Carbon and Forest Management Work Group

Proposed Management Scenarios for the April 10 Work Group Meeting

This document summarizes the scenarios considered by the Carbon and Forest Management Work Group, and is organized into four sections:

- **Part 1:** New scenarios, which includes some of the more complex ideas
- **Part 2:** Scenarios that did not pass but require more discussion
- **Part 3:** Scenarios eliminated or recommended for elimination
- **Part 4:** Scenarios that have been passed by the work group

In this document, DNR notes any adjustments that have been made to the scenarios as a result of discussion with the work group.

In the March 10 meeting, the work group decided to model half of the scenarios with no climate change, and half with moderate climate change (based on representative concentration pathway [RCP] 4.5). Because each model run counts as a scenario, **the work group can select a total of eight, unique scenarios**. Four have already been chosen so **only four more scenarios may be selected**.

Below is a list of all the scenarios, organized by status.

New scenarios and scenarios needing more discussion (Parts 1 and 2)
****Only four maybe selected****

New scenarios

- Scenario 8: Longer rotations and significantly increase thinning
- Scenario 9: Increased emphasis on silviculture
- Scenario 10: Multiple dials

Scenarios that did not pass but require more discussion (modified per work group discussion)

- Scenario 5: Thinning only
- Scenario 6: Increase deferrals, Option A
- Scenario 7: Increase deferrals, Option B

Scenarios eliminated or recommended for elimination (Part 3)

The work group agreed to eliminate the first three scenarios, and DNR recommends eliminating the fourth scenario. Refer to Part 3 for an explanation.

- No harvest
- Manage by state minimum requirements (instead of the HCP)
- Defer forests that may develop into structurally complex forest
- Polyculture with long harvest rotation

Scenarios that have been passed by the work group (Part 4)

- Scenario 1: DNR current operations
- Scenario 2: Lengthen harvest rotation
- Scenario 3: Shorten harvest rotation
- Scenario 4: Significantly increase thinning

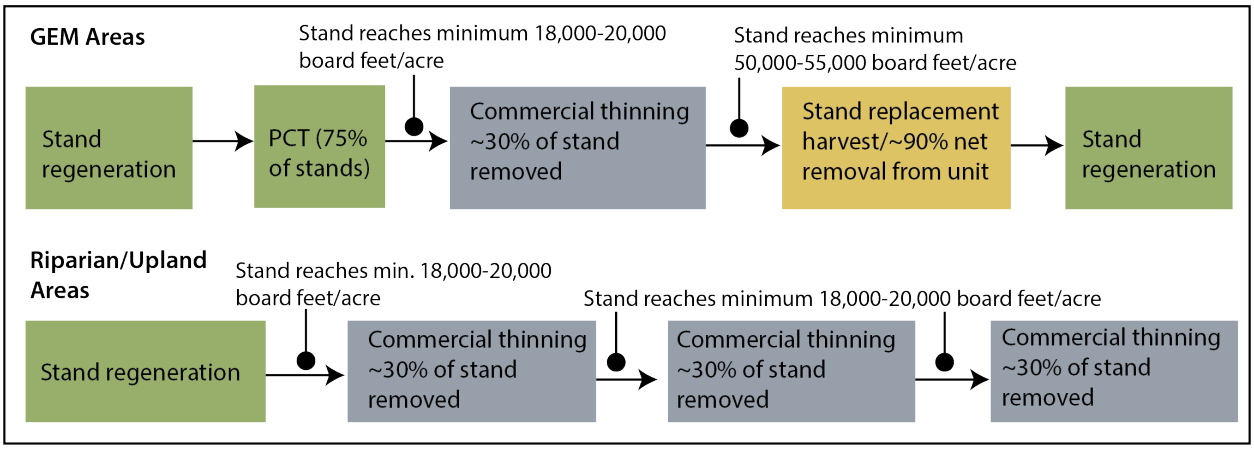
Part 1: New Scenarios

■ **Scenario 8: Longer rotations and significantly increase thinning**

***Dials turned*:** Harvest rotation length and thinning

This scenario combines Scenario 2 (lengthen harvest rotation) and Scenario 4 (significantly increase thinning). Scenario 4 includes the "friendly amendment" of pre-commercial thinning (PCT). Refer to Part 4 for a description of these scenarios. Refer to the graphic below to understand how these two scenarios will interact when combined. The two-decade waiting period between thinnings has been removed.

Junction of longer rotations and significantly increase thinning scenario



■ Scenario 9: Increased emphasis on silviculture

Dial turned: Thinning

This scenario is designed to increase the growth of forests on state trust lands through more intensive silvicultural practices. NOTE: Some of these improvements will need to be represented in the model in a generalized way, for example as a percentage of growth improvement.

