TETRA TECH

Memorandum

Date:	December 10, 2018		
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Cc:			
From:	Ken Berard		
Project:	WRD Modeling – Rio Hondo Spreading Ground TO#3	**Project Number:**	200-10949-17001-03
Subject:	Hydraulic Modeling for Shifting Operations and WRD Rio Hondo Spreading Grounds		

PURPOSE

The purpose of this report is to analyze the Central Basin MWD (CBMWD) recycled water system for various water supply scenarios between the Los Coyotes Treatment Plant and the San Jose Creek Treatment Plant. Restrictions placed on each of these treatment plants will dictate available recycled water supply the District will be able to obtain. In addition, changes in customers demands will affect the water supply demand at each of the plants. However, by adjusting flow between pressure zones 1 and 2, the District will be able to shift water supply requirements between the two treatment plants. This report evaluates the ability to shift water supply between the two treatment plants by adjusting the PRV setting between pressure Zones 1 and 2.

This report also identifies the capacity of recycled water that could be provided to the Water Replenishment District (WRD) at the Rio Hondo Spreading Grounds (RHSG) under these various future operating settings.

GENERAL

Existing System

The recycled water distribution system contains two pump stations: Rio Hondo pump station (RHPS) to the north (located in Zone-1) which is supplied by the San Jose Creek Water Treatment Plant (SJCWTP) and Cerritos pump station (CPS) located to the south (Zone-2) which is supplied by the Los Coyotes Water Treatment Plant (LCWTP). The San Jose Creek Treatment Plant supplies water to the CBMWD system via the RHPS.

A significant increase in elevation occurs from the southerly Zone-2 to the northerly Zone-1 with over 240 feet in elevation change. A pressure reducing station, known as the Norwalk Pressure Reducing Station (located in Santa Fe Springs), separates zone 1 and zone 2 and controls flows between the zones. The Norwalk Pressure Reducing Station will be referred to throughout this memo as, simply, the “PRV”.

The change in elevation from the Cerritos PS to the Zones 1-2 interface at the PRV is approximately 70 feet which is equivalent to nearly 30 psi (minimum) in reduced pressure. Additional pressure losses will occur due to friction and is dependent on the flow rate and piping/appurtenances.

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In fiscal year 2017, the total user demand from the system based on meter data for the entire year was approximately 4,420 AFY. New users are in the process of being added to the system, and will be included in the new fiscal year. The hydraulic model of the existing system includes these new users that total approximately 530 AFY of demand. These users are anticipated to be connected in the imminent future and are assumed to be existing for this study.

Water Rights Transfer and Zones 1 & 2 Supply

CBMWD has a contract for 5,000 AFY of water rights at the SJCWTP. CBMWD is considering a "transfer" up to 3,000 AFY of this to WRD. If the transfer is implemented, CBMWD would have 2,000 AFY that could be pumped out of RHPS to the system. Physical deliveries to WRD are also possible and would be through the Rio Hondo Spreading Grounds at a connection to the CBMWD system in Zone 1. Since providing water rights at the San Jose Creek Water Treatment Plant (SJCWTP) does not involve significant physical improvements, it may be advantageous to maximize this mode of delivery.

Some of the scenarios considered in this study assume the 3,000 AFY of water rights transfer to WRD (for use at their Albert Robles Center or "ARC") and the restriction of pumping a maximum of 2,000 AFY out of RHPS. This restriction is significant because it affects the effective area that can be served from the RHPS. Currently the RHPS provides the water supply for all of Zone 1 plus a significant amount to Zone 2 and Zone 3 (through the PRV). The 2,000 AFY restriction will require the RHPS to significantly reduce or eliminate supply to Zone 2 which means that the Cerritos PS will have to provide more of the supply to the northerly portions of Zone 2/3.

At times when the RHPS has been out of service, the District has found that the CPS can provide service to much of Zone 1, but not the highest elevation areas. The computer model confirmed this and it is important to note that this means the RHPS must remain on at all times. That is, it will not be possible to utilize the RHPS strictly for peak demands and to turn it off for low demands in order to stay under the 2,000 AFY ceiling.

The modeling also showed that it would not be possible to have the CPS supply water into Zone 1 while the RHPS is operating, because the RHPS pressures are necessarily too high to allow CPS water into Zone 1.

