5.0 LANDSCAPE MANAGEMENT PROCEDURES

This Landscape Management Procedures chapter is intended to direct the work as determined by the management goals, objectives and standards (Section 4.0) in a way which is consistent with industry best management practices. This chapter is supplemental to the specifications (Appendix D) of this management plan. In addition, the following management procedures have been permitted as acceptable approaches for performing work within the project site, which is regulated by the Critical Areas Preservation Ordinance. Any deviation from these standards must first be granted written approval from the City of Tacoma's permitting authority prior to the management action being approved.

5.1 TOTAL PROJECT SIZE

The total project area is approximately 31 acres. Due to the unpredictable nature of the site and its existing conditions, the management procedures of this management plan will need to be executed over an extended period of time. Project size thresholds are needed in order to ensure that any given project does not exceed the ability to be managed effectively if a complex issue or setback arises, for example an erosional event or a high level of plant mortality. In addition to the need to implement a maximum allowable site disturbance threshold, a minimum project size needs to be defined in order to ensure that the aggregate total of small projects does not bring the site out of compliance with the standards of this management plan.

Disturbance, as defined in this management plan, refers to permitted maintenance and management activities such as pruning, invasive removal, and planting. Site clearing and grading are not considered permitted maintenance and management activities through this management plan. Any proposal to clear and/or grade will require additional review and may require additional permitting not covered by this management plan.

5.1.1 MAXIMUM PROJECT SIZE

The allowable maximum site disturbance (project size) is as follows:

1. A maximum disturbance of 0.25 contiguous acres (10,890 square feet) in any given year (one project) without an Erosion Control Management Plan.
2. If over 0.25 contiguous acres is proposed to be disturbed, an Erosion Control Management Plan will need to be prepared by a Certified Erosion and Sediment Control Lead (CESCL) in order to effectively manage for any potential erosion events.

5.1.2 MINIMUM PROJECT SIZE

The allowable minimum project size is one of the following (whichever is greater):

1. 400 square feet; or,
2. if work is proposed to prune and/or remove an existing tree the minimum project size shall be the measurement for the 100 percent soil-binding effective tree root zone (refer to Section 4.2.1.1).

5.2 PLANT SELECTION

Plant selection is intended to replicate the historical target ecosystem (North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest). This ecosystem includes a multi-layer canopy structure with a mix of large trees, small trees, shrubs, and groundcover. Before producing a proposed planting palette, consult Appendix D, Table 1 for the recommended plantings for specific locations, light and soil conditions within the project area.

In addition to plants typical of the historical target ecosystem, there are native species which may be better suited to conditions within the project area and have been documented as good choices for providing slope stability. The planting assemblage may include these additional species where slope stability or other conditions are particularly challenging.

5.2.1 TREES

Large trees should generally consist of climax species of native conifers (Douglas-fir, Western hemlock, Western redcedar, and grand fir). Douglas-fir and grand fir are considered an excellent species for reforestation due to their ability to tolerate a wide range of conditions. Western redcedar and western hemlock are late successional species which require shade/part-shade and mature soils with organic matter for healthy growth; cedar and hemlock species should be installed selectively in areas with appropriate conditions. Deciduous pioneer species such as red alder and bigleaf maple are not recommended for planting as they currently dominate the project area. Small trees may include species whose mature height is typically less than 50 ft, such as shore pine (*Pinus contorta var. contorta*), vine maple (*Acer circinatum*) and cascara (*Rhamnus purshiana*).

5.2.2 SHRUBS AND GROUNDCOVER

Understory vegetation in the target ecosystem includes, but is not limited to: vine maple, sword fern (*Polystichum munitum*), salal (*Gaultheria shallon*), low Oregon grape (*Mahonia nervosa*), salmonberry (*Rubus spectabilis*), devil's club (*Oplopanax horridus*), and evergreen huckleberry (*Vaccinium ovatum*).

Of those, sword fern, salal, low Oregon grape and evergreen huckleberry are evergreen species which provide a dense ground cover (typically under 4 ft) below the forest canopy. These species require shaded forested conditions to thrive and are recommended for installation in areas with established canopies of evergreen trees. Vine maple is an excellent species for revegetation and can tolerate a wide range of conditions; however, it is deciduous and should be planted in combination with other evergreen subcanopy species.

