University of Idaho
College of Art and Architecture

Department of Landscape Architecture
Larc 380 - Water Conservation Technologies - Spring 2014 – Austin

Quiz One

Water Supply Introduction

1. What is the current annual rate of decline in the level of the Grand Ronde aquifer?
    a. About 1'
    b. About 2'
    c. About 3'
    d. About 4'
    e. About 5'

2. What is the daily per capita water use (in gallons) in Moscow?
    a. About 67
    b. About 87
    c. About 107
    d. About 127
    e. About 157

3. What is the average annual per capita water use for flushing toilets (in gallons, assuming 1.6 gallons per flush?
    a. About 920 gallons
    b. About 1,920 gallons
    c. About 2,920 gallons
    d. About 3,920 gallons
    e. About 4,920 gallons

4. Evaporation stress exceeds annual precipitation in Moscow, Idaho.
    a. True
    b. False

5. What is the average annual precipitation for Moscow (in inches)?
    a. About 13.4"
    b. About 20.4"
    c. About 23.4"
    d. About 28.4"
    e. About 33.4"

Water Harvesting from Roofs

6. In the Contec Engineering example of the impact of roof, surface and cooling system capture of non-potable water, what were the effects on potable water requirements?
    a. Potable water use was reduced form 3.1 million gallons to 1.25 million.
    b. Potable water use was reduced form 3.3 million gallons to 3.1 million.
    c. Potable water use was reduced form 0.3 million gallons to 0.125 million.
    d. Potable water use was reduced form 1. 3 million gallons to 1.25 million.
    e. Potable water use was reduced form 1.25 million gallons to 0.25 million.

7. Green roofs produce lower quality runoff than metal roofs.
    a. True
    b. False

8. About how many gallons of water per 100 square feet of roof area represent the first flush?
    a. 0.1
    b. 0.5
    c. 0.7
    d. 1
    e. 1.5

9. Calculate the gallons of water that can be collected from a 2,000 sq. ft. roof in and area with 24" of precipitation and with a runoff coefficient of 90%.
    a. 481
    b. 4,000
    c. 5,775
    d. 26,928
    e. 323,136

10. The water harvested for the Santa Ursula project supplied water for both laundry and irrigation.
    a. True
    b. False

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Quiz Two

1. The techniques discussed in the harvesting water from the landscape tutorial disconnect impervious surfaces.
    a. True
    b. False
2. What is the porosity of 2" drain rock?
    a. 20%
    b. 30%
    c. 40%
    d. 50%
    e. 60%
3. How far beyond their drip lines (canopy) should tree catchment basins extend?
    a. 6”
    b. 1’
    c. 2’
    d. 3’
    e. 4’
4. Calculate the volume (in cubic feet) of water held behind a berm on a slope if a basin is 8’ wide, 2' deep, and 60' long. Show your work.
    a. 960
    b. 400
    c. 480
    d. 3,590
5. For only the Natural Vegetation column below which set of percentages correctly represent the hydrology of an area with natural vegetation.

	Natural Vegetation	Urban Area with 75% Imperviousness
Evaporation	a. 40% b. 20% c. 10% d. 15%	a. 60% b. 30% c. 50% d. 20%
Runoff	a. 10% b. 20% c. 35% d. 20%	a. 10% b. 55% c. 20% d. 30%
Shallow infiltration	a. 25% b. 30% c. 35% d. 25%	a. 20% b. 10% c. 25% d. 35%
Deep infiltration	a. 25% b. 30% c. 20% d. 40%	a. 10% b. 5% c. 5% d. 15%

6. For only the column above labeled the Urban Area with 75% Imperviousness, which set of percentages correctly represent the hydrology of an urban area.

7. Stormwater management focuses on the reduction of which two stormwater characteristics?
    a. Total suspended solids and nitrogen
    b. Biological oxygen demand and total suspended solids
    c. Non-point source pollution and sediment
    d. Non-point source pollution and pathogenic bacteria
    e. Volume and peak rate of runoff

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Quiz Three

18. What is the chance that a 5-year, 24-hour storm will occur during any year?
    a. 1%
    b. 2%
    c. 5%
    d. 20%
    e. 50%

19. What is a "design storm"?
    a. An attractive snowfall
    b. The 2-year 24-hour storm
    c. A storm magnitude defined by a regulatory agency
    d. The water quality storm

20. Which two factors determine a runoff curve number (CN)?
    a. Climate and region
    b. Climate and slope
    c. Land cover type and degree of imperviousness
    d. Soil type and land cover type
    e. Initial abstraction and land cover type

