In compliance with the Americans with Disabilities Act, if you have a disability and need a disability-related modification or accommodation to participate in this meeting, please contact the General Manager at (916) 725-6873. Requests must be made as early as possible, and at least one full business day before the start of the meeting.

Customer Advisory Committee meetings are video recorded, and available for web streaming at www.chwd.org and www.youtube.com.

CALL TO ORDER:

ROLL CALL OF COMMITTEE MEMBERS:

PLEDGE OF ALLEGIANCE:

PUBLIC COMMENT:
The Public shall have the opportunity to directly address the Customer Advisory Committee on any item of interest to the public before or during the Committee’s consideration of that item pursuant to Government Code Section 54954.3. Public comment on items of interest within the jurisdiction of the Committee is welcome. The Committee Chair will limit comments to three (3) minutes per speaker.

REVIEW AND REORDERING OF THE AGENDA:
Agenda items may be moved to accommodate those in attendance wishing to address that item. Please inform staff at (916) 725-6873 or at cac@chwd.org, if you feel that you may need an accommodation.

(A) Action Item   (D) Discussion Item   (I) Information Item

BUSINESS:

B-1. Approval of Meeting #2 Summary Including Member Questions and District Answers – August 28, 2018 (A)

B-2. Briefing on Infrastructure Challenges and Water Main Assessment (D)
   1. Discuss and provide feedback on Technical Memorandum No. 2: Infrastructure Challenges.
   2. Discuss and provide feedback on Technical Memorandum No. 3: Main Replacement Findings and Costs.

B-3. CAC Meeting Schedule (D)
   Receive a report on the 2019 Customer Advisory Committee Meeting Schedule.
COMMITTEE MEMBERS’ AND FACILITATOR REPORTS:

C-1. Facilitator’s Report (I)
C-2. Committee Members’ Reports (I)

FUTURE CHWD COMMUNITY ADVISORY COMMITTEE MEETING DATES:

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 5, 2019</td>
<td>6:30 PM</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>February 26, 2019</td>
<td>6:30 PM</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>March 19, 2019</td>
<td>6:30 PM</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>June 11, 2019</td>
<td>6:30 PM</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>September 10, 2019</td>
<td>6:30 PM</td>
<td>Regular Meeting</td>
</tr>
</tbody>
</table>

ADJOURNMENT:

CERTIFICATION:

I do hereby declare and certify that this agenda for this Regular Meeting of the Customer Advisory Committee of the Citrus Heights Water District was posted in a location accessible to the public at the District Administrative Office Building, 6230 Sylvan Road, Citrus Heights, CA 95610 and the Citrus Heights Community Center, 6300 Fountain Square Drive, Citrus Heights, CA 95610 at least 72 hours prior to the regular meeting in accordance with Government Code Section 54954.2.

Christopher Castruita, Management Services Supervisor/Chief Board Clerk

Dated: December 5, 2018
INTRODUCTION

Jenna Moser, Chair of the Customer Advisory Chair (CAC), called the meeting to order at 6:30 p.m. After welcoming the members of the CAC, she turned the meeting over to Laura Mason-Smith, the CAC meeting facilitator, who reviewed with the CAC the Meeting Agenda:

1. Introductions
2. Public Comment
3. Approve minutes of May 29, 2018 CAC Meeting #1
4. Water Demand Forecast, District Pipeline Asset Inventory, and Main Replacement Benchmarking
   a. Water Demand Forecast, Technical Memorandum 1-- how projected changes in water usage will affect the way the District replaces and sizes water mains
   b. District Pipeline Asset Inventory Results-- age of the water system, various pipe types, and where they’re located throughout the system
   c. Main Replacement Basics and Benchmarking-- major benchmarks to evaluate various options
5. Public Comment
6. Next Steps
7. Close

Laura reiterated that meeting materials will be provided electronically to the CAC members in advance of and following CAC meetings and will be posted on the CHWD website, Customer Advisory Committee Section. In addition, meeting summaries that provide an overview of each of the CAC meetings as well as a video of the meetings will be posted to the website to be available to the CAC members and the general public.
ATTENDEES

CAC Members:
- Kimberly Berg  Commercial Representative
- Patti Catalano  Residential Representative
- Katherine Cooley  Institutional Representative
- Wes Ervin  Commercial Representative
- Michael Goble  Residential Representative
- Suzanne Guthrie  Residential Representative
- Doug MacTaggart  Residential Representative
- Richard Moore  Residential Representative
- Jenna Moser  Residential Representative and CAC Chair
- Richard Moses  Residential Representative
- Mike Nishimura  Commercial Representative
- David Paige  Residential Representative
- Aimee Pfaff  Residential Representative
- Cyndi Price  Institutional Representative
- Ray Riehle  CHWD Director
- Colleen Sloan  Residential Representative
- Noe Villa  Institutional Representative
- David Wheaton  Residential Representative and CAC Vice Chair

Unable to attend were:
- Julie Beyers  Residential Representative
- Porsche Middleton  Residential Representative
- Dave Mitchell  Institutional Representative
- James Monteton  Residential Representative
- Peg Pinard  Residential Representative
- Javed Siddiqui  Residential Representative
- Chris Ralston  Institutional Representative

CHWD Staff:
- Chris Castruita  Management Services Supervisor/Chief Board Clerk
- Tamar Dawson  Assistant Engineer
- Paul Dietrich  Project Manager
- David Gordon  Operations Manager
- Madeline Henry  Management Services Specialist/Deputy Board Clerk
- Rex Meurer  Water Efficiency Supervisor
- Missy Pieri  Engineering Manager/District Engineer
- Susan Sohal  Administrative Services Manager
- Hilary Straus  General Manager

Consultants:
- Roger Kohne  Harris & Associates
- Andrew MacDonald  Harris & Associates
- Eric Vaughan  Harris & Associates
- Laura Mason-Smith  Mason-Smith Success Strategies
PUBLIC COMMENT

There was one public comment not related to the meeting agenda which was addressed with the customer individually by General Manager Hilary Straus.

APPROVAL OF MAY 29, 2018, CAC MEETING #1 MINUTES

The minutes of the May 29, 2018, CAC Meeting #1 were unanimously approved without comments or changes.

WATER DEMAND FORECAST, DISTRICT PIPELINE ASSET INVENTORY, AND MAIN REPLACEMENT BENCHMARKING

To continue to build shared understanding among the CAC members, Project 2030 Manager Missy Pieri outlined Project 2030 accomplishments thus far and where the Project is headed (please see http://chwd.org/customer-advisory-committee/ for the slide presentation detail).

Water Demand Forecast, Technical Memorandum 1-- how projected changes in water usage will affect the way the District replaces and sizes water mains

- Eric Vaughan and Roger Kohne reviewed and explained drivers of water demand and technical considerations. As outlined in Technical Memorandum #1, current and projected future water demands are one of the important “building blocks” for the Water Main Replacement Study.

- Chris Castruita reviewed State-mandated policy and regulatory impacts to water demand, specifically those incorporated in California Assembly Bill 1668 and Senate Bill 606.

- Roger Kohne reviewed how the Water Demand Forecast will be used as part of the Project 2030 Water Main Replacement Study.

- CAC members identified questions about the Technical Memorandum #1 which were then answered by the District Staff and Consultants (please see Pages 5-6 of this Summary for questions and answers).
District Pipeline Asset Inventory Results-- *age of the water system, various pipe types, and where they’re located throughout the system*

Missy Pieri outlined the goal of the recently-completed Asset Inventory -- *to add key data to the District’s GIS water facility map* -- and the results of completing the Pipeline Inventory.

- All paper maps have now been digitized.
- 99% of the District’s pipe types and pipe age are now known and mapped (versus only 77% and 42%, known respectively prior to the Asset Inventory completion).
- The age and pipe type data will be used when prioritizing water main replacements in the Water Main Assessment/Risk Analysis step of Project 2030:
  - Generally replace older mains first, and
  - When comparing two pipes of the same year, pipe type may be a factor in determining which pipe is replaced first.

**Main Replacement Basics and Benchmarking-- *major benchmarks to evaluate various options***

Roger Kohne explained:
- The role of District Operations and Engineering staff in assessing and replacing water mains.
- The elements contributing to main replacement costs.
- Benchmarking:
  - Acts as a standard by which something can be measured or judged, and
  - Enables tracking performance indicators and shows whether goals are being met.
- Why Utilities benchmark:
  - Prioritize main replacement.
  - Improve operational efficiency.
  - Optimize future capital investments.
  - Make informed decisions.
- Benchmarking steps.
- Performance versus main replacement investments.
- Next steps.
CAC MEMBER QUESTIONS AND DISTRICT ANSWERS

Q1: Is there any possibility of the District’s service area expanding or decreasing, and what would be the impacts?

A1: There is the possibility of limited and very minor changes to the District’s service area, but any expected changes would be insignificant.

Q2: What kind of goals or limitations will be coming from the State for outside water usage? How will those be enforced?