5.2.3 EDGE HABITAT

Vegetation within edge areas and openings should consist of native species which can tolerate diverse light and soil moisture conditions, while providing for fast, aggressive growth in order to compete with invasive species such as Himalayan blackberry. In addition to planting evergreen trees, which will eventually provide a shaded cover and restrict the growth of Himalayan blackberry, aggressive, fast growing shrubs such as Nootka rose (*Rosa nutkana)* and snowberry (*Symphoricarpos albus*) should be included.

5.2.4 TOP OF SLOPE

Planting areas which have the potential to impact views within the project area include the top of slope and the slope face. The top of slope typically contains glacial till and ice contact soil which limits the rooting depth of large trees. Therefore, the planting focus at the top of slope should consist of a well-developed cover of small evergreen trees, shrubs, and understory in order to retain top soil and prevent surface stormwater runoff from eroding the top of slope. This planting strategy can also support views, as there are many low growing, well rooted native species which can provide this function.

5.3 PLANT INSTALLATION

Plant installation on steep slopes requires additional care and planning. Soil disturbance associated with installation has the potential to increase erosion of surface soil, which could damage existing understory vegetation or plantings installed downslope. This effect can be minimized by limiting the total time spent on the slope for installation through careful planning and adhering to the following procedures (Myers 1993):

- Avoid planting in wet weather conditions
- Identify planting areas and establish minimal access routes for installation
- Conduct digging concurrently with plant installation (this limits the number of trips into and out of the site)
- Use the smallest plant stock (e.g., seedling stock or stakes) available whenever feasible to minimize soil disturbance.

The removal of existing mature deciduous species [red alders, bigleaf maples, and black cottonwoods (*Populus balsamifera v. trichocarpa*)] to accommodate new plantings is not recommended as tree removal can cause further slope instability. Additionally, the root systems of the removed trees or those which have undergone mismanagement will have experienced significant decay within 5 to 7 years of the trauma, leaving a window for increased erosion as the new plantings mature and root cohesion is at its lowest (GeoEngineers 2000).

5.3.1 PLANTING STOCK

Plant stock may include containerized stock, bare root stock, and seedlings and are installed by planting the material into excavated holes in the soil surface. Well-developed rooted plant material creates root mass faster than other methods (such as seeding), especially when planting species with varied rooting characteristics (Myers 1993). Disturbance to the slope can be minimized by using the smallest feasible planting stock and the least intrusive planting method. Additionally, smaller (a.k.a. younger) plant material often adapts more quickly after transplant. Larger plantings require regular care and maintenance (such as irrigation) which should not be applied to steep slopes. Younger plant material is also easier to carry and handle, less expensive, and requires less soil disturbance during installation.

5.3.1.1 Seeding

Seeding for vegetative cover can be used for forbs, grasses, shrubs, and trees. Seeding alone will not repair eroding slope areas (Myers 1993); however, when applied with other soil stabilizing or engineering techniques, seeding may be appropriate. Seeding methods which may be applicable on slope areas include:

- Hydroseeding is a very common application method and involves mechanically broadcasting a mix of seed, water, fertilizer, mulch, and bonded fiber matrix onto the slope. Locations where hydroseeding is applicable in the project area is limited due to access; however, it may be applicable within areas of the slope crest (hydroseed downslope) or the slope toe (hydroseeding upslope).
- Seed drilling consists of drilling soil holes for seed planting, this method would only be applicable to tree and shrub species and only in areas which are accessible, making it practical only on mild slopes (less than 60 percent) and in small planting areas.
- Broadcast seeding scatters seeds uniformly by hand onto the slope. Seed germination will be more successful if the soil has been roughened slightly and should be mulched immediately with compost to help retain the seed and to keep the surface soil moist (Myers 1993).

Seeding should primarily be used for erosion control (Section 5.4), such as the use of grasses to stabilize surface soil. Although seeding requires the lowest level of effort for installation, seeding woody plant species should only be applied if other planting methods are not feasible as it takes longer for root growth to become established (5 to 10 years) compared to installation of rooted stock. Additionally, woody plants can also be limited in availability, have low germination rates, and be costly depending on species. Seeding alone on steep slopes (greater than 60 percent) is not recommended, as seed applied to the soil surface tends to be easily "transported" by surface runoff.

5.3.1.2 Live Stakes

Live staking is the placement of freshly cut (live) individual shrub branches (stakes) directly into the ground. Live staking is appropriate for species that easily root from cuttings such as willow (*Salix* sp.), red osier dogwood (*Cornus sericea v. stolonifera*), and snowberry (*Symphoricarpos albus*). Live stakes are effective in reinforcing the soil structure on relatively stable slopes greater than 60 percent but can also be used on slopes less than 60 percent (Myers 1993). Installation of live stakes requires very little soil disturbance, meaning the level of effort for installation is low; however, access to the slope face is an important consideration. Live stakes generally require moist conditions for optimal growth and success and are most appropriate in areas with wetlands or seeps.

