Department of Natural Resources

Economic & Revenue Forecast

Fiscal Year 2023, First Quarter
September 2022

Forecast Summary

Lumber and Log Prices. Lumber prices have been exceptionally volatile for the past two years. In 2021, prices peaked at around $1,600/mbf in May then plummeted to a low of $414/mbf in August (West Coast standard or better 2x4, Douglas-fir/Hemlock). Prices rebounded over the next several months to peak at $1,400/mbf in March 2022, but have again fallen dramatically to $640/mbf in August. Prices are expected to continue falling slowly until the beginning of 2023, however, they are still expected to remain above $400/mbf — the average price for several years prior to 2019. Though, given the price behavior in recent years, as well as increasing interest rates and a stalling housing market, it is entirely possible that prices will fall further.

The high lumber prices pulled up log prices, with the price of a "typical" DNR log rising from a low of $500/mbf in April 2020 to peak at $720/mbf in April 2021. Prices then softened to a trough of $600/mbf in October 2021, before increasing again to peak at $790/mbf in July 2022. Since then they have fallen to $720/mbf in August 2022. Although the decrease in one month's prices can't be taken as a trend, prices are expected to continue to fall through Q4 of 2022.

Timber Sales Volume. DNR currently plans to offer around 530 mmbf for sale in FY 23. Building in likely no-bids and sales falling off for various reasons, our sales volume forecast is unchanged at 500 mmbf for FY 23 and outlying years.

Currently, there is no expectation that the timber sales program will be able to recoup the sales delayed in FY22. Additionally, it is possible that future forecast volumes will be reduced due to the by the Department's Carbon Project, which will remove 10,000 acres of forest land from the planned harvest schedule and instead generate revenue through carbon offsets. However, the current 500 mmbf forecast in outlying years is typically quite conservative, so it is also possible that the new program will have no meaningful effect on the forecast.

Timber Sales Prices.

The forecast timber sales prices are increased to $360/mbf for FY 23. Given the most recent average sales prices from the August auction, this is a reasonable middle ground between the potential for higher prices if house construction remains high relative to pre-2020 and lower prices due to slower housing demand and decreased export demand. The outlying years' forecast prices are unchanged at $350/mbf.

Timber Removal Volume and Prices.

Removal volumes for FY 22 were much lower than we had anticipated in June. Typically there is a large spike in recognized removals in June, and our forecast takes that into account. Unfortunately, the expected jump in removals didn't happen in FY 22.

The removal volume forecast for FY 23 and outlying years is unchanged.

Removal prices are decreased slightly in FY 23 due to an error that inflated prices in the June forecast — without that error, the forecast price would actually have increased. Removal prices in outlying years are increased slightly due to both higher sales prices in FY 22 and lower removals in FY 22, which leaves more high value timber to be harvested in later years.

Timber Revenue. Timber revenue in FY 23 is reduced due to a lower forecast price, while outlying years' is increased due to the increases in removal prices.

Timber revenues for the 2021-23 biennium are $365 million — about 3 percent lower ($9 million) than previously forecast. Forecast revenues for the 2023-25 biennium are increased to $367 million — about 2 percent higher ($6 million).

Non-Timber Revenues. In addition to revenue from timber removals on state-managed lands, DNR generates sizable revenues from managing leases on uplands and aquatic lands.

Forecast uplands revenue for all years is decreased by between $0.5 million and $0.9 million due to higher dryland agricultural and commercial revenue being offset by lower revenue from or-

chard/vineyard agriculture, minerals and hydrocarbon, and other leases.

The aquatic lease forecast for FY 23 and outlying years is unchanged.

The geoduck forecast revenue for FY 23 is increased slightly to $18 million, and there are no changes to outlying years. This price forecast may again prove too conservative, but there a very wide range of possibilities for geoduck prices in the coming year.

In addition to the normal risks that can swing geoduck revenue wildly — including things paralytic shellfish poison closures, compliance vessel availability, and sewage contamination from flooding run-off — there are concerns about the ongoing strength of geoduck demand from China, with the renminbi-dollar exchange rate falling by more than 8 percent thus far in 2022. If the fall in renminbi, or other issues in the Chinese economy, cause a drop in geoduck demand then revenue will likely look more like the $10-$13 million in revenue in FY 20 and FY 21.

However, if Chinese demand remains as it is now, then revenue will likely be closer to $20 million.

Additionally, geoduck are still covered by tariffs initiated during the trade war between China and the U.S. from 2018. These have been suspended during the COVID-19 pandemic, but they are still on the books.

Total Revenues. The forecast revenue for the 2021-23 biennium are decreased to $521 million, and the forecast revenue for the 2023-2025 biennium are increased to $517 million.

Coronavirus pandemic[1]

The COVID-19 pandemic has significantly altered the economic landscape. It, and government and business reactions to it, has affected almost every aspect of economic life, from consumer behavior and purchasing decisions to production and supply chain operations.

Additionally, although there are no more government enforced public health measures in the U.S. or many other countries to limit its spread, the pandemic is ongoing. It is clear both that the disease can still cause widespread disruption and it will take some time for economies to work through the chaos that it has wrought.

Currently, transmission levels are rated as high for the majority of the country, despite significantly fewer tests being tracked by the Centers for Disease Control and Prevention. Future waves are less likely to appear in the case data due to the availability of at-home testing undermining centralized surveillance - epidemiologists estimate that the true number of COVID-19 infections are somewhere between 3 and 31 times the official reports.

Although it's impossible to say with certainty how the pandemic will behave in the future, with very few precautions taken to avoid the spread of the disease within the U.S. and many countries across the globe, waning immunity from current vaccines, and repeated evolution of immunity escaping variants thus far, it seems likely that COVID-19 will continue to cause waves of disease and disruption for quite some time. Additionally, each wave may cause longer term effects in some of the population through "long-COVID"[2].

Taken all together, the forecast is built with the expectation that the pandemic will continue indefinitely, with waves of infections from new variants every three to six months. However, these waves themselves are unlikely to *seriously* affect DNR revenue in the short- to mid-term. DNR revenue comes predominantly from timber, with some from agriculture and other uplands leases as well. Hous-

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[1]We are not epidemiologists or experts on public health or pandemics. This section is written with our best understanding of the pandemic and its dynamics gathered from reputable sources with the aim of translating those into likely broader economic effects and then more direct effects on DNR revenue. In addition to the significant uncertainty still surrounding the future path of the epidemic even for experts, uncertainty arises from our limited experience and understanding. Additionally, all of the assertions here are linked to references in the main paper. Most references have been omitted here for space.

[2]Although "long COVID" does not seem to be well defined yet, a good general definition is in `https://www.nature.com/articles/s41598-021-95565-8`: "Symptoms, signs, or abnormal clinical parameters persisting two or more weeks after COVID-19 onset that do not return to a healthy baseline can potentially be considered long-term effects of the disease"

ing market demand largely drives timber prices and commodity prices largely drive agricultural revenue. These will be discussed in their respective sections of the forecast, but, in short, the demand for these appear to be largely independent of the pandemic.

Assuming that this is the course that the pandemic takes, these infection waves from new variants will likely continue to disrupt supply chains, undermine productivity, constrain labor force growth, and keep upward pressure on inflation. These type of effects are much less clear than things like stay-at-home orders, so the overall ongoing impact of the pandemic will likely be more insidious and difficulty to quantify, and occur over a longer time horizon. The repercussions could include things such as:

- Reduced demand for services or fluctuations in demand for different types of goods and services as people change behavior depending on whether there is a wave in cases.

- Disruptions to shipping, both international and domestic, because of overrun ports or outbreaks in port cities, as happened in mid-August 2021 at Ningbo-Zhoushan, the world's third-largest container port[3].

- Reduced economic output across the global economy due to outbreaks among labor in other sectors, further disrupting supply chains.

- Reduced labor availability due to school and child-care closures or availability - for instance classes being canceled due to a lack of teachers.

- Impaired productivity growth and labor availability due to long COVID.

Having written all that, the COVID-19 pandemic is still a wild card and significantly increases the potential risks and volatility of DNR revenue. This does not affect the point forecasts provided, but it does increase the range of potential and *equally likely* outcomes.

Other notes to the Forecast. In the previous fore-cast, the Russian invasion of Ukraine had spiked prices for oil, timber and grains, and looked like it may have cause significant turmoil in the global economy. It seemed like the price increases could flow through to DNR revenue. However, the oil and timber prices have fallen back to about what they were prior to the invasion and wheat prices have fallen sharply as well, though they're now still about 15 percent higher than they were in 2021.

In addition to the above, a number of sources of uncertainty may affect DNR revenue specifically, and the overall economic activity more broadly. These include: legal challenges to the sustainable harvest volume and marbled murrelet conservation strategy; uncertainty about the type and quality of stumpage DNR is able to bring to market more than six months out; and the ongoing (but apparently dormant) trade war and political tension with China directly affecting timber, agricultural products and geoduck exports and price.

Additionally, although the timber sales volume estimates are based on the best available internal planning data, they are subject to adjustments due to operational and policy decisions.

From the beginning of 2018 until just before the COVID-19 pandemic, the U.S. and China engaged in an escalating trade dispute. Prior to the pandemic, the tariffs on geoduck were 25 percent and were a significant driver of the drop in geoduck prices in late 2019. The log tariffs and a slow-down in housing starts were the major contributors to the lower domestic price of logs through late 2019. With the pandemic, tariffs were reduced to 5 percent tariff on geoduck, wheat, and softwood logs. There is no indication that tariffs between the countries will be reduced further or removed soon.

Finally, climate change has emerged as a meaningful immediate risk as opposed to an amorphous risk in the far future, as previously rare extreme weather events become more common. In 2021, drought in Washington decreased wheat production on DNR lands by about 40 percent. In September and October 2021, extraordinary rainfall in British Columbia

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[3]https://www.ft.com/content/e1263950-1173-4832-a011-ada04df1e93c

destroyed roads and railways, essentially halting timber harvests, lumber production, and timber exports through the Port of Vancouver. More recently, in mid-June 2022, there was concurrently: massive flooding wreaking havoc in Montana and Wyoming, thunderstorms that took out power grids throughout the Great Lakes, and a record setting heat wave killed at least 2,000 cattle in Kansas[4].

Climate change affects Washington state's fire seasons – drought and rising temperatures dry out fuels fast, leaving conditions ripe for wildfires to begin earlier in the year, burn longer, and spread more unpredictably than in the past. Although these do not appear to have seriously affected revenue from DNR timberlands since 2015, they pose a significant risk to both our short-term timber revenue forecast, potentially destroying standing timber under contract, as well as long-term revenue by destroying younger stands that would be harvested in future decades. Research suggests that the massive fires in Oregon around Labor Day 2020 caused not only immediate damage, but will reduce future Oregon harvests by *115 to 365 mmbf per year for the next 40 years.* That, with the more immediate damage of the fires, suggests an overall economic impact of $5.9 billion[5].

