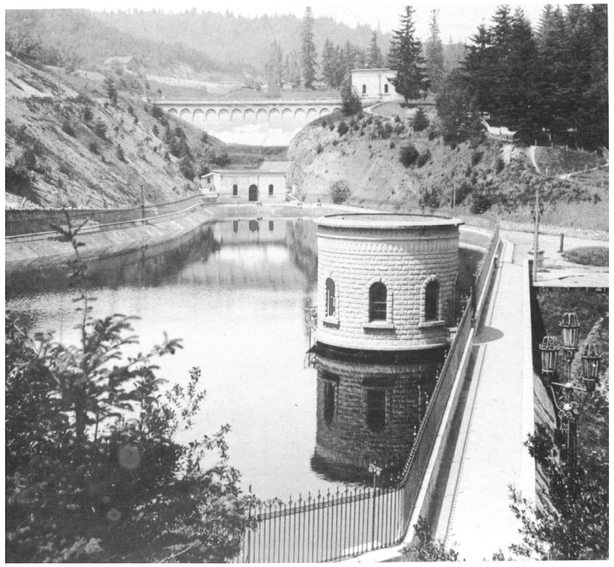
Appendix 1

Addition Background and Studies



Reservoir 4, 1910

Precedent images

RESERVOIR 4: FUNCTION AND LANDSLIDE

Functionality of Reservoir 4

Reservoir 4 was constructed as a drinking water storage reservoir. It primarily served the industrial areas along the Willamette River in Northwest Portland. As the industries changed and their water use was reduced, the water storage capacity required at Reservoir 4 was also reduced. As a result, Reservoir 4 is no longer needed to store drinking water, and will be taken offline by the end of this project. It already is little-used and often holds no water. The project could simply leave Reservoir 4 in place once the new covered Reservoir 3 is installed. This strategy would keep the dry basin as it is today, but would not protect it from continued damage by the landslide. In addition, public access would not be allowed. It would be difficult for the Portland Water Bureau to justify spending water ratepayer funds to maintain or repair the historically significant structures in this area because they would no longer be serving the water system.

Modern Functions to be Met On-Site

Operationally, the new buried reservoir and all the associated development must meet requirements that did not exist when the open reservoirs were originally built. These requirements include the following:

1. Manage stormwater runoff volumes, rates, and quality
2. Manage the flow rate and water quality of discharges from cleaning the buried reservoir and water features
3. Detain and manage overflows from the covered reservoir if one should occur.

Meeting these requirements requires space on the site, whether the facilities are constructed above or below ground—and city code strongly favors above ground, planted stormwater management facilities.

The landslide severely limits the on-site area available for these important functions, but fortunately there is enough room for them at the Reservoir 4 site. The physical area needed to serve the stormwater, overflow, and dechlorination functions is significantly smaller than the current Reservoir 4 footprint, even after moving outside the toe of the landslide. Discussion of the landslide and the proposed solution to ongoing landslide damage is described below in detail.

New Use in a Historic District

The U. S. Secretary of the Interior's Standards for Preservation start with Standard #1, "A property will be used as it was historically, or be given a new use that maximizes the retention of distinctive materials, features, spaces, and spatial relationships."

At Reservoir 4, one of its two historic uses can be restored to the area: an accessible public recreational destination. The other use, as a storage basin for public drinking water, cannot be restored. However, the proposed new use is strongly related to its original water storage use because it is a water facility-related function.

Environmental Opportunity

The proposed new water quality and stormwater use at Reservoir 4 allows for an added benefit to the site. The scale and location of this facility is uniquely suitable for ecological enhancement; it is large and directly adjacent to Washington Park and, more broadly, Forest Park (a regional anchor habitat). The design team sees this as an opportunity for innovation, and has strongly pushed to take an already progressive approach to stormwater management (BES's Stormwater Management Manual) to the next level of habitat creation and landscape ecological improvement. We have looked at broader city of Portland ecological goals and have identified the most appropriate local ecologies and species of concern to use as design targets. This holistic approach resonates the historic impetus for design, the coupling of functional utility and beautiful amenity, while updating the context to deal with contemporary water issues in a unique and exciting manner.

Landslide

When the Washington Park Reservoirs were constructed in the late 1800's, an ancient landslide was re-activated due to excavation at the toe of the landslide. The slide is still moving today and continues to damage the existing reservoirs and infrastructure.

Prior to construction of the reservoirs, the landslide had either stopped moving or was moving very slowly because it had reached an approximate equilibrium. The heavy weight of the soil at the bottom of the slope resisted being pushed by the force of the landslide.

When the reservoir construction removed a lot of soil (and weight), it freed the landslide to move more rapidly, and it did. Our strategy is to help slow it down and resist further movement by returning as much of that soil weight as we can. The effectiveness of this strategy is determined by the location and depth of the soil that we place. We are proposing to re-create a similar topography to what existed before Reservoir 4 was constructed. The original excavation removed material up to 40 feet in depth across a span of as much as 70 feet horizontally.

