Data to Guide Green Infrastructure Placement in GeoPlanner

When considering the placement of green infrastructure practices in your scenarios in GeoPlanner, you must take into account certain constraints related to the land use, soil type, terrain, and other characteristics of the landscape. The use of different data layers to site features on a map is an important element of the geodesign process which seeks to approach a landscape as a holistic entity by considering many characteristics at once. Furthermore, each green infrastructure type also has its own suitability criteria that influence which areas are considered optimal for placement.

Land Use and Availability

One of the main considerations in the placement of green infrastructure is the land use type, which differentiates between private and public land and residential, industrial, commercial, and government owned sites. In GeoPlanner, you may want to use a land use layer in order to define public and private land and refrain from placing green infrastructure practices on privately owned plots, such as in residential or industrial sites. For example, curb strips, the areas of grass between the road and sidewalk, are good locations to place green infrastructure practices in residential areas, but privately owned yards would not be considered a suitable site.

Another consideration related to land use is the current occupancy and utility of a piece of land. For example, parks are a good place to put green infrastructure because they are public land, usually owned by the city. However, you would not want to cover athletic fields with practices as that would undermine the current use of the land. Therefore, you have to consider whether a piece of land already has a specified use.

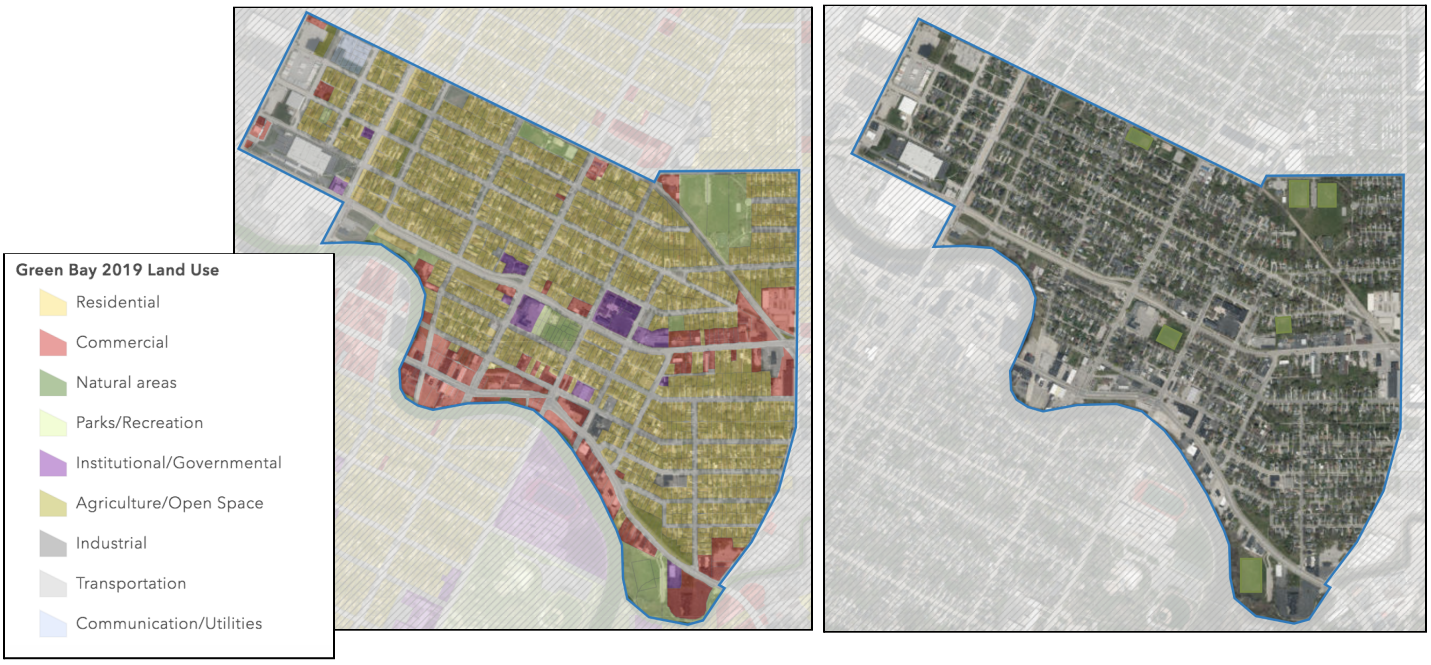

Figure 1: Olde North and Three Corners neighborhoods in Green Bay, WI overlaid with a land use data layer (left) and athletic fields data layer (right).

Soil Type

Many types of green infrastructure practices rely on good soil infiltration to function. These include rain gardens, permeable pavement, bioswales, native plantings, and constructed wetlands. Sandy, well-draining soils are ideal for these green infrastructure practices. However, in poor infiltrating soils, green roofs or rain barrels may be the preferred green infrastructure type. Underdrains can also be used for some green infrastructure practices where soil infiltration is poor (3). A soils type data layer in GeoPlanner, such as the USD Hydrologic Soil Group layer, can differentiate between the soil groups across a site and help determine the most suitable location for green infrastructure practices.

