.
Circular shape promotes water circulation, improving water quality.	Steel storage tanks require maintenance (e.g. painting of the interior surface) and typically have lower lifetimes when compared to concrete tanks.
Leakage can be readily detected.	Cathodic protection is required to prevent corrosion.
	When maintenance is required, entire tank needs to be taken out of service.

Design Criteria

Table 6-5: Steel Tank Design Criteria

Parameter	Criteria
Design Capacity, MG	5
Number of Tanks	1
Dimensions of Tank, Diameter (ft) x Depth (ft) (Free Board (ft))	210 x 24 (4)
Number of Feed Pumps	2 (1 duty + 1 standby)
Feed Pump Capacity, Each	3,500 gpm
Feed Pump Discharge Head	20 feet
Feed Pump Motor hp, Each	30 hp
Number of Distribution Pumps	2 (1 duty + 1 standby)
Distribution Pump Capacity, Each	3,500 gpm
Distribution Pump Discharge Head	230 feet
Distribution Pump Motor hp, Each	300 hp

Preliminary Layout

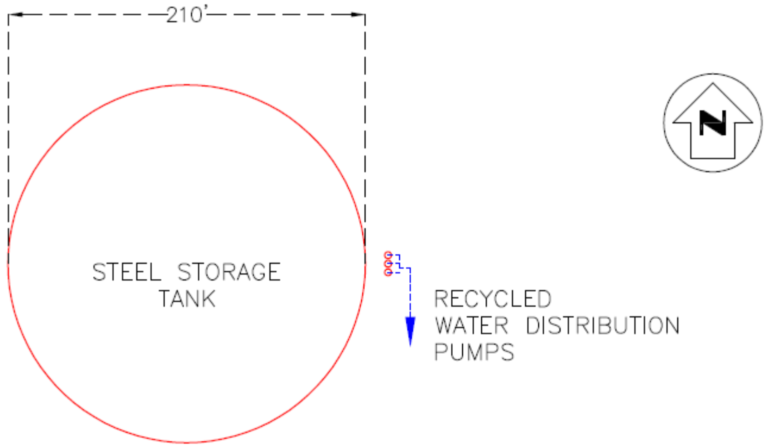

Figure 6-2: Preliminary Layout of 5 MG Steel Tank

Cost Summary

Table 6-6: Steel Tank and Recycled Water Pump Station Cost Summary

Parameter	Cost ($)
Total Capital Cost[a]	6,400,000
Total Annual O&M Cost[b]	370,000
20 Year Life-Cycle-Cost[c]	13,100,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for feed and distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

6.2.3 Prestressed Concrete Tank

Description

A single partially buried, strand-wrapped circular prestressed concrete storage tank has been considered in the evaluation of this alternative. Advantages and disadvantages of prestressed concrete tanks are summarized in Table 6-7 and the design criteria are summarized in Table 6-8. A preliminary layout for the prestressed concrete tank at the TTDF is presented in Figure 6-3. Preliminary construction, O&M, and 50 year life-cycle cost estimates for the planned prestressed concrete storage tank are presented in Table 6-9.

Advantages and Disadvantages

Table 6-7: Prestressed Concrete Tank Advantages and Disadvantages

Advantages	Disadvantages
Prestressed concrete storage tanks are lower maintenance than both steel tanks or lined and covered earthen basins.	Prestressed concrete storage tanks are typically more expensive than both steel tanks and lined and covered earthen basins.
Prestressed concrete storage tanks have a longer life than steel tanks or lined and covered earthen basins.	Leak detection for partially buried tank is difficult - an observation vault is required for leak detection.
Circular shape promotes water circulation, improving water quality.	Piping and tank repairs are more costly due to buried depth.

Design Criteria

Table 6-8: Prestressed Concrete Tank Design Criteria

Parameter	Criteria
Design Capacity, MG	5
Number of Tanks	1
Dimensions of Tank, Diameter (ft) x Depth (ft) (Free Board (ft))	178 x 30 (2)
Number of Distribution Pumps	2 (1 duty + 1 standby)
Distribution Pump Capacity, Each	3,500 gpm
Distribution Pump Discharge Head	230 feet
Distribution Pump Motor hp, Each	300 hp

Preliminary Layout

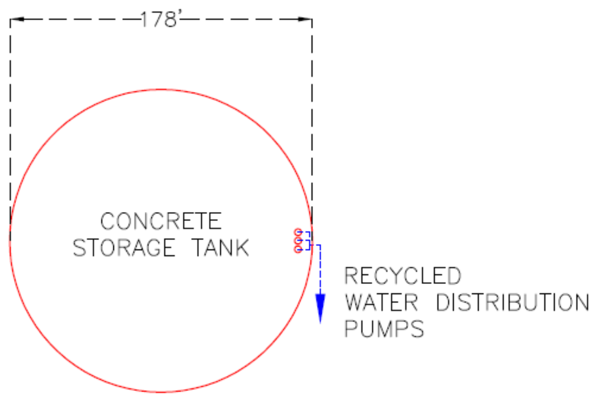

Figure 6-3: Preliminary Layout of 5 MG Prestressed Concrete Tank

Cost Summary

Table 6-9: Prestressed Concrete Tank and Recycled Water Pump Station Cost Summary

Parameter	Cost ($)
Total Capital Cost[a]	7,500,000
Total Annual O&M Cost[b]	290,000
20 Year Life-Cycle-Cost[c]	12,700,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

6.2.3 Conversion of Train A Aeration Basin

Description

The conversion of a Train A aeration basin into a storage tank requires the removal of all mechanical internals including aeration piping (with diffusers) and the old mechanical aerators (with the associated supports and platforms). In addition, the converted aeration basin requires modifications to support a cover, including a supporting curb around the perimeter of the basins and support columns within the basin. Due to the long life and minimal maintenance associated with aluminum covers, a flat aluminum cover has been considered in the evaluation of this alternative.

Advantages and disadvantages of using a converted Train A aeration basin as a recycled water storage tank are summarized in Table 6-10. The design criteria for this alternative are summarized in Table 6-11. A preliminary layout of the converted Train A aeration basin is presented in Figure 6-4. Preliminary construction, O&M, and 50 year life-cycle cost estimates for the conversion of a Train A aeration basin are presented in Table 6-6.

Advantages and Disadvantages

Table 6-10: Conversion of Train A Aeration Basin Advantages and Disadvantages

Advantages	Disadvantages
This alternative uses an existing structure, reducing costs and minimizing footprint.	The conversion of a Train A aeration basin is only feasible if a MBR is used.
	Due to conversion of existing aeration basin, the storage capacity is limited to about 2.7 MG.

Design Criteria

Table 6-11: Conversion of Train A Aeration Basin Design Criteria

Parameter	Criteria
Design Capacity, MG	2.7
Number of Tanks	1
Dimensions of Tank, Length (ft) x Width (ft) x Side Water Depth (ft)	170 x 170 x 16
Number of Distribution Pumps	2 (1 duty + 1 standby)
Distribution Pump Capacity, Each	3,500 gpm
Distribution Pump Discharge Head	230 feet
Distribution Pump Motor hp, Each	300 hp

Preliminary Layout

Figure 6-4: Train A Aeration Basin Converted to Storage Basin

Cost Summary

Table 6-12: Conversion of Train A Aeration Basin and Recycled Water Pump Station Cost Summary (2.7 MG Storage Capcity)

Parameter	Cost ($)
Total Capital Cost[a]	2,900,000
Total Annual O&M Cost[b]	290,000
20 Year Life-Cycle-Cost[c]	8,100,000

[a]Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).
[b]Including power for distribution pumps and general maintenance. Unit power cost is considered as $ 0.14/kWh.
[c]At a 5% discount rate and a 4% escalation rate.

6.3 SUMMARY OF COSTS

Table 6-13 presents a summary of the construction, O&M, and 20 year life-cycle cost estimates for each of the four storage alternatives evaluated. As shown in the Table, excluding the option of converting a Train A aeration basin into a storage tank (only an option if MBR option is selected), earthen basins are the lowest cost both in terms of capital cost (~$2,400,000 less than a steel tank, the next lowest cost alternative) and 20 year life-cycle cost (~$3,100,000 less than a prestressed concrete tank, the next lowest cost alternative).

Table 6-13: Summary of Cost for Each Storage and Distribution Pump Station Alternative

Alternative	Storage Capacity (MG)	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20 Year Life Cycle Cost ($ Millions)
Earthen Basins, Lined and Covered	5.0	4.0	310	9.6
Steel Tank	5.0	6.4	370	13.1
Prestressed Concrete Tank	5.0	7.5	290	12.7
Train A Aeration Basin Conversion	2.7	2.9	290	8.1

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SECTION 7 – MEMBRANE BIOREACTOR (MBR) OPTION

7.1 BACKGROUND

As an alternative to tertiary filters, which were discussed in Section 4, MBR system can be used to produce Title 22 recycled water. This section first describes the MBR technical concept and how its different components are tied together and later briefly discusses the MBR alternatives considered prior to Workshop No. 1. A detailed analysis of the selected alternative will be presented in Section 9. Refer to Section 9 for information regarding the design criteria and specifications of equipment.

7.2 TECHNICAL CONCEPT

The MBR is a multi-purpose process providing secondary treatment for organic and nitrogen removal, and using membrane filters to separate the mixed liquor solids from the wastewater. The membranes take the place of the clarifiers and tertiary filters of the conventional treatment plant. By removing the secondary clarifiers from the mainstream through the plant, problems controlling the settling characteristics of the solids, as measured by Sludge Volume Index (SVI) are eliminated. This allows the aeration basin (bioreactor) mixed liquor to be increased in concentration by almost three times the usual levels, i.e. from 3,500 mg/L to 10,000 mg/L, reducing the volume of aeration basin required to less than one-half that of the conventional treatment process.

The MBR process dates back 50 years. In the last ten years, the process has been applied in numerous installations of increasing size. Several plants today have design capacities in excess of 10 mgd, with larger facilities in design and construction. The worldwide application of the process over the last ten years has taken it from an emerging technology to one that is regarded as proven based on its long term consistent performance at numerous plants.

The general concept of the MBR is similar to that of conventional treatment, except it takes advantage of the latest in membrane technology to minimize the footprint of the secondary and tertiary treatment facilities and to enhance the performance of the plant to produce an effluent of exceptional quality.

To consistently achieve NDN, i.e. to meet a Total Inorganic Nitrogen (TIN) level of 10 mg/L in the effluent, a treatment plant should be designed to reliably produce an effluent TIN level in the range of 5 to 8 mg/L. This can be accomplished by upgrading the treatment to provide biological nutrient removal (BNR). Further, addition of membranes will result in an effluent containing low levels of organics (BOD), solids (TSS) and nitrogen allowing for effective disinfection so that the final effluent complies with water quality standards for unrestricted reuse.

The current plant uses conventional activated sludge consisting of aeration basins followed by clarification to significantly reduce the level of BOD and TSS in the effluent and to achieve partial NDN. The City has a significant investment in the process and with some modifications it can be converted into a BNR facility to provide full secondary treatment.

Figure 7-1 shows a schematic of the overall liquid treatment train. This section of the TM will focus on the technical concepts of the fine screening, bioreactor and membrane portions of the plant.

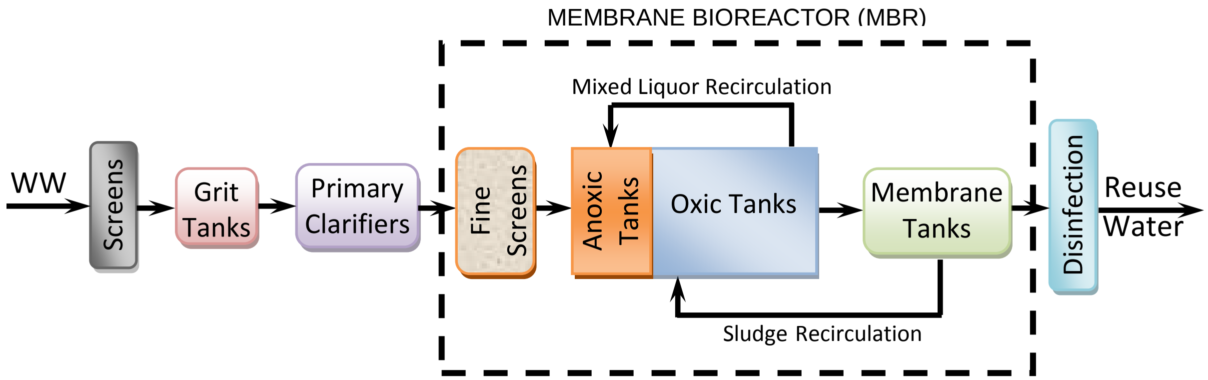


Figure 7-1: Membrane Bioreactor (MBR) Consisting of Activated Sludge Bioreactor and Membrane Filtration

7.2.1 Fine Screening

Hair, stringy material and other deleterious matter passing through the preliminary treatment (coarse bar racks and grit tanks) and primary settling tanks can damage the MBR membranes. To protect the membranes, ultra-fine screens are installed ahead of the MBR system on the primary effluent flow stream. Openings through the screens are in the range of 1 to 3-mm in size. The screens are of the band or drum type comprised of a series of perforated plates. The screen cleaning operation is automatically controlled based on differential level or time. These types of screens have been found to be the most efficient for removal of fine material. The screens are equipped with washing systems to clean odorous organic material from the screenings and return it back to the flow stream for treatment. The washed screenings are compacted to reduce the water content and volume prior to hauling off-site for disposal.

7.2.2 Secondary Treatment – Bioreactor (Aeration Basin)

The bioreactor portion of the MBR process is very similar to that in the conventional activated sludge system. The aeration basin will be divided into anoxic and oxic zones for denitrification, organic removal and nitrification. Primary effluent will enter the anoxic zones where it will be mixed with mixed liquor recirculated from the oxic zones. However, because of the high level of dissolved oxygen in the sludge return from the membrane chambers, this recycled sludge will be returned to the start of the oxic zones.

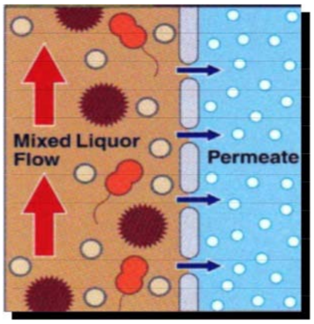
The anoxic zones are equipped with mixers to maintain the mixed liquor biomass in suspension without introducing ambient air (oxygen). This promotes the scavenging of oxygen from the nitrates present in the recirculated sludge and exhausting of the resultant nitrogen gas, which reduces the nitrogen content in the wastewater. The oxic zones are equipped with fine bubble diffusers to create an oxygen rich environment for the biomass.

The most significant difference between conventional activated sludge and the bioreactor portion of an MBR system is the ability to raise the mixed liquor concentration in the bioreactor from a conventional 3,500 mg/L to 10,000 mg/L, resulting in a reduction in the tankage volume required to provide an equal level of secondary treatment.

A consequence of the higher mixed liquor concentration is that the oxygen transfer efficiency is slightly lower (i.e. lower alpha), reducing the overall efficiency of the aeration system and increasing the aeration energy. This difference may add 10 to 15% to the amount of air required in the oxic zones of an MBR system. However, the oxygen contained in the membrane chamber's recycled sludge will typically balance the extra air/oxygen required in the aeration basins.

7.2.3 Tertiary Treatment - Membrane Filtration

Membrane technology started in the water treatment field, and has been successfully used in water treatment plants for more than 20 years. Membrane filtration can consistently reduce the level of solids and contaminants in the effluent to below detection limits. Though membranes are an effective physical barrier, straining out many contaminants, further treatment through a disinfection process is necessary to remove the remaining contaminants. This provides a "dual-barrier" to enhance the safety of the final effluent, complying with CDPH requirements for unrestricted reuse of the plant effluent.



Operating experience of several membrane manufacturers have shown that the membranes are consistently capable of producing an effluent essentially approaching non-detectable levels of organics, solids and pathogens. The clarity of the membrane effluent is significantly superior to that produced by traditional filtration processes. The high quality effluent is ideal for reuse applications and public acceptance.

In the MBR process, the membranes can be located externally from the mixed liquor tanks in tubes, but typically are submerged in tanks in direct contact with the mixed liquor and function as the clarification and filtration steps. Externally installed membranes are configured in pressure vessels with pumps transferring flow from the bioreactors to the vessels. In submerged membrane applications, pressure differential across the membranes in the form of a vacuum is provided using either the hydraulic grade (gravity) or a filtrate pump suction to siphon liquid (permeate) through the membrane material. In all cases, permeate or membrane effluent, passes through the membrane material leaving the solids behind for recirculation back to the bioreactors.

Unlike a media type tertiary filter, in an MBR system, the membranes are not backwashed, but rather, the solids are air scoured from the membrane surface and recycled back to the activated sludge bioreactor. The main waste from an MBR system is the waste activated sludge (WAS), similar to the WAS currently pulled from the secondary clarifiers.

Chemical cleanings of the membranes, performed using a clean-in-place (CIP) system, is dependent on the feed water quality and membrane manufacturer; thus, the frequency of cleaning can range from once or twice a week to three or four times a year. Extensive cleaning of the membranes beyond this routine cleaning is required approximately once or twice per year.

There are two types of membranes commonly used in an MBR system; hollow-fiber and flat-sheet. Both membrane types are able to reliably produce high quality water and therefore, the choice of membranes will be mostly a matter of capital and operational costs evaluated on a life cycle cost basis. Hollow-fiber membranes can be installed in a smaller footprint. Flat-sheet membranes require more area, but a lower operating differential pressure across the membranes (transmembrane pressure, TMP), and reportedly (per manufacturers) have a higher maximum flow capacity (flux rate).

Because both membrane types are a viable alternative for application at the Fresno TTDF, it is recommended that pre-selection be undertaken during the early stages of detailed design to select a membrane manufacturer and facilitate the design of the MBR system specific to that manufacturer.

7.3 Location and Capacity of MBR

Two locations were considered for MBR system: Train A and Train B (Figures 7-2 through 7-5):

- Train A:
    - Convert one of the secondary clarifiers to aeration basin of MBR (due to age of structure and sloping walls of the existing aeration basins in Train A, it was decided not to use them for this purpose)
    - Construct the membrane tanks in vicinity of secondary clarifiers
- Train B:
    - Use aeration basin No. 5 as the aeration basin of MBR
    - Modify secondary clarifier No. 6 to accommodate membrane tanks

Two flow rates were considered for analysis: 5 and 10 mgd. Primary effluent will be pumped to fine screens and then will flow by gravity to aeration basin and then membrane tanks. The flow for 5 mgd scenario is constant, while the flow for 10 mgd scenario includes a peaking factor of 1.23. For both flows, nitrogen removal (NDN) is included in the design.

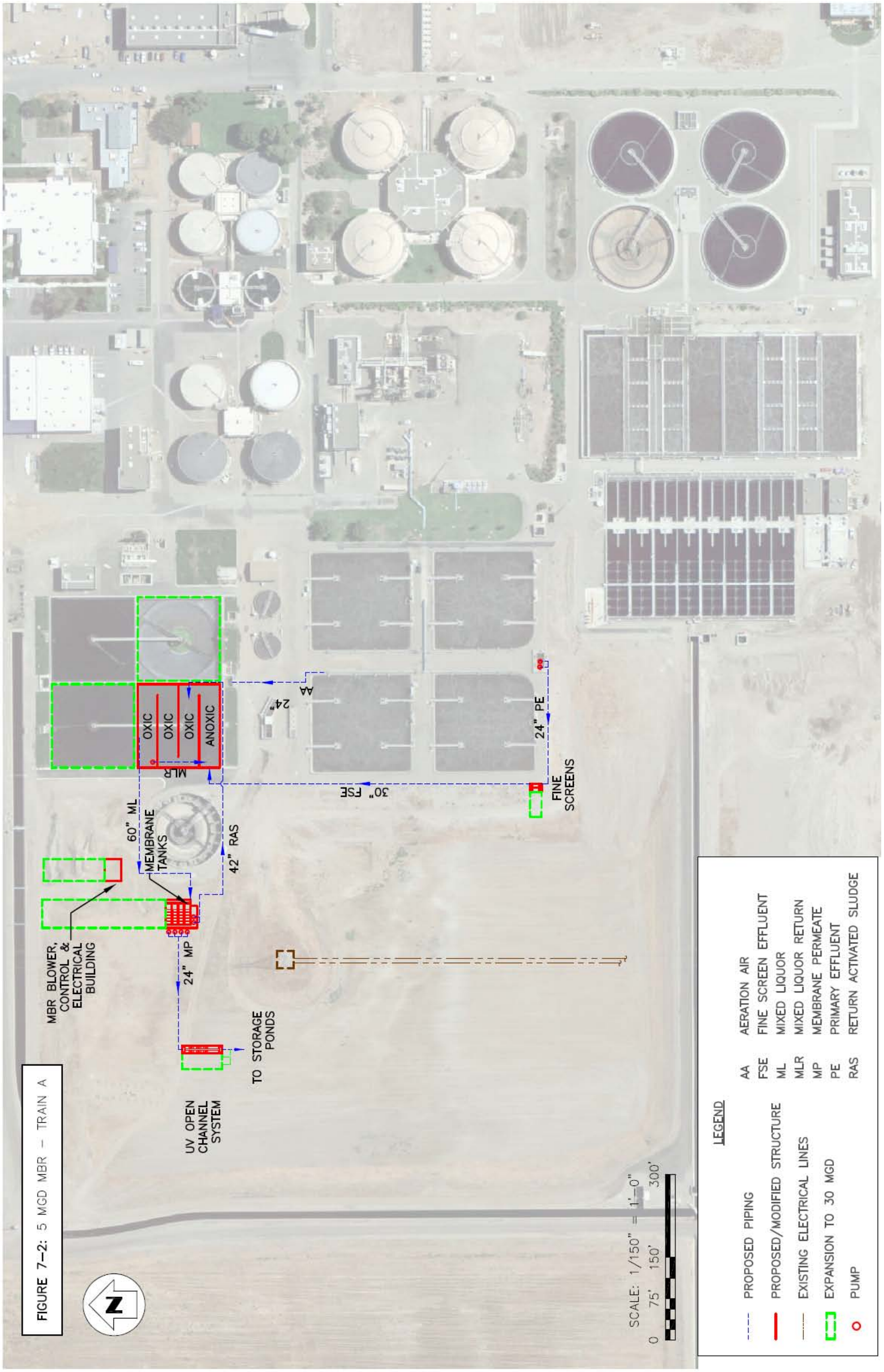


FIGURE 7–2: 5 MGD MBR – TRAIN A
MBR BLOWER, CONTROL & ELECTRICAL BUILDING
UV OPEN CHANNEL SYSTEM
TO STORAGE PONDS
24" MP
60" ML
MEMBRANE TANKS
42" RAS
MLR
OXIC
OXIC
OXIC
ANOXIC
24"
AA
30" FSE
24" PE
FINE SCREENS
SCALE: 1/150" = 1'-0"
0 75' 150' 300'
LEGEND
PROPOSED PIPING
PROPOSED/MODIFIED STRUCTURE
EXISTING ELECTRICAL LINES
EXPANSION TO 30 MGD
PUMP
AA AERATION AIR
FSE FINE SCREEN EFFLUENT
ML MIXED LIQUOR
MLR MIXED LIQUOR RETURN
MP MEMBRANE PERMEATE
PE PRIMARY EFFLUENT
RAS RETURN ACTIVATED SLUDGE

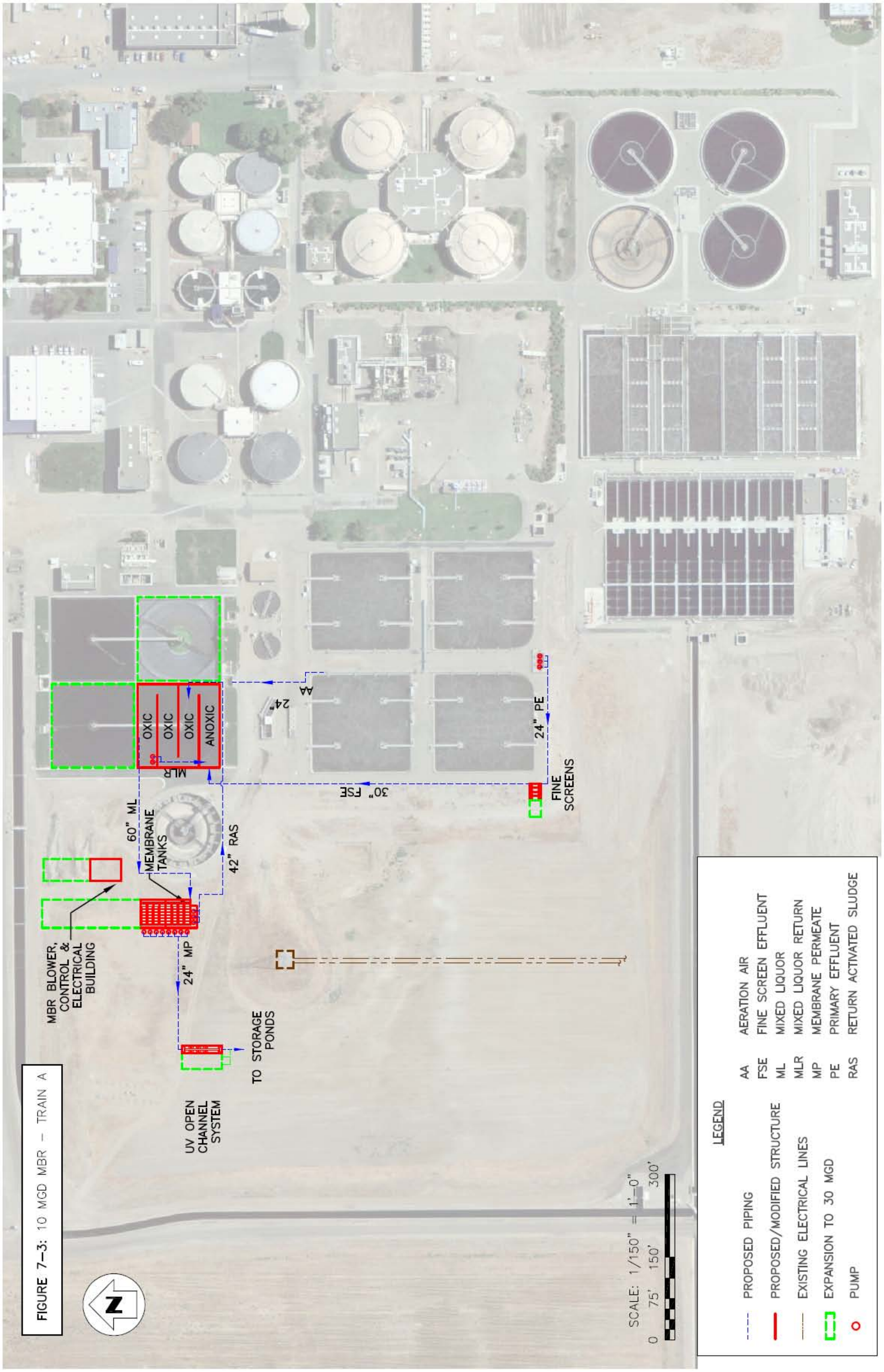


FIGURE 7–3: 10 MGD MBR – TRAIN A

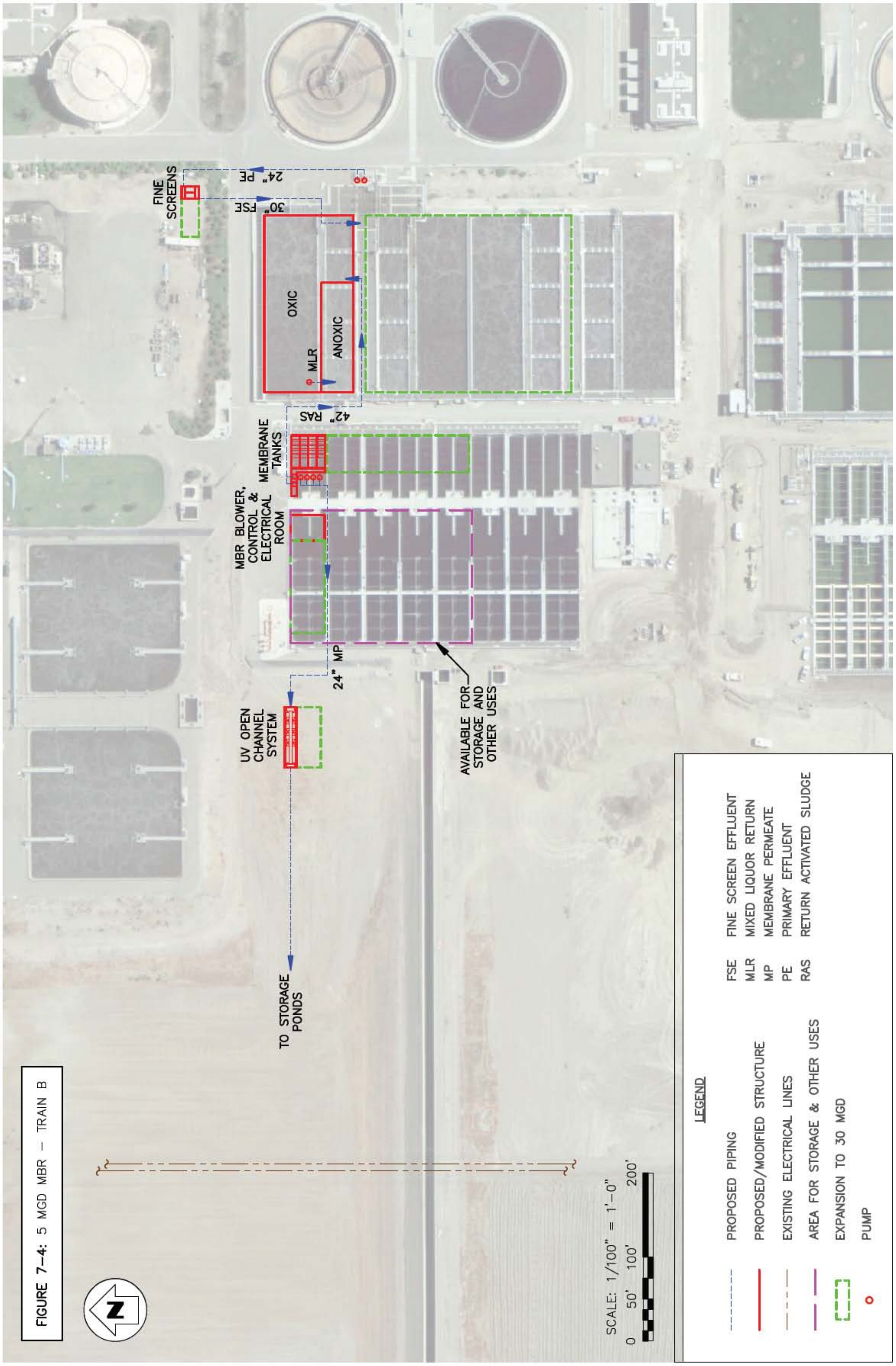


FIGURE 7–4: 5 MGD MBR – TRAIN B

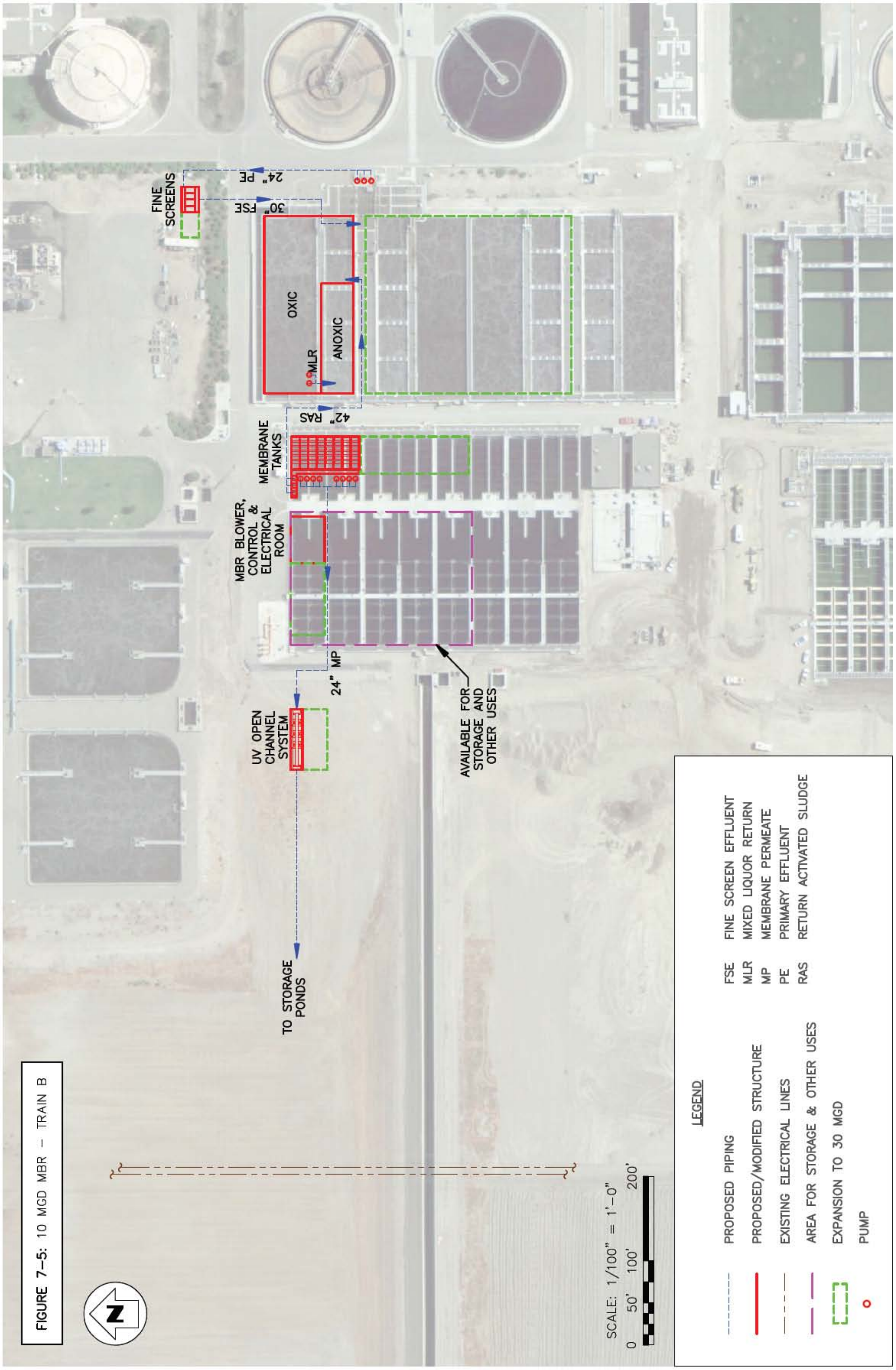


FIGURE 7–5: 10 MGD MBR – TRAIN B

7.4 COSTS

The capital costs for Train A and Train B (5 and 10 mgd) are shown in Tables 7-1 and 7-2, respectively. A credit for conventional NDN is included. This is the investment the City would need to make on secondary treatment system, if the plant had to be upgraded to NDN process using conventional tertiary filters rather than MBR. As can be seen, using Train A for MBR would result in higher cost. This is due to the extensive modifications needed in Train A.

Table 7-1: MBR Capital Cost – Train A [a]

Parameter	Capital Cost ($ Million)	
Flow	**5 mgd**	**10 mgd**
Equipment and Structures Cost	7.0	12.1
Total Capital Cost [b]	20.2	34.9
Credit for Conventional NDN [b,c]	(0)	(8.2)
Total Capital Cost Including NDN Credit	**20.2**	**26.7**

[a] UV credit not included.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit based on constructing additional facilities (one aeration basin and installing new equipment such as mixed liquor recycle pumps) if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.

Table 7-2: MBR Capital Cost – Train B [a]

Parameter	Capital Cost ($ Million)	
Flow	**5 mgd**	**10 mgd**
Equipment and Structures Cost	5.9	10.9
Total Capital Cost [b]	17.0	31.5
Credit for Conventional NDN [b,c]	(0)	(8.2)
Total Capital Cost Including NDN Credit	**17.0**	**23.3**

[a] UV credit not included.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit based on constructing additional facilities (one aeration basin and installing new equipment such as mixed liquor recycle pumps) if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.

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SECTION 8 – SUMMARY OF WORKSHOP NO.1

8.1 BACKGROUND

A Workshop was conducted with the City on November 4, 2010 to present and discuss various system alternatives for filtration, disinfection and storage systems for the proposed TTDF. These alternatives are discussed in detail in Sections 4, 5 and 6, respectively, of this TM. This Section of the TM summarizes the discussion carried out at the Workshop and highlights the important decisions made for subsequent work.

8.2 FILTRATION SYSTEM ALTERNATIVES ANALYSIS

Eight filtration technologies were analyzed and summarized during the Workshop. The technologies discussed were:

1. Dual media gravity filters
2. Deep bed mono media filters
3. Continuous backwash filters
4. Traveling bridge filters
5. Fuzzy filters
6. Cloth media filters
7. Nova Ultrascreen filter
8. Microfilters

The Workshop presentations & discussions included the following:

1. Introduction and filter history
2. Photos and cross-sections
3. Features of operation
4. Pros and Cons
5. Title 22 design criteria including reliability
6. Preliminary layout for 5 mgd expandable to 15 mgd and ultimately to 30 mgd.
7. Capital, O&M and life cycle cost analysis

Based on the discussions, the City indicated their preference for cloth media filters and Nova Ultrascreen filters. The City expressed their concern about possibility of air-borne dust contaminating the recycled water and directed that all filtration units be covered. City requested that revised cost estimates be prepared for the two preferred filtration technologies including a building to house cloth media filters and a canopy for Nova Ultrascreen filters. Subsequently, the City asked Parsons to consider a building for Nova filters as well. The City also asked Parsons to inquire Nova about potential effluent turbidity spikes following backwash with Nova filters. Parsons will revise the cost estimates and will contact Nova to inquire about the potential effluent spike problems immediately following the backwash.

8.2.1 Subsequent Developments

Following the Workshop, Parsons submitted revised cost estimates to the City for cloth media filters and Nova Ultrascreen filters. Table 8-1 presents a summary of revised costs for the two systems (including CMU buildings to house each type of filters) for 5 mgd constant flow rate.

Table 8-1: Revised Cost Summary for Cloth Media and Nova Ultrascreen Filters (5 mgd Constant Flow)

Parameter	Cloth Media Filters[e] ($)	Nova Ultrascreen Filters ($)
Equipment and Structures Cost[a]	1,870,000	1,325,000
Total Capital Cost[b]	5,000,000	3,800,000
Total Annual O&M Cost[c]	90,000	100,000
20 Year Life Cycle Cost[d]	6,700,000	5,650,000

[a] Includes CMU building to house the filters.

[b] Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[c] Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[d] At a 5% discount rate and a 4% escalation rate.

[e] Concrete structure designed for a total filtration capacity of 9 mgd.

Per City's request, Parsons contacted Nova to inquire about possible effluent turbidity spikes immediately following backwash operation. Staff at Nova clarified that Nova filters do not experience the effluent turbidity spikes, unlike cloth media filters, immediately following backwash. They attribute this to what they call "pulse backwashing". Nova filter discs go through much frequent backwash cycles; one backwash every 6-10 minutes each lasting for about 10-15 sec. This "pulse backwashing" not only eliminates effluent turbidity spikes but the volume of backwash is significantly less (less than 1% of feed water volume) when compared to cloth media filters. Nova also claims that due to the fact that Nova filter discs use a filter medium (precision woven SS mesh) which provides fine pore size control, their filtration system does not depend on cake filtration as is the case with cloth media filters. To substantiate their claim against effluent turbidity spikes following backwash, Nova supplied an evaluation report for Orange County South Regional Water Reclamation Facility – Sand Lake Road in Florida, where cloth media filters and Nova filters were tested side-by-side. The report supports Nova's claim that their filters do not experience effluent turbidity spikes as in the case of cloth media filters. This report is attached in Appendix C. The graphs presented in pages 5 and 6 of the report clearly document relatively constant effluent turbidity from Nova filters when compared to distinct spikes in effluent turbidity after every backwash in case of cloth media filters.

Based on the above analysis and fact finding, City selected Nova Ultrascreen filters as their system of choice for filtration for comparison against MBR system. Parsons would like to highlight the Nova's lack of experience in meeting Title 22 regulations in California. Nova Ultrascreen® filters have a long history (~10 years) of use in overseas installations; however, the history of use in the US on municipal wastewater is limited. There are currently no installations in California and the longest operating municipal wastewater installation in the US has been in operation for less than one year (in Orange Park, FL) and has a rated capacity of 3.0 mgd. If the City should consider this filtration system, Parsons strongly recommends a minimum of two (2) site visits to operating installations by Parsons and City staff to gain first-hand knowledge of the performance and operation of Nova filters before finalizing this choice.

In addition, disc filters in general, require the upstream biological treatment system to have a minimum SRT of 5 days prior to filtration (including Nova Ultrascreen filters) for consistent effluent quality. Without such a high SRT, the extra cellular enzymes secreted by the microorganisms will potentially plug the fine pores on the disk media. If the existing biological system does not provide an SRT of at least 5 days, modifications to the pertinent secondary treatment facilities' operations will be required.

8.3 DISINFECTION SYSTEM ALTERNATIVES ANALYSIS

Three disinfection technologies were analyzed and summarized during the Workshop. The technologies discussed were:

1. Open channel UV Disinfection
2. In-pipe UV Disinfection
3. Ozone Disinfection

Each disinfection technology was discussed in detail and consisted of the following:

1. Introduction
2. Photos and cross-sections
3. Features of operation
4. Pros and Cons
5. Title 22 design criteria including reliability
6. Preliminary layout for 5 mgd expandable to 15 mgd and ultimately to 30 mgd.
7. Capital, O&M and life cycle cost analysis

Based on the discussions, the City expressed their preference for in-pipe UV disinfection system similar to neighbouring Clovis Water Reuse Facility. At the Clovis facility, the City noted the operator's positive experience with operating and maintaining the in-pipe UV system. The City asked Parsons to revise the cost estimates to include 1.0 mgd capacity UV reactors instead of 2.3 mgd capacity reactors considered earlier by Parsons. City also wanted the cost estimate to include a canopy for in-pipe UV reactors. Table 8-2 presents a summary of the revised cost estimates for the 1 mgd in-pipe UV system compared to the 2.3 mgd in-pipe UV system. Final *selection of the UV system will be made during detailed design and will be based on competitive bidding between 1 mgd reactors and lager size reactors (2.3 mgd and others, as applicable).*

Table 8-2: Revised Cost Summary for In-pipe UV Disinfection Following Meida Filtration (5 mgd Constant Flow)

Parameter	2.3 mgd Reactors ($)	1 mgd Reactors ($)
Equipment and Structures Cost	1,460,000	2,000,000
Total Capital Cost[a]	4,800,000	6,500,000
Total Annual O&M Cost[b]	230,000	230,000
20 Year Life Cycle Cost[c]	8,900,000	10,600,000

[a] Including typical installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013).

[b] Including power, media replacement, general maintenance, and labor. Unit power cost is considered as $ 0.14/kWh.

[c] At a 5% discount rate and a 4% escalation rate.

8.4 STORAGE AND PUMPING SYSTEM ALTERNATIVES ANALYSIS

Three storage alternatives were analyzed and summarized during the Workshop. The alternatives discussed were:

1. Earthen basins (lined and covered)
2. Steel tanks
3. Pre-stressed concrete tanks
4. Converted Train A Aeration Basin

The pros and cons of each alternative along with capital, O&M and life cycle costs were discussed during the Workshop.

If modifications to Train A are required as part of the proposed treatment system (as in case of MBR alternative), then converting an aeration basin (Train A) into storage will be the preferred choice for the City. On the other hand, if a new storage tank needs to be constructed (for conventional filtration alternative), the City prefers pre-stressed concrete tanks due to their low maintenance cost, avoided costs for pumping the recycled water to the storage tanks (as in case of a steel tank) and aesthetics.

8.5 MEMBRANE BIO-REACTOR (MBR) OPTION

Parsons presented MBR system as an alternative to conventional filtration. The advantages with MBR include the ability to remove nitrogen, producing higher quality effluent exceeding Title 22 standards, utilizing existing basins, and enhancing the existing treatment capacity without addition of tanks and lowering the cost of downstream UV system.

The presentation included analysis of MBR system in Train A versus Train B. City likes the idea of utilizing Train A infrastructure (aeration basins and clarifiers), which reportedly are at the end of their useful life. In contrast, Train B is a newer and well operated system, which the City prefers not to make any modification to at this time. City directed Parsons to use exclusively Train A for MBR system analysis.

Parsons presented an MBR system that made the best use of existing infrastructure at Train A. Pre-aeration for MBR comes from modifying one of the four existing square secondary clarifiers. The City suggested Parsons to utilize the currently decommissioned secondary clarifier no. 5 to install membrane cassettes. In-pipe UV reactor system will be used for disinfection as in case of filtration alternatives. Parsons proposed the idea of converting one of the existing four square aeration basins (app. 2.7 MG each) into a recycled water storage tank; the City concurred with this recommendation.

City requested Parsons to evaluate the option of using a portion of the air from the existing aeration blowers for membrane air scouring. Parsons has addressed this issue in Section 9 of this TM.

8.6 THREE PLANS (PLANS A, B AND C)

At the end of the Workshop, City decided to have three Plans to be developed in further detail and to be included as part of this TM. The three Plans are called A, B and C, which are described below.

PLAN A (12 mgd MBR)

1. This MBR alternative will be based on Train A with 12 mgd average dry weather flow (maximum capacity of each basin to provide nitrification & denitrification) and 14.76 mgd peak dry weather flow (12 mgd times 1.23 peaking factor). The MBR alternative with 5 mgd average constant flow will only be discussed but not evaluated, since it involves de-rating of Train A (also Train B) capacity significantly.

2. This plan will include conversion of a Train A clarifier (one only) into pre-aeration basins preceding the membrane tanks.

3. This plan will evaluate conversion of clarifier no. 5 (circular) into membrane tanks versus construction of separate membrane tanks.

4. In-pipe ultraviolet (UV) is the preferred process for disinfection and will be designed and used as the basis for cost estimates for the same flows as above. Based on discussion at the Workshop, 1-mgd UV reactors will be used as the basis for the construction cost estimate. A canopy to cover the UV reactors will also be considered.

5. One aeration basin at Train A will be converted into a recycled water storage facility (about 2.7 MG).

PLAN B (5 mgd Filtration)

1. Plan B will incorporate a 5 mgd constant flow filtration system. Both Nova and Disk filter systems will be evaluated. Revised cost estimates including a canopy for the Nova filters and a building for the Disk filters will be submitted to the City. Furthermore, Parsons will contact Nova to investigate the issue of potential turbidity spikes in filtrate immediately after backwash. The cloth media disk filter system has reflected this phenomenon, although it is not of much concern since the effluent quality is mandated based on averages. Nova is preferred subject to resolution of this issue.

2. This plan will take 5 mgd of constant flow from the effluent junction box downstream of Train B for filtration and disinfection. There is no nitrification-denitrification (NDN) requirement right now for this flow. However, it may be required in the future, so leave space for any future facilities needed for this to be accomplished.

3. In-pipe UV is the preferred process for disinfection (a system using 1-mgd reactors with canopy).

4. Storage will be accomplished with a partially buried 5 MG pre-stressed concrete tank.

PLAN C (12 mgd Filtration)

1. Plan C will incorporate a 12-mgd constant flow filtration system. Here again, the flow will be taken from the effluent junction box downstream of Train B. There is no nitrification-denitrification (NDN) requirement right now for this flow. However, it may be required in the future, so leave space for any future facilities needed for this to be accomplished.

2. Nova and Disk filters will be evaluated as for Plan B. Nova is preferred subject to the resolution of the effluent quality issue as in Plan B.

3. In-pipe UV as for Plans A and B is the preferred process for disinfection (a system using 1-mgd reactors with canopy).

4. Storage will be accomplished with a partially buried 5 MG pre-stressed concrete tank.

8.7 POWER SUPPLY OPTIONS FOR TTDF

Per the scope of work, Parsons was to evaluate the feasibility of feeding the proposed TTDF facilities from an existing switchgear at RAS/WAS pump station located adjacent to the secondary clarifiers in train B. However, during the Workshop the City indicated that, for MBR system, it may be better to take the power feed from either four existing transformers or a 12kV switchgear located east of secondary clarifier no.1 in Train A. Parsons' evaluation of various options of power supply for TTDF are presented under Section 12 of this TM.

8.8 EFFLUENT ELECTRICAL CONDUCTIVITY (EC)

The City staff brought up an important issue that needs to be considered for design of the TTDF. The RWRF's discharge currently has a limit for electrical conductivity (EC) of 500 micro mhos/cm + EC of the source water. Meeting this limit is a challenge and may require various measures including source water treatment or replacement, expensive systems to remove salts in wastewater, industrial source control and/or public education on waste minimization. The various alternatives presented, including MBR, may not be effective removing all salts from the final effluent. However, MBR technology could help reduce EC levels through its nitrification/denitrification (NDN) abilities. Parsons estimates that effluent EC can be reduced by about 150 micro mhos/cm through NDN, as ammonia is converted to nitrogen gas and escapes into the atmosphere.

During the past few years, the RWRF has experienced a reduction of the effluent EC through an incidental NDN process that reduced ammonia to nitrogen gas. The reduction in the effluent was estimated between 8% to 9.5% of the total EC influent, enough to maintain compliance with the Waste Discharge Requirements (WDR) discharge limit.

8.9 OTHER KEY DECISIONS MADE

Aside from the discussion above, the following are the other key decisions made during the Workshop.

1. Site preparation (filling and compacting the percolation basins to grade) will be performed by the City.
2. All facilities (for Plans A, B and C) will be located north of Canal B.

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SECTION 9 – PLAN A: MBR, UV DISINFECTION AND STORAGE SCHEME (12 MGD CAPACITY)

9.1 BACKGROUND

Per Workshop No. 1 (Section 8 of this TM), Plan A which incorporates an MBR system, disinfection, and storage is discussed under this Section. The technical concept of MBR system was discussed in Section 7. During Workshop No.1, several key decisions were made regarding the analysis of Plan A, as mentioned briefly below:

- Design the system to achieve organics as well as nitrogen removal (NDN). This is to maximize the benefits which can be obtained from MBR considering the possible future effluent nitrogen requirements.
- Use the existing facilities of Train A – and not of Train B – to build Plan A scheme. Train A is the oldest amongst the three existing Trains, is obsolete in design, and is the best candidate for modifications and conversion to MBR.
- Due to age and sloping walls of the aeration basins in Train A, do not consider conversion of any of these basins to MBR bioreactor. This will be very expensive for retrofitting and/or very inefficient. Instead, use one of the secondary clarifiers in this Train for such purpose.
- In Train A, the rated capacity of each existing aeration basin and associated clarifiers is 8 mgd. Therefore, do not consider 5 mgd design flow as the basis for analysis because this would result in significantly de-rating the exiting train. Instead, use the maximum capacity that each aeration basin (in this case converted secondary clarifier) can handle to achieve NDN.
- UV Inline System (1 mgd capacity) will be used for disinfection of MBR permeate. Final selection of the UV system will be made during detailed design and will be based on competitive bidding between 1 mgd reactors and lager size reactors (2.3 mgd and others, as applicable).
- One of the aeration basins in Train A will be used to store the recycled water (approximate capacity of 2.7 MG).

Based on the above items, MBR system as discussed later in the section will be located in Train A and designed for maximum capacity that one converted secondary clarifier can handle.

9.2 DESIGN DEVELOPMENT

This Section of the TM takes the technical concepts discussed above and develops the mainstream treatment system: i.e. membrane bioreactor (MBR), to upgrade a portion of the RWRF from a carbonaceous BOD removal facility to a simultaneous nitrification and denitrification (nitrogen removal) Title 22 water reclamation facility capable of producing a high quality, low nitrogen effluent. Primary effluent is treated through an MBR system, providing oxidation, nitrification-denitrification and solids separation in a single process.

Primary effluent will be first pumped through fine screens and will then flow into the bioreactor (aeration basin) and then into the membrane tanks. The membrane permeate will be pumped to the UV system for disinfection prior to transfer into the storage basin. Two alternative locations are considered for membrane tanks – 1) conversion of secondary clarifier 5 2) a separate membrane tank. Figures 9-1 and 9-2 show the overall layouts for the MBR system for these two options. Detailed analysis of each option is presented later on in this document.

9.2.1 Capacity Analysis

As mentioned above and agreed upon during Workshop No.1, one of the secondary clarifiers in train A will be converted to the aeration basin associated with MBR. The capacity of the MBR system will be determined based on the amount of flow that the converted secondary clarifier can handle to achieve NDN. The basin will be compartmentalized to incorporate anoxic and oxic zones. The design criteria in Table 9-1 were developed as the basis for capacity analysis.

Table 9-1: Design Criteria for Capacity Analysis of MBR Aeration Basin to Achieve NDN

Item	Units	Design Value	Remarks
Flow Peaking Factor	-	1.23	Peak:Average ratio
Primary Effluent	-	-	Max month values
BOD	mg/L	224	70% of raw wastewater
TSS	mg/L	120	40% of raw wastewater
TKN	mg/L	30	65% of raw wastewater
MLSS	mg/L	10,000	
SRT (Minimum)	days	6	Oxic zone
Anoxic:Oxic Zone Ratio (Minimum)	-	0.3	
Total Volume of Basin	MG	2.3	One secondary clarifier
Maximum Oxygen Uptake Rate	mg/L-hr	135	For peak flow

Based on the above design criteria, the average flow that a converted secondary clarifier in Train A can handle was determined to be 12 mgd, corresponding to a peak flow of 14.76 mgd. These values were used to size the other equipment and structures associated with the MBR system.

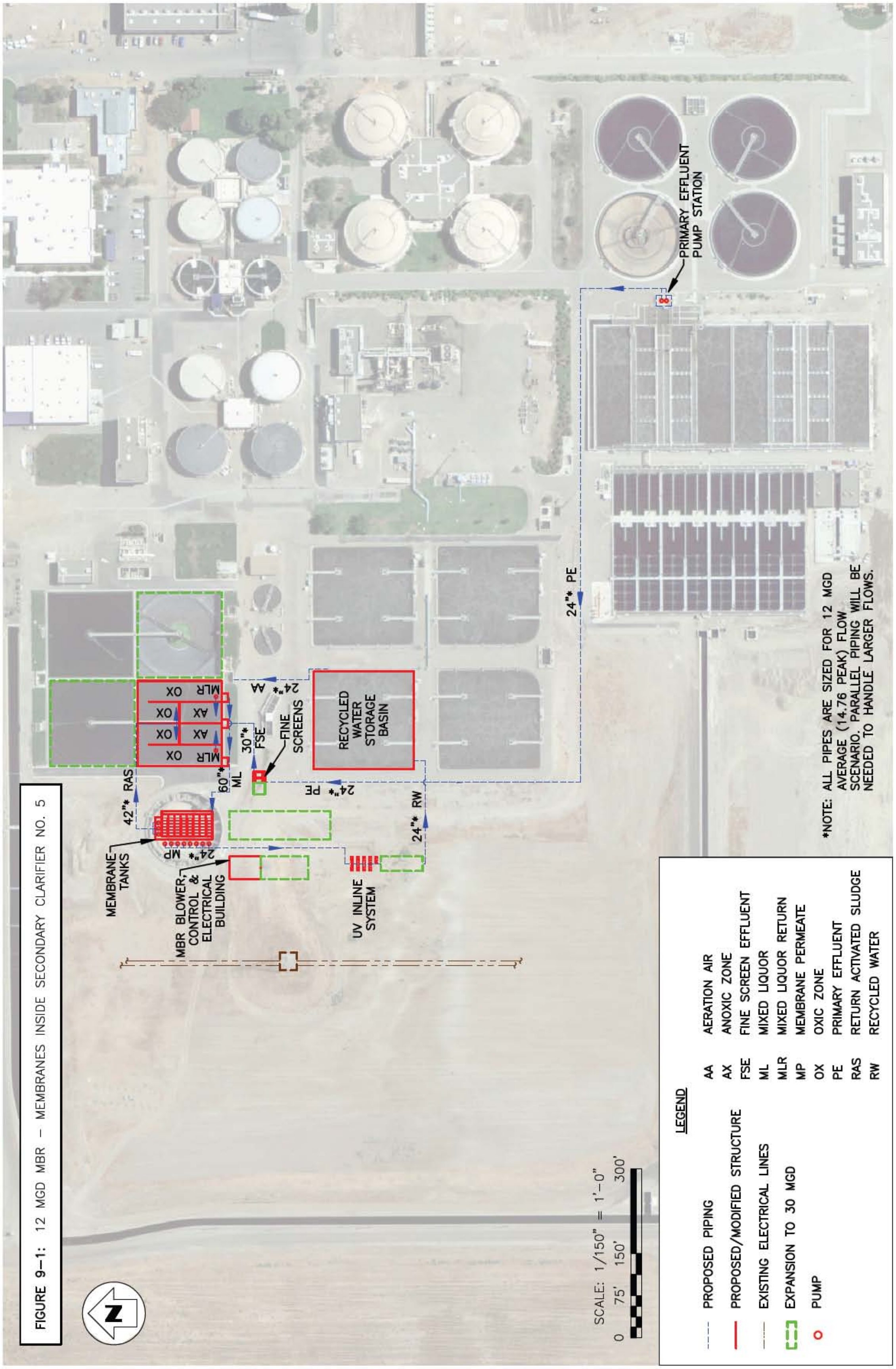

FIGURE 9–1: 12 MGD MBR – MEMBRANES INSIDE SECONDARY CLARIFIER NO. 5

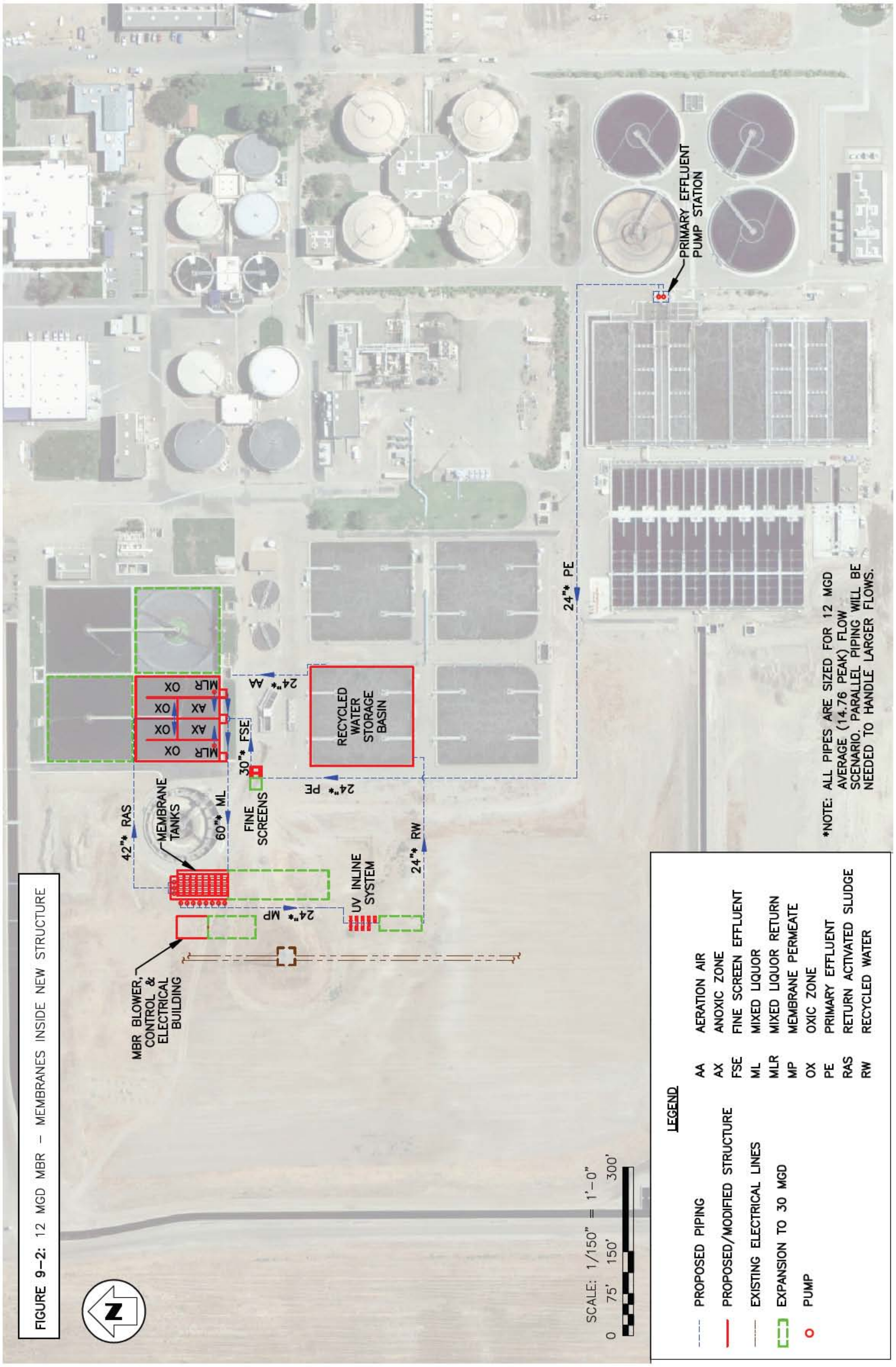

FIGURE 9–2: 12 MGD MBR – MEMBRANES INSIDE NEW STRUCTURE

9.2.2 Primary Effluent Pumps

The existing aeration basin distribution structure located on the east side of Train B will be modified to house the primary effluent pumps. These pumps will pump the desired flow from the distribution structure to fine screens. Table 9-2 shows the design characteristics for the pumps.

Table 9-2: Primary Effluent Pumps Design Characteristics

Item	Units	Design Value	Remarks
Type			Vertical propeller
Number	-	2 (1+1)	
Capacity, Each	gpm	10,300	Wet weather peak will not be handled in MBR
TDH	ft	20	
Horsepower	hp	100	
Drive			Variable speed

9.2.3 Fine Screens

There are different types of fine screens which could be used in an MBR facility; in-channel rotary drum screen, internally-fed rotary drum screen, and band screen. The first type, i.e. **in-channel rotary drum**, consists of an inclined screen basket, placed within a channel, and is equipped with an integrated auger for dewatering/compaction of collected screenings. The second type, i.e. **internally-fed rotary drum**, is a skid-mounted unit. The screen basket is installed in a horizontal configuration. Wastewater is fed into the unit, flows over the weirs and free falls into the screen basket. The screenings need to be handled by a separate dewatering unit. This type of screen requires more available head due to the free-fall condition. The third type, i.e. **band screen**, consists of several perforated plates joined together similar to a conveyor belt. The unit is installed vertically in a channel. Wastewater is fed into the center of the unit and flows across the plates out of the unit. There have been performance issues associated with this type of screen in the past during operation. The product, however, has reportedly been improved over the past few years.

The in-channel rotary drum screen was selected for consideration in this technical memorandum due to its apparent simplicity. By way of illustration, collection and dewatering of screenings are accomplished in a single unit as noted above. A dispenser holding a roll of plastic tubes is mounted at the discharge of the screenings dewatering auger such that the plant operator can pull down a portion of the plastic tube to form a bag to receive the screenings, thus containing the odor of the screenings in the bag and avoiding nuisances like flies or other insects. Nonetheless, it is Parsons' intent that if the MBR alternative is selected, all three types of fine screens will be evaluated for their reliability and cost-effectiveness, as well as odor control requirements and ease of screenings removal during the detail design. The best screens will be provided accordingly.

As shown on Figures 9-2 and 9-3, the fine screens will be located southwest of secondary clarifier No. 4 of Train A. Two fine screens would be installed with one of the units as standby. Each screen would be capable of handling the peak flow of 14.76 mgd. The units would be installed in concrete channels equipped with isolation gates to allow for maintenance without interfering with the plant's operation. Each fine screen would be equipped with an integrated washer/compactor for cleaning and concentrating the screenings prior to disposal off site.

The design characteristics for the fine screens and washer/compactors are shown in Table 9-3.

Table 9-3: Design Characteristics of Fine Screens and Washer/Compactors

Item	Units	Design Value	Remarks
Screens			
Type	-	-	In-channel perforated-plate drum
Number	-	2 (1+1)	
Capacity, Each	mgd	14.9	
Effective Opening Size	mm	2	
Channel Width	ft	8.5	Width at screen
Screenings Handling			
Type	-	-	Washer, dewatering, compactor unit
Number	-	2 (1+1)	Integrated with screens
Motor Power, Each	hp	3	Also powers screen basket

9.2.4 Bioreactors and Associated Equipment

This subsection describes the structures and equipment located downstream of fine screens and upstream of membrane tanks.

Bioreactor (Aeration Basin):

As mentioned above, one of the secondary clarifiers of Train A (clarifier No. 4) will be converted to aeration basin. To provide redundancy, the clarifier will be retrofitted to accommodate two bioreactors, each divided into anoxic and oxic zones, with the first quarter of each bioreactor dedicated to the anoxic zone. Baffles would be placed in the bioreactors to separate the anoxic and oxic zones to minimize back-mixing as the flow passes through in a plug flow regime. Additional baffling would be used to divide each anoxic and oxic zone into 3 compartments, again to minimize back-mixing. The plug flow conditions increase the efficiency of biological treatment, optimizing carbonaceous matter removal, nitrification and denitrification. Submersible mixers would be used to provide mixing in the anoxic zones. Table 9-4 provides the design characteristics of the bioreactors.

Table 9-4: Bioreactors Design Characteristics

Item	Units	Design Value	Remarks
Bioreactors			
Number (In Parallel)	-	2	Converted secondary clarifier No. 4
Volume, Each	MG	1.15	
Anoxic Zone			
Number per Bioreactor	-	1	
Dimensions of Zone (L x W x SWD), Each	ft x ft x ft	75 x 37 x 14	
Number of Compartments per Zone	-	3	Equal volume (in series)
Oxic Zone			
Number per Basin	-	1	
Dimensions of Zone (L x W x SWD), Each	ft x ft x ft	225 x 37 x 14	
Number of Compartments per Zone	-	3	Equal volume (in series)
Anoxic Zone Mixers			
Type			Submersible
Number per Compartment	-	1	
Total Number	-	7 (6+1)	One shelf spare
Horsepower, Each	hp	4	

Aeration System:

The air will be transferred to the oxic zones in the bioreactors through fine bubble diffusers. Either EPDM Membrane disks or more efficient aerator strips (e.g. AEROSTRIPTM), would be used to provide aeration. The aeration would be tapered so that approximately 70% of the oxygen is provided in the first half of the oxic zone to satisfy the high oxygen demand as the substrate enters the oxic zone.

The required air will be supplied to the oxic zones by the existing blowers. These blowers are of single-stage centrifugal type and have enough capacity to serve the biological needs of the MBR process as well as the remaining plant. The existing 24 inch air pipeline of aeration basin No. 3 will be used and extended to supply the air to the bioreactors. As discussed in Section 6, aeration basin No. 3 will no longer be in service and will be used as recycled water storage in the future.

The design characteristics for the aeration system are presented in Table 9-5.

Table 9-5: Aeration System Design Characteristics

Item	Units	Design Value	Remarks
Diffusers			
Type			Fine bubble, membrane (EPDM) disk or strip type
Aeration Pattern			Tapered along bioreactor length
Process Air Blowers			
Type			Single-stage centrifugal
Number	-	6 (5+1)	Existing blowers
Capacity, Each	scfm	27,000	
Discharge Pressure	psig	7.8 or 8.5	4 units at 7.8 and 2 units at 8.5
Horsepower	hp	1,500	

Mixed Liquor Return and Sludge Recirculation Pumps:

Two recirculation lines are provided in the MBR system; mixed liquor return and sludge recirculation. The mixed liquor return system transfers mixed liquor from the tail end of the oxic zone back to the head of the anoxic zone at a rate up to four times the average flow. This system transfers nitrates resulting from nitrification back to the anoxic zone for denitrification as the oxygen molecules associated with nitrates are used by the biomass.

The sludge recirculation system transfers sludge from the membrane tanks to the head of the oxic zone at a rate also up to four times the average flow. The recirculation system prevents the solids concentration in the membrane tanks from increasing excessively as permeate is removed from the mixed liquor. This sludge is highly oxygenated and provides a portion of the process oxygen needed for BOD removal and nitrification.

Sludge will be wasted from the MBR system from the membrane tanks. New pumps will be installed for this purpose.

The design characteristics for the recirculation and waste pumps are presented in Table 9-6.

Table 9-6: Sludge Pumping Systems Design Characteristics

Item	Units	Design Value	Remarks
Mixed Liquor Return Pumps			Returning flow from oxic zone to anoxic zone
Type			Axial propeller
Number	-	3 (2+1)	One shelf spare
Capacity, Each	gpm	16,700	
TDH	ft	3	
Horsepower	hp	30	
Drive			Variable speed
Sludge Recirculation Pumps			Returning flow from membrane tanks to oxic zone
Type			Vertical propeller
Number	-	3 (2+1)	
Capacity, Each	gpm	16,700	
TDH	ft	20	
Horsepower	hp	150	
Drive			Variable speed
WAS Pumps			
Type			Centrifugal
Number	-	2 (1+1)	
Capacity, Each	gpm	1,000	
TDH	ft	20	
Horsepower	hp	7.5	
Drive			Variable speed

9.2.5 Membranes

The membranes will be installed in 8 independent tanks. Two options were considered for the location of membranes; inside secondary clarifier No. 5 (Figure 9-2) and in a completely new structure (Figure 9-3). In the first option, the existing secondary clarifier No. 5 would be modified by removing the mechanisms and raising the bottom to house the membrane tanks. In the second option, the membrane tanks will be constructed east of secondary clarifier No. 5.

For the purpose of this Section, hollow-fiber membranes were considered. The following design criteria were developed as the basis for sizing the membranes:

- Minimum wastewater temperature of 16°C.
- Maximum flux rate of 14 gfd at average flow (all membrane tanks in service).
- Maximum flux rate of 20 gfd at peak flow (one membrane tank out of service).

Eight membrane tanks, each housing 6 membrane cassettes plus space for a future cassette, would have enough capacity to handle 12 mgd of flow. The tankage would be configured to allow isolation of a tank for maintenance and cleaning.

Permeate pumps will draw the MBR effluent through the membranes, directing it to the disinfection system. A building would house new air scouring blowers and membrane control and electrical system. The building would be located adjacent to the membrane structure.

As an alternative to installing new air scouring blowers, the existing single-stage blowers could be used for membrane scouring and also to provide the process air with proper piping and valves to address the different pressure requirements at membrane tanks and bioreactors. Although this approach is technically feasible, based on Parsons' experience, this would complicate the operation of the plant and result in inefficient long term operation. Dedicating one or two of the single-stage blowers to air scouring is not recommended as the maximum required scour air for the 12-mgd plant is only about half of the capacity of each blower. Using these blowers would require them to operate at half the full rated capacity and will result in an inefficient operation of the blowers. Therefore, separate air scour blowers are recommended.

Table 9-7 summarizes the design characteristics of the MBR membrane system.

Table 9-7: MBR Membrane System Design Characteristics

Item	Units	Design Value	Remarks
Tanks			
Number	-	8	
Cassettes per Tank			
Number of Installed	-	6	
Space for Future	-	1	
Total Membrane Surface Area	ft^2	852,480	
Air Scouring Blowers			
Type			High-speed turbo
Number	-	3 (2+1)	
Capacity, Each	scfm	7,900	
Discharge Pressure	psi	5	
Horsepower, Each	hp	250	
Drive			Variable speed

Item	Units	Design Value	Remarks
Permeate Pumps			
Type			Horizontal end suction
Number	-	9 (8+1)	One shelf spare
Capacity, Each	gpm	1,700	
TDH	ft	25	
Horsepower, Each	hp	20	
Drive			Variable speed
Backpulse Pumps			
Type			Horizontal end suction
Number	-	2 (1+1)	
Capacity, Each	gpm	1,480	
TDH	ft	25	
Horsepower, Each	hp	30	
Drive			Variable speed
Instrument Air Compressors			If Plant air not available
Number	-	2 (1+1)	
Horsepower, Each	hp	15	
Chemical Cleaning			
Sodium Hypochlorite			12.5% Solution
Frequency			
Recovery	Yearly	2	Per tank
Maintenance	Weekly	1	Per tank
Annual Consumption	gal	7,900	
Citric Acid			50% Solution
Frequency	Yearly	1-2	Part of Recovery Clean
Annual Consumption	gal	1,500	

9.3 DISINFECTION

During Workshop No.1, as is the case with Plans B and C, the City directed Parsons to consider in-pipe UV disinfection for Plan A. It was also decided during the workshop that smaller (1 MGD capacity) reactors be considered for preliminary design and cost estimates. The 1 MGD rating for each reactor is based upon high quality membrane permeate feed such as from the MBR system. Nine reactor trains (8 operating + one standby) will be required to disinfect 12 mgd average flow (12 x 1.23 = 14.7 peak flow) and each train will accommodate two reactors. Table 9-8 presents the design criteria for the in-pipe UV disinfection system. There are several larger in-pipe reactors currently available from other manufacturers that may be more economical for the present project and may be considered later during detailed design.

Table 9-8: In-pipe UV Disinfection Design Characteristics

Parameter	Criteria
Design Flow (Average), mgd	12
Peaking Factor	1.23
Type of UV System	In-pipe, Low Pressure, High Intensity
Number of Reactors	18 (8 trains + 1 standby) each train has 2 reactors
Flow Capacity per Reactor, mgd	1.0
Length of Reactor (ft)	8
Number of Lamps per Reactor	40
Total Number of Lamps Provided	720

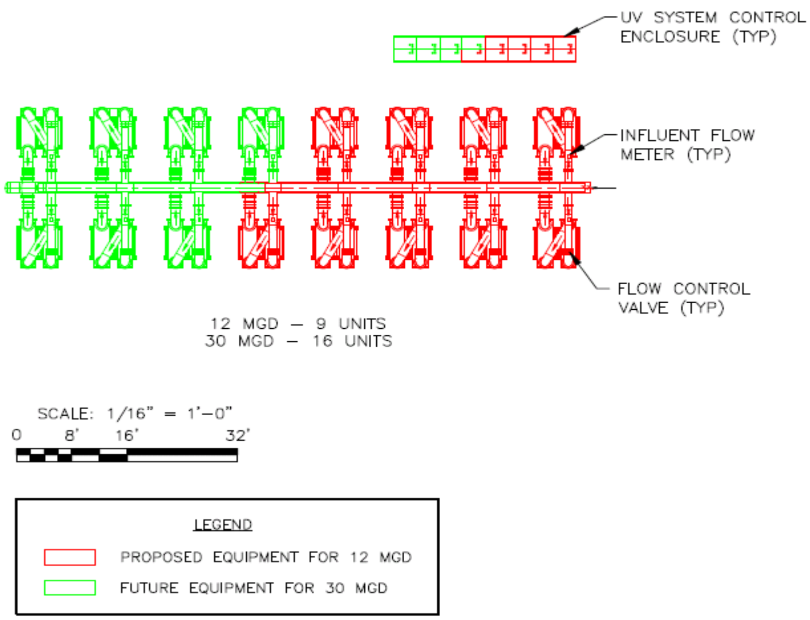

Figure 9-3: In-pipe UV Disinfection System Preliminary Layout

9.4 CONSTRUCTABILITY AND EXPANSION

It is critical that the treatment plant operation not be impacted by the construction activities. The plant must, at all times, be capable of performing at the level required to achieve the water quality standards set by its permit.

