Howard EcoWorks

2022 - Summer Internship Project

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This report includes findings on the estimated carbon footprint of Howard EcoWorks and analyzes the potential offsets of best management practices (BMPs) implemented by the nonprofit corporation. The four BMPs that were analyzed include bioretention systems, conservation landscapes, rain gardens, and tree plantings. Every BMP that EcoWorks has designed as of 2022 has been included in the report. The report also includes information on how the theoretical application of biochar and compost to existing BMPs would affect carbon sequestration.

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Findings & Figures

Type	Yearly	30 - Year
Rain Garden	- 0.9484 tons	- 28.4520 tons
Conservation Landscape	- 0.9176 tons	- 14.4345 tons
Tree Planting	- 17.214 tons	- 516.428 tons
Bioretention	+ 0.2939 tons	+ 8.8173 tons
BMP - Total Sequestration	- 18.7861 tons	- 550.4972
EcoWorks without Offsets	+ 54.50 tons	+ 1,635.00 tons
EcoWorks with Offsets	+ 35.7139 tons	+ 1,084.5028 tons

Figure 1: This chart shows the amount of CO_2eq. sequestered by each BMP (rain gardens, conservation landscapes, tree plantings, and bioretention systems) over a one year period and over a 30 year period. The 30 year period is calculated assuming no increase in the number of EcoWorks projects since 2022. Certain equations used in calculations were based on a 30-year timeline, however, it is important to acknowledge that different BMPs will sequester carbon at different rates over time. "EcoWorks without Offsets" shows how much CO2eq. Howard EcoWorks emits over a one year period and over a 30 year period. "EcoWorks with Offsets"" shows how much CO2eq. Howard EcoWorks emits over a one year period and over a 30 year period after sequestration from BMPs has been incorporated as offsets to the company's emissions.

Type of BMP	Amended Area of BMPs	Cumulative Amended Area of BMPs	CO_2eq. Sequestered by Biochar/Charcoal
Rain Garden	166.25 sq. ft.	20,947.5 sq. ft.	- 16.91376 tons
Conservation Landscape	293.3 sq. ft.	10,558.75 sq. ft.	- 8.52550 tons
Tree Planting	2.405 sq. ft. for 1 tree	770.75 sq. ft. for 320.48 trees	- 0.62236 tons
Bioretention	950 sq. ft.	2,850 sq. ft.	- 2.30122 tons
BMP - Total Sequestration	N/A	35,127 sq. ft. (0.806 acres)	- 28.36284 tons

Figure 2: This chart shows the potential amount of CO_2eq. that would be sequestered if every BMP was amended with biochar and compost. This value would not significantly increase or decrease over time (at least 100 years), as studies suggest that amending both compost and biochar with soil "locks" the existing carbon into the soil. Specifications about how much biochar and compost would be added to each type of BMP can be found in the report. "Amended Area of BMPs" shows the average area that could be amended for one BMP. "Cumulative Amended Area of BMPs" shows the total average area that could be amended for every BMP EcoWorks has installed since 2022. Assumptions regarding the area that can be amended per site are also listed in the report.

Units of Measurement (What is CO_2eq?)

Carbon dioxide equivalent (CO_2eq) is the unit of measurement used in this report to quantify how much carbon dioxide is sequestered by Howard EcoWorks.

CO_2eq is defined by the European Union as, "a unit based on the global warming potential (GWP) of different greenhouse gasses. The CO_2eq unit measures the environmental impact of one tonne of these greenhouse gasses in comparison to the impact of one tonne of CO_2." [6]

This is an accurate unit for measuring emissions, given that different processes emit different greenhouse gasses at varying degrees. The potencies of these gasses are highly varied, so by using CO_2 as a baseline, researchers and the general public are able to interpret this data more accurately.

