Bear Creek Watershed-scale Stormwater Management Plan: Water Quality Status and Trends

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Science Seminar

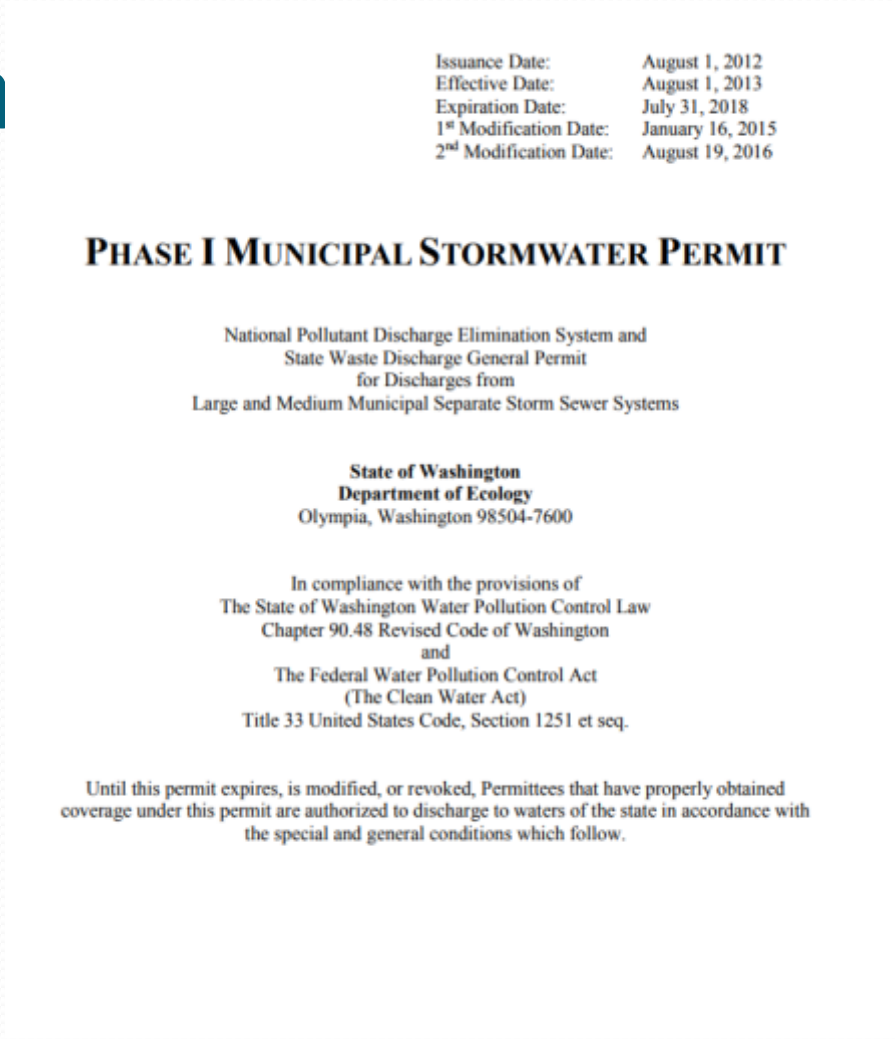
November 2, 2017

Department of Natural Resources and Parks
Water and Land Resources Division

King County

Watershed-scale Stormwater Management Plan

- Requirement for the NPDES Phase I Municipal Stormwater Permit
- King County is leading the development of the plan



Issuance Date: August 1, 2012
Effective Date: August 1, 2013
Expiration Date: July 31, 2018
1st Modification Date: January 16, 2015
2nd Modification Date: August 19, 2016

PHASE I MUNICIPAL STORMWATER PERMIT

National Pollutant Discharge Elimination System and
State Waste Discharge General Permit
for Discharges from
Large and Medium Municipal Separate Storm Sewer Systems

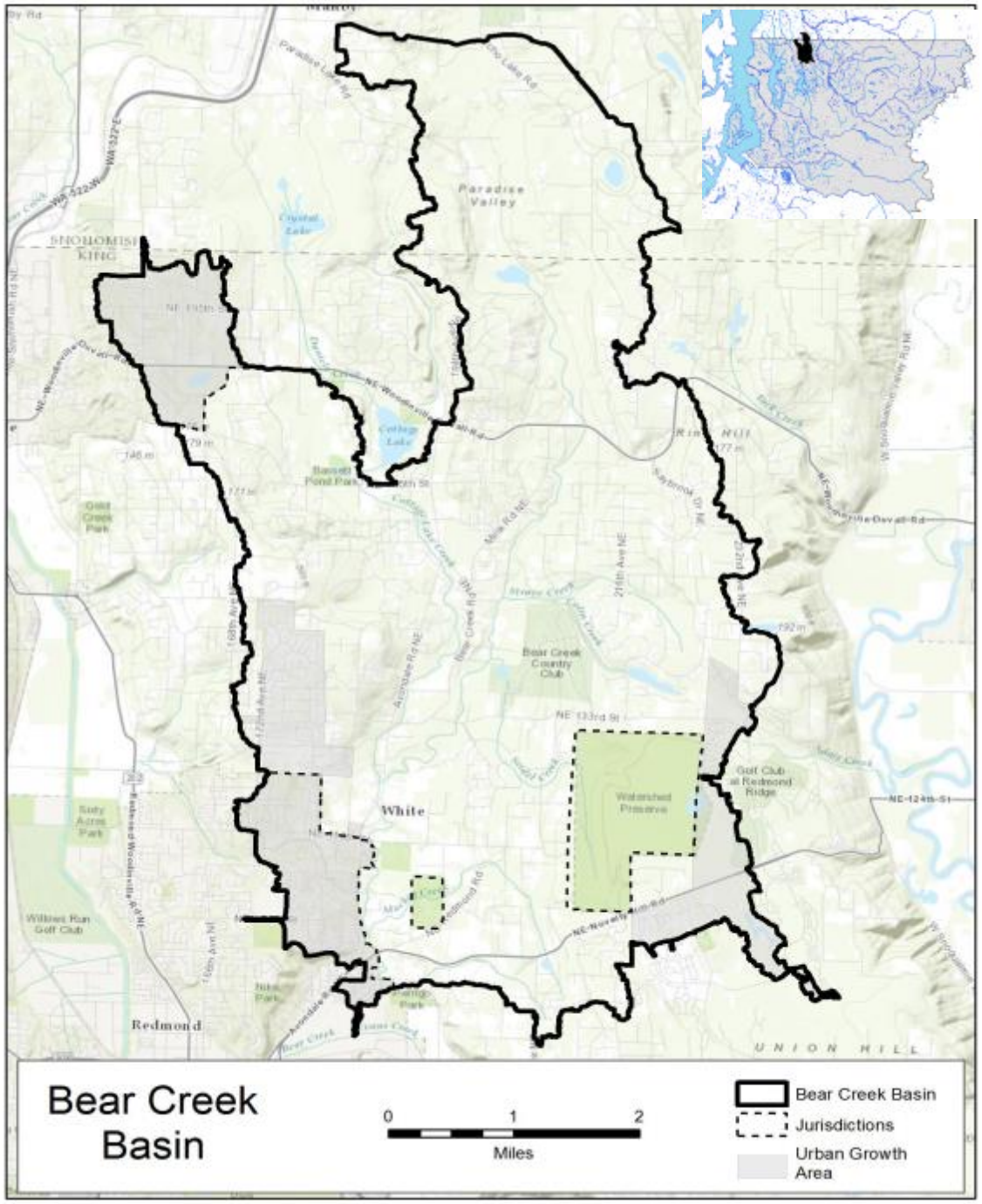
State of Washington
Department of Ecology
Olympia, Washington 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Until this permit expires, is modified, or revoked, Permittees that have properly obtained coverage under this permit are authorized to discharge to waters of the state in accordance with the special and general conditions which follow.

Bear Creek Watershed* and Partners

- King County (Lead)
- Snohomish County
- City of Redmond
- City of Woodinville
- WSDOT



Plan Goals & Objectives

Watershed Conditions

- Mostly built before modern stormwater standards
- Redevelopment pressures
- High quality, but has known WQ problems

