CVEN 458 "Hydraulic Engineering of WDS"

T E R M P R O J E C T

Term projects will involve design and/or analysis for water distribution systems for the "virtual cities" of Micropolis and Mesopolis. Projects will be done in groups with collaboration between groups on integration of project objectives; there will be 8 groups of 4 students (group assignments are attached).

I wish to add a common element of professional practice where firms often have separate projects focused on unique issues for the same client but are then expected to harmonize work with other firms' projects that are focused on different issues. Thus, each group will have a primary topic and will be assigned to collaborate with another group to integrate project outcomes with their work. A "first-come, first-serve" system will apply to choices of primary topic for each group; the collaborations between groups will be assigned by Dr. Brumbelow.

All projects will have two major deliverables:

- A written report prepared in a professional manner presenting the project work done; and
- A 10-12 minute oral presentation of the project.

Both deliverables will be due at the regularly scheduled final exam period for this class, which is Tuesday, May 12th, 10:30 AM-12:30 PM. The deliverables should be prepared by each group separately with appropriate shared work between collaborating groups.

Grading of the project will use the grading rubric attached. All grades will be determined by the instructor. The total project grade will be calculated from grades on the report and presentation as:

Written Report	50%
Oral Presentation	50%

Project Topics:

1. Design of water distribution system expansions for a new golf course community
(max. 2 groups)

The EPANet file "THE_MICROPOLIS_MODEL_golfcourse.net" is available from the course website and includes the site development map for a new golf course community to be built at the southwestern corner of the town. The site plan includes 135 residential lots, a clubhouse, streets, and an 18 hole golf course in 2 stages: the first stage is 9 holes planned for immediate construction shown in light green; the second stage will be constructed at an indefinite time in the future and is shown in dark green.

You should design all water distribution features necessary for this development including mains, service connections, valves, tanks, pumps, irrigation works, etc. Your analysis may find that the current water distribution system for Micropolis will require upgrades. If so, include these needed upgrades in your report.

For design standards, use those for Bryan and College Station, Texas, (www.bcsunited.net) and the State of Texas Rules and Regulations for Public Water Systems (TCEQ RG-195).

Your deliverables should include system layout and elements, hydraulic analysis for average day, maximum day, and peak hour conditions, and cost estimates.

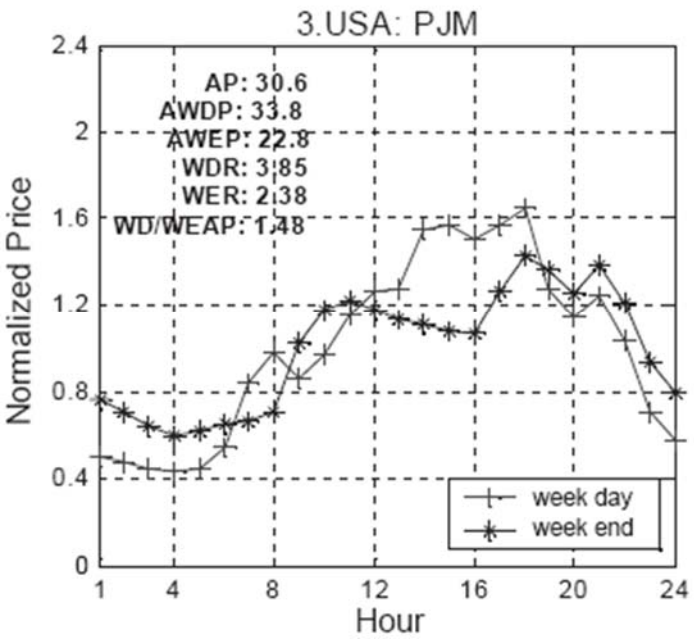
2. Energy audit of the Micropolis Water Distribution System
(max. 2 groups)

You should conduct an analysis to quantify the energy consumption and energy costs for the Micropolis water distribution system under a range of scenarios and assumptions. You should also investigate various measures to improve energy and cost efficiency for the system.

The Micropolis Regional Electric Cooperative offers 3 energy pricing alternatives to large users.

Pricing Option 1 is a flat rate of $0.125/kWh.

Pricing Option 2 includes diurnal variation with power price changing each hour according to the multipliers given in the graph below. Note that weekday and weekend multipliers are different. The base price is $0.084/kWh (i.e., price when multiplier equals 1).



(Li and Flynn 2004)

Pricing Option 3 differentiates between Winter (Oct-Apr) and Summer (May-Sep) pricing. The hourly rates in Option 2 are multiplied by 0.50 in Winter months and by 1.6 in Summer months. You should also factor in differing rates of water use by consumers between winter and summer. You may assume that in the lowest use month of the year aggregate demand is 0.7 times average, and in the highest use month of the year aggregate demand is 2.0 times average.