EcoWorks Emissions

The carbon footprint of Howard Ecoworks's operations was modeled using a software tool known as Greenhouse Gas Emissions Calculator. This calculator was designed under the standards of the GHG Protocol, a set of guidelines tailored to best approximate sources of net carbon dioxide emissions, and is used by agencies such as the EPA. The GHG Emissions Calculator estimates and aggregates the carbon footprint along these five parameters: mobile combustion, stationary combustion, purchased electricity, transportation, and refrigerants [7]. Due to the property manager being unavailable to disclose any information about electric bills, our team had to research the average amount of electricity consumed in an office space as large as Howard Ecoworks's headquarters . That value would serve as a proxy from which the calculator would then derive the amount of CO_2 produced in tonnes. Additionally, refrigerant data was not collected due to an inability to access necessary data, and the conclusion that the nature of EcoWorks' refrigerant use was negligible in calculations. Emissions from electricity used to power refrigerants was included. Because the facility lacks any steamers or natural gas boilers on site, stationary combustion was omitted as a parameter.

Summary of Findings

- Driving of vehicles not owned by Ecoworks accounts for a total of 38.528 tons of CO_2eq emitted per year [7].
- Office space accounts for a total of 7.994 CO_2eq emitted per year [7].
- Company owned vehicles account for a total of 8.026 CO_2eq emitted per year [7].
- Total company emissions are 54.548 CO_2eq a year [7].

Office Space

- Details regarding the office size are listed below…
    - Entire building: 36,352 sf.
    - NPC portion of the building: 27,332 sf.
    - EcoWorks Space: 1,414.8 sf.
        - EcoWorks Office Space: 886.7 sf.
        - EcoWorks Portion of Shared Office Space: 528.1 sf.
- Our team utilized a software called the Commercial Energy Calculator (created by Union Power Cooperative) to determine the amount of energy used by office space at EcoWorks[16]. The calculator determined that 27,317 kilowatt hours of electricity were consumed by EcoWorks' office space [16]. The program takes into account a variety of factors as detailed below…
    - Building Type: Low Rise Office Building

    - Age: 30-39 years (1986)
    - Annual Operating Hours: 2625
        - Hours Per Day: 10
        - Days a Week: 5.25
        - Weeks a Year: 50
    - Sq/Ft Heat and Cool: 1,414.8
    - Heating Type: Electric
    - Heat Setting (F): 72
    - Cooling Type: Electric (Typical)
    - Cooling Setting (F): 70
    - Lighting (Watts Sq/Ft): 2.54
        - Standard
    - Water Heat Type: Electric
    - Windows (Panes): Double Pane
    - Cooking Equipment: Yes (electric - and minimal)
    - Refrigeration: Yes
    - Elevator/Escalator: No
- 27,317 kilowatt hours of electricity was then inputted as a value into the GHG Calculator, coming out to 7.994 tons of CO_2eq emitted by EcoWorks office space per year [7]. The location of EcoWorks office space (Columbia, MD) was taken into consideration by the software, as different parts of the country receive energy from different sources.

Mobile Combustion: Company-Owned Vehicles

EcoWorks owns two vehicles (Chevy Silverados) and regularly rents one vehicle (1500 RAM truck) during the summer months. The vehicles were primarily used by employees for site-to-site travel, both installing and maintaining BMPs. The data required for this calculation was collected via maintenance records where the distance driven in a year per vehicle was recorded. The distances were totaled and inputted into the GHG calculator under “Vehicle Type” of “Gasoline Light-Duty Trucks". The result was that company owned vehicles account for a total of 8.026 CO2eq emitted per year by company-owned vehicles [7].

Mobile Combustion: Employee-Owned Vehicles

It is important to note that in many carbon accounting protocols, employee commutes are not required to be reported, however, the EPA suggests that it is taken into account.

In order to determine the total distance driven by EcoWorks employees, a survey was sent out asking them to report the method of transportation that they use and how many miles per week they travel by that mode of transportation for company purposes (commute, site-to-site travel, etc). The three modes of transportation were found to be gasoline-powered passenger vehicles, hybrid vehicles, and light-duty trucks. Data collected via this survey was then inputted into the GHG calculator on a yearly scale and it was determined that driving of vehicles not owned by Ecoworks accounts for a total of 38.528 tons of CO_2eq a year [7]. Assumptions are shown below…

