RAMONA MUNICIPAL WATER DISTRICT

Engineering Department / 105 Earlham Street / Ramona, CA 92065-1599

MEMORANDUM

To:	Water Master Plan Update 2022 *(Updated May 2023)*
From:	D. Michael Metts, PE / RMWD District Engineer
Subject:	WMPU Supplement, Fire Flow Analysis Update [Supplemental Review]
Date:	December 2022

Carollo Engineers and West Coast Civil (Consultant) completed the District's 2022 Water Master Plan Update (WMPU), with West Coast Civil being responsible for the hydraulic modeling portion of the WMPU. As part of the 2022 WMPU project, the existing District water model was updated to represent the existing District infrastructure and operating conditions, as well as the water demands throughout the District. Once the District staff received the updated model, District staff continued to review and use the model to evaluate proposed new developments and proposed changes in existing customer water use. During use of the updated water model, District staff identified that modeling of the Boulder Pressure Zone was incorrect. The Boulder Pressure Zone (1,976 feet) was inadvertently open to the Woodson Pressure Zone (1,800 feet). This issue impacted the fire flow analysis performed by the Consultant and the figure in the WMPU showed several nodes with fire flow deficiencies, particularly in the downtown area. After resolving the modeling issue, a new fire flow analysis (identical to that performed in the original analysis) was performed, which showed significant reduction in the number of nodes shown as fire flow deficient in the 2022 WMPU. Both pipeline size and fire flow were criteria for determining which pipelines were deficient. the revised analysis resulted in an approximate 67 percent reduction in the number of deficient pipelines that were recommended for upsizing by the WMPU. The revised information is documented herein as a supplement to the 2022 WMPU.

1 Background Information

As part of the 2022 WMPU, the District provided the then-current water system model to the Consultant. The project scope required the Consultant to update the water model to bring the infrastructure in the model up to date, incorporate current District operating data, and reflect current water demand distribution throughout the District water system. Once the model was updated, the project scope included evaluation of the District water system under a variety of operating scenarios, with and without application of appropriate fire flow conditions.

During completion of the WMPU, the Board of Directors approved decommissioning of the untreated water system. Analysis of the impacts of decommissioning was added to the project scope. The decommissioning analysis evaluated water system performance with remaining untreated water demands transferred to the treated water distribution system. Similar modeling analyses were performed for the decommissioning scenarios. The results of the decommissioning analyses were added to the WMPU as an appendix, to avoid requiring a costly rewrite of the entire WMPU document.

Once the WMPU project was complete, District staff received and began using the updated water model. As District staff began implementation of the WMPU recommendations, the water model was used to evaluate the water system performance based on specific identification of facility siting efforts (i.e., improvements FF-3, FF-4,

and FF-5). As the model was used, minor corrections were identified, with minor impact to the results of the WMPU, with the exception of the fire flow analysis and the number of pipelines included in improvement FF-1. Corrections associated with this memorandum represent a significant change to the WMPU results regarding fire flow and the pipeline prioritization list, with the revisions representing a marked increase in the existing water system fire flow capability and an associated reduction in pipelines that need to be upsized (resulting in significant savings to the District through 2035).

2 Hydraulic Model Change

Simulating the operation of a water system, particularly a large system, involves a large amount of both graphic and tabular information. From the WMPU, the District water model underwent a significant update. The original water model was developed in 1989 along with the previous water master plan development. Over the ensuing years, various information updates were incorporated, including newly constructed facilities, as well as increases and decreases in water demand. The water model also reflects the geometry of the water system, including the various pressure zones throughout the system. As shown in the WMPU, **Table 1** identifies the existing pressure zones within eh existing District water system.

Table 1. Existing Pressure Zones

Pressure Zone	HGL (ft msl)	Storage Reservoirs	Pump Stations (Zone Pumped To)	PRV (Zone Flows To)
Snow	1,150	Snow Tank	N/A	Chavez Lower
Woodson Regulated	1,429	N/A	N/A	Robb
SDCE Regulated	1,497	N/A	N/A	N/A
Rancho Villa	1,550	N/A	N/A	Rancho Villa
Tombill	1,646	N/A	N/A	Tombill
Santa Maria	1,646	N/A	N/A	Southern Oak
Mussey Grade	1,672	N/A	N/A	Mussey Grade
SDCE Regulated	1,700	N/A	N/A	Arena Arena 2 Couna
Downtown/West End	1,724	West End Reservoir	Poway PS	Woodson-Bargar
Woodson	1,800	Woodson Reservoir	Poway PS	N/A
Bargar	1,800	Bargar Clearwell	Olive Street PS	N/A
SDCE Regulated	1,840	N/A	N/A	Barona West Moonglow
SDCE	1,850	SDCE Tank 1 SDCE Tank 2 SDCE Tank 3 SDCE Tank 4 Julian Tank	Julian PS SDCE PS	27, 28
Gillette	1,900	Gillette Treated Tank	Gillette PS	N/A
Black Canyon	1,990	Black Canyon Tank	Black Canyon PS	N/A
Boulder	1,976	Boulder Tank	Boulder PS	N/A
ID-5	2,100	ID-5 Tank	ID-5 PS	N/A

Note:
Abbreviations: N/A – not applicable; SDCE – Sand Diego Country Estates.

