Oregon Department of Forestry Forest Management Plan

Modeled Outputs

December 13, 2023

Introduction and Background

Comparative Analysis & Yield Table Calibration

In 2020 the State Forests Division (Division) commissioned a Comparative Analysis using high-level modeled outcomes to assist the Board of Forestry (BOF) in deciding whether it was in the best interest of the state to continue to pursue a Habitat Conservation Plan and enter the National Environmental Policy Act (NEPA) process. The comparative analysis evaluated the modeled outcomes and tradeoffs expected between three different management scenarios. The scenarios included implementation of:

1. the current 2010 Northwest and Southwest Oregon State Forest Management Plans and an associated take avoidance approach to Endangered Species Act (ESA) compliance;
2. the 2018 draft revised Forest Management Plan and an associated take avoidance approach to ESA compliance; and
3. the draft Habitat Conservation Plan.

The high-level modeled outcomes used in the comparative analysis were intended for the purpose of comparing the relative differences between these three management scenarios based on several metrics including habitat quantity and quality, harvest volume, carbon, recreation, and financial metrics. This analysis was presented to the BOF in October 2020 and was used to inform the BOF's decision to direct the Division to move forward with the draft Habitat Conservation Plan and to develop a new Western Oregon State Forest Management Plan that is compatible with the draft Habitat Conservation Plan. Based on this direction the Division has been working for the past 3 years on supporting the NEPA process for the draft Habitat Conservation Plan and developing the 2023 draft Western Oregon State Forest Management Plan. This work included updating inputs to the model including inventory, silviculture prescriptions, reforestation zones, updated data (operationally limited areas, harvest units, roads, recent thinnings, etc.), and growth and yield tables.

Figures 1 and 2 compare the modeled volume outcome from the 2020 Comparative Analysis draft Habitat Conservation Plan run to the recently completed modeled volume outcome from Scenario 4 of the 2023 draft Western Oregon State Forest Management Plan with draft Habitat Conservation Plan. Scenario 4 is intended to emulate the 2020 Comparative Analysis draft Habitat Conservation Plan model run using updated inventory, growth and yield data and a more spatially explicit model.

Figure 1. Comparative Analysis Draft Habitat Conservation Plan Modeled Outcomes

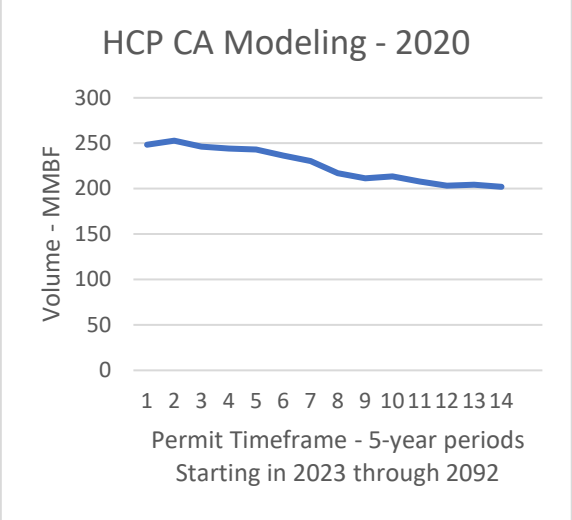
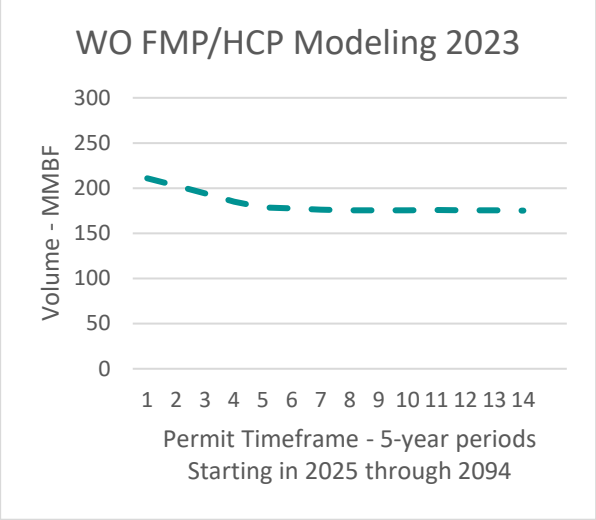


Figure 2. 2023 Western Oregon Forest Management Plan with draft Habitat Conservation Plan Modeled Outcomes



As illustrated above, the two forest models yield notably different volume outcomes due to variations in their modeling processes and updated information.

Differences in the modeling processes include:

Draft Habitat Conservation Plan Comparative Analysis	**2023 Western Oregon Forest Management Plan with draft Habitat Conservation Plan – Scenario 4**
• Linear programing model (2020) • 2017 inventory • Habitat Conservation Area: allowable hardwood harvest of 200 acres/year for the first 6 periods • Habitat Conservation Area: 2 thinnings allowed in each stand up to age 90 for first 6 periods (model outputs averaged 386 acres/year across the permit area) • Target age class outside Habitat Conservation Areas excluding Riparian Conservation Areas • Pre Labor Day Fires	• Spatially explicit model (2023) • 2021 inventory • Habitat Conservation Area: allowable hardwood harvest of 500 acres/year for the first 6 periods • Habitat Conservation Area: allows thinning 1,500 acres/year across the permit area for first 6 periods (model outputs averaged of 556 acres/year across the permit area) • Target NSO dispersal habitat outside Habitat Conservation Areas including Riparian Conservation Areas • The Labor Day Fires caused high to moderate severity damage to roughly 2% of the planning area, affecting 13,000 acres in the North Cascade District

- Ending inventory target of minimum ending inventory: 20,000 bdft/ac on operable acres
- Geographic harvest allocation where 75% of harvest volume came from the North Coast georegion, 15% came from the Valley georegion and 10% came from the Southern Oregon georegion.

- Non-declining inventory after 100 years on operable acres
- No geographic harvest allocation

- Updated silvicultural prescriptions and reforestation zones
- Updated data (operationally limited areas, harvest units, roads, recent thinnings, etc.)
- Updated Costs
- Updated Growth and Yield Tables

The primary distinction between the models is the update of the growth and yield tables, which forecast the productivity and volume of a forest stand at various ages, considering factors like species, density, and site conditions. These tables are generated using the Forest Vegetation Simulator (FVS), the growth model for forest inventory updates and modeling. Like most forest growth models, FVS typically predicts high yields, and calibration to reflect local conditions is necessary. The 2020 Comparative Analysis noted that modeled yields are often quite variable, compared to actual growth and mortality in forest stands across the landscape, which makes it difficult to predict actual long-term harvest volumes; however, the comparison was intended to be relative among the scenarios presented, and these inaccuracies would apply to all scenarios. No adjustments were made to the yield tables due to lack of time and capacity. Additionally, the effects of climate change, disturbance or other stochastic events were not modeled, and are also not modeled in this current work. The only adjustments made to the 2020 Comparative Analysis was to eliminate harvest areas less than 10 acres in size from the volume outputs, to help compensate for the lack of spatially explicit results in the linear programming model.

In 2022, the Division began revising Implementation Plans, as several districts' Implementation Plans were expiring, and all Implementation Plans needed to be revised to incorporate transition strategies in anticipation of the completion of the draft Habitat Conservation Plan process and issuance of incidental take permits, and while work on the 2023 draft Western Oregon State Forest Management Plan continued. Based on the observations during the comparative analysis modeling work, calibration of the yield tables was started for the revised Implementation Plan modeling project. Due to time constraints and multiple concurrent projects, this calibration consisted of limited adjustments by species (e.g., SDI Max, basal area growth, and SNC growth). During field review, it was noted that the modeled volume outcomes were again too high. Since these outputs were being used to set actual harvest objectives, a post-modeling reduction of the volumes was made utilizing actual local timber sale harvest volume information from similar forest stands and

the knowledge of the local district foresters to establish the annual harvest volume range for each district.

In 2023, the Division contracted forestry consultant Mason, Bruce and Girard (MBG) to collaborate on enhancing the accuracy of growth and yield projections using their forest biometrics and modeling expertise. MBG collaborated with the Division's Forest Analyst to create empirical volume yield curves using USFS Forest Inventory Assessment (FIA) plots and Division's Stand Level Inventory (SLI) data. These curves guided adjustments to FVS projections, with region-specific calibrations (coast, Cascades, southwest Oregon) and specific adjustments for the Tillamook District to account for growth impacts of Swiss needle cast, management history, and unique geography. The updated yield tables were well-received internally, aligning closer to actual forest volumes in respective districts, except for discrepancies in stands over 100 years old and alder stands. Further adjustments were made for older stands and alder stands that had been sprayed during the 1970s in parts of Tillamook District. Time constraints prevented a complete calibration of alder trees across the plan area.

This process of calibration and review resulted in using the improved yield tables in modeling the different scenarios for the 2023 draft Western Oregon State Forest Management Plan with the draft Habitat Conservation Plan that is described in this report.

Scope of the Modeling – 2023 draft Western Oregon State Forest Management Plan with Draft Habitat Conservation Plan

This new modeling analysis relies on the outputs of a spatially-explicit policy level forest management harvest model. The forest management model emulates how the forest would be managed. It projects harvest volumes, revenues, and forest stand metrics across the landscape based on the 2021 version of the Division's Stand Level Inventory and a series of model rules or parameters related to harvest objectives, planning unit scale, and acres available for harvest. Forest stand metric outputs are used to further estimate habitat suitability for three of the species covered under the draft Habitat Conservation Plan, habitat components for native wildlife generally, and carbon sequestration and storage.

Timeframe. The analysis considers a 150-year planning timeframe (2025-2174) under all scenarios. This is approximately equivalent to the 70-year permit term for the draft Habitat Conservation Plan with an additional 80-year time period, which ensures sustainable harvest through the harvest rotation following the permit term. The analysis assumes consistent forest management (e.g., spatial and temporal flow of harvest) and constraints (e.g., draft Habitat Conservation Plan conservation actions) throughout the timeframe.

Geography. The analysis covers Board of Forestry lands and Common School Forest lands managed by ODF in western Oregon, including those in all six districts from Astoria in the north to lands managed by the Western Lane District to the south. It does not include lands in

the Klamath-Lake district in eastern Oregon. The included land is referred to as the "plan area."

Scale. Geographic scale determines the area used to control harvest objectives. Setting a geographic scale for model objectives provides an opportunity to address concerns about equity, revenue distribution, and regional impacts to habitat (outside the context of the draft Habitat Conservation Plan). Two scales were used for the 2023 draft Western Oregon State Forest Management Plan modeling:

1) Georegion scale. State forests in the plan area are grouped into three geographic regions, North Coast – Astoria, Forest Grove, and Tillamook Districts; Valley – North Cascade and West Oregon Districts; Southern – Western Lane District (includes Veneta, Coos and Southwest Oregon units).
2) District scale. State forests are organized by the field office or district out of which they are managed.

Harvest Flow. Harvest flow is the timing and amount of harvest over time within a geographic area. Flow considers the predictability and sustainability of harvest. The analysis considered two harvest flow scenarios:

1) Even-flow. Level of harvest that can be sustained during the modeled timeframe without ever declining. Overall harvest is limited by available inventory and growth over time, but is stable, allowing for a more predictable implementation.
2) Departure: This is a departure from even-flow to achieve a balance across forest age classes and respect habitat constraints while pursuing the highest net value timber product harvest. Near-term harvest volume may be higher, but declines over time until inventory regrows to allow for future harvest. In this specific scenario, two additional constraints were applied to the departure scenario: 1) the volume was not allowed to fluctuate more than 5% between the five-year modeling periods, and 2) volume could not be more than 10% different from the 100-year average volume. These two constraints were used to keep the rate of departure somewhat more manageable from the standpoint of ODF's ability to implement such a scenario.

Methods, Assumptions and Uncertainties for the Analysis

Scenarios. This analysis defines and models differences in outcomes across four scenarios. The primary purpose of this analysis is to show a range of outputs possible under the 2023 draft Western Oregon State Forest Management Plan with the draft Habitat Conservation Plan.

The four scenarios that were modeled across the plan area are:[1]

1) Scenario 1: maximize volume with an even-flow;
2) Scenario 2: maximize volume with an even-flow, constrained by longer rotations (average harvest age of 100 years);
3) Scenario 3: maximize net present value using a discount rate of 4% with an even flow; and
4) Scenario 4: maximize net present value using a discount rate of 3% allowing for departure.

Key Assumptions and Uncertainties. Uncertainties are inherent in modeling due to the assumptions that must be made based on the best available data, the quality of the inputs used, and the fact that parameters change over time. While model outputs may be a useful tool to aid in decision making, they are not an exact number that can be counted on in perpetuity, but merely an estimate of what could be accomplished under a certain set of stagnant assumptions. This is why harvest modeling is redone in conjunction with the Implementation Plan cycle. Modeling may also be run when changes to inputs or assumptions are large enough to change Implementation Plan objectives, for example after large disturbance events or perhaps a change in management standards as determined through monitoring and adaptive management.

Key assumptions and uncertainties with this model are:

- The model is assumed to be correctly specified and that there are no logic errors, or errors of omission or commission.
- Assumes no further additional constraints in the Forest Management Plan outside of the draft Habitat Conservation Plan.
- Timber prices and costs are assumed to stay constant in a real sense (inflation adjusted) and reflect the most recent prices available by district (from 2022).
- Division staff based their estimates of harvest costs on expected costs per thousand board feet (MBF) by district.
- Summed future costs and benefits are time discounted using a real (inflation-adjusted) discount rate. Data in charts over time do not include discounting.
- Assumptions used in the model for the different scenarios may be wrong.
- The model doesn't consider effects from climate change, pests, pathogens, drought, or disturbance. While these are not modeled at this time, the draft FMP strategies are intended to provide the flexibility necessary to consider these effects in implementation planning.
- Assumes that future growth trends will be consistent with recent growth observations.
- The growth model doesn't factor in future ingrowth of trees naturally seeding into a stand or gains from using improved seed or improved silviculture.

[1] The plan area is the Board of Forestry Lands (BOFL) and the Common School Forest Lands (CSFL) in Western Oregon. It does not include lands in the Klamath-Lake district or in eastern Oregon, nor does it include the CSFL in Douglas and Coos counties that are part of the Elliott State Forest.

- Future growth is uncertain as it is derived from a model. There is still additional calibration work to do in the future and outcomes will change as inventory data improves.
- Some districts noted projected volumes per acre are still high for harvests associated with current stands. While replacement stands are anticipated to have higher yields than current stands, the degree to which they match predictions of yield tables are unknown.
- Actual available acres are one of the larger uncertainties. Some constrained acres may be specifically mapped out such as campgrounds, while others such as stream buffers were estimated using a terrain model to predict location, size, fish use and duration. Districts noted during MSR that additional reductions in available acres will likely come from wetlands, small rock outcroppings, inner gorge areas, the difference between modeled stream buffers and the buffers resulting from actual stream locations and conditions in the field, stream-associated wetlands, steep slopes and small acres left inaccessible due to buffers as some examples.
- The Division is continually working to improve the forest inventory by increasing the percentage of forest that is measured and improving the technology and techniques that are used. Approximately 60% of stocked forest stands are measured in the Stand Level Inventory. The inventory relies on imputation, matching unmeasured stands with measured stands that most closely resemble them, to estimate the values of the non-measured stands. The State Forests Division is developing a lidar-based inventory that will replace Stand Level Inventory when completed. The Division is in the process of developing a raster-based estimate of forest biometrics across most of state forest ownership using lidar data collected since 2020. This improved inventory could change future modeled outputs.
- Updates to inventory and growth and yield tables may change inventory metrics that are used to calculate habitat suitability indices for covered species. While this does not create much uncertainty around ingrowth of total suitable habitat generally, it may affect interpretation around the quality of habitat. Biological interpretation of habitat suitability indices may change thresholds based on monitoring and adaptive management.
- Changing markets, pond values, logging costs, reforestation costs and project costs affect volumes harvested and resulting revenue.
- The model assumes that 2 green trees per acre are retained in each harvested unit, but due to different policies, additional green trees could be retained due to scenic areas, domestic water point of diversions, supplemental trees for snags, unstable slopes, nest trees, and old growth patches as examples.
- Assume that adjacent regeneration units can be scheduled annually with at least a 5 year gap between adjacent units.
- Changes in politics (e.g., a new governor or a new board) could result in new management direction.

Relative differences across scenarios are likely to affect only a subset of actions the Division engages in while fulfilling its mission. The analysis focuses on those actions that may result in changes in conservation, timber harvest, revenue, and carbon storage. Results and analyses are based on actual empirical data and detailed forest modeling, complemented where necessary with the expert judgement of the project team and input from Division staff.

Metrics. To do this analysis, Division staff and the project team reviewed all identifiable categories of potential differences in effects among the four scenarios.

Table 1. Metrics for Analysis

Variable	Units of Measure
Economic	
Area Available for Harvest	Acres
Annual Harvest Volume	MMBF (million board-feet)
Annual Timber Revenue	Dollars
Timber Management Costs	Dollars
Timber Inventory	MMBF (million board-feet)
Environmental	
Quality and Quantity of Terrestrial Habitat (Covered Species)	Acres of suitable habitat
Quality and Quantity of Non-Covered Species Habitat	Acres by stand age and qualitative metrics
Carbon Storage	C tons (tons of carbon) In live trees & in harvested wood products

Economic Outcomes

HARVEST VOLUME

The four scenarios involve differences in timber management and harvest approaches outside of the Habitat Conservation Areas.

The overarching management objective for inside the Habitat Conservation Areas is to increase the quality and quantity of habitat for terrestrial covered species. Habitat restoration and improvement goals and objectives inside the Habitat Conservation Areas are the same across all four scenarios. Harvest volume is not an objective within the Habitat Conservation Areas, but rather a byproduct of habitat restoration or improvement activities. Silvicultural prescriptions for habitat restoration and improvement within the Habitat Conservation Areas will be site specific, while prescriptions in the model are generic. The Conservation Fund will be utilized to fund certain restoration activities and improvements while other funding sources for some of these activities that can't pay for themselves are being investigated. Given these factors, the amount of volume that may be harvested from inside the Habitat Conservation Areas is uncertain and will be reported separately from volume outside the Habitat Conservation Areas. Division harvest and revenue goals will be based upon harvest volumes outside of Habitat Conservation Areas. All tables and figures for volume and revenue for the remainder of this report are only for outside of the Habitat Conservation Areas unless otherwise indicated.

The total average annual harvest volume produced by the four scenarios ranges from 168 to 187.3 million board feet. Most of the scenarios were run with an even flow of harvest volume except for Scenario 4 which was run with a departure. Even flow was chosen as it represents a sustainable and predictable flow of harvest to meet Greatest Permanent Value. However, it does constrain the model so that the difference between the harvest levels achievable across the different scenarios is minimal.

Table 2. Summary of 70-year Average Annual Harvest Volume (mmbf) by Scenario and Scale.

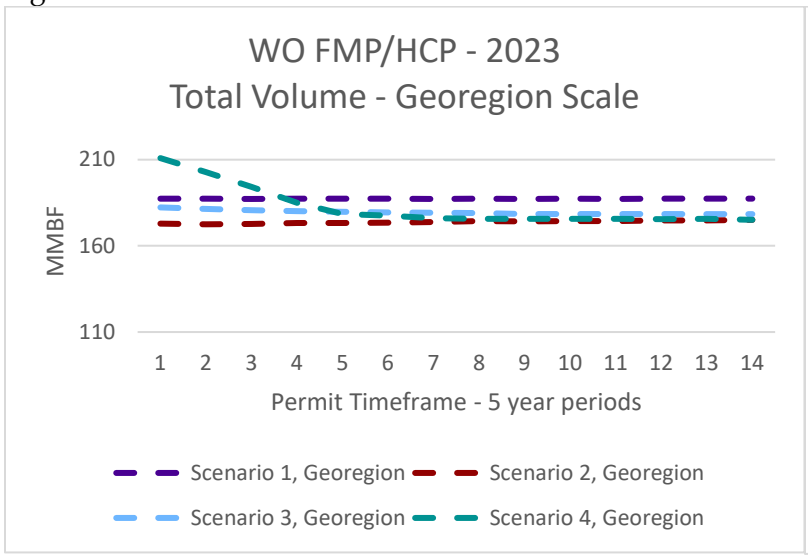
	Georegion Scale				District Scale		
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3
Total Average Annual Harvest Volume (Inside and Outside of Habitat Conservation Areas)[1]	187.3	173.8	179.5	182	185	172.3	168
Common School Lands Annual Harvest[1]	5.9	5.8	6.4	6.2	5.7	5.4	6
Board of Forestry Lands Annual Harvest[1]	181.4	167.8	173.2	176.3	179.4	166.9	162.3
Average Annual Harvest Volume Outside Habitat Conservation Areas[2]	149.8	133.5	143.8	152.2	149.7	132	134
Inside Habitat Conservation Areas[2]	37.5	39.5	36.9	39.4	35.2	39.7	34.2
Average Rotation Age (years)	80	92[3]	77	76	80	92[3]	75

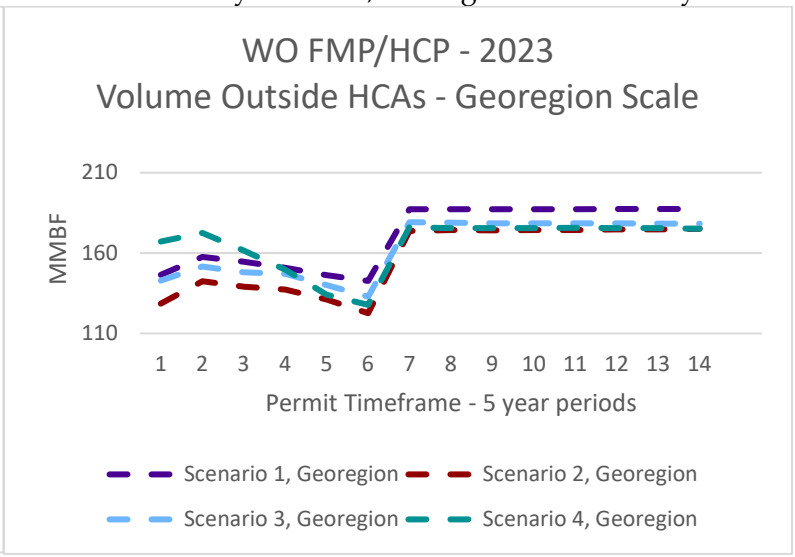
[1] Total average volumes are achieved from harvest units inside and outside of Habitat Conservation Areas for the first 30 years and outside of the Habitat Conservation Areas for the remainder of the permit term.