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[4] `https://www.washingtonpost.com/climate-environment/2022/06/16/summer-climate-disasters/`

[5] 2020 Labor Day Fires: Economic Impacts to Oregon's Forest Sector, Oregon Forest Resources Institute ''`https://oregonforests.org/sites/default/files/2021-09/OFRI-LaborDayFiresEconomicReport_Final 2021.pdf`''

Table 1: September 2022 Forecast by Source (millions of dollars)

Timber Sales		FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27
Volume (mmbf)		534	542	429	500	500	500	500	500
	Change			(1)	-	-	-	-	-
	% Change			0%	0%	0%	0%	0%	0%
Price ($/mbf)		291	395	419	360	350	350	350	350
	Change			$ 9	$ 10	$ -	$ -	$ -	$ -
	% Change			2%	3%	0%	0%	0%	0%
Value of Timber Sales		**155.3**	**214.2**	**179.7**	**180.0**	**175.0**	**175.0**	**175.0**	**175.0**
	Change			$ 3.4	$ 5.0	$ -	$ -	$ -	$ -
	% Change			2%	3%	0%	0%	0%	0%
Timber Removals									
Volume (mmbf)		561	528	484	510	510	510	500	500
	Change			(15)	0	0	0	-	-
	% Change			-3%	0%	0%	0%	0%	0%
Price ($/mbf)		332	341	365	370	367	355	350	350
	Change			(3.8)	(3.8)	8.6	3.7	-	-
	% Change			-1%	-1%	2%	1%	0%	0%
Timber Revenue		**186.2**	**180.2**	**176.6**	**188.7**	**186.9**	**181.0**	**175.0**	**175.0**
	Change			(7.5)	(1.9)	4.5	2.0	-	-
	% Change			-4%	-1%	2%	1%	0%	0%
Upland Leases									
Irrigated Agriculture		9.0	8.8	8.9	9.0	9.0	9.0	9.0	9.0
	Change			(0.1)	-	-	-	-	-
	% Change			-1%	0%	0%	0%	0%	0%
Orchard/Vineyard		8.8	9.4	8.2	8.4	8.4	8.4	8.4	8.4
	Change			(0.4)	(0.6)	(0.6)	(0.6)	(0.6)	(0.6)
	% Change			-4%	-7%	-7%	-7%	-7%	-7%
Dryland Ag/Grazing		6.2	6.8	6.0	6.4	6.4	6.1	6.1	6.1
	Change			0.3	0.4	0.4	0.1	0.1	0.1
	% Change			6%	7%	7%	2%	2%	2%
Commercial		10.3	11.3	11.2	11.2	11.2	11.2	11.2	11.2
	Change			0.4	0.4	0.4	0.4	0.4	0.4
	% Change			4%	4%	4%	4%	4%	4%
Other Leases		10.0	13.7	11.9	10.8	11.2	11.5	11.5	11.5
	Change			0.5	(1.0)	(0.7)	(0.5)	(0.6)	(0.8)
	% Change			5%	-8%	-6%	-4%	-5%	-6%
Total Upland Leases		**44.3**	**50.0**	**46.3**	**45.8**	**46.2**	**46.2**	**46.2**	**46.2**
	Change			0.8	(0.8)	(0.5)	(0.6)	(0.7)	(0.9)
	% Change			2%	-2%	-1%	-1%	-1%	-2%
Aquatic Lands									
Aquatic Leases		12.7	9.7	14.5	12.3	12.3	12.3	12.3	12.3
	Change			2.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	% Change			16%	0%	0%	0%	0%	0%
Geoduck		10.6	13.0	19.3	17.9	16.5	16.2	16.2	16.2
	Change			1.3	0.2	-	-	-	-
	% Change			7%	1%	0%	0%	0%	0%
Aquatic Lands Revenue		**23.4**	**22.6**	**33.8**	**30.2**	**28.8**	**28.5**	**28.5**	**28.5**
	Change			3.3	0.1	(0.1)	(0.0)	(0.0)	(0.0)
	% Change			11%	0%	0%	0%	0%	0%
Total All Sources		**253.8**	**252.9**	**256.7**	**264.7**	**262.0**	**255.7**	**249.7**	**249.7**
	Change			(3.4)	(2.5)	3.9	1.3	(0.7)	(1.0)
	% Change			-1%	-1%	2%	1%	0%	0%

Table 2: September 2022 Forecast by Fund (millions of dollars)

Key DNR Operating Funds		FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27
041	RMCA - Uplands	33.5	33.5	38.1	42.5	41.8	40.8	39.8	39.8
	Change			(1.0)	(0.1)	0.4	(0.2)	(0.5)	(0.6)
	% Change			-3%	0%	1%	-1%	-1%	-1%
041	RMCA - Aquatic Lands	9.9	10.2	14.8	13.3	12.6	12.4	12.4	12.4
	Change			1.4	0.1	(0.0)	(0.0)	(0.0)	(0.0)
	% Change			11%	1%	0%	0%	0%	0%
014	FDA	28.3	27.2	23.9	20.0	21.9	22.0	21.5	21.5
	Change			0.4	(2.1)	(0.2)	(0.2)	(0.3)	(0.3)
	% Change			2%	-9%	-1%	-1%	-1%	-1%
21Q	Forest Health Revolving	12.4	13.5	12.2	17.3	12.6	11.0	10.3	10.3
				(1.7)	3.6	2.6	2.7	2.1	2.1
				-12%	26%	26%	32%	26%	26%
Total DNR Key Operating Funds		**84.1**	**84.4**	**89.1**	**93.1**	**88.9**	**86.2**	**84.1**	**84.1**
	Change			(0.9)	1.6	2.7	2.2	1.3	1.2
	% Change			-1%	2%	3%	3%	2%	1%

Current Funds									
113	Common School Construction	59.5	53.2	57.6	67.9	68.1	67.0	65.7	65.7
	Change			(1.5)	(0.1)	0.5	(0.5)	(0.9)	(0.9)
	% Change			-3%	0%	1%	-1%	-1%	-1%
999	Forest Board Counties	68.7	69.5	53.6	48.0	54.0	53.9	52.6	52.6
	Change			(0.4)	(4.3)	0.3	(0.5)	(0.7)	(0.7)
	% Change			-1%	-8%	0%	-1%	-1%	-1%
001	General Fund	4.7	4.4	5.5	4.1	3.5	3.5	3.4	3.4
	Change			0.7	(0.3)	(0.3)	(0.1)	(0.0)	(0.0)
	% Change			14%	-6%	-7%	-2%	-1%	-1%
348	University Bond Retirement	0.6	1.6	2.6	2.7	2.3	2.0	1.9	1.9
	Change			(0.4)	(0.3)	0.0	0.0	(0.0)	(0.0)
	% Change			-13%	-9%	1%	1%	-1%	-1%
347	WSU Bond Retirement	1.9	2.6	1.6	1.6	1.6	1.6	1.6	1.6
	Change			0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	% Change			1%	-1%	-1%	-1%	-2%	-3%
042	CEP&RI	3.6	2.2	3.7	5.4	5.0	4.7	4.6	4.6
	Change			(0.1)	1.1	0.5	0.1	(0.1)	(0.1)
	% Change			-3%	25%	11%	2%	-1%	-1%
036	Capitol Building Construction	4.4	7.7	6.0	8.9	8.4	7.9	7.5	7.5
	Change			(1.1)	(0.7)	(0.0)	(0.0)	(0.1)	(0.1)
	% Change			-16%	-8%	0%	0%	-1%	-1%
061/3/5/6	Normal (CWU, EWU, WWU, TESC) School	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Change			(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
	% Change			-7%	-8%	-8%	-9%	-9%	-9%
Other Funds		1.1	0.6	0.1	1.0	0.5	0.2	0.1	0.1
	Change			(1.4)	0.1	0.1	0.0	(0.0)	(0.0)
	% Change			-93%	6%	16%	27%	-1%	-1%
Total Current Funds		**144.7**	**141.9**	**130.8**	**139.6**	**143.5**	**141.0**	**137.6**	**137.6**
	Change			(4.2)	(4.6)	1.0	(0.9)	(1.8)	(2.0)
	% Change			-3%	-3%	1%	-1%	-1%	-1%

(Continued)

Table 3: September 2022 Forecast by Fund (millions of dollars), cont'd

Aquatic Lands Enhancement Account			FY 20	FY 21	FY 22	FY 23	FY 24	FY 25	FY 26	FY 27
02R			13.5	12.4	19.0	16.9	16.2	16.1	16.1	16.1
		Change			1.9	0.1	(0.0)	(0.0)	(0.0)	(0.0)
		% Change			11%	0%	0%	0%	0%	0%
Permanent Funds										
	601	Agricultural College Permanent	5.4	5.7	3.9	5.9	4.9	4.2	3.8	3.8
		Change			(0.4)	0.6	0.5	0.1	(0.0)	(0.0)
		% Change			-10%	10%	11%	3%	-1%	-1%
	604	Normal School Permanent	2.6	2.8	4.0	3.2	2.7	2.7	2.7	2.7
		Change			0.0	0.5	(0.0)	(0.0)	(0.0)	(0.0)
		% Change			0%	20%	-2%	-1%	-1%	-1%
	605	Common School Permanent	0.2	0.4	0.2	0.3	0.3	0.3	0.3	0.3
		Change			(0.1)	-	-	-	-	-
		% Change			-42%	0%	0%	0%	0%	0%
	606	Scientific Permanent	3.1	4.9	9.3	4.4	4.7	4.7	4.6	4.6
		Change			0.7	(0.6)	(0.2)	(0.1)	(0.1)	(0.1)
		% Change			8%	-13%	-4%	-2%	-1%	-1%
	607	University Permanent	0.1	0.3	0.5	1.2	0.7	0.6	0.5	0.5
		Change			(0.2)	0.0	(0.0)	0.0	(0.0)	(0.0)
		% Change			-33%	1%	-1%	4%	-1%	-1%
Total Permanent Funds			**11.4**	**14.2**	**17.8**	**15.1**	**13.3**	**12.5**	**12.0**	**12.0**
		Change			(0.1)	0.4	0.2	0.0	(0.1)	(0.1)
		% Change			0%	3%	2%	0%	-1%	-1%
Total All Funds			**253.8**	**252.9**	**256.8**	**264.7**	**262.0**	**255.7**	**249.7**	**249.7**
		Change			(3.3)	(2.5)	3.9	1.3	(0.7)	(0.9)
		% Change			-1%	-1%	2%	1%	0%	0%

Figure 1: Timber Forecast Charts
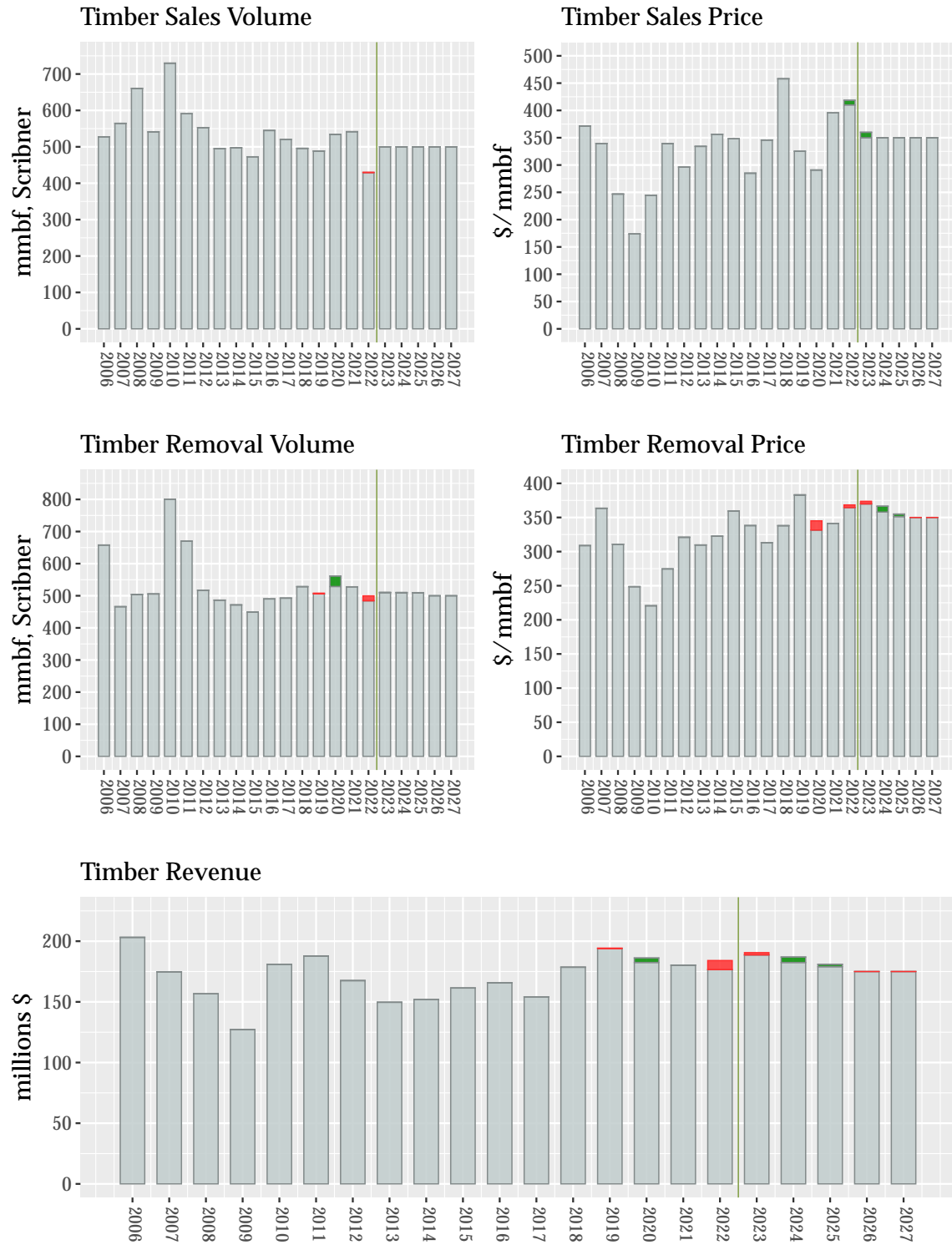
Figure 2: Other Uplands Forecast Charts

