

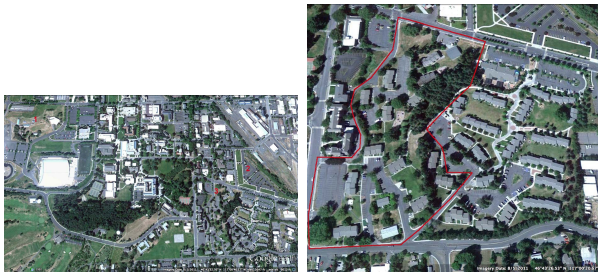
Water Conservation Technologies, Larc 380

Semester Assignment

Introduction

Over the length of the semester we will apply the concepts and techniques presented in this course to a redevelopment project. The project will focus on locating, sizing, detailing and documenting a number of site-scale, water management programs.

Site Location



Left: Aerial view of the University of Idaho campus, site 3 is the project site. Right: The project area is outlined in red.

The site is the married student housing project on the University of Idaho campus. Located at the intersection of Sweet Avenue and Deakin, the site is composed of a shallow valley. There are a few steeply sloping areas and upland benches. The existing buildings have nearly reached the end of their life. In fact, some of the buildings are currently unoccupied since they have been condemned due to the presence of mold that compromises air quality within the structures.

Site Planning

Three building footprints of proposed student housing structures have been provided for you. We will distribute these buildings in an in-class exercise in order to allow you to focus on the water issues this semester. However, you will develop parking, planting, irrigation, rough grading and water treatment plans. The water treatment plan will be supported by three dimensional models and sections to illustrate the concept and detail the construction requirements. Finally, and most important for this course, is the documentation of the performance of the landscape for water management and water quality. Download the [AutoCad base](#) here.

Tasks

The semester-long assignment is divided into several tasks associated with the topics of the course.

Download the project site base and contours. Combine them into a single file. Right click the links below to download the .dwg files.

Project AutoCad Base

Project AutoCad Contour Lines

Task 1 - Site Inventory and Analysis

Work in teams of six persons or less. Print the site base sheet (with contours) and annotate it during your site visits to document the existing conditions. Visit the site with a camera, two tape measures, twine, line level, a calculator an engineering scale, and your base sheet.

- Measure the slope percentage of the wooded slope on the eastern boundary. From contours and spot elevations find the greatest difference in elevation on the site.
- Gather data for our stormwater calculations - Determine the length and slope percentages for the longest path that water follows to reach the outlet at Sweet Avenue. Note the location of grade breaks and surface cover on the site base. Document the route with photographs.
- Locate opportunities for earth sheltered buildings. At these places measure the slope percentage and photograph the place.
- Verify the location of existing trees and shrub masses. Note off-site connections to green space (future ecological corridor connection).

Task 1 Deliverables

- A new project base sheet that includes the following elements:
- Existing contours, low points, high points
- Street curbs, names
- Existing manholes, catch basins, storm sewer lines
- Existing trees and shrub masses.
- Existing street lights
- Outside the boundary of the site show about 50' of existing buildings, roads, parking, open space, etc. for context.

Presentation template

- In InDesign prepare a 24" x 36" sheet with drawing scale, north arrow, project title, student names, professor's name, semester and year. Save the sheet as a template to receive Adobe Illustrator and other assets.

Site inventory and analysis

- Create an Adobe Illustrator file of the imported AutoCad Base. In the illustrator file generate professional graphics showing: slopes greater than 25% and slopes 0-5%, Time of Concentration line with distances, land cover and slope, square footage of the site, square footage of wooded areas, square footage of off-site stormwater contribution, manhole and catch basin locations, low and high points, grade breaks, soil type boundaries, soil infiltration rate, precipitation average by month, existing trees and shrub masses, existing driveway and street curbs, lights, and names, outline of existing parking areas, off-site connections to open space. Illustrate the site conditions with at least 20 photographs of the site elements and note the opportunities and constraints that they depict. Import the Ai file into the InDesign template and export as a PDF and submit with the file name SiteInvTeam*One* or *Two*. See the course calendar for the due date.

