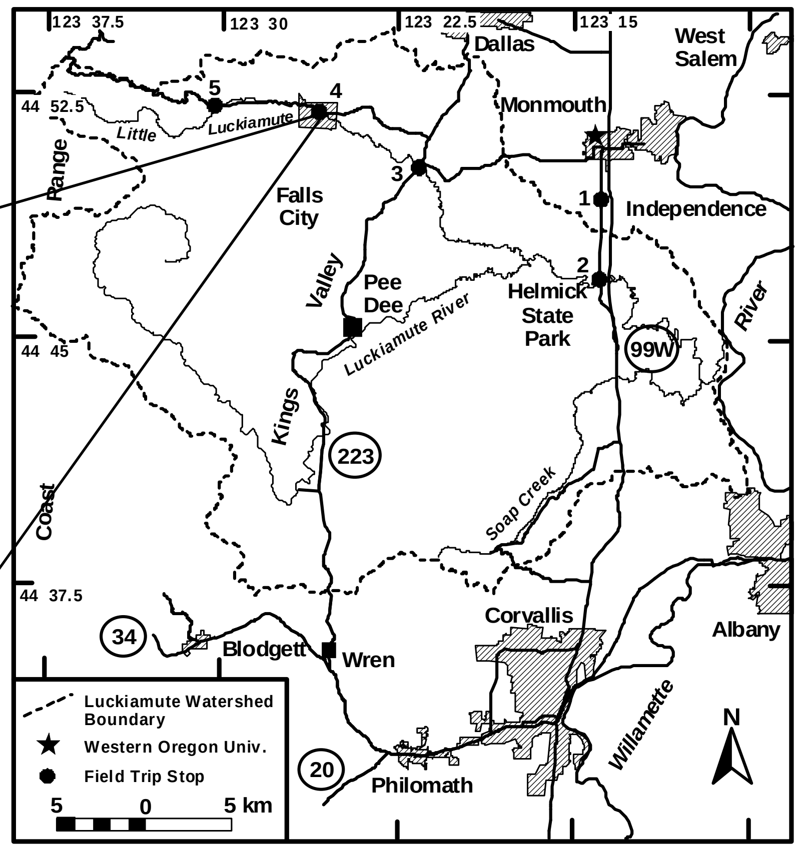
# Geomorphology and Environmental Geology the Luckiamute Watershed, Central Coast Range, Oregon

## Greenbelt Land Trust
## Luckiamute Watershed Council
## Western Oregon University

## Field Guide

## May 10, 2014

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**Earth and Physical Science Department**
**Chair, Division of Natural Sciences and Mathematics**
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**Monmouth, Oregon 97361**
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*NOTE: Selected pages omitted / recycled from a previous field trip.*

## Field Trip Introduction

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  - Greenbelt Land Trust

- Background
  - Luckiamute Watershed – Focus of 2001 WOU Environmental Science Institute Course
    - Undergraduate Science Majors
    - Pre-service Science Education Majors
    - Practicing Science Education Professionals
  - Contextual Learning Modules
    - Geomorphology / Hydrology
    - Field Botany / Aquatic Invertebrates
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  - Funding and Acknowledgments
    - National Science Foundation – OCEPT Project
    - Oregon Community Foundation
    - Western Oregon University
    - US Geological Survey / Institute for Water and Watersheds

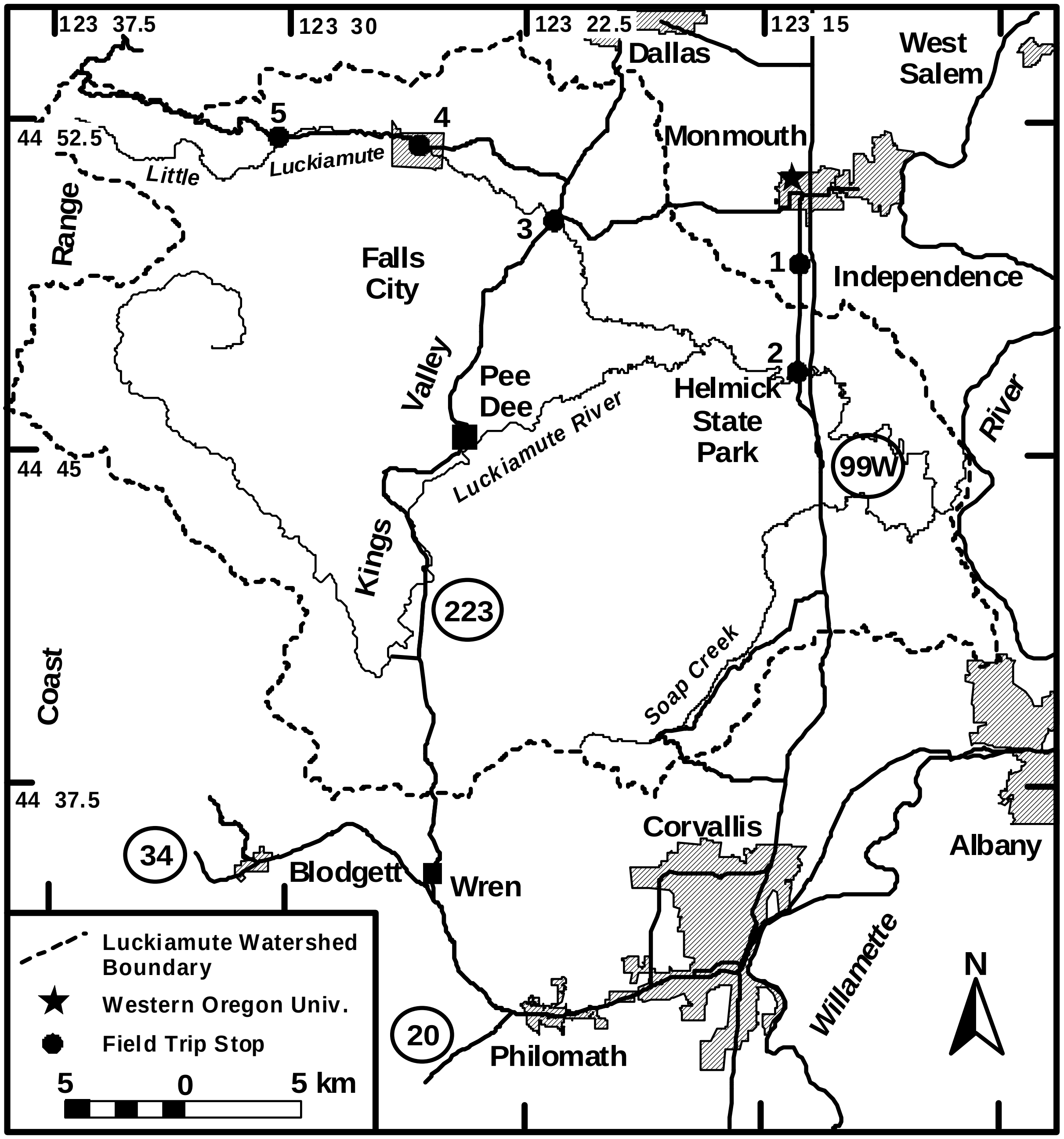


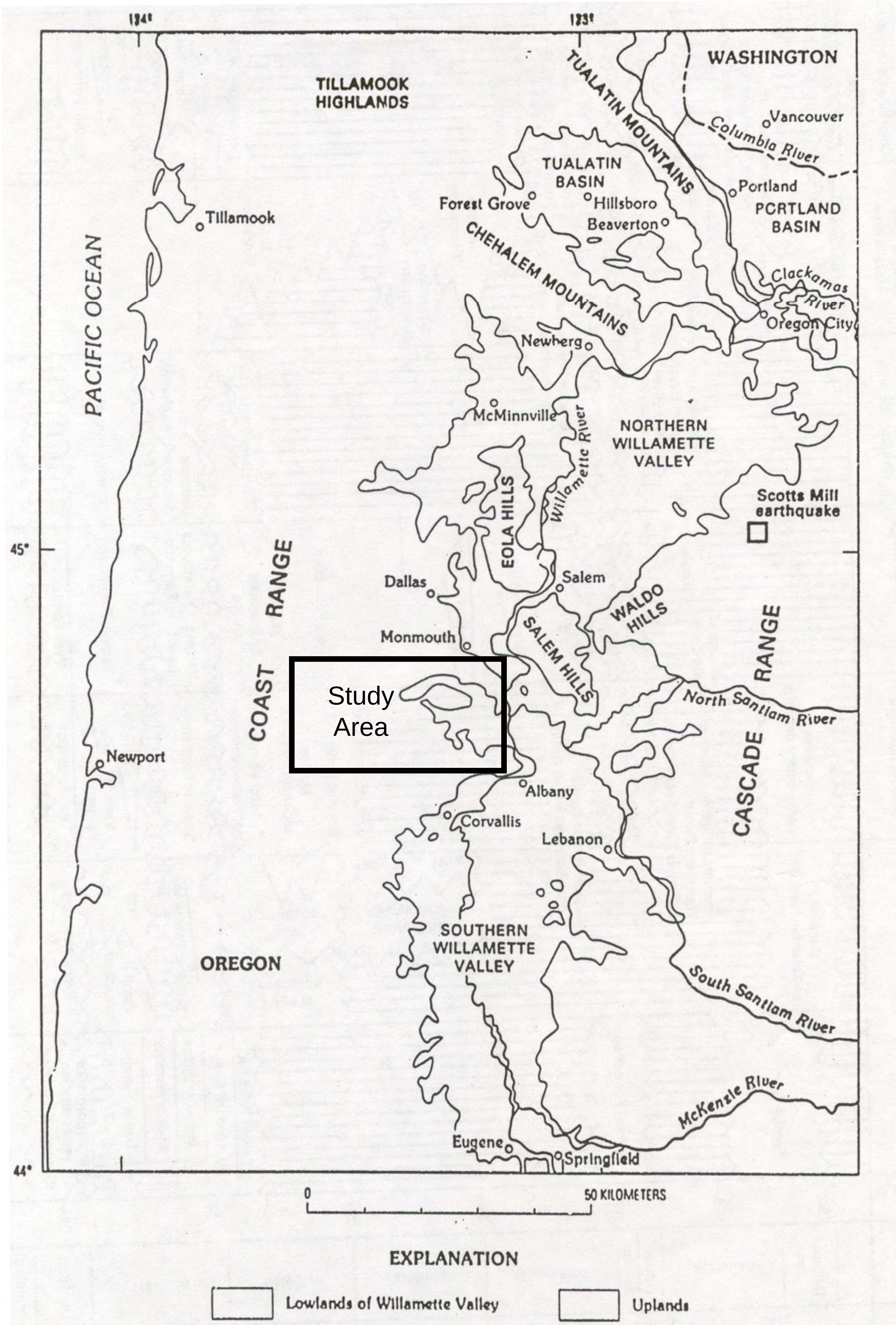

Figure 1. Location map of the Luckiamute watershed.

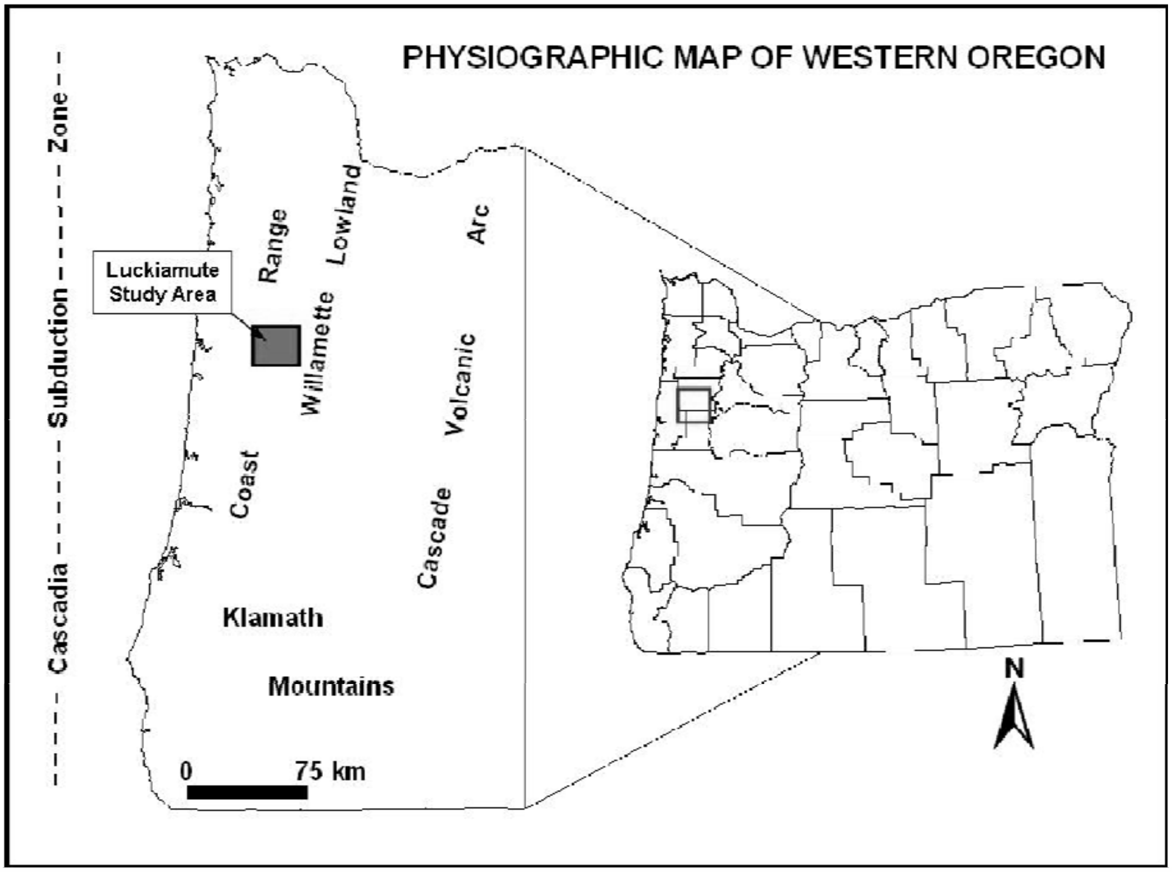
## History of Luckiamute Research and Service Learning at Western Oregon University

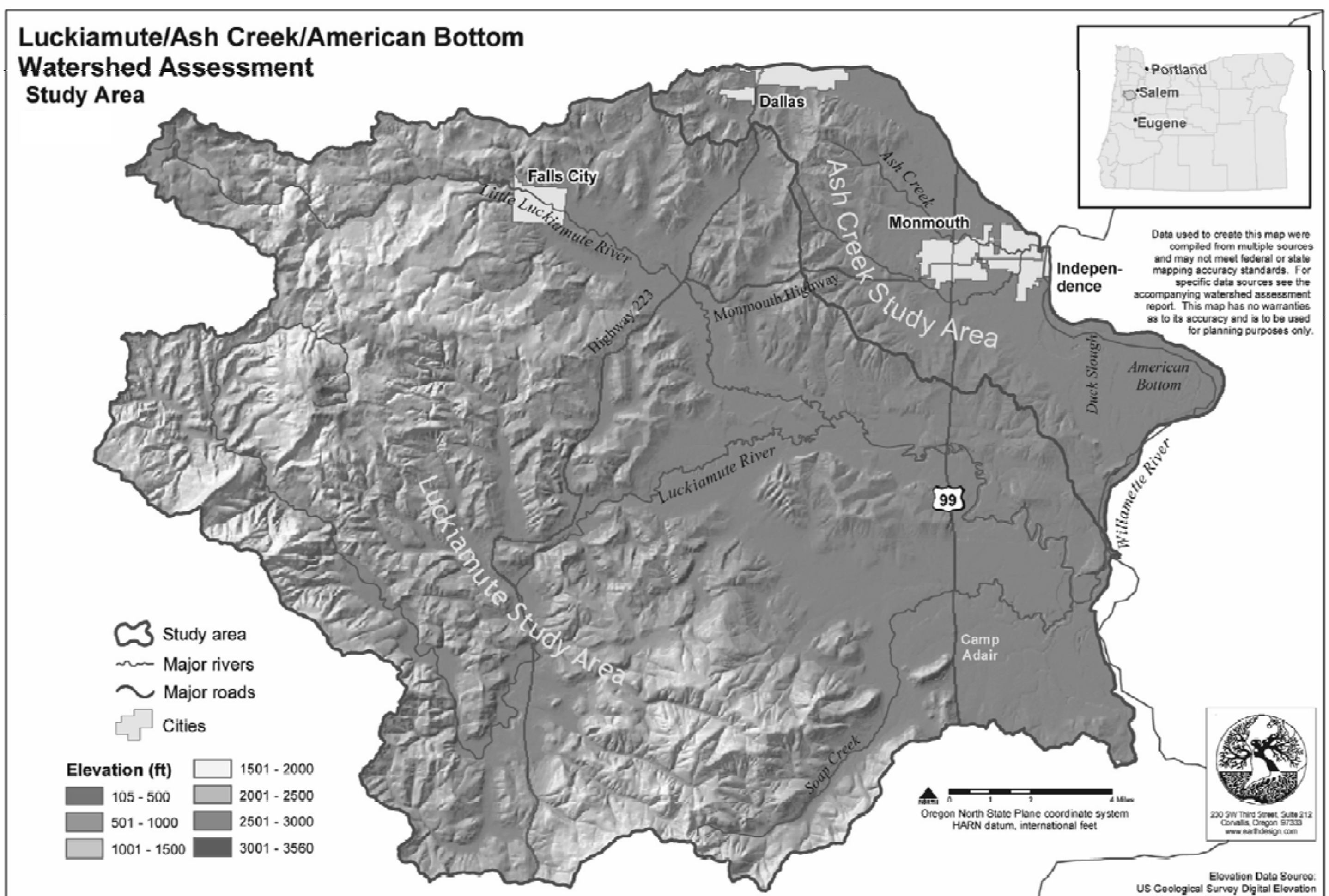
| | |
|---|---|
| 1999-Present | WOU Geology and Biology Class Field Trips |
| 2001 | Environmental Science Institute Course<br>Geomorphology, Env. Chemistry, Botany, Climatology |
| 2002 | Proposal Development (Watershed Learning Model) |
| 2003-2004 | Watershed Assessment / Luckiamute Watershed Council |
| 2003-2010 | Support of Luckiamute Watershed Council |
| 2008-2009 | LWC / Rapid Bio-Assessment GIS Support Services |
| 2004-Present | Research: Hydrogeomorphic Analysis |
| 2004-Present | Reseach: Invasive Plant Distribution |

**Physiographic Setting of the Luckiamute Watershed**

- Boundaries
  - Crest of Coast Range to West (headlands)
  - Willamette River to East
- Drainage Area = 815 $km^2$
  - Largest Fifth-Field Watershed in central and northern Coast Range
  - Primary Tributaries
    - Little Luckiamute – northern watershed
    - Luckiamute – southern watershed
  - Secondary Tributaries
    - Soap Creek, Maxfield Creek, Woods Creek, Teal Ck
- Elevation Range:
  - Min: 46 m (150 ft) at Willamette
  - Max: 1016 m (3333 ft) at Fanno Peak
  - Avg. Basin Elevation: 277 m (910 ft)
- Basin Morphometry
  - Average Stream Gradient: 3 m /km
  - Total Stream Length: 90.7 km


124°
123°
WASHINGTON
TILLAMOOK
HIGHLANDS
TUALATIN MOUNTAINS
Vancouver
Columbia River
TUALATIN
BASIN
Portland
Forest Grove
Hillsboro
PORTLAND
BASIN
Tillamook
Beaverton
CHEHALEM MOUNTAINS
Clackamas
River
Oregon City
PACIFIC OCEAN
Newberg
McMinnville
Willamette River
NORTHERN
WILLAMETTE
VALLEY
EOLA HILLS
Scotts Mill
earthquake
45°
COAST
RANGE
Dallas
Salem
WALDO
HILLS
Monmouth
SALEM HILLS
RANGE
Study
Area
North Santiam River
CASCADE
Newport
Albany
Corvallis
Lebanon
SOUTHERN
WILLAMETTE
VALLEY
OREGON
South Santiam River
McKenzie River
Eugene
Springfield
44°
0
50 KILOMETERS
EXPLANATION
Lowlands of Willamette Valley
Uplands




**From Luckiamute Watershed Council**

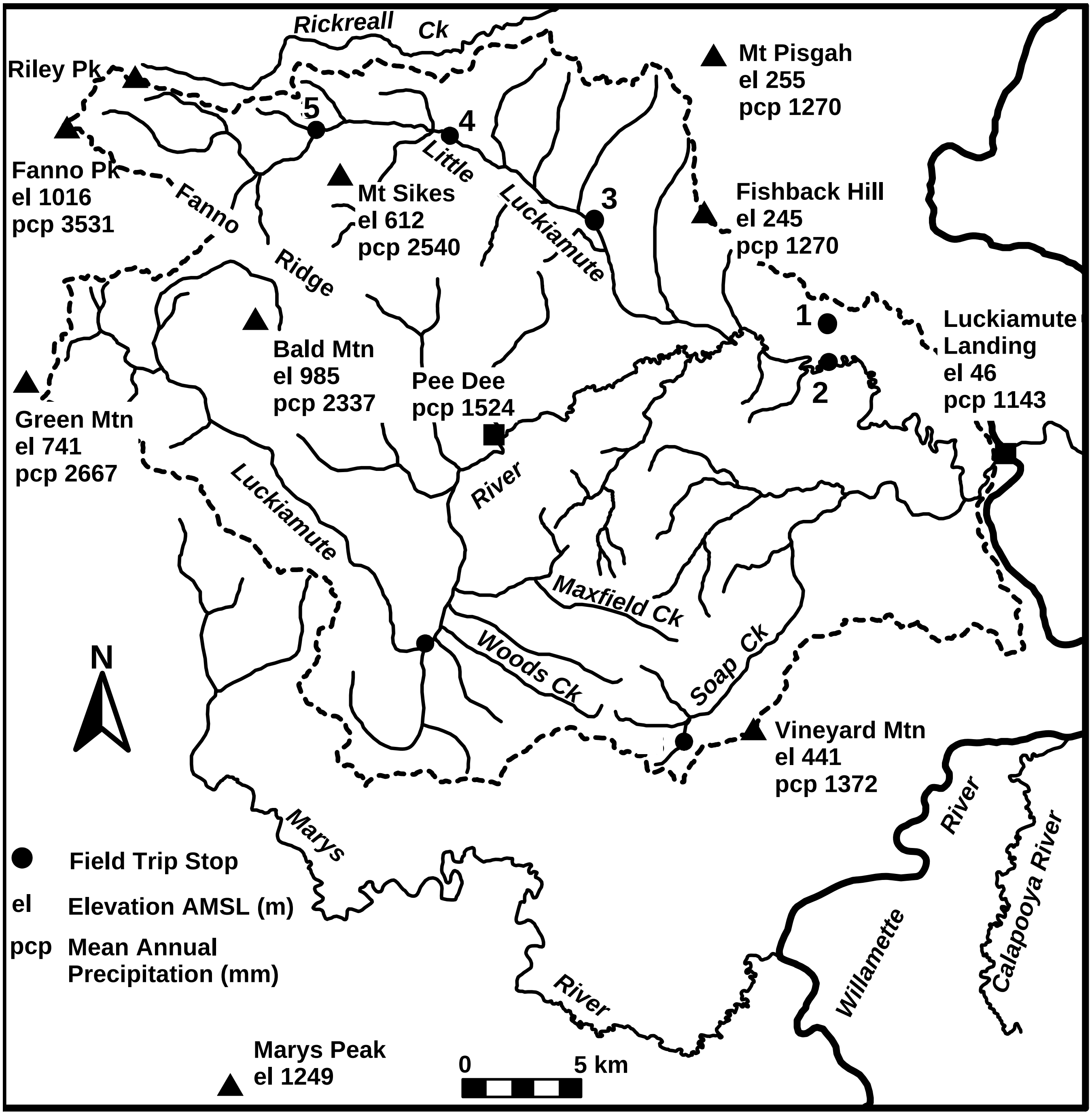
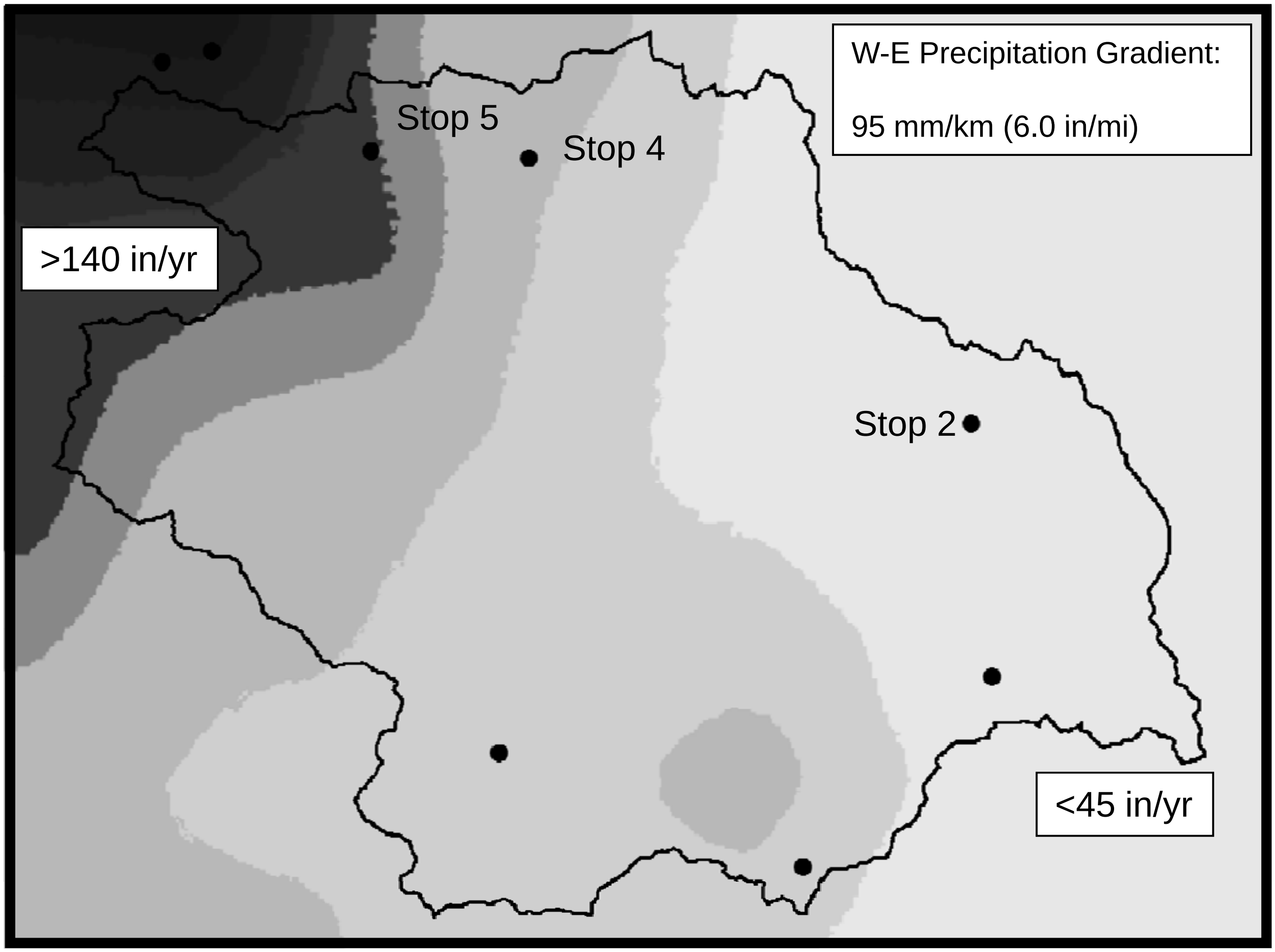
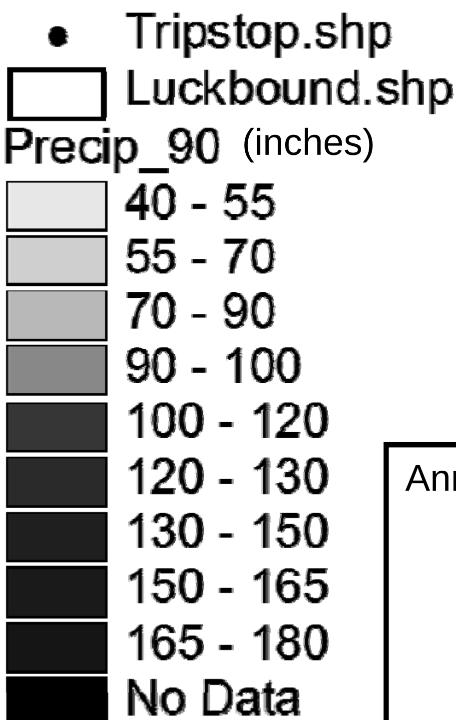



Figure 2. Physiographic map and spot annual precipitation for the Luckiamute Watershed.



