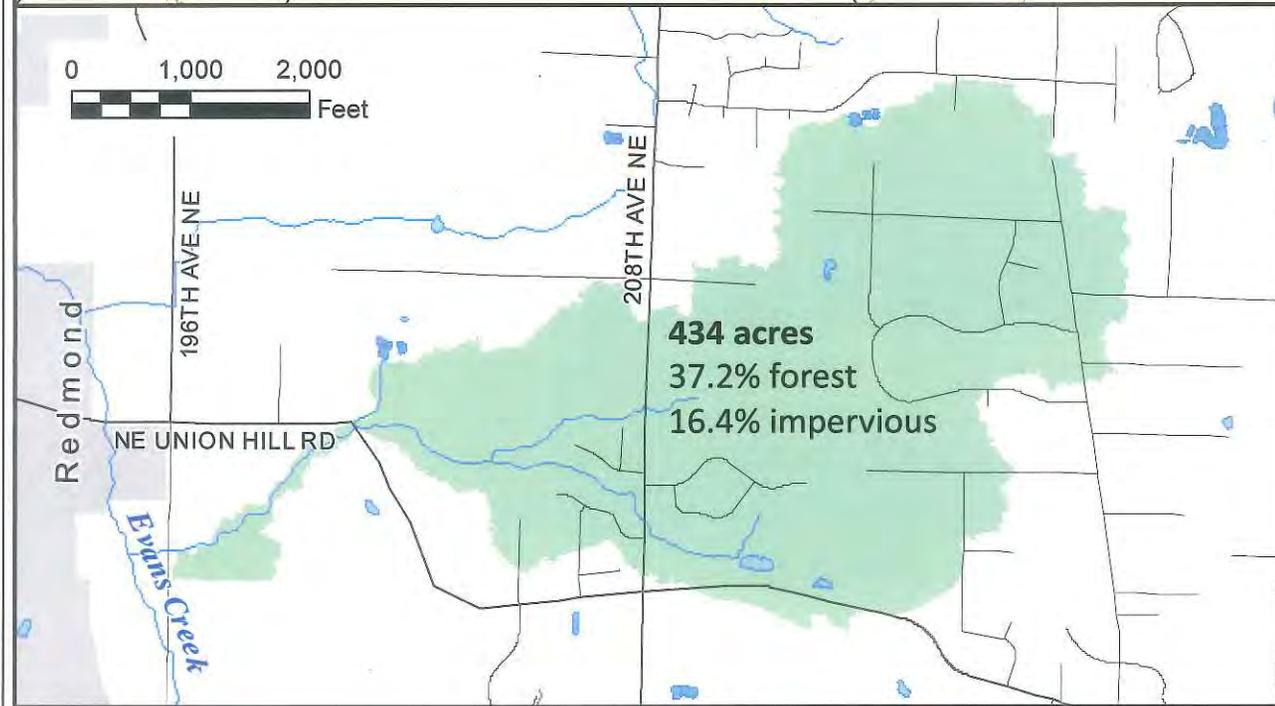


NATIONAL ESTUARY PROGRAM  
WATERSHED PROTECTION AND RESTORATION GRANT  
WASHINGTON DEPARTMENT OF ECOLOGY

# Evans Creek Tributary 108 Basin Wide Retrofit Siting

10/24/2013 10:31



# Evans Creek Tributary 108 Basin Retrofit Project

## Tributary 108 Basin Location

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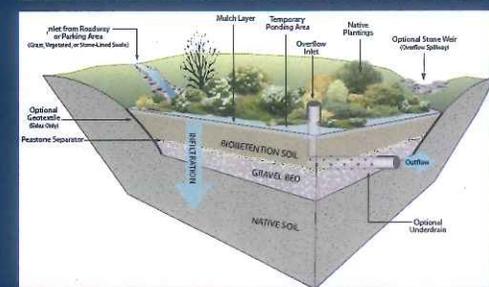
### Detail Frame

-  Tributary 108 Basin
-  Incorporated City
-  Water course
- Waterbodies**
-  Lake or pond
-  Impoundment

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 Water and Land Resources Division

# Project Goals

- Plan a basin wide system of stormwater controls and LID that meets Department of Ecology flow standards.
- Predesign three projects that implement elements of the planned retrofit.
- Ultimately – improve B-IBI scores & beneficial uses



# Purpose for this Presentation

- Solicit feedback on
  - project basin selection
  - retrofit design approach
  - use of M.R. #5 & #7 as the basin discharge goal
- Engage in open discussion on
  - system cost estimates
  - retrofit implementation challenges and costs
  - public support for retrofitting in general based on its financial implications

# Presentation Outline

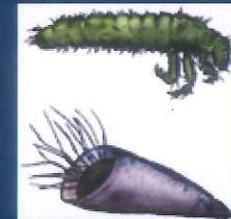
- Basin Selection
- Subbasin Delineation
- Project Subbasin Selection
  
- Design Approach
- 8% Discharge Goal
- Cost Estimates



# Basin Selection

- King County List of Small Basins for Retrofit
  - Small basins were identified for potential retrofit based on documented degradation

- Benthic Index of Biotic Integrity (B-IBI)
  - Fair to poor biological condition categories

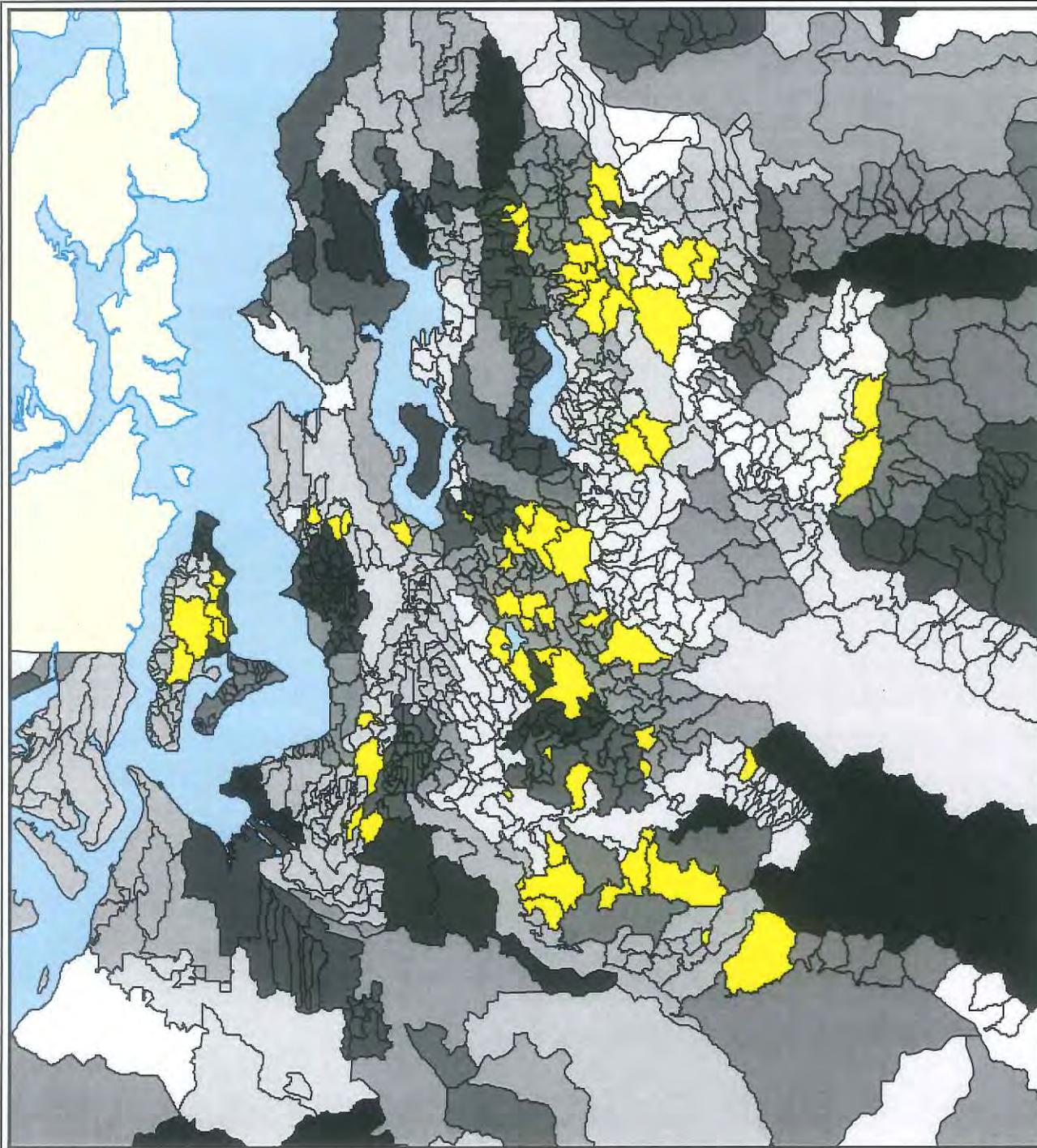


- Water Quality Assessments
  - Section 303(d) of the Clean Water Act
  - Waterbodies listed as impaired.



# Basin Selection

- Priority Point Scoring
  - Impact Scores
    - Opportunity to mitigate impairment
      - Composite of tributary and downstream ratings
        - » B-IBI
        - » 303(d)
      - Channel condition
      - Percent of basin developed
  - Basin Size Score
    - Time scale to fully retrofit basin
    - Proximity of stormwater influence on stream health



## Small Stream Basin Retrofit Prioritization

### Small Basins for Retrofit

-  Priority Subbasins
-  Subbasin Boundaries

0 4 8 12  
Miles



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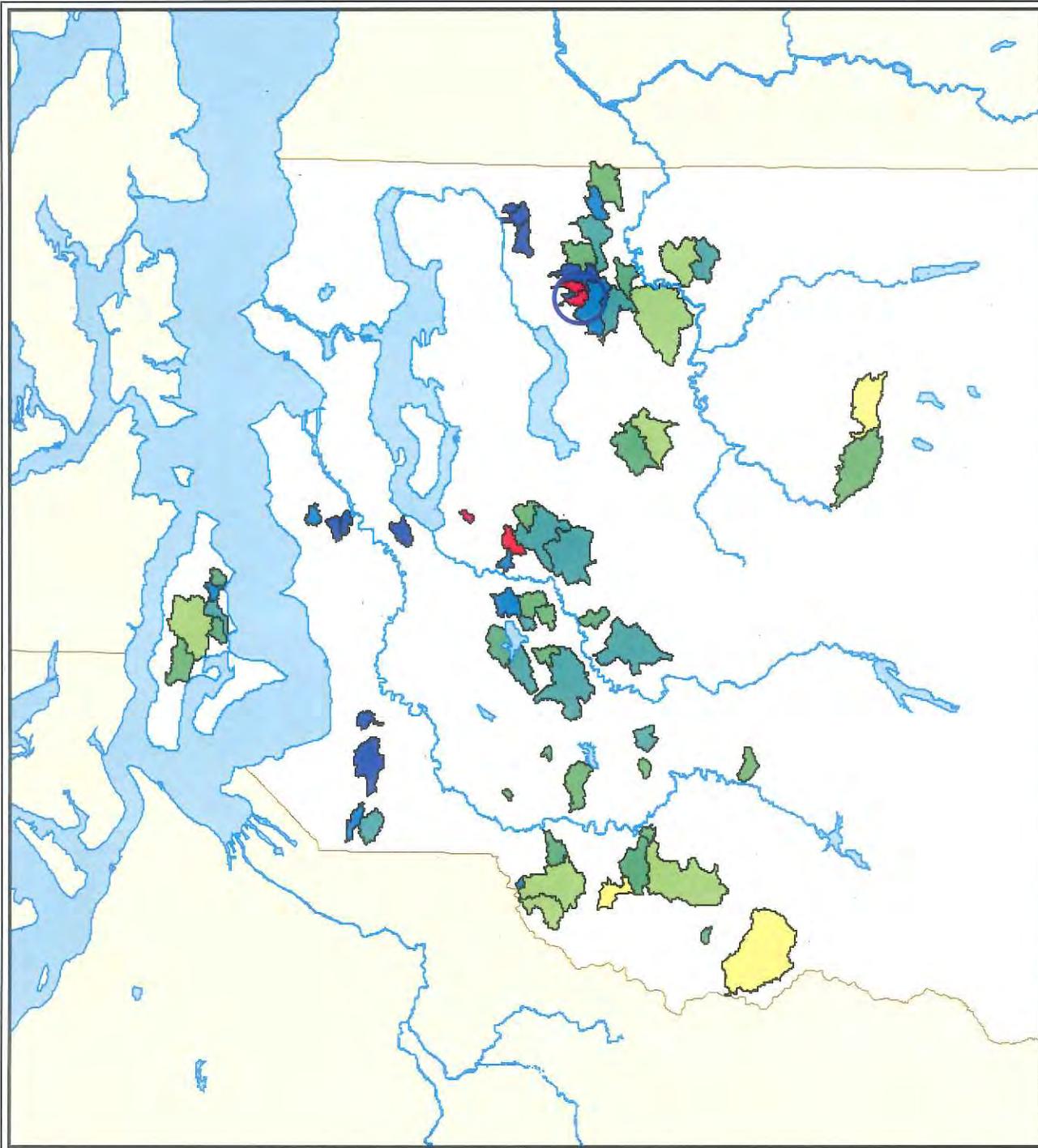
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## Small Stream Basin Retrofit Prioritization Priority of Basins

### Total Priority Score



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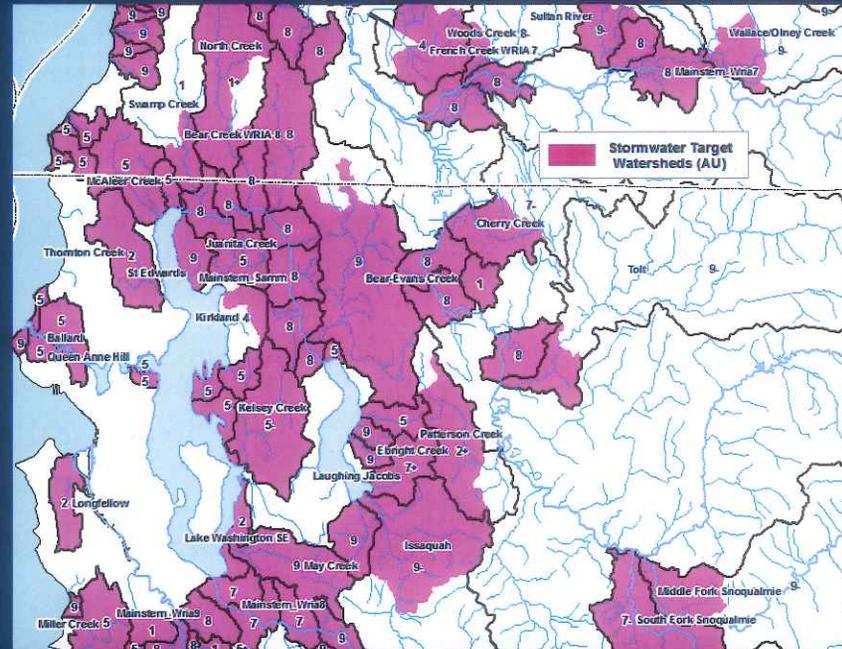


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# Basin Selection

- Stormwater Retrofit Target Watersheds
  - Watershed Selection
    - High/moderate-high overall water flow
    - In or next to Urban Growth Areas
    - Except basins with > 90% urban area
  - Watershed Integrity Index
    - Based on Puget Sound Characterization

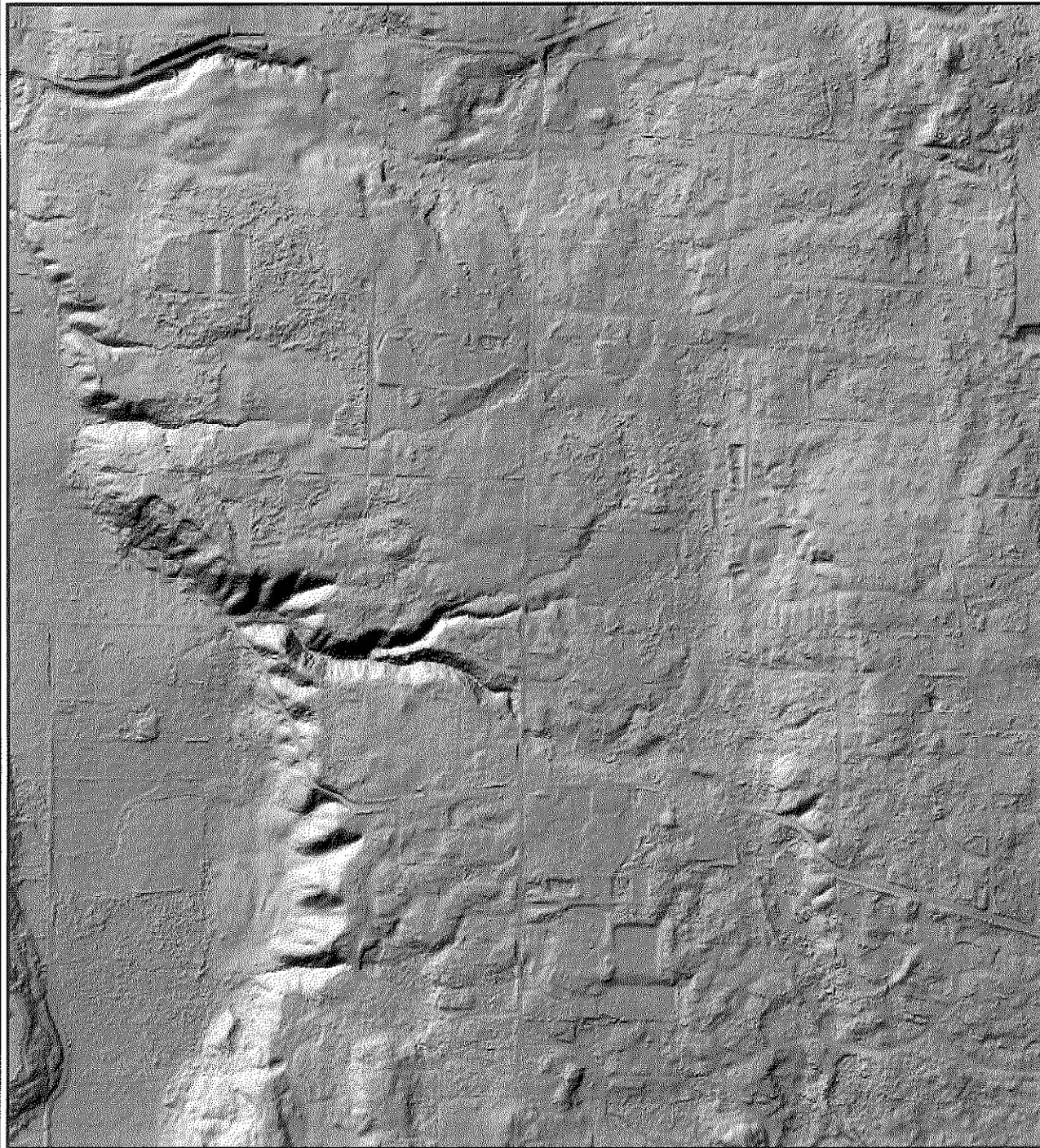


# Basin Selection

- Evans Creek Tributary 108
  - Highest overall priority score on King County List of Small Basins for Retrofit
    - High degree of development and impact
  - Highest possible Watershed Integrity Index among Stormwater Retrofit Target Watersheds
    - Best potential for remediation