If WRD is not ready to take the water rights for the ARC, all deliveries to WRD would be through the spreading grounds. These scenarios would allow more water to be spread than similar scenarios where 3,000 AFY of rights is also provided to WRD, however, the combined amount to WRD would be less. These scenarios were also explored in the event WRD cannot take immediate transfer of the water rights (**Table 4**).

Distribution of Demands and Flows

It is estimated that the RHPS will provide approximately 3,590 AFY under existing conditions (2016-2017 fiscal year and PRV set to 65.5 psi). The Zone 1 demands are estimated to be approximately 1,140 AFY, so it can be deduced that the RHPS supplies about 2,450 AFY to Zone 2 through the PRV. The system supply sources and zone demands are summarized in **Table 1**, and includes flows based on existing conditions (including the additional 530 AFY "imminent" users) and flows based on 2017 historical conditions (excluding the additional 530 AFY "imminent" users).It should be noted that RHPS which is in Zone 1 provides 80% of the water supply while Zone 1 accounts for only 20% of the total demands. Since Zone 1 is at a higher elevation than Zone 2, the fact that Zone 1 has so much supply and so little demand provides the District with substantial flexibility to alter the water supply balance between the two Treatment Plants or to maintain the balance in the event of changed water demands. The balancing of the two Treatment Plant supplies can be accomplished by adjusting the PRV settings.

Historical and Existing PRV Setting

The PRV is actually made up of 3 parallel Cla-Val valves in a vault that work together to set a reduced pressure downstream of the vault. The 3 valves are the “lead”, “lag”, and “stand-by” valves. The individual setting of each valve may differ by 1-2 psi. Changes to the pressure setting of the PRV can be accomplished by changing each of the valves by the same amount. PRV settings throughout this memorandum refer to the average pressure setting downstream of the vault. This combined average downstream pressure will be referred to as the “effective pressure”

Historically (per 2017 SCADA data), the PRV has been set at an effective pressure of about 66.5 psi. This had allowed approximately 2,630 AFY through the PRV from Zone 1 to Zone 2 and required RHPS to produce approximately 3,510 AFY. When the 530 AFY demand from the “imminent” users are added, the PRV setting must be reduced if the amount of supply from RHPS is to remain unchanged (i.e. 3,510 AFY). The model has indicated that the setting at the PRV must be reduced 1 psi to a setting of 65.5 psi in order to maintain the amount RHPS supplies. Refer to **Table 1** for a summary of these settings and flows.

Impact of PRV Settings

System flow between Zone 1 and Zone 2 through the PRV are highly sensitive to the pressure setting. Generally, a reduction in pressure setting at the PRV will cause less flow through the PRV from Zone 1 to Zone 2. A graph comparing PRV pressure setting to annual flow (AFY) has been prepared and is included in the **Appendix**. At an effective pressure setting of 62 psi or less, the PRV will not open, and the PRV would effectively act as a closed valve.

System Pressures

For this study, the minimum pressure requirement for supply to recycled water users is assumed to be 40 psi. The maximum system pressure permitted is assumed to be 130 psi. Since some of the pressures are relatively high, a large pressure reduction can be experienced while still maintaining the minimum 40 psi service pressure. It is recognized that a large pressure drop for an existing customer may be disruptive even if the final pressure is above District guidelines. These large pressure drops will be discussed under the various scenarios.

HYDRAULIC MODEL

The H2ONET hydraulic model has been updated with system user demands based on 2017 billing meter data. In addition, 530 AFY of demand from imminent customers was added to the model. Since those customers are considered imminent, the model with the 2017 demands plus 530 AFY is referred to as the Existing System. It should be noted that the 2017 billing meter data made some substantial revisions to the demands compared to the earlier version of the computer model.

The validity of the model was checked by comparing model run results with SCADA flow and pressure data of the system facilities, including the Rio Hondo Pump Station, the PRV, and the Cerritos Pump Station. It was found that the model did not simulate the actual system as well as was expected. Upon examination of the reason for the discrepancy, it was found that some of the pipe C-factors in the model did not appear to be consistent with pipe diameter and/or age or other consistent variable. Although there is no documentation for the C-factors in the original model, it is likely that the C-factors in the original model were adjusted in local areas in order to better simulate system pressures. However, it is likely that the original model demands departed from the actual demands and that is the reason for the original model discrepancies.

We adjusted the pipe C-factors to be consistent throughout the model such that C-factors for pipe above 16" C = 140 and pipes 16" and less were C = 130. These C factor adjustments improved the model accuracy and appear to be satisfactory.