- **Seed and seedling improvement:** Across state trust lands, about 60 percent of the seedlings that DNR plants are grown from improved seed stock. Improved seeds are gathered from orchard trees that have performed well in field testing across a wide range of environments. This scenario would increase the percentage of improved seedlings to 80 percent, for a potential, average growth increase of about 10 percent. To simplify modeling, ESSA could assume a 2 percent growth increase across all GEM lands, relative to current practices.

- **Planting density and species:** Increase planting density based on site class.

    - Site class 1: Increase density from 400 to 435 seedlings per acre
    - Site class 2: Increase density from 360 to 400 seedlings per acre
    - Site class 3 and 4: Increase density from 320 to 360 seedlings per acre

    To simplify modeling, ESSA could assume 400 seedlings per acre across all GEM lands.

- **Site preparation**: Increase site preparation from 75 to 90 percent of planted acres. Site preparation enhances seedling survival and growth through removal of competing vegetation. It also makes the site easier to plant.

- **Release treatment:** Increase release treatments from 75 to 100 percent of planted stands. Release treatments involve the removal of competing vegetation through mechanical or chemical means.

- **Pre-commercial thinning (PCT)**: Conduct PCT on 75 percent of stands. Each thinning would remove approximately 25 percent of the stems per acre, relative to initial planted density.

- **Commercial thinning**: Require one commercial thinning entry per harvest rotation. Commercial thinning removes approximately 30 percent of the timber volume and is done when the stand has at least 18,000-20,000 board feet per acre.

■ Scenario 10: Multiple dials

***Dials turned*:** Rotation length, deferrals, and thinning

- **Lengthen harvest rotation** (Refer to Scenario 2).

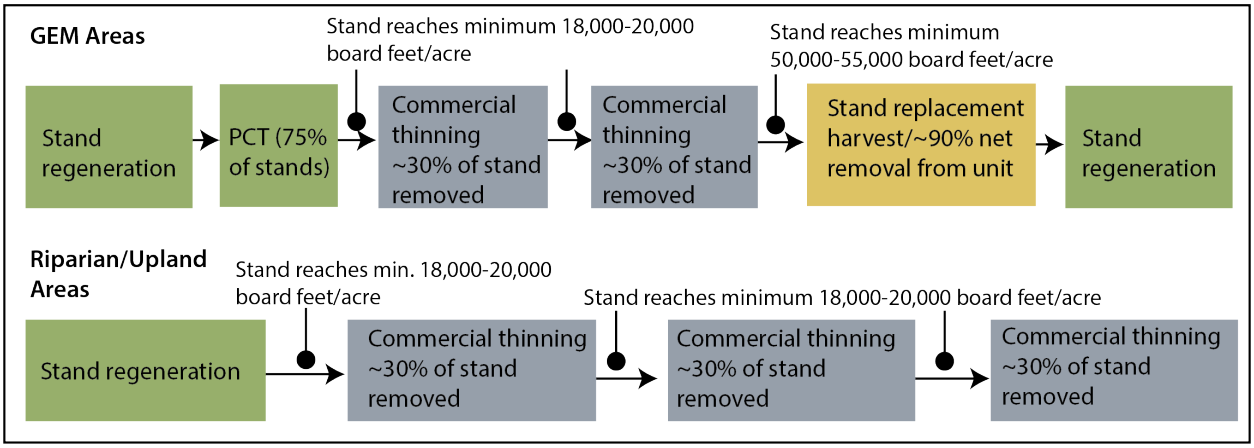
- **Defer** 100 percent of a) older, carbon-dense, structurally complex forest (as DNR Defines them in its *Policy for Sustainable Forests*)[1]; and b) less complex forest stands (as defined by stakeholders) in GEM areas (Refer to Scenario 7). The later category will be explained in the

[1] Only definition of structurally complex forest recognized by DNR

April 10 meeting. Forest selected for deferral are those that are not already deferred for other reasons. (refer to Scenario 7)

- **Significantly increase thinning** (Refer to Scenario 4). For the multiple dial scenario only, the "significantly increased thinning" scenario will be modified to include more than one thinning entry (refer to the following graphic). The two-decade waiting period between thinning entries has been removed. Within spotted owl management units, DNR will specifically target thinning in forests that have not yet developed into habitat. Like other thinning scenarios, DNR will follow all requirements of the *State Trust Lands Habitat Conservation Plan* (HCP) for thinning in riparian, northern spotted owl, and marbled murrelet management areas.

