WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Conversion and Land Use Classification Modeling

Project Background

Washington's salmon are in trouble. After suffering decades of population loss due to pollution, overfishing, loss of habitat, and the effects of global climate change, DNR, in collaboration with local, regional, tribal, and federal partners, is seeking to reverse this trend.

Our client desired a solution capable of analyzing data at "watershed scale", that would enable them to assess, prioritize, and deploy resources to support this effort, while coordinating with other partners statewide.

Objectives

Assist
Assist DNR in identifying pertinent data for salmon recovery efforts.

Identify
Identify data that may help determine likelihood of land conversion

Provide
Provide a Proof of Concept data driven model to help predict land conversion.

Solution Developed

The team developed two models to assist DNR in identifying parcels of land at risk of being sold and that may then be at risk of conversion (development). Together, they will allow DNR to prioritize projects and identify partnerships near salmon habitats at greatest risk of losing riparian buffer zones due to development.

Parcel Conversion model (Growth model): Predicts if land parcels will be sold, which may be an indicator of potential future development of a parcel.

Land Use Classification model: Analyzes near real-time satellite imagery and provides insights into land uses on the ground. May be used to validate the parcel conversion models findings over time.

Project Team

Project Manager	Business / Data Analyst	Business / Data Analyst	Asst. Project Manager

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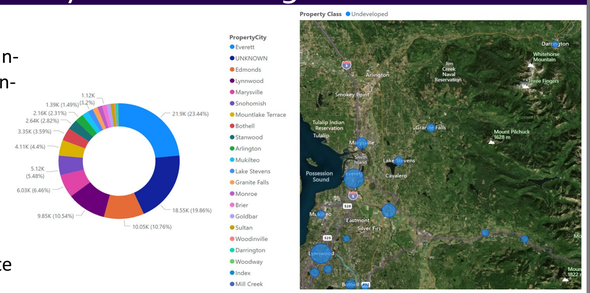
Growth Model

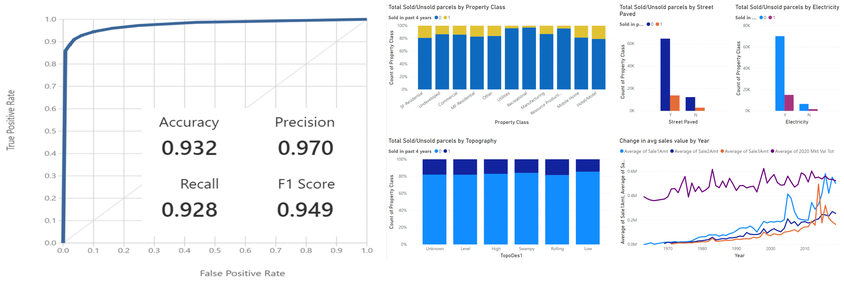
Our growth model uses Assessor data from Snohomish County to predict the likelihood that a parcel will be sold. As land conversion is a significant threat to the riparian buffers essential for protecting salmon habitat, understanding which parcels are being purchased may help DNR focus their efforts on protecting those areas.

Analysis and Findings

Our descriptive and diagnostic analysis focused on identifying undeveloped parcels, and their owners, as well as the key features used in our predictive growth model.

Developed in Azure ML Studio, our growth model is deployed via Excel, and was 93.2% accurate in predicting parcel sales.





Recommendations for Use

- Partner with local land owners in areas at high likelihood of development
- Focus resource deployment where it can contribute greatest impact relative to other DNR and regional salmon habitat protection and rehabilitation efforts
- Continue to enhance the model by adding economic and demographic data or through resources like UrbanSim

Tools and Platforms Utilized

SQL · Azure · QGIS · sentinelhub · colab · Power BI · python · Excel · MRLC

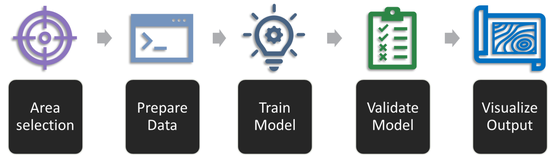
Land Use Classification Model

Our land use classification (LUC) model provides DNR an easy way to observe changes in land use without having to rely on field observations. Enabling DNR to monitor large areas with minimal resource commitment, it can also be used to validate growth model predictions over time.

Analysis and Findings

Selecting areas of interest (AOI) matching DNR's specifications, we obtained Sentinel-2 satellite imagery of Snohomish county for various periods between 2016-19 and imported them into our workflow via the Sentinel Hub API and eo-learn library for Python.

The National Land Cover Database (NLCD) served as ground label data. This along with shapefiles for our AOI's were scaled and re-projected in QGIS. Descriptive and diagnostic analytics were performed in python as part of model training and evaluation. Our final LUC model used LightGBM and provided overall classification accuracy of 78%.



LightGBM	CatBoost	Multi-layer Perceptron
Overall Accuracy: 78%	**Overall Accuracy:** 74.1%	**Overall Accuracy:** 73.9%
Fast training time	Moderate training time	Longest training time
Best classification on all land-use types	Less prone to overfitting	Lower accuracy on water and developed land types
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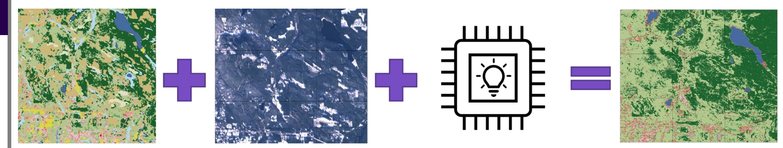
Model training and evaluation visualized.



Recommendations for Use

- Paired with the growth model, deploy statewide in support of salmon habitat protection and restoration efforts
- Integrate model with DNR GIS assets to support additional program offerings
- Increasing training sample sizes and obtaining imagery and label data of the same resolution may improve model accuracy
  - Aerial or Drone imagery may be considered if available