

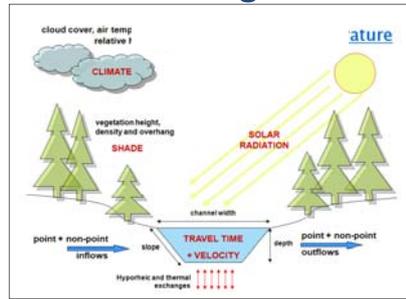
New Visual Tools to Use with Stream Temperature and Shade Modeling

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Collecting Data



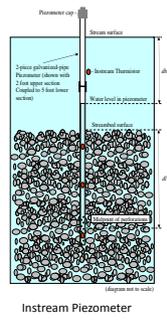
Data are collected to support temperature modeling.
Water and Air Temperature



Travel Time and Stream Flow



Groundwater Gain/Loss



Instream Piezometer

Thermal IR Flight



Riparian Vegetation



Weather



Airports, PAWS, USFS, NOAA are sources for windspeed/cloud cover.

Channel Geometry and Substrate

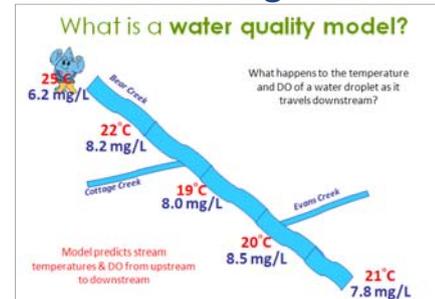


Wetted and bankfull width and depth Wolman pebble count.

For further information

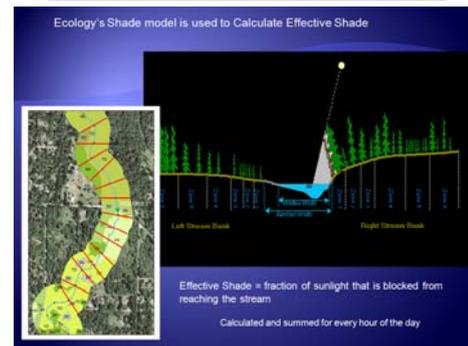
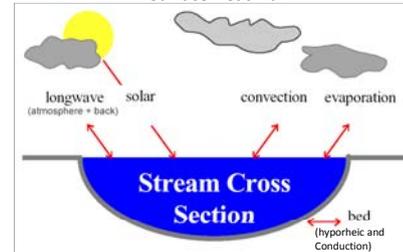
Some figures above were provided by Teizeen Mohamedali, Mindy Roberts, and other Ecology Staff. Consult the [Water Temperature Assessment in Washington State](http://www.ecy.wa.gov/apps/watersheds/temperature/index.html) web page for more information on Ecology projects. <http://www.ecy.wa.gov/apps/watersheds/temperature/index.html>

Modeling

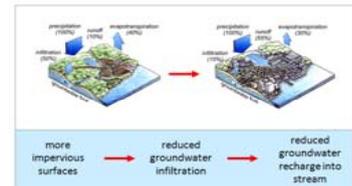


Data are entered into a model (often QUAL2Kw) to evaluate water temperature and impact of changes to shade, channel, and flow.

Surface Heat Flux

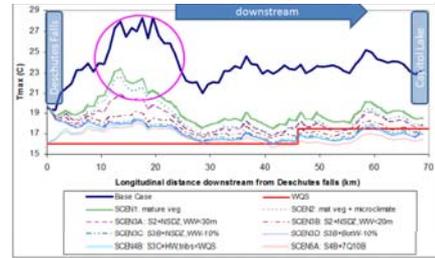


Vegetation data from the field and GIS is combined in Ecology's shade model to calculate shading from vegetation and hills.



Information from other agencies can be incorporated and evaluated (e.g. for Bear-Evans TMDL: groundwater recharge).

Temperature benefits of management actions



Results from numerous studies show that increasing streamside vegetation is the most effective change humans can make.

Acronyms and abbreviations

DO-Dissolved oxygen; GIS-Geographic Information System; LIDAR-Light distance and ranging; IR-Infrared; PAWS-Polar automatic weather station; USFS-U.S. Forest Service; NOAA-National Oceanic and Atmospheric Administration; TMDL-Total Maximum Daily Load; NAIP-National Agriculture Imagery Program.