A2: SB606/AB1668, which was passed in May 2018, provides a framework for the State Water Resources Control Board (SWRCB) to create water use regulations. The District is awaiting the details from the SWRCB on how they will implement those regulations. Customers can click here to view a fact sheet on the new water regulations, including frequently asked questions. The regulations will be enforced at the District-wide level, not on an individual basis.

Q3: What is the minimum or maximum allowed use of water? Is there a baseline?

A3: As noted in SB606/AB1668, there is maximum allowable indoor water use of 55 gallons of water per capita in 2022, going down incrementally to 50 gallons per capita in 2030. This regulation will be measured and enforced at the District level, and there is no requirement in the new laws that residents must meet a specific target or stop behavior like washing clothes and bathing.

Q4: If the District exceeds mandated water consumption, what are the penalties, and how will they be enforced?

A4: That has not yet been determined by the State Water Resources Control Board.

Q5: What is the relationships between line size, flow rates, and other factors in determining the size of the lines to replace?

A5: Flow rate and pipeline velocity will be used to help determine the size of water main replacements. In addition, the District is centrally located and has several interties with other neighboring water agencies which will assist in providing water to the District and the wider region for emergency purposes and other opportunities to collaborate for water management. Those interties may further optimize the sizing of water main replacements.
Q6: What time of year are you measuring water use?
A6: The data shown represents annual average water consumption, meaning it represents water use from throughout the year.

Q7: What is the level of confidence in the predicted demand forecast, since it varies 17% between low and high?
A7: The range in demand forecasts covers a reasonable level of change in demand over the next 30 years. It is based on an expectation that the state legislation passed in 2018 remains in effect through 2050, and on population increases used by planning agencies across the region.

Q8: Does the San Juan Water District have future or strategic goals that impact this water demand forecast?
A8: The District looked at the San Juan Water District Urban Water Management Plan for compatibility with this project, and found that our assumptions were consistent with their forecast and goals.

Q9: How can we collect and filter rain water to supplement water supplies?
A9: The District encourages homeowners to use water capture and efficiency practices that work best for their respective residences. However, rain water catchment is not considered a viable source of water supply for the region.

Q10: Can we get a water pipeline to get water from flood-prone to drought-stricken areas?
A10: This is a project that is beyond the scope District boundaries as it would need to be considered at a regional or statewide level.

Q11: Are all diameters of pipe compatible with trenchless technology?
A11: There are multiple trenchless technologies. The technologies that are going to be most relevant to the District would be more compatible with larger diameter pipelines.

Q12: Is a residential water re-use program possible?
A12: All of the regional waste water treatment plants that treat water to a level where it could be reused are a significant distance from the District service area. This makes it cost prohibitive to create such a program.

Q13: How does the District regulate water pressure?
A13: The majority of the District’s water pressure is not regulated. However, there are two zones with higher water pressure, and the District uses pressure regulating valves to reduce pressure to an acceptable level in those areas. The scope of this project includes an analysis of regulating water pressure throughout the District. The pressure regulation analysis includes a potential power generation component.

Q14: With the new State water usage regulations, how will the District differentiate between customers’ indoor and outdoor use?
A14: Neither the District nor the State currently have a way to differentiate between each customer’s indoor and outdoor use. The water usage regulations will be carried out at the District level.

Q15: How will the State regulations affect businesses, parks, and greenscapes? And, how will baselines be determined?
A15: The State Water Resources Control Board is currently developing standards for both business and outdoor water use. These will be based in part on the amount of landscape and hardscape that currently exist.

Q16: How will the elderly and physically challenged people handle the State mandates for water usage, both physically and regarding cost?
A16: This is a good question that the State must grapple with as it develops the regulations. The District and other water agencies throughout the state are using the regulatory process to communicate the concerns of the elderly and physically challenged, along with other water users, to the SWRCB.

Q17: What does the service fee on customers’ bills cover?
A17: Customers water bills are about 70% fixed charges and 30% variable charges based upon water use. The fixed charges cover the costs to run the District and maintain infrastructure regardless of the amount of water that is used.
Q18: Is it more expensive to replace Asbestos Cement Pipe (ACP) pipe?
A18: The District generally does not remove asbestos cement pipe, or any pipe material, from the ground. Therefore it is no more expensive to replace ACP pipe than any other pipe material.

Q19: Do you expect to come up with multiple benchmarks; for example, pipe age, pipe type, etc.?
A19: The District may make adjustments to a few benchmarks over time, rather than create many different benchmarks to keep record of. As industry trends continue, the District intends to revisit these benchmarks in order to judge performance.

Q20: What are the intervals to check against the benchmarks to know if we're headed in the right direction?
A20: A lot of the information is being collected in real time. The District would likely check these benchmarks on an annual basis, as we currently do with water loss. Over the long term, the District will look for trends in performance to compare with established benchmarks.

Q21: How does the District coordinate with other agencies for water main replacement?
A21: The District routinely checks with the City, County, and other regional agencies to coordinate water main projects and other infrastructure projects within and around our service area.

Q22: What does water loss per household mean?
A22: Water loss per household is based on an assumption of 1-4 people per residence. Calculated on a per capita basis, the water loss per household is approximately 1/4th of the water loss per residence.

Q23: Is there any financial gain to selling water to another District?
A23: Yes, there is financial gain to selling water to other agencies outside of the service area. Because of the unpredictable nature of these types of transactions, the District does not factor any projected revenue into its budget and long term financial model.
Q24: Are there any other utilities that have gone through a process like this that we can learn from, or are most districts behind CHWD?

A24: Yes, there are a number of utilities throughout the state who have gone through or are currently going through the process of asset management. We intend to use industry best practices in asset management. At the same time, we are implementing a very rigorous public engagement process that other agencies may wish to use in the future.

CAC PROCESS AND LOGISTICS OVERVIEW

The CAC reviewed the upcoming CAC meeting schedule (see meeting materials on the website for the schedule graphic). These after-dinner meetings and the high-level topics anticipated for each of the meetings are shown below.

<table>
<thead>
<tr>
<th>Meeting #3: December 11, 2018, 6:30-9:15 pm, Citrus Heights Community Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Replacement Findings and Costs</td>
</tr>
<tr>
<td>Funding Concepts Introduction</td>
</tr>
<tr>
<td>Selection of Main Replacement Options</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meeting #4: March 2019, 6:30-9:15 pm, Citrus Heights Community Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Replacement Funding Analysis</td>
</tr>
<tr>
<td>Market Research Primer</td>
</tr>
<tr>
<td>Selection of two Main Replacement and Funding Packages for market research</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meeting #5: May 2019, 6:30-9:15 pm, Citrus Heights Community Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Market Research Results</td>
</tr>
<tr>
<td>Develop Final Board Recommendation</td>
</tr>
<tr>
<td>Steps for Implementation Plan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Meeting #6: September 2019, 6:30-9:15 pm, Citrus Heights Community Center</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review Implementation</td>
</tr>
</tbody>
</table>
CAC MEMBER COMMENTS

1. I appreciate the information provided
2. This collaboration effort is very good and good to see
3. The more I’m starting to learn, the more I don’t know
4. It’s very impressive to see the amount of work being done; I commend all the staff
5. I appreciate the background information for us lay people
6. Thank you for all the information to help us understand
7. I’m learning a lot
8. Thank you for the outstanding job; I’m learning a lot that is very helpful to understand the issues
9. Very informative—thank you
10. The projector needs to work better so that the Power Point slides are more readable
11. A lot of staff work has gone into preparing for this meeting and Project 2030
12. Very impressed by the logic and sequence of the Project
13. Appreciate the welcoming of CAC members’ questions
14. I feel like a sponge tonight and hearing everyone’s questions and clear answers
15. The extensive preparation and effort is very noticeable and helpful
16. The asset inventory was a massive undertaking
17. This is an important process
18. Appreciate everyone’s thoughtful questions

PUBLIC COMMENTS

None

CLOSE

CAC Chair Jenna Moser thanked the CAC members and District staff and consultants for their participation and adjourned the meeting at 9:15 p.m.

APPROVED:

______________________________  _______________________________
CHRISTOPHER CASTRUITA        JENNA MOSER, Chair
Deputy Secretary               Customer Advisory Committee
Citrus Heights Water District  Citrus Heights Water District
CITRUS HEIGHTS WATER DISTRICT

DISTRICT STAFF REPORT TO
CUSTOMER ADVISORY COMMITTEE OF CITRUS HEIGHTS WATER DISTRICT
DECEMBER 11, 2018 REGULAR MEETING

SUBJECT: BRIEFING ON INFRASTRUCTURE CHALLENGES AND WATER MAIN ASSESSMENT
STATUS: Action Item
REPORT DATE: December 4, 2018
PREPARED BY: Missy Pieri, Engineering Manager/District Engineer

OBJECTIVE:
1. Discuss and provide feedback on Technical Memorandum No. 2: Infrastructure Challenges.
2. Discuss and provide feedback on Technical Memorandum No. 3: Main Replacement Findings and Costs.

BACKGROUND AND ANALYSIS:
At the October 18, 2017 Board Meeting, the Citrus Heights Water District (CHWD) Board of Directors approved the Professional Services Agreement with Harris & Associates for the Project 2030 Water Main Replacement Study (Study).