Irrigated Agriculture Revenue

Orchard & Vineyard Revenue

Dryland Ag & Grazing Revenue

Commercial Revenue

Other Upland Revenue

Total non−Timber Upland Revenue
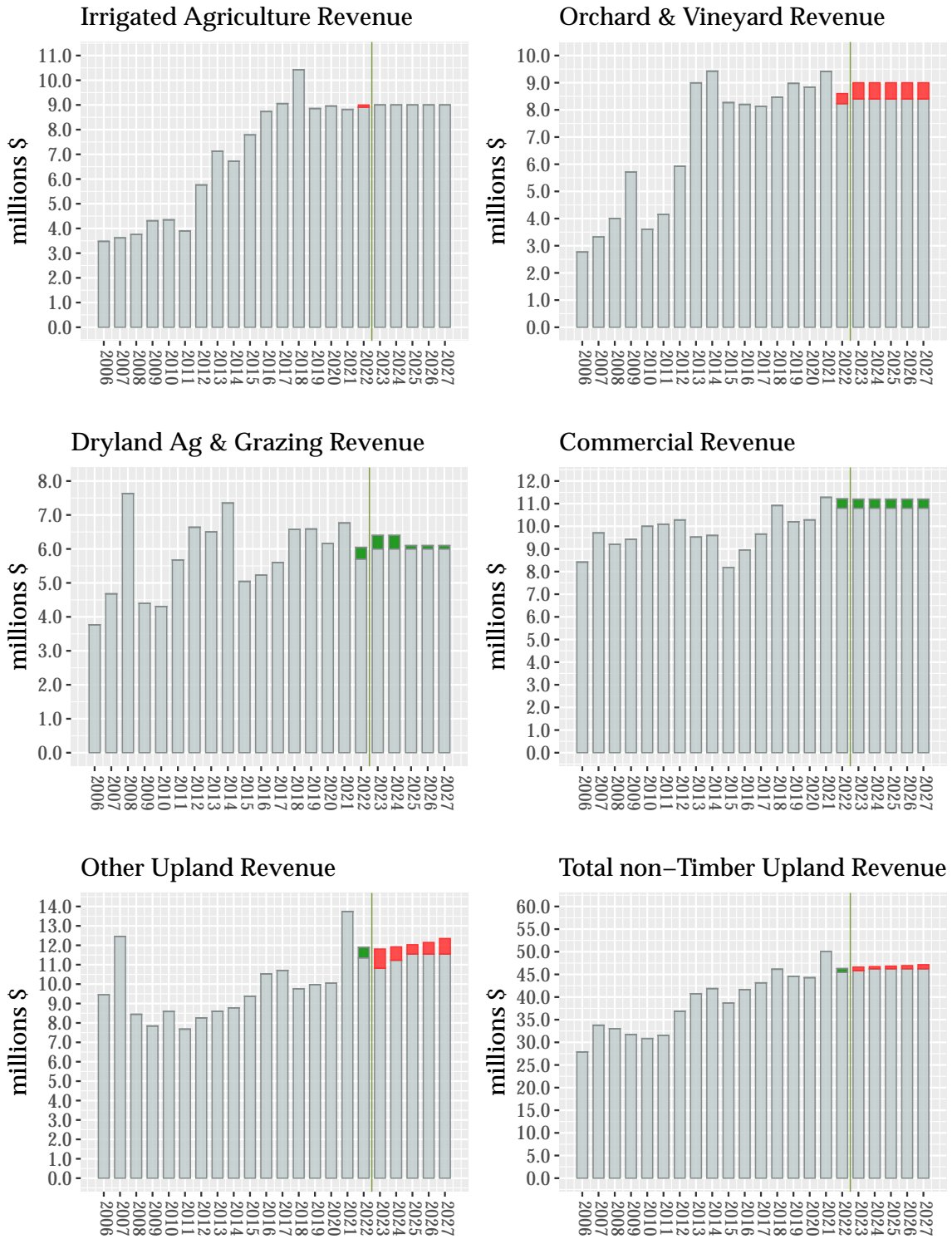
Figure 3: Aquatics and Total Forecast Charts

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Acronyms and Abbreviations

bbf   Billion board feet
BLS   U.S. Bureau of Labor Statistics
CAD   Canadian dollar
CNY   Chinese yuan (renminbi)
CPI   Consumer Price Index
CY   Calendar Year

DNR   Washington State Department of Natural Resources
ECB   European Central Bank
ERFC   Washington State Economic and Revenue Forecast Council
FDA   Forest Development Account
FEA   Forest Economic Advisors
Fed   U.S. Federal Reserve Board

FOMC   Federal Open Market Committee
FY   Fiscal Year
GDP   Gross domestic product
HMI   National Association of Home Builders/Wells Fargo Housing Market Index
IMF   International Monetary Fund
ITC   U.S. International Trade Commission

mbf   Thousand board feet
mmbf   Million board feet
PSP   Paralytic shellfish poisoning
PPI   Producer Price Index
Q1   First quarter of year (similarly, Q2, Q3, and Q4)
QE   Quantitative easing

RCW   Revised Code of Washington
RMCA   Resource Management Cost Account
SA   Seasonally adjusted
SAAR   Seasonally adjusted annual rate
SLA   Softwood Lumber Agreement

TAC   Total allowable catch
USD   U.S. dollar
WDFW   Washington Department of Fish and Wildlife
WWPA   Western Wood Products Association
WTO   World Trade Organization

Preface

This *Economic and Revenue Forecast* projects revenues from Washington state lands managed by the Washington State Department of Natural Resources (DNR). These revenues are distributed to management funds and beneficiary accounts as directed by statute.

DNR revises its Forecast quarterly to provide updated information for trust beneficiaries and state and department budgeting purposes. Each DNR Forecast builds on the previous one, emphasizing ongoing changes. Forecasts re-evaluate world and national macroeconomic conditions, and the demand and supply for forest products and other goods. Finally, each Forecast assesses the impact of these economic conditions on projected revenues from DNR-managed lands.

DNR Forecasts provide information used in the *Washington Economic and Revenue Forecast* issued by the Washington State Economic and Revenue Forecast Council. The release dates for DNR Forecasts are influenced by the state's forecast schedule as prescribed by RCW 82.33.020. The table below shows the anticipated schedule for future *Economic and Revenue Forecasts*.

This Forecast covers fiscal years 2022 through 2027. Fiscal years for Washington State government begin July 1 and end June 30. For example, the current fiscal year, Fiscal Year 2023, runs from July 1, 2022, through June 30, 2023.

The baseline date (the point that designates the transition from "actuals" to predictions) for DNR revenues in this Forecast is August 1, 2022. The forecast numbers beyond that date are predicted from the most up-to-date DNR sales and revenue data available, including DNR's timber sales results through August 2022. Macroeconomic and market outlook data and trends are the most up-to-date available as the Forecast document is being written.

Unless otherwise indicated, values are expressed in nominal terms without adjustment for inflation or seasonality. Therefore, interpreting trends in the Forecast requires attention to inflationary changes in the value of money over time, separate from changes attributable to other economic influences.

Economic Forecast Calendar

Forecast	Baseline Date	Final Data and Publication Date (approximate)
November 2022	October 1, 2022	November 15, 2022
February 2023	January 1, 2023	February 15, 2023
June 2023	May 1, 2023	June 15, 2023
September 2023	August 1, 2023	September 15, 2023

Acknowledgements

Macroeconomic Conditions

This section briefly reviews macroeconomic conditions in the United States and world economies because they influence DNR revenue — most notably through the bid prices for DNR timber and geoduck auctions and lease revenues from managed lands.

COVID-19 Pandemic

The COVID-19 pandemic has significantly altered the economic landscape[6]. It, and government and business reactions to it, has affected almost every aspect of economic life, from consumer behavior and purchasing decisions to production and supply chain operations.

Additionally, although there are no more government enforced public health measures in the U.S. or many other countries to limit its spread, the pandemic is ongoing. It is clear both that the disease can still cause widespread disruption and it will take some time for economies to work through the chaos that it has wrought.

Currently, transmission levels are rated as high for the majority of the country, despite significantly fewer tests being tracked by the Centers for Disease Control and Prevention[7]. Future waves are less likely to appear in the data due to the availability of at-home testing undermining centralized surveillance - epidemiologists estimate that the true number of COVID-19 infections are somewhere between 3 and 31 times the official reports[8]. The current transmission is largely due to the BA.5 Omicron sub-variant (in the previous forecast BA.2 was dominant, with BA.4 and BA.5 increasing), but there appear to be new variants — ones better able to evade the immune system — ready to displace it [9]. Although it's impossible to say with certainty how the pandemic will behave in the future, with very few precautions taken to avoid the spread of the disease within the U.S. and many countries across the globe, waning immunity from current vaccines[10], and repeated evolution of immunity escaping variants thus far, it seems likely that COVID-19 will continue to cause waves of disease and disruption for quite some time[11].

Assuming that this is the course that the pandemic takes, these waves would likely cause some short term economic disruption by periodically debilitating some portion of the labor force for one to three weeks at a time. This sort of labor disruption could undermine output, constraining supply and keeping upward pressure on inflation.

Additionally, each wave will likely cause longer-term effects through "long COVID"[12]. In addition to the widely known long-term damage COVID-19 can cause to the lungs, even mild cases can potentially damage the brain[13], increase risks of heart problems[14] (such as myocarditis, clots, inflamma-

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[6]We are not epidemiologists or experts on public health or pandemics. This section is written with our best understanding of the pandemic and its dynamics gathered from reputable sources with the aim of translating those into likely broader economic effects and then more direct effects on DNR revenue. In addition to the significant uncertainty still surrounding the future path of the epidemic even for experts, uncertainty arises from our limited experience and understanding.

[7]`https://covid.cdc.gov/COVID-data-tracker/#county-view?list_select_state=all_states&data-type=Risk`

[8]`https://www.medrxiv.org/content/10.1101/2022.05.25.22275603v1.full.pdf+html` and `https://www.bloomberg.com/news/newsletters/2022-06-04/coronavirus-daily-just-how-wildly-are-COVID-cases-undercounted`

[9]`https://www.nytimes.com/2022/09/22/science/omicron-covid-variant.html` and `https://covid.cdc.gov/COVID-data-tracker/#variant-proportions`

[10]`https://www.nature.com/articles/s41467-022-30884-6`

[11]`https://www.nature.com/articles/s41598-022-13137-w`

[12]Although "long COVID" does not seem to be well defined yet, a good general definition is in `https://www.nature.com/articles/s41598-021-95565-8`: "Symptoms, signs, or abnormal clinical parameters persisting two or more weeks after COVID-19 onset that do not return to a healthy baseline can potentially be considered long-term effects of the disease"

[13]`https://www.nature.com/articles/s41586-022-04569-5` and `https://www.nature.com/articles/s41467-022-30932-1`

[14]`https://publichealth.jhu.edu/2022/COVID-and-the-heart-it-spares-no-one` and `https://www.thelancet.com/journals/lanres/article/PIIS2213-2600(21)00085-0/fulltext`

[15]`https://www.nature.com/articles/s41581-021-00487-3`

tion, and arrhythmias), and damage kidneys[15], the liver and other organs[16].

