Agenda

Sacramento Suburban Water District

Facilities and Operations Committee

3701 Marconi Avenue, Suite 100
Sacramento, CA 95821

Wednesday, August 1, 2018
11:00 a.m.

Public documents relating to any open session item listed on this agenda that are distributed to the Committee members less than 72 hours before the meeting are available for public inspection in the customer service area of the District's Administrative Office at the address listed above.

The public may address the Committee concerning any item of interest. Persons who wish to comment on either agenda or non-agenda items should fill out a Comment Card and give it to the General Manager. The Committee Chair will call for comments at the appropriate time. Comments will be subject to reasonable time limits (3 minutes).

In compliance with the Americans with Disabilities Act, if you have a disability, and you need a disability-related modification or accommodation to participate in this meeting, then please contact Sacramento Suburban Water District Human Resources at (916)679-3972. Requests must be made as early as possible and at least one-full business day before the start of the meeting.

Call to Order

Pledge of Allegiance

Roll Call

Announcements

Public Comment
This is an opportunity for the public to comment on non-agenda items within the subject matter jurisdiction of the Committee. Comments are limited to 3 minutes.

Consent Items
The committee will be asked to approve all Consent Items at one time without discussion. Consent Items are expected to be routine and non-controversial. If any member of the Committee, staff or interested person requests that an item be removed from the Consent Items, it will be considered with the action items.

1. **Minutes of the May 30, 2018 Facilities and Operations Committee Meeting**
   Recommendation: Approve subject minutes.

Items for Discussion and or Action

2. **Presentation on Well Site Selection Planning**
   Recommendation: Receive staff report and direct staff as appropriate.

3. **Distribution Main Asset Management Plan Update**
   Recommendation: Receive staff report and direct staff as appropriate.

4. **2017 Consumer Confidence Report Review**
   Recommendation: Receive staff report and direct staff as appropriate.

Adjournment

* *

Upcoming Meetings:

Monday, August 20, 2018 at 6:00 p.m., Regular Board Meeting

* *

I certify that the foregoing agenda for the August 1, 2018 meeting of the Sacramento Suburban Water District Facilities and Operations Committee was posted by July 27, 2018 in a publicly-accessible location at the Sacramento Suburban Water District office, 3701 Marconi Avenue, Suite 100, Sacramento, California, and was made available to the public during normal business hours.

Dan York
General Manager/Secretary
Sacramento Suburban Water District

Minutes

Sacramento Suburban Water District
Facilities and Operations Committee
Wednesday, May 30, 2018

Call to Order
Chair Jones called the meeting to order at 2:01 p.m.

Pledge of Allegiance
Chair Jones led the Pledge of Allegiance.

Roll Call

Directors Present:	Dave Jones and Robert Wichert.
Directors Absent:	None.
Staff Present:	General Manager Dan York, Amy Bullock, Matt Underwood, David Morrow, Todd Artrip, Mitchell McCarthy, David Espinosa, Dan Bills and Jim Arenz.

Public Present: William Eubanks and Ryan Gunstream.

Announcements
None.

Public Comment
None.

Consent Items

1. **Minutes of the March 6, 2018 Facilities and Operations Committee Meeting**

   Director Wichert moved to approve Consent Item 1; Chair Jones seconded. The motion passed by unanimous vote.

AYES:	Jones and Wichert	ABSTAINED:	
NOES:		RECUSED:	
ABSENT:			

Items for Discussion and Action

2. **Regional Water Meter Replacement Program**
   Matt Underwood (Mr. Underwood) presented the staff report and went through a PowerPoint presentation.

   General Manager Dan York (GM York) stated that at the last Regional Water Authority Board meeting other agencies and water purveyors are now interested in participating in the program. With other newly interested parties the number has gone from 80,000 to half a million potential connections.

Chair Jones inquired what the main purpose of the program is.

Mr. Underwood stated that at this stage the main purpose is to find out what opportunities are available.

Chair Jones stated for the record that Director Wichert is present for the meeting at 2:10 p.m.

Chair Jones noted that it is very important that the program be successful and is concerned about who is doing what to ensure that staff is successful in the program.

Mr. Underwood stated that there will be a number of groups formed including an assignment of a chair to the committee or formed group(s).

Chair Jones inquired about the calibration of the meters.

Mr. Underwood stated that there are people at all different levels with different processes of testing and calibrating their meters.

GM York stated that the administrative group is composed of General Managers who are attending other District board meetings showing support of the program.

Director Wichert inquired how many signatures are already in.

Mr. Underwood stated that he is not sure exactly how many signatures, but he's aware that Citrus Heights Water District, Orange Vale Water District, San Juan Water District, Fair Oaks Water District and Carmichael Water District have already signed on.

GM York stated that Sacramento Suburban Water District is one of the last local districts to sign on as the next scheduled Board meeting date is in June.

Director Wichert stated that he reviewed the program offline and thinks it's a great program and further expressed that this is definitely a program the District should be involved in, especially since there is no fiscal impact at this time.

Mr. Underwood confirmed that at this stage there is no fiscal impact.

Director Jones stated that he sees a really good program coming out of this model for potential future sharing projects.

Mr. Underwood stated that there will be grant funding available.

Director Wichert recommended that this item be moved to consent item on the next month's regular Board meeting. Chair Jones seconded the motion.

3. **Fixed Network Meter Reading Issues**
Mr. Underwood presented the staff report.

GM York stated that legal may need to get involved due to the contract with Delta Engineering and KP that is combined with Sacramento Suburban Water District. The issue is that KP committed to install collectors, however there was no limit stated in the contract.

Chair Jones inquired what the cost of a collector is and the expected lifespan.

Mr. Underwood stated that approximately three new collectors would be $80,000 and $115,000 for five new collectors. The warranty is two years on new collectors.

Director Wichert stated that the cell phone systems don't require collectors.

Mr. Underwood confirmed that cell phone systems don't require collectors and that is another option the District is considering for the future.

Director Wichert inquired what type of batteries are used.

Mr. Underwood stated that the batteries are a lithium ion battery, however the type of battery is not the issue.

Director Jones inquired if Mr. Underwood had an idea or timeline of when the issue will be resolved.

Mr. Underwood stated that hopefully the issue will be resolved by the end of this year if not, then by the end of the year staff will have an idea of which direction to head.

Mr. Underwood stated that this item will be on next month's regular Board meeting agenda as an information item.

4. **Maintaining a Sufficient, Reliable Water Supply**
Jim Arenz presented the staff report and went through a PowerPoint presentation.

Director Wichert inquired how much the stainless steel casing costs.

Mr. Arenz stated that stainless steel casing runs about $50,000 to $80,000. If you do the math, paying the money upfront to get the stainless steel casing that does not degrade for approximately 70-75 years or longer is a big benefit and saves money long term.

Chair Jones inquired how many well sites are on a half of acre or more.

Mr. Arenz stated that he is unsure how many of the District's well sites are about a half an acre or more, however, he is hoping that the new sites be close to the transmission mains.

Director Wichert inquired about when the last time the District had a well that failed.

Mr. Arenz stated that Well 44 failed which was about 15 years ago.

Director Wichert inquired about what the other agencies in the area expect out of their wells in terms of age.

Mr. Arenz stated that everyone uses a 50 year standard.

GM York stated that another critical avenue is to start doing some land acquisitions.

GM York stated that the County of Sacramento just purchased a residential property in the Arden Oaks area that had a house on it. The County demolished the house and drilled the well right in the middle of the residential property.

Chair Jones inquired if the District anticipates one or two wells a year for the next 50 years.

Mr. Arenz stated that the priority is the North Service Area and anticipate 12-15 wells over the next 15 years.

Public comment from William Eubanks (Mr. Eubanks) stated that if the District had to put higher producing wells close to large transmission mains for the purpose of treatment sites then the District will be bankrupt in no time. The District should be working on three or more property accusations tied up and confirmed at a given time to ensure that if or when you need the new wells you have the adequate sites for them.

Dan Bills (Mr. Bills) commented that if the District does not stagger the replacement of wells, then it all could come to a head at once. The District can't wait for failure to act. The District is much better served financially without having to go into debt or borrow money to do a ratable implementation of new wells than waiting for failure of a well. A cluster analysis would be wise to do to get an idea of how to proceed.

Director Wichert inquired if the District has ever done a cluster analysis. He stated he would like to see that data either at the next Facilities and Operations Committee meeting.

GM York confirmed that staff will work on the cluster analysis and provide it to the Committee as soon as possible.

5. Short Term Water Transfer Pilot Project – Sacramento County

GM York presented the staff report.

GM York stated that the Pilot Transfer with the County of 1,000 AF could occur between January and July of 2019.

Chair Jones inquired if there is a flow meter at Cypress.

GM York stated that there is no flow meter at Cypress but there are plans for Carmichael Water District to install a flow meter at the intertie.

Director Wichert stated that the item should go to the regular Board meeting as an Action item.

Adjournment
Chair Jones adjourned the meeting at 3:15 p.m.

Dan York
General Manager/Secretary
Sacramento Suburban Water District

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SACRAMENTO SUBURBAN WATER DISTRICT

Facilities and Operations Committee

Agenda Item: 2

Date: July 25, 2018

Subject: Presentation on Well Site Selection Planning

Staff Contact: James Arenz, Senior Project Manager
Dave Morrow, P.E., Senior Engineer

Recommended Committee Action:

Receive presentation by the Engineering Department related to new well site selection planning methodologies. The presentation provides information related to the development of a GIS database tool and process of site selection. Provide comment on the presentation and provide direction as appropriate.

Background:

The District has 66 active municipal wells with 35 of them over the age of 50 years. While all efforts are made to prolong a well's useful life to maximize best use of customer funds and rehabilitation efforts of some wells may allow for restoration of a portion of lost capacity, some wells may experience an unrecoverable decrease in yield and/or groundwater contamination. Unfortunately, nearly all of the District's older well site properties are too small for new infrastructure (e.g., replacement well, treatment plant).

The District has identified a need to develop sufficient information in preparation to replace wells in order to maintain sufficient capacity. This will most likely include the need to secure new land.

Discussion:

A GIS-based well siting screening tool is in development. The tool will be used by staff to employ a comprehensive approach to evaluating and selecting new production well sites. The GIS tool combines readily available GIS information to focus on viable well locations within the District. Information used to focus a well site search includes District boundaries, parcel locations, size information, known toxic release locations, groundwater plumes and flow gradients, existing District pipelines of sufficient sizes and proximity, and other very site-specific well siting criteria including geologic formations, water quality data, and the proximity to existing wells.

The well siting methodically eliminates from further consideration sites that do not meet District well siting criteria and provides the District with a Groundwater Atlas that will be extremely valuable in well site selections. The use of the GIS selection tool database will help ensure the success of a new well and reduce potential costs associated with unknown site conditions.

Please see Exhibit 1 for a copy of the presentation by West Yost Associates.

Fiscal Impact:

No direct immediate fiscal impact is expected.

Implementation of the presented approach is intended to generally reduce future fiscal impacts by identifying wells sites within our service area that will reduce the anticipated cost of future well construction and to facilitate prudent utilization of District funds. Other impacts will depend on Board direction as it relates to allocation of monies for CIP funding priorities.

Strategic Plan Alignment:

Water Supply – 1.B. Provide for the long-term water supply needs of the customers through prudent planning that will ensure capacity to serve system demands.

Water Supply – 1.D. Manage the District's water supplies to ensure their quality and quantity.

Facilities and Operations – 2.A. The District will utilize appropriate planning tools, identify financial resources necessary, and prioritize system requirements to protect and maintain District assets and attain water resource objectives incorporating resource sustainability and lifecycle cost analysis into the framework.

Facilities and Operations – 2.B. Monitor and improve the District's efficiencies in operating and maintaining system infrastructure.

Facilities and Operations – 2.C. Develop cost-effective strategies utilizing technology and available resources to optimize delivery of water and enhance service.

Facilities and Operations – 2.I. Implement energy management initiatives that reduce energy costs while protecting critical operations from water supply interruptions.

Exhibit 1

Well Site Selection

Systematic Selection of Suitable Sites for New Wells

An example of a GIS process using well siting criteria developed in collaboration with SSWD Staff

WEST YOST ASSOCIATES

SACRAMENTO SUBURBAN WATER DISTRICT
CLEARLY REFRESHING SERVICE!

GIS Well Site Screening Tool

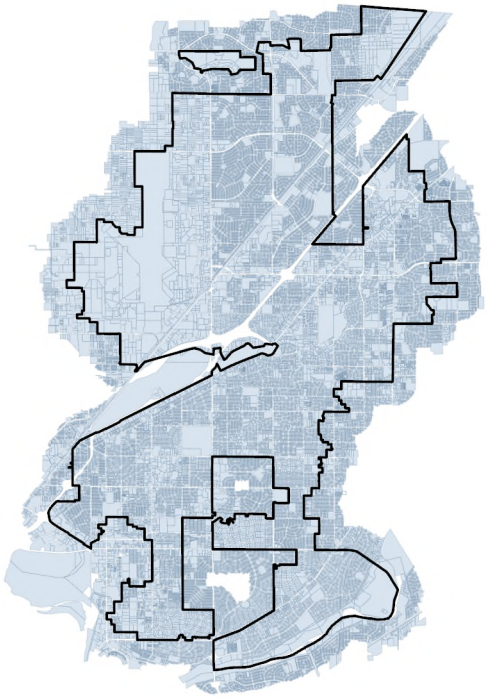
- Starts with a model of ideal well site features
  - Appropriate Parcel Size and Shape
  - Access to necessary infrastructure
  - Avoids known hazards and incompatible land uses
- Utilizes available special data sets
  - Parcel and land use maps
  - Regulatory agency environmental case and plume maps
  - Water, sewer, and storm drain maps
  - High resolution aerial Photography

Systematic Selection

- Methodically eliminates from further consideration sites that do not meet District well siting criteria

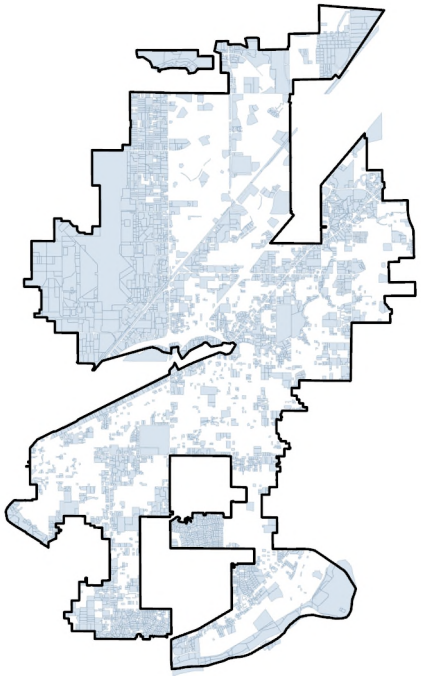
Well Site Selection

Begins with all parcels within SSWD boundaries. Over 44,000 Parcels.



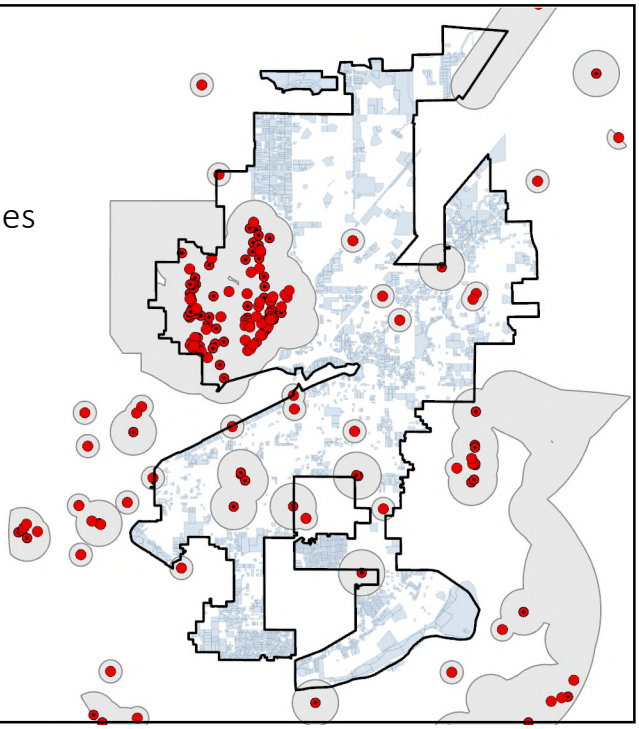
Parcels of Suitable Size and Shape are Selected

4373 Parcels



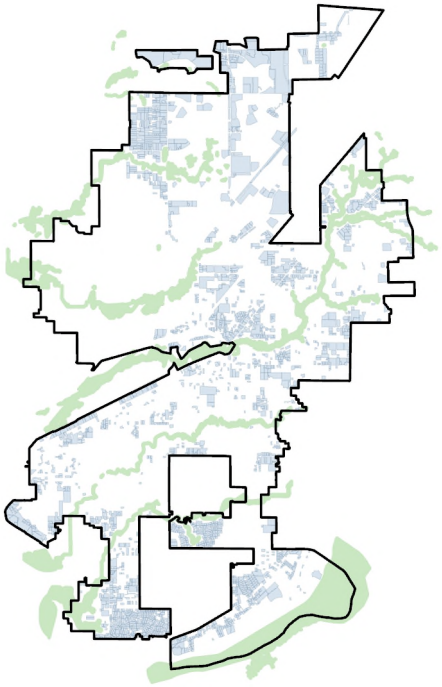
Parcels Near Documented Hazardous Chemical Releases are removed.

3078 parcels remain.



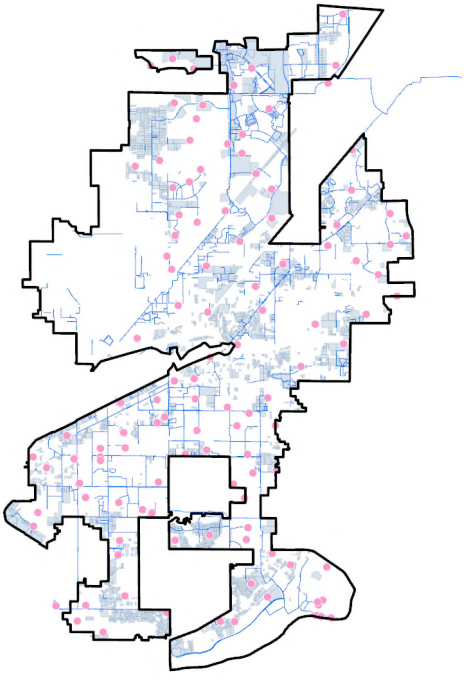
Parcels Near Critical Habitats are Removed

2435 parcels remain



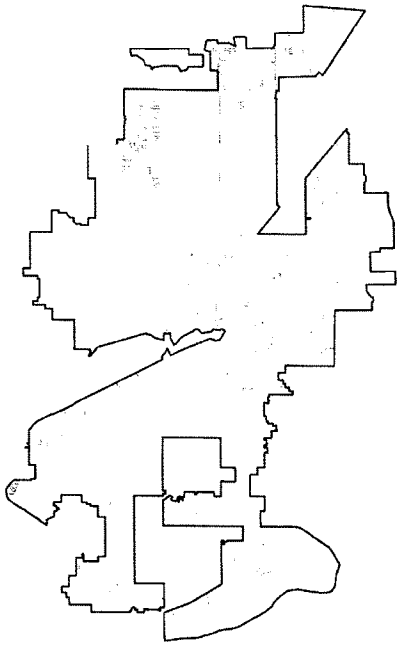
Parcels Within 1000’ of a 12” or Larger Water Main are Selected

2158 parcels remain



Parcels Listed as Vacant are Selected

170 parcels Remain



Further Selection Steps

- The remaining 170 sites will be reduced further by:
  - Selecting parcels within 1000' of sewer and storm drains of suitable size
  - Verifying the parcels are still vacant
  - Conducting field evaluations and ranking eligible parcels

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Facilities and Operations Committee
Agenda Item: 3

Date: July 26, 2018

Subject: Distribution Main Asset Management Plan Update

Staff Contact: Dana Dean, P.E., Engineering Manager

Recommended Committee Action:
Review Draft *Distribution Main Asset Management Plan* (Plan) update and provide input as appropriate. Direct staff to present the draft Plan, together with a Committee recommendation on acceptance, to the full Board of Directors at the October 15, 2018, regular Board meeting.

Background:
The Sacramento Suburban Water District (SSWD) Board of Directors adopted the first *Water Main Replacement Plan* (Plan) on November 21, 2005. Plans have been periodically updated with the most recent update being approved in 2014. This Plan is an update to the 2014 version, and includes information on leak history, failure rate, and condition.

