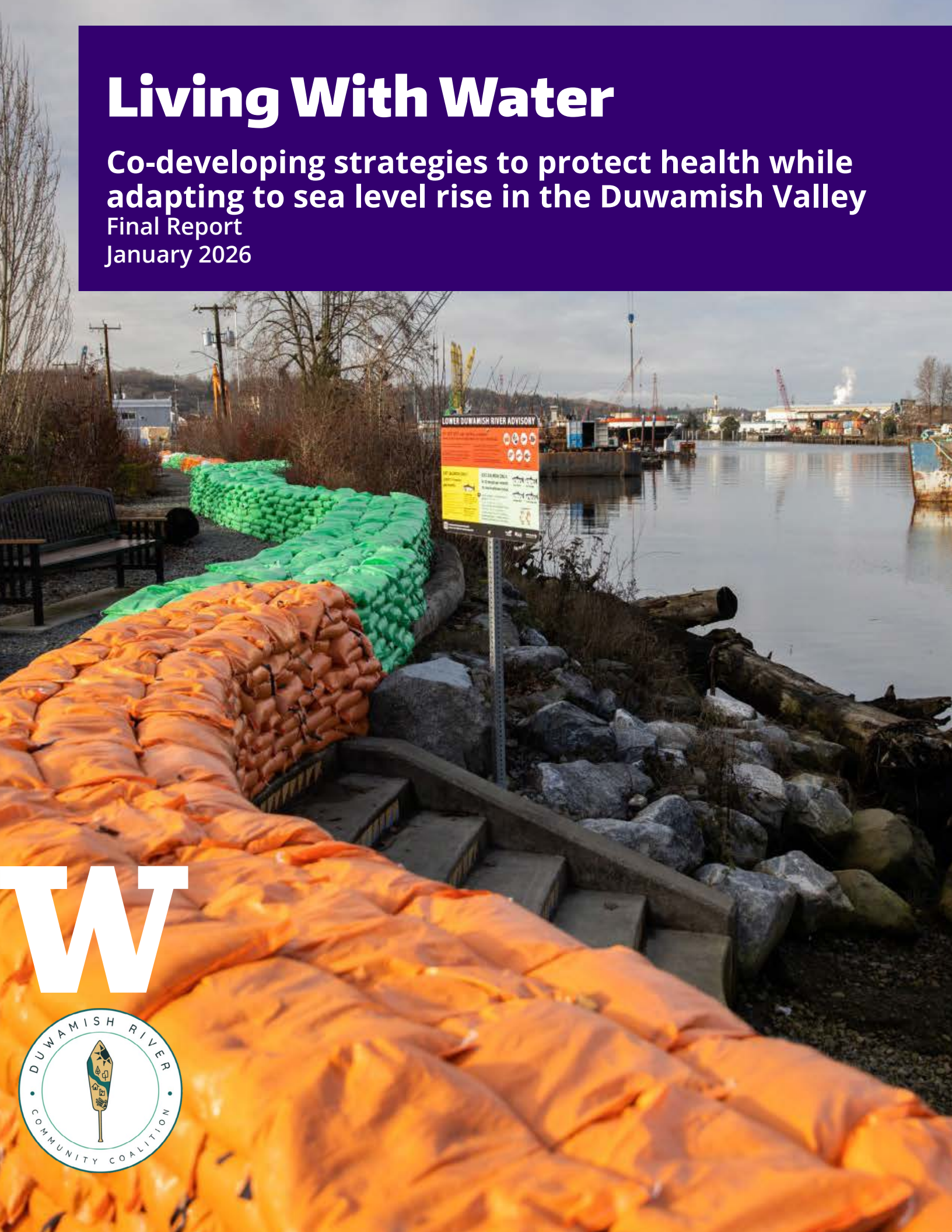
Living With Water

Co-developing strategies to protect health while adapting to sea level rise in the Duwamish Valley

Final Report

January 2026



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DUWAMISH RIVER COMMUNITY COALITION

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Executive Summary

The Living With Water (LWW) project is a collaboration between the University of Washington and the Duwamish River Community Coalition (DRCC), a non-profit community-based organization based in Seattle's South Park neighborhood. Following an unprecedented flooding event in 2022 along the Duwamish River in the South Park neighborhood, DRCC and UW collaboratively designed this community-directed climate resilience research project in the Duwamish Valley. The project was designed to assess potential flood adaptation strategies while centering community leadership, values, priorities, health, and equity. The project aims to (1) identify available flood adaptation strategies and evaluate their alignment with community values, and (2) co-design conceptual strategies for flood adaptation aligned with those values. The team also conducted an internal evaluation of the project's performance in terms of equitable distribution of burdens and benefits and community representation. The project team pursued these aims through an interdisciplinary, multimethods approach that included a literature review, community interviews and discussions, a community workshop, and internal team interviews.

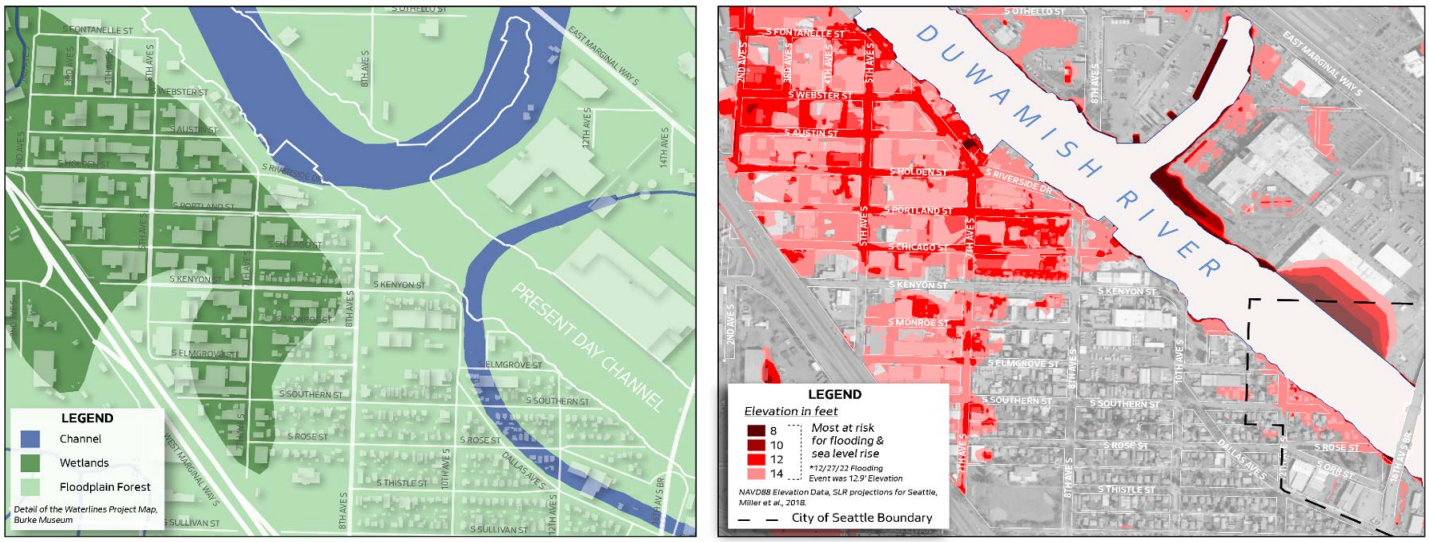
The team affirmed the SASPER findings that South Park community members largely prefer nature-based solutions (NBS) that aim to simultaneously protect natural ecosystems and human well-being over hardened infrastructural strategies for flood adaptation. The project's literature review identified 126 unique flood adaptation strategies, with most representing passive nature-based risk reduction measures (e.g., restoring floodplains, elevating buildings) or active or engineered nature-based risk reduction measures (e.g., constructed wetlands, vegetated berms), and included studies that compared these NBS to hardened infrastructure measures (e.g., sea walls). Interviews with community members identified common community values and priorities, including housing insecurity, tension around relocation, attachment to place, and the desire for long-term, "green" solutions. Follow up community discussions and a workshop identified the areas of South Park that community members value most, potential NBS of interest, and possible siting locations. These were vetted and reinforced by additional feedback through community engagement events. Finally, examining the internal equity of the project identified several successes and shortcomings that can help guide future community-engaged research partnerships.

The biggest takeaways from the project's multiple efforts to capture community preferences for flood adaptation include: widespread support for NBS that support both the natural environment and human health and well-being; strong attachment to place and an interest in retrofitted, floodable homes and/or relocation within the South Park neighborhood in order to accommodate rising sea levels; and an insistence on consistent and equity-centered community engagement in all flood adaptation planning by the city and other government entities.

Project Background

In December 2022, Seattle's South Park neighborhood, on the west bank of the Duwamish River, experienced an unprecedented and destructive flood that impacted more than 40 households. The flood occurred during an early morning "King" high tide that was more than two to three feet higher than normal and exceeded the National Oceanic and Atmospheric Administration's (NOAA's) predictions.[1] The acute flood was caused by the channelized Duwamish River overtopping its banks. Future flooding had been predicted in this area – the city projects a 1-foot rise in sea level by 2050 and three feet by 2100[2] – but the flood event in 2022 occurred sooner than expected. The premature event was caused by faster-than-expected sea level rise in recent years, compounded by heavy rainfall, low atmospheric pressure, and a historical lack of public investment in infrastructure in South Park. The impacted neighborhood is an EPA-designated "environmental justice" community that is home to racially- and ethnically-diverse, low-income, and immigrant and refugee residents. The two hardest hit areas of South Park were a residential neighborhood that was constructed over a historical wetland, then surrounded by commercial and industrial development, and a strip of homes along a channelized stretch of the Duwamish "Waterway" – an area that had once been distant from the river but now is directly adjacent to the straightened canal (Figure 1).[3] All residents impacted by the flood were English, Spanish and/or Khmer (Cambodian) language speakers. Many were temporarily displaced, and most Khmer neighbors were permanently displaced by the flood.

Figure 1. Historical wetland and flood/sea level rise risk in South Park



1a. Historical wetlands and channel ~ 1850 *1b. Flood sea level rise risk in South Park*

Maps by Ry Yahn (Seattle Public Utilities) in collaboration with Amir Sheikh (University of Washington)

The 2022 flood occurred just as the non-profit Duwamish River Community Coalition (DRCC), the University of Washington (UW), and local government partners were completing a community-driven needs assessment to better understand Duwamish Valley residents' concerns and priorities for building "climate resilience"– the ability to prepare for, recover from, and adapt to the impacts of climate change.[4] Titled the Duwamish Valley SASPER (Seattle Assessment for Public Health Emergency Response), the project adapted the U.S. Centers for Disease Control and Prevention's (CDC) "CASPER" sampling methodology[5] to better address key equity needs in the community, including youth engagement, multilingual survey teams, and inclusion of un-housed residents.[6] CDC-trained teams of local youth, alongside UW students, city and

county staff, and the Public Health Reserve Corps, went door-to-door in the Duwamish Valley neighborhoods of South Park and Georgetown to collect information about residents' climate concerns, their preparedness to deal with climate-related hazards, and their preferences for climate adaptation strategies in their community.

The SASPER revealed strong community support for green infrastructure and community-led adaptation strategies, and a strong sense of neighbor-to-neighbor connectedness (community cohesion). The findings subsequently informed city investments in climate resilience "hubs," and the project was recognized by city officials and federal funding agencies (e.g., NIEHS) for its community-centered approach to climate adaptation planning.[7–9] The SASPER also informed more in-depth community-engaged planning and research initiatives, including the LWW study described in this report.

Given that future flooding in South Park is expected and city-directed adaptation efforts are underway, DRCC requested UW's assistance to conduct more in-depth, community-driven, long-term climate adaptation research in the Duwamish Valley. The resulting community-engaged research (CEnR) project "scales up" the SASPER by assessing specific climate adaptation strategies with a focus on improving community health and justice. Since the 2022 flood, the City of Seattle has been planning and delivering new flood prevention strategies, including larger stormwater pipes and resurfaced roads in the short term, and possible levees and/or multi-use berms in the future. While such engineered solutions may provide some flood protection for particular areas, these benefits last only as long as flood risks stay below infrastructural capacity. Uncertainties around future sea level rise may limit the longevity of such infrastructure, and the engineered solutions could redistribute flood waters, introducing new flood risks elsewhere along the river channel. Engineered infrastructure that supplants NBS may also pose risks to ecosystem services (e.g., recreational open space, urban heat reduction) that promote human health and help mitigate climate hazards.[10,11] Accordingly, DRCC sought an independent, community-led, values-based assessment of multiple climate adaptation strategies that explicitly consider human health, environmental resilience, and social and economic equity.

