Rain Garden Basics

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Why and How?

- Regulations
  - Federal
  - State
  - Local
- Bio-remediate
  - It’s cheap

Why a storm water user fee?

- EPA
- Maintain and replace infrastructure
- Improve stream water quality

State and EPA requirements

- Murfreesboro
- Designated urban area
- EPA requires
- MS4 program
- Ensure water quality in local bodies of water
- Requires milestones to met-need equipment, training, staffing

MS4 program

- Storm Water Phase II Rule
  - EPA effort preserve, protect & improve water resources
  - Phase II Rules
    - MS4 storm water management program
      - Reduce discharge of pollutants by maximum extent practicable (MEP)
      - Satisfy Clean Water Act

MS4 control measures

- 1. Public education & outreach
- 2. Public participation/involvement
- 3. Illicit discharge & elimination
- 4. Construction site runoff control
- 5. Post-construction runoff control
- 6. pollution prevention/good housekeeping

Maintain & replace infrastructure

- Infrastructure
- In place some time
- Pipers clog
- Impede storm water flow
- Open ditches gradually fill
- Vacuum and water jet trucks
- Replace with BMP

Improve stream water quality

- Murfreesboro streams impaired
- Streams may not be suitable for certain aquatic life/human recreation
- Monitoring/research useful-aid in stream quality
- BMP
  - Bio retention area, debris catchments, bank restoration
- Improve water quality

Public outreach & education

- Public out reach
- Ensure water quality
- School education program
- Workshops
- Low impact development

BMP improvement

- Restoration
- Habitat

What is an impervious surface?

- Rainwater cannot infiltrate
- More water volume-runoff into storm drain
- Storm water fee
- Median impervious area of single family residential [SFU] propertied-3,470 sq ft

What is an impervious surface?

- Review of 20,000 + properties
- $3.25 per month
- Commercial property- how many equivalent SFUs
- Commercial – 34,700 sq ft = 10* $3.25= $32.50

How fee billed?

- SFU-added to bill
- Apartment-bill property owner
- Commercial- bill property owner

What is goal of storm water fee?

- Maintain water quality
- Allow city to comply – federal-state regulations-unfunded mandate
- Flood damage reduction/drainage
- Long term maintenance

What is goal of storm water fee?

- Protect water supply
- Stream restoration
- BMP-road construction
- Education for schools
- Workshops for better water quality

What can you do for clean water?

- Conserve water
- Keep grass clipping out of stream
- Keep restaurant and business waste away from rain

What can you do for clean water?

- Use min herbicides/fertilizers & keep off paved surfaces
- Pick up pet waste
- Report water pollution

More information

- And other slide shows
- http://www.murfreesboro.gov/government/water_sewer/stormwater.htm

Want to avoid

What really goes down the drain?

Rain Garden Rain Water Management

Retrofitting Middle Tennessee State University

History

- This power point is the result of work completed students in ABAS 3370 and 4370. Mr. Larry Sizemore’s valuable resource in guiding students and myself.
- Dr. W. Anderson has edited the power point text students submit at the end of the semester 2005, 2006 & 2007.

What is the system currently used to manage rain water at MTSU?

- Roof runoff to points away from campus building.