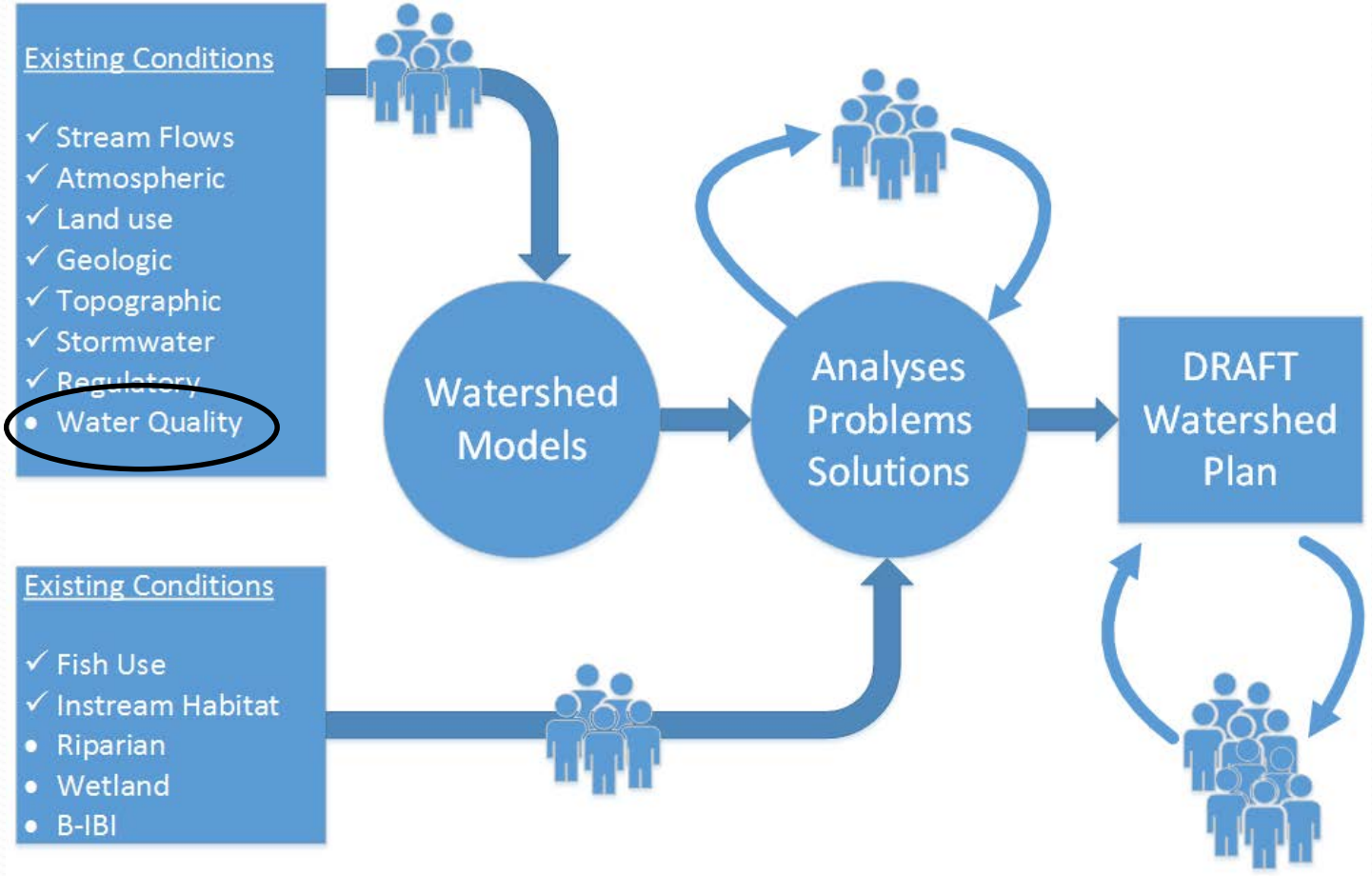
Goal

- Restore Bear Creek so that it provides healthy aquatic habitat for Chinook salmon and other species now and into the future.

Primary Objective

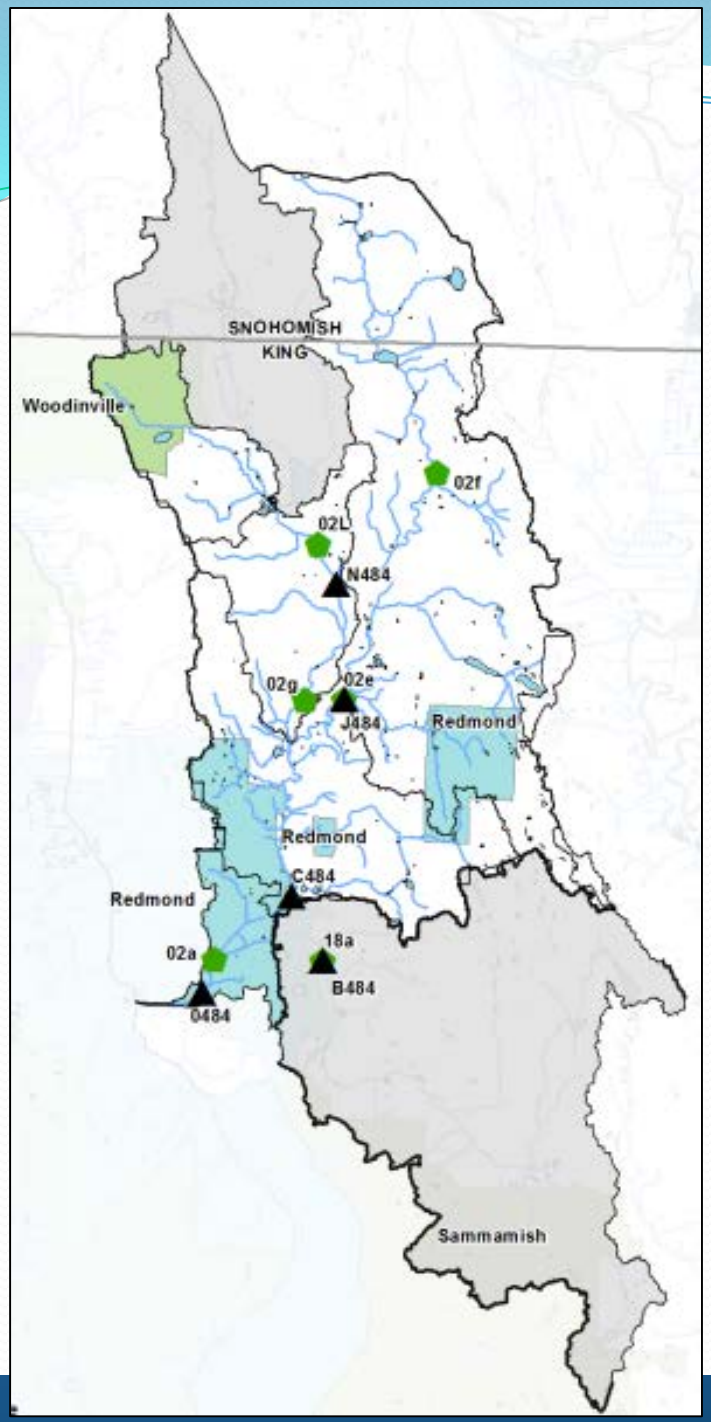
- Identify a stormwater management strategy or strategies that would result in hydrologic, water quality, and stream channel habitat conditions that fully support *existing* and *designated uses.*

Watershed-scale Stormwater Plan



Long-term Trends

Long-term monitoring in Bear Creek



- 5 sites used for long-term water quality
- 6 sites used for continuous temperature data

Legend

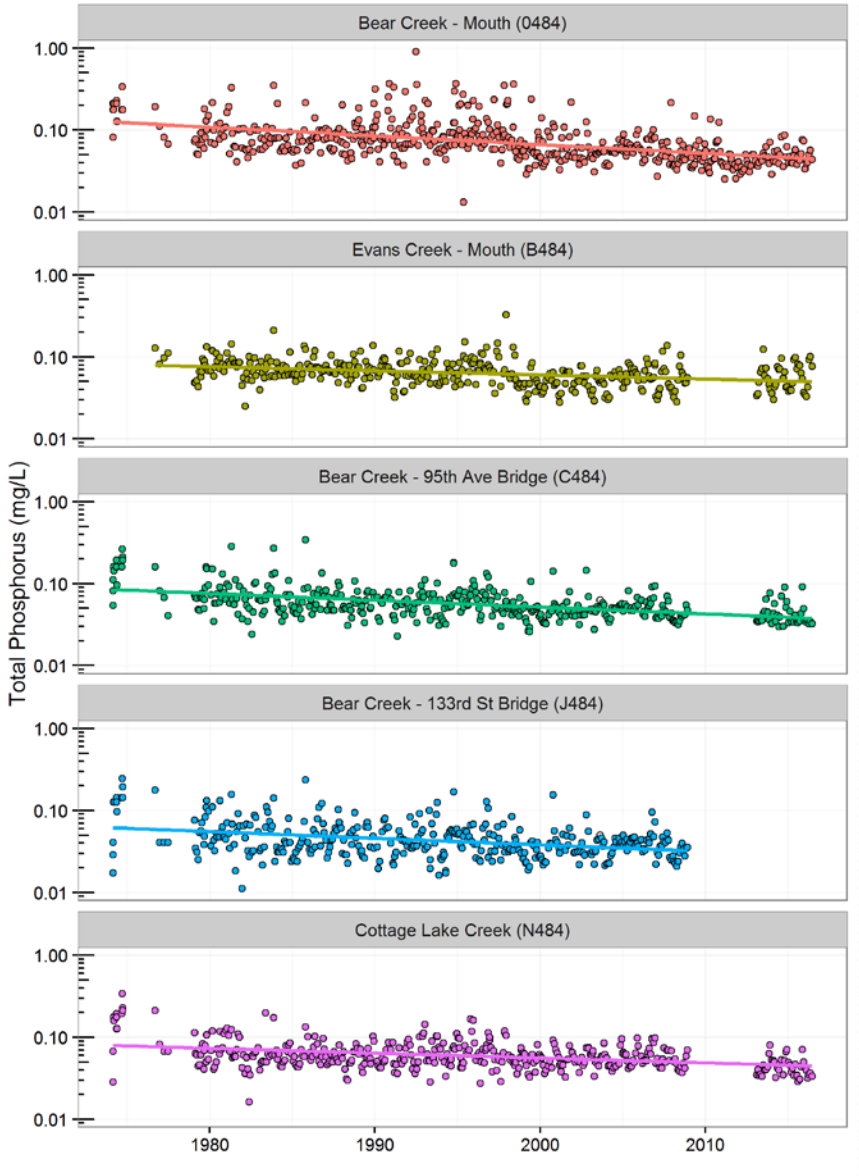
- Long-term water quality sites
- Continuous temperature sites
- Area outside Basin Plan study area
- Local jurisdictions

Trend Results

+ Bacteria is improving (90% decline at mouth from 1975 – 2015)
- Temperature is increasing (0.3 to 0.6 °C per decade)
- Dissolved oxygen is decreasing (0.1 to 1 mg/L per decade)
  - Big decrease at Evans Creek
+ Nutrients are decreasing (20-70% decreases)