LWW applies a recently-developed flood adaptation hierarchy to explore equity-forward outcomes. This framework uses a six tiered-approach to evaluating flood adaptation strategies, prioritizing approaches that sustain or enhance natural ecosystems. It also provides guidance for considering equity impacts as they relate to the distribution of impacts (who is impacted by flooding), resources (who has access to resources), and voices (who is included in decision making) before and after implementation.[12] Based on its alignment with findings from our SASPER survey indicating community preference for NBS, we employed this framework to identify prospective solutions for flood adaptation and integrate a community values-driven approach to designing and evaluating alternatives.

Our approach (1) identifies and assesses climate adaptation strategies as they relate to South Park's unique environmental and community health needs; and (2) develops and evaluates the use of a values-based framework to support equitable climate adaptation strategies. The integration of community values into the selection of adaptation approaches is intended to result in solutions that (a) are more acceptable, appropriate, and sustainable to implement, and (b) promote community health, well-being, and environmental justice in the long term.

The research team from UW worked with DRCC to:

1. Build community capacity for flood adaptation planning by:
    - Providing educational materials about the root causes of flooding in the neighborhood – including areas of historical wetlands, shallow groundwater, stormwater, and sea level rise (pg 10);
    - Identifying the range of available flood adaptation strategies and their benefits and limitations (pg 12); and
    - Conducting research to identify residents' core values and aligned priorities for adapting to flood risks through interviews and discussions (pg 14);
2. Co-design conceptual strategies and possible locations for preferred NBS strategies through structured community discussions and a participatory workshop (pg X); and
3. Evaluate the project's performance in achieving an equitable distribution of benefits and burdens among project partners and the impacted community, in order to inform future CEnR projects (Appendix 6).

The collaborative project used CEnR and participatory approaches that build on the findings of the SASPER survey, particularly the community's strong cohesion and support for community-led and green infrastructure (nature-based) solutions to climate change adaptation. At DRCC's request, the project sought to build community capacity for climate resilience planning independent of the City of Seattle and other external stakeholders.

This report summarizes the findings of the LWW project for the Duwamish Valley community, policy-makers, and other interested stakeholders. Additional information can be found in the report's appendices, academic journal articles by the project team, and a two-page "fact sheet" highlighting the project's key takeaways.

The project team shared the root cause of flooding and historical wetland graphics at a DRCC-City of Seattle open house in June 2024. Image Credit: BJ Cummings

Methods and Results

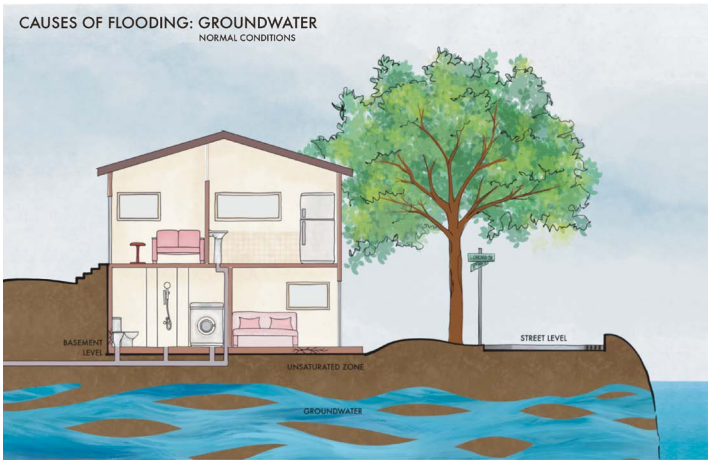
Educational Materials

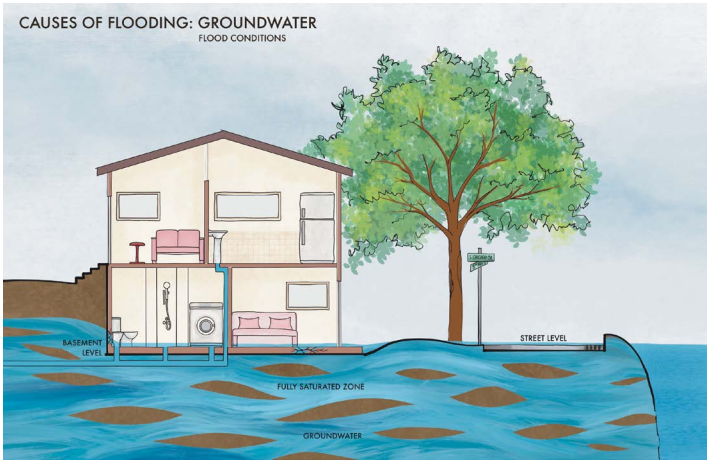
At DRCC's request, members of the UW team contracted with a graphic design student to develop and adapt materials to illustrate the root causes of flooding in the impacted areas of South Park. These included a graphic showing the contours of a historical wetland underlying the northern South Park residential flood zone in the area bordering and interspersed with light and heavy industry (Callout Box 1, Appendix 2a). Graphics were also adapted to illustrate three causes of flooding–groundwater, stormwater, and sea level rise–which can occur individually or in combination, and are interrelated (e.g., when sea level rises, so does tidally-influenced groundwater) (Callout Box 2, Appendix 2b). DRCC conducted community outreach and education events utilizing these materials both before the study commenced and throughout the study period. The materials were also used in City of Seattle-sponsored flood adaptation planning events and LWW activities to improve community knowledge and understanding of the causes of flooding.

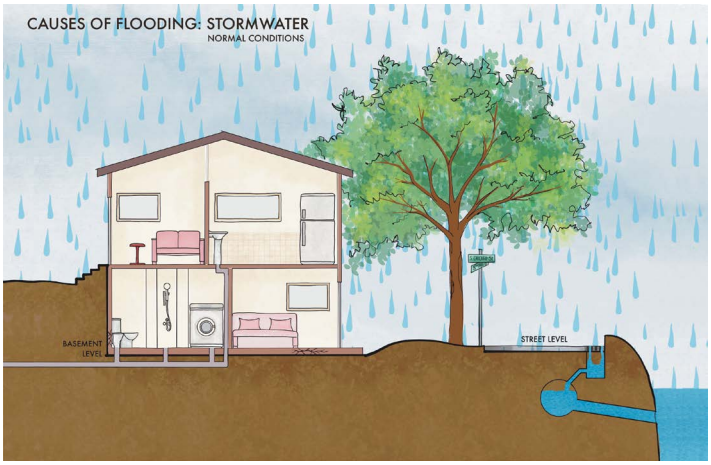
Callout box 1. Historical wetland graphics

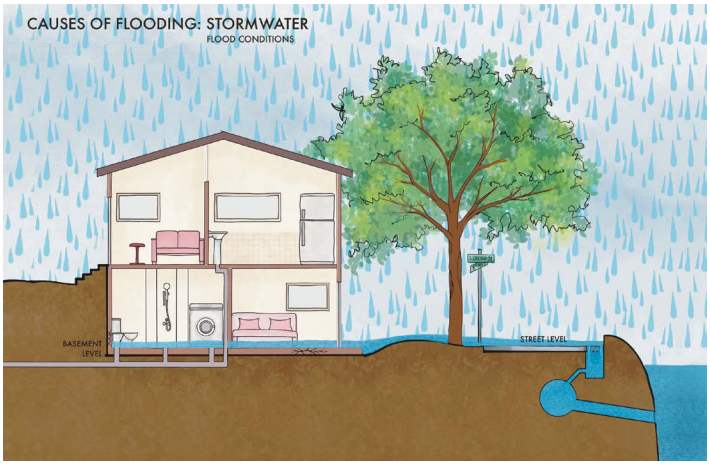
These graphics were adapted by the University of Washington from materials developed by the Waterlines Project of the Burke Museam of Natural History and Culture and the Quaternary Research Center at the University of Washington. Designer: Naomi Vettah, UW Communication Leadership Program.

Callout box 2. Root cause of flooding graphics









These graphics were adapted by the University of Washington from materials developed by the Flood Community Advisory Group, Duwamish River Community Coalition, Villa Communitaria, Just Health Action, and Seattle Public Utilities. Designer: Naomi Vettah, UW Communication Leadership Program.

Research Activities

To meet its three specific research aims, the LWW study employed a multi-methods approach, summarized in Figure 2. Aim 1 was to identify flood adaptation strategies and their alignment with community values and priorities, which the team pursued through a literature review, community interviews, and community discussions. Aim 2 was to co-design conceptual strategies for flood adaptation, which was pursued by hosting a community workshop and gathering community feedback. Aim 3 was to evaluate the impacts of the project on systemic equity, which the team pursued through a warm-up activity, interviews, and a cool-down activity with the project team, as well as an evaluation activity with community members at the community workshop.

Figure 2. Living with water project aims and associated methods

Aim 1	Methods
Identify flood adaptation strategies and their alignment with community values and priorities	• Literature review • Community interviews • Community discussions

Aim 2	Methods
Co-design conceptual strategies for flood adaptation	• Community workshop • Community feedback

Aim 3	Methods
Evaluate the impacts of the project on systemic equity	• Warm-up activity with project team • Project team interviews • Evaluation activity at community workshop • Cool-down activity with project team

Literature Review

We conducted a formal review of the existing academic literature to develop a comprehensive list of different types of flood adaptation strategies, with a focus on nature-based solutions (NBS) (see Callout Box 3).[13] In consultation with UW librarians, we developed search terms for identifying articles (Appendix 3a). We limited our search to U.S. and Europe-based studies to ensure the strategies we identified could be relevant and applicable to the Duwamish Valley context. This may have prevented us from identifying novel NBS from non-Western

Callout box 3. Nature-based solutions definitions

Nature-based solutions are "natural areas and engineered solutions that mimic natural processes' to addess societal challenges.[13]

and/or low- or middle-income countries, thus limiting the generalizability of our findings.[14,15] We used a framework called the Flood Adaptation Hierarchy (Figure 3) to help us categorize the different types of solutions and relevant technical, economic, and social considerations. The framework categorizes flood adaptation strategies on a scale ranging from natural flood solutions (e.g., protecting coastlines) to hard engineering solutions (e.g., building sea walls).[12] The literature review identified a wide range of flood adaptation strategies for Duwamish Valley residents to learn about and consider alongside their place-based values and priorities. We focused the review on NBS, as the previous SASPER study identified Duwamish Valley residents' strong preference for "green" or "nature-based" solutions. However, we included hard engineering solutions when they were discussed in relation to or in comparison with hardened strategies.

Figure 3. Flood adaptation hierarchy

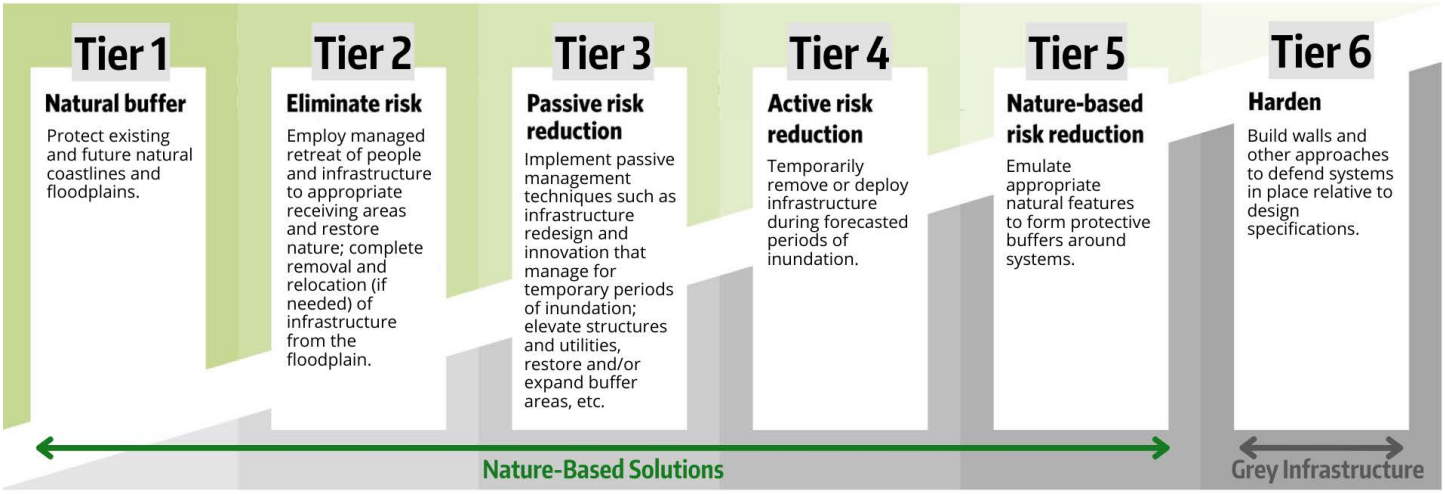


Figure adapted from "A new framework for flood adaptation: introducing the Flood Adaptation Hierarchy" by Peck et al., 2022 and licensed under Creative Commons Attribution 4.0 International License. Changes include adding tier labels, arrows at the bottom of the figure, the words "or deploy" to the Tier 4 box, and removing arrows between the tiers and text at the top left and bottom right of the figure.

