FEASIBILITY STUDY FOR THE IMPLEMENTATION OF GREEN INFRASTRUCTURE WITHIN SELECTED HOUSING SITES OWNED AND MANAGED BY THE MULFORD CORPORATION, IN YONKERS, NY

GROUNDWORK HUDSON VALLEY WITH THE MULFORD CORPORATION & MUNICIPAL HOUSING AUTHORITY FOR THE CITY OF YONKERS
GREEN INFRASTRUCTURE FEASIBILITY STUDY

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EXECUTIVE SUMMARY

In this project, The Mulford Corporation, the nonprofit affiliated with the Municipal Housing Authority for the City of Yonkers (MHACY), will significantly increase green infrastructure practices across its affordable housing system. The project will not only reduce runoff into three regional watersheds, the Saw Mill, Bronx, and Sprain Rivers, but will advance the agency’s climate resiliency goals. Activities will take place at 10 properties, including older, high-rise buildings near the Saw Mill River and smaller-scale homes and apartments in the other watersheds. Taken together, the properties are home to hundreds of low-income people. In the project, more than 1,800,000 square-feet of MHACY managed properties will be converted to natural biofilters, capturing an estimated 373,560 gallons (49,943 Cubic Feet) of stormwater annually. In addition, 427 new trees will be planted to capture more rainwater and provide shade over time to mitigate heat hazards. Groundwork Hudson Valley (GWHV) is the main partner and is working with MHACY on a broader Climate Safe Neighborhood initiative. Its youth corps, the Green Team, will assist in the project plantings to further their conservation skills.

PROJECT OBJECTIVES: ENVIRONMENTAL AND SOCIAL

Yonkers is the fourth largest city in New York State, with an average population density of 11,178 people per square mile (total of 18 square miles.) The city offers a safe, family-oriented community to an increasingly diverse and growing population. As the cost of living in Manhattan and surrounding areas has increased, Yonkers population grew 2.75% since 2010. The mayor and planning board of Yonkers recognize the need to grow sustainably. The City of Yonkers has introduced a Green Development mandate with guidelines for increasing the quality of life, air, increasing access to open space, ensuring environmental justice for residents who have faced social and financial hurdles, and lowering the heat island effect in Yonkers through the introduction of plants and other Green Infrastructure (GI) systems. This project proposes that Groundwork Hudson Valley (GHV)
work with the Mulford Corporation to introduce GI into selected public housing developments in Yonkers. The objectives of this project, GI in Mulford residences, align closely with the Green Development mandate approved by the city. This feasibility study will analyze overall conditions in Yonkers, and determine which of the Mulford Corporation sites best lend themselves to effective green infrastructure insertions. GI practices for the Mulford properties will include the following: Bioretention associated with downspout disconnection, stormwater street trees, stormwater harvesting and reuse, and urban forestry for stormwater mitigation. There are two primary and overlapping goals for this project: environmental and social.

ENVIRONMENTAL GOALS
Stormwater runoff: GI is an effective stormwater mitigation method, slowing the rush of water, often containing pollutants, into water treatment facilities, or in the worst case, combined stormwater and sewer overflow (CSO) which can, in this case, go directly into the Hudson River and other water bodies in Yonkers, such as Tibbets Brook, the Saw Mill River, the Bronx River, and other small lakes and ponds. Yonkers Joint Wastewater Treatment Plan, which handles wastewater from 22 municipalities and 7 separate sewage districts, is over capacity during storm events. While the (11) green infrastructure insertions at Mulford properties covered in this study would not, in themselves, significantly reduce stormwater at the Yonkers facility, an accretion of like projects would have a significant effect in lowering costs for the city and in extending the lifespan of the existing facility. Yonkers has extreme topography, and much exposed bedrock in addition to paved surfaces, and therefore has significant stormwater flushing into street drains rather than infiltrating into the groundwater system. Reducing the volume of stormwater runoff into civil engineered systems, and holding it on site with bioengineering and plant materials, will begin to restore natural processes to urban areas. As urban soils begin to function through planting and proper grading, the soil will increasingly be able to support healthy plant life. Slowing the movement of stormwater in particular neighborhoods will reduce both local and regional flooding.
Slowed runoff keeps stormwater from collecting as much debris, chemicals, sediments, and other pollutants. Lower discharge rates, both into the treatment facility and by way of CSO’s, will reduce pollutant loads into regional streams and rivers. GI practices allow sediment to be filtered near its source; often pollutants are broken down or sequestered by plant materials.