[2] This is the average volume calculated over 30 years as the draft Habitat Conservation Plan allows for management within the Habitat Conservation Areas for the first 30 years of the permit term. After 30 years the average annual harvest volume outside the Habitat Conservation Areas will increase to the total average annual harvest volume.

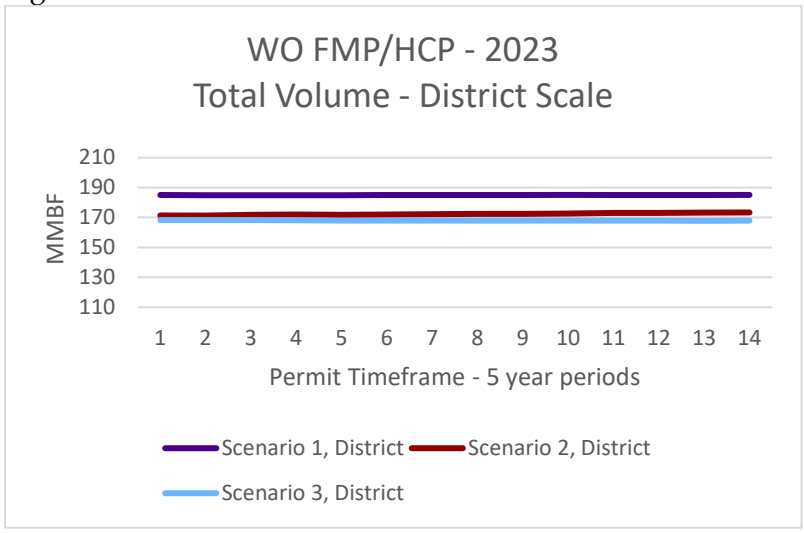
[3] The target age for the 150-year model was 100 years which averaged 92 years across the 70-year permit term.

Figures 3 & 4. Total Volume and volume Outside Habitat Conservation Areas by Scenario, Georegion Scale and 5-year time periods.





Figures 5 & 6. Total Volume and Volume Outside Habitat Conservation Areas by Scenario, District Scale and 5-year time periods.



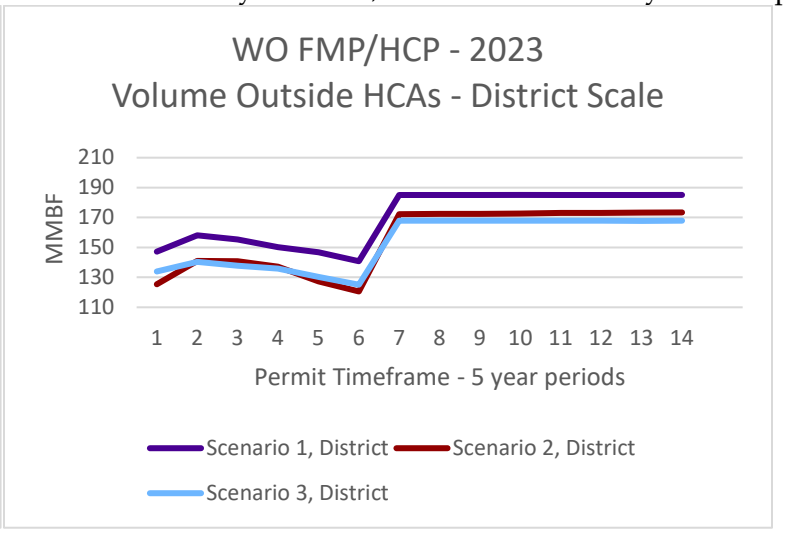


Table 3. 70-year Average Annual Total Volume (MMBF) by Scenario, Scale and County

	Georegion Scale				District Scale		
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3
Total County Volume[1]	181.4	167.8	173.2	176.3	179.4	166.9	162.3
Benton	3.8	3.1	3.5	3.2	3.3	3	2.8
Clackamas.	1.7	1.5	1.7	1.9	1.7	1.5	1.7
Clatsop	47.9	44.4	45.2	45.6	49.1	44.5	44.5
Columbia	4	3.9	3.8	3.8	4.5	4.2	3.5
Coos	1.4	1.5	1.5	1.4	1.4	1.5	1.5
Curry	–	–	–	–	–	–	–
Douglas	1.5	1.4	1.3	1.4	1.5	1.4	1.3
Jackson	–	–	–	–	–	–	–
Josephine	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Lane	8.5	8.2	8.5	9.3	8.5	8.2	8.5
Lincoln	8.3	7.2	7.5	7.4	7.5	6.5	6.4
Linn	7.7	7.3	7.6	8	8.3	7.2	7.8
Marion	3.5	3	3.5	3.6	3.7	3	3.5
Polk	2.6	2.4	2.6	2.6	2.6	2.2	2.4
Tillamook	74.2	69.1	69.8	72.2	69.7	67.1	62.6
Washington	16	14.5	16.4	15.6	17.3	16.3	15.5
Yamhill	–	–	–	–	–	–	–

[1] Total County volume is for Board of Forestry Lands only.

Figures of volume by period for each county by scenario and scale are available in Appendix A.

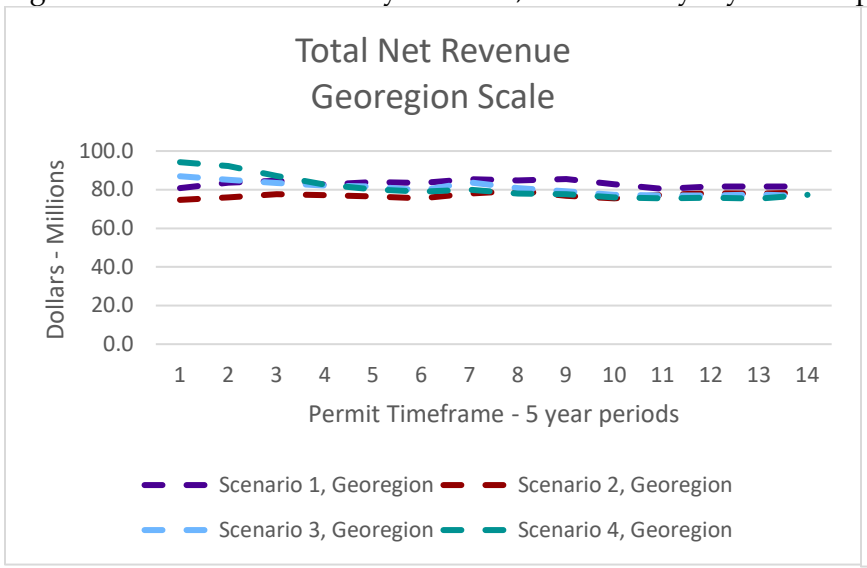
NET REVENUE

Total net revenue in the model includes both Board of Forestry and Common School lands and is calculated by removing logging costs, road maintenance and transportation costs from the pond value which is an estimate calculated using a 10-year average of pond values calculated in 2022. Due to limitations in the modeling, road construction and in-unit spur costs are not included in the net revenue calculation and the stumpage. This resulted in an average range of stumpages from $442 - $450 per mbf across the scenarios. The total net revenue does not remove reforestation costs as those are removed from the State Forest (Forest Development Fund and Common School Land) share of the net revenue. Each year 63.75 percent of the total net annual harvest revenue from Board of Forestry lands is distributed to the counties and is shown in Table 4. The remaining 36.25 percent of the total net annual harvest revenue from Board of Forestry lands is distributed to the State Forest Division Forest Development Fund. Net revenue for Common School Lands and the Forest Development Fund is the same as the total net revenue calculation described above with the additional removal of reforestation costs.

Table 4. Summary of 70-year Average Annual Net Revenue by Scenario and Scale (Dollars – Millions)

	Georegion Scale				District Scale		
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3
Volume (mmbf)	187.3	173.8	179.5	182	185	172.3	168
Total Net Revenue	$83.1	$77.1	$80.6	$80.8	$82.6	$76.9	$75.6
County Net Revenue	$51.5	$47.7	$49.8	$49.9	$51.2	$47.7	$46.7
Common School Land Net Revenue[3]	$2.2	$2.2	$2.5	$2.4	$2.1	$2.0	$2.3
Forest Development Fund Net Revenue	$27.1	$25.5	$26.1	$26.2	$27.0	$25.5	$24.5

Figures 7 & 8. Net Revenue by Scenario, Scale and by 5-year time periods



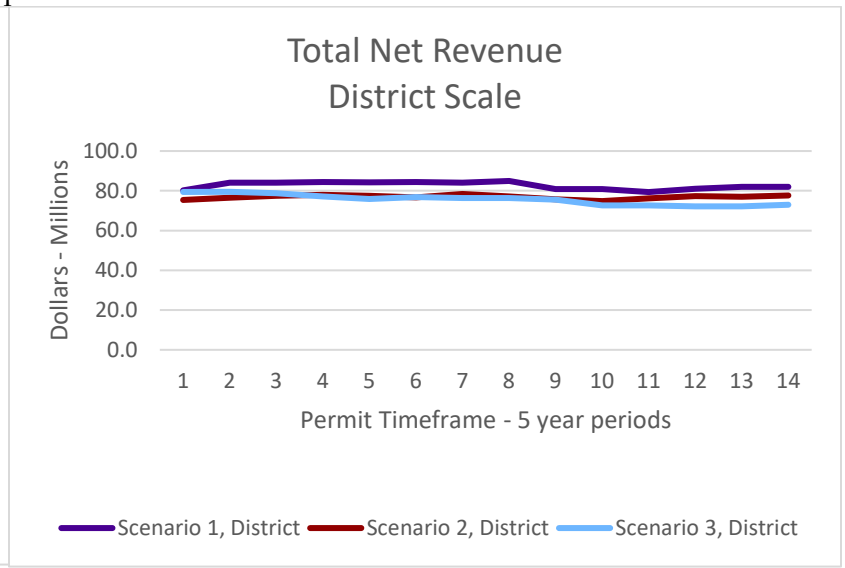


Table 5. 70-year Average Annual Net Revenue by Scenario, Scale and County (Dollars – Millions)

	Georegion Scale				District Scale		
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 1	Scenario 2	Scenario 3
Benton	$1.2	$0.9	$1.1	$1.0	$1.0	$0.9	$0.8
Clackamas	$0.6	$0.5	$0.6	$0.6	$0.6	$0.5	$0.6
Clatsop	$14.8	$13.7	$13.9	$14.0	$15.1	$13.6	$13.7
Columbia	$1.2	$1.2	$1.2	$1.2	$1.4	$1.3	$1.1
Coos	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3	$0.3
Curry	-	-	-	-	-	-	-
Douglas	$0.2	$0.3	$0.2	$0.3	$0.2	$0.3	$0.2
Jackson	-	-	-	-	-	-	-
Josephine	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1	$0.1
Lane	$2.6	$2.5	$2.6	$2.8	$2.6	$2.5	$2.6
Lincoln	$2.3	$2.0	$2.1	$2.1	$2.1	$1.8	$1.8
Linn	$2.3	$2.2	$2.3	$2.4	$2.5	$2.2	$2.4
Marion	$1.1	$1.0	$1.1	$1.1	$1.2	$0.9	$1.1
Polk	$0.8	$0.7	$0.7	$0.7	$0.7	$0.6	$0.7
Tillamook	$19.2	$18.0	$18.5	$18.6	$18.2	$17.7	$16.5
Washington	$4.9	$4.4	$5.0	$4.7	$5.3	$4.9	$4.7
Yamhill	-	-	-	-	-	-	-

Figures of revenue by period for each county by scenario and scale are available in Appendix A.

Environmental Outcomes

Factors Influencing Conservation Outcomes

Constraints on Harvest. Constraints on harvest within Habitat Conservation Areas and riparian areas are the same under all modeled scenarios and scales. As such, model outcomes are similar from inside the HCA and are not broken out by scenario.

Habitat Quality and Quantity – draft Habitat Conservation Plan - Covered Species

TERRESTRIAL SPECIES

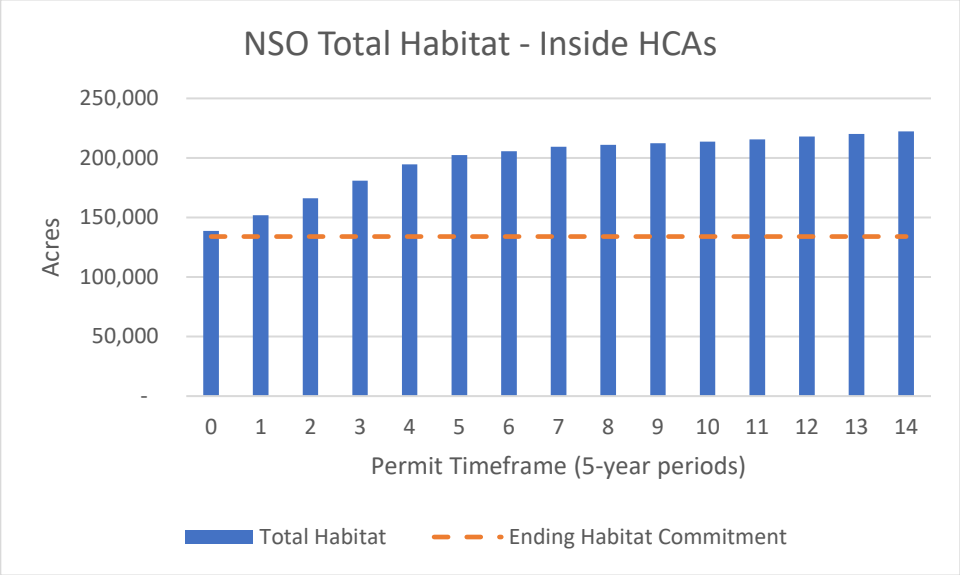
Species Habitat Outcomes

The three species for which habitat is quantified are all strongly associated with late-seral conifer forests. As such, the HSIs include parameters that characterize attributes of late-seral forests, particularly those that provide key habitat features, such as old trees used by marbled murrelets, northern spotted owls, and red tree voles for nesting. By linking the HSIs to the SLI and the forest management model, habitat suitability can be assessed at any point during the draft Habitat Conservation Plan permit term. Suitable habitat growth and harvest are both accounted for in the forest management model, allowing ODF to estimate the overall potential gain in quality and quantity of habitat. This process ensures that habitat commitments in the draft Habitat Conservation Plan can be achieved. At the time of finalizing this report, the Division is still working on the delineation between highly suitable and suitable habitat, due to changes in forest metrics in the recalibrated growth and yield tables. Total modeled habitat quantity is shown below.

Comparison of Scenarios for Conservation Objectives

Northern spotted owls occur in all districts across the 2023 draft Western Oregon State Forest Management Plan area. The draft Habitat Conservation Plan biological goals and objectives for northern spotted owls, within Habitat Conservation Areas, are: 1) conserve and maintain at least 15,000 acres of existing nesting and roosting habitat; 2) conserve, maintain, and enhance at least 73,000 acres of foraging habitat; 3) increase the quantity of nesting and roosting habitat by 69,000 acres (for a total of 84,000 acres) by the end of the permit term, while maintaining 50,000 acres of foraging habitat within the Habitat Conservation Areas. Total nesting, roosting, and foraging habitat at the end of the permit term shall be 134,000 acres.

Figure 9. Acres of Total Habitat Over Time for Northern Spotted Owl inside the Habitat Conservation Areas.



Another draft Habitat Conservation Plan objective for northern spotted owls is to maintain at least 40% of the permit area outside of Habitat Conservation Areas as dispersal habitat to allow diffuse movement across a permeable landscape. The draft Habitat Conservation Plan defines dispersal habitat as stands of trees averaging 11 inches in diameter at breast height or greater, having at least 40% canopy closure. This 40% objective is measured at two different geographic areas for all scenarios and scales: 1) the north coast that includes the Astoria, Tillamook and Forest Grove districts, and 2) areas included in the West Oregon, North Cascade and Western Lane districts. The figures below show how the scenarios at both the district and georegion scales meet this commitment.

Figure 10. Percent of Dispersal Habitat Over Time for Northern Spotted Owl outside the Habitat Conservation Areas by Scenario, District Scale and 5-year periods.

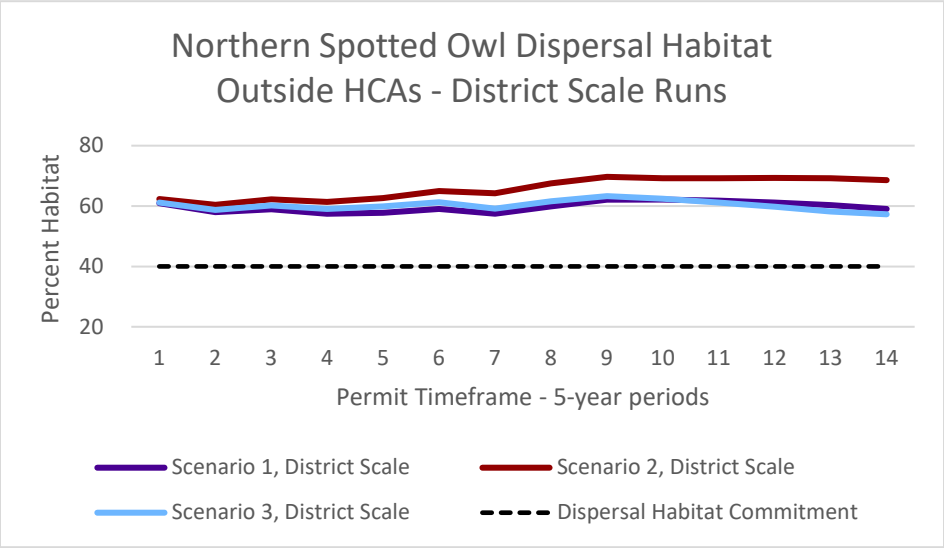
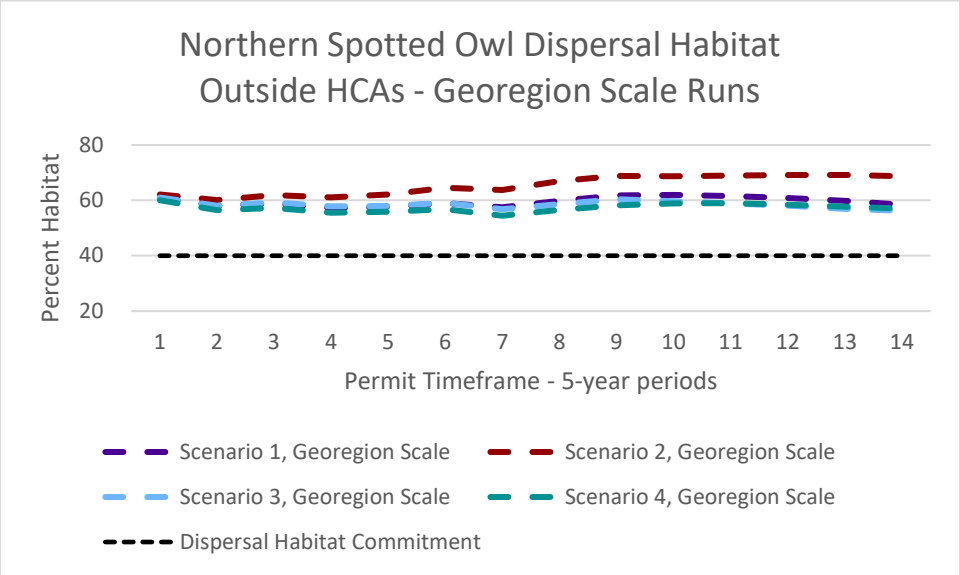
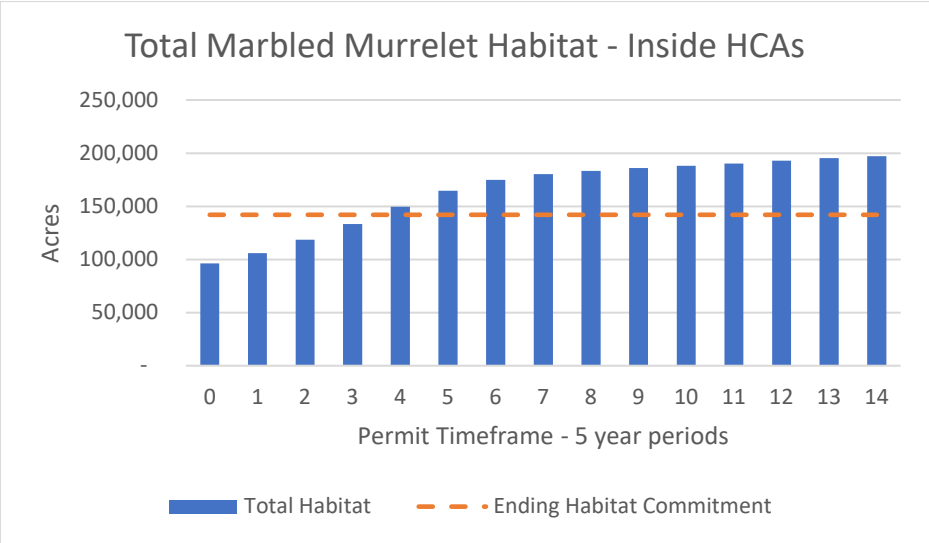


Figure 11. Percent of Dispersal Habitat Over Time for Northern Spotted Owl outside the Habitat Conservation Areas by Scenario, Georegion Scale and 5-year periods.



