# Seattle Public Utilities Taylor Creek

## Dead Horse Canyon Vegetation Assessment Summary Report

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## Summary

As a part of the Tree Impact Assessment conducted for the Taylor Creek Restoration, Urban Forestry Services | Bartlett Consulting developed and implemented a pre-construction soil, canopy and vegetation cover assessment for the purpose of identifying the dominant vegetation on site for the purposes of construction mitigation.

The canopy cover across the site averages 85% cover and consists of mostly deciduous trees and the midstory. Understory vegetation cover averages 125% indicating very little vegetation layering is present. The most prominent understory species on site were sword fern (*Polystichum munitum*), salmonberry (*Rubus spectabilis*), and western red cedar (*Thuja plicata*).

Soil throughout the canyon were sampled to assist with mitigation planning. The soils are very gravely and sandy with low organic matter concentrations and low available nutrients for plants. The results of this assessment can be used to develop mitigation, and replanting plans and set goals and thresholds for post construction monitoring.

Historic data collected by the Green Seattle Partnership for this park was compared to the results of this survey with most data corresponding well. Further and more detailed vegetation analysis is possible with the data provided.

## Introduction

Urban Forestry Services | Bartlett Consulting (UFS|BC) was contracted to identify and assess the condition of trees and shrubs along the west side of the Dead Horse Canyon portion of Taylor Creek. The assessment occurred within the identified construction limits of a proposed temporary access to install woody debris for stream restoration. An existing pedestrian trail and sewer line are located along this area.

This Vegetation Assessment Summary is an addition to the Tree Construction Impact Assessment and is intended to provide information for more than only the overstory trees. These data can be used to inform restoration and mitigation plans and create informed thresholds for success to meet goals for stream restoration impact repairs, or for management in other degraded areas in the canyon.

Urban Forestry Services was contracted to review the forest data provided by Seattle Parks through their Green Seattle Partnership (GSP) and then develop a forest vegetation survey for the purposes of monitoring potential impacts to the area and the success of restoration. The initial intent was to overlap with the Seattle Park Monitoring Field Guide. After review of the GSP data and discussion with city staff regarding the goals for data collection, we decided to install transects across the potential construction area perpendicular to the slope rather than set up the standard forest inventory circular plots. This sampling design provides a greater focus on the potential construction impacts across the slope and reduces field collection variation by using more objective measurement methods than the GSP data collection methods.

Site visits were made in September of 2022 after the tree inventory data were collected and analyzed but before leaf fall. This vegetation data were collected at the end of a warm dry summer. Biological conditions in the soil and the plant cover documented at that time data were collected may not be consistent throughout different seasons. This variation should be small in comparison to the changes expected with construction and site repairs.

After data were collected, multiple construction designs were provided for the stream restoration. Option 1, the full road alignment is what this vegetation data collection design was set up to assess. SPU has since removed Option 1 from consideration due to community and stakeholder feedback. The preferred shorter temporary road (Option 3) follows the same alignment as Option 1 and consists of the first 6 of the 12 measured transects. This data summary is not a full vegetation analysis and does not compare differences in construction options, however, all vegetation data are provided in the spreadsheet paired with this brief summary report and can be summarized for multiple construction options, used for control plots, or compared to the GSP databases for change in time for this park.

## Methods

The proposed area to provide access for stream restoration runs approximately 2,700 feet up the west side of Dead Horse Canyon parallel or along the existing trail and across the river to two spurs. Twelve (12) transects were set up in a stratified random design perpendicular to the proposed full length temporary access road (Option 1). The full road was stratified into 12 sections of 225 feet and each transect was randomly placed within each section using a random number generator. This design spaces transects throughout the canyon project yet allows future random transect set up that does not require the exact position to provide comparative data.

Transects are identified with a one-by-one wooden stake on the uphill side of the existing trail and proposed temporary road. These stakes are labeled with an aluminum tag identifier #1-12. Transect directions are perpendicular to the slope crossing the existing trail. Transect lengths vary but cover the proposed impacted area and buffer identified in the temporary road design. Transects that are shorter than the proposed impacted width were shortened due to access and safety on steep slopes. Details on the start point, direction and length of each transect are in Appendix II.

Statistics were not run between transects for this general analysis. Data were collected with the intent that statistical analysis may be conducted if desired. All observations made in this document are correlations and data trend observations. Where relevant, comparisons are made between the upper (Option 1) and lower canyon (Option3) as well as with the 2005 GSP vegetation community data provided for the corresponding areas (Appendix VI).

The following measurements were taken along each of the twelve transects in September of 2022. Data collected are similar to what is documented with Seattle Parks GSP monitoring; however, data collected has more detail and, the intent of these measurements are for mitigation, and monitoring construction impacts and represent observations only at single moment in time.

**Vegetation cover:**
The line intercept method was used to measure vegetation cover (Elzinga et al). Individual species were identified and then grouped into categories of ground cover, understory shrubs, midstory canopy and young trees. Bare ground, and invasive species were also identified as separate categories. For this study, "ground cover" only includes plants and does not include organic matter such as leaf litter or moss, or coarse woody debris. These were categorized separately for potential future comparisons with the GSP data.

Detailed vegetation ground cover measurements require a separate on the ground taped transect that requires a greater investment in time to measure the detail of individual plants. Due to the variation of herbaceous cover over a season, and the low contribution this metric provides for restoration purposes, funding was not allocated to this level of detail in vegetation documentation. Many groundcovers will naturally reestablish on their own from seed sources elsewhere in the canyon, or they can be reseeded when site conditions in the impacted and repaired area are appropriate. Details on understory groundcover species can be pulled from the GSP data throughout the site.

**Overstory canopy:**
A concave densiometer was used to measure canopy cover (Forestry Suppliers Inc, Department of Ecology) at three points along each transect; the uphill starting point, on the trail near the center of each transect and the end of the transect at the lower end of the slope. Data were collected in four directions at each point to develop an average percent canopy cover.

**Soil Texture, Nutrient and biotic analysis:**
Bulk density and soil moisture sample core collections were attempted for each transect and nutrient, biotic and sieve analysis samples were collected from half (seven) of the 12 transects (Transect 1-4, 6,8,12)

Soil samples were collected from the slope above the trail for consistency and to reduce trail runoff impacts. Soils were mixed and divided into two separate gallon bags. Samples were sent to Earthfort labs in Corvallis OR for biotic analysis and to William F. Black Soil Testing in Mount Vernon WA for nutrient and sieve analysis (Appendix V). These data were assessed for general patterns and trends across the landscape.

## Observations

The area in this study runs along the west side of Dead Horse Canyon. The vegetation transects cross an existing trail located over the SPU utility sewer line running up the canyon. The non-vegetated area of the trail is incorporated into the vegetation cover analysis. This was done in assumption that a new trail will be installed after construction is completed.

The lower impact construction option (Option 3) is located in the lower portion of the canyon. Transects 1 through 6 are within this option and will be referred to as the "lower canyon" when differences between the upper and lower canyon are identified. (Seattle Public Utilities)

The 2021 Forest Type Zones defined by the GSP show the portion of each transect below the trail are within a riparian forest (Appendix II), while the uphill portion of transect 1-10, on the west side of the canyon are in a "mesic moist conifer/conifer mixed deciduous" forest. Transects 11 and 12 located on the very south east side of the upper canyon are a "dry mesic conifer/conifer mixed deciduous" forest. General field observations indicate the variation in vegetation type between the transects in this study is larger than the differences between the vegetation zones. Future analysis to identify statistical differences in vegetation cover and richness and compare with the generalized GSP data may be conducted by separating the linear transects into to each GSP zone by using the trail/bare ground crossing as the break.

## Overstory Canopy Cover

Most of the deciduous overstory tree canopy is between 80 and 100 feet tall. Throughout the forest, this mostly deciduous big leaf maple and red alder canopy averages 89% cover. Very little canopy layering was observed through the forest (Appendix I "Photos of Tree Canopy"). Where individual coverage measurements drop below 85% (Figure 1) gaps associated with recent tree failures were often observed. These canopy cover data provide greater detail than the general GSP category measurements documented for the same area that commonly measure ">76%"

No significant patterns in overstory canopy cover were observed between individual transects or between the lower canyon (Transects 1-6, Option 3) and upper canyon (Option 1) measurements. There does seem to be a difference between the uphill (dark green) and downhill (yellow) portion of each transect (Figure 1). The canopy associated with the GSP forest types at the top of each transect (mesic moist, riparian, and dry mesic communities) had an overall lower cover and greater variation than the riparian GSP communities measured at the base of the transects. This may be attributed to more frequent gaps in the forest associated with new snags or tree failures, or more areas with less canopy layering.

