MARIN MUNICIPAL WATER DISTRICT

San Geronimo and Bon Tempe Treatment Plants
Filter Rehabilitation and Seismic Upgrades

Draft Design Report

MWH®

BUILDING A BETTER WORLD

CLIENT REVIEW DRAFT | March 2016

Marin Municipal Water District

Filter Rehabilitation and Seismic Upgrades at Marin Municipal Water District's Surface Water Treatment Plants

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1. Introduction

The existing dual-media filters at the Marin Municipal Water District (MMWD) Water Treatment Plants (WTPs) are to be rehabilitated for improved performance and operational longevity. This document provides the Design Report (Task 4.1) for the Filter Rehabilitation and Seismic Upgrades Project and will define the required elements of this rehabilitation and establishes design criteria that will be used for detailed design.

1.1. Background

The District was established in 1912 with the primary purpose of providing a reliable water supply to residents in central and southern Marin County from two existing reservoirs. The MMWD now operates two water treatment plants: (1) the San Geronimo Water Treatment Plant (SGTP) and (2) the Bon Tempe Water Treatment Plant (BTTP). The SGTP was constructed in 1961 and expanded in 1972 and has a design capacity of 35 million gallons per day (mgd). The BTTP was constructed in 1958 with a design capacity of 20 mgd. In 1994, Chemical Storage and Feed Facilities were added at both plants.

The Master Plan for the WTPs, completed in October 2015, found that major seismic rehabilitation of the filters (and other structures) is required to meet the District's reliability goal of producing water within 24 hours of a major earthquake. Note that this effort is not part of a jurisdictionally mandated seismic retrofit program, thus the District is permitted to select the performance objectives and scope of the evaluation and retrofit. The individual filters at both plants (four at the BTTP and six at the SGTP) are identical in size and have similar anthracite/sand filter media, plastic block underdrains and rotary surface wash. The filters are the final removal of turbidity particles prior to the reservoirs reaching the distribution system.

1.2. Results of Previous Studies

1.2.1. Filter Process Findings from the Master Plan

Overall, the filters at both plants have performed well over the past 15 years since the new underdrains and media were replaced, but there have been some occurrences of sub-optimal performance including frequent backwashing, low filter production efficiencies, and extended filter ripening periods. Staff also report that the filter media at both plants is not being cleaned effectively.

During the master planning process, various improvements to the filtration systems at both WTPs were investigated including filter media replacement, addition of air scour for improved backwashing, addition of filter-to-waste (FTW), implementation of direct filtration at the BTTP, construction of new filters at the SGTP, and microfiltration membranes.

1.2.2. Results from Existing Conditions Analysis

1.2.2.1. Structural Investigation of Filter Structures

MWH performed a preliminary structural analysis and investigation of the filter structures at the BTTP and SGTP, detailed in a draft Technical Memorandum (TM), titled "Existing Conditions Analysis – Filter Rehabilitation and Seismic Upgrades Project at Bon Tempe and San Geronimo Water Treatment Plants," dated February 12, 2016.

1.2.2.2. Bon Tempe Water Treatment Plant

The Bon Tempe Water Treatment Plant (BTTP) was originally constructed in 1958 and includes the Control Building, Rapid Sand Filters (Filters), Flocculation and Sedimentation Tank, Clearwell, Wastewater Recovery Pond, and other miscellaneous civil and site improvements. The Control Building and Filters are structurally connected and generally consist of reinforced concrete bearing wall structures supported on mat foundations. The Control Building is a two-story reinforced concrete structure with the lower floors originally used for liquid chemical storage and equipment rooms, and the upper floor is used for chemical storage and office space. The Filter structure is generally an open basin/tank type structure with a two level enclosed Pipe Gallery (lower level) and Control Gallery (upper level) on the north side. The Filter structure is located adjacent to the Flocculation and Sedimentation Tank, and is structurally separated from the Floc/Sed Tank by an expansion joint located near the mixing chamber. In 1994, a chemical storage and feed building was constructed, on the west side of the Filters, north of the Control Building.

See **Appendix A, Figure 1** for a site plan showing the general BTTP layout and the location of the Filters and Chemical Building Addition.

1.2.2.3. San Geronimo Water Treatment Plant

The San Geronimo Water Treatment Plant (SGTP) was originally constructed in 1961 and included the Control Building, Rapid Sand Filters (Filters), Flocculation and Sedimentation Tank, Clearwell, Wastewater Recovery Pond, Pump Station, and other miscellaneous civil and site improvements. The Control Building and Filters are structurally connected and generally consist of reinforced concrete bearing wall structures supported on mat foundations. The Control Building is a two-story reinforced concrete structure with the upper floor consisting of the control room, office spaces, laboratory, feeder room and chlorination room; and the lower floor consisting of the chemical storage, liquid chemical storage, and equipment room. The Filter structure, on the west side of the Control Building, is an open basin/tank type structure with four (4) filter basins, an enclosed Pipe Gallery (lower level) and Control Gallery (upper level) on the south side of the Filters. The Flocculation and Sedimentation Tank is located on the north side of the Filters and is seismically separated from the Filters by an expansion joint between the two structures. In 1972, as part of the SGTP Expansion Project, two Filter basins, one Flocculation and Sedimentation Tank, and multiple Sludge Drying Beds were constructed. The Pipe/Control Gallery were extended to the west adjacent to the new Filter Basins. A 2-inch expansion joint seismically separates the original Filters and Pipe/Control Gallery from the new. In 1994, a

chemical storage and feed building was constructed, on the south side of the Filters, west of the Control Building.

See **Appendix A, Figure 1A** for a site plan showing the general SGTP layout and the location of the Filters and Chemical Building Addition.

1.2.2.4. Structural Analysis of Filter Structures:

The investigation of the filter structure followed the requirements in the 2013 California Building Code (2013 CBC) Section 3401.7 for existing building structures. The 2013 CBC allows the use of the American Society of Civil Engineers Standard "Seismic Evaluation and Retrofit of Existing Buildings – ASCE/SEI 41-06 for repairs and seismic retrofit of existing structures or portions thereof. MWH has used the 2013 version of the Standard (ASCE 41-13) for this study as it represents the most current provisions for the seismic evaluation and retrofit of existing buildings.

ASCE 41-13 specifies nationally applicable provisions for the seismic evaluation and retrofit of existing buildings; and many of the provisions, checklists and requirements are based upon observations of building performance in actual earthquakes. The filter structures at BTTP and SGTP are classified as non-building structures. With careful modification, the ASCE 41 Standard can be adopted for use with non-building structures. The following specific modifications were made for this project:

- Consideration of hydrodynamic loading on the filter structure walls using the provisions of ACI 350.3.
- Special consideration of wall out-of-plane loading for the filter walls.

As required by Task 3.2.1, a Tier 1 screening was performed for the filter structures at both BTTP and SGTP. The Tier 1 screening is a checklist evaluation of the building/structures designed to assess the building and identify potential deficiencies. Checklist items identified as being non-compliant under a Tier 1 evaluation are either retrofitted to remove the deficiency or further evaluated under a Tier 2 or Tier 3 investigation. Tier 2 and Tier 3 investigations are more complex in nature, and further in-depth study may provide sufficient information to remove a deficiency.

The completed Tier 1 evaluation checklists for BTTP and SGTP can be found in the Existing Conditions Analysis TM.

1.2.2.5. Results of Investigation

Wall out-of-plane loading (resistance to seismic inertial forces or fluid pressure perpendicular to the plane of the wall) is not directly addressed under the ASCE 41-13 Tier 1 screening process except for wall anchorage at flexible diaphragms and the transfer of diaphragm forces to shear walls. This is because, in general, occupied buildings within the scope of ASCE 41 have not historically experienced major damage from wall out-of-plane actions except at the diaphragm connections. The filter structures are non-building liquid containing structures and wall out-of-plane loading, including the consideration of hydrodynamic forces, is critical to their performance. For this study, MWH has used the Tier 2 evaluation procedures in ASCE 41 to

assess wall out-of-plane performance. Hydrodynamic loads were calculated using the procedures in American Concrete Institute publication ACI 350.3-06, Seismic Design of Liquid Containing Concrete Structures and Commentary.

Walls were analyzed for shear and flexure (bending) stresses considering hydrodynamic loading assuming the filters are operating with the water surface at normal operating levels. Demand to Capacity (D/C) ratios were calculated for critical walls and are presented in **Table 1** and **Table 2.** Any D/C ratio greater than 1.0 (boxed in the Tables) indicates a condition where further analysis or retrofit will be required. Based on the results of the preliminary analysis, the End Walls and Side Walls at the Filters had D/C Ratios that exceeded 1.0 and will require retrofit/strengthening.

Table 1. – Preliminary Analysis Results - Wall Out-of-Plane Loading -Bon Tempe Water Treatment Plant

Location	Condition	D/C Ratio	Notes
Filter Side Wall (End cell) - Case 1A	Shear (k)	0.84	At base of wall (vertical)
	Flexure (k*ft)	0.87	At base of wall (vertical)
	Shear (k)	1.31	At side of wall (horizontal)
	Flexure (k*ft)	6.74	At side of wall (horizontal)
Filter Side Wall (Interior cell) - Case 1B	Shear (k)	0.83	At base of wall (vertical)
	Flexure (k*ft)	1.02	At base of wall (vertical)
	Shear (k)	1.68	At side of wall (horizontal)
	Flexure (k*ft)	8.57	At side of wall (horizontal)
Filter End Wall at Pipe/Control Gallery – Case 2	Shear (k)	1.14	At base of wall, midpoint (vertical)
	Flexure (k*ft)	1.84	At base of wall, midpoint (vertical)
	Shear (k)	0.66	At side of wall, top (horizontal)
	Flexure (k*ft)	2.75	At side of wall, midpoint (horizontal)
	Flexure (k*ft)	0.51	At midspan of wall (horizontal)

Location	Condition	D/C Ratio	Notes
Filter End Wall at Channels – Case 3	Shear (k)	0.23	At base of wall, midpoint (vertical)
	Flexure (k*ft)	0.16	At base of wall, midpoint (vertical)
	Shear (k)	0.42	At influent channel slab, midpoint (vertical)
	Flexure (k*ft)	0.86	At influent channel slab, midpoint (vertical)
	Shear (k)	0.83	At side of wall, top (horizontal)
	Flexure (k*ft)	1.43	At side of wall, top and midpoint (horizontal)
	Flexure (k*ft)	0.90	At midspan of wall (horizontal)
Filter Interior Gullet Walls (Tank Full)	Shear (k)	0.77	
	Flexure (k*ft)	0.94	
Filter Interior Gullet Walls (Gullet Filling)	Shear (k)	0.21	
	Flexure (k*ft)	0.37	

Table 2. – Preliminary Analysis Results - Wall Out-of-Plane Loading -San Geronimo Water Treatment Plant

Location	Condition	D/C Ratio	Location (Reinf)
Filter Side Wall	Shear (k)	0.71	At base of wall (vertical)
	Flexure (k*ft)	0.79	At base of wall (vertical)
	Shear (k)	0.79	At top of wall (horizontal)
	Flexure (k*ft)	6.33	At top of wall (horizontal)
Filter Gullet Wall	Shear (k)	0.22	At base of wall (vertical)
	Flexure (k*ft)	0.85	At base of wall (vertical)
Filter End Wall @ Pipe Gallery	Shear (k)	1.03	At base of wall (vertical)
	Flexure (k*ft)	4.08	At base of wall (vertical)
	Shear (k)	0.75	At top of wall (horizontal)
	Flexure (k*ft)	3.94	At top of wall (horizontal)
Filter End Wall @ Influent Channel	Shear (k)	0.67	At base of wall (vertical)
	Flexure (k*ft)	4.62	At base of wall (vertical)
Filter Manifold Wall	Shear (k)	0.25	At base of wall (vertical)
	Flexure (k*ft)	0.37	At base of wall (vertical)

1.2.2.6. Additional Seismic/Structural Retrofit

As part of the structural investigations, MWH performed field observations of existing conditions and reviewed As-Built documents of other areas adjacent to the filter structure at both Plants. Structural components within the pipe gallery, control gallery, and chemical buildings were evaluated and found to be non-compliant or needed further analysis under the Tier 1/Tier 2 evaluation. The rod bracing within the control galleries is susceptible to out-of-plane buckling and should be replaced with rigid tube steel or pipe bracing. The trapeze hanger pipe supports in the pipe gallery require additional rod stiffeners and/or lateral bracing to the walls. Many pipes including the filter backwash pipe are missing lateral bracing altogether. The chemical feed buildings' wall-to-roof anchorage, appear deficient and will require further evaluation to determine if additional roof framing members and anchors are needed to adequately transfer the seismic loads to the walls. MWH identified these additional items within the Existing Conditions Analysis TM, and included them in **Table 3**- Section 2.1.

1.3. Filter Rehabilitation and Seismic Upgrades Overview

Operational/process rehabilitation of the filters will be combined with seismic strengthening of the filter structures. The recommended structural rehabilitation work necessary to address the deficiencies discussed in Section 1.2 consists of thickening the perimeter filter walls, which requires the removal of the existing media and underdrains. Therefore, additional operational related filter rehabilitation work and correction of other structural deficiencies were requested by MMWD staff to be included in this project in order to meet the performance goal of providing water service within 24 hours following a damaging seismic event. The following upgrades are included in this design report:

- Seismic retrofit
- Filter media replacement
- Underdrain replacement
- Provisions for future air/water backwash (SGTP only)

Furthermore, the following projects were included in this design report to facilitate taking individual plants out of service:

- Smith-Conifer Reliability Project
- Phoenix Lake Pipeline Bypass Replacement

All of these upgrades projects and design criteria are discussed in more detail in Section 2 – Elements of Design.

2. Elements of Design

2.1. Seismic Retrofit

The seismic retrofit items for BTTP and SGTP are summarized in **Table 3**. Preliminary seismic retrofit concepts and details for BTTP and SGTP are included in **Appendix A**, **Figures 2** through **21**. All retrofit items in the table apply to both sites except where noted. See the Existing Conditions Analysis TM, dated February 2016, for additional information regarding the Tier 1 Evaluation and development of the retrofit items.

Table 3. – Bon Tempe and San Geronimo WTP Seismic Retrofit Items

Retrofit Item	Seismic Retrofit Scope	Notes
Overall Building System	Evaluate by calculating actual building deflections and assess impacts.	
Diagonal Bracing @ Pipe Gallery	1. Confirm by calculations building torsion was addressed by 1994 Retrofit. 2. Evaluate original gravity column capacity for added diagonal bracing in 1994. 3. Retrofit existing connections to wrap around column and add bolts with adequate edge distance.	May require brace replacement and/or brace and connection modifications.
Filter Wall to Slab Connections	Check development of wall dowels into foundation. Add additional anchorage if necessary.	
Shear Walls	Perform detailed calculations to confirm shear wall resistance in the short direction of the filter structure.	
Floor Diaphragm	1. Evaluate area around opening at Control Gallery floor, north end, adjacent to shear wall. Strengthen if required. 2. Perform calculations to assess re-entrant corner at Control Gallery/Operations Building interface.	**BTTP only** **See Appendix A - Figure 3**
Flexible Diaphragms	Add/confirm welding of metal deck roof diaphragm to steel frames at Control Gallery	**See Appendix A - Figures 6, 18, and 19**
Filter Walls – Out of Plane	1. Add additional wall thickness at side and end walls of each filter basin. 2. Add additional lateral wall resistance with angles at base of walls.	**See Appendix A - Figures 2, 4, 5, and 10 through 17**
Gullet Assembly Attachment	Strengthen connection.	**See Appendix A - Figures 3 and 11**

Retrofit Item	Seismic Retrofit Scope	Notes
Filter Influent Channel Corbel	Rebuild column support under corbel.	**BTTP only** **See Appendix A - Figure 2**
Control Gallery/Building Bracing	Replace tension only rod bracing with tube or pipe bracing.	**See Appendix A - Figures 6, 18, and 19**
Pipe Gallery - Piping	1. Brace filter backwash piping. 2. Add seismically compliant bracing to trapeze hangers. 3. Retrofit vertical rod supports > 12" long. 4. Cement mortar lined pipe recoating and lateral restraint	**See Appendix A - Figures 7 and 20**
Chemical Building	Evaluate wall out-of-plane anchorage at roof, in strong direction of deck, parallel to roof joists. If required, add roof members and anchors to adequately transfer loads to the walls.	**See Appendix A - Figures 8 and 21**
General	Upgrade of miscellaneous structural components/connections around the plant, secure small diameter eye bolt connections to loose steel cables at HVAC units, secure site piping, anchorage of electrical cabinet bases	

2.2. Seismic Retrofit and Design

2.2.1. Structural Design Criteria

This section presents a summary of the structural codes and design criteria that will be used for the project. These requirements will be incorporated on all new construction unless indicated otherwise.

2.2.1.1. Governing Codes and Design Standards

Structural design will be performed in accordance with the 2013 Edition of the California Building Code (current enforceable code) except where other applicable codes are more restrictive.

2.2.1.2. Design References and Standards

Structural design shall be in accordance with the following references and standards. Where the version is not listed, use the version listed under Referenced Standards in CBC 2013.

- American Society of Civil Engineers (ASCE) 7-10 - Minimum Design Loads for Buildings and Other Structures
- American Concrete Institute (ACI) 318-11 - Building Code Requirements for Structural Concrete

- ACI 350-06 – Code Requirements for Environmental Engineering Concrete Structures
- ACI 350.1-01 – Tightness Testing of Environmental Engineering Concrete Structures
- ACI 350.3-06 – Seismic Design of Liquid-Containing Concrete Structures
- ACI 350.4R-04 – Design Considerations for Environmental Engineering Concrete Structures
- ACI 530-11 – Building Code Requirements for Masonry Structures
- ACI 530.1-11 – Specifications for Masonry Structures
- American Institute of Steel Construction 325-10 (AISC) – Steel Construction Manual, 14th Edition (includes AISC 360-10 Specification for Structural Steel Buildings and AISC 303-10 Code of Standard Practice for Steel Buildings and Bridges)
- AISC 341-10 Seismic Provisions for Structural Steel Buildings
- American Welding Society (AWS) D1.1-10 – Structural Welding Code – Steel
- AWS D1.2-10 – Structural Welding Code – Aluminum
- American Iron and Steel Institute (AISI) 2007 – North American Standards for Coldformed Steel Framing
- Aluminum Association Aluminum Design Manual (AA ADM) 1-2010
- American Society of Testing and Materials (ASTM) – Standards and Specifications
- Steel Deck Institute (SDI) 2010 – Standard Specifications for Steel Roof Deck and Steel Floor Deck
- Steel Joist Institute (SJI) 2010 – Standard Specifications for Steel Joists and Joist Girders
- U.S. Army Corps of Engineers (USACE) Engineer Manuals (EM) 1110-2-2100 – Stability Analysis of Concrete Structures
- CalTrans Bridge Design Specifications - September 2014
- MWH – MWH Design Quality Procedures
- Moody/U.S. Department of the Interior, Bureau of Reclamation (USBR) – Moments and Reactions for Rectangular Plates – Engineering Monograph No. 27, W.T. Moody – Reprinted 1986
- Portland Cement Association (PCA) – Rectangular Concrete Tanks
- PCA – Circular Concrete Tanks without Pre-stressing

2.2.2. Materials of Construction

Structures in this project will be reinforced concrete, masonry, and steel structures. The following materials of construction apply to all new construction on The Project unless noted otherwise.

2.2.2.1. Reinforced Concrete

The reinforced concrete used on this project shall be designed for strength, durability, shrinkage reduction, sulfate resistance and aesthetics. See cast-in-place concrete specification for slump, aggregate sizes, and water/cement ratios for different mixes.

Cement	ASTM C150 Type II or V, unless noted otherwise. ASTM C150 Type II or V used in mortar or grout for CMU.

Pozzolans	No pozzolans (including flyash) shall be used in concrete for hydraulic concrete structures.
Admixtures	A combination of water-reducing admixtures may be used in all concrete mixes for ease of pumping and placement, to achieve the lowest possible water/cement ratios to minimize shrinkage and control cracking. Admixtures containing calcium chloride shall not be used.
New Reinforcing	ASTM A615 Grade 60 unless otherwise noted ASTM A706 Grade 60, if welded where required for special seismic force resisting systems. Carbon Equivalent shall not exceed 0.55 percent. Welded wire fabric - ASTM A185
Existing Reinforcing	fy = 33 ksi (BTTP) fy = 33 ksi (SGTP)

New Concrete	Structural Concrete (all structural applications)	= 4,000 psi
	Sitework Concrete (civil and sitework applications)	= 3,000 psi
	Lean Concrete (unreinforced applications)	= 2,000 psi
Existing Concrete	Structural Concrete (BTTP)	f'c,eq = 4,800 psi
	Structural Concrete (SGTP)	f'c,eq = 6,000 psi

2.2.2.2. Structural Steel

Steel may be used for the primary structural system for buildings as well as for roof and miscellaneous framing, and pipe supports. The protective coatings specification will be referenced for coating requirements.

- Wide flange shapes — ASTM A992
- Structural pipe — ASTM A53, Type E or S, Grade B standard weight
- Hollow structural sections — ASTM A500 Grade B
- Other shapes, plates, bars — ASTM A36
- Bolts — ASTM A325
- Anchors rods — ASTM A307, Grade A or B, hot-dip galvanized, or ASTM A1554, GR55, hot-dip galvanized

2.2.2.3. Metal Deck

- Roof or floor deck — ASTM A611 or A446, Fy = 33 ksi

2.2.2.4. Stainless Steel

- Submerged or corrosive areas — Type 316
- All other uses — Type 304

2.2.2.5. Aluminum

- All applications, except as noted — Alloy 6061 T6
- Handrails and grating — Alloy 6061 or 6063

2.2.2.6. Post-Installed Concrete Anchors

Post-installed concrete anchors shall be adhesive, screw in, or expansion type and shall have an approved International Code Council – Engineering Services (ICC-ES) report. Material shall be stainless steel or galvanized steel. Determination of type and material shall depend on use, temperature, corrosively, design loads and concrete dimensions. Only cast-in-place "headed" anchor bolts shall be used for anchorage of vibratory equipment.

2.2.2.7. Concrete Masonry

Post-installed concrete anchors shall be adhesive, screw in, or expansion type and shall have an approved International Code Council – Engineering Services (ICC-ES) report. Material shall be stainless steel or galvanized steel. Determination of type and material shall depend on use, temperature, corrosively, design loads and concrete dimensions. Only cast-in-place "headed" anchor bolts shall be used for anchorage of vibratory equipment.

2.2.2.8. Waterstops

- New construction: Polyvinyl chloride (PVC) flat strip waterstops, unless noted otherwise. Use center-bulb-type waterstop at movement/expansion joints.
- Retrofit: PVC or preformed hydrophilic waterstops.

2.2.3. Geotechnical Information

The geotechnical information shall be based on the Geotechnical Technical Memorandum by MWH dated March 10, 2016.

The Geotechnical Parameters from the Geotechnical Technical Memorandum are shown in **Table 4**:

Table 4. – Summary of Geotechnical Parameters

Parameter	Unit	BTTP	SGTP
Soil description	--	Highly weathered sandstone	Surface deposits, predominantly CL soil
Soil Site Class	--	D	D
Moist unit weight of native soil	pcf	130	125
Moist unit weight of backfill material	pcf	130	130
Angle of internal friction of native soil	degrees	30	28

Parameter	Unit	BTTP	SGTP
Angle of internal friction of backfill material	degrees	30	30
Allowable bearing pressure	psf	3,000	3,000
Static active lateral earth pressure	psf	45H	45H
Static at-rest lateral earth pressure	psf	65H	65H
Static passive lateral earth pressure	psf	250H	250H
Seismically-induced lateral earth pressure	psf	20H	20H
Friction factor at concrete/native soil contact	--	0.4	0.35

2.2.4. Design Loads

Design loads for the structures are summarized in the following paragraphs.

2.2.4.1. Dead Loads (D)

Includes the weight of the structure and all fixed equipment.

- Weights of materials:
- Reinforced concrete 150 pcf
- Steel 490 pcf
- Aluminum 170 pcf
- Concrete masonry unit (normal weight) 135 pcf
- Soil (above groundwater) Per **Table 4**

2.2.4.2. Live Loads (L)

Uniform live loads need not be applied in addition to equipment loads to floor areas that will be permanently covered with equipment. Design for uniform live load or actual equipment load, whichever is greater.

- Building Roof Live Load
- Floor Live Loads (uniform):
    - Concrete Roof Deck
    - Process Area, Typical UNO
    - Heavy Equipment Rooms
- Platforms and Stairs (uniform)
- Floor Live Loads (concentrated):
    - Typical (unless otherwise noted) Stairs
    - Heavy Equipment Rooms (or known equipment weight)
    - Traffic Areas HS-20 Vehicle Load designation

2.2.4.3. Fluid Loads (F)

Consider unbalanced fluid loads wherever they can occur. Design for maximum operating fluid levels for static and seismic loads. Design for maximum possible fluid level (flooded) based on a worst-case scenario (see load combinations).

- Process water — 62.4 pcf
- Chemicals — Per published densities

2.2.4.4. Soil Loads (H)

Design buried structures for lateral loads due to soil and groundwater. Design buried structures for hydrostatic uplift loads due to groundwater. Use buoyant weight of soil counteracting uplift loads.

- Lateral earth pressures — Per **Table 4**
- Design groundwater elevation — TBD
- Seismic soil loads — See seismic load criteria

2.2.4.5. Seismic Load Criteria (E):

Seismic loads for design of the seismic force-resisting systems and nonstructural components will be determined per the requirements of CBC, ASCE 7, and Chapters 11 through 13. Use the following parameters to calculate the seismic loads:

- Risk Category (ASCE 7, Table 1.5-1) — IV
- Seismic Importance Factor (ASCE 7, Table 11.5-1) — 1.50

2.2.4.5.1. Bon Tempe Water Treatment Plant

- Spectral Response Acceleration, S_S — 1.511
- Spectral Response Acceleration, S_1 — 0.683
- Site Coefficient, Fa (ASCE 7, Table 11.4-1) — 1.173
- Site Coefficient, Fv (ASCE 7, Table 11.4-2) — 1.768
- Spectral Response Coefficient, S_{DS} (ASCE 7, Eqn 11.4-3) — 1.007
- Spectral Response Coefficient, S_{D1} (ASCE 7, Eqn 11.4-4) — 0.592
- Seismic Design Category (ASCE 7, Tables 11.6-1 & 11.6-2) — D

2.2.4.5.2. San Geronimo Water Treatment Plant

- Spectral Response Acceleration, S_S — 1.571
- Spectral Response Acceleration, S_1 — 0.721
- Site Coefficient, Fa (ASCE 7, Table 11.4-1) — 1.173
- Site Coefficient, Fv (ASCE 7, Table 11.4-2) — 1.768
- Spectral Response Coefficient, S_{DS} (ASCE 7, Eqn 11.4-3) — 1.047
- Spectral Response Coefficient, S_{D1} (ASCE 7, Eqn 11.4-4) — 0.721
- Seismic Design Category (ASCE 7, Tables 11.6-1 & 11.6-2) — D

2.2.4.5.3. Existing Structure Performance Levels and Ground Motions

The following Performance Levels and ground motions shall be used for existing structure evaluations at both Plants, per 2013 CBC Section 3401.7:

- Immediate Occupancy Performance Level at the BSE-1 earthquake, redefined by the 2013 CBC as the ASCE 7-10 (2/3) MCER ground motion.
- Collapse Prevention Performance Level at the BSE-2 earthquake, redefined by the 2013 CBC as the ASCE 7-10 MCER ground motion.

2.2.4.6. Snow Loads (S)

- Ground snow load, Pg psf (ASCE 7, Figure 7-1) 0

2.2.5. Load Combinations

The load combinations used for existing structure evaluation shall be in accordance with ASCE 41.

Load combinations for new elements shall be in accordance with the 2013 CBC.

2.2.6. Structural

Design requirements are summarized in the following sections for stability, deflection, vibration, and durability.

2.2.6.1. Stability

Design structures to resist sliding, overturning, and flotation using the following criteria and factors of safety:

Against sliding:

- Normal FS = 1.5
- Seismic FS = 1.1

Against overturning:

- Normal FS = 1.5
- Seismic FS = 1.1

Against flotation:

- Extreme (100-year flood water level) FS = 1.1
- Operation (design ground water level) FS = 1.5

Keep resultant force within the middle third of the foundation base if possible.

Use concrete weight of 145 pcf for dead loads resisting flotation.

Resistance to uplift of structures due to high groundwater levels will be provided by the dead load of the structure and the weight of soil within a wedge 20 degrees from vertical extending upward from the footing extensions (use buoyant weight below design groundwater elevation).

Resistance to lateral seismic loads shall be provided by the following: friction between foundation mat or footing, passive soil pressure, friction between backfill and side walls, and lateral loads carried by drilled piers into soil. Combinations of these used shall be in accordance with the geotechnical report.

2.2.6.2. Deflection Criteria

The following maximum deflection criteria, under live load only, shall be used:

- Floors L/360
- Roofs L/240
- Floor plates and gratings L/180
- 1/4 – inch maximum L/400 vertical

2.2.6.3. Vibration

For new equipment and existing pipe and equipment supports, precaution shall be taken to accommodate any vibration loads.

2.2.6.4. Hydraulic Concrete Structures

New portions of hydraulic concrete structures shall be designed for maximum durability and water-tightness following the design methodology of ACI 350. Distribute flexural reinforcement to control crack width according for severe environmental exposure, unless the requirements for using normal environmental exposures are met.

Shrinkage cracking shall be controlled through the use of low-shrinkage concrete, movement joints and minimum shrinkage and temperature reinforcement. Provide contraction joints at 30- to 50-foot spacing where possible. Provide expansion joints in long structures, at 150-foot maximum spacing, or where abrupt changes in configuration or support occur. Refer to ACI 350.4R for more information about movement joints. Provide shrinkage and temperature reinforcement per ACI 350 7.12.2.1. Adjust reinforcement ratio as noted when partial contraction joints are used.

Provide 6-inch flat strip PVC waterstops in all new wall and slab construction and contraction joints. Provide 9-inch PVC waterstops with center bulb at new wall and slab expansion joints. Provide hydrophilic or PVC retrofit waterstops where new construction abuts existing construction.

2.2.7. Corrosion Protection

Protective coating shall be specified and applied to the interior surfaces of the concrete filter basins to protect against the pH levels of the coagulated water.

2.2.8. Seismic Design for Nonstructural Components

Architectural, mechanical, and electrical components shall be designed for seismic loads as required by ASCE 41, Chapter 13, for Seismic Design Category D, as a minimum.

2.2.9. Anchoring to Concrete

Cast-in anchors and post-installed anchors shall be designed to meet the requirements of ACI 318, **Appendix D**, except for special anchor types not covered by the Appendix.

2.2.10. Structural Special Inspections Requirements

Special inspections, structural testing, structural observations and written statements shall be provided in accordance with the CBC Chapter 17 and as summarized on the Contract Drawings.

2.3. Filtration Process Upgrades

Table 5 shows a summary of rehabilitation elements for the filter rehabilitation and seismic upgrades project.

Table 5. – Summary of Rehabilitation Elements

Element of Design	Rehabilitation Task
Filter Media	Remove existing media and replace with 34” of 0.95 mm anthracite and 12” of 0.5 mm sand at the BTTP and 34” of 1.05 mm anthracite and 12” of 0.55 mm sand at the SGTP.
Underdrains	Demolish existing underdrains and replace with new low-profile HDPE block system and media retention plate to match existing underdrain type at both plants.
Air/Water Backwash	Maintain existing rotary surface wash system at both plants. Utilize existing air scour piping and penetration to install new blower and air scour system that connects into the new underdrains at SGTP. Install air piping in the filter walls at the BTTP for later addition of air/water backwash.

2.3.1. Process Design Criteria

2.3.1.1. Existing Conditions

The SGTP has six filters and the BTTP has four filters. All of the filters have the same dimensions, each with two bays of 36 feet by 12 feet. Filters are dual media, and both plants operate at 3 to 3.5 mgd per filter very consistently. The existing filter media at both plants was installed between 1999 and 2002 with new gravel-less underdrains. A summary of the existing conditions in relation to the design upgrades discussed in this report is included in **Table 6**.

Table 6. – Summary of Existing Conditions

PARAMETER	UNIT	DESIGN VALUE	
		BTTP	SGTP
Media			
Configuration	inches	34-inches of anthracite over 12-inches of sand	34-inches of anthracite over 12-inches of sand
Effective Media Size	mm	0.90 mm anthracite over 0.50 mm sand	0.90 mm anthracite over 0.50 mm sand
Underdrain	-	Plastic Block with media retaining caps	Plastic Block with media retaining caps
Surface Wash	-	Rotary	Rotary
Air Scour	-	No air scour capability included at the BTTP.	Original plant was designed to inject air at the surface of the media during backwash. Pipe penetrations into filters in place, but not currently used.

2.3.1.2. Basis of Design Overview

The proposed process design basis for the rehabilitated filters at the BTTP and SGTP is summarized in **Table 7.**

Table 7. – Process Design Criteria

PARAMETER	UNIT	DESIGN VALUE	
		BTTP	SGTP
Influent			
Flow Rate			
Low Flow	mgd	2	6
Average Flow	mgd	5	13
Design Capacity	mgd	20	35
Water Quality			
Settled Water Turbidity	NTU	0.3-1 (up to 4 during direct filtration)	0.2-2.2
Water Temperature	°C	10 to 25	10 to 25
Plant Ferric Dose	mg/L	10 to 25	20 to 40

PARAMETER	UNIT	DESIGN VALUE	
		BTTP	SGTP
Filtration			
Filtration Rate	-		-
Low Rate	gpm/sf	2.0	2.0
High Rate	gpm/sf	3.5	3.5
Max Rate[1]	gpm/sf	6.0	6.0
Expected UFRV	gal/sf	Normal Filtration: 9,400 Direct Filtration: 2,600	Nicasio: 12,000 Kent: 17,000
Target Turbidity	NTU	<0.1	<0.1
Expected Turbidity	NTU	0.02 to 0.05	0.03 to 0.04
Filter Configuration			
Filter Cell Length	ft	11.33	11.33
Filter Cell Width	ft	34.67	34.67
Cells per Filter	-	2	2
Filter Area	sf	786	786
Number of Filters	-	4	6
Total Filter Area	sf	6,288	9,432
Media Configuration			
Media – Top Layer			
Media Type	-	Anthracite	Anthracite
Specific Gravity	g/cm^3	1.60 to 1.65	1.60 to 1.65
Effective Size	mm	0.95 ± 0.05	1.05 ± 0.05
Uniformity	-	≤1.4	≤1.4
Layer Depth	in	34	34
Media – Bottom Layer			
Media Type	-	Sand	Sand
Specific Gravity	g/cm^3	2.60 to 2.65	2.60 to 2.65
Effective Size	mm	0.50 ± 0.03	0.55 ± 0.03
Uniformity	-	≤1.4	≤1.4
Bed Depth	In	12	12
Media Support System			
Underdrain	-	Low Profile HDPE	Low Profile HDPE

PARAMETER	UNIT	DESIGN VALUE	
		BTTP	SGTP
		Block	Block
Support Media Type	-	Media Retention Plate	Media Retention Plate
Backwash			
Maximum Backwash Rate	gpm/sf	17	17
Backwash Area	sf	786	393 (one cell backwashed at a time)
Air Scour	-	Install air scour piping only into thickened filter walls for future capability	Utilize existing air scour piping and penetration to install new blower and air scour system
Air Flow Rate	SCFM	NA	1500
Design Air Scour Rate	SCFM/sf	NA	3.8
Discharge Pressure Loss	psi	NA	4.6
Blower Size	HP	NA	75
Surface Wash	-	Reinstall existing Rotary System	Reinstall existing Rotary System

[1]With all filters online at the SGTP and with all but one filter at the BTTP.

Appendix B includes figures showing these process upgrades. **Figures 22** through **23** show the process upgrades at the BTTP and **Figures 24** through **27** show the process upgrades at the SGTP.

2.3.2. Process Hydraulics

The filter rehabilitation and seismic upgrades project will not change the existing vertical profiles of the filters, so the overall plant hydraulic profile and process hydraulics will not change. The filtration cycle water level, media surface elevation, and media submergence will all be the same as under current operation, and the filters will continue running to the same terminal headloss. Therefore, this project is not anticipated to change the hydraulics upstream or downstream of the filters.

2.3.3. Proposed Operating Window

Overall, neither plant has operated at its capacity (35 mgd at the SGTP and 20 mgd at the BTTP) in the past 10 years except for a few instances at the BTTP. This is primarily because water demand has been declining over the past 15 years. Furthermore, at the flow capacity, the plants' clarifiers would be operating at loading rates above industry standards, which would lead

to high solids loadings on the filters. If the plants were to run at high filtration rates, filter backwashing would be more frequent, leading to overloading of the washwater handling systems. Flows at the SGTP have averaged from 10 mgd to 15 mgd over the past 10 years and flows at the BTTP have averaged from 3 to 6 mgd in the past 10 years. This filter rehabilitation project will allow the SGTP and BTTP to operate at high production rates in the future and will allow the SGTP to have more flexibility in treating different source water (improve UFRVs when treating Nicasio water).

Tables 8 and **9** show the filtration rates at each plant with different numbers of filters online at low, average, and maximum flow. Under normal operation at low and average flow, the filtration rate can be kept between 1.7 and 3.0 gpm/sf as is generally done under current practice. At least 1.7 gpm/sf is recommended to avoid floc accumulation at the surface of the media, which would lead to rapid headloss accumulation and shorter filter runs. At the maximum plant flow, all filters (at SGTP) or all but one filter (at BTTP) should be brought online, and filtration rates up to 6 gpm/sf will be required.

Table 8. – Operating Window for BTTP

Filters Online	Filtration Velocity (gpm/sf)		
	2 mgd	5 mgd	20 mgd
4	0.44	1.10	4.42
3	0.59	1.47	5.89
2	0.88	2.21	8.84
1	1.77	4.42	17.67

Table 9. – Operating Window for SGTP

Filters Online	Filtration Velocity (gpm/sf)		
	6 mgd	13 mgd	35 mgd
6	0.88	1.91	5.15
5	1.06	2.30	6.18
4	1.33	2.87	7.73
3	1.77	3.83	10.31
2	2.65	5.74	15.46
1	5.30	11.49	30.92

2.3.4. Filter Media Replacement

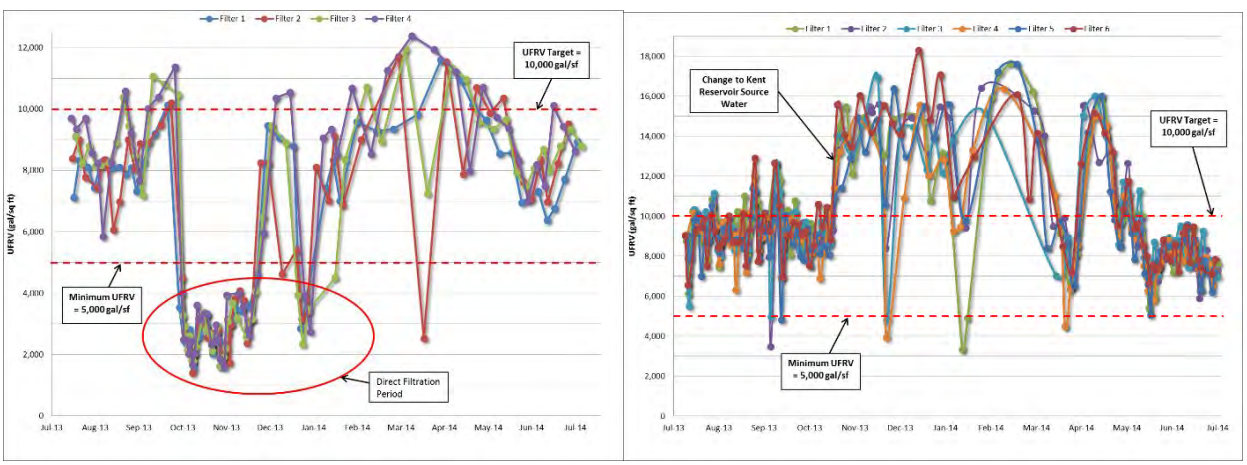
As a result of the modifications to the filter structure and underdrains, the existing sand and anthracite filter media will also need to be replaced. The filter media diameter and depth for the

anthracite and sand layers were evaluated with a filtration model to optimize the performance of the filters.

2.3.4.1. Analysis of Filter Data and Model Calibration

The raw data included in the analysis included the filter run log from each plant organized by start and stop dates, which provided flow rate, head loss, final turbidity, and filter run duration. The run logs were supplemented by date-referenced data for filter run volumes, coagulant dose, raw water and settled water turbidity, and temperature.

To calculate average filter performance, the raw data for each site was separated into two cases reflecting major changes in operating conditions. For BTTP, this included conventional filtration (Case 1) and direct filtration with the sedimentation tanks offline (Case 2). For SGTP, this included raw water from the Nicasio Reservoir (Case 1) and from the Kent Reservoir (Case 2). Filter runs for which the data was incomplete were not used to calculate average performance. In the case of BTTP, it is not appropriate to model both direct filtration and filtration after sedimentation using the same calibrated model, as the suspended solids loading to the filter must be handled differently. The filter UFRV graphs clearly show the divide in filter performance between the two cases. The UFRV drops immediately from over 10,000 gal/sf to less than 4,000 gal/sf. The UFRV performance is also clear for SGTP between the two source waters jumping from around 10,000 gal/sf while filtering Nicasio water to between 13,000 – 17,000 gal/sf while filtering Kent water. See graphs below showing the change in UFRV by quality of water for the BTTP on the left and the SGTP on the right.



The dates chosen as representative for Case 1 and Case 2 are shown **Table 10**.

Table 10. – Representative dates used to model filters at BTTP and SGTP for each case.

	Case 1	Case 2
BTTP	7/8/2013 – 9/18/2013	10/20/2013 – 11/20/2013
SGTP	7/28/2013 – 11/4/2013	11/5/2013 – 12/31/2013

Average operating conditions and filter performance results are shown in **Appendix C** and summarized in **Table 11** on the following page. Influent turbidity, filtration rate, coagulant dose, and temperature were significantly different between the two cases for each plant. For each case, representative values were assumed for backwash time and backwash volume, and average values were calculated for terminal headloss, clean bed headloss, headloss accumulation, run time to terminal headloss, unit filter run volume (UFRV), net water production (NWP), and operating turbidity to be used in calibrating the filter model. This analysis also looked at the final turbidity to identify filter runs terminated by particle breakthrough. Breakthrough was rare at SGTP – it was observed twice in a dataset of 371 total filter runs. However, at three of the four filters at BTTP, breakthrough was observed multiple times out of around 50 filter runs.

Table 11. – Average operating conditions and filter performance results from data analysis.

Parameter	Unit	SGTP Data		BTTP Data	
		Case 1	Case 2	Case 1	Case 2
Operating Conditions					
Filter Influent Turbidity	NTU	0.96	1.99	0.54	0.51
Coagulant dose	mg/L	37	26	25	15
Loading rate	gpm/sf	2.9	2.6	2.6	1.5
Temperature	°C	21	12	23	17
Setpoints					
Backwash Time	min	10	10	11.5	11.5
Unit Backwash Volume	gal/sf	162	162	138.9	138.9
Terminal Headloss	ft	7.7	7.1	7.9	7.6
Filter Performance					
Clean bed Headloss	ft	1.04	1.09	0.78	0.39
Headloss Accumulation	ft/h	0.123	0.065	0.128	0.258
Run Time	hr	57	29	55	92
UFRV	gal/ft2	9553	14002	8555	2648
NWP	Gal/sf/d	4043	3637	3601	2075
Operating Turbidity	NTU	0.035	0.037	0.024	0.047

These average operating conditions and filter performance results were used to calibrate the MWH dual-media filter model. The model predicts dual-media filter performance based on the media configuration and operating conditions, and its underlying calculations are shown in **Appendix C**. This model was calibrated using the existing media configuration and the performance data for Case 1 and Case 2. Given the media configuration and operating conditions as inputs, the model was able to closely predict filter performance for each case, indicating effective calibration. See **Appendix C** for the filter model calculations.

2.3.4.2. Filter Media Selection

A series of media configuration options were evaluated using the calibrated model. The filter media configurations, shown in **Appendix C**, include the effective size (mm), the specific gravity (g/cm^3), the uniformity coefficient (dimensionless) and the layer depth (in). The selected specific gravity and uniformity coefficients for sand and anthracite are typical values and are not varied in the media configurations. A total of eight media configurations were evaluated, the first four varying the media effective size (BT-1 to BT-4, SG-1 to SG-4), and the last four varying the layer depth (BT-5 to BT-8, SG-5 to SG-8). Scenarios BT-0 and SG-0 indicate the existing media. For each scenario, media sizes were selected to maintain compatible fluidization rates between the two layers so that intermixing will not occur during backwash. If the media does not maintain this compatibility, headloss will increase and filter cycle lengths will be reduced.

The key parameters evaluated for the filters are the predicted turbidity, the predicted unit filter run volume (UFRV), the predicted filter run time, the time to breakthrough, and the clean bed headloss. The best media configuration provides effluent with low turbidity, high unit filter run volume and high filter run time without a breakthrough occurring for both cases. The results of each media configuration are found in the Media Configuration Evaluation section in **Appendix C**. The predicted turbidity for each media configuration for each case has very low variation within each case, ranging between 0.02 to 0.05 NTU depending on the operating conditions. Since turbidity is met, the UFRV must be examined to maintain high filter run time and, ideally, filter run times longer than breakthrough times.

For BTTP, the UFRV for Case 1 and Case 2 is best with the media size for sand between 0.90 and 0.95 mm and anthracite as 0.5 mm. This configuration is projected to have the efficiency of breakthrough happening around the same time as terminal headloss is reached, and no improvements were observed by varying the thickness of the layers. Increasing the 0.90 mm sand thickness by 0.05 mm allows for better balance between the sand and anthracite layers; the 0.95 mm sand with 0.50 mm anthracite is the more compatible option. For SGTP, the UFRV and filter run time for Case 1 are best with anthracite effective size as 1.2 mm and sand effective size as 0.6 mm (SG-4) but for Case 2 the anthracite effective size of 1.05 mm and sand effective size of 0.55 mm (SG-3/5/6/7/8) are better. Since the time to breakthrough is a concern for the larger media under Case 2, the smaller media is preferred. The predicted UFRV is still very high during Case 1 (Nicasio) while not jeopardizing the performance during Case 2 (Kent). The recommended media design for each plant is shown in **Table 12**.

Table 12. – New Media Characteristics

		BTTP		SGTP	
Parameter	**Unit**	**Top Layer**	**Bottom Layer**	**Top Layer**	**Bottom Layer**
Material	**-**	**Anthracite**	**Sand**	**Anthracite**	**Sand**
Effective Size (d_{10})	mm	0.95 ± 0.05	0.50 ± 0.03	1.05 ± 0.05	0.55 ± 0.03
Uniformity Coefficient (UC)	-	≤1.4	≤1.4	≤1.4	≤1.4
Specific Gravity (SG), saturated surface-dry	g/cm^3	1.60 to 1.65	2.60 to 2.65	1.60 to 1.65	2.60 to 2.65
Layer Depth	in	34	12	34	12

The model was run with the same cases at high flow rate corresponding to the plant capacity, to investigate how well the filters would perform at maximum capacity. The filters are predicted to perform well (albeit with shorter run times due to higher headloss) at both plants at filtration rates up to 6 gpm/sf, with the exception of Case 2 at BTTP. In this case, direct filtration at high loading rates leads to very short filter runs due to the extreme increase in solids loading to the media, and the filter runs are projected to be quite short in this case under any media configuration.

In general, the new media identified is expected to give very similar filtered water turbidity and provide an increase in the UFRV and filter run time for each plant as summarized in **Table 13**. This table shows the expected UFRV, run time, and backwash loss of the rehabilitated filters, and compares them with the baseline values for the existing filters in **Table 11**. These values are calculated in **Appendix C**.

Table 13.– Expected increase in performance from updating the filters with the recommended media.

	BTTP				SGTP			
Parameter	**Case 1**	**Case 2**	**Case 1 – High Rate**	**Case 2 – High Rate**	**Case 1**	**Case 2**	**Case 1 – High Rate**	**Case 2 – High Rate**
Expected UFRV (gal/sf)	9,410	2,601	6,131	1,313	12,427	17,316	10,925	11,306
Predicted increase in UFRV (gal/sf)	698	79	-341	-73	1,762	2,657	1,639	1,164
Expected filter run time (hr)	61	28	17	4	72	113	30	31
Predicted increase in filter run time (hr)	5	1	-1	0	10	17	5	3
Current Backwash Loss (%)	1.6%	5.5%			1.7%	1.1%		
Expected Backwash Loss (%)	1.5%	5.4%	2.3%	10.7%	1.3%	0.9%	1.5%	1.4%

2.3.4.3. Media Quality Assurance

The media specification will provide a target value for the effective size of each layer of media at each plant, along with a tolerance acknowledging the inherent variability in both the production of filter media and in its sampling and analysis. For anthracite, this size can be specified with a tolerance of +/- 0.05 mm and for sand this tolerance is +/- 0.03 mm. The specification will be written with the intention that the media manufacturer will target the value in the middle of the allowable range to reduce the likelihood that media will have to be rejected.