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Quiz Four

21. Define the primary stormwater purpose of the detention pond.
    a. To protect streams and rivers from increased volume and velocity
    b. To permanently hold stormwater runoff on-site
    c. To detain sediment temporarily to avoid sedimentation of streams and rivers
    d. To improve water quality of stormwater runoff before it reaches streams and rivers
    e. To provide detain first flush pollutants
22. What is the purpose of a multi-stage outlet?
    a. To provide multiple openings in case one gets clogged with debris
    b. To provide a controlled flow outlet for each design storm
    c. To accommodate the 50-year, 24-hour storm
    d. To allow "big box" retailers to construct acres of impervious surfaces
    e. To allow vegetation to grow in stage one and water outflow in stage 2
23. List one advantage of detention basins as a stormwater management solution.
    a. The provide design jobs for beginning engineers
    b. They provide wildlife habitat
    c. They improve water quality
    d. They are recreation and aesthetic resources
    e. They don't take much space compared to other stormwater management solutions
24. What is the percentage difference in pollution removal for a six-batch retention basin compared to a one-batch basin?
    a. 20%
    b. 30%
    c. 40%
    d. 50%
    e. 60%
25. In the study of the Australian wet pond/wetland comparison, what was the percentage of fecal bacteria removed by the wet pond? What percentage was removed by the wetland?
    a. The wet pond removed -2.5% and the wetland removed 79%
    b. The wet pond removed 2.5% and the wetland removed 79%
    c. The wet pond removed 25% and the wetland removed 79%
    d. The wet pond removed 79% and the wetland removed 25%
26. The study of the bioretention basin in Charlotte, North Carolina revealed that the peak runoff was reduced by what percentage?
    a. 16%
    b. 36%
    c. 56%
    d. 76%
    e. 96%
27. The study of the University of New Hampshire bioretention basin demonstrated a delay in the peak runoff. What was the delay in minutes?
    a. 42 minutes
    b. 92 minutes
    c. 142 minutes
    d. 192 minutes

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Quiz Five

28. Rooted macrophytes (wetland plants) generally require water depth less than _____ feet?
    a. 1
    b. 2
    c. 3
    d. 4
    e. 5

29. Conventional development of the Inland Empire Utilities Agency headquarters would have required which stormwater device at what cost?
    a. Sky hook at $10 million
    b. Activate sludge reactor at $10 million
    c. Box culvert $2 million
    d. 1 mile pipeline at $1 million

30. The Chino Creek Wetlands are designed to retain the _____ -year design storm.
    a. 2
    b. 10
    c. 25
    d. 50
    e. 100

31. At the Chino Creek wetlands what technique is used in the marsh to mix and redistribute water to the vegetated benches?
    a. Booster pumps
    b. End suction centrifugal pumps
    c. Deep water trenches
    d. Siphon chambers
    e. Capillary tubes

32. The Chino Creek wetlands demonstrated that a stormwater treatment park is a cost effective way of managing and treating stormwater compared to capture and treatment on individual parcels within the watershed?
    a. True
    b. False

33. How much cooler is the ASLA green roof than conventional black roofs?
    a. 2ºF
    b. 12ºF
    c. 22ºF
    d. 32ºF
    e. 42ºF

34. What is the typical soil depth for an extensive roof?
    a. 1”
    b. 3”
    c. 5”
    d. 7”
    e. 9”

35. How much does a 3-inch depth of wet soil media weigh?
    a. 1.5 pounds
    b. 4.5 pounds
    c. 7.5 pounds
    d. 10.5 pounds
    e. 13.5 pounds

36. Extensive roofs can retain about _____" of rainfall per inch of soil.
    a. 0.1”
    b. 0.3”
    c. 0.5”
    d. 0.7”
    e. 0.9”

37. The research of stormwater capture on extensive roofs in Auckland, New Zealand found that _____% of the total amount of rainfall was captured and evaporated or transpired.
    a. 16%
    b. 56%
    c. 76%
    d. 96%

38. How many inches of water does the drain mat on the Academy of Sciences green roof hold?
    a. 0.5”
    b. 1.5”
    c. 2.5”
    d. 4”
    e. 6”

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Quiz Six

39. What is the EPA standard for total suspended solids in secondary sewage effluent?
    a. 1.5 mg/Liter
    b. 5 mg/Liter
    c. 10 mg/Liter
    d. 15 mg/Liter
    e. 30 mg/Liter

40. What does the abbreviation TMDL stand for?
    a. Too Many Damn Labels
    b. Total Milligrams of Dissolved Lithium
    c. Tons of Malleable Lead
    d. Total Maximum Daily Load
    e. Tomas Maximilian del Laria (father of pollution testing)

41. What is the maximum number of colonies of *E. coli* within a 100 mL sample of water for rivers, lakes and coastal waters used for swimming (primary contact)?
    a. 1.6
    b. 29.6
    c. 126
    d. 1620
    e. 1 million

42. Which land-use typically contributes the most Phosphorus (P) to stormwater?
    a. Lawns
    b. Residential streets
    c. Industrial roofs
    d. Commercial streets

