


Slide 1



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

**Stakeholder Advisory Group  
Meeting #5**

Board of Water Supply  
City & County of Honolulu

Tuesday, January 12, 2016

Slide 2



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

International Water Forum

Dave Ebersold  
Facilitator

**WELCOME**

The slide features a light blue background with a decorative border at the bottom. The top section contains the 'WATER FOR LIFE' logo and tagline, and the International Water Forum logo. The central text identifies the facilitator as Dave Ebersold and displays the word 'WELCOME' in large, bold, teal letters.

Slide 3




**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

Metropolitan Water District

**Public Comments on Agenda**

The slide features a header banner with a scenic background of water and green hills. The text 'WATER FOR LIFE' is in a bold, sans-serif font, with the tagline 'Safe, dependable, and affordable water now and into the future' in a smaller, italicized font below it. The Metropolitan Water District logo, a stylized water drop, is positioned on the right side of the banner. The main body of the slide is a solid teal color with the text 'Public Comments on Agenda' centered in a bold, dark teal font. A decorative border with a repeating geometric pattern is located at the bottom of the slide.



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

## Meeting Objectives

- ◆ Hear important news regarding the BWS
- ◆ Continue to refine Water Master Plan objectives
- ◆ Learn more about the BWS's water quality and treatment activities
- ◆ Get an update on the condition assessment of the system

Slide 5



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

Ernest Lau, P.E.  
BWS Manager and Chief Engineer

**BWS UPDATES**

The slide features a header banner with a scenic landscape of mountains and water. The text 'WATER FOR LIFE' is in a bold, sans-serif font, with the tagline 'Safe, dependable, and affordable water now and into the future' in a smaller, italicized font below it. To the right of the banner is a logo consisting of a stylized water drop above the text 'Biosand Water Purification'. The main body of the slide is a solid light blue color. At the bottom, there is a decorative border with a repeating pattern of small, stylized water drops.

Slide 6



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

Water for Life logo: A stylized white water drop with a leaf-like shape inside, set against a green background.

Water for Life tagline: *Safe, dependable, and affordable water now and into the future*

Water for Life website: [www.waterforlife.org](http://www.waterforlife.org)

**The BWS can speak to your  
community, group, or organization  
about these or any other topics.**

Decorative border: A row of small, repeating water drop icons along the bottom edge of the slide.

Slide 7



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

Water for Life logo


**Mahalo!**      **Questions & Answers**

ENTRUSTED TO US TO  
**PRESERVE**  
FOR FUTURE GENERATIONS

Image of a child splashing water

Decorative border at the bottom

This slide features a light blue background. At the top, there is a banner with the text 'WATER FOR LIFE' and the tagline 'Safe, dependable, and affordable water now and into the future'. To the right of the banner is the Water for Life logo, which consists of a stylized water drop icon above the text 'Water for Life'. Below the banner, the words 'Mahalo!' and 'Questions & Answers' are displayed in a bold, dark blue font. In the center, there is a rectangular image showing a young child splashing water. Overlaid on the right side of this image is the text 'ENTRUSTED TO US TO PRESERVE FOR FUTURE GENERATIONS'. At the bottom of the slide, there is a decorative border with a repeating pattern of small, light blue water drop icons.



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*

**Action**

- ◆ Review and accept notes from Stakeholder Advisory Group Meeting #3 on Wednesday, September 16, 2015
- ◆ Review and accept notes from Stakeholder Advisory Group Meeting #4 on Wednesday, November 18, 2015





Slide 9



**WATER FOR LIFE**  
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Dave Ebersold  
Facilitator

**WATER MASTER PLAN OBJECTIVES**

The slide features a light blue background with a decorative border at the bottom consisting of a repeating pattern of small water drop icons. The text is centered and presented in a clean, sans-serif font.