In addition to meeting the above criteria, the media must be of sufficient purity and cleanliness for this application. Sand media should have a hardness of 7 on the Mohs scale and no more than 5% acid solubility. For both layers, the percentage of foreign material should not exceed 1% by weight, and the media should be washed to remove fine particles after placement in the filter and before the filter goes into service. A 34-inch anthracite layer is too large to be placed in a single lift due to the excessive washing required for cleaning, thus, the filters require two 17-inch lifts. Each lift will need to be washed and scraped three times per cleaning.

The contractor will be required to prepare several submittals for the filter media during construction of this project, as part of the quality assurance process. An initial submittal will provide product data for the proposed material. Once the product data has been approved, samples will be taken and tested during the shop drawing review process, during production of the media, prior to shipment to the jobsite, and during placement of the media.

The media supplied for the rehabilitated filters must be checked for backwash compatibility – that is, the anthracite and sand layers should have comparable fluidizing behavior at a given backwash rate. This compatibility check is done with the follow equation (Kawamura, 2000), where the difference between the two sides of the equation should be less than an absolute value of 0.06:

$$\frac{d_{10-Bot} \times UC_{Bot}}{d_{10-Top} \times UC_{Top}} = \left(\frac{SG_{Top} - 1}{SG_{Bot} - 1}\right)^{\frac{2}{3}}$$

Where d_{10} is the effective size (mm), UC is the uniformity coefficient (dimensionless), and SG is the specific gravity of the media (dimensionless); and the subscripts “Bot” and “Top” denote the bottom and top media layers, respectively. This compatibility check for the media is documented in **Appendix C** for the design media, which found the selected sand and anthracite to be compatible. The construction contractor will be required to provide product data and samples for the sand and anthracite, which will include this compatibility check on the material to be used. Filter cores will be taken to check the in-place media meets the specifications.

As noted above, compatibility was the basis for changing to 0.95 mm sand at BTTP even if the sand size will be the same. This is illustrated in **Table 14**, which shows the difference between the two sides of the above equation for different effective size values of each media layer assuming typical values for specific gravity and uniformity. This analysis is shown in full for both plants in **Appendix C**.

Table 14. – Layer compatibility with existing media (dashed line) and proposed media (solid line) at BTTP.

Sand (mm) / Anthracite (mm)	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54
0.80	0.03	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.13	0.15
0.81	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.13	0.14
0.82	0.02	0.03	0.04	0.06	0.07	0.08	0.09	0.11	0.12	0.13
0.83	0.01	0.03	0.04	0.05	0.06	0.07	0.09	0.10	0.11	0.12
0.84	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.11
0.85	0.00	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11
0.86	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.10
0.87	0.01	0.00	0.01	0.02	0.03	0.05	0.06	0.07	0.08	0.09
0.88	0.02	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.09
0.89	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.06	0.07	0.08
0.90	0.03	0.02	0.01	0.00	0.02	0.03	0.04	0.05	0.06	0.07
0.91	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06
0.92	0.04	0.03	0.02	0.01	0.00	0.02	0.03	0.04	0.05	0.06
0.93	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05
0.94	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.04	0.05
0.95	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04
0.96	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03
0.97	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03
0.98	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02
0.99	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02
1.00	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01
1.01	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01

2.3.5. Underdrain Replacement

2.3.5.1. Existing Underdrain Conditions

In a previous project, the filter underdrains at both plants were replaced with plastic block underdrains and media retaining caps that eliminate the need for support gravel. The underdrains at the SGTP are Leopold Superblock Type II underdrains and the underdrains at the BTTP are Tetra low profile underdrains. Further discussion on potential vendors for the new underdrains is included in the following section.

Photos of the existing lower gullet and underdrains from the BTTP underdrain inspection from February 2015 are shown below.

2.3.5.2. Underdrain Selection

The Existing Conditions Analysis Report from February 2016 determined that additional wall thickness is needed to strengthen the filter structures to resist seismic forces. In order to do this the existing underdrains must be removed and replaced after the structural work is completed. Based on the recommendations in the Master Plan, any new underdrains installed at SGTP or BTTP should be compatible with air/water backwash as most modern underdrains of the capability to support either water only or air/water backwash. This will give the option to the District if implementing air/water backwash now or in the future.

There are several options for type of underdrain system that can be designed at the SGTP and BTTP. Leading underdrain systems on the market include:

- Tetra LP Block® manufactured by DeNora
- Leopold Type XA® block manufactured by Xylem Inc
- Stainless Steel, AWI or Johnson
- Plastic nozzle type underdrain systems

These products are shown in the photos below.

For many years, there were very few options for air-water backwash system, with the most common being nozzle underdrains. This changed when Leopold developed its Universal® block underdrain. Nozzle systems have the disadvantage of increasing the filter depth by 2 to 4 feet with their requisite plenums to provide for even distribution of air and water. However, when combined with an integral media support (IMS®) cap, which eliminates the need for support gravel, the total depth of the Universal® underdrains and cap can be as little as 9 inches.

When Leopold was the only manufacturer of block underdrains with air-water capability, it was necessary to bid their system against nozzle underdrains to get competitive bids, and to do so required preparing two separate designs. Today, there are multiple manufacturers of block underdrains, which allows selection of the specific block underdrain system to be based on a competitive bids. Other underdrain systems (e.g., AWI's Phoenix System and Johnson Screens' Triton System) have been developed more recently that provide air-water backwash with even shallower depths which allow for deeper media.

Both block and nozzle underdrain systems have proven successful at MWH-designed water treatment plants. There is less experience with other types of underdrains, but they also have successful installations. For this application, MWH's recommendation is the low profile underdrains to match the existing underdrain type at the plants and to avoid plenums. The specific low profile vendor can be determined at a later date through competitive bidding.

2.3.6. Provisions for Future Air/Water Backwash at SGTP

2.3.6.1. Existing Systems

The BTTP and SGTP both are equipped with rotary surface wash systems that have performed well over the years. However, during site investigations for the Master Plan, plant operations staff indicated that the filters have started accumulating mud around the edges along with cracking, making it difficult to clean properly.

Based on WTP floc retention profiles, there was clear removal of floc during backwash, but the turbidity values appeared to be very high based on our experience, both before and after backwash, and the values at the surface after backwash remained much higher than the remainder of the filter.

Furthermore, the SGTP originally had an air scour systems, but it has been removed. The air scour system at the SGTP used to inject air at the surface of the media during backwash and was not like a modern air scour system where air is injected into or at the top of the underdrains. Although the system was removed, the pipe penetrations into the filters are still in place and can be used.

2.3.6.2. Air Water Backwash

As discussed in the Filter Rehabilitation at Marin Municipal Water District Surface Water Treatment Plants Proposal dated November 2015, air can be supplied from above the filters or through the lower filter gullets. In the first option, the air was introduced from the perimeter walls opposite the gullets. In the second option, the air would be introduced at the gullet walls. In both cases, the air piping needs to rise above the water level and be encased to prevent a potential cross connection.

Based on the chosen final seismic upgrades, the filter perimeter walls will undergo seismic strengthening, so Option 1 is the best location to introduce air into the filters. As shown in **Appendix B**, **Figure 26**, the existing 8-inch air scour pipe penetration at the SGTP will be reused and pipe will be encased and routed above the filter water level to prevent a potential cross connection. A three-inch air header is shown with one-inch connections to the laterals. At the BTTP, this similar piping will be installed into the thickened perimeter walls for future capability of air/water backwash as shown in **Appendix B, Figure 23**.

2.3.6.2.1. Air Scour Blower and Power Supply

As shown in the design criteria, initial air scour sizing calculations determined that the new blower at the SGTP needs deliver an air flow rate of approximately 1500 SCFM and have a discharge pressure loss of approximately 4.6 psi. It is important to note that the SGTP only backwashes one filter cell at a time, so the total backwashed filter area is 393 sf which translated to 3.8 SCFM per sf. A new 75 HP blower will be located in the dry chemical storage area in a similar location to where the blowers were located in the San Geronimo Water Treatment Plant Expansion Project (70B-56). This will allow for similar pipe routing and the area still appears to be open. **Appendix B**, **Figure 27** shows a blower and piping plan with the blower sizing and proposed piping arrangement. The new blower piping will connect into the existing air piping at the SGTP.

Another issue with adding air scour is the impact on the power supply system. A new blower will be needed, but in MWH's review of the plant electrical systems in the High Level Facilities Evaluation, it was found that the existing power supply systems are very old and do not have much capacity for adding new loads. At the SGTP, power for a new blower will probably need to come from the high service pump station, since it has more capacity and has been modified more recently than the plant switchgear.

2.4. Other Upgrades

Table 15 shows a summary of other upgrade projects planned to be included with the filter rehabilitation and seismic upgrades project based on input from plant staff and to make it easier to take individual plants out of service:

Table 15. – Summary of Other Upgrades

Element of Design	Rehabilitation Task
Smith - Conifer Reliability Project	SCADA controlled intertie between the Conifer Way and Smith Saddle pressure zones in the treated water distribution system
Phoenix Lake Pipeline Bypass Replacement	Project to increase the capacity of the bypass and allow more water to be delivered to the north part of the distribution system. The control valves will be housed in a below grade vault containing manual isolation valves, hydraulically operated control valves and SCADA monitoring.

2.4.1. Smith - Conifer Reliability Project

This project will provide a SCADA controlled intertie between the Conifer Way and Smith Saddle pressure zones in the treated water distribution system. When combined with a proposed pump station to Smith Saddle, it will allow the District to monitor and control the transfer of water between zones. This will increase reliability and redundancy in the system and facilitate extending plant shutdowns at SGTP for plant improvements. The Smith-Conifer Reliability Project will be accomplished within the existing treated water pump station at SGTP.

An existing manual valve will be replaced with a motor actuated valve and a bidirectional flow meter will be installed in series. Both will be connected to plant SCADA. The proposed installation is shown schematically on **Appendix B**, **Figure 28**.

2.4.2. Phoenix Lake Pipeline Bypass Replacement Project

The Phoenix Lake Bypass Replacement Project will increase the capacity of the bypass and allow more water to be delivered to the north part of the distribution system currently served primarily by SGTP. This in turn will allow more flexibility in taking SGTP offline for filter seismic rehab work and other future work. Multiple valves with varying size are provided to support low, medium and high bypass flow rates.

The control valve configuration is based on modeling and a preliminary piping schematic developed by the District. The control valves will be housed in a below grade vault. The control valve manifold will include manual isolation valves, hydraulically operated, solenoid controlled, diaphragm valves with SCADA system monitoring. A new flow meter will be installed to measure

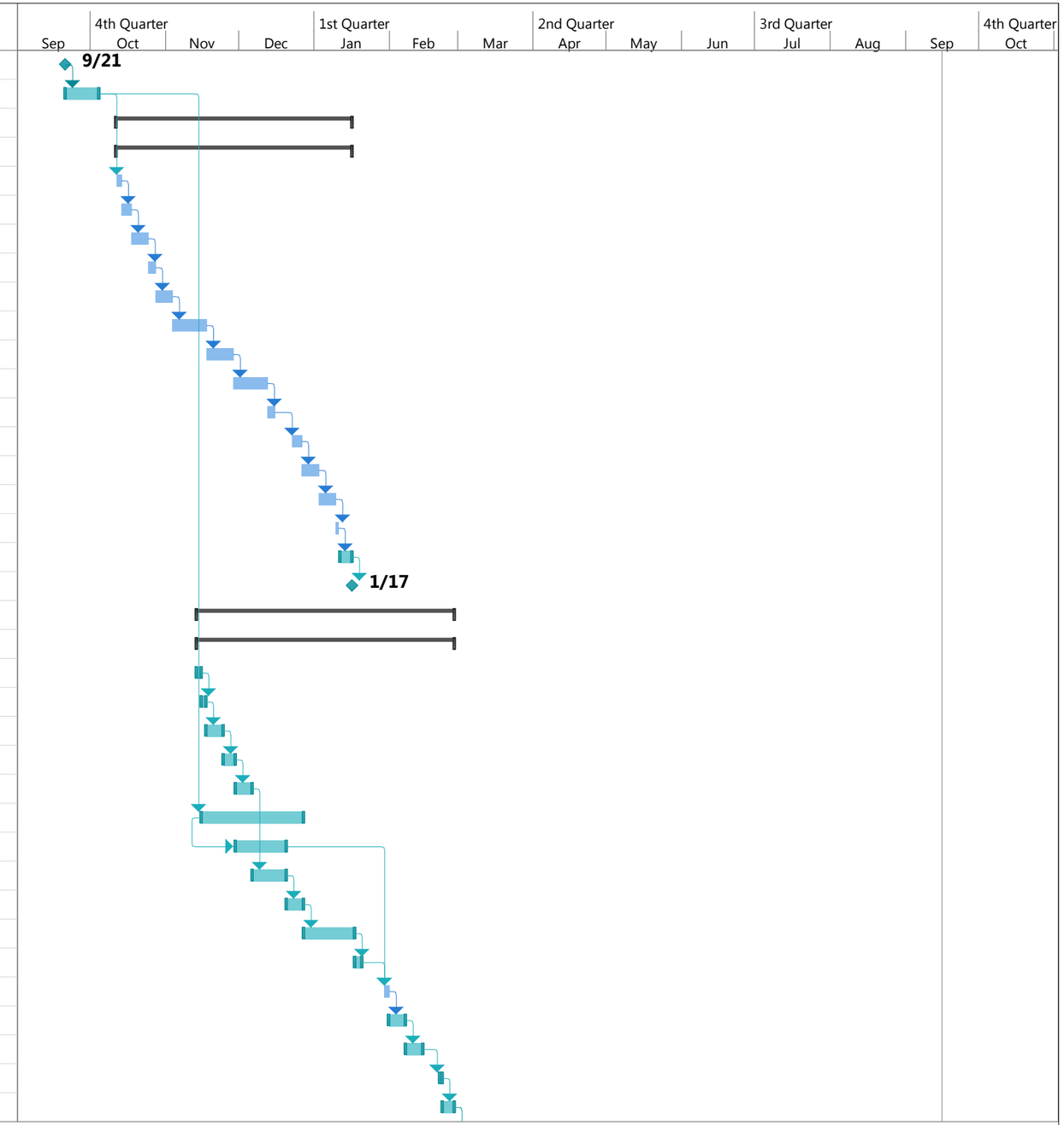
the Phoenix Bypass and transmit the data to SCADA. The valve and meter vaults will be provided with full traffic rated covers with secure locking devices. The vaults will be drained by gravity to the adjacent creek. The proposed installation is shown schematically on **Appendix B**, **Figure 29**.

3. Construction Sequencing

The preliminary construction schedule is shown in the following pages. As can be seen in the schedule, construction is expected to begin in September 2016 with an expected construction duration of one year. The schedule shows the two filters at BTTP retrofitted first, followed by Filters 1 and 2 at SGTP. Then the last four filters at the SGTP would be retrofitted together, followed by the last two filters at BTTP. It is important to note that this schedule does not include the Phoenix Bypass, Smith-Conifer or the additional structural improvements.

Furthermore, delivery time for new underdrains is approximately 6 months. Therefore, it is recommended to pre-purchase the underdrains and then assign the supply contract to the general contract following award of the general contract. Pre-purchase advertising should be done in April 2016.

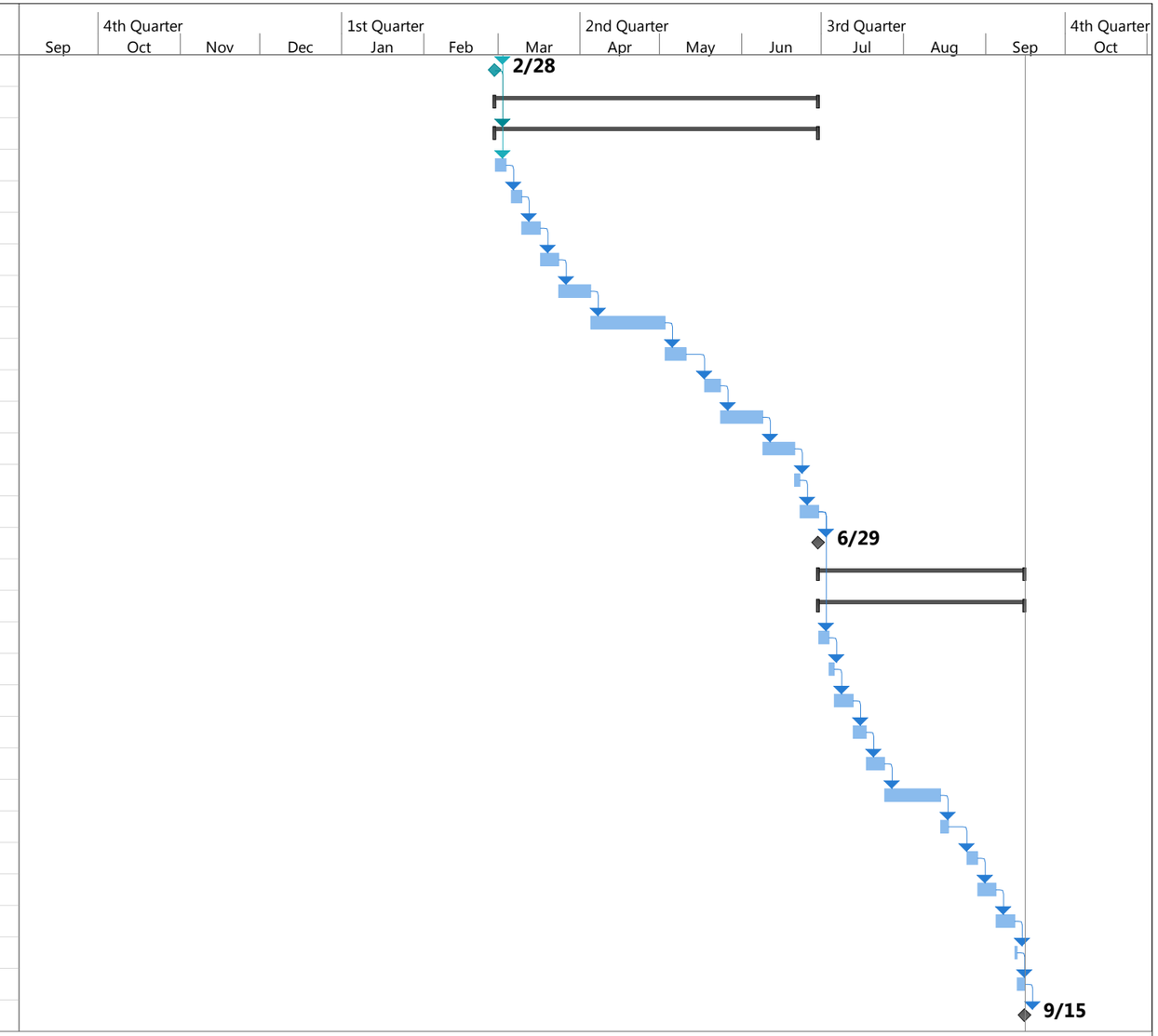
ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Notice to Proceed	0 days	Wed 9/21/16	Wed 9/21/16	
2		Mobilization	10 days	Wed 9/21/16	Tue 10/4/16	1
3		**BTTP Filters 1-2**	**69 days**	**Wed 10/12/16**	**Tue 1/17/17**	
4		**Begin Outage**	**69 days**	**Wed 10/12/16**	**Mon 1/16/17**	
5		Remove Surface Wash Piping	2 days	Wed 10/12/16	Thu 10/13/16	2FS+5 days
6		Remove Media	2 days	Fri 10/14/16	Mon 10/17/16	5
7		Remove Endura-Flex Coating	5 days	Tue 10/18/16	Mon 10/24/16	6
8		Demolish Underdrains	3 days	Tue 10/25/16	Thu 10/27/16	7
9		Prep Filter Walls	5 days	Fri 10/28/16	Thu 11/3/16	8
10		Install Underdrains	10 days	Fri 11/4/16	Thu 11/17/16	9
11		Install Air Piping	7 days	Fri 11/18/16	Mon 11/28/16	10
12		Install Dowels and Reinforcing	10 days	Tue 11/29/16	Mon 12/12/16	11
13		Apply Shotcrete	3 days	Tue 12/13/16	Thu 12/15/16	12
14		Test Water Flow Distribution	2 days	Fri 12/23/16	Mon 12/26/16	13FS+5 days
15		Install Media	5 days	Tue 12/27/16	Mon 1/2/17	14
16		Replace Surface Wash	5 days	Tue 1/3/17	Mon 1/9/17	15
17		Conduct Media Sieve Analyses	1 day	Tue 1/10/17	Tue 1/10/17	16
18		Disinfect Filters	3 days	Thu 1/12/17	Mon 1/16/17	17
19		**Return Filter to Service**	0 days	Tue 1/17/17	Tue 1/17/17	18
20		**SGTP Filters 1-2**	**76 days**	**Mon 11/14/16**	**Tue 2/28/17**	
21		**Begin Outage**	**76 days**	**Mon 11/14/16**	**Mon 2/27/17**	
22		Remove Surface Wash Piping	2 days	Mon 11/14/16	Tue 11/15/16	
23		Remove Media	2 days	Wed 11/16/16	Thu 11/17/16	22
24		Remove Endura-Flex Coating	5 days	Fri 11/18/16	Thu 11/24/16	23
25		Demolish Underdrains	3 days	Fri 11/25/16	Tue 11/29/16	24
26		Prep Filter Walls	5 days	Wed 11/30/16	Tue 12/6/16	25
27		Upgrade Electrical Service	30 days	Wed 11/16/16	Tue 12/27/16	2FS+30 days
28		Install Blower	15 days	Wed 11/30/16	Tue 12/20/16	27SS+10 days
29		Install Underdrains	10 days	Wed 12/7/16	Tue 12/20/16	26
30		Install Air Piping	5 days	Wed 12/21/16	Tue 12/27/16	29
31		Install Dowels and Reinforcing	15 days	Wed 12/28/16	Tue 1/17/17	30
32		Apply Shotcrete	3 days	Wed 1/18/17	Fri 1/20/17	31
33		Test Water/Air Flow Distribution	2 days	Mon 1/30/17	Tue 1/31/17	32FS+5 days,28
34		Install Media	5 days	Wed 2/1/17	Tue 2/7/17	33
35		Replace Surface Wash	5 days	Wed 2/8/17	Tue 2/14/17	34
36		Conduct Media Sieve Analyses	1 day	Wed 2/22/17	Wed 2/22/17	35
37		Disinfect Filters	3 days	Thu 2/23/17	Mon 2/27/17	36



Preliminary Construction Schedule

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
38		**Return Filter to Service**	0 days	Tue 2/28/17	Tue 2/28/17	37
39		**SGTP Filters 3-6**	**88 days**	**Tue 2/28/17**	**Thu 6/29/17**	
40		**Begin Outage**	**88 days**	**Tue 2/28/17**	**Thu 6/29/17**	**38**
41		Remove Surface Wash Piping	4 days	Tue 2/28/17	Fri 3/3/17	37
42		Remove Media	4 days	Mon 3/6/17	Thu 3/9/17	41
43		Remove Endura-Flex Coating	5 days	Fri 3/10/17	Thu 3/16/17	42
44		Demolish Underdrains	5 days	Fri 3/17/17	Thu 3/23/17	43
45		Prep Filter Walls	8 days	Fri 3/24/17	Tue 4/4/17	44
46		Install Dowels and Reinforcing	20 days	Wed 4/5/17	Tue 5/2/17	45
47		Apply Shotcrete	6 days	Wed 5/3/17	Wed 5/10/17	46
48		Test Water/Air Flow Distribution	4 days	Thu 5/18/17	Tue 5/23/17	47FS+5 days
49		Install Media	12 days	Wed 5/24/17	Thu 6/8/17	48
50		Replace Surface Wash	8 days	Fri 6/9/17	Tue 6/20/17	49
51		Conduct Media Sieve Analyses	2 days	Wed 6/21/17	Thu 6/22/17	50
52		Disinfect Filters	5 days	Fri 6/23/17	Thu 6/29/17	51
53		**Return Filter to Service**	0 days	Thu 6/29/17	Thu 6/29/17	52
54		**BTTP Filters 3-4**	**56 days**	**Fri 6/30/17**	**Fri 9/15/17**	
55		**Begin Outage**	**56 days**	**Fri 6/30/17**	**Fri 9/15/17**	
56		Remove Surface Wash Piping	2 days	Fri 6/30/17	Mon 7/3/17	52
57		Remove Media	2 days	Tue 7/4/17	Wed 7/5/17	56
58		Remove Endura-Flex Coating	5 days	Thu 7/6/17	Wed 7/12/17	57
59		Demolish Underdrains	3 days	Thu 7/13/17	Mon 7/17/17	58
60		Prep Filter Walls	5 days	Tue 7/18/17	Mon 7/24/17	59
61		Install Dowels and Reinforcing	15 days	Tue 7/25/17	Mon 8/14/17	60
62		Apply Shotcrete	3 days	Tue 8/15/17	Thu 8/17/17	61
63		Test Water Flow Distribution	2 days	Fri 8/25/17	Mon 8/28/17	62FS+5 days
64		Install Media	5 days	Tue 8/29/17	Mon 9/4/17	63
65		Replace Surface Wash	5 days	Tue 9/5/17	Mon 9/11/17	64
66		Conduct Media Sieve Analyses	1 day	Tue 9/12/17	Tue 9/12/17	65
67		Disinfect Filters	3 days	Wed 9/13/17	Fri 9/15/17	66
68		**Return Filter to Service**	0 days	Fri 9/15/17	Fri 9/15/17	67



Preliminary Construction Schedule

Task		Project Summary		Manual Task		Start-only		Deadline	
Split		Inactive Task		Duration-only		Finish-only		Progress	
Milestone		Inactive Milestone		Manual Summary Rollup		External Tasks		Manual Progress	
Summary		Inactive Summary		Manual Summary		External Milestone			

4. Opinion of Probable Construction Cost

Using newly developed cost estimate inputs, a summary Opinion of Probable Construction Cost (OPCC) was generated to communicate the preliminary level costs for the Filter Rehabilitation and Seismic Upgrades project, which consists of the upgrades described previously in this report. For this exercise, the OPCC creates allowances for framework costs borne by the owner for pre-construction activities and for expenses related to the management and support of field construction activities to represent an overall project cost inclusive of implementation and construction costs.

Newly developed cost inputs were equalized in terms of assumed contractor adders, escalation, and project implementation allowances. Pricing is reflected in current dollars (1st quarter of 2016) and does not include an allowance to the mid-point of construction, which is currently undefined. The OPCC's pricing level can be related to the Engineering News Record Construction Cost Index at 11,169 (San Francisco) or the California Department of Transportation (Caltrans) Price Index at 108.32 (12 month average).

Class 4 cost estimates are based on the current preliminary design definition and related pricing assumptions and are prepared in accordance with the Association for the Advancement of Cost Engineering International Recommended Practice 18R-97. The assumed accuracy range for this effort is -20 percent to +30 percent of tendered pricing. Final project costs will depend on actual labor and material costs, when the facilities are constructed, productivity, competitive market conditions, final project scope, project schedule, environmental conditions, and other variable factors. Consequently, the final project costs will vary from the cost estimates presented in this report.

The preliminary cost estimates are summarized in **Table 16** below. Detailed cost estimate worksheets are included in **Appendix E**.

Table 16. - Preliminary Cost Estimate for Filter Rehabilitation and Seismic Upgrades Project[1]

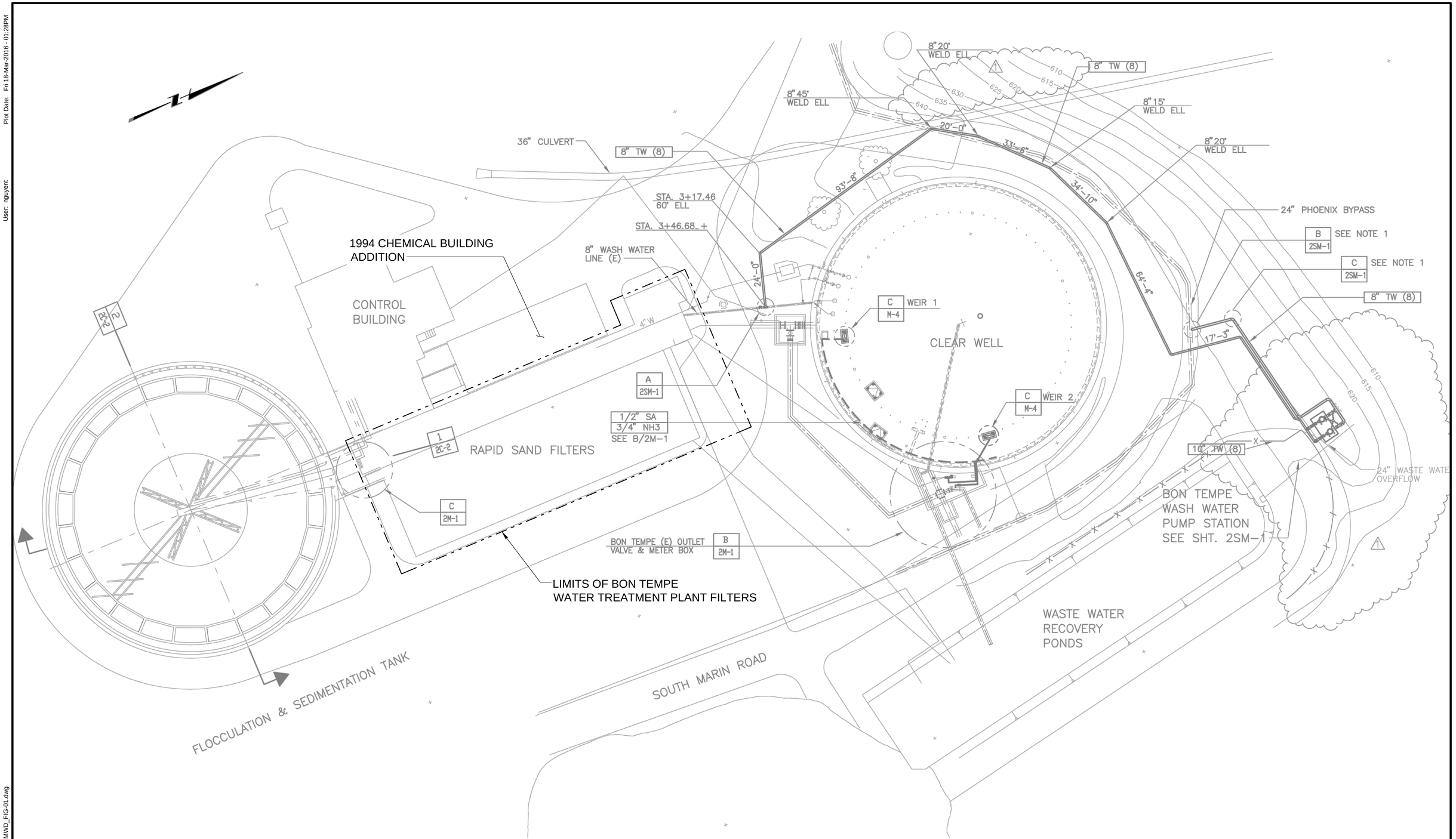
Cost Type	BTTP (mil)	SGTP
Direct Construction Cost[2]	$1.2	$1.6
Base Construction Cost[2]	$1.8	$2.4
Total Construction Cost[2]	$2.0	$2.7
Total Project Cost[2]	**$2.4**	**$3.3**
Cost Range	*$1.9 to $3.1*	*$2.6 to $4.2*

Notes:

[1] See Appendix E for detailed cost estimate worksheets

[2] See Appendix E for assumptions on allowances for start-up, design, contingency, soft costs, project allowances

Appendix A - Structural Figures



SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP LOCATION OF FILTERS	FIG-1 Job#_here

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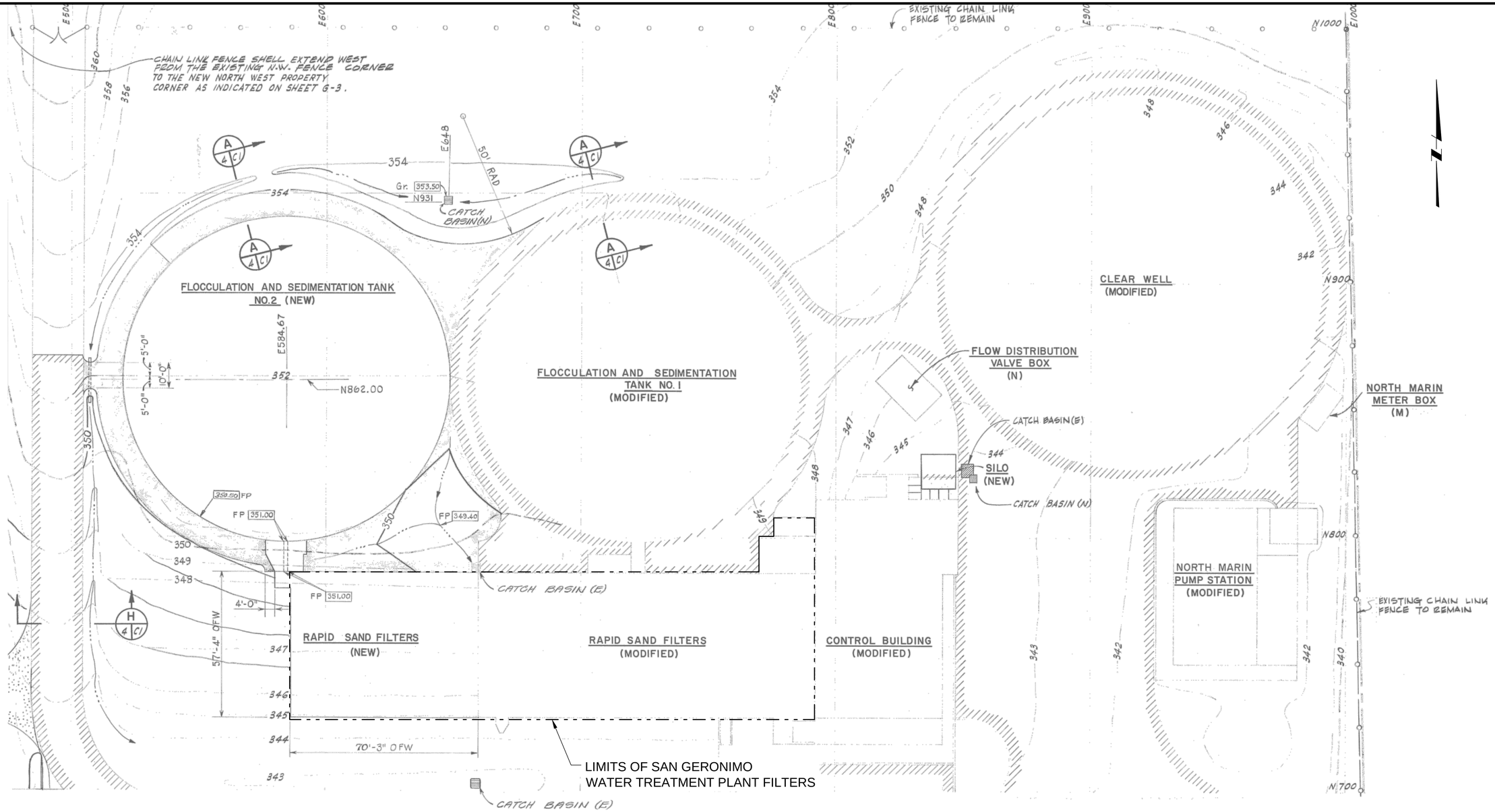

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP LOCATION OF FILTERS	FIG-1A Job#_here

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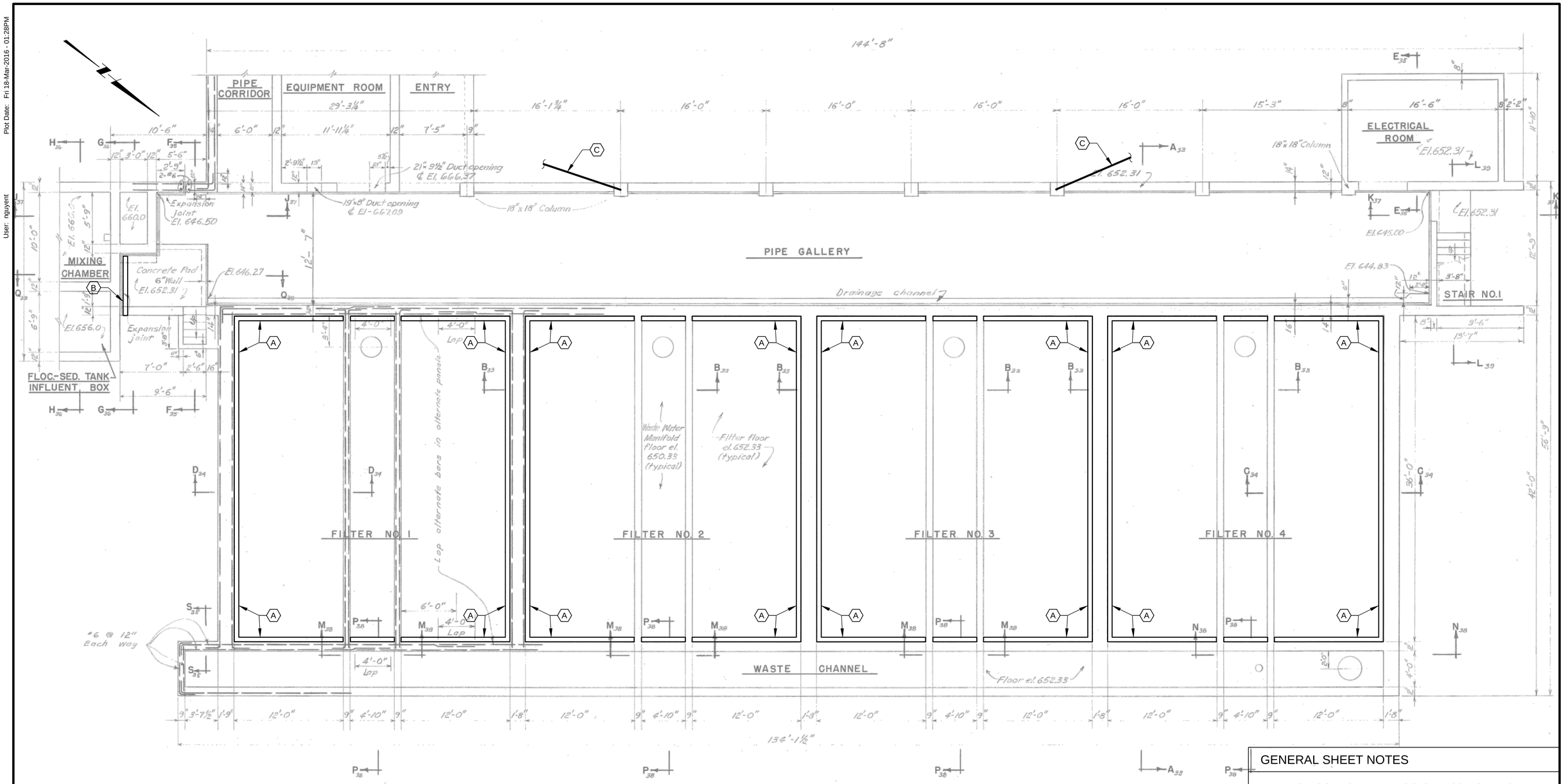

LOWER FLOOR PLAN

Scale: 3/16" = 1'-0"

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

B. REBUILD COLUMN SUPPORT UNDER INFLUENT CHANNEL CORBEL.

C. PROVIDE CONFINEMENT AT BRACE TO COLUMN CONNECTION (TOP AND BOTTOM, EA BRACE).

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP FILTERS 1-4 - LOWER PLAN	FIG-2 Job#_here

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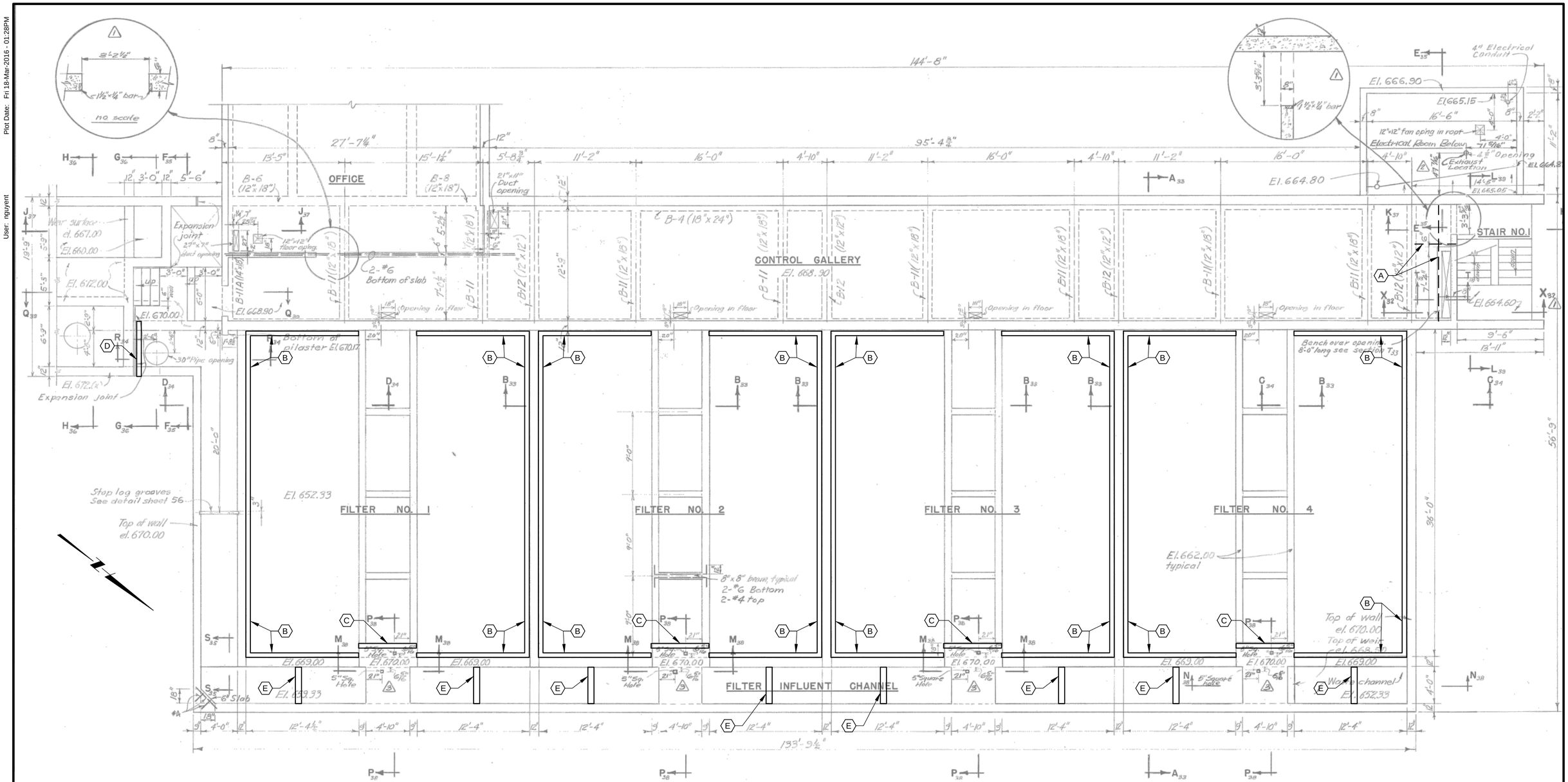
File: C:\pwworkdir\d0286346\MWD_FIG-03.dwg



UPPER FLOOR PLAN

Scale: 3/16" = 1'-0"

SHEET KEYNOTES

A. STRENGTHEN DIAPHRAGM SLAB AROUND OPENING.

B. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

C. STRENGTHEN GULLET ASSEMBLY ATTACHMENT TO WALL.

D. REBUILD COLUMN SUPPORT UNDER INFLUENT CHANNEL CORBEL.

E. ADD SUPPORTS TO TOP OF FILTER END WALLS AT CHANNELS.

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SCALE SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP FILTERS 1-4 - UPPER PLAN	FIGURE FIG-3 Job#_here

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GENERAL SHEET NOTES

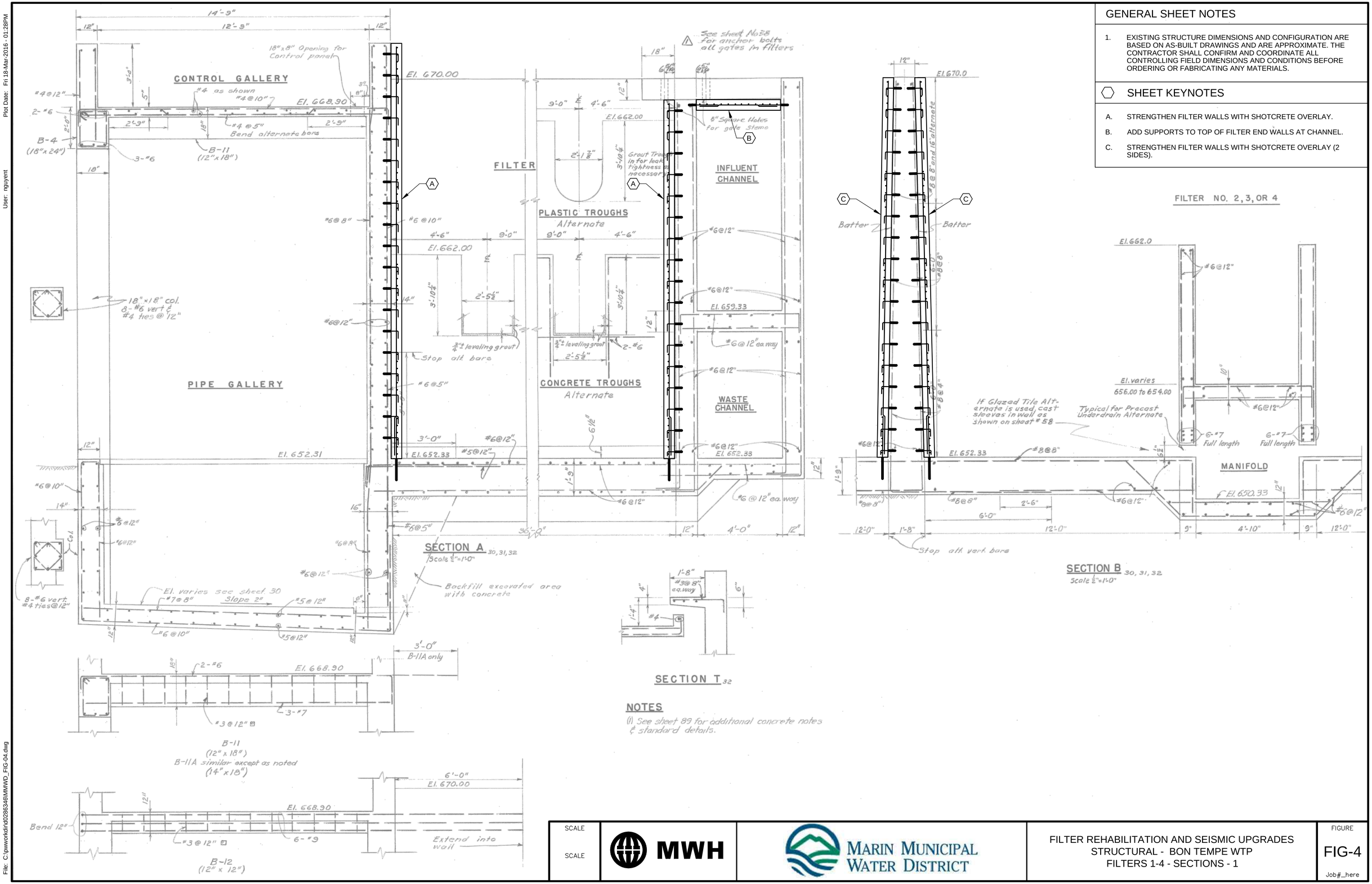
1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

B. ADD SUPPORTS TO TOP OF FILTER END WALLS AT CHANNEL.

C. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY (2 SIDES).



NOTES

(1) See sheet 89 for additional concrete notes & standard details.

