CITY / NATURE FOR URBAN RESILIENCE

GREENER BELLTOWN : BLUER SOUND

2017 Scan | Design Interdisciplinary Master Studio
University of Washington, College of Built Environments
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Project Belltown
Recharge the Battery
The Nature Conservancy
Magnuson Klemencic Engineers

photo by: Kyle Cotchett
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Foreword

The 2017 Scan | Design Interdisciplinary Masters Studio focused on:

> **integrating multi-functional natural processes** to create a vibrant, healthful, climate-change resilient Belltown neighborhood while also helping to restore downstream environments;

> **utilizing green infrastructure to eliminate combined sewer overflows into Elliott Bay** in ways that also help to regenerate a healthy urban nature and equitably provide the renewing benefits that contact with nature can afford;

> **developing design ideas and typologies that can inspire the retrofit of streets, urban spaces and buildings** to meet the 2030 District's and Seattle Public Utility's stormwater storage and management goals.

Inspired by our experiences of Copenhagen's and Malmö's planning policies and design trials for sustainable and climate resilient cities, we integrated the design goals of the Seattle 2030 District, Seattle Public Utilities and the Belltown Community as we re-envisioned Belltown at the district, site and detail scales. Throughout the studio, we worked in tandem with people engaged in ongoing initiatives for Belltown, inviting them to the studio for guest lectures and soliciting their design critique and feedback at the mid-term workshop and final review. Both in Copenhagen and over two weeks in Seattle, Master Teacher Louise Grassov, partner at Schulze + Grassov, offered the studio invaluable insight into Danish public space design and engaged in generative design critique for each student and design project, prompting their work in Seattle to build upon lessons learned in Copenhagen and Malmö.

We have many people to thank for making this studio and study tour an extraordinary teaching and learning experience. The Scan | Design Foundation has continued to provide generous support for both the travel and studio components of this program. We are sincerely thankful for their continued support of this student learning experience. We are ever so appreciative of the insight and stamina that Louise Grassov brings to the studio through her teaching and design critique. We extend a heartfelt thank you to the community stakeholders and professionals, ranging from local residents to engineers and landscape architects for contributing their expertise and perspectives over the course of the studio. We thank the Seattle 2030 District for partnering with us and for incorporating the students’ design processes into their own visioning for the District’s potential. We thank Seattle Public Utilities for engaging with the studio to share their goals for the drainage district and for pushing student design ideas to investigate solutions to the Belltown basin’s combined sewer overflows. We are also appreciative of the Nature Conservancy’s willingness to host the mid-term community workshop in which the students presented and received feedback from a range of community and professional stakeholders. We thank you all, and hope the provocative ideas generated through this studio help make Belltown’s potential as a vibrant and resilient neighborhood tangible and inspiring.

Nancy Rottle  Professor, Landscape Architecture, University of Washington

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Students engage in an exercise that challenges them to explain their early designs to classmates unfamiliar with their projects and to integrate their design suggestions.

The Napkin Sketch project elicited a wide range of both conceptual and spatial design ideas that helped narrow down potential project site options.

Margot Chalmers diagrams and takes notes.

The class took a Saturday to visit IslandWood's environmental education campus on Bainbridge Island.

Opposite Page: Julieta Talavera, creative director of the Connector’s Society, discusses the role of public green space in Malmö's city plan.

The Seattle 2030 District has set the ambitious goal of managing 67 million gallons of the Belltown district’s stormwater and reducing potable water use by 50% below the district’s baseline by 2030, titling this array of projects, Greener Belltown: Bluer Sound. At the same time, Seattle Public Utilities has singled out Belltown for a concerted investigation of potential solutions to the neighborhood’s role in reducing its number of combined-sewer overflow events, exploring strategies to providing an additional 130,000 gallons of stormwater storage capacity. This convergence of urban stormwater management and climate resilience efforts in the Belltown neighborhood posed a fantastic opportunity for the Scan | Design Interdisciplinary studio to explore and demonstrate how these commendable goals might take shape in Belltown’s public spaces and how they might enhance the quality of public space to support urban ecology, social amenity and ultimately urban resilience.

Having experienced and learned from Copenhagen and Malmö’s pioneering work in managing and storing their stormwater through both urban scale projects and constellations of smaller interventions, the students explored both adventurous and implementable opportunities for applying those lessons in Belltown.
STUDIO SEQUENCE

1 GUIDED SITE VISIT

2 DISTRICT ANALYSIS + STORMWATER TOOLBOX

3 DISTRICT FRAMEWORK

4 SITE SELECTION + SCOPING
   3 Napkin Sketch Exercise
   12 Concept Diagrams Exercise
   Life-Space-Building Charrette

5 DISTRICT VISIONS + SITE DESIGNS
   Stakeholder Workshop
   Temporal Invitations Exercise
   Final Review

1 Nicky Bloom diagrams and sketches in the field.

2 The class reflects on their 12 Concepts project, providing a peer-review of each others’ work.
Upon returning from Seattle and starting the studio, the students were introduced to the project district and asked to work in groups to collect information about the neighborhood’s water, mobility and ecological systems. Three other groups looked at the district’s deep context, social amenities and existing/ongoing plans for the future.

In order to collectively develop a working knowledge of existing “tools” for addressing urban stormwater challenges, students were also asked to each research and report on several stormwater storage and management technologies or approaches, contributing their findings to a “City/Nature Toolbox”.

The documents produced through each of these exercises can be found on the Studio website: http://courses.be.uw.edu/SDMasterStudio

1 The Social Amenities analysis group mapped key public spaces within the district.

2 As a part of the Deep Context analysis, Yang He mapped sound intensity levels at several sites across the district.

3 The Mobility analysis group analyzed and characterized the nature of alley ways throughout the neighborhood.
Opposite Page: Yutong Hu observes the soon-to-be demolished viaduct on a site visit to the Belltown study area. Both the tunnel portal and the tunnel were identified and explored as project opportunity sites within this studio.

DISTRICT FRAMEWORKS

Having completed initial district analyses centered on inventorying and analyzing a range of existing, planned and possible conditions within Belltown, students worked in groups to develop District Frameworks for the systems they had analyzed. Groups started by evaluating the opportunities and needs of the district as they relate to: water, mobility, deep context, social amenity, and ecology. Through these district frameworks, students practiced communicating district opportunities with regards to each system by developing cohesive, functional and poetic visions. Each framework responds to the 2030 District’s and SPU’s stormwater storage and management goals, quantifying the water stored or managed if this aspect of the design were to be maximized within the district.
Opportunity sites include underutilized and heavily paved regions in Belltown, as well as cultural sites highlighted by Friends of Belltown’s plan for reflecting native history in the district’s design.

New development and pedestrian routes that are planned and in process inform the pathway and chosen water reuse tactics. New construction and buildings constructed after 2010 are viable sites for intensive green roofs.

The neighborhood has limited and very scattered green spaces. A new framework would integrate existing projects into a network of social amenities with water reuse and ecosystem functions.

The street chosen as a spine, Battery St., receives water flowing down slope from the two nearest high points. Closing the Battery Street Tunnel provides additional opportunities for regrading and a suitable pedestrian corridor.
A Greener Belltown would emphasize neighborhood-scale resiliency, water reuse practices, and creating social amenities that integrate the layered identities of the site, from its native history to the remnants of 1950s infrastructure to its current and changing built environment.

This framework suggests a decentralized and multi-faceted approach to water in the built environment by creating many small, artful diversions for water reuse that invite the public to interact with water reuse through a primary spine or water collection corridor along Battery Street, and a social and educational hub at the original site of the Little Prairie village. A series of alley way capillaries are the site of other diversions, and water collected along the roofs and facades of existing buildings lead to a water detention, filtration, and storage pathway located in the Battery Street Tunnel.
## Concept

**District Frameworks**

### Water Reuse

<table>
<thead>
<tr>
<th>WATER TYPE</th>
<th>SOURCE</th>
<th>TREATMENT METHOD</th>
<th>RECYCLING USES</th>
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</thead>
<tbody>
<tr>
<td>Roof Runoff</td>
<td>Roof</td>
<td>No treatment</td>
<td>Irrigation, toilets</td>
</tr>
<tr>
<td></td>
<td>Rainwater harvesting</td>
<td>UV or Filter</td>
<td>Potable</td>
</tr>
<tr>
<td></td>
<td>Sidewalks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greywater</td>
<td>Building (sinks &amp; shower)</td>
<td>Biofiltration</td>
<td>Irrigation, toilets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VFCW (Vertical Flow Construction Wetland)</td>
<td>toilets Washing Machine</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MBR</td>
<td></td>
</tr>
<tr>
<td>Blackwater</td>
<td>Streets</td>
<td>Living Machine</td>
<td>Irrigation, toilets</td>
</tr>
<tr>
<td></td>
<td>Toilets</td>
<td>WWTP (Wastewater Treatment Plant)</td>
<td>toilets Puget Sound</td>
</tr>
</tbody>
</table>

Filtration of greywater and blackwater from buildings, as well as collection and storage of rainwater for localized uses.

**Tunnel Reuse**

Utilizing the Battery St. Tunnel to restore the soil, store and filter water, and serve the community.

**Social & Ecological Space**

Elevating public right of way with landscape while providing places to pass, play and stay.

### Identity & Water Awareness

Displaying water while providing amenity spaces such as trash cans, public restrooms, information boards and art installations.

### Tools

- Extensive Green Roofs
- Intensive Green Roofs
- Blue Roofs
- Utilizing Balconies and Building Facades
- Visible Water Transport and Filtration
- Constructed Wetlands and Living Systems

Images by: Hanna Tania

[Drawings by: Roxanne Glick](#)
Daylighted portions of the Battery St. Tunnel would feature a series of storage, filtration, and ecological functions while serving as an educational pathway to the Little Prairie hub. Vertical layering of water filtration from rooftops to streets and sidewalks to the bottom of the tunnel connect greywater and blackwater systems to constructed wetland filtration systems.

Possibilities for greywater and blackwater filtration and storage on a district scale. Constructed wetlands accept street runoff and building runoff storing and filtering water in spaces that also function as public throughfares and amenities.
EXAMPLE PROJECTS AND CONNECTIONS

Battery Street Tunnel and Recent Building Retrofit

The Belltown street grid directs treated greywater to capillary alleys which then lead to the green spine of Battery Street with a variety of non-infiltrating bioretention and constructed wetlands.

New buildings can build extra floors (above dashed line) for installing water saving features such as intensive green roofs and greywater recycling systems. Here a green balcony system treats water.

Where Battery Street meets the viaduct remnant site, there is an opportunity to establish a Little Prairies Landmark Park on the approximate location of the lost village.

Blackwater collected in the Batter Street tunnel flows into a Living Machine™ beneath a lattice of pedestrian vistas. A cistern pond would further retain water before it is highlighted in park water features.

Buildings around the park retrofitted with blue and green roofs, green walls and green screens lead roof runoff to park landscaping and biofiltration cells.

Little Prairies Landmark Community Park

New Building on Historic Street
REFERENCES

Rainwater Harvesting and Reuse
1) Patricia H. Waterfall, “Harvesting Rainwater for Landscape Use.”
2) Ray A. Bucklin, “Cisterns to Collect Non-Potable Water for Domestic Use.”
3) Seattle Department of Construction and Inspections, “Rainwater Harvesting for Beneficial Use.”
4) Portland Water Bureau, “Resources for Rainwater Harvesting.”