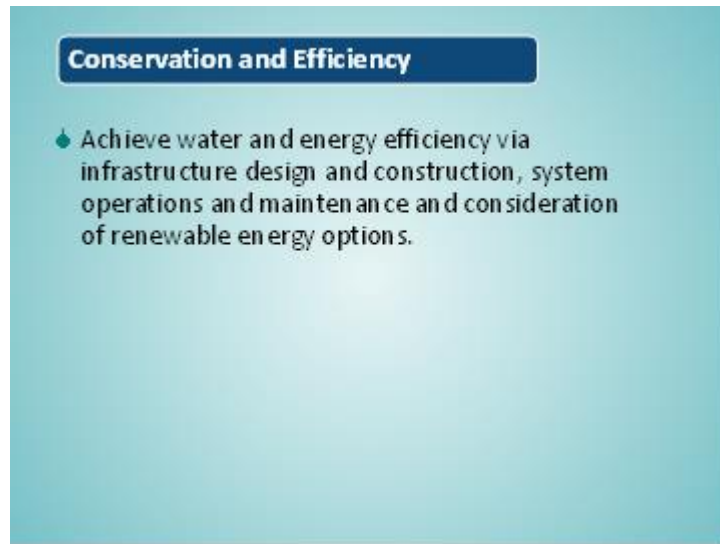


In Meeting 2, we began the process of focusing on framing objectives for the Water Master Plan (WMP). These are intended to articulate where we want to be in terms of five critical areas you had identified as priorities in our first meeting and in the preceding interviews and discussions.

We continued discussing these objectives during Meetings 3 and 4, and believe that we have achieved consensus on the first three.



Now let's turn our attention to the remaining objectives.



**Conservation and Efficiency**

- ◆ Achieve water and energy efficiency via infrastructure design and construction, system operations and maintenance and consideration of renewable energy options.

Today we will discuss the 4<sup>th</sup> objective and try to reach group consensus.

### Water Resource Sustainability

Water sources are protected and available now and into the future by:

- ◆ Coordinated management and improvement of the watershed and groundwater supply.
- ◆ Conducting long-range planning (including risks due to climate change).
- ◆ Collaborating with Dept. of Land and Natural Resources and other relevant land owners.
- ◆ Considering alternative source of water (e.g., stormwater, recycled water, brackish water and seawater).

We will also address the 5<sup>th</sup> objective if time permits.



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International Water Agency

**Mahalo!**      **Questions & Answers**

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FOR FUTURE GENERATIONS

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Slide 15



WATER FOR LIFE  
*Safe, dependable, and affordable water now and into the future*

Water Quality Division

**Erwin Kawata**  
Water Quality Division Program Administrator

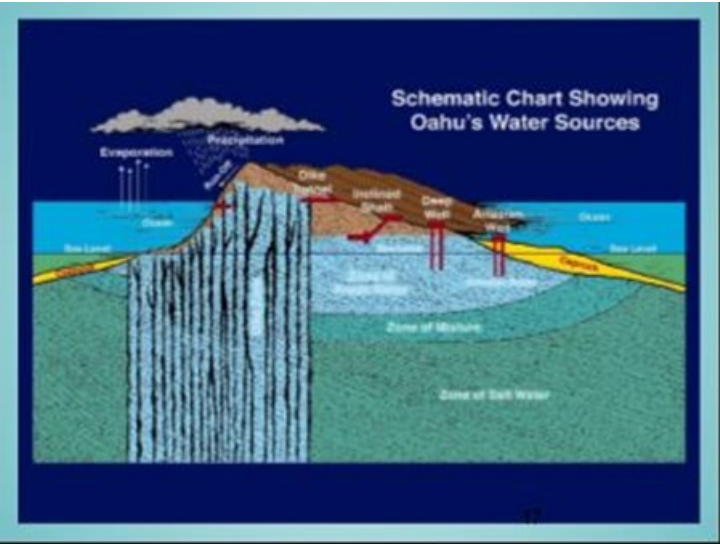
**WATER QUALITY**

The slide features a header with a scenic background of a river and hills. The text is centered on a light blue background. A decorative border of small water droplets is at the bottom.