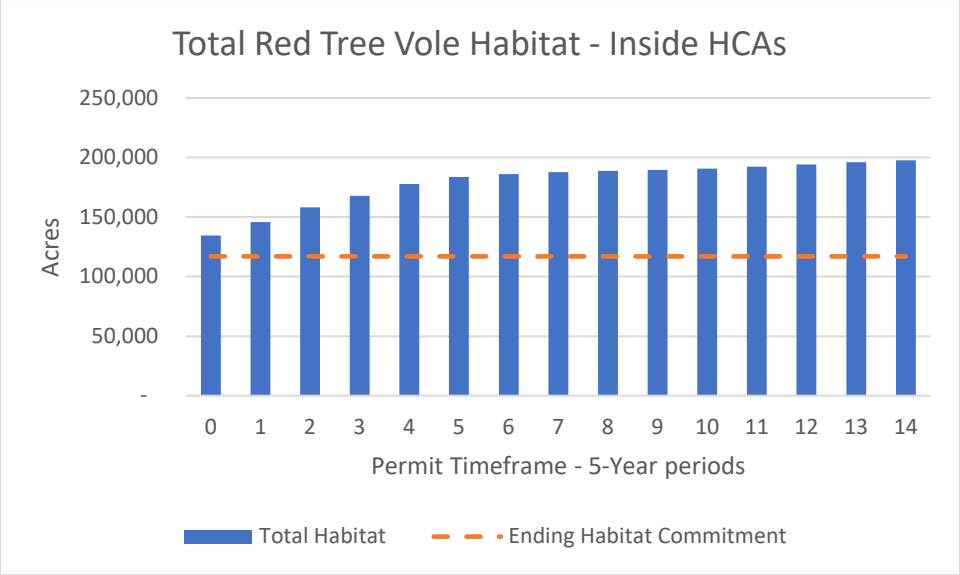
Marbled Murrelets are found across the plan area with the exception of the North Cascade District and the majority of the Southwest Unit -Western Lane District. The draft Habitat Conservation Plan biological goals and objectives for Marbled Murrelets within Habitat Conservation Areas, are: 1) conserve, maintain, and enhance at least 62,000 acres of existing suitable habitat and 1,000 acres of existing highly suitable habitat including locations where occupancy has been previously documented, and 2) increase the amount of habitat by at least 45,000 acres of suitable habitat and 34,000 acres of highly suitable habitat in locations that minimize patch edge/interior habitat ratios. This amounts to a total of 107,000 acres of suitable habitat and 35,000 acres of highly suitable habitat conserved by the end of the permit term.

Figure 12. Acres of Total Habitat Over Time for Marbled Murrelets inside the Habitat Conservation Areas



Red Tree voles occur in the Astoria, Tillamook, Forest Grove, West Oregon Districts and also the portion of the Veneta Unit -Western Lane District north of the Siuslaw River. The draft Habitat Conservation Plan biological goals and objectives for Red Tree Voles within Habitat Conservation Areas are: 1) conserve, maintain, and enhance at least 48,000 acres of suitable habitat and 5,000 acres of highly suitable habitat, including areas where occupancy has been previously documented, and 2) increase the amount of suitable habitat by 30,000 acres and highly suitable habitat by 34,000 acres. This amounts to a total of 78,000 acres of suitable habitat and 39,000 acres of highly suitable habitat by the end of the permit term.

Figure 13. Acres of Total Habitat Over Time for Red Tree Voles inside the Habitat Conservation Areas



AQUATIC SPECIES

The Riparian Conservation Areas are designed to support and protect the ecological process that address the limiting factors and the Biological Goals and Objectives for covered aquatic species. They were built using the best available data, including current and historic occurrence data, SLI, LiDAR, and habitat models. Constraints on harvest within riparian areas are the same under all scenarios, no commercial harvest is allowed.

Habitat Quality and Quantity – Non-Covered Species

TERRESTRIAL SPECIES

Forest age distribution is used as a proxy to assess the presence and quantity of a diverse range of habitats within the permit area, represented by area of forest stands at different ages over time. For example, terrestrial species that favor an open canopy for grazing and forage (e.g. ungulates) would favor young forest conditions.

The figures below provide a snapshot of average stand ages at the beginning (2025–2039) and end (2080–2095) of the plan period, respectively, inside and outside Habitat Conservation Areas.

Figure 14. Average Forest Stand Age Class Distribution Inside and Outside Habitat Conservation Areas by scenario at the district scale, 2025–2039

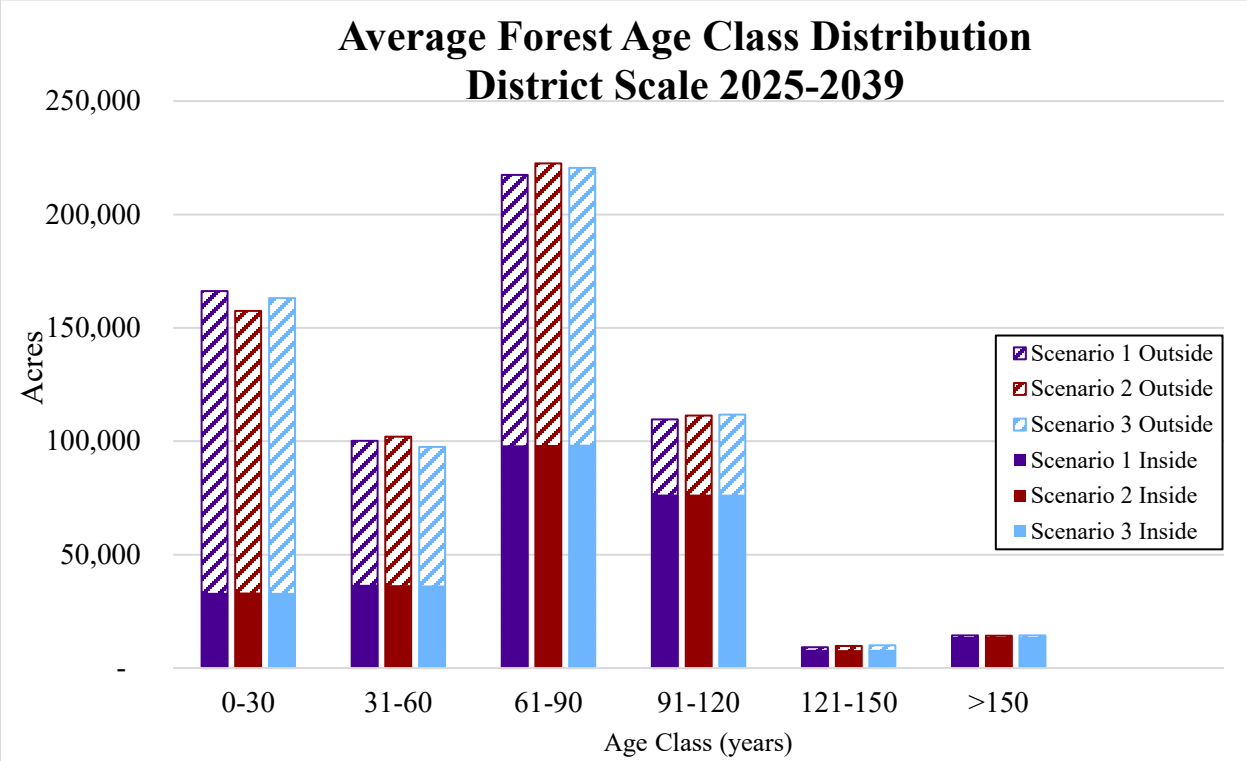


Figure 15. Average Forest Stand Age Class Distribution Inside and Outside Habitat Conservation Areas by scenario at the georegion scale, 2025–2039

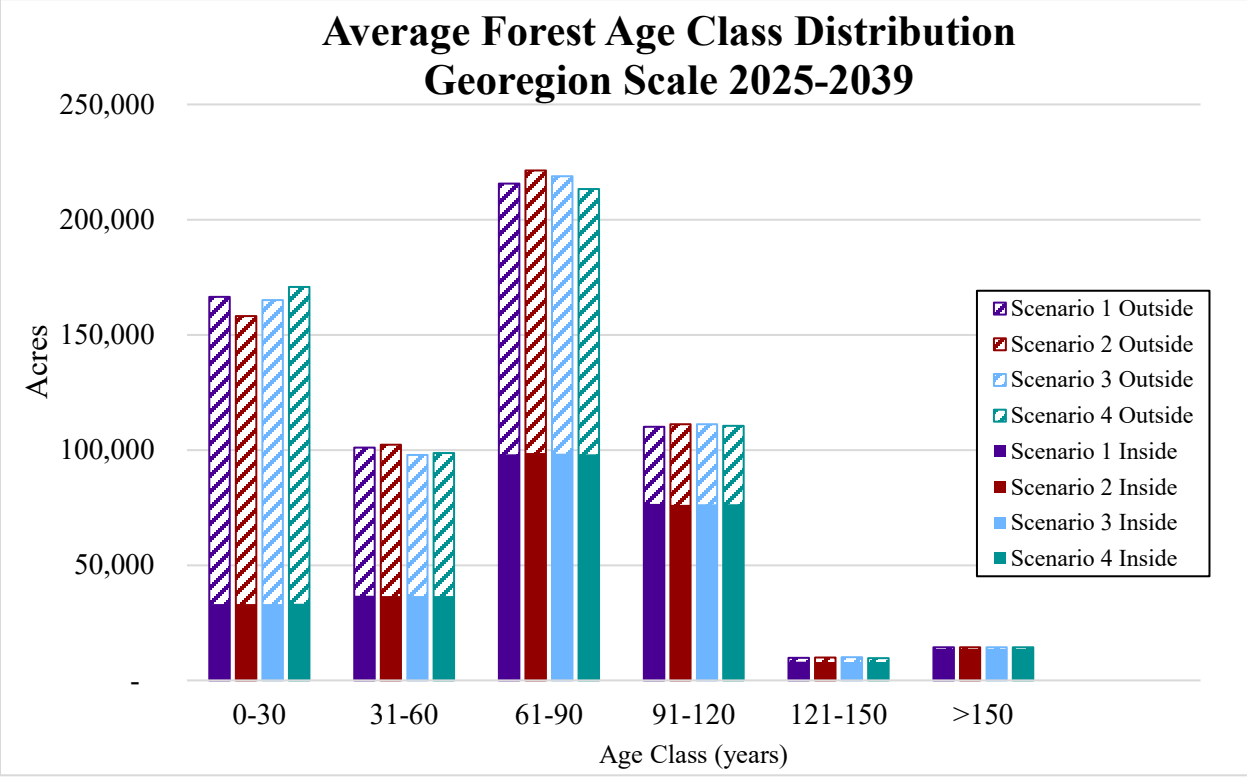


Figure 16. Average Forest Stand Age Class Distribution Inside and Outside Habitat Conservation Areas by scenario at the district scale, 2080–2094

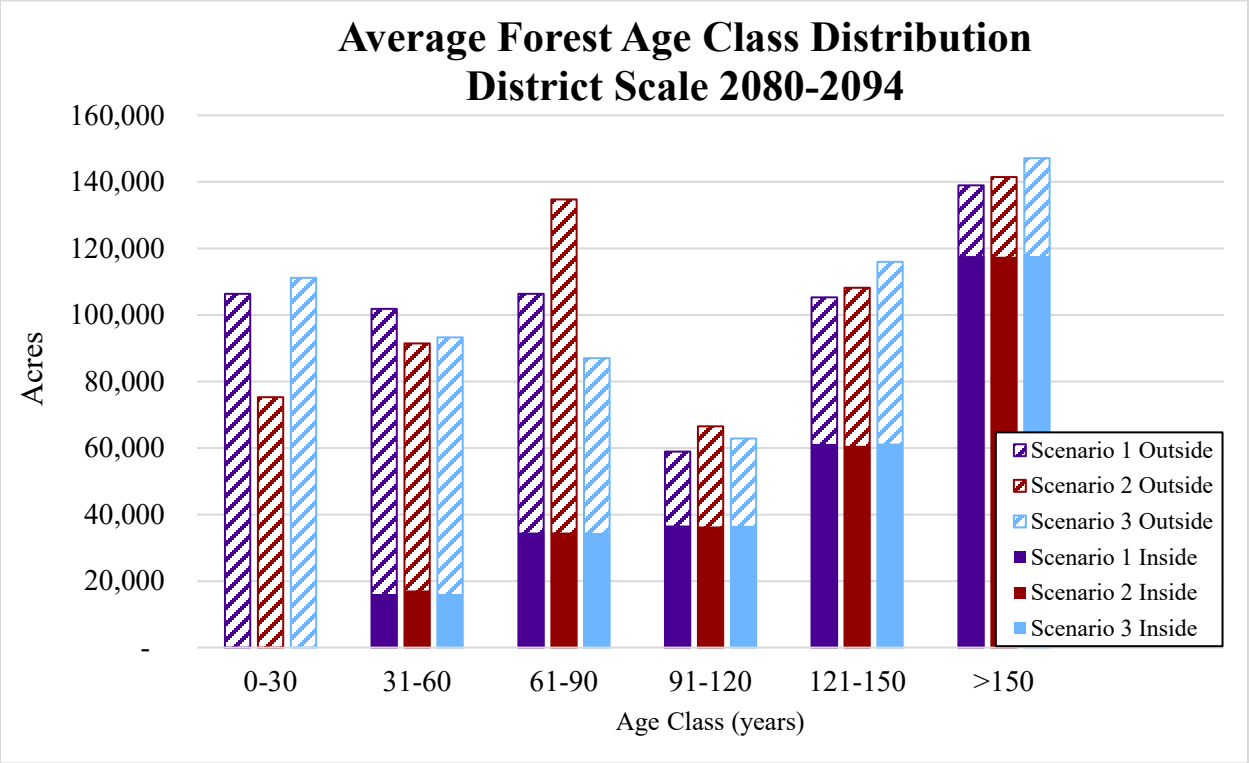
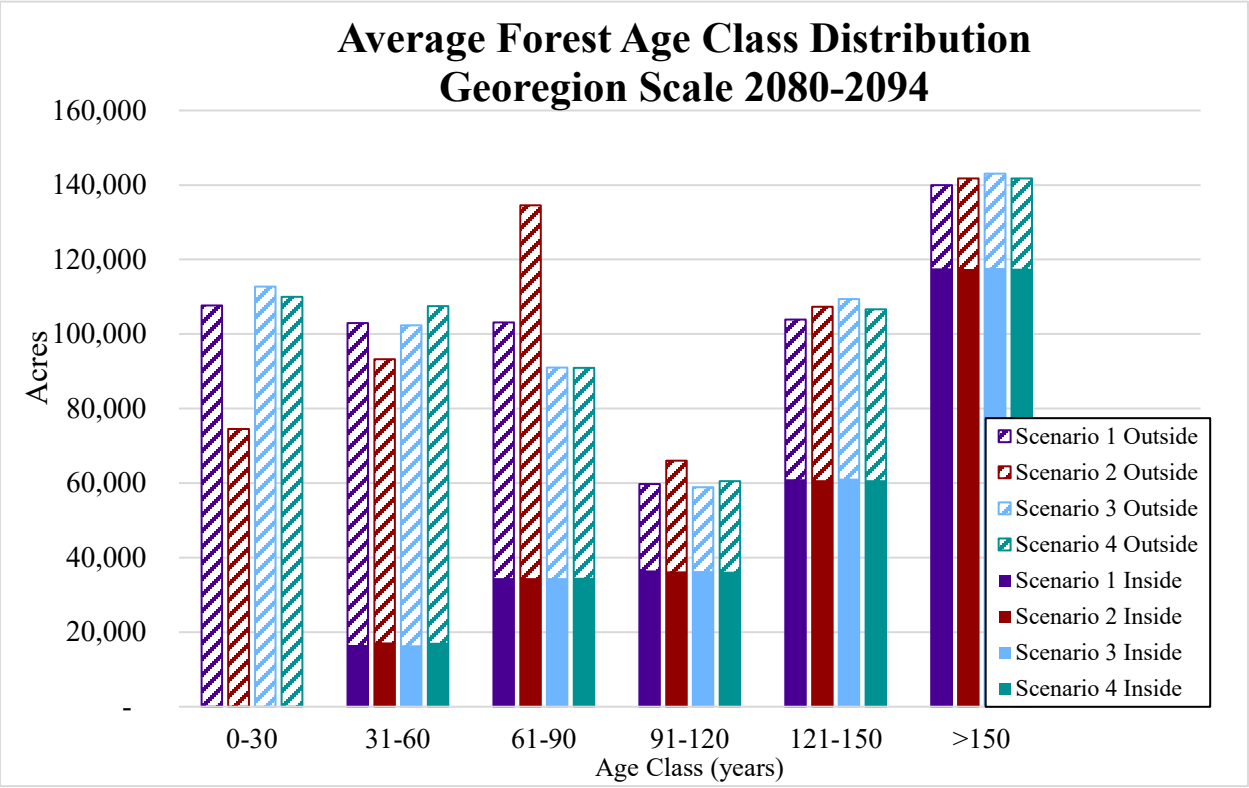


Figure 17. Average Forest Stand Age Class Distribution Inside and Outside Habitat Conservation Areas by scenario at the georegion scale, 2080–2094



Carbon Storage

This analysis included consideration of carbon storage volume outcomes across the four scenarios. Carbon storage is accounted for in two categories that include harvested wood products and forest carbon which is the combination of above ground biomass and below ground carbon that is stored in roots.

Tree harvest removes carbon from forests in the form of logs. However, the carbon in those logs is emitted to the atmosphere at different rates depending on how the wood and bark are used, so the tracking of the fate of forest carbon in various harvested wood products becomes an important part of forest carbon accounting. Some portions of harvested trees remain in the forest, moving between forest ecosystem carbon pools and decay slowly along with other dead tissue (e.g., branches and foliage) or are disposed of through in-forest burning with immediate carbon and other greenhouse gas emissions. Other parts become stored in short-lived or long-lived products (e.g., paper and house frames, respectively), converted into other bioproducts, or burned to supply industrial or residential energy and/or heat.

Carbon storage is reported by the weight of carbon (tons) within forest carbon and harvested wood products. In order to model carbon storage, forest carbon estimates are derived from the FVS fire and fuels carbon reports while harvest wood product end use ratios and product half-lives are derived from the Oregon Harvested Wood Products Carbon Inventory report (Morgan et al 2021).

Figure 18. Tons of Carbon Stored in the forest and in harvested wood products by Scenario, District Scale and model period.