5.3.1.3 Contour Wattling/Fascines

Contour wattling is generally feasible on slopes up to 65 percent (Myers 1993); however, this may be applicable in steeper conditions when used in conjunction with engineering methods. Contour wattling consists of installing wattles of bundled live willow, red-osier dogwood, or snowberry branches into trenches contoured along the slope. This practice is a very time consuming and labor intensive strategy which requires a significant quantity of plant material and may be useful for specific targeted erosional areas such as gullies, but is typically cost prohibitive for large areas.

5.3.1.4 Brush Layering

Similar to contour wattling, brush layering consists of live woody plant material such as snowberry, willow, and red-osier dogwood placed into the slope face along excavated trenches along slope contours to create a live "fence" to capture eroding debris. This method is generally feasible for slopes up to 65 percent (Myers 1993). It is used for soil reinforcement and to resist potential skin slides. This is a very time consuming and labor intensive strategy and can be very disruptive to the existing soil. This technique should be used with caution in small targeted areas.

5.4 EROSION CONTROL

Erosion control BMPs can be implemented to aid in plant establishment. Erosion control BMPs include (but are not limited to) the use of erosion control nets and blankets, straw wattles, and placement of mulch. These BMPs generally require low to moderate installation effort and should be applied in accordance with the most current version of the City of Tacoma Stormwater Management Manual's erosion control BMPs (City of Tacoma 2012). Seeding is also a preferred BMP for erosion control and is discussed in Section 5.3.1.1.

5.4.1 Erosion Control Nets and Blankets

Erosion control nets and blankets are intended to temporarily prevent erosion and hold seed and mulch in place on steep slopes so vegetation can become well established (City of Tacoma 2012). Nets are strands of material woven into an open, but high-tensile strength net. Blankets are strands of loosely woven material that forms a layer of interlocking fibers, typically held together by biodegradable or photodegradable netting. Nets and blankets can be used for slopes greater than 50 percent.

5.4.2 Wattles

Wattles are temporary erosion control barriers consisting of straw wrapped in biodegradable tubular plastic or similar encasing material to prevent surface erosion. Wattles may reduce the velocity and can spread the flow of rill and sheet runoff, and can capture and retain sediment. The wattles are placed in shallow trenches and staked along the contour of disturbed or newly constructed slopes. Wattles can be used temporarily on slopes up to 67 percent until permanent vegetation can be established.

5.4.3 Mulching

Mulching is the application of straw, wood chips, or other suitable materials on the surface of a slope. This technique should be applied on slopes less than 50 percent and may be placed by hand or by a machine. Mulching can reduce erosion by protecting the soil surface from raindrop impact or wind. This BMP is also beneficial when included with plant installation, as it increases moisture retention, provides insulation from heat and cold, and can reduce the competition from grasses when mulch is placed around woody plantings.

5.4.4 Engineering Solutions

Engineering solutions typically are inert structural designs to slow or arrest the creep behavior of the surface soil on steep slopes, thus allowing vegetation to become established. These methods have a high level of effort and cost, as these methods generally require geotechnical engineering for design and construction crews for installation. Within the project area, the use of engineering solutions should be targeted for the support of public safety, infrastructure protection, and trail design. The following subsections describe several engineering solutions that may be applicable to the Schuster slope.

5.4.4.1 Shallow Anchored Mats

A shallow anchored mat generally consists of an erosion mat, geogrid material, or wire mesh material placed over the slope surface that is held in place using shallow staples or anchors (generally less than 36 inches in depth). Shallow anchored mats typically can be installed using hand tools. Long-term performance is generally on the order of several years and the intent of the shallow anchored mats is to reduce slope creep long enough for vegetation to become established. Depending on soil conditions, the systems can be applied to slopes greater than 60 percent. The performance of these systems is dependent on the depth of the soil creep zone, which is a function of soil type and slope steepness.