The major new construction associated with the MBR system will be the fine screens, bioreactors, membrane structure, and blower building. In case of fine screens, membrane structure, and blower building, construction will be performed in areas that are not associated with the present operation of the plant. This would allow the construction of these facilities to take place independent of the current operation. In case of bioreactors, modifications of one of the secondary clarifiers should not impact the plant operation as one of the square clarifiers is currently not being used. Minor construction activities, as necessary, can be performed during periods of low flow to avoid negative impacts on the plant performance. Finally, sequencing of construction will be necessary when making connections to existing piping and the plant electrical and control systems; these constraints will be carefully developed and specified in the contract documents.

The ultimate capacity of the Fresno TTDF is planned to reach an average flow of 30 mgd. Additional fine screens, bioreactors, membrane tanks, and blowers will be needed to handle the ultimate capacity. As shown in Figures 9-2 and 9-3, space has been provided for the above equipment/structures, adjacent to the proposed facilities, to accommodate the future expansion.

9.5 PRELIMINARY COSTS

Preliminary costs are developed for two scenarios. The only difference between two scenarios is the location of the membranes; inside the secondary clarifier No. 5 and outside the clarifier in a completely new structure. At this point in the design process, these costs are preliminary and should be used only for comparative purposes.

The costs are estimated using several resources. The quotes from the manufacturers, information available from the similar projects performed by Parsons, and also our own experience, including construction in the Central Valley, were used to determine the costs.

The capital costs for the two scenarios are shown in Table 9-9. For both scenarios, a credit for conventional NDN is included. This is the investment the City would need to make on secondary treatment system, if the plant had to be upgraded to NDN process using conventional tertiary filters rather than MBR. As can be seen, locating the membranes inside the secondary clarifier No. 5 would result in $0.5 million additional cost to the City. This is mainly due to the substantial modifications required to the clarifier before it can accommodate the membranes.

Table 9-9: Plan A Capital Cost (12 mgd) [a]

Parameter	Capital Cost ($ Million)	
	Membranes Inside Secondary Clarifier No. 5	Membranes in New Structure
MBR Equipment and Structures Cost	15.5	15.1
MBR Total Capital Cost [b]	44.2	43.7
Credit for Conventional NDN [b,c]	(8.9)	(8.9)
MBR Total Capital Cost Including NDN Credit	35.3	34.8
UV Disinfection Total Capital Cost [b]	12.9	12.9
Storage (Aeration Basin No.3) Total Capital Cost [b]	3.1	3.1
Plan A Total Capital Cost	**51.3**	**50.8**

[a] For detailed cost analysis see Appendix A.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit based on constructing additional facilities (one aeration basin and installing new equipment such as mixed liquor recycle pumps) if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.

An evaluation of the operation and maintenance (O&M) cost was also performed (Table 9-10). As was the case for capital cost, credit is given for operation of secondary treatment of a conventional NDN plant. The O&M cost for both scenarios is the same.

Table 9-10: Plan A O&M Cost (12 mgd) [a]

Parameter	O&M Cost ($)
MBR Total Annual O&M Cost [b,c]	1,834,000
Credit for Conventional NDN [b,c]	(670,000)
MBR Total Annual O&M Cost Including NDN Credit	1,164,000
UV Disinfection Total Annual O&M Cost [c]	271,000
Recycled Water Storage and Distribution Pumping Annual O&M Cost	680,000
Plan A Total Annual O&M Cost	2,115,000

[a] For detailed cost analysis see Appendix A.
[b] Including power and chemicals consumption, membrane/diffusers replacement, general maintenance, and labor.
[c] Assuming power usage rate of 14¢ per kWh.

Using the estimated capital and O&M costs, a 20-year life cycle cost analysis was performed. The results are shown in Table 9-11. The option of housing the membranes in new structure is presented in Table 9-11 as the Plan A Life-Cycle Cost.

Table 9-11: Plan A Life-Cycle Cost (12 mgd)

Parameter	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
MBR System	34.8[1]	1,165[1]	55.9
Disinfection (In-pipe UV)	12.9	270	17.8
Storage (Aeration Basin No.3) and Distribution Pumping	3.1	680	15.4[2]
TOTAL	50.8	2,115	89.1

[1]Includes credit for conventional NDN
[2]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

9.6 ADVANTAGES AND DISADVANTAGES OF PLAN A VERSUS PLANS C

Section 11 of this TM summarizes the advantages and disadvantages of Plan A versus Plan C. Both Plans A and C are of 12 mgd capacity, while Plan B is 5 mgd in capacity and therefore will not be used to compare against Plan A.

Subsequent to Workshop No.2 (Section 14), The City further refined the MBR alternative(s), which are discussed in detail in Section 15 of this TM.

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SECTION 10 - PLANS B AND C: NOVA FILTRATION, UV DISINFECTION AND STORAGE SCHEMES

10.1 BACKGROUND

Per Workshop No.1 (Section 8 of this TM), Plans B and C, which include Nova ultrascreen filter, are discussed under this Section.

Several key decisions regarding filtration schemes were made during Workshop No.1, which are summarized below.

- Nova ultrascreen filters will be used for both Plans B and C as filtration system of choice.
- UV Inline System (1 mgd capacity) will be used for disinfection of filtered effluent. Final selection of the UV system will be made during detailed design and will be based on competitive bidding between 1 mgd reactors and lager size reactors (2.3 mgd and others, as applicable).
- A pre-stressed concrete tank (5 MG capacity) will be used to store the recycled water.
- Plan B will have a treatment capacity of 5 mgd (constant flow – no peaking factor) with provisions for phased expansion to 30 mgd of ultimate capacity.
- Plan C will have a treatment capacity of 12 mgd (constant flow – no peaking factor) with provisions for phased expansion to 30 mgd of ultimate capacity.

Figure 10-1 below presents the schematic for Plans B and C.

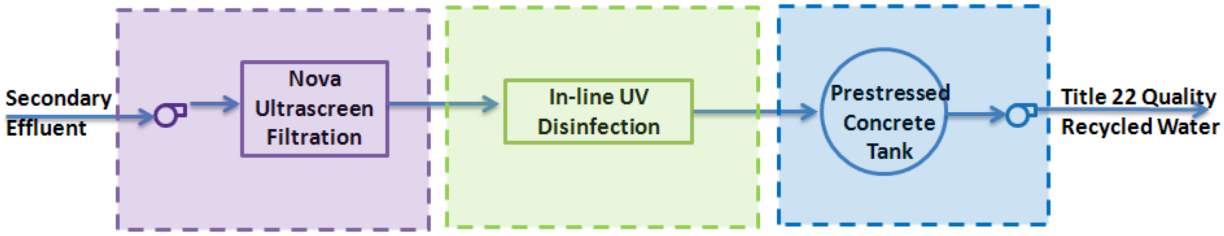

Figure 10-1: Selected Filtration, Disinfection, and Storage Scheme

10.2 EVALUATION OF CONVENTIONAL FILTRATION PLANS (PLAN B AND PLAN C)

10.2.1 Plan B (5 mgd Capacity)

Under this scheme, the TTDF will be fed from distribution canal "B" from which secondary effluent can be withdrawn at a constant rate of 5 mgd, even during periods of low influent flow. Considering this, the TTDF under Plan B will have a capacity of 5 mgd of constant flow (i.e. no flow peaking factor considered).

The design criteria for Plan B are summarized in Table 10-1 and the preliminary construction, O&M, and life-cycle cost estimates for Plan B are presented in Table 10-2. Note that, as per the decision made during Workshop No. 1, 1 mgd capacity in-pipe UV reactors are considered; however, due to the lower quality of filtered water produced with conventional filtration, an in-pipe UV reactor rated at 1 mgd when treating high quality membrane permeate is de-rated to 0.55 mgd when treating conventional filtrate. Figures 10-2 and 10-3 present the preliminary layout drawings for the Nova Ultrascreen filters and the in-pipe UV disinfection system, respectively. The layout drawings show the facilities for initial capacity of 5 mgd (i.e. the equipment required for Plan B) as well as for phased expansions to 15 mgd and 30 mgd.

Table 10-1: Plan B Design Criteria

Parameter	Criteria
Design Flow, mgd	5 (constant flow)
Filtration – Nova Ultrascreen	
CDPH Approved Filtration Rate, gpm/ft^2	16
Number of Filter Units	2
Number of Disks per Unit	10
Total Filtration Area, ft^2	444
Filtration Rate with One Filter Offline, gpm/ft^2	15.6
Headloss Through Filter, ft (Operating)	2 - 2.5
Disinfection – Inline UV	
Type of UV System	In-pipe, Low Pressure, High Intensity
Number of Reactors	12 (5 trains + 1 standby) each train has 2 reactors
Flow Capacity per Reactor, mgd	0.55
Length of Reactor (ft)	8
Number of Lamps per Reactor	40
Total Number of Lamps Provided	480
Storage – Prestressed Concrete Tank	
Design Capacity, mg	5
Number of Tanks	1
Dimensions of Tank, Diameter (ft) x Side Water Depth (ft)	178 x 28

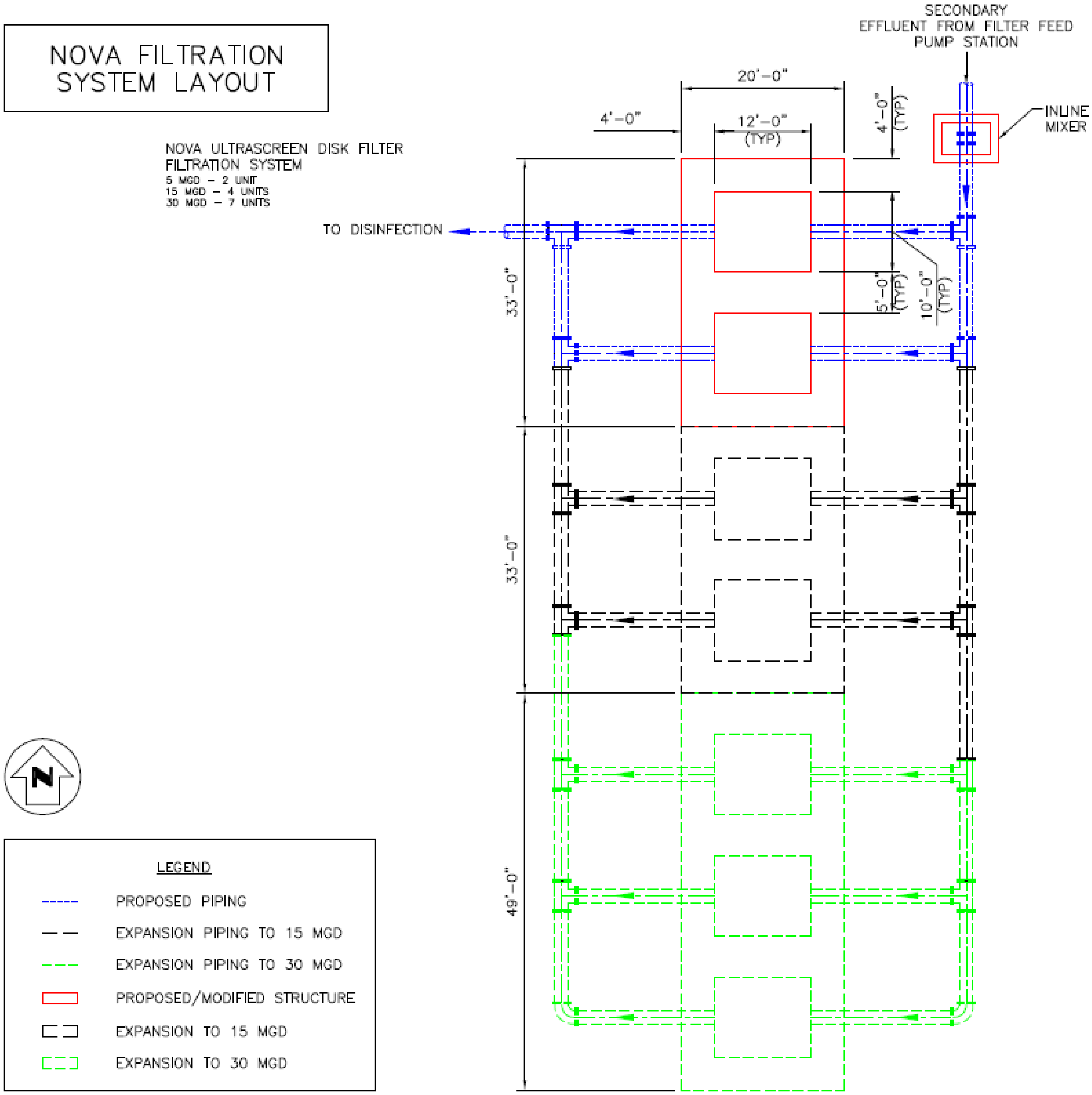

Figure 10-2: Plan B Nova Ultrascreen Filter Preliminary Layout

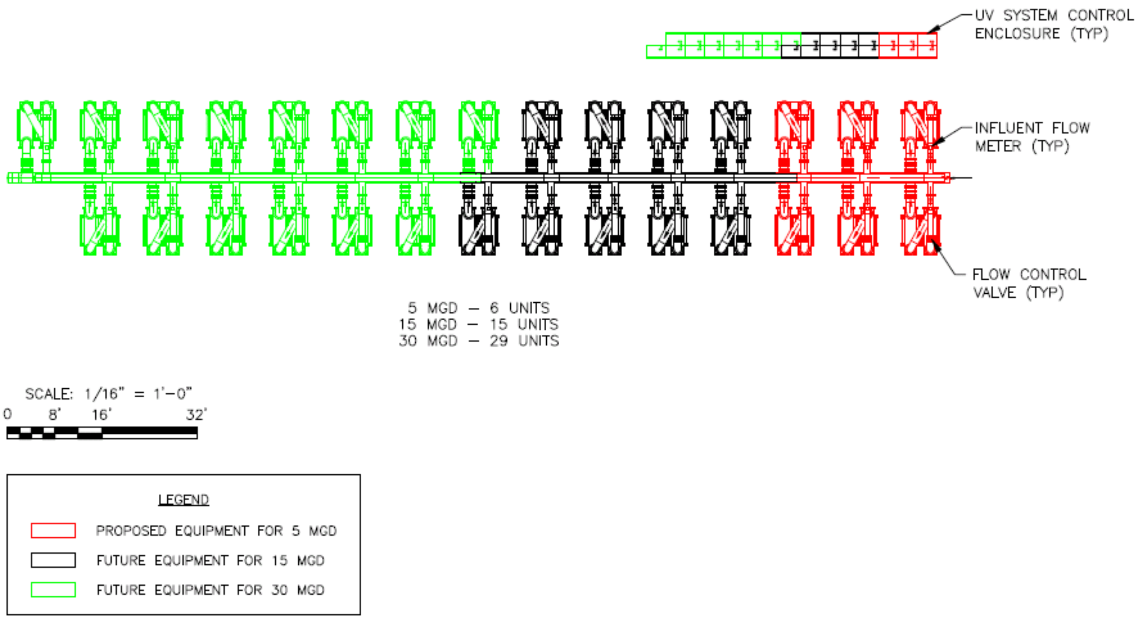

Figure 10-3: Plan B UV Disinfection System Preliminary Layout

Table 10-2: Plan B (5 mgd Capacity) Preliminary Cost Summary

Parameter	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
Filters (Nova Ultrascreen)	4.2	100	6.0
Disinfection (In-pipe UV)	6.5	230	10.6
Storage (5 MG Circular Prestressed Concrete Tank) and Distribution Pumping	7.5	290	12.7[1]
TOTAL	18.2	620	29.3

[1]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

10.2.2 Plan C (12 mgd Capcity)

The TTDF under Plan C is similar to Plan B discussed above, except that it has a capacity of 12 mgd of constant flow (i.e. no flow peaking factor considered). As discussed in Section 10, Plan A, which incorporates an MBR system in place of conventional filtration, has a capacity of 12 mgd. In order to compare the use of a MBR system to the use of conventional tertiary filtration, the design criteria, preliminary layout drawings, and preliminary construction, O&M, and life-cycle cost estimates for Plan C have been developed.

The design criteria for Plan C are summarized in the Table 10-3 and the preliminary construction, O&M, and life-cycle cost estimates are presented in Table 10-4. Figures 10-4 and 10-5 present the preliminary layout drawings for the Nova Ultrascreen filter and the in-pipe UV disinfection system, respectively. Note that the Nova Ultrascreen units proposed for Plan C (16 disk units) are larger than the units proposed for Plan B (10 disk units). The layout drawings show the initial capacity of 12 mgd as well as the expansion to 30 mgd.

Table 10-3: Plan C Design Criteria

Parameter	Criteria
Design Flow, mgd	12 (constant flow)
Filtration	
CDPH Approved Filtration Rate, gpm/ft^2	16
Number of Filter Units	3
Number of Disks per Unit	16
Total Filtration Area, ft^2	1,056
Filtration Rate with One Filter Offline, gpm/ft^2	11.8
Headloss Through Filter, ft (Operating)	2 - 2.5
Disinfection	
Type of UV System	In-pipe, Low Pressure, High Intensity
Number of Reactors	24 (11 trains + 1 standby) each train has 2 reactors
Flow Capacity per Reactor, mgd	0.55
Length of Reactor (ft)	8
Number of Lamps per Reactor	40
Total Number of Lamps Provided	960
Storage	
Design Capacity, mg	5
Number of Tanks	1
Dimensions of Tank, Diameter (ft) x Side Water Depth (ft)	178 x 28

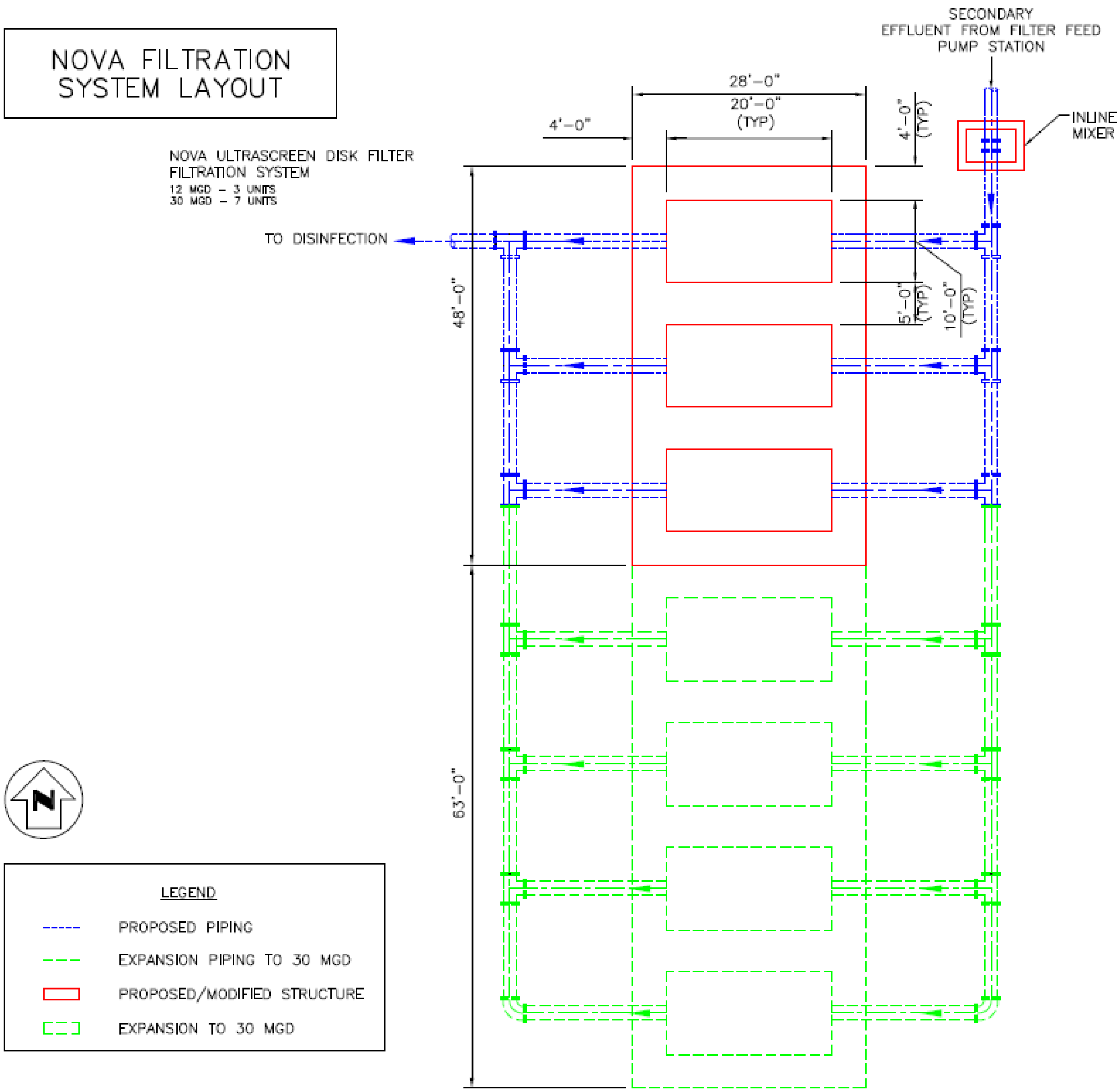

Figure 10-4: Plan C Nova Ultrascreen Filter Preliminary Layout

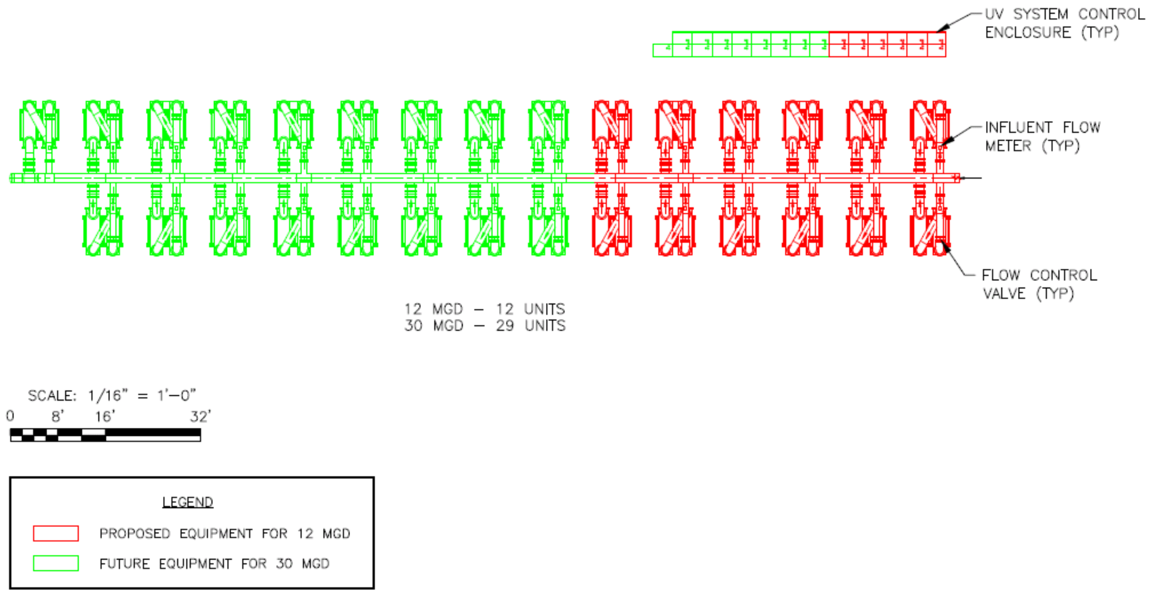

Figure 10-5: Plan C UV Disinfection System Preliminary Layout

Table 10-4: Plan C (12 mgd Capacity) Preliminary Cost Summary

Parameter	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
Filters (Nova Ultrascreen)	7.3	155	10.1
Disinfection (In-pipe UV)	13.5	465	21.9
Storage (5 MG Circular Prestressed Concrete Tank) and 12 mgd Distribution Pumping	7.7	680	19.9[1]
TOTAL	28.5	1,300	51.9

[1]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

10.3 ADVANTAGES AND DISADVANTAGES OF PLAN A VERSUS PLANS C

Section 11 of this TM summarizes the advantages and disadvantages of Plan A versus Plan C. Both Plans A and C are of 12 mgd capacity, while Plan B is 5 mgd in capacity and therefore will not be used to compare against Plan A.

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SECTION 11 – COMPARISON OF MBR SYSTEM WITH NOVA FILTRATION SYSTEM (PLAN A VS. PLAN C)

11.1 BACKGROUND

In this section, the Plan A (described in Section 9) and Plan C (described in Section 10) will be compared. The advantages and disadvantages of each Plan are presented along with preliminary construction, O&M, and life-cycle cost estimates of each Plan.

Under Plan A, the TTDF will produce an average of 12 mgd of denitrified Title 22 quality effluent and will be designed to handle peak flows of up to 14.76 mgd. The use of existing Train A facilities will be maximized: a secondary clarifier will be converted into a bioreactor for achieving organic and nitrogen (NDN) removal, a new structure will house the membranes, and Aeration Basin No. 3 will be converted into a recycled water storage tank. The option of housing the membranes in a new structure as opposed to inside secondary clarifier No. 5 is considered for Plan C due to lower cost (refer to Section 9). Under Plan C, the TTDF will produce 12 mgd of Title 22 quality effluent without a flow peaking factor. The TTDF feed water will be withdrawn from distribution Canal B at a constant rate of 12 mgd. No modifications to the upstream biological treatment facilities will be made - thus, the recycled water produced under Plan C will contain nitrogen in the form of ammonia, nitrates, and nitrites at concentrations approximately equal to current secondary effluent concentrations.

11.2 COMPARISON OF PLAN A AND PLAN C

The major difference between Plan A and Plan C is the means of filtration: Plan A will utilize membrane filtration (MBR) while Plan C utilizes media filtration (Nova Ultrascreen). This section will primarily focus on the benefits and drawbacks of these technologies.

The difference in filtration technology allows Plan A to achieve nitrogen removal without additional tanks, use an existing aeration basin for recycled water storage, and achieve disinfection meeting NWRI guidelines with a smaller UV disinfection system. These benefits are reflected in the preliminary Plan A construction, O&M, and life-cycle cost estimate.

11.2.1 Ease of Expandability

Figures 11-1 and 11-2 below show the preliminary layout drawings for Plan A and Plan C, respectively. The preliminary layout drawings show the footprint for a 12 mgd TTDF (in red) and the future footprint for a 30 mgd TTDF (in green).

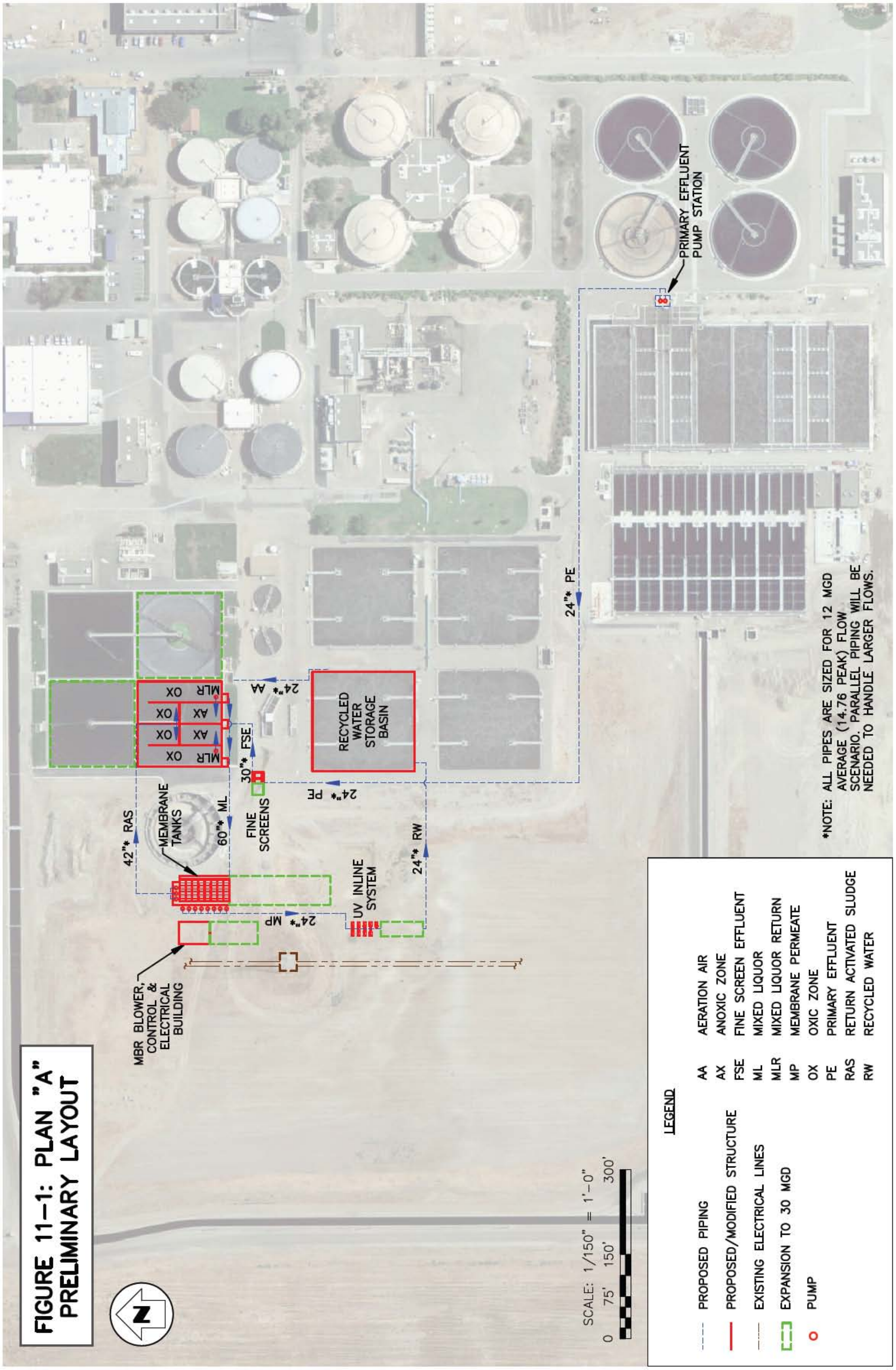

FIGURE 11–1: PLAN "A" PRELIMINARY LAYOUT

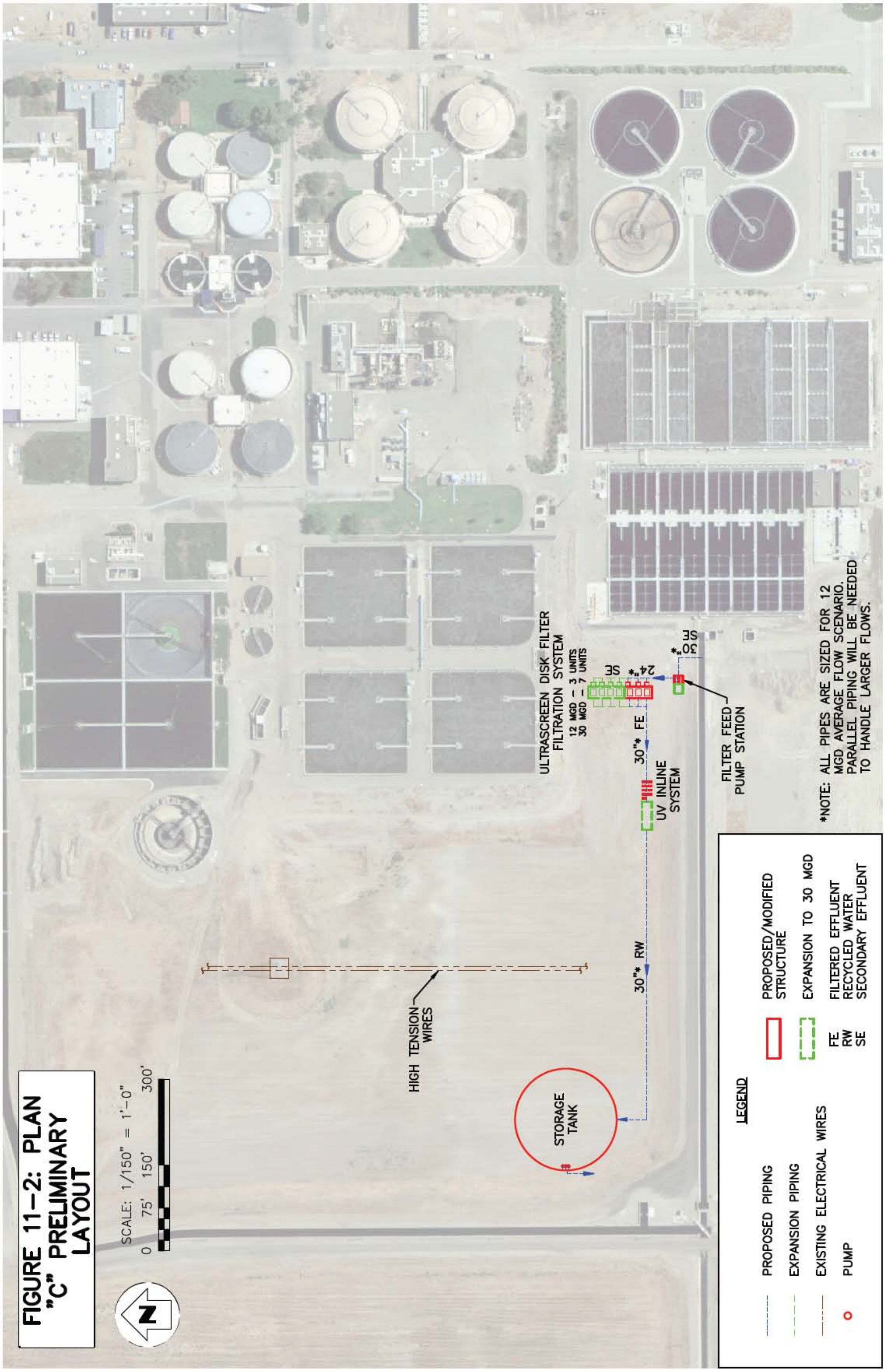
FIGURE 11–2: PLAN "C" PRELIMINARY LAYOUT
SCALE: 1/150" = 1'–0"
0 75' 150' 300'
N
HIGH TENSION WIRES
STORAGE TANK
30"* RW
UV INLINE SYSTEM
30"* FE
ULTRASCREEN DISK FILTER FILTRATION SYSTEM
12 MGD – 3 UNITS
30 MGD – 7 UNITS
SE
24"* SE
30"* SE
FILTER FEED PUMP STATION
*NOTE: ALL PIPES ARE SIZED FOR 12 MGD AVERAGE FLOW SCENARIO. PARALLEL PIPING WILL BE NEEDED TO HANDLE LARGER FLOWS.
LEGEND
PROPOSED PIPING
EXPANSION PIPING
EXISTING ELECTRICAL WIRES
PUMP
PROPOSED/MODIFIED STRUCTURE
EXPANSION TO 30 MGD
FE FILTERED EFFLUENT
RW RECYCLED WATER
SE SECONDARY EFFLUENT

Under Plan C, additional facilities will need to be constructed in order to increase the TTDF capacity to 30 mgd; however, the expansion would be straightforward. Nova Ultrascreen filters are supplied as prefabricated, packaged units ready for "plug and play" installation. The site work will consist of the extension of the concrete equipment pad and an equipment canopy or a building.

Under Plan A, two additional secondary clarifiers will need to be converted to bioreactors and a new structure will need to be constructed to house the additional membrane modules required for increasing the TTDF capacity to 30 mgd. Even though new structures do not need to be built for the additional bioreactor capacity required, the existing secondary clarifiers will need to be modified and therefore the construction sequencing for the expansion of Plan A will be more complex than for the expansion of Plan C.

11.2.2 Reliability

Both Plan A and Plan C will be provided with features to ensure adequate reliability. As discussed in Section 4, the TTDF under Plan C will be designed with multiple Nova Ultrascreen filter units capable of treating the entire flow with one unit not in operation.

The TTDF under Plan A will be provided with eight independent membrane tanks, each with six membrane cassettes. Sufficient membrane area will be provided to allow for redundancy.

11.2.3 Constructability

Plan A maximizes the use of existing Train A facilities. The use of existing facilities will not impact the sequence of construction due to the fact that at least one of the units in Train A is typically out of service and construction can be performed on one unit at a time. The constructability of Plan C is slightly easier since no modifications of existing facilities are planned. The secondary effluent will simply be withdrawn from distribution Canal B and fed to the new TTDF.

It is our understanding that a minimum SRT of 5 days in the upstream biological treatment system is required prior to filtration with disk filters (including Nova Ultrascreen filters) for consistent effluent quality. If the existing biological system does not provide an SRT of at least 5 days, modifications to the pertinent secondary treatment facilities' operation will be required.

11.2.4 Simplicity of Operation

The treatment systems used in both Plan A and Plan C will be automated; however, since the MBR is a biological process as well as a filtration process, the operation of Plan A facilities will likely be somewhat more complex. However, trained and experienced City staff should be able to operate and maintain both the systems with similar ease.

11.2.5 History of Use

Nova Ultrascreen filters have a long history (~10 years) of use in overseas installations; however, the history of use in the US on municipal wastewater is limited. There are currently no installations in California and the longest operating municipal wastewater installation in the US has been in operation for less than one year (in Orange Park, FL) and has a rated capacity of 3.0 mgd. If this filtration system is selected, site visits to a minimum of two operating installations is recommended to obtain firsthand knowledge of their performance and operation.

There are numerous MBR installations at municipal wastewater treatment plants producing water for recycle/reuse purposes and the history of use is well documented.

11.2.6 Environmental Impacts, Including Public Perception and Acceptance

While both Plan A and Plan C are capable of producing an effluent that meets the requirement for unrestricted reuse water as set forth by the Department of Public Health, Plan A far exceeds the requirements for unrestricted reuse water. In addition to conventional uses of reuse water, MBR treated water has been used by industry for cooling water applications because of its high quality as a feed to additional treatment units, such as reverse osmosis, ahead of manufacturing processes. MBR effluent is also being used as the feed water to advanced water treatment in indirect potable water systems.

In terms of environmental impacts such as energy efficiency, however, Plan A is more energy intensive - even when considering the credit of reduced UV disinfection power consumption. The estimated incremental power consumption for Plan A over Plan C is approximately 4,425 MWh per year (considering the power consumption credit for achieving nitrogen removal). This is primarily due to the power consumed by the air scour blowers and the sludge recirculation pumps.

11.2.7 Staffing Requirements

Plan A involving membrane system, requires relatively more operator attention due to the fact that periodic chemical cleaning and backwashing of membranes is required. Additionally more sophisticated controls are involved requiring skilled operators to run the system. Comparatively, Plan C is simpler to operate. For the purposes of this TM, we have estimated 1 FTE for Plan A. For Plan C the required hours are half of that of Plan A.

11.2.8 Preliminary Capital, O&M, and Life-Cycle Costs

Table 11-1 below presents preliminary capital, O&M, and life-cycle cost estimates for Plan A and Plan C.

Table 11-1: Comparison of Plan A and Plan C Preliminary Capital, O&M, and Life-Cycle Costs

Parameter	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20 Year Life-Cycle Cost ($ Millions)
MBR (Train A)[1]	34.8	1,165	55.9
Disinfection (In-line UV)	12.9	270	17.8
Storage (Converted Train A Aeration Basin) and Distribution Pumping	3.1	680	15.4[2]
Total Plan A Cost	**50.8**	**2,115**	**89.1**
Filters (Nova Ultrascreen)	7.3	155	10.1
Disinfection (In-line UV)	13.5	465	21.9
Storage (Circular, Prestressed Concrete Storage Tank) and Distribution Pumping	7.7	680	19.9[2]
Total Plan C Cost	**28.5**	**1,300**	**51.9**

[1]Includes credit of $8.9 million capital cost and $670,400 O&M cost for conventional NDN.
[2]Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

Table 11-2: Comparison of Plan A and Plan C Non-Economic Features

Parameter	Plan A	Plan C
Ease of Expandability	Good	Good
Reliability	Good	Good
Constructability	Good	Good
Simplicity of Operation	Average	Good
History of Use	Good	Average
Environmental Impacts, Including Public Perception and Acceptance	Excellent	Average
Staffing Requirements	Good	Good

Per the above cost data, Plan C is far more economical than Plan A, approximately $22.3 million lower than Plan A in capital costs and approximately $815,000 lower than Plan A in O&M costs. However, per Table 11-2 above, Plan A does provide several non-economic advantages over Plan C that need to be considered in decision making. For more information on comparison of MBR system with conventional filtration system and key drivers for decision making, refer to Section 14. The results of this analysis including preliminary cost data were presented to the City during Workshop No. 2 (Section 14). Refer to Section 15 for an evaluation of further modified MBR alternatives.

SECTION 12 – EVALUATION OF POWER SUPPLY OPTIONS FOR TTDF

12.1 BACKGROUND

Per the contracted scope of work, an evaluation needs to be done to determine the feasibility of feeding the new loads of proposed TTDF from low voltage switchgear "R/W-SWG1" in the RAS/WAS Electrical Building. A draft version of this Section was submitted to the City in December 2010 as a part of the draft TM, which included evaluation of two power source options:

a. Utilizing low voltage switchgear "R/W-SWG1" in the RAS/WAS Electrical Building as the power source (per contract)

b. Utilizing the 4.16 KV medium voltage switchgear "BL-MVS3" at the Blower Building No.2 Electrical Room

Subsequent to the submission of a draft version of this TM, Parsons' electrical engineer met with the City's staff at the RWRF on January 20, 2011 to understand the facility's electrical system and to review the "as-built" electrical drawings. During the meeting, estimated electrical loads associated with a 12 MGD TTDF for both conventional filtration and MBR systems were discussed. The City's staff expressed keen interest in planning the electrical infrastructure for an ultimate future flow of 30 mgd.

The following electrical loads (operating) were estimated for each alternative.

Conventional Filtration System	- 12 mgd - 1,311 HP
	- 30 mgd – 3,307 HP
MBR System	- 12 mgd – 2,272 HP
	- 30 mgd – 5,617 HP

Detailed break-up of the loads are attached as Exhibit 1 at the end of this Section. Based on these estimated loads and discussions with the City's staff, it was determined that the two power source options, existing low voltage switchgear "R/W-SWG1" in the RAS/WAS pump station electrical building and existing 4.16 KV Switchgear "BL-MVS3", presented in the draft TM are no longer feasible. The estimated loads are deemed to be too large for the existing infrastructure at the two power sources.

During the meeting, the City's staff noted that there are four "under-utilized" electrical transformers, TD, TE, TF and TG, located near Train A aeration basins and preference should be given to maximize the use of existing infrastructure. In addition, the existing 12 KV Subservice Switchgear "12-MS2" was identified as another potential power source. This 12 KV switchgear has available spare power circuit breakers and are of adequate capacity to serve the estimated power loads for both conventional filtration and MBR alternatives.

12.2 EXISTING ELECTRICAL INFRASTRUCTURE

Currently, Pacific Gas and Electric Company (PG & E) is supplying power to the RWRF with one (1) 70 KV high voltage power line via one (1) 10 MVA power transformer (City owned) with secondary voltage of 12 KV. The secondary side of the transformer is connected to two (2) main circuit breakers 53-BKR-CMA and 53-BKR-CMB of Main 12 KV Service Switchgear,12-MS1. Switchgear 12-MS1 is equipped with a normally open (NO) tie circuit breaker, 53-BKR-CMT. This switchgear is rated at 12 KV, 2000A, 500 MVA short circuit capacity with Bus "A" and Bus "B" separated by the NO tie circuit breaker.

In addition, there is a 12 KV back-up line from PG&E that has a capacity of 5 MVA for emergency use. This back-up line is tied to the Switchgear 12-MVS1 thru 29-BKR-201Circuit Breaker. This breaker is normally open with kirk key interlock and is operated manually.

From the Switchgear 12-MVS1, feeder circuit breakers and cables feed several electrical Substations /Electrical Buildings throughout the facility. Feeder circuit breakers 29-BKR-103 and 29-BKR-203 and corresponding two feeder cables connect the 12 KV service to Subservice Switchgear 12-MS2.

For future expansion of the TTDF to 30 MGD capacity, it is anticipated that the City will rely on the cooling fans equipped on the existing 10 MVA step-down transformer to increase the capacity by up to 12% to meet the additional load. Per the City's staff, the facility's established summer peak demand is about 6500 KVA.

12.3 EVALUATION OF THE POWER SOURCES FOR CONVENTIONAL FILTRATION AND MBR SYSTEMS

As discussed earlier in this Section, the following two power source options will be discussed in detail.

A. 12 MGD Conventional Filtration System Expandable to 30 MGD Capacity

B. 12 MGD MBR System Expandable to 30 MGD Capacity

   1. Option 1 – Power from Swithgear 12-MS2 using spare circuit breakers and new duct banks

   2. Option 2 – Power from Swithgear 12-MS2 using existing circuit breakers and extending existing duct banks via transformers TG and TF.

A. <u>12 MGD Conventional Filtration System Expandable to 30 MGD Capacity</u>

The proposed TTDF with conventional filtration and in-pipe disinfection will utilize the existing two (2) 12 KV circuit breakers 60-BKR-104 and 60-BKR-204 that are currently feeding existing transformers "TG" and "TF". The two transformers, per City's staff, are currently "under-utilized" with minimal to no load and therefore can be disconnected. The existing # 2 15 KV Class cables will be removed as they are inadequate to carry the estimated loads of TTDF. The existing 4" conduits will be used to route the new # 3/0 15 KV Class cables to 12 MGD TTDF. The TTDF will have a 15 KV Class Switchboard with a 600A main isolation switch and two (2) 600A fused disconnect feeder switches. Each feeder switch will feed one step-down transformer. The first feeder switch will feed the 12 MGD facility step-down transformer and the other will feed the second step-down transformer for the future loads up to an additional 18 MGD to make the total capacity of 30 MGD. The secondary sides of the two (2) step-down transformers will be tied to a double ended 480 V Switchboard/MCC with a normally open (NO) tie circuit breaker. The 15 KV Class Switchboard and the transformers will be located outdoor in NEMA 3R enclosures.

The feeder cable length from the Subservice Switchgear 12-MS2 to the TTDF is approximately 1600 feet. Approximately 550 feet of two (2) new 4" conduit duct banks from the existing EMH-6 to the TTDF switchboard/transformer pad will be required. Refer to Sketch No. 1 and 2 for the single line diagrams of the proposed electrical system.

B. <u>12 MGD MBR System Expandable to 30 MGD Capacity</u>

The proposed MBR and in-pipe disinfection Facility will have similar features like the conventional TTDF discussed above, with same size conduits but with larger step-down transformers, and larger feeder cables.

Option 1 - This option utilizes the existing two spare circuit breakers in Switchgear 12-MS2 as well as (2) 4" spare conduits on the north side of the Switchgear Building and extending them to the MBR Facility site. This route requires approximately 1,300 feet of cables from the power source to the MBR Facility. Refer to Sketch No. 3 and 4 for the single line diagrams.

Option 2 - The second option utilizes the existing circuit breakers 60-BKR-104 and 60-BKR-204 as well as existing conduits from the 12 KV Subservice Switchgear Building to the existing Transformers "TF" and "TG". As stated earlier, these transformers are under-utilized and can be disconnected. The existing # 2 - 15KV Class cables will be removed and the 4" conduits will be extended towards the West and up North to the MBR Facility transformer pad. The approximate length of the 1-4" conduit trench is about 1800 feet and the length of 2-4" conduit trench is about 600 feet. The approximate feeder cable length from the power source using the 4"conduit for transformer "TG" to the MBR Facility is about 2500 feet. For the feeder cables using the conduit for the Transformer "TF" to the MBR Facility is about 2200 feet. Refer to Sketch No. 5 and 6 for the single line diagrams.

12.4 LIST OF SINGLE LINE DIAGRAMS

The following sketches were developed as part of this technical memorandum and are enclosed in Appendix B for reference.

1. Sketch No. 1, Single Line Diagram - 12 MGD Conventional Filtration System

2. Sketch No. 2 , Single Line Diagram – Up to 30 MGD Conventional Filtration System

3. Sketch No. 3, Single Line Diagram – 12 MGD MBR System (Option 1)
4. Sketch No. 4, Single Line Diagram – Up to 30 MGD MBR System (Option1)
5. Sketch No. 5, Single Line Diagram – 12 MGD MBR System (Option 2)
6. Sketch No. 6, Single Line Diagram – Up to 30 MGD MBR System (Option2)
7. Dwg. E-1, City of Fresno Plant No. 1 – Site Plan Primary Distribution (Marked-up to show proposed TTDF)

12.5 FURTHER MODIFICATIONS

Subsequent to Workshop No.2 (See Section 14), further modifications to MBR system alternatives were made, which required certain revisions to the power source options discussed in this Section. These revisions are summarized under Section 15 of this TM.

EXHIBIT 1

ESTIMATED ELECTRICAL LOADS

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Table 12-1: Proposed TTDF (MBR) Electrical Loads (30 MGD)

Process Area	Description	Connected Load (HP)	Duty Load (HP)
MBR System	Primary Effluent Pumps	375	250
MBR System	Fine Screens	12	9
MBR System	Anoxic Mixers	72	72
MBR System	Mixed Liquor Return Pumps	180	180
MBR System	Sludge Recirculation Pumps	900	750
MBR System	WAS Pumps	22.5	15
MBR System	Air Scouring Blowers	1,500	1,250
MBR System	Permeate Pumps	400	400
MBR System	Backpulse Pumps	60	30
MBR System	Instruments Air Compressors	30	15
Disinfection	UV Lamp Ballasts	680	646
Distribution	Distribution Pumps	2,400	2,000
	Total (HP)	**6,631.5**	**5,617**

***Assume 1 KVA = 1 HP**

Primary Effluent Pumps: 2+1; 125 hp each (12,800 gpm at 23’ TDH)

Fine Screens: 3+1; 3 hp each

Anoxic Mixers: 18; 4 hp each

Mixed Liquor Return Pumps: 6; 30 hp each (13,900 gpm at 3-4’ TDH)

Sludge Recirculation Pumps: 5+1; 150 hp each (16,700 gpm at 20’ TDH)

WAS Pumps: 2+1; 7.5 hp each (1,000 gpm at 20’ TDH)

Air Scouring Blowers: 5+1; 250 hp each (7,900 scfm at 5 psi)

Permeate Pumps: 20; 20 hp each (1,700 gpm at 25’ TDH)

Backpulse Pumps: 1+1; 30 hp each (1,480 gpm at 25’ TDH)

Instruments Air Compressors: 1+1; 15 hp each

UV Lamps: 19 Duty Trains + 1 Standby Train; 34 hp per Train

Distribution Pumps: 5 + 1; 400 hp each (4,200 gpm at 230’ TDH)

Table 12-2: Proposed TTDF (MBR) Electrical Loads (12 MGD)

Process Area	Description	Connected Load (HP)	Duty Load (HP)
MBR System	Primary Effluent Pumps	200	100
MBR System	Fine Screens	6	3
MBR System	Anoxic Mixers	24	24
MBR System	Mixed Liquor Return Pumps	60	60
MBR System	Sludge Recirculation Pumps	450	300
MBR System	WAS Pumps	15	7.5
MBR System	Air Scouring Blowers	750	500
MBR System	Permeate Pumps	160	160
MBR System	Backpulse Pumps	60	30
MBR System	Instruments Air Compressors	30	15
Disinfection	UV Lamp Ballasts	306	272
Distribution	Distribution Pumps	1,200	800
	Total (HP)	**3,261**	**2,271.5**

***Assume 1 KVA = 1 HP**

Primary Effluent Pumps: 1+1; 100 hp each (10,300 gpm at 20’ TDH)

Fine Screens: 1+1; 3 hp each

Anoxic Mixers: 6; 4 hp each

Mixed Liquor Return Pumps: 2; 30 hp each (16,700 gpm at 3’ TDH)

Sludge Recirculation Pumps: 2+1; 150 hp each (16,700 gpm at 20’ TDH)

WAS Pumps: 1+1; 7.5 hp each (1,000 gpm at 20’ TDH)

Air Scouring Blowers: 2+1; 250 hp each (7,900 scfm at 5 psi)

Permeate Pumps: 8; 20 hp each (1,700 gpm at 25’ TDH)

Backpulse Pumps: 1+1; 30 hp each (1,480 gpm at 25’ TDH)

Instruments Air Compressors: 1+1; 15 hp each

UV Lamps: 8 Duty Trains + 1 Standby Train ; 34 hp per Train

Distribution Pumps: 2 + 1; 400 hp each (4,200 gpm at 230’ TDH)

Table 12-3 : Proposed TTDF (Tertiary Filtration) Electrical Loads (30 MGD)

Process Area	Description	Connected Load (HP)	Duty Load (HP)
Tertiary Filtration	Filter Feed Pumps	240	200
Tertiary Filtration	Coagulant Dosing Pumps	1.0	0.75
Tertiary Filtration	Backwash Pumps	52.5	52.5
Tertiary Filtration	Washwater Return Pumps	80	60
Tertiary Filtration	Filter Drive	42	42
Disinfection	UV Lamp Ballasts	986	952
Distribution	Distribution Pumps	2,400	2,000
	Total (HP)	**3,801.5**	**3,307.25**

***Assume 1 KVA = 1 HP**

Filter Feed Pumps - 5 + 1; 40 hp each (4,200 gpm at 20’ TDH)

Coagulant Dosing Pumps - 3 + 1 at 0.25 hp

Backwash Pumps – 7; 7.5 hp each

Washwater Return Pumps - 3 + 1; 20 hp each (2,000 gpm at 20’ TDH)

Filter Drive – 7; 6 hp each

UV Lamps – 28 duty Trains + 1 standby Train; 34 hp per Train

Distribution Pumps - 5 + 1; 400 hp each (4,200 gpm at 230’ TDH)

Table 12-4: Proposed TTDF (Tertiary Filtration) Electrical Loads (12 MGD)

Process Area	Description	Connected Load (HP)	Duty Load (HP)
Tertiary Filtration	Filter Feed Pumps	120	80
Tertiary Filtration	Coagulant Dosing Pumps	0.75	0.5
Tertiary Filtration	Backwash Pumps	22.5	22.5
Tertiary Filtration	Washwater Return Pumps	40	20
Tertiary Filtration	Filter Drive	18	18
Disinfection	UV Lamp Ballasts	405	370
Distribution	Distribution Pumps	1,200	800
	Total (HP)	**1,806.25**	**1,311**

***Assume 1 KVA = 1 HP**

Filter Feed Pumps - 2 + 1; 40 hp each (4,200 gpm at 20' TDH)

Coagulant Dosing Pumps - 2 + 1 at 0.25 hp

Backwash Pumps – 3; 7.5 hp each

Washwater Return Pumps - 1 + 1; 20 hp each (2,000 gpm at 20' TDH)

Filter Drive – 3; 6 hp each

UV Lamps – 11 duty Trains + 1 standby Train; 34 hp per Train

Distribution Pumps - 2 + 1; 400 hp each (4,200 gpm at 230' TDH)

SECTION 13 – INTEGRATION OF TTDF CONTROLS WITH EXISTING SCADA SYSTEM

13.1 BACKGROUND

This Section of the TM describes the present condition and expansion philosophy of the Supervisory Control and Data Acquisition (SCADA) system and Instrumentation at the RWRF. The expanded SCADA and Instrumentation, which will be consistent with the existing design, will be able to handle the control and communication requirements of the proposed TTDF.

13.2 EXISTING SCADA AND INSTRUMENTATION

Parsons reviewed the existing SCADA block diagram (refer to Carollo Engineers Dwg. 0N04, Rev. 1, dated 6/23/06). The existing SCADA consists of two independent communication networks: Modbus Plus and Remote I/O. Each loop uses different communication media that includes shielded twisted pair cables and coaxial cables, respectively. Fiber optic cables are used for communications between buildings.

The existing SCADA consists of several Programmable Logic Controllers (PLCs) and Operator Interface Stations (OISs) located throughout the plant. Each PLC system on the plantwide network operates in a redundant processor configuration. The fiber optic communication modules are also configured with redundancy.

13.3 DISCUSSION

Parsons will design SCADA and instrumentation systems to match and be compatible with the existing SCADA. A new PLC control panel will be provided in a redundant processor configuration with an uninterruptible power supply (UPS). The PLC panel will be located in a new Electrical and Control Building located close to the proposed TTDF. The PLC will be linked to the existing PLCs and OISs by fiber optic cables routed to the existing RAS/WAS Pump Station Electrical Room and will communicate via Modbus Plus. The PLC control panel will also be linked to the vendor-supplied PLC control panels by digital data communication cables. Under Plan A, the PLC control panel will be linked to the new Membrane Bioreactor system and Inline Ultraviolet Disinfection system control panels. Under Plans B and C, the PLC control panel will be linked to the new Nova Ultrascreen Filtration system and Inline Ultraviolet Disinfection system control panels.

A new OIS will be provided in the new Electrical and Control Building. The new OIS will be configured with graphics and symbols to match the existing OISs. Parsons will incorporate the new process areas into the new OIS, which will be accessible at the existing SCADA OISs. New SCADA screens will be added to monitor and control the new process areas. Parsons will conduct further investigation of the existing SCADA hardware and software during Design Development Phase.

The above discussion assumes that the existing Modbus Plus network has the capacity to handle the additional data transfers required by the new PLC and OIS. However, there is a concern that the network may be near or at its maximum capacity and that the additional nodes will overload the network. Further investigation of the Modbus Plus network is required to determine its capabilities. Plants of this size are usually designed with or have converted to Ethernet communications, which has a much larger bandwidth (i.e. handles more data) and communicates at higher speeds (i.e. 100 Mbits/s compared to 2 Mbits/s maximum) than Modbus Plus communications. Parsons will further investigate the existing network during Design Development Phase.

A new Closed-Circuit Television (CCTV) camera will also be provided in the TTDF. The camera, control receiver, and Ethernet encoder will match the existing CCTV equipment. The new camera will be tied into the plant's existing CCTV equipment.

For the proposed TTDF, Parsons will specify field instruments after consultation with the RWRF plant personnel and/or will match existing instruments to achieve instrument standardization throughout the plant. This criterion is intended to minimize spare parts inventory and improve operator familiarity with similar equipment. Instrument data sheets will be prepared to specify the same brand and model numbers already in use at the RWRF, as much as possible.

SECTION 14 – SUMMARY OF WORKSHOP NO.2 AND NEW PROJECT DIRECTION

14.1 BACKGROUND

A second Workshop (Workshop No.2) was conducted with the City on February 3, 2011 to present and discuss the comparison of Plan A with Plan C, as detailed under Section 11. The discussions included pros and cons of MBR system compared to conventional filtration system. This Section summarizes the discussion carried out at the Workshop and highlights the important decisions made for subsequent work.

14.2 DISCUSSION AND KEY DECISIONS

During the Workshop No.2, very crucial plant operating and maintenance issues were discussed in detail with the City's operations staff and the following key considerations were identified:

1. Train A facilities, reportedly, are old, of obsolete design and are difficult to operate and maintain. Further, nitrogen removal cannot be achieved reliably with the current configuration of the aeration basins in Train A. Discussions with the City's operations staff indicated that the ceramic disc diffusers installed in the aerations basins need replacement/cleaning and it may not be possible to restore them to their original state due to their age. The aeration pipe grids that connect the diffusers are old and unique to the type of diffusers currently installed. Further, the secondary clarifiers in Train A are in need of central column and scraper mechanism replacement. Based on the above described extensive repair/replacement needs related to Train A infrastructure coupled with the long age of the equipment, it appears that replacement of Train A facilities in the near future would be a prudent measure, If the intention is to continue to use Train A for the long term.

2. North Fresno Wastewater Reclamation Facility, operated by the City, was issued a WDR/NPDES permit on December 10, 2009 by the Central Valley Regional Water Quality Control Board (RWQCB) with a Total Nitrogen (TN) limit of 10 mg/L for the recycled water used for golf course irrigation. It is expected that the proposed TTDF at the RWRF will also have a similar TN limit for irrigation water. This means that it will be short sighted to design the TTDF with no consideration for nitrogen removal.

3. In this report, all the options involving conventional filtration systems are designed to produce Title 22 recycled water without nitrogen removal. However, as discussed above, if nitrogen removal becomes a requirement per the anticipated WDR/NPDES permit for the TTDF, additional aeration basins and secondary clarifiers will be required to provide enough Solids Retention Time (SRT) in the system for consistent and reliable nitrogen removal. On the other hand, the MBR alternative will not only produce effluent exceeding Title 22 criteria, but will achieve nitrogen removal without additional basins.

Based on the above discussion, it is evident that the MBR system alternative for TTDF has a clear advantage over the conventional filtration system alternatives. By converting Train A facilities into MBR (See Plan A), not only will the system be capable of producing effluent meeting all permit limitations, but also will avoid the future replacement and upgrading cost of Train A for nitrogen removal. This means that constructing an MBR system will, in effect, be an equivalent capacity replacement for Train A. Therefore, MBR will be more cost effective compared to conventional filtration systems, when considering both its ability to produce high quality effluent with nitrogen removal and the avoided cost of future upgrades/replacement of Train A facilities for nitrogen removal.

Moving forward, both Parsons and the City collectively decided to pursue MBR as the technology of choice for TTDF. In addition to the option of converting Train A facilities into MBR, the City expressed their interest to explore the option of having MBR designed and built as a separate stand-alone system with all new structures.

14.2 NEW PROJECT DIRECTION – POST WORKSHOP NO.1 AND WORKSHOP NO.2

The City asked Parsons to develop and compare the following two MBR alternatives for their review and final selection.

1. Converting Train A into MBR – (5 mgd constant flow; no peaking factor) – This is similar to Plan A as discussed in Section 9 of this report, except that the capacity will be 5 mgd constant flow instead of 12 mgd with peaking factor.
2. Constructing a separate standalone MBR system with all new tanks – (5 mgd constant flow; no peaking factor)

A new final section (Section No. 15) is added to this report to discuss and compare the two selected MBR system alternatives.

POST-WORKSHOP NO.2 ANALYSIS (SECTION 15 - SECTION 16)

SECTION 15 – SELECTED MBR ALTERNATIVES ANALYSIS

15.1 BACKGROUND

Workshop No. 2 was held on February 3, 2011 and was attended by the City's and Parsons' staff. Tertiary filters, MBR, and electrical feed alternatives were discussed and several key decisions were made with respect to the tertiary treatment systems as summarized below:

- MBR alternative offers several advantages over the conventional filtration alternatives, which include higher quality recycled water and nitrogen removal. Also, as Train A is reportedly approaching the end of its useful life (see Section 14), implementation of an MBR system could be tied with Train A phase out. This would avoid substantial costs associated with replacing and/or upgrading of Train A facilities in the near future, if tertiary filters were used. Therefore, MBR will be more cost effective compared to conventional filtration systems, when considering both its ability to produce high quality effluent with nitrogen removal and the avoided cost of future upgrades/replacement of Train A facilities for nitrogen removal. Based on the discussions, it was decided to pursue the MBR alternative as the system of choice for filtration, nitrogen removal and future capacity replacement for Train A.
- The MBR system should be designed to handle 5 mgd of constant flow. The influent pipeline should be capable of conveying 15 mgd of flow, with a parallel pipeline added in the future when the demand for recycled water increases beyond 15 mgd.
- The location of the MBR system should be evaluated considering a completely new structure for the system versus retrofitting the existing Train A structure for this purpose. In the case of using a new structure, the MBR system would be located north of Canal B. In the case of using existing Train A facilities, an existing secondary clarifier would be retrofitted into aeration basins and a new tank(s) would be constructed to house the membranes.

This Section develops and compares the two MBR system alternatives mentioned above.

15.2 DESIGN DEVELOPMENT

This subsection describes the design of MBR system for two different alternatives; 1) retrofitting existing Train A facilities, 2) using completely new structures.

15.2.1 Layout – 5 mgd Constant Flow – Retrofitting Train A Facilities into MBR

In this alternative, secondary clarifier No. 4 (Train A) would be modified and converted into the pre-aeration bioreactors of MBR system (Figure 15-1). Primary effluent would be taken from the existing stub at Train C and delivered by gravity to bioreactors. The gravity pipeline would be routed underneath Canal B as an inverted siphon. Fine screens would be located at the upstream side of this gravity line (near Train C) to minimize solids accumulation within the pipe. Following the pre-aeration bioreactors, the flow would be conveyed to the membrane tanks located west of secondary clarifier No. 5. The MBR blower building would be located west of membrane tanks. Space is allowed for expansion to 30 mgd. The existing 24 inch diameter air line serving aeration basin No. 3 (Train A) would be used and extended to deliver process air to bioreactors. In-pipe UV system will be used to disinfect the MBR permeate to achieve Title 22 recycled water quality. Aeration basin No. 3 would be used for storage of the recycled water. The power for the MBR system would be supplied from the 12 kV electrical building, located east of Train A secondary clarifiers, through new conduits. See Subsection 15.5 for electrical details.

15.2.2 Layout – 5 mgd Constant Flow – MBR with All New Construction

The structures for MBR system would be located north of Canal B as shown in Figure 15-2. Primary effluent would be taken from the existing stub at Train C and delivered by gravity to pre-aeration Bioreactors. The gravity pipeline will be routed underneath Canal B as an inverted siphon. Fine screens would be located at the upstream side of this gravity line (near Train C) to minimize solids accumulation within the pipe. Bioreactors, membrane tanks, and blower building would have common walls to minimize the concrete and piping costs. Space is allowed for expansion to 30 mgd. The existing 24 inch diameter air line serving aeration basin No. 4 (Train A) would be used and extended to deliver process air to bioreactors. In-pipe UV system will be used to disinfect the MBR permeate to achieve Title 22 recycled water quality. Aeration basin No. 4 would be used for storage of the recycled water. The power for the MBR system would be supplied from the 12 kV electrical building, located east of Train A secondary clarifiers, through existing and new conduits. See Subsection 15.5 for electrical details.

15.2.3 Capacity Analysis

Process analysis was performed to determine the volume of aeration basins required to handle 5 mgd of flow and to achieve NDN. The basins would be compartmentalized to incorporate several anoxic and oxic zones. The design criteria in Table 15-1 were developed as the basis for capacity analysis.

Table 15-1: Design Criteria for Capacity Analysis of MBR Aeration Basin to Achieve NDN

Item	Units	Design Value	Remarks
Flow Peaking Factor	-	1	Peak:Average ratio
Primary Effluent	-	-	Max month values
BOD	mg/L	224	70% of raw wastewater
TSS	mg/L	120	40% of raw wastewater
TKN	mg/L	30	65% of raw wastewater
MLSS	mg/L	10,000	
SRT (Minimum)	days	6	Oxic zone
Anoxic:Oxic Zone Ratio (Minimum)	-	0.3	
Maximum Oxygen Uptake Rate	mg/L-hr	128	

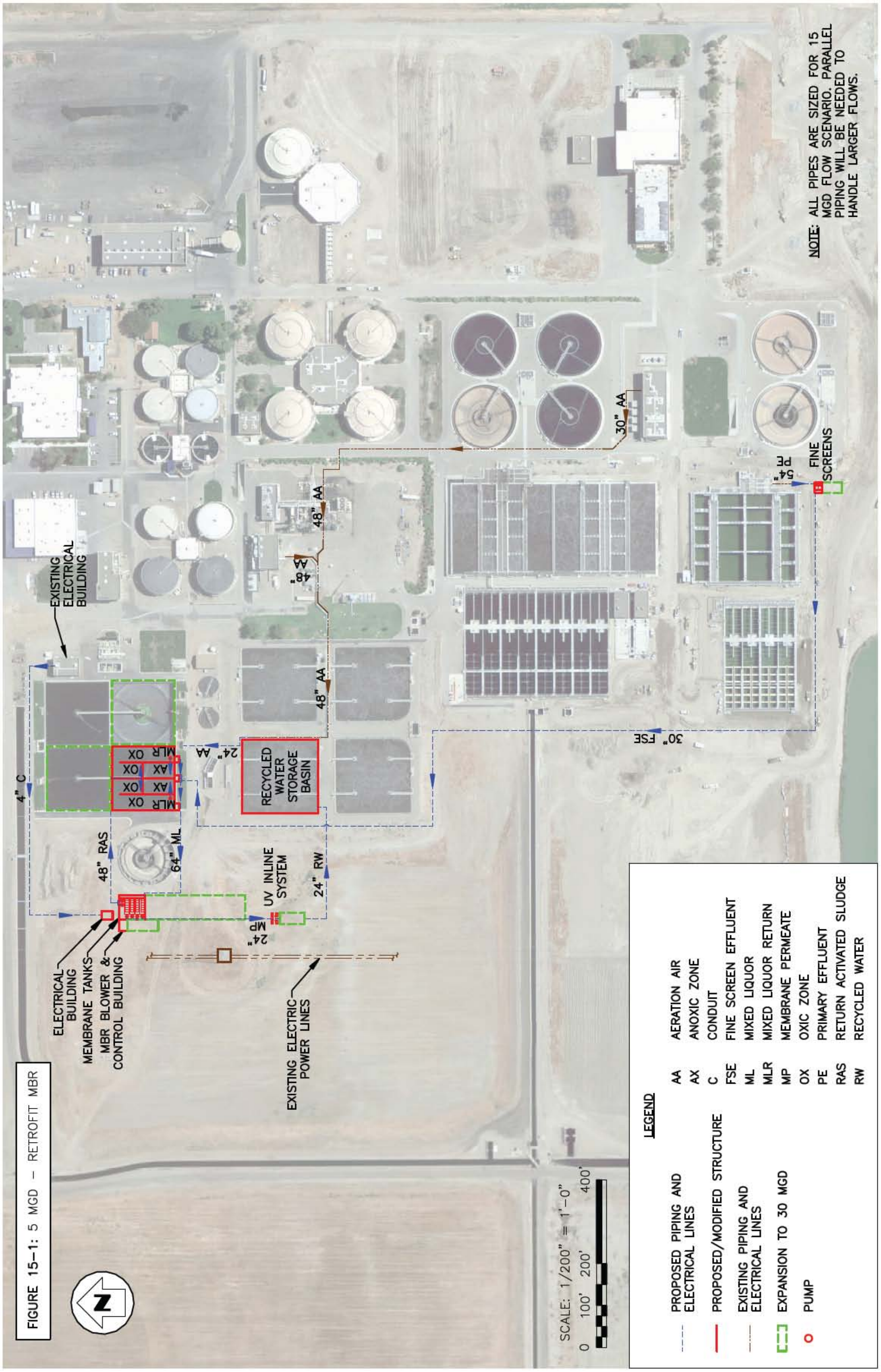


FIGURE 15–1: 5 MGD – RETROFIT MBR
N
SCALE: 1/200" = 1'-0"
0 100' 200' 400'
ELECTRICAL BUILDING
MEMBRANE TANKS
MBR BLOWER & CONTROL BUILDING
EXISTING ELECTRIC POWER LINES
EXISTING ELECTRICAL BUILDING
UV INLINE SYSTEM
RECYCLED WATER STORAGE BASIN
FINE SCREENS
4" C
48" RAS
64" ML
24" MP
24" RW
24" AA
48" AA
30" AA
30" FSE
54" PE
MLR OX
AX OX
NOTE: ALL PIPES ARE SIZED FOR 15 MGD FLOW SCENARIO. PARALLEL PIPING WILL BE NEEDED TO HANDLE LARGER FLOWS.
LEGEND
PROPOSED PIPING AND ELECTRICAL LINES
PROPOSED/MODIFIED STRUCTURE
EXISTING PIPING AND ELECTRICAL LINES
EXPANSION TO 30 MGD
PUMP
AA AERATION AIR
AX ANOXIC ZONE
C CONDUIT
FSE FINE SCREEN EFFLUENT
ML MIXED LIQUOR
MLR MIXED LIQUOR RETURN
MP MEMBRANE PERMEATE
OX OXIC ZONE
PE PRIMARY EFFLUENT
RAS RETURN ACTIVATED SLUDGE
RW RECYCLED WATER

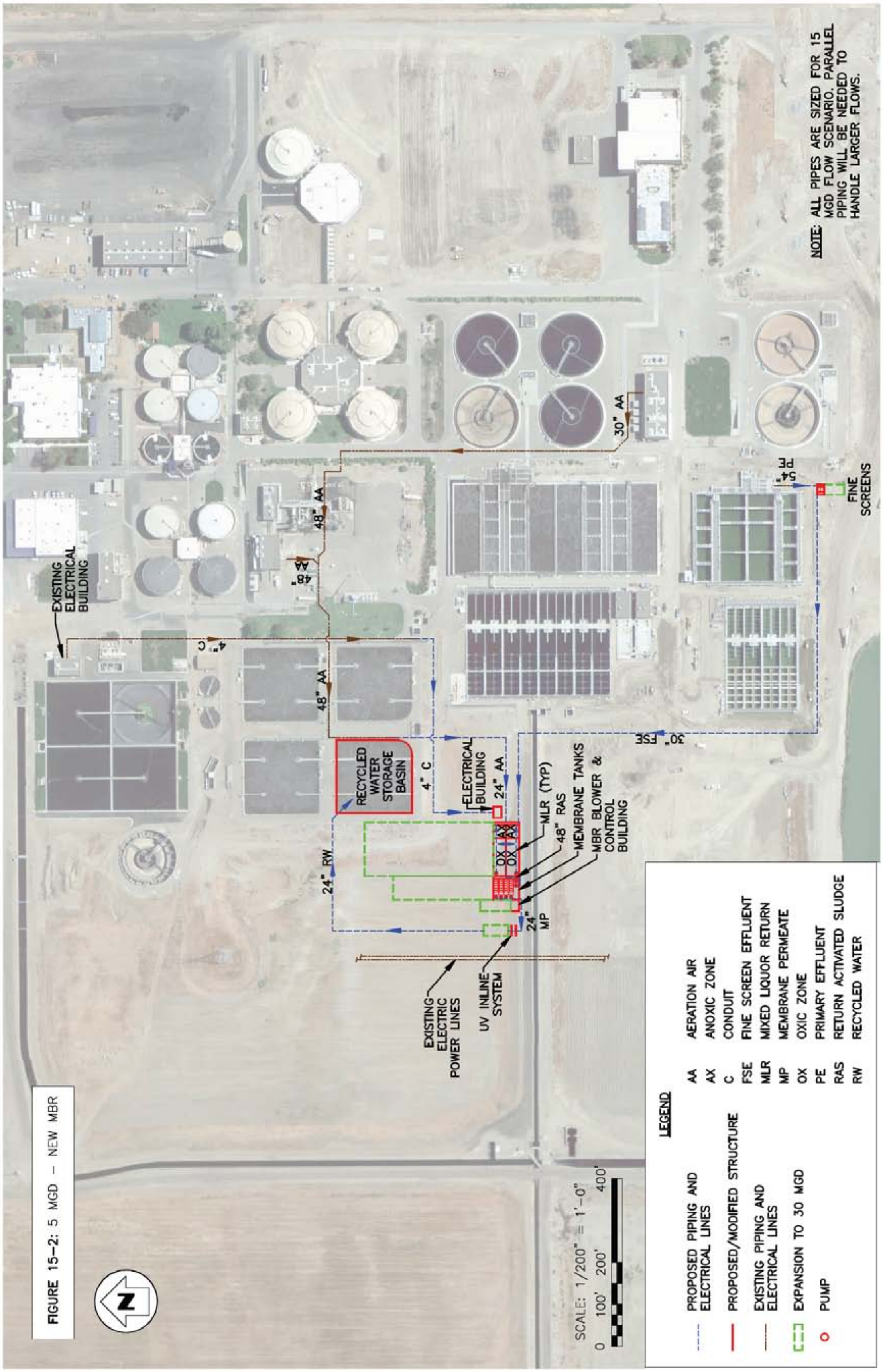


FIGURE 15-2: 5 MGD – NEW MBR

15.2.4 Fine Screens

The flow (i.e. primary effluent) would be conveyed by gravity to fine screens located southeast of aeration basins of Train C (Figures 15-1 and 15-2). Two fine screens would be installed with one of the units as standby. Each screen would be capable of handling 5 mgd of flow to provide prudent redundancy. The units would be installed in concrete channels equipped with isolation gates to allow for maintenance without interfering with the plant's operation. Each fine screen would be equipped with an integrated washer/compactor for cleaning and concentrating the screenings prior to disposal off site.

