Integrating Green Infrastructure and Urban Ecology in Regional Transit Corridors

Spring 2018 • LA 459/559 • Introduction to Green Infrastructure

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UNIVERSITY OF OREGON
TRIMET
SCI Sustainable Cities Initiative
SCYP Sustainable City Year Program

Acknowledgments

The students who produced the creative ideas and solutions found in this report would like to thank TriMet and its Southwest Corridor partners for providing data and information to make this SCYP report possible. We would especially like to thank Jeb Doran, TriMet Project Manager, for his guidance throughout the project.

About SCI

The Sustainable Cities Initiative (SCI) is a cross-disciplinary organization at the University of Oregon that promotes education, service, public outreach, and research on the design and development of sustainable cities. We are redefining higher education for the public good and catalyzing community change toward sustainability. Our work addresses sustainability at multiple scales and emerges from the conviction that creating the sustainable city cannot happen within any single discipline. SCI is grounded in cross-disciplinary engagement as the key strategy for improving community sustainability. Our work connects student energy, faculty experience, and community needs to produce innovative, tangible solutions for the creation of a sustainable society.

About SCYP

The Sustainable City Year Program (SCYP) is a year-long partnership between SCI and a partner in Oregon, in which students and faculty in courses from across the university collaborate with a public entity on sustainability and livability projects. SCYP faculty and students work in collaboration with staff from the partner agency through a variety of studio projects and service-learning courses to provide students with real world projects to investigate. Students bring energy, enthusiasm, and innovative approaches to difficult, persistent problems. SCYP's primary value derives from collaborations resulting in on-the-ground impact and expanded conversations for a community ready to transition to a more sustainable and livable future.

SCI Directors and Staff

Marc Schlossberg, SCI Co-Director, and Professor of Planning, Public Policy, and Management, University of Oregon

Nico Larco, SCI Co-Director, and Associate Professor of Architecture, University of Oregon

Megan Banks, SCYP Manager, University of Oregon

About TriMet

The Tri-County Metropolitan Transportation District of Oregon was created by the Oregon Legislature in 1969 to operate and oversee mass transit in the Portland Metropolitan region. This public entity was formed by the legislature as a municipal corporation to replace the multiple private interest mass transit companies that previously operated in Multnomah County, Clackamas County, and Washington County; the counties that make up TriMet.

In addition to operating bus lines, light rail, and paratransit in the defined Tri-Metropolitan district, TriMet also connects to external mass transit services to provide wider blanket coverage for the region. TriMet's nationally recognized transit system provides more than 100 million rides annually, and carries 45% of rush hour commuters going into the downtown Portland area. TriMet not only moves people, but helps build sustainable cities by improving public health; creating vibrant, walkable communities; supporting economic growth; and working to enhance the region's livability.

Several civic leaders have been highlighted as key Figures in the creation, establishment, and ultimate success of TriMet. Governor Tom McCall is credited with the initial call for the creation of the public corporation; other key contributors include Congressman Earl Blumenauer, Rick Gustafson, Dick Feeney, and Mayor Neil Goldschmidt. All were instrumental in shaping the organization itself, as well as the land use, civic development, and transformation policies that make TriMet the success that it is today.

The vision and efforts of these individuals and countless others have borne fruit. Recently, TriMet celebrated the second anniversary of the opening of its most recent light rail line. Since its inauguration the 7.3-mile MAX Orange Line has experienced continued growth, having a six percent year-to-year increase in ridership. Illustrating the holistic approach that has been a part of TriMet from its inception, there have been wider community benefits such as a positive impact on employment and a focus on sustainable practices such as bio-swales, eco-roofs, a first-in-the-nation eco-track segment, solar paneling, and regenerative energy systems.

TriMet is a key partner in the region's Southwest Corridor Plan and Shared Investment Strategy. Eleven partner agencies are participating in planning for a new 12-mile light rail line in southwest Portland and southeast Washington County that will also include bicycle, pedestrian, and roadway projects to improve safety and access to light rail stations. Southwest Corridor stakeholders include Metro (the regional government), Washington County, Oregon Department of Transportation, and the cities of Beaverton, Durham, King City, Portland, Sherwood, Tigard, and Tualatin. This collaborative approach strives to align local, regional, and state policies and investments in the Corridor, and will implement and support adopted regional and local plans. These initiatives and outcomes from participation with the UO's Sustainable City Year Program will help develop ideas that are cost effective to build and operate, provide safe and convenient access, and achieve sustainability goals while supporting the corridor's projected growth in population and employment.

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Course Participants

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Executive Summary

The following report documents design concepts that address stormwater management for the TriMet Southwest Corridor (SWC) light rail project. Students in the University of Oregon's Landscape Architecture course on stormwater management worked with TriMet and its Southwest Corridor partners as part of the Sustainable City Year Program (SCYP). Students were divided into teams and tasked with proposing concepts for stormwater infrastructure at certain stations of the future SWC line.

The stations addressed were as follows, from north to south:

- The Woods Corridor, Team 1
- 13th Avenue Station, Team 2
- 50th Avenue Station, Team 3
- Tigard Triangle Station, Team 4
- OPS Facility Station, Team 5

This report outlines and identifies key concepts produced by each team for each of the above stations. Although the overall purpose of the project was to design at each station, the class was also asked to approach their projects with the "triple bottom line" in mind. Therefore, each team approached their stormwater design concepts with social, economic, and environmental considerations. The report is divided into sections based on the assigned SWC stations. Each section's design concept includes technical details of stormwater infrastructure and illustrative examples to reinforce their ideas.

Introduction

TriMet, the tri-county transit agency in Portland, Oregon, is recognized for being on the forefront of public transportation trends in the US, and it continues to expand in the region. A new transit corridor to southwest Portland is currently underway. The planned Southwest Corridor (SWC) route passes through existing neighborhoods as well as protected habitats. It was with this understanding the stormwater management class set out to consider design concepts that could be integrated with the new corridor to reduce the impacts of urbanization on existing ecosystems while maximizing and showcasing the benefits of a new public transportation initiative at TriMet. Students divided into five site-specific teams. Each team focused on delivering a design concept that would optimize on-site stormwater management, prevent impacts of a ten-year storm event, and decrease the likelihood of inundating the city's existing stormwater infrastructure to achieve the "triple bottom line." The report that follows includes design concepts from each of the five teams in the class.

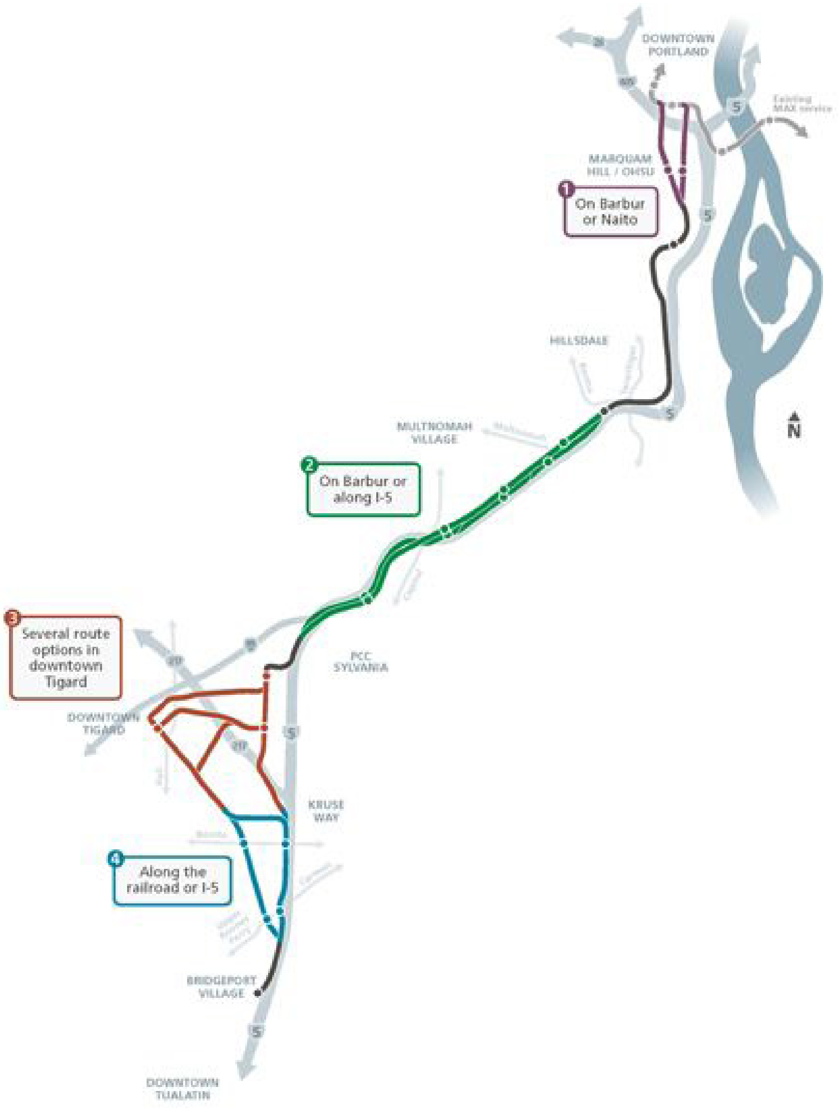

Figure 1: A map showing the proposed path of the Southwest Corridor light rail line and station locations. Note: OPS Facility not shown.

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Team 1: Woods Corridor

The Woods Corridor is a secluded route through the tree-lined Terwilliger Parkway that jogs alongside SW Barbur Boulevard. A station stop is not proposed here, but because the SWC light rail track will travel through this important habitat—which has a watershed connection to the Willamette River—special consideration was needed to assess how the SWC light rail's path may impact ecology and stormwater runoff in the area.

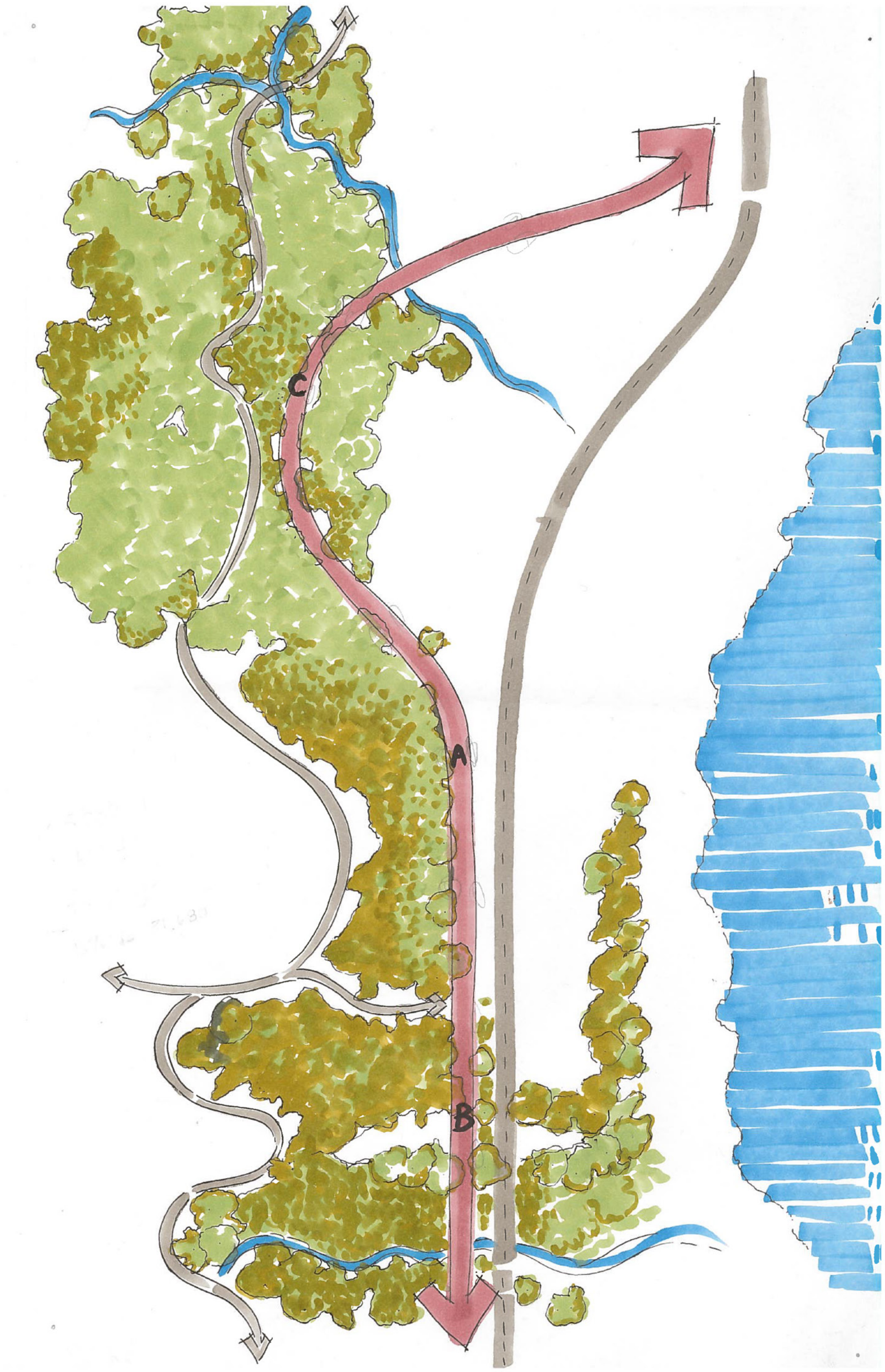

Figure 2: Corridor route through Terwilliger Parkway

Woods Corridor Watershed

Slowing water flow so that it is retained and filtered back into the watershed—while being treated in the process—improves water quality and prevents erosion.