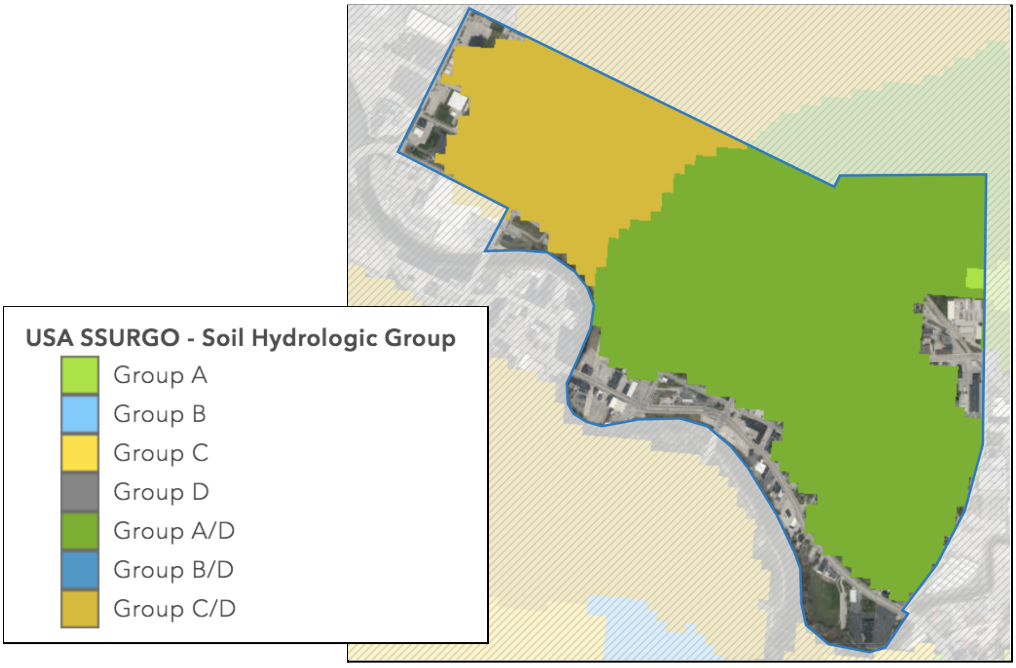

Figure 2: Olde North and Three Corners neighborhoods in Green Bay, WI overlaid with a hydrologic soil group data layer. Group A = high infiltration rate, Group B = moderate infiltration rate, Group C = slow infiltration rate, Group D = very slow infiltration rate. Groups A/D, B/D, and C/D are dual hydrologic groups where the first letter represents drained areas, and the second letter represents undrained areas (4).

Terrain

Many green infrastructure practices cannot be placed on terrain that has a slope above a particular angle. Therefore, a terrain or elevation data layer, such as acquired through LiDAR data, can help determine the locations where the slope is too steep for the placement of green infrastructure practices.

Furthermore, elevation data can help determine the direction that stormwater will drain during a rain event. This can be used to deduce the locations where flooding is predicted, such as in the low-lying areas, and green infrastructure plans can therefore be implemented to focus efforts in these areas.