Task 2 - Building and Drainage Concept

Working in teams of six or less, distribute the proposed buildings on the site according to the in-class exercise. Calculate the proposed population of the site and the number of dwelling units per gross acre

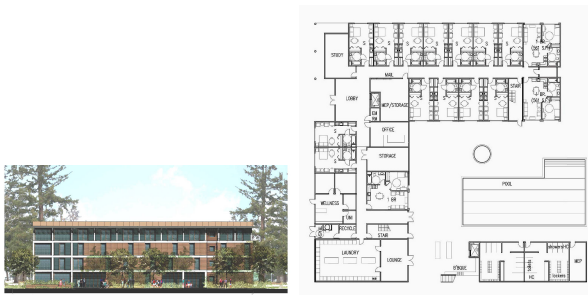
(our target is 30 - 40 units per acre). Locate and size parking to meet the standard of .75 spaces per unit. Assume 350 square feet per parking space (including aisles). Locate parking areas (minimize parking at the street edge on Taylor, Blake and Sweet Ave.). Do not draw the individual spaces or associated planting areas for this task. Locate and size all walkways and plaza spaces. The detailed design of the plazas will be done later.

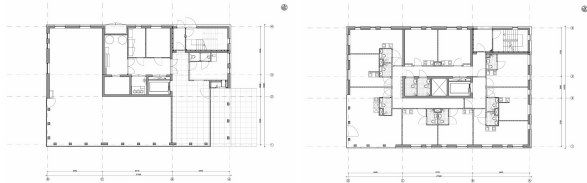
Below are a series of images and plans for student housing. Adopt these floor plans and distribute them where most appropriate on the site (note that the University of the Pacific option can be adapted as an earth sheltered building). Define the number of floors in the buildings shown to meet your purposes. Trace the images in AutoCad and rescale them to match the scale of your master plan (1" = 40'). Then copy the building footprint and place it to create arrangements that enclose exterior spaces. Then define the paved and landscaped space. Calculate the are of the plaza paving for each building group.

University of Southern Denmark Student Housing



University of the Pacific McGeorge Student Housing in Sacramento





Task 2 Deliverables

- Create an Adobe Illustrator file of an imported AutoCad Base. In the illustrator file generate professional graphics showing: proposed buildings (define building by number and stories - R1/3), proposed cut and fill slopes, flow arrows indicating drainage around each building and across each parking area.
- Create a table in InDesign that documents the project size (acres), population, number of dwelling units per gross acre, number of parking spaces and the area of each lot (number the lots L1, L2 etc.) and the square footage of each roof (number each roof, R1, R2, etc.), square footage of each plaza (number each plaza, P1, P2, etc.), total walkway area (see sample below).

	Project Data								
Site size									
Population									
DU/gross ac									
Walkway SF									
	1	2	3	4	5	6	7	8	9
Parking lot spaces/SF	15/5,250	21/7,350							
Roof SF	10,000	20,000	10,000						
Plaza SF	15,000	30,000	10,000						

- Import the Ai file and table into the InDesign presentation template. Title the sheet as "Building and Drainage Concept". Save as a PDF file and submit as BldgConceptTeamOne or Two. See the course calendar for the due date.

Task 3 Pre-Development and Conventional Post-Development Runoff Rate and Volume

In teams of two use the TR-55 Program to generate the pre-development peak cubic feet per second runoff for a 1" event, the 2-year, 10-year and 25-year 24-hour storms. From the TR-20 report find the runoff depth for each of these storms. Calculate the pre-development runoff volume for each storm.

Next generate the same information for the post-development condition. Assume all roof, streets, plazas and walkways are impervious. Calculate the post development runoff volume for each storm. Calculate the difference between the pre- and post-development runoff volumes for each design storm.

Note: for the off-site contribution of stormwater on Taylor Street assume meadow grass in good condition for the pre-development condition. For the site assume the same cover for the valley area and woodland for slopes over 25%. Model the woodland and grassland area as separate sub-drainage areas since the runoff Curve Numbers differ by more than 5.