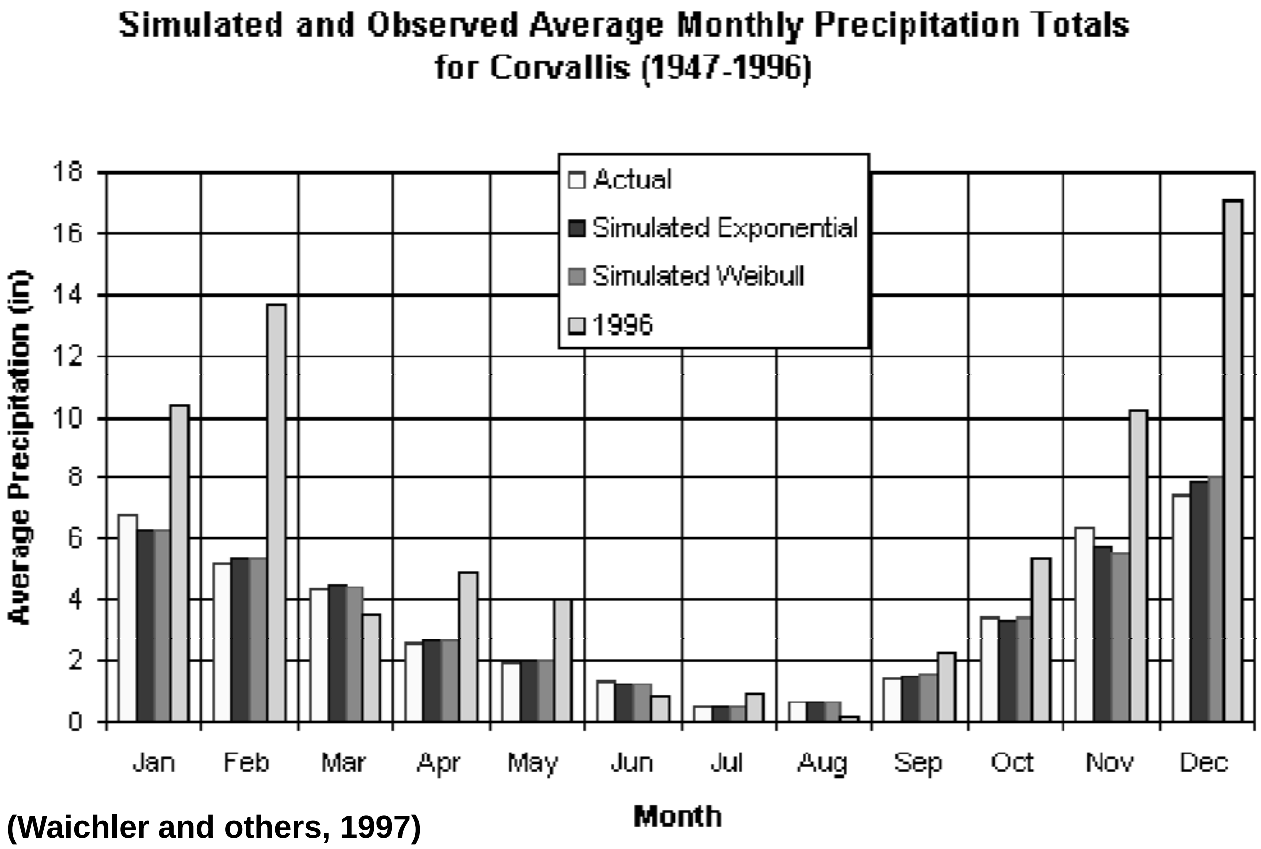




**1990 Average Annual Precipitation for the Luckiamute Watershed (inches) (from the Oregon Climate Service)**

Annual Precipitation

Basin Maximum: 3600 mm (>140 in) – Divide
Basin Minimum: 1140 mm (~45 in) – Willamette Valley
Basin-wide Precipitation Average = 1894 mm (~75 in)
Seasonal Precipitation Cycle (October – March)

Average Runoff = 61% of Annual Precipitation



(Waichler and others, 1997)

Water Balance of Luckiamute Watershed

| Period (1961-1990) | Mean Precipitation (mm) | Precip. (Input) (m$^3$) | Observed Mean Discharge (cfs) | Observed Total Discharge (m$^3$) | INFILTRATION + EVAPOTRANSPIRATION Difference (Precip-Discharge) (m$^3$) | Difference as % of Precip. ("%LOSS") |
|---|---|---|---|---|---|---|
| Annual | 1894 | 1.23E+09 | | 7.55E+08 | 4.77E+08 | 39% |
| Jan | 335 | 2.18E+08 | 2232.146 | 1.69E+08 | 4.86E+07 | 22% |
| Feb | 258 | 1.68E+08 | 1853.276 | 1.27E+08 | 4.09E+07 | 24% |
| Mar | 216 | 1.41E+08 | 1472.097 | 1.12E+08 | 2.89E+07 | 21% |
| Apr | 101 | 6.57E+07 | 795.9956 | 5.84E+07 | 7.27E+06 | 11% |
| May | 51.9 | 3.38E+07 | 396.072 | 3.00E+07 | 3.72E+06 | 11% |
| Jun | 41.7 | 2.71E+07 | 188.61 | 1.38E+07 | 1.33E+07 | 49% |
| Jul | 11.3 | 7.35E+06 | 71.32473 | 5.41E+06 | 1.94E+06 | 26% |
| Aug | 23.8 | 1.55E+07 | 37.25441 | 2.83E+06 | 1.27E+07 | 82% |
| Sep | 50.3 | 3.27E+07 | 49.19311 | 3.61E+06 | 2.91E+07 | 89% |
| Oct | 143 | 9.30E+07 | 124.4226 | 9.44E+06 | 8.36E+07 | 90% |
| Nov | 284 | 1.85E+08 | 904.1411 | 6.64E+07 | 1.18E+08 | 64% |
| Dec | 378 | 2.46E+08 | 2069.228 | 1.57E+08 | 8.89E+07 | 36% |

**Water budget for Luckiamute Watershed (Waichler and others, 1997)**

**Tectonic Setting of the Luckiamute Watershed**

- Convergent Tectonic Margin
  - Subduction of Juan de Fuca Plate Beneath North America
    - Convergent Rates: 3.5-4.0 cm/yr
  - Style of Tectonism
    - Oblique Convergence
    - Tectonic accretion
    - Clockwise Rotation
- Coast Range Orogenesis
  - Accreted Marine Volcanic and Sedimentary Rocks
  - Active Uplift Between 15-10 Ma to Present
  - Neotectonics
    - General Uplift and Eastward Tilting
- Tectonic Influence on Luckiamute
  - Luckiamute drains the eastward tilted flanks of the Coast Range (Rhea, 1993)
  - Luckiamute Watershed located at segment boundary of Juan de Fuca Subduction zone

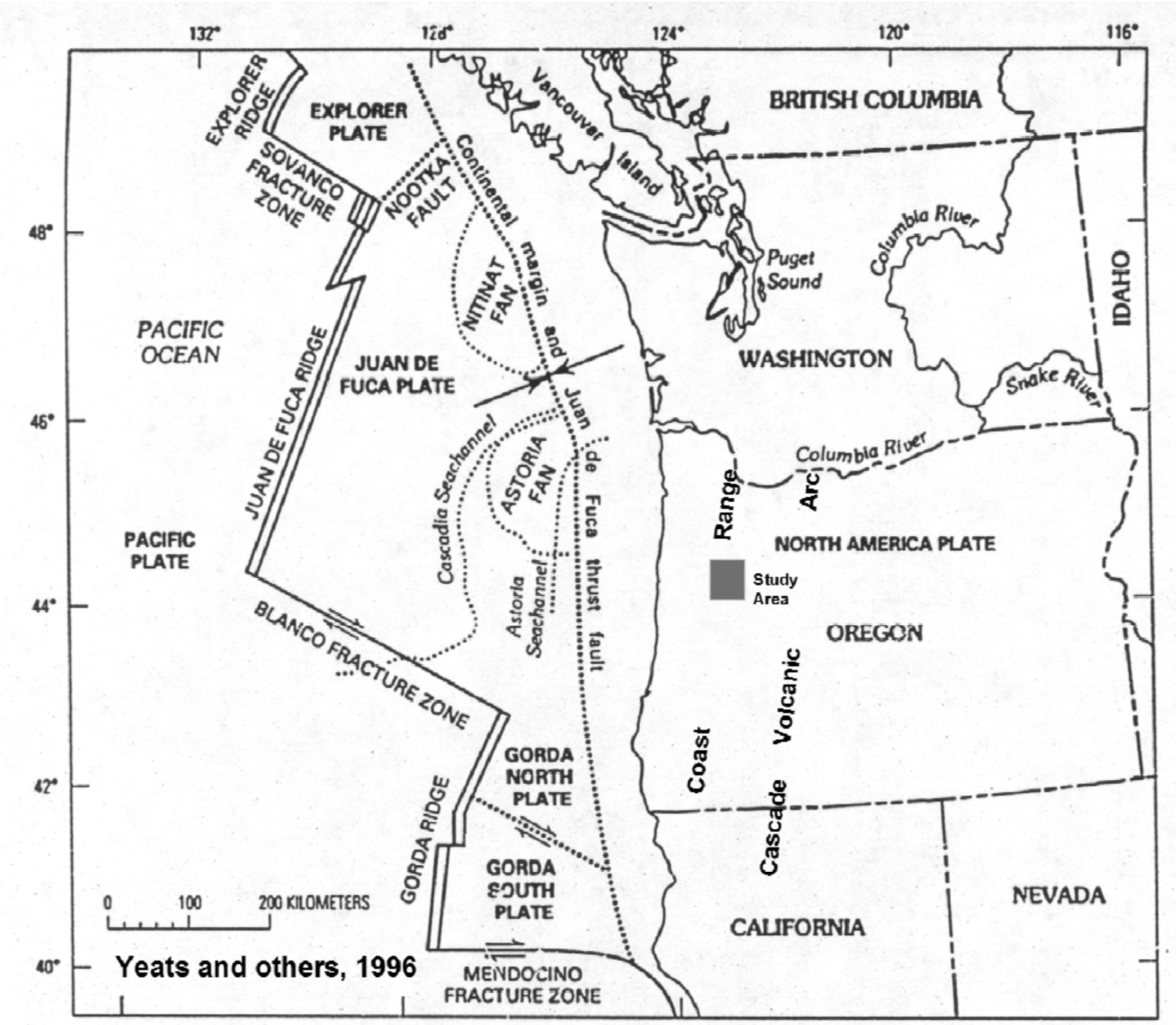
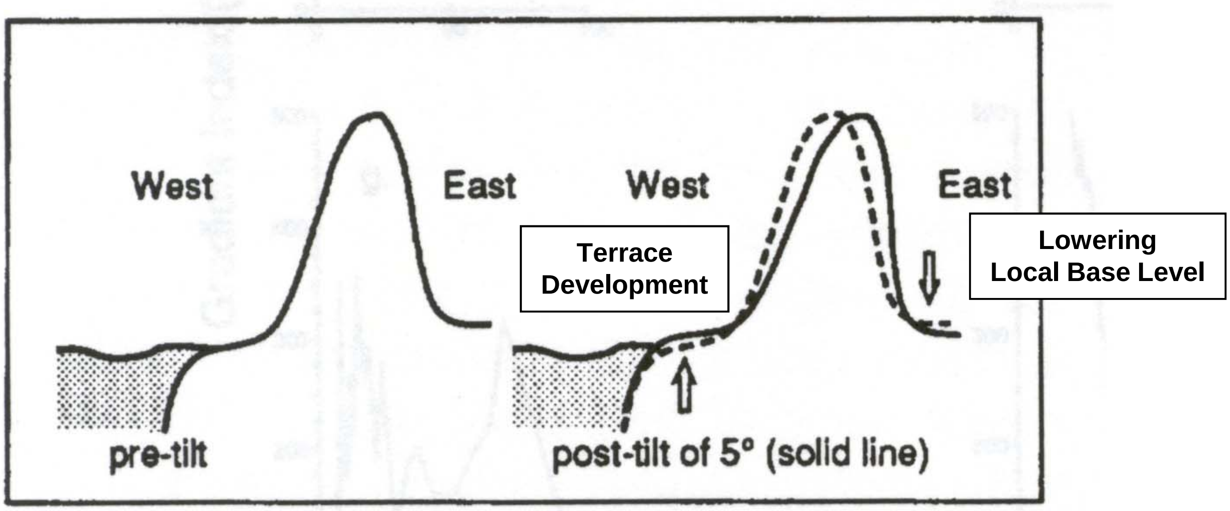
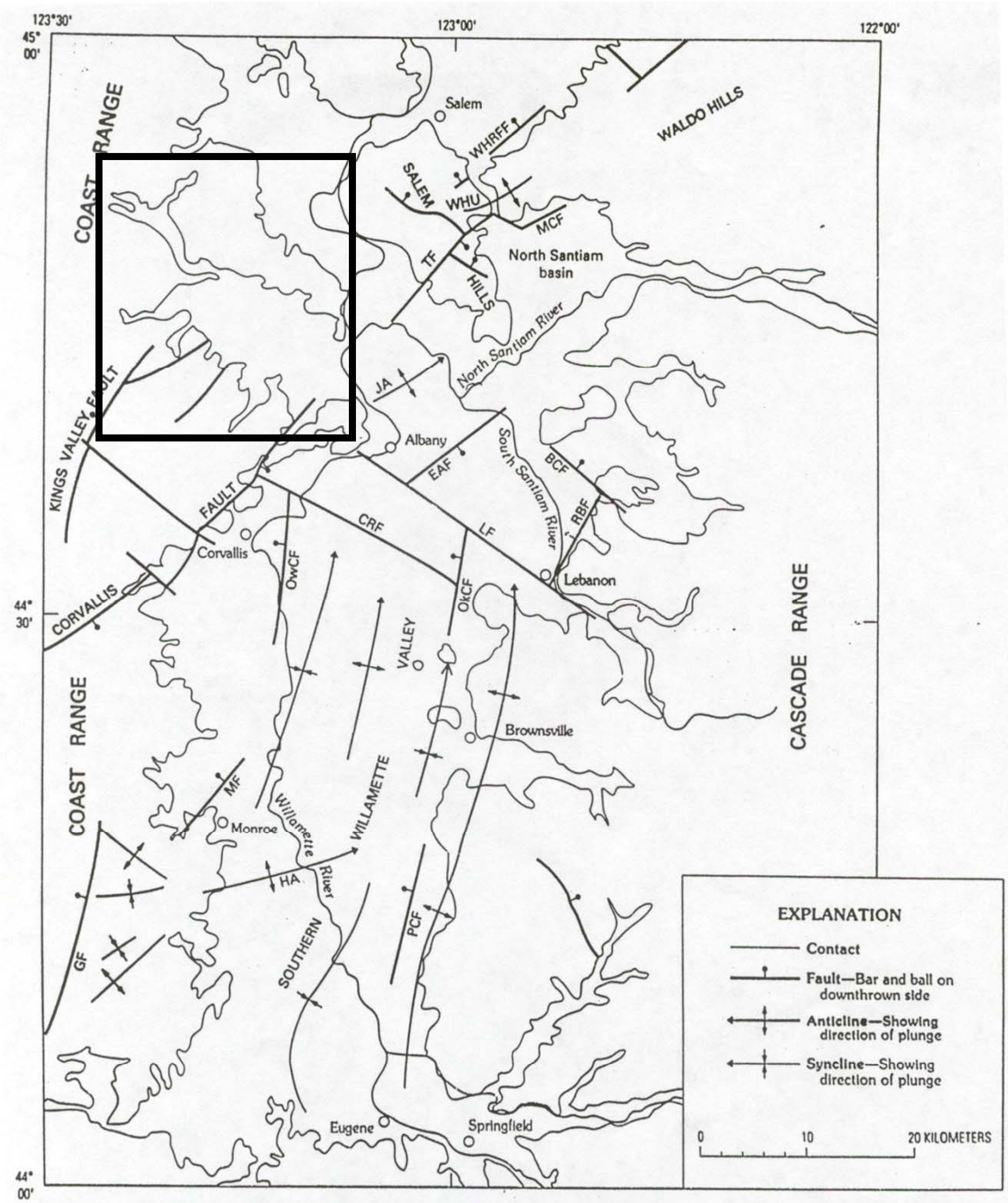
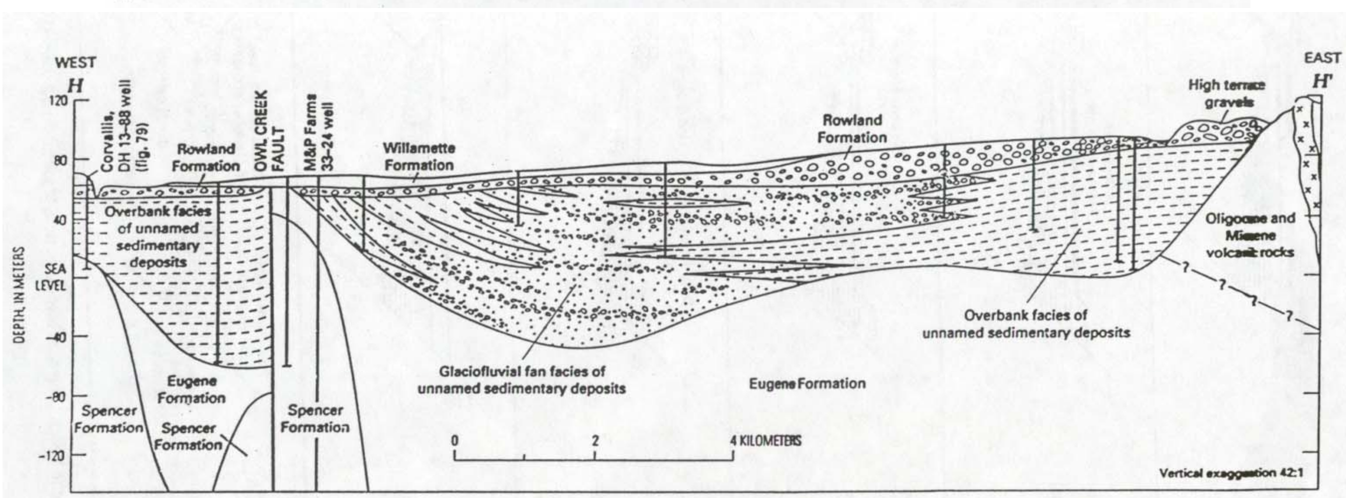



**Plate tectonic configuration of the Pacific Northwest.**




**Cartoon showing effects of Coast Range tilting on watershed gradient (from Rhea, 1993)**


123°30'
123°00'
122°00'
45° 00'
44° 30'
44° 00'
COAST RANGE
Salem
WALDO HILLS
WHRFF
SALEM
WHU
MCF
TF
HILLS
North Santiam basin
North Santiam River
JA
KINGS VALLEY FAULT
Albany
EAF
South Santiam River
BCF
RBF
FAULT
CRF
LF
Corvallis
OwCF
OkCF
Lebanon
CORVALLIS
VALLEY
CASCADE RANGE
Brownsville
MF
Monroe
Willamette River
WILLAMETTE
HA
GF
SOUTHERN
PCF
Eugene
Springfield
EXPLANATION
Contact
Fault—Bar and ball on downthrown side
Anticline—Showing direction of plunge
Syncline—Showing direction of plunge
0
10
20 KILOMETERS


WEST
H
EAST
H'
DEPTH, IN METERS
120
80
40
SEA LEVEL
-40
-80
-120
Corvallis, DH 13-88 well (fig. 79)
Rowland Formation
OWL CREEK FAULT
M&P Farms 33-24 well
Willamette Formation
Rowland Formation
High terrace gravels
Overbank facies of unnamed sedimentary deposits
Oligocene and Miocene volcanic rocks
Overbank facies of unnamed sedimentary deposits
Glaciofluvial fan facies of unnamed sedimentary deposits
Eugene Formation
Eugene Formation
Spencer Formation
Spencer Formation
Spencer Formation
0
2
4 KILOMETERS
Vertical exaggeration 42:1

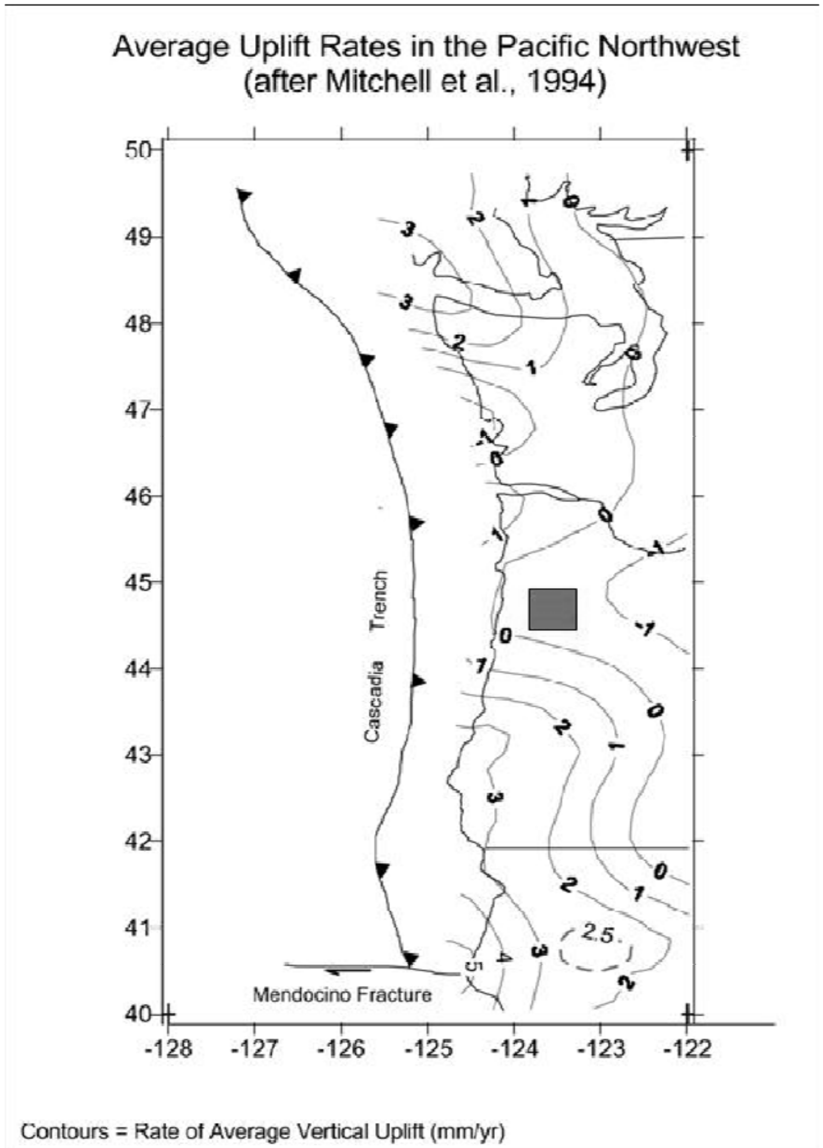
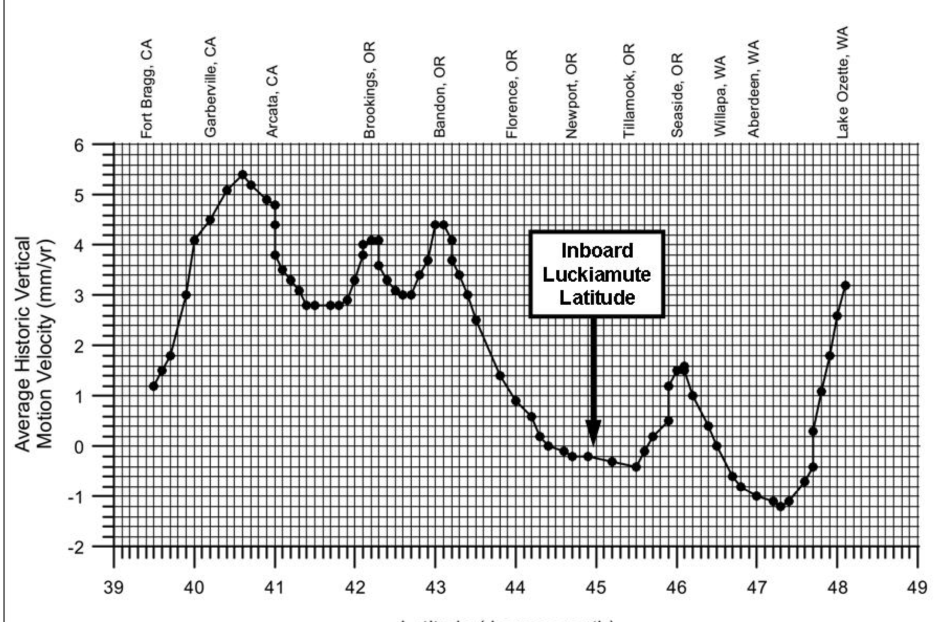



