Rainy Days, Nature's Ways:

Embracing Stormwater and Play at The Village School

University of Oregon
Giff Glastonbury, Master of Landscape Architecture
Katherine Harrison, Master of Landscape Architecture
Katherine E. Rola, Master of Community and Regional Planning
Keith Stanley, Bachelor of Landscape Architecture
Yeongseo Yu, Ph.D. Candidate of Landscape Architecture
Yekang Ko, Ph.D. Associate Professor of Landscape Architecture, Faculty Advisor

Community Partners
Andy Peara, Executive Director, The Village School
Merrily Elestad, 4-5th Grade Teacher, The Village School
Cara Bryston Staff Wellness Coordinator, The Village School
Shelly Miller, Supervisor, Ecological Services and GIS, Eugene Parks and Open Space
Evan Elderbrock, Emerald Ash Borer Support Specialist, Oregon Urban and Community Forestry Assistant Program
Scott Altenhoff, Manager, Oregon Urban and Community Forestry Assistant Program

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Abstract

This project presents a co-design proposal for integrating stormwater management and nature play at the Village School, a Waldorf-based K-8 school in Eugene, Oregon. The Village School faces drainage issues. With Eugene's annual average rainfall of 70 inches, this results in a soggy field and muddy conditions, limiting the possibilities for outdoor play. The primary focus of our design proposal is the schoolyard, where children play and learn. The project aims to handle stormwater from the surrounding runoff region and divert stormwater from the school building roof using green infrastructure strategies to create a multifunctional space. Engaging school students, teachers, staff, and community partners was integral to the co-design process.

Key green infrastructure elements include bank stabilization, permeable pavement, two new infiltration swales, and native plantings within the swales and along the hillside. The water diversion strategy directs stormwater from a large rooftop into a “dry creek” that incorporates nature play in the creek bed. Infrastructure considerations are based on analysis using the SWMM model for a single day of heavy rainfall, comparing existing conditions to proposed designs and runoff over time. Aligning with state and local environmental planning goals and policies, nature-based solutions resonate with the core values of Waldorf education and reflect the Pacific Northwest's unique climate and landscapes. The proposed solutions offer a multifunctional approach, aligning with state and local policies while incorporating the feedback, values, and vision of the school board, community stakeholders, and, most importantly, the students.

The Village School: Waldorf School

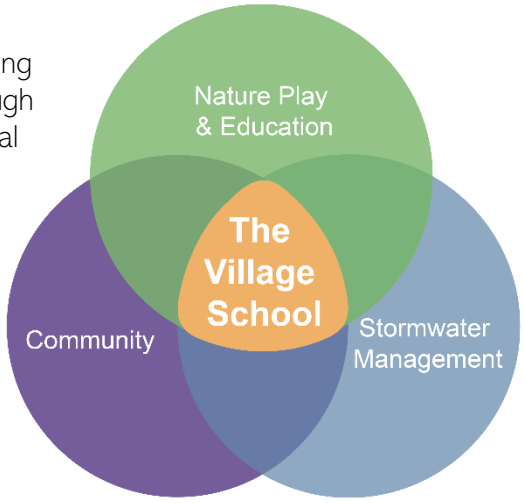
The Village School is a Waldorf inspired; holistic nature school located in South Eugene, Oregon. The Village School serves 225 students through K – 8th grade. The playground serves a wide range of students with diverse race, gender, socioeconomic status, and accessibility needs. The curriculum is centered around the importance of nature play, teaching students through hands-on activities and integrating the outdoors as an extension of the classroom. The teachers facilitate self-guided learning in the classroom, centering equity and accessibility for all students. This education framework helps build a foundation for collective impact from a young age. Centering learning in this way helps improve children's well-being and shapes a generation of climate literate change makers.

The management of land on the school site is important to support the health, educational, and recreational activities of the children and surrounding community. The current conditions limit children's play and learning opportunities for most of the year due to high rainfall in the region through nine months of rainy seasons (up to 70 inches of annual rainfall according to the National Weather Service) and the drainage issues on the school site. The hillside itself, which is a popular play area for kids, is also experiencing erosion concerns. Access to nature reduces stress and improves social-emotional wellness in children, and this project's goal is to improve the quality of play students engage year-round. The school site is subdivided into four zones, the North Parking, South Parking, East Side, and Schoolyard (Figure 1). Each zone is impacted by downstream water movement from the broader region and offers opportunities for integration of green water management infrastructure, creation of nature interaction spaces, and collective participation in execution. Through participatory design and planning, students and teachers assessed needs and prioritized features to capitalize on year-round learning opportunities while managing the stormwater.

