Urban Hydrology Spring 2013 Final Exam Study Guide

1) **Introduction to Water and Cities** important concepts:
   a) components of the water cycle,
   b) watershed concept,
   c) watershed delineation,
   d) water budgets and associated calculations
   e) hydrograph components (peakflow, lag time, baseflow, etc.)
   f) history of water management in cities (based on reading)
   g) definition of urbanization
2) **Effects of Urbanization on Aquatic Systems** important concepts:
   a) Changes to stream hydrographs that result from urbanization
   b) Loss of urban stream networks
   c) Controls on the hydrologic response to urbanization
   d) Major components and steps of TR-55 analysis
   e) Riparian zones
   f) Meandering and pool-riffle streams
   g) Geomorphic effects of urbanization – sediment yields during and post construction; channel morphology changes,
   h) hydrologic tracers – types and characteristics
   i) isotopes as hydrologic tracers – hydrograph separation and source water fingerprinting
   j) Graphical versus isotope hydrograph separation: equations, physical basis, data requirements
   k) Insights and challenges from using isotopes as urban hydrology tracers
   l) Chloride as a tracer of road salt and waste water – sources of chloride, historical trends, seasonal and event dynamics,
3) **The (Present and) Future of Water in Cities**
   a) Combined sewer overflows (CSOs) – What are combined sewers and where are they found? What approach is Cleveland taking to dealing with CSOs? What other approaches are cities trying?
   b) What is stormwater? What effects can it have? How is it regulated?
   c) Effects of stormwater control on hydrographs
   d) Types of stormwater treatments – principles, general design, and advantages and disadvantages of each
      i) Wet ponds
      ii) Stormwater wetlands
      iii) Infiltration practices – trench, basin
      iv) Sand filters
      v) Bioretention
      vi) Swales
      vii) Permeable pavement
      viii) Cisterns and rainbarrels
      ix) Green roofs

e) Considerations for allocating resources ($) for stormwater control
f) Low Impact Development/Green infrastructure – Definitions. What can they include?
g) Ecosystem Services – Definition. Examples of how it can be applied to stormwater management, stream restoration, etc.
h) Stream restoration – goals, approaches, principles to guide it
    i) Natural channel design
    ii) Valley morphology restoration
    iii) Regenerative stormwater conveyance
i) Stream restoration techniques – What are the following designed to do?
    i) Channel morphology and floodplain connection
    ii) In-stream structures
    iii) Streambank bioengineering
j) Dams – why build? How many? What effects do they have (upstream and downstream)?
k) Dam removal – why? What are issues that need to be considered before a dam is removed? What are some possible environmental consequences of dam removal?
l) Urban soils –
    i) Basic soil soils: soil profiless, soil horizons, soil forming factors, texture, structure, water holding properties.
    ii) Urban soil – What is it? Issues with it? How can it reconditioned? How does demolition and vacancy affect soils?
    iii) How does soil affect the outcomes of rain gardens?
m) Watershed-scale stormwater management
    i) Challenges and benefits
    ii) How can it be implemented? How can its success be evaluated? Will stream ecosystems improve?
    iii) Describe a case study of attempted watershed-scale stormwater management
n) Rain garden design
    i) Factors to consider for rain garden sizing and siting
    ii) Plant selection
    iii) Soil issues
    iv) Maintenance and efficacy

4) **Data Collection and Analysis**
    a) Testable hypotheses
    b) Considerations for hydrologic data collection and analysis
    c) Creating good figures

For the final exam you can bring:

1) a calculator
2) a couple colors of pens or pencils
3) 1 one-sided sheet of notes