Figure 7. Plot of South-to-North Average Uplift Rate Profiles Along the Coast of the Pacific Northwest



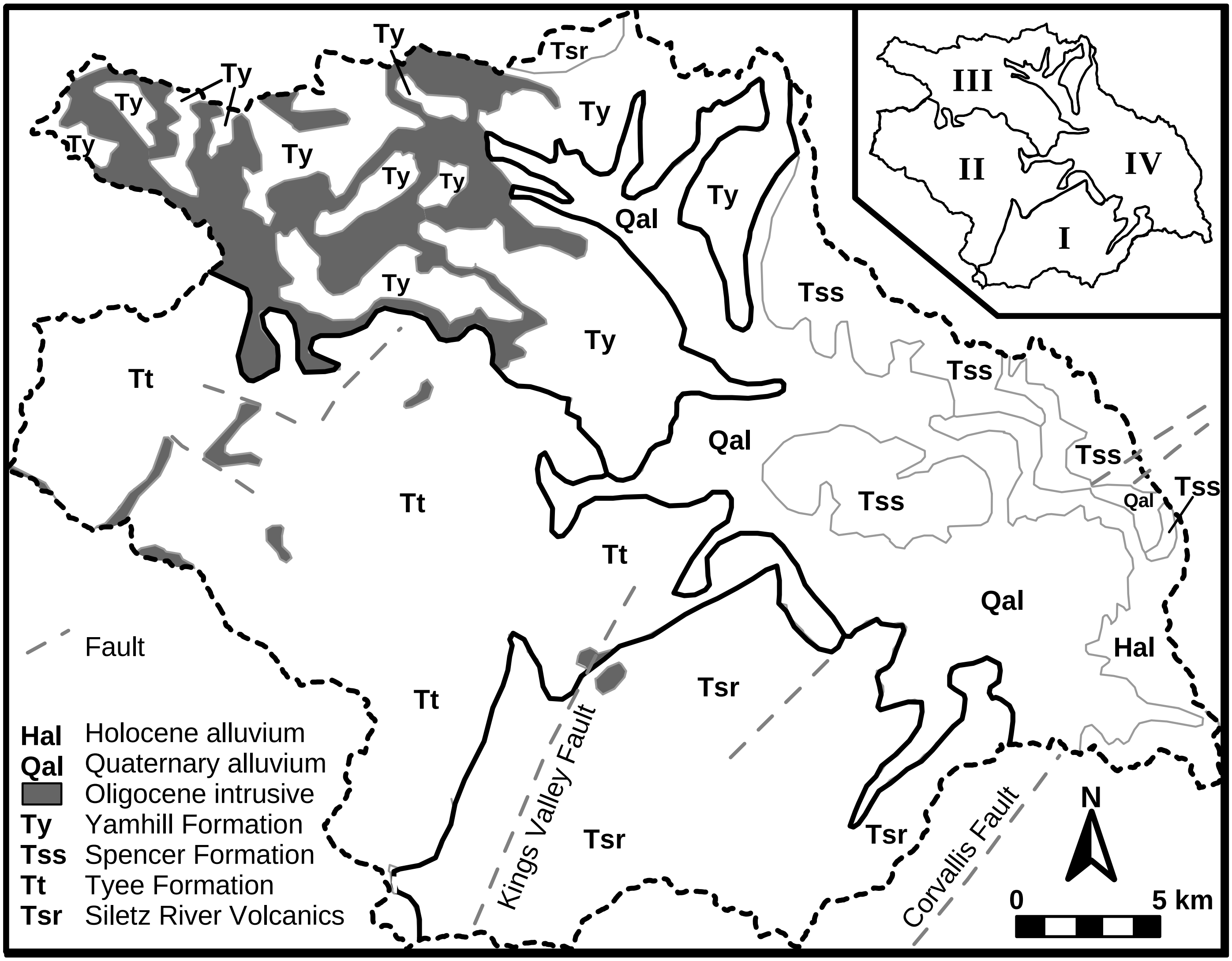
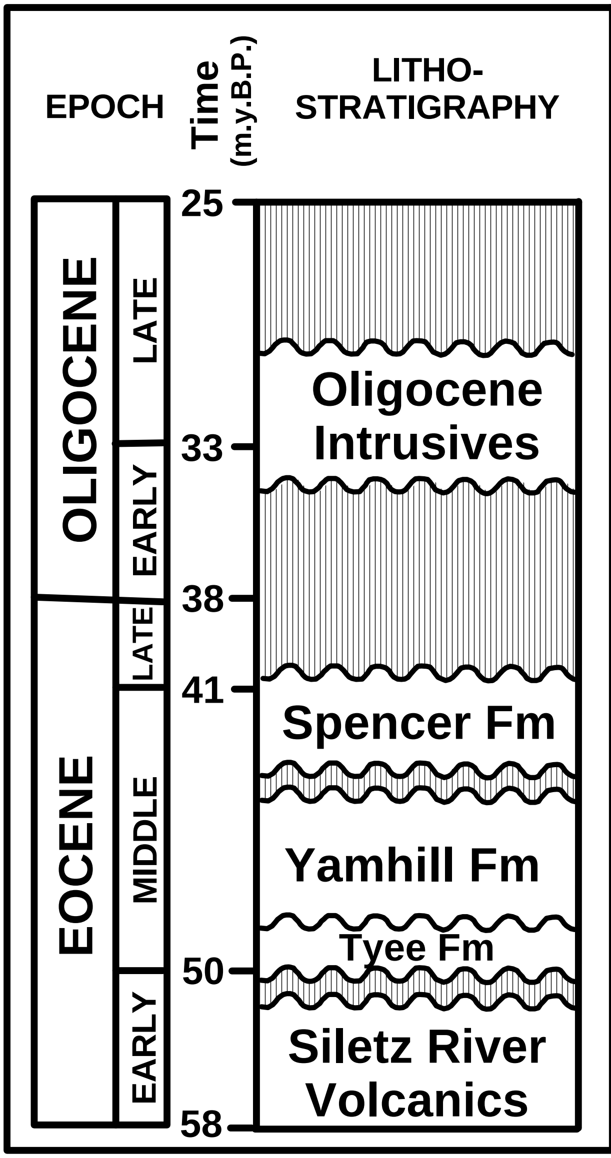



Figure 3. Bedrock geology of the Luckiamute Watershed (after Walker and MacLeod, 1991). Inset map shows grouping of recognized lithospatial domains: I = Siletz River Domain, II = Tyee Domain, III = Yamihill-Ti (Tertiary Intrusive) Domain, IV = Spencer-Valley Fill Domain.

# Bedrock Geology of the Luckiamute Watershed




**Qal – Quaternary Alluvium**

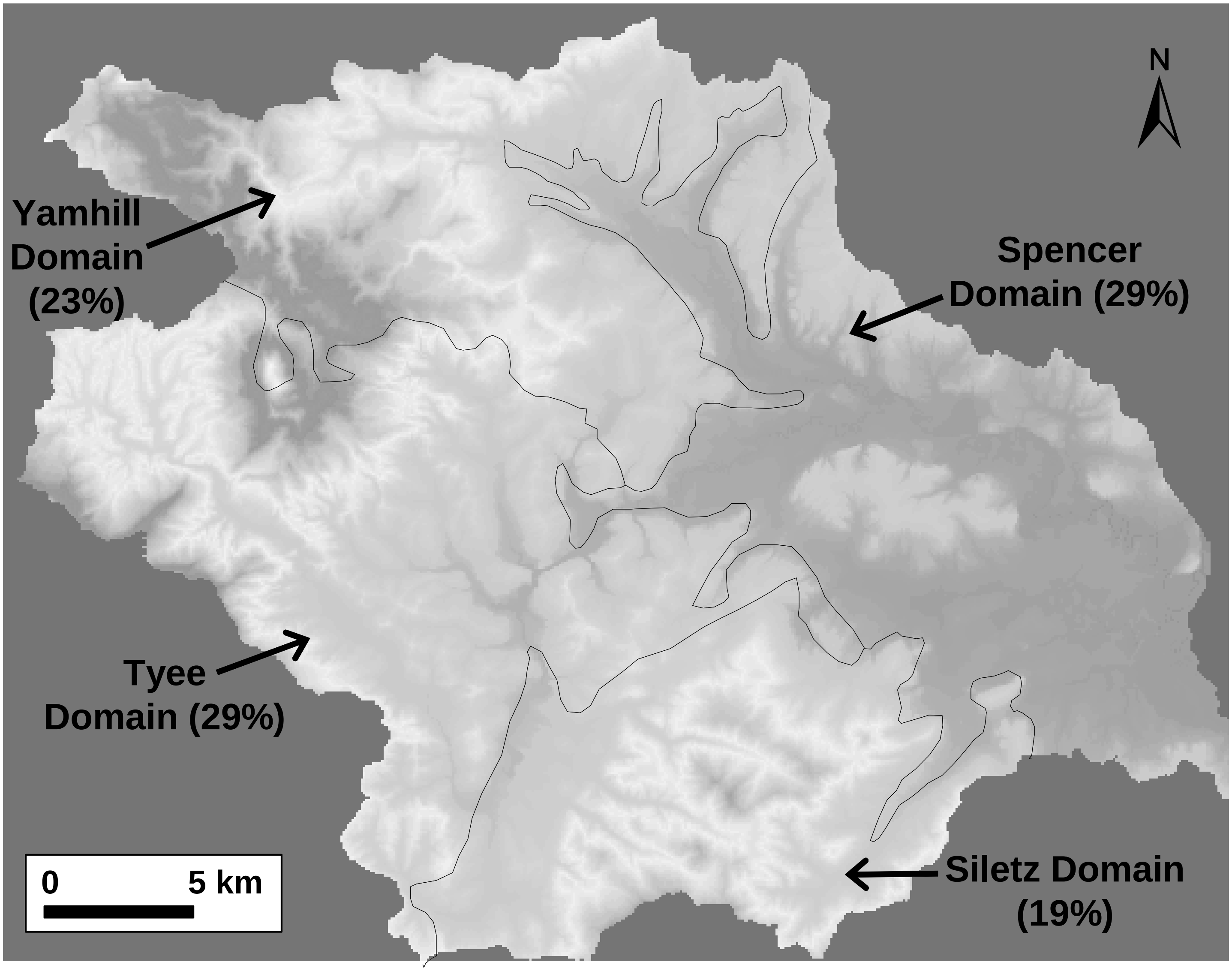
**Ti – Oligocene Mafic Intrusives**: Sheets, sills, and dikes of massive gabbro.

**Tss – Spencer Formation**: Thick- to thin-bedded marine tuffaceous sandstone, siltstone, and mudstone.

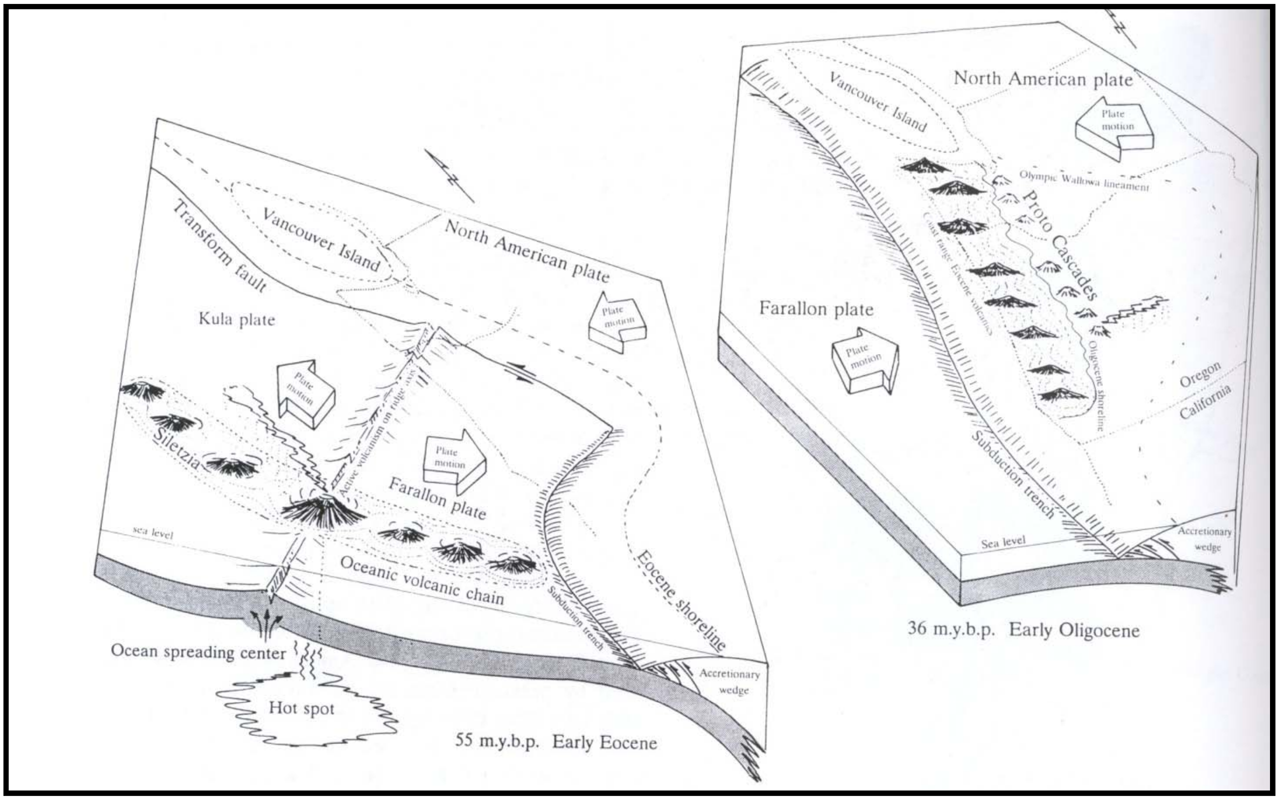
**Ty – Yamhill Formation**: Massive to thinly bedded marine silstone and sandtone interbeds. Locally includes interlayered basalt lava flows.

**Tt – Tyee Formation**: Rhythmically bedded, medium-grained feldspathic sandstone and carbonaceous siltstone. Interpreted as deposits of submarine turbidity currents and fans.

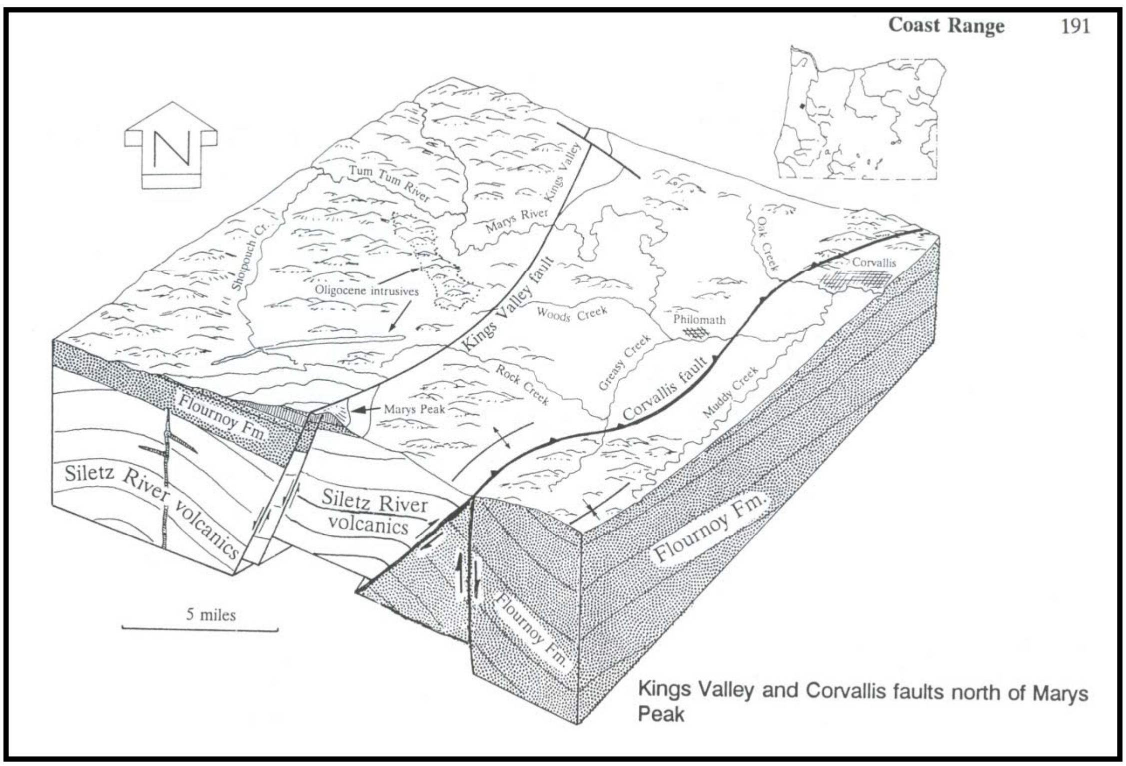
**Tsr – Siletz River Volcanics**: Aphanitic to porphyritic, vesicular pillow flows, tuff breccia, and lava flows. Local interbeds of basaltic siltstone and sandstone. Prevasively zeolitized and veined with calcite. Marine origin interpreted as accreted oceanic crust and seamounts.


N
Yamhill
Domain
(23%)
Spencer
Domain (29%)
Tyee
Domain (29%)
Siletz Domain
(19%)
0
5 km

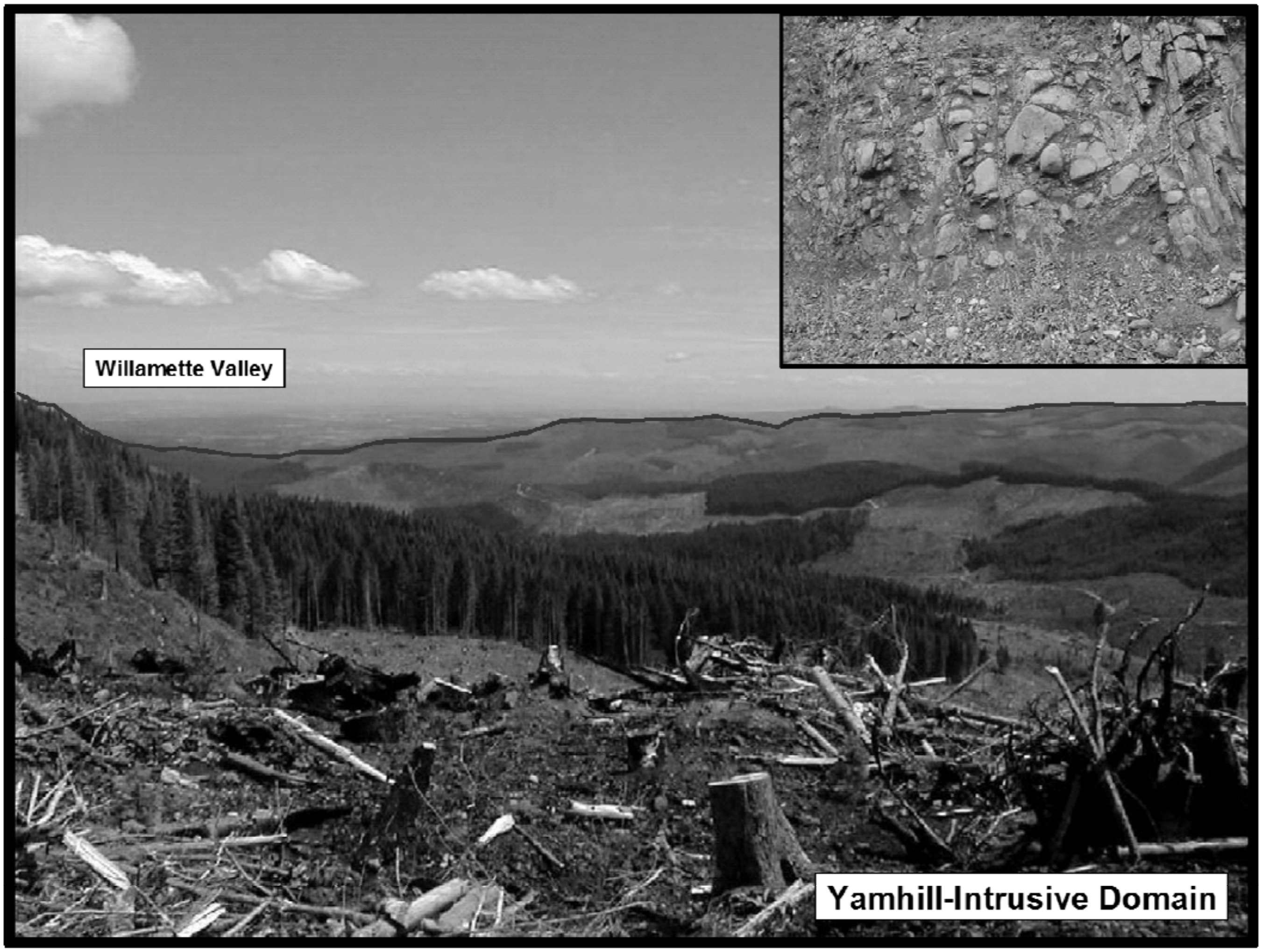

Siletz River Volcanics – Pillow Basalts

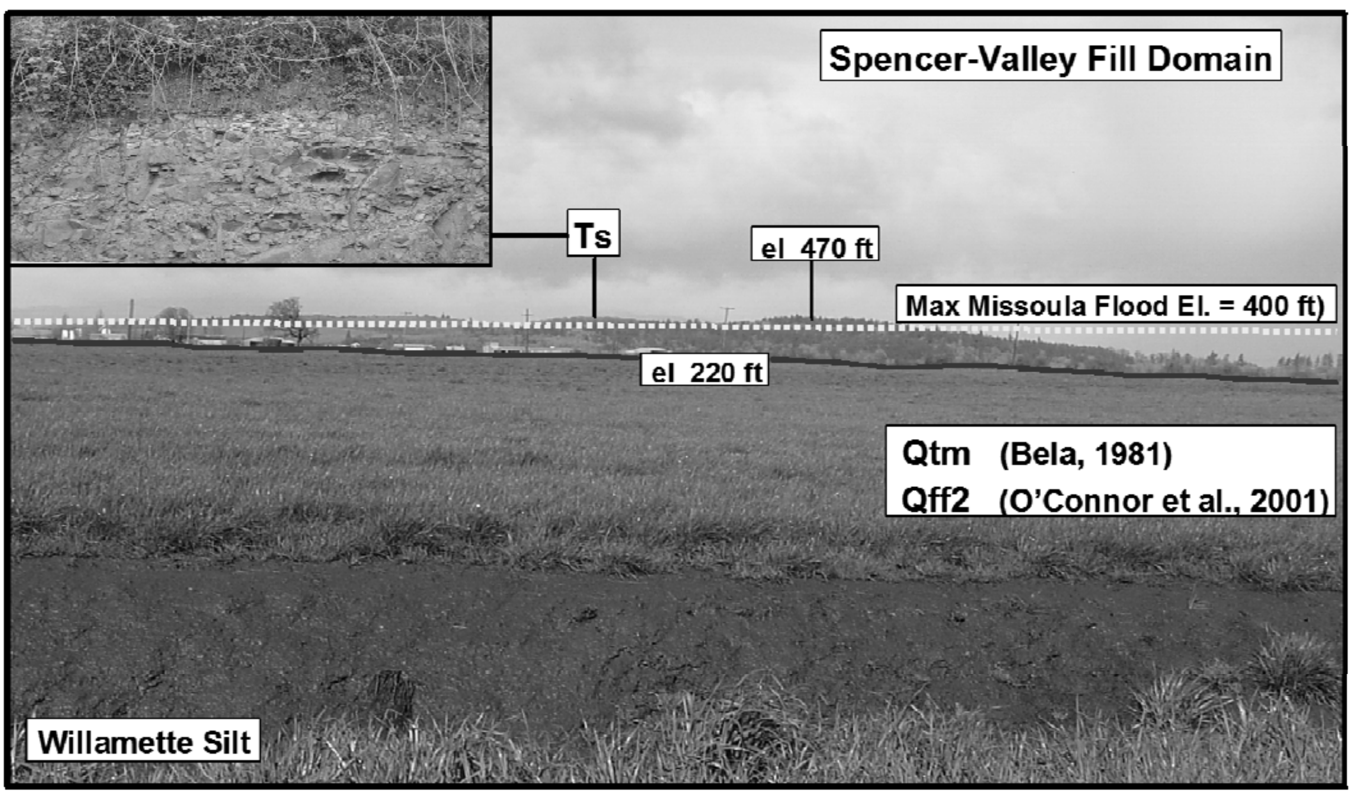



**Accretionary tectonic model for Siletz River Volcanics (from Orr and Orr, 1999)**




**Schematic of Corvallis and Kings Valley Faults (from Orr and Orr 1999)**


Willamette Valley
Yamhill-Intrusive Domain


Spencer-Valley Fill Domain
Ts
el 470 ft
Max Missoula Flood El. = 400 ft)
el 220 ft
Qtm (Bela, 1981)
Qff2 (O'Connor et al., 2001)
Willamette Silt