The building blocks of the Study include:

- Asset Inventory
- Water Demand Forecast
- Water Main Replacement and Costs
- Water Main Replacement Phasing Plan
- Funding Strategy/Rate Options Analysis
- Implementation Plan
- Market Research on the final 2 options.

At Customer Advisory Committee meeting #2, held on August 28, 2018, the Project Team provided a briefing on the Water Demand Forecast, summarized in Technical Memorandum No. 1: Water Demand Forecast. This memo considers key assumptions such as population change, land development, legislative/regulatory mandates and other factors that could impact future District-wide water usage. The water demands will be used to determine future water main sizes that are proposed to be replaced and will assist in the prioritization of water main replacements.

At the Customer Advisory Committee meeting #3, to be held on December 11, 2018, Technical Memorandum No. 2: Infrastructure Challenges (Technical Memo No. 2) and Technical Memorandum No. 3: Water Main Assessment (Technical Memo No. 3) will be presented.

Technical Memo No. 2 identifies the infrastructure challenges, water supply challenges, and regulatory challenges that will likely impact the replacement of water mains beginning in 2030 and beyond.
Technical Memo No. 3 summarizes the key assumptions and methodology used to create the water main assessment and replacement cost estimates. This information will serve as the foundation for developing water main replacement phasing options and associated funding strategies.

At the December 11 meeting, staff will request feedback on Technical Memo No. 2 and 3. The input will be used by staff and, where agreed, will be incorporated into the final version of Technical Memo No. 2 and 3.

RECOMMENDATION:
Provide input and feedback to be included in the Project 2030 Study Technical Memorandum No. 2: Infrastructure Challenges and Technical Memorandum No. 3: Water Main Assessment.

ATTACHMENTS:
Technical Memorandum No. 2: Infrastructure Challenges
Technical Memorandum No. 3: Water Main Assessment
ATTACHMENT 1

Technical Memorandum No. 2
Infrastructure Challenges
Table of Contents

Acronyms and Abbreviations ........................................................................................................ ii
Section 1  Introduction and Purpose .............................................................................................. 1
Section 2  Infrastructure Challenges............................................................................................ 2
  2.1  AWWA’s Methodology ......................................................................................................... 2
  2.2  AWWA’s Key Findings ......................................................................................................... 3
  2.3  Approach to Water Main Replacement Planning ............................................................... 4
Section 3  Water Supply Challenges .............................................................................................. 5
Section 4  Regulatory Challenges ................................................................................................ 7
Section 5  Conclusions and Next Steps ........................................................................................ 8
  5.1  Infrastructure Challenges ..................................................................................................... 8
  5.2  Water Supply Challenges ...................................................................................................... 8
  5.3  Regulatory Challenges .......................................................................................................... 8
Section 6  References .................................................................................................................... 9
### Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AB</td>
<td>Assembly Bill</td>
</tr>
<tr>
<td>ASCE</td>
<td>American Society of Civil Engineers</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society of Testing and Materials</td>
</tr>
<tr>
<td>AWWA</td>
<td>American Water Works Association</td>
</tr>
<tr>
<td>District</td>
<td>Citrus Heights Water District</td>
</tr>
<tr>
<td>RWA</td>
<td>Regional Water Authority</td>
</tr>
<tr>
<td>SB</td>
<td>Senate Bill</td>
</tr>
<tr>
<td>SGA</td>
<td>Sacramento Groundwater Authority</td>
</tr>
<tr>
<td>SJWD</td>
<td>San Juan Water District</td>
</tr>
<tr>
<td>SWRCB</td>
<td>State Water Resources Control Board</td>
</tr>
<tr>
<td>UWMP</td>
<td>Urban Water Management Plan</td>
</tr>
<tr>
<td>WUC</td>
<td>Water Utility Council</td>
</tr>
</tbody>
</table>
Section 1  Introduction and Purpose

Renewal and replacement of infrastructure, funding of improvements, and public understanding of the value of water are the most important issues to water system managers. The Citrus Heights Water District (CHWD or District) is currently using a 30-year Capital Improvement Plan that was developed in 1998 as a key planning tool in determining annual capital improvement projects, which includes water main replacement. As the above Plan is nearing the end of its term, the District is undertaking a process to review and refine its long term water main replacement program, which the District titled Project 2030 - Water Main Replacement Study. Key elements of this Study include: 1) Asset Inventory and Project Polygon Development, 2) Water Demand Forecast, 3) Water Main Assessment, 4) Water Main Replacement Phasing Options and Preferred Option, 5) Project Cost Estimates, 6) Funding Strategy, including Water Rate Options and Debt Service Options, and 7) Implementation Plan.

The purpose of this Technical Memorandum is to:

- Identify infrastructure challenges, water supply challenges and regulatory challenges for the District and the surrounding areas.

- Provide a high-level overview into these areas providing some context as to why water main replacement is complex and requires consistent capital investment to safeguard its reliability.
Section 2  Infrastructure Challenges

There are a number of scientific and educational water associations that exist to provide various tools to the international water community for improving water quality and supply. One such organization is the American Water Works Association (AWWA). AWWA focuses on advancing water resources engineering research, policy, standards, and best practices. In 2012, AWWA published its findings on the state of the country’s water infrastructure in a landmark report called *Buried No Longer: Confronting America’s Water Infrastructure Challenges (Report)* (WUC, 2012). The report begins:

A new kind of challenge is emerging in the United States, one that for many years was largely buried in our national consciousness. Now it can be buried no longer. Much of our drinking water infrastructure, the more than one million miles of pipes beneath our streets, is nearing the end of its useful life and approaching the age at which it needs to be replaced.

The report goes on to describe the state of water infrastructure integrity throughout the country on a region-by-region basis examining the impacts of population, technological advancements in materials, diminishing water supplies, and an evolving regulatory environment. Key takeaways from the report include application of a consistent analytical methodology and a set of key findings to assist local governments in facing infrastructure replacement challenges.

2.1  AWWA’s Methodology

To gain an understanding of infrastructure challenges on a national level, AWWA applied the following methodology:

- Understanding the timing of water system development in the United States.
- Understanding the various materials from which pipes were made, and where and when the pipes of each material were likely to have been installed in various sizes.
- Understanding the life expectancy of the various types and sizes of pipe in actual operating environments.
- Understanding the replacement costs for each type and size of pipe.
- Developing a probability distribution for the “wear-out” of each type and size of pipe grouping.
2.2 AWWA’s Key Findings

As identified in the AWWA Report, review of the nation’s water infrastructure yielded several key findings. These are discussed below from the perspective of the District.

- **AWWA Key Finding #1: The Needs Are Large**

  Pipelines are the single largest set of assets the District owns. Maintaining and replacing pipelines is necessary for the reliable high quality service that ratepayers demand. The District has a responsibility to balance repair costs with replacement costs to make sure funds are used most effectively.

- **AWWA Key Finding #2: Household Water Bills Will Go Up**

  Annual water main replacement costs are expected to rise. As large historical expansions of pipelines in the District’s history reach the end of their expected service life, the District will enter into a phase of more intensive replacement. This phase will persist for decades and for practical purposes, a more robust water main replacement program will be necessary.

- **AWWA Key Finding #3: There Are Important Regional Differences**

  In comparison to other regions in the country, the West is characterized by continuous growth and relatively recently constructed infrastructure. Even though the District is approaching build-out (i.e. there is very little undeveloped land remaining within the District’s service area), neighboring cities and agencies are expanding which puts pressure on regional sources of supply. Older cities in the rest of the countries are already experiencing a crisis surrounding infrastructure replacement, while the District still has time to prepare.

- **AWWA Key Finding #4: There Are Important Differences Based on System Size**

  By AWWA’s methodology, the District is considered a large system (i.e. serving a population greater than 50,000). Large systems, which typically have higher population densities, tend to require fewer miles of pipe and facilities per person than smaller systems, and costs can be spread over a larger population base.

- **AWWA Key Finding #5: The Costs Keep Coming**

  A more robust long-term water main replacement program is expected. Growing systems typically have revenue from water sales and from development to pay for infrastructure improvements. However, growth in the District is slowing and the system continues to
As a result, funding for capital projects (i.e. water main replacement) must receive increased support from water sales.

- **AWWA Key Finding #6: Postponing Investment Only Makes the Problem Worse**

Postponing investment has two negative impacts: the annual budget for capital replacement projects will increase and more pipes will fail threatening public health and safety. The District understands this concern and this is one of the primary drivers for the Project 2030 Study.

### 2.3 Approach to Water Main Replacement Planning

An adaptation of AWWA’s approach to planning for the replacement of the specific inventory of the District’s assets is at the heart of Project 2030 Water Main Replacement Study.

The concept is to predict the timeframe that each pipe will become a liability to the District and schedule its replacement in a way that minimizes risk, consequences of failures, and rate impacts to customers. To assist with this planning process, the following information has been collected on every pipe in the District’s distribution system and assembled into a geographic information system (GIS):

- **Useful Life Remaining** – This is the average service life of a pipe minus its years in service.

- **Location of Critical Facilities** – A critical facility is one whose continued water service is essential for public health and safety.