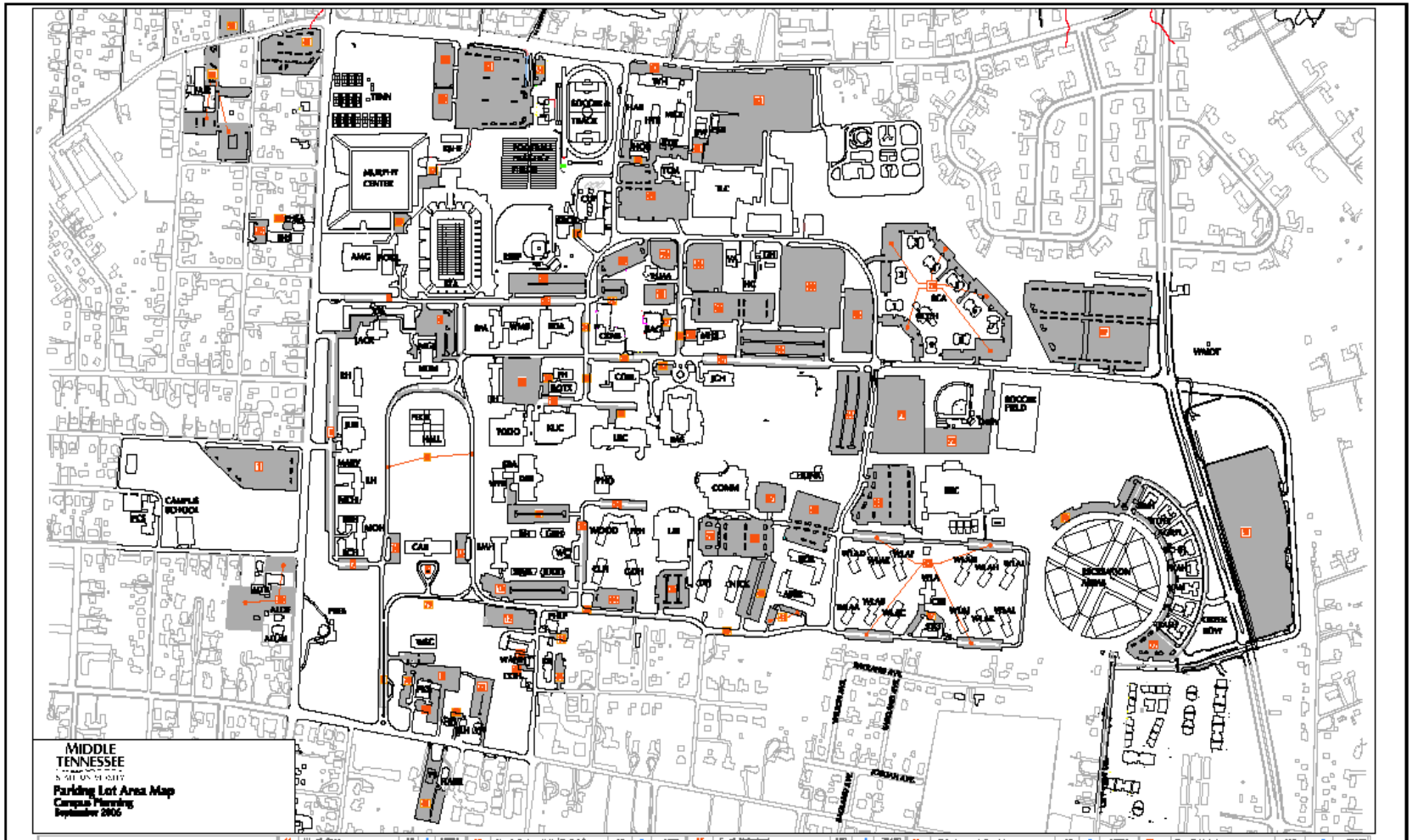
- Lawns and paved areas direct surface water to constructed drainage way

- Water is directed a basin next to Rutherford Blvd.

What are some of the problems caused by these methods?

- Petrochemicals from parking lot runoff
- Metals from parking lot runoff
- Sediments from parking lot runoff
- Sinks and sinkholes developed in Karsts terrain.