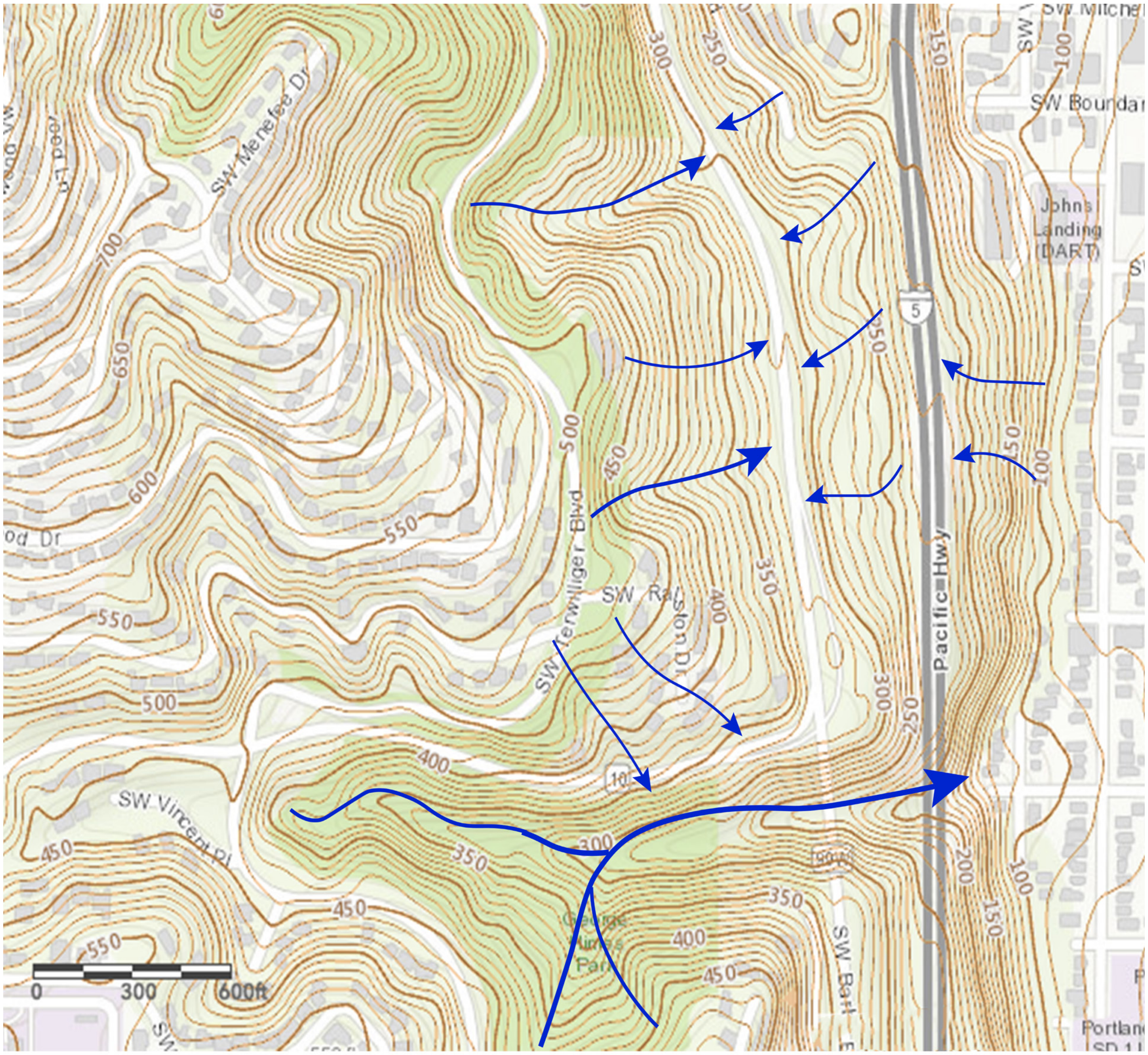

Figure 3: Contour map diagramming the flow of water.

Design Concept for the Woods Corridor

To honor the existing ecology at the site, Team 1 decided to use strategies found in nature to inform their design concept. This team focused on creating four main connectors to encourage natural animal movement around the project.

1) A canopy connection, where lanes could create a barrier around a median with trees, would help limit the distance for animals to have to travel as they cross.
2) Create an overland and stream crossing connection to increase natural movement upland.
3) Maintain day-lit streams and promote aquatic movement by avoiding the use of culverts that cause woody debris and rocks to accumulate.
4) Install vegetated basins that create habitat for smaller insects, act as a natural buffer between habitat and road, and treat stormwater before infiltration.

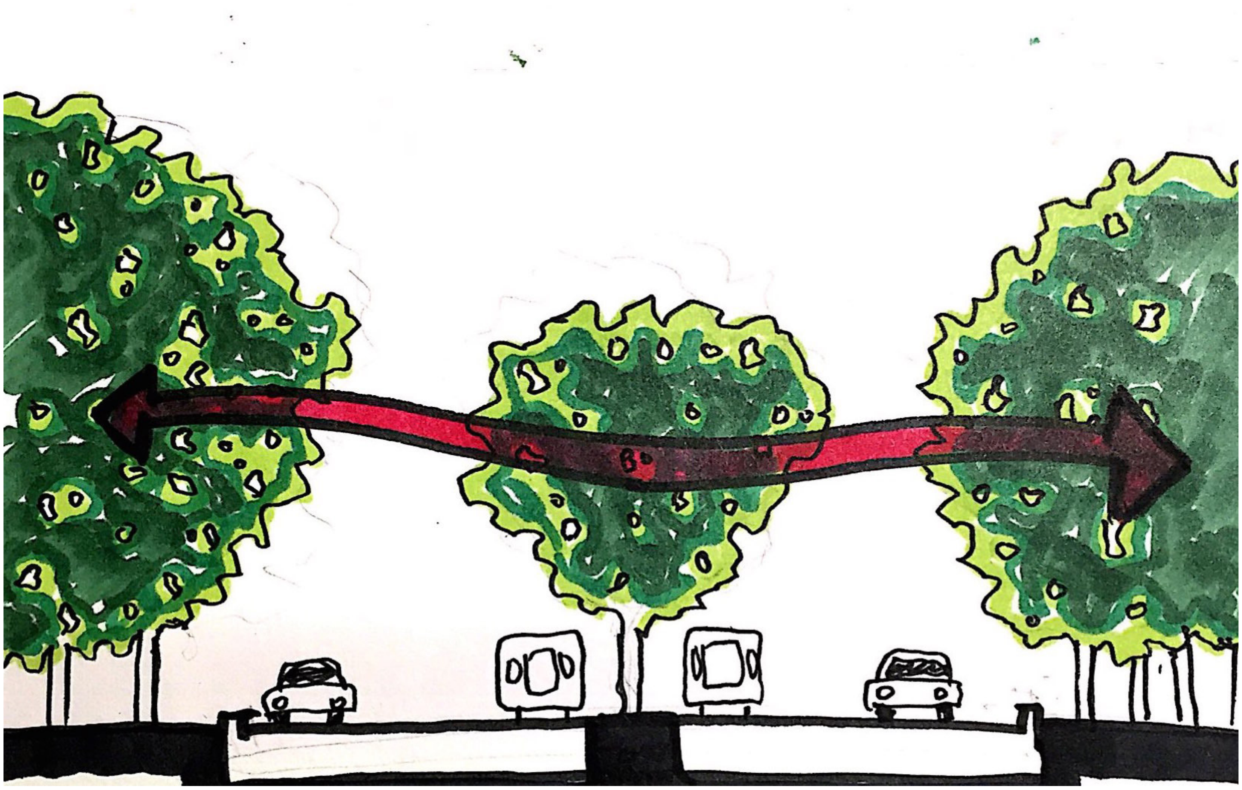

Figure 4: Diagram of canopy connection for improved animal movement.

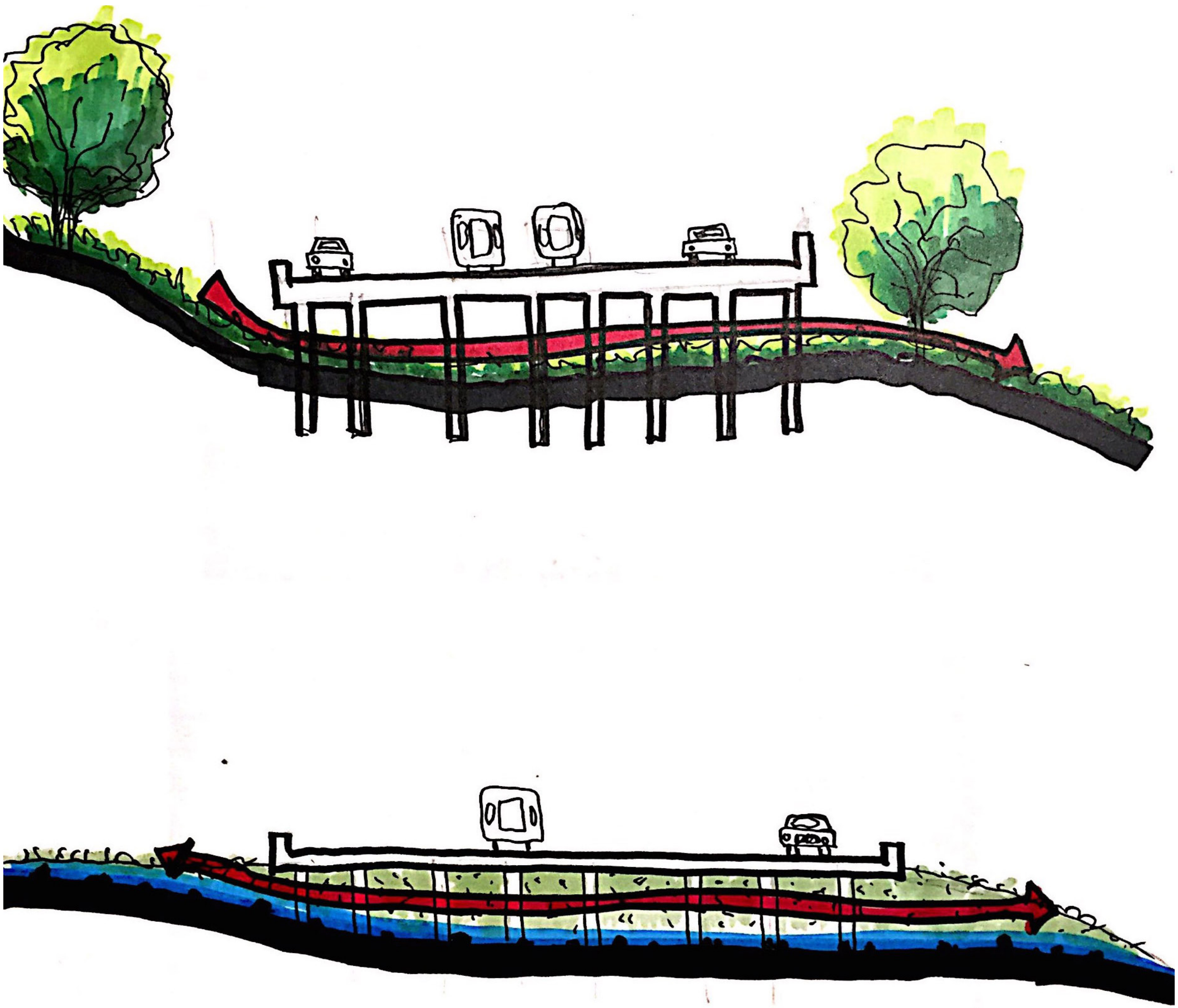

Figure 5: Diagrams of overland and stream crossings for improved animal movement.

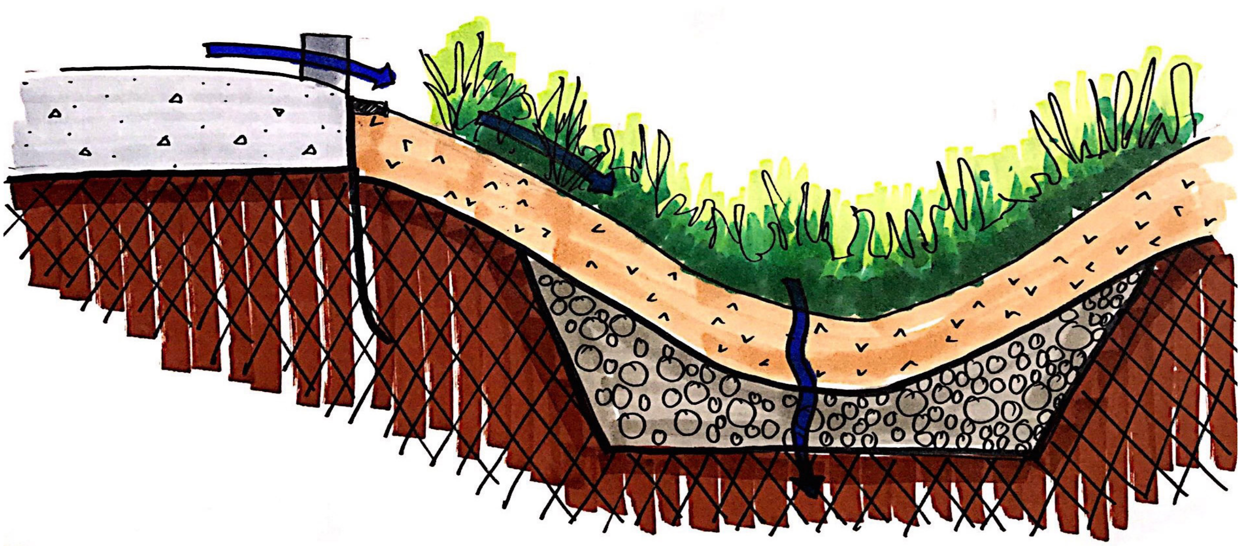

Figure 6: Diagram of a vegetated basin.