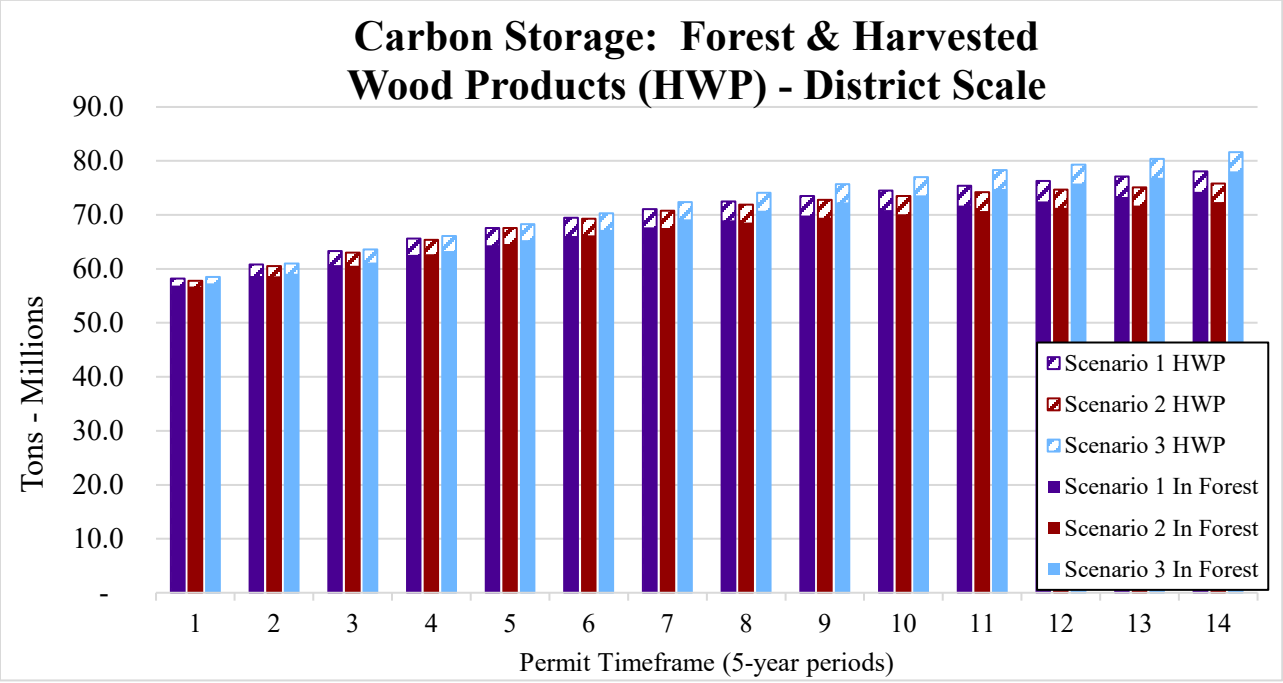
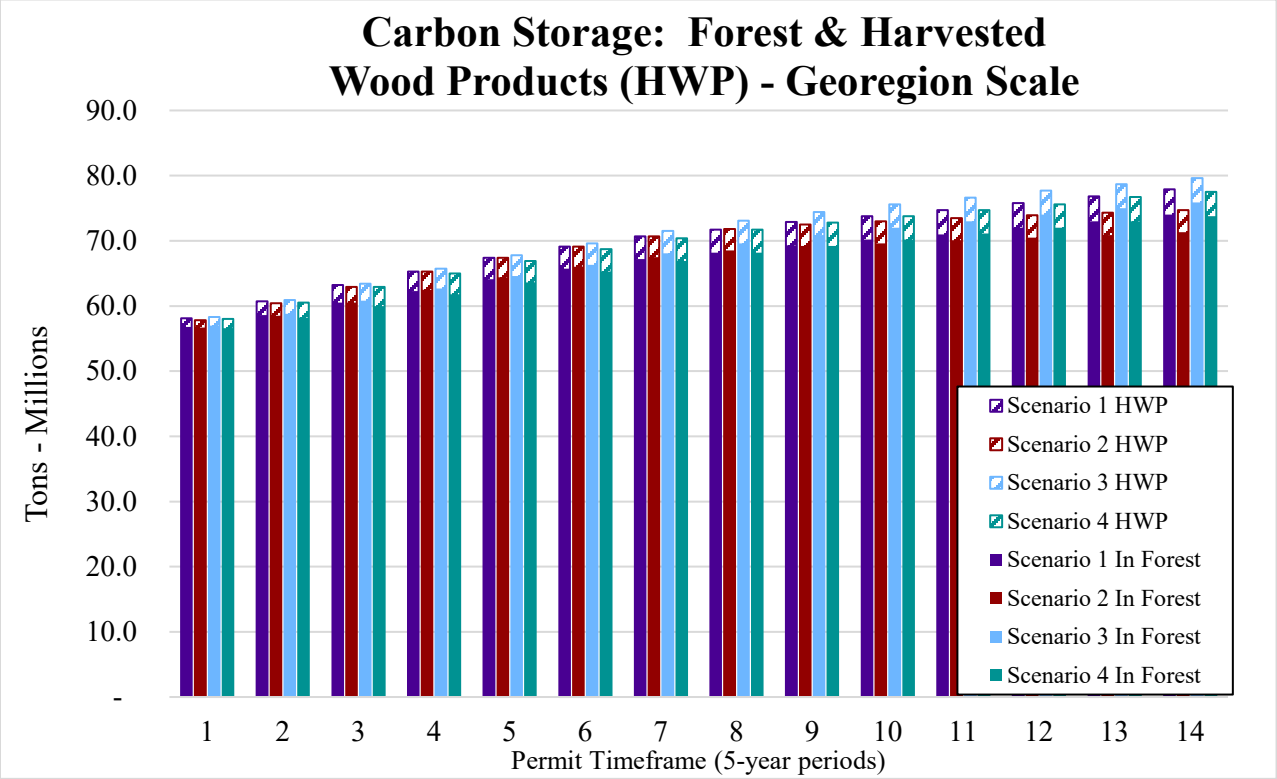


Figure 19. Tons of Carbon Stored in the forest and in harvested wood products by Scenario, Georegion Scale and model period.



Social Outcomes

Recreation outcomes were not found to be substantially affected in terms of differences across the four scenarios. However, all model scenarios indicate there would be visual impacts to a number of high use, popular areas such as Browns Camp, Jones Creek, Black Rock, Santiam Horse Camp and the Tillamook Forest Center due to anticipated increased pace and scale of harvesting in some recreation areas are outside of Habitat Conservation Areas. Likely high-use trails will see noticeable visual impacts adjacent to trail systems. Efforts to mitigate the effects of increased harvest around popular recreation areas will be addressed more explicitly during implementation planning.

Outdoor recreation and cultural values across the management scenarios will be discussed in forthcoming Socioeconomic Report that will be presented to the Board next spring.

Appendix A

BENTON COUNTY

Figure A1. Benton County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

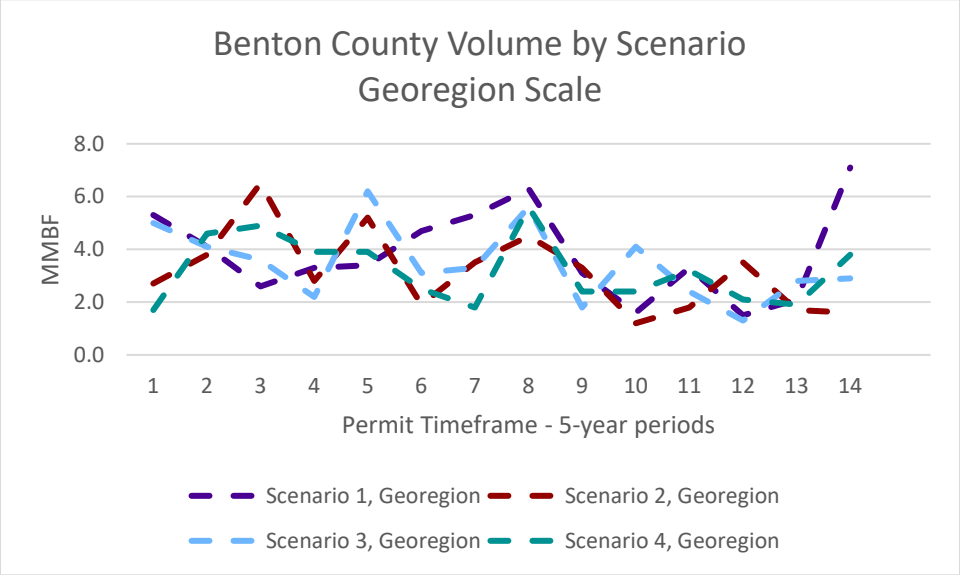


Figure A2. Benton County Average Annual Volume by Scenario, District Scale for each 5-year time period.

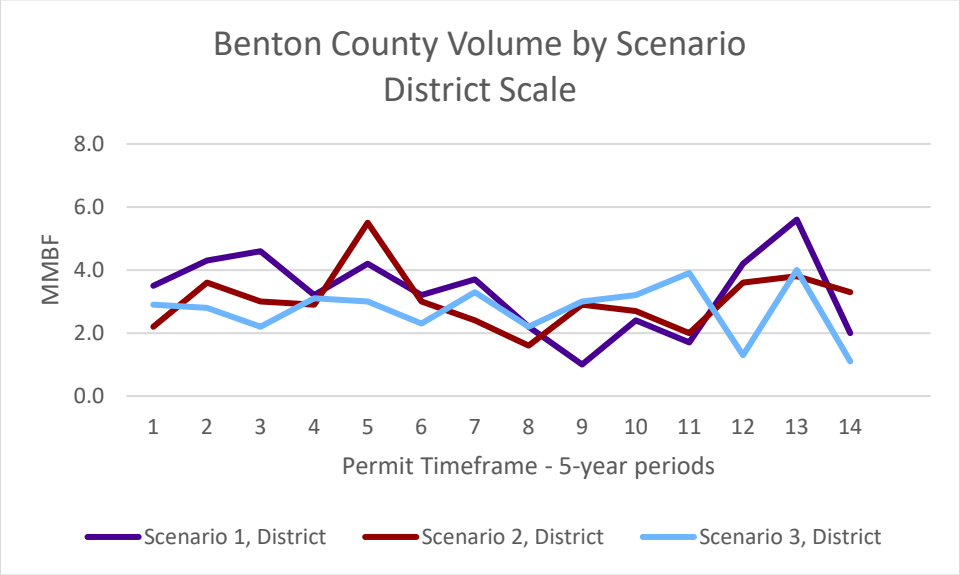


Figure A3. Benton County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

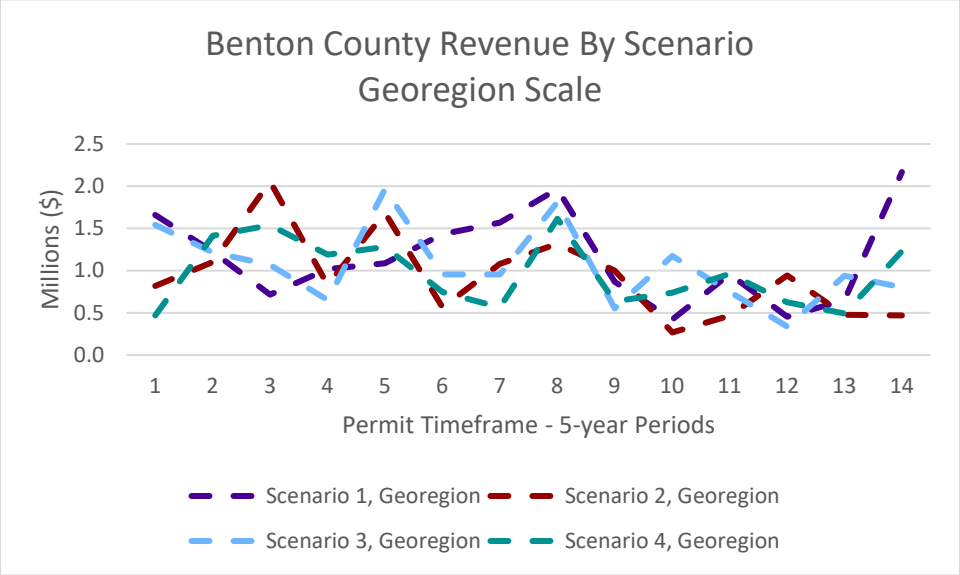


Figure A4. Benton County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

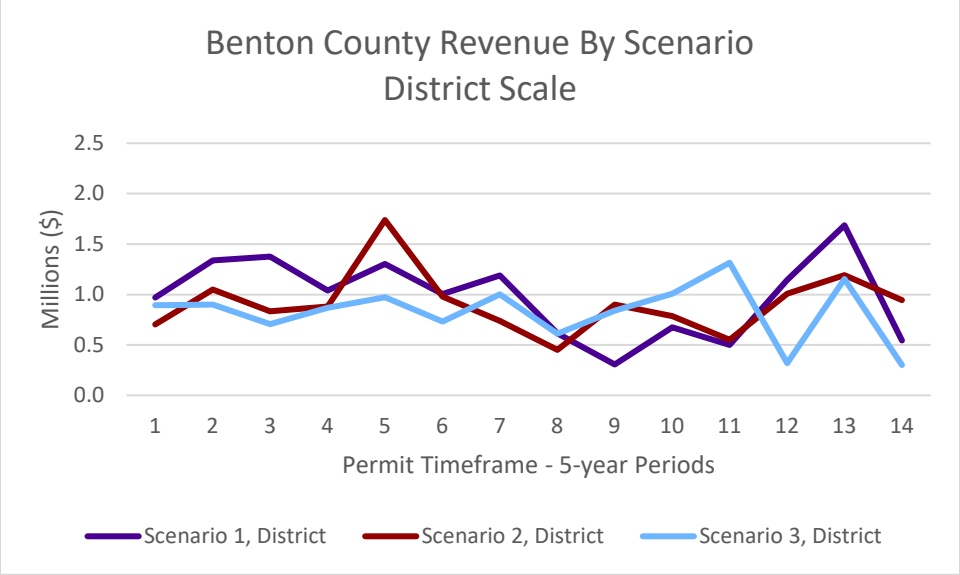


Figure A5. Clackamas County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

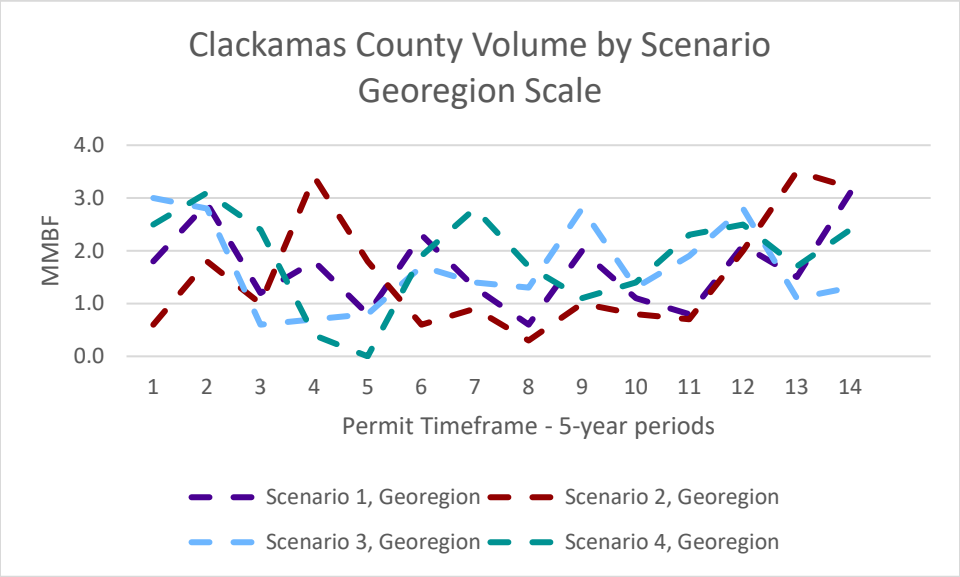


Figure A6. Clackamas County Average Annual Volume by Scenario, District Scale for each 5-year time period.

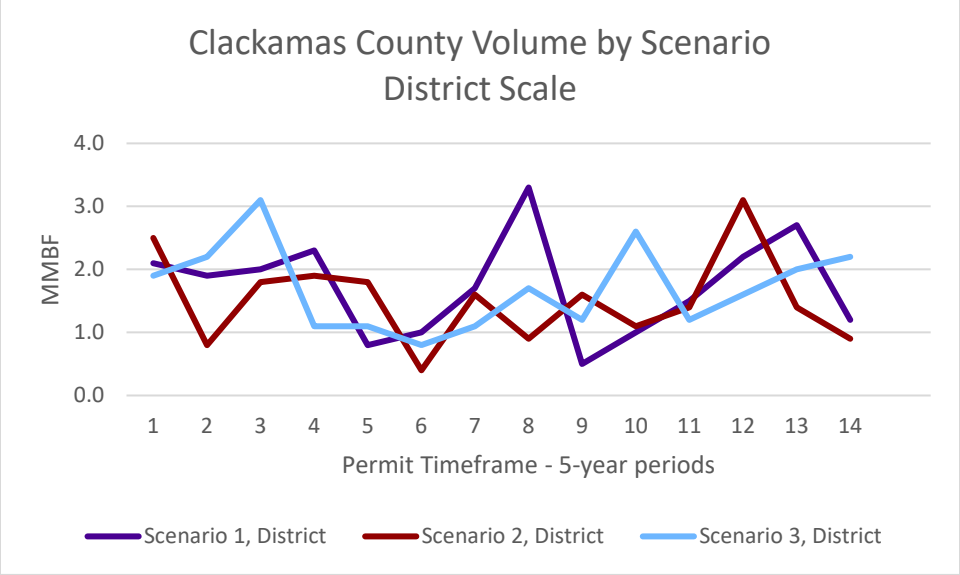


Figure A7. Clackamas County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

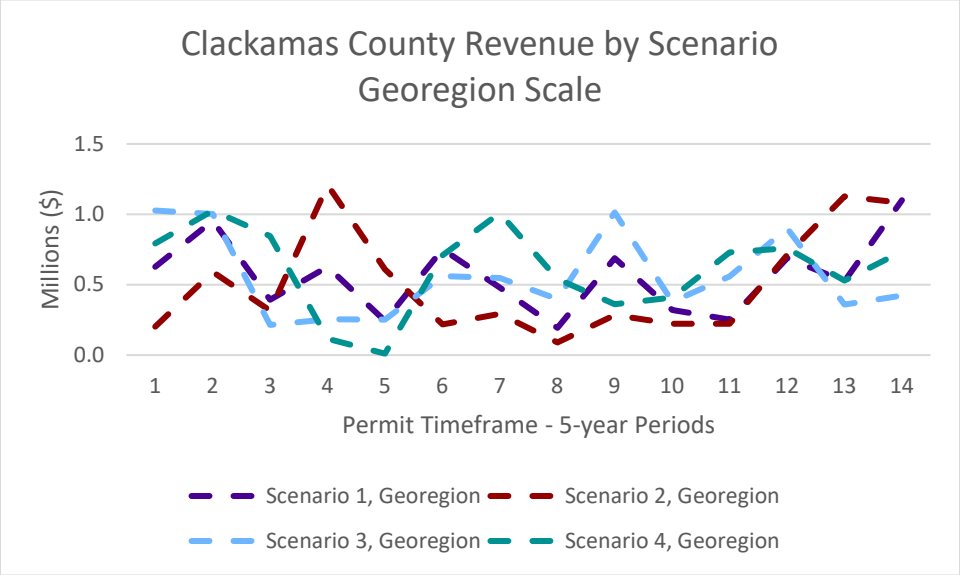
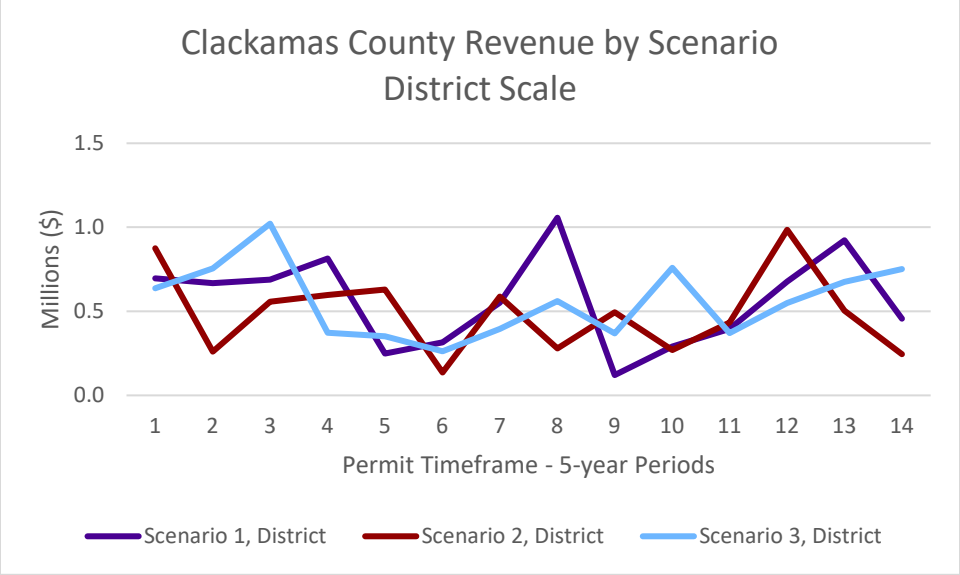


Figure A8. Clackamas County Annual Average Revenue by Scenario, District Scale for each 5-year time period.



CLATSOP COUNTY

Figure A9. Clatsop County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

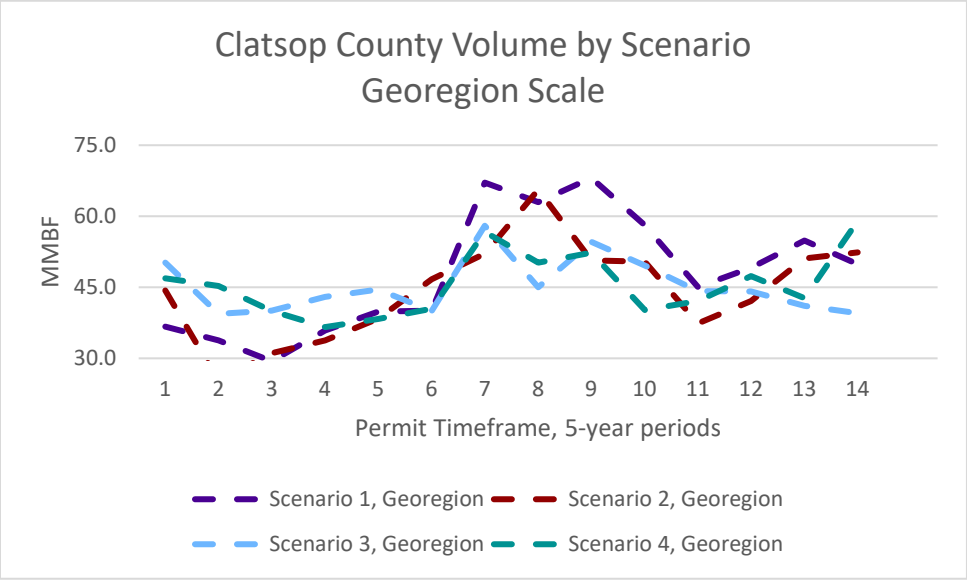


Figure A10. Clatsop County Average Annual Volume by Scenario, District Scale for each 5-year time period.

