LESSON 6 - PERFORMANCE TASK
Student Recommended GSI Project Sites

Problem Statement: How can I apply the practices of engineering design to recommend the best green stormwater infrastructure (GSI) applications for a high priority site in my neighborhood?

Subject: Human Geography, Science, Engineering, Math, Civics, Common Core
Grade Level: Middle School or High Schools

DESCRIPTION

This is it! Apply your knowledge by making a professional recommendation for how the right application of GSI design choices could eliminate polluted stormwater runoff at a site of your choosing.

BACKGROUND

In **Lesson 1** you learned about the problem with stormwater by analyzing infographics, written text, videos, and maps. In **Lesson 2** you studied the GSI Solutions Photo Galleries to learn about how green stormwater infrastructure could be applied in just the right way at just the right site to manage polluted stormwater runoff. In **Lesson 3** you looked at GSI applications in your city by writing a professional email to begin a classroom conversation with city staff responsible for implementing the city's Stormwater Management Plan. In **Lesson 4** you gathered background on the Clean Water Act and how federal and state policy guides regulations for your city. The series of selected **Case Studies in Lesson 5** helped you to think like an engineer by analyzing different GSI projects, applying the eight practices of engineering design to think backwards from the final solution to the design choices evaluated to the original description of the problem.

STUDY STUDENT EXAMPLES

Scroll through one or more of these four student examples to see how each student chose a site near where they lived. As you review their work, consider some of these questions.

1. Is the problem clearly stated for this location?
2. Do the maps, photos, and diagrams tell a clear story of where the stormwater falls on impervious surfaces?
3. Does the rainy day photo essay show evidence of pollution and clogged storm drains?

4. Has the annual precipitation rate been calculated for the total impervious surface area under design so that we know how much water we need to manage on site?
5. Do you think the selected GSI Solutions are the most effective for managing polluted stormwater runoff on this site?
6. What about graphic design choices and layout of the storymap? Do you think the student used effective design choices to explain their solution? Make a list of the techniques they used for your own design later.
7. How about the word choice and text layout? Is the technical vocabulary used correctly? Are there typoes or grammar challenges that you would correct for?
8. What other choices might you make if you were designing GSI for this site?

GSI STUDENT Recommendation - Simran - Grocery Store
GSI STUDENT Recommendation - Sofia - Skate Park
GSI STUDENT Recommendation - Linnie - Safeway
GSI STUDENT Recommendation - Ericka - Fred Meyer

WALK ABOUT

Take some time to walk around one or more sites that you think would benefit from GSI applications. Train your eyes to observe details for the size of rooftops, the number and location of downspouts from the gutters, the size of parking lots, the number of empty parking spaces that could be repurposed for a bioswale, trees, or rain gardens. Notice the slope of the site, where the storm drains are and which way the water might flow.

Take photographs to document all that you see and create a folder system where you can select from the best of these later when you design your storymap solution.

Consider some of these sites.

- Your school campus
- A nearby shopping center
- Your family grocery store
- A business district
- A strip mall along a busy street
- And commercial intersection with shops or gas stations on all four corners
- An housing complex or apartment building