Source: Table 3.1 Existing Pressure Zones in 2022 WMPU

As shown in **Table 1**, the Boulder Press Zone has an average hydraulic grade line (HGL) of 1,976 feet. The Boulder Pressure Zone is in the western portion of the District, as shown on **Figure 1** *(figures are at the end of the memorandum)*, serving primarily the Mt. Woodson area. The Boulder Tank is located along Mt. Woodson Road. The Boulder Pump Station conveys water from the Woodson Pressure Zone (HGL of 1,800 feet) to the Boulder Tank, having a design capacity of 1,285 gallons per minute (gpm).

Waterlines within the Boulder Pressure Zone connect to the Woodson Pressure Zone along South Woodson Drive near the Mt. Woodson entrance monument, as well as in the vicinity of Archie Moore Road and Camino Del Indio. As water is pumped into the Boulder Pressure Zone from the Woodson Pressure Zone, the valves connecting the pipelines between the two pressure zones are normally closed. In the model, a closed valve is shown by "closing" the pipeline between two nodes. It was determined that the modeled pipeline along the Archie Moore Road connection was inadvertently left open between the two pressure zones. This pipeline was closed to reflect the proper configuration of the distribution system. **Figure 1** illustrates the various pressure zones in the District water system, with the Boulder Zone shown on the left side of the figure in pink.

As discussed, analyses within the WMPU project included a fire flow analysis of the entire treated water system. To properly convey the impact of the identified issue, it is important to explain how the modeling software

completes a fire flow analysis. In the model, each demand location (node) is assigned a specific fire flow value based on the water demands connected to the node. When evaluating the fire flow capability of the system, the modeling software applies the identified fire flow at one node and evaluates the remainder of the system. The software then turns off that fire flow demand and applies the fire flow demand of another node. The software continues to evaluate fire flow at subsequent nodes until all nodes in the water system model have been evaluated. The modeling software establishes the fire flow that can be achieved, while the pressure at no other node in the water system drops below 20 pounds per square inch (psi) and/or any pipeline velocity exceeds 10 feet per second (fps). At the point which a node drops below 20 psi or a pipeline exceeds 10 fps, the model reports the fire flow for that specific node that can be achieved without causing an unacceptable pressure reduction or velocity increase in any portion of the water system.

As the Boulder Pressure Zone was "open" to the Woodson Pressure Zone in the model, the ground elevations of the Boulder Pressure Zone are too high to be properly served by the Woodson Pressure Zone. Therefore, when evaluating the fire flow of the entire water distribution system, the nodes in the Boulder Pressure Zone would drop below the 20-psi threshold in the analysis. This situation is not reflective of actual water system operation. The result is that the analysis calculated fire flow values as deficient at many nodes in the system and do not reflect what these nodes can actually provide for fire flow. As the analysis includes the entire water system, fire flow values that could be achieved across the water system were suppressed. Correction of the "open" pipeline results in an increase in predicted fire flow across the entire distribution system.

3 Revised WMPU Results

The 2022 WMPU recommendations included a multi-year programmatic replacement of 6-inch and smaller water infrastructure across the entirety of the water system. Specifically, the 2022 WMPU identified the following recommendation:

- Capital Program (CP) FF-1 (Programmatic Water Main Replacement). This program defines the programmatic replacement of water mains sized below the District's minimum water main diameter of eight (8) inches. Replacement of these pipelines will occur over an extended period. As such, the WMPU identified a recommended prioritization to focus on initial replacement of the most critical mains.

From the 2022 WMPU analysis, it was projected that 383,000 feet of 4- and 6-inch pipelines were required to be upgraded to 8-inch pipelines. **Figure 2** *(figures are at the end of the memorandum)* illustrates the results of the original analysis under maximum day demand without untreated water demands, showing a considerable number of system nodes identified to provide less than 50 percent of the required fire flow. The downtown Ramona area particularly showed significant fire flow deficiencies, as shown by the high number of red dots (25-50% fire flow delivered), as well as some deficiencies on the western side of the system. **Figure 3** represents the same analysis conditions as Figure 2, with the correction of the "open" condition applied.