Our initial search for all flood adaptation strategies identified 785 articles. We screened these articles to determine if they were an original research study, based in the U.S. or Europe, and described the technical, economic, and/or social considerations of NBS for river or shoreline flood management. We generated a final list of 74 articles that identified 126 unique flood adaptation strategies (Appendix 3b).

Most of the strategies identified fell in Tiers 3 (36%) and 5 (28%) of the Flood Adaptation Hierarchy.[12] Tier 3 includes passive NBS-based risk reduction measures that upgrade landscapes or infrastructure to manage temporary flooding, such as shoreline restoration and elevating existing buildings and utilities. Tier 5 includes active nature-based engineering that primarily uses living and/or natural materials, including the construction of green spaces, vegetated berms, and infiltration bioswales. Twenty-three percent of the papers compared NBS alternatives with Tier 6 (non-NBS) strategies. Tier 6 alternatives use "gray" (hardened) infrastructure–so called due to their use of concrete and steel materials–such as retaining walls, bulkheads, and storm surge barriers. As Tier 6 methods are not NBS strategies, they were only included in the literature review when studied in combination or comparison with NBS strategies. A majority of articles (51%) addressed technical considerations of the flood adaptation strategies, 42% addressed social considerations, and 37% addressed economic

considerations. Quite a few articles addressed multiple considerations, e.g., both technical and economic considerations.

Technical considerations: Of the identified flood adaptation strategies, 41% had at least one study that assessed changes to flood risk as a result of their implementation. NBS strategies most consistently decreased flood risk when used in combination with other NBS or gray alternatives. NBS strategies in Tiers 1-5 were associated with improved habitat and increased carbon sequestration, which have environmental and human health benefits.[16–18] Multiple studies noted that individual NBS strategies alone may not be sufficient to address intensifying flooding associated with climate change.[19,20]

Economic considerations: For 23% of the identified strategies, at least one study highlighted barriers to funding. In some cases, costs outweighed the NBS benefits that were assessed in the study. However, NBS were frequently found to be cost-effective over time, especially when co-benefits (e.g., recreation, public health, biodiversity) were accounted for. In addition, NBS were more likely to be cost-effective when multiple strategies or clusters were installed in close proximity to each other. For instance, green roofs were most effective when installed on multiple buildings in the same area.

Social considerations: Over half (56%) of the flood adaptation strategies had at least one study evaluating the degree of community support for that strategy. Findings varied across papers – some reported a high level of support for NBS, while others reported that NBS was perceived to be less effective than gray infrastructure, leading community members to prefer gray measures over NBS. In many of these cases, limited NBS knowledge and low institutional capacity for NBS implementation and governance were reported as key challenges. Co-benefits were assessed for 21% of the strategies, with improved public health being the most commonly reported co-benefit, particularly for alternatives that increased access to green space and its associated health benefits. This includes mental and physical health benefits through air quality improvements, heat mitigation, increased social cohesion, and recreation opportunities associated with NBS.[11,16,18] Such co-benefits were also cited as an important driver of community support.

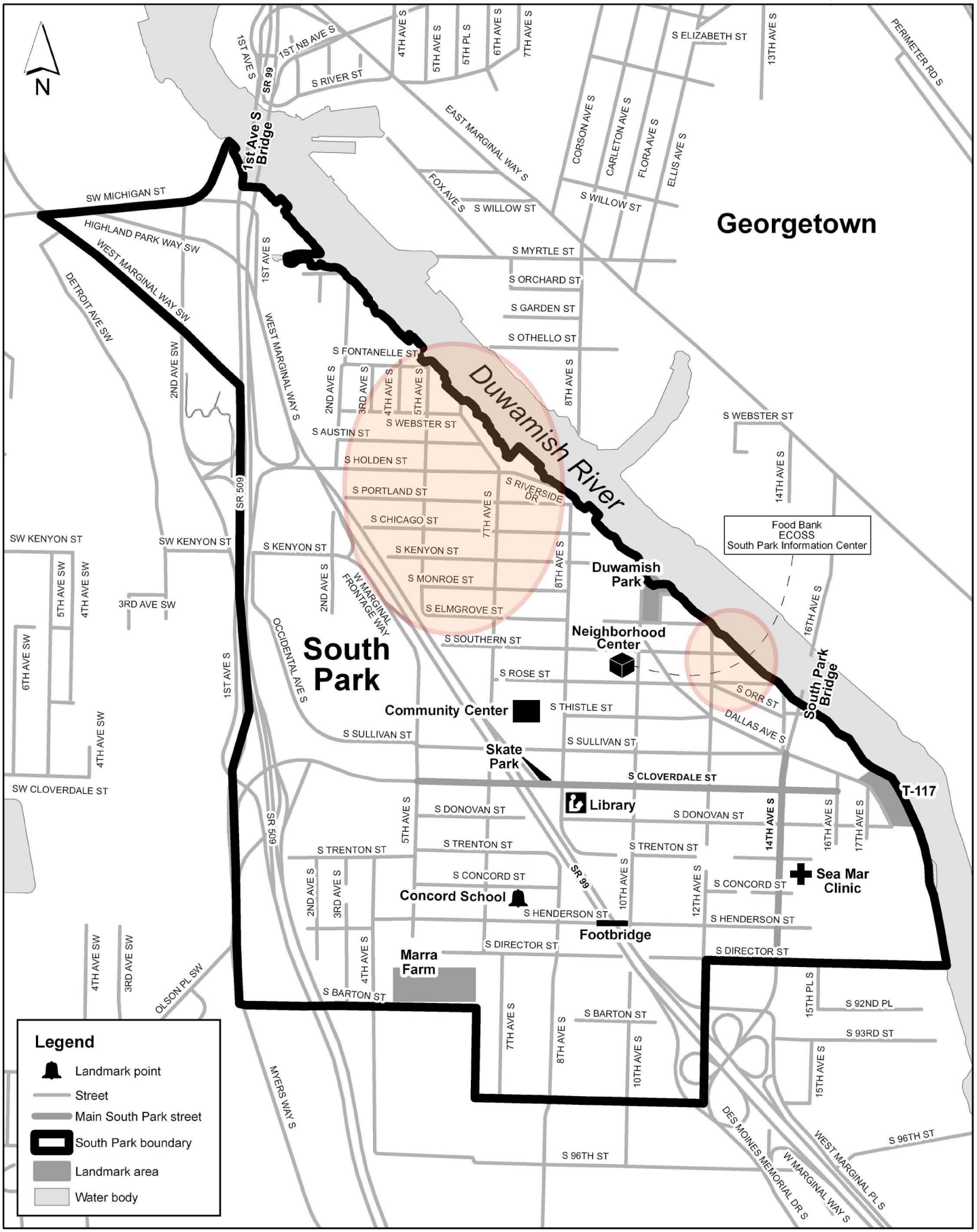
Community Interviews

Methods

We conducted 23 semi-structured interviews with South Park residents to understand their experiences with flooding, perceptions of environmental risk, and values and priorities related to flood adaptation. Participants were recruited by DRCC and received $50 compensation for their time. The research team collaborated closely with DRCC to ensure the interview process was community-informed and culturally responsive, and approached the study with an awareness of positionality and the historical context of environmental inequities in the Duwamish Valley. The interviews took place between December 2024 and May 2025.

Interviews were conducted in English or Spanish and lasted approximately 90 minutes. Participants represented a range of ages, housing situations, and lengths of residence in South Park. Most (20) were long-term residents who had directly experienced the 2022 flooding, while others had recently moved to or relocated from the area. Most Khmer neighbors were permanently displaced by the flood, none of whom were interviewed for this study.

Figure 4. Generalized areas in South Park affected by 2022 flood



The northern South Park flood zone within the City of Seattle and the 'Sliver by the River' in unincorporated King County were affected by the 2022 flooding.

Eight participants were residents of the "Sliver by the River," which is a flood-prone zone in South Park that lies in King County but is not incorporated into the City of Seattle. Twelve participants lived within the northern South Park flood zone within the City of Seattle limits, in the residential/industrial "fenceline" area overlaying a historical wetland (see Figure 4). The remaining participants lived elsewhere in South Park or in close proximity to the neighborhood and identified strongly as members of the South Park community. Twelve of the interviewees lived in homes that were directly impacted by the 2022 flood. Each interview explored participants' connections to the Duwamish River, experiences during and after the 2022 flood, encounters with other flood events, and views on adaptation, community resilience, and future vision for the neighborhood. Interviews began with general background questions and gradually moved toward reflections on flooding, attachment to place, and hopes for the neighborhood's future (see interview questions in Appendix 4).

Analysis

The study employed a "grounded theory" approach to guide the analysis of the interview data.[21,22] This approach does not predefine thematic categories; instead, insights are generated from the data through iterative cycles of coding and comparison. The application of the grounded theory framework produces findings informed by community narratives, allowing themes to emerge from residents' lived experiences rather than from the research team's assumptions.

As shown in Figure 5, interview analysis began with initial coding in a software called NVivo, which involved reading transcripts line by line and assigning descriptive terms (known as "codes") to the words and phrases residents used in their responses (e.g., "flood," "green space," "displacement"). We explored the frequency with which these codes were used, to identify commonalities across the interviews. Finally, we categorized the codes into thematic areas (e.g., "resistance to displacement," "housing insecurity," "attachment to place," and "long-term vision") and summarized key takeaways in each of these areas.

Findings

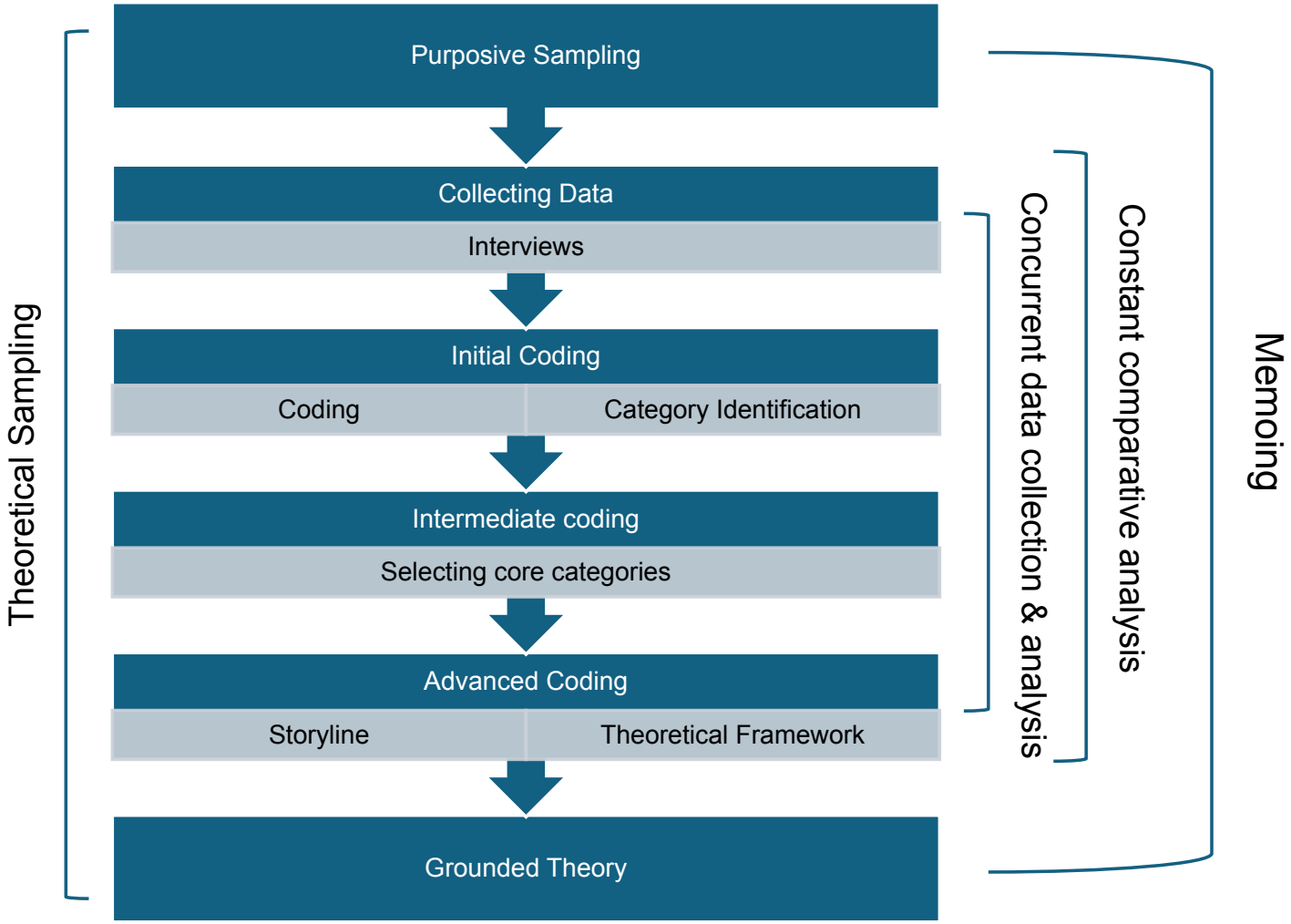
The interviews yielded several key takeaways reflecting the values and priorities of neighborhood residents affected by the 2022 floods.