Blackwater Filtration

Blue and Green Roofs
1) Philadelphia Water Storm Plan Review, Chapter 3, “Site design and storm water management integration.” Figure 3.5-8 “Full Build Out Example, Green Roof/Blue Roof” Image. https://www.pwdplanreview.org/manual/chapter-3/3.5-integrated-stormwater-management-examples
2) Cefil.co.uk, Image. Accessed October 15, 2017

Blue and Green Roofs continued

Greywater Recycling Data Sheet Sources:

Calculation Data Sources:

DISTRICT FRAMEWORK
**Rainwater Calculations**

**Roof for Rainwater Harvesting**

<table>
<thead>
<tr>
<th>Area (ft²)</th>
<th>Holding Capacity (gallons)</th>
<th>Avg Annual Roof water (gallons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE Roof Area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11,906</td>
<td>28,576</td>
<td>243,613</td>
</tr>
<tr>
<td>48,783</td>
<td>146,350</td>
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<td>26,264</td>
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<td>537,363</td>
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<tr>
<td><strong>86,954</strong></td>
<td><strong>490,095</strong></td>
<td><strong>1,779,079</strong></td>
</tr>
</tbody>
</table>

**100 Year Storm Water Managed by Green & Blue Roof**

- 24 Hour Precipitation: 3,297,838 gallons
- 6 Hour Precipitation: 1,300,922.2 gallons

**SEATTLE PUBLIC UTILITIES GOAL**

- One Combined Sewer Overflow per year
- 130,000 gallons of water storage at peak events

**SEATTLE 2030 DISTRICT GOAL**

- 50% Water Reduction and Management from Baseline
- Manage 228 million gallons/year

**Rainwater in green/blue roofs: 490,095 gallons**

- Reduction from greywater recycling: 1,284,436.8 gallons/day

**Total CSO reduction**: 1,774,531.4 gallons/day

**Membrane Bio Reaction (MBR)**

- -28% reduction

**Total Produced from Building**

- 1,783,940 gallons/day

**Greywater Produced from Building**

- 1,153,926 gallons/day

**Blackwater Produced from Building**

- 630,014 gallons/day

**Potable Water Reduction Potential as a result of Greywater Recycling**

- 1,284,437 gallons/day
- 468,819,432 gallons/year

**SEATTLE 2030 DISTRICT GOAL**

- Greywater production: 468,819,432 gallons/year
- Average roof water holding capacity: 1,779,078.85 gallons/year

**Potential Reduction**: 470,598,511 gallons/year
RAINWATER CALCULATIONS

100 year storm water managed by green/blue roofs

24 Hour precipitation: 5.07 inches x 86,954.0 ft²
  : 440,856.7 ft³
  : 3,297,837.7 gallons
6 Hour precipitation : 2.00 inches x 86,954.0 ft²
  : 173,908.0 ft³
  : 1,300,922.2 gallons

Belltown annual harvesting

BLUE Roof Area : 14883.5 ft² x 80% = 11,906.8 ft²
EXTENSIVE Roof Area : 60978.9 ft² x 80% = 48,783.12 ft²
INTENSIVE Roof Area: 328,301.1 ft² x 80% = 26,264.08 ft²
Total roof area for rainwater harvest : 86,954.0 ft²

Rainwater harvesting

Gallons per inch of rain = Roof Area x 0.6 Maximum capacity.
BLUE Roof: 4 inch x 11,906.8 ft² x 0.6 = 28,576.32 gallons
EXTENSIVE Roof: 5 inch x 48,783.12 ft² x 0.6 = 146,349.36 gallons
INTENSIVE Roof: 20 inch x 26,264.08 ft² x 0.6 = 315,168.96 gallons
Total roof water Holding capacity: 490,094.64 gallons

Average Inches of Rain per Year in Seattle = 34.1 inches
BLUE Roof: 34.1 inches x 11,906.8 ft² x 0.6 = 243,813.13 gallons
EXTENSIVE Roof: 34.1 inches x 48,783.12 ft² x 0.6 = 998,102.64 gallons
INTENSIVE Roof: 34.1 inches x 26,264.08 ft² x 0.6 = 537,363.08 gallons
Average annual roof water holding capacity: 1,779,078.85 gallons

BELLTOWN WATER USE CALCULATION

Seattle water use Gallons/Person/Day: 52 gallons/day
Belltown population: 23,915 (2014 data)
(28,698 in 2030 assuming 20% growth)
Residential potable water use: 1,243,580 gallons/day

BLACKWATER TREATMENT

5 flushes/person/day
Average toilet flush: 2.75 gal
2 x 2.75 x 23,915 (residents) = 131,532.5 gallons/day
3 x 2.75 x 60,422 (workers) = 498,481.5 gallons/day
Blackwater produced = 630,014 gallons/day

GREYWATER RECYCLING

Assuming all buildings retrofitted with separated pipes and a neighborhood greywater recycling system.

Average greywater produced by office: 0.6 gallons/person/day
Workers in Belltown: 60,422
Office greywater Production: 39,878.5 gallons/day
Residential greywater production: 1,114,047.5 gallons/day
Potential shared residential and office greywater recycling (MBR: -28%)
Total greywater Production from residential and office: 1,153,926.0
total greywater produced from residential, office and blackwater: 1,783,940 gallons/day
Potable Water Reduction Potential as a result of Greywater Recycling:
1,284,436.8 gallons/day
Reflection:

Belltown presents boundless opportunities in addressing stormwater, urban greening, and multi-modal mobility. All of the proposed design elements that reflect these opportunities also contribute to the human health and livability of this rapidly densifying neighborhood. However, there are several constraints associated with the physical layout of this site. Steep slopes make it difficult for bicyclists and pedestrians to easily access parts of Belltown, and slight re-grading is necessary if all of Belltown’s streets are to be ADA accessible and inviting to pedestrian and bicycle use. These slopes provide ample opportunity to incorporate stepped wetland filtration systems and pedestrian walkways, however this will require large amounts of grading work and infrastructure.
The public right-of-way presents a myriad of opportunities to not only improve movement through Belltown, but re-adapt the streets and alleys as social spaces. This mobility framework addresses multiple forms of movement patterns and simultaneously serves Belltown's ecological, hydrological, and social needs throughout the implementation of the following measures:

- Multi-functional streets that act as corridors and spaces for play, rest, and socializing.
- An integrated ecological and hydrological ribbon that connects the new waterfront design with the Space Needle/Seattle Center. This green ribbon acts as a habitat and pollinator corridor throughout Belltown.
- Hydrological functions that are integrated throughout Belltown, aiding in stormwater retention and filtration.
- Integrate stormwater catchment areas by the waterfront as water detention and filtration sites. These will serve social and educational functions as walkways will wind through and over the wetlands. The walkways will also serve to make Belltown's steeper streets ADA accessible.
- Multi-modal modes of transportation (in particular bicycling and pedestrian) that encourage users to wind through the connective green ribbon.
- Parking lots and alleys will be reconfigured to serve as more inviting social spaces, transforming them into green corridors. Permeable pavement will mitigate stormwater runoff through absorbing and filtering water, and green walls and plantings will serve as green corridors for pollinators, insects, birds and small mammals. Technology such as tree boxes and Silva cells will be implemented to encourage healthy canopy growth and aid in water detention and filtration.
This comprehensive diagram illustrates the needs and opportunities of Belltown neighborhood regarding mobility choices, stormwater management, urban greening and social amenities.
Address multiple issues on the site while providing various benefits for the neighborhood.
**URBAN GREENERY**

**Form:**
The ribbon of urban green runs through the site. We try to create a connection with existing trees, leading people walking as this way.

**Function:**
- Create habitat for animals
- Filter air, reduce air pollution
- Filter water
- Shading buildings, lowering cooling costs
- Reduces urban heat island effect
- Psychological benefits for city dwellers, stress reduction
- Increase property values

**User Friendly:**
Considering the slope of the street, we choose the more gentle way for pedestrian to walk. Along the walkway, we design lots of small sections as a part of our urban forestry plan.

Conceptual sections illustrate the idea of the green ribbon and its multi-functionality that could benefit the site in many different ways: stormwater, mitigation, and mobility.
Conceptual sketch showing how to integrate Silva cells with wetlands to mitigate storm water runoff.

Rain water collection from roof to the ground and reutilizing it for watering plants. Permeable pavement can receive more water and can send it to the underground storage to store, treat before infiltration to the soil. The grading and landscaping solution can create opportunities for pedestrian to stay, socialize or have a nice walk to their destinations.

Pedestrian Focused Improvements / Residential Streets:

Reimagining residential sidewalks with pervious pavement, native plants/ water absorbent vegetation, benches and wide sidewalks with subtle grading, that is comfortable for pedestrian to move, stay and play.
**URBAN WETLANDS**

**Improvement of Pedestrian Access**

These parts need to be improved for pedestrians since the pedestrian is not easily able to access the wetlands because of cars and bicycles.

**Benefits of Habitats**

This wetland can create habitat for animals. Also, this eco-water filtering system can serve clear water to not only the animals but human.

**The Wetland Bridge and the Form**

The form of zig-zag wetland bridge can hold more water and serve more habitats spaces for the animal and insects than the straight form of the bridge. It can create the connection between the ecological element and pedestrian in the city.
Observation section
Considering the pedestrian on the bridge, we choose the idea of observation section. Along the bridge way, people can observe inside the wetlands and can educate themselves about the value of integrating ecological systems into urban areas.

Temporal Wetland Walkway
This walkway runs over a series of stepped wetlands, serving both ecological and social needs. This space will be temporal, and change as rain events happen. The wetlands will be located on hills going up from the waterfront, the pathway will zigzag to be an ADA accessible walkway. By being located close to the waterfront, the wetlands will be able to catch and treat water that is flowing down from the upper section of Belltown.

During rain events, the wetlands will fill up, spilling over into one another after the ground is saturated with water. Filtration material sits below each wetland, allowing cleansed water to seep back down into the ground. The vegetation will serve as a “green corridor” to help connect habitat for insects, birds, pollinators and small mammals throughout Belltown. Users will be able to peer down below the grated walkway into the temporal wetland spaces and enjoy an elevated boardwalk experience.
BICYCLE FRAMEWORK FOR BELLTOWN

image by Farzana Rahman

Proposed bike routes in Belltown
Belltown is a challenging Seattle neighborhood to bicycle through. Between harrowingly steep hills, rush hour traffic and construction that spans miles, bicyclists have much to navigate. This framework attempts to form a safe network for bicyclists with a focus of connectivity, directness, established green spaces and limiting extreme grade changes. Our hope is that everyone will have a safe, efficient and pleasant ride.

Broad Street promises the most direct access to the waterfront bike trail near Alaskan Way.

Proposed bike paths along 2nd and 4th Avenue correlate with established green areas.

Belltown is full of sharp elevation changes but these routes along 2nd and 4th Avenue seek out the least extreme slopes available.

Vine and Bell Street establish connection between recommended routes.

image by Dorothy Mulkern
The alleys will serve as multi-functional green pedestrian corridors. They will provide stormwater collection and filtration services through the use of porous paving. Utilizing a series of filters, this paving will minimize stormwater runoff by allowing water to seep back into the ground. The series of filter materials underneath the surface of the alleys will remove pollutants such as Nitrogen, Phosphorus, and metals such as copper and lead. The alleys will also serve as habitat corridors, as they feature green walls that can provide habitat for insects, birds and pollinators. The green walls also serve as visual and textural delight for pedestrians wandering through, and will encourage people to utilize the alleyways, creating a safer environment by providing “eyes on the street”. Image by Margot Chalmers.
Parking lots are to have permeable paving installed, allowing water to be absorbed into the ground and cleansed. Trees with permeable, cleansing underground tree boxes will be installed, and the grading will adjust the flow of water to go into the tree box. This reduces the amount of irrigation the tree needs, and the tree's roots further aid in water absorption and reuse. Parking lots will be lined with green walls, furthering Belltown’s “green corridor” and habitat connectivity.

