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Solid Waste Forecast FY19-20

Property and Environmental Services

Solid Waste Information and Analysis

November 2018

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CONTENTS

FIGURES

APPENDICES

EXECUTIVE SUMMARY

Metro's annual Solid Waste Forecast provides policymakers, the solid waste industry, and the general public with insights into the types and quantities of waste that the greater Portland area is likely to generate in the next few years and the conditions that affect the generation of waste. This information affects the revenues Metro is likely to generate for its solid waste operations, waste reduction and other related programs, and it illustrates the impacts that different policy decisions and economic conditions can have on the waste stream.

Metro's forecast is grounded in local and national economic data and trends. The forecast is also based on Metro's four decades of experience in managing the greater Portland area's garbage and recycling system and observing the economic and policy conditions that affect the amounts and types of waste that homes and businesses create. This forecast is intended to assist policymakers and industry leaders in making decisions affecting the management of garbage and recycling in the greater Portland area.

Assumptions Overview

The national and regional economies have been expanding for nine years, and while the next cyclical downturn will eventually come, the fundamentals suggest that it will not be in the next couple of years. Employment has been growing steadily since July 2010, albeit at slower rates, and the regional unemployment rate recently hit an all-time low of 3.7 percent. Home price expectations are better now than they were a year ago, with growth expectations around 5 percent for 2019 and 4 percent for 2020. While the outlook incorporates some slowing in construction-related indicators, overall continued regional economic growth underpins this year's Solid Waste Forecast.

This year's forecast also incorporates some improvements in the capture of source-separated food waste in the region with the onset of various new programs for both residential and commercial food waste. Collectively, these programs should start diverting more than 11,000 tons from the waste stream as soon as 2020, reducing growth in discarded waste by as much as 1 percent per year. Post-collection recovery of mixed dry waste is expected to continue to decline at most solid waste facilities in the region with recovery rates stabilizing no sooner than 2020. The high-level implications of these assumptions on the tonnage outlook, from both a financial and regulatory perspective, are provided below. More detail on each assumption underpinning this year's forecast and detailed forecast results are provided in the Major Assumptions and Results sections, respectively, starting on page 5.

Financial

Tonnage that incurs the Regional System Fee ("system fee") grew from 1.32 million tons in fiscal year ("FY", July 1 through June 30) 2016-17 to almost 1.4 million tons in FY 2017-18. Metro's fiscal year begins on July 1 and ends on June 30. Tonnage growth is expected to continue, reaching almost 1.46 million tons this year in FY 2019-19 and 1.48 million tons in FY 2019-20.

Since the same tonnage that incurs the system fee also incurs the Solid Waste Excise Tax ("excise tax"), plus some additional waste from outside the region, tonnage subject to the excise tax is also expected to continue to grow, reaching 1.5 million tons in FY 2019-20..

Regulatory

Shifting to calendar years ("CY", January 1 through December 31), which is the unit of time relevanet to Metro's regulatory purview, regional tonnage available for wet waste allocations grew in 2016 to almost 719,000 tons and again in 2017 to almost 735,000 tons. With most of the data now available for CY 2018, the growth rate is expected to slow somewhat, but then pick up again in 2019. For 2018, available tonnage should top about 742,000 tons, and in CY 2019 it should reach almost 760,000 tons.

METHODS

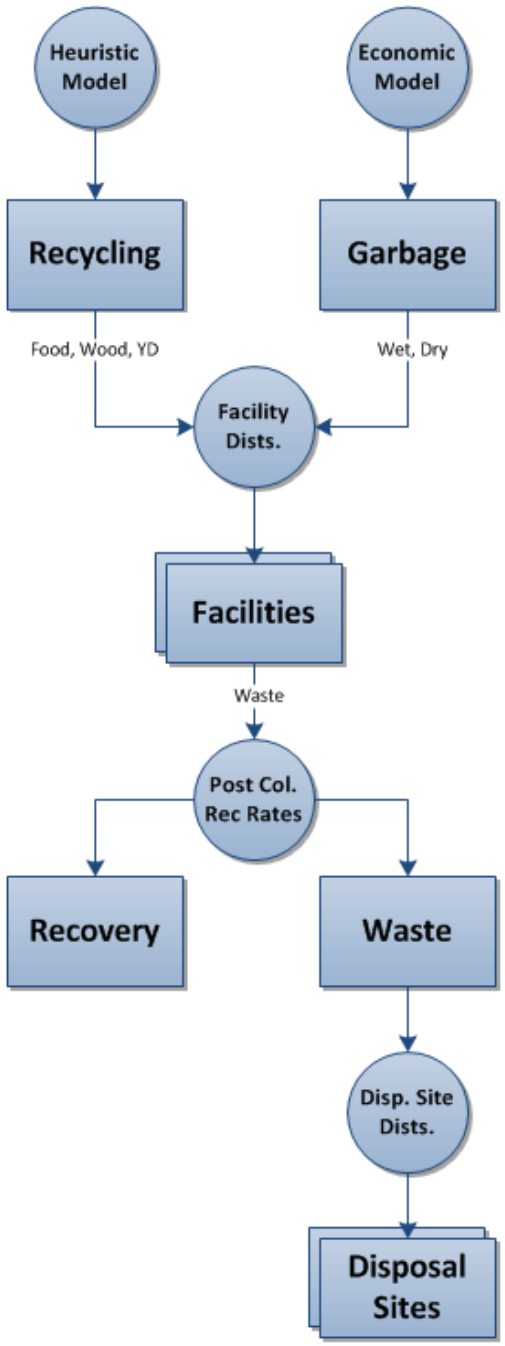
Model Summary

Metro's solid waste forecasting model (Figure 1) is an integrated temporal model of waste generation, distribution and disposal in the Metro region. The model is used annually to build the solid waste forecast for cost estimation, budgeting, rate-setting and regulatory purposes for the next calendar and fiscal years.

Because of its financial and regulatory focus, the forecast is focused primarily on garbage (wet and dry waste), but it also yields some high-level information on recycling streams. Since it produces five additional years of forecasts beyond the next calendar and fiscal years of focus, the forecast can be used in medium-range planning. Figure 1 depicts the key steps in the model which are summarized below.

Waste Generation: Metro uses a pair of econometric equations to estimate quantities of wet and dry wastes in Clackamas, Multnomah and Washington counties ("tri-county region"), and a simple heuristic model to estimate some source-separated recycling streams of interest. For the former, an initial equation uses economic indicators related to household and business consumption to forecast total regional garbage, while a second equation uses construction-related indicators to split the garbage into wet and dry sub-streams. The resulting wet and dry forecasts are then adjusted based on stakeholder feedback received during the forecast review process described below. Appendix C provides specification and model diagnostic details on these equations as well as historical and forecast data sources for all model variables.

Figure 1: Model Overview



For the latter, specifically source-separated food, wood and yard debris, the forecast assumes that current, or "base" tonnage will persist, and then new program tonnage (from anticipated new or expanded residential and commercial food waste programs) will add to this base in future years, depending on timing. These new program assumptions are developed largely from the feedback received through the review process. Assumed new programs in the model will also act to divert

additional wastes from wet or dry discards forecasted by the econometric models and subsequent adjustments mentioned above.

The model also uses the latest MetroScope spatial forecast to split tri-county wet waste into wet waste generated in the Metro jurisdictional boundary ("Metro region") and that generated outside the Metro region but within the bounds of the tri-county region. MetroScope is an integrated land-use and transportation model that produces forecasts of where people work and where they live based on aggregate economic trends and population forecasts. It predicts the final demand of where people live and where businesses locate based on economic choices made by consumers, producers of goods and services, and real estate developers.

Facility-specific streams: After the model estimates the waste stream forecasts indicated above, it distributes each stream to various facilities. This distribution of waste is a vital part of the forecast's ability to predict which tons of waste set rates, incur costs and generate revenue for Metro. Issues that might affect these distributions, such as anticipated operational changes at facilities, market changes, or new policies, are identified through the forecast review process and used by the model to inform distributions.

Post-collection recovery: Because Metro assesses fees and taxes on wastes that are ultimately disposed at a landfill or sent to a waste-to-energy facility, the model uses important assumptions identified through the review process about post-collection recovery operations at various facilities, including transfer stations and material recovery facilities in the Metro region. These issues may include anticipated new technologies, upcoming or assumed market disruptions or operational changes.

Disposition of waste: Metro's current waste disposal contract with Waste Management, which expires at the end of 2019, includes a declining block price rate for disposal based on tonnage volume directly sent, or caused to be sent under Metro's regulatory authority, to any disposal site owned by Waste Management. Metro's contract also includes a percentage guarantee of wet waste flow to a Waste Management landfill. In order to estimate Metro's disposal costs and to monitor Metro's compliance with its flow guarantee, the forecast includes assumptions of the distribution of waste to Waste Management and other landfills.

Review Process

A review process is used to set the key assumptions within each of the modeling steps discussed above and to finalize the forecast. The process starts with a detailed assumptions review in mid-August. The assumptions are solicited through a questionnaire (Appendix B) submitted to solid waste planners, analysts, economists, regulators and local government solid waste program directors. Results from the questionnaire are combined with the economic outlook to form a preliminary forecast in late September. A Forecast Review Panel, consisting of Metro's economist, finance director, and all solid waste directors, then reviews the preliminary forecast and suggests changes before finalization and distribution, typically in October.

MAJOR ASSUMPTIONS

Economic Outlook

This section outlines the national and regional economic outlook that underpins the forecast. The document also provides details on the history of and outlook for each of the indicators in Metro's solid waste economic models. More technical detail on the models is available in the attached Modeling Overview document in Appendix C.

Overview

The U.S. economy grew at its fastest pace in nearly four years in Spring 2018. Real gross domestic product (GDP) rose 4.1 percent in the second quarter of 2018. That was an increase from a 2.2 percent growth rate in the first quarter. Growth was broadly-based across the economy, reflecting robust growth in consumer spending, solid domestic business investment, and surges in exports and government spending. IHS Markit, one of Metro's economic consultants, expects real U.S. GDP to grow faster through 2020 as compared to its outlook last year.

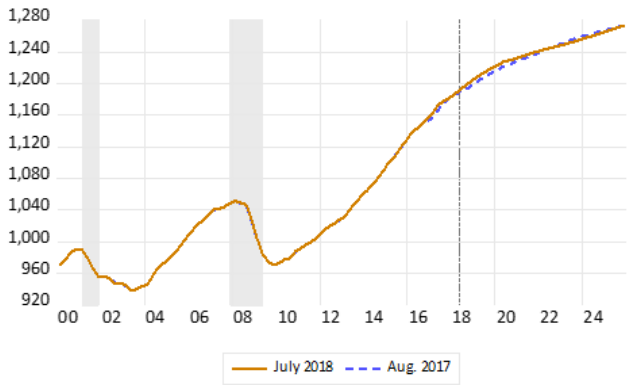
The Portland MSA region has seen 95 consecutive months of job growth on a year-over-year (Y/Y) basis dating back to July 2010. May job readings showed manufacturing surging ahead at a 3.8 percent (Y/Y) pace. Private non-manufacturing jobs posted a robust 3.2 percent increase (Y/Y). The regional unemployment rate reached 3.4 percent in May 2018 and currently stands at a seasonally-adjusted rate of 3.7 percent.

Consumers appear more optimistic today than they were a year ago. Readings from the University of Michigan consumer sentiment index peaked in March 2018, and readings over the last three years still show an expected upward trend. IHS Markit believes that confidence levels will remain high and will edge higher this year with a more prominent taper beginning in early 2019.

Employment

Figure 2 presents the current and previous outlooks for employment growth in the Portland Metropolitan Statistical Area (MSA). The dates of previous recessions are shaded grey.

Figure 2: Employment Outlook – Portland MSA



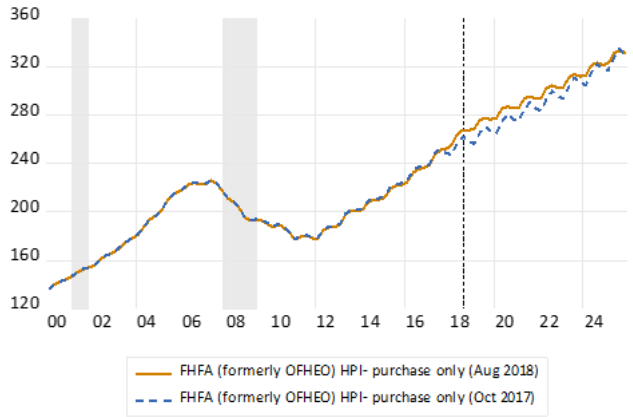
Source: BLS, NERC, Metro

The employment outlook is slightly higher this year than last year. More job growth is expected to yield greater quantities of wet and dry waste. Total nonfarm employment is projected to edge higher in the current regional forecast. The regional economy grew 0.3 percent faster in 2017, or about 4,000 more jobs than expected. Projected growth rates are consistent between the current job forecast and the expectations from a year ago. A higher 2017 base year allows the current forecast in the short-run to edge higher.

Home Prices

Figure 3 presents the current and previous outlooks for home price growth in the U.S., specifically the Federal Housing Finance Administration's (FHFA) home price index. IHS Markit raised its projection for the FHFA Housing Price Index (HPI). This is due to the likely prospect of an under-production of housing units. A shortfall is likely to lead to higher housing prices as demand exceeds supply. The market will respond to higher housing prices by trying to increase housing construction. Recent trends in the housing market caused housing production to fall behind greater demand for housing. The robust recovery has put more money in the hands of consumers and returned many previously unemployed and underemployed workers back to full time employment status. This allowed pent up demand for new housing, which built up during the Great Recession, to be released. The July 2018 forecast of the FHFA HPI rose at a revised rate of 6.71 percent in 2017 as compared to 5.86 percent in the outlook last year. The HPI is projected to grow faster this year, up to 6.74 percent, and tapering off to 5.21 percent in 2019 and 4.13 percent in 2020.

Figure 3: Home Price Outlook – U.S.



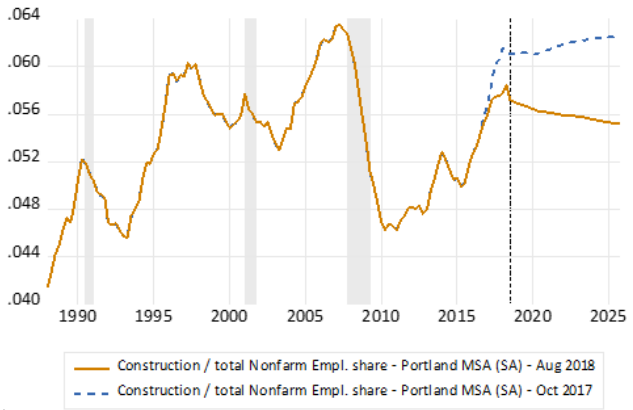
Source: FHFA, IHS Markit

Construction Employment

The outlook for construction employment, or more specifically, the ratio of construction employment to total employment, is presented in Figure 4. The actual ratio of construction to total jobs in the last four quarters lagged behind expectations for a year ago, reflecting a relative slowdown in construction. As a result, the Northwest Economic Research Center (NERC) at

Portland State University takes a more moderate view of construction job trends in this year's outlook. As the economy hits full-employment, achieving higher growth will become more difficult with shortages in skilled construction workers.

Figure 4: Construction Contribution Outlook – Portland MSA

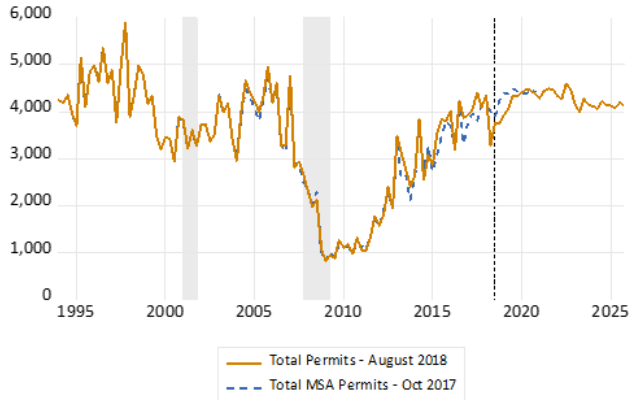


Source: BLS, NERC, Metro

House Permits

Figure 5 presents the current and previous outlooks for residential (both single and multi-family units) construction permits in the Portland MSA. Actual housing permits issued in the last four quarters ran about 800 units ahead of forecast expectations a year ago. Permits for multi-family housing units in Multnomah County, in particular, jumped significantly in 2017. Since then, permitting has slowed, both in Portland and the region as a whole. This trend should continue in the next few quarters (Q3 2018 to Q1 2019) and NERC's forecast is consequently lower than it was a year ago during this time frame. While measures 26-199 and 102 are on the ballot as of this writing and could likely affect the housing permit outlook, exactly how and when this might occur is beyond the scope of this analysis.