Lived Experience of Flooding

South Park neighbors consistently characterized the 2022 King Tide flood as both the most catastrophic in memory and part of an accelerating pattern of recurring disasters. The flood displaced families for months and up to a year, destroyed irreplaceable heirlooms, and inflicted deep trauma and ongoing anxiety about South Park's future. As one neighbor stated, "I have not been fully functioning since the flood." Some neighbors said they no longer travel for extended periods of time during the King Tide season, out of fear that they will return to a flooded home.

Spanish-speaking neighbors highlighted particular barriers to accessing assistance. One couple described the extent of their loss: "We were planning to move to another house so most of our belongings were in boxes in the basement [...] Years of work and savings, all gone." While they were able to return home, many immigrant families (the majority of whom were renters), including Latine and most of the Khmer neighbors, were permanently displaced. Those who were able to return to their houses reported continuing to pay rent on damaged or unsafe properties or facing eviction when landlords sold their flood-damaged homes. Informal leasing arrangements, fear of engaging with authorities due to citizenship status, language barriers, and general housing insecurity contributed to long-term dislocation.

Figure 5. Interview research design framework



Summary of the interplay between the essential grounded theory methods and processes. Figure adapted from "Grounded theory research: A design framework for novice researchers" by Chun Tie et al., 2019[21] and licensed under Creative Commons Attribution 4.0 International License. Changes include removing "survey," "focus groups," and "other data" from the "collecting data" box; "data saturation" from the "intermediate coding" box; and "theoretical sensitivity" from the left side of the figure.

Even among homeowners who did receive some form of support (e.g., storage trailers, repair aid), feelings of gratitude were intertwined with deep frustration about the quality and consistency of the assistance provided. Several described repair processes that felt rushed, incomplete, or poorly coordinated, leaving them to navigate layers of bureaucratic confusion at a moment when they were already overwhelmed by loss. Interactions with city-hired contractors were often frustrating and marred communication breakdowns between residents, contractors, and city mediators. One resident explained: "We had a mediator [during the repairs]... [but] many times we just had to be like, 'Nope, nope, nope.' They hadn't replaced some of the carpets... the electrical was all weird... they talked about giving us the value of the furnace... but then said we had to pay for installation. It didn't make sense."

This recurring cycle of environmental damage, insufficient support, and bureaucratic opacity has fueled growing frustration. Several interviewees perceived that public agencies and utilities do not consistently welcome or meaningfully incorporate their ideas or feedback, or carry through on their commitments. As per one neighbor's comment: "The community of South Park is used

to having conversations of great plans [...] that are going to benefit everybody. And year goes on, we're still talking about it. Another year goes by, the flyers on the walls are getting wrinkly and yellow because they [...] were never touched again. Three years, the conversation's gone. That always happens here in South Park. That is such a normal thing to kind of feel like we've been bailed on, or that the project was too intense or too hard, or we get told the funding ran out." Suggesting fatigue and feeling overburdened after the authorities fail to follow through, the neighbor concluded, "Why do we have to keep repeating ourselves?"

Community Solidarity and Collective Care

In the wake of the 2022 flood and amidst the recurring threat of more flooding, neighbors consistently emphasized that community solidarity and local organizations, not government systems, form the backbone of neighborhood resilience. Across interviews, residents who experienced flooding described slow, confusing, and insufficient responses from public agencies, noting that although aid eventually arrived, neighbors and grassroots groups were the true first responders. This sense of self-reliance was reinforced during a lesser flood during a December 2024 King Tide, when one resident commented, "If it wasn't for [my neighbor] calling, nobody from Seattle would even know we flooded." Participants offered numerous examples of community-led action: "A couple of neighbors... literally for hours, just stood there pumping water out of our backyards," one recalled, while others described help spreading informally through hand-delivered notes, food, and clothing. This ethic of collective care is deeply embedded in everyday life—"Every single solitary group in their own language said, 'We know our neighbors and we watch out for each other,'" noted another neighbor. These networks compensate for institutional gaps and highlight residents' call for transparent, multilingual communication as a basic equity requirement. At the same time, people expressed hope for shared community spaces—a center that "really is for the people"—that could strengthen collective care, support youth, and reflect South Park's multicultural identity.

> ***"It's been three years since we [were displaced], but we cannot leave South Park behind... I cannot detach."***

Safety, Health, and Housing Security

The recurring floods have magnified long-standing socioeconomic vulnerabilities in South Park. Homeowners expressed anxiety about declining property values and uncertainty regarding potential "buyouts", where the City would purchase neighbors' properties. Some see buyouts as an inevitable option, given the likelihood of future flooding. As one neighbor explained: "My grandparents always said: 'The river will always fight for its space.'... My aunt has her house just a few meters from the sea. When the sea decides to rise... the houses get pushed back. I imagine it's the same with the Duwamish River."

Yet, many fear that accepting a buyout would mean losing their primary asset and being priced out of the community: "If they gave me fair market value, I couldn't buy anything else in South Park. I'd be forced out," explained one homeowner. Another remarked, "We could never afford to live next to a body of water anywhere else but here [in South Park]."

Beyond the financial strain, residents emphasized serious health and safety risks linked to floodwater contamination and deteriorating housing conditions. Several neighbors learned only after the flood that the water flowing into their homes included sewage and toxicants—a consequence of living adjacent to a federal Superfund site. Some residents reported long-term soil contamination requiring medical testing and vaccinations after exposure: "The soil

is still contaminated with arsenic and lead… they sent us to the clinic for a general checkup," expressing frustration about not being able to use their backyard.

These concerns were compounded by persistent mold, moisture, and structural decay in flood-damaged homes—issues especially acute for renters whose landlords refused to make repairs. "Water has come in several times and the landlord hasn't replaced the floor—I'm worried there's moisture underneath," one resident said, raising fears about respiratory illness and chronic dampness.

Layered onto these environmental health risks were longstanding concerns about neighborhood violence and safety. As one neighbor put it, "There was a kid that was shot down here recently… but I really believe in the community," reflecting how residents navigate fear, stigma, and reliance on strong social ties.

These accounts reveal a clear pattern: the burdens of flooding fall disproportionately on low-income, immigrant, and undocumented neighbors, underscoring how environmental hazards compound existing inequities and further erode residents' sense of safety, stability, and long-term security in South Park.

Relocation, Displacement, and Gentrification

While South Park neighbors' opinions on relocation range from skepticism to curiosity, they are increasingly concerned about forced displacement, both as a result of flooding itself and flood adaptation measures. This tension surfaced repeatedly in discussions of buyouts, housing affordability, and long-term flood planning. In the context of possible flood adaptation options, neighbors repeatedly noted, "improvements in the neighborhood lead to more displacement," creating deep anxiety that "beautification," and new infrastructure could unintentionally trigger the loss of affordable housing and long-standing community ties. As one neighbor warned, "beautifying the community will attract new folks and kick out the ones already here." For this reason, neighbors stressed that any adaptation plan must be developed with the community.

Residents also consistently noted that climate adaptation, including NBS, could contribute to gentrification if not accompanied by strong anti-displacement measures. This tension highlights a core environmental justice principle articulated throughout the interviews: ecological restoration must be paired with anti-displacement safeguards, including guaranteed affordability, renter protections, and community-led decision-making. A few suggestions on how to achieve this included the need for "more robust, proactive communication… including knocking on doors, because the owner might live somewhere else and the person impacted never gets the info," as well as multilingual outreach and involvement.

Some neighbors feel that retreat may eventually be necessary. Yet even those open to relocation emphasized that the only acceptable scenario is one that allows them to stay in South Park, ideally through options that preserve community ties. As explained by one neighbor: "We'd lose a lot of good neighbors… I don't even know if people would want to make that sacrifice." Underlying these perspectives is a shared environmental justice concern: any flood adaptation effort—whether NBS, infrastructure upgrades, or buyouts—must be paired with strong anti-displacement protections. Without guaranteed affordability, renter protections, and community-led decision-making, residents fear that adaptation could replicate the very inequities that have long contributed to South Park's vulnerability.

Connection to Place and the River

Despite years of damage, loss, and insecurity, neighbors' attachment to South Park and to the Duwamish River remains strong and rooted in place. This attachment is a major reason many resist the idea of leaving. The river is often described as a paradoxical presence. As one long-term neighbor explained, "The river is beautiful but feels sinister because of its contamination. It took me years to feel comfortable engaging with it." This deep connection complicates discussions about relocation or buyouts. As one immigrant neighbor expressed, "The river gave me everything. It gave me my voice. It's where I met my community [...] "It's been three years since we [were displaced], but we cannot leave South Park behind... I cannot detach."

This sense of belonging also extends across generations. Parents worry that relocation would sever their children's connection to the only neighborhood they have known—its parks, festivals, youth programs, and the river itself. Other immigrant residents carry stories inherited from their families about rivers, flooding, and land from their home countries, shaping how they understand South Park today. Elder neighbors speak of wanting future generations to enjoy a cleaner river, safer homes, and a community that still feels like South Park. Together, these narratives underscore that attachment to place is not just personal—it is familial, historical, and forward-looking. In the words of one long-term neighbor: "I would love for [my kid and their friends] to just be able to enjoy everything that [South Park] has to offer because of the river, you can go boating or fishing or in the community, you can go for walks and then there's all sorts of events in South Park. So I think it would just be a great thing for them to still be able to enjoy those things."For neighbors, the Duwamish River is a site of memory, activity (e.g., fishing), community, and identity, making questions of relocation inherently social, emotional, and political.

> ***"The river gave me everything. It gave me my voice. It's where I met my community."***

Environmental Justice, Long-Term Vision, and Future Resilience

Neighbors emphasized that flooding in South Park is not an isolated crisis but a chronic, systemic condition that demands long-term and justice-centered interventions. While some households have taken individual protective measures, such as installing pumps or French drains, residents overwhelmingly stressed that these efforts are insufficient in the face of accelerating river change. Institutional solutions, grounded in transparency, accountability, and equity, were described as essential for adaptation.

Across interviews, NBS emerged as a widely supported approach for managing flood risk, restoring the health of the Duwamish River, and repairing long-standing environmental injustices. "What I would be most interested in," explained one neighbor, "is seeing where we could do things that are similar to the People's Park [a shoreline restoration project in South Park] and create that space that could absorb an increase in volume in the river."[23] For many parents, the motivation to support these approaches is grounded in long-term protections and intergenerational care: "Anything that helps clean up the mess, that's what I'd be most interested in—for my kids, for future generations." Another neighbor explained, "I'm always for nature-based solutions... even if they're slower, if they allow me to remain in my home."

