Economic Impacts of Expanding Riverbend Landfill

September 20, 2013

Prepared for:

Waste Management

Final Report



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1 Executive Summary

The Riverbend Landfill Company, Inc. (RLC), a wholly owned subsidiary of Waste Management, intends to file a land use application to change its existing zoning. This zone change would allow the Riverbend Landfill to eventually expand its footprint and total capacity.

As a municipal solid waste landfill, Riverbend Landfill may accept solid waste collected by households and businesses, construction and demolition debris, and non-hazardous special waste. In addition to providing disposal services to Yamhill County, it serves communities on the Oregon coast and portions of Multnomah, Clackamas, and Washington Counties.

RLC asked ECONorthwest to analyze the economic impacts of expanding and continuing to operate Riverbend Landfill. The analysis focuses on impacts only to Yamhill County. The analysis estimates the impacts of expanding and continuing to operate Riverbend Landfill and compares those impacts to alternative disposal options. Economic impacts result from operating the Riverbend Landfill, based on the assumption that it would accept 510,000 tons of waste per year through 2030. Economic impacts also result from construction activity associated with expanding the Riverbend Landfill, estimated to cost \$25.5 million (2013 dollars).

Following the zone change, RLC plans to aggressively pursue opportunities to develop a new "Green Tech" facility at Riverbend. One possible Green Tech facility would convert a portion of the waste stream that is currently landfilled into a pelletized fuel source. Such a facility could create a marketable energy product, reduce residual waste disposal volumes and maximize the life of the landfill. Assuming the Green Tech facility is developed by late 2015, the projected landfill capacity would last until about 2034. This analysis examines the impact of constructing such a Green Tech facility in addition to any expansion of the existing landfill facility.

If Riverbend Landfill is not expanded and ceases to accept waste, Yamhill County's waste would need to be diverted and disposed elsewhere. This analysis assumes a new transfer station would be built in McMinnville to allow the diversion of waste to a different site at a cost of \$2 million (2013 dollars) for construction. Yamhill County's waste would be hauled from the new transfer station to one of three alternative disposal sites. The three alternative sites are:

- **Coffin Butte Landfill.** Coffin Butte is 38 miles from McMinnville, near Corvallis.
- **Columbia Ridge Landfill and Recycling Center.** Located in Gilliam County, Columbia Ridge is 183 miles from McMinnville.
- Wasco County Landfill. This landfill is 123 miles from McMinnville, near The Dalles in Wasco County.

Table 1 summarizes the economic impacts for each alternative compared to the continued operation of Riverbend Landfill. The table shows that expanding Riverbend Landfill generates significant and clear benefits to Yamhill County and its residents. The table lists the types of

impact, and shows the impact of expanding Riverbend Landfill and the impact of hauling waste to alternative sites.

Type of Impact	Expand Riverbend	Alternate	Disposal Options
Cost of Disposal			
Per- ton cost	\$30.40	Coffin Butte:	\$77.61
		Columbia Ridge:	\$65.00
		Wasco County:	\$67.19
Total annual cost for Yamhill			
County service area	\$4,693,000	Coffin Butte:	\$9,818,000
		Columbia Ridge:	\$8,223,000
		Wasco County:	\$8,500,000
Annual cost of solid waste service in			
Yamhill County		Inc	crease by
		Coffin Butte:	17%
		Columbia Ridge:	13%
		Wasco County:	13%
Licensing and host fees generated			
to Yamhill County, per year	\$1,200,000	Coffin Butte:	\$64,000
		Columbia Ridge:	\$94,000
		Wasco County:	\$78,000
Construction (Landfill vs Transfer Stat	ion)	***************************************	
Employment (job-years)	263	29	
Personal income	\$7,662,000	\$869,000	
Operation (Landfill vs Transfer Station	ר)		
Employment, per year	36	Coffin Butte:	14
		Columbia Ridge:	19
		Wasco County:	16
Personal income, per year	\$2,122,000	Coffin Butte:	\$883,000
		Columbia Ridge:	\$1,126,000
		Wasco County:	\$1,007,000
Electricity generation	4.8 MW capacity		
	36,500 MW-hours per year	Reduces life	time of electricity
	Powers 2,500 homes	genera	ition capacity
Air emissions from hauling waste			······································
outside of Yamhill County			
Metric tons per year of CO2, NOx	No increase	Coffin Butte:	691
and PM2.5		Columbia Ridge:	2,644
		Wasco County:	1,777
Cost per year of emissions	No increase	Coffin Butte:	\$79,000 to \$193,000
		Columbia Ridge:	\$300,000 to \$739,000
		Wasco County:	\$202,000 to \$498,000
Green Tech		,,,,,,,,,,,,	
Construct facility			
Employment (job-years)	110		None
Personal income	\$3,368,000		
Operate facility			
Employment, per year	88		None
Personal income	\$4,959,000		
Haul Material to Port			
Emitted metric tons per year of			
CO2. Nox and PM2.5	2.116		None
Cost per year of emissions	\$240.000 to \$592.000		
Use material as fuel source	, = ,		
Avoided metric tons of CO2	35.000		None
Cost of avoided CO2	¢1 /15 to \$2 OFF willing		
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Table 1. Summary of economic impacts (2013 dollars)

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Expanding Riverbend Landfill provides large economic benefits to Yamhill County and its residents. The costs of hauling waste are lower, many more local jobs and associated income are generated, and the County generates more revenue from landfill license fees. If Riverbend Landfill ceases to operate, Yamhill County residents would not only pay more for garbage service, but fewer of the dollars they spend on garbage service would stay within the local economy.