Discussion:
The District has a responsibility to provide its customers with a reliable and safe water distribution system. The Plan sets forth a strategy to replace aging, deteriorating, and undersized water mains throughout the District with an emphasis on the next 15 to 20 years. The Plan is based on a ranking matrix derived from various criteria to identify areas in most need of main replacement.

The Plan is adaptive and perpetual in that all mains are ranked in order of priority for replacement. The Plan is expected to be updated regularly at intervals of between 3 and 5 years with priority areas changing as additional information becomes available and analyses evolve. With regular updates it will evolve as older lines are replaced, leak history changes, and system data is improved. Coordination between the Main Replacement and Meter Retrofit Programs is essential to prevent inefficient use of revenue.

The Plan is intended to be used as a tool for ongoing communication between the Board and staff to prioritize areas in need of water main replacement. Furthermore, it is to be used as a planning tool during annual Capital Improvement Program (CIP) budget discussions with the Board. The Plan does not represent a financial commitment by the Board, other than those CIP funds already approved and adopted, but provides a prioritization of main replacements for future planning. The Plan provides a direction and strategy for the replacement of water mains.

The purpose and goals of the Plan are to:

- Provide a cornerstone for the District's Asset Management Program.
- Continue providing a safe and reliable water distribution system.
- Provide a perpetual water main replacement projection that is adaptable to new and evolving technologies, management practices, and District needs.
- Prioritize main line replacement based on selected criteria to address areas with highest need.
- Coordinate with the District's long term CIP.
- Coordinate with the District's Meter Retrofit Program to ensure compliance with State requirements to have all services metered by January 1, 2025.
- Provide a direction and framework for future Plan revisions.

If the Board adopts the updated Plan, a final report will be issued to all Directors.

Summary of Significant Changes

- Updated distribution system data (e.g., leak history, material, etc.).
- Added a failure rate chart.
- Failure Rate – Added a criterion to the Likelihood of Failure (LOF) category to account for failure rate differences among the various main replacement areas.
- Pipe Condition – Added a discussion of ongoing efforts into evaluation of pipe material condition. This information was included in development of Pipe Age and Pipe Type criteria.
- Risk of Failure – Changed Risk of Failure (ROF) computation to be a product of rather than a summation of Consequence of Failure (COF) and Likelihood of Failure (LOF). This approach is consistent with the *2017 Water System Master Plan's* recommendations to assess risk in future Distribution Main Asset Management Plans.
- Pipe Damage Factor – Added a criterion to the Consequence of Failure (COF) category to account for a likely higher severity of damage caused by failure of certain pipe types.
- Crossings – Added a criterion to the Consequence of Failure (COF) category to account for risks associated with failures likely to impact nearby waterways.
- Valve Spacing – Added a criterion to the Consequence of Failure (COF) category to account for risks associated with failures occurring on reaches with widely spaced valves and the likely higher impact to the environment and greater number of customers.
- Meter Retrofit Factor – Added a modifier to the Risk of Failure (ROF) to raise priority of un-metered Main Replacement Areas to address the State requirement to be fully metered by 2025.

Fiscal Impact:

The Plan projects a capital need of about $300 million over the next 20 years (2018 dollars). However, as reflected by language in the Plan, it does not represent a financial commitment by the Board, other than those CIP funds already approved and adopted. The Plan does provide a prioritization of main replacements for future planning and is designed to be perpetual, as it will evolve as ranking priorities change and new information becomes available. The Plan will be used as a planning tool during annual CIP budget discussions with the Board.

Strategic Plan Alignment:

Water Supply – 1.B. Provide for the future needs of the District through prudent planning that will ensure sufficient capacity to serve all customers: Replacing old water mains that have outlived their useful life with new, larger water mains will help improve water system reliability, ensure distribution of adequate supply, provide sufficient pressure, and improve fire flows.

Facilities and Operations – 2.A. The District will utilize appropriate planning tools, identify financial resources necessary, and prioritize system requirements to protect and maintain District assets and attain water resource objectives: The updated Plan meets this goal because it is a planning tool that will guide where District funds would be allocated for replacement of water mains.

The updated Plan benefits District customers as it is a tool utilized to help determine where District funds should be spent on the replacement of old water mains that have outlived their useful life.

DRAFT

DISTRIBUTION MAIN ASSET MANAGEMENT PLAN

Updated _____ 2018
Updated August 2014
Updated August 2011
Updated January 2008
Adopted November 2005

SACRAMENTO SUBURBAN WATER DISTRICT
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ABBREVIATIONS

Abbreviation	Definition
$\%Age_x$	Percentage of pipe Age “x” within $Area_i$
$\%_x$	Percentage of pipe material “x” within $Area_i$
AC	Asbestos Cement
ASCE	American Society of Civil Engineers
CA_i	Commercial Accounts per designated Area “i”
CC_i	Creek Crossing per per Area "i"
CC	Concrete Cylinder
CCS_i	Creek Crossing Score per Area “i”
CI	Cast Iron
CIP	Capital Improvement Program
COF	Consequence of Failure
COF_i	Consequence of Failure for an individual replacement area
CONC	Concrete
C_{UL}	Criteria Upper Limit
DI	Ductile Iron
ED	Effective Diameter
EPA	Effective Pipe Age
EPT	Effective Pipe Type
$FWCS_i$	Freeway Crossing Score per Area “i”
FW_i	Freeway Crossing per Area "i"
l_i	Length of respective material within the replacement area
L_i	Total length of Main within the replacement area
L_i	Total length of Main within the replacement area
LOF	Likelihood of Failure
LOF_i	Likelihood of Failure for an individual replacement area
MLS	Mortar Lined Steel
NSA	North Service Area
ODS	Outside Diameter Steel
PC_i	Percent Commercial per designated Area “i”
PDS_i	Pipe Diameter Score per main replacement area
PDS_i	Pipe Damage Score per designated Area “i”
PVC	Polyvinyl Chloride
RC_i	Railroad Crossing per Area "i"
RFPP	Requests for Price Proposals

ROF	Risk of Failure
ROF_i	Risk of Failure for an individual replacement area
$RRCS_i$	Railroad Crossing Score per Area "i"
SC_i	Sum of Crossings per Area "i"
$Score_x$	Corresponding Pipe Material Score (i.e. ACP = 4)
$Score_y$	Corresponding Pipe Age Score
SSA	South Service Area
SSWD	Sacramento Suburban Water District
TA_i	Total Accounts per designated Area "i"
UNK	Unknown
V_i	Valves per Area "i"
$V_{500'_i}$	Valves per 500 feet per Area "i"

INTRODUCTION

The *Distribution Main Asset Management Plan* (Plan) is intended to be used as a tool for ongoing communication between the Board and staff to prioritize areas in need of water main replacement. Furthermore, it is to be used as a planning tool during Capital Improvement Program (CIP) budget discussions with the Board. The Plan does not represent a financial commitment by the Board, other than those CIP funds already approved and adopted, but only provides a prioritization of main replacements for future planning. The Plan provides a direction and strategy for the replacement of water mains.

The purpose and goals of the Plan are to:

- Provide a cornerstone for the District's Asset Management Program.
- Provide a safe and reliable water distribution system.
- Provide a perpetual water main replacement schedule that is adaptable to new and evolving technologies, management practices, and District needs.
- Prioritize main line replacement based on selected criteria to address areas with highest need.
- Coordinate with the District's long term CIP.
- Coordinate with the District's Meter Retrofit Program to ensure compliance with State requirements to have all services metered by January 1, 2025.
- Provide a direction and framework for future plan revisions.

For the purpose of this Plan, a distribution main is defined as a water pipe between 4- and 14-inches in diameter providing service to commercial, industrial, public, and residential properties. An exception was made for about 3,000 feet of 16-inch diameter pipe where service connections exist, most of which is located within McClellan Business Park. This Plan does not include discussion or recommendations for transmission mains.

BACKGROUND

Overview of Need for Distribution Main Replacement

Water utilities throughout the United States are currently facing the challenge of extensive rehabilitation and replacement of aging and deteriorated water mains. The Sacramento Suburban Water District (District, SSWD) is no different in this regard. In 2010, the American Society of Civil Engineers (ASCE) published a report card on America's infrastructure and their rating for drinking water systems was a "D-". The 2017 report update gave a grade of "D" and estimated the 25-year funding requirement for drinking water infrastructure in the United States at $1 trillion.

Of particular concern for the District are older portions of the distribution system that date back to prior to the 1950's, with some portions in service since the mid-1920's. An ongoing program to replace aging water mains is necessary to maintain reliability and high quality service to District customers.

The formation of the former Arcade Water District and Northridge Water District date back to the 1950's. The distribution mains in the District's South Service Area, (SSA), (formerly part of the Arcade Water District) were constructed during the building boom following World War II. The most common pipe material used in the 1950's and 1960's was tar coated steel pipe, known as "Outside Diameter Steel" (ODS). In place for over 50 years, ODS typically has frequent leaks resulting is service outages and outsized impact on Operations and Maintenance efforts. In summary, ODS has become largely unreliable and requires replacement on a priority basis.

A significant portion of aging water mains are located in back-lot and side-lot easements where access to perform repairs is difficult and must be made across the homeowner's property. The service and repair work, when necessary, is inconvenient to customers and very costly for the District. Additionally, many of the mains are installed in areas without recorded easements.

Today's standard for water main installation is to install the main in the public right-of-way fronting customer's homes, where access for service and repairs is more convenient for the customer and much more efficient for the District's Operations and Maintenance efforts. However, County regulations

continue to change and these changes often result in additional constraints on construction. Changes include inability to use bridge structures to cross streams, and more stringent restoration of existing right-of-way improvements (e.g., pavement, Americans with Disability Administration improvements).

Summary of Status of Distribution System

There are about 625 miles of distribution water mains (sizes 4- to 14-inches in diameter) in the District. Two key elements will direct the path of main replacement for the next 10-20 years. They are the replacement of older pipe with waning integrity. These material types are comprised of ODS, Asbestos Cement (AC), and Mortar-Lined Steel (MLS). Mains will be relocated from backyard to the roadways in front of customer's homes.

There are approximately 160 miles of backyard main remaining in the District. About 66 miles of these are in the South Service Area (SSA). The District currently has about 13 miles of ODS pipe in service, both in front yard and backyard mains. About 5 miles of the backyard mains are ODS pipe. ODS has the highest maintenance requirements of any distribution main in the District. The integrity of the ODS has been weakened by deterioration of its protective coating and corrosion of the steel.

Criteria used to develop the scoring matrix included: age of mains, location of mains, line size, maintenance or leak history, amount of ODS, amount of 4- and 6-inch AC, MLS based on the number of service connections, fire hydrant coverage, percent of wharf hydrants, water model data, and risk factors.

The final analysis, as shown in Appendix 1, is a list of rankings identifying the priority of the main replacement areas. An analysis is completed with the Rank 1 identified area as the next priority for main replacement. While areas are assigned a total score and ranked by main replacement areas, actual projects and the sequencing of those projects may depend on project size, available budget, and other factors. One other significant factor that affects scheduling and sequencing is the County of Sacramento's Paving Program and their Ordinance that includes a moratorium which prohibits cuts in pavements on any streets within 3 years of being repaved, and a significant fee levied for work in roads

4-5 years after paving. A project may be moved up in priority if the District knows of planned paving and resultant moratorium.

The District proposes to replace old, unreliable, and undersized water mains over the next 10-20 years or more at a rate of about 6 to 8 miles of new water mains per year (about 120 to 160 miles of new mains in 20 years). The total cost of 2017 and 2018 main replacement is approximately $1.8 to $1.9 million dollars per mile of new main. This total cost includes administration, fees, environmental review, engineering services, materials, construction, construction management, inspection, and testing. This equates, dependent on total amount of main replaced, to $216 to $304 million over the next twenty years with no allowance for cost escalation (i.e., present value costs).

Plan History

The Board of Directors adopted a *Water Main Replacement Plan* on November 21, 2005. The Board adopted plan updates in 2008, 2011, and most recently in 2014 (now named the *Distribution Main Asset Management Plan*).

At the time the Plan was adopted, it was anticipated that the *Water Main Replacement Plan* would be amended periodically in the future. In 2011, the title was changed to *Distribution Main Asset Management Plan* to distinguish between the *Water Transmission Main Asset Management Plan*. It was recognized that new information would be made available in the future that might influence the ranking of project areas and the priority of need. In the 2008 and 2011 updates additional criteria were added, called “Hydraulic Factors”, and “Risk of Failure” was included. Furthermore, the District has experienced a rise in leaks on its MLS mains. The problem has been found to be due to corrosion susceptibility that is caused by installing copper water services on MLS pipe.

Project Approach

The Plan proposes to relocate backyard water mains with new water mains located in the public rights-of-way, usually along the frontage of the properties served whenever practical. A new District water service will be installed in the public right of way from the new main line to the new or existing water meter.

The District will coordinate with a property owner a suitable location for the new meter. Additionally, new hydrants, valves, and other water system appurtenances will be installed as required with new water mains. Coordination between the installation of new water meters and the construction of the new mains will benefit both water main replacement and water meter retrofit programs.

The average useful life of water distribution mains is between 50 and 120 years depending on the pipe material, soil conditions, water quality, construction methods, and several other factors. Based on this information, to meet the District's goal to replace its distribution system over a 100-year interval, approximately 7 miles of water main per year need to be replaced.

Review and reassessment of the Plan is recommended in 3-5 year intervals. Future information that would influence the ranking of project areas and the scoring matrix used in the Plan, include but are not limited to: improved recordkeeping systems, identification of new evaluation criterion, acquisition of new service areas, infrastructure failures, catastrophic events, and/or changes in District policies. It is also intended that this will be an adaptive and perpetual Plan in that areas where the water mains have been recently replaced will continue to be evaluated and ranked. Obviously, those areas with new water mains would then rank lowest on the priority list for replacement. However, over considerable time, those areas will again rise up on the priority list for replacement.

Distribution Main Replacement History

The former Arcade Water District had a program to replace aging backyard water mains. Arcade replaced about 14 miles of backyard mains with new mains located in the public right-of-way. The District initiated a main replacement program in 2004, and through 2017 has replaced about 100 miles of distribution main with a focus on backyard mains of Outside Diameter Steel (ODS) pipe. The new Ductile Iron (DI) pipe main has a life expectancy of 100-150 years.

Main replacement completed from 1993 through 2017 are summarized below in Table 1.

Table 1. Completed Distribution Main Replacement Projects (1993-2017)

Time Period	Main Installed [miles]	Average Main Replaced Per Year [miles/year]	Customer Services Switched to New Mains
1993 - 2001	13.5	1.5	1140
2004 - 2007	12.3	3.08	1183
2008 - 2011	33.4	8.34	2344
2012 - 2014	24.7	8.23	2110
2015 - 2017	20.3	6.78	TBD
Totals	**104.2**	**-**	**6777 + TBD**

Inventory of Existing Distribution Mains in District

Currently there are approximately 627 miles of Distribution Mains in the District. A breakdown of the water main type, length in miles and percentage of pipeline material in service in the District is shown in Table 2.

Table 2. Quantity of Distribution Mains in District by Type

Main Type	Quantity [miles]	% of System
Asbestos Cement (AC)	324.9	52
Ductile Iron (DI)	136.5	22
Polyvinyl Chloride (PVC)	86.6	14
Mortar Lined Steel (MLS)	48.9	8
Outside Diameter Steel (ODS)	12.6	2
Cast Iron (CI)	9.2	1
Miscellaneous (alum., & PEP)	8.1	1
Total	**626.8**	**100**

PROCEDURES AND STANDARDS FOR WATER MAIN REPLACEMENT

New Water Main Installation

The new water mains and customer service lines will be installed in public rights-of-way. New customer in-tract service lines will extend from the outlet side of the meter to a point of connection with the customer. Included in the installation of the customer in-tract service will be a curb stop, water meter with meter setter, and a utility box.

As part of a main replacement project, new steamer-type fire hydrants will replace existing hydrants warf-type hydrants. Additional fire hydrants will be installed to meet current spacing Standards. Overall, this is expected to improve fire protection reliability and fire fighting capability within the District. The projects will also provide for the installation of new control valves to meet current SSWD Standards.

State Requirement for Water Meter Installation

State law (AB 2572) requires all services to be metered by January 1, 2025. CIP budgeting has not permitted a pace of main replacement sufficient to result in 100% metering by the Distribution Main Program alone. As a result, the District's Meter Retrofit Program (adopted by the Board of Directors in February 2004) was implemented several years ago to ensure District compliance with AB 2572. Therefore, about one thousand meters are being installed each year on (mainly backyard) mains. will be installed in backyards pending water main relocation.

Abandonment of Backyard Water Mains

After the new water main has been installed and the service line reconnected, the old backyard water main will be sealed and abandoned in place. Some locations will require the backyard main to remain in service after the new main is installed in the public right-of-way. This situation would be observed between the boundary of work between current and future areas where only half of the backyard services would be connected to a new main. The other half would be connected to a new main in a future main replacement project, thus requiring the existing backyard main to remain in service longer.

EVALUATION METHODOLOGY

The Main Replacement Areas are shown in Figure 1. In 2014 the District subdivided the main replacement areas into areas of a size more manageable for a CIP project, with a focus on creating areas of 8-miles of main or less.

The District gathered pipe data from the GIS database, sorted with Windows Access, that pertained to the District's Main Replacement Areas. The data gathered was broken into four categories, which also contained sub criteria. The two main categories where data was collected were Consequence of Failure (COF) and Likelihood of Failure (LOF). These categories were multiplied to determine the Risk of Failure (ROF) rank for each of the 197 Main Replacement Areas. Additionally, there were two categories that were included as modifiers to the ROF rank. One modifier was Safety Factors (previously called Hydraulic Factors), which included hydrant coverage and the percent of wharf hydrants within a Main Replacement Area. The second modifier was a Cost Savings factor, which accounted for the overlap outlined in the Districts Meter Asset Management Plan.

The first category, COF, was broken into five sub criteria: Pipe Damage, Pipe Diameter, Customer Type, Crossings, and Valves per 500 feet. It was determined that these five sub criteria posed a major liability to the District. The LOF category was then broken into four sub criteria: Pipe Type, Pipe Age, Main Location, and Failure Rate. These four criteria were based on historical District and Industry data connecting the chance a pipe would fail. The COF and LOF scores were multiplied to produce the *Risk of Failure (ROF)* score. The two modifiers were added to the ROF score to account for hydraulic issues in any Main Replacement Areas and to account for area similarities in the Districts Meter Asset Management Plan.

Due to the complexity and additional costs involved with McClellan Business Park, the top ranked Main Replacement Areas were separated in to two figures.

Figure 2A.

- Shows the top 30 ranked Distribution Main Replacement Areas excluding McClellan Business Park.

Figure 2B.

- Shows the top 10 ranked Distribution Main Replacement Areas within McClellan Business Park.

Figure 3A.

- Shows all the material within the district.

Figure 3B – **Figure 3G.**

- Isolates each individual pipe: AC, DI, PVC, MLS, ODS, and CI, respectively.

Figure 4.

- Pipe age is shown as a ***weighted age*** of the pipe in each of the Main Replacement Areas. This was achieved by multiplying the pipe's age by the fraction of the respective Pipe Type over the Total Main within each Main Replacement Areas.

Figure 5.

- A comparison of the front yard and backyard mains in the Main Replacement Areas

Figure 6A.

- All the leaks on active distribution main.

Figure 6B.