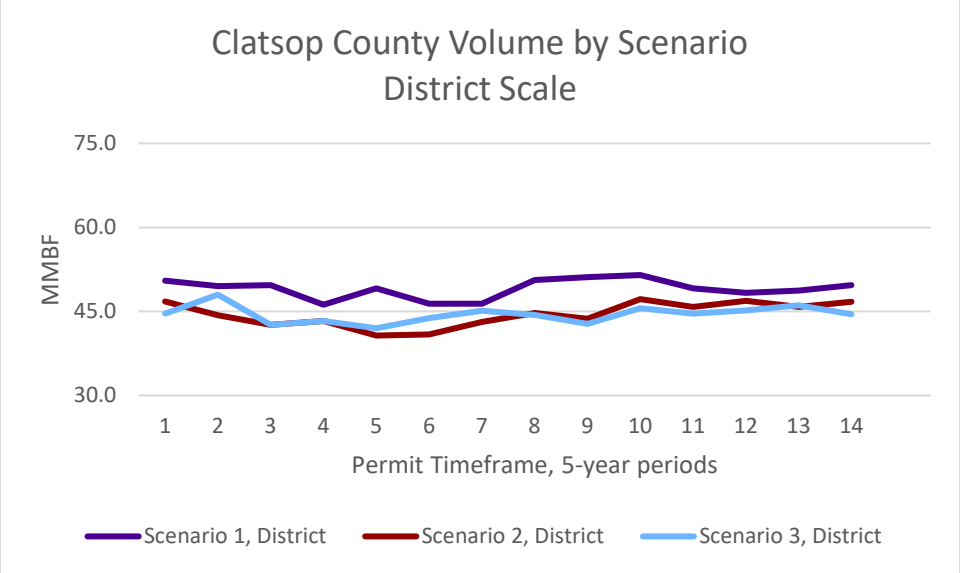


Figure A11. Clatsop County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

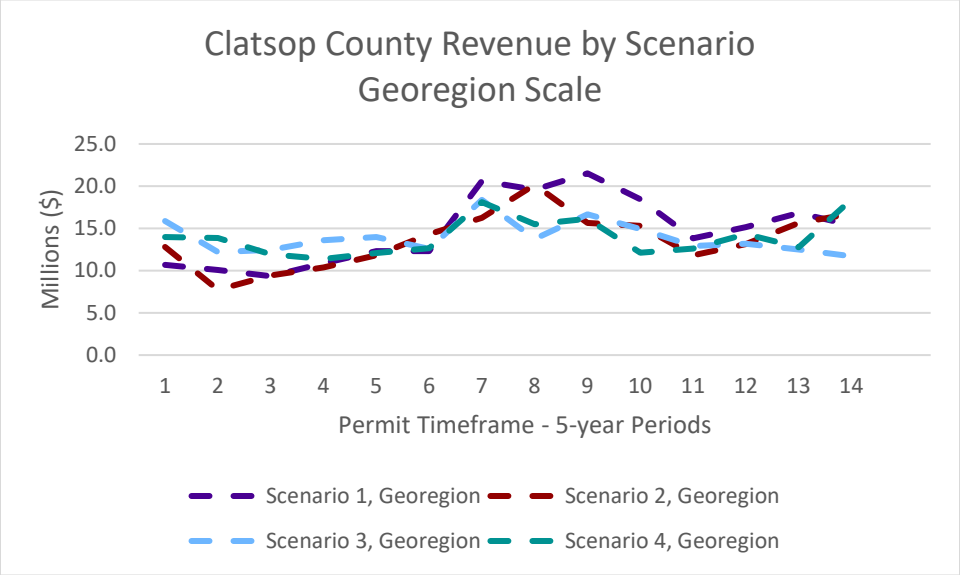


Figure A12. Clatsop County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

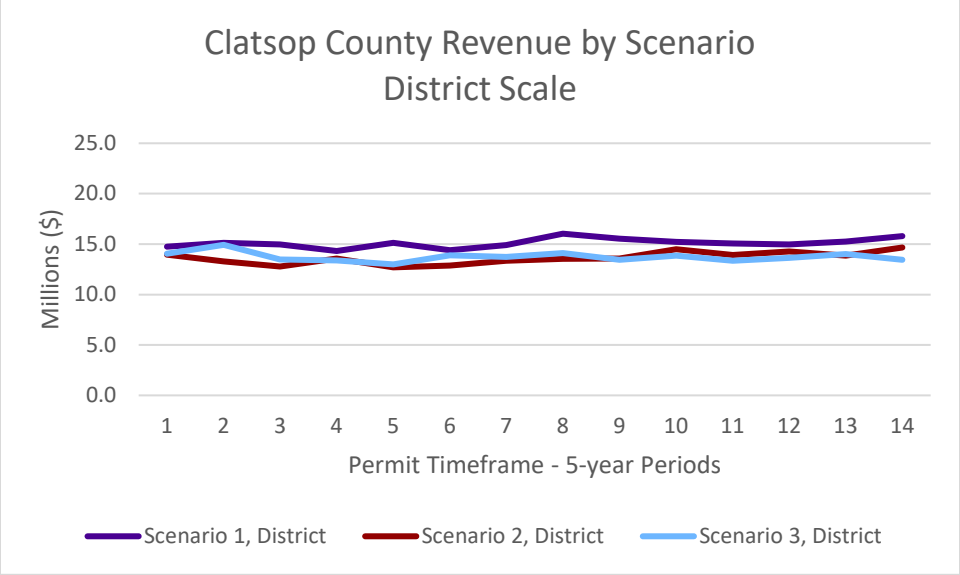


Figure A13. Columbia County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

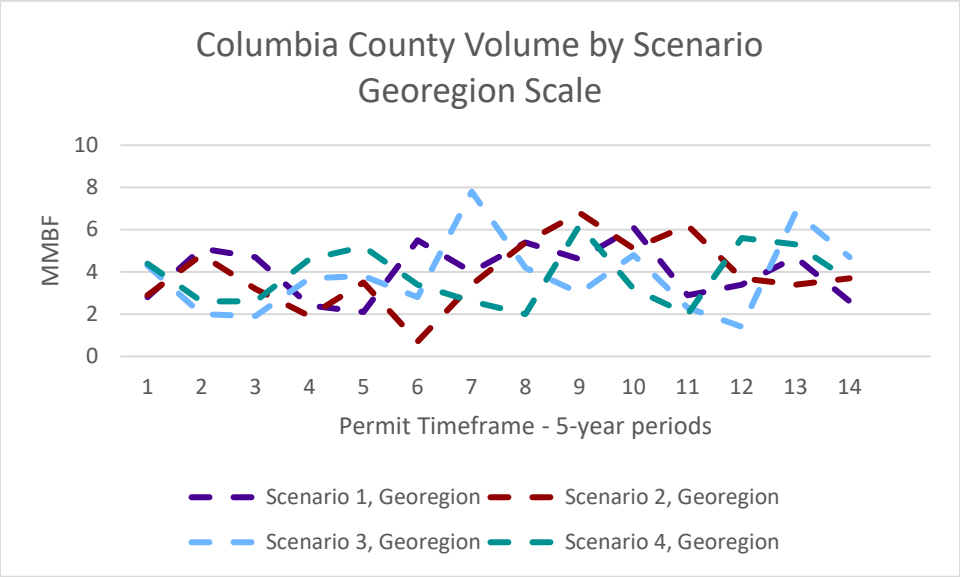


Figure A14. Columbia County Average Annual Volume by Scenario, District Scale for each 5-year time period.

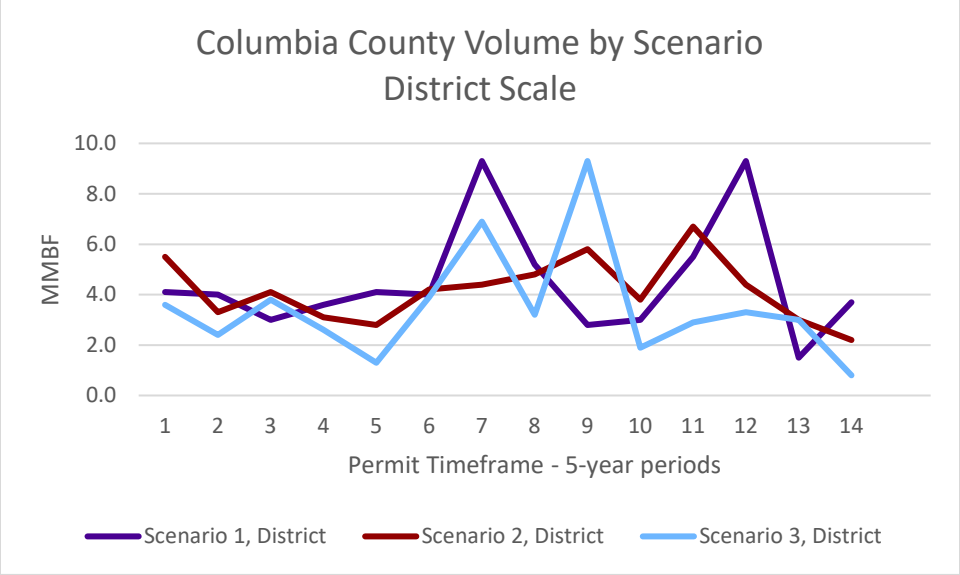


Figure A14. Columbia County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

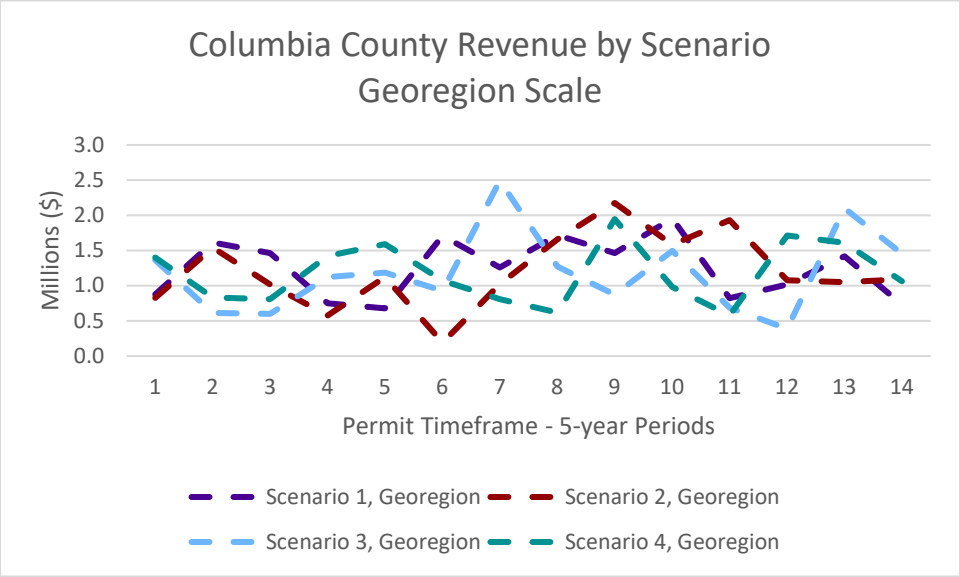
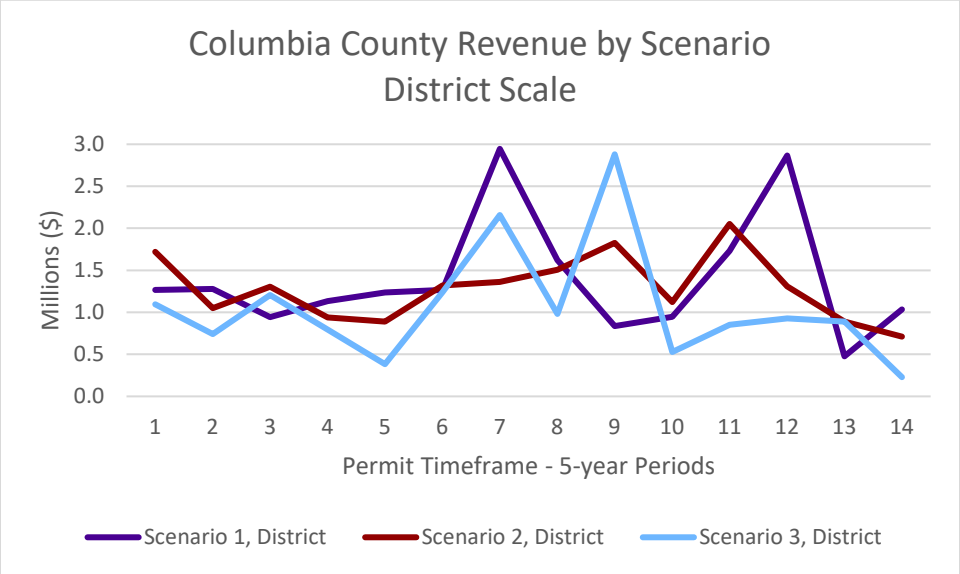


Figure A15. Columbia County Average Annual Revenue by Scenario, District Scale for each 5-year time period.



COOS COUNTY

Figure A16. Coos County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

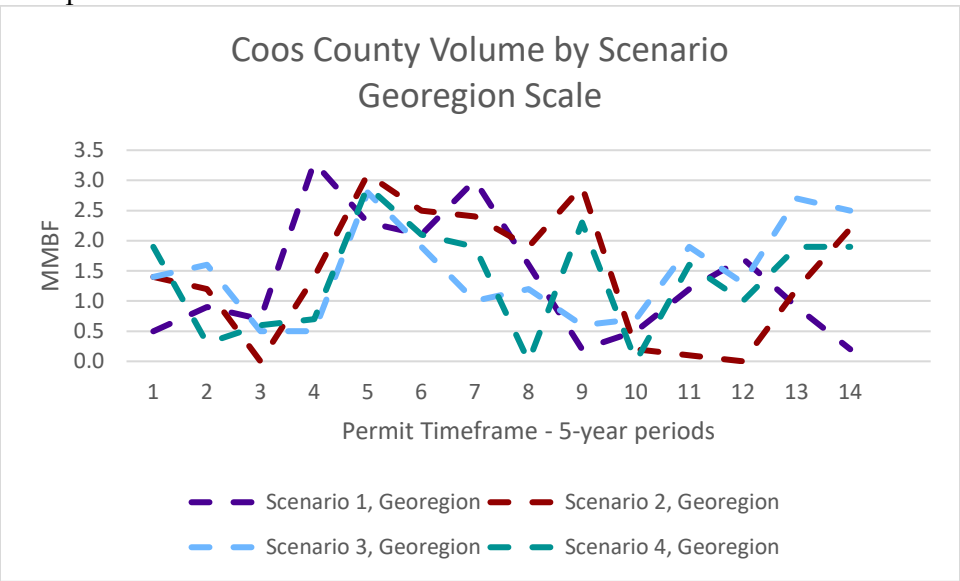


Figure A17. Coos County Average Annual Volume by Scenario, District Scale for each 5-year time period.

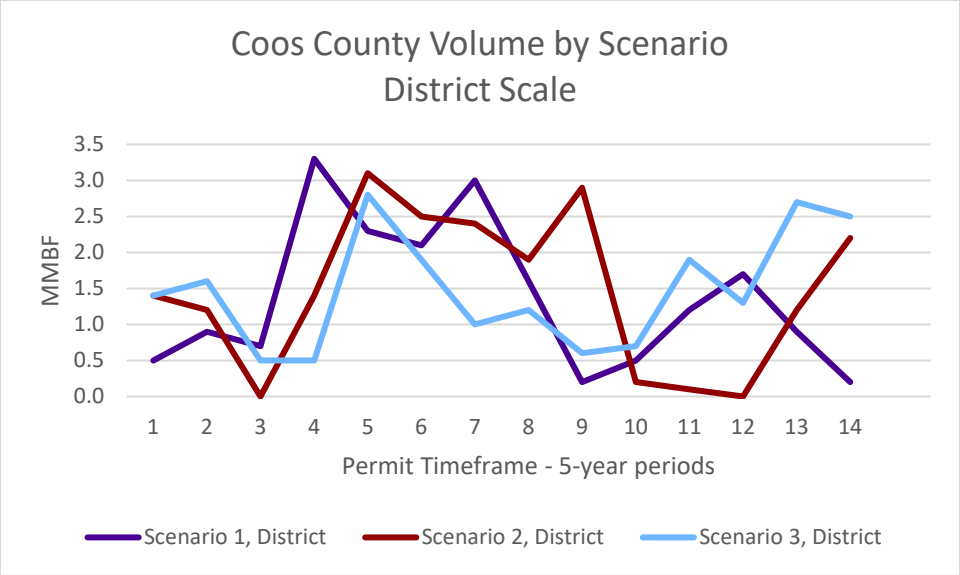


Figure A18. Coos County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

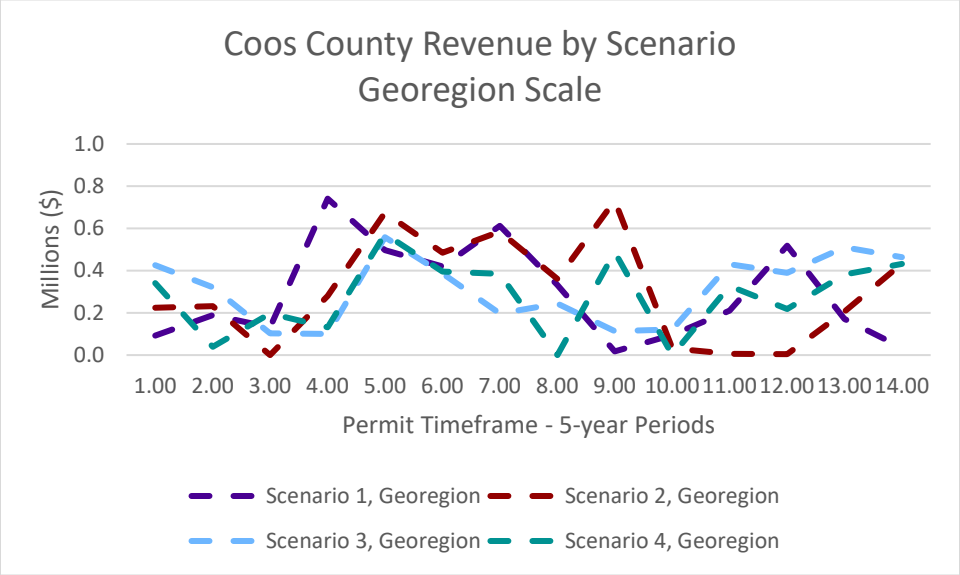
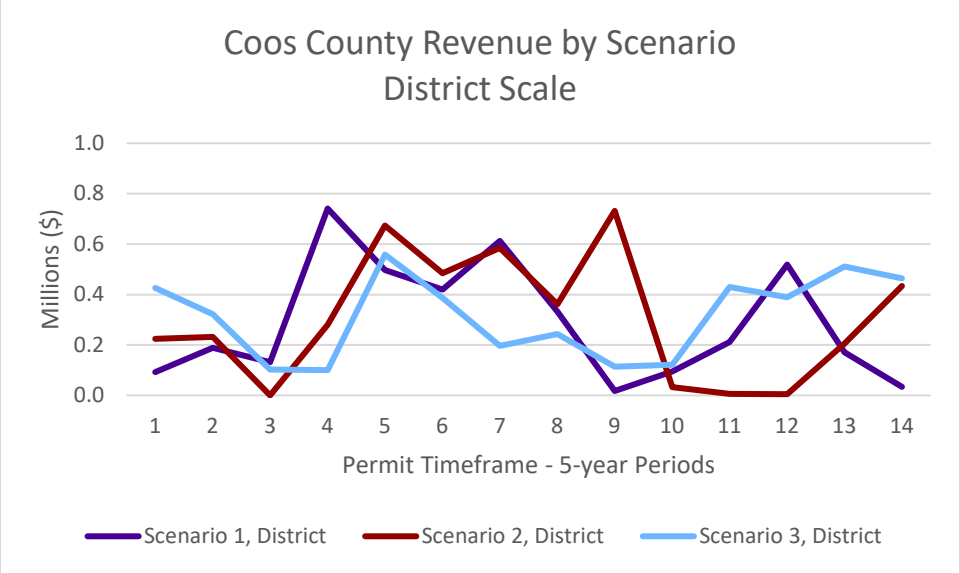


Figure A19. Coos County Average Annual Revenue by Scenario, District Scale for each 5-year time period.