Woods Corridor Systems & Sizing

To manage runoff from roughly one linear mile of public right-of-way and 475,000 square feet of light rail, Team 1 proposed the use of multiple small facilities along the Woods Corridor track to mitigate the total volume of runoff. The four stormwater strategies the team explored address both animal movement and the need for multiple facilities along the line. Students determined that using green tracks on the rail line and along the elevated roadway across Raven Creek in addition to adding basins along road edges could slow and treat stormwater while improving natural animal movement.

Figure 7: Section drawing of green tracks to help with stormwater managment.

Figure 8: Stormwater collection basin section.

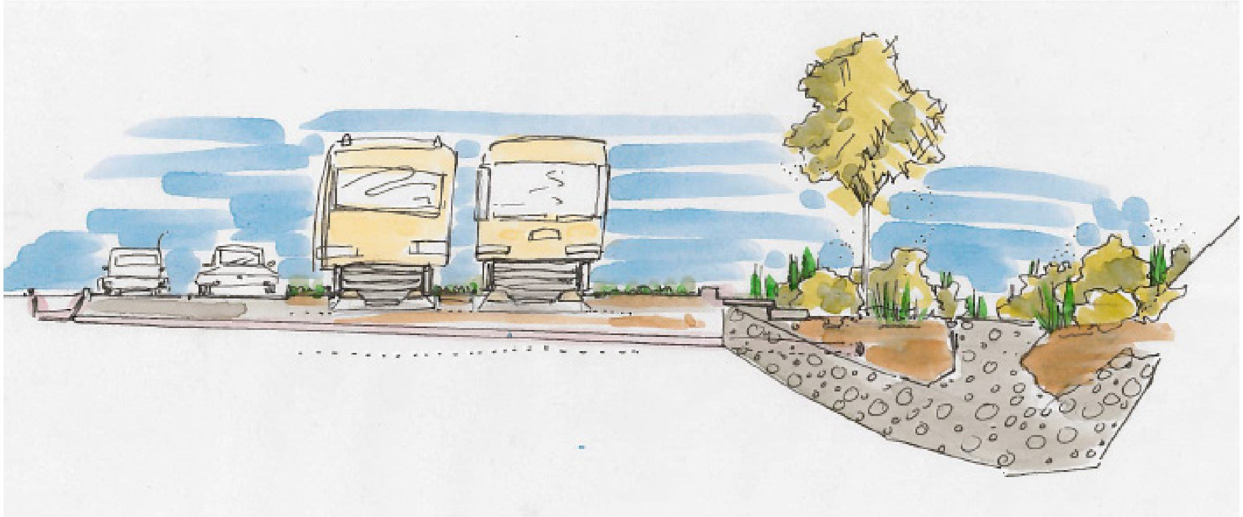

Figure 9: Section cut of roadway with adjacent basin for stormwater collection from road.

Woods Corridor Triple Bottom Line

This project focused primarily on ecology and stormwater mitigation, but design concepts also addressed economic concerns. For instance, the use of roadside basins to treat water before infiltrating groundwater could help combat car pollutants entering the Willamette River from public land; green tracks could treat and slow stormwater along the train line; and day-lit streams could mitigate construction runoff in lieu of culverts or backfill. The combined implementation of these strategies has the potential to lessen or eliminate overflow into the city's combined sewer system and prevent related impacts to the Willamette River that have occurred in the past.

Figure 10: Rendering of train line on green tracks between a basin and Barbur Boulevard.

Team 2: 13th Avenue Station

The 13th Avenue station is located where the SWC light rail line turns west between the Hillsdale and the Burlingame suburbs of southwest Portland. This is a heavily congested area with many thoroughfares. Maintaining an appropriate travel speed is important for commuter timing, but providing safety around the station is important as well.

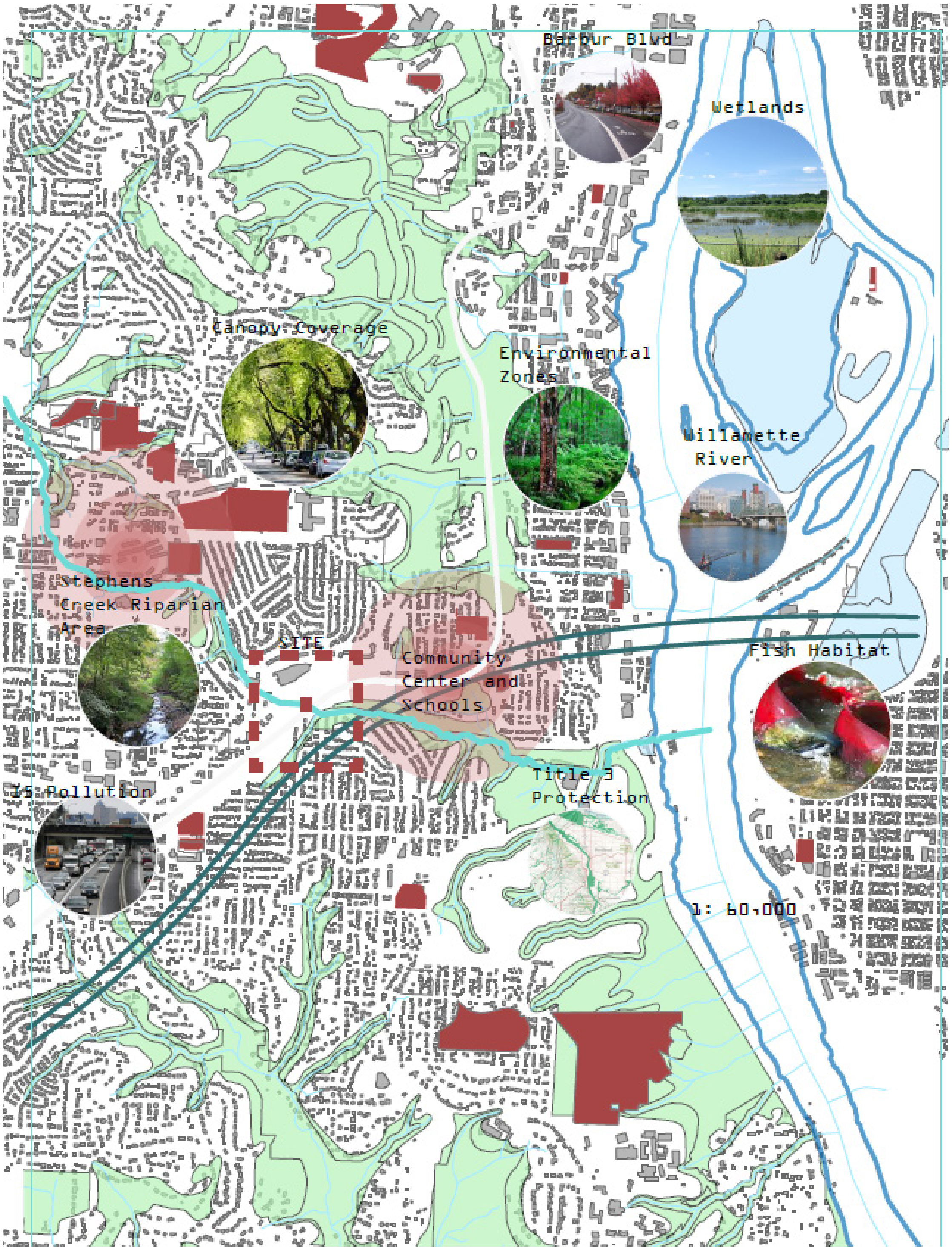

Figure 11: Diagram highlighting important components surrounding the project.

13th Avenue Station Watershed

Team 2 considered crossings over the culverted zone of the Stevens Creek watershed to slow and treat stormwater while detaining runoff. Slowing down the waterflow with street planters along Barbur Boulevard has the potential to stabilize the existing landslide area. Furthermore, treating stormwater onsite before it reenters Stevens Creek could improve water quality. This could also support fish habitat where the creek connects with the Willamette River downstream by decreasing stormwater debris.

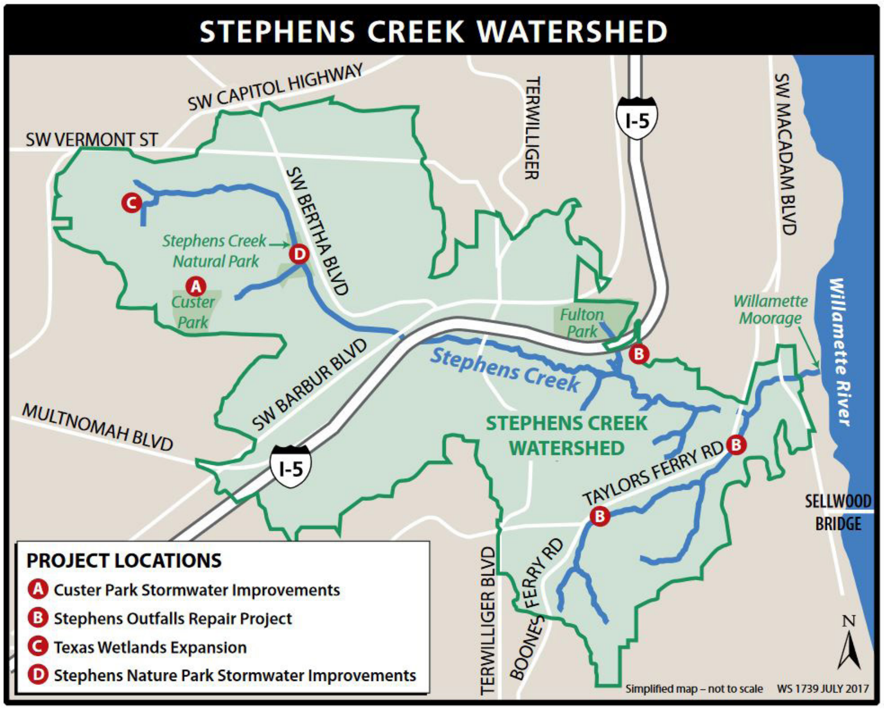

Figure 12: Watershed boundaries along Stevens Creek.

Stephens Creek Watershed Stats

- 754 acres in the watershed
- 19,500 feet (about 3.7 miles) of natural stream channel
- Impervious area, mostly streets, covers less than half of this watershed
- 168 acres of parks and open space
- Endangered Species Act-listed fish (including Chinook, coho and steelhead) from the Willamette River rely on the lower part of Stephens Creek for cool, clean water and as a place to rest

Design Concept for 13th Avenue Station

Located next to Fred Myer and between two community centers, the 13th Avenue station was conceptualized as a community hub along the new light rail line. The team looked at the local neighborhood diversity and designed concepts for a station that could help stimulate surrounding businesses. The hydrology of the area was considered an important aspect of the design, so the team designed the concept for the station in a way that would help capture as much of the surrounding stormwater runoff as possible. Team 2 determined oversizing and centralizing runoff in a large basin would allow surrounding buildings to benefit from a unified stormwater infrastructure while bringing beauty and an open community space to pedestrian walkways. Figure 13 shows the collection zones.

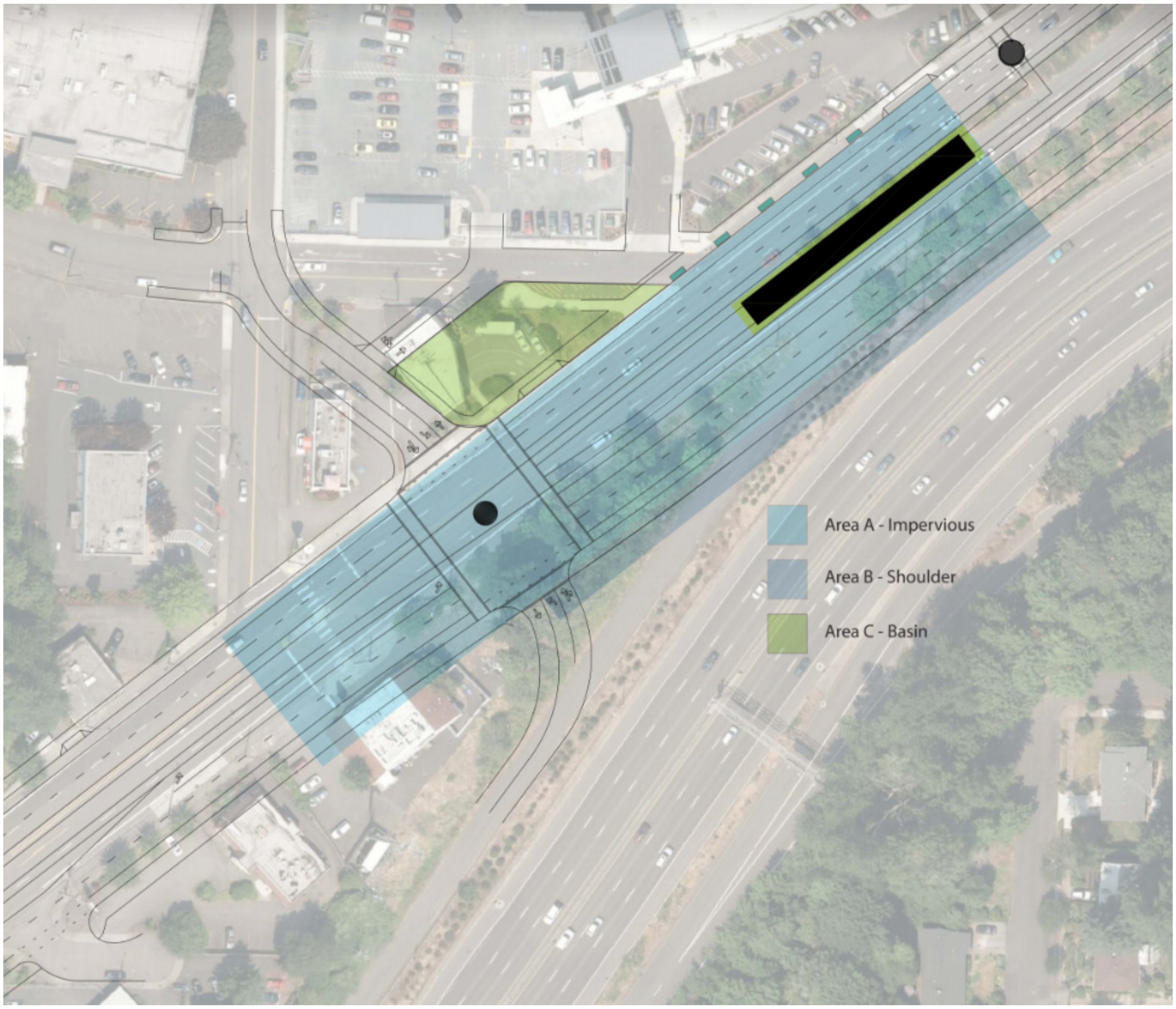

Figure 13: Spacial area of collection zones around station.