Current research suggest that around 1 in 15 of those who get COVID-19 will suffer from long COVID[17].It appears that vaccination reduces long COVID risks by only 15 percent[18], so even in highly vaccinated areas, future waves will likely leave some amount of the workforce less productive at least, if not pull them from the labor force entirely.

In August, a Brookings Institute report was updated with new U.S. Census data and estimated that around 16 million Americans had long COVID and between 2 and 4 million had left the labor force because of it[19]. Additionally, recent data appear to suggest that since the start of the pandemic, there has been a large increase in those working with a disability, and those who are not working because of a disability[20].

Having written all of that, the direction of the pandemic will still be affected by society's response to it. Although the Omicron subvariants appear to be very good at avoiding immunity thus far[21], whether through vaccination or previous infection, Moderna has just released an updated version of its COVID-19 booster that appears to work against the BA.4 and BA.5 subvariants[22].

A meaningful part of COVID-19's ongoing effects will depend on how other countries react to outbreaks. China, in particular, is still following a zero-COVID policy. The effect of this is that even a few cases can shut down large parts of cities. If those cities happen to be a port cities, like Shenzhen or Ningbo-Shoushan, then even small outbreaks can disrupt international shipping, and cause more supply-chain issues, putting upward pressures on costs and inflation. Fortunately, it appears that at least some of the congestion in U.S. ports has eased, alleviating at least one part of the supply-chain problem[23].

Unfortunately, even if there are no more economic shutdowns, widespread disruptions, or long-term labor market issues from long COVID, many of the pandemic's larger economic effects are still working their way through the economy. After spending most of 2021 with low inventories and constrained supply chains, many businesses are now flush with excess inventory, after finally getting old orders filled, at the same time that demand is dropping off.

Taken all together, the forecast is built with the expectation that the pandemic will continue indefinitely, with waves of infections from new variants every three to six months[24], but is unlikely to *seriously* affect DNR revenue in the short- to mid-term. DNR revenue comes predominantly from timber, with some from agriculture and other uplands leases as well. Housing construction demand largely drives timber and commodity prices largely drive agricultural revenue. These will be discussed in their respective sections of the forecast, but, in short, they will likely be largely unaffected by the ongoing pandemic.

Even without clear effects such as stay-at-home or-

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[16]https://www.nature.com/articles/s41598-021-95565-8

[17]https://www.nature.com/articles/s41467-021-26513-3

[18]https://www.nature.com/articles/d41586-022-01453-0

[19]https://www.brookings.edu/research/is-long COVID-worsening-the-labor-shortage/

[20]https://www.bloomberg.com/opinion/articles/2022-06-15/long COVID-is-showing-up-in-the-employment-data

[21]https://www.washingtonpost.com/business/omicron-is-turning-out-to-be-a-weak-vaccine/2022/05/16/8777e9b6-d510-11ec-be17-286164974c54_story.html

[22]https://www.nbcnews.com/health/health-news/moderna-bivalent-COVID-vaccine-appears-work-omicron-subvariants-ba4-

[23]https://www.wsj.com/livecoverage/stock-market-news-inflation-consumer-price-index-may-2022/card/southern-california-port-congestion-falls-PuSRAl7kl3DzDJuzkVjF

[24]Though these waves are unlikely to appear in the data. With the availability of at-home testing undermining centralized surveillance, epidemiologists estimate that true COVID infections are somewhere between 3 and 31 times official reports - https://www.medrxiv.org/content/10.1101/2022.05.25.22275603v1.full.pdf+html and https://www.bloomberg.com/news/newsletters/2022-06-04/coronavirus-daily-just-how-wildly-are-COVID-cases-undercounted. Additionally, it appears that a new wave of subvariants are increasing currently, with BA.4 and BA.5 supplanting BA.2 https://www.msn.com/en-us/health/medical/stealth-omicron-was-just-overtaken-in-the-us-by-a-new-subvariant-that-evades-immunity/ar-AAYHJEm

ders, the ongoing pandemic, with waves of variants like Delta and Omicron, will probably still have some effects on the economy, though some will likely be more insidious and difficulty to quantify, and occur over a longer time horizon. The repercussions could include things such as:

- Reduced demand for services or fluctuations in demand for different types of goods and services as people change behavior dependent on whether there is a spike in cases.

- Disruptions to shipping, both international and domestic, because of overrun ports and outbreaks in port cities, as happened in mid-August 2021 at Ningbo-Zhoushan, the world's third-largest container port[25].

- Reduced economic output across the global economy due to outbreaks among labor in other sectors, further disrupting supply chains.

- Reduced labor availability due to school and child-care closures or availability.

- Impaired productivity growth due to long COVID.

To summarize, the assumptions underlying this forecast are:

- There will be no more stay-at-home orders or significant limitations on economic activity by governments in the U.S.

- Successive waves of COVID-19 will not cause major disruptions to DNR revenue streams, which are relatively insulated from the direct effects of COVID-19.

- Even if new COVID-19 infections drop substantially, it will not create a meaningful boost in economic activity that will affect DNR revenues.

Having written all that, the COVID-19 pandemic is still a wild card and significantly increases the potential risks and volatility of DNR revenue. This does not affect the point forecasts provided, but

it does increase the range of potential and *equally likely* outcomes.

In addition to the real health and economic problems caused by the pandemic, the upheaval of the economic systems and the ongoing pandemic impacts have dramatically increased the difficulty of economic modeling. Broadly, economic models rely on historical data to try to forecast or understand how the future will look. Initially, the suddenness and severity of the coronavirus impacts meant that economic models were operating well outside of their historical bounds. Additionally, models typically rely on consistent relationships between economic variables, but COVID-19 has also distorted some of those relationships for instance by changing underlying consumer behavior or by undermining parts of the economy, such as manufacturing supply chains.

This causes "out of sample" or "generalization" errors — the current data or relationships between variables are far enough outside of the normal bounds that the models become ever more inaccurate. These issues have even caused some models to be pulled offline — for instance the New York Fed's Nowcast model's publication was suspended on September 3, 2021 due to uncertainty and volatility caused by the pandemic[26].

Altogether, this means that the path of the economy is inordinately unclear, even in the short term.

U.S. Economy

Gross Domestic Product

Typically, GDP is a useful indicator of how the U.S. economy is growing overall. When GDP is growing well, then generally there will be an increase in jobs, spending, and overall economic welfare. This often includes growth in housing spending and construction, which influences timber prices and DNR's income from timber. It is a useful indicator of how other, more directly relevant indicators may move in the future.

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[25]https://www.ft.com/content/e1263950-1173-4832-a011-ada04df1e93c
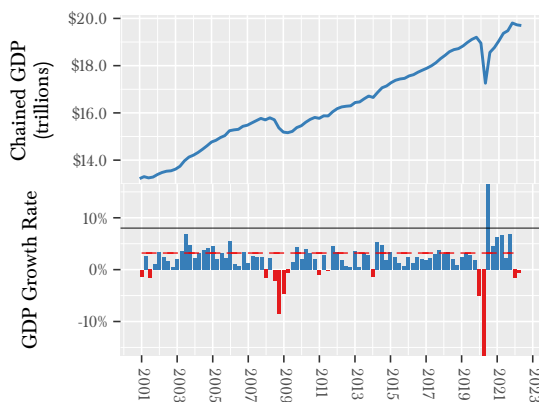[26]https://www.newyorkfed.org/research/policy/nowcast

The onset of the COVID-19 pandemic caused the sharpest quarterly GDP decline in history: first -0.86 percent in Q1 and then a staggering -9.62 percent in Q2 (-31.4 percent SAAR). However, it rebounded with growth of 33.4 (SAAR) percent in Q3 and 4.0 percent (SAAR) in Q4. This meant that the average annualized GDP was -3.5 percent for 2020, and left chained GDP at roughly what it was in Q3 2018 (Figure 4).

Generally, GDP growth rebounds after a recession, spiking to well above the historical average. This did not happen with the Great Recession in 2008-09, but with the fiscal stimulus packages and monetary stimulus, the U.S. economy grew very well in 2021, with annual growth of 5.5 percent.

That was extremely unlikely to last. First-quarter 2022 GDP shrank by 1.6 percent and second-quarter it shrank by 0.6 percent (SAAR). Additionally, inflation has been much higher and the Federal Reserve has started raising interest rates. The rate rises will likely reduce GDP growth substantially, if not force the economy into a recession.

Figure 4: U.S. Gross Domestic Product

The Atlanta Fed's GDPNow high-frequency forecast predicts Q1 2022 GDP at 0 percent. As noted in the summary section, the New York Fed's Nowcast,

the other major high-frequency forecast we typically look at, suspended publication on September 3, 2021, because of uncertainty and volatility caused by the pandemic.

The September FOMC meeting materials shows forecasts between 0.1-0.3 percent percent real GDP growth in 2022. This is a well below the June forecast of 1.5-1.9 percent, and a steep drop from the 3.6-4.5 percent growth expectations in the December materials. Expectations for 2023 are slightly better at 0.5-1.5 percent growth, while outlying years are closer to what we saw pre-pandemic at between 1.4 and 2.0 percent from 2024.

Having said that, there is a real possibility of a recession later this year and early 2022 due to increased interest rates.

Figure 5: Unemployment Rate and Monthly Change in Jobs

Note that the y-axis of the bottom chart is limited to 15 percent because the Q2 and Q3 2020 GDP growth are such outliers that they distort the chart.
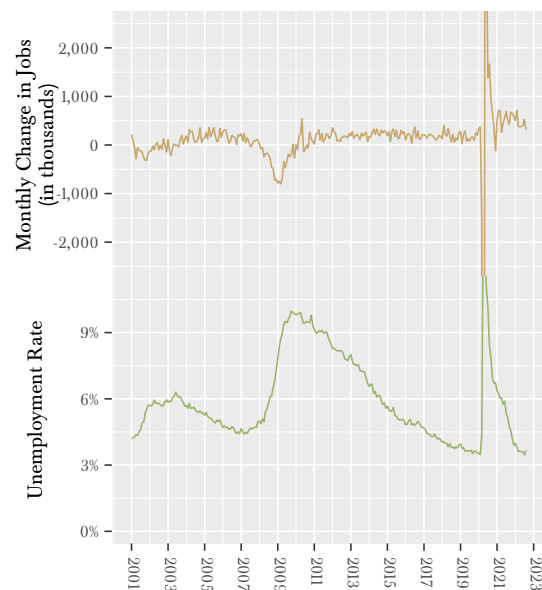
Note that the y-axes for these charts are limited because of the extreme changes in Q2 2020.

Employment and Wages

The labor market is the primary driving force behind consumption, which typically constitutes

about 70 percent of GDP and naturally extends to the demand for housing, the major driver of U.S. timber demand. The U.S. headline unemployment rate measures the number of people looking for work as a percentage of the number of people in the labor force.