The economic impacts are the following:

- **Cost of disposal.** Hauling waste to any of the three alternative disposal sites would cause the per-ton cost of disposal to increase for Yamhill County residents and businesses. The annual cost of disposal to the entire County would increase by \$3.5 to \$5.1 million (depending on the alternative site). The increased costs are caused by the additional cost of managing waste at a transfer station and hauling the waste to the alternative sites.
- Fees to Yamhill County. If Riverbend Landfill expands, RLC will pay approximately \$1.2 million per year in licensing and host fees to Yamhill County. That revenue supports about two-thirds of the County's Solid Waste Fund budgeted expenses, and pays for post-closure costs of closed landfills, solid waste education programs, household hazardous waste collection, and other programs. If Riverbend Landfill closes, the County would no longer collect licensing and host fees from RLC, but it would collect license fees from a new transfer station, which we estimate to be between \$64,000 and \$94,000 per year.
- Employment and income from construction. RLC will spend \$25.5 million to expand Riverbend Landfill. The construction activity will generate 202 jobs directly associated with construction activities and \$6.1 million in associated personal income. The construction activity will generate secondary jobs and income impacts, as the construction and its employees purchase goods and services in the local economy. In total, construction of the expansion will generate 263 jobs and \$7.7 million in associated income. Under the alternative disposal scenarios, a \$2 million transfer station will be constructed, creating 29 (23 of which are directly associated with construction activities) jobs and \$869,000 in personal income.
- Employment and income from operations. Operating Riverbend Landfill currently requires 17 full-time equivalent jobs, generating \$1.6 million in associated personal income per year to operate the facility. Operating Riverbend Landfill yields secondary jobs, as the Landfill and its employees purchase goods and services in the local economy. We estimate that operating Riverbend Landfill generates 19 secondary jobs and \$500,000 in personal income, for a total of 36 jobs and \$2.1 million in personal income. Hauling waste to alternative sites would create about half as many jobs—operating the transfer station and driving the waste to alternative sites would generate between 14 and 19 jobs and between \$900,000 and \$1.2 million personal income (depending on the alternative site). Between 11 and 14 of those jobs would be directly employed in transfer station operations and hauling the waste.
- **Electricity generation.** RLC is currently generating and selling electricity to McMinnville Water and Light by combusting landfill gas. Expanding Riverbend Landfill would extend

its ability to generate electricity. The landfill gas from Riverbend Landfill creates a generating capacity of 4.8 megawatts, sufficient to generate about 36,500 megawatt-hours of electricity. This is enough energy and capacity to power 2,500 homes. The electricity-generating capacity displaces the need for new electrical turbines powered by natural gas, which generate additional greenhouse gas emissions and other air pollutants.

- Air emissions from hauling waste. Hauling solid waste from Yamhill County to any of the three alternative disposal sites generates carbon dioxide (CO2), nitrogen oxides (NOx), carbon monoxide, and particulate matter. Expanding Riverbend Landfill avoids the generation of transportation-related greenhouse gases and pollutants that decrease air quality. The economic cost of the CO2 is between \$28,000 and \$297,000 per year; the cost of the NOx is between \$23,000 and \$200,000 per year; and the cost of particulate matter is between \$28,000 and \$242,000 per year.
- **Tourism Impacts.** ECONorthwest could find no evidence that the presence or absence of Riverbend Landfill had any impact on tourism in Yamhill County.
- **Green Tech facility.** The Green Tech facility would generate a fuel source that emits less carbon per BTU of energy generated.
 - Construction of the facility would generate an estimated 89 jobs directly associated with constructing the facility and \$2.8 million in personal income. The construction activity and its workers would create additional jobs and income by purchasing local goods and services, creating a total of 110 temporary jobs and \$3.4 million in personal income.
 - The facility would generate an estimated 43 jobs directly associated with operating the facility and hauling the material to a port, and \$3.8 million in personal income, per year. The facility and its employees would generate additional jobs and income by purchasing local goods and services, creating a total of 88 permanent jobs and \$5.0 million in personal income, per year.
 - The facility would reduce total CO2 emissions by about 33,000 metric tons, which has an economic value between \$1.3 million and \$3.7 million.

2 Introduction

The Riverbend Landfill Company, Inc. (RLC), a wholly owned subsidiary of Waste Management, intends to file a land use application to change its existing zoning. This zone change would allow the Riverbend Landfill to eventually expand its footprint and total disposal capacity.

Riverbend Landfill is located on Highway 18, about two miles southwest of the McMinnville city limits. As a municipal solid waste landfill, Riverbend Landfill may accept solid waste collected by households and businesses, construction and demolition debris, and nonhazardous special waste. In addition to providing disposal services to Yamhill County, it serves communities on the Oregon coast and portions of Multnomah, Clackamas, and Washington Counties.

