Climate Risk Impact Analysis: Quantifying the Uncertain

Increasing Disruption to Transportation System

Climate hazards are increasing in frequency, intensity, and scale. These hazards often trigger and intensify each other. Disruption to the state's multimodal transportation system is increasing as a direct result.

Relevant hazards include

- Coastal sea level rise, flooding, erosion
- Increased rainfall, flooding, landslides
- Drought conditions, wildfires
- Snow and ice events

Hazard Uncertainty

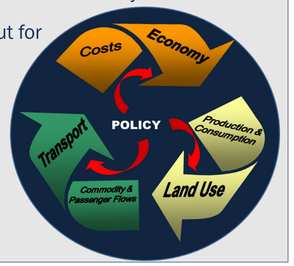
Agency resources are spread thinner, and budgets are increasingly tightening as climate hazards increase. Action has been hampered by uncertainty for semi random events causing disruption.

Oregon's Statewide Integrated Model

The Statewide Integrated Model (SWIM) was developed to evaluate economic impacts of different transportation system investments. It is capable of forecasting a variety of future scenarios and is great for "What If" scenario analysis.

SWIM reports economic metrics out for different geographic levels

- Employment by industry
- Population growth
- Gross state product
- Traffic volumes



Oregon Department of Transportation

Quantifying the Economic Impacts of Disruption

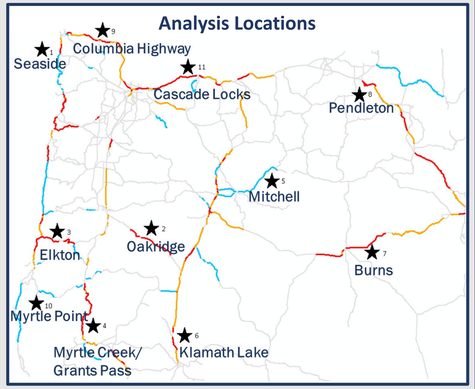
A multidisciplinary team identified and prioritized the most at-risk locations across the state. The 11 highest risk corridors are identified on the map. Using SWIM, future scenarios were developed for each location to quantify the range of economic impacts of increasing climate related events.

Scenario Analysis per Location

One Day Closure
No Future Forecast
The first scenario modeled a one-day closure, which focuses on system user costs related to detours (primarily time and distance for the user). This represents the impact of infrequent (one-time) events.

Chronic Closures
20 Year Forecast
The second scenario modeled multiple years of increasing disruption, with hazards causing prolonged detours. It was designed to capture impacts from increased uncertainty and unreliability. This was modeled with a time/toll penalty, (adding 20 mins to a route).

Full Closure
20 Year Forecast
The last scenario modeled a worst-case scenario, illustrating potential impacts for locations where after years of closures, ODOT is unable maintain the system, and is forced to let the infrastructure deteriorate.



Location 1: Seaside, OR

Rerouting Analysis

The two images to the left illustrate traffic volumes for the highway section in Seaside, OR. Users passing over the identified segment are highlighted in red when the segment is open, in the left image. Once the segment is closed, the detoured users are highlighted in red to show their detour routes in the right image. The left image shows how users originally travel, and the right shows how users detour around the closure.

Chronic and Full Closure Scenario Results for Seaside, OR

From the second and third scenarios of chronic and full closure at this location, simulated disruption over time showed severe reductions in forecast population, employment, economic production, and vehicle miles traveled (VMT). At the local level, Seaside experienced a reduction in forecast population ranging from 8% to 42% and a reduction in forecast employment ranging from 24% to 56% fewer jobs. At the county level, Clatsop county experienced reductions in forecasts between 3% to 9% for population, between 3% to 8% for employment, between 1% to 4% for economic production, and between 13% to 19% for VMT.

System User Costs

From the rerouting analysis the difference in time and travel distance users experience was measured and used to calculate the range of total user costs for each location, shown in the table. For the Seaside, OR location above, the range of total user costs is $997,000 - $1,330,000 for a single day closure.

Estimated Cost of One Day Closure

Network Location	Range of Additional Time Costs		Range of Additional Operating Costs		Range of Total User Costs*	
#1 Seaside	$710,000	$946,500	$287,000	$383,500	$997,000	$1,330,000
#2 Oakridge	$112,000	$224,500	$131,000	$261,500	$243,000	$486,000
#3 Elkton	$15,000	$30,000	$29,000	$57,000	$44,000	$87,000
#4 Grants Pass	$861,000	$1,292,000	$268,000	$402,000	$1,129,000	$1,694,000
# 5 Mitchell	$27,000	$54,000	$38,000	$76,000	$65,000	$130,000
#6 Klamath Lake	$136,000	$272,000	$87,000	$174,000	$223,000	$446,000
#7 Burns	$247,000	$370,000	$272,000	$408,000	$519,000	$778,000
#8 Pendleton	$626,000	$834,500	$118,000	$157,500	$744,000	$992,000
#9 Columbia Highway	$110,000	$221,000	$53,000	$105,000	$163,000	$326,000
#10 Myrtle Point	$101,000	$202,500	$90,000	$180,500	$191,000	$383,000
#11 Cascade Locks	$433,500	$650,000	$55,500	$83,000	$489,000	$733,000

* Using ODOT average annual traffic volumes with +/- 10% variation; figures reported in 2021 dollars;

General Conclusions

From our analysis of the scenarios at the 11 locations we concluded that repeated disruption to the transportation system increases travel costs for users and reduces reliability. At some point users begin to assess alternatives. Long term disruption creates economic conditions in which households and businesses choose to relocate. These negative economic impacts affect smaller communities with less transportation redundancy more severely. The Seaside, OR example clearly shows the effect on smaller towns. Larger cities that have more robust transportation networks and available rerouting options see potential increases in population, employment, and production as a result of disruption.

Quantifying the Uncertain

Climate disasters are dynamic - it's unknown where and when they'll occur, or how severe they'll be when they do. Resultingly, it's difficult to analyze their precise economic impact. Instead of looking for an exact answer, our approach modeled a variety of high-risk locations and a range of severities and tested them to get a range of economic impacts. This tiered scenario approach allows ODOT to articulate the potential impacts of the state choosing not to invest in climate-related mitigation and brings that information to decision makers who decide how to strategically invest in the state transportation system. These scenarios report out results regionally, which captures impacts for both rural and urban parts of Oregon. Multiple scenarios enable agency leadership to better understand the scope of the issues across the state and make informed decisions about trade-offs. One of the most important aspects of this work is providing quantified impacts that can be used in benefit/cost assessment and return on investment analysis.

This information is imperative to help the State of Oregon move forward in budget and investment discussions, and to develop a strategic approach to meet the needs of the state given rising costs and uncertainty associated with increasing risk of extreme climate events.