Developing Efficient Water Solutions at Rice University

HUMA 118

Sheldon, Sakakeeny, Blosser

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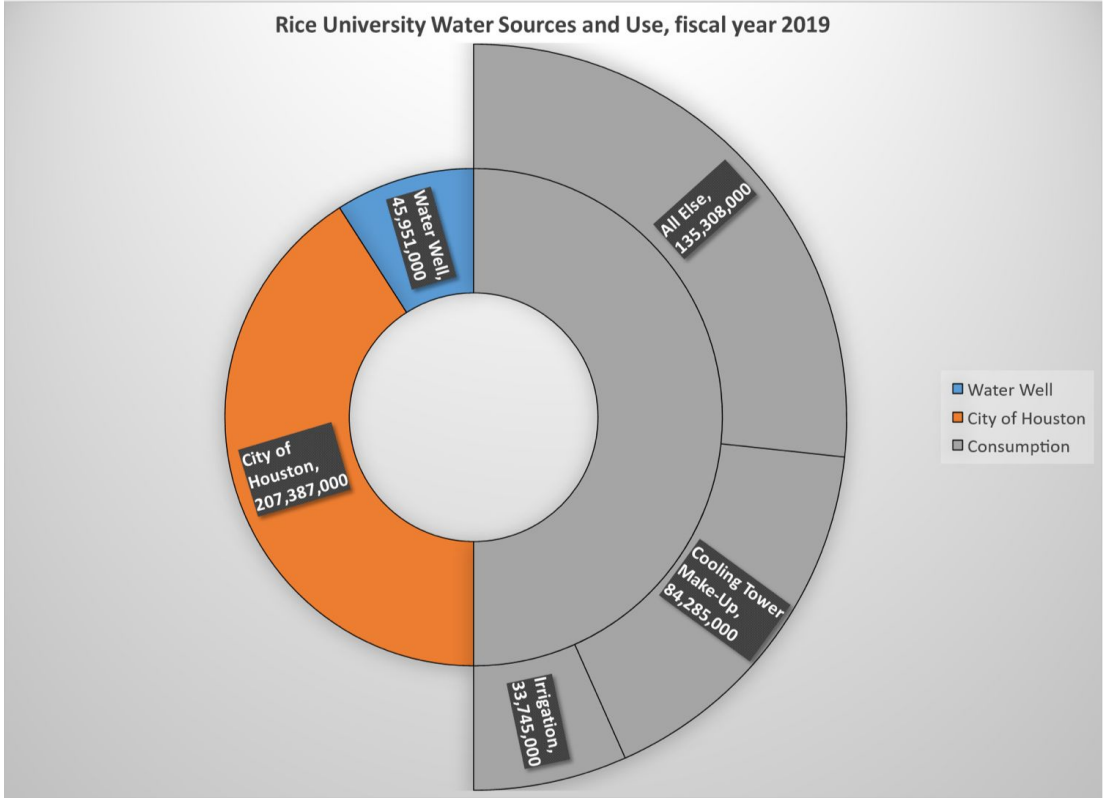
Rice Water Usage and Costs