The design characteristics for the fine screens and washer/compactors are shown in Table 15-2.

Table 15-2: Design Characteristics of Fine Screens and Washer/Compactors

Item	Units	Design Value	Remarks
Screens			
Type	-	-	In-channel perforated-plate drum
Number	-	2 (1+1)	
Capacity, Each	mgd	5	
Effective Opening Size	mm	2	
Channel Width	ft	5.3	Width at screen
Screenings Handling			
Type	-	-	Washer, dewatering, compactor unit
Number	-	2 (1+1)	Integrated with screens
Motor Power, Each	hp	2	Also powers screen basket

15.2.5 Bioreactors and Associated Equipment

This subsection describes the structures and equipment located downstream of fine screens and upstream of membrane tanks.

Bioreactor (Pre-Aeration Basin):

Depending on the MBR alternative considered, the bioreactors (pre- aeration basins) would be provided by retrofitting the secondary clarifier No. 4 or by using a new structure. To provide redundancy, two bioreactors would be designed, each divided into several anoxic and oxic zones, with the first quarter of each bioreactor dedicated to the anoxic zone. Baffles would be placed in the bioreactors to separate the anoxic and oxic zones to minimize back-mixing as the flow passes through in a plug flow regime. Additional baffling would be used to divide each anoxic and oxic zone into 3 compartments, again to minimize back-mixing. The plug flow conditions increase the efficiency of biological treatment, optimizing carbonaceous matter removal, nitrification and denitrification. Submersible mixers would be used to provide mixing in the anoxic zones. Table 15-3 provides the design characteristics of the bioreactors. As can be seen in the Table, volume of bioreactors is larger for the first alternative (Retrofit MBR). This is due to the fact that an existing structure (secondary clarifier No. 4) is being used and the volume available in this structure is more than what is actually needed to handle 5 mgd of flow.

Table 15-3: Bioreactors Design Characteristics

Item	Units	Design Value		Remarks
		Retrofit MBR	New MBR	
Bioreactors				
Number (In Parallel)	-	2	2	
Volume, Each	MG	1.0	0.42	
Anoxic Zone				
Number per Bioreactor	-	1	1	
Dimensions of Zone (L x W x SWD), Each	ft x ft x ft	75 x 37.5 x 12	27.5 x 30 x 17	
Number of Compartments per Zone	-	3	3	Equal volume (in series)
Oxic Zone				
Number per Basin	-	1	1	
Dimensions of Zone (L x W x SWD), Each	ft x ft x ft	225 x 37.5 x 12	82.5 x 30 x 17	
Number of Compartments per Zone	-	3	3	Equal volume (in series)
Anoxic Zone Mixers				
Type				Submersible
Number per Compartment	-	1	1	
Total Number	-	7 (6+1)	7 (6+1)	One shelf spare
Horsepower, Each	hp	4	4	

Aeration System:

The air would be transferred to the oxic zones in the bioreactors through fine bubble diffusers. Either EPDM Membrane disks or more efficient aerator strips (e.g. AEROSTRIP™), would be used to provide aeration. The aeration would be tapered so that approximately 70% of the oxygen is provided in the first half of the oxic zone to satisfy the high oxygen demand as the substrate enters the oxic zone.

The required air would be supplied to the oxic zones by the existing blowers. These blowers are of single-stage centrifugal type and have enough capacity to serve the biological needs of the MBR process as well as the remaining plant. The existing 24 inch diameter air pipeline of aeration basin No. 3 (Retrofit MBR Alternative) or aeration basin No. 4 (New MBR Alternative) would be used and extended to supply the air to the bioreactors. Aeration basin No. 3 (Retrofit-MBR Alternative) or aeration basin No. 4 (New-MBR Alternative) would no longer be in service and would be used as recycled water storage in the future.

The design characteristics for the aeration system are presented in Table 15-4.

Table 15-4: Aeration System Design Characteristics

Item	Units	Design Value	Remarks
Diffusers			
Type			Fine bubble, membrane (EPDM) disk or strip type
Aeration Pattern			Tapered along bioreactor length
Process Air Blowers			
Type			Single-stage centrifugal
Number	-	6 (5+1)	Existing blowers
Capacity, Each	scfm	27,000	
Discharge Pressure	psig	7.8 or 8.5	4 units at 7.8 and 2 units at 8.5
Horsepower, Each	hp	1,500	

Mixed Liquor Return and Sludge Recirculation Pumps:

Two recirculation lines will be provided in the MBR system: mixed liquor return and sludge recirculation. The mixed liquor return system transfers mixed liquor from the tail end of the oxic zone back to the head of the anoxic zone at a rate up to four times (adjustable) the average flow. This system transfers nitrates resulting from nitrification back to the anoxic zone for denitrification as the oxygen molecules associated with nitrates are used by the biomass.

The sludge recirculation system transfers sludge from the membrane tanks to the head of the oxic zone at a rate also up to four times (adjustable) the average flow. The recirculation system prevents the solids concentration in the membrane tanks from increasing excessively and thus plugging the membranes, as permeate is removed from the mixed liquor. This sludge is highly oxygenated and provides a portion of the process oxygen needed for BOD removal and nitrification. Sludge would be wasted from the MBR system from the sludge recirculation line. New pumps would be installed for this purpose.

The design characteristics for the recirculation and WAS pumps are presented in Table 15-5.

Table 15-5: Sludge Pumping Systems Design Characteristics

Item	Units	Design Value	Remarks
Mixed Liquor Return Pumps			Returning flow from oxic zone to anoxic zone
Type			Axial propeller
Number	-	3 (2+1)	One shelf spare
Capacity, Each	gpm	7,000	
TDH	ft	3	
Horsepower	hp	15	

Item	Units	Design Value	Remarks
Drive			Variable speed
Sludge Recirculation Pumps			Returning flow from membrane tanks to oxic zone
Type			Vertical propeller
Number	-	2 (1+1)	
Capacity, Each	gpm	14,000	
TDH	ft	20	
Horsepower	hp	125	
Drive			Variable speed
WAS Pumps			
Type			Centrifugal
Number	-	2 (1+1)	
Capacity, Each	gpm	450	
TDH	ft	20	
Horsepower	hp	5	
Drive			Variable speed

15.2.6 Membranes

The membranes would be installed in 4 new independent tanks. For the purpose of this Section, hollow-fiber membranes were considered. The following design criteria were developed as the basis for sizing the membranes:

- Minimum wastewater temperature of 16^{o}C.
- Maximum flux rate of 12 gfd (all membrane tanks in service).
- Maximum flux rate of 16 gfd (one membrane tank out of service).

Four membrane tanks, each housing 6 membrane cassettes plus space for a future cassette, would have enough capacity to handle 5 mgd of flow. The tankage would be configured to allow isolation of a tank for maintenance and cleaning.

Permeate pumps would draw the MBR effluent through the membranes, directing it to the disinfection system. A building would house new air scouring blowers and membrane control and electrical system. The building would be located adjacent to the membrane structure.

Table 15-6 summarizes the design characteristics of the MBR membrane system.

Table 15-6: MBR Membrane System Design Characteristics

Item	Units	Design Value	Remarks
Tanks			
Number	-	4	
Cassettes per Tank			
Number Installed	-	6	
Space for Future	-	1	
Total Membrane Surface Area	ft2	417,360	
Air Scouring Blowers			
Type			High-speed turbo
Number	-	3 (2+1)	
Capacity, Each	scfm	3,950	
Discharge Pressure	psi	5	
Horsepower, Each	hp	125	
Drive			Variable speed
Permeate Pumps			
Type			Horizontal end suction
Number	-	5 (4+1)	One shelf spare
Capacity, Each	gpm	1,350	
TDH	ft	25	
Horsepower, Each	hp	20	
Drive			Variable speed
Backpulse Pumps			
Type			Horizontal end suction
Number	-	2 (1+1)	
Capacity, Each	gpm	1,480	
TDH	ft	25	
Horsepower, Each	hp	30	
Drive			Variable speed
Instrument Air Compressors			If Plant air not available
Number	-	2 (1+1)	
Horsepower, Each	hp	15	
Chemical Cleaning			
Sodium Hypochlorite			12.5% Solution
Frequency			
Recovery	Yearly	2	Per tank
Maintenance	Weekly	1	Per tank
Annual Consumption	gal	4,000	
Citric Acid			50% Solution
Frequency	Yearly	1-2	Part of Recovery Clean
Annual Consumption	gal	750	

15.3 DISINFECTION

During Workshop No.1, the City chose in-pipe UV disinfection as opposed to an open channel UV system. One of the major drivers was the positive feedback received from the staff at neighboring Clovis Water Reuse Facility in operating and maintaining their in-pipe UV system. Therefore, for the purpose of this TM, 1-mgd capacity in-pipe UV reactors were considered. The 1 MGD rating for each reactor is based upon high quality membrane permeate feed such as from the MBR system. Four reactor trains (3 operating + one standby) will be required to disinfect 5 mgd of flow and each train will accommodate two reactors. Table 15-7 and Figure 15-3 show the design criteria and preliminary layout for the in-pipe UV disinfection system, respectively. There are several larger in-pipe reactors currently available from other manufacturers that may be more economical for the present project and will be evaluated during detailed design.

Table 15-7: In-pipe UV Disinfection Design Characteristics

Parameter	Criteria
Design Flow, mgd	5
Type of UV System	In-pipe, Low Pressure, High Intensity
Number of Reactors	8 (3 trains + 1 standby) each train has 2 reactors
Flow Capacity per Reactor, mgd	1.0
Length of Reactor (ft)	8
Number of Lamps per Reactor	40
Total Number of Lamps Provided	320

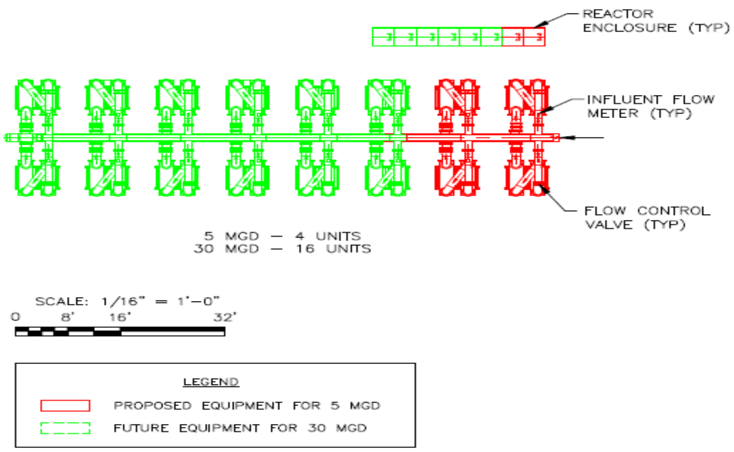


Figure 15-3: In-pipe UV Disinfection System Preliminary Layout

15.4 PRELIMINARY COSTS

Preliminary costs were developed for two alternatives: retrofitting the existing facilities in Train A for aeration basins of MBR system or using a completely new structure for this purpose. The costs estimated are according to Class 4 level per AACE (Association for the Advancement of Cost Engineering) guidelines. At this point in the design process, these costs are preliminary and should be used only for comparative purposes.

The costs were estimated using several resources. Quotes from the manufacturers, information available from similar projects performed by Parsons, including construction in the Central Valley, were used to determine these costs.

The capital costs for the two alternatives are shown in Table 15-8. For both alternatives, the credit for conventional NDN is negligible. This is the investment the City would need to make on a secondary treatment system, if the plant had to be upgraded to an NDN process using conventional tertiary filters rather than MBR. As the existing secondary systems for both Train B and Train C are designed and constructed with future NDN in mind, the aerations basins provide required SRT to achieve NDN and only require installation of new mixed liquor recycle pumps, the cost of which is deemed insignificant for comparison purposes. As indicated in Table 15-8, there is little cost difference between the two alternatives. Retrofitting the existing structure would result in less concrete cost but in higher piping cost.

15.4.1 Avoided Cost of Future Upgrades/Replacement of Train A

As discussed earlier, a credit could be given to compensate for the cost of replacing and upgrading Train A in the near future, which would occur under conventional filtration alternatives but not under MBR alternatives. To estimate this credit, $3-$4 per gal of wastewater treated was used as cost basis, which would translate into $15-$20 million of avoided future capital investment for a 5 mgd system. For the purposes of cost comparison in this Section, $18 million is considered as avoided capital replacement cost. Note that the estimated avoided cost is based on constructing new basins to remove nitrogen but without new aeration blowers.

Table 15-8: MBR Alternatives Capital Cost (5 mgd) [a]

Parameter	Capital Cost ($ Million)	
	Retrofit MBR	New MBR
MBR Equipment and Structures Cost	8.4	8.7
MBR Total Capital Cost [b]	24.5	24.4
Credit for Conventional NDN [b,c]	(0)	(0)
MBR Total Capital Cost Including NDN Credit	24.5	24.4
UV Disinfection Total Capital Cost [b]	5.3	5.3
Storage (Aeration Basin No.3 or 4) Total Capital Cost [b]	3.1	3.1
Total Capital Cost	**32.9**	**32.8**
Train A Capacity Replacement (Avoided Cost) [d]	(18)	(18)
Net Effective Capital Cost	**14.9**	**14.8**

[a] For detailed cost analysis see Appendix A.
[b] Including installation, civil, mechanical, electrical and instrumentation, contractor overhead and profit, contingency (20%) and escalation to midpoint of construction (2012-2013)
[c] NDN credit is insignificant (only involves installation of minor new equipment such as mixed liquor recycle pumps). NDN credit is based on the premise that if the City were to choose conventional filters instead of MBR and were required to achieve NDN in the conventional secondary treatment process.
[d] Near future replacement cost of Train A facilities equivalent to 5 mgd capacity

An evaluation of the operation and maintenance (O&M) costs was also performed (Table 15-9). The O&M cost difference between the two alternatives is insignificant and hence assumed to be the same. Credit is given to MBR system for avoided cost of operation and maintenance of a secondary treatment system to achieve NDN.

Table 15-9: MBR Alternatives O&M Cost (5 mgd) [a]

Parameter	O&M Cost ($)
MBR Total Annual O&M Cost [b,c]	833,000
Credit for Conventional NDN [b,c,d]	(280,000)
MBR Total Annual O&M Cost Including NDN Credit	553,000
UV Disinfection Total Annual O&M Cost [c,d]	150,000
Recycled Water Storage and Distribution Pumping Annual O&M Cost [d]	283,000
Total Annual O&M Cost	986,000

[a] For detailed cost analysis see Appendix A.
[b] Including power and chemicals consumption, membrane/diffusers replacement, general maintenance, and labor.
[c] Assuming power usage rate of 14¢ per kWh.
[d] Proportioned using 12 mgd costs developed in previous Sections.

Using the estimated capital and O&M costs, a 20-year life cycle cost analysis was performed. The results are shown in Table 15-10.

Table 15-10: MBR Alternatives Life-Cycle Cost (5 mgd)

Alternative	Parameter	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
RETROFIT TRAIN A INTO MBR	MBR System	24.5	553[1]	34.5
	Disinfection (In-pipe UV)	5.3	150	8.0
	Storage (Aeration Basin No.3) and Distribution Pumping	3.1	283	8.2[2]
	TOTAL	**32.9**	**986**	**50.7**
	Train A Capacity Replacement Cost	**(18)**		
	Net Effective Capital Cost	**14.9**		
NEW MBR	MBR System	24.4[1]	553[1]	34.4
	Disinfection (In-pipe UV)	5.3	150	8.0
	Storage (Aeration Basin No.4) and Distribution Pumping	3.1	283	8.2[2]
	TOTAL	**32.8**	**986**	**50.6**
	Train A Capacity Replacement Cost	**(18)**		
	Net Effective Capital Cost	**14.8**		

[1] Includes credit for conventional NDN
[2] Although the life of the storage structure is 50 years, a 20 year life cycle cost is presented for consistency.

15.5 REVISIONS TO POWER SOURCE OPTIONS

The power source options for TTDF for both conventional filtration and MBR alternative are described under Section 12 of this report. Single line diagram illustrating the proposed electrical system along with proposed electrical duct bank and cable routing plans are developed and enclosed as part of Section 12. The following revisions are made to the electrical strategy due to the new location for MBR.

A. 5 mgd Constant Flow – MBR with All New construction

For this option, feed will be drawn from existing Sub Service Switchgear "12KV-MS2" building. Two (2) existing circuit breakers 60-BKR-104 and 60-BKR-204 will be utilized to provide a double ended feed to the new indoor type 12 KV switchgear. This new switchgear will be provided with two (2) main circuit breakers, a normally open (NO) tie circuit breaker, two (2) feeder circuit breakers and extra space for two (2) additional circuit breakers for future expansion. All the 480 V Motor Control Centers are also indoor type. The new 12 KV switchgear and all the 480V Motor Control Centers will be housed in a building close to the MBR structure. The step-down transformers, however, are all outdoor type and will be located on an open concrete pad close to the new electrical building. Refer to Sketch No. 7 for a single line diagram showing the proposed system. Two (2) existing – 4"C conduits on the north-south electrical duct bank will be utilized up to Manhole EMH-6. From Manhole EMH-6, two (2) new -4"C conduits will be installed down to the new 12 KV switchgear Electrical Building. Refer to revised drawing E-1 (Rev.1) for electrical conduits and cable routes for this option.

B. 5 mgd Constant Flow – Retrofitting Train A Facilities into MBR

The proposed power source for this option is already discussed in detail in Section 12. The arrangement and type of equipment used will be similar to the option described above. The conduits and cable routes will utilize the two (2)-4"C spare conduits at Manhole EMH-2 on the north side of the Sub Service Switchgear "12KV-MS2" building. These conduits will be extended west and then south to the proposed location of the new electrical building. Refer to revised drawing E-1 (Rev.1) for electrical conduits and cable routes for this option.

15.6 DISCUSSION

It is evident from the data presented in Table 15-10 above, that the two MBR alternatives compared are very close to each other from a cost standpoint. The capital cost difference between the two alternatives is insignificant and is within the margin of error of our estimates. The concrete savings realized by retrofitting existing structures are balanced by less extensive piping required by using new structures.

However, using all new structures offers a more flexible and compact design. By properly planning the new facilities, they can be built in a monolithic construction with common walls, which would make it easier to build and more efficient to operate. The future expansion of tertiary facilities would follow the same compact pattern. Also, the design would not need to be tailored based on the constraints of existing facilities, but based on the best design practices. For example, deeper new aeration basins compared to the retrofitted basins would allow for a more efficient aeration system.

Further, a separate standalone MBR system will be easier to construct and will also provide some redundant treatment facilities associated with that particular train in the interim and for several years until the City decides to totally decommission that train due to its obsolescence.

15.7 CONCLUSION

Based on the above discussion, Parsons recommends using all new structures for constructing the MBR system, as it would be a more prudent and reliable approach to achieve filtration, nitrogen removal and future capacity replacement for Train A.

SECTION 16 – RECOMMENDED PROJECT DESCRIPTION

This Section provides a brief description of the recommended project for TTDF at RWRF. The location and selection of technology for TTDF was thoroughly evaluated considering a variety of factors as presented in this TM and summarized in Section 15. A simplified schematic of the project is presented in Figure 16-1 below.

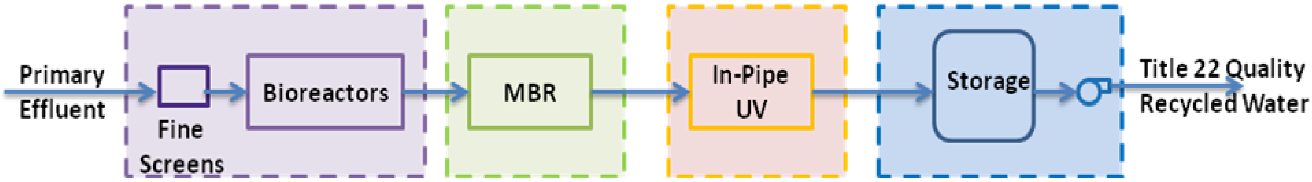


Figure 16-1: Simplified Schematic of Recommended Project for TTDF

16.1 Summary of Recommended Project

The TTDF will have a design capacity of 5 mgd (constant flow) and the facilities would be located on a “green field” site north of Canal B as shown in Figure 16-2. Primary effluent would be taken from the existing stub at Train C and delivered by gravity to pre-aeration bioreactors. The gravity pipeline will be routed underneath Canal B as an inverted siphon. Fine screens would be located at the upstream side of this gravity line (near Train C) to minimize solids accumulation within the pipeline. Bioreactors, membranes tanks, and blower building would have common walls to minimize the concrete and piping costs. In-pipe UV system will be used to disinfect the MBR permeate to achieve Title 22 recycled water quality. Aeration basin No. 4 would be used for storage of the recycled water. The facility will be laid out for ultimate design capacity of 30 mgd. The existing 24 inch diameter air line serving aeration basin No. 4 (Train A) would be used and extended to deliver process air to bioreactors. The power for this project would be supplied from the 12 kV electrical building, located east of Train A secondary clarifiers, through existing and new (extended) conduits.

16.2 Design Criteria

The design criteria in Table 16-1 were developed as the basis for the recommended project for TTDF.

Table 16-1: Design Criteria for TTDF

Item	Units	Design Value	Remarks
Design Flow Rate	mgd	5	
Flow Peaking Factor	-	1	Peak:Average ratio
Primary Effluent	-	-	Max month values
BOD	mg/L	224	70% of raw wastewater
TSS	mg/L	120	40% of raw wastewater
TKN	mg/L	30	65% of raw wastewater
MLSS	mg/L	10,000	
SRT (Minimum)	days	6	Oxic zone
Anoxic:Oxic Zone Ratio (Minimum)	-	0.3	
Maximum Oxygen Uptake Rate	mg/L-hr	128	

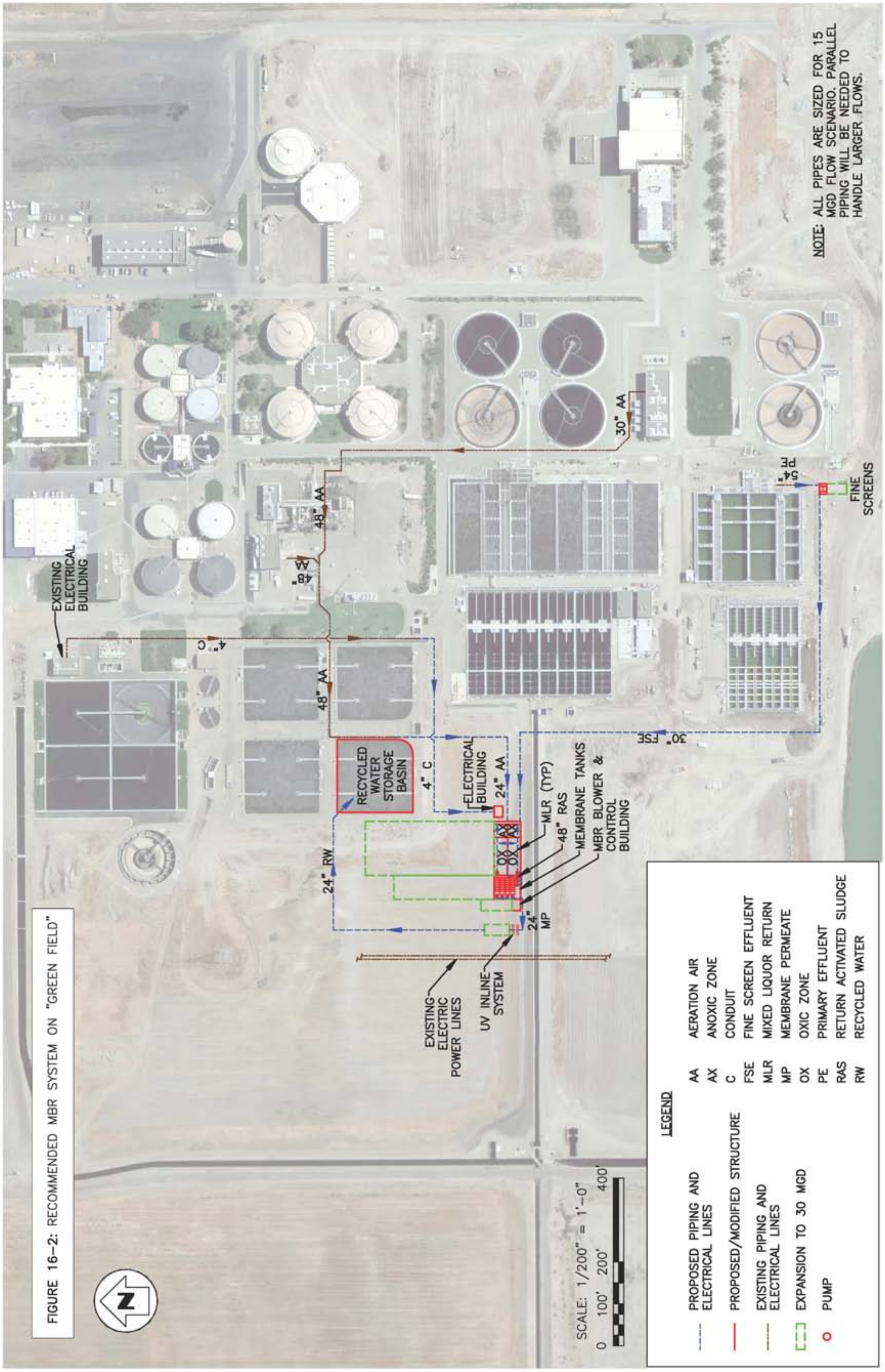


FIGURE 16–2: RECOMMENDED MBR SYSTEM ON "GREEN FIELD"

16.3 Process Equipment List

A list of major processes and equipment is presented in Table 16-2 below. An appropriate level of redundancy is incorporated into the process design and equipment sizing for reliable operation and maintenance of the TTDF.

Table 16-2: List of Major Process Equipment

Item	Units	Design Value	Remarks
Screens			
Type	-	-	In-channel perforated-plate drum
Number	-	2 (1+1)	One duty, one standby
Capacity, Each	mgd	5	
Bioreactors			
Number (In Parallel)		2	Anoxic and oxic zones in each
Volume, Each	MG	0.42	
Diffusers			
Type			Fine bubble, membrane (EPDM) disk or strip type
Aeration Pattern			Tapered along bioreactor length
Process Air Blowers			
Type			Single-stage centrifugal
Number	-	6 (5+1)	Existing blowers
Capacity, Each	scfm	27,000	
Discharge Pressure	psig	7.8 or 8.5	4 units at 7.8 and 2 units at 8.5
Horsepower, Each	hp	1,500	
Mixed Liquor Return Pumps			Returning flow from oxic zone to anoxic zone
Type			Axial propeller
Number	-	3 (2+1)	Two duty, one shelf spare
Capacity, Each	gpm	7,000	
TDH	ft	3	
Horsepower	hp	15	
Drive			Variable speed
Sludge Recirculation Pumps			Returning flow from membrane tanks to oxic zone
Type			Vertical propeller
Number	-	2 (1+1)	One duty, one standby
Capacity, Each	gpm	14,000	
TDH	ft	20	
Horsepower	hp	125	
Drive			Variable speed
WAS Pumps			
Type			Centrifugal

Item	Units	Design Value	Remarks
Number	-	2 (1+1)	One duty, one standby
Capacity, Each	gpm	450	
TDH	ft	20	
Horsepower	hp	5	
Drive			Variable speed
Membrane Tanks			
Number	-	4	
Cassettes per Tank			
Number Installed	-	6	
Space for Future	-	1	
Total Membrane Surface Area	ft2	417,360	
Air Scouring Blowers			
Type			High-speed turbo
Number	-	3 (2+1)	Two duty, one standby
Capacity, Each	scfm	3,950	
Discharge Pressure	psi	5	
Horsepower, Each	hp	125	
Drive			Variable speed
Permeate Pumps			
Type			Horizontal end suction
Number	-	5 (4+1)	Four duty, one shelf spare
Capacity, Each	gpm	1,350	
TDH	ft	25	
Horsepower, Each	hp	20	
Drive			Variable speed
Backpulse Pumps			
Type			Horizontal end suction
Number	-	2 (1+1)	One duty, one standby
Capacity, Each	gpm	1,480	
TDH	ft	25	
Horsepower, Each	hp	30	
Drive			Variable speed
Instrument Air Compressors			If Plant air not available
Number	-	2 (1+1)	One duty, one standby
Horsepower, Each	hp	15	
Chemical Cleaning			
Sodium Hypochlorite			12.5% Solution
Frequency			
Recovery	Yearly	2	Per tank
Maintenance	Weekly	1	Per tank

Item	Units	Design Value	Remarks
Annual Consumption	gal	4,000	
Citric Acid			50% Solution
Frequency	Yearly	1-2	Part of Recovery Clean
Annual Consumption	gal	750	
UV System			
Design Flow	mgd	5	
Type of UV System			In-pipe, Low Pressure, High Intensity
Number of Trains		4 (3+1)	Three duty, one standby
Number of Reactors		8 (6+2)	Six duty, two standby
Flow Capacity per Reactor	mgd	1.0	
Length of Reactor	ft	8	
Number of Lamps per Reactor		40	
Total Number of Lamps Provided		320	

16.4 Preliminary Costs

Preliminary costs were developed according to Class 4 level per AACE (Association for the Advancement of Cost Engineering) guidelines. Using the estimated capital and O&M costs, a 20-year life cycle cost analysis was performed. The results are shown in Table 16-3.

Table 16-3: MBR System Life-Cycle Cost (5 mgd)

Parameter	Capital Cost ($ Millions)	O&M Cost ($ Thousands)	20-Year Life Cycle Cost ($ Millions)
MBR System	24.4	553	34.4
Disinfection (In-pipe UV)	5.3	150	8.0
Storage (Aeration Basin No.4) and Distribution Pumping	3.1	283	8.2
TOTAL	**32.8**	**986**	**50.6**
Train A Capacity Replacement Cost	**(18)**		
Net Effective Capital Cost	**14.8**		

16.5 Power Source

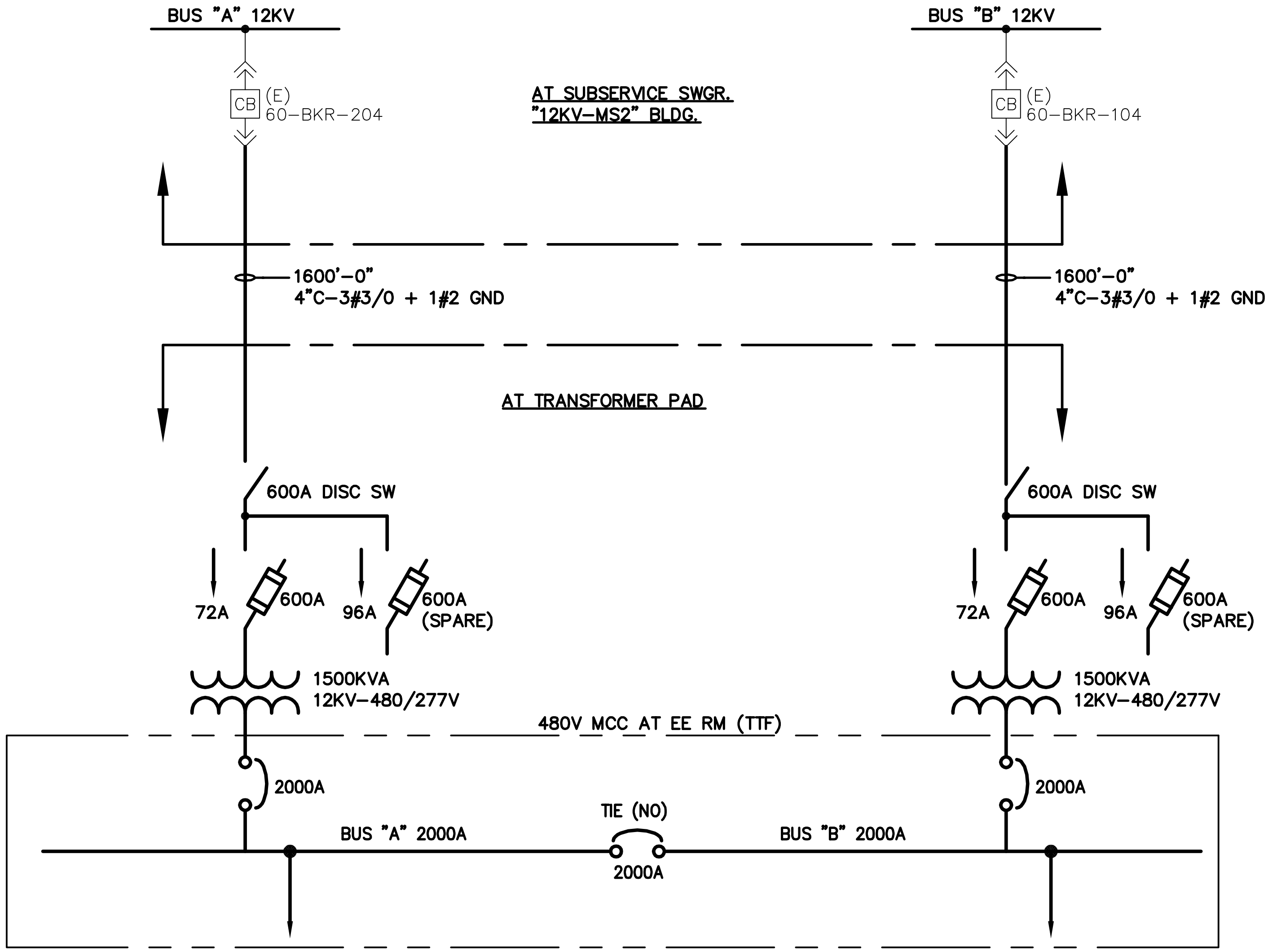
For the proposed TTDF on a “green field” site, power feed will be drawn from existing Sub Service Switchgear “12KV-MS2” building. Two (2) existing circuit breakers 60-BKR-104 and 60-BKR-204 will be utilized to provide a double ended feed to the new indoor type 12 KV switchgear. This new switchgear will be provided with two (2) main circuit breakers, a normally open (NO) tie circuit breaker, two (2) feeder circuit breakers and extra space for two (2) additional circuit breakers for future expansion. All new 480 V Motor Control Centers are also indoor type. The new 12 KV switchgear and all the 480V Motor Control Centers will be housed in a building close to the MBR structure. The step-down transformers, however, are all outdoor type and will be located on an open concrete pad close to the new electrical building. Two (2) existing – 4”C conduits on the north-south electrical duct bank will be utilized up to Manhole EMH-6. From Manhole EMH-6, two (2) new -4”C conduits will be installed down to the new 12 KV switchgear Electrical Building.

APPENDIX A

PRELIMINARY CONSTRUCTION AND O&M COST ESTIMATES

APPENDIX B

REFERENCE DRAWINGS

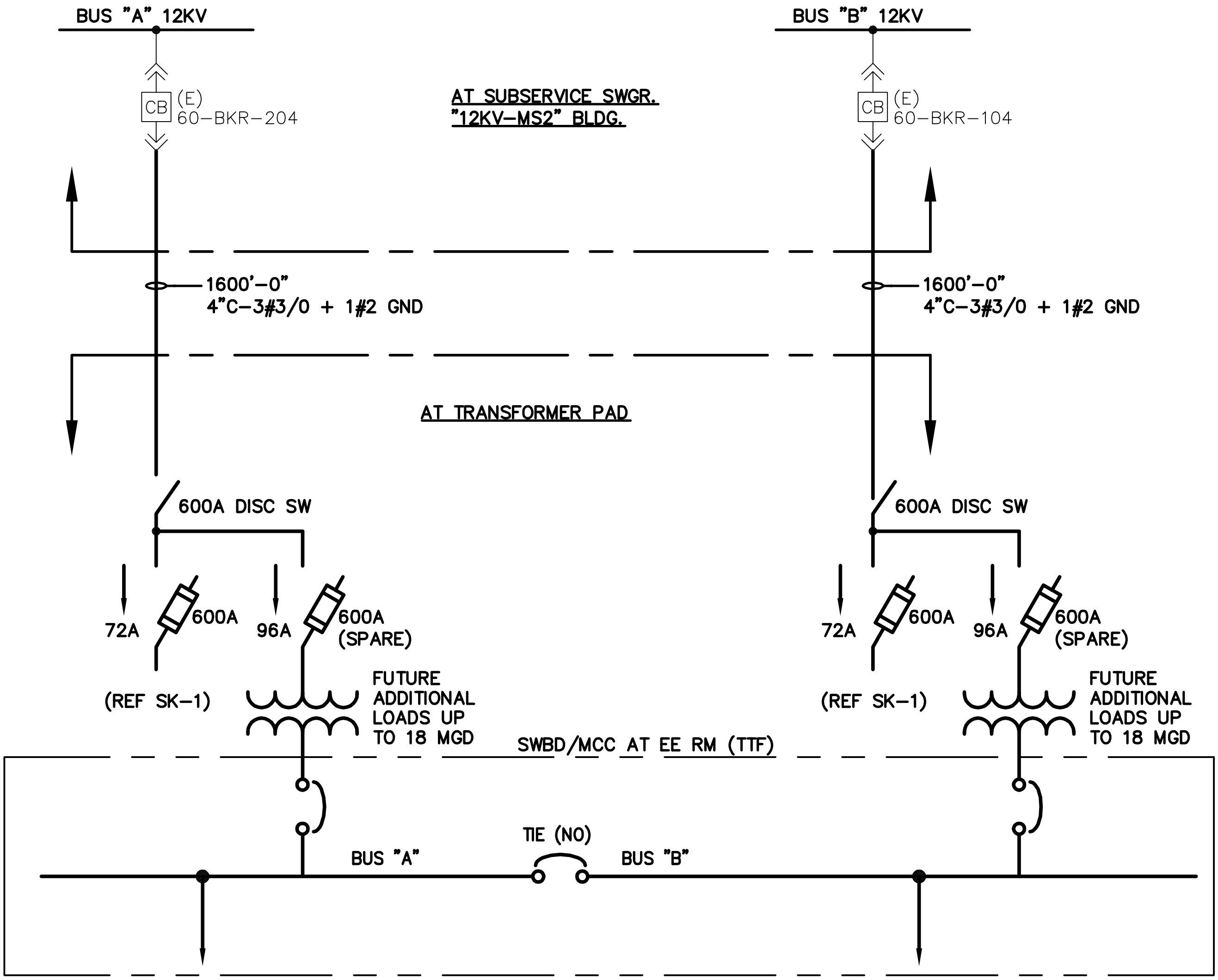


CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - 12 MGD CONVENTIONAL
FILTRATION SYSTEM

SK-1

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

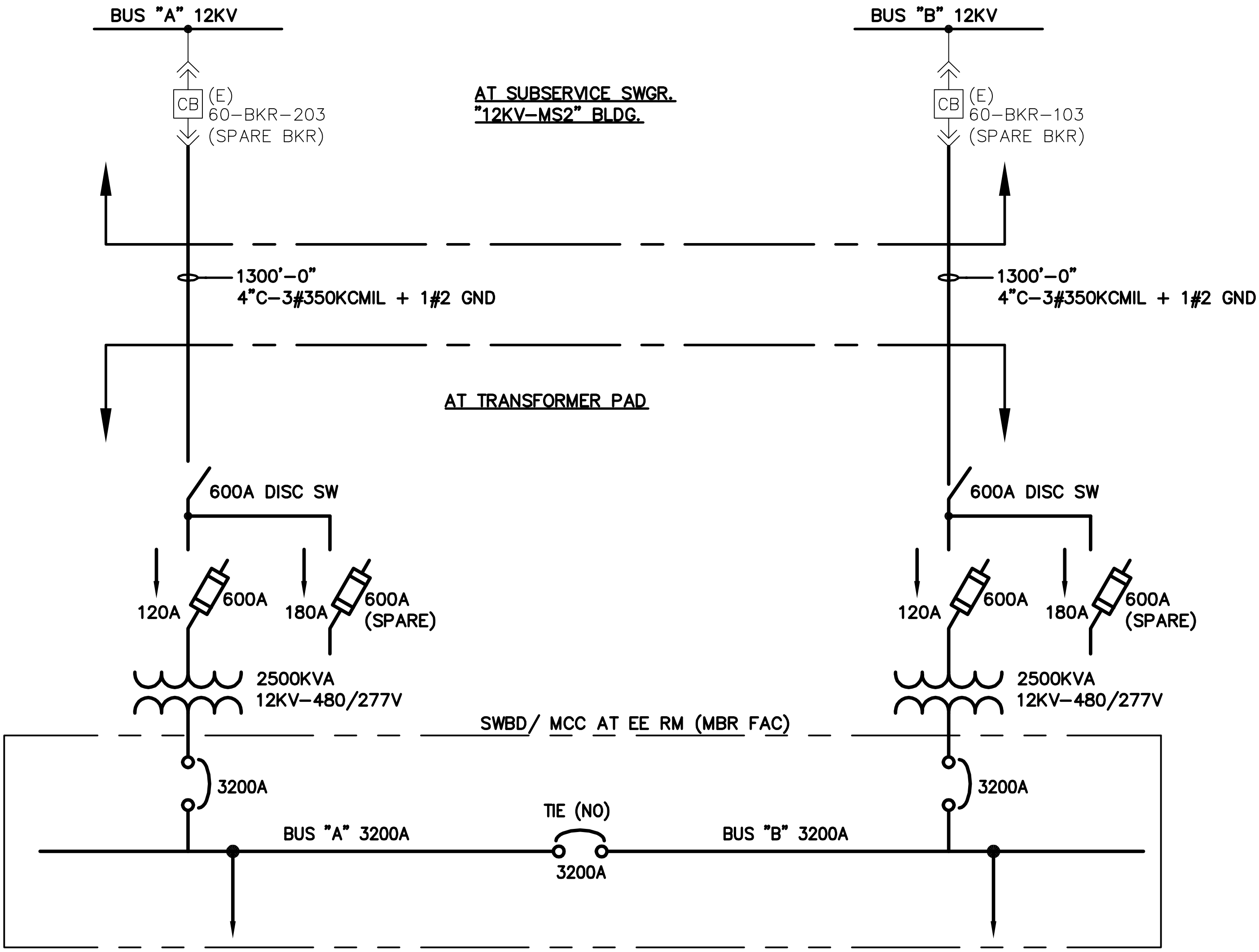


CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - UP TO 30 MGD CONVENTIONAL FILTRATION SYSTEM

SK-2

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011



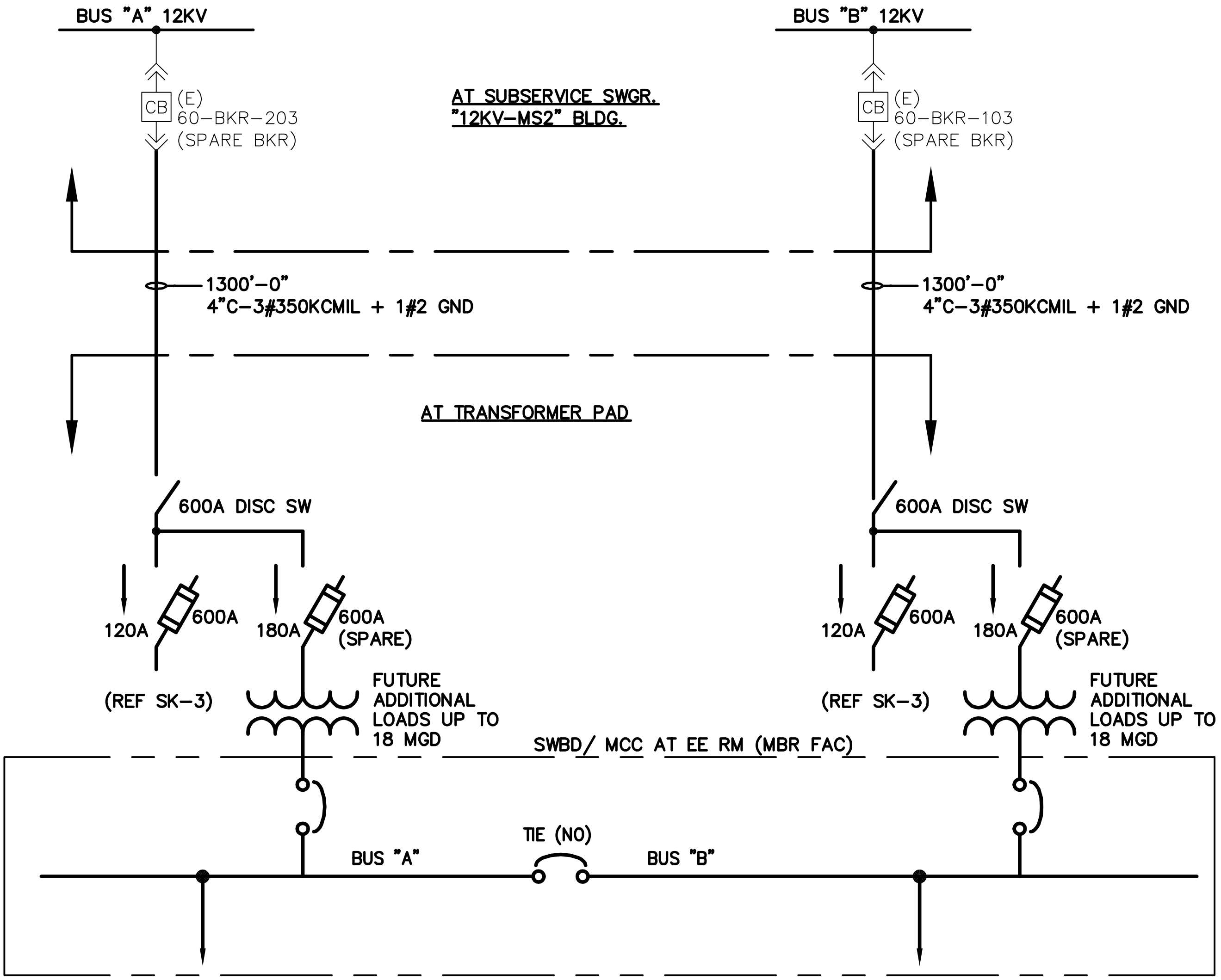
CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - 12 MGD MBR SYSTEM
OPTION 1 (SPARE BREAKERS - NEW 4" CONDUITS)

SK-3

DESIGN BY: E. GATDULA

SCALE: NONE | DATE: 02/01/2011



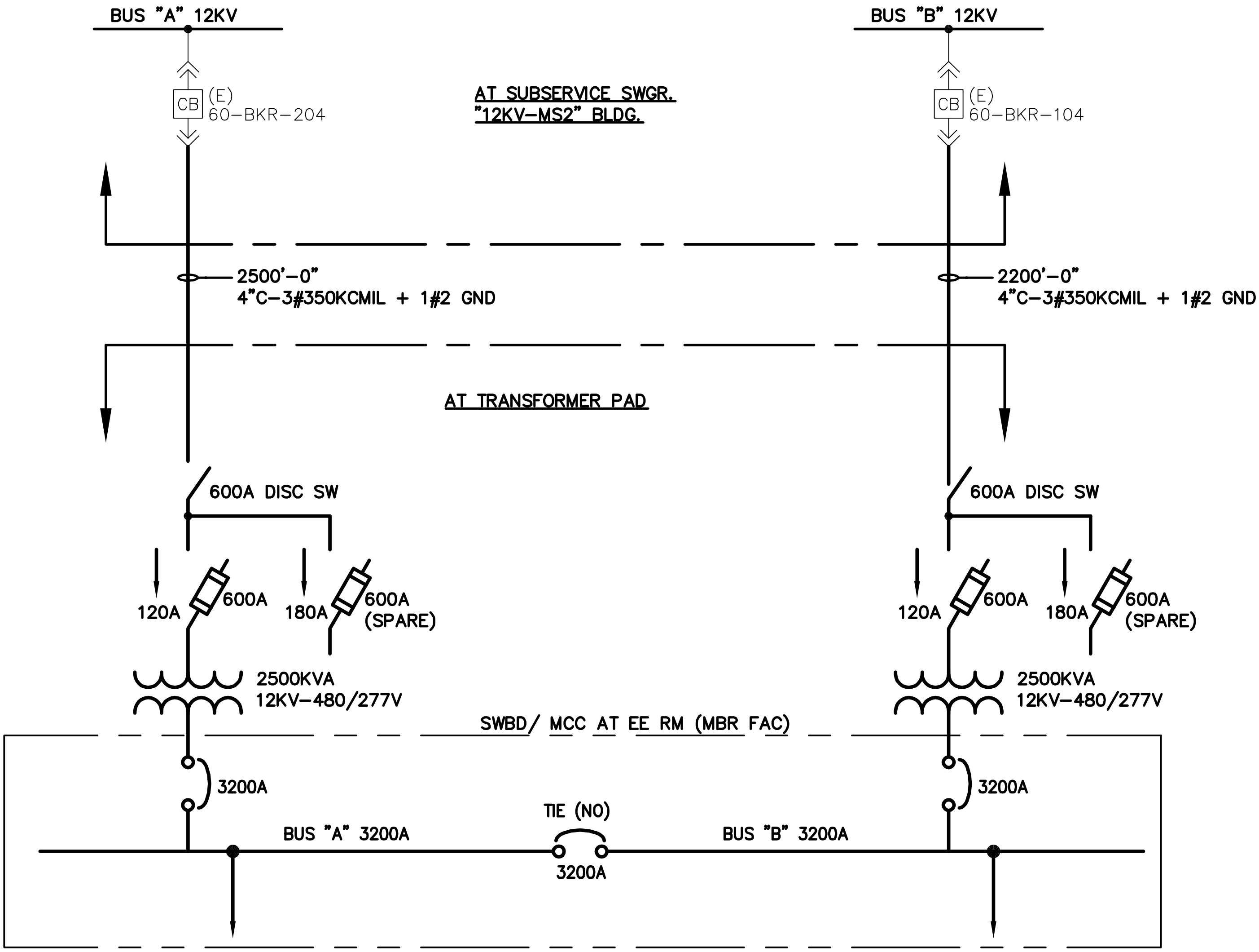
CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - UP TO 30 MGD MBR SYSTEM
OPTION 1 (SPARE BREAKERS - NEW 4" CONDUITS)

SK-4

DESIGN BY: E. GATDULA

SCALE: NONE | DATE: 02/01/2011

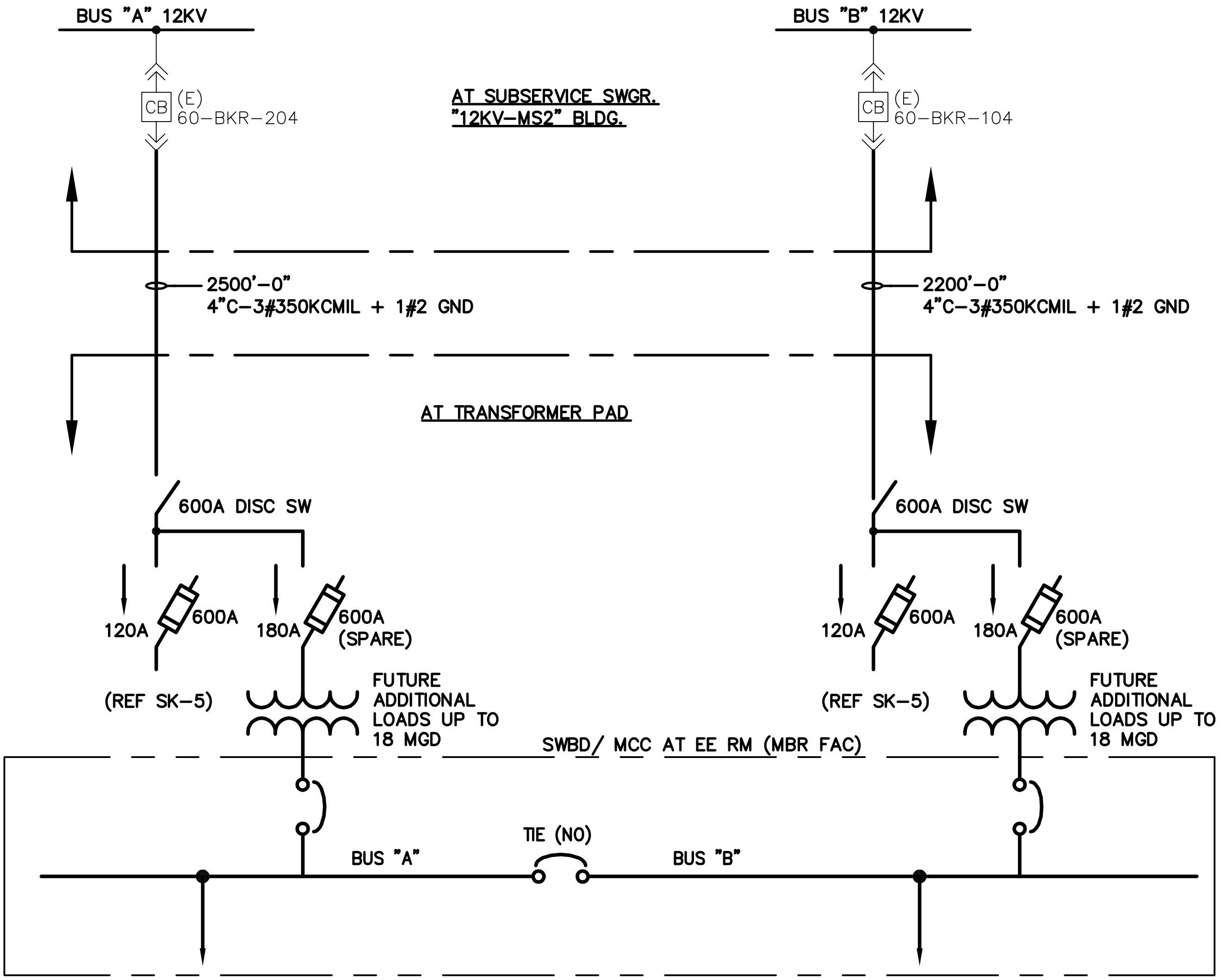


CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - 12 MGD MBR SYSTEM
OPTION 2 (EXIST. BREAKERS - EXIST./ NEW 4" CONDUITS)

SK-5

DESIGN BY: E. GATDULA
SCALE: NONE | DATE: 02/01/2011

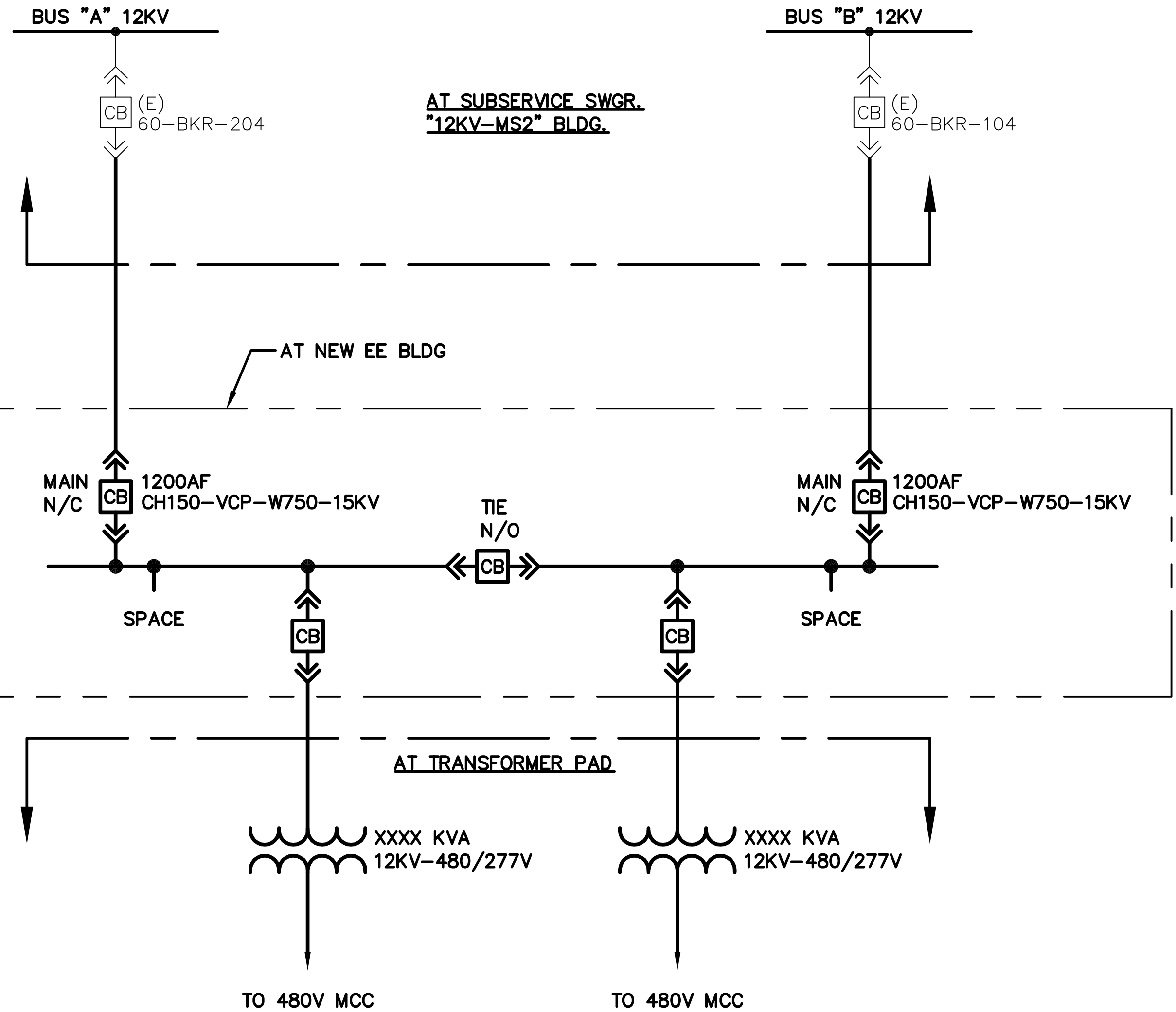


CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - UP TO 30 MGD MBR SYSTEM
OPTION 2 (EXIST. BREAKERS - EXIST./ NEW 4" CONDUITS)

SK-6

DESIGN BY: E. GATDULA
SCALE: NONE
DATE: 02/01/2011



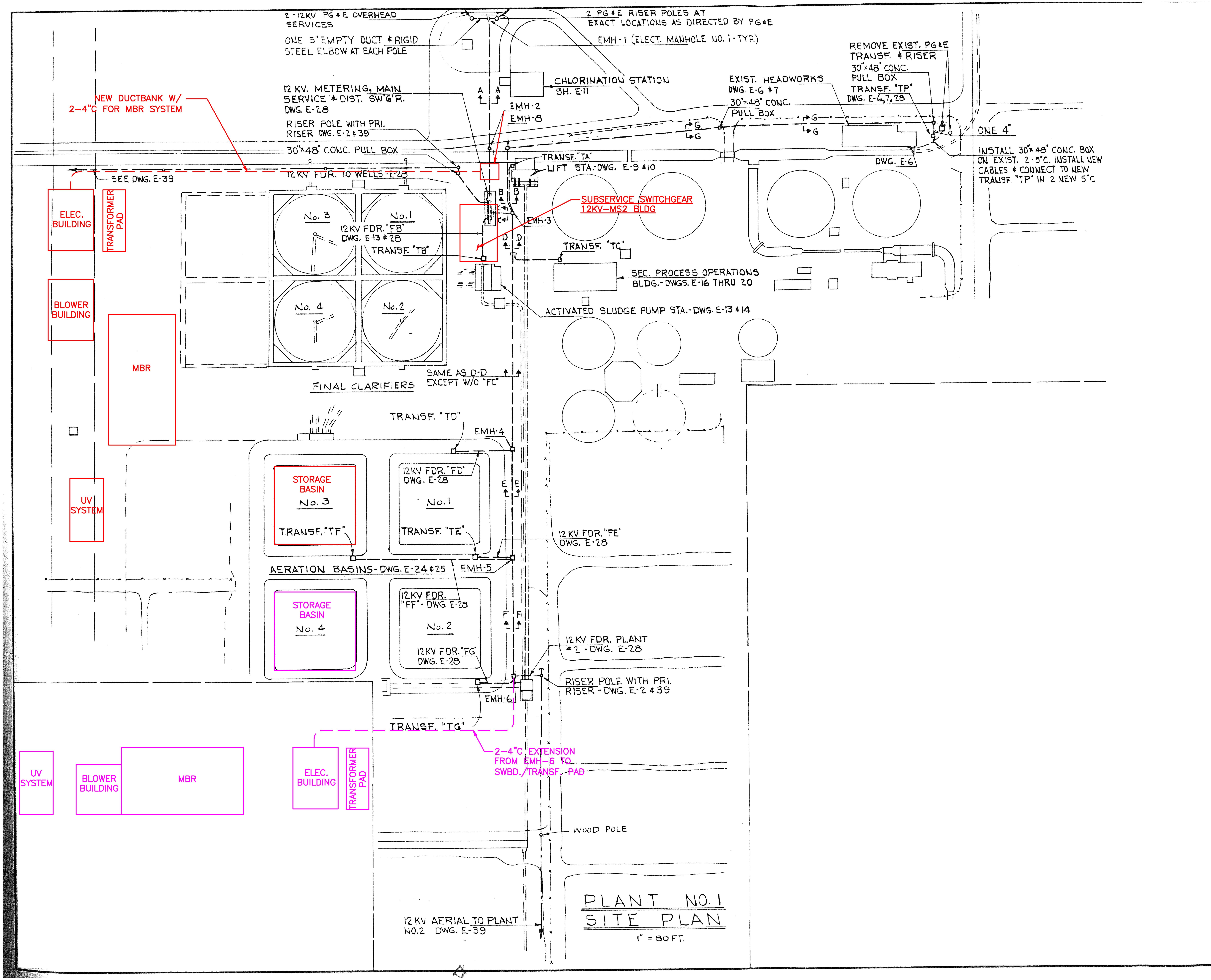
CITY OF FRESNO - TERTIARY TREATMENT AND DISINFECTION FACILITY

SINGLE LINE DIAGRAM
TTDF - 5 MGD MBR SYSTEM
PREFERRED ELECTRICAL EQUIPMENT ARRANGEMENT

SK-7

DESIGN BY: E. GATDULA

SCALE: NONE | DATE: 02/25/2011



HALF SCALE

248 of 287

E-1 REV 1

CITY OF FRESNO
FRESNO COUNTY, CALIFORNIA

WASTEWATER TREATMENT, DISPOSAL & RECLAMATION PROJECT

ELECTRICAL
PLANT NO. 1
SITE PLAN
PRIMARY DISTRIBUTION

JENKS & ADAMSON
CONSULTING SANITARY & CIVIL ENGINEERS

Drawn by:	S G	Scale:	AS NOTED
Des/Chkd by:	E L M	Date:	JUNE 1973

APPENDIX C

REFERENCE DOCUMENTS

WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

RESOLUTION NO. R5-2002-0254-A01
AMENDING WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

WHEREAS, the California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) adopted Waste Discharge Requirements Order No. 5-01-254 for the Cities of Fresno and Clovis at its regularly scheduled public meeting on 19 October 2001; and

WHEREAS, Order No. 5-01-254 references the Cities of Fresno and Clovis as Discharger and the City of Fresno as Operator; and

WHEREAS, Order No. 5-01-254 requires that the Discharger comply with all pretreatment requirements contained in Title 40, Code of Federal Regulations (CFR), Part 403, including implementing the necessary legal authorities; and

WHEREAS, when Order No. 5-01-254 was adopted, legal adequacy review of the Operator's pretreatment program was still pending; and

WHEREAS, the legal adequacy review was completed and a 21 November 2001 letter from Board staff to the Operator identifies revisions that are necessary for the ordinance and the interjurisdictional agreements contained in the Operator's pretreatment program to comply with the federal pretreatment regulations set forth in 40 CFR Part 403; and

WHEREAS, although the Discharger has been made aware of the required revisions, the process of effecting the revisions will take some time; and

WHEREAS, the action to amend Waste Discharge Requirements Order No. 5-01-254 for this existing facility is exempt from the provisions of the California Environmental Quality Act in accordance with Title 14, California Code of Regulations, Section 15301; and

WHEREAS, the Board has notified the Discharger, interested agencies, and persons of its intent to amend waste discharge requirements for the Discharger and has provided them with an opportunity for public hearing and an opportunity to submit their views and recommendations; and

WHEREAS, the Board, in a public meeting, heard and considered all comments pertaining to this action; therefore be it

RESOLVED, that the Board hereby amends Waste Discharge Requirements Order No. 5-01-254 as follows:

RESOLUTION NO. R5-2002-0254-A01
AMENDING WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-245
FOR CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

REVISED FINDING

1. On Page 5, in Finding No. 20, delete last sentence and replace with "Pretreatment program review identified certain revisions to the City of Fresno's Municipal Code and interjurisdictional agreements that are necessary for the pretreatment program to contain the legal authorities required for compliance with the federal pretreatment regulations set forth in 40 CFR 403. The required revisions are set forth in a 21 November 2001 letter from Board staff to the Operator, and it is reasonable that a schedule be established (Provision H.35) for completion of the required revisions. The Operator's current pretreatment program, with revisions and updates submitted by the Operator on 5 April 2001, shall remain in effect and is approved conditional upon completion of the required revisions to the program in accordance with the time schedule set forth herein."

NEW PROVISION

2. On Page 35, add a new Provision H.35 that states: "The Operator shall, no later than **15 January 2003**, submit sufficient documentation to demonstrate that its ordinance and interjurisdictional agreements contained in its pretreatment program contain adequate legal authorities to implement and enforce the pretreatment requirements in compliance with 40 CFR 403."

I, GARY M. CARLTON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of a Resolution adopted by the California Regional Water Quality Control Board, Central Valley Region, on 1 March 2002.

____
GARY M. CARLTON, Executive Officer

BLH:fmc

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 5-01-254

WASTE DISCHARGE REQUIREMENTS
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Board) finds that:

1. The Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility is a wastewater treatment facility (WWTF) that serves the cities of Fresno and Clovis; the Pinedale Water District and Pinedale Utilities District, both of which are within the city limits of Fresno; and some areas within Fresno County not within the city limits of Fresno or Clovis. The City of Clovis owns 9.5 percent of the WWTF's treatment capacity, while the City of Fresno owns the rest. The cities of Fresno and Clovis are referred to as Discharger. The City of Fresno is responsible for day-to-day WWTF operations, and is referred to as Operator. The WWTF is on property owned by the City of Fresno and covers 3,290 acres in Sections 20, 21, 22, 27, and 33, of T14S, R19E, MDB&M, as shown in Attachment A, which is part of this Order.

2. The WWTF features two separate wastewater treatment plants. Plant 1 is an activated sludge treatment plant that includes headworks, primary and secondary clarifiers, aeration basins, and anaerobic digesters (see Attachment B). The Discharger recently expanded Plant 1 to increase its nominal treatment capacity from 68 million gallons per day (mgd) to 88 mgd. Plant 2 is a 6-mgd-capacity trickling filter treatment plant that includes primary and secondary clarifiers (see Attachment C). Plant 2 is remotely located from Plant 1 and is currently not utilized. Also included within the 3,290-acre WWTF property are 1,660 acres of effluent disposal ponds; a 145-acre winery stillage disposal site (Stillage Site), portions of which have been in service since 1974; and about 600 acres of farmland on which WWTF effluent is recycled by local growers under lease agreements with the Operator.

3. Waste Discharge Requirements (WDRs) Order No. 96-054, adopted by the Board 23 February 1996, prescribes requirements for an average dry weather flow discharge of 68 mgd from Plant 1 and of 6 mgd from Plant 2 (when in operation). Order No. 96-054 also regulates the 145-acre Stillage Site generally in accordance with guidelines for land disposal of stillage waste from wineries (Stillage Guidelines) adopted by the Board in 1983. Prior to 1996, WDRs Order No. 74-10 regulated the discharge of stillage to a 95-acre portion of the Stillage Site.

4. Cease and Desist (C&D) Order No. 96-055, adopted by the Board 23 February 1996, directed the Discharger to achieve compliance with its WDRs by implementing specific short-term and long-term tasks and measures. Tasks included a study regarding the expansion of WWTF treatment and disposal pond capacity and the possibility of reclaiming substantially all wastewater. Measures included salinity control and compliance with an effluent salinity limitation. The Operator has

implemented salinity source control, upgraded the WWTF to accommodate current and projected wastewater flow through 2008, increased disposal capacity, and submitted a study describing the feasibility of expanded water recycling operations. On 19 October 2001, the Board adopted Order No. 5-01-241 rescinding C&D Order No. 96-055.

5. The Operator submitted a Report of Waste Discharge, dated 31 December 1996, in support of a 20-mgd increase in Plant 1 treatment and disposal capacity (i.e., to 88 mgd) and a 30 percent increase over current permitted flow of 72 mgd (i.e., to 94 mgd). The Discharger projects the added capacity should be sufficient until 2008.

6. Currently, average and maximum daily discharge flows are 68 mgd (on an annual basis) and 72 mgd (on a maximum monthly average basis), respectively. Discharger monitoring reports from 2000 characterize the WWTF effluent and municipal source water as follows:

Constituent	Units	Average	Minimum	Maximum
Effluent 5-day biochemical oxygen demand (BOD_5)	mg/L	26	8	53
Total dissolved solids (TDS)	mg/L			
Source water		240	220	250
Effluent		440	340	500
Conductivity at 25°C (EC)	µmhos/cm			
Source water		350	--	--
Effluent		780	690	870
Effluent Chloride	mg/L	72	60	107
Effluent Sodium	mg/L	81	74	100
Effluent bicarbonate alkalinity (as $CaCO_3$)	mg/L	208	164	255

7. The Discharger frequently adds ferric chloride to the influent prior to primary clarification. While this enhances pretreatment for organic and solids removal and control of hydrogen sulfide, it does increase the discharge's chloride and EC concentration. From 1 January 1999 through 4 April 2001, the discharge's monthly average chloride concentration ranged from 59 to 87 mg/L, averaged 70 mg/L, and had a 95% confidence level of 82 mg/L. Similarly, for this same period, the discharge's monthly EC concentration ranged from 594 to 924 µmhos/cm, averaged 757 µmhos/cm, and had a 95% confidence level of 842 µmhos/cm.

EFFLUENT DISPOSAL AND REUSE

8. At the current average daily discharge flow of 68 mgd, the WWTF discharges about 76,000 acre-feet per year (af/yr). Of this amount, about 4,000 af/yr of effluent is recycled directly, an amount that represents about only five percent of the WWTF's current annual discharge flow. Dedicated pumps and piping carry the effluent to reclamation areas for irrigation of crops such as alfalfa, cotton, silage corn, and wine grapes. Current and proposed on-site water recycling is by local farmers (hereafter Users) under lease agreements on 766 acres within the WWTF property (hereafter reclamation area). Off-site water recycling is by growers under separate water

reclamation requirements. Of the 72,000 af/yr discharged to the 1,660 acres of disposal ponds, about 63,400 af/yr (88 percent) percolates to groundwater and 8,600 af/yr (12 percent) is lost through evaporation.

9. The Discharger's practice of disposing of most discharge flow by percolation has, over the years, created an extensive groundwater mound under the WWTF disposal ponds (hereafter effluent mound). The effluent mound appears to be about 10-feet high, ranges in depth from 25 to 60 feet below ground surface (bgs), extends well beyond the perimeter of the WWTF property, and affects groundwater contours throughout a 25-square-mile area.

10. The Fresno Irrigation District (FID) covers 245,000 acres in central Fresno County, extends from Pine Flat Dam along the Kings River to the Kerman area, and includes the Fresno-Clovis metropolitan area.

11. In 1974, the City of Fresno entered into an agreement with FID to establish a groundwater reclamation system consisting of onsite extraction wells and piping that delivers groundwater to FID's Dry Creek and Houghton Canals during the growing season for agricultural use on the western side of FID. Both canals can each convey up to about 200 cubic feet per second. The 1974 agreement between FID and the Operator currently stipulates, in part, that the Operator may discharge a maximum of 30,000 af/yr of extracted groundwater to FID canals. To date, there are no restrictions on the use of extracted groundwater discharged to FID canals.

12. In 1975, the Operator installed 21 reclamation wells within the WWTF property. The amount of water extracted ranges between 10,000 af/yr (minimum) to 30,000 af/yr (maximum), an amount equivalent to 12 to 37 percent of the WWTF's current annual discharge flow. As of 30 April 2001, all 21 reclamation wells were operational. The estimated delivery capacity is in excess of 30,000 af/yr. With the exception of several newly-installed "Flowpath™" reclamation wells, the Operator's reclamation wells extract groundwater from depths exceeding 200 feet bgs, which is 140 to 175 feet below the top of the effluent mound. The Operator pumps from these depths rather than those associated with the effluent mound reportedly due to shallow zone's low specific yields. The Flowpath ™ wells, installed in the fall of 2000, extract from depths ranging from 80 to 240 feet bgs. The Operator periodically monitors the quality of groundwater extracted from the reclamation wells for TDS, EC, sodium, chloride, nitrogen compounds, and general minerals. The chloride concentration in extracted groundwater is comparable to WWTF effluent and not to groundwater extracted from the WWTF's background monitoring wells. Consequently, the reclamation well network, while drawing from depths below the top elevation of the effluent mound, is effectively extracting percolated effluent and not regional groundwater. Water quality data from October 2000 for groundwater extracted from three Flowpath ™ reclamation wells indicate the following average concentrations in mg/L: chloride (79), dissolved iron (0.19), dissolved manganese (1.24), total nitrogen (< 2), sodium (76), TDS (490), and total organic carbon (5).

13. The Operator normally delivers between 15,000 and 20,000 af/yr to FID canals with its current reclamation well network. For the Operator to deliver in excess of 30,000 af/yr to FID canals, the Operator would have to add more reclamation wells. Any increase in the discharge of extracted groundwater beyond that specified in the 1974 agreement is subject to FID approval.