Summary

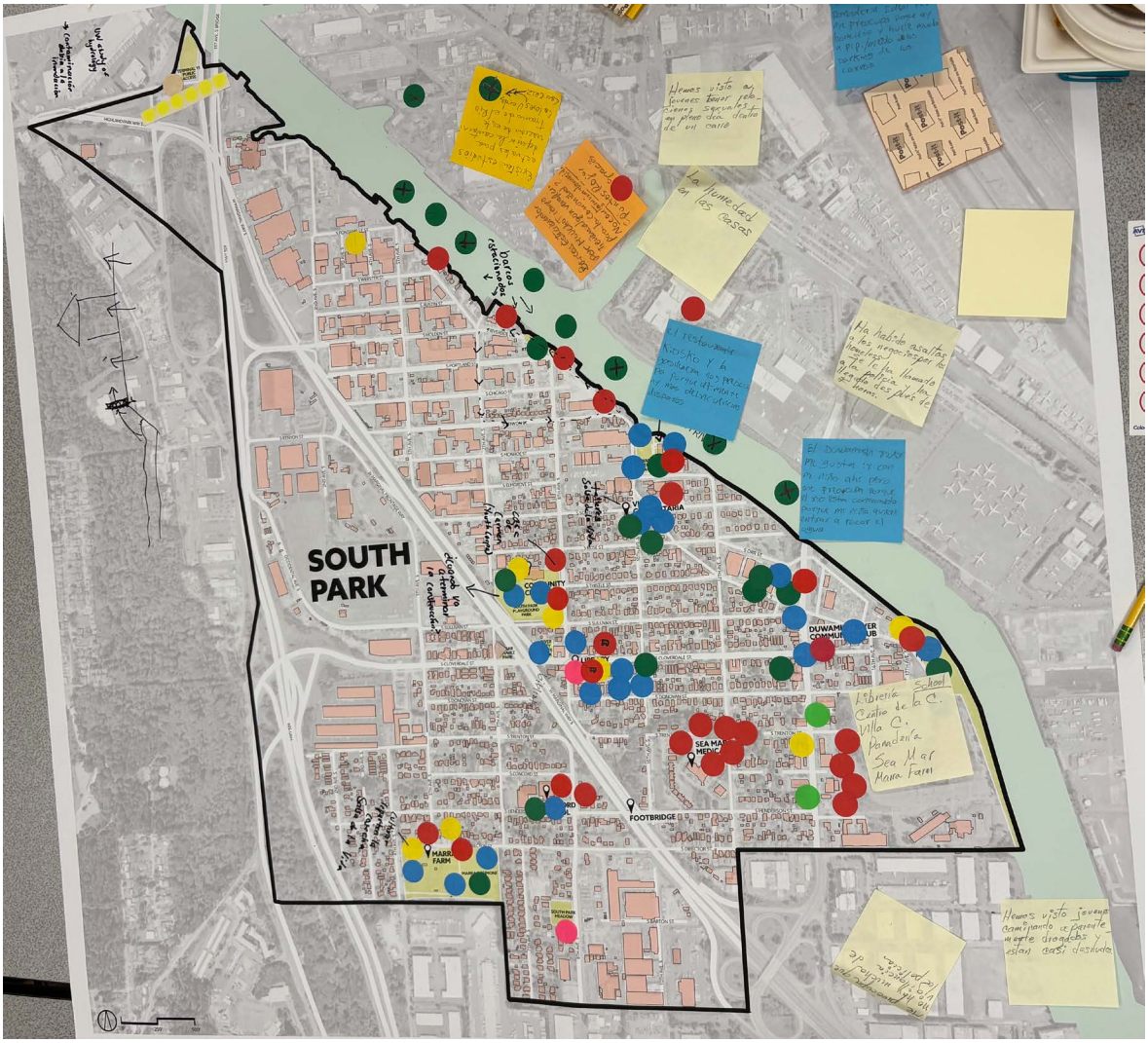
Several themes emerged in the interviews: repeated flooding, housing insecurity, tense relocation debates, profound attachment to place, and desire for long-term, "green" solutions. South Park neighbors continue to endure cycles of loss and recovery with limited institutional

support, relying on mutual aid and neighbor networks to survive. Yet, even amid exhaustion and frustration, a strong sense of hope and joyful visions for the future persist.

Neighbors envision a future where adaptation does not mean displacement—where they can remain rooted in their community, maintain their ties to the Duwamish River, and see resilience strategies implemented in ways that make staying possible. Their stories collectively highlight the urgent need for equitable, community-centered adaptation—one that addresses both the physical realities of flooding and the social, cultural, and economic foundations that sustain life in South Park.

Community Discussions

On May 3, 2025, we hosted a multilingual community discussion in South Park to understand the values and priorities of residents around protecting spaces and places in their neighborhood from flooding. Residents were recruited via a flyer posted on social media and direct outreach by DRCC. Twenty-four residents attended the event and were assigned to one of three groups: one Spanish-speaking and two English-speaking groups. All participants spoke English and/or Spanish; no members of the Khmer community attended.



Neighbors marked maps of South Park during the focus group conversations, as they discussed their favorite spaces and places within the neighborhood. Image Credit: Clare McCarthy

The event began with a brief introduction from DRCC and UW team members. UW facilitators then led residents in two rounds of group discussions. Each group had a facilitator and a notetaker and was provided with a map of South Park, markers, and post-it notes.

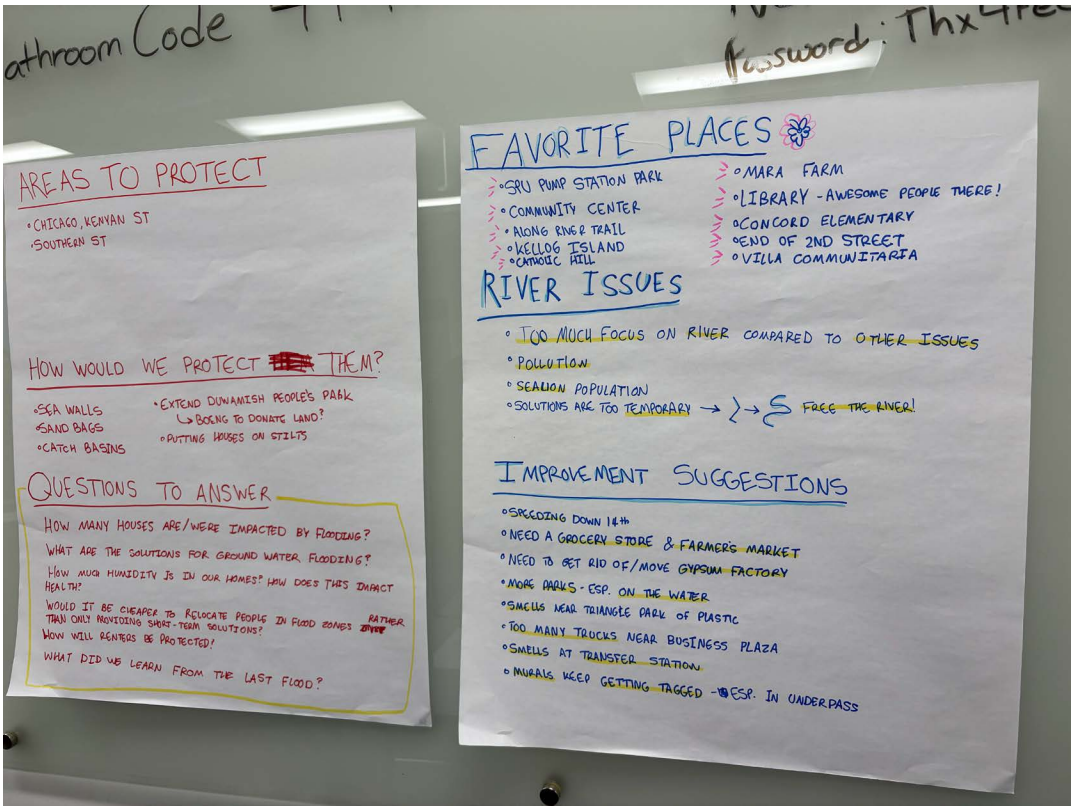
During the first round of discussion, facilitators asked participants about their favorite spaces and places in the community. Facilitators prompted residents to consider what they like about the spaces and if there was anything that they would like to see changed. Using the map and materials provided, residents could mark the places discussed. Between the first and second discussion rounds, a team member shared the educational materials developed as a first step of this project to explain the root causes of flooding in the neighborhood.

During the second discussion round, facilitators asked participants what spaces and places in South Park are most important to protect from flooding and their concerns about these spaces during flooding. If groups had sufficient time, they also began to discuss residents' concerns and future visions for the neighborhood – a conversation that continued during the community workshop held later in the month.

The group discussions during the event highlighted particular places in South Park that are most valued by the community and those they want to see protected from flooding.

Priority places the community seeks to protect from flooding include residential streets and homes, industrial areas of South Park–which provide jobs and a tax base–and public spaces that provide disaster support, such as the Port of Seattle's Duwamish River Community Hub.

Participants also identified other key community spaces, including the South Park Community Center, Duwamish River People's Park, Marra Farm, and the SeaMar Health Clinic.

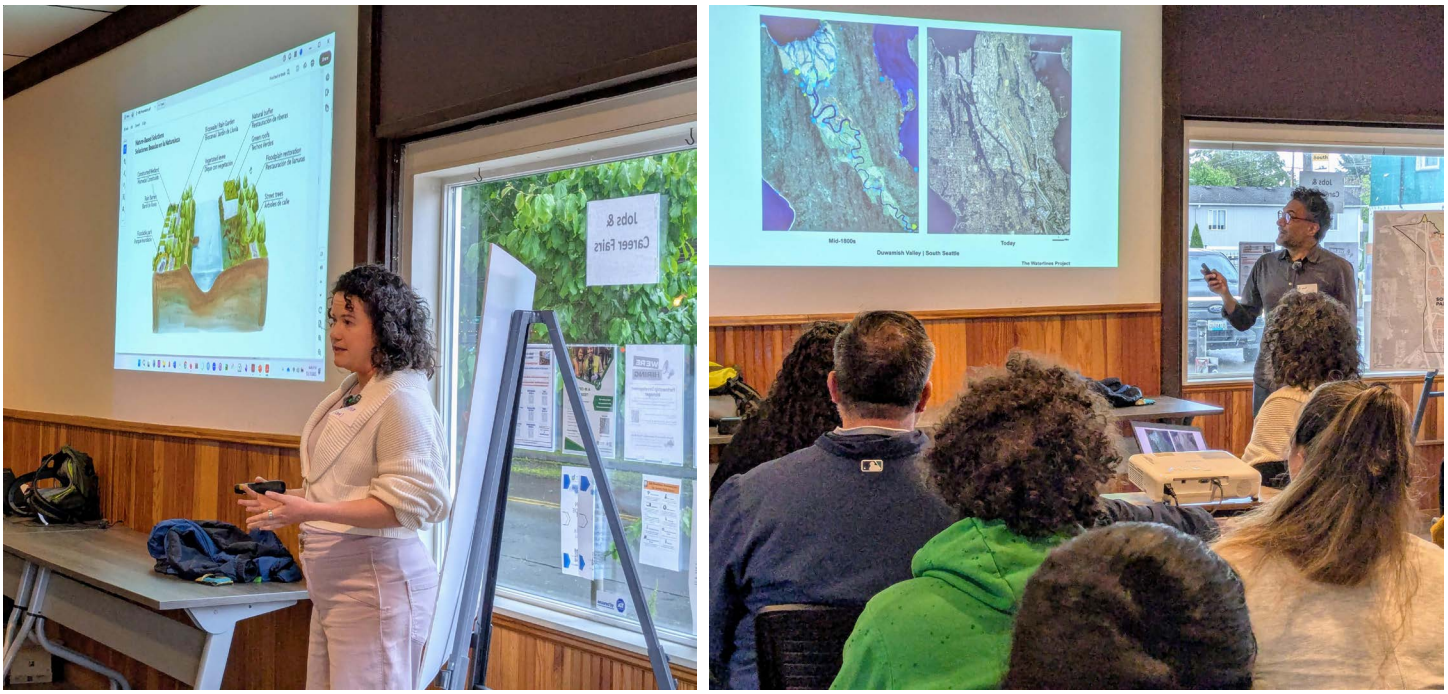


Notetakers from UW captured the key points of the community discussions on flipchart paper. Image Credit: Clare McCarthy

Community Workshop

On May 17, 2025, the LWW team hosted a workshop to further educate residents about a range of NBS strategies and facilitate a conceptual visioning process to consider where and how NBS could be applied in South Park. The workshop was used to gather direct community input on the application of NBS in the neighborhood.

Residents were recruited by DRCC via social media, WhatsApp, word of mouth, and flyers around the neighborhood. Twenty-nine residents attended the event, all of whom spoke English and/or Spanish, including two English-speaking Khmer residents from the flood zone. All presentation slides and workshop materials were provided in both English and Spanish.