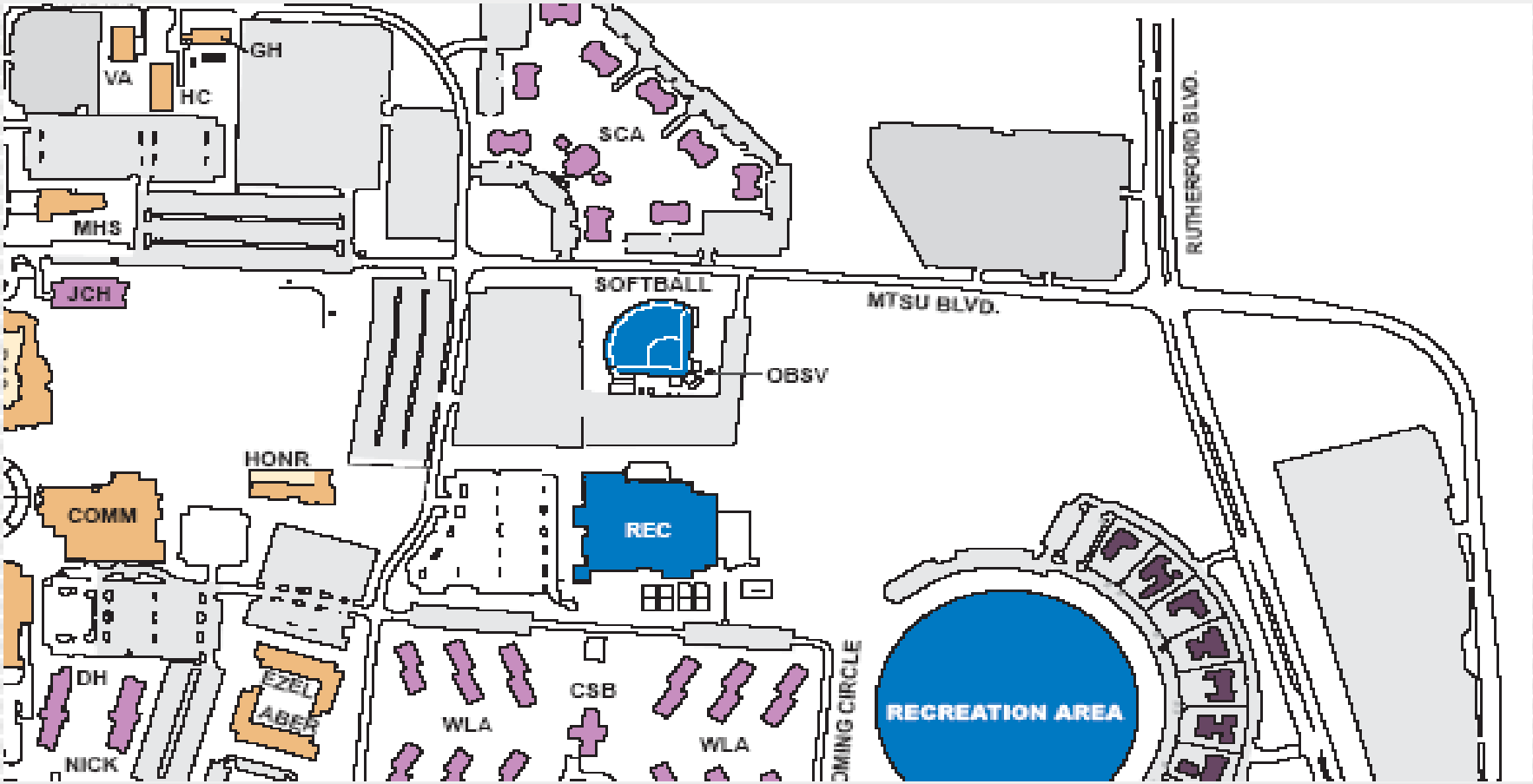
MTSU Campus Map



Parking Inventory

Lot #	Lot name	Total	ADA	Area
01	Bell Street	349	0	115029
02	VIB for BCH	263	25	80057
03	Faculty/Staff (KES/AHW)	27	2	4785
04	E. of KUM	114	6	64841
05	Old Main Cir. South	84	0	16445
06	Visitor's Cir	18	0	3847
07	S. of Schardt	40	0	6486
08	Old Main Dr. North	88	10	17470
09	Parking Services	132	0	37358
10	Audit Office	12	0	4834
11	Project Help	13	1	4837
12	SW of Blue Raider Drive & Bond Ln	128	0	38721
13	N. of Stone / Judd	159	0	38963
14	W. of Greek	33	2	12854
15	E. of Greek	37	2	13048
16	Friendship Dr	68	9	12875
17	Davis Science	120	3	48645
18	Library Waterside/Kuck	28	2	8856
19	E. of James Hall (ROTC)	142	13	63016
20	ROTC/Forest Hall	19	0	9319
21	W. of BDA (Maintenance)	165	0	77359
22	N. Smith Field (JF)	904	1	5591
23	East of BDA (BI Field)	92	4	3767
24	Humphrey	44	4	21484
25	W. of Center (MTAU)	48	1	7855
26	Shark Aquaculture/Science	5	1	8075
27	Saunders Ln	34	0	16645
28	Weatherland Health Services	12	0	4943
29	N. of Corlew Hall (BI Rsrch)	17	1	8888
30	Hart Lab	30	2	8853
31	BAS	89	8	41123
32	Vaughn House (Cole)	82	1	32747
33	N. of Wood/Felder (Philip)	88	8	34438
34	S. of Library	97	5	43886
35	Family Housing Maintenance	56	0	14368
36	S. of Samuel & Sam Hall	8	0	8758
37	S. of Davis	8	0	8878
38	E. of Weaks	150	11	53488
39	S. of Abernathy	30	0	10443
40	Barnock Lane Apartments	283	13	54888
41	N. of East	188	3	84117
42	Moore Gym Lot	282	13	137007
43	Orchard Lot	217	0	38170
44	E. of Rutherford	189	1	78459
45	MTSU Blvd. North of Cummings	49	2	8388
46	Maintenance Lot	885	4	117098
47	Holmes & Water pool	23	3	31174
48	Greenhouse	641	12	208078
49	S. of Greenfield Lot A	58	54	31778