14. The Discharger submitted a technical report, *Fresno-Clovis Regional Wastewater Reclamation Facilities Master Plan Summary Report* (Master Plan), dated November 1996, pursuant, in part, to C&D Order No. 96-055. The Master Plan describes several near- and long-term options for off-site effluent reuse/disposal to meet the Discharger's disposal needs through 2020. The Master Plan further describes the institutional and structural elements of each option, including its financial analysis and multi-year implementation schedule.

15. The Master Plan recommends the following effluent disposal and reuse projects: (a) adding about 270 acres of on-site disposal ponds, (b) maximizing the discharge to FID canals from of its existing reclamation well network, and (c) implementing a reuse project that would recycle an amount equivalent of the annual WWTF discharge flow. At the full capacity of 80 mgd, the annual discharge flow is about 90,000 af/yr, which far exceeds the discharge of any municipal sewage treatment facility in the San Joaquin Valley. The Discharger has increased its on-site disposal pond acreage and has continued to explore opportunities for the direct reuse of effluent. The City currently is constructing pipelines that will provide effluent for the irrigation of an additional 630 acres of reclamation area. The City also has a project under way to increase the capacity of the existing reclamation well network.

16. Calpine Corporation (hereafter Calpine) is planning to construct a new gas-fired turbine in Fresno County (Central Valley Energy Center, hereafter referred to as CVEC). Calpine proposes to pump approximately 7,000 af/yr from the Operator's reclamation wells to provide cooling tower and industrial process water for the CVEC. Once extracted, the recycled water will be dosed with sodium hypochlorite prior to introduction into a 20.5 mile, 30-inch diameter pipeline, which will terminate into two 1.5 million gallon storage tanks at the CVEC site.

17. In addition to its Kings River entitlement, FID and the Operator have signed contracts to purchase up to 135,000 af/yr of surface water from the Friant Division of the Central Valley Project, operated by the U.S. Bureau of Reclamation (Bureau). The contract between FID, the Operator, and the Bureau is up for renewal, which may change the terms and conditions of the 1974 agreement between FID and the Operator. Until the contract renewal is consummated, the economic value of WWTF effluent as a source of agricultural supply is uncertain. This economic uncertainty influences the Discharger's scheduling for implementing a large-scale effluent reuse project.

PRETREATMENT

18. Fifty-six significant industrial users discharge waste into the WWTF collection system, including 14 users from the metal finishing categories, according to data submitted by the Operator in February 2001. Other industrial users discharging into the WWTF include soft drink bottlers, meat packers, food processors (fruit, vegetable, grain, nuts, and seeds), dairy and poultry products processors, plastic manufacturers, wineries, and several linen and industrial laundries.

19. Pretreatment effluent standards established pursuant to section 307 of the Federal Clean Water Act (CWA) and amendments thereto are applicable to the discharge.

20. The Discharger originally developed a pretreatment program in conformance with 40 CFR 403. The Board approved the program on 17 June 1984. The Operator has subsequently submitted a revised pretreatment program (dated 6 June 1996), also in conformance with 40 CFR 403, which updates its original submission to bring it in line with current practices. The Operator updated its pretreatment program in 2001, in part, to reflect its latest municipal code and enforcement response plan, incorporate WWTF upgrades, and describe modifications in sampling procedures. The Board is reviewing the revised pretreatment program for completeness and adequacy.

21. A pretreatment compliance inspection conducted in June 1999 indicated that all elements of the Discharger's pretreatment program comply with the federal pretreatment regulations in 40 CFR 403.

SLUDGE MANAGEMENT AND BIOSOLIDS DISPOSAL

22. Pursuant to section 13274 of the California Water Code, the State Water Resources Control Board adopted on 17 August 2000 Water Quality Order No. 2000-10-DWQ, *General Waste Discharge Requirements for the Discharge of Biosolids to Land for use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities* (hereafter General Biosolids Order).

23. The WWTF produced 12,800 dry tons of sludge in 1999, or an average of 35 tons/day. Dissolved air flotation and gravity belt units thicken sludge, anaerobic digesters stabilize it, and belt filter presses dewater it.

24. Prior to 1993, the Operator pumped digested sludge to 62 acres of sludge drying beds consisting of unlined open earthen basins. The Operator has since constructed additional treatment facilities on the majority of the 62-acre site of the old sludge beds, with a small portion converted into effluent disposal ponds.

25. The Operator previously stockpiled over 75,000 cubic yards of biosolids that had been originally classified as "hazardous" waste due to its concentrations of lead and cadmium. In September 1994, the Discharger submitted a technical report, *Work Plan To Collect and Analyze Sludge Samples*. In July 1997, the California Department of Toxic Substances re-evaluated the biosolids and re-classified it as nonhazardous. During the fall of 1998, the Operator transported the stockpiled biosolids to the Fresno Sanitary Landfill as part of the landfill's final closure project. From September 1998 through January 1999, the Operator diverted 25 percent of the biosolids previously produced at the WWTF to the Fresno Sanitary Landfill as part of its final closure project.

26. In August 1997, the Discharger entered into a contract with McCarthy Farms (MFF) to haul nonhazardous WWTF biosolids to MFF's land application site near Corcoran or to MFF's composting site in Lost Hills operated by San Joaquin Composting, Inc. These sites are regulated by waste discharge requirements adopted by the Board. In April 1999, the Operator certified that WWTF biosolids met the requirements for Class B biosolids and implemented a direct land application program in conjunction with MFF in Corcoran.

HYDROLOGY, SOILS AND GROUNDWATER

27. The WWTF lies within the Fresno Hydrologic Area (No. 551.30), which is within the Kings River Basin, as depicted on interagency hydrologic maps prepared by the California Department of Water Resources (DWR) in August 1986. The WWTF is not within a 100-year floodplain, and all storm water runoff is reportedly contained on-site. Incidental on-site runoff (e.g., runoff along the canal banks) drains into Dry Creek Canal, which flows through the WWTF property.

28. Dry Creek Canal originates in the City of Fresno and flows seasonally downstream of the WWTF. Houghton Canal flows seasonally downstream of the WWTF and originates at a junction with Dry Creek Canal in the City of Fresno. Dry Creek Canal has an undetermined terminus southwest of the WWTF. Houghton Canal has an undetermined terminus west of the WWTF.

29. Areal soils consist of unconsolidated alluvial deposits of interbedded layers of sand, gravel, silt, sandy clay, clay and localized cobble zones. Soils in the upper five feet of the Stillage Site are described as well-sorted sands with good permeability (i.e., 0.7 to 1.0 in/hr) and therefore suitable for rapid infiltration of stillage waste.

30. The WWTF is in a semiarid region. Average annual precipitation and evapotranspiration are about 11 inches and 62 inches, according to information published by DWR.

31. Areal groundwater comprises the north portion of an essentially closed groundwater basin (Tulare Lake Basin) and flows southwesterly under unconfined conditions from the foothills east of Fresno westward to a northwest-trending line through Kerman and Raisin City. West of that line, groundwater occurs under both unconfined and semiconfined conditions. Extensive groundwater pumpage near the cities of Fresno and Raisin City have caused local changes in groundwater flow direction.

32. Groundwater in the WWTF vicinity occurs in an unconfined aquifer at depths ranging from 30 to 60 feet below ground surface (bgs). The Operator has delineated two zones of groundwater quality within the unconfined aquifer: a shallow zone consisting of the upper 50 feet of the aquifer and a lower zone, the top of which is about 200 feet below the water table.

33. The Operator monitors area groundwater via a groundwater monitoring well network currently comprised of 22 wells in the WWTF vicinity. In August 1996, the Operator proposed constructing additional groundwater monitoring wells along the WWTF perimeter to further characterize groundwater quality further and to assess potential groundwater impacts pursuant to Monitoring and Reporting Program No. 96-054. The Operator has not constructed the additional proposed groundwater monitoring wells.

34. Background or upgradient groundwater quality is highly variable due to the presence of dairies and other land uses that impact water quality. The Discharger currently monitors upgradient water quality in three wells, two monitoring wells (MW-10A and MW-10B) approximately 10,000 feet north of the WWTF property's north boundary and one domestic well (I) approximately 9,000 feet east of the WWTF's property's northeast corner. Of the two monitoring wells, MW-10A monitors the shallow zone and MW-10B, the deeper zone.

35. Upgradient or background groundwater is of high quality and meets all primary and secondary maximum contaminant levels for drinking water, according to the Operator's report, *Technical Memorandum No. 1-Update of Groundwater Quality Conditions* (April 1999). High quality groundwater conditions are generally associated with areas characterized by the absence of dairies or other localized sources of waste discharges.

36. Compared to background groundwater quality, groundwater passing under the WWTF contains elevated concentrations of TDS, EC, sodium, chloride, total phosphorus, and bicarbonate alkalinity. WWTF operations that have degraded groundwater for those constituents include stillage disposal and effluent disposal operations and the past use of sludge-drying beds. Groundwater within and surrounding the WWTF property has been degraded by other activities (e.g., past and existing dairy operations, a closed landfill), which over the years have created localized areas of groundwater degradation (hereafter referred to as "hot spots"). The Discharger's current groundwater monitoring well network is not adequate to distinguish groundwater impacts that are exclusively attributable to WWTF operations or to waste constituents originating from identified hot spots.

37. As indicated in Finding No. 8, evaporative losses account for about 12 percent of the current discharge flow to the disposal ponds. Evaporative losses will decrease to about 10 percent of the proposed increased discharge flow of 80 mgd, and result in an increase in the concentrations of waste constituents in effluent percolating to groundwater by about 10 percent. Therefore, groundwater underlying disposal ponds in areas unaffected by other waste discharges can be expected to contain salt constituents (e.g., chloride, EC, and TDS) in concentrations about 10 percent greater than that in WWTF effluent. A similar concentration increase can be expected for sodium provided there is no attenuation of sodium in the soil profile. The concentrating effect of evaporation appears to diminish as percolating effluent blends with regional groundwater, as indicated by the lower concentrations of chloride, TDS, and sodium in groundwater extracted in the recently-installed Flowpath ™ reclamation wells (as described in Finding No. 12).

38. As indicated in Finding No. 12, recent monitoring of groundwater extracted from the newly-installed Flowpath ™ reclamation wells has revealed very low concentrations of nitrogen and elevated concentrations of dissolved manganese (almost 25 times the drinking water standard of 0.05 mg/L). In contrast, monitoring of shallow groundwater has revealed nitrate-nitrogen concentrations approaching and even exceeding the drinking water standard of 10 mg/L and very low dissolved manganese concentrations.

STILLAGE SITE

39. The Operator's 145-acre stillage disposal site, or Stillage Site, consists of a 95-acre site (SS-1), 95 acres of which have been in service since 1974, and a 50-acre site (SS-2) in service since December 1998 (see Attachment A). Stillage waste is generated from the distillation of wine in continuous stills and pot stills (infrequently used) for the production of distilled spirits. Stillage waste is conveyed year-round to the Stillage Site by a dedicated pipeline.

40. Prior to 1974, four wineries discharged a maximum of 1.1 mgd of stillage waste to the Operator's sanitary sewer system. This practice resulted in nuisance conditions and other problems at the domestic wastewater treatment plant's infiltration beds. In 1974, the Operator began discharging up to 1.07 mgd of stillage via dedicated pipelines to the 95-acre SS-1 under the terms and conditions of WDRs Order No. 74-10. The Stillage Site has been operated generally in accordance with the minimum requirements of Board-adopted Stillage Guidelines. The Operator has not, however, adjusted its stillage disposal operation to ensure that it is protective of groundwater quality, even when groundwater monitoring data revealed that it had degraded and continues to degrade groundwater quality (discussed below).

41. The Stillage Site is divided into long narrow checks, approximately 500 feet long by 100 feet wide, most of which are equipped with concrete inlet structures to prevent erosion. Stillage is discharged to individual checks until it reaches depths ranging from 2.5 to about 4 inches, depending on the time of year. Once applied, the stillage is allowed to dry from six days to several weeks until all that remains is a thin, dry layer (called leathers). Checks are ripped and disked to a depth of 18 to 24 inches prior to reapplication of stillage. Prior to 1996, leathers were disked into disposal area soils. In 1996, the Operator began removing leathers from checks to help reduce the nutrient build-up in disposal area soils. Scraped leathers are stockpiled on site and reportedly used as soil amendment on landscaped areas within the WWTF property.

42. Recent monitoring data characterizes the BOD_5 and nitrogen concentrations in stillage as averaging about 12,000 mg/L and 400 mg/L, respectively. About 90 percent of the BOD_5 is in the soluble form; nitrogen occurs predominantly in the organic form, expressed as total Kjeldahl nitrogen (TKN). Typically, the peak discharge season is from August through November, during which discharge flows average about 0.215 mgd. Off-season discharge flow averages about 0.15 mgd.

43. The Operator discharged a total of about 79 million gallons of stillage in 2000. Peak daily flows occurred in mid-June, and ranged from 1.1 to 1.27 mgd. At an average TKN concentration of 400 mg/L, this discharge to the entire 145 acres of the Stillage Site equates to a nitrogen load in excess of 1,800 lbs/acre/year.

44. The Operator began growing crops in the Stillage Site in 1996 to reduce residual nitrogen, as recommended by the Stillage Guidelines. Soil monitoring data collected by the Operator in 1992 indicate that the Operator's long-term stillage disposal operation has resulted in a massive accumulation of nitrogen in the upper two feet of disposal area soils (i.e., 21,300 lbs TKN/acre).

45. Order No. 96-054, Stillage Discharge Specification B.8, requires the Discharger to grow crops in the Stillage Site to assist in the removal of residual nitrogen from the soil. The Discharger is exempt from this requirement if it can demonstrate that its stillage disposal operation has been and can be accomplished without nitrogen control and without violating Groundwater Limitations. The Discharger was required to submit a report on measures to be implemented to provide for nutrient uptake in the Stillage Site, or justification why such measures are unnecessary, pursuant to Order No. 96-054, Provision G.7. The Operator submitted a report that describes (a) alternatives to current disposal practices (i.e., implementing pretreatment by anaerobic digestion or discharging

to a different site) and (b) plans to plant crops on portions of the Stillage Site and to monitor soils before and after cropping.

46. In 1996, the Operator conducted a field experiment in which it planted Sudan grass on 35 acres of SS-1, allowed the crop to mature, and harvested it twice. Before and after cropping, the Operator analyzed soil samples for various constituents, including TKN, ammonia, phosphorus, and calcium. After harvesting, the Operator found that while reductions of these constituents occurred as a result of the planting, the concentrations were still quite elevated compared to background levels. The Operator has yet to initiate systematic cropping and harvesting of portions of the SS.

47. Excessive application of stillage waste to land can overload the shallow soil profile, cause anaerobic soil conditions, retard the degradation, stabilization, transformation, and immobilization of waste constituents, and create objectionable odors that lead to public nuisance. Degradation of waste constituents within the soil profile increases the concentration of alkalinity in soil pore water. Anaerobic soil conditions can lead to the dissolution of soil minerals such as calcium and magnesium. Hydraulic overloading flushes waste constituents, their decomposition by-products, and dissolved minerals into the soil profile. If attenuation is inadequate, these compounds may be released at concentrations in excess of applicable water quality objectives or could reasonably be expected to affect beneficial uses underlying groundwater.

48. The Operator's decades-long stillage disposal operation has degraded groundwater beneath SS-1 to the degree that its beneficial uses as a domestic and agricultural supply are impaired. Data from a monitoring well in this area (MW-2) shows that the EC of groundwater passing under SS-1 consistently exceeds the recommended secondary maximum contaminant levels for drinking water of 900 μmhos/cm. Additional monitoring data shows groundwater degradation for TDS, total alkalinity, calcium, magnesium, and manganese.

49. Currently, the Stillage Site receives stillage waste year round from only one winery, Cribari Winery, which is owned and operated by Canandaigua Wine Company, a New York corporation. Canandaigua Wine Company intends to cease discharge of stillage waste to the Stillage Site by the end of fall 2003.

50. The Operator reports that Plant 1 lacks the treatment capacity to handle all of the stillage waste currently generated by the Cribari Winery.

BASIN PLAN AND REGULATORY CONSIDERATIONS

51. The *Water Quality Control Plan for the Tulare Lake Basin, 2nd Edition,* (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives, contains implementation plans and policies for protecting all waters of the Basin, and incorporates by reference plans and policies of the State Water Resources Control Board. These requirements implement the Basin Plan.

52. The Dry Creek and Houghton Canals carry irrigation deliveries from the Kings River and Friant Kern Canal, both waters of the United States. They also carry urban storm water runoff and surface waters from upgradient ephemeral streams. The Dry Creek and Houghton Canals are

valley floor waters. The designated beneficial uses of valley floor waters, according to the Basin Plan, are municipal and domestic, agricultural, industrial service, and industrial process supply; water contact and noncontact water recreation; warm freshwater, wildlife, and rare, threatened, or endangered species habitat; and groundwater recharge.

53. Historically, groundwater has been the sole source of municipal and domestic supply for the Fresno-Clovis metropolitan area, and for thousands of residents in surrounding rural areas. The Basin Plan designates the beneficial uses of groundwater in the vicinity of the WWTF and its discharges to land as municipal, agricultural, industrial service, and industrial process supply and water contact and noncontact water recreation.

54. In 1977, the United States Environmental Protection Agency (EPA) determined that the groundwater aquifer serving the Fresno-Clovis metropolitan area is a sole source of drinking water pursuant to section 1424 of the Safe Drinking Water Act.

55. Water in the Tulare Lake Basin is in short supply, requiring importation of surface waters from other parts of the State. The Basin Plan encourages reclamation on irrigated crops wherever feasible and indicates that evaporation of reclaimable wastewater is not an acceptable permanent disposal method where the opportunity exists to replace an existing use or proposed use of fresh water with recycled water. The Basin Plan further requires plans for new or expanded wastewater treatment facilities to include wastewater reclamation, or reasons why this is not possible.

56. Section 13050(h) of the California Water Code defines water quality objectives as ". . . the limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention on nuisance within a specific area."

57. The Basin Plan establishes numerical and narrative water quality objectives for surface and groundwaters within the basin, and recognizes that water quality objectives are achieved primarily through the Board's adoption of waste discharge requirements and enforcement orders. Where numerical water quality objectives are listed, these are the limits necessary for the reasonable protection of beneficial uses of the water. Where compliance with narrative water quality objectives is required, the Board will, on a case-by-case basis, adopt numerical limitations in orders which will implement the narrative objectives to maintain existing and anticipated beneficial uses of waters in the subject area.

58. The Basin Plan identifies numerical water quality objectives for waters designated as municipal supply. These are the maximum contaminant levels (MCLs) specified in the following provisions of Title 22, California Code of Regulations: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of section 64431, Table 64444-A (Organic Chemicals) of section 64444, and Table 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) and 64449-B (Secondary Maximum Contaminant Levels-Ranges) of section 64449. The Basin Plan's incorporation of these provisions by reference is prospective, and includes future changes to the incorporated provisions as the changes take effect. The Basin Plan requires the application of objectives more stringent than MCLs as necessary to ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses, whether the use is domestic drinking water supply, agricultural supply, or some other use.

59. The Basin Plan contains narrative water quality objectives for chemical constituents in and toxicity of groundwater that address constituents in the discharge that are potentially harmful to beneficial uses. The toxicity objective requires that groundwater be maintained free of toxic substances in concentrations that produce detrimental physiological responses in plants or animals. The chemical constituent objective states groundwater shall not contain chemical constituents in concentrations that adversely affect beneficial uses. Guidelines for identifying the quality of irrigation water necessary to sustain various crops were compiled by Ayers and Westcot in 1985 *(Food and Agriculture Organization of the United Nations – Irrigation Drainage Paper No. 29).* The Basin Plan recognizes these Guidelines for providing relevant numerical criteria to evaluate compliance with the previously described narrative water quality objectives. The Guidelines are intended for use in estimating the potential hazards to crop production associated with long term use of the particular water being evaluated. The Guidelines divide water quality characteristics as having "No Problem – Increasing Problems – Severe Problems" based on large numbers of field studies and observations, and carefully controlled greenhouse and small plot research. In general, crops sensitive to sodium or chloride are most sensitive to foliar absorption from sprinkler applied water. Bicarbonate has been a problem when fruit crops or nursery crops are sprinkler irrigated during periods of very low humidity and high evaporation. The following table contains numerical criteria adapted from the Guidelines for protection of a range of crops under various circumstances, but the most stringent is not necessarily the concentration that assures no adverse affect on any nonagricultural beneficial use:

Problem and Related Constituent	No Problem	Increasing Problem
Salinity of irrigation water (EC, µmhos/cm)	< 750	750 – 3,000
Salinity of irrigation water (TDS, mg/L)*	< 450	450 – 1,800
Specific Ion Toxicity		
from ROOT absorption		
Sodium (mg/L)	< 69	69 – 207
Chloride (mg/L)	< 142	142 – 355
Boron (mg/L)	< 0.5	0.5 – 2.0
from FOLIAR absorption		
Sodium (mg/L)	< 69	> 69
Chloride (mg/L)	< 106	> 106
Miscellaneous		
NH_4-N (mg/L) (for sensitive crops)	< 5	5 – 30
NO_3-N(mg/L) (for sensitive crops)	< 5	5 – 30
HCO_3 (mg/L) (only with overhead sprinklers)	< 90	90 - 520
pH	normal range = 6.5 – 8.4	

* Assumes an EC:TDS ratio of 0.6:1

60. The existing and anticipated beneficial uses of area groundwater for agricultural supply include irrigation of crops sensitive to salt and boron. According to the 1994 DWR land use map, irrigated crops within five miles of the WWTF consist of alfalfa, almonds, beans, corn, cotton, grain and hay, melons, peaches, plums, tomatoes, and vineyards. Based on climate, soil type, and water

quality, other crops sensitive to salt and boron might be capable of being grown in the area, and changing market conditions could drive a change in cropping patterns, but neither is expected to necessitate greater protection than crops already identified.

61. The Guidelines presents the maximum EC of irrigation water for various crops with respect to percent crop reductions (i.e., 0, 10, 25, and 50). The table below extracts irrigation water EC data (in µmhos/cm) for crops cultivated in the WWTF vicinity (as described in Finding No. 60). As indicated below, zero crop yield reductions are not evident when irrigating all but one crop (bean) with water having an EC of less than 1,000 µmhos/cm.

Crop	0% Reduction	10% Reduction
Beans	700	1,000
Almonds	1,000	1,400
Plums	1,000	1,400
Vineyards	1,000	1,700
Corn (Sweet)	1,100	1,700
Peaches	1,100	1,400
Corn (Forage)	1,200	2,100
Alfalfa	1,300	2,200
Melon (Cantaloupe)	1,500	2,400
Tomatoes	1,700	2,300
Hay (Barley)	4,000	4,900
Cotton	5,100	6,400

62. The Guidelines indicate that boron sensitive crops such as stone fruit and grapes may show injury when irrigated with water with boron ranging from 0.5 to 1.0 mg/L and reduced yield and vigor when irrigated with water with boron ranging from 1.0 to 2.0 mg/L. Bicarbonate has been a problem when fruit crops or nursery crops are sprinkler irrigated during periods of very low humidity and high evaporation.

63. To maintain the beneficial uses of flood irrigation of stone fruit, and sprinkler irrigation of vegetables and fruit, it is necessary that area groundwater have EC values of 1,000 µmhos/cm or less, and low concentrations of chloride, sodium, boron, and bicarbonate.

64. The average EC of WWTF effluent in 2000 was about 430 µmhos/cm above source water EC and the average bicarbonate of WWTF effluent in 2000 was 208 mg/L as $CaCO_3$ (as indicated in Finding No. 6). Despite the Discharger's implementation of an effective salinity source control program, however, the average sodium concentration of WWTF effluent (81 mg/L in 2000) exceeds the 69 mg/L recommended by the Guidelines for sodium sensitive crops (for either root or foliar absorption). Unless other means of sodium control are possible, irrigating at night is one method to mitigate potential adverse effects of sprinkler irrigation of sodium-sensitive crops with water containing elevated levels of sodium and of bicarbonate. Because the groundwater degradation from sodium can be mitigated by reasonable changes in irrigation management practices and because the Discharger has implemented best practicable source control for sodium and bicarbonate alkalinity (a matter that will require further documentation by means of studies

required herein), the consequent degradation from sodium and bicarbonate alkalinity for the time can be found at the present time to be consistent with Resolution No. 68-16.

65. As explained in the attached Information Sheet, this Order implements water quality objectives established as necessary to maintain the existing and anticipated beneficial uses of area groundwater for the production of stone fruit, grape, and other crops that are sensitive to salt (i.e., sodium and chloride), boron, or both. The numerical values reflect the highest tolerable level of quality necessary to sustain sprinkler application, as these are more restrictive than for flood irrigation. These objectives include EC (990 µmhos/cm), and the following expressed as mg/L: chloride (106), sodium (103), boron (0.7), and TDS (560). The Order’s nitrogen limit of 10 mg/L is for total nitrogen because all forms of nitrogen can convert to nitrate in groundwater and the nitrate standard is 10 mg/L as nitrogen in drinking water. It is reasonable to conclude that a total nitrogen limit of 10 mg/L is adequately protective of existing and anticipated agricultural land uses. This Order implements a narrative groundwater limitation for taste and odor by prescribing a groundwater limitation of 0.5 mg/L for ammonia. This concentration is based on a European Union drinking water standard. Discharger monitoring data indicate that effluent ammonia concentrations typically exceed 5 mg/L. As such, there is reasonable potential for the discharge to cause violations of the narrative water quality limitation for taste. There are numerous domestic wells in the area encompassed by the groundwater mound created by percolating effluent. The groundwater ammonia limitation is protective of the beneficial uses of area groundwater for domestic supply.

66. California Department of Water Resources standards for the construction and destruction of groundwater wells (hereafter DWR Well Standards), as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 94-81* (December 1981), and any more stringent standards adopted by the Discharger or county pursuant to CWC section 13801, apply to all monitoring wells.

67. The discharge authorized herein and the treatment and storage facilities associated with the discharge of treated municipal wastewater, except for discharges of residual sludge and solid waste, are exempt from the requirements of Title 27, California Code of Regulations (CCR), section 20380 et seq. (hereafter Title 27). The exemption, pursuant to Title 27 CCR section 20090(a), is based on the following:

    a. The waste consists primarily of domestic sewage and treated effluent;

    b. The waste discharge requirements are consistent with water quality objectives; and

    c. The treatment and storage facilities described herein are associated with a municipal wastewater treatment plant.

68. The discharge of stillage waste authorized herein is exempt from the requirements of Title 27. The exemption, pursuant to section 20090(b), is based on the following:

    a. The Board is issuing these waste discharge requirements,

b. These waste discharge requirements implement the Basin Plan and allow discharge only in accordance with the Basin Plan, and

c. The wastewater is not hazardous waste and need not be managed according to Title 22, CCR, Division 4.5, Chapter 11, as a hazardous waste.

69. In the process of crop irrigation, evaporation and crop transpiration remove water from and result in accumulation of residual salts in the soil root zone. These salts would retard or inhibit plant growth except for a fraction of irrigation water applied to leach the harmful salt from the root zone. The leached salts eventually enter groundwater and concentrate above the uppermost layer of the uppermost aquifer. As this is the general condition throughout the agricultural Tulare Lake Basin, water supply wells for all beneficial uses typically are constructed to extract groundwater from below this level.

70. Infiltration from wastewater treatment and wastewater disposal ponds results in wastewater intersecting and accumulating on and in the uppermost layer of the uppermost groundwater until dispersed horizontally and vertically into the main mass of the aquifer. Compliance with the various water quality objectives necessary to protect present and future beneficial uses within the aquifer should be determined by water representative of the uppermost zones. Site-specific studies to determine the appropriate zones and geographical locations should be conducted by the Discharger subject to Executive Officer approval.

TITLE 22

71. Domestic wastewater contains pathogens harmful to humans that are typically measured by means of total and fecal coliform, as indicator organisms. The California Department of Health Services (DHS) has primary statewide responsibility for protecting public health. In 1977, DHS established statewide criteria in Title 22, California Code of Regulations (CCR), section 60301 et seq., (hereafter Title 22) for the use of recycled water and has developed guidelines for specific uses. Revisions of the water recycling criteria in Title 22 became effective on 2 December 2000. The revised Title 22 expands the range of allowable uses of recycled water, establishes criteria for these uses, and clarifies some of the ambiguity contained in the previous regulations.

72. The 1988 Memorandum of Agreement (MOA) between DHS and the State Water Resources Control Board on the use of recycled water establishes basic principles relative to the agencies and the regional boards. Under terms of the MOA, the Board implements Title 22 and DHS recommendations for the protection of public health. In addition, the MOA allocates primary areas of responsibility and authority between these agencies, and provides for methods and mechanisms necessary to assure ongoing, continuous future coordination of activities relative to the use of recycled water in California.

73. Title 22 requires recyclers of treated municipal wastewater to submit an engineering report detailing the use of recycled water, contingency plans, and safeguards. The Discharger submitted an engineering report to DHS pursuant to Title 22 for on-site water reclamation operations on

1 February 2001. The DHS commented on the Discharger's Title 22 Engineering Report by letter dated 22 March 2001. The Discharger is in the process of responding to these comments.

74. By letter dated 10 May 2001, DHS recommended that the Discharger expedite efforts to expand recycling and curtail discharge to groundwater. The DHS recommends that the Board require the Discharger to (a) assess the current status of all private and domestic wells that exist within the 25-square-mile area described in Finding No. 9, (b) monitor domestic supply wells within this area for contaminants to assure they are producing safe water for domestic use, and (c) conduct a comprehensive study to assess the fate and effects of the discharge on groundwater.

75. By letter dated 24 August 2001, DHS further recommended that the Board require the Discharger, in collaboration with FID, to (a) identify the types of crops grown in the area served by FID canals that receive groundwater extracted by the Operator's reclamation wells and (b) provide information on the dilution of the extracted groundwater with fresh water prior to irrigation application. If food crops are found to be grown in the subject area, DHS recommends the Discharger be required to evaluate the degree of filtration and virus removal provided. The DHS also recommended the Discharger provide continuous turbidity monitoring of representative reclamation wells for at least one year.

DEGRADATION

76. State Water Resources Control Board (SWRCB) Resolution No. 68-16 (hereafter Resolution 68-16 or the "Antidegradation" Policy) requires the Board in regulating the discharge of waste to maintain high quality waters of the state until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect beneficial uses, and will not result in water quality less than that described in the Board's policies (e.g., quality that exceeds water quality objectives).

77. The Basin Plan identifies the greatest long-term problem facing the entire Tulare Lake Basin as the increase in salinity in groundwater, which has accelerated due to the intensive use of soil and water resources by irrigated agriculture. The Basin Plan recognizes that degradation is unavoidable until a valley wide drain is constructed to carry salts out of the basin. Until the drain is available, the Basin Plan describes numerous salt management recommendations and requirements. The later includes the requirement that discharges to land from wastewater treatment facilities not have an EC greater than source water plus 500 μmhos/cm. Accordingly, the Basin Plan allows for salinity degradation and focuses on controlling the rate of increase.

78. The Board finds that some degradation of groundwater beneath the WWTF and reclamation and disposal areas is consistent with Resolution 68-16 provided that:

- the degradation is confined to a specified area
- the Discharger minimizes the degradation by fully implementing, regularly maintaining, and optimally operating best practicable treatment and control (BPTC) measures

- the degradation is limited to waste constituents typically encountered in municipal wastewater as specified in the groundwater limitations in this Order
- the degradation does not result in water quality less than that prescribed in the Basin Plan

79. Some degradation of groundwater by some of the typical waste constituents released with discharge from a municipal wastewater utility after effective source control, treatment, and control is consistent with maximum benefit to the people of California. The technology, energy, water recycling, and waste management advantages of municipal utility service for the Cities of Fresno and Clovis far exceed any benefits derived from a metropolitan area otherwise reliant on numerous concentrated individual wastewater systems, and the impact on water quality will be substantially less. When allowed, the degree of degradation allowed depends upon many factors (i.e., background water quality, the waste constituent, the beneficial uses and most stringent water quality objective, source control measures, waste constituent treatability).

80. The WWTF described in Finding No. 2 provides treatment and control of the discharge that incorporates:

- technology for secondary treatment of municipal wastewater
- biosolids handling and treatment for reuse
- constituent attenuation within the vadose zone
- concrete treatment structures
- recycling of wastewater on cropped properties
- a pretreatment program that includes effective salinity source control
- an active inflow and infiltration (I/I) rehabilitation program
- a capital recovery fund
- an operation and maintenance (O&M) manual
- staffing to assure proper operation and maintenance

81. Discharger practices that may not constitute BPTC as used in Resolution 68-16 include the reliance of effluent disposal by evaporation and percolation. The impact to area groundwater caused by this practice is mitigated to some degree by the Operator's discharge to FID canals of about 15,000 af/yr of groundwater extracted from a network of reclamation wells situated throughout the disposal pond area. However, as indicated in Finding No. 12, the concentrations of dissolved manganese in groundwater extracted from several reclamation wells exceed the water quality objective of 0.05 mg/L (as referenced in Finding No. 58). Neither WWTF effluent nor groundwater sampled from shallow monitoring wells exhibit such high dissolved manganese concentrations. Further, the Discharger's stillage disposal operation appears to have degraded and polluted groundwater underlying SS-1 (Finding No. 48). The existing impacts on groundwater and the appropriate level of degradation that complies with Resolution 68-16 has not been evaluated.

82. This Order, therefore, establishes schedules of tasks to evaluate BPTC for each treatment, storage, and disposal component of the WWTF and to characterize groundwater for all waste constituents.

83. This Order establishes groundwater limitations that will not unreasonably threaten present and anticipated beneficial uses or result in groundwater quality that exceeds water quality objectives set forth in the Basin Plan. This means that where the stringency of the limitations for the same waste constituent differs according to beneficial use, the most stringent applies as the governing limitation for that waste constituent. This Order contains tasks for assuring that BPTC and the highest water quality consistent with the maximum benefit to the people of the State will be achieved. Accordingly, the discharge is consistent with the antidegradation provisions of Resolution 68-16. Based on the results of the scheduled tasks, the Board may reopen this Order to reconsider groundwater limitations and other requirements to comply with Resolution 68-16.

CEQA FINDINGS

84. The City of Fresno certified a final environmental impact report (EIR) dated 31 October 1995 for an expansion in WWTF treatment and disposal capacity in accordance with the California Environmental Quality Act (CEQA) (Public Resources Code section 21000 et seq.) and the State CEQA Guidelines. The expansion project includes (a) increasing Plant 1 treatment capacity to 80 mgd to accommodate urban growth in the Discharger's service area, (b) discontinuing use of Plant 2 to improve the WWTF's overall air emissions, reliability, and operations, and (c) constructing an additional 600 acres of infiltration basins (i.e., effluent disposal ponds) to provide disposal capacity for the increased flows and to comply with Board-prescribed pond freeboard requirements. The EIR estimates that, at full build out, the project would discharge an additional 11,200 af/yr of effluent to area groundwater. While the EIR states that the infiltration of effluent over the years has caused concentrations in groundwater of TDS, EC, and sodium to increase, the EIR states that the project would not affect public or private water supplies. The EIR identifies the project's impact on groundwater as temporary, as the City "shall commit to developing a plan for the reclamation of water infiltrated at the plant by 1997." The EIR further states that the City of Fresno "shall continue to develop and implement a reuse program for its treated wastewater to reduce the need for future infiltration basins. The EIR indicates the City "is also developing a reuse program for its treated wastewater to alleviate groundwater conditions under the treatment plant…[to]…mitigate the cumulative effects to water resources to a level of less than significant." The City's proposed mitigation measure must result in implementation of additional projects that recycle a total of at least 11,200 af/yr, but these projects have yet to be realized.

85. The project certified by the City of Fresno as described in the EIR differs from the project characterized in the Discharger's 31 December 1996 Report of Waste of Discharge (RWD). The RWD describes a project in which the City would increase Plant 1's treatment capacity to 88 mgd, continue use of Plant 2, and construct an additional 600 acres of disposal ponds. The increase in amount of effluent percolating from the project described in the RWD is nearly 25,000 af/yr, not the 11,200 af/yr identified in the EIR. Since submitting the RWD, the Discharger indicates that (a) it plans, as necessary, to treat some industrial flows in Plant 2 prior to full treatment in Plant 1; (b) the 80 mgd specified in the EIR represents the annual monthly average daily discharge flow; and (c) the EIR did not accurately reflect that Plant 1 would be designed, constructed, and operated

to treat a maximum monthly average daily discharge flow of 88 mgd. The additional 8 mgd short-term treatment capacity accommodates seasonal peaks from food-processing industries that generally occur in September.

86. As described in Finding No. 16, Calpine proposes to recycle up to 7,000 af/yr of effluent extracted by reclamation wells. If Calpine completes its project utilizing extracted effluent, the Discharger will still need to implement reuse projects for an additional 4,200 af/yr to accomplish its goal of reusing the 11,200 af/yr discharge flow to groundwater resulting from the WWTF expansion project.

87. The Board, as a responsible agency under CEQA, has reviewed the City's EIR for the project relative to impacts to groundwater quality and concurs that the increased percolation will have a significant effect on water quality by contributing to increases in salts and increasing the already dominant groundwater mound and affected geographic area. Further, the Board concurs that the City's mitigation measure of implementing reuse projects to offset the project's increase in flow (i.e., 11,200 af/yr) will mitigate the project's potential incremental impact, but observes that the measure has yet to be implemented. Given that the full increase will be reached in 2008, the stated commitment of the City to mitigate, and applicable reclamation policies, full mitigation by 2004 is not unreasonable. Regardless, the scale of the reuse program is not sufficient to mitigate the same adverse water quality impacts occurring from the pre-project discharge, which must be evaluated by the Board in accordance with Resolution No. 68-16. The following provisions mitigate or avoid the adverse impact of the project on water quality: (a) annual monthly average daily discharge flow is limited to 80 mgd and maximum monthly average daily discharge flow is limited to 88 mgd (WWTF Discharge Specification B.1); reuse projects must recycle 11,200 af/yr by 2004 (Provision H.15); (c) water quality of private domestic and agricultural wells within the influence of the discharge must be evaluated (Provision H.18); and treatment and control practices must be evaluated along with consequent degradation of groundwater for consistency with Resolution No. 68-16 (Provisions H.12, H13, and H14).

88. On 25 March 1998, the City of Fresno adopted a negative declaration (Environmental Assessment 98-03), in accordance with CEQA and State CEQA Guidelines for the discharge of stillage to the 50-acre stillage disposal site (SS-2) adjacent to the existing 95-acre stillage disposal site (SS-1). Mitigation measures 3 – 15 are identical to Stillage Discharge Specifications C.1 – C.13 from WDRs Order No. 96-054. The negative declaration does not adequately mitigate the potentially significant effect on groundwater from accumulation of nitrogen in stillage disposal area soils, nor adequately monitor the fate of waste constituents that percolate through the soil profile. The following provisions mitigate or avoid the adverse impact of the project on water quality: (a) planting and harvesting of crops will reduce the nitrogen content in soils (Stillage Disposal Specification D.1) and (b) vadose zone monitoring for waste constituents and their decomposition by-products will provide adequate monitoring (Monitoring and Reporting Program).

GENERAL FINDINGS

89. Section 13263 of the CWC authorizes the Board to prescribe discharge requirements that implement the Basin Plan and other applicable plans and take into consideration other factors,

including the factors in CWC section 13241, which includes economic considerations. The State Water Resources Control Board, however, has held that a regional board need not specifically address section 13241 factors when implementing existing water quality objectives in waste discharge requirements because the factors were already considered in adopting water quality objectives. These waste discharge requirements implement adopted water quality objectives. Therefore, no additional analysis of the section 13241 factors is required.

90. Pursuant to CWC section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.

91. California Water Code (CWC) section 13267 authorizes the Board to require anyone who discharges waste that could affect the quality of water, as the Discharger does, to furnish, under penalty of perjury, technical and monitoring program reports.

92. The Board considered all the above and the supplemental information and details in the attached Information Sheet, which is incorporated by reference herein, in establishing the following conditions of discharge.

93. The Board has notified the Discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for this discharge and has provided them with an opportunity for a public hearing and an opportunity to submit their written views and recommendations.

94. The Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that Order No. 96-054 is rescinded and that, pursuant to CWC sections 13263 and 13267, the Cities of Fresno and Clovis, their agents, successors, and assigns, in order to meet the provisions contained in the Clean Water Act and Division 7 of the California Water Code and regulations adopted there under, shall comply with the following:

A. Discharge Prohibitions

1. Discharge of wastes from the WWTF and of stillage from the Stillage Site to surface waters or surface water drainage courses is prohibited.

2. Discharge of waste classified as “hazardous” as defined in section 2521(a) of Title 23, CCR, section 2510 et seq., or “designated” as defined in section 13173 of the California Water Code, is prohibited.

3. Bypass or overflow of untreated or partially treated waste from the WWTF to disposal ponds, to reclamation areas, or to the Stillage Site, is prohibited.

4. By **31 December 2003** discharge of stillage to SS-1 is prohibited.

5. Discharge of stillage to areas within or beyond the WWTF property other than to the Stillage Site (as defined in Finding No. 39) without Board-adopted waste discharge requirements or waiver from said requirements is prohibited.
6. Discharge of effluent to areas outside of the WWTF property boundary without Board-adopted water reclamation requirements or waiver from said requirements is prohibited.

7. Grazing of animals producing milk for human consumption within areas irrigated with effluent is prohibited.

B. WWTF Discharge Specifications

1. The discharge flow from WWTF (i.e., the combined flow from Plant 1 and Plant 2 when in service and discharging directly to disposal ponds) shall not exceed:

   a. an annual monthly average daily discharge flow of 80 mgd; and

   b. a maximum monthly average daily discharge flow of 88 mgd.

2. The discharge from Plant 1 (including that from Plant 2 when in service and discharging directly to disposal ponds) shall not exceed the following limits:

Constituent	Units	Monthly Average[1]	Daily Maximum
BOD_5[2]	mg/L	40	80
Total Suspended Solids (TSS)	mg/L	40	80
Settleable Solids	mL/L	0.2	0.5

[1] Arithmetic mean of measurements made during the month
[2] Five-day, 20° Celsius biochemical oxygen demand

3. The arithmetic mean of BOD_5 and of total suspended solids in effluent samples collected over a monthly period shall not exceed 20 percent of the arithmetic mean of the values for influent samples collected at approximately the same times during the same period (80 percent removal).

4. The monthly average EC of the discharge, shall not exceed the flow-weighted average EC of the source water plus 500 µmhos/cm, or a maximum of 900 µmhos/cm, whichever is less. The flow-weighted average for the source water shall be a moving average for the most recent twelve months.

5. The discharge shall not have a pH less than 6.0 or greater than 9.0.

6. Objectionable odors shall not be perceivable beyond the limits of the WWTF property at an intensity that creates or threatens to create nuisance conditions.

7. Notwithstanding WWTF Discharge Specifications B.1 through B.6, no waste constituent shall be released or discharged, or placed where it will be released or discharged, in a concentration or in a mass that causes violation of Groundwater Limitations.

C. Disposal Pond Specifications

1. The dissolved oxygen content in the upper zone (1 foot) of effluent in disposal ponds shall not be less than 1.0 mg/L.

2. Disposal ponds shall be managed to prevent breeding of mosquitoes. In particular:

   a. An erosion control program should assure that small coves and irregularities are not created around the perimeter of the water surface.

   b. Weeds shall be minimized through control of water depth, harvesting, or herbicides.

   c. Dead algae, vegetation, and debris shall not accumulate on the water surface.

   d. Vegetation management operations in areas in which nesting birds have been observed shall be carried out either before or after, but not during, the **1 April to 30 June** bird nesting season.

3. Public contact with effluent shall be precluded through such means as fences, signs, or acceptable alternatives. Signs shall be as shown in Attachment D, a part of this Order.

4. Disposal ponds shall have sufficient capacity to accommodate allowable discharge flow and design seasonal precipitation and ancillary inflow and infiltration, excluding effluent discharged as authorized by valid requirements to reclamation areas and to off-site effluent storage and disposal areas. Design seasonal precipitation shall be based on total annual precipitation using a return period of 100 years, distributed monthly in accordance with historical rainfall patterns. Freeboard shall never be less than two feet (measured vertically) or a lesser freeboard if certified in writing by a registered civil engineer as adequate to prevent overtopping, overflows, or levee failures.

5. On or about **15 November** of each year, available disposal pond storage capacity shall at least equal the volume necessary to comply with Disposal Pond Specification C.4.

D. Stillage Discharge Specifications

1. **Effective immediately,** the Discharger shall commence regularly planting and harvesting crops in the Stillage Site to reduce the nitrogen content in stillage disposal area soils.

2. Objectionable odors originating from stillage disposal areas shall not be perceivable beyond the limits of the WWTF property boundary.

3. The maximum daily stillage discharge shall not exceed the following limits:

Period of Year	Maximum Discharge (mgd)
1 May to 30 Sep	1.36
1 Oct to 30 Nov	0.77
1 Dec to Apr 30	0.46

4. Stillage shall be discharged to land in long narrow checks or basins. The check or basin surface should be leveled within 0.1 foot per 100 feet and be free of potholes.

5. At the inlet of the checks, stillage shall be distributed using splash plates or other devices to prevent deep holes from forming.

6. The depth of applied stillage shall not exceed the following in any one application:

Period of Year	Maximum Depth (inches)
1 May to 30 Sep	3.7
1 Oct to 30 Nov	3.0
1 Dec to Apr 30	2.5

7. Standing stillage shall not be present 24 hours after application has ceased.

8. Checks receiving stillage applications shall be allowed to dry for at least the following period before re-application of waste:

Period of Year	Drying Time (days)
1 May to 30 Sep	6
1 Oct to 30 Nov	9
1 Dec to Apr 30	13

9. Land area used for disposal shall equal or exceed the following:

Period of Year	Land Area (acres per 100,000 gpd of stillage waste)
1 May to 30 Sep	6
1 Oct to 30 Nov	9
1 Dec to Apr 30	13

10. Once applied stillage has dried, the Discharger shall remove leathers prior to re-application. The Discharger shall store collected leathers in a manner that precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations. Further, the Discharger shall dispose of collected leathers not recycled as a soil amendment

in a manner that precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations.

11. The resulting effect of the stillage discharge on soil pH shall be such as not to exceed the buffering capacity of the soil profile.

12. Soil depth in the Stillage Site shall be 10 feet or greater above unbroken hardpan, groundwater, or impermeable soils. There shall be no unripped hardpan within the top 10 feet of the soil profile.

E. Sludge Specifications

Sludge in this document means the solid, semisolid, and liquid residues removed during primary, secondary, or advanced wastewater treatment processes. Solid waste refers to grit and screening material generated during preliminary treatment. Residual sludge means sludge that will not be subject to further treatment at the WWTF. Biosolids refers to sludge that has undergone sufficient treatment and testing to qualify for reuse pursuant to federal and state regulations as a soil amendment for agriculture, silviculture, horticulture, and land reclamation.

1. Sludge and solid waste shall be removed from screens, sumps, ponds, clarifiers, etc. as needed to ensure optimal plant operation.

2. Treatment and storage of sludge generated by the WWTF and solids from the Operator's stillage disposal operation (i.e., leathers) shall be confined to the WWTF property and conducted in a manner that precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations.

3. Any storage of residual sludge, solid waste (including stillage leathers), and biosolids on property of the WWTF shall be temporary and controlled and contained in a manner that minimizes leachate formation and precludes infiltration of waste constituents into soils in a mass or concentration that will violate Groundwater Limitations.

4. Residual sludge, biosolids, and solid waste shall be disposed of in a manner approved by the Executive Officer and consistent with Title 27. Removal for further treatment, disposal, or reuse at sites (i.e., landfill, WWTF, composting site, soil amendment sites) operated in accordance with valid waste discharge requirements issued by a regional water quality control board will satisfy this specification.

5. Use of biosolids as a soil amendment shall comply with General Biosolids Order (State Water Resources Control Board Water Quality Order No. 2000-10-DWQ, *General Waste Discharge Requirements for the Discharge of Biosolids to Land for Use as a Soil Amendment in Agricultural, Silvicultural, Horticultural, and Land Reclamation Activities*). The Discharger must obtain a "Notice of Applicability" of the General Biosolids Order from the Executive Officer prior to discharge of biosolids to any site. Alternatively, use of biosolids

as a soil amendment shall comply with valid waste discharge requirements issued by a regional water quality control board.

6. Use and disposal of biosolids should comply with the self-implementing federal regulations of 40 CFR 503, which are subject to enforcement by the U.S. Environmental Protection Agency (EPA), not the Board. If during the life of this Order the State accepts primacy for implementation of 40 CFR 503, the Board may also initiate enforcement where appropriate.

F. Reclamation Specifications

The following specifications apply to reclamation areas under the control of the Discharger within the WWTF property boundary. Other reclamation sites are covered by separate waste reclamation requirements.

1. Recycled water (i.e., effluent) shall remain within the Discharger's on-site reclamation areas. Recycled water provided off-site shall only be provided to users that hold Board-adopted water reclamation requirements, or users who have obtained a waiver of reclamation requirements from the Board.

2. Use of recycled water shall be limited to flood irrigation of fodder, fiber, seed crops, and of crops such as wine grapes that undergo extensive commercial, physical, or chemical processing before human consumption, and shall comply with the provisions of Title 22.

3. The Discharger shall maintain the following setback distances from areas irrigated with recycled water:

Setback Distance (feet)	To
25	Property Line
30	Public Roads
50	Drainage courses
100	Irrigation wells
150	Domestic wells

4. No physical connection shall exist between recycled water piping and any domestic water supply or domestic well, or between recycled water piping and any irrigation well that does not have an air gap or reduced pressure principle device.

5. The perimeter of reclamation areas shall be graded to prevent ponding along public roads or other public areas.
6. Areas irrigated with recycled water shall be managed to prevent breeding of mosquitoes. More specifically:

   a. All applied irrigation water must infiltrate completely within a 48-hour period.

b. Ditches not serving as wildlife habitat should be maintained free of emergent, marginal, and floating vegetation.

c. Low-pressure and unpressurized pipelines and ditches accessible to mosquitoes shall not be used to store recycled water.

7. Recycled water shall be managed to minimize runoff onto adjacent properties not owned or controlled by the Discharger.

8. Recycled water shall be managed to minimize contact with workers.

9. If recycled water is used for construction purposes, it shall comply with the most current edition of *Guidelines for Use of Reclaimed Water for Construction Purposes*. Other uses of recycled water not specifically authorized herein shall be subject to the approval of the Executive Officer and shall comply with Title 22.

10. Public contact with recycled water shall be precluded through such means as fences or acceptable alternatives. Signs with proper wording (shown below) of a size no less than four inches high by eight inches wide shall be placed at all areas of public access and around the perimeter of all areas used for effluent disposal or conveyance to alert the public of the use of recycled water. All signs shall display an international symbol similar to that shown in Attachment D, a part of this Order, and present the following wording:

"RECYCLED WATER—DO NOT DRINK"

"AGUA DE DESPERDICIO RECLAMADA—POR FAVOR NO TOME"

11. Reclamation of WWTF effluent shall be at reasonable agronomic rates considering the crop, soil, climate, and irrigation management plan. The annual nutrient loading of reclamation areas, including the nutritive value of organic and chemical fertilizers and of the recycled water, shall not exceed the crop demand.

G. Groundwater Limitations

Release of waste constituents from any storage, treatment, or disposal component associated with the WWTF shall not, in combination with other sources of the waste constituents, cause groundwater under and beyond the WWTF and discharge area(s) to exceed any of the following:

1. Constituent concentrations specified below or natural background concentration, whichever is greater:

   a. Total coliform organisms of 2.2 MPN/100 mL.

   b. Total nitrogen in excess of 10 mg/L.

c. For constituents identified in Title 22 (as described in Finding No. 58), the MCLs quantified therein.

2. Constituent concentrations listed below or natural background concentration, whichever is greater:

Constituent	Units	Limitation
Boron	mg/L	0.7
Chloride	mg/L	106
EC	µmhos/cm	990
Sodium	mg/L	103
Total Dissolved Solids[1]	mg/L	560

[1] A cumulative constituent comprised of dissolved matter consisting mainly of inorganic salts, small amounts of organic matter, and dissolved gases [e.g., ammonia, bicarbonate alkalinity, boron, calcium, chloride, copper, iron, magnesium, manganese, nitrate, phosphorus, potassium, sodium, silica, sulfate, total alkalinity]

3. Taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses, including but not limited to ammonia (as N) in excess of 0.5 mg/L, or natural background, whichever is greater.

4. Constituent concentrations identified as follows or natural background concentration, whichever is greater: toxic substances in concentrations that produce detrimental physiological responses in human, plant, or animal, or aquatic life; or chemical constituents and pesticides in concentrations that adversely affect beneficial uses.

H. Provisions

1. For purposes of day-to-day communication regarding compliance with terms of this Order, the Board will communicate directly with the City of Fresno. Correspondence and notifications between the Board and City of Fresno shall be as if to or from all parties identified in Finding No. 1 as "Discharger."

2. The Discharger shall comply with the *Standard Provisions and Reporting Requirements for Waste Discharge Requirements*, dated 1 March 1991, which are attached hereto and by reference a part of this Order. This attachment and its individual paragraphs are commonly referenced as Standard Provision(s).

3. The Discharger shall comply with Monitoring and Reporting Program No. 5-01-254 that is part of this Order, and any revisions thereto as ordered by the Executive Officer.

4. The Discharger shall submit to the Board on or before each report due date the specified document or, if an action is specified, a written report detailing evidence of compliance with the date and task. If noncompliance is being reported, the reasons for such noncompliance shall be stated, plus an estimate of the date when the Discharger will be in compliance. The Discharger shall notify the Board by letter when it returns to compliance with the time schedule.

5. **By 15 April 2002**, the Discharger shall submit a technical report describing a work plan for monitoring its stillage disposal operation. The technical report shall at a minimum describe:

   a. The methods the Discharger will employ for determining the daily quantity of stillage discharge and the amount of acreage covered by the discharge on a daily basis.

   b. Alternatives for disposal should the Discharger be in threatened violation of any conditions of this Order.

   c. The location, depths, and number of soil sampling points.

   d. Vadose zone monitoring procedures, specifically:

      i) The location, depths, and number of vadose zone liquid sampling points.

      ii) The method for collecting samples of liquid percolating through the soil.

   The technical report must be prepared by a qualified professional such as a California registered civil engineer, agricultural engineer, or a certified soil scientist experienced in land treatment of food processing wastewater. The Discharger shall implement the Stillage Site monitoring program within **30 days** following Executive Officer approval of the technical report.

6. **By 15 April 2002**, the Discharger shall submit a sludge management plan that satisfies the information requirements of Attachment E, "Information Needs For Sludge Management Plan." A California registered civil engineer experienced in sludge disposal must prepare and certify the sludge management plan. Following written approval of the sludge management plan from the Executive Officer, this Provision shall be considered satisfied.

7. **By 15 July 2002**, the Discharger shall complete a hydrogeologic investigation within the area affected and potentially affected by the WWTF and submit a technical report to the Executive Officer. The technical report, which shall be prepared and professionally certified by a geologist registered to practice in California, shall describe the underlying geology, existing wells (active and otherwise), local well construction practices and standards, well restrictions, and hydrogeology. The report shall recommend representative monitoring zones of the uppermost aquifer with consideration given to the Discharger's existing data and provide a detailed evaluation of the existing monitoring well network. The recommendations shall be reviewed and approved as appropriate by the Executive Officer.

8. Within 210 days following Executive Officer approval of representative monitoring zones in accordance with **Provision H.7**, the Discharger shall submit a technical report proposing a modified groundwater monitoring network. The technical report shall consist of a Monitoring Well Installation Work Plan for a network that satisfies Attachment F, "Standard Monitoring Well Provisions for Waste Discharge Requirements." The network shall include one or more background wells and sufficient number of wells to evaluate performance of BPTC measures and to determine compliance with this Order's Groundwater Limitations. These include monitoring wells immediately downgradient of components that do or may release waste constituents to groundwater (e.g., disposal ponds, Stillage Site, former sludge drying bed area, biosolids storage areas). Every monitoring well shall comply with applicable Well Standards. Monitoring of wells constructed to yield representative samples from approved monitoring zones within the uppermost aquifer in accordance with this Order's Monitoring and Reporting Program shall comprise the representative zone monitoring program. Implementation of the Monitoring Well Installation Work Plan shall be subject to the prior approval of the Executive Officer.

9. The Discharger shall comply with the following compliance schedule in implementing the groundwater monitoring network approved by the Executive Officer in Provision H.8:

Task	Compliance Date
a. Implement Monitoring Well Installation Work Plan	180 days following Work Plan approval by Executive Officer
b. Complete Monitoring Well Installation	120 days following Work Plan implementation
c. Commence Groundwater Monitoring	30 days following completion of task 9.b
d. Submit Monitoring Well Installation Report of Results	60 days following completion of task 9.b
e. Submit technical report that characterizes natural background water quality in approved representative monitoring zones for all monitored constituents	365 days following completion of task 9.d

Technical reports submitted pursuant to this Provision shall be prepared and certified by a California registered civil engineer or geologist, and are subject to Executive Officer approval.

10. Compliance with Groundwater Limitations will be evaluated based on the approved representative zone monitoring program following completion of Provision H.9, task e. Should the Discharger fail to comply with the schedule to characterize natural background groundwater quality at the approved monitoring zone(s) by the date specified in Provision H.9, task e, the Board shall not consider the lack of natural background characterization as sufficient defense to enforcement for violations of Groundwater Limitations G.1 through G.4.

11. **By 15 October 2002**, the Discharger shall submit a written work plan in the form of a technical report that sets forth a schedule for a systematic and comprehensive technical evaluation of each component of the WWTF's waste treatment and control to determine for each waste constituent best practicable treatment and control as used in Resolution 68-16. The technical report shall contain a preliminary evaluation of each component and propose a time schedule for completing the comprehensive technical evaluation. The technical report shall be prepared and certified by a California registered civil engineer. The schedule to complete all comprehensive technical evaluations shall be as short as practicable, and shall not exceed two years. Upon written determination of adequacy by the Executive Officer of the technical report, this Provision shall be considered satisfied.

12. **By two years from satisfaction of Provision H.11**, the written comprehensive technical evaluation shall be submitted with the Discharger's written recommendations for any WWTF modifications (e.g., component upgrade and retrofit) and/or operational modifications that are necessary to ensure BPTC. Comprehensive technical evaluations shall be prepared and certified by a California registered civil engineer. The proposed schedule for modifications shall be identified. The schedule shall be as short as practicable but in no case shall completion of the necessary improvement exceed four years past the Executive Officer's determination of the adequacy of the comprehensive technical evaluation submitted pursuant to this provision unless the schedule is reviewed and specifically approved by the Board. The adequacy of the component evaluation, recommended improvements, and schedule are subject to the Executive Officer's review and determination.

13. The groundwater limitations set forth in this Order are not final and not an entitlement. **By 15 June 2005**, the Discharger shall submit a technical report that proposes specific numeric groundwater limitations for each waste constituent that reflects full implementation of BPTC and compliance with the most stringent applicable water quality objectives for that waste constituent. The report shall describe how these were determined considering actual data from monitoring wells comprising the approved representative zone monitoring program, impact reductions through full implementation of BPTC, reasonable growth, the factors in Water Code section 13241, State Water Resources Control Board Resolution No. 68-16, the Basin Plan, etc. The most stringent applicable water quality objective shall be interpreted based on the Regional Board policy entitled Application of Water Quality Objectives on pages IV-21 through IV-23 of the Basin Plan. Where the stringency of a proposed water quality objective can vary according to land use, the Discharger must provide documentation from similar third party government authorities that there is no potential for the more sensitive land use to occur, and the reason, if it wishes the Board to consider a proposed water quality objective, that provides protection for only less sensitive uses. The Board will consider the documentation and recommendation for the governing water quality objective, and it is this accepted value that will establish the maximum permissible groundwater limitation the Board will consider in Phase 2 evaluation. The Discharger may, at its discretion, submit results of a validated groundwater model or other hydrogeologic information to support its proposal.

14. Upon completion of tasks set forth in Provisions H.12 and H.13, the Board shall consider the evidence provided and make a determination regarding (a) whether the Discharger has justified BPTC and (b) the appropriate final numeric groundwater limitations that comply with Resolution 68-16.

15. The Discharger shall expand its WWTF effluent reuse operation to recycle an additional 11,200 af/yr over that recycled currently (as described in Finding Nos. 8 and 12). This amount may include the 7,000 af/yr reuse project proposed by Calpine (described in Finding No. 16). The Discharger shall comply with the following time schedule in implementing additional reuse project(s):

Task	Compliance Date
a. Submit technical report and implementation schedule	**15 October 2002**
b. Submit Title 22 Engineering Report to DHS	**90 days** following Executive Officer approval of Task 15.a
c. Comply with CEQA	**270 days** following completion of Task 15.b
d. Submit Report of Water Reclamation for additional reuse project(s)	**60 days** following completion of Task 15.c
e. Implement additional reuse project(s)	**110 days** following completion of Task 15.d

Reports submitted pursuant to Tasks a, b, d of this Provision shall be prepared and certified by a California registered civil engineer.

16. **By 1 April 2002**, the Discharger, in collaboration with FID, shall submit a technical report that (a) identifies the types and acreages of crops in the FID service area that receives groundwater extracted from the Operator's reclamation wells and (b) provides information on the dilution of the extracted groundwater with fresh water prior to irrigation. The crop identification should provide information on fluctuations in cropping patters in the subject area. The dilution information should provide and interpret historic flow data of FID surface water deliveries to cropland receiving extracted groundwater for a range of water year types (e.g., drought, normal, and wet). The Discharger shall submit a copy of the technical report to DHS. Upon written approval of the Executive Officer of the technical report, this Provision shall be considered satisfied.

17. **By 15 February 2002,** the Discharger shall submit a technical report for Executive Officer approval that describes a work plan and implementation schedule for installing and operating continuous turbidity monitoring devices on representative reclamation wells for at least a one-year period. The Discharger shall submit a copy of the technical report to DHS. The Discharger shall implement continuous turbidity monitoring on approved representative

monitoring wells prior to the startup of reclamation well discharge in the spring 2002 irrigation season.

18. **By 15 July 2002**, the Discharger shall submit a technical report describing a work plan and implementation schedule for sampling a representative number of private domestic and agricultural wells in the 25-square-mile area surrounding and downgradient of the WWTF (as described in Finding No. 9). The technical report shall, at a minimum, include:

    a. A map depicting the location of all individual and agricultural wells in the subject area.

    b. A map depicting the land use within the subject area.

    c. A map and listing of individual and agricultural wells proposed for sampling, and a justification of why each well was selected for sampling.

    d. The driller's log for the selected wells.

    e. A proposed list of monitored constituents, including, at a minimum, the following: TDS, EC, general minerals (defined in the Monitoring and Reporting Program), nitrogen compounds (i.e., nitrate, nitrite, ammonia, organic nitrogen), total organic carbon, endocrine disrupting compounds, and pharmaceuticals.

    f. A thorough description of the sampling and testing protocol.

    A California registered civil engineer or geologist shall certify the technical report. The Discharger shall submit a copy of the technical report to DHS. Within **30 days** following Executive Officer written approval of the technical report, the Discharger shall commence sampling of approved domestic and agricultural wells and continue sampling in accordance with the approved work plan. Upon evaluation of submitted data, the Executive Officer may require the Discharger to sample additional wells.

19. **By 15 July 2002**, the Discharger shall submit a technical report describing a work plan and implementation schedule for an evaluation of the degree of soil treatment provided by the current recharge and extraction operation. The evaluation shall include, at a minimum, a determination of the level of filtration and virus removal treatment provided. A California registered civil engineer or geologist shall certify the technical report. The Discharger shall submit a copy of the technical report to DHS. Within **30 days** following Executive Officer written approval of the technical report, the Discharger shall implement the work plan. Within **120 days** following the work plan implementation, the Discharger shall submit a technical report describing the results of the evaluation. The Discharger shall submit a copy of the technical report to DHS. Following written acceptance of the technical report by the Executive Officer, this Provision will be considered satisfied.

20. **By 1 March 2002,** the Discharger shall submit a report for Executive Officer approval outlining EPA test methods and detection limits for priority pollutants listed in Title 40, Code of Federal Regulations, Part 131.

21. By **15 March 2002**, the Discharger shall submit a technical report that shows whether the disposal ponds have adequate capacity for the 100-year annual rainfall at design flow of 80 mgd. The technical report shall also include a nutrient balance that estimates the amount of nitrogen (tons and lbs/acre) that will percolate annually to groundwater underlying the disposal ponds at the design flow. A California registered civil engineer must oversee and certify the technical report. Following written approval of the technical report from the Executive Officer, this Provision shall be considered satisfied.

22. At least **90 days prior** to termination or expiration of any lease, contract, or agreement involving the Stillage Site, reclamation areas, or off-site reuse of effluent, used to justify the capacity authorized herein and assure compliance with this Order, the Discharger shall notify the Board in writing of the situation and of what measures have been taken or are being taken to assure full compliance with this Order.

23. The Discharger shall not allow pollutant-free wastewater to be discharged into the WWTF collection, treatment, and disposal systems in amounts that significantly diminish the system's capability to comply with this Order. Pollutant-free wastewater means stormwater (i.e., inflow), groundwater (i.e., infiltration), cooling waters, and condensates that are essentially free of pollutants.

24. The Discharger shall use best practicable treatment or control, including proper operation and maintenance, to comply with terms of this Order.

25. Each User of recycled water who is farming lands within the WWTF property should receive appropriate employee training to assure proper operation of recycling facilities, worker protection, and compliance with this Order. The Operator and Users shall each designate a Recycled Water Supervisor responsible for compliance with these waste discharge requirements. The Recycled Water Supervisor shall be responsible for the avoidance of cross-connections during the installation, operation and maintenance of the reclamation area's pipelines and equipment.

26. If the Board determines that waste constituents in the discharge have reasonable potential to cause or contribute to an exceedance of an objective for groundwater, this Order may be reopened for consideration of addition or revision of appropriate numerical effluent or groundwater limitations for the problem constituents.

27. The Discharger shall report to the Board any toxic chemical release data it reports to the State Emergency Response Commission within 15 days of reporting the data to the Commission pursuant to section 313 of the "Emergency Planning and Community Right to Know Act of 1986."

28. The Discharger shall comply with all pretreatment requirements contained in 40 CFR 403 and shall be subject to enforcement actions, penalties, fines, and other remedies by EPA or other appropriate parties, as provided in the CWA, as amended, and the CWA. The Discharger shall implement and enforce its approved Publicly-Owned Treatment Works (POTW) Pretreatment Program, which is hereby made an enforceable condition of these requirements. EPA may initiate enforcement action against an industrial user for noncompliance with applicable standards and requirements as provided in the CWA.

29. The Discharger shall enforce the requirements promulgated under Sections 307(b), (c), (d), and 402(b) of the CWA. The Discharger shall cause industrial users subject to federal categorical standards to achieve compliance no later than the date specified in those requirements or, in the case of a new industrial user, upon commencement of the discharge.

30. The Discharger shall perform the pretreatment functions required in 40 CFR 403, including, but not limited to:

    a. Implementing the necessary legal authorities as provided in 40 CFR 403.8(f)(1);

    b. Enforcing the pretreatment requirements under 40 CFR 403.5 and 403.6;

    c. Implementing the programmatic functions as provided in 40 CFR 403.8(f)(2);

    d. Providing the requisite funding and personnel to implement the pretreatment program as provided in 40 CFR 403.8(f)(3);

    e. Publishing a list of industrial users that were in significant noncompliance of applicable pretreatment requirements as required by 40 CFR 403.8(f)(2)(vii); and

    f. Conducting inspections in accordance with provisions of 40 CFR 403.8(f)(1)(v) and 403.8(f)(2)(v) and ensuring compliance with pretreatment standards and requirements by (1) assessing and collecting, when appropriate, civil penalties and civil administrative penalties in accordance with Government Code Sections 54740, 54740.5, and 54740.6, or (2) other equally effective means.

31. In the event of any change in control or ownership of land or waste discharge facilities described herein, the Discharger shall notify the succeeding owner or operator of the existence of this Order by letter, a copy of which shall be immediately forwarded to this office. To assume operation under this Order, the succeeding owner or operator must apply in writing to the Executive Officer requesting transfer of the Order. The request must contain the requesting entity's full legal name, the state of incorporation if a corporation, the name and address and telephone number of the persons responsible for contact with the Board, and a statement. The statement shall comply with the signatory paragraph of Standard Provision B.3 and state that the new owner or operator assumes full responsibility for compliance with this Order. Failure to submit the request shall be considered a discharge

without requirements, a violation of the California Water Code. Transfer shall be approved or disapproved by the Executive Officer.

32. The Discharger must comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Board or court orders requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.

33. A copy of this Order shall be kept at the discharge facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.

34. The Board will review this Order periodically and will revise requirements when necessary.

I, GARY M. CARLTON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 19 October 2001.

GARY M. CARLTON, Executive Officer

Order Attachments:

Monitoring and Reporting Program No.
A: Vicinity Map
B: Plant 1 Diagrammatic Layout
C: Plant 2 Diagrammatic Layout
D: Symbol For Recycle Water Signs
E: Information Needs for Sludge Management Plan
F: Standard Monitoring Well Provisions for Waste Discharge Requirements
G: Recommended Recycled Water Monitoring Form
Information Sheet
Standard Provisions (1 March 1991 version) (separate attachment to Discharger only)

BLH:jlk:fmc 10/19/01 AMENDED

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. 5-01-254

MONITORING AND REPORTING PROGRAM
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

This Monitoring and Reporting Program (MRP) is issued pursuant to Water Code Section 13267. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. Sample station locations are depicted on Attachments B and C. Changes to sample location shall be established with concurrence of Board's staff, and a description of the revised stations shall be submitted to the Board and attached to this Order. All samples should be representative of the volume and nature of the discharge or matrix of material sampled. The time, date, and location of each sample shall be recorded on the sample chain of custody form.

WWTF INFLUENT MONITORING

Samples shall be collected at the headworks and should be representative of the influent for the period sampled. Time and date of collection of samples shall be recorded. Influent monitoring shall include at least the following:

Constituent	Units	Type of Sample	Sampling Frequency
Maximum Daily Flow	mgd	Continuous	Daily
Average Daily Flow	mgd	Continuous	Daily
Monthly Average Flow	mgd	Computed	Monthly
Annual Monthly Average Daily Flow[1]	mgd	Computed	Monthly
Settleable Solids	mL/L	Grab	2/week[2]
pH	pH units	Continuous	Daily[4]
BOD_5[2]	mg/L	24-hr Composite	2/week[3]
Monthly Average BOD_5	mg/L	Calculated	Monthly
Total Suspended Solids	mg/L	24-hr Composite	2/week[3]
Monthly Average TSS	mg/L	Calculated	Monthly

1 Based on the previous twelve months
2 Five-day biochemical oxygen demand at 20ºC
3 Nonconsecutive days
4 Median value for 24-hour period

WWTF DISCHARGE MONITORING

Effluent samples shall be collected just prior to discharge to the disposal ponds and should be representative of the volume and nature of the discharge. Time of collection of composite and grab samples shall be recorded. Effluent monitoring from Plant 1 (and from Plant 2 when in operation and discharging directly to disposal ponds) shall include at least the following:

Constituent	Units	Type of Sample	Sampling Frequency[1]
pH	pH Units	Continuous	Daily[2]
Settleable Solids	mL/L	Grab	2/Week[3]
BOD_5			
Concentration	mg/L	24-hr Composite	2/Week[3]
Monthly Average	mg/L	Calculated	Monthly
Percent Removal	%	Calculated	Monthly
Total Suspended Solids			
Concentration	mg/L	24-hr Composite	2/Week[3]
Monthly Average	mg/L	Calculated	Monthly
Percent Removal	%	Calculated	Monthly
Total Dissolved Solids (TDS)[4]	mg/L	24-hr Composite	Weekly[5]
EC[6]	µmhos/cm	24-hr Composite	2/Weekly
Chloride	mg/L	24-hr Composite	2/Week[3,5]
Ammonia Nitrogen (as NH_3-N)	mg/L	24-hr Composite	Weekly
Nitrate Nitrogen (as NO_3-N)	mg/L	24-hr Composite	Weekly
Nitrite Nitrogen (as NO_2-N)	mg/L	24-hr Composite	Weekly
Total Kjeldahl Nitrogen (TKN)	mg/L	24-hr Composite	Weekly
Total Nitrogen	mg/L	Calculated[7]	Weekly
General Minerals[8]	mg/L	24-hr Composite	Quarterly[9]
Metals[10,11]	µg/L	24-hr Composite	Semiannually[12]
Priority Pollutants[13]	µg/L	Grab	Semiannually[12,14]

1 If results of monitoring a pollutant appear to violate discharge specifications, but monitoring frequency is not sufficient to validate violation (e.g., the monthly mean for BOD_5), or indicate a violation and potential upset of the treatment process (e.g., less than minimum dissolved oxygen concentration), the frequency of sampling shall be increased to confirm the magnitude and duration of violation, if any, and aid in identification and resolution of the problem.
2 Median value for 24-hour period
3 Nonconsecutive days
4 TDS as referred to in this program shall be determined using EPA Method No. 160.1 for combined organic and inorganic TDS and EPA Method No. 160.4 for inorganic.
5 Concurrent with EC sampling (i.e., on the same day)
6 Conductivity at 25º

[7] Total Nitrogen as referred to in this program shall be calculated as : TKN + NO_2-N + NO_3-N
[8] General Minerals as referred to in this program shall include the constituents in the Analyte listed below.
[9] January, April, July, and October
[10] Metal analyses as referred to in this program shall include aluminum arsenic, barium, copper, cadmium, chromium, lead mercury, molybdenum, selenium, silver, zinc, and nickel.
[11] Samples shall pass through a 0.45 μm filter prior to analysis.
[12] April and October, coincident with general minerals analyses
[13] The Discharger must submit a report for approval by 1 March 2002 outlining EPA test methods and detection limits for priority pollutants listed in Title 40, Code of Federal Regulations, Part 131).
[14] Sampling to commence in April 2002

General Minerals Analyte List

Alkalinity (as $CaCO_3$), unfiltered		Phosphorus, total dissolved (P)
Boron	Hardness (as $CaCO_3$), calculated	Potassium
Bicarbonate (as $CaCO_3$), unfiltered	Iron	Sodium
Calcium	Magnesium	Sulfate
Carbonate (as $CaCO_3$), unfiltered	Manganese	

Sample Collection and Preservation: Any sample placed in an acid-preserved bottle must first be filtered through a 0.45 μm nominal pore size filter. If field filtering is not feasible, samples shall be collected in unpreserved containers and submitted to the laboratory within 24-hours with a request (on the chain-of-custody form) to filter immediately then preserve the sample.

