

Activity: Reforestation

Reforestation

Description: Reforestation refers to trees planted in groups in urban areas such as: parking lots, right of ways (ROW), parks, schools, public lands, vacant land, and neighborhood open spaces, to provide shade and stormwater retention and to add aesthetic value.



Advantages/Benefits:

- Reduces effective impervious cover
- Reduces stormwater runoff
- Provides aesthetic value
- Provides rainfall interception
- Shade provides cooling and energy savings
- Provides habitat
- Provides pollutant removal
- Provides flow attenuation

Disadvantages/Limitations:

- Poor quality urban soils may require soil amendments or remediation
- Long-term maintenance is required for high tree survival rates
- Must be implemented over large areas to see significant reduction in stormwater runoff
- Time required for trees to mature
- Poor soils, improper planting methods, conflicts with paved areas and utilities, inputs from road salt, lack of water, or disease can lead to low survival rate

Design Considerations:

- See Page 2

Selection Criteria:

Twice the forest Rv factor for the corresponding soil type.

Equal to the forest Rv factor if amended soils are used in conjunction with reforestation.

***This GIP is subject to MWS approval**

Land Use Considerations:

Residential

Commercial

Industrial

Maintenance:

- Trees may require irrigation in dry periods

L Maintenance Burden

L = Low M = Moderate H = High

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Design Considerations:

- Stormwater trees are limited to areas where there is sufficient space for fully grown trees as well as utilities and a separation distance from structures.
- Tree species with desirable stormwater control characteristics should be utilized. For trees receiving runoff, tree species must have a high tolerance for common urban pollutants. This includes salt tolerance if receiving runoff from areas treated for snow and ice. References for appropriate tree selection are included in **Table 10.2**.
- Mulch can be used around trees as an added filtration mechanism. The use of amended soils results in additional credit.
- Soils and mulch play a significant role in pollutant removal and tree health. Selection of soils and mulch intended to improve stormwater controls should allow water to infiltrate into the soil, with planting soil characteristics and volume tailored to meet the needs of a healthy tree.
- If sheet flow is used to route impervious areas to reforested area, care should be taken to avoid erosion of ground cover.
- Credit is subject to MWS approval.

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SECTION 1: DESCRIPTION

Site reforestation involves planting trees at a development site with the explicit goal of establishing a mature forest canopy that will intercept rainfall, increase evapotranspiration rates, and enhance soil infiltration rates.

SECTION 2: PERFORMANCE

The overall runoff reduction credits for reforestation through lower runoff coefficients are summarized in **Table 10.1**.

Table 10.1. Reforestation Runoff Coefficient Credit							
Level 1 Design				Level 2 Design			
Twice the forest Rv factor for the corresponding soil type.				Equal to forest Rv factor if Amended Soils (See GIP-07 A-7) are used in conjunction.			
A	B	C	D	A	B	C	D
0.04	0.06	0.08	0.10	0.02	0.03	0.04	0.05
Impervious area may be routed to the reforestation area following the guidance and applying the Runoff Coefficient Credits detailed in GIP-09 . The reforestation area should be treated as a vegetated filter strip for the application of this GIP.							

SECTION 3: DESIGN TABLE

The overall runoff reduction credits for reforestation through lower runoff coefficients are summarized in **Table 10.2**.

Table 10.2. Design Specifications for Reforestation	
Item	Specifications for Level 1 and Level 2
Area	Minimum contiguous area of 5,000 sq. ft.
Tree Type	No more than 20% of any single tree species. Consider composition of local forests in planting design. 2/3 of trees must be large canopy. See the USGS landfire map for delineation of forest type and the 2006 Descriptions of Ecological Systems for Modeling of LANDFIRE Biophysical Settings Ecological Systems of location US State TN .PFD for description of species within each forest type. Links: http://landfire.cr.usgs.gov/viewer/ http://www.tn.gov/environment/na/pdf/tn_eco_systems.pdf http://www.se-eppc.org/pubs/middle.pdf
Density	<ul style="list-style-type: none"> 300 large canopy trees – species that normally achieve an overall height at maturity of thirty feet or more per acre 10 shrubs substitute for 1 large canopy tree 2 small canopy trees substitute for 1 large canopy tree Note: Adjustments to densities may be possible with MWS approval.
Canopy Rate	Achieve 75% forest canopy within first 10 years
Size	Tree - Minimum tree size 6-8 ft in height Shrub – 18-24 inches or 3 gallon size
Ground Cover	Entire area should be covered with 2-4 inches of organic mulch or a native seed mix

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Reforestation areas are eligible under the following qualifying conditions:

- The minimum contiguous area of reforestation must be greater than 5,000 square feet, with no more than 20% of the area in any single tree species. The basic density of plantings is 300 large canopy trees per acre, approximately 12 feet on center. When shrubs are substituted for trees, there must be 10 shrubs per one large canopy tree. Two small canopy trees, such as Dogwoods or Red Buds, may be substituted for one large canopy tree. Adjustments can be made to these densities for areas of urban reforestation with the approval of MWS. Reforestation should consider the composition of area forests, and two thirds of selected trees must be large canopy. Reforestation methods should achieve 75% forest canopy within ten years.
- The minimum size requirement for reforestation is saplings 6-8 feet in height. The minimum size requirement for shrubs is 18-24 inches, or 3 gallon size. In addition, the entire reforestation should be covered with 2-4 inches of organic mulch or with a native seed mix in order to help retain moisture and provide a beneficial environment for the reforestation.
- A long-term vegetation management plan must be prepared and filed with MWS in order to demonstrate the ability to maintain the reforestation area in an appropriate forest canopy condition. The plan should include a scale drawing showing the area to be planted, along with a plant list which includes species, size, number, and packaging. In addition, the reforestation area shall be clearly identified on all construction drawings and EPSC plans during construction.
- The reforestation area must be protected by a perpetual stormwater easement or deed restriction which stipulates that no future development or disturbance may occur within the area.
- The planting plan must be approved by MWS, including any special site preparation needs.
- The construction contract should contain a care and replacement warranty extending at least two growing seasons, to ensure adequate growth and survival of the plant community.
- The final size of the trees should be considered when designing the planting plan. Tennessee One-Call (811) must be contacted prior to the submission of the planting plan to ensure that no utilities will be impacted by the tree planting. The planting plan must also avoid placing trees under overhead utilities.
- If using the reforestation area as a vegetated filter strip to receive additional credit under **GIP-09**, follow all GIP design criteria and insure that additional routed runoff does not cause erosion or degrade the quality of ground cover.