Figure 5: Construction Permit Outlook – Portland MSA

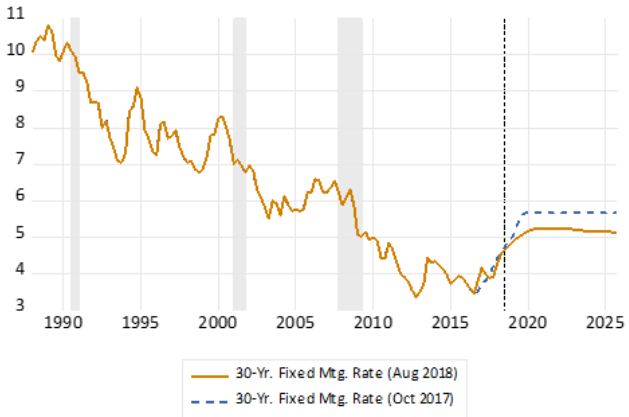


Source: US Census. NERC

Mortgage Rates

Figure 6 presents the current and previous outlooks for 30-year fixed mortgage rates in the U.S. Fixed mortgage rates are about 10 basis points lower than projected in the IHS forecast of a year ago. Despite several interest rate hikes from the Federal Reserve to bring normality to interest rates, long-term rates seem to be lower than expected. Core inflation – inflation minus food and energy costs – remains subdued even with strong GDP growth. This gives the Federal Reserve the leeway to raise short-term interest rates, but long-term rates are less likely to increase with inflation expected to hover around 2 percent. The effect is a boost to dry waste disposal projections.

Figure 6: Mortgage Rate Outlook – U.S.



Source: Freddie Mac. IHS Markit

Waste Generation

Metro's econometric models (detailed in Appendix C) predict the generation of garbage as a function of the economic variables described in the previous section. These model forecasts are then adjusted based on the input of stakeholders during the review process previously outlined. The garbage forecast focuses on two sub-streams:

1. ***Wet wastes***, often referred to as "putrescible" wastes, are municipal solid wastes that tend to have an organic component in the stream, and arise from households and businesses in the region.

2. ***Dry wastes*** tend to be bulky wastes, and construction and demolition (C&D) wastes that do not have a significant (or any) organic waste component. As such, they are often referred to as "non-putrescible" wastes, and arise from households, businesses and construction activities in the region.

For the generation of recycling streams, Metro uses a heuristic approach, consisting of two parts. First, "base" tonnage, or that from existing recycling programs, is assumed to continue at current levels for each stream. Second, tonnage from new recycling programs that are expected to start in the forecast horizon are added to the base in order to derive the final forecast of each stream. Since new recycling programs divert materials from wet or dry waste streams, the model subtracts this "additional" diversion from the wet and dry forecasts above, accordingly. The forecast focuses on three recycling streams:

1. ***Residential food waste mixed with yard debris*** is a recycling stream generated by single-family households in select jurisdictions throughout the region that have "curbside" programs for this waste. Since the vast majority of the weight of this stream is yard debris (more than 90 percent), the food-specific diversion from overall wet waste tonnage tends to be minimal.

2. ***Commercial food waste*** is a recycling stream generated by businesses throughout the region. Since most if not all of the weight of this stream is food, new programs have a larger diversion effect on quantities of wet waste.

3. ***Wood and yard debris (to Metro facilities)*** are two separate streams generated by households, businesses and construction activities, the first of which diverts waste from dry discards. Since regional quantities of these streams have no financial impact to Metro, the forecast focuses only on the wood and yard debris delivered to Metro's two public transfer stations.

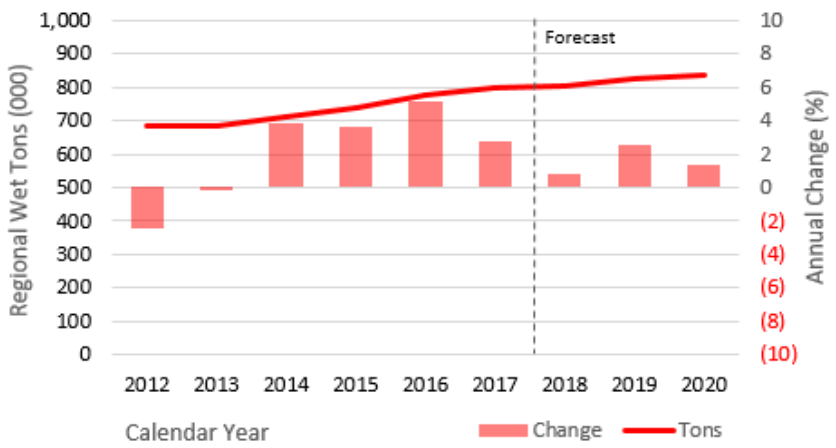
Wet Waste

Before the last recession, wet waste in the tri-county region peaked at about 805,000 tons in CY 2006. By the time tonnage hit bottom in 2013, wet waste was at about 685,000 tons. Since then, wet waste grew to about 776,000 tons in 2016, at a clip of about 4 percent per year. In 2017 however, growth in tonnage slowed significantly to under 3 percent and tonnage was just under

800,000. This year, growth slowed again to just under 1 percent, but is expected to pick up in 2019 and 2020 to about 2.6 percent and 1.3 percent, respectively, as the economic outlook improves. Figure 7 presents historical and forecasted regional wet tonnage (line, left axis), along with annual growth rates (bar, right axis) from 2012 through 2020.

Figure 7: Tri-County Region Wet Waste – 2012 - 2020

	Tons	Change
CY	thousands	YOY %
2012	686	-2.5
2013	685	-0.2
2014	711	3.8
2015	738	3.7
2016	776	5.2
2017	797	2.7
2018	804	0.9
2019	824	2.6
2020	835	1.3



Sources:

o history: Metro Solid Waste Information System (SWIS)

o forecast: Econometric model results, intercept-shifted based on stakeholder expectations

Aside from the inherent uncertainty associated with the economic outlook, other factors could pose risks for the regional wet waste forecast. In particular, information about market problems with some recyclable materials could cause generators to decrease source-separation, commingling otherwise recyclable materials with garbage.

In order to forecast the split in wet waste between those generated in the Metro region, and those generated outside the region, the model uses the latest MetroScope spatial forecast of household and employment growth in the region. MetroScope provides base year (2015) household and employment data by travel analysis zone (TAZ), as well as forecasts of those data for a horizon year (2040). For each year of the solid waste forecast, a linear interpolation of these data by transportation analysis zones is used in conjunction with wet waste generation parameters to estimate the percentage share of wet waste generated outside the region, and conversely, inside the region.

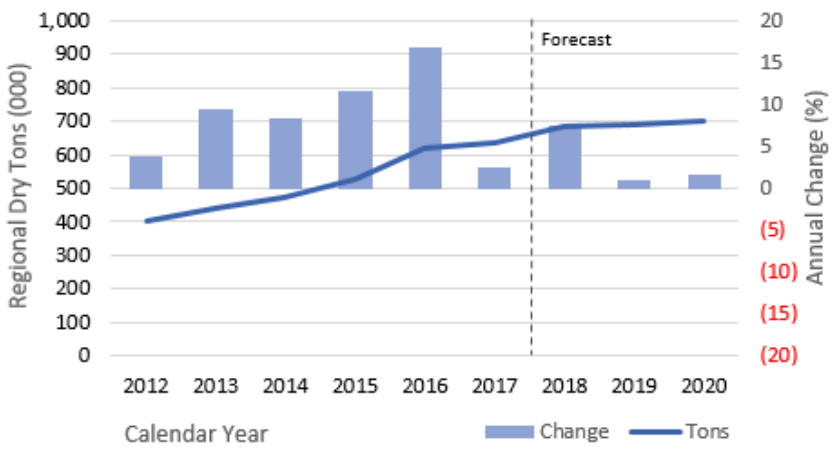
Dry Waste

Before the last recession, dry waste in the tri-county region hit a peak of about 603,000 tons in CY 2007. But by 2011, it hit a low of 385,000 tons. Since then, tonnage grew at accelerating rates through 2016 when tons hit 618,000. In 2017, growth rates slowed dramatically, and dry waste grew to about 634,000 tons. This year, the expectations are for another pick-up in growth to about 682,000 regional tons, with continuing but much slower growth out to 2020. Figure 8 presents

historical and forecasted tri-county region dry tonnage (line, left axis), along with annual growth rates (bar, right axis) from 2012 through 2020.

Figure 8: Tri-County Region Dry Waste– 2012 - 2020

	Tons	Change
CY	thousands	%
2012	400	3.8
2013	438	9.5
2014	474	8.3
2015	530	11.6
2016	618	16.7
2017	634	2.6
2018	682	7.6
2019	689	0.9
2020	700	1.6



Sources:

o history: Metro Solid Waste Information System (SWIS)

o forecast: Econometric model results, intercept-shifted based on stakeholder expectations

As is the case with the wet waste forecast, market problems with some recyclable materials pose an upside risk for the dry waste forecast. Specifically, increased dry waste could come from recycling facilities seeking to dispose of non-marketable recyclable materials. As for downside risks, a company engaged in recycling roofing shingles in the region is pursuing an option to collect shingles for use as landfill roadbed, and two new drywall recyclers recently opened. These enterprises could increase the source-separation of roofing shingles and drywall at construction sites, and therefore divert additional materials from the dry waste stream.

Residential Food Waste Mixed with Yard Debris

There are currently five local jurisdictions in the Metro region with curbside programs for residential food waste mixed with yard debris. Those programs (and their start dates) are City of Portland (November 2011), City of Lake Oswego (June 2016), City of Forest Grove (July 2016), City of Milwaukie (August 2017) and City of Beaverton (October 2017). These programs are currently capturing a total of about 106,000 tons of material per year. Looking forward, this ("base") tonnage is expected to remain stable through the forecast horizon, while two new programs are expected to add to this base, as follows:

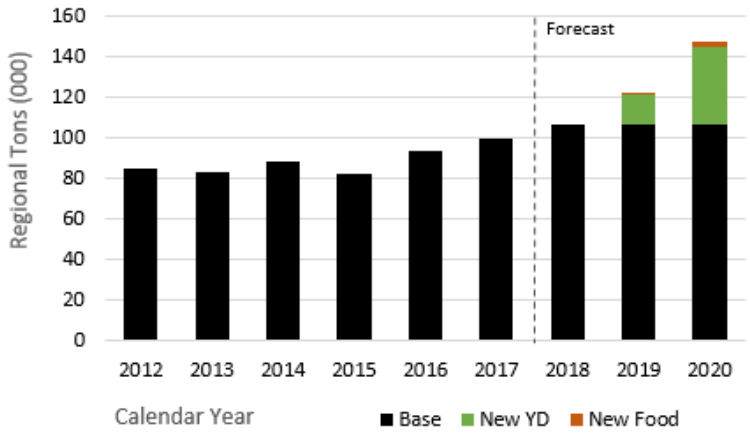
- Unincorporated Washington County – expected to begin June 2019, and yield about 27,600 annual tons. At 6.5 percent assumed food composition, this program should divert an additional 1,800 annual tons from the wet waste stream.

- City of Gresham - expected to begin January 2020, and yield about 13,100 annual tons. At 6.5 percent assumed food composition, this program should divert an additional 850 annual tons from the wet waste stream.

Figure 9 presents the implications of these existing and new programs on regional tonnage of source-separated residential food waste mixed with yard debris. From 2012 through 2015, the only regional program was the City of Portland's, and annual tonnage was between 80,000 and 85,000 per year. Since then, new programs have been implemented and tonnage climbed to about 106,000 per year. With the implementation of the two new programs expected above, regional tonnage of residential food waste mixed with yard debris should climb to about 147,000 per year by 2020.

Figure 9: Residential Food Mixed with Yard Debris – 2012 - 2020

	Tons (000)		
	Existing	New Programs	
CY	Base	Yd Debris	Food
2012	84	---	---
2013	83	---	---
2014	88	---	---
2015	82	---	---
2016	93	---	---
2017	99	---	---
2018	106	---	---
2019	106	15	1
2020	106	38	3



Sources:

o history: Metro Solid Waste Information System (SWIS)

o forecast: Based on estimated new program tonnage, timing, and 6.5% food composition.

Other programs were also mentioned during the review process as possibilities for implementation during the forecast horizon, including potential programs in the cities of Hillsboro, Tualatin, West Linn and others. Since there was no consensus in the reviewers' responses on these programs, including start dates and other factors, these programs are not included in the regional forecast, but can be considered upside risks to the forecast for this waste stream, and therefore downside risks to the wet waste forecast.

Commercial Food Waste

A variety of businesses in jurisdictions throughout the Metro region also participate in food waste source-separation. Collectively, these firms capture about 25,000 tons per year and the expectation is that they should continue to do so. With the implementation of the regional Business Food Waste

Program[1], tonnage from new participating firms is expected to add to this base, and divert all tons from wet waste, as follows[2]:

- Group 1 (Businesses that generate 1,000 pounds or more of food scraps per week): Expected to add half the anticipated 18,000 additional tons (42K total minus 25K existing business tons), or about 9,000 additional tons per year, starting in 2020. The other 9,000 tons should come later in 2021.

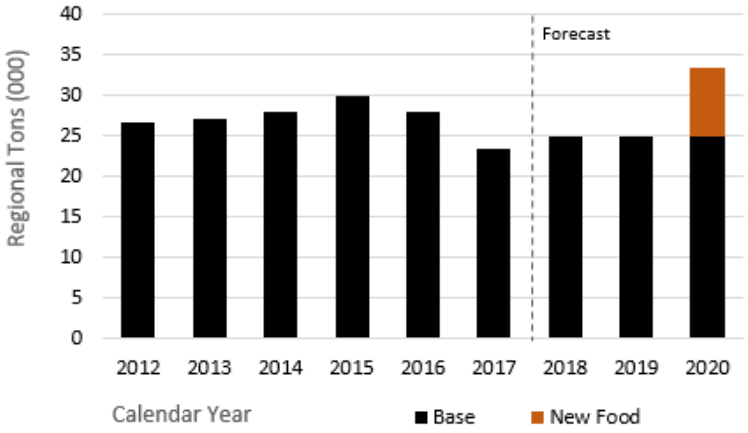
- Group 2 (Businesses that generate between 500 and 1,000 pounds of food scraps per week): Expected to add half the anticipated 10,000 additional tons, or about 5,000 tons per year, starting 2021. The remaining 5,000 tons from this group should come in 2022.

- Group 3 (K through 12 schools and businesses that generate between 250 and 500 pounds of food scraps per week): Expected to add half the anticipated 6,500 additional tons, or 3,250 tons per year, starting in 2022. Like the other groups above, the remaining 3,250 tons from this group should come a year later, in 2023.

Figure 10 presents the implications of these on regional tonnage of source-separated commercial food waste.

Figure 10: Commercial Food Waste – 2012 - 2020

	Tons (000)	
	Existing	New
CY	Base	Food
2012	27	---
2013	27	---
2014	28	---
2015	30	---
2016	28	---
2017	23	---
2018	25	---
2019	25	---
2020	25	9



Sources:

o history: Metro Solid Waste Information System (SWIS)

o forecast: Based on estimated new program tonnage and timing

[1] Ordinance No. 18-1418, adopted by Metro Council in July 2018, establishes a phased program that requires businesses of various sizes to recycle food waste over the coming years.

[2] Starting tonnage estimates and timing taken from the Staff Report to Ordinance No. 18-1418 (p. 4), assuming 50 percent capture. Adjustments were made (to both tons and timing) to represent a more gradual phase-in of the program over time.

Since 2012, regional tonnage ranged between 25,000 and 30,000 tons per year, until last year, when it dropped to about 23,000 tons. This year, regional tonnage climbed back to about 25,000 tons per year. The tonnage fluctuations are thought to largely arise from the participation of businesses, and the degree to which they can separate their food waste. In 2020, when Metro's new Business Food Waste Program begins to take effect and systematically draw new businesses into capturing food waste, regional tonnage is expected to climb to nearly 34,000 tons per year, and even higher in the years beyond.

Wood and Yard debris (to Metro stations)

Finally, for source-separated wood and yard debris delivered to Metro transfer stations, the forecast assumes that current tonnage should continue, with no new major sources. Specifically, Metro Central should continue to receive about 1,900 tons of yard debris, and 700 tons of source-separated wood waste, per year. Metro South should continue to receive about 12,000 tons of yard debris, plus another 1,000 tons of source-separated wood waste, per year.

Facility Distributions

After the model estimates the regional waste streams above, it incorporates assumptions for distributing each stream to facilities. The distribution of waste to various public and private facilities is important for rate-setting and budgeting. For rate-setting, distributions determine the tonnage bases for fees and taxes, as well as tonnage and transaction charges for Metro's own disposal utility. These tonnage bases, of course, also forecast regional fee and tax revenue, and estimate fixed and variable operating costs and revenues for Metro's disposal utility, which are important for budgeting.

Wet Waste

Distributions of Metro region wet waste to transfer stations is regulated by Metro. Specifically, there are five private transfer stations operating in the region that are franchised and authorized by Metro to accept wet waste. In addition, Metro authorizes some wet waste to be hauled directly to out-of-region transfer stations or disposal sites by way of non-system licenses, including the Covanta Marion waste-to-energy facility near Brooks. Metro allocates specific wet waste tonnage amounts to these franchisees and non-system licensees in a manner that Metro believes will best achieve the public interest, and which provides assurance that at least 40 percent of the waste will flow to Metro's two public transfer stations. Any unallocated tons to, or allocated but unutilized tons from private facilities, is assumed to flow to Metro's transfer stations.