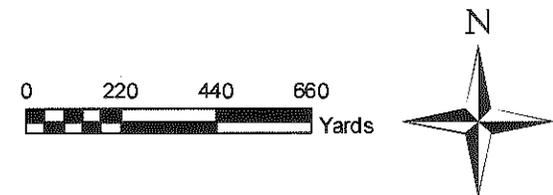
# Basin and Subbasin Delineation

- Data Input
  - Lidar digital elevation model
  - Plat drainage plans
  - Site reconnaissance
- ArcGIS Spatial Analyst
  - DEM modification
  - Hydrology Tools



## Evans Creek Tributary 108 Basin Delineation

### Elevation Model and Drainage Network



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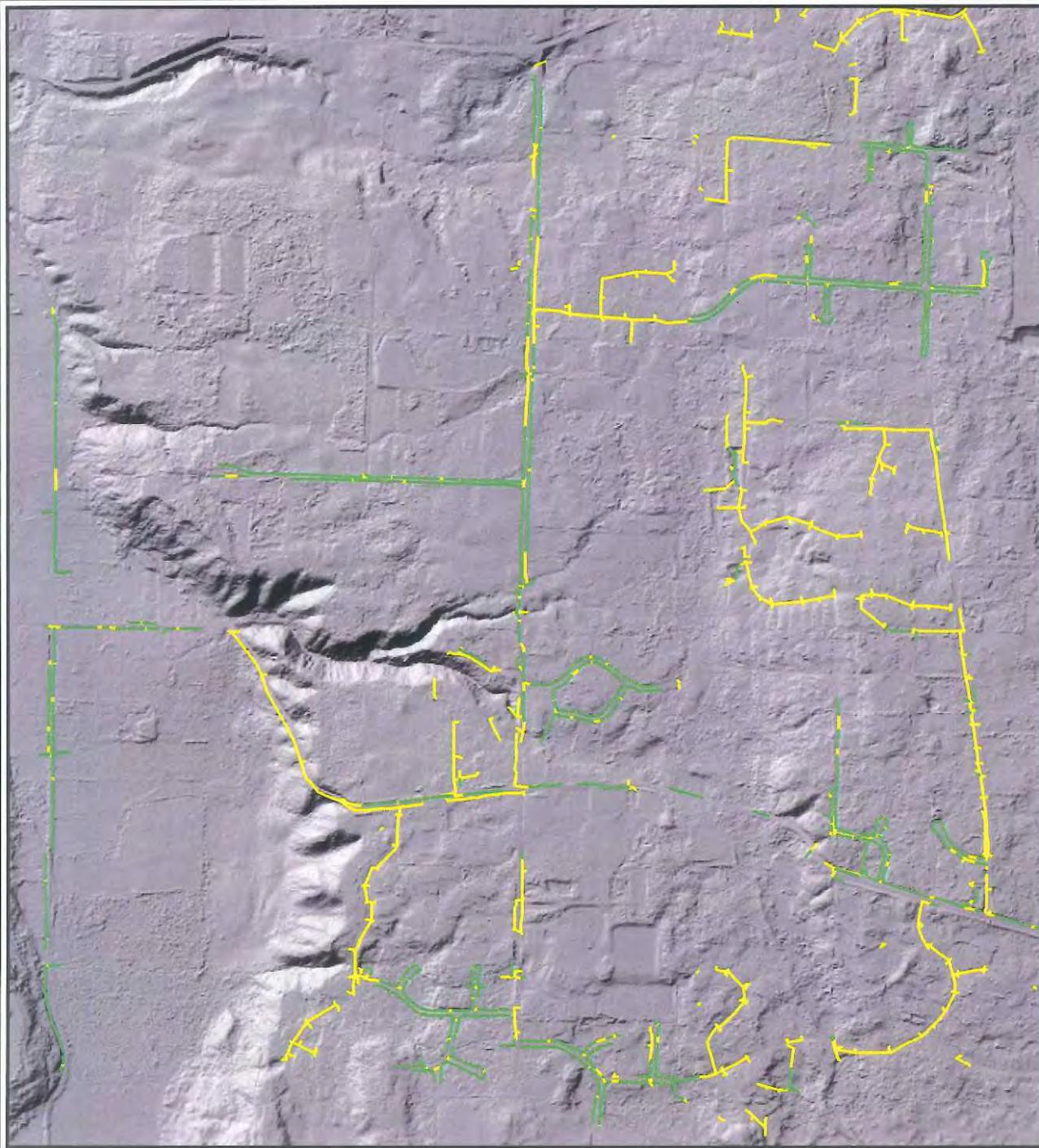
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## Evans Creek Tributary 108 Basin Delineation

## Elevation Model and Drainage Network

0 220 440 660  
Yards



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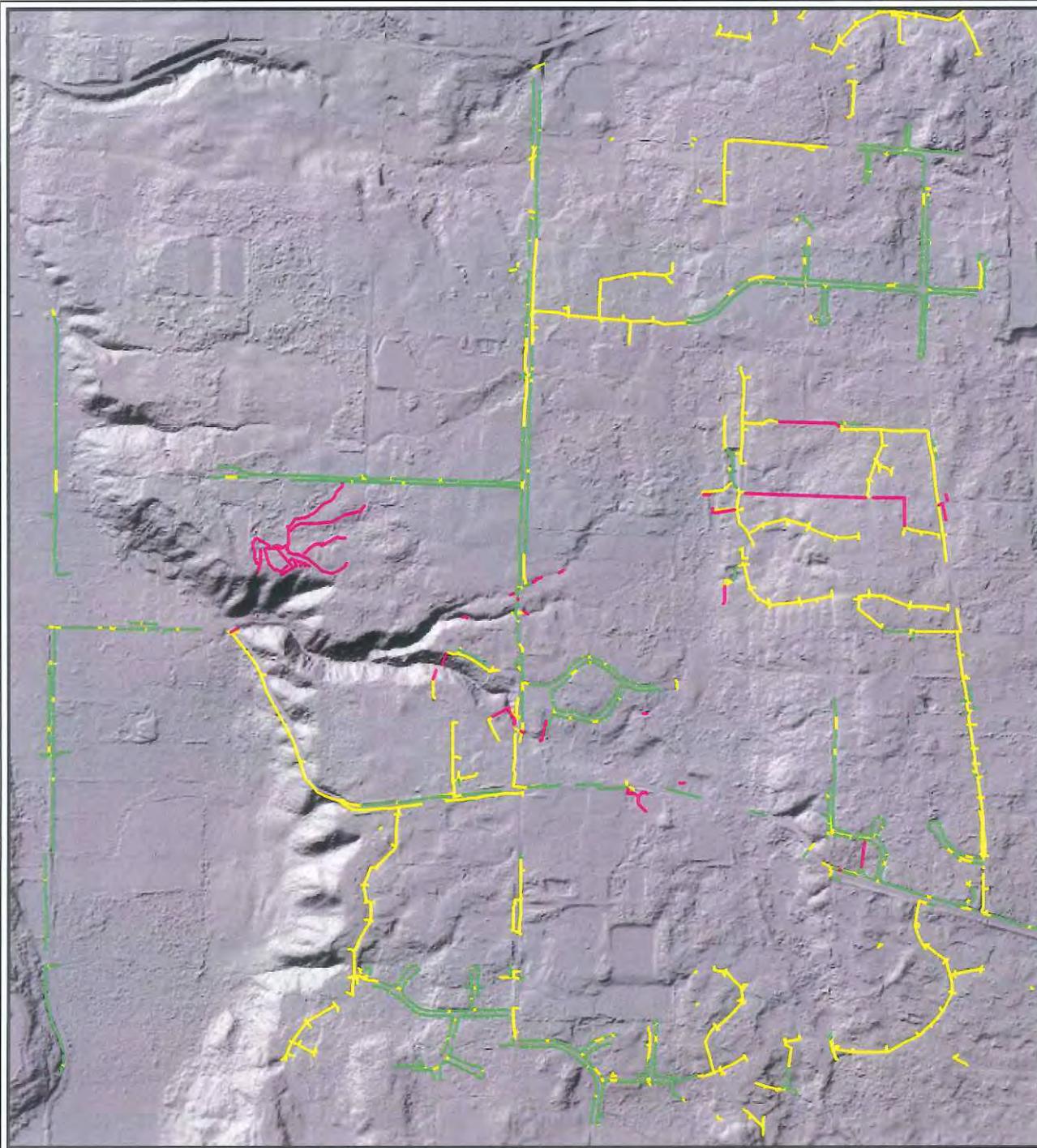
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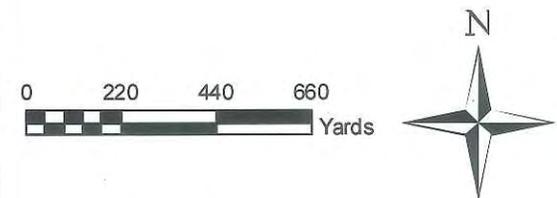
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## Evans Creek Tributary 108 Basin Delineation

## Elevation Model and Drainage Network



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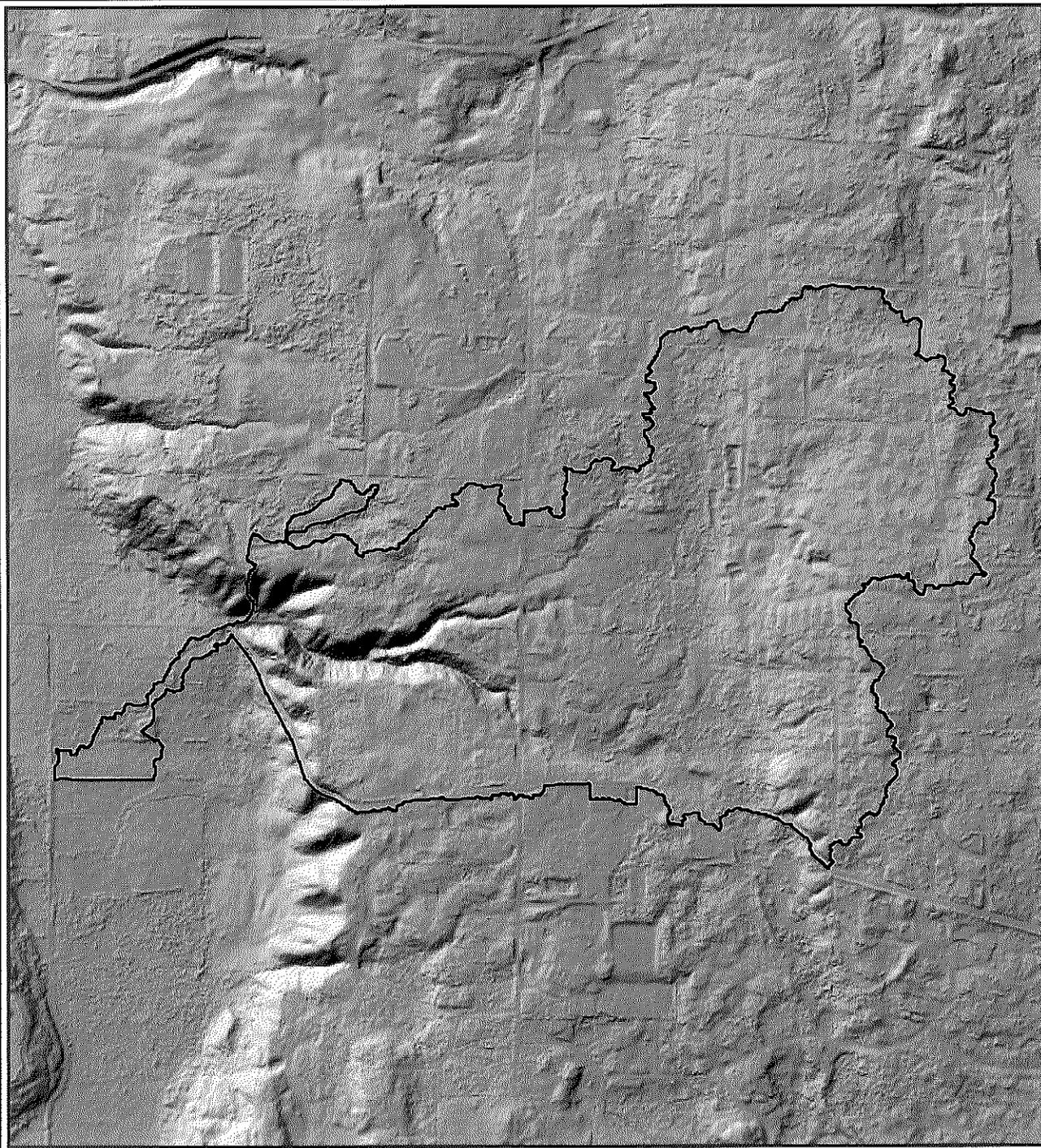
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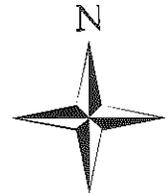
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# Evans Creek Tributary 108 Basin Delineation Developed Basin

 Developed Boundary



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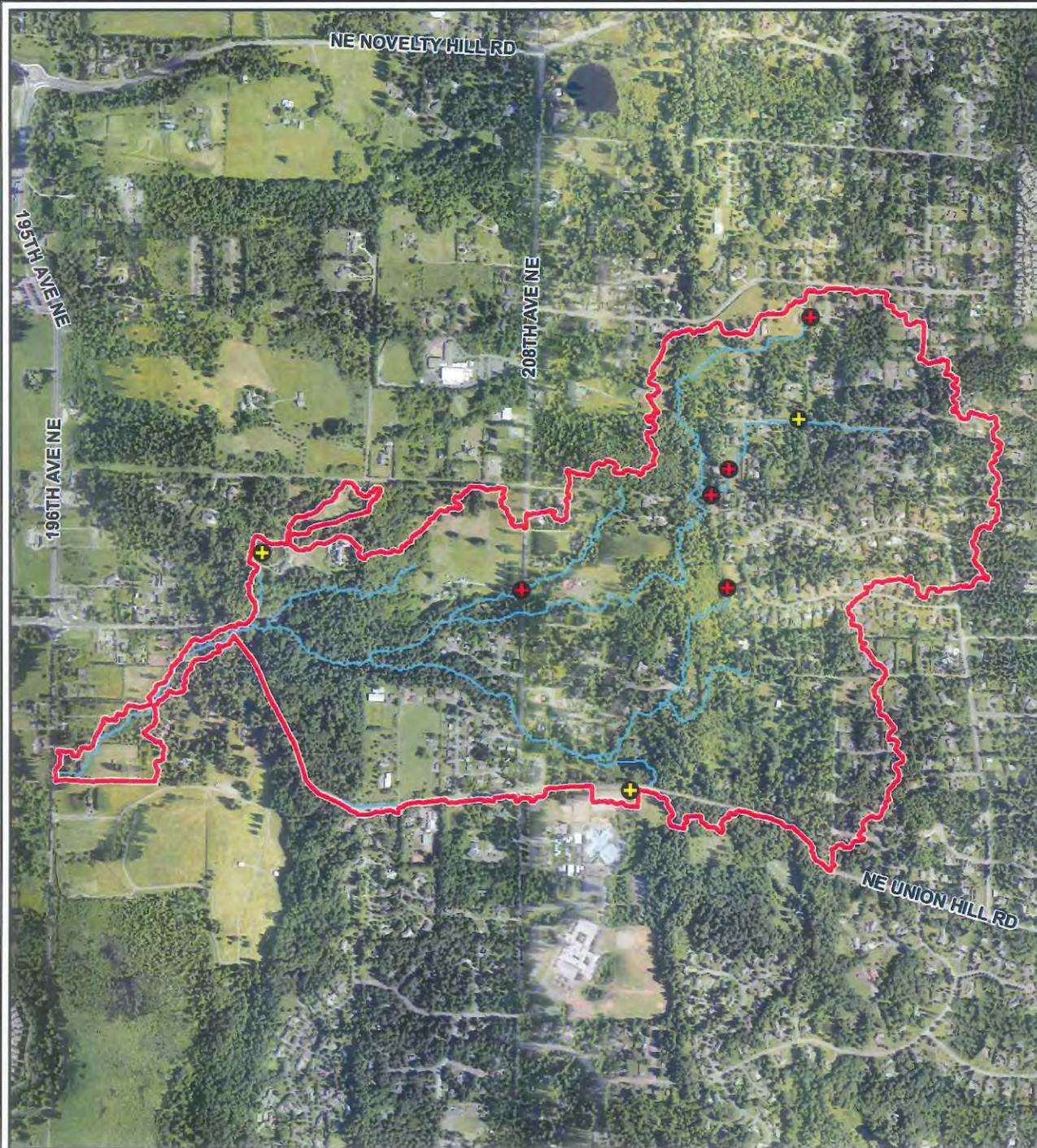


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# Basin and Subbasin Delineation

- Subbasins
  - Existing and potential facility locations
  - Major confluences and breaks in grade
  - Major road crossings



