Nature-Based Solutions to Hazard Mitigation Planning

EPA United States Environmental Protection Agency

FEMA

University of Oregon | CSC Community Service Center

Overview

1. EPA and FEMA: Nature-Based Solutions to Natural Hazard Mitigation Planning
2. Ashland, OR: Pilot Project Process
3. Ashland, OR: Recommended NHMP Action Items
4. Ashland, OR: Pilot Project Lessons Learned

NE Siskiyou Green Street Project; Pervious Pavement Projects
City of Portland

1. EPA and FEMA: Nature-Based Solutions to Natural Hazard Mitigation Planning

EPA United States Environmental Protection Agency

FEMA

CSC Community Service Center

EPA and FEMA Objectives

EPA United States Environmental Protection Agency

- Water quality
- Ecosystem health
- Endangered species protection
- Nonpoint source pollution
- DEQ TMDL and MS4 permit

Green Infrastructure and Low Impact Development

FEMA

- Pre-disaster risk reduction
- Reduce hazard exposure to people and property
- New projects designed to increase ecosystem service benefits

Image Source: USGS – UO Community Service Center

Green Infrastructure & Low Impact Development

GI = Management that protects, restores, or mimics the natural water cycle

LID = Practices that minimize disturbance of natural vegetation and drainage, mimic pre-development patterns

Regional/Municipal — **Neighborhood/Community** — **On-Site**

Johnson Creek Watershed, City of Portland

N. Gary Ave. Portland Pilot Project

Ocean County Soil Conservation District

Image Source: EPA Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs, EPA 2013

Natural Hazard Mitigation Plans

Plan content:

1. Risk assessment
2. Mitigation strategy
3. Action Items
4. Implementation and monitoring strategy

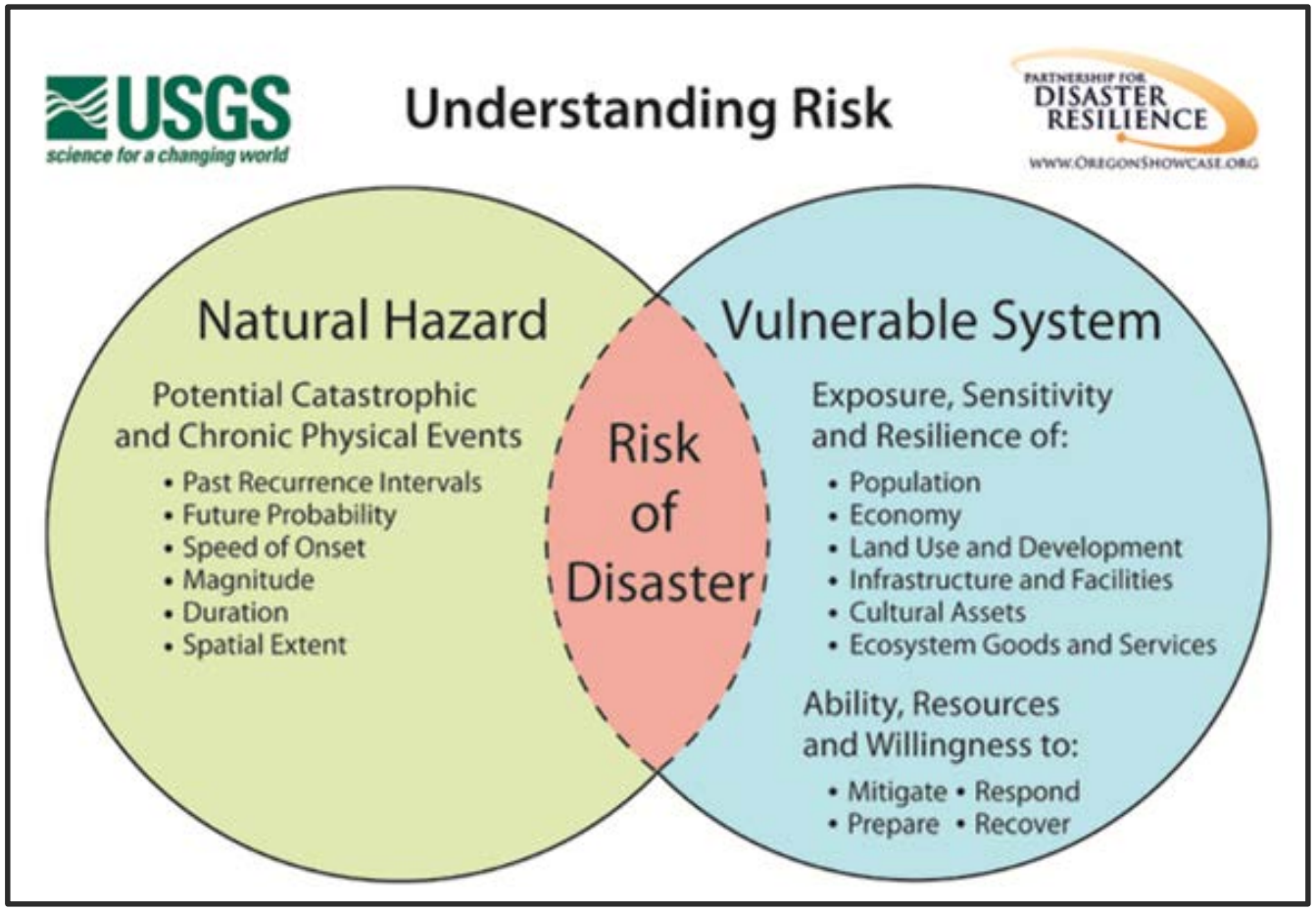


Image Source: USGS - Oregon Partnership for Disaster Resilience Research Collaboration, 2006

NHMP Process

Traditional approach:

Team:

- Emergency manager
- Public Works
- Fire
- Law Enforcement

Strategies:

- Culverts
- Levees
- Hardened Infrastructure

Pilot approach:

Team:

- Emergency manager
- Public Works
- Fire/Law Enforcement
- Community Planning
- Natural Resources Manager
- Floodplain manager
- Water quality specialist

Strategies:

- GI/LID
- Engineering with nature

Environmental and Community Co-Benefits

GI and LID Example Best Management Practices	Natural Hazard Mitigation			Co-Benefits	
	Flood	Fire	Landslide	Water Quality	Community Benefits
Minimize Impervious Area					
Limit Disturbance of Undeveloped Land					
Prevent Runoff from Landscape and Hardscape Areas					
Protect Land and Ecosystems					

Source: Best Management Practice from Low Impact Development in Western Oregon: A Practical Guide for Watershed Health with CSC additions. **Co-Benefit scoring from CSC research and should be interpreted as opportunities for further investigation.**

Economic Co-benefits

Natural Hazard Mitigation Saves!

“[S]ociety saves $6 for every $1 spent through mitigation grants funded through select federal agencies . . .”

The National Institute of Building Sciences, Multihazard Mitigation Council

Source: Natural Hazard Mitigation Saves - 2017 Interim Report

EPA Cost-Benefit GI/LID Case Studies

- Utilizing economic analysis of GI/LID can address public concerns and gain stakeholder support
- GI/LID can cost less than grey infrastructure alone
- GI/LID approaches result in multiple benefits
- LID/GI approaches can be successfully integrated into Capital Improvement Programs

Rory M. Shaw Wetlands Park, Sun Valley Watershed

Source: EPA Case Studies Analyzing the Economic Benefits of Low Impact Development and Green Infrastructure Programs, EPA 2013

FEMA / EPA Project Goals

GI/LID  NHMP

- Expand the range of tools used to mitigate flood and other natural hazard risk
- Institutionalize green infrastructure and low impact development (GI/LID) into natural hazard risk management planning
- Enable FEMA funds to be directed to GI/LID projects
- Integrate GI/LID strategies as NHMP action items to reduce natural hazard risk and achieve co-benefits
    - Improved water quality, climate mitigation, habitat protection, air quality, and quality of life

