WEST YOST ASSOCIATES
Consulting Engineers

TECHNICAL MEMORANDUM

DATE: November 22, 2016 Project No.: 693-20-16-01-10.0
SENT VIA: EMAIL

TO: SRWA Technical Advisory Committee

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REVIEWED BY: Gerry Nakano, RCE #29524

SUBJECT: Recommended Improvements for the Cities of Ceres and Turlock Local Distribution Systems to Integrate the Stanislaus Regional Water Authority Surface Water Supply Project

OVERVIEW

This Technical Memorandum (TM) presents preliminary infrastructure sizing and location recommendations for the Stanislaus Regional Water Authority (SRWA) Surface Water Supply Project (Project) transmission and distribution facilities within the cities of Ceres and Turlock systems. These facilities are needed to distribute surface water within each system. Improvement recommendations were developed using the hydraulic performance criteria developed for this Project, and Phase 2 design delivery flowrates for each Project participant (15 million gallons per day (mgd) for the City of Ceres and 30 mgd for the City of Turlock). Once Phase 2 transmission locations and sizes were established, facilities required for the Phase 1 Project (10 mgd for City of Ceres and 20 mgd for City of Turlock) were identified.

Following this overview, this TM presents the following:

- Performance Criteria
- Analysis Scenarios
- City of Ceres Distribution System
- City of Turlock Distribution System

Hydraulic criteria for the analysis were presented and discussed at the May 26, 2016 Technical Advisory Committee (TAC) workshop. Preliminary distribution system improvements for Phase 2 of the project were presented in the July 7, 2016 TAC workshop. Revised Phase 2 improvements, based on comments received at the July workshop, and Phase 1 improvements were presented at the October 13, 2016 TAC workshop.

PERFORMANCE CRITERIA

West Yost Associates (West Yost) developed preliminary distribution system performance criteria for the cities of Ceres and Turlock based on the Water System Master Plans for each city. These were reviewed with the TAC at the May 26, 2016 workshop. Based on the TAC input, some criteria were modified, so that consistent planning criteria are used for each system. Table 1 summarizes the criteria adopted for the analysis.

Table 1. Hydraulic Criteria Used to Analyze Each City Distribution System

Parameter	Criterion	Notes
Pressure	40 psi minimum 60 psi maximum	
Distribution Pipeline Maximum Velocity	5 feet (ft)/second	Maximum velocities are typically limited to reduce friction losses and reduce the risk of hydraulic transients.
Distribution Pipeline Maximum Headloss	• 7-8 ft/1000 ft for pipelines less than 12-inch diameter • 3-4 ft/1000 ft for pipelines equal to or greater than 12-inch.	Used for sizing improvements. Not used to improve existing system pipelines if pressures are adequate.
Hazen Williams C-values for improvements	130	Reasonable but conservative value for new pipeline.

ANALYSIS SCENARIOS

Analysis scenarios were developed based on demand projections, and Phase 1 (30 mgd total) and Phase 2 (45 mgd total) water treatment plant (WTP) capacities developed for the Project, as summarized in the Preliminary Phasing and Water Treatment Plant Sizing for the SRWA Surface Water Supply Project TM (West Yost, June 16, 2016). In that TM, Phase 1 of the WTP was assumed to supply needs through 2025, and Phase 2 of the WTP was assumed to supply needs through buildout, which is 2035 for Ceres and 2040 for Turlock.

Total city water system infrastructure needed to integrate surface water into the city systems was developed using the Phase 2 WTP capacities and buildout maximum day demands. Phase 1 infrastructure needs were developed using the Phase 1 WTP capacities and 2025 maximum day demands. Scenarios were also developed to check whether surface water could be delivered to all points within each city's water system, while maintaining adequate system pressure.

Table 2 summarizes the hydraulic scenarios modeled. For the City of Ceres, the model is set up to perform static (snapshot in time) evaluations, so both peak hour and minimum hour on maximum day were evaluated. Peak hour demands simulate the highest demand on the system, when all storage, including the terminal tank from SRWA, would be supplying the difference between peak hour and maximum day demand. The minimum hour demand scenario simulates a low demand condition, when tanks would be filling, and was used to check that tank re-fill was adequate with the recommended infrastructure. The original Turlock model provided to West Yost was already

set up for extended period simulation (EPS). Therefore, EPS evaluations were performed that evaluate hourly performance on the maximum demand day and hourly tank fill and draw.

Table 2. Hydraulic Modeling Scenarios Used for Determining City Infrastructure Needs to Integrate the SRWA Project

Hydraulic Scenario	Description	Notes
City of Ceres		
Peak Hour and Minimum Hour of Maximum Day, 2035, Phase 2 Facilities	• 29 mgd maximum day demand, with 14 mgd from wells and 15 mgd from surface water • 46 mgd peak hour demand • 15 mgd minimum hour demand	Peak hour scenario used to size surface water transmission facilities. Minimum hour scenario used to check storage tank re-fill.
Daily Demand of 15 mgd, Phase 2 Facilities with Surface Water only	• 15 mgd daily demand, all from surface water • 24 mgd peak hour demand • 8 mgd minimum hour demand	Sensitivity analysis to determine if only surface water could be used to meet demands and maintain pressures.
Peak Hour and Minimum Hour of Maximum Day 2025, Phase 1 Facilities	• 20 mgd, maximum day demand, with 10 mgd from wells and 10 mgd from surface water • 32 mgd peak hour demand • 11 mgd minimum hour demand	Peak hour scenario used to determine which Phase 2 facilities are also needed for Phase 1. Minimum hour scenario used to check storage tank re-fill.
Daily Demand of 10 mgd, Phase 1 facilities with only Surface Water	• 10 mgd daily demand, all from surface water. • 16 mgd peak hour demand • 5 mgd minimum hour demand	Sensitivity analysis to determine if surface water could be used to meet demands and maintain pressures.
City of Turlock		
Maximum Day (hourly), 2040, Phase 2 Facilities	• 58 mgd maximum day demand with 28 mgd from wells and 30 mgd from surface water • 76 mgd peak hour • 45 mgd minimum hour	Used to size surface water transmission facilities.
Daily Demand of 30 mgd, Phase 2 Facilities with Surface Water only	• 30 mgd daily demand, all from surface water	Sensitivity analysis to determine if only surface water could be used to meet demands and maintain pressures.
Maximum Day (hourly), 2025, Phase 1 Facilities	• 43 mgd maximum daily demand, with 23 mgd from wells and 20 mgd from surface water • 56 mgd peak hour demand • 33 mgd minimum hour demand	Used to determine which Phase 2 facilities are also needed for Phase 1.
Daily Demand of 20 mgd	• 20 mgd, all from surface water	Sensitivity analysis to determine if only surface water could be used to meet demands and maintain pressures.

Results of the analysis are discussed in subsequent sections.

CITY OF CERES DISTRIBUTION SYSTEM

The City of Ceres system includes fifteen wells that currently supply the system, with two wells offline due to water quality. There are also two additional wells that have been drilled, but not yet equipped (Wells 41 and 42).[1] The total capacity of the thirteen active wells is 15.3 mgd, and the firm capacity is 13.2 mgd.[2] The system also includes two ground-level storage tanks, the Blaker Tanks, with 3.8 million gallons (MG) nominal storage capacity. Current maximum day demand, based on estimated 2013 peak water use, is 13.0 mgd.[3] Figure 1 shows the existing distribution system.

Ceres projects significant growth, primarily in the southern portion of the service area, with demands projected to more than double by buildout, which is estimated to occur by 2035. In 2011, Ceres completed a Water Master Plan (WMP), which evaluated distribution system infrastructure requirements with a new 6 mgd surface water supply, introduced at a new tank in the northeast corner of the system, and at a joint Ceres/Modesto turnout and tank on the west side of the system. The overall philosophy for infrastructure improvements in the WMP was to provide a 16-inch diameter transmission grid space at one-mile intervals to integrate surface water and groundwater supplies into the distribution system. In the southern portion of the City of Ceres' system, where there is no existing infrastructure, this new transmission grid would serve new growth.

Ceres Phase 2 Facilities

A buildout (2035) maximum demand day scenario was evaluated to determine what future facilities are needed for Phase 2 of the Project. Ceres has planned Project Phase 2 deliveries of up to 15 mgd.

The infrastructure identified in the WMP was used as a starting point for updating infrastructure needs, with the following revisions:

- Delivering all surface water in the northeast corner of the system to a new terminal tank and booster pump station.
- Eliminating the joint Ceres and Modesto turnout and tank facilities on the west side of the system.
- Adding a new 1.5 million gallon (MG) storage tank in the northwest part of the system, along Richland Avenue, near Lions Park.

[1] Existing active potable wells include Well 14, 16, 20, 21, 22, 23, 25, 27, 28, 32, 34, 35, 38, 39 and 40. Wells 20 and 25 are offline due to water quality. Wells 14 and 16 would be retired with implementation of surface water. Total and active well capacity from 'pumping water levels.xlsx' based on April 2016 data.
[2] Firm well capacity is defined as the well capacity available, with the largest well out of service, as identified in the City of Ceres Water Master Plan.
[3] Estimated from 2013 average daily production, with a maximum day to average day peaking factor of 1.8, as estimated in the City's 2011Water Master Plan.