DISPOSAL POND MONITORING

Disposal pond monitoring shall include at least the following:

Constituent/Parameter	Unit	Type of Sample	Sampling Frequency[1]
Dissolved Oxygen (DO)	mg/L	Grab[2]	As Required[3]
Temperature	°C	Grab	As Required[4]
Freeboard	feet[5]	Observation	
External Disposal Ponds			Daily
Internal Disposal Ponds			Weekly[6]

[1] If results of monitoring appear to violate Disposal Pond Specifications, but monitoring frequency is not sufficient to validate violation or indicate a violation and potential upset of the treatment process (e.g., less than minimum dissolved oxygen concentration), the frequency of sampling shall be increased to confirm the magnitude and duration of violation, if any, and aid in identification and resolution of the problem.
[2] Samples shall be collected at a depth of one foot from each pond in use, opposite the inlet, and analyzed for DO. Samples shall be collected between 0700 and 0900 hours.
[3] If offensive odor detected by or brought to the attention of WWTF personnel, monitor affected pond(s) daily until dissolved oxygen > 1.0 mg/L. If DO results for any pond in use indicate noncompliance with Disposal Pond Specification C.1, the Discharger shall implement corrective measures as specified in the O&M manual and monitor said pond daily until its DO stabilizes above 1.0 mg/L.
[4] Concurrent with DO monitoring

[5] For freeboard measurements greater than 2 feet, estimate to nearest half foot. For freeboard measurements less than 2 feet, estimate to nearest quarter foot.
[6] At least once every seventh calendar day on nonconsecutive days

Markers (e.g., staff gages) shall be placed in disposal ponds adjacent to public roads, private properties, and surface waters. The markers shall have calibrations indicating the water level at design capacity and available operational freeboard. The Discharger shall inspect all disposal ponds daily to determine compliance with Disposal Pond Specification D.4, which requires freeboard of all disposal ponds to never be less than two feet (measured vertically). In addition, the Discharger shall inspect the condition of the disposal ponds in use daily and write visual observations of developing potential problems in a bound logbook. Notations shall include observations of whether weeds are developing in the water or along the bank, and their location; whether dead algae, vegetation, scum, or debris are accumulating on the disposal pond surface and their location; whether burrowing animals or insects are present; and the general color of effluent in the disposal pond. A summary of entries made in the log during each month shall be submitted along with the monitoring report the following month. The Discharger shall certify in each November monitoring report that it is in compliance with Disposal Pond Specification C.5.

RECLAMATION OPERATION MONITORING

The type of crop(s) irrigated, amounts of water and/or reclaimed water applied to the crops(s) (in acre-feet) and amounts of sludge and chemical fertilizers (in pounds of nitrogen per acre) shall be measured and reported to the Board quarterly in accordance with the following schedule:

Monitoring Period	Reports Due
January – March	1 May
April – June	1 August
July – September	1 November
October – December	1 February

The Discharger shall utilize the form presented in Attachment G (or variation thereof subject to Board staff approval) for reporting the reclamation area monitoring data.

STILLAGE DISCHARGE MONITORING

The areas of land utilized for stillage disposal shall be reported monthly. Additionally, a sampling station shall be established where a representative sample of the stillage can be obtained. Stillage discharge monitoring shall include at least the following:

Constituent	Units	Type of Sample	Frequency
Flow	mgd	Measured	Daily
pH	pH units	Grab	Weekly
BOD_5, total	mg/L	Grab	Weekly
BOD_5, soluble	mg/L	Grab	Weekly

Constituent	Units	Type of Sample	Frequency
COD, total	mg/L	Grab	Weekly
COD, soluble	mg/L	Grab	Weekly
Total Suspended Solids	mg/L	Grab	Weekly
Volatile Suspended Solids	mg/L	Grab	Weekly
Total Kjeldahl Nitrogen (TKN)	mg/L	Grab	Weekly
Nitrate Nitrogen (as NO_3-N)	mg/L	Grab	Monthly[1]
Total Nitrogen	mg/L	Calculated	Monthly[1]
Total Phosphorus (P)	mg/L	Grab	Monthly[1]
Total Organic Carbon (TOC)	mg/L	Grab	Monthly[1]
Carbon/Nitrogen/Phosphorus ratio	---	Calculated	Monthly[1]
EC	µmhos/cm	Grab	Monthly[1]
TDS	mg/L	Grab	April, October

[1] Coincident with time of weekly sample

STILLAGE SITE APPLICATION MONITORING

Constituent	Units	Type of Sample	Frequency
Precipitation[1]	inches	Rain gauge	Daily
Flow	mgd	Measured	Daily
Area	acres	Measured	Daily
Drying Time[2]	days	Calculated	Per Application
BOD_5, maximum[3]	lbs/acre/day	Calculated	Monthly
BOD_5, average[4]	lbs/acre/ day	Calculated	Weekly
Total Kjeldahl Nitrogen (TKN)[5]	lbs/acre/day	Calculated	Monthly

[1] On-site rain gauge, National Weather Service, or California Irrigation Management Information System
[2] Report per active application area
[3] Maximum daily BOD_5 loading rate shall be calculated using the total volume of stillage applied on the day of application, estimated daily application area, and a running average of the three most recent results of BOD_5, which shall also be reported along with supporting calculations.
[4] Average BOD_5 loading rate shall be calculated using the total volume of stillage applied on the day of application, the total application period (i.e., day of application and drying time), estimated application area on day of application, and a running average of the three most recent results of BOD_5, which shall also be reported along with supporting calculations.
[5] Loading rate for nitrogen shall be calculated using the daily applied load and the estimated daily application area.

STILLAGE SITE SOILS MONITORING

The Discharger shall inspect and document the condition of the Stillage Site at least once a week. Notations should be made in a bound log book and include observations on whether ponding waste, soil clogging, odors, insects, or other potential nuisance conditions are present. The notations shall also document any corrective actions taken. A summary of entries made in the log during each month shall be submitted along with the monitoring report the following month.

The Discharger shall establish representative soil surface and soil profile monitoring locations within and outside the Stillage Site. There shall be at least one monitoring location per 20 acres. The samples shall be collected and analyzed for at least the following constituents:

Constituent	Units	Sample[1]	Frequency
Soil pH	pH Units	Grab	Semiannually[2]
Total Alkalinity (as $CaCO_3$)	mg/kg	Grab	Semiannually[2]
Cation Exchange Capacity	meq/100 grams	Grab	Semiannually[2]
Total Phosphorus (P)	mg/kg	Grab	Semiannually[2]
Nitrate Nitrogen (as NO_3-N)	mg/kg	Grab	Semiannually[2]
Total Kjeldahl Nitrogen (TKN)	mg/kg	Grab	Semiannually[2]
Total Nitrogen	mg/kg	Calculated	Semiannually[2]

1 Samples shall be collected at 0.5, 1, 2, 3-foot depths.
2 April and October

STILLAGE SITE VADOSE ZONE MONITORING

The Discharger shall establish representative vadose monitoring locations in the Stillage Site in accordance with the approved work plan required by Provision H.5. The samples shall be collected and analyzed for at least the following constituents:

Method	Constituent	Minimum Sample (mL)	Frequency
	pH	5	Twice/year[1]
	EC	10	Twice/year[1]
EPA 351.3 or 4500N-org	TKN	20	Twice/year[1]
EPA 300.0	Nitrate	20	Twice/year[1]
	Phosphorus		Twice/year[1]
	Sulfate		Twice/year[1]
	Chloride		Twice/year[1]
EPA 200.7	Calcium	5	Twice/year[1]
	Iron		Twice/year[1]
	Magnesium		Twice/year[1]
	Manganese		Twice/year[1]
	Potassium		Twice/year[1]

Method	Constituent	Minimum Sample (mL)	Frequency
	Total Alkalinity	20	Twice/year[1]
EPA 310.1			
EPA 415.1	TOC	150	Twice/year[1]

[1] In accordance with the vadose zone monitoring program described in the Discharger's approved work plan for monitoring its stillage disposal operation (Provision H.5).

GROUNDWATER MONITORING

Prior to collecting samples, the monitoring well shall be adequately purged to remove water that has been standing within the well screen and casing that may not be chemically representative of formation water. Depending on the hydraulic conductivity of the geologic setting, the volume removed during purging is typically from 3 to 5 volumes of the standing water within the well casing and screen, or additionally the filter pack pore volume.

At least quarterly and concurrently with groundwater quality sampling, the Discharger shall in each well measure groundwater level and report the data as groundwater depth (in feet and hundredths) and as groundwater surface elevation (in feet and hundredths above mean sea level). The horizontal geodetic location for each monitoring well shall be provided where the point of beginning shall be described by the California State Plane Coordinate System, 1983 datum.

Samples shall be collected from approved monitoring wells and analyzed for the following constituents at the following frequency:

Constituent	Units	Type of Sample	Frequency
Total Coliform Organisms	MPN/100 mL	Grab	Quarterly[1]
Total Organic Carbon (TOC)	mg/L	Grab	Quarterly[1]
Ammonia Nitrogen (as NH_3-N)	mg/L	Grab	Quarterly[1]
Nitrate Nitrogen (as NO_3-N)	mg/L	Grab	Quarterly[1]
Total Kjeldahl Nitrogen (TKN)	mg/L	Grab	Quarterly[1]
Total Organic Nitrogen (as N)	mg/L	Calculated	Quarterly[1]
EC	µmhos/cm	Grab	Quarterly[1]
Total dissolved solids (TDS)	mg/L	Grab	Quarterly[1]
General Minerals	mg/L	Grab	Quarterly[1]
Metals[2]	µg/L	Grab	Quarterly[1]
Dissolved Oxygen	mg/L	Grab	Quarterly[1]
Oxidation-Reduction Potential	mV	Grab	Quarterly[1]

[1] January, April, July and October
[2] Samples shall pass through a 0.45 µm filter prior to analysis.

In reporting the results of the first sampling event pursuant to this MRP, the Discharger shall include a detailed description of the procedures and techniques for: (a) sample collection, including purging techniques, sampling equipment, and decontamination of sampling equipment; (b) sample preservation and shipment; (c) analytical procedures; and (d) chain of custody control.

EXTRACTED GROUNDWATER MONITORING

Prior to collecting samples, the reclamation well shall be adequately purged to remove water that has been standing within the well screen and casing that may not be chemically representative of formation water. Depending on the hydraulic conductivity of the geologic setting, the volume removed during purging is typically from 3 to 5 volumes of the standing water within the well casing and screen, or additionally the filter pack pore volume. Samples shall be collected from the reclamation wells and analyzed for the following constituents at the following frequency:

Constituent / Parameter	Units	Type of Sample	Frequency
Flow	million gallons	metered	Monthly
	acre-feet	Calculated	Monthly
Total Coliform Organisms	MPN / 100 mL	Grab	Quarterly[1]
Total Dissolved Solids (TDS)	mg/L	Grab	Quarterly[1]
pH	pH Units	Grab	Quarterly[1]
EC	µmhos/cm	Grab	Quarterly[1]
Total Kjeldahl Nitrogen (TKN)	mg/L	Grab	Quarterly[1]
Ammonia Nitrogen (as NH_3-N)	mg/L	Grab	Quarterly[1]
Nitrate Nitrogen (as NO_3-N)	mg/L	Grab	Quarterly[1]
Total Nitrogen	mg/L	Calculated	Quarterly[1]
Total Phosphorus (P)	mg/L	Grab	Quarterly[1]
Chloride	mg/L	Grab	Quarterly[1]
General Minerals	mg/L	Grab	Semiannually[2]
Total Organic Carbon (TOC)	mg/L	Grab	Semiannually[2]
Metals[3]	µg/L	Grab	Semiannually[2]

[1] January, April, July and October
[2] April and October, coincident with general minerals
[3] Samples shall pass through a 0.45 µm filter prior to preservation.

PRETREATMENT MONITORING

The Discharger shall submit an annual report to the Board, with copies to the U.S. Environmental Protection Agency (EPA) Regional Administrator and the State Water Resources Control Board, describing the Discharger's pretreatment activities over the previous 12 months. In the event that the Discharger is not in compliance with any conditions or requirements of this Order, the Discharger shall include the reasons for the noncompliance and state how and when the Discharger shall comply with such conditions and requirements. This annual report shall be submitted by **28 February** and shall contain, but not be limited to item E.7 of *Standard Provisions and Reporting Requirements for Waste*

Discharge Requirements, dated 1 March 1991 (Standard Provisions).

Signed copies of the reports shall also be submitted to the EPA Regional Administrator and the State Board at the following addresses, or as advised in writing subsequent to adoption of this Order:

Regional Administrator
U.S. EPA, Region 9
Water Management Division (W-5-2)
75 Hawthorne Street
San Francisco, CA 94105

Pretreatment Program Manager
Division of Water Quality
State Water Resources Control Board
P.O. Box 944213
Sacramento, CA 94244-2130

BIOSOLIDS MONITORING

To monitor whether discharges to the WWTF are interfering with the treatment process or lessening biosolids quality, the Discharger shall collect monthly composite samples of sludge in accordance with EPA's *POTW Sludge Sampling And Analysis Guidance Document, August 1989*, *Test Methods for Evaluating Solid Waste, Physical Chemical Methods (SW-846)*. Monthly the Discharger shall submit a certification statement for biosolids classification, how the pathogen reduction and the vector reduction were met. Supporting documentation and analytical results must be submitted with the certification. The certification statement and report shall be submitted to the Executive Officer.

Biosolids monitoring shall include the following:

Constituent[1]	Sampling Frequency[2]	Constituent[1]	Sampling Frequency[2]
pH	Monthly	Molybdenum	Monthly
Total Solids	Monthly	Nickel	Monthly
Total Nitrogen	Monthly	Selenium	Monthly
Nitrate Nitrogen (as NO_3-N)	Monthly	Silver	Monthly
Ammonia Nitrogen (as NH_3-N)	Monthly	Zinc	Monthly
Total Phosphorus (P)	Monthly	Fecal Coliform[3]	Monthly
Potassium	Monthly	Vector Reduction[3]	Monthly
Arsenic	Monthly	Salmonella[4]	Quarterly[5]
Cadmium	Monthly	Enteric Viruses[4]	Quarterly[5]
Chromium	Monthly	Helminth Ova[4]	Quarterly[5]
Cobalt	Monthly	Semi-Volatile Organics	Quarterly[5]
Copper	Monthly	Pesticides	Quarterly[5]
Lead	Monthly	PCBs	Quarterly[5]
Mercury	Monthly		

Constituent[1]	Sampling Frequency[2]	Constituent[1]	Sampling Frequency[2]

[1] In metal analyses, ICAP may not be used for arsenic, mercury, and selenium.
[2] The Discharger shall sample for these parameters at the specified frequency if biosolids are to be land-applied.
[3] If biosolids are classified as Class B and land applied and do not meet 40 CFR 503 Alternatives for Processes to Significantly Reduce Pathogens (PSRP) or Processes to Further Reduce Pathogens (PFRP). Vector reduction as defined in 40 CFR 503.33(b)(1) through 503.33(b)(8).
[4] If biosolids are classified as Class A.
[5] January, April, July, and October

WATER SUPPLY MONITORING

Discharger shall utilize its computerized database of the production from municipal wells supplying the cities of Fresno and Clovis. The chemical analysis shall be the most recent analysis in accordance with Title 22 requirements. The flow weighted average concentration shall be calculated and reported for each mineral listed in the following table. The electronic form of the data shall accompany the written calculations.

Constituent[1]	Units	Reporting Frequency[2]
Total Dissolved Solids	mg/L	Quarterly[3]
EC	µmhos/cm	Quarterly[3]

[1] Constituents shall be reported as a flow-weighted average of all wells during the quarter.
[2] Moving average shall include the most recent analysis for each well.
[3] January, April, July, October.

REPORTING

Monthly monitoring reports containing samples collected at frequencies of monthly or greater shall be submitted to the Board by the **1st day of the second month** following sampling. Quarterly reports shall be submitted to the Board by the **1st day of the second month** following the calendar quarter.
In reporting the monitoring data, the Discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in a manner that illustrates clearly whether the Discharger complies with waste discharge requirements, including calculation of all averages, etc. If any pollutant is monitored at the locations designated herein more frequently than is required by this Order, the results of such monitoring shall be included in the calculation and reporting of the values required in the discharge monitoring report form. Such increased frequency shall be indicated on the discharge monitoring report form. Monthly and quarterly monitoring reports shall discuss the compliance record for the reporting period. If violations have occurred, the report shall also discuss the corrective actions taken and planned to bring the discharge into full compliance with this Order.

The Discharger may also be requested to submit an annual report to the Board with tabular and graphical summaries of the monitoring data obtained during the previous year. Any such request shall be made in writing. The report shall discuss the corrective actions taken and planned to bring the discharge into full compliance with the waste discharge requirements.

By **1 February of each year**, the Discharger shall submit a written Annual Report to the Executive Officer containing the following:

1. The names, certificate grade and general responsibilities of persons operating and maintaining the wastewater treatment plant (Standard Provision E.1).

2. The names and telephone numbers of (a) persons to contact regarding plant emergency and routine situations and (b) persons designated as Recycled Water Supervisors.

3. A statement certifying when the flow meter and other monitoring instruments and devices were last calibrated, including identification of who performed the calibration (Standard Provision C.4).

4. A statement identifying whether the current operation and maintenance manual, and contingency plan, reflect the wastewater treatment plant as currently constructed and operated, and the dates when these documents were last reviewed for adequacy.

5. The results of an evaluation conducted pursuant to Standard Provision E.4 and a figure depicting monthly average discharge flow for the past five years.

6. A statement describing whether the disposal ponds have adequate capacity for a 100-year rainfall at a design flow of 80 mgd. The statement shall include a summary of disposal pond monitoring of percolation rates for the previous year. The summary shall describe the method(s) used to determine percolation rates and shall include for each disposal pond.

   a. Period during which percolation rate was determined (i.e., initial and final dates)

   b. Measured percolation rate and calculated percolation rate (adjusted for evaporation losses) in inches/day

7. The most recent Annual Water Supply Report for the City of Fresno.

8. A summary of onsite reclamation operations for the previous water year (i.e., from October through September). The summary shall discuss total monthly water application; total wastewater recycled annually; total nutrient loading annually from applied wastewater, biosolids, and chemical fertilizers; and total estimated amount of nutrients removed through crop harvest. In short, the summary shall present a mass balance relative to constituents of concern and hydraulic loading along with supporting data and calculations. The summary shall also include a tabulation and interpretation of analytical results of reclamation soil monitoring.

9. A summary of Stillage Site nitrogen control measures for the previous water year (i.e., from October through September). The summary shall discuss total monthly stillage application; total wastewater recycled annually (if applicable); total nutrient loading annually from applied stillage and wastewater (if applicable), and total estimated amount of nutrients removed through crop harvest. In short, the summary shall present a mass balance relative to constituents of concern and hydraulic and waste constituent loading along with supporting data and calculations. The summary shall include a tabulation and interpretation of analytical results of Stillage Site soil monitoring for the previous calendar year. The summary shall also present tabulated Stillage Site monitoring data for the previous calendar year on 3.5" computer diskettes (or submitted separately via e-mail), either in MS-DOS / ASCII format or in another file format acceptable to the Executive Officer (e.g., Microsoft Excel).

10. A summary of groundwater monitoring data for the previous calendar year. The summary shall include

    a. Hydrographs showing the groundwater elevation in each approved monitoring well for at least the previous five years. The hydrographs should show groundwater elevation with respect to the elevations of the top and bottom of the screened interval and be presented at a scale of values appropriate to show trends or variations in groundwater elevation.

    b. Graphs of the laboratory analytical data for all samples taken from each approved well (monitoring and reclamation) within at least the previous five calendar years (as data become available). Each such graph shall plot the concentration of one or more waste constituents over time for a given monitoring well, at a scale appropriate to show trends or variations in water quality. The graphs shall plot each datum, rather than plotting mean values. For any given evaluated constituent, the scale for the background plots shall be the same as that used to plot downgradient data. Separate graphs shall show hydrologic equipotential gradients and equal concentration gradients for evaluated constituents.

    c. All monitoring analytical data obtained during the previous four quarterly reporting periods, presented in tabular form, as well as 3.5" computer diskettes (or submitted separately via e-mail), either in MS-DOS / ASCII format or in another file format acceptable to the Executive Officer (e.g., Microsoft Excel).

    d. A comprehensive discussion of the compliance record, and the result of any corrective actions taken or planned that may be needed to bring the Discharger into full compliance with the waste discharge requirements.

11. A summary of groundwater extraction operations for the previous calendar year. This summary shall address the past year's groundwater extraction activities and extracted groundwater quality and shall contain all monitoring analytical data obtained during the previous four quarterly reporting periods, presented in tabular form, as well as 3.5" computer diskettes (or submitted separately via e-mail), either in MS-DOS / ASCII format or in another file format acceptable to the Executive Officer (e.g., Microsoft Excel).

12. A summary of biosolids monitoring, including

a. Annual sludge production in dry tons and percent solids.

b. A schematic diagram showing sludge handling facilities and solids flow diagram.

c. A description of disposal methods, including the following information related to the disposal methods used at the WWTF. If more than one method is used, include the percentage of annual sludge production disposed of by each method

   i. For **landfill disposal**, include: (a) the Order numbers of WDRs that regulate the landfill(s) used, (b) the present classifications of the landfill(s) used, and (c) the names and locations of the facilities receiving sludge.

   ii. For **land application**, include: (a) the locations of the site(s), (b) the Order numbers of any WDRs that regulate the site(s), (c) the application rate in lbs/acre/year (specify wet or dry), and (d) subsequent uses of the land.

   iii. For **incineration**, include: (a) the names and location of the site(s) where sludge incineration occurs, (b) the Order numbers of WDRs that regulate the site(s), (c) the disposal method of ash, and (d) the names and locations of facilities receiving ash (if applicable).

   iv. For **composting**, include: (a) the location of the site(s), and (b) the Order numbers of any WDRs that regulate the site(s).

The Annual Report shall discuss the compliance record for the reporting period. If violations have occurred, the report shall also discuss the corrective actions taken and planned to bring the discharge into full compliance with this Order. Reports submitted concerning WWTF performance must also be signed and certified by the chief plant operator. When reports contain laboratory analyses performed by the Discharger and the chief plant operator is not in the direct line of supervision of the laboratory, reports must also be signed and certified by the chief of the laboratory.

The Discharger shall implement this monitoring program on the first day of the month following adoption of this Order. All reports submitted in response to this Order shall comply with the signatory requirements in Standard Provision B.3.

Ordered by:______________________________
GARY M. CARLTON, Executive Officer

19 October 2001
(Date)

BLH:jlk:fmc:10/19/01 AMENDED

INFORMATION SHEET

ORDER NO. 5-01-254
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

The Fresno-Clovis Metropolitan Regional Wastewater Reclamation Facility is a wastewater treatment facility (WWTF) that serves the cities of Fresno and Clovis; the Pinedale Water District and Pinedale Utilities District, both of which are within the city limits of Fresno; and some areas within Fresno County not within the city limits of Fresno or Clovis. The cities of Fresno and Clovis are referred to as Discharger. The City of Fresno is responsible for day-to-day WWTF operations, and is referred to as Operator. The WWTF, on property owned by the Operator, originated in 1891 as a 40-acre "sewage farm" for raw sewage disposal. Beginning in 1924, the Operator began extracting groundwater from deep on-site irrigation wells to draw down the shallow water table caused by groundwater mounding under the WWTF disposal ponds[1].

The WWTF currently encompasses 3,290 acres and includes two separate treatment plants; 1,660 acres of disposal ponds; about 600 acres of reclamation area; 290 acres of wet-weather effluent disposal area: and a 145-acre wine stillage disposal area that currently serves Canandaigua Wine Company, a New York corporation. The Operator recently expanded the WWTF property by 480 acres and proposes to convert some of the newly acquired area to disposal ponds and to use the remainder for year-round water reclamation.

The Operator submitted a Report of Waste Discharge in 1996, to support a proposed increase in WWTF discharge flow from 74 to 94 million gallons per day (mgd). Plant 1 is now an 88-mgd-capacity activated sludge treatment plant that includes headworks and primary and secondary clarifiers. Plant 2, which is currently in stand-by mode, is a 6-mgd-capacity trickling filter plant that includes primary and secondary clarifiers. The WWTF currently treats about 68 mgd, or 24,800 million gallons annually (76,000 acre-feet).

The Operator's January 2001 Title 22 Engineering Report (hereafter Title 22 Report) describes the WWTF as follows:

> Influent is pumped from the collection system into the Headworks for screening, flow measurement, and grit removal. The flow from the Headworks is then divided equally among six primary clarifiers. The effluent from the clarifiers converges at the Primary Effluent Splitting Structure. The primary solids are pumped directly into anaerobic digesters. Currently nine are in service, two are being rehabilitated, and one is used as a feed storage structure for the Dewatering facility.
>
> The primary effluent is divided into two trains. The "B" side receives sixty-four percent of the flow and consists of four plug flow type aeration basins in parallel. Each basin consists of five influent cells followed by a large tank. The aeration effluent enters eight rectangular sedimentation basins, also in parallel, whose effluent flows to a network of percolation ponds via a canal system.

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1 Loehr, R. C. et al. (1979). Land Application of Wastes. Volume I, Publisher, City.

"A" side receives thirty-six percent of the primary effluent and consists of four complete mix aeration basins. This aeration effluent enters five final clarifiers.

Solids from these secondary systems are thickened using a combination of five dissolved air floatation units and two gravity belt thickeners. The thickened secondary solids from each unit feed into a common header and the solids are distributed to the digesters.

The feed digester (Digester #1) receives digested biosolids from all digesters on line. This is pumped to the dewatering facility, which contains seven belt filter presses. The dewatered solids are stored in a silo and then shipped by truck to an application site.

The WWTF has an average power demand of 6.3 megawatts (MW). The WWTF is supplied by two sources of power. Feeder A (10 MW) is the primary source of power; Feeder B (5 MW) is a standby source of power. The Operator's Title 22 Report indicates that a new substation adjacent to the WWTF and owned by the City of Fresno will provide the WWTF's power supply by May 2001. A second 12 KW supply feeds directly into the WWTF's switchgear from a separate substation, thereby assuring reliable power. Further, the WWTF has three standby engine generators onsite with capacities of 25 KW (propane), 350 KW (diesel), and 1,600 KW (diesel). The overall onsite standby capacities allows the WWTF to continue to operate process components during a power outage, including the primary treatment units, plus one of the large aeration blowers. The Operator has implemented a computerized maintenance program to monitor equipment data, preventive maintenance, and repairs. Instrumentation, electrical, and mechanical equipment are on a preventive maintenance program that regularly schedules calibration and service of the equipment. Equipment repairs are scheduled on the computerized maintenance program, and the repair data is entered into the computer. The data from the preventive maintenance and repairs has established equipment history to help in the scheduling of repairs with a minimum of equipment downtime and improved equipment reliability.

The Operator reports that 56 significant industrial users discharge waste into the WWTF collection system, including 14 users from the metal finishing categories. Other industrial users discharging into the WWTF include soft drink bottlers, meat packers, food processors, dairy and poultry products processors, plastic manufacturers, wineries, and several linen and industrial laundries. The Discharger originally developed a pretreatment program in conformance with 40 CFR 403. The Board approved the program on 17 June 1984. The Operator has subsequently submitted a revised pretreatment program (dated 6 June 1996), also in conformance with 40 CFR 403, which updates its original submission to bring it in line with current practices. The Operator updated its pretreatment program in 2001, in part, to reflect its latest municipal code and enforcement response plan, incorporate WWTF upgrades, and describe modifications in sampling procedures. Board staff is reviewing the revised pretreatment program for completeness and adequacy. Once the program is deemed complete, staff will submit for Board consideration a proposed Order approving the revised pretreatment program.

Sludge from the WWTF is thickened by dissolved air flotation and gravity belts, anaerobically digested, and dewatered by seven belt filter presses, three of which went on line in July 1993. Prior to 1993, digested sludge was pumped to 62 acres of open earthen basins beds that are no longer in service and the Operator has since constructed additional treatment facilities on the majority of the 62 acre site. Plant Wells 1001 and 1002, which are in proximity to these former drying beds, have high concentrations of TDS and nitrates.

The Operator previously stockpiled 100,000 cubic yards of dried sludge at the WWTF. Over 75,000 cubic yards of the stockpiled sludge was classified as "hazardous" waste due to the lead and cadmium concentrations present in it. In July1997, the California State Department of Toxic Substances reclassified the sludge as nonhazardous. The stockpiled sludge was transported to the Fresno Sanitary Landfill in 1998 as part of the landfill's final closure project.

Effluent Disposal and Reclamation

At the current annual average discharge flow of 68 mgd, the WWTF's annual discharge flow is 24,820 million gallons (or about 76,000 af). Of this amount, about 4,000 af/yr of effluent is recycled directly, an amount that represents about only five percent of the WWTF's current annual discharge flow. On-site effluent recycling effluent currently occurs on 528 acres within the WWTF property, an amount that will reportedly increase to 766 acres (hereafter reclamation area). Area farmers recycle effluent on site under lease agreements with the Operator, as summarized below:

Field No.	Lessee		Acreage	Types of Crops		AF used in 1999
1	Quist Dairy		121	Alfalfa, Silage, Cotton, Wheat		175
6B	Dan Sousa		160	Wine Grapes, Silage, Alfalfa		462
7B	Quist Dairy		117	Cotton, Alfalfa, Silage, Wheat		51
7C	Quist Dairy		130	Cotton, Silage, Wheat		12
8*	Quist Dairy		238	Cotton, Silage, Alfalfa, Wheat		0
		Total	766		Total	700

*Field 8 currently does not have access to recycled water; however, the Operator anticipates that necessary improvements will be made to convey recycled water to the field by 2002.

Off-site effluent recycling currently occurs on 2,770 acres surrounding the WWTF property by growers under separate water reclamation requirements (WRRs), as summarized below:

Field No.	WRRs Order No.	Reclaimer	Acreage	Types of Crops		AF used in 1999
2	94-370	Al Coelho Jr.	560	Cotton, Wine Grapes, Alfalfa		502
3	94-369	Golden State Vintners	1,560	Wine Grapes		1,528
6A	94-372	Joe Souza	320	Alfalfa, Silage, Wheat		580
6C	94-367	Myrna Craviero (Dan Souza)	130	Alfalfa, Silage, Wheat		299
7A	94-371	Quist Dairy (Alvin J. Quist)	200	Cotton, Alfalfa, Silage, Wheat		135
		Total	2,770		Total	3,044

As indicated above, about 3,700 af of effluent was directly recycled in 1999, an amount equivalent to less than five percent of current WWTF's annual discharge flow. Of the 72,000 af/yr discharged to the disposal ponds, about 63,400 af/yr (88 percent) percolates to groundwater and 8,600 af/yr (12 percent) is lost through evaporation (i.e., 62 in/yr evaporation from 1,660 acres of disposal ponds). Over the years, the Operator's reliance on effluent disposal by percolation has created an extensive groundwater mound (approximately 10-feet high) that persists year-round, ranges in depth from 25 to 61 feet below ground surface (bgs), and extends well beyond the perimeter of the WWTF property. The mounded effluent appears to affect groundwater contours throughout the surrounding township.

The Operator owns and operates a network of 21 groundwater extraction wells on the WWTF property (hereafter reclamation wells). The reclamation wells extract from 150 to 200 feet below ground surface (bgs), operate about 10 months of the year, and discharge about 10 to 40 mgd (or about 15,300 af/yr) to the Houghton Canal and the Dry Creek Canal under an agreement with FID. Order No. 96-054 did not establish numerical or narrative effluent limits for the discharge from the groundwater extraction wells, require any monitoring of the flow or quality of the extracted groundwater, or impose any restrictions on the use of extracted groundwater.

The 1974 agreement between the Operator and FID currently stipulates, in part, that (a) the Operator must discharge into FID canals a minimum of 100,000 af of extracted groundwater during any ten year period; (b) the Operator may discharge a maximum of 30,000 af/yr of extracted groundwater to FID canals; (c) for every acre-foot of extracted groundwater the Operator discharges to FID canals, FID may deliver to the Operator 0.45 af of surface water up to a maximum of 7,600 af/yr. The Operator uses this surface water throughout the City of Fresno for aquifer recharge (i.e., by discharging to groundwater recharge basins situated within the metropolitan area). Most of the surface water delivered to Fresno's groundwater recharge basins is from the Friant Division of the Central Valley Project (CVP), operated by the U.S. Bureau of Reclamation (Bureau). The Operator and FID have signed contracts to purchase up to 135,000 af/yr of CVP surface water from the Bureau.

The Operator normally delivers between 15,000 and 20,000 af/yr to FID canals, an amount that is equivalent to 19 to 25 percent of the current annual discharge flow. Any increase in the discharge of extracted groundwater beyond that stipulated in the 1974 agreement is subject to FID approval.

The Discharger submitted a technical report, *Fresno-Clovis Regional Wastewater Reclamation Facilities Master Plan Summary Report* (Master Plan), dated November 1996, pursuant, in part, to C&D Order No. 96-055. The Master Plan describes a planning structure to maximize effluent reuse through land-based alternatives, primarily effluent reuse for agriculture. It documents options for off-site effluent reuse/disposal to meet the Discharger's disposal needs through 2020. The Master Plan presents financial impact analyses and multi-year implementation schedules for each option. These options include
(a) adding about 270 acres of on-site disposal ponds; (b) increasing the amount of groundwater extracted and discharged to FID's canals to 28,000 to 33,000 af/yr, which is about equal to the capacity of the existing on-site extraction wells; and (c) reclaiming effluent on lands outside of FID's service area through the development of a partnership among the Operator, FID, Raisin City Water District, Mid-Valley Water District, James Irrigation District, and Tranquillity Irrigation District. According to the Master Plan, negotiations for the reuse project will take up to 18 months to finalize and construction of the reuse project's infrastructure (e.g., pipelines) will take up to 36 months to complete. The Master Plan further indicates that FID may seek mitigation for delivery of effluent outside of the FID service area. The Discharger has increased its on-site disposal pond acreage, but has yet to implement the Master Plan's effluent reuse options.

Calpine Corporation (hereafter Calpine) is planning to construct a new gas-fired turbine in Fresno County (Central Valley Energy Center, hereafter referred to as CVEC). Calpine proposes to pump approximately 7,000 af/yr from the Operator's reclamation wells to provide cooling tower and industrial process water for the CVEC. Once extracted, the recycled water will be dosed with sodium hypochlorite prior to introduction into a 20.5 mile, 30-inch diameter pipeline, which will terminate into two 1.5 million gallon storage tanks at the CVEC site.

The California Department of Health Services (DHS) commented on the tentative WDRs circulated for public comment on 10 April 2001. Among the concerns expressed by DHS was that the Discharger has discharged and will continue to discharge a significant amount of wastewater to groundwater with minimal treatment and inadequate monitoring.

On 23 April 2001, DHS released for public review the first draft of regulations governing projects designed to use recycled water for the purpose of recharging by infiltration or injection of recycled water in a groundwater basin designated in a Water Quality Control Plan, as defined in CWC section 13050(j), for use as a source of domestic water supply. The draft regulations do not specify the hydraulic loading rate that constitutes groundwater recharge. The draft regulations proposed higher levels of treatment (e.g., nutrient removal, filtration) than is typically provided for domestic wastewater disposed of through percolation. The draft regulations also propose to control total nitrogen, regulated contaminants (i.e., those for which Title 22 establishes maximum contaminant levels) and physical characteristics and control of nonregulated contaminants such as total organic carbon (TOC). The draft regulations propose that recycled water rechargers monitor mounded groundwater for TOC, total nitrogen, and pharmaceuticals (e.g., endocrine disrupting chemicals).

In its 10 April 2001 letter, DHS recommends that the Discharger expedite efforts to expand its recycling efforts and curtail discharge to groundwater. In its regulation of this ongoing discharge, DHS recommends that the Board require the Discharger to (a) assess the current status of all private and domestic wells that exist within the 25-square-mile area described in Finding No. 9; (b) monitor domestic supply wells within this area for contaminants to assure they are producing safe water for domestic use and are not adversely impacted by the wastewater the Discharger has discharged to area groundwater; and (c) conduct a comprehensive study to assess the fate and effects of the past and current discharge on the groundwater basin. DHS further recommends that the Board require the Discharger to (a) identify the types of crops grown in the area served by FID canals that receive groundwater extracted by the Operator's reclamation wells and (b) provide information on the dilution of the extracted groundwater with fresh water prior to irrigation application. If the crop identification reveals that food crops are grown in the subject area, DHS recommends that the Board require the Discharger to
undertake a timely evaluation of the degree of soil treatment provided by the current recharge and extraction operation and a determination of the level of filtration and virus removal treatment provided. DHS also recommends the Board require the Discharger to provide continuous turbidity monitoring of representative reclamation wells for at least one year.

Stillage Guidelines

Stillage is the waste material produced by the distillation of wine, pomace, or raisins for fortifying spirits and is the least readily disposal of all winery wastes. In the mid-1940s, the Wine Institute funded a study by Coast Laboratories on wine stillage composition. The study's 1946 report, *The Disposal of Winery Waste*, characterized conventional stillage as follows: (a) total solids content average 1.6 percent, about one-third of which is suspended solids, largely yeast; (b) pH range from 3.4 to 4.2; and (c) BOD_5 content average 12,500 mg/L.

In 1979, the Wine Institute funded Metcalf & Eddy engineers to survey existing practices of 16 seasonally discharging stillage disposal operations. The study's 1980 report, *Land Application of Stillage Waste: Odor Control and Environmental Effects* (hereafter the Wine Institute Study), summarized the results of this study and recommended guidelines for stillage disposal operations to minimize water quality effects and nuisance conditions.

Board Resolution No. 83-105 amended the Basin Plan to prescribe guidelines for the land disposal of stillage wastes from wineries. The guidelines reflect the recommendations of the Wine Institute Study and prescribe minimum operational procedures for two types of stillage disposal (i.e., rapid infiltration and slow infiltration). The maximum application rates and minimum drying times prescribed by the Stillage Guidelines for rapid infiltration are outlined in the following table:

Period of Year	Depth of Stillage Application (inches)	Drying Time (days)	Minimum Land Requirement (acres per 100,000 gpd of stillage waste)
1 Aug to 30 Sep	3.7	6	7
1 Oct to 30 Nov	3	9	12.3
1 Dec to 1 May	2.5	13	20.6

The values below represent the organic load to land allowed by the Stillage Guidelines for rapid disposal systems. The values assume an average stillage BOD_5 concentration of 12,500 mg/L and reflect two different application time periods. The first is the organic load on the actual day of application, while the second is the organic load averaged over the entire application cycle (i.e., including drying days).

		BOD_5 Loading	
Period of Year	Application gallons/acre	On day of application lbs/acre/day	Averaged over entire application cycle lbs/acre/day
1 Aug – 30 Sep	100,000	10,500	1,500
1 Oct – 30 Nov	81,000	8,500	850
1 Dec – 1 May	68,000	7,000	500

Excessive application of stillage waste to land can overload the shallow soil profile, cause anaerobic soil conditions, retard the degradation, stabilization, transformation, and immobilization of waste constituents, and create objectionable odors that lead to public nuisance. Degradation of organic matter within the soil profile increases the concentration of alkalinity in soil pore water. Anaerobic soil conditions can lead to the dissolution of soil minerals such as calcium and magnesium. Hydraulic overloading flushes waste constituents, the by-products of organic degradation, and dissolved minerals into the soil profile where they will continue to leach into and unreasonably degrade groundwater.

In applying food-processing wastewater to land for biological treatment, loadings of total suspended solids (TSS) typically range from 70 to 200 lbs/acre/day and loadings of BOD_5 should not exceed 100 lbs/acre/day to prevent the creation of nuisances, according to EPA's *Pollution Abatement in the Fruit and Vegetable Industry* (Publication No. 625/3-77-0007) (hereafter *Pollution Abatement*). In well-operated land treatment systems, wastewater application is typically followed by several days of rest, according to *Pollution Abatement*. This management practice maintains aerobic conditions in the soil profile. Slow-rate systems with BOD_5 loading rates that occasionally exceed 300 lbs/acre/day have successfully avoided odor problems by using adequate drying times between applications, according to *Natural Systems for Waste Management and Treatment*, by Sherwood C. Reed and others.

Organic loadings recommended by the Wine Institute Study and allowed by the Stillage Guidelines, while exceeding the loading rates recommended by *Pollution Abatement,* reflect longstanding disposal practices by stillage disposal operations that discharged on a seasonal basis (e.g., from August to November). The Wine Institute Study rationalized its recommended organic loadings by assuming that 80 percent of stillage BOD_5 is contained in suspended solids trapped on the surface leaving 20 percent in soluble compounds to infiltrate the soil profile. The resultant organic loading to the soil profile (as soluble BOD_5) calculated at 120 lb/acre/day over the course of the entire application cycle.

The Wine Institute Study also cites work by Jewell and Loehr[2, 3] to support organic loads in excess of that recommended by *Pollution Abatement*, especially for acclimated soils (i.e., those that had been receiving waste for a number of years). Jewell and Loehr monitored the oxygen uptake of bacteria in soils collected from a land application site that had received vegetable processing wastewater. The experiment utilized a Warburg respirator apparatus, which is typically used to determine the oxygen uptake of microbial cells in liquid samples (e.g., 20 to 40 ml). In extrapolating the results of laboratory oxygen uptake experiments to field conditions, Jewell and Loehr concluded that food-processing waste disposal sites with acclimated soils could consume oxygen at rates exceeding 600 lbs/acre/day. Additionally, Jewell and Loehr concluded that acclimated soils could accommodate organic loads (as chemical oxygen demand) of up to 16,000 lbs/acre/day without suffering prolonged oxygen depletion and nuisance from organic overloading. Key to the rapid degradation of organic wastes applied to land is adequate drying time. While Jewell and Loehr may have identified the oxygen transfer rate in small samples of acclimated soil, their application of these rates to field conditions was premature given the lack of field validation. Further, it appeared that Jewell and Loehr were unconcerned about what leached to groundwater since the waste application sites they examined demonstrated clear and unambiguous

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2 Jewell, W. J. and R.C. Loehr (1975) Land Treatment of Food Processing Waste. Presented at the American Society of Agricultural Engineering. Winter Meeting. Chicago. Paper No. 75-2513.

3 Jewell, W. J. et al. (1978) Limitations of Land Treatment of Wastes in the Vegetable Processing Industries. Cornell University.

evidence that groundwater had been degraded, not only for total dissolved solids but also for organics (as COD).

Stillage is very high in organic nitrogen content compared to other food-processing wastes. Organic nitrogen (as total Kjeldahl nitrogen, or TKN) is primarily retained in the upper two to three feet of the soil profile. Soil bacteria transform organic into inorganic nitrogen (i.e., ammonia, nitrites and nitrates). Nitrate and nitrite are highly soluble, not bound to the soil, and are readily leached through the vadose zone and into groundwater subsequent to the application of water to the soil.

The Wine Institute Study describes stillage disposal sites as having soil TKN concentrations in excess of 2,500 mg/kg, with concentrations decreasing substantially at depths below two feet and reducing further to background levels at depths of six feet. Groundwater data collected during the Wine Institute Study was minimal and inconclusive regarding nitrogen contamination from stillage disposal operations.

The Stillage Guidelines recommend that stillage application sites be planted with crops, *if necessary,* to assist in the removal of residual nitrogen concentrations from the soil during periods when it is not used for stillage disposal. At the time of the Wine Institute Study, stillage disposal operations were seasonal, whereas now wineries such as Canandaigua operate and discharge year-round. The Stillage Guidelines further recognize the need to impose more stringent disposal requirements as necessary to comply with water quality objectives. "If necessary" was intended to be predicated on monitoring the buildup of nitrogen in the soil, but has been largely ignored by the industry.

Stillage Site

The Operator owns and operates a 145-acre wine Stillage Site, which consists of a 95-acre portion (SS-1) in operation since 1974 and a 50-acre portion (SS-2) in service since 1998. SS-1 was regulated by Order No. 74-10 until 1996, when regulation of the stillage disposal operation was included in the WWTF's waste discharge requirements (Order No. 96-054). Currently, the Stillage Site receives stillage waste year round from only one winery, Canandaigua Wine Company, a New York corporation (hereafter Canandaigua).

Recent monitoring data (1996 through 1998) indicates that during the crush season (from August to November), the Operator discharges an average 0.21 mgd of stillage to the 145-acre disposal site (1.0 mgd daily maximum). During the rest of the year, the Operator discharges an average of 0.12 mgd (0.71 mgd daily maximum). The waste is discharged to land without any prior treatment. The Discharger reports that the stillage pipeline is in need of extensive maintenance repairs. The lease agreement between the Discharger and Canandaigua for its discharge of stillage to the Stillage Site expires in 2004. By fall 2003, Canandaigua plans to relocate its stillage operation to its Paul Masson winery in Madera County and cease discharge of stillage to the Stillage Site. The WWTF does not have the treatment capacity to accommodate Canandaigua's stillage discharge.

In 2000, the Stillage Site received about 79 million gallons of stillage. Peak daily flows occurred in mid-June and ranged from 1.1 to 1.27 mgd. The table below compares year 2000 total monthly stillage discharge flows to those recommended by the Stillage Guidelines and currently permitted for the original 95-acre SS-1:

Month	Amount Discharged (mg)	Maximum Amount Allowed (mg)[1]
Jan	6.732	14.26
Feb	6.504	12.88
Mar	5.874	14.26
Apr	3.668	13.8
May	6.14	42.16
Jun	16.91	40.8
Jul	1.113	42.16
Aug	6.771	42.16
Sep	9.857	40.8
Oct	7.665	23.87
Nov	7.534	23.1
Dec	0.64	23.87
Total	79.4	335

[1] Value assumes the discharge complies with all other relevant stillage discharge specifications (e.g., no standing stillage after 24 hours of application)

As indicated above, the Operator's stillage discharge in 2000, in terms of monthly discharge flow, is less than 25 percent of that permitted by the Stillage Guidelines for the original 95-acre SS-1 (assuming the discharge complied with all remaining discharge specifications). In 1998, the Operator reduced the waste loading to the original SS-1 by placing into service the new 50-acre stillage disposal area (SS-2).

The following table compares the water quality from MW-2 that is in the middle of SS-1 and MW-5 (5,400 feet from MW-2) that is in the vicinity of the WWTF disposal ponds. The data show that the Operator's long-term stillage disposal operation has degraded area groundwater as evidenced by elevated concentrations of TDS, alkalinity, calcium, magnesium, and manganese.

Constituent	Units	MW-2	MW-5
Total Dissolved Solids	mg/L	1,700	450
Total Alkalinity (as $CaCO_3$)	mg/L	1,600	260
Calcium	mg/L	300	46
Magnesium	mg/L	200	24
Manganese	mg/L	10	0.1

In February and March 1999, the Operator performed laboratory tests to determine the soluble and insoluble fractions of stillage BOD_5. Specifically, the Operator split six samples of stillage and analyzed one sample for total suspended solids and total BOD_5, centrifuged the other sample at 2000 revolutions per minute for 15 minutes, and analyzed the resulting liquid for suspended solids and BOD_5. The results indicate that almost 90 percent of stillage BOD_5 is in soluble form. These results imply that the actual organic loading from the land application of stillage may be appreciably higher than previously thought.

As described previously, the Wine Institute Study assumed that most BOD_5 would be retained in surface organic solids and that biological degradation processes would mineralize the majority of the nitrogen, which would be then be biologically converted to nitrogen gas. In reality, most BOD_5 in stillage applied to the Stillage Site is soluble and only a small fraction is in the retained organic solids. In July 1992, the Operator tested Stillage Site soils for TKN analysis. The samples were taken at the surface, one foot, and two feet below the surface at six sites. When groundwater monitoring well 2 (MW-2) was drilled in SS-1, the Operator collected soil samples at 5, 10, 15, 20, 25, 30, 35, 40, and 45 feet bgs, and analyzed them for TKN. The Operator found that the majority of TKN occurs within the upper two feet of SS-1 soils, as indicated below:

Depth, ft	0.5	1	2	5	10	15	20	25	30	35	40	45
TKN, mg/kg	5,225	2,468	460	114	213	161	101	89	88	55	72	65

The average TKN from 5 to 45 feet is 106 mg/kg. There was no measurable nitrate or nitrite in the soil samples. These findings correspond with the data in the 1980 Wine Institute Study. In the 1992 study, the average TKN concentration was 2,700 mg/kg in the upper two feet of soil in SS-1. Assuming a minimum soil weight of 90 lbs/ft^3, there are 21,300 lbs-TKN/acre in the upper two feet in SS-1. The Discharger applied 104,000 lbs TKN to the site in 1998 and 245,000 lbs TKN in 1999. In 1992, based upon the 1998 and 1999 rates of application, there were 9 to 20 years of nitrogen accumulation in the top two feet of soil. Since stillage has been discharged to the site since 1974, the data indicates minimal biodegradation of the applied TKN.

In Finding No. 13 of Order No. 96-054, the Board found that no crops had been grown in the disposal area to aid in nitrogen control. Provision G.7 of Order No. 96-054 required the Operator to "submit a written technical report and schedule on measures to be implemented to provide for nutrient uptake in the stillage disposal area or justify why it should not be necessary." In its report, *Schedule of Measures to be Implemented to Provide for Nutrient Uptake in the Stillage Disposal Area* (April 1998), the Discharger investigated the use of Sudan grass for nitrogen uptake from Stillage Site soils. While this report recommended that the Operator plant and harvest crops to reduce the large accumulation of nitrogen in Stillage Site soil, the Operator has not yet initiated systematic cropping and harvesting. The SS-2 area was added in 1998 but has not been planted crops to remove nitrogen. In the report, *Technical Memorandum No. 1, Update of Groundwater Quality Conditions* (April 1999), groundwater monitoring from MW-2 showed high concentrations of EC and TDS.

Groundwater Monitoring and Evaluation

Area soils are coarse, well sorted sands with good permeability (i.e., from 0.7 to 1.0 in/hr). Groundwater underlying the WWTF occurs in an unconfined aquifer at depths ranging from 31 to 60 below ground surface (bgs). Regional groundwater generally moves southwesterly, according to FID groundwater elevation contour maps.

The Operator has one background monitoring well upgradient of the WWTF site, but no downgradient wells off-site. Several of the on-site monitoring wells are adjacent to localized areas of groundwater degradation (hereafter hot spots) such as existing or historic confined animal facilities with plumes that mask the impacts of the discharge on area groundwater. Consequently, the impacts of the discharge upon the chemical characteristics of the regional aquifer are not well defined.

Since 1990, the Operator has been investigating potential impacts on groundwater quality associated with current and past discharges from the WWTF as well as discharges to the 145-acre Stillage Site. It has documented these investigations in the following reports:

- *Wastewater Treatment Facility, Phase I Investigation, Groundwater Impacts from Effluent Disposal*, June 1991;

- *Wastewater Treatment Facility, Phase II Investigation, Groundwater Impacts from Effluent Disposal*, February 1993;

- *Master Plan Report, Task 700, Technical Memorandum No. 3, Evaluation of Reclamation Operations and Recommended Groundwater Monitoring Program*, August 1996;

- *Update of Groundwater Quality Conditions, Vicinity of Fresno/Clovis Regional Wastewater Reclamation Facility*, July 1998; and

- *Technical Memorandum No. 1, Update of Groundwater Quality Condition*, April 1999.

The reports contain the following findings. The groundwater mound created by percolating WWTF effluent persists year-round and is less than 20 feet below the bottom of the percolation/disposal ponds. The Operator's extraction wells pull from the deep zone aquifer (approximately 200 feet) rather than the shallow zone that is associated with the percolation/disposal ponds (approximately 50 feet). This is reportedly due to low yields associated with pumping from the shallow zone. Groundwater extracted and discharged to FID canals recovers less than 36 percent of the percolated water. Percolated effluent has contributed to increases in constituents such as EC, TDS, sodium, chloride, manganese, and phosphorus and decreases in nitrate concentrations. Impaired groundwater quality is associated with localized on-site plant operations such as the Stillage Site and former dairy sites. Groundwater beneath the former sludge disposal area in the northeastern portion of the WWTF is characterized by high nitrate and EC concentrations. The off-site extent and impact of recharged effluent downgradient of the WWTF is unknown, although the resultant groundwater quality beyond the WWTF boundary is believed to be adequate for agricultural use.

The reports made the following recommendations. Groundwater extraction needs to be increased to provide increased groundwater/pond bottom separation and to control off-site migration of treated effluent and groundwater affected by on-site chemical sources. The groundwater monitoring network and program should be revised to provide for depth-specific monitoring on-site and off-site and to evaluate future wastewater management actions on water quality beneath and downgradient of the plant.

Chloride, a conservative ion, is known to pass through soil untransformed and relatively uninhibited by the sorption process and thereby is a reliable marker ion for comparing two liquid streams. Staff compiled data from self-monitoring reports for effluent chloride concentrations for the period of January 1997 through June 2000. The Discharger presented staff with mineral analyses collected from extraction wells for the period of January 1989 through June 1999. Staff calculated the mean, variance, and number of samples for each set of data. Staff used the standard normal deviate, z, to compare the mean chloride concentration in the effluent with the mean chloride concentration for the extraction wells. Based upon a calculated z = 1.42, staff concluded that the mean concentration of 74.5 (n=38) mg/L from the reclamation wells was not statistically significantly different from the mean concentration of 77.8 mg/L (n=210) in the effluent.

$$z = \frac{\overline{X_A} - \overline{X_B}}{\sqrt{\frac{s_A^2}{n_A} + \frac{s_B^2}{n_B}}}$$

The Discharger has designated monitoring well 10A as the shallow zone and monitoring well 10B as the deep zone background water quality. The mean chloride concentration (16.1 mg/L) in the shallow zone was significantly greater (5.19 mg/L) than in the deep zone (z=21.6). The chloride concentration in the effluent and the composite chloride concentration in the extraction wells were significantly greater than in both MW-10A (z=27.6) and MW-10B (z=25.3).

Nitrate was measured in the effluent of reclamation well RW-15 from May 1993 through September 1996. A plot of the data showed an exponential decrease in the nitrate from 9.2 mg/L in May 1993 to a baseline value of 0.6 mg/L in May 1996. An analysis of RW-12 data presented similar results. Reclamation wells located in proximity to identified hot spots have significantly higher nitrogen concentrations than those with lower nitrogen application rates.

At the proposed discharge flow of 80 mgd (89,600 af/yr) and continued direct reuse of 4,000 af/yr, about 85,600 af/yr will be discharged to the 1,660 acres of disposal ponds, of which 8,600 af/yr (10 percent) will evaporate and 77,000 af/yr (90 percent) will percolate to groundwater. The concentration affect of evaporative losses will cause an 11 percent increase in concentrations of waste constituents in effluent percolating to groundwater. This is illustrated in the mass balance calculation below.

(85,600 af/yr) (100 mg/L) = (8,600 af/yr) (0 mg/L) + (77,000 af/yr) (X mg/L)

X = 111 mg/L, or 11 percent greater that the concentration discharged to the disposal ponds.

The table below shows the concentrations of salinity constituents in WWTF effluent, effluent percolating to groundwater, and in four monitoring wells situated in an area removed from dairies or other concentrated sources of waste discharges.

				Shallow groundwater		Deeper groundwater	
Constituent	Units	Effluent to ponds[1]	Effluent to groundwater[2]	MW 13A[3]	MW 14A[3]	MW 13B[3]	MW 14B[3]
Chloride	mg/L	72	80	70	78	70	82
EC	µmhos/cm	780	866	901	781	1,170	902
Sodium	mg/L	81	90	78	83	81	92
TDS	mg/L	440	488	566	460	742	575

[1] Average values based on 2000 monitoring data
[2] Estimated at 11% greater than concentration in effluent discharged to disposal ponds
[3] Average values based on quarterly monitoring data from April 2000 through May 2001

As indicated above, the concentrations of salinity constituents in groundwater comprised predominately of percolating effluent are comparable to that of WWTF effluent as it is concentrated due to the effect of evaporation.

Water quality data from October 2000 for groundwater extracted from three recently-installed Flowpath™ reclamation wells, which extract groundwater from depths of 80 to 240 feet bgs, indicate the following average concentrations in mg/L: chloride (79), dissolved iron (0.19), dissolved manganese (1.24), total nitrogen (< 2), sodium (76), TDS (490), and total organic carbon (5). With few exceptions (i.e., MW-14A, MW-14B, and MW-15A), manganese concentrations in groundwater extracted from the WWTF's
monitoring wells are typically less than the detection limit of 0.02 mg/L. In contrast, the average manganese concentration of 1.24 mg/L in groundwater extracted from the Flowpath™ wells is almost 25 times the drinking water standard of 0.05 mg/L.

A reasonable explanation for the low concentrations of nitrate and high concentrations of manganese and total organic carbon in groundwater extracted from reclamation wells is the microbial degradation of organic carbon in percolating effluent. Biological wastewater treatment is the process of dissimilation and assimilation whereby organic compounds are broken down (dissimilation) or incorporated into cell mass (assimilation). The biochemical oxidation of organic carbon compounds to carbon dioxide and water and the conversion of nitrogen to nitrate provide cells energy. These processes occur in an aqueous solution giving the byproducts of carbonic acid and nitric acid.

If effluent percolating to groundwater contains more organic carbon than can be oxidized by the residual oxygen in the effluent, the soil and groundwater beneath the ponds may be an anoxic or oxygen deficient environment. In an aqueous environment under anoxic conditions, nitrate and oxidized forms of manganese and iron substitute for oxygen as a terminal electron acceptor whereby nitrate is reduced to nitrogen and manganese and iron are transformed to reduced forms. The reduced forms of manganese and iron have a higher solubility product, K_{sp}, and therefore become more soluble in water. This reduced form dissolves in water and migrates.

Basin Plan

The *Water Quality Control Plan for the Tulare Lake Basin, Second Edition* (hereinafter Basin Plan) designates beneficial uses and contains water quality objectives for all waters of the Basin. Beneficial uses often determine the water quality objectives that apply to a water body. For example, waters designated as municipal and domestic supply must meet the maximum contaminant levels (MCLs) for drinking waters. The Basin Plan sets forth the applicable beneficial uses (industrial, agricultural, and domestic supply in this instance), procedure for application of water quality objectives, and the process for and factors to consider in allocating waste assimilation capacity. The Basin Plan incorporates plans and policies of the State Water Resources Control Board by reference.

The Houghton and Dry Creek Canals are Valley Floor Waters, according to the Basin Plan. The beneficial uses of Valley Floor Waters are identified in the Basin Plan as agricultural supply, aesthetics, and groundwater recharge. The beneficial uses of underlying ground water are domestic, industrial, and agricultural supply. Dry Creek Canal originates in the City of Fresno within the Tulare Lake Basin and flows seasonally downstream of the WWTF. Houghton Canal flows seasonally downstream of the WWTF and originates within the Tulare Lake Basin at a junction with Dry Creek Canal in the City of Fresno. For irrigation purposes, they carry surface waters from the Kings River and Friant Kern Canal, both waters of the United States. They also carry urban storm runoff and surface waters from upgradient ephemeral streams. Downstream of the WWTF, the known beneficial uses are agricultural supply, aesthetics, and groundwater recharge.

The Basin Plan indicates that degradation of groundwater in the Tulare Lake Basin by salts is unavoidable without a plan for removing the salts from the Basin. In the absence of a valley wide drain to carry salts out of the valley, the Basin Plan indicates that the only other solution is to manage the rate of degradation by minimizing the salt loads to groundwater. The Board implements this policy, in part, by prescribing effluent salinity limits in waste discharge requirements for all discharges to land in the Basin. The Basin Plan's discharge salinity limit consists of narrative and numerical limits:

> The incremental increase in salts from use and treatment must be controlled to the extent possible. The maximum EC shall not exceed the EC of the source water plus 500 μmhos/cm. When the source water is from more than one source, the EC shall be a weighted average of all sources.

The Basin Plan encourages reclamation and does not consider disposal by evaporation/percolation or discharge to surface waters a permanent disposal solution when the potential exists for reclamation. Further, the Basin Plan requires that project reports for new or expanded wastewater facilities shall include plans for wastewater reclamation or the reasons why this is not possible.

Antidegradation

The antidegradation directives of section 13000 of the California Water Code require that waters of the State that are better in quality than established water quality objectives be maintained "consistent with the maximum benefit to the people of the State." Waters can be of high quality for some constituents or beneficial uses and not others. Policies and procedures for complying with this directive are set forth in the Basin Plan (including by reference State Water Board Resolution No. 68-16, "Statement of Policy With Respect to Maintaining High Quality Waters in California," or "Antidegradation" Policy).

Resolution 68-16 is applied on a case-by-case, constituent-by-constituent basis in determining whether a certain degree of degradation can be justified. It is incumbent upon the Discharger to provide technical information for the Board to evaluate that fully characterizes:

- all waste constituents to be discharged, the background quality of the uppermost layer of the uppermost aquifer
- the background quality of other waters that may be affected
- the underlying hydrogeologic conditions
- waste treatment and control measures
- how treatment and control measures are justified as best practicable treatment and control
- the extent the discharge will impact the quality of each aquifer
- the expected degradation compared to water quality objectives

In allowing a discharge, the Board must comply with CWC section 13263 in setting appropriate conditions. The Board is required, relative to the groundwater that may be affected by the discharge, to implement the Basin Plan and consider the beneficial uses to be protected along with the water quality objectives essential for that purpose. The Board need not authorize the full utilization of the waste assimilation capacity of the groundwater (CWC 13263(b)) and must consider other waste discharges and factors that affect that capacity. The applicable beneficial uses (industrial, agricultural, and domestic supply in this instance), procedure for application of water quality objectives, and the process for and factors to consider in allocating waste assimilation capacity are set forth in the Basin Plan.

This discharge has been occurring for years. Previous conditions of discharge have specified that, except for EC, the discharge, in combination with other sources, shall not cause underlying groundwater to contain waste constituents in concentrations statistically greater than background quality. In the case of EC, the previous Order stipulated that the combined effect of the discharges shall not cause an incremental increase greater than 20 μmhos/cm in EC over the most recent five-year period. Certain waste constituents in municipal wastewater are not fully amenable to waste treatment and control and it is reasonable to expect some impact on groundwater. Some degradation for certain constituents is consistent with maximum benefit to the people of California because the technology, energy, water recycling, and waste management advantages of municipal utility service to the State far outweigh the environmental impact damage of a community that would otherwise be reliant on numerous concentrated individual wastewater systems. Economic prosperity of the Cities of Fresno and Clovis is of maximum benefit to the people of California, and therefore sufficient reason to accommodate increases in wastewater discharge provided terms of reasonable degradation are defined and met. The proposed Order authorizes some degradation consistent with the maximum benefit to the people of the State.

Groundwater monitoring data at this site is insufficient to establish the most appropriate receiving water limits. In addition, as explained elsewhere in this information sheet, certain aspects of waste treatment and control practices have not been and are unlikely to be justified as representative of BPTC. Reasonable time is necessary to gather specific information about the facility and the site to make informed, appropriate, long-term decisions. This proposed Order, therefore, establishes receiving water limitations to assure protection of the beneficial uses of waters of the State pending the completion of certain tasks and provides time schedules to complete specified tasks. The tasks provide that the Discharger is expected to identify, implement, and adhere to best practicable treatment and control as individual practices are reviewed and upgraded in this process. During this period, degradation may occur from certain constituents, but by interim conditions can never exceed water quality objectives (or background water quality should it exceed objectives) or cause nuisance.

Water quality objectives define the least stringent limits that could apply as water quality limitations for groundwater at this location, except where background quality unaffected by the discharge already exceeds the objective. The values below reflect water quality objectives that must be met to maintain specific beneficial uses of groundwater. Unless natural background for a constituent proves higher, the groundwater quality limit established in proposed Order is the most stringent of the values listed for the listed constituents.

Constituent	Units	Value	Beneficial Use	Criteria or Justification
Ammonia	mg/L	0.5	MUN[1]	Taste and Odor[2]
Boron	mg/L	0.7	AGR[3]	Boron senstivity[4]
Chloride	mg/L	106	AGR[3]	Chloride sensitivity on certain crops irrigated via sprinklers[4]
		142	AGR[3]	Chloride sensitivity on certain crops[4]
		250	MUN[1]	Recommended Secondary MCL[5]
		500	MUN[1]	Upper Secondary MCL[5]
Conductivity (EC)	µmhos/cm	750	AGR[3]	Salt sensitivity[4]
		900	MUN[1]	Recommended Secondary MCL[5]
		1,600	MUN[1]	Upper Secondary MCL[5]
Iron	mg/L	0.3	MUN[1]	Secondary MCL[6]
Manganese	mg/L	0.05	MUN[1]	Secondary MCL[6]
Nitrate as N	mg/L	10	MUN[1]	Primary MCL[7]
Nitrite as N	mg/L	1	MUN[1]	Primary MCL[7]
pH	pH Units	6.5 to 8.5	MUN	Secondary MCL[8]
Sodium	mg/L	69	AGR[3]	Sodium sensitivity on certain crops[4]
Total Coliform Organisms	MPN/100 mL	2.2	MUN[1]	Basin Plan
Total Dissolved Solids	mg/L	450	AGR[3]	Salt sensitivity[4]

Constituent	Units	Value	Beneficial Use	Criteria or Justification
		500	MUN[1]	Recommended Secondary MCL[5]
		1,000	MUN[1]	Recommended Upper MCL[5]
Total Trihalomethanes	µg/L	100	MUN[1]	MCL[9]
Chloroform	µg/L	1.1	MUN[1]	Narrative Toxicity Criteria[10]
Bromodichloromethane	µg/L	0.27	MUN[1]	Narrative Toxicity Criteria[10]
Dibromochloromethane	µg/L	0.37	MUN[1]	Narrative Toxicity Criteria[10]
Bromoform	µg/L	4.3	MUN[1]	Narrative Toxicity Criteria[10]

See footnotes next page

1 Municipal and domestic supply
2 Council of the European Union, On the Quality of Water Intended for Human Consumption, Council Directive 98/83/EC (3 November 1998).
3 Agricultural supply
4 Ayers, R. S. and D. W. Westcot, Water Quality for Agriculture, Food and Agriculture Organization of the United Nations – Irrigation and Drainage Paper No. 29, Rev. 1, Rome (1985)
5 Title 22, California Code of Regulations (CCR), section 64449, Table 64449-B
6 Title 22, CCR, section 64449, Table 64449-A
7 Title 22, CCR, section 64431, Table 64431-A
8 United States Environmental Protection Agency
9 Title 22, CCR, section 64439
10 California Environmental Protection Agency, Office of Environmental Health Hazard Assessment Cancer Potency Factor as a Drinking Water Level, *California Environmental Protection Agency Toxicity Criteria Database*

Municipal wastewater contains numerous dissolved inorganic waste constituents (i.e., salts, minerals) that together comprise total dissolved solids (TDS). Each component constituent is not individually critical to any beneficial use. Constituents that are critical are individually listed. The cumulative impact from these other constituents, along with the cumulative affect of the constituents that are individually listed can be effectively controlled using TDS as a generic indicator parameter. Most dissolved inorganic substances in water are in the ionized form and so contribute to a solution's ability to carry an electrical current, or its "electrical conductivity" (EC). EC varies both with the number and type of ions the solution contains and is strongly temperature dependent. It is standard practice to report a solution's EC at 25° Celsius (this value is technically called "specific conductance"). Only ions can carry a current, however. Un-ionized species of weak acids or bases will not carry a current, nor will uncharged soluble organic materials, such as ethyl alcohol and glucose, even though these constituents comprise a portion of TDS. Although EC is affected by the nature of the various ions, their relative concentrations, and ionic strength of the water, EC measurements can give a practical estimate of the variations in a solution's dissolved mineral content. An empirical factor may be developed from simultaneous measurements of TDS and EC that allows for the rapid estimation of TDS from EC measurements.

Treatment Technology and Control

Given the character of municipal wastewater, secondary treatment technology is generally sufficient to control degradation of groundwater from decomposable organic constituents. Adding disinfection significantly reduces populations of pathogenic organisms, and reasonable soil infiltration rates and unsaturated soils can reduce them further. Total coliform, the indicator parameter for pathogenic organisms, should not be found in groundwater beneath a well-designed, well-operated facility. The Discharger indicates, however, that groundwater extracted from municipal wells occasionally contains detectable concentrations of coliform organisms.

Municipal wastewater typically contains nitrogen in concentrations greater than water quality objectives, which vary according to the form of nitrogen. Degradation by nitrogen can be controlled by an appropriate secondary treatment system (e.g., oxidation ditch), tertiary treatment for nitrogen reduction, and agronomic reuse on harvested crops. The effectiveness varies, but generally best practicable treatment and control should be able to control nitrogen degradation at a concentration well below the water quality objectives.

Waste constituents that are forms of salinity pass through the treatment process and soil profile and effective control of long-term affects relies upon effective source control and pretreatment measures. In the best of circumstances, long-term land discharge of treated municipal wastewater will degrade groundwater with salt (as measured by TDS and EC) and the individual components of salts (e.g., sodium, chloride). Not all TDS constituents pass through the treatment process and soil profile in the same manner or rate. Chloride tends to pass through both rapidly to groundwater. As chloride concentrations in most groundwaters in the region are much lower than in treated municipal wastewater, chloride is a useful indicator parameter for evaluating the extent to which effluent reaches groundwater.

Other indicator constituents for monitoring for groundwater degradation due to recharged effluent include total coliform bacteria, ammonia, total nitrogen, and total trihalomethanes (when the effluent is chlorinated). Chlorine disinfection of effluent causes formation of trihalomethanes, which are priority pollutants. Treatment to reduce these in wastewater generally has not been performed, and little is known at this point on the typical impact on groundwater. Total trihalomethanes (TTHMs) are chlorinated organic materials that are toxic at low concentrations. Common TTHMs include bromoform, bromodichloromethane, dibromochloromethane, and chloroform. While the State drinking water regulations (i.e., Title 22, CCR, section 64439) establish a maximum contaminant level for TTHMs of 100 μg/L, the actual concentrations at which THMs components are considered "toxic" to humans are much lower (e.g., chloroform's human health toxicity limit is 1.1 μg/L). The Basin Plan states that groundwaters "shall be maintained free of toxic substances in concentrations that produce detrimental physiological responses in human, plant, animal, or aquatic life associated with designated beneficial uses."

Boron is another TDS constituent that may occur in wastewater in concentrations greater than groundwater depending on the source water, to the extent residents use cleaning products containing boron, and whether any industrial dischargers utilize boron (e.g., glass production, cosmetics). Still other constituents in treated municipal waste that may pass through the treatment process and the soil profile include recalcitrant organic compounds (e.g., ethylene glycol, or antifreeze), radionuclides, and pharmaceuticals. Hazardous compounds are not usually associated with domestic wastes and when present are reduced in the discharge to inconsequential concentrations through dilution with domestic waste, treatment, and the implementation of effective pretreatment programs.

A discharge of wastewater that overloads soils with nutrients and organics can result in anaerobic conditions in the soil profile, which in turn creates organic acids and decreases soil pH. Under conditions of low soil pH (i.e., below 5), iron and manganese compounds in the soil can solubilize and leach into groundwater. Discharge of residual sludge to land may also lead to increases in groundwater alkalinity and hardness to concentrations that impair the water's beneficial uses and contribute to an overall increase in TDS. Overloading soils with nutrients and organics is preventable and does not constitute BPTC as used in Resolution 68-16. Elevated concentrations in groundwater compared to percolating effluent of dissolved iron, dissolved manganese, alkalinity, and hardness are useful indicators to determine whether components of the WWTF with high-strength waste constituents, such as sludge handling facilities, are ineffective in containing waste.

Title 27

Title 27, CCR, section 20380 et seq. ("Title 27"), contains regulations to address certain discharges to land. Title 27 establishes a waste classification system, specifies siting and construction standards for full containment of classified waste, requires extensive monitoring of groundwater and the unsaturated zone for any indication of failure of containment, and specifies closure and post-closure maintenance requirements. Generally, no degradation of groundwater quality by any waste constituent is acceptable.

Discharges of domestic sewage and treated effluent can be treated and controlled to a degree that will not result in unreasonable degradation of groundwater. For this reason, they have been conditionally exempted from Title 27, except for residual sludge and solid waste generated as part of the treatment process [section 20090(a) of Title 27]. The condition requires that the discharge not result in violation of any water quality objective in groundwater.

Treatment and storage facilities for sludge that are part of the WWTF are considered exempt from Title 27 under section 20090(a), under the condition that the facilities not result in a violation of any water quality objective. However, residual sludge (for the purposes of the proposed order, sludge that will not be subjected to further treatment by the WWTF) is not exempt from Title 27. Solid waste (e.g., grit and screenings) that results from treatment of domestic sewage and industrial waste also is not exempt from Title 27. This residual sludge and solid waste are subject to the provisions of Title 27.

Accordingly, the municipal discharge of effluent and the operation of treatment or storage facilities associated with a municipal wastewater treatment plant can be allowed without requiring compliance with Title 27, but only if resulting degradation of groundwater is in accordance with the Basin Plan. This means, among other things, degradation of groundwater must be consistent with Resolution 68-16 and in no case greater than water quality objectives.

PROPOSED ORDER TERMS AND CONDITIONS

Discharge Specifications

As in other WDRs orders for municipal discharges recently adopted by the Board, the proposed Order implements a two-phased approach to setting final groundwater limitations. While the Board has determined that some degradation is in the public interest, it cannot yet determine how much due to incomplete data and evaluation of treatment and control measures. In Phase 1 of this 'implementation approach,' WDRs orders establish receiving water limitations that assure protection of the beneficial uses of groundwater pending the completion of certain tasks in accordance with a time schedule. In Phase 2, determination of site-specific groundwater limitations to be adopted in WDRs will depend upon the Board's evaluation of the results of the tasks. The numerical implementation of many Basin Plan narrative water quality objectives in Phase 1, in accord with the procedures prescribed in the Basin Plan, represents the threshold above which there will be adverse impacts on beneficial uses of groundwater (e.g., drinking water MCLs). Since the proposed Order implements existing water quality objectives, the Board is not required to undertake further consideration of the factors in Water Code section 13241, including economic considerations.

The discharge specifications prescribed in this Order for BOD_5, TSS, and EC, are based on the Basin Plan. The proposed Order carries over the effluent limitations for BOD_5, TSS, settleable solids, and EC from the previous Order. The Basin Plan requires municipal facilities discharging in excess of 1 mgd to provide removal of 80 percent or reduction to 40 mg/L, whichever is more restrictive, of both 5-day BOD and suspended solids. While the current Order prescribes a monthly average daily discharge limit of 40 mg/L for BOD and for TSS, it does not require 80 percent removal. The proposed Order's WWTF Discharge Specification B.3 implements the Basin Plan's 80 percent removal requirement. From January 2000 to September 2001, monthly average influent and effluent BOD and suspended solids concentrations indicate that percent removals range from 47 to 94 and average 86 for BOD and range from 64 to 97 and average 90 for suspended solids. The Discharger currently relies on groundwater recharge for effluent disposal. In 2000, the discharge's monthly average chloride concentration ranged from 59 to 87 mg/L, averaged 70 mg/L, and had a 95% confidence level of 82 mg/L. The Basin Plan establishes a maximum effluent chloride limit of 175 mg/L for discharges to areas that may recharge to good quality groundwater. The previous Order prescribed monthly average and daily maximum chloride discharge limitations of 175 and 205 mg/L, respectively. As discussed later, the proposed Order prescribes a groundwater chloride limitation of 106 mg/L to protect the existing and future beneficial uses of area groundwater. Rather than carrying over the previous Order's discharge chloride limitations, which, if approached, would result in exceedances of the proposed Order's groundwater chloride limitation, the proposed Order does not prescribe a discharge chloride limitation. The proposed Order requires the Discharger to conduct a study that establishes appropriate groundwater limitations based on the factual circumstances of the discharge. In lieu of continuing to impose an effluent chloride limitation that may not be protective of groundwater given the present information, Staff is recommending a limit be formulated and proposed for Board consideration after the Discharger completes its groundwater study. The discharge specifications regarding dissolved oxygen and freeboard are consistent with Board policy for the prevention of nuisance conditions, and are applied to all such facilities.