RLC asked ECONorthwest to analyze the economic impacts of expanding and continuing to operate Riverbend Landfill. This report summarizes ECONorthwest's analysis. The analysis estimates the impacts of expanding Riverbend Landfill and compares those impacts to alternative disposal options. This report examines only a subset of the potential impacts of an expanded Riverbend Landfill: it focuses on describing and, as possible, quantifying economic impacts to Yamhill County.

2.1 Evaluation Methods and Data

The evaluation used the following sources of information:

- Interviews with waste haulers that deliver waste to Riverbend Landfill. ECONorthwest interviewed key RLC staff to understand the amount of waste delivered to Riverbend Landfill and contacted RLC competitors to determine the expected cost of delivering the waste to alternative disposal sites.
- Interviews with County staff. ECONorthwest interviewed Solid Waste staff at Yamhill County to understand the fiscal impacts of the Riverbend Landfill to the County.
- Landfill operations data from RLC. ECONorthwest worked with staff at RLC to understand Riverbend Landfill operations.
- National data sources. ECONorthwest relied on federal agencies for electricity and air emissions data.

The text of this report provides a full description of the data and methods used to determine the economic impacts of expanding the Riverbend Landfill.

2.2 Organization of the Report

After this introductory chapter, the remainder of this report is organized into two chapters and an appendix:

- **Chapter 3: Evaluation Framework** presents a framework for evaluating the impacts associated with expanding the Riverbend Landfill. This chapter describes some basic principles of analysis, and the alternatives analyzed.
- **Chapter 4: Economic Impacts** compares the economic impacts of expanding Riverbend Landfill to hauling waste to alternative disposal facilities.
- Appendix: Overview of Economic Multiplier Models describes measuring economic impacts using input/output models.

3 Evaluation Framework

This chapter discusses principles that are fundamental to an economic impact analysis. It has two sections:

- Key Issues Affecting this Analysis discusses the key issues that affect the logic and assumptions of an economic impact analysis.
- Alternatives describes the different alternatives used in the analysis to compare economic impacts.

3.1 Key Issues Affecting this Analysis

This section discusses assumptions that affect an analysis of economic impacts.

- Identify the base case. To estimate the net benefits of expanding Riverbend Landfill, the benefits and costs of one possible future (with an increased capacity at the Riverbend Landfill) must be compared to the benefits and costs that would occur in a different future (without the increased capacity). Such evaluation usually occurs by comparing alternative scenarios to the 'base case.' In this analysis, the 'base case' assumes that RLC expands Riverbend Landfill.
- Identify study area boundaries. Different types of impacts affect different geographies. In the case of a landfill, the cost of disposal affects the landfill's entire service area. Although some economic effects may occur elsewhere, the focus of this analysis is on Yamhill County. The analysis identifies the economic impacts that affect Yamhill County's residents, businesses, and county government.
- **Properly attribute causality.** Establishing a base case affects an analyst's ability to properly identify cause-and-effect relationships. Attributing effects to causes, and doing so only once (i.e., avoiding double counting), is essential to an evaluation of net impacts.
- **Clarify timing of impacts.** Economic effects occur over time. Some impacts are single events, such as the construction of a transfer station. Other impacts are ongoing, such as the annual license fees paid to Yamhill County. This analysis, conducted in 2013, is based on 2013 data and estimates jobs, income, tax revenue, and other factors based on 2013 values. This analysis identifies impacts that are one-time, and those that are ongoing, but does not estimate future values. Instead, the analysis describes the ongoing impacts in 2013 dollars, and notes that the impacts would continue on an annual basis into the future.

3.2 Alternatives

The analysis of economic impacts is organized to compare the base case of expanding Riverbend Landfill, to hauling the waste to other landfills in the region. This section describes assumptions used in the analysis of the alternatives.

3.2.1 Expand Riverbend Landfill

Riverbend Landfill accepts municipal solid waste generated from households and businesses. The Riverbend Landfill provides disposal services for Yamhill County and outside the County.

RLC estimates that 510,000 tons of waste will be disposed at Riverbend Landfill in 2013 and annually into the future. We use 510,000 tons per year to estimate economic impacts. RLC estimates that Yamhill County residents and businesses generate 24.8% (126,500 tons) of the total annual volume of waste disposed at Riverbend Landfill.¹

RLC will eventually apply to expand the Riverbend Landfill by 3.5 million cubic yards of capacity, or 4.1 million tons. RLC reports that the eventual expansion is expected to cost \$25.5 million (in 2013 dollars).

There are currently 17 employees at Riverbend Landfill, and the total value of the income for those employees (wages plus the cost of providing benefits) equals \$1.6 million. This analysis assumes the landfill will require this level of employment throughout its operating life.

RLC has built a system to capture methane gas generated in the Riverbend Landfill by decomposing waste and convert it to usable electricity. The expansion would extend the time that the Riverbend Landfill can be used to generate electricity.