- Adding the existing 16-inch diameter transmission pipeline on Central Avenue and Richland Avenue, which was completed in 2015.
- Retiring of several wells, which have been taken offline for water quality reasons.
- Adding new wells constructed since completion of the WMP.
- Updating the pipeline diameter of the pipeline on Mitchell Avenue that runs between Hatch Road and Service Road from 10-inch to 12-inch based on field verification of the pipeline diameter by Ceres.
- Re-aligning the proposed Highway 99 crossing on Whitmore, to the south at 3rd Street and Lawrence Street, since recent reconstruction of the Whitmore/Highway 99 interchange includes construction of a sound wall, which precludes a pipeline crossing at this location.

Figure 2 shows the recommended buildout infrastructure, based on the WMP with revisions made in this study. The following improvements are recommended:

- 2 MG Terminal Tank.
- Terminal Tank booster pump station with 19 mgd firm capacity, 160 ft total dynamic head.
- 5,300 ft of 24-inch diameter pipeline, along East Hatch Road, from Faith Home Road to Mitchell Road.
- 8,100 ft of 16-inch diameter pipeline, along East Hatch Road, from Mitchell Road to Richland Avenue.
- 1,500 ft of 24-inch diameter pipeline, along Faith Home Road from East Hatch Road.
- 3,800 ft of 16-inch diameter pipeline, along Faith Home Road from 24-inch diameter pipeline to East Whitmore Avenue.
- 1,800 ft of 16-inch diameter pipeline, along East Whitmore Avenue from Faith Home Road to Eastgate Road.
- 2,700 ft of 16-inch diameter pipeline, along Eastgate Road from East Whitmore Avenue to Roeding Road.
- 800 ft of 16-inch diameter pipeline, along Roeding Road from Eastgate Road to Esmar Road.
- 2,600 ft of 16-inch diameter pipeline, along Esmar Road from Roeding Road to East Service Road.
- 2,800 ft of 16-inch diameter pipeline, along East Service Road from Esmar Road to existing 24-inch diameter pipeline just west of Mitchell Road.
- 8,100 ft of 16-inch diameter pipeline, along East Whitmore Avenue from Eastgate Road to 3rd Street.

- 2,800 ft of 16-inch diameter pipeline, along 3rd Street from Whitmore Avenue to El Camino, under freeway, and along Railroad Avenue to Kinser Road.
- 2,500 ft of 16-inch diameter pipeline, along Kinser Road from Railroad Avenue to South Blaker Road.

As noted above, infrastructure is needed both for future growth and to integrate surface water and groundwater supplies. In order to determine the portion of infrastructure cost that should be allocated to surface water, an analysis was performed for the buildout maximum day scenario to determine what areas generally receive more than 50 percent surface water. These facilities were considered to be constructed as part of the SRWA project, and were included in the cost estimating, documented elsewhere, for the Phase 2 project. Figure 2 shows these facilities in the dashed box.

Figure 3 shows pressures and pipeline headloss gradient (headlosses per 1,000 feet of pipeline) for the Ceres system, with a buildout peak hour system demand of 46 mgd, supplies of 14 mgd from wells and 15 mgd from surface water, with 17 mgd provided by the booster pumps at the storage reservoirs. As shown on the figure, most pressures range from 50 to 60 psi. There are a few areas where the head loss gradients exceed criteria adopted for this study. However, since pressures are within the desired range, additional improvements were not recommended.

A second scenario was also evaluated to determine whether surface water could be delivered to the entire system with no wells operating, while maintaining adequate system pressure, if average daily demands were equal to the available surface water supply. Figure 4 shows peak hour pressures and pipeline headloss gradient for the Ceres system, with a peak hour system demand of 24 mgd, and an average daily supply of 15 mgd from surface water. As shown on the figure, pressures can generally be maintained between 50 and 60 psi with surface water as the only supply to the system.

Ceres Phase 1 Facilities

A near-term (2025) maximum demand day scenario was evaluated to determine what future facilities are needed for Phase 1 of the Project. Ceres has planned Project Phase 1 deliveries of up to 10 mgd.

Figure 5 shows needed infrastructure to meet maximum day 2025 demands delivering 10 mgd of surface water and 10 mgd of groundwater. The following improvements are needed for Phase 1:

- 2 MG Terminal Tank.
- Terminal Tank booster pump station with 14 mgd firm capacity, 160 ft total dynamic head.
- 5,300 ft of 24-inch diameter pipeline, along East Hatch Road, from Faith Home Road to Mitchell Road.
- 8,100 ft of 16-inch diameter pipeline, along East Hatch Road, from Mitchell Road to Richland Avenue.
- 1,500 ft of 24-inch diameter pipeline, along Faith Home Road from East Hatch Road.

- 3,800 ft of 16-inch diameter pipeline, along Faith Home Road from 24-inch diameter pipeline to East Whitmore Avenue.
- 1,800 ft of 16-inch diameter pipeline, along East Whitmore Avenue from Faith Home Road to Eastgate Road.
- 2,700 ft of 16-inch diameter pipeline, along Eastgate Road from East Whitmore Avenue to Roeding Road.
- 800 ft of 16-inch diameter pipeline, along Roeding Road from Eastgate Road to Esmar Road.
- 2,600 ft of 16-inch diameter pipeline, along Esmar Road from Roeding Road to East Service Road.
- 2,800 ft of 16-inch diameter pipeline, along East Service Road from Esmar Road to existing 24-inch diameter pipeline just west of Mitchell Road.

These improvements along Hatch Road and Faith Home Road provide redundancy for delivery of surface water by completing looping with existing large-diameter (16-inch diameter and greater) pipelines in the system, and increase the connectivity of the system between the areas east and west of Highway 99.

Figure 6 shows pressures and pipeline headloss gradients for the Ceres system, for 2025 peak hour conditions. The peak hour on the maximum day has a system demand of 32 mgd, and a supply of 10 mgd from wells and 10 mgd from surface water, with 12 mgd provided by the booster pumps at the storage reservoirs. As shown on the figure, pressures range from 40 to 60 psi. There are a few areas where the head loss gradients exceed criteria adopted for this study. However, since pressures are within the desired range, additional Phase 1 improvements were not recommended.

A second 2025 scenario was also evaluated to determine whether surface water could be delivered to the entire system with no wells on, and maintain adequate system pressure. The analysis showed that pressures can be maintained between 40 and 60 psi for this scenario.

CITY OF TURLOCK DISTRIBUTION SYSTEM

The City of Turlock system includes 24 active wells[4], with a total capacity of 44 mgd, and a firm capacity of 36 mgd.[5] The system also includes three ground-level storage tanks, the Southeast, Southwest and West tanks, that provide balancing storage. Current maximum day demand, based on estimated 2013 peak water use, is 33 mgd.[6] Figure 7 shows the existing distribution system.

Turlock projects significant growth, with future development of commercial and industrial uses on the west side of the system, and future residential development on the east side of the system.

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[4] Existing active potable wells include Well 3, 4, 8, 13, 14, 15, 19, 20, 22, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, 39 and 40. Well 31 is considered a standby well. Total and active well capacity from "Well Data Summary Final.xls".
[5] Firm well capacity is defined as the well capacity available, with 6000 gpm reserved as standby, as identified in the City of Turlock Water Master Plan Update.
[6] Based on 2013 average daily production of 20 mgd times 1.65, the estimated maximum day to average day use from Turlock's 2009 Water Master Plan Update.

Demands are projected to increase by about 80 percent by buildout, which is estimated in 2040. In 2009, Turlock completed a WMP, which evaluated distribution system infrastructure requirements with a 15 mgd surface water supply, introduced at a new tank in the northeast corner of the system. The overall philosophy for infrastructure improvements in the WMP update was to provide new transmission along the east and north sides of the system, with a number of turnouts from the new transmission main to integrate surface water and groundwater supplies into the distribution system.

Turlock Phase 2 Facilities

A buildout (2040) maximum demand day scenario was evaluated to determine what future facilities are needed for Phase 2 of the Project. Turlock has planned Project Phase 2 deliveries of up to 30 mgd.

The infrastructure identified in the WMP was used as a starting point for updating infrastructure needs, with the following revisions:

- Re-locating the proposed terminal tanks and booster pump station to a property located east of North Quincy Road, between East Zeering Road and East Monte Vista Avenue, based on latest plans from the City.
- Plans for two 2.5 MG storage tanks at the terminal reservoir site.
- Addition of existing Southeast, Southwest and West tanks, all completed since the 2009 WMP Update.
- Retirement of several wells that have been taken offline for water quality reasons
- Addition of one new well, Well 40; constructed since completion of the WMP.

Figure 8 shows the recommended buildout infrastructure, based on the WMP with revisions made in this study. The following improvements are recommended:

- Two 2.5 MG tanks at the Terminal Tank site.
- Terminal Tank booster pump station with 37 mgd firm capacity, 185 ft total dynamic head.
- 4,000 ft of 24-inch diameter pipeline, along East Taylor Road from North Quincy Road to Colorado Avenue.
- 3,800 ft of 16-inch diameter pipeline, along East Taylor Road from Colorado Avenue to North Geer Road.
- 700 ft of 24-inch diameter pipeline, along North Geer Road from East Taylor Road to Memory Lane.
- 700 ft of 24-inch diameter pipeline, along Colorado Avenue, from East Taylor Road to Dancer Way
- 4,100 ft of 24-inch diameter pipeline, along North Quincy Road from Terminal Tank tie-in to East Taylor Road.
- 1,200 ft of 42-inch diameter pipeline from Terminal Tank site to North Quincy Road.