Landslide Mitigation

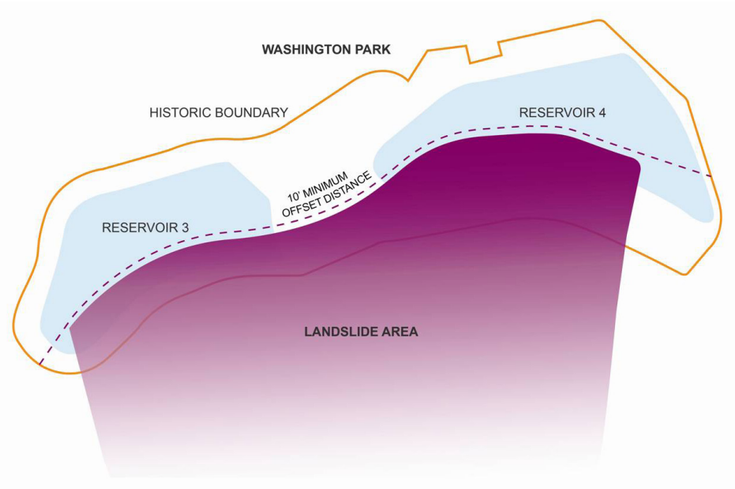
In order to restore the former slope, we must fill in the basin of Reservoir 4 and place fill on the slope above it, all the way up to the upper existing service road. In order to mitigate (slow) the slide, it is crucial to have the fill be sufficiently deep at the bottom of the slide, which is in the filled portion of Reservoir 4. This is because for fill material like this, the depth determines how much weight is being applied–the deeper the fill, the greater the weight. The replaced fill on the toe of the slide at the Reservoir 4 site will help slow (accommodate) the overall slide movement above both Reservoirs 3 and 4.

Mitigating the landslide movement will have the following results:

- Grades (i.e., surface elevations) within the existing footprint of the reservoir will be nearly 30 feet above the existing reservoir's maximum pool elevation of approximately 230 feet.
- The footprint of the new water feature (at elevation 230 feet) will be approximately one-half the extent of the existing reservoir.
- The view from Sherwood Blvd and the upper service road will be blocked by the new fill to the extent that only the eastern half of the new water feature would be visible. The western half would be below the line of sight.

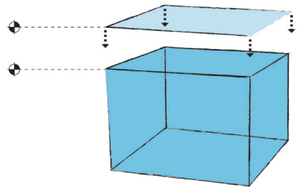
Summary

The proposal to closer re-establish the old hillside's contours and redevelop the Reservoir 4 basin allows Reservoir 3 to continue to serve the city's water system. This approach will also preserve the majority of the built structures, restore public access to the area, and provide a unique and beneficial habitat area. The proposal will also be able to accommodate a large pool of water in its historic relationship next to the dam and gatehouse, retaining important historic views, experiences, and character-defining features.



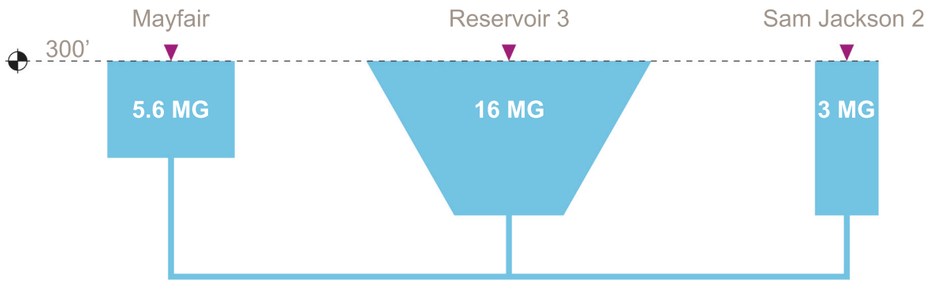
Landslide Encroachment into Basins and Critical 10' Offset

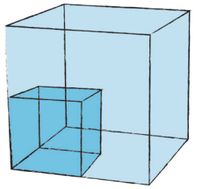
RESERVOIR DESIGN PARAMETERS



WATER SURFACE ELEVATION

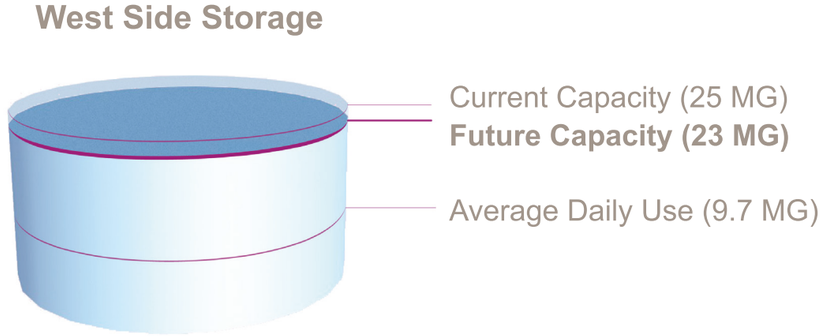
Maintaining the existing water surface elevation at Reservoir 3 is a critical part of retaining Portland's gravity fed water system. The existing drinking water surface elevation affects water pressure and water storage capacity throughout the 300' pressure zone. Two other reservoirs (Sam Jackson and Mayfair) in the 300' pressure zone would be affected by changes in the drinking water surface elevation at Washington Park Reservoir 3.