Significantly increase thinning scenario as modified for the multiple dials scenario



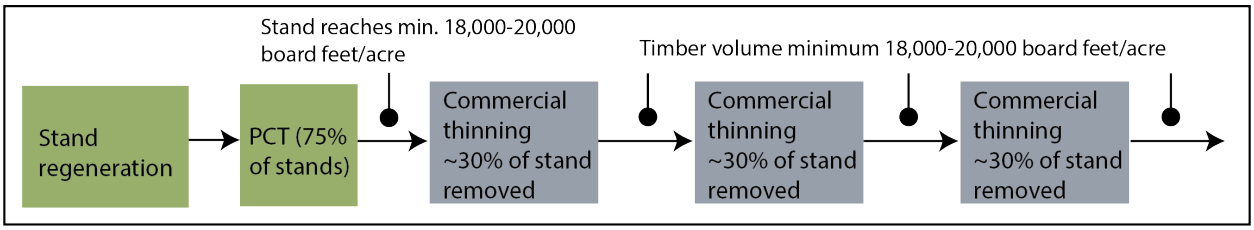
Part 2: Scenarios that Did Not Pass But Require More Discussion

Scenario 5: Thinning only

Dial turned: Thinning

Under this scenario, forest stands in all land classifications (GEM, upland, riparian) will undergo commercial thinning repeatedly with **no stand replacement harvest**. Like the current operations scenario, stands must meet the minimum requirement of roughly 18,000-20,000 board feet per acre to be available for thinning. Based on work group feedback, DNR has added PCT and removed the two decade waiting period between thinnings for this scenario. Like other thinning scenarios, DNR will follow all requirements of the *State Trust Lands Habitat Conservation Plan* (HCP) for thinning in riparian, northern spotted owl, and marbled murrelet management areas.

Thinning only (all areas)



■ Scenario 6: Increase deferrals Option A

Dial turned: Deferrals

Under this scenario, DNR will defer 100 percent of older, carbon-dense, structurally complex forests (as defined by DNR's *Policy for Sustainable Forests*)[2] in GEM areas. Forest selected for deferral are those that are not already deferred for other reasons. Refer to Appendix A for the definition of structurally complex forest that DNR will use.

These forests will be deferred from stand replacement harvest indefinitely, although they may be thinned if needed to maintain forest health or meet other ecological objectives.

DNR will consider the 2,000 acres identified under another section of this proviso as already deferred.

■ Scenario 7: Increase deferrals Option B

Dial turned: Deferrals

Under this scenario, DNR will defer the following:

- 100 percent of older, carbon-dense, structurally complex forests (as defined by DNR's *Policy for Sustainable Forests*) in GEM areas. Forest selected for deferral are those that are not already deferred for other reasons. Refer to Appendix A for the definition of structurally complex forest that DNR will use.
- 100 percent of less complex forest stands (as defined by stakeholders) in GEM areas. This category of forest will be explained at the April 10 work group meeting.

These forests will be deferred from stand replacement harvest indefinitely, although they may be thinned if needed to maintain forest health or meet other ecological objectives.

DNR will consider the 2,000 acres identified under another section of this proviso as already deferred.

[2] Only definition of structurally complex forest recognized by DNR

Part 3: Scenarios Eliminated or Recommended for Elimination

■ **No harvest**

■ **Manage by state minimum requirements (instead of the HCP)**

The "no harvest" scenario would preclude all harvest on state trust lands, and the "Manage by state minimum requirements" scenario would involve managing per the Forest Practices Rules instead of the HCP. The work group agreed in the March 10 meeting to remove both scenarios from consideration.

■ **Defer forests that may develop into structurally complex forest**

The work group eliminated this scenario because it was unclear which forests would be deferred.

■ **Polyculture with long rotations (recommend eliminating)**

Polyculture means growing two or more species in one stand. In the Northwest, alder is usually paired with a shade-tolerant conifer like western redcedar. Because these species grow at markedly different rates, they have different rotation lengths. The two species are planted in a way that facilitates harvesting one and leaving the other to grow.

This idea is experimental and may or may not be operationally feasible. In addition, the growth and yield of polyculture stands would likely be highly variable and almost impossible to project with any kind of certainty, at least until more research is done. For these reasons, **polyculture is unsuitable as a scenario for this project**. DNR recommends that polyculture be recorded as an idea for the future, pending additional research by DNR and other organizations.

DNR is currently experimenting with polyculture through the Type 3 (T3) Watershed Experiment in the Olympic Experimental State Forest. The study will include an analysis of carbon sequestration and storage. Refer to the study plan for more information.

Part 4: Scenarios That Have Been Passed by the Work Group

■ **Scenario 1: DNR current management**

The following scenario has been expanded to show more detail on DNR's current management.

GEM areas:

- **Stand replacement harvest**: To be eligible for stand replacement harvest, forest stands typically have roughly 30,000 to 35,000 board feet per acre, although this range can vary from site to site. For Douglas-fir, this range translates to a harvest rotation of approximately 50-80 years depending on site class. Stand replacement harvest removes an average of 90 percent of the

timber volume within each timber sale unit, although actual removals may vary widely depending on objectives and stand conditions.

