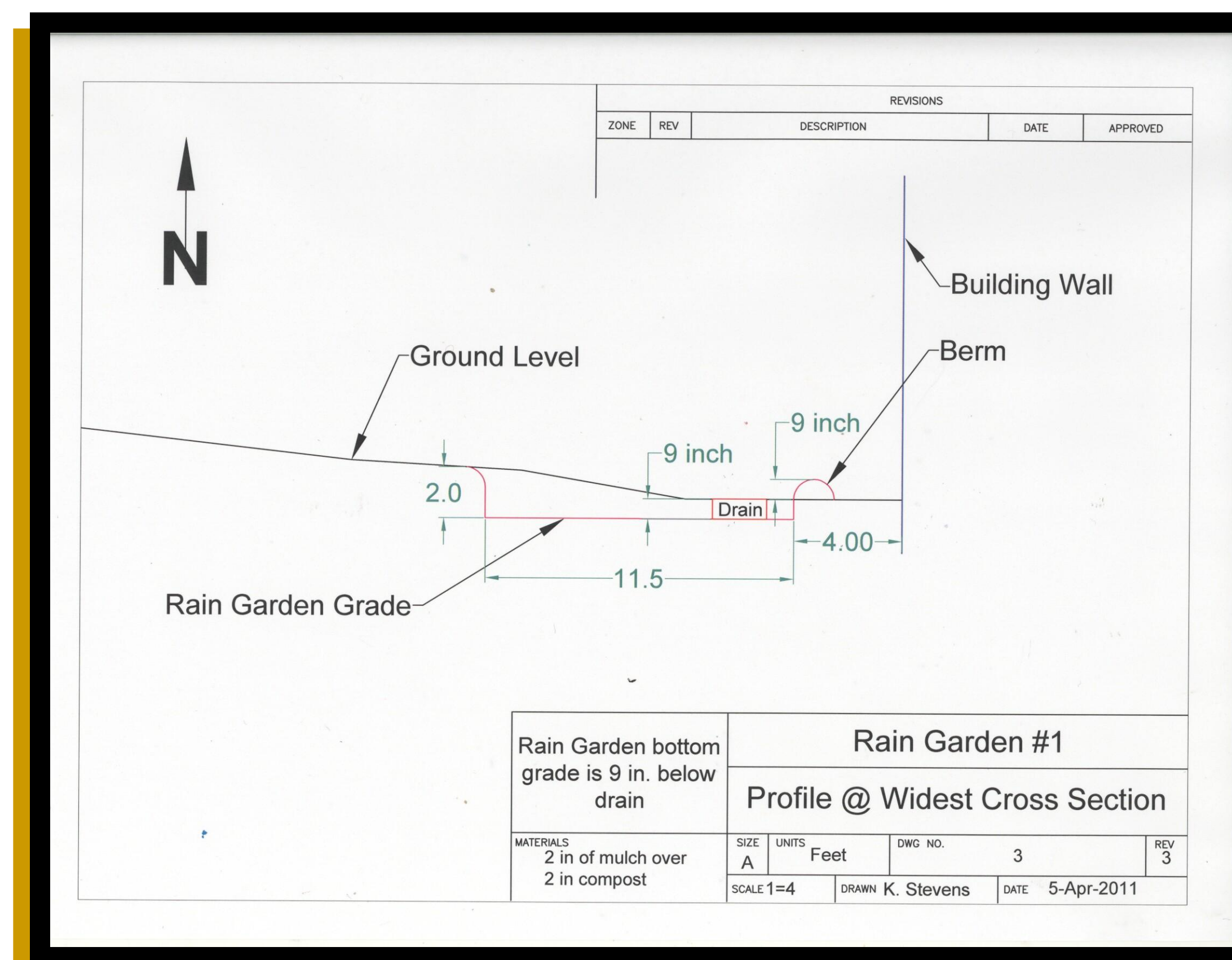