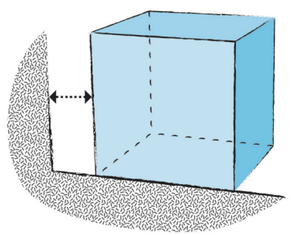




STORAGE CAPACITY

Creating functional, safe and resilient storage capacity in the Portland water system is a primary goal for this project. Reservoir 3 currently accounts for almost 2/3rds of Portland's West Side storage capacity. Maintaining this capacity for emergency response and resiliency is a critical driver.





HISTORIC LANDSLIDE

An ancient landslide above both reservoirs has been a maintenance issue ever since the original reservoirs were built in 1894. This landslide has caused damage to the existing water reservoirs, buildings and facilities over the last 100 years. Mitigating the impact of this landslide on the newly constructed reservoir is a major design parameter that requires careful consideration by the design team.

RESERVOIR SITE SELECTION - ALTERNATIVE SITE STUDIES

In 2002, the PWB completed an Alternate Sites Analysis. This study identified potential sites to construct storage facilities to replace existing open reservoirs at Mt. Tabor and Washington Park, and provided the methodology for analysis and the findings that led the current proposal to locate a buried reservoir at the Washington Park site.

There were four screening criteria. Any site that could not meet all four was eliminated. These are explained in greater detail as

SITE SCREENING CRITERIA

1. Elevation
The water surface elevation must be at 300'.
Determines water pressure in the area served.

2. Space for storage
- Minimum screening requirement was 2.5 acres to hold 5 million gallons (MG).
- Less than 5 MG would not be adequate for terminal storage.
- Later, it was recognized that the target should be more than 12 MG.

3. Zoning allows construction/use
Reservoir use cannot be prohibited; must be able to pass zoning tests.
- Prohibited in Residential zones.
- In Environmental Protection overlay, must be shown to be impossible elsewhere (see further discussion under General Feasibility)

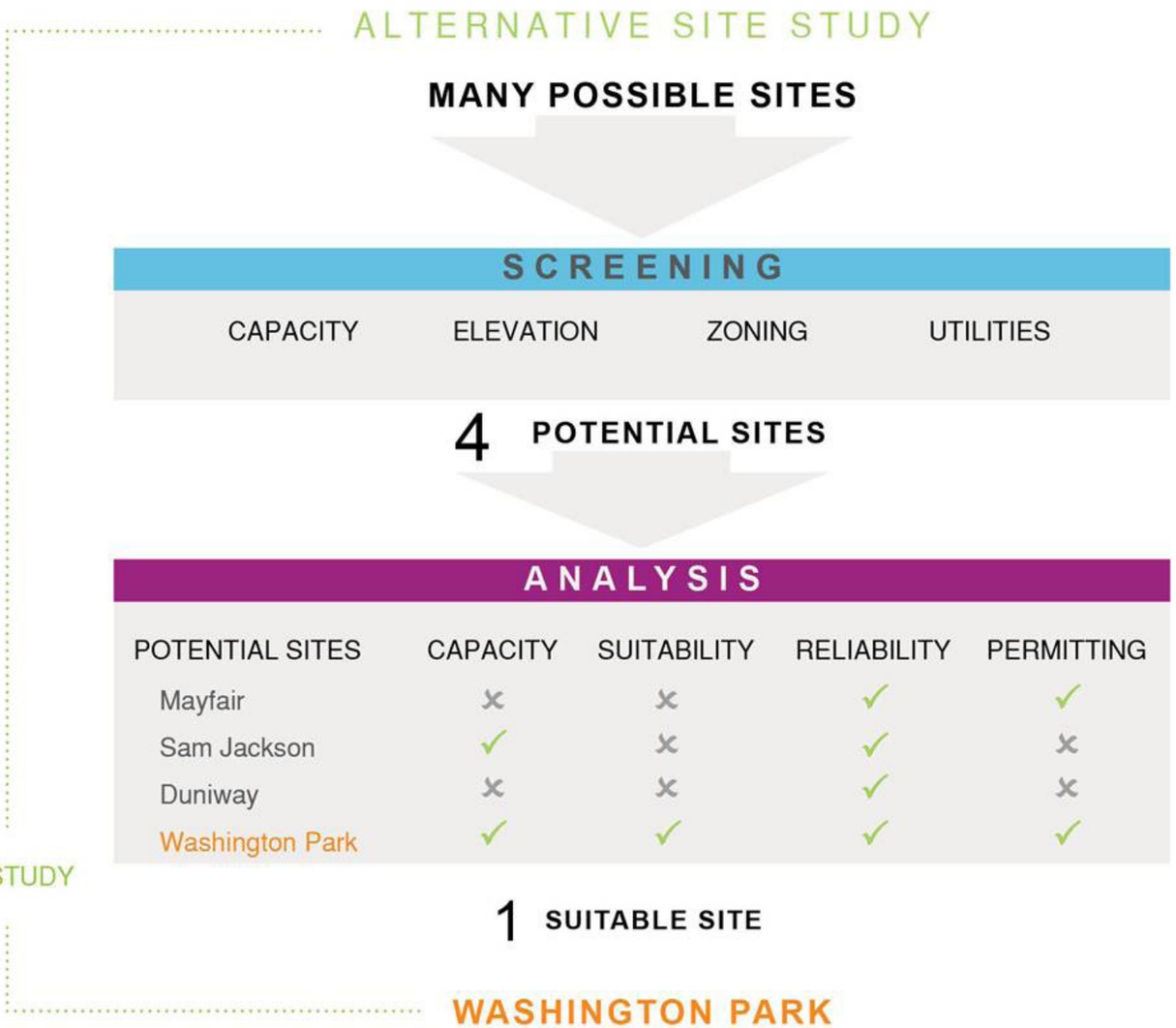
4. Proximity to major transmission lines
Must be able to receive and distribute large volumes quickly.
- Need large inlet and outlet pipes.
- Very costly to build new transmission lines.

