Developing the Historical Context for Understanding Present Day Land Use-Water Quality Relationships

Julia Michalak
Interdisciplinary Urban Planning and Design
Adviser: Dr. Marina Alberti
University of Washington
Urban Ecology Research Lab

King County

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Road Map

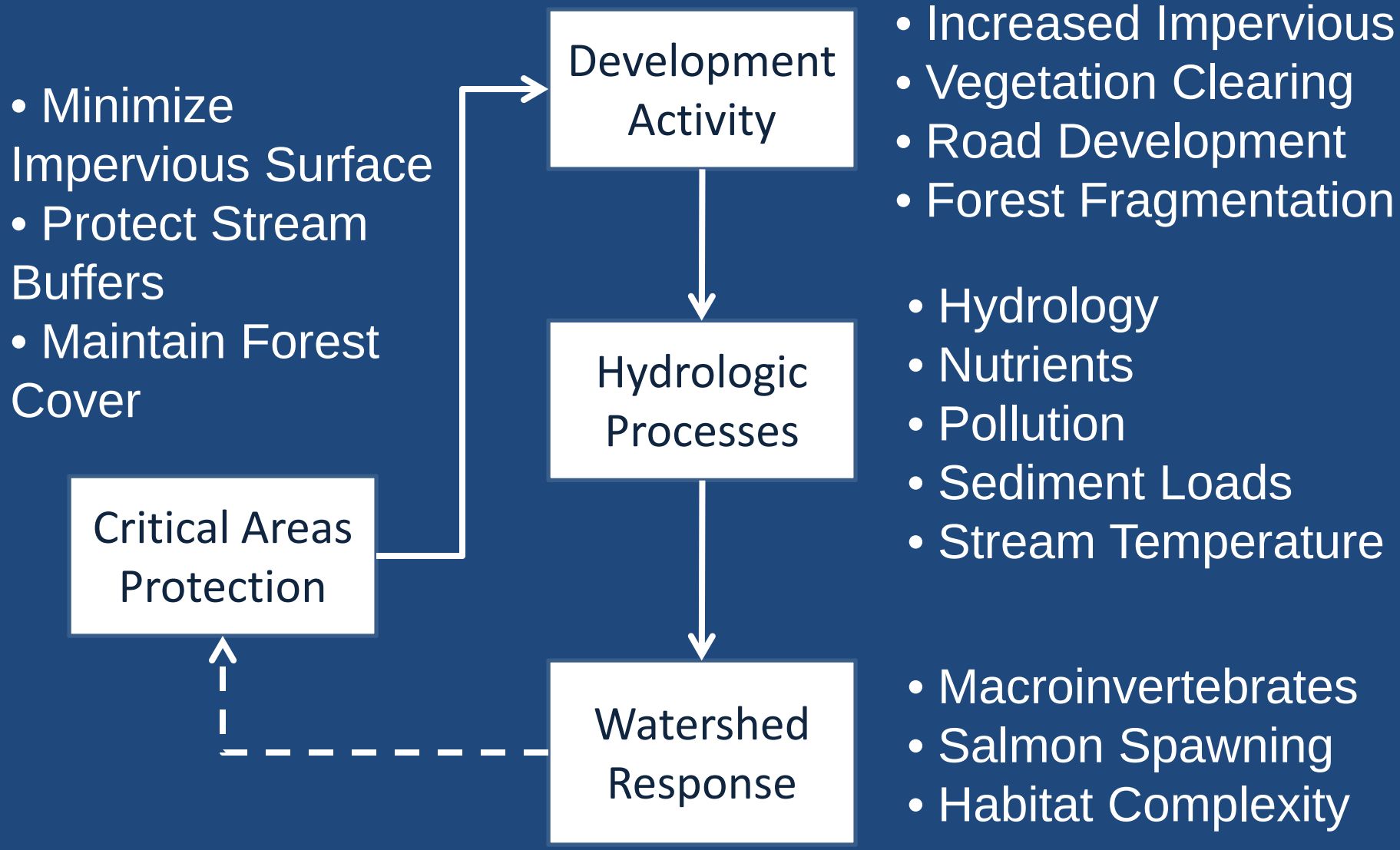
- Critical Areas Ordinance Monitoring Overview
- Historic Analysis:
  - Why is Watershed History Important?
  - Study Questions
  - Methods and Data Sources
  - Historic Land Use Results
    - Forest Cover Change
    - Land Cover Composition 1907/11, 1948, 1986, 2007
    - Recent History
  - Qualitative Conclusions
  - Management Implications