# Tyee Domain Landscape


**Geomorphology of the Luckiamute Watershed**

Valley Floor-Fluvial Regime
- •Landforms
  - •Channel
  - •Floodplain
  - •Terrace
  - •Small-scale Fans
  - •Strath-pediment surfaces
  - •Low-relief colluvial hillslopes (Spencer Fm)
- •Deposits
  - •Alluvial Fill (sorted sand and gravel)
  - •Debris Flow Deposits (diamicton)
  - •Slackwater Silts and Clay
- •Processes
  - •Channel Transport
  - •Overbank Sedimentation

•Hillslope-Colluvial Regime
- •Landforms
  - •Ridge tops
  - •Hillslopes-Sideslopes
  - •Hollows
  - •Pediment Surfaces
- •Deposits
  - •Colluvium (gravel diamicton)
  - •Residuum (gravel diamicton)
- •Processes
  - •Collvial Creep
  - •Debris Slide / Flow
  - •Tree-throw / Bioturbation

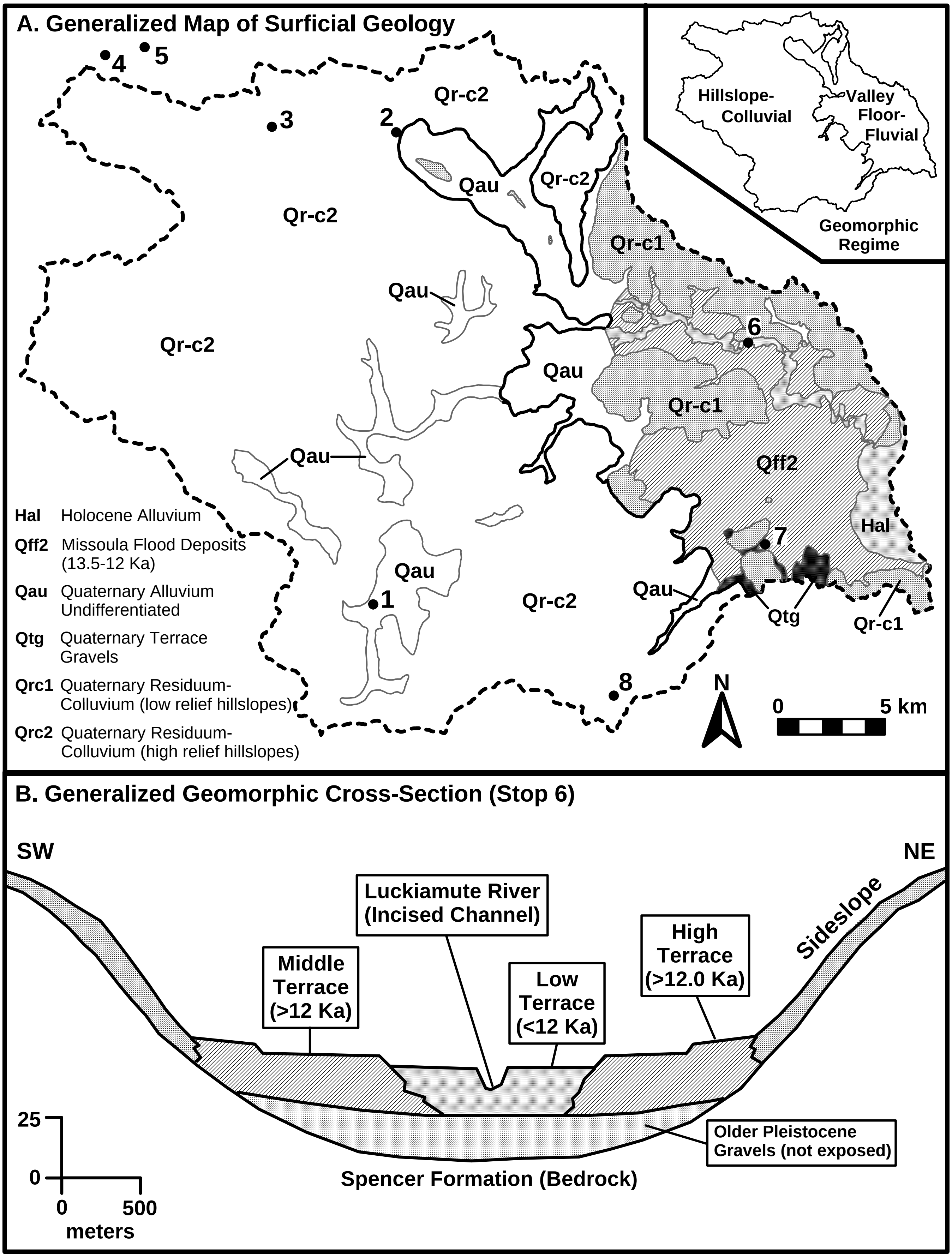
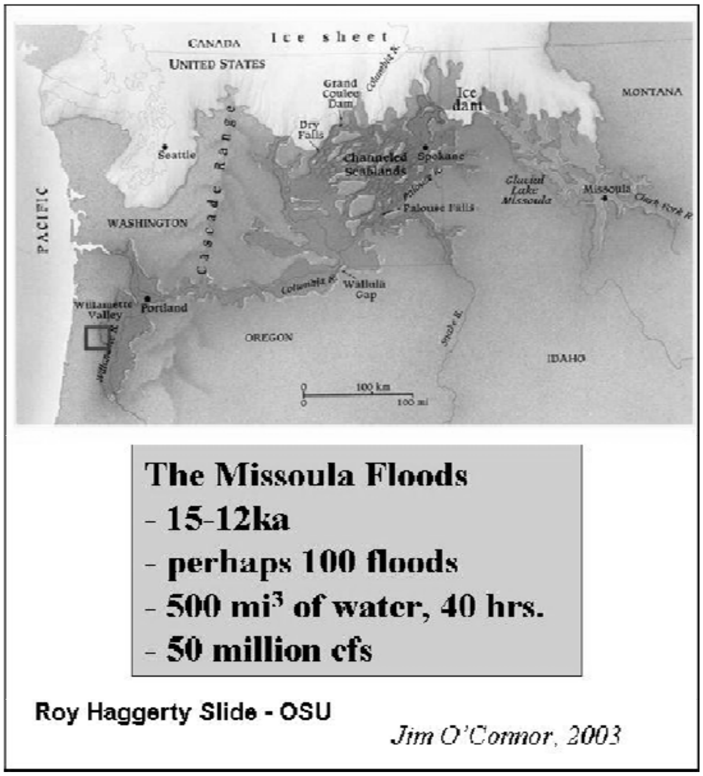
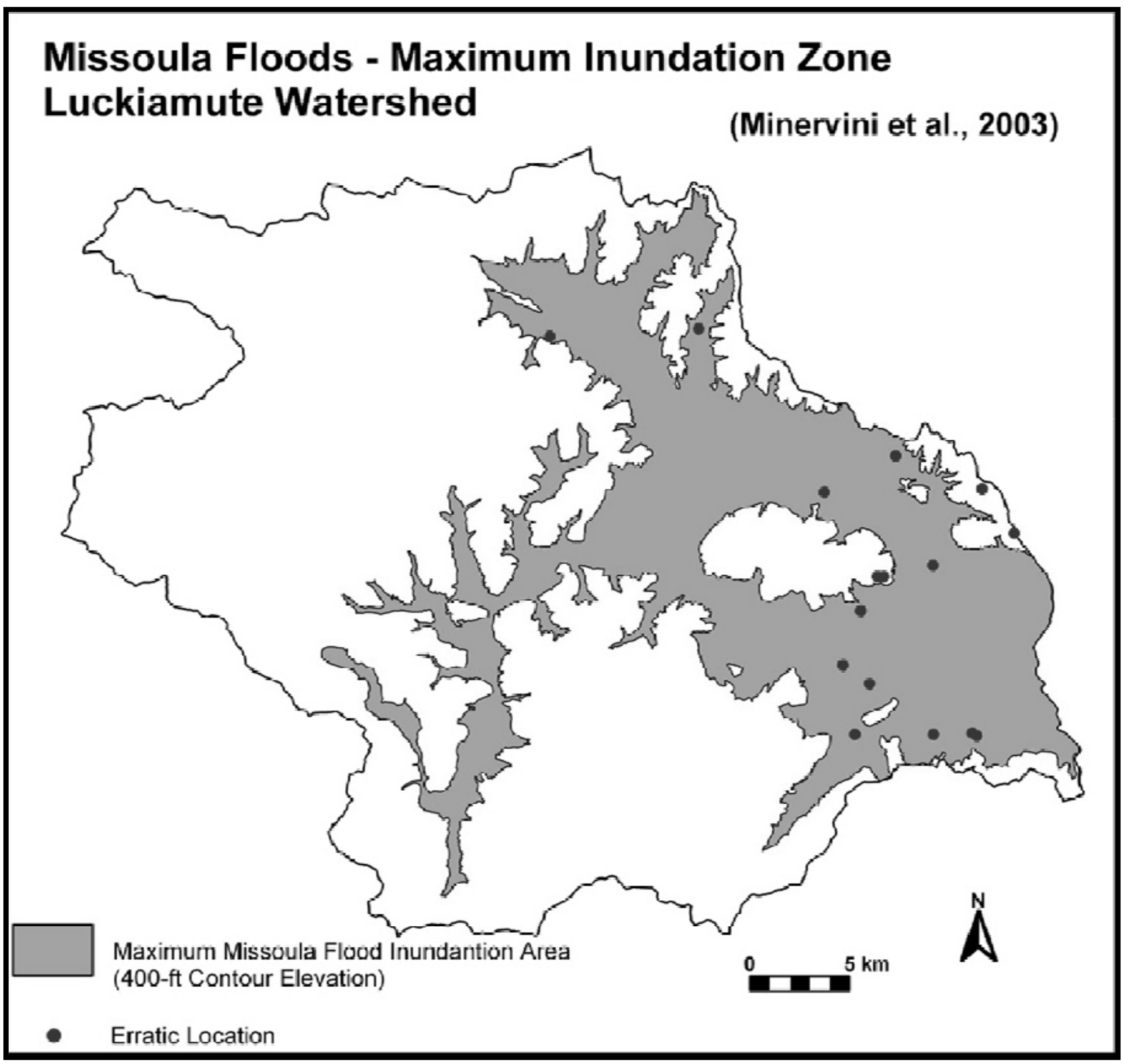
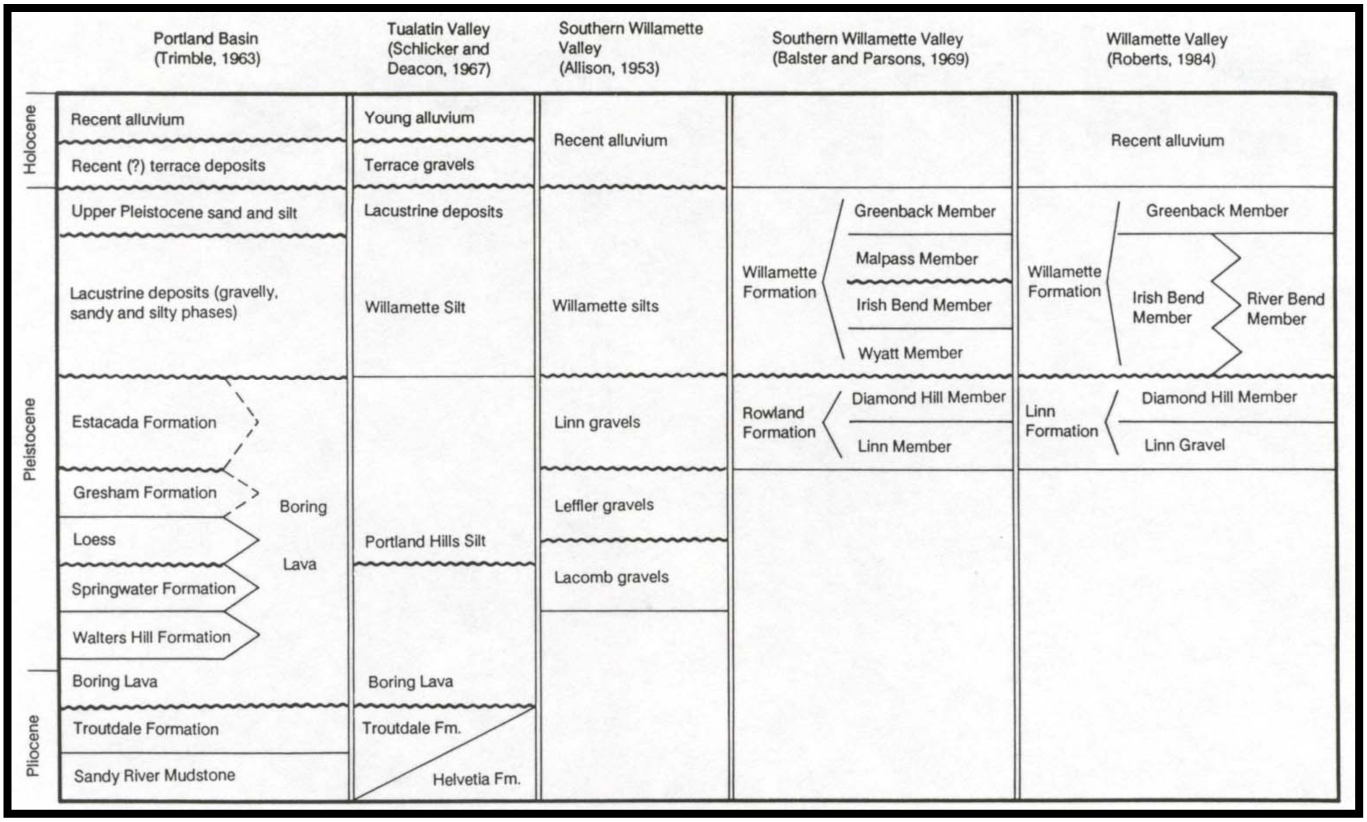
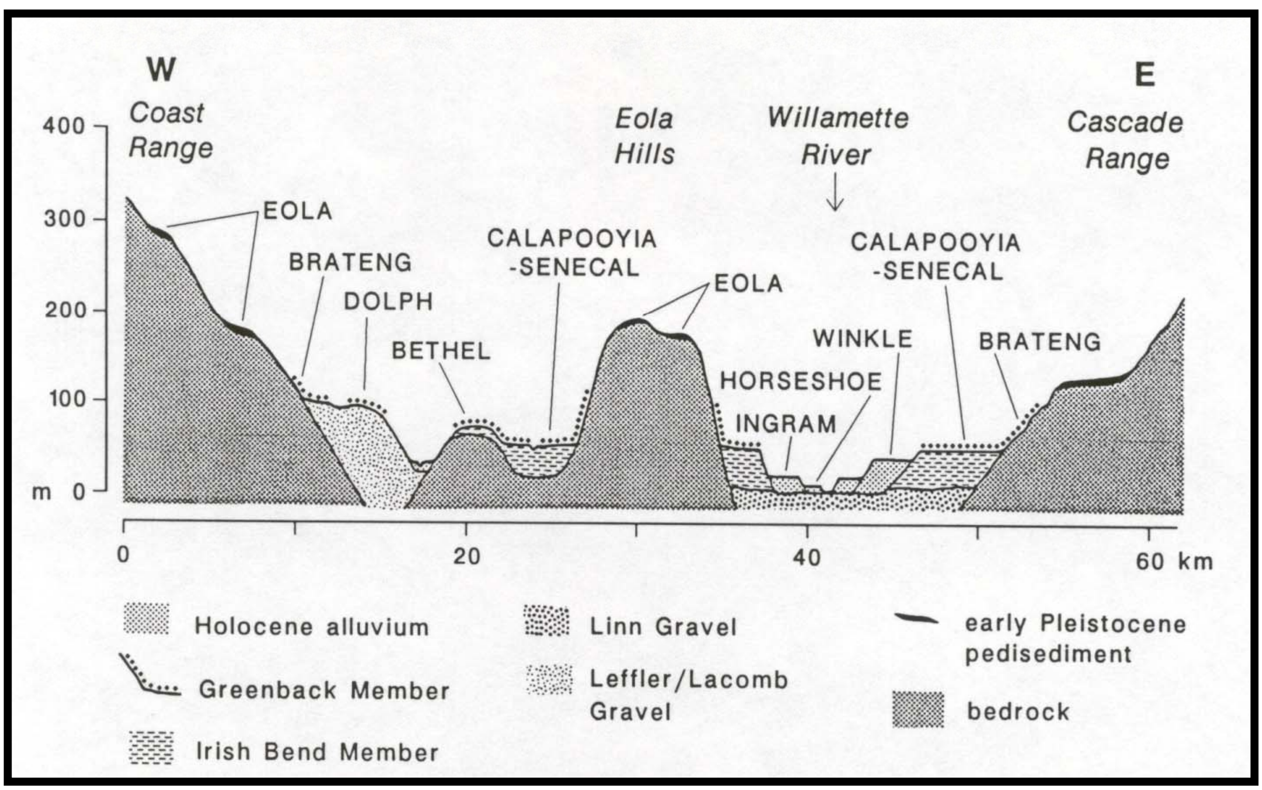



Figure 4. Surficial geology and geomorphology of the Luckiamute River Basin. Surficial map units are modified from O'Connor and others (2001), after Taylor and others (1996). Cross section shown in frame B represents generalized landform elements at Helmick State Park (Stop 6).

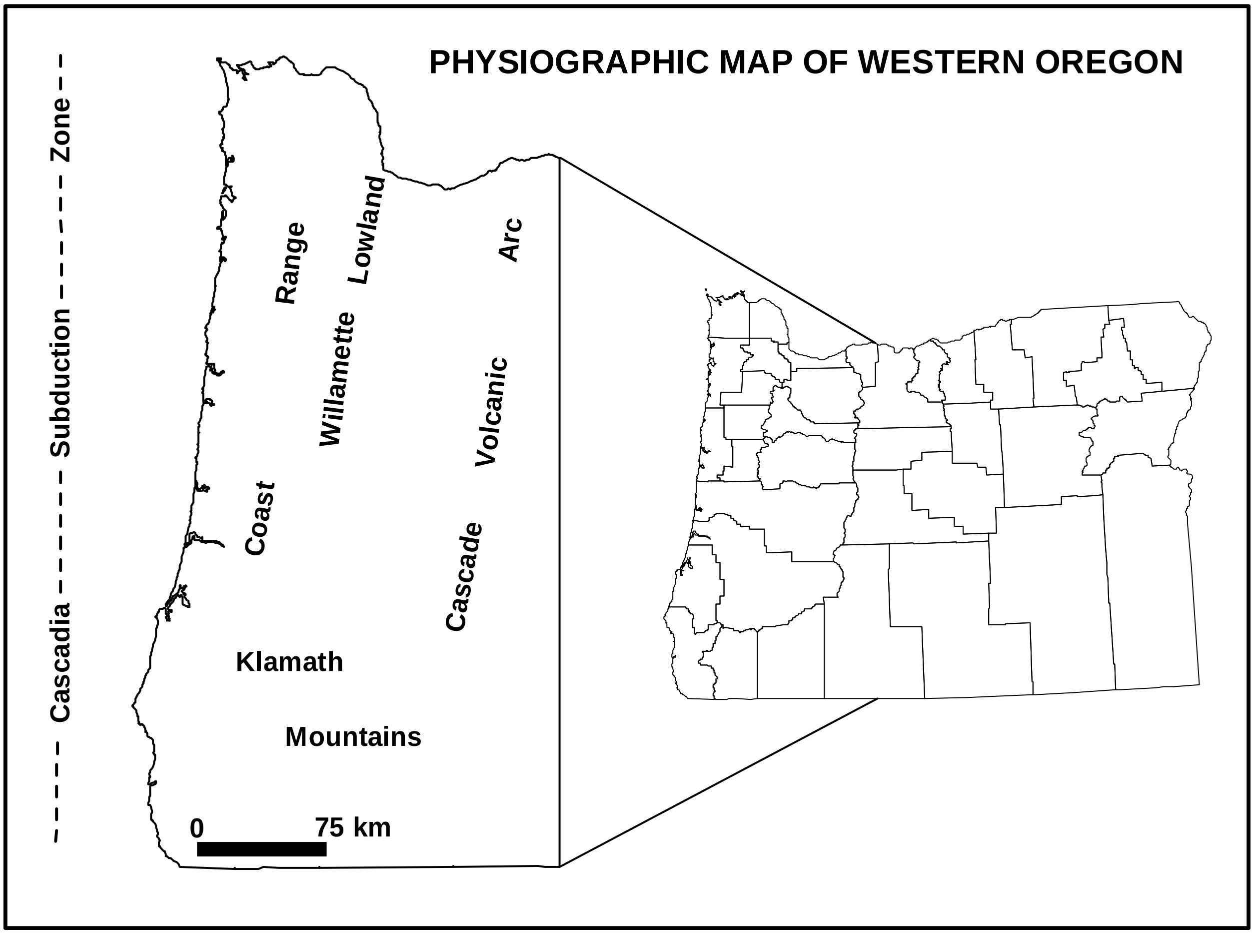

CANADA
Ice sheet
UNITED STATES
Grand Coulee Dam
Ice dam
MONTANA
Dry Falls
Seattle
Channeled Scablands
Spokane
Glacial Lake Missoula
Missoula
PACIFIC
WASHINGTON
Palouse Falls
Cascade Range
Wallula Gap
Willamette Valley
Portland
OREGON
IDAHO
100 km
100 mi
The Missoula Floods
- 15-12ka
- perhaps 100 floods
- 500 mi³ of water, 40 hrs.
- 50 million cfs
Roy Haggerty Slide - OSU
Jim O'Connor, 2003


Missoula Floods - Maximum Inundation Zone
Luckiamute Watershed
(Minervini et al., 2003)
Maximum Missoula Flood Inundantion Area
(400-ft Contour Elevation)
Erratic Location
0
5 km
N




**Quaternary stratigraphy and geomorphic surfaces of the Willamette Basin (from McDowell, 1991).**




## Oregon Coast Range

**Unglaciated, forested landscape**

**Paleogene-Neogene marine volcanic and sedimentary rocks (Walker and MacLeod, 1991)**

**Long history of oblique convergence and tectonic accretion (Wells et al., 1984)**

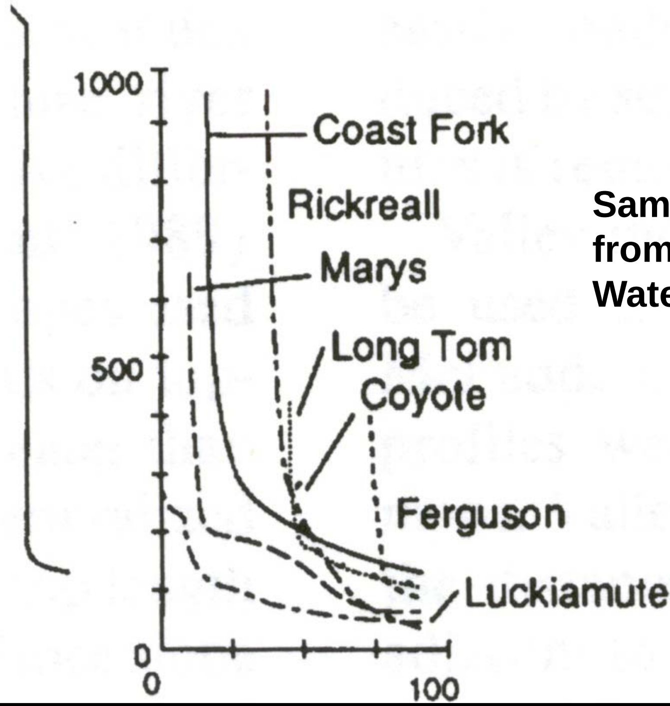
**Active mountain building during the past 10-15 Ma (Snavely et al., 1993)**

**Pleistocene uplift rates = 0.1-0.3 mm/yr (Kelsey et al., 1996)**

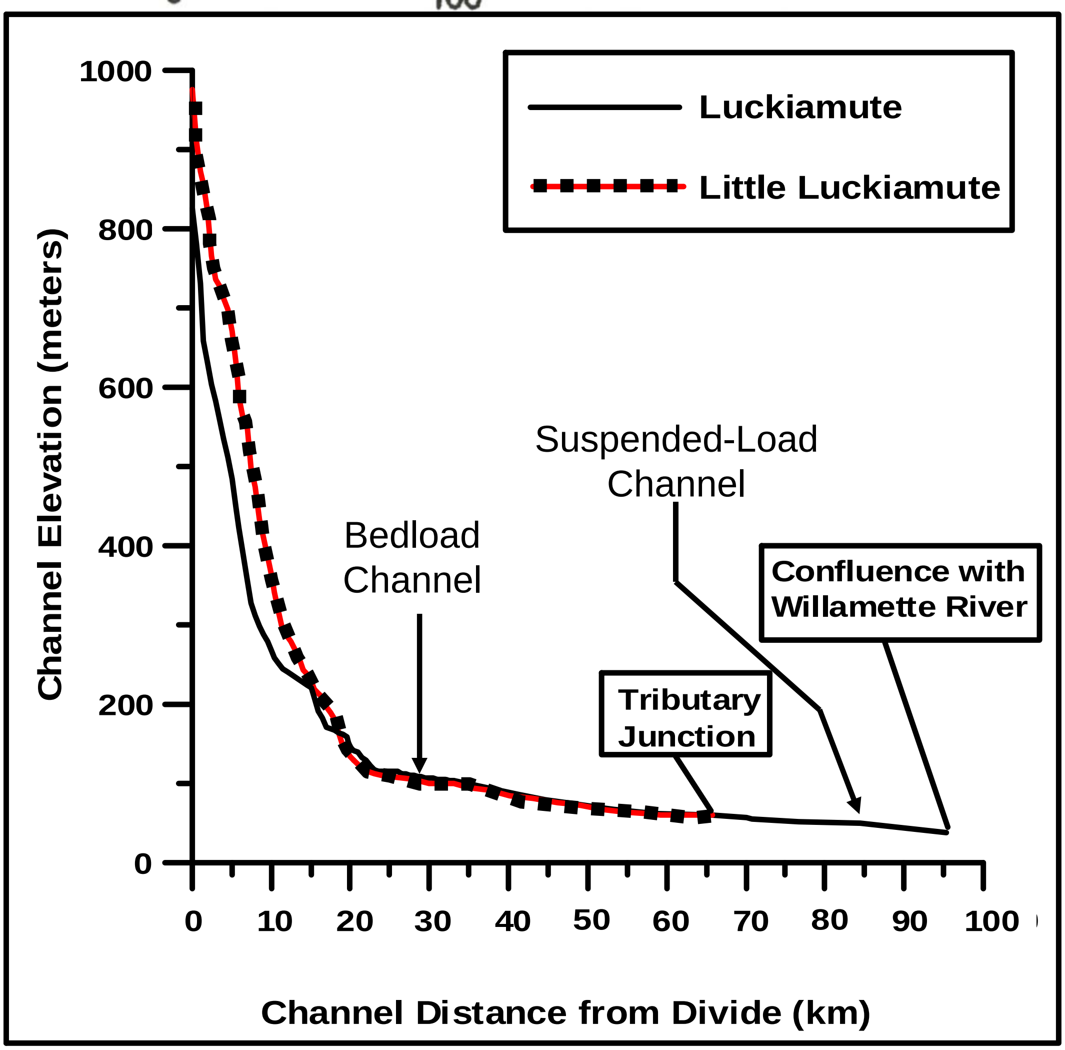
**Historic uplift rates = 1-3 mm/yr (Mitchell et al., 1994)**