The model then distributes wet tons to facilities based on the combination of assumed allocations to private facilities, and the assumed utilization of those allocations by those facilities (allocations multiplied by utilizations equals distributions). Figure 11 presents the assumptions for the allocations for each franchisee and licensee, which differ by year.

Figure 11: Wet Waste Allocations – 2019 - 2025

	CY 2019 Allocation			CY 2020 Allocation						CY 2021
Franchisee or	**CY 2018**	Method	**CY 2019**	Method (Mixed)					**CY 2020**	**to 2025**
Licensee	**Allocation**	Fixed Tons	**Allocation**	%	*Tms*	Avail.	*Eq*		**Allocation**	% Based
Gresham Sanitary Service	23,687	---Increase-->	**44,919**	----------Increase--------->					**49,000**	**6.4%**
Pride	79,880	----Steady--->	**79,880**	10.1%	X	768,228	=		**77,437**	**10.1%**
Troutdale	79,880	----Steady--->	**79,880**	16.0%	X	768,228	=		**122,532**	**16.0%**
Willamette Resources, Inc.	79,880	----Steady--->	**79,880**	10.1%	X	768,228	=		**77,437**	**10.1%**
Forest Grove	125,000	----Steady--->	**125,000**	9.8%	X	768,228	=		**75,210**	**9.8%**
Canby	16,600	----Steady--->	**16,600**	----------Decrease--------->					**13,000**	**1.7%**
Vancouver	25,601	----Steady--->	**25,601**	----------Decrease--------->					**23,000**	**3.0%**
Covanta Marion	3,980	----Steady--->	**3,980**	----------Steady---------->					**3,980**	**0.5%**
		Tons to Private:	**455,740**					**Tons to Private:**	**441,597**	
		Regionally Available Tons:	**759,567**					**Regionally Available Tons:**	**768,228**	
		% Allocated:	**60.0%**					**% Allocated:**	**57.5%**	

For next year (CY 2019), all allocations except that for Gresham Sanitary Service (GSS) are expected to remain at 2018 levels. For GSS, the forecast incorporates an increased allocation up to the maximum tons permitted to maintain a 60 percent private tonnage allocation given available regional tonnage. For CY 2020, the assumed methodology is based on a combination of fixed tonnage amounts for some entities, and percentage shares based on travel time analysis multiplied by available tonnage, for others. Then for years 2021 and beyond, the percentage shares implied by the 2020 tonnage allocations for each entity are used in combination with regionally available tons in each year to form those allocations.

As for the utilization of those allocations, Figure 12 presents both historic utilizations (expressed as the percentage of allocated tonnage actually used at year end) and those assumed over the forecast period. For the current year, the forecast incorporates utilizations based on expected trends for each entity. For CY 2019 and beyond, the assumption is for an across-the-board utilization of 95 percent for each entity.

Figure 12: Wet Waste Allocation Utilization – 2015 - 2025

	Allocation Utilization					
	Actuals			Anticipated		
Franchisee or	CY 2015	CY 2016	CY 2017	CY 2018	CY 2019	----------> CY 2025
Licensee	% Used	% Used	% Used	Expected	Assumed Fixed @ 95%	
Gresham Sanitary Service	---	36.2%	98.7%	97.7%	95.0%	---------->
Pride	93.4%	95.7%	98.0%	99.7%	95.0%	---------->
Troutdale	99.8%	99.2%	92.7%	100.0%	95.0%	---------->
Willamette Resources, Inc.	96.6%	99.6%	97.0%	87.4%	95.0%	---------->
Forest Grove	91.8%	95.6%	96.8%	95.9%	95.0%	---------->
Canby	78.8%	81.6%	66.7%	69.7%	95.0%	---------->
Vancouver	79.1%	76.4%	74.7%	66.9%	95.0%	---------->
Covanta Marion	36.6%	43.2%	38.7%	57.5%	95.0%	---------->
All Entities	**92.8%**	**94.3%**	**93.4%**	**93.5%**	**95.0%**	---------->

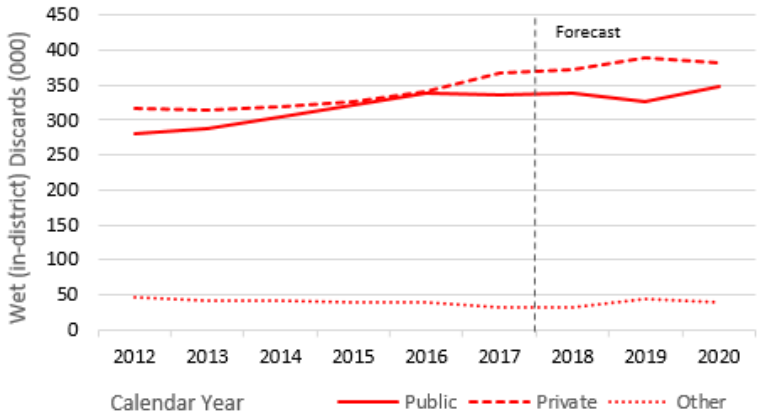
The implications of these assumptions (the combination of allocations and utilizations) on the distribution of wet waste to public and private facilities is presented in Figure 13.

Wet waste tonnage to both public and private facilities have generally been on the rise since 2014, as regionally available tons grew and allocations increased marginally. However, since 2016, available tons haven't been keeping pace with the amount allocated to private facilities, and resulting distributions of wet waste to Metro's public facilities actually decreased in 2017, and are expected to remain flat in 2018. In 2019, the growth in allocations is expected to be larger than the growth in regionally available tons, and the assumed utilizations greater. This should reduce distributions of wet waste to the public facilities (and increase them to the private facilities) in 2019. In 2020, however, allocations to private entities are expected to contract while utilization holds steady, and the result is a return to growth of wet waste to the public transfer stations. By 2020, public stations are expected to receive almost 350,000 wet tons, private stations are expected

to receive a little over 380,000 tons, with the remainder (38,000 tons) being directly hauled to out-of-region facilities.

Figure 13: Distributions of Metro Region Wet Waste – 2019 - 2020

	Tons (thousands)		
	To Regional		To
CY	Public	Private	Other*
2012	280	316	45
2013	287	313	40
2014	305	318	42
2015	322	328	38
2016	339	341	38
2017	337	367	32
2018	338	373	31
2019	327	389	44
2020	349	382	38



Notes:

o source: Metro Solid Waste Information System (SWIS)

* Other are licensees authorized to deliver waste directly to Canby and Vancouver facilties, and to Covanta Marion

Distributions of the out-of-district portion of wet waste are assumed to follow historic patterns and are used primarily to determine the additional tonnage base for excise tax, and community enhancement fee revenues.

While the risks to wet waste distributions should be mostly from uncertain utilizations, the allocations themselves may also be uncertain. As this report goes to press, Metro received a franchise application to establish a new transfer station to be located at 138th and Sandy in Portland and operated by City of Roses. The applicant requested as much as 30,000 tons per year of wet waste allocation from Metro. The request, if granted, would significantly alter the allocations and resulting wet waste distributions from those expected and presented in this forecast.

Dry Waste

The region has several facilities that accept and process mixed dry waste generated in the Metro region. These include transfer stations (both public and private) and material recovery facilities. In addition, a small but growing amount of dry waste is delivered directly to disposal sites. Unless there are major market disruptions or operational issues at facilities, the distribution of mixed dry waste among these various players remains relatively stable over time.

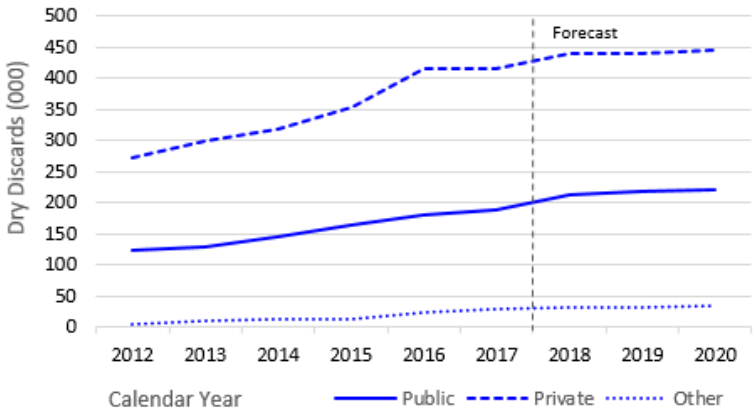
Recently, Recology's Suttle Road material recovery facility ceased accepting mixed dry waste (Recology's Foster Road facility ceased accepting mixed dry waste in 2016). The model assumes that two private facilities (Greenway Recycling and Environmentally Conscious Recycling) and one public facility (Metro Central) will absorb Recology's Suttle Road losses in roughly equal proportion. Other than this minor disturbance, the forecast assumes relatively stable dry waste

market shares moving forward. Figure 14 presents the implications of these assumptions on the distribution of dry waste to private and public facilities.

Dry waste tonnage has been growing for both public and private facilities, as has waste delivered directly to disposal sites, including Covanta Marion. By 2020, public stations are expected to receive more than 220,000 tons, private facilities (including transfer stations and material recovery facilities) are expected to receive about 446,000 tons, and waste delivered directly to disposal sites should hit 33,000 tons.

Figure 14: Distributions of Dry Waste – 2012 - 2020

	Tons (thousands)		
	To Regional		To
CY	Public	Private	Other*
2012	123	272	5
2013	128	300	10
2014	144	318	13
2015	164	352	13
2016	180	415	23
2017	188	417	29
2018	212	439	32
2019	218	439	32
2020	221	446	33



Notes:

o source: Metro Solid Waste Information System (SWIS)

* Other are tons delivered directly to a disposal site, including Covanta Marion

Since the closure of the WestRock paper mill in Newberg in November 2015 and Metro's suspension of the Enhanced Dry Waste Recovery Program for wood waste, an increasing amount of dry waste generated in the region is being delivered directly to landfills. In addition to these wood market issues, additional approvals from the Oregon Department of Environmental Quality for recycling facilities to dispose of source-separated recyclable material could increase the share of wastes being delivered directly to landfills and decrease the wastes being delivered to those of public or private facilities.

Residential Food Waste Mixed with Yard debris

There are currently five facilities in the region, and some processors outside the region, that accept the residential food waste mixed with yard debris that is generated and collected in the Metro region. While the majority of the 100,000 tons captured in 2017 (about 93 percent) were delivered to in-region facilities, this percentage declined significantly from 2016 as new licenses were issued to haulers and generators wishing to deliver waste directly to processors outside the region.

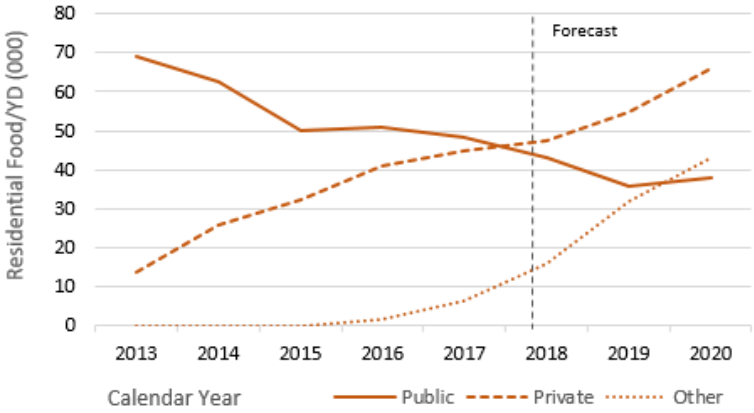
Moving forward, the expectation is that this trend will continue, at least through 2020. All of the anticipated tonnage (or about 28,000 tons per year) from Washington County's new curbside residential program should flow directly to the main processor in that area, which is Recology

Oregon Compost, formerly Nature's Needs, located near North Plains. All of the City of Gresham's anticipated new program tonnage (about 13,000 tons per year) is assumed to flow to Metro Central. Finally, Recology's Suttle Road reload facility and Troutdale and Willamette Resources, Inc. (WRI) transfer stations are expected to maintain their shares of regional residential food waste, which should drive the shares of Metro's two transfer stations down significantly, starting in 2019.

Figure 15 shows the implications of these assumptions on the distribution of residential food waste mixed with yard debris to private and public facilities. Tonnage to Metro's transfer stations has been declining since 2013, and is expected to continue to decline through 2019. In 2020, Metro should see an increase in tonnage from City of Gresham's new curbside program. Conversely, private facilities and direct-haul licenses are expected to continue to increase in tonnage, to 66,000 and 43,000 tons, respectively, by 2020.

Figure 15: Distributions of Residential Food/YD – 2013 - 2020

	Tons (thousands)		
	To Regional		To
CY	Public	Private	Other*
2013	69	14	0
2014	63	26	0
2015	50	32	0
2016	51	41	1
2017	48	45	6
2018	43	48	16
2019	36	55	32
2020	38	66	43



Notes:

o source: Metro Solid Waste Information System (SWIS)

* Other are licensees authorized to deliver waste directly to processors outside the region

One of the major risks involved with these distributional assumptions is on the supply of available disposal options for this waste. With two new curbside programs adding almost 41,000 new tons of demand, the existing array of facilities may not adequately meet this demand. Consequently, tip fees at existing private facilities could increase. If this happens, distributions of waste would be shifted to public facilities, where tip fees can be and frequently are subsidized for this waste stream.

Commercial Food Waste

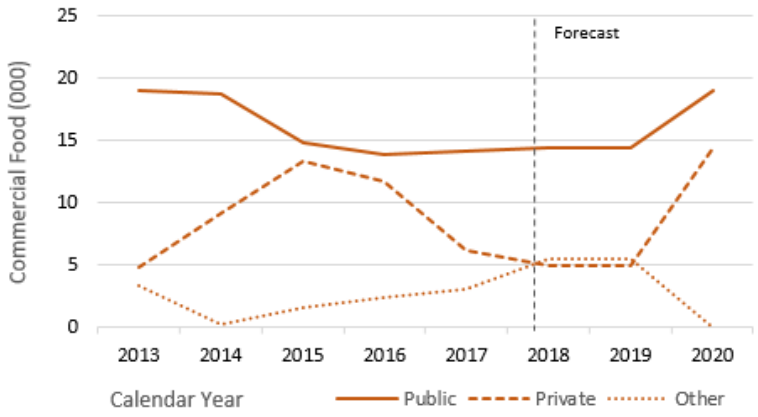
For commercial food waste transfer, reload and processing, there are only two in-region facilities (WRI, Metro Central) and a couple of out-of-region processing facilities handling Metro waste. One of these processors is Divert, located in Albany, Oregon, which processes food waste from grocery stores in the Metro region into a slurry for anaerobic digestion. These out-of-region facilities handled a little more than 8 percent of the waste in 2016, which climbed to 13 percent in 2017, and is expected to grow further to more than 20 percent in 2018.

Starting in 2020, when the Business Food Waste Program is expected to capture an additional 9,000 tons of regional commercial food waste, the model incorporates changes to this distributional mix. Specifically, licenses to out-of-region processors are expected to be eliminated, and a new regional processing facility should be ready to take up that share of waste. Further, the model incorporates the assumption that Metro Central will maintain its relatively large share of this waste stream and that other private transfer stations will all participate as consolidators of the waste to the new regional processing facility.

Figure 16 shows the tonnage implications of these assumptions on the distribution of waste between public and private facilities. By 2020, Metro Central should receive about 19,000 tons, private facilities should see about 14,000 tons, and no source-separated commercial food waste should be licensed for direct-haul to out of region processors.

Figure 16: Distributions of Commercial Food Waste – 2013 - 2020

	Tons (thousands)		
	To Regional		To
CY	Public	Private	Other*
2013	19	5	3
2014	19	9	0
2015	15	13	2
2016	14	12	2
2017	14	6	3
2018	14	5	5
2019	14	5	5
2020	19	14	0



Notes:

o source: Metro Solid Waste Information System

* Other are licensees authorized to deliver waste directly to processors, including Divert, outside the region

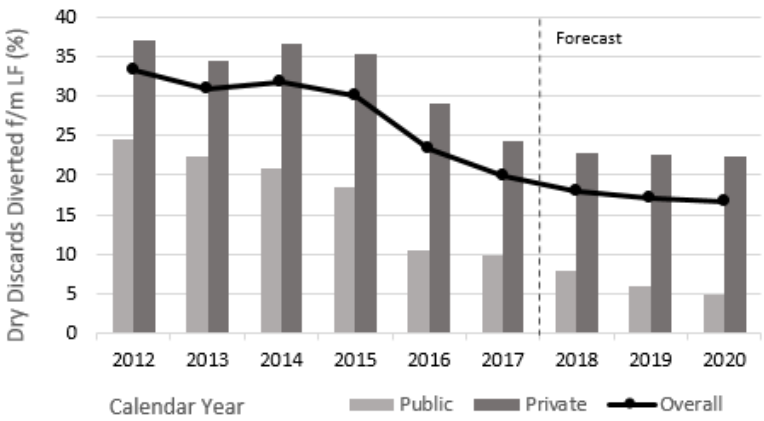
Post-Collection Diversion

After distribution, the model uses assumptions about post-collection recovery operations at public and private transfer and material recovery facilities that accept dry discards, to forecast how much waste will be recovered, and how much will be disposed, primarily for revenue and cost estimation purposes. While most recovery of recyclable materials happens by generators before collection (i.e. source-separation), between 100,000 and 200,000 tons of material gets recovered annually after collection. The region currently has two public facilities and eight private facilities that are engaged in post-collection recovery operations of dry waste.