- **Site preparation:** Over the past 10 years, DNR has done site preparation on approximately 75 percent of areas being replanted.
- **Stand regeneration:** About 60 percent of the seedlings that DNR plants on state trust lands are grown from improved seed stock. Improved seeds are gathered from orchard trees that have performed well in field testing across a wide range of environments.

  DNR plants more seedlings on more productive sites. In general, DNR plants approximately:

  - Site class 1: 400 seedlings per acre
  - Site class 2: 360 seedlings per acre
  - Site class 3 and 4: 320 seedlings per acre

  To simplify modeling, ESSA could assume 360 seedlings per acre across all GEM lands.

  On most sites, DNR plants at least two species. For example, in 2022, 72 percent of harvested sites were replanted with two or more species. Nearly 80 percent of these sites were planted with Douglas-fir, and secondary species included western hemlock (11 percent) and western redcedar (5 percent). Other species planted (1 to 2 percent) include Sitka spruce, red alder, white pine, and noble fir.
- **Release treatments:** Over the past 10 years, DNR has done release treatments (herbicide spraying or slashing) on roughly 75 percent of planted stands. Release treatments are typically done about two years after planting.
- **PCT:** Based on its most recent estimates, DNR has done PCT on approximately 50 percent of its forests in GEM areas, on average, over the past 10 years. Note that the amount of PCT (and release treatments) that DNR can perform from one year to the next is highly dependent on funding, so acres can vary widely from one year to the next. Recent PCT work has been funded through an appropriation from the Climate Commitment Act.

  PCT is done when stands are anywhere from 8 to 12 years of age, on average (earlier on more productive sites, later on less productive sites). DNR removes approximately 25 percent of the stems per acre in a PCT, relative to initial planting density.
- **Commercial thinning:** Over the past 10 years, DNR has performed commercial thinning on less than approximately 8 percent of GEM lands. Depending on objectives, the technique can be an intermediate-type thinning, in which trees are removed in a regular pattern and remaining trees have similar growing space; or a variable density thinning but without large gaps. In either case, the volume removed in a thinning is roughly 30% of timber volume within the thinning boundary.

Riparian:

- **Stand replacement harvest**: Generally not allowed except under limited circumstances (such as hardwood conversions).

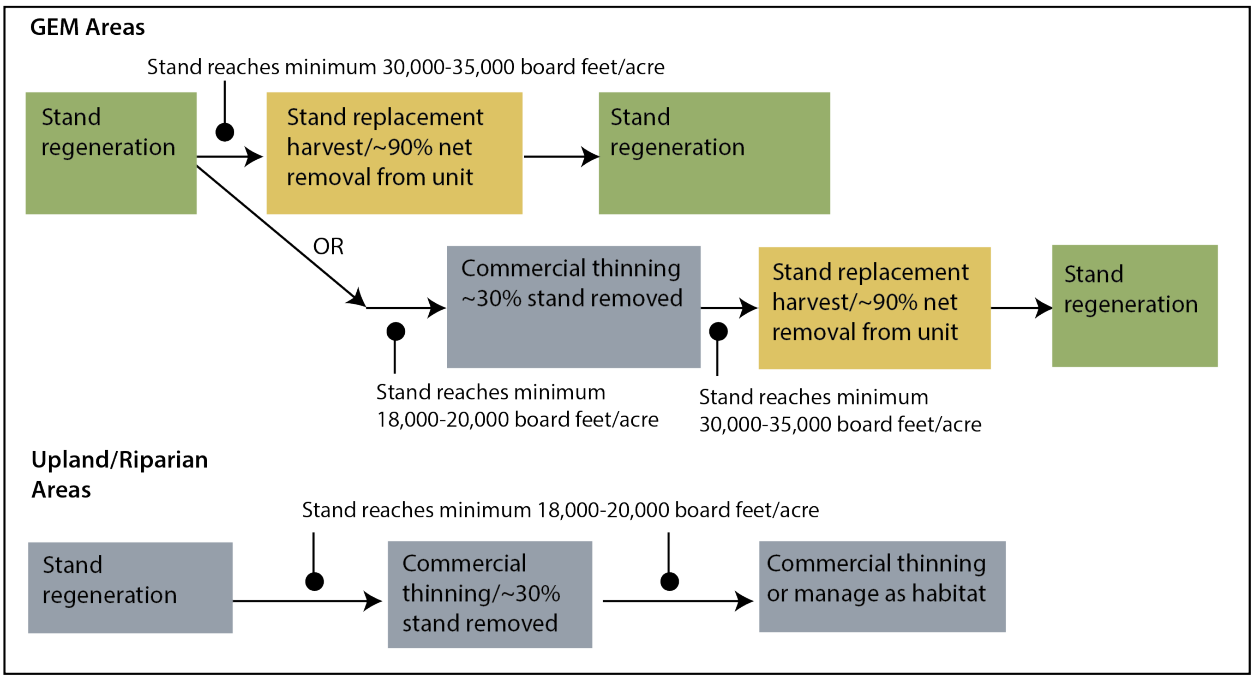
- **Commercial thinning**: Currently, DNR does virtually no commercial thinning in riparian areas.
- **Pre-commercial thinning:** Currently, DNR does virtually no pre-commercial thinning in riparian areas.