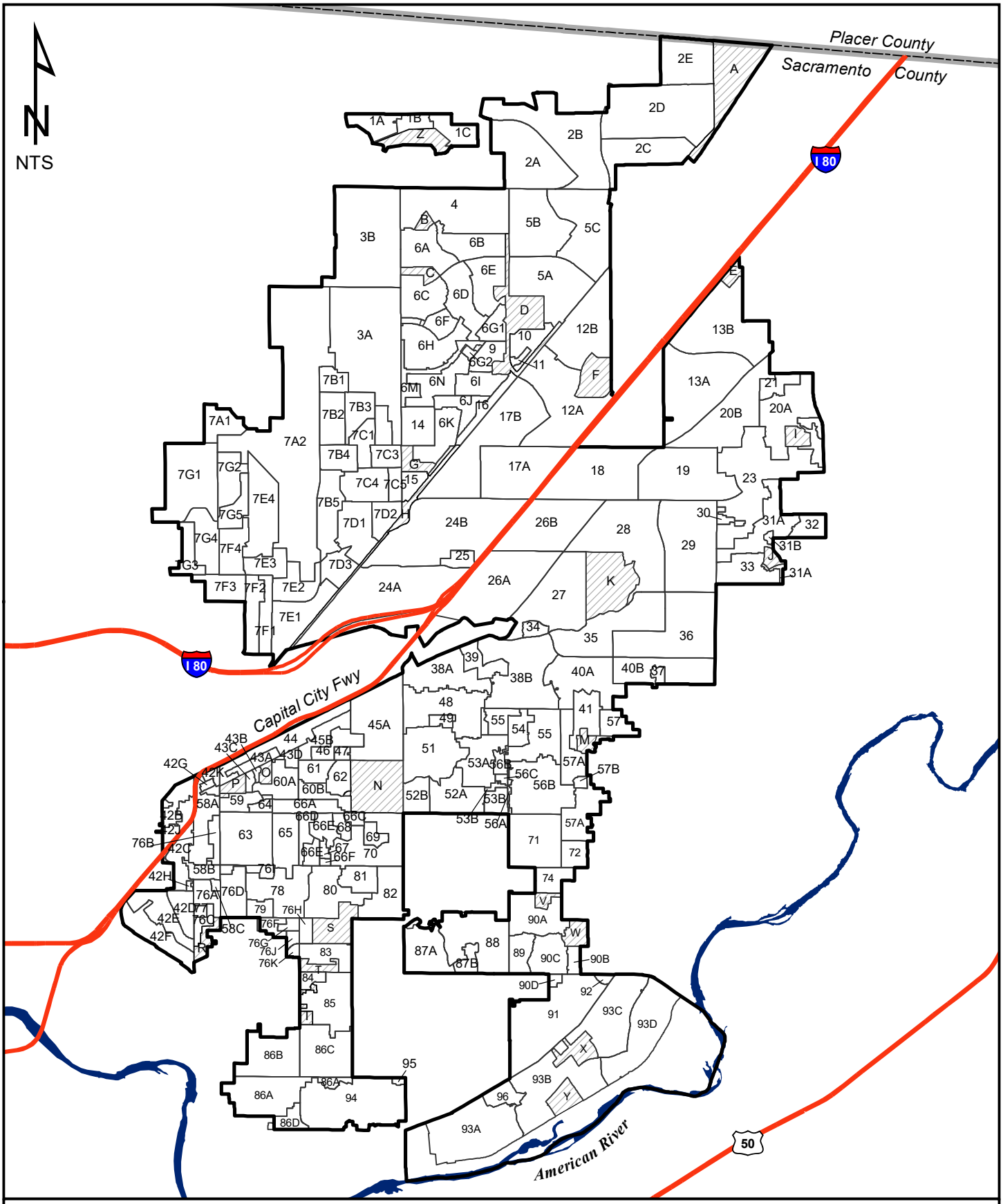
- Distinguishes the leaks on active distribution main that occurred on AC pipe.

Figure 7A.

- A comparison of leaks ranked by the number of leaks and grouped by the pipe material and diameter.

Figure 7B.

- A comparison of leaks per mile ranked by the leaks per mile and grouped by the pipe material and diameter.



Legend

Distribution Main Areas

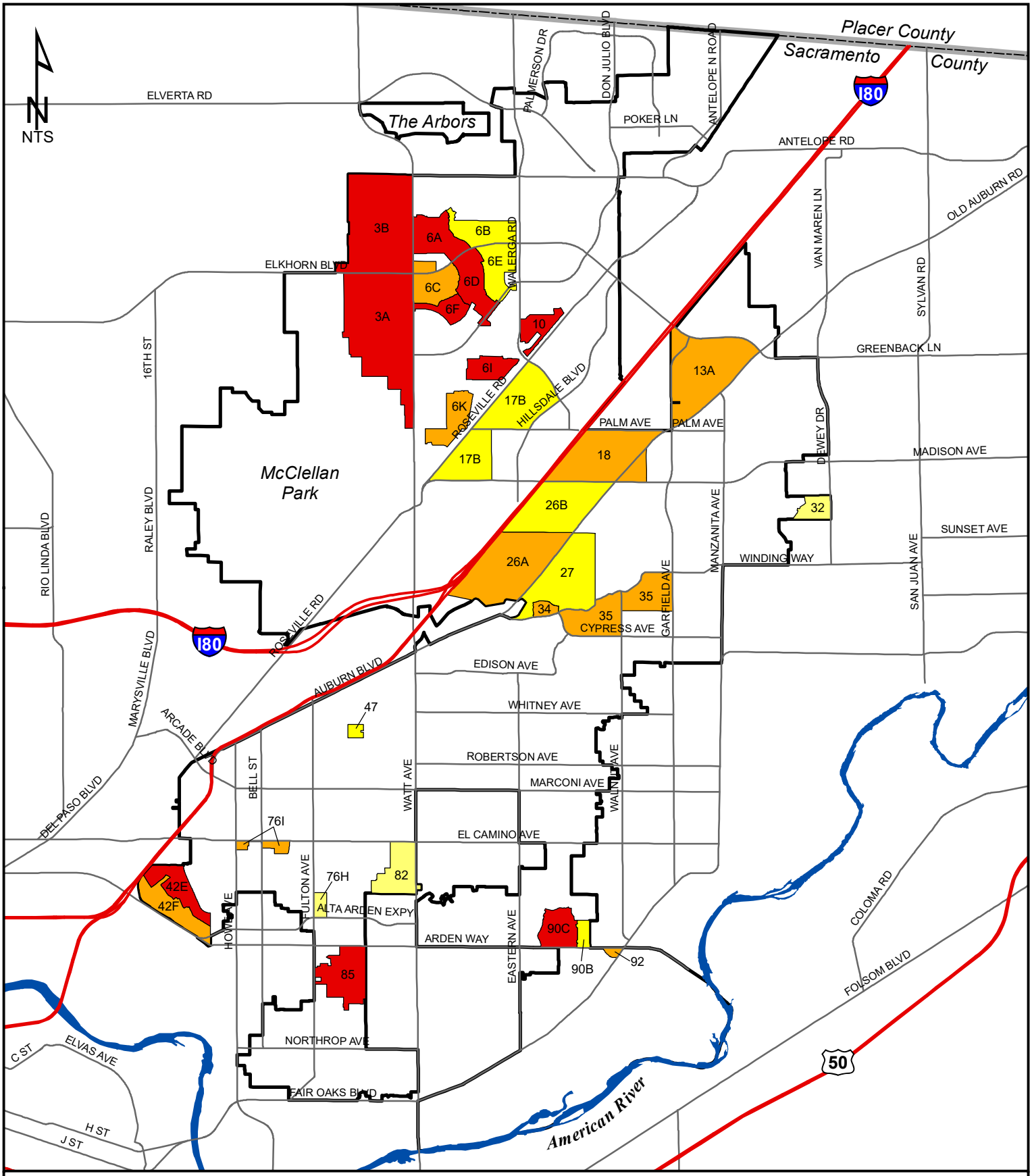
Single Service Large Parcels

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 1

Distribution Mains Areas



Legend

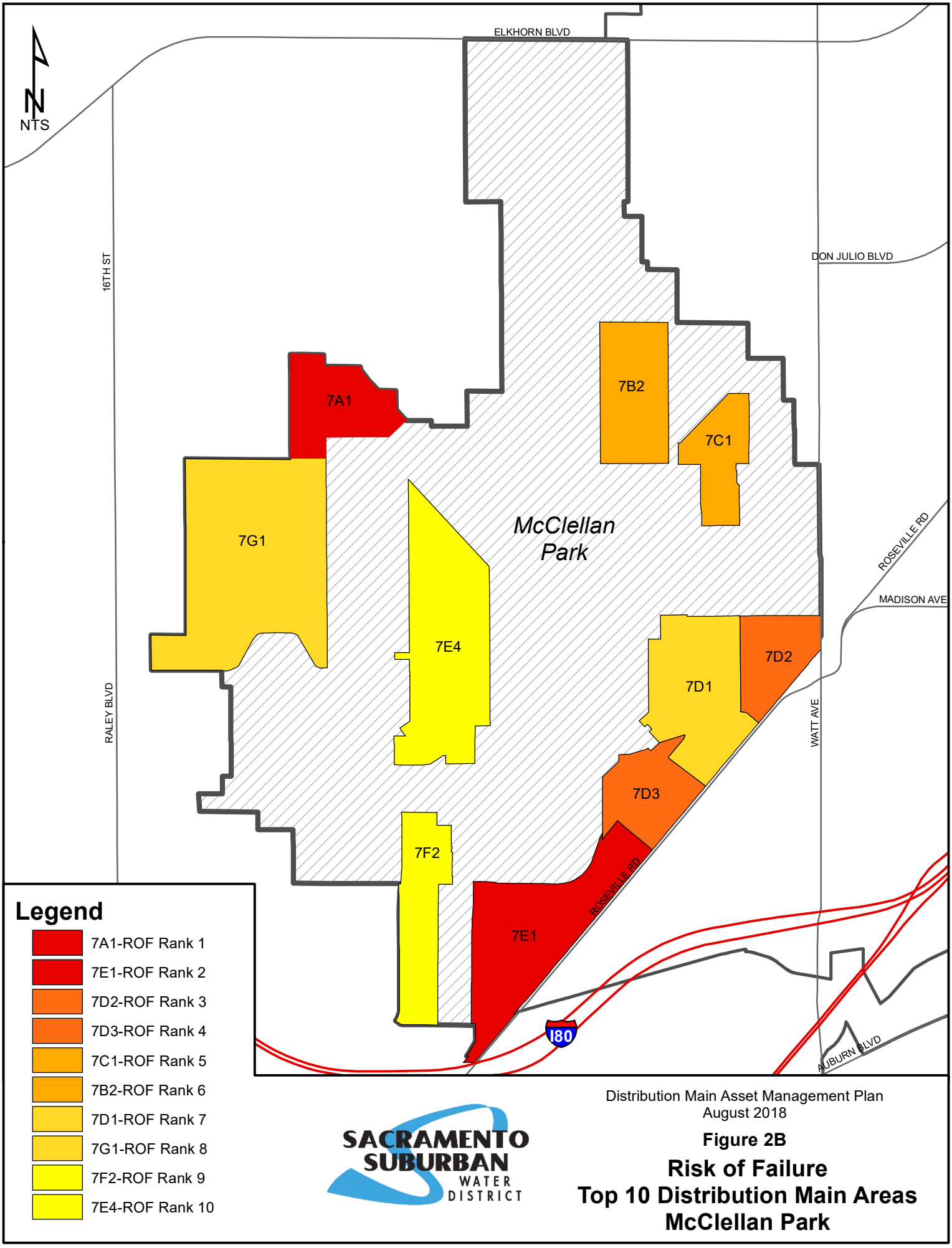
- ROF Rank 1-10
- ROF Rank 11-20
- ROF Rank 21-30

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 2A

Risk of Failure
Top 30 Distribution Main Areas
Excluding McClellan Park

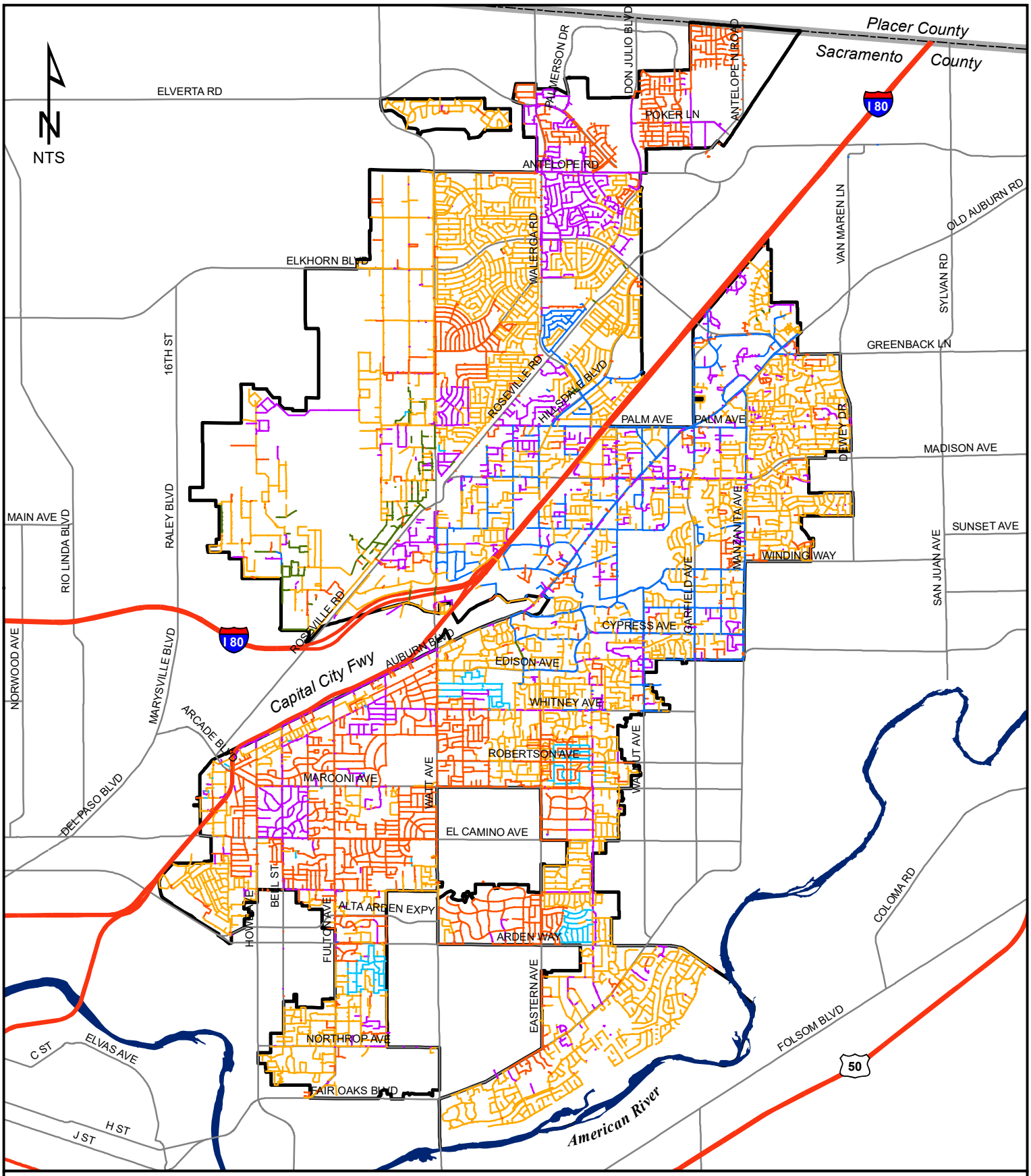


SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 2B

Risk of Failure
Top 10 Distribution Main Areas
McClellan Park



Legend

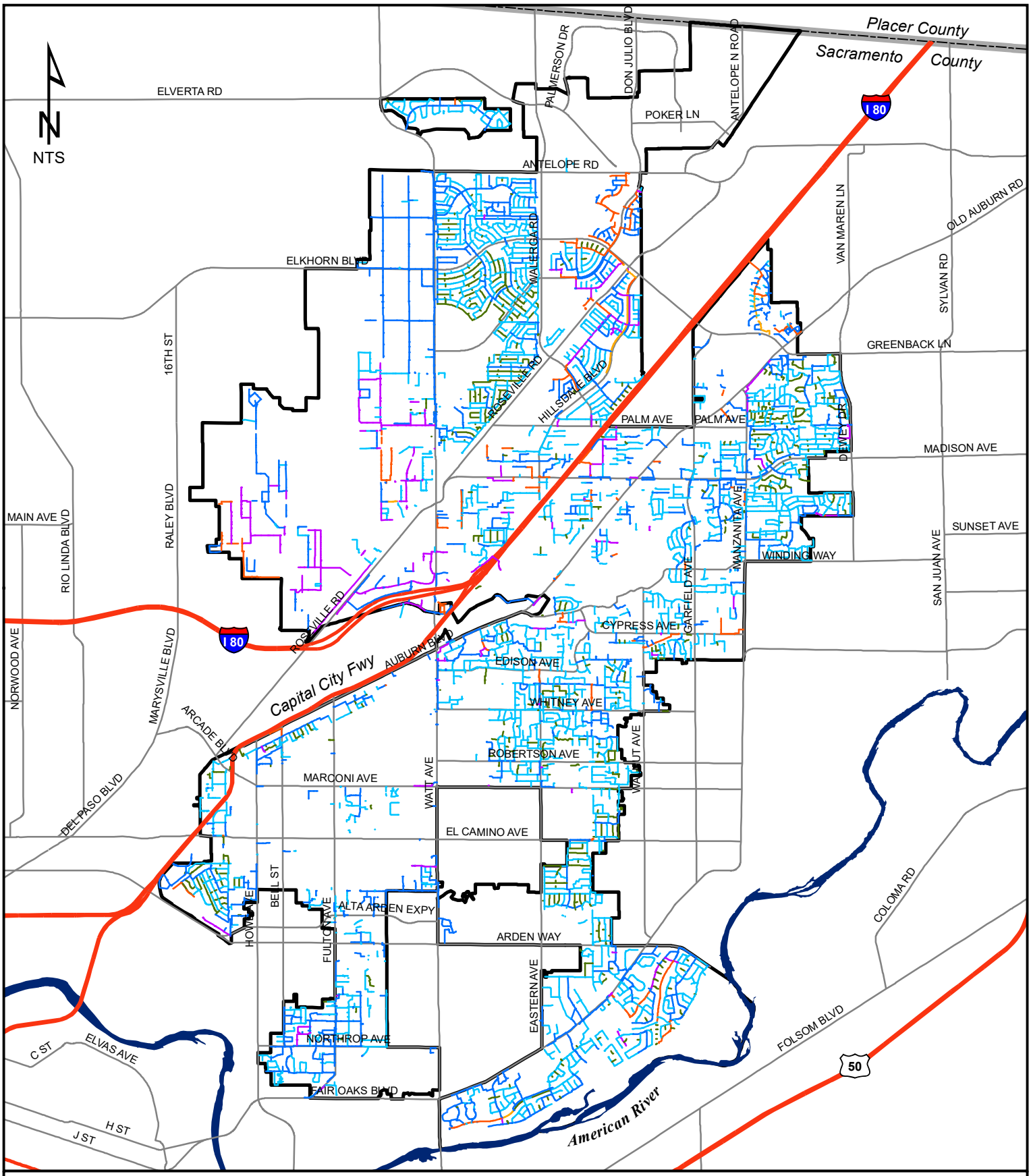
- AC
- DI
- PVC
- MLS
- ODS
- CI

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3A

Distribution Main by Type - All



Legend

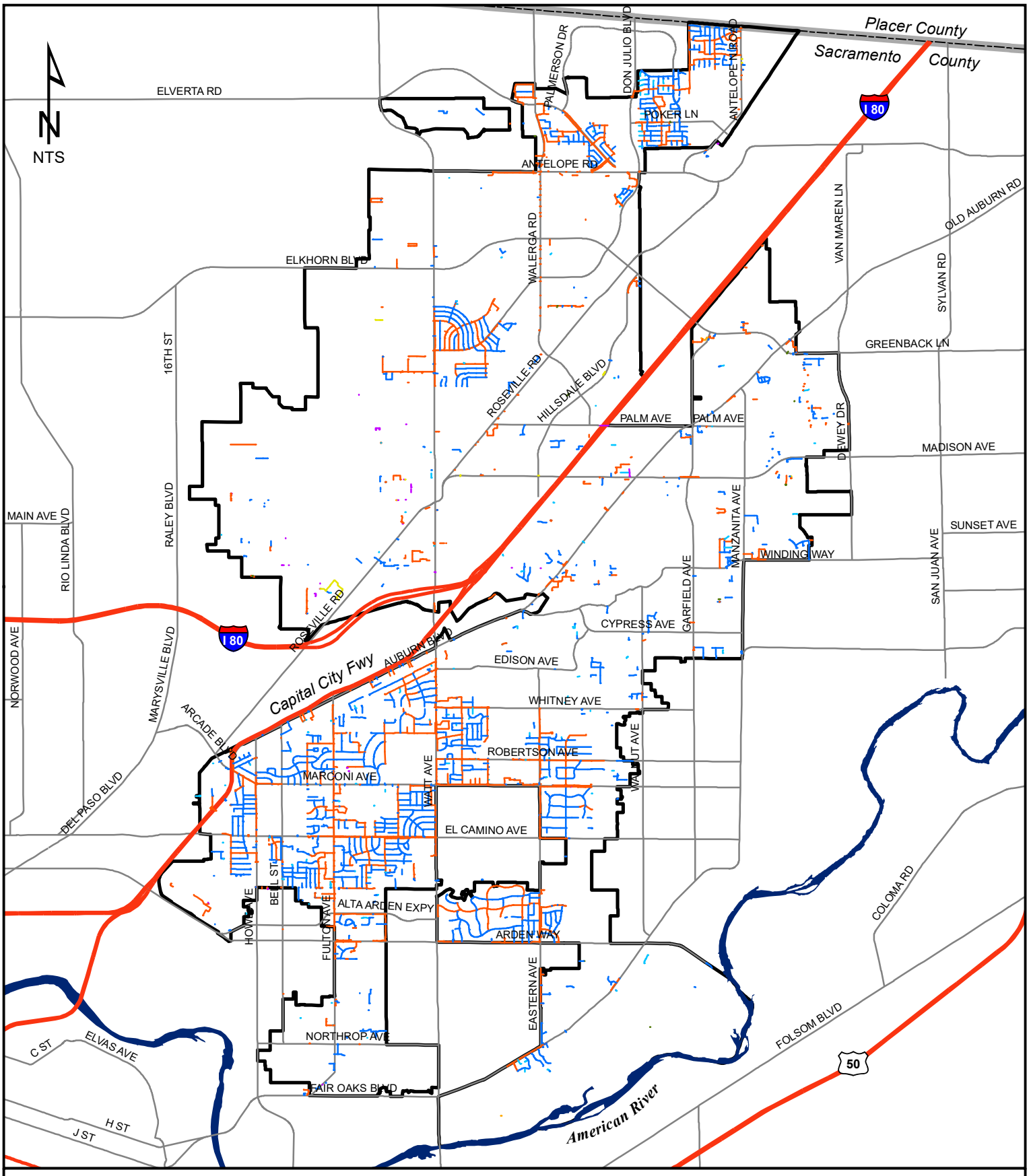
- 4"
- 6"
- 8"
- 10"
- 12"
- 14"