Figure 17 presents recovery rates for public and private facilities engaged in post-collection recovery operations. Since peaking in 2012 at about 33 percent, on average, overall recovery rates have been on the decline. Recovery rates declined significantly in 2016 with the closure of a major wood market at the end of 2015, with overall rates falling almost 7 percentage points, from 30 to 23 percent. Rates declined by a few points again in 2017 to about 20 percent, due to continued wood market pressure, enhanced screening for asbestos-containing materials at Metro's transfer stations, and the suspension of Metro's Enhanced Dry Waste Recovery Program for wood.

Figure 17: Post-Collection Recovery Rates – Public, Private and Overall

	% Dry Discards Recovered		
CY	Public	Private	Overall
2012	24.6	37.1	33.2
2013	22.5	34.5	30.9
2014	20.9	36.6	31.7
2015	18.5	35.3	30.0
2016	10.4	29.1	23.4
2017	9.7	24.4	19.8
2018	7.9	22.9	18.0
2019	5.9	22.6	17.1
2020	4.9	22.4	16.6



Notes:

o source: Metro Solid Waste Information System (SWIS)

Looking forward, the model incorporates the assumption that recovery rates will continue to decline at varying magnitudes by facility, but at decreasing rates of change, through 2020. During this time, the assumption is that most painted and treated wood, and even some stockpiled clean wood, will be sent to landfills. After 2020, the model assumes that recovery rates will stabilize at roughly 16.5 percent overall (5 percent for public facilities, 22 percent for private facilities).

Waste Disposition

After distributing wet and dry waste to various types of facilities and estimating the amount of post-collection recovery processing residual waste ("dry residual waste"), the model incorporates assumptions for distributing the resulting waste from facilities to landfills. These assumptions and their resulting distributions allow the forecast to include estimates of the tonnage subject to a declining block disposal rate[3] for estimating Metro's disposal costs. The distributions also allow the forecast to estimate the tonnage subject to the flow guarantee,[4] and for monitoring those provisions in its disposal contract with Waste Management.

With respect to dry waste, the forecast assumes status quo. That is, current dry waste flows from facilities to disposal sites will remain static on a percentage basis, through the forecast horizon.

For wet waste, the disposal assumptions differ for flows from now through 2019 and after 2019 through the forecast horizon. For wet waste flows through the end of 2019, the provisions of Change Order 11[5] to Metro's current contract with Waste Management should remain in effect, and Metro will continue to comply with the flow guarantee. The flow guarantee requires 87% of the Metro region's wet waste to flow to Waste Management-owned landfills through CY 2019.

In CY 2020 and beyond, Metro's disposal contract will likely remain with Waste Management, but without a declining block rate and flow guarantee provision, other than from Metro's two transfer stations. As a result, the flows of waste from private facilities to Waste Management landfills (or any other landfill) are no longer material, and only those tons from Metro facilities are included in the forecast results starting January 2020.

[3] Through 2019, Metro's disposal contract provides for declining per-ton disposal rates based on the amount of waste sent to its contractor's landfills directly from Metro's two transfer stations, or caused to be sent to its contractor's landfills with its regulatory authority, which includes waste from private facilities.

[4] Through 2019, Metro's disposal contract requires that a certain percentage of the region's wet waste must be sent to a landfill owned by Waste Management. Through 2017, that percentage was 90 percent. By a recent change order, that percentage is now 87 percent for 2018 and 2019.

[5] Due to capacity issues at Riverbend Landfill and the need to divert waste from that landfill, in February 2017 the parties agreed to divert waste from Riverbend Landfill to Coffin Butte Landfill and to count that diverted waste towards the 87 percent requirement. In 2020, Metro's Landfill Capacity Policy (Ord. 17-1401) prohibits disposal of waste generated in the Metro region at a new or limited capacity landfills, like Riverbend.

RESULTS

The needs that drive the solid waste forecast are currently focused on producing tonnage quantities that estimate key solid waste costs and revenues, budgets, rates, and regulatory tonnage allocations. As a result, the model structure and accompanying output all yield result quantities of a financial and regulatory nature. Those quantities are defined in more detail below, and presented in the subsequent sections.

Focus Areas

The primary results of the solid waste forecast are presented within the following three focus areas:

1. *Fee and Tax Related Tonnage:* This section presents actual and forecasted tonnage, by fiscal year, that generates system fee, excise tax, and Community Enhancement Fee ("enhancement fee") revenue for the Solid Waste, General and Community Enhancement Fee funds, respectively. Since the revenue involved with these funds is significant, the tonnage forecasts here are vitally important for the budgeting process. Also, the system fee and excise tax rates are rates that change annually, and the forecasts also assist with setting those annual rates. More detail on each fee and tax is provided below.
2. *Metro Disposal Utility-Related Tonnage*: This section presents tonnage that generates revenue to Metro's disposal utility, in order to cover the costs for operating (both fixed and variable expenses), transport and disposal of wastes. To cover these costs, Metro charges specific tonnage charges (per ton) and transaction fees (per load) for each of five streams of waste. Because these charges change annually like the system fee and excise tax rates, the forecasts here are also vital in setting those rates, anticipating costs and revenues to the Solid Waste Fund, and building agency budgets.
3. *Wet Allocatable Tonnage*: This section presents the available tonnage that forms the basis for Metro's regulatory allocations of wet waste to private franchisees and licensees. While the allocation and utilization assumptions for the forecast are described above, any available tonnage that is unallocated, or allocated tonnage that is unused by private facilities is assumed to flow to Metro transfer stations.

The forecast produces a number of other data series other than those described above. Appendix A provides these other series by calendar and fiscal years. It also provides statistics on how well last year's forecast is performing against accumulated actuals, and how this forecast differs from the forecast made last year, in 2016.

Fee and Tax-Related Tonnage

Regional System Fee

The system fee is a specific (per-ton) fee on wet and dry waste that is generated in the Metro region and ultimately disposed (after any post-collection recovery). The revenue from the system fee covers the costs of regional solid waste programs and services, including household hazardous waste management, latex paint recovery, waste reduction planning and programs, waste reduction education, St. John's Landfill post-closure activities, solid waste facility regulation, and illegal dumpsite monitoring and cleanup. The fee is collected at all landfills and mass burners serving the region, and at Metro's transfer stations. Revenue from the system fee does not cover any of Metro direct cost for disposal and processing.

Figure 18 presents the tonnage subject to the full system fee (currently $17.81 per ton), in total and by component, for the last two, current and next fiscal years. Tonnage grew from 1.32 million tons in FY 2016-17 to almost 1.4 million tons in FY 2017-18, and growth was strong within all components. Tonnage growth is expected to continue, reaching almost 1.46 million tons this year, and 1.48 million in FY 2019-20. Compared to last year's forecast for FY 2018-19 (marked "budget" in the table below), the FY 2019-20 forecast would imply an increase in system fee receipts to the Solid Waste Fund by about $1.8 million at the current system fee rate.

Figure 18: Tonnage Subject to the Regional System Fee

	Fiscal Year-Ending (Jul 1 - Jun 30)				
	2017	**2018**	**2019**		**2020**
	actuals	*actuals*	*budget* *	*forecast*	*forecast*
Public Core					
Tons	523,199	532,333	509,686	550,843	556,780
Change (%)	*2.7*	*1.7*	*(4.3)*	*3.5*	*1.1*
Private Core (ID)					
Tons	706,842	755,745	769,529	792,583	801,152
Change (%)	*8.6*	*6.9*	*1.8*	*4.9*	*1.1*
Private Special					
Tons	93,000	111,624	94,499	115,280	119,338
Change (%)	*(21.9)*	*20.0*	*(15.3)*	*3.3*	*3.5*
Subject to System Fee					
Tons	**1,323,040**	**1,399,702**	**1,373,714**	**1,458,706**	**1,477,270**
Change (%)	***3.4***	***5.8***	***(1.9)***	***4.2***	***1.3***

Solid Waste Excise Tax

The Solid Waste Excise Tax is also a specific charge assessed on wet and dry discards that are generated in the Metro region and ultimately disposed. The same tonnage that incurs the full system fee also incurs the full excise tax, plus some additional wet waste generated outside of the Metro region that get delivered to in-region private transfer stations. The revenue from the excise

tax contributes toward Metro general government activities, including agency administration and the Metro Council. Like the system fee, the excise tax is collected at the same disposal sites, and does not cover any of Metro's direct costs for disposal and processing.

Figure 19 presents the tonnage subject to the full excise tax (currently $12.41 per ton), for the last two, current and next fiscal years. Since tonnage here is highly dependent on that which incurs the system fee, tonnage is expected to continue to grow this and next fiscal year, reaching 1.5 million tons in FY 2019-20. At the current tax rate, this would imply an increase of almost $1.4 million in excise tax receipts to the General Fund next year, over what is currently budgeted for this year.

Figure 19: Tonnage Subject to the Solid Waste Excise Tax

	Fiscal Year-Ending (Jul 1 - Jun 30)				
	2017	**2018**	**2019**		**2020**
	actuals	*actuals*	*budget* *	*forecast*	*forecast*
Subject to System Fee					
Tons	1,323,040	1,399,702	1,373,714	1,458,706	1,477,270
Change (%)	*3.4*	*5.8*	*(1.9)*	*4.2*	*1.3*
Private Core (OD)					
Tons	16,437	20,459	18,134	24,513	25,040
Change (%)	*26.7*	*24.5*	*(11.4)*	*19.8*	*2.2*
Subject to Excise Tax					
Tons	**1,339,477**	**1,420,161**	**1,391,848**	**1,483,219**	**1,502,310**
Change (%)	***3.6***	***6.0***	***(2.0)***	***4.4***	***1.3***

Community Enhancement Fee

The enhancement fee is a specific pass-through fee on certain types of solid waste delivered to regional solid waste facilities, collected on behalf of the communities in which those facilities are located. The revenue collected from Metro's enhancement fee is allocated to community enhancement projects in the cities that host these solid waste facilities, based on the recommendations of local committees that annually review applications for funding.

Figure 20 presents the tonnage subject to the enhancement fee (fixed in Metro code at $1.00 per ton) by host facility, for the last two, current and next fiscal years. As discussed previously, a new regional processing facility is expected to start receiving source-separated commercial food waste in 2020. This new facility would collect and remit the enhancement fee directly to Metro. In addition to source-separated food, wet waste (delivered to private and public transfer stations) incurs the enhancement fee, as does dry waste, source-separated wood, and yard debris (delivered to public transfer stations only). Given the growth and distributional expectations for those waste streams presented in the preceding sections, growth, both in sign and magnitude, is expected to vary by account. Overall, however, tonnage should grow from 1.05 million tons in FY 2017-18 to 1.08 million tons in FY 2018-19, and then again to 1.10 million tons in FY 2019-20.

Figure 20: Tonnage Subject to the Community Enhancement Fee

	Fiscal Year-Ending (Jul 1 - Jun 30)				
	2017	**2018**	**2019**		**2020**
	actuals	*actuals*	*budget*	*forecast*	*forecast*
Forest Grove	125,655	122,561	128,895	126,082	102,062
Gresham	11,656	24,771	23,901	35,747	47,592
Pride	78,504	80,892	84,908	83,214	78,997
Suttle Road	28,121	29,631	26,864	32,330	38,406
Troutdale	87,501	97,562	99,260	100,146	122,121
WRI	93,035	87,093	97,198	84,369	87,999
Metro Central	288,593	287,650	272,346	292,944	301,579
Metro South	314,138	319,218	314,846	326,113	323,488
New Facility*	0	0	0	0	3,198
Total Tons	**1,027,204**	**1,049,378**	**1,048,218**	**1,080,945**	**1,105,442**
Change (%)	***4.5***	***2.2***	***(0.1)***	***3.0***	***2.3***

* Assumed new regional commercial food waste processor, coincident with sunrise of Business Food Waste Program.

Metro Disposal Utility-Related Tonnage

Tonnage Charges

Metro assesses tonnage charges for each of five incoming streams of waste to its transfer stations, in order to cover the variable operating costs associated with consolidating, processing, transport and disposal of each stream. Currently, those streams and their associated charges are:

- Mixed solid waste, or MSW (i.e. wet and dry discards): $64.41 per ton
- Clean Wood: $56.84 per ton
- Yard Debris: $48.62 per ton
- Residential Organics (i.e. Residential food mixed with yard debris): $66.08 per ton
- Commercial Organics (i.e. Commercial food waste): $65.23 per ton

Figure 21 presents the total tonnage subject to tonnage charges for each stream (tonnage for Metro Central and Metro South are combined for each stream), for the last two, current and next fiscal years.

Figure 21: Tonnage Subject Metro Tonnage Charges

	Fiscal Year-Ending (Jul 1 - Jun 30)				
	2017	**2018**	**2019**		**2020**
	actuals	*actuals*	*budget* *	*forecast*	*forecast*
MSW					
Tons	**523,199**	**532,333**	**509,686**	**550,843**	**556,780**
Change (%)	*2.7*	*1.7*	*(4.3)*	*3.5*	*1.1*
Clean Wood					
Tons	**1,404**	**2,291**	**2,550**	**1,827**	**1,844**
Change (%)	*55.5*	*63.2*	*11.3*	*(20.2)*	*0.9*
Yard Debris					
Tons	**12,402**	**13,955**	**13,645**	**13,405**	**13,389**
Change (%)	*(8.4)*	*12.5*	*(2.2)*	*(3.9)*	*(0.1)*
Residential Org.					
Tons	**51,439**	**44,658**	**49,253**	**38,292**	**36,471**
Change (%)	*6.2*	*(13.2)*	*10.3*	*(14.3)*	*(4.8)*
Commercial Org.					
Tons	**14,287**	**13,621**	**12,058**	**14,690**	**16,585**
Change (%)	*1.5*	*(4.7)*	*(11.5)*	*7.8*	*12.9*

MSW, or the combination of wet and dry waste delivered to Metro's two transfer stations, has been growing and should reach almost 557,000 tons in FY 2019-20. Clean wood and yard debris should see FY 2019-20 tonnage levels of about 1,800 and 13,000, respectively, which is not significantly different from previous years. Deliveries of residential organics should see declines in FY 2019-20, given the forecast's distributional assumptions about a relatively expanding private sector role. On

the other hand, deliveries of commercial organics should see gains next fiscal year, as the Business Food Waste Program is expected to capture additional food waste from the commercial sector. Tonnage for this stream in FY 2019-20 should be between 16,000 and 17,000.

Transaction Fees

To cover the fixed operating costs associated with each stream, namely transaction costs and costs associated with operating its scalehouses, Metro assesses two separate transaction fees (one for customers using its automated scalehouses, and one for customers using its staffed scalehouses), and a minimum load charge (for customers with loads of 360 pounds or less, using its staffed scalehouses), on each load of waste to its transfer stations. Currently, the transaction fees are the same across waste streams, while the minimum load charges vary by stream, as follows:

- Automated scalehouse: $2.00 per load
- Staffed scalehouse: $10.00 per load
- Minimum load charges: Mixed solid waste ($28.00 per load), Clean Wood ($20.00 per load), Yard Debris ($19.00 per load), Residential Organics ($22.00 per load) and Commercial Organics ($22.00 per load)

Figure 22 presents the automated scale, staffed scale and total minimum weight loads for the last two, current and next fiscal years. In keeping with a general expansion of tons across streams and no expected significant changes to vehicle payloads in the forecast horizon, load counts are also expected to grow. By FY 2019-20, Metro's automated scales should see about 110,000 loads and its staffed scales should see almost 305,000 loads. Minimum weight loads should increase to about 111,000 loads in FY 2019-20.

Figure 22: Loads Subject to Metro Transaction Fees

	Fiscal Year-Ending (Jul 1 - Jun 30)				
	2017	**2018**	**2019**		**2020**
	actuals	*actuals*	*budget* *	*forecast*	*forecast*
Auto Scale					
Loads	**98,267**	**104,597**	**97,551**	**107,962**	**109,880**
Change (%)	*1.6*	*6.4*	*(6.7)*	*3.2*	*1.8*
Staffed Scale					
Loads	**266,097**	**288,101**	**293,535**	**301,672**	**304,927**
Change (%)	*1.9*	*8.3*	*1.9*	*4.7*	*1.1*
Min Weight					
Loads	**95,882**	**104,383**	**107,243**	**109,036**	**110,856**
Change (%)	*15.0*	*8.9*	*2.7*	*4.5*	*1.7*

Transport and Disposal

Metro's costs for transport and disposal of ***outgoing*** waste to Columbia Ridge Landfill are recovered by the tonnage charges assessed on ***incoming*** wastes described above. But for good measure, and mostly to estimate the costs, for budgeting purposes, of its major trucking, fuel and disposal contracts, the forecast yields estimates of tonnage subject to these transport and disposal costs. The prices and rates (which, when multiplied by the tonnage and load units below) that determine these costs are contained in Metro's cost model, and are beyond the scope here.