Task 3 Deliverables

- Create a table using InDesign displaying pre- and post-development results. Display peak runoff CFS, runoff depth in inches, time of peak runoff, runoff depth in feet, runoff volume in cubic feet, the difference in pre- and post-development runoff volumes in cubic feet.
- Plot an outlet hydrograph showing the pre- and post-development condition for the 1" (water quality storm) event. Import the plot into Illustrator and redraw the image for presentation. This sheet will probably not be full. We will add information to it when we complete the next task.
- Import the table and Ai file into the InDesign presentation template. Title the sheet as "Pre- and Post-Development Runoff and Volume". Save as a PDF file and submit as TR55 *LastNames of Members*. See the course calendar for the due date.

Task 4 - Water Harvesting

Locate the runoff volume difference between pre- and post-development for the water quality storm from the previous task. This is the on-site storage target for a modified site design that incorporates green infrastructure elements that manage and treat stormwater. This task will focus on water harvesting to achieve two purposes. One is to reduce the consumption of potable water by substituting roof runoff for non-potable uses, such as toilet flushing. Second, the collection of roof runoff and using it in the building removes it from the stormwater volume. There is a potential conflict of goals here. Green roofs are valuable for reducing roof runoff and improving building energy performance. However, specifying green roofs reduces the amount of water available for harvesting for reuse and may reduce its quality. Green roofs are less effective, from an energy standpoint, on tall buildings. Therefore, you might specify white roofs on the tallest buildings and green roofs on others.

Decide on a green roof strategy and then working as individuals calculate the potential volume of water that you can collect from each of the roofs each month. Next estimate the amount of water needed to flush the toilets in the buildings each month. This will require an occupancy estimate for the summer months. We will attempt to get this from the UI facilities management department. Determine the storage volume required to serve the buildings during the months of low rainfall.

In addition to the water harvested and reused there is contaminated grey and black water that we will collect and treat on-site. In this task you are to determine the monthly volume of greywater and blackwater that will require treatment. We will use hybrid wetlands to treat this water and make it available for reuse in irrigation.

Task 4 Deliverables

- Produce a table using InDesign displaying the required monthly volume and the harvesting potential for each building. Display the storage volume required for each building and the volume of runoff (water not used in the building).
- Produce a section or sketchUp model of a typical storage tank solution that incorporates the tank into the landscape design (aesthetic treatment). Provide the cost of the tank and the cost per gallon stored per year.
- Add this information to the TR55 sheet and resubmit.

Task 5 - Pollution Treatment

This task requires you to work independently again to redesign the parking lots to achieve two goals. First, the lot design must provide for shade over 50% of the surface area at noon on June 21, ten years after construction. Assume tree diameters at 60% of full maturity.

Second all of the runoff from the parking area must receive treatment to reduce non-point source pollution. There are several design options that will meet this goal to varying degrees. Often different techniques are combined to achieve reductions in runoff rate, runoff volume and pollution. For example the parking bays might be constructed of permeable paving (permeable concrete, permeable asphalt or unit pavers) to slow runoff and begin water quality improvement. The outflow might be directed to a bioretention basin or stormwater wetland for additional detention, infiltration and water quality improvement. You are to devise a treatment sequence and calculate the reduction in the runoff peak, infiltration volume, and expected water quality improvement.

This is a complicated problem since it requires that you acquire research data documenting the performance of various stormwater treatment landscapes compared to the pollution levels of conventional (untreated) runoff.

Task 5 Deliverables

- Create a table identifying the pollution concentrations and load that you expect in the parking lot runoff and the concentration (or percent reduction) of the contaminants due to the landscape treatment. Also, indicate the water quality standard for each contaminant if it has been set.
- Create a table displaying the runoff volume for the water quality storm and the size of the landscape elements required to contain and treat it. Note the anticipated outflow.
- Produce a plan that places and correctly sizes stormwater treatment landscapes associated with the parking areas. Produce a plan view enlargement and a section or sketchUp model of the treatment landscape. Include construction details and specifications critical to the effective performance of these landscape elements.
- Assemble the products on the InDesign presentation template. Title the sheet as "Pollution Treatment". Save as a PDF file and submit as Treatment *LastNames of Members*. See the course calendar for the due date.