50	Greenfield Lot C	28	4	14368
51	Greenfield Lot B	882	0	328411
52	Greenfield Lot A	108	4	31909
53	E. of Murphy Center	5	0	8848
54	W. of Stadium	13	0	8018
55	Ellington Lot	27	0	8882
56	Ellington Acres Lot	8	1	2884
57	E. of Cream House	588	10	184871
58	Rec. Center	348	12	113328
59	Shipping and Receiving	18	0	8878
60	Stock Houses	13	0	3396
61	S. of Greenhouse & Barn	98	4	31841
62	Bird House lot	13	0	8510
63	N. of Rutherford Health Services	302	7	94287
64	Bryan	190	8	28888
65	S. of Moore Gym	212	0	74527
66	N. of Nursing (S-Circle Lot)	168	0	38733
67	Eastman	71	0	18024
68	Observatory/BI Fielder	430	0	141028
69	Observatory/MTSU	958	5	74891
70	S. of Library	88	10	28777
71	Scientific Classrooms	457	20	164940
72	Greek Row	218	9	86713
73	Blue Raider Dr. S. of Cope	4	0	8807
74	Rec Field Lot	112	0	23108
75	Underwater Fields	88	4	28873
76	Monohan Grand	13	0	11343
77	Central Plant	5	1	8118
78	Dykeside Center	28	5	10888
79	Wheatley Lot	314	4	87883
80	Faculties	897	4	160918
81	Rutherford Lot	980	0	334198
82	Founders Lane Lot	182	0	88681
83	Middle Tennessee Building	197	0	110888
84	Art Barn Annex	57	0	28891
85	Across Rutherford	836	14	288942
86	Art Barn Lot	80	0	23068
87	Parking	43	0	18773
TOTAL		12884	317	4278651

Blowup of MTSU campus map



Location of Rain Gardens One and Two

- Rain Gardens One (F 2005-Sp 2006) and Two (F 2006) are near the MTSU campus greenhouse (GH) and Horticulture Center (HC).
- Rain Garden Three (F 2007) is south of rain garden one.

Runoff from Parking Lot #302

Surface drainage ditch on campus parking lot #302

- The photo looks North toward the campus greenhouse and Rain Gardens One and Two.
- This is where Rain Garden Three was constructed.