## Evans Creek Tributary 108 Subbasin Delineation

### Existing Stormwater Facility Locations

 Basin Boundary

 Flow Paths

#### Stormwater Facilities

 County Maintained Facility

 Private Facility



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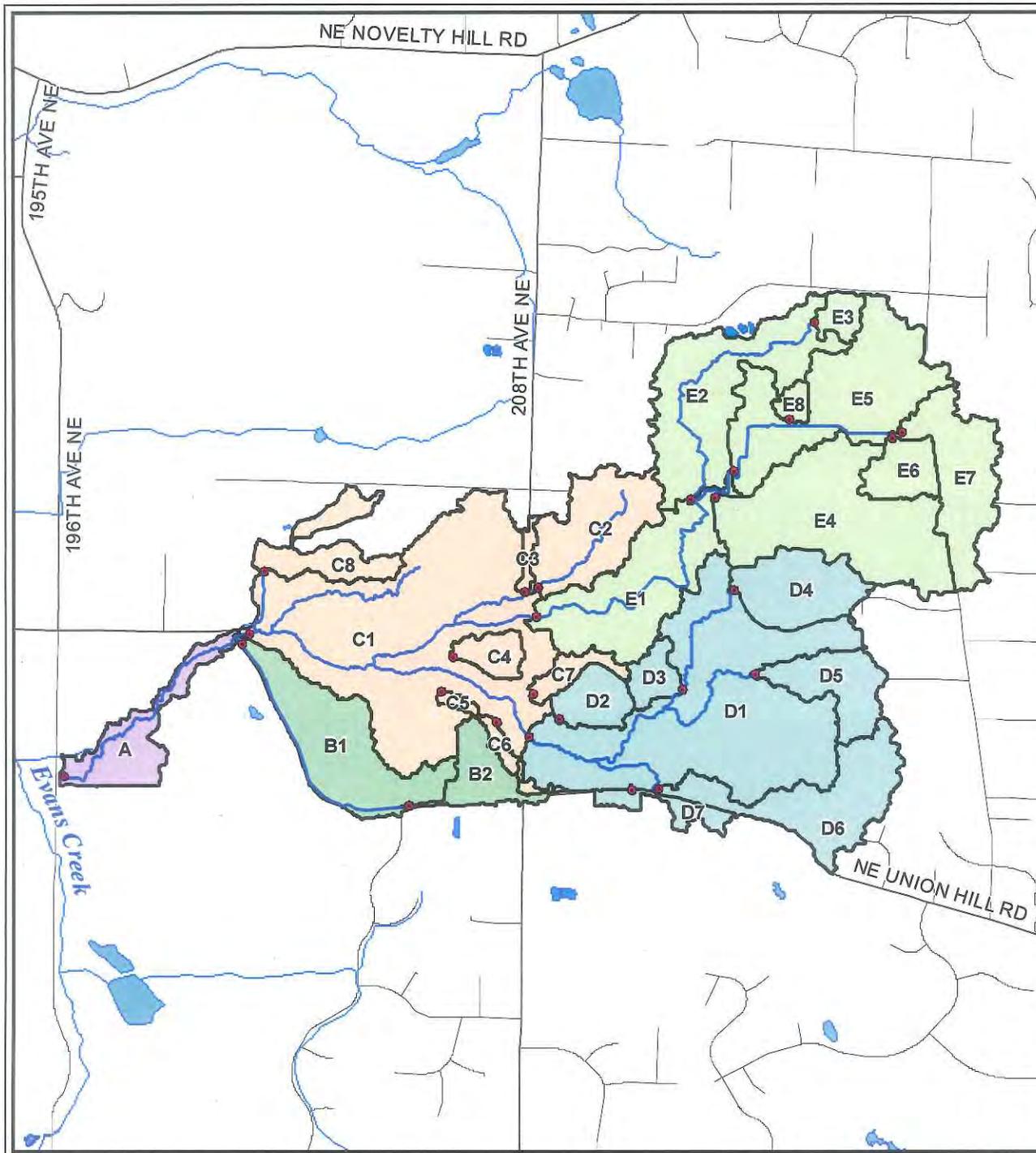
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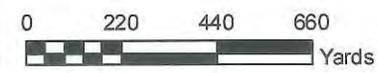
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# Evans Creek Tributary 108 Subbasin Delineation

## Subbasins and Outfall Locations

- Subbasin Outfalls
  - ~ Flow Paths
- Basin Regions**
- A
  - B
  - C
  - D
  - E



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# Project Subbasin Selection

- North Kitsap County LID Retrofit Project Implementation Plan
- Two screening levels
  - Level One
    - Available GIS data
  - Level Two
    - Records research
    - Site visits

# Project Subbasin Selection

- Level One
  - Site slope
  - Available area
  - Effective Impervious Area
  - Risk to the environment

# Level One Criteria

- Site Slope
  - Slope  $\leq 3\%$   $\rightarrow$  3
  - Slope  $> 3\%$  and  $\leq 5\%$   $\rightarrow$  2
  - Slope  $> 5\%$   $\rightarrow$  1

# Level One Criteria

- Available Area

- Width available  $\geq$  60 feet → 3
- Width available  $\geq$  30 feet and  $<$  60 feet → 2
- Width available  $<$  30 feet → 1
- Area available is in existing facility → 1
- Potential facility site is private property → 0

# Level One Criteria

- Impervious Surface

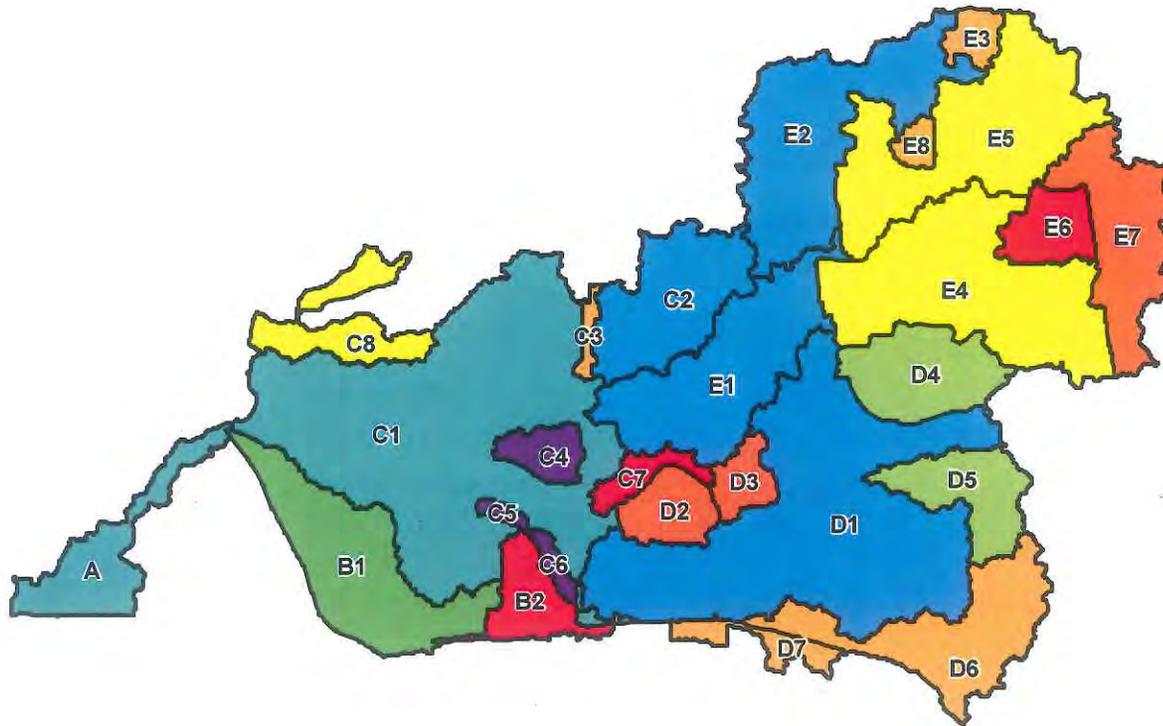
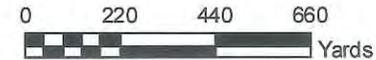
- Impervious  $\geq 35\%$   $\rightarrow$  3
- Impervious  $\geq 15\%$  and  $< 35\%$   $\rightarrow$  2
- Impervious  $< 15\%$   $\rightarrow$  1

# Level One Criteria

- Risk to Environment
  - Not near setback or critical area buffer → 3
  - Near setback or critical area buffer → 2
  - Within setback or critical area buffer → 1
  - Within critical area → 0

# Evans Creek Tributary 108 Level 1 Site Prioritization Level 1 Overall Score

## Overall Score



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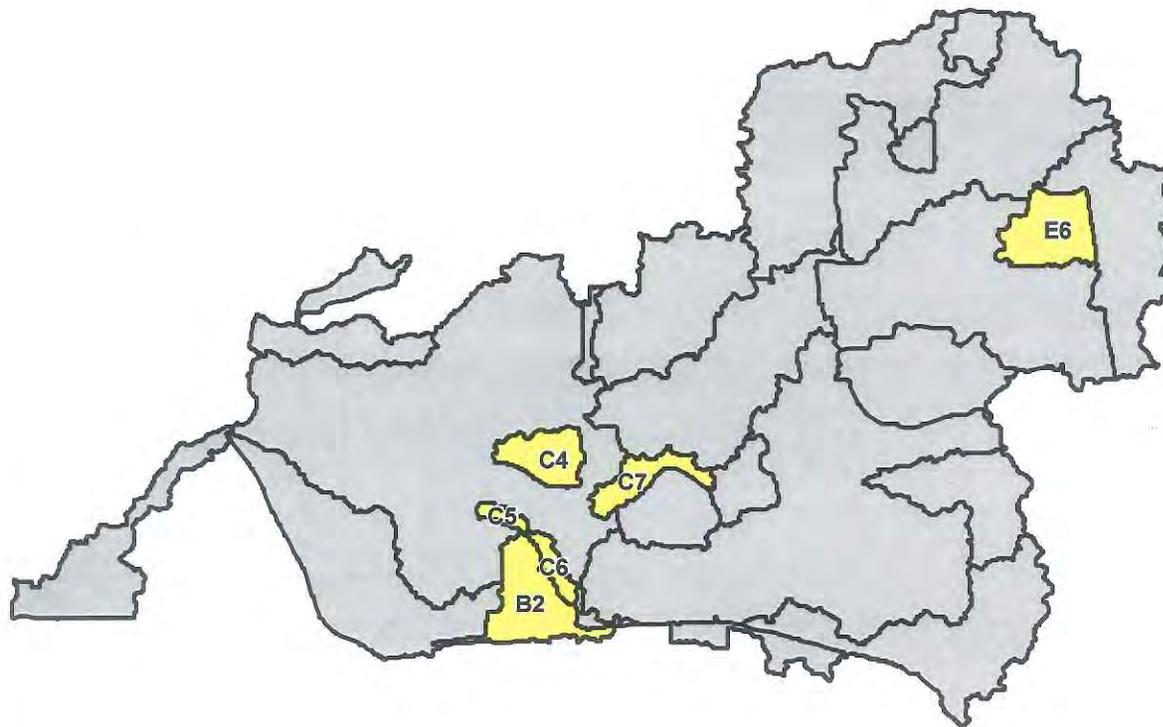


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# Evans Creek Tributary 108 Level 2 Site Prioritization Level 2 Subbasins

 Selected Subbasin



0 220 440 660  
Yards



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# Level Two Criteria

- Water Quality Benefit
- Drainage and Local Flooding
- Utility Coordination
- Constructability
- Operation and Maintenance
- Ease of Funding

# Level Two Criteria

- Utility Coordination
  - Limited potential utility conflicts → 3
  - Opportunity to coordinate retrofit with planned utility or roadway projects → 3
  - Moderate potential utility conflicts → 2
  - Numerous potential utility conflicts → 1

# Level Two Criteria

- Constructability

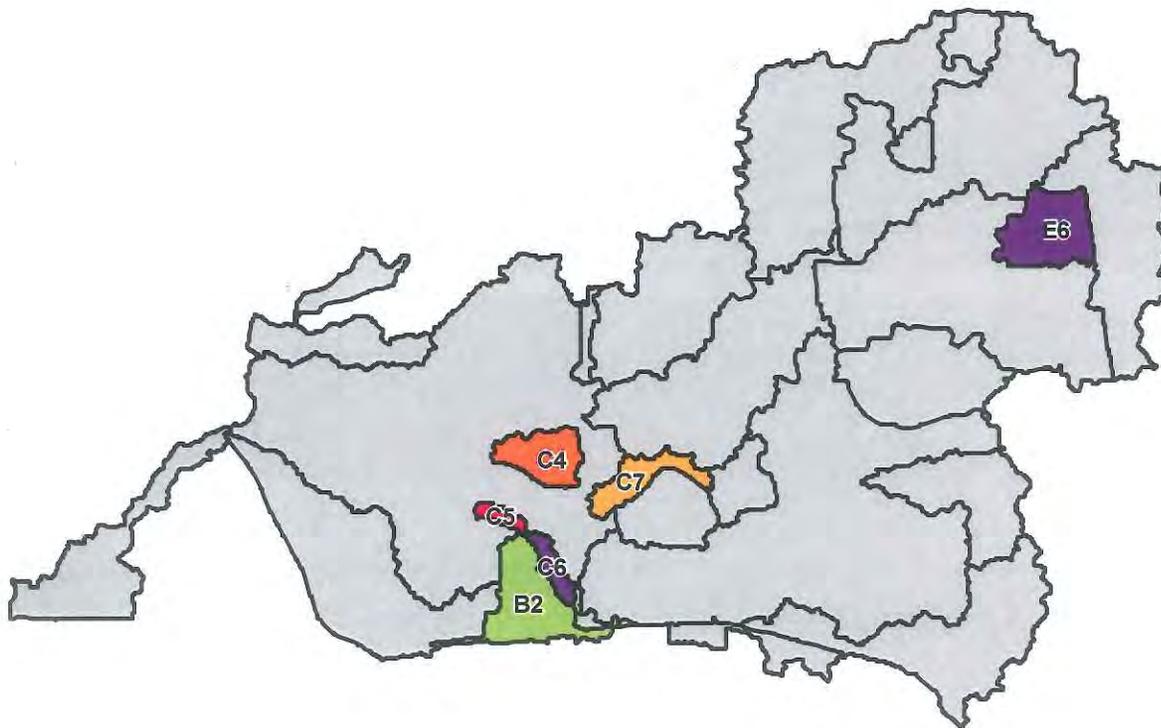
- No significant construction impacts to residents, and county crews can construct the project in approximately 2 weeks or less → 3
- No significant construction impacts to residents, and construction not expected to be complicated by utility or other types of conflicts → 2
- No significant construction impacts to residents, but utility conflicts may increase construction time/costs → 1
- Significant construction impacts to residents, or
- Costs exceed value → 0

# Level Two Criteria

- Operation and Maintenance
  - County has necessary equipment, staff experience, and budget to maintain the retrofit → 3
  - Project may require purchase of new equipment, training staff, and/or additional budget to properly maintain the retrofits → 2
  - Project located outside of County-owned right-of-way and will require external O&M → 1
  - Long-term operation and maintenance of project is not feasible or cost effective → 0

# Evans Creek Tributary 108 Level 2 Site Prioritization

## Level 2 Overall Score



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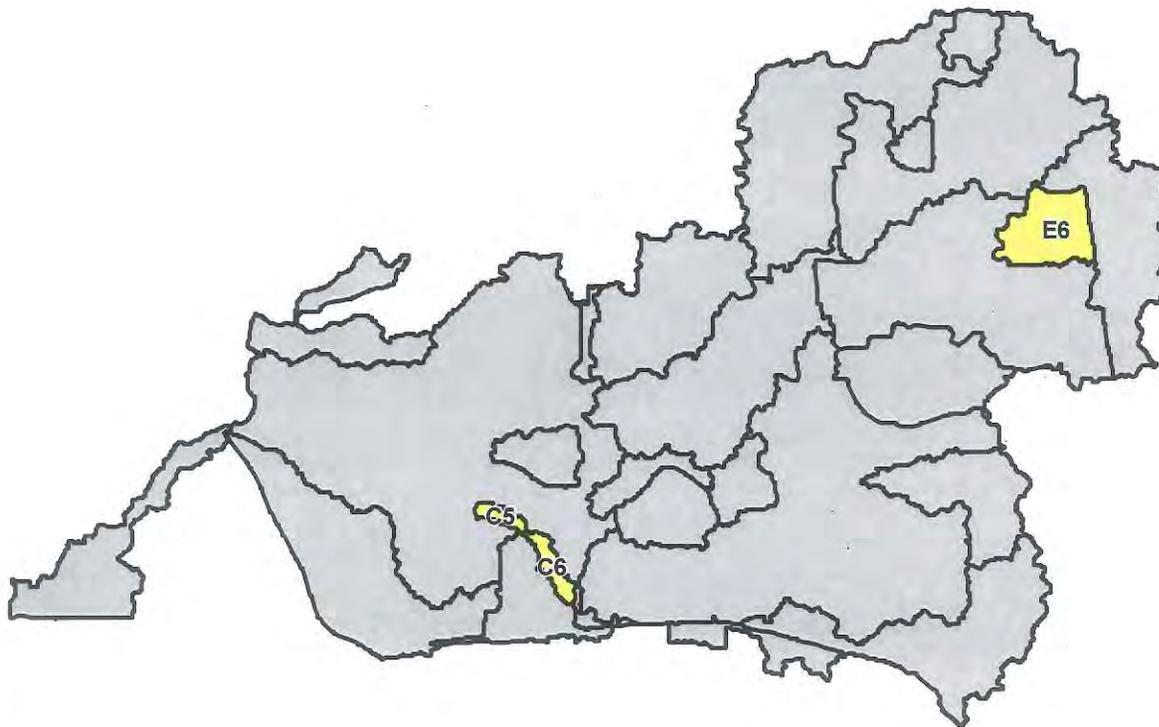


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# Evans Creek Tributary 108 Level 2 Site Prioritization Level 2 Results