DOUGLAS COUNTY

Figure A20. Douglas County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

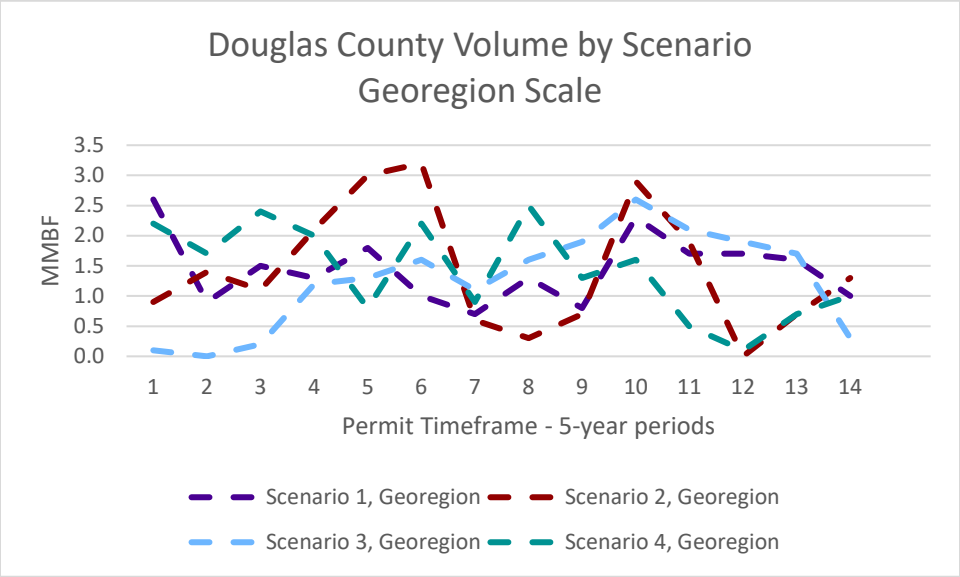


Figure 21. Douglas County Average Annual Volume by Scenario, District Scale for each 5-year time period.

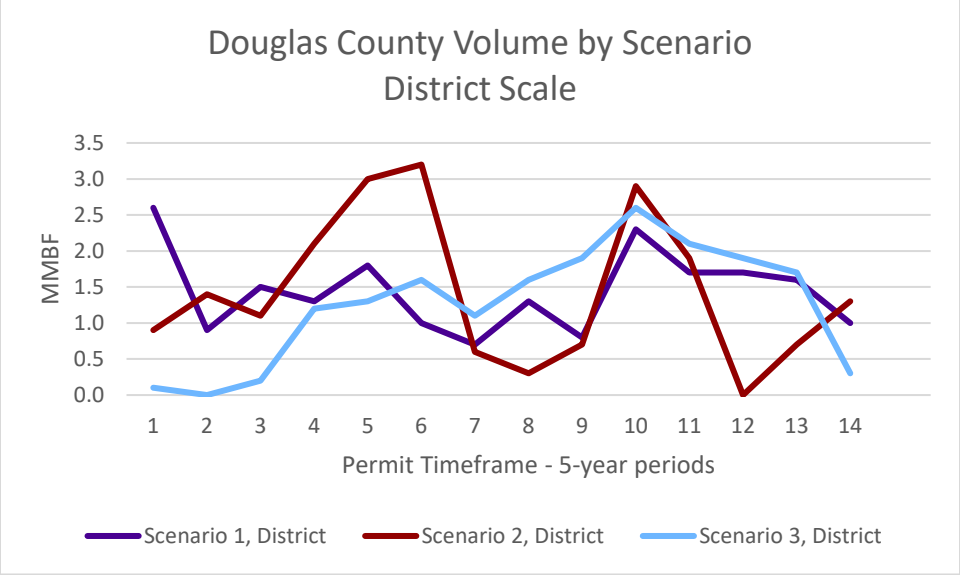


Figure A22. Douglas County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

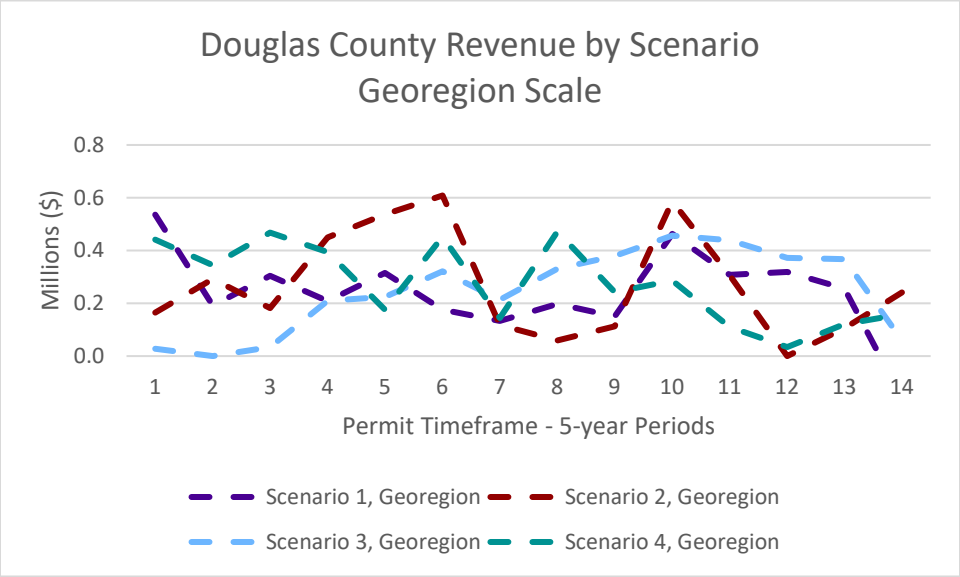


Figure 23. Douglas County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

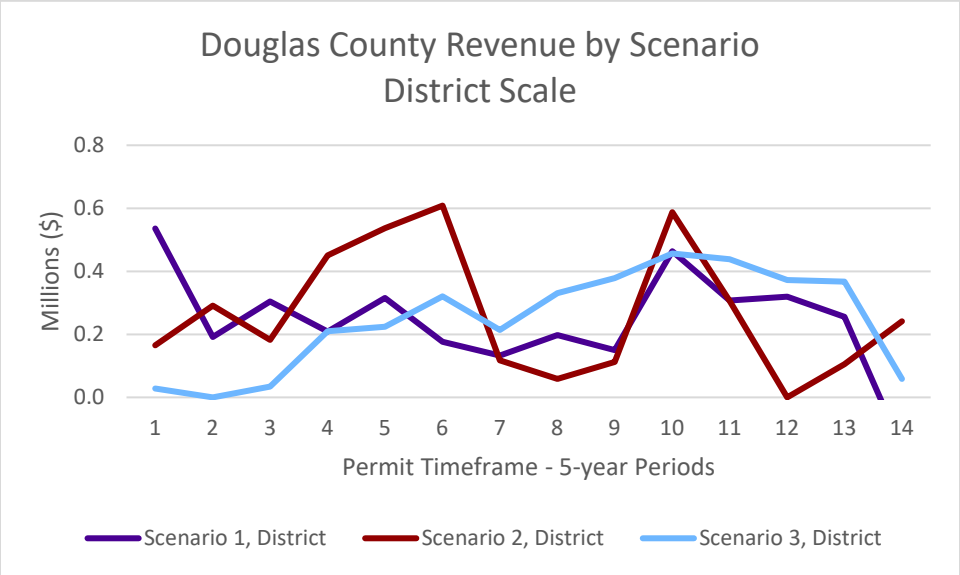


Figure 24. Josephine County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

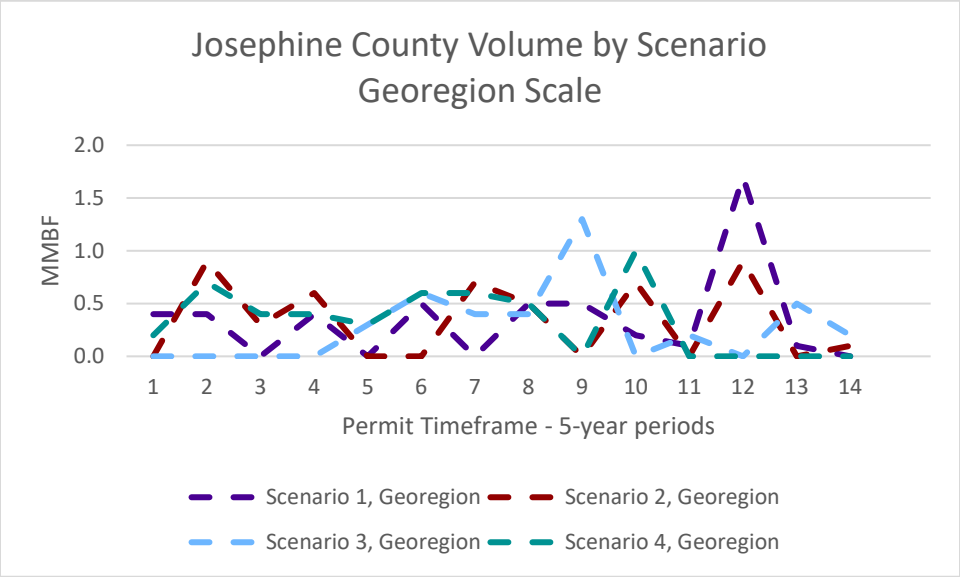


Figure 25. Josephine County Average Annual Volume by Scenario, District Scale for each 5-year time period.

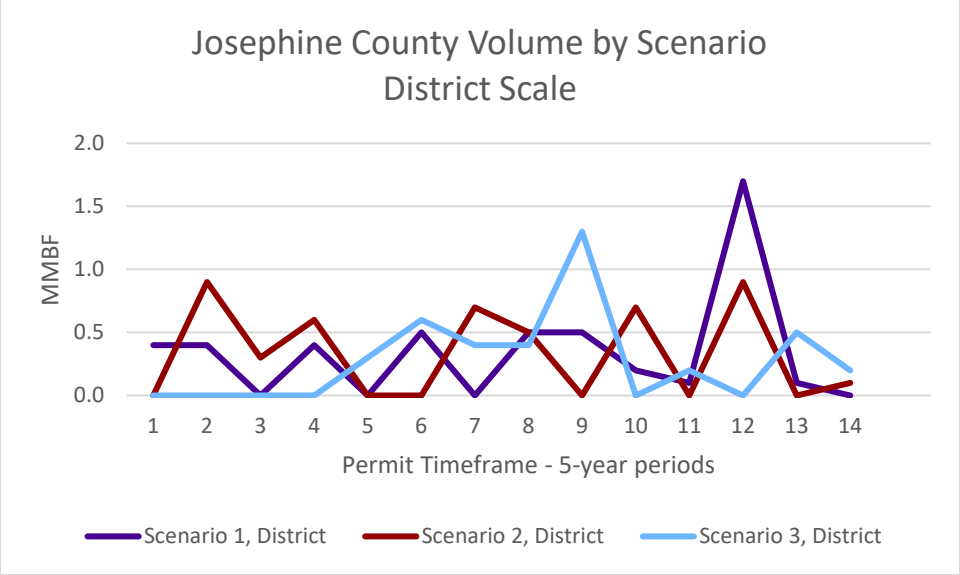


Figure 26. Josephine County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

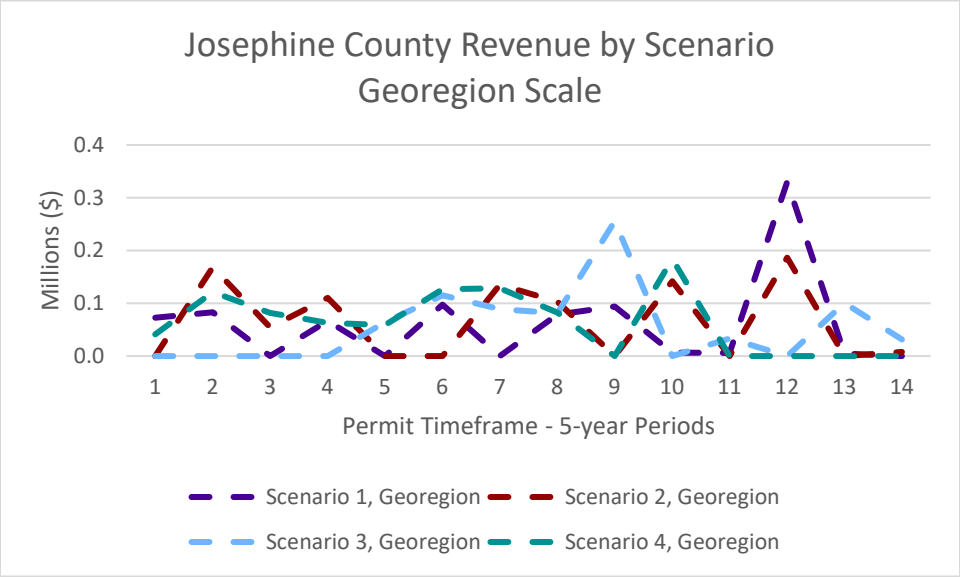


Figure 27. Josephine County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

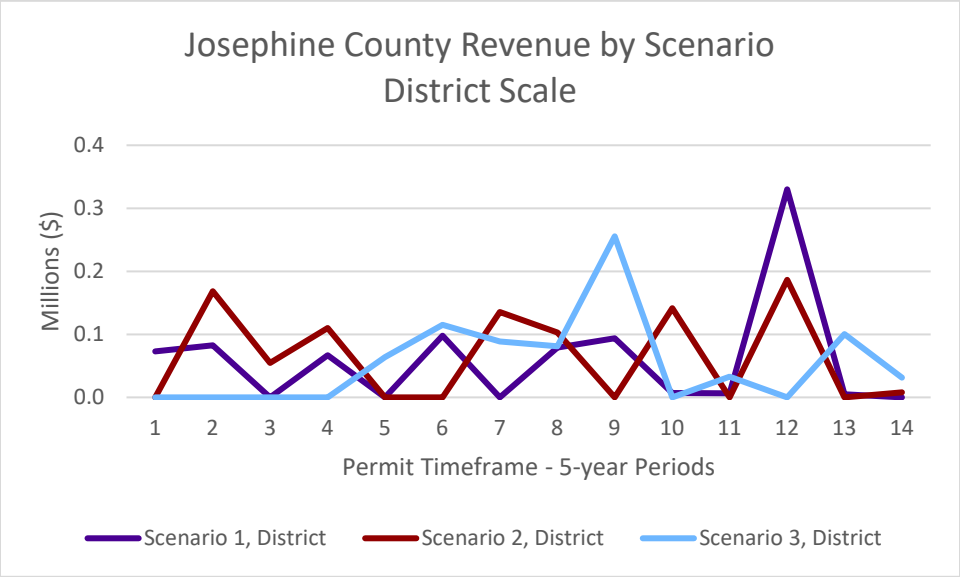


Figure 28. Lane County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

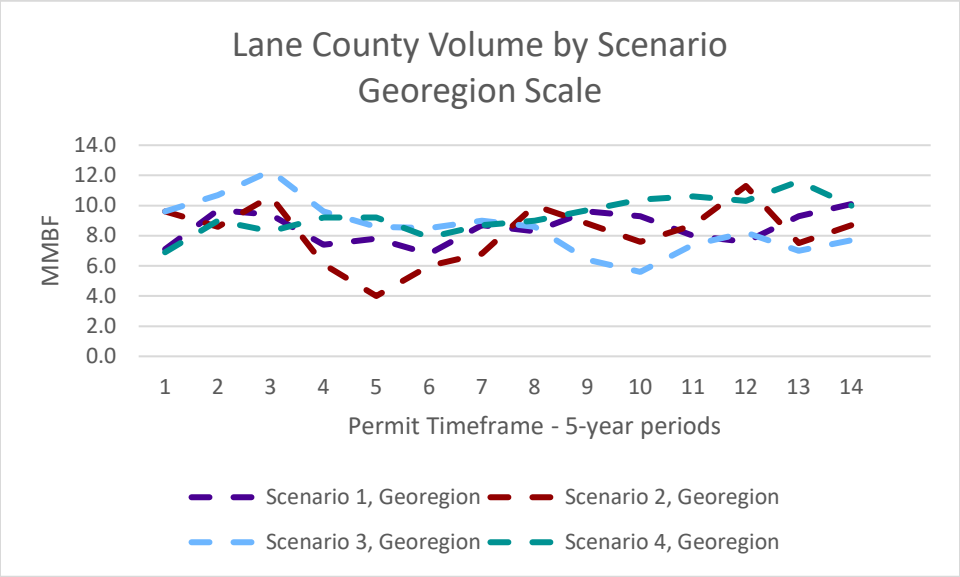


Figure 29. Lane County Average Annual Volume by Scenario, District Scale for each 5-year time period.

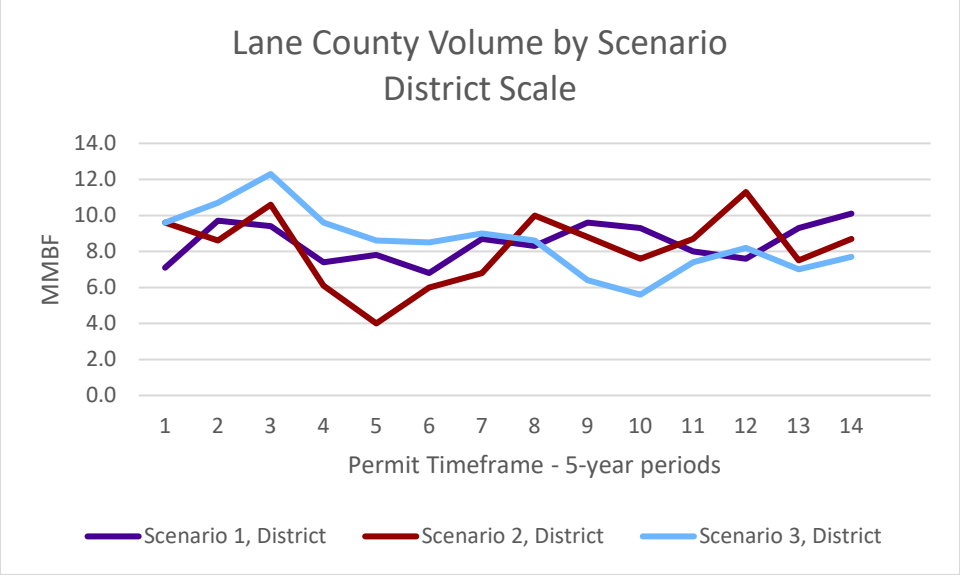


Figure 30. Lane County Annual Average Revenue by Scenario, Georegion Scale for each 5-year time period.

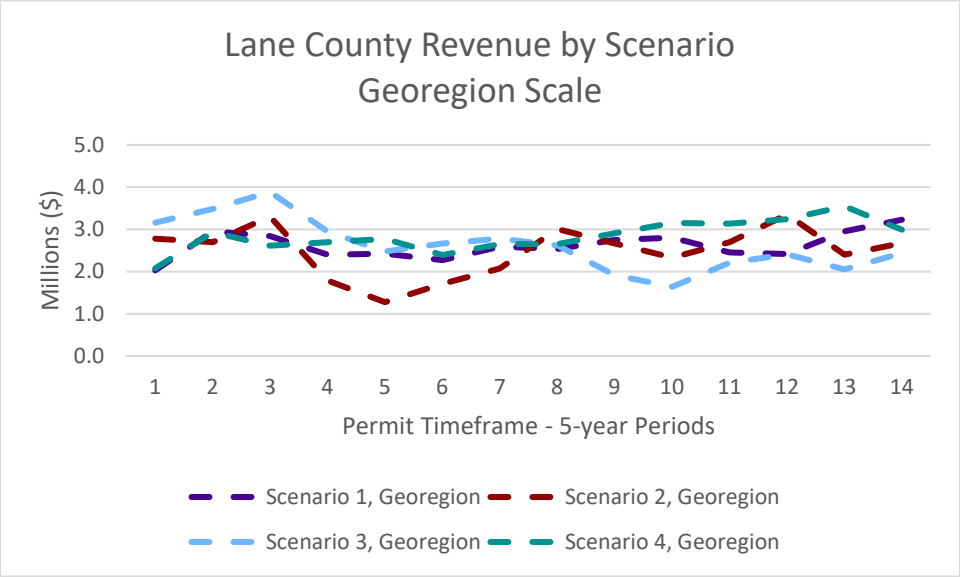
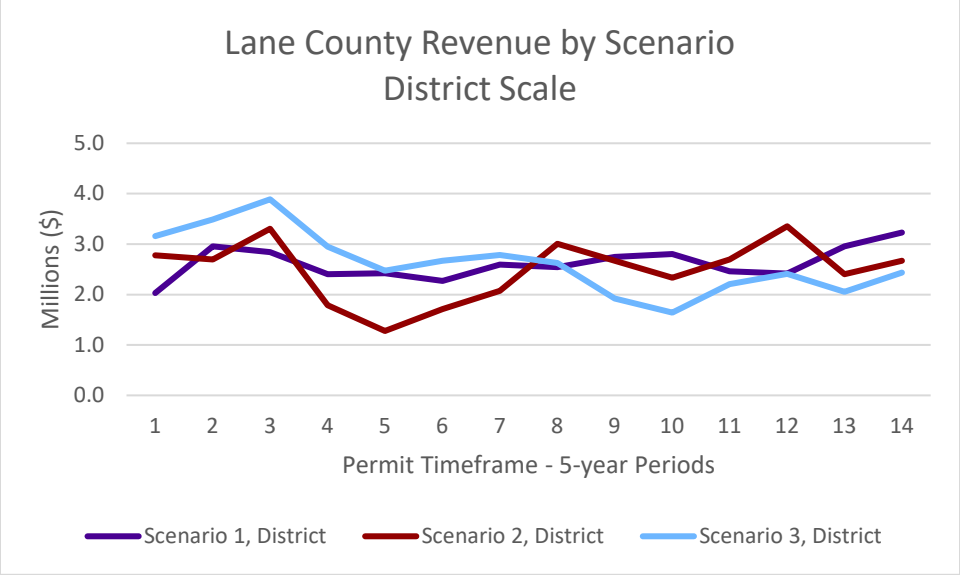


Figure 31. Lane County Average Annual Revenue by Scenario, District Scale for each 5-year time period.