1969
First request by OR Health Division to **cover or replace** open reservoirs

1972
EPA rated water system as **'deficient'** due to open reservoirs

1996
Open **reservoir study begins**- engineering studies, risk assessment, alternative recommendations

2002
ALTERNATIVE SITE STUDY



Screening revealed eight potential sites on the Westside. Note that Eastside storage cannot replace storage on the Westside, particularly because river crossings are vulnerable to interruption in an earthquake or other disaster. Without Westside storage, Portland west of the Willamette could be left entirely without water for drinking, firefighting, hospitals, or anything else.

GENERAL FEASIBILITY:

The eight potential sites with general feasibility were on the west side of the Willamette River at the right elevation, had adequate space for water storage, were not in zones prohibiting the use, and were in proximity to major transmission lines.

Three of these eight sites were in private ownership, which would require condemnation. All three of these were also already developed. This was not deemed practicable.

A fourth site was identified as a "Drainage area in Forest Park north of Cornell Road." This site was eliminated because, upon closer study, its zoning would not have allowed a drinking-water reservoir.

The Forest Park site is immediately east of the Audubon Society preserve on NW Cornell Road. It is zoned Open Space with an Environmental Protection overlay (the p zone) and a Future Urban overlay (the f overlay). It is in the Balch Creek Watershed Subdistrict of the Northwest Hills Plan District and is also within the Forest Park Natural Resource Management Plan area.

The Environmental Protection overlay makes it impossible to place a utility such as this on this site. The reason for this is that the development must meet approval criteria spelled out in Section 33.430.250.F.1 and 2, which state:

"In Environmental Protection zones the applicant's impact evaluation must demonstrate that all of the following are met:

1. All sites within the Portland city limits, in which the proposed use or development is possible, are also in the resource areas of the Environmental Protection zones;
2. Of these sites, development on the proposed site would have the least significant detrimental environmental impact;..."

The Alternate Site Analysis Study showed that, in fact, there is at least one other site (Washington Park Reservoirs being one) outside of the Environmental Protection zone that could work. Any site outside the Environmental Protection zone would have less detrimental impact than construction on the environmentally-zoned site in Forest Park. Ultimately, no

The four remaining potential sites were Mayfair Tank site, Sam Jackson Tank site, Duniway Park, and the existing site at Washington Park. These four sites were then evaluated using four criteria that address the suitability of any specific site for construction of a drinking water reservoir.

SITE-SPECIFIC EVALUATION CRITERIA:

1. Capacity/ Potential Storage Volume

- Larger sites reduce number of facilities, thus saving money.
- Larger volumes allow for better operational control.
- Larger sites allow for necessary related services, such as overflow.

2. Suitability for Construction

- Factors include topography, soil, environmental sensitivity.
- Well-suited sites allow lower costs, greater reliability, easier permitting, easier operation.

3. Reliability

- Reliability is enhanced when vulnerable systems, like pipelines, between reservoirs are minimized.
- Vulnerable systems can be damaged or interrupted more easily than the reservoir itself.
- Transmission pipes, regulators, pump stations, river and stream crossings, and pipes on bridges are all vulnerable systems.
- Hazards include steep slopes, unstable subsurface conditions, and fault zones.

4. Permitting

- Sites with fewer restrictions on the Basic Utilities use category are more desirable.
- Sites with less environmental impact are more desirable.

(Note that the Washington Park Reservoirs National Historic District did not yet exist.)

Of the four pre-screened sites, only the existing site at Washington Park proved to be adequate to provide approximately 15 MG of buried water storage, suitability for construction (the landslide can be mitigated), reliability due to location, and an existing allowed use.

Here is a summary of the principal deciding factors in the evaluation of each site:

Site	Evaluation
Mayfair tank site	• This site is at the far north end of the service area. Flow in this part of the distribution system tends to stagnate, impacting water quality. • Additional transmission line improvements would be necessary to address stagnation issue. Adds considerable expense. • Site can hold up to 5 MG of additional storage. • Steep, unstable ground to north, west, and south of existing tank is currently reinforced.
Sam Jackson tanks site	• This site is at the far south end of the service area, and will require transmission line improvements to make it feasible. • If a neighboring site can be purchased, it would be possible to have three 3 MG tanks at this site, but not a single larger tank. • The location of this site in the Terwilliger Plan District's design overlay zone will make permitting difficult.
Duniway Park site	• Above-ground tanks are required in this location to serve the 299-foot pressure zone (the upper Washington Park reservoir elevation). • There is capacity for about 5 to 6 MG of storage at this site. • The site is located at the far south end of the service area and will require transmission line improvements to make it feasible. • The site is underlain by non-engineered artificial fill, which is unsuitable for reservoir foundations and very expensive to mitigate. • This site would also require significant transmission line improvements in order to be operable. • This site is in the Terwilliger Plan District, and permitting is likely to be difficult.
Washington Park Reservoirs site	• Meets elevation and space criteria. • Ideal site for reliability (close to downtown and central to area serviced). • No major transmission line improvements required. • Allows approximately 15 MG of storage. • Must address landslide issue. • Permitting easier than most locations because storage would be within existing reservoir areas (prior to historic resource designation).