RESULTS

SCENARIO-1: Existing Scenarios

These scenarios include the existing demands (i.e. including imminent 530 AFY demands). Under the various conditions, it was determined how much water could be spread at the Rio Hondo spreading grounds.

RHPS Limited to 2,000 AFY / CPS Limited to 5,500 AFY

The first task in this study was to evaluate the quantity of recycled water, if any, that could be delivered to the spreading grounds with no improvements to the existing infrastructure, and restricting the pumping of Rio Hondo PS to 2,000 AFY (3,000 AFY of the total 5,000 AFY capacity is assumed as direct transfer to WRD). This Rio Hondo PS flow amounts to a reduction of 1,830 AFY compared to existing conditions.

Results indicate that with no improvements to the existing infrastructure, **0 AFY** could be spread at the Rio Hondo spreading grounds. Zone 1 consumes 1,140 AFY of the of the 2,000 AFY pumped from RHPS. The remainder is conveyed to Zone 2 via the PRV during the peak demand season. The pressure setting at the PRV is 65.5 psi. These results are summarized in scenario 1 of **Table 2**.

No Limitations at RHPS and CPS

With no improvements to the existing infrastructure, this run considers the hypothetical condition that RHPS is not limited by water rights. Under these conditions, this run determined how much water could be spread to RHSG.

With no limitations at the pump stations, approximately **2,030 AFY** can be physically pumped to RHSG. These results are summarized in scenario 1 of **Table 3**.

RHPS Limited to 5,000 AFY / CPS Limited to 5,500 AFY

This run considers the interim condition such that WRD may not immediately be capable of receiving 3,000 AFY of rights at the San Jose Creek Treatment Plant, and the RHPS can pump 5,000 AFY from SJCWTP. With no improvements to the existing infrastructure, approximately **1,680 AFY** can be spread to the RHSG. These results are summarized in scenario 1 of **Table 4**.

SCENARIO-2: Close PRV

If the setting of the PRV is lowered below 62 psi, or closed completely, Zones 1 and 2 would be completely separated and the Rio Hondo PS would supply only the demands of Zone 1 and Cerritos PS would supply only the demands of Zones 2 and 3. The model indicates pressures are adequate with the PRV closed.

RHPS Limited to 2,000 AFY / CPS Limited to 5,500 AFY

With the PRV closed and RHPS limited to 2,000 AFY, approximately **860 AFY** could be spread at the Rio Hondo spreading grounds. These results are summarized in scenario 2 of **Table 2**.

No Limitations at RHPS and CPS

3,000 AFY is allowed to be spread at the Rio Hondo Spreading Grounds in lieu of transfer to WRD at San Jose Creek. With the PRV closed, supply from RHPS serves only Zone 1 and whatever is remaining can be sent to the spreading grounds. The model indicated that **2,140 AFY** can be spread and this requires a supply of 3,280 AFY from RHPS These results are summarized in scenario 2 of **Table 3**.

RHPS Limited to 5,000 AFY / CPS Limited to 5,500 AFY

Results are similar to the conditions above since supply from RHPS never reaches its maximum capacity with the PRV closed. **2,140 AFY** can be pumped to the RHSG. These results are summarized in scenario 2 of **Table 4**.

SCENARIO-3: Close PRV and Construct Delivery Pipeline to RHSG

Several alternatives have been proposed for a pipeline expansion that would deliver water from the existing Zone 1 pipeline on Beverly Blvd. to the Rio Hondo Spreading Grounds, while also providing opportunity for new potential customers along the route. For the purpose of determining an approximate delivery quantity, this memorandum only considers the pipeline route down Paramount Blvd. With the PRV closed and pipeline constructed, this scenario will determine the amount that can be delivered to RHSG from RHPS.

RHPS Limited to 2,000 AFY / CPS Limited to 5,500 AFY

Spreading to RHSG is limited to **860 AFY**. These results are summarized in scenario 3 of **Table 2**.

No Limitations at RHPS and CPS

Without supply limitations from RHPS, **15,710AFY** can be spread at RHSG via the Paramount Blvd. pipeline extension. 13,570 AFY is spread to RHSG via the proposed delivery pipeline, and 2,140 AFY is spread via the existing Mines Ave. pipeline. These results are summarized in scenario 3 of **Table 3**.