SCALE			FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP FILTERS 1-4 - SECTIONS - 1	FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT		FIG-4 Job#_here

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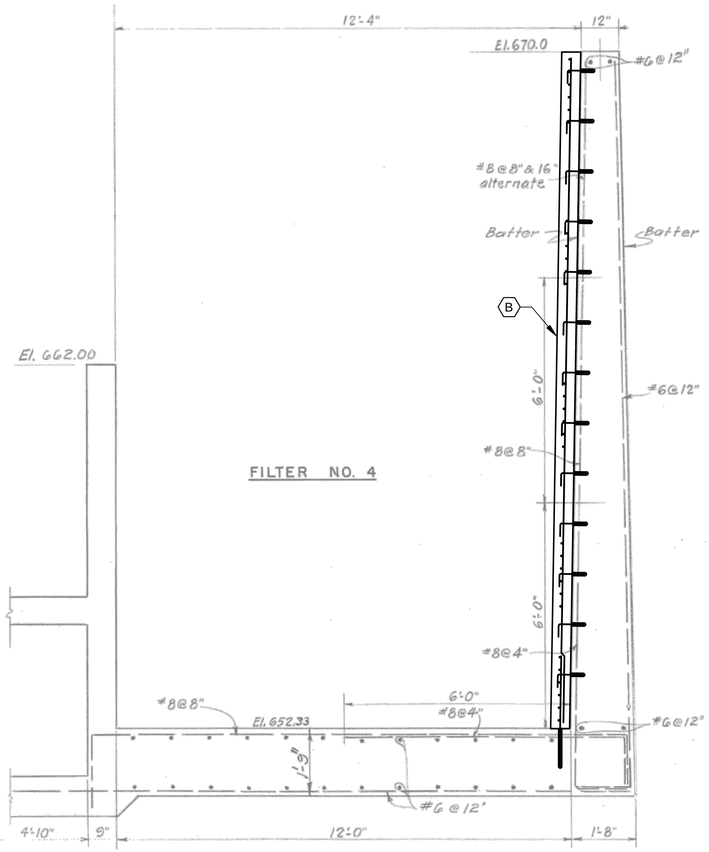

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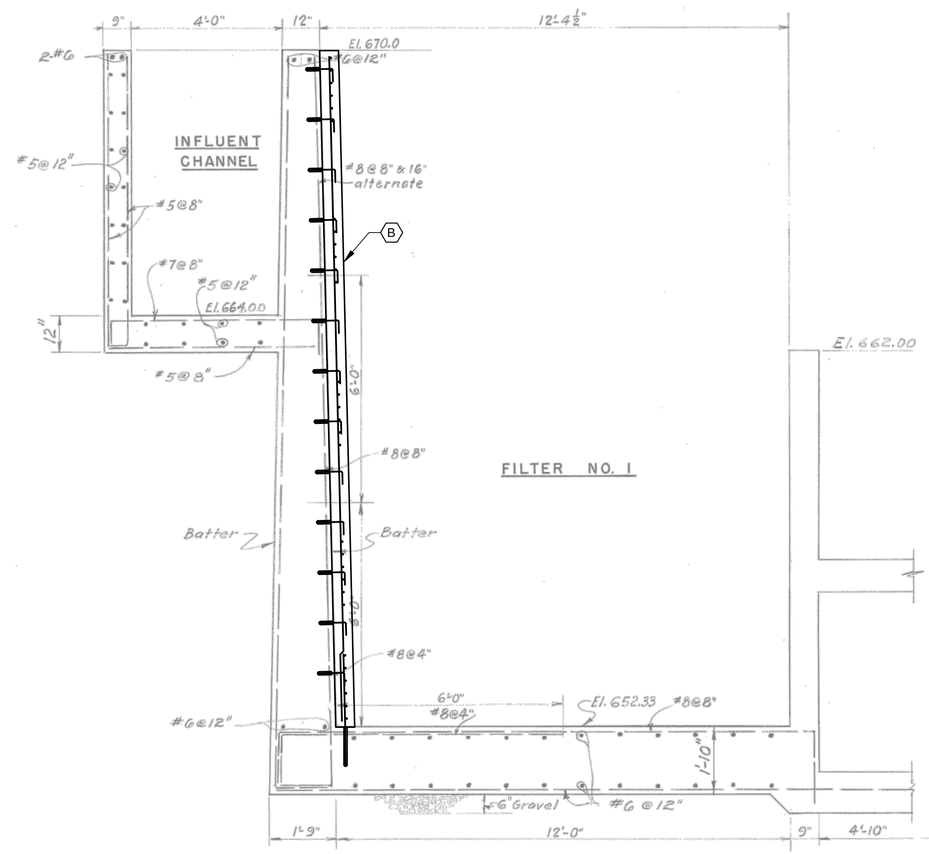

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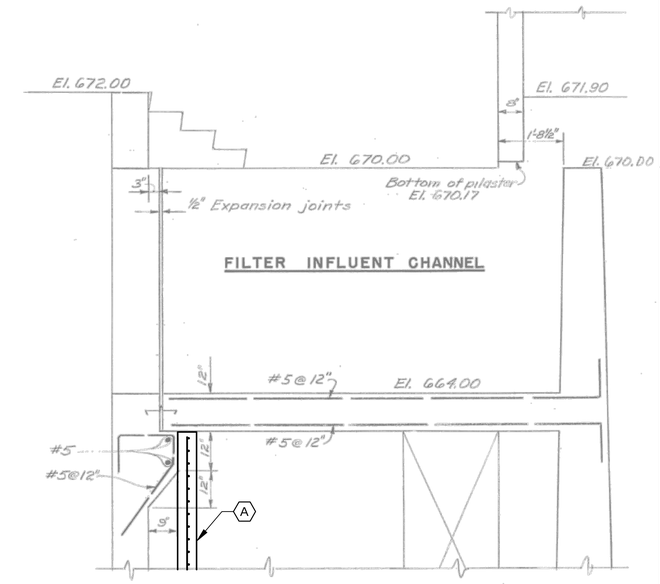

SECTION R 32
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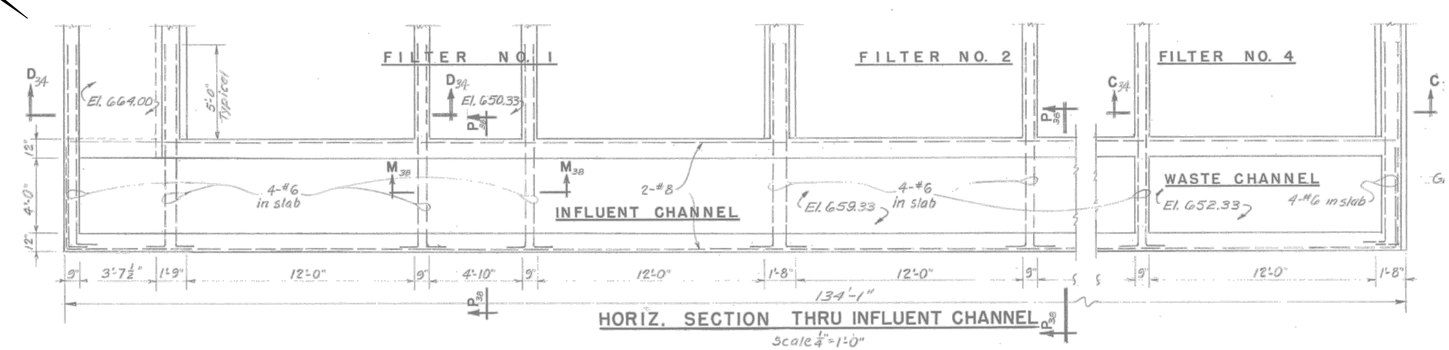
NOTES

(1.) See Sheet 89 for concrete notes & additional concrete details.



HORIZ. SECTION THRU INFLUENT CHANNEL
Scale ¼"=1'-0"

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

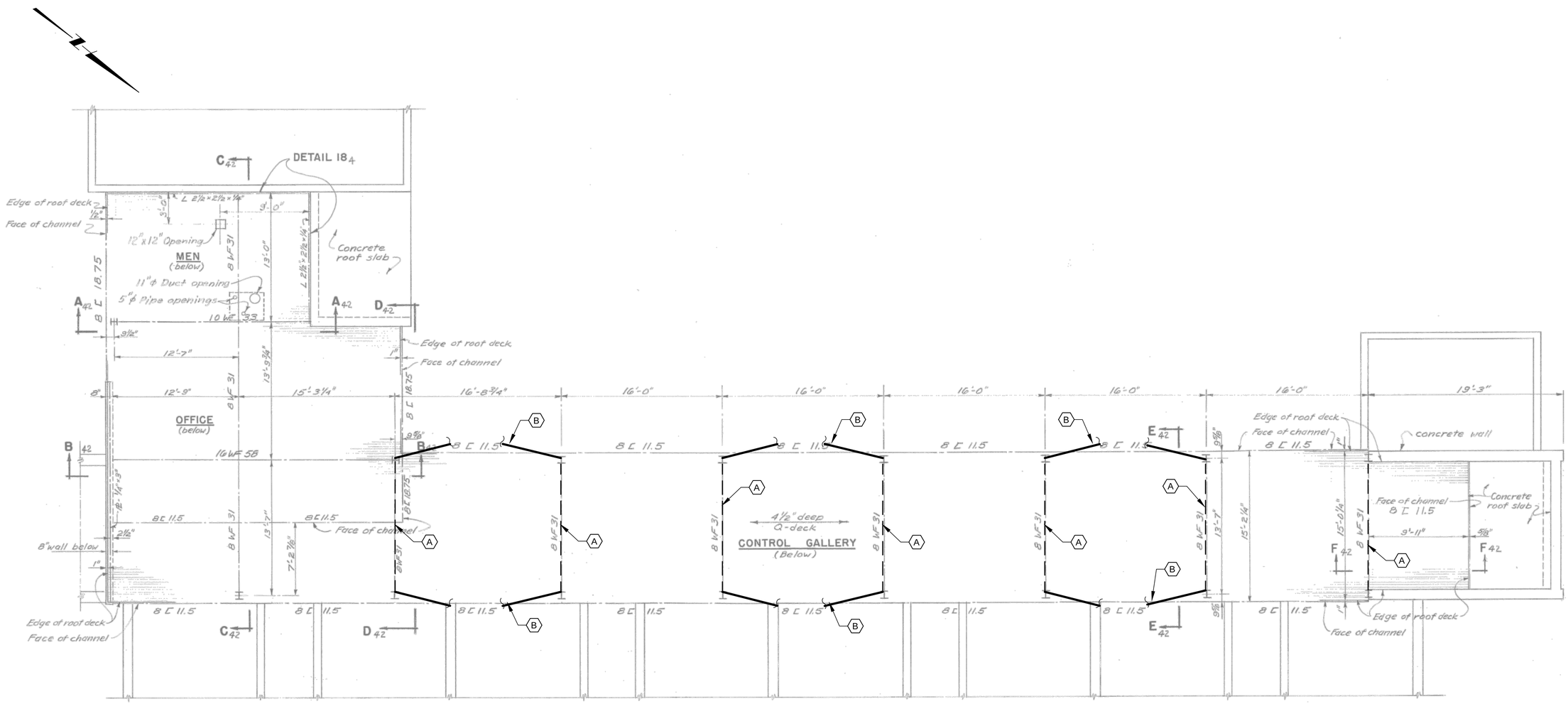
SHEET KEYNOTES

A. PROVIDE ADDITIONAL COLUMN SUPPORT UNDER CORBEL.

B. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY (1 SIDE).

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP FILTERS 1-4 - SECTIONS - 2	FIG-5 Job#_here

Plot Date: Fri 18-Mar-2016 - 01:29PM
User: nguyent



ROOF PLAN
Scale: 3/16"=1'-0"

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

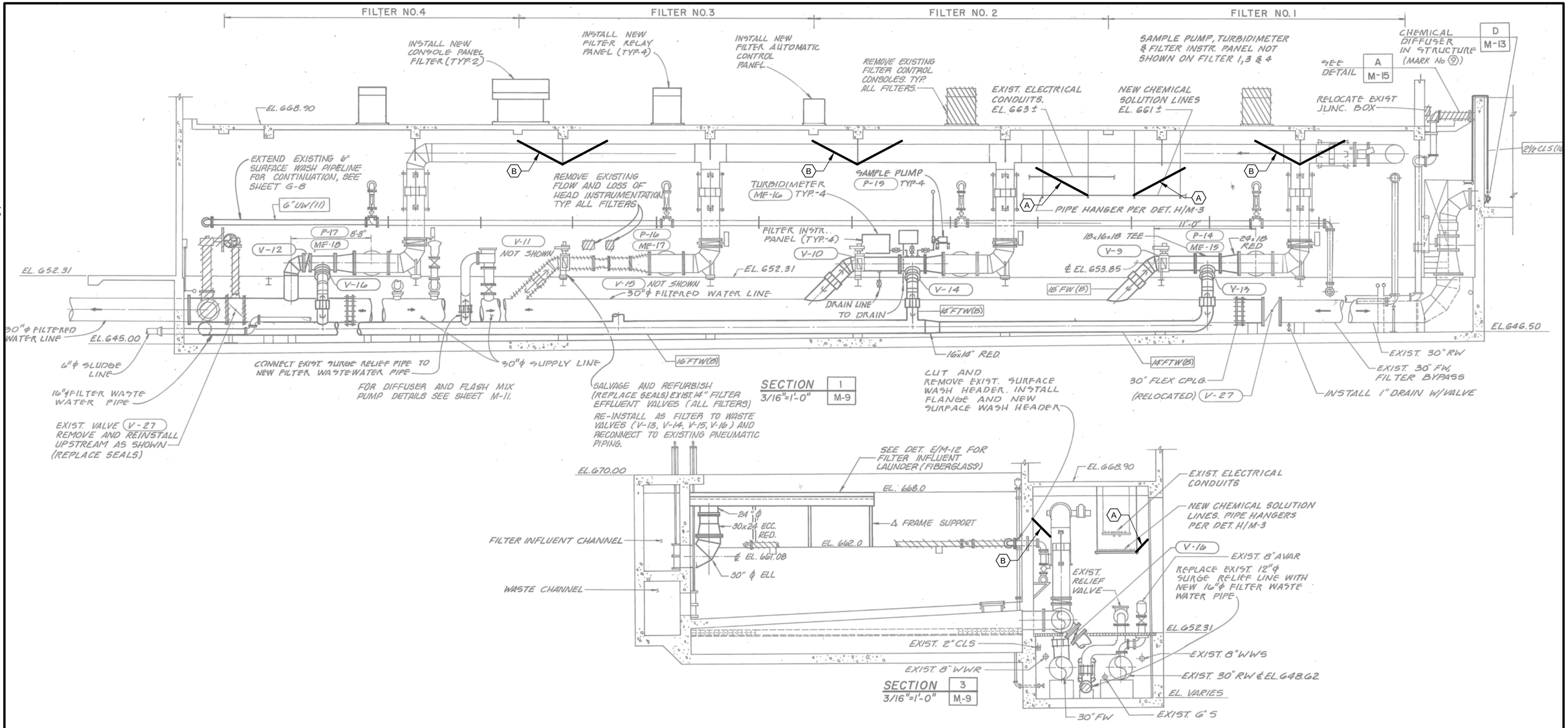
SHEET KEYNOTES

A. ADD/CONFIRM WELDING OF METAL DECK ROOF DIAPHRAGM TO STEEL FRAMES.

B. REPLACE TENSION ONLY ROD BRACING WITH TUBE STEEL OR PIPE BRACING.

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP CONTROL GALLERY - ROOF PLAN	FIG-6 Job#_here

File: C:\pwworkdir\d0286346\MMWD_FIG-06.dwg



GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

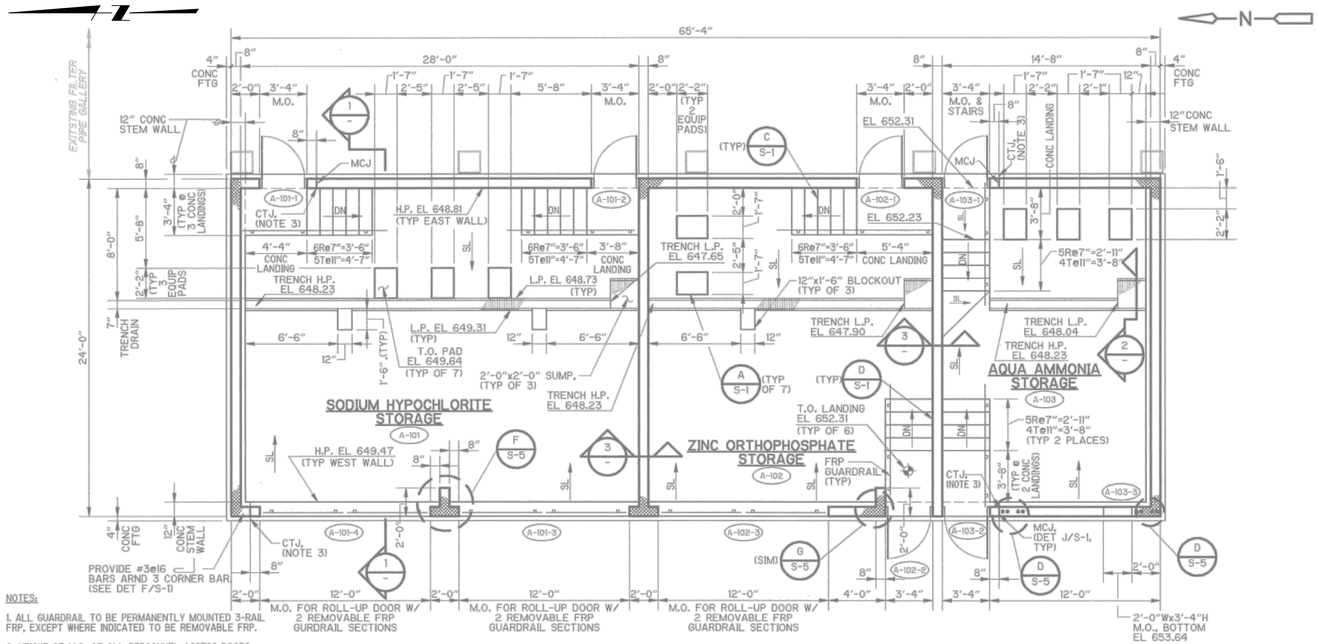
A. ADD SEISMIC BRACING TO TRAPEZE HANGERS.

B. BRACE FILTER BACKWASH PIPING.

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP PIPE GALLERY - SECTION	FIG-7 Job#_here

Plot Date: Fri 18-Mar-2016 - 01:29PM
User: nguyent
File: C:\pwworkdir\d0286346\MWD_FIG-07.dwg

Plot Date: Fri 18-Mar-2016 - 01:29PM
User: nguyent
File: C:\pwworkdir\ind0286346\MKWD_FIG-08.dwg



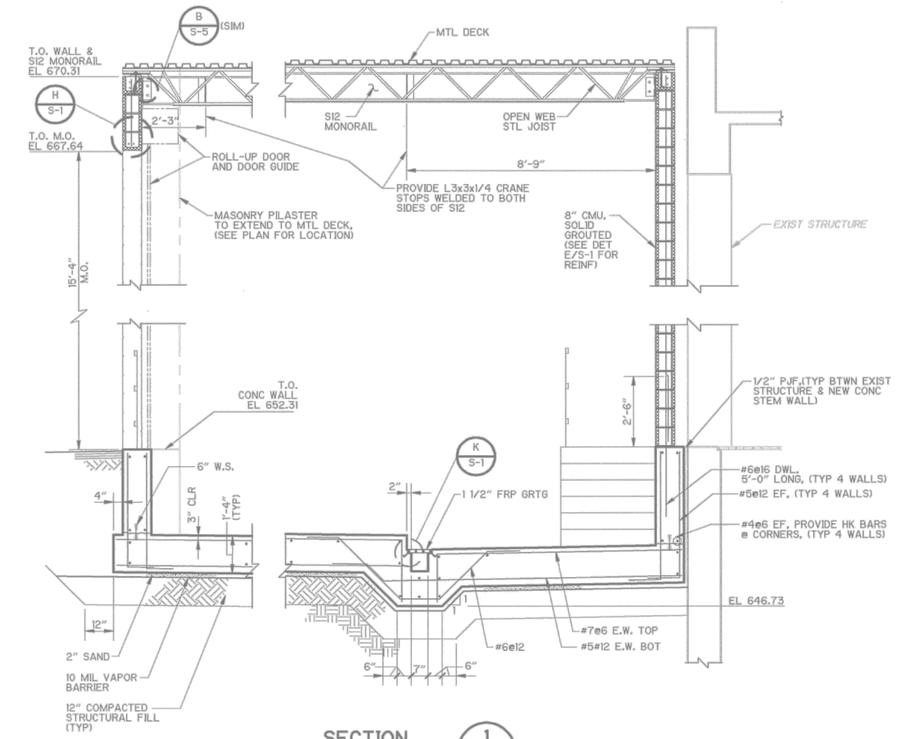
NOTES:

1. ALL GUARDRAIL TO BE PERMANENTLY MOUNTED 3-RAIL FRP, EXCEPT WHERE INDICATED TO BE REMOVABLE FRP.
2. HEIGHT OF M.O. AT ALL PERSONNEL ACCESS DOORS SHALL BE 9'-4" ABOVE CONC STEM WALL.
3. AT CONTROL JOINTS, EXTEND EVERY OTHER BAR (50x OF REINF) THROUGH JOINT AND PROVIDE CLASS B TENSION SPLICE. ALSO PROVIDE WATER STOPS.
4. SEE DETS E&F/S-1 FOR TYP MASONRY REINF.
5. SEE DET G/S-1 FOR LINTEL SCHEDULE.

STRUCTURAL BASE

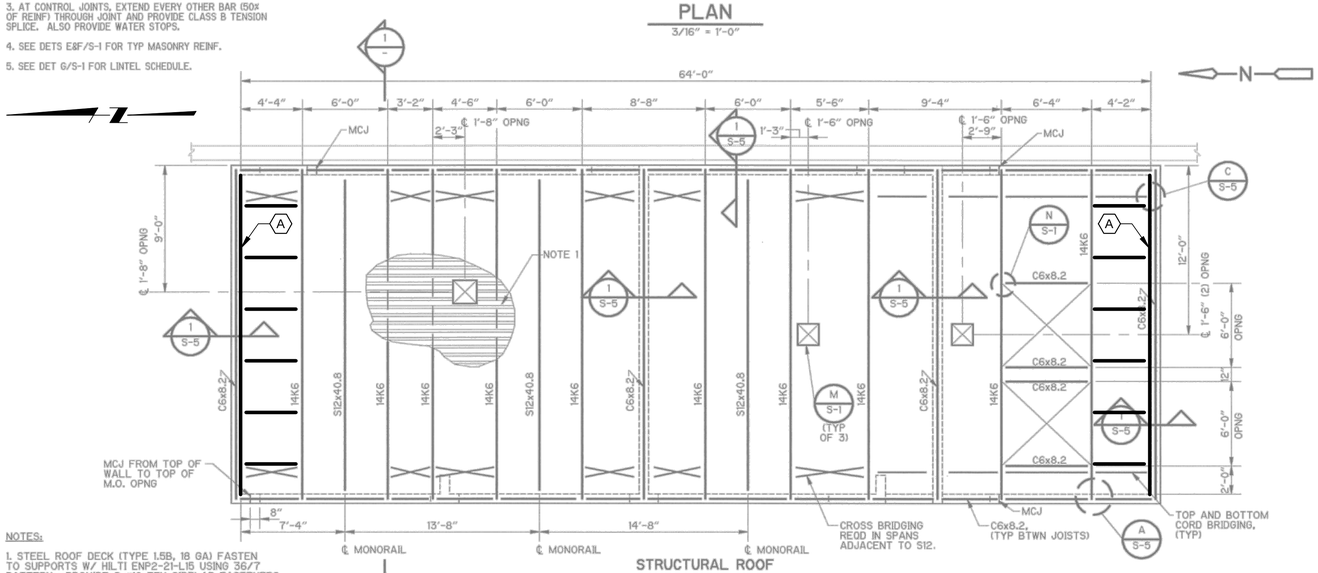
PLAN

3/16" = 1'-0"



SECTION 1

3/8" = 1'-0"



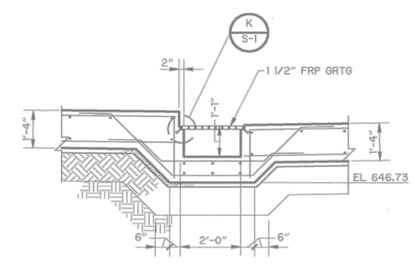
NOTES:

1. STEEL ROOF DECK (TYPE 1.5B, 18 GA) FASTEN TO SUPPORTS W/ HILTI ENP2-21-L15 USING 36/7 PATTERN. PROVIDE 6-#10 TEK SIDELAP FASTENERS PER SPAN.
2. BAR JOIST SHALL BE DESIGNED FOR A NET UPLIFT OF 15 psf.

STRUCTURAL ROOF

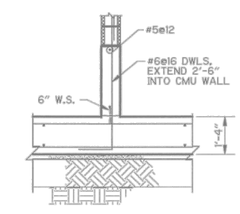
PLAN

3/16" = 1'-0"



SECTION 2

3/8" = 1'-0"



SECTION 3

3/8" = 1'-0"

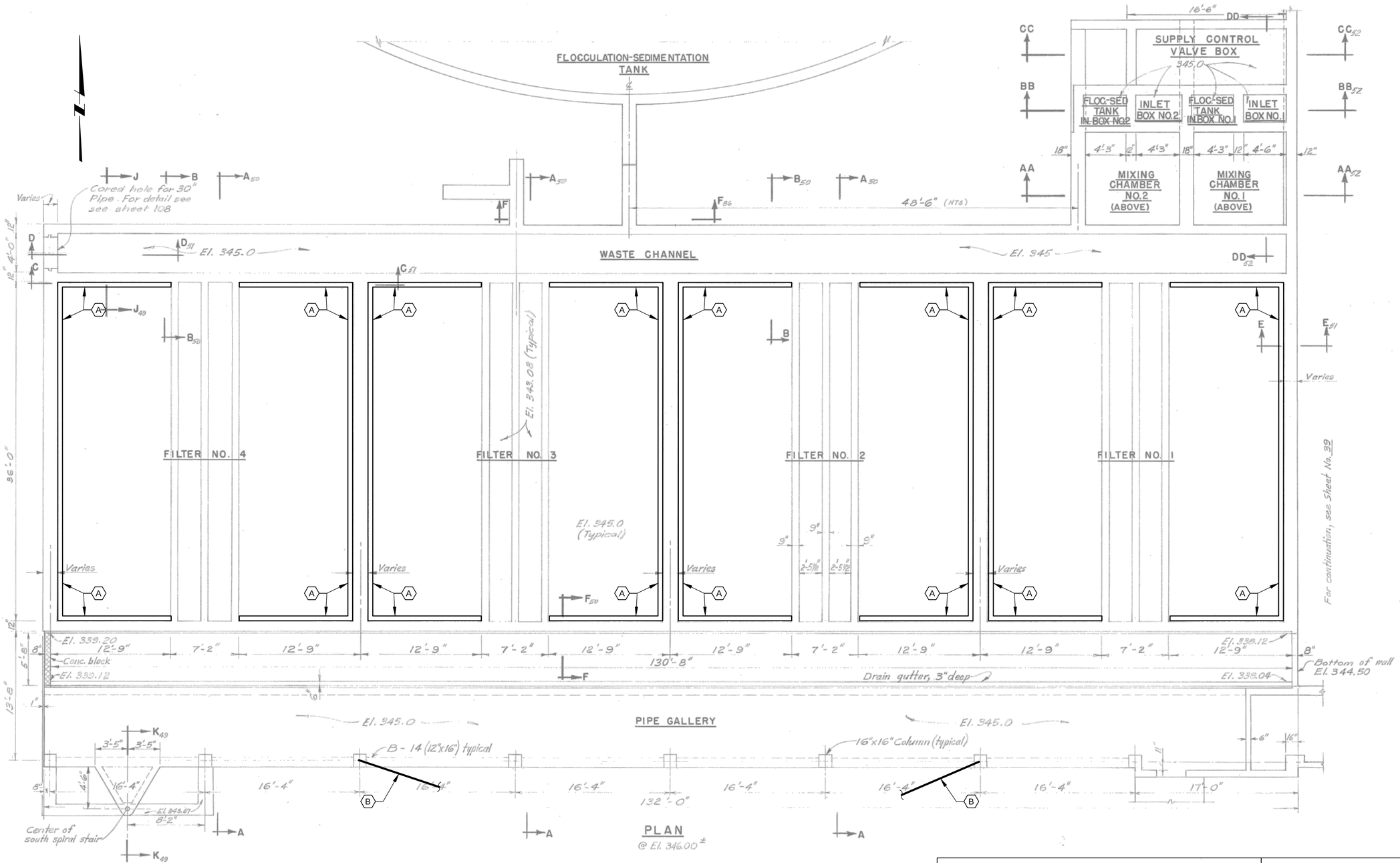
GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. ADD WALL OUT-OF-PLANE ANCHORAGE AT ROOF.

SCALE			FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - BON TEMPE WTP CHEMICAL BUILDING - ROOF PLAN	FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT		FIG-8 Job#_here



GENERAL SHEET NOTES	RETROFIT LEGEND
1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.	A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY. B. PROVIDE CONFINEMENT AT BRACE TO COLUMN CONNECTION (TOP AND BOTTOM, EA BRACE).

SCALE

SCALE

MWH

MARIN MUNICIPAL WATER DISTRICT

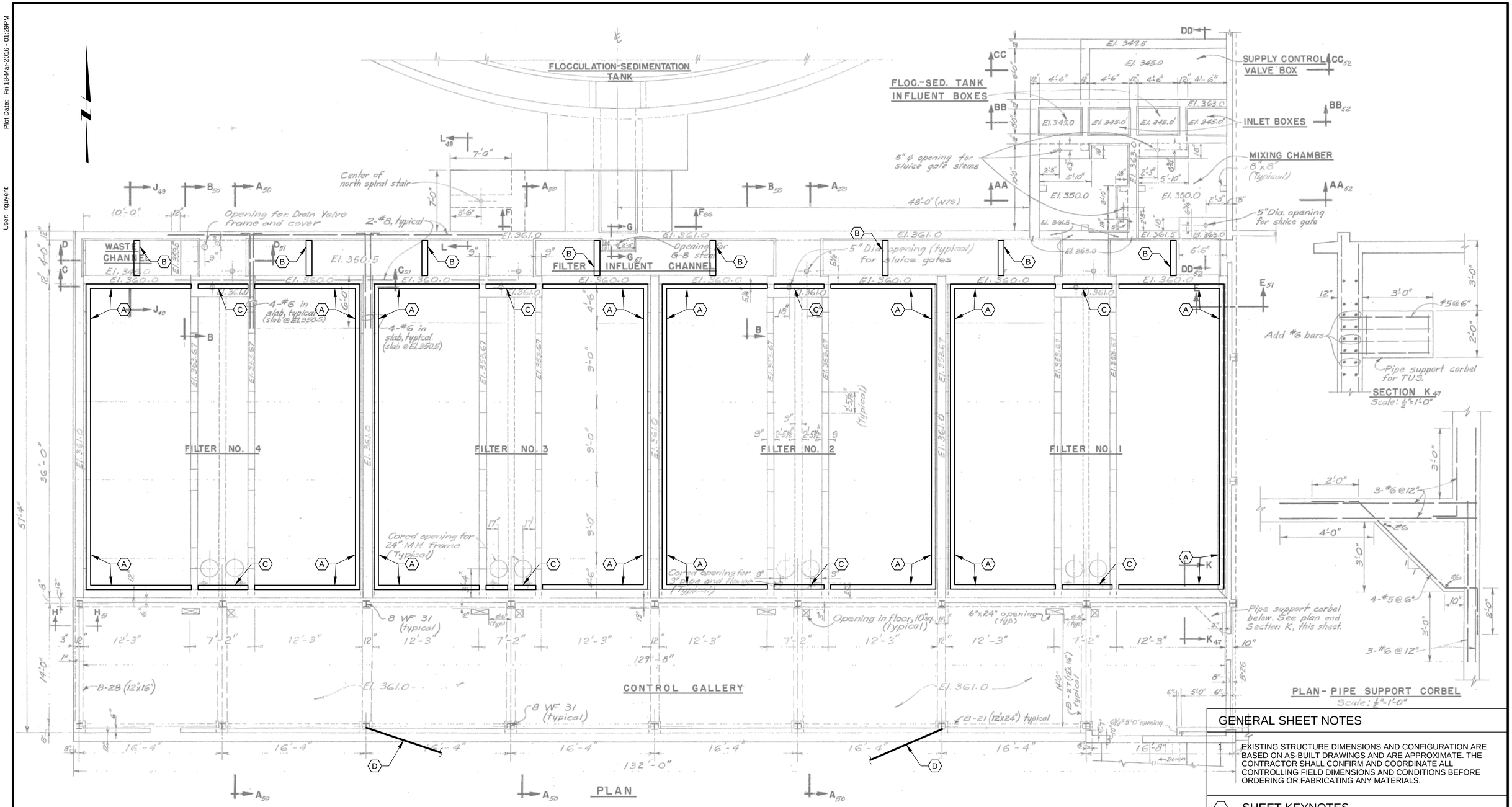
FILTER REHABILITATION AND SEISMIC UPGRADES
STRUCTURAL - SAN GERONIMO WTP
FILTERS 1-4 - LOWER PLAN

FIGURE

FIG-10

Job#_here

Plot Date: Fri 18-Mar-2016 - 01:29PM
User: nguyent
File: C:\pwworkdir\d0286346\MMWD_FIG-10.dwg



GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

B. ADD SUPPORTS TO TOP OF FILTER END WALLS AT CHANNELS.

C. STRENGTHEN GULLET ASSEMBLY ATTACHMENT TO WALL.

D. PROVIDE CONFINEMENT AT BRACE TO COLUMN CONNECTION.

SCALE SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP FILTERS 1-4 - UPPER PLAN	FIGURE FIG-11 Job#_here

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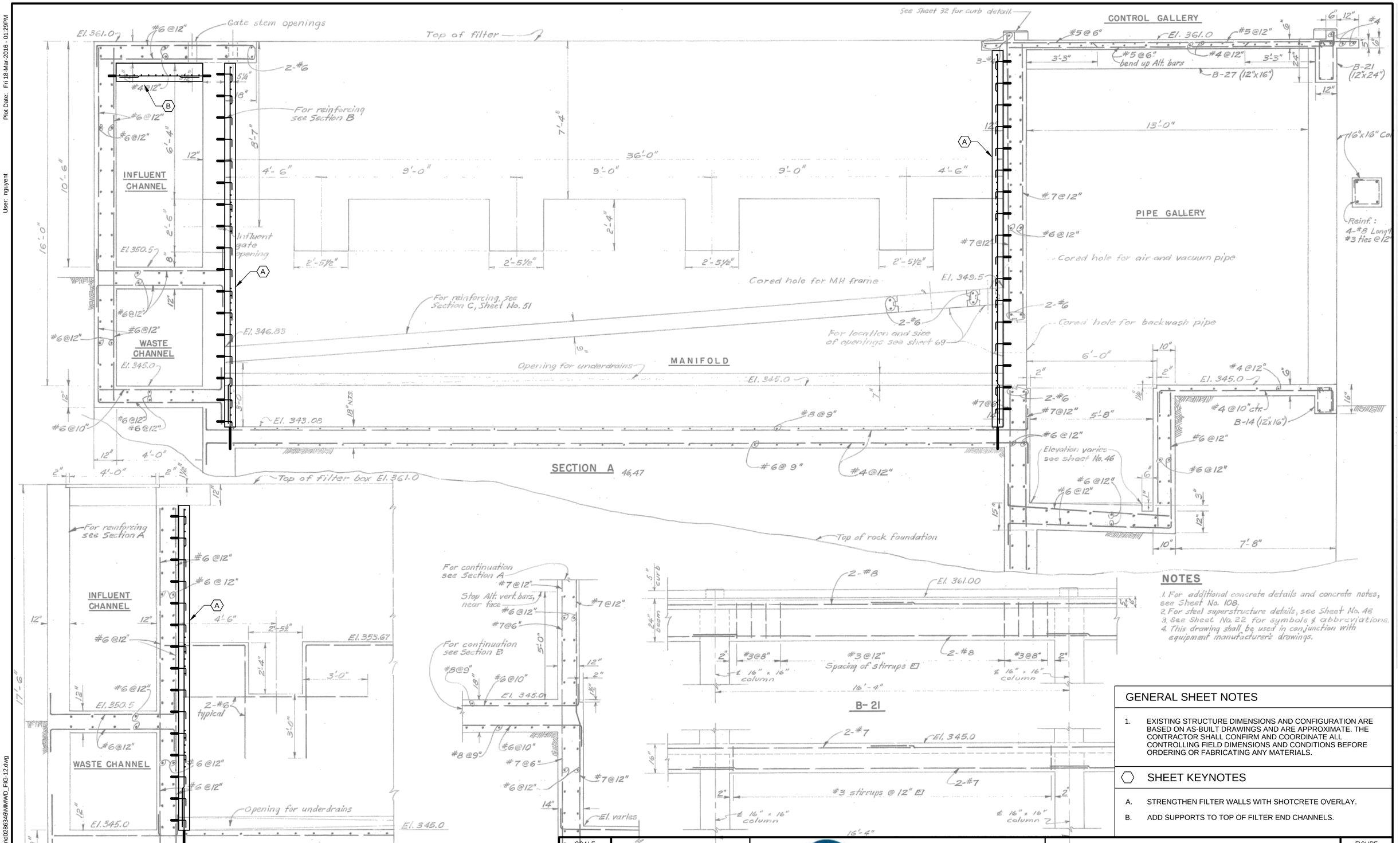
User: nguyenvt
File: C:\pwworkdir\d0286346\MWD_FIG-12.dwg



NOTES

1. For additional concrete details and concrete notes, see Sheet No. 108.
2. For steel superstructure details, see Sheet No. 48
3. See Sheet No. 22 for symbols & abbreviations.
4. This drawing shall be used in conjunction with equipment manufacturer's drawings.

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

B. ADD SUPPORTS TO TOP OF FILTER END CHANNELS.

SCALE

SCALE

MWH

MARIN MUNICIPAL WATER DISTRICT

FILTER REHABILITATION AND SEISMIC UPGRADES
STRUCTURAL - SAN GERONIMO WTP
FILTERS 1-4 - SECTIONS - 1

FIGURE
FIG-12
Job#_here

Plot Date: Fri 18-Mar-2016 - 01:30PM
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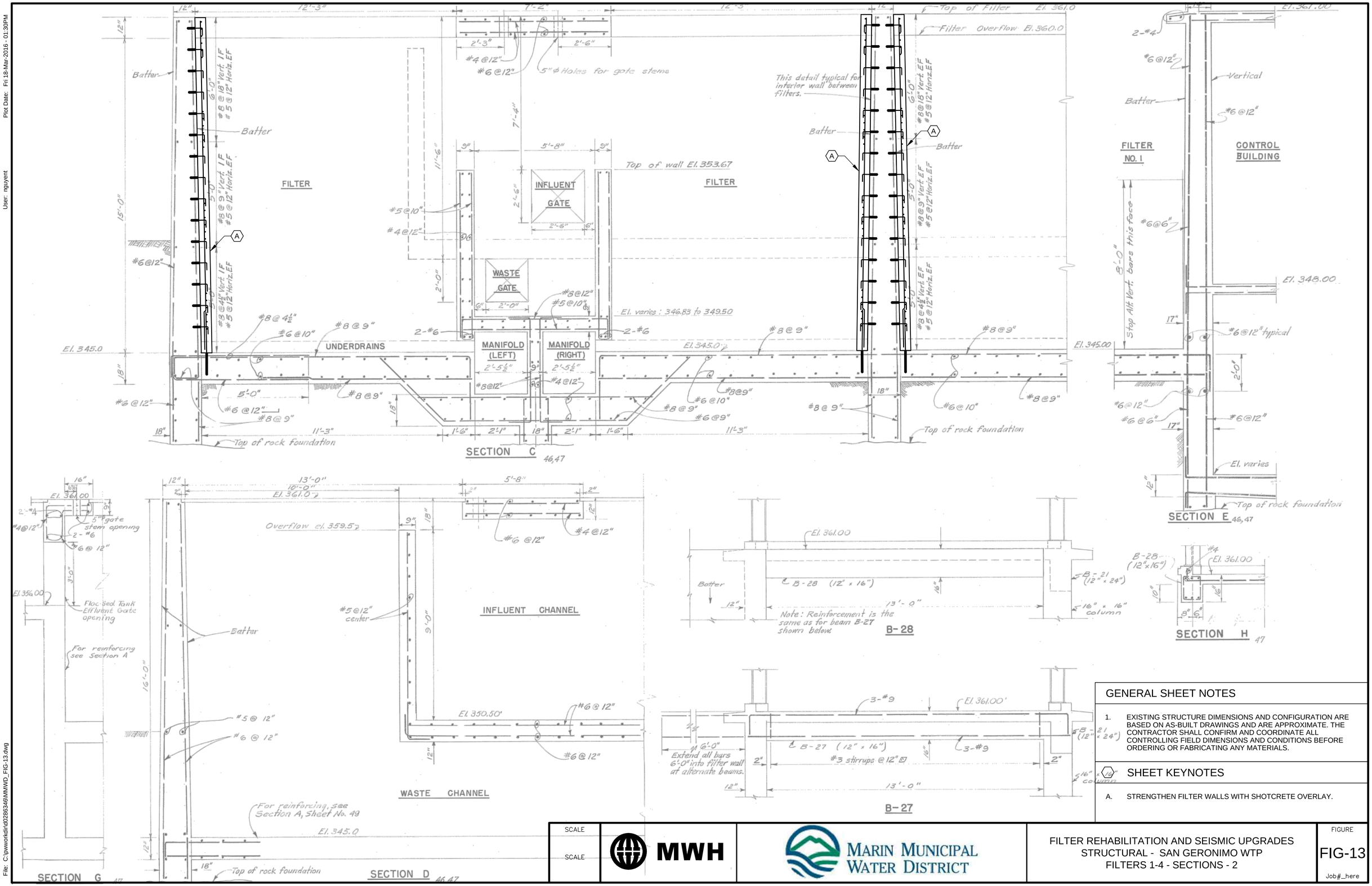


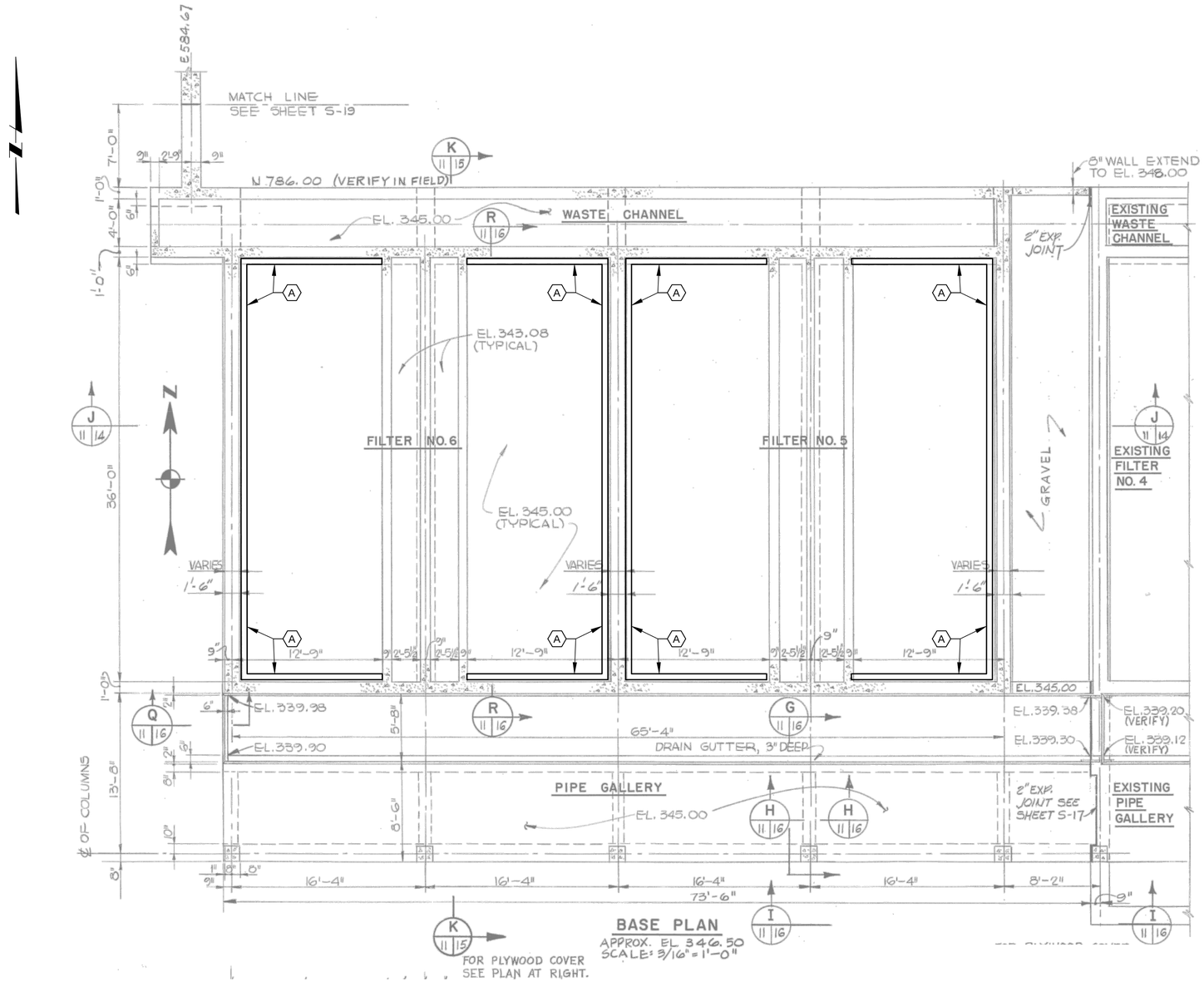
GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP FILTERS 1-4 - SECTIONS - 2	FIGURE
SCALE				FIG-13
				Job#_here



GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP FILTERS 5-6 - LOWER PLAN	FIG-14 Job#_here

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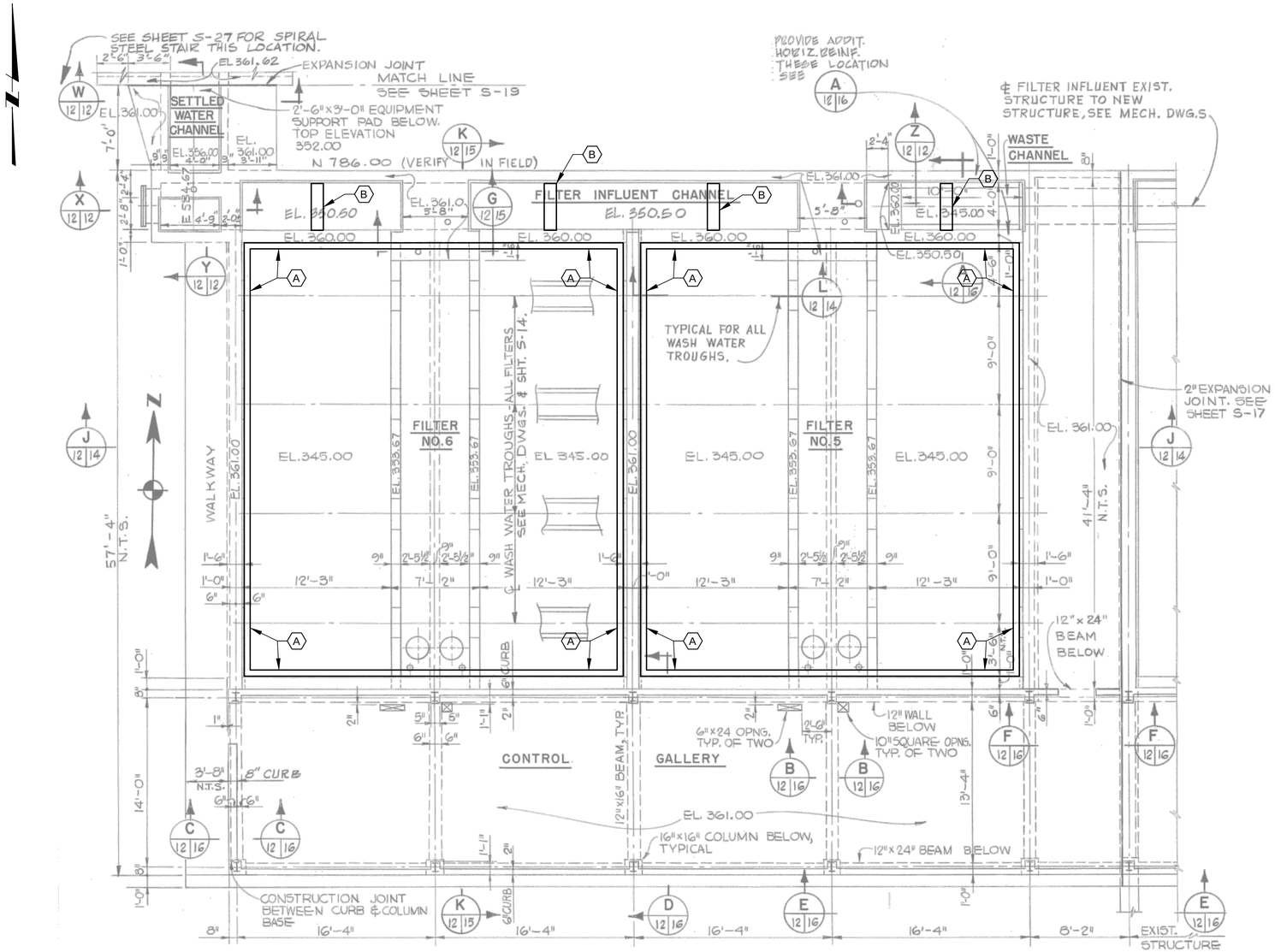
File: C:\pwworkdir\d0286346\MMWD_FIG-14.dwg



TOP PLAN

SCALE: 3/16" = 1'-0"

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

B. ADD SUPPORTS TO TOP OF FILTER END WALLS AT CHANNELS.

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP FILTERS 5-6 - UPPER PLAN	FIG-15 Job#_here

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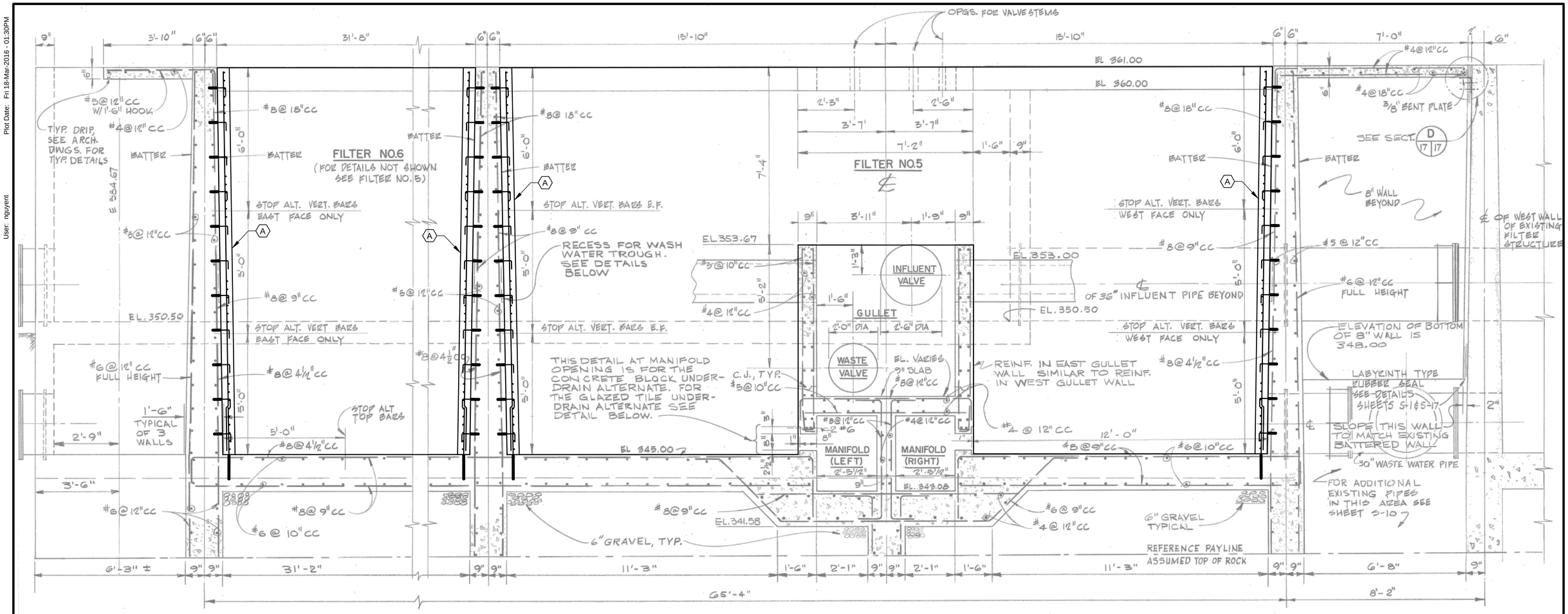
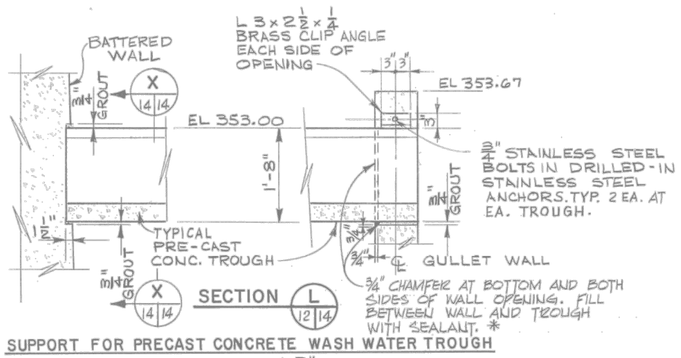
Plot Date: Fri 18-Mar-2016 - 01:30PM
User: nguyent
File: C:\pwworkdir\d0286346\MMWD_FIG-16.dwg



SECTION J 10 14
SCALE: ½"=1'-0"
11:12

NOTE:
COORDINATE MANIFOLD DETAILS WITH MANUFACTURER'S DRAWINGS.