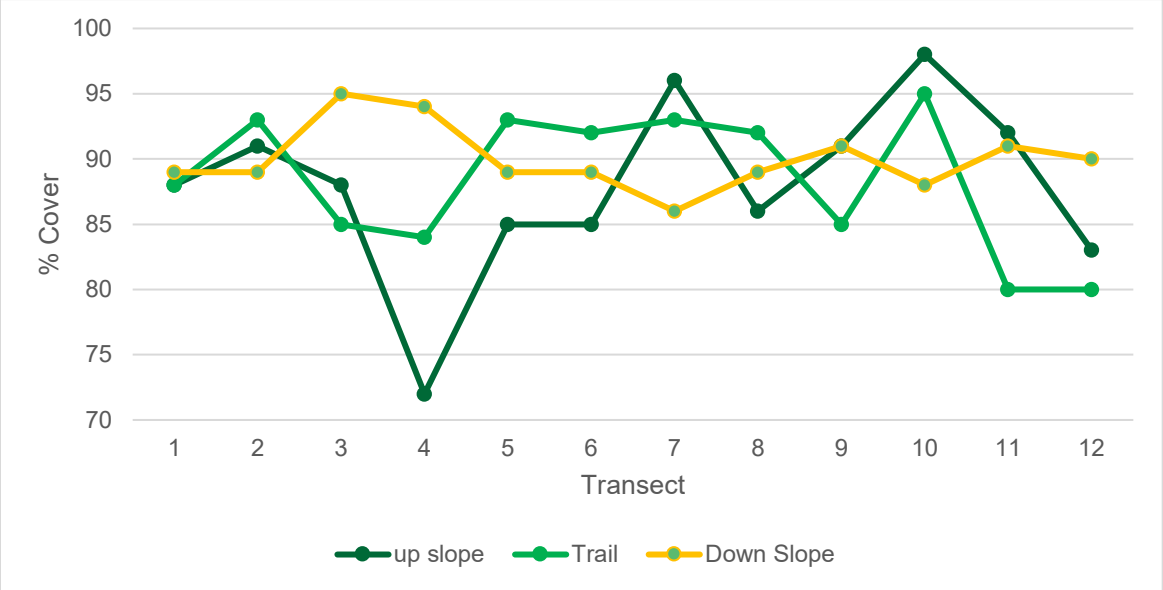


*Figure 1. Three canopy cover average points per transect located up slope at the start of each transect, on the existing trail at mid transect and downslope at the end of each transect.*

Construction impacts associated with the lower canyon (Option 3, Transects 1-6) will decrease the overall canopy height and cover at first, however with diverse replanting to encourage multiple canopy layers and a

species palate that will adapt to the stresses put on an urban forest, the canopy cover may increase in the lower canyon in future decades.

## Understory Vegetation Cover

The understory vegetation cover was measured by plant species (Appendix IV) and combined into coverage categories for the richness analysis (Appendix II).

The most prominent species measured through the canyon were western hazelnut (*Corylus cornuta*), red twig dogwood (*Cornus stolinifera*) salmonberry (R*ubus spectabilis*), sword fern (*Polystichum munitum*) and trailing blackberry (*Rubus ursinus).* Other plant species and their associated categories can be found in Appendix III and IV. The number of species was not different and averaged seven species of plants per transect.

Table 2 depicts the total (absolute) cover per transect separated into cover categories and Table 3 shows the average percent cover for each cover category. The total understory vegetation cover (low shrubs, midstory canopy, young trees and groundcover) averages 125% across the canyon (Table 2). Vegetation cover ranges from below 100% indicating large areas of exposed ground, to transects with over 100% cover which indicates multiple layers of vegetation in those areas.

Transects in the lower canyon (1-5) have lower average cover and lower average shrub cover than those higher in the canyon. Statistical differences can be further analyzed and reported with this data. Transects 6, 8, and 10 in the upper canyon have a larger young tree coverage (dark green). Transects with young tree cover represent areas where a large investment in restoration tree planting occurred in the past.

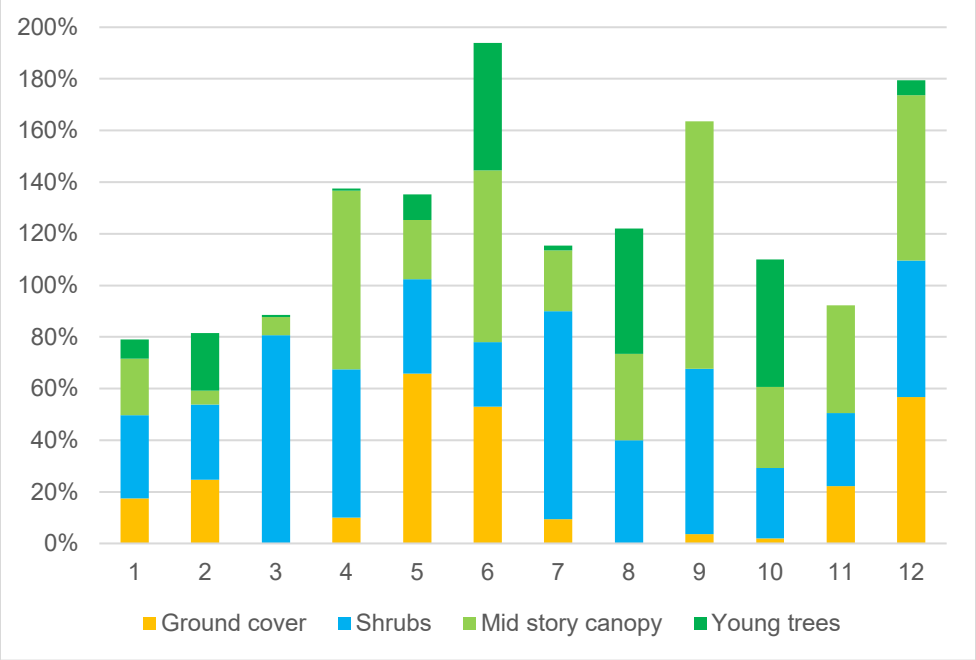


*Table 2. Vegetation cover (absolute) per transect.*

Total invasive species cover is low (<5%) in the areas measured (Table 3). All transects are located in areas where invasive removal has occurred in the past and measurements were of remnant patches or regrowth of English Ivy, Himalayan blackberry and Hedge bind weed. The open bare ground average of 31% (Table 3) is because each transect intersects the trail. This trail and bare ground contribution is consistent between transects (Appendix II). The lower canyon has a higher bare ground average than the upper canyon and a

lower invasive species cover than the upper canyon. This may be explained if the lower canyon had a greater investment in invasive species removal, in turn opening up more bare ground areas before native species can be planted or grow in. In addition, vegetation may struggle to establish in the areas where steep slopes erode quickly leaving open bare ground. Many areas in the lower canyon had steep slopes with low vegetation cover. Other areas of the canyon further from the existing trail and proposed construction that were not measured seem to have much greater invasive species cover.

Woody debris measurements were lower than expected relative to GSP measurements. They range from 0 to 13% with most transects having less than 5% coverage. This contradicts the general observation that the forest has a lot of down trees. This low overall and highly variable measurements indicate the woody debris may be clustered. More woody debris was measured in the upper canyon (5%) than in the lower canyon (1%)

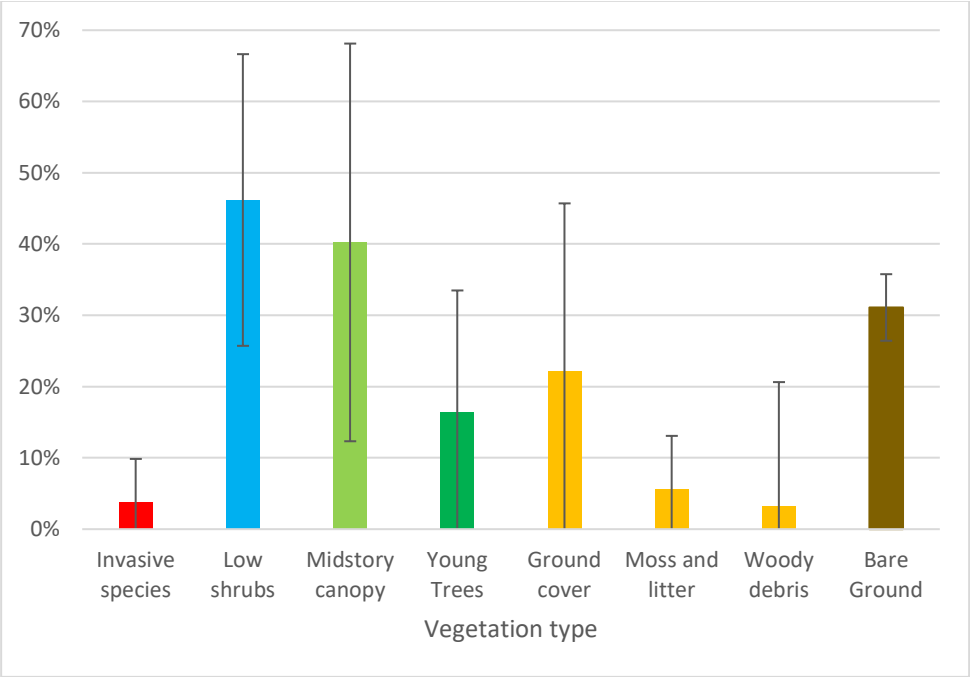


*Table 3. Average vegetation cover by category*

## Soil Assessment

Many areas had exposed bare soil with no organic topsoil or litter coverage. This is surprising given the annual leaf litter input from the forest canopy each year. Soils were sampled in the fall before the next organic input so organic measurements are likely lower than other times of the year.

### *Soil Physical Properties*

Most of the collected soil samples had a large number of round rocks over ½ inch diameter. The soil texture tests however consist only of gravel less than ½ inch diameter (Appendix V). All soil samples were classified as a gravelly sandy silt composition with very low organic content (<2%).

The large rocks in the soil samples significantly impact bulk density measurements resulting in poor quality and unreliable results through the lower canyon. These large round rocks were observed in areas where erosion was occurring. Where soil bulk density sampling was successful, density was low and uncompacted (Appendix II). This means the coarse sand and gravel substrate is very porous between soil particulates matching what was observed on site.