LINCOLN COUNTY

Figure 32. Lincoln County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

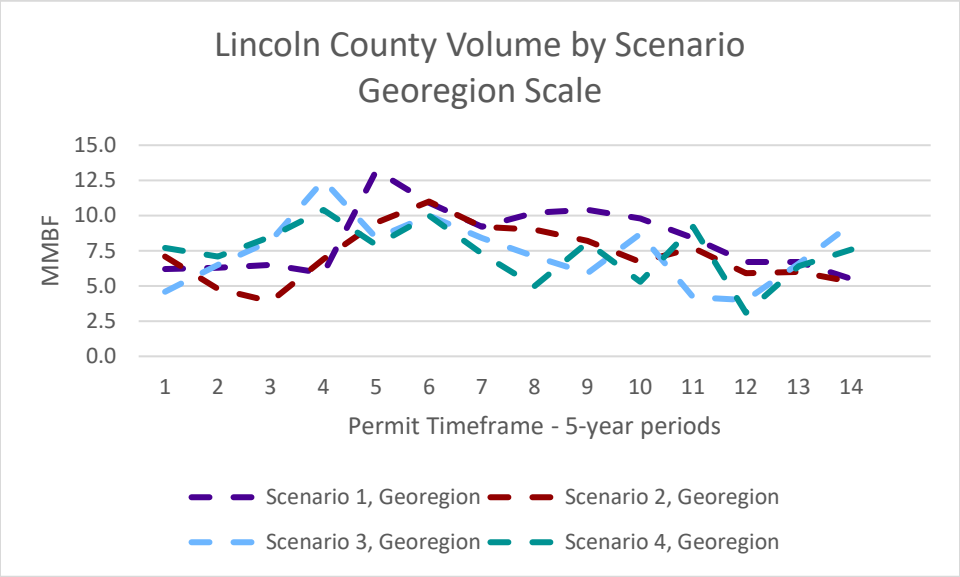


Figure 33. Lincoln County Average Annual Volume by Scenario, District Scale for each 5-year time period.

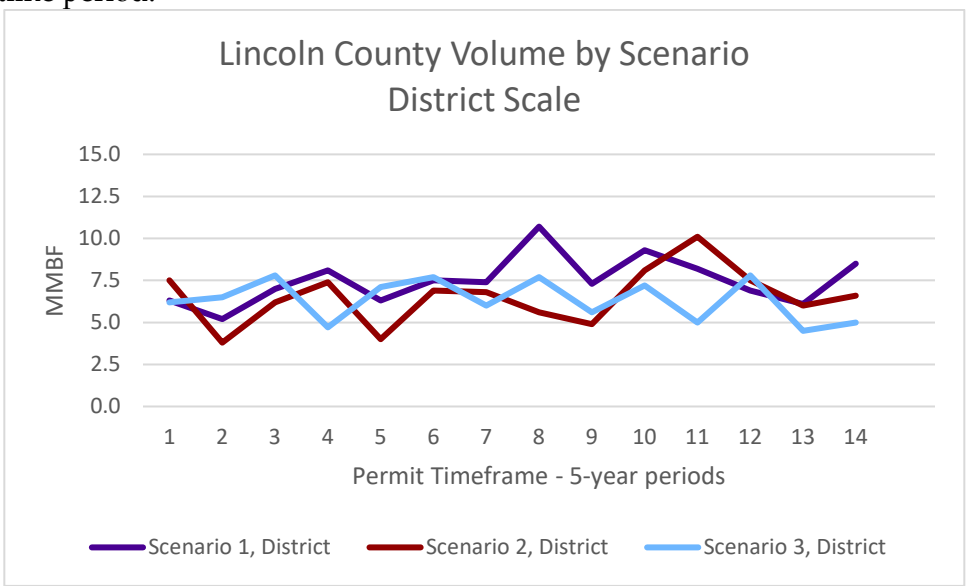


Figure 34. Lincoln County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

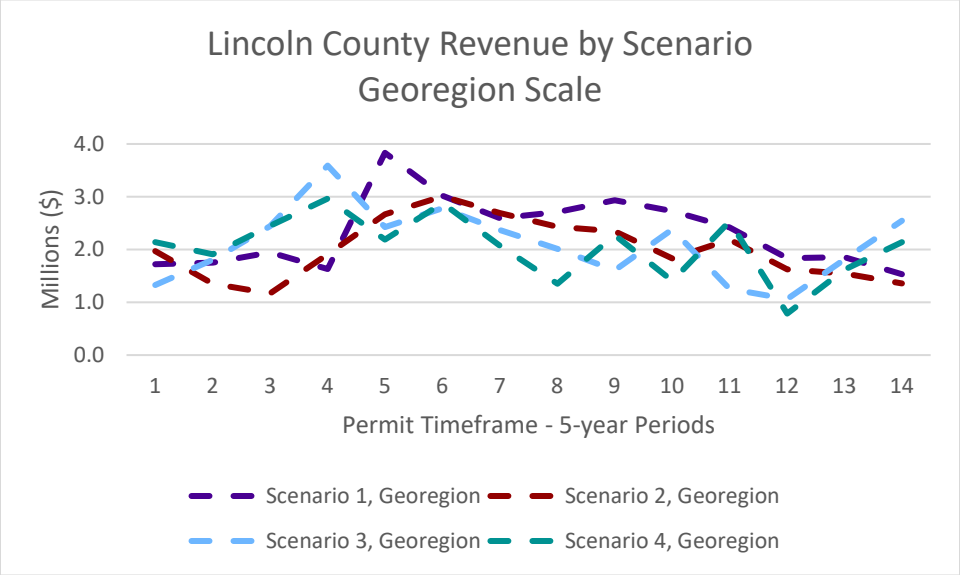


Figure 35. Lincoln County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

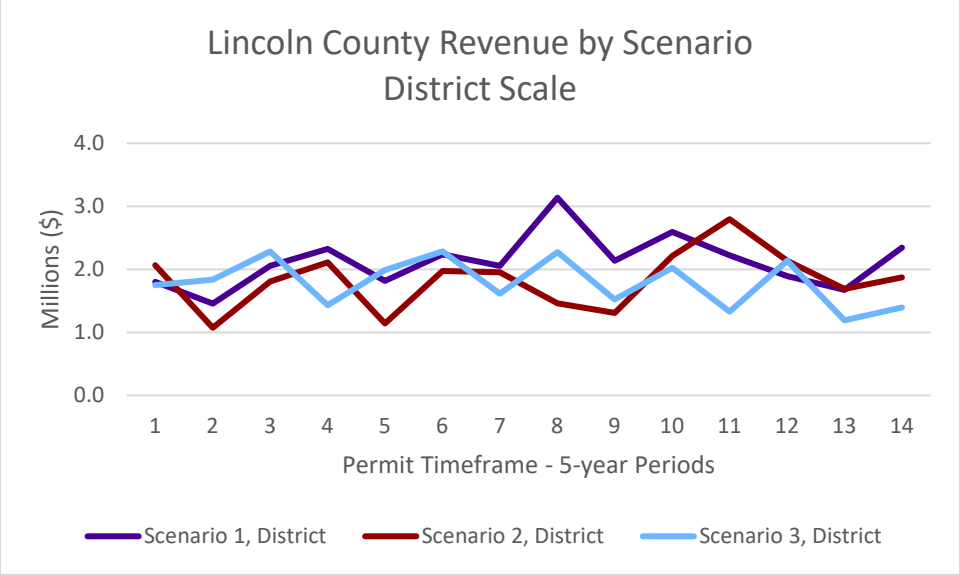


Figure 36. Linn County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

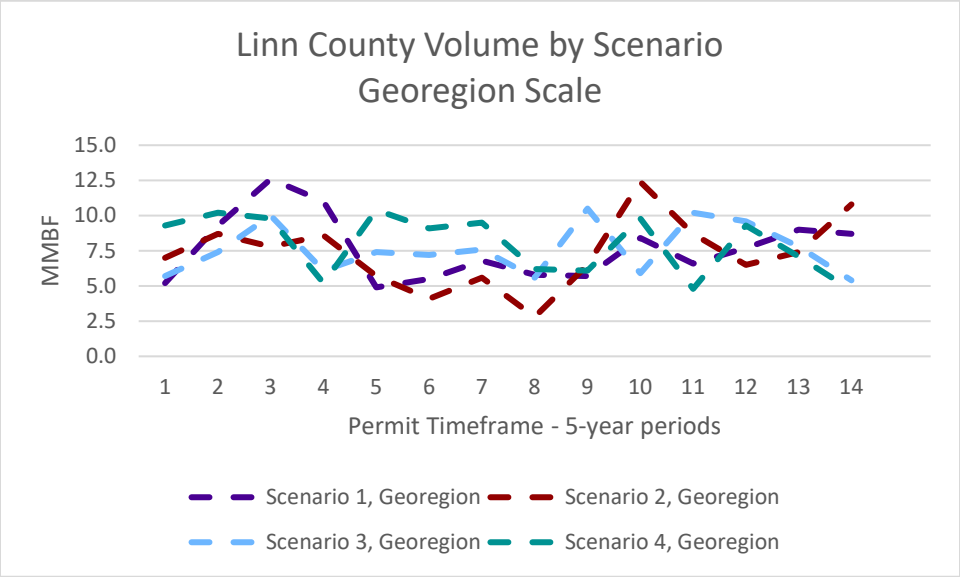


Figure 37. Linn County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

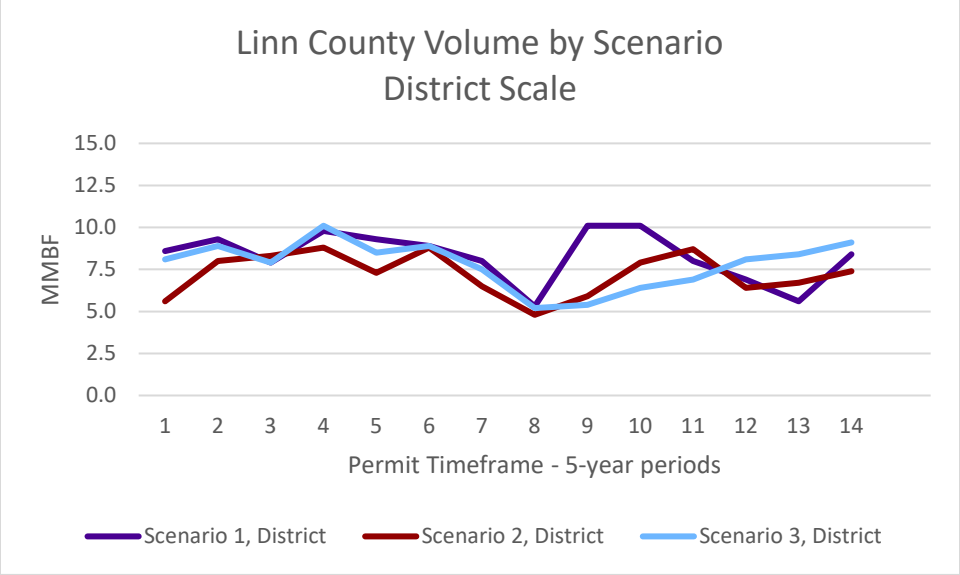


Figure 38. Linn County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

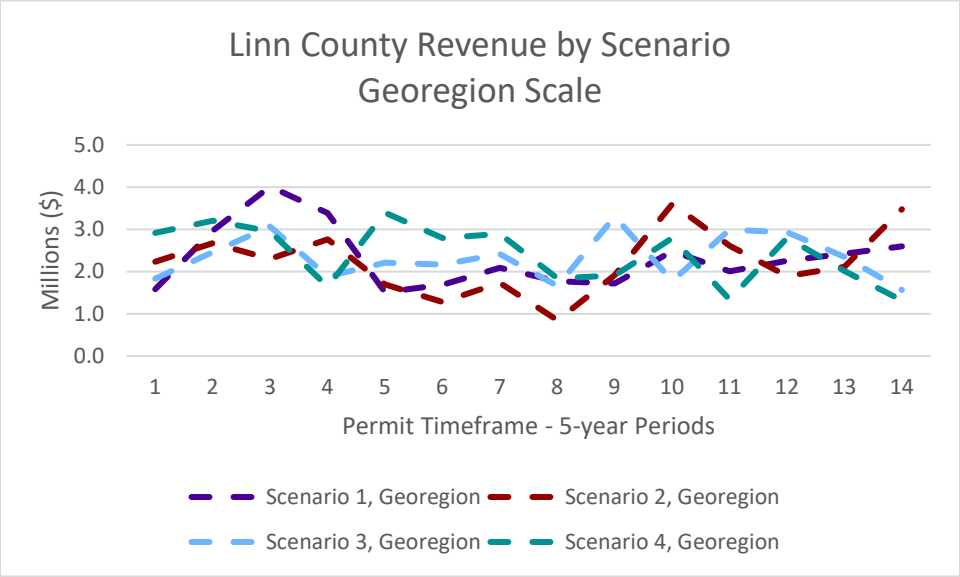


Figure 39. Linn County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

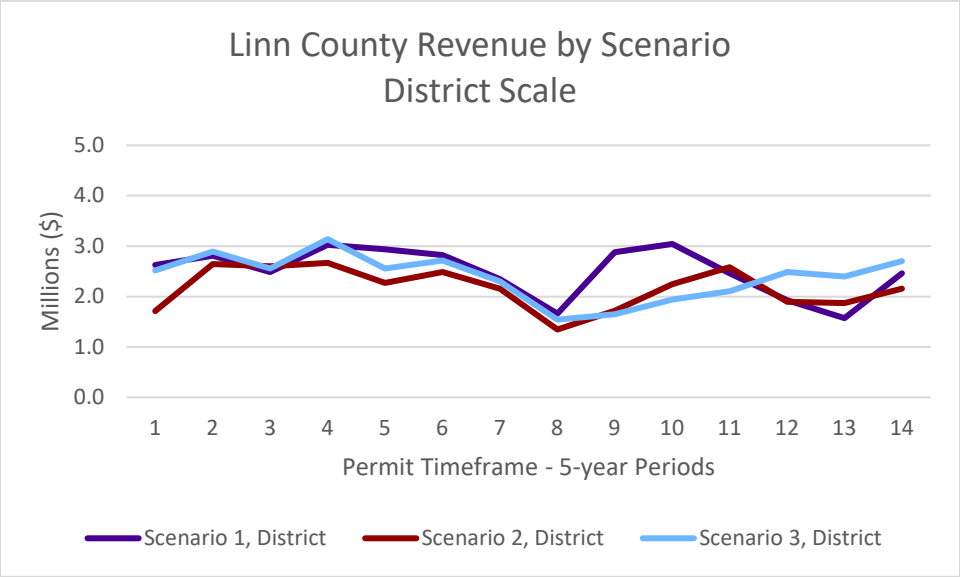


Figure 40. Marion County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

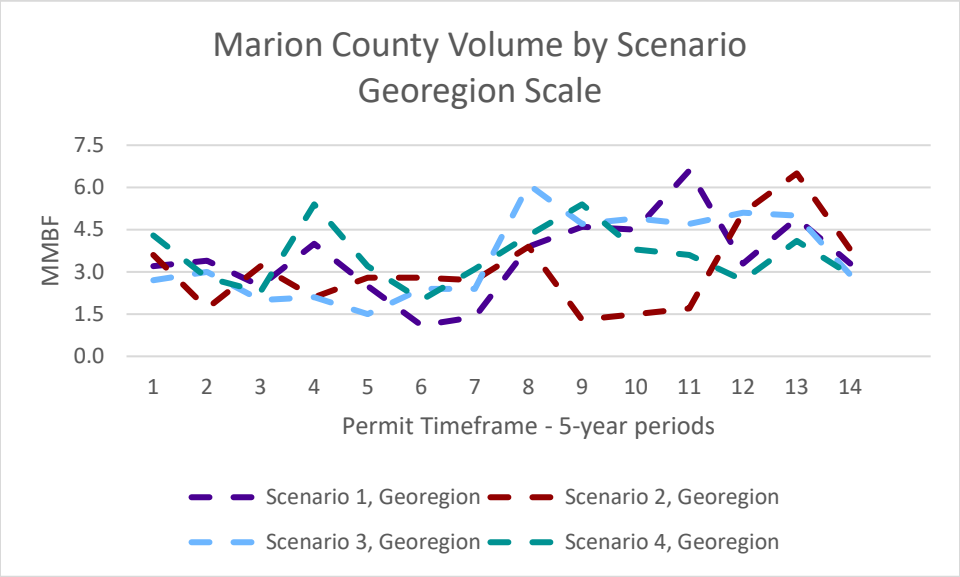


Figure 41. Marion County Average Annual Volume by Scenario, District Scale for each 5-year time period.