Other upland areas:

- **Stand replacement harvest, pre-commercial thinning, commercial thinning**: Stand replacement harvest is only allowed in select areas. When performed, it has the same requirements as stand replacement harvest in GEM lands. Thinning (PCT and commercial) is allowed in some upland areas per the requirements of the HCP and other policies and laws. Thinning rules vary depending on habitat type and objectives. Commercial thinning in habitat areas is usually variable density with gaps ranging from a quarter to half acre each. PCTs in uplands have the same parameters as GEM lands.
- **Stand regeneration:** Only applicable in areas that have undergone stand replacement harvest. Parameters are the same as GEM lands.

Following is a graphic showing current management practices. Currently, the top track (regenerate, harvest, regenerate) is far more common than the middle track (regenerate, thin, harvest, replant) or the lower track (thin only).

DNR current management



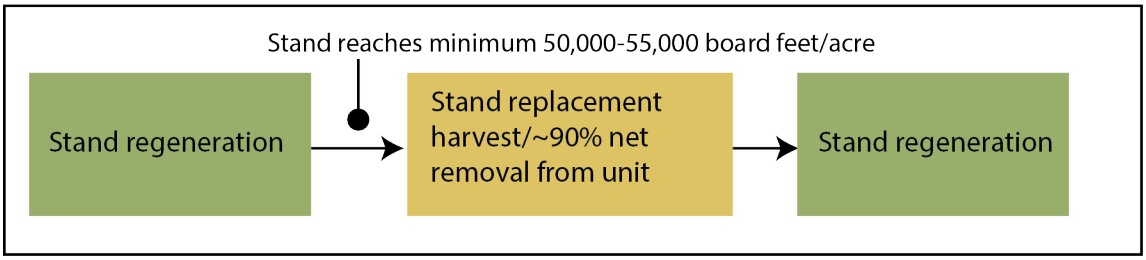
■ Scenario 2: Lengthen harvest rotation

Dial turned: Harvest rotation length

This scenario is specific to stand replacement harvest in **GEM areas only**.

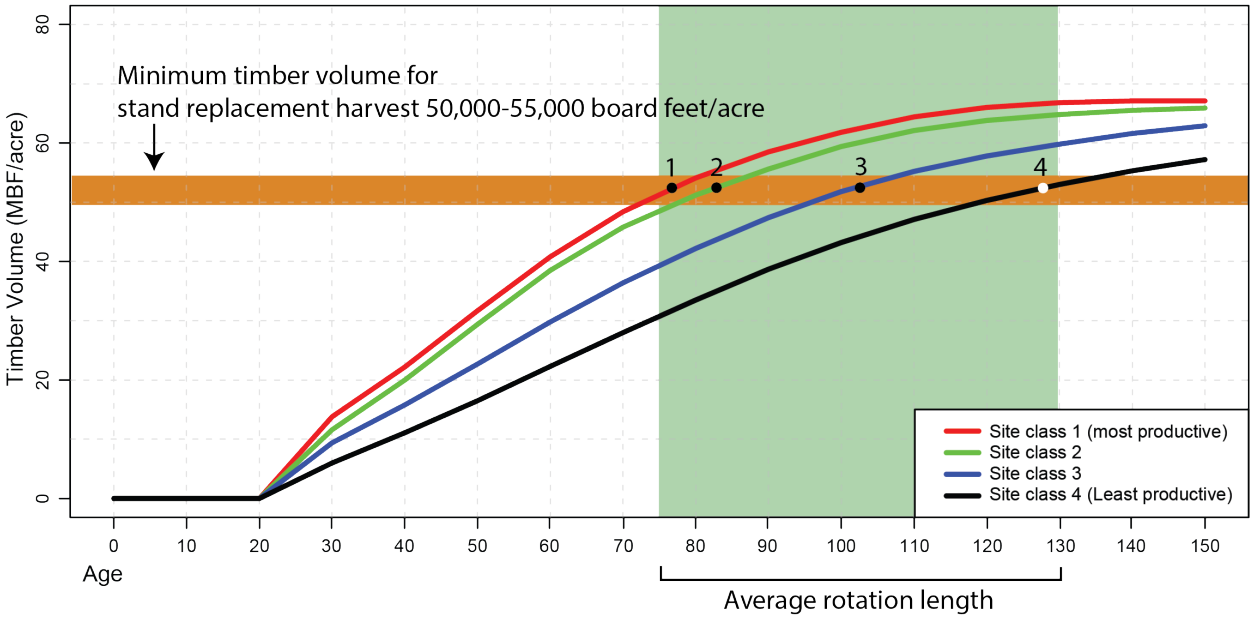
For stand replacement harvest, a forest stand must have a minimum of about 50,000-55,000 board feet per acre to be considered available. For Douglas-fir, this range translates to a harvest rotation of roughly 75 to 130 years, depending on site class. Stand replacement harvest removes an average of 90 percent of the timber volume within the boundaries of each timber sale unit, although actual removals may vary widely depending on objectives and stand conditions.