RHPS Limited to 5,000 AFY / CPS Limited to 5,500 AFY

With supply limitations from RHPS of 5,000 AFY and without considering transfer of 3,000 AFY to WRD (interim condition), **3,860 AFY** can be spread to RHSG via the Paramount Blvd. pipeline extension and the Mines Ave. pipeline. These results are summarized in scenario 3 of **Table 4**.

SCENARIO-4: Additional 890 AFY from CPS (Reduced Backwash at LCTP)

CBMWD has considered ways to increase recycled water output from the CPS. One potential solution is to reduce the quantity of water used to backwash tanks at the Los Coyotes Treatment Plant as operated by LACSD. LACSD has deduced that they can reduce the amount of tank backwash by approximately 890 AFY, which can then be supplied to the recycled water system.

Of the 890 AFY supplied from CPS, 530 AFY can be supplied to the new “imminent” users without increasing supply at the Rio Hondo Pump Station. This could be accomplished by lowering the pressure setting at the PRV, and allowing less water from RHPS into Zone 2. The pressure setting at the PRV to maintain the same flow output from RHPS as existing conditions (3,500 AFY) is 64.5 psi. This leaves an additional 360 AFY which can be spread to the RHSG without increasing supply at RHPS.

RHPS Limited to 2,000 AFY / CPS Limited to 5,500 AFY

Spreading to RHSG is equal to the surplus quantity of backwash water from CPS, **360 AFY**. These results are summarized in scenario 4 of **Table 2**.

No Limitations at RHPS and CPS

Spreading to RHSG is equal to the surplus quantity of backwash water from CPS, **360 AFY**. These results are summarized in scenario 4 of **Table 3**.

RHPS Limited to 5,000 AFY (No Transfer to WRD at SJCWTP) / CPS Limited to 5,500 AFY

Spreading to RHSG is equal to the surplus quantity of backwash water from CPS, **360 AFY**. These results are summarized in scenario 4 of **Table 4**.

SCENARIO-5: Emergency Scenario – Cerritos Pump Station Out of Service

CBMWD has experienced disruptions of service at the Cerritos Pump Station and is concerned about the affect future disruptions of service may have on the future distribution system. The model shows that during average and low demand months (October – April) with the Cerritos Pump Station out of service, the Rio Hondo Pump Station is able to meet the flow and pressure demands of the entire system. The PRV is assumed to be at the existing setting of 65.5 psi. It should be noted that during average demand months, pressures near the top of Zone 2 (i.e. near the PRV) experience pressures approaching minimum pressure of 40 psi, but are still considered adequate. Flow results for an average month are summarized in **Table 5**.

During high demand and peak demand months (May – September), however, adequate pressure cannot be served to Zone 2. In fact the peaking of demands has a tremendous impact on pressure, and pressures throughout Zone 2 become technically negative.

MANAGING WATER SUPPLY FLOWS

In order to meet end of year target allowable flows from SJCWTP and LCWTP, water supply flows should be monitored and managed on a consistent basis. Although total demands in the system are out of the District's control, the setting at the PRV can be managed to adjust the balance of flow between SJCWTP in Zone 1 and LCWTP in Zone 2. Minor adjustments such as lowering the PRV setting would allow for less supply from SJCWTP, and increasing the PRV setting would increase supply from SJCWTP.

Demands throughout the system fluctuate by month. Because of these seasonal fluctuations, calculating AFY at the end of the year is not a simple formula. These seasonal fluctuations should be accounted for and adjusted throughout the year based on variations from this seasonal curve. It is recommended that the District monitor flows from both treatment plants on a weekly basis to avoid drastic adjustments at the end of the year. It is recommended that the district regularly calculate cumulative flows throughout the year.

Once excessive efficient flow is predicted and it is deemed an adjustment of flow is required, corrective action must be taken. Flow can be adjusted by changing the PRV setting. As previously described, adjusting the PRV has a major impact on the balance of production from SJCWTP and LCWTP.

A tool for monitoring existing flows and predicting future flows has been developed and included with this memorandum. The tool is a spreadsheet that compares actual flow from the treatment plants to a recommended flow, and quantifies how close the district is to meeting target allowable flows at the end of the year. The tool also recommends adjustments in PRV settings to meet the end of year targets. A sample calculation using the tool is included in the **Appendix**. Also included in the Appendix is the PRV setting vs Flow Chart, which will serve as a guide to determine how much the PRV needs to be adjusted. The PRV setting vs Flow Chart and the Monitoring tool should be used together to adjust future flows. PRV settings and pump station flows should be recorded on a regular basis, so that A PRV setting vs Flow Chart from actual system data can be produced. This will improve the accuracy of predicting flow for future years.