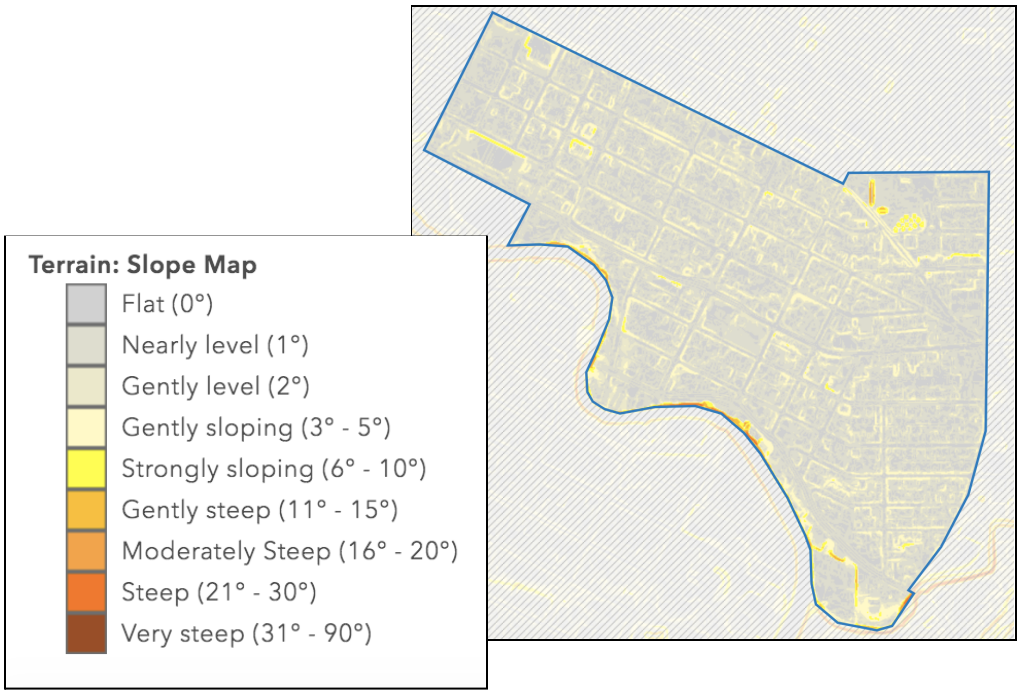

Figure 3: Olde North and Three Corners neighborhoods in Green Bay, WI overlaid with a terrain data layer.

Groundwater Table Depth

The groundwater table is another important consideration. Many green infrastructure practices should not be placed on sites with high groundwater levels, such as areas that are consistently wet or form puddles (1). However, a minimum water table depth of 0.5 feet is required for bioswales, permeable pavement, and rain gardens (3).

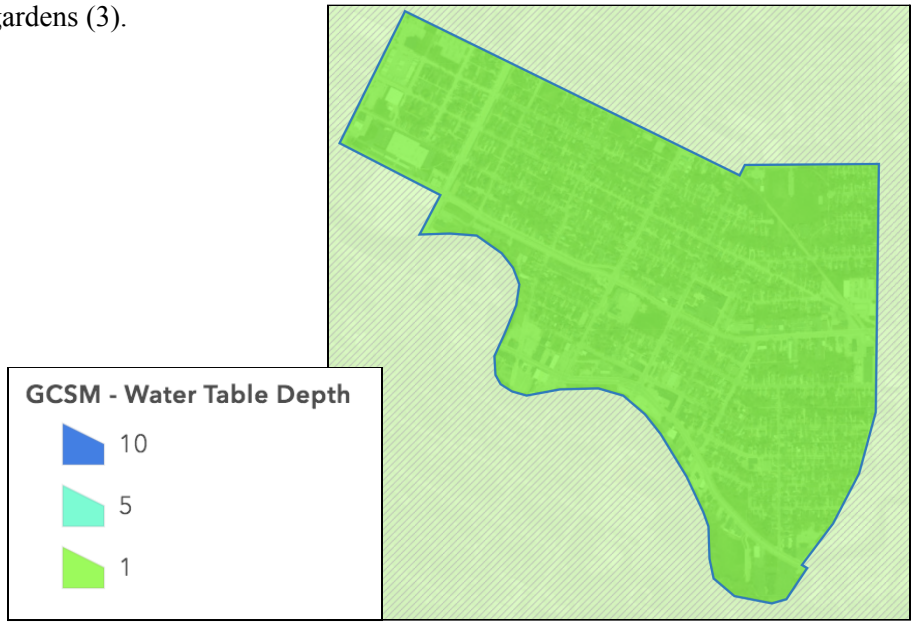

Figure 4: Olde North and Three Corners neighborhoods in Green Bay, WI overlaid with a water table data layer. The three numbers signify the depth-to-water table estimate where 10 = > 50 ft, 5 = 20 - 50 ft, and 1 = 0 - 20 ft (1).

Bedrock Depth

A shallow bedrock depth (< 50 ft from the land surface) may also impede the infiltration capacity of some green infrastructure practices, depending on the bedrock type (1).

