How Can Green Design Solve Water Management Problems?

Context

This lesson is intended for introductory level architecture students who are interested in green design strategies. Green design refers to utilizing natural solutions to design challenges such as water management, as in this problem-based learning activity. After completing this lesson, students will hopefully understand how to go about assessing the built environment, identify issues with managing stormwater, and explore the various green design strategies for handling excess water in the built environment. They will also research which strategy or combination of strategies might be best for resolving the particular issue described in the problem, and they will propose a design document for resolving the problem using a green design strategy. Introductory level students are those in their first or second year of architecture instruction. As such, these students may have taken some or most of their introductory level courses and could be assumed to have at least an application-level understanding of design.

Problem

Perry Hall is a multi-story residence hall on a college campus that is surrounded by green space with the exception of one side which is mostly paved for a parking lot. Whenever it rains substantially, water pools in low areas of the parking lot, including one area nearest the entryway to the residence hall. If the rain is heavy and wet conditions continue for a few days, sometimes the entryway inside the residence hall vestibule floods as well. It is clear there is a stormwater management problem. What are the contributing factors to this problem and how can this stormwater be managed with green design?

The attached map (pg. 5) shows an outline of the residence hall and parking lot. The blue water drop icons indicate the areas where water pools during heavy rain. If possible, images from the site would be included in the problem document as well.

Objectives

- Evaluate a water management problem
- Discuss the challenges of managing water runoff
- Identify possible green design solutions to water management
- Determine the green design strategy that best resolves the problem
- Produce a design proposal for resolving the water challenge

Tutorial

For this scenario, students are taking on the role of architects who are brought in to solve a water flooding issue using green design strategies. The client specifically wants to use natural solutions where possible. Each group of students represents their own design firm, and they are "competing" for the job by submitting a design proposal.

Identify Facts

Students will be able to take a "site visit" to explore the problem areas and get a sense of the environment. They will document their site visit and make notes of issues they think could be resolved with green design. Students will also meet with the client (either an expert in the field or another instructor acting as the client) to ask questions about the site and the client's specific goals. Ideally, a site with actual water issues would be available for students to visit, but more resources around the Perry Hall site could be developed to make this case available to distance students, such as a virtual environment or a series of images and topographic map, etc.

Generate Hypotheses

Based on their site visit and what they know of green design strategies so far, students should generate at least two preliminary ideas of solutions that could resolve the water problems described in the scenario. These solutions can be one specific green design strategy or a combination of strategies. They should also reflect on why they chose their specific solutions.

Identify Knowledge Gaps

Students should identify what else they need to know about the site or about their preliminary green design solutions and identify resources for finding the information they need. Some sample questions might be:

- What kinds of green design strategies are feasible in this environment?
- What green design solutions are available for this problem?
- How is water typically managed in these types of sites?

Self Directed Learning

Students should review their notes from the site visit and conduct research on green design strategies:

- Rain Gardens
- Bioretention
- Swales
- Green Roofs
- Porous Pavement

As part of their research, students should also attempt to understand at a base level how each strategy impacts the local watershed.

Evaluate

Based on their new understanding of green design strategies students should re-evaluate their hypotheses and update them if needed. At this point, students should work with their group to identify the solution they will propose. Students should compose a design proposal that identifies the primary issues to be solved with their design, why their solution is the best fit for the site based on the facts they collected, and how their green design strategy will impact the water problem (essentially, explain how and why their solution works using their self-directed research). Students should include blueprints or images when relevant. Students should also put together a cost estimate for implementing their solution. Additionally, tradeoffs will need to be identified and justified in the proposal. Students will present their proposals to the class and the "client" will provide feedback.

Student Reflection

After viewing other groups' presentations, students should individually reflect on how their group's proposed solution compares to the rest of the class.

- What would they change, or keep the same?
- What did others identify that their group missed?
- How did the other groups' designs address or fail to address the problems?
- What would have helped your group do a better job?

Scaffolding

The instructor will coach learners through the site visit process to help them identify what they should be looking for at the site. The instructor will also discuss site visit notes and research notes with students to ensure they are on the right track. The instructor will utilize questioning methods to elicit conversations around students' hypotheses and research intentions to make sure they are addressing the problems. Students will include images in their presentation to make their ideas visually available for discussion and reflection among the class.

My Reflection

I think problem-based learning for this concept is a useful way for students to practice the skills professionals use when attempting to solve problems using design. Ideally, a real building case could be used. If this were going to be implemented in a distance learning environment, students could attempt to find their own water problems to explore and resolve. The instructor could also build a case around a fictional building using images from existing water and flooding problems to illustrate the specific problems the students should explore. Additionally, bringing in a second faculty member or someone from the community to act as the client would help provide students the chance to gather additional information about the

problem. The person acting as the client would ideally help guide students to the right problem areas and encourage them to explore green design strategies.