Multi-modal Mobility:

The new Seattle waterfront plan re-imagines Alaskan Way and Elliott Ave as a multi-modal corridor (Car+Bus+Bike+Pedestrian Walkway) along the waterfront with safe pedestrian connections.
WATER STORAGE/MANAGEMENT CALCULATIONS: WETLANDS

FORMULA

1. Find square footage of wetlands (draw a polygon over your plan in AutoCad, then look at properties to find square footage).

2. Find volume: Multiply square footage by average depth of wetlands.

SYSTEM'S RETENTION TIME: Minimum 4 days
FLOW-THROUGH TIME: Water must be able to pass through the system for the peak discharge of no less than a 2-yr/24-hr storm

Total flow rate infiltrating = 1.0 in/hr x 1 ft/12 in x 1000 ft squared x 1 hr/3600 sec
*Formula varies with different design criteria and materials.

BELLTOWN CALCULATIONS

AREA of PROPOSED WETLANDS: 145,201 sq. ft.

AVERAGE WETLAND DEPTH: 18”

VOLUME: 1629264.62 gallons

Seattle has an annual precipitation of 30-40” (although this may fluctuate due to climate change, with longer periods of drought and more intense precipitation)

100 year storm event = 1.4”/hr

RECOMMENDED WETLAND TYPE FOR THIS SITE: semi-wet; inundated only during storm events

Flow rate must be under 4”/sec to minimize erosion

References:


PERMEABLE PAVEMENT

Proposed opportunity areas:

**Streets:** Clay, Cedar, Vine, Wall, Battery, Bell, Blanchard, and Lenora Street.
Total square footage of these streets: 832,000 SFT (approx.)

**Parking Lots** (both private+Public): 498,156 SFT (approx.)

**Total proposed permeable surface** (Streets+Parking lots) = 1,330,156 SFT (aprx.)

**Calculation:** A typical permeable concrete pavement reservoir has a void ratio of 30% and 1 Cu.Ft (12”x12”x12”) of reservoir can hold 3 Cu.Ft of water or 2,244 gallons of water. In order to match CSO’s goal of 130,000 gallons of water storage for Belltown neighborhood, we need (130,000/2,244) = 57,932 SFT of permeable surface. Where our proposed opportunity areas including the streets and parking lots, we can store min 2,984,870 gallons of water for the neighborhood. As our proposed permeable surface areas are way more than the required storage SFT, this leaves us with more room and options for choosing strategic locations for both the permeable surface and reservoir.

However, the depth of the reservoir can vary depending on various design criteria, constraints, and storage requirements. Another important element is the material, size, and depth of the stone bedding, which must be designed so that the water level never rises into the asphalt.

**References:**


SILVA CELL CALCULATIONS

Calculation:
1. using CAD measure the length of streets where we want to put Silva cells
2. chose a mould of silica cells and use it size and find how the date of how much water it can store
3. decide the way how we set silica cells. We choose 100’ in length as a unit which included 118 silica cells
4. calculate the total number of silica cells in the whole area
5. multiply the total number of silica cells and volume of water which single silica cell could store

Reference:

<table>
<thead>
<tr>
<th>Length</th>
<th>Number</th>
<th>Stormwater Storage approx.</th>
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<tbody>
<tr>
<td>337'-8 1/2&quot;</td>
<td>397</td>
<td>7819.5 gal</td>
</tr>
<tr>
<td>805'-6 5/16&quot;</td>
<td>590</td>
<td>11597 gal</td>
</tr>
<tr>
<td>515'-4 5/8&quot;</td>
<td>606</td>
<td>11887.7 gal</td>
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<td>572'-3/16&quot;</td>
<td>674</td>
<td>13261.4 gal</td>
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<td>535'-8 7/8&quot;</td>
<td>631</td>
<td>12416.1 gal</td>
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<td>663'-2 7/8&quot;</td>
<td>782</td>
<td>15401.2 gal</td>
</tr>
<tr>
<td>238'-10 13/16&quot;</td>
<td>280</td>
<td>5521.2 gal</td>
</tr>
<tr>
<td>377'-7 3/16&quot;</td>
<td>445</td>
<td>8771 gal</td>
</tr>
<tr>
<td>461'-1&quot;</td>
<td>544</td>
<td>10699 gal</td>
</tr>
<tr>
<td>521'-9 9/16&quot;</td>
<td>615</td>
<td>12099 gal</td>
</tr>
<tr>
<td>130'-1 1/8&quot;</td>
<td>153</td>
<td>3011.6 gal</td>
</tr>
<tr>
<td>443'-3 11/16&quot;</td>
<td>523</td>
<td>10566.9 gal</td>
</tr>
<tr>
<td>392'-8 11/16&quot;</td>
<td>462</td>
<td>9087.5 gal</td>
</tr>
<tr>
<td>446'-7 9/16&quot;</td>
<td>526</td>
<td>10355.5 gal</td>
</tr>
<tr>
<td>1760'-4 3/4&quot;</td>
<td>2077</td>
<td>40814.6 gal</td>
</tr>
</tbody>
</table>

total: 183,309.2 gal
**Tree Box Calculations**

<table>
<thead>
<tr>
<th>Length</th>
<th>Number</th>
<th>Stormwater Storage approx.</th>
</tr>
</thead>
<tbody>
<tr>
<td>413'-5 1/16&quot;</td>
<td>41</td>
<td>866 gal</td>
</tr>
<tr>
<td>378'-0 1/4&quot;</td>
<td>37</td>
<td>781 gal</td>
</tr>
<tr>
<td>334'-0 3/8&quot;</td>
<td>33</td>
<td>435 gal</td>
</tr>
<tr>
<td>476'-3 5/8&quot;</td>
<td>48</td>
<td>1014 gal</td>
</tr>
<tr>
<td>283'-8 15/16&quot;</td>
<td>29</td>
<td>612 gal</td>
</tr>
<tr>
<td>429'-7 9/16&quot;</td>
<td>41</td>
<td>866 gal</td>
</tr>
<tr>
<td>366'-0 1/8&quot;</td>
<td>37</td>
<td>781 gal</td>
</tr>
<tr>
<td>386'-1 1/8&quot;</td>
<td>39</td>
<td>824 gal</td>
</tr>
<tr>
<td>337'-11 1/2&quot;</td>
<td>33</td>
<td>697 gal</td>
</tr>
<tr>
<td>382'-5 3/16&quot;</td>
<td>39</td>
<td>824 gal</td>
</tr>
<tr>
<td>719'-10 11/16&quot;</td>
<td>71</td>
<td>1500 gal</td>
</tr>
<tr>
<td>477'-1 11/16&quot;</td>
<td>48</td>
<td>1014 gal</td>
</tr>
<tr>
<td>467'-11 5/8&quot;</td>
<td>47</td>
<td>993 gal</td>
</tr>
<tr>
<td>475'-6 13/16&quot;</td>
<td>48</td>
<td>1014 gal</td>
</tr>
<tr>
<td>424'-9 9/16&quot;</td>
<td>42</td>
<td>887 gal</td>
</tr>
<tr>
<td>357'-10 5/8&quot;</td>
<td>36</td>
<td>760 gal</td>
</tr>
<tr>
<td>602'-3 7/8&quot;</td>
<td>60</td>
<td>1268 gal</td>
</tr>
<tr>
<td>572'-7 1/16&quot;</td>
<td>58</td>
<td>1225 gal</td>
</tr>
</tbody>
</table>

**Total:** 16,361 gal

**Calculations:**

1. Use the Auto CAD measure the potential parking lot where we want to put tree boxes.
2. Find how much water tree box can store.
3. Decide the way how we put tree boxes. We choose 20 feet as a unit.
4. Calculate the total number of tree boxes in the whole length of the parking lot area.
5. Multiply the total number of tree boxes and volume of water which single tree box could store the water.

**References:**

http://www.tmdl.co.kr/subpage.php?sd=38sc=3_8
District Opportunities
DISTRICT FRAMEWORK

Nina Mross, Sophie Krause, Yang He

Framework Goal = Supporting Arts, Culture, History, and Creative Expression at the neighborhood level:

Grounding a conceptual walking tour framework that enhances and daylights the many identities and sensory experiences of an adapting Belltown.

By mapping historic landmarks, cultural landmarks, and potential loved sites, this framework works to marry the history, people, eras, and arts that make Belltown an old, new, and “now” place.

In reaching to advance it’s presence as an Arts and Cultural district, how can urban nature strategies also help strengthen the four domains essential to understanding community cultural conditions and dynamics: opportunities for engagement and participation, systems of support for cultural expression, placemaking, and community building?
INTERVENTIONS

PARKING TO PRAIRIES:
NATIVE BELLTOWN VISION

ADAPT HISTORIC BUILDINGS:
Hull Building: Green-less, Hard, Heat Island

ADAPTED:
Side Cisterns, Green Facades, Planters
Image by Nina Mross
DENNY HILL WALK

**Elevated Pathway** near the site of the former summit of Denny Hill. Attached to the Monorail, this pathway connects users with the history and topography of the neighborhood. Public views of Elliott Bay and Puget Sound can be found from the top, re-democratizing what had been a public amenity before high rise development. GSI tools are integrated into the structure for performance, habitat, and beauty.

LITTLE PRAIRIES PARK

**Community Park** near the site of the original Little Prairies Village, next to the current Battery St. Tunnel entrance. Following the outline in the Native Belltown Vision Plan, this park incorporates desired design elements as well as dense GSI.

**PLANTING PALETTE**

- Gaultheria shalon
- Rosa nutkana
- Pinus contorta
Making Outfall Events Visible

Using the NPS069 Outfall to highlight how stormwater management works in urban areas.

From Viaduct to Art Space: Public Art Pillars

Some remaining parts of the Viaduct can be a historical and cultural landmark for Belltown and it would be cool for the future generation to see the Viaduct. In our plan, instead of removing the whole viaduct, we’re keeping some pillars from the viaduct and making it a “canvas” for artists. Local artists and art lovers will be welcomed to paint on these pillars. The Art Pillars will make the streetscape more vivid and fun and thus add to the cultural identity of this art district. On the top of the pillars, there are some cisterns collecting water and irrigating the plants. In this way, the pillars will be turned into artful green stormwater infrastructure.
WHAT CAN A CISTERN SAY?

Materiality can be performative, such as using historical photographs etched into glass as panels for an external cistern sculpture. Imagine standing outside of NPS069 and being able to see historical imagery of what the area looked like during the Denny Hill Regrade era.
ADAPTING HISTORIC BUILDINGS

What if every historic building in Belltown had...

A Blue Roof...

An External Cistern...

A Rain garden...

Evapotranspiration on Green Facades:
If each historic building had two mature wisteria vines or greenscreens, that would mean processing 506,000 gallons of water over a summer.