Figure 1. Aerial site context, including four zones aligned with stormwater catchment modeling.

Design Goals and Objectives

To address the school's concerns and aspirations regarding stormwater management and playground upgrades through natural play, our design aims to co-create a multifunctional playground. This playground integrates stormwater management using green infrastructure and nature play, aligning with the school's values. Our design also seeks to benefit the community by treating stormwater on site while supporting the education, health and well-being of students, school staff, and community members.



Aligning Regional, State and Local Planning

Oregon is renowned for its comprehensive statewide land use planning and progressive climate action planning. Currently, Oregon targets to reduce greenhouse gas emissions by at least 45% below 1990 levels by 2035, and by at least 80% by 2050. Oregon has an established system of state, regional, and local planning efforts created through Senate Bill 100 (ORS 197.010). This bill established a multilevel effort coordinated through the creation of local comprehensive planning documents that algin with The State Planning Goals[1]. Updated in 2019, The Metro Plan[2] for the City of Eugene outlined alignment with State Planning Goals, 4, forest lands, 5, open space, and 6, air, water, and land resource quality. The goals of the plan emphasize protecting natural resources through wise management, maintaining open spaces, and providing a healthy and attractive environment including clean water. In 2020, the City of Eugene updated its Climate Action Plan (CAP)[3] to include five specific actions under the Resiliency category to support stormwater management.

- Action R4: Evaluate stormwater design standards considering climate change modeling by 2022.
- Action R9: Implement the Comprehensive Stormwater Management Plan to protect public health, safety, and wildlife habitat, and reduce flooding risk.
- Action R28: Support funding for constructing and maintaining green stormwater infrastructure like bioswales, green roofs, and porous pavement.
- Action R30: Support practical exclusions from federal and state regulations for constructed green infrastructure stormwater management facilities.
- Action R33: Support funding and programs for measures in the Natural Hazards Mitigation Plan to reduce impacts of floods, fires, landslides, and extreme storms.

In accordance with Eugene Code (EC)[4] 9.6790, the City of Eugene developed its Stormwater Manual to implement the Stormwater Development Standards specified in Eugene Code 9.6791 through 9.6797. It provides design criteria for various structural controls for developers and design professionals. The Oregon Department of Environmental Quality aligns with federal guidelines by providing Stormwater Management Standards for the state. The Eugene Stormwater Management Manual (ESWM)[5] is listed as example of Site Performance Standards.

[1] Oregon Department of Land Conservation and Development, Oregon State Planning Goals (2019)
[2] Eugene-Springfield Metropolitan Area General Plan, The Metro Plan (Updated 2019)
[3] City of Eugene, Climate Action Plan 2.0 (2017)
[4] City of Eugene, Eugene Code (Updated 2024)
[5] The City of Eugene, Stormwater Management Manual (2014)

Incorporating Community Planning

In 2020, stakeholders assembled The Village School Master Plan (VSMP)[6], a collection visions and ideas from the faculty staff, families, and students over the course of one year (Figure 2). Last year the school implemented changes to their courtyard, increasing impervious surfaces on the site, resulting in the need to incorporate water mitigation strategies, impervious surface offsets with bioswales, in compliance with city code. The school seeks to improve water retention and infiltration across the site, while incorporating elements of the 20-year master plan. Our proposed design includes many features for four target zones on the school site:

Figure 2. The Village School 2020 Master Plan features.

1. Schoolyard: 20,Wetland Stormwater Collection; 23, Play Field, 24 & 25, Natural Climbing Features, Boulders, Stormwater Features, and Slope Stabilization; 27, Stormwater Collection, Inspection & Play; 29, Seating and Plantings; 28, Natural Structures; 30, ADA Accessibility to Play
2. East Parking Lot: 31, Water Management & Hard Surface Play
3. North Parking Lot: 2, Water Management
4. South Parking Lot: 5, Trees; 7, Garden

Community Guided Co-Design

Interviews

Figure 3. Hand draw rendering for conceptual site design discussion.