 Final Selection



0 220 440 660  
Yards



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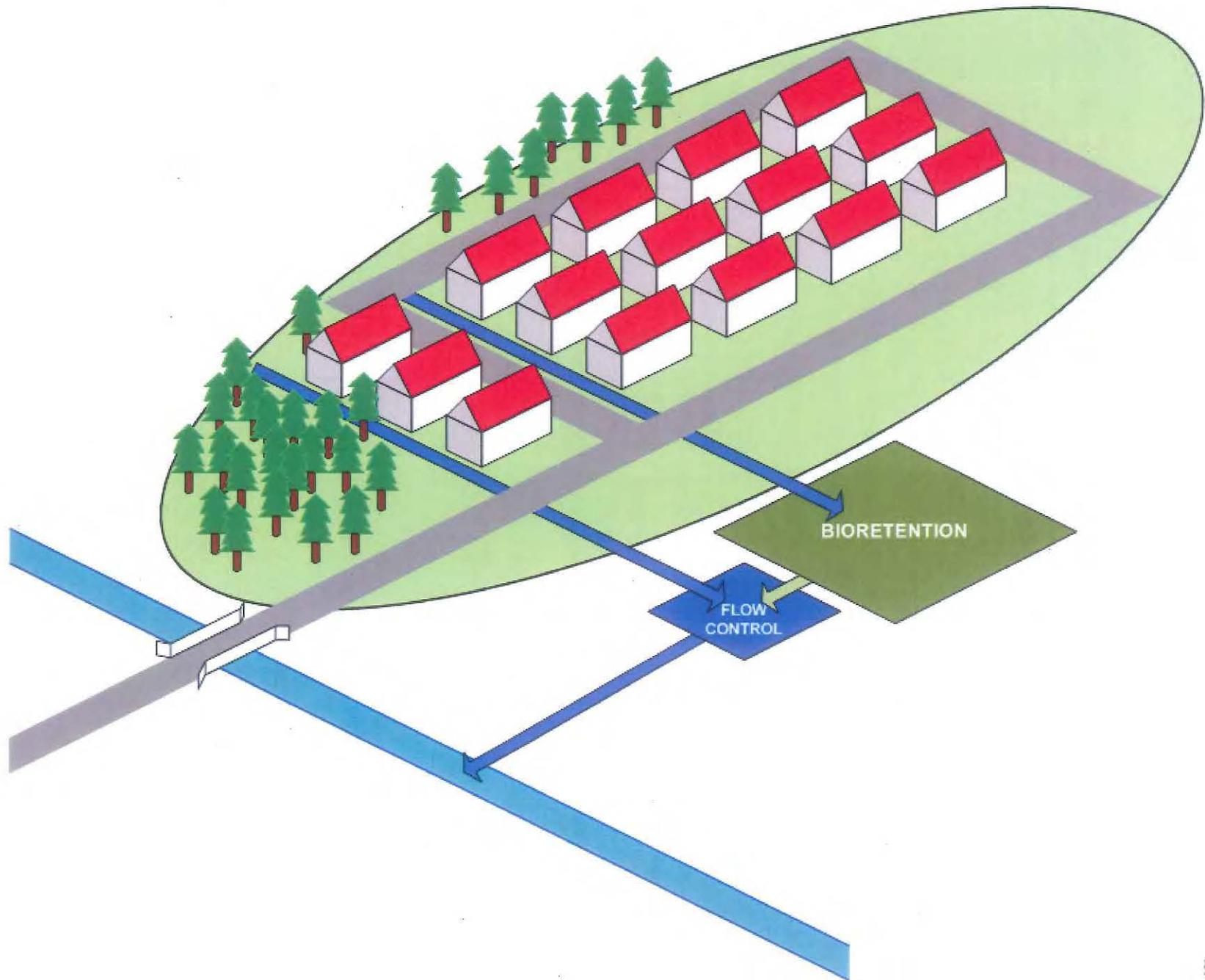
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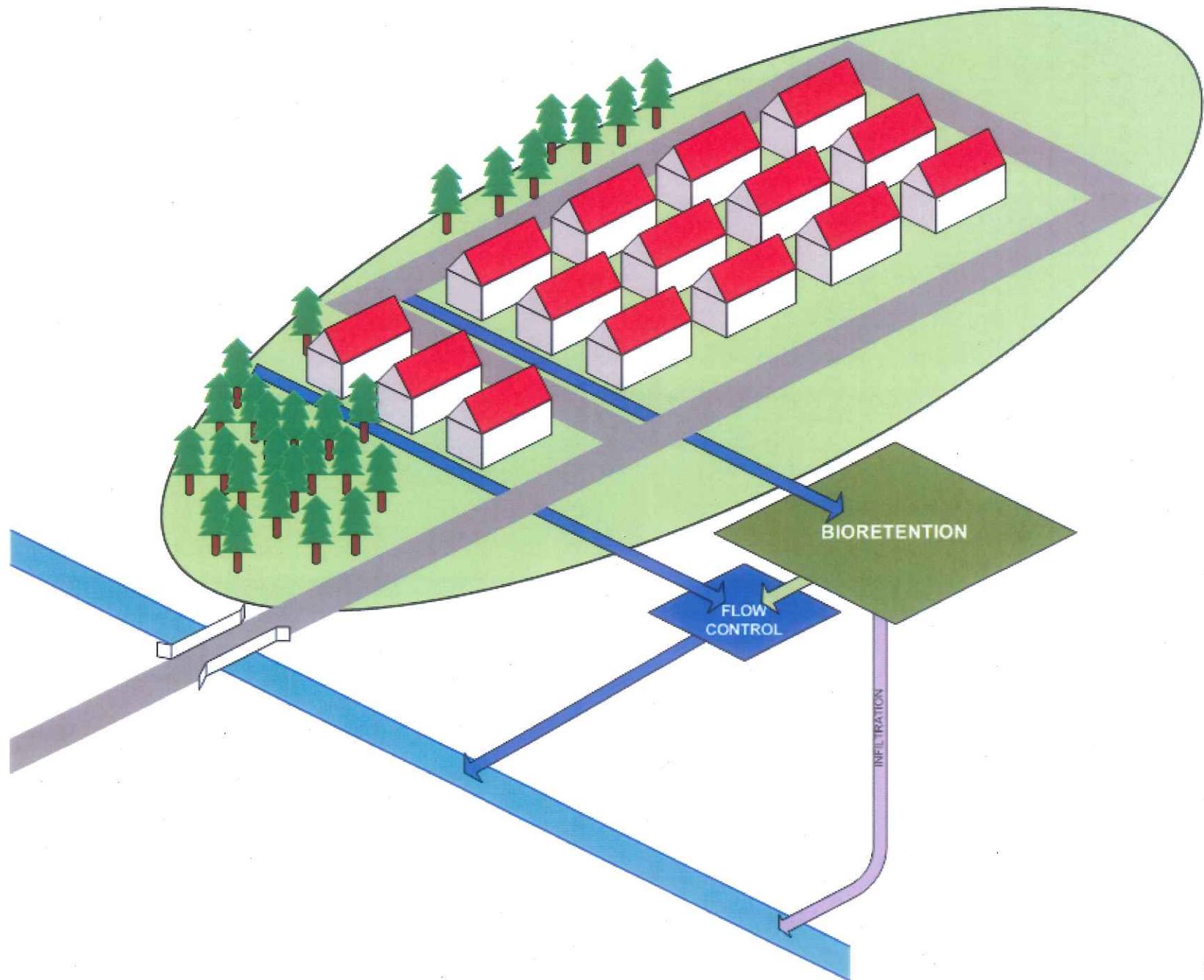
# Design Approach

- Stormwater Retrofit Analysis and Recommendations for Juanita Creek Basin
  - Seven mitigation scenarios modeled using HSPF
    - Generally targeted meeting regulatory standards
  - Scenario targeting M.R. #5 and #7 was used as design template for basin wide retrofit
    - Hydrologic outcomes associated with these standards correlate to B-IBI scores that support beneficial uses

# Design Approach

- ECY08
  - Bioretention facilities
    - 80% of runoff from impervious surface
    - Overflows routed to flow control
  - Flow control
    - 20% of runoff from impervious surface
    - Runoff from other land segments
- Soil Depth and Quality (BMP T5.13)
  - Implemented under Redevelopment



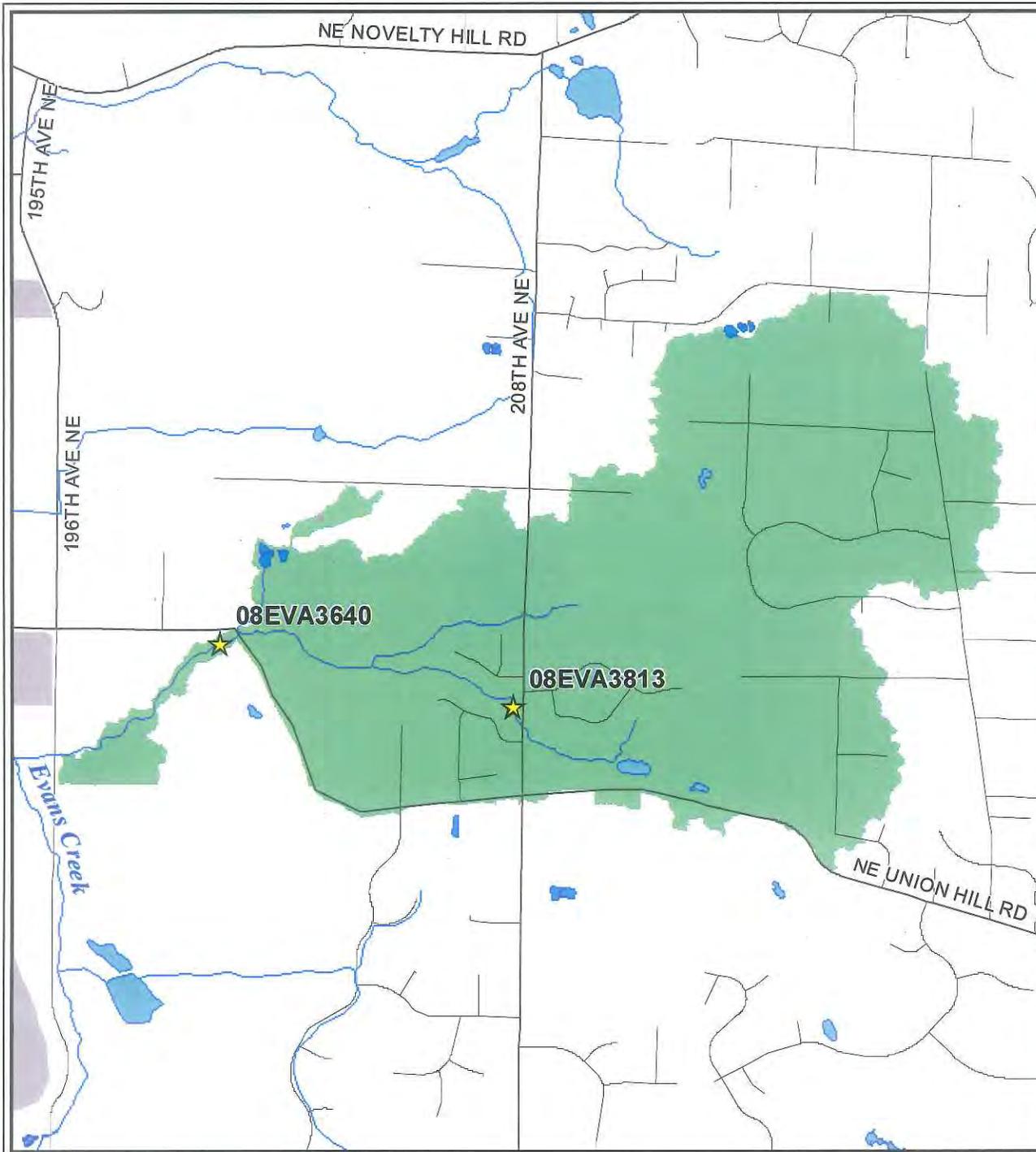


# Design Approach

- Partially Mitigated Runoff Timeseries
  - Overflows from bioretention + remaining runoff
  - Generated using HSPF models for each subbasin
- WWHM was used to size flow control facilities
  - Autopond
    - Partially mitigated runoff time series
    - Predeveloped land segmentation
  - Stage/Storage/Discharge tables exported

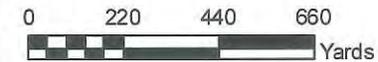
# Design Approach

- Fully Mitigated Conditions
  - Complete HSPF model
    - Bioretention and Detention Facilities in Series
  - Evaluate how well standards are met at B-IBI ambient monitoring sites
    - Instream
    - Downstream of outfalls from development



# Evans Creek Tributary 108 HSPF Model Development B-IBI Ambient Monitoring Sites

-  B-IBI Site
-  Tributary 108 Developed Basin



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# B-IBI Site 08EVA3640



**B-IBI Site 08EVA3813**



# Design Approach

- HSPF Models
  - Surface/Interflow/Active groundwater
    - Points of compliance in downstream stream channel
  - HSPF Special Actions account for water volume infiltrated in bioretention facilities
    - Global variables used to represent volume stored in aquifer
    - Discharge to stream calculated as decay rate derived from modeled active groundwater outflow

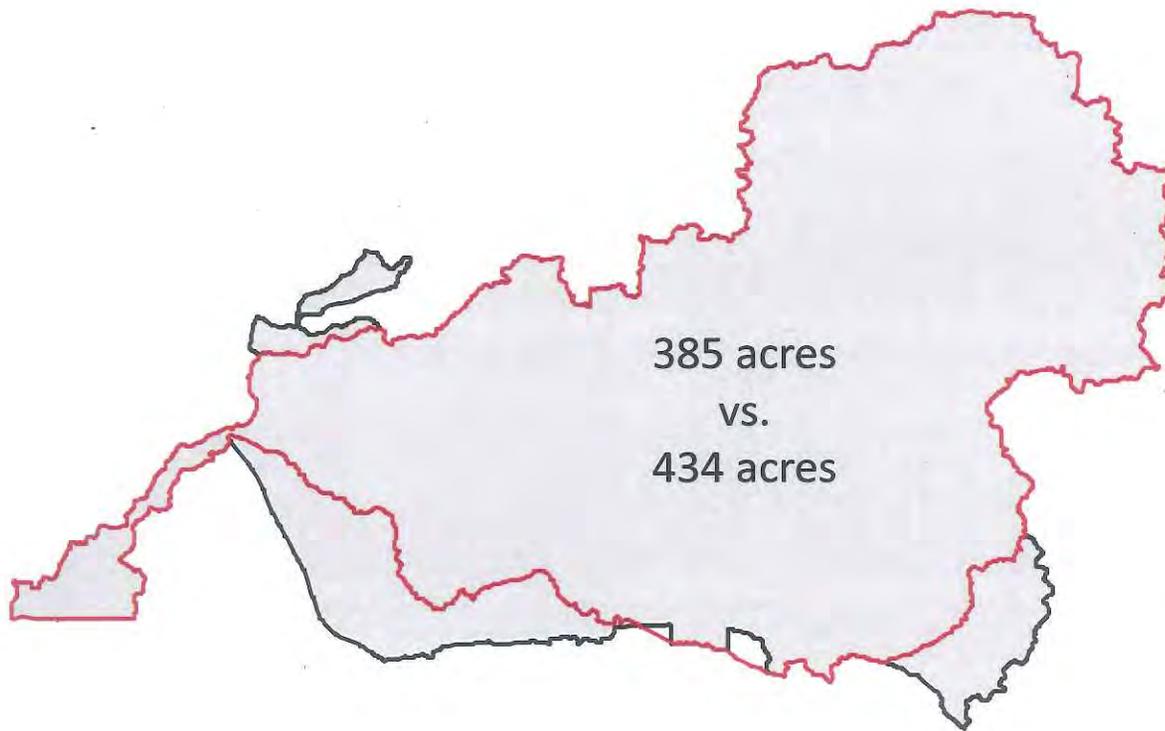
# Design Approach

- HSPF Predeveloped and Mitigated Models
  - USGS regional calibration used to model hydrologic processes
    - WWHM pasture parameters used to represent amended soil BMP
  - 63-year precipitation & pan evaporation records
  - Hourly time step
  - Pre-developed and developed basins each delineated
    - Channel geometries maintained unchanged between models