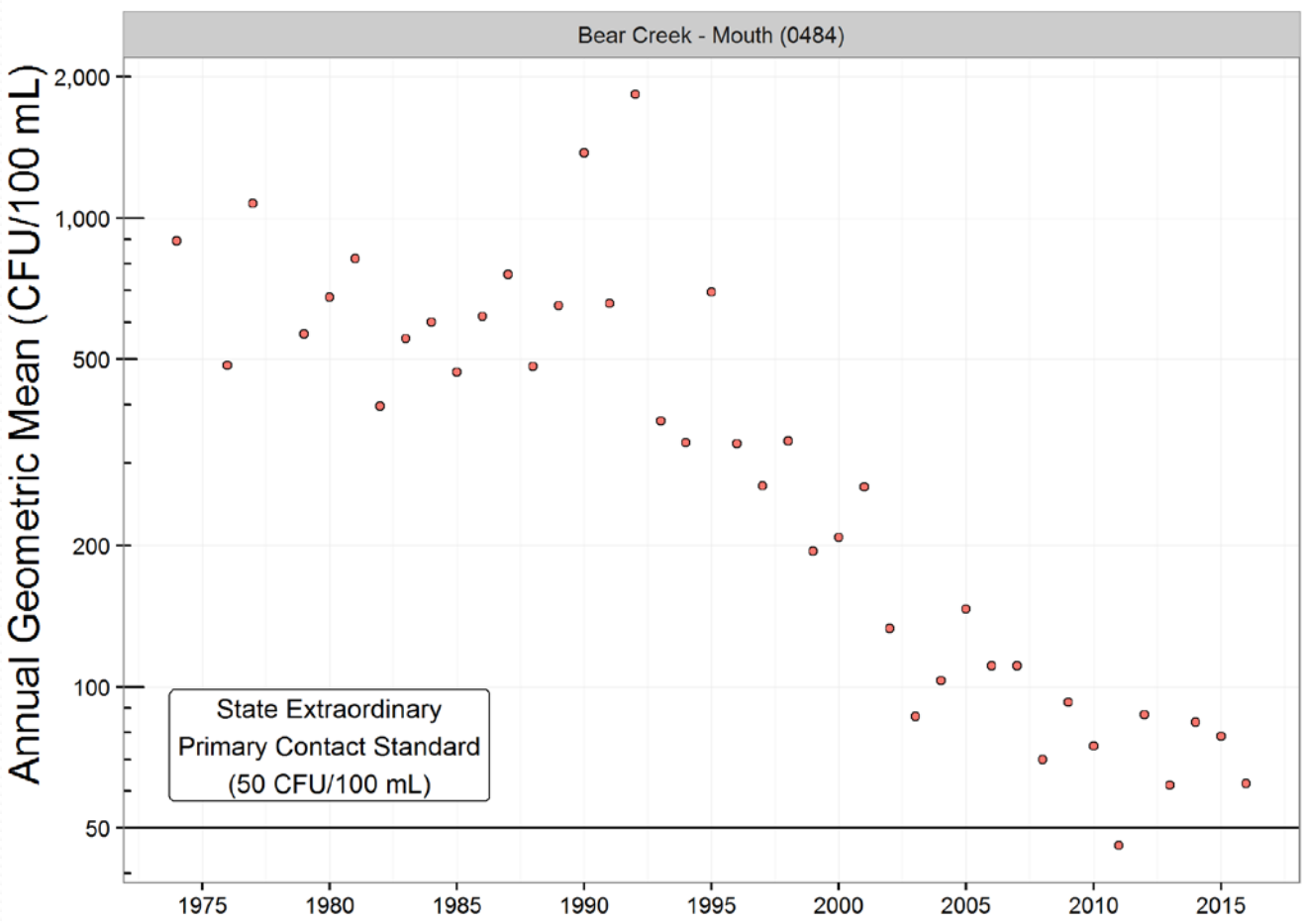
Parameter	Bear Creek @ Redmond (0484)	Bear Creek @ 95th Ave Bridge (C484)	Bear Creek @ 133rd Ave Bridge (J484)	Cottage Lake Creek @ Tolt Pipeline (N484)	Evans Creek @ Union Hill Rd (B484)
Fecal Coliform	↘	↘	↘	↘	↘
Temperature	↗	↗	↗	↗	↗
Dissolved Oxygen	–	↘	↘	↘	↘
pH	–	↗	–	–	↘
Conductance	↗	↗	↗	↗	↗
Total Suspended Solids	↘	↘	↘	↘	↘
Turbidity	–	↗	–	–	–
Total Phosphorus	↘	↘	↘	↘	↘
Ortho-phosphorus	↘	↘	↘	↘	↘
Total Nitrogen (1993 forward)	↘	↘	↘	–	–
Ammonia	↘	↘	–	–	↘
Nitrate + Nitrite	↘	–	↘	–	↘

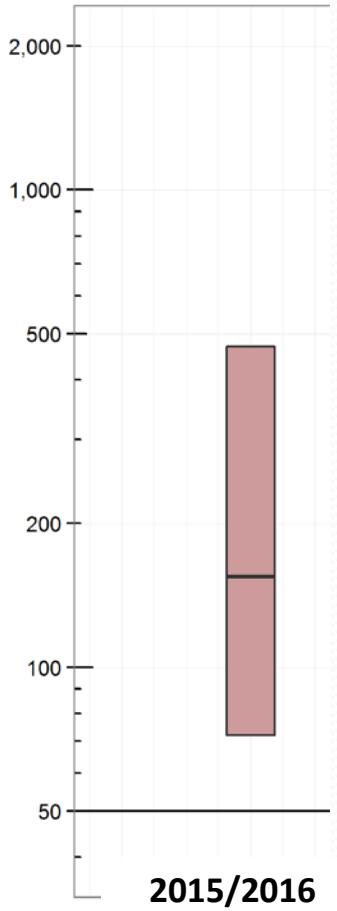
Nutrients are decreasing over time



- Phosphorus at all sites (30 to 60%)
- Nitrogen at some sites
  - 70% NO3 at Evans
  - 61% NH4 at Bear mouth

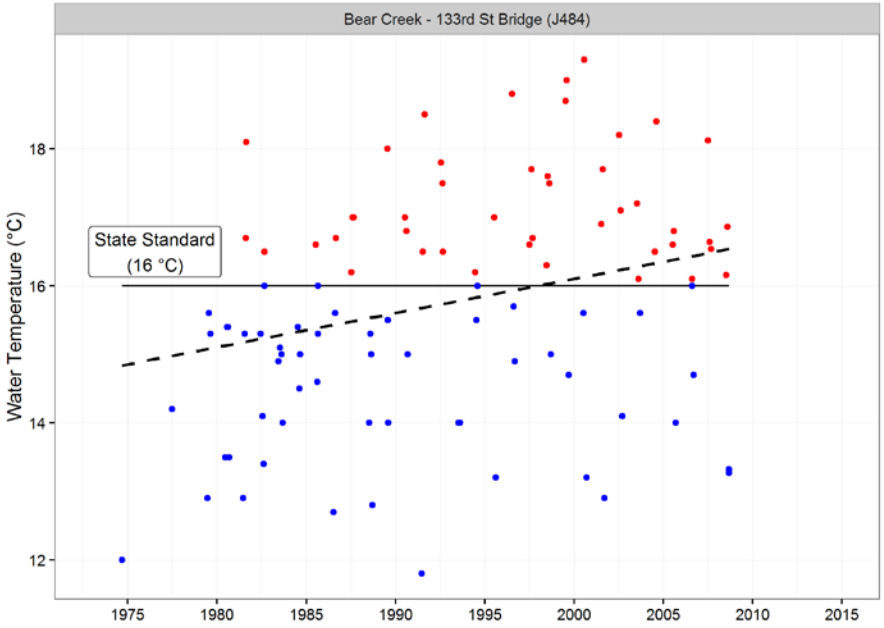
Fecal coliforms have decreased but still above standard