Starting in February 2024, the project team met with The Village School Board of Directors and site planning committee every two weeks. Using hand draw site sketchers to guide conversations, these conversations yielded a set of priorities that reflected the 2020 master plan (Figure 3). Prioritized design features included, the universal access ramp, stabilization to the hillside to allow for play, incorporation of plants, improved drainage, creation of circulation for play, water play features, and alternatives to existing swale. Key design considerations were also informed through an interview with Shelly Miller, Supervisor for the Ecological Services and GIS teams at Eugene Parks and Open Space. Her feedback emphasized the integration of ecological elements to create eco-friendly, self-sustaining water systems. Shelly also brought forth safety concerns around ensuring water is clean enough for play, and that play features do not hinder the functionality of the stormwater treatment infrastructure – two considerations which are addressed in our design proposal.

[6]The Village School, The Village School Master Plan (2020)

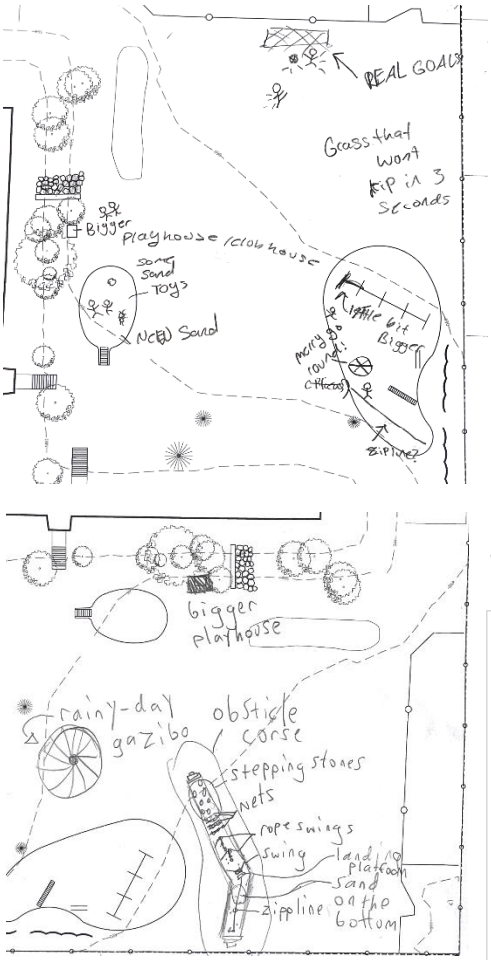


Figure 5.. Design illustrated by students.

Student Engagement

On April 19th, our team visited The Village School and spoke with Ms. Merrily's classroom of 5th grade Students (VSS) to learn about what their dreams and desires were for an upgraded schoolyard. Our visit consisted of a short presentation on what landscape architects and planners do, and we shared some ideas of precedents and concepts from other schools. We then provided the 35 students with a base map of their shoolyard and asked them to draw their own ideas. The students each highlighted a number of similar ideas that they would like to see incorporated at their school (Figure 4, Figure , Figure 6) Engaging students in the design of the space builds ownership and educates children on the lifecycle of plants and water in their surroundings and brings awareness to their impact.

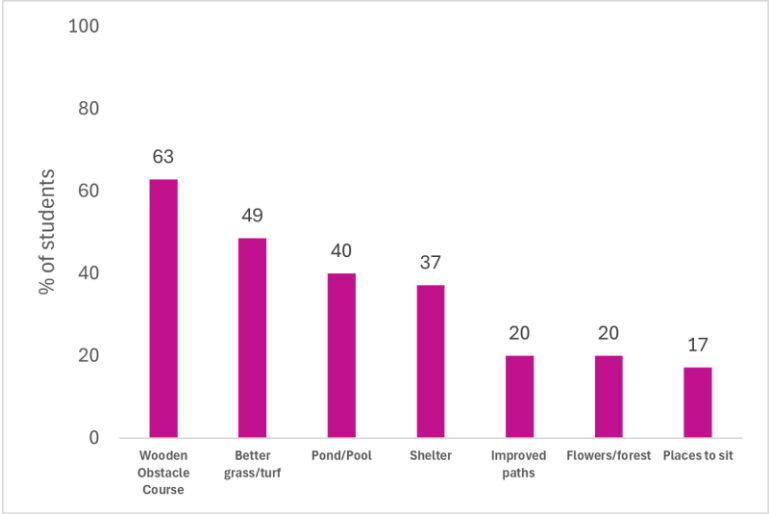


Figure 6.. Percentage of students identified desired schoolyard play features.