Critical Areas Ordinance Monitoring Study

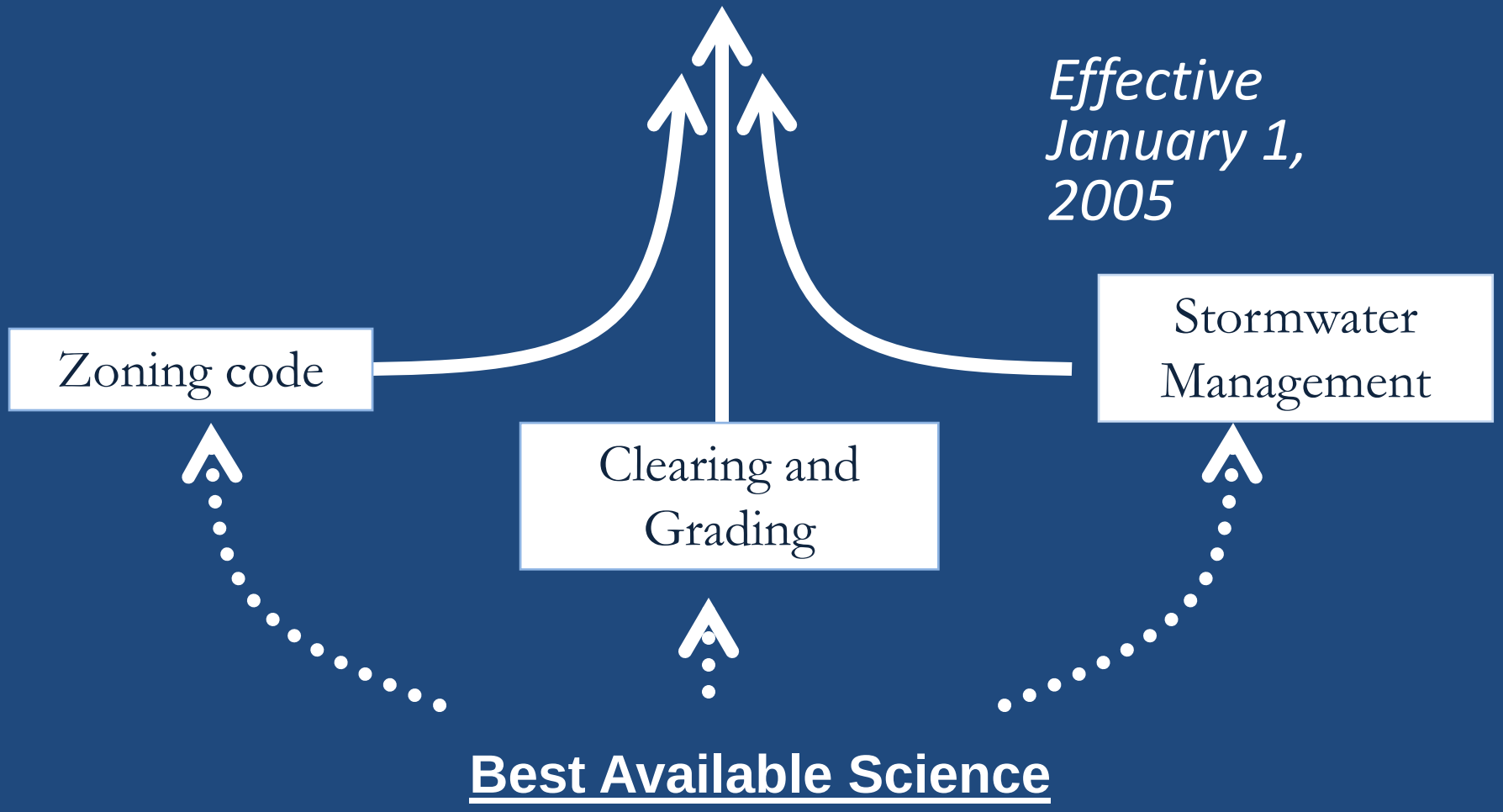
King County

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Land Use and Watershed Condition

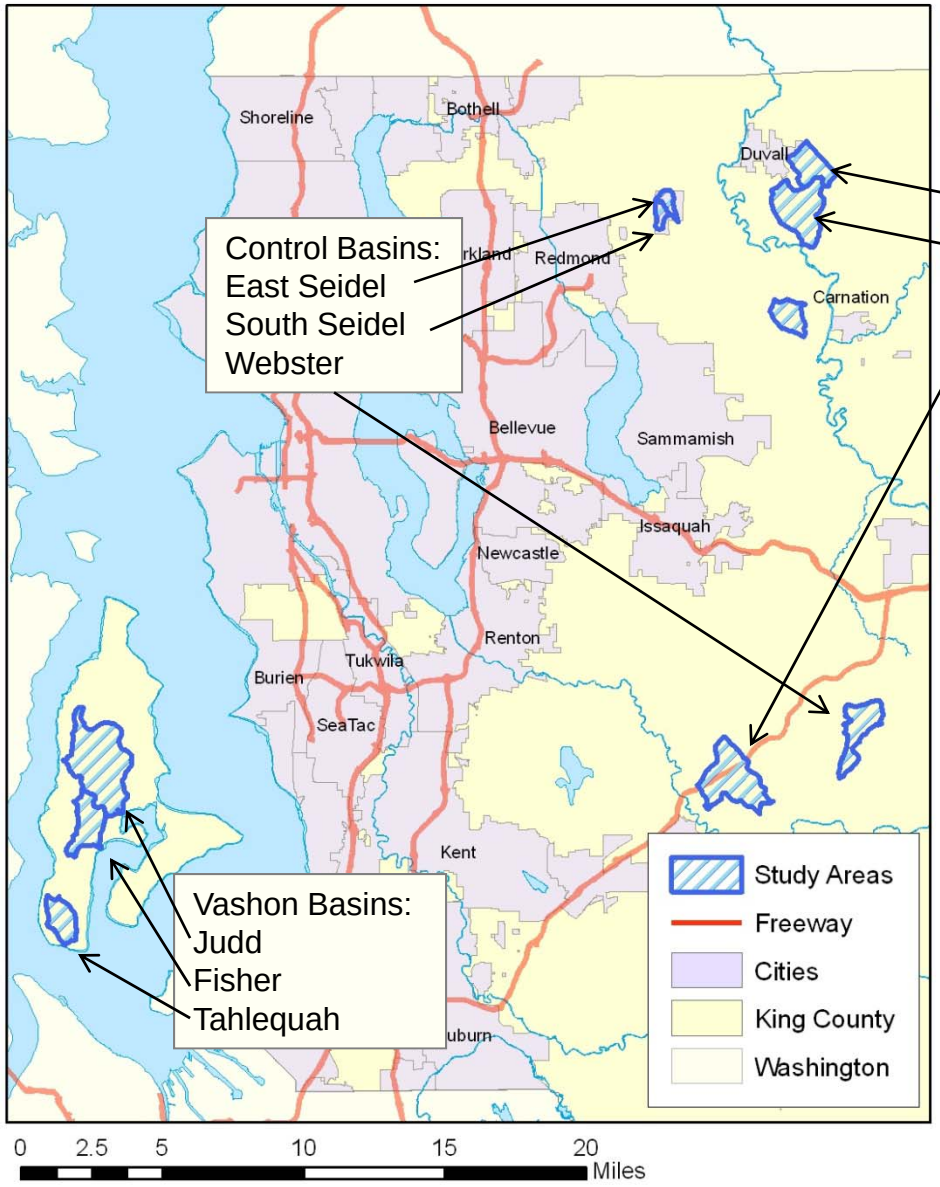


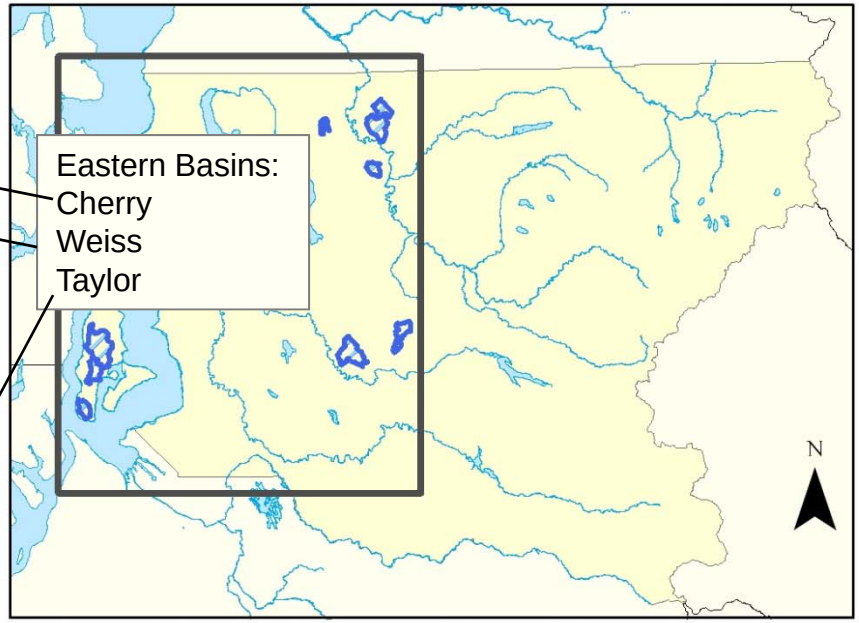
Critical Areas Ordinances (CAO)