5.4.4.2 Deep Anchored Mats

This system includes the design and installation of welded wire mesh with deep anchors (generally greater than 36 inches in depth). Deep anchored mats typically require mechanized installation. The intent of these systems is to completely arrest the creep behavior of the surface soil and also stabilize deep-seated slope instability. They have a longer lifespan than most of the shallow anchored mats and are considered a more permanent engineering solution. The system can be used on slopes of 60 percent to near vertical. Installation of the anchors generally requires mechanized equipment, which may be difficult to implement considering the limited access to the site.

5.4.5 DEBRIS CONTAINMENT

If stabilization of the slope is not feasible and sufficient space is available, a debris containment system along the toe of the slope to contain debris from above and protect public safety and infrastructure may be a viable option. The level of effort to complete debris containment varies based on the system. A number of options are available for debris containment systems including cabled Jersey barriers; stacked, gravity block walls; soldier pile walls with wood or concrete lagging; cable restraint systems (such as Geobrugg); or soil berms. The system will need to be designed to resist the impact forces from a slope failure. Adequate space behind the debris catchment would also be required to accommodate the accumulated slope debris and accumulated debris would need to be removed periodically.

5.5 INVASIVE SPECIES CONTROL

Effectiveness of the various short-term control methods of invasive plants varies depending on species, density, and site access. (King County 2008a, b). Manual removal is effective when dealing with small populations or isolated invasive plants. Climbing species such as English ivy may not be reachable for manual or mechanical removal; in this case cutting the vegetative portion of the plant off from the roots (often called ivy rings), and leaving the upper vegetative portion to die off, may be an effective control method. Mechanical removal is effective for large-scale control especially when incorporated with engineering solutions; however, it may not be feasible on steep slopes or areas with limited access. Covering, sometimes referred to as "sheet mulching" is effective with small populations in targeted areas; however, covering may be impractical for larger areas, especially on slopes, because the process of cutting vegetation, covering the area and ensuring that the covering remains in place is labor intensive and may be cost prohibitive.

In accordance with the US EPA's guidance on Integrated Pest Management, the least invasive method of invasive control shall be employed, which may include herbicide use if the situation dictates that it is infeasible to use other control methods. Foliar herbicide treatment is not recommended for small patches of invasives surrounded by native vegetation since many herbicides are non-selective. If it is determined that the preferred removal practice of the large stands of invasive species is through the application of an herbicide, the limitations to herbicide use shall be in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and specific restrictions of the US EPA and State Department of Agriculture, WDFW, and DOE. Note, certain pesticides are considered Restricted-Use Pesticides under FIFRA, and may be applied only by or under the direct supervision of specially trained and certified applicators and restricted from certain areas (i.e. wetlands, streams and other aquatic areas). For specific control methods for the priority invasive species, refer to Appendix B.

Invasive species that are currently impacting forest health in the project area include:

- English ivy (*Hedera helix*): Class C noxious weed. A shade-tolerant vine species which is inhibiting the regeneration of native understory plants. This species produces adventitious roots that allow the vines to anchor to tree trunks, creating heavy foliage growth in the tree crown. This increases the weight of the tree canopy and increases the potential for disease and failure.
- Japanese knotweed (*Polygonum cuspidatum*): Class B noxious weed. Once established, this species is difficult to control. It spreads via long, stout rhizomes and can form dense stands that crowd out native vegetation and degrade wildlife habitat. Japanese knotweed is commonly found in disturbed areas near the slope crest and the slope toe.
- Scotch broom (*Cytisus scoparius*): Class B noxious weed. This shrub spreads aggressively in sunny, dry areas, outcompeting understory vegetation and young trees.
- Old man's beard (*Clematis vitalba*): Class C noxious weed. This species grows rapidly and blankets all layers of the forest, smothering vegetation, and increasing the potential for disease and tree failure. Old man's beard is commonly found on the edges of forested areas where sunlight is available.
- Himalayan blackberry (*Rubus armeniacus*): Class C noxious weed. An aggressively growing species with large hooked thorns that creates dense thickets which severely inhibit native understory vegetation. Its ability to reproduce from a variety of vegetative pieces increases its

ability to inhibit the growth of native understory and commonly creates monocultures in disturbed, sunny areas.

- Reed canarygrass (*Phalaris arundinacea*): Class C noxious weed. Commonly found in wetlands, stormwater ditches, and disturbed wet areas. This species outcompetes native species and creates dense monocultures.
- English holly (*Ilex aquifolium*): Monitor list. Although slow-growing, this species survives in both sun and shade and can reach 15 to 50 ft in height and 15 ft in width. This growth can create dense thickets and suppress the establishment of native species.