CAN IMPACTS BE AVOIDED?

Some level of impacts cannot be avoided. The Washington Park Reservoirs could be decommissioned as a water storage facility. Nevertheless, some degree of landslide mitigation will need to be put in place to protect important remaining facilities. Even if those measures can be designed to avoid the historic basins, this course of action comes with serious consequences.

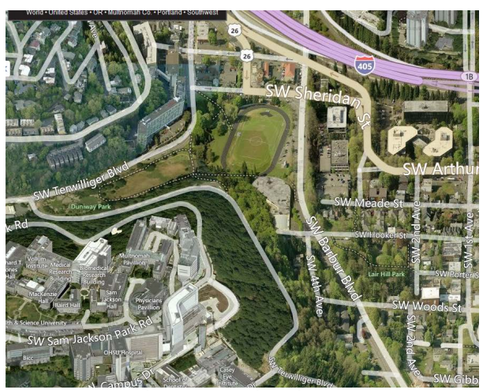
First, there are consequences to the City's water system. Water facilities for the City of Portland would need to be constructed elsewhere (or not at all). If another site is chosen, the other viable sites come with very significant operational, environmental, and logistical drawbacks. In fact, even combining the other available and usable sites does not add up to the volume the system requires.

Second, there are consequences for the historic site if the Portland Water Bureau constructs water facilities elsewhere. The reservoirs would be decommissioned from the drinking water system and left in their current condition. The historic site would remain vulnerable to continuing landslide damage and the site would not be accessible for safety reasons. Unfortunately, the facility is not comparable to a historic building, which can be adaptively reused by another purchaser.

This project is a huge opportunity for the restoration of the Washington Park Reservoirs Historic District. The project will not only save and restore most of the contributing structures, but the future of the site will be assured for many decades to come. The site can become not only functional and historic, but also inviting, inspirational, and educational.