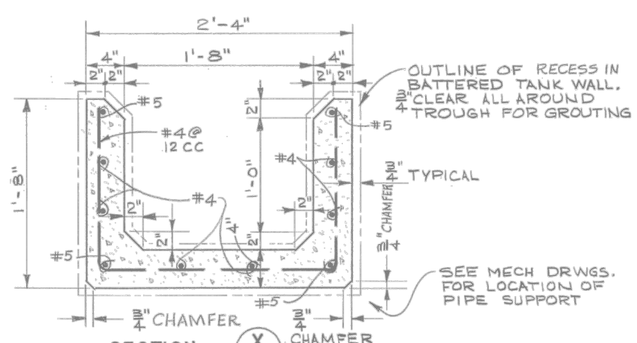


SECTION L 12 14

SUPPORT FOR PRECAST CONCRETE WASH WATER TROUGH

SCALE: ¾" = 1'-0"

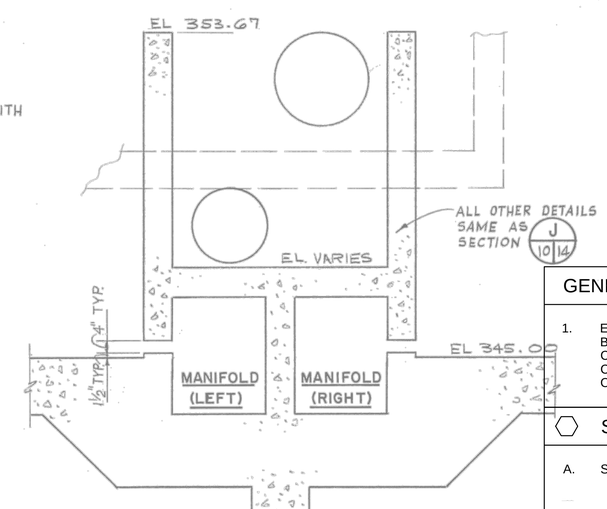
*AT EXIST. TROUGHS CHIP OUT SIMILAR CHAMFER, REMOVE EXIST. GROUT TO DEPTH OF ¾" AND FILL WITH SEALANT.



SECTION X 14 14

PRECAST CONCRETE WASH WATER TROUGH

SCALE 1½" = 1'-0"



GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

SCALE

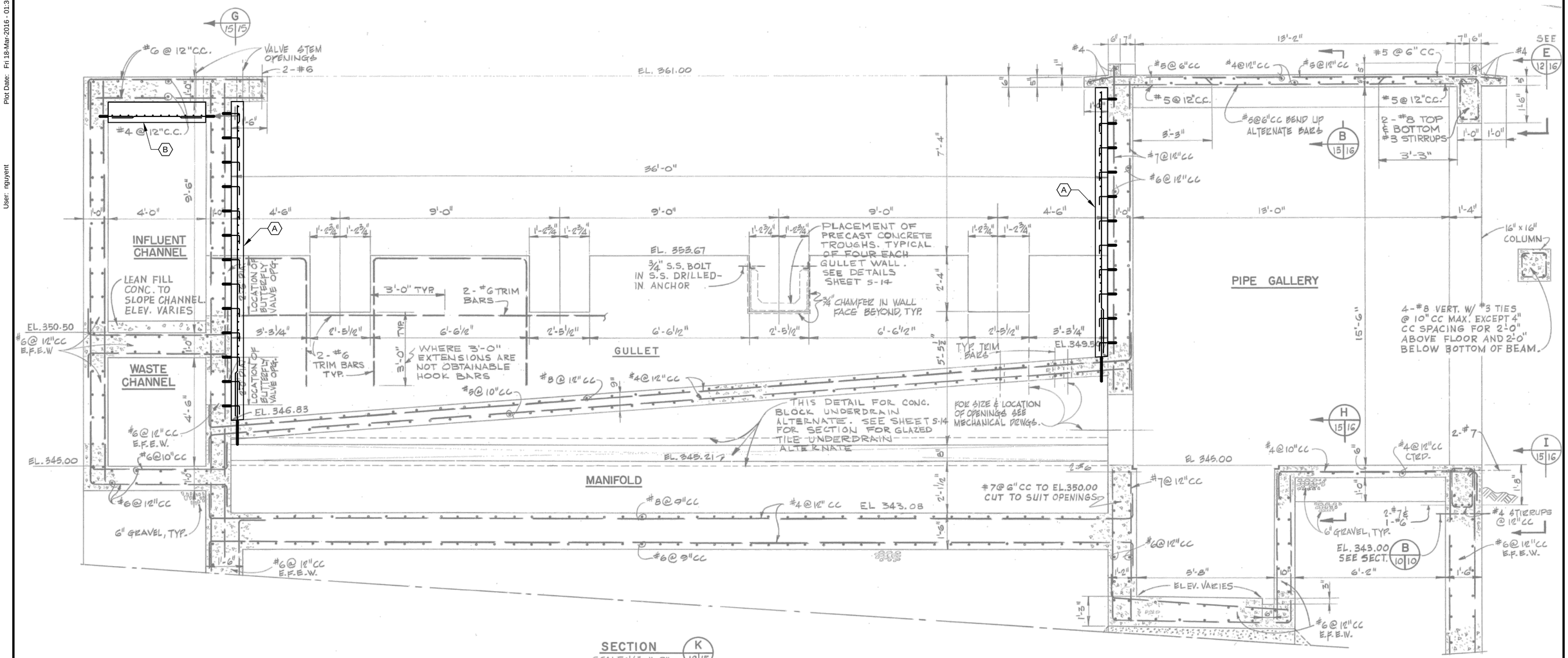
MWH

MARIN MUNICIPAL WATER DISTRICT

AIL ALTERNATE
0"

FILTER REHABILITATION AND SEISMIC UPGRADES
STRUCTURAL - SAN GERONIMO WTP
FILTERS 5-6 - SECTIONS - 1

FIGURE
FIG-16
Job#_here



GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. STRENGTHEN FILTER WALLS WITH SHOTCRETE OVERLAY.

B. ADD SUPPORTS TO TOP OF FILTER END CHANNELS.

SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP FILTERS 5-6 - SECTIONS - 2	FIGURE FIG-17 Job#_here
SCALE				

Plot Date: Fri 18-Mar-2016 - 01:30PM
User: nguyent
File: C:\pwworkdir\d0286346\MMWD_FIG-17.dwg

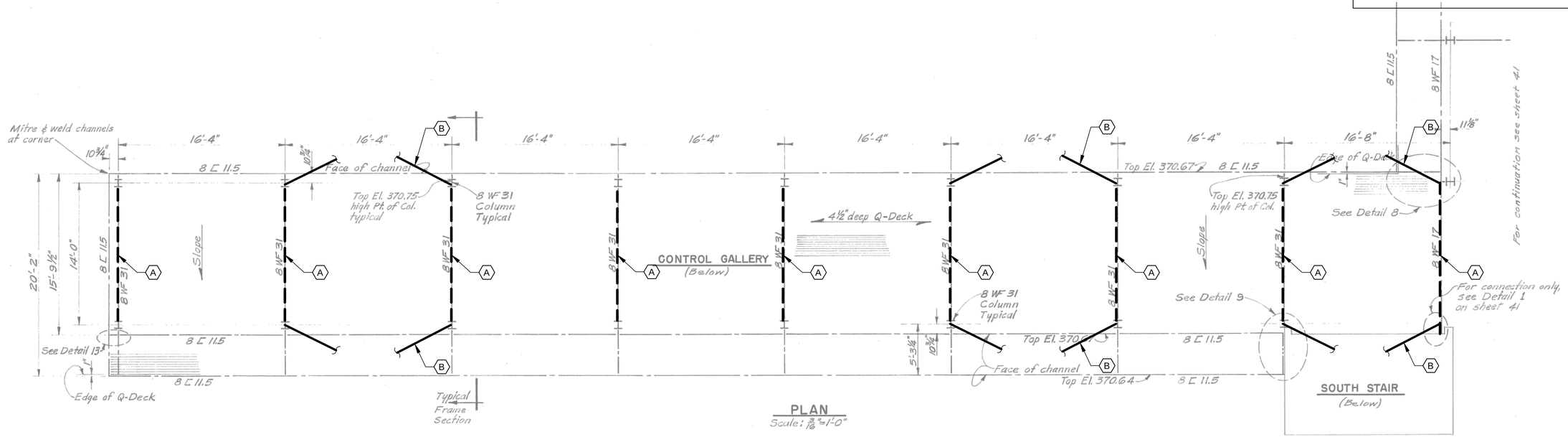
GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. ADD/CONFORM WELDING OF METAL DECK ROOF DIAPHRAGM TO STEEL FRAMES.

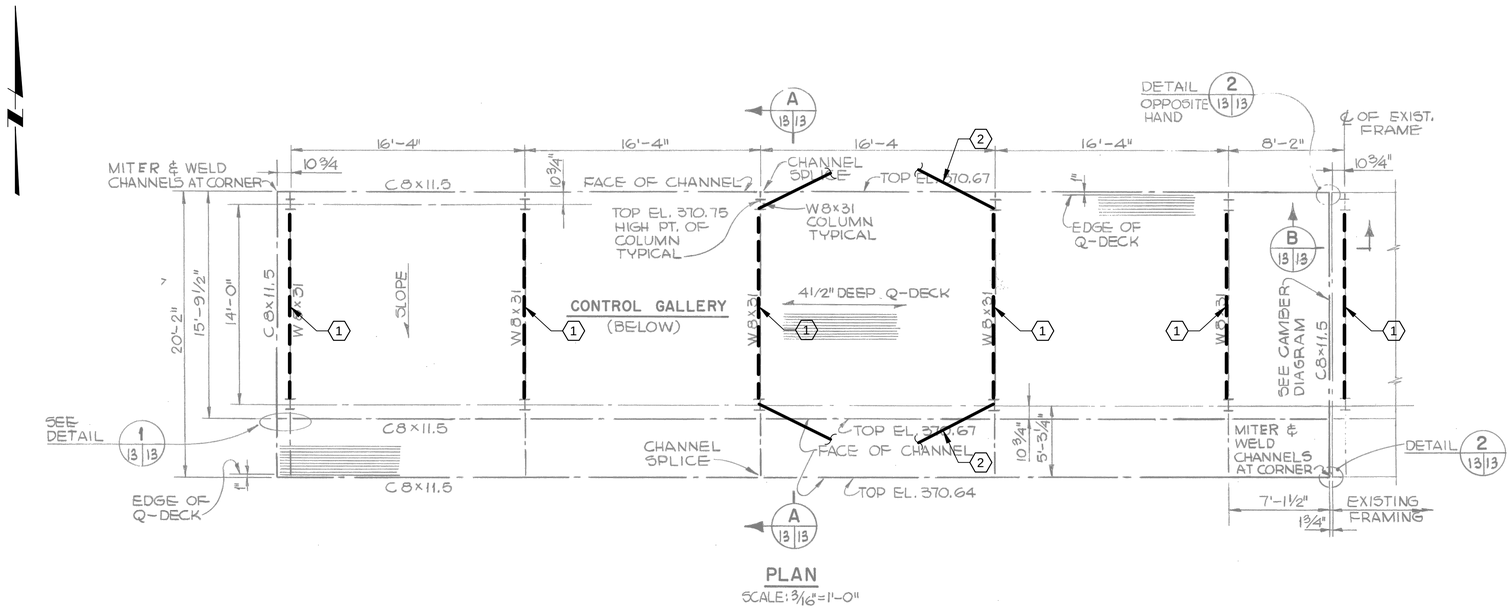
B. REPLACE TENSION ONLY ROD BRACING WITH TUBE STEEL OR PIPE BRACING.



PLAN
Scale: 3/16"=1'-0"

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP CONTROL GALLERY - ROOF PLAN - 1	FIG-18 Job#_here

Plot Date: Fri 18-Mar-2016 - 01:30PM
User: nguyent
File: C:\pwworkdir\d0286346\MMWD_FIG-18.dwg



PLAN

SCALE: 3/16"=1'-0"

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. ADD/CONFORM WELDING OF METAL DECK ROOF DIAPHRAGM TO STEEL FRAMES.

B. REPLACE TENSION ONLY ROD BRACING WITH TUBE STEEL OR PIPE BRACING.

SCALE

SCALE

MWH

MARIN MUNICIPAL WATER DISTRICT

FILTER REHABILITATION AND SEISMIC UPGRADES
STRUCTURAL - SAN GERONIMO WTP
CONTROL GALLERY - ROOF PLAN - 2

FIGURE

FIG-19

Job#_here

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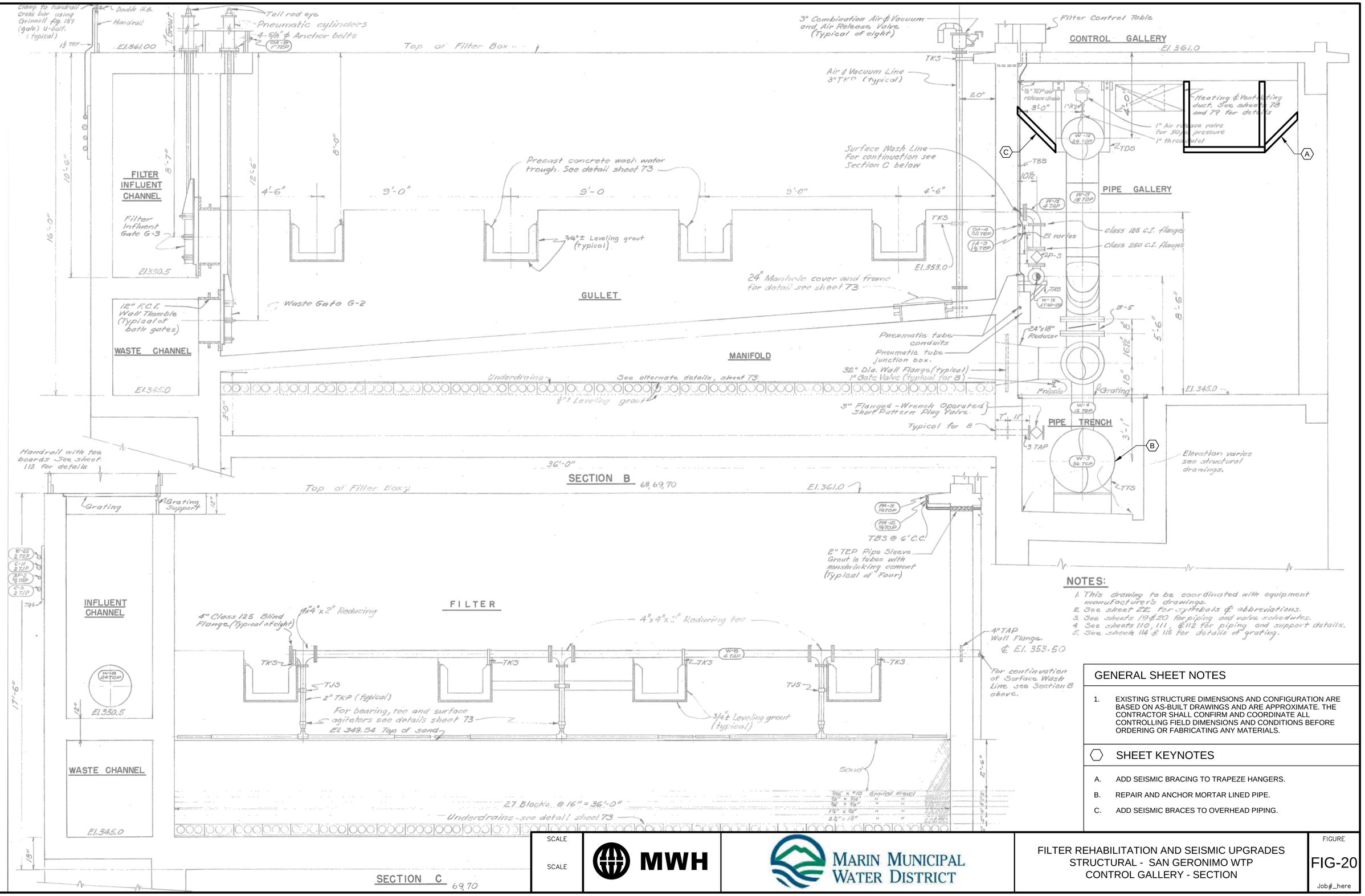

NOTES:

1. This drawing to be coordinated with equipment manufacturer's drawings.
2. See sheet 22 for symbols & abbreviations.
3. See sheets 19 & 20 for piping and valve schedules.
4. See sheets 110, 111, & 112 for piping and support details.
5. See sheets 114 & 115 for details of grating.

GENERAL SHEET NOTES

1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. ADD SEISMIC BRACING TO TRAPEZE HANGERS.

B. REPAIR AND ANCHOR MORTAR LINED PIPE.

C. ADD SEISMIC BRACES TO OVERHEAD PIPING.

SCALE

SCALE

MWH

MARIN MUNICIPAL WATER DISTRICT

FILTER REHABILITATION AND SEISMIC UPGRADES
STRUCTURAL - SAN GERONIMO WTP
CONTROL GALLERY - SECTION

FIGURE

FIG-20

Job#_here

Plot Date: Fri 18-Mar-2016 - 01:31PM
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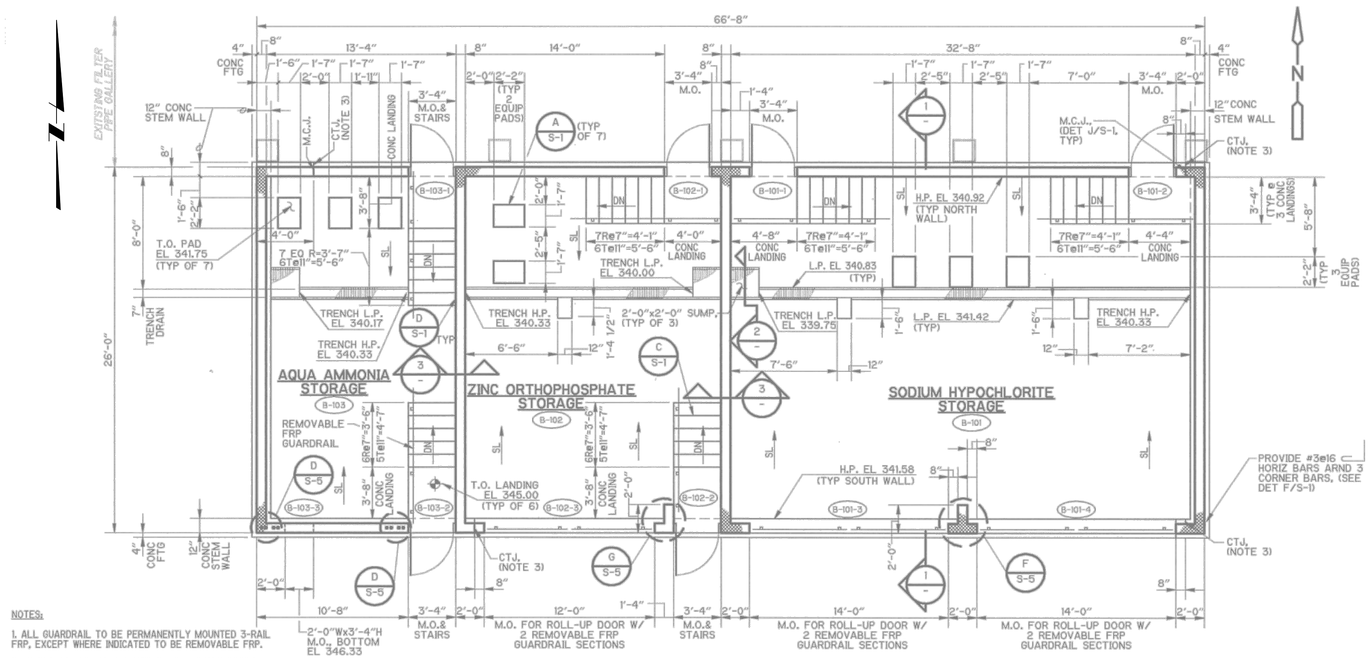
File: C:\pwworkdir\d0286346\MWD_FIG-21.dwg



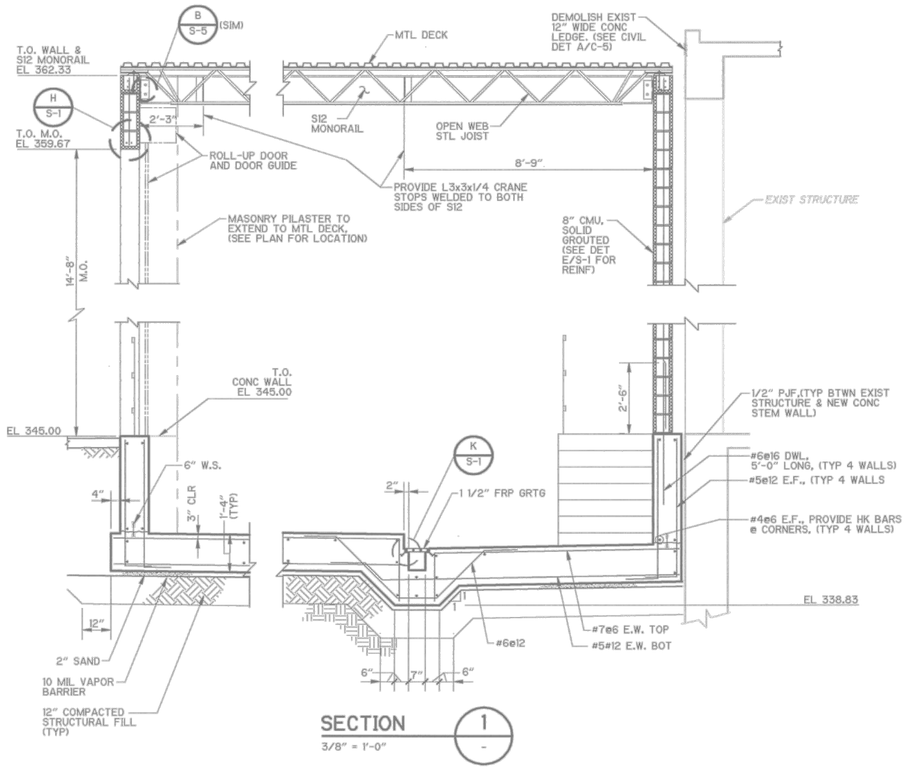
NOTES:

1. ALL GUARDRAIL TO BE PERMANENTLY MOUNTED 3-RAIL FRP, EXCEPT WHERE INDICATED TO BE REMOVABLE FRP.
2. HEIGHT OF M.O. AT ALL PERSONNEL ACCESS DOORS SHALL BE 9'-4" ABOVE CONC STEM WALL.
3. AT CONTROL JOINTS, EXTEND EVERY OTHER BAR (50x OF REINF) THROUGH JOINT AND PROVIDE CLASS B TENSION SPLICE. ALSO PROVIDE WATER STOPS.
4. SEE DETS E&F/S-1 FOR TYP MASONRY REINF.
5. SEE DET G/S-1 FOR LINTEL SCHEDULE.

STRUCTURAL BASE

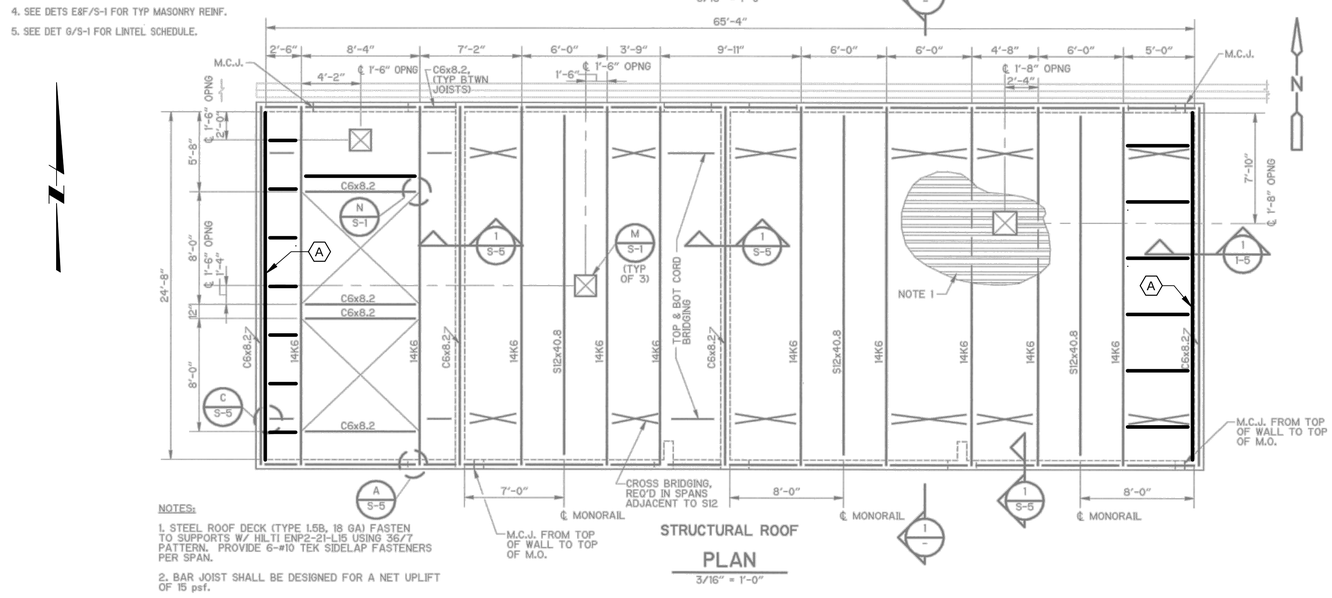
PLAN

3/16" = 1'-0"



SECTION 1

3/8" = 1'-0"



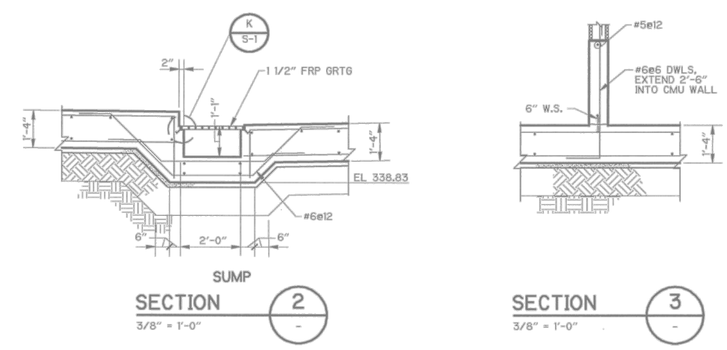
NOTES:

1. STEEL ROOF DECK (TYPE 1.5B, 18 GA) FASTEN TO SUPPORTS W/ HILTI ENP2-21-L15 USING 36/7 PATTERN. PROVIDE 6-#10 TEK SIDELAP FASTENERS PER SPAN.
2. BAR JOIST SHALL BE DESIGNED FOR A NET UPLIFT OF 15 psf.

STRUCTURAL ROOF

PLAN

3/16" = 1'-0"



SECTION 2

3/8" = 1'-0"

SECTION 3

3/8" = 1'-0"

GENERAL SHEET NOTES

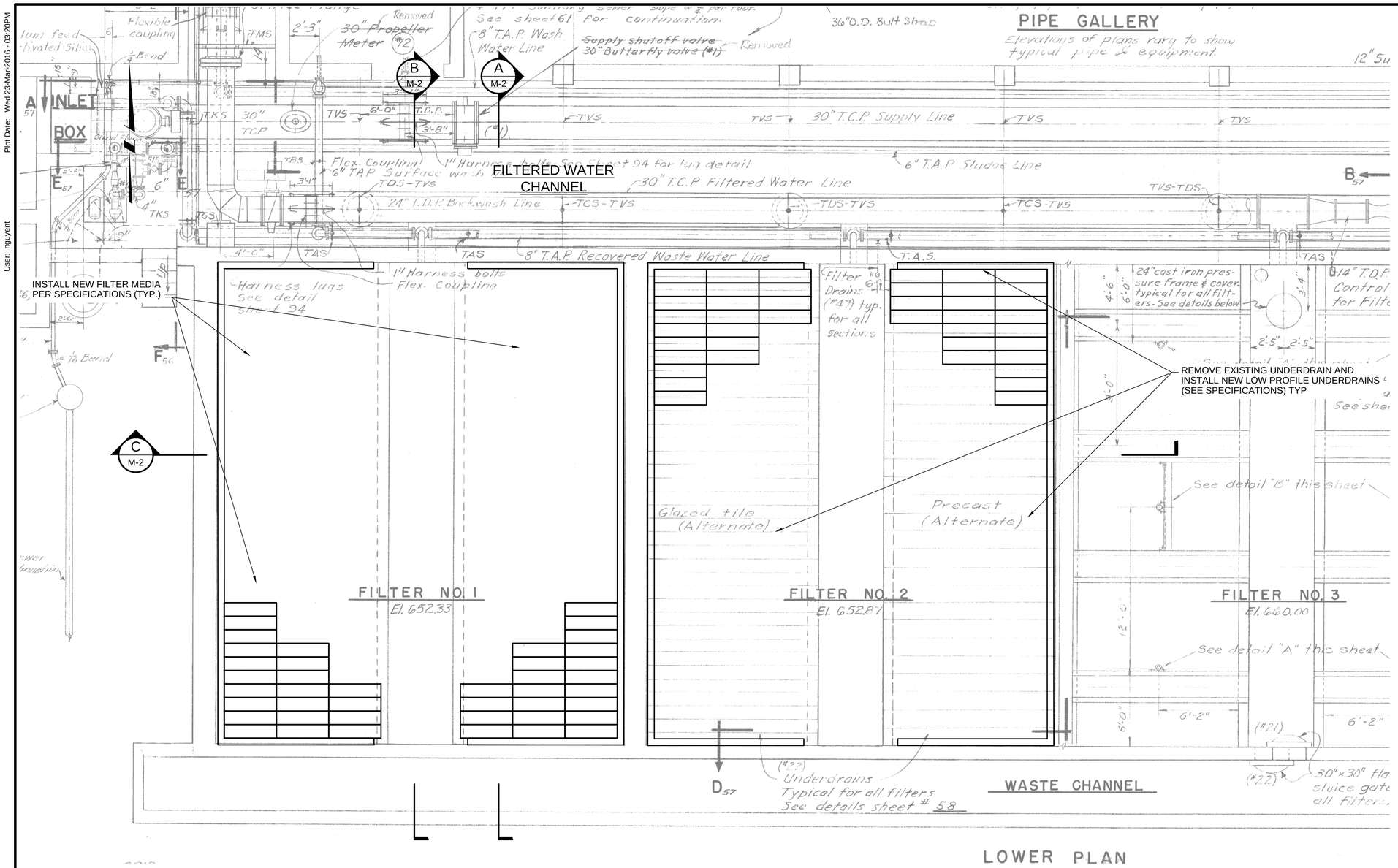
1. EXISTING STRUCTURE DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.

SHEET KEYNOTES

A. ADD WALL OUT-OF-PLANE ANCHORAGE AT ROOF.

SCALE				FIGURE
SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES STRUCTURAL - SAN GERONIMO WTP CHEMICAL BUILDING - ROOF PLAN	FIG-21 Job#_here

Appendix B - Process Figures



GENERAL SHEET NOTES

1. EXISTING DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
2. FOR THICKENED FILTER WALLS SEE STRUCTURAL DRAWINGS.

SCALE

SCALE

MWH

MARIN MUNICIPAL WATER DISTRICT

FILTER REHABILITATION AND SEISMIC UPGRADES
MECHANICAL - BON TEMPE WTP
TYPICAL FILTER PLAN

FIGURE

FIG-22

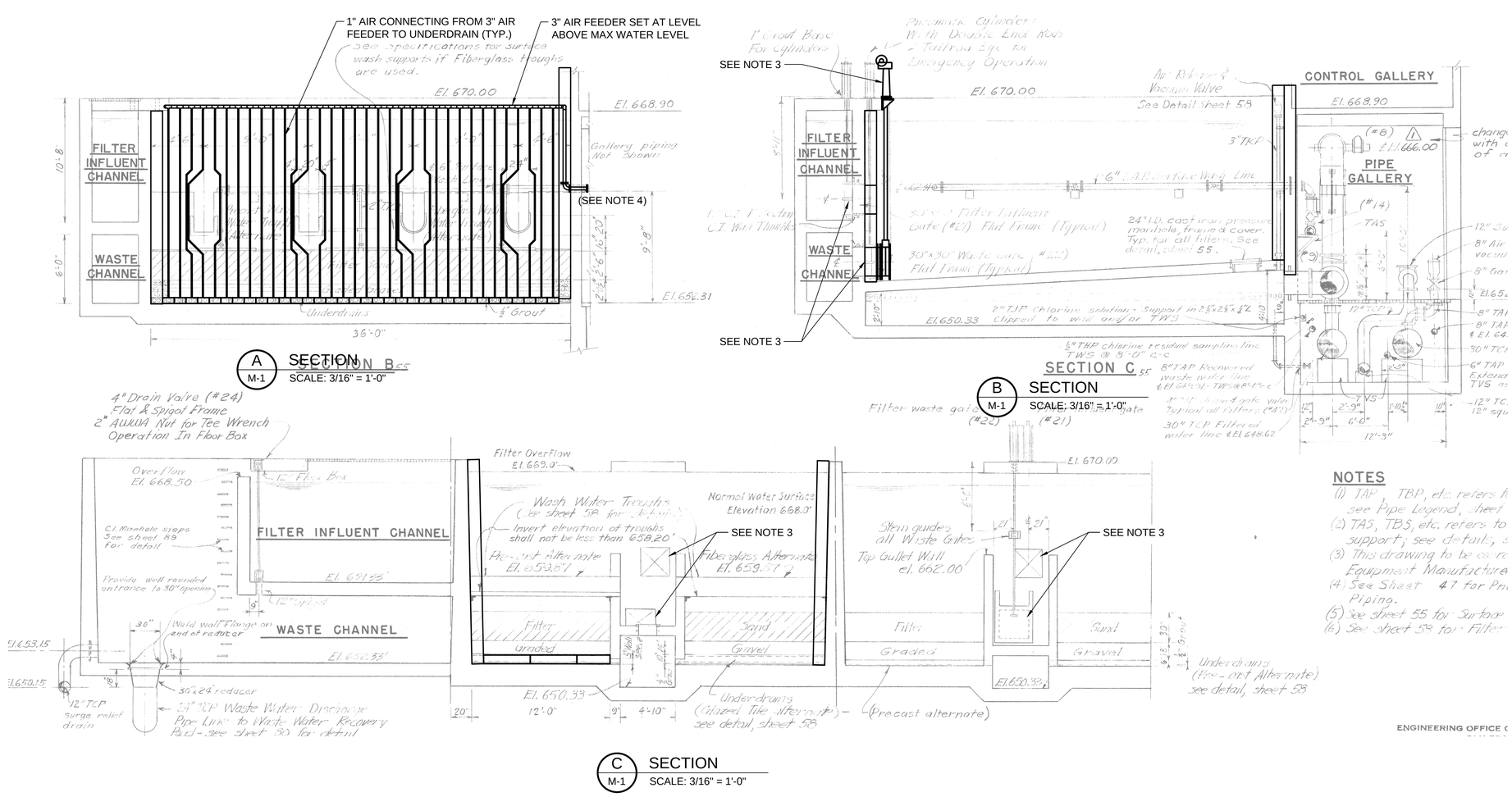
Job#_here

Plot Date: Wed 23-Mar-2016 - 03:20PM
User: nguyent
File: C:\pwworkdir\d0286365\MWWD_FIG-M-01.dwg

Plot Date: Wed 23-Mar-2016 - 03:20PM
User: nguyent

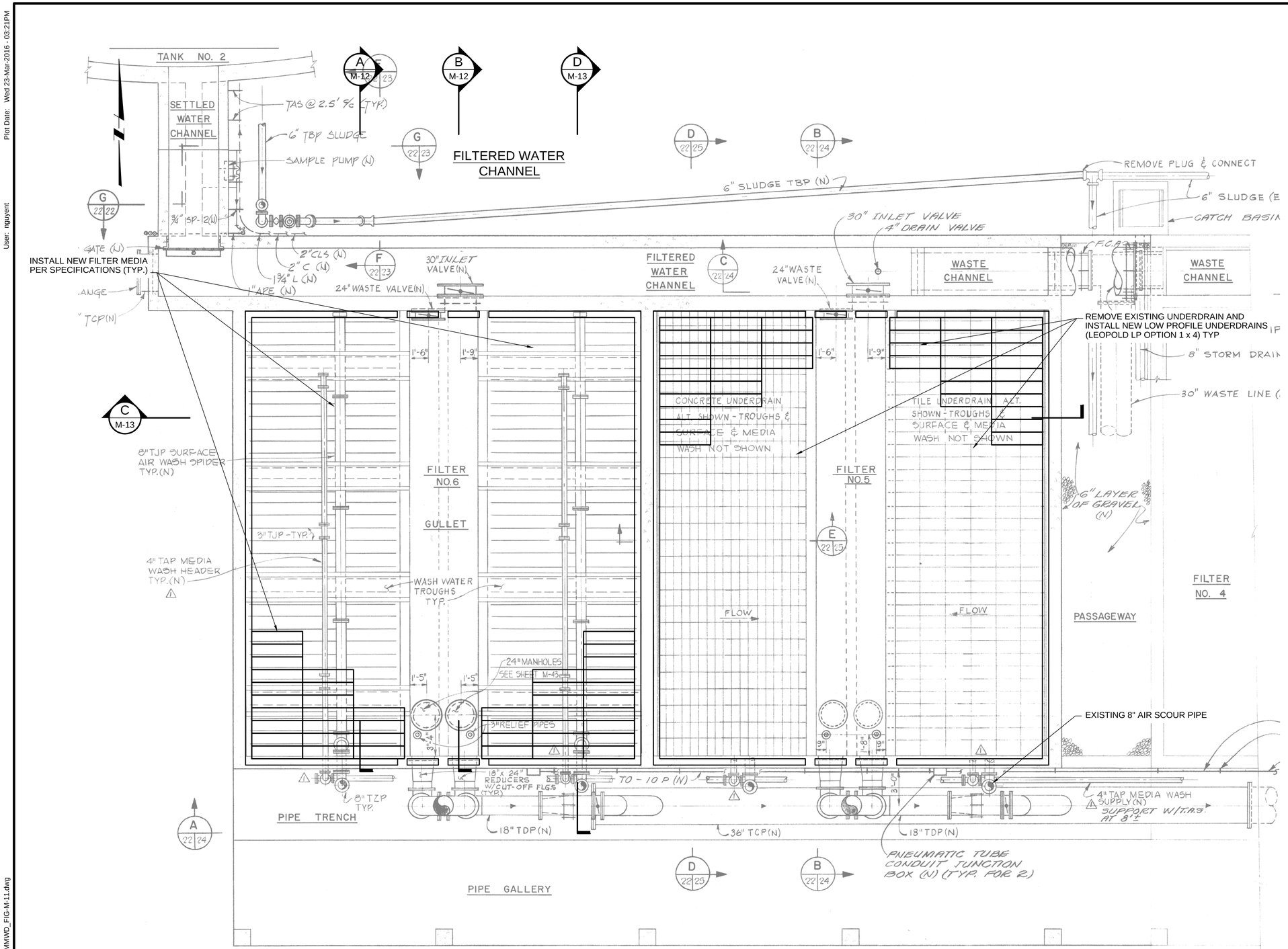
GENERAL SHEET NOTES

1. EXISTING DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
2. FOR THICKENED FILTER WALLS SEE STRUCTURAL DRAWINGS.
3. REMOVE AND RELOCATE EXISTING GATE AND OPERATOR.
4. INSTALL AIR PIPING INTO THICKENED WALL FOR FUTURE AIR/WATER BACKWASH CAPABILITY.



SCALE					FIGURE
SCALE	MWH		MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES MECHANICAL - BON TEMPE WTP TYPICAL FILTER SECTIONS	FIG-23 Job#_here

File: C:\pwworkdir\d0286365\M\MWD_FIG-M-02.dwg



GENERAL SHEET NOTES

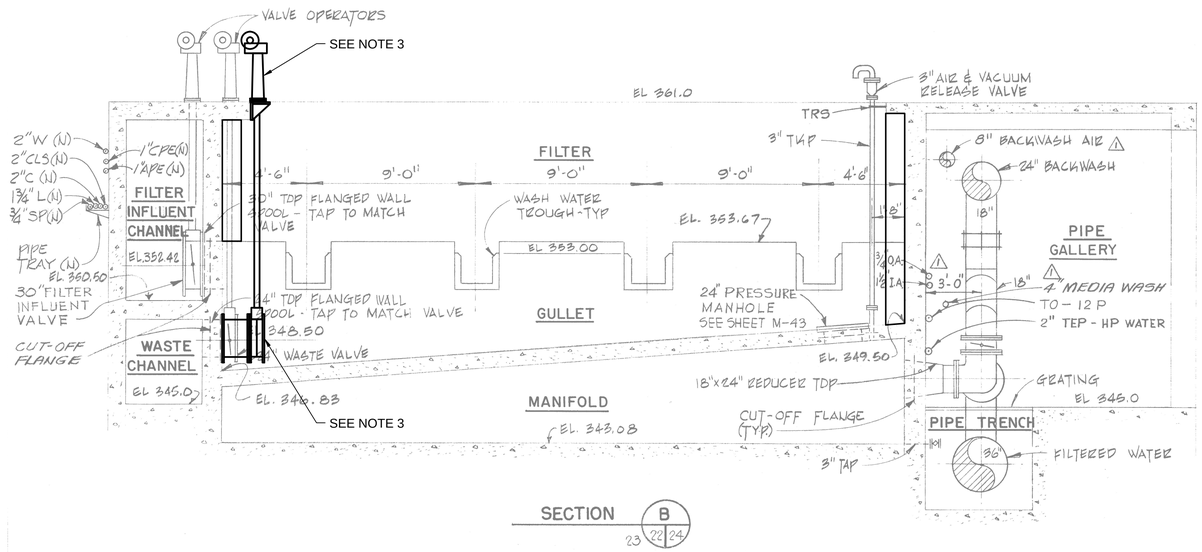
1. EXISTING DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
2. FOR THICKENED FILTER WALLS SEE STRUCTURAL DRAWINGS.

SCALE SCALE	MWH		MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES MECHANICAL - SAN GERONIMO WTP TYPICAL FILTER PLAN	FIGURE FIG-24 Job#_here

Plot Date: Wed 23-Mar-2016 - 03:21PM
User: nguyent
File: C:\pwworkdir\d0286365\MMWD_FIG-M-11.dwg

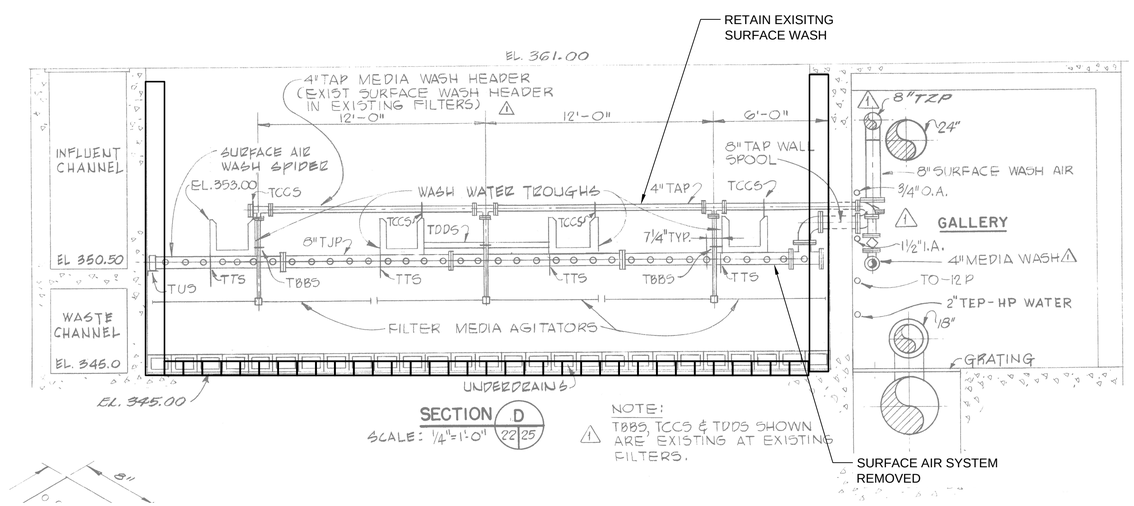
GENERAL SHEET NOTES

1. EXISTING DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
2. FOR THICKENED FILTER WALLS SEE STRUCTURAL DRAWINGS.
3. REMOVE AND RELOCATE EXISTING GATE AND OPERATOR.