MY WATERSHED ADDRESS

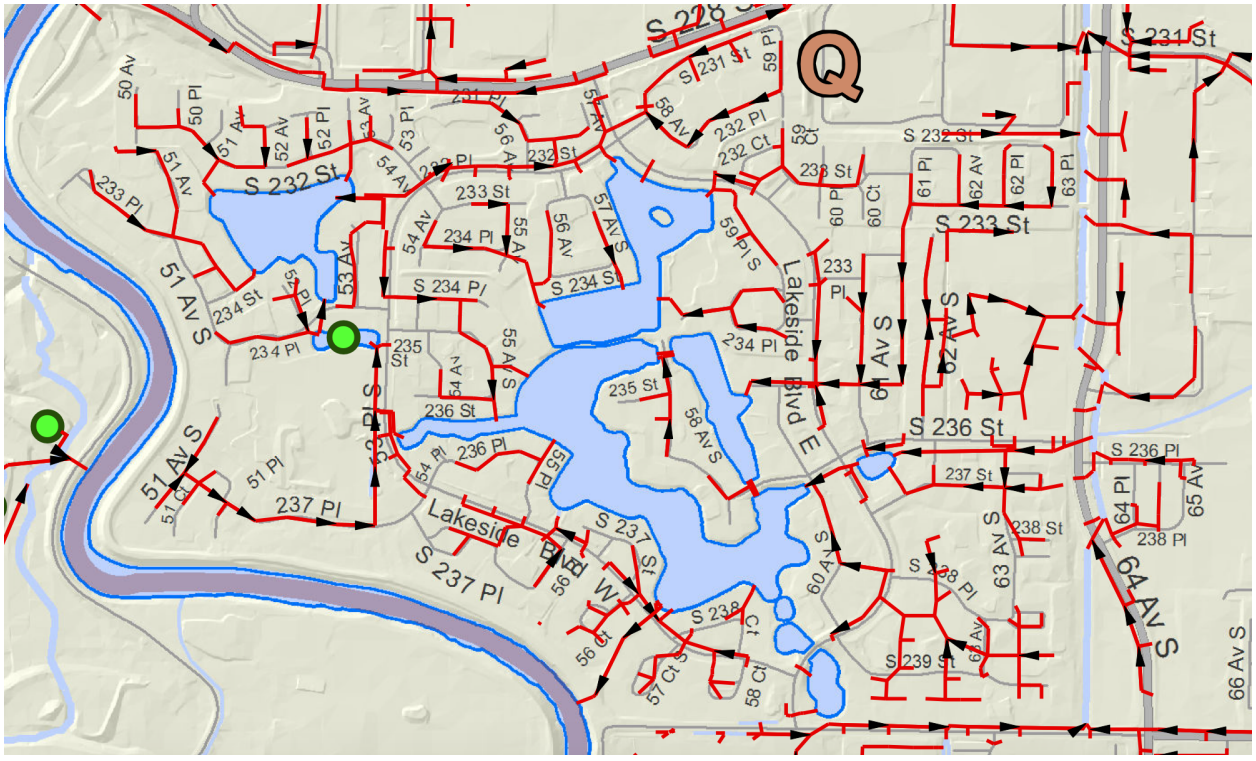
Use a wide range of the map layers at mywater.world to zoom in on your site and learn more about the underlying geographic features, the stream drainage basins, contours lines, and land

use choices. You may want to use screen shots from some of thes map views to help build your case. Be sure to click on these map layers in particular.

Topography	Hydrography	Impervious Surface Area	Salmon Spawning Habitat
Hillshade	Sub-Basin Boundaries	Land Use	School District Boundaries
Satellite View	Contour Lines	City Boundaries	Schools and Colleges

CITY MAPS OF STORMWATER INFRASTRUCTURE

It's pretty fascinating to get a hold of a map that your city maintains to see the actual system of stormwater pipes in the ground and where they flow, sometimes into detention ponds or sometimes you can identify outfalls straight into a nearby stream, lake, or river.



Check out a few of these examples to practice reading the icons and flow direction, and then ask your city for a digital copy to use in your classroom. You may be able to find it

on your own just by searching for “surface water drainage map”, or “stormwater infrastructure map.” When you do access this important map, zoom in on your project site and capture some screen shots for use in your storymap.

- Kent Drainage Map
- Sammamish Drainage Map
- Bellevue Drainage Map
- Seattle Drainage Map

RAINY DAY PHOTO ESSAY

This is the real test. Get your raincoat on and visit the site you have selected on a very rainy day or perhaps right after a major rain storm. Create an extensive photo essay of how you observe stormwater interacting with the existing gray infrastructure of roof tops, gutters, downspouts, asphalt, curbs, and storm drains.

- Do you see evidence of rainbow oil leaks from cars?
- Do you see leaf clutter?
- Bits of plastic litter plus oil sludge clogging up one or more storm drains?

Make some notes on where GSI would be an obvious benefit.

ENGINEERING DESIGN PROCESS

Review the three elements of engineering designing solutions. An effective design process typically involves iterations and interactions among these three elements. Take a moment to reflect on these elements in two ways.

1. Do you see evidence of an engineering design team, at some point in the history of the project site you are evaluating, employing these practices in some way? Decisions were made based on the best possible solutions given the constraints and the law at the time.

2. New stormwater laws require cities to make meaningful progress towards managing polluted stormwater runoff on site. How will you apply these three elements in your design thinking as you make recommendations for various GSI solutions?

DEFINE: The project team uses precise criteria for success and identifies constraints that are likely to limit possible solutions.

DEVELOP SOLUTIONS: The project team uses their combined expertise to propose one or more possible solutions. They also may go through the process of combining parts of different known solutions to create new solutions as they test ideas.

OPTIMIZE: The project team employs a systematic process to iteratively test and refine a solution that is the optimum choice for this site given the design constraints.

Review the 8 Engineering Design Practices with sub questions from Lesson 7, 8, 9.

SELECT YOUR GSI SOLUTIONS

Go for it. Apply what you know about GSI strategies as well as the engineering designing process to come up with what you think is the optimal solution for managing polluted stormwater runoff at your site. You may want to review the resources in **Lesson 5** or revisit the EPA's website What is Green Infrastructure?