The proposed Order limits the use of recycled water to flood irrigation of fodder, fiber, seed crops, and of crops such as wine grapes that undergo extensive commercial, physical, or chemical processing before human consumption, and requires the Discharger to comply with the provisions of Title 22. To ensure compliance with Title 22 and Board reclamation policy, the proposed Order requires the Discharger to implement best management practices with respect to effluent reuse (e.g., to reuse effluent at reasonable agronomic rates considering the crop, soil, climate, and irrigation management plan). The setback distances prescribed in Reclamation Specification F.3 are carried over from the previous Order with one exception. While the previous Order required a setback distance of 100 feet for both irrigation and domestic wells, the proposed Order prescribes a setback distance of 150 feet for domestic wells in accordance with Title 22, section 60307(d).

The conditions for sludge, solid waste, and biosolids management proposed in the proposed Order are intended to assure that degradation resulting from the City's management of sludge is in accordance with the Basin Plan. The proposed Order requires that storage, use and disposal of biosolids comply with the self-implementing federal regulations of 40 CFR 503, which are subject to enforcement by the U.S. Environmental Protection Agency not the Board, and the Statewide General Order for the Discharge of Biosolids (Water Quality Order No. 2000-10-DWQ) (or any subsequent document which replaces Order No. 2000-10-DWQ).

In accordance with DHS recommendations described earlier, the proposed Order requires the Discharger to (a) assess the current status of all private and domestic wells that exist within the 25-square-mile area described in Finding No. 9, (b) monitor domestic supply wells within this area for contaminants, and (c) conduct a comprehensive study to assess the fate and effects of the past and current discharge on the groundwater basin. The proposed Order further requires the Discharger to (a) identify the types of crops grown in the area served by FID canals that receive groundwater extracted by the Operator's reclamation wells and (b) provide information on the dilution of the extracted groundwater with fresh water prior to irrigation application. Because it is likely that food crops are grown or could be grown in the subject
area, the proposed Order requires the Discharger to undertake a timely evaluation of the degree of soil treatment provided by the current recharge and extraction operation and a determination of the level of filtration and virus removal treatment provided.

Regarding the discharge of stillage to the Stillage Site, the proposed Order carries over the previous Order's specifications for stillage disposal, which were adapted from the Stillage Guidelines. While the Operator has been discharging stillage to SS-1 for decades, it only recently began discharging stillage to SS-2. The groundwater impacts from the Operator's long-term discharge of stillage appear to be limited to salinity constituents, although there is the potential for nitrate contamination due to the accumulation of organic nitrogen in SS-1 soils. In the event the stillage discharge causes or contributes to exceedances of water quality objectives, the proposed Order has a Provision that allows the Board to reopen the Order to consider adding or revising appropriate stillage discharge specifications or groundwater limitations for the problem constituents.

Canandaigua's discharge to the Stillage Site is scheduled to cease by fall 2003, and the WWTF does not have the capacity to treat the discharge. While the continued discharge of stillage during the next two years may further degrade area groundwater for salinity, Staff is recommending that the Board allow it to it be continued in the manner previously permitted, provided the Board requires the Operator to commence regularly planting and harvesting crops in the Stillage Site and to store collected leathers in a manner that will violate Groundwater Limitations. Staff is also recommending that the Board require the Operator to provide more detailed monitoring data on its stillage disposal operation, including data on the quality of soil-pore water under the Stillage Site. The technical report required by Provision H.5 of the proposed Order includes a description of the manner in which the Discharger proposes to monitor the quality of soil pore water beneath the Stillage Site. Vadose zone liquid can be readily sampled via lysimeters. The proposed Order's Monitoring and Reporting Program identifies the minimum sample size required for listed monitored constituents. The benefits of acquiring soil pore water quality data through vadose zone monitoring justify the costs involved in lysimeter acquisition, installation, sample collection, and laboratory analysis. Analytical results from this effort will be instrumental in evaluating the efficacy of treatment provided by the soil profile within the Stillage Site. Analytical results collected after stillage disposal ceases by January 2004 will monitor the extent to which stillage waste constituents (or their decomposition byproducts) continue to leach through the soil profile, especially in the original 95-acre stillage disposal area (SS-1). As indicated in Finding No. 44, the long-term discharge of stillage to SS-1 has resulted in a massive accumulation of organic nitrogen in the upper two feet of the soil profile. Attenuation of this massive loading through cropping is expected to take numerous years. At such time when SS soil nitrogen content is comparable to background, the Discharger may request termination of vadose zone monitoring. Such a modification in the proposed Order's Monitoring and Reporting Program can be executed by the Executive Officer.

The proposed Order prescribes groundwater limitations that reflect numerical and narrative water quality objectives (WQOs) for groundwater established in the Basin Plan. The proposed Order requires the discharge not to cause or contribute to exceedances of the groundwater limitations. Designated beneficial uses of area groundwater include municipal (MUN) and agricultural (AGR) supply. The Basin Plan states that "[w]ater quality objectives apply to all waters within a surface or ground water resource for which beneficial uses have been designated, rather than at an intake, wellhead or other point of consumption." Groundwater WQOs include (1) chemical constituents (including pesticides and radioactivity), (3) salinity, (4) tastes and odors, and (5) toxicity. For groundwaters designated MUN, the Basin Plan establishes numerical WQOs for bacteria and chemical constituents. The latter consists of drinking water maximum contaminant levels (MCLs) in Title 22, sections 64431 (Inorganic Chemicals); 64431 (Fluoride); 64443 (Radioactivity) 64444 (Organic Chemicals); 64449 (Secondary MCLs – Consumer Acceptance Limits); and lead not to exceed 0.015 mg/L.

The total coliform organism limitation of 2.2 MPN/100 mL in Groundwater Limitation G.1.a is based on the Basin Plan's WQO (i.e., the concentration of TCO over any 7-day period shall be less than 2.2/100 mL). Groundwater Limitation G.1.b prescribes a value of 10 mg/L as total nitrogen to ensure that groundwater nitrate levels will remain at or below the Title 22 primary drinking water MCL for nitrate (45 mg/L as nitrate or 10 mg/L as N). The limitations for chemical constituents prescribed in Groundwater Limitation G.1.c reflect the Title 22 drinking water MCLs. Groundwater Limitation G.2 prescribes limits for boron, chloride, EC, sodium, and TDS to protect existing and future beneficial uses of area groundwater for agriculture. The majority of area agriculture water supply is currently delivered via flood irrigation. Accordingly, it may not be critical to maintain the low salt concentrations in agricultural supply required for sprinkler irrigation. Additionally, the Discharger has implemented best practicable control for salt constituents through its implementation of an effective salinity source control program.

The proposed Order requires the Discharger to conduct a BPTC evaluation of the discharge (including source control, pretreatment, and treatment). Once it completes its BPTC evaluation, the Discharger may, at its discretion, propose for Board consideration site-specific, constituent-specific limits for salinity constituents (e.g., chloride, EC, sodium, and TDS). In the next Order regulating the discharge, the Board will evaluate the Discharger's justification of BPTC implementation and its proposed groundwater salinity limitations. It is possible upon further documentation that the resulting degradation from salt can be found consistent with Resolution 68-16. Monitoring data submitted to date for WWTF effluent and groundwater indicates that the discharge will not result in exceedances of the proposed Order's groundwater limitation for boron of 0.7 mg/L. Staff determined the groundwater limitations for the remaining constituents as follows. The proposed Order prescribes an effluent EC limit of 900 µmhos/cm. Currently, WWTF effluent averages less than 800 µmhos/cm. As described previously, the concentration effect of evaporative losses are such that the concentration of waste constituents in effluent percolating to groundwater is about 11 percent greater than that discharged to disposal ponds. It is reasonable to assume that the relative concentrations of chloride and sodium in WWTF effluent will remained unchanged as the effluent EC approaches the 900 µmhos/cm limitation. The table below summarizes the derivation of the proposed Order's groundwater limitations for chloride, EC, sodium, and TDS.

Constituent	Units	Current discharge to disposal ponds[1]	Discharge to disposal ponds at maximum EC[2]	Discharge to groundwater at maximum EC[3]	Proposed Limitation
Chloride	mg/L	72	832	91.3	106[4]
EC	µmhos/cm	780	900	990	990
Sodium	mg/L	81	94[2]	103	103
TDS	mg/L	440	507[5]	557	560

[1] Average values based on 2000 monitoring data
[2] Assumes relative concentrations remain unchanged at higher EC concentration
[3] Estimated at 11% greater than concentration in effluent discharged to disposal ponds
[4] Reflects maximum chloride concentration for chloride-sensitive crops
[5] Assumes unchanged ratio of TDS:EC of 440:780 (i.e., TDS = 0.564 * EC)

The last two groundwater limitations reflect narrative WQOs contained in the Basin Plan. Groundwater Limitation G.3 implements the Basin Plan's WQO for taste and odor. The taste threshold for ammonia, a waste constituent in municipal wastewater, is 0.5 mg/L. The limitation of 0.5 mg/L for ammonia ensures that this waste constituent will not adversely affect the beneficial use of area groundwater for human consumption. Lastly, Groundwater Limitation G.4 implements the Basin Plan's WQO for toxicity.

Monitoring Requirements

Section 13267 of the CWC authorizes the Board to require monitoring and technical reports as necessary to investigate the impact of a waste discharge on waters of the state. In recent years there has been increased emphasis on obtaining all necessary information, assuring the information is timely as well as representative and accurate, and thereby improving accountability of any discharger for meeting the conditions of discharge. Section 13268 of the CWC authorizes assessment civil administrative liability where appropriate.

The proposed Order prescribes monitoring of discharge BOD_5, TSS, pH, and EC. The monitoring of these constituents is necessary to check compliance with discharge specifications. The proposed Order also prescribes monitoring of discharge nitrogen (as nitrite, nitrate, TKN, and total nitrogen), quarterly monitoring of minerals, and semiannual monitoring of metals and priority pollutants for discharges from Plant 1 and Plant 2 (when in operation), and quarterly and annual monitoring of source water quality. Staff is recommending the Discharger monitor effluent for priority pollutants to evaluate whether there is reasonable potential for the discharge to cause toxicity in groundwater. The source water monitoring, at the request of the Operator, utilizes data compiled in the Operator's electronic database for DHS reporting requirements. This lessens the financial burden on the Operator and increases the likelihood that source water quality is adequately characterized. Monitoring by the Operator over the years has not revealed any significant radiological waste constituents in either WWTF effluent or area groundwater. As such, the proposed Order eliminates the monitoring of radiological constituents in the discharge and groundwater.

The previous Order required the Discharger to sample systematically a representative number of disposal ponds at least once every seventh calendar day for dissolved oxygen (DO) and freeboard. During the two-year period beginning 1 January 1998, the Operator measured pond DO 7,624 times and found the value to be less than 1.0 mg/L for only 14 separate occurrences for a frequency of 0.0018 (0.18%). Therefore, the proposed Order decreases the frequency of pond DO monitoring to an as-needed basis.

Monitoring available freeboard in disposal ponds is necessary for several reasons. It documents compliance Disposal Pond Specification C.4, which requires all ponds to have a minimum of two feet available freeboard. It provides data for detecting reductions in effluent infiltration rates, which may, in turn, signify the need for pond maintenance to restore design infiltration rates. It also provides data that may signify levee damage (i.e., a sudden drop in freeboard may signify leakage caused by burrowing animals). The proposed Order requires the Discharger to (1) inspect pond freeboard of all disposal ponds daily and document all instances of noncompliance with Disposal Pond Specification C.4, which requires all ponds to have a minimum of two feet available freeboard; (2) monitor pond freeboard daily in external disposal ponds; (3) monitor pond freeboard at least once every seventh calendar day in a internal disposal ponds.

The proposed Order prescribes monitoring of stillage waste, including flow, BOD_5 (total and soluble), COD (total and soluble), total organic carbon, total nitrogen (nitrate and TKN), phosphorus, TDS, and EC. The monitoring of these constituents is necessary to check compliance with stillage discharge specifications and to monitor constituents that have a potential impact upon groundwater or will potentially create nuisance conditions. Further, the proposed Order requires the Operator to provide detailed descriptions on the manner in which it conducts its stillage discharge operation, perform periodic monitoring of Stillage Site soils, monitor vadose zone water quality, and monitor the quantity and chemical characteristics of groundwater passing under the Stillage Site. This information will be used by the Board to evaluate similar stillage disposal operations elsewhere in the Central Valley Region.

The proposed Order requires the Discharger to collect composite samples of sludge when it is removed in accordance with EPA's *POTW SLUDGE SAMPLING AND ANALYSIS GUIDANCE DOCUMENT, AUGUST 1989,* and test for arsenic, cadmium, molybdenum, copper, lead, mercury, nickel, selenium, and zinc. The proposed Order requires the Discharger to submit an annual summary of sludge discharge operations.

The Title 27 zero leakage protection strategy relies heavily on extensive groundwater and unsaturated zone monitoring to increase a discharger's awareness of, and accountability for, compliance with the prescriptive and performance standards. With a high volume, concentrated, uncontained discharge to land, monitoring takes on even greater importance. The proposed Order includes monitoring of applied waste quality, application rates, and groundwater.

The proposed Order requires a monitoring well network that effectively measures the quality of groundwater that could be impacted by the discharge. The existing well network monitors the uppermost layer of the aquifer, and data indicate a number of problem areas that call into question some aspects of treatment and control. The proposed Order requires the Discharger to evaluate the uppermost aquifer for a representative zone against which groundwater limitations will be applied. Use of the existing network will continue for the purposes of monitoring the effects of the discharge on the uppermost layer of groundwater until an alternate network suitable for evaluating the effectiveness of BPTC and compliance with Groundwater Limitations is approved by the Executive Officer in accord with the process outlined in the proposed Order.

The proposed Order also requires monitoring of groundwater extracted by the reclamation wells. The proposed Order's groundwater monitoring requires quarterly sampling from identified monitoring wells for constituents in the discharge that may degrade groundwater quality and for which numerical limitations have been prescribed (e.g., nitrate, total nitrogen, chloride, sodium, etc.). Additional monitored constituents include total organic carbon, general minerals, metals, dissolved oxygen, and oxidation-reduction potential. The last two parameters, which can be readily obtained through the use of hand-held probes during the time of sample collection, provide information to evaluate the extent to which microbial degradation of organic matter has created anoxic or anaerobic conditions (i.e., conditions of very low or no dissolved oxygen). Factual evidence of organic overloading would include the presence of total organic carbon and soluble manganese in extracted groundwater along with very low or no dissolved oxygen and nitrate, and oxidation-reduction potentials corresponding to manganese reduction.

Consistent with the implementation approach taken in the proposed Order, evaluation of compliance with Groundwater Limitations cannot occur until the initiation of the approved representative zone monitoring program. The approved representative zones of the aquifer will be identified in the hydrogeologic investigation described in Provision H.7. Wells must be installed to measure the quality of water within these zones for comparison with Groundwater Limitations as part of the proposed Order. The proposed Order provides a schedule for proposing, then providing the monitoring network, for these representative zones. Until the network is installed and monitoring initiated, the Board cannot evaluate compliance with Groundwater Limitations.

In accordance with DHS recommendations described earlier, the proposed Order requires the Discharger to monitor a representative sample of domestic supply wells within the 25-square-mile area encompassed by the mound of percolated effluent. The collected data will be used to determine if these supply wells are producing safe water for domestic use. In addition, the proposed Order requires the Discharger to install continuous turbidity meters on representative reclamation wells and to collect continuous turbidity data for at least one year. Acquisition of turbidity data for groundwater extracted from the Operator's reclamation wells is essential in determining the quality of percolated effluent that the Operator discharges to FID canals for unrestricted use. To qualify as a "filtered" wastewater pursuant to Title 22, section 60301.320, the groundwater extracted from reclamation wells must not have a turbidity that exceeds an average of 2 NTU within a 24-hour period, 5 NTU more than 5 percent of the time within a 24-hour period, and 10 NTU at any time.

As described previously, the proposed Order requires the Discharger to provide detailed monitoring data on its stillage disposal operation, including water quality data for soil-pore water collected from lysimeters installed in Stillage Site soils.

CEQA CONSIDERATIONS

The City of Fresno certified a final environmental impact report (EIR) dated 31 October 1995 for an expansion in WWTF treatment and disposal capacity in accordance with the California Environmental Quality Act (CEQA) (Public Resources Code section 21000 et seq.) and the State CEQA Guidelines. The expansion project includes (a) increasing Plant 1 treatment capacity to 80 mgd to accommodate urban growth in the Discharger's service area, (b) discontinuing use of Plant 2 to improve the WWTF's overall air emissions, reliability, and operations, and (c) constructing an additional 600 acres of infiltration basins (i.e., effluent disposal ponds) to provide disposal capacity for the increased flows and to comply with Board-prescribed pond freeboard requirements. The EIR estimates that, at full build out, the project would discharge an additional 11,200 af/yr of effluent to area groundwater. While the EIR states that the infiltration of effluent over the years has caused concentrations in groundwater of TDS, EC, and sodium to increase, the EIR states that the project would not affect public or private water supplies. The EIR identifies the project's impact on groundwater as temporary, as the City "shall commit to developing a plan for the reclamation of water infiltrated at the plant by 1997." The EIR promises that the City "shall continue to develop and implement a reuse program for its treated wastewater to reduce the need for future infiltration basins. The EIR further states that the City "is also developing a reuse program for its treated wastewater to alleviate groundwater conditions under the treatment plant…[to]…mitigate the cumulative effects to water resources to a level of less than significant."

The project certified by the City of Fresno as described in the EIR differs from the project characterized in the Discharger's 31 December 1996 Report of Waste of Discharge (RWD). The RWD describes a project that increases Plant 1's treatment capacity to 88 mgd, continues use of Plant 2, and adds 600 acres of disposal ponds. The increase in amount of effluent percolating from the project described in the RWD is nearly 25,000 af/yr, well over the 11,200 af/yr identified in the EIR. Since submitting the RWD, the Discharger indicates that (a) it plans to treat some industrial flows in Plant 2, as necessary, prior to their full treatment in Plant 1; (b) the 80 mgd specified in the EIR represents the annual monthly average daily discharge flow (i.e., the average of the monthly average daily discharge flow for the calendar year); and (c) the EIR did not correctly reflect that the Plant 1 would be designed, constructed, and operated to treat a short-term maximum monthly average daily discharge flow of 88 mgd. The additional 8 mgd treatment capacity accommodates seasonal peaks from food-processing industries that generally occur in September.

This Order, in accordance with the terms of the certified EIR, limits treatment and disposal capacity to 80 mgd, and requires the Discharger to implement one or more reuse projects by spring 2004 to recycle an additional 4,200 acre-feet of treated wastewater in addition to that currently either directly or indirectly recycled or is proposed to be recycled by Calpine.

The Board has reviewed the City of Fresno's EIR for the WWTF expansion project and finds that any potential significant adverse impacts to water quality will be mitigated to insignificant levels or is acceptable due to overriding considerations provided the Discharger complies with the terms in the proposed Order. The proposed Order, in accordance with the terms of the City of Fresno's certified EIR, limits the WWTF's annual monthly average daily discharge flow to 80 mgd and its maximum monthly average daily discharge flow to 88 mgd. The proposed Order requires the Discharger to implement by 2004 one or more reuse projects to recycle at least 4,200 af/yr in order to render as temporary the WWTF expansion project's impacts to groundwater. It further requires the Discharger to evaluate, in consultation with DHS, the discharge's impact on area groundwater's use as a domestic and municipal supply.

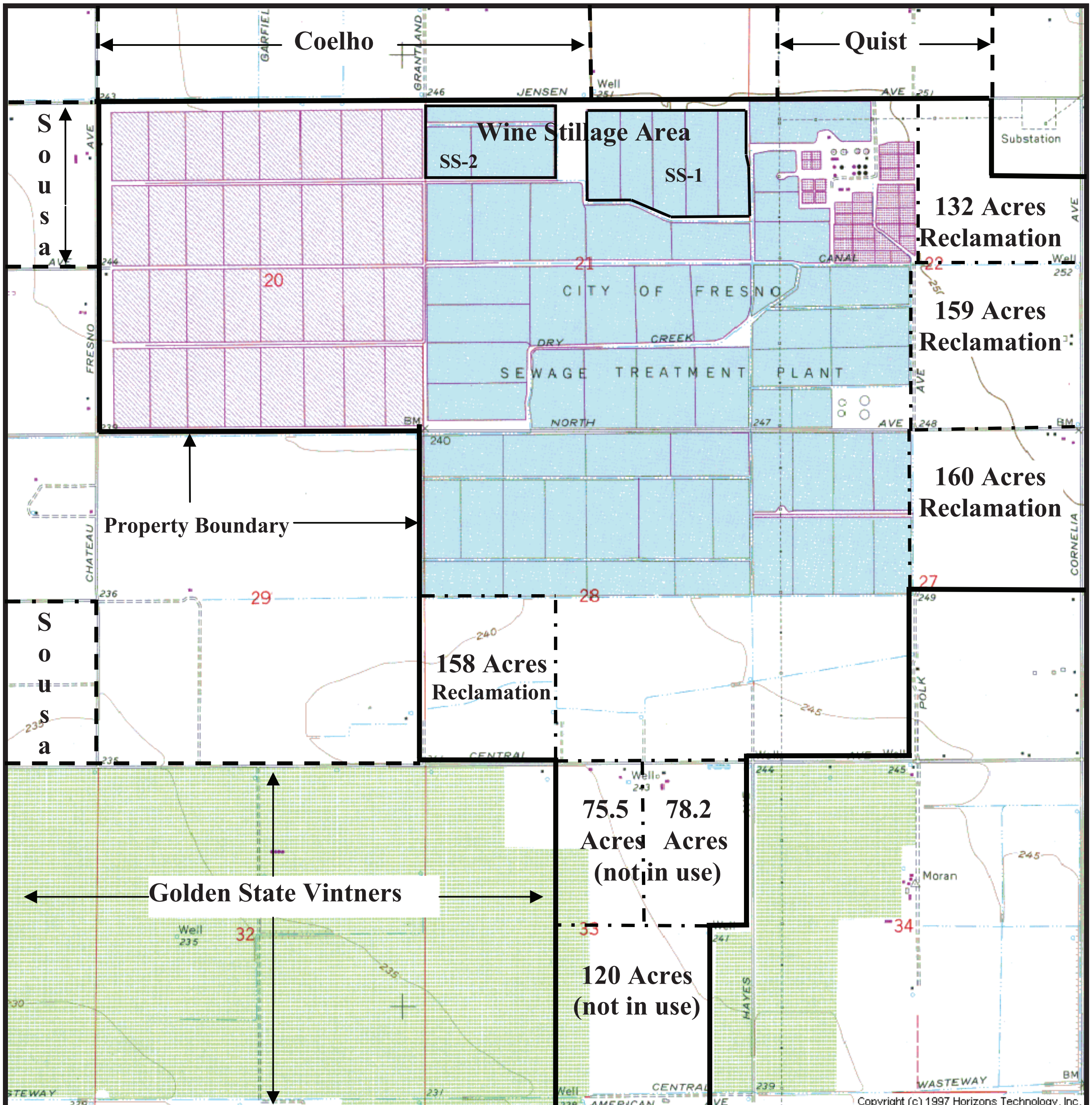
On 25 March 1998, the City of Fresno adopted a negative declaration (Environmental Assessment 98-03), in accordance with CEQA and State CEQA Guidelines for the discharge of stillage to the 50-acre stillage disposal site (SS-2) adjacent to the existing 95-acre stillage disposal site (SS-1). Mitigation measures 3 – 15 are identical to Stillage Discharge Specifications C.1 – C.13 from WDRs Order No. 96-054. In its review of this document, the Board, as a responsible agency under CEQA, finds that it does not adequately mitigate the potentially significant adverse impact to groundwater due to the accumulation of nitrogen in stillage disposal area soils, nor does it monitor the fate of waste constituents as it percolates through the upper soil profile. This Order requires the Discharger to commence planting and harvesting crops in the Stillage Site to reduce the nitrogen content in stillage disposal area soils. It also requires the Discharger to implement vadose zone monitoring for waste constituents and their decomposition by-products.

Reopener

The conditions of discharge in the proposed Order were developed based on currently available technical information and applicable water quality laws, regulations, policies, and plans, and are intended to assure conformance with them. However, information is presently insufficient to develop final effluent and groundwater limitations, so the proposed Order contains interim limitations. Additional information must be developed and documented by the Discharger as required by schedules set forth in the proposed Order. As this additional information is obtained, decisions will be made concerning the best means of assuring the highest water quality possible may that could involve substantial cost. It may be appropriate to reopen the Order if applicable laws and regulations change, but the mere possibility that such laws and regulations may change is not sufficient basis for reopening the Order. The CWC requires that waste discharge requirements implement all applicable requirements.

Several other more likely reasons for reconsidering terms of the Order exist, and the Order may be opened for this purpose at the Board's discretion. For example, Board procedures require periodic review of the effectiveness of requirements at a frequency proportional to the threat the discharge has to water quality with update as appropriate. The Order will definitely be reopened for consideration of BPTC and establishing final numeric groundwater limitations. It is also conceivable that monitoring of compliance may identify a waste constituent, possibly a toxic waste constituent, that violates or threatens to violate groundwater limitations, establishing a need to consider an appropriate numeric effluent limit for that waste constituent.

BLH:jlk:10/19/01 AMENDED



1700 FT (approximate)

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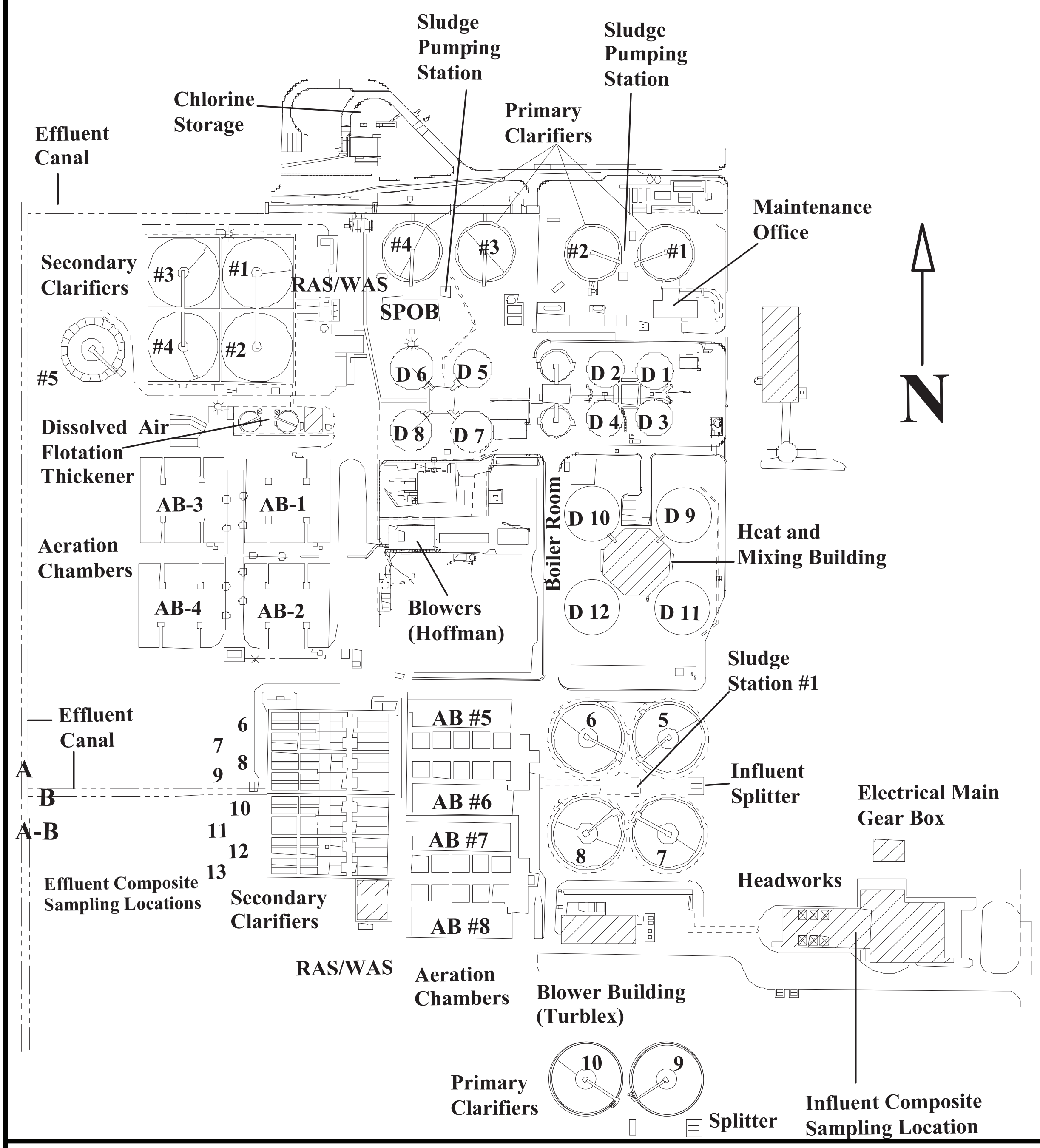
Attachment A

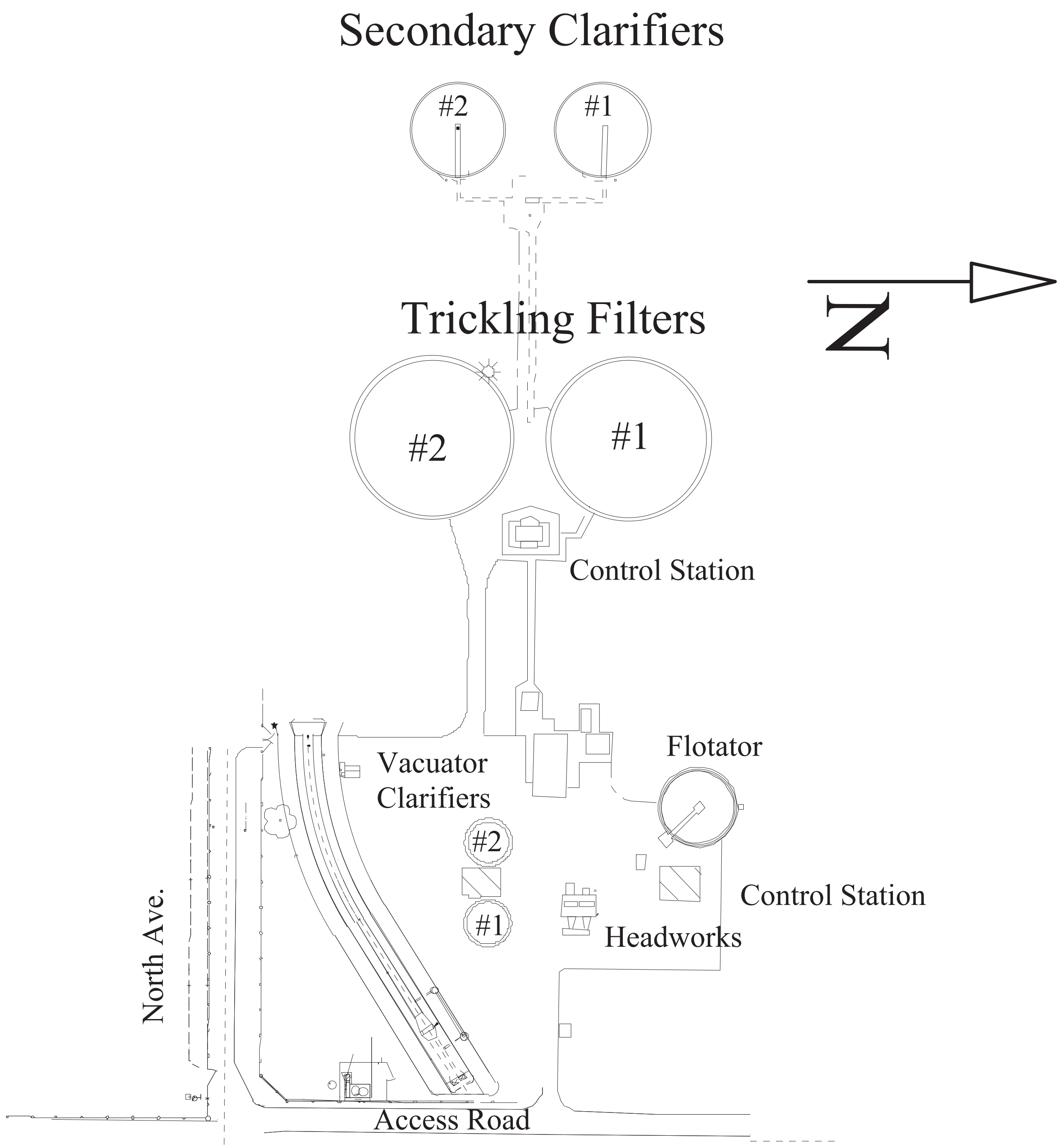
Vicinity Map

WASTE DISCHARGE ORDER NO. 5-01-254

Cities of Fresno and Clovis
Wastewater Treatment Facility
Fresno County
Sections 20, 21, 22, 27, 28, and 33 of T14S R19E
Fresno, CA USGS 15' Quadrangle



ATTACHMENT B
PLANT 1 DIAGRAMMATIC LAYOUT
WASTE DISCHARGE REQUIREMENTS ORDER NO 5-01-254
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY



ATTACHMENT C
PLANT 2 DIAGRAMMATIC LAYOUT
WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

ATTACHMENT D

Symbol for Recycle Water Signs

WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254

CITIES OF FRESNO AND CLOVIS

WASTEWATER TREATMENT FACILITY

FRESNO COUNTY

TENTATIVE WASTE DISCHARGE REQUIREMENTS ORDER NO. 5-01-254
FOR
CITIES OF FRESNO AND CLOVIS
WASTEWATER TREATMENT FACILITY
FRESNO COUNTY

ATTACHMENT E
INFORMATION NEEDS FOR SLUDGE MANAGEMENT PLAN

A. Wastewater Treatment Facility (WWTF)

1. Describe treatment processes at the wastewater treatment facility.
2. List significant industrial users (SIUs) that discharge to the wastewater treatment facility and describe how SIUs affect sludge production, sludge handling, and biosolids disposal.
3. Indicate whether the WWTF has an adopted source control ordinance or a pretreatment program, and if the latter whether the program is approved by the Board.
4. Indicate whether WWTF accepts septage and, if so, describe septage handling operation facilities.
5. Provide a WWTF site map showing:
   a. existing sludge handling facilities (e.g., sludge drying beds and sludge storage areas)
   b. abandoned sludge handling facilities (if applicable)
   c. location of groundwater monitoring wells, if any, and groundwater gradient.

B. Sludge Production

1. Provide a schematic diagram showing solids flow and sludge handling operations; include, where applicable, supernatant flow and handling operations.
2. Specify the quantity of sludge expected to annually accumulate in each wastewater treatment process, how it is quantified, and the expected removal frequency.
3. For sludge handling facilities with sludge drying beds:
   a. Describe number and size of sludge drying beds.
   b. Describe sludge drying bed construction (e.g., liner, leachate collection system).
   c. If sludge drying beds are not lined, thoroughly describe measures taken to ensure that area groundwater is not adversely affected by sludge drying operations.
   d. Indicate the expected frequency with which sludge will be applied to and removed from sludge drying beds.
4. Describe how biosolids are transferred to onsite biosolids storage facility (if applicable). If biosolids are removed directly from sludge drying beds, provide a plan that indicates when during the year you expect to dispose of biosolids and explain that whoever is responsible for disposing of your biosolids will be able to remove and dispose it at this time.

C. Biosolids Characterization

1. Describe proposed sampling procedures by indicating number of samples, sample locations, and sample composition. For reference consult *POTW Sludge Sampling an Analysis Guidance Document*, published by the EPA Publication No. 833-B-89-100.
2. Describe the methods proposed to meet the necessary levels of pathogen reduction (i.e., Class A or B according to 40 CFR 503.32) for the proposed method of sludge disposal.
3. Describe the methods proposed to meet vector reduction requirements, in accordance with 40 CFR Part 503.33.

D. Biosolids Storage

1. If on-site biosolids storage is used,
   a. Describe:
      i. Size of biosolids storage area
      ii. How frequently it will be used (emergency basis only or routine use)
      iii. Typical storage duration
      iv. Leachate controls
      v. Erosion controls
      vi. Run-on/runoff controls
   b. Indicate measures that will be taken to ensure that area groundwater is not adversely affected by the biosolids storage facility.
   c. For biosolids storage facilities that contain biosolids between 1 October and 30 April, describe how facilities are designed and maintained to prevent washout or inundation from a storm or flood with a return frequency of 100 years.
   d. Provide a map of showing setback distances from (where applicable)
      i. Property lines
      ii. Domestic water supply wells
      iii. Non-Domestic water supply wells
      iv. Public roads and occupied onsite residences
      v. Surface waters, including wetlands, creeks, ponds, lakes, underground aqueducts, and marshes
      vi. Primary agricultural drainage ways
      vii. Occupied non-agricultural buildings and off-site residences
      viii. Primary tributary to a waterway or reservoir used for domestic water supply
      ix. Domestic surface water supply intake

E. Spill Response Plan

1. Emergency contacts and notification procedures
2. Personal protective equipment requirements
3. Response instructions for
    a. spill during biosolids transport
    b. storage facility failure
    c. when hazardous or other unauthorized material is found

F. Method of Disposal

1. Describe and provide the following information related to biosolids disposal method(s). If more than one method will be utilized, include the percentage of annual biosolids production expected to be disposed of by each method.
    a. Landfill Disposal
        i. Name(s) and location(s) of landfill(s).
        ii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the landfill(s).
        iii. Present classification of the landfill(s).
        iv. Name and telephone number of the contact person at the landfill(s).
    b. Incineration
        i. Name(s) and location(s) of incineration site(s).
        ii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the incineration site(s).
        iii. Method of disposal of ash from the incineration site(s).
        iv. Names and locations of facilities receiving ash from the incineration site(s), if applicable.
        v. Name and telephone number of the contact person at the incineration site(s).
    c. Composting
        i. Name(s) and location(s) of composting site(s).
        ii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the composting site(s).
        iii. Name and telephone number of the contact person at the composting site(s).
    d. Land Application

i. Ownership of the site(s) where biosolids are applied.

ii. Assessor Parcel Numbers (APNs) of site(s) where biosolids are applied.

iii. Waste discharge requirements order numbers adopted by the Regional Board that regulate the biosolids application site(s).

ATTACHMENT F
STANDARD MONITORING WELL PROVISIONS

Prior to installation of groundwater monitoring wells, the Discharger shall submit a workplan containing at least the information specified in this document. Wells may be installed after the executive officer's approval of the workplan. Upon installation of the monitoring wells, the Discharger shall submit a report of results, as described below. A registered geologist, certified engineering geologist, or civil engineer registered or certified by the State of California must sign all workplans and reports.

Monitoring Well Installation Workplan

A. General Information:
   Monitoring well locations and rationale
   Survey details
   Equipment decontamination procedures
   Health and safety plan
   Topographic map showing any existing monitoring wells, proposed wells, waste handling facilities, utilities, and other major physical and man-made features.

B. Drilling Details: describe drilling and logging methods

C. Monitoring Well Design:
   Casing diameter
   Borehole diameter
   Depth of surface seal
   Well construction materials
   Diagram of well construction
   Type of well cap
   Size of perforations and rationale
   Grain size of sand pack and rationale
   Thickness and position of bentonite seal and sand pack
   Depth of well, length and position of perforated interval

D. Well Development:
   Method of development to be used
   Method of determining when development is complete
   Method of development water disposal

E. Surveying Details: discuss how each well will be surveyed to a common reference point

F. Soil Sampling (if applicable):
   Cuttings disposal method

Analyses to be run and methods
Sample collection and preservation method
Intervals at which soil samples are to be collected
Number of soil samples to be analyzed and rationale
Location of soil samples and rationale
QA/QC procedures

G. Well Sampling:
Minimum time after development before sampling (48 hours)
Well purging method and amount of purge water
Sample collection and preservation method
QA/QC procedures

H. Water Level Measurement:
The elevation reference point at each monitoring well shall be within 0.01 foot. Ground surface elevation at each monitoring well shall be within 0.1 foot. Method and time of water level measurement shall be specified.

I. Proposed time schedule for work.

Monitoring Well Installation Report of Results

A. Well Construction:
Number and depth of wells drilled
Date(s) wells drilled
Description of drilling and construction
Approximate locations relative to facility site(s)
A well construction diagram for each well must be included in the report, and should contain the following details:
Total depth drilled
Depth of open hole (same as total depth drilled if no caving occurs)
Footage of hole collapsed
Length of slotted casing installed
Depth of bottom of casing
Depth to top of sand pack
Thickness of sand pack
Depth to top of bentonite seal
Thickness of bentonite seal
Thickness of concrete grout
Boring diameter
Casing diameter
Casing material
Size of perforations

Number of bags of sand
Well elevation at top of casing
Depth to ground water
Date of water level measurement
Monitoring well number
Date drilled
Location

B. Well Development:
Date(s) of development of each well
Method of development
Volume of water purged from well
How well development completion was determined
Method of effluent disposal
Field notes from well development should be included in report.

C. Well Surveying: provide reference elevations for each well and surveyor's notes

D. Water Sampling:
Date(s) of sampling
How well was purged
How many well volumes purged
Levels of temperature, EC, and pH at stabilization
Sample collection, handling, and preservation methods
Sample identification
Analytical methods used
Laboratory analytical data sheets
Water level elevation(s)
Groundwater contour map

E. Soil Sampling (if applicable):
Date(s) of sampling
Sample collection, handling, and preservation method
Sample identification
Analytical methods used
Laboratory analytical data sheets

NOVA DISK FILTER EVALUATION AT ORANGE COUNTY SOUTH REGIONAL WATER RECLAMATION FACILITY – SAND LAKE ROAD

DISK FILTER EVALUATION AT ORANGE COUNTY SOUTH REGIONAL WATER RECLAMATION FACILITY – SAND LAKE ROAD

NOVA WATER DISK FILTER MODEL 1001 - ULTRASCREEN

Introduction – Nova Water Technologies in conjunction with Carter and Verplanck received permission to test the Ultrascreen disk filter at the SLR water reclamation facility on secondary clarifier effluent. The objectives include a real time comparison with the existing Aqua Aerobic disk filters for multiple parameters and the ability to demonstrate compliance with the California State Department of Health Title-22 standards for public access reuse of reclaimed water from municipal sewage.

The comparison with the Aqua filters is being organized and overseen by managerial level county utility staff while the Title-22 documentation is being conducted by Carollo

Engineers from their Sarasota, FL office (Sean Poust) and being supported by Dr Keith Bourgeous from the Sacramento, CA office.

Background – The Ultrascreen disk filter is a product originally developed by Nuove Energie located in Vicenza, Italy. Nuove has been involved in liquid/solid separation process equipment for almost 20 years and has teamed with Nova Water for developing applications for the Ultrascreen filter in North America. Since teaming with Nova the Ultrascreen technology has been demonstrated with good results at more than a dozen wastewater facilities including the Orange County NW facility. The Ultrascreen disk filter is available in multiple capacities. The model 1001 represents the smallest standard production unit and has 17 square feet of filtration media.

The key difference in the filtration media used on the Ultrascreen versus the Aqua filter is the material and the weave configuration. The Ultrascreen uses a precision woven stainless steel mesh allowing for precise micron size adjustments for the specific process purpose. The Aqua filter can use several types of media from needle felt to nonwoven nylon or acrylic mounted on a woven backing.

Objectives – For the performance comparison between the Aqua filter and the Nova filter the following major parameters were proposed for data collection and review:

Flow to each filter measured as gpm per square foot of media. Both filters have flow meters installed. The Aqua filter is using a Panametrics brand unit. The Nova filter is using an Endress and Hauser brand mag meter.

Influent NTU which is the same to both filters as the Nova filter draws water from the Aqua feed trough. The influent NTU is being measured by a HACH brand continuous on line turbidimeter.

Effluent NTU measured at the filter discharge for both filters. Both filters are using HACH brand continuous on line turbidimeters.

Measure the volume of backwash reject water produced by both filters. The Aqua filter is using an ABB brand mag flow meter. The Nova filter is using a physical capture tank for reject collection that can hold more than 250 gallons. This can accommodate at least one full 24 hour period of reject collection. These values are being measured and recorded manually and supervised by Carollo Engineers weekly.

The final filter layout is shown below with feed and drain piping and a temporary observation platform. The building in the background houses the VFD's for the filter drive, the filter feed pump and the backwash pump, the data recorder and the turbidimeter analyzers.

<u>Data Collection</u> – The influent flow rate to the Aqua filter is being recorded by the plant SCADA system. The influent flow to the Nova filter is being recorded by an ABB brand Videographic data recorder. Some typical graphs are included.

The influent turbidity for both filters is being recorded by the same data recorder.

The effluent turbidity for the Aqua filter is being recorded by the plant SCADA system and the ABB data recorder.

The Aqua reject flow meter is being read and recorded manually.

The Nova filter data is being recorded for influent feed gpm, influent NTU, effluent NTU, and backwash pump operating cycles. These are being recorded on the ABB data recorder.

<u>Sample Collection</u> – Samples are being collected by the county plant staff on an established schedule. The influent and effluent for both filters are sampled at approximately the same time and the samples are collected multiple times each day. The Carollo staff has also collected samples from both filters for additional analysis. The Carollo staff will continue collecting samples each Monday for the duration of the Title-22 protocol. The county staff is also collecting samples for Carollo to support the Title-22 collection.

Note: Nova Water staff has not collected any of the samples being analyzed by either party for either filter.

Sample Analysis and Results – The lab results from county collected samples will be tabulated and reviewed by county staff. To date Nova Water has not been informed as to any results.

The lab results from Carollo collected samples are being reviewed by Carollo and some of the data has been forwarded to Nova Water for our review. Some of the Carollo data is included in this progress report.

Test Protocol and Schedule – The testing calendar was originally targeted for a March to April time frame. Several factors prevented this from being accomplished. The main issues were electrical and instrumentation. The filter was reliably on line in May and Nova Water began a series of tests to determine possible loading rates, reject rates and particle capture capabilities. The nature of the secondary clarifier effluent suspended particles indicated the need for Nova to apply a filtration mesh with finer weave characteristics. Fortunately this is accomplished fairly easily with the Ultrascreen design but even so there was a lead time required to get the fabric and that caused some additional waiting time.

Once the new mesh was installed (20 micron) the Nova filter was tested again for establishing the basic parameters. Our original goal was to operate at a maximum hydraulic loading rate of 16 gpm per square foot. Both the original 25 micron mesh and the current 20 micron mesh have demonstrated they can meet this hydraulic throughput

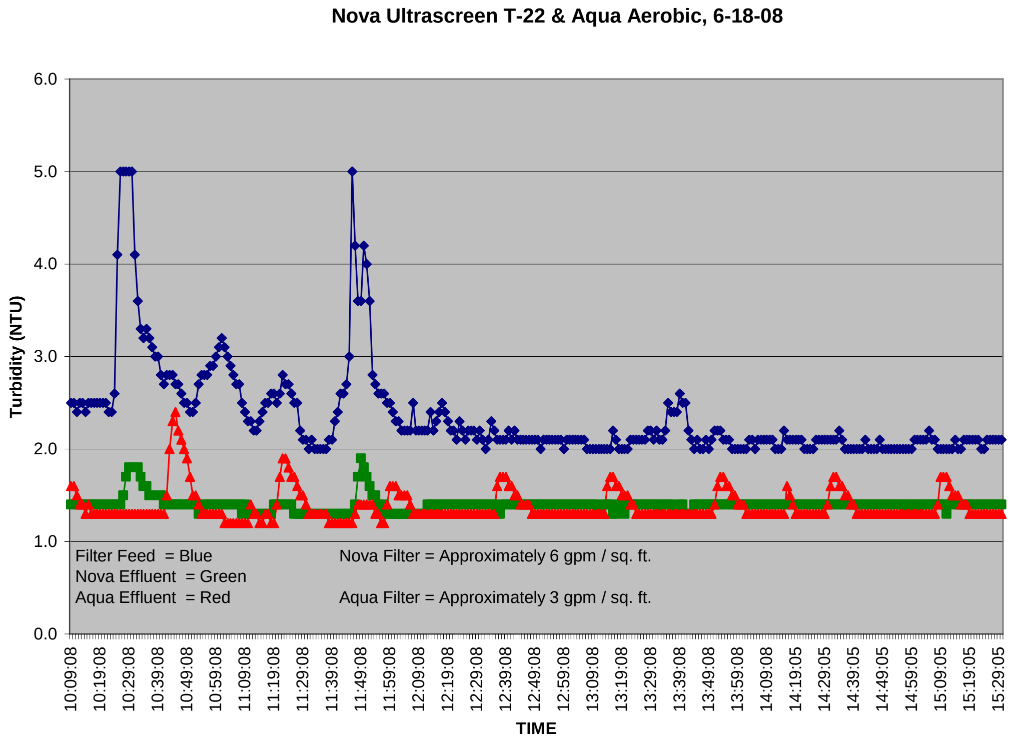
For the purpose of data collection we have operated the Nova filter initially at 102 gpm average or 6 gpm/sq ft and 5 rpm rotation speed. During this time the Aqua filter was operated at approximately 3 gpm/sq ft.

The second operating point for the Nova filter was 6 gpm/sq ft and 6 rpm rotation speed. The Aqua filter was operated at approximately 4 gpm/sq ft.

Moving forward into the coming weeks the Nova filter will be increased incrementally up to 16 gpm/sq ft and the Aqua filter is proposed to operate at up to 8 gpm/sq ft.

Observations – To date the filters have been operating well and each design is producing approximately equal results for effluent turbidity as expressed in NTU's. The Nova filter has so far demonstrated that it can operate at 6 gpm/sq ft continuously over a wide range of influent turbidity values and maintain effluent values of less than 2.0 NTU which is our target for the Title-22 criteria. The Aqua filter has also operated well at the 3-4 gpm/sq ft loading rates.

A typical data recording is shown in the graph below. Both filters are showing the expected responses to significant spikes in influent turbidity. Both filters are performing within expectations. The Nova filter has been able to handle the NTU spikes as effectively as the Aqua filter overall. For the data period covered the Nova filter is operating at approximately double the hydraulic loading rate of the Aqua filter based on readings from the two influent flow meters.

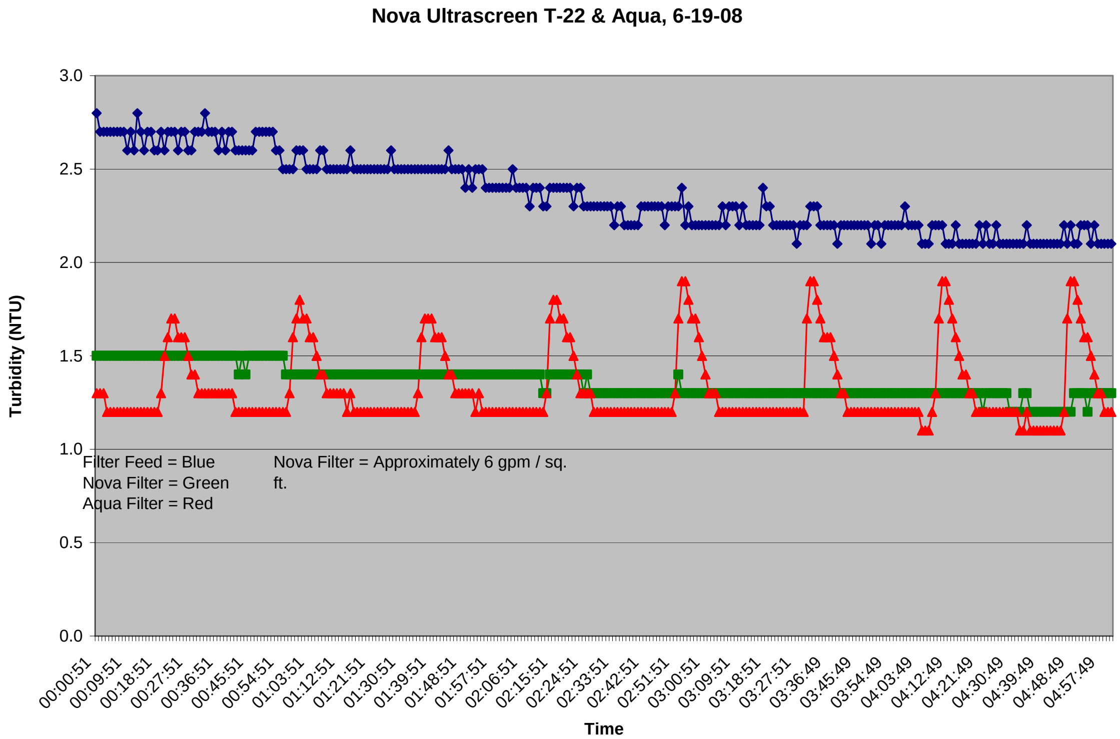


The Nova filter displays a relatively flat effluent turbidity trend when compared to the Aqua filter. The reason for this difference is the pulse wash nature of the Ultrascreen. The duration of backwash for the Ultrascreen is brief and the frequency is more often than the Aqua technology employs. The Ultrascreen uses a pressure washing concept where the Aqua filter is using a vacuum suction approach. Both concepts work and the Aqua backwash frequency can be noted on the chart as a brief increase in turbidity accompanies each of the backwash cycles.

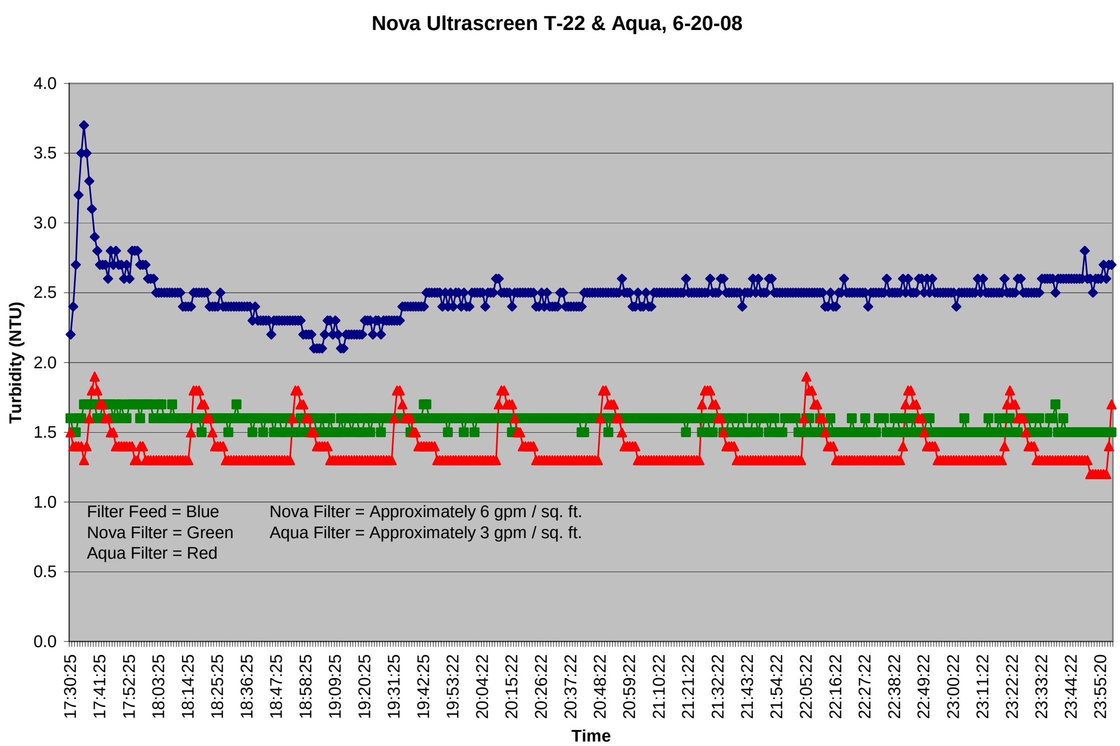
The backwash cycle for the Aqua filter is presently controlled by the filter water elevation above the disks (differential) versus the filter effluent elevation. The Nova filter is being operated at a consistent elevation for initiating the backwash cycle during the testing at SLR.

Note: It is also possible to operate the Nova filter using a PLC with programmed logic that can vary the desired backwash initiation elevation to optimize the filter operation for changing influent condition like flow and turbidity.

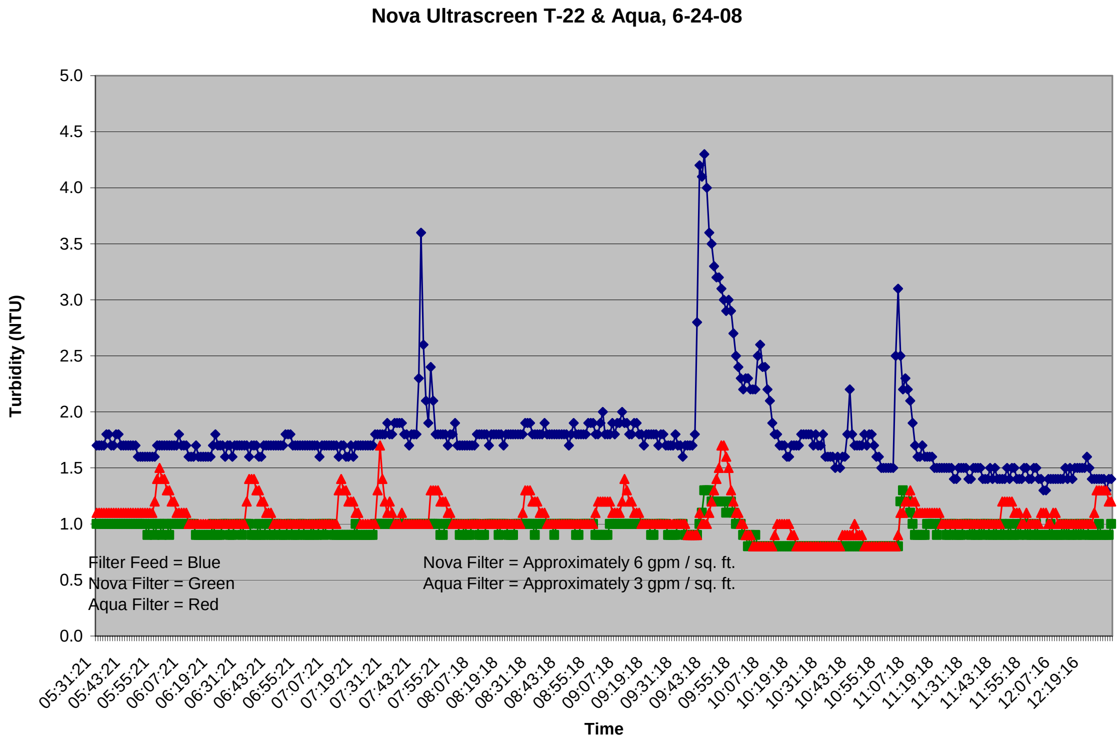
Additional turbidity graphic displays are shown below.



The Nova filter is producing a relatively flat NTU trend line even with variable influent.

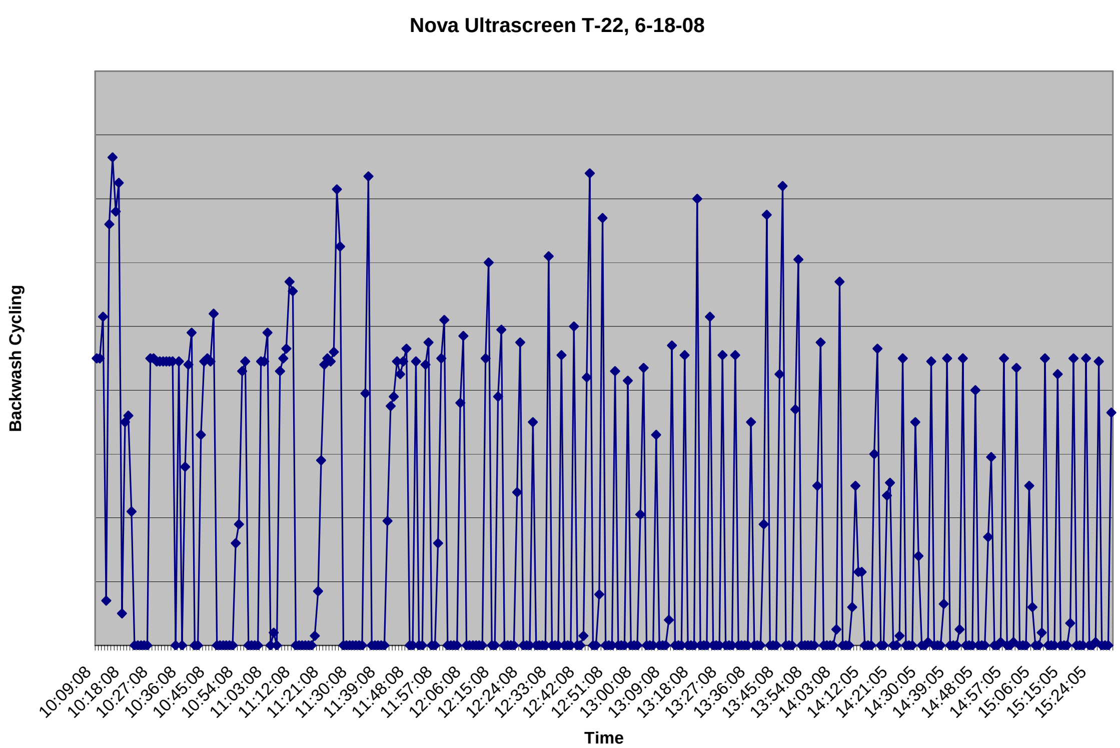


Both filters are producing effluent below the Title-22 threshold value of 2.0 NTU.



Both filters show response to influent turbidity spike on June 24th around 10 AM.

Backwash and Reject - The pulse backwash concept employed by the Nova filter takes advantage of three principles; media, pressure and elevation. Each is discussed below.



Media – The precision woven stainless steel media provides fine pore size control while presenting a shallow profile to the water being filtered. Particles rejected on the feed side of the media do not penetrate the mesh at any depth as is the design concept employed with cloth filtration. This allows the particles to be separated from the mesh easily when the time comes for backwashing.

Pressure – The original cloth filtration concepts using needle felt employed high pressure washing cycles for removing the captured particles. Once the particles are deeply embedded in the cloth fabric a substantial amount of volume and pressure is required to extract them

The Ultrascreen concept uses the opposite approach. The precision mesh maintains a dynamic film layer of rejected solids at the surface of the media and because there is no significant depth to the media particles are easily washed at low pressure from the outside to the inside using previously filtered water. At SLR we have demonstrated that wash pressures as low as 20 psig can be used for keeping the media clean at an acceptable level for extended periods of time.

Elevation – The Ultrascreen disks are in constant slow rotation during filtration cycles. The disks are approximately 50% submerged at the maximum normal operating liquid level. This allows the 50% of the disk above the water level elevation to be washed as it rotates above the filter feed well. The filter initiates a backwash cycle when the internal feed water elevation reaches a preset point. This allows the disks to be cleaned when they need to be without hindering the ongoing filtration of continuous influent flow.

During times of low turbidity in the influent water the disks can operate for many minutes without requiring a backwash cycle. Eventually captured particles begin to coat the disk media and headloss increases. When the backwash elevation is reached the wash pump energizes and the disks are washed just long enough to return the headloss to normal. The wash pump shuts off and the process repeats itself.

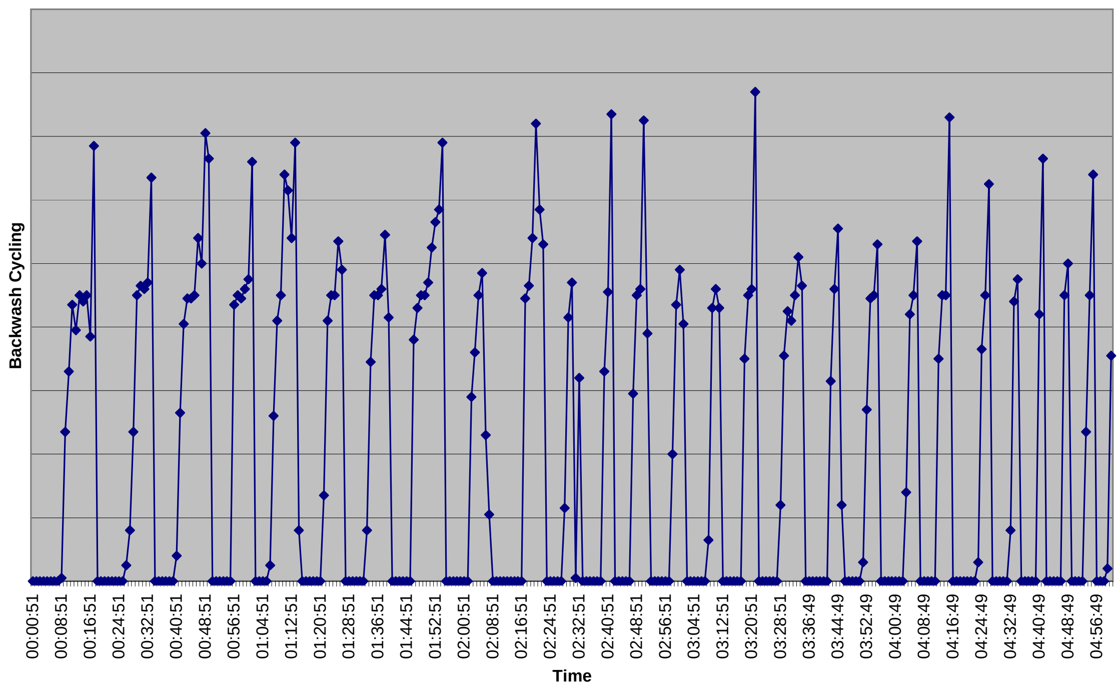
The dirty water is caught in a simple collection trough and leaves the filter under gravity flow. The entire backwash cycle normally takes 10-15 seconds to complete. The time between backwash cycles is highly variable based on influent turbidity and TSS loading. The typical cycles at SLR have been 1.5 – 2.0 minutes so far.

Reject – Using the pulse backwash approach the Nova filter has been able to produce reject rates that have been below one quarter of one percent to date. This is well below the reject rates of traditional cloth disk filters.

Note: On larger systems the individual backwash pumps would be replaced by a typical wash water pressure manifold that can feed wash water to all the filters in a given configuration. A simple solenoid controlled valve can operate at each filter to allow backwash water to flow when called for.

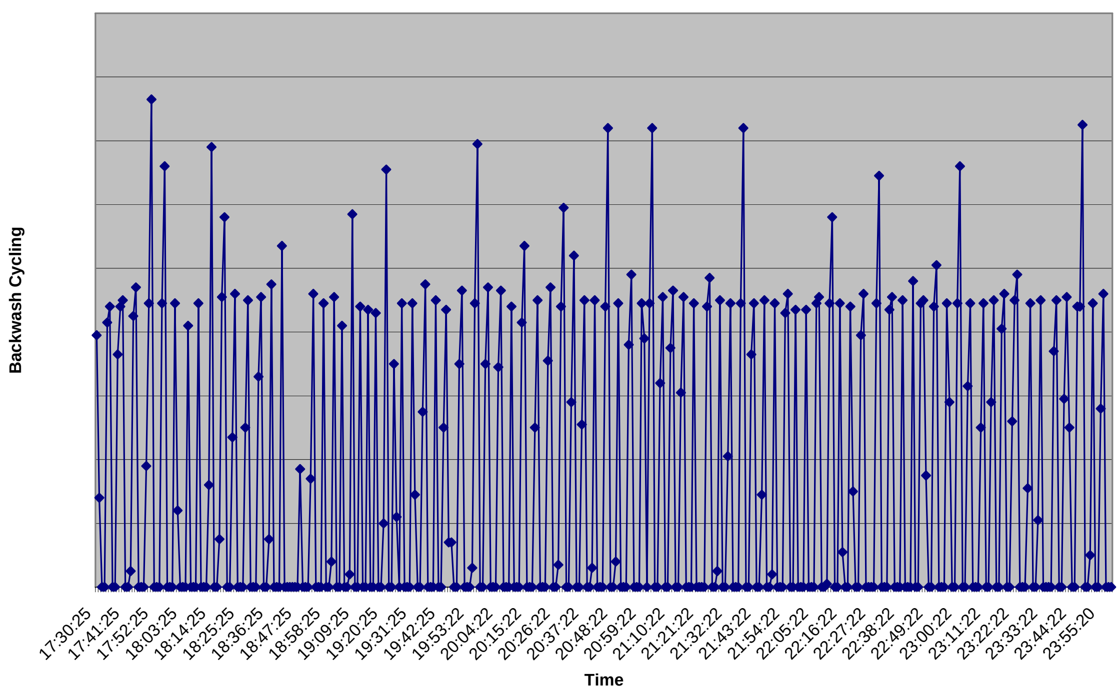
Additional backwash graphs and feed flow rate graphs are shown below.

Nova Ultascreen T-22, 6-19-08



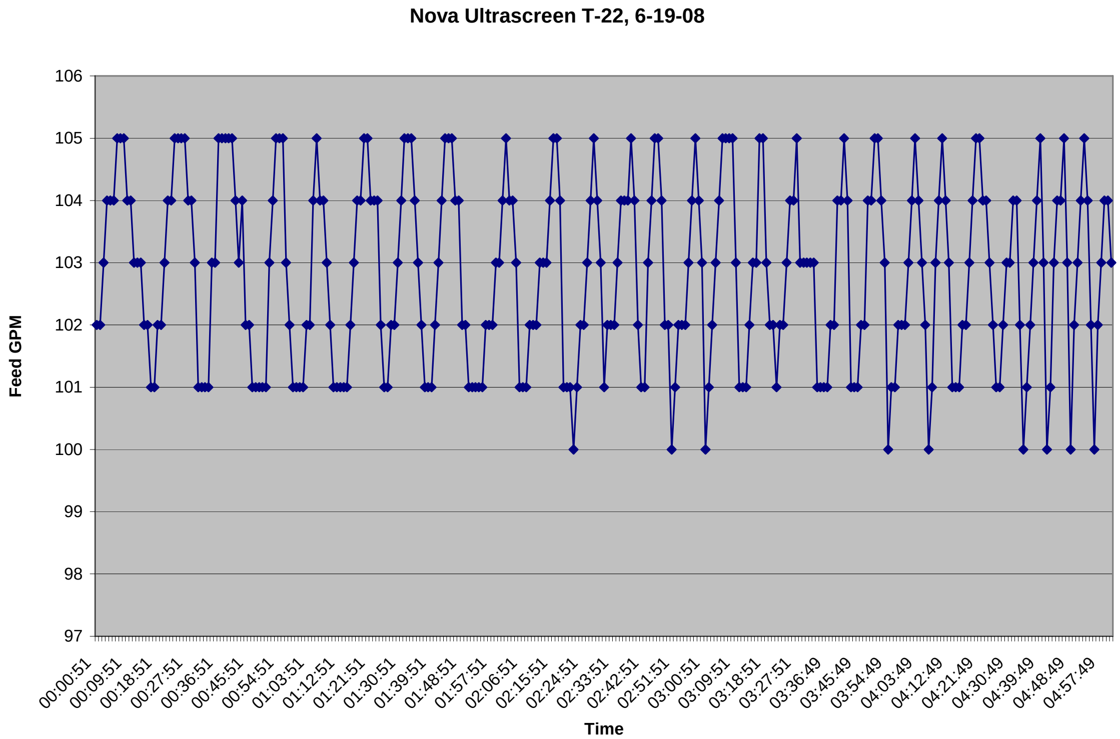
Typical pulse backwash cycles from June 19th.

Nova Ultrascreen, Backwash 6-20-08

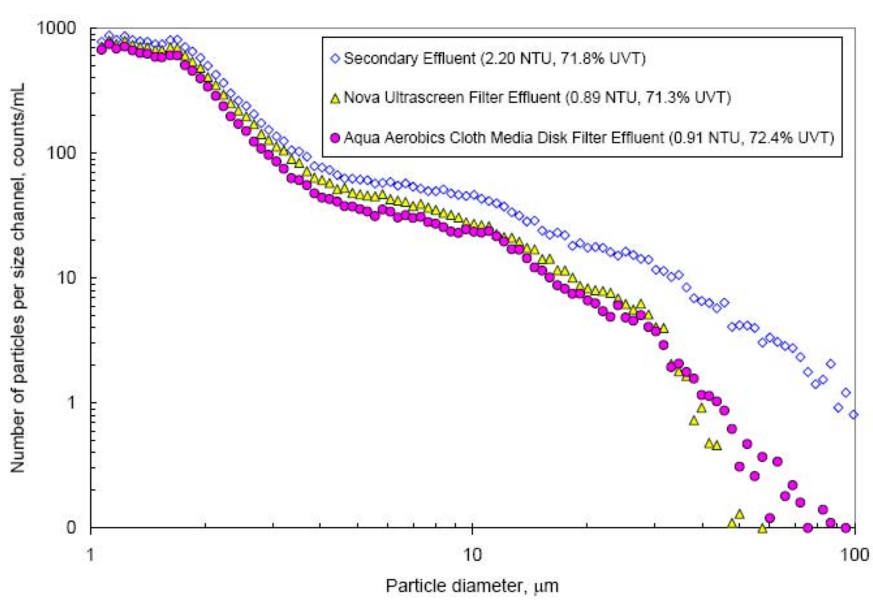


Typical pulse backwash cycles from June 20th.

The influent flow rate has also been data recorded. An example is below. The target flow rate is 102 gpm average for the Nova filter with 17 sq ft of filtration media for a hydraulic loading rate of 6 gpm/sq ft.



Particle Counting and Size Distribution - The Carollo testing is also looking at particle size removal and particle size distribution as part of their analytical work. Early test indications from samples suggest there is minimal difference between the cloth filter media and the stainless steel mesh performance in this regard. See the graph below.



In reviewing the graph show above it can be seen that the secondary clarifier is producing effluent with relatively low turbidity. The number of particles being removed by filtration in either filter is minimal until the 9-10 micron particle size range is reached. Both filters show approximately the same particle size distribution on particles smaller than about 9 microns and both filters show good removal of particles larger than 10 microns.

Summary - The significant difference in media selection appears to make little difference in the particle size distribution overall. The dynamic disk operation associated with the Nova filter is allowing the filter to operate at higher hydraulic loading and maintain approximately the same water quality as the cloth filter, 6 gpm/sq ft versus 3 gpm/sq ft for the first two weeks of testing.