SECTION B 23 22 24

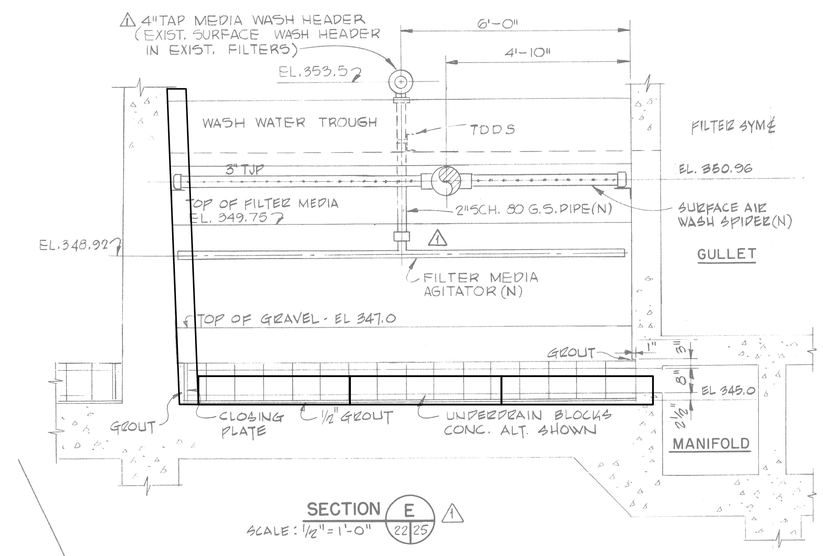
A M-10 SECTION
SCALE: 1/4" = 1'-0"



SECTION D 22 25
SCALE: 1/4"=1'-0"

NOTE:
TBBS, TCCS & TDDS SHOWN ARE EXISTING AT EXISTING FILTERS.

B M-10 SECTION
SCALE: 1/4" = 1'-0"

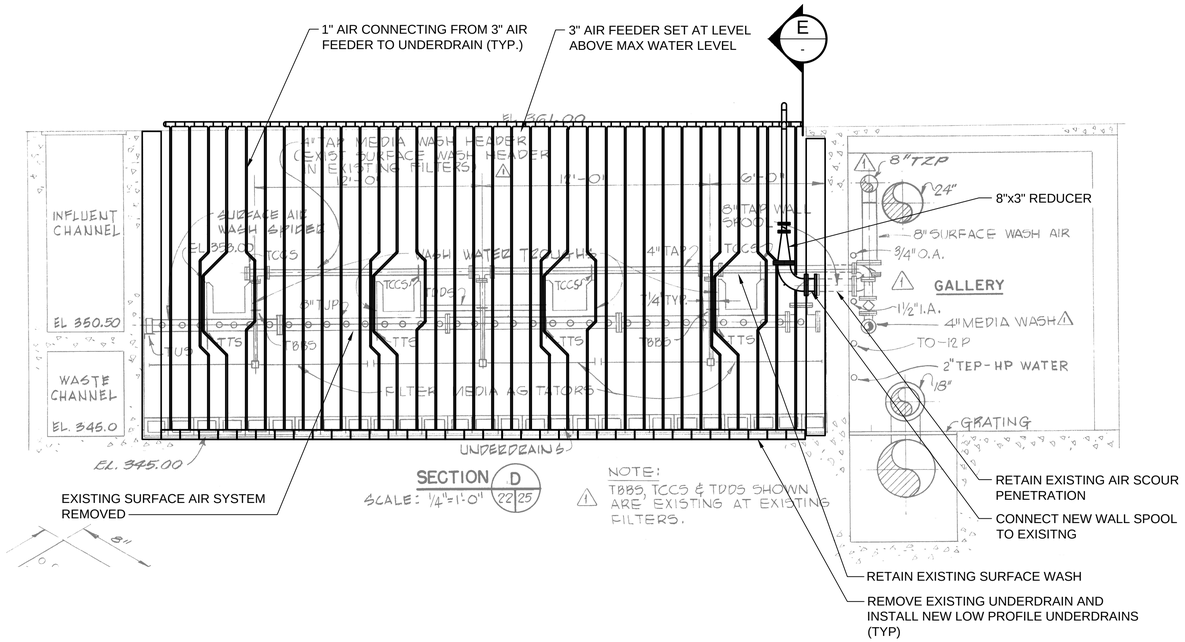


SECTION E 22 25
SCALE: 1/2" = 1'-0"

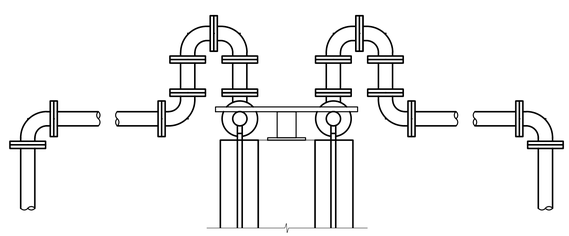
C M-10 SECTION
SCALE: 1/2" = 1'-0"

SCALE SCALE	MWH		MARIN MUNICIPAL WATER DISTRICT		FILTER REHABILITATION AND SEISMIC UPGRADES MECHANICAL - SAN GERONIMO WTP TYPICAL FILTER SECTIONS	FIGURE FIG-25 Job#_here

Plot Date: Wed 23-Mar-2016 - 03:21PM
User: nguyent
File: C:\pwworkdir\d0228365\MMWD_FIG-M-12.dwg



D / M-10 SECTION
SCALE: 1/4" = 1'-0"



E / - SECTION
SCALE: 3/4" = 1'-0"

GENERAL SHEET NOTES

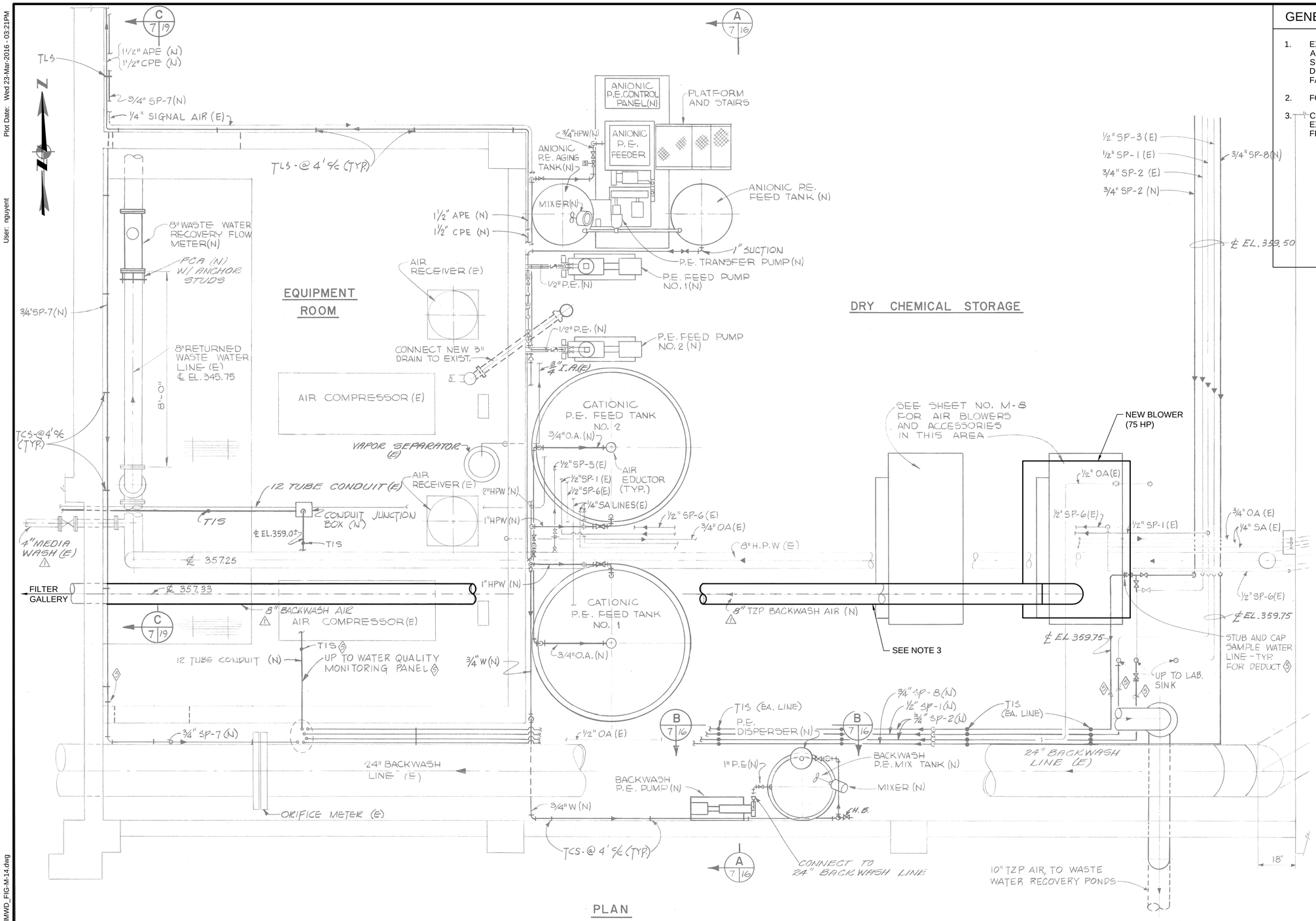
1. EXISTING DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
2. FOR THICKENED FILTER WALLS SEE STRUCTURAL DRAWINGS.

SCALE SCALE	MWH		MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES MECHANICAL - SAN GERONIMO WTP TYPICAL FILTER NEW AIR SCOUR SECTION	FIGURE FIG-26 Job#_here

Plot Date: Wed 23-Mar-2016 - 03:21PM
User: nguyent
File: C:\pwworkdir\d0286365\MMWD_FIG-M-13.dwg

GENERAL SHEET NOTES

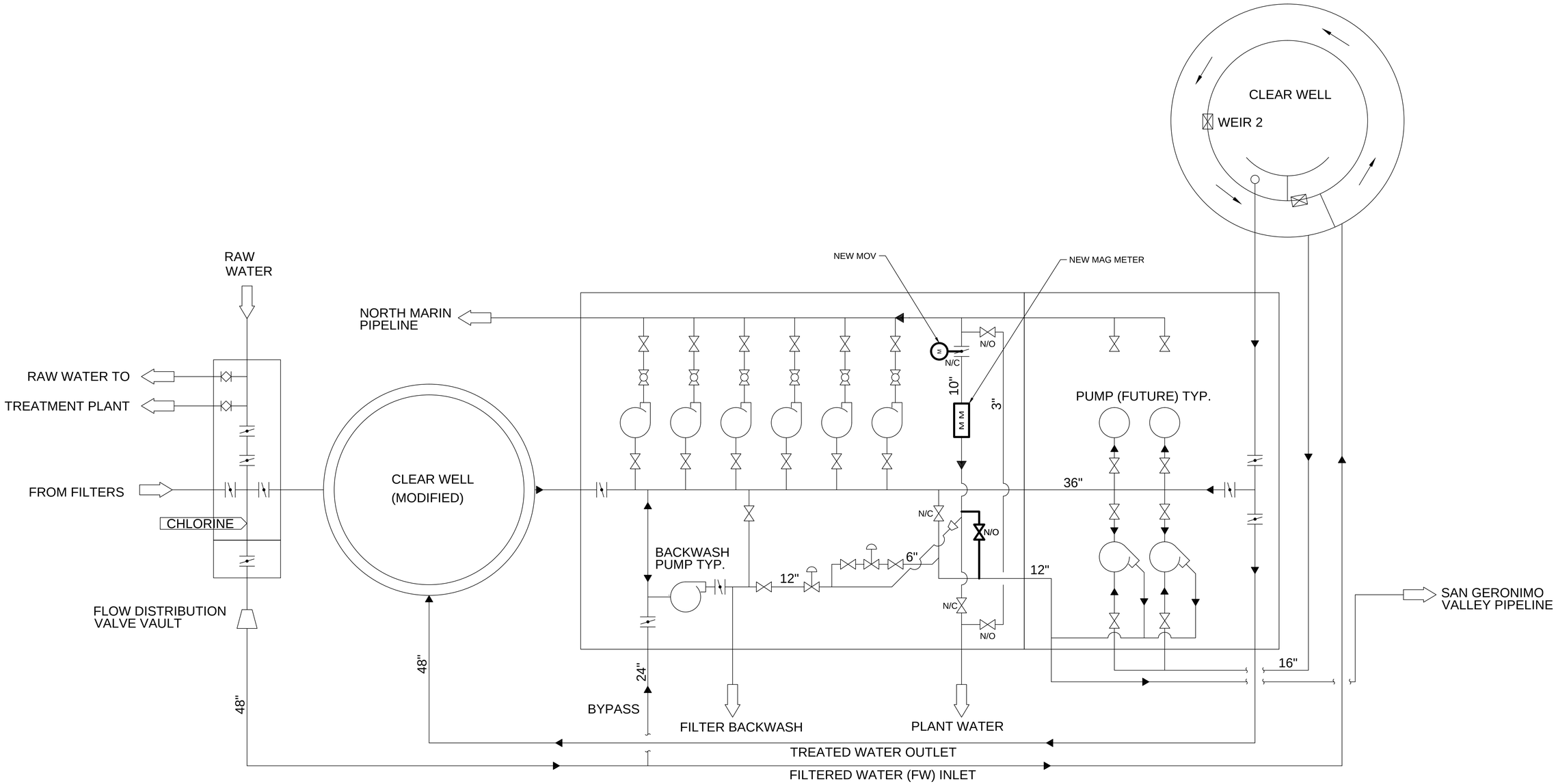
1. EXISTING DIMENSIONS AND CONFIGURATION ARE BASED ON AS-BUILT DRAWINGS AND ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
2. FOR THICKENED FILTER WALLS SEE STRUCTURAL DRAWINGS.
3. CONNECT PIPING TO EXISTING PIPING, CONTRACTOR SHALL USE EXISTING PENETRATIONS AND PIPE AS NEEDED TO ROUTE SYSTEM FROM BLOWER TO FILTER AIR APPLICATION POINT.



PLAN

SCALE					FIGURE
SCALE	MWH		MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES MECHANICAL - SAN GERONIMO WTP AIR SCOUR BLOWER AND PIPING PLAN	FIG-27 Job#_here

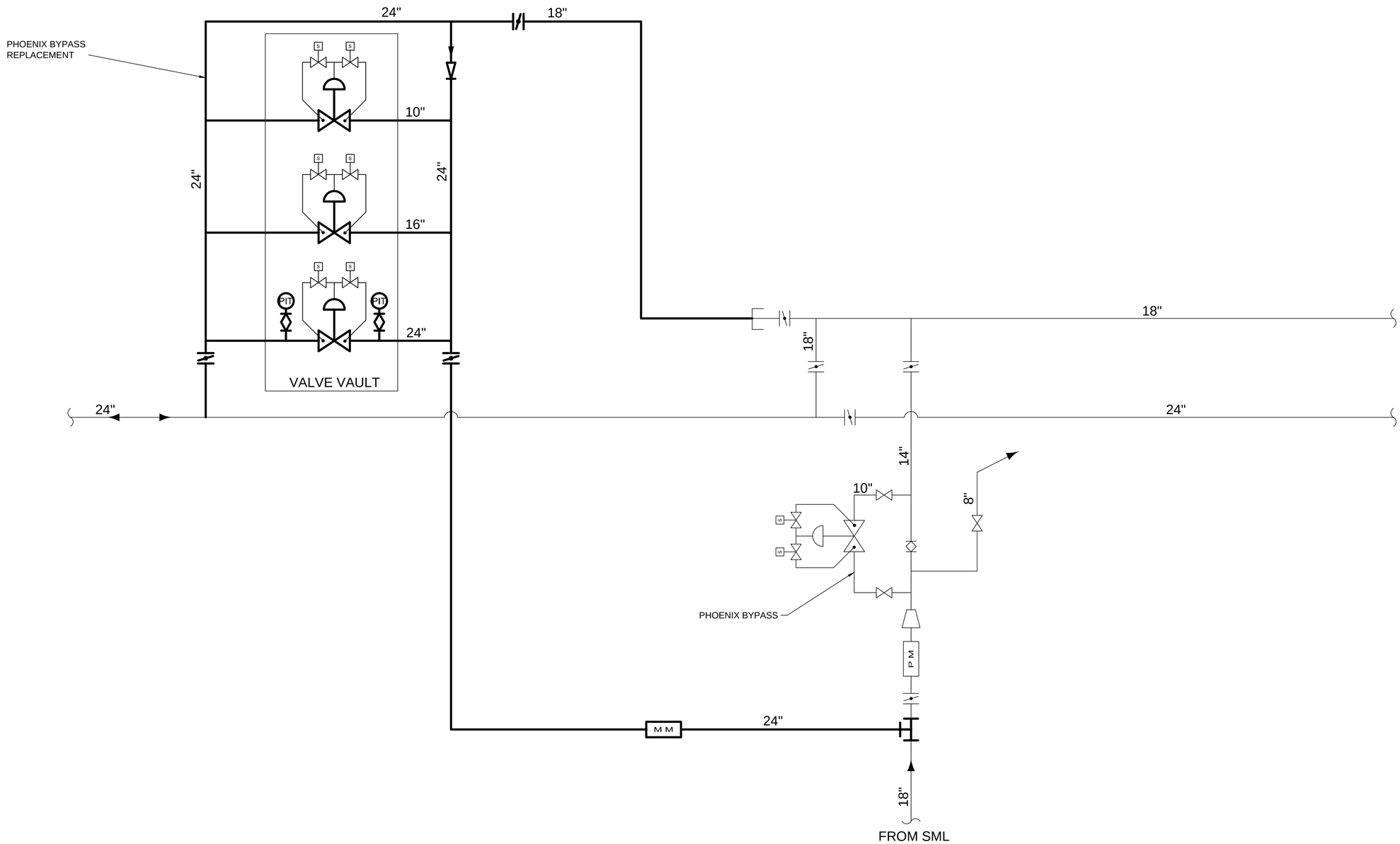
Plot Date: Wed 23-Mar-2016 - 03:21PM
User: nguyent
File: C:\pwworkdir\d0286365\M\WD_FIG-M-14.dwg



SAN GERONIMO TREATED WATER STORAGE AND PUMP STATION TREATMENT PLANT

SCALE				
NO SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES GENERAL SCHEMATIC FLOW DIAGRAM	FIGURE FIG-28 Job#_here

Plot Date: Wed 23-Mar-2016 - 03:21PM
User: nguyent
File: C:\pwworkdir\d0\2986334\MMWD_btsfd.dwg



SCALE				
NO SCALE	MWH	MARIN MUNICIPAL WATER DISTRICT	FILTER REHABILITATION AND SEISMIC UPGRADES GENERAL SCHEMATIC FLOW DIAGRAM	FIGURE FIG-29 Job#_here

Plot Date: Wed 23-Mar-2016 - 03:22PM

User: nguyent

File: C:\pwworkdir\d0228633\MMWD_SYSTEM MAP.dwg

Appendix C - Filter Model Results

MMWD Filter Rehab

Compiled Filter Run Results - BTTP

Area =	864	sf
BW Time =	11.5	min
BW Vol =	120000	gal

Case 1 =	7/28/2013	to	9/18/2013
Case 2 =	10/20/2013	to	11/20/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
1.1			7/1/2013	41456		1		4.1				8.30						0.03		57.5							
1.2	7/3/2013	41458	7/6/2013	41461		1	3.8	4.3			0.65	8.10				0.05	0.10	0.03	5	58.0				0.039			
1.3	7/8/2013	41463	7/10/2013	41465		1	3.5	3.4			1.16	8.10				0.04	0.07	0.03	0	48.0				0.044			
1.4	7/13/2013	41468	7/15/2013	41470		1	2.8	3.7			0.54	8.40				0.05	0.05	0.03	0	46.0				0.052			
1.5	7/17/2013	41472	7/20/2013	41475		1	4.2	3.8			0.92	8.30				0.05	0.05	0.03	0	53.0				0.042			
1.6	7/23/2013	41478	7/25/2013	41480		1	3.5	3.0			0.90	8.90				0.04	0.05	0.02	0	61.5				0.040			
1.7	7/28/2013	41483	7/30/2013	41485	Case 1	1	3.3	4.9	6.32	3.65	0.83	7.70	23.1	0.83	24.8	0.05	0.06	0.03	0	41.5		2.94	7.18	0.050	7315	298	168
1.8	8/1/2013	41487	8/3/2013	41489	Case 1	1	3.0	3.0	7.40	3.38	0.66	7.60	22.9	0.53	26.5	0.06	0.06	0.03	0	52.5		2.72	6.65	0.040	8565	349	156
1.9	8/7/2013	41493	8/9/2013	41495	Case 1	1	3.0	3.0	7.20	3.26	0.92	8.10	22.6	0.58	24.7	0.05	0.05	0.03	0	53.0		2.62	6.41	0.041	8333	340	151
1.10	8/12/2013	41498	8/13/2013	41499	Case 1	1	3.4	3.2			1.00	9.26	22.8	0.60	24.4	0.05	0.05	0.03	0	64.0				0.039			
1.11	8/16/2013	41502	8/18/2013	41504	Case 1	1	4.5	3.0	7.35	3.21	0.84	8.40	23.1	0.56	23.8	0.05	0.05	0.03	0	55.0		2.58	6.30	0.042	8507	347	148
1.12	8/20/2013	41506	8/22/2013	41508	Case 1	1	3.8	2.7	7.41	3.42	1.05	8.50	23.2	0.62	24.9	0.04	0.07	0.03	0	52.0		2.75	6.72	0.044	8576	349	158
1.13	8/24/2013	41510	8/26/2013	41512	Case 1	1	3.2	3.0	7.18	2.90	0.06	8.30	23.1	0.51	24.7	0.04	0.04	0.03	0	59.5		2.33	5.69	0.042	8310	339	134
1.14	8/29/2013	41515	8/31/2013	41517	Case 1	1	2.8	3.0			0.86	7.40	23.4	0.49	24.3	0.04	0.04	0.03	0	57.0				0.035			
1.15	9/3/2013	41520	9/5/2013	41522	Case 1	1	3.4	3.2	7.00	3.26	0.88	6.60	23.0	0.48	25.0	0.05	0.05	0.02	0	51.5		2.62	6.41	0.034	8102	330	151
1.16	9/7/2013	41524	9/9/2013	41526	Case 1	1	4.0	3.8	7.18	3.25	1.02	8.00	23.4	0.42	24.4	0.04	0.05	0.03	0	53.0		2.61	6.39	0.040	8310	339	150
1.17	9/11/2013	41528	9/13/2013	41530	Case 1	1	2.3	4.5	6.50	3.76	0.59	7.00	23.0	0.51	24.3	0.04	0.05	0.03	0	41.5		3.02	7.39	0.047	7523	307	173
1.18	9/15/2013	41532	9/18/2013	41535	Case 1	1	2.5	2.0	7.35	3.12	0.33	8.10	22.4	0.60	24.9	0.03	0.05	0.02	0	56.5		2.51	6.14	0.042	8507	347	144
1.19	9/23/2013	41540	9/26/2013	41543		1	3.0	3.5	8.17	3.50	0.38	8.00	20.7	0.70	23.8	0.07	0.11	0.04	6	56.0		2.81	6.88	0.041	9456	385	162
1.20	9/30/2013	41547	10/5/2013	41552		1	3.0	3.6	9.00	3.51	0.92	7.90	20.0	0.58	23.7	0.06	0.07	0.04	0	61.5		2.82	6.90	0.035	10417	424	163
1.21	10/10/2013	41557	10/13/2013	41560		1	4.0	1.4	3.14	3.28	1.25	2.60	18.8	0.32	20.9	0.07	0.09	0.03	0	23.0		2.63	6.44	0.018	3634	148	147
1.22	10/14/2013	41561	10/16/2013	41563		1	1.8	1.7	2.20	1.82	0.57	7.20	18.9	0.38	13.8	0.04	0.09	0.05	0	29.0		1.46	3.58	0.070	2546	104	81
1.23	10/16/2013	41563				1	1.7				0.31					0.07	0.08		0								
1.24	10/18/2013	41565	10/19/2013	41566		1	2.2	1.7	2.20	1.76	0.50	8.40	18.7	0.34	13.9	0.04	0.08	0.04	0	30.0		1.41	3.46	0.080	2546	104	78
1.25	10/19/2013	41566	10/21/2013	41568	Case 2	1	1.2	1.7	2.50	1.69	0.30	9.30	18.4	0.30	13.9	0.07	0.12	0.05	14	35.5		1.36	3.32	0.077	2894	118	75
1.26	10/21/2013	41568	10/22/2013	41569	Case 2	1	1.7	1.1	1.59	1.21	0.30	7.00	18.2	0.32	15.6	0.15	0.15	0.06	28	31.5		0.97	2.38	0.065	1840	75	52
1.27	10/22/2013	41569	10/23/2013	41570	Case 2	1	1.4	1.1	1.37	1.06	0.39	5.40	18.0	0.28	13.8	0.07	0.15	0.05	90	31.0		0.85	2.08	0.049	1586	65	45
1.28	10/23/2013	41570	10/26/2013	41573	Case 2	1	1.0	1.1			0.23	4.70	17.8	0.33	13.3	0.06	0.14	0.04	83	34.0				0.040			
1.29	10/26/2013	41573	10/28/2013	41575	Case 2	1	1.0	1.5	2.31	1.48		8.00	17.3	0.33	13.7	0.06	0.15	0.03	10	37.5		1.19	2.91		2674	109	66
1.30	10/28/2013	41575	10/30/2013	41577	Case 2	1	1.9	1.9	2.70	1.85	0.61	8.00	16.9	0.43	14.4	0.07	0.16	0.05	93	35.0		1.49	3.64	0.064	3125	127	83
1.31	10/30/2013	41577	11/2/2013	41580	Case 2	1	1.9	2.2	2.93	1.76	0.20	9.20	17.1	0.54	15.4	0.04	0.13	0.02	61	40.0		1.41	3.45	0.069	3391	138	79
1.32	11/2/2013	41580	11/4/2013	41582	Case 2	1	2.0	2.0	2.30	1.94	0.60	8.67	16.3	0.63	16.7	0.05	0.09	0.07	0	28.5		1.56	3.81	0.086	2662	108	86
1.33	11/4/2013	41582	11/5/2013	41583	Case 2	1	2.3	1.7	2.06	1.98	0.61	8.70	16.4	0.63	16.9	0.06	0.08	0.02	0	25.0		1.59	3.89	0.099	2384	97	87
1.34	11/5/2013	41583	11/6/2013	41584	Case 2	1	2.3	2.0	1.80	2.06	0.59	8.10	16.3	0.58	16.9	0.03	0.06	0.04	0	21.0		1.65	4.04	0.109	2083	85	90
1.35	11/7/2013	41585	11/9/2013	41587	Case 2	1	1.5	2.3	2.40	2.13	0.30	8.50	16.0	0.69	16.0	0.04	0.08	0.02	0	27.0		1.71	4.19	0.093	2778	113	95
1.36	11/10/2013	41588	11/2/2013	41580	Case 2	1	1.8	2.2	2.93	1.76	0.52	9.20	17.1	0.54	15.4	0.05	0.05	0.02	0	40.0		1.41	3.45	0.066	3391	138	79
1.37	11/2/2013	41580	11/4/2013	41582	Case 2	1	2.0	2.0	2.30	1.94	0.60	8.67	16.3	0.63	16.7	0.05	0.09	0.07	0	28.5		1.56	3.81	0.086	2662	108	86
1.38	11/4/2013	41582	11/5/2013	41583	Case 2	1	2.3	1.7	2.06	1.98	0.61	8.70	16.4	0.63	16.9	0.06	0.08	0.02	0	25.0		1.59	3.89	0.099	2384	97	87
1.39	11/5/2013	41583	11/6/2013	41584	Case 2	1	2.3	2.0	1.80	2.06	0.59	8.10	16.3	0.58	16.9	0.03	0.06	0.04	0	21.0		1.65	4.04	0.109	2083	85	90
1.40	11/7/2013	41585	11/9/2013	41587	Case 2	1	1.5	2.3	2.40	2.13	0.30	8.50	16.0	0.69	16.0	0.04	0.08	0.02	0	27.0		1.71	4.19	0.093	2778	113	95
1.41	11/10/2013	41588	11/17/2013	41595	Case 2	1	1.8	2.0	2.40	2.13	0.52	8.10	15.2	0.76	12.0	0.05	0.05	0.05	0	27.0		1.71	4.19	0.086	2778	113	95
1.42	11/17/2013	41595	11/19/2013	41597	Case 2	1	2.0	1.8	2.66	1.96	0.36	8.00	14.9	0.61	11.2	0.08	0.15	0.07	40	32.5		1.58	3.86	0.072	3079	125	88
1.43	11/19/2013	41597	11/22/2013	41600		1	0.0	2.0	3.10	1.86		7.90	14.6	0.42	14.8	0.09	0.25	0.07	8	40.0		1.49	3.66		3588	146	84
1.44	11/24/2013	41602	11/26/2013	41604		1	1.5	1.7	3.03	1.63	0.49	9.03	14.0	0.34	12.9	0.09	0.09	0.05	0	44.5		1.31	3.21	0.058	3507	143	74
1.45	11/27/2013	41605	11/29/2013	41607		1	1.8	1.6	3.23	1.74	0.28	8.27	14.0	0.34	14.0	0.08	0.08	0.05	0	44.5		1.40	3.42	0.055	3738	152	79
1.46	11/30/2013	41608	12/2/2013	41610		1	1.5	1.5	3.13	1.62	0.53	8.30	13.9	0.36	15.0	0.07	0.09	0.04	0	46.5		1.30	3.17	0.051	3623	148	73
1.47	12/4/2013	41612				1	3.0				0.40					0.10	0.10		0								
1.48	12/6/2013	41614	12/7/2013	41615		1	2.7	2.8	4.10	2.77	0.75	7.50	12.2	0.31	22.1	0.09	0.09	0.03	0	35.5		2.23	5.45	0.058	4745	193	126
1.49	12/12/2013	41620	12/15/2013	41623		1	2.0	2.5	8.40	3.10	0.73	7.50	11.0	0.68	21.5	0.06	0.06	0.03	0	65.0		2.49	6.10	0.032	9722	396	144
1.50	12/21/2013	41629	12/23/2013	41631		1	3.4	3.6	8.04	3.45	0.58	8.20	10.8	0.64	21.3	0.06	0.04	0.03	0	56.0		2.77	6.77	0.041	9306	379	160
1.51	12/30/2013	41638				1	4.0				0.40					0.05	0.03		0								
2.1			7/1/2013	41456		2		2.6				8.40						0.03		52.5							
2.2	7/3/2013	41458	7/5/2013	41460		2	3.8	3.5			0.52	7.60				0.03	0.08	0.02	0	52.5				0.041			
2.3	7/7/2013	41462	7/9/2013	41464		2	3.3	3.7			0.92	8.10				0.04	0.07	0.02	0	47.0				0.047			
2.4	7/12/2013	41467	7/14/2013	41469		2	3.1	3.0			0.71	8.50				0.04	0.05	0.03	0	55.0				0.043			
2.5	7/16/2013	41471	7/19/2013	41474		2	2.4	3.1			0.40	8.50				0.04	0.07	0.02	0	51.5				0.048			
2.6	7/21/2013	41476	7/24/2013	41479		2	2.8	3.0			0.80	8.50				0.04	0.07	0.02	0	57.0				0.041			
2.7	7/27/2013	41482	7/29/2013	41484	Case 1	2	2.9	4.0	7.45	3.19	0.43	8.50	23.3	0.36	25.5	0.04	0.04	0.02	0	56.0		2.57	6.27	0.044	8623	351	148
2.8	7/31/2013	41486	8/3/2013	41489	Case 1	2	3.3	3.5	8.00	3.40	0.83	8.50	22.9	0.53	26.5	0.03	0.10	0.03	2	56.5		2.73	6.68	0.041	9259	377	157
2.9	8/5/2013	41491	8/7/2013	41493	Case 1	2	3.6	3.4	6.91	3.38	0.91	8.30	22.8	0.56	25.2	0.04	0.07	0.03	0	49.0		2.72	6.65	0.046	7998	326	156
2.10	8/10/2013	41496	8/14/2013	41500	Case 1	2	2.5	3.8			0.73	8.30	22.9	0.55	24.5	0.04	0.04	0.03	0	49.0				0.047			
2.11	8/15/2013	41501	8/16/2013	41502	Case 1	2	3.2	4.0	6.60	3.77	0.67	8.00	23.1	0.53	24.5	0.04	0.05	0.02	0	42.0		3.03	7.41	0.053	7639	311	174
2.12	8/18/2013	41504	8/13/2013	41499	Case 1	2	3.4	3.5			1.00	9.00	22.8	0.60	24.4	0.04	0.03	0.03	0	55.5				0.044			
2.13	8/26/2013	41512	8/27/2013	41513	Case 1	2	3.9	3.0	5.38	3.69	0.99	5.30	23.1	0.62	24.9	0.03	0.05	0.03	0	35.0		2.97	7.25	0.038	6227	254	169

MMWD Filter Rehab

Compiled Filter Run Results - BTTP

Area =	864	sf
BW Time =	11.5	min
BW Vol =	120000	gal

Case 1 =	7/28/2013	to	9/18/2013
Case 2 =	10/20/2013	to	11/20/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
2.14	8/30/2013	41516	9/1/2013	41518	Case 1	2	3.0	1.8	6.20	2.68	0.76	6.30	23.3	0.56	25.1	0.04	0.04	0.02	0	55.5		2.15	5.27	0.030	7176	292	124
2.15	9/4/2013	41521				2	4.0				0.68					0.04	0.05		0								
2.16	9/7/2013	41524	9/11/2013	41528	Case 1	2	3.0	2.0	7.15	3.36	0.98	7.00	23.3	0.46	24.3	0.02	0.04	0.02	0	51.0		2.70	6.61	0.036	8275	337	155
2.17	9/13/2013	41530	9/15/2013	41532	Case 1	2	2.5	2.5	7.88	3.29	0.78	9.10	22.6	0.62	24.9	0.04	0.05	0.03	0	57.5		2.64	6.46	0.044	9120	372	152
2.18	9/18/2013	41535	9/21/2013	41538		2	2.7	3.0	7.90	2.79	0.28	8.10	21.8	0.52	26.1	0.05	0.06	0.03	0	68.0		2.24	5.48	0.035	9144	373	129
2.19	9/26/2013	41543	9/30/2013	41547		2	4.0	4.3	8.42	4.17	0.80	8.20	20.6	0.56	23.5	0.04	0.05	0.03	0	48.5		3.35	8.19	0.047	9745	397	193
2.20	10/5/2013	41552	10/7/2013	41554		2	2.6	3.7	9.06	3.72	0.63	8.10	20.1	0.56	23.0	0.04	0.05	0.01	0	58.5		2.99	7.30	0.039	10486	427	172
2.21	10/13/2013	41560	10/15/2013	41562		2	2.2	1.8	3.99	1.92	0.30	7.80	19.0	0.32	14.0	0.04	0.05	0.03	0	50.0		1.54	3.76	0.046	4618	188	87
2.22	10/15/2013	41562	10/17/2013	41564		2	1.5	1.3	2.40	1.72	0.36	8.20	18.8	0.36	14.0	0.08	0.11	0.03	18	33.5		1.38	3.38	0.071	2778	113	77
2.23	10/17/2013	41564	10/18/2013	41565		2	1.7	1.7	2.20	1.79	0.30	7.20	18.7	0.38	13.1	0.04	0.11	0.04	12	29.5		1.44	3.52	0.071	2546	104	79
2.24	10/18/2013	41565	10/20/2013	41567	Case 2	2	1.6	1.2	2.28	1.77	0.06	7.50	18.6	0.36	14.1	0.12	0.17	0.11	0	31.0	YES	1.42	3.47	0.073	2639	108	78
2.25	10/20/2013	41567	10/21/2013	41568	Case 2	2	1.7	1.6	1.77	1.49	0.41	6.90	18.4	0.30	13.9	0.05	0.18	0.03	43	28.5		1.20	2.93	0.069	2049	83	65
2.26	10/21/2013	41568	10/23/2013	41570	Case 2	2	1.0	1.3	1.24	1.14	0.20	3.30	18.0	0.28	13.8	0.08	0.14	0.29	39	26.0	YES	0.92	2.25	0.036	1435	58	48
2.27	10/23/2013	41570	10/24/2013	41571	Case 2	2	1.3	1.5	1.80	1.42	0.22	4.20	17.8	0.31	13.4	0.06	0.09	0.03	0	30.5		1.14	2.78	0.040	2083	85	62
2.28	10/25/2013	41572	10/27/2013	41574	Case 2	2	1.2	2.2	2.83	1.64	0.41	8.50	17.5	0.40	12.4	0.10	0.08	0.04	0	41.5		1.32	3.22	0.059	3275	133	74
2.29	10/27/2013	41574				2	1.3				0.26					0.06	0.16		37								
2.30	10/28/2013	41575	10/29/2013	41576	Case 2	2	1.6	1.9	2.78	2.02	0.37	8.10	17.1	0.40	14.2	0.04	0.05	0.04	0	33.0		1.63	3.97	0.071	3218	131	91
2.31	10/29/2013	41576	11/1/2013	41579	Case 2	2	1.9	2.5	2.60	2.08	0.10	8.10	17.0	0.54	14.0	0.19	0.23	0.04	97	30.0		1.67	4.09	0.081	3009	123	93
2.32	11/1/2013	41579	11/3/2013	41581	Case 2	2	1.3	2.0			0.20	8.20	17.0	0.52	14.3	0.05	0.14	0.04	35	22.0				0.111			
2.33	11/3/2013	41581	11/4/2013	41582	Case 2	2	2.0	2.0	2.30	2.01	0.20	8.00	16.3	0.63	16.7	0.06	0.08	0.04	0	27.5		1.61	3.94	0.086	2662	108	89
2.34	11/4/2013	41582	11/6/2013	41584	Case 2	2	2.4	2.0	1.89	1.97	0.24	7.00	16.3	0.58	16.9	0.05	0.10	0.03	0	23.0		1.59	3.88	0.090	2188	89	86
2.35	11/6/2013	41584	11/8/2013	41586	Case 2	2	2.4	1.6	2.40	1.92	0.22	8.10	16.2	0.65	15.8	0.05	0.11	0.03	6	30.0		1.54	3.77	0.080	2778	113	85
2.36	11/8/2013	41586	11/1/2013	41579	Case 2	2	1.4	2.5	2.60	2.08	0.17	8.10	17.0	0.54	14.0	0.05	0.11	0.04	16	30.0		1.67	4.09	0.081	3009	123	93
2.37	11/1/2013	41579	11/3/2013	41581	Case 2	2	1.3	2.0			0.20	8.20	17.0	0.52	14.3	0.05	0.14	0.04	35	22.0				0.111			
2.38	11/3/2013	41581	11/4/2013	41582	Case 2	2	2.0	2.0	2.30	2.01	0.20	8.00	16.3	0.63	16.7	0.06	0.08	0.04	0	27.5		1.61	3.94	0.086	2662	108	89
2.39	11/4/2013	41582	11/6/2013	41584	Case 2	2	2.4	2.0	1.89	1.97	0.24	7.00	16.3	0.58	16.9	0.05	0.10	0.03	0	23.0		1.59	3.88	0.090	2188	89	86
2.40	11/6/2013	41584	11/8/2013	41586	Case 2	2	2.4	1.6	2.40	1.92	0.22	8.10	16.2	0.65	15.8	0.05	0.11	0.03	6	30.0		1.54	3.77	0.080	2778	113	85
2.41	11/8/2013	41586	11/16/2013	41594	Case 2	2	1.4	2.2	2.78	2.15	0.17	7.94	15.4	0.60	12.7	0.05	0.11	0.04	16	31.0		1.73	4.23	0.076	3218	131	97
2.42	11/17/2013	41595				2	2.0				0.68					0.06	0.09		0								
2.43	11/18/2013	41596	11/19/2013	41597	Case 2	2	2.0	2.0	2.63	2.30	0.48	8.20	14.9	0.61	11.2	0.07	0.18	0.06	55	27.5		1.84	4.51	0.086	3044	124	103
2.44	11/19/2013	41597	11/22/2013	41600		2	2.0	2.0	3.40	1.94	0.56	7.90	14.6	0.42	14.8	0.07	0.20	0.05	11	42.0		1.56	3.82	0.053	3935	160	88
2.45	11/23/2013	41601	11/25/2013	41603		2	1.8	1.8	3.62	1.77	0.42	8.00	14.0	0.50	13.1	0.08	0.08	0.04	0	49.0		1.43	3.48	0.047	4190	171	81
2.46	11/26/2013	41604	11/28/2013	41606		2	1.8	1.6	3.34	1.96	0.21	7.80	13.9	0.40	12.8	0.06	0.09	0.04	0	41.0		1.57	3.84	0.056	3866	158	88
2.47	11/29/2013	41607	11/30/2013	41608		2	1.6	1.5	2.10	2.14	0.38	4.50	13.9	0.35	14.3	0.09	0.09	0.06	0	23.5		1.72	4.21	0.053	2431	99	95
2.48	12/2/2013	41610	12/3/2013	41611		2	1.7	2.9	2.77	2.66	0.37	8.20	13.7	0.34	17.7	0.10	0.10	0.08	2	25.0		2.14	5.23	0.095	3206	131	119
2.49	12/7/2013	41615	12/10/2013	41618		2	2.8	3.0	7.32	3.11	0.69	9.00	11.3	0.54	20.4	0.07	0.07	0.03	0	56.5		2.50	6.11	0.045	8472	345	144
2.50	12/14/2013	41622	12/16/2013	41624		2	3.8	3.7			1.80	8.00	11.1	0.65	21.5	0.05	0.05	0.02	0	46.0				0.041			
2.51	12/23/2013	41631	12/25/2013	41633		2	3.6	3.7	4.10	2.03	1.00	7.80	10.8	0.67	22.3	0.06	0.06	0.03	0	48.5		1.63	3.99	0.043	4745	193	93
3.1			7/3/2013	41458		3		3.8				8.30						0.02		58.0							
3.2	7/4/2013	41459	7/7/2013	41462		3	3.8	3.3			1.14	8.20				0.04	0.05	0.03	0	69.0				0.031			
3.3	7/9/2013	41464	7/12/2013	41467		3	3.8	2.7			1.02	8.00				0.03	0.08	0.02	0	64.5				0.033			
3.4	7/14/2013	41469	7/16/2013	41471		3	3.3	2.4			0.88	8.00				0.02	0.04	0.02	0	61.0				0.036			
3.5	7/19/2013	41474	7/21/2013	41476		3	3.6	2.8			0.99	8.50				0.05	0.06	0.02	0	65.0				0.035			
3.6	7/24/2013	41479	7/27/2013	41482		3	2.8	2.9			0.71	8.80				0.04	0.04	0.02	0	78.0				0.032			
3.7	7/29/2013	41484	7/31/2013	41486	Case 1	3	4.0	3.0	8.10	3.63	1.11	8.10	23.0	0.54	25.2	0.03	0.08	0.02	0	53.5		2.92	7.14	0.040	9375	382	168
3.8	8/3/2013	41489	8/5/2013	41491	Case 1	3	3.3	3.1	7.31	2.83	0.91	8.20	22.8	0.53	24.9	0.04	0.05	0.02	0	62.0		2.27	5.56	0.036	8461	345	131
3.9	8/7/2013	41493	8/10/2013	41496	Case 1	3	3.4	2.5	7.80	2.97	0.90	7.90	22.7	0.55	25.8	0.04	0.04	0.02	0	63.0		2.39	5.84	0.034	9028	368	138
3.10	8/12/2013	41498	8/15/2013	41501	Case 1	3	3.3	3.2	7.24	3.41	1.03	7.90	23.2	0.66	25.0	0.04	0.02	0.02	0	51.0		2.74	6.70	0.041	8380	341	157
3.11	8/16/2013	41502	8/19/2013	41505	Case 1	3	2.8	2.5	7.25	2.90	0.80	8.30	23.6	0.59	23.6	0.04	0.05	0.03	0	60.0		2.33	5.70	0.038	8391	342	134
3.12	8/22/2013	41508	8/24/2013	41510	Case 1	3	2.7	3.2	7.33	3.09	0.80	8.20	23.3	0.63	25.8	0.04	0.05	0.02	0	57.0		2.48	6.07	0.040	8484	346	143
3.13	8/27/2013	41513	8/29/2013	41515	Case 1	3	2.9	4.5	7.90	3.27	0.76	7.90	23.2	0.50	23.6	0.04	0.02	0.02	0	58.0		2.63	6.42	0.038	9144	373	151
3.14	8/31/2013	41517	9/3/2013	41520	Case 1	3	2.8	3.5	9.22	3.18	0.72	8.00	23.4	0.46	24.4	0.03	0.05	0.02	0	69.5		2.56	6.26	0.032	10671	435	148
3.15	9/5/2013	41522	9/7/2013	41524	Case 1	3	4.0	3.5	8.40	3.39	0.85	7.90	23.3	0.41	22.4	0.03	0.04	0.02	0	59.5		2.72	6.66	0.036	9722	396	157
3.16	9/9/2013	41526	9/11/2013	41528	Case 1	3	3.0	3.0	7.52	3.19	0.73	7.60	23.3	0.46	24.3	0.02	0.08	0.02	0	56.5		2.57	6.28	0.037	8704	355	148
3.17	9/15/2013	41532	9/17/2013	41534	Case 1	3	1.7	2.3	6.39	2.71	0.40	7.30	22.0	0.63	25.6	0.05	0.05	0.02	0	56.5		2.18	5.33	0.037	7396	301	125
3.18	9/21/2013	41538	9/24/2013	41541		3	3.0	3.1	9.83	3.23	0.42	7.50	21.4	0.60	22.9	0.04	0.04	0.03	0	73.0		2.60	6.35	0.030	11377	464	150
3.19	9/30/2013	41547	10/2/2013	41549		3	4.3	3.5			1.29	7.60	20.3	0.63	23.5	0.06	0.06	0.03	0	64.0				0.030			
3.20	10/7/2013	41554	10/12/2013	41559		3	2.5	4.3	9.30	3.72	0.72	8.00	18.8	0.51	24.5	0.03	0.05	0.01	0	60.0		2.99	7.31	0.037	10764	439	173
3.21	10/14/2013	41561	10/16/2013	41563		3	1.3	1.7	2.90	1.66	0.37	8.60	18.9	0.38	13.8	0.02	0.04	0.03	0	42.0		1.33	3.26	0.060	3356	137	75
3.22	10/16/2013	41563	10/17/2013	41564		3	1.7	1.7	2.60	1.98	0.34	9.30	18.8	0.36	14.0	0.07	0.11	0.04	22	31.5		1.59	3.89	0.087	3009	123	89
3.23	10/17/2013	41564	10/18/2013	41565		3	1.7	2.4			0.40	8.30	18.7	0.38	13.1	0.05	0.05	0.10	0	22.5	YES			0.107			
3.24	10/19/2013	41566	10/20/2013	41567	Case 2	3	1.7	2.2	2.32	2.10	0.50	7.70	18.6	0.36	14.1	0.06	0.09	0.18	0	26.5	YES	1.69	4.13	0.083	2685	109	93
3.25	10/20/2013	41567	10/22/2013	41569	Case 2	3	1.7	1.0	1.59	1.36	0.30	6.50	18.2	0.32	15.6	0.06	0.11	0.16	11	28.0	YES	1.10	2.68	0.067	1840	75	59
3.26	10/22/2013	41569	10/23/2013	41570	Case 2	3	1.2	1.0	1.58	1.15	0.37	4.10	18.0	0.28	13.8	0.09	0.09	0.03	0	33.0		0.92	2.26	0.034	1829	75	50