- **Vulnerable Locations** – Pipes that are located in areas where the environment may cause them to deteriorate faster than normal or where they may be more difficult to repair.

- **High Traffic Intersections** – Crossings of streets that have a high volume of vehicular traffic.

Using database analysis, the above information and other criteria, will be used to generate a recommended pipe replacement priority list. This information will be presented in greater detail in Technical Memorandum 3 and further analyzed in the Implementation Plan.
Section 3  Water Supply Challenges

Water supply challenges are expected in high population growth areas. Water utility managers typically use multi-decade planning horizons for evaluating water supply options. The District collaborates with key organizations such as the Regional Water Authority (RWA) whose mission is “…protecting and enhancing the reliability, availability, affordability and quality of water resources.” Their mission aligns closely with the three principle aspects of effective water supply management which are ensuring availability, reliability, and sustainability.

- **Availability** refers to securing water rights and contracts for water supply service.

  As its primary source of supply, the District purchases surface water from the San Juan Water District (SJWD). SJWD obtains its surface water through a combination of rights and contracts. All of the surface water supplies are withdrawn from Folsom Reservoir.

  As its secondary source of supply, the District owns and operates six high capacity production wells to pump and provide groundwater to its customers. The District is a member of the Sacramento Groundwater Authority (SGA), which manages local groundwater production on behalf of the District and the other member agencies.

  Maintaining strong relations with these entities promotes long-term water supply availability.

- **Reliability** refers to the capacity and operations of systems to produce and convey water supply as needed for normal operations as well as under emergency conditions.

  The District has two connections with SJWD to receive treated surface water. Two wholesale connections means there is redundancy built into this primary source of supply.

  In addition to its six groundwater production wells, the District maintains multiple system connections with neighboring water districts for enhanced reliability during events such as emergencies or droughts. By having multiple water sources and an active and on-going maintenance program, combined with a well networked and looped system, long-term water system reliability is achievable.

- **Sustainability** refers to meeting the needs of existing customers without compromising the ability of future generations to meet future customers’ needs.

  The District works cooperatively with SJWD, RWA, and SGA on sustainability of local and imported water resources. In addition to focusing on the sustainability of its water supply, the District is also preparing to meet any future water demand requirements through its water efficiency program.
An example of regional efforts regarding sustainability is a regional water supply project currently in the planning stages called the RiverArc Project (https://riverarcproject.com/). The project proposes to develop surface water from the Sacramento River as a new source. The District will be an indirect beneficiary of the project as the increase and diversification of supply will improve sustainability for the entire region.

Cooperative water supply management and greater water use efficiency promotes long-term sustainability.
Section 4  Regulatory Challenges

Regulatory agencies develop policy and standards for a wide variety of water-related topics including health and safety, environmental protection, emergency preparedness, and water conservation. Satisfying current regulatory requirements is built into the District’s systems and operations. However, it is prudent to be aware of pending regulations and the challenges the District may face once new regulations are adopted and new requirements are issued. Water conservation, also known as water use efficiency, is a regulatory topic that is currently being revised at the State level and will likely require the District to implement additional measures to ensure regulatory compliance.

As a matter of State policy, water use efficiency began in earnest with the Water Conservation Act of 2009. Governor Schwarzenegger set the ambitious goal of achieving a 20% reduction in per capita water use between 2010 and 2020 on a statewide basis through water conservation and the use of recycled water for irrigation and other non-potable water applications. At the time, the State anticipated achieving and maintaining this level of water use efficiency for 2020 and beyond.

However, the State has now passed new legislation to pick up where the Water Conservation Act of 2009 left off. Per the State Water Resources Control Board (SWRCB; June 7, 2018), SB 606 and AB 1668 emphasize efficiency and stretching existing water supplies. According to SWRCB, efficient water use is the most cost-effective way to achieve long-term conservation goals, as well as to provide the water supply reliability needed to adapt to the longer and more intense droughts climate change is causing in California.

As of this writing, the State is in the process of creating water use efficiency policy based on SB 606 and AB 1668. Until policy is adopted, the specific ramifications of these new laws is not known. In the event the District’s water use and efficiency programs do not meet the new objectives, additional water efficiency programs and projects as needed to achieve the objectives will be required.
Section 5    Conclusions and Next Steps

The District faces challenges at the local level in terms of maintaining infrastructure. It faces challenges at the regional level in terms of maintaining access to water supply. And it faces challenges in achieving regulatory compliance with State requirements. Below is a summary of how the District is addressing these challenges.

5.1    Infrastructure Challenges

The District is aware of the upcoming challenges concerning water main replacement. Project 2030 was devised to analyze these challenges and to prepare a roadmap to help navigate its complexities.

For many years, the District has enjoyed the long service life of pipelines associated with past system expansion. By 2030, the service life for a large group of pipelines in the District’s distribution system will expire. Strategic investment and a proactive approach to water main replacement is required.

The District will continue to research this topic and prepare reasonable, equitable and responsible approaches to resolving critical issues as they arise.

5.2    Water Supply Challenges

Effective management of water supply challenges is complex and, therefore, can be costly. Redundancy and supply diversification have enormous benefits to the District and its customers but require investment in infrastructure, reliable equipment and skilled operations personnel. Water efficiency extends the effectiveness of supply management by reducing stress on the sources of supply but requires implementation of a comprehensive water efficiency program and the cooperation of end users. Continued investment in, and maintenance of, water supply infrastructure and programs are the best way to ensure the highest level of availability, reliability and sustainability.

5.3    Regulatory Challenges

The State endeavors to be open and informative regarding legislative initiatives concerning water resources and associated changes to the regulatory environment. The District stays abreast of impending statutes and regulations in order to anticipate whether and in what way the District may need to adapt to change and to continue to assure compliance.
Section 6  References


State Water Resources Control Board. (June 7, 2018). *Fact Sheet: Water Efficiency Legislation will Make California More Resilient to Impacts of Future Droughts.*
ATTACHMENT 2

Technical Memorandum No. 3
Water Main Assessment
# Table of Contents

Section 1  Purpose .................................................................................................................... 1

Section 2  Background .............................................................................................................. 2

Section 3  Existing System Description .................................................................................. 3

Section 4  Water Main Assessment .......................................................................................... 4
  4.1 Methodology .................................................................................................................. 4
  4.1.1 Software .................................................................................................................... 5
  4.2 Likelihood of Failure (LOF) ............................................................................................ 6
    4.2.1 LOF Factor 1 – Pipe Age/Remaining Useful Life/Survival Probability ............... 7
    4.2.2 LOF Factor 2 - Pipe Material: Characteristics and Performance ...................... 8
    4.2.3 LOF Factor 3 - Pipeline Vulnerability ..................................................................... 9
    4.2.4 LOF Factor 4 - Historical Water Main Breaks ..................................................... 11
  4.3 Consequence of Failure (COF) ....................................................................................... 13
    4.3.1 COF Factor 1 - Pipe Diameter .............................................................................. 13
    4.3.2 COF Factor 2 - Pipe Flow ...................................................................................... 15
    4.3.3 COF Factor 3 - Transmission Pipelines ............................................................... 16
    4.3.4 COF Factor 4 - Critical Facilities .......................................................................... 17
    4.3.5 COF Factor 5 - Creek Crossings (Environmental) .................................................. 19
    4.3.6 COF Factor 6 - High Traffic Areas ....................................................................... 20
    4.3.7 COF Factor 7 - Difficult Access Areas (Backyard Mains) ..................................... 22
  4.4 LOF and COF Weighting Factors .................................................................................... 24
  4.5 Initial Findings .................................................................................................................. 24

Section 5  Replacement Cost Estimates .................................................................................... 25
  5.1 Construction Costs .......................................................................................................... 25
  5.2 Other Project Costs ......................................................................................................... 26
  5.3 Pipe Rehabilitation .......................................................................................................... 26
  5.4 Trenchless Pipe Replacement ....................................................................................... 26
  5.5 Unit Costs ....................................................................................................................... 27
  5.6 System Replacement Costs ............................................................................................. 28

Section 6  Technical Memo Next Steps .................................................................................... 29

Planned Additional Sections:
  Phasing Plan
  Financial Plan
  Conclusions
  Next Steps
  Appendix
Figures

Figure 3-1. Project 2030 Water Main Replacement Study
Figure 3.2. InfoMaster Risk Assessment Set-Up Screen for 2030
Figure 3-3. Overall Risk Matrix Setup
Figure 3-4. Creek Crossing Locations
Figure 3-5. Locations for Historical Main Breaks 2004-2018
Figure 3-6. Transmission Pipelines
Figure 3-7. Critical Customers
Figure 3-8. High Traffic Areas
Figure 3-9. Difficult Access Areas (Backyard Mains)

Tables

Table 3-1. Risk Likelihood Scoring for Pipeline Survival Probability in 2030
Table 3-2. Risk Likelihood Scoring for Pipe Material
Table 3-3. Risk Likelihood Scoring for Pipeline Vulnerability
Table 3-4. Risk Likelihood Scoring for Historical Main Breaks
Table 3-5. Risk Consequence Scoring for Pipe Diameter
Table 3-6. Risk Consequence Scoring for Pipe Flow
Table 3-7. Risk Consequence Scoring for Transmission Pipelines
Table 3-8. Risk Consequence Scoring for Critical Customers
Table 3-9. Risk Consequence Scoring for Creek Crossings
Table 3-10. Risk Consequence Scoring for High Traffic Areas
Table 3-11. LOF and COF Weighting Factors
Table 3-12. Unit Cost
Table 3-13. Replacement Costs
**Section 1  Purpose**

Renewal and replacement of infrastructure, funding of improvements and public understanding of the value of water are key issues to water system managers. The Citrus Heights Water District (CHWD or District) is currently using a 30-year Capital Improvement Plan (Plan) that was developed in 1998 as a key planning tool in determining annual capital improvement projects, which includes water main replacement. As the above Plan is nearing the end of its term, the District is undertaking a process to review and refine its long term water main replacement program, which the District titled Project 2030 - Water Main Replacement Study (Study). Key elements of this Study include: 1) Asset Inventory and Project Polygon Development, 2) Water Demand Forecast, 3) Water Main Assessment, 4) Water Main Replacement Phasing Options and Preferred Option, 5) Project Cost Estimates, 6) Funding Strategy, including Water Rate Options and Debt Service Options, and 7) Implementation Plan (see Figure 3-1).