A Unique EPA and FEMA Partnership

2. Ashland, OR: Pilot Project

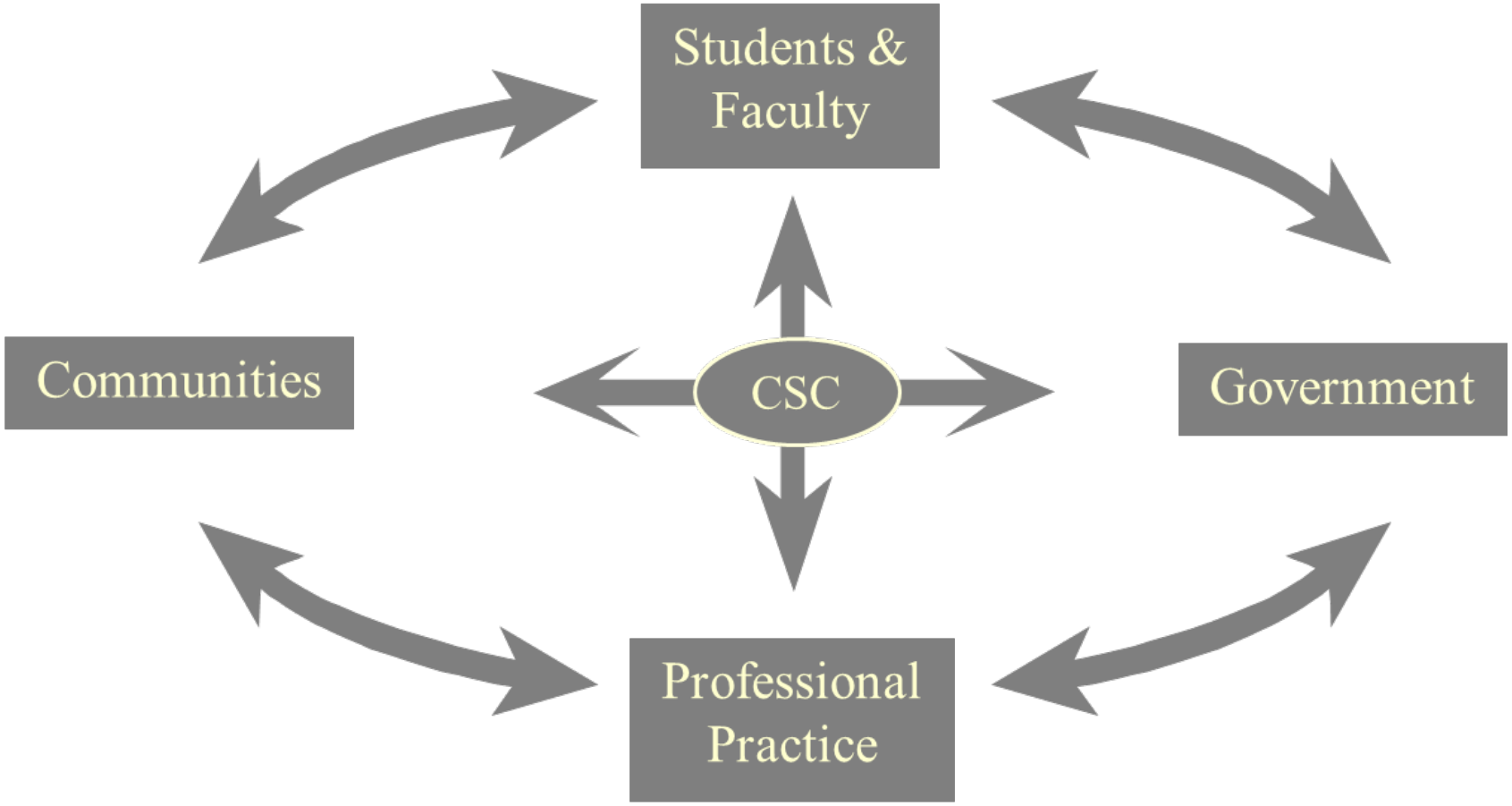
EPA United States Environmental Protection Agency

FEMA

CSC Community Service Center

UO Service Learning Model

The **Community Service Center** (CSC) links the energy, expertise, and innovation of the UO with planning and public policy needs of Oregon communities.



CSC Focus Areas:

- Agile Strategy Development
- Strategic DoingTM
- **Natural Resources**
- Social Planning
- Community and Economic Development
- Energy
- Food Systems
- Housing
- Transportation
- Parks & Recreation Planning
- **Natural Hazards and Community Resilience**

Image Source: UO Community Service Center

CSC Delivery models

Campus Based

- Classes
- Graduate student employees
- Interns
- $5K to $500K; 3-months to 3-years

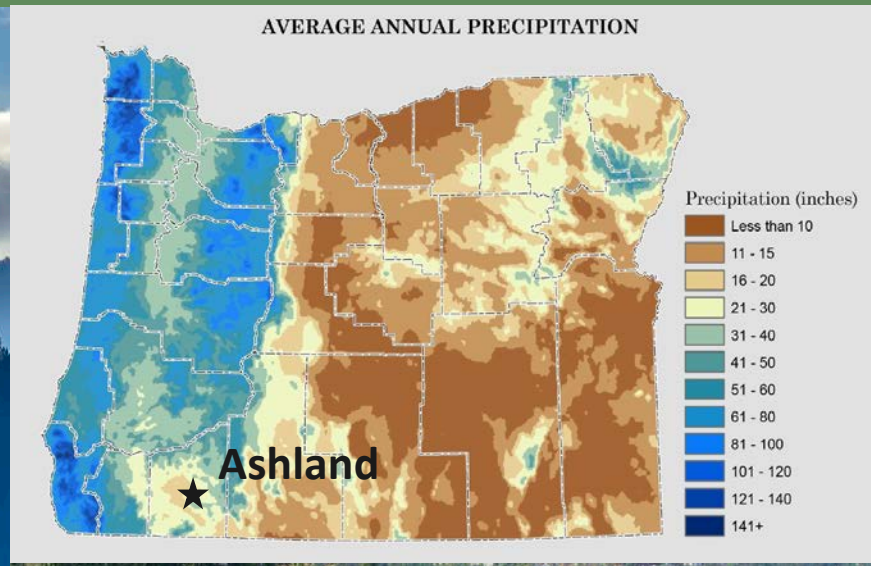
Field Based

- Dedicated AmeriCorps service member
- 11 months; 1,700 hours
- $22,000 cash match

Image Source: UO Community Service Center

Pilot Project: Ashland, Oregon

- Where: Foothills of Siskiyou and Cascade Mountains, Rogue Valley
- Population: 21,000
- Economy: Arts, Tourism, and Outdoor Recreation



ImageSources: Wikipedia, City of Ashland; DOGAMI

Key Project Partners

Federal Emergency Management Agency (FEMA)

Brett Holt, FEMA Region 10 Mitigation Planning Program Manager

Environmental Protection Agency (EPA)

Krista Mendelman, EPA Region 10 Green Infrastructure Coordinator

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City of Ashland, OR

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Ciara Marshall, Water Resource Technician

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Mark Schexnayder, Planner

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Juilie Smitherman, Water Conservation Specialist

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Jennie Morgan, RVSS Stormwater Permit Coordinator

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Joseph Murray, OEM Hazard Mitigation Planner

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Stacey Detwiler., Rogue Riverkeeper Conservation Director

Michelle McMullin, NOAA Fisheries West Coast Region

UO Community Service Center Team

Josh Bruce, OPDR Director and Project Director

Ethan Lockwood, Project Manager

Emily Fenster, Student Consultant

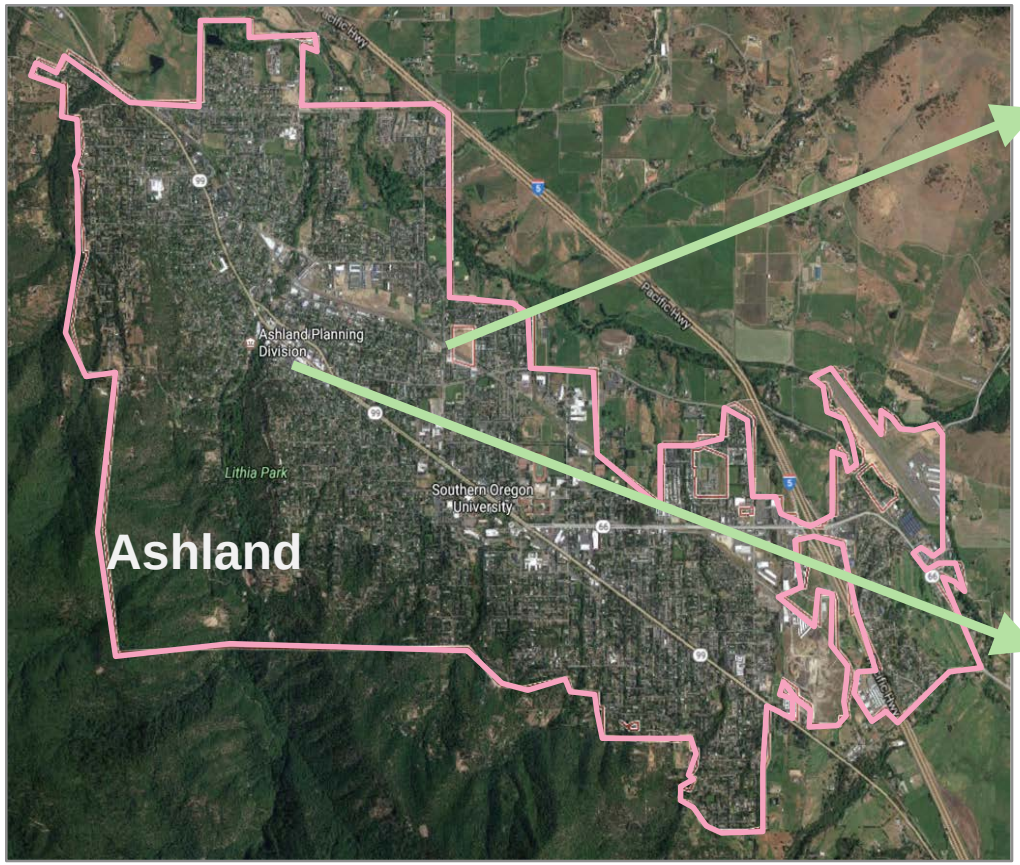
Emily Hajarizadeh, Student Consultant

Michael Johnduff, Student Consultant

Kristen Sabo, Student Consultant

Ashland's Existing GI/LID Leadership

- **40 LID Stormwater projects as of 2010**
- **Multiple Action Items in NHMP with GI/LID overlap**
  - Community education
  - Evaluate land use in high risk areas