## Today's Discussion

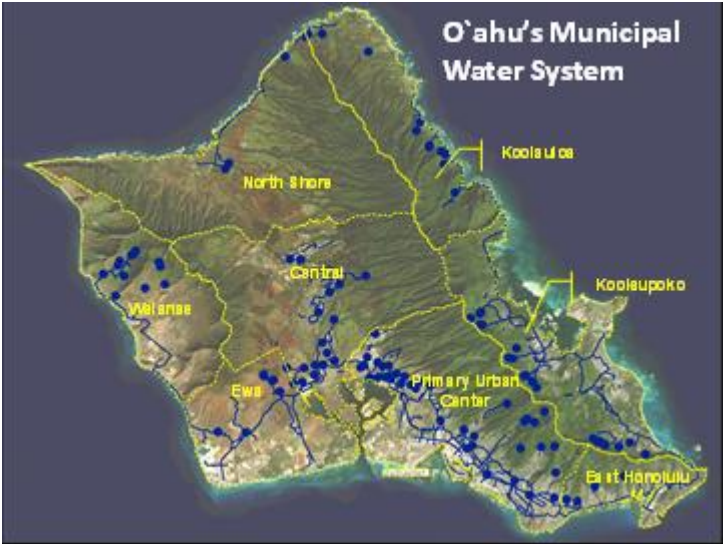
- ◆ Water quality overview
- ◆ Drinking water regulations and regulatory agencies
- ◆ Drinking water testing
- ◆ BWS water quality program
- ◆ Common inquiries about water quality
- ◆ Questions





### Oahu's Water Quality

- ◆ Groundwater of basal origin.
- ◆ Contains naturally occurring minerals (calcium, sodium, etc.).
- ◆ High clarity, stable, no seasonal changes (groundwater vs. surface water).
- ◆ Low bacteria levels. Does not need extensive treatment to improve aesthetics.
- ◆ Influenced by activities in the environment (Central Oahu experiences).



## Safe Drinking Water Act (SDWA)

- ◆ Enacted in 1974
- ◆ Amended in 1986 and 1996
- ◆ Contaminants regulated in 1974 = 18; Today = 91; 75 applies to BWS.
- ◆ Specific requirements
  - Maximum contaminant limits (MCLs) = drinking standards
  - Monitoring
  - Treatment
  - Enforcement
  - Public Notification
- ◆ Water quality data collection rules (i.e. Unregulated Contaminant Monitoring Rule)

## SDWA Regulating Agencies

- ◆ U.S. Environmental Protection Agency
  - Implements SDWA
  - Writes federal regulations
  - Enforce requirements
  - Give states authority to implement and enforce regulations called Primacy
- ◆ State of Hawaii Department of Health (DOH)
  - Primacy agency in Hawaii
  - Adopts federal regulations, enforce requirements
  - Can have more stringent rules
    - ◆ 1, 2, 3 – Trichloropropane (TCP)

### Drinking Water Regulations

- ◆ National standard applying to all states.
- ◆ Universal standard that defines safe DW.
- ◆ Chemicals regulated based on EPA health studies, occurrence nationwide and amount found.
- ◆ EPA reevaluates rules every 6 years and need for other contaminants to be regulated every 5 years.
- ◆ Regulations in place today is regulating contaminants found in drinking water.

## Drinking Water Regulatory Testing

- ◆ Department of Health
  - 1974 – June 30, 2010
  - Large water utilities (BWS) responsible from July 1, 2010
  - All other utilities from January 1, 2011
- ◆ BWS
  - Chemical and Microbiological Laboratories
  - Water treatment and resource monitoring
  - SDWA Testing since July 1, 2010

## Drinking Water Testing at BWS

### ◆ Past

- Started chemical testing (chloride and pH) in 1931
- Started bacteriological examinations in 1933
- Water quality deemed “excellent”
- One chemist and one microbiologist

### ◆ Today

- 6 chemists, 4 microbiologists, 8 lab technicians
- 1 laboratory director
- 30,000 chemical and microbiological tests annually
- SDWA requirements



### Laboratory function at BWS

- ◆ 1938 – Distribution System Division responsible for water service of sufficient quality and quantity and adequate fire protection
- ◆ 1958 – Water Distribution Division
- ◆ 1967 – Operations Division
- ◆ 1973 – Planning and Engineering
- ◆ 2000 – Operations Unit
- ◆ 2010 – Water Systems Operations (formerly Operations Unit)

## Water Quality Division


- ◆ Created in 2013
- ◆ Reporting to the Manager the independent auditing and monitoring of BWS water quality and related activities.
- ◆ Responsible for all matters relating to the administration and compliance of the department's island-wide water system with all drinking water and environmental laws, rules, and regulations.