Design Elements: Integrating Stormwater & Nature Play

Through our engagement, students identified design features as priorities for safe outdoor play. Play not only supports fine and gross motor skills, but also key social skills, problem solving abilities, and creative thinking. The Center for Disease Control and Prevention[7] recommends kids engage in at least 60 minutes of physical activity per day. Unfortunately, the Kaiser Family Foundation[8] estimated that kids ages 8-18 are engaging in 7.5 hours of screentime for entertainment per day. For many kids today, time in the schoolyard may be the only opportunity for them to engage in outdoor play. This is why incorporating features the students requested, including obstacle courses, a turf field, and the integration of ponds/pools, is so important. The design supports the children's curiosity about interactions with water and nature elements by incorporating water directed from a clean roof fed source, allowing for safe play in ponding water in the swales and infiltration areas.

[7] Center For Disease Control and Prevention, Physical Activity for Children (2024)
[8] Kaiser Family Foundation, American College of Pediatricians (2020)

1. Schoolyard

The school play yard creates a learning laboratory where access to nature provides opportunities to build environmental and climate literacy. The proposed design centers equitable access to nature play by defining a primary circulation route around the ADA accessible ramp and bridges. The curvilinear ADA ramp traverses the hillside and across numerous play zones which incorporate natural features such logs, boulders, and mature vegetation along the slopes, dry creek, and swales. While the features provide slope stabilization and minimize run off from children exploring, they also create intentional interactive water play opportunities accessible by all students.

Rain Garden: The rain garden supports drainage through the integration of subdrains and native trees, shrubs, and ground cover for water uptake. This feature includes boulder steppers giving children the option to stay above or play with standing roof fed water. (VSS, VSMP 24 – 30; ESWM § 2.3.6; ESWM § 2.3.9; ESWM § 2.9.3 - 5)

Vegetated Swale: The existing small swale (238 sq. ft) will be replaced by a new (500 sq. ft) grassed catchment basin area planted with deeply rooting native evergreen trees, shrubs, and ground cover that serves to direct water diverted from the roof and allow for intentional ponding for water play. Includes ADA accessible bridge. (VSS; VSMP 20, 24 - 30; ESWM § 2.3.6; ESWM § 2.3.12; ESWM § 2.9.3 - 5)

"Dry Creek" Infiltration Trench: The trench provides a catchment for water diverted from the ~7,000 sq. ft roof area of the school building. The water drains to a subdrain inlet that diverts excess water into the subdrain catchment system. Logs and boulders within the trench provide additional stability for soil runoff and offer natural features for children to climb on or play with water pooled below. (VSS; VSMP 20, 24 - 30; ESWM § 2.3.7; ESWM § 2.3.8.3; ESWM § 2.9.3 - 5)

Islands of Permeable Play: Multi-functional islands provide space for play while increasing surface infiltration. These spaces include ropes on the slope, a playhouse, a sand zone, engineered wood fiber area with a swing-set, a turf field with subgrade drainage for year round play, and a natural grass field that allows for unstructured, imaginative play. (VSS; VSMP 23- 30)

2. East Parking Lot

The design proposes replacing 1700 sq. ft of asphalt with permeable pavement to reduce pollution runoff and prevent contamination in interactive water play features. (VSMP 31; ESWM § 2.3.5)

3. North Parking Lot

Runoff traveling along the parking lot would be caught by a rain garden before traveling onto the schoolyard. (VSMP 2; ESWM § 2.3.6; ESWM § 2.3.6; ESWM § 2.9.3 - 5)

4. South Parking Lot

Incorporation of rain gardens and native evergreen trees, shrubs, and ground cover to support water management and infiltration, while also creating a space for students to relax and connect with nature while waiting to be picked up from school. (VSMP 5, 7; ESWM § 2.3.6; ESWM § 2.9.3 - 5)

Performance

Our design aligns with the Climate Action plan, adhering closely to Eugene stormwater design standards (EC §9.6792(3)(a)). Specifically focusing on Action R4, we evaluated our stormwater design performance to check how our design proposal contributes to reducing urban flood risk (CAP AR9). The following calculations demonstrate compliance with EC §9.6792(3)(a), to ensure stormwater quality, the site development plan reduces runoff pollution and mitigates volume, duration, time and concentration, and rate of stormwater.