Longer harvest rotation



This minimum board feet per acre requirement is much higher than DNR's current minimum of 30,000 to 35,000 board feet per acre. Increasing the minimum board feet per acre requirement will lengthen the harvest rotation, because it will take the forest stand longer to reach this timber volume.

Sample Yield Curve for Douglas Fir in western Washington



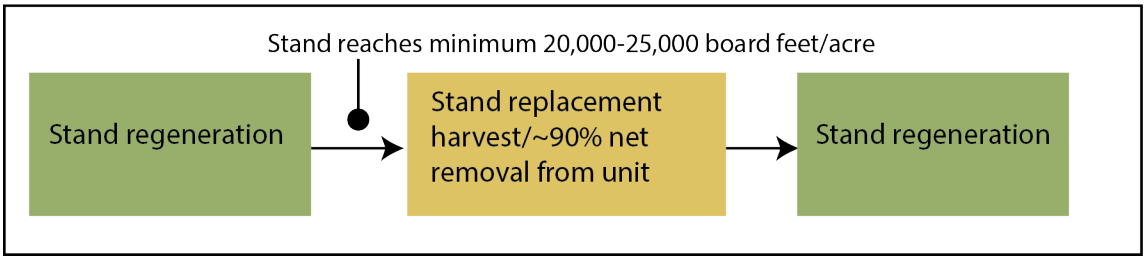
■ Scenario 3: Shorten harvest rotation

Dial turned: Harvest rotation length

This scenario is specific to stand replacement harvest in **GEM areas only**.

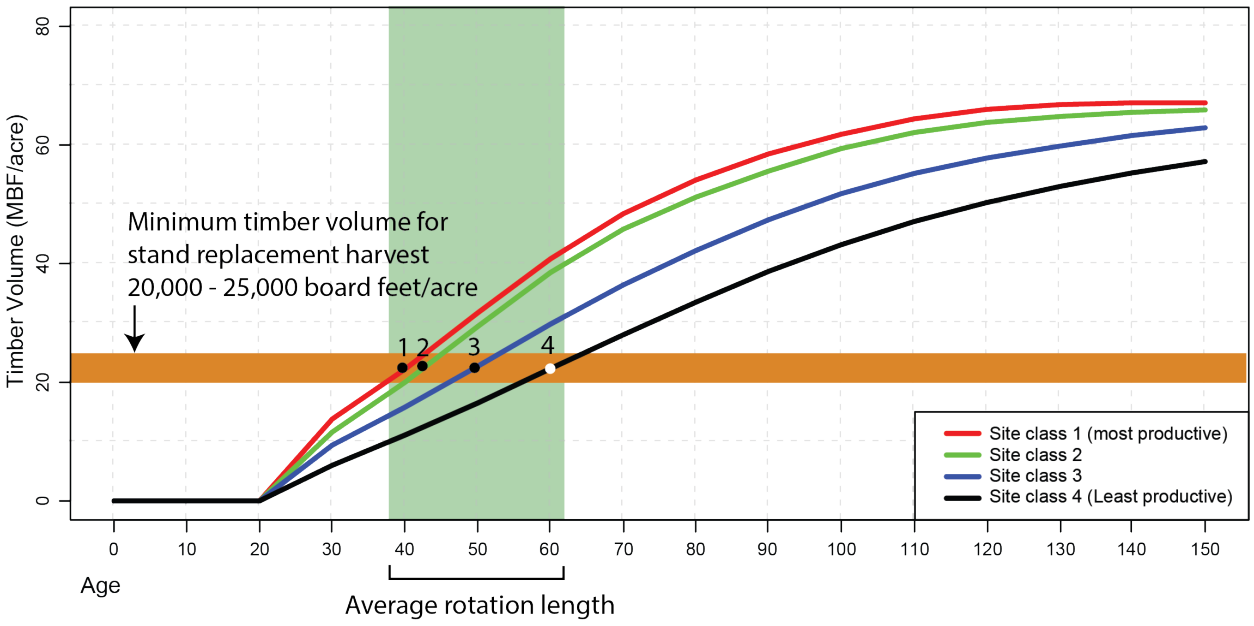
For stand replacement harvest, a forest stand must have a minimum of about 20,000-25,000 board feet per acre to be considered available. For Douglas-fir, this range translates to a harvest rotation of roughly 40-60 years, depending on site class. Stand replacement harvest removes an average of 90 percent of the timber volume within each timber sale unit, although actual removals may vary widely depending on objectives and stand conditions.