MMWD Filter Rehab

Compiled Filter Run Results - BTTP

Area =	864	sf
BW Time =	11.5	min
BW Vol =	120000	gal

Case 1 =	7/28/2013	to	9/18/2013
Case 2 =	10/20/2013	to	11/20/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
3.27	10/23/2013	41570	10/25/2013	41572	Case 2	3	1.3	1.0	2.00	1.33	0.37	3.70	17.6	0.30	13.5	0.06	0.09	0.03	0	36.0		1.07	2.62	0.028	2315	94	59
3.28	10/25/2013	41572	10/27/2013	41574	Case 2	3	1.2	1.3				2.20	17.5	0.40	12.4	0.05	0.04	0.04	0	34.5							
3.29	10/28/2013	41575	10/31/2013	41578	Case 2	3	1.4	2.0	3.00	2.03	0.36	8.10	16.8	0.51	15.2	0.06	0.12	0.04	24	35.5		1.63	3.99	0.066	3472	141	91
3.30	10/31/2013	41578	11/1/2013	41579	Case 2	3	1.4	2.0	2.52	2.02	0.31	7.40	17.0	0.54	14.0	0.06	0.11	0.04	13	30.0		1.62	3.96	0.072	2917	119	90
3.31	11/2/2013	41580	11/3/2013	41581	Case 2	3	2.3	2.5	2.39	2.09	0.51	8.10	17.0	0.52	14.3	0.06	0.07	0.05	0	27.5		1.68	4.10	0.084	2766	113	93
3.32	11/4/2013	41582	11/5/2013	41583	Case 2	3	7.0	2.3	1.89	2.27	0.35	8.40	16.4	0.63	16.9	0.07	0.12	0.04	18	20.0		1.82	4.46	0.123	2188	89	99
3.33	11/5/2013	41583	11/7/2013	41585	Case 2	3	2.6	2.0	2.30	2.40	0.36	8.20	16.4	0.69	15.9	0.13	0.15	0.04	15	23.0		1.93	4.72	0.104	2662	108	106
3.34	11/7/2013	41585	11/10/2013	41588	Case 2	3	2.3	2.3			0.30	8.30	15.9	0.65	17.1	0.12	0.12	0.04	5	30.5				0.080			
3.35	11/2/2013	41580	11/3/2013	41581	Case 2	3	2.3	2.5	2.39	2.09	0.51	8.10	17.0	0.52	14.3	0.06	0.07	0.05	0	27.5		1.68	4.10	0.084	2766	113	93
3.36	11/4/2013	41582	11/5/2013	41583	Case 2	3	7.0	2.3	1.89	2.27	0.35	8.40	16.4	0.63	16.9	0.07	0.12	0.04	18	20.0		1.82	4.46	0.123	2188	89	99
3.37	11/5/2013	41583	11/7/2013	41585	Case 2	3	2.6	2.0	2.30	2.40	0.36	8.20	16.4	0.69	15.9	0.13	0.15	0.04	15	23.0		1.93	4.72	0.104	2662	108	106
3.38	11/7/2013	41585	11/10/2013	41588	Case 2	3	2.3	2.3			0.30	8.30	15.9	0.65	17.1	0.12	0.12	0.04	5	30.5				0.080			
3.39	11/20/2013	41598	11/23/2013	41601		3	0.0	1.8	2.83	1.89		7.00	14.5	0.46	14.8	0.07	0.17	0.05	44	36.0		1.52	3.71		3275	133	85
3.40	11/24/2013	41602	11/26/2013	41604		3	1.5	1.8			0.35	8.10	14.0	0.34	12.9	0.09	0.08	0.08	0	38.5				0.061			
3.41	11/28/2013	41606	11/29/2013	41607		3	1.6	1.6			0.30	4.90	14.0	0.34	14.0	0.09	0.09	0.11	2	29.5	YES			0.048			
3.42	11/30/2013	41608	12/1/2013	41609		3	1.5	1.7	2.64	1.89	0.41	5.65	13.8	0.36	13.9	0.08	0.09	0.04	0	33.5		1.52	3.72	0.048	3056	125	85
3.43	12/3/2013	41611	12/4/2013	41612		3	1.4	1.5	2.80	2.80	0.39	7.70	13.2	0.36	13.0	0.10	0.10	0.05	2	24.0		2.25	5.50	0.093	3241	132	125
3.44	12/5/2013	41613	12/5/2013	41613		3	2.7	2.7			0.71	8.40	12.6	0.31	14.6	0.08	0.08	0.04	0	27.5				0.085			
3.45	12/10/2013	41618	12/11/2013	41619		3	3.0	1.8	5.75	3.03	0.67	5.80	11.1	0.30	20.2	0.07	0.09	0.03	0	45.5		2.44	5.96	0.034	6655	271	139
3.46	12/16/2013	41624	12/18/2013	41626		3	4.2	3.7	8.40	3.77	1.50	8.20	10.9	0.63	20.7	0.07	0.07	0.03	0	53.5		3.03	7.41	0.038	9722	396	175
3.47	12/25/2013	41633	12/28/2013	41636		3	3.7	4.0	7.90	2.96	0.70	8.20	10.6	0.66	21.6	0.07	0.07	0.03	0	64.0		2.38	5.82	0.036	9144	373	137
4.1	7/1/2013	41456	7/4/2013	41459		4	4.4	3.8			1.30	8.00				0.05	0.09	0.02	0	64.5				0.032			
4.2	7/5/2013	41460	7/8/2013	41463		4	3.0	3.5			0.80	8.40				0.05	0.06	0.07	0	71.5				0.032			
4.3	7/10/2013	41465	7/13/2013	41468		4	3.4	2.8			0.97	7.60				0.05	0.07	0.02	0	66.0				0.031			
4.4	7/15/2013	41470	7/17/2013	41472		4	3.1	4.2			0.80	8.80				0.05	0.08	0.02	0	66.5				0.037			
4.5	7/20/2013	41475	7/23/2013	41478		4	3.5	3.5			1.00	8.50				0.05	0.06	0.02	0	10.0				0.229			
4.6	7/25/2013	41480	7/28/2013	41483	Case 1	4	3.0	3.1	8.62	2.67	0.70	8.20	23.3	0.47	24.6	0.04	0.04	0.02	0	77.5		2.15	5.25	0.029	9977	407	124
4.7	7/29/2013	41484	8/1/2013	41487	Case 1	4	4.2	3.0	8.30	2.95	1.08	8.40	23.1	0.47	24.1	0.03	0.12	0.02	10	67.5		2.37	5.80	0.033	9606	391	137
4.8	8/3/2013	41489	8/7/2013	41493	Case 1	4	3.0	2.0	8.62	2.48	0.73	9.67	22.8	0.56	25.2	0.05	0.06	0.02	0	83.5		1.99	4.87	0.033	9977	407	115
4.9	8/9/2013	41495	8/12/2013	41498	Case 1	4	3.0	3.0	7.60	2.52	0.44	8.40	22.7	0.55	24.8	0.04	0.04	0.02	0	72.5		2.02	4.94	0.033	8796	358	116
4.10	8/14/2013	41500	8/16/2013	41502	Case 1	4	3.8	4.2	7.30	3.13	0.82	7.90	23.1	0.53	24.5	0.05	0.05	0.02	0	56.0		2.51	6.15	0.039	8449	344	145
4.11	8/18/2013	41504	8/20/2013	41506	Case 1	4	3.9	3.8	5.20	3.57	1.00	6.00	23.6	0.56	23.7	0.04	0.06	0.02	0	35.0		2.87	7.01	0.044	6019	245	163
4.12	8/21/2013	41507				4	3.8				0.91					0.03	0.08		0								
4.13	8/13/2013	41499	8/26/2013	41512	Case 1	4	3.5	2.0	7.33	2.77	0.80	7.30	23.1	0.51	24.7	0.04	0.04	0.02	0	63.5		2.23	5.44	0.031	8484	346	128
4.14	8/27/2013	41513				4	3.2				0.77					0.03	0.06		0								
4.15	9/2/2013	41519	9/5/2013	41522	Case 1	4	2.7	3.9	9.40	3.22	0.68	8.60	23.0	0.48	25.0	0.03	0.05	0.02	0	70.0		2.59	6.33	0.034	10880	443	150
4.16	9/6/2013	41523	9/9/2013	41526	Case 1	4	4.0	3.0	8.18	3.07	0.69	8.50	23.4	0.42	24.4	0.05	0.05	0.02	0	64.0		2.47	6.03	0.037	9468	386	142
4.17	9/11/2013	41528	9/15/2013	41532	Case 1	4	3.0	3.0	6.80	2.89	0.32	7.50	22.6	0.62	24.9	0.05	0.05	0.02	0	56.5		2.32	5.68	0.039	7870	321	133
4.18	9/17/2013	41534	9/21/2013	41538		4	1.5	3.0	8.90	2.48	0.29	7.60	21.8	0.52	26.1	0.03	0.05	0.02	0	86.0		2.00	4.88	0.026	10301	420	115
4.19	9/26/2013	41543	9/26/2013	41543		4	3.2	4.0			0.84	8.40	20.7	0.70	23.8	0.06	0.03	0.02	0	62.0				0.037			
4.20	10/5/2013	41552	10/10/2013	41557		4	3.7	1.8	10.10	3.79	0.36	7.40	19.4	0.60	25.4	0.06	0.04	0.02	0	64.0		3.04	7.44	0.034	11690	476	176
4.21	10/12/2013	41559	10/15/2013	41562		4	1.4	1.4	3.56	1.63	0.30	5.10	19.0	0.32	14.0	0.04	0.04	0.03	0	52.5		1.31	3.20	0.028	4120	168	74
4.22	10/15/2013	41562	10/16/2013	41563		4	1.4	1.8	2.20	1.79	0.43	8.20	18.9	0.38	13.8	0.03	0.07	0.03	0	29.5		1.44	3.52	0.080	2546	104	79
4.23	10/16/2013	41563	10/18/2013	41565		4	1.8	1.5	2.20	1.99	0.25	7.20	18.7	0.38	13.1	0.04	0.11	0.10	15	26.5	YES	1.60	3.92	0.080	2546	104	88
4.24	10/18/2013	41565	10/19/2013	41566		4	1.7	1.7			0.40	6.80	18.7	0.34	13.9	0.09	0.09	0.11	0	21.5	YES			0.091			
4.25	10/20/2013	41567	10/21/2013	41568	Case 2	4	1.4	1.9	2.15	1.69	0.30	6.80	18.4	0.30	13.9	0.06	0.12	0.04	20	30.5		1.36	3.32	0.065	2488	101	75
4.26	10/21/2013	41568	10/22/2013	41569	Case 2	4	1.3	1.0	1.47	1.10	0.50	2.90	18.2	0.32	15.6	0.05	0.12	0.03	43	32.0		0.89	2.17	0.023	1701	69	47
4.27	10/22/2013	41569	10/24/2013	41571	Case 2	4	1.3	1.0	1.80	1.05	0.26	3.10	17.8	0.31	13.4	0.05	0.13	0.02	45	41.0		0.85	2.07	0.021	2083	85	46
4.28	10/24/2013	41571				4	1.0				0.43					0.04	0.08		0								
4.29	10/25/2013	41572	10/26/2013	41573	Case 2	4	1.0	2.4	3.20	2.26	0.20	8.50	17.8	0.33	13.3	0.09	0.04	0.03	0	34.0		1.82	4.44	0.074	3704	151	102
4.30	10/27/2013	41574				4	1.4				0.30					0.06	0.13		27								
4.31	10/27/2013	41574	10/28/2013	41575	Case 2	4	1.6	2.0	2.77	1.85	0.49	8.20	17.3	0.33	13.7	0.07	0.07	0.03	0	36.0		1.48	3.63	0.065	3206	131	83
4.32	10/28/2013	41575	10/31/2013	41578	Case 2	4	1.9	2.3	2.96	2.03	0.26	7.80	16.8	0.51	15.2	0.04	0.11	0.05	28	35.0		1.63	3.99	0.066	3426	140	91
4.33	10/31/2013	41578	11/2/2013	41580	Case 2	4	0.0	2.3	2.95	2.28		9.40	17.1	0.54	15.4	0.08	0.12	0.03	20	31.0		1.84	4.49		3414	139	103
4.34	11/3/2013	41581	11/5/2013	41583	Case 2	4	2.0	2.4	2.06	2.25	1.40	8.20	16.4	0.63	16.9	0.05	0.09	0.03	0	22.0		1.81	4.42	0.094	2384	97	99
4.35	11/5/2013	41583	11/6/2013	41584	Case 2	4	2.2	2.0	2.10	2.24	0.32	8.30	16.3	0.58	16.9	0.05	0.08	0.05	0	22.5		1.80	4.40	0.108	2431	99	99
4.36	11/6/2013	41584	11/8/2013	41586	Case 2	4	2.3	2.3	2.63	2.25	0.40	8.80	16.2	0.65	15.8	0.04	0.06	0.02	0	28.0		1.81	4.43	0.091	3044	124	101
4.37	11/9/2013	41587	11/2/2013	41580	Case 2	4	2.3	2.3	2.95	2.28	0.37	9.40	17.1	0.54	15.4	0.06	0.06	0.03	0	31.0		1.84	4.49	0.089	3414	139	103
4.38	11/3/2013	41581	11/5/2013	41583	Case 2	4	2.0	2.4	2.06	2.25	1.40	8.20	16.4	0.63	16.9	0.05	0.09	0.03	0	22.0		1.81	4.42	0.094	2384	97	99
4.39	11/5/2013	41583	11/6/2013	41584	Case 2	4	2.2	2.0	2.10	2.24	0.32	8.30	16.3	0.58	16.9	0.05	0.08	0.05	0	22.5		1.80	4.40	0.108	2431	99	99
4.40	11/6/2013	41584	11/8/2013	41586	Case 2	4	2.3	2.3	2.63	2.25	0.40	8.80	16.2	0.65	15.8	0.04	0.06	0.02	0	28.0		1.81	4.43	0.091	3044	124	101
4.41	11/9/2013	41587				4	2.3				0.37					0.06	0.06		0								
4.42	11/16/2013	41594	11/18/2013	41596	Case 2	4	2.2	2.0			0.65	8.30	14.9	0.65	11.1	0.06	0.10	0.03	10	33.5				0.070			
4.43	11/18/2013	41596	11/21/2013	41599		4	2.0	2.0			0.72	8.10	15.0	0.58	10.8	0.04	0.19	0.04	50	39.0				0.058			

MMWD Filter Rehab

Compiled Filter Run Results - BTTP

Area =	864	sf
BW Time =	11.5	min
BW Vol =	120000	gal

Case 1 =	7/28/2013	to	9/18/2013
Case 2 =	10/20/2013	to	11/20/2013

	Filter Run Dates						Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Filter Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
4.44	11/21/2013	41599	11/24/2013	41602		4	2.0	1.6	3.55	1.74	0.73	8.00	14.2	0.41	14.6	0.09	0.18	0.02	12	49.0		1.40	3.42	0.045	4109	167	79
4.45	11/25/2013	41603	11/27/2013	41605		4	1.5	1.8	3.15	1.91	0.35	8.20	13.9	0.34	15.6	0.07	0.09	0.06	0	39.5		1.54	3.76	0.061	3646	149	86
4.46	11/29/2013	41607	11/30/2013	41608		4	1.6	1.5				5.50	13.9	0.35	14.3	0.09	0.09	0.03	0	31.0							
4.47	12/1/2013	41609	12/2/2013	41610		4	1.7	3.2	2.33	2.28	0.36	6.40	13.9	0.36	15.0	0.09	0.09	0.12	0	24.5	YES	1.83	4.49	0.075	2697	110	101
4.48	12/9/2013	41617	12/12/2013	41620		4	2.0	2.5	5.30	2.29	0.40	5.40	11.3	0.62	23.5	0.09	0.09	0.02	0	55.5		1.84	4.50	0.027	6134	250	105
4.49	12/18/2013	41626	12/21/2013	41629		4	4.0	3.4	9.20	3.71	1.30	8.00	10.8	0.58	22.0	0.08	0.08	0.02	0	59.5		2.98	7.29	0.034	10648	434	172
4.50	12/28/2013	41636	12/31/2013	41639		4	4.0	2.9	9.37	3.12	1.30	8.30	10.4	0.71	21.5	0.05	0.05	0.02	0	72.0		2.51	6.14	0.030	10845	442	145

MMWD Filter Rehab

Compiled Filter Run Results - SGTP

Area =	864	sf
BW Time =	10	min
BW Vol =	140000	gal

Case 1 =	7/28/2013	to	11/4/2013
Case 2 =	11/5/2013	to	12/31/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
1.1			7/2/2013	41457		1		3.1				7.00						0.03		43.5							
1.2	7/2/2013	41457	7/4/2013	41459		1	3.1	3.5			0.80	8.00				0.05	0.13	0.02	35	53.0				0.041			
1.3	7/4/2013	41459	7/6/2013	41461		1	3.5	3.1			1.20	9.10				0.04	0.13	0.03	20	52.0				0.046			
1.4	7/6/2013	41461	7/8/2013	41463		1	3.1	3.2			0.90	6.50				0.03	0.15	0.03	22	46.5				0.037			
1.5	7/8/2013	41463	7/11/2013	41466		1	3.2	3.2			0.80	6.30				0.05	0.14	0.03	35	50.5				0.033			
1.6	7/11/2013	41466	7/13/2013	41468		1	3.4	3.4			0.90	8.50				0.04	0.12	0.03	23	64.5				0.036			
1.7	7/13/2013	41468	7/16/2013	41471		1	3.4	3.4			1.00	7.30				0.64	0.13	0.03	11	55.0				0.035			
1.8	7/16/2013	41471	7/18/2013	41473		1	3.5	3.0			0.90	8.10				0.05	0.06	0.03	0	68.0				0.032			
1.9	7/18/2013	41473	7/21/2013	41476		1	3.0	2.4			0.90	6.20				0.06	0.09	0.03	0	54.5				0.030			
1.10	7/21/2013	41476	7/23/2013	41478		1	2.4	3.1			0.60	6.80				0.04	0.12	0.01	18	59.0				0.032			
1.11	7/23/2013	41478	7/26/2013	41481		1	3.1	3.4			0.80	7.40				0.01	0.05	0.01	0	56.0				0.036			
1.12	7/26/2013	41481	7/28/2013	41483	Case 1	1	3.2	2.9	8.04	3.48	0.90	6.60	22.2	1.02	33.9	0.04	0.06	0.03	0	55.5		2.79	6.83	0.031	9306	379	161
1.13	7/28/2013	41483	7/30/2013	41485	Case 1	1	2.9	3.0	5.63	3.51	0.60	4.70	22.0	1.15	36.0	0.04	0.07	0.02	0	38.5		2.82	6.90	0.032	6516	266	161
1.14	7/30/2013	41485	8/1/2013	41487	Case 1	1	2.8	3.1			0.90	7.60	22.2	0.98	35.1	0.08	0.09	0.02	0	54.5				0.037			
1.15	8/1/2013	41487	8/3/2013	41489	Case 1	1	3.2	3.0			1.20	8.40	22.2	0.66	35.3	0.04	0.12	0.06	20	61.0				0.036			
1.16	8/4/2013	41490	8/5/2013	41491	Case 1	1	3.5	3.1			1.00	7.30	22.1	0.93	35.3	0.05	0.08	0.03	0	63.0				0.030			
1.17	8/6/2013	41492	8/6/2013	41492	Case 1	1	3.0	3.1			0.90	7.10	21.8	1.07	33.9	0.04	0.10	0.02	0	61.5				0.031			
1.18	8/8/2013	41494	8/8/2013	41494	Case 1	1	3.5	3.5			1.10	7.60	21.8	1.05	34.8	0.10	0.19	0.03	70	59.0				0.034			
1.19	8/10/2013	41496	8/10/2013	41496	Case 1	1	3.4	3.4	8.96	3.84	0.89	8.10	22.0	1.05	35.8	0.04	0.07	0.05	0	56.0		3.09	7.55	0.039	10370	423	178
1.20	8/11/2013	41497	8/13/2013	41499	Case 1	1	3.2	2.9			1.20	7.80	22.1	1.15	35.5	0.04	0.13	0.02	30	57.5				0.035			
1.21	8/13/2013	41499	8/15/2013	41501	Case 1	1	3.1	3.2	9.95	3.51	0.90	8.10	22.3	0.80	35.8	0.04	0.12	0.03	15	68.0		2.82	6.90	0.032	11516	469	163
1.22	8/15/2013	41501				1	3.2				1.00					0.04	0.12		20								
1.23	8/17/2013	41503				1	3.4				1.20					0.04	0.12		20								
1.24	8/17/2013	41503	8/19/2013	41505	Case 1	1	3.1	3.1	6.83	2.93	0.80	8.80	23.1	1.25	34.2	0.05	0.12	0.02	15	56.0		2.35	5.75	0.044	7905	322	135
1.25	8/19/2013	41505	8/20/2013	41506	Case 1	1	3.1	3.3			1.00	7.60	23.0	0.51	36.8	0.05	0.13	0.03	16	49.0				0.041			
1.26	8/20/2013	41506	8/21/2013	41507	Case 1	1	3.2	3.2			0.59	7.30	22.8	0.62	36.1	0.06	0.14	0.02	22	55.5				0.037			
1.27	8/21/2013	41507				1	3.2				1.20					0.05	0.11		11								
1.28	8/23/2013	41509	8/23/2013	41509	Case 1	1	3.2	3.2			1.01	8.60	22.2	0.50	38.9	0.04	0.12	0.02	20	57.0				0.041			
1.29	8/26/2013	41512	8/26/2013	41512	Case 1	1	3.3	3.0			0.73	7.60	22.8	0.50	34.6	0.04	0.09	0.02	0	64.0				0.033			
1.30	8/27/2013	41513	8/28/2013	41514	Case 1	1	3.3	3.3			0.90	8.00	22.7	0.50	37.7	0.05	0.12	0.04	16	54.0				0.040			
1.31	8/29/2013	41515	8/29/2013	41515	Case 1	1	3.3	3.2	8.80	3.61	1.30	7.60	22.7	0.50	34.7	0.04	0.11	0.03	9	58.5		2.90	7.09	0.033	10185	415	167
1.32	8/31/2013	41517	8/31/2013	41517	Case 1	1	3.3	4.6			1.10	7.20	23.0	0.52	40.1	0.05	0.11	0.03	10	38.5				0.048			
1.33	9/2/2013	41519	9/4/2013	41521	Case 1	1	3.1	3.5			0.80	8.00	23.0	0.45	39.2	0.05	0.13	0.02	35	53.0				0.041			
1.34	9/4/2013	41521	9/6/2013	41523	Case 1	1	3.5	3.1	10.10	4.66	1.20	9.10	22.7	0.40	38.8	0.04	0.13	0.03	20	52.0		3.75	9.16	0.046	11690	476	216
1.35	9/6/2013	41523	9/8/2013	41525	Case 1	1	3.1	3.2	7.42	3.83	0.90	6.50	23.0	0.52	39.4	0.03	0.15	0.03	22	46.5		3.08	7.53	0.037	8588	350	177
1.36	9/8/2013	41525	9/11/2013	41528	Case 1	1	3.2	3.2			0.80	7.70	22.9	0.24	36.4	0.05	0.14	0.03	35	60.0				0.035			
1.37	9/11/2013	41528	9/13/2013	41530	Case 1	1	3.4	3.4			0.90	8.50	22.8	0.27	36.0	0.04	0.12	0.03	23	64.5				0.036			
1.38	9/13/2013	41530	9/16/2013	41533	Case 1	1	3.4	3.4			1.00	7.30	22.4	0.29	33.4	0.64	0.13	0.03	11	55.0				0.035			
1.39	9/16/2013	41533	9/18/2013	41535	Case 1	1	3.5	3.0			0.90	8.10	21.9	0.24	34.5	0.05	0.06	0.03	0	68.0				0.032			
1.40	9/18/2013	41535	9/21/2013	41538	Case 1	1	3.0	2.9			0.90	6.20	21.4	0.53	39.9	0.06	0.09	0.03	0	54.5				0.030			
1.41	9/21/2013	41538	9/23/2013	41540	Case 1	1	2.4	3.1			0.60	6.80	21.4	0.23	35.7	0.04	0.12	0.01	18	59.0				0.032			
1.42	9/23/2013	41540	9/26/2013	41543	Case 1	1	3.1	3.4			0.80	7.40	20.8	0.45	39.1	0.01	0.05	0.01	0	56.0				0.036			
1.43	9/26/2013	41543	9/28/2013	41545	Case 1	1	3.2	2.9			0.09	6.60	20.4	0.36	39.3	0.04	0.06	0.03	0	55.5				0.036			
1.44	9/28/2013	41545	9/30/2013	41547	Case 1	1	2.9	3.0	10.82	6.74	0.60	4.70	20.4	0.41	37.9	0.04	0.07	0.02	0	38.5		5.42	13.26	0.032	12523	510	313
1.45	9/30/2013	41547				1	2.8				0.90					0.08	0.09		0								
1.46	10/1/2013	41548	10/3/2013	41550	Case 1	1	2.7	3.2	7.76	3.62	0.90	6.60	20.1	0.79	37.2	0.01	0.01	0.01	0	51.5		2.91	7.11	0.034	8981	366	167
1.47	10/3/2013	41550	10/5/2013	41552	Case 1	1	3.4	3.3			0.90	7.80	20.3	0.62	36.3	0.01	0.05	0.01	0	65.0				0.032			
1.48	10/5/2013	41552	10/8/2013	41555	Case 1	1	3.3	3.3	7.39	3.48	1.00	6.30	19.7	0.63	38.0	0.03	0.06	0.01	0	51.0		2.80	6.83	0.032	8553	349	160
1.49	10/8/2013	41555	10/10/2013	41557	Case 1	1	3.3	3.2	9.90	3.49	0.91	8.00	19.4	0.72	38.1	0.02	0.06	0.01	0	68.0		2.81	6.87	0.032	11458	467	162
1.50	10/10/2013	41557	10/13/2013	41560	Case 1	1	3.2	3.0	8.30	3.14	1.00	7.60	17.9	0.58	35.7	0.03	0.06	0.01	0	63.5		2.52	6.16	0.032	9606	391	145
1.51	10/13/2013	41560	10/15/2013	41562	Case 1	1	3.0	2.5	7.62	3.36	0.80	5.20	18.4	0.72	33.9	0.03	0.05	0.01	0	54.5		2.70	6.59	0.025	8819	359	155
1.52	10/16/2013	41563	10/19/2013	41566	Case 1	1	2.9	2.5			0.80	6.60	18.0	2.40	37.3	0.01	0.26	0.01	0	60.5				0.029			
1.53	10/19/2013	41566	10/21/2013	41568	Case 1	1	2.5	3.3	8.86	3.38	6.70	8.50	18.0	2.30	33.2	0.04	0.05	0.01	0	63.0		2.71	6.63	0.009	10255	418	156
1.54	10/21/2013	41568	10/24/2013	41571	Case 1	1	3.9	3.8	8.15	3.66	1.30	7.70	18.1	2.70	37.3	0.01	0.06	0.02	0	53.5		2.94	7.18	0.036	9433	384	169
1.55	10/24/2013	41571	10/27/2013	41574	Case 1	1	2.9	3.0	8.30	3.35	0.70	7.00	17.5	2.30	37.4	0.02	0.10	0.02	0	59.5		2.69	6.58	0.032	9606	391	155
1.56	10/27/2013	41574	10/29/2013	41576	Case 1	1	3.1	3.3	8.51	3.68	0.90	7.80	17.2	2.50	35.1	0.02	0.10	0.02	0	55.5		2.96	7.23	0.038	9850	401	170
1.57	10/30/2013	41577	11/1/2013	41579	Case 1	1	3.0	3.5	9.40	3.47	1.10	7.20	16.7	2.50	37.8	0.03	0.09	0.02	0	65.0		2.79	6.82	0.029	10880	443	161
1.58	11/2/2013	41580	11/4/2013	41582	Case 1	1	3.1	3.0	8.72	3.38	1.11	8.30	16.1	2.90	33.7	0.03	0.08	0.02	0	62.0		2.71	6.63	0.035	10093	411	156
1.59	11/5/2013	41583	11/10/2013	41588	Case 2	1	3.3	2.7	13.30	3.14	1.20	7.00	12.9	2.70	24.6	0.02	0.03	0.04	0	101.5		2.53	6.18	0.017	15394	627	147
1.60	11/10/2013	41588	11/14/2013	41592	Case 2	1	3.1	3.2	14.20	3.53	0.90	7.90	12.7	2.80	26.4	0.02	0.10	0.08	0	96.5		2.84	6.94	0.022	16435	670	165
1.61	11/15/2013	41593	11/19/2013	41597	Case 2	1	3.2	2.7	11.10	3.23	0.98	6.20	12.2	2.30	26.4	0.03	0.06	0.02	0	82.5		2.60	6.35	0.019	12847	523	150
1.62	11/22/2013	41600	11/26/2013	41604	Case 2	1	3.0	3.5	13.70	3.44	1.10	6.50	12.1	2.60	24.0	0.02	0.03	0.03	0	95.5		2.77	6.77	0.017	15856	646	160
1.63	11/27/2013	41605				1	3.1				1.10					0.01	0.03		0								
1.64	12/1/2013	41609	12/2/2013	41610	Case 2	1	2.5	3.5			1.00	7.50	11.9	2.60	25.9	0.02	0.02	0.01	0	118.5				0.017			
1.65	12/7/2013	41615	12/11/2013	41619	Case 2	1	3.2	3.8	11.98	3.08	1.10	7.60	11.3	0.56	26.2	0.01	0.02	0.05	0	93.5		2.47	6.04	0.021	13866	565	143
1.66	12/12/2013	41620	12/16/2013	41624	Case 2	1	3.0	2.7	13.62	3.01	1.10	6.90	11.3	0.65	26.8	0.04	0.06	0.04	0	108.5		2.42	5.92	0.016	15764	642	140

MMWD Filter Rehab

Compiled Filter Run Results - SGTP

Area =	864	sf
BW Time =	10	min
BW Vol =	140000	gal

Case 1 =	7/28/2013	to	11/4/2013
Case 2 =	11/5/2013	to	12/31/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
1.67	12/23/2013	41631	12/27/2013	41635	Case 2	1	3.4	4.0			1.10	7.20	10.9	0.74	23.9	0.03	0.04	0.03	0	91.5				0.020			
2.1			7/1/2013	41456		2		3.3				9.60						0.03		52.0							
2.2	7/2/2013	41457	7/4/2013	41459		2	3.3	3.5			1.00	8.70				0.05	0.17	0.03	30	48.0				0.049			
2.3	7/4/2013	41459	7/6/2013	41461		2	3.5	3.5			1.10	9.90				0.07	0.10	0.03	0	49.0				0.055			
2.4	7/6/2013	41461	7/8/2013	41463		2	3.5	3.4			1.10	8.90				0.04	0.08	0.03	0	55.0				0.043			
2.5	7/8/2013	41463	7/10/2013	41465		2	3.4	3.2			1.00	6.30				0.03	0.12	0.03	10	50.5				0.032			
2.6	7/10/2013	41465	7/12/2013	41467		2	3.2	3.4			1.00	8.70				0.07	0.12	0.03	30	55.5				0.042			
2.7	7/12/2013	41467	7/15/2013	41470		2	3.4	3.2			1.00	8.60				0.03	0.10	0.02	1	60.0				0.039			
2.8	7/15/2013	41470	7/17/2013	41472		2	3.3	3.3			0.90	8.60				0.05	0.13	0.02	32	59.0				0.040			
2.9	7/17/2013	41472	7/20/2013	41475		2	3.4	3.6			1.10	8.50				0.06	0.14	0.02	20	51.0				0.044			
2.10	7/20/2013	41475	7/22/2013	41477		2	3.6	3.5			1.10	8.30				0.04	0.14	0.02	35	66.0				0.033			
2.11	7/22/2013	41477	7/24/2013	41479		2	3.5	3.4			1.00	8.00				0.05	0.07	0.02	0	49.0				0.044			
2.12	7/25/2013	41480	7/27/2013	41482		2	3.6	3.2			1.10	8.20				0.05	0.06	0.06	0	59.0				0.037			
2.13	7/27/2013	41482	7/29/2013	41484	Case 1	2	3.2	3.1	7.24	3.31	0.95	8.00	21.9	1.08	34.6	0.08	0.11	0.02	7	52.5		2.66	6.50	0.041	8380	341	153
2.14	7/29/2013	41484	7/31/2013	41486	Case 1	2	3.2	3.3	7.17	3.51	1.30	8.10	21.8	1.10	35.0	0.08	0.10	0.02	5	49.0		2.82	6.90	0.042	8299	338	162
2.15	8/2/2013	41488				2	3.0				1.00					0.05	0.13		20								
2.16	8/3/2013	41489				2	3.3				1.00					0.06	0.12		10								
2.17	8/4/2013	41490				2	2.6				1.10					0.04	0.12		14								
2.18	8/5/2013	41491	8/6/2013	41492	Case 1	2	3.4	3.2	8.91	3.17	1.10	8.60	21.8	1.07	33.9	0.06	0.12	0.06	12	67.5		2.55	6.23	0.034	10313	420	147
2.19	8/7/2013	41493	8/7/2013	41493	Case 1	2	3.0	3.3			0.80	7.90	21.8	0.94	35.3	0.05	0.07	0.03	0	62.0				0.035			
2.20	8/9/2013	41495	8/9/2013	41495	Case 1	2	2.7	3.3	8.45	3.07	0.06	8.30	22.0	1.45	33.3	0.11	10.00	0.02	10	66.0		2.47	6.04	0.038	9780	398	142
2.21	8/10/2013	41496	8/11/2013	41497	Case 1	2	3.3	3.0	7.94	3.43	1.00	7.40	21.9	1.70	34.7	0.07	0.15	0.02	30	55.5		2.76	6.75	0.035	9190	374	159
2.22	8/12/2013	41498	8/13/2013	41499	Case 1	2	3.4	3.4	8.35	3.40	1.00	8.20	22.1	1.15	35.5	0.04	0.16	0.06	30	59.0		2.73	6.67	0.037	9664	394	157
2.23	8/13/2013	41499	8/15/2013	41501	Case 1	2	3.3	3.1			0.67	7.40	22.3	0.80	35.8	0.06	0.07	0.03	0	70.0				0.029			
2.24	8/15/2013	41501	8/16/2013	41502	Case 1	2	3.1	3.1	9.90	3.37	0.90	8.70	22.7	1.10	32.8	0.04	0.14	0.02	20	70.5		2.71	6.62	0.034	11458	467	156
2.25	8/16/2013	41502	8/18/2013	41504	Case 1	2	3.1	2.2			0.94	8.50	22.5	0.85	34.6	0.04	0.12	0.07	6	60.5				0.038			
2.26	8/18/2013	41504	8/19/2013	41505	Case 1	2	3.1	2.9	7.79	3.37	0.66	8.30	23.1	1.25	34.2	0.09	0.18	0.03	70	55.5		2.71	6.62	0.042	9016	367	156
2.27	8/19/2013	41505	8/21/2013	41507	Case 1	2	3.4	2.9	7.50	3.60	0.80	7.00	22.8	0.62	36.1	0.04	0.11	0.03	2	50.0		2.89	7.07	0.038	8681	354	166
2.28	8/21/2013	41507	8/22/2013	41508	Case 1	2	2.9	3.2			0.10	8.60	22.7	0.55	36.6	0.05	0.12	0.03	14	61.5				0.042			
2.29	8/22/2013	41508				2	3.2				1.19					0.05	0.13		10								
2.30	8/23/2013	41509	8/24/2013	41510	Case 1	2	3.2	3.2			1.10	8.20	22.5	0.58	36.4	0.03	0.11	0.02	10	54.0				0.040			
2.31	8/25/2013	41511	8/26/2013	41512	Case 1	2	3.4	3.3	8.96	3.44	1.00	8.00	22.8	0.50	34.6	0.07	0.16	0.03	32	62.5		2.77	6.76	0.034	10370	423	159
2.32	8/26/2013	41512	8/27/2013	41513	Case 1	2	3.0	3.3			1.10	6.20	22.5	0.68	37.8	0.06	0.12	0.03	11	53.0				0.029			
2.33	8/28/2013	41514	8/28/2013	41514	Case 1	2	3.2	3.2	8.59	3.55	0.96	8.30	22.7	0.50	37.7	0.06	0.11	0.02	19	58.0		2.86	6.99	0.039	9942	405	164
2.34	8/30/2013	41516	8/30/2013	41516	Case 1	2	3.2	2.4			1.10	7.10	22.9	0.48	40.2	0.03	0.12	0.03	15	54.0				0.034			
2.35	8/31/2013	41517	9/1/2013	41518	Case 1	2	3.4	3.3			0.90	9.60	22.9	0.47	38.5	0.08	0.12	0.03	18	52.0				0.051			
2.36	9/2/2013	41519	9/4/2013	41521	Case 1	2	3.3	3.5	7.81	3.91	1.00	8.70	23.0	0.45	39.2	0.05	0.17	0.03	30	48.0		3.14	7.67	0.049	9039	368	180
2.37	9/4/2013	41521	9/6/2013	41523	Case 1	2	3.5	3.5			1.10	9.90	22.7	0.40	38.8	0.07	0.10	0.03	0	49.0				0.055			
2.38	9/6/2013	41523	9/8/2013	41525	Case 1	2	3.5	3.4			1.10	8.90	23.0	0.52	39.4	0.04	0.08	0.03	0	55.0				0.043			
2.39	9/8/2013	41525	9/10/2013	41527	Case 1	2	3.4	3.0			1.00	6.80	22.9	0.55	36.3	0.03	0.12	0.03	10	47.0				0.038			
2.40	9/10/2013	41527	9/12/2013	41529	Case 1	2	3.2	3.4	10.50	4.54	1.00	8.70	23.0	0.30	36.4	0.07	0.12	0.03	30	55.5		3.65	8.92	0.042	12153	495	211
2.41	9/12/2013	41529	9/15/2013	41532	Case 1	2	3.4	3.2	8.72	3.49	1.00	8.60	22.4	0.26	38.7	0.03	0.10	0.02	1	60.0		2.80	6.85	0.039	10093	411	161
2.42	9/15/2013	41532	9/17/2013	41534	Case 1	2	3.3	3.3	8.84	3.60	0.90	8.60	22.3	0.27	37.2	0.05	0.13	0.02	32	59.0		2.89	7.07	0.040	10231	417	166
2.43	9/17/2013	41534	9/20/2013	41537	Case 1	2	3.4	3.6	9.34	4.40	1.10	8.50	22.0	0.28	36.6	0.06	0.14	0.02	20	51.0		3.53	8.64	0.044	10810	440	204
2.44	9/20/2013	41537	9/22/2013	41539	Case 1	2	3.6	3.5			1.10	8.30	21.5	0.36	39.1	0.04	0.14	0.02	35	66.0				0.033			
2.45	9/22/2013	41539	9/24/2013	41541	Case 1	2	3.5	3.4	3.18	1.56	1.00	8.00	21.4	0.27	39.2	0.05	0.07	0.02	0	49.0		1.25	3.06	0.044	3681	150	70
2.46	9/25/2013	41542	9/27/2013	41544	Case 1	2	3.6	3.2			1.10	8.20	20.3	0.34	35.5	0.05	0.06	0.03	0	59.0				0.037			
2.47	9/27/2013	41544	9/29/2013	41546	Case 1	2	3.2	3.1			0.95	8.00	20.5	0.43	38.9	0.08	0.11	0.02	7	52.5				0.041			
2.48	9/29/2013	41546	9/30/2013	41547	Case 1	2	3.2	3.3			1.30	8.10	20.4	0.41	37.9	0.08	0.10	0.02	5	49.0				0.042			
2.49	10/1/2013	41548	10/3/2013	41550	Case 1	2	3.2	3.2	8.40	3.60	1.30	8.60	20.1	0.79	37.2	0.03	0.10	0.02	0	56.0		2.89	7.07	0.040	9722	396	166
2.50	10/3/2013	41550	10/6/2013	41553	Case 1	2	3.2	3.2	8.94	3.46	1.00	8.30	20.2	0.61	37.9	0.02	0.10	0.02	0	62.0		2.78	6.80	0.036	10347	422	160
2.51	10/6/2013	41553	10/9/2013	41556	Case 1	2	3.0	2.9	8.10	3.41	0.90	7.20	19.4	0.91	36.7	0.03	0.16	0.02	30	57.0		2.74	6.70	0.034	9375	382	158
2.52	10/9/2013	41556	10/11/2013	41558	Case 1	2	3.2	3.1			1.10	8.40	19.4	0.76	36.0	0.05	0.12	0.03	15	63.5				0.035			
2.53	10/11/2013	41558	10/14/2013	41561	Case 1	2	3.1	3.4	7.59	3.17	1.00	8.70	18.5	0.67	35.7	0.04	0.15	0.03	8	57.5		2.55	6.23	0.041	8785	358	146
2.54	10/14/2013	41561	10/16/2013	41563	Case 1	2	3.2	3.1	8.90	3.29	1.00	8.40	18.4	0.71	36.0	0.06	0.12	0.03	17	65.0		2.64	6.46	0.035	10301	420	152
2.55	10/16/2013	41563	10/19/2013	41566	Case 1	2	3.1	2.5	8.62	3.36	1.10	8.20	18.0	2.40	37.3	0.04	0.14	0.02	20	61.5		2.70	6.61	0.035	9977	407	156
2.56	10/19/2013	41566	10/21/2013	41568	Case 1	2	3.4	3.9	7.78	3.46	1.20	9.00	18.0	2.30	33.2	0.04	0.13	0.03	20	54.0		2.78	6.80	0.044	9005	367	160
2.57	10/22/2013	41569	10/24/2013	41571	Case 1	2	3.2	2.9	8.21	3.65	1.20	7.60	18.1	2.70	37.3	0.03	0.15	0.02	20	54.0		2.93	7.17	0.036	9502	387	169
2.58	10/25/2013	41572	10/27/2013	41574	Case 1	2	3.0	2.8	8.32	3.38	1.00	8.20	17.5	2.30	37.4	0.04	0.16	0.02	30	59.0		2.72	6.65	0.037	9630	392	156
2.59	10/28/2013	41575	10/30/2013	41577	Case 1	2	3.4	3.1	7.85	3.73	1.00	8.10	16.9	2.60	37.2	0.04	0.15	0.03	20	50.5		3.00	7.33	0.043	9086	370	172
2.60	10/30/2013	41577	11/2/2013	41580	Case 1	2	2.7	3.1	9.10	3.36	0.80	8.90	16.9	2.70	37.2	0.04	0.19	0.02	30	65.0		2.70	6.60	0.038	10532	429	156
2.61	11/3/2013	41581	11/5/2013	41583	Case 2	2	3.1	2.5	8.51	3.14	1.30	7.50	13.1	2.60	29.3	0.04	0.10	0.02	0	65.0		2.53	6.17	0.029	9850	401	145
2.62	11/6/2013	41584	11/10/2013	41588	Case 2	2	3.3	3.1	12.22	3.10	1.30	8.00	12.9	2.70	24.6	0.03	0.14	0.03	18	94.5		2.49	6.10	0.022	14144	576	144
2.63	11/11/2013	41589	11/15/2013	41593	Case 2	2	3.0	3.5	12.82	3.42	1.10	8.40	12.6	2.90	23.5	0.03	0.12	0.04	18	90.0		2.75	6.72	0.025	14838	605	159
2.64	11/16/2013	41594	11/19/2013	41597	Case 2	2	63.2	3.2	12.27	3.18	1.00	7.50	12.2	2.30	26.4	0.03	0.11	0.02	10	92.5		2.56	6.26	0.021	14201	579	148
2.65	11/26/2013	41604	12/1/2013	41609	Case 2	2	3.5	2.5	14.20	2.94	1.20	7.00	12.2	2.70	24.6	0.03	0.03	0.02	0	116.0		2.36	5.77	0.015	16435	670	137

MMWD Filter Rehab

Compiled Filter Run Results - SGTP

Area =	864	sf
BW Time =	10	min
BW Vol =	140000	gal

Case 1 =	7/28/2013	to	11/4/2013
Case 2 =	11/5/2013	to	12/31/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
2.66	12/2/2013	41610	12/7/2013	41615	Case 2	2	3.5	3.2	14.32	3.14	0.90	8.50	11.6	0.68	25.9	0.03	0.10	0.02	0	109.5		2.52	6.17	0.021	16574	675	146
2.67	12/9/2013	41617	12/12/2013	41620	Case 2	2	2.8	2.9	7.69	3.55	0.90	5.20	11.2	0.62	28.4	0.03	0.04	0.02	0	52.0		2.85	6.97	0.025	8900	363	164
2.68	12/16/2013	41624	12/21/2013	41629	Case 2	2	2.7	3.0	13.07	2.65	1.00	5.70	11.3	0.58	24.9	0.02	0.03	0.02	0	118.5		2.13	5.20	0.012	15127	616	123
2.69	12/25/2013	41633	12/29/2013	41637	Case 2	2	3.4	3.9	13.70	3.52	0.93	8.20	11.0	0.60	25.8	0.03	0.03	0.02	0	93.5		2.83	6.91	0.024	15856	646	164
3.1			7/2/2013	41457		3		3.4				7.20						0.03		46.5							
3.2	7/2/2013	41457	7/5/2013	41460		3	3.3	3.5			1.10	8.30				0.05	0.12	0.01	30	51.0				0.043			
3.3	7/5/2013	41460	7/7/2013	41462		3	3.5	3.0			1.00	7.80				0.03	0.06	0.01	0	42.5				0.049			
3.4	7/7/2013	41462	7/9/2013	41464		3	3.0	3.2			1.00	6.50				0.02	0.05	0.03	0	46.5				0.036			
3.5	7/9/2013	41464	7/11/2013	41466		3	3.2	3.2			1.10	7.70				0.05	0.15	0.03	20	60.0				0.034			
3.6	7/11/2013	41466	7/14/2013	41469		3	3.1	3.0			1.00	8.90				0.06	0.13	0.03	18	63.5				0.038			
3.7	7/14/2013	41469	7/16/2013	41471		3	2.6	3.4			0.92	7.70				0.09	0.10	0.03	0	56.0				0.037			
3.8	7/16/2013	41471	7/19/2013	41474		3	2.7	3.0			0.90	8.30				0.06	0.12	0.04	22	69.5				0.032			
3.9	7/19/2013	41474	7/21/2013	41476		3	3.4	3.0			1.00	6.10				0.06	0.13	0.04	22	54.5				0.029			
3.10	7/21/2013	41476	7/23/2013	41478		3	3.1	3.2			1.10	6.80				0.06	0.12	0.03	27	48.0				0.036			
3.11	7/23/2013	41478	7/26/2013	41481		3	3.2	3.3			1.10	8.00				0.05	0.12	0.03	18	59.5				0.035			
3.12	7/26/2013	41481	7/28/2013	41483	Case 1	3	3.3	3.3	8.21	3.43	1.20	7.80	22.2	1.02	33.9	0.09	0.12	0.04	20	57.5		2.75	6.73	0.035	9502	387	158
3.13	7/28/2013	41483	7/30/2013	41485	Case 1	3	3.4	3.9	5.06	3.74	1.20	5.70	22.0	1.15	36.0	0.05	0.12	0.04	22	32.5		3.00	7.34	0.042	5856	239	170
3.14	7/31/2013	41486				3	3.2				1.00					0.05	0.13		15								
3.15	8/1/2013	41487	8/2/2013	41488	Case 1	3	3.5	3.0			0.90	8.40	21.8	0.70	34.9	0.04	0.13	0.03	20	65.0				0.035			
3.16	8/2/2013	41488	8/4/2013	41490	Case 1	3	3.0	2.6			1.10	6.20	22.2	1.10	34.3	0.04	0.12	0.02	15	61.0				0.025			
3.17	8/6/2013	41492	8/6/2013	41492	Case 1	3	3.2	3.0			1.10	8.10	21.8	1.07	33.9	0.10	0.20	0.02	55	66.0				0.032			
3.18	8/7/2013	41493	8/8/2013	41494	Case 1	3	3.3	3.5	8.34	4.30	1.00	7.50	21.8	1.05	34.8	0.04	0.15	0.05	18	46.5		3.46	8.46	0.043	9653	393	199
3.19	8/9/2013	41495	8/10/2013	41496	Case 1	3	3.3	3.4			0.90	7.80	22.0	1.05	35.8	0.07	0.16	0.02	20	63.0				0.033			
3.20	8/10/2013	41496				3	3.3				1.00					0.05	0.12		20								
3.21	8/11/2013	41497				3	3.0				0.90					0.04	0.12		20								
3.22	8/13/2013	41499	8/13/2013	41499	Case 1	3	3.4	3.3	8.33	3.28	1.00	7.60	22.1	1.15	35.5	0.01	0.19	0.03	70	61.0		2.63	6.44	0.033	9641	393	152
3.23	8/15/2013	41501	8/17/2013	41503	Case 1	3	3.2	3.4			0.90	7.70	22.8	1.35	36.1	0.11	0.19	0.03	45	61.5				0.034			
3.24	8/18/2013	41504	8/20/2013	41506	Case 1	3	3.1	3.4			1.10	8.20	23.0	0.51	36.8	0.08	0.13	0.03	20	50.5				0.043			
3.25	8/20/2013	41506	8/22/2013	41508	Case 1	3	3.0	3.2			0.80	7.90	22.7	0.55	36.6	0.06	0.15	0.03	23	62.5				0.035			
3.26	8/22/2013	41508				3	3.2				0.90					0.05	0.11		8								
3.27	8/23/2013	41509				3	3.4				1.10					0.04	0.12		10								
3.28	8/24/2013	41510				3	3.2				1.10					0.03	0.07		0								
3.29	8/25/2013	41511				3	2.9				0.83					0.03	0.12		15								
3.30	8/26/2013	41512	8/26/2013	41512	Case 1	3	3.3	3.3	9.13	3.56	1.10	8.10	22.8	0.50	34.6	0.06	0.12	0.02	16	61.5		2.86	7.00	0.035	10567	431	165
3.31	8/28/2013	41514	8/28/2013	41514	Case 1	3	3.3	3.3	8.70	3.57	1.00	8.00	22.7	0.50	37.7	0.06	0.17	0.03	38	58.5		2.87	7.01	0.036	10069	410	165
3.32	8/29/2013	41515	8/30/2013	41516	Case 1	3	3.2	3.2	7.60	3.29	0.87	8.00	22.9	0.48	40.2	0.04	0.12	0.03	9	55.5		2.64	6.46	0.039	8796	358	152
3.33	9/2/2013	41519	9/5/2013	41522	Case 1	3	3.3	3.5			1.10	8.30	23.0	0.50	35.1	0.05	0.12	0.01	30	51.0				0.043			
3.34	9/5/2013	41522	9/7/2013	41524	Case 1	3	3.5	3.0			1.00	7.80	22.8	0.53	39.2	0.03	0.06	0.01	0	42.5				0.049			
3.35	9/7/2013	41524	9/9/2013	41526	Case 1	3	3.0	3.2	7.63	3.94	1.00	6.50	22.9	0.48	38.5	0.02	0.05	0.03	0	46.5		3.17	7.74	0.036	8831	360	182
3.36	9/9/2013	41526	9/11/2013	41528	Case 1	3	3.2	3.2			1.10	7.70	22.9	0.24	36.4	0.05	0.15	0.03	20	60.0				0.034			
3.37	9/11/2013	41528	9/14/2013	41531	Case 1	3	3.1	3.0	9.30	3.51	1.00	8.90	22.7	0.35	36.8	0.06	0.13	0.03	18	63.5		2.83	6.91	0.038	10764	439	163
3.38	9/14/2013	41531	9/16/2013	41533	Case 1	3	2.6	3.4			0.92	7.70	22.4	0.29	33.4	0.09	0.10	0.03	0	56.0				0.037			
3.39	9/16/2013	41533	9/19/2013	41536	Case 1	3	2.7	3.0			0.90	8.30	21.7	0.33	38.4	0.06	0.12	0.04	22	69.5				0.032			
3.40	9/19/2013	41536	9/21/2013	41538	Case 1	3	3.4	3.0			1.00	6.10	21.4	0.53	39.9	0.06	0.13	0.04	22	54.5				0.029			
3.41	9/21/2013	41538	9/23/2013	41540	Case 1	3	3.1	3.2			1.10	6.80	21.4	0.23	35.7	0.06	0.12	0.03	27	48.0				0.036			
3.42	9/23/2013	41540	9/26/2013	41543	Case 1	3	3.2	3.3			1.10	8.00	20.8	0.45	39.1	0.05	0.12	0.03	18	59.5				0.035			
3.43	9/26/2013	41543	9/28/2013	41545	Case 1	3	3.3	3.3			1.20	7.80	20.4	0.36	39.3	0.09	0.12	0.04	20	57.5				0.035			
3.44	9/28/2013	41545	9/30/2013	41547	Case 1	3	3.4	3.9			1.20	5.70	20.4	0.41	37.9	0.05	0.12	0.04	22	32.5				0.042			
3.45	9/30/2013	41547	10/1/2013	41548	Case 1	3	3.2	3.7	10.29	3.36	1.00	7.60	20.4	1.00	36.8	0.05	0.13	0.02	15	73.5		2.70	6.60	0.027	11910	485	156
3.46	10/1/2013	41548	10/3/2013	41550	Case 1	3	3.2	3.2	7.40	3.52	1.30	7.30	20.1	0.79	37.2	0.03	0.07	0.02	0	50.5		2.83	6.91	0.036	8565	349	162
3.47	10/3/2013	41550	10/6/2013	41553	Case 1	3	3.2	3.3	9.10	3.52	1.20	7.50	20.2	0.61	37.9	0.03	0.08	0.02	0	62.0		2.83	6.92	0.031	10532	429	163
3.48	10/6/2013	41553	10/8/2013	41555	Case 1	3	3.3	2.9			1.00	7.00	19.7	0.63	38.0	0.02	0.09	0.02	0	58.0				0.032			
3.49	10/8/2013	41555	10/11/2013	41558	Case 1	3	3.0	2.6	9.40	3.42	1.00	8.40	19.4	0.76	36.0	0.03	0.10	0.02	0	66.0		2.75	6.72	0.034	10880	443	158
3.50	10/11/2013	41558	10/13/2013	41560	Case 1	3	3.1	3.3	7.63	3.13	1.00	7.70	17.9	0.58	35.7	0.05	0.11	0.03	10	58.5		2.52	6.15	0.035	8831	360	145
3.51	10/13/2013	41560	10/16/2013	41563	Case 1	3	3.3	2.9	8.68	3.28	1.10	8.30	18.4	0.71	36.0	0.05	0.11	0.02	15	63.5		2.64	6.45	0.035	10046	409	152
3.52	10/16/2013	41563	10/19/2013	41566	Case 1	3	3.0	2.5			1.10	7.00	18.0	2.40	37.3	0.04	0.12	0.02	11	63.0				0.029			
3.53	10/19/2013	41566	10/21/2013	41568	Case 1	3	3.1	3.7	6.90	3.31	1.10	7.60	18.0	2.30	33.2	0.04	0.12	0.03	15	50.0		2.66	6.51	0.040	7986	325	153
3.54	10/21/2013	41568	10/23/2013	41570	Case 1	3	3.3	3.8	8.10	3.74	1.20	8.20	18.0	2.70	36.3	0.04	0.16	0.03	30	52.0		3.00	7.35	0.041	9375	382	173
3.55	10/24/2013	41571	10/26/2013	41573	Case 1	3	3.8	3.1	7.70	3.33	1.20	8.00	17.5	2.48	36.2	0.04	0.12	0.03	24	55.5		2.68	6.54	0.037	8912	363	154
3.56	10/26/2013	41573	10/28/2013	41575	Case 1	3	3.1	3.2	8.91	3.51	1.00	8.10	17.3	2.70	37.7	0.05	0.13	0.03	21	61.0		2.82	6.89	0.035	10313	420	162
3.57	10/29/2013	41576	11/1/2013	41579	Case 1	3	3.0	3.0			1.20	7.30	16.7	2.50	37.8	0.04	0.16	0.03	28	58.0				0.032			
3.58	11/1/2013	41579	11/4/2013	41582	Case 1	3	3.5	2.3	7.90	3.51	1.07	7.00	16.1	2.90	33.7	0.03	0.14	0.03	20	54.0		2.82	6.90	0.033	9144	373	162
3.59	11/4/2013	41582	11/8/2013	41586	Case 2	3	3.2	3.0	12.86	3.13	1.30	8.30	13.0	2.90	25.0	0.04	0.15	0.03	32	98.5		2.52	6.16	0.022	14884	606	146
3.60	11/8/2013	41586	11/12/2013	41590	Case 2	3	3.3	2.5			1.20	7.90	12.6	3.20	25.4	0.03	0.15	0.03	20	88.0				0.023			
3.61	11/15/2013	41593	11/19/2013	41597	Case 2	3	3.5	3.7	11.89	3.28	0.92	7.40	12.2	2.30	26.4	0.04	0.04	0.06	0	87.0		2.64	6.45	0.023	13762	561	153
3.62	11/23/2013	41601	11/27/2013	41605	Case 2	3	3.0	3.7	13.47	3.48	1.20	7.40	12.0	2.60	25.2	0.04	0.04	0.05	0	93.0		2.79	6.83	0.020	15590	635	162