When the gravel component is removed (>1/4") from the analysis, the remaining sand, silt and clay texture can be assessed using a soil triangle. All soils are classified as a Coarse Sandy Loam, or a Loamy Coarse Sand (Appendix II). This classification is well draining and has capacity to hold nutrients which is good for many of or native trees and shrubs. With the additional gravel component, these soils drain and erode very quickly which will add a complexity to plant establishment and slope stabilization required after construction.

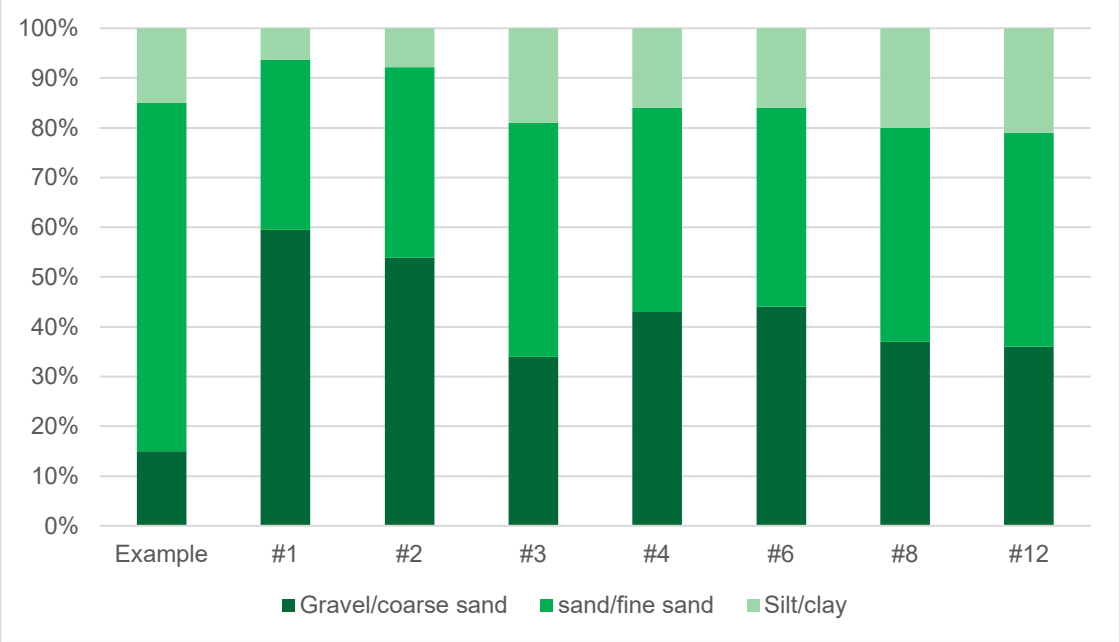


*Figure 3. Soil Texture comparison between transects. The gravel component of these soils dominates the sand, silt and clay ratios.*

### *Soil Chemical Properties*

Soil moisture was adequate (>10%) at the time samples were collected. This was surprising given the soil organic matter that often holds moisture was consistently very low (< 2%). Small summer rain events and the location of samples in the middle of a sloped ravine where water moves from the top of the slope may have contributed to these moisture readings. The soils ranged in pH from acidic to fairly neutral. Total carbon and nitrogen levels were also low, however their ratios are good. These results are not abnormal for pacific northwest forests and indicate the forest system is balanced but stressed. plant available phosphorus and potassium were low for all samples as well (Appendix II, and V). Samples were taken at the same time vegetation measurements were conducted at the end of the growing season when soil nutrients and organic material would be lower in comparison to other seasons when litter is fresh on the ground or breaking down into the soil through the spring and early summer.

### *Soil Biotic Properties*

Soil biotic measurements paralleled the low organic and nutrient results where there is a wide representation of a diverse system, but very low numbers of each species were measured. The fungal and bacterial biomass

are low, but the ratios are balanced (Earthfort analysis) and the number of nematodes that feed off fungal and bacteria are low but are well balanced. The root feeder nematodes were the only biota that fluctuated between transects. These seemed to be greater where wetter soils were sampled.
Further sampling is required to develop correlations between transects and different forest environments. Samples taken at other times of the year, such as during the spring when soils are moist and leaves remain on the ground, will likely show different results.

The biotic measurements indicate that if soil conditions are improved to create habitat for the soil biota, the number of biota will increase as well. Reducing disturbance through stabilizing the slope, increasing woody debris and soil organic matter will increase habitat opportunities and nutrients to improve overall soil health.

## Conclusions

Using the vegetation transect data and soil sample analysis, the following recommendations may be applied to mitigate and repair forest conditions after construction and to enhance the existing urban forest.

Three phases of post construction repairs should be considered:
1. Protect existing vegetation through the repair process
2. Prioritize temporary soil stabilization and erosion control.
3. Plant primary successional species that will do well in more open exposed forest edge environments and are known for erosion control. These are often considered “restoration superstar” plants. Many are recommended below.
4. After initial site stabilization and establishment, focus on improving forest diversity and health.

Soil repair:

Before construction
1. Wood chip mulch 8” to 12” deep should be retained around protected trees in the construction area and along the forest edge near construction to protect soils from compaction.
2. Slopes above the construction area, below retained trees and vegetation, and just below the construction area should be stabilized to reduce erosion associated with vibration and other work in the area. Straw waddles or stabilized Large Woody Debris (LWD) or other natural terracing should be installed to retain soil on the slope in conjunction with jute netting (preferred for planting areas) or coir mat with wood chip mulch.
3. Additional recommendations for soil protection near retained trees is provided in the tree inventory report.

After construction
1. Large Woody Debris (LWD) should be secured perpendicular to the repaired slope through all impacted areas and overlap into the non-impacted edges of the forest.
2. Temporary soil erosion control is highly recommended on all exposed and repaired slopes before planting. Jute netting will likely be needed to hold wood chip mulch or temporary erosion control seed mixes on site.
3. Up to 4” of course wood chip mulch or hog fuel should be installed over netting. This may be raked or spread from preexisting tree and soil protection areas.
4. Consider biochar additions to soil before installing wood chip mulch as an experiment to improve long term soil biotic habitat.

These soil care recommendations will stabilize surface soil movement, increase organic input into the system, improve soil moisture retention, decrease erosion, and provide habitat and food for bacteria, fungi, and other beneficial soil food web components. Mulch will slowly degrade to increase nutrients to for tree and plant productivity and survival.

Vegetation repair:

Before Construction:

1. All the debris from trees removed for construction and located on the ground may be retained for restoration on site. Logs (>6") should be retained at a minimum of over eight feet long. Longer logs may be required for post construction repairs. Smaller branches may be piled for wildlife habitat or chipped and retained on site for soil protection and improvement.
2. Salvage smaller sized trees and shrubs from the proposed impacted area. This should be conducted in the fall and winter months. Trees should be bare root transplanted and watered throughout the following summer. a nursery holding facility, donations to neighboring homes or direct transplant to bare other areas of the park are all potential options.

After Construction:

1. Replant tree species identified in the tree survey that were identified to be in good health and that will increase diversity of the site. Western red cedar, and grand fir are successful in shadier areas, Douglas fir in very open areas, some black cottonwood, pacific willow and Sitka spruce may work well in wetter areas. These planted trees will eventually replace the existing big leaf maple and red alder canopy. Consider experimenting with different genetic stock to improve climate resilience.
2. Plant smaller species trees to fill in the midstory canopy including Pacific dogwood (Cornus nutalii), vine maple (Acer circinatum), Pacific rhododendron (Rhododendron macrophyllum), Pacific crabapple (Malus fusca) and cascara (Frangula purshiana). Smaller trees should provide a future midstory canopy layer to increase structural diversity and canopy cover throughout the forest.
3. Plant mid-story canopy shrubs common on the site such as western hazelnut (*Corylus* cornuta), oso berry (*Oemleria cerasiformis*) salmonberry (*Rubus spectabilus*), and red osier dogwood (*Cornus sericea*). Increase species diversity by adding pacific ninebark (*Physocarpus capitatus*), ocean spray (Holidiscus discolor) and thimble berry (*Rubus parviflorus)* in dry, more open areas Sitka willow, (*Salix sitchensis*) and mock orange (*Philadelphus lewisii*) in more moist environments.
4. Replant salal and sword fern throughout the site. These plant root systems will help stabilize the slope.
5. Increase shrubs and groundcover diversity by adding woodland strawberry or trailing blackberry may spread between other plants.
6. Identify and plant newly established wetland areas that have not naturally reestablished with a separate species palate observed on site such as skunk cabbage, stink current (*Ribes braceiosum*) and an assortment of sedges and rushes.

Monitoring:

1. Develop goals for plant survival, cover and richness for the 5-year maintenance period that mirror what was found on site. The upper canyon transects (6-12) and the GSP data can be used as control metrics.
    a. Understory vegetation cover over 100%.
    b. Greater than seven species per transect.
    c. Woody debris cover greater than 10%.
    d. Invasive species less than 5%
    e. Bare ground (including the trail) <20%
2. Develop an installation and maintenance plan to meet the established site goals and performance requirements for all permitting.
3. Develop action thresholds to drive replanting and adaptive management through the maintenance period.
4. Collect transect data in a stratified random design immediately post construction and one, three, and five years after construction to measure progress. Ensure the metrics measured will provide data to manage the performance requirements.
5. Use the pre-construction transect data to compare post construction canopy cover, vegetation cover and richness. New plant survival and density can also be collected in a 2-meter belt transect through the maintenance period.

6. Collect soil samples at year 1, and 5 at the same time of year as this assessment to compare soil chemical and biotic data changes. Collect soils from both the construction area and reference areas up canyon.