Falcon Heights Subdivision; Dry detention

North Mountain Park: Sediment basin, vegetated swales, constructed wetland

Image Source: Google Maps; City of Ashland

Hazards: Flooding

Jackson County NHMP

Table 3-8 Flood Summary

Hazard	Flood (Riverine)
Type	Climatic
Speed of Onset	Slow to moderate
Location	Mapped flood zones, floodplain
Extent	Moderate to severe
Prior Occurrence	17 significant events since 1964
Probability	~34% overall; 1% annual within SFHA

Sources: Oregon NHMP, DOGAMI, FEMA, analysis by OPDR

- **Ashland flood probability is HIGH (One event likely in a 10-35 year period)**
- **Ashland flood vulnerability is MODERATE (higher than county)**

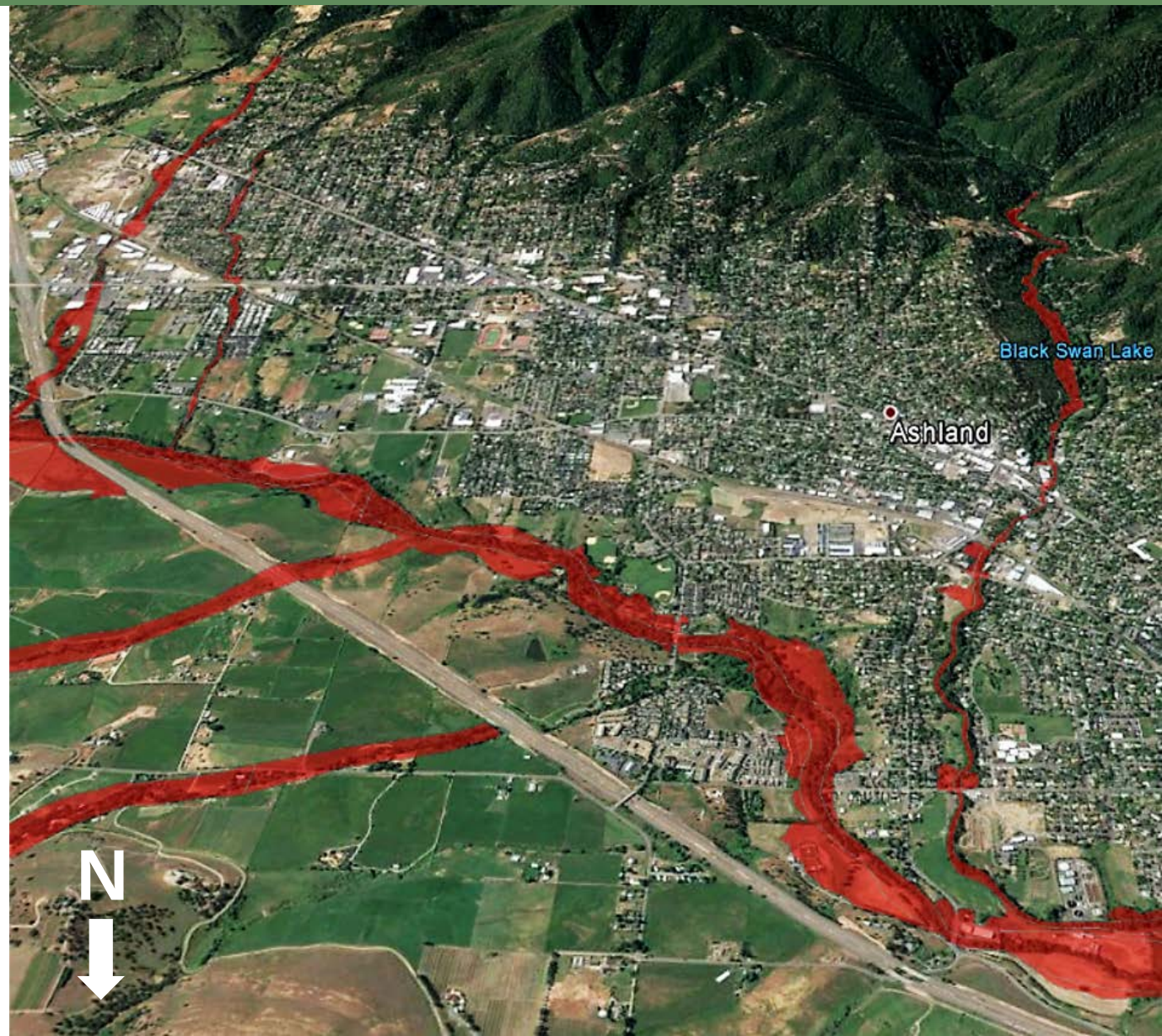


Image Source: Jackson County RISK Flood Map KML in Google Earth

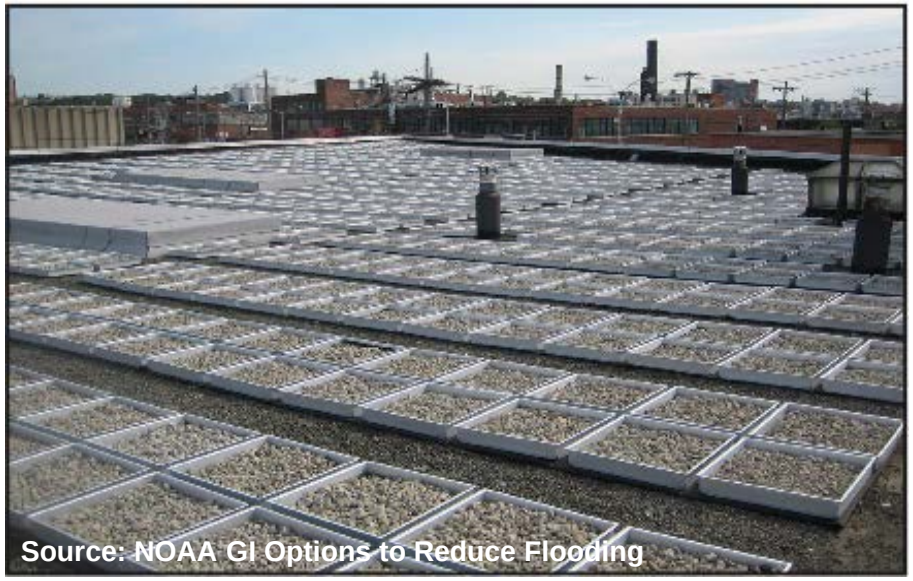
Flood Mitigation Examples


Source: NOAA GI Options to Reduce Flooding

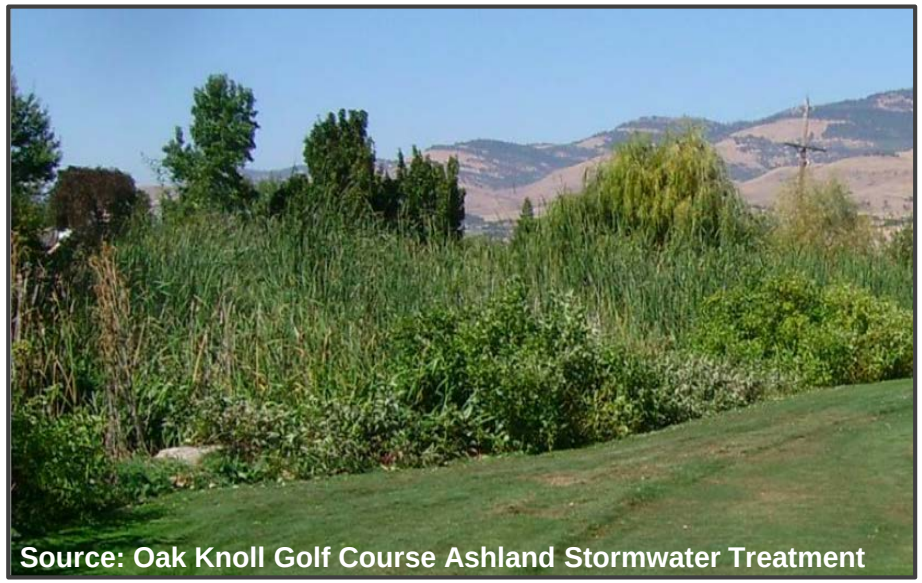
Green Roof


Source: NOAA GI Options to Reduce Flooding

Bioswales

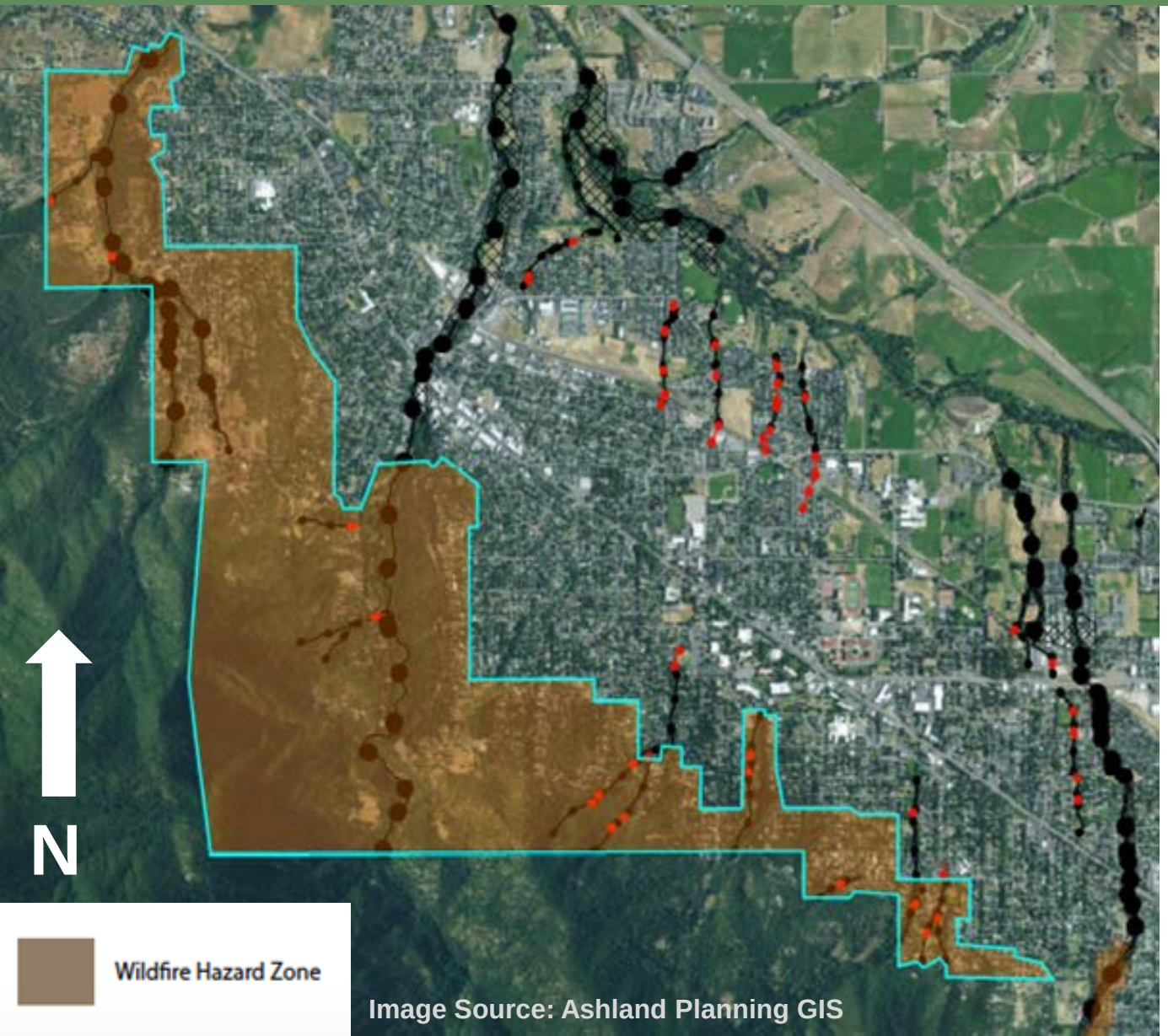

Source: NOAA GI Options to Reduce Flooding

Blue Roof


Source: Oak Knoll Golf Course Ashland Stormwater Treatment

Restored Wetlands

Hazards: Wildfire



Jackson County NHMP

Table 3-18 Wildfire Summary

Hazard	Wildfire
Type	Climatic, Human Caused
Speed of Onset	Moderate to rapid
Location	Countywide, Wildland Urban Interface
Extent	Minor to extreme
Prior Occurrence	6 major events from 2012-2017
Probability	100% for minor-moderate events, 70-80% for extreme events

Sources: Oregon NHMP, Rogue Valley Integrated Community Wildfire Protection Plan (2017), analysis by OPDR

- **Probability of wildfire in Ashland is HIGH.**