43. In the study of watershed streams near Atlanta GA measured the concentration of metals. Lead was at which measurement level?
    a. Below detection
    b. Below regulatory standard
    c. Acute
    d. Chronic

44. Very coarse sand is 2-1 mm in size.
    a. True
    b. False

45. The Seattle SEA streets project features a sidewalk on only one side of a narrow street, sheet flow to a curb and gutter and curb cuts draining water into a wet pond.
    a. True
    b. False

46. The Seattle SEA streets project reduced the volume of stormwater leaving the neighborhood by _____ percent.
    a. 20
    b. 40
    c. 70
    d. 80
    e. 99

47. At Siskiyou street demonstration project the area of infiltration beds were _____ percentage of the catchment area.
    a. 1
    b. 5
    c. 10
    d. 15
    e. 30

48. The bioretention basin in Charlotte, North Carolina demonstrated a very high capacity to remove ammonium and zinc. What was the removal percentage for ammonium?
    a. 73
    b. 80
    c. 93
    d. 99

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Quiz Seven

1. The Wilmington stormwater wetland decreased the fecal coliform bacteria an average of _____ percent.
    a. 10
    b. 31
    c. 55
    d. 77
    e. 99

2. Characterize the effectiveness of the Wilmington stormwater wetland for the removal TSS, ammonium, total phosphorus and nitrate.
    a. Low
    b. Moderate
    c. High

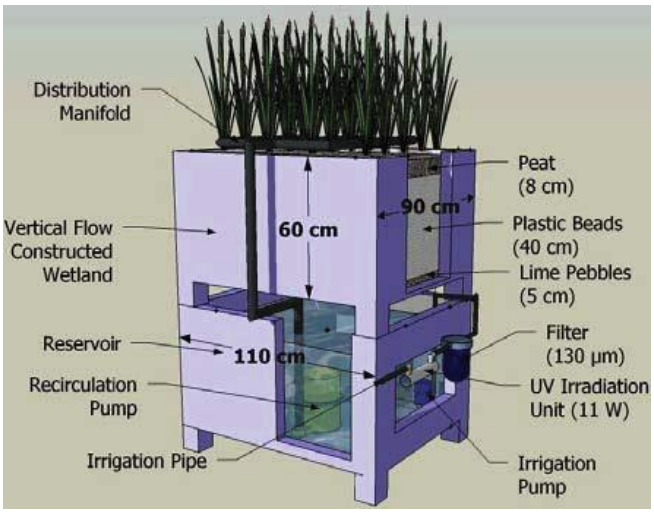
3. What are rotifers?
    a. Rotating bio-filters
    b. Microorganisms
    c. Emergent plants
    d. Fungi

4. What is the purpose of the two, six-foot deep, forebays in the Wilmington stormwater wetland?
    a. To trap nitrates
    b. To trap BOD
    c. To trap sediment
    d. To trap invasive plant seeds
    e. To trap ammonium

5. What device evenly distributes stormwater across the Wilmington stormwater wetland?
    a. A notched weir
    b. A dam
    c. A deep water trench
    d. A 6” perforated pipe
    e. A gravel-filled trench

6. Approximately how much greywater is generated by each person per day?
    a. 15
    b. 35
    c. 55
    d. 100

7. Study the table and the image below. Which column in the table correctly characterizes the performance of the greywater treatment system shown in the image?



	A	B	C	D
How the water is oxygenated	By an aeration pump	By pants submerged in the bottom tank	By water dripping between tanks	By an algae mat
Water recirculation rate	10 gpm	20 gpm	20 gpm	80 gpm
Percent of ammonia removal	11%	41%	81%	81%
Amount of nitrate gain	5 mg/L	15 mg/L	25 mg/L	45 mg/L
Percent of reduction in *E. coli*.	99%	79%	99%	59%

8. The Brazilian example of a constructed wetland system for treating greywater found that at least _____% of the COD was removed from the raw greywater.
    a. 12
    b. 32
    c. 52
    d. 72
    e. 92

9. How does the EPIC greywater reuse system deliver water to the root zone of plants without drip emitters.
    a. Through capillary action
    b. Siphon tubes
    c. Intermittent flooding
    d. Spray heads connected to the underground storage chambers

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Quiz Eight

58. Why is activated sludge added to water after the primary treatment phase in a conventional wastewater treatment plant?
    a. To convert phosphorus to phosphate
    b. To eliminate the need to aerate the water
    c. To oxygenate the water
    d. To add bacteria and other microorganisms

59. What are the BOD and TSS secondary treatment standards set by the U.S. EPA?
    a. 10
    b. 20
    c. 30
    d. 40
    e. 50

60. List two features of highly efficient septic tanks.
    a. One round chamber and one rectangular chamber
    b. Two chambers and an aeration pump
    c. Multiple chambers and an effluent filter
    d. An oil/water separator, sludge tank and three holding chambers