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3B

Distribution Main by Type - AC



Legend

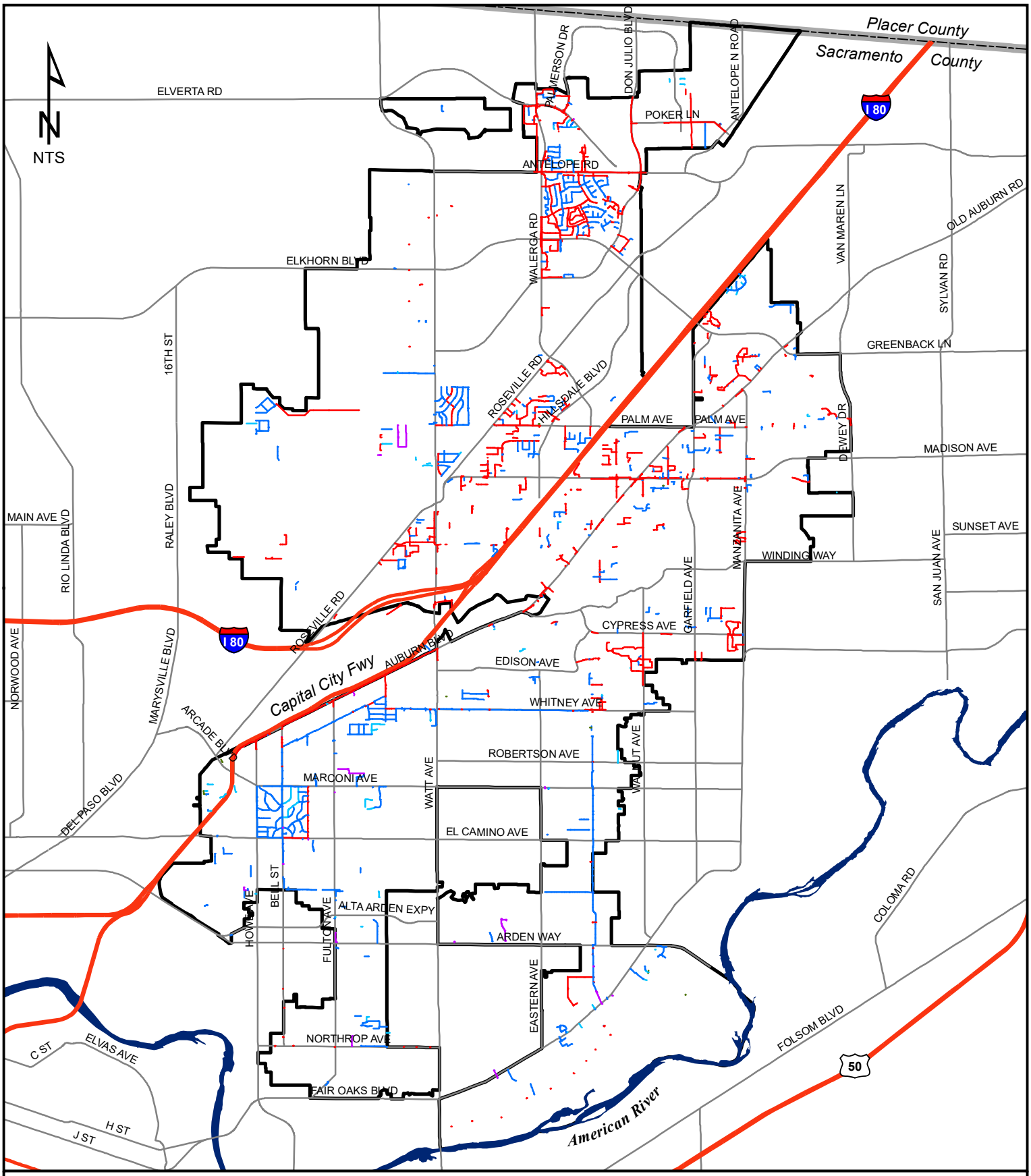
- 4"
- 6"
- 8"
- 10"
- 12"
- 14"
- 16"

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3C

Distribution Main by Type - DI



Legend

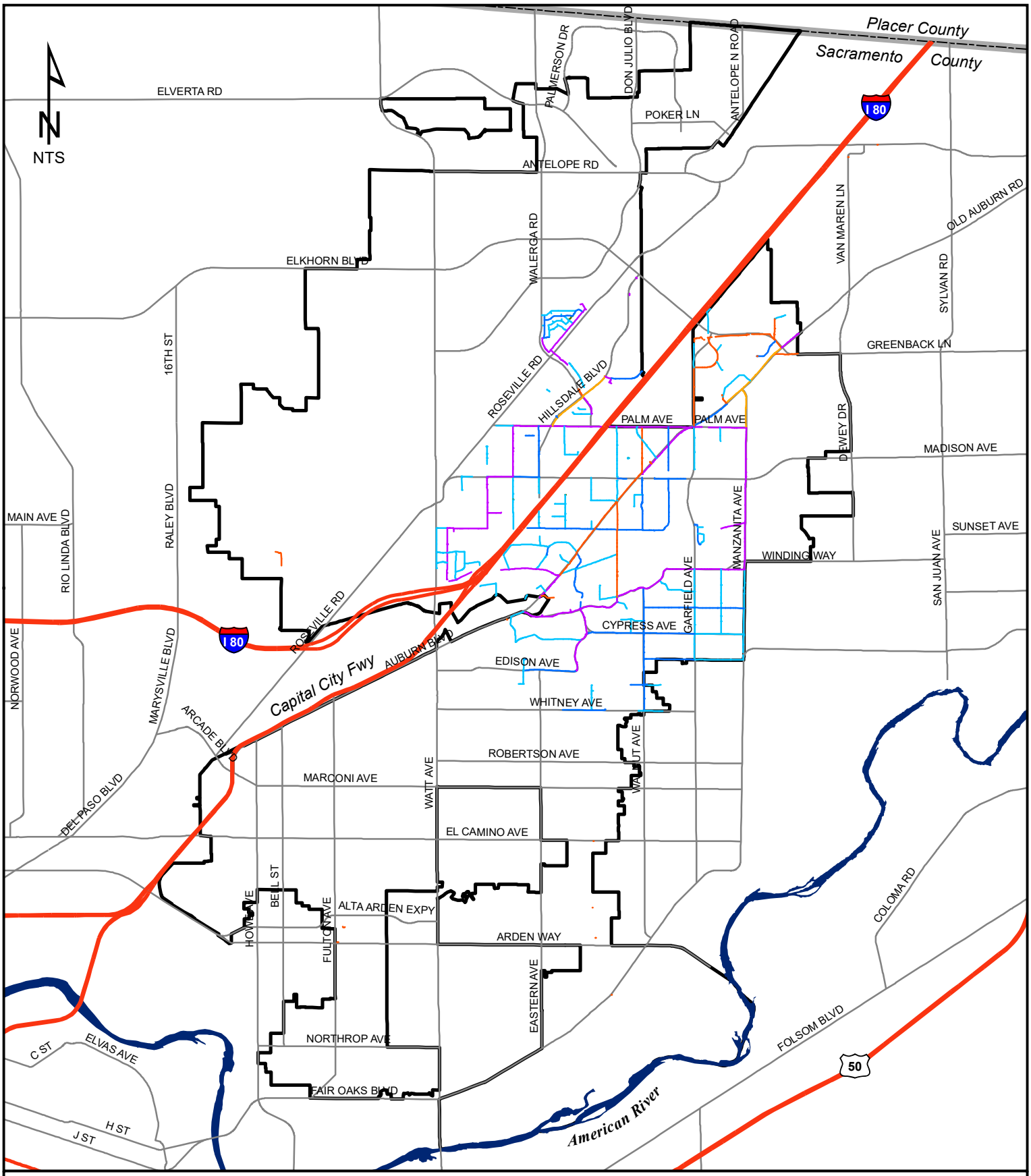
- 4"
- 6"
- 8"
- 10"
- 12"
- 16"

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3D

Distribution Main by Type - PVC



Legend

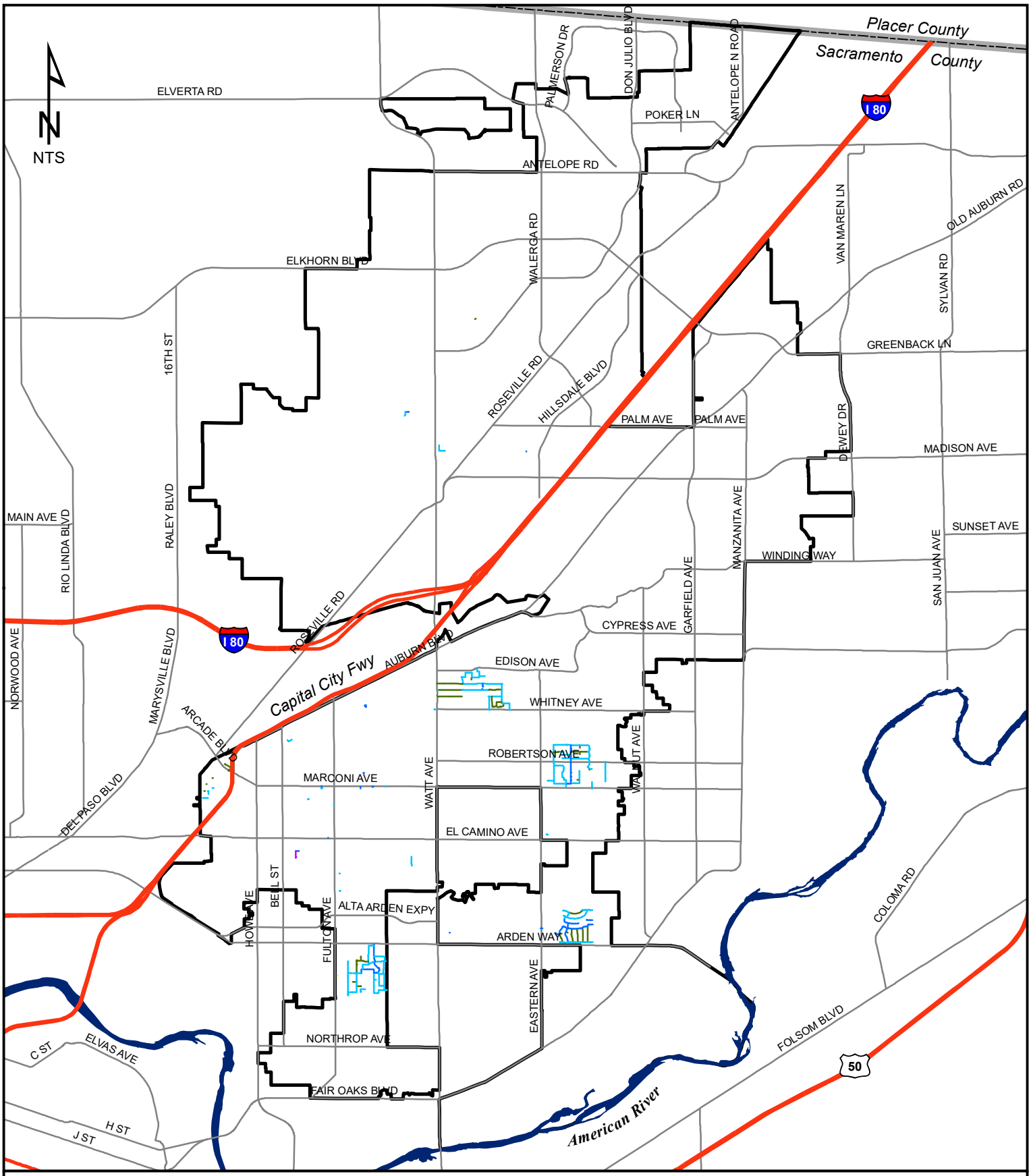
- 4"
- 6"
- 8"
- 10"
- 12"
- 14"

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3E

Distribution Main by Type - MLS



Legend

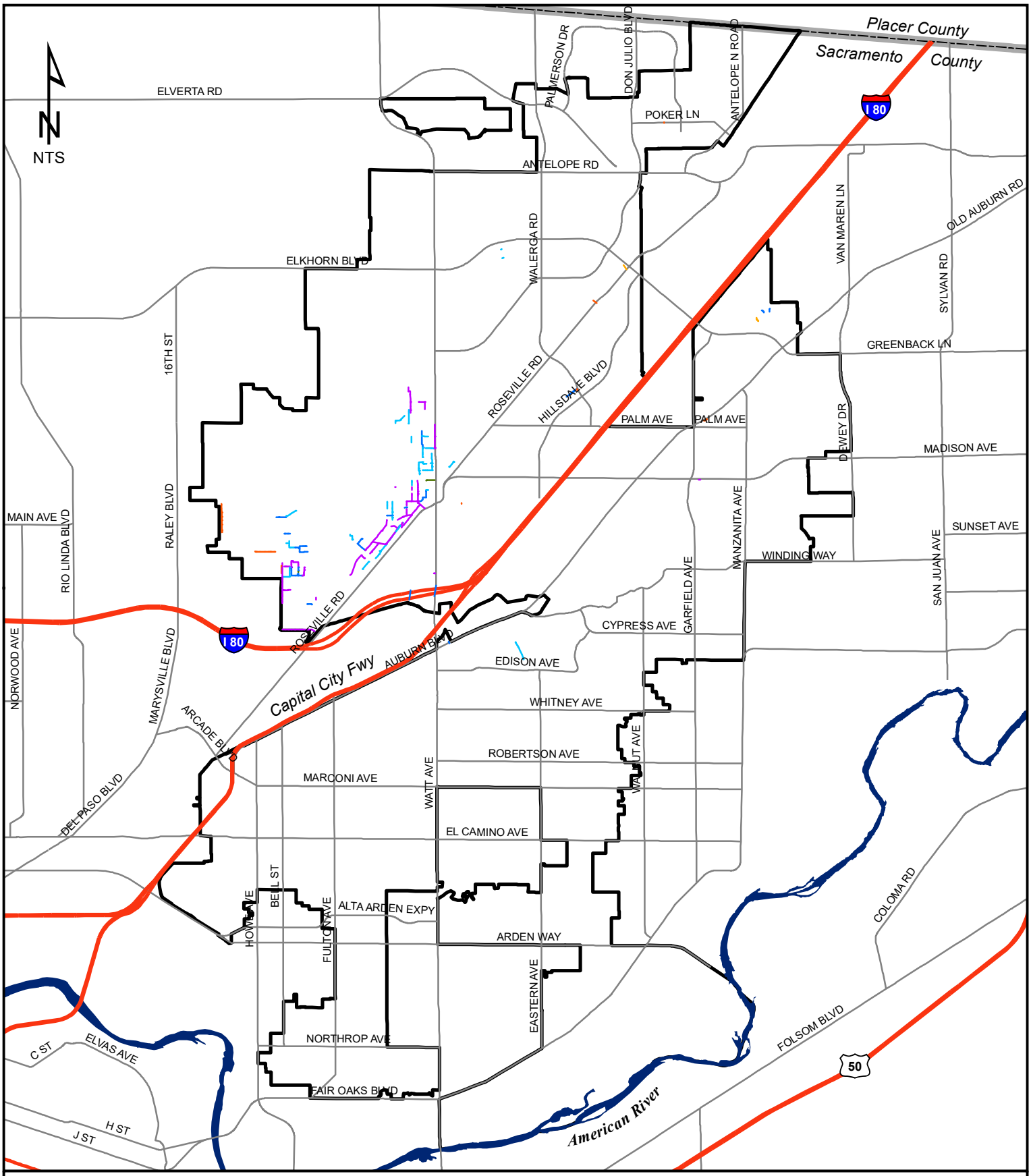
- 4"
- 6"
- 8"
- 10"

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3F

Distribution Main by Type - ODS



Legend

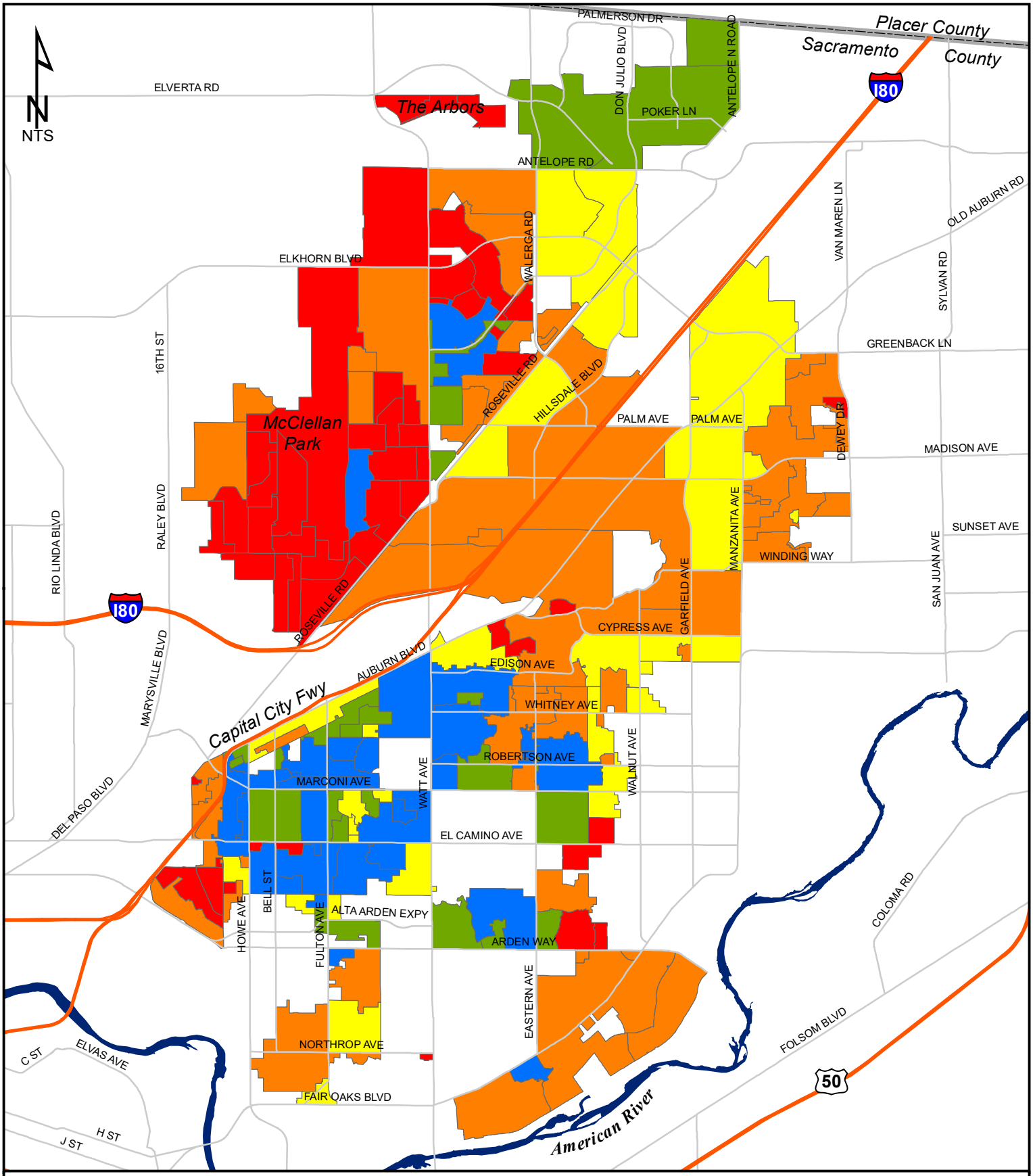
- 4"
- 6"
- 8"
- 10"
- 12"
- 14"