![Figure 3-1. Project 2030 Water Main Replacement Study](image)

This Memorandum summarizes the key assumptions and methodology used to create the main assessment and replacement cost estimates (Items 3 and 5 above). This information will serve as the foundation for developing water main replacement phasing options (Item 4 above) and associated funding strategies (Item 6 above).
Section 2  Background

The Citrus Heights Water District is located in the northeast portion of Sacramento County and south Placer County, California, approximately 15 miles northeast of downtown Sacramento. The District was formed on October 25, 1920 under Division 11, the Irrigation District Act of the State of California Water Code. A three-member Board of Directors is elected at large from divisions within the District and governs the District.

CHWD provides water service to portions of the cities of Citrus Heights and Roseville, and portions of the unincorporated communities of Orangevale, Fair Oaks, Carmichael and a portion of unincorporated Placer County. The District initially used American River surface water supply from the North Fork Ditch Company to serve its customers. The customer base was initially comprised of small family farms and limited urban areas. Concurrently with the completion of Folsom Dam in 1956, the San Juan (Suburban) Water District (SJWD) was formed and acquired the facilities and water rights of the North Fork Ditch Company. SJWD has also contracted for additional water from the United States Bureau of Reclamation (USBR) and Placer County Water Agency (PCWA). Citrus Heights Water District now receives surface water from the American River through the San Juan Water District. Along with CHWD, SJWD provides treated surface water to Fair Oaks Water District, Orange Vale Water Company, portions of the City of Folsom, and SJWD’s own retail service area. These agencies are collectively referred to as the SJWD Family of Agencies or wholesale customer agencies (WCAs). SJWD also provides treated surface water to Sacramento Suburban Water District and the City of Roseville. CHWD continues to supplement its surface water supply with groundwater for readiness-to-serve purposes and to meet peaking, pressure, shortage, and emergency demands.

In the early years of the District, residential and agricultural growth were nominal. Since then, urban development has flourished to such a degree that presently there is no significant agricultural water use within the District. The District is nearly built-out and now serves a predominantly residential customer base.

It is important to note that the majority of urban development within the District’s service territory occurred between 1960 and 1985. Water mains were installed by private developers and inspected by District staff. These water mains became donated assets to the District, and it became CHWD’s responsibility to operate, maintain, and plan for the replacement of these facilities. As the District looks ahead, a “tidal wave” of water main replacements may be needed beginning in the year 2030 and carrying several years forward, as the water mains installed in the 1960’s reach 70 years old.
Section 3  Existing System Description

The District has approximately 250 miles of distribution and transmission water mains ranging in size from 4” to 42” with pipe material consisting of asbestos cement, polyvinyl chloride, mortar lined steel, cast/ductile iron, and coal tar wrapped/coated steel. Distribution mains are pipes that are 12-inch and smaller in diameter; whereas transmission mains are classified as pipes 14-inch and larger in diameter. The majority of the District’s water mains are distribution mains and are 6-inch and 8-inch in diameter. The larger water mains or transmission mains make up a small percentage of the District’s water mains, but convey the majority of the water from its source (Folsom Lake) and distribute it throughout the service area. These transmission mains are considered the backbone of the water system.

The District has a wide range of pipe material as stated above; however, the majority of the smaller pipelines or distribution mains are asbestos cement. The larger transmission pipes generally consist of mortar lined and coated steel and ductile iron.

The District receives surface water from Folsom Lake via gravity thru a District owned 42-inch water transmission main as well as the 72” Cooperative Transmission Pipeline. The gravity fed system provides adequate pressure to serve all its customers within the service area. However, there are two areas where pressures exceed normal operating levels and the pressure in these zones are controlled by pressure reducing valves.

It is important to note that the 42-inch, 30-inch and some of the 24-inch transmission mains were in place prior to any significant planned development. As subdivisions and properties were developed, the location of the transmission mains were then positioned within side-yards, back-yards, and in some cases, through the middle of properties. The initial installation of the water distribution mains were generally installed behind the back of the sidewalk, but as the District replaces these facilities, the new water mains have been installed within the road right-of-way to minimize the impact to property owners. The District has easements for a majority of the water mains that are outside the County or City right-of-way. The easements grant the District legal right to operate and maintain its system; even though the utilities are within private property.
Section 4  Water Main Assessment

This section describes the methodology used to develop the water main risk assessment, the type and evaluation of various risk factors and consequences, and initial overall risk profile for CHWD’s water distribution system. This information will serve as the foundation for developing water main replacement phasing and associated financial strategies.

4.1 Methodology

The assessment of risk to CHWD regarding its underground pipeline assets and infrastructure uses a conventional practice of considering factors that contribute to the likelihood of failure (LOF) and consequence of failure (COF) of any given pipeline segment. As the terms suggest, Likelihood of Failure identifies the various factors that contribute to the possibility that a pipe will experience a failure, while Consequence of Failure identifies the various potential impacts of such a failure. The risk assessment considers “failure” to be the inability to utilize the asset (e.g. pipeline) for its intended purpose of conveying water to CHWD customers, for both short-term and long-term periods of time. Furthermore, a pipe failure is considered repairable so the pipe can ultimately be returned to service.

Once the factors for both LOF and COF are determined, a scoring system is developed for each category. To help standardize the scoring of LOF and COF factors, all scoring was based on a 0 to 10 scale, with 10 reflecting the highest likelihood or consequence of failure, 1 reflecting a negligible impact, and zero suggesting no risk in that particular factor. In the following sections of the report, the description and definition for each LOF and COF factor are presented.

After the individual LOF and COF scores have been determined, the scores for each factor are combined to create a total risk score. The combination of LOF and COF factors into a single risk score has been used in various ways by utilities, including the East Bay Municipal Utility District (EBMUD). The conventional and accepted method of calculating a total risk score has been to add up all of the individual LOF factors into a single LOF score, do the same with the COF factors, and to multiply the two scores into a single risk score. The equation for this is:

\[
\text{Total Risk Score} = (\%_{LOF_1} \times \text{LOF}_1 + \%_{LOF_2} \times \text{LOF}_2 + \ldots) \times (\%_{COF_1} \times \text{COF}_1 + \%_{COF_2} \times \text{COF}_2 + \ldots)
\]

The % LOF and % COF values in the equation that are multiplied with each of the individual LOF and COF factors are weighting factors that are used to further define the relative importance of these factors. The values of these weighting factors were developed by the project team and reflect the District’s unique water system and are presented in Section 4-4.
To further standardize the scoring, the $\%_{\text{LOF}}$ and $\%_{\text{COF}}$ weighting factors add up to 100% for both the LOF and COF factors:

$$\%_{\text{LOF}_1} + \%_{\text{LOF}_2} + \ldots = 100\%$$
$$\%_{\text{COF}_1} + \%_{\text{COF}_2} + \ldots = 100\%$$

This illustrates the relative importance of the various factors to one another in developing the overall risk calculations.

4.1.1 Software

For this analysis, CHWD used the InfoMaster software package developed by Innovyze. InfoMaster interfaces directly with CHWD’s own records and documentation, including its ArcGIS and Cityworks computer maintenance and work order systems, by accessing asset information for all of CHWD’s pipes. These records were recently updated by CHWD and the project team and presented to the CAC in Workshop #2.

In order to develop a risk profile, the software user selects the desired COF and LOF factors (checked boxes) in the Risk Assessment set-up screen as shown in Figure 3-2.