61. What percentage of private, small scale septic systems fail?
    a. 30%
    b. 40%
    c. 50%
    d. 60%
    e. 70%

62. Study the table and select the correct set of specifications for a Horizontal Subsurface Flow wetland?

	A	B	C	D
Inlet and outlet trench gravel size	.8-1.2" diameter	¼ - 3/8" diameter	3/8" - ¾" diameter	1 ½" – 3" diameter
Main bed depth	6"-12"	12"-18"	12"-18"	24"-30"
Percent slope on the top and bottom of the bed	1%	0.5%	2%	0%
Residency time required to meet secondary water quality standards	12 hours	1 day	2 days	3 days

63. The performance of the University of New Hampshire gravel wetland demonstrated at least 95% removal of dissolved inorganic nitrogen, total suspended solids, zinc, and total petroleum hydrocarbons and diesel.
    a. True
    b. False

64. How many square feet of HSSF wetland area per person served is required to meet EPA secondary treatment standards in summer and winter?
    a. 21
    b. 5
    c. 50
    d. 30
    e. 2

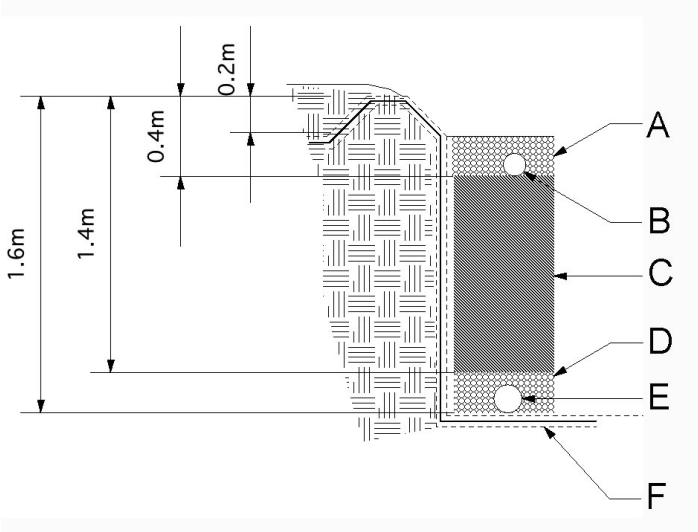
65. Although the porous paving and gravel wetland at the Greenland Meadows shopping center performed better it cost lightly more than a conventional system of stormwater sewers and detention ponds.
    a. True
    b. False

66. The vertical subsurface flow wetland treating wastewater receives continuous water inflow.
    a. True
    b. False

67. For treatment of domestic wastewater, VSSF wetlands require only _____ square feet per person served.
    a. 21.5
    b. 2
    c. 50
    d. 5

68. In the Austrian case study of the two-stage VSSF demonstration wetland, the amount of nitrate increased since VSSF wetlands are aerobic.
    a. True
    b. False

Annotate (provide as much information about the element as you can) the section of the VSSF wetland shown below. 6 points.



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1. How many square feet per person served is required for proper sizing of FWS wetlands intended to treat domestic wastewater to secondary standards?
    a. About 5
    b. About 10
    c. About 21
    d. About 30
    e. About 50

2. What kind of outlet structure was used on the Dye Branch stormwater wetland cells?
    a. Multi-stage stand pipe
    b. Free-board outlet device
    c. Broad-crested weir
    d. V-notch weir

3. What element was added to the retention basin in Aarhus, Denmark to cause it to behave more like a hybrid wetland and treat dissolved pollutants?
    a. A planted sand filter just before the outlet structure
    b. A siphon tube
    c. A planted sand filter just after the pond inlet
    d. Planted floating polypropylene islands

4. What are the four categories of ecosystem service articulated by the Millennium Ecosystem Assessment?
    a. Economic, cultural, aesthetic, environmental
    b. Provisioning, regulating, supporting, cultural
    c. Aquatic, atmospheric, geological, terrestrial
    d. Avian, mammalian, reptilian, human

5. The Oaklands Park hybrid wetland provides advanced treatment of domestic wastewater. Which standard did this system meet for concentration of pathogens?
    a. Drinking water standard
    b. Secondary recreational contact standard
    c. Primary recreational contact standard
    d. *E. coli* less than 100 cfu per 100 mL

6. The contemporary hybrid wetland demonstration project in the Czech Republic required _____square meters per person served.
    a. 1 m^2
    b. 2 m^2
    c. 3 m^2
    d. 4 m^2
    e. 5 m^2

7. The contemporary hybrid wetland demonstration project in the Czech Republic achieved a concentration of _____ mg/L of nitrate in the effluent.
    a. 0.1
    b. 1.1
    c. 3.3
    d. 4.4