MMWD Filter Rehab

Compiled Filter Run Results - SGTP

Area =	864	sf
BW Time =	10	min
BW Vol =	140000	gal

Case 1 =	7/28/2013	to	11/4/2013
Case 2 =	11/5/2013	to	12/31/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
3.63	12/10/2013	41618	12/12/2013	41620	Case 2	3	3.6	3.0	4.42	3.42	1.60	3.40	11.2	0.62	28.4	0.03	0.03	0.03	0	31.0		2.75	6.72	0.018	5116	208	155
3.64	12/17/2013	41625	12/22/2013			3	3.0	3.0			1.20	6.00		0.60		0.04	0.04	0.03	0	119.5				0.012			
3.65	12/27/2013	41635	12/30/2013			3	4.0	4.2			0.59	7.80		0.86		0.04	0.04	0.03	0	83.5				0.026			
4.2	7/1/2013	41456	7/3/2013	41458		4	3.3	3.0			1.00	7.10				0.04	0.10	0.03	0	49.5				0.038			
4.3	7/3/2013	41458	7/5/2013	41460		4	3.0	3.5			1.00	9.10				0.04	0.14	0.02	29	52.0				0.047			
4.4	7/5/2013	41460	7/7/2013	41462		4	3.5	3.2			1.10	7.80				0.04	0.11	0.02	10	49.0				0.042			
4.5	7/7/2013	41462	7/10/2013	41465		4	3.2	3.0			1.00	7.50				0.04	0.10	0.02	1	54.0				0.037			
4.6	7/10/2013	41465	7/12/2013	41467		4	3.0	3.4			1.10	8.90				0.07	0.35	0.03	47	56.5				0.042			
4.7	7/12/2013	41467	7/15/2013	41470		4	3.4	2.9			1.10	8.20				0.04	0.13	0.03	25	63.0				0.034			
4.8	7/15/2013	41470	7/17/2013	41472		4	3.1	3.3			0.90	8.00				0.03	0.10	0.02	0	57.0				0.038			
4.9	7/17/2013	41472	7/19/2013	41474		4	3.3	3.6			1.00	9.10				0.03	0.10	0.03	13	53.5				0.046			
4.10	7/19/2013	41474	7/22/2013	41477		4	3.6	3.3			0.90	7.00				0.06	0.17	0.04	30	54.5				0.034			
4.11	7/22/2013	41477	7/24/2013	41479		4	3.3	3.2			1.10	7.60				0.08	0.17	0.04	60	48.0				0.041			
4.12	7/24/2013	41479	7/26/2013	41481		4	2.9	3.3			0.75	8.70				0.06	0.17	0.04	37	60.0				0.040			
4.13	7/26/2013	41481	7/29/2013	41484	Case 1	4	3.3	3.4	8.29	3.40	1.10	7.90	21.9	1.08	34.6	0.06	0.15	0.04	20	58.5		2.73	6.68	0.035	9595	391	157
4.14	7/29/2013	41484	7/30/2013	41485	Case 1	4	3.0	3.8			1.00	5.00	22.0	1.15	36.0	0.05	0.16	0.05	30	25.0				0.049			
4.15	7/31/2013	41486	8/2/2013	41488	Case 1	4	3.3	3.2	9.34	3.64	1.00	8.40	21.8	0.70	34.9	0.05	0.15	0.02	25	61.5		2.93	7.16	0.037	10810	440	169
4.16	8/2/2013	41488				4	3.2				0.83					0.06	0.07		0								
4.17	8/3/2013	41489	8/3/2013	41489	Case 1	4	3.0	3.0			1.10	8.40	22.2	0.66	35.3	0.06	0.19	0.02	50	60.5				0.037			
4.18	8/5/2013	41491	8/5/2013	41491	Case 1	4	3.1	3.4	8.90	3.29	1.00	7.80	22.1	0.93	35.3	0.05	0.17	0.04	35	65.0		2.64	6.46	0.032	10301	420	152
4.19	8/6/2013	41492	8/7/2013	41493	Case 1	4	3.1	3.0	8.52	3.56	1.30	6.10	21.8	0.94	35.3	0.04	0.12	0.02	20	57.5		2.86	6.99	0.025	9861	402	164
4.20	8/8/2013	41494	8/9/2013	41495	Case 1	4	3.5	2.7			1.40	7.90	22.0	1.45	33.3	0.06	0.12	0.02	20	61.5				0.032			
4.21	8/10/2013	41496	8/10/2013	41496	Case 1	4	3.4	3.3	8.10	3.19	1.00	8.70	22.0	1.05	35.8	0.04	0.18	0.05	30	61.0		2.56	6.26	0.038	9375	382	147
4.22	8/12/2013	41498	8/12/2013	41498	Case 1	4	3.0	3.4	8.10	3.29	0.90	8.10	21.9	0.89	32.5	0.04	0.11	0.04	5	59.0		2.65	6.48	0.037	9375	382	152
4.23	8/14/2013	41500	8/16/2013	41502	Case 1	4	3.4	3.0			0.97	8.00	22.7	1.10	32.8	0.04	0.11	0.04	9	74.0				0.029			
4.24	8/16/2013	41502	8/18/2013	41504	Case 1	4	3.0	2.6	8.71	3.40	1.00	7.80	22.5	0.85	34.6	0.05	0.09	0.03	0	61.5		2.73	6.68	0.034	10081	411	157
4.25	8/18/2013	41504	8/19/2013	41505	Case 1	4	2.6	3.2			0.88	6.90	23.1	1.25	34.2	0.04	0.15	0.03	35	49.0				0.037			
4.26	8/19/2013	41505	8/21/2013	41507	Case 1	4	3.2	3.0			0.90	7.50	22.8	0.62	36.1	0.06	0.12	0.02	15	51.5				0.039			
4.27	8/21/2013	41507	8/23/2013	41509	Case 1	4	3.4	3.2	8.90	3.56	1.00	9.20	22.2	0.50	38.9	0.03	0.10	0.04	0	60.0		2.86	7.00	0.042	10301	420	165
4.28	8/25/2013	41511	8/25/2013	41511	Case 1	4	3.2	3.3	8.97	3.53	0.81	8.30	22.6	0.63	34.8	0.06	0.14	0.03	23	61.0		2.84	6.94	0.037	10382	423	163
4.29	8/27/2013	41513	8/27/2013	41513	Case 1	4	3.3	3.3	7.87	3.70	0.70	7.20	22.5	0.68	37.8	0.06	0.13	0.03	20	51.0		2.98	7.28	0.039	9109	371	171
4.30	8/28/2013	41514	8/29/2013	41515	Case 1	4	3.2	3.2			1.10	7.40	22.7	0.50	34.7	0.04	0.11	0.02	5	19.5				0.098			
4.31	8/30/2013	41516				4	3.3				0.80					0.07	0.13		14								
4.32	8/30/2013	41516				4	3.3				0.90					0.05	0.13		24								
4.33	8/31/2013	41517	9/1/2013	41518	Case 1	4	4.1	3.3			1.70	8.10	22.9	0.47	38.5	0.03	0.09	0.02	0	56.0				0.035			
4.34	9/1/2013	41518	9/3/2013	41520	Case 1	4	3.3	3.0	8.41	4.08	1.00	7.10	23.1	0.58	35.8	0.04	0.10	0.03	0	49.5		3.28	8.01	0.038	9734	397	188
4.35	9/3/2013	41520	9/5/2013	41522	Case 1	4	3.0	3.5	9.35	4.32	1.00	9.10	23.0	0.50	35.1	0.04	0.14	0.02	29	52.0		3.47	8.48	0.047	10822	441	200
4.36	9/5/2013	41522	9/7/2013	41524	Case 1	4	3.5	3.2	6.60	3.23	1.10	7.80	22.8	0.53	39.2	0.04	0.11	0.02	10	49.0		2.60	6.35	0.042	7639	311	149
4.37	9/7/2013	41524	9/10/2013	41527	Case 1	4	3.2	3.0	9.36	4.16	1.00	7.50	22.9	0.55	36.3	0.04	0.10	0.02	1	54.0		3.34	8.18	0.037	10833	441	193
4.38	9/10/2013	41527	9/12/2013	41529	Case 1	4	3.0	3.4			1.10	8.90	23.0	0.30	36.4	0.07	0.35	0.03	47	56.5				0.042			
4.39	9/12/2013	41529	9/15/2013	41532	Case 1	4	3.4	2.9			1.10	8.20	22.4	0.26	38.7	0.04	0.13	0.03	25	63.0				0.034			
4.40	9/15/2013	41532	9/17/2013	41534	Case 1	4	3.1	3.3			0.90	8.00	22.3	0.27	37.2	0.03	0.10	0.02	0	57.0				0.038			
4.41	9/17/2013	41534	9/19/2013	41536	Case 1	4	3.3	3.6			1.00	9.10	21.7	0.33	38.4	0.03	0.10	0.03	13	53.5				0.046			
4.42	9/19/2013	41536	9/22/2013	41539	Case 1	4	3.6	3.3			0.90	7.00	21.5	0.36	39.1	0.06	0.14	0.04	30	54.5				0.034			
4.43	9/22/2013	41539	9/24/2013	41541	Case 1	4	3.3	3.2			1.10	7.60	21.4	0.27	39.2	0.08	0.17	0.04	60	48.0				0.041			
4.44	9/24/2013	41541	9/26/2013	41543	Case 1	4	2.9	3.3			0.75	8.70	20.8	0.45	39.1	0.06	0.17	0.04	37	60.0				0.040			
4.45	9/26/2013	41543	9/29/2013	41546	Case 1	4	3.3	3.4	8.82	3.96	1.10	7.90	20.5	0.43	38.9	0.06	0.15	0.04	20	53.5		3.18	7.78	0.039	10208	416	183
4.46	9/29/2013	41546	9/30/2013	41547	Case 1	4	3.0	3.8			1.00	5.00	20.4	0.41	37.9	0.05	0.16	0.05	30	25.0				0.049			
4.47	9/30/2013	41547	10/1/2013	41548	Case 1	4	3.3	2.9	6.33	3.71	1.00	5.20	20.4	1.00	36.8	0.05	0.15	0.02	25	41.0		2.98	7.28	0.031	7326	299	170
4.48	10/1/2013	41548	10/4/2013	41551	Case 1	4	3.2	3.0	8.80	3.58	1.30	8.50	20.2	0.67	34.3	0.04	0.10	0.06	0	59.0		2.88	7.03	0.037	10185	415	166
4.49	10/4/2013	41551	10/6/2013	41553	Case 1	4	3.0	3.0	9.10	3.41	1.20	8.10	20.2	0.61	37.9	0.03	0.11	1.04	5	64.0	YES	2.74	6.71	0.033	10532	429	158
4.50	10/6/2013	41553	10/9/2013	41556	Case 1	4	2.9	3.2	8.06	3.36	0.92	7.10	19.4	0.91	36.7	0.07	0.15	0.06	60	57.5		2.70	6.61	0.033	9329	380	155
4.51	10/9/2013	41556	10/12/2013	41559	Case 1	4	3.1	3.1	8.90	3.45	1.20	8.10	18.5	0.69	37.4	0.06	0.18	0.04	50	62.0		2.77	6.77	0.034	10301	420	159
4.52	10/12/2013	41559	10/14/2013	41561	Case 1	4	3.1	3.0	8.02	3.21	1.00	7.70	18.5	0.67	35.7	0.04	0.12	0.03	7	60.0		2.58	6.30	0.034	9282	378	148
4.53	10/14/2013	41561	10/17/2013	41564	Case 1	4	3.1	3.3	8.34	3.39	1.00	8.20	18.4	0.70	37.4	0.05	0.18	0.05	25	59.0		2.73	6.67	0.037	9653	393	157
4.54	10/18/2013	41565	10/20/2013	41567	Case 1	4	3.0	2.6	8.10	3.35	1.00	8.00	18.0	2.20	37.2	0.04	0.14	0.06	30	58.0		2.69	6.59	0.037	9375	382	155
4.55	10/20/2013	41567	10/22/2013	41569	Case 1	4	2.6	3.6	7.50	3.60	1.10	8.00	18.1	2.50	36.4	0.08	0.20	0.06	40	50.0		2.89	7.07	0.042	8681	354	166
4.56	10/23/2013	41570	10/25/2013	41572	Case 1	4	3.2	3.0	8.20	3.39	0.51	8.40	17.7	3.01	37.3	0.07	0.20	0.1100	37	58.0	YES	2.73	6.67	0.041	9491	387	157
4.57	10/26/2013	41573	10/28/2013	41575	Case 1	4	3.0	2.8			1.20	6.70	17.3	2.70	37.7	0.04	0.22	0.06	45	46.0				0.036			
4.58	10/28/2013	41575	10/30/2013	41577	Case 1	4	3.0	3.0	7.50	3.50	1.20	6.60	16.9	2.60	37.2	0.07	0.15	0.06	30	51.5		2.81	6.87	0.032	8681	354	161
4.59	10/31/2013	41578	11/2/2013	41580	Case 1	4	3.7	3.2	8.69	3.66	1.30	8.30	16.9	2.70	37.2	0.07	0.17	0.06	30	57.0		2.94	7.19	0.037	10058	410	169
4.60	11/3/2013	41581	11/6/2013	41584	Case 2	4	3.3	3.3	10.49	3.19	1.00	7.60	12.7	2.70	30.1	0.05	0.15	0.02	32	79.0		2.56	6.26	0.025	12141	495	148
4.61	11/7/2013	41585	11/11/2013	41589	Case 2	4	3.5	3.1	12.15	3.17	1.10	8.60	12.5	2.90	25.8	0.03	0.12	0.05	20	92.0		2.55	6.23	0.025	14063	573	147
4.62	11/12/2013	41590	11/15/2013	41593	Case 2	4	3.0	3.2			1.10	8.00	12.6	2.90	23.5	0.06	0.25	0.04	45	91.0				0.023			
4.63	11/19/2013	41597	11/23/2013	41601	Case 2	4	3.7	3.0	13.70	3.26	1.00	7.60	13.6	2.80	26.0	0.06	0.07	0.06	0	101.0		2.62	6.40	0.020	15856	646	152
4.64	11/27/2013	41605	12/1/2013	41609	Case 2	4	3.7	3.1			1.10	8.60	12.2	2.70	24.6	0.06	0.06	0.04	0	117.5				0.019			

MMWD Filter Rehab

Compiled Filter Run Results - SGTP

Area =	864	sf
BW Time =	10	min
BW Vol =	140000	gal

Case 1 =	7/28/2013	to	11/4/2013
Case 2 =	11/5/2013	to	12/31/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
4.65	12/6/2013	41614				4	3.0				1.20					0.04	0.06		0								
4.66	12/11/2013	41619	12/12/2013	41620	Case 2	4	3.8	3.0	3.60	3.26	1.20	3.00	11.2	0.62	28.4	0.03	0.06	0.03	0	26.5		2.62	6.41	0.021	4167	170	147
4.67	12/21/2013	41629	12/24/2013	41632	Case 2	4	3.0	2.2	10.00	3.33	0.90	5.40	11.5	0.62	26.4	0.04	0.04	0.03	0	72.0		2.68	6.55	0.019	11574	472	155
4.68	12/30/2013	41638				4	4.2				1.20					0.03	0.04		0								
5.1			7/1/2013	41456		5		3.2				9.00						0.03		54.5							
5.2	7/1/2013	41456	7/3/2013	41458		5	3.3	3.4			1.00	9.00				0.07	0.17	0.04	40	51.0				0.048			
5.3	7/3/2013	41458	7/6/2013	41461		5	3.4	3.5			1.10	9.90				0.07	0.15	0.04	40	49.5				0.054			
5.4	7/6/2013	41461	7/8/2013	41463		5	3.5	3.2			1.10	8.30				0.04	0.18	0.06	40	51.0				0.043			
5.5	7/8/2013	41463	7/9/2013	41464		5	3.2	3.1			1.10	5.60				0.10	0.21	0.05	80	31.5				0.044			
5.6	7/9/2013	41464	7/12/2013	41467		5	3.1	3.2			0.90	8.80				0.05	0.16	0.05	50	58.0				0.042			
5.7	7/12/2013	41467	7/14/2013	41469		5	3.2	3.4			1.00	7.80				0.07	0.21	0.06	75	48.5				0.043			
5.8	7/14/2013	41469	7/15/2013	41470		5	3.0	3.5			0.80	7.70				0.08	0.22	0.04	80	38.5				0.055			
5.9	7/15/2013	41470	7/18/2013	41473		5	3.6	3.6			1.00	8.50				0.05	0.15	0.06	50	57.0				0.040			
5.10	7/18/2013	41473	7/20/2013	41475		5	3.6	3.6			1.00	8.90				0.04	0.16	0.05	90	48.5				0.050			
5.11	7/20/2013	41475	7/22/2013	41477		5	3.6	4.0			1.00	8.00				0.11	0.21	0.04	60	54.0				0.040			
5.12	7/22/2013	41477	7/24/2013	41479		5	4.0	3.3			1.10	8.20				0.07	0.15	0.04	33	46.0				0.047			
5.13	7/24/2013	41479	7/26/2013	41481		5	3.3	3.5			1.00	8.90				0.07	0.15	0.05	34	55.5				0.043			
5.14	7/26/2013	41481	7/29/2013	41484	Case 1	5	3.5	3.0	8.30	3.32	1.00	8.60	21.9	1.08	34.6	0.06	0.16	0.05	60	60.0		2.67	6.52	0.039	9606	391	154
5.15	7/29/2013	41484	7/31/2013	41486	Case 1	5	3.1	3.2	7.25	3.45	0.85	7.50	21.8	1.10	35.0	0.06	0.18	0.05	50	50.5		2.77	6.77	0.040	8391	342	159
5.16	7/31/2013	41486	9/1/2013	41518	Case 1	5	3.3	3.2	8.13	3.58	0.93	9.00	22.9	0.47	38.5	0.07	0.16	0.03	39	54.5		2.88	7.04	0.045	9410	383	165
5.17	9/1/2013	41518	9/3/2013	41520	Case 1	5	3.3	3.4	8.12	3.82	1.00	9.00	23.1	0.58	35.8	0.07	0.17	0.04	40	51.0		3.07	7.51	0.048	9398	383	177
5.18	9/3/2013	41520	9/6/2013	41523	Case 1	5	3.4	3.5	7.71	3.74	1.10	9.90	22.7	0.40	38.8	0.07	0.15	0.04	40	49.5		3.00	7.35	0.054	8924	364	173
5.19	9/6/2013	41523	9/8/2013	41525	Case 1	5	3.5	3.2	7.21	3.39	1.10	8.30	23.0	0.52	39.4	0.04	0.18	0.06	40	51.0		2.73	6.67	0.043	8345	340	156
5.20	9/8/2013	41525	9/9/2013	41526	Case 1	5	3.2	3.1			1.10	5.60	22.9	0.48	38.5	0.10	0.21	0.05	80	31.5				0.044			
5.21	9/9/2013	41526	9/12/2013	41529	Case 1	5	3.1	3.2			0.90	8.80	23.0	0.30	36.4	0.05	0.16	0.05	50	58.0				0.042			
5.22	9/12/2013	41529	9/14/2013	41531	Case 1	5	3.2	3.4	10.32	5.11	1.00	7.80	22.7	0.35	36.8	0.07	0.21	0.06	75	48.5		4.10	10.04	0.043	11944	487	237
5.23	9/14/2013	41531	9/15/2013	41532	Case 1	5	3.0	3.5			0.80	7.70	22.4	0.26	38.7	0.08	0.22	0.04	80	38.5				0.055			
5.24	9/15/2013	41532	9/18/2013	41535	Case 1	5	3.6	3.6	8.50	3.58	1.00	8.50	21.9	0.24	34.5	0.05	0.15	0.06	50	57.0		2.88	7.03	0.040	9838	401	166
5.25	9/18/2013	41535	9/20/2013	41537	Case 1	5	3.6	3.6			1.00	8.90	22.0	0.28	36.6	0.04	0.16	0.05	90	48.5				0.050			
5.26	9/20/2013	41537	9/22/2013	41539	Case 1	5	3.6	4.0			1.00	8.00	21.5	0.36	39.1	0.11	0.21	0.04	60	54.0				0.040			
5.27	9/22/2013	41539	9/24/2013	41541	Case 1	5	4.0	3.3	7.34	3.83	1.10	8.20	21.4	0.27	39.2	0.07	0.15	0.04	33	46.0		3.08	7.53	0.047	8495	346	177
5.28	9/24/2013	41541	9/26/2013	41543	Case 1	5	3.3	3.5	10.06	4.35	1.00	8.90	20.8	0.45	39.1	0.07	0.15	0.05	34	55.5		3.50	8.55	0.043	11644	474	202
5.29	9/26/2013	41543	9/29/2013	41546	Case 1	5	3.5	3.0	8.82	3.53	1.00	8.60	20.5	0.43	38.9	0.06	0.16	0.05	60	60.0		2.84	6.93	0.039	10208	416	163
5.30	9/29/2013	41546	9/30/2013	41547	Case 1	5	3.1	3.2			0.85	7.50	20.4	0.41	37.9	0.06	0.18	0.05	50	50.5				0.040			
5.31	9/30/2013	41547	10/1/2013	41548	Case 1	5	3.3	2.9	4.42	3.86	0.93	3.90	20.4	1.00	36.8	0.07	0.16	0.02	39	27.5		3.10	7.58	0.033	5116	208	175
5.32	10/1/2013	41548	10/4/2013	41551	Case 1	5	3.2	3.0	9.24	3.39	1.30	8.40	20.2	0.67	34.3	0.04	0.08	0.03	0	65.5		2.72	6.65	0.033	10694	436	157
5.33	10/4/2013	41551	10/6/2013	41553	Case 1	5	3.0	3.4	8.60	3.44	0.90	8.40	20.2	0.61	37.9	0.03	0.08	0.02	0	60.0		2.76	6.76	0.038	9954	406	159
5.34	10/7/2013	41554	10/9/2013	41556	Case 1	5	2.9	3.1	7.90	3.39	0.90	8.10	19.4	0.91	36.7	0.05	0.11	0.03	20	56.0		2.72	6.65	0.039	9144	373	156
5.35	10/9/2013	41556	10/12/2013	41559	Case 1	5	3.2	3.1	8.81	3.20	1.00	8.70	18.5	0.69	37.4	0.04	0.13	0.03	19	66.0		2.57	6.30	0.036	10197	415	148
5.36	10/12/2013	41559	10/14/2013	41561	Case 1	5	3.1	2.8	7.33	3.11	0.90	8.20	18.5	0.67	35.7	0.09	0.11	0.03	11	56.5		2.50	6.12	0.039	8484	346	144
5.37	10/14/2013	41561	10/17/2013	41564	Case 1	5	3.2	3.0	7.16	3.34	1.10	7.80	18.4	0.70	37.4	0.05	0.12	0.03	26	51.5		2.68	6.56	0.040	8287	338	154
5.38	10/17/2013	41564	10/19/2013	41566	Case 1	5	2.8	3.4	8.59	3.41	0.85	9.00	18.0	2.40	37.3	0.04	0.14	0.03	25	60.5		2.74	6.70	0.041	9942	405	158
5.39	10/20/2013	41567	10/22/2013	41569	Case 1	5	2.6	3.2	7.62	3.52	0.80	8.20	18.1	2.50	36.4	0.05	0.11	0.02	7	52.0		2.83	6.91	0.043	8819	359	162
5.40	10/22/2013	41569	10/25/2013	41572	Case 1	5	3.6	2.9	8.34	3.64	1.10	8.10	17.7	3.01	37.3	0.04	0.12	0.03	21	55.0		2.93	7.15	0.039	9653	393	168
5.41	10/25/2013	41572	10/28/2013	41575	Case 1	5	3.0	3.4	7.48	3.42	1.20	8.60	17.3	2.70	37.7	0.04	0.11	0.03	5	52.5		2.75	6.72	0.043	8657	353	158
5.42	10/28/2013	41575	10/31/2013	41578	Case 1	5	3.2	3.7	7.80	3.57	1.10	8.00	16.7	2.60	35.5	0.04	0.07	0.03	0	52.5		2.87	7.01	0.040	9028	368	165
5.43	11/1/2013	41579	11/3/2013	41581	Case 1	5	3.3	3.0	7.40	3.62	0.80	8.10	16.5	2.70	37.3	0.04	0.05	0.03	0	49.0		2.91	7.12	0.045	8565	349	167
5.44	11/4/2013	41582	11/7/2013	41585	Case 2	5	2.2	3.5	10.00	3.24	0.70	7.50	13.1	2.70	30.3	0.04	0.12	0.03	16	74.0		2.61	6.37	0.028	11574	472	150
5.45	11/8/2013	41586	11/12/2013	41590	Case 2	5	3.2	3.2	10.47	3.26	0.90	6.80	12.6	3.20	25.4	0.02	0.03	0.06	0	77.0		2.62	6.41	0.023	12118	494	152
5.46	11/14/2013	41592	11/17/2013	41595	Case 2	5	3.5	2.8	11.85	3.09	1.10	7.20	12.6	2.70	25.3	0.03	0.03	0.06	0	92.0		2.48	6.07	0.020	13715	559	144
5.47	11/18/2013	41596	11/22/2013	41600	Case 2	5	3.7	3.0	13.70	3.30	1.20	7.50	12.6	2.40	23.6	0.03	0.07	0.09	0	99.5		2.66	6.49	0.019	15856	646	154
5.48	11/24/2013	41602	11/28/2013	41606	Case 2	5	3.0	3.1			1.00	6.60	12.0	2.50	26.0	0.04	0.04	0.06	0	80.5				0.021			
5.49	12/1/2013	41609	12/6/2013	41614	Case 2	5	3.1	3.0	13.60	3.15	1.10	7.00	11.4	2.90	25.2	0.04	0.04	0.08	0	103.5		2.53	6.20	0.017	15741	641	147
5.50	12/9/2013	41617	12/10/2013	41618	Case 2	5	2.4	2.9			1.00	6.00	11.1	0.73	26.2	0.02	0.03	0.03	0	94.5				0.016			
5.51	12/12/2013	41620	12/17/2013	41625	Case 2	5	3.0	2.8	15.04	3.07	1.10	7.50	11.4	0.71	26.7	0.02	0.02	0.03	0	117.5		2.47	6.04	0.017	17407	709	143
5.52	12/22/2013	41630	12/25/2013	41633	Case 2	5	2.5	3.4			0.80	5.60	11.5	0.67	24.0	0.02	0.03	0.02	0	86.5				0.017			
6.1			7/1/2013	41456		6		3.1				7.50						0.03		63.0							
6.2	7/1/2013	41456	7/3/2013	41458		6	3.2	3.1			1.20	7.40				0.05	0.16	0.03	40	47.0				0.040			
6.3	7/3/2013	41458	7/5/2013	41460		6	3.1	3.5			1.30	8.40				0.05	0.14	0.03	20	58.5				0.037			
6.4	7/5/2013	41460	7/7/2013	41462		6	3.5	3.0			1.10	7.50				0.04	0.13	0.03	20	47.0				0.042			
6.5	7/7/2013	41462	7/9/2013	41464		6	3.3	3.3			1.30	7.30				0.05	0.13	0.03	37	53.5				0.034			
6.6	7/9/2013	41464	7/12/2013	41467		6	3.2	3.2			1.30	7.50				0.05	0.15	0.03	45	55.5				0.034			
6.7	7/12/2013	41467	7/14/2013	41469		6	3.2	3.0			1.00	8.10				0.03	0.16	0.04	30	62.0				0.035			
6.8	7/14/2013	41469	7/16/2013	41471		6	3.2	3.5			1.40	6.90				0.05	0.16	0.02	105	35.5				0.047			
6.9	7/16/2013	41471	7/19/2013	41474		6	3.5	3.3			1.30	8.40				0.05	0.12	0.03	16	63.0				0.034			
6.10	7/19/2013	41474	7/21/2013	41476		6	3.3	2.6			1.20	6.80				0.03	0.15	0.02	20	56.0				0.030			

MMWD Filter Rehab

Compiled Filter Run Results - SGTP

Area =	864	sf
BW Time =	10	min
BW Vol =	140000	gal

Case 1 =	7/28/2013	to	11/4/2013
Case 2 =	11/5/2013	to	12/31/2013

	Filter Run Dates					Filter	Flow Rate (mgd)		Volume	Average	Headloss (ft)		Temperature	Influent	Coagulant	Filtered Turbidity (NTU)			Ripening	Run Time		Filtration Rate		HL Accum	UFRV		NWP
Run Tag	Start	Value	End	Value	Case	Number	Start	Stop	(mgal)	Flow (mgd)	Clean Bed	Terminal	(°C)	Turbidity (NTU)	Dose (mg/L)	Initial	Peak	Final	Time (min)	(hr)	Breakthrough	(gpm/sf)	(m/hr)	Rate (m/hr)	(gal/ft^2)	(m)	(m/day)
6.11	7/21/2013	41476	7/23/2013	41478		6	3.0	3.1			1.00	6.20				0.07	0.13	0.02	28	41.0				0.039			
6.12	7/23/2013	41478	7/25/2013	41480		6	3.0	3.2			1.10	8.00				0.02	0.12	0.02	11	56.5				0.037			
6.13	7/25/2013	41480	7/28/2013	41483	Case 1	6	3.2	3.0	8.30	4.58	1.10	7.40	22.2	1.02	33.9	0.05	0.12	0.03	15	43.5		3.68	9.00	0.044	9606	391	212
6.14	7/28/2013	41483	7/29/2013	41484	Case 1	6	3.0	3.2	6.01	3.39	1.20	6.40	21.9	1.08	34.6	0.06	0.13	0.03	20	42.5		2.73	6.67	0.037	6956	283	156
6.15	7/30/2013	41485	9/1/2013	41518	Case 1	6	2.9	3.1			1.00	7.50	22.9	0.47	38.5	0.06	0.12	0.03	11	63.0				0.031			
6.16	9/1/2013	41518	9/3/2013	41520	Case 1	6	3.2	3.1			1.20	7.40	23.1	0.58	35.8	0.05	0.16	0.03	40	47.0				0.040			
6.17	9/3/2013	41520	9/5/2013	41522	Case 1	6	3.1	3.5	9.30	3.82	1.30	8.40	23.0	0.50	35.1	0.05	0.14	0.03	20	58.5		3.07	7.50	0.037	10764	439	177
6.18	9/5/2013	41522	9/7/2013	41524	Case 1	6	3.5	3.0	6.90	3.52	1.10	7.50	22.8	0.53	39.2	0.04	0.13	0.03	20	47.0		2.83	6.92	0.042	7986	325	162
6.19	9/7/2013	41524	9/9/2013	41526	Case 1	6	3.3	3.3	8.58	3.85	1.30	7.30	22.9	0.48	38.5	0.05	0.13	0.03	37	53.5		3.09	7.56	0.034	9931	405	178
6.20	9/9/2013	41526	9/12/2013	41529	Case 1	6	3.2	3.2			1.30	7.50	23.0	0.30	36.4	0.05	0.15	0.03	45	55.5				0.034			
6.21	9/12/2013	41529	9/14/2013	41531	Case 1	6	3.2	3.0			1.00	8.10	22.7	0.35	36.8	0.03	0.16	0.04	30	62.0				0.035			
6.22	9/14/2013	41531	9/16/2013	41533	Case 1	6	3.2	3.5			1.40	6.90	22.4	0.29	33.4	0.05	0.16	0.02	105	35.5				0.047			
6.23	9/16/2013	41533	9/19/2013	41536	Case 1	6	3.5	3.3			1.30	8.40	21.7	0.33	38.4	0.05	0.12	0.03	16	63.0				0.034			
6.24	9/19/2013	41536	9/21/2013	41538	Case 1	6	3.3	2.6			1.20	6.80	21.4	0.53	39.9	0.63	0.15	0.02	20	56.0				0.030			
6.25	9/21/2013	41538	9/23/2013	41540	Case 1	6	3.0	3.1	8.47	4.96	1.00	6.20	21.4	0.23	35.7	0.07	0.13	0.02	28	41.0		3.99	9.74	0.039	9803	399	229
6.26	9/23/2013	41540	9/25/2013	41542	Case 1	6	3.0	3.2			1.10	8.00	21.2	0.36	39.1	0.02	0.12	0.02	11	56.5				0.037			
6.27	9/25/2013	41542	9/28/2013	41545	Case 1	6	3.2	3.0			1.10	7.40	20.4	0.36	39.3	0.05	0.12	0.03	15	43.5				0.044			
6.28	9/28/2013	41545	9/29/2013	41546	Case 1	6	3.0	3.2			1.20	6.40	20.5	0.43	38.9	0.06	0.13	0.03	20	42.5				0.037			
6.29	9/30/2013	41547				6	2.9				1.00					0.06	0.12		11								
6.30	10/1/2013	41548	10/2/2013	41549	Case 1	6	2.7	3.4	6.40	3.49	0.90	6.00	20.2	0.85	35.6	0.03	0.03	0.02	0	44.0		2.81	6.86	0.035	7407	302	160
6.31	10/2/2013	41549	10/5/2013	41552	Case 1	6	3.4	3.0	8.30	3.56	1.40	7.00	20.3	0.62	36.3	0.03	0.10	0.02	0	56.0		2.86	6.99	0.030	9606	391	164
6.32	10/5/2013	41552	10/7/2013	41554	Case 1	6	3.0	3.3	8.32	3.50	1.00	7.20	19.9	0.60	36.1	0.04	0.10	0.03	0	57.0		2.82	6.88	0.033	9630	392	162
6.33	10/7/2013	41554	10/10/2013	41557	Case 1	6	3.3	3.2	8.90	3.39	1.30	7.80	19.4	0.72	38.1	0.04	0.09	0.03	0	63.0		2.73	6.66	0.031	10301	420	157
6.34	10/10/2013	41557	10/13/2013	41560	Case 1	6	3.2	2.5	8.80	3.20	1.00	8.00	17.9	0.58	35.7	0.04	0.12	0.02	15	66.0		2.57	6.29	0.032	10185	415	148
6.35	10/13/2013	41560	10/15/2013	41562	Case 1	6	2.5	3.0	8.34	3.23	1.10	7.30	18.4	0.72	33.9	0.04	0.13	0.03	10	62.0		2.59	6.34	0.030	9653	393	149
6.36	10/15/2013	41562	10/18/2013	41565	Case 1	6	3.0	3.0	8.50	3.40	1.20	7.60	17.9	0.71	35.1	0.05	0.15	0.03	30	60.0		2.73	6.68	0.033	9838	401	157
6.37	10/18/2013	41565	10/20/2013	41567	Case 1	6	2.9	3.2	6.90	3.18	1.20	6.70	18.0	2.20	37.2	0.03	0.15	0.03	20	52.0		2.56	6.26	0.032	7986	325	147
6.38	10/21/2013	41568	10/23/2013	41570	Case 1	6	3.7	3.2	7.84	3.69	1.30	7.20	18.0	2.70	36.3	0.04	0.14	0.03	22	51.0		2.97	7.25	0.035	9074	370	170
6.39	10/23/2013	41570	10/26/2013	41573	Case 1	6	3.8	2.9	9.73	3.36	0.80	8.00	17.5	2.48	36.2	0.04	0.14	0.02	25	69.5		2.70	6.60	0.032	11262	459	156
6.40	10/27/2013	41574	10/29/2013	41576	Case 1	6	3.0	3.0	8.70	3.60	0.90	7.40	17.2	2.50	35.1	0.03	0.13	0.03	28	58.0		2.89	7.07	0.034	10069	410	167
6.41	10/29/2013	41576	11/1/2013	41579	Case 1	6	3.3	3.3	9.60	3.44	1.30	8.00	16.7	2.50	37.8	0.04	0.14	0.02	26	67.0		2.76	6.76	0.030	11111	453	159
6.42	11/2/2013	41580	11/4/2013	41582	Case 1	6	3.1	3.2	8.10	3.41	1.11	8.00	16.1	2.90	33.7	0.03	0.12	0.03	25	57.0		2.74	6.70	0.037	9375	382	158
6.43	11/4/2013	41582	11/8/2013	41586	Case 2	6	2.9	3.2			1.20	9.00	13.0	2.90	25.0	0.04	0.13	0.05	77	102.0				0.023			
6.44	11/10/2013	41588	11/14/2013	41592	Case 2	6	3.0	3.5	12.93	3.57	1.50	7.30	12.7	2.80	26.4	0.03	0.03	0.04	0	87.0		2.87	7.01	0.020	14965	610	166
6.45	11/14/2013	41592	11/18/2013	41596	Case 2	6	3.2	3.7	12.36	2.98	1.30	6.70	12.3	2.54	26.0	0.03	0.07	0.03	0	99.5		2.40	5.86	0.017	14306	583	139
6.46	11/19/2013	41597	11/24/2013	41602	Case 2	6	3.2	3.0	14.72	3.26	1.40	7.00	12.7	2.70	25.2	0.03	0.05	0.03	0	108.5		2.62	6.40	0.016	17037	694	152
6.47	11/27/2013	41605	12/2/2013	41610	Case 2	6	3.0	2.9	13.02	2.79	1.20	6.50	11.9	2.60	25.9	0.02	0.03	0.02	0	112.0		2.24	5.48	0.014	15069	614	130
6.48	12/6/2013	41614	12/10/2013	41618	Case 2	6	3.0	3.7	14.26	3.06	1.10	7.00	11.1	0.73	26.2	0.02	0.03	0.03	0	112.0		2.46	6.01	0.016	16505	672	142
6.49	12/12/2013	41620	12/16/2013	41624	Case 2	6	2.9	2.6	13.46	3.03	1.00	6.50	11.3	0.65	26.8	0.03	0.05	0.02	0	106.5		2.44	5.96	0.016	15579	635	141
6.50	12/17/2013	41625	12/22/2013	41630	Case 2	6	2.8	2.1	12.94	2.59	1.00	5.20	11.6	0.60	26.8	0.03	0.08	0.02	0	120.0		2.08	5.09	0.011	14977	610	121
6.51	12/29/2013	41637				6	3.9				1.20					0.02	0.03		0								

MODEL CALIBRATION WORKSPACE

Link operating conditions, media characteristics, and calibration parameters to their corresponding values on the "Main Interface" page.
The model output values are already linked, and should be compared to available data. Calibration parameters are found with Solver.