Post Construction Forest Diversity Improvements.

1. If soil samples indicate a negative change in soil nutrient or biota, provide nutrients or inoculants to construction area soils based on recommendations.
2. If herbaceous cover at year 5 lower than reference sites or original measurements, consider a fall and spring seed mix to improve ground cover diversity. Select species based on the post construction canopy cover soil condition assessments.
3. Identify and plant newly established wetland areas again if these areas have not naturally reestablished.

This concludes the summary report for the vegetation assessment. Further analysis and comparisons may be conducted using the vegetation data provided. All vegetation data is located in an Excel spread sheet format and summarized as Appendix attachments in this report. Additional data for trees located within the proposed impact areas on the site can be found in the Taylor Creek Restoration Tree Impact Assessment.

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## Appendix I: Photos

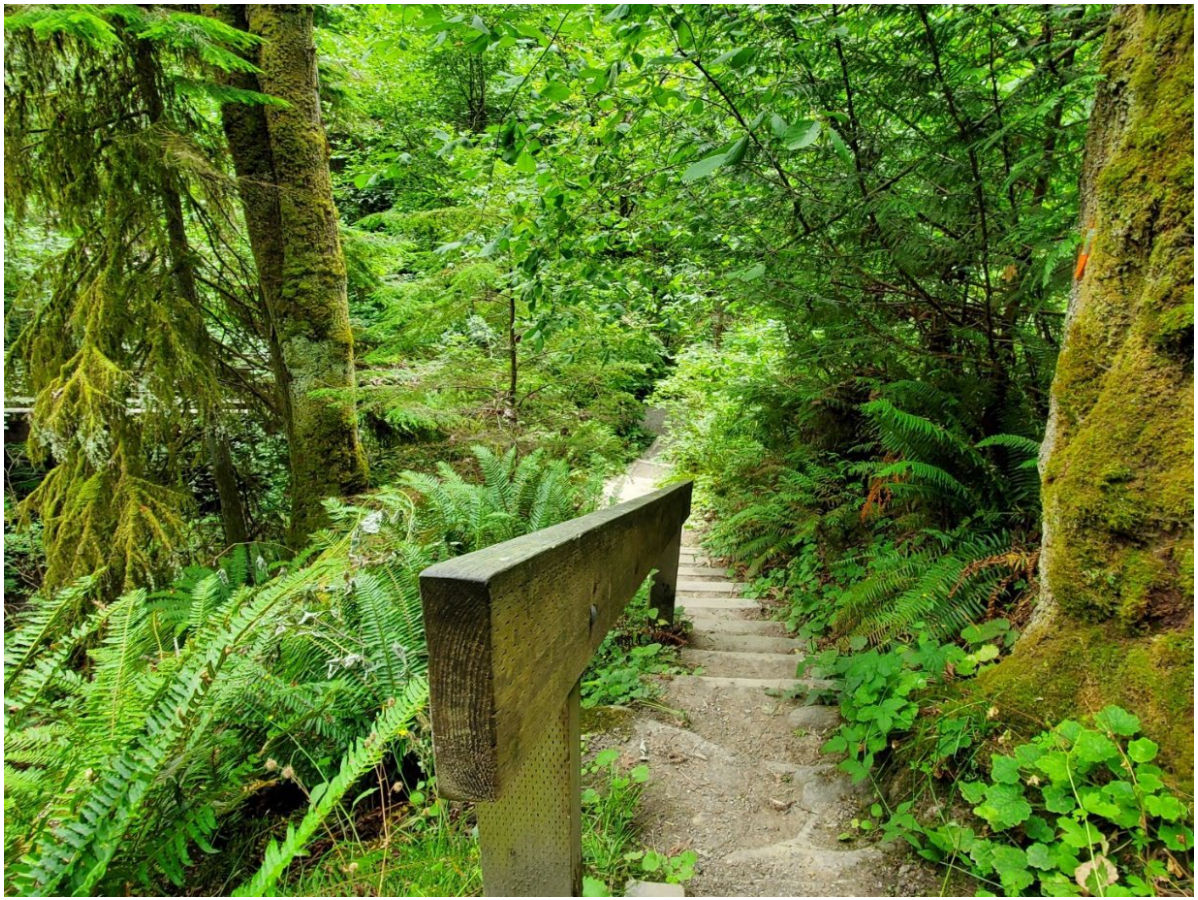
Photos of Tree Canopy



Canopy cover ranges from 80-100% Most of the canopy is deciduous. Allowing for ample winter light that will promote growth of evergreen understory shrubs.  These gaps will increase in size with proposed construction.

## Photos of Vegetation on Slopes

Some slopes have low vegetation cover and are actively eroding.  Many areas have bare soil exposure with very little organic matter retention.



Many steep slopes have high vegetation cover. These slopes are still moving but do not seem to have the active surface erosion. Though woody debris is visible throughout the forest, the transect measurements did not indicate an abundance of debris.

## Photos of Midstory Canopy

Midstory canopy creates a layer over 10 feet above the ground cover.  This layering adds shade and complexity to the forest environment.

## Photo Examples of Vegetation to Transplant

Small trees, ferns and individual shrubs may be transplanted to other areas of the park before construction.

## Appendix II: Consolidated Transect Data

| Transect | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ~Distance from north trail head (feet) | 36 | 241 | 529 | 702 | 1059 | 1181 | 1540 | 1684 | 2011 | 2128 | 2460 | 202 from Y |
| ~ Start point Latitude (Deg N) | 122.2481846 | 122.2481923 | 122.2475666 | 122.2474592 | 122.2474727 | 122.2475613 | 122.2472474 | 122.246.9488 | 122.2471679 | 122.2467394 | 122.2462064 | 122.2461495 |
| Longitude (Degrees W) | 47.5085063 | 47.5079085 | 47.5073187 | 47.5068913 | 47.5059572 | 47.5056317 | 47.5046616 | 47.5043536 | 47.5035632 | 47.5033559 | 47.5028163 | 47.5035943 |
| Transect length (meters/ feet) | 16/53 | 13/43 | 13/43 | 12/39 | 17/56 | 20/66 | 20/66 | 20/65 | 17/56 | 15/49 | 18/59 | 22/72 |
| Transect true bearing (degrees) | 90 | 45 | 45 | 90 | 90 | 60 | 90 | 60 | 70 | 60 | 90 | 290 |
| Benchmark trees in and *near* transect | 1033 | 3060 | 1137, 3095 | 3018 | 3177,3183, 3186 | 3212 | 3325 | 3342, 3340 | 3416, 3422, 3423 | 3346, 3347, 1675 | 3409 | 3487 |
| **Green Seattle Partnership (GSP) Corresponding Data** | | | | | | | | | | | | |
| GSP Location | Northwest Steep Ravine | Northwest Steep Ravine | Waters Ave | Bangor North | Bangor South | Bangor South | The Boardwalk | Central Taylor | DHC WNPS 2007 | N/A | SPU/ WNPS | Darrell's Slope |
| GSP vegetation community | riparian | riparian | mesic moist/riparian | mesic moist/riparian | mesic moist/riparian | mesic moist/riparian | mesic moist/riparian | mesic moist/riparian | mesic moist/riparian | mesic moist/riparian | dry mesic/riparian | dry mesic/riparian |
| **Canopy Densiometer Measurements** | | | | | | | | | | | | |
| Up slope | 88 | 91 | 88 | 72 | 85 | 85 | 96 | 86 | 91 | 98 | 92 | 83 |
| Trail | 88 | 93 | 85 | 84 | 93 | 92 | 93 | 92 | 85 | 95 | 80 | 80 |
| Down slope | 89 | 89 | 95 | 94 | 89 | 89 | 86 | 89 | 91 | 88 | 91 | 90 |
| **Soil Analysis Results** | | | | | | | | | | | | |
| Soil Texture | Coarse Sandy Loam | Loamy Coarse Sand | Coarse Sandy Loam | Loamy Coarse Sand | | Coarse Sandy Loam | | Coarse Sandy Loam | | | | Coarse Sandy Loam |

| Transect | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gravel/coarse sand | 66% | 55% | 34% | 43% | | 44% | | 37% | | | | 36% |
| sand/fine sand | 38% | 39% | 47% | 41% | | 40% | | 43% | | | | 43% |
| Silt/clay | 7% | 8% | 19% | 16% | | 16% | | 20% | | | | 21% |
| % Moisture (%) | x | x | x | x | | | 18 | 22 | 11 | 10 | 9 | 11 |
| Bulk Density G/cm3 | x | x | x | x | | | 0.95 | 1.02 | 0.96 | 0.89 | 1.13 | 1.19 |
| Moisture | 15.5 | 7.39 | 9.83 | 31.66 | | 6.97 | 17.7 | 21.26 | 11.11 | 10.19 | 8.78 | 14 |
| pH | 5.97 | 5.32 | 5.61 | 6.31 | | 5.92 | | 6.21 | | | | 5.42 |
| Organic Matter | <2% | <2% | <2% | <2% | | <2% | | <2% | | | | <2% |
| Carbon /N ratio | 8.33 | 9.15 | 7.31 | 7.5 | | 7.14 | | 6.67 | | | | 6.45 |
| Aluminum (toxic) | | 2.9 | 1.72 | | | | | | | | | 1.19 |
| Ammonium (NH4) | 0.75 | 1.06 | 0.5 | 0.55 | | 0.5 | | 0.62 | | | | <0.5 |
| fungal/bacteria ratio | 0.92 | 1.2 | 0.61 | 0.67 | | 0.56 | | 0.43 | | | | 0.37 |
| fungal root feeders | 1.46 | 0 | 0 | 0 | | 3.3 | | 6.93 | | | | 0.3 |
| **Consolidated Vegetation richness** | | | | | | | | | | | | |
| Bare Ground | 58% | 36% | 30% | 35% | 23% | 15% | 12% | 55% | 19% | 31% | 54% | 5% |
| Moss and litter | 0% | 0% | 0% | 33% | 0% | 17% | 7% | 7% | 0% | 4% | 0% | 0% |
| Large Woody Debris | 0% | 0% | 0% | 3% | 1% | 4% | 1% | 0% | 3% | 13% | 2% | 12% |
| Native shrubs | 32% | 29% | 81% | 58% | 36% | 25% | 81% | 40% | 64% | 27% | 28% | 53% |
| Native midstory canopy | 22% | 5% | 7% | 69% | 23% | 67% | 24% | 34% | 96% | 31% | 42% | 64% |
| Young Trees | 7% | 22% | 1% | 1% | 10% | 50% | 2% | 49% | 0% | 49% | 0% | 6% |
| Native ground cover | 18% | 25% | 0% | 10% | 66% | 53% | 10% | 0% | 4% | 2% | 22% | 57% |
| Invasive species | 0% | 0% | 0% | 2% | 0% | 3% | 21% | 0% | 7% | 7% | 0% | 7% |