- Full Time Employees - 48 weeks of work a year per employee
    - Assuming office is operational ~50 weeks a year with holidays
    - ~2 weeks of vacation per employee
    - Some employees work remote 1-2 days a week
- Ready Crew
    - 10 people
    - Only commute, no site travel in their own cars
    - Assuming they use passenger vehicles
    - Values derived from finding the average employee commute distance and applying it to the Ready Crew
        - Average EcoWorks employee commutes 22.89 miles a day (to and from the office), however, many employees live outside of the county
        - Given that these employees live in Howard County, the assumption is that the average commute for a READY Crew employee is 15 miles a day (to and from the office)
    - Ready Crew gets the Fourth of July off of work
    - Total miles 5,340
    - Crew leads work for 38 days (4 employees)
    - Remainder of the crew works for 34 days (6 employees)
- Summer Interns
    - 2 interns
    - 7 weeks of employment per intern

EcoWorks' Site-to-Site Travel

Theoretically, this value should already be accounted for within EcoWorks' emissions. Because employees were asked to estimate the amount of travel done from site to site, which would have included travel for BMP installation and maintenance. These calculations serve as a reference for mobile combustion values.

Travel emissions for each type of BMP were estimated with information from Field Operations Manager, Genevieve Simard. The average distance from office/farm to the BMPs is estimated to be 5 miles.

- Tree Plantings
    - 4 trips total
    - 39 sites
    - Estimated: 1,560 miles
- Rain Gardens
    - 20 trips within the first year
    - Additional 3 visits for the remainder of the BMP's lifetime (assuming there are no issues)
    - 126 sites listed in MS4, however, some are located on the same properties, so we will assume 80 sites for this calculation
    - Estimated: 18,400 miles
- Bioretention
    - 20 trips within the first year
    - Additional 3 visits for the remainder of the BMP's lifetime (assuming there are no issues)
    - 3 sites listed in MS4
    - Estimated: 630 miles
- Conservation Landscapes
    - 10 trips within the first year
    - Additional 3 visits for the remainder of the BMP's lifetime (assuming there are no issues)
    - 36 sites listed in MS4, however, some are located on the same properties, so we will assume 23 sites for this calculation
    - Estimated: 2,990 miles
- Total
    - According to the EPA GHG Calculator, emissions from the total 23,580 miles of travel accounted for 11.255 tons of CO_2eq [7].

BMP Emissions/Offsets

Tree Plantings

The information for these equations was derived from a document that contained data from HOCO tree plantings in 2020 and 2021 (these were the only years with HOCO tree plantings). The documents “Tree HOCO Inquiries (Fall 2021)” and “2020 Tree Planting Projects” contained information on the species and number of trees planted. Using this information, an estimation was made of what the diameter of each species would be after either full growth or 30 years (if a tree would not be of full size by 30 years). The carbon sequestration of these trees was then derived from calculations provided by Camilo Mora at the University of Hawaii, Manoa [12]. These calculations use tree diameter at breast height (~4 feet off the ground) and account for root structure, as roughly 24% of tree weight is underground [12]. An 80% survival rate was also applied to the final value. The total amount of carbon sequestered from documented plantings was found to be 345,375 kg of CO_2 over 30 years, equivalent to 380.7 tons [12].

According to the spreadsheet, “PolygonBMP_2020”, there were 16 plantings not accounted for in the “Tree HOCO Inquiries (Fall 2021)” or “2020 Tree Planting Projects” sheets. In order to account for the sequestration done by undocumented sites, the average plant distribution of the documented sites was determined and applied to the 16 remaining sites. The average sequestration per documented site was found to be 16.552 tons CO_2 sequestered over 30 years. Applying this value to the 16 undocumented sites, it was inferred that undocumented sites account for roughly 264.835 tons CO_2 over 30 years.

In total, it was found that the HOCO tree plantings will account for an estimated total of 516.428 tons of CO_2 over a span of 30 years with a standard 80% survival rate. While it is important to acknowledge that younger trees uptake carbon at a much faster rate than older trees do, a quantifiable statement would be that EcoWorks sequesters 17.214 tons of CO_2 every year from HOCO tree plantings.