### Protecting Water Quality


- ◆ Continuous surveillance (water testing) provides early warning for potential contaminants.
  - 75 contaminants required under SDWA. BWS tests for over 200.
- ◆ Stay in front of regulatory requirements.
- ◆ Employ treatment but preserve aesthetics.

## Water Treatment

### Chlorination



### Granular Activated Carbon



## Central Oahu Experiences

- ◆ Pesticide contamination
- ◆ Surface activities can impact quality.
- ◆ Soils retain some contaminants and pass others.
- ◆ Proper application and waste disposal key to water quality.



### Water quality questions

- ◆ Do I need a water filter?
- ◆ Is our water contaminated?
- ◆ Which is safer, bottled water or tap water?
- ◆ Main breaks and water quality.
- ◆ What is the biggest threat to Oahu's water quality?
  - The activities that take place in the environment.

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International Water Agency

**Mahalo!**      **Questions & Answers**

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**WATER FOR LIFE**  
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Jon Toyoda, P.E.  
Consultant Project Manager for the Water Master Plan

**CONDITION ASSESSMENT  
OF RESERVOIRS**

Water for Life logo: A stylized white water drop icon above the text "Water for Life".





Today we will discuss the condition assessment of the BWS's reservoirs.



Reservoirs are critical facilities in the water system.

In some cases, major repairs or replacement to reservoirs can take two years or longer to implement.

The BWS routinely performs comprehensive reservoir assessments on a 10-year cycle. The results will help identify and prioritize projects for the 30-year Capital Improvement Program (CIP).

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Reservoirs are located wherever the BWS has customers.

They regulate system water pressure in the vicinity.

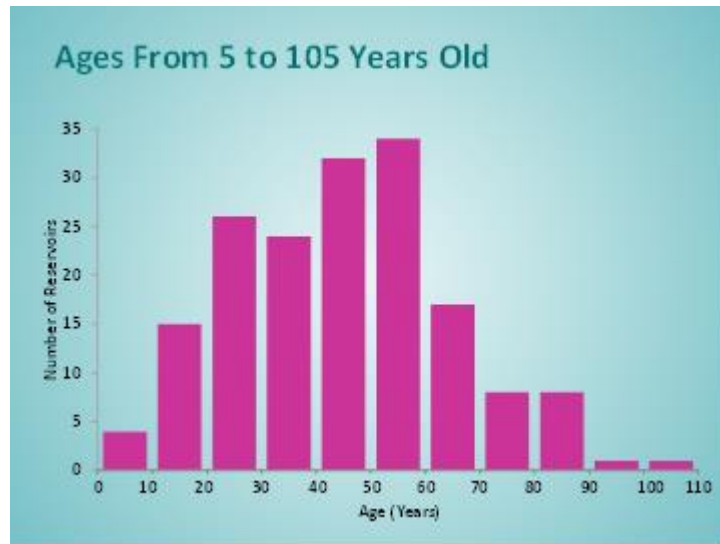
### What Do Reservoirs Do?



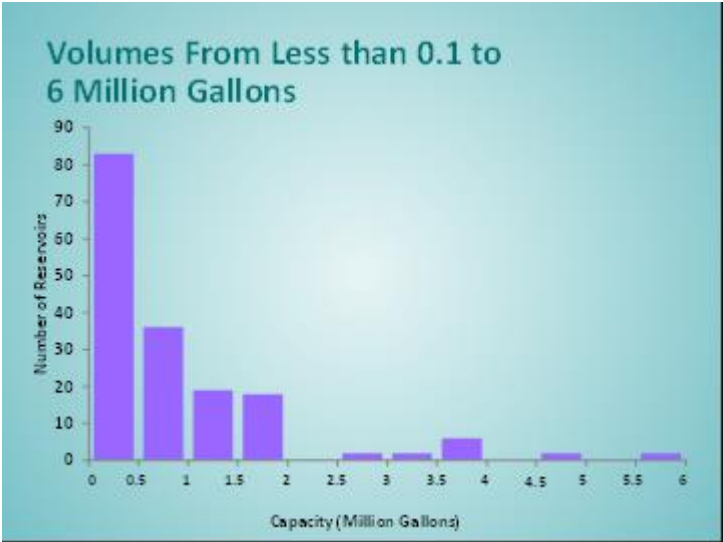
- ◆ **Operating Storage**
  - Peak Hour Demands
- ◆ **Fire Storage**
  - Public Safety
- ◆ **Emergency Storage**
  - Reliable Service




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The oldest reservoir owned by the BWS was built in 1911 and has the capacity to hold 300,000 gallons of water.