- **Vulnerability is also HIGH; 1,400 homes in and around Ashland are inside the Wildland Urban Interface (WUI) boundary.**

Wildfire Mitigation Examples

Indigenous wildflowers and native plants can be drought tolerant and fire resistant.

Green lawns and other irrigated areas can serve as fire breaks.

Careful spacing and trimming of trees and shrubs can reduce fire risk.

Deciduous trees can be spaced to mitigate risk within the home ignition zone.

Images Source: Bennet, Max. Landscaping with Fire-Resistant Plants. OSU Extension Service

Hazards: Landslide/Earthquake

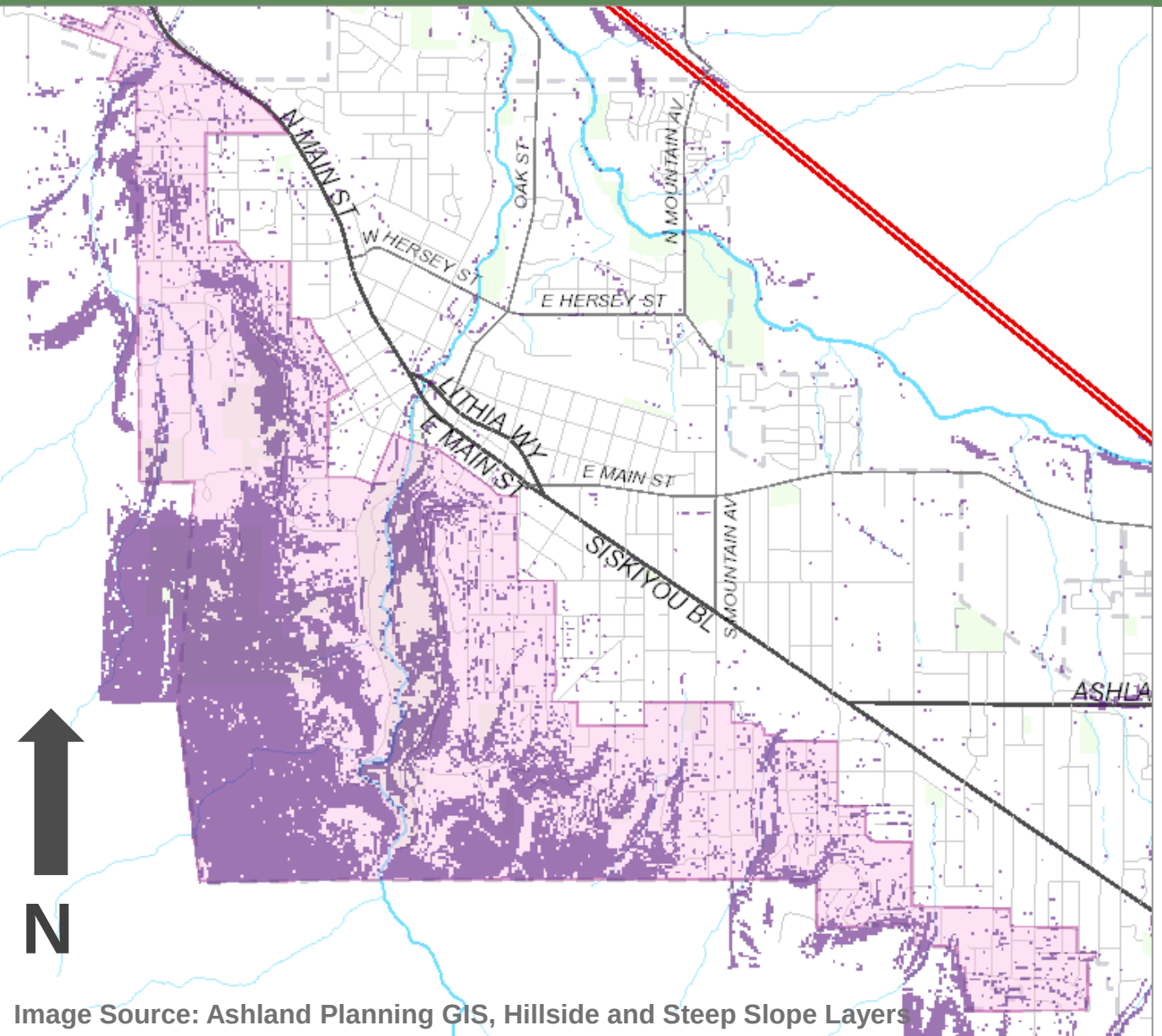


Image Source: Ashland Planning GIS, Hillside and Steep Slope Layers

Jackson County NHMP

Table 3-10 Landslide Summary

Hazard	Landslide
Type	Climatic/Geologic
Speed of Onset	Slow to rapid
Location	Steep slopes, weak geology
Extent	Minor to severe, most highly concentrated in southeastern, central, and centraleastern portions of the county including areas east of I-5 and along the North Fork Little Butte Creek
Prior Occurrence	10 significant events since 1974
Probability	~24% overall

Sources: Oregon NHMP, DOGAMI, analysis by OPDR

- **Probability of landside in Ashland is HIGH.**
- **Probability of earthquake in Jackson County is MEDIUM.**

Landslide/Earthquake Mitigation Examples

Image Source: Polster Environmental Services Ltd

Apply soil stabilization measures, such as planting soil- stabilizing vegetation on steep, slopes to mitigate landslides.

NOTE: Highlights *potential* conflicts between wildfire and landslide GI/LID mitigation options.

Ashland Pilot Overview

Integrate GI/LID strategies as NHMP action items to reduce natural hazard risk and achieve co-benefits in Ashland.