Operating conditions

WTP:	SGTP
Case:	Case 2

Particle count	#/mL	0.00
Turbidity	NTU	1.99
Suspended solids	mg/L	0.00
Coagulant dose	mg/L	26
Filter aid dose	mg/L	0.00
Loading rate	m/hr	6.3
Temperature	°C	12

Calibration parameters

b	0.5 to 50	Increase time to breakthrough	15
f	0.35 to 35	Reduce time to headloss	0.29
k	0.4 to 40	Increase final particle count	1.49
p	2.5 to 10	Reduce final turbidity	4.31
n	0.0175	Increase clean bed headloss	0.016
T	20	Calibration temperature for n	21

Calibration procedure

1. Enter the operating temperature for the filter data in K15
2. Minimize the clean bed headloss error (R11) by changing *n* (K14)
3. Minimize the headloss accumulation error (R12) by changing *f* (K11)
4. Minimize the sum of the error in final particles and turbidity (R20) by simultaneously changing *k* and *p* (K12:K13)
5. Check that the total error has decreased to a reasonable level

Model output and data comparison

Parameter	Unit	Measured	Predicted	Difference
Clean bed Headloss =	m	0.33	0.3349	**0%**
Headloss accumulation =	m/h	0.020	0.0201	**1%**
Time to Breakthru =	hr		131	
Time to headloss =	hr	92	91.6	0%
UFRV =	m	571	574	1%
NWP =	m/d	148	148	0%
Final Particles =	#/mL		222	
Log [No/N] =	log		2.5	
Operating Turbity =	ntu	0.037	0.0352	4%
	Final particles / turbidity error			**4%**
	Total error			6%

MODEL CALIBRATION LOG

Bon Tempe Treatment Plant

Parameter	Unit	Case 1		Case 2	
		Data	Model	Data	Model
Clean bed Headloss	m	0.24	0.20	0.12	0.14
Headloss Accumulation	m/h	0.039	0.039	0.079	0.079
Time to Breakthru	hr		65		30
Time to Headloss	hr	57	57	29	27
UFRV	m	349	355	108	103
NWP	m/d	147	147	85	84
Final Particles	#/mL		72		276
Log [No/N]	log		2.4		1.8
Operating Turbidity	NTU	0.024	0.023	0.047	0.045

San Geronimo Treatment Plant

Parameter	Unit	Case 1		Case 2	
		Data	Model	Data	Model
Clean bed Headloss	m	0.32	0.30	0.33	0.33
Headloss Accumulation	m/h	0.037	0.037	0.020	0.020
Time to Breakthru	hr		154		131
Time to Headloss	hr	55	56	92	92
UFRV	m	389	390	571	577
NWP	m/d	165	165	148	148
Final Particles	#/mL		203		223
Log [No/N]	log		2.2		2.5
Operating Turbidity	NTU	0.035	0.033	0.037	0.035

MMWD Filter Rehab

Media Configuration Evaluation

Bon Tempe Treatment Plant

Predicted Turbidity (NTU)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
BT-0	0.023	0.045	0.025	0.055
BT-1	0.023	0.043	0.024	0.054
BT-2	**0.023**	**0.045**	**0.025**	**0.056**
BT-3	0.024	0.045	0.025	0.057
BT-4	0.024	0.047	0.025	0.059
BT-5	0.023	0.045	0.025	0.055
BT-6	0.023	0.044	0.025	0.055
BT-7	0.024	0.045	0.025	0.057
BT-8	0.024	0.046	0.025	0.057

Predicted UFRV (gal/sf)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
BT-0	8713	2522	6471	1386
BT-1	8603	2500	6471	1386
BT-2	**9410**	**2601**	**6131**	**1313**
BT-3	8940	2471	5824	1248
BT-4	8514	2353	5547	1188
BT-5	9410	2601	6131	1313
BT-6	9351	2601	6131	1313
BT-7	9410	2601	6131	1313
BT-8	9410	2601	6131	1313

Predicted Filter Run Time (hr)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
BT-0	57	27	18	4
BT-1	56	27	18	4
BT-2	**61**	**28**	**17**	**4**
BT-3	58	27	16	3
BT-4	56	26	15	3
BT-5	61	28	17	4
BT-6	61	28	17	4
BT-7	61	28	17	4
BT-8	61	28	17	4

Time to Breakthrough (hr)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
BT-0	65	30	18	4
BT-1	65	30	18	4
BT-2	**61**	**28**	**17**	**4**
BT-3	58	27	16	3
BT-4	56	26	15	3
BT-5	61	28	17	4
BT-6	61	28	17	4
BT-7	61	28	17	4
BT-8	61	28	17	4

Clean Bed Headloss (in)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
BT-0	7.8	5.4	18.4	21.4
BT-1	8.9	6.2	21.0	24.4
BT-2	**7.5**	**5.2**	**17.6**	**20.5**
BT-3	7.2	5.0	17.0	19.7
BT-4	6.2	4.3	14.5	16.9
BT-5	8.1	5.6	19.1	22.2
BT-6	8.7	6.1	20.5	23.8
BT-7	6.9	4.8	16.2	18.8
BT-8	6.3	4.4	14.8	17.1

San Geronimo Treatment Plant

Predicted Turbidity (NTU)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
SG-0	0.033	0.035	0.037	0.039
SG-1	0.033	0.034	0.036	0.038
SG-2	0.034	0.036	0.037	0.040
SG-3	**0.035**	**0.037**	0.038	0.041
SG-4	0.036	0.038	0.040	0.043
SG-5	0.035	0.036	0.038	0.041
SG-6	0.034	0.036	0.038	0.041
SG-7	0.035	0.037	0.039	0.042
SG-8	0.035	0.037	0.039	0.042

Predicted UFRV (gal/sf)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
SG-0	9572	14173	8063	10707
SG-1	9379	13812	7659	9860
SG-2	11334	16830	9702	11871
SG-3	**12427**	**17316**	**10925**	**11306**
SG-4	15496	15151	13697	9893
SG-5	12314	17316	10689	11306
SG-6	12202	17316	10453	11306
SG-7	12539	17316	11161	11306
SG-8	12652	17316	11397	11306

Predicted Filter Run Time (hr)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
SG-0	56	92	22	30
SG-1	55	90	21	27
SG-2	66	109	27	33
SG-3	**72**	**113**	**30**	**31**
SG-4	90	99	38	27
SG-5	72	113	30	31
SG-6	71	113	29	31
SG-7	73	113	31	31
SG-8	74	113	32	31

Time to Breakthrough (hr)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
SG-0	154	131	51	37
SG-1	154	131	51	37
SG-2	138	118	46	33
SG-3	**132**	**113**	**43**	**31**
SG-4	115	99	38	27
SG-5	132	113	43	31
SG-6	132	113	43	31
SG-7	132	113	43	31
SG-8	132	113	43	31

Clean Bed Headloss (in)

	Case 1	Case 2	Case 1 - HR	Case 2 - HR
SG-0	11.6	13.2	24.4	30.9
SG-1	13.3	15.0	27.8	35.3
SG-2	10.8	12.2	22.6	28.6
SG-3	**9.2**	**10.4**	**19.3**	**24.4**
SG-4	7.5	8.5	15.7	19.8
SG-5	9.9	11.3	20.9	26.4
SG-6	10.7	12.1	22.5	28.4
SG-7	8.4	9.6	17.7	22.4
SG-8	7.7	8.7	16.1	20.4

Dual-media Filtration Performance Model

USER INPUT DATA

Parameter		Unit	Value
Operating conditions			
Particle count		#/mL	
Turbidity		NTU	0.54
Suspended solids		mg/L	
Coagulant dose		mg/L	25
Filter aid dose		mg/L	
Loading rate		m/hr	6.2
Temperature		°C	23
Media characteristics			
Top Layer	d_{10}	mm	0.90
	SG	g/cm^3	1.65
	UC	-	1.40
	Depth	m	0.86
Bottom Layer	d_{10}	mm	0.50
	SG	g/cm^3	2.65
	UC	-	1.40
	Depth	m	0.30
Terminal head loss		m	2.4
Mode of operation			
Conventional filtration			

DATABASE LOOKUP

Data type	Lookup value
Operating conditions	Case 1
Media characteristics	BT-0
Water treatment plant	BTTP

CALIBRATION PARAMETERS

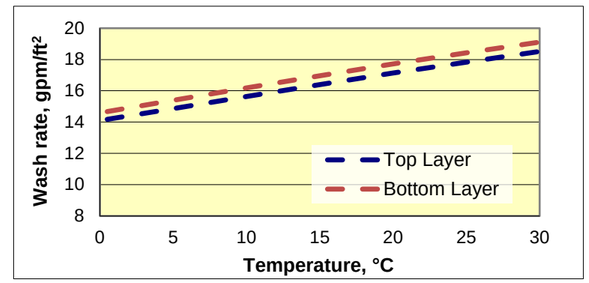
Variable	Typ. Value	Significance	Value
b	0.5 to 50	Increase time to breakthrough	2.00
f	0.35 to 35	Reduce time to headloss	2.08
k	0.4 to 40	Increase final particle count	0.48
p	2.5 to 10	Reduce final turbidity	4.46
n	0.0175	Increase clean bed headloss	0.012
T	20	Calibration temperature for n	23

COLOR KEY

= Operating conditions data
= Media characteristics data
= Calibration parameters
= Model predictions
= Reference or pilot-testing data

MODEL OUTPUT

Clean bed headloss =	0.20	m	7.8	in
Headloss accumulation =	0.039	m/hr	1.5	iph
Time to breakthrough =	64.9	hr		
Time to headloss =	56.9	hr		
UFRV =	355	m	8,713	gal/ft^2
NWP =	147	m/d	3,604	gpd/ft^2
Final particles =	72	#/mL		
Particle removal =	2.37	log		
Operating turbidity =	0.023	NTU		
Backwash rate =	42.8	m/hr	17.5	gpm/ft^2
Overall L/d ratio =	1569			



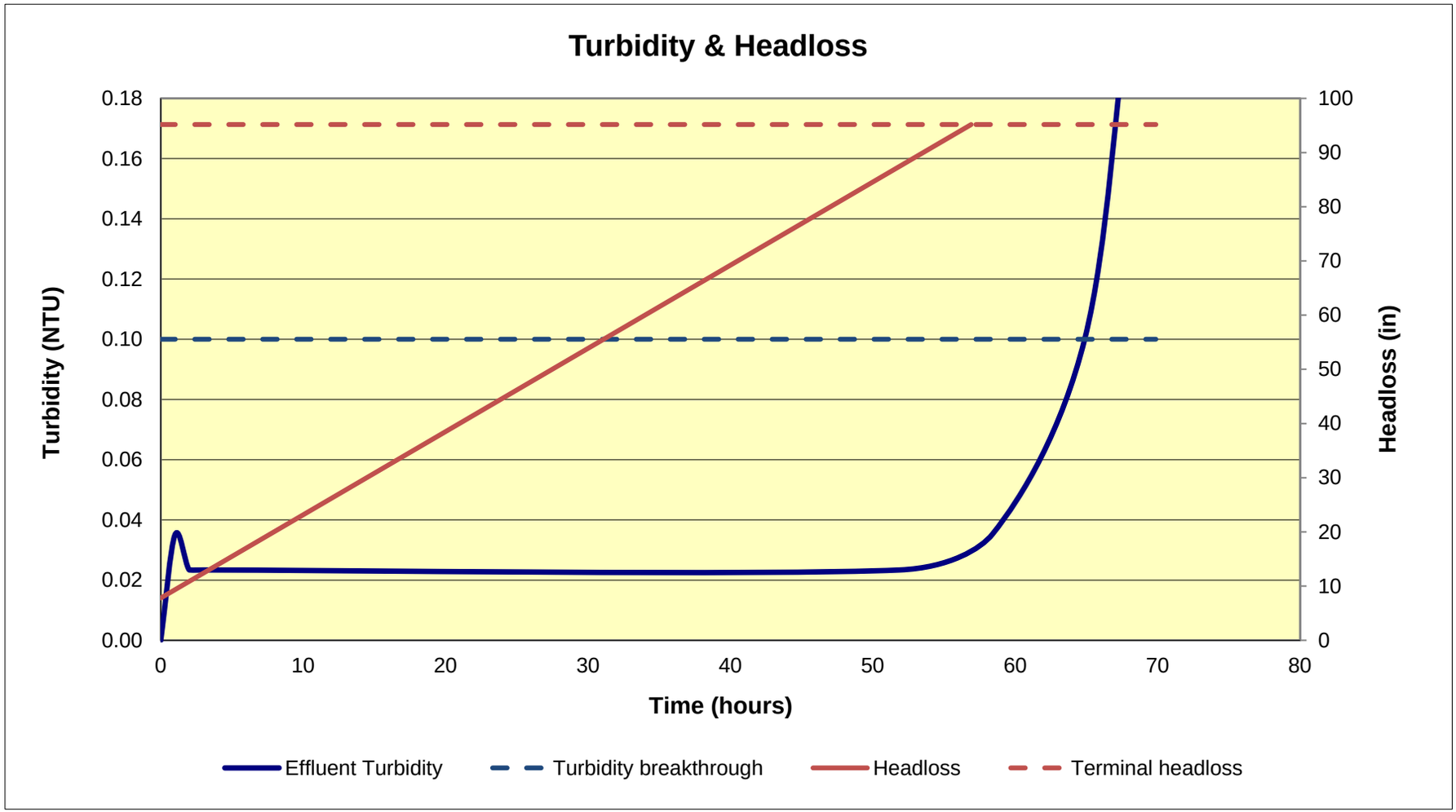
Backwash compatibility check

$$\frac{d_{10-Bot} \times UC_{Bot}}{d_{10-Top} \times UC_{Top}} = \left(\frac{SG_{Top} - 1}{SG_{Bot} - 1}\right)^{\frac{2}{3}}$$

0.556 = 0.537

Media Balanced

GRAPH OF PREDICTED FILTER RUN



FILTER PERFORMANCE CALCULATIONS

Overall L/d ratio

L_{top}/d_{top} =	0.960	
$L_{top}/d_{top}+L_{bot}/d_{bot}$ =	1.569	
Overall L/d =	1569	
Total bed depth L =	1.17	m

Clean bed head loss

$\nu[T_{Cal}]$ =	0.936	mm^2/s	c_1 =	-9.85E-06	
$\nu[T]$ =	0.935	mm^2/s	c_2 =	0.0011	
ν_{Ratio} =	0.999		c_3 =	-0.0577	
$H[L_{top}/d_{top}]$ =	0.104	m	b =	1.7845	
$H[L_{top}/d_{top}+L_{bot}/d_{bot}]$ =	0.198	m			
Clean bed headloss =	0.20	m			

$$\nu(T) \approx c_1T^3 + c_2T^2 + c_3T + b$$

$$HL_{Clean} = nV_a\left(\frac{L_{top}}{d_{top}^{\ 2}} + 1.3\frac{L_{bot}}{d_{bot}^{\ 2}}\right)\left(\frac{\nu[T]}{\nu[T_{Cal}]}\right)$$

Influent concentrations

Raw Particles =	16,726	#/mL
Raw Turbidity =	0.54	#/mL
Suspended Solids =	0.68	mg/L
Alum =	24.71	mg/L
Influent concentration C_0 =	2.57	mg/L

If given, these values are taken from user input data.
If not given, these values are estimated empirically:

$$Raw\ Particles \approx (Raw\ Turb - 0.018) \times 32{,}000$$

Conventional filtration $\quad Raw\ SS \approx Raw\ Turb \times 1.25 \qquad C_0 \approx 3.8 \times Raw\ SS$

Direct filtration $\quad C_0 \approx a \times Raw\ Turb + Alum$

Filter cycle time

Sigma (breakthrough) =	890	
Gamma (headloss) =	2.43E-03	
Breakthrough time =	64.9	hrs
Headloss time =	56.9	hrs
Filter run time =	56.9	hrs
Headloss accumulation =	0.039	m/hr

Scaling factors:

$$\sigma = bV_a^{\ c}d_{10}^{\ d}\left(1+\frac{eC_{fa}}{C_{alum}}\right)^i \qquad \Gamma = fV_a^{\ g}d_{10}^{\ h}\left(1+\frac{eC_{fa}}{C_{alum}}\right)^j$$

Estimated run time:

$$t_b = \frac{\sigma L}{V_aC_0} \qquad t_h = \frac{H_d - H_0}{\Gamma V_aC_0} \qquad \frac{dH}{dt} = \Gamma V_aC_0$$

Filter water efficiency

Unit backwash volume =	5.7	m
Backwash time =	11.5	min
Net water production =	147	m/day
Unit filter run volume =	355	m

$$NWP = V_a\left(24\ hr - \frac{24\ hr}{t_{Fi}\ hr} \times \frac{t_{BW}\ min}{60\ min}\right) - UFBV \times \frac{24\ hr}{t_{Fi}\ hr}$$

$$UFRV = V_at_{Fi}$$

Filtrate quality

Final particles =	72	#/mL
Particle removal =	2.37	log
Operating turbidity =	0.023	NTU

Final particles:

$$N_{out} = \frac{kd_{bot}^{\ l}V_a^{\ r}}{\left[1+m\left(\frac{L}{d}\right)\right]^q}$$

Turbidity:

$$NTU_{out} = 0.018 + \frac{N_{out}}{p}$$

Model parameters from pilot tests:

a =	0.10	Alum, influent turbidity and C_0
b =	2.0E+03	Basic sigma coeff
c =	-0.5	Sigma and filter rate
d =	-1	Sigma and d_{10}
e =	200	Sigma, gamma and filter aid
f =	2.1E-03	Basic gamma coeff
g =	-1.5	Gamma and filter rate
h =	0	Gamma and d_{10}
i =	0.15	Sigma and filter aid
j =	1.50	Gamma and filter aid
k =	4.8E+02	Basic particle/mL coeff
l =	0.25	Effluent particles & sand size
m =	0.05	Effluent particles and L/d
n =	0.012	Carman-Kozeny constant
o =	0.018	Turbidity of pure water
p =	13370	Effluent turbidity coeff
q =	0.5	Effluent particles and L/d [exp]
r =	0.25	Particles and filtration rate
s =	0.2	Particles and filter aid

BACKWASH VELOCITY CALCULATIONS

Ref: Kawamura, S., "Design and Operation of High-Rate Filters - Part I," *J. AWWA* , 10/75
[equation 7, Figure 4]

$$V_{Backwash} = \kappa \left(\frac{\rho_{Media} - \rho_{Water}}{\rho_{Water}} g \right)^{\frac{2}{3}} \nu_{Water}{}^{-\frac{1}{3}} d_{60}$$

Basic physical properties

Temperature	°C	0.5	5	10	15	20	25	30
Abs. temperature	K	273.65	278.15	283.15	288.15	293.15	298.15	303.15
Water density	g/cm^3	1.0001	1.0001	0.9997	0.9991	0.9982	0.9971	0.9957
Kinematic viscosity	mm^2/s	1.7559	1.5228	1.3104	1.1399	1.0039	0.8950	0.8058
κ and g factor		0.738	0.738	0.738	0.738	0.738	0.738	0.738

Top layer velocities

Anthracite d_{60} = 1.26 mm

Temperature	°C	0.5	5	10	15	20	25	30
Backwash velocity	m/min	0.58	0.61	0.64	0.67	0.70	0.73	0.76
	in/min	22.8	23.9	25.1	26.3	27.5	28.6	29.7
	m/hr	34.7	36.4	38.3	40.1	41.9	43.7	45.3
	gpm/ft^2	14.2	14.9	15.6	16.4	17.1	17.8	18.5

Bottom layer velocities

Sand d_{60} = 0.70 mm

Temperature	°C	0.5	5	10	15	20	25	30
Backwash velocity	m/min	0.60	0.63	0.66	0.69	0.72	0.75	0.78
	in/min	23.5	24.7	26.0	27.2	28.4	29.6	30.7
	m/hr	35.9	37.6	39.6	41.5	43.3	45.1	46.7
	gpm/ft^2	14.7	15.4	16.2	17.0	17.7	18.4	19.1

Required velocity at given temperature

Top layer	m/hr	42.8
Bottom layer	m/hr	44.3
Recommended	m/hr	42.8
Difference	%	3%

DATABASE OF MODEL CALIBRATION PARAMETERS

Carman-Kozeny Coefficient

Application	Temp (°C)	n Value
BTTP	23	0.0120
SGTP	21	0.016

Bon Tempe Treatment Plant

Test ID	FITTING PARAMETERS			
	b	f	k	p
Case 1	2	2.08	0.48	4.46
Case 2	2.5	1.20	2.10	3.46
Case 1 - HR	2	2.08	0.48	4.46
Case 2 - HR	2.5	1.20	2.10	3.46

San Geronimo Treatment Plant

Test ID	FITTING PARAMETERS			
	b	f	k	p
Case 1	10	0.99	1.32	4.37
Case 2	15	0.29	1.49	4.31
Case 1 - HR	10	0.99	1.32	4.37
Case 2 - HR	15	0.29	1.49	4.31

DATABASE - FILTER MEDIA CONFIGURATIONS

Bon Tempe Treatment Plant

Parameter		Unit	BT-0	BT-1	BT-2	BT-3	BT-4	BT-5	BT-6	BT-7	BT-8	(INSERT)
Top Layer	d_{10}	mm	0.9	0.9	**0.95**	1.00	1.05	0.95	0.95	0.95	0.95	
	SG	g/cm^3	1.65	1.63	**1.63**	1.63	1.63	1.63	1.63	1.63	1.63	
	UC	-	1.4	1.4	**1.4**	1.4	1.4	1.4	1.4	1.4	1.4	
	Depth	in	34	34	**34**	34	34	32	30	36	38	
Bottom Layer	d_{10}	mm	0.50	0.45	**0.5**	0.5	0.55	0.5	0.5	0.5	0.5	
	SG	g/cm^3	2.65	2.64	**2.64**	2.64	2.64	2.64	2.64	2.64	2.64	
	UC	-	1.4	1.4	**1.4**	1.4	1.4	1.4	1.4	1.4	1.4	
	Depth	in	12	12	**12**	12	12	14	16	10	8	

San Geronimo Treatment Plant

Parameter		Unit	SG-0	SG-1	SG-2	SG-3	SG-4	SG-5	SG-6	SG-7	SG-8	(INSERT)
Top Layer	d_{10}	mm	0.9	0.9	1.0	**1.05**	1.2	1.05	1.05	1.05	1.05	
	SG	g/cm^3	1.65	1.63	1.63	**1.63**	1.63	1.63	1.63	1.63	1.63	
	UC	-	1.4	1.4	1.4	**1.4**	1.4	1.4	1.4	1.4	1.4	
	Depth	in	34	34	34	**34**	34	32	30	36	38	
Bottom Layer	d_{10}	mm	0.50	0.45	0.5	**0.55**	0.6	0.55	0.55	0.55	0.55	
	SG	g/cm^3	2.65	2.64	2.64	**2.64**	2.64	2.64	2.64	2.64	2.64	
	UC	-	1.4	1.4	1.4	**1.4**	1.4	1.4	1.4	1.4	1.4	
	Depth	in	12	12	12	**12**	12	14	16	10	8	

DATABASE - OPERATING CONDITIONS AND SETPOINTS

Bon Tempe Treatment Plant

Case 1 = normal operation
Case 2 = direct filtration

Parameter	Unit	Case 1	Case 1 - HR	Case 2	Case 2 - HR
Turbidity	NTU	0.54	0.54	0.51	0.51
Coagulant dose	mg/L	25	25	15	15
Loading rate	m/hr	6.2	14.7	3.7	14.7
Temperature	°C	23	23	17	17
Conventional / Direct		Conventional filtration	Conventional filtration	Direct filtration	Direct filtration
Backwash Time	min	11.5	11.5	11.5	11.5
Unit Backwash Volume	m	5.7	5.7	5.7	5.7
Terminal Headloss	m	2.4	2.4	2.3	2.3

San Geronimo Treatment Plant

Case 1 = operation with Nicasio water
Case 2 = operation with Kent water

Parameter	Unit	Case 1	Case 1 - HR	Case 2	Case 2 - HR
Settled water turbidity	NTU	0.96	0.96	1.99	1.99
Coagulant dose	mg/L	37	37	26	26
Loading Rate	m/hr	7.0	14.7	6.3	14.7
Temperature	°C	21	21	12	12
Conventional / Direct		Conventional filtration	Conventional filtration	Conventional filtration	Conventional filtration
Backwash Time	min	10	10	10	10
Unit Backwash Volume	m	6.6	6.6	6.6	6.6
Terminal Headloss	m	2.4	2.4	2.2	2.2

MMWD Filter Rehab

Options for Media Balance

Existing Size Range - BTTP

Specified Size Range - BTTP

Specified Size Range - SGTP

Specific Gravities

Sand SG = 2.64 g/mL

Anthracite SG = 1.63 g/mL

Uniformity Coefficients

Sand UC = 1.4

Anthracite UC = 1.4

Compatibility Limits:

Balance within ± 0.06

Balance Evaluation

Sand (mm) / Anthracite (mm)	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.57	0.58	0.59	0.60
0.80	0.03	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.13	0.15	0.16	0.17	0.18	0.20	0.21	0.22
0.81	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.18	0.19	0.20	0.21
0.82	0.02	0.03	0.04	0.06	0.07	0.08	0.09	0.11	0.12	0.13	0.14	0.15	0.17	0.18	0.19	0.20
0.83	0.01	0.03	0.04	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.13	0.15	0.16	0.17	0.18	0.19
0.84	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.10	0.11	0.13	0.14	0.15	0.16	0.17	0.19
0.85	0.00	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12	0.13	0.14	0.15	0.17	0.18
0.86	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.12	0.13	0.15	0.16	0.17
0.87	0.01	0.00	0.01	0.02	0.03	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.13	0.14	0.15	0.16
0.88	0.02	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.09	0.10	0.11	0.12	0.13	0.14	0.15
0.89	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12	0.13	0.15
0.90	0.03	0.02	0.01	0.00	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.12	0.13	0.14
0.91	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.12	0.13
0.92	0.04	0.03	0.02	0.01	0.00	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11	0.12
0.93	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.10	0.11	0.12
0.94	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.04	0.05	0.06	0.07	0.08	0.09	0.10	0.11
0.95	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
0.96	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.07	0.08	0.09	0.10
0.97	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.98	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
0.99	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
1.00	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.01	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07
1.02	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05	0.06
1.03	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.02	0.03	0.04	0.05
1.04	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04	0.05
1.05	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.00	0.01	0.02	0.03	0.04
1.06	0.10	0.09	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03	0.04
1.07	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.01	0.02	0.03
1.08	0.11	0.10	0.09	0.08	0.07	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02	0.03
1.09	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.01	0.02
1.10	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01	0.02
1.11	0.12	0.11	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.01	0.01	0.00	0.01
1.12	0.13	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.04	0.03	0.02	0.01	0.00	0.01
1.13	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01	0.00
1.14	0.13	0.12	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.05	0.04	0.03	0.02	0.01	0.00
1.15	0.14	0.13	0.12	0.11	0.10	0.09	0.08	0.08	0.07	0.06	0.05	0.04	0.03	0.02	0.02	0.01

MMWD Filter Rehabilitation

Filter Velocity Scenarios - BTTP

Filter Area =	786	sf			
Low Flow =	2	mgd	Low rate =	2.0	gpm/sf
Average Flow =	5	mgd	High rate =	3.5	gpm/sf
Peak Flow =	20	mgd	Max rate =	6.0	gpm/sf

Filters Online	Filtration Velocity (gpm/sf)		
	2 mgd	5 mgd	20 mgd
4	0.44	1.10	4.42
3	0.59	1.47	5.89
2	0.88	2.21	8.84
1	1.77	4.42	17.67

MMWD Filter Rehabilitation

Filter Velocity Scenarios - SGTP

Filter Area =	786	sf			
Low Flow =	6	mgd	Low rate =	2.0	gpm/sf
Average Flow =	13	mgd	High rate =	3.5	gpm/sf
Peak Flow =	35	mgd	Max rate =	6.0	gpm/sf

Filters Online	Filtration Velocity (gpm/sf)		
	6 mgd	13 mgd	35 mgd
6	0.88	1.91	5.15
5	1.06	2.30	6.18
4	1.33	2.87	7.73
3	1.77	3.83	10.31
2	2.65	5.74	15.46
1	5.30	11.49	30.92

Appendix D - List of Planned Drawings and Specifications

SPECIFICATIONS LIST

Division 1 - General Requirements

01 10 00	Summary of Work
01 10 13	Specifications, Contract Drawings and As-Built Drawings
01 29 00	Payment Procedures
01 29 73	Schedule of Values
01 31 13	Project Coordination
01 32 16	CPM Construction Schedule
01 33 00	Contractor Submittals
01 35 45	Construction Waste Management
01 41 00	Safety and Regulatory Requirements
01 41 60	Special Inspections
01 42 19	Reference Standards
01 45 00	Quality Control
01 50 00	Mobilization
01 50 10	Protection of Existing Facilities
01 51 00	Temporary Utilities
01 52 00	Field Offices, Equipment and Services
01 55 00	Site Access and Storage
01 57 19	Temporary Environmental Controls
01 74 10	Testing and Disinfection of Concrete and Steel Water Structures
01 79 00	Demonstration and Training

Division 2 - Existing Conditions

02 41 19	Demolition and Reconstruction

Division 3 - Concrete

03 01 30	Concrete Repair and Rehabilitation
03 11 00	Concrete Formwork
03 21 00	Reinforcement Steel
03 31 00	Cast-in-Place Concrete
03 32 00	Joints in Concrete
03 37 19	Pneumatically Placed Concrete
03 60 00	Grouting

Division 4 - Masonry (Not Used)

Division 5 - Metals

05 12 10	Structural Steel Framing
05 50 00	Miscellaneous Metalwork

Divisions 6-8 (Not Used)

Division 9 - Finishes

09 96 00	Protective Coating

Divisions 10-23 (Not Used)

Division 26 - Electrical

26 00 00	Electrical Work, General
26 01 26	Electrical Tests
26 05 19	Wire and Cabling
26 05 26	Grounding
26 05 33	Electrical Raceway Systems

Division 27-28 (Not Used)

Division 31- Earthwork

31 23 19	Dewatering

Division 40 - Process Integration

40 05 00	Piping General
40 05 02	Piping Identification
40 05 23	Stainless Steel Pipe
40 05 30	PVC Pressure Pipe
40 05 31	CPVC Pressure Pipe
40 90 10	Control Strategies
40 91 00	Process and Control Instrumentation Systems
40 91 08	Pressure Measuring

Division 41 - Process Equipment

41 40 53	Plastic Block Air Scouring Filter Underdrains

Division 43 - Material Handling Equipment

43 30 00	Valves, General

Division 46 - Water & Wastewater Equipment (Not Used)

MMWD Filter Rehabilitation and Seismic Upgrades - Drawing List

Drawing Number	Title
General	
G-1	COVER SHEET
G-2	LIST OF DRAWINGS
G-3	LOCATION MAP AND VICINITY MAP
G-4	PROCESS FLOW DIAGRAM
G-5	DESIGN CRITERIA
G-6	HYDRAULIC PROFILE
G-7	SYMBOLS
G-8	ABBREVIATIONS
Civil	
GC-1	SYMBOLS & LEGENDS
GC-2	PIPING AND TRENCHING DETAILS
C-1	BTTP SITE PLAN
C-2	BTTP YARD PIPING PLAN PLANT
C-3	SGTP SITE PLAN
C-4	SGTP YARD PIPING PLAN PLANT
C-5	PHOEINIX BYPASS SITE PLAN
C-6	PHOEINIX BYPASSGRADING PLAN
C-7	PHOEINIX BYPASSYARD PIPING PLAN
Structural	
GS-1	GENERAL NOTES AND STRUCTURAL STANDARD DETAILS - I
GS-2	SPECIAL INSPECTIONS AND STRUCTURAL OBSERVATIONS - I
GS-3	SPECIAL INSPECTIONS AND STRUCTURAL OBSERVATIONS - II
GS-4	STRUCTURAL STANDARD DETAILS - II
GS-5	STRUCTURAL STANDARD DETAILS - III
GS-6	STRUCTURAL STANDARD DETAILS - IV
GS-7	STRUCTURAL STANDARD DETAILS - V
S-1	BTTP FILTERS 1-4 - LOWER PLAN
S-2	BTTP FILTERS 1-4 - UPPER PLAN
S-3	BTTP CONTROL GALLERY - ROOF PLAN
S-4	BTTP FILTERS 1-4 - SECTIONS - I
S-5	BTTP FILTERS 1-4 - SECTIONS - II
S-6	BTTP INFLUENT CHANNEL STRENGTHENING - DETAILS
S-7	BTTP PIPE GALLERY - PLAN
S-8	BTTP PIPE GALLERY - SECTIONS - I
S-9	BTTP PIPE GALLERY - SECTIONS - II
S-10	BTTP PIPE GALLERY -FRAME BRACE ELEVATIONS
S-11	BTTP CONTROL GALLERY -FRAME BRACE ELEVATIONS
S-12	BTTP CHEMICAL BUILDING -ROOF PLAN
S-13	SGTP FILTERS 1-4 - LOWER PLAN
S-14	SGTP FILTERS 1-4 - UPPER PLAN
S-15	SGTP FILTERS 1-4 CONTROL GALLERY - ROOF PLAN
S-16	SGTP FILTERS 1-4 - SECTIONS - I

S-17	SGTP FILTERS 1-4 - SECTIONS - II
S-18	SGTP FILTERS 1-4 PIPE GALLERY - PLAN
S-19	SGTP FILTERS 1-4 PIPE GALLERY - SECTIONS - I
S-20	SGTP FILTERS 1-4 PIPE GALLERY - SECTIONS - II
S-21	SGTP CONTROL GALLERY FILTERS 1-4 FRAME BRACE ELEVATIONS
S-22	SGTP FILTERS 5-6 - LOWER PLAN
S-23	SGTP FILTERS 5-6 - UPPER PLAN
S-24	SGTP FILTERS 5-6 CONTROL GALLERY - ROOF PLAN
S-25	SGTP FILTERS 5-6 - SECTIONS - I
S-26	SGTP FILTERS 5-6 - SECTIONS - II
S-27	SGTP FILTERS 5-6 PIPE GALLERY - PLAN
S-28	SGTP FILTERS 5-6 PIPE GALLERY - SECTIONS - I
S-29	SGTP FILTERS 5-6 PIPE GALLERY - SECTIONS - I
S-30	SGTP CONTROL GALLERY FILTERS 5-6 FRAME BRACE ELEVATIONS
S-31	SGTP CHEMICAL BUILDING -ROOF PLAN
S-32	PIPE GALLERY BRACING DETAILS
S-33	CONTROL GALLERY BRACING DETAILS
S-34	WALL TO ROOF ANCHORAGE DETAILS
S-35	PIPE BRACING - TYPICAL DETAILS
S-36	MISCELLANEOUS BRACING DETAILS
Mechanical	
GM-1	PIPING SCHEDULE
GM-2	EQUIPMENT SCHEDULES - I
GM-3	EQUIPMENT SCHEDULES - II
GM-4	MECHANICAL - STANDARD DETAILS - I
GM-5	MECHANICAL - STANDARD DETAILS - 2
GM-6	MECHANICAL - STANDARD DETAILS - 3
M-1	BTTP FILTER BASINS - PLAN OF BASINS
M-2	BTTP FILTER BASINS - SECTIONS
M-3	BTTP FILTER BASINS - SECTIONS
M-4	BTTP FILTER BASINS - DETAILS
M-5	BTTP FILTER GALLERY PLAN AND DETAILS
M-6	SGTP FILTER BASINS - PLAN OF BASINS
M-7	SGTP FILTER BASINS - SECTIONS
M-8	SGTP FILTER BASINS - SECTIONS
M-9	SGTP FILTER BASINS - DETAILS
M-10	SGTP FILTER GALLERY PLAN AND DETAILS
M-11	SGTP BLOWER PLAN AND DETAILS
M-12	CONIFER WAY-SMITH SADDLE INTERTIE - PUMP STATION PLAN AND SECTIONS
M-13	PHOENIX BYPASS REPLACEMENT - BYPASS VAULT PLAN AND SECTION
M-14	PHOENIX BYPASS REPLACEMENT - METER VAULT PLAN AND SECTIONS
Electrical	
GE-1	ELECTRICAL SYMBOLS
GE-2	ELECTRICAL SYMBOLS AND GENERAL NOTES
GE-3	CONTROL AND SIGNAL STANDARD DETAILS - I
GE-4	CONTROL AND SIGNAL STANDARD DETAILS - III
GE-5	CONTROL AND SIGNAL STANDARD DETAILS - III

E-1	BTTP FILTER POWER, CONTROL AND SIGNAL PLAN
E-2	BTTP CONTROL DIAGRAMS - FILTERS
E-3	BTTP DETAILS AND SCHEMATICS - I
E-4	BTTP CONDUIT SCHEDULE - I
E-5	SGTP FILTER POWER, CONTROL AND SIGNAL PLAN
E-6	SGTP BACKWASH BLOWER CONTROL AND SIGNAL PLAN
E-7	SGTP CONTROL DIAGRAMS - FILTERS
E-8	SGTP DETAILS AND SCHEMATICS - I
E-9	SGTP DETAILS AND SCHEMATICS - II
E-10	SGTP CONDUIT SCHEDULE - I
E-11	SGTP CONDUIT SCHEDULE - II
E-12	CONIFER WAY-SMITH SADDLE INTERTIE - POWER, CONTROL AND SIGNAL PLAN
E-13	CONIFER WAY-SMITH SADDLE INTERTIE - DETAILS AND SCHEMATICS - I
E-14	PHOENIX BYPASS REPLACEMENT - POWER, CONTROL AND SIGNAL PLAN
E-15	PHOENIX BYPASS REPLACEMENT - DETAILS AND SCHEMATICS - I
Instrumentation	
GI-1	INSTRUMENTATION SYMBOLS AND ABBREVIATIONS
GI-2	PROCESS SYMBOLS
GI-3	INSTRUMENTATION INSTALLATION DETAILS -I
GI-4	INSTRUMENTATION INSTALLATION DETAILS - II
GI-5	INSTRUMENTATION INSTALLATION DETAILS - III
I-1	BTTP CONTROL SYSTEM ARCHITECTURE DIAGRAM
I-2	BTTP P&ID - FILTERS
I-3	SGTP CONTROL SYSTEM ARCHITECTURE DIAGRAM
I-4	SGTP P&ID - FILTERS
I-5	SGTP P&ID - BLOWERS
I-6	CONIFER WAY-SMITH SADDLE INTERTIE - P&ID - CONTROL VALVE AND FLOW METER
I-7	CONIFER WAY-SMITH SADDLE INTERTIE - PANEL LAYOUT
I-8	CONIFER WAY-SMITH SADDLE INTERTIE - WIRING DIAGRAM 1
I-9	PHOENIX BYPASS REPLACEMENT - P&ID - BYPASS VAULT
I-10	PHOENIX BYPASS REPLACEMENT - P&ID - METER VAULT
I-11	PHOENIX BYPASS REPLACEMENT - PANEL LAYOUT
I-12	PHOENIX BYPASS REPLACEMENT - WIRING DIAGRAM 1
I-13	PHOENIX BYPASS REPLACEMENT - WIRING DIAGRAM 2

Appendix E – Draft Opinion of Probable Construction Cost

MWH
Walnut Creek

JLL
3/23/2016

MMWD
WTP Master Plan
Capital Improvement Plan
Bon Tempe Water Treatment Plant
Filter Upgrades - 4 Ea

Opinion of Probable Total Project Costs (TPC)

Currency: USD-United States-FEB 2015 Dollar

Grand Total Price: $ 2,400,000

BI #	GC	Description	Quantity	UOM	Unit Cost	Total Cost	Comments	Spread Unit Price	Final Unit Price	Final Total
A		**Replace (e) Filter Media / Seismic Upgrades for Reliability**	1	ls		$1,098,429		*$2,400,000*	*$2,400,000*	*$2,400,000*
1	P	***Remove/Replace (e) Filter Media & Underdrains***			*$533,240*					
2	S	Remove Old Filter Media	640	cy	$13	$8,000	vacuum truck, 1 week			
3	S	Transport/Dispose Old Filter Media	640	cy	$45	$28,800	to local Class III, non-haz for metals, $15/cy = fee			
4	P	Remove/Dispose Old Underdrains/Troughs	4,320	sf	$2.8	$12,000	one day/filter			
5	P	Purchase New Filter Media - Anthracite	512	cy	$75	$38,400	FOB plant			
6	P	Purchase New Filter Media - Sand	128	cy	$55	$7,040	FOB plant			
7	P	Power Wash Filter Interiors	3	dys	$2,000	$6,000	say 10,000 sf			
8	P	Purchase New Troughs	480	lf	$155	$74,400				
9	P	Purchase New Underdrains	4,320	sf	$55	$237,600	budget quote: JBL			
10	P	Install New Troughs/Underdrains	25	dys	$3,500	$87,500	say 5 dys/filter			
11	P	Install New Filter Media	6	dys	$3,500	$21,000	6-8 men + small equipment			
12	P	Backwash/Scrape New Filter Media	3	dys	$3,500	$10,500				
13	P	Test Filter Media	1	ls	$2,000	$2,000				
14	S	***Misc Seismic Upgrads***								
15	P	Add Supports to Top of Filter Wall - Reinforced Conc Beam	8	ea	$7,000	$56,000	reinforced concrete beam with drilled epoxy dowels			
16	P	Strengthen Gullett Assembly To Wall	12	ea	$5,000	$60,000				
17	P	Strenghten Diaphragm AB w/ FRP	-	ls	$10,000	$0				
18	P	Rebuild Column Supports under Influent Channel Corbel	1	ea	$5,000	$5,000	reinforced concrete wall support w/ footing, 8'x5'x12" w/ ftg			
19	P	New Steel Plate Bolted Connections to Wrap Around Columns	4	ea	$4,000	$16,000				
20	P	Confirm Welding of Metal Deck Roof Diaphragm to Stl Frames	7	loc	$2,000	$14,000	15' long = 105 lf of welding metal deck to roof			
21	P	Replacement to HSS Chevron Bracing & Connections	18	loc	$2,000	$36,000	6 frames x 3 connections, 12" HSS			
22	S	Add Seismic Bracing to Trapeze Hangers	20	loc	$1,500	$30,000	Add rod stiffeners and bracing anchored to (e) wall at 20 locations			
23	S	Brace FB TFR Bachwash Piping	10	loc	$1,500	$15,000	add braces to wll at 10 locations			
24	S	Add Wall Out-of-Anchorage at Roof	2	loc	$5,000	$10,000	addl structural framing at rood & new anchorge along 2 walls - 50'			
25	S	***Filter Seismic Upgrades***	*9,506*	*sf*	*$253,977*		assume: 33x36x17'H filters (6)			
26	S	Purchase Dowels	2,376	ea	$0.45	$1,063	#4s at 24" OC EW, 1' L, 8" into (e) concrete			
27	S	Drill/Grout Dowels	2,376	ea	7.31	$17,360	3 men + man lift + grout mixer at 40/hr = 320/day/crew			
28	S	Install Reinforcing Steel at Dowels	95,060	lb	$0.90	$85,554	#6s at 6" OC EW; = ~200 lbs/cy			
29	S	Place Shotcrete - 8"	250	cys	$600	$150,000	incls 5% waste			
30	S	New Polyeurethance Coating at Interior of Filter Walls	10,000	sf	$5.00	$50,000	assume 1 coat system			
31	S	Misc Structural Upgrades	1	ls	$15,000	$15,000	site piping, felxible joint connector on gas lines			
32	S	Replace Cement/Mortar Lining on Large Pipe - 3' dia	130	lf	$32	$4,212	4 days for 2 men + matls + small tools, assumed acessable			
					Running Subtotal:	$1,098,429				
G		**Startup/Commission/Owner Training**	1	ls		$0				
1	P	Pre-commissioning	-	hrs	$200	$0				
2	P	Vendor Support	-	ls	$10,000	$0				
3	P	Commissioning	-	hrs	$200	$0				
4	P	Training	-	hrs	$150	$0				
5	P	Startup Expendables	-	ls	$7,500	$0				
					Running Subtotal:	$1,098,429				
6	P	Unlisted Items Allowance, known but not priced	1	ls	5.0%	$54,921	on running subtotal			
					Running Subtotal:	$1,153,351	**Direct Construction Cost (DCC)**			
H		**Construction Allowances**				$664,967				
1		Prime Contractor General Conditions	1	ls	8%	$60,000				
2		Subcontractor General Conditions	1	ls	8%	$34,000				
3		Market Factor	1	ls	0%	$0	Premium for uncompetitive conditions, logistics, complexity,			
4		Construction Phasing Factor	1	ls	0%	$0	Premium for interfaces, constraints, etc.			
5		Subcontractor Markups	1	ls	15%	$67,348	H/O Overheads, Job Fee & Risk, insur, bond			
6		Prime Contractor OH&P on Subs	1	ls	5%	$25,817	Oversight + Risk			
7		Prime Contractor OH&P on Self-Perform	1	ls	11.0%	$87,800	Job Fee + Risk			
8		Contractor Insurance Program	1	ls	2.5%	$35,708	Performance/Payments Bonds, Genl Liability			
9		State Sales Taxes	1	ls	8.75%	$51,241	On Materials at 40% of running subtotal			
10		Design/Estimating Contingency	1	ls	20%	$303,053				
			Markup Factor	1.6554	**Running Subtotal:**	$1,818,320	**Base Construction Cost (BCC)**			
I		**Project Allowances**				$181,832				
1		Escalation	1	ls		$0	Excluded, current costs			
2		Construction Change Contingency	1	ls	10%	$181,832	rehab scope			
					Running Subtotal:	$2,000,000	**Total Construction Costs (TCC)**			
J		**Owner Allowances**				$400,000				
1	--	Misc Owner's Soft Costs (All)	1	ls	20.0%	$400,000	Excluded			
			Markup Factor	2.1849					Delta	Check Total
					Grand Total:	$2,400,000	**Total Project Cost (TPC)**		*$0*	*$2,400,000*
					Cost Range:	$1,900,000	$3,100,000	AACEI Criteria		

Qualifications:

1) This OPCC is classified as a Class 4 cost estimate per AACE guidelines. Stated accuracy range = -20% to + 30%
2) Pricing basis = 1st Qtr 2015, escalation to midpoint of construction is excluded
3) P=Prime, S=Subcontractor
4) Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
5) Special Inspections not included.
6) Permit Fees excluded

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MMWD
WTP Master Plan
Capital Improvement Plan
Bon Tempe Water Treatment Plant
Filter Upgrades - 4 Ea

Opinion of Probable Total Project Costs (TPC)

Currency: USD-United States-FEB 2015 Dollar

Grand Total Price: $ 2,400,000

BI #	GC	Description	Quantity	UOM	Unit Cost	Total Cost	Comments	Spread Unit Price	Final Unit Price	Final Total

OPCC Disclaimer

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AACE International **CLASS 4** Cost Estimate - Class 4 estimates are generally prepared based on limited information and subsequently have fairly wide accuracy ranges. Typically, engineering is 10% to 40% complete. They are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. Virtually all Class 4 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric and modeling techniques. Expected accuracy ranges are from -15% to -30% on the low side and +20% to 50% on the high side, depending on the technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances. As little as 20 hours or less to perhaps more than 300 hours may be spent preparing the estimate depending on the project and estimating methodology (AACE International Recommended Practices and Standards).

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MMWD
WTP Master Plan
Capital Improvement Plan
San Geronimo Water Treatment Plant
Filter Upgrades - 6 Ea

Opinion of Probable Total Project Costs (TPC)

Currency: USD-United States-FEB 2015 Dollar

Grand Total Price: $ 3,230,000

BI #	GC	Description	Quantity	UOM	Unit Cost	Total Cost	Comments	Spread Unit Price	Final Unit Price	Final Total
A		**Replace (e) Filter Media / Seismic Upgrades for Reliability**	1	ls		**$1,476,536**		*$3,226,000*	*$3,225,000*	*$3,225,000*
1	P	***Remove/Replace (e) Filter Media & Underdrains***			*$778,936*					
2	S	Remove Old Filter Media	1,056	cy	$8	$8,000	vacuum truck, 1 week			
3	S	Transport/Dispose Old Filter Media	1,056	cy	$45	$47,520	to local Class III, non-haz for metals, $15/cy = fee			
4	P	Remove/Dispose Old Underdrains/Troughs	7,128	sf	$1.7	$12,000	one day/filter			
5	P	Purchase New Filter Media - Anthracite	845	cy	$75	$63,360	FOB plant			
6	P	Purchase New Filter Media - Sand	211	cy	$55	$11,616	FOB plant			
7	P	Power Wash Filter Interiors	3	dys	$2,000	$6,000	say 10,000 sf			
8	P	Purchase New Troughs	480	lf	$155	$74,400				
9	P	Purchase New Underdrains	7,128	sf	$55	$392,040	budget quote: JBL			
10	P	Install New Troughs/Underdrains	30	dys	$4,000	$120,000	say 5 dys/filter			
11	P	Install New Filter Media	8	dys	$3,500	$28,000	6-8 men + small equipment			
12	P	Backwash/Scrape New Filter Media	4	dys	$3,500	$14,000				
13	P	Test Filter Media	1	ls	$2,000	$2,000				
14	S	***Misc Seismic Upgrads***								
15	P	Add Supports to Top of Filter Wall - Reinforced Conc Beam	8	ea	$7,000	$56,000	reinforced concrete beam with drilled epoxy dowels			
16	P	Strengthen Gullet Assembly to Wall - 16 loc	96	ea	$400	$38,400	connection = steel angle supports w / 4 four anchors to wall/trough			
17	P	Provide Column Supoorts Under Influent Channel Corbel								
18	P	New Steel Plate Bolted Connections to Wrap Around Columns	4	ea	$4,000	$16,000				
19	P	Confirm Welding of Metal Deck Roof Diaphragm to Stl Frames	9	loc	$2,000	$18,000	15' long = 105 lf of welding metal deck to roof			
20	P	Replacement to HSS Chevron Bracing & Connections	27	loc	$2,000	$54,000	9 frames x 3 connections, 12" HSS			
21	S	Add Seismic Bracing to Trapeze Hangers	20	loc	$1,500	$30,000	Add rod stiffeners and bracing anchored to (e) wall at 20 locations			
22	S	Brace FB TFR Bachwash Piping	10	loc	$1,500	$15,000	add braces to wll at 10 locations			
23	S	Add Wall Out-of-Anchorage at Roof	2	loc	$5,000	$10,000	addl structural framing at rood & new anchorge along 2 walls - 50'			
24	S	***Filter Seismic Upgrades***	*14,076*	*sf*	*$365,060*		assume: 33x36x17'H filters (6)			
25	S	Purchase Dowels	2,112	ea	$0.45	$945	#4s at 24" OC EW, 1' L, 8" into (e) concrete			
26	S	Drill/Grout Dowels	2,112	ea	7.31	$15,431	3 men + man lift + grout mixer at 40/hr = 320/day/crew			
27	S	Install Reinforcing Steel at Dowels	140,760	lb	$0.90	$126,684	#6s at 6" OC EW; = ~200 lbs/cy			
28	S	Place Shotcrete - 8"	370	cys	$600	$222,000	incls 5% waste			
29	S	New Polyeurethance Coating at Interior of Filter Walls	14,000	sf	$5.00	$70,000	assume 1 coat system			
30	S	Misc Structural Upgrades	1	ls	$20,000	$20,000	site piping, felxible joint connector on gas lines			
31	S	Replace Cement/Mortar Lining on Large Pipe - 3' dia	200	lf	$26	$5,140	3 days for 2 men + matls + small tools, assumed acessable			
					Running Subtotal:	**$1,476,536**				
G		**Startup/Commission/Owner Training**	1	ls		**$0**				
1	P	Pre-commissioning	-	hrs	$200	$0				
2	P	Vendor Support	-	ls	$10,000	$0				
3	P	Commissioning	-	hrs	$200	$0				
4	P	Training	-	hrs	$150	$0				
5	P	Startup Expendables	-	ls	$7,500	$0				
					Running Subtotal:	**$1,476,536**				
6	P	Unlisted Items Allowance, known but not priced	1	ls	5.0%	$73,827	on running subtotal			
					Running Subtotal:	**$1,550,363**	**Direct Construction Cost (DCC)**			
H		**Construction Allowances**				**$893,680**				
1		Prime Contractor General Conditions	1	ls	8%	$79,000				
2		Subcontractor General Conditions	1	ls	8%	$46,000				
3		Market Factor	1	ls	0%	$0	Premium for uncompetitive conditions, logistics, complexity,			
4		Construction Phasing Factor	1	ls	0%	$0	Premium for interfaces, constraints, etc.			
5		Subcontractor Markups	1	ls	15%	$92,508	H/O Overheads, Job Fee & Risk, insur, bond			
6		Prime Contractor OH&P on Subs	1	ls	5%	$35,461	Oversight + Risk			
7		Prime Contractor OH&P on Self-Perform	1	ls	11.0%	$116,500	Job Fee + Risk			
8		Contractor Insurance Program	1	ls	2.5%	$47,996	Performance/Payments Bonds, Genl Liability			
9		State Sales Taxes	1	ls	8.75%	$68,874	On Materials at 40% of running subtotal			
10		Design/Estimating Contingency	1	ls	20%	$407,340				
			Markup Factor	1.6553	**Running Subtotal:**	**$2,444,040**	**Base Construction Cost (BCC)**			
I		**Project Allowances**				**$244,404**				
1		Escalation	1	ls		**$0**	Excluded, current costs			
2		Construction Change Contingency	1	ls	10%	**$244,404**	rehab scope			
					Running Subtotal:	**$2,688,000**	**Total Construction Costs (TCC)**			
J		**Owner Allowances**				**$538,000**				
1	--	Misc Owner's Soft Costs (All)	1	ls	20.0%	**$538,000**	Excluded			
			Markup Factor	2.1848					Delta	Check Total
					Grand Total:	**$3,226,000**	**Total Project Cost (TPC)**		*($1,000)*	*$3,225,000*
					Cost Range:	**$2,600,000**	**$4,200,000**	AACEI Criteria		

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Opinion of Probable Total Project Costs (TPC)

Currency: USD-United States-FEB 2015 Dollar

Grand Total Price: $ 3,230,000

BI #	GC	Description	Quantity	UOM	Unit Cost	Total Cost	Comments	Spread Unit Price	Final Unit Price	Final Total

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