Most Are Constructed "At Grade"



At Grade

The slide features a light blue background. At the top, the text "Most Are Constructed 'At Grade'" is written in a dark teal font. Below this text are two side-by-side images. The left image is a schematic diagram of a rectangular tank with a blue body and a grey base, set against a yellow-to-white gradient background with a green ground line. The right image is a photograph of a large, cylindrical, light-colored metal storage tank in an outdoor setting, with a white utility vehicle parked in front of it. Below the images, the text "At Grade" is centered.




### Large Reservoir "At Grade"



At Grade

The image contains two side-by-side visual elements. On the left is a schematic diagram of a reservoir, showing a blue rectangular tank with horizontal lines, resting on a green base representing the ground level. On the right is a photograph of a large, cylindrical, tan-colored metal water tower or reservoir situated in an open field under a cloudy sky. A white vehicle is parked near the base of the structure for scale.


### Partially Buried Reservoir on a Slope



The diagram on the left shows a blue rectangular reservoir partially buried in a green slope. The top of the reservoir is level with the ground surface. The photograph on the right shows a real-world example of a large, cylindrical, tan-colored reservoir built into a grassy hillside. A dark car is parked on a road in the foreground, and a brick wall is visible between the road and the reservoir.

Partially Buried

### Buried Reservoir



The diagram on the left shows a blue rectangular reservoir with three horizontal sections, resting on a grey base. The photograph on the right shows a real-world example of a buried reservoir in a field, with a green access box and two circular concrete structures in the foreground.

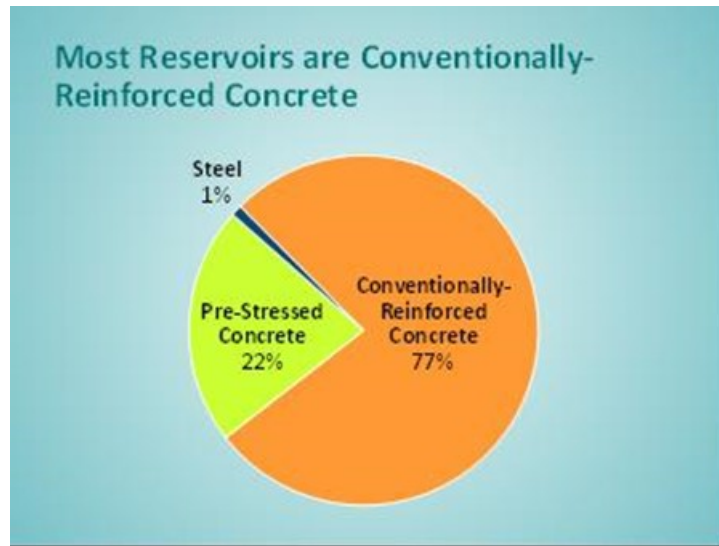
Buried

### There are Only Two Elevated Reservoirs



The diagram on the left shows a stylized blue elevated reservoir with a cylindrical body and a rounded top, set against a yellow-to-white gradient background with a green base. The photograph on the right shows a real-world example of a tall, green-painted elevated reservoir with a white top section, situated in a wooded area with a yellow construction vehicle at its base.

Elevated



Three-quarters of the BWS reservoirs are conventionally reinforced. Of these, about two-thirds were constructed after 1961.

### Conventionally Reinforced Reservoirs

- ◆ Long track record of success with minimal maintenance



- Conventional reinforcement protects the body of the reservoir from cracking and leaks.
- This type of reservoir has a long track record of success with minimal maintenance.
- However, this type of reinforcement is less efficient for larger reservoir capacities.

## Wire-Wound Reservoirs

- ◆ Have required varying levels of maintenance



- Tanks built in 1950s – 1960s have required varying levels of maintenance.
- Pre-stressed wires were applied to the exterior and covered with pneumatic mortar.