13th Avenue Station Systems & Sizing

Team 2 considered many system options. The first idea they worked with involved creating a centralized basin around which community activities could occur. Second, they examined the possibility of adding a green roof to the station cover to slow and treat water immediately before it meets the ground. The team also considered using street planters along Barbur Boulevard as a stormwater solution. In addition to these three main ideas, the team suggested implementing green tracks, pervious pavers along walkways, and more street planters on adjacent feeder streets.

Figure 14: Section cut through station showing all stormwater systems.

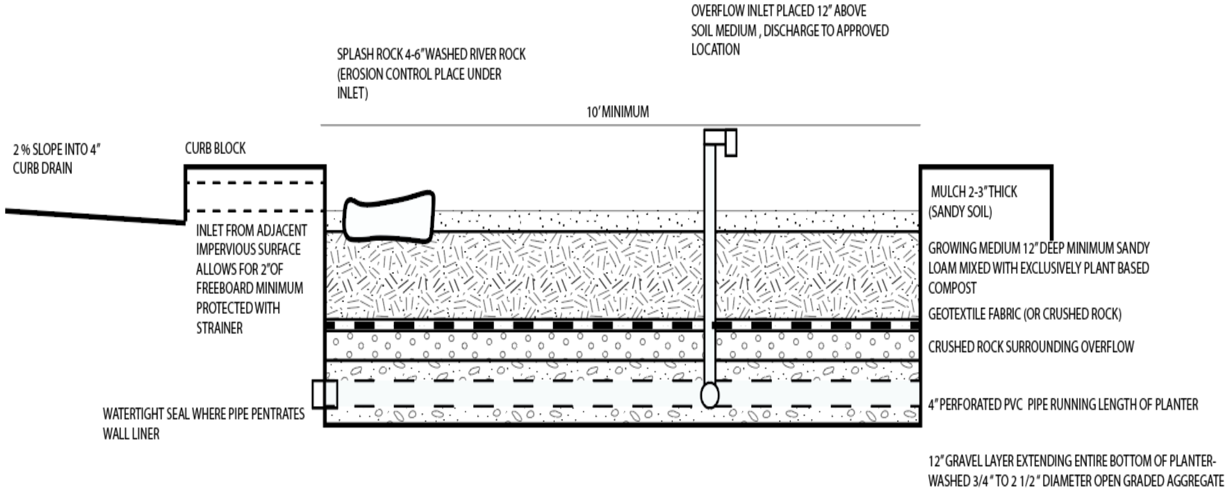

Figure 15: Detail drawing of a street planter.

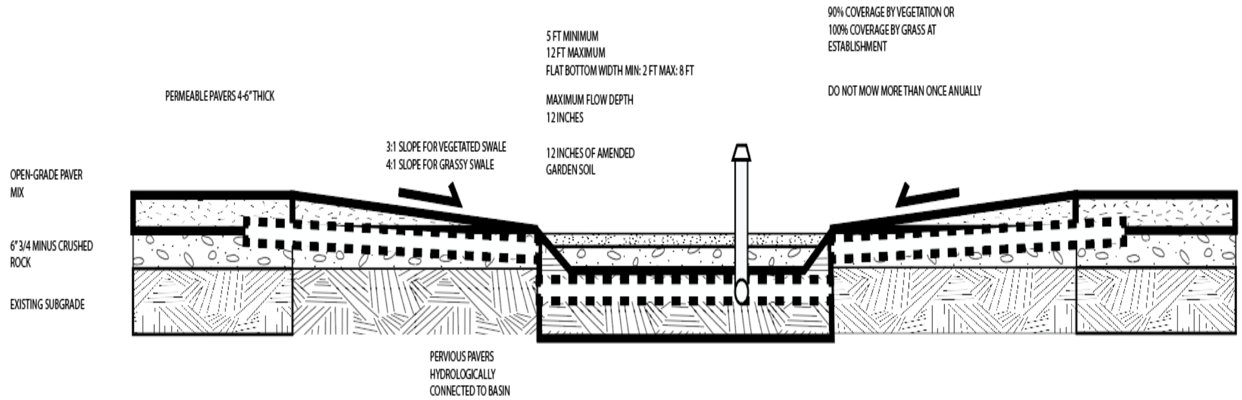

Figure 16: Detail drawing of the central basin.

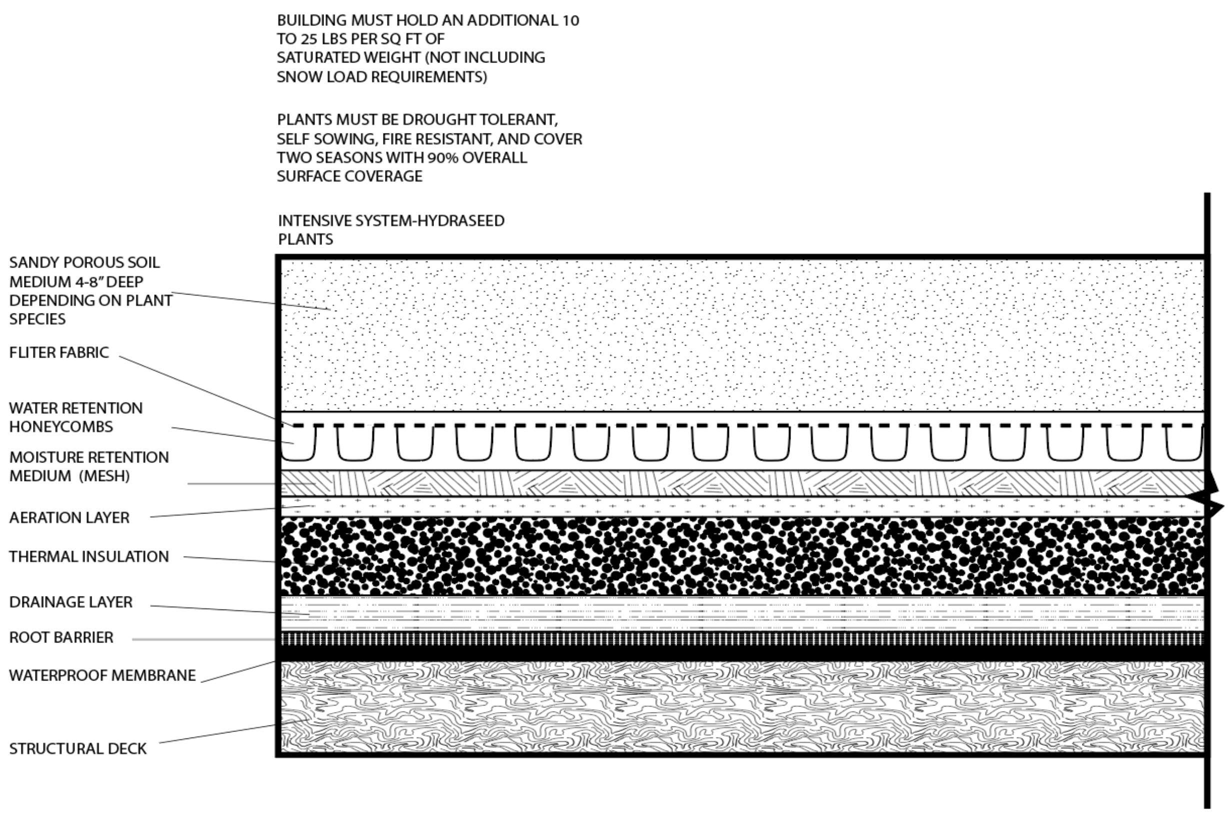

Figure 17: Detail drawing of the green roof.

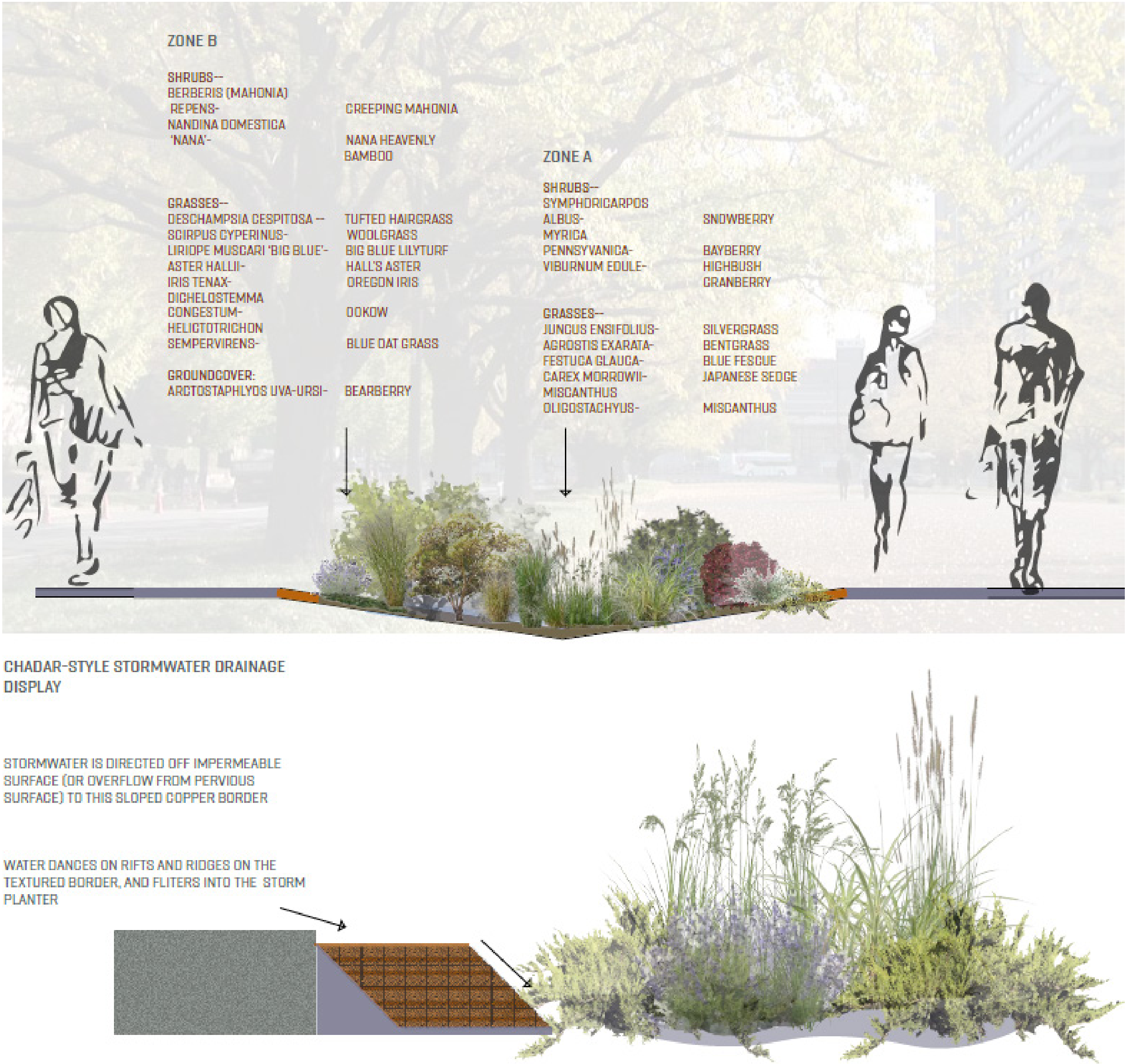

Figure 18: Diagram showing plant species used in planters and basin.

13th Avenue Station Triple Bottom Line

Team 2’s design concept centered around a recurrent theme of creating stormwater infrastructure that could also double as community space. For example, Team 2’s design concept could increase economic value of the area is by developing pedestrian space centralized in the community and around existing businesses while improving the walkability at the station. Designing a stop centered around a community space with existing local businesses while addressing stormwater infrastructure also enhances the design concept objective of increasing the triple bottom line.

Team 3: 50th Avenue Station

Located at the bottom of 53rd Street and leading up to the Portland Community College (PCC) Sylvania campus, this station could serve as the main stop for student commuters. PCC sits at the bottom of the hill. Team 3 considered the capture and treatment of stormwater that flows down 50th Avenue the key to their design concept.