# Evans Creek Tributary 108 Basin Delineation

## Predeveloped vs. Developed Basin

-  Predeveloped Boundary
-  Developed Boundary



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June 20, 2014

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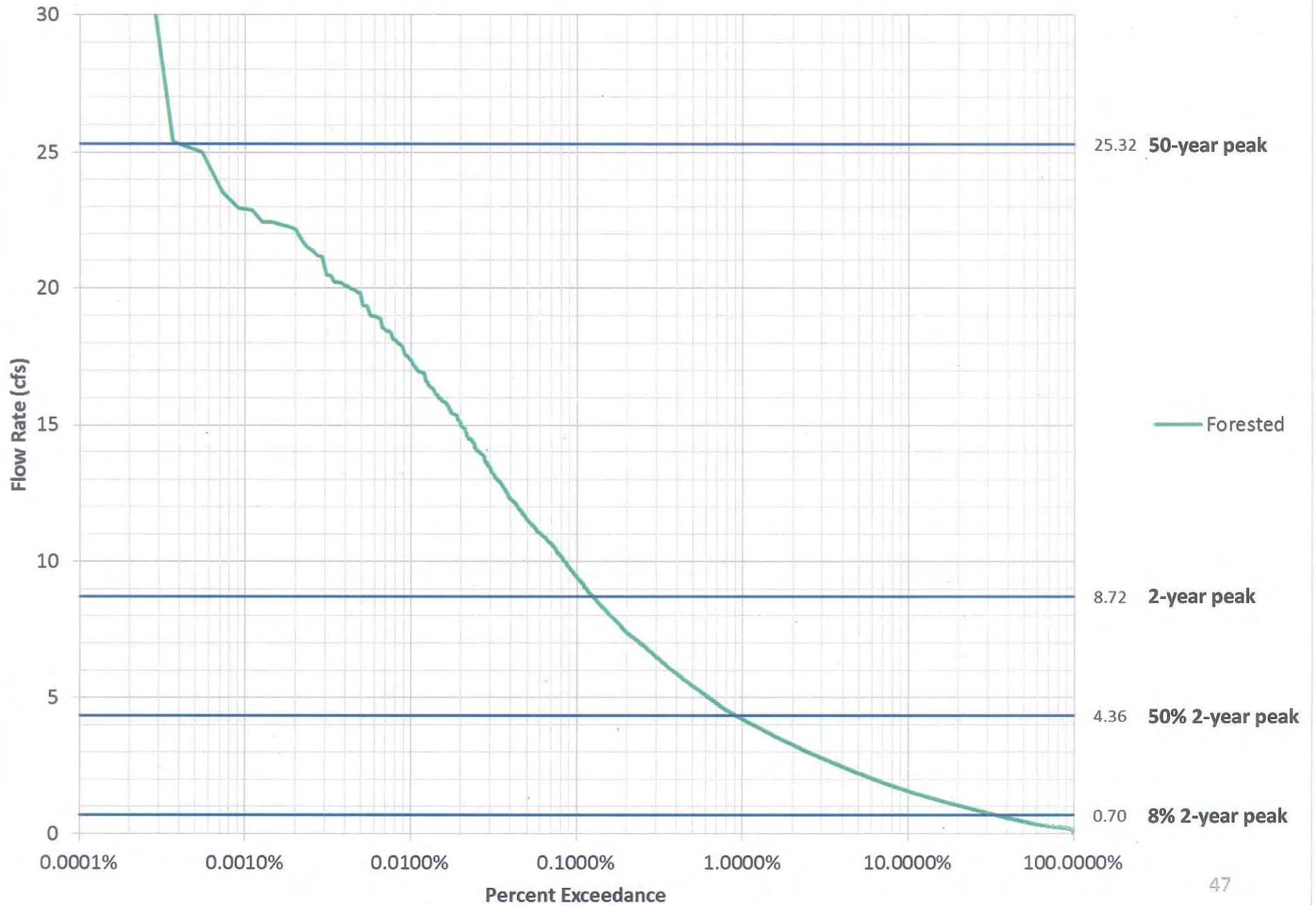
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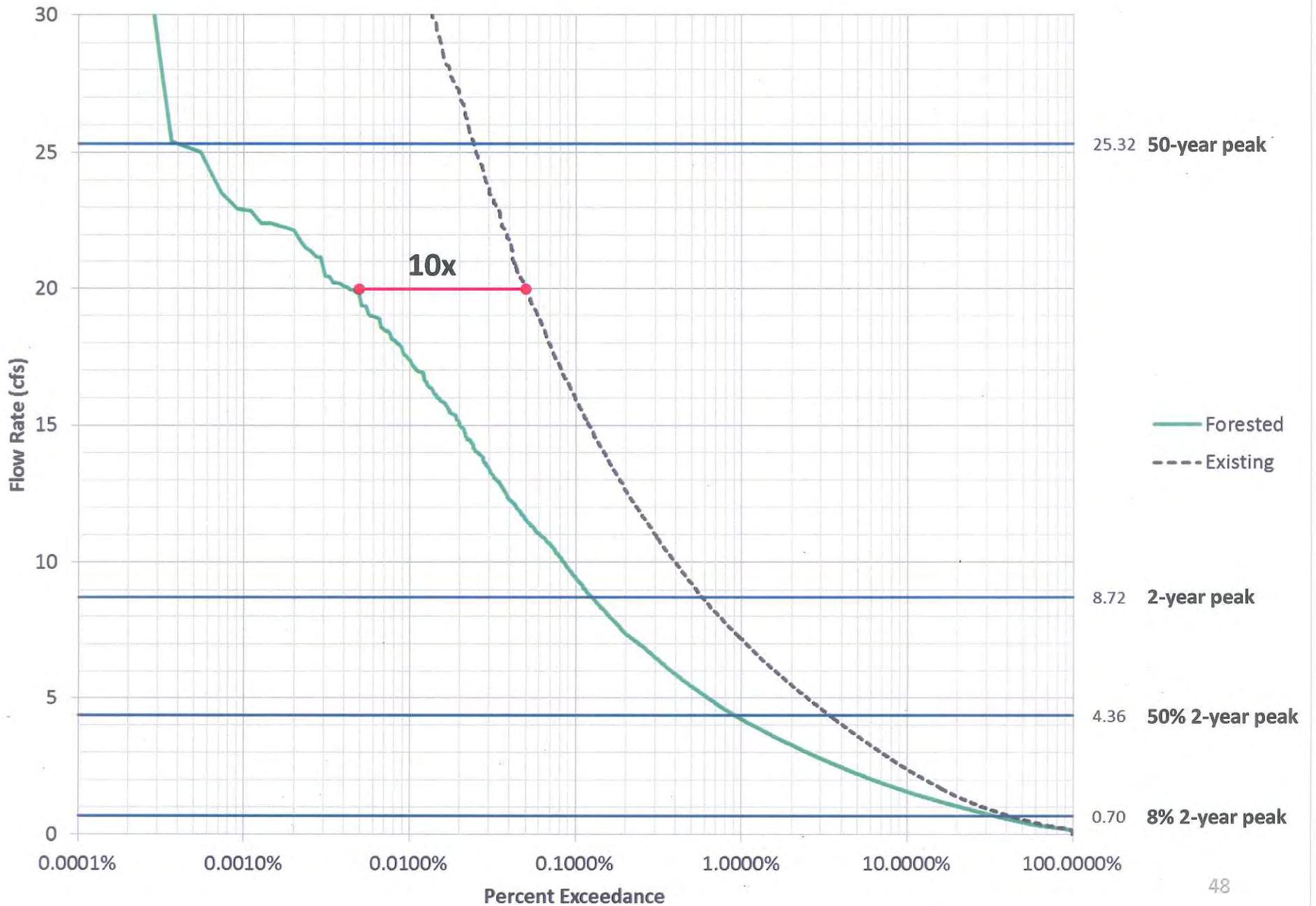
# Flow Standards

- Stormwater Management Manual for Western Washington
  - Minimum Requirement #5
    - On-site Stormwater Management
    - Match from 8% to 50% of pre-developed 2-year peak flow
  - Minimum Requirement #7
    - Flow Control
    - Match from 50% of pre-developed 2-year peak flow to predeveloped 50-year peak flow
    - Durations exceeding predeveloped 2-year peak flow allowed up to 110% for up to half occurrences

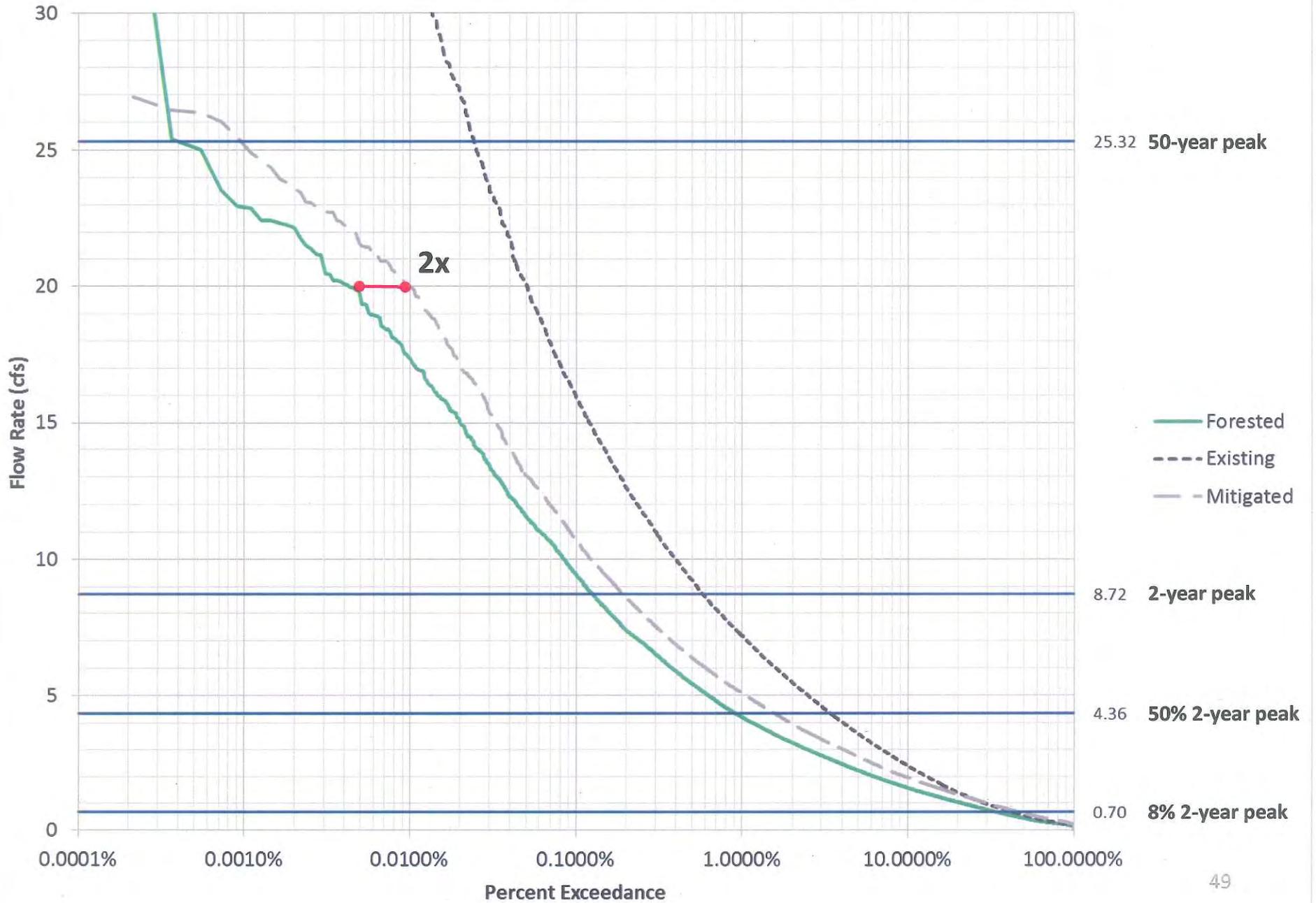
# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3640

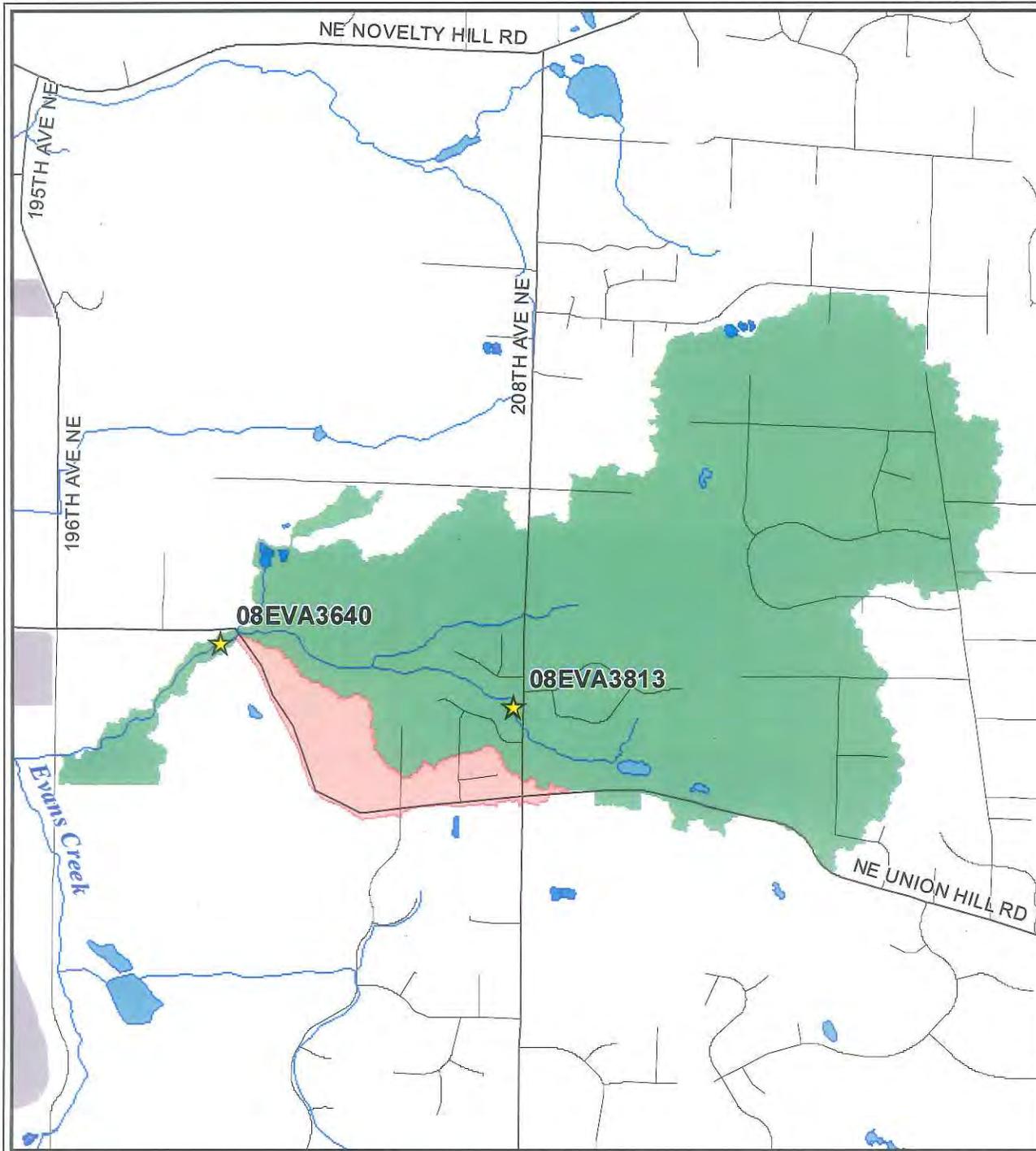


# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3640



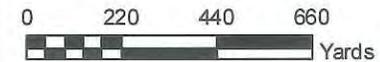
# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3640





# Evans Creek Tributary 108 HSPF Model Development Modifications to Mitigated Scenario

-  B-IBI Site
-  Tributary 108 Basin
-  Basin Area Removed



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September 23, 2014

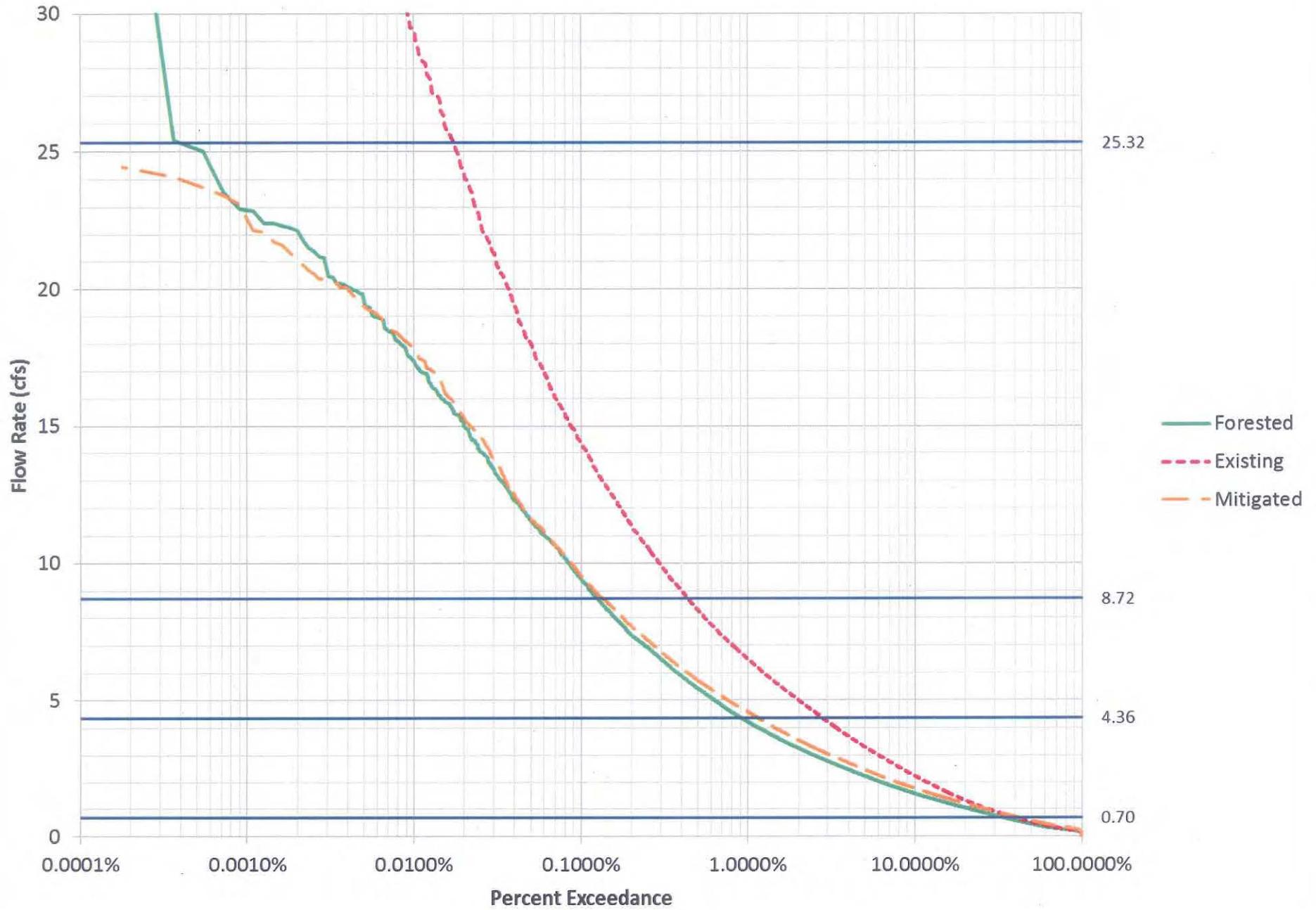
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Small Stream Basin Retrofit Siting 1117558\Evans Creek Retrofit Siting 1121161\  
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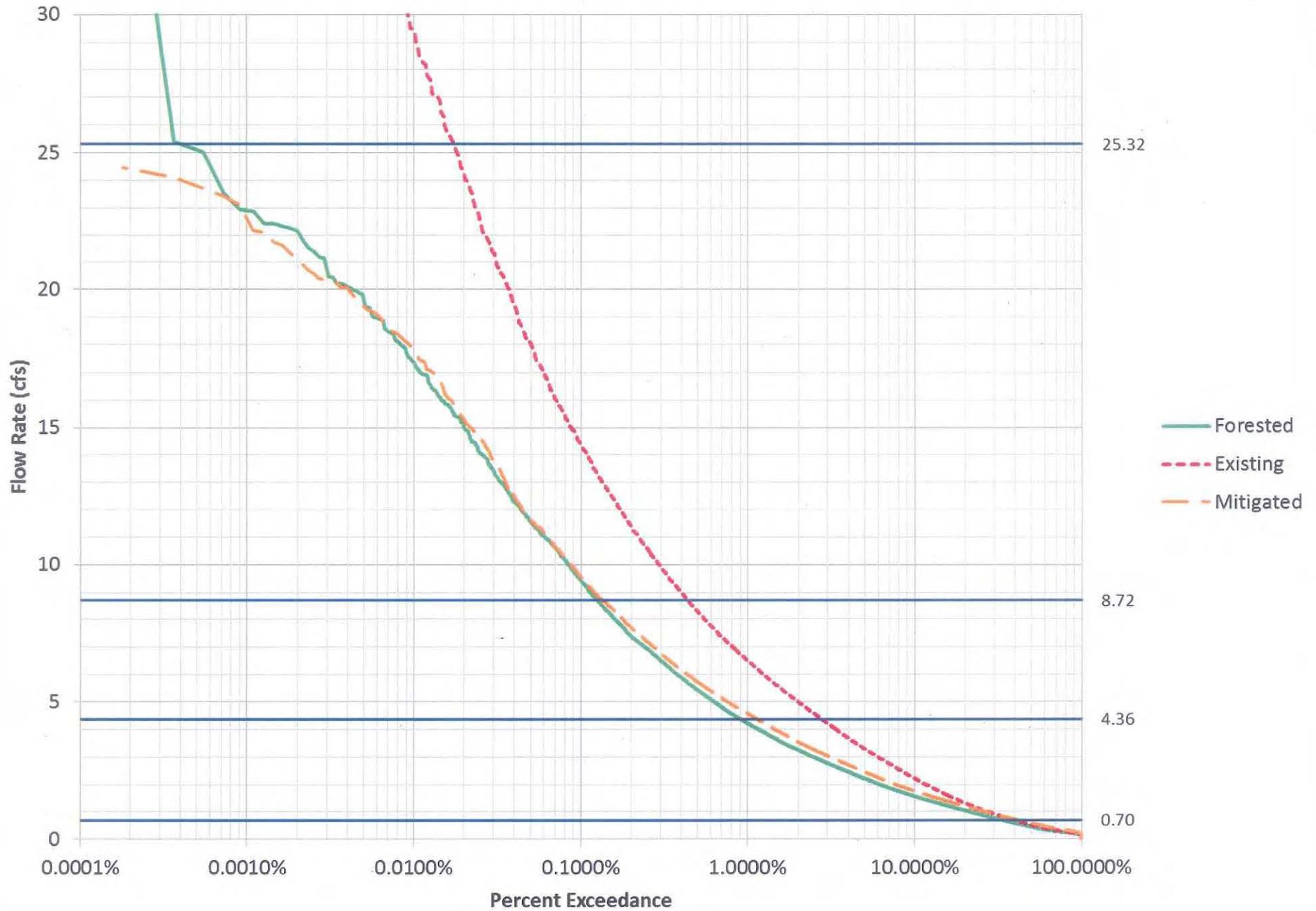
# Flow Exceedance Probability at Upstream Side of Union Hill Road