- 3,900 ft of 42-inch diameter pipeline along North Quincy Road from Terminal Tank tie-in to East Tuolumne Road.
- 5,100 ft of 36-inch diameter pipeline, along North Quincy Road from East Tuolumne Road to East Canal Drive.
- 2,900 ft of 24-inch diameter pipeline, along North Quincy Road from East Canal Drive to East Avenue.
- 8,000 ft of 30-inch diameter pipeline, along East Canal Drive, from North Quincy Road to North Geer Road.
- 6,800 ft of 24-inch diameter pipeline, along West Canal Drive, from North Geer Road to North Tully Road, and along North Tully Road to Chakkar Estates Drive.
- 4,300 ft of 16-inch diameter pipeline, along East Avenue, from North Quincy Road to 200 ft east of Oak Street.
- Turnout and valve connections, as shown on Figure 8. Recommended valves are motorized operated butterfly valves or plug valves.

Infrastructure is needed for integration of surface water and groundwater supplies. All future facilities shown on Figure 8 were included in the surface water cost estimate for Turlock local facilities, except for the Northwest Tank, which is needed to provide system storage.

Figure 9 shows buildout peak hour pressures and pipeline headloss gradient for the Turlock system, with a peak hour system demand of 76 mgd, 28 mgd from wells, 30 mgd from surface water and 18 mgd provided by the booster pumps at the storage reservoirs. As shown on the figure, pressures range from 40 to 60 psi. There are some pipelines where the head loss gradients exceed criteria adopted for this study. However, since pressures are within the desired range, additional improvements were not recommended.

A second scenario was also evaluated to determine whether surface water could be delivered to the entire system with no wells operating, while maintaining adequate system pressure, if average daily demands were equal to the available surface water supply. Figure 10 shows peak hour pressures and pipeline headloss gradient for the Turlock system, with a peak hour system demand of 39 mgd, and a supply of 30 mgd from surface water. As shown on the figure, pressures can be maintained between 40 and 60 psi with surface water as the only supply to the system.

Turlock Phase 1 Facilities

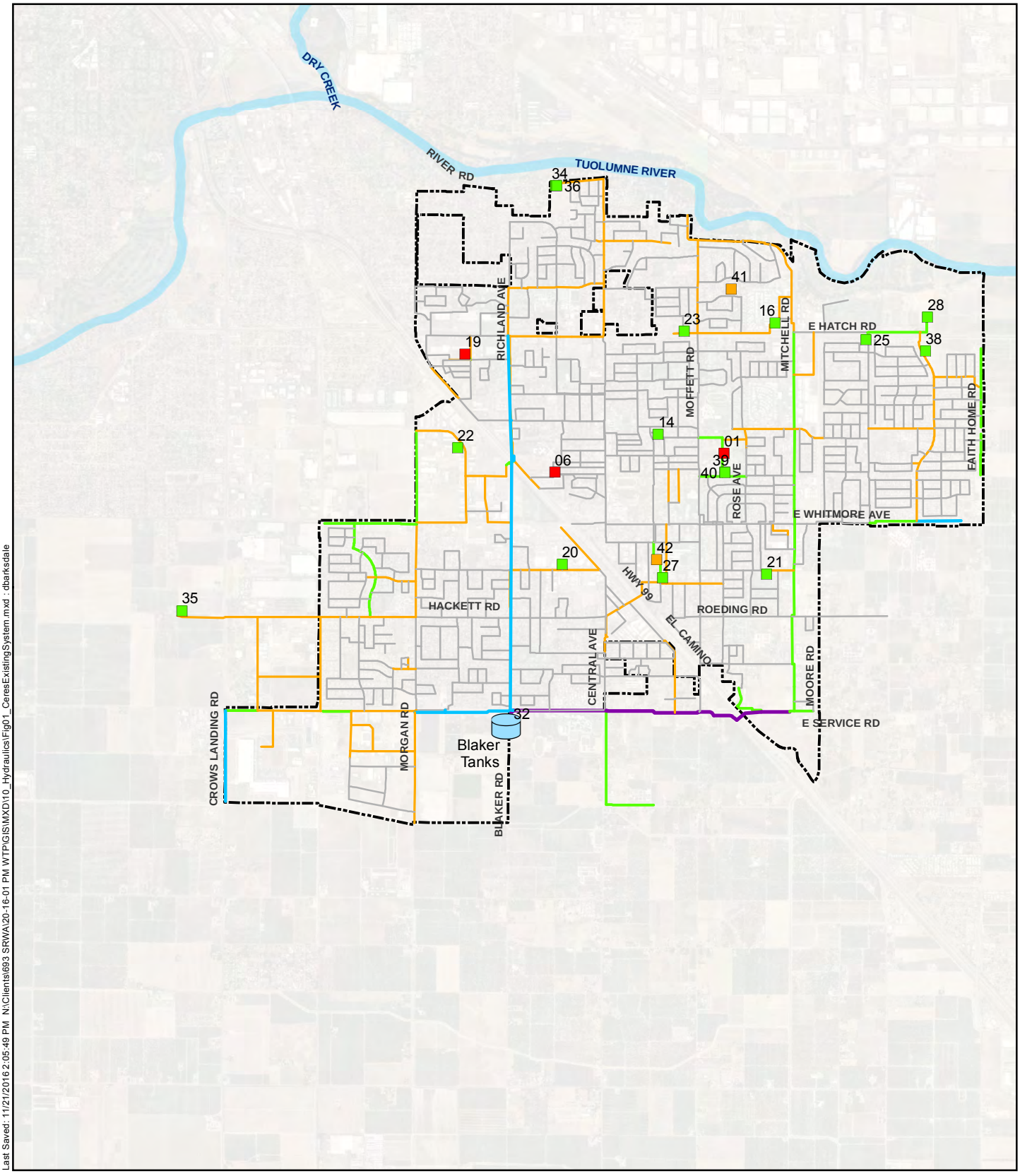
A near-term (2025) maximum demand day scenario was evaluated to determine what future facilities are needed for Phase 1 of the Project. Planned Project deliveries to Turlock for Phase 1 are 20 mgd.

Figure 11 shows needed infrastructure to meet maximum day 2025 demands delivering 20 mgd of surface water and 18 mgd from wells. The following facilities are recommended for Phase 1:

- 2.5 MG tank at Terminal Tank site.
- Terminal Tank booster pump station with 20 mgd firm capacity, 185 ft total dynamic head.
- 4,000 ft of 24-inch diameter pipeline along East Taylor Road, between Colorado Avenue and North Quincy Avenue.
- 700 ft of 24-inch diameter along Colorado Avenue, from Est Taylor Road to Dancer Way.
- 4,100 ft of 24-inch diameter, 3,900 ft of 42-inch diameter, and 5,100 ft of 36-inch diameter pipelines along North Quincy from East Taylor Road to Canal Street.
- 8,000 ft of 30-inch pipeline along Canal Street to Geer Road.

Figure 12 shows peak hour pressures and pipeline headloss gradient for the Ceres system, for 2025 maximum day conditions. Peak hour on the maximum day has a system demand of 32 mgd, and a supply of 10 mgd from wells and 10 mgd from surface water. As shown on the figure, pressures range from 40 to 60 psi. There are a few areas where the head loss gradients exceed criteria adopted for this study. However, since pressures are within the desired range, additional Phase 1 improvements were not recommended.

A second 2025 scenario was also evaluated to determine whether surface water could be delivered to the entire system with no wells on, and maintain adequate system pressure. The analysis showed that pressures can be maintained between 40 and 60 psi for this scenario.



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Symbology

- Tank
- Active Well
- Inactive Well
- Well Not Yet Equipped
- Roads

Pipeline Diameter

- ≤8"
- 10"
- 12"
- 14" - 18"
- ≥24"

N

0 1,900 3,800

Scale in Feet

SRWA
Stanislaus Regional Water Authority

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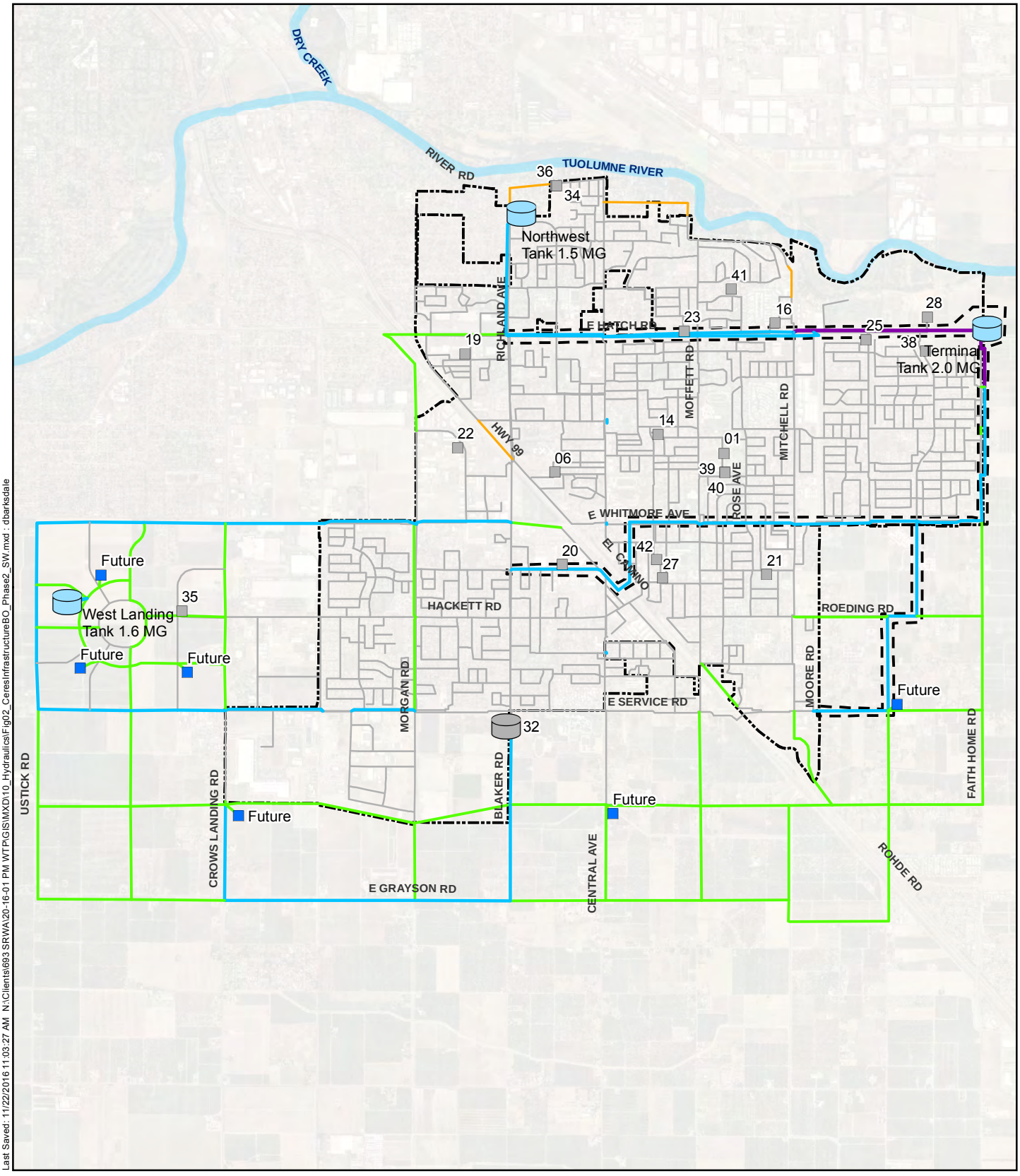
Figure 1
Ceres Existing System