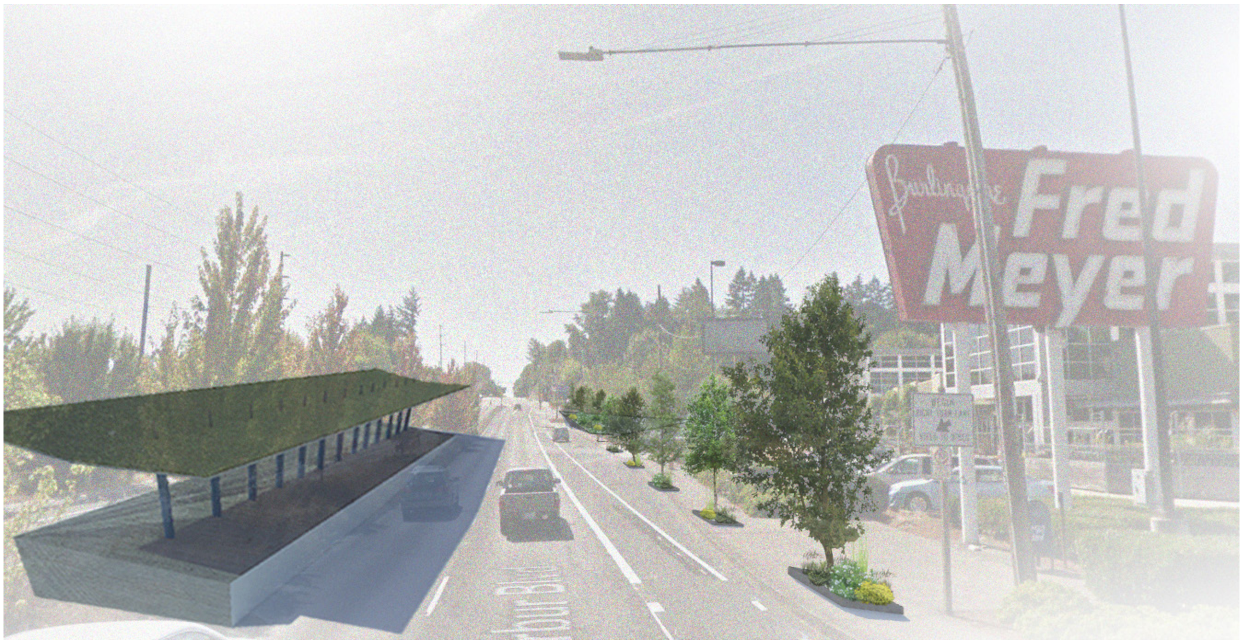

Figure 19: Rendering of the 13th Avenue station across from Fred Myer.

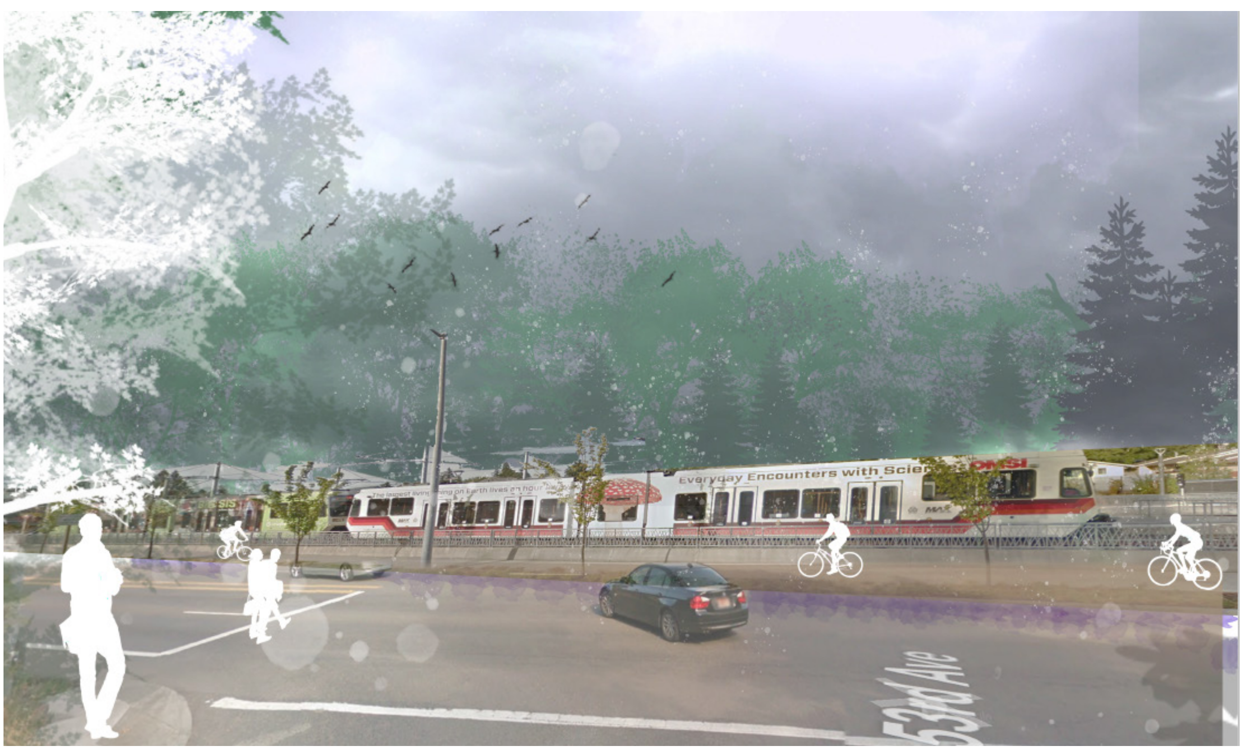

Figure 20: Rendering showing station at the bottom of 53rd Street.

Figure 21: Diagram highlighting natural areas and green space around station.

50th Avenue Station Watershed

Team 3 was interested in protecting the quality of the watershed by slowing down waterflow on the slope descending the PCC Slyvania campus where it can be treated before entering the city's combined sewer system. Therefore, the team focused on hillside soil quality as well as opportunities to decrease erosion on 53rd Street.

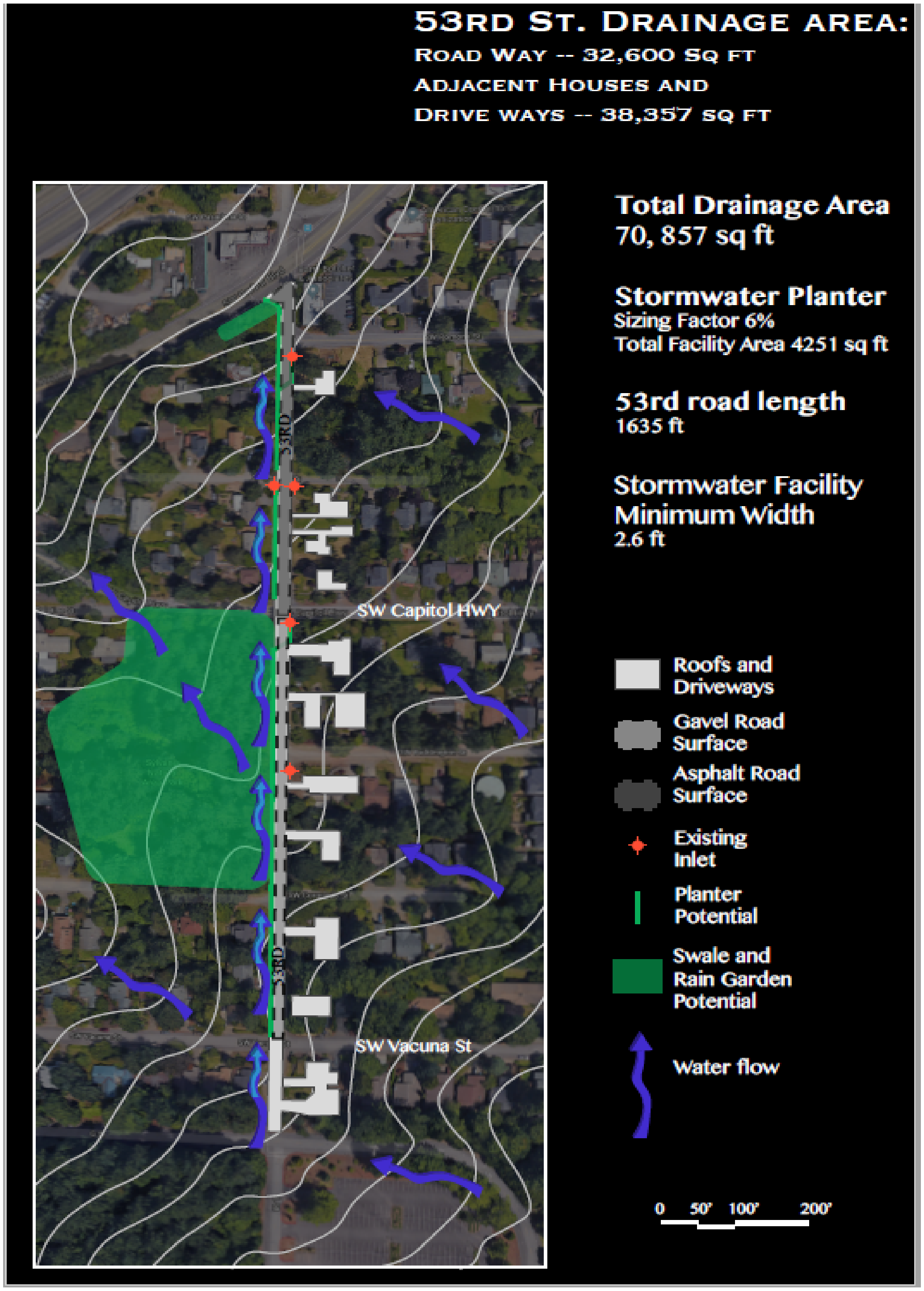

Figure 22: Waterflow diagram down 53rd Street.

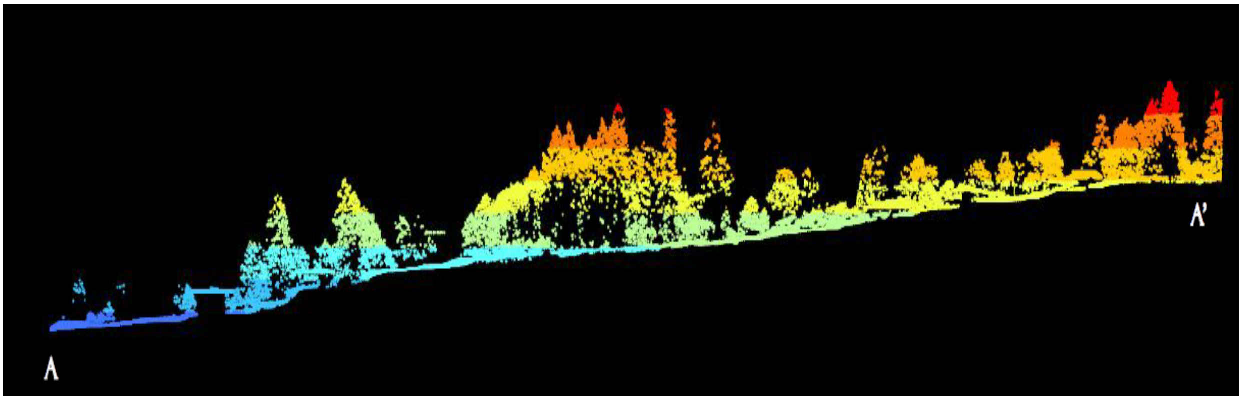

Figure 23: Section cut of the grade from PCC to the station stop.

Design Concept for 50th Avenue Station

The close proximity of this station to PCC was a main theme in Team 3's design. Considerations for future development on and near this station and how the station might someday more directly connect to the campus forced the team to consider the thoroughfare along 53rd Street as well. The design concept uses wayfinding along the main corridor to bring awareness to the stormwater infrastructure as a guide and story along the route to engage the neighboring community with student contributions. Also, with the station at the bottom of the pathway, a large swale could act as a detention center to treat and hold stormwater.


Figure 24: Rendering of neighborhood and student artwork creates engagement along path.

Figure 25: Renderings of swale and trench grate design.

50th Avenue Station Systems & Sizing

Installing planters along 53rd Street that could feed into a large swale at the bottom of Barbur Boulevard could slow the water flow during peak stormwater events. This system could also work to eliminate erosion on the steep hillside. By slowing the water debris, pollutants filter out before being retained back into the groundwater at the swale. The roadside swale could also act to manage stormwater from Barbur Boulevard while improving water quality. Furthermore, a raingarden next to the station could create a natural buffer between Barbur Boulevard and I-5.

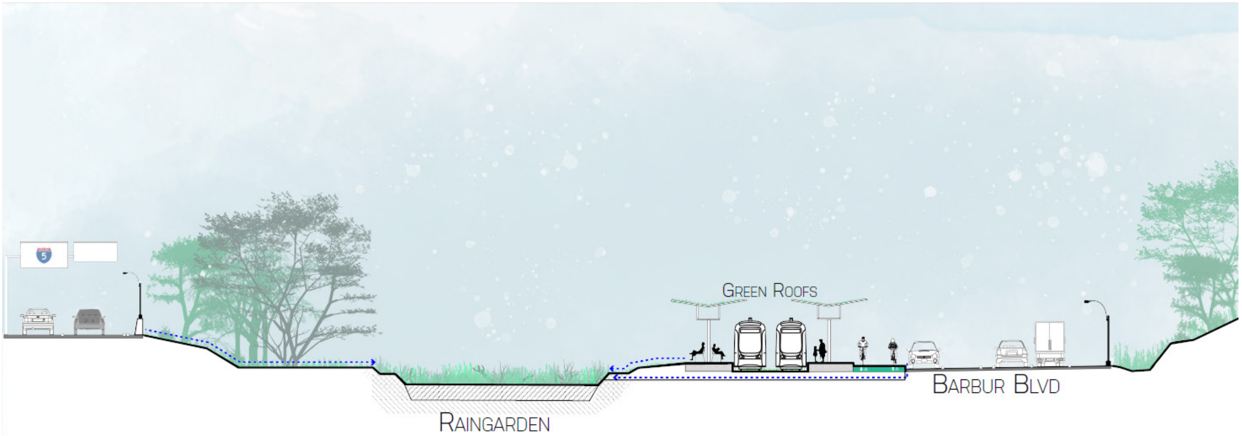

Figure 26: Section cut through station showing raingarden and swale.