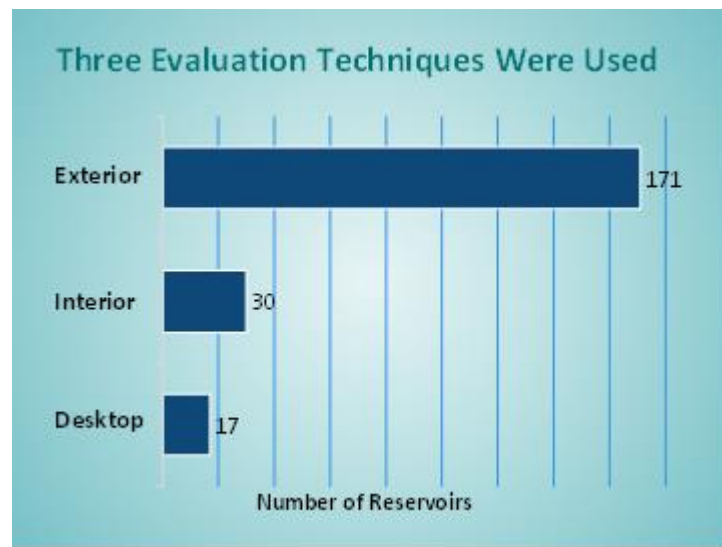


- Wire-wound tank repairs maintain and extend the surface life of reservoirs.
- Post-tensioned strands of wire were applied to exteriors of some of the BWS's tanks.
- External post-tensioned reservoirs can pose some maintenance, corrosion, and security concerns.






- The majority of the BWS reservoirs are the strand-wound type.
- This is considered the state-of-the-art design for the construction of new tanks.
- This design is appropriate for tanks of larger capacities.
- Concrete protects the wire from corrosion.



1. Exterior Visual inspections were conducted on all 171 reservoirs
2. Interior inspections, using Remote Operated Vehicles, were conducted on 30 reservoirs that are more than 40 years old or those that have not had their interiors inspected before.
3. Desktop analysis was used to inspect 17 reservoirs. Data samples from different designs and materials were evaluated numerically with respect to how they would fare in hurricane or earthquake conditions.

### Objectives of Exterior Inspections

- ◆ Document condition of concrete, rebar, paint and appurtenances
- ◆ Document performance of prior repair methods over time
- ◆ Identify voids between concrete and reinforcement by "sounding"



Exterior appurtenances inspected included vents, guardrails, ladders, and security cameras.

Sounding is a method of inspection utilized to assess the performance or repairs of reservoirs. Crackling noises indicate spacing within the concrete. A hammer is used to determine the extent of the void and the types of repairs that are needed.

## Inspected Upper and Lower Seals and Walls

### Upper and Lower Seals

- ◆ Leaks, gaps and vegetation

### Walls

- ◆ Leaks, spalled concrete and large cracks
- ◆ Sound entire wall surface
- ◆ Coating system



## Inspected Foundation Slabs

- ◆ Leaks
- ◆ Cracks
- ◆ Deterioration



## Inspected Roofs

- ◆ Ponding
- ◆ Deterioration
- ◆ Cracks
- ◆ Access Hatches



## Inspected Reservoir Sites

- ◆ Vegetation
- ◆ Landscaping
- ◆ Roadways
- ◆ Fences





The Remote Operated Vehicle allows the inspection of components that are usually submerged in water, without having to take the reservoir out of service, drain it, or use a human diver.

The Remote Operated Vehicle is about the size of a water cooler:

- 26" x 15" x 10"
- 39 lbs.