**Eastward tilting = 1 x $10^{-8}$ rad/yr (Adams, 1984)**

**Holocene erosion rates = 0.05-0.33 mm/yr (Roering et al., 2005)**

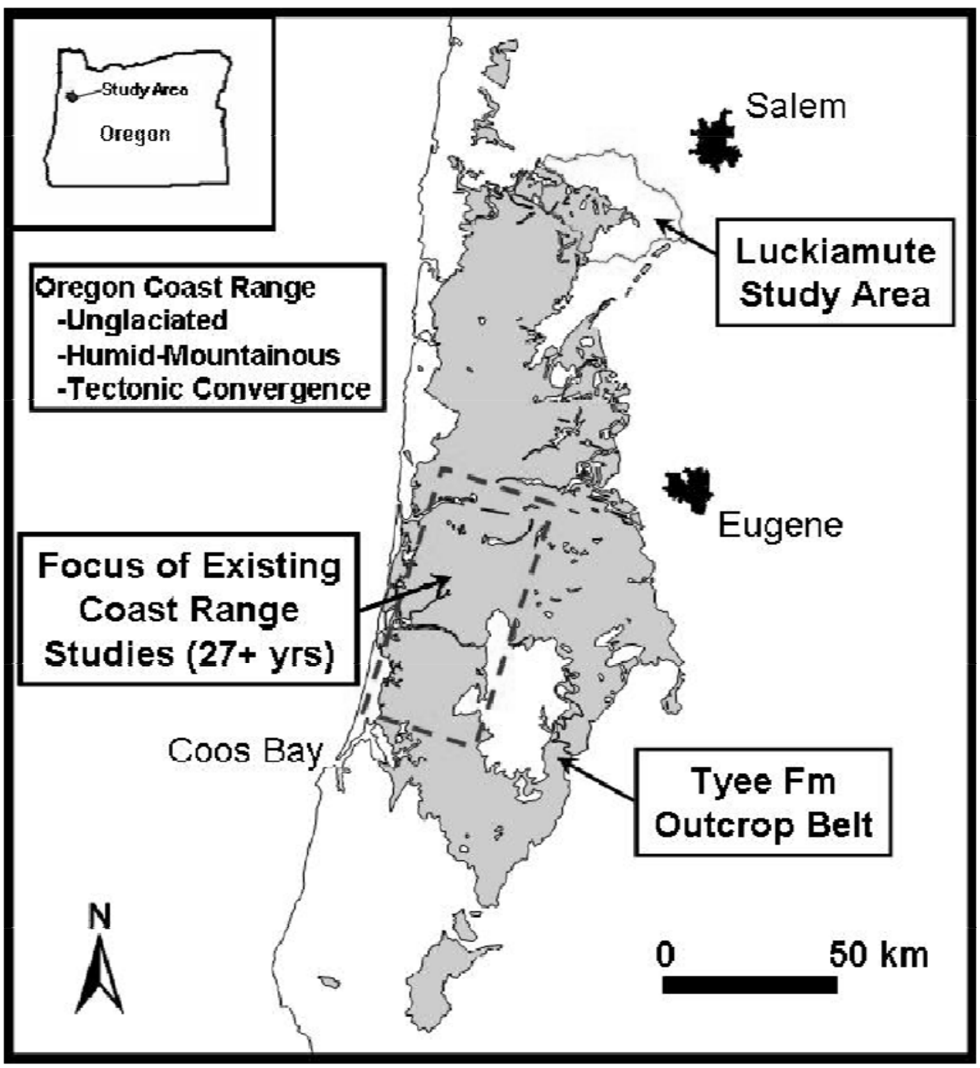



**Sampling of Longitudinal Profiles from Central Coast Range Watersheds (Rhea, 1993)**

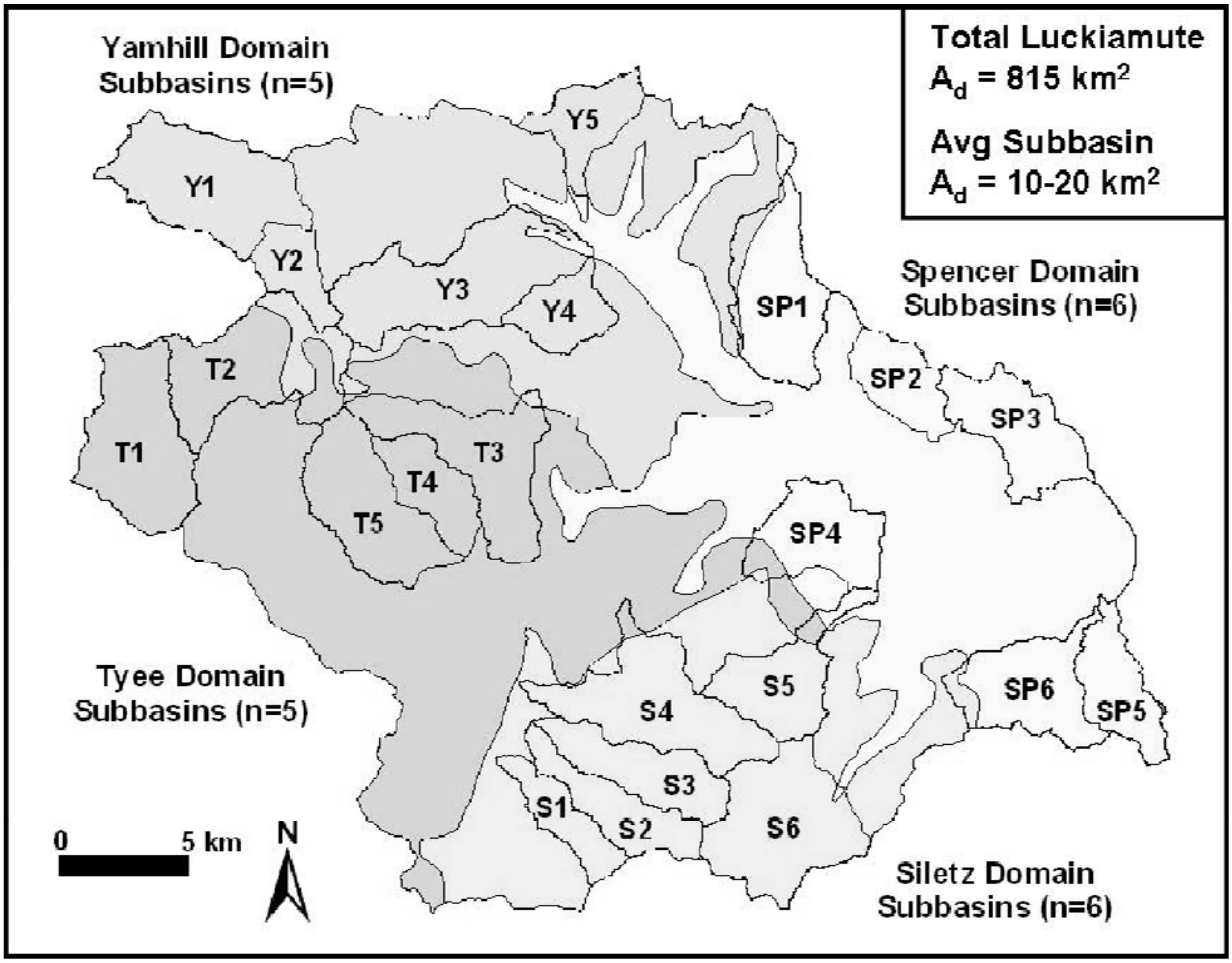


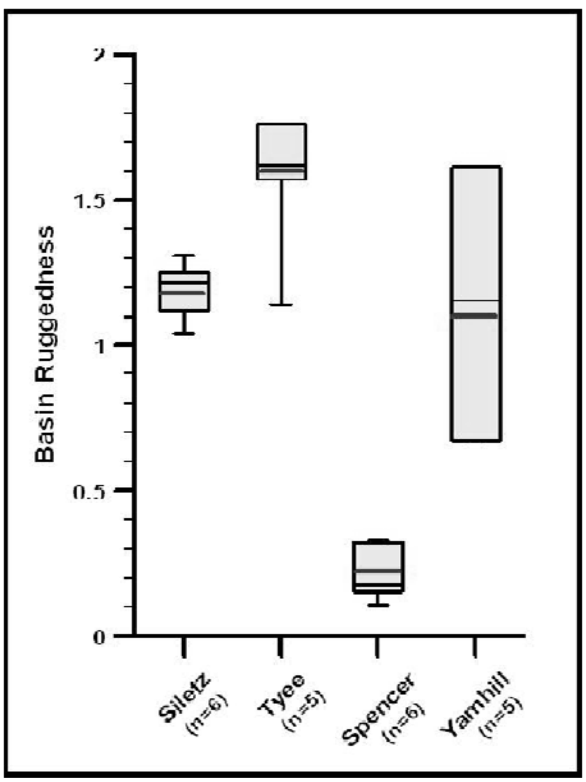

Longitudinal profile along the Luckiamute River (after Rhea, 1993).

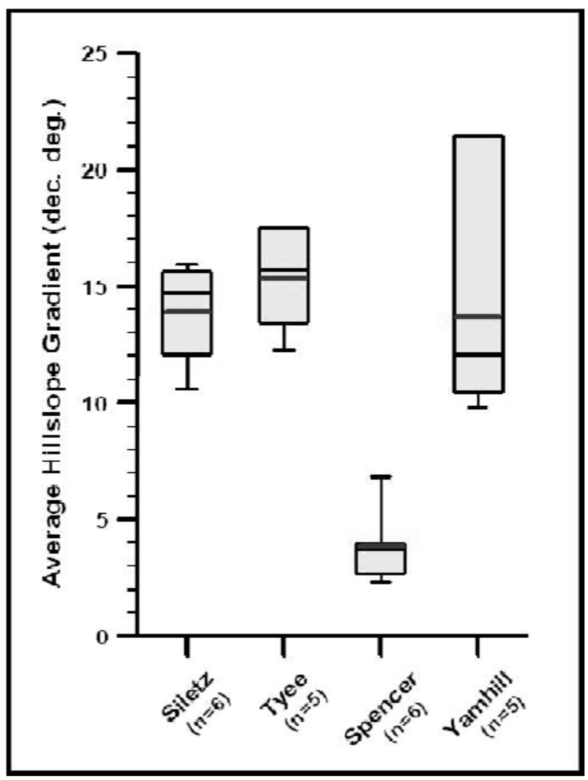
| SAMPLINIG OF PREVIOUS WORK IN TYEE LANDSCAPES OF "THE OCR"<br>University of Washington – UC Berkeley Geomorphic Offspring and Related Cousins | |
|---|---|
| Pierson (1977) | Debris flow processes |
| Dietrich and Dunne (1978) | Sediment budgets |
| Jackson and Beschta (1982) | Bedload transport |
| Burroughs (1985) | Landslide modeling |
| Dietrich and others (1986) | Hillslope processes |
| Montgomery and Dietrich (1988) | Landscape evolution |
| Benda (1990) | Debris flow processes |
| Benda and Cundy (1990) | Debris flow processes |
| Reneau and Dietrich (1990) | Debris flow processes |
| Reneau and Dietrich (1991) | Landscape evolution |
| Personius and others (1993) | Terrace chronologies |
| Montgomery and Dietrich (1994) | Landslide modeling |
| Benda and Dunne (1997) | Debris flow processes |
| Montgomery and others (1997) | Hillslope process experiments |
| Roering and others (1999) | Hillslope process experiments |
| Montgomery and others (2000) | Landslide modeling |
| Heimsath and others (2001) | Weathering processes |
| Schmidt and others (2001) | Slope stability |
| Anderson and others (2002) | Weathering processes |
| May (2002) | Debris flow processes |
| Casebeer (2003) | Sediment budgets |
| Lancaster and Hayes (2003) | Debris flow processes |
| May and Gresswell (2003) | Sediment production |
| Roering and others (2003) | Slope stability |
| Schmidt and others (2003) | Slope Stability |
| Kobor and Roering (2004) | Bedrock-channel processes |
| Roering and others (2005) | Slope processes / Landscape Evolution |

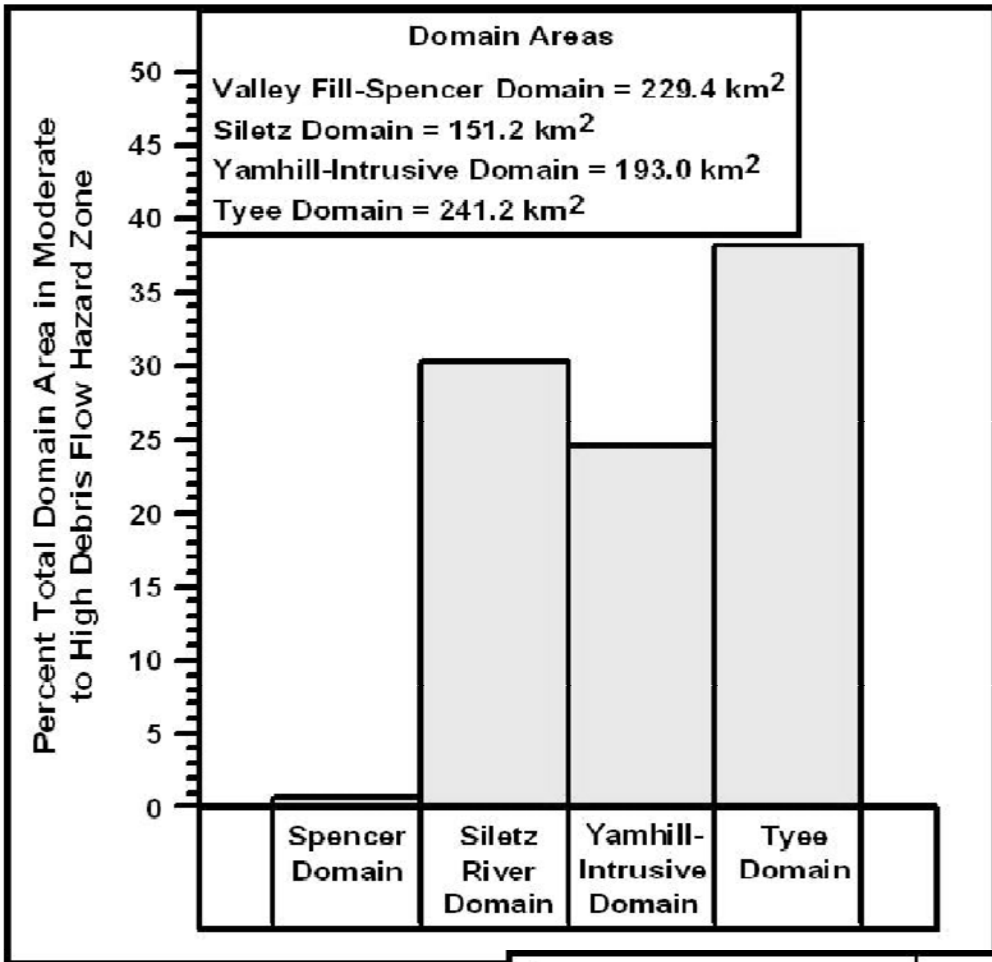


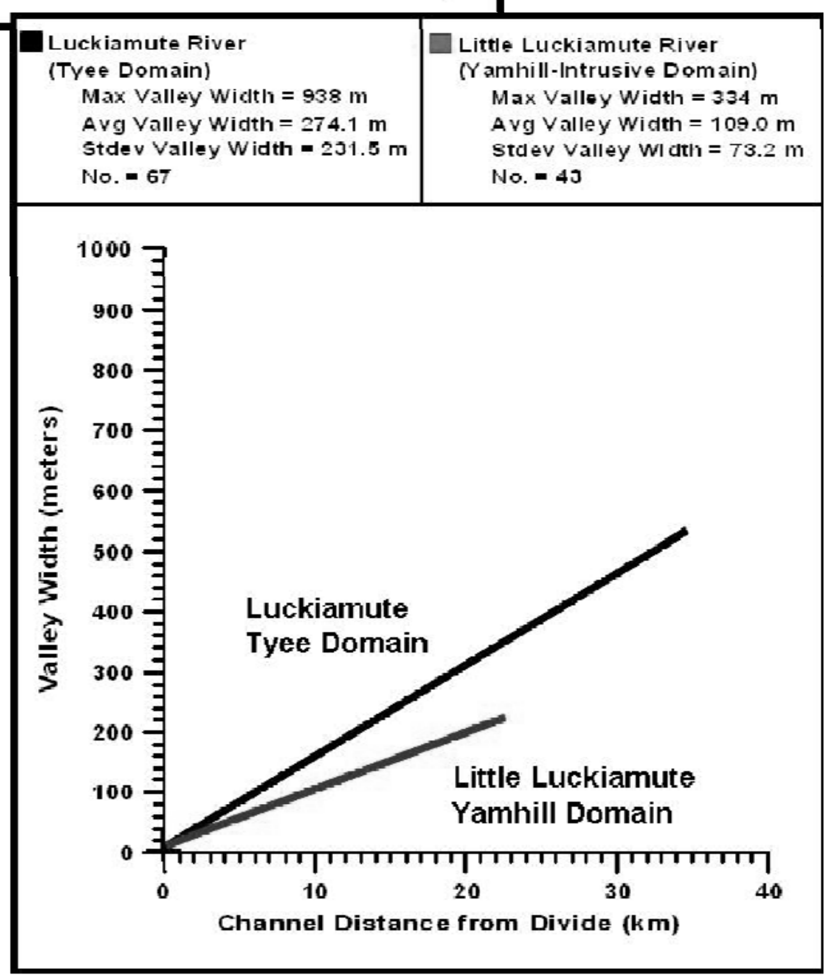
## GEOMORPHIC ANALYSIS -LUCKIAMUATE STUDY AREA




Domain Areas
Valley Fill-Spencer Domain = 229.4 km2
Siletz Domain = 151.2 km2
Yamhill-Intrusive Domain = 193.0 km2
Tyee Domain = 241.2 km2
Percent Total Domain Area in Moderate to High Debris Flow Hazard Zone
Spencer Domain
Siletz River Domain
Yamhill-Intrusive Domain
Tyee Domain


Luckiamute River
(Tyee Domain)
Max Valley Width = 938 m
Avg Valley Width = 274.1 m
Stdev Valley Width = 231.5 m
No. = 67
Little Luckiamute River
(Yamhill-Intrusive Domain)
Max Valley Width = 334 m
Avg Valley Width = 109.0 m
Stdev Valley Width = 73.2 m
No. = 43
Valley Width (meters)
Luckiamute
Tyee Domain
Little Luckiamute
Yamhill Domain
Channel Distance from Divide (km)

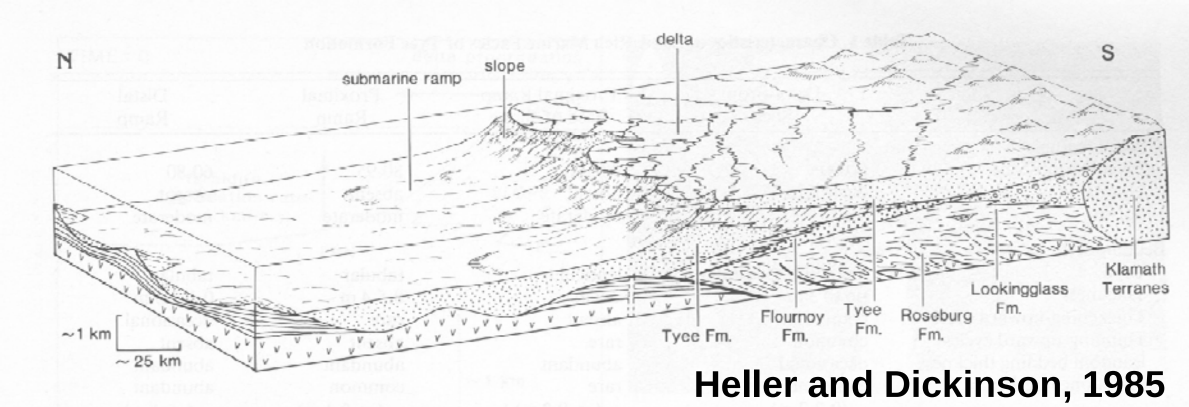
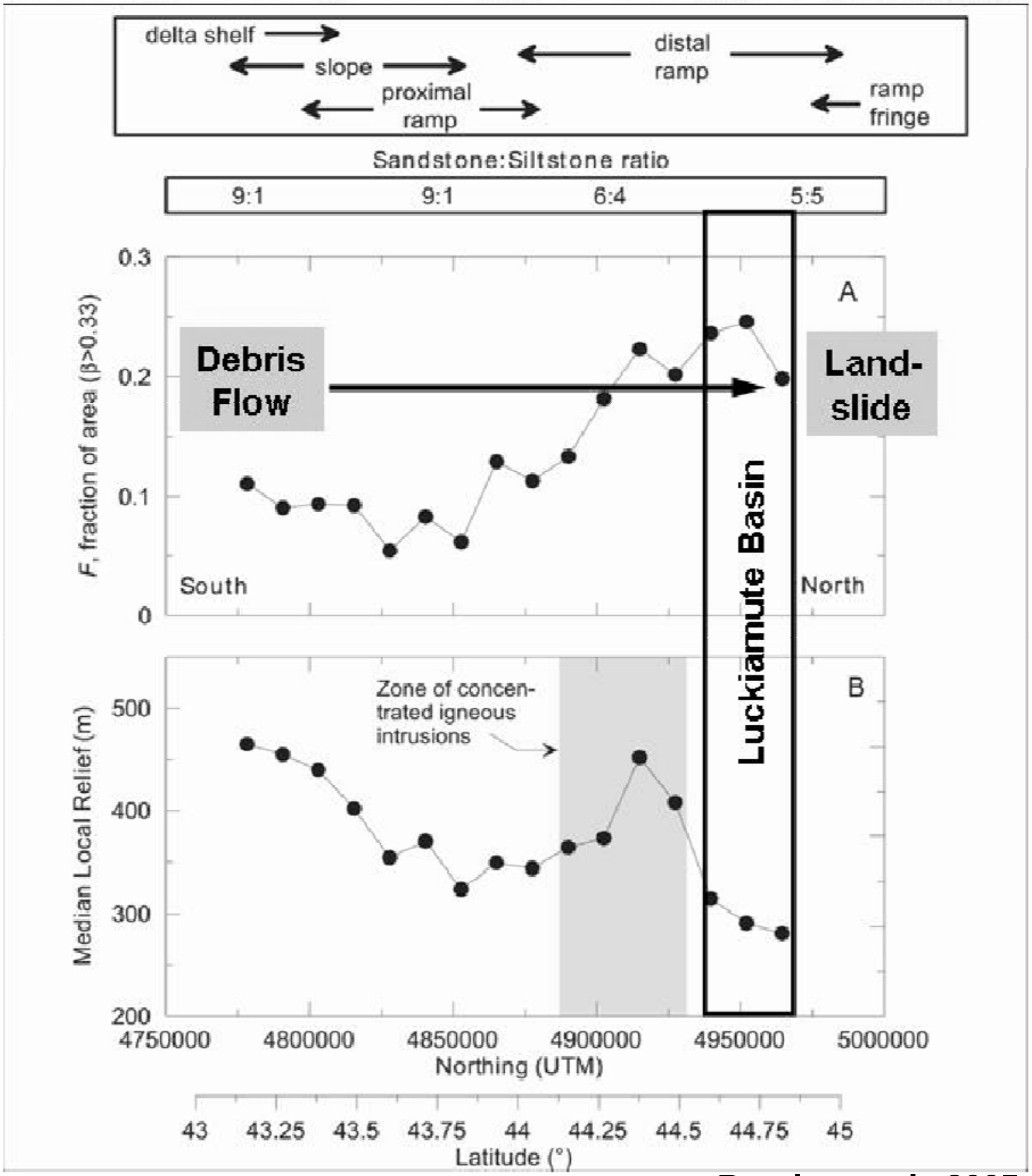



**Figure 8**—Paleogeographic reconstruction of southern part of Oregon Coast Range during Eocene deposition of Tyee Formation (cf. Chan and Dott, 1983). See Figure 9 for actual (measured) facies relations within Tyee Formation.