Trees and plants: Introducing more plant material into properties, greening them, will increase evapotranspiration, which will lower summer temperatures. This has the environmental benefit of lessening reliance on air conditioning in the summer. Large canopy trees also lower heat indexes by increasing shade. Trees and plants hold water on site and release it slowly, providing passive irrigation and reducing landscape maintenance costs for The Mulford Corporation and increasing the health and longevity of the trees and plants on the properties.

SOCIAL GOALS
Placing green infrastructure in public spaces provides visual access to natural processes which has educational benefits, as well the environmental and fiscal benefits described above. Residents of selected public housing units would become aware of natural processes surrounding their apartments and homes. Reducing local temperatures will lessen the financial burden on residents; plant materials surrounding public housing will provide shade and cool the areas considerably, reducing the need for residents to use air conditioning which some cannot afford.

Economic and social project goals include providing employment and training for young people in Yonkers, as the GI elements are built and maintained. The financial modeling for this GHV grant is based on a combination of volunteer and paid labor which will be returned to the community, increase community involvement, and teach both career-building skills and the value of local stewardship to those who assist in building the projects.
PROJECT DESCRIPTION

The buildings owned and managed by The Mulford Corporation which were considered for GI practices fall into two primary categories, single or adjoined townhouses with shared parking areas and shared front yards; and apartment buildings with shared entrances and elevators. In general, with some variations based on available space and topography, the Green Infrastructure (GI) practices for the townhouses and the GI practices at the two apartment towers will the same.

Universal issues to be ameliorated are:

- Erosion of topsoil, and sediment loading into local water bodies
- Puddling, poor drainage, muddy areas around housing structures
- Landscapes requiring extreme maintenance
- Lack of plant material to shade pavements
- Extreme, localized heat conditions (urban heat island effect) in areas where paving dominates the landscape
- Overloading the CSO system in heavily paved areas, with excessive stormwater runoff

Soils in Yonkers are predominantly Urban Land-Charlton Chatfield (rocky with 3-45% slope), and Urban Land-Paxton Woodbridge (10 - 25% slope.) Chatfield soils are extremely rocky and steep with numerous bedrock outcroppings. These difficult and shallow soils, further degraded by building and rebuilding, do not hold water well, adding to the difficulty in growing plant materials and sequestering ground water.
TOWNHOUSES / DUPLEXES
- Bioretention can be used at the base of slopes in front yards. Plantings surrounding the bioretention will hold water and prevent erosion.
- Bioretention can be implemented at parking lot edges, capturing storm water that sheet drains from the lot.
- Downspouts can be disconnected from the townhouses, capturing the storm water in cisterns. Overflow from the cisterns can be channelized to bioretention systems. Cisterns can be held and used for irrigation of on-site plantings. (Community gardens, community plantings, etc.)
- Shade trees should be planted to uptake stormwater near the curbs.
- Any existing rain leaders can be disconnected or interrupted to direct water to bioretention areas.

Bioretention can be used at the base of slopes to retain water before it flows into the storm sewer. Gardens also provide habitat for pollinators.

Bioretention section view.

Rainwater can be collected on the rooftops, and used for landscape maintenance.
**APARTMENT BUILDINGS WITH SHARED ENTRANCES AND ELEVATORS**

- Bioretention is a practice that can be used near apartment entrances, and near entry sidewalks, and surrounding the properties either near curbs or in street medians.
- Large canopy shade trees should be installed in the building courtyards, as needed, to provide shade and hold water both in the tree, and root systems. Silva Cell (or similar technologies) is an effective system to use for paved areas. The trees will be ensured to survive, and the trees can be connected into a contiguos system that holds water just below paved level.
- In lawn / green areas, urban “forests”, or groves of trees, can be planted to retain water on site in the roots, trunks, and leaves of trees, ultimately allowing the water to evapotranspire into the atmosphere.

**PERMITTING**

For those sites within 200 feet of any freshwater body, there may be review required by the Army Corps of Engineers, and permitting will be required from the NYSDEC. All sites will require land disturbance permitting by the City of Yonkers. If any of these sites disturb more than 5,000 SF each, those sites shall require a State Pollutant Discharge Elimination System (SPDES) general permit.