Invasive species that do not appear to currently be impacting forest health, but have been observed in the project area include:

- Garlic mustard (*Alliaria petiolata*): Class A noxious weed. A shade tolerant species often found in the forest understory, to include urban parks, trails, and streambanks. Becomes very difficult to control once it has become established on a site.
- Butterfly bush (*Buddleja davidii*): Class B noxious weed. Creates dense thickets which outcompete native vegetation. This species also has the potential to alter soil conditions, increasing the likelihood of impacting native plant species. Butterfly bush is commonly found in disturbed, sunny areas.
- Spurge laurel (*Daphne laureola*): Class B noxious weed. Commonly found growing in the forest understory, this evergreen shrub colonizes rapidly in the sun or shade, forming monocultures and outcompeting native species. All parts of this plant are highly toxic to humans and animals.
- Poison hemlock (*Conium maculatum*): Class B noxious weed. As the name implies, poison hemlock is toxic to both humans and animals. This highly adaptive biennial plant can quickly infest open areas.
- Tansy ragwort (*Senecio jacobaea*): Class B noxious weed. A toxic species found on roadsides, pastures, and cleared forested areas.
- Field bindweed (*Convolvulus arvensis*, a.k.a. morning glory): Class C noxious weed. Field Bindweed outcompetes native species by forming climbing, dense tangled mats of vegetation. This species has an extensive system of rhizomes which grow deep in the soil.

5.6 PUBLIC SAFETY

5.6.1 CRIME PREVENTION

Crime Prevention Through Environmental Design (CPTED) principals enhance public safety by incorporating the concepts of natural surveillance and access control into vegetation management decisions. Natural surveillance is the concept of managing vegetation to increase visibility and allow observation of areas within a reasonable distance from a public space (standard 10 ft). Natural surveillance is intended to allow site users to feel safe while using the amenity (i.e. trail, walkway). For natural surveillance, there should be open views between 3 to 8 ft above the ground surface, where shrubs and groundcovers do not extend above 3 ft and trees are limbed up to 8 ft. Additionally, there should be a distance of 10 feet between trails, public areas, and the natural wood lines where vegetation is maintained for natural surveillance. This distance may be increased where necessary to accommodate for larger view clearances into specific areas of concern.

Access control is the concept of physically guiding users to intended access areas and limiting opportunities for access into unintended areas (VCPA 2005). Access control is intended to reduce opportunities for the public to enter areas not intended for public use, both to protect forest vegetation and also to discourage illicit use of areas that are infrequently monitored. For natural access control, trails and public areas should be well maintained, with clearly identifiable entrance and exit points.

5.7 VIEWS FROM ADJACENT AREAS

5.7.1 SELECTIVE PRUNING AND REMOVAL

Proper pruning can be a tool in creating and improving views. Selective pruning should follow the guidelines presented in the *Open Space Management Plan for Stadium Way – Schuster Parkway* (Van Pelt 2002, "Chapter IV Vegetation Management; Section C Recommended Tasks for View Enhancement"). For conifer species, selective pruning includes methods such as windowing (removing select branches), inter-limbing (removing select branch whorls), and skirting up (removing lower branches; Menashe 1993). The pruning of broad leaf trees is usually more complicated and includes the select removal of branches and thinning of the crown. When completed correctly by a trained arborist, the tree's health is maintained; however, incorrect pruning can cause severe damage to the tree and can increase the likelihood of failure. Practices such as topping, of both conifers and broad leaf species, leave multiple areas for disease entry and trigger superfluous growth known as "coppice sprouting" which creates dense clumps of multiple stems with weak attachments. Additionally, excess removal of crown vegetation leaves large openings in the canopy, which can encourage invasive species such as Himalayan blackberry and allow for increase erosion due to lack of vegetative cover.

All pruning shall be conducted in accordance with the most updated version of the Approved American National Standard (ANSI) for Tree Care Operations – Tree, Shrub, and Other Woody Plant Management – Standard Practices (Pruning; Tree Care Industry Association Inc. 2008). No more than 25 percent of any one tree's crown may be removed in any pruning event. Additionally, pruning should be conducted in a manner to avoid large openings in the vegetation cover that may increase soil erosion.

Where feasible, the downed wood should remain in place so as to minimize the land disturbance that would otherwise be caused by the removal of the large debris from the site. If a tree is designated for removal, consider leaving a portion of the trunk in place as a "snag" to provide for additional forest habitat. This should only be done with consideration to potential conflicts with adjacent infrastructure or public areas.