UW team members deliver a presentation on the root causes of flooding and NBS at the start of the workshop, Image Credit: BJ Cummings

NBS education and priorities activity

The event began with an overview of NBS strategies. The LWW team reviewed the root causes of flooding and described ten different types of NBS, supported by graphics and photos (Figure 6; Appendix 5a). This presentation was followed by a break during which residents used sticky dots on a poster listing NBS strategies to "vote" on which NBS they would like to prioritize, with options of floodable buildings, constructed wetlands, floodplain restoration, vegetated levees, street trees, bioswales/rain gardens, floodable parks, green roofs, rain barrels, and natural buffers.

Retrofitting existing housing to floodable buildings received the most support (20 votes), followed by floodplain restoration (11) and constructed wetlands (11) (Figure 7). All three of these solutions represent Tier 3 strategies in the Flood Adaptation Hierarchy (Figure 3). Relocation or retreat from the flood zones (a Tier 2 strategy) was not included as an option during the workshop, which focused on more active and structural strategies. Given that the interview analysis and community feedback sessions later revealed community members' strong interest in relocation, not including relocation in the workshop discussions may have been a missed opportunity to capture more robust input on this option and potential areas for resettlement.

Figure 6. Vegetated levee graphic

Vegetated Levee

Other Names: Living Levee, Horizontal Levee, Naturalized Levee

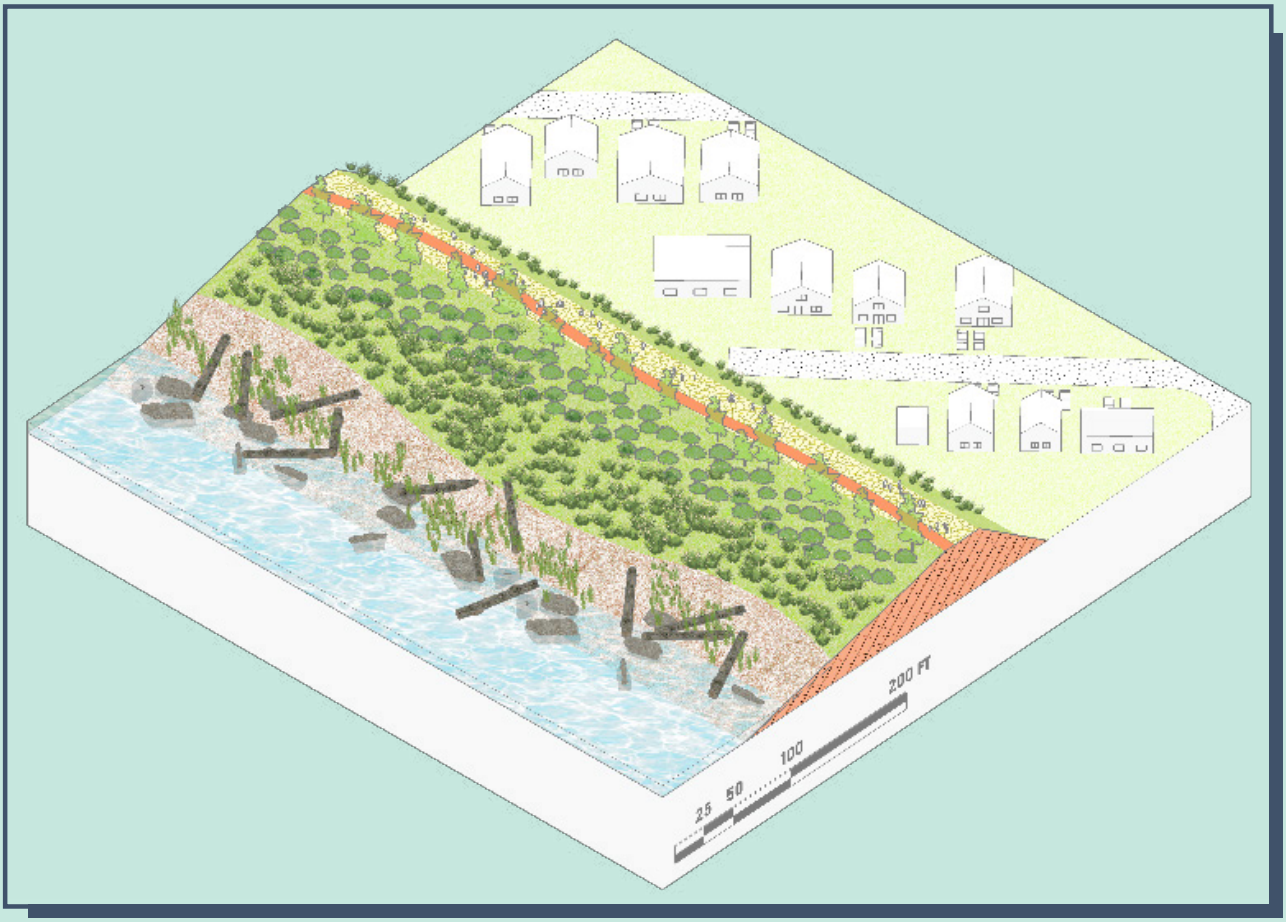
FOR RIVER OVERTOPPING: Earthen mounds with vegetation that are aligned parallel to rivers to block water from overtopping the river during floods or high tides

Benefits

- Reduces risk of flooding
- Provides habitat for plants and wildlife
- Increases greenery in the community
- Could create recreational space
- Could provide long-term flood protection depending on design

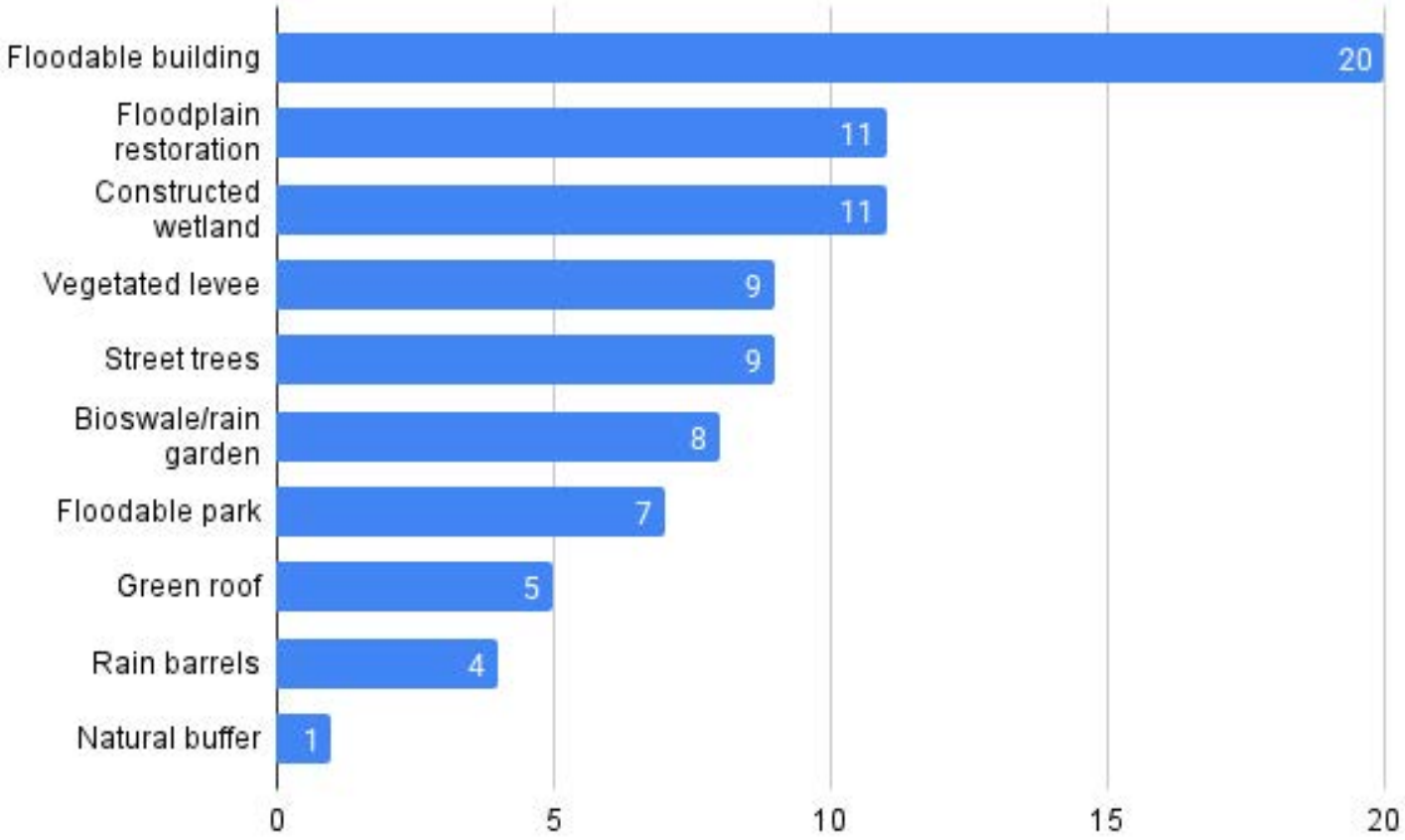
Considerations

- Requires a lot of land area which could displace people
- Impacts river views and access
- Takes a long time to get built
- Does not help with groundwater flooding



An example of the NBS graphics presented during the workshop

Figure 7. Nature-based solution voting activity results



Bar chart depicting the results of a workshop activity where neighbors voted on which nature-based solutions to prioritize in South Park

Future visions activity

During the break, residents were also invited to participate in a "future visions" activity. The LWW team created drawings visualizing specific quotes collected during the community interviews (e.g., "my hope would be that whatever we design would allow the community to continue to access both physically and visually the river"). Four of these sketches, two of which are depicted in Figure 8, were compiled on a board to which residents could add post-it notes to respond to the visions and add new visions (see the board of vision sketches in Appendix 5b).

Several responses indicated positive reactions, like "I love this vision - can swim in the river with my daughter," in response to the first sketch in Figure 8. Some responses suggested edits to the visions: in response to the sketch depicting residents being moved away from the river (second sketch in Figure 8), one person wrote that they would prefer to be supported with adaptation rather than be moved. Another response posed a new vision that included potential relocation: "[Highway] 99 is gone and all of that land is converted into nature-based solutions, affordable housing + community use."

Figure 8. Drawings for "Future Visions" activity

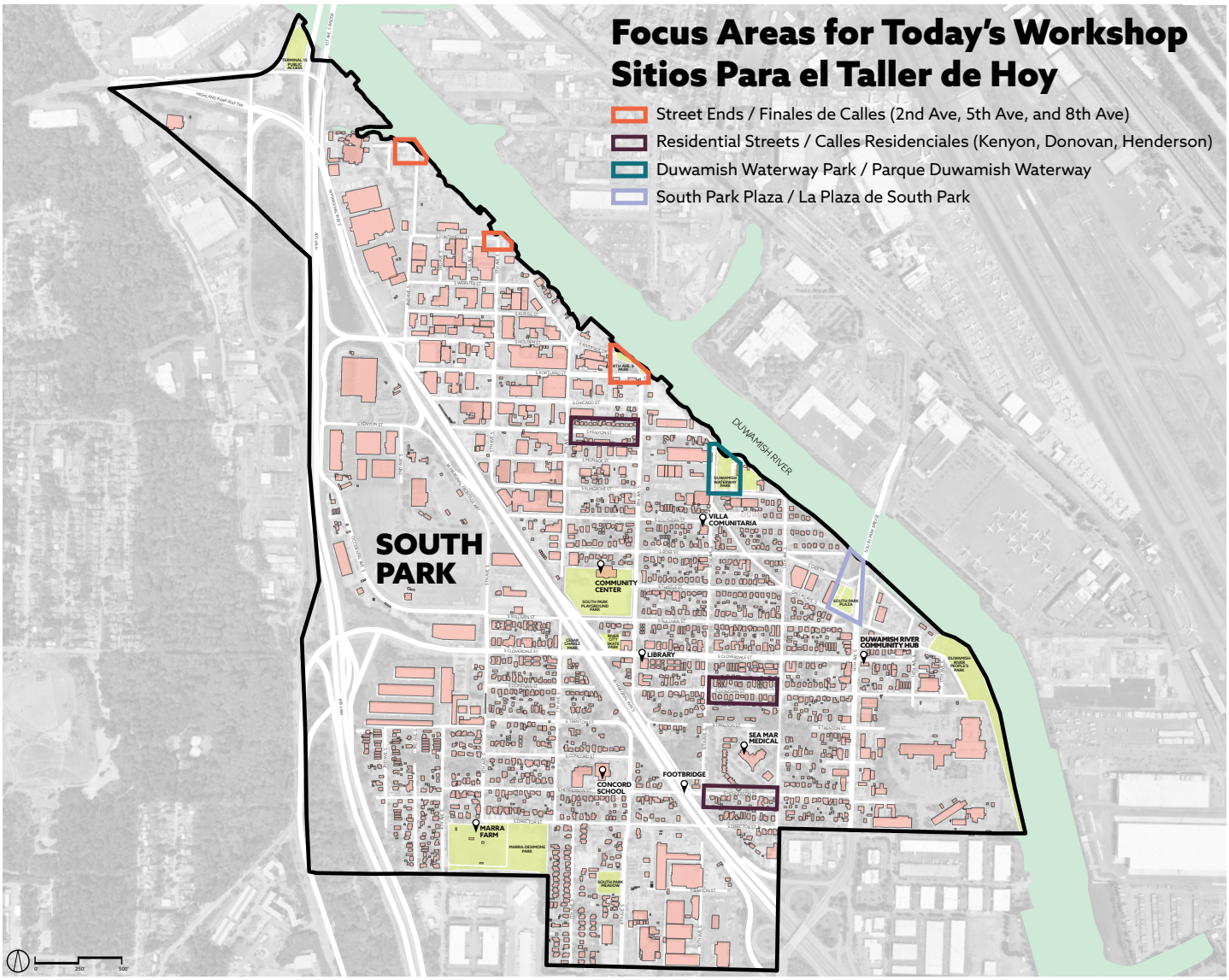
"I would hope that my children... could go swimming in the Duwamish, that they could fish..."