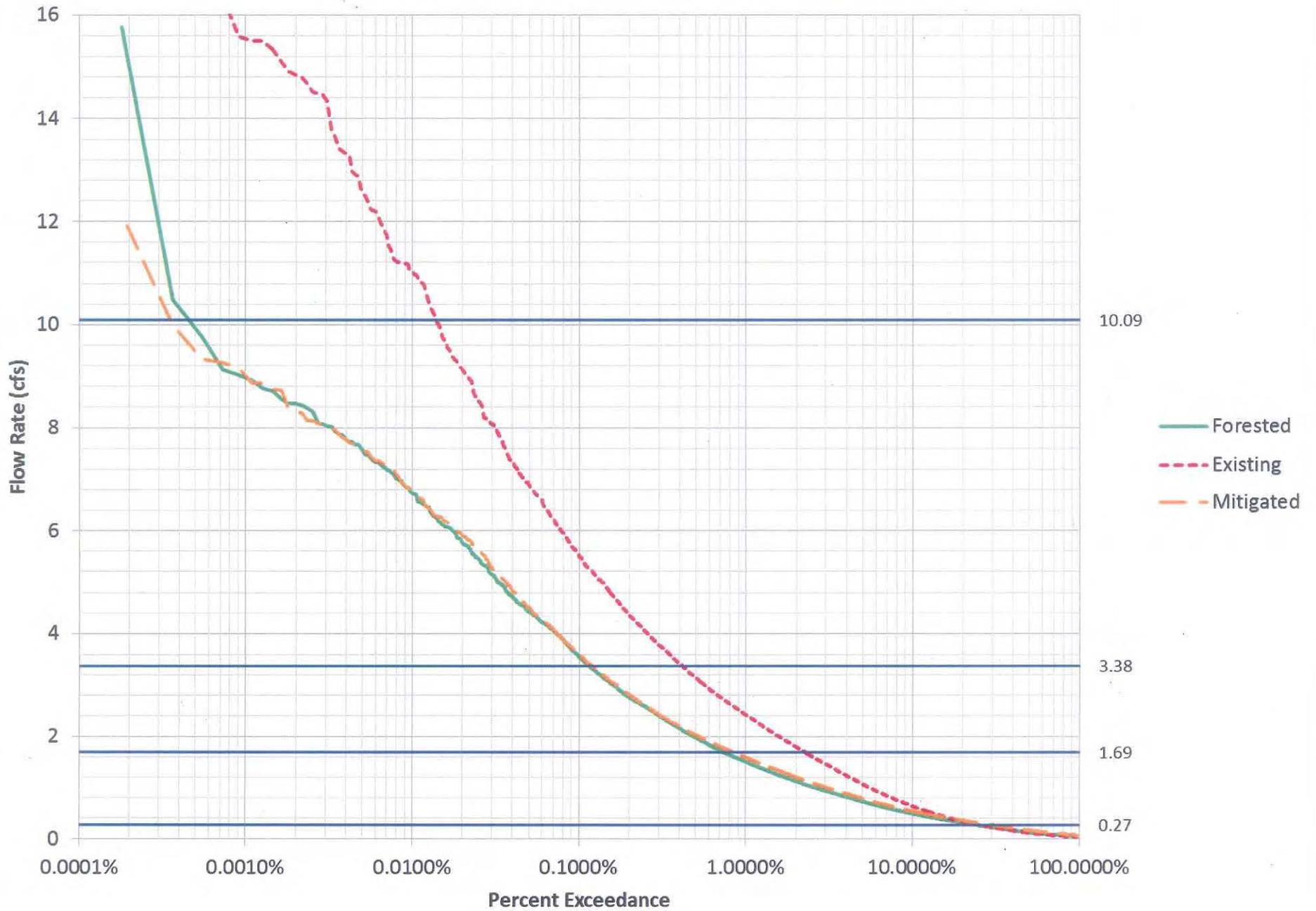
# Above B-IBI Site 08EVA3640

Flow Control Standard	Mitigation
Minimum Requirement #5 8% to 50% of pre-developed 2-year peak	66.4%
Minimum Requirement #7 50% to 100% of pre-developed 2-year peak	93.4%
Minimum Requirement #7 2-year to 50-year pre-developed peak	99.2%

# Flow Exceedance Probability at Upstream Side of Union Hill Road



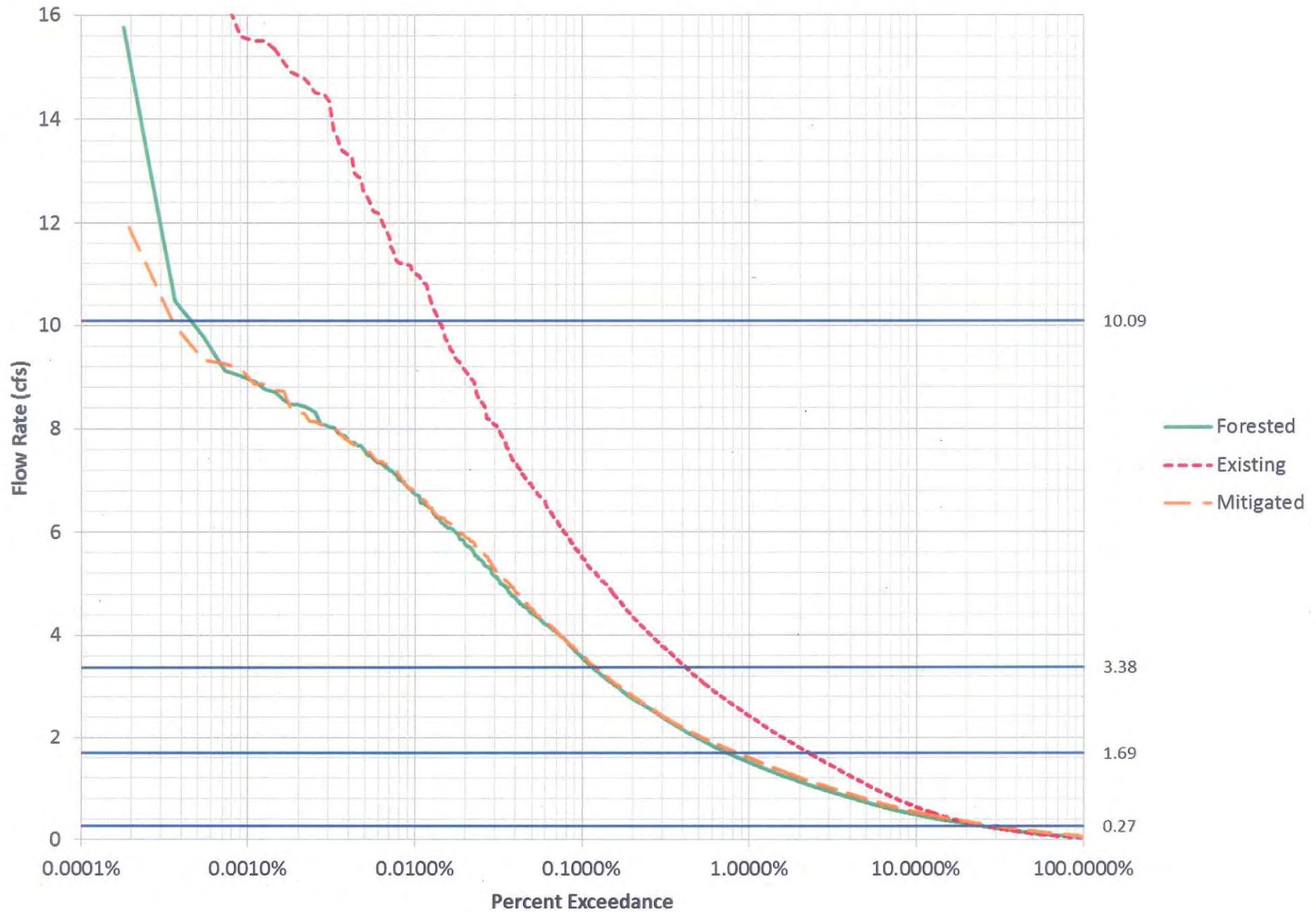
# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3813

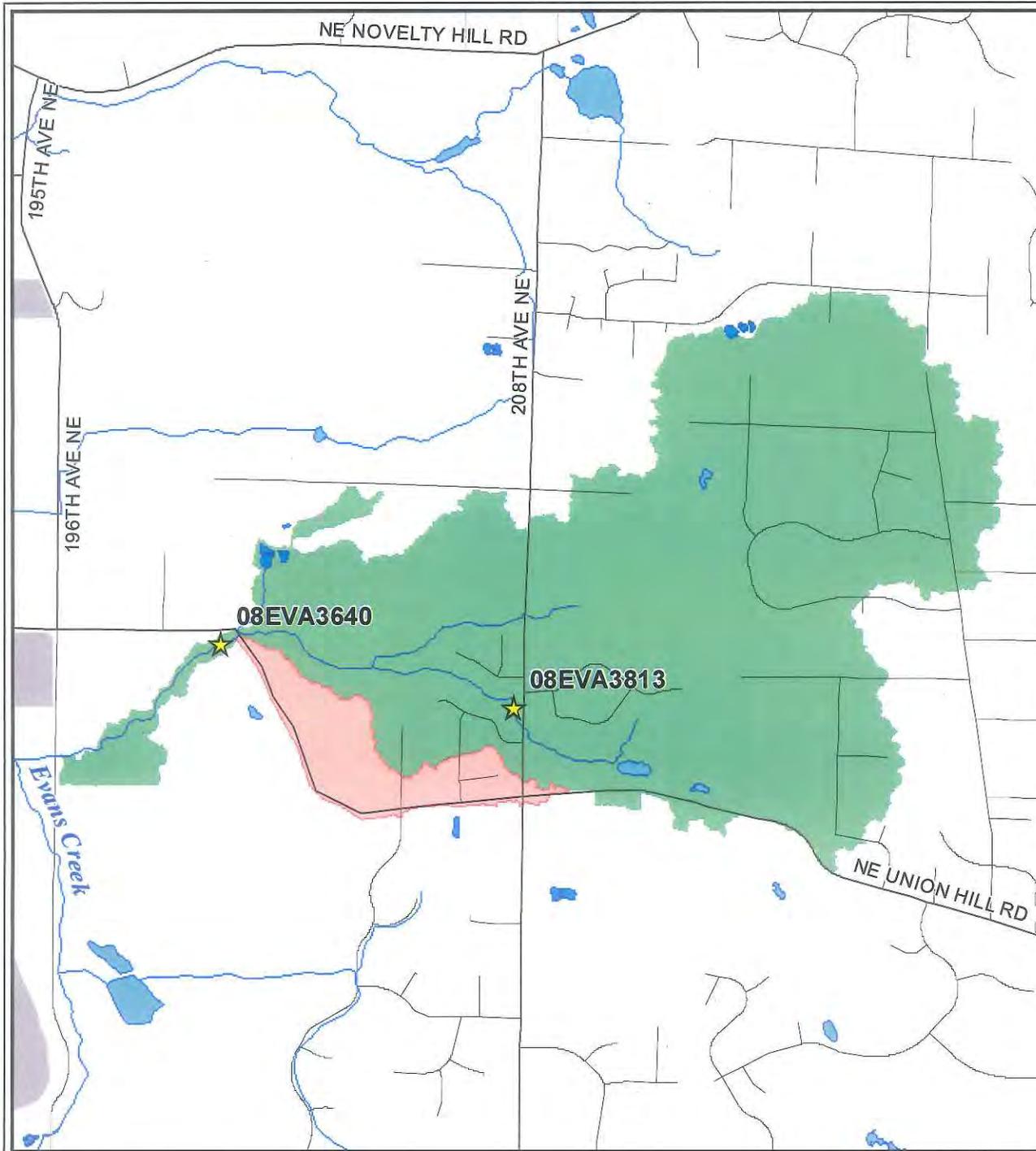


# B-IBI Site 08EVA3813

Flow Control Standard	Mitigation
Minimum Requirement #5 8% to 50% of pre-developed 2-year peak	53.4%
Minimum Requirement #7 50% to 100% of pre-developed 2-year peak	97.7%
Minimum Requirement #7 2-year to 50-year pre-developed peak	99.0%

# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3813

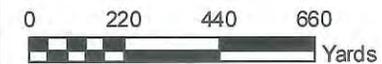




# Evans Creek Tributary 108 HSPF Model Development

## Modifications to Mitigated Scenario

-  B-IBI Site
-  Tributary 108 Basin
-  Basin Area Removed



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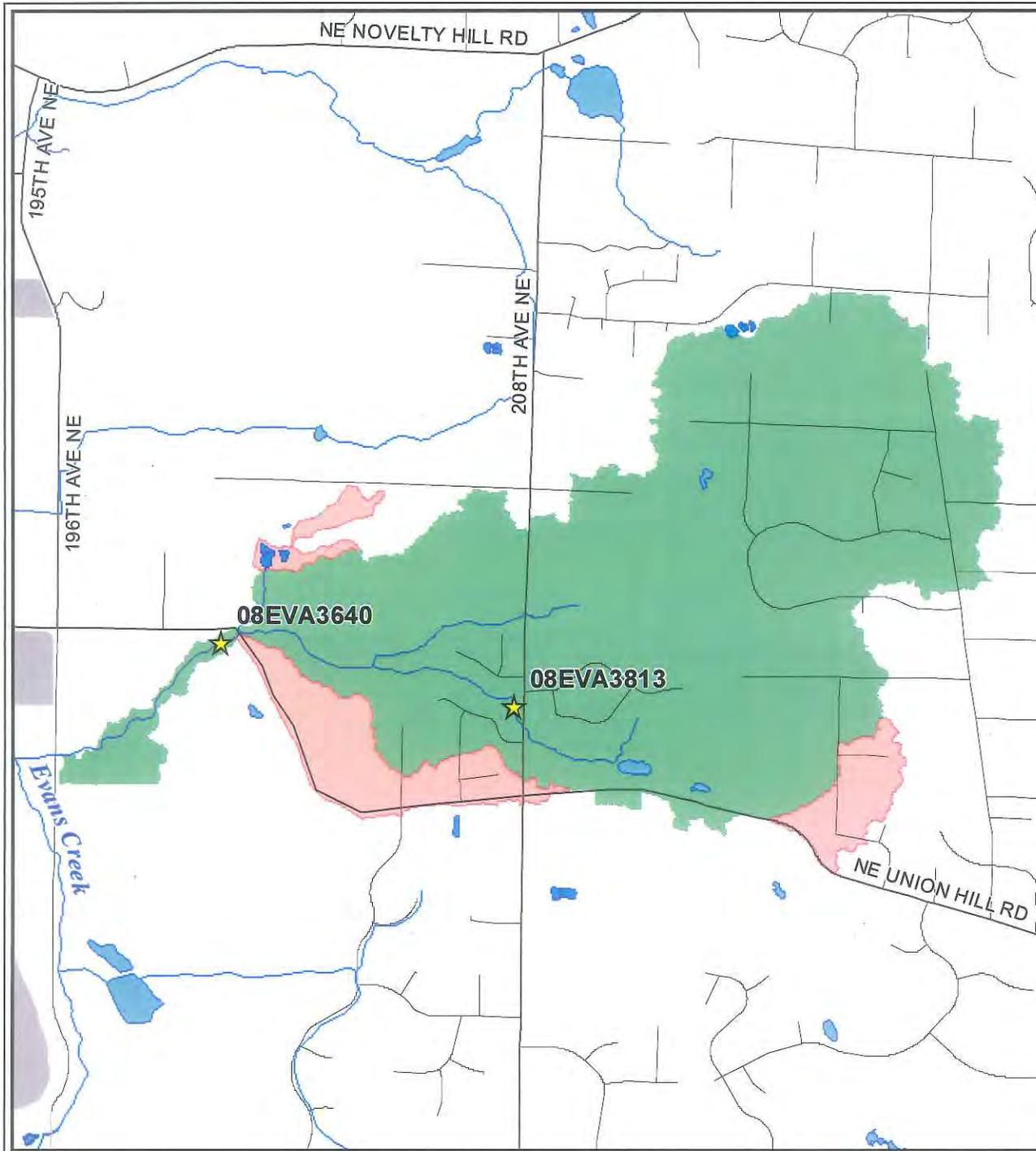
September 23, 2014