Different alternative technology processes exist that RLC could pursue at Riverbend Landfill to recover waste that currently gets disposed in a landfill. The Green Tech process most likely to work at the Riverbend Landfill site is a technology Waste Management has developed to create a fuel from waste that serves as a substitute for coal. Waste Management has constructed similar facilities at other landfills, and plans to site such a facility at Riverbend Landfill if the expansion proceeds. This particular type of facility takes the non-recyclable waste and sorts it, so that about one-third (170,000 tons per year) can be converted to fuel pellets. The remainder would be disposed in the Riverbend Landfill. For the purposes of this study, we call this facility the Green Tech facility.

Waste Management reports that it will cost \$31 million to construct the Green Tech facility and that operating it will require 35 employees. The total value of their wages and benefits is \$3.29 million.

3.2.2 Haul Waste to other Landfills

If Riverbend Landfill does not expand, it will no longer accept waste. The area currently served by Riverbend Landfill would need to find alternative disposal options.

¹ All data describing Riverbend Landfill facilities were provided by Waste Management staff.

This analysis assumes that the waste collected in Yamhill County by garbage collection vehicles will need to be transferred to larger, long haul trucks. A new transfer station would need to be constructed to provide that transfer capacity.² We assume that the new transfer station would be built in the vicinity of McMinnville, but we have not identified a specific location for this hypothetical scenario.

Staff at RLC estimated that a new transfer station, sized to accommodate waste generated in Yamhill County, would cost roughly \$2 million (in 2013 dollars) to construct. This cost estimate assumes that the facility is relatively simple and does not include any materials recovery capability. This cost estimate excludes the cost of any compacting equipment.

This analysis assumes the new transfer station would require six employees for operations and the total value of the income for those employees (wages plus the cost of providing benefits) equals \$564,000 per year.

This analysis considers three alternative locations. Figure 1 shows the location of Riverbend Landfill and the three alternative landfills.¹

- **Coffin Butte Landfill.** Coffin Butte is 38 miles from McMinnville, near Corvallis.
- **Columbia Ridge Landfill and Recycling Center.** Located in Gilliam County, Columbia Ridge is 183 miles from McMinnville.
- Wasco County Landfill. This landfill is 123 miles from McMinnville, near The Dalles in Wasco County.

² The existing transfer station in Newberg is not large enough to accommodate all of Yamhill County's waste.



Figure 1. Location of Riverbend Landfill and alternative landfill sites

Source: oregonexplorer.info/mappingtools

Table 2 shows the distance and estimated travel times from a hypothetical McMinnville transfer station and the reported per ton tipping fee for the alternative landfills and Riverbend Landfill.

Landfill	Miles from WOW Transfer Station	Travel Time (minutes) from McMinnville Transfer Station	Per Ton Tipping Fee
Coffin Butte	38	0:58	\$52.50
Columbia Ridge	183	3:22	\$28.00
Wasco County	123	2:34	\$36.19
Riverbend	na	na	\$30.40

Table 2. Distance and time from McMinnville transfer station and tipping fees for alternative sites, 2013

Source: Mileage and travel time from www.maps.google.com, tipping fees obtained through interviews with landfill operators.

4 Economic Impacts

This chapter is organized into nine sections, each describing a different type of economic impact. For each impact, we discuss the economic impacts associated with expanding Riverbend Landfill and those associated with transporting waste to an alternative site for disposal. The nine types of impacts are:

- 1. Cost of Disposal
- 2. Yamhill County Fees
- 3. Employment and Income-Construction
- 4. Employment and Income-Operations
- 5. Electricity
- 6. Air Emissions from Hauling Waste
- 7. Tourism Impacts
- 8. Green Tech Facility
- 9. Other Impacts

4.1 Cost of Disposal

If Riverbend Landfill does not continue to operate, the waste would be transferred to long-haul trucks at a transfer station, and then hauled to the alternative landfills. To estimate the cost of disposal, ECONorthwest calculated the per-ton hauling costs and added the tipping fee and compared those costs to disposing waste at Riverbend Landfill. Table 3 summarizes the calculations, which were based on the following assumptions.

- **Travel time.** ECONorthwest used travel times from McMinnville as estimated by maps.google.com (shown in Table 2) and rounded up the travel times to half-hour increments.³ We also added an hour to each trip to account for the time required to unload the waste at its destination.
- **Travel cost.** ECONorthwest multiplied the travel time by \$102 per hour. The costs include the time to bring the empty truck back to McMinnville.⁴
- Tons per trailer. Waste transported to Coffin Butte would likely be in an open-top container with an average load weight of about 27 tons. Waste hauled to Columbia Ridge

³ The analysis coverts travel times to half-hour increments to show realistic travel costs. Although a portion of the waste stream will likely be processed at the existing Newberg transfer station, we used McMinnville as a point of origin to estimate travel costs.
⁴ Travel costs provided by Dan Walsh of Walsh Trucking (personal communication, July 12, 2013). The figure is an estimate of hourly costs to haul solid waste. The cost includes the cost of the truck and the driver.

or Wasco Landfill would likely be compacted and carried in closed containers with an average load weight of about 34 tons.⁵

- **Transfer Station fee.** Managing the waste at the McMinnville Transfer Station will cost approximately \$10 per ton.
- **Tipping fee.** ECONorthwest interviewed staff at three alternative landfills to determine the public tipping fee.