Are there alternative ways of dealing with runoff?

- A decentralized system directs water and contain it in a naturalized setting.
- A decentralized system can minimize runoff of an average rain by 90%
- Allowing plants and soil to filter pollutants from water.

What is a decentralized runoff management system?

- Runoff water directed into rain gardens
- Rain Garden shallow basin allow runoff water to percolate through the soil and transpire through the plants.

How does a decentralized system work?

Two ways:

1) Plant canopy; trees, shrubs, and un-mowed grasses reduces water that reaches the ground.

2) Rain garden acts as collection points, an infiltration device (sponge) for runoff water from the surrounding area not covered by rain garden canopy.

MTSU-time frame

- Began Rain Garden One the Fall 2005.
- It was completed Rain Garden One the Spring 2006.

MTSU-time frame

- Began and finished Rain Garden Two the Fall 2006.
- The rain gardens collect runoff from gravel parking lots West and North of the Horticulture Center.

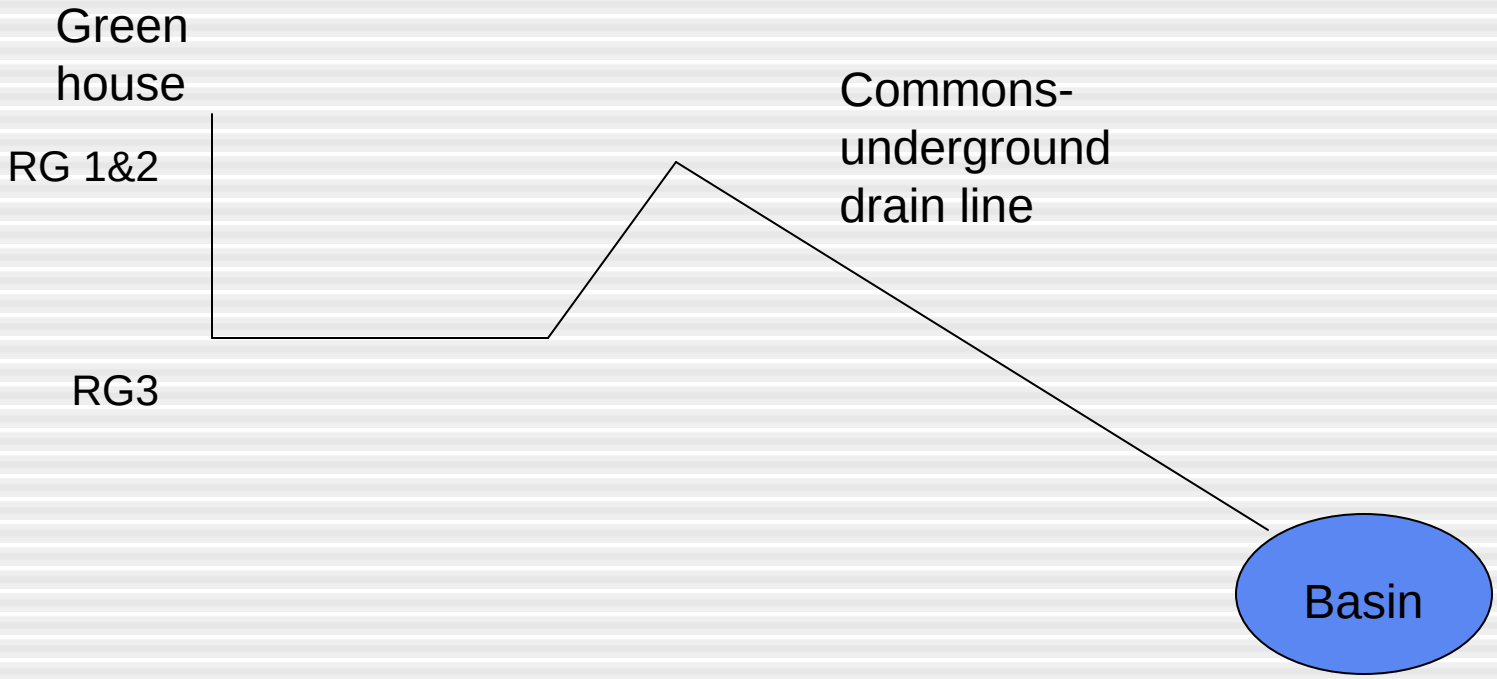
MTSU-time frame

- Began and finished Rain Garden Three during the Fall 2007 Semester
- The rain garden collects runoff from parking lot number 66.