**WATER VOLUME CALCULATIONS TO BE MANAGED**

<table>
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<tr>
<th>Catchment Number</th>
<th>Description</th>
<th>Total Area (Acres)</th>
<th>Impervious Area (Acres)</th>
<th>Percent Impervious</th>
<th>Rv</th>
<th>Required WQv (ft³)</th>
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<td>O’Rourke</td>
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<td>Walsh</td>
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<td>4</td>
<td>Reagan</td>
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<td>5</td>
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<td>0.44</td>
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<td>6</td>
<td>Troy</td>
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<td>0.44</td>
<td>62%</td>
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<td>7</td>
<td>Doran</td>
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<td>8</td>
<td>Christopher</td>
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<td>Fiorillo</td>
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<td>Smith</td>
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<td>0.75</td>
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<td><strong>Total</strong></td>
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* Bioretention layer includes 3” ponding, 18” soil with 20% soil porosity, and 6” of gravel with 40% voids
** Each tree assumes 10’ x 10’ x 5’ planting medium with 20% soil porosity
The Mulford properties in this study are nearly all sited in densely populated areas, near or adjacent to major highways. Two are in downtown Yonkers. Due to the dense and paved conditions of most of the properties, the annual recorded temperatures are much higher than housing in vegetated areas.
NY State Surficial Geology, showing Yonkers predominantly as poorly draining soil with numerous areas of bedrock stipple or outcrops.

Flooding to a depth of more than 4 inches is an issue that affects all the public housing which is near to waterways or highway corridors. Also downtown Yonkers, due to the preponderance of paving, is prone to flash flooding. GI practices would alleviate some of the flooding near the housing.

The extreme slopes in Yonkers, coupled with rocky soils and multiple areas of exposed bedrock, intensify the damaging effects of stormwater and flooding, and the difficulty of planting large canopy trees in certain areas.
SITE PLAN OF YONKERS - KEY PLAN FOR PROJECTS
The O'Rourke Townhouses are located in the Crestwood neighborhood. There are thirteen buildings on the property, which includes two-bedroom and three-bedroom units.

No brownfields or endangered species are documented in the vicinity of Curran Townhouses.
The neighborhood is zoned for residential and commercial, or institutional. Roads and sidewalks, as well as adjacent commercial districts, contribute to high heat.
The O’Rourke Townhouses are not in either the 100 year or the 500 year floodplains. Crestwood lake, nearby, receives any runoff stormwater from the properties.

The townhouse site is quite flat, and the surrounding slopes and road infrastructure will encourage water to drain across the property and toward Crestwood Lake.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices:
$240,000

WQv Calculations:
Required WQv = 12,525 Cubic Feet
The Valentine Townhouses are located in the Colonial Heights neighborhood. There are three buildings on the property, which contain two-bedroom and three-bedroom units. On-site parking is available.

No brownfields or endangered species are documented in the vicinity of Valentine Townhouses.

View northwest from Helena Avenue, showing shared front yards.

Parking area viewed from Central Park Avenue.

Parking lot viewed from Helena Avenue.
The neighborhood is zoned for residential and commercial/retail. Central Park Avenue, just adjacent to the townhouses, is a busy commercial avenue. Roads and sidewalks, as well as adjacent commercial and retail districts, contribute to high heat.
The Valentine Townhouses are not in the 100 or 500 year flood plains. However the area is heavily paved and therefore is prone to poor drainage.

Steep slope on the west side of Central Park Avenue contributes to rainwater washing downhill toward the Valentine Townhouses.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices: $129,600

WQv Calculations:
Required WQv = 1,708 Cubic Feet
Walsh Houses is a newly renovated senior community that consists of three eight-story elevated buildings that include efficiency units, one-bedroom units, and multiple Handicap Accessible units. Many of the units have verandas. Most open space and vegetation directly behind and adjacent to the housing towers is on steep slopes. The Walsh Houses are located in the downtown area of Yonkers.

No brownfields or endangered species are documented in the vicinity of Walsh Houses.
There are several housing projects in the vicinity -- as well as the availability of open space, the War Memorial Park. The towers are in a densely populated part of Yonkers, downtown. Due to the close proximity of the Saw Mill River, vehicular circulation is limited.
Hydrology on the site is problematic. Due to a very steep slope directly behind the towers, with retained soil and rock, storm water washes downhill past the apartment buildings, across the parking lots in between the buildings, and into the Saw Mill River. The central tower is in the 100 and the 500 year floodplains, and the easternmost tower is near the 100 and 500 year floodplains.