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# Evans Creek Tributary 108 HSPF Model Development

## Modifications to Mitigated Scenario

-  B-IBI Site
-  Tributary 108 Basin
-  Basin Area Removed



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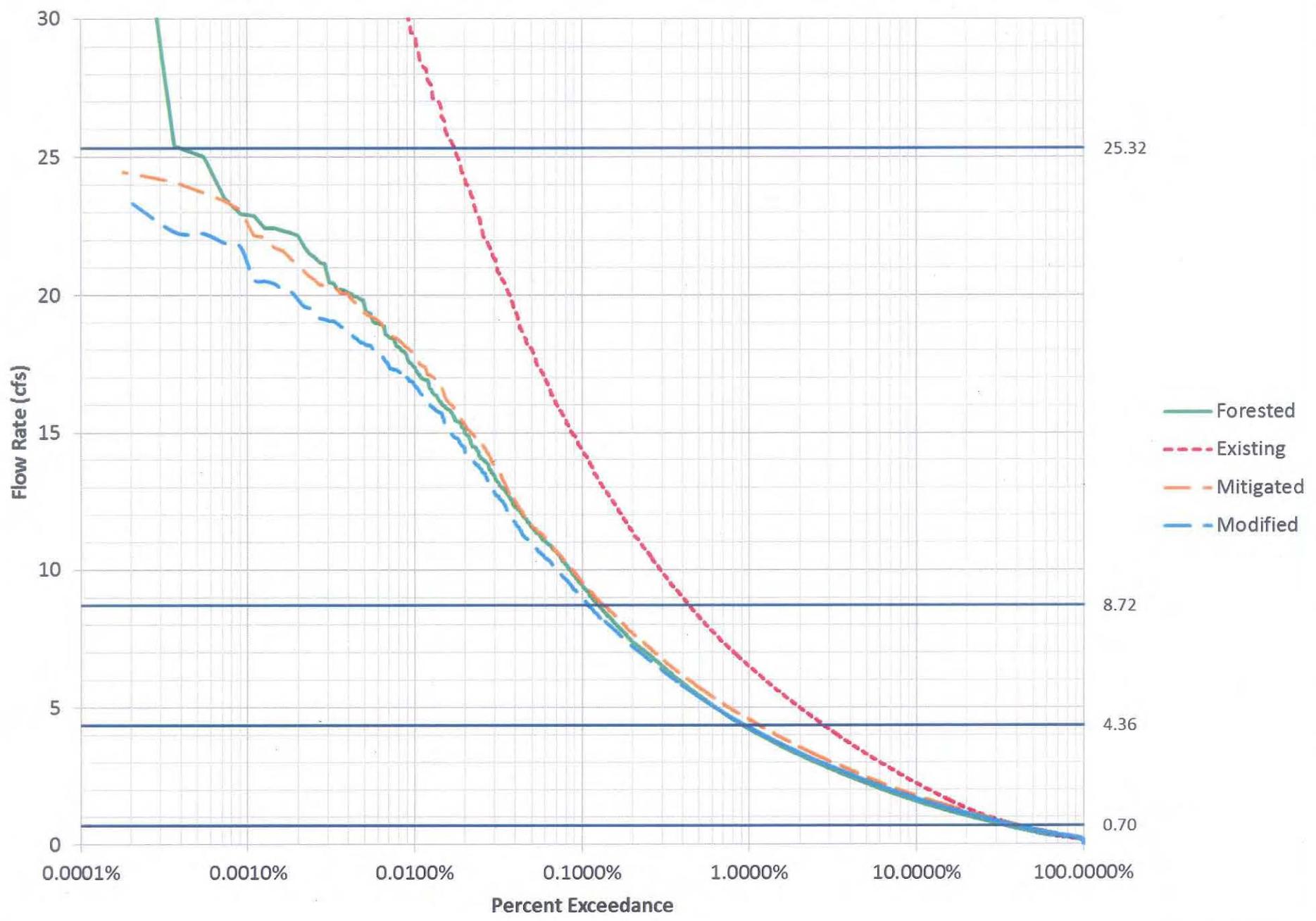
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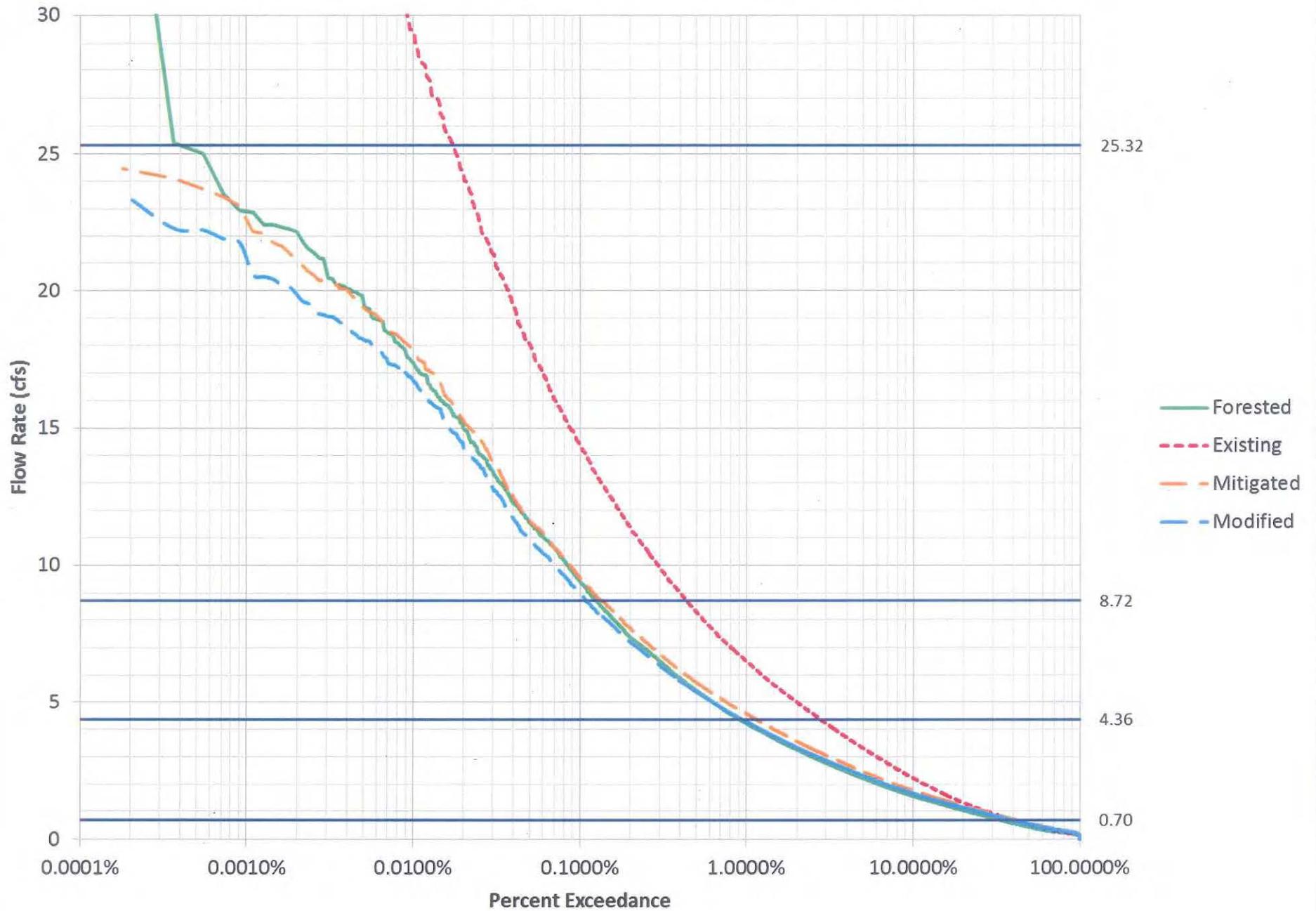
# Flow Exceedance Probability at Upstream Side of Union Hill Road



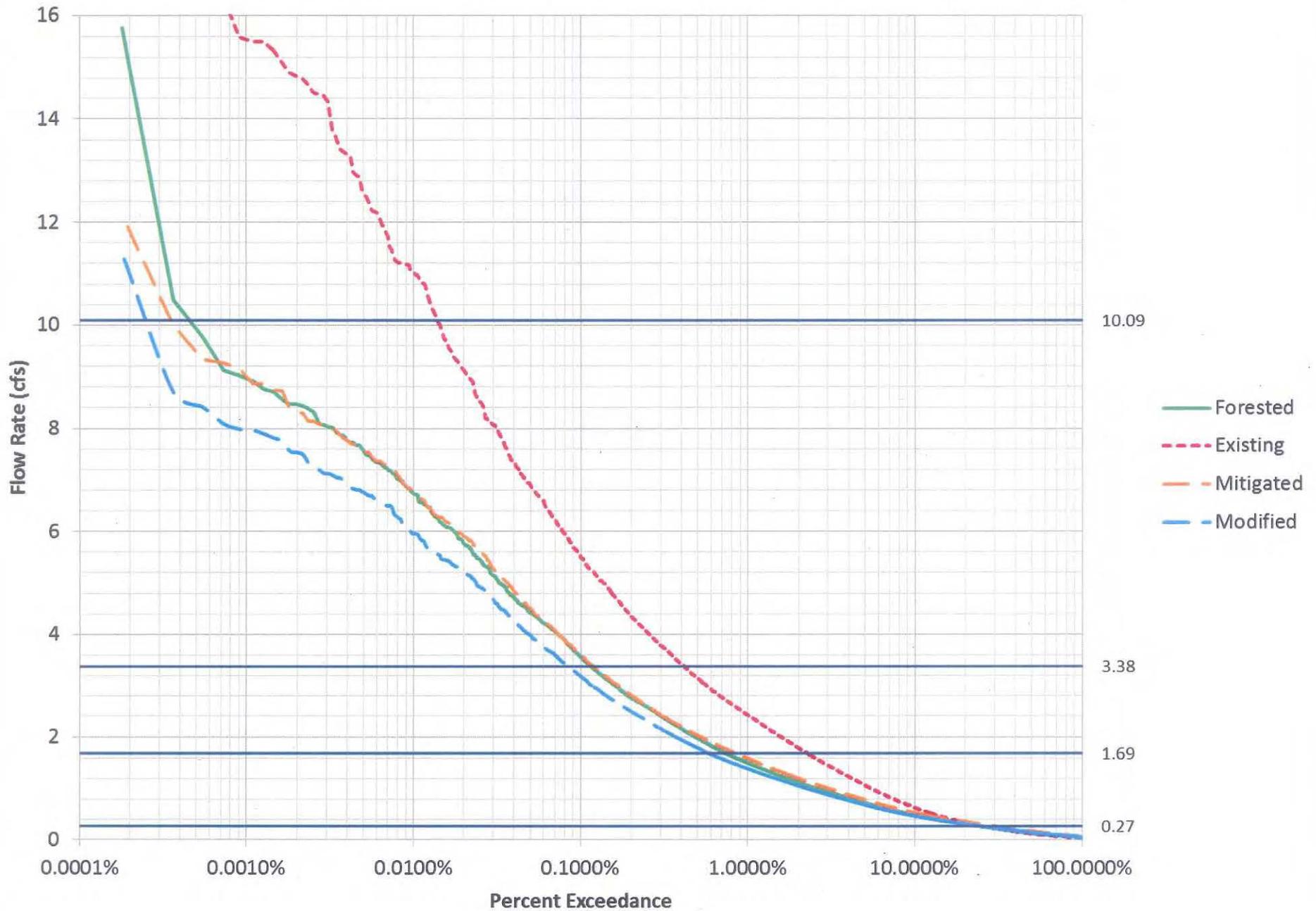
# Above B-IBI Site 08EVA3640

Flow Control Standard	Mitigation
Minimum Requirement #5 8% to 50% of pre-developed 2-year peak	83.5%
Minimum Requirement #7 50% to 100% of pre-developed 2-year peak	102.5%
Minimum Requirement #7 2-year to 50-year pre-developed peak	105.3%

# Flow Exceedance Probability at Upstream Side of Union Hill Road



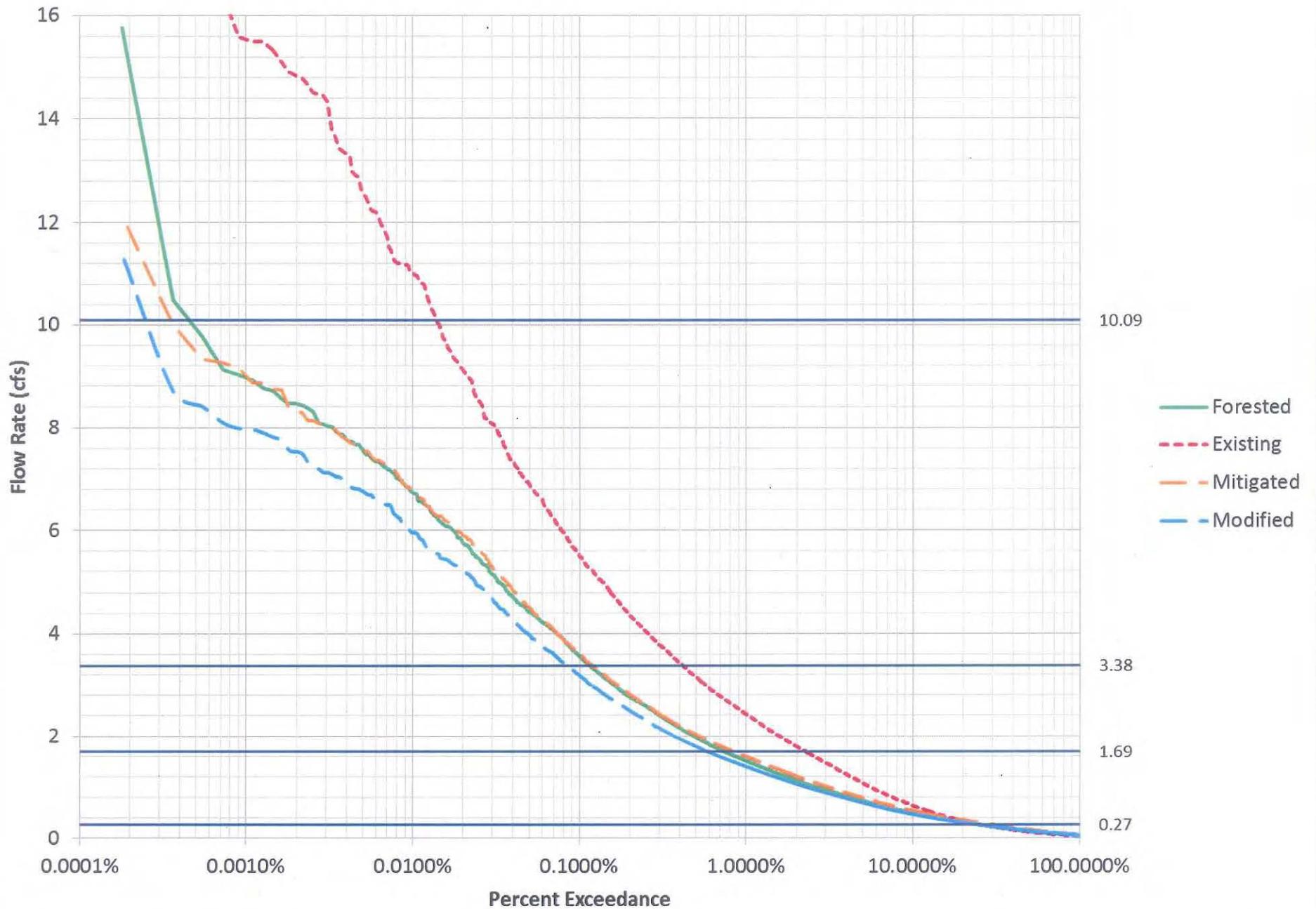
# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3813