## Appendix III: Vegetation Species List

| Species Code | Common Name | Scientific Name |
|---|---|---|
| Young Trees | | |
| **ACMA** | big leaf maple | Acer macrophyllum |
| ALRU | red alder | Alnus rubra |
| THPL | western red cedar | Thuja plicata |
| TSHE | western hemlock | Tsuga heterophylla |
| Mid Story Canopy shrubs and small trees 5-10 feet | | |
| COCO | western hazelnut | Corylus cornuta |
| COST | red twig dogwood | Cornus stolenifera or C. spp |
| **ILAQ** | English holly | Ilex aquafolium |
| OMCE | Oso berry | Oemleria cerasiformis |
| RUPA | Thimble berry | Rubus parviflorus |
| RUSP | salmon berry | Rubus spectabilis |
| SARA | red elderberry | Sambucus racemosa |
| **SOAU** | mountain ash | Sorbus aucuparia |
| | vine maple | Acer circinatum |
| | Pacific dogwood | Cornus nutalii |
| | oceab spray | Holodiscus discolar |
| | Pacific ninebark | Physocarpus capitatus |
| | Pacific rhododendron | Rhododendron macrophyllum |
| Shrubs 12 -60" | | |
| ATFI | lady fern | Athyrium filis-femina |
| GASH | Salal | Gaultheria shallon |
| MANE | Oregon grape | Mahonia aquifilium |
| POMU | sword fern | Polystichum munitum |
| **RUAR** | Himalayan blackberry | Rubus armeniacus |
| RIBR | stink current | Ribes bracteosum |
| SYAL | snow berry | Symphocarpus Albus |
| VAPA | red huckleberry | Vaccinium parvifolium |
| | stink currant | Ribes bracteosum |
| | maidenhair fern | Adiantum pedatum |
| Ground Cover < 12 inches | | |
| **CASE** | hedge bindweed | Calystegia sepium |
| GRASS | Grass | Gramineae |
| **HEHE** | English Ivy | Hedera helix, H. hibernica |
| RUUR | trailing blackberry | Rubus ursinus |
| BG | Bare ground | |
| HERB | Herbaceous groundcover | |
| LITR | organic litter | |
| MOSS | over bare ground | |
| WOOD | down woody debris >4" | |

**Legend**

Green = overstory trees and midstory shrubs.
Blue = understory shrubs
Orange = groundcover categories
Red = invasive species
No Code = species noted on site but not in transects

## Appendix IV: Vegetation Cover Data

| Species Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ACMA | | | | 1% | | 7% | | 4% | | | | |
| ALRU | | | | | | | 2% | | | | | |
| ATFI | | | | 22% | | 1% | 19% | 2% | | | 8% | 1% |
| BG | 58% | 36% | 30% | 35% | 23% | 15% | 12% | 55% | 19% | 31% | 54% | 5% |
| CASE | | | | | | | | | | | | 1% |
| COCO | | | 5% | 29% | | 56% | | 19% | | 31% | | 23% |
| COST | | | | | | 11% | | | | | | 35% |
| GASH | 2% | | | | | | | | 24% | | | |
| GRASS | | | | | | 4% | | | | | | |
| HEHE | | | | 2% | | | 20% | | 6% | | | 0% |
| HERB | 18% | 25% | | 10% | | 26% | 10% | | 4% | 2% | 6% | 24% |
| ILAQ | | | | | | | 1% | | | 1% | | |
| LITR | | | | 33% | | 17% | | 7% | | | | |
| MANE | | | | | 12% | 5% | | | | | | |
| MOSS | | | | | | | 7% | | | 4% | | |
| OMCE | 6% | 1% | 2% | | 23% | | 6% | | 2% | | | |
| POMU | 30% | 29% | 62% | 32% | 15% | 19% | 52% | 37% | 41% | 27% | 21% | 50% |
| RIBR | | | | | | | 11% | 2% | | | | |
| RUAR | | | | | | 3% | | | | 5% | | 5% |
| RUSP | 16% | 5% | | 40% | | | 16% | 15% | 94% | | 42% | 6% |
| RUUR | | | | | 66% | 24% | | | | | 16% | 33% |
| SARA | | | | | | | 2% | | | | | |
| SOAU | | | | | | | | | 1% | | | |
| SYAL | | | 18% | 4% | 9% | | | | | | | |
| THPL | 7% | 22% | 1% | | 10% | 43% | | | | 37% | | 6% |
| TSHE | | | | | | | | 45% | | 13% | | |
| VAPA | | | | | | | | | | | | 2% |
| WOOD | 0% | 0% | 0% | 3% | 1% | 4% | 1% | 0% | 3% | 13% | 2% | 12% |

## Appendix V Green Seattle Partnership (GSP Data)

| Zone Name | Target System | Canopy Cover % | Total Invasive Cover % | Conifer Cover | Non Invasive Canopy Cover | CWD | Litter Depth | Bare Ground | Soil Texture | Year | Month |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Northwest Steep Ravine** | **Riparian Forest and Shrubland** | **> 76 %** | | **30** | **91** | **0 - 5 %** | **< 1/2"** | **0 - 20 %** | **silt** | **2014** | **Oct** |
| SPU Transect 1 | | 88 | 0 | | 61 | 0 | | 58 | | 2022 | Sept |
| SPU Transect 2 | | 91 | 0 | | 56 | 0 | | 36 | | 2022 | Sept |
| **Waters Ave** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **> 76 %** | **1.5** | **40** | **110** | **0 - 5 %** | **< 1/2"** | **0 - 20 %** | **silt** | **2014** | **Oct** |
| SPU Transect 3 | | 89 | 0 | | 89 | 0 | | 30 | | 2022 | Sept |
| **Bangor North** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **> 76 %** | **0.5** | **36** | **100** | **0 - 5 %** | **< 1/2"** | **0 - 20 %** | **silt** | **2014** | **Oct** |
| **Bangor North** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **>75%** | **2.3** | **15** | **95** | **0-5%** | **.25"** | **0-20%** | **sand** | **2011** | **Nov** |
| SPU Transect 4 | | 83 | 2 | | 128 | 3 | | 35 | | 2022 | Sept |
| **Bangor South** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **> 76 %** | **20.5** | **19** | **86** | **0 - 5 %** | **< 1/2"** | **0 - 20 %** | **silt** | **2014** | **Oct** |
| **Bangor South** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **>75%** | **4.1** | **13** | **93** | **5-10%** | **.25"** | **0-20%** | **sand** | **2010** | **Aug** |
| SPU Transect 5 | | 89 | 0 | | 69 | 1 | | 23 | | 2022 | Sept |
| SPU Transect 6 | | 88 | 3 | | 142 | 4 | | 15 | | 2022 | Sept |
| **The Boardwalk** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **> 76 %** | **10.2** | **35** | **94** | **26 - 50 %** | **> 1"** | **0 - 20 %** | **clay** | **2017** | **Oct** |