Objective: Protect or improve watershed condition

Study Areas

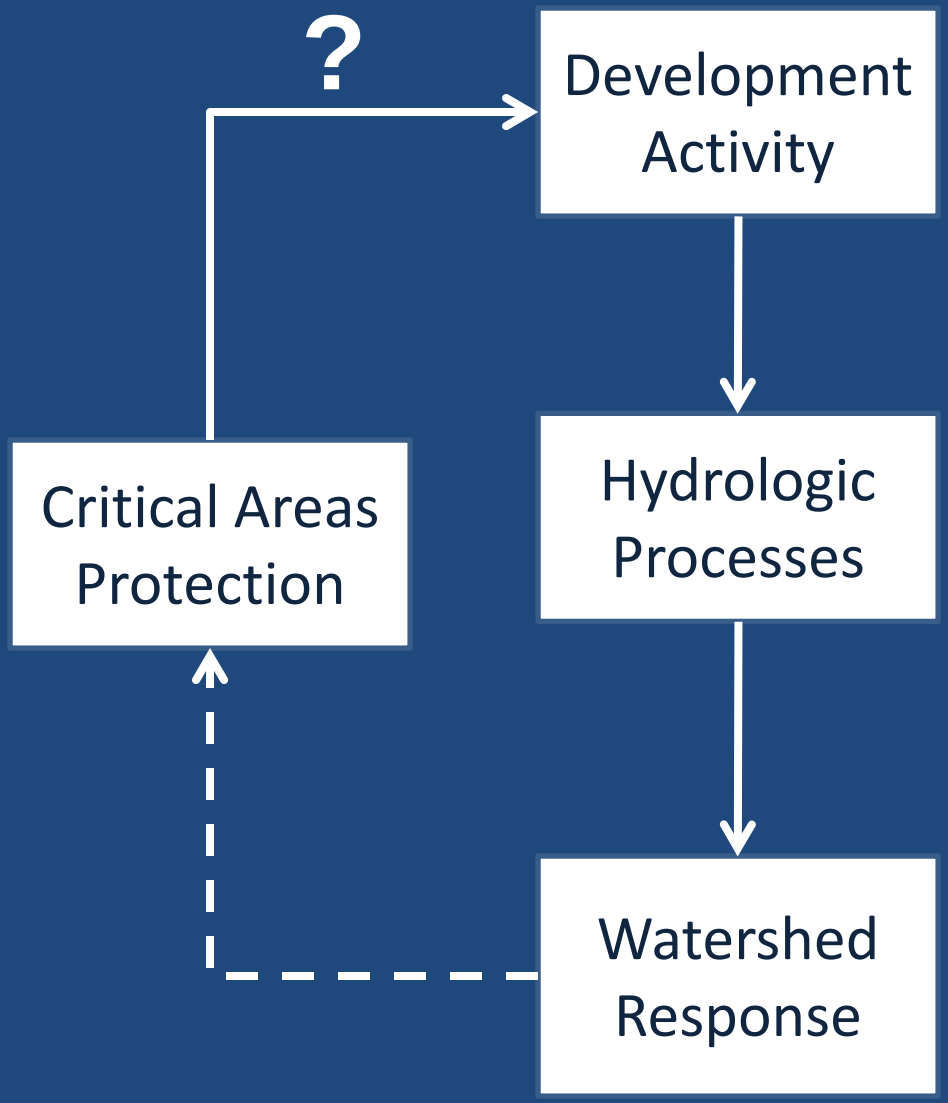




Selection Criteria:

- Small watersheds - 2nd or 3rd order streams (60 to 1260 hectares)
- Common post-glacial geology (Elevation range 44 to 7933 ft)
- Treatment basins: high number of unimproved parcels

Watershed Response



Land-Cover Change:

- Impervious
- Vegetation Change
- Type of Land Use
- Location of Change

Hydrologic Processes:

- Flow
- Water quality

Watershed Response:

- Benthic Macroinvertebrates
- Physical Habitat Characteristics

Developing a Land Cover History for the Study Basins

King County

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

The Ghost of Land Use Past

(Harding et al 1998)

- Present day land use/land cover not always indicative of historic conditions
- Explain present day watershed condition
- Explain watershed trajectory over time
- Insights into system recovery

Fisher 1936

Fisher 2007

Study Questions

- Do the watersheds share a common history?
- What are the implications of historic impacts for present day watershed condition?
- Can watersheds recover from significant land-cover impacts?

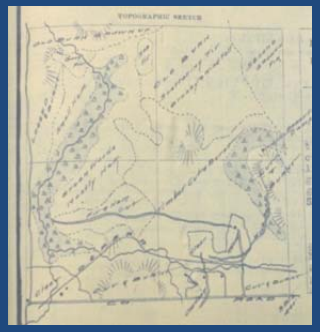
Fisher 1936

Fisher 2007

Data Timeline

1907-08

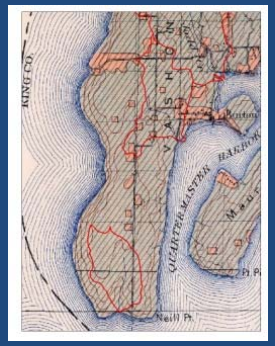
Eastern and Control Basins



Timber Cruise (40 acre tract)