"In my personal vision, I would love to be moved away and have a townhome away from the river -something small."

Mapping exercise

Finally, facilitators led residents through a mapping exercise. Participants selected one of four South Park areas to focus on: 1) Duwamish Waterway Park, 2) South Park Plaza, 3) Kenyon, Donovan, and Henderson streets (a representative sample of residential streets), or 4) 2nd Avenue, 5th Avenue, and 8th Avenue street ends (street ends that connect to the river and were the entrypoint for floodwaters into the neighborhood in 2022) (Figure 9). These four areas were chosen based on input received during the community discussions. Groups discussed which NBS strategies they were most interested in seeing in that area, where the strategies could be placed, and why they chose that particular strategy and location. The discussion occurred across two Spanish-speaking groups and three English-speaking groups, with a facilitator and notetaker in each. Each group was provided with a map of the focus area, laser-cut models of each NBS strategy sized to the map scale, photos and descriptions of each NBS, post-it notes, and markers. Participants were invited to place selected NBS strategies on the maps and discuss how the particular NBS could help resolve certain challenges in each focus area.

Figure 9. Focus areas for community workshop



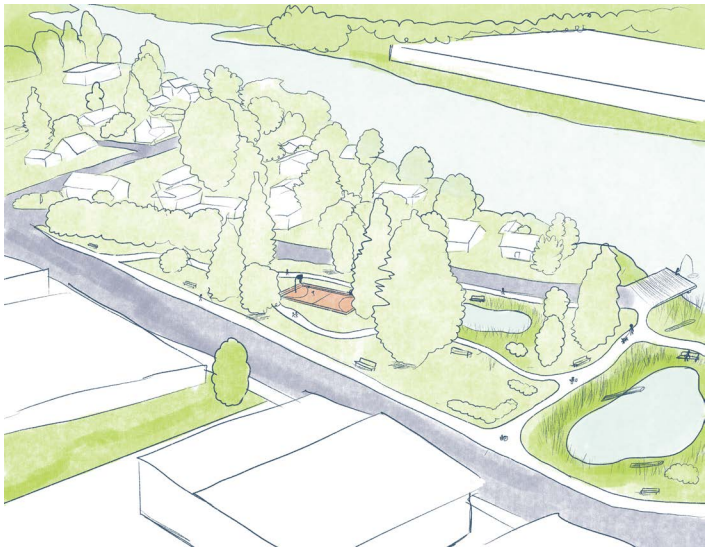
Map showing the areas within South Park that neighbors discussed during the community workshop

During the mapping exercise, community members in the group discussing Duwamish Waterway Park expressed an interest in natural buffers, floodplain restoration, and wetland restoration at the park, as well as making the park floodable. They emphasized improving the natural habitat while maintaining river access. The South Park Plaza group discussed constructing a restored wetland in the triangle north of the Plaza as well as installing green roofs, bioswales, and vegetated berms in the industrial areas. Some residents discussed moving away from the "Sliver by the River," which could then be converted to NBS. The river street ends group discussed converting areas not used by industry into vegetated berms or restored wetlands, and expressed interest in the 8th Avenue street end becoming a floodable park. Finally, the inland residential streets group talked about using bioswales, street trees (native vegetation), green roofs, and rain barrels (see Appendix 5c for a summary of the mapping exercise discussions).

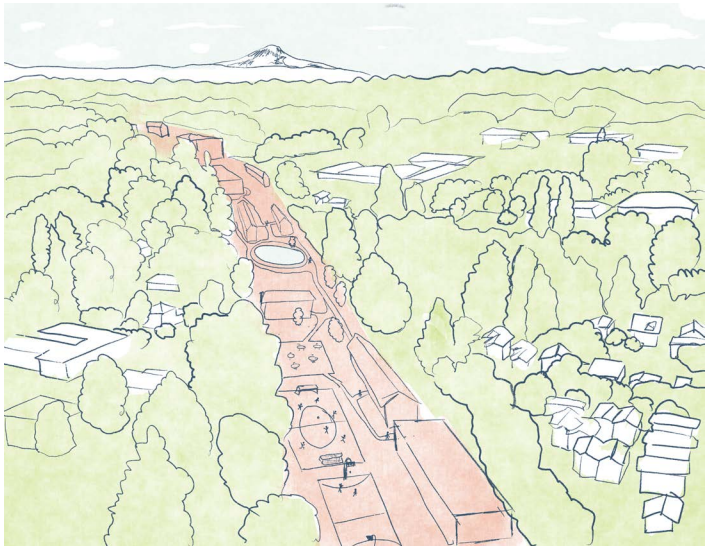
Workshop deliverables

Following the workshop, the LWW team produced a summary pamphlet (Appendix 5d), additional vision sketches (Figure 10), and a unified conceptual map representing the workshop results for use in soliciting broader community feedback (Figure 11).

Figure 10. Vision drawings resulting from the community workshop



Vision drawing depicting a restored wetland and floodable park

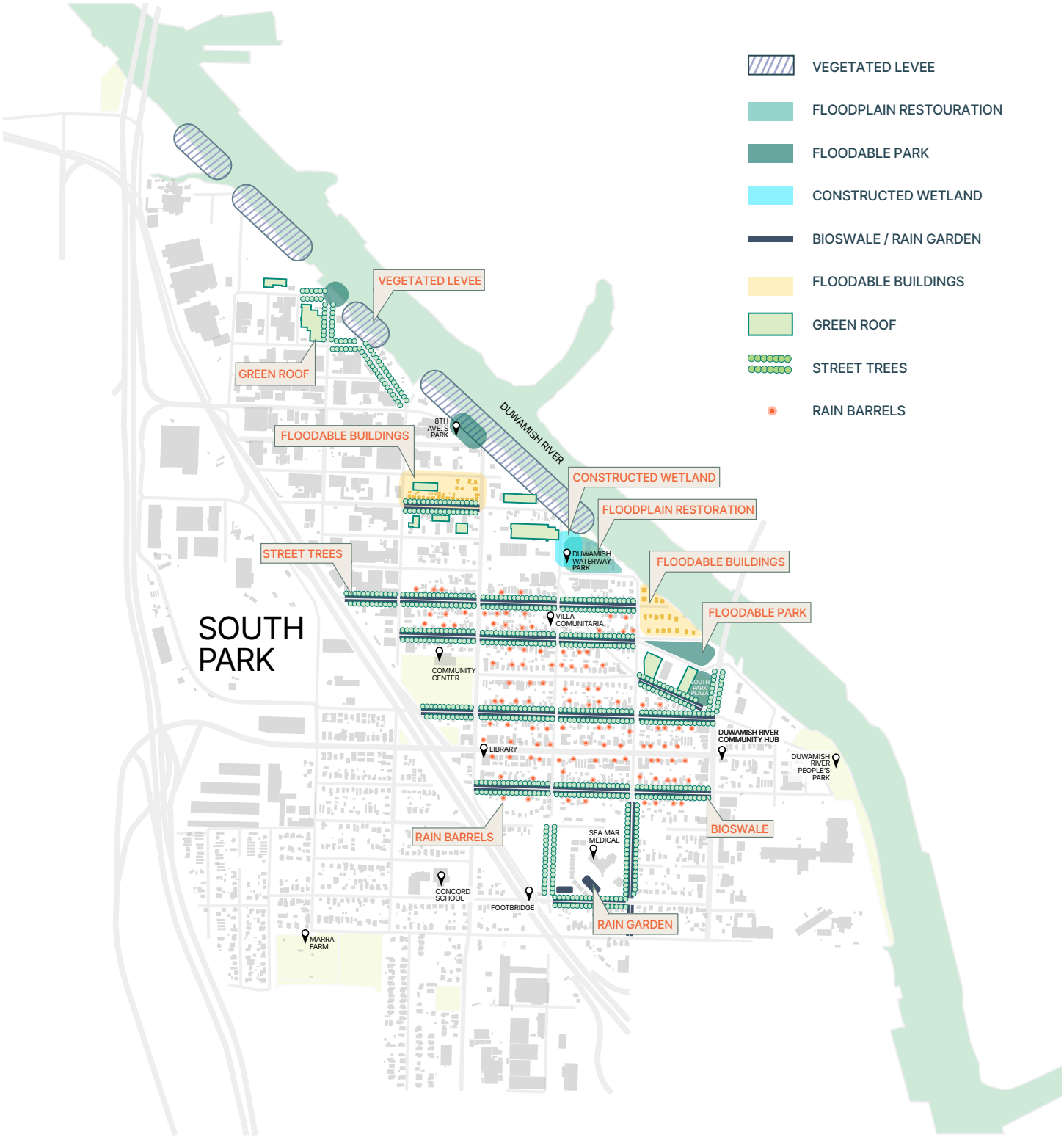


Vision drawing depicting South Park with Highway 99 removed

Because the community workshop focused on four particular areas in South Park – (1) Duwamish Waterway Park, 2) South Park Plaza, 3) Kenyon, Donovan, and Henderson inland residential streets, and 4) 2nd Ave, 5th Ave, and 8th Ave street ends – the NBS elements on the map are clustered around these areas. For that reason, the vegetated berm appears fragmented on the map, although in reality, an effective berm would likely need to be uninterrupted. Before any NBS strategies are implemented, technical engineering considerations must be analyzed, and further community engagement must be pursued to gather additional input on the siting and design details and ensure community support.

Overall, the results demonstrate that community members are interested in floodplain restoration and areas of vegetated berms along certain reaches of the Duwamish River. They are also interested in floodplain restoration and constructed wetlands in Duwamish Waterway Park and the South Park Plaza, as well as green roofs on residences and large industrial buildings throughout the neighborhood. Impacted residents are especially interested in floodable buildings in the “Sliver by the River” and the northern residential/industrial “fenceline” flood zone. Applying street trees, rain barrels, bioswales, and rain gardens to manage stormwater across the residential streets of South Park that are farther from the river also appeals to neighbors.