Irrigation: $270,000

Cooling Tower: $732,000

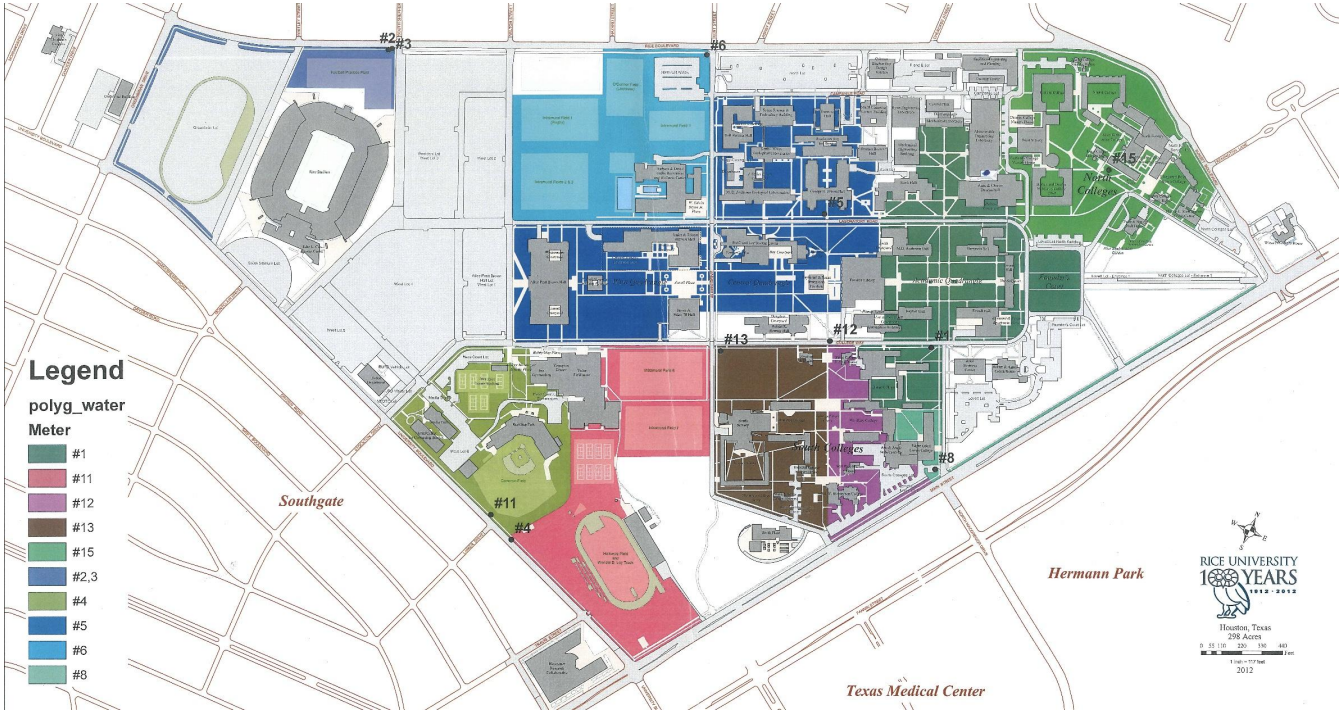
All Else: $1.45 million

Total: $2.2 million



Rice Vegetation

- 120-143 vegetated acres
- 72-100 irrigated acres
- 4200 trees, 2100 oaks
- St. Augustine's Grass-- requires an inch of water per week
- Jasmine along Inner Loop-- less water intensive
- Native vegetation



Rice Irrigation Map

Smart Technologies

ET (evapotranspiration-based) Controller

Soil Moisture Sensor

Irrigation Technology Companies

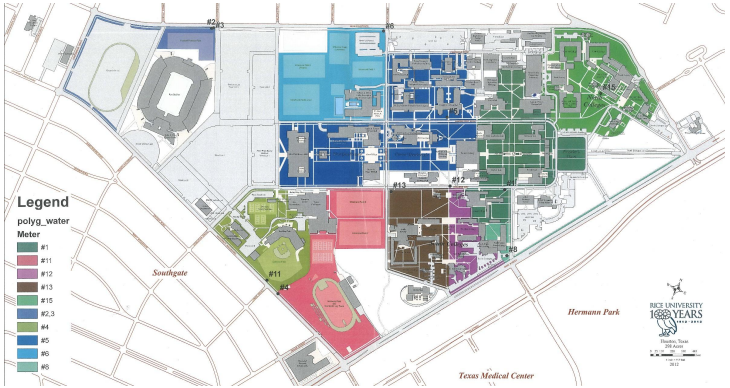
- Most basic model
- Used by UNT and University of Dayton

- “Luxury Model”
- Used at UT-Austin

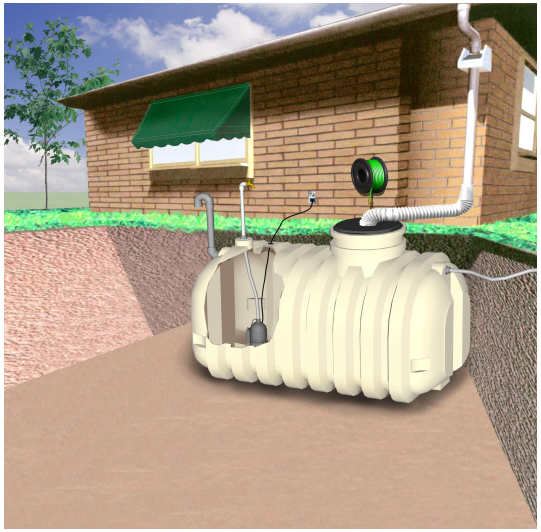
- “Middle-of-the-road option”
- Grounds committee prefers this technology