	Travel Time (minutes) from Transfer Station	Travel Cost	Tons per Travel Cost		Processing	Per Ton	Total Cost
Landfill	(1)	(2)	Trailer	per Ton	Fee	Tipping Fee	per Ton
Coffin Butte	120	\$408	27	\$15.11	\$10.00	\$52.50	\$77.61
Columbia Ridge	270	\$918	34	\$27.00	\$10.00	\$28.00	\$65.00
Wasco County	210	\$714	34	\$21.00	\$10.00	\$36.19	\$67.19
Riverbend	na	na	na	na	na	\$30.40	\$30.40

Table 3. Estimate per-ton cost of disposing waste (2013 dollars)

1. Travel time is rounded to nearest half-hour.

2. Travel cost multiplies travel time by the hourly rate and doubles the figure to account for the return trip.

Source: Calculated by ECONorthwest. See text for explanation of method.

The estimated disposal cost for the three alternative disposal sites ranges from approximately \$65 to \$78 per ton, or \$35 to \$47 per ton higher than Riverbend Landfill.

RLC estimates that the Riverbend Landfill will accept 510,000 tons per year and Yamhill County residents and businesses will generate 24.8% of the waste stream (126,500 tons per year).

Table 4 shows the total cost of disposing waste to the residents and businesses of Yamhill County for Riverbend Landfill and the three alternative disposal sites.⁶ The annual cost of disposal for Riverbend Landfill assumes that Waste Management collects two-thirds of Yamhill County's waste and Western Oregon Waste collects the remaining one-third. The portion collected by Waste Management includes a \$10 per-ton fee associated with moving that garbage through a transfer station for transport to Riverbend Landfill.

The total cost of disposal increases by \$5.1 million for Coffin Butte, \$3.5 million for Columbia Ridge, and \$3.8 million for Wasco County. This is the increase in disposal costs for all garbage customers across Yamhill County. Not only will the costs increase, but also the revenue that funds disposal will no longer be part of the Yamhill County economy.

⁵ Personal communication with Dan Walsh, Walsh Trucking, July 12, 2013.

⁶ To calculate the cost of disposing at Riverbend Landfill, ECONorthwest assumes that Western Oregon Waste pays \$30.40 per ton for disposal.

Landfill	Total Annual Cost of Disposal	Cost Difference from Riverbend	
Coffin Butte	\$9,818,000	\$5,125,000	
Columbia Ridge	\$8,223,000	\$3,530,000	
Wasco County	\$8,500,000	\$3,807,000	
Riverbend	\$4,693,000	\$0	

Table 4. Total annual disposal cost for waste generated in Yamhill County,by disposal option (2013 dollars)

Source: Calculated by ECONorthwest. See text for explanation of method.

The increased cost of disposal would affect the households and businesses that currently dispose waste at Riverbend Landfill. To estimate the impacts to Yamhill County residents, ECONorthwest relied on current fees that households are charged by Waste Management.

ECONorthwest assumed that the average household generates 31 pounds of garbage per week, or 1,612 pounds per year (0.806 tons).⁷ The basic monthly service fee for residential customers of Waste Management is \$18.48 per month, or \$222 annually. Based on a \$30.40 per-ton tipping fee, \$24.50 of the annual fee pays for the disposal cost. The remainder of the fee covers the cost of collecting the waste. If we compare the disposal costs across the alternatives, costs for households increase between 13% and 17%. Commercial customers that generate large volumes of waste are likely to see a greater increase in costs because disposal accounts for a larger portion of total costs. Individual accounts would see varied increases in rates, depending on the cost structure of collection.

4.2 Yamhill County Fees

This section describes how the alternatives affect the revenue generated to Yamhill County from license and franchise fees. Yamhill County charges three types of fees that would be affected by the changes to Riverbend Landfill.

- **In-County Waste License Fee.** RLC pays the County \$1.60 per ton for all solid waste generated within Yamhill County that is delivered to Riverbend Landfill.
- **Out-of-County Waste License Fee.** RLC pays the County \$2.60 per ton for all solid waste generated outside of Yamhill County that is delivered to Riverbend Landfill.
- **Transfer Station Franchise Fee.** There is one existing transfer station in Yamhill County. The Newberg Transfer Station pays a franchise fee equal to 2% of gross receipts.

Yamhill County also collects franchise fees for solid waste collection, but those collection franchise agreements are independent of any disposal options within the County.

⁷ WOW reported to ECONorthwest that the typical residential customer in McMinnville generates between 28 and 34 pounds of waste per week.

In the 2012 Fiscal Year, Riverbend Landfill generated almost \$1.1 million in license fees to Yamhill County (see Table 5).

Table 5. Fees generated from Riverbend Landfill(2012 Fiscal Year)

Fee Type	Revenue
In-County License Fee	\$194,018
Out-of-County License Fee	\$894,746
Total	\$1,088,764
Source: Sherrie Mathison, Yamhill County	Solid Waste Coordinator

The solid waste fees support the Solid Waste Fund at Yamhill County. The revenue generated by Riverbend Landfill accounts for 91% of the budgeted new revenue for the Solid Waste Fund for the 2013-14 Fiscal Year.⁸ Total budgeted costs for personnel and materials and services in the current fiscal year are about \$1.6 million. The budgeted fees generated by Riverbend Landfill cover about two-thirds of the Solid Waste Fund's budgeted expenses.

