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Establishing the East Seattle School Open Space

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The Evergreen State College: Soil Ecology to Inform Ecosystem Restoration

Introduction

The site chosen for restoration is a 2.87-acre area that until recently was home to the historic East Seattle School building on the north end of Mercer Island, WA. Mercer Island is a suburb of Seattle and is unceded ancestral land of the Duwamish people. The island was first settled by non-native people in the 1870s. By the 1890s, most of its old growth trees had been logged (Gellatly, 1977). Despite this ecosystem destruction, settler residents also established a culture of conservation and appreciation of nature whose legacy is evidenced by its large forested parks that are part of the 350 acres of open space maintained by the city (see image 1 for map of open spaces). I chose the East Seattle School site for three reasons: (1) it is deeply degraded due to having been cleared and covered with asphalt and multiple buildings that were built before environmental and safety standards, (2) the spot is important to the Island's history and should be preserved for public use; and (3) it is adjacent to a small park with older trees that can serve as 'mothers' as new trees become established. Establishing the East Seattle School Open Space can support ecological resilience by rebuilding soil life, providing wildlife habitat, reduce the impact of nearby development, and provide opportunities for nature education and connection.

Background on disturbance

The site is located on the northwest end of the island in the island's oldest neighborhood (see Image 2). It is bordered by 28th Street SE to the north, W Mercer Way to the east, SE 30th Street to the south and 62nd Avenue SE to the west. It is four blocks east of Lake Washington. Single-family homes, both historic and modern, surround the site.

The East Seattle School building, originally built in 1914, was constructed of cast in place reinforced concrete, and had an overall footprint of 114’ x 50’. A gymnasium was added at an unknown date, and a gymnasium extension was added in 1938. The gymnasium was torn down and replaced in 1990. The 1990 gymnasium measured approximately 98’ by 105’ and had tilt-up concrete exterior walls finished with stucco. Approximately 50.3 % of the site was in built area/impervious surfaces (63,162 sq. ft.) and approximately 49.7 % of the site was in open space areas/pervious surfaces (62,291 sq. ft.) (City of Mercer Island, 2020).

The school was closed in 1984, and the city leased the buildings to the Boys and Girls Club, who took over ownership of the property in 1986. The Club sold the property to a private company in 2007 and entered into a 12-year lease. Soon thereafter, the Club moved its main operations to a new building and used the East Seattle buildings only for storage, leaving it mainly unoccupied. The buildings fell into disrepair and became a target for vandals. The original school building was deemed eligible for the National Registry of Historic Places, but attempts to protect it as a historic landmark were unsuccessful (City of Mercer Island, 2020; Eals, 2019). Demolition began in late 2020 (Mercer Island Reporter, 2020).

The1914 school building was located in the center of the site, and the 1990 gym was on the south end of the school (see Image 3). There were parking lots on the east and west sides of the school, lawn on the west and south side of the gym, and a grassy field with a volley ball court in the northeast corner of the site (City of Mercer Island, 2020).

Nothing remains of the original forest that once stood on the land.

The challenges of ecosystem restoration on this site are numerous. Given that over half of the land was covered in either building or parking lots for more than 100 years, soil life is likely to be minimal on much of the site. Soil sealing due to buildings and pavements reduces microbial activity, soil organic carbon, and carbon soil sequestration in urban soils (Pereira, O'Riordan & Stevens, 2021). In addition to the damage caused by removal of vegetation and topsoil, anthropogenic land use also harms ecosystems due to soil compaction. Soil compaction reduces organic matter and ectomycorrhizal activity and inhibits plant growth (Amaranthus, Page-Dumroese, Harvey, Cazares, & Bednar, 1996). As local restoration expert Clay Antieau notes in his response to Mercer Island's Open Space Plan, compacted "soils take a very long time (if ever) to return to 'pre-compaction' physical, chemical, and biological conditions" (City of Mercer Island, 2015, p. 85). An additional challenge is the likelihood of toxic substances remaining in the soil after demolition, primarily lead given the age of the building and the likelihood of potentially multiple layers of lead paint as well as its proximity to a busy roadway once used by cars fueled by leaded gasoline (Clark, Brabander, & Erdil, 2006).

Restoration target(s)

The overall goal of this restoration project is to increase ecological resilience on Mercer Island by returning the East Seattle School site to a Douglas fir-Western red cedar forest by planting a mix of native hardwoods and conifers as well as climate-resilient non-native trees, shrubs including evergreen shrubs, and plants. Returning the land to forest will make this heavily developed area more resilient by (1) improving soil ecology and stability, (2) supporting networks of mycorrhizal fungi, (3) integrating climate-adaptive species, (4) providing habitat for local birds and wildlife, and (5) encouraging neighborhood residents to connect to natural world.