Rain Gardens

In order to determine the carbon sequestration potential of rain gardens, an equation was derived from a study titled, “Carbon sequestration potential for mitigating the carbon footprint of green stormwater infrastructure” [11]. Factors taken into consideration by this study included construction, travel of workers, travel for maintenance, average vegetation abundance and sequestration ability, soil sequestration, end of life phase/deconstruction [11]. The equations are listed below [11].

- 30-year mean carbon footprint: 62.9 ± 21.2 kg CO2 eq. m^{-2}
- 30-year mean carbon sequestration: −75.5 ± 68.4 kg CO2 eq. m^{-2}
- 30-year mean net carbon footprint: −12.6 kg CO2 eq. M^{-2}

According to the spreadsheet titled, “BMPData_2022” there are 126 rain gardens planted by EcoWorks. Through working with project leads, an estimated value of 150 - 200 sq. ft. per rain garden was determined. An average of 175 sq. ft. per rain garden was utilized.

Using the carbon footprint equations listed above, the average value for carbon footprint is…[11]

- 128,851.41 ± 43,428.45 kg CO2 eq. over 30 years

Using the carbon footprint equations listed above, the average value for net carbon sequestration is…[11]

- -154,662.66 ± 140,118.22 kg CO2 eq. over 30 years

Using the carbon footprint equations listed above, the values for net carbon footprint are as follows…[11]

- Cumulative Area: -25,811.25 kg CO2 eq. over 30 years

Although sequestration rates are subject to change over time, this value can be converted into an annual statistic of 860.38 kg of CO2 eq. sequestered per year or 0.948406606 tons of CO2 eq. sequestered per year.

Bioretention Systems

In order to determine the carbon sequestration potential of bioretention systems, an equation was derived from the same study as was used for rain gardens [11]. The equations are listed below. The net value is what will be used in assessing final sequestration values.

- 30-year mean carbon footprint: 98.4 ± 19 kg CO2 eq.m^{-2}
- 30-year mean carbon sequestration: −69.7 kg CO2 eq. m^{-2}
- 30-year mean net carbon footprint: 28.7 kg CO2 eq. M^{-2}

According to the “BMPData_2022” spreadsheet, there are three bioretention systems. Through discussion with employees at EcoWorks, it was determined that the average area of a bioretention system was roughly 1,000 square feet. This comes out to a total of 3,000 square feet (or 278.71 square meters) of bioretention systems installed by EcoWorks.

Inputting this value into the net carbon footprint equation results in a value of 7,998.98 kg of CO2 eq. emitted over 30 years [11]. Although sequestration rates are subject to change over time, this value can be turned into an annual statistic of 266.63 kg of CO2 eq. emitted per year or 0.293909 tons of CO2 eq. emitted per year.

Reasons why bioretention systems showed to have large carbon footprints include the relatively large amount of material that is required to build them and the production and transportation of said material [11]. According to the study, "this system requires a large amount of material such as concrete, pipes and filter media, which can account for approximately 50% of the carbon footprint" [11]. While this type of BMP may not be the most effective at sequestering carbon, their positive environmental impact associated with runoff and pollutants makes them a valuable installation.

Conservation Landscapes

The main components of conservation landscapes that contribute to carbon sequestration include the use of trees, shrubs, and grasses/perennial plants. As advised by Jeff Walden, mulch was not included as a factor due to the fact that it decomposes above ground and the stored carbon is theoretically released back into the atmosphere.

According to the "BMPData_2022" spreadsheet, there are 36 total conservation landscapes planted by EcoWorks. The MS4 Project Metrics spreadsheet listed six rain garden sites that were used to determine the average area of this type of BMP: 293.3 square feet. 36 sites with an average area of 293.3 square feet resulted in a total of 10,558.75 square feet of rain gardens planted by EcoWorks. The spreadsheet, MS4 Project Metrics, was also used to determine the average amount of each resource used per 100 square feet of rain garden.

- 0.17 trees per 100 square feet
    - Total Trees: 17.95
- 1.93 shrubs per 100 square feet
    - Total Shrubs: 203.78
- 21.53 perennials per 100 square feet
    - Total Perennials: 2,273.3
    - Due to lack of available data, this statistic was not be used in this form

Assumptions and Methods for calculating carbon sequestration for trees, shrubs, and grasses/perennials are listed below.