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 3G

Distribution Main by Type - CI



Legend

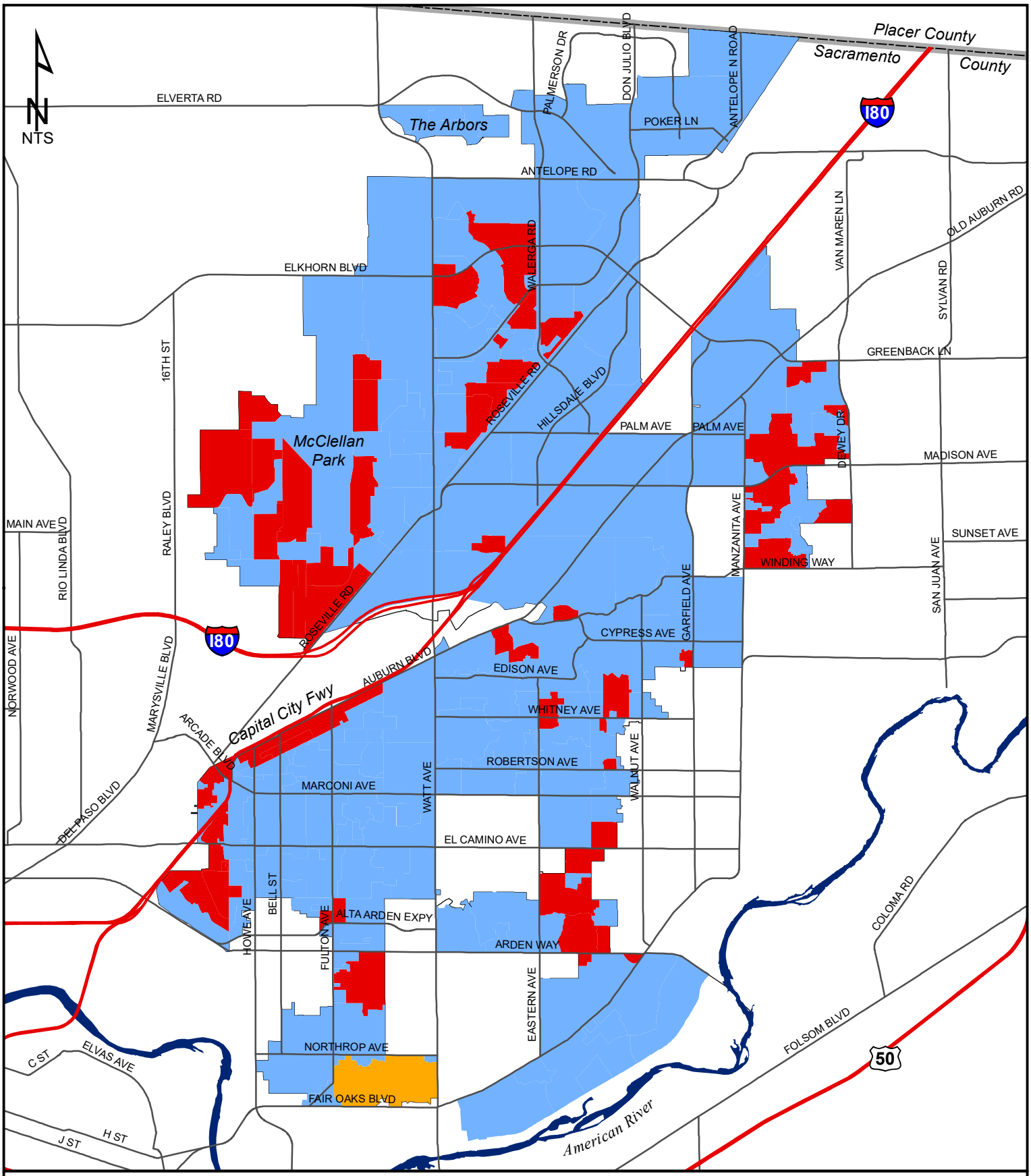
- 1956 and before
- 1957-1971
- 1972-1986
- 1987-2001
- 2002 to Present

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 4

Age of Distribution Main Areas



Legend

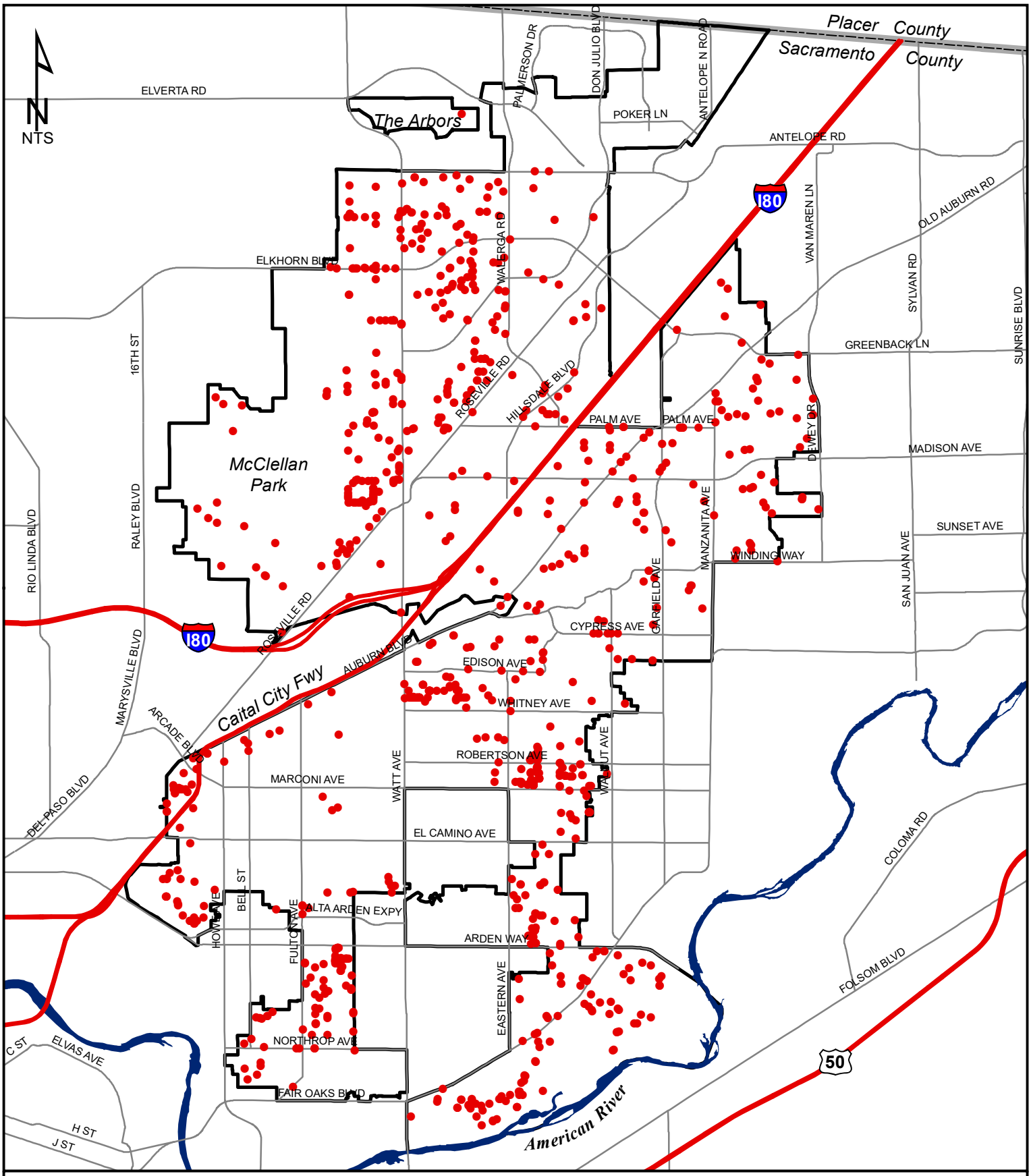
- Backyard
- Frontyard
- No Service

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 5

Front Yard and Backyard Distribution Main Areas



Legend

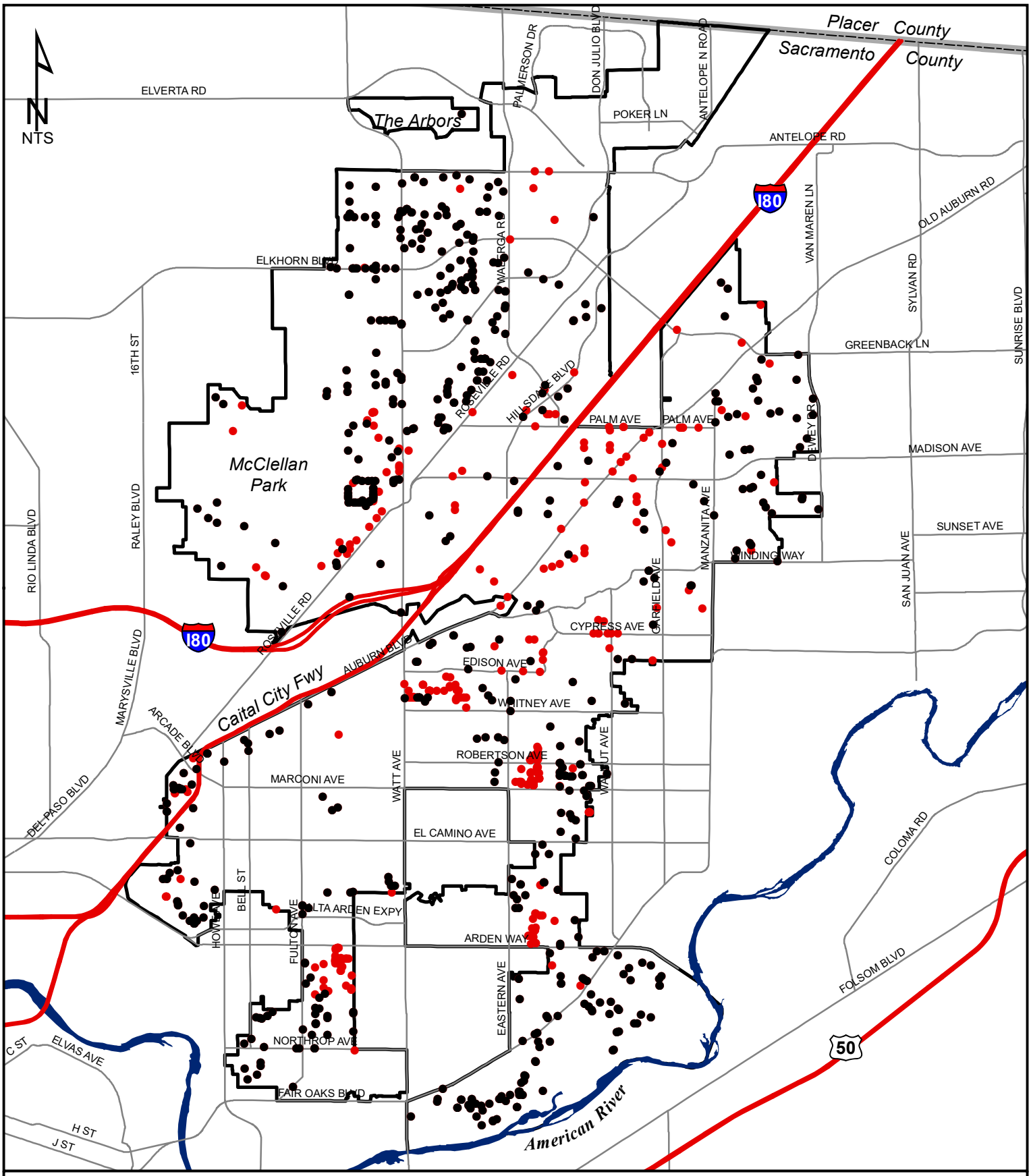
- Leaks

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

Figure 6A

Active Distribution Main Leak History



Legend

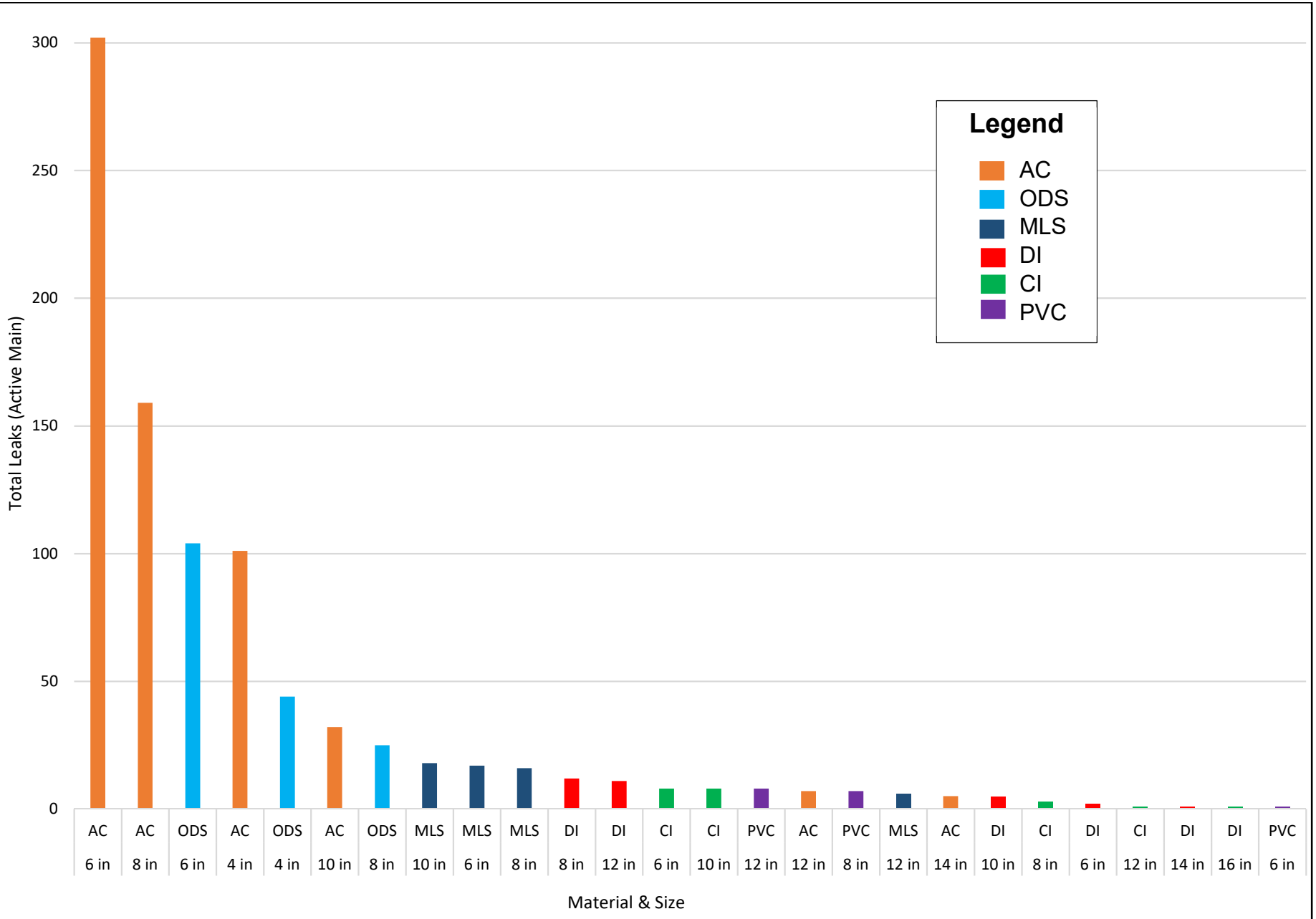
- Leaks on AC
- Leaks on Other

SACRAMENTO SUBURBAN WATER DISTRICT

Distribution Main Asset Management Plan
August 2018

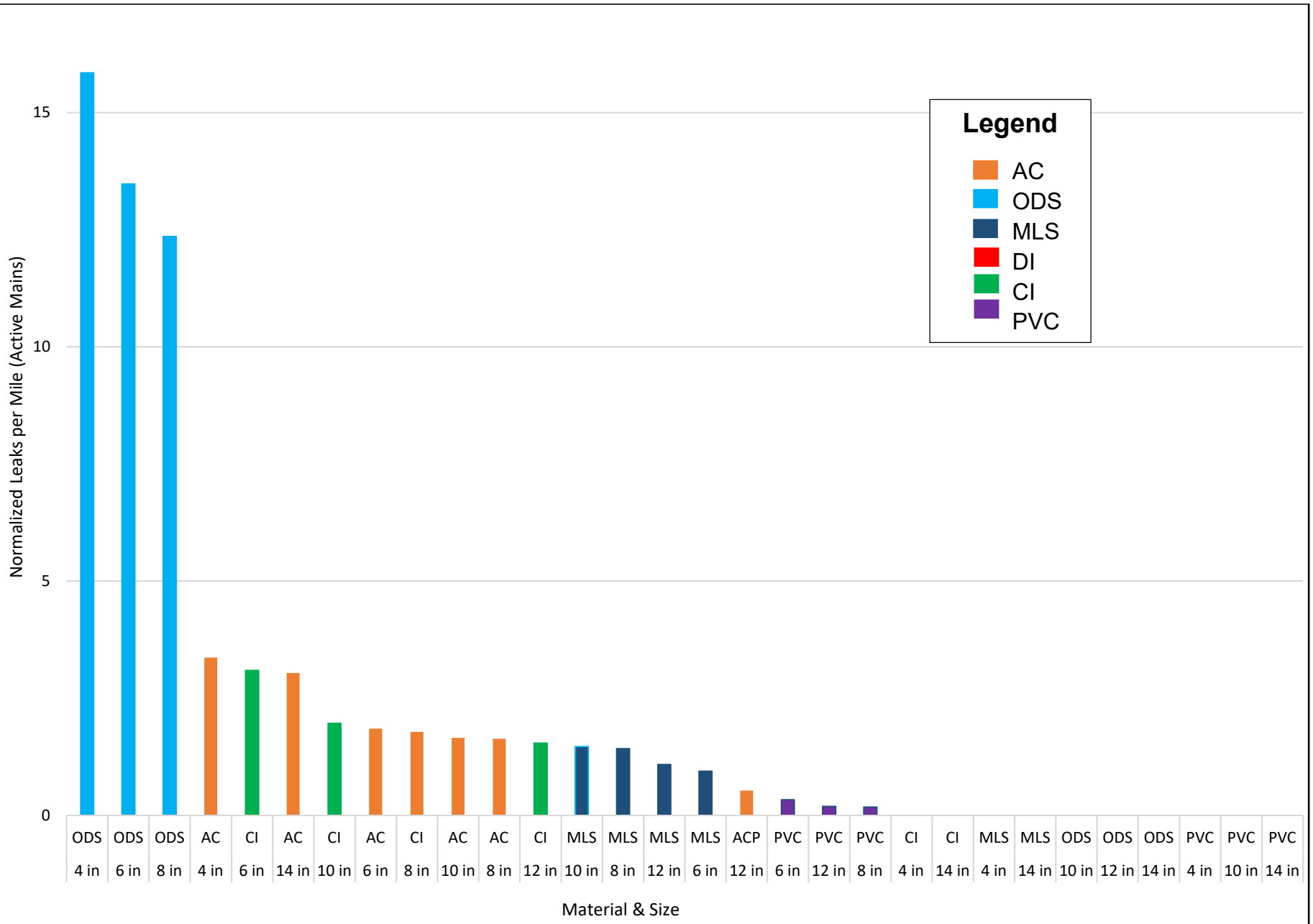
Figure 6B

Active Distribution Main Leak History



SACRAMENTO SUBURBAN WATER DISTRICT

Figure 7A
Distribution Main Leak History By Pipe Material & Size



SACRAMENTO SUBURBAN WATER DISTRICT

Figure 7B
Normalized Distribution Main Leaks/Mile By Pipe Material & Size

Material Condition Evaluation

The Engineering Department used various consultants to evaluate high priority Pipe Materials used within the District. The gathered Material Evaluation data was used, in unison with Failure Rate (Figure 7B: Active Distribution Main Leak History per Mile by Pipe Material & Size), to evaluate the condition of each Pipe Material. Failure Rate of each pipe was calculated by using Leaks/Mile of each Pipe Material and Size. The condition assessments using the consultants' data substantiate the Failure Rate that was calculated in this Plan.