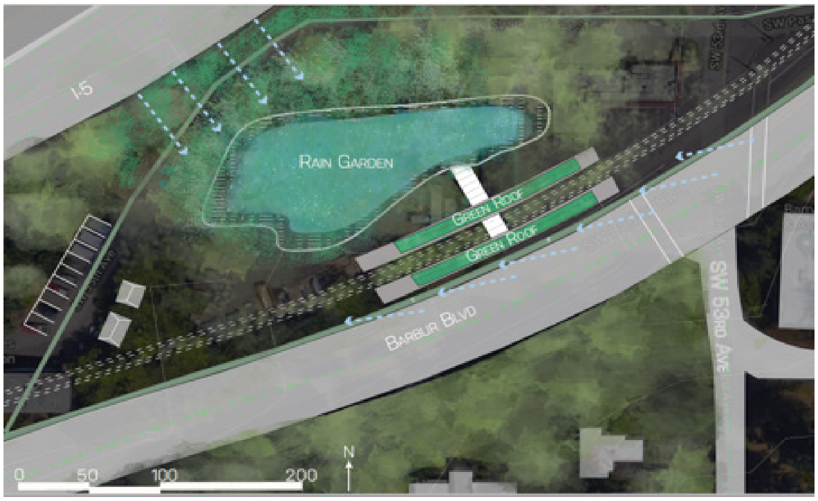

Figure 27: Diagram of station and raingarden.

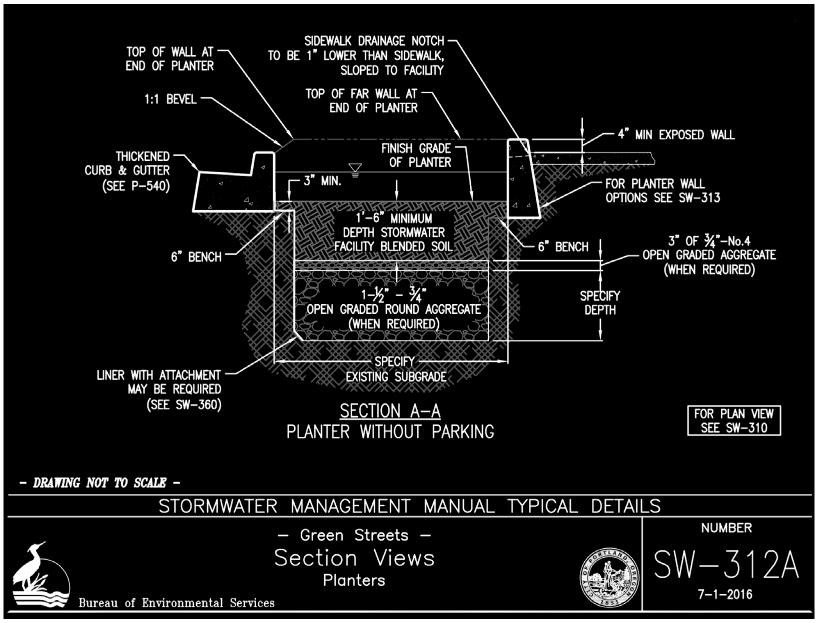

Figure 28: Detail drawing of swale design.

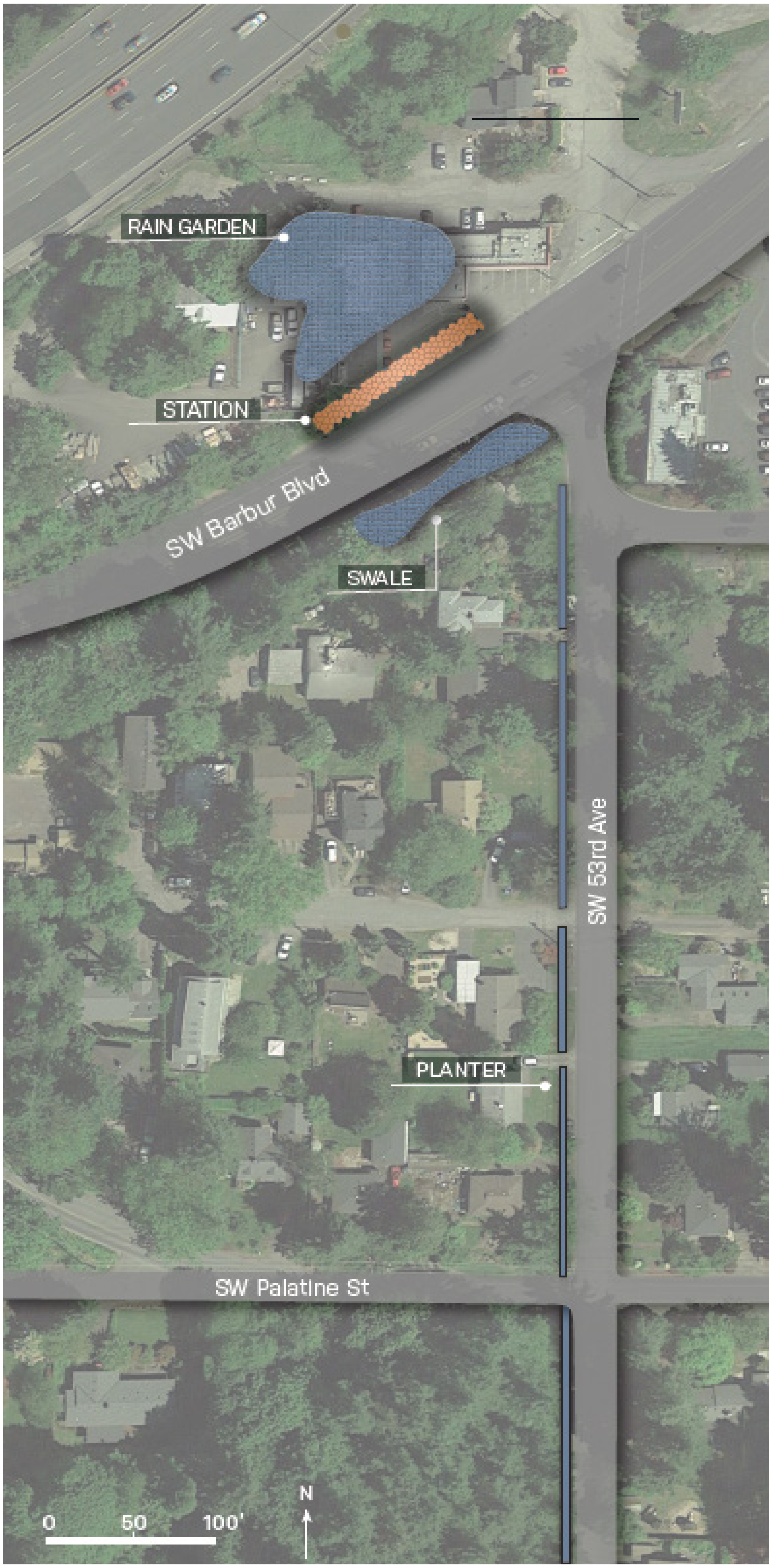

Figure 29: Diagram of stormwater systems connecting and working together.

50th Avenue Station Triple Bottom Line

Team 3 recommends engagement with PCC from the onset to encourage an economic incentive for developing a wayfinding walkway for the students to the station and the community to the campus. The development of the walkway through the tree-lined residential neighborhoods could create community enhancement by engaging residents and students in the art and story of the neighborhood. This could all be done by featuring signage about how stormwater infrastructure is improving water and soil quality.

Figure 30: Rendering of street planters down 53rd Street.

Team 4: Tigard Triangle

The Tigard Triangle is situated where SW 72nd Street and Highway 217 meet. Due to the fast-paced flow of traffic on Highway 217, Team 4 considered speed and continuous vehicular movement around the station. This team also focused on ecology and hydrology of the surrounding area, as this station is located at one of the biggest watersheds along the SWC light rail route.

Figure 31: Station location off 72nd Street next to Highway 217

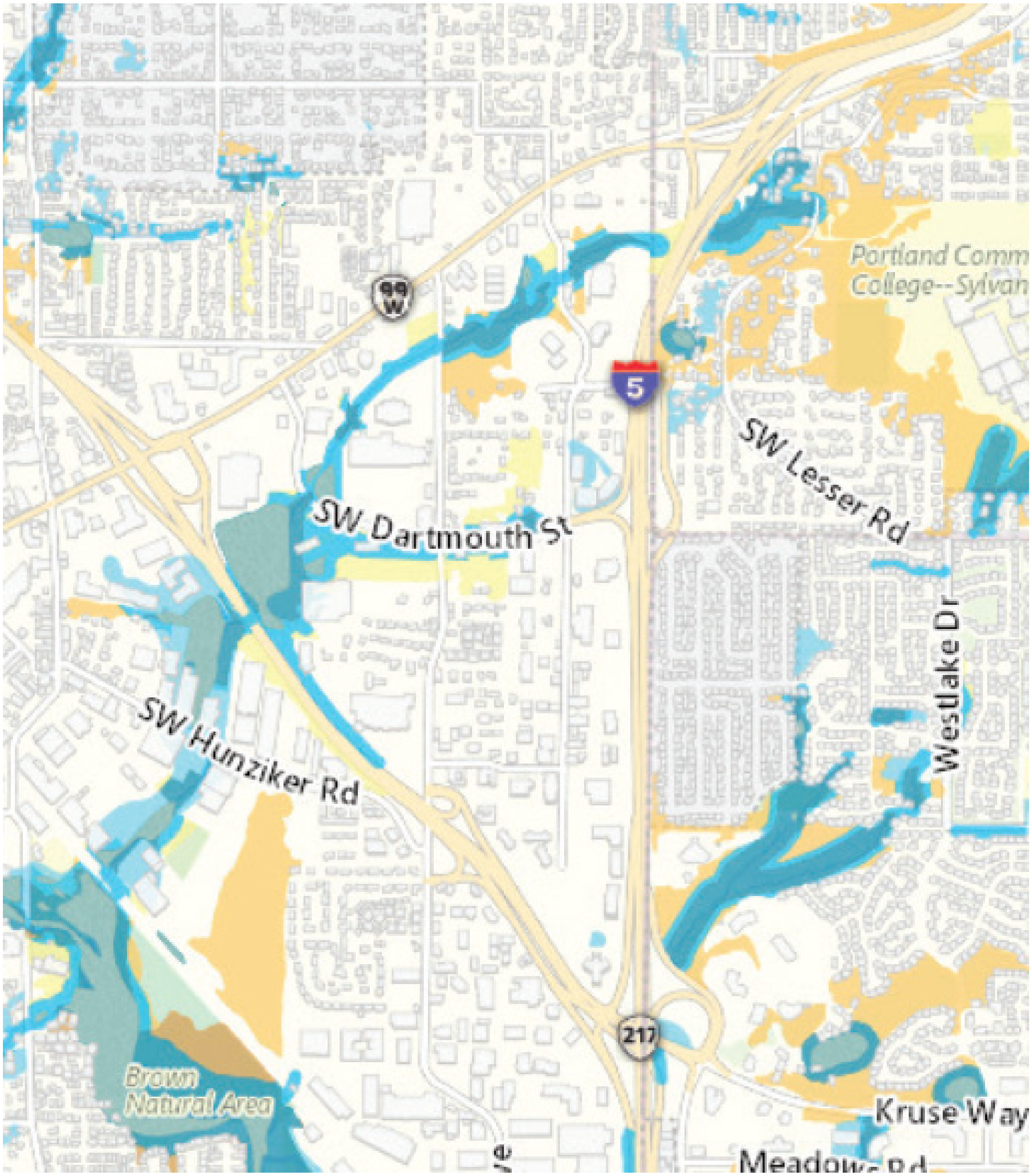

Figure 32: Map highlighting habitat around the station.

Tigard Triangle Watershed

This station could impact the Fanno Creek Watershed, so the team's design concept aimed to filter out pollutants while stabilizing the steep slope of the hillside to slow waterflow during storm events. As part of a natural drainage basin of the Columbia River, the Fanno Creek Watershed covers about 32 square miles in Multnomah, Washington, and Clackamas counties. Seven square miles of that are within Portland's city limits. Fanno Creek starts in Portland's West Hills neighborhood and enters the Tualatin River about nine miles above Tualatin's confluence with the Willamette River where it feeds into the Portland suburb of West Linn.