Roering et al., 2005

# Geomorphic Implications in the Luckiamute Basin

**Tyee Domain in the Luckiamute Basin:**

**Steeper, rugged hillslopes**
**More finely dissected by low-order channels**
**Tendency to spawn debris flow**
**Lower stream-power index compared to Yamhill Domain**
**Higher average valley widths, increased sediment accommodation space**

**Working Hypotheses for Tyee Domain:**

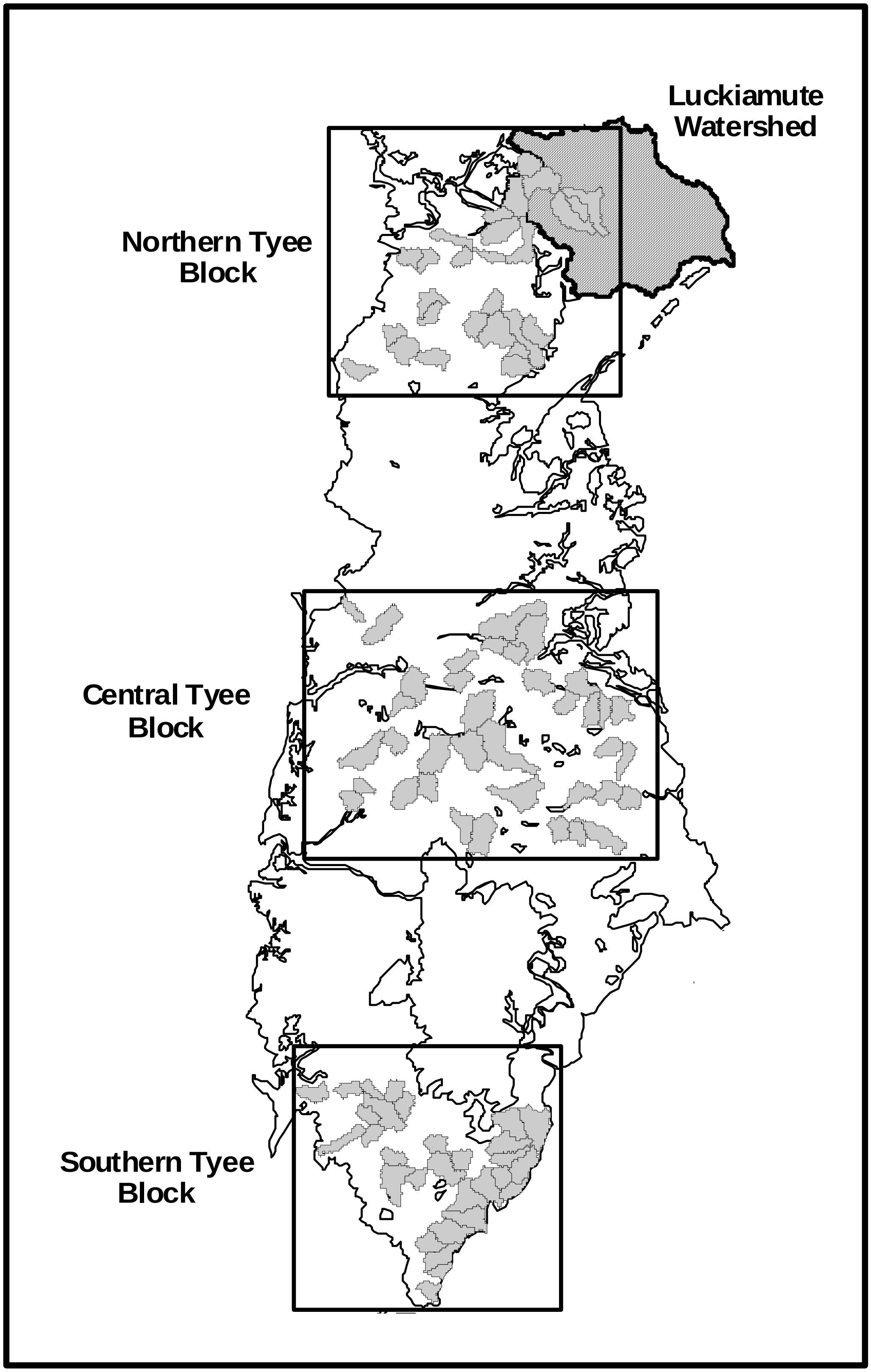
**Hillslope transport rates are greater than the ability of the channel system to export sediment**

**Steep hillslopes and increased valley widths result in comparative decrease of net sediment-transport efficiency**

**The study implies that spatial variation of bedrock lithology is a primary factor controlling slope gradients, hillslope delivery rates, and resulting sediment-transport efficiency of the channel system.**

**The Luckiamute Watershed is uniquely positioned at the northern terminus of the Tyee outcrop belt, thus providing an opportunity for comparative geomorphic analysis.**

**The rich body of work from other Tyee landscapes in the OCR will serve as the platform from which to extend future research into other bedrock domains.**




**Ongoing Research:** Extension of comparative watershed analysis southward in the Tyee Outcrop belt and northward into other bedrock domains. The Luckiamute lies at an interesting and critical geologic transition zone in the Oregon Coast Range.

# Vegetation and Invasive Plant Distribution Luckiamute Watershed

**What is an Invasive Plant?**

Invasive plants are species that are not native to a region or country. They have the ability to compete with and replace native species in natural habitats

**Predicting "Invasiveness"**

The Importance of understanding life history

- Rapid initial growth and root system expansion
- Ability to outcompete neighboring plants
- High seed output (in both optimal and less-than-optimal conditions
- Morphological/physiological similarity to native species
- Varied breeding systems (e.g., possibilities for both self-pollination and outcrossing)

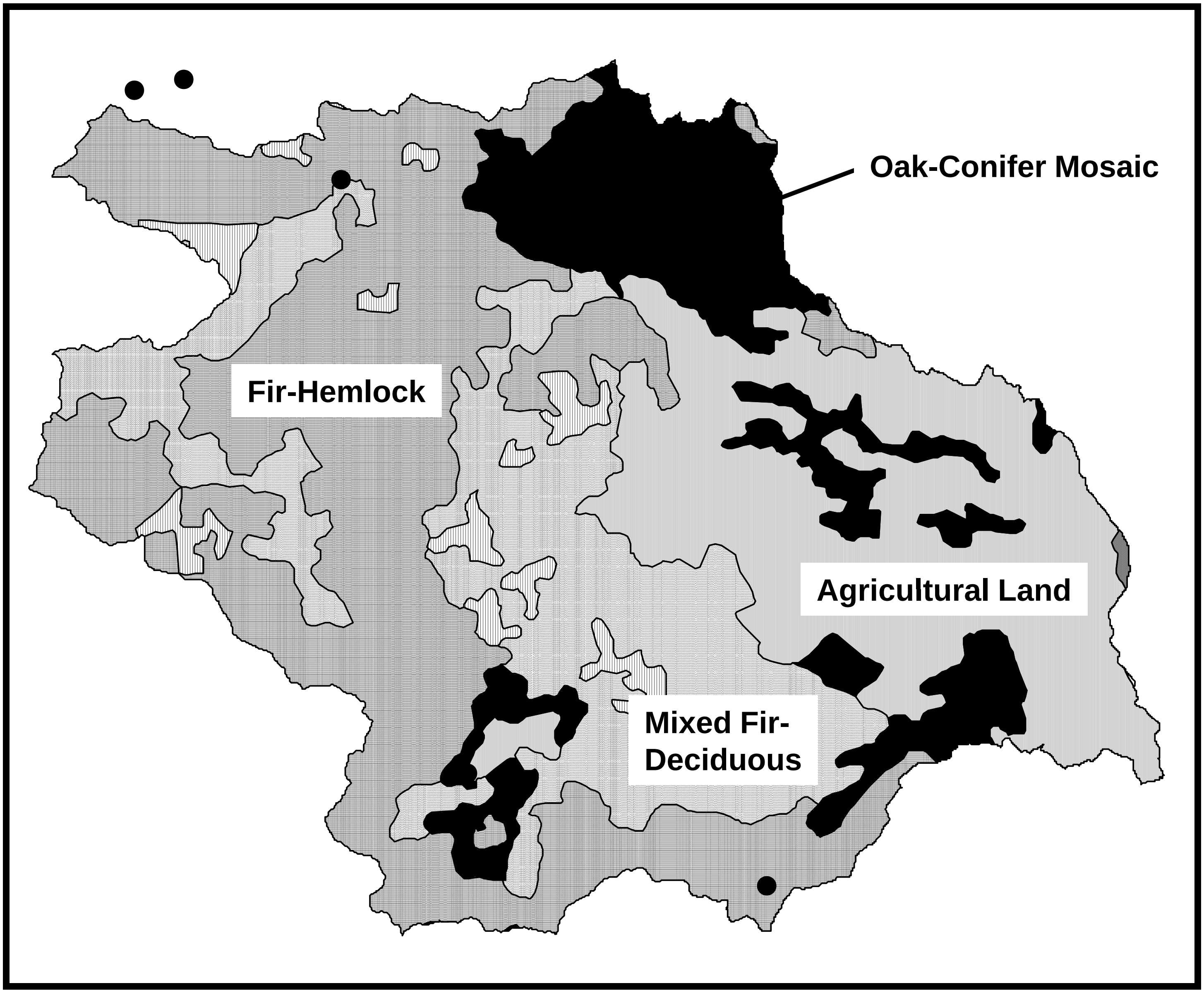
**Why Invasive Plants are a Problem**

- Invasive plants are a pervasive problem
  - In western Oregon
    - disruption of native habitats and annual economic losses
  - In the United States
    - annual losses of over $130 billion
- Vegetative disturbance of natural ecosystems
  - soil substrate conditions, nutrient availability, canopy shading (solar influx), and riparian hydrology
- Most abundant concentrations of invasive species
  - typically associated with human-caused disturbance
  - disturbed zones on the landscape act as primary conduits
  - understanding the controls on spatial distribution of invasive plants in the context of disturbance regime is critical for designing effective watershed conservation and restoration plans

Most Problematic Invaders in the Mid-Willamette Region:

- Himalayan Blackberry
- Knotweed
- Reed Canary Grass

**Vegetation Distribution in the Luckiamute Watershed (from Oregon State Vegetation Map)**



# Common Invasive Plant Species

| NAME | ORIGIN |
|---|---|
| *Brachypodium sylvaticum (*false brome*)* | Africa, Eurasia |
| *Cirsium arvense* (Canada thistle) | Eurasia |
| *Cirsium vulgare* (bull thistle) | Eurasia |
| *Daucus carota* (wild carrot) | Europe |
| *Dipsacus fullonum* (common teasel) | Europe |
| *Hedera helix* (English ivy) | Eurasia, Africa |
| *Humulus lupulus (*common hops*)* | Europe |
| *Hypericum perforatum* (common St. Johnswort) | Europe |
| *Phalaris arundinacea* (reed canarygrass) | Agric. |
| *Polygonum cuspidatum (*Japanese knotweed*)* | Japan |
| *Rubus armeniacus* (Himalayan blackberry) | Armenia |
| *Solanum dulcamara* (bittersweet nightshade) | Europe |
| *Tanacetum vulgare* (common tansy) | Europe |

# Himalayan Blackberry (*Rubus armeniacus*):

## Location:
▪Throughout the watershed in sunny and disturbed areas
▪Occurs in dense clumps and is capable of invading open spaces with their trailing stems.
▪Dispersed throughout the watershed by seed and stem fragments.

## Description: **Highly Invasive**
•Can grow meters in diameter and height in just a few years.
•Stems are thick with strong upward thorns.
•Leaves occur in groups of three or five, are round to oblong and toothed, and have a white coating underneath.
•In June, small white to pink flowers will bloom
•Berries ripening from July to August.

# Knotweeds (*Polygonum* spp.):

## Location:

▪Found in the upper-most reaches of the watershed.
▪Have been spread throughout the watershed
▪Threatening the entire riparian zone.
▪Found in extremely dense colonies; can spread through flooding events.

## Description: **Highly Invasive**

•Creeping perennials stand 10 to 15 feet tall
•Light green ovate leaves.
•Blooming of numerous greenish-white flowers occurs from July to August.
•Dies back each year with the first frost, then begins new growth from the same shoot system the following year.

While some species of Knotweed do not appear to produce fertile seeds, other species and their hybrids in the watershed may have no difficulty in doing so.

# Reed Canarygrass (*Phalaris arundinacea*):

## Location:

▪Found primarily in riparian zone throughout the watershed

▪Can withstand flood seasons due to its thick shoots and extensive rhizomes

▪Has become widely dispersed throughout the watershed

- ▪Erosion along the banks and water transport

## Description: **Perennial**

•Stout, largely colonial grass

•Densely clustered flowers are located on short separate branches

•Stands .5-1.5 m tall.

•Leaf blades are about 20 mm wide

•Flowering occurs May to June and seeds mature by July

Seeds do not germinate when in dense shade. Keep those native trees growing!

# Luckiamute Riparian Zone Botanical Surveys

## Plant Survey Site Selection

•Ideally, One hundred meters of wooded riparian zone, fairly undisturbed and perpendicular to the Luckiamute, Little Luckiamute River or Soap Creek

•Identified riparian zone by utilizing 100 year floodplain map and contacted landowners within that area

•Systematic plant surveys conducted across 20 sites to delineate:
- •invasive species occurrence
- •distribution and
- •population density

**Logistical Difficulties:**
Overdeveloped land
- •100 m of vegetated land perpendicular to the river is hard to find

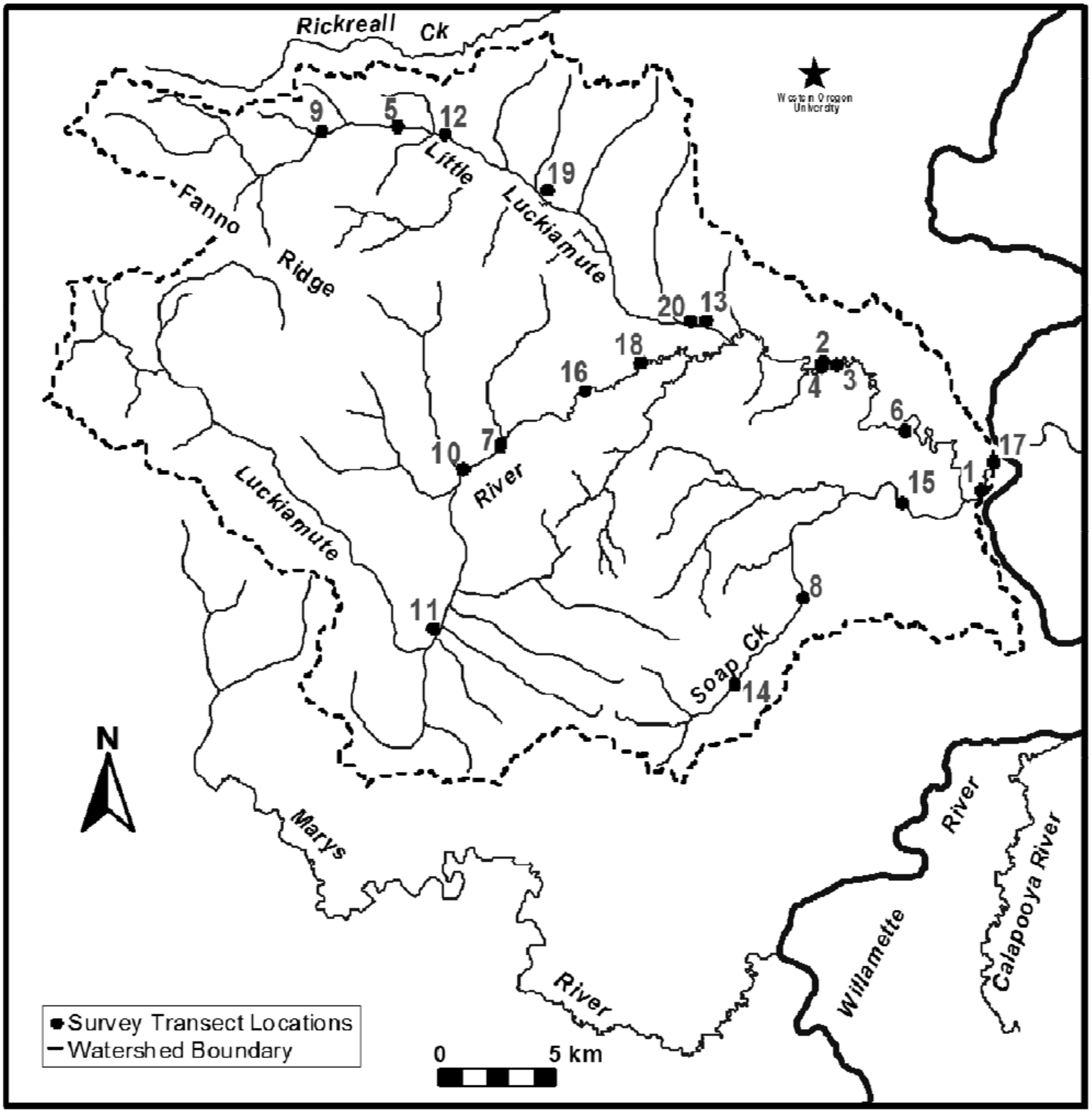
•Approval for survey access by landowners
•Adequate distribution of survey locations

## Survey Procedures

**Materials Used**
- Tape measure
- One square meter frame

**Methods**
- Surveys conducted along 100 meter transects located perpendicular to the river
  - 100 m, not always available
- All plants are identified in each square meter along the transect
- Plants identified by scientific names and recorded by percent cover within each square meter
- Other data taken involves the amount of visible electromagnetic radiation along the transect
  - Usually in the 400 to 700 nm range
- GPS data was also collected along each transect
- Data then entered into the computer, compiled, graphed and analyzed

# Luckiamute Watershed
# Invasive Plant Survey Locations



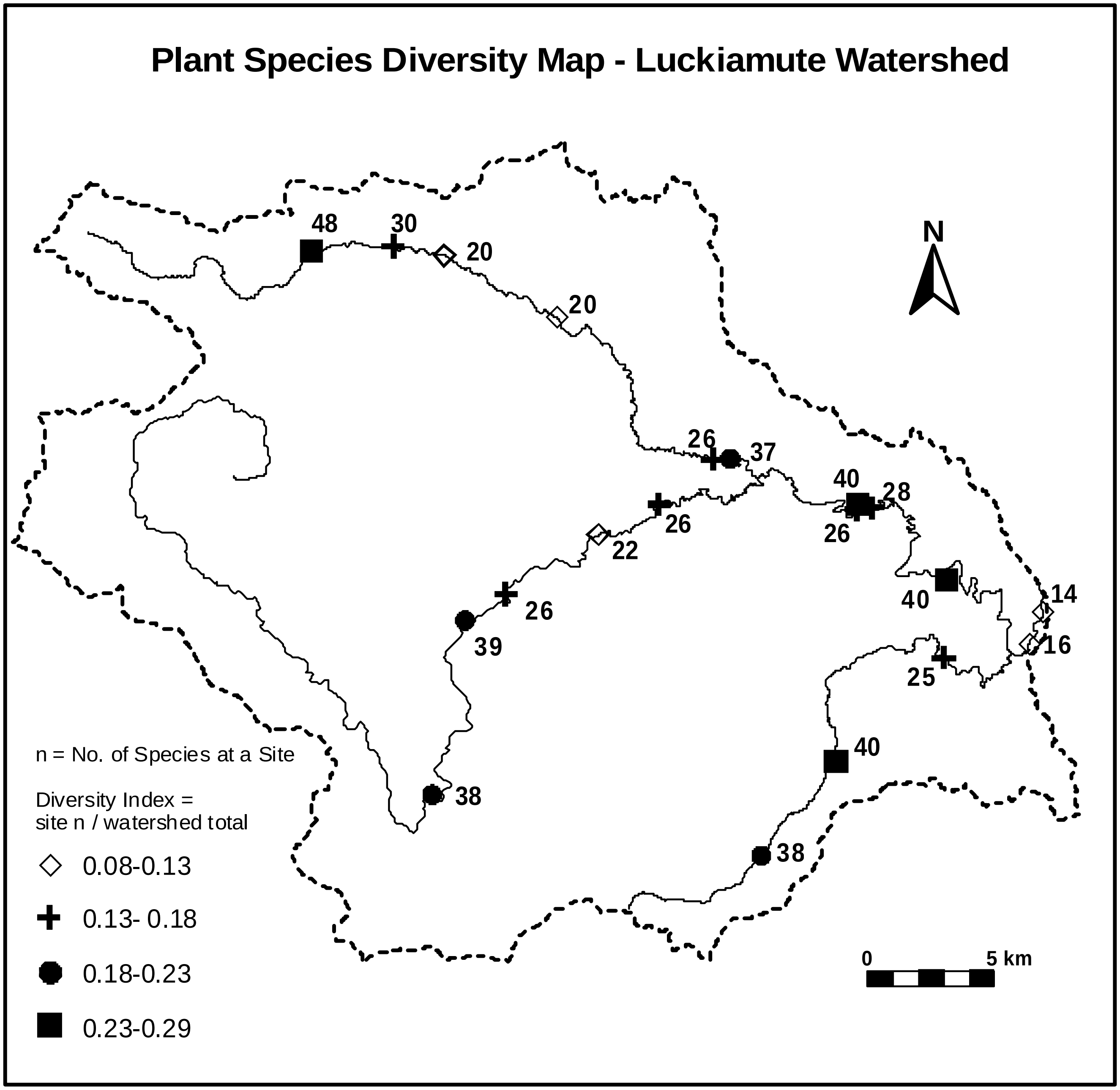
# Summary of Plant Species Encountered in Riparian Understory – Luckiamute Watershed

| | |
|---|---|
| Total No. of Species Encountered | 170 |
| Total No. of Invasive Species | 55 |
| Total No. of Native Species | 75 |
| Total No. with No Origin Data | 40 |
| Percent Invasives | 32.4% |
| Percent Natives | 44.1% |
| Percent Unknown Origin | 23.5% |
| Native/Invasive Ratio | 1.4 |

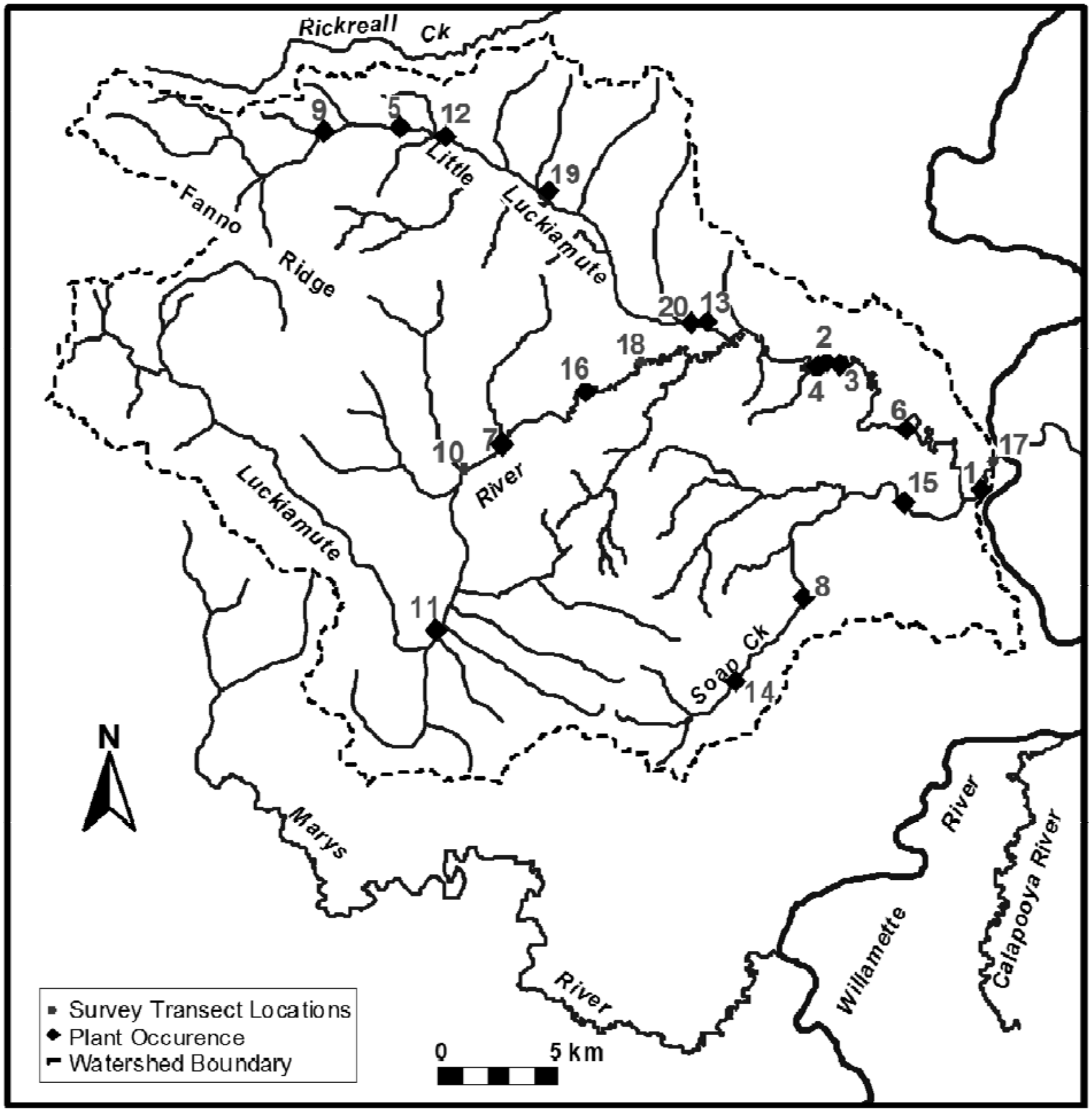
Most Common Species Encountered in Greater than 70% of Transects (total n = 20)

| | | |
|---|---|---|
| Rubus leucodermus | Blackcap | 90% native |
| Rubus armeniacus | Himalaya blackberry | 85% introduced |
| Symphoricarpos albus | Snowberry | 85% native |
| Urtica dioca (gracilis) | Stinging nettle | 80% native |
| Corylus cornuta (californica) | Western hazel | 75% native |
| Phalaris arundinacea | Reed canarygrass | 75% introduced |
| Polystichum munitum | Sword fern | 70% native |