| Zone Name | Target System | Canopy Cover % | Total Invasive Cover % | Conifer Cover | Non Invasive Canopy Cover | CWD | Litter Depth | Bare Ground | Soil Texture | Year | Month |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **The Boardwalk** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **>75%** | **10** | **30** | **93** | **5-10%** | **.75"** | **0-20%** | **silt** | **2010** | **Aug** |
| SPU Transect 7 (long?) + Central TC riparian | | 92 | 21 | | | 1 | | 12 | | 2022 | Sept |
| **Central Taylor Creek Riparian** | **Riparian Forest and Shrubland** | **> 76 %** | **8.4** | **48** | **198** | **> 50 %** | **< 1/2"** | **20 - 40 %** | **clay** | **2015** | **Jul** |
| **Central Taylor Creek Riparian** | **Riparian Forest and Shrubland** | **51-75%** | **22.1** | **20** | **70** | **10-25%** | **.25"** | **0-20%** | **clay** | **2009** | **Jun** |
| **DHC WNPS 2007** | **Mesic-Moist Conifer and Conifer Deciduous Mixed Forest** | **>75%** | **0.2** | **11** | **96** | **5-10%** | **.75"** | **0-20%** | **silt** | **2009** | **Jun** |
| SPU Transect 8- (+ central TC riparian | | 89 | 0 | | | 0 | | 55 | | 2022 | Sept |
| SPU Transect 9 | | 89 | 7 | | | 3 | | 19 | | 2022 | Sept |
| **SPU/WNPS Climate Grant** | **Riparian Forest and Shrubland** | **> 76 %** | **93.5** | **32** | **124** | **26 - 50 %** | **1/2" - 1"** | **0 - 20 %** | **clay** | **2017** | **Oct** |
| **SPU/WNPS Climate Grant** | **Riparian Forest and Shrubland** | **26-50%** | **6** | **10** | **30** | **5-10%** | **.25"** | **0-20%** | **clay** | **2009** | **Jun** |
| SPU Transect 11 | | 88 | 0 | | | 2 | | 54 | | 2022 | Sept |
| **Darrell's Slope** | **Dry-Mesic Conifer and Conifer Deciduous Forest** | **51 - 75 %** | **5.5** | | | **0 - 5 %** | **.5 - 1"** | **0 - 20 %** | **silt** | **2016** | **Aug** |
| **Darrell's Slope** | **Dry-Mesic Conifer and Conifer Deciduous Forest** | **>75%** | **9** | **7** | **92** | **0-5%** | **.25"** | **0-20%** | **sand** | **2009** | **Jun** |
| **Darrell's Slope** | **Dry-Mesic Conifer and Conifer Deciduous Forest** | **> 76 %** | **1** | **14** | **99** | **5 - 10 %** | **< 1/2"** | **0 - 20 %** | **silt** | **2014** | **Oct** |
| SPU Transect 12 | | 84 | 7 | | | 12 | | 5 | | 2022 | Sept |

## Appendix VI: Soil Test Results

Earthfort Soil Life Tests

earthfort®
soil brought to life

# Testing Descriptions 2022

We utilize a variety of testing methodologies to measure the abundance of life in the soil. In measuring the categories of biological functional groups, the totals of each of these groups represent a snapshot of the biological profile at the time of testing. We have found that when performed together, these individual tests represent a comprehensive picture of the overall health and utility of the material tested.

**Soil Life Test**

*Includes*: Moisture Percentage, pH, Electrical Conductivity, Total Fungi, Total Bacteria, Biological Carbon and Nitrogen.

**Compost Basic**

*Includes*: Moisture Percentage, pH, Electrical Conductivity, Aerobic AND Total Fungi, Total Bacteria.

**Liquid Basic**

*Includes*: pH, Electrical Conductivity, Aerobic AND Total Fungi, Total Bacteria.

**Add-Ons**

Aerobic Fungi/Bacteria for soil, Protozoa, Nematodes, and E. Coli

635 SW Western Blvd. Corvallis, OR, 97333 USA

## Assay Detail

**Moisture Percentage (Dry Weight)**

This is a measure of moisture. Used for soils and solid amendments, such as compost, we determine how much of the material is dry matter. A higher number indicates low moisture, while a lower number indicates higher moisture content. Subtracting the Dry Weight from 1 equals the moisture content. (*For example, if your dry weight is reported as 0.80, then your moisture content is 0.20 or may be reported as 20%.*) The ideal range for this number is climate and crop specific.

**pH**

The pH of the sample, utilizing the saturated paste method.

**Electrical Conductivity (E.C.)**

The conductivity of the sample, or, how well the ion exchange is working.

**Total Fungi and Total Bacteria**

Microbial biomass has been shown to be a reliable short-term predictor of accumulation of organic matter, and has great use in evaluating regenerative methods. Reported in µg/g.

**Living Carbon and Nitrogen**

Carbon and Nitrogen reported in #/acre based on living biomass.

**Aerobic Bacteria**

**Samples are prepared and stained with fluorescein diacetate (FDA is a substrate that binds and fluoresces to the metabolically aerobic bacteria and fungi) and quantified using direct microscopy.**

Measuring the Biomass of bacteria in a sample is the first step in understanding the health of a soil and the potential benefit of an inoculum or amendment. Total population of bacteria provides us with an indicator of abundance of food for predators, nutrient cycling capacity and general diversity of the bacterial population. We report this number as µg/g or µg/ml of biomass. The Aerobic population is the component of the Total Biomass that is currently metabolizing oxygen. The relative range of these two numbers varies based on crop type and season. When looking at inoculants the balance between Active and Total is important for two different reasons: In compost this balance needs to be below 10%, indicating a mature and stable material. In liquid inoculums, higher levels are better for a foliar application. This high aerobic activity assists the organisms stick to the plant surface.

For soil application of a liquid, this balance may not be as critical as they will become active in the soil environment.

**Aerobic Fungi**

**Samples are prepared and stained with fluorescein diacetate (FDA is a substrate that binds and fluoresces to the metabolically aerobic bacteria and fungi) and quantified using direct microscopy.**

Fungi in the soil play an important role, nutrient retention and transportation, soil structure and its relationship to pH. Plant system succession is directly linked to the ratio of Fungi to Bacteria and is the first area we address when we approach remediation steps. Like bacteria, we report Biomass of Fungi in µg/g or µg/ml. Instead of counting individual populations, we measure length and width of fungi present. Reporting this as biomass, we do direct comparisons of Fungi and Bacteria. When we observe and measure fungi we look at 2 primary things: total population and aerobic level (same basic method as Bacteria).

**Protozoa – Flagellates, Amoebae, Ciliates**

**Ciliates, flagellates, and amoebae are enumerated by direct counting of serial dilutions of the sample using microscopy. Estimates of total protozoa are calculated using the most probable number approach.**

Our Protozoa method involves creating several dilutions of the sample and then correlating presence and absence of each group to create a Most Probable Number in #/g or #/ml. Unlike bacteria and fungi, it can take up to 5 days to complete this test. Protozoa are typically single cell organisms that feed upon bacteria. Flagellates and Amoebae are true aerobes, meaning they must have adequate oxygen to survive, while Ciliates are Facultative Anaerobes, meaning they can survive in low oxygen conditions. Numbers of protozoa are very important as an indicator of potential nutrient cycling, if there are sufficient levels of Flagellates and Amoebae then aerobic nutrient cycling can occur. However, high levels of Ciliates can be an indicator that anaerobic nutrient cycling is occurring. We use Ciliates to help identify potential anaerobic conditions in the sample.

**Nematodes**

**Nematodes are extracted from the sample using an enhanced Baermann funnel technique. The nematodes are then identified to genus and counted using direct microscopy.**

The process for identifying and quantifying Nematodes is relatively simple in function, but the results are often a very useful indicator of the health of soil. Nematodes are very important for the nutrient cycling they provide, similar to Protozoa. We report the total

number of nematodes per gram or ml in the sample, we then breakdown this total population to the Genus and Functional Group. The Functional Groups are as follows:

***Bacterial Feeders:*** This group of Beneficial Nematodes feeds on bacteria, they help to keep the bacterial populations in balance and in the process of consumption cycle soluble nutrients in the root zone of the plants.

***Fungal Feeders:*** As the name would suggest this group of Nematodes feeds on fungi, again, keeping these populations in balance and cycling nutrients in the root zone. Many of these types of Nematodes also feed on fungi that can cause disease in plants. Having a good population and variety of these organisms can be a valuable asset for the soil in which we grow plants that are more susceptible to some types of fungal diseases.

***Predatory Nematodes:*** These Nematodes are specialized in eating other Nematodes; typically they prey on Root Feeding Nematodes and can help minimize the damage from them. This group will also consume Protozoa and some types of micro-arthropods. Again, this becomes an excellent source of nutrients for plants.

***Fungal/Root Feeders:*** This is an interesting group of Nematodes, they typically act as Fungal Feeders, but if the population of Fungi is low, or if the right combination of plant and Nematode are present they will eat the roots of the plants. We use this group as an indicator for both healthy fungal populations and, at the same time, for potential disease issues in the plants.

***Root Feeders:*** This is the group of Nematodes that is truly parasitic to plants, there is a wide variety of these types, and depending on the Genus and the plant being grown can be a real problem for production and health of the plant. As few as 1 root feeder per gram of soil can hinder productivity. As an indicator of soil health, this is a group to watch. By looking at the total population, examining levels of functional groups, and cross-referencing to the plant being grown, we can get a fairly good picture of productivity. In Soil Amendment products, we also look for Nematodes, in liquids we typically find very few; they do not like pure liquid environments. In solid amendments, such as compost, we can find very high numbers of Nematodes, but usually very low diversity, despite the low diversity, compost is one of the best sources for Nematode Inoculants.

**Escherichia coli bacteria (E. coli)**

We utilize a plate count method, the R-CARD® test method, which offers the most convenient, streamlined way to detect not only the presence of E. coli, but also the number of colony forming units per gram (CFU/g). This allows us to complete tests quickly and share reports within a few days.

This test is typically performed on composts and other soil amendments to identify potential health risks. Each State has regulations regarding safe levels of this organism for use on food crops and for material handler safety.

**Testing and Reports**

All of our testing methods are scientifically validated and considered important indicators of soil health and function. We have created a testing menu that consolidates the most efficient use of these methods to distill key data and make informed soil management decisions easier.

We provide reports that indicate the levels of the above measurements found in your sample, and a desired range based on the indicated plant type. These desired levels can be affected by seasonality, agronomic practices, and environmental factors. We offer in-depth Report Reviews and Consulting to help determine the best approach to remediate potential problems as displayed on your reports.

With over 20 years of working directly with clients – both in the field and through the lab – we have developed an expertise in the practical application of the science behind soil biology. Whatever your circumstance, we can help you achieve your goals of a healthier, more productive soil.