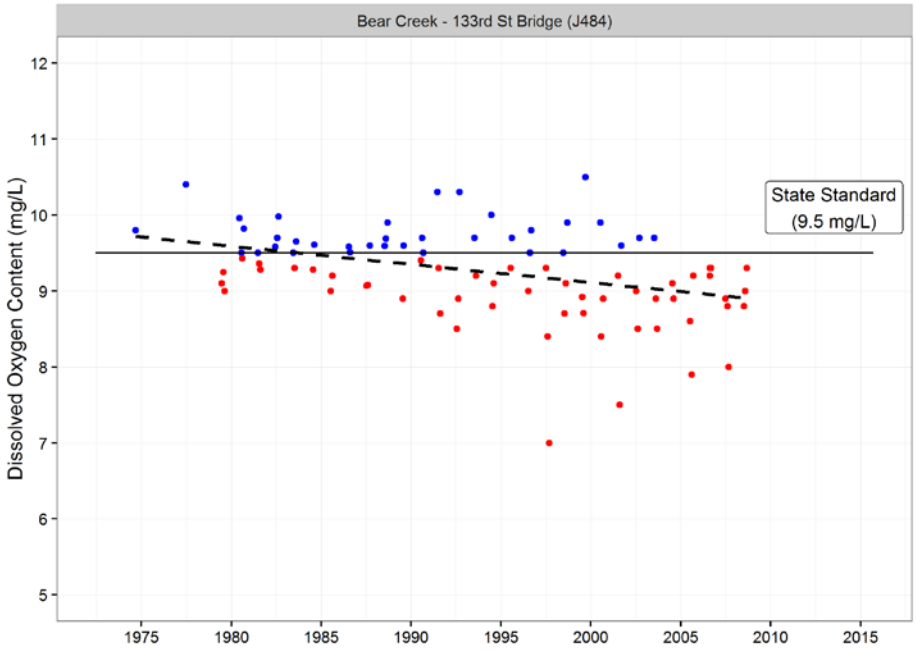


2015/2016 Bacteria Range Area-Wide

Temperature and DO getting worse



Increased frequency and magnitude of state standards violations for temperature

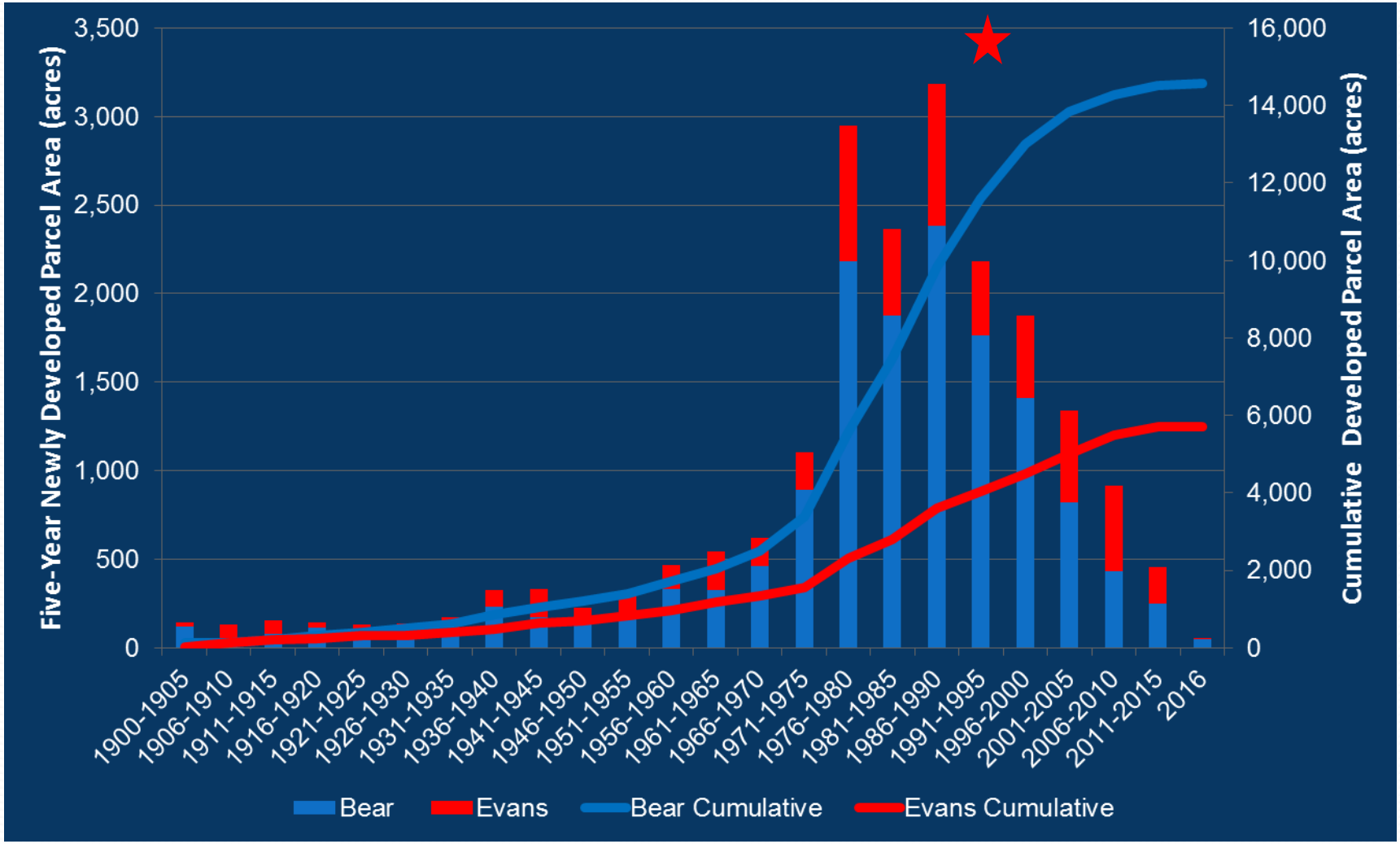


Increased frequency and magnitude of state standard violations for dissolved oxygen

What's Driving Long-term Trends?

- **Why** is water quality **improving**? (nutrients, fecals)
  - Land use change? (agriculture -> suburbs/forest)
  - Bacteria TMDL Implementation?
  - Stream stewardship? (livestock exclusion)
  - Land use regulations?
  - Probably **all of the above**
- **Why** are **temperature** and **dissolved oxygen getting worse**?
  - Riparian **deforestation**?
  - **Decreased** cool, **groundwater** input?
  - Increased **organic matter** loading from wetlands in **Evans Creek**?

Urbanization over Time



Time

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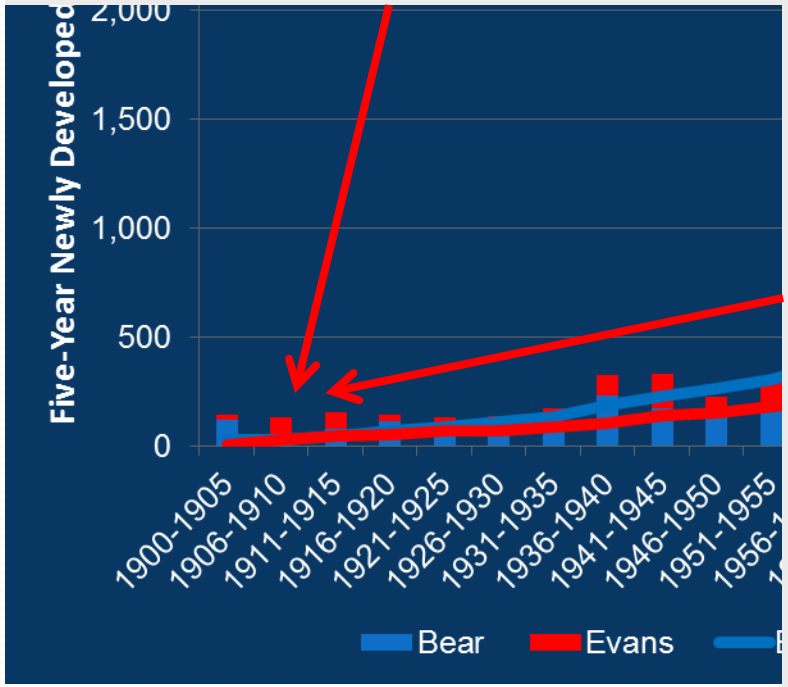

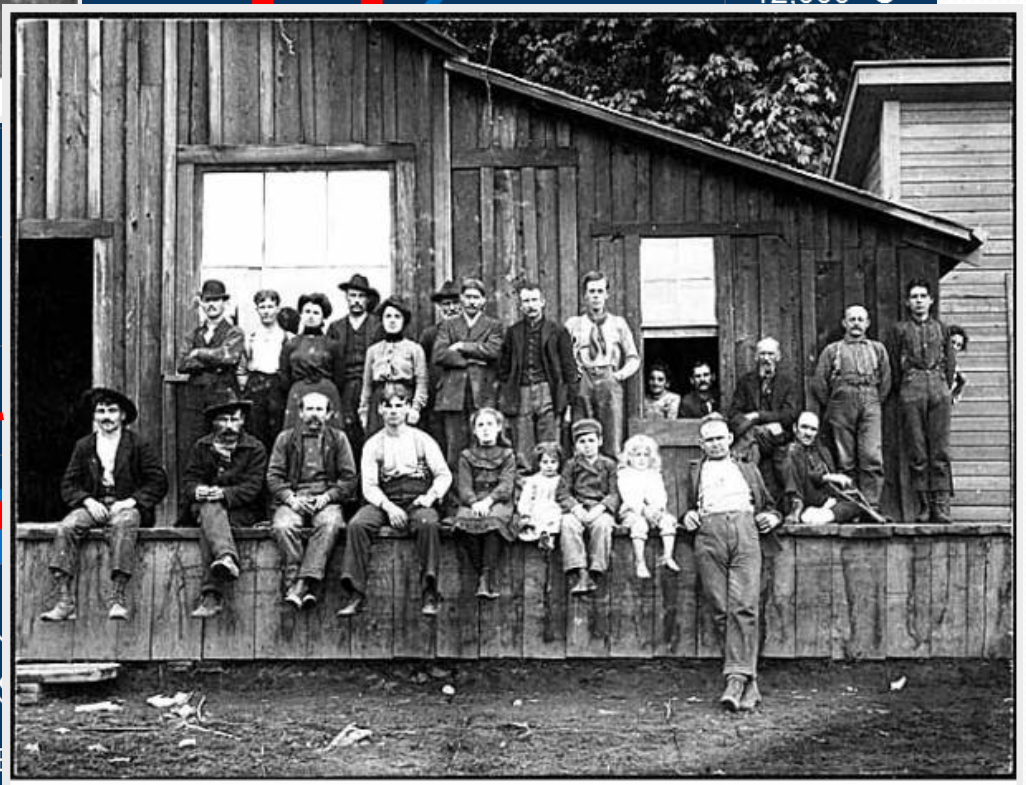

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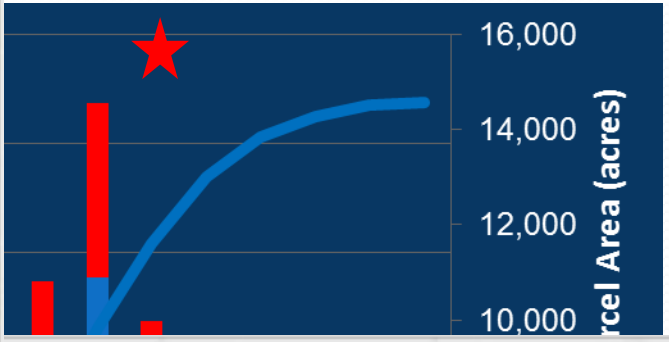