Figure 11. Conceptual map of flooding solutions in South Park



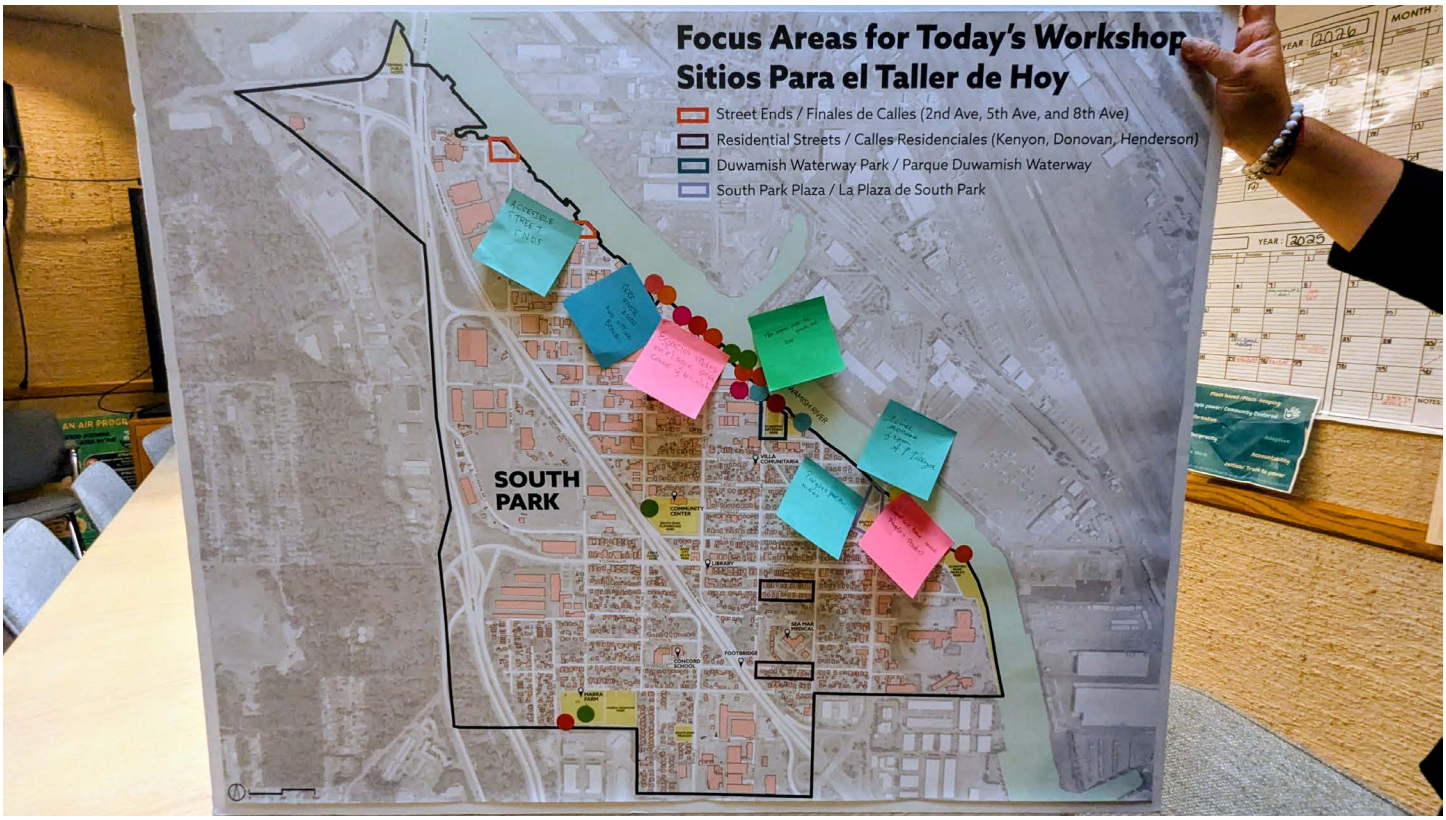
A conceptual map of flooding solutions in South Park, developed based on input gathered from the community workshop.

Community Feedback

DRCC shared information about the LWW project with the greater Duwamish Valley community through a series of 25+ engagement events between June and October 2025. The events included community markets, neighborhood meetings, festivals, weekly meal distributions, boat tours, and informational sessions. DRCC hosted informal conversations with community members, shared the root cause of flooding materials, educational materials on NBS strategies, and the conceptual map from the community workshop. Residents were invited to leave their input by adding post-it notes with their thoughts to the conceptual map, placing stickers on areas of concern and/or preferred NBS strategies, and engaging in conversation with DRCC staff. Through these outreach events, DRCC solicited community feedback on the draft conceptual map from 250+ people, 95% of whom were Duwamish Valley residents and 60% of whom were South Park residents who had been directly impacted by neighborhood flooding.

Tabling for community feedback at public events in South Park. Image Credit: DRCC

The feedback received through these events confirmed broad community support for NBS and concurrence with the conceptual siting of various strategies represented in the conceptual map. DRCC representatives reported that community members expressed a strong desire for their concerns and preferences for flood adaptation to be heard in the public planning process. DRCC staff reported that as residents learned more about NBS strategies at these events, the more highly they prioritized them as preferred solutions. The South Park community-at-large was more interested in NBS than in gray infrastructure, such as sea walls. Community members who had been directly affected by flooding also expressed a high level of interest in buyouts or other assistance to allow for their safe retreat from the flood zones, so long as they could be relocated within the neighborhood. Despite the interest in moving away from the flood zones and mitigating or accommodating sea level rise with NBS in those areas, residents placed a high priority on avoiding displacement from the neighborhood.



The conceptual map developed following the community workshop is marked with additional community feedback gathered by DRCC. Image credit: BJ Cummings

Discussion

Conclusions

LWW is an interdisciplinary, multi-methods, community-directed project to develop a flood adaptation strategy aligned with the values and priorities of South Park residents. Integrating the results of the individual methods allows us to discern areas of convergence as well as tension between community goals, priorities, and values.

The literature review provided insight into the benefits and limitations of a wide range of NBS and their potential performance and benefits relative to hardened "gray" infrastructure and to other NBS strategies. The findings affirmed that applying NBS can bolster flood risk reduction capacity more than installing "gray" infrastructure solutions alone, and are cost-effective when considering longer timescales and environmental and health "co-benefits." While the literature review identified varied community support for NBS across varying study and geographic contexts, co-benefits related to health and recreation helped drive community support. The NBS strategies overall also better aligned with the values articulated in the LWW study interviews.

Key themes revealed by the analysis of the interviews include strong attachment to place, a preference for long-term, "green" solutions, and a desire for equitable, community-centered flood adaptation that does not result in neighbor displacement.

The co-benefits of NBS support many of these values, whether by adapting structures to accommodate floodwaters ("floodable buildings") or replacing currently developed areas with restored and constructed natural systems, like vegetated berms, softened shorelines, and wetlands. Many of these NBS strategies also reflect historical conditions prior to the channelization of the river, including the presence of a natural levee between the river and the now-filled wetland in the north flood zone (circa 1850), the wetland itself, and shallow shoreline habitat in many areas that are now lined with steep rip-rap banks and/or industrial development. Implementing NBS strategies that reconnect these hydrological systems can improve water retention during flood events while also offering other health-promoting co-benefits such as better recreation opportunities, more green space, improved air quality, and enhanced habitats for salmon and other species. NBS strategies generally also have greater longevity as compared to gray engineered solutions, supporting the community's concern for future generations.

A tension emerges around relocation that may be required for extensive NBS and restoration, due to the community's resistance to displacement. However, rather than move out of the area and erode existing community bonds, some residents articulated visions for relocation within the neighborhood. The community discussions, community workshop, and feedback events lent specificity to particular preferred NBS and potential locations for siting a variety of strategies, including vegetated berms, floodable buildings, green stormwater infrastructure (rain barrels, green roofs), and even areas of potential retreat and relocation.

Finally, the community's high level of participation in the study and the comments provided through the feedback events indicate that residents are committed to engaging in flood adaptation planning. They are dedicated to ensuring that planning efforts robustly involve impacted residents and reflect their priorities and values, including care for the environment, each other, and future generations.

Limitations

The LWW project has several limitations that will require ongoing community-based research and planning to resolve. Although the project team dedicated significant effort to including perspectives from a wide variety of people living in South Park, some key perspectives, such as those of Khmer neighbors directly impacted by the 2022 flood, were not sufficiently represented in the study. The LWW team also faced challenges in documenting all of the perspectives of Spanish speakers during the community discussions and workshop, as fewer team members spoke Spanish and had to facilitate larger groups, as compared to the English-speaking groups.

Furthermore, the conceptual map generated following the community workshop is a visual representation of input collected during the workshop and cannot be strictly interpreted as a flood adaptation "vision." For example, NBS strategies selected by workshop participants for the inland residential streets may or may not be generalizable to all residential streets in the neighborhood. The omission of retreat or relocation from the NBS strategies presented in the workshop likely skewed the selection of strategies represented. While the conceptual map, interviews, community discussions, and workshop results represent a significant addition to previous city-directed community input, additional community engagement is required to convert the conceptual map into a vision that more broadly represents community preferences for the future application and siting of specific flood adaptation strategies in South Parks. Further refinement of NBS strategies and siting considerations can also be supported by engaging the affected community and public planners in a continued reflection on the equity considerations associated with each tier of solutions in the Flood Adaptation Hierarchy (see Appendix 2c).

Finally, the LWW project occurred against the backdrop of the 2025 shift in federal policies, which generated significant concerns for community safety and shifted community priorities. This may have resulted in selective pressures against participation, repressing representation for some sectors of the community and preferencing others.

Integration with public planning efforts

UW undertook the LWW project at the request of DRCC in response to the 2022 flood and related City-led planning efforts for flood adaptation in the Duwamish Valley. In order to build capacity in the community and center the environmental justice community of South Park, UW and DRCC designed the LWW project to center the directly impacted residents. The study team met regularly with the City of Seattle planning team throughout the project to coordinate on outreach opportunities and share findings, but the two flood adaptation projects proceeded independently of each other. As a result, the LWW study team was aware of but not limited by potential constraints on the City's flood adaptation alternatives.

The City of Seattle's partners in its planning process include industrial and business owners in South Park and Georgetown, in addition to neighborhood residents. The shoreline is a patchwork of publicly- and privately-held properties. The City owns the streets and several utility and park properties along the waterfront, but much of the waterfront along the South Park bank of the river in Seattle is occupied by industrial businesses that depend on access to the water. Key waterfront businesses on the South Park shoreline have indicated their intent to manage their own flooding issues privately. As a result, the City plans to implement a two-part approach to flooding and sea level rise adaptation that maximizes upcoming public investments and anchors water management infrastructure in publicly-owned land, including the right of

way. This makes certain solutions challenging, such as installing a continuous vegetated berm in the northern mixed residential/industrial flood zone. The City's lead agency for flood adaptation planning is Seattle Public Utilities, which has certain legally-mandated limits on the uses of ratepayer-generated funds, requiring them to work across City agencies to develop a funding plan for activities that fall outside of those limitations. Additionally, the City does not currently have a program or funding for buyouts of residential properties in the flood zone. Finally, the "Sliver by the River" lies in unincorporated King County, outside of the City limits, further complicating the coordination needed to pursue an integrated, comprehensive plan to protect the residents of South Park from future flooding.

Having conducted the LWW project without being constrained by those considerations, the study reflects the flood adaptation solutions prioritized by South Park residents. The results of LWW are accessible to all of the government entities, as well as to South Park residents, as they decide on the technical, policy, and budgetary considerations needed to pursue a flood adaptation plan. We hope that LWW helps all involved entities to collaborate on a plan that supports the community's well-being, respects their priorities, and honors their values.

A UW team member displays a map where some community workshop attendees marked where they live in the South Park neighborhood. Image Credit: BJ Cummings

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Appendices

The appendices can be viewed on the Center for Disaster Resilient Communities' website: https://cdrc.uw.edu/what-we-do/projects/living-with-water/.

Appendix 1: Glossary of terms and acronyms

Appendix 2: Historical wetland and root cause of flooding graphics

- 2a: Historical wetland graphics
  - Historical river and wetlands
  - Current land use overlay
- 2b: Root cause of flooding graphics
  - Groundwater flooding
    - Groundwater: Normal conditions
    - Groundwater: Flood conditions
  - Sea level rise flooding
    - Sea level rise: Normal conditions
    - Sea level rise: Flood conditions
  - Stormwater flooding
    - Stormwater: Normal conditions
    - Stormwater: Flood conditions

Appendix 3: Literature review materials

- 3a: Literature review search terms
- 3b: Identified flooding alternatives
- 3c: Flood Adaptation Hierarchy Equity Considerations

Appendix 4: Community interview questions

Appendix 5: Community workshop materials

- 5a: Nature-based solutions poster
- 5b: Visioning activity poster
- 5c: Summary of map exercise discussions
- 5d: Summary pamphlet

Appendix 6: Equity evaluation materials

- 6a: Methods
- 6b: Results

Learn More

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Center for Disaster Resilient Communities

https://cdrc.uw.edu/what-we-do/projects/living-with-water/

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Quaternary Research Center

Climate Impacts Group

Burke Museum, University of Washington

Cascadia CoPes Hub
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Center for Disaster Resilient Communities, University of Washington

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