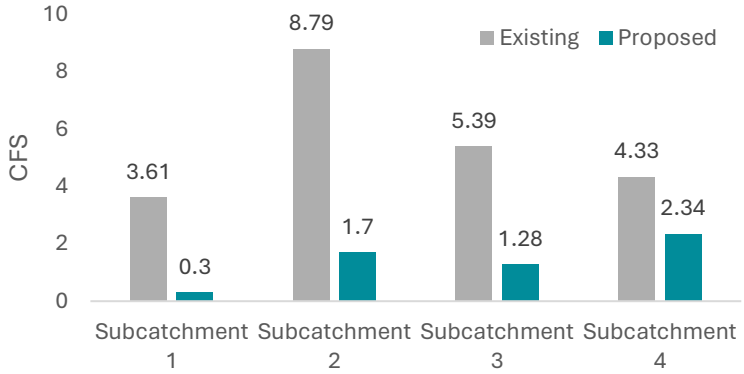


Figure 5. Runoff comparison in a day in cubic feet per second.

Using the SWMM-EPA tool[9], we conducted simulations to project the impact of our design under extreme precipitation conditions. Using 15 minutes precipitation data from January 18, 2012, recognized as the most heavily rainy day of the year, we assessed and compared stormwater runoff between our design and the existing condition.

The proposed design for the entire site presents significant improvements, potentially reducing peak runoff of rainwater by up to 0.64 cubic feet per second while delaying peak flow rates by approximately 20 minutes (Figure 7). Moreover, our analysis indicates a meaningful enhancement in infiltration rates, showing an increase to 6.14 in/hr compared to the existing site's 3.52 in/hr (Figure 8). This translates to a potential reduction of up to 75% in peak runoff during intense rainfall events.

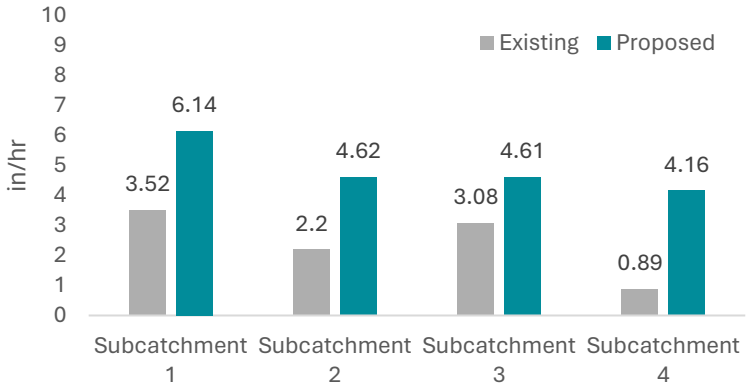


Figure 6. Infiltration comparison in a day (inches/hour).

In addition to the SWMM analysis, we also factored in the various benefits of tree planting using estimations from the i-Tree My Tree tool[10]. By adding 90 trees across the four subcatchment zones, our projections show that the added trees will yield approximately 12,395 lbs of carbon sequestration benefits over 20 years. This equates to a 45,450 lbs (about twice the weight of a school bus) of CO^2 uptake and an estimated monetary benefit of $3,068.70. Note that both SWMM and i-Tree tools are based on a series of simplified assumptions; the simulation results are subject to potential variations.

[9] US Environmental Protection Agency, Stormwater Management Model (updated 2023)
[10] U.S. Forest Service, I-Tree, Tree My Tree (2024)

Implementation

In discussions with the school staff and Shelly Miller, the Ecosystem Services Supervisor at the City of Eugene, we developed a three-phase (near (1 - 2 years), mid (3 – 5 years), and long-term (6+ years) design implementation plan that is feasible and flexible to accommodate the future growth of the school. These phasing suggestions are outlined in Figure 9, which incorporates standards for maintenance and ecologically sustainable planting practices.

Maintenance Plan

The implementation of the design elements offers an opportunity to refurbish the existing soil to increase infiltration and climate resiliency through the incorporation of vegetation that would increase water uptake, soil stability, and reduce heat island effects. These elements must be routinely inspected and maintained in compliance with the Eugene Operation and Maintenance Standards (ESWM § 4.2.3). As a private entity, The Village School Staff is responsible for documenting each stormwater feature quarterly for the first two years and twice per year after. Inspection logs must include accessibility, channelization, debris and litter, erosion damage, excavation of infiltration, infiltrating swales, inlets, mulch, nuisance vegetation, outlets, sedimentation, slope condition and vegetation health (EC §6.615(4); ESWM § 4.5.4 - 4.5.10).