Stanislaus Regional Water Authority
Surface Water Supply Project



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Symbology

- Existing Tank
- Future Tank
- Existing Well
- Future Well
- Included in Phase 2 Project Cost Estimate

Existing Pipeline

- Existing Pipeline

Future Pipeline Diameter

- ≤8"
- 10"
- 12"
- 14" - 18"
- ≥24"

N

0 1,900 3,800

Scale in Feet

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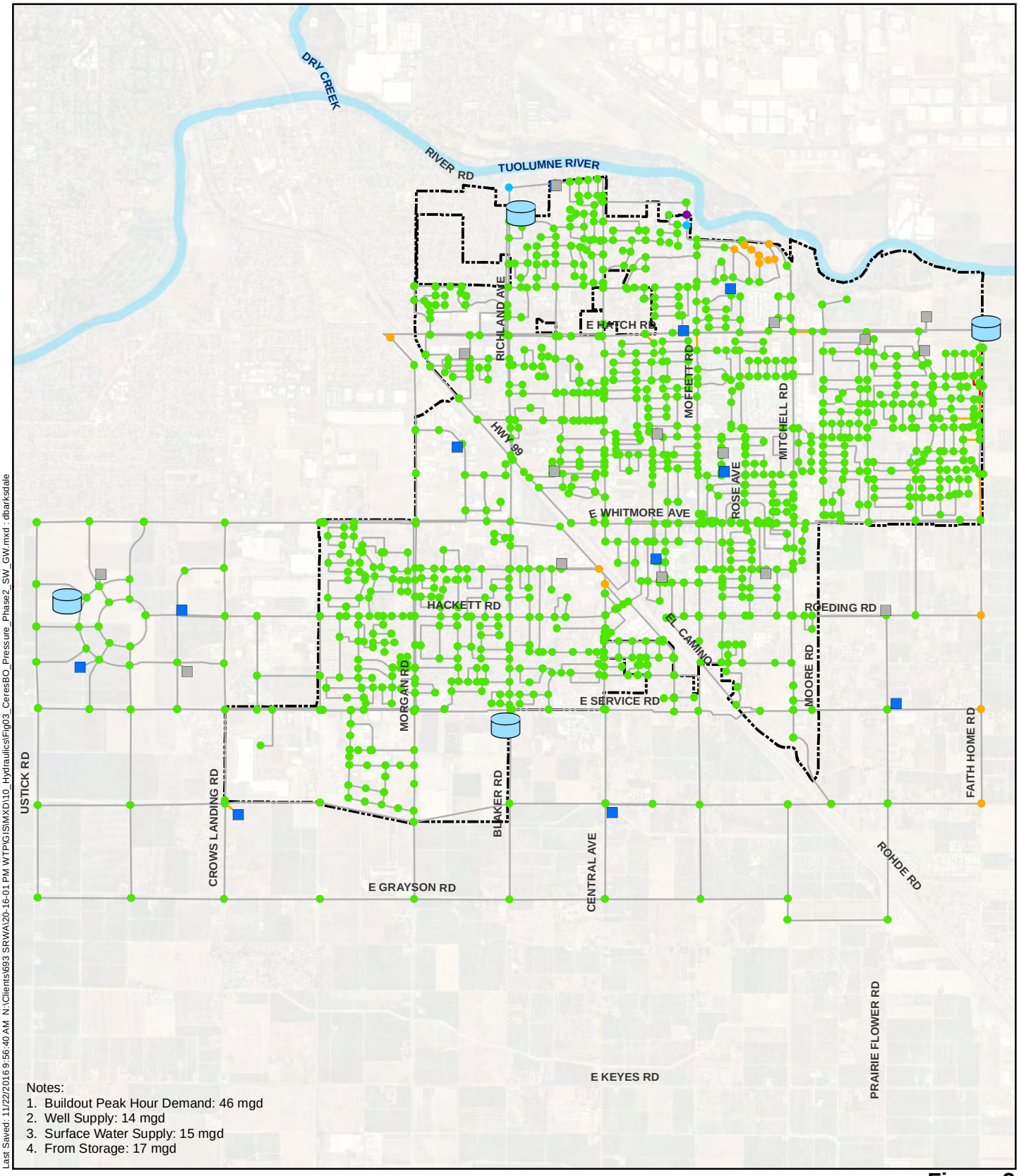
Figure 2

Ceres Infrastructure at Buildout with Phase 2 (15 mgd) Surface Water Project

Stanislaus Regional Water Authority
Surface Water Supply Project



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Notes:
1. Buildout Peak Hour Demand: 46 mgd
2. Well Supply: 14 mgd
3. Surface Water Supply: 15 mgd
4. From Storage: 17 mgd

Symbology

- Tank
- Well On
- Well Off

Headloss

- <4 ft/1000 ft
- 4 - 8 ft/1000 ft
- >8 ft/1000 ft

Pressure

- <40 psi
- 40 - 50 psi
- 50 - 60 psi
- 60 - 65 psi
- >65 psi

N

0 1,900 3,800

Scale in Feet

Figure 3

Ceres Buildout Peak Hour Pressure and Headloss Gradient, Phase 2 (15 mgd) Surface Water Project and Groundwater

Stanislaus Regional Water Authority
Surface Water Supply Project

SRWA Stanislaus Regional Water Authority

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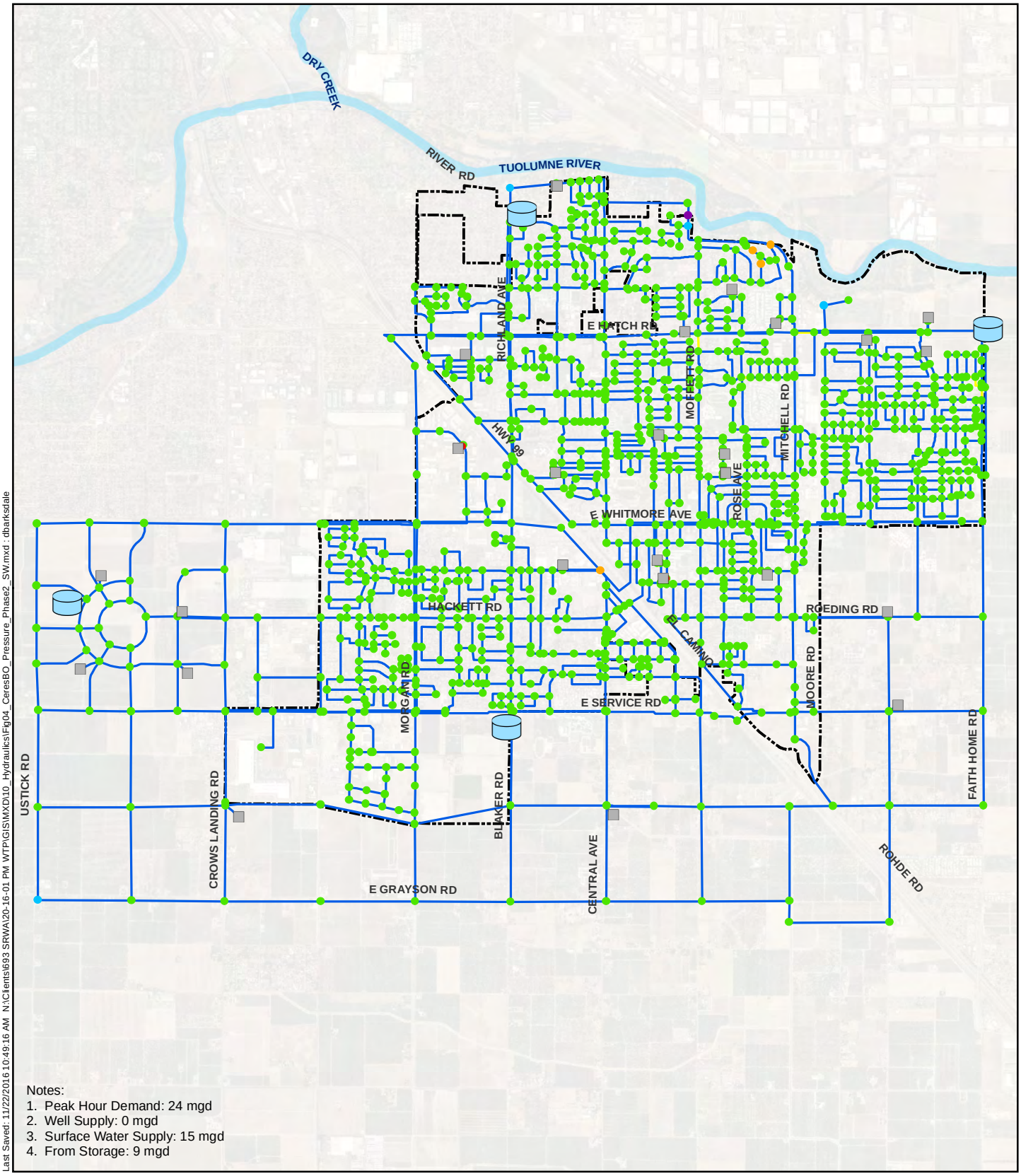