Economic Analysis

- Installation Costs: $50,000 - $75,000
- Increased efficiency: between 23% - 73%
- **Annual Savings: between $17,500 - $56,000 annually**
- **2.3 - 7.3 million gallons of water saved**
- Payback Period: 1< - 4.25 years
- Reduce controls from 74-76 to 30



Additional Irrigation Technology: Low Tech



Options: Rainwater cisterns and natural vegetation

Cisterns at Rice

- Houston rainfall: 53 in/year
- Rice Non-permeable square footage:
  - 2,043,328.52 sqft total
- Develop catchment system

Cisterns at Rice: Analysis

Selection:

- Ideal Roof Type: slanted, smooth, large area
- Locatation: Underground, closed spaces

Building Costs:

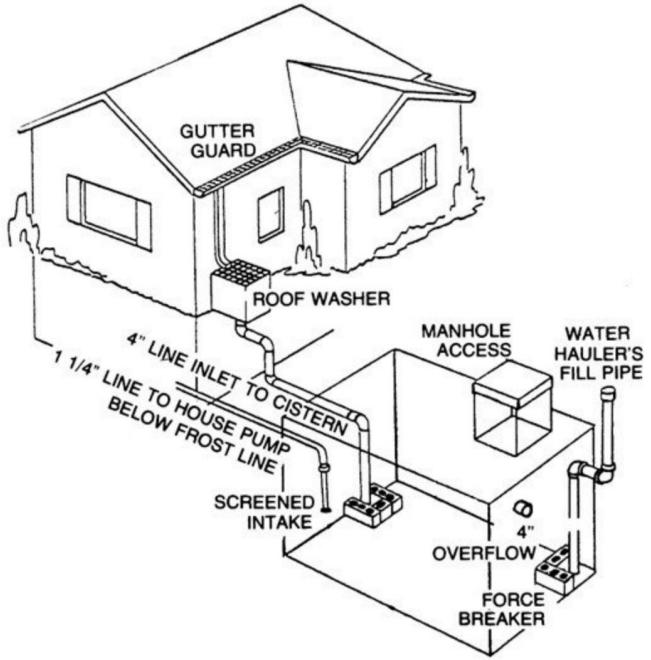
- 5,000-10,000 gal: $7,000 and up
- Installation Costs: $17,000-$21,000
    - $68,000-$84,000 total

Savings:

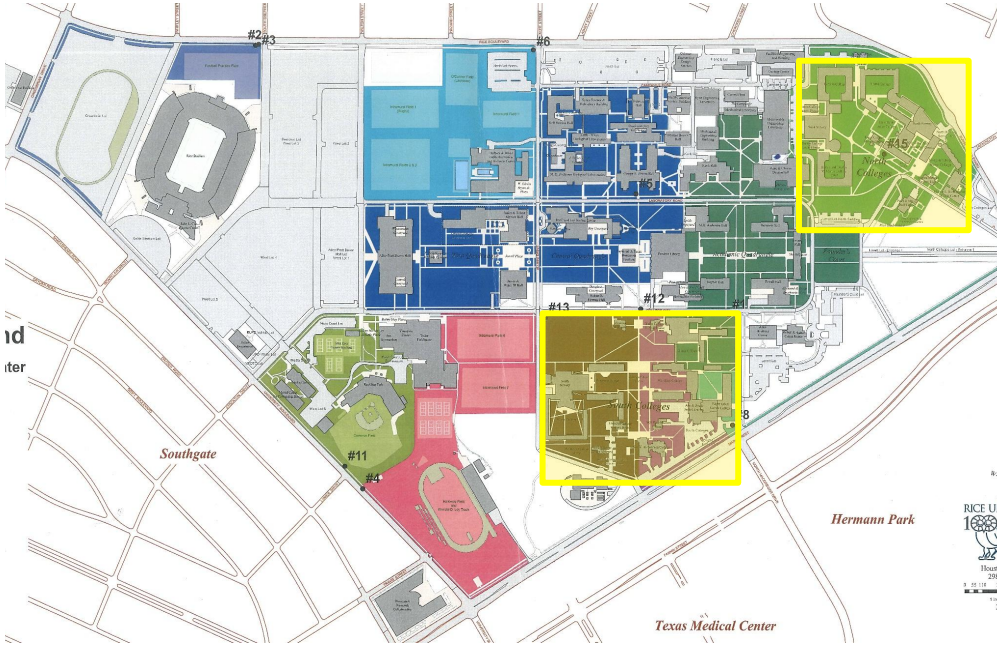
- $270,000 spent on irrigation currently
- $176,000 maximum profits in the first year