Categories in Likelihood of Failure (LOF) that were informed by the Material Condition Evaluation are Pipe Type and Pipe Age. The condition assessment gathered from Failure Rate as well as various consultants recommendations created the criteria scoring found in Table 8: Pipe Type Score. The condition of the Pipe Material degrades with Pipe Age because of the effects of corrosion from water and/or soils. Newer Pipe Materials are less susceptible to corrosion with modern installation standards.

The worst pipe, Outside Diameter Steel (ODS), was given the maximum possible points five (5) based on the Failure Rate and previous Distribution Main Asset Management Plan's priority to replace all the ODS pipe. No Material Evaluation was completed on ODS because the District has main replacement projects scheduled to eliminate the remainder of this pipe within multiple Main Replacement Area's within a few years.

Next, Asbestos – Cement (AC) pipe was given a four (4) based on Failure Rate and Material Evaluation from consultants estimating the remaining useful life. Reports concluded that small diameter AC Pipe were at higher risk of failure because of the smaller section modulus (JDH Corrosion Consultants, Inc., 2014). The report also stated that all AC Pipes tested were losing wall thickness from both the interior and exterior of pipe walls due to the major loss of calcium (JDH Corrosion Consultants, Inc., 2014). Expansive soils within the District can lead to swelling and shrinkage of the soil and this can generates bending stresses on the AC pipes (East Bay Municipal Utility District, 2012). The Failure Rate (Figure 7B) data confirms that the District's smallest AC Pipes have the highest Failure Rate (Leaks/Mile).

Mortar Line Steel (MLS) pipe was given a three (3) based a Failure Rate and Material Evaluation from consultants. MLS Pipe ranks high on the Consequence of Failure category "Pipe Damage" but not as high in the "Pipe Type" category. The Failure Rate of this material ranks 4th highest among the District's Pipe Material. A Condition assessment of the MLS Pipe showed that the MLS Pipe's welds, mortar, and service points were in good condition (TEAM Industrial Services, 2018), confirming the Failure Rate data.

Pipe Material Condition Evaluations help rank the Pipe Material by critical age and type. As required, future evaluations should be done to support the Failure Rate data gathered by the District.

Criteria Considered for Prioritizing Areas for Distribution Main Replacement

Risk of Failure (ROF) for the Distribution Main Replacement Areas considered four categories that contribute to the decision to replace water mains. The four categories used to rank the distribution main's properties are:

1. Consequence of Failure
2. Likelihood of Failure
3. Safety Factors
4. Meter Retrofit Factor

Consequence of Failure (COF) is one of the categories used in the Risk of Failure (ROF) analysis. It evaluates data in the Districts Main Replacement Areas that will have the highest financial and physical repercussions if a water main were to fail. Likelihood of Failure (LOF) is the second category used in the ROF analysis. The LOF provides data on the Districts Main Replacement Areas that have the highest probability of a water main to fail.

The next two categories were modifiers for the ROF Score. Safety Factors (SF) (previously hydraulic factors) included hydrant coverage and the percent of wharf hydrants within a Main Replacement Area. The last modifier was a Meter Retrofit (MR) factor. This modifier accounted for the overlap of meter retrofit areas that were at the top of ROF Rank.

Each of the Main Replacement Areas were then ranked based on Total Score. Total Score equals:

$$Total\ Score = LOF\ x\ COF\ x\ (1 + SF) +\ MR$$

An Overall Rank of 1 indicates the Main Replacement Area with the worst combined results, while an Overall Rank of 197 indicates the best. Further description of the categories are given below.

Consequence of Failure (COF)

COF is one of the categories used in the ROF analysis. It evaluates data in the Districts Main Replacement Areas that will have the highest financial and physical repercussions if a water main were to fail. COF consists of five criteria, which includes: Pipe Damage, Pipe Diameter, Customer Type, Crossings, and Valves per 500 feet.

Pipe Damage

Purpose

The Pipe Damage criteria quantifies the damage caused by a leak/blowout for the Districts various Pipe Material types. For example, a leak on Asbestos Concrete pipe is typically small and concentrated, which causes little damage to the surrounding area. Conversely, a leak on Mortar Line Steel (MLS) or Polyvinyl Chloride (PVC) is typically massive due to the size of the blowout area.

Scoring

Scoring is based largely on input from the Districts Operations Department personnel. Based on experience and knowledge, a leak on MLS and PVC pipe material cause the most damage and requires immediate repair to prevent catastrophic damage to the surrounding area. Additionally, pipe of Unknown material was given the maximum score. All other material has proven to typically be a slow leak that does not require the same level of urgency; therefore, they were all given a lower score.
The effective Pipe Damage Score was calculated by taking the total percentage of each main material within the Main Replacement Area and multiplying it by the scoring matrix (see Table 3 and Equation 1).

Table 3: Pipe Damage Score

Pipe Material	Pipe Damage Score (PDS_i)
AC	1
CC	
CI	
CONC	
DI	
ODS	
MLS	5
PVC	
UNK	

Equation 1: Pipe Damage Score per replacement area.

$$Pipe\ Damage\ Score = \sum PDSi \times {}^{l_i}/_{L_i}$$

PDS_i = Pipe Damage Score per designated Area "i"

l_i = Length of respective material within the replacement area

L_i = Total length of Main within the replacement area

Pipe Diameter

Purpose

The Pipe Diameter criteria was used to classify Main Replacement Areas containing larger mains. Large mains have the ability to cause major damage, leaving the District liable.

Scoring

The Pipe Diameter score was broken up by giving the smallest distribution mains size (4-inch) a score of 1 and then adding an addition point for every two (2) inch increase in pipe diameter (see Table 4). Then the Effective Pipe Diameter was calculated by taking the total percentage of each distribution main size within the replacement area and multiplying it by the Pipe Diameter Score (equation 2).

Table 4: Pipe Diameter Score

Pipe Diameter (in.)	Pipe Diameter Score (PDS_i)
10.01+	5
10.00 – 8.01	4
8.00 – 6.01	3
6.00 – 4.01	2
4.00 – 0.00	1

Equation 2: Percent of pipe diameter within replacement area.

$$Pipe\ Diameter\ Score = \sum PDSi \times {}^{l_i}/_{L}$$

PDS_i = Pipe Diameter Score per main replacement area

ED = Effective (Pipe) Diameter

D_i = Pipe Diameter

l_i = Length of respective diameter within the replacement area

L = Total length of Main within the replacement area

Customer Type

Purpose

The Customer Type criteria was used to determine the financial impact of a main break in a majority commercialized area. Loss of water in a commercialized area can result in loss of business and/or loss of goods to a company, which leaves the District liable.

Scoring

The Customer Type scoring was determined by taking the total amount of Commercial Accounts per Total Accounts for each Main Replacement Area (Equation 3).

Table 5: Customer Type Score

Criteria [$PC_i \geq X\%$]	Customer Type Score
50%	5
40%	4
30%	3
20%	2
10%	1

Equation 3: Percent of Commercial Accounts within Main Replacement Area.

$$PC_i = \frac{CA_i}{TA_i}$$

PC_i - Percent Commercial per designated Area "i"

CA_i - Commercial Accounts per designated Area "i"

TA_i – Total Accounts per designated Area "i"

Crossings

Purpose

The Crossing criteria was used to determine the consequence of a main break while crossing a creek, freeway, or railroad; which would result in a higher liability and cost to repair for the District. A main break that leaks into a creek may cause discharge fines by regulatory agencies (e.g. Division of Drinking Water, Sacramento County Environmental Management, etc.), and a break under a freeway or railroad would cause major transportation issues in the respective areas.

Scoring

The Crossing criteria scoring was determined by taking the sum of Infrastructure Crossings from equations 4-9.

Note: A fixed value was added for each crossing type to aid in normalizing the scores. The table below shows the ranges used for the Crossing Score, followed by the equations (Equation 4 - Equation 9) used to obtain the Crossing Score.

Table 6: Crossing Score

Criteria[$CS_i \geq X$]	Crossings Score
13	5
10.4	4
7.8	3
5.2	2
2.6	1

Equation 4: Creek Crossings – The number of creek crossings within a Main Replacement Area.

$$CCS_i = 3 + CC_i$$

Equation 5: Freeway Crossings – Assumed there would be a five times greater cost associated with a main break under a freeway compared to a Creek Crossing.

$$FWCS_i = 1 + FW_i \times 5$$

Equation 6: Railroad Crossings- Assumed there would be a three times greater cost associated with a main break under a railroad compared to a Creek Crossing.

$$RRCS_i = 1 + RC_i \times 3$$

Equation 7: Sum Crossings per Area– Addition of CCS_i, $FWCS_i$, and $RRCS_i$

$$SC_i = CCS_i + FWCS_i + RRCS_i$$

Equation 8: Criteria Upper Limit

$$C_{UL} = Max(SC_i)$$

Equation 9: Criteria Range Interval

$$C_R = \frac{C_{CL}}{5}$$

CCS_i – Creek Crossing Score per Area "i"

$FWCS_i$ – Freeway Crossing Score per Area "i"

$RRCS_i$ – Railroad Crossing Score per Area "i"

SC_i – Sum of Crossings per Area "i"

Valves per 500 feet

Purpose

The Valves per 500 feet criteria was used because SSWD Improvement Standard Section D-5 (b) requires valve spacing to be at a minimum of 1 valve per 500 feet. A Main Replacement Area is considered superior with a greater valve density, because a main break can be isolated quicker, with less customers affected by shutdowns.

Scoring

The Valves per 500 feet scoring was determined by the valve density ($V_{500'_i}$) using Equation 10. A valve density of one (1) indicates the minimum density being met, while all areas that exceeded this requirement received a score of one (1). Scoring for replacement areas that did not mean the standard are shown in Table 5.

Table 7: Valves per 500 Feet

$V_{500'_i}$	**Valves per 500 feet Score**
≥1	1
<1	5

Equation 10: Valves per 500 feet.

$$V_{500'_i} = \frac{V_i}{L_i} \times 500'$$

$V_{500'_i}$ – Valves per 500 feet per Area "i"

V_i - Valves per Area "i"

L_i – Main Length per Area "i"

Likelihood of Failure (LOF)

Likelihood of Failure (LOF) is the second category used in the ROF analysis. The LOF provides data on the Districts Main Replacement Areas that have the highest probability of a water main to fail. LOF consists of four criteria, which includes: Pipe Type, Pipe Age, Main Location, and Failure Rate.

Pipe Type

Purpose

The Pipe Type is one of the greatest indicators of water main reliability. Since Main Replacement Areas consist of multiple Pipe Types, an effective Pipe Type was determined individually. Pipe Type Score ranges were determined from calculating the Leaks/Mile for each pipe type (Appendix ##).

Scoring

Pipe Type scoring was analyzed for every Main Replacement Area. The calculated effective Pipe Type is based on the percentage of each pipe in the Area multiplied by the corresponding Pipe Material score. The equations and criteria table are below.

Table 8: Pipe Type Score

Pipe Material	Pipe Type Score
ODS/Other/UNK	5
AC	4
MLS/CI	3
PVC	2
DI	1

Equation 11: Effective Pipe Type per replacement area.

$$EPT = \sum (\%_{ACP} \times Score_{ACP} + \%_{DIP} \times Score_{DIP} + \cdots + \%_{x} \times Score_{x})$$

EPT – Effective Pipe Type

$\%_x$ – Percentage of pipe material "x" within $Area_i$

$Score_x$ – Corresponding Pipe Material Score (i.e. ACP = 4)

Pipe Age

Purpose

The Pipe Age is indicative of potential failure. Main Replacement Areas with the oldest pipe are more likely to experience a failure.

Scoring

Pipe Age scoring used average age (in years) for each pipe type and pipe diameter. Average age was then multiplied by the Materials percentage within the Main Distribution Area (Equation 12), which calculated the Weighted Age by Material for each area. The summation of the Weighted Age by Material gave us the effective pipe age for the area, which was then scored based off the table below.

Table 9: Pipe Age Score

Pipe Age	Pipe Age Score
60+	5
45.01 - 60	4
30.01 – 45	3
15.01 – 30	2
0 – 15	1

Equation 12: Effective Pipe Age per Main Replacement Area.

$$EPA = \sum \left(\%_{Age_{0-15}} \times Score_{0-15} + \%_{15.01-3} \times Score_{30.01-45} + \cdots + \%_{x} \times Score_{y} \right)$$

EPA – Effective Pipe Age

$\%_{Agex}$ – Percentage of Pipe Age "x" within $Area_i$

$Score_y$ – Corresponding Pipe Age Score (i.e. 60+ = 5)

Main Location

Purpose

Main Location criteria was a huge factor in previous Distribution Main Asset Management Plans. Backyard mains are more prone to damage due to trees and various landscaping potentially growing directly on top of a main. Backyard mains also pose a challenge for District personnel trying to access our assets, and an inconvenience to customers when maintenance is required.

Scoring

Main Location scoring examined all Distribution Areas for front yard vs. backyards. If pipe was determined to be in backyard, it received a score of two (2). If pipe was determined to be located in the front yard, it received a score of one (1).

Table 10: Main Location Score

Main Location	Main Location Score
Backyard	2
Front Yard	1

Failure Rate

Purpose

Failure Rate criteria is a great indicator of the pipe condition. Main Replacement Areas pipes with a large number of leaks per mile have likely reached their effective useful life.

Scoring

The failure rate scoring was calculated by taking total mainline leaks in the Main Replacement Area per total length of main in the area (see Equation 13), and scored using Table 11.

Table 11: Failure Rate Score

Failure Rate (Leaks per mile)	Failure Rate Score
>3	5
1 - 3	3
<1	1

Equation 13: Leaks per Mile per Area. $= \frac{\sum Leaks_i}{\sum Miles_i}$

$Leaks_i$ = Total Leaks within the replacement area

$Miles_i$ = Total length of Main within the replacement area in miles

Risk of Failure (ROF)

The ROF is the overall score based on the multiplication of LOF and ROF (Equation 14), and represents the overall Risk of the mains within the Main Replacement Areas.

Equation 14: Risk of Failure Score.

$$ROF_i = COF_i \times LOF_i$$

ROF_i = Risk of Failure for an individual replacement area

COF_i = Consequence of Failure for an individual replacement area

LOF_i = Likelihood of Failure for an individual replacement area

Safety Factors

Fire protection is an essential part of the District water system, and cannot not be accounted strictly on main size and material. Therefore, the Safety Factor score acts as a modifier to the ROF. The Safety Factor score is determined using Equation 15, and the multiplied by the ROF score (Equation 16).

Equation 15: Safety Score per Replacement Area.

$$Safety\ Score = \frac{[Hydrant\ Coverage\ Score]\ +\ [Wharf\ Hydrant\ Score]}{15}$$

Equation 16: Modified Safety Score.

$$Modified\ Safety\ Score = (1 + Safety\ Score)\ \times ROF$$

Hydrant Coverage

Purpose

The Hydrant Coverage criteria was used in reference to SSWD Improvement Standard Section D-5 (c) , requiring for 500 feet between fire hydrants in residential areas, and 300 feet in commercial areas.

Scoring

The Hydrant Coverage scoring analyzed the area not included inside the radius of commercial and residential hydrant coverage within each Main Replacement Areas. This area was then divided by the total area of the Main Replacement Area. Hydrant Coverage Deficiencies, shown in Table 12, scored the Main Replacement Areas that did not have adequate hydrants. Next, a weighted rank was created using a multiplying factor of two (2) due to the importance placed on fire hydrant coverage. Results can be seen in Appendix XX.

Table 12: Hydrant Coverage Score

Hydrant Coverage Deficiencies (%)	Hydrant Coverage Score
20.01 - 100	10
5.01 – 20	6
0 - 5	2

Wharf Hydrants

A wharf head hydrant is a hydrant which connects directly to a water main. It is essentially a hydrant top screwed onto a vertical piece of 4 Inch diameter pipe coming off the top of or adjacent to the water main. It was fairly common for these types of hydrants to be used in the 1940's and 50's in residential neighborhoods that were served by only 6" or smaller water mains.

Purpose

The wharf heads typically have only a single or double 2-1/2" outlet. Therefore, their ability to deliver fire flows are much less than the more modern types of fire hydrants (steamer type) used today.

Scoring

To evaluate this criterion, the total number of wharf hydrants in each Main Replacement Area were counted and then divided by the total number of fire hydrants in each Main Replacement Area. The wharf percentage was then scored based on the criteria in Table 13. This criterion is not considered as

important as hydrant coverage and fire flow capability because even a wharf type hydrant is useful for fighting fires and is better than no hydrant at all. Results can be seen in Appendix XX.

Table 13: Wharf Hydrant Score

Wharf Hydrant (%)	Score
100 -80	5
79.9 - 60	4
59.9 – 40	3
39.9 - 20	2
19.9 - 0	1

Meter Retrofit Factor

The Meter Retrofit Factor was the second modifier, which accounted for the area overlap outlined in the District's Meter Asset Management Plan. With the last couple of years of the Meter Retrofit Program, Distribution Main Replacement Areas have been identified as high Risk. Preferably, the District does not want to install new main for at least 10 years after an area was fully metered. With this overlap the District realized a cost savings for the Rate Payers by incorporating as many areas from the Meter Asset Management Plan into the Distribution Asset Management Plan.

The factor of 0.50 was added to any Main Replacement Area that has not been metered. Engineering analysis of the cost savings and customer satisfaction was performed as it pertained to adding a factor to the non-metered areas. The cost savings included materials used and labor costs, while the customer satisfaction considered the hindrance of working in a customers yard under the 10 year gap.

Distribution Main Evaluation Areas

As a result of the analysis, the identified evaluation areas are ranked in terms of priority for main replacement. The scoring indicates that some areas have a higher priority for main replacement than other areas. Information was also solicited from the District's field staff and managers regarding their experience in the maintenance of the District's water system. In general, their experience supported the rankings shown. In the future, additional information may become available that may necessitate revisions in the priority assignments.

While areas are ranked for main replacement, actual projects and the sequencing of those projects may depend on project size, available budget, and other factors. One other significant factor that affects scheduling and sequencing is a County of Sacramento Ordinance that includes a moratorium which prohibits cuts in pavements on any streets within 3 years of being constructed or repaved. A project may also move up on the priority list if the District knows that the County is planning an overlay project in that area in the near future because it is prudent to install the new water main in a street or streets before they are overlayed and the moratorium takes effect.

Projected Timing and Cost of Distribution Main Replacement Plan

In 2006, the District contracted with The Reed Group, Inc. to prepare a "*Multi-Year Financial Plan, Water Rates, and Facilities Development Update Charge Study*." The multi-year financial plan prepared by The Reed Group reflected five-year operating and capital program budgets that covered the period from CY2007 through CY2011. As a result of this study and report, a series of three annual rate increases of 13% per year was adopted by the Board of Directors in January 2007 that was almost exclusively tied to funding capital replacement projects, such as main replacements.

Ten percent (10%) of the total thirteen percent (13%) of these annual rate increases is earmarked for the District's Capital Improvement Program (CIP) and is intended to fund a "pay-as-you-go" method of financing ongoing capital replacement projects. These approved rate increases will result in a pay-as-you-go annual CIP budget of approximately $19 million per year in 2017. Raw material costs unpredictable long-term and only moderately predictable short-term, and are reflective of world markets and will have an impact on main replacement budgets. For reference, in 2010-2011, pipe material costs increased by approximately 35%.

Additional rate increases or use of reserve funds may be needed to keep up with construction inflation to maintain this same level of spending on a pay-as-you-go basis. Recently, labor rates and material costs have increased sharply due to factors such as economic and construction activity and State prevailing wage updates.

Projects will be completed as funds are available and approved by the Board. No funding mechanism has been proposed or is in place beyond the pay-as-you-go level of financing currently proposed in the District's rates. As stated previously, rates will generate approximately $19 million annually (2017 data) that can be scheduled for capital replacement projects, including main replacements.