Shorter harvest rotation



This minimum board foot per acre requirement is lower than DNR's current minimum of 30,000-35,000 board feet per acre. Reducing the minimum board feet per acre will shorten the harvest rotation, because the forest stand will reach this volume sooner than it would if the board feet requirement were higher.

Sample Yield Curve for Douglas Fir in western Washington



■ Scenario 4: Significantly increase thinning

Dial turned: Thinning

This scenario increases commercial thinning in all land classes (GEM, upland, and riparian). It has been modified to include the "friendly amendment" of PCT.

In GEM areas, DNR will require one commercial thinning entry in each harvest rotation. The minimum timber volume for a thinning will be roughly 18,000-20,000 board feet per acre. Depending on objectives, the technique can be an intermediate-type thinning, in which trees are removed in a regular pattern and remaining trees have similar growing space, or a variable density thinning but without large gaps. In either case, the volume removed in a thinning is roughly 30% of timber volume within the thinning boundary.

In this scenario, DNR will also conduct commercial thinning in upland and riparian areas that allow it. These areas are managed for ecological objectives according to the conservation strategies in the *State Trust Lands Habitat Conservation Plan*, and each strategy has its own harvest rules. Upland thinnings are almost always variable density, and habitat areas are thinned from below. Thinning intensity in habitat areas is variable and depends largely on stand objectives.

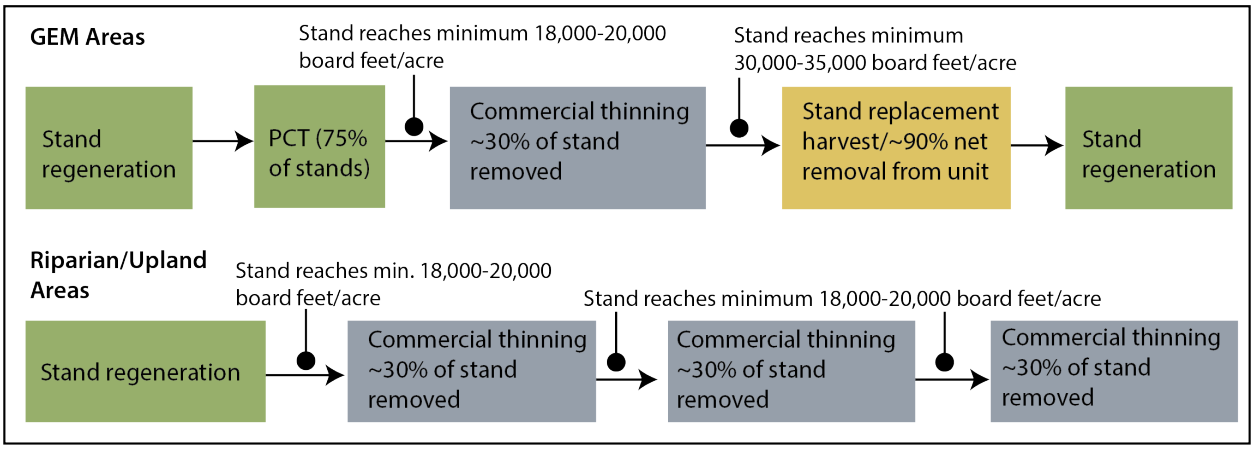
The minimum timber volume for thinning in these areas will be the same as GEM lands: roughly 18,000-20,000 board feet per acre. Some stands may be thinned a second time depending on stand objectives.

In addition, DNR will conduct PCT on 75 percent of forest stands. Stands should be roughly 8-10 years old, and the thinning will remove approximately 25 percent of the stems per acre, relative to initial planting density.

Why not 100% for PCT?

Whether to conduct a PCT is a stand-level decision. Some stands may benefit from a PCT, and others may not. DNR will capture this uncertainty in the model by applying PCT to only 75 percent of stands.

Significantly increase thinning



Appendix A: Structurally Complex Forest

For the purposes of scenario development for the Carbon and Forest Management Work Group, DNR will use the definition of structurally complex stand in its 2006 *Policy for Sustainable Forest (Appendix C)*:

> A forest in the 'botanically diverse' 'niche diversification' or 'fully functional' stage of stand development. Forests in these phases have varying sizes of trees, understory vegetation and lichen, downed wood and snags, etc.

The Policy for Sustainable Forests uses stand development terms from the booklet *Identifying Mature and Old Forests in Western Washington* by Robert Van Pelt. These terms are different than the terms DNR used in the December 2023 work group meeting, which are based on a different stand classification system. Refer to the table below for a crosswalk between these terms and the general characteristics of each stage.