Upkeep:

- Microbial Growth Prevention



Natural Vegetation



Natural vegetation already implemented in Harris Gully Natural Area

Benefits of Sustainable HVAC systems at Rice

- Cold water is produced in both the South and Central plant and delivered to buildings on campus through an underground piping system
- The towers utilize public water supply when water evaporates or is already allocated to academic buildings
- A complex process is completed to ensure the coils for air conditioning within academic buildings support both cooling and heating
- Some buildings on campus are retrofitted to allow for HVAC condensate recovery
- Since its inception in 2011, harvesting condensate water has saved nearly 14 million gallons of water per year
- Both Brockman Hall and the Bioscience Research Collaborative are retrofitted for condensate recovery

Reducing Costs for HVAC and Water Usage

- It will be beneficial to continually track savings on an hourly and real time basis
- The cooling tower should not be using more than 3 gallons of water per ton-hour of cooling
- It would be effective to reside in the 2 - 2.5 gallon per ton-hour range
- Can utilize side stream filtration to reduce debris and other buildup within a cooling tower (flow rate ranges from 3% to 10% an hour
- Using Geothermal heat pumps to extract/reject portions of energy recovery can save $325,975 anually on the cooling tower
- Drift eliminators can capture water droplets and minimize losses to .001 percent

Harnessing Wastewater to reduce costs

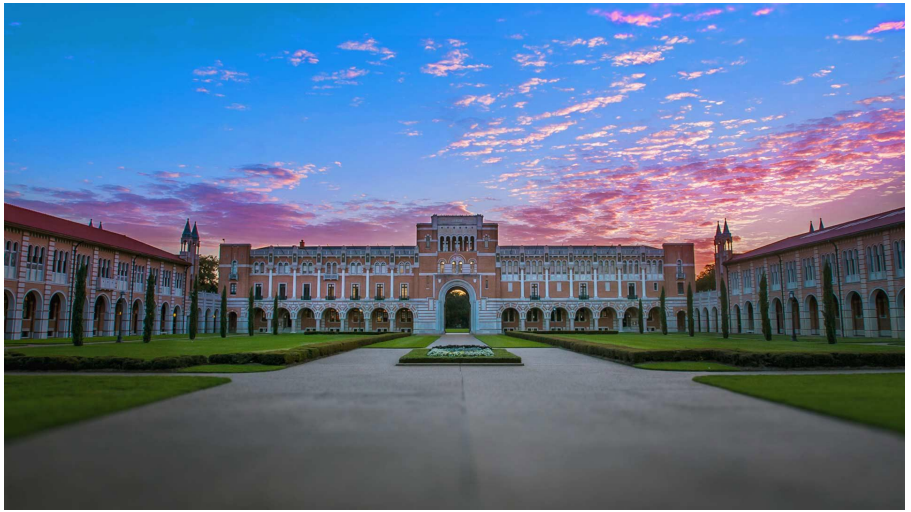
- The U.S. Department of Energy estimates that 350 billion kWh can be saved by using wastewater for HVAC systems
- The SHARC system created by IWS exchanges energy with wastewater
- Implementing this technology will allow Rice to add to its already high number of LEED points
- The SHARC can reduce GHG emissions and CO2
- System will supply conditioning and heating for buildings by capturing thermal energy
- Reduce the $2,000,000 spent on water and drainage per year
- SHARC system has a lifespan of 30 - 40 years
- It will cost roughly $500,000 - $1,000,000 to purchase the SHARC system
- Installation is free
- Wastewater can reduce 1.5 billion MWh of natural gas use for HVAC on an annual basis

A Look at The SHARC System

- http://www.sharcenergy.com/what-we-do/

Implementation Factors

- Protection against fluctuations in water price -- $2.6 million next year
- Matching Peer Institutions
- Quick payback period
- Spending endowment
- Construction
- Houston Regional Water Goals
- Expanding Campus
- Wellness benefits of green spaces
- Balancing campus aesthetic with sustainability goals
- Health and Safety Regulations
- Retraining Labor
- Reduce Energy Usage



Conclusions

Recommendations:

- Smart system, 4 cisterns with selective natural vegetation, and SHARC system

Benefits to Rice:

- Total Cost: $625k - $2.69m
- Total Saved: $513k-558k annually
- Payback Period: 1.2 -5 years