23 Historic Buildings
220 gallons/day x 100 days of summer = 22,000 gallons
22,000 gallons x 23 buildings = 506,000 gallons

Historic Buildings
Average Roof Area Per Building 23 7,000 sq. ft.
Avg. Depth of Blue Roof 3”
Volume of Water Per Building 13,090 gallons
Potential Site Area 206,667 sq. ft.
Average Water Storage Depth 4”
Cubic Feet of Water 68,900
Volume of Water Per Building 13,090 gallons
Historic Buildings
Average Size Garden 23 30 sq. ft.
Avg. Depth 6”
Rainfall Captured in Rain Event 70 gallons

Total Volume of Water 301,070 gallons
Total Storage Potential 515,400 gallons
Total Volume of Water 1,610 gallons
**BLUE ROOF STORAGE:**
- Ave roof area: 7,000 ft²
- Blue roof depth: 3”
- Storage per building: 13,090 gals

\[
13,090 \times 23 = 301,070 \text{ GAL}
\]

**SIDES CISTERN STORAGE:**
- Size of Beckoning Cistern
  - 15’ x 6’
  - 3,000 gals

\[
3,000 \times 23 = 69,000 \text{ GAL}
\]

**RAIN GARDEN STORAGE:**
- 30 ft
- 6” Depth
- 112 gals

\[
112 \times 23 = 2,576 \text{ GAL}
\]

\[
= \text{TOTAL STORAGE: 372,646 GALLONS}
\]

**GREEN FACADE EVAPOTRANSPIRATION:**
- Two mature climbing vines
- 2 vines transpire 220 gals/day in the hot season
- 220 \times 100 \text{ days} = 22,000 gallons

\[
22,000 \times 23 \text{ BUILDINGS} = 506,000 \text{ GAL}
\]

**ROOF RUNOFF:**
- 1” Storm:
  - 7,000 ft² \times .83 \times .623 = 
  - 3619 \times 23 = 83,251 \text{ Gal}

\[
\text{YEARLY: 83,251} \times 40” = 3,330,059 \text{ GAL}
\]

References:
1) https://www.seattle.gov/arts/arts-and-cultural-districts - Office of Arts and Culture
2) http://friendsofhistoricbelltown.org/wp/ - Friends of Historic Belltown
3) http://www.belltownartwalk.com/ - Belltown Art Walk
Maximizing Wide Sidewalks:

Green walls on the neighborhoods building facades utilize and slow stormwater runoff from rooftops. The north-east side of the buildings supports healthy management of the vegetation due to the orientation to the sun and managed water access from rooftop cisterns. These wide sidewalks on the shadier side of the street allow for large and continuous bioretention cells to manage water from all surrounding impervious surfaces.
There are few existing open-space opportunities within Belltown and the existing parks are highly used by residents. The new waterfront design opens new opportunities for social staying and access into the neighborhood. Pedestrians corridors are connected through the streetscapes leading to and from the surrounding neighborhoods. Greenwalls can be utilized on existing blank facades for slowing stormwater, fighting heat island effect, and supporting natural processes. The core of Belltown is the focus of developing social spaces and networks of movement inwards. Locations for bioretention planters, both flat non-infiltrating and tiered weirs. Sub-surface connections allow planters to work as integrated units maximizing water retention. Private social space in buildings. Study area boundary.
BIORETENTION CELLS

43 DISTRICT FRAMEWORKS | SOCIAL SPACES

With the larger frame of integrating green stormwater infrastructure to not only meet stormwater management goals but also to enhance public life, it seemed intuitive to first notice where people are moving and where they are staying. 1st and 2nd Avenue are activated by businesses and restaurants, while 3rd Avenue is a heavily trafficked transit corridor. Wide sidewalks on these avenues present an opportunity to integrate bioretention cells, which can filter water from impervious surfaces before directing it through an under-drain.

Placed on the sunny side of the avenues where people are likely to stay, bioretention cells also present an opportunity for social amenity. They may provide seating, buffer pedestrians from the street, or help form a protected bike lane. In all cases, they can make stormwater management a more visible, and beautiful, process.

Water + People = Robust Public Life

Current Sidewalk Conditions

Current sidewalks along avenues feature some tree canopy but little other green space. Bioretention cells could function as a small but impactful intervention.

Google Maps

Google Maps
Different Options for Placement
Bioretention cells could help delineate space for a protected bike lane, enhancing pedestrian flows and prioritizing biker safety. Especially on streets identified as busy transit corridors, bioretention cells would improve air quality, reduce the amount of impervious surface, and provide traffic calming. Leaving space in between bioretention cells could also provide room for parallel parking, if desired.

Encouraging Staying
Bioretention cells with opportunities for seating can buffer people from the street and encourage them to stay.
Our goal was to blend street designs that could lead people to linger and socialize in with stormwater management solutions. In Belltown, there are great examples of how roofwater can be captured and detained before entering the storm drain. However, there exists the need to address street and sidewalk runoff. To combat this issue, we have imagined a terracing bioretention system that has curb cuts to capture street runoff and sidewalk gutters to catch sidewalk runoff. Benches that saddle the terraced rain gardens will help slow the movement of water, while providing a place for people to sit and enjoy the street.

This stormwater management would be implemented on all of the sidewalks between 1st Avenue and Elliot Avenue. The steep topography and current impervious surface that dominates the terrain calls to the need to slow the movement of water in the area.
Invitations to Stay:
Alongside addressing street and sidewalk runoff, seating can be incorporated to invite residents and visitors of Belltown to enjoy the street.
Green Bus Stops as Social/Educational Spaces

Belltown has excessive impermeable surfacing, a lack of green space, a shortage of social spaces, and an apparent lack of awareness of the stormwater contamination of the Puget Sound happening right at the base of the hill. One solution that would address several of these factors simultaneously would be to convert all public transit stop shelters into functional, educational green roofs. While the overall square footage available to convert is only around 3,000 square feet, one advantage of green roofs at street level is to teach people about their function and use while creating much-needed beautiful gathering space. While massive green roofs on the large, private, flat roofs that abound in Belltown would create a more significant benefit in terms of stormwater management, bus stops offer a supplementary tool that operates on public infrastructure that is already built. Bus stops create a pre-existing potential network for education, and converting the roofs and installing art and educational signage describing other green stormwater infrastructures operating in Belltown would influence a large audience of public transit users, thus improving both the corridor functioning of Belltown and also providing critical patches of “stay” space.
Bus Stop Converted to Green Roof

Precedent: San Francisco

Precedent: Sheffield

Precedent: Sheffield
Image: pbs.twimg.com

Image: OurTravelPics.com + Nicky Bloom

DISTRICT FRAMEWORKS
Street Runoff:

Our project site is full of streets and alleys that produce large amounts of stormwater, currently sent directly to water treatment. We propose capturing as much street runoff as possible to store for irrigation and other non-potable uses.

Stormwater captured would be captured from roofs and streets, and flow into the waterbar/trench drain system. From there, water is directed into bioretention planters and cisterns.

Runoff Volume:

Runoff from streets and alleys in our study area is estimated at 14,609 gallons per hour, or the volume of 6 Beckoning Cisterns (left) for every hour of rainfall. This huge volume represents a significant opportunity for water pooling, storing, and reuse.

Harnessing this water could contribute substantially to Belltown's current goals for stormwater management and potable water use reduction.

Alleys:

Stormwater flowing into alleys can be collected using covered channel trench drains (above left) or simple waterbars (above) depending on factors such as grade change/topography, connections with other GSI interventions, risk of flooding, etc.

Drains on Streets with Crowns:

Streets with crowns (non alleys) are designed to shed water to either side. Instead of sending that water to the sewers, water enters a covered channel-style drain and begins to flow through the stormwater interface.
REFERENCES


Central Coast Low Impact Development Initiative. “LID Plant Guidance for Bioretention.”


https://www2.iccsafe.org/states/Virginia/Plumbing/PDFs/Appendix%20B_Rates%20of%20Rainfall%20for%20Various%20Cities.pdf


STORMWATER RETENTION CALCULATIONS

GREEN WALLS
Technology:
- Using a cistern to capture storm-water
- Drip irrigation using .5 gal/hr emitters per ‘system’
- Calculating the storm-water retained only
- Based on 25 sq ft green wall ‘systems’
- Each ‘system’ handles 5.3 gal/day

Average height of buildings: 6 stories
Total blocks in study area: 46
Average facade usable on block: 50%
Average length of the blocks: 290 feet
Average facade usable: 29%

Calculation:
60 ft (height) x 290 ft (block) x .5 (coverage) =
270 sq ft x 29 % (facade use) x 46 (blocks) =
36,390 sq ft / 25 sq ft (GW systems) =
1,455 (25 sq ft systems) x 2.5 gallons =
3,640 gallons of runoff/day x 365 =
1,328,600 gallons of runoff/year


STREET RUNOFF
The length of each road was measured using GIS from the center of the street for site boundaries, and to the curb for all others.

Average Street Width: 54 feet
Average Avenue Width: 42 feet
Alley Width: 20 feet

Formula for Runoff Volume:

\[
\text{Runoff Volume in cubic feet/hour} = \left( \text{Rainfall depth/hour} \times \text{Runoff coefficient} \times \text{Square footage} \right)
\]

Runoff coefficient: 1.4 inches/hour = .117 feet/hour
*claims to be for a 100 year storm event as classified in 2006*

\[
\left( .117 \text{ feet/hour} \times .98 \text{ for pavement} \right) \times (17033.52 \text{ square feet}) = 1,953.1 \text{ cubic feet/hour}
\]

cubic feet to gallons:

\[
\text{runoff in gallons/hour} = \left( \text{runoff in cubic feet/hour} \times 7.48 \text{ gallons/cubic foot} \right)
\]

\[
(1,953.1 \text{ cubic feet/hour}) \times (7.48 \text{ gallons/cubic foot}) = 14,608.9 \text{ gallons of runoff/hour}
\]

assuming 40” rainfall a year,

\[
584,357 \text{ gallons of runoff/year}
\]

GREEN ROOFS ON BUS STOPS
There are about 17 bus stops in the study area, and each bus stop is around 18’x10’, which means there is approximately 3,145 square feet of roof space available on public bus stop roofs.

If 100% of that available bus stop roof space was converted to green roof planting, then according to the District 2030 Stormwater Calculator, the network of bus stop green roofs could manage about:

22,600 gallons of stormwater per year

\[ \times 17 \]

36,000 gallons of stormwater per year

\[ \times 17 \]

DATA: DISTRICT 2030 STORMWATER CALCULATOR

GREENER BELLTOWN : BLUER SOUND  City / Nature for Urban Resilience
BIORETENTION CELLS:
These calculations are based on the placement of bio-retention cells along sidewalks on the north (sunny) side of avenues within the study area.

Though bioretention cells will vary in size depending on contextual constraints and needs, we will make generalizations about the average size of a cell. The National Association of City Transportation Officials (NACTO) suggests a minimum width of 4 ft and length of 10 ft, with a maximum ponding depth of 6 in. Maximum soil depth is 36 in.

The amount of stormwater managed by this intervention will be purportedly equal to the Soil Storage Volume of one bioretention cell, multiplied by the proposed number of bioretention cells within the study area.

Soil Storage Volume (ft³) =
Soil Area (ft²) x
Soil Depth below the overflow (ft) x
Void Ratio (0.2 for bioretention soils)

SSV for one bioretention cell:
40 ft² x 3 ft x 0.2 = 24 ft³

Number of Avenue blocks in site area: 41
Average length of Avenue block: 418 ft
Average length of bioretention cell: 10 ft
Average number of cells per Avenue block (allowing for a 10 ft pedestrian cut through after each 40 ft of cells): 33
Number of cells in study area: 1,353

1,353 bioretention cells x 24 ft³ = 32,472 ft³

1 ft³ = 7.48052 US liquid gallons

Total stormwater managed by 1,353 bioretention cells:
242,907.43 gallon
510,104 gallons of runoff/day
186,187,960 gallons of runoff/year

BIORETENTION TERRACE:
The bioretention terracing solution would be placed from Broad Street to Lenora between 1st Avenue and Elliot Avenue. Making them 3ft wide and the length of the sidewalk would give us about 597,600 ft² of bioretention surface area. We are assuming this slope would be planted with sandier soils and would be 3ft deep. The total volume of the bioretention cells in the area would be 1,792,800 ft³.