Notes:
1. Peak Hour Demand: 24 mgd
2. Well Supply: 0 mgd
3. Surface Water Supply: 15 mgd
4. From Storage: 9 mgd

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Symbology

Tank
Well On
Well Off

Headloss

<4 ft/1000 ft
4 - 8 ft/1000 ft
>8 ft/1000 ft

Pressure

<40 psi
40 - 50 psi
50 - 60 psi
60 - 65 psi
>65 psi

N

0 1,900 3,800

Scale in Feet

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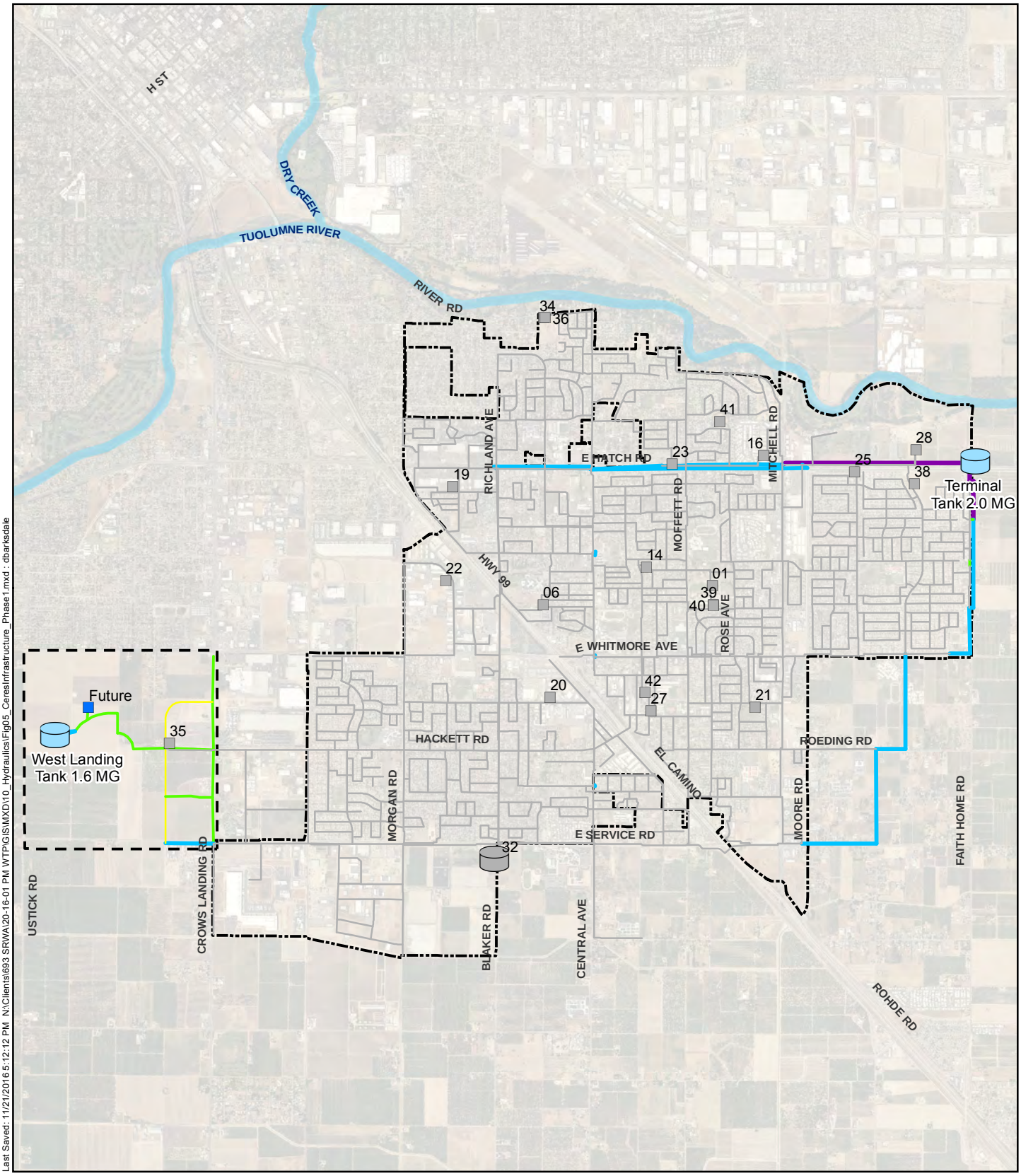
Figure 4

Ceres Peak Hour Pressure and Headloss Gradient, Phase 2 (15 mgd) Surface Water Only

Stanislaus Regional Water Authority
Surface Water Supply Project



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Symbology

- Existing Tank
- Future Tank
- Existing Well
- Future Well
- Existing Pipeline
- Infrastructure assumed to be in place. Not part of Phase 1 Surface Water Project.

Phase 1 Pipeline Diameter

- ≤8"
- 10"
- 12"
- 14" - 18"
- ≥24"

N

0 1,900 3,800

Scale in Feet

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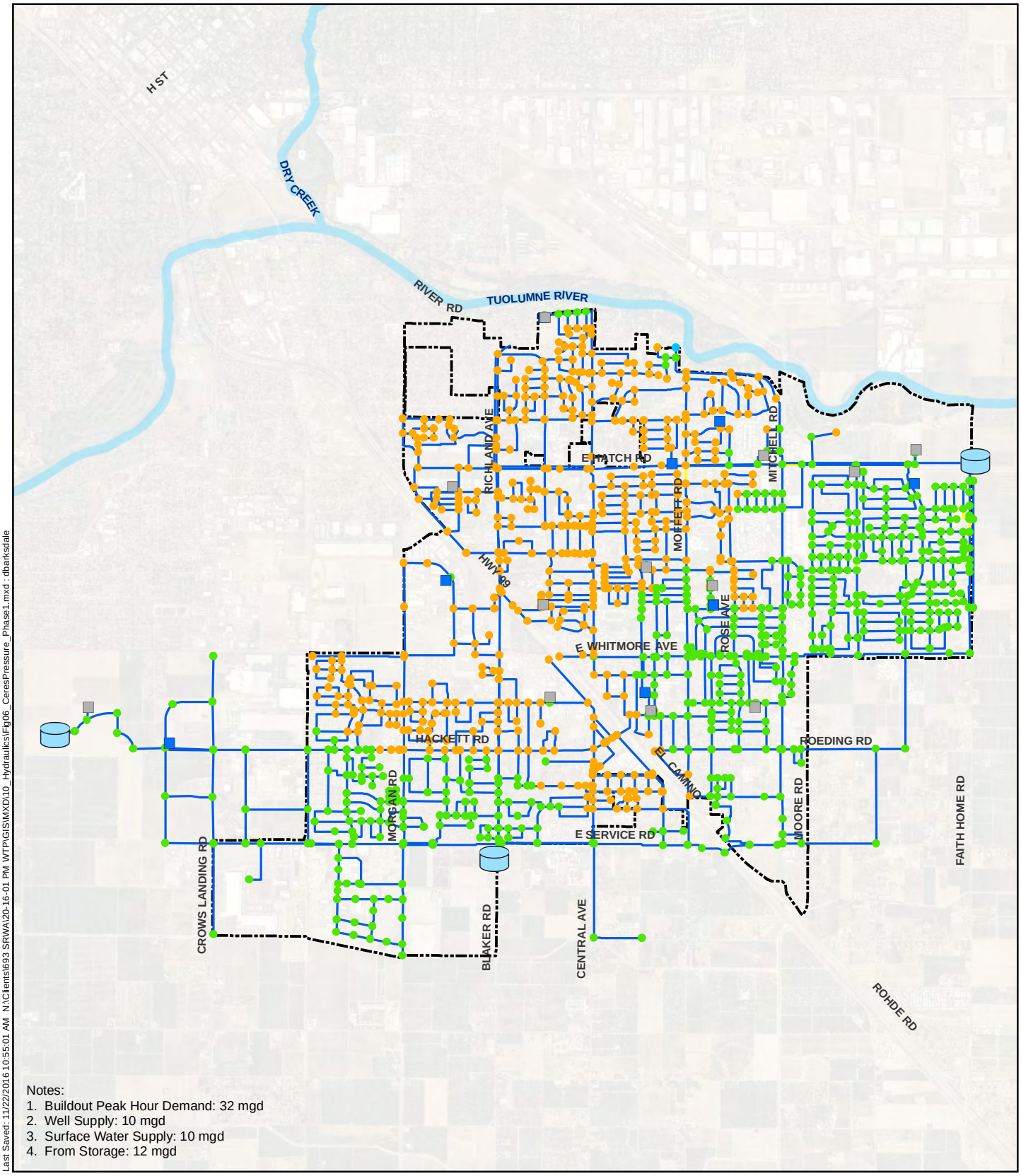
Figure 5