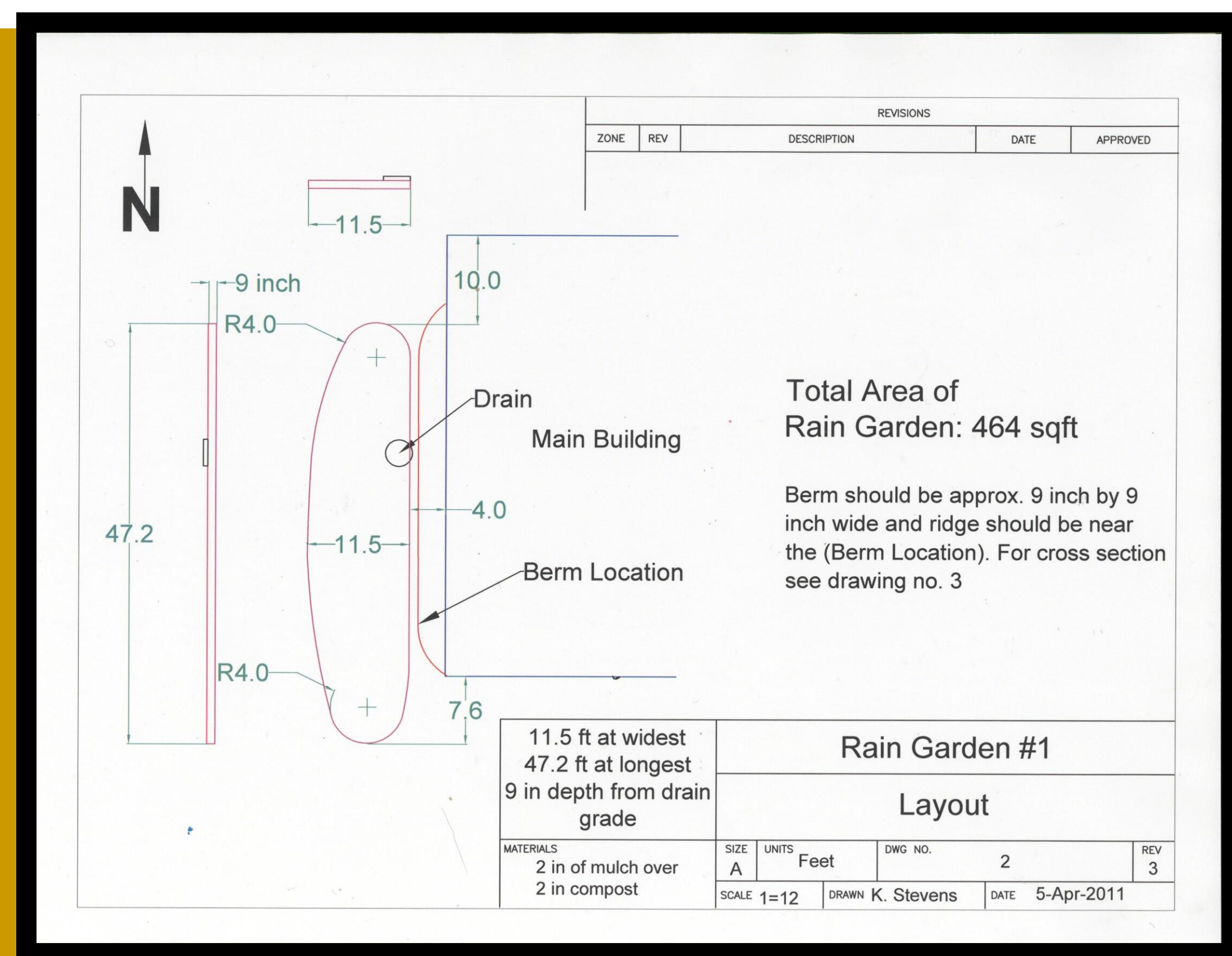