Figure 6: Employment and Unemployment
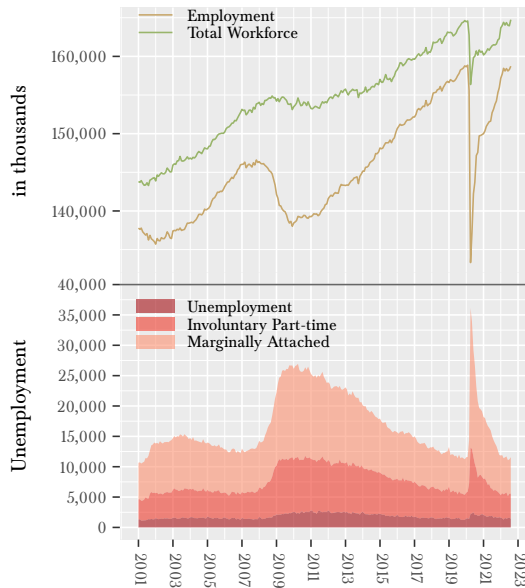
With the beginning of the pandemic, the unemployment rate shot up to 14.7 percent in April 2020, the highest it has been since the Great Depression (Figure 5). At the same time, the labor force participation rate — that is, the percentage of the working-age population that is in the labor force — decreased substantially from 63.4 percent in February to 60.2 percent in April 2020. The decrease in the labor force participation rate meant that the increase in the unemployment rate was a meaningful underestimate of the actual rate of unemployed people who would have preferred employment.

Since mid-2020, both have improved considerably, with the unemployment rate decreasing to 3.6 percent in March 2022, and staying very near that level through August, and the labor force participation rate increasing to 62.4 percent (Figure 6). Over-

all, there are around 200,000 more jobs in August 2022 than in February 2020 and about 200,000 more people in the labor force (that is, employed or looking for work).

The unemployment rate is likely to either remain stable or increase slowly from its current level. Since the FOMC has started raising rates more aggressively, the number of job openings has fallen by 1.1 million, from 11.2 million in July to 10.1 in August. Given that one of the stated purposes of the Fed raising rates is to slow down job growth, it seems fairly likely that the national unemployment rate will start to increase. The FOMC expected unemployment between 4.1-4.5 percent in 2023.

Figure 7: Labor Market Indicators
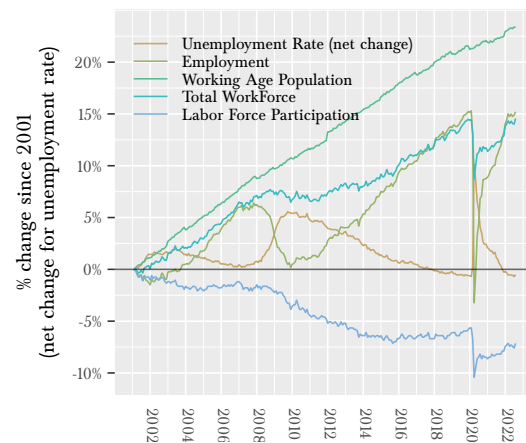
Inflation

Until recently, aside from a short period in 2012, core inflation had been below the FOMC's target since the recession in 2008. Similarly to GDP forecasts, inflation forecasts were consistently too high, with each year predicted to break the cycle of weak inflation, only to disappoint as the year progresses (Figure 8).

For policy purposes, the FOMC uses the core Personal Consumption Expenditures (PCE) index as the measure of inflation, which removes the more volatile fuel and food prices. In a fairly striking policy change, the FOMC announced in September 2020 that it would "aim to achieve inflation

moderately above 2 percent for some time so that inflation averages 2 percent over time and longer-term inflation expectations remain well anchored at 2 percent." This was a marked departure from policy in the last 10 years, when there were a number of (sometimes-contentious) interest rate increases, even though inflation was well below 2 percent.
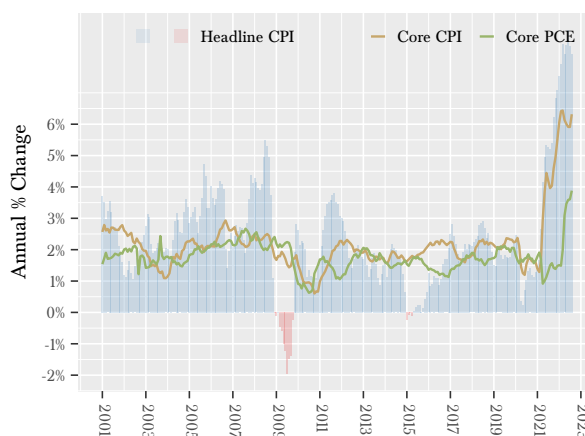
Figure 8: U.S. Inflation Indices

However, since April 2021, inflation has been higher than the FOMC's target, and remained high on the back of supply chain issues and strong demand, as well as shocks to the market like Russia's invasion of Ukraine.

In March the FOMC decided to start raising interest rates to bring inflation down. Notes from its September meeting show that the FOMC expects core inflation between 5.3 and 5.7 percent in 2022, a substantial increase from their December expectations of 2.5 to 3.0 percent.

In the previous forecast, we were expecting inflation to continue to remain relatively high but dropping off through the year. However, we now expect inflation to drop off substantially in the coming months. There are a number of reasons for this. The main reason is that the FOMC are raising rates much more quickly than expected and are signaling in statements to the press that they see not reason to slow down yet. Additionally, a number of indicators suggest that the economic growth is already slowing rapidly: Job openings decreased by around 10 percent from June to August; and the prices for shipping freight have decreased on slower demand and untangling supply chains, and vehicle and gas prices have dropped dramatically. Finally, the headline PCE fell 1.4 percent in July, increasing only 3.5 percent in August (SAAR).

Interest Rates

Interest rates are a powerful tool used by the Federal Reserve Bank to influence the U.S. economy[27]. An increase in interest rates will generally slow down economic growth — business investment slows down because borrowing money becomes more expensive, so job and wage growth slow down (constraining consumption). Similarly, it becomes more expensive for consumers to borrow, impeding demand, particularly in the housing and auto markets. The opposite of all of this is also true — decreasing or lowering interest rates can help drive economic expansion through expanded investment and consumption.

From December 2008 to December 2015, the Federal Reserve held the federal funds rate in the 0.0-0.25 percent range. To keep rates that low for that long was unprecedented and reflected the immense damage done by the Great Recession. During that time, the Fed pledged to keep the rates near 0 until it judged that there had been sufficient progress toward its dual mandate of maximum employment and around 2.0 percent inflation.

Beginning in December 2015, the FOMC gradually raised interest rates from 0.0-0.25 percent range to 2.25-2.5 percent range by the end of 2018. It is notable that these increases were made based on

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[27]We refer to interest rates broadly, but the Fed specifically governs the Federal funds rate, which heavily influences interest rates across the economy.

progress in the recovery of employment and inflation, and a strong economic growth outlook, rather than employment or inflation that had reached any threshold. Given this history, it was a significant change that the FOMC backed away from this policy in late 2020 after dropping rates back to 0.0-0.25 earlier in the year, and promising to keep rates very low until the *average* inflation averages around 2 percent.

The Fed began increasing interest rates in March 2022 due to continued high inflation. They increased rates by 0.25 percent in each month from March through May, and then increased rates more dramatically by 0.75 percent in June and again in September. At the June meeting, the FOMC expected the rate would be between 3.1 and 3.6 percent at the end of 2022. At the September meeting was increased substantially to between 4.1 and 4.4 percent. These are an enormous change from the expectations in December when it was expecting the Federal funds rate to remain at between 0.6 and 0.9 percent.

As mentioned above, these increases are likely already slowing down the economy and have made it likely that the economy will fall into a recession in late 2022 or early 2023.

The U.S. Dollar and Foreign Trade

Between February and April 2020, the U.S. dollar trade-weighted index jumped almost 6 percent, largely due to a "flight to safety" from the uncertainty caused by the pandemic (Figure 9). From April 2020 to mid-2021, the index fell, but it has been quickly climbing again since mid-2021. Currently it is about as high as it was at its peak in 2020.

A higher dollar means that timber and lumber from the Pacific Northwest become more expensive for international buyers and, conversely, timber and lumber imported into the U.S. becomes less expensive. This will tend to undermine local prices and DNR's timber and agricultural revenues. Wildstock geoduck revenue will also be negatively affected because geoduck is primarily marketed abroad.

Figure 9: Trade-Weighted U.S. Dollar Index
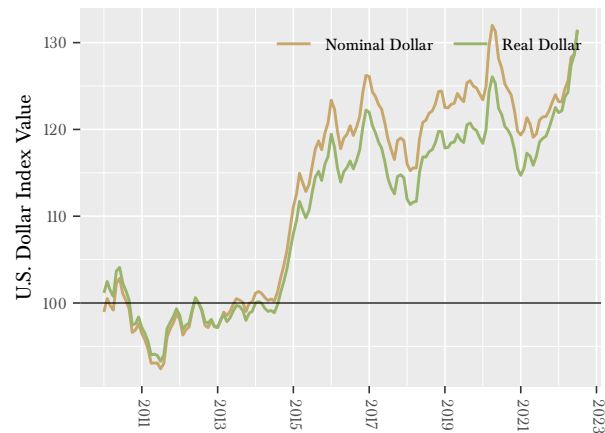
Foreign trade and access to export markets is normally important for DNR revenues. Chinese demand for timber and lumber was a major support for lumber prices after 2010, even though DNR timber cannot be exported directly. Additionally, much of the soft white wheat produced in Washington is exported to Asia and the vast majority of the Pacific Northwest geoduck harvest is exported to China.

Until recently, the dollar's strength hasn't been particularly concerning. Strong domestic demand supported prices for timber products, such that any price effect on stumpage would likely be small. Agricultural product prices also remained high, and geoduck auctions continued to have very strong prices — even as economic trouble in China has become more apparent.

However, the dollar continues to get stronger, likely from increased interest rates compared to other countries, while domestic demand is likely to drop off due to high interest rates suppressing house price growth and housing demand. This means that if domestic demand falters, then there's not likely to be much in the way of international demand to support prices. This is a meaningful risk to our price forecast.

Petroleum

Crude oil and its derivatives strongly affect production, transportation, and consumption in the world and U.S. domestic economies. Broadly, an increase in oil prices acts like a tax increase for consumers and can discourage consumption. Additionally, all other things being equal, higher petroleum prices will increase diesel fuel prices and will make transportation-sensitive industries — such as Pacific Northwest logging and agriculture — less competitive in international markets.

The Russian invasion of Ukraine initially pushed oil prices much higher, with nominal prices jumping from $86 in January to $122/barrel in June — the highest they had been since 2014 (Figure 10). These prices were high enough to create a drag on economic growth. However, they were fairly short lived. Since peaking in June, prices have dropped to $90/barrel in September.

Figure 10: Crude Oil Prices
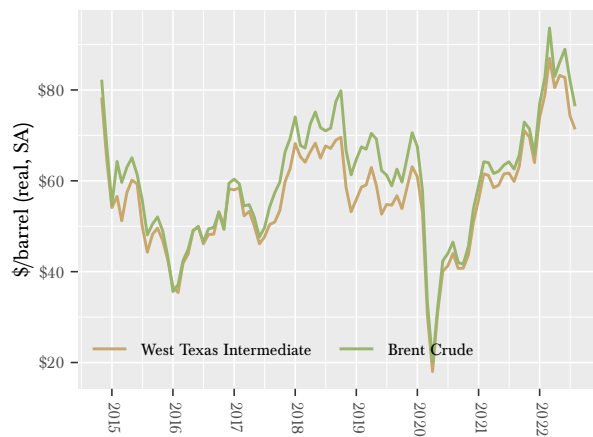
Wood Markets

Timber stumpage revenue constitutes about 70 percent of total DNR revenues on average. Therefore, DNR is vitally concerned with understanding stumpage prices, log prices, lumber prices, and the related supply-and-demand dynamics underlying all three. This section focuses on specific market factors that affect timber stumpage prices and overall timber sales revenue generated by DNR.

Figure 11: Lumber, Log, and Stumpage Prices in Washington

and the road-building requirements of a particular sale.