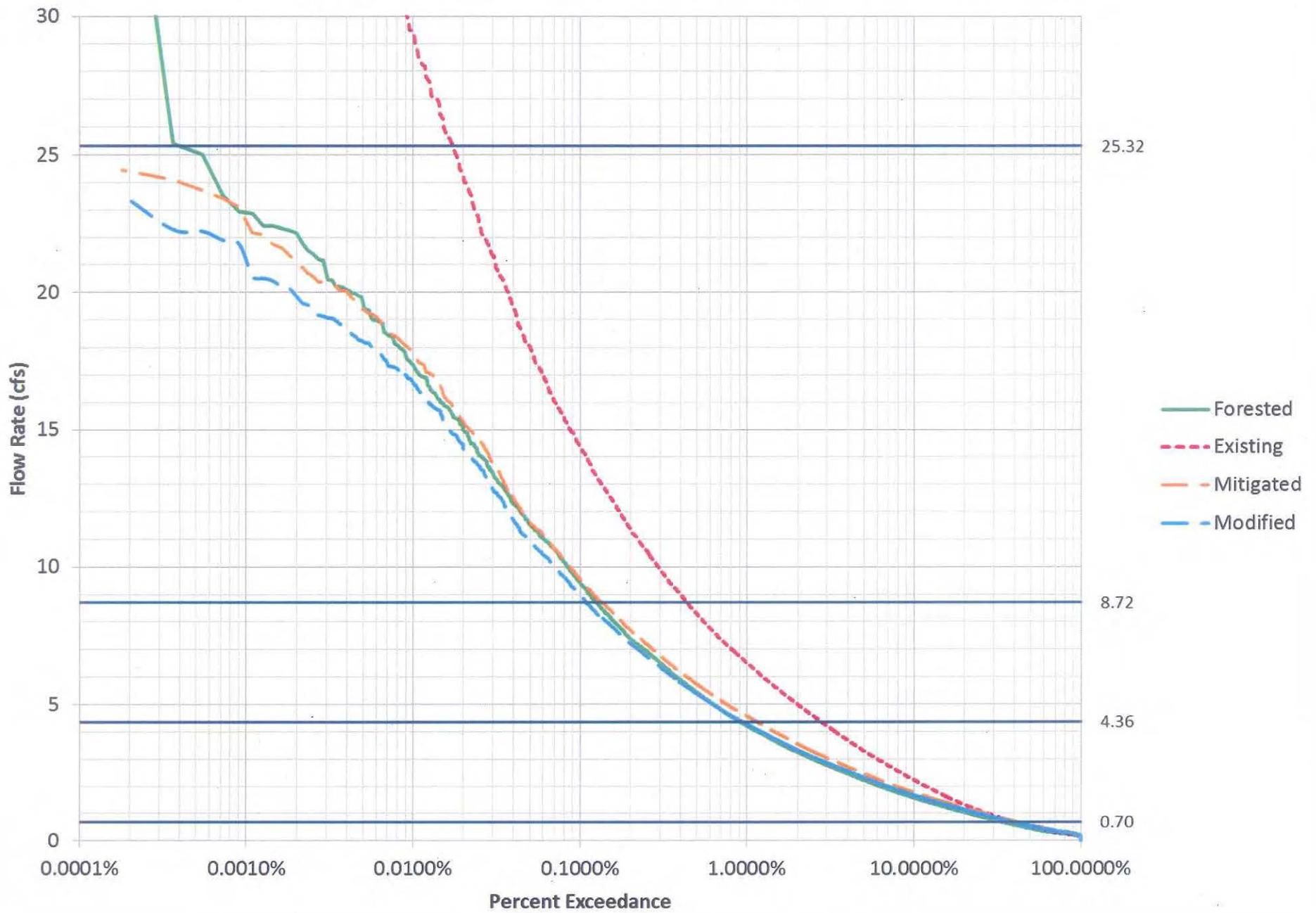
# B-IBI Site 08EVA3813

Flow Control Standard	Mitigation
Minimum Requirement #5 8% to 50% of pre-developed 2-year peak	111.8%
Minimum Requirement #7 50% to 100% of pre-developed 2-year peak	110.6%
Minimum Requirement #7 2-year to 50-year pre-developed peak	108.7%

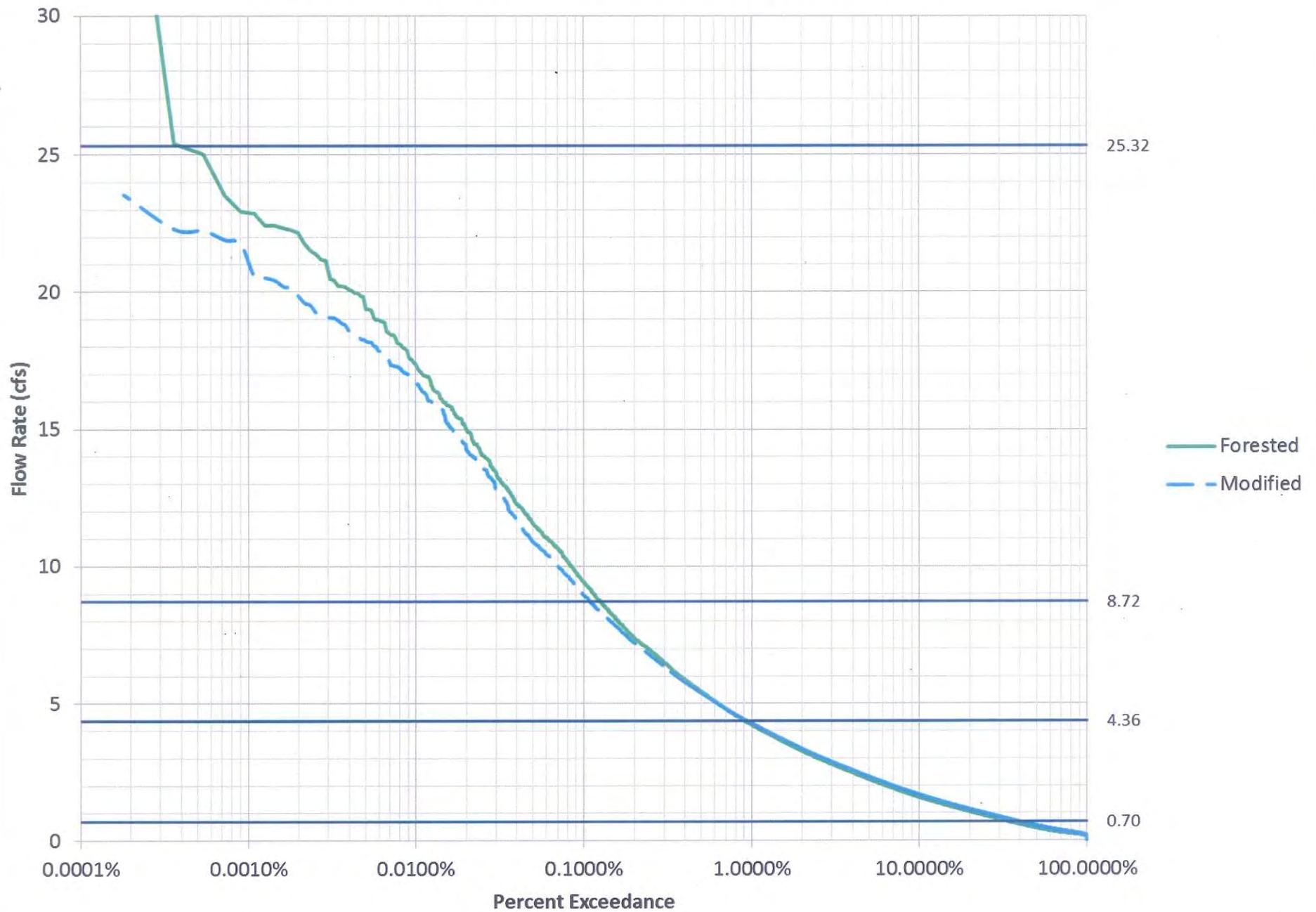
# Flow Exceedance Probability at B-IBI Monitoring Station 08EVA3813



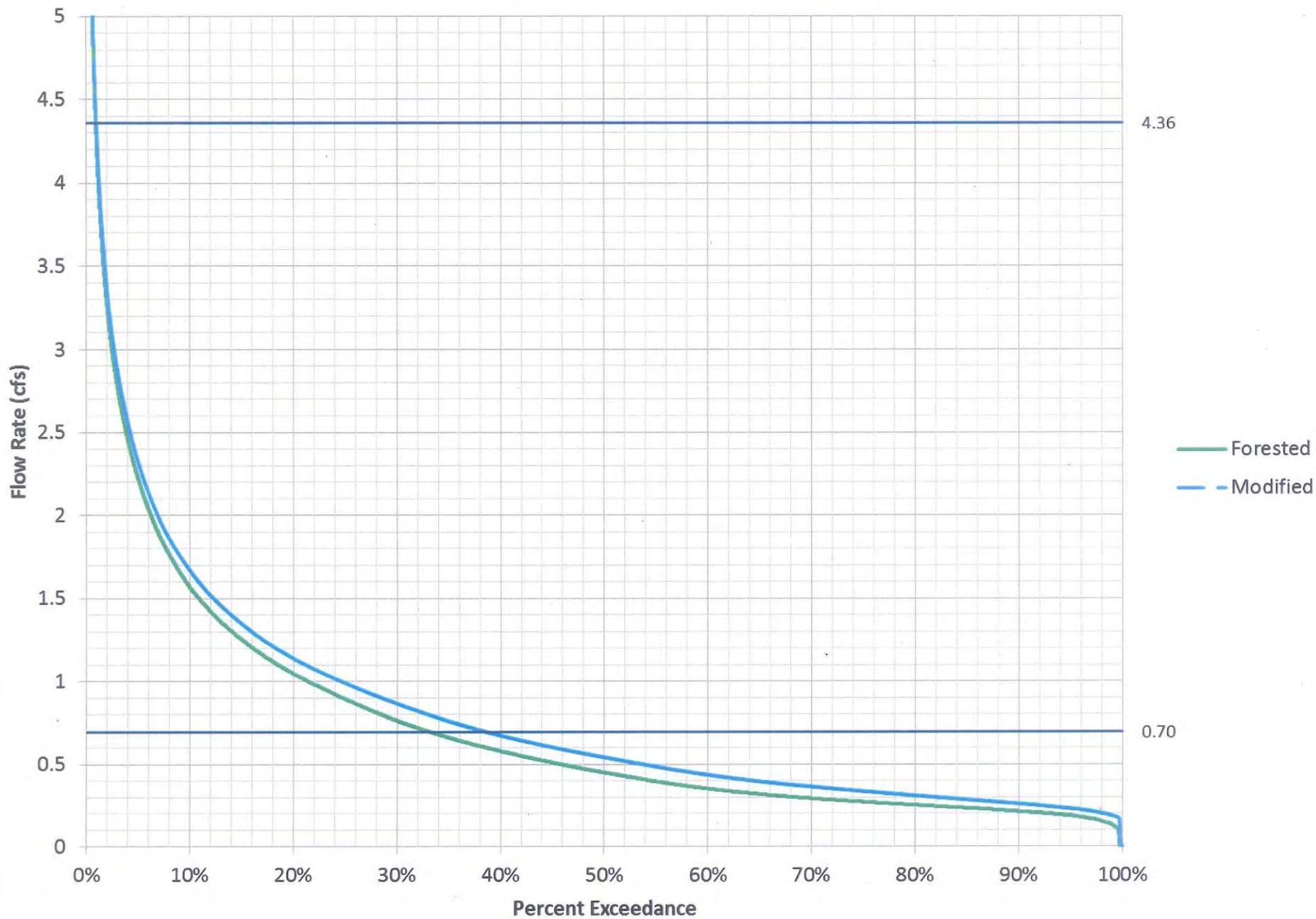
# Flow Exceedance Probability at Upstream Side of Union Hill Road



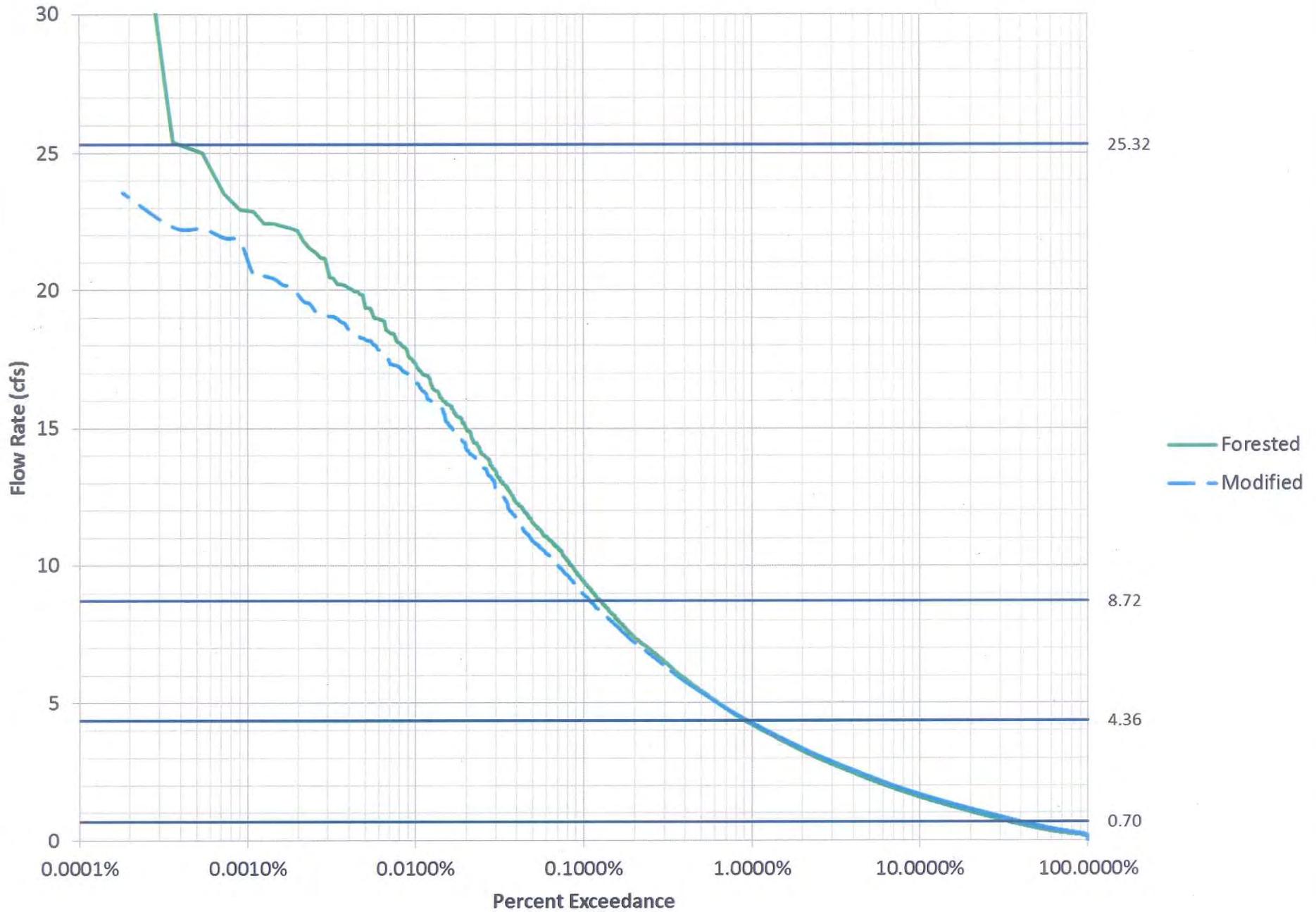
# Flow Exceedance Probability at Upstream Side of Union Hill Road



# Flow Exceedance Probability at Upstream Side of Union Hill Road



# Flow Exceedance Probability at Upstream Side of Union Hill Road





Salmonid Viability: **B-IBI  $\geq$  35** (Karr, Horner, Horner, 2003)



# Evans Creek Tributary 108 Design Approach

## Area Required for 3-Inch Bioretention

-  Subbasin Boundary
-  Minimum Area Required



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June 27, 2014

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# Cost Estimates

- Residential Bioretention Facilities
- Soil Depth and Quality
- Flow Control Vaults
  - Cost scaled to full Tributary 108 basin

# Cost Estimates

- Residential Bioretention Facility
  - Puget Sound Stormwater LID Cost Database
    - Materials and Construction \$30.55/sq.ft.
      - Including design, estimated \$35.00/sq.ft.
    - Maintenance, Annual Cost \$1.22/sq.ft.
  - 500 square foot bioretention facility
    - Serves 2,000 square feet of impervious
      - \$17,000 for materials, construction and design
      - \$610 for maintenance annually

# Cost Estimates

- Soil Depth and Quality
  - \$0.93 per square foot
    - 1997 figures adjusted for inflation
    - Prepared for Redmond Public Works
  - 8,890 square feet
    - Quarter acre lot, cleared
    - 2,000 square feet impervious surface
  - \$8,223

# Cost Estimates

## Two Detention Vaults in Two Small Subbasins

Earthwork	\$	14,958
Drainage	\$	110,650
Temporary Erosion Control	\$	7,000
Traffic Control	\$	4,000
<b>SubTotal</b>	<b>\$</b>	<b>136,608</b>
Mobilization (15% of SubTotal)	\$	20,491
Sales Tax	\$	14,610
Construction Changes (min 10%)	\$	15,710
<b>Total</b>	<b>\$</b>	<b>187,419</b>

# Cost Estimates

- Cost Scaled to Evans Creek Tributary 108 Basin
  - 434 acre basin – 37.2% forest & 16.4% impervious
  - Cost of detention vault installation only
  - Scaled from two small subbasins
- Scaled by cost per area of impervious surface  
\$11.3M
- Scaled by cost per area of developed land  
\$22.8M

# Purpose

- Solicit feedback on
  - project's basin selection
  - system design approach
  - use of M.R. #5 & #7 as the basin discharge goal
- Engage in open discussion on
  - system cost estimates
  - retrofit implementation challenges and costs
  - public support for retrofitting in general based on its financial implications

# Contact Info

**Claire Jonson, Project Manager**

claire.jonson@kingcounty.gov

206-477-4720

**Scott Miller, Project Engineer**

scott.miller@kingcounty.gov

206-477-4779

**Dale Nelson, Project Engineer**

dale.nelson@kingcounty.gov

206-477-4785

# Design Considerations

- Some subbasins do not have enough public land available to construct facilities.
  - LID elements are assumed to be distributed throughout each subbasin
  - Promote construction and maintenance of LID elements by property owners
  - Provide extra storage in neighboring subbasins to meet ECY8% standard at points of compliance

# Design Considerations

- LID implementation to be required under redevelopment standards may take several decades to become a basin wide system
  - Design proposed flow controls to handle flows expected in the interim