SECTION 4: DESIGN CONSIDERATIONS

Trees are often one of the most economical stormwater control measures that can be introduced into urban ROWs. Tree canopies intercept rainfall before it becomes stormwater and the tree boxes into which trees are planted can be used to capture and treat runoff. Trees also reduce the urban heat island effect, improve the urban aesthetic and improve air quality. Data and modeling show that urban trees can remove over 50% of the moisture in the soil beneath their canopy. Refer to **Table 10.2** for native tree species. A list of native trees is also provided in **GIP-01 Table 1.7**.

Tree plantings within the ROW must receive approval from Public Works. Vacant residential lots also provide reforestation opportunities. These lots can become an urban forest and an amenity to a neighborhood. Vegetation management plans must account for Health Department codes regarding overgrown lots and safety concerns of the residents. Special criteria for reforesting empty residential lots include:

- The area between curb and sidewalk and a 10 foot wide buffer adjacent to the sidewalk (away from the street) shall be kept mowed and clear.

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- While the trees are being established, mowing is permitted between the trees. Eventually, the canopy should shade out the grass and forest undergrowth will be established. Vegetation management plans should consider if residents would prefer the site mowed in perpetuity.



Figure 10.1 MWS Tree Planting Event

SECTION 5: DESIGN CRITERIA

5.1 Runoff Reduction Calculations

Level 1 Reforestation involves using soil types currently on a site, without soil amendments. Current soil should be preserved from compaction and disturbance during construction and should be clearly identified on all construction drawings and EPSC plans. Trees should be planted following tree selection criteria in **Table 10.2**. Use **Table 10.1** to find R_v factors for Level 1 which equal twice the forested area R_v factors.

Level 2 Reforestation requires the use of amended soils. Soil Amendment guidance is located in **GIP-07 A-7**. This area is then treated as original forested area for calculation purposes. Level 2 design allows for use of Forested R_v factors as shown in **Table 10.1**.

For both levels, once the forest area R_v is determined continue through the design process with weighted R_v calculations (**Equation 3.1**) located in **Volume 5, Section 3.2.1**.

SECTION 6: MAINTENANCE

The requirements for the Maintenance Document are in Appendix C of Volume 1 of the Manual. They include the execution and recording of an Inspection and Maintenance Agreement or a Declaration of Restrictions and Covenants, and the development of a Long Term Maintenance Plan (LTMP) by the design engineer. The LTMP contains a description of the stormwater system components and information on the required inspection and maintenance activities. The property owner must submit annual inspection and maintenance reports to MWS.

Mowing is permitted but not encouraged between the trees while they are being established. Eventually, the canopy should shade out the grass and forest undergrowth will be established removing the need to mow. Vegetation management plans should consider if residents would prefer the site mowed in perpetuity.

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Additional maintenance activities include:

- Watering the trees as needed during dry periods
- Repairing areas of erosion or reseeding areas that are bare
- Removing trash and debris from area
- Replanting any trees that die throughout the year. (The construction contract should contain a care and replacement warranty extending at least two growing seasons, to ensure adequate growth and survival of the plant community.)
- Addressing areas of standing water which might breed mosquitoes
- Picking up branches that have fallen
- Grooming trees or shrubs as needed
- Removing any trees or limbs damaged in storms that might pose a danger

SECTION 6: REFERENCES

Balousek. 2003. Quantifying decreases in stormwater runoff from deep-tilling, chisel-planting and compost amendments. Dane County Land Conservation Department. Madison, Wisconsin.

Chollak, T. and P. Rosenfeld. 1998. Guidelines for Landscaping with Compost-Amended Soils. City of Redmond Public Works. Redmond, WA. Available online at:
<http://www.ci.redmond.wa.us/insidecityhall/publicworks/environment/pdfs/compostamendedsoils.pdf>.

City of Chesapeake. 2010. Chesapeake Landscape Specifications Manual: Tree and Shrub Planting Guidelines. Approved on October 16, 2008 and amended effective August 1, 2010. Available online at:
http://www.chesapeake.va.us/services/depart/planning/pdf/ord-Landscape-Specifications-Manual_adopted-0901608.pdf.

City of Portland. 2008. "Soil Specification for Vegetated Stormwater Facilities." Portland Stormwater Management Manual. Portland, Oregon.

Virginia Dept. of Conservation and Recreation. 2010. Design Specification No. 4: Soil Compost Amendment Version 1.7, Appendix 4-A, Initial Minimum Design Criteria for Reforestation, Disconnection, Filter Strips, and Grass Channels. Available online at: <http://csnetwork.squarespace.com/all-things-stormwater/soil-compost-amendments.html>.