Term used in December 2023 work group meeting (based on Franklin et al. 2002.)[3]	**Term used in Van Pelt guide and the *Policy for Sustainable Forests* (based on Carey and Curtis 1996.)[4]**	**Characteristics**
Maturation II	Botanically diverse	Small gaps begin to form from natural disturbances such as wind, resulting in a understory developing with different tree species growing into the lower and middle tree (mid-story) canopy. Large pieces of down woody material (fallen trees) and large snags (standing dead trees) are few or absent in the stand.
Vertical diversification	Niche diversification	The lower and mid-story tree canopies have diversified, with more tree species and a greater range in tree diameters. The amount of large down woody material and number of snags has increased.
Horizontal diversification	Fully functional	The original trees from stand initiation are dying out more rapidly, resulting in abundant snags, large pieces of down woody material, and larger gaps in the

[3] Franklin, J.F., Spies, T.A., Van Pelt, R., Carey, A.B., Thornburgh, D.A., Berg, D.R., Lindenmayer, D.B., Harmon, M.E., Keeton, W.S., Shaw, D.C. and Bible, K., 2002. Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example. *Forest ecology and management*, *155*(1-3), pp.399-423.

[4] Carey, A.B. and Curtis, R.O., 1996. Conservation of biodiversity: a useful paradigm for forest ecosystem management. *Wildlife Society Bulletin*, *24*(4), pp.610-620.
Scenarios

Term used in December 2023 work group meeting (based on Franklin et al. 2002.)[3]	Term used in Van Pelt guide and the *Policy for Sustainable Forests* (based on Carey and Curtis 1996.)[4]	Characteristics
		upper tree canopy. Shade-tolerant trees have reached the upper tree canopy.

On the following page is a table that shows the stand development stages definitions to be used in modeling (botanically diverse, niche diversification, and fully functional).

Table 1. Stand development stage defintions to be used in modeling

Stages			Stand-level Variable and Associated Threshold Value									
							Management Activity					
Summarized	Detailed		QMD	Canopy Layer	RD	Stand Age	BioThin Age	Years Since BioThin	Thin Age	Years Since Thin	Snag Ratio1	CWD
Ecosystem Initiation	Ecosystem Initiation		<2									
Competitive Exclusion	Sapling Exclusion		>=2									
	Pole Exclusion		>5									
		or							>0	>=0		
	Large Tree Exclusion		>11									
		or	>11						>0	>=0		
	Understory Development		>=2	>1								
		or	>=2		>=MaxRD							
		or	>=2			>MaxRD Age						
		or	>=2				>0	>=0				
Structually Complex	Botanically Diverse		>=2	>1								
		or	>=2	>1		>=MaxRD Age+60						
		or	>=2	>1			>0	>=0				
		or	>=2	>1	>=MaxRD							
		or	>=2		>=MaxRD	>=MaxRD Age+60						
		or	>=2		>=MaxRD		>0	>=0				
		or	>=2			>=MaxRD Age+60	>0	>=0				
		or	>=2				>0	>5				
		or	>=2	>1		>MaxRD Age						
		or	>=2			>=MaxRD Age+60						
		or	>=2			>MaxRD Age	>0	>5				
	Niche Diveris-ification		>=2	>1		>=MaxRD Age+80					>0.07	>2400
		or	>=2	>1		>=MaxRD Age+80	>0	>0				
		or	>=2	>1			>0	>5				
		or	>=2		>=MaxRD	>=MaxRD Age+80					>0.07	>2400
		or	>=2		>=MaxRD	>=MaxRD Age+80	>0	>0				
		or	>=2		>=MaxRD		>0	>5				
		or	>=2			>=MaxRD Age+80					>0.07	>2400
		or	>=2			>=MaxRD Age+80	>0	>0				
		or	>=2			>MaxRD Age	>0	>5				
		or	>=2			>=MaxRD Age+80	>0	>=0			>0.07	>2400
		or	>=2			>=MaxRD Age+80	>0	>0				
		or	>=2				>0	>5			>0.07	>2400
	Fully Functional		>=2	>1		>=MaxRD Age+160					>0.07	>2400
		or	>=2	>1		>=MaxRD Age+160	>0	>0				
		or	>=2	>1			>0	>40				
		or	>=2		>=MaxRD	>=MaxRD Age+160					>0.07	>2400
		or	>=2		>=MaxRD	>=MaxRD Age+160	>0	>0				
		or	>=2		>=MaxRD		>0	>40				
		or	>=2			>=MaxRD Age+160					>0.07	>2400
		or	>=2			>=MaxRD Age+160	>0	>0				
		or	>=2			>MaxRD Age	>0	>40				
		or	>=2			>=MaxRD Age+160	>0	>=0			>0.07	>2400
		or	>=2			>=MaxRD Age+160	>0	>0				
		or	>=2				>0	>40			>0.07	>2400