![Figure 3.2. InfoMaster Risk Assessment Set-Up Screen for 2030](image_url)
InfoMaster takes these records and, along with staff input on the various LOF and COF factors, calculates a risk score for all pipeline segments in the CHWD service area (nearly 14,000 segments equaling approximately 250 miles). These risk scores are then arranged in a matrix to form an overall risk profile as shown in Figure 3-3 below. The profile is developed using a 0-5 scale defined as:

5 = “Extreme” Risk (High LOF and High COF)
4 = “High” Risk (Medium-to-High LOF and COF)
3 = “Medium” Risk (Medium LOF and COF / Medium-to-High LOF with low COF / Low LOF with Medium-to-High COF)
2 = “Low” Risk (Low-to-Medium LOF and COF)
1 = “Negligible” Risk (Low LOF and COF)

![Figure 3-3. Overall Risk Matrix Setup](image)

The risk profile or water main prioritization list developed for CHWD will be presented in a future technical memorandum as the list is being further refined.

### 4.2 Likelihood of Failure (LOF)

As the name implies, LOF considers the primary risk factors that contribute to the likelihood that a pipeline will experience a failure leading to disruption of service to some CHWD customers. The four factors that were used to predict an increased risk relative to similar pipelines in CHWD’s distribution system are 1) Pipe Age/Remaining Useful Life/Survival Probability;
2) Pipe Material; 3) Pipeline Vulnerability; and 4) Historical Water Main Breaks. These four LOF factors will be further discussed below.

4.2.1 LOF Factor 1 – Pipe Age/Remaining Useful Life/Survival Probability

It is often easiest to consider the age of the pipeline assets in determining when they should be replaced. This would simply look at the year each pipeline was installed and then assume how many years that pipe should last. However, the more conventional method is to calculate the remaining useful life of the pipe that accounts not only for when the pipe was installed but also uses industry-based experience on pipeline life expectancy, deterioration, and statistical survivability over time. Where available, specific data by the utility can be incorporated in this modeling; however, like many utilities, CHWD currently has limited pipeline data due to the nature of how the system was originally built-out. As part of the final Implementation Plan for this project, CHWD will collect additional pipeline condition assessment data to further refine this analysis in the future.

Table 3-1 shows the model output for the values (“Breaker” as identified by InfoMaster software setup) and ranges in calculated pipeline Survival Probability, which is defined as “the likelihood that the average pipe in a given cohort has not experienced a failure in a given year”. It is important to note that such a pipeline failure is considered repairable and does not suggest that the entire pipeline segment cannot be used following such a repair.

**Table 3-1. Risk Likelihood Scoring for Pipeline Survival Probability in 2030**
In 2030, the model suggests that slightly more than 10 miles of pipeline would be considered to have a survival probability of less than 25 percent, approximately 150 miles has a survival probability between 25 and 50 percent, and over 100 miles has a survival probability greater than 50 percent. Over time these values change, with an increasing number of miles of pipeline moving into the ranges of less than 25 and 25-50 percent survival probability, and a subsequent decrease of pipelines with a survival probability of greater than 50 percent. This will be discussed further in Section 4.4.

4.2.2 LOF Factor 2 - Pipe Material: Characteristics and Performance

This factor considers that different pipeline materials have different risk elements that contribute to varying likelihood of failure. As presented in an earlier section of this report, asbestos cement pipe (ACP) is the material that was most commonly used during the rapid growth and development period in CHWD in the 1960s and 1970s. ACP was commonly used by many utilities in the United States, primarily in the Southwest.

The scoring system used for the various pipeline materials is presented in Table 3-2. The lowest scores (lowest risk) were given to ductile iron pipe (“Breaker” = DIP) and polyvinyl chloride pipe (“Breaker” = PVC), both of which have become the current standard for water utilities around the country, including CHWD, and are noted for its long life and low failure rates. Some of CHWD’s older and larger diameter transmission (backbone) pipelines are steel with an interior cement mortar lining (“Breaker” = CML) and were given a relatively low risk score of 3. While CHWD’s experience with asbestos cement pipe (“Breaker” = ACP) has not been as troublesome as other utilities, CHWD nevertheless acknowledges the failure risks associated with ACP in assigning it a moderate score of 6. These materials constitute the vast majority of CHWD’s pipelines. Other materials, generally older and no longer used for new construction, were given higher risk scores.
4.2.3 LOF Factor 3 - Pipeline Vulnerability

Unlike above-ground equipment and infrastructure that can potentially be vulnerable to a number of risk factors, such as accidents, vandalism, terrorism, or natural disasters, underground utilities are inherently better protected from external risks. Some places, particularly in high seismic risk regions such as the San Francisco Bay Area and Los Angeles, have varying degrees of underground risk due to proximity to seismic faults, but in the Sacramento region such risks are generally low and uniform.

CHWD has 17 locations throughout its system, presented in Figure 3-4, where pipelines cross a creek and/or are attached to bridges at those crossings, and are therefore considered to be at greater risk of damage or failure. Several of these pipes, including the largest transmission pipelines in CHWD’s system, are older and were constructed in what is now considered a floodplain. These pipelines are vulnerable to either storm debris that could get trapped or entangled with the pipe when it is in contact with flood waters, or whose ground supports could be damaged due to repeated erosion.
The scoring system used for pipeline vulnerability is presented in Table 3-3. Pipeline segments (24 total for the 17 locations) that currently are designated as a creek crossing were given a score of 10 (“Breaker” = True), constituting the highest risk score for this category. All buried pipeline assets in the CHWD system were given an LOF score of zero (“Breaker” = False) for this factor.

In recent years, CHWD has replaced several small and medium-sized pipeline segments at creek crossing locations by raising them out of the flood plain and attaching them to adjacent roadway bridges. These locations were given lower risk scores, though they remain vulnerable to damage due to automobile accidents, vandalism, or even terrorism. These will be assigned an intermediate score in the updated risk calculations.
As will be discussed in Section 4.3, pipelines that cross a waterway are also assigned a consequence of failure score due to potential environmental impacts resulting from a pipe failure.

4.2.4 **LOF Factor 4 - Historical Water Main Breaks**

CHWD provided historical water main break data based upon repair orders (work orders) that had been logged in Cityworks by CHWD staff from 2004 to 2018. These break data were geocoded into ArcGIS from Cityworks which provided high accuracy for leak/break locations, as shown on Figure 3-5. The number of leaks/breaks can be quantified as approximately a dozen per year. Analysis of the leaks/breaks indicates that most (75 percent) reside on service lines to customers and not on the distribution system pipes.
InfoMaster was used to associate the leaks/breaks with the closest distribution pipe. This provides a worst-case scenario analysis of the distribution network based upon the limited leaks/breaks in the system. Pipe segments with recorded leaks/breaks were assigned a score of 10 ("Breaker" = True) while the rest of the system received a score of 0 ("Breaker" = False).
4.3 Consequence of Failure (COF)

The COF factors described below reflect the potential impact of a failure of any individual pipe segment. The District considered the following seven COF factors: 1) Pipe Diameter; 2) Pipe Flow; 3) Transmission Pipelines; 4) Critical Facilities; 5) Creek Crossings; 6) High Traffic Areas and; 7) Difficult Access Areas, which are discussed in further detail below.

While the analysis does not directly consider or measure the likely duration of the pipeline failure and subsequent repair or replacement, several COF factors indirectly take duration of the failure or outage (e.g. difficulty to access, location in high traffic areas) into account.

4.3.1 COF Factor 1 - Pipe Diameter

A significant consequence of a pipeline failure is tied to the amount of water that any individual segment conveys. There are several ways to assess this, including the amount of water that typically flows through each pipe (this is described in the next section), as well as the actual size (diameter) of the pipeline. Pipe flow and diameter were each scored as separate factors since it is
the case that some larger pipelines currently do not convey as much water as they were originally
designed for (the inverse is also true, namely that some smaller pipes are carrying more water, at
a greater velocity, than originally intended). Many of these instances can be attributed to changes
in customer demand patterns (e.g. increased conservation and efficiency, please refer to
Technical Memorandum No. 1), newer above-ground infrastructure (groundwater wells, pump
stations, and storage tanks), and changes in the way CHWD operates the overall water
distribution system. For that reason, consequence of failure was scored based both pipe size and
flow.

The scoring system used for different pipe diameter sizes ("Breaker") is shown in Table 3-5.
This table also shows the number of pipeline segments and total lengths for each size in
CHWD’s service area.

**Table 3-5. Risk Consequence Scoring for Pipe Diameter**
4.3.2 COF Factor 2 - Pipe Flow

As described above, the flow of water through any given pipe, and the loss of that capacity in the event of a pipe failure, was scored as shown in Table 3-6:

**Table 3-6. Risk Consequence Scoring for Pipe Flow**

| Consequence of Failure Wizard (Pressurized Main - "COF2") |

The flow values (“Breaker”, expressed in gallons per minute) that served as the basis for the scoring were based on Maximum (or Peak) Day Conditions, which represent the highest average flow experienced over a 24 hour period. Flow data from 2013 in CHWD’s hydraulic model analysis done by West Yost Associates, were used for this scoring. Technical Memorandum 2 – Water Demand Analysis, developed several future demand forecasts and concluded that water demand will likely remain fairly consistent over the next several decades as population growth and increased customer demand will be offset by continued water efficiency gains and regulatory restrictions.
4.3.3 COF Factor 3 - Transmission Pipelines

Like many utilities, CHWD’s water distribution system is comprised of both smaller distribution pipes that convey water to individual homes and neighborhoods, and larger transmission pipelines that bring water from the various sources (e.g. San Juan Water District) and help transport it throughout the entire service area. The latter, also referred to as backbone pipelines, serve an especially vital function and were therefore given a separate COF scoring value. These various scoring locations are presented in Figure 3-6.