The relationship between lumber and log prices is less consistent. Lumber prices are significantly more volatile, and both the direction and size of price movements can differ from log prices. This is due to both demand and supply-side factors. On the demand side, mills will often have an inventory of logs in their yards, as well as an inventory of "standing logs," so they do not always need to bid up log or stumpage prices to take advantage of high lumber prices. From the supply side, landowners often do not need to sell their timber, so when prices fall too far, they can withhold supply and allow their trees to grow and increase in quality.

Figure 12: Lumber, Log, and DNR Stumpage Price Seasonality

In general, timber stumpage prices reflect demand for lumber and other wood products, timber supply, and regional lumber mill capacity. There is a consistent, positive relationship between log prices and DNR's stumpage prices, despite notable volatility in stumpage prices (Figure 11). High log prices make access to logs more valuable, increasing purchasers' willingness to pay for stumpage (the right to harvest). Volatility in stumpage prices arise not only from log prices, but also from the volume of lumber and logs held in mills' inventories and from DNR-specific issues, such as the quality and type of the stumpage mix offered at auction, the region,

There are differences in price seasonality between lumber, logs, and stumpage, as illustrated in Figure 12. These prices are affected by a degree of seasonality that is largely the result of when each of these commodities will be used. For instance, lumber prices tend to be higher starting in February, when housing construction starts to pick up, and decline through fall as demand wanes, while stumpage prices tend to be highest in December-March, when harvesters are lining up harvestable stock for the summer. DNR stumpage price volatility is also affected by the firefighting season and the

quality of the stumpage mix, which varies throughout the year but tends to be lower from July through September.
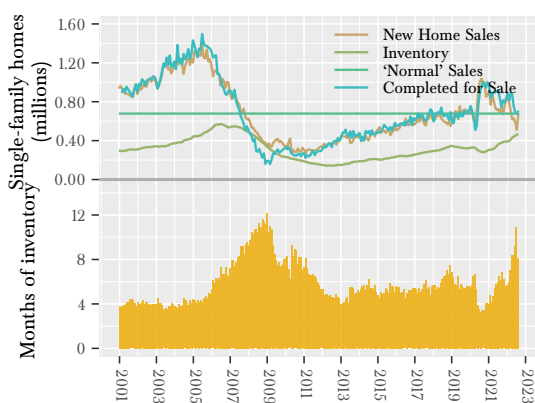
U.S. Housing Market

This section continues with a discussion of the U.S. housing market because it is particularly important to overall timber domestic demand.

New residential construction (housing starts) and residential improvements are major components of the total demand for timber in the U.S. From 2000-18, these sectors have averaged 69 percent of softwood consumption — 37 percent going to housing starts and 32 percent to improvements — with the remainder going to industrial production and other applications.

The 2007 crash in the housing market and the following recession drastically reduced demand for new housing, which undermined the total demand for lumber. Since the 2009-11 trough through to the beginning of the COVID-19 pandemic in early 2020, an increase in housing starts drove an increase in lumber demand.

Figure 13: New Single-Family Home Sales

As with almost every other part of the economy, the coronavirus pandemic created a lot of uncertainty in the housing market. Since the initial collapse in activity in early 2020, both starts and new home sales have risen significantly — largely driven by strong household balance sheets and record-low mortgage rates. However, these increases appear to be reversing due to mortgage rates that have more than doubled.

New Home Sales

Unsurprisingly, new home sales plummeted during the 2008-09 recession, reaching a record low of 306,000 (SAAR) in 2011 before beginning a slow rise to average 680,000 (SAAR) in 2019 (Figure 13).

From January through April 2020, new single-family home sales fell back to 570,000 (SAAR) as the initial effects of the pandemic took hold. However, April was the bottom. From then, new home sales quickly grew well beyond their January 2020 highs to a peak of 1,036,000 (SAAR) in August 2020, averaging 960,000 in the latter half of the year. New home sales slowed a little in 2021, averaging 769,000 (SAAR) per month, and have dropped even further in 2022, averaging 611,000 (SAAR) per month in the 5 months since the Fed started increasing interest rates in March.

In the previous forecast, we modified our expectations to see weakening home sales, if not a meaningful fall. With the Fed raising rates faster than previously expected, a meaningful fall appears to have already started. The increased Fed rates have more-than doubled mortgage interest rates, which in turn have substantially increased mortgage payments.

Households still have strong balance sheets and wages are increasing, though not quite keeping up with inflation, which will mitigate some of the effect of increased interest rates. Additionally, the housing stock in the U.S. is quite old. New housing was underbuilt from 2008 and there is record-low inventories of existing housing on the market while there is still demand.

Overall, it is likely that sales will remain higher than the period between 2008 and 2013, but it would no longer be surprising to see them come down to below the long-term average.

Housing Starts

In April 2009, U.S. housing starts fell to the lowest point since the Census Bureau began tracking these data in 1959. U.S. housing starts picked up in 2011 and continued to rise, largely because of increases in multi-family starts. Single-family starts were more or less flat after the recession through 2012, but rose slowly through most of 2019 (Figure 14).

Single family starts hit 1.6 million in January and February 2020 before dropping sharply in April to 0.9 million. Again, as with sales, April 2020 was the nadir, and starts climbed back quickly to more than 1.5 million in October through January. Single family starts averaged 1.1 million in 2021, and increased slightly to an average of 1.2 million through April 2022. But, as with sales, starts have fallen substantially since then.

Figure 14: Housing Starts
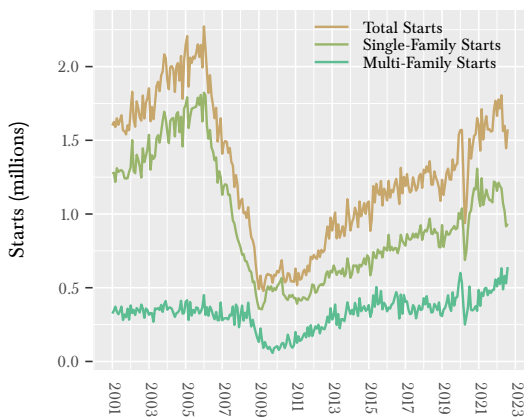
It is notable that it's really only single-family starts that have dropped in the last several months. Multi-family starts have been more stable, likely because rents are still quite high and those are typically built for the rental market. Unfortunately for DNR's revenues, multi-family construction uses less lumber than single-family houses, so the drop in single-family starts will likely have a meaningful effect on lumber demand.

Housing Prices

U.S. housing experienced six unprecedented years of falling or flat prices following the 2008 recession. House prices started rising again only in 2012 as economic and employment indicators continued to improve. Figure 15 charts the seasonally adjusted S&P/Case-Shiller Home Price Index for the 20-city composite, which estimates national existing home price trends, as well as the Index for Seattle.

Figure 15: Case-Shiller Existing Home Price Index
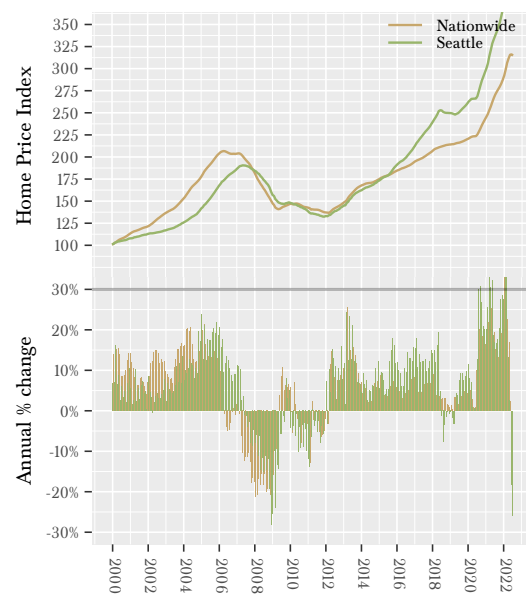
Although the pandemic initially stalled national price growth, the national Case-Shiller ended 2020 with 10 percent year-over-year price growth. Locally, for Seattle, the year-over-year price growth was 13 percent. Since then, prices have increased even faster. In March 2022, year-over-year prices nationwide were 21 percent higher, and Seattle prices were *28* percent higher.

However, price growth has begun to slow nationally, and has turned negative in Seattle. The Seattle Case-Shiller actually fell from 414.0 in May to 393.8 in July — about a 5 percent drop.

Although the Case-Shiller is a robust metric of house price changes, it's a slow moving metric be-

cause it is a moving average of the index's previous three month; therefore, the most recent index value from July reflects an average of the May, June, and July prices. This means that prices from May, when increased mortgage rates were just starting to affect the market, are likely pulling up the index.
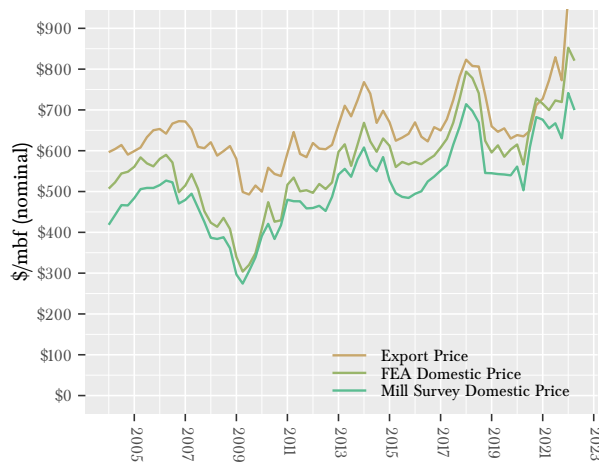
Export Markets

Although federal law prohibits export of logs from public lands west of the 108th meridian, log exports can still have a meaningful impact on DNR stumpage prices. Exports compete with domestic purchases for privately sourced logs and strong export competition pulls more of the supply from the domestic market, pushing up domestic prices. However, changes in export prices do not necessarily influence domestic prices in a one-to-one relationship.

Export prices are almost always higher than domestic prices, a difference that is referred to as the "export premium" (Figure 16). The export premium is primarily due to the characteristics of the export markets, which can include a demand for higher-quality wood, a high value placed on long-term contracts, and high transaction costs.

Note that the export prices shown in Figure 16 are weighted by DNR's typical species mix, not the species mix of actual export volumes.

Figure 16: Log Export Prices

The primary markets for logs and lumber from Washington are China and Japan. Japan primarily imports Douglas-fir and has been relatively consistent, averaging 1.8 million m^3 per year since 2009[28]. China primarily imports hemlock, but it has been much more variable in its demand.

After entering the market meaningfully in 2010, demand from China was a major support for log and lumber prices in Washington (Figure 17). That started waning in late 2014 as China's economic health wavered, the U.S. dollar appreciated while the value of the euro and ruble dropped (making U.S. timber comparatively more costly), and a 25 percent Russian tariff on log exports was reduced.

Figure 17: Log Export Volume
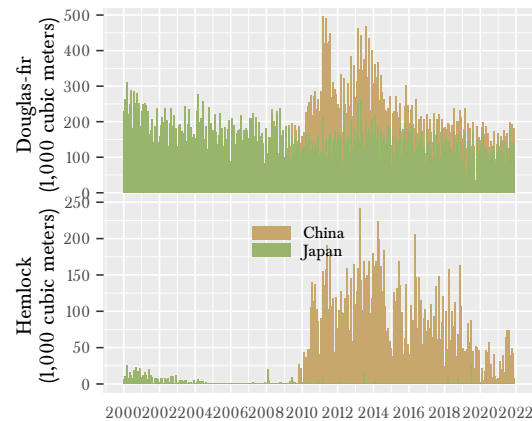
Surprisingly, exports to Japan in 2020 actually increased by about 7 percent. However, exports to China continue to fall, and were down 41 percent in 2020 compared to 2019.Through September, exports to Japan are down by 2 percent, but exports to China have rebounded and are up around 60 percent — though this is still well below the levels of the mid-2010s.