After correcting the "open" condition between the Boulder and Woodson Pressure Zones, the number of pipelines identified with fire flow deficiencies decreased by approximately 67 percent. **Figure 4** *(figures are at the end of the memorandum)* illustrates the conditions within the water system when the correction is applied under maximum day demand with untreated flows attributed to the treated water system. As shown, the number of red and orange nodes are significantly reduced. The corrected analysis does not eliminate the need to replace 4- and 6-inch pipelines throughout the system but changes the prioritization, as percent fire flow delivered along with

pipeline size were the two criteria used to prioritize the pipelines. Pipelines that are 4- and 6-inches but meet 100% of fire flow requirements are therefore eliminated from FF-1 but may be included in the District's other pipeline replacement program based on material and age.

It is noted that District staff also evaluated the existing and future maximum day demand with untreated demands applied and with/without the proposed water service to the Barona Reservation. **Figures 5 and 6** *(figures are at the end of the memorandum)* illustrate the water service conditions under these scenarios, which were previously provided as part of the September 2022 Barona Water Service Study.

4 Summary

Having identified and corrected the "open" condition between the Boulder and Woodson Pressure Zones, the total number of pipelines requiring replacement has been reduced by 67 percent from 383,000 feet to 125,000 feet. **Table 2** shows the updated lengths of pipeline associated with the eight levels of risk assessment from the 2022 WMPU analysis.

Table 2. Pipeline Replacement Program Risk Assessment Results (WMPU Recommended Program FF-1)

Priority	Description	Replacement Pipe Length (ft)	
		2022 WMPU	Updated Results
1	Diameter less than or equal to 4" with less than 25% of FF* delivered	8,300	830
2	Diameter less than or equal to 4" with 25-50% of FF delivered	11,600	3,220
3	Diameter equal to 6" with less than 25% of FF delivered	0	0
4	Diameter less than or equal to 4" with 50-75% of FF delivered	3,800	6,770**
5	Diameter equal to 6" with 25-50% of FF delivered	74,200	5,770
6	Diameter less than or equal to 4" with 75-99% of FF delivered	1,200	2,570**
7	Diameter equal to 6" with 50-75% of FF delivered	137,000	47,820
8	Diameter equal to 6" with 75-99% of FF delivered	146,900	58,063
	Total	**383,000**	**125,043**

**FF = Fire flow.*
***Note: The length of these pipes increased because pipelines moved from priority 1 & 2 to 4 & 6 because of improved fire flow capability. In the updated results, a total of 11,510 feet of 4-inch pipeline meet 100-percent or greater fire flow requirements and were removed from the priority list.*

From the 2022 WMPU, the total length of pipeline replacement for the FF-1 recommendations was 383,000 feet at an estimated cost of $126.5 million between now and 2035. With the revised analysis, the total length of pipeline replacement for the FF-1 recommendations was 125,043 feet with an approximate revised cost of $41,3 million over the same period.

The 2022 WMPU has recommended a near term (2021-2025) replacement of 98,000 linear feet (approximately 18.5 miles) for those pipelines in priority groups 1 through 5. However, with the revised analysis only 16,590 linear feet (approximately 3 miles) are in priority groups 1 through 5, which is an 84% reduction in length and results in a significant near-term cost reduction. Priority groups 6 and 7 totaled 137,000 linear feet (approximately 26 miles) for replacement in 2026-2030 and has been reduced to 50,390 feet (approximately 9.5 miles). Priority 8 for replacement in 2031 and beyond was reduced from 150,000 to 58,063 linear feet (28 miles to 11 miles.

In addition to these pipelines, there are approximately 103,540 feet of dead-end pipelines that provide less than 100 percent fire flow. Analysis of these dead-end pipelines was proposed to be handled on a case-by-case basis because most of these services are supplemented with on-site water storage, in accordance with local and state fire code. Similarly, the number of dead-end pipelines requiring replacement (via upsizing or looping) for fire flow deficiencies was reduced.

District staff has incorporated the results of this analysis into the ongoing Water Facilities Plan Update. District staff will focus its initial efforts on pipelines based on the risk prioritization shown above. **Figure 7** *(figures are at the end of the memorandum)* illustrates the recommended pipeline improvements from the WMPU based on the updated model results.