Figure 3-6. Transmission Pipelines

The scoring system used for this COF factor is listed in Table 3-7. Pipelines 14-inch in diameter or larger (“Breaker” in this table) were given a score of 10. All non-backbone pipelines were given a score of zero.
4.3.4 COF Factor 4 - Critical Facilities

CHWD considers service to all customers as important. However, this COF factor acknowledges that there are certain institutional or commercial facilities served by CHWD who critically depend on uninterrupted water delivery. A common examples for many utilities would be a large hospital, though CHWD currently does not directly serve any such large health care facilities. Relevant examples of such customers include within CHWD’s service area include local surgery centers (dental), public safety agencies (police and fire), assisted living facilities, and schools. As presented in the table below, different scores were given to the various customer classes based on an assumed risk to the end-users at these institutions. These various scoring locations are presented in Figure 3-7.
The scoring system used for this COF factor is listed in Table 3-8. Scoring for various critical customer categories (“Breakers” in this table) range from 10 for dental and medical surgical centers to a 1 for general commercially zoned areas. The vast majority of pipelines serving CHWD customers not in any of these categories received a score of zero.
4.3.5 **COF Factor 5 - Creek Crossings (Environmental)**

Pipelines that cross a creek (see Figure 3-4) were given a COF score for potential environmental impacts resulting from a failure and release of drinking water that contains chlorine for disinfection/purification into a natural waterway. While the levels of chlorine are considered low for human consumption, these levels pose greater ecological hazards and subsequent regulatory (punitive) consequences. Unlike the LOF scoring, all creek crossing pipelines were given the same maximum score since, regardless of variable LOF vulnerability, the consequence of the failure would be very similar. CHWD may wish to perform future risk assessment studies to better quantify and distinguish the environmental impacts at these crossing.

The scoring system used for pipeline creek crossings is presented in Table 3-9. This scoring system is very similar to the pipeline vulnerability scoring in Table 3-3. Pipeline segments that currently are designated as a creek crossing were given a score of 10 (“Breaker” = True), constituting the highest risk score for this category. All other pipeline assets in the CHWD system were given an LOF score of zero (“Breaker” = False) for this factor.
4.3.6 COF Factor 6 - High Traffic Areas

Pipelines that are located in high traffic commercial areas or in streets considered to be major arterials were a higher score for this risk factor since the anticipated traffic disruption due to the initial pipe failure, as well as the ensuing emergency repairs, would be much more significant than in residential areas. These various scoring locations are presented in Figure 3-8.
The scoring system used for this COF factor is presented in Table 3-10. Pipeline segments (approximately 9.5 miles) that currently are identified as high traffic areas in the above figure were given a score of 10 ("Breaker" = True). These include pipelines located in major roadway arterials around the Sunrise Mall and Marketplace centers, including Greenback Lane, Madison Ave, and Sunrise Blvd (shown in red in Figure 3-8). All other pipelines were given an LOF score of zero ("Breaker" = False) for this factor.

For the next round of risk calculations, it is anticipated that a moderate score of 5 will be assigned to pipelines located within other significant arterial streets (shown in green in Figure 3-8), including Oak Ave, San Juan Ave/Sylvan Road, Auburn Blvd/Old Auburn Road, Fair Oaks Blvd and Hazel Ave.
4.3.7 COF Factor 7 - Difficult Access Areas (Backyard Mains)

The majority of water pipelines were constructed under city streets and therefore in the public right-of-way, where access allows immediate repair and replacement work to occur. However, at various locations throughout CHWD’s distribution system water mains are located in residential backyards or other locations were immediate access may be more difficult. In most of these instance, CHWD has a construction and utility easement giving it the right to enter the property and make the repairs. Nevertheless, CHWD’s “good neighbor” policy dictates that it work closely with individual homeowners and customers to minimize disruption and property impacts.

Where feasible, CHWD would likely consider relocation of such pipeline segments to within the public right-of-way, but in many cases such relocation can be costly or may be impractical. The importance of this factor is to help CHWD identify these locations, plan replacement well before failure occurs, and conduct early feasibility assessments for potential relocation off of private property. These various scoring locations are presented in Figure 3-9.
Figure 3-9. Difficult Access Areas (Backyard Mains)

Pipeline segments identified as being located in private easements, backyards, or otherwise in areas with access challenges, were given a score of 10 (“Breaker” = True). All other pipeline assets in the CHWD system were given a score of zero (“Breaker” = False) for this factor.
4.4 LOF and COF Weighting Factors

The weighting factors for the LOF and COF risk factors discussed in Sections 4.2 and 4.3 are shown in Table 3-11. The values of these weighting factors were developed by the project team and reflect the District’s unique water system. It is common for there to be a greater number of COF factors, which identify the various impacts of a pipeline failure, than LOF factors that affect the probability of failure. The software tool being used for this analysis allows these weighting factors to be easily modified in the future as more detailed information (e.g. main break data) is collected.

<table>
<thead>
<tr>
<th>Likelihood of Failure (LOF)</th>
<th>Consequence of Failure (COF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipe Age / Survival Probability</td>
<td>50% Transmission Pipelines</td>
</tr>
<tr>
<td>Pipe Material</td>
<td>25% Pipe Size</td>
</tr>
<tr>
<td>Historical Main Breaks</td>
<td>15% Pipe Flow</td>
</tr>
<tr>
<td>Creek Crossings (Vulnerability)</td>
<td>10% Critical Customers</td>
</tr>
<tr>
<td></td>
<td>Creek Crossings (Environmental Impact)</td>
</tr>
<tr>
<td></td>
<td>High Traffic Areas</td>
</tr>
<tr>
<td></td>
<td>Difficult Access Areas (Backyard Mains)</td>
</tr>
<tr>
<td>Likelihood of Failure (LOF) Total</td>
<td>100% Consequence of Failure (COF) Total</td>
</tr>
</tbody>
</table>

4.5 Initial Findings

The information presented in this section is considered preliminary. Some findings may change with further analysis that is planned. The following initial findings have been reached based on the analysis performed to date:

1. Transmission mains are more vulnerable and failure consequences may be significant.
2. The pace of water main replacement will increase from the District’s existing pace.
3. There is an inherent trade-off between the planned pace of future main replacements and overall risk of increasing pipe failures in the system.
Section 5  Replacement Cost Estimates

The total cost to the District for water main replacement includes construction costs and “other project costs” accounting for engineering and management. Estimates for construction costs include materials, labor, and equipment. Estimates for “other project costs” are based on percentages of construction costs. Total replacement costs are high but strategic investment and a proactive approach to water main replacement generally have much lower overall costs when compared to reactive repairs and replacements due to breaks.

The following planning level estimates are provided for the purpose of financial planning and project phasing. Every individual project or phase will have unique costs based on economic and physical conditions. There may be several cost saving alternatives on a phase by phase basis and those will be considered during specific project delivery planning. For the purpose of this study, a typical unit cost will be developed, based on typical conditions with the District.

5.1  Construction Costs

Construction costs include all materials and labor required for water main replacement projects. These cost items include, but are not limited to:

1. Mobilization  
2. Traffic control  
3. Pavement saw-cutting  
4. Pavement demolition  
5. Pipe removal or abandonment  
6. Trench excavation  
7. Backfilling  
8. Pipe  
9. Valves  
10. Water Services  
11. Fire hydrants  
12. Pavement replacement  
13. Flushing and testing  
14. Overhead and profit of contractors

A typical water main replacement project is used to estimate unit costs (cost per foot). For the District, typical water main replacement projects are in developed areas and within existing paved roadways.
5.2 Other Project Costs

Other project costs, sometimes referred to as soft costs, include other tasks and labor costs that occur before or after construction. These items include:

1. Cost contingency
2. Project and construction management
3. Engineering
4. Permitting
5. Inspections

Soft costs are estimated as a percentage of construction costs based on experience. A 20 percent cost contingency will be used to account for unknown and unexpected conditions and cost changes. Additionally, for project management, engineering and permitting 25 percent will be added. This accounts for all staff and consultant time associated with project delivery.

5.3 Pipe Rehabilitation

Pipe rehabilitation is a way to reduce project costs. There are many cases that a pipe’s useful life can be extended by 30 to 50 years by using various rehabilitation methods. Methods and cost vary, but generally any improvement to the pipe by repairing and/or lining the interior is considered pipe rehabilitation. Again, these project decisions will be made for each project or phase and were not considered for the purposes of the project cost estimates.

5.4 Trenchless Pipe Replacement

Another construction technique that has many proven advantages, and possible cost savings, is trenchless pipe replacement. Generally trenchless pipe replacement is any technique that eliminates the need for excavation of the existing pipe. However, excavation is still needed at various points along the alignment (e.g. at the launching and receiving pits and at water service and fire hydrant connections). The main benefit and cost savings comes from reduced disruptions and traffic flow and therefore lower traffic and pedestrian control costs.