- Trees
    - It was assumed that the trees planted in these conservation landscapes were small/medium sized trees with 30-year diameter of roughly 10 inches. The same calculations that were used for determining carbon sequestration from tree plantings were also used for these calculations [12].
    - It was determined that 848 kg of CO_2 eq. were sequestered per tree over 30 years. Given that there were an estimated 17.95 trees planted amongst all of EcoWorks' rain gardens, it can be estimated that 12,177.28 kg of CO_2 eq. would be sequestered over 30 years with a standard 80% survival rate
    - Although sequestration rates are subject to change over time, this value can be turned into an annual statistic of 405.91 kg of CO_2 eq. sequestered yearly with an 80% survival rate.
- Shrubs
    - Due to lack of shrub-specific data, the same approach used for trees was used for shrubs.
    - Given a sample population, it was estimated that the cumulative number of shrubs planted amongst all conservation landscapes was 203.78. Because the shrub species were not specified, the four most commonly planted shrubs that EcoWorks uses were picked and their sequestration levels were calculated over a 30 year span. The four shrubs were hazelnut, inkberry, serviceberry, and witch hazel. For estimation purposes, it was assumed that the four species were planted at equal proportions (each of the four species made up 25% of all shrubs planted). Using these values it was determined that the average amount of carbon dioxide sequestered per shrub over 30 years was 4 kg. 203.78 shrubs sequestering four kg gave a value of 815.12 kg of CO_2 sequestered over 30 years, or 21.17 kg of CO_2 per year.
- Grasses/Perennials
    - EcoWorks does not cover the entire landscape with perennials (shrubs and trees take up space, as well as soil that is left uncovered) so it was assumed that the perennial/grass values account for roughly 80% of the total 980.94 square meters of conservation landscapes. This results in a value of 784.75 m^{-2} being applied to the perennial/grass sequestration values. Two studies were used to determine the amount of carbon sequestered by this type of vegetation.
    - Study 1 focused on tall, native grasses and found that 0.0741315 kg and 0.42007895 kg of carbon was sequestered per square meter [15]. The average of this range is 0.247105 kg of sequestered carbon per square meter. Given that roughly 980.94 square meters of EcoWorks conservation landscapes are covered by

grasses/perennials, the amount of carbon sequestered according to this study would be 169.675 kg (when using the average value) [15].

- Study 2 focused on meadows and small shrubs, and addressed the following factors: above-ground, litter, roots, organic, mineral matter [14]. However, only the values for above-ground matter, litter, and roots were utilized because minerals are not significantly affected by EcoWorks' plantings, and organic matter (soil) is largely pre-existing prior to the plantings. Given that the yearly flux according to this study was -3.135e-8 kg of C per m^{-2}, it is assumed that once fully-grown, perennials/grasses will continue to sequester carbon at a rate that is negligible [14]. It is important to note that this is the value of a plot that is already well established and fully grown. Roots of new perennials grow extensively, but this statement is based on when they have reached an adequate depth/area and are fully established. The baseline carbon storage (above-ground, litter, roots) was found to be 1.27 ± 0.324 kg of carbon per meter squared [14]. Given that roughly 980.94 square meters of EcoWorks conservation landscapes are covered by grasses/perennials, the amount of carbon sequestered according to this study would be 872.06 ± 222.48 kg [14]. Because these studies are based on fully established plots and that the Net Ecosystem Exchange was found to be negligible, this value was included on the yearly scale, but did not increase in value when put on the 30 year scale.
- The values from both studies were averaged to account for the variation in types of grasses/perennials that were planted. The values derived from the two studies are listed below, along with the final average value of how much carbon grasses/perennials sequester in EcoWorks conservation landscapes.
  - Study 1: 0.18703 tons of CO_2 sequestered
  - Study 2: 0.71604 tons of CO_2 sequestered
  - Average: 0.4515 tons of CO_2 sequestered

Compost & Biochar Information

Biochar Information and Data

According to the University of California, Agriculture and Natural Resources, biochar is composed of roughly 80% carbon [2]. This coincides with the data provided by Kelpie Wilson, where she also states that biochar is 80% carbon.