Figure 1. Existing Water System Pressure Zones

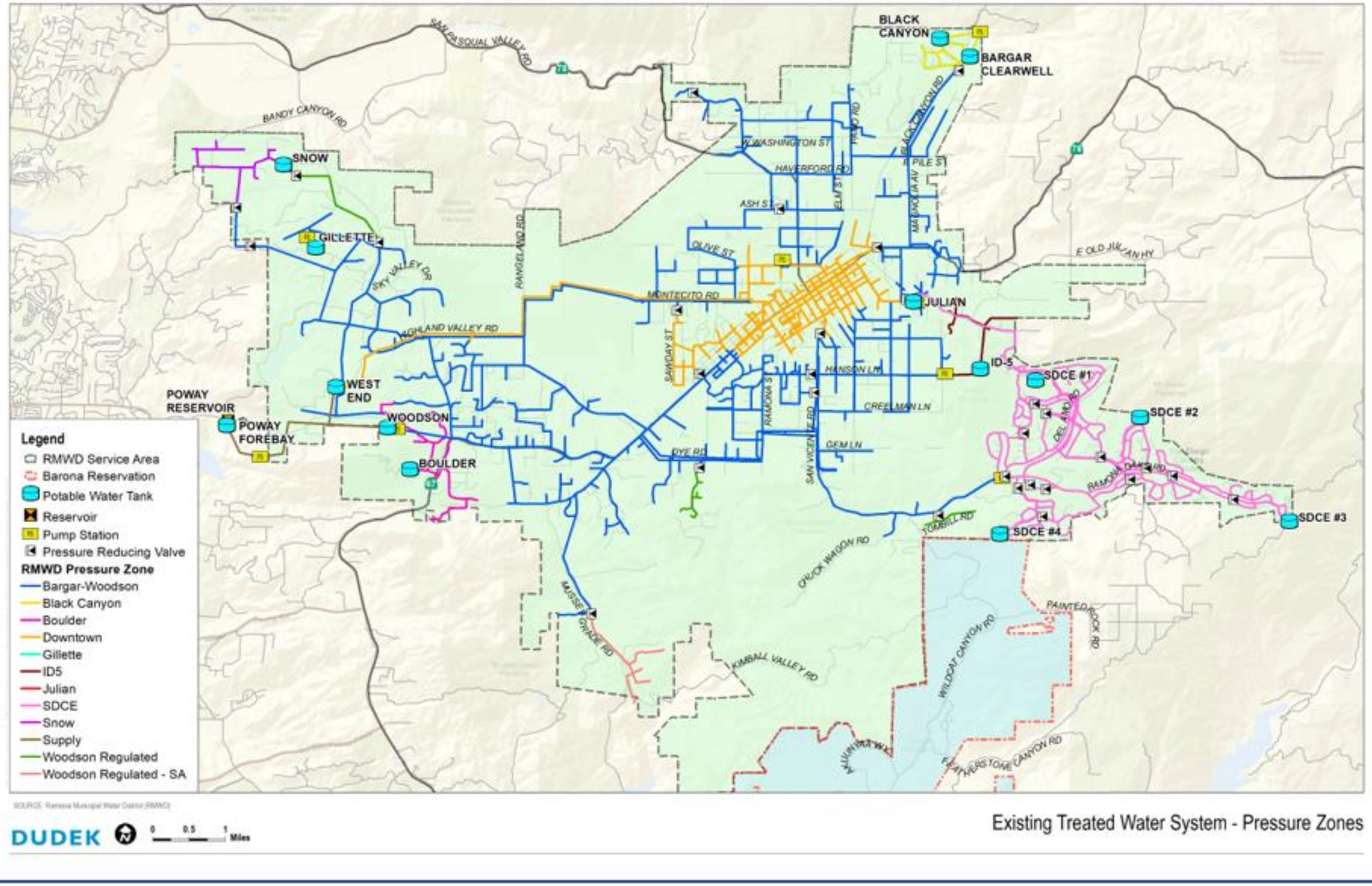