We have calculated how much rainfall this solution could possibly soak up by assuming an infiltration rate of 3.5in per hour for a 24 hour period. Multiplying this by total volume, we assume this strategy could infiltrate 752,976 gallons/day or

274,836,240 gallon of runoff/year

TOTAL WATER RETENTION POSSIBLE:
462,973,157 GALLONS MANAGED PER YEAR

DISTRICT FRAMEWORK:

ECOLOGY

Julia Brasch, Allison Ong, Diana Settlemeyer and Jess Vetrano

This framework aims to maximize the potential biodiversity, habitat connections, and habitat typologies in Belltown.
ECOLOGY: EXISTING CONDITIONS

LEGEND
- Tree (Height>35ft + Spread>25ft)
- Belltown Study Area
- Unkept Vegetation
- Areas of Potential
- Green Roof
- Urban Park/Planter

map by Jess Vetrano
Existing Conditions

The existing ecological typologies (explored in the ecology district analysis) were analyzed and condensed to display where the most potential lies for future habitat in Belltown. The trees in the neighborhood were inventoried and narrowed down to display those with the most potential for creating habitat canopies, which we define as trees that grow taller than 35’ and spread wider than 25’. Parks, plazas, and planters are identified using the same symbology as they provide similar habitat conditions. Unkempt vegetation and areas of potential are displayed as areas with the least existing habitat, but the fewest constraints for creating new habitat. Finally, the existing distribution of green roofs is included to display the non-ground level habitat that Belltown currently contains.
In addition to examining connections within the project area, this framework looks beyond the site boundaries to external nodes of biodiversity. It is important to pay attention to their role in the ecology of the area and enhance their connections to the site.

**Biodiversity Connections**

Streets with potential for continuous canopy are designated **Canopy Corridors**. Continuous canopy supports habitat and migration for birds and insects. Intersecting corridors are buffered by green roofs and walls.

Streets that lack potential for continuous canopies but have other green interventions such as planters, were designated **Garden Streets**. This typology caters to a more human scale while still contributing to a green Belltown.

Parking lots and sites to be demolished represent opportunities to create new habitat from scratch. We envision these to be radical **Habitat Epicenters** where living things of all kinds are invited to stay.
Images by Allison Ong and Diana Settlemyer
GARDEN STREETS

Garden streets build off of existing habitat typologies that cater to the human-scale. An existing example of this typology is Bell Street Park, which contains planters and small street trees, but primarily aims to prioritize pedestrian mobility. As a result, garden streets will incorporate similar scales of vegetation as already exist, and will serve smaller species.

Flora
Vine Maple | Bee Balm | Twin Berry | Red Alder

Fauna
Honey Bee | Anna’s Hummingbird

Tools
Bioretention Planters | Green Walls | Green Facades | Pollinator Strips | Insect Hotels | P-Patch

Images by Allison Ong & Julia Brasch

Existing garden street (Bell Street)


Insect hotel typologies

Average streetscape (left) transitioned to pollinator strip (right)
Continuous canopy corridors build on streets that already have large growth trees with spreads that are able to connect in the center. These corridors expand beyond the street level, incorporating habitat on roofs as well. It aims to accommodate birds and insects from a sky standpoint, creating habitat above the urban life.

**Flora**
- English (hedge) Maple | Red Oak | Western Red Cedar | Douglas Fir

**Fauna**
- Chickadee | Bushtit | Townsend’s Big-Eared Bat | Pileated Woodpecker | Peregrine Falcon

**Tools**
- Pollinator Strips | Insect Hotels | Canopy Trees | Green Roofs (including roof agriculture) | Blue Roofs | Constructed Wetlands
Elevated pedestrian/bicyclist path

Constructed wetland

Seun City Walk

vaswcd.org

Allison Ong & Julia Brasch
Habitat epicenters utilize areas that are considered “blank slates” from an ecological standpoint, meaning they have no established habitat typologies to build off of. As a result, the proposed interventions within this category are more radical than those found in the previous two. They aim to introduce new habitat to Belltown, and create areas that maximize habitat potential and accommodate unique and/or endangered species.

For Battery Street, we propose utilizing debris from the demolished viaduct to partially fill the Battery Street Tunnel. The remainder of the tunnel should be filled with gravel and sand below Silva/strata cells that can support a wider variety of vegetative habitat than is possible elsewhere in Belltown. At the Battery Street Portal Site, we propose a constructed wetland area that will introduce an entirely new habitat typology to the area. A raised pedestrian/cyclist walkway could be incorporated for connectivity and natural immersion.

The Harbor Habitat Epicenter would include building off of the seawall remodel project to enhance the shoreline for aquatic habitat, as well as introducing floating wetlands in the harbor where possible. Some viaduct infrastructure could be maintained to support roosting posts for large harbor birds (osprey, eagles, etc.), or even raised habitat islands.

Potential future habitat epicenters could be included in the expansion of the p-patch into the adjacent surface parking lot, as well as the transition of the other surface parking lots to vegetated areas and potentially additional constructed wetlands.

**Flora**

Red Twig Dogwood | Willow | Eelgrass

**Fauna**

Osprey | Oregon Spotted Frog | Northern Leopard Frog | Dragonfly

**Tools**

Strata Cells | Bat Boxes | Habitat Islands | Floating Wetlands | Pollinator Strips
GREENER BELLTOWN : BLUER SOUND  City / Nature for Urban Resilience

63 DISTRICT FRAMEWORKS  |  ECOLOGY

Images by Allison Ong

Washington Post
Constructed nesting post

baltimorewaterfront.com
Constructed wetland in harbor

EELGRASS  SALMON  OSPREY
**Bat Houses**

- Typically roost under the bark of a dead tree and other safe crevices
- Bat Houses can be placed on buildings or on poles with at least 20 feet of open space
- Supports Big Brown Bat (Eptesicus fuscus), Little Brown Bat (Myotis lucifugus), Mexican Free-Tailed Bat (Tadarida brasiliensis), Pallid Bat (Antrozous pallidus), and Yuma Myotis (Myotis yumanensis)
- A common single-chamber bat house is capable of housing 50 bats, while a larger multi-chamber design can attract nursery colonies of 200 or more bats
- Ten bat houses spread along the harbor and into the Battery Street site would provide **habitat for around 2,000 bats**

**Constructed Wetlands**

- Located over the Battery Street Tunnel and the Battery Portal Site
- Provides habitat for hundreds of species of birds, amphibians, and insects
- Serves as a food source for the bat houses in these areas
- With a 6 inch gap between the berm and the surface of the water during normal conditions, these wetlands could **accommodate over 500,000 gallons of water** during a major storm event

**Bat Houses**

- Located along Garden Streets because of their need for partial sunlight and their educational potential for pedestrians
- Useful for insects that hibernate in the winter
- Offers habitat for pollinators and insects that eat garden pests
- Caters to beetles, ladybugs, butterflies, and green lacewings
- Just a handful of insect hotels could **add thousands of beneficial insects**

**Pollinator Strips**

- Some pollinators can only fly about three blocks before they need more food, so creating strips throughout the neighborhood is essential for pollinator survival
- **Pollinator habitat almost quadruples** by just using existing planting space more effectively — wildflowers and herbs instead of lawns and mulch, and fruiting trees rather than just leaf canopies
- Should contain a wide variety of species that bloom at different times of the year and provide a spectrum of different colors
- There should be at least 5-7 plants (or 9 ft²) in each pollinator attraction area, and there should be some repetition of species within these groupings
- This framework has the potential to provide over **100,000 square feet of pollinator strips** if they were to be implemented at 3 ft widths along every proposed street typology

**Canopy and Bird Habitat**

- In order to provide valuable habitat for bird populations using street vegetation:
- Structural diversity (the use of plants of a variety of heights and densities) is very important, and
- The presence of a diversity of tree ages, as dead or dying trees serve as nesting places for many species
- Selecting native plants that offer flowers and fruit can support increased bird numbers by providing food
- Plants that support insect populations in turn support bird populations
- Maintaining existing large trees as much as possible: **the larger the tree, the more habitat it offers.**
- With the addition of a strategic plant selection along the identified key corridor streets in Belltown, bird habitat could be increased significantly.
- A total of **15,250 ft of canopy** could be produced in the framework plan (including embellishment of existing canopy)
  - 12 sides of blocks at 400 ft = 4,800 ft
  - 25 sides of blocks at 250 ft = 6,250 ft
  - 14 sides of blocks at 300 ft = 4,200 ft.

**Insect Hotels**

- Some pollinators can only fly about three blocks before they need more food, so creating strips throughout the neighborhood is essential for pollinator survival
- **Pollinator habitat almost quadruples** by just using existing planting space more effectively — wildflowers and herbs instead of lawns and mulch, and fruiting trees rather than just leaf canopies
- Should contain a wide variety of species that bloom at different times of the year and provide a spectrum of different colors
- There should be at least 5-7 plants (or 9 ft²) in each pollinator attraction area, and there should be some repetition of species within these groupings
- This framework has the potential to provide over **100,000 square feet of pollinator strips** if they were to be implemented at 3 ft widths along every proposed street typology

**Insect Hotels**

- Located along Garden Streets because of their need for partial sunlight and their educational potential for pedestrians
- Useful for insects that hibernate in the winter
- Offers habitat for pollinators and insects that eat garden pests
- Caters to beetles, ladybugs, butterflies, and green lacewings
- Just a handful of insect hotels could **add thousands of beneficial insects**

**Canopy and Bird Habitat**

- In order to provide valuable habitat for bird populations using street vegetation:
- Structural diversity (the use of plants of a variety of heights and densities) is very important, and
- The presence of a diversity of tree ages, as dead or dying trees serve as nesting places for many species
- Selecting native plants that offer flowers and fruit can support increased bird numbers by providing food
- Plants that support insect populations in turn support bird populations
- Maintaining existing large trees as much as possible: **the larger the tree, the more habitat it offers.**
- With the addition of a strategic plant selection along the identified key corridor streets in Belltown, bird habitat could be increased significantly.
- A total of **15,250 ft of canopy** could be produced in the framework plan (including embellishment of existing canopy)
  - 12 sides of blocks at 400 ft = 4,800 ft
  - 25 sides of blocks at 250 ft = 6,250 ft
  - 14 sides of blocks at 300 ft = 4,200 ft.

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**References:**


NRSC. “Pollinator Biology and Habitat.” April 2013. Web.

www.audubon.org/magazine/july-august-2013/how-create-bird-friendly-yard


DISTRICT FRAMEWORKS | METRICS

GREENER BELLTOWN : BLUER SOUND  City / Nature for Urban Resilience

photo by Tatyana Vashchenko
<table>
<thead>
<tr>
<th>TARGET</th>
<th>STRATEGY</th>
<th>CAPACITY</th>
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<td><strong>SEATTLE 2030 DISTRICT’S STORMWATER MANAGEMENT TARGET:</strong></td>
<td><strong>FRAMEWORK STRATEGIES:</strong> green walls, bioretention cell avenues, trees at bus stops, bioretention cell terraces, blue roofs on historic buildings, extensive green roofs, intensive green roofs on future buildings, permeable paving on select streets, detention wetlands along waterfront, filterra treeboxes along “the green ribbon”</td>
<td><strong>STORMWATER MANAGEMENT POTENTIAL:</strong> 894,413,635 gallons managed per year</td>
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<td><strong>61,000,000 GALLONS MANAGED PER YEAR</strong></td>
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<td><strong>STORMWATER STORAGE POTENTIAL:</strong> 2,338,670 gallons</td>
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<td><strong>SEATTLE PUBLIC UTILITY’S STORMWATER STORAGE CAPACITY TARGET:</strong></td>
<td><strong>FRAMEWORK STRATEGIES:</strong> green walls, blue roofs on historic buildings, side cisterns, rain gardens, combined roof to rain garden, green screen (evapotranspiration), intensive green roofs on future buildings, Silva Cells on “the green ribbon”</td>
<td><strong>POTENTIAL POTABLE WATER SAVINGS:</strong> 468,819,140 gallons</td>
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<td><strong>130,000 GALLONS</strong></td>
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Opposite Page: Hanna Tania presents her group’s vision for the Belltown District. Their approach consisted of a myriad of creative small-scale interventions organized into a game that could be played at public outreach events.