Task 6 - Stormwater Retention and Detention

This task requires you to work independently and requires that you return to tasks 4 and 5 to recover the volumes that leave the harvesting and treatment elements. These will continue through the landscape to either infiltrate, evaporate, become used in irrigation or flow through the project outlet (storm sewer). However, the water quality storm volume must be retained entirely on-site.

Retrieve the water quality volume from a task 3. While the parking lot water has been treated once, runoff from the landscape also contains contaminants. There will also be runoff from walkways and plazas that

contribute runoff. Find research data that indicates the contaminants expected from the landscape. Repeat the exercise from task five to locate, size and determine the reduction in contaminants from the landscape elements that you select. These could be stormwater wetlands or bioinfiltration basins or retention basins. As in the last task, provide plan, section and sketchUp models to illustrate the design and critical construction elements. Again note the outflow from the landscapes that you specify.

Task 6 Deliverables

See task 5 for the required products. Assemble the products on the InDesign presentation template. Title the sheet as "Pollution Treatment". Save as a PDF file and submit as Retention *LastNames of Members*. See the course calendar for the due date.

Task 7 - Blackwater and Greywater Treatment

This task requires you to work independently. You have already calculated the amount of wastewater produced by the building residents. Retrieve these amounts from task 4. Locate the required septic tanks and wetland treatment stages. The treated greywater can be reused for toilet flushing in the buildings if the volume of water from roof harvesting is insufficient. Otherwise it can be used for irrigation or to sustain wetland for aesthetic and habitat purposes. Treated blackwater can be used for habitat or irrigation. Once you have decided on a treatment and reuse strategy locate and size the treatment landscapes based on the environmental engineering literature. Be sure that stormwater runoff does not flow into these treatment wetlands. Use Task 4 as your guide to the processes and products required for this task.

Task 7 Deliverables

Plan and section drawings of each treatment wetland.

Treatment volumes and sizing criteria

A table of anticipated influent and effluent levels, similar to example below

Contaminant	Septic Tank Effluent mg/L	% removal by VSSF	VSSF Effluent mg/L	% removal by HSSF	HSSF Effluent mg/L
BOD	150	90	15	90	1.5
TSS					
Nitrate					
Etc					

Assemble the products on the InDesign presentation template. Title the sheet as "Wastewater Treatment". Save as a PDF file and submit as Wastewater *LastNames of Members*. See the course calendar for the due date.

Task 8 - Secondary Benefits

The stormwater landscapes that you have proposed in the previous tasks include benefits, such as aesthetic scenery, wildlife habitat and irrigation supply. This section asks that you reconsider your design for the project in order to maximize these secondary benefits. For example, you should develop a planting plan dominated by native plants, especially in areas adjacent to the habitat corridor through the site. Similarly, native and drought tolerant plants can minimize that amount of water needed for irrigation. After selecting the planting pallet and completing the planting plan, determine the irrigation volume required to achieve a thriving and attractive landscape. Use the research from the [Water Use Classifications of Landscape Species](#) research from California. Right click the link to download the PDF file to your computer. We will use the Region 1 data since it matches Moscow's summer conditions. Determine the water needs of each plant in your palette and for the total landscape. How much of this need can be provided by water that you store on-site in cisterns or ponds?

Task 8 Deliverables

- Planting design
- Plant Water Need spreadsheet.
- Volume of potable water conserved through substitution of non-potable water for toilet flushing and irrigation.

Task 9 - Irrigation Design for Water Conservation

We can engage a number of irrigation design practices and equipment specifications that will conserve the precious water we collect on-site or pump from the aquifer. A potential resource that may be available since the University of Idaho is adjacent to the wastewater treatment plant is the reuse of sewage effluent for irrigation.

Task 9 Deliverables

Water a water conservation plan associated with irrigation.

Note: This is a text version of the assignment available at the web site

<http://www.webpages.uidaho.edu/larc380/new380/pages/Assignments/Assignment1.html>