Topography is extreme and there is exposed bedrock on the steep, retained slope, along with thin soils. Much of the site is over 25% slope, in fact, it is well over that. Rainwater streaming rapidly downhill erodes the soil, causing sediment and point source pollution to flow directly into the Saw Mill River. There was a mudslide on this slope in 2018, which overturned retaining walls and caused building evacuation.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices:
$174,000

WQv Calculations:
Required WQv = 8,839 Cubic Feet
The Reagan Townhouses are located in the northeast section of the city. There are eight buildings on the property, which includes two-bedroom and three-bedroom units. Two of the apartments are Handicap Accessible Units.

No brownfields or endangered species are documented in the vicinity of Reagan Houses.
The Reagan Townhouses are sited between two major road systems, Route 87, and Central Park Avenue. Surrounding land use is residential with some commercial and institutional.
The townhouses are not in either the 100 year or 500 year floodplains. However, exposed bedrock and the preponderance of highway infrastructure near the townhouses causes stormwater to run into the properties.

There are steep slopes on both sides of the property, with the higher side being where Route 87 passes by, and the property sloping from there downhill to Central Park Avenue.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices:
$144,600

WQv Calculations:
Required WQv = 9,473 Cubic Feet
Martinelli Manor is a newly renovated seniors’ complex located in the northeast section of the city. It consists of a three-story elevated building. The building has parking on site.

No brownfields or endangered species are documented in the vicinity of Martinelli Manor.
The neighborhood is zoned for residential and commercial.

LAND USE

5  Mature trees along edge of Millard Avenue.

6  Sidewalk and front facade along Ellison Avenue.
The townhouses are extremely close to, though not technically within, both the 100 year floodplain and the 500 year floodplain. The proximity of the Sprain Brook Parkway, with Sprain Brook, as well as the Bronx River, create conditions for flooding during storm events.

PROXIMITY TO FLOOD PLAINS

The apartment building is set into a slope, creating very steep conditions on one side of the property, and a low point or dip near Palmer Road that is ideal for bioretention.

SLOPE ANALYSIS
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices: $27,000

WQv Calculations:
Required WQv = 2,731 Cubic Feet
Troy Manor is a seniors’ complex located in the Park Hill neighborhood. It consists of a five-story elevated building containing one-bedroom units.

No brownfields or endangered species are documented in the vicinity of Troy Manor.
The neighborhood is zoned for residential and commercial, or institutional. The area has a high heat index.
The townhouses are not affected by the 100 year floodplain or the 500 year floodplain. Flooding is primarily due to the fact that the area is heavily paved.

PROXIMITY TO FLOOD PLAINS

The townhouse site is relatively flat. Steep surrounding areas contribute to water flowing toward the building.

SLOPE ANALYSIS
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices:
$38,700

WQv Calculations:
Required WQv = 2,355 Cubic Feet
The Doran Townhouses are located in the Lawrence Park neighborhood. There are five buildings on the property, and all of the apartments are two-bedroom units. The buildings have been recently developed.

No brownfields or endangered species are documented in the vicinity of Doran Townhouses.
The neighborhood is zoned for residential and commercial, with some institutional. Roads and sidewalks, as well as adjacent commercial districts, contribute to high heat. The proximity of Cross County Parkway has an impact on the stormwater.
The townhouses are not affected by the 100 year floodplain or the 500 year floodplain. This part of Yonkers is heavily paved which will cause urban heat island effect and flash flooding.

There are sloping hills surrounding the townhouses which may direct water toward the buildings.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices: $348,600

WQv Calculations:
Required WQv = 3,101 Cubic Feet
The Christopher Townhouses are located in the Lincoln Park neighborhood. There are three buildings on the property, which include two-bedroom and three-bedroom units. The Christopher Townhouses are situated in a residential (single family) neighborhood that is located across from the Tibbetts Brook Park, the largest recreational facility in Yonkers.

No brownfields or endangered species are documented in the vicinity of Christopher Townhouses.
The neighborhood is zoned for residential and institutional. The Christopher Townhouses are situated in a residential (single family) neighborhood that is located across from the Tibbetts Brook Park, the largest recreational facility in Yonkers.
PROXIMITY TO FLOOD PLAINS

The townhouses are not affected by the 100 year floodplain or the 500 year floodplain. The townhouses are at the base of a hill and receive stormwater that flows downhill toward them.