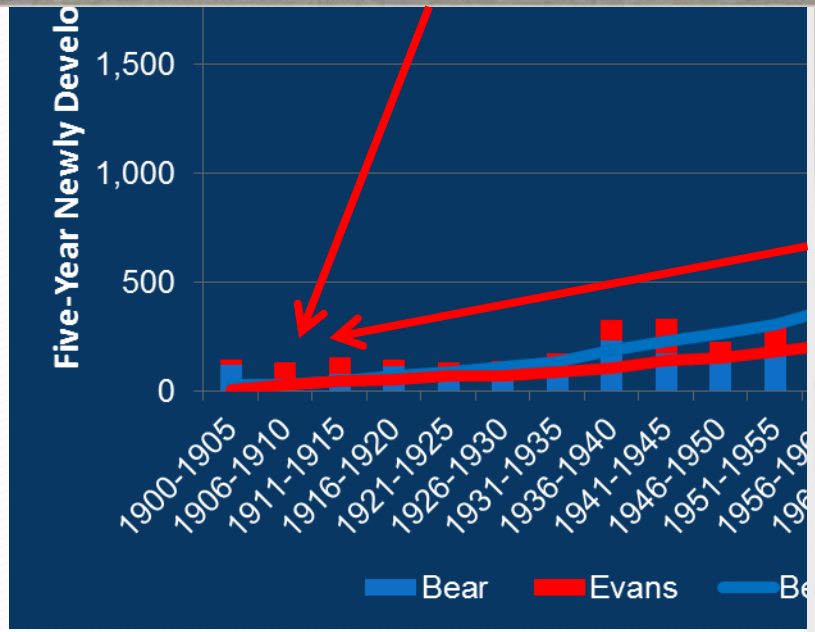

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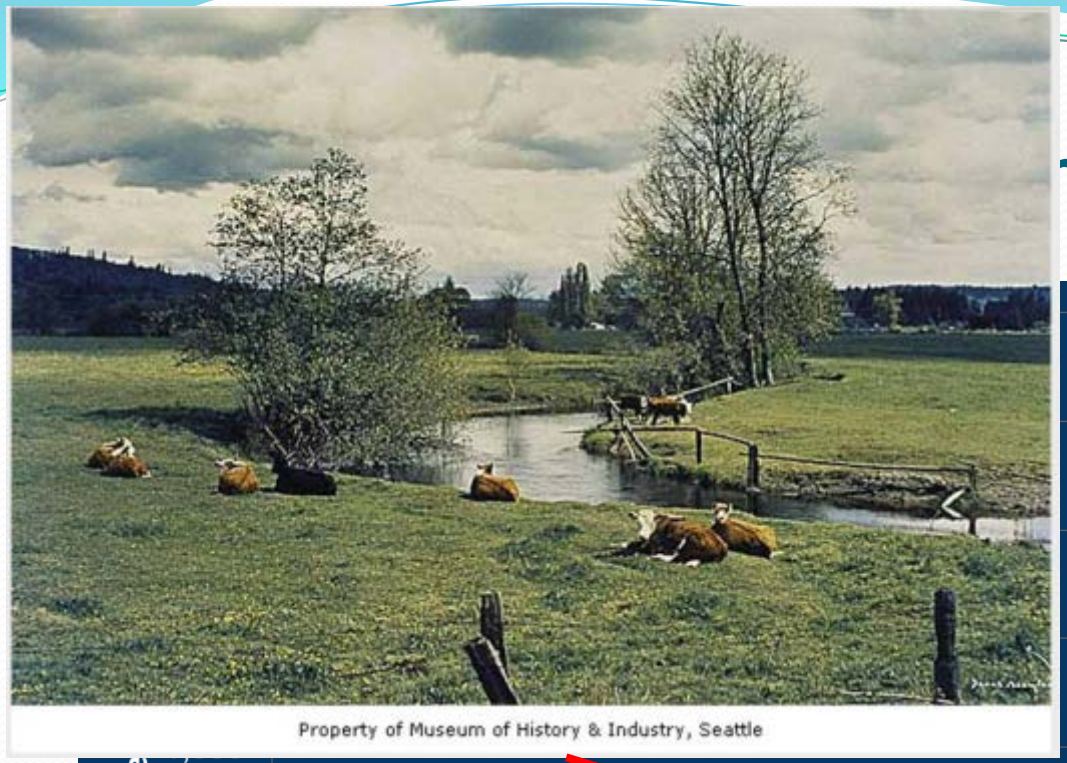

Property of Museum of History & Industry, Seattle

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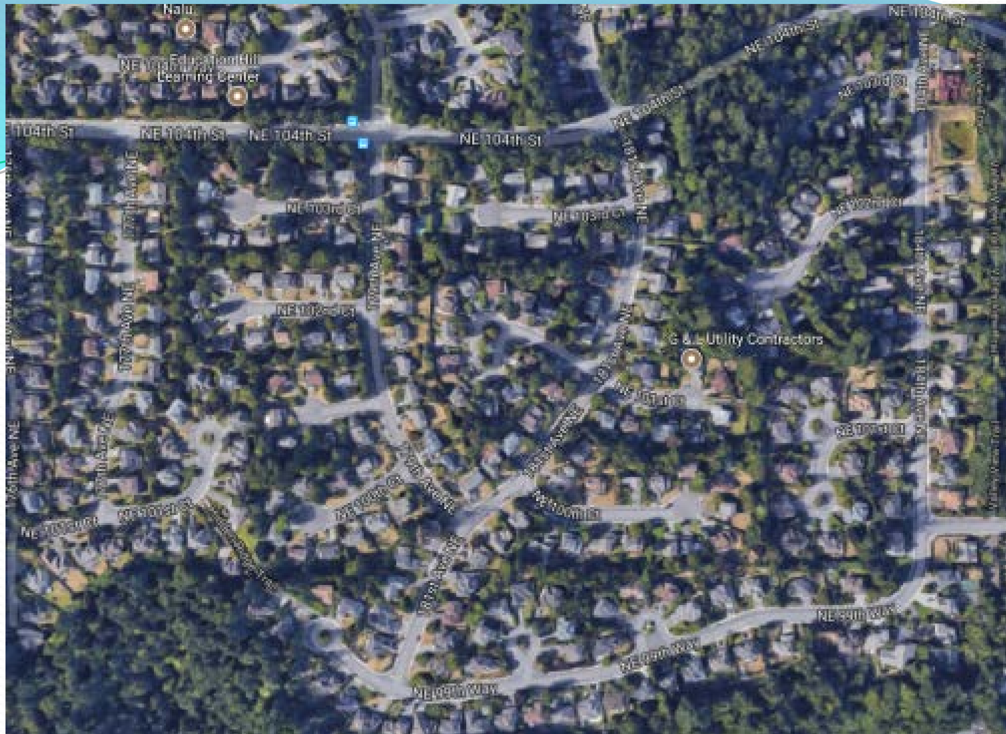

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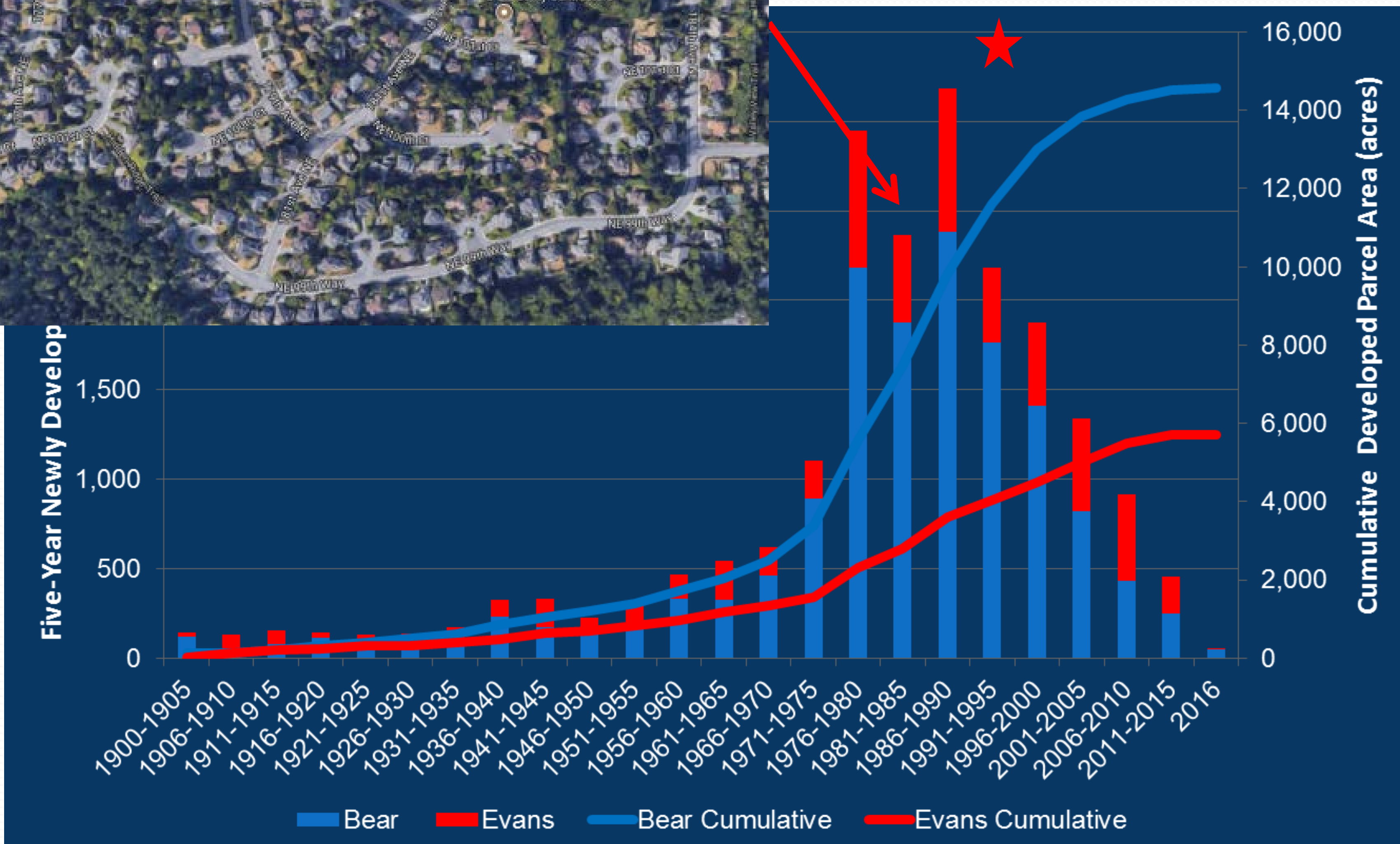
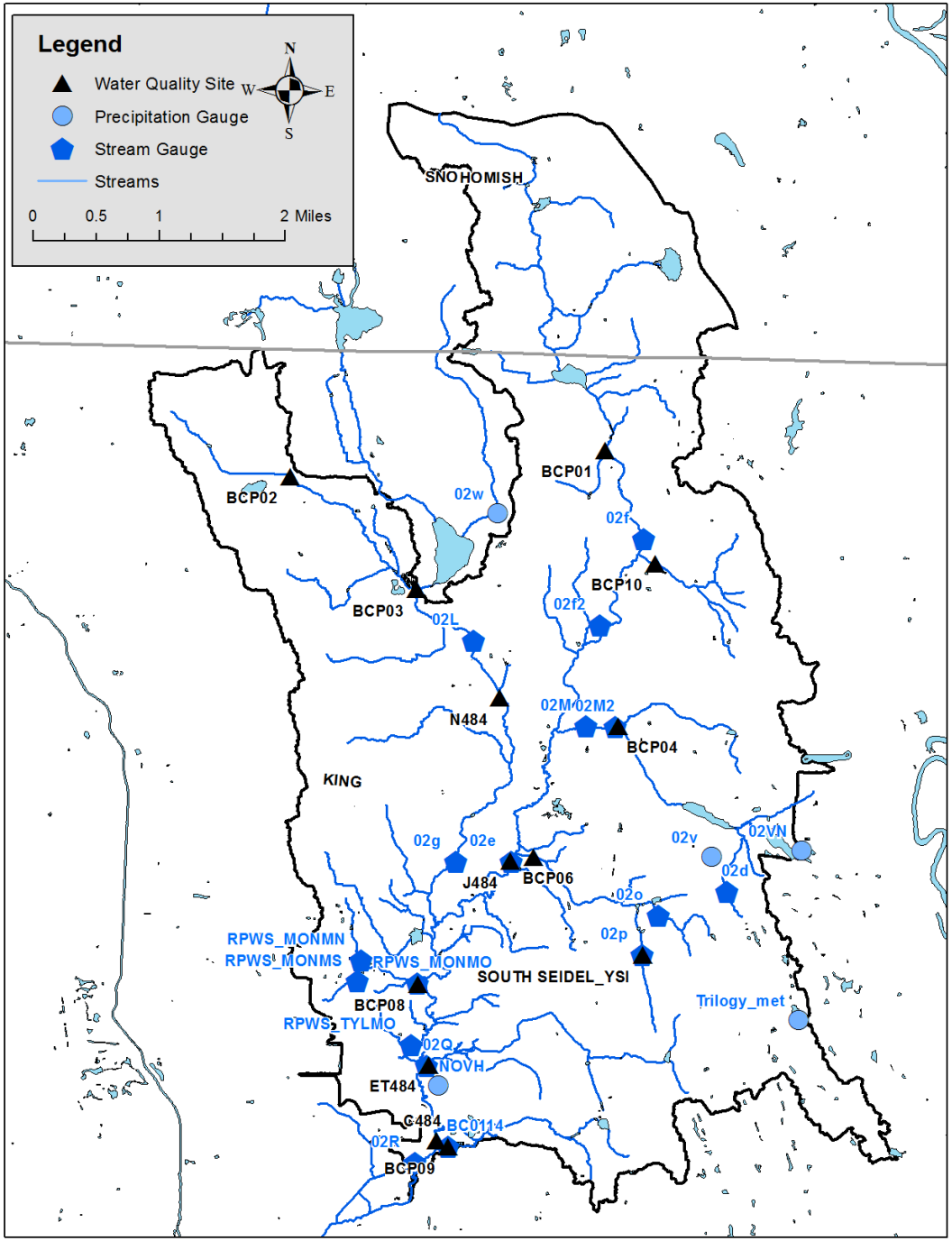