Riparian Vegetation and Water Quality

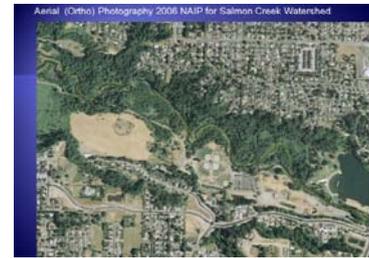
What do results show?

The largest improvements (decreases) to water temperature come from increasing the amount of streamside shade. Streamside vegetation projects have many water quality and land use benefits:

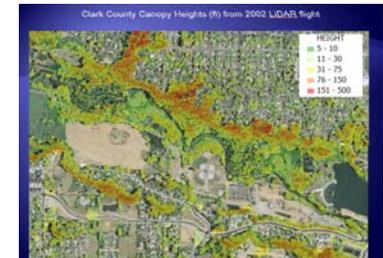
- Mature streambank plants use **fertilizers and nutrients** that would otherwise enter the stream.
- Warmer water cannot hold as much **dissolved oxygen** as cold water and speeds growth of algae.
- Increased stream temperatures during the summer affects **aquatic organisms** by decreasing the supply of oxygen, disrupting metabolism, increasing susceptibility to toxins, increasing vulnerability to disease, reducing the ability to avoid predators, and reducing food supply.
- Streamside restoration projects can **help prevent erosion** and sediment loss. Dirt, gravel, and rocks can be washed into a stream from poorly-managed forest lands, agricultural areas or building sites. This change can make streams shallower, wider, harder to shade, and warmer.
- Mature streambank plants add valuable **woody debris** to the stream channel and help **filter pollutants** from runoff water.
- Where streams have been straightened and channelized, restoration projects can help **reestablish connections with the natural floodplain and with cool groundwater resources**.

Visual Tools and Indicators

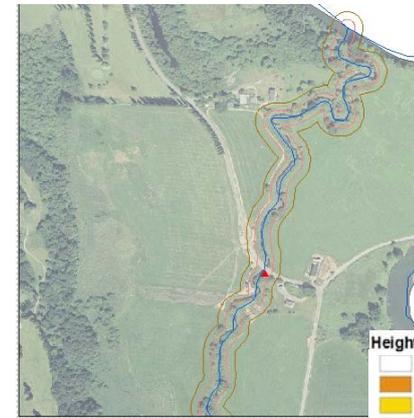
How can we track streamside vegetation?



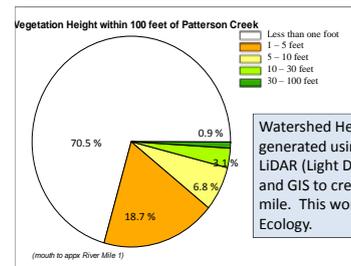
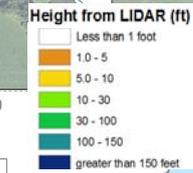
National Agriculture Imagery Program (NAIP) entire WA state covered in 2006 with either 36" or 18" pixel resolution.



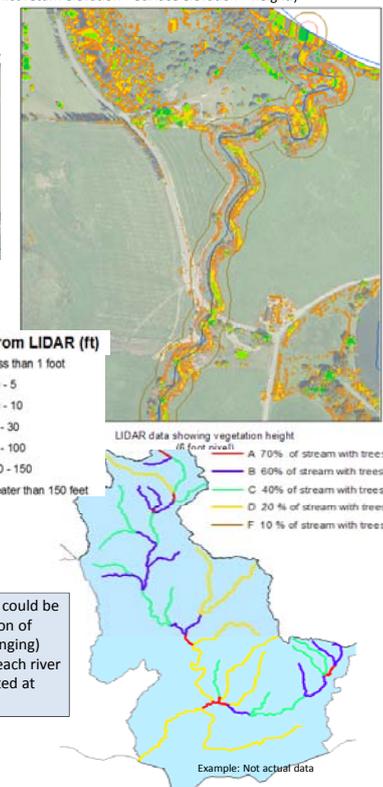
Puget Sound LIDAR consortium is one source of vegetation height data (First return elevation - Surface elevation = height.)



Patterson Creek (mouth to appx River Mile 1)



Watershed Health Indicators could be generated using a combination of LIDAR (Light Distance and Ranging) and GIS to create scores for each river mile. This work is being piloted at Ecology.



LIDAR data showing vegetation height (ft) for river mile 1:
A 70% of stream with trees
B 60% of stream with trees
C 40% of stream with trees
D 20% of stream with trees
E 10% of stream with trees
F 10% of stream with trees



Example: Not actual data