Figure 23 presents the outgoing tons and loads (which determine Metro's trucking and fuel costs) of waste from Metro transfer stations to its disposal contractor, Waste Management, along with the additional waste from private facilities that contribute to Metro's declining block disposal costs. These data are provided for the last two, current and next fiscal years.

Figure 23: Tons, Loads Subject to Transport and Disposal Costs

	Fiscal Year-Ending (Jul 1 - Jun 30)				
	2017	**2018**	**2019**		**2020**
	actuals	*actuals*	*budget* *	*forecast*	*forecast*
WM-Bound Waste					
From Metro					
Tons	503,326	498,493	489,754	540,274	544,917
Loads	**14,882**	**14,948**	**14,328**	**16,043**	**15,794**
From Private					
Tons	384,939	372,678	417,298	343,020	185,495
Total					
Tons	**888,264**	**871,171**	**907,052**	**883,293**	**730,412**
Change (%)	***6.9***	***(1.9)***	***4.1***	***1.4***	***(17.3)***

For Metro's trucking and fuel cost outlook, in fiscal years 2016-17 and 2017-18, Metro shipped about 15,000 loads to Columbia Ridge Landfill through its contractor, Walsh Trucking. This year, due to slightly lower payloads and higher expected tonnage, loads should increase to about 16,000. In FY 2019-20, tonnage to Columbia Ridge is expected to continue to grow, but average payloads should also nudge up, decreasing loads to about 15,800.

For Metro's disposal cost outlook, the end of CY 2019 marks the end of Metro's current disposal contract with Waste Management, the owner of Columbia Ridge Landfill. As a result, the tonnage subject to Metro's disposal costs in FY 2019-20 (about 730,000 tons) will only include waste from Metro's own transfer stations, plus waste from private facilities for the last half of 2019 only.

Allocatable Tonnage

The total regional tonnage available for allocation to private franchised or designated transfer stations is the portion of wet discards that are generated in the Metro region.

Figure 24 presents the total allocatable tonnage for the last two, current and next CYs. After growing by 4.5 percent in 2016 to almost 719,000 tons, growth decelerated in 2017 to 2.2 percent, and the data so far in 2018 suggest continued deceleration in growth, but growth nonetheless. This year, available tonnage should reach about 742,000 tons. In 2019, however, moderate growth should continue, and available tonnage should reach almost 760,000 tons.

Figure 24: Regional Allocatable Tonnage

	Calendar Year				
	2016	**2017**	**2018**		**2019**
	actuals	*actuals*	*budget* *	*forecast*	*forecast*
Total					
Tons	**718,993**	**734,742**	**747,236**	**741,829**	**759,567**
Change (%)	*4.5*	*2.2*	*1.7*	*1.0*	*2.4*

Appendix A: Detailed Forecast Data

Table A1: Delivery Tonnage – Last Forecast Performance

(tons, unless otherwise specified)	Cumulative Oct-17* - Aug-18** Totals	Difference Tons	Difference %	Analysis Controlling Parameters Actual	Last FC	Diff
Delivery Tonnage						
Private Core						
Wet				*Private Share of Reg. Wet*		
Actual	428,921	-34,188	(7.4)	*58.6%*	*62.5%*	*-3.9%*
Last FC	463,109					
Dry				*Private Share of Reg. Dry*		
Actual	427,345	9,784	2.3	*69.3%*	*70.5%*	*-1.2%*
Last FC	417,561					
Total				*Private Share of Reg. Core*		
Actual	856,265	-24,405	(2.8)	*63.5%*	*66.1%*	*-2.6%*
Last FC	880,670					
Metro Core						
Wet				*Metro Share of Reg. Wet*		
Actual	302,949	25,469	9.2	*41.4%*	*37.5%*	*3.9%*
Last FC	277,480					
Dry				*Metro Share of Reg. Dry*		
Actual	189,297	14,903	8.5	*30.7%*	*29.5%*	*1.2%*
Last FC	174,394					
Total				*Metro Share of Reg. Core*		
Actual	492,246	40,372	8.9	*36.5%*	*33.9%*	*2.6%*
Last FC	451,874					
Regional Core						
Wet				*Wet Share of Reg. Core*		
Actual	731,870	-8,719	(1.2)	*54.3%*	*55.6%*	*-1.3%*
Last FC	740,589					
Dry				*Dry Share of Reg. Core*		
Actual	616,641	24,686	4.2	*45.7%*	*44.4%*	*1.3%*
Last FC	591,955					
Total						
Actual	1,348,511	15,967	1.2			
Last FC	1,332,544					

*First period of last year's forecast; **Last period of actual data

Table A2: Delivery Tonnage – Calendar Year

(tons, unless otherwise specified)

	Calendar Year											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Delivery Tonnage												
Private Core												
Wet	406,757	415,438	436,527	460,331	465,928	497,677	486,452	493,827	501,501	512,674	525,973	538,392
Change	2.2	2.1	5.1	5.5	1.2	6.8	(2.3)	1.5	1.6	2.2	2.6	2.4
Dry	330,563	365,675	437,748	445,938	470,625	471,148	478,839	485,183	493,925	501,312	509,457	519,039
Change	6.7	10.6	19.7	1.9	5.5	0.1	1.6	1.3	1.8	1.5	1.6	1.9
Total	737,319	781,113	874,274	906,270	936,553	968,825	965,291	979,010	995,426	1,013,986	1,035,430	1,057,431
Change	4.2	5.9	11.9	3.7	3.3	3.4	(0.4)	1.4	1.7	1.9	2.1	2.1
Metro Core												
Wet	304,643	322,088	339,189	336,535	337,725	326,614	348,680	352,801	357,468	365,000	374,281	382,914
Change	6.2	5.7	5.3	(0.8)	0.4	(3.3)	6.8	1.2	1.3	2.1	2.5	2.3
Dry	143,798	163,916	180,458	188,276	211,756	217,536	221,087	224,016	228,052	231,462	235,223	239,647
Change	12.0	14.0	10.1	4.3	12.5	2.7	1.6	1.3	1.8	1.5	1.6	1.9
Total	448,442	486,004	519,646	524,811	549,481	544,149	569,766	576,817	585,520	596,462	609,504	622,562
Change	8.0	8.4	6.9	1.0	4.7	(1.0)	4.7	1.2	1.5	1.9	2.2	2.1
Regional Core												
Wet	711,400	737,526	775,715	796,867	803,652	824,291	835,132	846,628	858,970	877,674	900,254	921,306
Change	3.8	3.7	5.2	2.7	0.9	2.6	1.3	1.4	1.5	2.2	2.6	2.3
Dry	474,361	529,591	618,205	634,214	682,381	688,684	699,926	709,199	721,977	732,774	744,681	758,686
Change	8.3	11.6	16.7	2.6	7.6	0.9	1.6	1.3	1.8	1.5	1.6	1.9
Total	1,185,761	1,267,117	1,393,921	1,431,081	1,486,034	1,512,975	1,535,058	1,555,827	1,580,946	1,610,448	1,644,935	1,679,993
Change	5.6	6.9	10.0	2.7	3.8	1.8	1.5	1.4	1.6	1.9	2.1	2.1

Table A3: Delivery Tonnage – Fiscal Year

(tons, unless otherwise specified)

	Fiscal Year											
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Delivery Tonnage												
Private Core												
Wet	405,945	405,289	425,489	447,374	467,849	481,597	492,096	490,119	497,643	507,056	519,286	532,148
Change	0.4	(0.2)	5.0	5.1	4.6	2.9	2.2	(0.4)	1.5	1.9	2.4	2.5
Dry	323,768	341,403	410,171	441,031	460,175	471,709	474,942	481,968	489,495	497,568	505,329	514,183
Change	8.5	5.4	20.1	7.5	4.3	2.5	0.7	1.5	1.6	1.6	1.6	1.8
Total	729,713	746,692	835,659	888,405	928,024	953,306	967,038	972,087	987,138	1,004,625	1,024,616	1,046,331
Change	3.8	2.3	11.9	6.3	4.5	2.7	1.4	0.5	1.5	1.8	2.0	2.1
Metro Core												
Wet	293,713	316,289	336,499	341,067	329,163	335,334	337,477	350,709	355,099	361,176	369,569	378,531
Change	6.6	7.7	6.4	1.4	(3.5)	1.9	0.6	3.9	1.3	1.7	2.3	2.4
Dry	135,075	155,438	172,787	182,132	203,171	215,508	219,303	222,544	226,024	229,749	233,334	237,425
Change	10.2	15.1	11.2	5.4	11.6	6.1	1.8	1.5	1.6	1.6	1.6	1.8
Total	428,788	471,727	509,286	523,199	532,333	550,843	556,780	573,253	581,123	590,925	602,903	615,956
Change	7.7	10.0	8.0	2.7	1.7	3.5	1.1	3.0	1.4	1.7	2.0	2.2
Regional Core												
Wet	699,658	721,578	761,988	788,441	797,012	816,931	829,573	840,827	852,741	868,232	888,855	910,679
Change	2.9	3.1	5.6	3.5	1.1	2.5	1.5	1.4	1.4	1.8	2.4	2.5
Dry	458,843	496,841	582,957	623,163	663,346	687,217	694,245	704,513	715,519	727,318	738,664	751,608
Change	9.0	8.3	17.3	6.9	6.4	3.6	1.0	1.5	1.6	1.6	1.6	1.8
Total	1,158,500	1,218,419	1,344,945	1,411,604	1,460,357	1,504,148	1,523,817	1,545,340	1,568,261	1,595,550	1,627,519	1,662,287
Change	5.2	5.2	10.4	5.0	3.5	3.0	1.3	1.4	1.5	1.7	2.0	2.1

Table A4: Delivery Tonnage – Current versus Previous Forecast

Current *minus* Previous Forecast

(tons, unless otherwise specified)

	Calendar Year						Fiscal Year					
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Delivery Tonnage												
Private Core												
Wet	(10,711)	(10,986)	(25,547)	(22,183)	(19,376)	(11,757)	(15,898)	(18,224)	(23,872)	(20,785)	(15,586)	(6,481)
Change	(2.2)	(2.2)	(5.0)	(4.3)	(3.7)	(2.2)	(3.2)	(3.6)	(4.6)	(4.0)	(3.0)	(1.2)
Dry	5,411	(7,204)	(2,640)	522	8,927	14,954	3,482	(4,942)	(1,069)	4,669	11,904	18,887
Change	1.2	(1.5)	(0.5)	0.1	1.8	3.1	0.7	(1.0)	(0.2)	1.0	2.5	3.9
Total	(5,299)	(18,190)	(28,187)	(21,661)	(10,450)	3,197	(12,415)	(23,166)	(24,942)	(16,116)	(3,682)	12,406
Change	(0.6)	(1.8)	(2.8)	(2.2)	(1.0)	0.3	(1.3)	(2.3)	(2.5)	(1.6)	(0.4)	1.2
Metro Core												
Wet	11,268	9,043	25,257	21,000	15,957	15,164	16,118	17,032	23,172	18,530	15,577	16,257
Change	3.5	2.8	7.8	6.3	4.7	4.3	5.0	5.3	7.1	5.5	4.5	4.6
Dry	6,267	17,094	19,335	20,930	24,825	27,666	15,738	18,215	20,135	22,869	26,242	29,502
Change	3.0	8.5	9.6	10.3	12.2	13.6	7.9	9.1	9.9	11.3	12.9	14.5
Total	17,535	26,136	44,592	41,931	40,783	42,830	31,856	35,248	43,307	41,399	41,819	45,759
Change	3.3	5.0	8.5	7.8	7.5	7.7	6.1	6.8	8.2	7.7	7.6	8.2
Regional Core												
Wet	558	(1,943)	(290)	(1,183)	(3,419)	3,407	221	(1,192)	(700)	(2,255)	(9)	9,776
Change	0.1	(0.2)	(0.0)	(0.1)	(0.4)	0.4	0.0	(0.1)	(0.1)	(0.3)	(0.0)	1.1
Dry	11,679	9,890	16,695	21,452	33,752	42,620	19,220	13,273	19,066	27,538	38,146	48,389
Change	1.7	1.5	2.4	3.1	4.9	6.2	2.9	1.9	2.8	4.0	5.5	7.0
Total	12,236	7,946	16,405	20,269	30,333	46,027	19,440	12,082	18,365	25,283	38,137	58,165
Change	0.8	0.5	1.1	1.3	2.0	2.9	1.3	0.8	1.2	1.6	2.4	3.7

Table A5: Revenue Tonnage and Other Aggregates – Last Forecast Performance

(tons, unless otherwise specified)	Cumulative Oct-17* - Aug-18**			Analysis		
		Difference		Controlling Parameters		
	Totals	Tons	%	Actual	Last FC	Diff
Revenue Tonnage						
Private Core				*Avg. PC Recovery Rates*		
Actual	710,247	19,259	2.8	*17.1%*	*21.5%*	*-4.5%*
Last FC	690,988					
Metro Core				*Metro Share of Reg. Core*		
Actual	492,246	40,372	8.9	*36.5%*	*33.9%*	*2.6%*
Last FC	451,874					
Regional Core						
Actual	1,202,493	59,631	5.2			
Last FC	1,142,862					
Solid Waste Fund-related						
Actual	1,308,293	80,358	6.5			
Last FC	1,227,935					
General Fund-related						
Actual	1,328,849	84,409	6.8			
Last FC	1,244,440					
Other Tonnage						
Subject to Reg. Allocation				*Out-Dist. % of Reg. Wet*		
Actual	674,974	-5,083	(0.7)	7.8%	8.2%	-0.4%
Last FC	680,057					
Subject to Disposal Costs						
Actual	809,278	-18,339	(2.2)			
Last FC	827,616					
Subject to Com. Enhancement Fee						
Actual	972,653	27,170	2.9			
Last FC	945,483					

*First period of last year's forecast; **Last period of actual data

Table A6: Revenue Tonnage and Other Aggregates – Calendar Year

(tons, unless otherwise specified)

	Calendar Year											
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenue Tonnage												
Private Core	564,299	595,506	696,970	723,540	773,866	804,478	797,765	807,638	820,048	834,766	852,149	869,901
Change	2.2	5.5	17.0	3.8	7.0	4.0	(0.8)	1.2	1.5	1.8	2.1	2.1
Metro Core	448,442	486,004	519,646	524,811	549,481	544,149	569,766	576,817	585,520	596,462	609,504	622,562
Change	8.0	8.4	6.9	1.0	4.7	(1.0)	4.7	1.2	1.5	1.9	2.2	2.1
Regional Core	1,012,741	1,081,510	1,216,617	1,248,352	1,323,347	1,348,627	1,367,532	1,384,455	1,405,568	1,431,228	1,461,653	1,492,462
Change	4.7	6.8	12.5	2.6	6.0	1.9	1.4	1.2	1.5	1.8	2.1	2.1
Total Solid Waste Fund-related	1,095,657	1,182,285	1,326,610	1,349,307	1,435,812	1,467,240	1,487,547	1,505,773	1,528,089	1,554,852	1,586,280	1,617,992
Change	4.3	7.9	12.2	1.7	6.4	2.2	1.4	1.2	1.5	1.8	2.0	2.0
Total General Fund-related	1,106,692	1,194,423	1,341,295	1,366,990	1,459,344	1,491,876	1,513,013	1,532,196	1,555,337	1,582,972	1,615,294	1,647,857
Change	4.3	7.9	12.3	1.9	6.8	2.2	1.4	1.3	1.5	1.8	2.0	2.0
Other Tonnage												
Subject to Reg. Allocation	665,048	687,824	718,993	734,742	741,829	759,567	768,228	777,211	787,383	803,799	824,029	842,845
Change	3.8	3.4	4.5	2.2	1.0	2.4	1.1	1.2	1.3	2.1	2.5	2.3
Subject to Disposal Costs	735,947	787,569	858,392	881,049	883,353	883,238	558,845	565,750	574,254	585,028	597,884	610,723
Change	5.6	7.0	9.0	2.6	0.3	(0.0)	(36.7)	1.2	1.5	1.9	2.2	2.1
Subject to Com. Enhancement Fee	649,450	822,014	1,006,475	1,037,942	1,071,176	1,082,977	1,129,107	1,155,145	1,177,976	1,201,192	1,225,177	1,248,431
Change	5.6	26.6	22.4	3.1	3.2	1.1	4.3	2.3	2.0	2.0	2.0	1.9

Table A7: Revenue Tonnage and Other Aggregates – Fiscal Year

(tons, unless otherwise specified)