Matthew Slaughter, President

Earthfort, LLC.

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

Report Sent: 09/28/2022
Sample # 01-137177
Unique ID: T1
Plant: Not Indicated
Season: summer
Invoice Number: 21600
Sample Received: 09/19/2022

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 15.50 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 5.40 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 347.65 | > 300 | Low fungal biomass, foods and biology may be required. |
| Total Bacteria µg/g | 376.62 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 0.92 | > 0.5 | |
| Biological Carbon pounds per acre | 796.69 | > 990 | |
| Biological Nitrogen pounds per acre | 95.60 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 8.33 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137177 |
| Unique ID: | T1 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | 3.59 | > 10 | Low numbers, but good diversity. |
| **Bacterial Feeders** | 0.34 | > 4 | |
| Rhabditidae | 0.34 | | |
| **Fungal Feeders** | 0.78 | > 4 | |
| Aporcelaimium | 0.11 | | |
| Chrysonemoides | 0.22 | | |
| Eudorylaimus | 0.22 | | |
| Prodorylaimus | 0.22 | | |
| **Fungal/Root Feeders** | 1.46 | < 1 | |
| Aphelenchoides | 0.34 | | Foliar nematode |
| Ditylenchus | 0.45 | | Stem & Bulb nematode |
| Filenchus | 0.67 | | |
| **Predatory** | 0.00 | > 2 | |
| **Root Feeders** | 1.01 | < 1 | |
| Paratylenchus | 0.45 | | Pin nematode |
| Pratylenchus | 0.11 | | Lesion nematode |
| Tylenchulus | 0.45 | | Citrus nematode |

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137178 |
| Unique ID: | T2 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 7.39 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 5.00 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 328.89 | > 300 | Good fungal biomass. |
| Total Bacteria µg/g | 275.19 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 1.20 | > 0.5 | |
| Biological Carbon pounds per acre | 664.50 | > 990 | |
| Biological Nitrogen pounds per acre | 72.60 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 9.15 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137178 |
| Unique ID: | T2 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | 3.37 | > 10 | Low numbers, but good diversity. |
| **Bacterial Feeders** | 1.98 | > 4 | |
| Alaimus | 0.20 | | |
| Cephalobus | 0.59 | | |
| Cervidellus | 0.20 | | |
| Eumonhystera | 0.20 | | |
| Plectus | 0.20 | | |
| Rhabditidae | 0.59 | | |
| **Fungal Feeders** | 0.59 | > 4 | |
| Eudorylaimus | 0.20 | | |
| Tylencholaimellus | 0.40 | | |
| **Fungal/Root Feeders** | 0.59 | < 1 | |
| Aphelenchoides | 0.20 | | Foliar nematode |
| Ditylenchus | 0.20 | | Stem & Bulb nematode |
| Filenchus | 0.20 | | |
| **Predatory** | 0.20 | > 2 | |
| Clarkus | 0.20 | | |
| **Root Feeders** | 0.00 | < 1 | |

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137179 |
| Unique ID: | T3 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 9.83 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 4.90 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 182.57 | > 300 | Low fungal biomass, foods and biology may be required. |
| Total Bacteria µg/g | 297.87 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 0.61 | > 0.5 | |
| Biological Carbon pounds per acre | 528.48 | > 990 | |
| Biological Nitrogen pounds per acre | 72.23 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 7.32 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137179 |
| Unique ID: | T3 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | NaN | > 10 | None observed. |
| **Bacterial Feeders** | 0.00 | > 4 | |
| **Fungal Feeders** | 0.00 | > 4 | |
| **Fungal/Root Feeders** | 0.00 | < 1 | |
| **Predatory** | 0.00 | > 2 | |
| **Root Feeders** | 0.00 | < 1 | |

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137180 |
| Unique ID: | T4 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 31.66 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 5.20 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 254.98 | > 300 | Low fungal biomass, foods and biology may be required. |
| Total Bacteria µg/g | 382.46 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 0.67 | > 0.5 | |
| Biological Carbon pounds per acre | 701.18 | > 990 | |
| Biological Nitrogen pounds per acre | 93.49 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 7.50 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137180 |
| Unique ID: | T4 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | NaN | > 10 | None observed. |
| **Bacterial Feeders** | 0.00 | > 4 | |
| **Fungal Feeders** | 0.00 | > 4 | |
| **Fungal/Root Feeders** | 0.00 | < 1 | |
| **Predatory** | 0.00 | > 2 | |
| **Root Feeders** | 0.00 | < 1 | |

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137181 |
| Unique ID: | T6 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 6.97 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 5.20 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 141.17 | > 300 | Low fungal biomass, foods and biology may be required. |
| Total Bacteria µg/g | 250.97 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 0.56 | > 0.5 | |
| Biological Carbon pounds per acre | 431.35 | > 990 | |
| Biological Nitrogen pounds per acre | 60.39 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 7.14 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137181 |
| Unique ID: | T6 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | 4.80 | > 10 | Low numbers, but good diversity. |
| **Bacterial Feeders** | 1.05 | > 4 | |
| Cervidellus | 0.30 | | |
| Eumonhystera | 0.30 | | |
| Plectus | 0.15 | | |
| Prismatolaimus | 0.30 | | |
| **Fungal Feeders** | 0.30 | > 4 | |
| Aporcelaimellus | 0.15 | | |
| Eudorylaimus | 0.15 | | |
| **Fungal/Root Feeders** | 3.30 | < 1 | |
| Aphelenchoides | 0.15 | | Foliar nematode |
| Ditylenchus | 0.75 | | Stem & Bulb nematode |
| Filenchus | 2.40 | | |
| **Predatory** | 0.00 | > 2 | |
| **Root Feeders** | 0.15 | < 1 | |
| Mesocriconema | 0.15 | | Ring Nematode |

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137182 |
| Unique ID: | T8 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 21.26 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 5.10 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 125.27 | > 300 | Low fungal biomass, foods and biology may be required. |
| Total Bacteria µg/g | 292.30 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 0.43 | > 0.5 | |
| Biological Carbon pounds per acre | 459.33 | > 990 | |
| Biological Nitrogen pounds per acre | 68.90 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 6.67 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137182 |
| Unique ID: | T8 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | 10.06 | > 10 | Good numbers, but low diversity. |
| **Bacterial Feeders** | 2.46 | > 4 | |
| Chiloplacus | 0.22 | | |
| Cuticularia | 0.45 | | |
| Eucephalobus | 0.22 | | |
| Plectus | 0.45 | | |
| Prismatolaimus | 0.45 | | |
| Rhabditidae | 0.45 | | |
| Teratocephalus | 0.22 | | |
| **Fungal Feeders** | 0.67 | > 4 | |
| Mesodorylaimus | 0.67 | | |
| **Fungal/Root Feeders** | 6.93 | < 1 | |
| Aphelenchoides | 1.34 | | Foliar nematode |
| Ditylenchus | 0.89 | | Stem & Bulb nematode |
| Filenchus | 2.01 | | |
| Lelenchus | 2.68 | | |
| **Predatory** | 0.00 | > 2 | |
| **Root Feeders** | 0.00 | < 1 | |

# Soil Life Test

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137183 |
| Unique ID: | T12 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Assay Name | Result | Range | Commentary |
|---|---|---|---|
| **Soil Life Test** | | | |
| Moisture % | 14.02 | > 20 | Add organic matter to build soil structure, increase water holding capacity. |
| pH | 4.40 | 5.5 to 9 | |
| Electrical Conductivity µS/cm | 10.00 | 200 to 1000 | |
| Total Fungi µg/g | 85.16 | > 300 | Low fungal biomass, foods and biology may be required. |
| Total Bacteria µg/g | 230.25 | > 600 | Low bacterial biomass, inoculum and foods may be required. |
| Total Fungi to Total Bacteria ratio | 0.37 | > 0.5 | |
| Biological Carbon pounds per acre | 346.96 | > 990 | |
| Biological Nitrogen pounds per acre | 53.78 | > 143 | |
| Biological Carbon to Biological Nitrogen ratio | 6.45 | > 7 | |
| **Aerobic Fungi and Bacteria** | | | |
| Aerobic Fungi µg/g | Not Ordered | > 15 | |
| Aerobic Bacteria µg/g | Not Ordered | > 30 | |
| Aerobic Fungi to Aerobic Bacteria ratio | Not Ordered | > 0.5 | |
| **Protozoa** | | | |
| Flagellates MPN/g | Not Ordered | > 25000 | |
| Amoebae MPN/g | Not Ordered | > 25000 | |
| Ciliates MPN/g | Not Ordered | | |
| **Application Recommendations** | | | |
| Product | Quantity | | Area |
| | | | |
| | | | |
| | | | |
| | | | |
| **Notes** | | | |

# Nematode Detail

Report prepared for:
Urban Forestry Services- Bartlett Consulting
Anna Heckman
15119 McLean Rd.
Mount Vernon, WA 98273

**For interpretation of this report, please contact your local Soil Steward or the lab.**

| | |
|---|---|
| Report Sent: | 09/28/2022 |
| Sample # | 01-137183 |
| Unique ID: | T12 |
| Plant: | Not Indicated |
| Season: | summer |
| Invoice Number: | 21600 |
| Sample Received: | 09/19/2022 |