Returning to Forest

Records show that when settlers starting visiting it, Mercer Island was mostly uninhabited and full of large evergreen trees (cedar, Douglas fir, hemlock), berry bushes (blackberry, thimbleberry, salmonberry, Oregon grape, blackcaps, salal, huckleberry, gooseberry, and strawberry), birds, and animals (deer, raccoons, muskrat, weasels). Logging started in the 1880s, and in 20 years most of the old growth was harvested (Gellatly, 1977). A recent survey of Mercer Island's open spaces documenting the percent of open space plots where various species are currently found, shows that historical species no longer dominate: Grand Fir (.46), Douglas Fir (1.84), Western Red Cedar (26.9), and Western Hemlock (2.07). The most dominate species, found in 56.3% of plots, is Big Leaf Maple (City of Mercer Island, 2015). Native trees and plants continue to flourish on the island and are included in the restoration plan.

Efforts will be made to tie the East Seattle Open Space into the nearby mini-forest at Secret Park. Secret Park is a .5 acre area across a residential street from the East Seattle School plot. In 2017-2018, students from the University of Washington partnered with the City of Mercer Island to develop and carry out a restoration plan for this small strip of forest. An assessment of Secret Park where students described its vegetation before restoration states that:

Site vegetation can be characterized by 30% vegetative cover through the canopy

> by late successional trees such as Douglas-fir (*Pseudotsuga menziesii*), western red cedar (*Thuja plicata*), and Pacific madrone (*Arbutus menziesii*). The subcanopy accounts for about 40% cover generally by indian plum (*Oemleria cerasiformis*), invasive and non-native English holly (*Ilex aquifolium*), and wild cherry (*Prunus avium*), and English ivy (*Hedera helix)* and Himalayan blackberry (*Rubus armeniacus)…* Greatly reduced Himalayan blackberry (relative to previous populations) and several juvenile native conifers throughout the site can be attributed to previous restoration efforts *(*Burns et al, 2018, p. 10).

Other species found at the site were: Oregon ash (*Fraxinus latifolia*), bracken fern (*Pteridium aquilinum*), sword fern (*Polystichum munitum*), and salal (*Gaultheria shallon*), sedges (*Cyperaceae), and* cottonwood trees (*Populus trichocarpa)*. One target of the restoration project was to remove as much invasive species as possible, including Cherry laurel (Prunus laurocerasus), English holly (Ilex aquifolium), English hawthorn (Crataegus monogyna) and Himalayan blackberry (Rubus armeniacus). They noted that this would need to be an ongoing effort as invasive plants can re-establish from neighboring gardens (Burns et al, 2018).

In their restoration efforts, students planted a variety of native trees and shrubs, removed invasive species, and closed off social trails to decrease disturbance. The students projected that "If properly and continuously maintained, Secret Park will be dominated by native conifers such as Douglas-fir (*Pseudotsuga menziesii),* Western red cedar (*Thuja plicata*), and grand fir (*Abies Grandis*)… The sub-canopy and ground canopy would be rich in ocean spray, indian plum, sword fern, and bracken fern. The ecosystem in the future would be classified as a Douglas-fir, western redcedar forest" (Burns et al, 2018 , pp. 18-19). Information from the Secret Park restoration, along with city data on native plants currently thriving in other forested areas on Mercer Island and expert reports on the city's open space plan, were all used to develop the species lists for the East Seattle Open Space.

This project differs from the Secret Park restoration project in that Secret Park was already in a forested state, albeit one suffering the impacts of nearby development including soil compaction and invasive species. Reforesting at East Seattle Open Space will require more intensive long-range planning and oversight, additional amendments, and careful selection of species to encourage the reestablishment of soil life. The first step to encouraging a forested ecosystem is rebuilding and stabilizing the soil.

<u>Improving soil ecology and stability</u>

Soils are important for maintaining life on earth. All of the life-supporting realm--atmosphere, lithosphere, hydrosphere, and biosphere--meet in the pedosphere. Soil organisms create the foundation for the above-ground plants and animals in an ecosystem. Soils are full of microscopic organisms performing a variety of important functions, including 'ecosystem engineering', or the creation, transformation, or maintenance of a habitat. Degradation of soils impacts the biodiversity above ground (Parker, 2010).

Moreover, soils can sequester carbon, potentially slowing climate change, and high plant diversity increases carbon capture and storage rates (Yang, Tilman, Furey, & Lehman, 2019). Healthy soil is needed to support plant diversity.

<u>Supporting networks of mycorrhizal fungi</u>

Mycorrhizal fungi are crucial to soil and plant life. Mycorrhizal fungi have a mutualistic relationship with plants as they trade nutrients within plant roots (Gorzelak et al, 2015). These fungi also form networks that allow plants to communicate with each other through biochemical signaling and also to share resources for survival. These networks can help trees communicate not only within species but also in some cases across species to help forest communities recover after disturbance (Song et al, 2015). Native, late successional arbuscular mycorrhizal fungi helps soils resist invasive non-native plant species (Koziol et al, 2018)

Integrating climate-adaptive species

Effects of climate change in the PNW include rising temperatures, stronger winds, increasing precipitation in the winter and decreased precipitation in the summer with potential drought conditions. In the face of climate change, all restoration projects need to both increase local ecosystem resilience and help address the causes of climate change through means such as sequestering carbon.