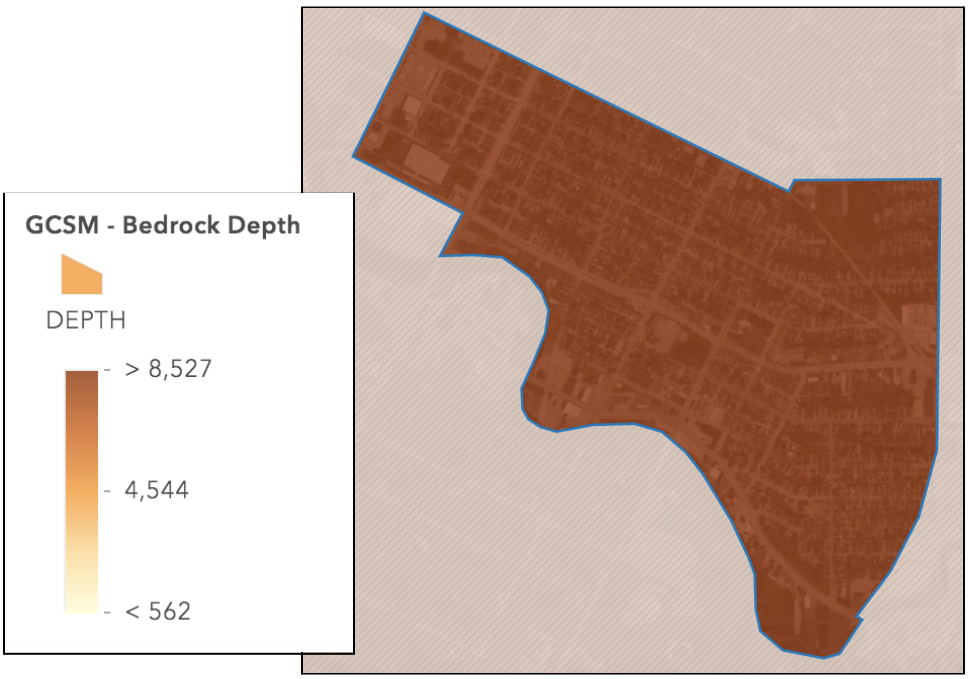

Figure 5: Olde North and Three Corners neighborhoods in Green Bay, WI overlaid with a bedrock depth data layer.

Neighboring Properties

When placing green infrastructure practices on a site, careful attention should be paid to neighboring properties and the potential impacts that these practices may have. For example, in the case of constructed wetlands, a buffer zone may be necessary between the wetland and a neighboring property. Furthermore, properties that have high pollutant loading, such as where vehicles consistently idle, are poor locations for some green infrastructure practices due to the high levels of contaminants (3).

Suitability Requirements for Green Infrastructure Practices

Each green infrastructure practice also has its own specific placement constraints which must be considered. Here are some of the main limitations for eight different green infrastructure types.

Green Roofs

Green roofs can only be placed on buildings that have a slope of up to 30% (3). The roof must also be constructed of a material other than wood and must receive adequate sunlight (not shaded by other tall buildings).

Permeable Pavement

Permeable pavements are best constructed in low-volume areas, such as residential roads and driveways, sidewalks, parking lots, and patios (3). In contrast, highways and other busy and high-speed roads may not be a suitable location for permeable pavement because of the high levels of traffic that these areas receive and the risk of spills and contaminants. Permeable pavement can only be placed on ground that has a slope of less than 10%.

Bioswales

Bioswales must be located on ground that has a slope of less than 6%. Typical areas that are suitable for bioswales include right of ways, medium strips, curb strips, parking lots, and traffic islands. The recommended minimum dimensions are 10 x 40 ft.

Rain Gardens

Rain gardens should be sited on relatively flat sites and adequately distanced from underground facilities which the rain garden may disrupt. For example, they should be placed at least 10 feet away from buildings with basements and 15 feet away from septic tanks, water wells, or septic drain fields. The proximity to busy roads must also be considered in the placement of rain gardens because the use of salt on roads in the winter can harm the plants grown in this type of green infrastructure. Salt tolerant plants may be chosen for areas that receive runoff from heavily salted roads.

Native Plantings

Native plantings have similar suitability requirements as rain gardens.

Constructed Wetlands

Constructed wetlands are typically located on sites between water and land, as they are considered a transition point between these two landscapes. They should be placed on low, flat sites with slopes less than 15% (2). However, a gentle slope is beneficial because it allows water to flow through the wetland using gravity (2). A constructed wetland should also be above the water table and outside of a floodplain. They should always be situated at least 10 feet from property lines (3). In order to maintain a permanent pool, the preferred soil type for this green infrastructure practice is slow draining soils, such as those in the Hydrologic Soil Group C or D (3).

Rain Barrels

Rain barrels must be placed on flat, even ground in shaded areas to prevent the growth of algae. Furthermore, the available space around a building must be considered for the placement of rain barrels.

Stormwater Trees

Trees must be sited an adequate distance from other trees and tall buildings, so they receive enough sunlight.

Works Cited

1. *GCSM Usage Documentation—Overview*. (2019). ArcGIS. https://www.arcgis.com/home/item.html?id=e1e89ae505594459a46407f1daf4ad5d
2. EPA. (n.d.). *A Handbook of Constructed Wetlands*. *1*, 53. https://www.epa.gov/sites/default/files/2015-10/documents/constructed-wetlands-handbook.pdf
3. Ellis, K., Berg, C., Caraco, D., Drescher, S., Hoffmann, G., Keppler, B., LaRocco, M., & Turner, A. (2014). *LID Manual for Coastal SC – North Inlet-Winyah Bay*. National Estuarine Research Reserve System Science Collaborative. http://northinlet.sc.edu/lid/
4. *Hydrologic Soil Group*. (2016). USDA. file:///Users/celestegunderson/Downloads/HydrologicSoilGroup_DominantCondition.pdf