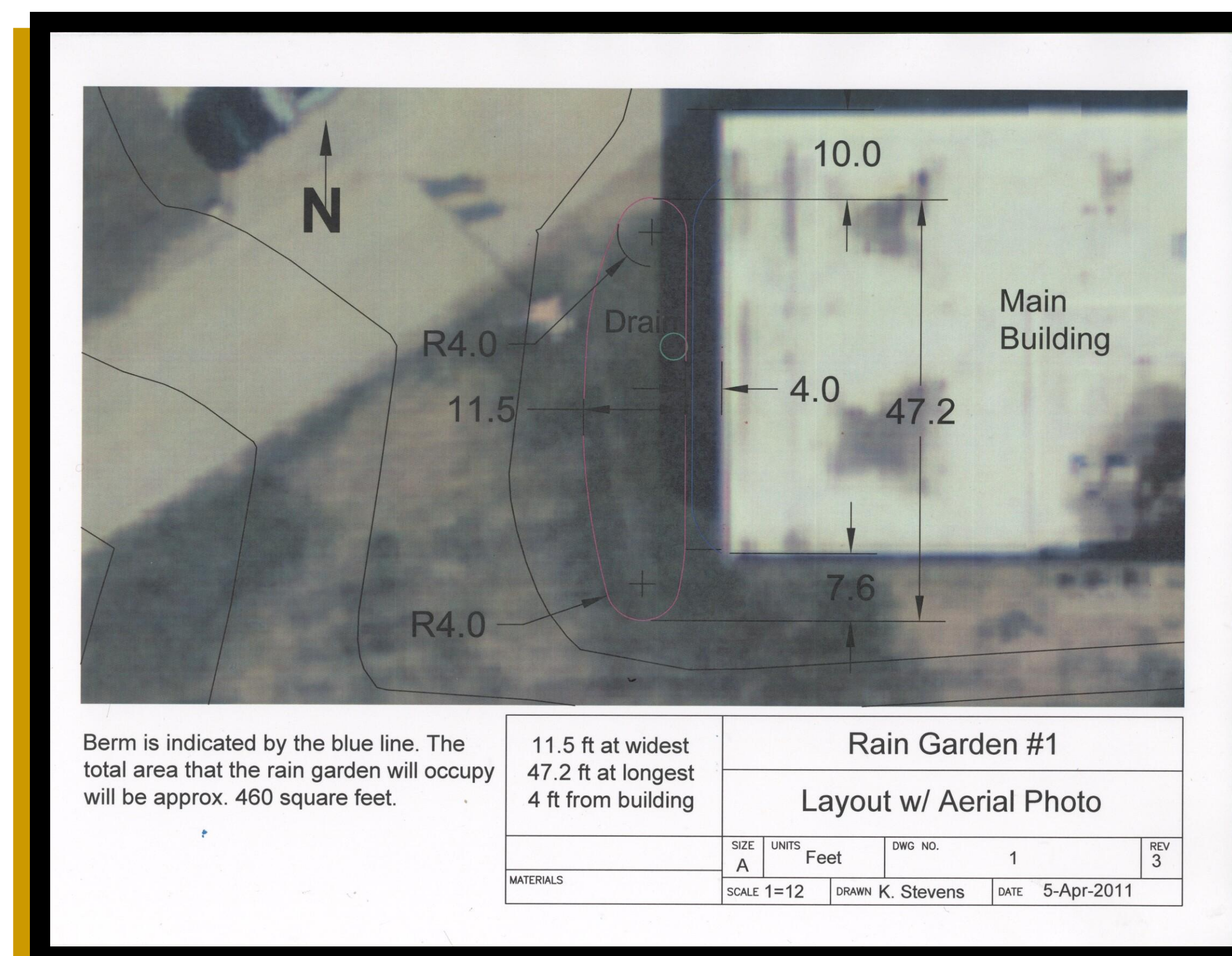