Do the Math

To make your GSI recommendation realistic, get some numbers to back you up. Use the sets of numeric information below to determine what types of GSI are appropriate for your site. This kind of accuracy builds evidence to persuade stakeholders to implement lots more GSI both in new construction and in retrofitting existing urban landscapes.

ONE: Find the **total surface area** of a roof or parking lot here: How to Measure Area with Google Maps: 10 Steps (with Pictures) (wikihow.com)

TWO: Use the **Rain Harvesting Formula** for calculating the number of gallons of rain that typically fall each year on your site.

Roof Area (square feet) X Precipitation Amount (inches/year.) X 0.623 = # of gallons accumulated that need to be treated by GSI.

THREE: Find your city's average rainfall using one of these tools:

Use the US Climate Data Portal for Washington State and click on any city to get detailed climate data for temperature and precipitation.

Or use the Seattle weather blog and click on "Rain Stats." These annual numbers will be similar for much of the central puget sound lowland cities, but the numbers change significantly for cities that are in the foothills of the Cascades or Olympic Mountains.

FOUR: Build Your Storymap

Build your storymap including some or all of the images, maps, and documents you have collected in your field observations and online.

Suggested criteria for an effective GSI Student Recommendation

1. The problem is clearly stated for this location.
2. Map layers from mywater.world and other sources are used to assess the site.
3. City maps of surface water infrastructure are incorporated to demonstrate where the stormwater actually flows.
4. Dry day photo essay shows existing site features and traditional applications of gray infrastructure.
5. Rainy day photo essay shows evidence of pollution and clogged storm drains.
6. The annual precipitation rate has been calculated for the total impervious surface area under design so that it is clear how much water we need to manage on site.
7. GSI solutions are optimized for managing polluted stormwater runoff on this site.
8. Graphic design choices help the viewer understand the main ideas and follow the story.
9. Technical vocabulary is used correctly.
10. There are no typos or grammar challenges.

WHAT ABOUT CLIMATE CHANGE?

Do we need to adjust for the impacts of climate change?

What happens when our winter storms become more intense, bring heavy rains, and last longer? Have we designed our GSI solutions to accommodate peak storm events. And then, in the summer, what happens when droughts and heat waves become the new normal and some of the plants and trees that we included in our GSI strategies cannot survive the heat?

- See the UW Climate Impact Group's PNW Climate Impacts In Brief.
- Also see Washington State Climate Summaries developed by NOAA.
- State of Knowledge - Climate Change in Puget Sound

STAKEHOLDER COMMUNICATIONS

Your local city staff person responsible for implementing the Stormwater Management Plan will be interested to know that an entire class of students is fully aware of the benefits and possible applications of GSI strategies in your city.

Prepare a professional class letter and provide links to all of the team or individual GSI Recommendation storymaps. Explain why you made these hypothetical proposals and what you learned about the challenge of managing polluted stormwater runoff in your city. Build an ongoing learning relationship with your city staff.

Ask them to share additional case studies around the city where GSI is starting to be employed. Ask for any maps, construction photos, or engineering diagrams they may have for some of

these projects so you can refine your understanding of GSI applications and build a legacy folder for next year's students in this same class.

If you are proud of your work and your team and teacher have signed off on its accuracy and feasibility, we invite you to submit it to our student team of Sustainability Ambassadors who will post it with a green pin as one of the "**GSI Student Recommend Project Sites"** on mywater.world

Email info@sustainabilityambassadors.org. Be sure to put **GSI Student Recommend Project Site** in the subject line along with your name, school, and school district.

WHAT CAN WE DO?

1. Help plant 3 Million Trees
2. Switch to these strategies for Natural Yard Care (in 15 different languages!)
3. Take personal action at Puget Sound Starts Here
4. Don't Feed the Tox-Ick Monster - 7 Simple Actions
5. See playlist of 20 King County informational videos on Yard Talk
6. Build a Rain Garden at 12,000 Rain Gardens
7. Advocate for Green Stormwater Infrastructure around your school neighborhood
8. Follow the indicators that scientists track on the dashboard Puget Sound Vital Signs

HELP IMPROVE THIS LESSON

1. What advice do you have for making this lesson better?
2. How would you teach parts of this lesson to younger students?
3. Are there broken links that we need to know about?
4. Did you find even better links in your research?
5. Would you like to share examples of your work so that other classrooms can learn by your example?

   CONTACT: info@sustainabilityambassadors.org

FUNDER & PARTNER ACKNOWLEDGEMENT

Learn More about Sustainability Ambassadors
www.sustainabilityambassadors.org/