According to the EIA, if a material such as coal contains 51% carbon, 2,000 pounds of coal contains 1,020 pounds of carbon [3]. If this 1,020 pounds of carbon were burned, it would produce 3,740 pounds of carbon dioxide [3]. This is because during combustion, carbon binds with oxygen which is of greater density. Using this information can we assume that 1 kg of biochar will contain 0.8 kg of carbon, and this 0.8 kg of sequestered carbon is preventing the formation of 2.936 kg of CO_2. Therefore, 1 kg of biochar prevents the formation of 2.936 kg of CO_2 eq.

When biochar is applied, it is often measured in the form of cubic yards. In order to determine the weight of one cubic yard of biochar, the following information was utilized. The bulk density of biochar made from hardwood was found to be 0.28 - 0.48 (g/cm^3) [1]. Using this information it was determined that the weight of one cubic yard of biochar is 471.96 - 809.07 (lbs/yd^3). Therefore, the average weight of one cubic yard of biochar would be 290.534985 (kg/yd^3).

In order to determine how much biochar Ecoworks uses, the following information was used. According to the spreadsheet, “My Rain Garden Calculator”, 0.1583333 cubic yards of biochar was used for a 300 square foot area of rain garden. Therefore, one cubic yard of biochar sequesters 853.0107 kilograms of carbon dioxide equivalent.

Compost Information and Data

The primary gas released by food decomposition is methane, a highly potent greenhouse gas with a GWP almost thirty times that of carbon dioxide. By composting food waste, emissions can be limited as methane-producing microbes are not active in anaerobic conditions [4]. According to the EPA, landfilling 100 pounds of food waste results in the release of 8.3 pounds of methane, which is equal to 207.5 pounds of CO_2 equivalent [5]. In comparison, composting 100 pounds of food waste results in the release of 4.15 pounds of methane, which is equal to 103.75 pounds of CO_2 equivalent [5].

Various sources were used to estimate the weight of a cubic yard of compost so that it could be determined how much carbon was sequestered per cubic yard. Using three estimates of 1,250, 1,000, and 1,3000 pounds, it was determined that the average weight per cubic yard of compost was 537 kilograms [8, 9, 13].

In order to determine how much compost EcoWorks uses, the same approach was used as it was for biochar. According to the spreadsheet, “My Rain Garden Calculator”, 0.1583333 cubic yards of compost was used for a 300 square foot area of rain garden.

Using these values it was found that 1 kilogram of compost sequestered 1.0375008 kilograms of carbon dioxide equivalent. Therefore, one cubic yard of compost sequesters 557.13795 kilograms of carbon dioxide equivalent.

Compost and Biochar Relationship

Compost is often mixed with biochar in order to create a soil amendment that has extremely positive effects on the surrounding vegetation. Biochar alone is effective at retaining water, reducing runoff, increasing levels of microbial activity, and collecting both excess nutrients and pollutants such as heavy metals. However, biochar is extremely porous and could potentially “soak up” excess nutrients in the soil that plants rely upon. By mixing biochar with compost, which has high levels of nutrients, the biochar becomes “charged” as these nutrients soak into the porous material. Adding compost-charged biochar to the soil increases the amount of nutrients that are readily available while also eliminating the risk of the biochar soaking up already-existing nutrients. This is a process that EcoWorks uses in many of their projects and it has shown to have positive effects. When creating this soil amendment, EcoWorks relies upon a 50/50 volume ratio of compost to biochar.

Carbon Offsets from Theoretical Compost and Biochar Application to Existing BMPs

The following information was determined to examine the potential impact that compost and biochar application would have on the carbon sequestration potential of EcoWorks' BMPs. This assumes that the mix was applied across all tree plantings, rain gardens, bioretention systems, and conservation landscapes at equal proportions.

