Analytical Essay Part 1:

Long-term Capitol Lake Management Plan Review in Relation to the Sea Level Rise in Downtown Olympia

Even with modernized bridges, waterside walks, and the man-made Capitol Lake, downtown Olympia has a long history of being a meeting place since before the prehistoric era. Native American tribes, ancestors from the current Nisqually and Squaxin tribal members, had resided in Budd inlet fishing and living in longhouses up until the Euro-Americans began exploring and building settlements in mid 1800s (Thurston County Historic Commission [TCHC], 1992). However, such a long history of downtown Olympia as a festive gathering spot has now been threatened by impending flooding and inundation due to the rising of global sea levels. This essay explores the current and two alternative options of the Capitol Lake/lower Deschutes Management Plan correlating with the current sea level rise plan of the City of Olympia.

Response to sea level rise of the City of Olympia

In response to the sea level rise, the City of Olympia has developed Annual work plans since 2008 to solve the inundation and flooding of the lower downtown area (APWA Spring Conference. 2016). Among 4 engineering options to control flooding—diverting, storing, confining, or pumping the flood water—the city of Olympia has narrowed their options down to two viable options: diverting and pumping (Coast & Harbor Engineering [CHE], 42-43, 2011). In order to divert water back to the sound, gravity drain pipes are being installed in 5 different segments of downtown along with outfalls that collect flood water and release it to the nearest water outlet: East Bay, West Bay, Capitol Lake, and two along the western shoreline of West Bay (CHE, 42-43, 2011). These water outlets, including Capitol Lake,

face the responsibility of containing water influx from draining the land as well as providing enough water reserve to keep the raised sea level from encroaching backward into downtown.

The limitation of the Capitol Lake as a floodwater outlet due to sediment accumulation

The fate of Capitol Lake, opposed to the initial purpose as an iconic "reflecting pool" to improve the commerce and artistry in city-planning viewpoint when first built in 1951 (Department of Washington Enterprise Services [DES]–Chapter 3.1.1, 2016), has been questioned as to its capability of water management encountering the sea level rise and downtown inundation. The feasibility of the current Capitol Lake Management Plan, "Managed Lake", casts doubts about the water capacity due to what damming the Lower Deschutes River has brought: sediment accumulation.

Deschutes River transports approximately 35,000 cubic yards of bedload sediment into Capitol Lake, and most of it is stored within the lake because of 5th Avenue Dam blocking the water flow. Due to more than 65-years of sediment accumulation, current water capacity of Capitol Lake is about 60% compared to that of when the dam was built in 1951 (DES–Chapter 4.1, 2016). If the city plans to "revive" the lake by simply digging out the accumulated sediment and conduct dredging as a long-term solution, the cost of only dredging would comprise 87.50% of the total cost, which would account for 133.33% of the cost of any of the other alternative plans (DES–Figure 9, 2016). This one-time plan is contradictory to a sustainable strategy since it would require annual dredging and signify a more superficial answer to a long-term problem.

Comparison of the two options in relation to the sea level rise – water capacity

The two Alternative plans of the Existing Options of the Capitol Lake Long-Term Management Plan ("CLAMP") are "Hybrid Option: Dual Basin" and "Restored Estuary", approaching the Capitol Lake sediment issue from a more ecological perspective. Both options include widening the current 82-feet

wide 5th Avenue Dam into a 500 feet wide dam, transforming Capitol Lake as part of the Lower Deschutes River and turning it back into an estuary (TCHC, 1992). The difference of these options is how much of Capitol Lake would be open as an estuary; “Restored Estuary” alters the whole lake into an estuary whereas the “Hybrid Option” allows half of the lake and blocks the other half as a water reservoir and blockage against sea level rise (DES–Chapter 3.3.1, 2016).

According to the “Hybrid Option”, the half-lake formed by dividing the lake with a sheet pile wall would work as a protecting division against water influx to Heritage Park in the downtown side. The “half-lake” would be filled with salt water because of two culverts in the lower wall for water circulation, which indicates the increase of water inside the half-lake as the raised sea level affects the other open half of the lake and the Budd Inlet estuary.