Five-Year Newly Develop
0
500
1,000
1,500
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Cumulative Developed Parcel Area (acres)
1900-1905
1906-1910
1911-1915
1916-1920
1921-1925
1926-1930
1931-1935
1936-1940
1941-1945
1946-1950
1951-1955
1956-1960
1961-1965
1966-1970
1971-1975
1976-1980
1981-1985
1986-1990
1991-1995
1996-2000
2001-2005
2006-2010
2011-2015
2016
Bear
Evans
Bear Cumulative
Evans Cumulative

Current Conditions

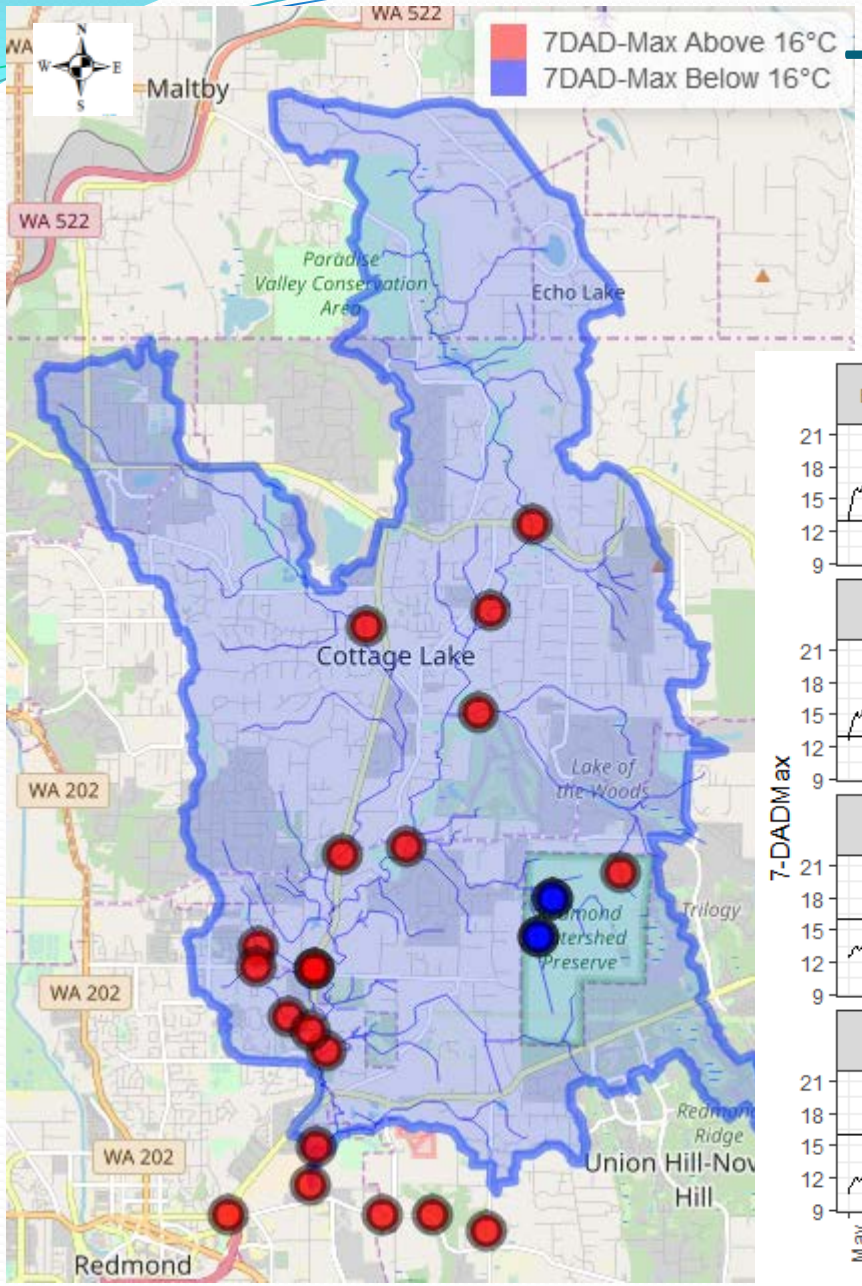


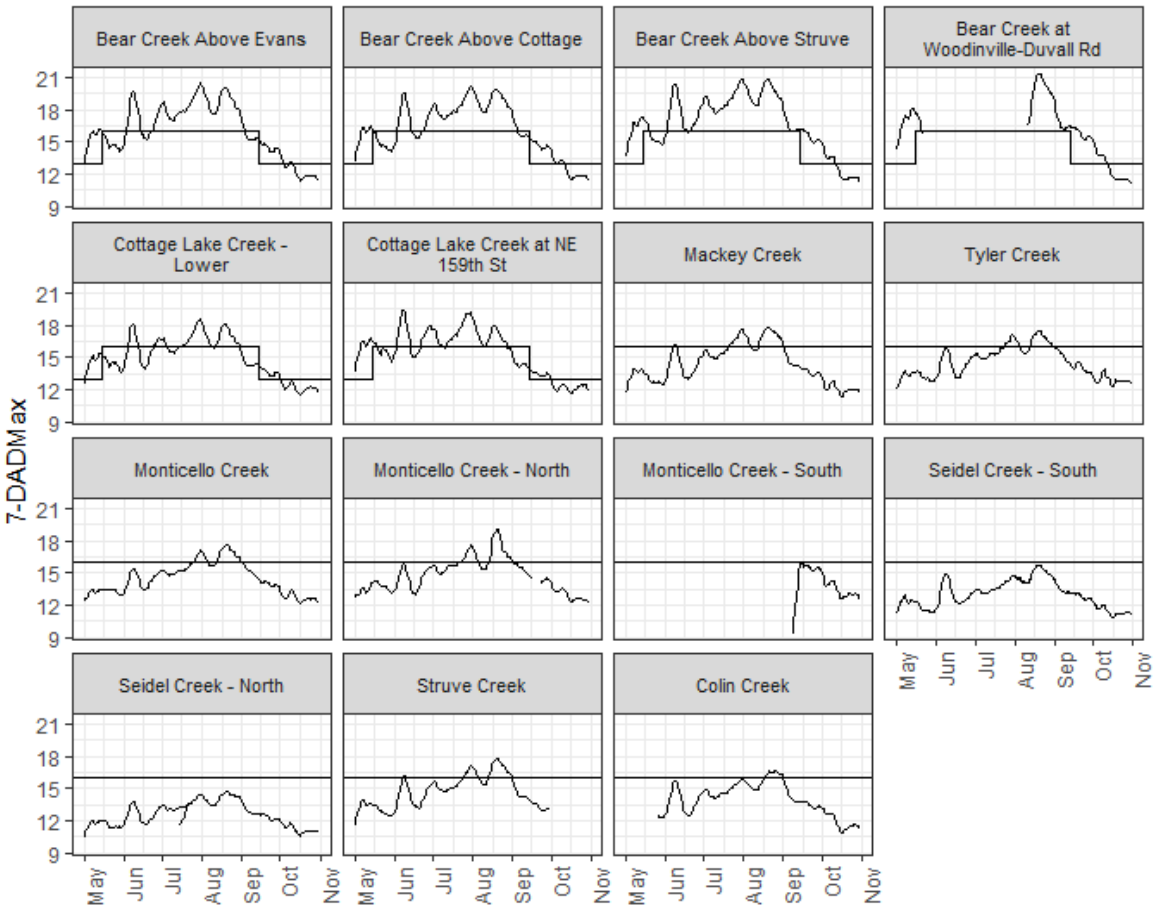
Current Conditions Monitoring

- 13 sites monitored for Water Quality
  - 6 Base Flow, 6 Storm Events
  - March 2015 – January 2016
- Parameters Analyzed include:
  - Dissolved Oxygen
  - Temperature
  - Total Suspended Solids
  - Dissolved Zinc, Copper
  - Fecal Bacteria
  - Nitrogen