Having spent several weeks analyzing the Belltown District and developing design frameworks and strategies for key systems shaping this neighborhood, the class collectively identified and narrowed a range of opportunity sites. The opportunities identified ranged from bounded parcels, to networks of streets, to flexibly deployable interventions. Students formed groups based on their design interests and developed robust visions that hold the potential to catalyze a more socially, ecologically and hydrologically resilient public realm in Belltown.
DISTRICT ANALYSIS

Transportation
There are various types of roads in Belltown. Road typology helps to decide the main function of the street through project analysis.

Streets Facilities
Based on usage, there are three different spaces identified which can be potential spaces for human activities and biodiversity.

Water Management
The district network of sewer and drainage is used as a base map for interventions related to stormwater to mitigate the CSO issue.

Building Types
The buildings types are used to determine the interventions to be applied to enhance the public realm.

DISTRICT VISIONS:

SMALL-SCALE INTERVENTIONS

Hanna Tania, Yutong Hu, Yunxin Du

An urban public realm is interconnected by the experience of walking and staying on the street. This project identifies opportunities for introducing various small-scale interventions in Belltown. Using the toolbox of interventions that are developed in this project, a wide range of interventions can be layered and integrated to develop multi-functional spaces that address urban resilience, elevate the public realm, create habitat and manage stormwater.

Belltown is rapidly growing with a lot of development in progress. Each street serves different modes of transportation and is surrounded by a variety of building types. With its unique features, patterns, and qualities, there are many needs and opportunities identified within the neighborhood. This project focuses on identifying different street categories and types of street users to further develop the small-scale interventions that have the potential to elevate the urban experience.
TYPES OF POCKET SPACES

For Car
- Sound cancellation
- Safety
- Good visibility
- Temporary parking
- Shared street with bike lanes

For Pedestrian & Green
- Seating areas
- Street aesthetics
- Place for children and elders
- Balance of trees and visibility
- Light
- Right soil selection
- Branding, identity & art

For Stormwater
- Water collection features
- Site water treatment
- Detention areas
- Cisterns
- Education
- Play

For Social
- Minimal intervention
- Seating, shelter
- Branding, identity & art
- Water closet
- Street vendors
- Street aesthetics

For Bus Stops
- Seating areas
- Social zone
- Rain shelter
- Green roof (bird habitat)
- Interactive space
- Education
- Branding, identity and art

For Alleys
- Seating areas
- Green walls
- Pathway
- Light
- Community gathering
- Branding, identity and art
- Water detention
OBJECTIVES

Lifting the quality of the public realm in Belltown by adding elements that are inviting and sustainable.

Stormwater:
- Harvest
- Reuse
- Retention
- Infiltration
- Treatment

Public Realm:
- Inviting & Attractive
- Connectivity
- Comfort
- Human Scale
- Community Engagement

Ecology:
- Wildlife Habitat
- Adaptive / Resilient
- Energy / Sustainable

Priorities

Every intervention in the toolbox has multiple functions. Some will place greater focus on one element over others:

- Incorporating STORMWATER management
- Producing ENERGY in an urban setting
- Creating the IDENTITY of Belltown
- Introducing urban LIGHTING elements
- Providing spaces for BIODIVERSITY in the urban area
- Engaging PEOPLE with experience

Qualifications

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SMALL SCALE INTERVENTIONS TOOLBOX FOR BELLTOWN

HOW TO USE THE TOOLBOX?

STEP 0: Choose a site in Belltown that needs to be improved.
Analyze the site opportunities and limitations.

STEP 1: How to negotiate people and cars?

STEP 2: How to treat the street surface?

STEP 3: How to treat pedestrian space?

STEP 4: Which interventions for water and biodiversity?
Which interventions for culture and identity?

STEP 5: Further develop the interventions to site specific requirements
**STEP 1: CAR - PEOPLE NEGOTIATION**

**STEP 2: STREET GROUND TREATMENTS**

**STEP 3: PEDESTRAIN SPACE TREATMENTS**

**STEP 4A: WATER & BIODIVERSITY INTERVENTIONS**

**STEP 4B: HUMAN & IDENTITY INTERVENTIONS**

- **PUSH**
  - Collect water and layer space in between the terrace areas which allow different usage of space in different periods of time.

- **TERRACE**
  - Roof overhangs that collect and filtrate rainwater while providing space for biodiversity.

- **RAINFALL**
  - Decorative elements on the floor to elevate public right of way aesthetics and experiences.

- **DEPRESS**
  - Collect rain water and create a separate layer of space.

- **NOT A TREE**
  - Tree-like structure provides areas to transfer and filtrate greywater while providing areas for biodiversity and pedestrian space.

- **PATTERN & COLOR**

- **ART ON FLOOR**

- **URBAN INFORMATION**
  - Billboards to educate and raise awareness of the city goals of cost and saving by recycling water and using other means of transportations.
SEASONAL CHANGE

The small-scale interventions work all year round. In different seasons, they serve different functions. The design for the interventions has to be adaptable to respond to a variety of needs. These multi-functional interventions could benefit the community both in rain or shine, day or night, winter or other seasons.

STREET ANALYSIS

Every street in Belltown has different characteristics. In order to develop street design prototypes, the streets are categorized by the buildings’ functions: either residential and/or retail spaces. The scale of the building impacts the street characteristics and requirements for the public realm. With mixed-use housing under development and the neighborhood becoming denser with high rise towers, three street design prototypes are developed. “Urban backyards”, “social nodes”, and “connectivity spaces” serve as references of how to apply the small-scale intervention toolbox on other streets in Belltown.
SITE IMPLEMENTATION

- **PUSH** + **RAISE**
- **PULL** + **TEXTURE** + **DEPRESS**
- **PUSH** + **TERRACE** + **PATTERN & COLOR**
- **RAIN CURTAIN** + **GREEN WALL** + **WATER SCULPTURE**
- **GREEN BOX**
- **NOT A TREE** + **GREEN LANE**
- **ART WALL** + **URBAN INFORMATION**
- **SHELTER** + **SEATING**
- **CANOPY** + **SEATING** + **SIGNATURE** + **ART ON FLOOR**

**URBAN BACKYARD**

**CONNECTIVITY SPACE**

**SOCIAL NODE**
URBAN BACKYARD

The site is located on Blanchard Street, between 1st and 2nd Ave, surrounded by low-rise residential buildings. As the urban backyard for the district, the design focus is place-making on an urban green and neighborhood-friendly street. The improvements in creating new public spaces and mitigating stormwater through a range of processes are achieved by the applications of the following small-scale interventions:

- Step 1 Push
- Step 2 Pattern and Color
- Step 3 Raise
- Step 4A Rain Curtain, Water Sculpture, Green Wall
- Step 4B Seating, Art wall, Urban Information
SMALL-SCALE INTERVENTIONS

BIODIVERSITY CORRIDOR
- Canopy
- Green Roofs
- Planters

PUBLIC REALM
- Circulating
- Gathering
- Biking

STORMWATER MANAGEMENT
- Infiltration
- Detention
- Harvesting
- Filtration

SECTION 1"=12'
**SOCIAL NODE**

The site is located on 3rd Ave, between Cedar Street and Vine Street, which has bus stations distributed on both sides of the avenue. It is a two-lane road and 90 feet wide which could provide enough space for bus stations and human activities. Currently the bus stations are very simple and have no sitting place. To elevate the experience, series of small scale interventions will be introduced as follows:

- **Step 1**  Pull
- **Step 2**  Texture
- **Step 3**  Depress and Raise
- **Step 4A**  Green Box and Green Lane
- **Step 4B**  Shelter and Seating

**BIODIVERSITY + STORMWATER + PUBLIC REALM**

Raising spaces that separate people and cars while providing space to collect water that flows through shelters. The green roof on the shelter serves to enhance biodiversity.

**STORMWATER + PUBLIC REALM**

Rain water is filtered as it moves through green boxes. Those green boxes create a safe public space for human activities, providing privacy and have visibility at the same time.

**BIODIVERSITY + PUBLIC REALM**

The rainwater that is collected from the surrounding buildings’ roof is transported through a channel while low green boxes help separate cyclists and pedestrians.
VERTICAL LAYERS

Water retention
Shelter

Green box
Social zone

Water detention
Swing

Parking space
Combine with the bus station and bike lane, and pull street to create temporary parking space. Use permeable pavement to help drain rainwater

Bus station
Pull street to separate cars, cyclists, and pedestrians, and create safe space for bus station

Green space
Use intersections to create green space to contain water and provide habitat for biodiversity

SECTION 1'12"
CONNECTIVITY SPACE

Vine St has been a green belt for Seattle. The block in between Elliott Ave and Alaskan Way has yet to be developed. This street is next to Victoria clipper, Olympic Sculpture Park, dense housing, and receives a lot of throughfare. The CSO outfall is located close to this location, making this site an important area to manage rainwater flow. With a steep elevation and under-utilized streets, the area is proposed to be the Street Park of Belltown, closing it to car traffic to accommodate new space for people to stay and linger and stormwater management.

STEP 1:
Push

STEP 2:
Table + Color

STEP 3:
Raise + Terrace + Layer
SMALL SCALE INTERVENTIONS

4. GreenLane
   Filters rainwater

5. Gateway
   Creates identity for the area

6. Water Sculpture
   Detains and retains water during heavy rain to reduce load on the CSO system

7. Fun-ctional
   Urban gym and playscape

8. Seating + Signature
   Elevate public realm and create identity for social space

WINTER CONDITIONS
Provide space for snow overflow to prevent salted snow from filling the planter boxes

The social space will re-activate the tree's blank facade.
In Seattle’s alleys, the city’s hidden functions are tucked away. Vents hum, deliveries are received, trash is left behind or discovered. Alleys are ducked into or hurried through, afloat with strains of jazz or the steady drip of leaky air conditioners. As a ubiquitous space in the city, they present the potential for a landscape design laboratory — a series of spaces with common conditions and dimensions, but particular contexts and restraints.
Presented here are two designs of prototypical alleys for a network of shared pedestrian alleys throughout Belltown. These passageways act as an internal circulation system of connections to cultural hubs in the neighborhood, while also providing invitations to linger in spaces that are typically hurried through. Each representing a distinct alley typology, both designs transform unactivated and underutilized public rights-of-way into lively public space geared toward water storage, detention, infiltration, and conveyance that would mitigate the effects of stormwater on Elliott Bay.

In early analysis we identified quality criteria for a desirable alley to arrive at a set of design motivations. Existing qualities and uses were integrated, while green stormwater infrastructure and enhanced porosity were introduced to turn alleys into lively passageways with layered functions. Car access is limited to increase pedestrian safety, comfort, and health.
Proposed views in from Vine Street, depicted during night and day.
RESIDENTIAL ALLEY

Located between a residential building and a parking garage, and adjacent to the Belltown P-Patch and Cistern Steps, this alley is one of the last points for infiltration before the CSO outfall at the base of Vine Street. Users passing through the site include residents of the surrounding buildings, commuters passing through the parking garage, and gardeners headed to the nearby P-Patch.

The alley is relatively wide but lacks invitations, and empty facades overwhelm the human scale, rendering the alley placeless. In our design we encourage apartment residents, gardeners, and commuters that already pass through the alley daily to linger by activating the site at different levels to shift the confined scale of an alley through verticality. We also designate spaces for community gathering and performance, and expand the alley’s surface area for water infiltration, retention, and storage.