The Solid Waste Fund supports many of the County's costs:⁹

- Post-closure costs associated with two closed landfills—Newberg and Whiteson. Budgeted post-closure costs for the 2013 fiscal year are \$960,000.
- Planning staff—the Solid Waste Fund supports 3.1 full-time equivalents (FTE) of County Planning staff, including 1.0 FTE of a Code Enforcement Official and 1.0 FTE of a Management Analyst.
- Household hazardous waste collection program.
- Roadside cleanup and cleanup of illegal dumpsites.
- Solid waste and recycling education programs.

The Green Tech facility will reduce the amount of waste disposed at the Riverbend Landfill. This analysis does not estimate the expected license fees paid to Yamhill County from such a facility. Waste Management expects that the license fee agreement with the County would change to take into account the altered waste stream volume.

4.2.1 Expand Riverbend Landfill

If Riverbend Landfill expands, Yamhill County will continue to receive license fees from Riverbend Landfill. The current license fee structure is based on tons of waste disposed. The Green Tech facility will significantly alter the amount of waste disposed in the landfill. This

⁸ As reported in the Yamhill County Budgetary Revenue and Expense Worksheet for Fiscal Year ending June 30, 2014 (http://www.co.yamhill.or.us/). The total revenue for the Solid Waste Fund is \$4.86 million, but \$3.71 million of that is the beginning balance, carried over from the previous year. Expected new revenues equal \$1.15 million.

⁹ As reported in the Yamhill County Budgetary Revenue and Expense Worksheet for Fiscal Year ending June 30, 2014 (http://www.co.yamhill.or.us/).

analysis does not speculate about a new fee structure agreed upon between RLC and Yamhill County for a combined Riverbend Landfill and Green Tech facility.

In this analysis, we assume that the Riverbend Landfill will receive 510,000 tons of waste per year for disposal, and in-county residents and businesses will generate 24.8% of that waste. By applying the in-county and out-of-county waste license fee rates to the waste stream, we estimate that Riverbend Landfill will generate almost \$1.2 million per year in fees (see Table 6).

Riverbenu Lanumi	
Fee Type	Revenue
In-County License Fee	\$212,160
Out-of-County License Fee	\$981,240
Total	\$1,193,400
Source: ECONorthwest.	

Table 6. Estimated annual fees generated from Riverbend Landfill

4.2.2 Haul Waste To Other Landfills

If Riverbend Landfill does not expand, a new transfer station would likely be needed to accommodate waste generated in the area. This analysis assumes that transfer station would generate a franchise fee for the County similar in structure to the franchise fee the Newberg Transfer Station pays Yamhill County (i.e., 2% of gross receipts).

This analysis assumes that the County would continue to receive franchise fees from the Newberg Transfer Station, and there would be no change in that revenue stream. The analysis also assumes that the County would continue to collect franchise fees for the collection of waste, and there would be no change in that revenue stream.

To estimate the fees associated with a new transfer station in McMinnville, ECONorthwest assumed that all the waste generated in Yamhill County (132,600 tons in 2012) would be hauled to the existing Newberg Transfer Station and the hypothetical new transfer station. We assume the transfer stations' gross revenues equal the total tons generated in Yamhill County times the per-ton cost to manage and transport the waste. The total costs are shown in Table 3. We apply the 2% franchise fee to that gross revenue. Table 7 shows that the estimated gross revenue generated from the Yamhill County waste stream and the associated revenue from a franchise fee. This analysis estimates that the alternative landfills would generate between approximately \$67,000 and \$98,000 in revenue to the County.

Table 7. Estimated annual franchise fees from new transfer station (2013 Dollars)

	Total Gross	Franchise Fee to
Landfill	Revenues	Yamhill County
Coffin Butte	\$3,177,000	\$64,000
Columbia Ridge	\$4,681,000	\$94,000
Wasco County	\$3,922,000	\$78,000

Source: Calculated by ECONorthwest. See text for explanation of method.

The above calculation assumes the franchise fee is 2% of gross revenues, and that gross revenues include the transfer station fee and the cost of transporting the waste to a disposal site. It is possible that this over-estimates franchise fee revenue. The transfer station would not necessarily be responsible for transporting the waste; a separate company could contract for that portion.

The calculation may also over-estimate franchise fees because it assumes that all waste generated in Yamhill County will go through a transfer station. It is likely that large, industrial waste producers will have their waste delivered to a landfill in a long-haul truck directly from their own facility. That waste will not go through a transfer station and the County will not receive any franchise fee revenue.

4.3 Employment and Income-Construction

This section describes how construction activities associated with the alternatives affect the number of jobs and associated personal income in Yamhill County. Separate sections discuss the job and income impacts for constructing and operating the Green Tech facility and operating the Riverbend Landfill.

Economists can measure employment and income impacts using input-output models.¹⁰ Starting with the initial project being studied, input-output models track dollars as they ripple through an economy from one sector to the next. Ultimately, the models determine the number of jobs, amount of income, and dollars of economic output that can be traced to the initial project. Appendix A provides more information about measuring economic impacts using input-output models.