As a result of the Russian invasion of Ukraine, sanctions were placed on Russia that limit its international trade. Russia supplies around 12 percent of the world's export logs. Although much of this is

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[28]Trade data is from the U.S. International Trade Commission Dataweb at `https://dataweb.usitc.gov/`

sold to China, the reduction of timber on the world market appears to have pushed up export prices (Figure 16).

Price Outlook

Lumber Prices

Lumber prices have been exceptionally volatile the past two years (Figure 11). In 2021, prices peaked at around $1,600/mbf in May then plummeted to $414/mbf in August (West Coast standard or better 2x4, Douglas-fir/Hemlock). Prices rebounded over the next several months to peak at $1,400/mbf in March 2022, but have again fallen dramatically to $640/mbf in August. Prices are expected to continue falling slowly until the beginning of 2023, however, they are still expected to remain above $400/mbf — the average price for several years prior to 2019. Though, given the price behavior in recent years, as well as increasing interest rates and a stalling housing market, it is entirely possible that prices will fall further.

Log Prices

Figure 18 presents prices for Douglas-fir, hemlock, and DNR's composite log. The latter is calculated from prices for logs delivered to regional mills, weighted by the average geographic location, species, and grade composition of timber typically sold by DNR. In other words, it is the price a mill would pay for delivery of the typical log harvested from DNR-managed lands. The dark green line for the DNR composite log price on Figure 18 is the same as the light green line on Figure 11.

Log prices appear to have also bottomed in April 2020 and had recovered by August, though they have obviously not reached the same extremes as lumber prices. Timber harvesters and mills often have an inventory of standing timber to draw from, so they don't always need to bid up new logs. After reaching a somewhat-steady range of between $600/mbf and $720/mbf from September 2020 to January, jumped to the mid-high $700s, where it's mostly remained.
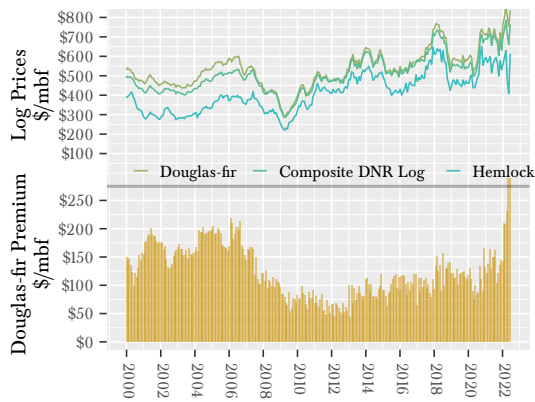
Stumpage Prices

Timber stumpage prices are the prices that successful bidders pay for the right to harvest timber from DNR-managed lands (Figure 19). At any time, the difference between the delivered log price and DNR's stumpage price is equivalent to the sum of logging costs, hauling costs, and harvest profit (Figure 11). Subtracting the average of these costs from the log price line gives us a derived DNR stumpage price.

When actual DNR stumpage prices differ significantly from the derived stumpage prices, a correction is likely to occur. Currently, stumpage prices are roughly in line with what we would expect, given log prices. Although log and lumber prices bottomed out in April 2020, DNR stumpage prices fell through May 2020, to a low average auction price of $215/mbf. However, they rebounded earlier than expected, jumping to $347/mbf in July, which typically has the lowest auction prices of a year. DNR timber auctions had very strong prices through the end of the year, so that the average stumpage for FY 21 was $396/mbf. The average price for FY 22 was $427/mbf. The average for FY 23 through August is $394/mbf.

As always, these prices also depend heavily upon the characteristics of the sales, particularly the type and quality of the wood, the type of logging, and the costs associated with road-building and maintenance. Right now, sales prices may also be more heavily influenced by the ready availability of the sales — that is, whether purchasers can begin harvesting soon or whether they have to do a lot of preparatory work.

Figure 18: DNR Composite Log Prices

DNR Stumpage Price Outlook

DNR currently contracts with a forest economics consulting firm that provides log and timber stumpage price forecasts, as well as valuable insights into the housing, lumber, and timber markets. By modeling DNR's historical data on its price forecasts, we arrive at a stumpage price outlook (Figure 19, note that the FEA "forecast" series reflects the species and class characteristics of typical DNR timber; the original series were West Coast averages, and are not shown).

It is important to note that these are nominal price expectations.

Figure 19: DNR Timber Stumpage Price
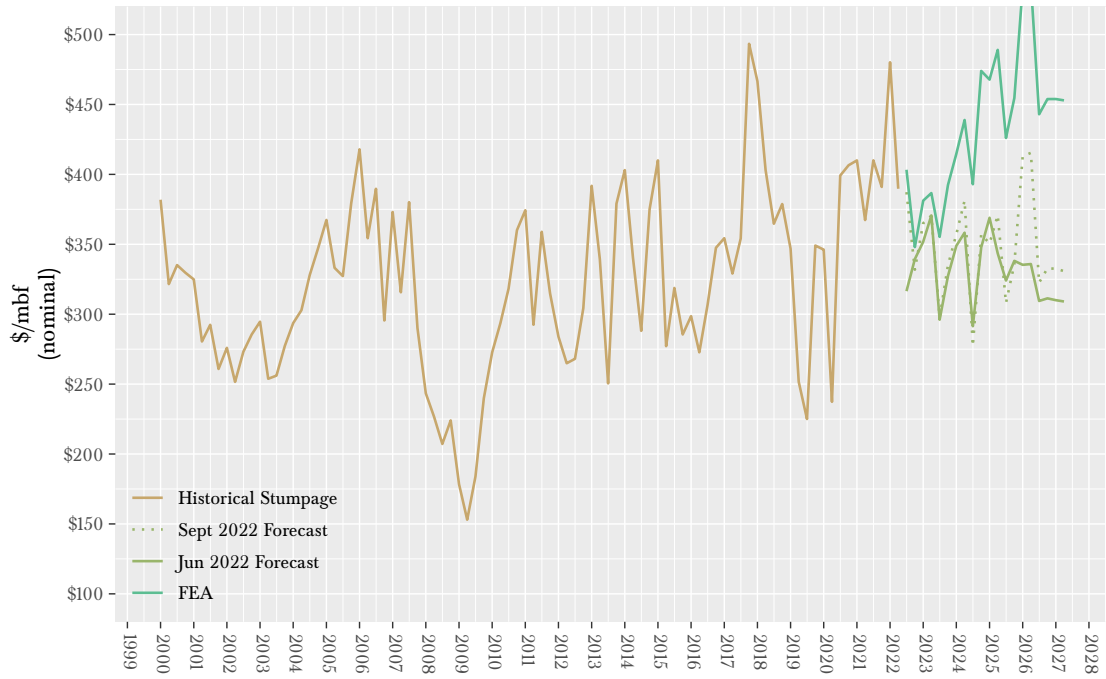
DNR Revenue Forecast

This Revenue Forecast includes revenue generated from timber sales on trust uplands, leases on trust uplands, and leases on aquatic lands. It also forecasts revenues to individual funds, including DNR management funds, beneficiary current funds, and beneficiary permanent funds. Caveats about the uncertainty of forecasting DNR-managed revenues are summarized near the end of this section.

Timber Revenue

DNR sells timber through auctioned contracts that vary in duration. For instance, contracts for DNR timber sales sold in FY 2019 needed to be harvested between three months and three years from the date of sale, with most being about two years in length. The purchaser determines the actual timing of harvest within the terms of the contract, which is likely based on perceptions of market conditions. As a result, timber revenues to beneficiaries and DNR management funds lag behind sales.

For the purposes of this chapter, timber that is sold but not yet harvested is referred to as "inventory" or "under contract." Timber volume is added to the inventory when it is sold and placed under contract, and it is removed from the inventory when the timber is harvested.
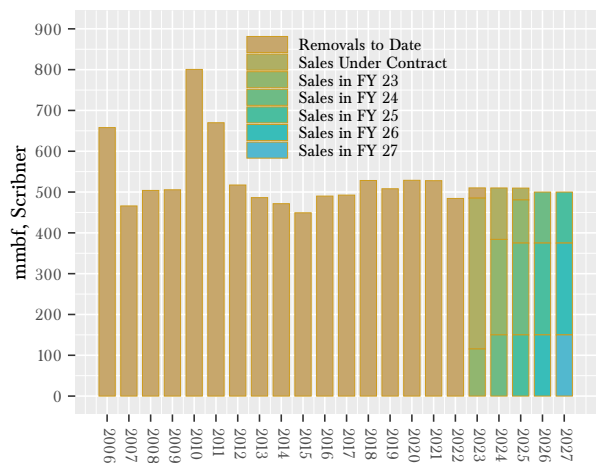
Timber Sales Volume

The sales volume for FY 22 was 430 mmbf, a significant decrease from the 530 mmbf planned in January. As noted in the previous forecast, the proposal to limit DNR timber harvests to only stands less than 120 years old stalled many planned sales and required review of many sales that had already been prepared, delaying the preparation of other sales. Additionally, severe winter weather delayed some sales planning in December and January, while staffing constraints in some regions also affected sales planning.

The sales volume forecast for FY 23 and outlying years is unchanged at 500 mmbf. Currently, there is no expectation that the timber sales program will be able to recoup the delayed sales to add these the future years. It is possible that future forecast volumes will be reduced due to the by the Department's Carbon Project, which will remove 10,000 acres of forest land from the planned harvest schedule and instead generate revenue through carbon offsets. However, the current 500 mmbf forecast in outlying years is typically quite conservative, so it is also possible that the new program will have no meaningful effect on the actual volume sold or harvested.

Figure 20: Forecast Timber Sales Volume

Figure 21: Forecast Timber Removal Volume

Timber Removal Volume

The removal volume forecast is unchanged in all years.
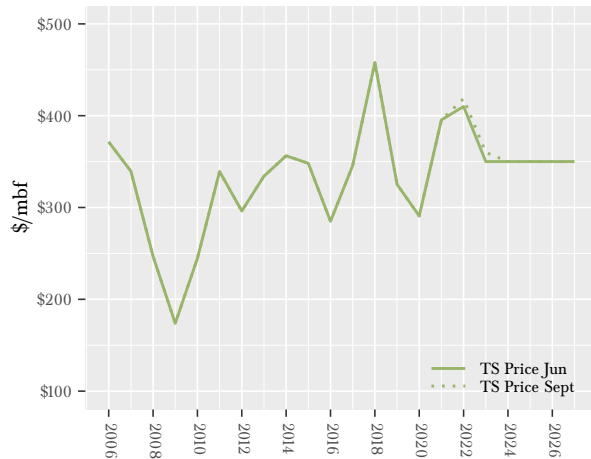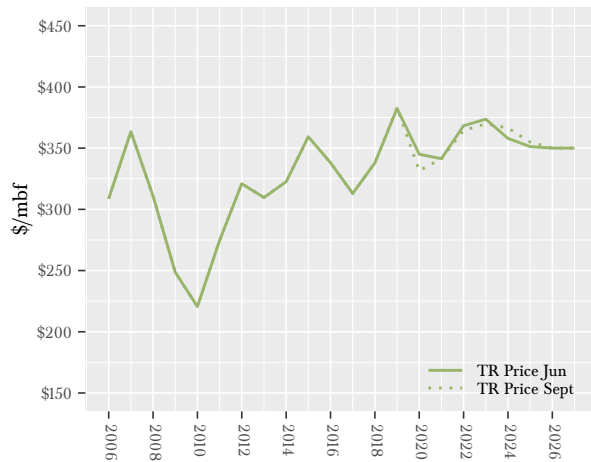
Figure 22: Forecast Timber Sales Price

Timber Sales Prices

The price results of monthly DNR timber sales are quite volatile (Figure 11). As discussed in the stumpage price outlook, the DNR sales price (stumpage) forecast is informed by West Coast log and stumpage price estimates from a forest economics consulting firm.

The forecast timber sales prices are increased to

$360/mbf for FY 23. Given the most recent average sales prices from the August auction, this is a reasonable middle ground between the potential for higher prices if house construction remains high relative to pre-2020 and lower prices due to slower housing demand and decreased export demand. The outlying years' forecast prices are unchanged at $350/mbf.