	Fiscal Year											
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Revenue Tonnage												
Private Core	564,488	565,468	651,133	706,842	755,745	792,583	801,152	802,656	813,786	827,340	843,378	860,944
Change	3.0	0.2	15.1	8.6	6.9	4.9	1.1	0.2	1.4	1.7	1.9	2.1
Metro Core	428,788	471,727	509,286	523,199	532,333	550,843	556,780	573,253	581,123	590,925	602,903	615,956
Change	7.7	10.0	8.0	2.7	1.7	3.5	1.1	3.0	1.4	1.7	2.0	2.2
Regional Core	993,276	1,037,194	1,160,419	1,230,041	1,288,078	1,343,426	1,357,932	1,375,909	1,394,909	1,418,265	1,446,281	1,476,900
Change	5.0	4.4	11.9	6.0	4.7	4.3	1.1	1.3	1.4	1.7	2.0	2.1
Total Solid Waste Fund-related	1,071,864	1,126,841	1,279,567	1,323,040	1,399,702	1,458,706	1,477,270	1,496,599	1,516,850	1,541,357	1,570,424	1,601,994
Change	3.6	5.1	13.6	3.4	5.8	4.2	1.3	1.3	1.4	1.6	1.9	2.0
Total General Fund-related	1,082,861	1,138,293	1,292,541	1,339,477	1,420,161	1,483,219	1,502,310	1,522,531	1,543,674	1,569,029	1,598,979	1,631,422
Change	3.7	5.1	13.6	3.6	6.0	4.4	1.3	1.3	1.4	1.6	1.9	2.0
Other Tonnage												
Subject to Reg. Allocation	654,343	673,812	708,685	729,382	733,555	754,216	763,748	772,680	782,253	795,519	813,825	833,355
Change	3.0	3.0	5.2	2.9	0.6	2.8	1.3	1.2	1.2	1.7	2.3	2.4
Subject to Disposal Costs	706,700	760,626	831,250	888,264	871,171	883,293	730,412	562,268	569,966	579,596	591,403	604,250
Change	2.6	7.6	9.3	6.9	(1.9)	1.4	(17.3)	(23.0)	1.4	1.7	2.0	2.2
Subject to Com. Enhancement Fee	629,219	674,116	982,945	1,027,204	1,049,368	1,080,945	1,105,442	1,141,731	1,166,288	1,189,401	1,213,059	1,236,684
Change	3.9	7.1	45.8	4.5	2.2	3.0	2.3	3.3	2.2	2.0	2.0	1.9

Table A8: Revenue Tonnage and Other Aggregates – Current versus Previous Forecast

Current *minus* Previous Forecast

(tons, unless otherwise specified)

	Calendar Year						Fiscal Year					
	2018	**2019**	**2020**	**2021**	**2022**	**2023**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Revenue Tonnage												
Private Core	4,376	26,128	14,041	17,125	24,015	33,252	18,441	20,147	15,579	20,547	28,599	39,901
Change	0.6	3.4	1.8	2.2	3.0	4.1	2.4	2.6	2.0	2.6	3.6	5.0
Metro Core	17,535	26,136	44,592	41,931	40,783	42,830	31,856	35,248	43,307	41,399	41,819	45,759
Change	3.3	5.0	8.5	7.8	7.5	7.7	6.1	6.8	8.2	7.7	7.6	8.2
Regional Core	21,912	52,264	58,633	59,056	64,798	76,082	50,297	55,395	58,886	61,946	70,418	85,660
Change	1.7	4.0	4.5	4.5	4.8	5.6	3.9	4.3	4.5	4.6	5.2	6.3
Total Solid Waste Fund-related	26,019	75,696	82,198	82,753	88,627	100,044	67,908	78,914	82,536	85,727	94,330	109,703
Change	1.8	5.4	5.8	5.8	6.2	6.9	4.9	5.6	5.8	6.0	6.5	7.5
Total General Fund-related	27,548	82,254	89,542	91,206	98,021	110,579	72,788	85,855	90,419	94,637	104,277	120,827
Change	1.9	5.8	6.3	6.3	6.7	7.5	5.2	6.1	6.3	6.5	7.1	8.2
Other Tonnage												
Subject to Reg. Allocation	1,796	(1,312)	(1,686)	(5,641)	(10,462)	(6,902)	1,558	(1,591)	(3,620)	(8,000)	(8,672)	(2,271)
Change	0.2	(0.2)	(0.2)	(0.7)	(1.3)	(0.9)	0.2	(0.2)	(0.5)	(1.0)	(1.1)	(0.3)
Total Subject to Disposal Costs	(4,793)	(34,483)	(218,606)	(223,188)	(226,598)	(226,402)	(19,310)	(121,159)	(220,819)	(224,816)	(226,446)	(224,211)
Change	(0.5)	(3.8)	(28.1)	(28.3)	(28.3)	(27.9)	(2.1)	(14.2)	(28.2)	(28.3)	(28.1)	(27.5)
Subject to Com. Enhancement Fee	13,885	21,496	45,764	53,882	57,742	66,905	25,915	33,267	49,570	55,694	62,235	73,182
Change	1.3	2.0	4.2	4.9	5.2	5.9	2.5	3.1	4.5	5.0	5.5	6.4

Appendix B: FY 2019-20 Solid Waste Forecast Assumptions Questionnaire

FY 2019 - 20 Solid Waste Forecast

Forecast Assumptions Questionnaire

CY 2019 through CY 2025

Reviewer: _____

Date: _____

Note to Reviewer: **Please print, complete (parts in blue font) and return (scan/email or mail) by COB August 15, 2018. Feel free to use backside or additional pages as needed.**

Return to:

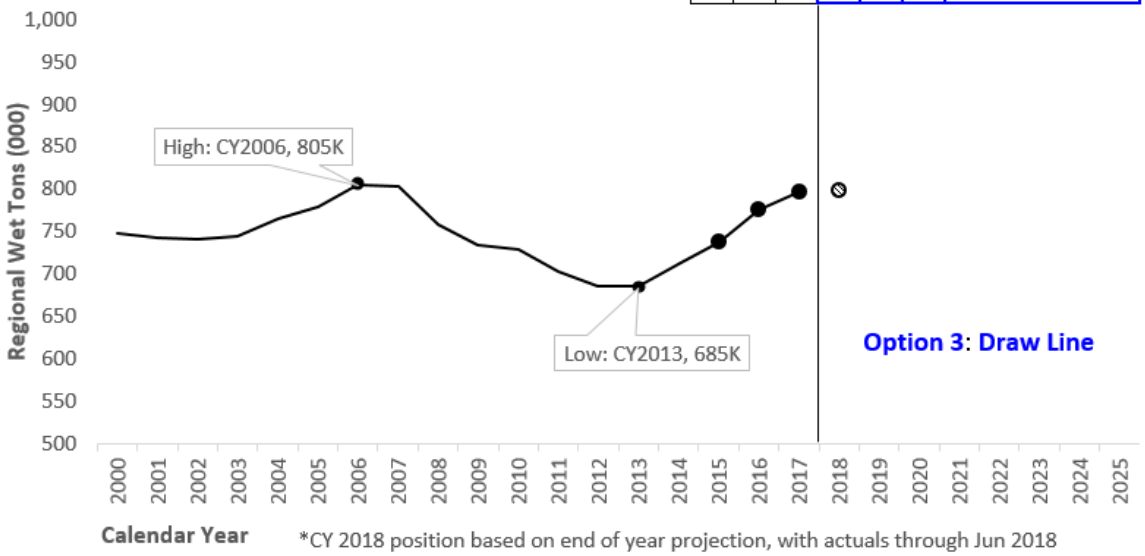
Joel Sherman
Metro
600 NE Grand Avenue
Portland, Oregon 97232
joel.sherman@oregonmetro.gov

Garbage

Please provide your judgement on the direction of solid waste tonnage (both wet and dry) from now through 2025 by filling in expected calendar year tons (Option 1), growth rates (Option 2), or by drawing the growth path directly on each graph (Option 3) below.

Regional Wet Discards

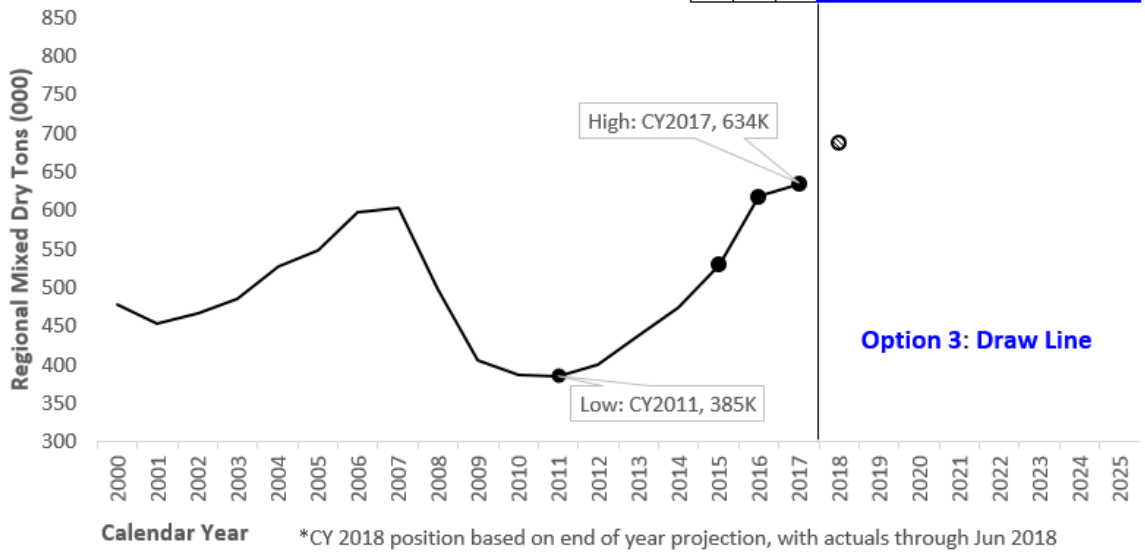
	Actuals			Short			Long
	2015	2016	2017	2018	2019	2020	2021 - 2025 Avg.
Option 1: Tons (thousands)	738	776	797				
Option 2: Annual Change (%)	3.7	5.2	2.7				



*CY 2018 position based on end of year projection, with actuals through Jun 2018

Regional Dry Discards

	Actuals			Short			Long
	2015	2016	2017	2018	2019	2020	2021 - 2025 Avg.
Option 1: Tons (thousands)	530	618	634				
Option 2: Annual Change (%)	11.6	16.7	2.6				



*CY 2018 position based on end of year projection, with actuals through Jun 2018

Recycling

Please provide any knowledge about new or expanding programs for each of the source-separated streams below, by completing the following tables.

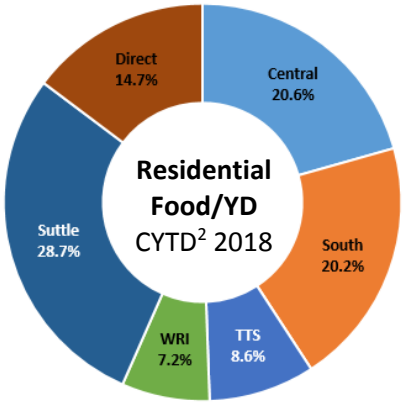
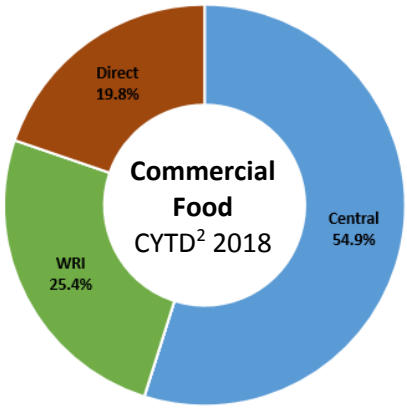
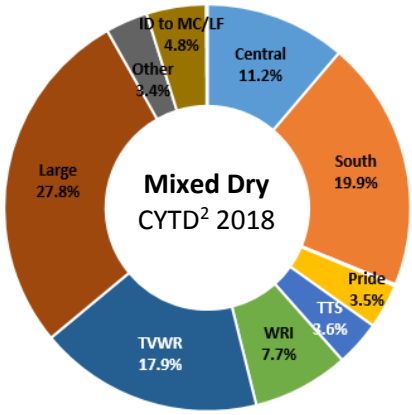
Residential Food Waste Mixed with Yard Debris		
Program	**Start (M, Y)**	**Approx. Annual Tons**
Existing: Cities of Portland, Lake Oswego, Forest Grove, Milwaukie Beaverton	11/2011 (pdx) 6/2016 (lo) 7/2016 (fg) 8/2017(mw) 10/2017(bv)	Total of all existing programs ~110,000/year
New/Expanded:_____	_____	_____
New/Expanded:_____	_____	_____
New/Expanded:_____	_____	_____
New/Expanded:_____	_____	_____
Comments:		

Commercial food scraps		
Program	**Start (M, Y)**	**Approx. Annual Tons**
Existing: Regional (various businesses)	Jan. 2007	24,000/year
New/Expanded:_____	_____	_____
New/Expanded:_____	_____	_____
New/Expanded:_____	_____	_____
New/Expanded:_____	_____	_____
Comments:		

Other Streams			
Stream/Program	**Start (M, Y)**	**Divert from… (wet or dry)**	**Approx. Annual Tons**
Stream/Program:_____	_____	_____	_____
Stream/Program:_____	_____	_____	_____
Stream/Program:_____	_____	_____	_____
Stream/Program:_____	_____	_____	_____
Comments:			

Facility Distributions

For each non-wet waste stream, please describe any known market or operational changes from now until 2025 that might affect the most recent shares observed at facilities, and by how much. *This may include new facility or non-system licensees, new mergers/acquisitions of existing haulers or facilities, or any events that may significantly modify facility operations.*

Recent Market Shares[1]	Issues affecting shares, how much & where
	
	
	

[1] Entities with less than 1% are suppressed, so slices may not add to 100%.

2 Data through June 2018.

o "Large" = ECR, Greenway, Suttle; "Other" = Aloha, CORE, KB, NW Shingle, Foster; "OD → LF" = Out-of-district direct to landfill; "ID to MC/LF" = In-district direct to landfill or burner.

For wet waste, facility distributions are determined by Metro tonnage allocations, along with how much (what percentage) those allocations get utilized. Please comment below on the assumed allocation methods for CY 2019 (Table 1) and all subsequent years (Table 2). In Table 3, provide your thoughts on utilization of allocations between 2019 and 2025, given actual utilizations over the last few years.

Table 1: CY 2019 Allocation

	CY 2018 Allocation	*div by*	Last FC CY 2018	*Eq*	Percent	*Tms*	CY 2019 Avail.	*Eq*	Allocation
GSS	23,687	/	747,236	=	3.17%	X	Forecast	=	Allocation
Pride	79,880	/	747,236	=	10.69%	X	Forecast	=	Allocation
Troutdale	79,880	/	747,236	=	10.69%	X	Forecast	=	Allocation
WRI	79,880	/	747,236	=	10.69%	X	Forecast	=	Allocation
Forest Grove	125,000	----------Fixed Tons---------->							Allocation
Canby	16,600	----------Fixed Tons---------->							Allocation
Vancouver	25,601	----------Fixed Tons---------->							Allocation
Covanta Marion	3,980	----------Fixed Tons---------->							Allocation

Comments:

Table 2: CY 2020 – 2025 Allocations

	CY 2020 Percent	*Tms*	Avail.	*Eq*	Allocation	CY 2021 - CY 2025
						ditto
GSS	Forecast	X	Forecast	=	Allocation	ditto
Pride	Forecast	X	Forecast	=	Allocation	ditto
Troutdale	Forecast	X	Forecast	=	Allocation	ditto
WRI	Forecast	X	Forecast	=	Allocation	ditto
Forest Grove	Forecast	X	Forecast	=	Allocation	ditto
Canby	Forecast	X	Forecast	=	Allocation	ditto
Vancouver	Forecast	X	Forecast	=	Allocation	ditto
Covanta Marion	---------Fixed Tons--------->				Allocation	ditto

Comments:

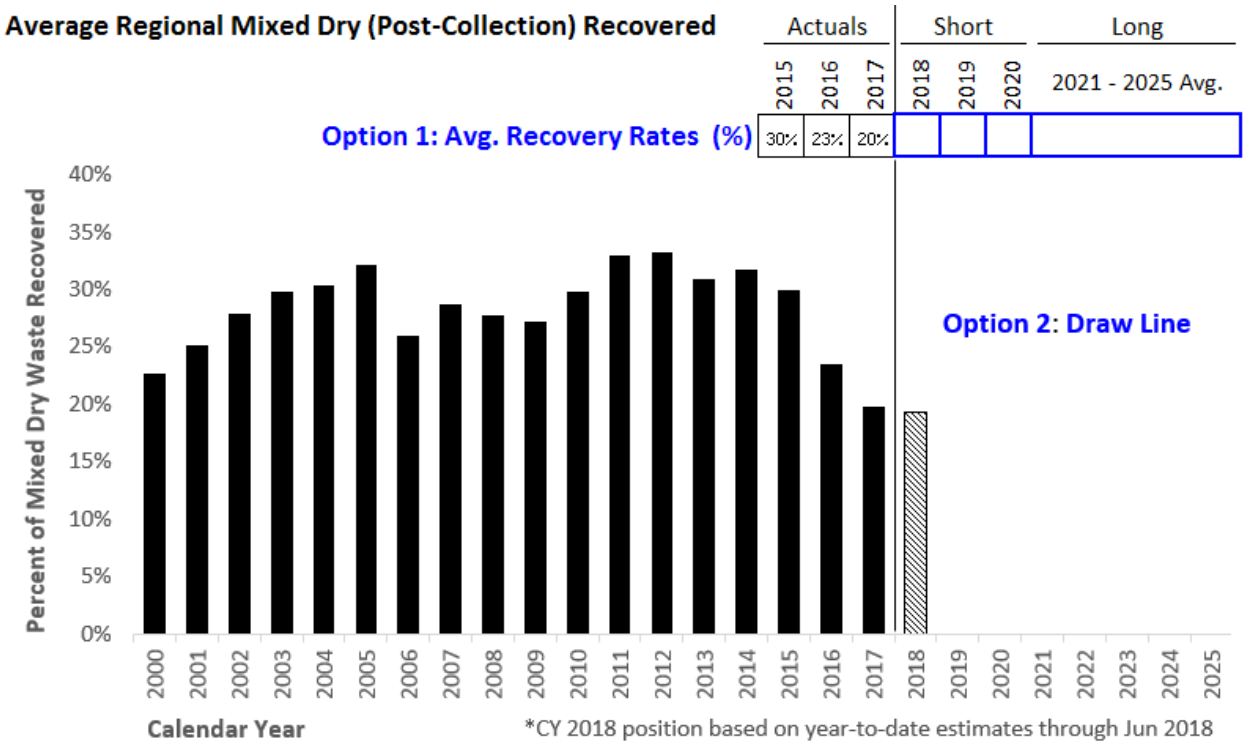
Table 3: Average Allocation Utilizations: Actual and Anticipated

CY 2015	CY 2016	CY 2017	CY 2018*	CY 2019 ----------CY 2025
93%	94%	93%	94%	**Comments:**

*CY 2018 based on end of year projection with actuals through May 2018

Post-Collection Recovery

Please provide your judgement on the direction and magnitude of mixed dry waste recovery rates by filling in expected calendar year rates (Option 1), or by drawing the growth path directly on the graph (Option 2) below. Below the graph, please provide any detailed comments on issues that might affect the rates at specific facilities or overall, and by how much.