SLOPE ANALYSIS

Topography is varied and sloping eventually down toward Tibbets Brook.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices: $100,200

WQv Calculations:
Required WQv = 2,194 Cubic Feet
The Fiorillo Townhouses are located in the Lincoln Park neighborhood. There are four buildings on the property, which contain two-bedroom units. The townhouses are near the Cross County Shopping Center. Two buildings are accessed from Clark Street, and two from Loring Avenue. There is a shared parking lot on Central Park Avenue.

No brownfields or endangered species are documented in the vicinity of Fiorillo Townhouses.
The neighborhood is zoned for residential and commercial, or institutional. Roads and sidewalks, as well as adjacent commercial districts, contribute to high heat. The proximity of the Yonkers race track and the Cross County Shopping Center add to congestion and the heat factor.
PROXIMITY TO FLOOD PLAINS

The townhouses are not affected by the 100 year floodplain or the 500 year floodplain. Flooding is primarily due to the fact that the area is heavily paved.

The townhouse site is relatively flat. Steeper slopes are across Central Park Avenue.

SLOPE ANALYSIS
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices:
$148,200

WQv Calculations:
Required WQv = 2,812 Cubic Feet
The Smith Townhouses are located in the southeast section of the city. There are four buildings on the property, which include a number of two-bedroom and three-bedroom units. The Smith Townhouses are situated in a residential (single family) neighborhood that is close to the Yonkers Raceway and Casino. The Cross County Shopping Center is also nearby.

No brownfields or endangered species are documented in the vicinity of Smith Townhouses.
The neighborhood is zoned for residential and commercial.
The townhouses are not affected by the 100 year floodplain or the 500 year floodplain. Flooding is primarily due to the fact that the area is heavily paved.

The townhouse site is relatively flat. Steeper slopes are across Central Park Avenue.
Green infrastructure strategies to include:
- Bioretention
- Disconnect gutters, direct stormwater to bioretention areas.
- Street Trees

Cost Estimate for GI practices:
$277,800

WQv Calculations:
Required WQv = 4,195 Cubic Feet
SCHEDULING
Duration of implementation: maximum 3 years
Projects should be designed as a group, bid as a group, and implemented in stages, in groups of 3 to 4.

MAINTENANCE
Projects shall be maintained by the Mulford Corporation Staff, aided by Groundwork Hudson Valley Green Team.

Once the bioretention areas are established, they will require only occasional weeding. The areas to be mowed by the maintenance staff will diminish so that overall maintenance costs should be less for the sites.

Landscape Architect tasked with design work shall provide maintenance guidelines and shall work with Mulford Corporation maintenance staff to train them regarding care for bioretention areas. Total WQv in cubic feet required by NY State Law to capture storm-water from roof areas and other site runoff and retain on site, for the 10 project sites, is 49,934 Cubic Feet.

BUDGET

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<td>1</td>
<td>O-Rourke Townhouses - Bioretention and trees</td>
<td>$ 240,000</td>
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<td>2</td>
<td>Valentine Townhouses - Bioretention and trees</td>
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<td>Walsh Houses- Bioretention and trees</td>
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<td>Martinelli Manor- Bioretention and trees</td>
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<td>Troy Manor- Bioretention and trees</td>
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<td>Doran Townhouses - Bioretention and trees</td>
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<td>Inspection and monitoring</td>
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<td>a.</td>
<td>Topographical Surveys- 10 sites</td>
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<td>b.</td>
<td>Geotechnical Borings - 10 sites</td>
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<td>c.</td>
<td>Landscape Architectural design</td>
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<td>d.</td>
<td>Civil Engineering &amp; Permitting</td>
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<td>Signage for 10 sites</td>
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<td><strong>Total</strong></td>
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a. Surveys shall be boundary and topographical surveys.
b. Geotechnical borings shall be to depth of 12' or refusal.
c. Landscape Architectural design includes planting plan, planting schedule, project management and coordination, construction administration.
d. Civil engineering and permitting includes site analysis, managing geotechnical work, removals and sediment plan, design of bioengineered systems,
e. 18 x 24 fiberglass sign with pedestal.