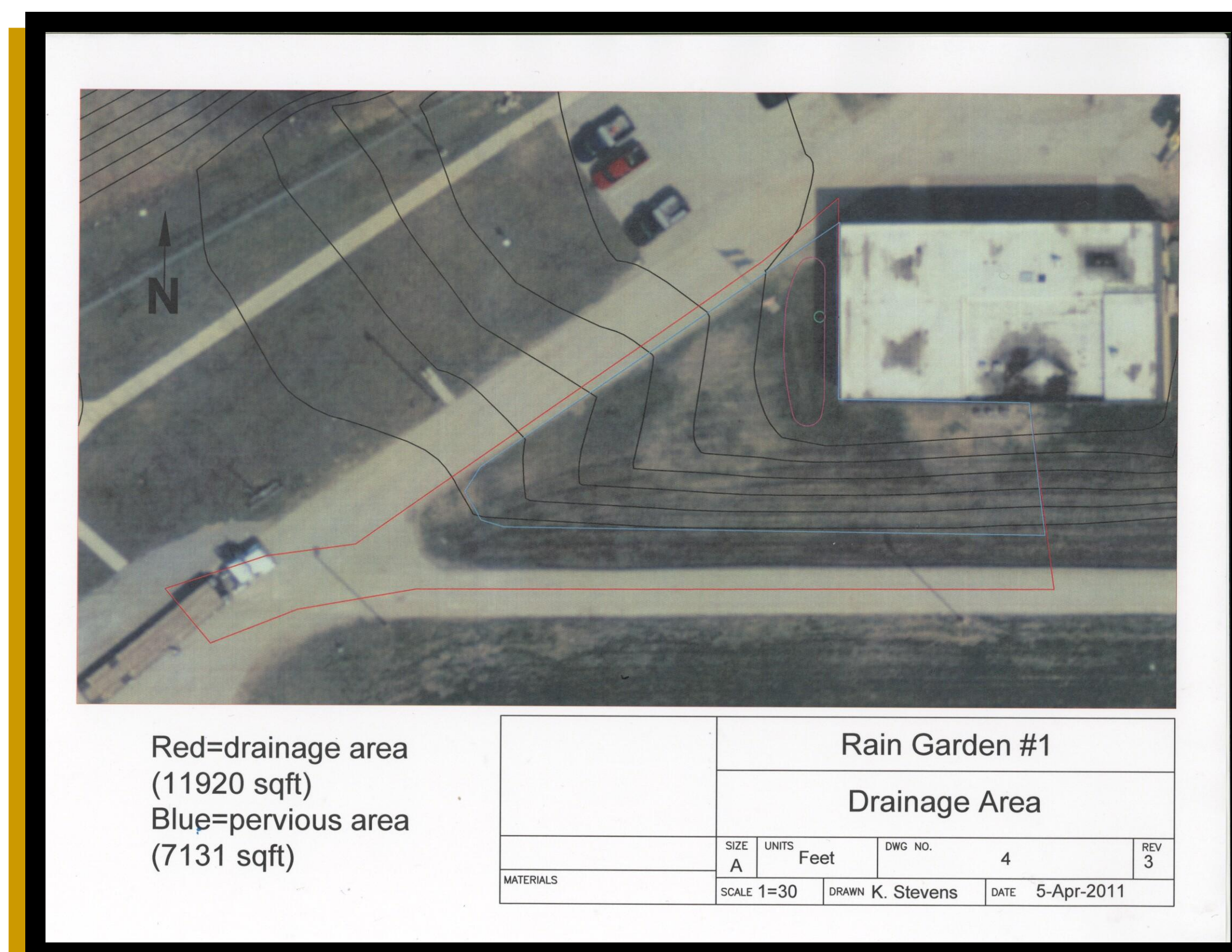