Issues affecting post-collection diversion, how much and where…

Disposition

Please comment on the disposal assumptions for the solid waste forecast in the boxes below. These assumptions are similar to those made in last year's forecast, and guide the estimates of waste subject to various provisions (block disposal rates, flow guarantees) of Metro's disposal contract. These assumptions are largely irrelevant after calendar year 2019.

Disposal of MRF Residual

2018 ----------> 2025
• **Assumption:** Current processing residual flows from facilities to disposal sites will remain static, on a percentage basis, through the forecast horizon
Comments:

Disposal of Wet waste

2018 ----------> 2019	**2020 ----------> 2025**
• **Assumption:** Metro will continue to honor the flow guarantee provisions of its current contract with Waste Management. • **Assumption:** the provisions of Change Order 10 will ensure that any waste which switched from Riverbend to Coffin Butte landfill will be counted as if it was delivered to a Waste Management-owned landfill. • **Assumption:** Gresham transfer station and Waste Connection (WC) haulers will continue to deliver waste to WC-owned landfills.	• **Assumption:** Metro contracts with Waste Management for disposal services, however, no flow guarantee provisions exist (other than a guarantee of flow from Metro transfer stations), and Change Order 10 is terminated. • **Assumption:** Vertically-integrated (VI) transfer stations use their own landfills. Non-VI transfer stations will continue to use the landfills which they are using now through negotiated contracts.
Comments:	

Feedback

This questionnaire is a work-in-progress, and the Solid Waste Forecast strives for continuous improvement each year. Please provide any feedback below for improving this questionnaire, or the process as a whole, for next year. Thanks for your time!

Appendix C: Econometric Model of Waste Generation

Econometric Model of Waste Generation

Introduction

About a year ago, and under the guidance of the solid waste forecast review panel, the regression model used to forecast regional tonnage was re-specified and estimated directly on regional discards (as opposed to regional generation), and changed to a quarterly periodicity (as opposed to annual). An additional equation was added to forecast the quarterly "split" between putrescible (wet) and non-putrescible (mixed dry) discards. All of these changes were made to ensure the validity, reliability and precision of solid waste forecasts remains high, while adhering to the objectives of the forecast.

This is the second forecast made with Metro's latest regression models, as the first forecast was conducted last year as a parallel test with the old model. That test yielded consistent and high-quality results. This is the first year of actual implementation of the new modeling approach in the Solid Waste Forecast.

Overview

This document summarizes the model information, input assumptions and results of the latest macroeconomic models of regional solid waste tonnage. Conceptually, two models are employed to produce forecasts of regional (Tri-county) wet and dry wastes. The first model forecasts total regional core discards (DISPOSALCORE) while the second forecasts the share of core discards that are dry (DRY_SHARE). Dry and wet waste forecasts are then calculated as follows:

Equation 1: Dry waste model

$$Dry_t = DISPOSALCORE_t \times DRY\_SHARE_t$$

Equation 2: Wet waste model

$$Wet_t = DISPOSALCORE_t - Dry_t$$

The appendix is organized by model, and includes three sub-sections for each of the two regression models:

- **Model:** This section will describe the model's underlying macroeconomic theory in relation to solid waste, and will provide the equation and estimation diagnostics (from EViews) for the regression model.

- **Predictors:** This section will describe each of the model's predictor or right-hand-side (RHS) variables, including its historical and forecasted source and period, as well as any transformations made to it prior to model entry. This section will include a narrative and graphical analysis of the history and outlook for each RHS.

- **Outcome:** This section will describe the model's outcome or left-hand-side (LHS) variable, including its historical source and period, and transformations made prior to regression. This section will include a narrative and graphical analysis of the history and outlook for the LHS.

Core Discards

"Core" solid waste discards are the combination of municipal solid wastes (MSW), bulky wastes, and construction and demolition wastes (C&D) generated and discarded by households and businesses in the Metro region. The latter two types (bulky and C&D) tend to be non-putrescible (dry) wastes, while the former type (MSW) tends to be putrescible (wet) wastes because of some quantity of food material that makes its way into the stream. As such, core discards are those that arise from the consumption behaviors of homes, businesses and construction activities in the region, and are comprised of wet and dry wastes.

Model

The consumption behaviors of households and businesses in the region, and the implications of those behaviors on the amounts and types of wastes generated is difficult to measure, and even more difficult to forecast over time. The literature on the determinants of waste generation in a municipality yields a wide array of potential predictors, with some significant in one study, only to be shown insignificant in another. Population is a common indicator in studies, as more people in a municipality must generate more waste. However, given the observed cyclical nature of waste in the Metro region over time, population is not a strong predictor; it simply varies too little over time.

Instead, Metro's macro model of core discards uses aggregate measures of the economic conditions that buttress consumption, namely jobs and major asset prices. The regional core discards (DISPOSALCORE) equation projects growth in core tonnage discards as a function of the growth in total regional employment (EEXDPV) and national housing prices (PHU1OFHEOXRNS), plus an autoregressive term of order 1 to correct for serial correlation, which biases the equation. The equation is specified as a log-log regression, and estimated with a least squares regression method.

Equation 3

$$\log DISPOSALCORE_t = \alpha + \beta_1 \log(EEXDPV) + \beta_2 \log(PHU1OFHEOXRNS) + \rho(AR_1)$$

Model coefficients, standard errors and p-values are provided in the figure below, as are standard model diagnostic statistics. The model was re-estimated with core disposal through 2018 Q1.

Equation: EQ_DISPOSALCORE Workfile: GARBAGE::disposal0718\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LOG(DISPOSALCORE)
Method: ARMA Conditional Least Squares (Marquardt - EViews legacy)
Date: 07/19/18 Time: 16:08
Sample (adjusted): 1991Q2 2018Q1
Included observations: 108 after adjustments
Convergence achieved after 12 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.662221	2.671723	1.370734	0.1734
LOG(EEXDPV)	1.028450	0.391200	2.628964	0.0099
LOG(PHU1OFHEOXRNS)	0.342550	0.173176	1.978043	0.0506
AR(1)	0.970465	0.018886	51.38459	0.0000

R-squared	0.941668	Mean dependent var	12.60753
Adjusted R-squared	0.939986	S.D. dependent var	0.109194
S.E. of regression	0.026750	Akaike info criterion	-4.368222
Sum squared resid	0.074419	Schwarz criterion	-4.268884
Log likelihood	239.8840	Hannan-Quinn criter.	-4.327944
F-statistic	559.6359	Durbin-Watson stat	2.189780
Prob(F-statistic)	0.000000		

Inverted AR Roots	.97

Figure 1: Core Disposal equation

The re-estimated core disposal equation is highly stable as compared to the equation estimated in 2017. The estimated coefficients changed very little with the update in data and variable fits remained significant out past 2 standard deviations (or 95% confidence). Overall fit of the core disposal equation remains statistically significant as evidenced by an R-square value close in value to 1. The information criterion statistics (Akaike and Schwarz) show improvement in the latest model re-estimation. Autocorrelation – normally evident in time series regression equation – has been corrected using the lagged AR1 term. The Durbin-Watson statistic which is close in value to 2 is evidence of the correction made. The overall goodness of fit for all variables taken together is significant as evidenced by the F-statistic exceeding the 1% critical value. This is a very tight fitting model; we can expect the equation to perform reasonably well in forecasting short-term changes in core solid waste levels.

Predictors

The model has two RHS predictors, as described below.

- **Total Non-Farm Employment (EEXDPV):** Total non-farm payroll employment for the Portland MSA.

- *Historical Source:* Bureau of Labor Statistics (BLS) Current Employment Survey (CES) program. The BLS reports monthly employment estimates for the 7-county Portland MSA. Series is total (non-farm) employment for the Portland MSA (Series #SMU41389000000000001), through May 2018 (2018 Q1).

- *Forecast Source:* Portland State University (PSU) Northwest Economic Research Center (NERC). NERC is an independent research unit at PSU. According to NERC, the center aims to provide high-quality, unbiased research and analysis by drawing on the wealth of knowledge and expertise available at PSU. The center produces economic and demographic growth projections for the Portland MSA on a semi-annual basis. NERC's latest total (non-farm) employment forecast for the MSA is their March 2018 forecast release.

- *Data Transformations*: The BLS reports employment estimates for the MSA by month. These monthly data are seasonally-adjusted using the X-13 method developed by the US Census Bureau. Seasonally-adjusted monthly data are averaged over 3 months to yield quarterly data. Quarterly data undergo transformation to natural logarithms.

- Analysis: The employment outlook is slightly higher in the current forecast (orange line) than the one a year ago (blue-dotted line). Employment, a proxy for overall economic output, is believed to be directly correlated to waste disposal levels. More job growth is expected to yield greater waste disposal. Total nonfarm employment is expected to edge higher in the current regional forecast. The regional economy grew 0.3 percent faster in 2017, or about 4,000 more jobs than expected. Projected growth rates are about even between the current job forecast and the forecast from a year ago. A higher 2017 base year nudges the current forecast to edge higher in the short-run.

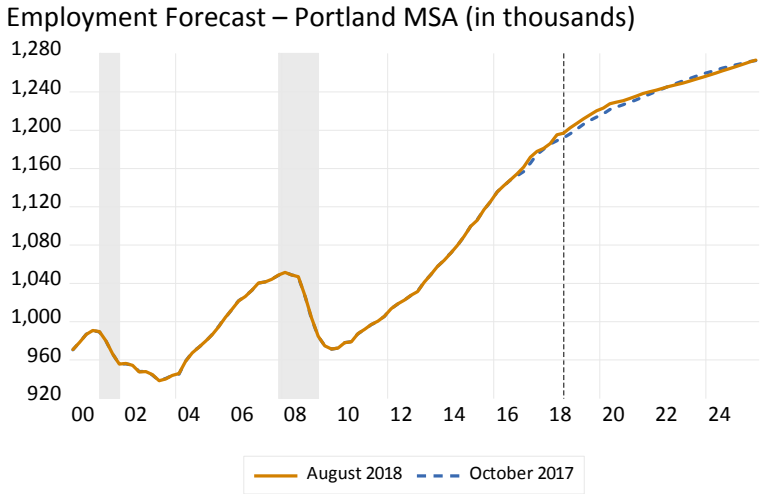


Figure 2
Source: BLS, NERC, Metro

- **Federal Housing Finance Administration (FHFA) House Price Index (HPI) <u>(PHU1OFHEOXRNS)</u>**
  The FHFA HPI is a broad measure of the movement of single-family house prices. The HPI is a weighted, repeat-sales index, meaning that it measures average price changes in repeat sales or refinancings on the same properties. This information is obtained by reviewing repeat mortgage transactions on single-family properties whose mortgages have been purchased or securitized by Fannie Mae or Freddie Mac since January 1975.

  - *<u>Historical Source</u>*: FHFA housing price index – purchase only for the US, through 2018 Q1.

  - *<u>Forecast Source</u>*: IHS Markit. IHS Markit is a national vendor of forecast products. According to IHS Markit, they are a team of economists, data scientists, financial experts and industry specialists whose expertise spans numerous industries, including leading positions in finance, energy and transportation. They provide forecast insights to businesses, financial institutions and government agencies to help each make informed decisions. IHS releases forecasts of U.S. growth conditions and trends on a monthly basis. The latest U.S. forecast is August 2018.

  - *<u>Data Transformations</u>*: Quarterly data (both historical and forecast) is received already seasonally adjusted by IHS Markit. The series is transformed to natural logarithms for the regression equation.

  - *<u>Analysis</u>*: IHS Markit has raised its projection level for the HPI. This is due to the likely prospect of an under production of housing units. A shortfall is likely to lead to higher housing prices as demand exceeds supply. The market will respond to higher housing prices by trying to increase housing construction which is believed to be a harbinger for waste disposal levels. The robust recovery has put more money in the hands of consumers and has returned many previously unemployed and underemployed workers back to full time employment status. This has released a pent up demand for housing which built up during the Great Recession. The August 2018 forecast of the FHFA housing price index (HPI) rose at a revised rate of 6.71 percent in 2017 as compared to 5.86 percent in the older forecast. The HPI is projected to grow faster in the current forecast up to 6.54 percent in 2018, and tapering off to 4.23 percent in 2019 and 3.35 percent in 2020. After 2020, the two forecasts reconcile and begin to converge.

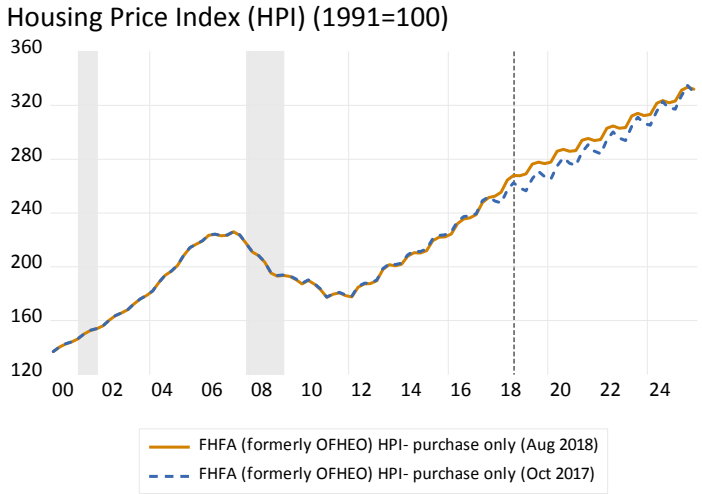


Figure 3

Source: FHFA, IHS Markit

Outcome: Core Discards Forecast

The model's LHS variable is tons of core discards for the Metro tri-county region (DISPOSALCORE).

- Historical Source: Metro's Solid Waste Information System (SWIS) tracks monthly deliveries of core discards to solid waste facilities in the region. Core discards are a composite of wet and dry discards from SWIS. Data is through May 2018 (2018 Q1).

- Data Transformations: Monthly core discards are seasonally-adjusted using the Census X-13 method, and summed over 3 months to yield quarterly data. Quarterly data are transformed by natural logarithms for modeling purposes.

- Analysis: The most recent job forecast from NERC indicates improved employment prospects, and the HPI forecast from IHS Markit predicts greater housing price appreciation. Taken together, the forecast assumptions project higher level of core waste disposal should be expected. The current core solid waste forecast is about 2.7 to 3.5 percent higher (or 10,000 to 14,000 tons more per year in the next 3 forecast years) than the forecast of a year ago. Driving this higher projection of total solid waste output are 1) a slightly greater nonfarm employment forecast, and 2) a housing price index that is projecting faster housing price appreciation.