1911

Vashon



Soil Survey 1:125,000

1936

Vashon, Control Basins Only

1:800

1948

All Basins

1:20,000

1965

1:60,000

Aerials

Data Timeline

1907-08 1911 1936 1948 1965 1986 1991 1995 1999 2002 2007

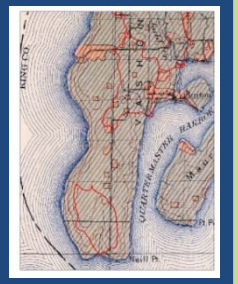
Eastern and Control

Vashon

Vashon and Control

All Basins

All Basins



Timber Cruise

Soil Survey

Aerials

Land Cover 30 m pixels

Methods

- Maps were scanned and georeferenced – PLSS Section boundaries
- Photos scanned and orthorectified (output 1 meter pixels)
- Land-cover polygons digitized
  - Photos analyzed at 1:10,000 with minimum polygon size of 1 hectare
- Polygons classified using a hierarchical classification system

Hierarchical Classification

Map Text (Timber Cruise)
Old Growth
Fir (conky, good, fair, live, scattering, thick growth)
Alder, maple, vine maple, cottonwood
Alder and Fir, Alder and Hemlock
Second growth, green woods, small hemlock, undergrowth of fir

Old Growth
Conifer
Deciduous
Mixed
2nd Growth

Forest

Polygon Description
Clumps of forest covering 40 to 60% of the polygon
Gaps occasionally visible (between 60 and 90% forest)
Spaces are not visible between trees

Clumped Forest
Forest with Gaps
Contiguous Forest

Datasets

King County

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

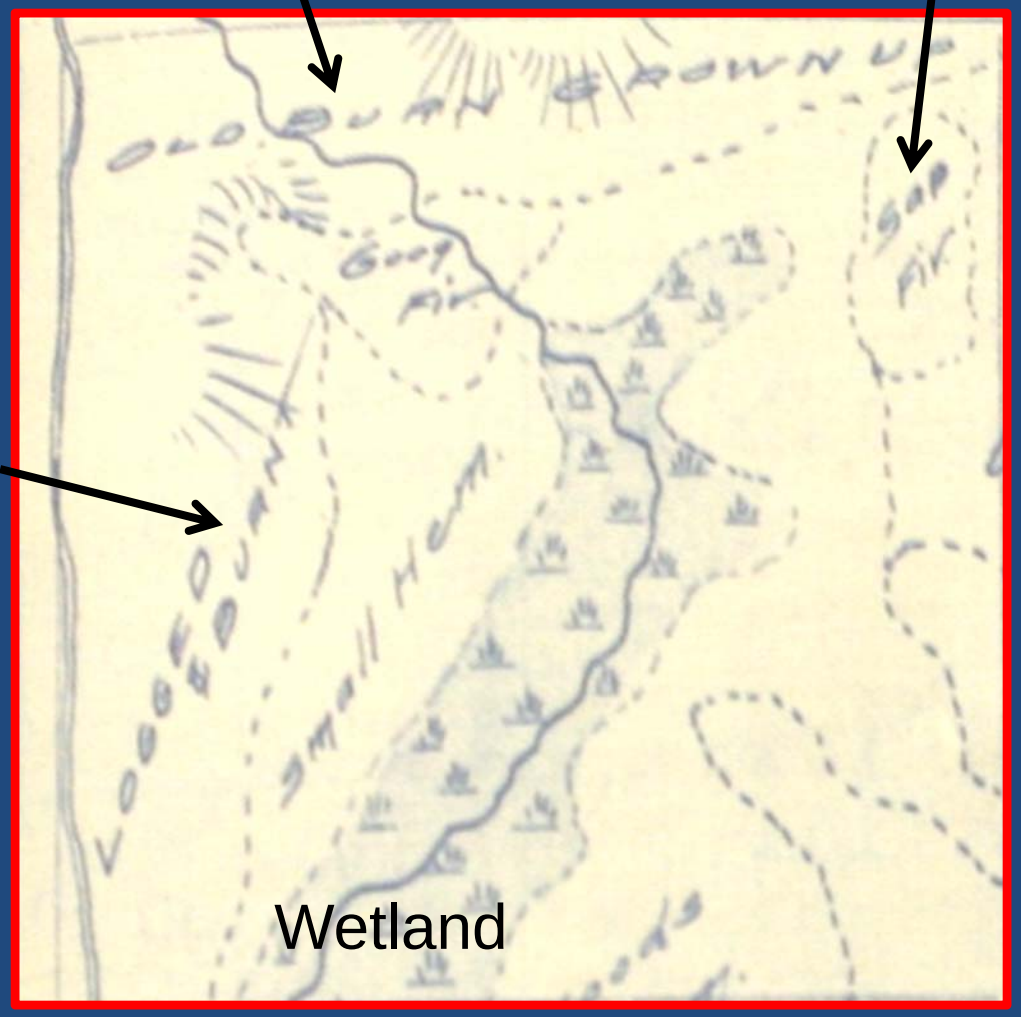
Timber Cruise 1907-8

TN22 RN06 Sec 2 - Taylor

Maps:
1 Mile x 1 Mile

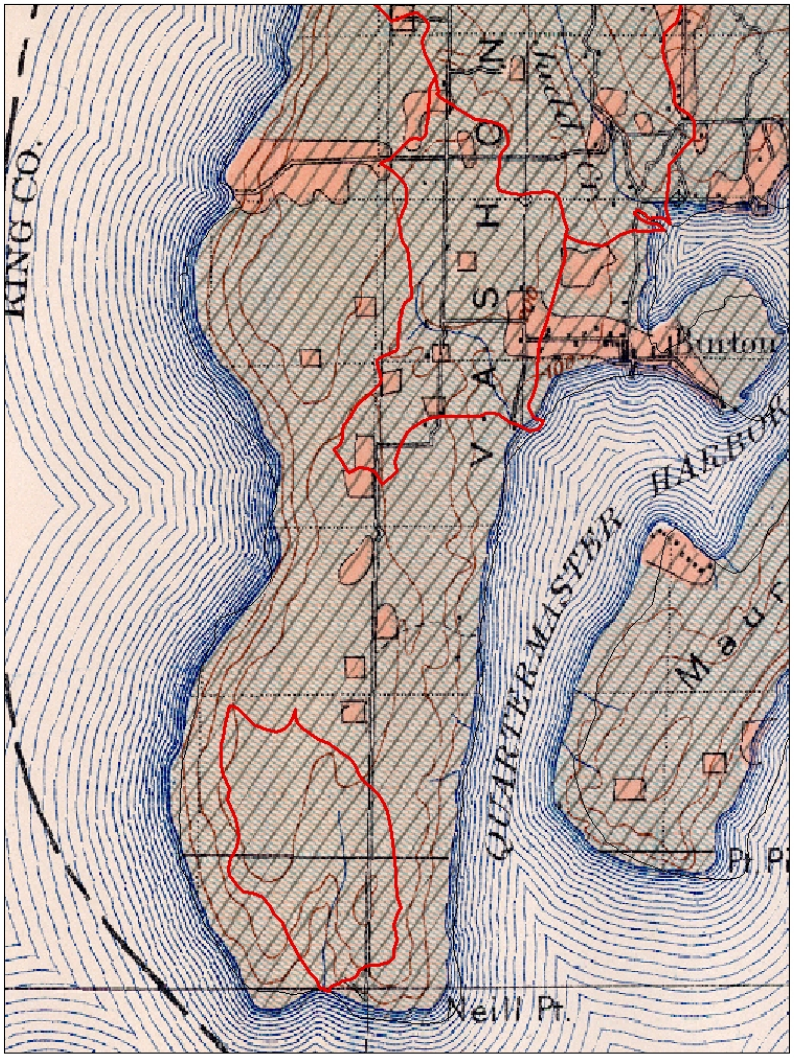
SW¼ SW¼ owner, Howard, of Seattle,
leased by Ed Hudson; house 1
story white 18 x 24 (old)
Barn 24 x 40
Orchard of 25 poor trees;