Providing habitat for local birds and wildlife

Ecosystems with higher biodiversity are more resilient. Moreover, the soil food web benefits from animal waste and foraging. Healthy soil food web feed the overall food chain supporting all insect and animal life.

Encouraging neighborhood residents to connect to natural world

Spending time in urban green spaces benefits human health and mental health in numerous ways, including improved affect and cognition (Bratmen et al, 2015) and reduced hypertension (Karden et al, 2015). Moreover, spending time in nature also increases a sense of connection to nature which can lead to increased desire to protect it (Rousseau & Deschacht, 2020)

Plant and soil evaluation

There are 9 Western Red Cedar trees about 40' tall on the south edge, 18 unidentified trees likely to be wild cherry (prunus aviam) on the SE corner, east edge, and NE corner, and one Pacific Madrone on the north edge. There are also a few alder trees one the west edge. All of these mature trees will be incorporated into the forest plan. Most of the non-built areas are either lawn grass, overgrown non-native shrubs, or invasive blackberry bushes, which will need to be removed.

The property generally ascends from the southwest to northeast with approximately 35 feet of elevation change. There is a steep edge between the volley ball court and rear parking lot and a few other areas where the slope has been altered to accommodate buildings that will need to be sculpted to return the surface to a more natural shape. The site is located within a residential neighborhood of single-family homes. It is bordered on the east by West Mercer Way, which is one of the island's main thoroughfares, leading to an I-5 on ramp about 1 mile north of the site.

<u>Soil type</u>

According to the websoil survey, the soil in this part of Washington State is "Kitsap silt loam." The handtest, however, suggested that there was some clay in my soil sample. The assessment of soil at nearby Secret Park found the soil texture was "homogenous in nature, rarely deviating from sandy loam. At the same time, coarse graininess is common throughout the site—the soil is well drained but compacted in some off-trail areas" (Burns et al, 2018, p. 7). The soil at the East Seattle School site is likewise somewhat variable and compacted. While digging for soil samples, some areas were easy to dig while others quite hard, and some were only a little most while others very wet. This lack of consistency adds a layer of complexity to the project since soil type has implications for density and the effectiveness of various treatments.

Soil analysis results

Organic matter (3.1%) and the Cation Exchange Capacity (CEC) (10.5/100g) are both low in the soil sample sites, and probably even lower in areas where there were buildings. This is likely a source of the deficiencies in calcium and sodium and slightly lower than ideal soil pH, described below. One goal of the project is to raise the level of organic matter into the hundreds and to double the CEC. Raising the level of organic matter is needed to improve plant growth as well as provide habitats for soil microbes and soil dwelling invertebrates.

Calcium at 1127 ppm is low, which will impact plant growth. Calcium provides structural support to plant walls, and a lack of calcium can result in plant death or weakened stems (Oldham, n.d.). Sodium is also low at 18 ppm. While plants do not need sodium as a nutrient, soils need sodium for good soil structure, which in turn affects plant root growth. Sulfur was very low at 3 ppm. Sulfur helps plants thrive by helping them produce proteins, amino acids, enzymes and vitamins and form seeds. Increasing the nutrient levels will improve plant growth, which will in turn improve conditions for soil flora.

Another important soil nutrient, Nitrogen, is low at 1 ppm. Although that could be because of the time of year the sample was taken and the inaccuracy of a one-time test versus one that captures rate, it is likely that nitrogen deficiency needs to be addressed. Nitrogen is essential for helping trees and understory plants produce the amino acids and proteins that help them grow. Moreover, nitrogen in the soil supports the cycling of other nutrients in the soil and is a piece of the nitrogen cycle, or the circulation of nitrogen in ecosystems, supporting life on earth. When raising nitrogen levels it is important to keep in mind its relationship to calcium and CEC (Periakis, Maguire, Bullen, Cromack,. Waring, & Boyle, 2005).

The soil pH at the site is 6.1, which is a little low for reestablishing forest life and will need to be raised slightly. A typical Douglas fir forest has a pH of 6.0-6.5, and western red cedars prefer a pH between 6-7.5. The pH needs to be at the right level to support the health of key tree species, the dominant plants in the forest.

Lead can be assumed to be present near building site. Lead is a problem for new plants as it may prohibit root growth (Fahr et al, 2013) and is potentially toxic to soil microorganisms (Sobolev & Begonia, 2008). Lead is also toxic to humans, and care must be taken to prevent exposure by limiting human contact with contaminated soil. This can be done pulling lead out of soil by trapping it in plants (phytoremediation), or otherwise capping, treating, or removing the soil.

Recommended treatments

Several treatments will be utilized to increase organic matter, CEC, pH, nitrogen, calcium, and sulfur levels; encourage mycorrhizal activity; remove and stabilize lead; and establish forest flora.

<u>Add organic matter and amendments to address deficiencies</u>

Compost, leaf litter, wood chips and biochar will be added to the soil to **raise organic matter, increase CEC and pH**. A common way to increase organic matter and

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