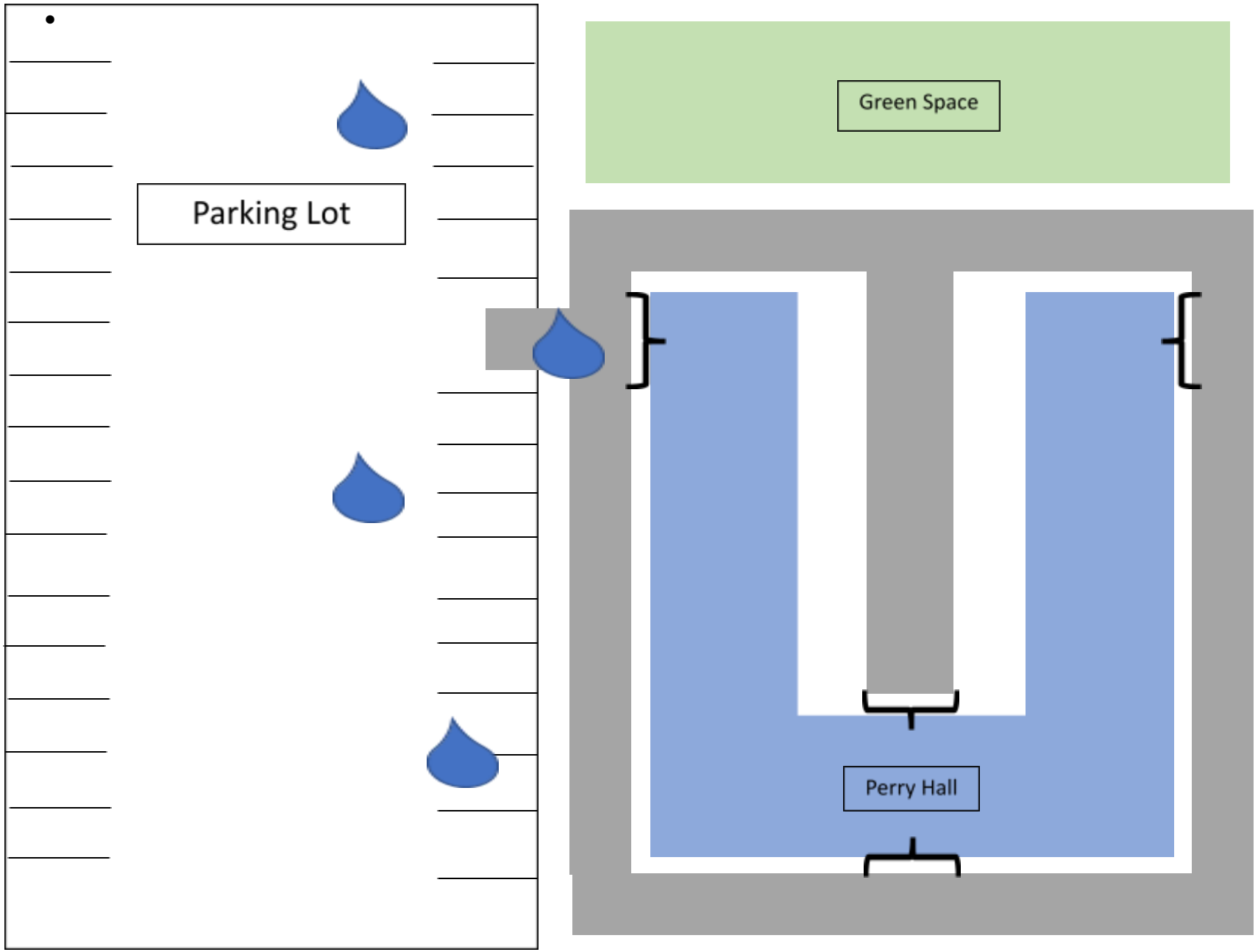
I found it a little difficult to design this problem-based learning activity without doing a bit of leading. I went back to the readings and it didn't seem like there were clear guidelines around how much scaffolding was too much. It would be up to the instructor to be comfortable enough with the subject matter to appropriately question and guide students during the early stages of this assignment to make sure they gather the right kinds of information in order to be successful at completing the design proposal.

Resources:

- Green Infrastructure Projects and descriptions: https://www.dec.ny.gov/lands/58930.html
- Green Roofs Video: https://youtu.be/oicImIFyRiQ
- Swales Project: https://youtu.be/grRcl76ZQdM
- Bioswales along a road: https://youtu.be/nKdbUfnze5E
- Rain Gardens: https://youtu.be/uMuMiZFNLrQ

Site Visit Checklist (via https://www.archisoup.com/architecture-site-analysis-site-visit):

- Entrance and access points (both pedestrian and vehicle)
- Security (gates, surveillance)
- Travelling to the site (road types and suitability, safety, public transport
- Boundary treatment (fencing, vegetation, land form, water)
- Extent of boundary (does it match the survey/OS map)
- Circulation (existing travel routes within the site)
- Noise levels (quiet and loud areas)
- Services (electric, gas, water, sewage)
- Existing buildings (condition? Relevant? Protected?)
- Existing landscape features (condition? Relevant? Protected?)
- Neighboring buildings (local vernacular, protected?)
- Views in and out of the site (areas to screen off and areas to draw attention to)
- Trees and vegetation (protected and rare species)
- Ecology (any areas likely to be home to protected species)
- Orientation (sun and wind paths)
- Light levels (areas in direct sunlight, shaded areas, dappled light)
- Accessibility (disability access)
- Surrounding context (historical, heritage, conservation area, SSSI, AONB)
- Existing materials in and around the site
- Topography (site levels)
- Flood level (is it likely to flood)
- Soil and ground conditions (types and suitability)
- Existing legal agreements (where are the rights of way, covenants)
- Hazards (Electricity lines, Drainage, Telephone lines, Sub-stations)


Green Space
Parking Lot
Perry Hall