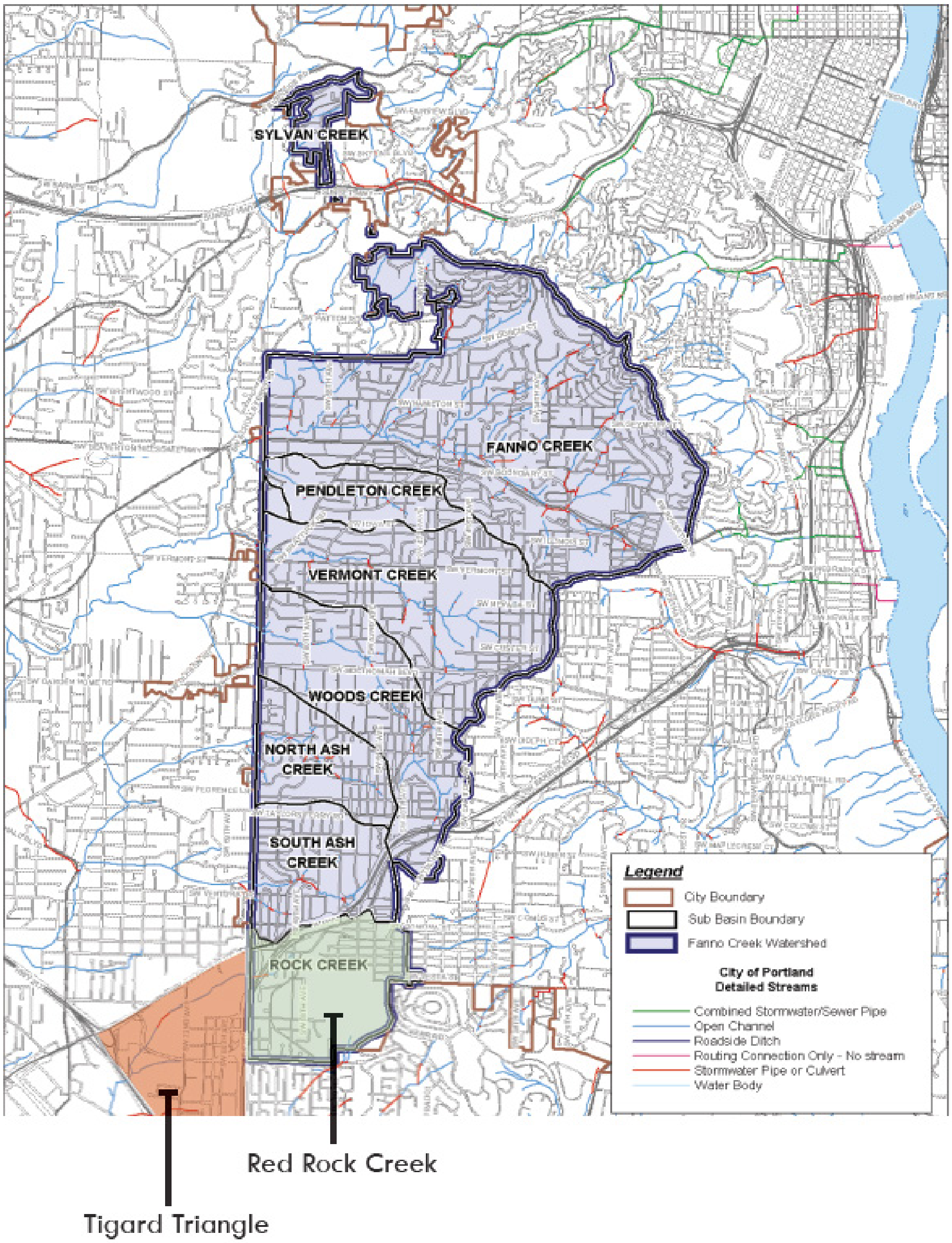

Figure 33: Map showing the area of the Fanno Creek Watershed.

Design Concept for Tigard Triangle

Team 4’s main design concept goal for the station was to calm the flow of traffic while improving water quality. Thus, the team settled on the design concept of a roundabout. A roundabout at the station could double as a filter that removes pollutants while maintaining traffic speed. Protecting ecology with stormwater management techniques was a key constraint. Factors such as topography, watershed hydrology, and ecological habitat all informed the team’s final design concept for this station.

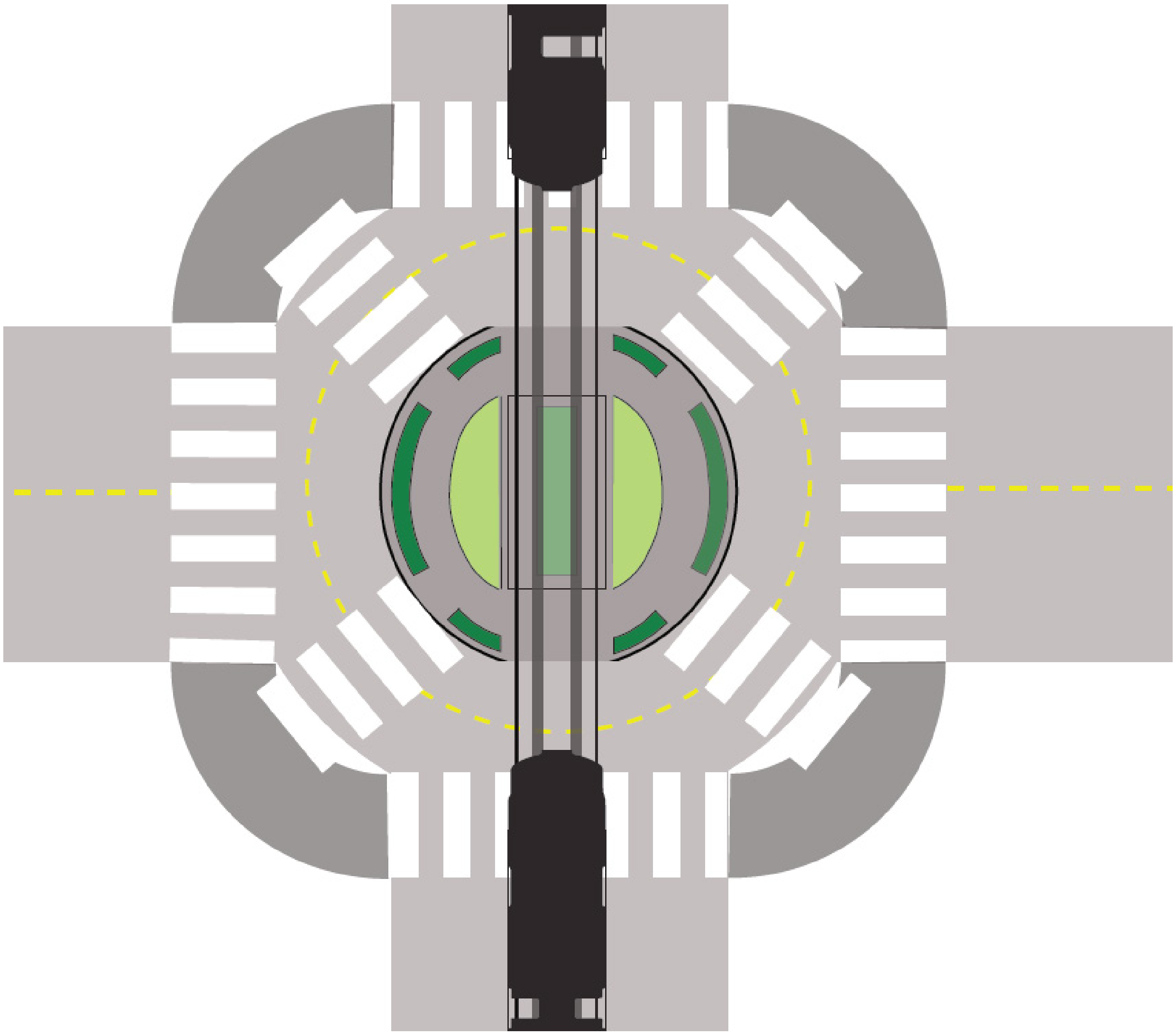

Figure 34: Design of proposed roundabout with tracks moving through middle.

Figure 35: Precedent image of a landscaped roundabout.

Tigard Triangle Systems & Sizing

In addition to the roundabout and hillside systems, Team 4 encourages utilizing an existing parking garage adjacent to the station. Retrofitting the structure with green walls could enhance water quality before stormwater reaches the ground by slowing and treating runoff polluted by car contaminants. Green roofs could be incorporated at the station for similar effects.

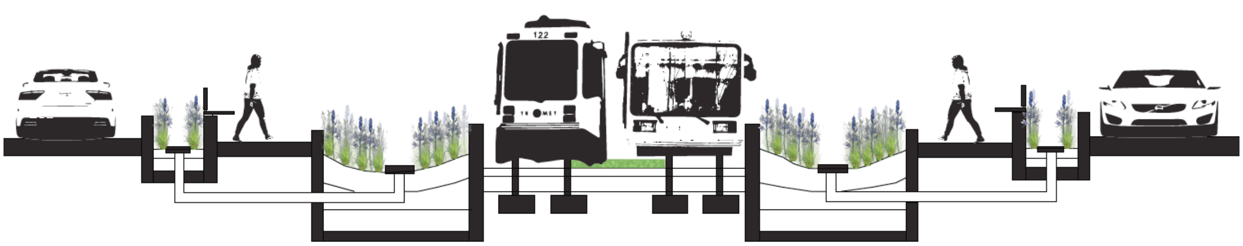

Figure 36: Section cut of the roundabout showing filter system.

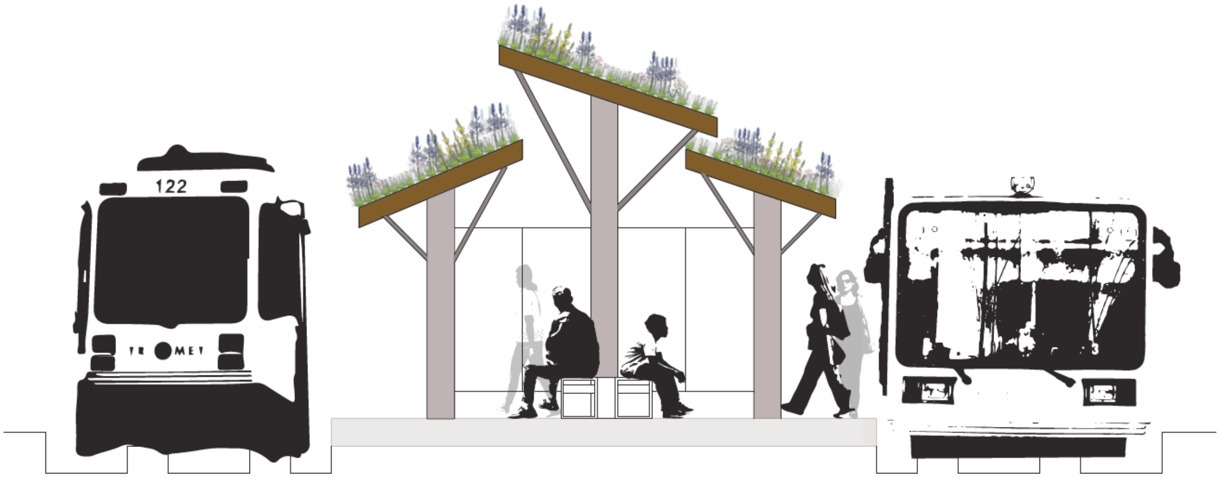

Figure 37: Section cut of station stop platform with green roof.

Figure 38: Rendering of proposed station stop with green roof.

Tigard Triangle Triple Bottom Line

By adding stormwater infrastructure to public space, a vegetated green wall can bring natural beauty to the area while also improving water quality and fostering habitat without the environmental and fiscal costs of new construction. Team 4 envisions this as a public amenity that could dovetail with community and ecological elements, as well as maximize the bottom line. Along with the aforementioned system improvements, adding a green wall to the garages and stormwater design would maximize the triple bottom line in reduced construction and infrastructure costs.

Figure 39: Rendering of parking garage with green wall.

Figure 40: Rendering of roundabout filter.

Team 5: OPS Facility Station

The OPS (Operations) Facility Station is located adjacent to Highway 217 and the Tigard Triangle Station. This station is home to the train turnaround for maintenance equipment and functions as a storage yard. Team 5 assumed an increased likelihood of pollutants at this station due to the nature of its use, so treatment of stormwater runoff was of utmost importance to this design concept.

Figure 41: Perspective view of the location for the OPS facility.

Figure 42: Map indicating site location next to open creeks important to the watershed.

OPS Facility Station Watershed

Fanno Creek originates in Portland's West Hills and meanders 15 miles through residential, commercial, and industrial lands. Fanno Creek drains 20,259 acres of land including parts of west Portland, Beaverton, and Tigard, as well as portions of Washington and Clackamas counties. Most of the watershed is in the separated stormwater system, meaning stormwater runoff flows through pipes, ditches, and drainage ways, before it eventually discharges into streams. Water quality concerns include temperature, phosphorus, and bacteria.

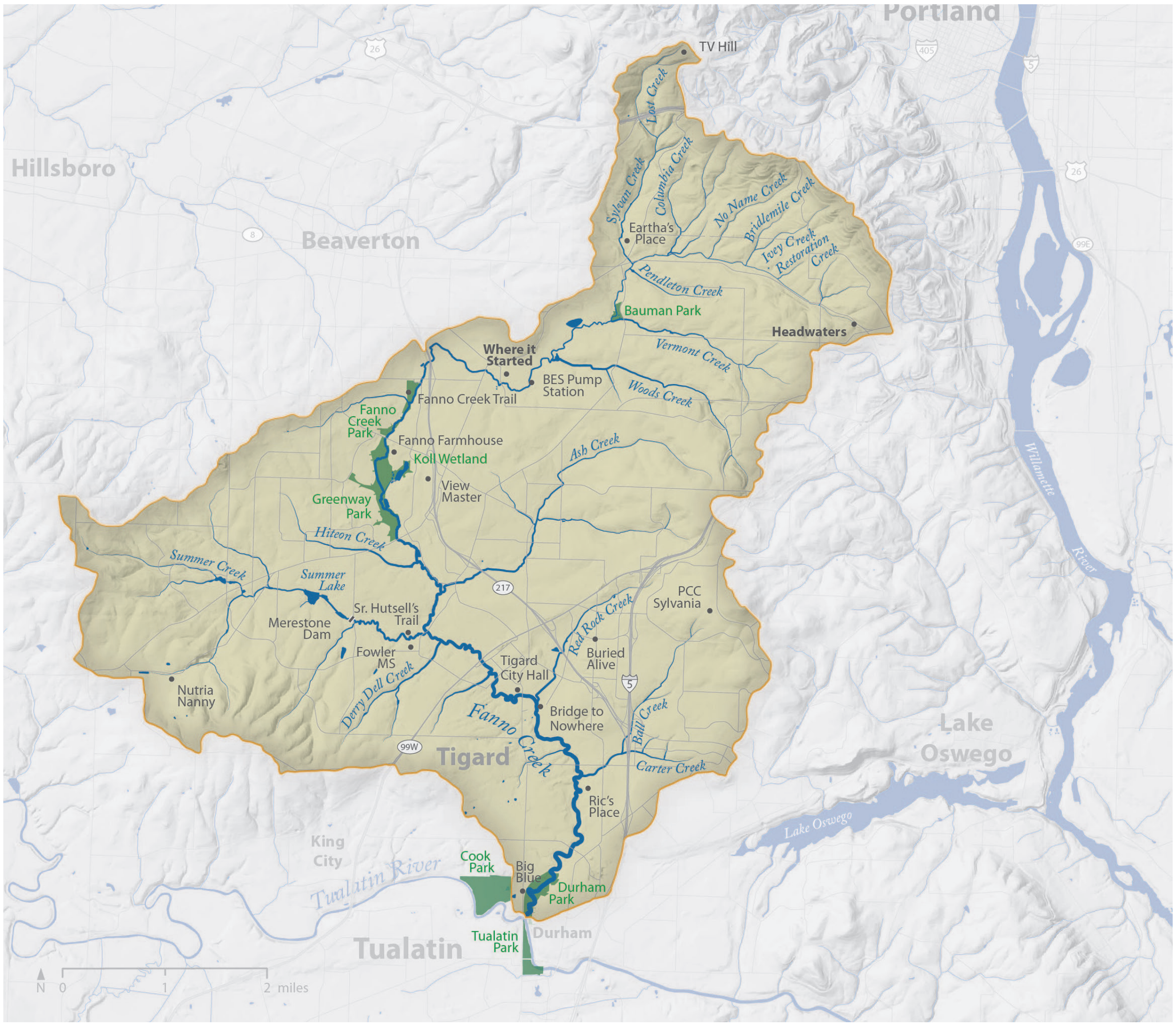

Figure 43: Map showing the Fanno Creek Watershed collection area.