Tree Plantings

For tree plantings it first had to be determined how much of the area could be amended with the compost-biochar mix. This was estimated using the suggested diameter of the area dug when planting a root ball [10]. Assuming the average root ball diameter is about 14 inches we can assume that the average diameter of the hole is 35 inches. Since 14 of the 35 inches is taken up by the root ball, we will assume that the remaining 21 inches of diameter will contain amended soil. This gives a total area of 346.36 square inches per tree (2.405 square feet) that can be amended with the mix. It was determined that 189 trees were planted among the 23 documented sites and there were 16 planting events that were undocumented. Using the info listed above we can assume that each of the undocumented sites had an average of 8.217 trees planted, totaling an estimated 131.48 trees planted among the undocumented sites. In total, this gives a value of roughly 320.48 trees planted across all tree planting events.

320.48 trees with 2.405 square feet of area per tree totals 770.75 square feet amended with the compost-biochar mix. If this area was amended with the mix at the specified rate of 0.1558333 cubic yards of compost and 0.1558333 cubic yards of biochar per 300 square feet, then 0.4003618 cubic yards of compost and 0.4003618 cubic yards of biochar would be used. This equates to 0.37646 tons sequestered by biochar and 0.2459 tons sequestered by compost. In conclusion, applying a 50/50 compost-biochar mix to all of EcoWorks' tree planting projects would sequester an additional 0.62236 tons of carbon dioxide equivalent.

Rain Gardens

Through discussions with EcoWorks employees, it was estimated that 95% of the area covered by rain gardens could be amended with a compost-biochar mix. 22,050 square feet is the estimated cumulative area of all EcoWorks' rain gardens (calculations shown in "Rain Garden Section"), therefore, 20,947.5 square feet could be amended. If this area was amended with the mix at the specified rate of 0.1558333 cubic yards of compost and 0.1558333 cubic yards of biochar per 300 square feet, then a total of 10.88106 cubic yards of compost and 10.88106 cubic yards of biochar would be used. This equates to 10.231279 tons of carbon dioxide equivalent

sequestered by biochar and 6.68248 tons of carbon dioxide equivalent sequestered by compost. In conclusion, applying a 50/50 compost-biochar mix to all of EcoWorks' rain garden projects would sequester an additional 16.91376 tons of carbon dioxide equivalent.

Bioretention Systems

Through discussions with EcoWorks employees, it was estimated that 95% of the area covered by bioretention systems could be amended with a compost-biochar mix. 3,000 square feet is the estimated cumulative area of all EcoWorks' rain gardens (calculations shown in "Bioretention Section"), therefore, 2,850 square feet could be amended. If this area was amended with the mix at the specified rate of 0.1558333 cubic yards of compost and 0.1558333 cubic yards of biochar per 300 square feet, then a total of 1.48041 cubic yards of compost and 1.48041 cubic yards of biochar would be used. This equates to 1.39199 tons of carbon dioxide equivalent sequestered by biochar and 0.90918 tons of carbon dioxide equivalent sequestered by compost. In conclusion, applying a 50/50 compost-biochar mix to all of EcoWorks' bioretention projects would sequester an additional 2.301217 tons of carbon dioxide equivalent.

Conservation Landscapes

Through discussions with EcoWorks employees, it was estimated that 100% of the area covered by conservation landscapes could be amended with a compost-biochar mix. 10,558.75 square feet is the estimated cumulative area of all EcoWorks' rain gardens (calculations shown in "Conservation Landscape Section"). If this area was amended with the mix at the specified rate of 0.1558333 cubic yards of compost and 0.1558333 cubic yards of biochar per 300 square feet, then a total of 5.48468 cubic yards of compost and 5.48468 cubic yards of biochar would be used. This equates to 5.15714 tons of carbon dioxide equivalent sequestered by biochar and 3.3683584 tons of carbon dioxide equivalent sequestered by compost. In conclusion, applying a 50/50 compost-biochar mix to all of EcoWorks' conservation landscapes would sequester an additional 8.52550 tons of carbon dioxide equivalent.

Total Values

In conclusion, applying a 50/50 mix of compost-biochar amendment to EcoWorks' already-existing BMPs would sequester a total of 28.36284 tons of carbon dioxide equivalent.

Citations

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