Alternative Contracting and/or Construction Methods

Prior to 2006, the District utilized a traditional design-bid-build project delivery method consisting of design (either by a consultant or in-house), bidding to a pre-qualified select group of general contractors, and then construction. In 2007 District staff recommended a "Master Service Contract" approach. The idea behind this alternative is to sole source one or more contractors by giving them enough work for 1 to 3 years in exchange for a more competitive price to do the work. Additional savings can be achieved by having the District purchase the majority of the materials, thereby avoiding contractor mark-ups.

In 2006, following Board approval, the District negotiated service contracts with both Ahlstrom and GM Construction for the entire year. These contracts were eventually extended into early-2007 at negotiated 2006 prices. Using this approach, Ahlstrom Construction constructed the new water mains in the street and installed the service saddles for the new customer in-tract service lines. GM Construction then followed behind and installed the new customer in-tract house service lines, meter boxes, meter setters and meters.

In early-2007, in recognizing the Board's desire for competitive bidding, staff solicited price proposals from more than one contractor for continuing the service contract approach. "Requests for Price Proposals" (RFPP) were transmitted to qualified contractors for both the main installation component and the service line component. The District received price proposals from several contractors for both service contracts. The contractor's price proposals were evaluated by staff based on a matrix of criteria including contractor experience, references from past projects, ability to work with the public, and cost. Listed references were contacted to discuss contractor's performance on similar projects with other public agencies. The scoring matrix was then completed by District staff. As a result of these RFPP's and the subsequent evaluation process, the District again selected Ahlstrom Construction and GM Construction to continue the service contract approach for the remainder of 2007 and beyond. The

service contracts awarded were for a 5-year period with annual contract renewals. The current service contract with Veerkamp General Engineering and GM Construction has proved to be a cost effective tool in the main replacement program. The existing service contract expires at the end of 2014. A new service contract will be proposed. District staff has recommended continuing using this approach at least for a significant portion of the District's planned main replacement projects.

The advantages to using the service contract approach for this type of construction are as follows:

- Cost savings of 10 to 20% have been realized using the service contract approach in combination with the District purchase of materials.
- Using the service contract approach saves District costs associated with bidding and awarding contracts using traditional design-bid-build approach.
- The quality of work is high because the contractors that the District negotiates with have considerable experience and know the District's standards and requirements.
- The contractors make a considerable commitment to the District by committing all of their resources (labor and equipment) towards the District's main replacement projects.
- Because the quality of the work is high, the County inspection costs are significantly less than traditional bid projects. In fact, the District's main replacement projects have become training grounds for the county and other utility districts.
- Customer complaints are very low and are responded to quickly.
- There have been very few, if any, warranty items on projects constructed by the Master Service Contract using the service contract approach.
- Service contracts promote better communications with the District, County, and Contractor.
- With the significant quantities of pipe the District has been able to order large quantities of pipe at a significant savings.

With such a large main replacement program, District staff is continuing to investigate other alternatives for cost effective management of the design and construction of the main replacement projects. Savings in time and money would allow more projects to be completed for less money and in a shorter time period which would be a great benefit to the District and its ratepayers.

Other contracting and/or construction alternatives still being considered are as follows:

1. Design/Build

   Under Design/Build, the District would hire a design/build contractor. They would be responsible for the design, construction, and all permitting under a single contract. The Contractor would work very close with District staff to insure District standards and specifications are followed. Design plans would be advanced only to the requirements needed to secure permits. The projects are completed in a shorter period of time and usually at a cost less than the traditional design, bid, and build concept. The risk involved in this approach would be the selection of a contractor that under performs.

2. Main Replacement in Larger "Blocks" or Sections

   Although projects have been getting bigger in terms of feet of new main installed, the District continues to respond to smaller "hot spots" in doing main replacement projects. Combining the projects into larger work areas would attract larger construction firms which may lower construction costs and get the projects completed in a shorter time period, in turn saving money. Management of one larger project is more efficient than managing several smaller projects.

3. Use of Alternate Pipe Materials

   The District currently specifies the use of DI for the water main construction. DI is slightly higher in cost than other pipe materials on the market. The District could potentially recognize a savings with the use of alternate pipe material. PVC "C-900" and PVC "Tight Fit" are examples of alternate materials available. All of the fore-mentioned pipe materials have been used successfully in water distribution systems throughout the country. The reliability of the alternate pipe material is generally good. However, DIP provides the best reliability and has a design life of 100 years or longer. Recently the District has experienced three major PVC Pipe failures resulting in significant costs to the District. It is anticipated that the cost savings from using alternate pipe materials will rarely exceed 5% of the project costs with actual savings in the 2% range.

ADAPTIVE AND PERPETUAL PLAN

Review and reassessment/update of the Plan is recommended in 3-5 year intervals. Future information that would influence the ranking of project areas in the Plan include but are not limited to: improved recordkeeping systems, identification of new evaluation criteria, acquisition of new service areas, a change in land use, updated model features, infrastructure failures, catastrophic events, and/or changes in District policies. Additionally, it is anticipated projects will need to be constructed outside of Rank order due to unforeseen circumstances and/or to achieve greater cost efficiencies.

It is also intended that this will be a perpetual plan in that areas where the water mains have been recently replaced will continue to be evaluated and their priority rank adjusted accordingly. Obviously, those areas with newer water mains would rank lower on the priority list for replacement; and over time those areas will rise on the priority list.

PUBLIC OUTREACH

There is a significant amount of customer contact and outreach that occurs during the design and construction phases of the District's main replacement projects. In the past few years, the level of public outreach between the District and our customers has increased considerably on these types of projects. The process currently used follows the steps outlined below.

- During the final design phase, a letter is sent to each parcel with an active water service within the project area explaining the need for the project and the proposed construction timeframe. This letter includes a sketch showing the homeowner the options for the new service line that will be installed as part of the project and a "Facts About Water Meters" flyer.
- Before design is completed, a District representative meets face to face with the homeowner to discuss the project. The District's representative will have a service location sheet showing the existing water system and the proposed system. The District's representative will discuss and determine with the homeowner the best location of the proposed new water service and water meter. The proposed construction dates are also discussed.
- After award of the construction contract, and three to four weeks prior to the start of construction, a letter is sent to all affected homeowners notifying them of the pending start of construction. This letter identifies the contractor that will be performing the work, provides a District contact name and phone number for questions and accessing the property.
- The selected contractor also sends out a letter introducing themselves, and also providing contact information including their Project Manager's and/or Project Foreman's phone numbers.
- Prior to any work being completed on a customer's property, a door hanger is placed 24 to 48 hours before commencing work at the residence describing the work to be completed and how long the water service may be interrupted.
- From the period of the first letter being sent to the end of the project, phone calls received are responded to in less than 24 hours and, if necessary, a face to face meeting is arranged with the homeowner.
- When the project is substantially complete, a customer satisfaction survey card is sent to each parcel with an active water service within the project area, requesting that any deficiencies be

noted for corrective action. Any deficiencies noted from these survey cards are added to the contractor's "punch list" developed by District staff.

- Prior to the customer being converted from flat rate to metered rate, a final letter is mailed to each property owner by the Customer Service Department.

The District has received numerous positive comments from customers regarding current customer outreach efforts. However, staff continues to explore ways to improve both customer outreach and service.

CONCLUSIONS AND RECOMMENDATIONS

Staff is proposing to continue the Distribution Main Asset Management Program. Replacing aging water mains will allow the District to provide decades of reliable and cost effective service for our customers. The current direction is to replace the backyard pipelines – first focusing on ODS, then moving on to AC along with problem areas of MLS – with new DI mains in the public right-of-way.

- The *Distribution Main Asset Management Plan* (Plan) is the cornerstone of the District's Asset Management Program.
- This Plan provides a reasonable plan and strategy for replacing the District's water mains and assisting in the *Meter Retrofit Plan* and *Water Transmission Asset Management Plan*.
- The *Distribution Main Asset Management Plan* provides a tool for communication between the Board and staff to identify areas of highest need for water main replacement.
- The Plan identifies probable costs associated with water main replacement but does not prescribe any funding mechanisms.
- There are approximately 160 miles of water main's located in back and side yard easements. Of these 160 miles, 18 miles are ODS pipe which has the highest frequency of leaks and are in the greatest need of replacement.
- Based on 2017 and 2018 years, the estimated total cost to replace 1 mile of backyard water main is in the range of $1.8 to $1.9 million dollars depending on the complexity of the main replacement project. This total cost includes the cost of engineering, permitting, inspection, public relations, and all associated construction costs including the installation of the new water main, water services and water meters, fire hydrants, valves, and reconnecting customer in-tract service lines to the new main.
- At a proposed replacement rate of approximately 6 to 8 miles per year, $216 to $304 million is needed over the next 20 years without inflation considered.
- Over the past 5 years the District has averaged $__ Million for its CIP budget. In 2018, the budget is $__ Million. In the future, annual Budget increases of 3% to 5% are expected. A large fraction of these funds will likely be allocated to main replacement projects.
- Due to the length of time to replace the backyard water mains, water meters will eventually be installed on backyard water services over the course of the meter retrofit program.

- A prioritization list has been established identifying the priority areas in need of main replacement that is objective, impartial, and defensible to our customers.
- The Plan is perpetual and will be reviewed and revised periodically as additional field and other information becomes available.
- The Plan can be used to coordinate with other Agencies.

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Distribution Main
Risk of Failure Ranking

Area	Consequence of Failure (COF)					Likelihood of Failure (LOF)				Risk of Failure (ROF) (0-1)			Safety Factors			Meter Retrofit Factor	Total Score	Overall Rank
	Doubly Weighted	*Normally Weighted*				*Normally Weighted*		*Doubly Weighted*		(COF x LOF)			*Doubly Weighted*	*Normally Weighted*	*Sum 15*			
	Pipe Damage (2-10)	Pipe Diameter (1-5)	Customer Type (1-5)	Crossings (1-5)	Valves per 500' (1-5)	Main Location (1-2)	Pipe Age (1-5)	Pipe Type (2-10)	Failure Rate (2-10)	COF Score	LOF Score	ROF Score	Hydrant Coverage (2-10)	Wharf Hydrants (1-5)	Safety Score			
06D	2.0	1.7	1	2	5	2	5	5.9	10	0.391	0.849	0.332	2	5	0.467	0.50	0.987	1
06I	2.1	1.9	1	1	5	2	5	5.9	10	0.368	0.847	0.311	2	5	0.467	0.50	0.957	2
42E	2.0	1.9	1	1	5	2	5	6.0	6	0.363	0.704	0.256	6	4	0.667	0.50	0.926	3
85	2.1	2.2	1	1	5	1	4	5.8	10	0.376	0.769	0.289	2	3	0.333	0.50	0.885	4
06A	2.0	2.2	1	1	5	2	5	6.0	6	0.375	0.703	0.263	2	4	0.400	0.50	0.869	5
90C	2.8	2.1	1	1	1	2	5	5.8	10	0.262	0.845	0.221	2	5	0.467	0.50	0.824	6
06F	2.0	1.7	1	2	1	2	5	5.9	10	0.256	0.846	0.217	2	5	0.467	0.50	0.818	7
06C	2.1	1.9	1	1	5	2	5	6.0	2	0.367	0.555	0.204	2	4	0.400	0.50	0.785	8
7A1	6.7	3.3	5	3	5	2	4	5.0	6	0.767	0.629	0.482	6	1	0.467	-	0.707	9
03B	2.0	3.2	5	4	1	1	5	5.5	10	0.506	0.796	0.403	10	1	0.733	-	0.699	10
10	9.5	2.9	1	3	5	2	4	9.6	2	0.714	0.652	0.466	2	4	0.400	-	0.652	11
03A	2.6	3.3	4	4	1	1	4	5.1	10	0.496	0.746	0.370	10	1	0.733	-	0.641	12
7E1	3.1	3.7	5	1	5	2	5	5.2	6	0.590	0.676	0.399	6	1	0.467	-	0.585	13
7D2	2.4	3.3	5	3	1	1	5	5.8	10	0.490	0.809	0.396	6	1	0.467	-	0.581	14
35	6.1	2.5	1	2	5	2	4	7.8	6	0.551	0.735	0.405	2	3	0.333	-	0.540	15
7D3	4.3	2.8	5	3	1	1	5	6.0	10	0.535	0.813	0.435	2	1	0.200	-	0.522	16
7C1	5.5	3.0	3	1	1	1	5	5.3	10	0.450	0.789	0.355	6	1	0.467	-	0.521	17
92	2.0	2.0	1	1	5	2	4	6.0	10	0.367	0.815	0.299	10	1	0.733	-	0.518	18
7B2	3.6	3.8	5	1	5	2	4	5.6	6	0.613	0.653	0.400	2	1	0.200	-	0.480	19
7D1	2.6	3.2	5	3	1	1	5	5.8	10	0.493	0.808	0.398	2	1	0.200	-	0.478	20
34	3.7	2.4	1	1	5	2	5	6.9	6	0.439	0.736	0.323	2	5	0.467	-	0.474	21
06K	3.0	2.0	1	1	5	2	4	5.8	10	0.398	0.806	0.321	2	5	0.467	-	0.470	22
7G1	8.3	2.6	5	3	5	2	4	5.0	2	0.798	0.482	0.385	2	1	0.200	-	0.461	23
7F2	2.8	3.3	5	1	1	2	5	5.9	6	0.439	0.702	0.308	6	1	0.467	-	0.452	24
42F	2.2	3.7	5	1	1	1	4	5.2	6	0.429	0.599	0.257	10	1	0.733	-	0.446	25
76I	2.9	3.6	5	2	1	1	5	4.6	10	0.484	0.764	0.370	2	1	0.200	-	0.444	26
13A	8.4	4.1	2	3	1	1	3	7.2	2	0.616	0.490	0.302	6	1	0.467	-	0.443	27
26A	6.7	3.1	2	4	1	1	4	6.9	2	0.560	0.514	0.288	6	2	0.533	-	0.442	28
7E4	4.7	2.5	5	3	1	2	5	6.0	2	0.541	0.555	0.301	6	1	0.467	-	0.441	29
7F4	4.4	3.3	5	2	5	2	5	5.9	2	0.656	0.551	0.361	2	1	0.200	-	0.434	30
18	6.2	3.6	3	3	1	1	4	6.3	6	0.563	0.640	0.360	2	1	0.200	-	0.432	31
7B3	3.5	3.1	5	1	1	1	5	5.1	10	0.456	0.780	0.356	2	1	0.200	-	0.427	32
7F3	5.4	4.0	5	1	5	1	5	5.8	2	0.681	0.512	0.348	2	1	0.200	-	0.418	33
7C2	2.5	3.3	5	1	1	1	5	6.0	6	0.425	0.667	0.283	6	1	0.467	-	0.416	34
27	6.8	3.4	2	2	1	1	4	7.1	6	0.509	0.671	0.342	2	1	0.200	-	0.410	35
76H	3.7	2.9	5	1	1	2	3	4.9	10	0.453	0.736	0.333	2	1	0.200	-	0.400	36
7G4	3.3	3.8	5	2	1	1	5	5.8	6	0.505	0.659	0.333	2	1	0.200	-	0.399	37
47	9.9	2.0	1	1	1	1	3	4.0	10	0.498	0.666	0.332	2	1	0.200	-	0.398	38

Distribution Main
Risk of Failure Ranking

Area	Consequence of Failure (COF)					Likelihood of Failure (LOF)				Risk of Failure (ROF) (0-1)			Safety Factors			Meter Retrofit Factor	Total Score	Overall Rank
	Doubly Weighted	*Normally Weighted*				*Normally Weighted*		*Doubly Weighted*		(COF x LOF)			*Doubly Weighted*	*Normally Weighted*	*Sum 15*			
	Pipe Damage (2-10)	Pipe Diameter (1-5)	Customer Type (1-5)	Crossings (1-5)	Valves per 500' (1-5)	Main Location (1-2)	Pipe Age (1-5)	Pipe Type (2-10)	Failure Rate (2-10)	COF Score	LOF Score	ROF Score	Hydrant Coverage (2-10)	Wharf Hydrants (1-5)	Safety Score			
7C3	4.8	3.2	5	1	1	1	5	5.7	6	0.499	0.657	0.328	2	1	0.200	-	0.393	39
7B4	5.0	3.2	5	1	1	1	5	5.4	6	0.508	0.645	0.328	2	1	0.200	-	0.393	40
7C5	3.0	2.1	5	1	1	1	5	5.5	10	0.404	0.798	0.322	2	1	0.200	-	0.387	41
7A2	9.3	2.7	1	1	5	1	5	5.3	2	0.633	0.492	0.311	2	1	0.200	-	0.374	42
90B	2.0	1.8	1	1	5	2	5	6.0	6	0.362	0.704	0.254	2	5	0.467	-	0.373	43
7C4	3.9	3.3	5	1	1	1	5	5.7	6	0.472	0.654	0.309	2	1	0.200	-	0.370	44
32	2.0	2.2	1	1	5	2	4	6.0	6	0.375	0.667	0.250	2	5	0.467	-	0.367	45
06B	2.0	2.2	1	1	5	2	4	6.0	6	0.375	0.667	0.250	2	5	0.467	-	0.367	46
06E	2.0	2.2	1	1	5	2	4	6.0	6	0.372	0.667	0.248	2	5	0.467	-	0.364	47
82	2.0	3.3	4	3	1	1	3	4.9	6	0.445	0.552	0.245	6	1	0.467	-	0.360	48
26B	6.0	2.9	2	1	1	2	4	7.0	2	0.432	0.555	0.239	6	1	0.467	-	0.351	49
7G2	3.7	2.9	4	2	5	1	5	5.2	2	0.587	0.490	0.287	2	1	0.200	-	0.345	50
17B	7.6	4.1	2	2	1	1	3	5.4	2	0.556	0.421	0.234	6	1	0.467	-	0.344	51
86D	2.5	3.0	5	1	1	1	3	5.0	6	0.415	0.557	0.231	6	1	0.467	-	0.339	52
24A	5.1	3.4	3	1	1	1	4	6.1	2	0.448	0.485	0.217	6	1	0.467	-	0.319	53
28	5.7	3.0	1	4	1	1	4	6.8	2	0.491	0.511	0.251	2	2	0.267	-	0.318	54
24B	5.6	3.3	1	2	1	1	4	6.4	2	0.430	0.496	0.214	6	1	0.467	-	0.313	55
19	5.8	3.2	1	2	1	1	3	6.2	6	0.432	0.601	0.260	2	1	0.200	-	0.312	56
7F1	4.2	3.6	5	1	1	2	5	5.2	2	0.493	0.526	0.259	2	1	0.200	-	0.311	57
13B	4.7	3.5	1	4	1	1	3	5.9	2	0.473	0.439	0.208	6	1	0.467	-	0.305	58
7G3	2.6	4.1	5	2	1	1	5	5.9	2	0.491	0.514	0.253	2	1	0.200	-	0.303	59
7E2	3.1	3.5	5	1	1	2	5	6.0	2	0.454	0.556	0.252	2	1	0.200	-	0.303	60
37	5.8	2.2	1	1	1	2	4	7.9	2	0.367	0.588	0.216	2	4	0.400	-	0.302	61
42J	2.8	2.4	1	1	1	1	4	5.2	10	0.273	0.749	0.204	6	1	0.467	-	0.300	62
76C	3.9	3.0	1	1	1	1	4	5.2	10	0.331	0.749	0.248	2	1	0.200	-	0.297	63
11	3.2	2.3	1	1	5	1	4	6.6	2	0.415	0.503	0.209	2	4	0.400	-	0.292	64
86C	3.5	2.6	1	2	1	1	3	5.2	10	0.337	0.712	0.240	2	1	0.200	-	0.288	65
44	5.4	4.0	5	2	1	2	3	4.1	2	0.579	0.412	0.238	2	1	0.200	-	0.286	66
42K	4.9	3.9	3	1	1	2	2	3.9	6	0.462	0.514	0.238	2	1	0.200	-	0.285	67
41	2.4	2.2	1	1	5	2	4	6.1	2	0.388	0.522	0.203	2	4	0.400	-	0.284	68
66B	3.9	2.4	4	1	1	1	3	5.3	6	0.408	0.567	0.231	2	1	0.200	-	0.278	69
74	3.1	1.9	1	2	1	2	5	5.7	6	0.299	0.694	0.208	2	3	0.333	-	0.277	70
17A	6.3	3.1	1	2	1	1	4	6.3	2	0.445	0.491	0.218	2	2	0.267	-	0.277	71
6G1	2.0	1.6	1	1	1	2	5	6.0	10	0.221	0.852	0.188	2	5	0.467	-	0.276	72
76J	2.0	4.0	5	1	1	2	2	3.8	2	0.434	0.363	0.157	10	1	0.733	-	0.273	73
6G2	2.0	1.8	1	1	1	2	5	6.0	10	0.227	0.852	0.193	2	4	0.400	-	0.271	74
93A	2.4	2.7	1	1	1	1	4	5.8	10	0.271	0.770	0.208	2	2	0.267	-	0.264	75
90A	3.1	2.1	1	1	1	2	4	5.7	6	0.273	0.655	0.179	2	5	0.467	-	0.263	76