- **Ordinance Review**
- **Ecosystem Service Evaluation**
- **GIS Assessment**
- **NHMP Actions Review and Recommendations**

Image Source: City of Ashland 1997 Flood, Downtown

Review Municipal Code for GI/LID Support

- The code review process considers how nature-based solutions for hazard mitigation fit into City's regulatory framework.
- The Ashland Municipal Code (AMC) was reviewed for this purpose.

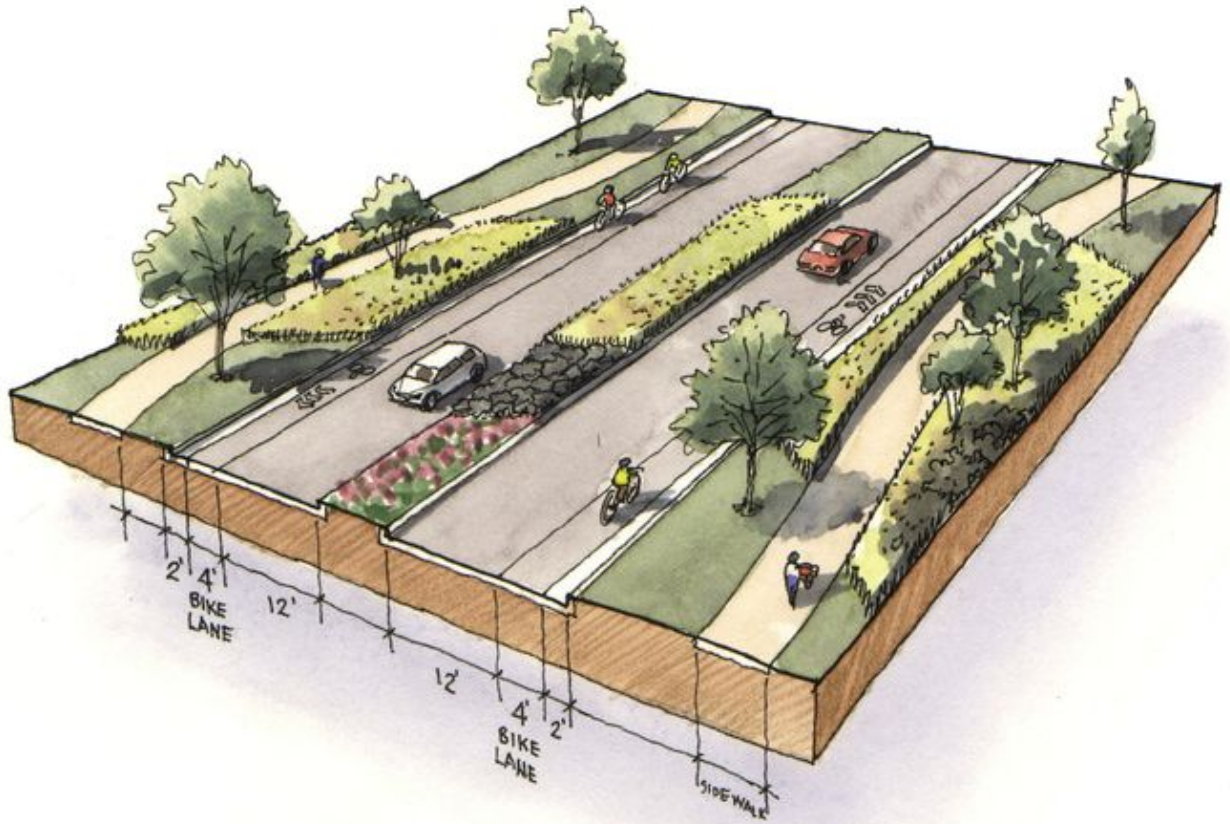


Image Sources: City of Dublin, Ohio Community Plan; FEMA Community Rating System Coordinator's Manual

Ordinance Review

Identify existing support and barriers to achieving natural hazard mitigation goals with GI/LID approaches

Croman Mill District (AMC 18.3.2)

Standards "provide an environment suitable for employment, recreation, and living." (AMC 18.3.2.010)

- Code includes "Green Design Standards"
- Central Boulevard and protected bike paths
- Street runoff stormwater management
- Tree planting; vegetated buffer strips