Existing Conditions:
Placeless alley exterior and details of adjoining parking garage.
PEDESTRIAN ALLEY NETWORK

VINE PASSAGE

Image by Yang He

MONKEY BARS
LANDFORM
CAR/WALKWAY

AMPHITHEATER
Provides sunken seating and performance space

ELEVATED WALKWAY
Creates a meandering experience

WATER CHANNEL
Manages surface runoff

Image by Fatema Maswood, Lauren Wong

Image by Fatema Maswood

Image by Yang He

LANDFORM MULTIFUNCTIONALITY

INfiltration + Reuse + Detention + Infiltration

NTS

PEDESTRIAN ALLEY NETWORK
URBAN OASIS

Sun Exposure:
The site receives morning and afternoon sun, but is still quite shaded. The planting palette below proposes a series of native plants well suited to deep shade.

The interplay of landform, cistern, elevated walkway, and the flow of water down the length of the alley create the suggestion of fluid movement through the site, as well as inviting and intimate spaces for gathering, play, or contemplation. Stormwater and rainwater collected from rooftops flows towards a central channel, a series of cisterns, and bioretention planters. In the center of the alley, the canal infiltrates into the soil beneath. Portions of the canal wrapping around landforms drain into cisterns and towards Cedar St.

*TOTAL AREA = 4,980 sq ft
ANNUAL PRECIPITATION = 3 ft
Reference: 2030 District Calculator

207,120 gallons/yr
Water Managed

Image by Yang He
MIXED-USE ALLEY
INTEGRATING WATER + NATURE + PEOPLE:

The current mixed-use nature of the alley influenced the initial programming of our proposed design. Based on our observation and analysis the alley lacks interactive building facades, spaces to socialize and designated utility and service spaces. Apart from the functional and social needs of the alley, one of our major consideration in the design is to integrate creative ways to mitigate and manage stormwater into the site.
URBAN OASIS:
MIXED USE ALLEY

1. GREEN FACADE
   Creates a green entryway

2. DETENTION PLANTER
   Detains roof runoff

3. PERMEABLE PAVEMENT
   Detains surface runoff

PROPOSED TRASH CIRCULATION

- CARGO BIKE
  Trash transport

- TRUCK ACCESS
  Trash collection

Jiyoung Park
An inviting space with movable furniture for lingering.

Image by Farzana Rahman, Jiyoung Park
URBAN OASIS: MIXED USE ALLEY

2. OPENING RESTAURANT BACK DOORS CREATES GREATER POROSITY WITHIN THE ALLEY

Image by Jiyoung Park

3. TERRACED GARDENS PROVIDE FOOD ACCESS AND SEATING

Image by Lauren Wong

*TOTAL AREA = 20,320 sq ft
ANNUAL PRECIPITATION = 3 ft
Reference: 2030 District Calculator

**INfiltration**
- permeable pavement: 234,200 gal/yr
- rain garden: 10,948 gal/yr

**Detention**
- biofiltration planter: 188,500 gal/yr

**Reuse**
- bike parking planter: 1,418 gal/yr
- water harvesting planter: 27,825 gal/yr

462,892 gallons/yr
Water Managed

Image by Yang He
Re revitalized parking lot serves functional, social, and ecological needs.

Image by Farzana Rahman
This project was catalyzed by the planned removal of the waterfront trolley tracks running along Alaskan Way. Despite its prime waterfront location, this area is used as a conduit for transport and boat tourists. It is largely an impermeable, grey expanse.

Our vision is to fill this void in the city fabric, by growing and layering social, cultural, ecological, and hydrological networks across the site. We looked at a pre-development ecotone of beach to bluff, and overlaid it onto the contemporary urban condition, interpreting beach, deflation plain, backshore, bluff, and upland forest into our interventions. In addition, we looked to the Native Belltown Vision for guidance in this culturally rich area.

Our big moves are reclaiming much of Alaskan Way, adding new pedestrian zones and access, several expansive new habitat areas, and a GSI alternative to the CSO interceptor pipe.
TROLLEY PLAZA & UPLAND MEADOW
Northwest Waterfront:
Rerouting Alaskan Way allows expansive pedestrian movement on the waterfront to connect existing public resources to future opportunities. Opening this large flexible space on the waterfront will allow for historic trolley cars to be used as incubator markets supporting local start-ups and small businesses. This area connects tourists through popular attractions as well as providing local event space utilizing an enlivening waterfront.

Image: Aaron Parker
DUNESCAPE BOARDWALK

The waterfront dunescape is a series of rolling boardwalk decking and sunken wetlands that help bring and connect people to the waterfront, provide habitat for birds and wetland creatures, and contain stormwater runoff.

The re-designed boardwalk will serve as a dynamic, open-ended public amenity with areas for relaxing, socializing, strolling, playing + learning. Underneath the boardwalk is an water storage layer that collects water from surrounding streets + buildings. A series of meandering wetland, dunegrass and structural features provide habitat throughout the waterfront.

The Dunescape at night

Soft, inviting pathway and overhead lighting allows the Dunescape to transform into a nighttime strolling + social gathering space. The lighting is designed for minimal interference with bird and wildlife habitat, as overhead structures block light from reaching the osprey nests above.

All images by Margot Chalmers
Inspired by the movement of avian wings, these multi-functional structures are found throughout the dunescape. These customizable shelters allow users to turn the wheel to open and close the aluminum shelter flaps to their desired extent. The structures funnel water via rainchains into wetland grasses and transfer water to the underground water table storage layer. The structures support nests for ospreys, drawing the user’s eye up and around the site.

All images: Margot Chalmers
(Above) Site Hydrology: Arrows depict the movement of water throughout this area of the site. Water is collected from surrounding rooftops, parking lots, and streets. It then infiltrates the boardwalk and enters the underground water storage layer before being deposited to the sound.

(Above) Plan Detail: This segment of the plan depicts how the Dunescape connects and functions with the community center and boardwalk.

(Above) Social Use and Movement: The site comprises of activity nodes, featuring places to play, gather, socialize, wander and relax. The site serves to connect people out onto the water as well as up into Belltown.
**DUNESCAPE DECKING AND HYDROLOGY**

- **Bullrush (Scirpus spp.)**
- **Dry, sandy soil for dunegrass**
- **Pipe allows water to flow into impermeable, lined “box” that stores water for wetland plants**
- **Dunegrass (Elymus mollis)**
- **Impermeable liner contains water**
- **Uncompacted subgrade**
- **Gravel water table storage layer slopes 1-2%**
- **Non-slip wood decking**

All images: Margot Chalmers
The existing Bell Street Bridge infrastructure is layered onto, thickening function and enhancing the experience. Cedar slats, green roofs, string lighting, and vines inhabit what was once a utilitarian space. Treated runoff and greywater is brought over the bridge and vaporized into clouds in the summer, cooling the sunny bridge. A new connection is made to the interceptor wetlands running along Alaskan Way. Black water is brought from the above neighborhoods into two large storage tanks underneath the new under-bridge plaza. At the upper entrance, a new Native Landing Portal welcomes visitors to Belltown, and the historic site of babáqwab, or Little Prairies, the Duwamish village that once stood here.
WATER’S EDGE: COMMUNITY CENTER

This center provides 4,000 ft² of public indoor space, plus a large plaza, performance space and roof deck. It has sports and educational capacity, restrooms and showers, a visitor’s center, and a cafe incubator on the roof. Pop-up events can be held both inside and out. Summer camps and after school programs use the space. In summer, the building is open and airy - in winter, warm and inviting. Both upper and lower levels have green roofs, fed by greywater from the building. A kayak dock brings waterborne visitors up to the center and Alaskan Way. Locals and tourists alike come for the views, the programming, the food, and the conviviality.
LOG JAM
FLOATING WETLANDS

At the foot of Vine St., between the Victoria Clipper and the Edgewater Hotel, a series of floating saltwater wetlands and docks brings visitors out into the water. Anchored near the seawall and allowed to float over deeper water, the docks move up and down with the tide thanks to hinged entrance ramps.

Positioned over CSO 069, these wetlands help clean the water in the event of an overflow, in addition to providing habitat and delight for people. Kayaks can pull up to the south edge of the docks. Inviting, ecological lighting activates the space at night, while protecting wildlife from too bright or harsh photonic disturbance.
LOG JAM: PAST AND PRESENT

Inspired by log jams along the coast, this design references both the natural environment and the history of timber, logging, and shipbuilding along Seattle’s waterfront. Large trees growing on bluffs fall into waterways, eventually ending up as driftwood logs. Loggers would use waterways to bring felled trees to the open harbor, where they could be shipped or processed.

Now, the shapes inspired by these histories bring new life and vital processes to the waterfront.
BATTERY STREET RAVINE

A new pedestrian connection between Elliott Ave and Alaskan Way at the base of Battery Street, draws formal inspiration from a ravine that used to exist in this area. The experience walking the bridge travels through history and the water cycle. View “C” shows an enclosure over the train tracks etched with historic photos of the same view beyond and could integrate other memorial elements to the burial ground in this area. In view “B” a native-planted seasonal stream (fed by roof runoff) is integrated with the bridge structure. In View “A” the pedestrian bridge terminates in a multilevel viewing deck with a structural glass ground level to maximize light for salmon habitat below.
New Battery Street Pedestrian Bridge Section

- new pedestrian bridge
- raised crosswalk on Alaskan Way
- street run-off bioretention strip
- subsurface wetland cells
- noise barrier wall with green screen
- Passage Through Time enclosure
- green wall and roof
INTERCEPTOR WETLAND

A 45,000 square-foot wetland can fit in the space of the removed trolley tracks and two lanes of road on Alaskan Way between Bell and Wall Streets and provide a needed neighborhood green space and waterfront connection. To make a CSO-treating wetland at this location worthwhile, a new pipe is proposed along the existing Bell Street pedestrian bridge that connects to the city system on Western Ave and Bell Street. The proposed CSO pipe hugs the existing Bell Street pedestrian bridge before plunging into underground pre-treatment tanks (accessible for maintenance through decking). Treated water is used for irrigation in waterfront planting areas.
Subsurface Flow Wetland

This proposal calls for blackwater-treating green infrastructure with a capacity up to 850,000 gallons of water that could be collected from 12 blocks of southern Belltown would help prevent combined sewer overflows. Water is treated in a series of horizontal flow subsurface wetland cells without the risk of contact with people or pets. According to the EPA Wastewater Technology Fact Sheet on Subsurface Flow Wetlands, water quality improvement is due to physical, chemical and biochemical processes, especially microorganisms attached to submerged surfaces including the gravel itself.
A Chihuly inspired glass wayfinding sculpture also deposits rainwater into a runnel water feature that extends throughout the plaza

Image by Rachel Wells

Battery Street Tunnel is capped with gabion architecture that doubles as amphitheater seating

Image by Dorothy Mulkern

Image by Sophie Krause
DISTRICT VISIONS:

BATTERY STREET PLAZA

Dorothy Mulkern, Rachel Wells, Sophie Krause

“Ideally situated between the city’s leading destinations, Battery Street holds promise to welcome millions of visitors to stop, linger and recharge.”

-Growing Vine Street and Project Belltown

Battery Street and Tunnel is precious open space in Belltown, Seattle’s highest density neighborhood slated for closure. This space could increase the city’s storm water management and public amenity capacity. With looming mandates and civic concerns (the EPA’s Consent Decree for significant CSO reduction by 2025, and a lack of publicly programmable space) filling the tunnel with viaduct rubble is a cost conscious but short sighted choice. As designers we recommend investing in Battery Street and Tunnel as a public resource to meet the longterm needs of a rapidly growing Seattle.