The Nova filter so far has produced essentially equivalent turbidity performance compared to the cloth filter technology over a wide range of influent NTU values.

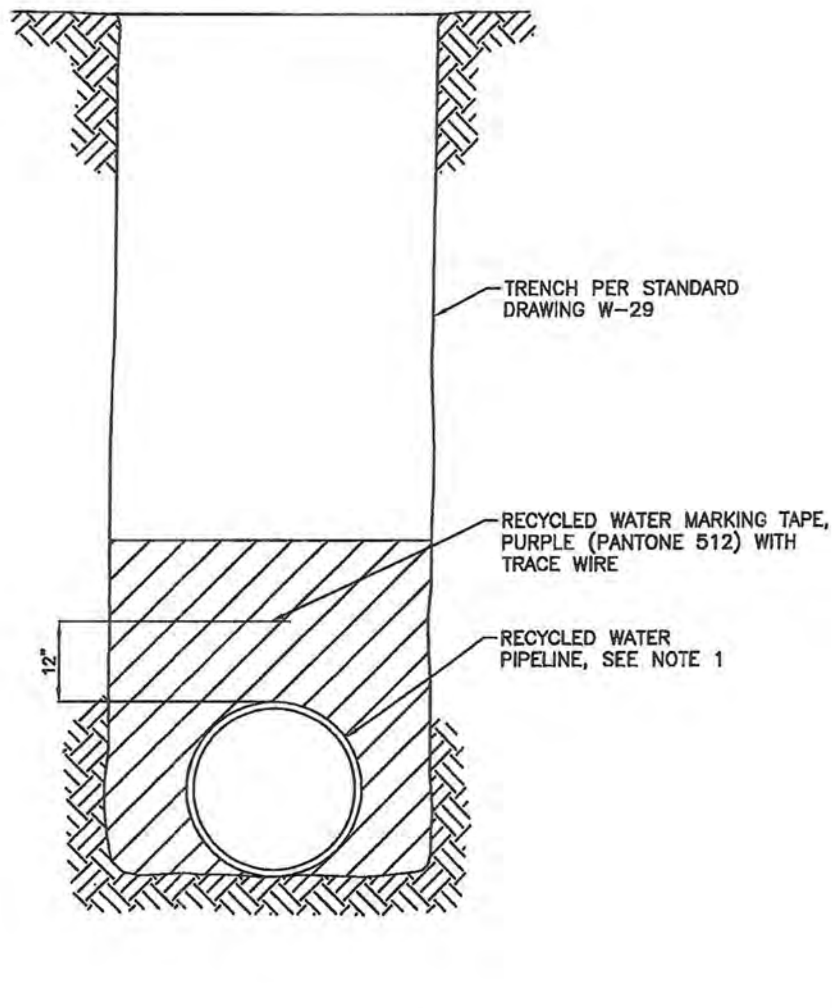
The Nova filter reject rate while operating at 6 gpm/sq ft has been measured in a separate collection vessel on multiple calibration runs and has been measured to be about one tenth of the reject rate of the cloth filter technology.

We also wish to thank Orange County for allowing us to be on site and utilizing their facility for this work.

APPENDIX E
STANDARD SPECIFICATIONS AND DRAWINGS
FOR RECYCLED WATER FACILITIES

RECYCLED WATER STANDARD DRAWINGS

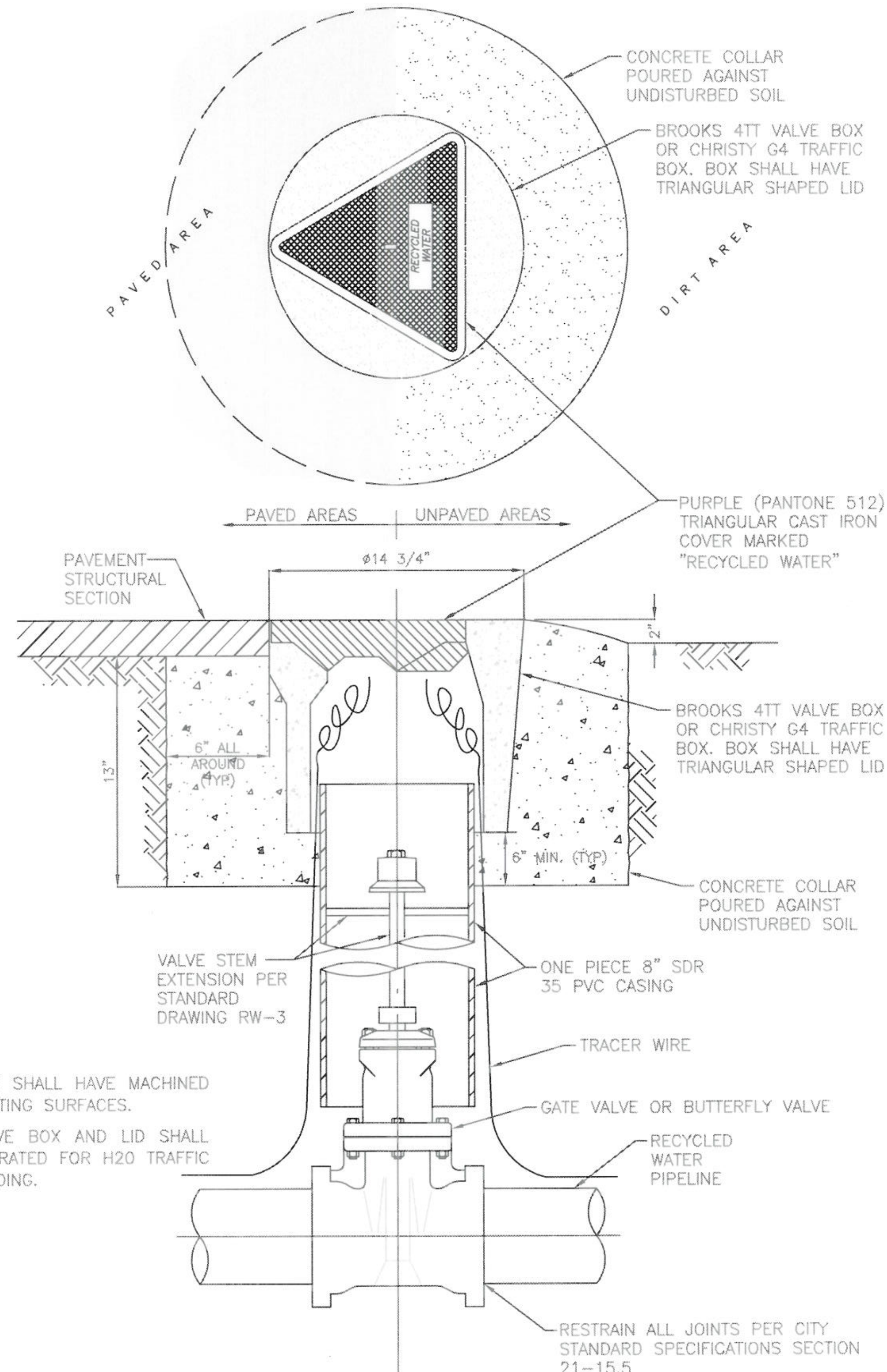
NO.	TITLE OF DRAWING
☐RW-1	Recycled Water Main Identification
☐RW-2	Recycled Water Valve and valve Box
☐RW-3	Recycled Water Valve Stem Extension
☐RW-4	1" Service Connection & Meter Box Installation
☐RW-5	1-1/2" & 2" Service Connection & Meter Box Installation
☐RW-6	4" Recycled Water Service
☐RW-7	Temporary 2" Recycled Water Blow-off
☐RW-8	Recycled Water Blow-off Assembly
☐RW-9	Recycled Water 1" or 2" Air Release/Vacuum Breaker Station
☐RW-10	Recycled Water 4" Air Release/Vacuum Breaker Station
☐RW-11	1" or 2" Air Release/Vacuum Breaker Valve Enclosure
☐RW-12	Recycled Water Main Separation Requirements
☐RW-13	Recycled Water Irrigation Information Sign
☐RW-14	Recycled Water Remote Control Irrigation valve Identification
☐RW-15	Recycled Water Backflow Preventer Identification
☐RW-16	Recycled Water Irrigation Box Cover Markings
☐RW-17	Recycled Water Irrigation System Clock Marking
☐RW-18	General Recycled Water Identification Tag
☐RW-19	Recycled Water Landscape Irrigation Head Identification
☐RW-20	Quick Coupling Valve
☐RW-21	Cross Connection Control Test Station
☐RW-22	Temporary Potable Water Supply to On-site Recycled Water System
☐RW-23	Temporary Potable Water Supply to Recycled Water System



NOTE:

1. RECYCLED WATER PIPELINES SHALL BE COLORED PURPLE (PANTONE 512) AND INTEGRALLY STAMPED "RECYCLED WATER – DO NOT DRINK" ON OPPOSITE SIDES OF THE PIPE. ALTERNATIVELY, NON-PVC RECYCLED WATER PIPELINES MAY BE MARKED WITH LETTERING ON PURPLE MARKING TAPE BEARING THE CONTINUOUS WORDING "RECYCLED WATER-DO NOT DRINK". THE MARKING TAPE SHALL BE A MINIMUM OF SIX INCHES WIDE AND SHALL BE SECURELY ATTACHED DIRECTLY TO THE TOP OF THE PIPELINE EVERY FIVE FEET.

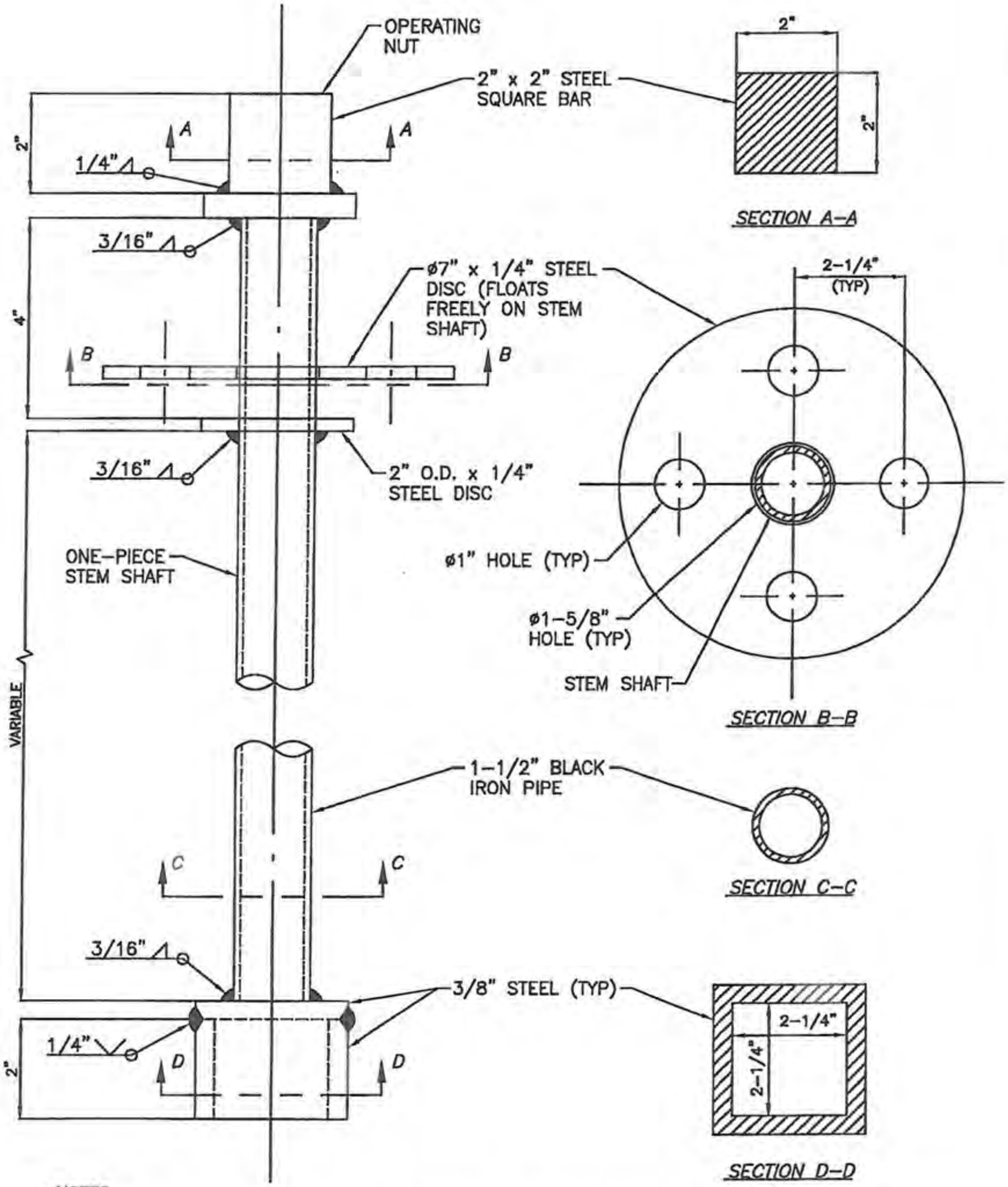
RECYCLED WATER MAIN IDENTIFICATION	REF. & REV. JUNE 2014	CITY OF FRESNO RW-1



NOTES:

1. LIDS SHALL HAVE MACHINED COATING SURFACES.
2. VALVE BOX AND LID SHALL BE RATED FOR H20 TRAFFIC LOADING.

RECYCLED WATER VALVE AND VALVE BOX	REF. & REV. AUGUST 2015	CITY OF FRESNO RW-2

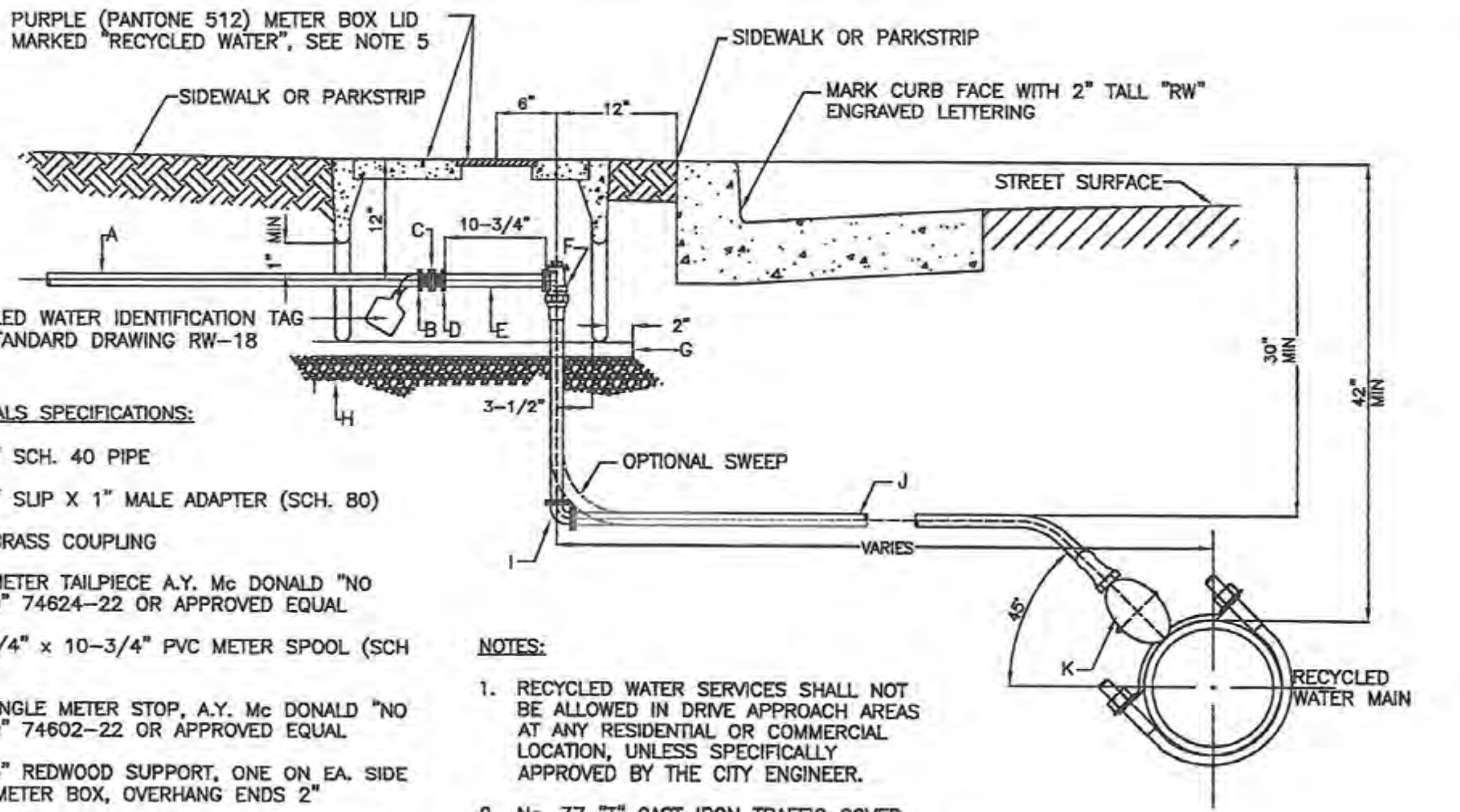


NOTES:

1. EXTENSION STEM SHAFT SHALL BE ROUND OR SQUARE STEEL TUBING OF ONE-PIECE DESIGN (NO PINNED CONNECTIONS OR COUPLINGS PERMITTED).
2. VALVES DEEPER THAN 5' REQUIRE A VALVE STEM EXTENSION.
3. EXTENSION STEMS SHALL NOT BE ATTACHED/BOLTED TO OPERATING NUT OF THE VALVE.
4. VALVE STEM EXTENSION SHALL BE HOT DIP GALVANIZED AFTER FABRICATION IS COMPLETE.

RECYCLED WATER VALVE STEM EXTENSION	REF. & REV. JUNE 2014	CITY OF FRESNO RW-3

1" SERVICE CONNECTION & METER BOX INSTALLATION



MATERIALS SPECIFICATIONS:

A 1 ½" SCH. 40 PIPE

B 1 ½" SLIP X 1" MALE ADAPTER (SCH. 80)

C 1" BRASS COUPLING

D 1" METER TAILPIECE A.Y. Mc DONALD "NO LEAD" 74624-22 OR APPROVED EQUAL

E 1-1/4" x 10-3/4" PVC METER SPOOL (SCH 80)

F 1" ANGLE METER STOP, A.Y. Mc DONALD "NO LEAD" 74602-22 OR APPROVED EQUAL

G 2"X4" REDWOOD SUPPORT, ONE ON EA. SIDE OF METER BOX, OVERHANG ENDS 2"

H 6" THICK ¾" CRUSHED ROCK WHEN BOX IS PLACED IN ALLEYS WITH TRASH PICK UP ONLY. ALL BOXES IN ALLEYS SHALL BE PLACED PARALLEL TO ALLEY

I COMP X COMP 90° ELL, A.Y. Mc DONALD "NO LEAD" 74761-22 OR APPROVED EQUAL

J TYPE "K" SOFT DRAWN COPPER TUBING CONTINUOUSLY WRAPPED IN PURPLE MARKING TAPE OR PURPLE (PANTONE 512) POLYETHYLENE CTS SDR-9 PE 3408, USE COMPRESSION JOINTS WITH STAILESS STEEL INSERT

K 1" CORPORATION STOP A.Y. Mc DONALD "NO LEAD" 74701-22 OR APPROVED EQUAL

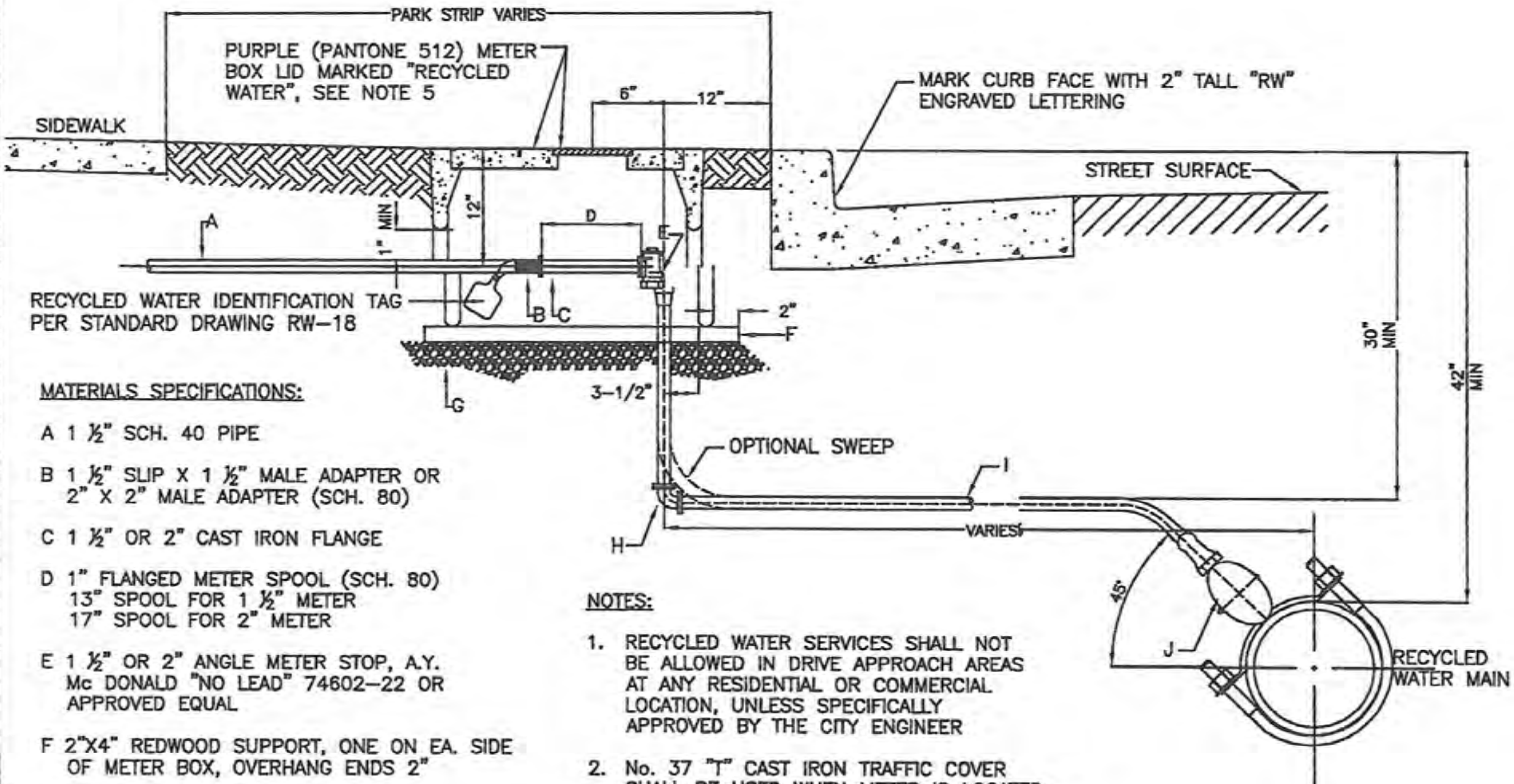
NOTES:

1. RECYCLED WATER SERVICES SHALL NOT BE ALLOWED IN DRIVE APPROACH AREAS AT ANY RESIDENTIAL OR COMMERCIAL LOCATION, UNLESS SPECIFICALLY APPROVED BY THE CITY ENGINEER.
2. No. 37 "T" CAST IRON TRAFFIC COVER SHALL BE USED WHEN METER IS LOCATED IN ALLEYS OR DRIVE APPROACH AREAS, OR BEHIND ROLLED CURBS.
3. ALL COPPER FITTINGS SHALL BE CAMPAK COMPRESSION-TYPE.
4. FOR PVC RECYCLED WATER MAIN TAPS, SERVICE SADDLES WITH CIRCUMFERENTIAL TYPE BANDS SHAPED TO FIT THE ACTUAL O.D. OF THE PIPE AND HAVING A MINIMUM BEARING WIDTH OF 3" (1-1/2" PER BAND) SHALL BE USED. FOR DUCTILE AND CAST IRON MAINS USE BRONZE OR DUCTILE IRON SERVICE SADDLES, WITH BRONZE OR STAINLESS DOUBLE STRAPS.
5. METER BOX SHALL BE OLD CASTLE B16 OR N16 BOX WITH CAST-IN CORNER BRACKETS. USE ARMORCAST A6000489T-COF LID
6. RECYCLED WATER SERVICES SHALL BE LOCATED A MINIMUM OF 4' CLEAR OF POTABLE WATER SERVICES.

REF. & REV.
JUNE 2014

CITY OF FRESNO

RW-4



MATERIALS SPECIFICATIONS:

A 1 ½" SCH. 40 PIPE

B 1 ½" SLIP X 1 ½" MALE ADAPTER OR 2" X 2" MALE ADAPTER (SCH. 80)

C 1 ½" OR 2" CAST IRON FLANGE

D 1" FLANGED METER SPOOL (SCH. 80)
13" SPOOL FOR 1 ½" METER
17" SPOOL FOR 2" METER

E 1 ½" OR 2" ANGLE METER STOP, A.Y. Mc DONALD "NO LEAD" 74602-22 OR APPROVED EQUAL

F 2"X4" REDWOOD SUPPORT, ONE ON EA. SIDE OF METER BOX, OVERHANG ENDS 2"

G 6" THICK ¾" CRUSHED ROCK WHEN BOX IS PLACED IN ALLEYS WITH TRASH PICK UP ONLY. ALL BOXES IN ALLEYS SHALL BE PLACED PARALLEL TO ALLEY

H COMP X COMP 90° ELL, A.Y. Mc DONALD "NO LEAD" 74761-22 OR APPROVED EQUAL

I TYPE "K" SOFT DRAWN COPPER TUBING CONTINUOUSLY WRAPPED IN PURPLE MARKING TAPE OR PURPLE (PANTONE 512) POLYETHYLENE CTS SDR-9 PE 3408, USE COMPRESSION JOINTS WITH STAINLESS STEEL INSERT

J 1" CORPORATION STOP A.Y. Mc DONALD "NO LEAD" 74701-22 OR APPROVED EQUAL

NOTES:

1. RECYCLED WATER SERVICES SHALL NOT BE ALLOWED IN DRIVE APPROACH AREAS AT ANY RESIDENTIAL OR COMMERCIAL LOCATION, UNLESS SPECIFICALLY APPROVED BY THE CITY ENGINEER

2. No. 37 "T" CAST IRON TRAFFIC COVER SHALL BE USED WHEN METER IS LOCATED IN ALLEYS OR DRIVE APPROACH AREAS, OR BEHIND ROLLED CURBS.

3. ALL COPPER FITTINGS SHALL BE CAMPAK COMPRESSION-TYPE.

4. POLYETHYLENE PIPE SHALL USE CAMPAK COMPRESSION-TYPE JOINTS WITH STAINLESS STEEL INSERT.

5. FOR 1½" SERVICE, METER BOX SHALL BE ARMORCAST OR APPROVED EQUAL. OLD CASTLE B30 BOX W/ CAST-IN CORNER BRACKETS ARMORCAST A6001969-COF LID FOR 1 ½" METER OR OLD CASTLE B36 BOX W/ CAST-IN CORNER BRACKETS & ARMORCAST A6001947T-COF LID FOR 2" METER.

6. FOR PVC RECYCLED WATER MAIN TAPS, SERVICE SADDLES WITH CIRCUMFERENTIAL TYPE BANDS SHAPED TO FIT THE ACTUAL O.D. OF THE PIPE AND HAVING A MINIMUM BEARING WIDTH OF 3" (1-1/2" PER BAND) SHALL BE USED. FOR DUCTILE AND CAST IRON MAINS USE BRONZE OR DUCTILE IRON SERVICE SADDLES, WITH BRONZE OR STAINLESS DOUBLE STRAPS.

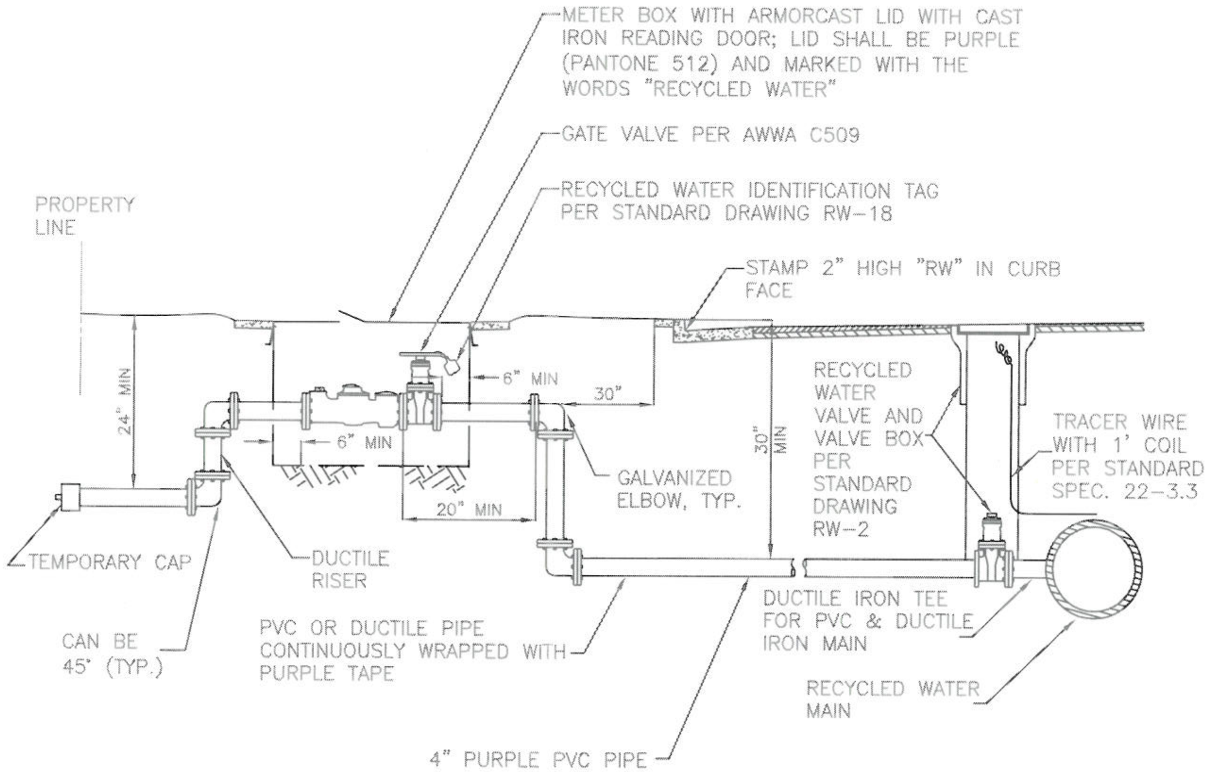
7. RECYCLED WATER SERVICES SHALL BE LOCATED A MINIMUM OF 4' CLEAR OF POTABLE WATER SERVICES.

1-1/2" & 2" SERVICE CONNECTION & METER BOX INSTALLATION

REF. & REV. JUNE 2014

CITY OF FRESNO

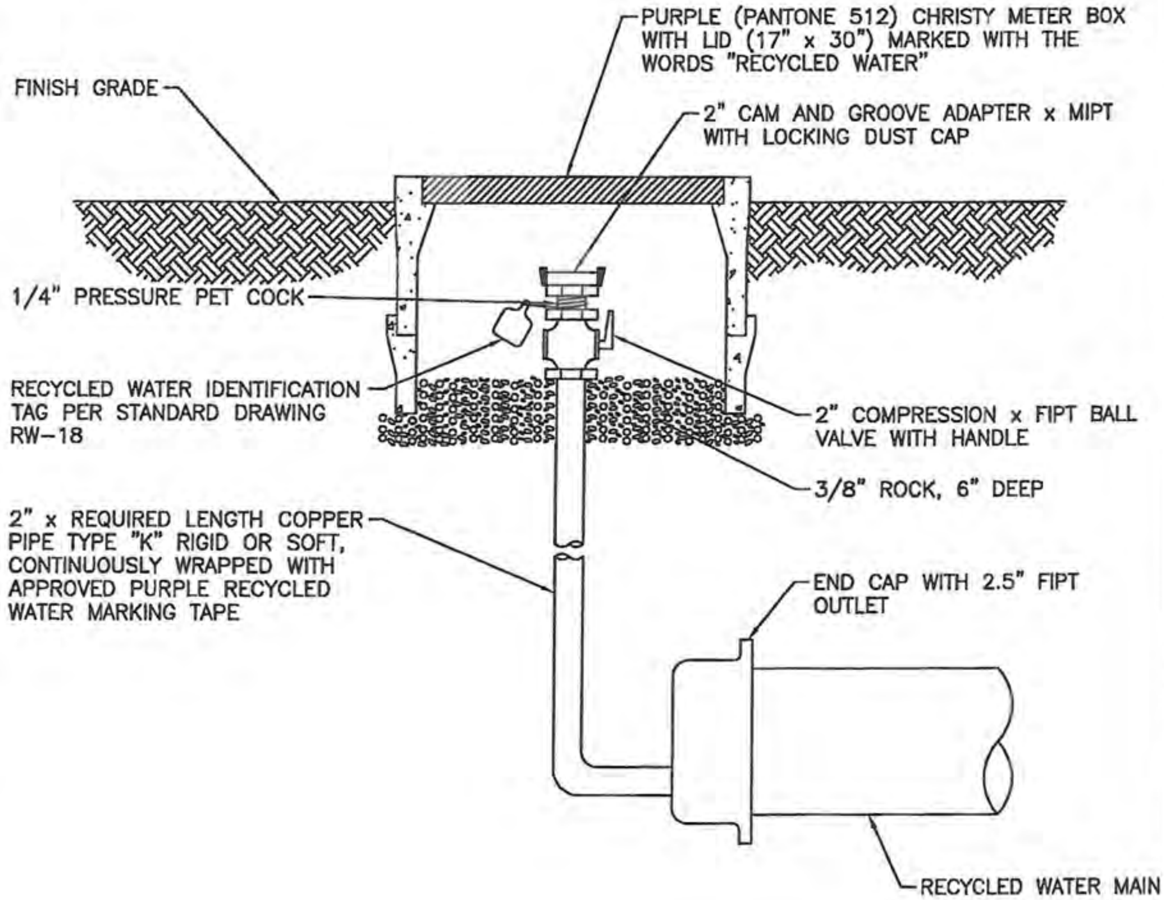
RW-5



NOTES:

1. RECYCLED WATER SERVICE AND METER BOX INSTALLATION SHALL BE INSPECTED AND APPROVED BY CITY PRIOR TO SIDEWALK INSTALLATION.
2. RECYCLED WATER SERVICES SHALL BE LOCATED A MINIMUM OF 4' CLEAR OF POTABLE WATER SERVICES.
3. ALL MATERIALS SHALL BE AS NOTED OR CITY-APPROVED EQUAL.
4. ALL METER BOXES IN DIRT OR LANDSCAPE AREAS SHALL BE SET IN A 6" CONCRETE SLAB MEASURING AT LEAST 1' BEYOND METER BOX ON ALL SIDES.
5. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5
6. RECYCLED WATER SERVICES SHALL NOT BE ALLOWED IN DRIVEWAY APPROACH AREAS AT ANY RESIDENTIAL OR COMMERCIAL LOCATION.

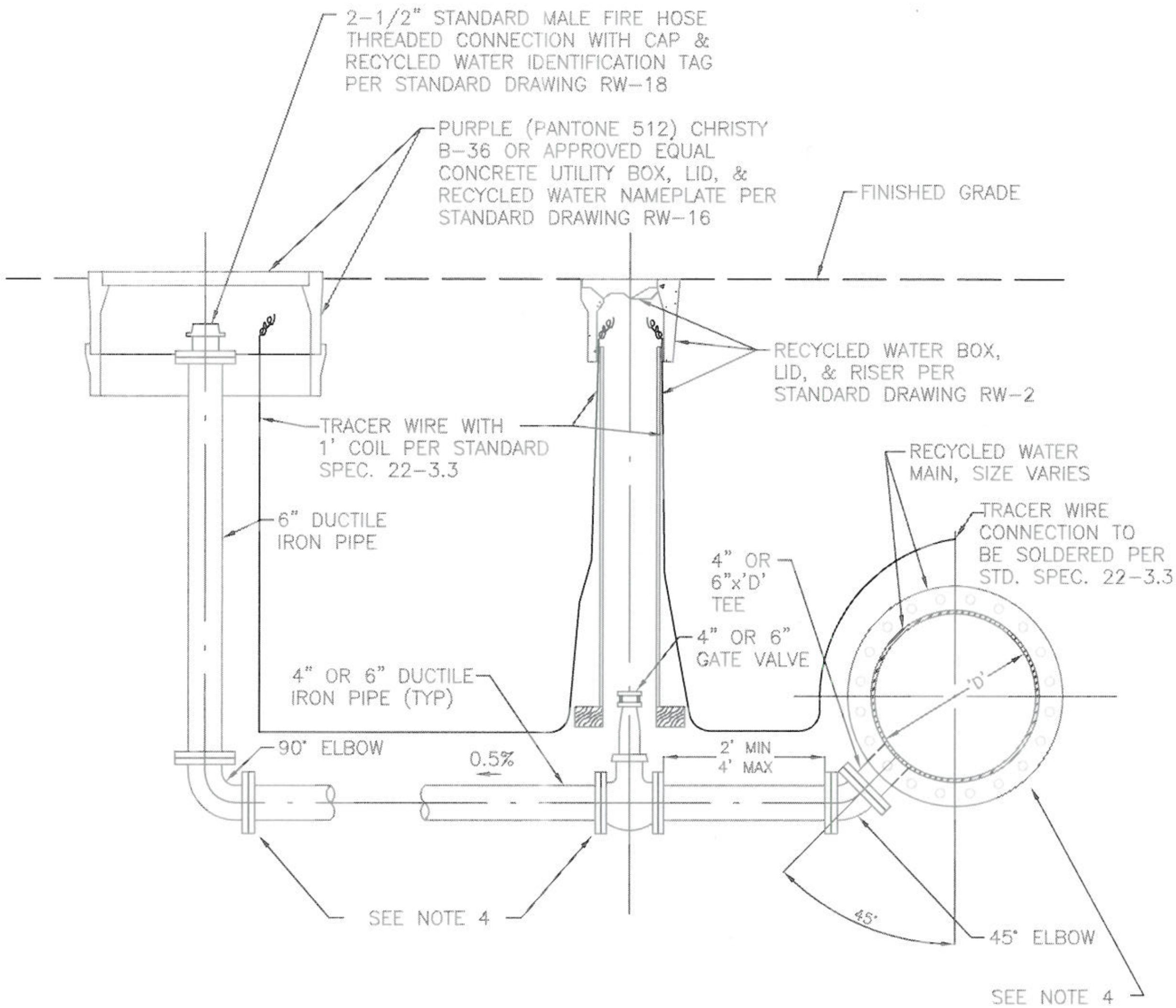
4" RECYCLED WATER SERVICE	REF. & REV. AUGUST 2015	CITY OF FRESNO RW-6



NOTES:

1. SET TOP OF METER BOX 2" ABOVE FINISH GRADE.
2. THE CONSTRUCTION OF A TEMPORARY BLOW-OFF FOR THE USE OF TESTING AND FLUSHING OF NEW RECYCLED WATER MAINS ONLY.
3. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

TEMPORARY 2" RECYCLED WATER BLOW-OFF	REF. & REV. JUNE 2014	CITY OF FRESNO RW-7

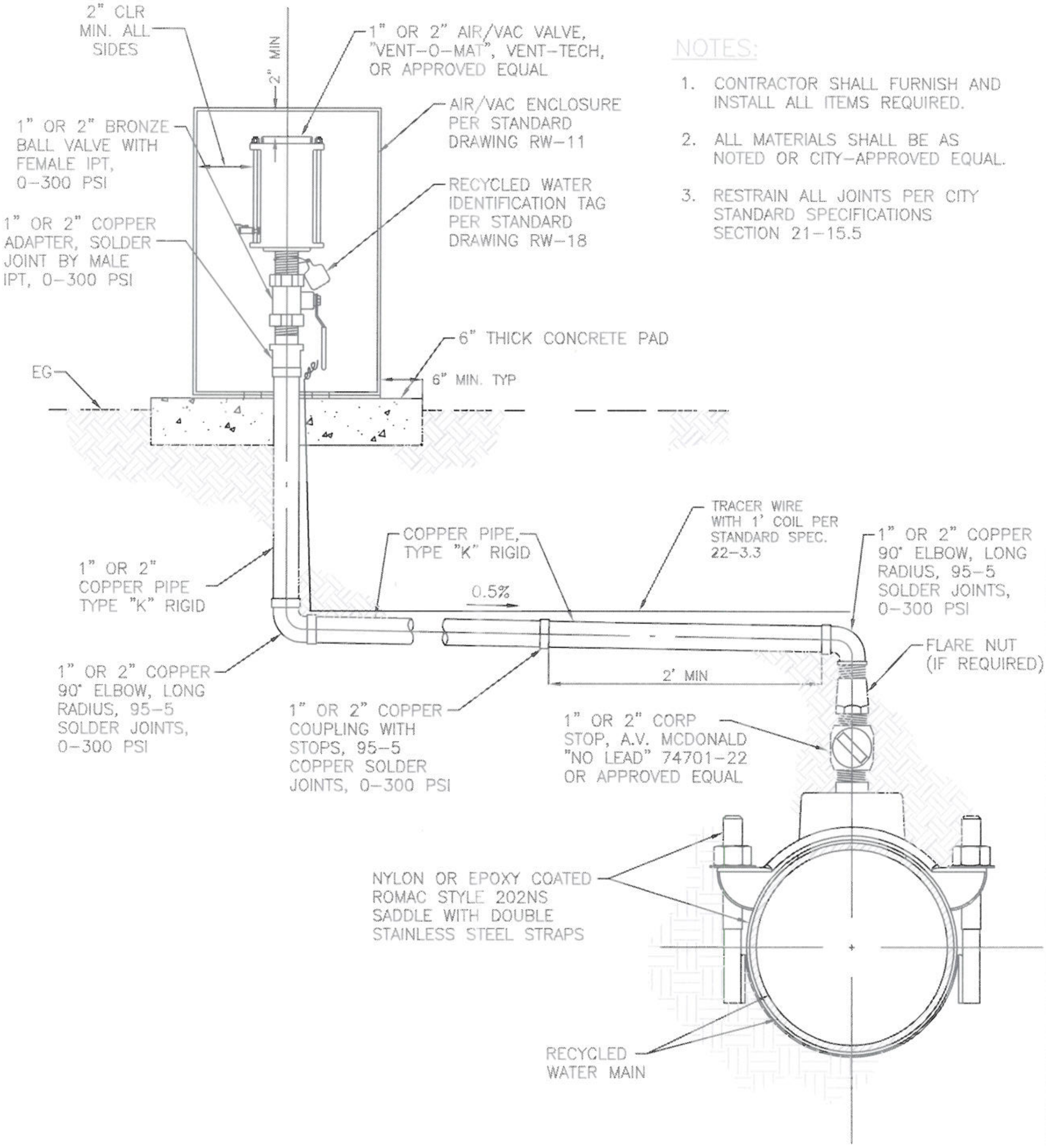


NOTES:

1. ALL FITTINGS SHALL BE SECURED WITH FLANGE CONNECTION, HARNESSES OR TIE-RODS AS APPLICABLE.
2. PLACE VALVES AND BLOW-OFFS OUTSIDE SIDEWALK AND DRIVEWAY AREAS.
3. ALL RISERS SHALL BE FLANGED, 6" DIAMETER.
4. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

BLOW-OFF PIPE SIZE SCHEDULE	
MAIN	BLOW-OFF
6"	4"
8"	4"
10"	4"
12"	6"
14"	6"
16"	6"
18"	6"
24"	6"
30"	6"

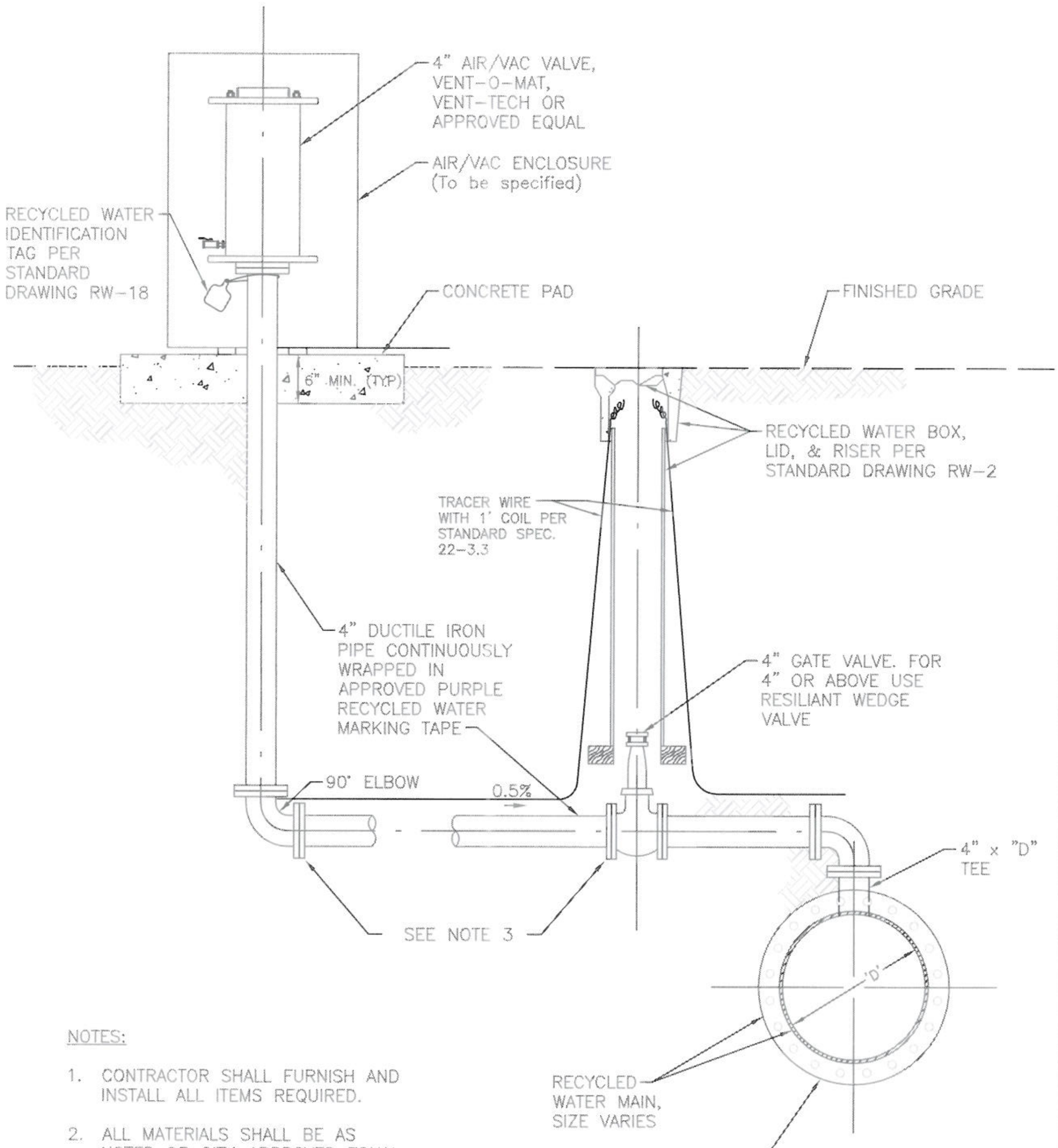
RECYCLED WATER BLOW-OFF ASSEMBLY	REF. & REV. AUGUST 2015	CITY OF FRESNO RW-8



NOTES:

1. CONTRACTOR SHALL FURNISH AND INSTALL ALL ITEMS REQUIRED.
2. ALL MATERIALS SHALL BE AS NOTED OR CITY-APPROVED EQUAL.
3. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

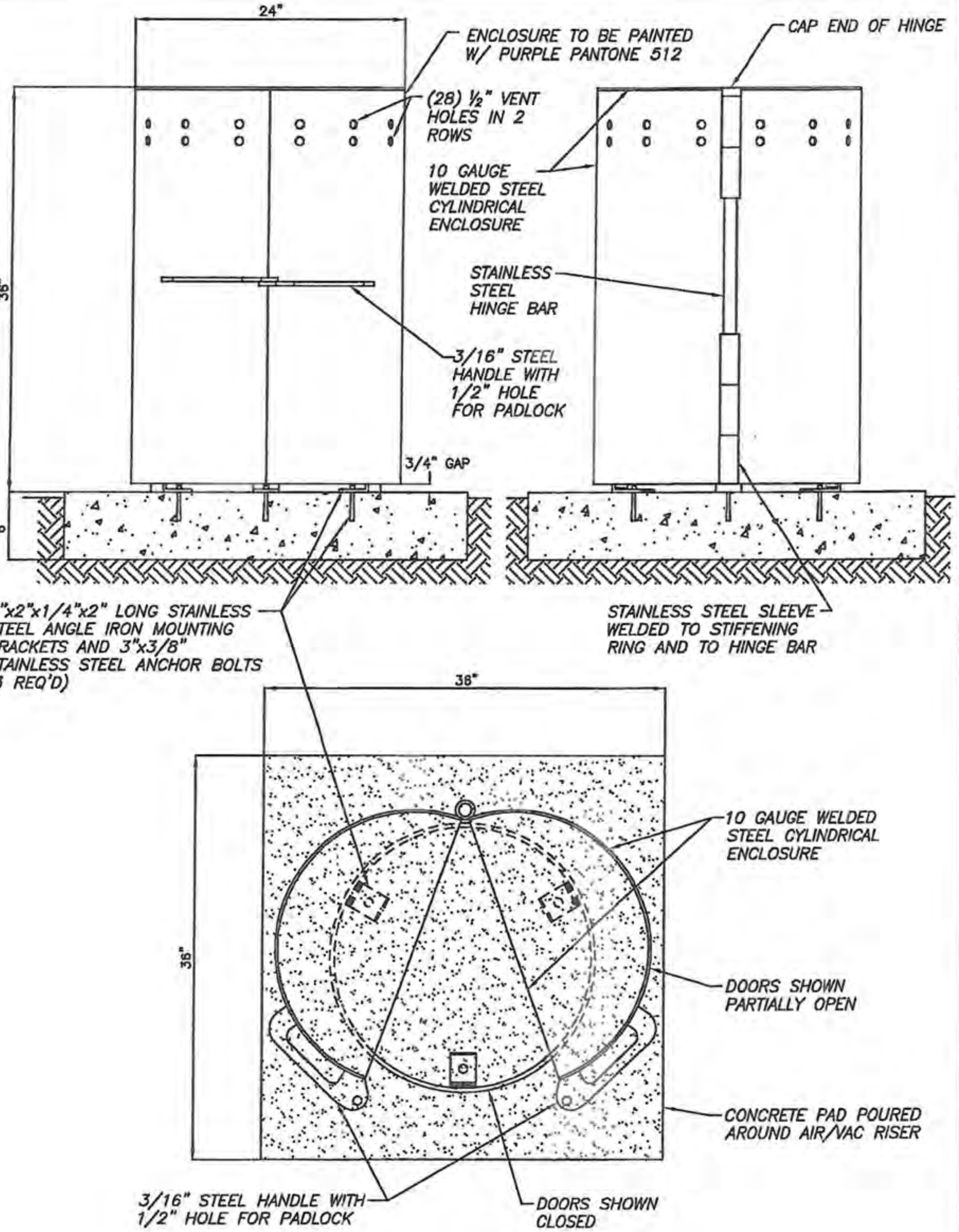
RECYCLED WATER 1" OR 2" AIR RELEASE/VACUUM BREAKER STATION	REF. & REV. AUGUST 2015	CITY OF FRESNO RW-9



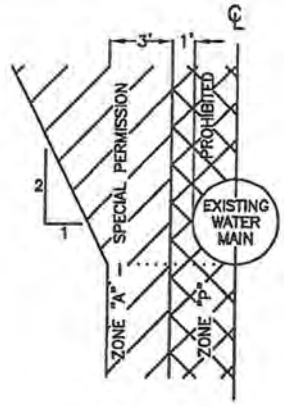
NOTES:

1. CONTRACTOR SHALL FURNISH AND INSTALL ALL ITEMS REQUIRED.
2. ALL MATERIALS SHALL BE AS NOTED OR CITY-APPROVED EQUAL.
3. RESTRAIN ALL JOINTS PER CITY STANDARD SPECIFICATIONS SECTION 21-15.5

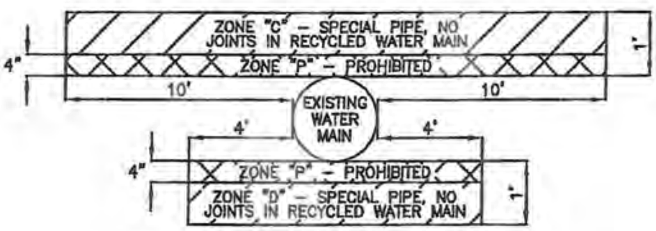
RECYCLED WATER 4" AIR RELEASE/ VACUUM BREAKER STATION	REF. & REV. AUGUST 2015	CITY OF FRESNO RW-10



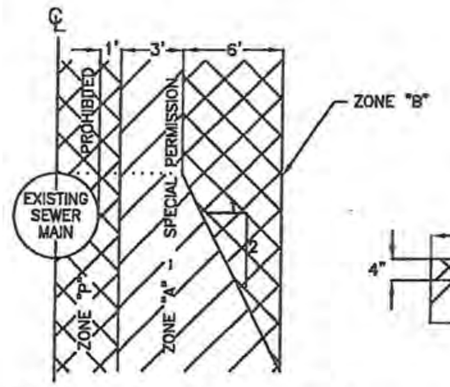
1" OR 2" AIR RELEASE/ VACUUM BREAKER VALVE ENCLOSURE	REF. & REV. JUNE 2014	CITY OF FRESNO RW–11



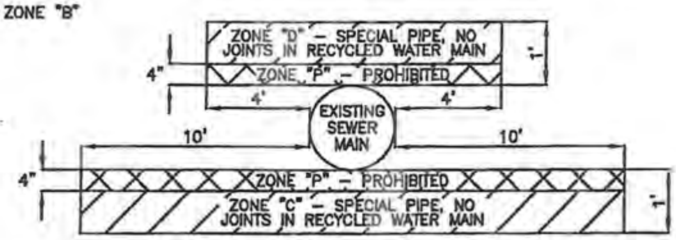
RECYCLED WATER MAIN PARALLEL
TO POTABLE WATER MAINS



RECYCLED WATER MAIN CROSSING
POTABLE WATER MAINS



RECYCLED WATER MAIN PARALLEL
TO SEWER MAINS



RECYCLED WATER MAIN CROSSING
SEWER MAINS

SPECIAL CONSTRUCTION REQUIRED FOR RECYCLED WATER

ZONE:

"A" NO RECYCLED WATER LINES PARALLEL TO WATER MAINS SHALL BE PERMITTED IN THIS ZONE WITHOUT PRIOR WRITTEN APPROVAL FROM COUNTY, CALIFORNIA DEPARTMENT OF PUBLIC HEALTH AND THE CITY.

"B" RECYCLED WATER MAIN SHALL BE CONSTRUCTED OF:
1. DUCTILE IRON PIPE WITH HOT DIP BITUMINOUS COATING.
2. DIPPED AND WRAPPED 1/4" THICK WELDED STEEL PIPE.
3. CLASS 305 PRESSURE RATED PLASTIC WATER PIPE (DR 14 PER AWWA C900) OR EQUIVALENT.
4. REINFORCED CONCRETE PRESSURE PIPE, STEEL CYLINDER TYPE, PER AWWA (C300 OR C302 OR C303).

"C" A RECYCLED WATER MAIN SHALL BE CONSTRUCTED OF:
1. DUCTILE IRON PIPE WITH HOT DIP BITUMINOUS COATING.
2. DIPPED AND WRAPPED 1/4" THICK WELDED STEEL PIPE.
3. CLASS 305 PRESSURE RATED PLASTIC WATER PIPE (DR 14 PER AWWA C900) OR EQUIVALENT.
4. REINFORCED CONCRETE PRESSURE PIPE, STEEL CYLINDER TYPE PER AWWA (C300 OR C302 OR C303).

"D" A RECYCLED WATER MAIN SHALL BE CONSTRUCTED OF:
1. DUCTILE IRON PIPE WITH HOT DIP BITUMINOUS COATING.
2. DIPPED AND WRAPPED 1/4" WELDED STEEL PIPE.
3. CLASS 200 PRESSURE RATED PLASTIC WATER PIPE (DR 14 PER AWWA C900) OR EQUIVALENT.
4. REINFORCED CONCRETE PRESSURE PIPE STEEL CYLINDER TYPE, PER AWWA (C300 OR C302 OR C303).

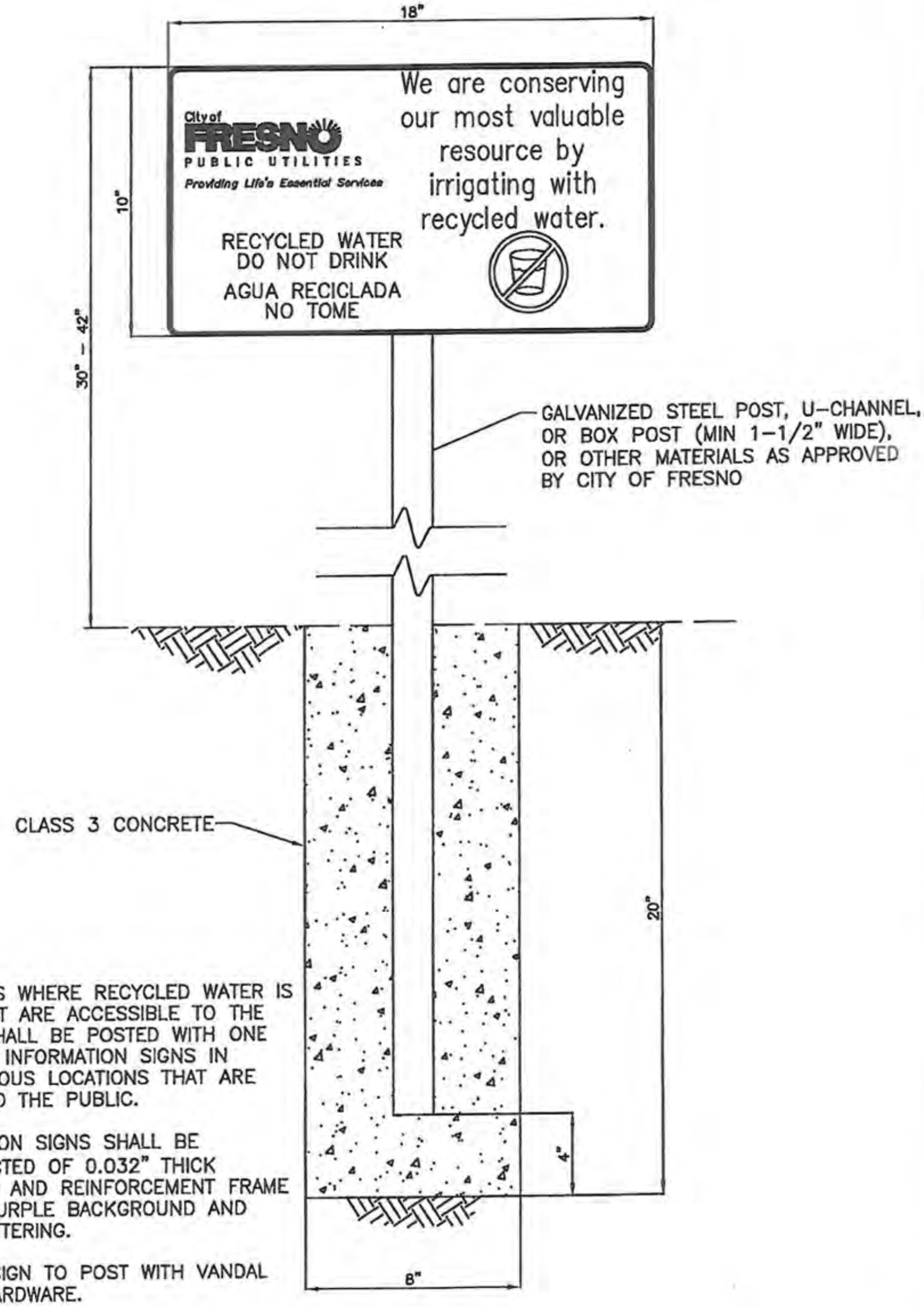
"P" NO RECYCLED WATER MAIN SHALL BE CONSTRUCTED

BASIC SEPARATION STANDARDS

1. SEPARATION DISTANCE SHALL BE MEASURED FROM THE NEAREST OUTSIDE EDGE OF PIPE.

2. WATER MAINS AND SUPPLY LINES OF 24" DIAMETER OR GREATER MAY CREATE SPECIAL HAZARDS BECAUSE OF THE LARGE VOLUMES OF FLOW. INSTALLATIONS OF WATER MAINS AND SUPPLY LINES 24" DIAMETER OR LARGER MUST BE REVIEWED AND APPROVED BY THE HEALTH AGENCY AND CITY ENGINEER PRIOR TO CONSTRUCTION.

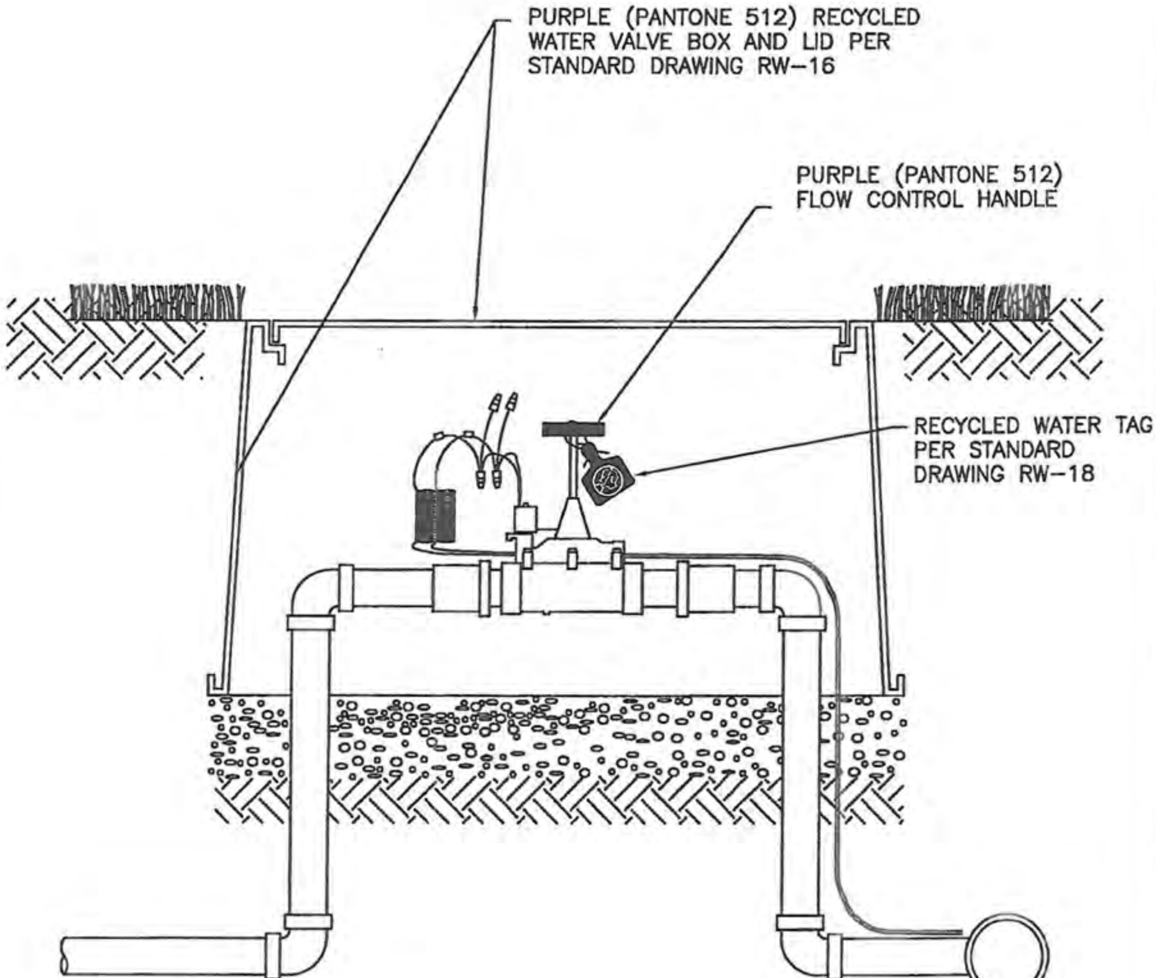
RECYCLED WATER MAIN SEPARATION REQUIREMENTS	REF. & REV. JUNE 2014	CITY OF FRESNO RW–12



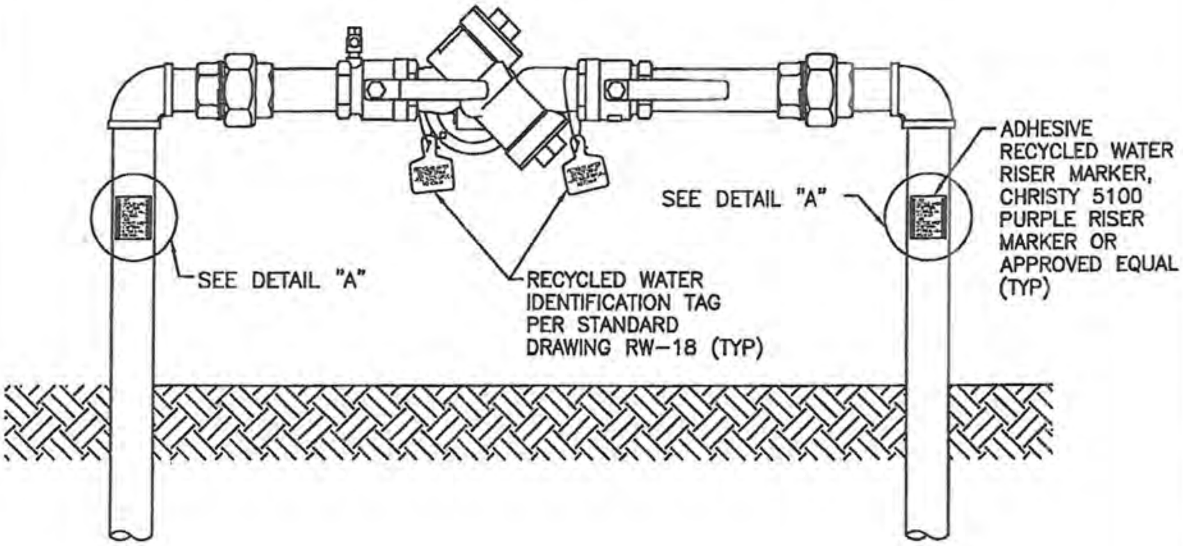
NOTES:

1. ALL AREAS WHERE RECYCLED WATER IS USED THAT ARE ACCESSIBLE TO THE PUBLIC SHALL BE POSTED WITH ONE OR MORE INFORMATION SIGNS IN CONSPICUOUS LOCATIONS THAT ARE VISIBLE TO THE PUBLIC.
2. INFORMATION SIGNS SHALL BE CONSTRUCTED OF 0.032" THICK ALUMINUM AND REINFORCEMENT FRAME WITH A PURPLE BACKGROUND AND WHITE LETTERING.
3. SECURE SIGN TO POST WITH VANDAL PROOF HARDWARE.

RECYCLED WATER IRRIGATION INFORMATION SIGN	REF. & REV. JUNE 2014	CITY OF FRESNO RW-13

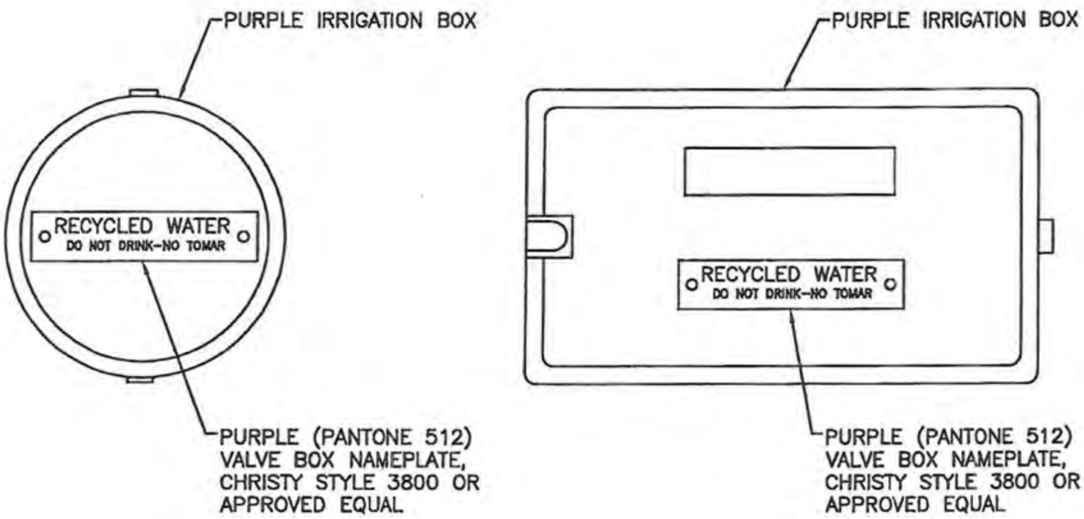


RECYCLED WATER REMOTE CONTROL IRRIGATION VALVE IDENTIFICATION	REF. & REV. JUNE 2014	CITY OF FRESNO RW-14



DETAIL "A"

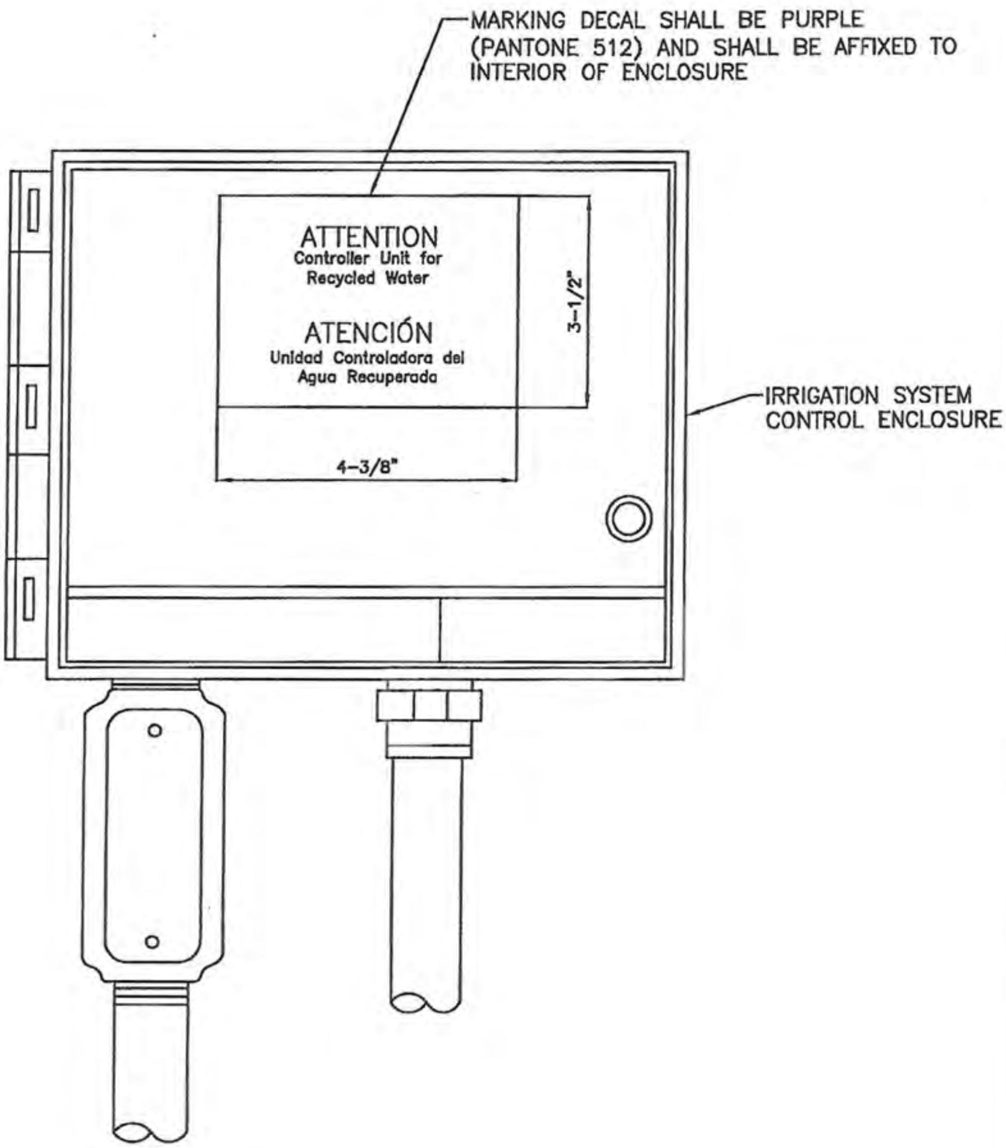
RECYCLED WATER BACKFLOW PREVENTER IDENTIFICATION	REF. & REV. JUNE 2014	CITY OF FRESNO RW–15



NOTES:

1. ALL RECYCLED WATER IRRIGATION BOXES AND LIDS SHALL BE COLORED PURPLE (PANTONE 512).
2. NAMEPLATE SHALL BE 5.75" LONG AND 1.25" WIDE AND SHALL BE MANUFACTURED IN PURPLE, WITH A UV RESISTANT CO–POLYMER PLASTIC.
3. NAMEPLATE SHALL BE ATTACHED TO VALVE BOX WITH TWO TAMPER–PROOF RIVETS.