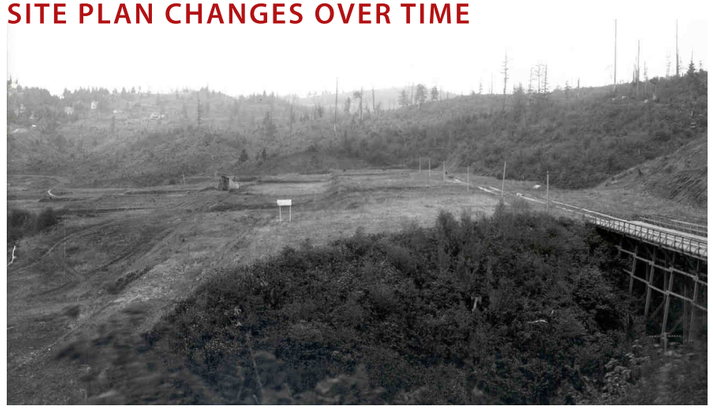
Mayfair tank site, NW Portland


Sam Jackson tanks, SW Portland

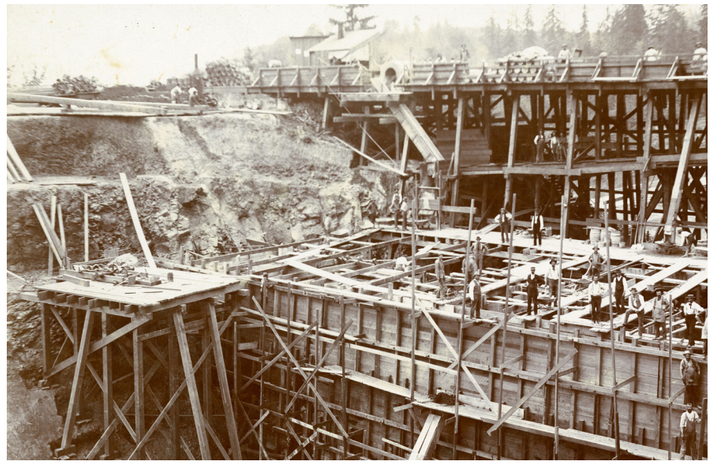


Duniway Park, SW Portland

SITE PLAN CHANGES OVER TIME