4.3.1 Expand Riverbend Landfill

If Riverbend Landfill is expanded, construction activity will include the expansion activity and the planned Green Tech facility. This section of the analysis calculates the employment and income impacts associated with only the landfill expansion activity.

RLC has estimated the total cost of expanding the Riverbend Landfill to be \$25.5 million (2013 dollars).¹¹ The expenditure would be made over a multiple-year period. This analysis estimates the total jobs and income impacts, not per-year impacts.

¹⁰ ECONorthwest used IMPLAN (for IMpact Analysis for PLANning) software to conduct the input/output analysis for the construction spending. IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. U.S. government agencies, other public agencies, and private firms including ECONorthwest have applied the model to a wide variety of public and private sector projects.

¹¹ Construction cost estimates provided by RLC.

To estimate the impacts of constructing the new Riverbend Landfill space, we relied on Waste Management's estimates of expenditures by category. We assigned the categories to industrial sectors, as defined by the input-output model.

The total cost is based on the following elements:

- Excavation and perimeter berm \$13.0 million. We assumed these costs are in the 'other new construction' category.
- Liner system and leachate system \$4.6 million. We assumed that 35% of these costs are in the 'other new construction' category and the remainder are in 'high density polyethylene liner manufacturing,' 'steel, iron pipe manufacturing,' and the 'pumping equipment manufacturing' categories. Only the 'other new construction' category has firms in Yamhill County. Therefore, all costs in the other categories have no local impacts the expense is made outside of Yamhill County.
- Final cover system \$2.1 million. We assumed that costs for the gas system are evenly divided between 'other new construction' and 'high density polyethylene liner manufacturing,' but there are no firms in the 'high density polyethylene liner manufacturing' industry in Yamhill County.
- Gas system \$1.5 million. We assumed that costs for the gas system are evenly divided between 'other new construction' and 'gas field extraction machinery,' but there are no firms in the 'gas field extraction machinery' industry in Yamhill County.
- Contingency (20%)—\$4.3 million. We applied the contingency amount proportionally to the four categories.

Table 8 shows the employment and income impacts in Yamhill County stemming from the addition of space at Riverbend Landfill. The table shows the number of jobs resulting from construction spending in two categories: primary and secondary.¹²

- **Primary effects** are those directly generated by the construction project. They include the jobs and income earned by the workers building the landfill.
- Secondary effects are those indirectly generated by the construction project. They include the jobs and income earned by workers in industries supplying the construction project and jobs and income earned by workers servicing the direct and indirect workers, such as clothing retailers and grocery stores.

¹² We use the terms primary and secondary to simplify the standard jargon of IMPLAN: direct, indirect, and induced. We combined IMPLAN's indirect and induced impacts under the heading of secondary impacts.

Table 8. Jobs and i	ncome (one-time)	in Yamhill	County from	n construction
activities-Expand R	liverbend Landfill ((2013 Dolla	ars)	

	Construction of Landfill			
Type of Impact	Total Jobs	Total Income		
Primary	202	\$6,108,700		
Secondary	61	\$1,553,700		
Total	263	\$7,662,400		

Source. Calculated by ECONorthwest using IMPLAN software. See text for full explanation.

Table 8 shows expanding the Riverbend Landfill will create a total of 202 jobs directly involved in the construction process and an overall total of 263 jobs. These jobs will be spread over the time it takes to create the expanded area of the Riverbend Landfill. The jobs include full-time and part-time jobs.

The Riverbend Landfill expansion would generate \$7.7 million in personal income over the entire construction period, and those workers directly involved in the construction process would earn \$6.1 million of that. Personal income includes the value of benefits for Yamhill County residents, and excludes income generated outside Yamhill County.

4.3.2 Haul Waste To Other Landfills

If Riverbend Landfill does not expand, a new transfer station would likely need to be constructed to accommodate waste generated in the area. Based on the volume of garbage generated in Yamhill County, RLC staff estimated that construction cost of the transfer station is \$2 million. This does not include the cost of a waste compactor used at the transfer station. A compactor would be purchased from a non-local manufacturer and would have no impact on the Yamhill County economy.

Table 9 shows the construction of a transfer station would create 23 jobs directly involved in the construction process, and an overall total of 29 jobs created as a result of the construction. The construction of the transfer station would generate \$869,100 in personal income, and those workers directly involved in the construction process would earn \$729,400 of that amount. The jobs and income associated with the transfer station would occur once. They would end when construction is complete.

	Construction of	Construction of Transfer Station		
Type of Impact	Total Jobs	Total Income		
Primary	23	\$729,400		
Secondary	6	\$139,700		
Total	29	\$869,100		

Table 9. Jobs and income (one-time) in Yamhill County from constructionactivities-transfer station (2013 Dollars)

Source. Calculated by ECONorthwest using IMPLAN software. See text for full explanation.

Construction activities associated with expanding Riverbend Landfill creates 234 more jobs and generates approximately \$6.8 million more personal income in Yamhill County than the alternatives.

4.4 Employment and Income-Operations

This section describes how operations activities associated with the alternatives affect the number of jobs and associated personal income generated in Yamhill County.

If Riverbend Landfill is expanded, operations activity will include operating the Riverbend Landfill and the planned Green Tech facility. This section focuses on impacts associated with operation of only the Riverbend Landfill. See Section 4.8 for the impacts associated with operating the Green Tech facility.