Distribution Main
Risk of Failure Ranking

Area	Consequence of Failure (COF)					Likelihood of Failure (LOF)				Risk of Failure (ROF) (0-1)			Safety Factors			Meter Retrofit Factor	Total Score	Overall Rank
	Doubly Weighted	*Normally Weighted*				*Normally Weighted*		*Doubly Weighted*		(COF x LOF)			*Doubly Weighted*	*Normally Weighted*	*Sum 15*			
	Pipe Damage (2-10)	Pipe Diameter (1-5)	Customer Type (1-5)	Crossings (1-5)	Valves per 500' (1-5)	Main Location (1-2)	Pipe Age (1-5)	Pipe Type (2-10)	Failure Rate (2-10)	COF Score	LOF Score	ROF Score	Hydrant Coverage (2-10)	Wharf Hydrants (1-5)	Safety Score			
7G5	2.6	3.1	5	1	1	1	5	5.9	2	0.424	0.514	0.218	2	1	0.200	-	0.261	77
43A	3.6	2.4	1	1	1	2	4	5.5	6	0.298	0.650	0.194	2	3	0.333	-	0.258	78
42D	2.3	2.1	1	1	1	2	5	5.9	6	0.247	0.701	0.173	2	5	0.467	-	0.254	79
06J	2.1	1.8	1	1	1	2	4	5.4	10	0.228	0.793	0.181	2	4	0.400	-	0.254	80
90D	3.2	2.0	1	1	1	2	4	5.7	6	0.274	0.656	0.180	2	4	0.400	-	0.252	81
05B	9.8	4.1	1	1	1	1	3	4.0	2	0.563	0.371	0.209	2	1	0.200	-	0.250	82
95	2.3	3.1	1	1	1	1	5	6.0	2	0.278	0.517	0.144	10	1	0.733	-	0.250	83
20A	2.2	2.1	1	3	1	1	4	5.8	6	0.310	0.623	0.193	2	2	0.267	-	0.244	84
36	5.9	2.7	1	1	1	1	4	6.9	2	0.389	0.514	0.200	2	1	0.200	-	0.240	85
72	2.4	1.9	1	1	1	2	5	5.9	6	0.244	0.700	0.171	2	4	0.400	-	0.239	86
46	9.8	3.1	1	3	1	1	2	4.0	2	0.597	0.332	0.198	2	1	0.200	-	0.238	87
05A	3.5	3.4	1	5	1	1	3	5.6	2	0.461	0.429	0.198	2	1	0.200	-	0.237	88
42B	2.9	2.0	1	1	1	1	4	5.1	10	0.265	0.745	0.198	2	1	0.200	-	0.237	89
22	2.3	2.2	1	1	1	2	5	5.9	6	0.252	0.701	0.177	2	3	0.333	-	0.235	90
42C	2.8	2.4	2	1	1	2	4	5.2	6	0.306	0.635	0.195	2	1	0.200	-	0.234	91
09	2.0	2.3	1	3	1	1	4	6.0	6	0.310	0.628	0.195	2	1	0.200	-	0.233	92
7B1	3.0	2.2	2	1	1	2	4	6.0	2	0.306	0.519	0.159	6	1	0.467	-	0.233	93
91	3.4	2.8	1	1	1	1	4	5.1	6	0.306	0.596	0.183	2	2	0.267	-	0.231	94
02B	5.2	4.5	2	1	1	1	2	2.8	2	0.455	0.289	0.131	10	1	0.733	-	0.227	95
54	2.8	2.1	1	1	1	1	4	5.5	6	0.264	0.612	0.162	2	4	0.400	-	0.227	96
38B	4.8	2.6	1	1	1	1	4	6.9	2	0.347	0.514	0.178	2	2	0.267	-	0.226	97
68	9.8	3.0	2	1	1	1	2	4.0	2	0.558	0.332	0.186	2	1	0.200	-	0.223	98
30	2.6	2.1	1	1	5	1	4	5.9	2	0.389	0.476	0.185	2	1	0.200	-	0.222	99
7E3	3.4	3.4	2	1	1	1	5	5.8	2	0.361	0.511	0.185	2	1	0.200	-	0.222	100
86B	2.0	2.8	1	2	1	1	4	5.9	6	0.295	0.625	0.184	2	1	0.200	-	0.221	101
29	4.1	3.1	1	3	1	1	3	6.2	2	0.408	0.451	0.184	2	1	0.200	-	0.221	102
53B	2.0	2.7	2	1	1	1	4	5.1	6	0.290	0.596	0.173	2	2	0.267	-	0.219	103
40B	5.2	3.0	2	1	1	1	3	6.1	2	0.405	0.449	0.182	2	1	0.200	-	0.218	104
49	9.9	3.3	1	1	1	1	2	4.0	2	0.542	0.334	0.181	2	1	0.200	-	0.217	105
57	5.2	2.8	1	2	1	1	3	6.1	2	0.400	0.450	0.180	2	1	0.200	-	0.216	106
55	3.2	2.6	1	3	1	1	4	5.8	2	0.358	0.476	0.170	2	2	0.267	-	0.216	107
38A	2.4	2.8	2	1	1	1	3	5.8	6	0.307	0.584	0.180	2	1	0.200	-	0.216	108
31A	2.5	2.3	1	2	1	1	4	5.6	6	0.292	0.615	0.179	2	1	0.200	-	0.215	109
45B	3.4	2.9	1	2	1	2	2	4.0	6	0.344	0.518	0.178	2	1	0.200	-	0.214	110
63	9.8	3.2	1	1	1	1	2	4.0	2	0.533	0.334	0.178	2	1	0.200	-	0.213	111
15	9.4	3.3	1	1	1	1	2	4.1	2	0.525	0.339	0.178	2	1	0.200	-	0.213	112
86A	2.0	2.5	1	2	1	1	4	5.8	6	0.286	0.622	0.178	2	1	0.200	-	0.213	113
93C	2.7	2.9	1	1	1	1	4	5.8	6	0.286	0.621	0.177	2	1	0.200	-	0.213	114

Distribution Main
Risk of Failure Ranking

Area	Consequence of Failure (COF)					Likelihood of Failure (LOF)				Risk of Failure (ROF) (0-1)			Safety Factors			Meter Retrofit Factor	Total Score	Overall Rank
	Doubly Weighted	*Normally Weighted*				*Normally Weighted*		*Doubly Weighted*		(COF x LOF)			*Doubly Weighted*	*Normally Weighted*	*Sum 15*			
	Pipe Damage (2-10)	Pipe Diameter (1-5)	Customer Type (1-5)	Crossings (1-5)	Valves per 500' (1-5)	Main Location (1-2)	Pipe Age (1-5)	Pipe Type (2-10)	Failure Rate (2-10)	COF Score	LOF Score	ROF Score	Hydrant Coverage (2-10)	Wharf Hydrants (1-5)	Safety Score			
1B	2.4	2.6	2	1	1	1	5	5.5	2	0.302	0.500	0.151	2	4	0.400	-	0.211	115
12A	4.0	2.8	1	1	1	1	4	6.9	2	0.324	0.514	0.167	2	2	0.267	-	0.211	116
40A	5.7	3.6	1	1	1	1	3	5.0	2	0.409	0.406	0.166	2	2	0.267	-	0.210	117
57A	3.3	2.4	1	1	1	1	3	5.1	6	0.293	0.560	0.164	2	2	0.267	-	0.208	118
42I	2.0	1.0	1	1	5	1	5	6.0	2	0.333	0.519	0.173	2	1	0.200	-	0.207	119
33	2.0	2.7	1	1	1	2	4	5.3	6	0.255	0.641	0.164	2	2	0.267	-	0.207	120
1C	2.0	2.3	1	2	1	1	5	5.8	2	0.275	0.512	0.141	2	5	0.467	-	0.207	121
53A	2.6	2.2	1	3	1	1	4	5.7	2	0.325	0.471	0.153	2	3	0.333	-	0.204	122
39	2.3	2.2	1	1	1	2	5	5.9	2	0.249	0.551	0.137	2	5	0.467	-	0.201	123
14	8.3	3.3	1	1	1	1	2	4.2	2	0.486	0.342	0.166	2	1	0.200	-	0.199	124
77	2.0	2.3	1	1	1	2	5	6.0	2	0.244	0.556	0.135	2	5	0.467	-	0.199	125
20B	3.4	2.8	1	3	1	1	3	6.0	2	0.373	0.443	0.165	2	1	0.200	-	0.198	126
93D	2.0	2.4	1	1	1	1	4	6.0	6	0.246	0.628	0.155	2	2	0.267	-	0.196	127
23	2.1	2.1	1	2	1	2	4	5.8	2	0.273	0.511	0.139	2	4	0.400	-	0.195	128
25	3.4	2.3	1	1	1	1	4	5.6	2	0.293	0.468	0.137	2	4	0.400	-	0.192	129
93B	2.4	2.3	1	1	1	1	4	5.8	6	0.255	0.622	0.159	2	1	0.200	-	0.191	130
05C	4.9	4.0	1	1	1	1	3	4.8	2	0.397	0.399	0.159	2	1	0.200	-	0.190	131
04	2.0	2.7	1	1	1	1	4	5.7	6	0.256	0.620	0.159	2	1	0.200	-	0.190	132
1A	2.1	2.2	1	1	1	1	5	6.0	2	0.243	0.519	0.126	2	5	0.467	-	0.185	133
43C	2.0	2.9	1	1	1	1	2	2.8	10	0.263	0.585	0.154	2	1	0.200	-	0.185	134
42G	2.0	2.7	1	1	1	1	2	3.2	10	0.257	0.599	0.154	2	1	0.200	-	0.185	135
02A	6.2	4.2	1	3	1	1	2	3.1	2	0.512	0.300	0.154	2	1	0.200	-	0.184	136
52A	2.0	3.7	1	2	1	1	2	3.4	6	0.323	0.461	0.149	2	1	0.200	-	0.179	137
12B	2.0	3.1	1	1	1	1	3	5.8	2	0.271	0.438	0.119	6	1	0.467	-	0.174	138
76F	2.0	2.7	1	1	1	1	3	5.0	6	0.255	0.556	0.142	2	1	0.200	-	0.170	139
42H	2.0	1.1	1	1	1	2	5	5.8	2	0.203	0.549	0.112	2	5	0.467	-	0.164	140
76K	2.3	4.0	5	1	1	1	2	3.3	2	0.444	0.307	0.136	2	1	0.200	-	0.164	141
66A	5.0	3.5	5	1	1	1	1	2.9	2	0.516	0.254	0.131	2	1	0.200	-	0.157	142
48	2.6	2.1	1	1	1	2	4	5.6	2	0.256	0.505	0.130	2	1	0.200	-	0.155	143
87B	5.8	4.2	1	1	1	1	2	3.0	2	0.434	0.295	0.128	2	1	0.200	-	0.154	144
43D	4.1	2.2	3	1	1	1	2	4.2	2	0.375	0.340	0.127	2	1	0.200	-	0.153	145
66D	2.0	4.3	5	1	1	1	2	2.7	2	0.445	0.286	0.127	2	1	0.200	-	0.153	146
89	2.0	3.4	1	1	1	1	2	3.0	6	0.280	0.443	0.124	2	1	0.200	-	0.149	147
21	2.0	2.3	1	1	1	2	4	5.0	2	0.242	0.482	0.117	2	2	0.267	-	0.148	148
02D	2.6	3.6	1	1	1	1	2	2.2	2	0.308	0.265	0.082	10	1	0.733	-	0.142	149
31B	2.0	2.6	1	1	1	1	3	4.3	2	0.252	0.382	0.096	2	5	0.467	-	0.141	150
16	2.0	2.0	1	1	1	1	4	5.1	2	0.233	0.447	0.104	2	3	0.333	-	0.139	151
58C	2.0	2.8	1	1	1	1	4	4.9	2	0.261	0.440	0.115	2	1	0.200	-	0.138	152

Distribution Main
Risk of Failure Ranking

Area	Consequence of Failure (COF)					Likelihood of Failure (LOF)				Risk of Failure (ROF) (0-1)			Safety Factors			Meter Retrofit Factor	Total Score	Overall Rank
	Doubly Weighted	*Normally Weighted*				*Normally Weighted*		*Doubly Weighted*		(COF x LOF)			*Doubly Weighted*	*Normally Weighted*	*Sum 15*			
	Pipe Damage (2-10)	Pipe Diameter (1-5)	Customer Type (1-5)	Crossings (1-5)	Valves per 500' (1-5)	Main Location (1-2)	Pipe Age (1-5)	Pipe Type (2-10)	Failure Rate (2-10)	COF Score	LOF Score	ROF Score	Hydrant Coverage (2-10)	Wharf Hydrants (1-5)	Safety Score			
56B	2.2	2.6	1	2	1	1	3	4.5	2	0.294	0.388	0.114	2	1	0.200	-	0.137	153
67	2.1	3.0	1	2	1	1	3	4.1	2	0.302	0.375	0.113	2	1	0.200	-	0.136	154
58A	2.5	3.5	1	1	1	1	1	2.1	6	0.298	0.375	0.111	2	1	0.200	-	0.134	155
76G	2.0	4.6	5	1	1	1	1	2.5	2	0.453	0.240	0.109	2	1	0.200	-	0.130	156
02C	4.6	3.9	1	1	1	1	2	2.6	2	0.383	0.283	0.108	2	1	0.200	-	0.130	157
57B	2.0	1.0	1	1	1	1	4	6.0	2	0.201	0.481	0.097	2	3	0.333	-	0.129	158
66E	2.0	3.8	3	1	1	1	2	3.1	2	0.360	0.299	0.108	2	1	0.200	-	0.129	159
87A	2.0	3.6	1	3	1	1	2	3.0	2	0.353	0.298	0.105	2	1	0.200	-	0.126	160
83	2.8	3.6	1	2	1	1	2	3.1	2	0.348	0.302	0.105	2	1	0.200	-	0.126	161
76D	2.0	3.8	1	2	1	1	1	2.0	2	0.326	0.222	0.073	10	1	0.733	-	0.126	162
66C	2.0	2.4	1	1	1	1	3	5.1	2	0.248	0.411	0.102	2	1	0.200	-	0.122	163
76A	2.3	3.4	1	1	1	1	3	3.4	2	0.290	0.348	0.101	2	1	0.200	-	0.121	164
45A	3.8	4.0	1	1	1	2	1	2.6	2	0.361	0.280	0.101	2	1	0.200	-	0.121	165
60B	4.4	3.9	2	1	1	1	1	2.6	2	0.409	0.245	0.100	2	1	0.200	-	0.120	166
66F	2.0	5.0	1	1	1	1	3	2.0	2	0.333	0.296	0.099	2	1	0.200	-	0.119	167
06M	2.0	3.7	1	2	1	1	2	3.0	2	0.324	0.296	0.096	2	1	0.200	-	0.115	168
78	3.1	3.8	2	2	1	1	1	2.4	2	0.394	0.238	0.094	2	1	0.200	-	0.113	169
84	2.2	4.1	4	1	1	1	1	2.1	2	0.411	0.225	0.092	2	1	0.200	-	0.111	170
65	2.0	3.7	2	3	1	1	1	2.4	2	0.391	0.235	0.092	2	1	0.200	-	0.110	171
56A	2.0	4.0	1	1	1	1	2	3.2	2	0.300	0.303	0.091	2	1	0.200	-	0.109	172
71	3.1	3.6	1	1	1	1	2	2.6	2	0.321	0.281	0.090	2	1	0.200	-	0.108	173
88	2.1	4.0	1	4	1	1	1	2.0	2	0.403	0.224	0.090	2	1	0.200	-	0.108	174
02E	2.0	4.0	1	2	1	1	2	2.0	2	0.332	0.259	0.086	2	1	0.200	-	0.103	175
79	4.0	2.9	1	1	1	1	1	2.7	2	0.332	0.248	0.083	2	1	0.200	-	0.099	176
51	2.6	3.7	1	2	1	1	1	2.3	2	0.344	0.233	0.080	2	1	0.200	-	0.096	177
61	2.2	4.0	2	1	1	1	1	2.2	2	0.342	0.228	0.078	2	1	0.200	-	0.093	178
59	3.1	3.5	1	1	1	1	1	2.4	2	0.322	0.238	0.077	2	1	0.200	-	0.092	179
06N	2.0	3.5	1	2	1	1	1	2.4	2	0.317	0.236	0.075	2	1	0.200	-	0.090	180
52B	2.0	4.1	1	2	1	1	1	2.0	2	0.336	0.222	0.075	2	1	0.200	-	0.090	181
58B	2.0	3.4	2	1	1	1	1	2.3	2	0.312	0.235	0.073	2	1	0.200	-	0.088	182
76B	2.0	4.1	1	1	1	1	1	2.0	2	0.304	0.222	0.068	2	1	0.200	-	0.081	183
70	2.0	3.7	1	1	1	1	1	2.2	2	0.289	0.230	0.066	2	1	0.200	-	0.080	184
06H	2.0	3.8	1	1	1	1	1	2.0	2	0.294	0.223	0.066	2	1	0.200	-	0.079	185
80	2.1	3.6	1	1	1	1	1	2.0	2	0.291	0.223	0.065	2	1	0.200	-	0.078	186
81	2.0	3.5	1	1	1	1	1	2.1	2	0.283	0.227	0.064	2	1	0.200	-	0.077	187
64	2.0	3.5	1	1	1	1	1	2.0	2	0.283	0.222	0.063	2	1	0.200	-	0.075	188
69	2.0	3.3	1	1	1	1	1	2.0	2	0.278	0.222	0.062	2	1	0.200	-	0.074	189
96	2.0	3.3	1	1	1	1	1	2.0	2	0.276	0.223	0.062	2	1	0.200	-	0.074	190

Distribution Main
Risk of Failure Ranking

Area	Consequence of Failure (COF)					Likelihood of Failure (LOF)				Risk of Failure (ROF) (0-1)			Safety Factors			Meter Retrofit Factor	Total Score	Overall Rank
	Doubly Weighted	*Normally Weighted*				*Normally Weighted*		*Doubly Weighted*		(COF x LOF)			*Doubly Weighted*	*Normally Weighted*	*Sum 15*			
	Pipe Damage (2-10)	Pipe Diameter (1-5)	Customer Type (1-5)	Crossings (1-5)	Valves per 500' (1-5)	Main Location (1-2)	Pipe Age (1-5)	Pipe Type (2-10)	Failure Rate (2-10)	COF Score	LOF Score	ROF Score	Hydrant Coverage (2-10)	Wharf Hydrants (1-5)	Safety Score			
60A	2.0	3.3	1	1	1	1	1	2.0	2	0.276	0.222	0.061	2	1	0.200	-	0.073	191
42A	2.0	3.1	1	1	1	1	1	2.0	2	0.272	0.222	0.060	2	1	0.200	-	0.072	192
62	2.0	3.1	1	1	1	1	1	2.0	2	0.272	0.222	0.060	2	1	0.200	-	0.072	193
43B	2.0	3.0	1	1	1	1	1	2.0	2	0.267	0.222	0.059	2	1	0.200	-	0.071	194
56C	2.0	1.0	1	1	1	1	1	2.0	2	0.200	0.222	0.044	2	1	0.200	-	0.053	195
60	2.0	1.0	1	1	1	1	1	2.0	2	0.200	0.222	0.044	2	1	0.200	-	0.053	196
7B5	2.0	1.0	1	1	1	1	1	2.0	2	0.200	0.222	0.044	2	1	0.200	-	0.053	197

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SACRAMENTO SUBURBAN WATER DISTRICT

Facilities & Operations Committee
Agenda Item: 4

Date: July 18, 2018

Subject: 2017 Consumer Confidence Report Review

Staff Contact: David Armand, Environmental Compliance Supervisor

Recommended Committee Action:
Review the 2017 Consumer Confidence Report.

Discussion:
At the July 16, 2018, Board meeting, a Director requested that this topic be added to the agenda for discussion.

Copies of the 2017 Consumer Confidence Report will be provided at the meeting.