To support the integrated water management, we employ the Miyawaki method[11], a forestation and planting method that integrates ecological practices to incorporate dense, mixed native plants (ESWM § 2.9.4), improve soil through organic material mixing (ESWM § 2.9.3), and build sustainable urban ecosystems. This approach allows the school to reduce irrigation demands, and for student and community collaboration through planting and maintenance.

Phase 1		Phase 2			Phase 3
Year 1	Year 2	Year 3	Year 4	Year 5	Year 6 +
Site Grading Soil Preparation					
Construct ADA Ramp	Installation of boulders and logs				
Construct turf field	Plant additional trees across site				Construct and plant raingarden
Construct and Plant Raingarden (inspect 4x/yr)	Dry Creek Plant Maintenance *(inspect 4x/yr)*				Depaving of hardscape
Construct & Plant Vegetated Swales *(inspect 4x/yr)*	Raingarden Plant Maintenance *(inspect 4x/yr)*	Plant Additional Vegetation		Probing Outlets	Permeable Surface Replacement
Construct & Plant Dry Creek Infiltration Tench *(inspect 4x/yr)*	Vegetated Swale Plant Maintenance *(inspect 4x/yr)*	Inspect water features needs *(2x/yr)*		Water Flow Testing	Construct and plant raingarden
Install subdrainage system *(inspect 4x/yr)*	Visual Inspection of Subdrains *(inspect 4x/yr)*	Visual Inspection of Subdrains *(inspect 2x/yr)*	Visual Inspection of Subdrains *(inspect 2x/yr)*	Visual Inspection of Subdrains *(inspect 2x/yr)*	Visual Inspection of Subdrains *(inspect 2x/yr)*

Figure 7. Design feature implementation and maintenance with lightest blue corresponding to 1. Schoolyard with sequential darker shades representing 2. East, 3. North and 4. South Parking Lots.

[11] U.S. Forest Service, Greening Our Schoolyards: Policies, Processes, and Practices (2023)

Financial Feasibility

Grants: There are several grant opportunities to support our design project (Figure 10). Grants offers a great one-time funding source to support projects. The Green Schoolyards America[12] presents funding sources to support living schoolyards. Two of these include:

- Inflation Reduction Act – Urban and Community Forestry (UCF) ($100,000 – 50,000,000 per grant) to support for long-term urban forest planning alongside community partners. Oregon Community Forestry Program recently received an award of $58 million for distribution.
- Environmental Justice Collaborative Problem-Solving (EJCPS) Cooperative Agreement Program (up to $500,000 per community based nonprofit) to support collaborative effort to address environmental/public health issues from environmental harms.

At the federal level, the State of Oregon Department of Environmental Quality's Clean Water State Revolving Fund[13] offers below-market loans for all phases of stormwater management, from planning to construction.

Fundraisers/Donation/Other Resources: The Village School is actively fundraising and parents and community members have raised upwards of $20,000 dollars to apply to school projects. The school is also slated to receive funding through the 4J School District Funding Levee. Additionally, community and student organizations such as Friends of Trees to support the project through in-kind donations and volunteered time for planting and installation of play structures.

		Total Cost	Existing Funds	Grant Award	Donation
Phase 1	ADA Ramp	18,000			7,000
	Slope Grade & Soil Prep	50,000			6,000
	Subdrain System	30,000			7,000
	Turf Playing Field	500,000	450,000		
	Native Vegetation Across Site	20,000		(UCF) 150,000	
Phase 2	Additional Vegetation	8,000			
Phase 3	Additional Swale & Water Play	5,000			
	Asphalt Depaving	9,000		(EJCPS) 20,000	
	Total	640,000	450,000	170,000	20,000
	Remaining Necessary Funds	-			

Figure 8. Estimated budget distribution for primary features in each phase of implementation. Includes proposed grant applications.

Conclusion

By closely collaborating with the school and community partners, our design proposal demonstrates a holistic integration of stormwater management and nature play, aligned with the City of Eugene Stormwater Manual and the local and state Climate Action Plans. Our proposal addresses the school's drainage issues enhances the master plan, leaving room for future adjustments as needed. The co-design process has inspired the school community to envision an enjoyable and educational playground. The Village School is ready to proceed, with funding expected in 2025 from the district levee. The School Board has hired a landscape architecture firm, involving our team member Giff, to initiate phase one and explore further funding opportunities.

[12] Green Schoolyards America, Living School Grounds (2024)
[13] U.S. Environmental Protection Agency, Clean Water State Revolving Fund (2023)