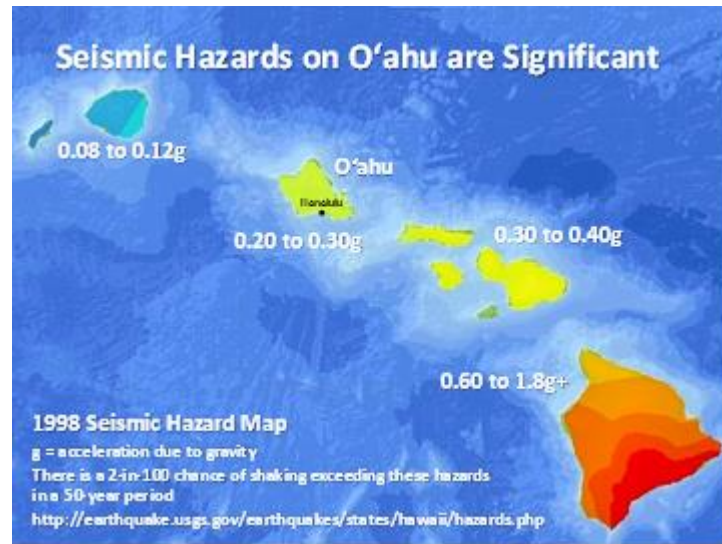


This reservoir, built in 1957, is a special case.

It is wire-wound with a retrofit of external cables encased in shotcrete. Inspections in 2005 and 2014 show a change in hollow areas as noted above.

We know that the cables are large in diameter, so some of the hollow areas are not necessarily indicative of major issues.

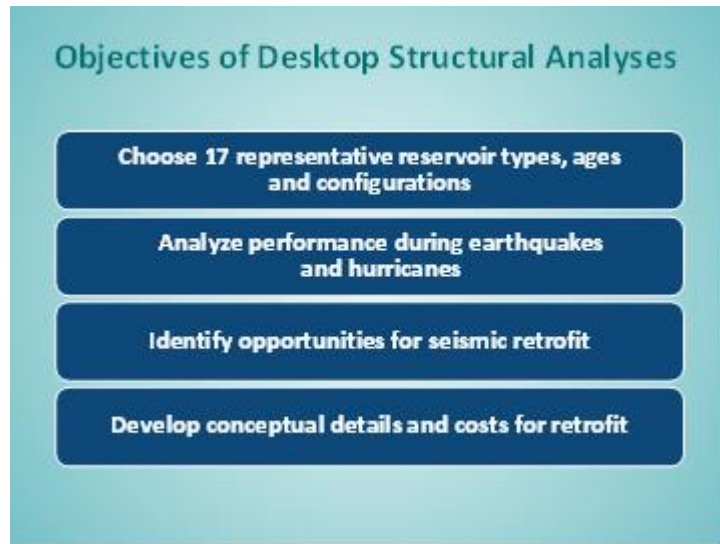
We recommend routine investigations to inspect the condition of the cables, which can change quickly.



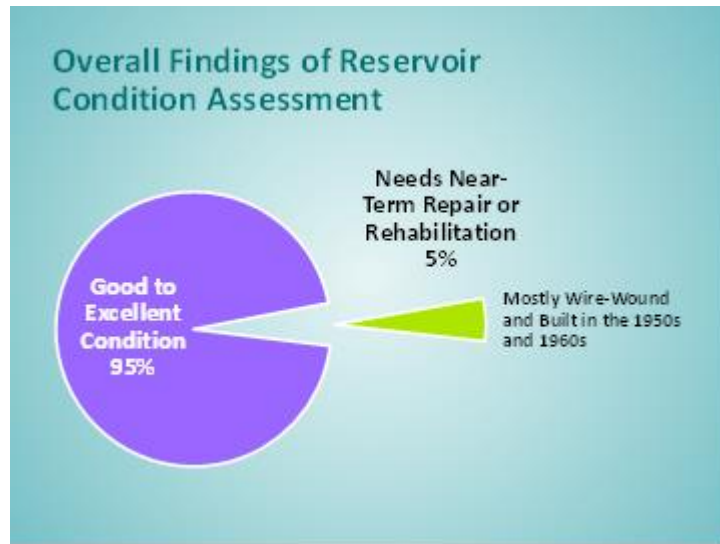
Seismic hazards are described as an amount of shaking, expressed as a percentage of “g”, the acceleration due to gravity. They range from around 0.1 g in Kauai to 1.0 g at Big Island.

According to this map, the seismic hazard ranges from approximately 0.2 to 0.3 g on O'ahu, which is classified as a high seismic zone. This is the reason we performed these numerical analyses.

The last large earthquake that caused extensive damage on O'ahu was 6.8 on the Richter Scale and was centered 65 miles SE of Honolulu in 1871.



There is no code requirement to upgrade the existing reservoirs. Our scope was to evaluate reservoirs to consider their seismic performance.



Approximately 8 tanks need near-term repair or rehabilitation.