Temperature

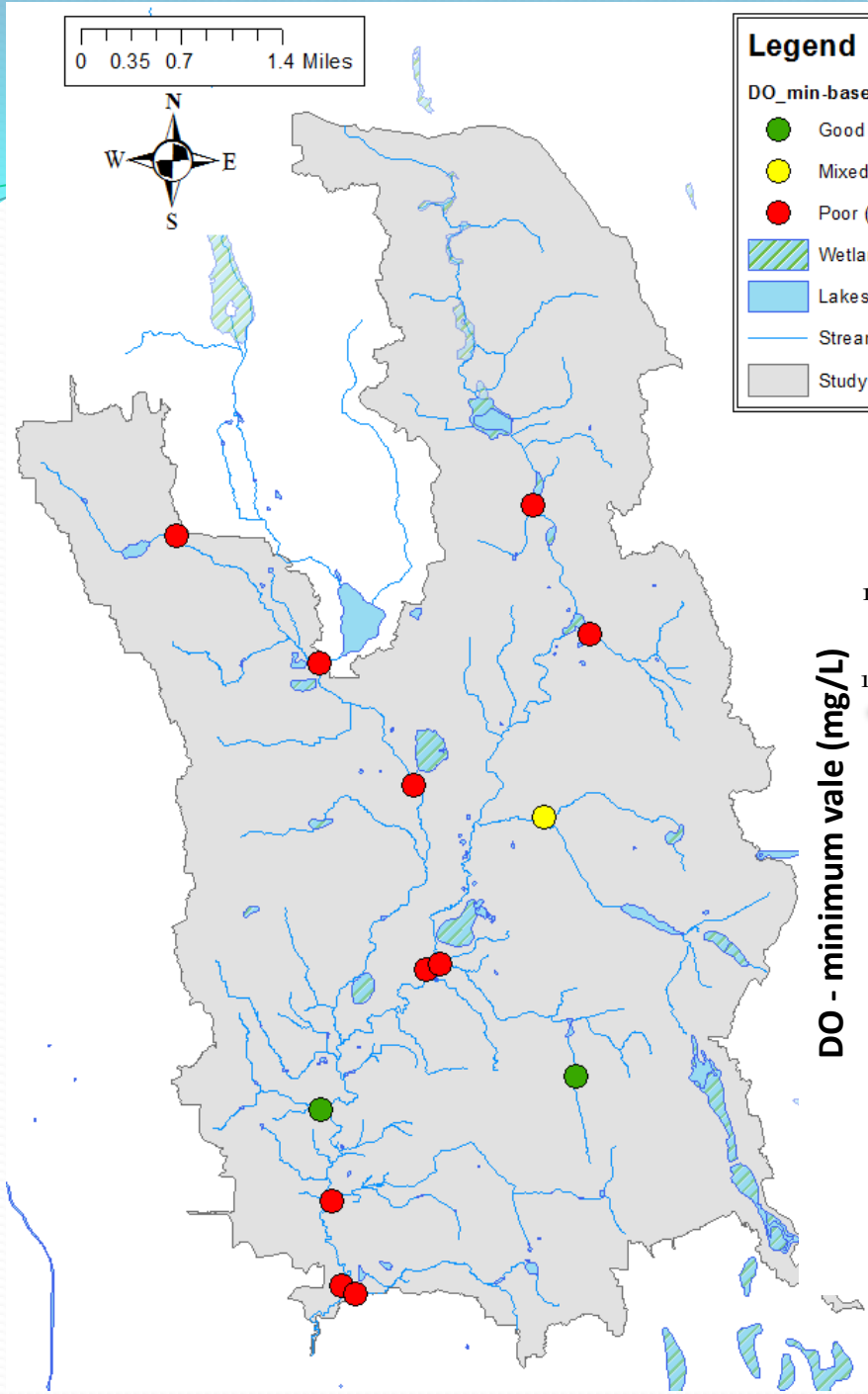
- Violated state standards throughout watershed in 2016.