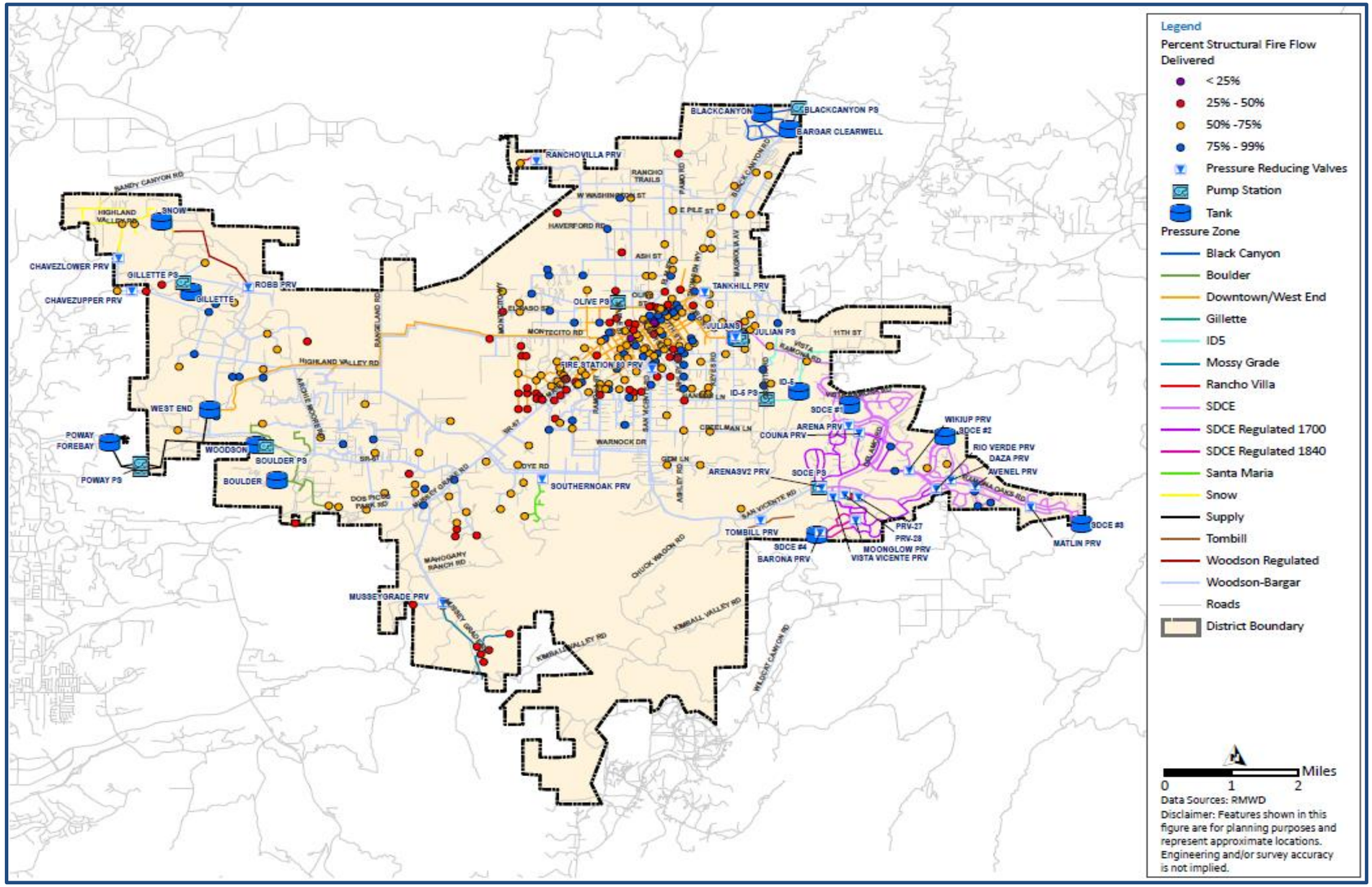
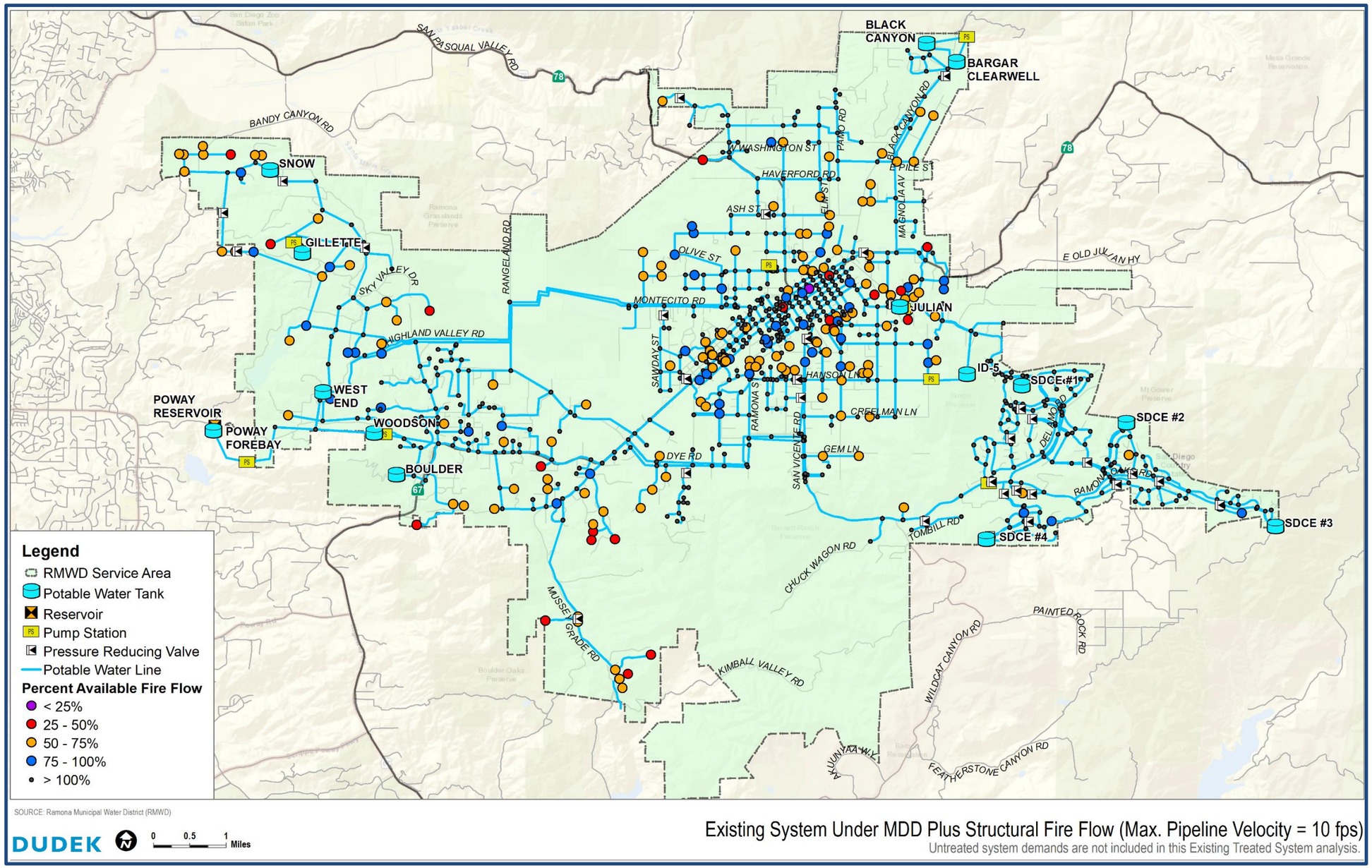