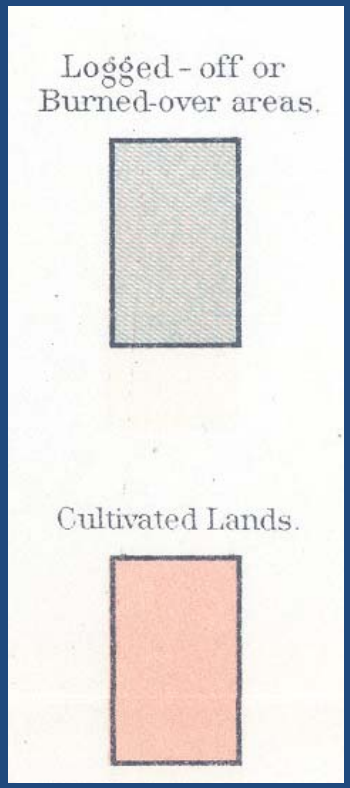
Notes: "SW ¼ SW ¼ Howard of Seattle… House 1 story white 18x24 (old) … Orchard of 25 poor trees"



1911 Soil Survey

1:125,000



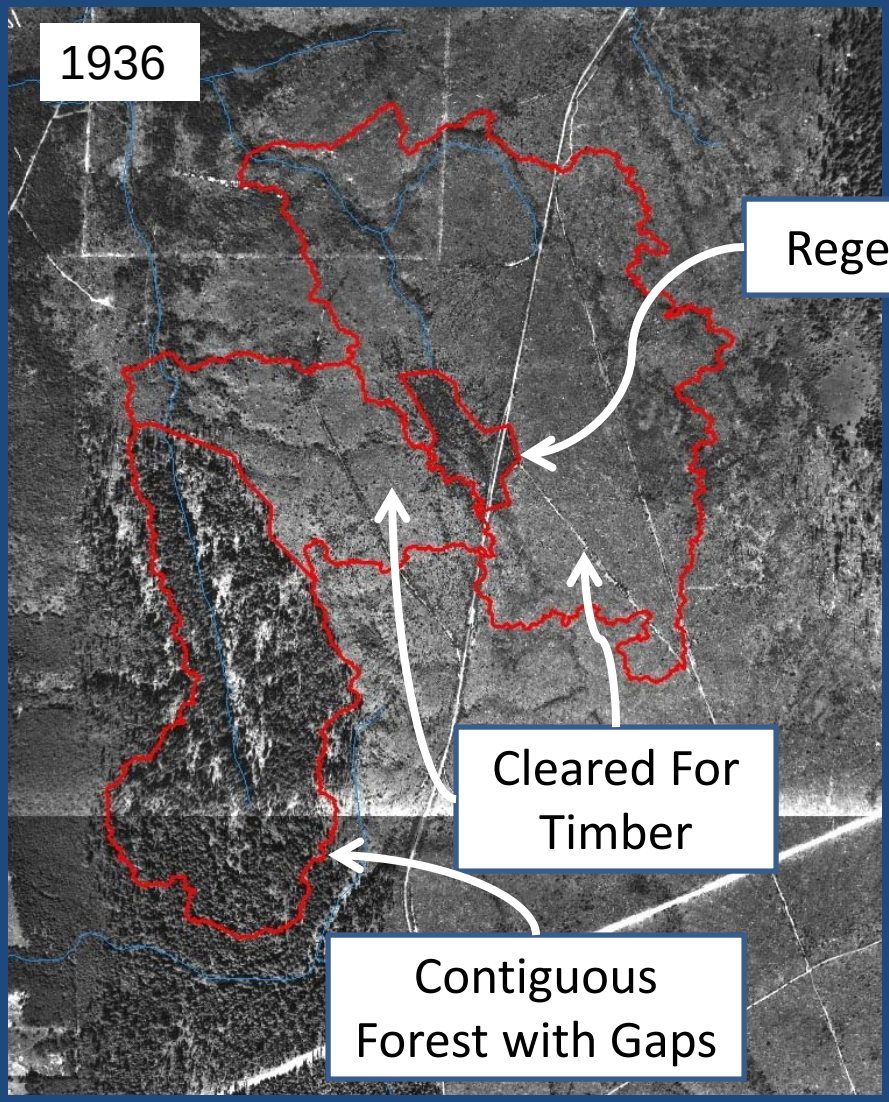


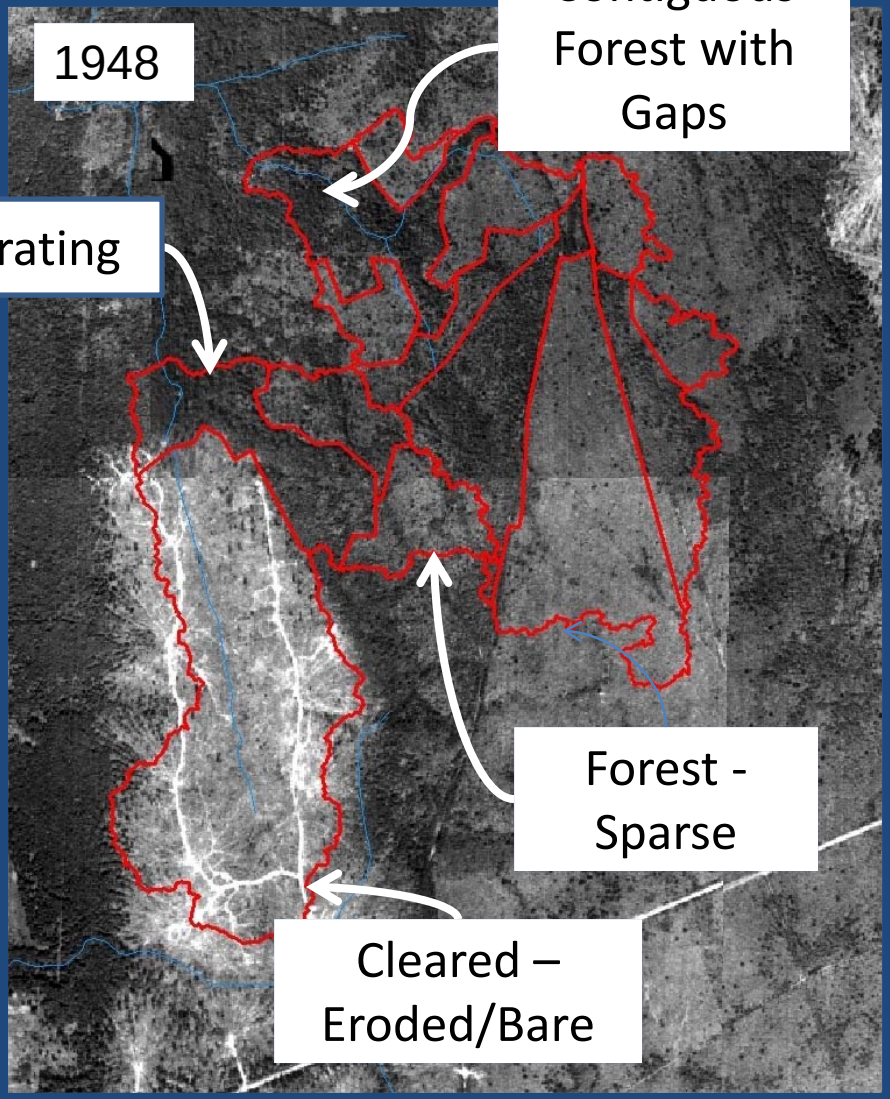
"Logged-off or Burned over areas"

"Cultivated Lands"