Ceres Infrastructure Required for Phase 1 (10 mgd) Project

Stanislaus Regional Water Authority
Surface Water Supply Project



Notes:
1. Buildout Peak Hour Demand: 32 mgd
2. Well Supply: 10 mgd
3. Surface Water Supply: 10 mgd
4. From Storage: 12 mgd

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Symbology

- Tank
- Well On
- Well Off

Headloss

- <4 ft/1000 ft
- 4 - 8 ft/1000 ft
- >8 ft/1000 ft

Pressure

- <40 pis
- 40 - 50 psi
- 50 - 60 psi
- 60 - 65 psi
- >65 psi

N

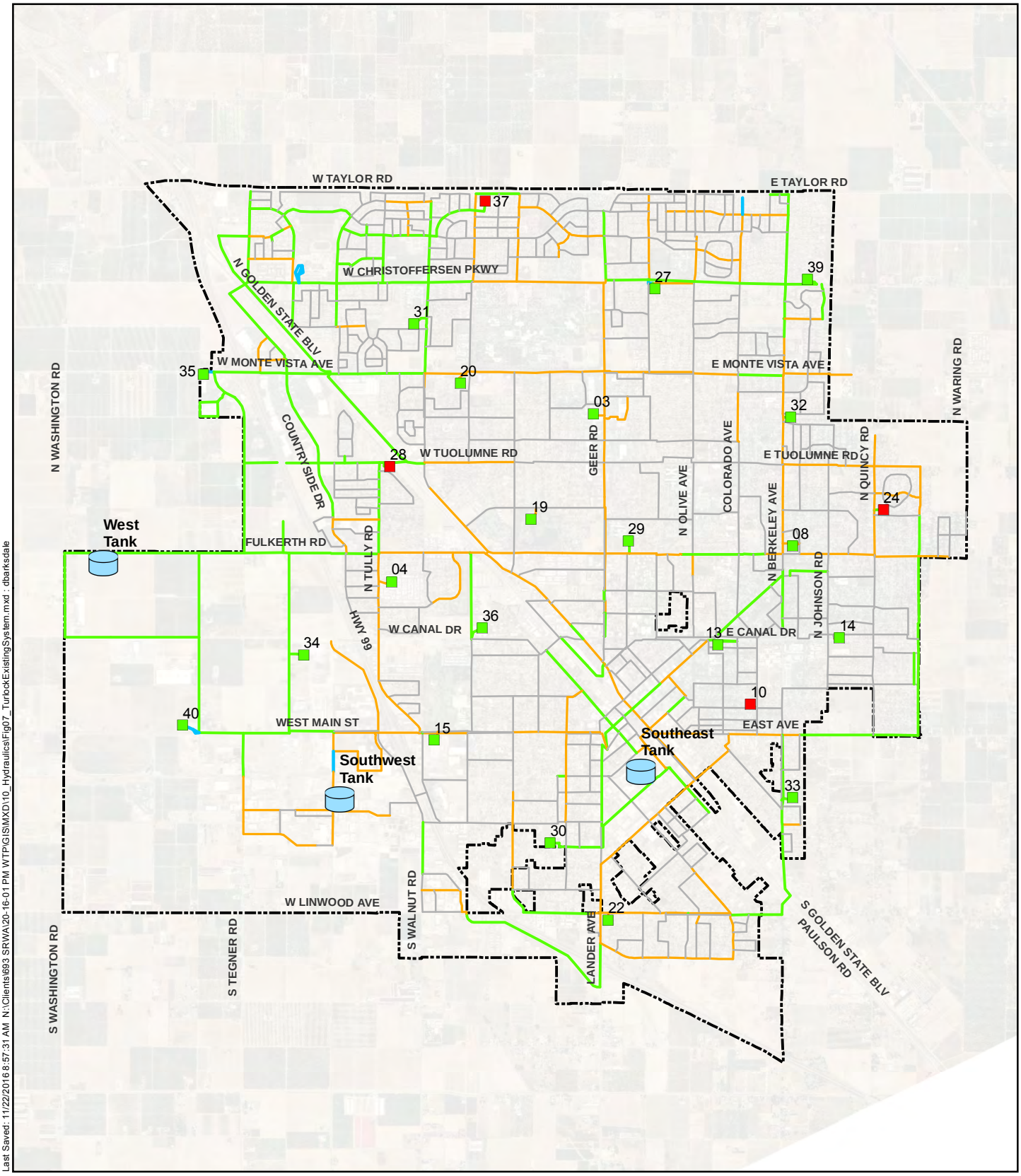
0 1,900 3,800

Scale in Feet

Figure 6

Ceres Near-Term Peak Hour Pressure and Headloss Gradient, Phase 1 (10 mgd) Surface Water Project and Groundwater

Stanislaus Regional Water Authority
Surface Water Supply Project



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Symbology

- Tank
- Active Well
- Inactive Well

Pipeline Diameter

- ≤8"
- 10"
- 12"
- 14" - 18"
- ≥24"

N

0 2,000 4,000

Scale in Feet

SRWA Stanislaus Regional Water Authority

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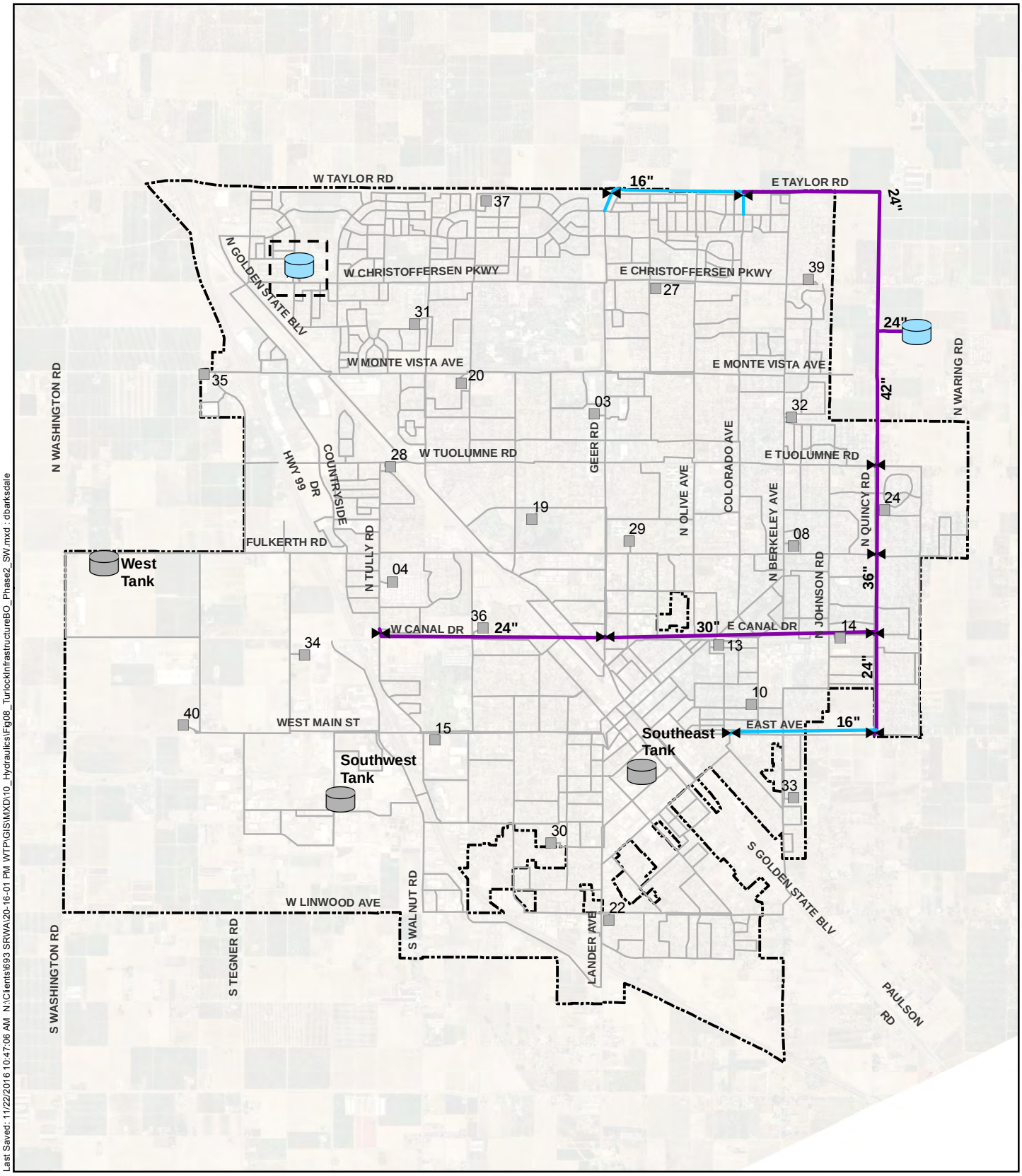
Figure 7
Turlock Existing System

Stanislaus Regional Water Authority
Surface Water Supply Project



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Symbology

- Existing Tank
- Future Tank
- Existing Well
- Future Control Valve
- Infrastructure assumed to be in place. Not part of Phase 1 Surface Water Project.