Timber Removal Prices

Timber removal prices are determined by sales prices, volumes, and harvest timing. They can be thought of as a moving average of previous timber sales prices, weighted by the volume of auctioned timber removed in each time period (Figure 23). Removal prices are decreased slightly in FY 23 due to an error that inflated prices in the June forecast — without that error, the forecast price would actually have increased. Removal prices in outlying years are increased slightly due to both higher sales prices in FY 22 and lower removals in FY 22, which leaves more high-value timber to be harvested in later years.

Figure 24: Forecast Timber Removal Value
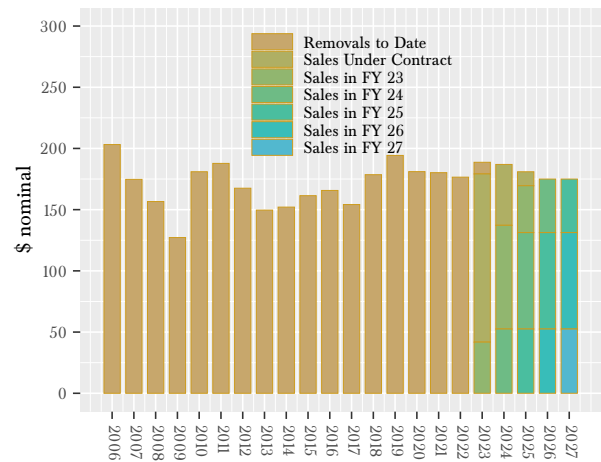
Timber Removal Revenue

Figure 24 shows projected annual timber removal revenues, broken down by the fiscal year in which the timber was sold. Revenue estimates reflect all of the changes described above.

Figure 23: Forecast Timber Removal Price

Timber revenues for the 2021-23 biennium are $365 million — around 3 percent lower ($9 million) than previously forecast. Forecast revenues for the 2023-25 biennium are increased to $367 million — around 2 percent higher ($6 million).

Figure 25: Forecast Timber Removal Revenue
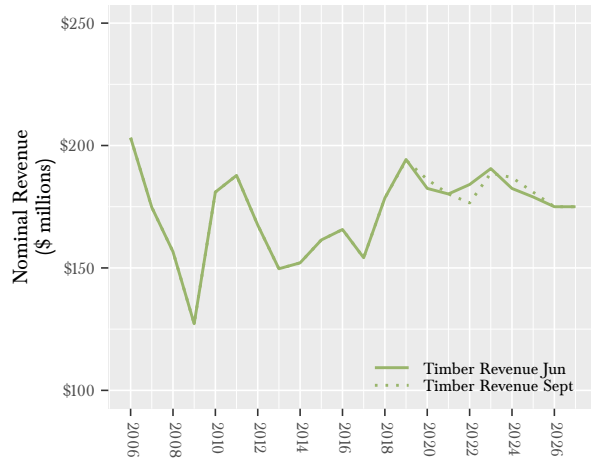
Upland Lease Revenues

Upland lease revenues are generated primarily from leases and the sale of valuable materials other than timber on state trust lands (Figure 26).

Forecast uplands revenue for FY 23 is decreased by less than $1 million to $46 million, due to lower minerals and hydrocarbon and other revenue off-

setting increased revenue from commercial, communication and dryland and grazing leases. Outlying years' revenue is reduced due to rebasing built-in annual percentage increases in communication leases to the current fiscal year.

Uplands revenues in outlying years are reduced as well, due to reduced forecasts for orchard/vineyard and other revenues.

Figure 26: Forecast Upland Lease Revenue
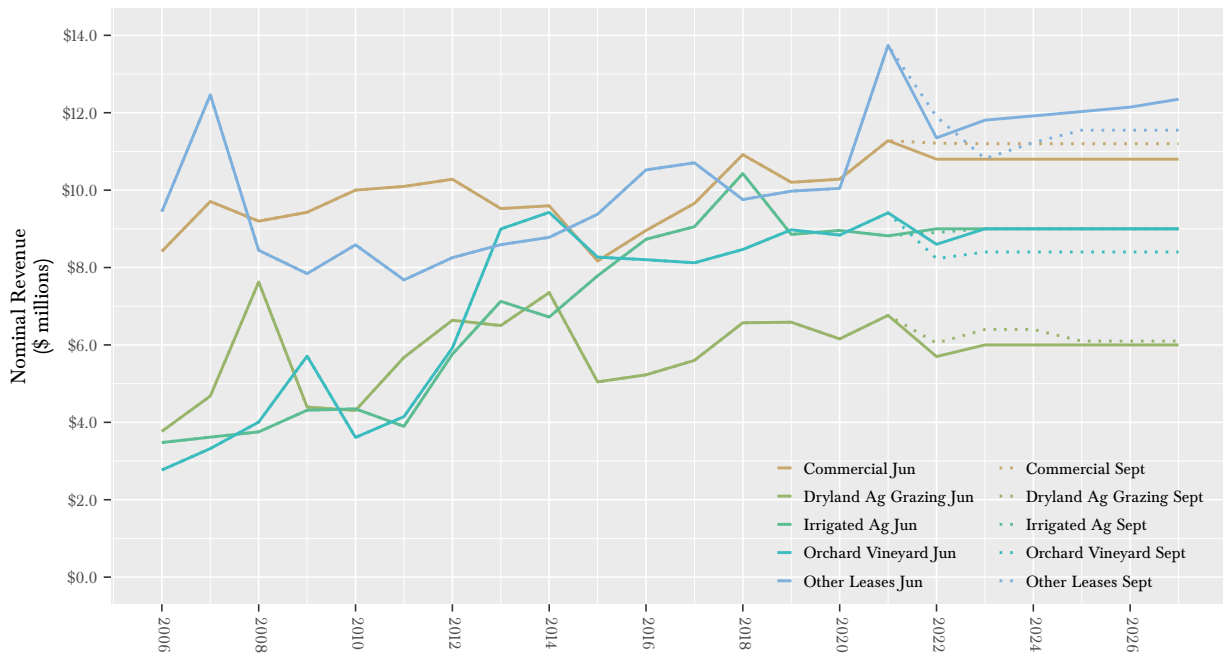
Aquatic Lands Revenues

Aquatic lands revenues are generated from leases on aquatic lands and from sales of geoduck. In the past, on average, leases have accounted for one-third of the revenue and geoduck sales accounted for the remainder. However, prices for geoduck plummeted in the beginning of FY 20, but they have recovered somewhat and are now forecast to account for around 60 percent of aquatic revenue.

The aquatic lease forecast for all years is unchanged (Figure 27).

Figure 27: Aquatic Lands Revenues
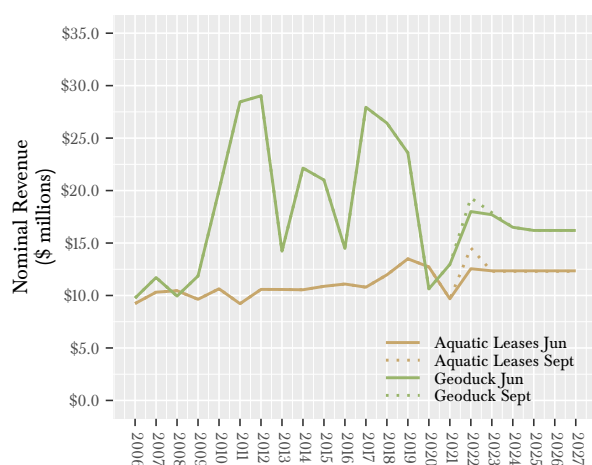
The geoduck price forecast is increased for FY 23 due to updated volume information. All other outlying years' forecasts are unchanged.

It is notable that the FY 22 geoduck revenue is much higher than the surrounding years' forecasts. This is because of the timing of some of the latter sales in FY 21, which had their revenue come in in FY 22.

There are, as always, potentially significant downside risks to geoduck revenues, even in the near term and in addition to the pandemic, that are important to consider but difficult to forecast:

- China's zero-COVID policy and political actions in Hong Kong have made some companies wary and driven some to move their

operations elsewhere, at least temporarily. Hong Kong is one of the main destinations for live geoduck, which are then sold onward to the mainland. Difficulties in Hong Kong already appear to be hampering current harvests. It is unclear if they will further affect geoduck revenue.

- Harvests (and therefore revenues) could be deferred or lost if geoduck beds are closed due to occurrence of paralytic shellfish poison.

- Harvests are slowed or delayed due to injury or death of divers.

- Early in 2021, heavy rains overwhelmed sewage treatment plants in the Puget Sound, spilling untreated sewage into the sound and closing geoduck tracts for several weeks. Although program staff were able to offer alternative harvest from different tracts, this type of risk will continue as climate change grows more severe.

- In light of recent Washington Department of Fish and Wildlife surveys of closed South Puget Sound geoduck tracts showing declining recovery rates and evidence of active poaching, future commercial harvest levels may be further reduced.
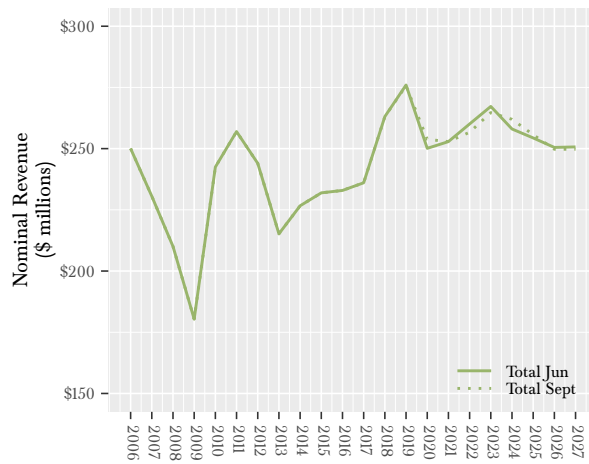
Figure 28: Geoduck Auction Prices
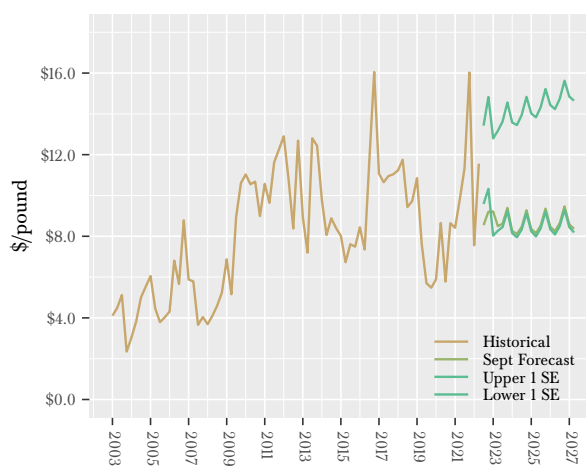
Total Revenues from All Sources

The forecast revenue for the 2021-23 biennium are decreased to $521 million, and the forecast revenue for the 2023-2025 biennium are increased to $517 million (Figure 29).

Figure 29: Total Revenues

Distribution of Revenues

The distribution of timber revenues by trust are based on:

- The volumes and values of timber in the inventory (sales sold but not yet harvested) by trust;

- The volumes of timber in planned sales for FY 23 by trust, and relative historical timber prices by DNR region by trust; and

- The volumes of timber by trust for FYs 23-25 based on output of the sustainable harvest model and relative historical timber prices by DNR region by trust.

Because a single timber sale can be worth more than $3 million, dropping, adding, or delaying even one sale can represent a significant shift in revenues to a specific trust fund.

Distributions of upland and aquatic lease revenues by trust are assumed to be proportional to historic distributions unless otherwise specified.

Management Fee Deduction.

The Forecast assumes that the Legislature and Board of Natural Resources will continue to approve the Resource Management Cost Account management deduction at 31 percent and the Forest Development Account management deduction at 25 percent.