Design Concept for the OPS Facility Station

Qunli Stormwater Park was used as a precedent for Team 5's design concept at the OPS station. Design strategies considered included the use of cut-and-fill techniques to create a "necklace" of ponds and mounds that could surround the former wetland. The goal would be to leave the core of the wetland untouched so as to encourage the natural transformation and evolution of the existing site.

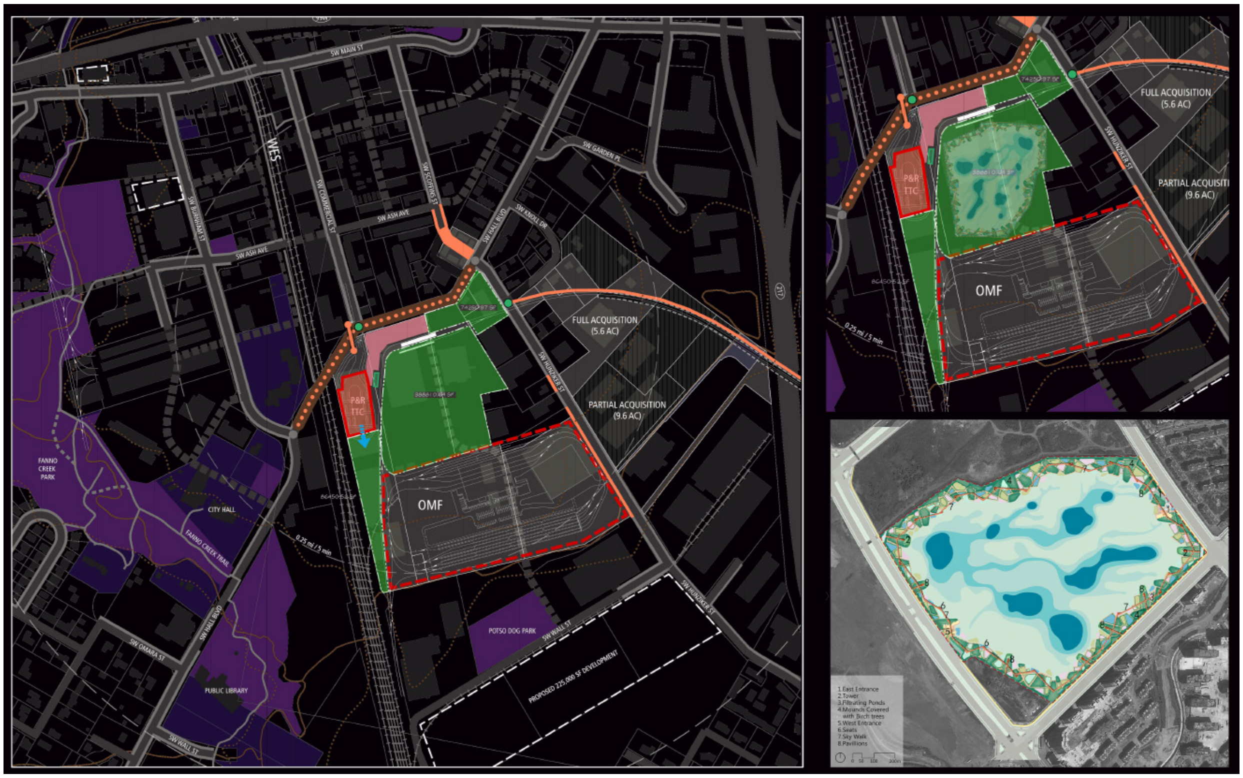

Figure 44: Design map showing zones for stormwater facilities, Qunli Park precedent bottom right.

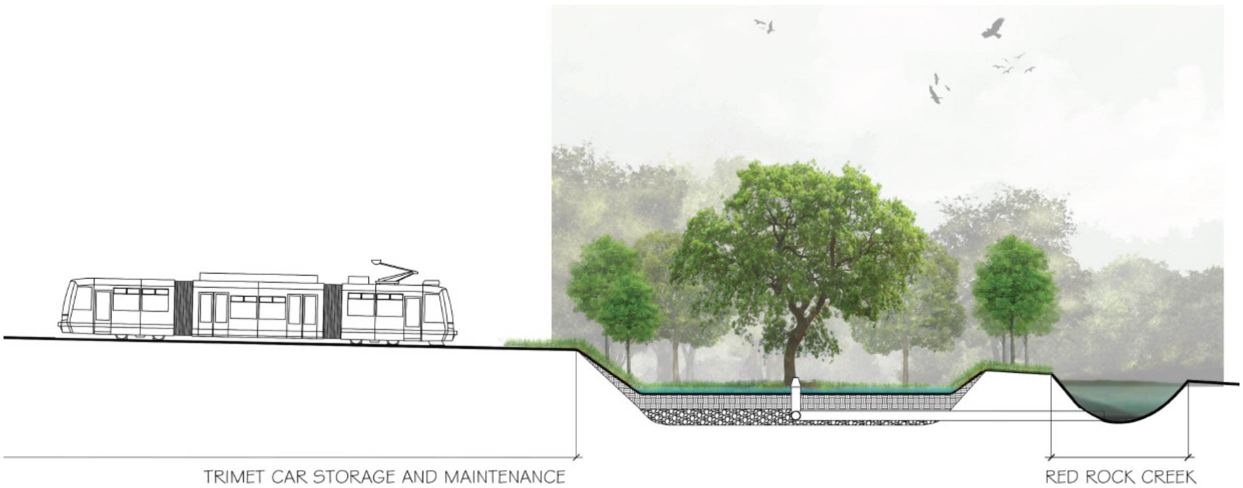

Figure 45: Section rendering showing proximity of maintenance equipment to the creek with swale between.

OPS Facility Station Systems & Sizing

The grassy swale at the south edge of the OPS station is the last “line of defense” for stormwater infiltration and retention on site before reaching Red Rock Creek. It acts as the overflow for the check dam and buffer between the potentially chemically polluted stormwater coming from the OPS facility. Team 5 believe the mounds and ponds surrounding the wetland could create a stormwater filtration and cleansing buffer zone for the core wetland in the middle. All these systems in combination could work to filter and recharge the groundwater supply to serve the goal of limiting untreated stormwater from reaching Fanno Creek.

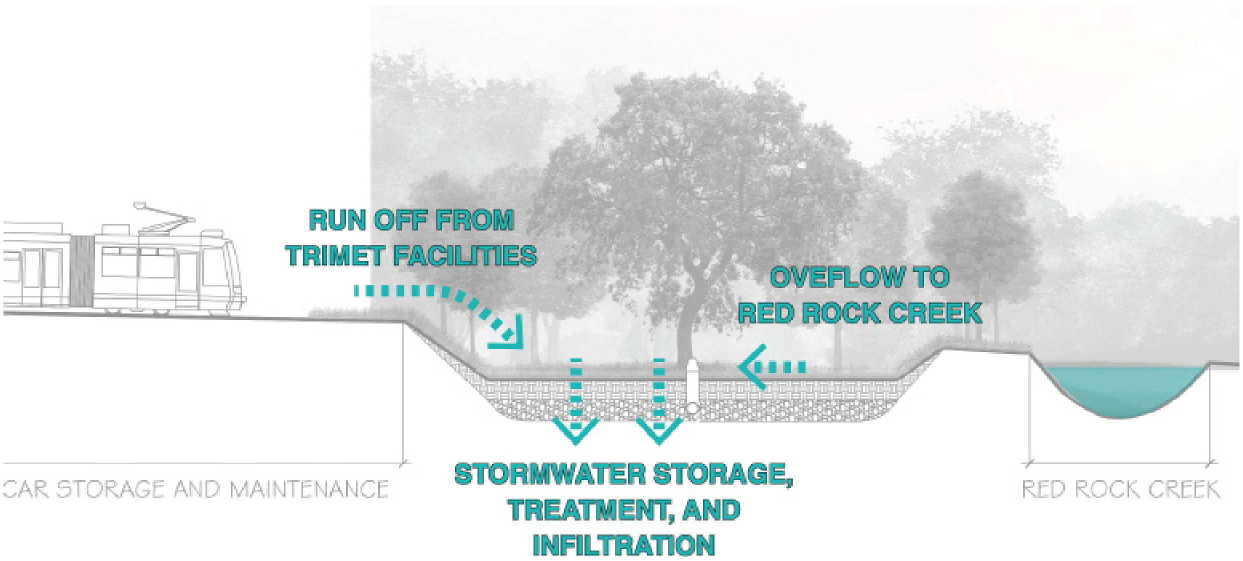

Figure 46: Section depicting water flow from maintenance area into swale.

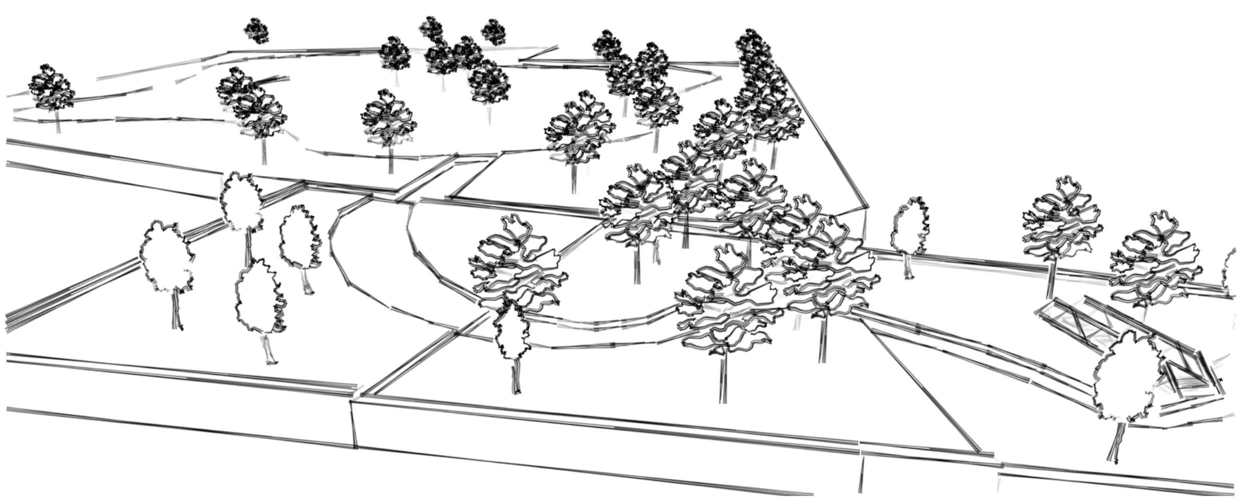

Figure 47: Perspective sketch imagining wetland to check dam connection.

Figure 48: Plan showing the water movement around the site.

OPS Facility Station Triple Bottom Line

These proposals suggest ecological improvement could be achieved through reduction of stream temperature, sediment, and pollutants entering Fanno Creek with the implementation of green stormwater infrastructure. Furthermore, the environmental benefits could work to increase community interaction with these natural areas while sharing their importance. This could create an economic incentive for the area by increasing surrounding property value and limiting stormwater treatment at city plants via city systems.

Figure 49: Map highlighting the stormwater systems.

Conclusion

The design concepts generated in this class examined how green stormwater infrastructure (GSI) methods could be used to activate community space, improve local ecology, and consider the budgetary constraints inherent in various types of system designs, also known as the "triple bottom line" for the purpose of this report. Keeping all three main issues a focal point in each of the five teams' projects helped students consider realistic approaches that could be considered by agencies that are currently managing such projects.

Lastly, the benefits of GSI are an increasingly important public concern. Taking the opportunity to implement educational wayfinding techniques as well as create visible system facilities alongside new development is a significant opportunity for modern municipal design projects. Slowing water, and addressing soil quality and landslide issues, will continue to ensure existing infrastructure remains safe, which reduces public costs and decreases the likelihood of expensive rebuilds after storms. Furthermore, highlighting the importance of treating water debris and pollutants before they hit the local watershed and environmental assets (such as the Willamette River) helps to maintain healthy ecosystems for all species.