Land Cover Polygons

South and East Seidel





Results

Forest Cover Change

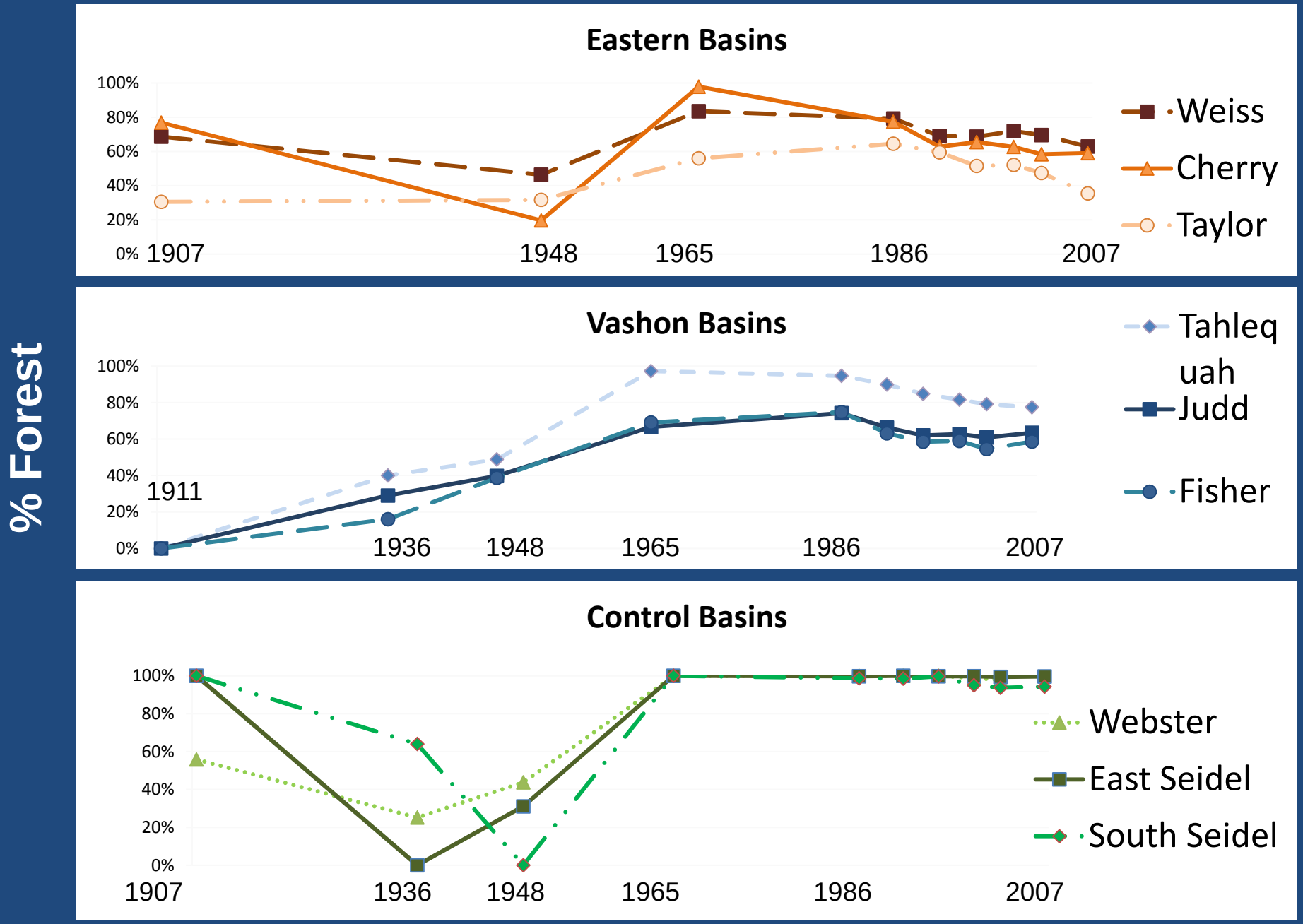
Land Cover Composition

Recent History

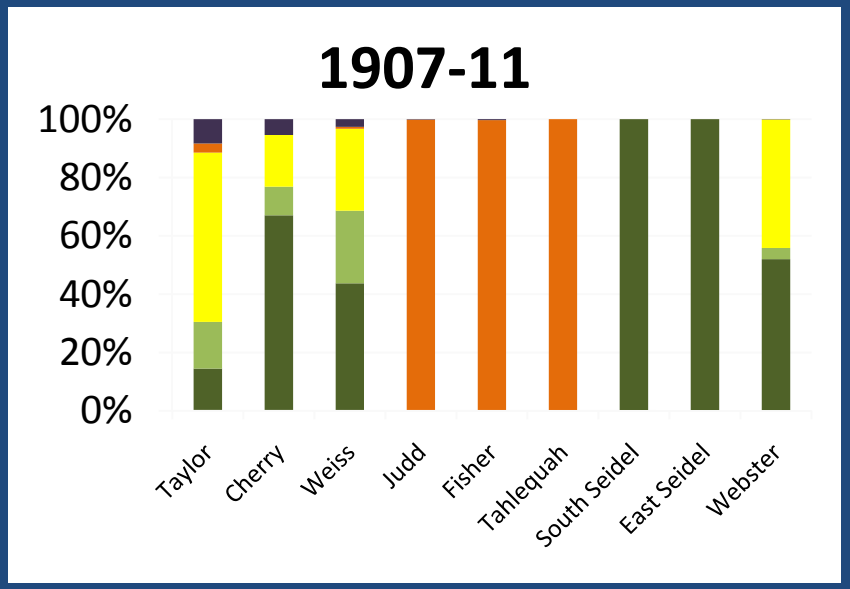
King County

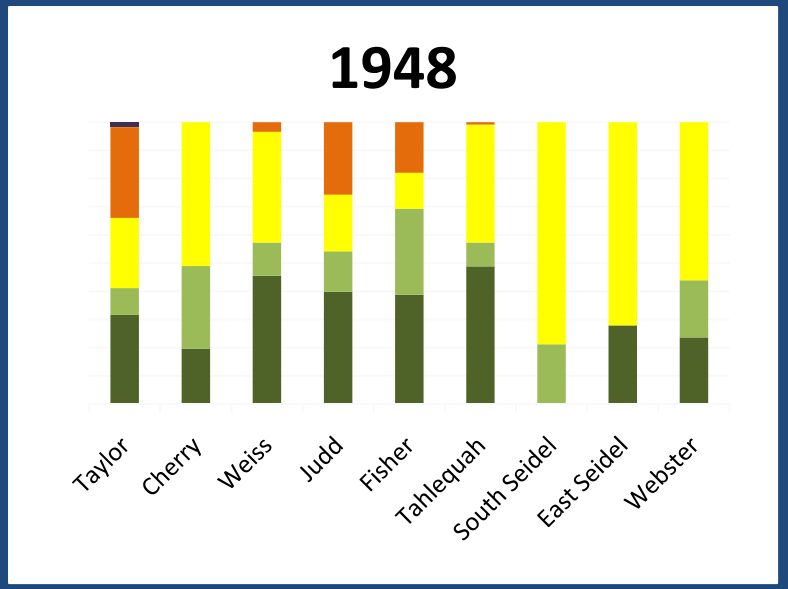
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