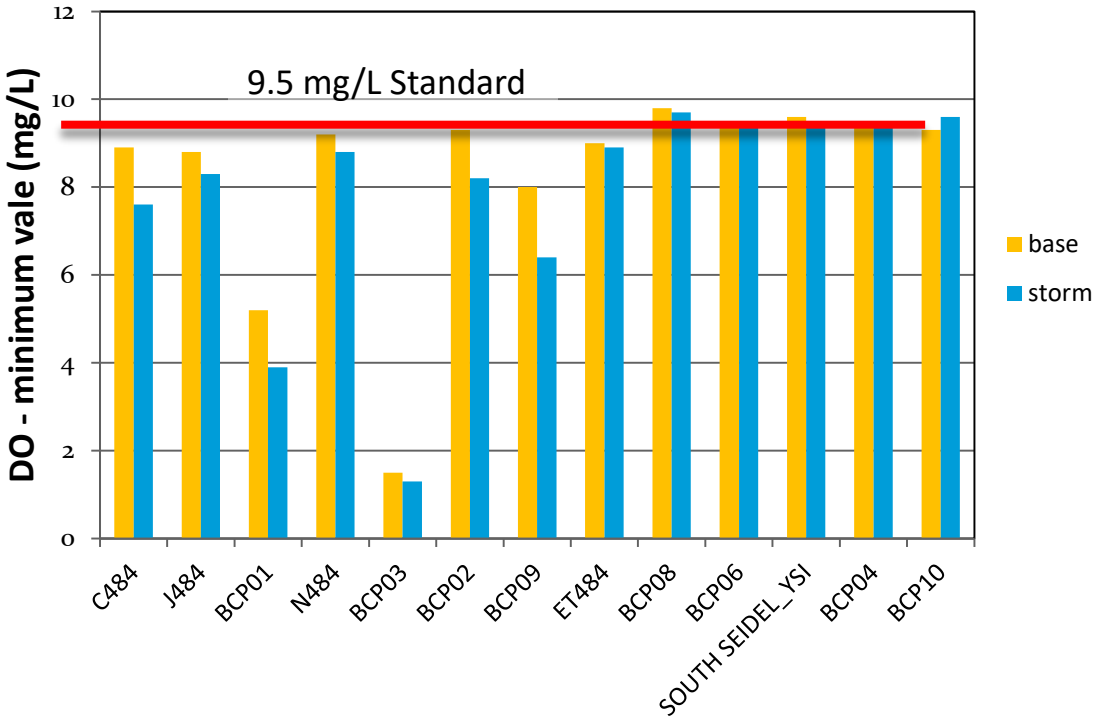


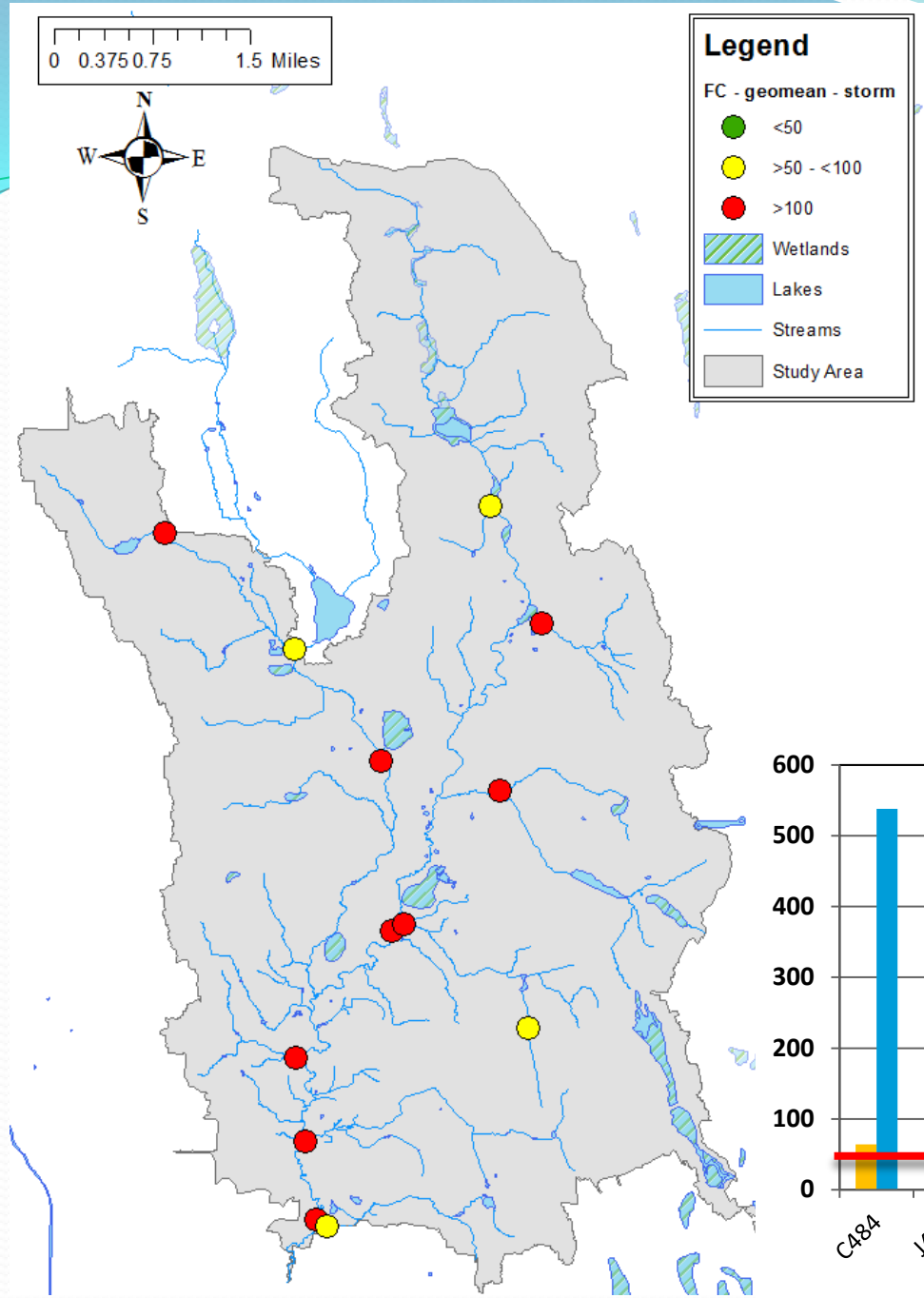


Dissolved Oxygen

- Of concern throughout watershed

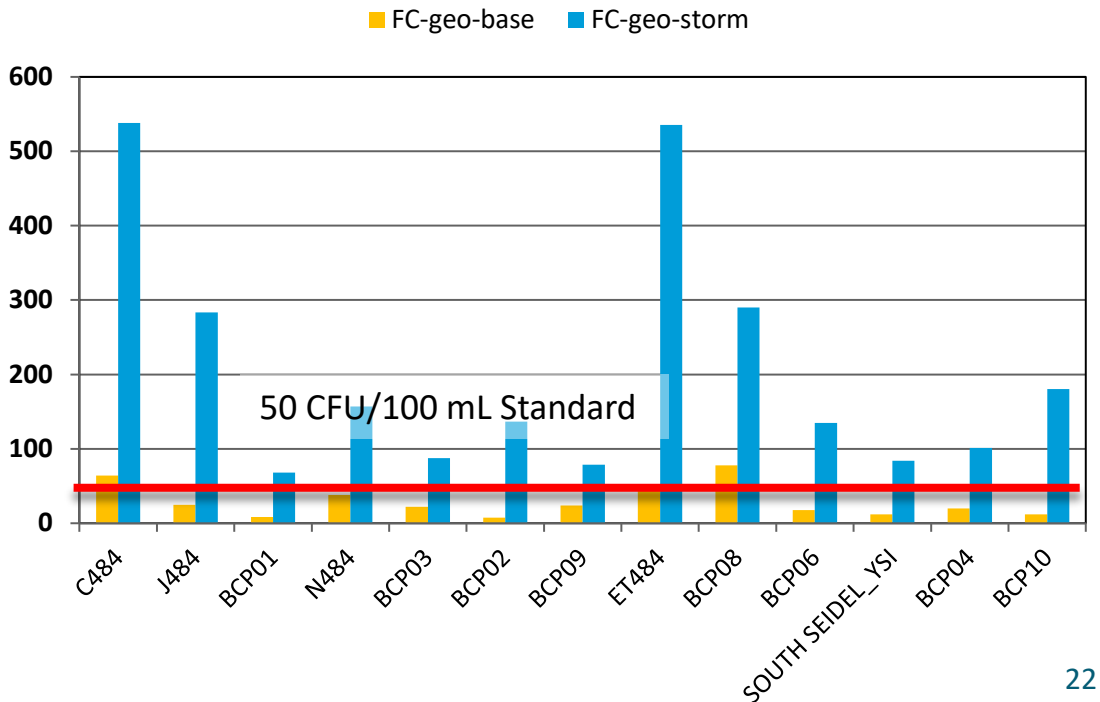






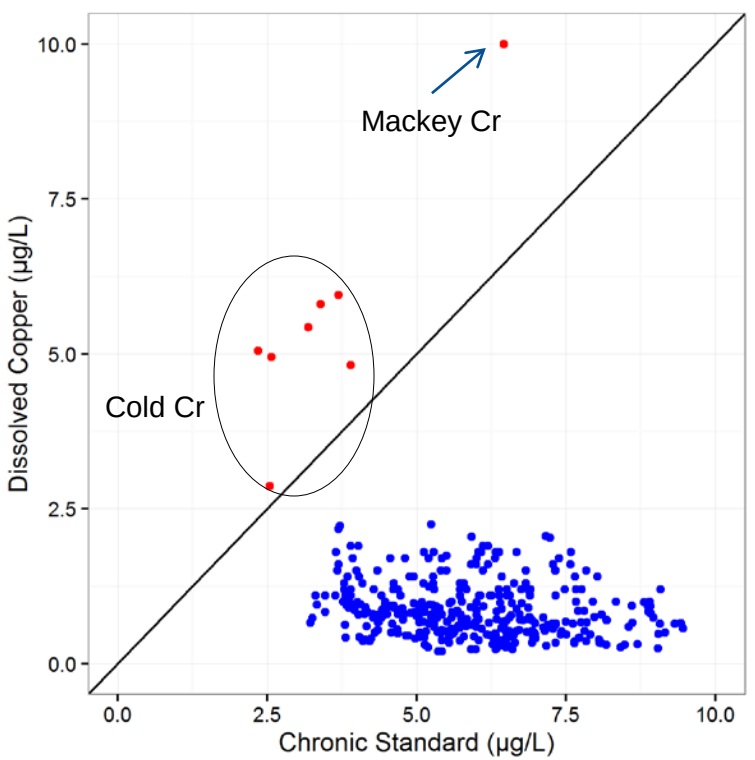
Fecal Coliform

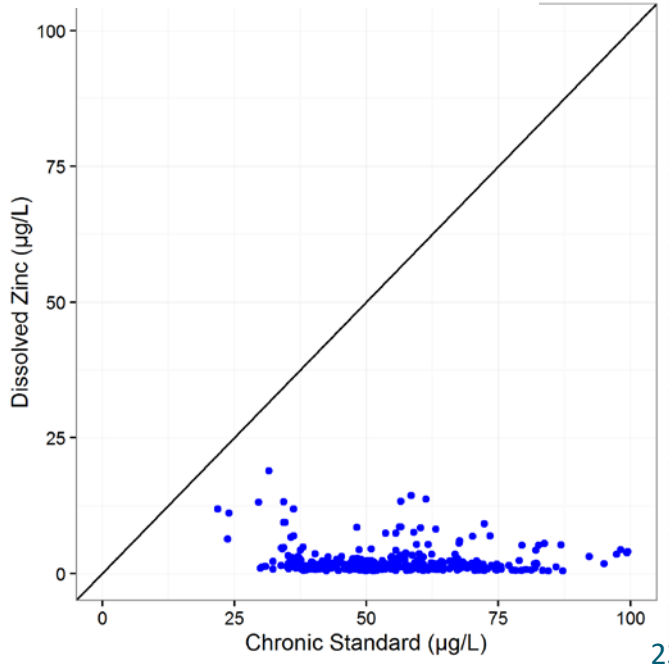
- Storm data over limit
- Only 2 sites have high base FC data
  - Monticello Cr
  - Lower Bear Cr



Metals

- Copper concentrations exceeded state standards at 2 locations in 2015 wet-weather monitoring
  - Cold Creek
  - Mackey Creek
- Metal concentrations were below state water quality standards in all previous routine samples

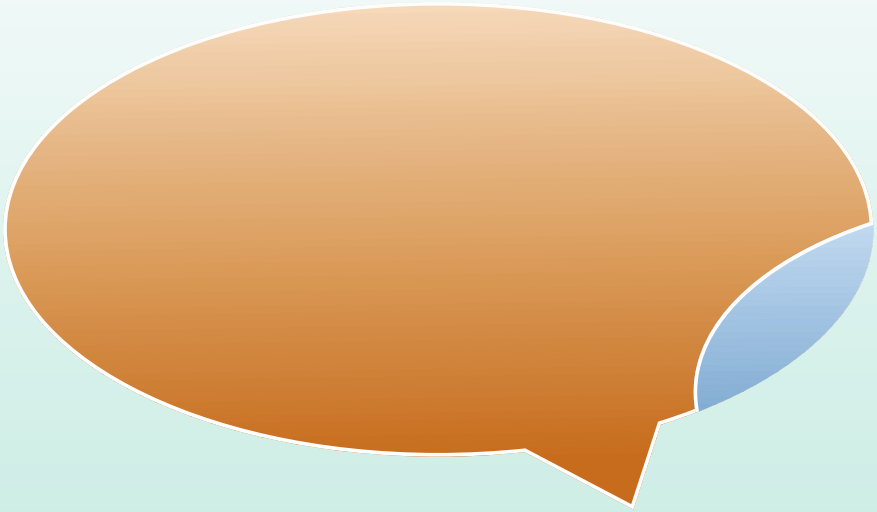




Conclusions

Parameter	Long-term Trends (1970s to 2015)	Current Conditions
Fecal Coliform	Improving	Not Meeting Standards
Temperature	Degrading	Not Meeting Standards
Dissolved Oxygen	Degrading	Not Meeting Standards
Total Suspended Solids	Improving	Elevated
Nutrients	Improving	NA

- Some water quality improvement, some water quality degradation.
- Watershed Plan identifies strategies for decreasing human health risk (bacteria) and protecting and restoring aquatic life (temperature, dissolved oxygen, TSS, habitat).



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