Results Tables

Table 1 – 2017 Historical Demands and Existing Demands (No Spreading)

	2017 Historical Demand (Excludes 530 AFY "Imminent" Users) (PRV @ 66.5 psi)	**Existing Demand** (Includes 530 AFY "Imminent" Users) (PRV @ 66.5 psi)	**Existing Demand** (Includes 530 AFY "Imminent" Users) (PRV @ 65.5 psi)
Total Demand	4,410	4,940	4,940
RHPS Flow (AFY)	3,510	3,830	3,590
CPS Flow (AFY)	900	1,110	1,350
PRV Flow (AFY) (Zone 1 to Zone 2)	2,630	2,690	2,450
Zone 1 Demand (AFY)	880	1,140	1,140
Zone 2 Demand (AFY)	2,670	2,880	2,880
Zone 3 Demand (AFY)	860	920	920

Table 2 – Spreading to RHSG – *RHPS Limited to 2,000 AFY / CPS Limited to 5,500 AFY*

	Scenario 1 Existing Settings Including 530 AFY “Imminent” Users (PRV @ 65.5 psi)	**Scenario 2** Close PRV	**Scenario 3** Close PRV + Delivery Pipeline to RHSG	**Scenario 4** 890 AFY from CPS (PRV @ 64.5 psi)
RHPS Flow (AFY)	2,000	2,000	2,000	2,000
CPS Flow (AFY)	2,940	3,800	3,800	3,290
PRV Flow (AFY) (Zone 1 to Zone 2)	860	0	0	510
Zone 1 Demand (AFY)	1,140	1,140	1,140	1,140
Zone 2 Demand (AFY)	2,880	2,880	2,880	2,880
Zone 3 Demand (AFY)	920	920	920	920
Transfer to WRD (AFY)	3,000	3,000	3,000	3,000
Spread to RHSG (AFY)	0	860	860	360

Table 3 – Spreading to RHSG – *No Limitations at RHPS and CPS*

	Scenario 1 Existing Settings Including 530 AFY "Imminent" Users (PRV @ 65.5 psi)	**Scenario 2** Close PRV	**Scenario 3** Close PRV + Delivery Pipeline to RHSG	**Scenario 4** 840 AFY from CPS (PRV @ 64.5 psi)
RHPS Flow (AFY)	5,630	3,280	16,830	3,500
CPS Flow (AFY)	1,340	3,800	3,800	1,730
PRV Flow (AFY) (Zone 1 to Zone 2)	2,460	0	0	2,080
Zone 1 Demand (AFY)	1,140	1,140	1,140	1,140
Zone 2 Demand (AFY)	2,880	2,880	2,880	2,880
Zone 3 Demand (AFY)	920	920	920	920
Transfer to WRD (AFY)	0	0	0	0
Spread to RHSG (AFY)	2,030	2,140	15,710	310

Table 4 – Spreading to RHSG – *RHPS Limited to 5,000 AFY (No Transfer to WRD at SJCWTP) / CPS Limited to 5,500 AFY*

	Scenario 1 Existing Settings Including 530 AFY "Imminent" Users (PRV @ 65.5 psi)	**Scenario 2** Close PRV	**Scenario 3** Close PRV + Delivery Pipeline to RHSG	**Scenario 4** 840 AFY from CPS (PRV @ 64.5 psi)
RHPS Flow (AFY)	5,000	3,280	5,000	3,500
CPS Flow (AFY)	1,340	3,800	3,800	1,730
PRV Flow (AFY) (Zone 1 to Zone 2)	2,180	0	0	2,080
Zone 1 Demand (AFY)	1,140	1,140	1,140	1,140
Zone 2 Demand (AFY)	2,880	2,880	2,880	2,880
Zone 3 Demand (AFY)	920	920	920	920
Transfer to WRD (AFY)	0	0	0	0
Spread to RHSG (AFY)	1,680	2,140	3,860	310

Table 5 – Emergency Scenario – Cerritos Out of Service

	Scenario 5 Emergency
RHPS Flow (AFY)	4,930
CPS Flow (AFY)	0
PRV Flow (AFY) (Zone 1 to Zone 2)	3,810
Zone 1 Demand (AFY)	1,140
Zone 2 Demand (AFY)	2,880
Zone 3 Demand (AFY)	920
Transfer to WRD (AFY)	0
Spread to RHSG (AFY)	0