Rain Garden Design for West Lafayette Wastewater Treatment Plant

Kephon Stevens (ANRE), Laura Page (ANRE)

Objective:

The rain garden will serve as a demonstration project of low impact design practices that can be viewed by those touring the West Lafayette Wastewater Treatment Plant. Two possible locations were examined at the plant and two rain garden designs were developed. The goal is to allow for the initial flush, or the first half inch to one inch of runoff to be absorbed. The plants used in a rain garden take up excess water that is not absorbed by the soil.



Drawings:

Drainage Area was calculated using AutoCAD Civil 3D with the area used outline in red and the non-impervious surface area shown with in the blue outline. The Layout shown including the aerial photo, indicates the widest and longest lengths of the rain garden along with important dimensions. The Layout includes dimensions and berm location, the rain garden will be 9 inches deep and will include appropriate amounts of compost and mulch. The final drawing is the Profile view. This view includes depths and dimensions with respect to the ground level grade.

Procedure and Design Process:

- Percolation Test:** Percolation testing was used to determine the infiltration rate of the soil at each potential rain garden site. A uniform hole of approx. 10 inches in diameter and 10 inches deep. The hole was then filled with an initial amount of water no less than 6 inches. Measurements were initially taken every 30 minutes then every 10 if the change in water depth was great enough. An equation was then used to calculate the percolation rate and from that rate, infiltration rate was determined.

d_i = Initial Water Depth (in)

Δd = average/final water level drop (in)

D = diameter of percolation hole (in)

Infiltration Rate = Percolation Rate / Reduction Factor, R_f

$$R_f = \frac{2d_i - \Delta d}{D} + 1$$

- Surveying and Contour Data:** Total station surveying was conducted at each of the potential sites to determine more specific elevations and to gather an idea of drainage in both areas. Two foot contour data was also provide to be able to determine drainage areas within the treatment plant site.
- Determining Drainage Area:** Drainage areas are key to determining the size of a rain garden. AutoCAD Civil 3D, along with surveying data, contour data, and Tippecanoe County aerial photos, was used to calculate drainage area and non-impervious areas. By using the contour and surveying data a drainage area could be outlined in AutoCAD and the drainage area was easily calculated.
- Size Calculations:** Three different design standards were used in calculating the size of the rain garden. After inputting all the data into Excel, the Lafayette/West Lafayette design guidelines provided the best size for the allowable area. This particular sizing is based on an assumed rain garden depth which is based on your infiltration rate that was calculated through percolation tests. Water in a rain garden should stand no longer than one or two days. The faster the infiltration rate, the deeper and smaller the garden can be and vice versa. After choosing a rain garden depth, the desired amount of runoff to be collected (in inches) is divided by the depth and then multiplied by the drainage area to obtain the rain garden size in square feet. The team has chosen 0.5 inches of runoff to account for the first flush.

$$(\text{Runoff Depth} / \text{Rain Garden Depth}) \times \text{Drainage Area} = \text{Rain Garden Size}$$

- Choosing One Design:** Two unique designs were developed for two different areas within the treatment plant. The design illustrated to the left is the chosen design, the choice between the two design was clear after discussion with our sponsors. The second design was a much larger rain garden due to a larger drainage area and a very poor infiltration rate due to clay content and compaction. The second design would have been too costly and time consuming for the sponsors.
- Materials and Implementation:** Design one was chosen, which is not only smaller but requires no soil amendments. Based on the size of the garden, about 180 plants will be needed. The plants should be chosen based on amount of water and sunlight they will receive in regards to location within the rain garden. Also, about two inches of compost and two inches of mulch will be added which is standard. A bobcat is on site to complete the needed excavations.
- Estimate:** The cost of the project will include 184 plant s@ \$2.50 per plug and approximately 15 bags of compost (5 ft³ coverage) @ \$10 per bag. The total cost will include the plant and compost purchases plus mulch and labor, which can be provide by the City of West Lafayette, for a total estimate of \$675.00.

Sponsors: Dave Henderson, Utility Director WWTP
Dan Dunten, Urban Conservationist Tippecanoe SWCD

Technical Advisor: Christina Murphy