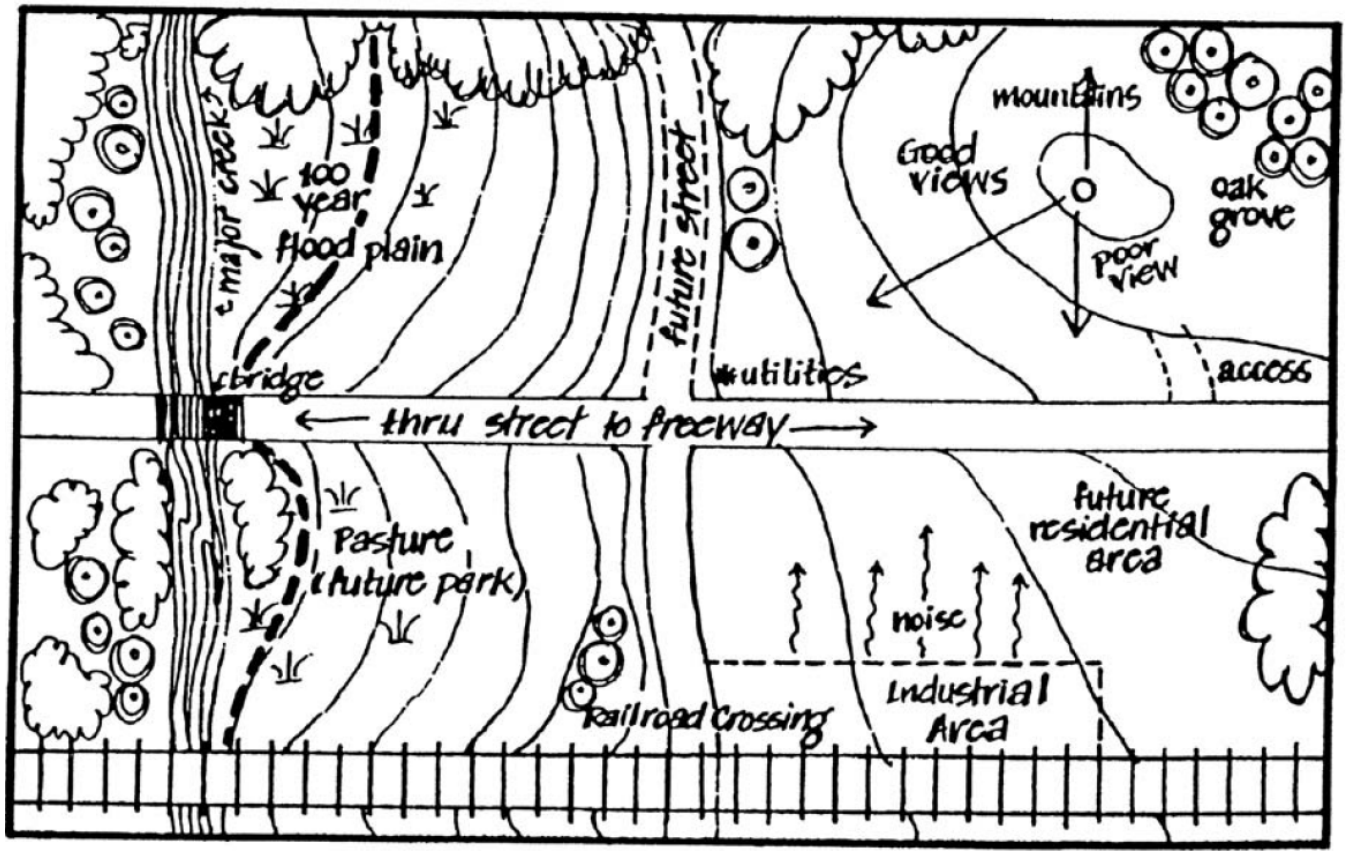


Image Source: City of Ashland Green Design Standard Manual

Evaluate Ecosystem Services

Seven ecosystem services evaluated

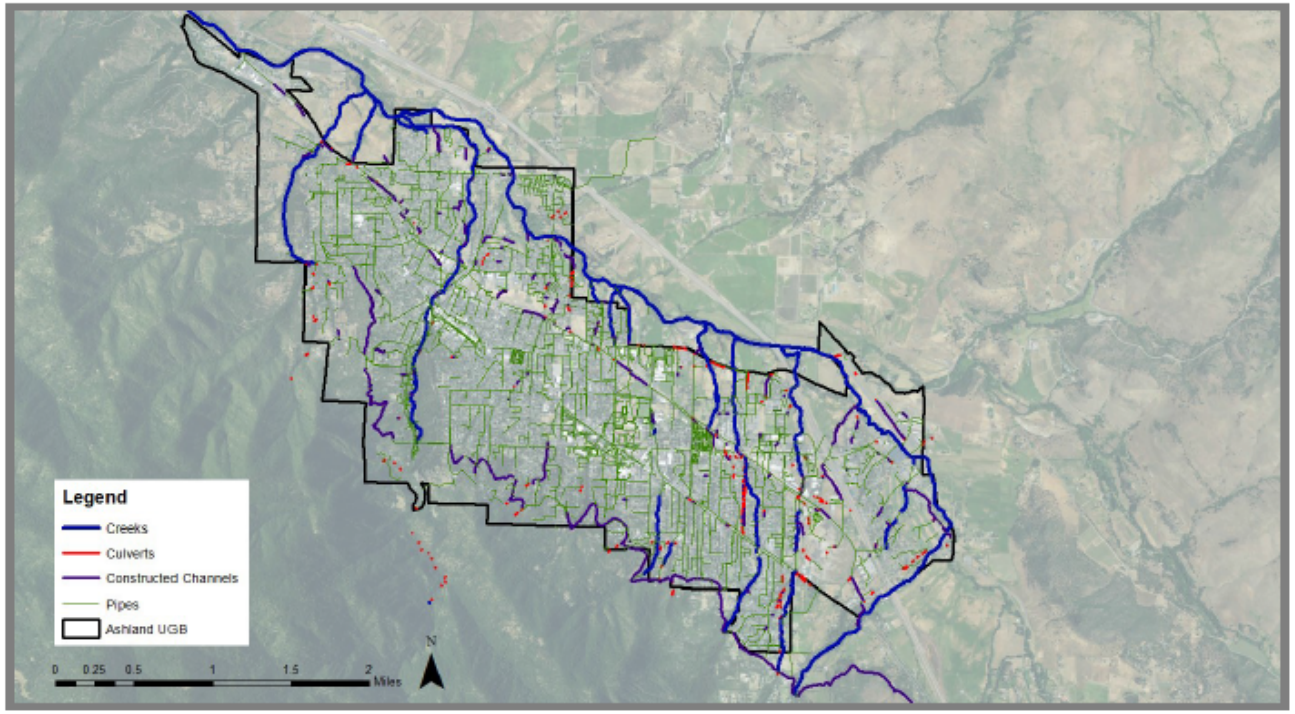
- Parks and Open Space Preservation
- Wildfire Resilience
- Steep Slope Stability
- Water Conveyance
- Stormwater Infiltration
- Sediment Retention
- Floodwater Storage

Image Source: Millennium Ecosystem Assessment

Surface Water Conveyance

In nature, surface water moves along a network of waterways: brooks, creeks, streams, and rivers. Generally speaking, these systems consist of a channel, banks, a flood way, and a flood plain. Water from rain events, snow and ice melt, and natural springs is collected and conveyed naturally according to the laws of hydrodynamics. Without human intervention, these systems can work to efficiently move water across the landscape. In addition, natural water conveyance systems provide additional ecosystem service benefits such as improved water quality, sediment conveyance, floodwater storage, and habitat.

Increasing attention has been turned to placing all water conveyance decisions within a watershed context as localized flood control measures, such as concrete channelization in a neighborhood, can result in increased flood risk downstream.



TAKEAWAY

Ashland is a hillside community located in the upper portion of the Ashland Creek Watershed. Numerous first to third order streams convey water from above, and through, Ashland to Bear Creek at the base of the watershed. LID techniques may be used to mitigate localized flooding within the city, while GI approaches along Bear Creek would have greater flood reduction benefits to downstream communities.

NHMP Benefits

Surface water conveyance can help to mitigate the number and severity of localized and downstream flood events.

- Minimizing and slowing overland stormwater flow by supporting soil and vegetation infiltration and roughness reduces the speed and rate of stormwater delivered to waterways and stormwater infrastructure.
- Decreasing the amount of runoff that reaches streams can keep stream flow rates within the stream channels conveyance capacity and prevent downstream flood events.
- Waterways are more resilient alternatives to hardened infrastructure such as pipes and culverts that are more susceptible to failure during flood and earthquake events.

GI/LID Best Management

Reducing the watershed's susceptibility to flood events is goal of GI and LID best management practices for water conveyance.

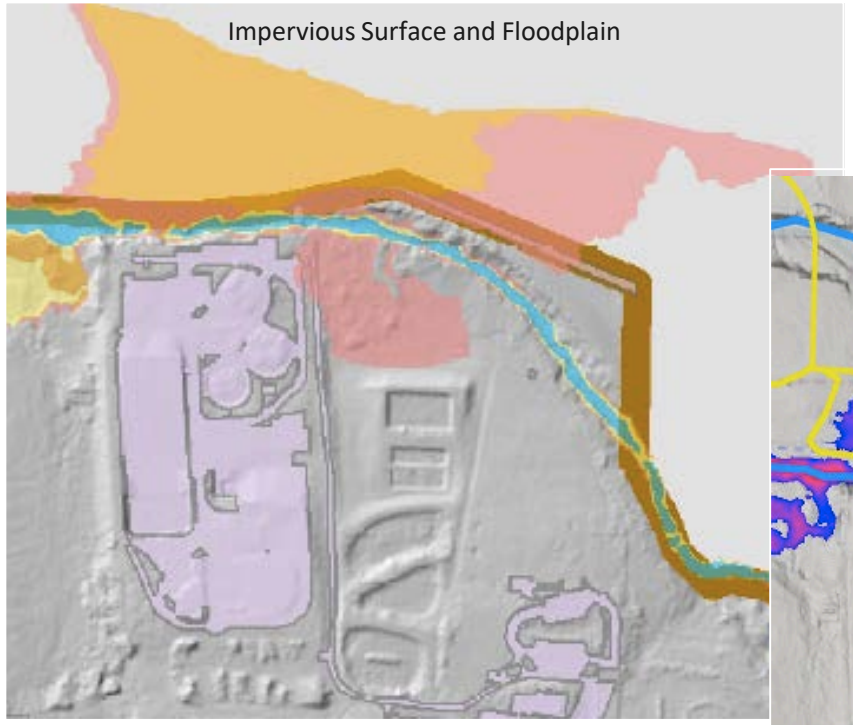
- Urban stream daylighting, the practice of uncovering some or all of a previously covered waterway, can increase the watershed's resilience to flood events.
- Channel stabilization, channel enlargement, bank protection, and river diversion techniques are GI approaches to preserving and enhancing stream channel conveyance.
- There are many LID tools for reducing urban impacts on water conveyance to reduce a stream channel's risk of flooding such as water conveyance swales, rain gardens, soakage trenches, vegetated rooftops, rain barrels, permeable pave-

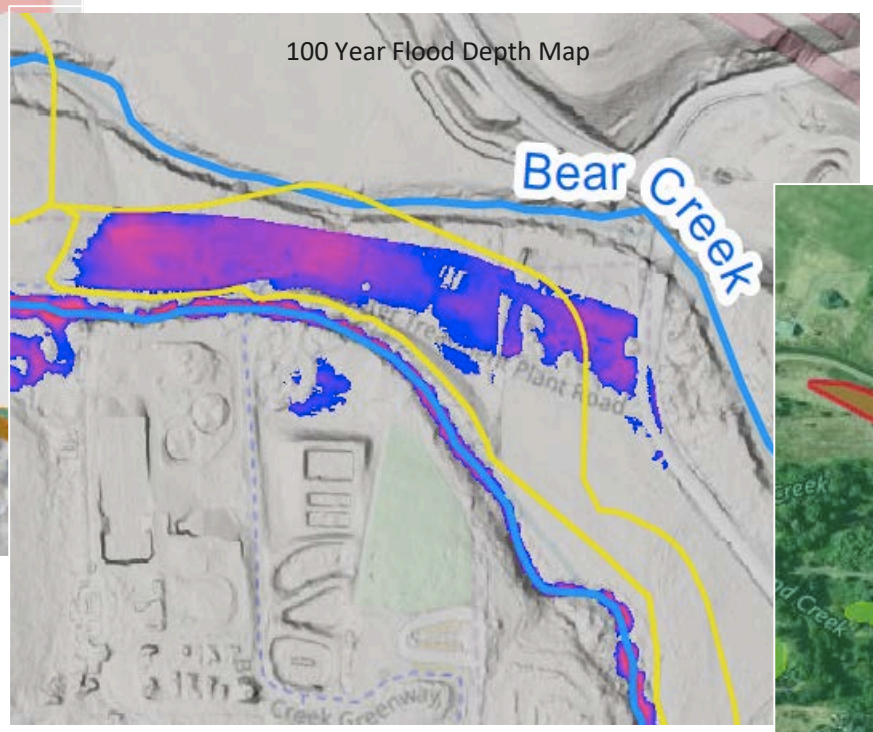
NHMP Actions

Possible NHMP action items to support the ecosystem service of surface water conveyance include:

- Increasing vegetation along stream channels to reduce sedimentation, mitigate bank erosion, and maintain channel width and conveyance capacity.
- Increase pervious surfaces and reduce impervious surfaces in areas of developed areas to reduce runoff and increase infiltration and absorption.
- Plan GI projects in concentrated conveyance areas to detain, or slow the flow of water into Bear Creek and Ashland Creek during periods of heavy precipitation and peak flow.