The current water volume of the whole Capitol Lake with the area of 260 acres and average depth of 10.4 feet in 2009 is 386,438 cubic kilometer (Department of Ecology, 2015). Under the status of the 0.25 feet sea level rise in Budd inlet, the additional amount of water expected inside the lake is about 0.2498 feet high; quite close to the Budd Inlet’s increased sea level which can be projected to be a similar increase of water level both in and out of the half-lake with the 0.5 ft sea level rise (CHE, 28-33, 2011). Additionally, the wall surrounding the half-lake should raise at least twice higher considering any instant event of huge influx of water flow due to reduced amount of water capacity of the half-lake. This isolated half-lake would not likely to contribute to the scenic downtown nor be a fundamental solution for the sea level rise plan that predicts and prepares for 50 feet raise of sea level (CHE, 28-33, 2011).

Erosion due to the increase of water in the lake and how the type of estuarine environment helps

What must also be considered with these Alternative Options is the effects of erosion and estuarine soil. The area along the shoreline near the Port of Olympia has been experiencing serious soil loss and weakened shore structure due to tidal movement (CHE, 34-35, 2011) of an average 17.16 feet

difference between high and low tides (NOAA, 2013). On top of tidal height, the rising sea level would loosen the shoreline through water level elevation. As the sea level rises, it takes drastically shorter time to gain higher water elevation; with the sea level rising 0.25, 0.5, 1, and 2 feet, the time it takes to reach 11.37 feet NGVD ("return period") would decrease to 40, 18, 2, and less than 1 year, respectively, compared to 100 years when there is no sea level rise (CHE, 38-39, 2011). The increased inundation risk due to tide and sea level rise phenomena will abate not only shoreline but also overall low area in downtown.

However, the type of soil that would fill in the Capitol Lake and Budd Inlet after opening the 5th Avenue Dam can help with the soil erosion issue. The Lower Deschutes River would carry bedload with smaller mass in slower hydraulic speed, dropping and stabilizing the sediment distribution (Batzer & Sharitz, 2014). The small sediment carried to the mouth of river has lower permeability, storing more water than sediment with higher permeability, such as silt and clay, which hold water better than coarse sand. Also, the vegetation that would withstand low oxygen and salt water in estuaries would contribute to expanding the water capacity in the restored Deschutes Estuary(Wetland International and The Nature Conservancy, 2014). Such role of sediment in lower river or estuary provides the reason that transported sediment should be released to form estuarine environment with potential water reserve.

Sediment release and distribution from dam removal in Elwha River

The Glines Canyon Dam and Elwha Dam removal (2011-2014) on the Elwha River in the State of Washington offers a good example of sediment distribution and formation of estuary to regulate and prepare for the water level increase. The sediment release after dam destruction has transformed 8 floodplains into land, with an average of 0.50m (±0.38m) of deposition covering the floodplains (Amy et al, 652-654, 2015). This 0.50m raise of floodplains is now dry during Summer and wet during Winter,

playing a water reservoir role; it is comparable to the pre-dam-removal floodplains not functioning as a place ready for overflow or inundation since they were submerged under water.

Along with the sediment discharge, dam removal showed less fluctuation of water elevation level between wet and dry seasons even with tides (Amy et al, 658-659, 2015). The formation of estuary in the Lower Elwha River has helped regulate sediment and water volume over the course of 4 years; the dam demolition was not just to reduce the volume of water by draining it out to the sea but to restore the sediment's function of retaining water in the lower river. The fundamental change of transforming lakes into an estuary of Elwha River has dramatically started to show when the second dam began its process of being demolished in 2012 (Amy et al, 652, 2015). This signals the reason why wider and more whole restoration is necessary in small downtown Olympia. If CLAMP were to choose the "Restored Estuary" and turn the whole lake into a part of Deschutes Estuary, it would include the faster water and sediment distribution and allow the estuary to work as a reservoir in response to the sea level rise.

Recommendations and Conclusion

As a part of the Deschutes River and Budd Inlet, it is unavoidable to not include the Capitol Lake Management Plan into the response of the impending Sea Level Rise. The two existing options of "Hybrid Option: Dual Basin" and "Restored Estuary" enclose Capitol Lake as a part of the lower river estuary while the city's plan for the sea level rise requires more variables to be considered. After comparing the two options, the "Restored Estuary" plan would prepare Capitol Lake to have more water capacity and prevent erosion with high water-retaining soil, which would withstand the combination of tides and accelerated erosion under the sea level rise effect. The natural approach of restoring the river flow in Elwha River informs us that simply opening the dam and accepting the water into the lake can resolve many more problems as well as revive our ancestor's culture of living with the Deschutes Estuary.