Figure 2. Percent Structural Fire Flow Delivered (From 2022 Water Master Plan with Boulder Zone Error)



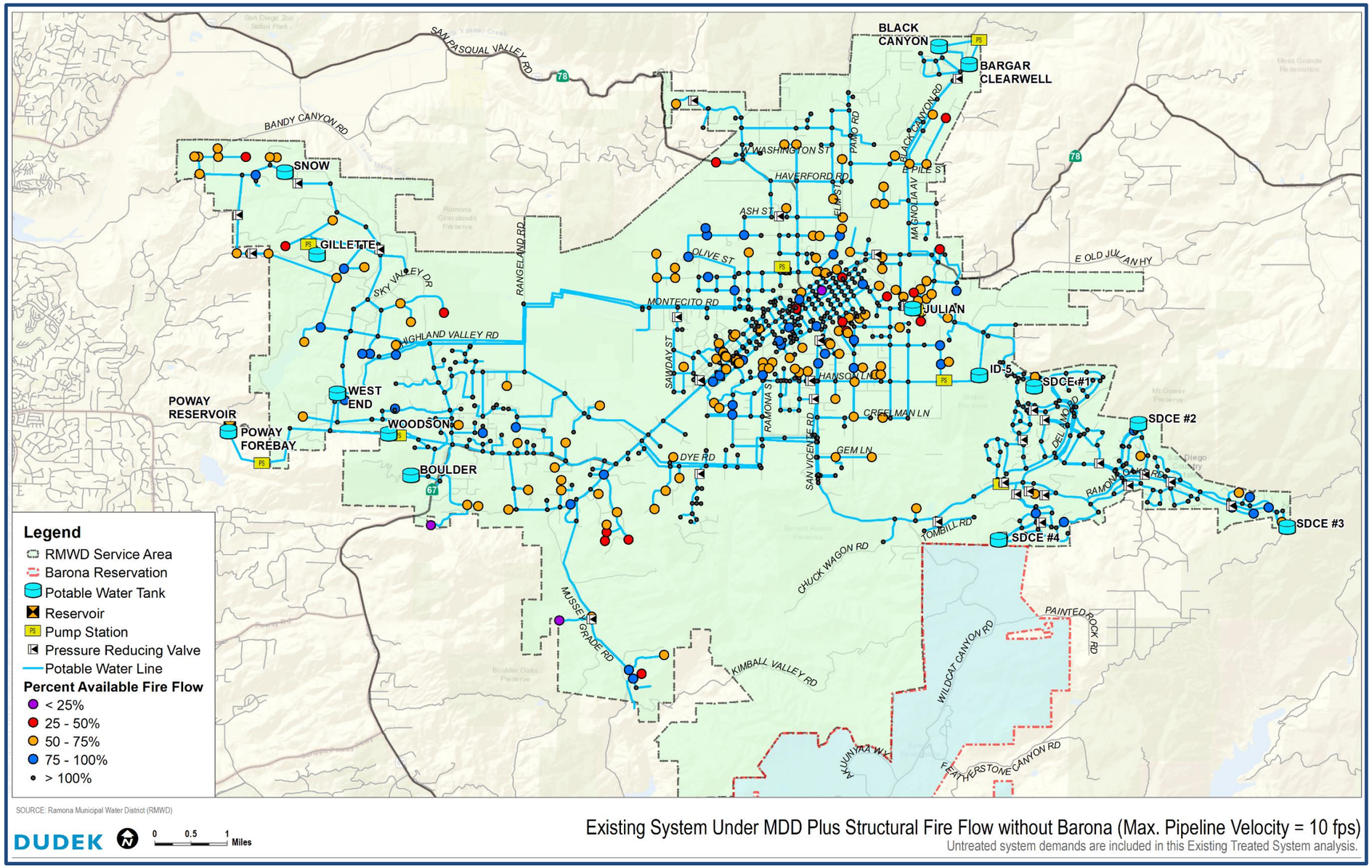
Note: Does not attribute untreated flows to the treated water system and does not have the Boulder Zone "open" condition issue resolved