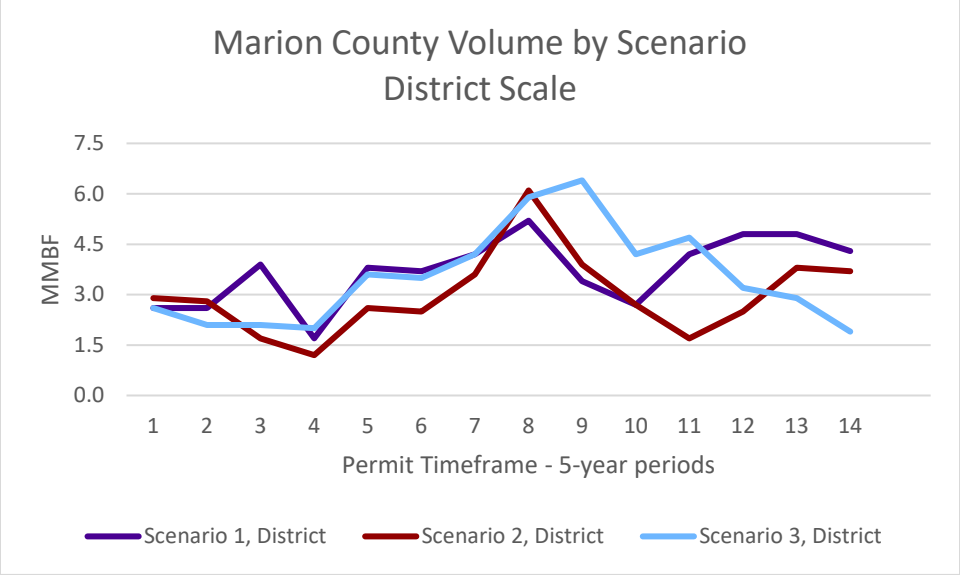


Figure 42. Marion County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

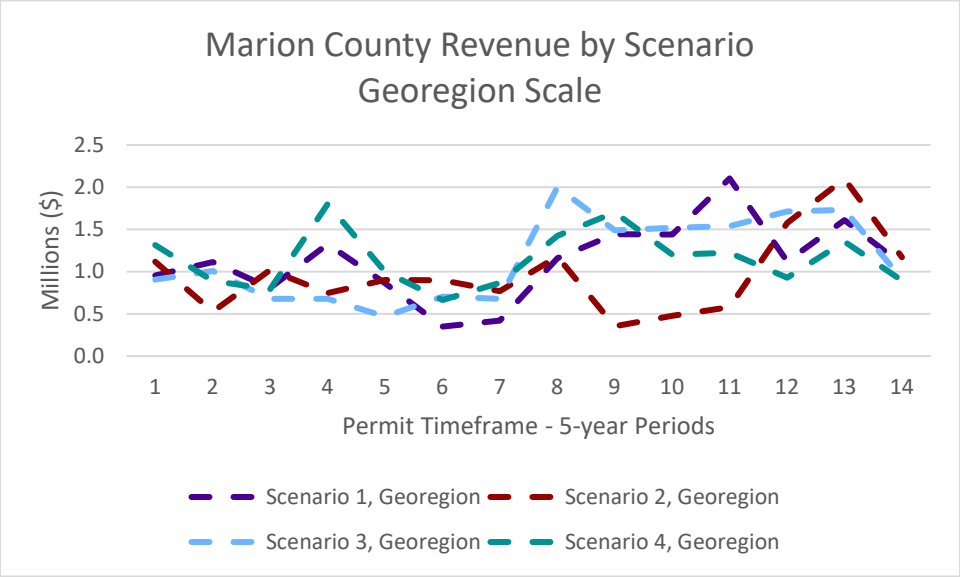


Figure 43. Marion County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

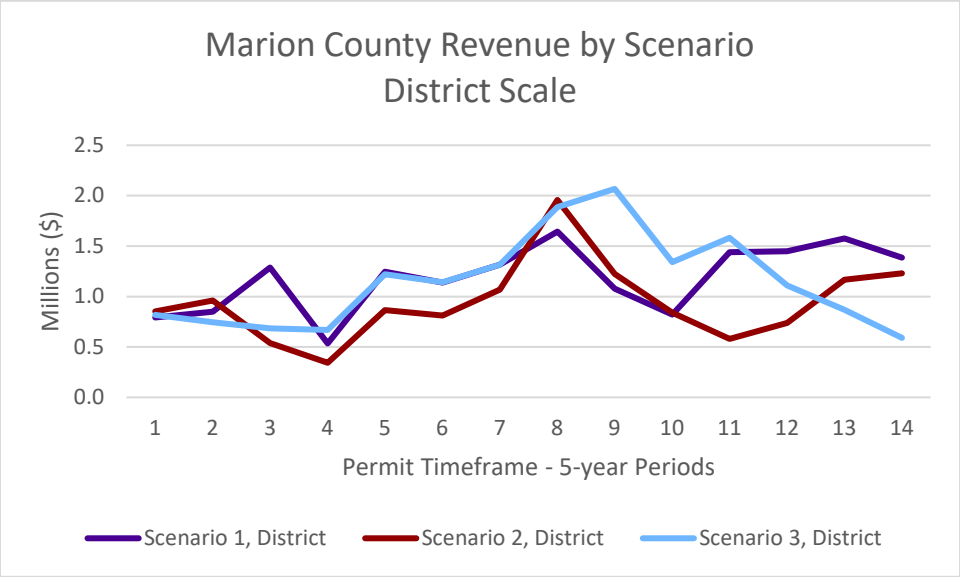


Figure 44. Polk County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

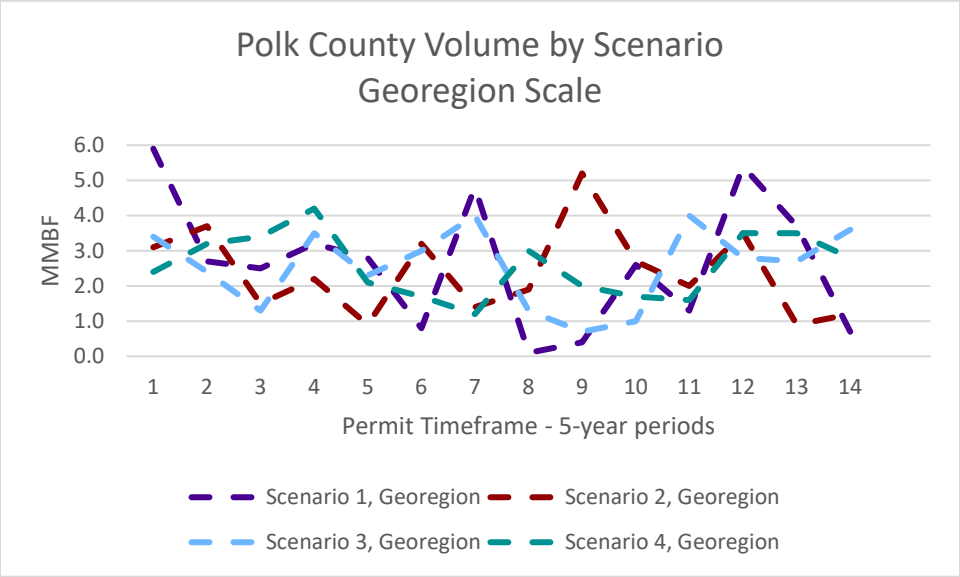


Figure 45. Polk County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

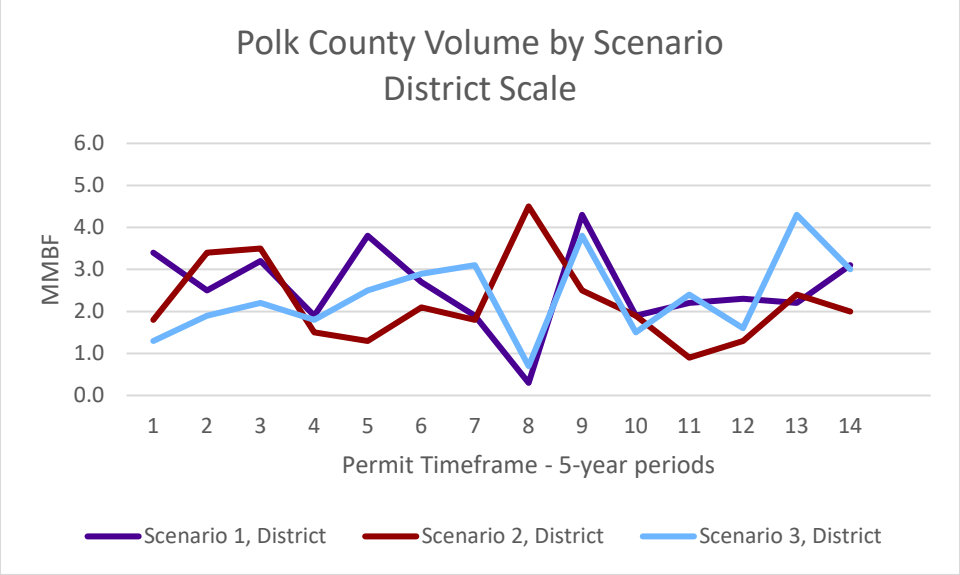


Figure 46. Polk County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

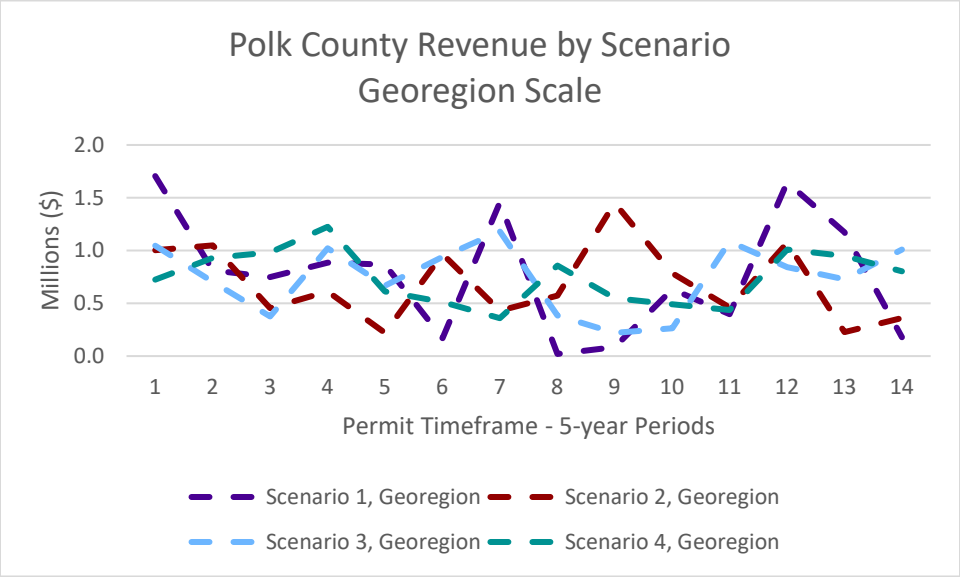


Figure 47. Polk County Average Annual Revenue by Scenario, Georegion Scale for each 5 year time period.

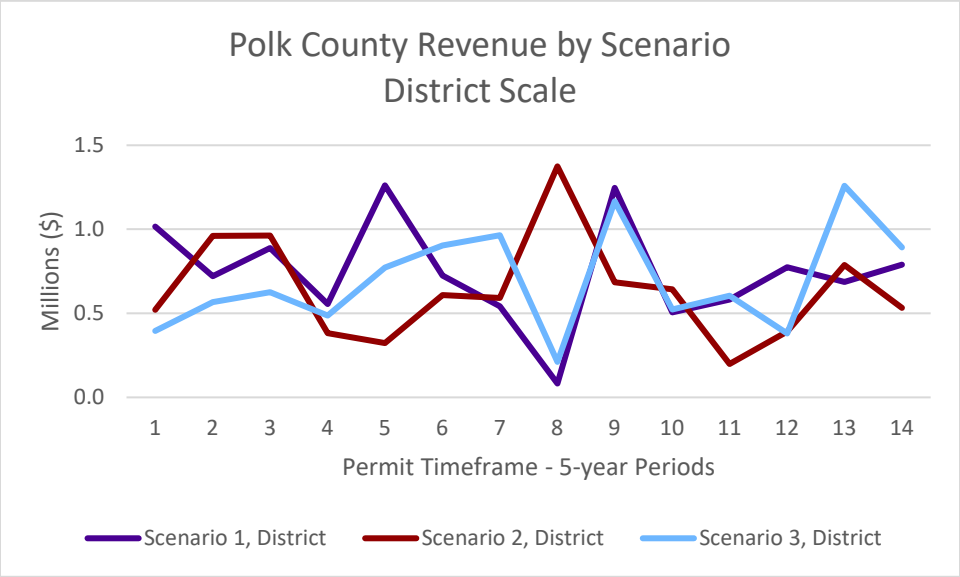


Figure 48. Tillamook County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

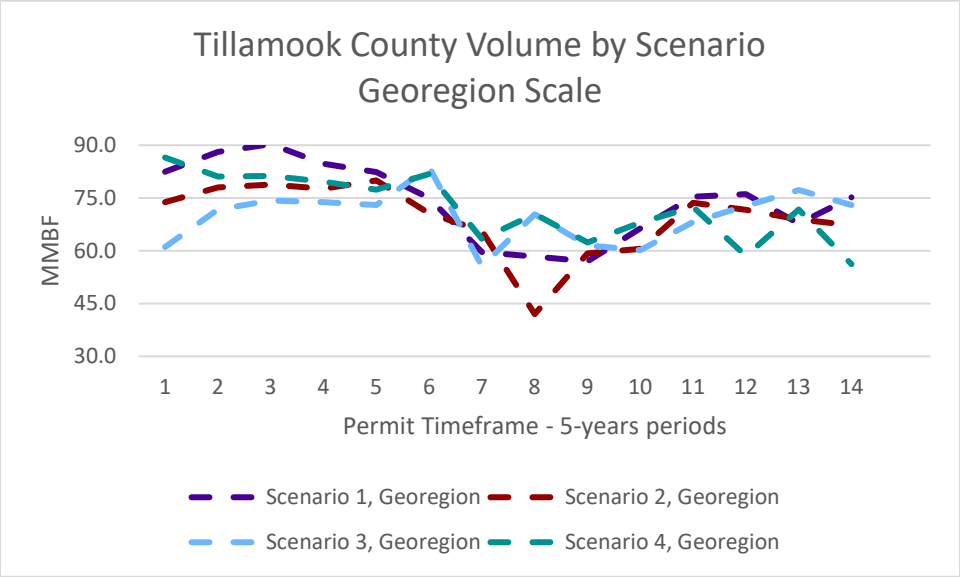


Figure 49. Tillamook County Average Annual Volume by Scenario, District Scale for each 5-year time period.

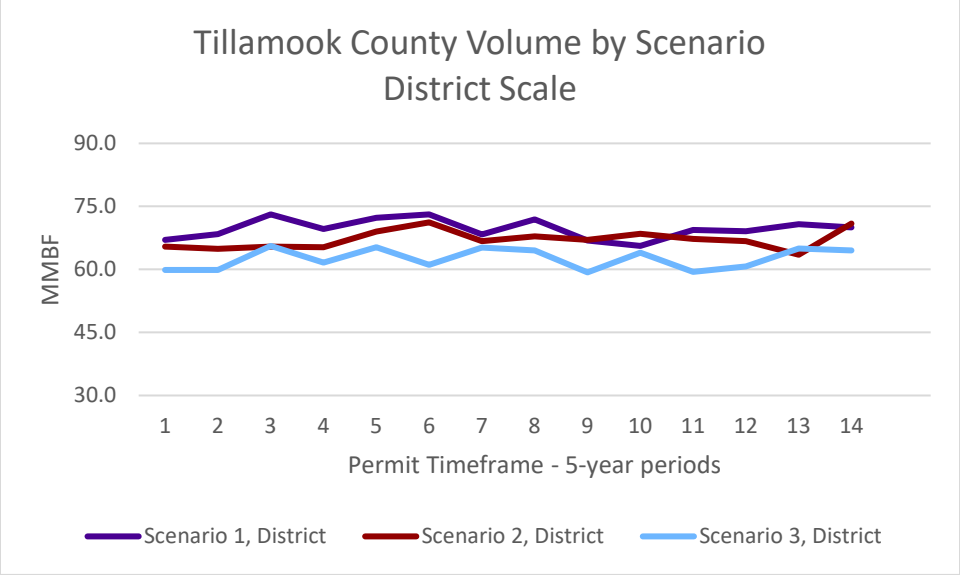


Figure 50. Tillamook County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

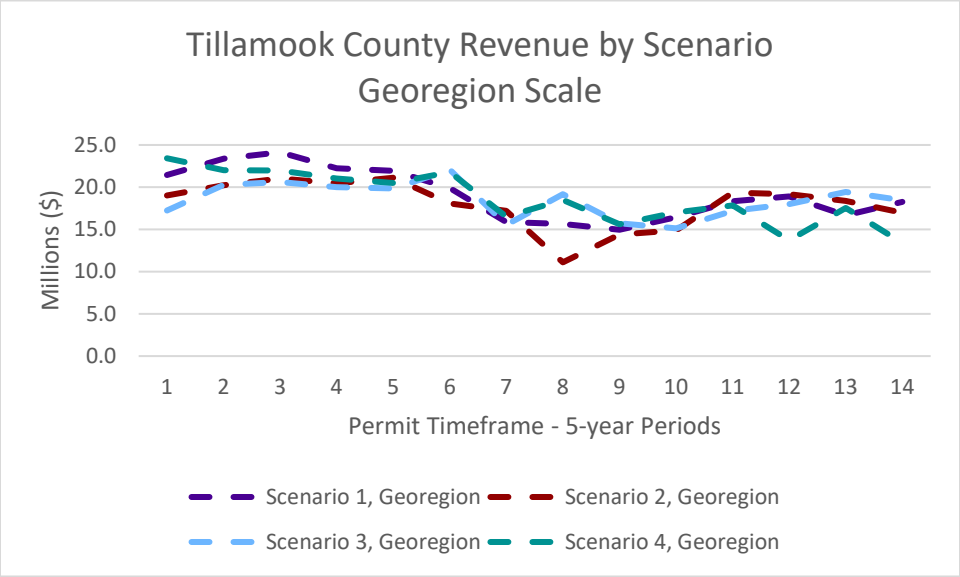


Figure 51. Tillamook County Average Annual Revenue by Scenario, District Scale for each 5-year time period.

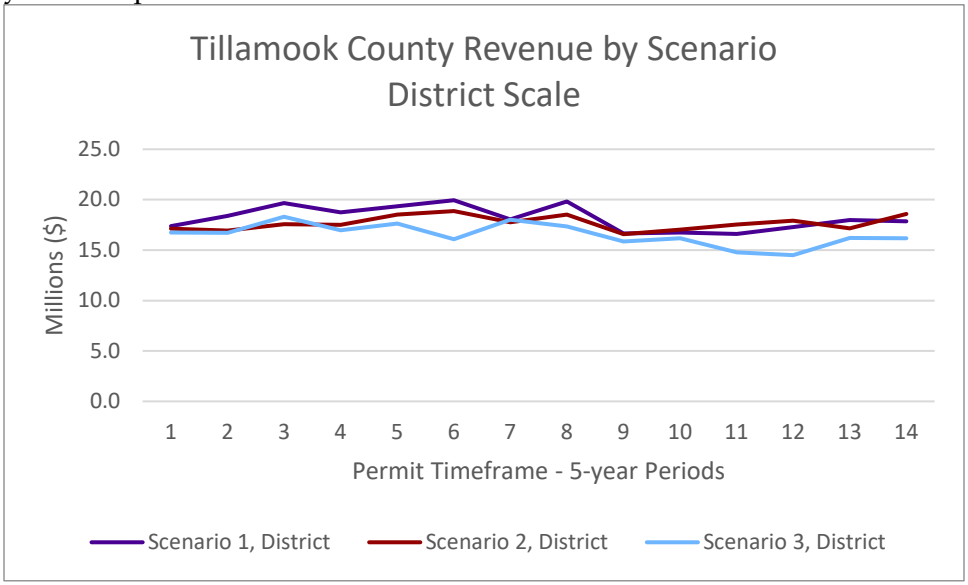


Figure 52. Washington County Average Annual Volume by Scenario, Georegion Scale for each 5-year time period.

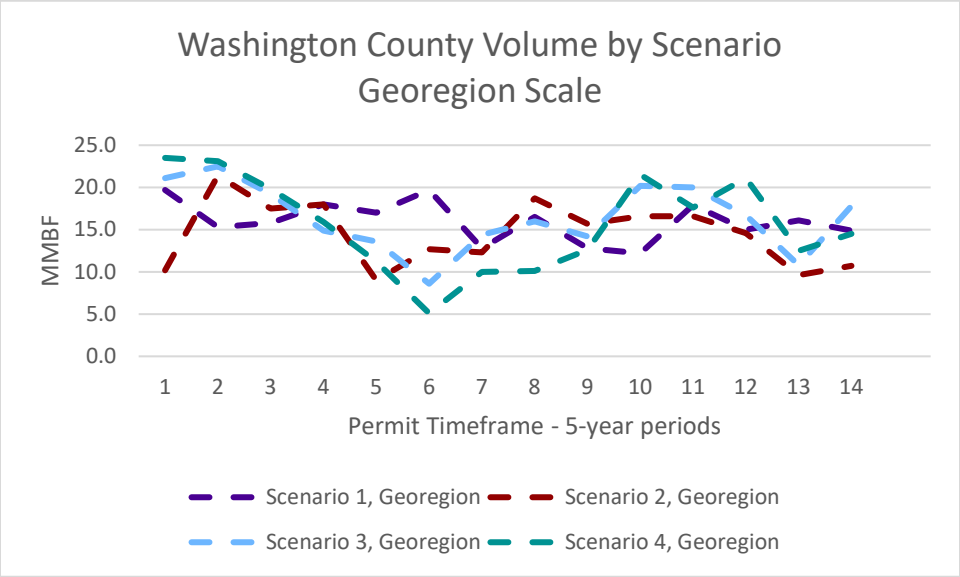


Figure 53. Washington County Average Annual Volume by Scenario, District Scale for each 5-year time period.

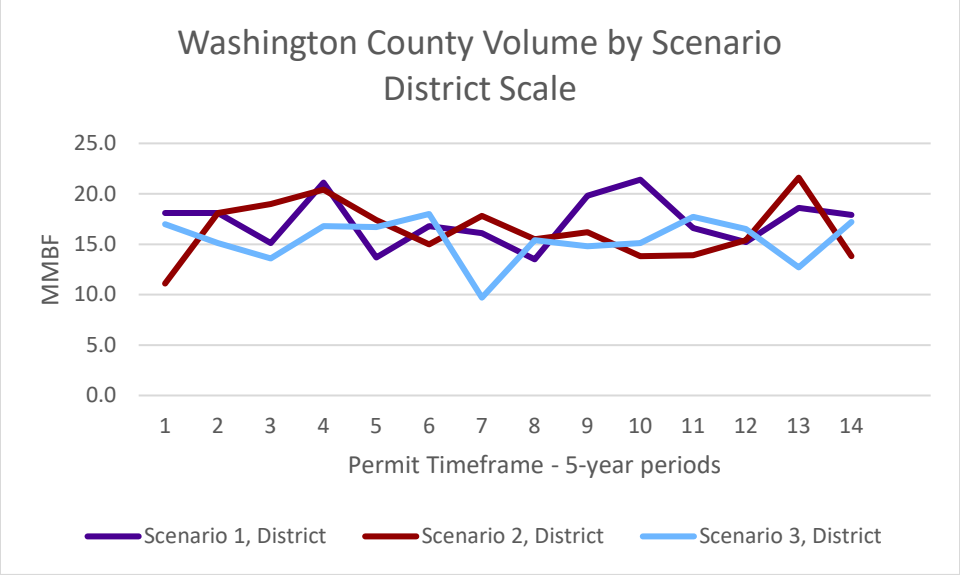


Figure 54. Washington County Average Annual Revenue by Scenario, Georegion Scale for each 5-year time period.

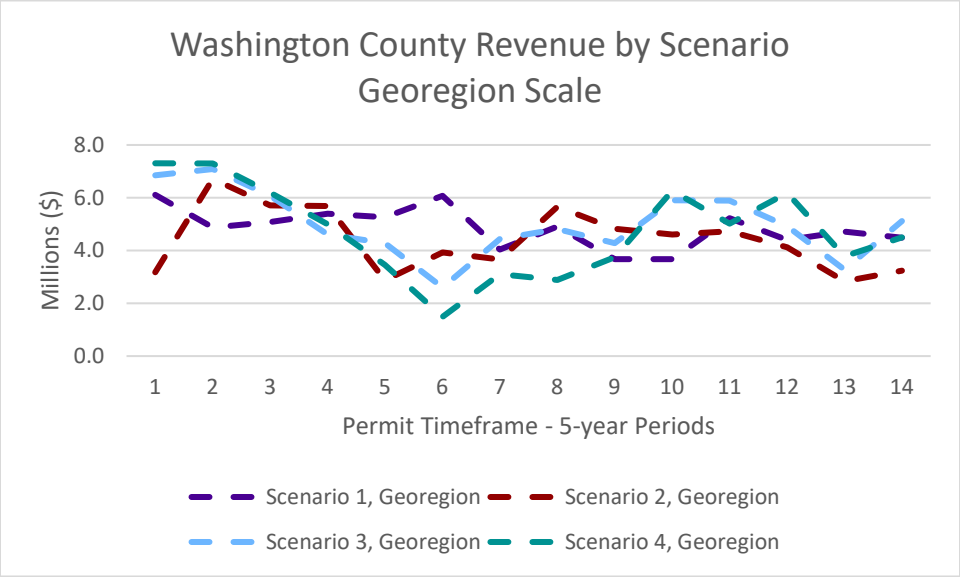


Figure 55. Washington County Average Annual Revenue by Scenario, District Scale for each 5-year time period.