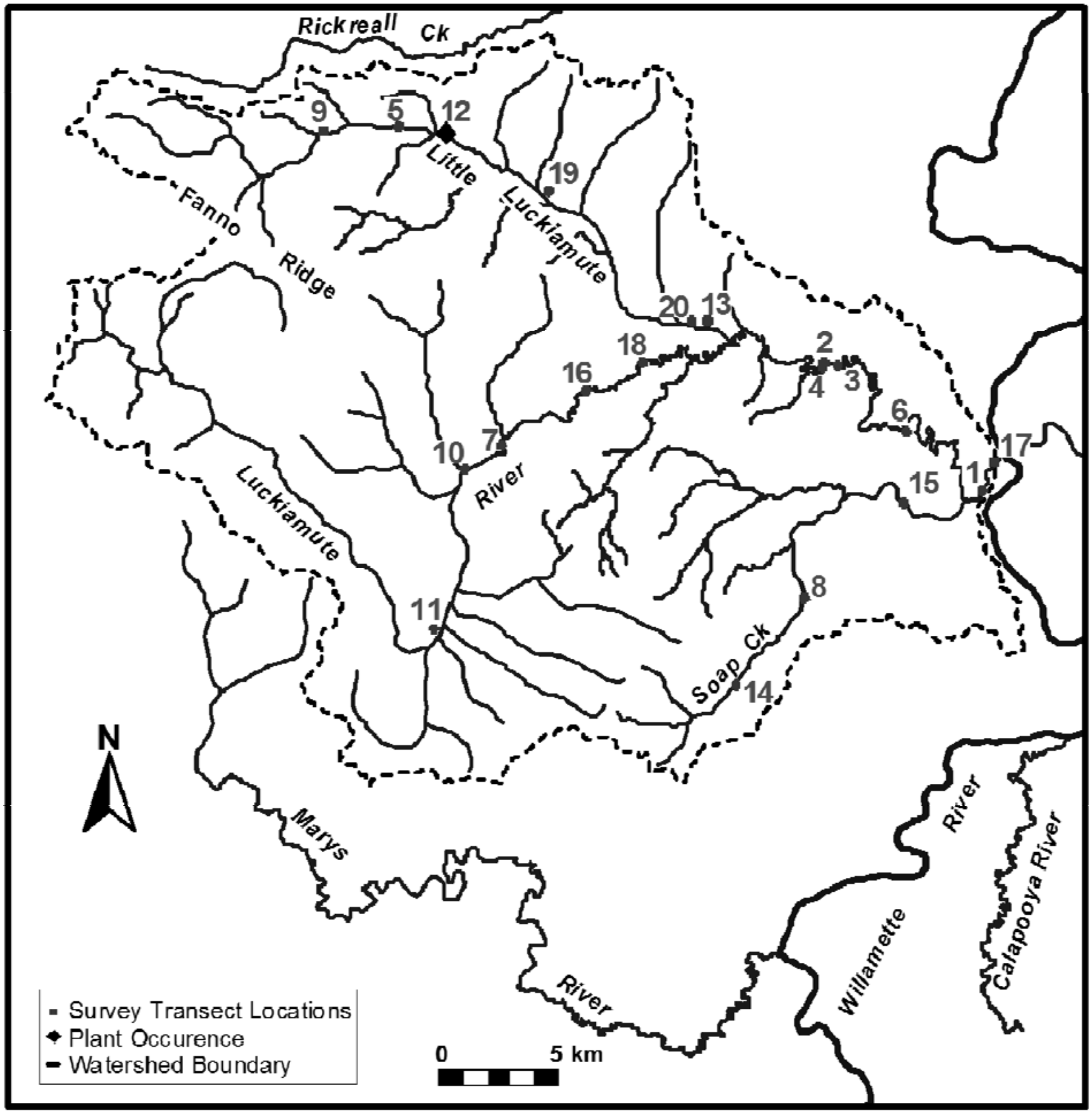
*Abies grandis* Grand fir
*Acer circinatum* Vine maple
*Acer macrophyllum* Big-leaf maple
*Achlys triphylla* Vanillaleaf
*Actaea rubra* Baneberry
*Adenocaulon bicolor* Pathfinder
*Alnus rubra* Red alder
*Amelanchier alnifolia* Service berry
*Anagallis arvensis* Scarlet Pimpernel
*Anemone deltoidea* White windflower
*Anthemis cotula* Dogfennel
*Apiaceae* Umbel family
*Aquilegia formosa* Columbine
*Arctium minus* Common burdock
*Asarum caudatum* Wild ginger
*Asteraceae* Aster family
*Athyrium felix-femin* Lady fern
*Berberis aquifolium* Tall Oregon-grape
*Berberis nervosa* Mountain Oregon-grape
*Bidens sp.* Beggar's ticks
*Brachypodium sylvaticum* False brome
*Brassicaceae* Mustard family
*Carex sp.* Sedge
*Centaurea xpratensis M*eadow knapweed
*Chenopodium album* Lamb's quarters
*Cicuta douglasii* Western water hemlock
*Cirsium arvense* Canada thistle
*Cirsium vulgare* Bull thistle
*Claytonia sibirica* Candy flower
*Clematis ligusticifolia* Wild Clematis
*Convovulus arvensis* Bindweed
*Cornus sericea* Creek dogwood
*Corylus cornuta (californica)* Western hazel
*Crataegus douglasii* Western hawthorn
*Crataegus sp.* Hawthorn
*Daucus carota* Wild carrot
*Delphinium trolliifolium* Wood larkspur
*Dicentra formosa* Bleeding-heart
*Digitalis purpurea* Foxglove
*Dipsacus fullonum* Wild teasel
*Epilobium angustifolium* Fireweed
*Epilobium ciliatum* Willow-herb
*Epilobium sp.* Willow-herb
*Equisetum arvense* Common horsetail
*Equisetum sp.* Horsetail
*Ericaceae* Heath family
*Euphorbia sp.* Spurge
*Fabaceae sp.* Legume family
*Fragaria vesca* Wood strawberry
*Fraxinus latifolia* Oregon ash
*Galium aparine* Bedstraw
*Galium sp.* Bedstraw
*Galium triflorum* Fragrant bedstraw
*Gaultheria shallon* Salal
*Geranium pusillum* Small-flowered Geranium
*Geranium robertianum* Herb Robert
*Geranium sp.* Geranium
*Glechoma hederacea* Ground ivy
*Gnaphalium sp.* Cudweed
*Goodyera oblongifolia* Rattlesnake plantain
*Hedera helix* English ivy
*Helianthus sp.* Sunflower
*Heracleum lanatum* Cow parsnip
*Heuchera micrantha* Small-flowered alum-root
*Heuchera sp.* Alum-root
*Hieracium aurantiacum* Orange hawkweed
*Hieracium sp.* Hawkweed
*Holodiscus discolor* Ocean spray
*Humulus lupulus* Common hop
*Hypericum perforatum* St. John's wort
*Hypochaeris radicata* False dandelion
*Ilex opaca* American holly
*Impatiens sp.* Touch-me-not
*Juncaceae sp.* Rush family
*Kickxia elatine* Sharppoint Fluellin
*Lactuca muralis* Wall lettuce
*Lactuca serriola* Prickly lettuce
*Lamiaceae sp.* Mint family
*Lapsana communis* Nipplewort
*Lathyrus sp.* Pea
*Leucanthemum vulgare O*xeye daisy
*Lilliaceae sp.* Lily family
*Lotus corniculatus* Bird's-foot trefoil
*Lotus sp.* Trefoil
*Lysichiton americanum* Yellow skunk cabbage
*Maianthemum dilatatum* Wild lily-of-the-valley
*Maianthemum racemosus* Large false Solomon's seal
*Maianthemum sp.* False Solomon's seal
*Malus sp.* Apple
*Marah oreganus* Old man-in-the-ground
*Melilotus sp.* Sweet-clover
*Melissa officinalis* Lemon balm
*Mentha xpiperita* Peppermint
*Mitella sp.* Mitrewort
*Oemleria cerasiformi s*Indian peach
*Osmorhiza berteroi* Common sweet cicely
*Oxalis oregana* Oregon wood-sorrel
*Penstemon sp.* Penstemon
*Phalaris arundinacea* Reed canarygrass
*Physocarpus capitatus* Ninebark
*Plantago aristata* Long-bracted plantain
*Plantago lanceolata* English plantain
*Plantago major* Common plantain
*Plantago sp.* Plantain
*Poaceae sp.* Grass family
*Polygonaceae* Knotweed family
*Polygonum cuspidatum J*apanese knotweed
*Polygonum lapathifolium* Dock-leaved smartweek
*Polypodium glycyrrhiza* Licorice fern
*Polystichum munitum* Sword fern
*Prosartes sp.* Fairy bells
*Prunella vulgaris* Self-heal
*Prunus sp.* Cherry
*Prunus virginiana* Western chokecherry
*Pseudostuga menziesii* Douglas-fir
*Pteridium aquilinum* Western bracken fern
*Quercus garryana* Oregon white oak
*Ranunculus sp.* Buttercup
*Rhamnus purshiana* Cascara
*Ribes sp.* Gooseberry
*Rosa eglanteria* Sweetbriar
*Rosa gymnocarpa* Wood rose
*Rosa nutkana* Common wild rose
*Rosa sp.* Rose
*Rubiaceae* Madder family
*Rubus armeniacus* Himalaya blackberry
*Rubus laciniatus* Evergreen blackberry
*Rubus leucodermus* Blackcap
*Rubus parviflorus* Thimbleberry
*Rubus spectabilis* Salmonberry
*Rubus ursinus* Wild blackberry
*Rumex acetosella* Red sorrel
*Rumex crispus* Curly dock
*Rumex sp.* Dock
*Salix sp.* Willow
*Sambucus racemosa* Red Elderberry
*Sambucus sp.* Elderberry
*Sanicula sp.* Snake-root
*Saxifragaceae* Saxifrage family
*Scirpus sp.* Bulrush
*Scutellaria lateriflora* Common skullcap
*Senecio jacobaea* Tansy ragwort
*Senecio sp.* Groundsel
*Senecio vulgaris* Common groundsel
*Sherardia arvensis* Field madder
*Solanum dulcamara* Bittersweet nightshade
*Solanum nigrum* Europena black nightshade
*Solanum sp.* Nightshade
*Soliva sessilis* Field burrweed
*Sonchus oleracea* Common sow thistle
*Sonchus sp.* Sow thistle
*Spiraea douglasii* Douglas' Spiraea
*Stachys cooleyae* Giant hedge-nettle
*Symphoricarpos albus* Snowberry
*Syntheris reniformis* Spring queen
*Tellima grandiflora* Fringe-cups
*Thalictrum sp.* Meadow-rue
*Toxicodendron diversilobum* Poison oak
*Trientalis latifolia* Western starflower
*Trifolium repens* White clover
*Trifolium sp.* Clover
*Trifolum vesiculosum* Arrowleaf clover
*Trillium sp.* Trillium
*Tsuga heterophylla* Western hemlock
*Urtica dioca (gracilis)* Stinging nettle
*Vaccinium sp.* Huckleberry
*Verbascum thapsus* Common mullein
*Veronica sp.* Speedwell
*Viola glabella* Wood violet
*Viola sp.* Violet


Plant Species Diversity Map - Luckiamute Watershed
48
30
20
20
N
26
37
40
28
26
26
22
40
14
26
39
16
25
40
n = No. of Species at a Site
Diversity Index =
site n / watershed total
0.08-0.13
0.13- 0.18
0.18-0.23
0.23-0.29
38
38
0
5 km

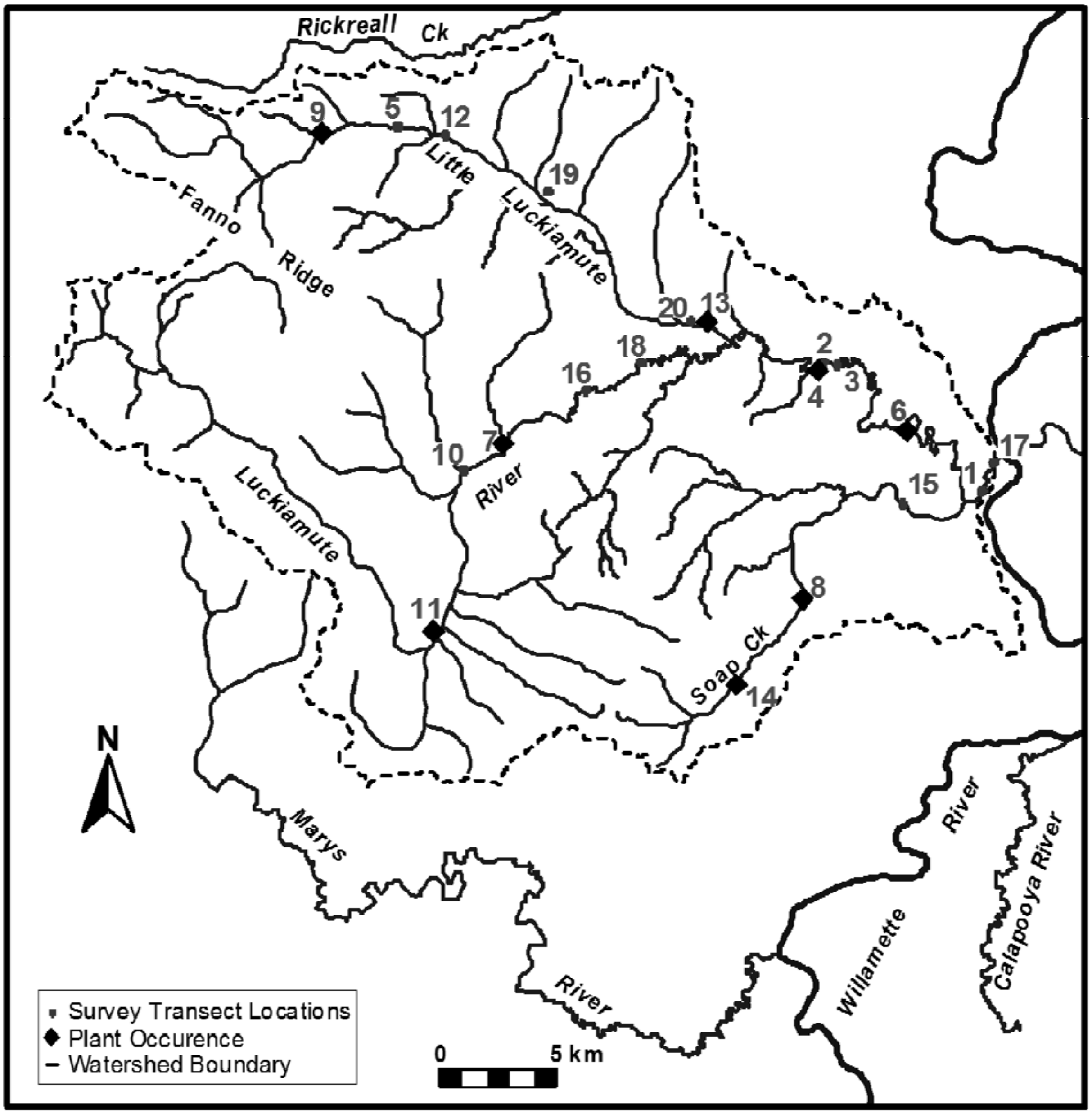
# Occurence of Himalaya blackberry- Rubus armeniacus



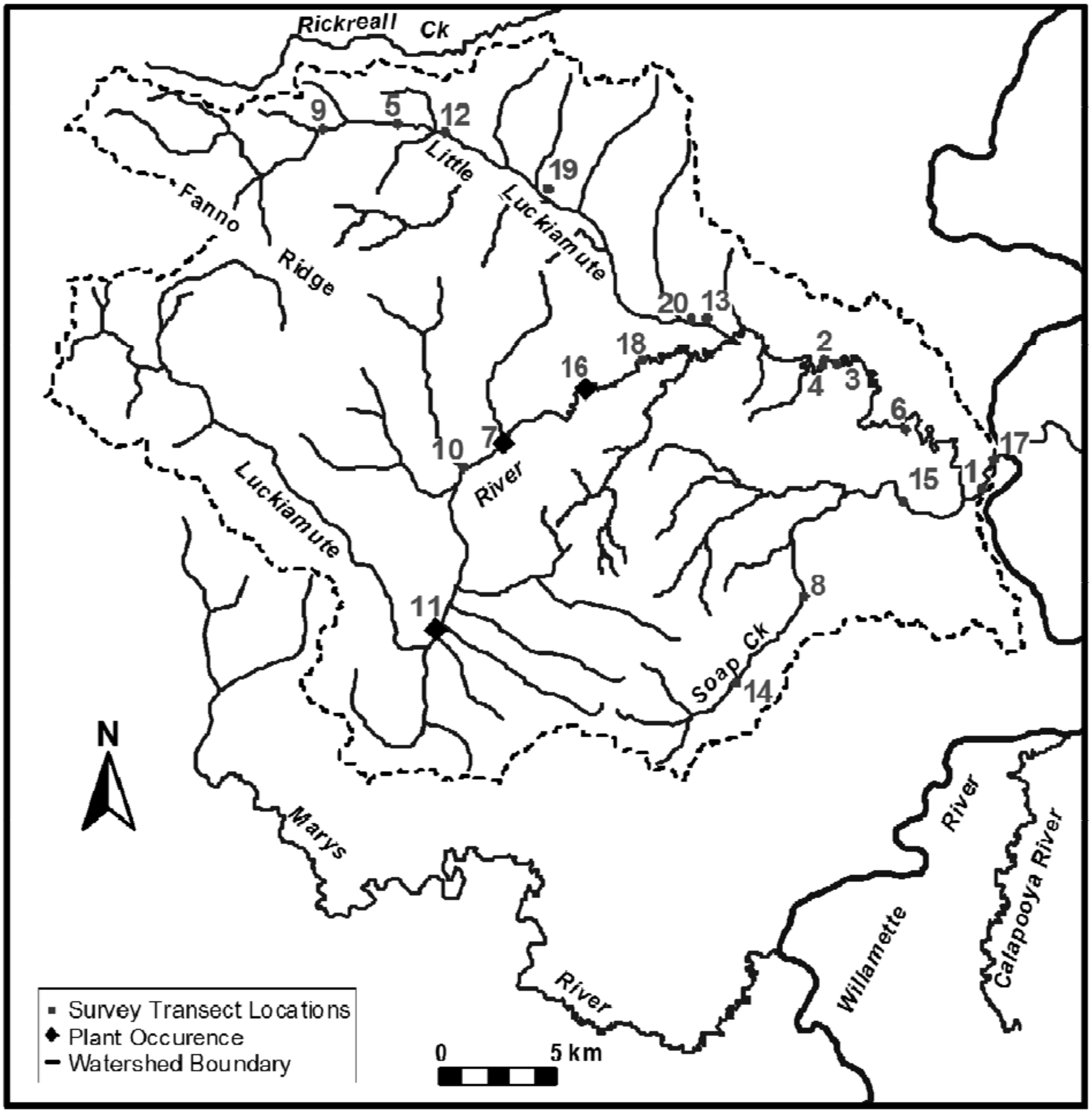
Occurence of English ivy - Hedera helix



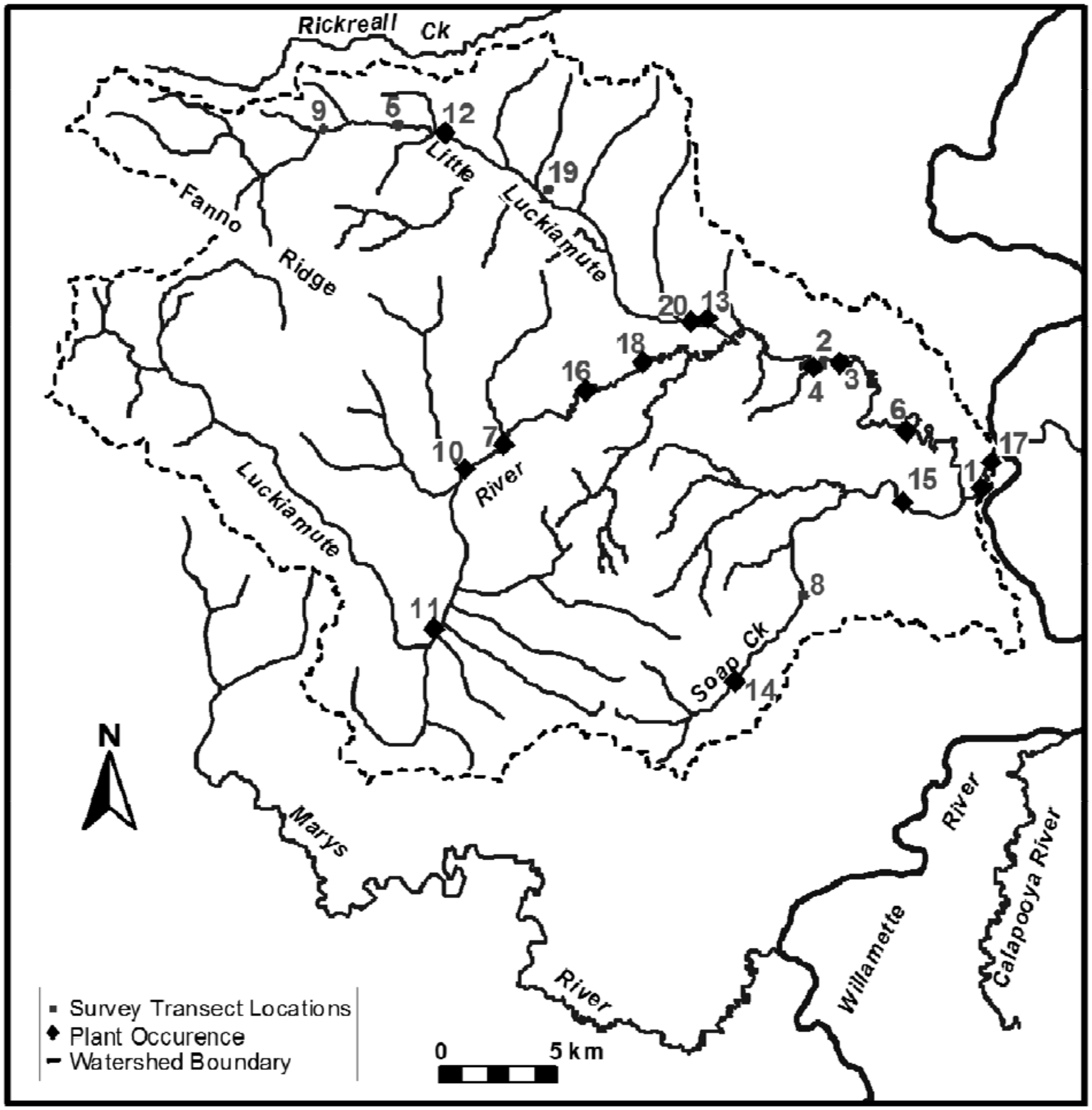
# Occurence of Canada thistle - Cirsium arvense



Occurence of Knotweed - Polygonaceae



Occurence of Reed canarygrass - Phalaris arundinacea



# Preliminary Conclusions, Current Status and Future Research

- Individual species “behave” as expected
  - E.g., Himalayan blackberry
- Correlation with light intensity important source of data
  - Anecdotal explanations are being quantified
- Are there differences between different sources of disturbance?
  - Preliminary data suggest yes

---

- Completed literature survey yielding nearly 200 relevant technical references and created a literature reference database
- Created several Geographic Information System (GIS) thematic layers
- Generated a contact list of riparian property owners along the Luckiamute
- Completed 20 field reconnaissance transects along more than 100 miles of the Luckiamute River and its tributaries
- Sponsored 7 undergraduate research assistants with stipends and transportation costs

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- Continued data analysis
- Additional baseline data collection
- Long-term monitoring
- Results that are pertinent for remediation and restoration strategies
- Serve as a regional resource for addressing invasive species questions within our community

# Field Trip Stop Summaries and Diagrams

## En Route to Stop 2

- Drive through Spencer Fm-Valley Fill Domain

- Note agricultural land use

## Stop 2. Helmick State Park

- Physiographic Location
  - Lower Luckiamute River, 18 km upstream from watershed outlet into the Willamette River

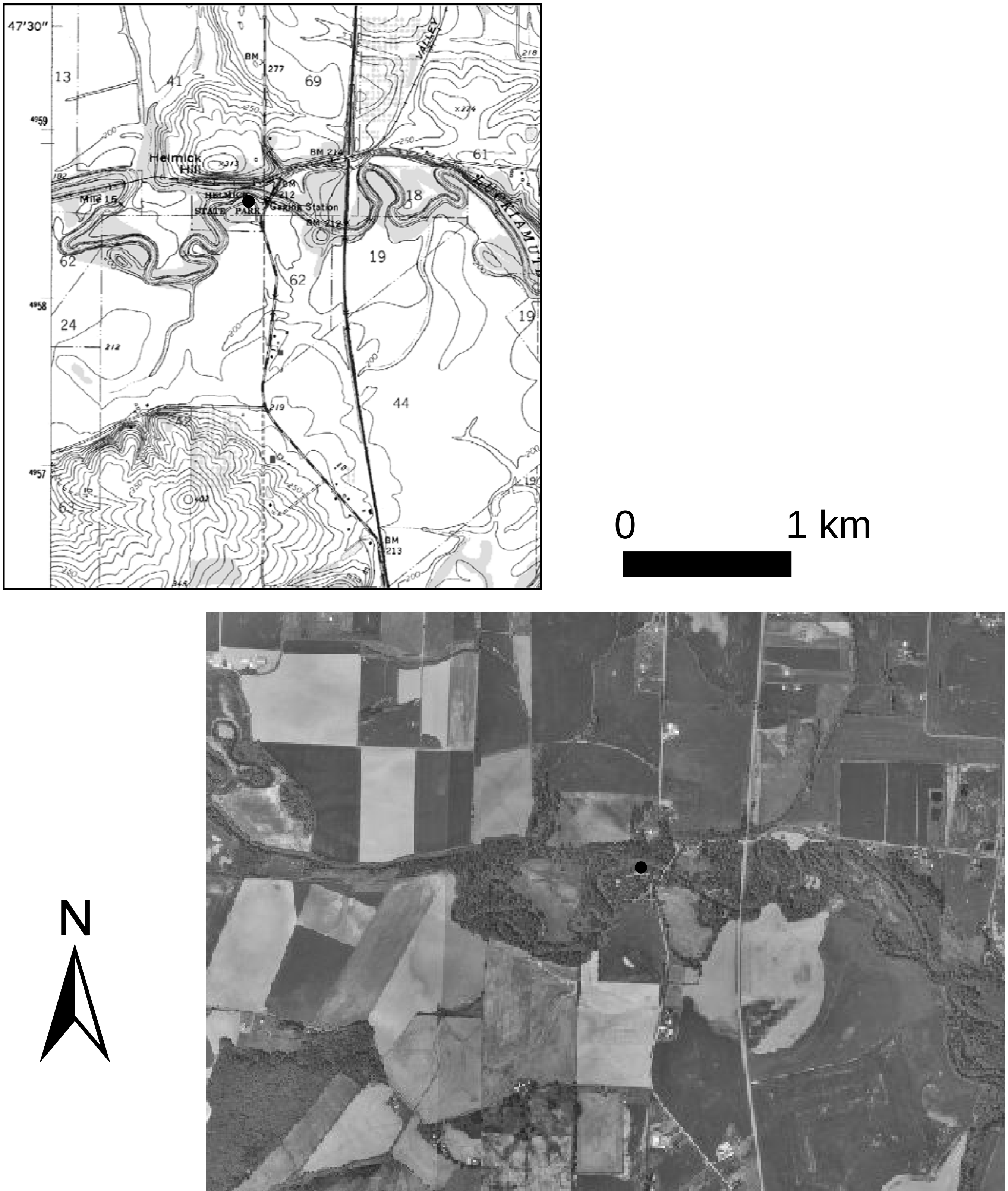
- Bedrock and Surficial Geology
  - Stop is located in the Spencer Fm-Valley Fill lithospatial domain
  - Note incised channel characteristics and low terraces