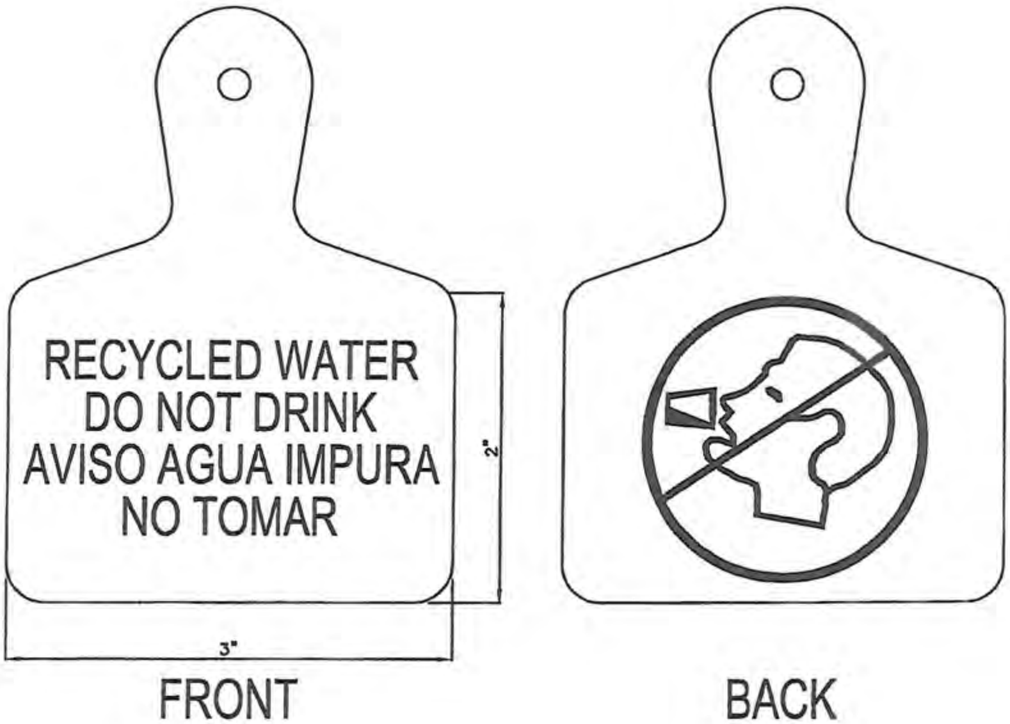
RECYCLED WATER IRRIGATION BOX COVER MARKINGS	REF. & REV. JUNE 2014	CITY OF FRESNO RW–16



NOTES:

1. ALL RECYCLED WATER IRRIGATION CONTROL ENCLOSURES SHALL BE IDENTIFIED WITH A MARKING DECAL.
2. MARKING DECAL SHALL BE BACKED WITH A PERMANENT ACRYLIC ADHESIVE.
3. MARKING DECAL SHALL BE CHRISTY STYLE 4100, OR APPROVED EQUAL.

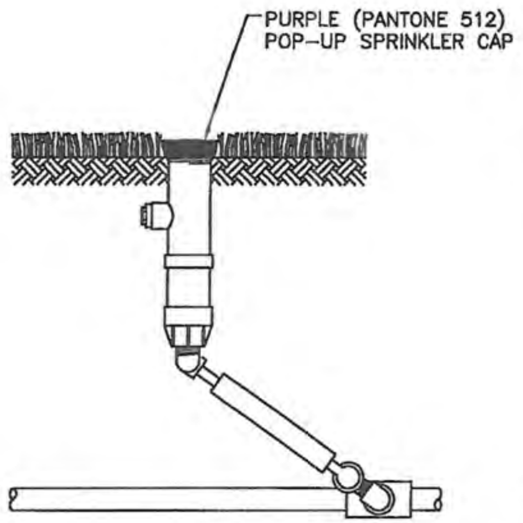
RECYCLED WATER IRRIGATION SYSTEM CLOCK MARKING	REF. & REV. JUNE 2014	CITY OF FRESNO RW-17



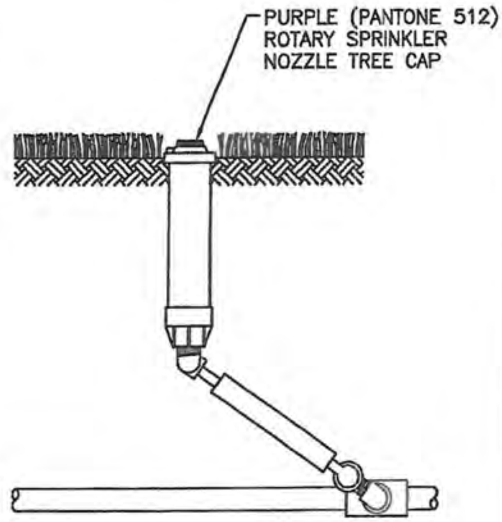
NOTES:

1. IDENTIFICATION TAGS SHALL INCORPORATE AN INTEGRAL ATTACHMENT NECK AND REINFORCED ATTACHMENT HOLE AND SHALL BE CAPABLE OF WITHSTANDING 180 LBS. OF PULL OUT RESISTANCE.
2. ALL LETTERING SHALL BE HOT-STAMPED IN BLACK AND APPROPRIATE FOR OUTDOOR USAGE.
3. IDENTIFICATION TAG COLOR SHALL BE PURPLE.
4. IDENTIFICATION TAG SHALL BE CHRISTY STYLE #007, OR APPROVED EQUAL.
5. IDENTIFICATION TAGS SHALL BE ATTACHED TO GATE VALVES, BALL VALVES, ANGLE STOPS, AND ALL OTHER VALVES IN RECYCLED WATER SERVICE.
6. ATTACH WITH UV RESISTANT ZIP TIES WITH A MINIMUM PULL STRENGTH OF 50 POUNDS.

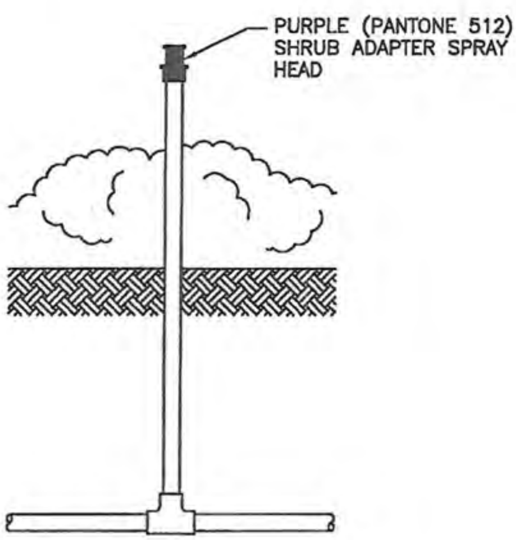
GENERAL RECYCLED WATER IDENTIFICATION TAG	REF. & REV. JUNE 2014	CITY OF FRESNO RW-18



POP-UP SPRINKLER

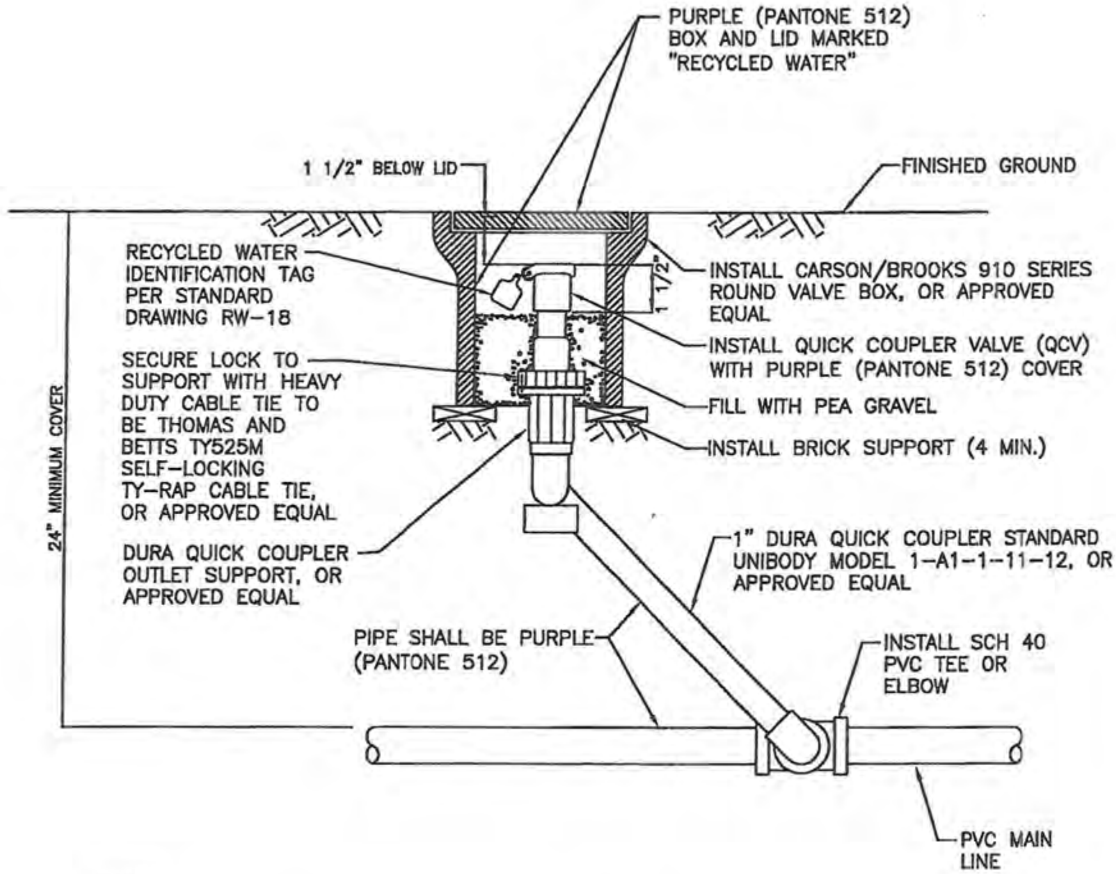


ROTARY SPRINKLER



SHRUB RISER SPRINKLER

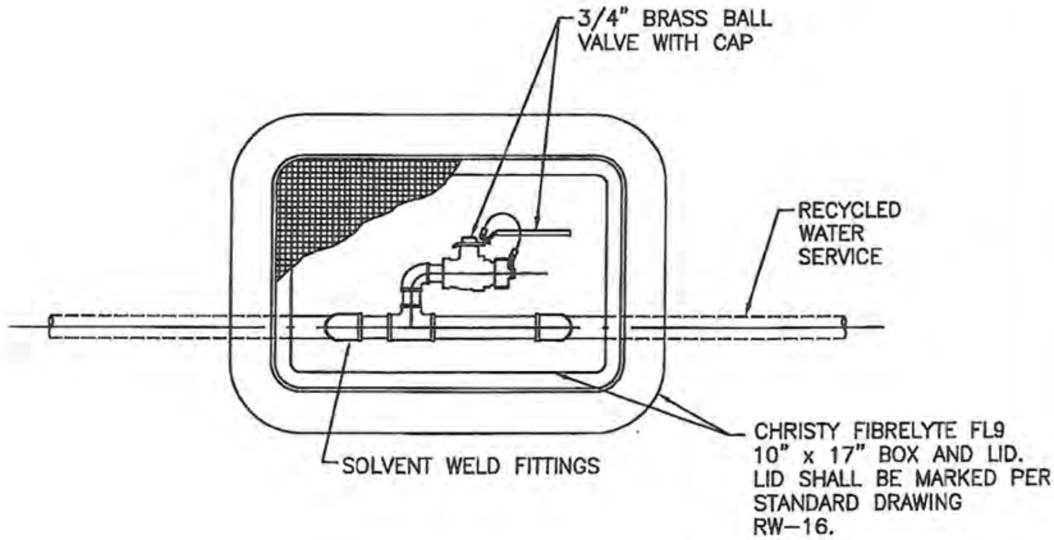
RECYCLED WATER LANDSCAPE IRRIGATION HEAD IDENTIFICATION	REF. & REV. JUNE 2014	CITY OF FRESNO RW-19

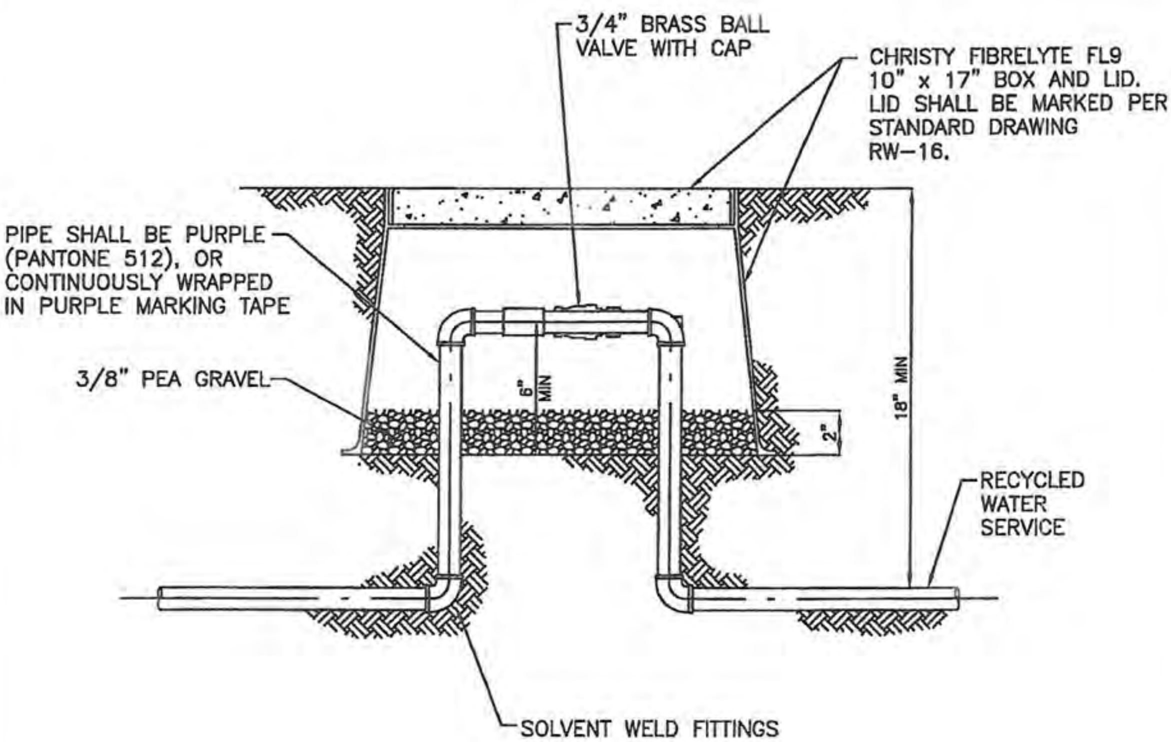


NOTES:

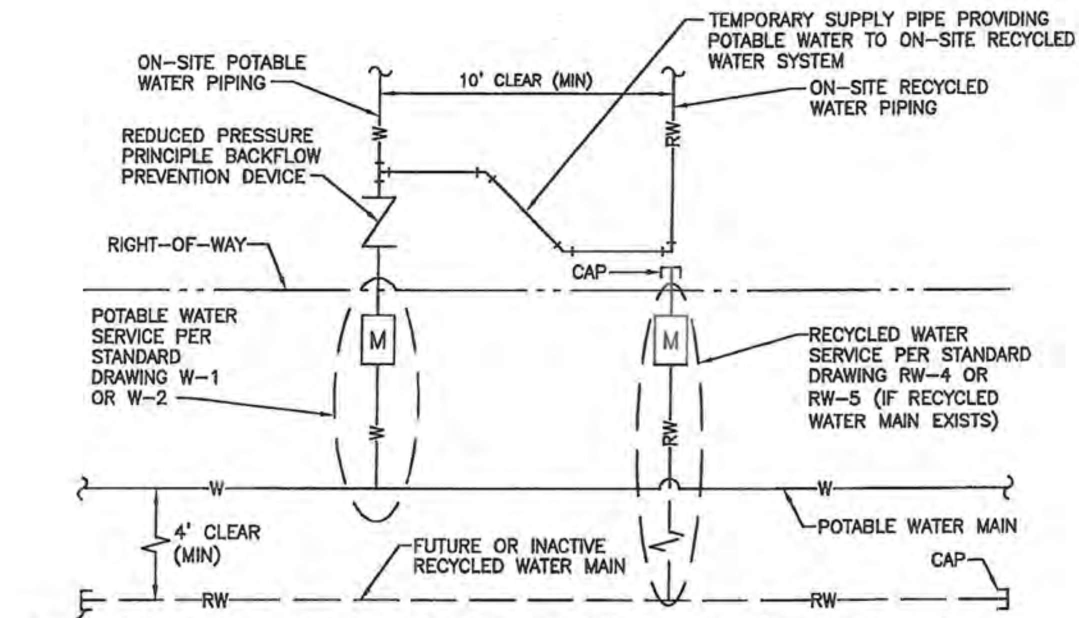
1. NEW-CONSTRUCTION – ALL QUICK COUPLING VALVES MUST HAVE NON-POTABLE LOCKING PURPLE THERMOPLASTIC RUBBER COVERS.
2. RETROFITS – REPLACE ALL EXISTING QUICK COUPLING VALVES WITH NON-POTABLE LOCKING PURPLE THERMOPLASTIC RUBBER COVERS.

QUICK COUPLING VALVE	REF. & REV. JUNE 2014	CITY OF FRESNO RW-20





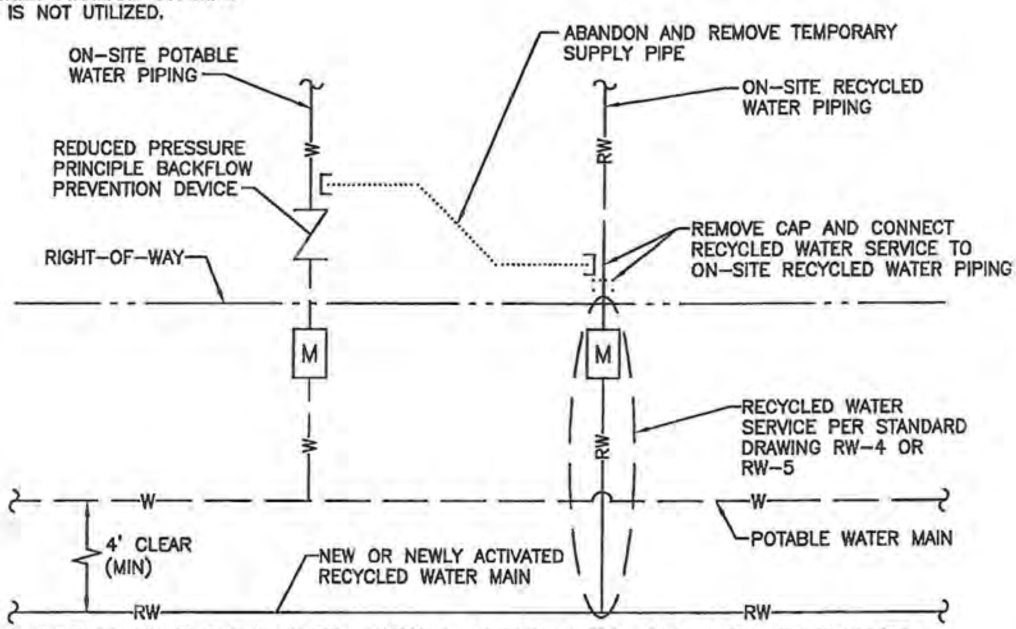
CROSS CONNECTION CONTROL TEST STATION	REF. & REV. JUNE 2014	CITY OF FRESNO RW-21



TEMPORARY POTABLE WATER SUPPLY TO ON–SITE RECYCLED WATER SYSTEM BEFORE RECYCLED WATER IS AVAILABLE

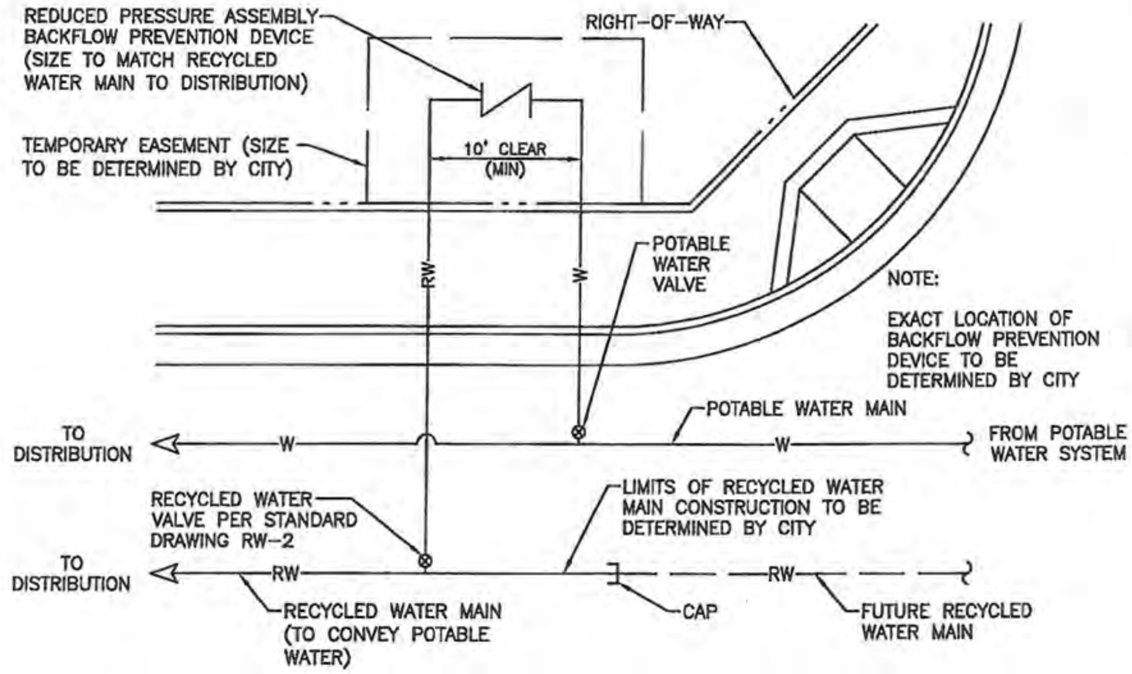
NOTE:

THIS STANDARD DRAWING IS ONLY USED WHEN STANDARD DRAWING RW–23 IS NOT UTILIZED.

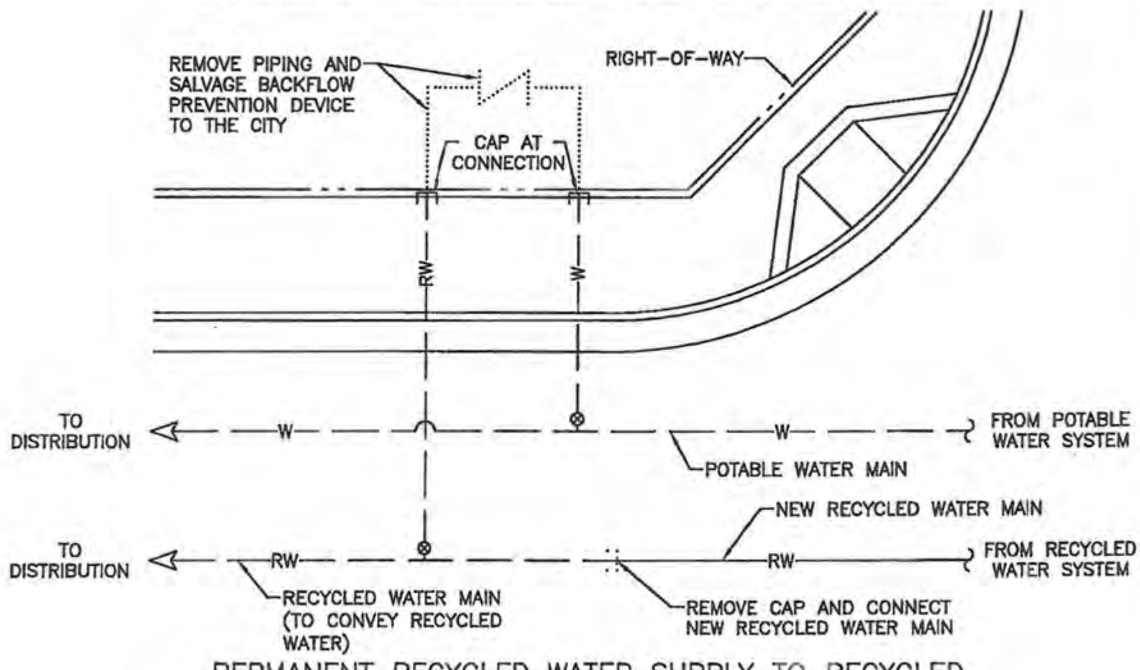


PERMANENT RECYCLED WATER SUPPLY TO ON–SITE RECYCLED WATER SYSTEM AFTER RECYCLED WATER IS AVAILABLE

TEMPORARY POTABLE WATER SUPPLY TO ON–SITE RECYCLED WATER SYSTEM	REF. & REV. JUNE 2014	CITY OF FRESNO RW–22



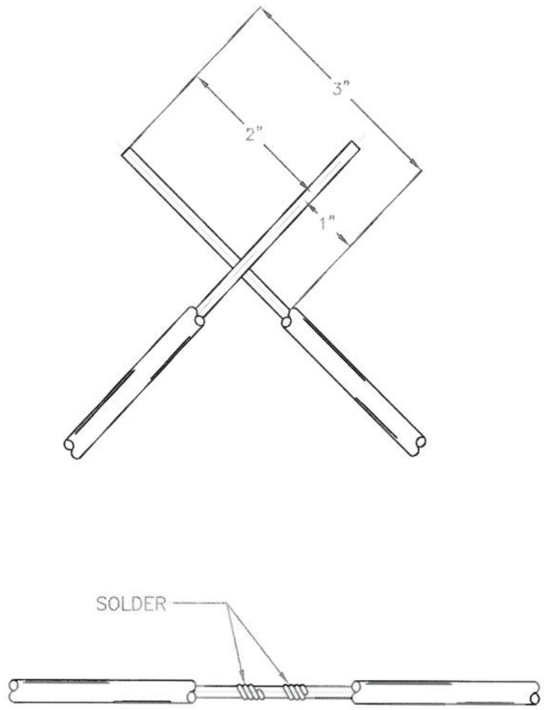
TEMPORARY POTABLE WATER SUPPLY TO RECYCLED WATER SYSTEM BEFORE RECYCLED WATER IS AVAILABLE



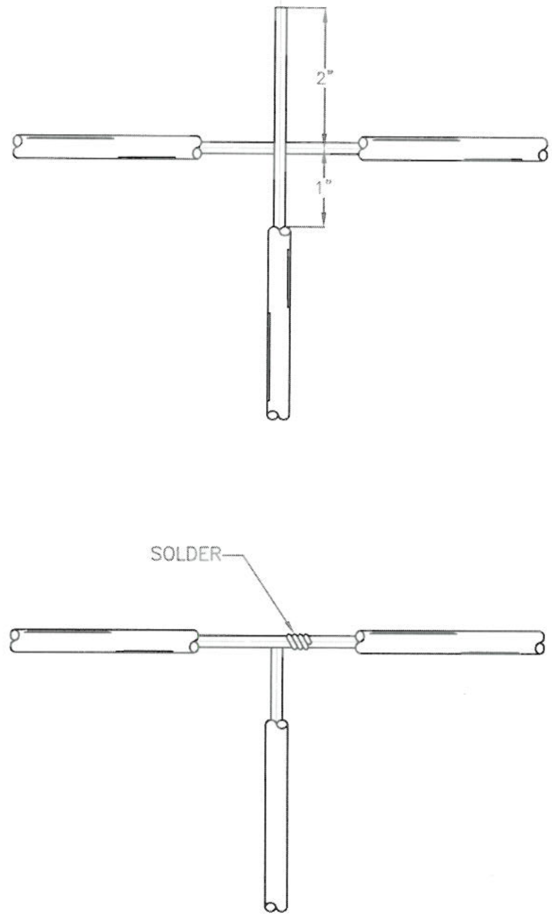
PERMANENT RECYCLED WATER SUPPLY TO RECYCLED WATER SYSTEM AFTER RECYCLED WATER IS AVAILABLE

TEMPORARY POTABLE WATER SUPPLY TO RECYCLED WATER SYSTEM	REF. & REV. JUNE 2014	CITY OF FRESNO RW-23

IN-LINE CONNECTION



BRANCH CONNECTION



NOTES:

1. STRIP THE INSULATION FROM THE WIRE AS SHOWN IN THE DRAWING, BUT DO NOT CUT THE COPPER WIRE.
2. LOOP THE WIRE ENDS A MINIMUM OF (4) TIMES FOR EACH WIRE OF THE CONNECTION.
3. USING A PROPANE TORCH, APPLY THE FLAME DIRECTLY TO THE JOINT (LOOPS) TO BE SOLDERED.
4. APPLY 62SN OR EQUIVALENT ROSIN CORE SOLDER TO THE SPLICE. SOLDER SHOULD FLOW INTO THE JOINT.
5. COVER ALL BARE COPPER WIRE WITH A WATERPROOF WRAP THAT IS APPROVED FOR UNDERGROUND CONNECTIONS. THE WRAP MUST EXTEND A MINIMUM OF TWO INCHES (2") BEYOND THE END OF THE STRIPPED WIRE.
6. ALL WIRE MUST BE 12 GAUGE COPPER WIRE.

TRACER WIRE SPLICE CONNECTION DETAIL	REF. & REV. AUGUST 2015	CITY OF FRESNO RW–24

SECTION 33 – RECYCLED WATER FACILITIES DESIGN CRITERIA

Part I – Introduction

Part II – General Provisions

Part III – Design Criteria

Part IV – Materials

SECTION 34 – RECYCLED WATER FACILITIES

SECTION 33 – RECYCLED WATER FACILITIES DESIGN CRITERIA

PART I - INTRODUCTION

33-1 DEFINITIONS

Unless the particular provision or context otherwise requires, the definitions and provisions contained in this Section 34 shall govern the construction, meaning and application of words and phrases used in the conditions in this Section 34. The definition of each word or phrase shall constitute, to the extent applicable, the definition of each word or phrase which is derivative from it, or from which it-is a derivative, as the case may be.

"Compression Joint"
: A push-on joint that seals by means of the compression of a rubber ring or gasket between the pipe and a bell or coupling.

"Confined"
: In areas were the hydraulic grade line is above the soffit of the Storm Drain pipe, only watertight joints are allowed and shall comply with Section 61 of the State Standard Specifications.

"Easement"
: A recorded document in which the land owner gives the City permanent rights to construct and maintain recycled water mains and/or facilities across private property.

"Health Agency"
: The State Department of Health Services, or the local health officer with respect to a small water system.

"Mechanical Joint"
: A joint comprised of pipe spigot, a follower gland (ring), a mechanical joint gasket and the bell of an adjoining pipe, fitting or valve wherein the joint seal is accomplished by tightening a series of bolts and nuts that compress the gasket against the bell recess and the pipe spigot outside diameter.

"Non-potable Water"
: Non-potable water is water that may contain objectionable pollution, contamination, minerals, or bacterial agents and is considered unsafe and/or unpalatable for drinking.

"Pantone"
: A color standard system referenced in the American Water Works Association California-Nevada Section Guidelines for Distribution of Nonpotable Water

"Pressure Class"

See definition for "Rated Working Water Pressure" below.

"Rated Working Water Pressure"

A pipe classification system based upon internal working pressure of fluid in the pipe, type of pipe material, and the thickness of the pipe wall.

"Recycled Water" and "Reclaimed Water"

Non-potable water that is the treated effluent from a wastewater treatment facility. The terms are identical and any reference to reclaimed water refers to recycled water and vice versa.

"Restrained Joints"

A non-standard or modified push-on or Mechanical Joint that is capable of preventing internal pressures or external forces from causing the joint to separate without the use of thrust blocks.

"Sleeve" A protective tube of steel with a wall thickness of not less than one fourth inch into which a pipe is inserted.

"Vertical Separation"

The difference in elevation between the outside bottom of the higher pipe and the outside top of the lower pipe.

"Water Supplier"

Any person who owns or operates a public water system.

33-2 OTHER REQUIREMENTS

Ordinances, requirements, and applicable standards of governmental agencies having jurisdiction within the area served by the Department of Public Utilities shall be observed in the design and construction of recycled water mains and facilities.

Such requirements include, but are not limited to, current revision of the following:

33-2.1 Standard Specifications for Public Works Construction, "latest edition, including all applicable supplements, prepared and promulgated by the California Chapter of the American Public Works Assn. and the Associated General Contractors of America."

33-2.2 State Health laws and regulations regulating the separation between water supply, recycled water and sewerage facilities.

33-2.3 State Uniform Plumbing code as adopted by the City of Fresno.

33-2.4 Road encroachment regulations of the City of Fresno, County, State of California, Fresno Irrigation District, and railroad permits where applicable.

33-2.5 American Water Works Association Standards

33-2.6 Titles 17 and 22 of the State Health and Safety Code regulating cross connection control and back-flow prevention and Chapter 6 of the City of Fresno Municipal Code, regulating cross connections for the City water system.

PART II – GENERAL PROVISIONS

33-3 OTHER REQUIREMENTS

Ordinances, requirements, and applicable standards of governmental agencies having jurisdiction within the area served by the Department of Public Utilities shall be observed in the design and construction of recycled water mains and facilities.

Such requirements include, but are not limited to, current revision of the following:

33-3.1 Scope

The design and construction of recycled water mains, facilities and other appurtenances for the City shall comply with these City Standard Specifications, or permit requirements of various governing bodies, except where specific modifications have been approved by the Engineer, in writing. A tentative plan must be submitted for comment prior to final design. All final Plans submitted by the Developer shall be signed by a registered civil engineer and all Work shall be in accordance with good engineering practice.

33-3.2 Standard Criteria

The City Standard Specifications set forth the procedure for designing and preparing Plans and Specifications for recycled water mains, facilities and appurtenances to be built within the City's recycled water service area. These standards shall include the Specifications on design and installation of ductile iron pipe and polyvinyl chloride (PVC) pressure pipe.

Whenever potable water, recycled water and sanitary sewer plans are to be designed and installed under one project, said work shall be shown on the same construction plans. In this case the Developer's engineer shall supply the City the original vellum or mylar for the final record.

33-4 ENFORCEMENTS

Provisions of these design and construction standards shall be enforced by the Engineer.

PART III – DESIGN CRITERIA

33-5 RECYCLED WATER MAIN PRESSURES, CAPACITIES, AND SIZES

33-5.1 Quantity of Recycled Water Flow

Recycled water needs shall be determined from maximum potential population and land use of the area to be served. For design purposes, the design recycled water flow shall equal the peak hour demand. In order to determine the design recycled water flow, the following criteria shall be used, unless otherwise approved by the Engineer.

33-5.2 Pressure

Recycled water mains shall be designed so that service pressures range between 45 and 60 psi.

33-5.3 Velocity

Recycled water mains shall be designed such that the mean velocity does not exceed five (5) feet per second under Maximum Daily Demand flow conditions.

33-5.4 Head Loss

Recycled water mains shall be designed to provide a mean head loss of not more than five (5) feet per thousand feet of pipe under Maximum Daily Demand flow.

33-5.5 Hazen-Williams "C"

Pipe analysis shall be performed by assuming a value of 110 for Hazen-Williams co-efficient "C".

33-5.6 Minimum Recycled Water Main Size

Recycled water mains shall have an inside diameter of six (6) inches or more. Four (4) inch mains may be permitted by the Engineer for cul-de-sacs that are 150 feet and shorter when the main serves less than five services.

33-6 LOCATION OF AIR RELEASE VALVE ASSEMBLIES

Air release valve assemblies shall be located at all points where air pockets may form and at locations shown and/or established by the Engineer.

33-7 LOCATION OF BLOW-OFF ASSEMBLIES

Blow-off assemblies shall be located at low points and dead ends, where sediment may collect. Design class shall be compatible with the pipeline working pressure.

33-8 RECYCLED WATER MAIN LOCATIONS

33-8.1 Recycled Water Main Location in Roads or Streets

The centerline of recycled water mains shall be located in public Streets in accordance with Drawing P-41, P-42 and RW-12 of City Standard Drawings. A minimum of four (4) feet of clearance must be maintained between parallel sewer and recycled water lines. Recycled water line locations shall be dimensioned from property line and centerline or section line of the street.

33-8.2 Curved Recycled Water Main Requirements

In curved streets the recycled water main shall not cross the center line, but shall follow the street curvature using join deflections or fittings or as shown on the drawings. Bending of PVC pipe barrels to accomplish horizontal and vertical curves is not permitted.

33-8.3 Joint Deflection for Curved Recycled Water Main

Deflection in joints of pipe shall be as limited by manufacturers recommendation.

33-8.4 Elbows

Elbow shall be placed at locations where coupling deflection would exceed the allowable, as limited by manufacturer's recommendation.

33-8.5 Recycled Water-Water-Sewer Separation

The provisions of State Health Codes shall be met in locating recycled water mains.

33-9 CRITERIA FOR THE SEPARATION

33-9.1 Basic Separation Standards

The "California Waterworks Standards" set forth the minimum separation requirements for recycled water and water main lines. These Standards, contained in Title 22 California Code of Regulations 64572 specify:

a) Parallel Construction:
   The horizontal distance between pressure water mains, recycled water lines and sewer lines shall be at least 4 feet.

b) Perpendicular Construction (crossing):
   Pressure water mains shall be at least one foot above sanitary sewer and recycled water lines where these lines must cross.

c) Separation distances specified in a) shall be measured from the nearest edges of the facilities.

d) Common Trench:
   Water mains and recycled water lines must not be installed in the same trench. When water and recycled water mains are not adequately separated, the potential for contamination of the water main supply increases. Therefore, when adequate physical separation cannot be attained, an increase in the factor of safety shall be provided by increasing the structural integrity of both the pipe materials and joints.

33-9.2 Basic Separation Standards

Local conditions such as available space, limited slope, existing structure, etc., may create a situation where there is no alternative but to install water mains or recycled water lines at a distance less than required by the Basic Separation Standards. In such cases, alternative construction criteria may be allowed in very special circumstances. Detail shall be submitted to City Engineer and Health Agency for approval prior to construction.

Water mains and supply lines of 24" diameter or greater may create special hazards because of the large volumes of flow. Therefore, installations of water mains and supply lines 24 inches diameter or larger shall be reviewed and approved by the Health Agency and City Engineer prior to construction.

33-9.3 Special Provisions

The Basic Separation Standards are applicable under normal conditions for recycled lines and water distribution mains. More stringent requirements may be necessary if conditions, such as, high groundwater exist.

New recycled water mains and sewers shall be pressure tested where the conduits are located ten feet apart or less.

In the installation of recycled water or water mains, measures shall be taken to prevent or minimize disturbances of the existing line. Disturbance of the supporting base of this line could eventually result in failure of this existing pipe.

Special consideration shall be given to the selection of pipe materials if corrosive conditions are likely to exist. These conditions may be due to soil type and/or the nature of the fluid conveyed in the conduit.

33-10 ALTERNATE CRITERIA FOR CONSTRUCTION

When new water mains, new sanitary sewer mains, or other non-potable fluid-carrying pipeline are being installed in existing developed areas, local conditions (e.g., available space, limited slope, existing structures) may create a situation in which there is no alternative but to install water mains, sanitary sewer mains, or other non-potable pipelines at a distance less than that is required by the regulations (Section 64572). In such cases, through permit action, the Engineering Department may approve alternate construction criteria. The alternate approval is allowed under Title 22 California Code of Regulations, Section 64551(c).

33-11 PROCEDURE FOR WATER, RECYCLED WATER AND SEWER SYSTEM INSTALLATIONS IN SUBDIVISIONS

a. Installation of all sewer mains, laterals and manholes and backfill.

b. Installation of all recycled water mains, services and backfill.

c. Installation of all water mains, services and backfill

d. Compact all Sewer trenches.
   - d1. Make preliminary pressure test. (Optional)
   - d2. Locate and repair leaks, if any.
   - d3. Recompact if necessary.

e. Compact all recycled water trenches.
   - e1. Make preliminary pressure test. (Optional)
   - e2. Locate and repair leaks, if any.
   - e3. Recompact if necessary.

f. Compact all water trenches.
   - f1. Make preliminary pressure test. (Optional)
   - f2. Locate and repair leaks, if any.

f3. Recompact if necessary.

g. Items (d), (e) and (f) may be done simultaneously if conditions permit.

h. All trenches shall be identified. Contractor shall also locate and mark Sewer, Water and Recycled water service laterals on curb face when constructed.

i. Compaction tests on sewer, water and recycled water taken by City.

j. Final air test for sewer and pressure test for water and recycled water, providing all leaks are repaired all compaction tests have been approved.

k. Any failure of final tests would require Contractor to reinitiate sequence of work starting with Item (i).

l. The Department of Public Utilities will construct the wet tie to connect to the City's system. This will allow the Contractor to sterilize and flush the newly constructed system. There is often an associated charge for the construction of these wet ties.

m. Flushing recycled water mains shall not be allowed in Street area if it conflicts with sewer and water installations. Often done after compaction tests have passed. Water seeps into trenches and holds up Developer's paving while Street dries out.

n. If storm sewers are to be installed, they shall be constructed first, unless otherwise directed.

33-12 EASEMENTS

Non-metallic pipes may be allowed in Easements which are neither confined or interior Easements.

33-12.1 Easements

The minimum width of a recycled water facility Easement shall be approved by the Engineer.

33-12.2 Recycled Water Main Location in Easement

The recycled water main shall be located 5 feet north or west of the center line of the Easement except where otherwise approved by the Engineer.

33-12.3 Where Easements Follow Common Lot Lines

The full Easement width shall be on one lot, in such a manner that access to lines will not be obstructed by walls, trees, or permanent improvements. Where this requirement cannot be met without interfering with existing buildings, easements may straddle lot lines, but the recycled water line shall not be located on the lot lines.

33-12.4 Deeds for Easements

Deeds for Easements shall provide for restrictions of permanent construction within the Easement to provide ingress and egress for maintenance. A recent title report will be required prior to acceptance of the Easement.

33-12.5 Dedications

Dedications shall be in accordance with City standard practice.

(A) For subdivision tracts the owners of land included within the subdivision shall provide a bill of sale on a form provided by the City. This bill of sale shall be a part of the acceptance of the subdivision.

(B) For other than subdivision tracts, the following shall be conveyed to the City:

(1) A deed of Easement satisfactory to the City for the operation maintenance of the recycled water facilities shall be prepared by a registered engineer or land surveyor, on City Easement forms properly executed by the owners;

(2) A bill of sale to the City for the recycled water mains and appurtenances.

33-13 DEPTH OF RECYCLED WATER MAINS

33-13.1 Basic Requirements

Recycled water mains shall be installed at a depth which shall be in accordance with the applicable ordinances, regulating the separation between water supply and sewerage facilities.

33-13.2 Standard Depths

Minimum depth shall be 42 inches to top of pipe measured from Street or surface above the pipe. Where the natural ground above the pipeline trench has been over-excavated and/or the pipeline is to be placed in the new embankment, embankment material shall be placed and compacted to an elevation of not less than 3 feet above the top of pipe prior to the trench excavation. Where 42 inches from top of curb cannot be maintained, pipe shall be installed with selected or imported bedding as approved by the Engineer or metallic pipe material shall be used.

33-13.3 Exceptions

Designs not in accordance with City Standard Drawing No. RW-12 shall be submitted to the Engineer for approval together with evidence that it complies with City Standard Drawing No. RW-12.

33-14 STRUCTURAL REQUIREMENTS

33-14.1 Buried Facilities

All structures and pipe placed underground shall be of sufficient strength to support with an adequate factor of safety the following applicable loads: the backfill, road surfacing, H-20 truck loading with impact, high loading to be specified by the Engineer or as required by permits for crossing State highways, railroad tracks, canals, and streams. Calculations showing factor of safety may be required by the Engineer.

33-14.2 Other Pipes and Structures

Recycled water lines designed to cross under other pipes or structures shall be protected from damage and shall be constructed in order not to endanger the other pipe or structure. Minimum clearance between outside of pipes or between pipes and other structures is 12 inches unless otherwise approved by the Engineer.

33-14.3 Flexible Joints

Flexible joints which will allow for differential settlements or other movement of recycled water pipe, facilities, adjacent pipe and adjacent structures shall be provided where recycled water lines enter encasements or other structures. Flexible joints shall be within three feet of such structures. Any deviations from these requirements shall require approval from the Engineer.

33-14.4 Thrust Blocks

The use of concrete thrust blocks may be required but will only be allowed when specifically approved in writing by the Engineer.

33-14.5 Mechanical Restrained Joints

Restrained Joint fittings shall be provided at all tees, crosses, reducers, bends, caps, plugs and valves such that the pipe is fully restrained in any one given direction.

These shall meet Uni-B-13 and ASTM F 1674-96 for PVC and be UL/FM approved through 12" for both ductile iron and PVC. The restraint mechanism shall consist of individually activated gripping surfaces to maximize restraint capability. Twist-off nuts, sized the same as the tee-head bolts, shall be used to ensure proper activating of restraining devices. The gland shall be manufactured of ductile iron conforming to ASTM A536-80. The retainer-gland shall have a pressure rating equal to that of the pipe on which it is used through 14" with a minimum safety factor of 2:1. See City Standard Drawings W-31, W-32, W-33, W-34, W-35, W-36 and W-37. Gland shall be Megalug by EBAA Iron, Inc., Uni-Flange by Ford Meter Box Co. Inc., or approved equal.

Push-on Restraint: When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used through 14". Harness assemblies including tie bolts shall be manufactured of ductile iron conforming to ASTM A536-80. Harness shall be manufactured by EBAA Iron, Inc., Ford Meter Box Co. Inc., or approved equal.

33-15 DESIGN CRITERIA FOR RECYCLED WATER METERS

The City shall determine the appropriate meter sizes and types, based on the building plumbing plans and the landscape sprinkler plans furnished by the Developer.

PART IV – MATERIALS

33-16 REQUIREMENTS

Materials shall be chosen for their strength, durability and ease of maintenance, with due consideration for dead and live loads, beam strength and resistance to corrosion. Pipe joints shall be selected to provide sufficient flexibility to adjust to the residual conditions during and after construction.

33-17 PIPE MATERIALS

The following are acceptable materials for recycled water line construction:

33-17.1 Ductile Iron Pipe and Ductile Iron Fittings

Ductile iron pipe and associated fittings shall conform to the applicable sections of the City Standard Specifications.

(a) Fabrication

Ductile iron pipe shall be Pressure Class 350 ductile iron for sizes up to and including 12 inch and Pressure Class 250 ductile iron from 14 inch to 20 inch; complete with all accessories and conforming to ANSI/AWWA C151/A21.51, unless otherwise indicated on the construction plans. Ductile iron pipe shall be eighteen (18) foot laying lengths.

(b) Joints

Joining of ductile iron pipe shall be with elastomeric-gasket bell ends or couplings. The joints and rubber gaskets shall be in conformance with ANSI/AWWA C111/A21.11.

(c) Inspection and Testing

City at its discretion may inspect the plant facilities, materials, manufacture and testing of the pipe to be furnished by Contractor. Testing of the pipe to ensure compliance with these Specifications shall be made in accordance with applicable AWWA Standards latest edition. All cost incurred by City for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

(d) Affidavit of Compliance

City may elect to waive any of the above testing and inspection requirements in which event the Engineer may require the manufacturer to submit affidavits stating that all pipe has been manufactured and tested in accordance with this Specification.

(e) Fittings

All fittings for use with ductile iron pipe shall be ductile iron manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. All Mechanical Joint or push-on joint fittings shall be rated for 350 psi working pressure in sizes 4" through 24". Flange fittings shall be rated for 250 psi working pressure. Flange drilling pattern shall be in accordance with ANSI/AWWA C110/A21.10, or commonly referred to as a 125# drilling pattern.

In accordance with Section 4.3 of ANSI/AWWA C153/A21.53, fittings may be provided with a cement-mortar lining and asphalt coating or fusion bonded epoxy inside and outside. Fusion bonded epoxy shall be in accordance with ANSI/AWWA C116/A21.16 and shall be applied to interior and exterior surfaces.

All tees and crosses shall have all flanged ends with the exception of blowoff, and pumping connections, which shall have flange by Mechanical Joint or push-on joint ends; reducers shall have flange by Mechanical Joint ends; elbows maybe either Mechanical Joint or flanged ends.

(f) Appurtenances

All appurtenances used in conjunction with the ductile iron pipe shall meet the City Standard Specifications.

(g) Lining and Coating

Unless otherwise approved, the internal surface shall be lined with a uniform thickness of cement mortar and then sealed with a thin asphaltic coating in accordance to AWWA C104.

(h) Encasement

The outside surface shall be protected with purple polyethylene encasement furnished and installed in accordance with AWWA C105.

(i) Marking/Identification

Ductile iron pipe shall be identified and marked in accordance to City Standard Drawing RW-1.

33-17.1.1 Confined Easements

All confined easement construction shall be ductile iron.

33-17.2 Polyvinyl Chloride (PVC) Pressure Pipe

Polyvinyl chloride (PVC) pressure pipe shall conform to the applicable sections of the City Standard Specifications.

(a) Fabrication

Polyvinyl chloride pressure pipe shall be purple in color, or be installed in a purple sleeve marked "RECLAIMED WATER –DO

NOT DRINK" the entire length of the pipeline, shall conform to AWWA C-900 latest edition for 12" and smaller and AWWA C905 latest edition for 14" and larger, unless otherwise indicated on the construction Plans.

(b) Joints

Joining of PVC pipe shall be with elastomeric-gasket bell ends or couplings. The bell ends shall be an integral thickened bell end (IB) or an integral Sleeve-reinforced bell end. The bell end joints shall have a minimum wall thickness of the bell or Sleeve-reinforced bell equal, at all points, to the DR Requirements for the pipe. The minimum wall thickness in the ring groove and bell-entry sections shall equal or exceed the minimum wall thickness of the pipe barrel.

If bell ends are not part of the pipe, one PVC coupling, manufactured of the same material and by the same manufacturer as the pipe, shall be furnished with each length of pipe together with two (2) rubber rings. The coupling shall be designed to ensure a water-tight joint with the pipe. The coupling body and socket shall have a wall thickness equal to the pipe barrel thickness with which the coupling is to be used.

All rubber rings shall be furnished by the pipe manufacturer. These rubber rings (Elastomeric Gaskets) shall be manufactured to conform with the requirements of ASTM F-477.

(c) Hydrostatic Proof-test

Each length of pipe shall be proof-tested at two (2) times its rated Pressure Class for a minimum dwell of five (5) seconds, in accordance with AWWA C900 and C905.

(d) Inspection and Testing

The City, at its discretion, may inspect the plant facilities, materials, manufacture and testing of the pipe to be furnished by Contractor.

Testing of the pipe to ensure compliance with these Specifications shall be made in accordance with applicable AWWA Standards latest edition. All cost incurred by City for witnessing the manufacture of the pipe and in obtaining test results shall be borne by Contractor furnishing the pipe.

(e) Affidavit of Compliance

City may elect to waive any of the above testing and inspection requirements in which event the Engineer may require the manufacturer to submit affidavits stating that all pipe has been manufactured and tested in accordance with this Specification.

(f) Fittings

All fittings for use with Polyvinyl chloride pipe shall be ductile iron manufactured in accordance with ANSI/AWWA C110/A21.10 or ANSI/AWWA C153/A21.53. All Mechanical Joint or push-on joint fittings shall be rated for 350 psi working pressure in sizes 4" through 24". Flange fittings shall be rated for 250 psi working pressure. Flange drilling pattern shall be in accordance with ANSI/AWWA C110/A21.10, or commonly referred to as a 125# drilling pattern. In accordance with Section 4.3 of ANSI/AWWA C153/A21.53, fittings may be provided with a cement-mortar lining and asphalt coating or fusion bonded epoxy inside and outside. Fusion bonded epoxy shall be in accordance with ANSI/AWWA C116/A21.16 and shall be applied to interior and exterior surfaces.

All tees and crosses shall have all flanged ends with the exception of blow-off, and pumping connections, which shall have flange by Mechanical Joint or push-on joint ends; reducers shall have flange by Mechanical Joint ends; elbows maybe either Mechanical Joint or flanged ends. A/C to C.I.O.D. (PVC adapter rings may not be used).

(g) Appurtenances

All appurtenances used in conjunction with PVC shall meet the City Standard Specifications.

(h) Detachable Ribbon or Tapes

Because PVC is non-conductive and subject to more damage if struck with excavation equipment, an identification marking tape shall be installed in accordance to City Standard Drawing No. RW-1.

33-18 VALVES

33-18.1 Butterfly Valves

(a) General

These Specifications designate the requirements for the manufacture and installation of butterfly valves. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valves as shown on the Plans and herein specified.

(b) Materials and Workmanship

Butterfly valves shall be of the rubber-seated tight-closing type. They shall meet or exceed AWWA Standard C504 latest revision. All valves must use full AWWA C504 Class 150B valve shaft diameter, and full Class 150B underground-service-operator torque rating throughout entire travel. All valves shall be NSF approved. Valve body shall be high-strength cast iron ASTM A126 Class B with 18-8 Type 304 stainless steel body seat. Valve vane shall be high-strength cast iron ASTM A48 Class 40, having rubber seat mechanically secured with an integral 18-8 stainless steel clamp ring and 18-8 stainless steel self-locked screws.

Rubber seat shall be full-circle 360 degree seat not penetrated by the valve shaft. Valve shaft shall be one piece, extending full size through the entire valve. Valve shaft shall be 304 stainless steel. Packing shall be O-ring cartridge designed for permanent duty underground. All exposed cap screws and fasteners on the valve body and flanges shall be Ni-Cad steel or approved equal.

(c) Valve Operations

Valve operators shall be of the manual type. The operator shall be totally enclosed, self-locking worm gear or screw type, with adjustable stops to limit disc travel. The number of complete turns of the operator required to rotate this disc 90 degrees shall be approximately the same as an equivalent sized gate valve. All valve operators shall be fully gasketed, weather-proof and factory packed with grease. Operators shall be of the size required for opening and closing the valve against 150 psi water pressure, and shall have a torque rating of not less than shown in AWWA C-504, 1, Class 150-B. Operators for valves located above ground shall have disc-position indicators and a hand-wheel.

Should the difference between the operating nut and the valve cover exceed 50 inches, an extension mast shall be installed so that the operating nut will not exceed 50 inches from the valve cover or ground surface. Buried operators shall be worm gear or screw type and shall be threaded to accommodate a two inch operating nut, and shall include the operating nut, and a 3/4" hex head plated bolt for operating nut hold-down. All exposed fastenings shall be specifically designed and suitable for permanent buried service. Input shaft and thread for the operating nut shall be at a right angle to the operating shaft. The input shaft shall extend vertically from the side when the valve is in the horizontal position.

Epoxy shall be applied to all surfaces of valve body and vane to an average minimum thickness of 5 mils, conforming to AWWA C 550 Standards. A primer shall be applied before the coating per the epoxy manufacturer's recommendations. The coating shall be applied to the entire valve body and vane before final assembly.

(d) Valve Ends

Valve ends shall be for Flanged Joint pipe and shall conform to ANSI CIII (AWWA A21.11-1972, Class 125) and drilled to ANSI B16.1 for cast iron flanges and flanged fittings, Class 125. Flanges shall be 125# ANSI. The butterfly valves shall be right closing Class 150-B designed for tight shut off with a maximum differential pressure across the disc of 200 psi. Valve shafts shall consist of a one-piece unit extending completely through the valve disc.

(e) Valve Boxes, Nuts and Bolts, Gaskets and Marker Posts shall conform to the provisions specified herein for gate valves.

(f) Marking/Identification

Install an identification tag in accordance to City Standard Drawing RW-18.

33-18.2 Gate Valves

(a) General

These Specifications designate the requirements for the manufacture and installation of gate valves. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valves as shown on the Plans and herein specified.

(b) Materials and Workmanship

Gate valves shall be non-rising stem resilient seated type. Valves shall conform to the latest version of AWWA C-509. Valve bodies shall be ductile iron and wedges shall be fully rubber encapsulated.

The stem shall have two O-rings above the collar and one O-ring below the collar. Stem seals must be replaceable with the valve under pressure. The stem material shall be stainless steel [ANSI-420], low zinc bronze or manganese bronze. The waterway shall be full size. No cavities or depressions are permitted in the seat area. Valve body and bonnet shall be electrostatically applied, fusion bonded, epoxy coated both inside and out by the valve manufacturer. The coating shall meet the requirements of AWWA C-550 and NSF 61 approved. All valve body and bonnets bolts and nuts shall be type 304 stainless steel.

All valves must be tested by hydrostatic pressure equal to the requirements in the AWWA C-509 specifications prior to shipment.

Tapping gate valve assemblies shall be used only in conjunction with tapping Sleeves and shall be furnished and installed by the Department of Public Utilities.

Nuts and bolts used for bolting flanged-end gate valves to pipeline flanges above ground, shall be hexagonal head machine bolts and hexagonal nuts conforming to ASTM A307, Grade B. All buried flanged-end gate valves shall be bolted to the pipe line flanges with Ni-Cad nuts and bolts or approved equal.

(c) Gaskets

Gaskets for flanged-end gate valves shall be right face 1/8".

(d) Valve Ends

Valves may be provided with Mechanical Joint ends, push-on joint ends, flanged ends, Mechanical Joint by flange ends or push-on joint by flange ends.

(e) Marking/Identification

Install an identification tag in accordance to City Standard Drawing RW-18.

33-19 APPURTENANCES

33-19.1 Blow-off Assemblies for Recycled Water Mains

(a) General

Blow-off assemblies shall be furnished and installed by the Contractor at the locations shown on the Plans. The Contractor shall furnish all labor, materials, tools and equipment necessary to furnish and install, complete and ready for operation, the assemblies as shown on the plans and herein specified. See City Standard Drawings RW-7 and RW-8.

(b) Materials, Fabrication and Installation

(1) Materials Shall be ductile iron and sized as designated on the City Standard Drawings. RW-7 and RW-8 or on the Plans.

(2) Valves Gate valves or butterfly valves for blow-off assemblies shall be as specified herein.

(3) Pipes and Fittings Shall be 6 inch or 8 inch ductile iron and shall conform with the standard for ductile iron pipe water main and fittings. Joints on the recycled water main side of the gate valves shall be flanged. Properly restrained MJ fittings are allowed downstream of the gate valve.

(4) Pipe Sleeves and Lids Shall be used per City Standard Drawing RW-2.

(5) Boxes and Lids Shall be per City Standard Drawings RW-7 and RW-8 or Engineer approved equivalent and marked "Recycled Water". Covers shall be seated flush with the surface of the natural ground or paved surface, such that they may not be damaged by, nor present an obstruction or rough surface to traffic.

33-19.2 Air Release Valve Assemblies

(a) General

Air release valve assemblies shall be furnished and installed by the Contractor at all points where air pockets may form and at the locations shown and/or established in the field by the Engineer. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the valve assemblies shown on the plans and herein specified. See City Standard Drawing No. RW-9, RW-10, and RW-11.

(b) Materials, Fabrication and Installation

Materials shall be in accordance with City Standard Drawings. The valve shall be a Vent-o-Mat RBX series, Vent- Tech or approved equal.

33-19.3 Recycled Water Service Assemblies (2 inches and smaller)

(a) General

Recycled water service assemblies shall be furnished and installed by the

Contractor at the locations shown on Plans or established in the field by the Developer. The Contractor shall furnish all labor, materials, tools and equipment necessary to install, complete and ready for operation, the assemblies as shown on the Plans and herein specified. The Contractor shall perform the installation of the lot services in accordance with the City Standard Drawing Nos. RW-4 and RW-5. The Developer shall provide the City with a Plan showing the "As Built" location of all services.

(b) Materials, Fabrication and Installation

(1) Materials Shall be those designated on the City Standard Drawings RW-4 and RW-5

Service Size	Corp. Stop	Service Pipe	Angle Meter Stop
1"	1"	1"	1"
1 ½"	1 ½"	1 ½"	
2"	2"	2"	

(2) Pipe and Fittings Service pipe shall be Type K soft copper tubing, or Polyethylene CTS 200 psi SDR-9 PE 3408. Solder fittings shall be soldered with 95% tin / 5% lead or silver solder (pure).

(3) Saddles Service saddles shall be used for all 1", 1-1/2", and 2" taps made on ductile iron and PVC pipe. A circumferential type stainless steel band or bands shaped to fit the actual O.D. of the pipe shall be used. Double strap bands shall provide a minimum bearing width of 1-1/2 inches per band along the axis of the pipe. Single strap bands shall provide a minimum bearing width of 3 inches per band along the axis of the pipe. Saddles shall not have lugs that will cut into the pipe when the saddle is tightened. Saddles are to be Jones, Ford, Mueller or approved equal.

Multiple O.D. range saddles shall not be used.

(4) Service Taps In no case shall a service tap be made in a main closer than 18 inches to a bell coupling joint, or fitting. Service taps shall not be less than two feet apart. Service taps shall be located opposite the service locations so that the service laterals will be perpendicular to the Street centerline. Service tap locations varying more than two feet from the perpendicular must be approved by the Engineer prior to installation. Service taps shall be in accordance with City Standard Drawing Nos. RW-4 and RW-5. Where dissimilar metals are joined, a dielectric connection, approved by the Engineer shall be provided. Hole

size drilled in the pipe shall be the same size as the corporation stop. The cutting tool shall be muller cutting type (hole) cutter which will retain the coupon.

Tapping Sleeves and corporation stop valves shall be used for service connections of 2 inches and smaller. For ductile iron recycled water mains, double strap ductile iron service saddles must be used.

(5) Service Boxes

Service casing and covers and meter boxes and covers shall be furnished and installed by the Contractor as shown of City Standard Drawings RW-4 and RW-5. All service casings shall be complete and in place at the time of acceptance of the subdivision. All services shall be marked by an "RW" clearly visible on the curb face. Minimum size 1 ½" X 1 ½ " maximum 3" X 3".

(6) Curb Stops in Driveway

No services in driveway approaches allowed.

(7) Encasement and Identification

Due to the corrosive nature of soils, a protective polyethylene sleeve shall be installed over the copper service line on all sizes from 1" to 2". It must be purple in color, to immediately identify it as non-potable service, and shall encase the service line from the corp stop to the angle meter stop in one continuous piece. It shall be attached to both the corp and the angle meter stop by using PVC tape, duct tape, or other suitable adhesive tape.

33-19.4 Valve Service Casing and Lid

Valve Service Casing and Lid Shall conform with City Standard Drawing RW-2. Covers shall be seated flush with the surface of the natural ground or paved surface such that they may not be damaged by, or present an obstruction or rough surface to traffic. Covers shall have a 9 inch wide and 6 inch thick stabilizing concrete ring constructed when the valve is outside the pavement area. Covers must be painted purple by using Pantone 512.

SECTION 34 – RECYCLED WATER FACILITIES

34-1 SCOPE

These City Standard Specifications are intended to describe the execution and workmanship to be used in construction of a recycled water system operated in the City of Fresno. It is presumed that the Developer or his/her engineer has prepared such general and special Specifications as are necessary to define the nature and location of the Work, contractual arrangements, payment for Work, and any other matters concerning the owner or his/her Contractor. All Street work permits shall be obtained and fees shall be paid by the Developer or Contractor.

34-2 GENERAL

34-2.1 Quality Control of Materials

The quality control of materials shall conform to the applicable sections of the City Standard Specifications as published by the City of Fresno.

34-2.2 Quality of Workmanship

All Work will be done by Persons experienced in the specific Work, under competent supervision and in a first class manner to the Engineer's complete satisfaction. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the trench. If the pipe-laying crew cannot put the pipe into the trench and in place without getting earth into it, the Engineer may require that before lowering the pipe into the trench a heavy tightly woven burlap bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe. After placing a length of pipe in the trench and completing the jointing operation, in a method approved by the pipe manufacturer, the pipe shall be secured in place with approved backfill material placed under it. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a watertight plug or other means approved by the Engineer. This provision shall apply during any Work stoppage.

34-2.3 Connections to Existing Facilities

Connections shall be performed by Wastewater Division personnel only. One week notice shall be given before any connection is to be made.

34-2.4 Defective Work

Any defective materials or workmanship which becomes evident within one year after the City assumes responsibility for the completed Work shall be replaced or repaired without cost to the City. Refusal of the Contractor to correct defective Work which is his/her responsibility will be considered just cause for excluding him/her from performing future Work to be connected to the City's system. Such exclusion does not impair the City's right to bring legal action to correct the deficiencies.

34-2.5 Construction Staking and "Record-Drawings"

Construction stakes will be set parallel to the recycled water main alignment at an offset distance and direction agreed upon with the Contractor but in no case shall construction stakes be offset more than 10 feet. Stakes will be set at no greater interval than 100 feet on straight alignments. For horizontally or vertically curved recycled water mains, the stake intervals shall be 25 feet. For all Street recycled water mains, regardless of alignment or slope, the Developer's engineers shall determine "Record-Drawings" elevations at the top of pipe centerline at each change in pipe grade and shall provide a written record of such elevations to the inspector. The Developer's engineer shall also provide "Record-Drawings" of all main line valve locations and all service stop locations.

34-3 POLYVINYL CHLORIDE (PVC) PRESSURE PIPE AND FITTINGS INSTALLATION

34-3.1 Scope of Work

The Contractor performing the Work under this Specification shall furnish all labor tools and equipment, which are necessary to install, complete, and ready for operation, the PVC pressure pipe recycled water mains as herein specified and/or as indicated on the contract drawings.

34-3.2 Installation

Installation shall conform to Chapter 7, Installation, of AWWA Standard C605 and AWWA Manual M23. Bending of PVC pipe barrels to accomplish horizontal or vertical curves is not permitted.

34-3.3 Tracer Wire with Marking Tape

Tracer wire used with PVC **where called for on the Plans** shall be copper wire, Type TW, Size AWG #12 and shall be placed above the PVC recycled water main along with a recycled water marking tape, purple (pantone 512). The marking tape shall be a minimum of six inches wide and a minimum of 12" but no greater than 24" above the pipeline. See City Standard Drawing No.'s RW-1 and RW-24.

34-4 DUCTILE IRON PRESSURE PIPE AND FITTINGS INSTALLATION

34-4.1 Scope of Work

The Contractor performing the Work under this Specification shall furnish all labor tools and equipment, which are necessary to install, complete, and ready for operation, the ductile iron pressure pipe recycled water mains as herein specified and/or as indicated on the contract drawings.

34-4.2 Installation

Installation shall conform to AWWA C-600 and Installation of Ductile Iron Pipe and Fittings in AWWA Manual M41.

34-5 VALVE CASING AND LID INSTALLATION

When recycled water mains are installed, casings and lids in Street areas shall be installed in a lowered position below any sub-grade which may be removed or re-compacted.

When sub-grade is compacted and base material installed and completed, casing and lids shall be completed in accordance with City Standard Drawing Nos. RW-2, "Recycled Water Valve and Valve Box," and RW-16, " Recycled Water Irrigation Box Cover Markings".

Valves located in the sidewalk shall be marked with a 2" X 4" stake so that casings and lids may be brought to finished grade at the time concrete is poured.

Any excavation necessary for valve casing and lid work shall be thoroughly re-compacted to the satisfaction of the Engineer. All casings shall be installed in a vertical position. All valve operating nuts shall be free of any dirt or debris and all valves shall be checked to ensure that they are left in a wide open position.

<u>It shall be the responsibility of the Contractor to do this Work exactly as specified.</u>

34-6 EARTHWORK FOR DUCTILE IRON AND PVC PIPE INSTALLATION

34-6.1 Trench Excavation

The trench shall be constructed per City Standard Specifications, Section 16, City Standard Drawings P-48 and RW-1. Unless shown otherwise on the Plans a minimum cover of 3.5' is required for mains.

34-6.2 Trench Bottom

The trench bottom shall be true and even so that the barrel of the pipe will have soil support for its full length. Earth mounds can be used to support the pipe with the Engineer's approval and under his/her direction.

34-6.3 Bell Holes

Bell holes are required for push-on and mechanical joint pipe. While push-on joints require only a small depression beneath each bell to allow pipe to lay flat on the trench bottom, mechanical joints require additional space for operation of a ratchet wrench.

Minor excavations, which are necessary for removing the sling and for assembling the joints, shall be made in advance of the laying crew and filled after these operations are completed.

34-6.4 Trench Width

The trench must be wide enough to permit proper installation of the pipe with room for assembling joints and tamping backfill around the pipe. The trench must be at least 12 inches wider than the outside diameter of the pipe to allow for proper placement, tamping, and compaction of the initial backfill. Per the City Standard Specifications, Section 16, the width of the trench at the top of the pipe shall not be greater than 16 inches more than the outside diameter of the barrel of the pipe to be laid therein. These requirements may be modified by the Engineer or as shown on the Plans.

34-6.5 Rock or Hardpan Excavation

In rock or hardpan excavations it is necessary that the rock or hardpan be removed so that it will not be closer than 4 inches to the bottom and sides of the pipe for sizes up to 24 inches in diameter. This same practice shall be followed should the trench excavation pass through piles of abandoned masonry, large pieces of concrete or other debris. The pipe shall not be permitted to rest on masonry walls, piers, foundations or other unyielding, subterranean structures which may be encountered in the excavation.

34-6.6 Barricades and Safety

The Contractor shall follow all the requirements in Section 7-10.4 of the City Standard Specifications.

34-6.7 Shoring

In addition to, and consistent with public safety considerations, every precaution for safety must be provided for the workers at the Site. Shoring must comply with Cal-OSHA Standards.

34-7 BACKFILLING AND TAMPING

Backfilling usually follows pipe installation as closely as possible. This protects the pipe from falling materials, eliminates possibility of lifting the pipe due to flooding of open trench, and avoids shifting pipe out of line by cave-ins. The purpose of backfilling is not only to protect the pipe by covering it, but to provide firm, continuous support that will prevent the pipe from settling or resting on the couplings. The essentials of a first class backfilling job shall be as follows:

Provide continuous bedding or support by carefully consolidating approved material under pipe and couplings and between the run of pipe and the trench walls. Provide a cushion on top by hand - placing approved material to at least 12" over the pipe - the balance can then be backfilled by machine.

The first step in providing firm, continuous support for the pipeline is to tamp soil solidly under the pipe and couplings. Tamping can be done with tamping bars to consolidate the backfill material. Hand tamping is best accomplished with damp loamy earth or sand.

The initial backfill material used shall be slightly damp which will pack more solidly under the pipe. This initial backfill is always placed by hand. It shall be shoveled in evenly along both sides of the pipe, making a layer about 4" thick. Then the tamping bar is used to tamp this soil firmly under the pipe. If more than 4" of soil is shoveled in before tamping, the soil can bridge and fail to go under the pipe. Next, another 4" layer is shoveled in and tamped. This is repeated until the pipe is firmly bedded in compact soil up to the top of the pipe. Two 6 inch lifts are then used to achieve a 12 inch cover over the pipe. This completes what is called the "initial" backfill, the thoroughly tamped soil which provides a continuous supporting bed for the pipeline. Where clay soil or unstable soil is encountered, the pipe shall be enveloped in a minimum of four inches of sand - then the backfill completed to at least 12" above the pipe with selected material, then dry sand or other suitable materials shall be laid.

The balance of the backfill which is usually placed by machine, need not be as carefully selected as the initial material. Cleanup shall be in accordance with the City Standard Specifications.

34-8 TESTING AND STERILIZATION

34-8.1 General

The Specifications constituting this section designate the requirements for the procedure, materials, performance, and payment for testing and sterilization of recycled water mains and appurtenances intended for the conveyance of non-potable water under pressure.

Scope of Work The Contractor shall furnish all labor, material, tools, and equipment, including all chemicals, necessary to perform all operations required to complete the testing and sterilization as herein specified.

34-8.2 Field Testing

(a) Hydrostatic Pressure Test Hydrostatic Pressure test. After the pipe and all appurtenances have been laid and the backfill has been placed and compacted, a hydrostatic pressure test shall be conducted. A hydrostatic test shall be conducted on the entire pipeline for a period of 2 hours at a hydrostatic pressure of 200 psi for Class 200 pipe and 150 psi for Class 150 pipe. In locations where there is a combination of Class 200 and Class 150 pipe, the system testing pressure shall be 150 psi. All valves in the pipeline shall be in the open position during system testing.

(b) Preparation The line shall be filled with water at least 24 hours prior to testing. While filling and immediately prior to testing, all air shall be expelled from the pipeline. Where air valves or other suitable outlets are not available for introducing water or releasing air for test purposes, taps and fittings approved by the Engineer shall be installed and later securely plugged.

(c) Procedure The procedure shall follow those specified in the AWWA Standard C-600 Sec. 5.2 for ductile iron and C-605 Sec. 7.3 for PVC pipe. The pressure in the pipeline shall be pumped up to the specified test pressure. When the test pressure has been reached, the pumping shall be discontinued until the pressure in the line has dropped 5 psi, at which time the pressure shall again be pumped up to the specified test pressure. This procedure shall be repeated until the end of the test period. At the end of the test period, the pressure shall be pumped up to the test pressure for the last time. The total quantity of water pumped to maintain pressure shall be measured and compared to the allowable.

(d) Leakage Shall not exceed the amount calculated, using AWWA Standard C-605 for PVC and C-600 for ductile iron.

34-8.3 Sterilization

Prior to pressure testing and prior to acceptance of Work, the entire pipeline including all valves, fitting, hydrants, service laterals, and other accessories shall be sterilized in accordance with AWWA C-601 latest revision. All mains shall be flushed with potable water after completion of construction and prior to disinfection. The Contractor shall provide a sufficient number of suitable outlets at the end(s) of the line(s) being sterilized in addition to those required by the Plans, to permit the main to be flushed with water at a velocity of at least 5.5 feet per second over its entire length. The outlets provided shall meet the requirements for fittings as specified for the type of main constructed. Temporary blow-offs may be installed during the sterilization and flushing to satisfy these requirements. Drainage facilities shall be constructed such that the water lines cannot be contaminated through the flushing outlet. After flushing, chlorine compound solution made with liquid chlorine, calcium hypochlorite in solution or sodium hypochlorite solution shall be water mixed and introduced into the mains to form a chlorine concentration of approximately 100 ppm or that which will provide a minimum residual of 50 ppm in all parts of the line after 24 hours have elapsed.

During the sterilization process all valves, hydrants and other accessories shall be operated. After chlorination, the water shall be flushed from the line at its extremities until the replacement water tests are equal chemically and bacteriologically to those of the permanent source of supply. The placing of chlorine capsules or tablets in pipe sections during the laying process will be considered as an acceptable method of sterilization. The chlorine water solutions shall be diluted to a chlorine concentration of not more than 100 ppm and not less than 50 ppm measured in the water lines. The Contractor shall keep adequate chlorine residual testing and indicating apparatus available on the site during the entire sterilization period.

After final flushing, the flushing fitting shall be plugged with devices intended for this purpose at the pressure class of the pipe. Where water main is coated, plugs and outlets shall be similarly coated. Bacteriologic samples of water for the specified bacteriologic test shall be taken from each end of the sterilized main (located downstream of the point of introduction of chlorine disinfectant and at other locations as determined necessary by the Engineer.) Additional samples shall be taken at intermediate points in such a manner that at least one sample is taken for each 700 feet of main. Bacterial samples will be taken a minimum of 48 hours after the mains have been flushed of all chorine.

The Contractor shall dechlorinate disinfecting water and flushing water if required by the Plans

34-9 SIGNAGE

A sign reading "Recycled Water-Do Not Drink" in English and Spanish, shall be posted at all points where consumption of the water may be attractive to the public, in areas of public use that receive reclaimed water and at all valves, control boxes, and similar features in accordance with City Standard Drawing No RW-13 . This requirement may also apply to sprinkler heads when after-market clip-on purple rings are readily available in accordance with City Standard Drawing No RW-19.

34-10 ABANDONMENT

34-10.1 General

All existing non-potable waterlines or structures that are to be abandoned must be identified in the drawing. In general, abandoned lines that are in service will be replaced with a parallel line of equal or larger size, and the Engineer shall demonstrate in any case that the abandonment does not adversely affect the water system.

34-10.2 Recycled Water Lines

All non-potable water lines to be abandoned shall be entirely filled by pumping concrete into them. The pump mix shall be a mixture sufficiently workable for the purposes intended.