### Leaking Bottom Seal





## Other Findings of Reservoir Condition Assessment

**Vast majority of reservoirs are in good  
to excellent condition**

**Certain reservoir configurations should be structurally  
inspected more frequently (every 5 years)**

**Concrete reservoirs do not have a fixed expiration date  
– if properly built and maintained, they can last a long time**

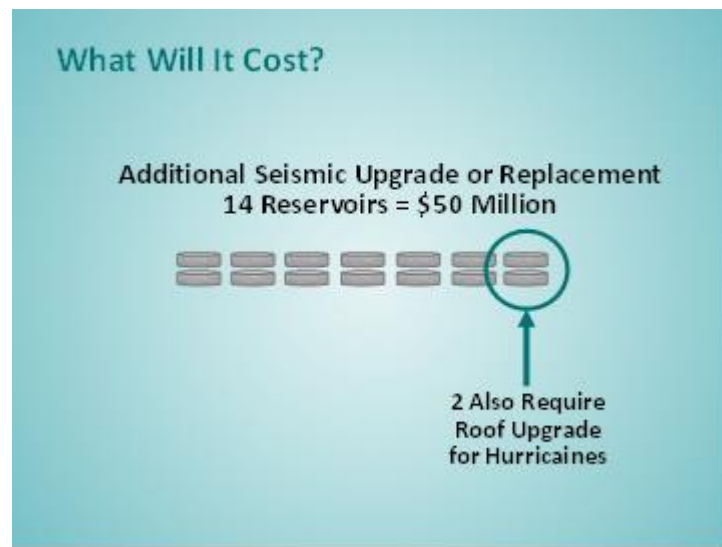
**Seismic retrofits can be implemented at relatively  
modest cost**





Based on internal and external inspections:

- 500 projects are needed to repair and upgrade BWS reservoirs.
- The cost is estimated at \$100 million.
- Each project has been prioritized as High, Medium, or Low.
- The projects that were designated as High Priority would cost between \$10 and \$15 million.



With respect to the note above about two reservoirs requiring roof upgrades for hurricanes, we are recommending replacing the reservoirs entirely for seismic adequacy.

**How the Findings Will Be Used**

- Methods and results will be documented in the Water Master Plan**
- Results will be used to prioritize repair and retrofit projects**
- Prioritized projects with cost estimates will be included in the 30-year Capital Improvement Plan**
- Highest-priority projects are already being addressed**



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International Water Agency

**Mahalo!**      **Questions & Answers**

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**WATER FOR LIFE**  
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International Water Agency

Dave Ebersold  
Facilitator

## SUMMARY AND NEXT STEPS

The slide features a light blue background with a decorative border at the bottom consisting of a repeating pattern of small water droplets. The text is centered and presented in a clean, sans-serif font.

## Tour of Hālawā Shaft

- ◆ Saturday, February 20, 2016
- ◆ 9 am to 12 pm
- ◆ Not open to the general public
- ◆ Designated an American Water Landmark by American Water Works Association
- ◆ Plus:
  - Take a tour of the Halawa Xeriscape Garden
  - Attend a Rain Barrel Catchment Workshop
  - Participate in a xeriscape activity
- ◆ More details to come!





**WATER FOR LIFE**  
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**Stakeholder Advisory Group Meeting 6**

- ◆ Wednesday, March 16, 2016
- ◆ 4:00 pm to 6:30 pm
- ◆ Neal Blaisdell Center
- ◆ Hawaii Suites

The slide features a light blue background with a decorative border at the bottom consisting of a repeating pattern of small white water droplets. The top banner includes the 'Water for Life' logo, which is a stylized white water droplet inside a circle, and the text 'Water for Life' in a bold, sans-serif font. Below the logo is the tagline 'Safe, dependable, and affordable water now and into the future' in a smaller, italicized font. The main title 'Stakeholder Advisory Group Meeting 6' is centered in a bold, dark blue font. The meeting details are listed below in a dark blue font, each preceded by a small white diamond icon.



**WATER FOR LIFE**  
*Safe, dependable, and affordable water now and into the future*



Water for People



ENTRUSTED TO US TO  
**PRESERVE**  
FOR FUTURE GENERATIONS

**Mahalo!**