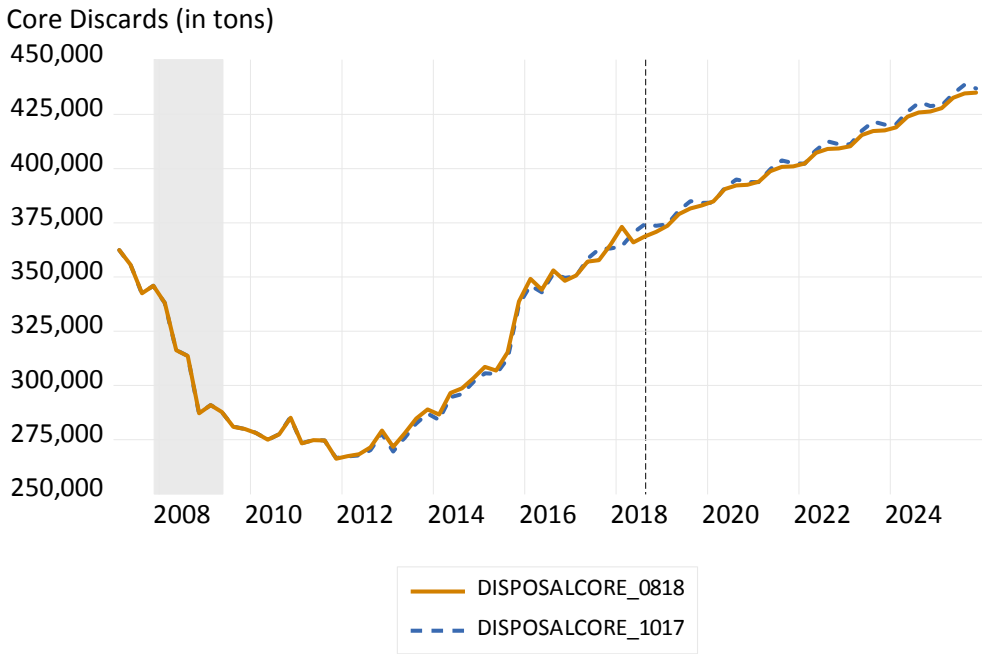


Figure 4

Source: Metro

Dry Share

The share (or percentage) of core solid waste discards that are dry informs the split of core waste into wet and dry components for the purpose of the solid waste forecast. Dry waste, again, is mainly composed of bulky waste from garage or office cleanouts and C&D (construction and debris) wastes from demolitions, new construction or remodels of homes and buildings. Dry waste is much more cyclical than wet waste.

Model

Due to its highly cyclical nature and relationship to construction wastes, Metro's model of the share of core discards that are dry uses economic indicators that follow the relative contribution of construction to economic growth. The equation projects growth in the dry share (DRY_SHARE) of core tonnage discards as a function of the growth in the proportion of construction industry employment to total employment (ECONPV/EEXDPV) in the region, national conventional mortgage interest rates (RMMTG30CON) and permits issued for the construction of residential units in the region (TOTALPERMITSPV). An autoregressive term of order 1 is also used to correct for serial correlation. The equation is specified as a log-log regression, and estimated with a least squares regression approach.

Equation 4

$$\log(DRYSHARE_t) = \alpha + \beta_1 \log\left(\frac{ECONPV_t}{EEXDPV_t}\right) + \beta_2 \log(RMMTG30CON_{t-4}) + \beta_3 \log(MAVG\_TOTALPERMITS_t) + \rho(AR_1)$$

A four-quarter lag, and a four-quarter moving average are indicated in RMMTG30CON and TOTALPERMITSPV, respectively, because the impact to the regional economy is delayed by the indicated number of quarters. For example, mortgage rates and building permits have a delayed impact on real economic events because they take time for its effects to transmit through various economic channels. The moving average implemented on TOTALPERMITSPV is lagged, in the form

Equation 5

$$\mathrm{MAVG\_TOTALPERMITSPV_t} = 0.25 \sum_{i=0}^{3} TOTALPERMITSPV_{t-i}$$

Model coefficients, standard errors and p-values are provided in the figure below, as are standard model diagnostic statistics. The model was estimated with dry shares through 2018 Q1. Estimation results of equation 4 are shown in figure 5.

Equation: EQ_DRY_SHARE Workfile: GARBAGE::dryshare0718\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LOG(DRY_SHARE)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 07/20/18 Time: 15:58
Sample: 2000Q1 2018Q1
Included observations: 73
Convergence achieved after 14 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.108817	0.460029	-0.236544	0.8137
LOG(ECONPV/EEXDPV)	0.428803	0.109053	3.932068	0.0002
LOG(RMMTG30CON(-4))	-0.142332	0.024152	-5.893207	0.0000
LOG(@MOVAV(TOTALPERMITSPV,4))	0.084704	0.019607	4.320146	0.0001
AR(1)	0.577015	0.107155	5.384882	0.0000
SIGMASQ	0.000470	0.000110	4.267226	0.0001

R-squared	0.920976	Mean dependent var	-0.926043
Adjusted R-squared	0.915078	S.D. dependent var	0.077651
S.E. of regression	0.022629	Akaike info criterion	-4.655049
Sum squared resid	0.034307	Schwarz criterion	-4.466792
Log likelihood	175.9093	Hannan-Quinn criter.	-4.580025
F-statistic	156.1681	Durbin-Watson stat	2.029968
Prob(F-statistic)	0.000000		

Inverted AR Roots	.58

Figure 5: Dry Share Disposal Equation

The re-estimated dry share equation is very stable as compared to the prior equation estimated in 2017. The estimated coefficients changed little between estimations; variable fits remained significant out past 3 standard deviations (or 99% confidence). Overall fit of the dry share equation remains statistically significant as evidenced by an R-square value above 0.9 – this is typical of time series regressions. The Akaike criterion became less efficient but the Schwarz criterion shows improvement in the latest model re-estimation. (It is not uncommon to see the critierion statistics to diverge slightly – divergence in the two information criterion are indeed very small.) Autocorrelation – normally evident in time series regression equation – has been corrected using the lagged AR1 term. (Sigmasq can be ignored. It is not part of the variable list in the equation, but is routinely generated by EViews as a diagnostic element.) The Durbin-Watson statistic is close in value to 2 which is evidence that the autocorrelation problem has been fixed. The overall goodness of fit for all variables taken together is significant as evidenced by the F-statistic exceeding the 1% critical value. The statistical fit is tight; we can expect the equation to forecast dry disposal tonnages reasonably well.

Predictors

The model has three RHS predictors as described below.

- **Ratio of Construction to Total Employment (ECONPV/EEXDPV)** Construction employment divided by total nonfarm payroll employment for the Portland MSA.

  - *Historical Source:* BLS CES. Ratio is of monthly construction employment in the MSA (Series #SMU41389002000000001) to annualized monthly total (non-farm) employment in the MSA (Series #SMU41389000000000001). Model is estimated on data through May 2018 (2018 Q1).

  - *Forecast Source*: NERC. March 2018 forecast release.

  - *Data Transformations*: Each monthly series is seasonally-adjusted using the Census X-13 method developed by the US Census Bureau. Each seasonally-adjusted series is averaged over 3 months to yield quarterly series. The ratio of the two series (construction to total employment) is calculated to yield one series, and multiplied by 100. The series is transformed to natural logarithms for modeling purposes.

  - *Analysis*: Actual proportion of construction jobs in the last 4 quarters lagged behind forecast expectations from a year ago. As a result, the NERC forecast takes a more moderate view of construction job trends. As the economy hits full-employment, achieving higher growth will become more difficult with shortages in skilled construction workers.

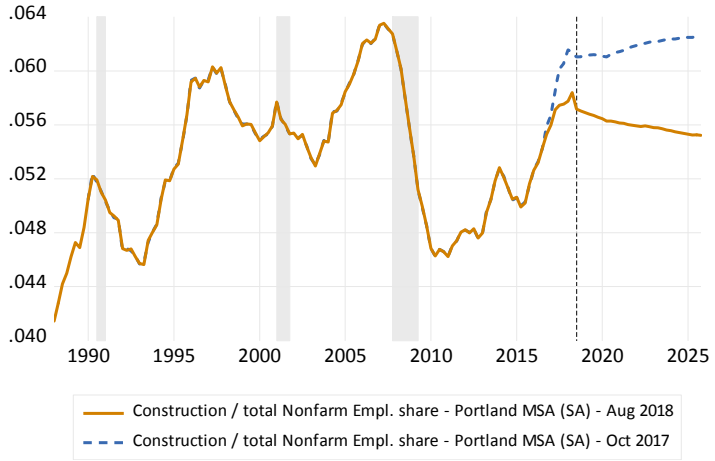


Figure 6

Source: BLS, Metro, IHS Markit

- **30-year Fixed Mortage Interest Rates (RMMTG30CON)** Average, conventional, 30-year fixed mortgage rates in the US.

  - *Historical Source:* Freddie Mac Primary Mortgage Market Survey (PMMS). The PMMS is a weekly survey of lenders based on first-lien prime conventional conforming home purchase

mortgages with a loan-to-value of 80 percent. The PMMS reports average national rates for a number of products, the 30-year fixed product being the one of interest here.

- *Forecast Source*: IHS Markit. July 2018 US Macro Forecast.

- *Data Transformations*: Quarterly data (both historical and forecast) is received already seasonally adjusted by IHS Markit (which publishes the adjusted historical PMMS data). The lagged fourth period rate (t-4) is assigned to the contemporaneous period (t). The series is transformed to natural logarithms for modeling purposes.

- *Analysis*: Fixed mortgage rates are about 10 basis points lower than projected in the IHS forecast of a year ago. Despite several rate hikes from the Fed to bring normality to interest rates, long-term rates seem to be lower than expected. Core inflation – inflation minus food and energy costs – remains subdued even with strong GDP growth. This gives the Fed the leeway to raise short rates, but long rates are less likely to increase with inflation expected to hover around 2 percent. The effect is a boost to dry waste disposal.

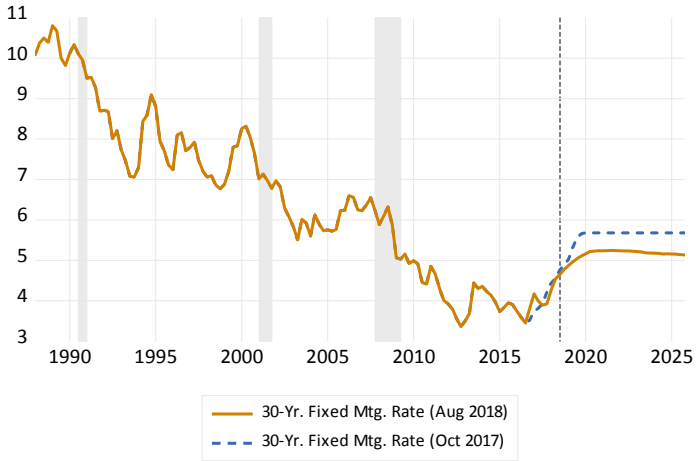


Figure 7

Source: Freddie Mac, IHS Markit

- **Home Permits (TOTALPERMITSPV)** Permits issued for the construction of residential units (including single and multi-family units) in the Portland MSA.

  - *Historical Source:* US Census Bureau, Building Permit Survey (BPS). The BPS provides national, state and local area statistics on new privately-owned residential construction each month. The BPS uses a monthly survey of selected permit-issuing places and an annual census of permit-issuing places that are not in the monthly sample. Permit data are available for structures with 1-unit, 2-4 units, and 5 units or more.

  - *Forecast Source*: NERC. April 2018 forecast.

- *Data Transformations*: Monthly data is seasonally-adjusted using X-13. The seasonally-adjusted series is summed over 3 months to yield a quarterly series. The average of the last four quarters is assigned to the contemporaneous quarter. The series is transformed to natural logarithms for modeling purposes.

- *Analysis*: Actual permits issued in the last 4 quarters ran by about 800 units ahead of forecast expectation a year ago. Due to usual seasonal slowing, housing permits decline in fall and winter. We see this going forward in the next few quarters (2018q3 to 2019q1). The NERC forecast is about 400 units lower in these 3 quarters – likely due to shortages in qualified workers that is tamping down production otherwise.

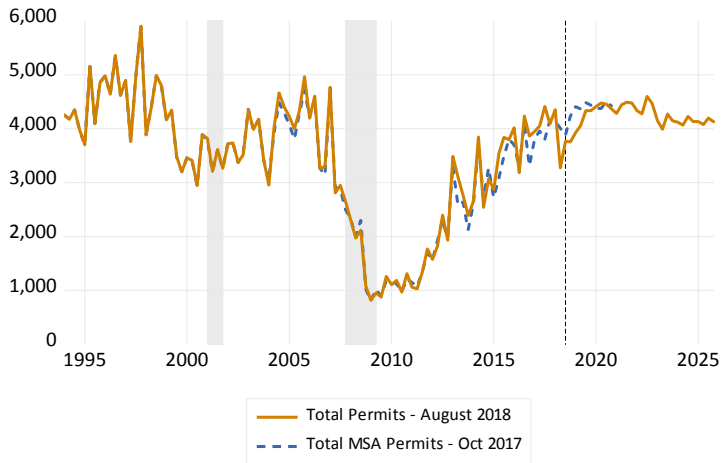


Figure 8: Portland MSA permits issued, total

Source: U.S. Census, NERC

Outcome: Dry waste share (a percentage)

The model's LHS variable is the share (interpreted as a percentage) of regional dry waste (DRY_SHARE) to total regional core discards, as modeled above.

- *Historical Source*: Metro's Solid Waste Information System (SWIS) tracks monthly deliveries of wet and dry discards to solid waste facilities in the region. All facilities keep wet and dry waste streams separate (and therefore are measured data) except for Metro transfer stations, where dry loads are distinguished from wet loads based on vehicle type (and are therefore calculated data). Data is through May 2018 (2018 Q1).

- *Data Transformations*: Monthly core discards, and monthly dry discards series are each seasonally-adjusted using the X-13 method. Each series is summed over 3 months to yield quarterly series. The ratio of the two series (dry to total waste) is calculated to yield one series, and multiplied by 100. The resulting series is logged.

- *Analysis*: The dry disposal forecast is derived from the core disposal forecast and a projection of dry waste shares. Dry waste shares are expected to decline slightly faster than predicted a year ago. The current predictors of the dry waste shares have been revised down from the forecast of a year ago. Construction employment relative to total nonfarm jobs is reduced. The expected number of new permits issued going forward has been lowered in the near term. Interest rates are lower in the latest U.S. forecast.

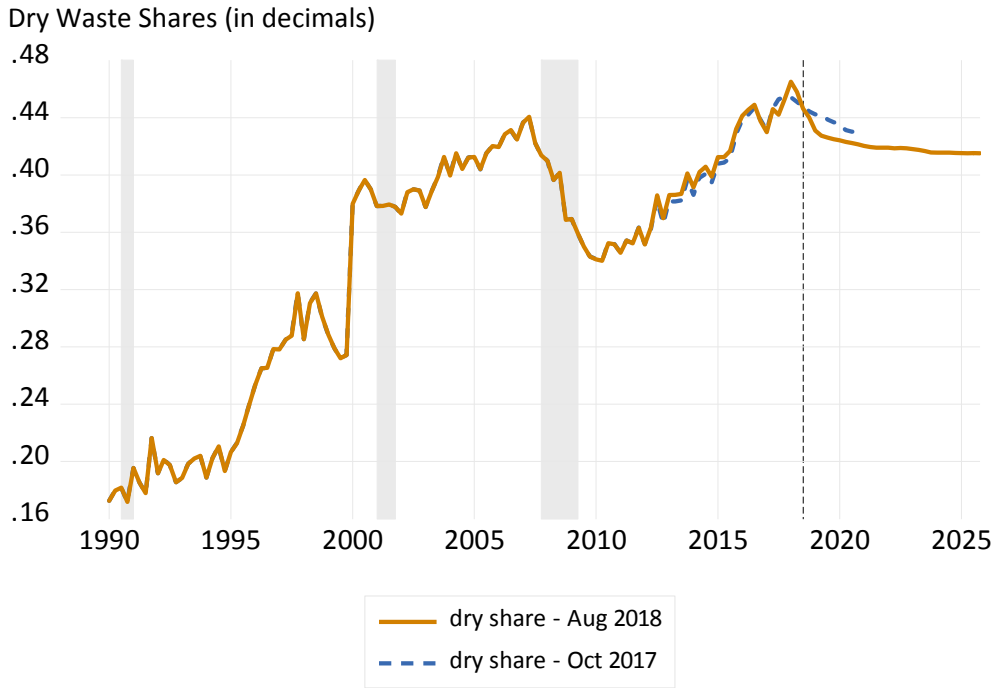


Figure 9: Dry Disposal Share History and Forecast

Source: Metro

Combined the expectation of lower construction shares and fewer permit issuances lowers the dry disposal share forecast. Lower interest rates actually boost the share of dry disposal. This partially offsets the decline induced by the other 2 variables, but not enough of a counterweight. So overall, the new projection of dry disposal *share* is lower in the current forecast (August 2018).