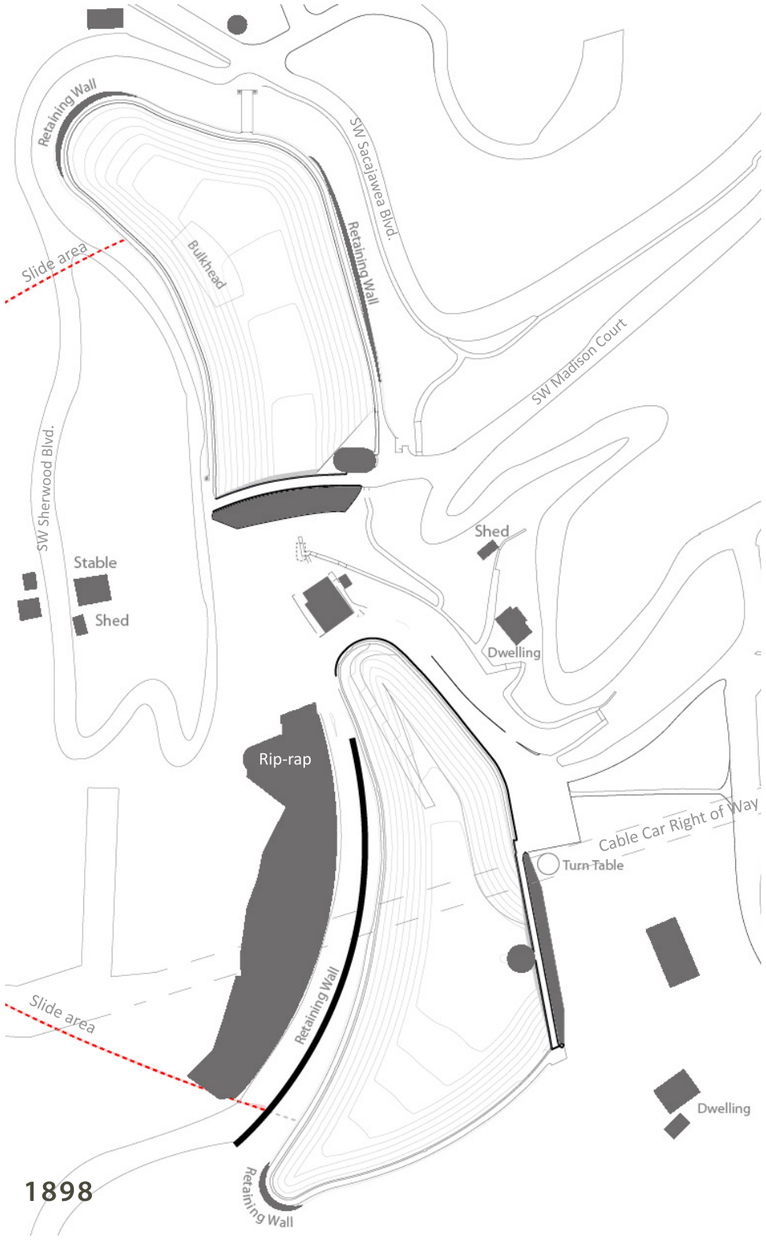


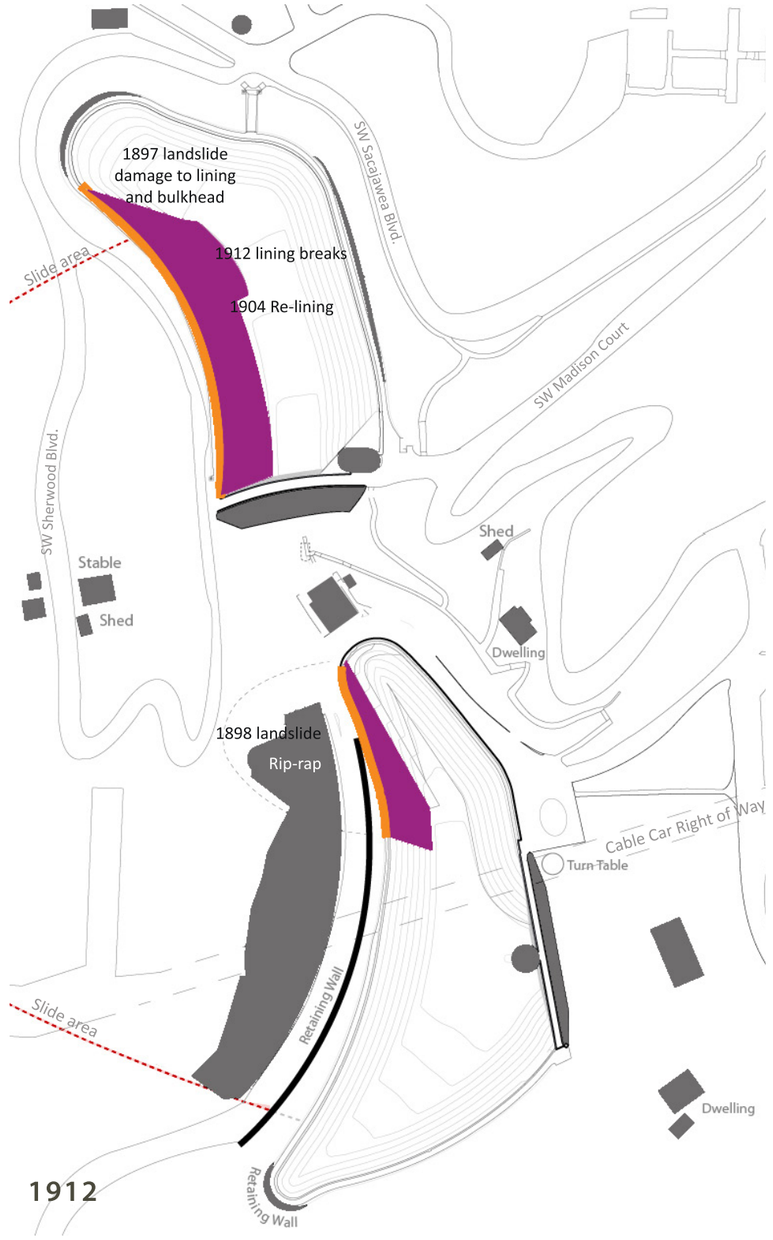
The site, pre-construction around 1893



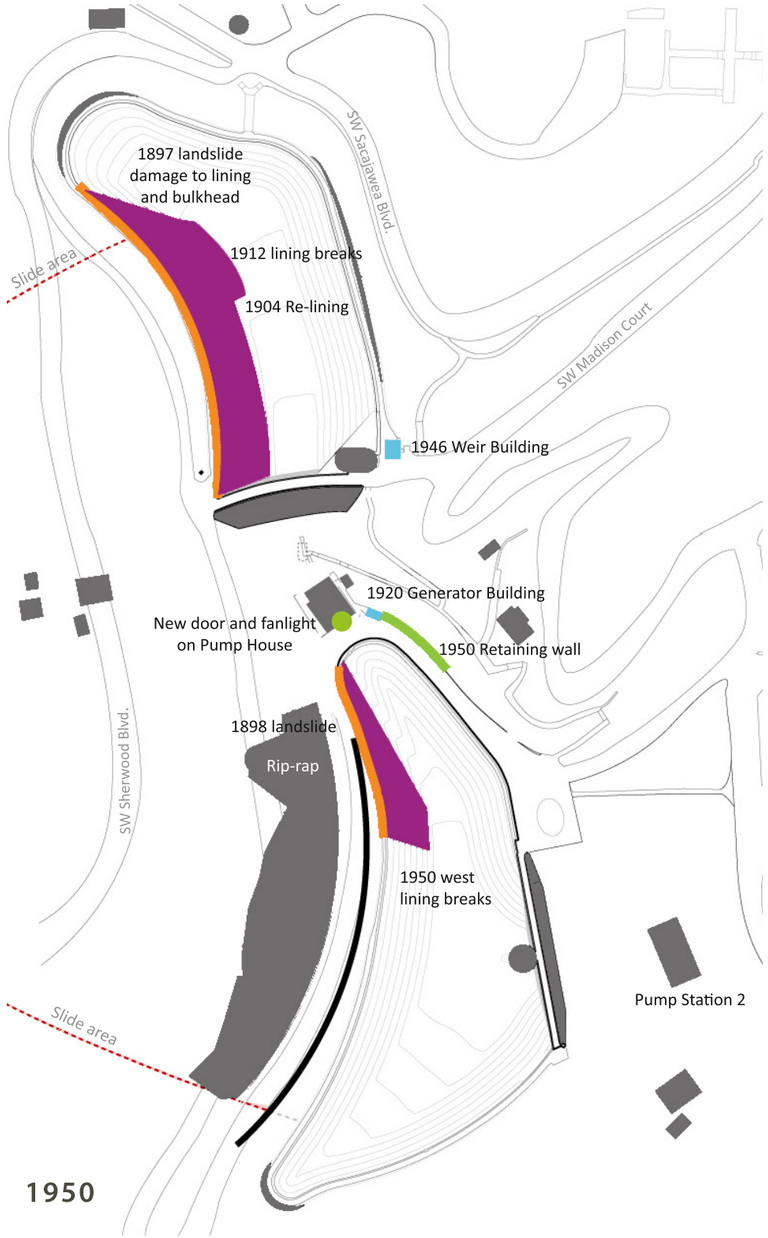
Dam 3, under construction

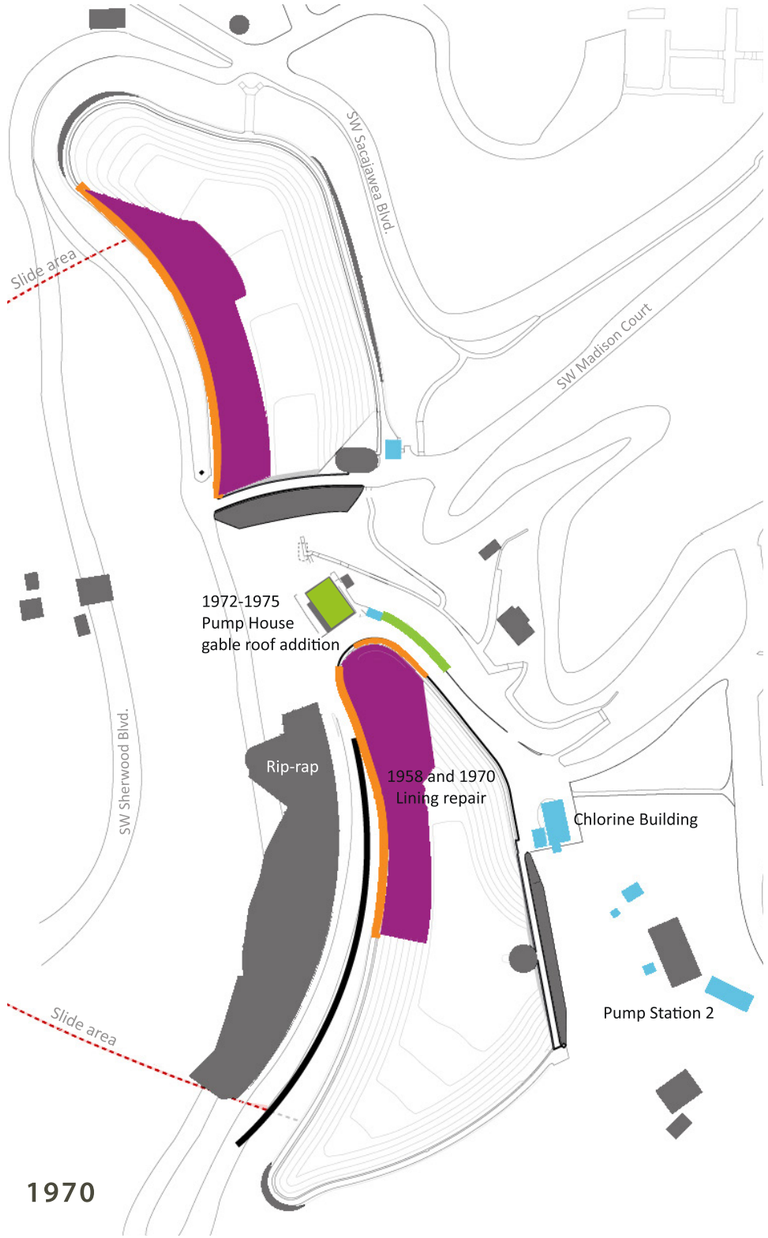