Figure 3. Percent Structural Fire Flow Delivered (Existing Demands without Untreated Demands on Treated System)



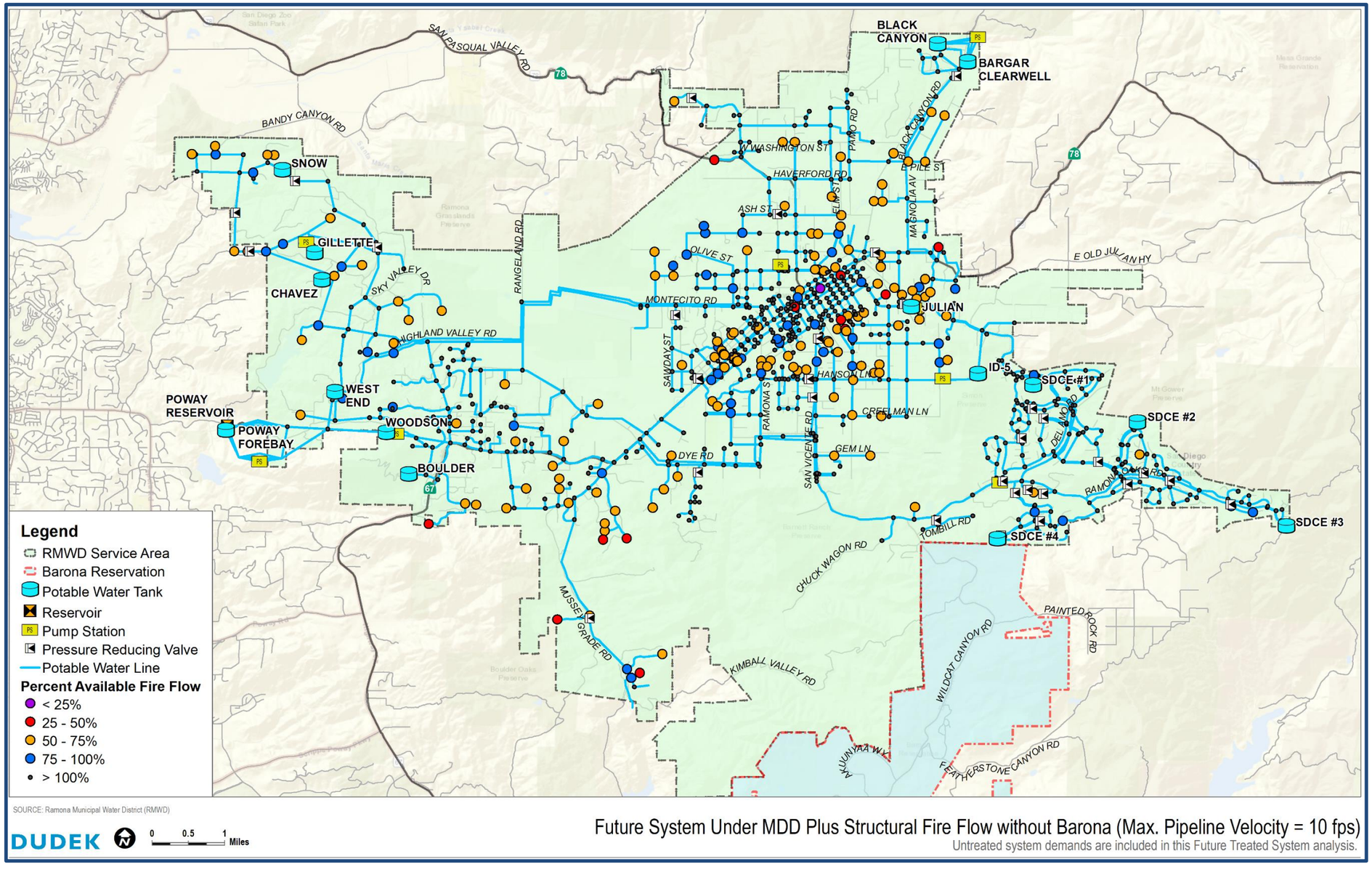
Note: Does not attribute untreated flows to the treated water system and has the Boulder Zone "open" condition issue resolved