Earthfort, LLC
635 SW Western Blvd
Corvallis, OR 97333
+1 (541) 257-2612
info@earthfort.com
http://earthfort.com

| Nematode Group and Genus | Result in #/g | Level | Notes |
|---|---|---|---|
| **Total Nematodes** | 1.14 | > 10 | Low numbers, but good diversity. |
| **Bacterial Feeders** | 0.60 | > 4 | |
| Cephalobus | 0.03 | | |
| Eucephalobus | 0.03 | | |
| Plectus | 0.03 | | |
| Rhabditidae | 0.51 | | |
| **Fungal Feeders** | 0.18 | > 4 | |
| Eudorylaimus | 0.15 | | |
| Mesodorylaimus | 0.03 | | |
| **Fungal/Root Feeders** | 0.30 | < 1 | |
| Ditylenchus | 0.18 | | Stem & Bulb nematode |
| Filenchus | 0.12 | | |
| **Predatory** | 0.06 | > 2 | |
| Clarkus | 0.03 | | |
| Mononchus | 0.03 | | |
| **Root Feeders** | 0.00 | < 1 | |

## Soil Texture Tests

Anna Heckman
Urban Forestry Services/Bartlett Consulting
15119 McLean Rd.
Mt. Vernon, WA 98273

Lab.#3088

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #1 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 31.75% | Gravel |
| #18 | 1.00 mm | 33.91% | Very coarse sand/fine gravel |
| #35 | 500 microns | 12.31% | Coarse sand |
| #60 | 250 microns | 9.56% | Medium sand |
| #140 | 100 microns | 6.08% | Fine sand |
| #270 | 50 microns | 2.91% | Silt |
| #500 | 25 microns | 2.67% | Clays |
| Passed #500 | 25 microns | 0.81% | Clays |

Recovery on testing: 99.92% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

Anna Heckman
Urban Forestry Services/Bartlett Consulting
15119 McLean Rd.
Mt. Vernon, WA 98273

Lab.#3088a

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #2 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 34.50% | Gravel |
| #18 | 1.00 mm | 19.72% | Very coarse sand/fine gravel |
| #35 | 500 microns | 13.62% | Coarse sand |
| #60 | 250 microns | 14.77% | Medium sand |
| #140 | 100 microns | 9.53% | Fine sand |
| #270 | 50 microns | 3.50% | Silt |
| #500 | 25 microns | 3.01% | Clays |
| Passed #500 | 25 microns | 1.35% | Clays |

Recovery on testing: 99.91% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

Anna Heckman
Urban Forestry Services/Bartlett Consulting
15119 McLean Rd.
Mt. Vernon, WA 98273

Lab.#3088b

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #3 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 9.15% | Gravel |
| #18 | 1.00 mm | 25.12% | Very coarse sand/fine gravel |
| #35 | 500 microns | 18.37% | Coarse sand |
| #60 | 250 microns | 15.91% | Medium sand |
| #140 | 100 microns | 12.63% | Fine sand |
| #270 | 50 microns | 9.81% | Silt |
| #500 | 25 microns | 8.25% | Clays |
| Passed #500 | 25 microns | 0.76% | Clays |

Recovery on testing: 99.90% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

Anna Heckman
Urban Forestry Services/Bartlett Consulting
15119 McLean Rd.
Mt. Vernon, WA 98273

Lab.#3088c

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #4 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 6.06% | Gravel |
| #18 | 1.00 mm | 37.47% | Very coarse sand/fine gravel |
| #35 | 500 microns | 16.54% | Coarse sand |
| #60 | 250 microns | 13.55% | Medium sand |
| #140 | 100 microns | 10.24% | Fine sand |
| #270 | 50 microns | 6.72% | Silt |
| #500 | 25 microns | 8.23% | Clays |
| Passed #500 | 25 microns | 1.19% | Clays |

Recovery on testing: 99.93% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

Anna Heckman
Urban Forestry Services/Bartlett Consulting
15119 McLean Rd.
Mt. Vernon, WA 98273

Lab.#3088d

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #6 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 17.41% | Gravel |
| #18 | 1.00 mm | 26.78% | Very coarse sand/fine gravel |
| #35 | 500 microns | 15.67% | Coarse sand |
| #60 | 250 microns | 17.37% | Medium sand |
| #140 | 100 microns | 6.97% | Fine sand |
| #270 | 50 microns | 5.53% | Silt |
| #500 | 25 microns | 9.05% | Clays |
| Passed #500 | 25 microns | 1.22% | Clays |

Recovery on testing: 99.92% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

Anna Heckman
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Mt. Vernon, WA 98273

Lab.#3088e

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #8 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 1.05% | Gravel |
| #18 | 1.00 mm | 35.67% | Very coarse sand/fine gravel |
| #35 | 500 microns | 17.05% | Coarse sand |
| #60 | 250 microns | 13.22% | Medium sand |
| #140 | 100 microns | 12.84% | Fine sand |
| #270 | 50 microns | 9.89% | Silt |
| #500 | 25 microns | 9.19% | Clays |
| Passed #500 | 25 microns | 1.10% | Clays |

Recovery on testing: 99.90% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

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Lab.#3088f

3-Oct-22

SUBJECT: SOIL SAMPLE FOR SIEVE ANALYSIS

SAMPLE IDENTIFICATION: T #12 - submitted 9/19/2022

Results of Mechanical Analysis: Particle distribution report.

Sieve Series Analysis: 100% of material passed a 1/2 inch mesh; this material was then classified by particle size analysis as follows:
Note: This sample was composed of rock and gravelly sand with very little organic content.

| MESH: | SIEVE SIZE | % Retained | Classification |
|---|---|---|---|
| | 1/4 INCH | 1.50% | Gravel |
| #18 | 1.00 mm | 34.28% | Very coarse sand/fine gravel |
| #35 | 500 microns | 20.21% | Coarse sand |
| #60 | 250 microns | 13.14% | Medium sand |
| #140 | 100 microns | 9.72% | Fine sand |
| #270 | 50 microns | 13.32% | Silt |
| #500 | 25 microns | 7.08% | Clays |
| Passed #500 | 25 microns | 0.75% | Clays |

Recovery on testing: 99.90% With all calculations being on a dry weight basis.

This particle distribution report was determined using U.S. Standard Sieve Series.

As a reference for a soil's potential to be used as a plant growth medium:
(Ideally the gravel and very coarse sand fractions should not exced 12 to 15 %. The coarse, medium, and fine sand fractions should be 70 to 85% of the total and the silt/clays at 5 to 15%).

William F. Black, Agronomist

## Soil Nutrient Tests

**Anna Heckman**

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# *William F. Black Soil Testing*

***Testing & Consulting***

360-770-6437
email: wfblacksoiltester@gmail.com

*10/3/2022*
Invoice 3088

SUBJECT: (7) Samples of soil received on 09/19/22 representing various soils for chemical and physical evaluation.
(Tests conducted on a plant available basis: Results in ppm, dry basis)

| Sample | pH | Calcium (Ca) | Ammonium ($NH_4$) | Nitrate ($NO_3$) | Phosphorus ($P_2O_5$) | Potassium ($K_2O$) | Magnesium (Mg) | Chloride (Cl) | Electro-conductivity | Manganese (Mn) | Iron ($Fe_{total}$) | Sulfate ($SO_4$) | Aluminum (Al) | Organic Matter % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T #1 | 5.97 | 57.0 | 0.75 | 3.0 | 0.11 | 2.15 | 39.5 | 1.0 | 0.088 | 2.03 | 19.0 | 0.0 | ND | <2.0 |
| T #2 | 5.32 | 38.0 | 1.06 | 9.0 | <0.1 | 4.72 | 16.8 | 1.0 | 0.052 | 1.15 | 152.8 | 0.0 | 2.9 | <2.0 |
| T #3 | 5.61 | 68.0 | 0.50 | <0.1 | <0.1 | 0.52 | 36.3 | 0.8 | 0.048 | 0.92 | 58.4 | 0.0 | 1.72 | <2.0 |
| T #4 | 6.31 | 82.0 | 0.55 | <0.1 | 0.27 | 0.25 | 59.6 | 1.3 | 0.120 | 14.70 | 63.2 | 0.0 | ND | <2.0 |
| T #6 | 5.92 | 87.0 | 0.50 | 1.0 | <0.1 | <0.1 | 25.6 | <0.5 | 0.057 | 0.94 | 35.0 | 0.0 | ND | <2.0 |
| T #8 | 6.21 | 77.0 | 0.62 | 2.0 | <0.1 | 0.17 | 39.1 | <0.5 | 0.062 | 3.15 | 45.8 | 0.0 | ND | <2.0 |
| T #12 | 5.42 | 33.0 | <0.5 | 2.0 | 0.13 | <0.1 | 19.6 | 1.3 | 0.077 | 3.30 | 150.4 | 0.0 | 1.19 | <2.0 |
| Theroritical optimum soil levels for landscape plantings. | 5.8-6.8 | 75-150 ppm | 1-3 ppm | 15-25 ppm | 2-4 ppm (6 max) | 5-8 ppm ( 12 max) | >18ppm | 0-10 ppm | <1.0 millimhos/cm at 30 degrees C | >4 ppm total | >40ppm | >0ppm | None Wanted (Toxic) | 6-12% by dry weight |

*Tr=traces ; ND = None Detectec
*<=less than
***>=greater than

Comments & Recommendations:
Reviewing these soils as having the potential to be used as a plant growing medium:

From the physical standpoint all samples represented soils of a gravelly sandy silt composition with very low organic content. From the chemical standpoint the soils ranged in pH from low to very good with fair to very good plant available calcium. The total nitrogen along with the plant available phosphorus and potassium were found low in all samples. Magnesium is very good in all samples. The total soluble salts were found to be low however there was some soluble aluminum which has an adverse effect on some plants, but is easily corrected by raising the pH with lime application.