GIS Assessment





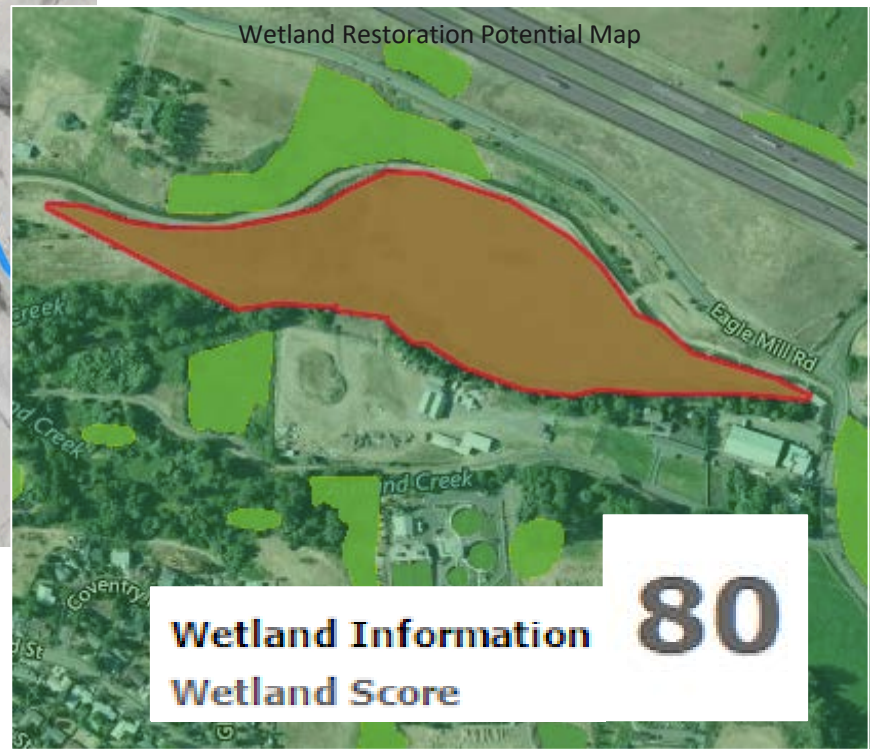


Image Sources: DOGAMI, City of Ashland GIS, Oregon Explorer Wetland Restoration Tool

3. Ashland, OR: Developing NHMP Action Items

EPA United States Environmental Protection Agency

FEMA

CSC Community Service Center

Existing NHMP Action Review

- Seven existing NHMP actions with GI/LID overlap
- Examples:
  - Water Treatment Plant Relocation:
    Construct and place into service a water treatment plant in a new location that is not prone to landslides.
  - Ashland Forest Resiliency Project:
    Identify funding to complete the implementation of the current Ashland Forest Resiliency Stewardship Project (AFR).
  - Ashland Firewise Communities:
    The Firewise program is Ashland's primary tool for residential vegetation management and public education of fire resistant landscaping and construction.

Recommendation 1: Floodwater Storage

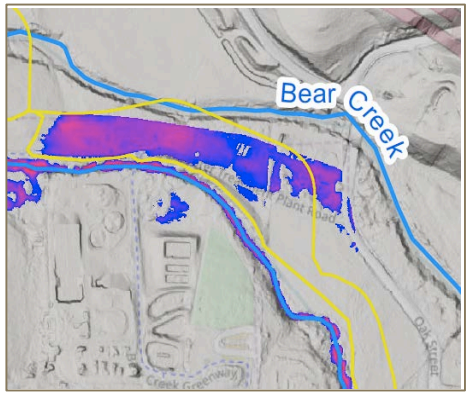
Increase floodwater storage by restoring wetlands and improving floodplain functionality at specific sites

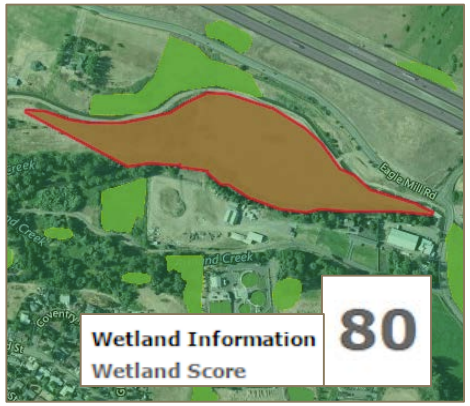
Image Sources: City of Ashland

Recommendation 1: Floodwater Storage

Analysis Steps

1. ID Impervious Surface and Floodplain
2. Compare with updated flood depth grids
3. ID wetland restoration potential (team used Oregon Explorer Wetland Restoration tool)





Project Site Analysis: Ashland Wastewater Treatment Plant

Hazard Exposure
- Located in 100 year flood plain
- Severe (>35%) Steep slopes
- Impervious surfaces; heat

Environmental Impact:
- Sited between protected wetland area and City Park
- Next to agricultural area
- Next to Ashland Creek

Low Impact Development
- Pervious pavement; stormwater conveyance; bioswale catchment and infiltration located next to impervious areas.

Green Infrasrtucture
- Wetland restoration; soil remediation for sediment retention and increased infiltration.

Recommendation 2: Green Streets Expansion

City-led implementation of green streets in high impervious surface drainages and near floodplains

Image Sources: Philadelphia Water Department Green Streets Design Manual; Corvallis, Oregon “Healthy Streets, Healthy Streams Program”

Recommendation 2: Green Streets Expansion

Use pervious streets, planting strips, minimizing street widths, water retention along impervious surfaces on drainages with over 8% impervious surfaces

- Co-Benefits:
  - Improve water quality
  - Reduce water quantity
  - Reduce risk of flooding and sedimentation
  - Aquifer recharge

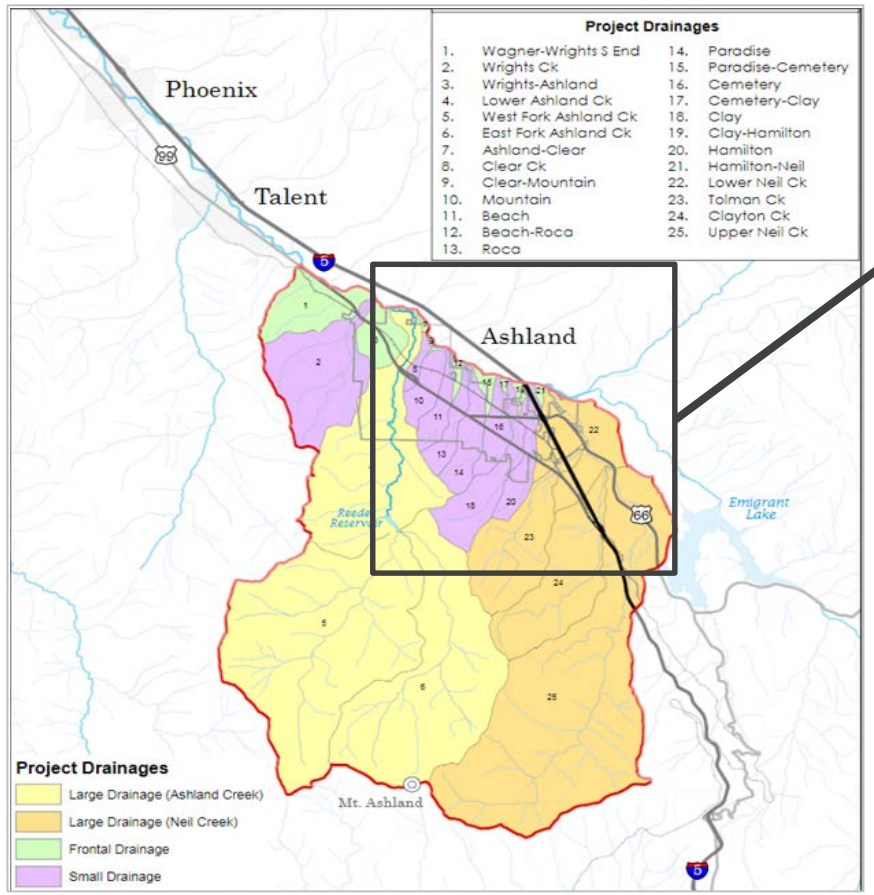
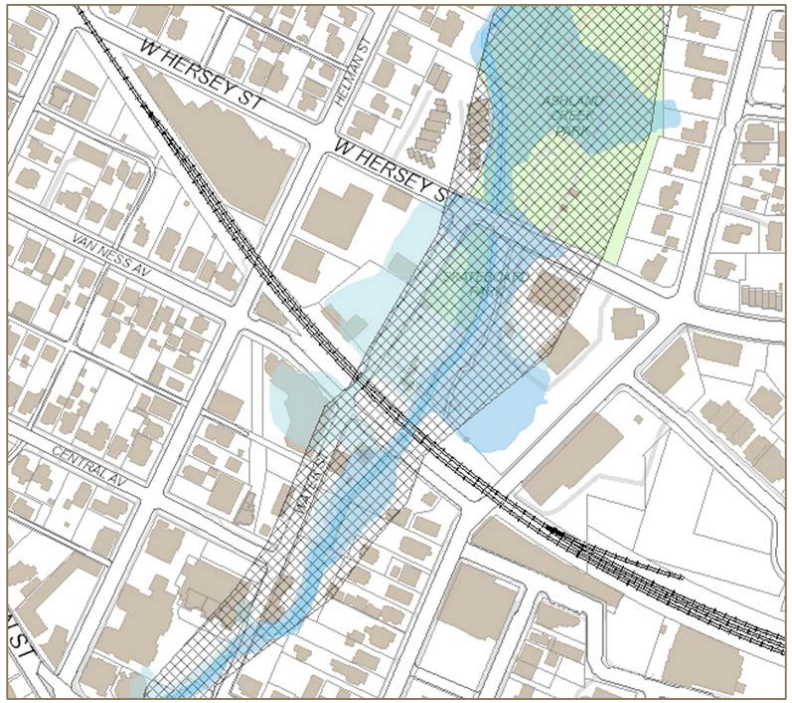