Decentralizing the pre-existing drainage system at MTSU

- Subsequent classes will build rain gardens along the drainage ditch that runs from the Horticultural Center to the drainage basin by Rutherford Blvd (approximately ½ mile).

Surface Drain system being retrofitted with Rain Gardens (RG)



Looking North toward Rain Garden one and site for RG3

Rain Garden 3 after Excavation

Before Rain garden one

Rain garden one

Rain Garden one

- Deeper and longer than on in a residential landscape
- Why?
- It had to fit in an existing drainage ditch

How to Plan a Rain Garden

- The garden should be down slope from the area that is draining into it.
- Small rain gardens are easier to maintain than one large garden.
- Be careful of how close the garden is to any buildings. If closer than ten feet it may interfere with the foundation.

Building Rain Garden Two: Placement

- The second rain garden is between the greenhouse and the eastern section of parking lot #302.
- It also capture and absorb water from the graveled lot that is West of the Horticulture Center.

Other Placement Considerations

- Do not place over a septic system or in an area of the yard where water pools.
- The garden should drain well.
- How a soil drains can be determined by the watching the site after a rainfall event
  - Does it drain within 2 to 3 day
  - If not infiltration and percolation rate can be estimated.
- Clay soil or compacted soil are unsuitable soils can be amended with sand to allow better infiltration.

What is water infiltration?

- How quickly does water move into a soil?
- Watch an area after a rain fall event.

What is the percolation rate?

- The percolation rate in the number of minutes inches required for one inch of water through a soil.
- The class used these perc rates:

  <60 minutes/inch

  60-75 minutes/inch

  >75 minutes/inch
- A good rate for a rain garden is <60 minutes per inch.

How to determine percolation rate by soil texture?

- Using a post hole digger, dug holes 6 to 8 inches for a shallow basin or 24 to 36 inches deep basin.
- Faster than 60 minutes per inch
  - Excavate a medium or fine textures subsoil
  - Fine reddish textured subsoil
- 60 to 75 minutes per hour
  - Soils that have reddish fine textured subsoil at least 24 inches and yellow clay between 24 to 36
- Slower than 75 minutes per inch
  - Excavate bed rock within 36 inches
  - or soil having is yellowish, grayish, or blackish fine textured subsoil

Building Rain Garden Two: The Percolation Rate

- Excavated holes in the proposed Rain Garden site 24 inches deep and equidistant apart.
- Filled holes with water and time how fast the drop one inch several times. Stick a tooth pick in the side of the hole.
- Measure water drop. Refilled the holes.

Building Rain Garden Two: Size

- The size of the rain garden can be calculated.
- The sized required to capture drainage was determined by Larry Sizemore observations.
- Dimensions: 8 feet x 24 feet by 6 inches deep

Finding the Area a Rain Garden

- Determine the area to be drained in the garden.
- For example if the garden is to catch water from a rain spout use the part of the roof that drains into that spout.
- Lawns, driveways, and other paved areas may also be the source of water for a rain garden.
- The area to drained can be multiplied by a size factor to determine the area of the rain garden.

Size factors are determined according to the type of soil and the depth of the garden and differ if the garden is <30’ or >30’ from a building.