The most common techniques are pipe bursting and microtunneling. Pipe bursting uses the existing pipe as a conduit to pull the new pipe through. An expander head is pulled through first under force and breaks the existing pipe as it is pulled through. Trenchless pipe replacement was not considered for the purposes of the project cost estimates.
5.5 Unit Costs

The BNi Building News Public Works 2018 Costbook was used to estimate construction costs for water main replacement. The Costbook has been an industry tool for over 70-years. It provides national averages for construction material and labor costs based on a compilation of thousands of actual up-to-the-minute costs. The national average is then multiplied by a Geographic Multiplier to help account for regional variations. The District’s construction cost database was used to confirm these regional variations.

These unit cost are used for estimating purposes only. Actually project costs will vary based on economic and physical conditions in 2030. Table 3-12 summarizes these unit costs.

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Pipe Type</th>
<th>Cost</th>
<th>Unit</th>
<th>Cost</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-inch</td>
<td>PVC</td>
<td>$230.95</td>
<td>Per LF</td>
<td>$1.22 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>8-inch</td>
<td>PVC</td>
<td>$252.24</td>
<td>Per LF</td>
<td>$1.33 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>10-inch</td>
<td>DIP</td>
<td>$306.43</td>
<td>Per LF</td>
<td>$1.62 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>12-inch</td>
<td>DIP</td>
<td>$336.70</td>
<td>Per LF</td>
<td>$1.78 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>14-inch</td>
<td>DIP</td>
<td>$394.39</td>
<td>Per LF</td>
<td>$2.08 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>16-inch</td>
<td>DIP</td>
<td>$444.08</td>
<td>Per LF</td>
<td>$2.34 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>18-inch</td>
<td>DIP</td>
<td>$485.21</td>
<td>Per LF</td>
<td>$2.56 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>24-inch</td>
<td>DIP</td>
<td>$630.77</td>
<td>Per LF</td>
<td>$3.33 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>30-inch</td>
<td>CML</td>
<td>$820.00</td>
<td>Per LF</td>
<td>$4.33 M</td>
<td>Per Mile</td>
</tr>
<tr>
<td>42-inch</td>
<td>CML</td>
<td>$1066.00</td>
<td>Per LF</td>
<td>$5.63 M</td>
<td>Per Mile</td>
</tr>
</tbody>
</table>

Notes:
1. Costs are in 2018 dollars.
2. Unit Costs were prepared based on the BNi Building News Public Works 2018 Costbook.
3. The total unit costs have been multiplied by the Sacramento multiplier of 118 to account for regional pricing.
5.6 System Replacement Costs

An estimated system cost is developed from combing the system improvements and applying the unit costs. Table 3-13 summarizes these results.

Table 3-13. Replacement Costs

<table>
<thead>
<tr>
<th>Pipe Size or Appurtenance</th>
<th>Total (miles or each)</th>
<th>Unit Cost (miles or each)</th>
<th>Total Cost (million)</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-inch</td>
<td>88.3</td>
<td>$1.22</td>
<td>$107.73</td>
<td>Includes 4&quot; to be replaced with 6&quot;</td>
</tr>
<tr>
<td>8-inch</td>
<td>110.2</td>
<td>$1.33</td>
<td>$146.57</td>
<td></td>
</tr>
<tr>
<td>10-inch</td>
<td>3.1</td>
<td>$1.62</td>
<td>$5.02</td>
<td></td>
</tr>
<tr>
<td>12-inch</td>
<td>32.5</td>
<td>$1.78</td>
<td>$57.85</td>
<td></td>
</tr>
<tr>
<td>14-inch</td>
<td>0.5</td>
<td>$2.08</td>
<td>$1.04</td>
<td></td>
</tr>
<tr>
<td>16-inch</td>
<td>0.8</td>
<td>$2.34</td>
<td>$1.87</td>
<td></td>
</tr>
<tr>
<td>18-inch</td>
<td>5.2</td>
<td>$2.56</td>
<td>$13.31</td>
<td></td>
</tr>
<tr>
<td>24-inch</td>
<td>4.9</td>
<td>$3.33</td>
<td>$16.32</td>
<td></td>
</tr>
<tr>
<td>30-inch</td>
<td>0.5</td>
<td>$4.33</td>
<td>$2.17</td>
<td></td>
</tr>
<tr>
<td>42-inch</td>
<td>3.4</td>
<td>$5.63</td>
<td>$19.14</td>
<td></td>
</tr>
<tr>
<td>Fire Hydrant</td>
<td>2,352</td>
<td>$8,000.00</td>
<td>$18.82</td>
<td></td>
</tr>
<tr>
<td>Air Release Valve</td>
<td>210</td>
<td>$4,000.00</td>
<td>$0.84</td>
<td></td>
</tr>
<tr>
<td>Blowoff</td>
<td>650</td>
<td>$2,500.00</td>
<td>$1.63</td>
<td></td>
</tr>
<tr>
<td>Service</td>
<td>20,032</td>
<td>$2,000.00</td>
<td>$40.06</td>
<td></td>
</tr>
<tr>
<td><strong>Construction Cost Subtotals</strong></td>
<td></td>
<td></td>
<td><strong>Total Construction Cost</strong></td>
<td>$432.36</td>
</tr>
<tr>
<td>Distribution Mains</td>
<td>234.6</td>
<td></td>
<td><strong>$317.16</strong></td>
<td>12-inch and smaller</td>
</tr>
<tr>
<td>Transmission Mains</td>
<td>14.8</td>
<td></td>
<td><strong>$53.85</strong></td>
<td>14-inch and larger</td>
</tr>
<tr>
<td>Appurtenances</td>
<td></td>
<td></td>
<td><strong>$61.35</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Construction Cost</strong></td>
<td></td>
<td></td>
<td><strong>$432.36</strong></td>
<td></td>
</tr>
<tr>
<td>Engineering, Management and Permitting (25%)</td>
<td></td>
<td></td>
<td><strong>$108.09</strong></td>
<td>Includes Construction Management and Inspections</td>
</tr>
<tr>
<td><strong>Total Replacement Costs</strong></td>
<td></td>
<td></td>
<td><strong>$540.45</strong></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1 Costs are in 2018 dollars.
2 Unit Costs based on Table 3-12

Based on the methodology summarized above the total cost, in 2018 dollars is $540 million. This represents the complete system replacements. These costs are planning level estimates and should be constantly reevaluated based on recent cost data.
Section 6  **Technical Memo Next Steps**

The following tasks will be undertaken to complete this technical memo:

1. Perform additional main assessments based on modified Likelihood of Failure (LOF), Consequence of Failure (COF), and associated weighting factors.
2. Develop main replacement phasing plan.
3. Develop financial plan.
OBJECTIVE:
Receive a report on the 2019 Customer Advisory Committee Meeting Schedule.

BACKGROUND AND ANALYSIS:
Customer Advisory Committee Chair Jenna Moser will discuss the proposed 2019 Customer Advisory Committee (CAC) Meeting schedule with the CAC.

<table>
<thead>
<tr>
<th>Day</th>
<th>Date</th>
<th>Meeting Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tuesday</td>
<td>February 5</td>
<td>Regular Meeting – Added</td>
</tr>
<tr>
<td>Tuesday</td>
<td>February 26</td>
<td>Regular Meeting – Added</td>
</tr>
<tr>
<td>Tuesday</td>
<td>March 19</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>Wednesday</td>
<td>April 17</td>
<td>60% Presentation at Board Meeting</td>
</tr>
<tr>
<td>Tuesday</td>
<td>June 11</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>Tuesday</td>
<td>September 10</td>
<td>Regular Meeting</td>
</tr>
<tr>
<td>Wednesday</td>
<td>October 16</td>
<td>Final Presentation at Board Meeting</td>
</tr>
</tbody>
</table>

Regular Meetings of the Customer Advisory Committee are held at 6:30 PM in the Citrus Heights Community Center. Meeting agendas are posted approximately 1 week prior to the meeting date. Meeting dates subject to change with 72 hour advance notice.

Regular Meeting – Added
It is anticipated that up to ten (10) spending and funding options will be presented to the Customer Advisory Committee (CAC) in future meetings for review and analysis. The various phasing and funding options will then be paired together to create discrete spending and funding alternatives. In order to provide sufficient time for the CAC to evaluate up to ten (10) spending and funding alternatives and reduce the options down to four (4), it is recommended that up to two additional CAC meetings be added to the overall schedule. The two additional meetings are proposed to be on February 5, 2019 and February 26, 2019. If, during the February 5, 2019 meeting, the four (4) alternatives are selected, then the February 26, 2019 will not be required.

Presentations at Board Meetings are held periodically to keep the Citrus Heights Board of Directors appraised of the progress reached on the Project 2030 Water Main Replacement Study. Chair Jenna Moser represents the CAC before the Board during briefings. CAC members are welcomed, but not required, to attend these Project 2030 update presentations.

RECOMMENDATION:
Receive and file the 2019 Customer Advisory Committee Meeting Schedule.
ATTACHMENT:
Project 2030 Water Main Replacement Project Public Engagement/CAC Workshop Handout