Dam 3, current conditions

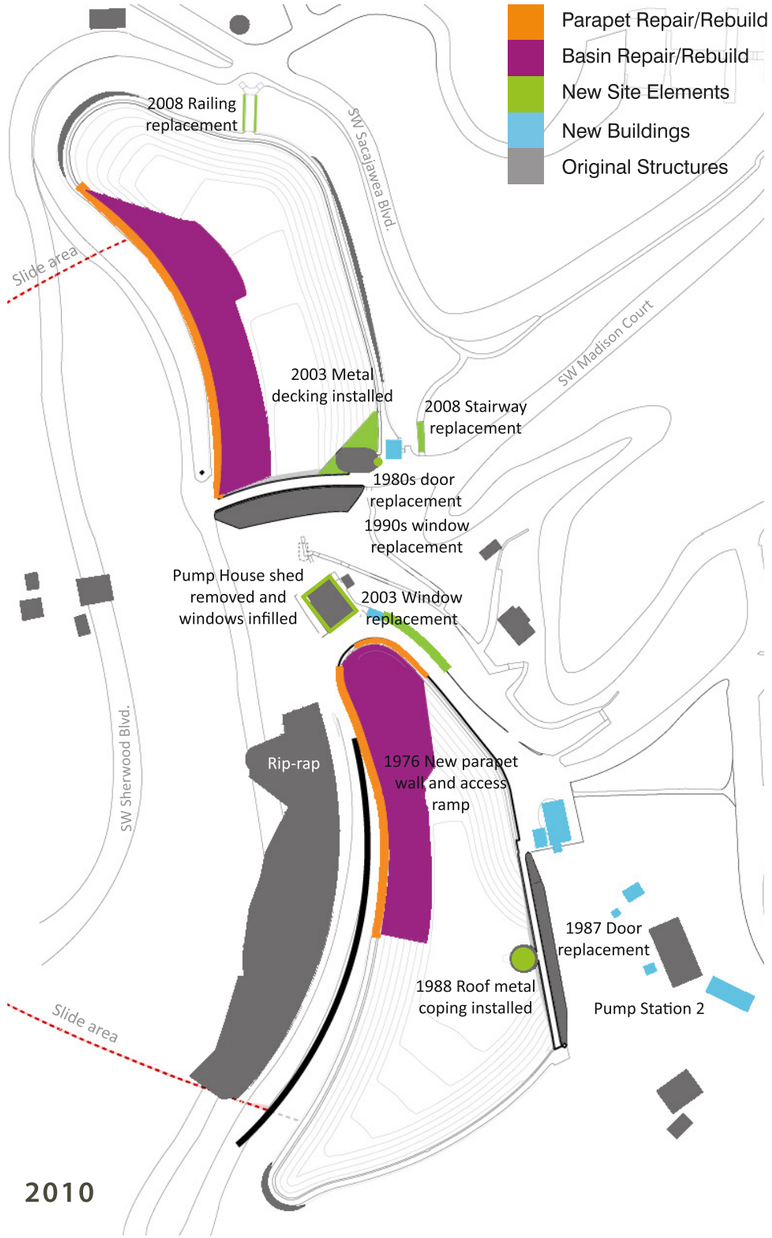




- Parapet Repair/Rebuild
- Basin Repair/Rebuild
- New Site Elements
- New Buildings
- Original Structures







Washington Park Reservoir Improvements Project