Figure 4. Percent Structural Fire Flow Delivered (Existing Demands with Untreated Demands on Treated System)



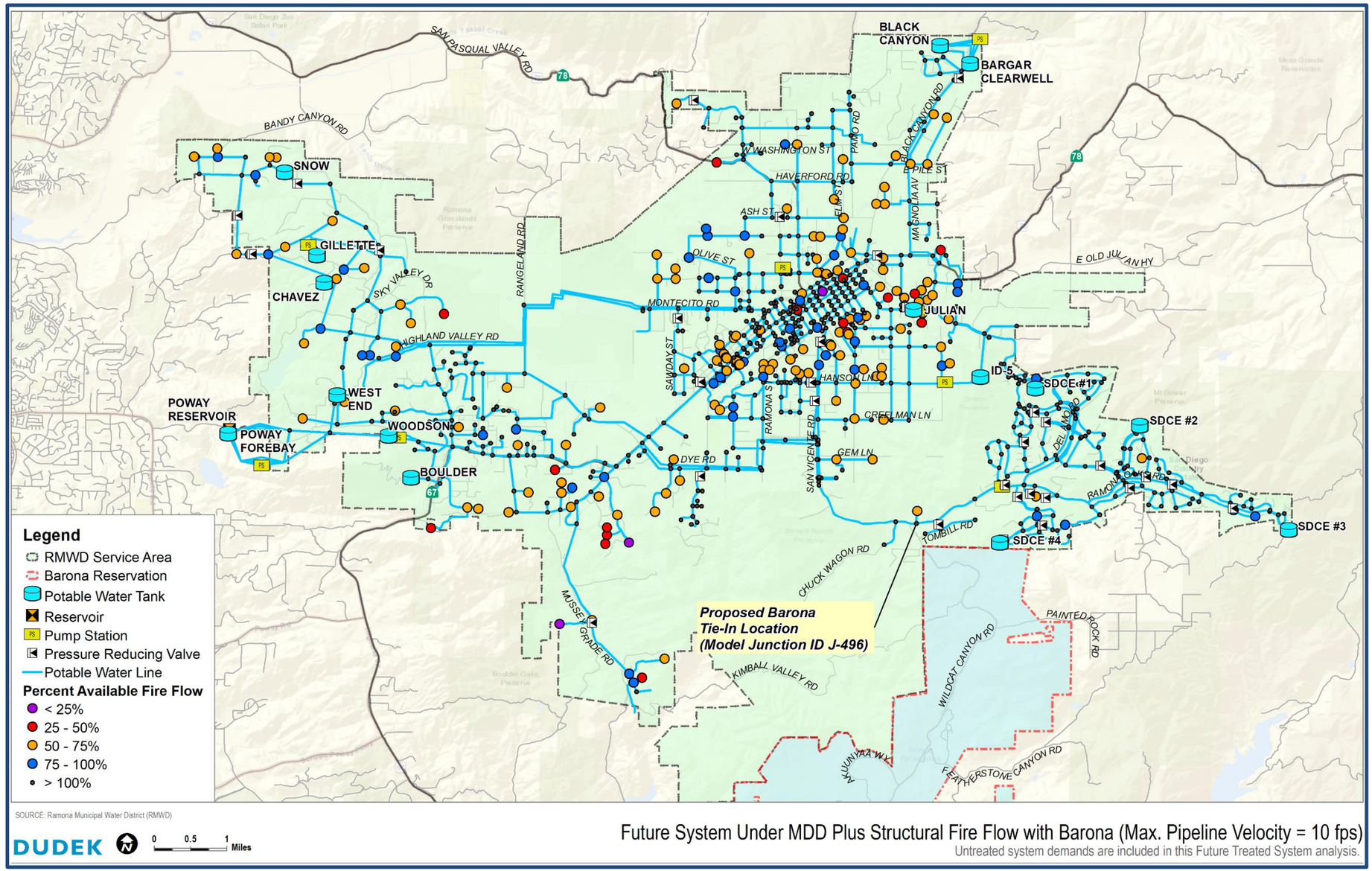
Note: Analysis includes untreated flows attributed to treated water system and has the Boulder Zone "open" condition issue resolved

Figure 5. Percent Structural Fire Flow Delivered (Future Demands without Barona Demand)



Note: Analysis includes untreated flows attributed to treated water system and has the Boulder Zone "open" condition issue resolved

Figure 6. Percent Structural Fire Flow Delivered (Future Demands with Barona Demand)



Note: Analysis includes untreated flows attributed to treated water system and has the Boulder Zone "open" condition issue resolved

Figure 7. Improvements to Address Existing System Capacity Needs