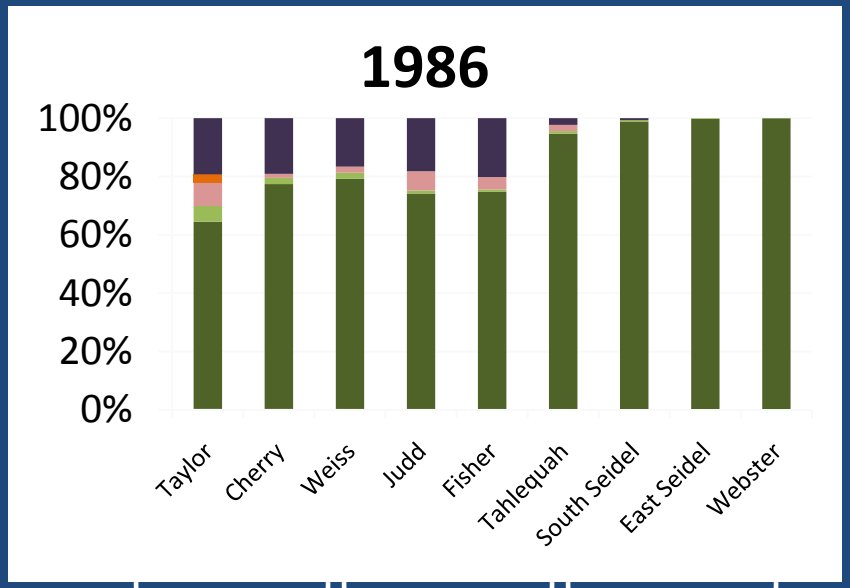
Change in % Forest Cover 1907 to 2007

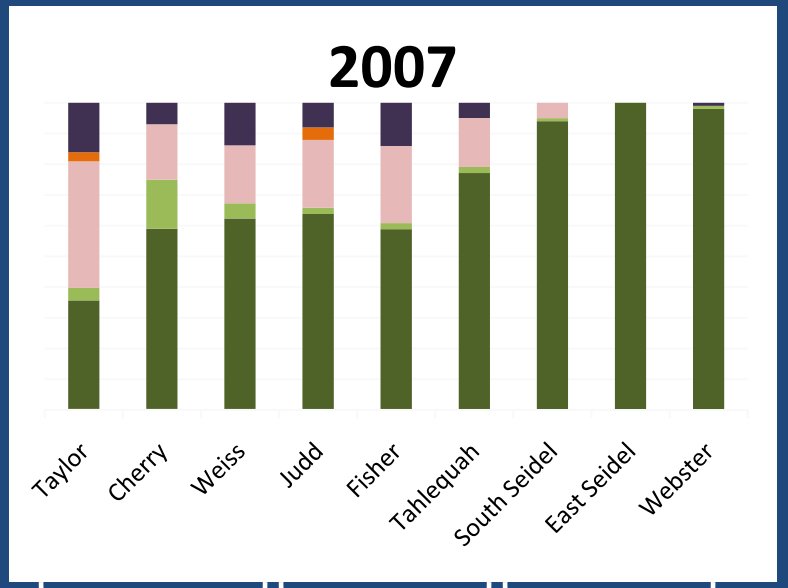


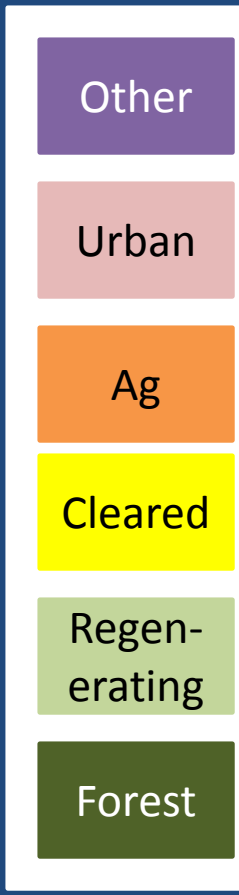
Land Cover Composition







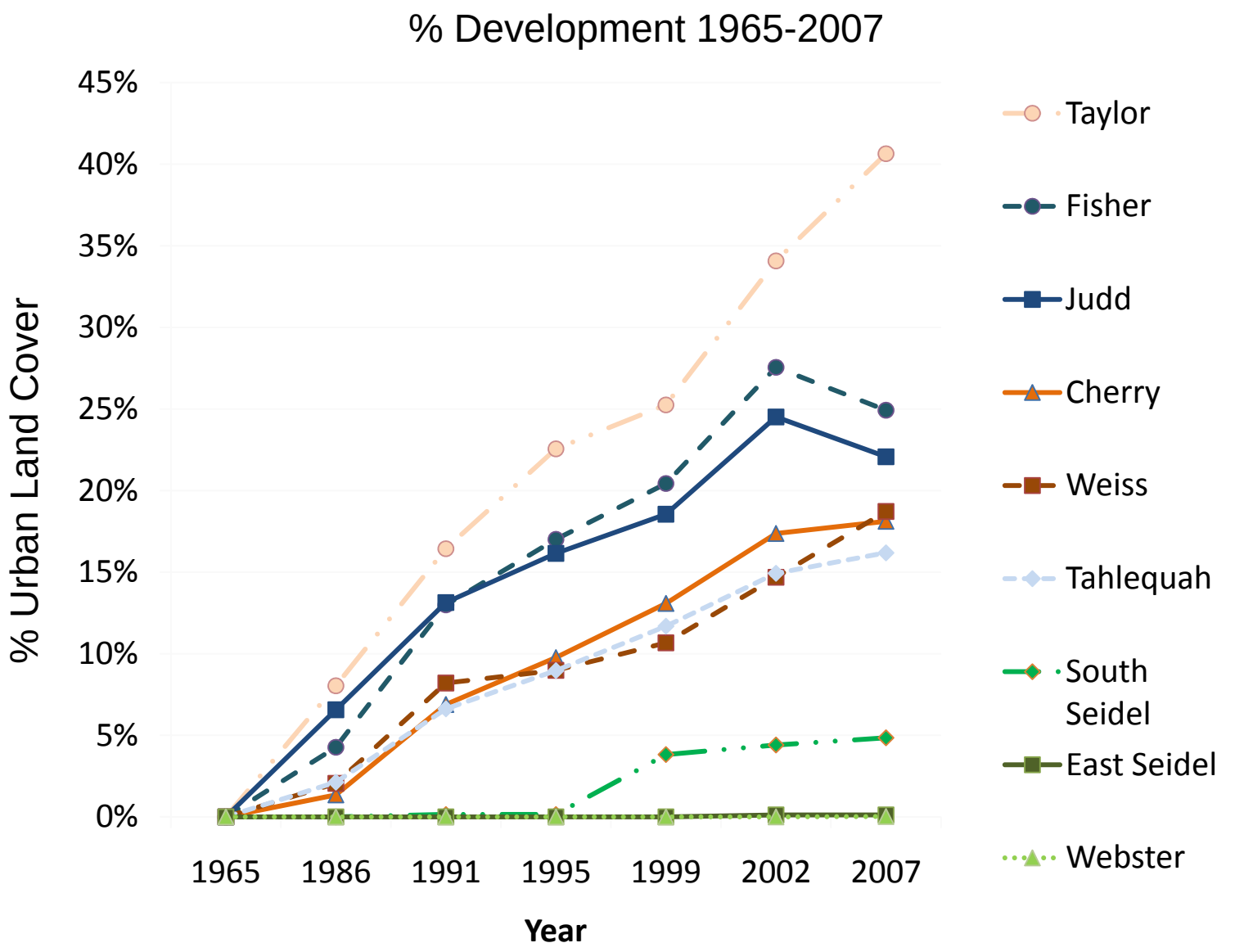




Eastern Vashon Control

Eastern Vashon Control

Recent Development History



BIBI Score:

Taylor	40
Fisher	42
Judd	38
Cherry	44
Weiss	30
Tahlequah	30
South Seidel	32
East Seidel	48
Webster	40

Data Source: UERL Land Cover

Conclusions

Qualitative Conclusions

Management Implications

King County

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Qualitative Conclusions

- Do the watersheds share a common history?
  - Yes, but…
  - What is the relative importance of the type, extent, duration, and time since impact?
- What are the implications of historic impacts for present day watershed condition?
  - Historic and present day landcover are not independent
  - Altered forest stand conditions
  - Woody Debris, Stream Bed Heterogeneity, and BIBI
- Can watersheds recover from significant land-cover impacts?
  - All have good to excellent BIBI scores

Implications for Management

- Watersheds are recovering from historic impacts and experiencing present-day impacts
- We know little of the relative importance of the type, extent, duration, and time since impact
- Questions
  - Do certain land cover changes permanently alter the trajectory of a watershed?
  - Are there time lags in watershed response?
  - What are the long term implications of our land use decisions today?

Data Sources and Acknowledgements

- **Critical Areas Monitoring Effectiveness Team**

Gino Lucchetti, King County Project Manager

  - **King County: Bob Fuerstenburg, Dr. Josh Latterell, Dr. Klaus Richter, Ray Timm**
  - **UW: Dr. Marina Alberti, Dr. Christian Torgersen**

- Funding provided by King County and the EPA

- Urban Ecology Research Lab
- Staff - UW Map Library and Special Collections Archive
- Janette Gomes - King County Archive
- Phil Stairs - Washington State Archive – Puget Sound Branch
- Paul McCombs - King County Department of Development and Environmental Services
- Dr. Tom Minichillo - King County Road Services
- Rob Ryan - Natural Resources Conservation Service
- Ken Rausher – King County GIS

Project Website:
http://www.kingcounty.gov/environment/data-and-trends/monitoring-data/critical-areas.aspx

Project Contact: Gino Lucchetti , Gino.Lucchetti@kingcounty.gov 206-296-8366