BATTERY STREET
BATTERY STREET TUNNEL

PEOPLE
WATER
+ TRAFFIC FLOW
existing
proposed
car-free

GENERAL CONTEXT
LOCAL CONTEXT
eatery...
In the Battery Street Tunnel, there is a structural divider in the center, meaning there are actually two twenty-five foot tunnels running under Battery Street. In order to be occupied or used, the tunnel needs to be structurally retrofitted to comply with modern seismic code. To simplify this process, we decided to make one side occupiable by people, and the other to store and treat water. The northwest side or “people side” contains:

- a gallery with information on the significance of the Battery Street Tunnel and education on the water treatment and storage taking place on site
- a reservable event and gallery space;
- parking, water storage, and rubble fill.

The southeast side or “water side” contains:

- polishing water treatment wetlands where the public can interact with the water
- cisterns for gray water storage
- living machines
- membrane bioreactor.

Our intention is to use these water treatment methods as a way to take stress off the sewer system, provide opportunities for graywater reuse, and educate the public through guided tours.
**WATER CATCHMENT**

- **Birch Bridges**: Allow visitors to walk through planters.
- **Textured Brick Pavement**: Channels water and invites pedestrians to linger.
- **Window to Tunnel**: Recessed seating area above glass with views into tunnel.
- **Glass Flower Sculpture**: Deposits rainwater into runnel and serves as wayfinding feature.

**Vertical Typology**

Rainwater moves vertically through the site, filtering via green stormwater infrastructure plantings as it travels passively. Ultimately making its way to the tunnel for treatment and storage through the plaza’s surface runnel, water is also circulated year-round as an aesthetic and teachable moment.

**Images by Sophie Krause**
Conclusion

Our intention for this project was to push the community’s vision on what is possible on this contentious site. With so many stakeholders and many different visions, our challenge was to balance these with Belltown 2030’s water management goals, EPA combined sewer overflow reduction requirements, and the need for public space in Belltown. We sought inspiration from the current proposals, while keeping Belltown’s culture, residents, practicality at the forefront of our process. We chose to create a space in the tunnel and at the street level that showcases local visual, light, and glass artists, speaking to Belltown’s rich artistic and progressive history. Our intention was to create an environment that facilitates small businesses and residents to interact and allows them to thrive.
SITE DESIGNS | P-PATCH PARK

Image by Jessica Vetrano
SITE DESIGN:

P-PATCH PARK

Julia Brasch, Kyle Cotchet, Diana Settlemyer, Jessica Vetrano

The Belltown Cottage Park and P-Patch is an important neighborhood landmark that has become one of the only open, green spaces in the area. The adjacent lot contains an abandoned building and an underused parking lot surrounded by an unstable slope riddled with invasive plant and rodent species. Without intervention, the site will likely be developed as a building, shading out the existing p-patch in what would be an enormous loss to the Belltown community.

With storm water management as the overall goal of this project, we have proposed using the site's close proximity to the CSO 069 and the steep elevation change to accommodate a subterranean combined sewer vault to mitigate the occurrence of outfall events. This concealed infrastructure beneath an open, public green that expands gardening area and manages surface water offers multiple benefits to the community in a way that private development would not.

Location:
Elliot Avenue between Vine Street and Wall Street

Image by Jessica Vetrano and Julia Brasch
EXISTING CONDITIONS

The site is located off of Elliot Avenue in between Vine Street and Wall Street. There is a steep and unstable slope held together by blackberry bushes. An abandoned building is situated on the site's southwest corner. People experiencing homelessness have been living in the space behind the building.

The surrounding land uses are predominately office and residential. There are two parking lots adjacent to the site, making the current land use of the site redundant.

Elliot Avenue is a busy thoroughfare that feeds traffic into downtown Seattle. The road creates high levels of noise pollution, but it was also observed that much of the foot traffic surrounding the site originates from this street.
With this context information in our hands, we wanted to create a program that responded to the existing conditions. We found these to be our user groups, the issues and opportunities the site presents for them, and what interventions we wish to use in our design to response.

<table>
<thead>
<tr>
<th>USERS</th>
<th>ISSUES &amp; OPPORTUNITIES</th>
<th>INTERVENTIONS</th>
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<tbody>
<tr>
<td>Community</td>
<td>Lack of public seating, gathering space</td>
<td>Terraced Seating</td>
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<tr>
<td>Students</td>
<td></td>
<td>Community Pavilion</td>
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<tr>
<td>Local Employees</td>
<td></td>
<td>Splash Pad</td>
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<tr>
<td>People experiencing homelessness</td>
<td>Lack of facilities</td>
<td>Revitalized Historic Building</td>
</tr>
<tr>
<td>Tourists</td>
<td></td>
<td>Cafe Providing Transitional Jobs</td>
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<td>Gardeners</td>
<td>Shortage of plots</td>
<td>Public Interpretive Art</td>
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<tr>
<td>Pollinators + Birds</td>
<td>Lack of habitat</td>
<td>Terraced Garden Plots</td>
</tr>
<tr>
<td>Water</td>
<td>Polluted runoff</td>
<td>Roof Top Garden</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pollinator Plants</td>
</tr>
</tbody>
</table>

Terraced Rain Gardens  | Constructed Wetlands                                      | Bioretention Planters                              |

Images by Julia Brasch
A. Relocated cottage
B. Expanded building footprint & new roof greenhouse & garden plots
C. Community Pavilion
D. Connection to existing p-patch
E. Connection to alley
F. Connection to wall street
G. Gathering area
H. Protected bike lane
I. Bioretention street planter with new vegetation
J. New green space
K. Vegetated bike lane buffer
L. Connection between existing vine street bioretention planters
M. Terraced rain gardens connected to wall street bioretention planter & adjacent building's roof runoff
N. Splash pad utilizing UV cleaned rainwater from terraced rain gardens
O. Constructed wetland connected to building graywater
P. Interpretive fountain into constructed wetland feeding clean water back into building
Q. Gently sloping terraced topography
R. Water cistern for surface water storage and p-patch irrigation with 6,000 gallon capacity
S. CSO vault with 143,626 gallon capacity

Image by Jessica Vetrano
PROPOSED SECTIONS

CSO VAULT

 Alleyway  20'  Site  133'  ROW  57'

 Vine Street ROW  Belltown P-Patch and Cottage Park  Site  Wall St ROW

0 10 20 30 Feet

Images by Kyle Cotchett
GRADING AND DRAINAGE

Image by Jessica Vetrano

GREENER BELTOWN : BLUER SOUND City / Nature for Urban Resilience
SITE DESIGNS  |  P-PATCH PARK

Image by Julia Brasch

GREENER BELLTOWN : BLUER SOUND  City / Nature for Urban Resilience
We strove to make one interconnected site that could mitigate storm water runoff issues, provide more p-patch plots, address the homelessness issue, and provide a place for the community to gather and play. We worked with the steep grade to create a terracing scheme that could provide space for a storm water vault, p-patch plots, an ADA accessible ramp, and facilities for public seating. It was felt that the exiting structure on the southwest corner helped define and create an intimate space. To ensure that this feeling was kept alive, we envision restoring the building and adding on two additional structures on the roof and north east corner. A pavilion was placed on the south east entrance that we see being able to house farmers markets and other community events despite the weather. One of the existing cottages was moved to the northwest side of the block in order to create cohesion between the exiting P-Patch and Cottage park to the new design. To make greater connections and calming efforts to the structures beyond our site, we have proposed moving the existing bicycle lane with the addition of a protected barrier to the location of current on street parking.
The Portal Park is named after its existing condition as the portal to a 4 lane tunnel for cars. The tunnel's imminent decommission opens the door to a variety of uses for the interior of the tunnel as well as the place where the tunnel emerges above ground. Another group explored the tunnel as a space for social, cultural, and stormwater uses. Building on their work, our site reimagines the opening of the tunnel based on the premise that people and stormwater runoff will be conveyed through the tunnel onto our site.

In this design, we layered cultural, historical, and stormwater function. Stormwater infrastructure is present throughout, as well as small and large gathering circles, viewing decks, views of Mt. Rainier and Puget Sound, lushly plantings, and much-needed open space. The site to the East of Bell Street allows for formal educational and social programming while the rest of Portal Park is left dedicated to immersive experiences of plants, views, people, and water.
A severe shortage of greenspace in the densest neighborhood in Seattle drew us to the Portal Park as it will eventually become the largest park in Belltown. The site's location on a steep slope also offers great opportunity for gravity-fed water treatment systems.
Site Analysis:
Existing access to sunlight, long views of Mt. Rainier and the Puget Sound, and current and future pedestrian circulation patterns heavily influenced our design.
SITE ANALYSIS

HISTORIC EVENTS

- village of 'Little Prairies', or Ba'qbaqwab, established
- native populations relocate to Little Prairies
- burial remains disturbed again

Little Prairies burned down by federal agents

HISTORIC FUNCTION

- food cultivation
- foraging
- prairie burning
- preservation
- gathering
- sheltering
- storytelling

- eating
- hunting
- slow
- spread
- wildlife
- fishing
- growth

1800

1900
Alaskan Way Viaduct constructed

Alaskan Way Viaduct demolished

waterfront project completed

Sea level rise

travel
driving
transit

education
storytelling
preservation
play
rest
slow
spread
soak
store

Image by Nicky Bloom
Program:

Native Seattlites gained ecological knowledge through direct experience with nature and through sharing those experiences with others. The concept for the program was the have a large natural area where people can experience natural elements first hand opposite a designated gathering space and program house that more pointedly connects people to the ecological knowledge and history in the site through events, workshops, exhibits, and classes.
Images by Allison Ong
DYNAMIC SPACE

Night Lights and Seasonal Change

A lighting plan illustrates that the space should feel safe and welcoming at night. Glowing council rings invite pedestrians down into the site from 1st Avenue or up the slope from Western, while lights illuminate all the pathways to extend the use and comfort of the space.

Seasonally rich plantings of red bud, vine maples, and native perennials provide a reason to return to the site over and over again to achieve the immersive, experiential education goals of the space.
People using the flexible program space for an event with dancing at dusk

Image by Nicky Bloom
Biofiltration Channel:
A series of terraced biofiltration cells treat the lightly filtered stormwater from the tunnel as it descends toward the Puget Sound. As the water is cleaned, it is piped over to a cistern beneath the hill council ring and stored to be used for plant irrigation on site or potentially linked to the greywater system of the adjacent condominium building.

Excess water is expressed in a final round stepwell shape that people can see before it drains back into the sewer after being slowed and cleaned en route.

Image by Nicky Bloom
View from Battery Street showing the bridge over the biofiltration cells, leading to the Large Council Ring.
Sections A, B, and C illustrate the layered nature of the design. In A, an overlook layers on top of a viewing deck on top of a constructed wetland so people can view the stormwater feature up close. In B, a hill with a great view of Mt. Rainier provides much-needed social gathering space. A cistern is built into the hill to store water collected and cleaned by the biofiltration channel. In C, a pervious plaza helps infiltrate rain water next to the Program House which provides indoor programming space and a potential venue for classes, meetings, celebrations, shows, and other events.
SECTION C: PERVERSIOUS PLAZA
A Netto tourboat winds its way through and around Copenhagen's canals and harbor.

Professor Nancy Rottle takes a moment to bounce.

COBE's Rune Boserup Jacobsen leads our group on a tour of the Bella Kvarter.

Aaron Parker cruises past the recently completed SUND Campus Nature Park.

Copenhagen's fun and whimsical play structures invite engagement from humans of all ages.

Western Harbor's water features are even better in the rain.
1: Nicky Bloom receives design critique from a panel of designers, artists and engineers at the final review.

2: Midway through the quarter, The Nature Conservancy hosted a stakeholder workshop at which Rick Johnson and Amy Waterman participated as design reviewers.

3: Noriko Marshall offers the Portal Park group design feedback at the studio’s final review.