<30 Feet	3-5” deep	6-7” deep	8” deep
Sandy Soil	0.19	0.15	0.08
Silty Soil	0.34	0.25	0.16
Clayey Soil	0.43	0.32	0.20

>30 feet	For all depths
Sandy Soil	0.03
Silty Soil	0.06
Clayey Soil	0.10

% Slope Relates to the Depth of the Rain Garden

- For slopes <4%, the garden depth should be 3-5 inches deep.
- Between 5-7%: 6 to 7 inches deep
- Between 8-12%: about 8 inches deep
- For slopes over 12%, another location should be considered.

Calculating the Area of the Rain Garden

- Find your slope.
- String line level, uphill & down hill
- Difference in height (rise) of stakes between string and ground
- Distance between stakes (run).
- Rise/run multiplied by100 equals percent slope.

Defining the Shape of the Rain Garden

- Shape should be aesthetic.
- Length of the garden should be perpendicular to the slope. Why? Catch as much water as possible.
- Garden should be about twice as long as it is wide.
- Width should be no more than 10-15 feet.

Building Rain Garden Two: Digging

- Front end loader used on campus but for residential garden a garden tiller .
- District conservationist (NRCS) showed the class how to measure slope with a level and rod. Home owner use a string and line level.
- Made sure the inlet is higher than outlet.

Digging a Rain Garden

- Mark garden perimeter
- Hammer stakes at the defining points around the perimeter, run a string level between stakes across the garden.
- Dig so that the bed is level at the desired depth.
- Use the removed soil to build a berm on the downhill edge of the garden.

Building Rain Garden Two: Planting

- The Fall 2006 class planted natives that Larry Sizemore recommended.
- There arrangement was naturalistic fashion - odd number groups.

Planting a Rain Garden

- Plants should be tolerant of moist and dry conditions.
- Conventional landscape plants can be used but consider native plants.
- Plant density should be higher and more naturalistic looking than conventional type plantings.

Spreading Mulch in Rain Garden Two

Building Rain Garden Two: Mulch and Rock

- Landscape fabric at the entrance of the Rain Garden.
- Covered the bottom of the Rain Garden with double-shredded mulch
- Covered the landscape fabric at the entrance with river rock.

The Finished Rain Garden 2

Looking South from Rain Garden 1 toward Rain Garden 3 before its Excavation in Fall 2007

Rain Garden 3 Specs

- **Infiltration Rate**
  - 3 inches in 90 minutes
- **Depth**
  - 7 inches
- **Materials Used**
  - river rock, landscape fabric, recycled concrete (from construction site on campus), native plants.

Plants Used

- River Oats - *Chasmanthium latifolium*
- Dogwood - *Cornus florida*
- Hibiscus – *Hibiscus moscheutos*
- Juncus - *Juncus effusus*

Construction of Rain Garden Three During Excavation

Construction of Rain Garden Three after Excavation

The only outlet for parking lot 66. The dark soil is a result of oil and other pollutants

Rain Garden 3 Excavation

Notice the normal red clay

Notice oil polluted clay

Dr. Anderson Points out Contaminated soil

River Rock

Spreading River Rock

Landscape Fabric

Although fabric is beneficial to prevent weeds, it does not allow the rock to settle. Notice how the fabric and rock washed away due to heavy rain.

Landscape Fabric Correction

We corrected the problem with recycled concrete and rocks to hold the fabric in place and to slow down the water flow.

Rain Garden 3 Completed, F 2007

In Summary

- Pollution and other environmental problems caused by conventional drainage systems in developed areas can be reduced by changing landscape practices.
- Limiting mowed lawn space, raise mower blade increases plant canopy, reduces water reaching the ground.
- Installing rain gardens in the landscape will allow excess water infiltrate into the soil in many places and will reduce the occurrence of sinkholes in a large centralized basin.

References

- http://clean-water.uwex.edu/pubs/raingarden/
- http://raingarden.il.gov/create.htm
- Prince George County Bioretention Manual
- Rain Gardens- solving drainage problems, Tennessee Gardener, August 2005
- Land Judging Guide, UTK, PB 727
- www.cleanwaterccampaign.com/what_can_I_do/raingarden.html