Existing Pipeline

- Existing Pipeline

Future Pipeline Diameter

- ≤8"
- 10"
- 12"
- 14" - 18"
- ≥24"

N

0 2,000 4,000

Scale in Feet

SRWA Stanislaus Regional Water Authority

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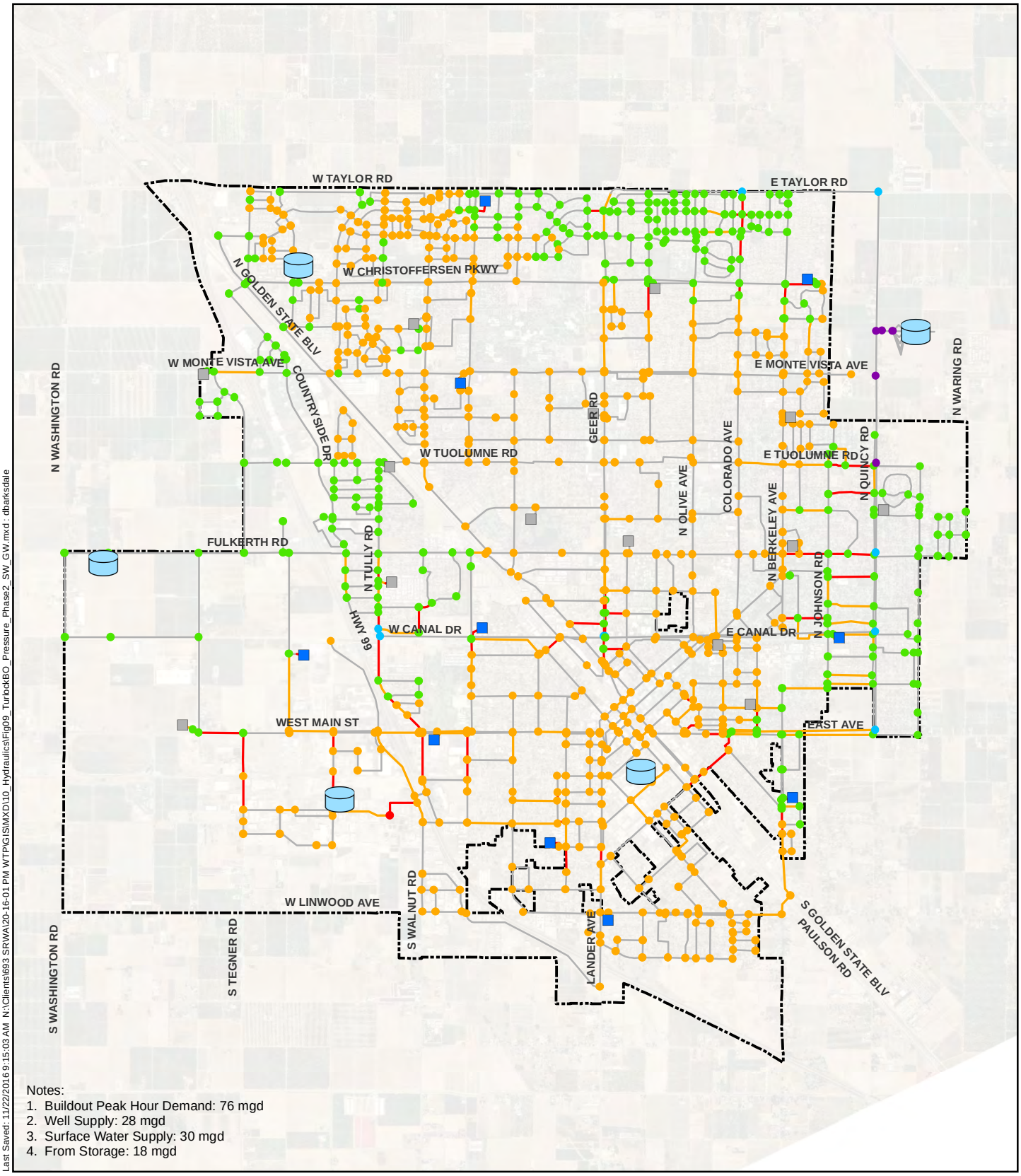
Figure 8

Turlock Infrastructure at Buildout with Phase 2 (30 mgd) Surface Water Project

Stanislaus Regional Water Authority
Surface Water Supply Project



Notes:
1. Buildout Peak Hour Demand: 76 mgd
2. Well Supply: 28 mgd
3. Surface Water Supply: 30 mgd
4. From Storage: 18 mgd

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Symbology

Tank
Well On
Well Off

Headloss

<4 ft/1000 ft
4 - 8 ft/1000 ft
>8 ft/1000 ft

Pressure

<40 psi
40 - 50 psi
50 - 60 psi
60 - 65 psi
>65 psi

N

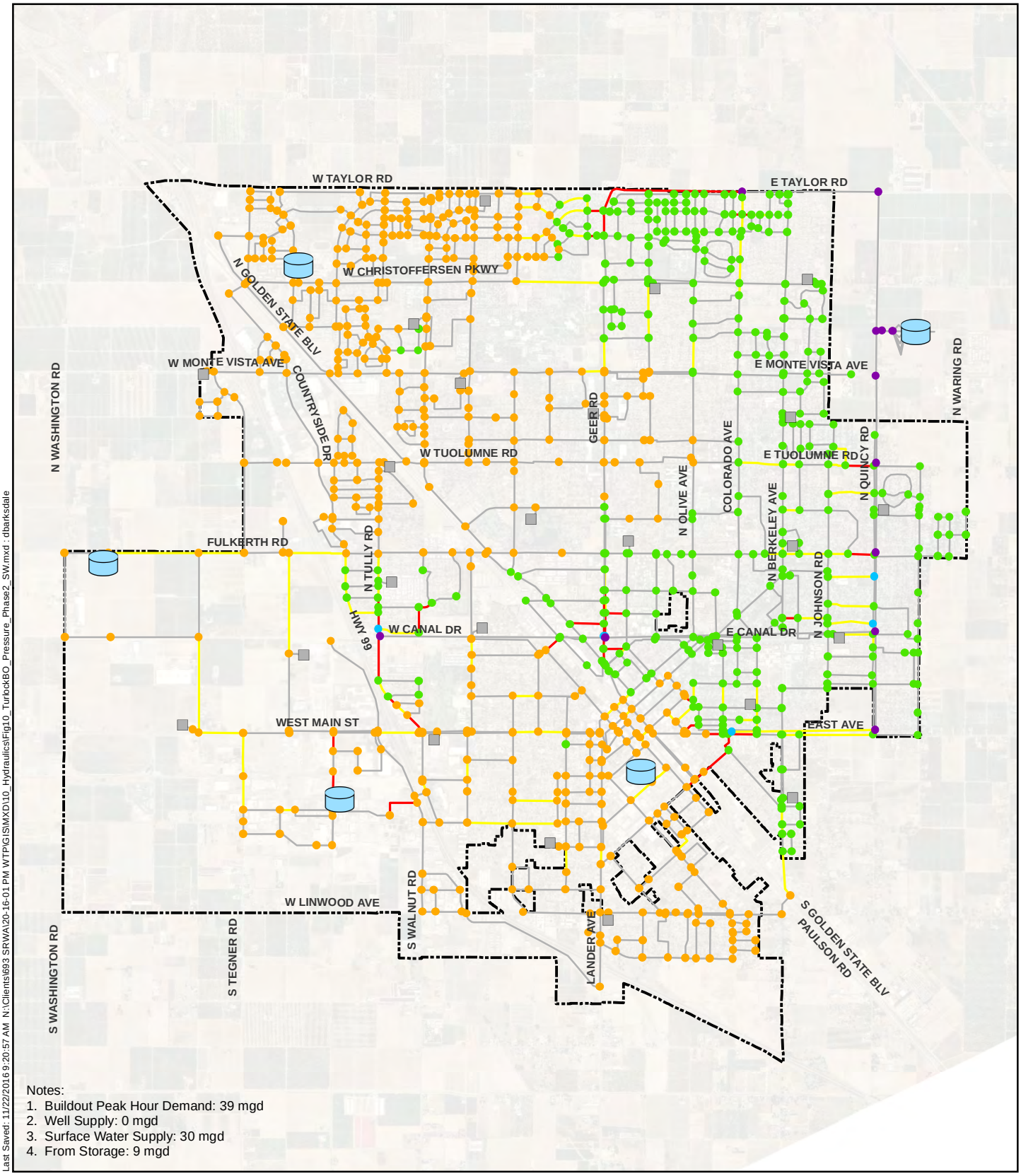
0 2,000 4,000

Scale in Feet

Figure 9

Turlock Buildout Peak Hour Pressure and Headloss Gradient, Phase 2 (30 mgd) Surface Water Project and Groundwater

Stanislaus Regional Water Authority
Surface Water Supply Project



Notes:
1. Buildout Peak Hour Demand: 39 mgd
2. Well Supply: 0 mgd
3. Surface Water Supply: 30 mgd
4. From Storage: 9 mgd