Additional analysis may come from retrofit of existing pumping facilities to any pump whose data is generally available; replacement of existing pipe, valve, or tank infrastructure; redesign of the system to include pressure zones; etc.

Your deliverables should include quantification of current energy use and cost, changed values after expansion of the Micropolis Country Club, and at least 5 alternatives for reduction of energy use and cost.

3. Quantitative Vulnerability Analysis of the Micropolis Water Distribution System and Mitigation Recommendations
(max. 2 groups)

You should conduct an analysis to determine vulnerabilities of the Micropolis water distribution system to failure to provide flows of adequate quantity. You should then propose and evaluate several courses of action to mitigate the system's vulnerabilities.

The vulnerability analysis should look at the system's ability to supply fire flows at all hydrants in the system as flow rates appropriate to the adjacent land use. If a hydrant is

not able to supply the minimum fire flow, determine the maximum flow that it can supply with residual pressure at 20 psi. Then, alter the system model with several scenarios of accidental or intentional damage to key system components (e.g., pumps, large mains, tanks, etc.). Determine how fire flow capacities are changed under the various damage scenarios.

Once you have determined the system's key vulnerabilities, evaluate several steps that may be taken to mitigate these vulnerabilities. Examples include: retrofit of existing mains with larger ones, enhancing system redundancy with greater density of mains, building more pumping facilities, etc. For each mitigation option, determine quantitatively how much vulnerability is reduced and the cost of implementing the option.

Your deliverables should include detailed presentation of existing vulnerabilities, estimates of the potential damages arising from these vulnerabilities, at least 5 mitigation alternatives, and quantitative analysis of the effectiveness and cost of each mitigation alternative.

4. Long-term planning for the Mesopolis Water Distribution System
(max. 2 groups)

The Virtual City of Mesopolis currently has a population of about 140,000 with average day water demand of about 28 MGD. The EPANet file {Mesopolis.NET} is available from the course website and includes a hydraulic model of the water distribution system. The background map also indicates 2 significant areas that are expected to develop over the next 20-25 years: the "West Valley" region south of downtown and west of the Mesopolis River, and the "Navy Coast" region at the northwestern corner of the region. At "build-out," it is expected that these areas will add an additional 25,000-35,000 residents as well as commercial development.

You should conduct an analysis to determine needs for expansion of the water distribution system to serve this future development. As the exact timing of the new development patterns is uncertain, you will need to define scenarios of development over time and formulate conceptual designs of new water infrastructure to support these scenarios. The full range of water distribution infrastructure is in the realm of possibility including distribution piping, transmission lines, pump stations, storage facilities, pressure zones, control valves, fire protection appliances, etc.

For a minimum of 3 development-time scenarios produce timed infrastructure expansion plans. Each plan should include physical infrastructure components, cost estimates (use 2009 dollars), hydraulic model results for average day, maximum day, and peak hour demands, and energy use estimates.

Your deliverables should include presentation of these time-scenarios with explicit discussion of the time aspect to each.

5. Energy audit of the Mesopolis Water Distribution System
(max. 2 groups)

Apply the assignment in Topic 2 above to the Mesopolis WDS.

6. Quantitative Vulnerability Analysis of the Micropolis Water Distribution System and Mitigation Recommendations
(max. 2 groups)

Apply the assignment in Topic 3 above to the Mesopolis WDS.

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Term Project: Written Report Review

Group Members:
Project Topic:
Collaborating Group:

Does the project address the objectives stated in the assignment? (15%)

Does the project report exhibit technical knowledge and competent application? (20%)

Does the report exhibit high-level understanding (a.k.a. "thinking about the big picture")? (20%)

Does the report demonstrate effective collaboration between this group and the collaborating group so that this group's project is clearly improved by the interaction? (15%)

Does the report clearly and completely present project activities and conclusions? (20%)

Does the report appear to be a professionally prepared document with appropriate formatting, citations, and lack of distracting errors and oversights? (10%)

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Term Project: Oral Presentation Review

Group Members:
Project Topic:
Collaborating Group:

Does the project address the objectives stated in the assignment? (15%)

Does the project presentation exhibit technical knowledge and competent application? (20%)

Does the presentation exhibit high-level understanding (a.k.a. "thinking about the big picture")? (20%)

Does the presentation demonstrate effective collaboration between this group and the collaborating group so that this group's project is clearly improved by the interaction? (15%)

Does the presentation clearly and completely present project activities and conclusions? (20%)

Is the presentation well-prepared and delivered with clear visuals and without distracting errors? (10%)