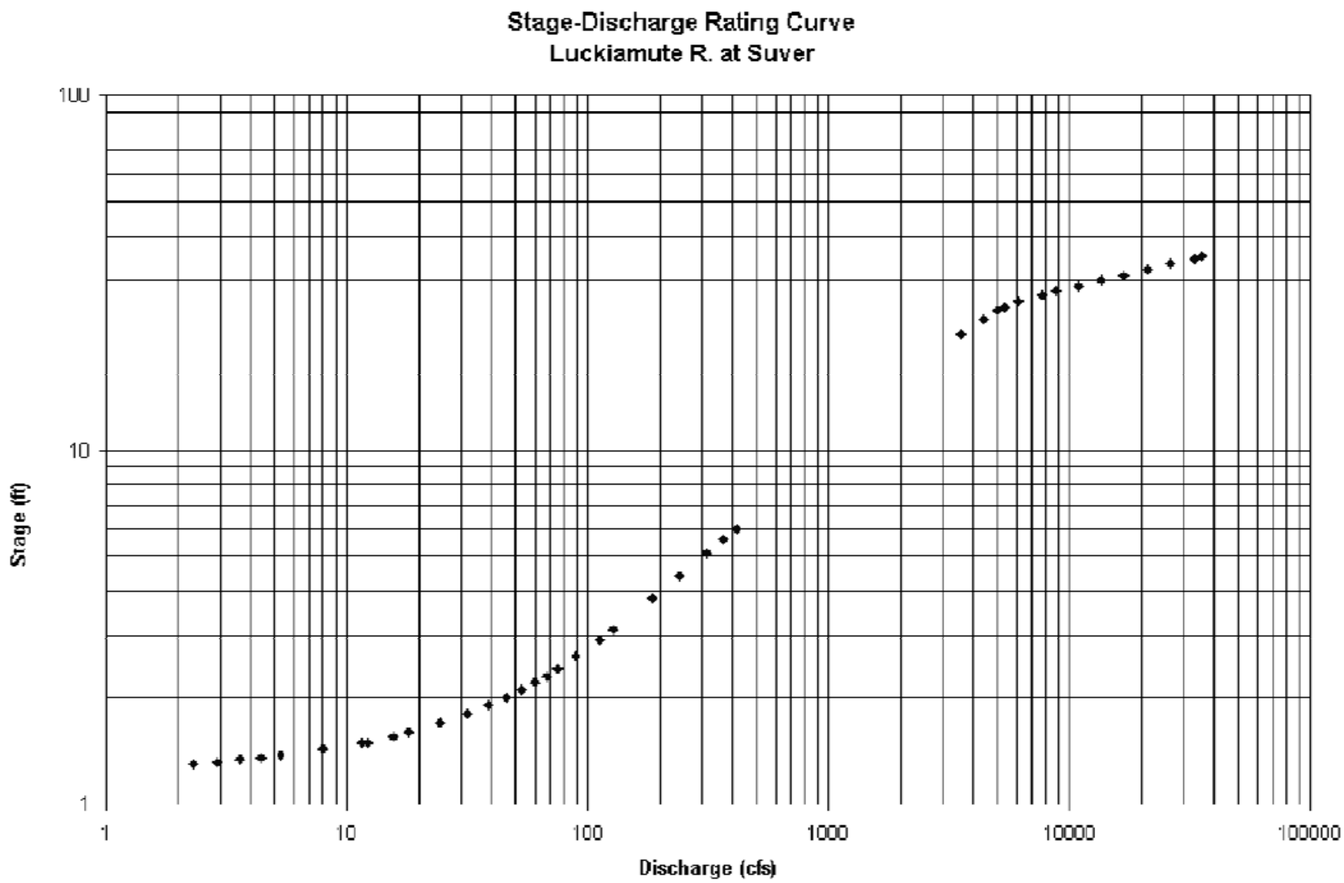
- Content Piece – Geomorphology, Hydrology, and Field Botany
  - Field Botany and Invasive Plant Surveys
  - Geomorphic Surfaces
  - Flood Hydrology
    - USGS Suver Gaging Station
    - Recurrence intervals and seasonal discharge patterns

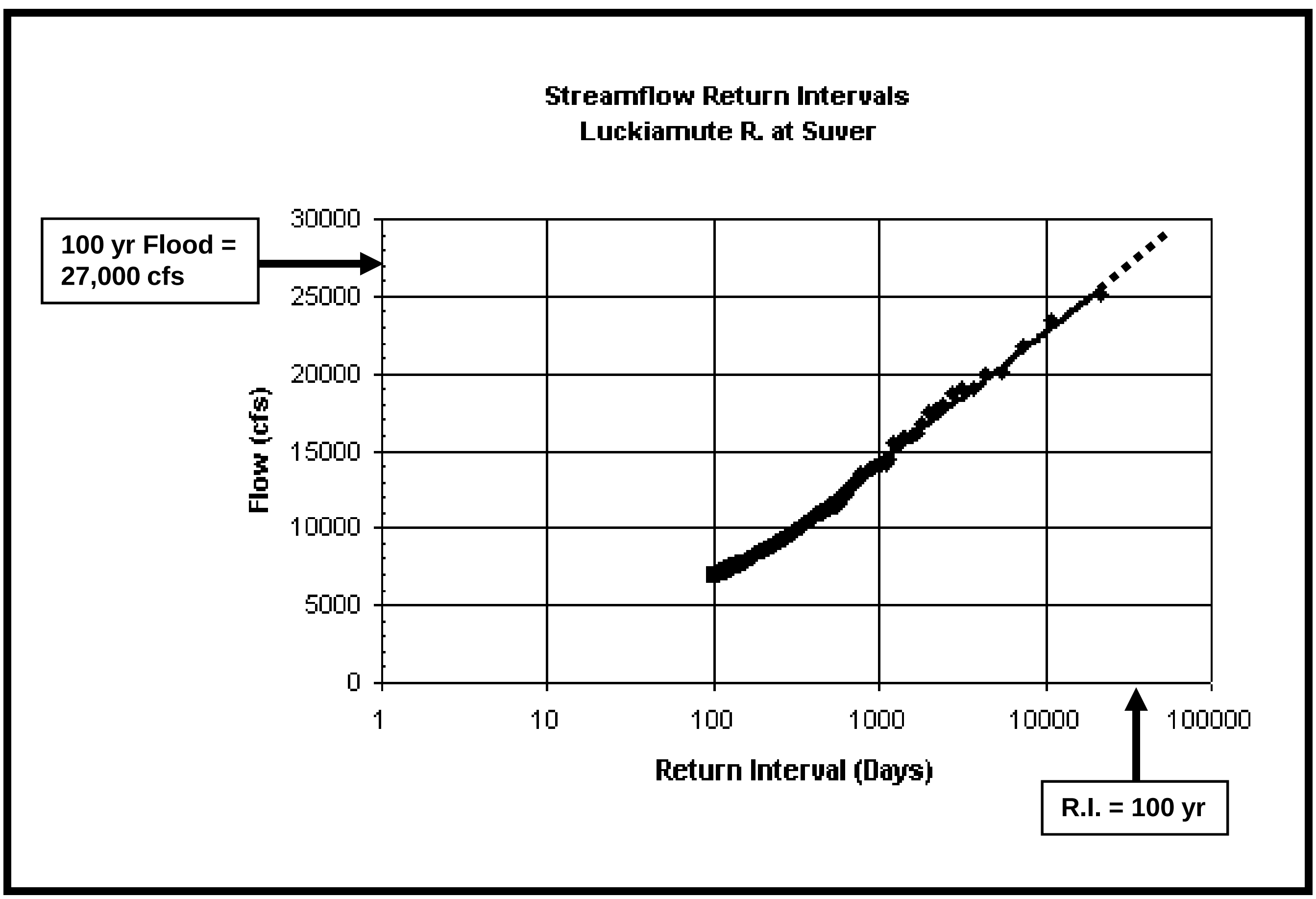
### The Helmick Family and Cultural History

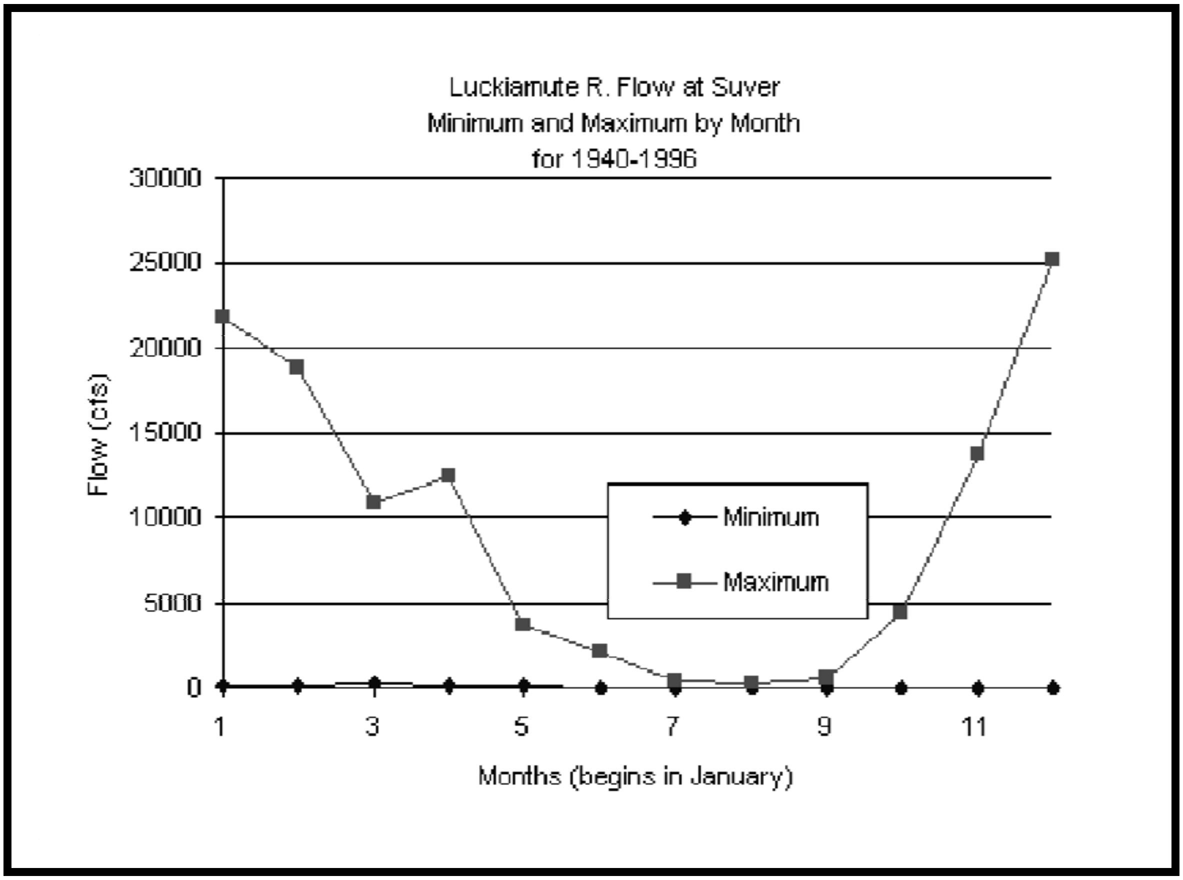
Helmick Hill is just west of the point where the Pacific Highway West crosses Luckiamute River. It was named for Henry Helmick, a pioneer of 1845, who with his wife Sarah took up a donation land claim on the Luckiamute in 1846. Their home was at the base of the hill. Helmick died in 1877. In 1924 Mrs. Helmick presented to the state land adjacent to the highway for a park which was dedicated with appropriate honors, and named Sarah Helmick State Park. She celebrated her 100th birthday on July 4, 1923.
*McArthur, Lewis L., Oregon Geographic Names, 6th edition. Oregon Historical Society Press, Portland, Oregon, 1992, p.405.*

# Stop 2:  Luckiamute River, Helmick State Park



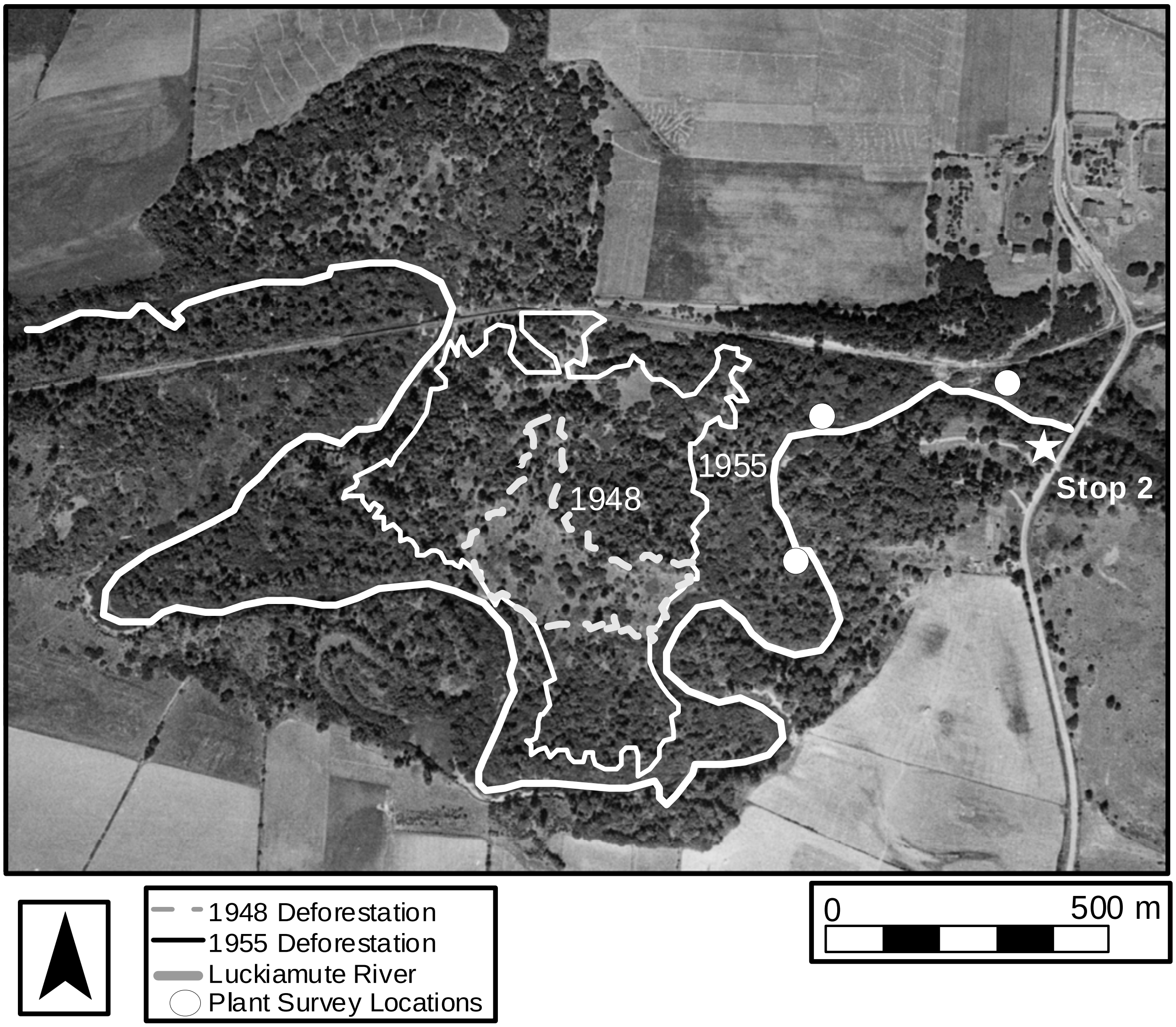

Stage-Discharge Rating Curve
Luckiamute R. at Suver
Stage (ft)
100
10
1
1
10
100
1000
10000
100000
Discharge (cfs)


Streamflow Return Intervals
Luckiamute R. at Suver
100 yr Flood = 27,000 cfs
Flow (cfs)
30000
25000
20000
15000
10000
5000
0
1
10
100
1000
10000
100000
Return Interval (Days)
R.I. = 100 yr




**Discharge characteristics for Luckiamute River, Helmick State Park (from Waichler and others, 1997).**

Helmick State Park
Example of Riparian Cover Change



# Results of Plant Survey Transect 3 – Field Stop 2 - Helmick Park

**Field Stop 2 - Helmick State Park Plant Data - Percent Species Cover Per Square Meter Quadrat**

Transect Quadrat (meters from stream channel)

| Species | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acer circinatum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acer macrophyllum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Carex* sp. | 1 | 10 | 1 | | | | | | | | | | | | | | | | | | | | | | |
| *Cornus sericea* | | 2 | 60 | 25 | | 10 | 15 | | 3 | 2 | 5 | | 2 | 2 | 2 | | | | | | | | | 15 | |
| *Corylus cornuta* subsp. *californica* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Galium* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Helianthus* sp. | 2 | | | | | | | | | | | | | | | | | | | | | | | | |
| *Heracleum lanatum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae sp. | 10 | 5 | | | | | 1 | | | | | | | | | | | | | | | | | | |
| *Maianthemum racemosus* subsp. *amplexicaule* | | | | | | | | | | | | | | | | | | | | | | | 8 | 15 | 5 |
| *Melilotus* sp. | | | | | | | | | | | | | 1 | | | | | | | | | | | | |
| *Oemleria cerasiformis* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Phalaris arundinacea* | | 40 | 5 | | | | | | | | | | | | | | | | | | | | | | |
| *Physocarpus capitatus* | | | | | | | | | | | 1 | 10 | | | | 75 | 60 | 30 | | | | | | | |
| Poaceae sp. | 30 | | | | | | 1 | | | | | | | | | | | | | | | | | | |
| *Prosartes* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rhamnus purshiana* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus armeniacus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus leucodermis* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus parviflorus* | | | | | | | | | | | | | | | | | | | | | | | | 25 | 35 |
| *Rubus spectabilis* | | | | | | | 3 | 40 | 3 | | | | | | | | | | 1 | | | | 15 | 30 | 15 |
| *Salix* sp. | | 40 | | | | | | | | | | | | | | | | 20 | | | | | | | |
| *Sambucus racemosa* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Solanum nigrum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Solanum* sp. | | | | | | | | | | | | 1 | | | | | | | | | | | | | |
| *Symphoricarpos albus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tellima grandiflora* | | | | | | | | 1 | | | | | | | | | | | | | | | | 1 | |
| *Urtica dioca* subsp. *gracilis* | | | | | | | | | | | | | | | | | | | | | | | | | |

| Species | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acer circinatum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Acer macrophyllum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Carex* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Cornus sericea* | | | | | | | | | 10 | | 5 | | 2 | 15 | | | | | | | | | | | |
| *Corylus cornuta* subsp. *californica* | | | | | | | | | | | | | | | | | | | | | | 1 | 2 | | |
| *Galium* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Helianthus* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Heracleum lanatum* | | | | | | | | | | | | | | | | | 12 | 1 | | | | | | | |
| Lamiaceae sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Maianthemum racemosus* subsp. *amplexicaule* | | | | | | | | | | | | 2 | | | 1 | | | | | | | | | | |
| *Melilotus* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oemleria cerasiformis* | | | | | | | | | | | | | | | | | | 20 | 3 | | | | | 10 | 3 |
| *Phalaris arundinacea* | | | | | | | | | | | | | 2 | 30 | | 1 | | | | | | | | | |
| *Physocarpus capitatus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae sp. | | | | | | | | | | | | | | | 35 | 30 | | | | | | | | | |
| *Prosartes* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rhamnus purshiana* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus armeniacus* | | | | | | | | | | | | | | | | | | | | | | | 25 | | |
| *Rubus leucodermis* | | | | | | | | 10 | | | | | 5 | | 35 | | 25 | 30 | 15 | 15 | 10 | 75 | 15 | 20 | 15 |
| *Rubus parviflorus* | 40 | 40 | 60 | 30 | 60 | 80 | 75 | 85 | 40 | 30 | 50 | 35 | 2 | 3 | 3 | 10 | | 5 | 60 | 60 | 75 | 20 | 15 | 10 | |
| *Rubus spectabilis* | 7 | | 10 | 20 | | 20 | 20 | 5 | 8 | 25 | 30 | 5 | | | | | | | | | | | 3 | 5 | |
| *Salix* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sambucus racemosa* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Solanum nigrum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Solanum* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Symphoricarpos albus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tellima grandiflora* | | | | | | | | | | | | | | | | | 2 | | | | | | | | |
| *Urtica dioca* subsp. *gracilis* | | | | | | | | | | | | | | | | | | | | | | | | | |

Transect Quadrat (meters from stream channel)

| Species | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acer circinatum* | | | 7 | 25 | 8 | 5 | 10 | 30 | 10 | 10 | 20 | | | 1 | | | | | | | 5 | | 5 | | 10 |
| *Acer macrophyllum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Carex* sp. | | | | | | | | | | | | | | | | | | | | | | | 2 | | |
| *Cornus sericea* | | | 4 | | | 3 | 1 | 5 | 10 | | | 10 | 5 | 5 | 5 | | | | | | | | | | |
| *Corylus cornuta* subsp. *californica* | | | | | | | | | | | | | | | | 1 | 5 | 5 | 30 | 30 | 40 | 40 | 3 | | |
| *Galium* sp. | | | | | | | | | | | | | | | | | | | | | | | 1 | | |
| *Helianthus* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Heracleum lanatum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Maianthemum racemosus* subsp. *amplexicaule* | | 2 | 4 | | | | | | | | | | | | | | | | | | | 3 | 2 | 30 | |
| *Melilotus* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oemleria cerasiformis* | | | | | | 2 | 4 | 1 | 2 | 5 | 15 | | | | | | | | | | | | | | |
| *Phalaris arundinacea* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Physocarpus capitatus* | | | | | | | | | | | | | 1 | 1 | 2 | 7 | 3 | | | | | | | | |
| Poaceae sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prosartes* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rhamnus purshiana* | | | | | | | | | | | | | | | 1 | | | 5 | | 5 | | | | | |
| *Rubus armeniacus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus leucodermis* | | | | | | | | | | | | | | | | | | | | | | | | | 5 |
| *Rubus parviflorus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus spectabilis* | 7 | 15 | | | | | | | | | | | | | | | | | | | | | | 5 | 20 |
| *Salix* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sambucus racemosa* | | | | | | | | | | | | | | | | 5 | 5 | | | | | | | | |
| *Solanum nigrum* | | | | | | | | | | | | | | | | | | | | | | | | 1 | |
| *Solanum* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Symphoricarpos albus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Tellima grandiflora* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Urtica dioca* subsp. *gracilis* | | | | | | | | | | | | | | | | | | | | | | 1 | 2 | 1 | |

| Species | 76 | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Acer circinatum* | 20 | 10 | | | | | | | | | | | | | 20 | 2 | 5 | | | | | | | | |
| *Acer macrophyllum* | | | | | | | | | | | | | | | | | | | 10 | 10 | | | 15 | 10 | |
| *Carex* sp. | | | | | 10 | 3 | | | 1 | 5 | | | | | | | | 1 | | | | | | | |
| *Cornus sericea* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Corylus cornuta* subsp. *californica* | | | | | | | | | | | | 15 | 15 | 20 | 5 | 10 | | 5 | 35 | 15 | | | | | |
| *Galium* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Helianthus* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Heracleum lanatum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| Lamiaceae sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Maianthemum racemosus* subsp. *amplexicaule* | | | | | 10 | | | | | | | | 6 | 10 | 7 | 5 | 4 | | | | 2 | | | | |
| *Melilotus* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Oemleria cerasiformis* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Phalaris arundinacea* | | | | | | | | | | | | | | | | | | 5 | | | | | | 5 | 20 |
| *Physocarpus capitatus* | | | | | | | | | | | | | | | | | | | | | | | | | |
| Poaceae sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Prosartes* sp. | | | | | | | | 10 | 10 | | | | | | | | | | | | | | | | |
| *Rhamnus purshiana* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Rubus armeniacus* | 1 | | 30 | 20 | | | 20 | 40 | 10 | 10 | 30 | 10 | 25 | 6 | 5 | | | | | | | | | 10 | 20 |
| *Rubus leucodermis* | | | | | | 15 | 15 | 15 | 25 | 30 | | | 10 | 10 | 10 | | 15 | 15 | 15 | 30 | 25 | 20 | 15 | | |
| *Rubus parviflorus* | | | | | | | | | | | | | | | | | | | | | | | | 10 | 15 |
| *Rubus spectabilis* | 50 | 60 | 45 | 15 | 60 | 20 | 40 | 15 | 15 | 15 | 30 | 10 | | | | 10 | 5 | | | | | | | | |
| *Salix* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Sambucus racemosa* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Solanum nigrum* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Solanum* sp. | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Symphoricarpos albus* | | | | 10 | 2 | | | | | | | 5 | 1 | 5 | | | | 5 | | 5 | | 5 | 30 | 20 | |
| *Tellima grandiflora* | | | | | | | | | | | | | | | | | | | | | | | | | |
| *Urtica dioca* subsp. *gracilis* | | | | | | | | | | | | | | | | | | | | | | | | | |

**THANKS FOR YOUR PARTICIPATION ON THE LUCKIAMUTE WATERSHED TOUR!**