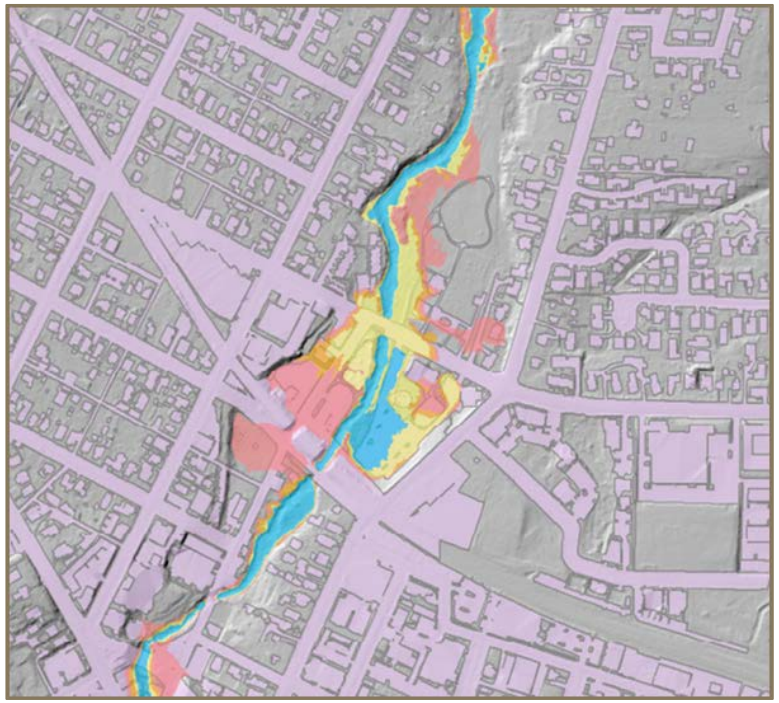
Image Sources: Ashland Inter-City Drainage from 2007 Bear Creek Watershed Assessment; Philadelphia Water Department Green Streets Design Manual

Recommendation 3: LID Retrofit Incentives

GI/LID Retrofit Incentives: Create incentive programs for private landowners to reduce impervious surface.



Ashland FEMA 2009 Floodmap with Ashland Modified Floodplain



Impervious Surface and Floodplain

Pavement Removal i.e. “Depave”

Image Sources: DOGAMI, City of Ashland GIS Maps, DEPAVE’s How to Depave: Guide to Freeing Your Soil

Recommendation 3: LID Retrofit Incentives

GI/LID Retrofit Incentives: Create incentive programs for private landowners to reduce impervious surface.

Select sites with high impermeability and use pervious streets, depavement to reduce runoff locally and downstream by offering rebates or stormwater credits for future improvement projects minimizing impervious surface.

- Co-Benefits:
    - Improve water quality
    - Reduce water quantity
    - Reduce risk of flooding and sedimentation

Image Source: Ashland Lawn Replacement Rebate Program

Rate Recommendations

FEMA STAPLEE Feasibility Review Criteria

Social – Socially acceptable? Equitable?

Technical – Feasible? Achievable?

Administrative – Staff, funding, time capability?

Political – Politically acceptable? Public support?

Legal – Compliance? Authority? Likely challenged?

Economic – Reasonable? Do benefits outweigh costs?

Environmental – Positive or negative affects?

Workshop participant evaluation and scoring

STAPLEE Criteria	Workshop Feasibility Score Average (0-2)
Recommendation 1: Increased Floodwater Storage Initiative	
Technical	1.3
Administrative	0.8
Political	1.2
Economic	0.3

Recommendation 2: Green Streets City-wide Expansion Program	
Technical	1.0
Administrative	0.8
Political	1.0
Economic	0.5

Recommendation 3: Targeted Low Impact Development Retrofit Incentive Program	
Technical	0.8
Administrative	0.8
Political	0.8
Economic	0.7

Final NHMP recommendations

Develop Increased Floodwater Storage Projects along Bear and Ashland Creek

Action:

This would minimize the occurrence and severity of flood events by increasing floodwater storage by restoring wetlands and improving the floodplains ability to store flood water along Bear and Ashland Creek. Co-beneifts would include improved habitat, water quality, and water conveyance.

GI/LID Best Management Practices

Divert and store stormwater to mitigate localized flooding, protect urbanized floodplains, and mitigate downstream flood effects through wetland restoration, bio-swale installation, and floodplain benching, increased connectivity, and vegetation.

Lead Organization

Ashland Public Works and Ashland Parks and Recreation

Internal Partners:

- Ashland Public Works
- Ashland Community Development Department
- Bear Creek Watershed Council/ Rogue Valley Council of Governments

External Partners:

- Federal Emergency Management Agency
- Environmental Protection Agency
- National Marine Fisheries Service
- Oregon Department of State Lands
- Oregon Watershed Enhancement Board
- Oregon Department of Environmental Quality
- Oregon Water Resources Department

Potential Funding Sources:

- FEMA Hazard Mitigation Assistance (HMA) Grant
- Ashland Public Works Stormwater & Drainage Capital Improvement Plan
- Ashland Parks and Recreation Department Funds
- DEQ Clean Water State Revolving Fund
- Oregon Water Resources Development Program

Develop a City Led "Green Streets" Program

Action:

Increase rainwater infiltration and decrease stormwater runoff in areas with high impervious surface coverage to reduce localized and downstream flooding through expansion of City-led implementation of "green streets" in high impervious surface inter-city drainages and near floodplains. Co-benefits would include improved water quality, both on-site and downstream, through on-site stormwater treatment and increased infiltration

GI/LID Best Management Practices:

Use pervious street paving and sidewalk treatments such as flow through planters, planting strips, tree boxes and bioretention features according to approved design standards to reduce the impact of development on the Ashland watershed.

Lead Organization

Ashland Public Works

Internal Partners:

- Ashland Community Development Department
- Ashland Parks and Recreation Commission

External Partners:

- Bear Creek/Rogue Valley Council of Governments
- Oregon Department of Environmental Quality
- Oregon Water Resources Department
- Environmental Protection Agency
- Federal Emergency Management Agency

Potential Funding Sources:

- FEMA Hazard Mitigation Assistance (HMA) Grant
- Ashland Public Works Stormwater & Drainage Capital Improvement Plan
- DEQ Clean Water State Revolving Fund
- Oregon Water Resources Development Program

4. Ashland, OR: Pilot Project Lessons Learned

EPA United States Environmental Protection Agency

FEMA

CSC Community Service Center

Lessons Learned – What Worked

Expanded Stakeholder Participation

- DEQ, Oregon Water Resources Department, NGOs

Collaboration with Department of Geology and Mineral Industries

- FEMA Risk MAP CTP – expanded impact
- Existing mapping protocol

Increased potential funding options

- DEQ, EPA, State Water Resources Fund

Lessons Learned – Stakeholder Engagement

Issue	Challenge	Impact
Participation	Funding lag contributed to lack of local capacity and buy-in at project kickoff	Limited local buy in and participation
Participation	Challenge getting the "right" people in the room	Workshops not as affective as they could have been
Participation	Engineering feasibility of specific interventions questioned	Conversation about potential strategies got sidetracked at times
Participation	Engineering disciplines not well represented	It was hard to address specific questions about GI/LID project feasibility
Participation	Limited private sector involvement	Public sector reluctant to consider private sector interventions.
Language	Lack of common language between GI/LID and NHMP audiences	Level of information was at times basic for some and advanced for others. Challenging to see shared benefits at times.
Language	Discussing GI/LID economic benefits appeared to resonate better than social, environmental, or hazard risk reduction benefits	Conversation tended to focus on short-term costs and benefits

Lessons Learned – Process

Issue	Challenge	Impact
GIS Assessment Timing	GIS outputs not available until late in the project	Limited ability to incorporate GIS into GI/LID opportunity assessment prior to stakeholder engagement
Communication	Not enough focus on community benefits	Limited local buy-in
Local Champion	No clear champion or local leader until late in the project	Limited local buy-in
Marketing	Hard to identify language that resonated with professionals from across the spectrum.	Didn't always have the "right" people in the room
Marketing	Using the NHMP to solicit engagement didn't always resonate with stakeholders.	Didn't always have the "right" people in the room

Lessons Learned – Organizational Structure

Issue	Challenge	Impact
Jurisdictional boundaries	Hard to capture costs locally for benefits that occur regionally	Flood storage projects challenging to implement because most benefits are outside city
City Structure	Hard to align goals across departments and plans	Limited incentives for cross-disciplinary participation
Plan Topic and Scale	Some issues may have had a risk reduction benefit, but may not have been best addressed through he NHMP	Private property interventions were not seen as viable.

Key Observations for Cross Sector Collaboration

Need to engage multi-disciplinary teams

- Emergency management and water quality not seen as complimentary
- Require through grants, take message outside your discipline

Language and funding programs are a barrier

- HMA, PDM, 44 CFR 201.6, Risk, Vulnerability, Mitigation
- TMDL, CWSRF, 319 Funds, MS4 Permit, Bioswale

Programs need shared set of principles

- Resilience presents an overarching framework
- Alignment needs to occur at the top

Questions

EPA United States Environmental Protection Agency

FEMA

CSC Community Service Center