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Symbology

Tank
Well On
Well Off

Headloss
- <4 ft/1000 ft
- 4 - 8 ft/1000 ft
- >8 ft/1000 ft

Pressure
- <40 psi
- 40 - 50 psi
- 50 - 60 psi
- 60 - 65 psi
- >65 psi

N

0 2,000 4,000

Scale in Feet

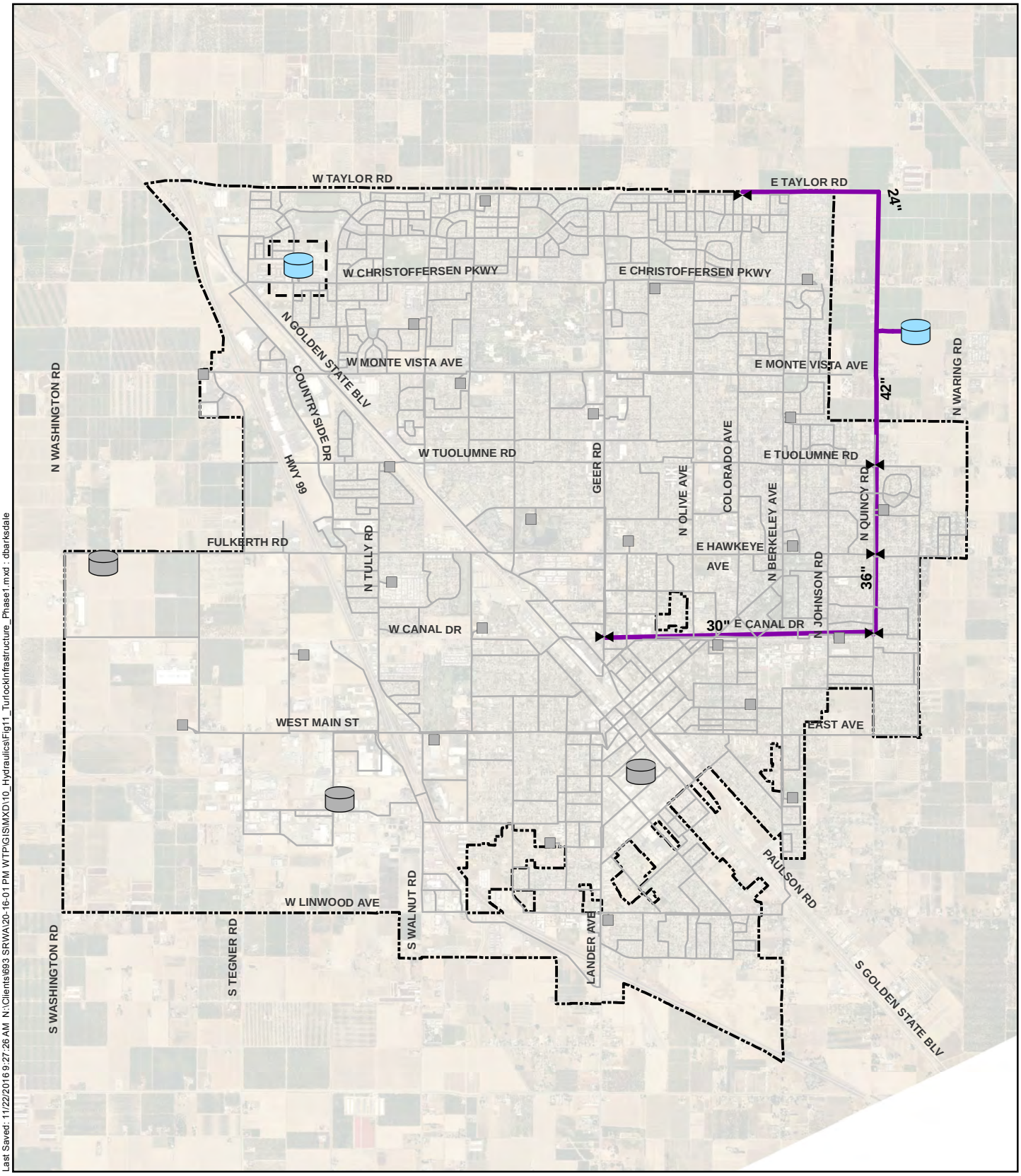
SRWA Stanislaus Regional Water Authority

WEST YOST ASSOCIATES

Figure 10

Turlock Peak Hour Pressure and Headloss Gradient, Phase 2 (30 mgd) Surface Water Only

Stanislaus Regional Water Authority
Surface Water Supply Project



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Symbology

- Existing Tank
- Future Tank
- Future Control Valve
- Existing Well
- Existing Pipeline
- Infrastructure assumed to be in place. Not part of Phase 1 Surface Water Project.

Phase I Pipeline Diameter

- ≤8"
- 10"
- 12"
- 14" - 18"
- ≥24"

N

0 2,000 4,000

Scale in Feet

SRWA Stanislaus Regional Water Authority

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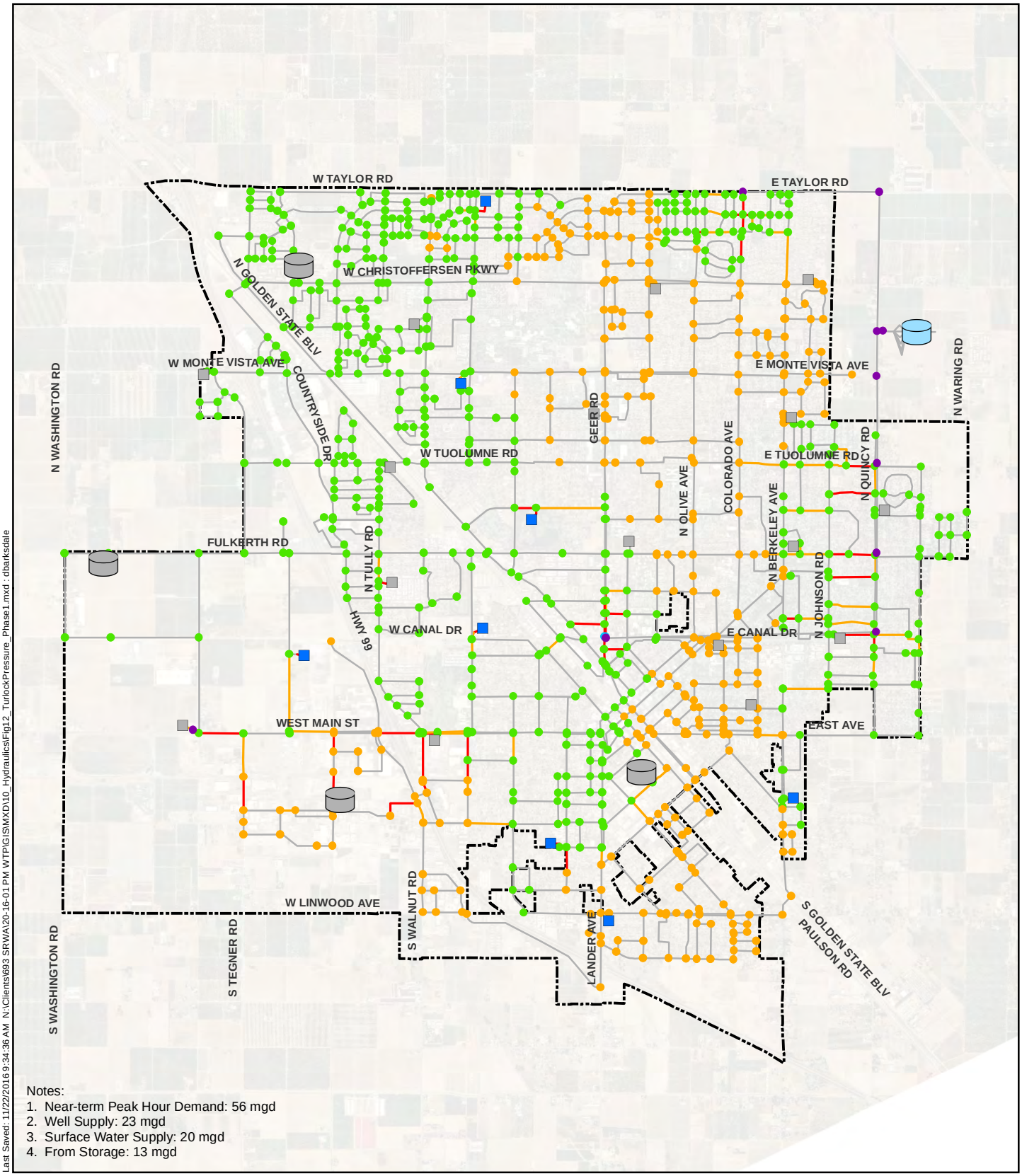
Figure 11

Turlock Infrastructure Required for Phase 1 (20 mgd) Project

Stanislaus Regional Water Authority
Surface Water Supply Project



Notes:
1. Near-term Peak Hour Demand: 56 mgd
2. Well Supply: 23 mgd
3. Surface Water Supply: 20 mgd
4. From Storage: 13 mgd

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Symbology

- Existing Tank
- Future Tank
- Well On
- Well Off

Pressure

- <40 psi
- 40 - 50 psi
- 50 - 60 psi
- 60 - 65 psi
- >65 psi

Headloss

- <4 ft/1000 ft
- 4 - 8 ft/1000 ft
- >8 ft/1000 ft

N

0 2,000 4,000

Scale in Feet

Figure 12

Turlock Near-Term Pressure and Headloss Gradient, Phase 1 (20 mgd) Surface Water Project and Groundwater

Stanislaus Regional Water Authority
Surface Water Supply Project

SRWA Stanislaus Regional Water Authority

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