4.4.1 Expand Riverbend Landfill

If the Riverbend Landfill is expanded, RLC estimates that it would continue to require 17 fulltime equivalent (FTE) permanent employees to operate the Riverbend Landfill. RLC estimates that total associated personal income is \$1.6 million per year (including the value of benefits).

Table 10 shows employment and income impacts in Yamhill County stemming from operating the Riverbend Landfill. The table shows the number of jobs and their income in two categories: primary and secondary.¹³

- **Primary effects** are those directly generated by operating the Riverbend Landfill. These comprise the workers employed at the Riverbend Landfill.
- Secondary effects are those indirectly generated by operating the Riverbend Landfill. They include the jobs and income earned by workers in industries supplying the landfill (including vendors that provide goods and services to Riverbend Landfill) and jobs and income earned by workers servicing the direct and indirect workers, such as clothing retailers and grocery stores.

	Onars) Operation	n of Landfill
Facility	Total Jobs	Total Income
Primary	17	\$1,598,000
Secondary	19	\$523,900
Total	36	\$2,121,900

Table 10. Jobs and income (annual) in Yamhill County from operating

Source. Calculated by ECONorthwest. See text for full explanation.

¹³ We use the terms primary and secondary to simplify the standard jargon of IMPLAN: direct, indirect, and induced. We combined IMPLAN's indirect and induced impacts under the heading of secondary impacts.

The table shows that operating the Riverbend Landfill will bring a total of 36 jobs to Yamhill County; 17 of those are directly employed in Riverbend Landfill operations. These jobs are considered permanent jobs, and will exist throughout the life of the Riverbend Landfill.

4.4.2 Haul Waste To Other Landfills

If Yamhill County's waste is hauled to one of the alternative landfills, it will generate jobs at the transfer station and jobs hauling the waste in trucks.

- RLC estimates the transfer station would require six full-time equivalent employees. Total associated personal income is \$564,000 per year.
- To estimate the number of full-time equivalent jobs, ECONorthwest calculated the number of truck trips required to haul 121,300 tons of waste to the three alternative disposal sites (based on data reported in Table 2), calculated the total hours to haul the waste, and divided the total by 2,080 working hours per year per job. ECONorthwest multiplied the total FTE by \$55,454, the median value of salary and benefits for a heavy-truck driver in Yamhill County.¹⁴

Table 11 summarizes the jobs and personal income directly associated with operating the transfer station and hauling the waste to an alternative site.

	Operation of Transfer Station		Haul Waste to Alternative Facility		Total	
	Jobs	Income	Jobs	Income	Jobs	Income
Coffin Butte	6	\$564,000	4.5	\$249,500	10.5	\$813,500
Columbia Ridge	6	\$564,000	8	\$443,600	14.0	\$1,007,600
Wasco County	6	\$564,000	6.3	\$349,400	12.3	\$913,400

 Table 11. Jobs and income (annual) in Yamhill County from operations activities-transfer station (2013 Dollars)

Source. Calculated by ECONorthwest. See text for full explanation.

Table 12 shows employment and income impacts in Yamhill County stemming from operating a transfer station and hauling the waste out of Yamhill County. The table shows the number of jobs and their income in two categories: primary and secondary.

- **Primary effects** are those directly generated by operating the transfer station and hauling the waste. These comprise the workers employed at the transfer station and by a trucking company.
- Secondary effects are those indirectly generated by operating the transfer station. They include the jobs and income earned by workers in industries supplying the transfer station (including vendors that provide goods and services) and jobs and income earned by workers servicing the direct and indirect workers, such as clothing retailers and grocery stores.

¹⁴ Salary and benefits data provided by www.salary.com. Accessed July 2013.

	Operation of Transfer Station				
Facility	Total Jobs	Total Income			
Coffin Butte					
Primary	11	\$813,500			
Secondary	3	\$69,500			
Total	14	\$883,000			
Columbia Ridge					
Primary	14	\$1,007,600			
Secondary	5	\$118,400			
Total	19	\$1,126,000			
Wasco County					
Primary	12	\$913,400			
Secondary	4	\$93,200			
Total	16	\$1,006,600			

Table 12. Jobs and income (annual) in Yamhill County from operatin	ıg
transfer station and hauling waste (2013 Dollars)	

Source. Calculated by ECONorthwest. See text for full explanation.

The table shows that operating the transfer station and hauling the waste to alternative sites will bring between 14 and 19 total jobs to Yamhill County, depending on the alternative disposal site. Between 11 and 14 of those jobs are directly employed in transfer station operations and hauling the waste. All these jobs are considered permanent jobs.

Expanding and operating Riverbend Landfill generates significantly more jobs and income than building and operating a transfer station and hauling the waste outside of the County. Table 13 shows total jobs, personal income, and expenditures in Yamhill County associated with each of the alternatives. Expanding the Riverbend Landfill generates 234 more jobs from construction activities and between 17 and 23 more jobs for operations.

	Constructio	on (one-time)	Operations (annual)		
	Jobs	Income	Jobs	Income	
Coffin Butte	29	\$869,100	14	\$883,000	
Columbia Ridge	29	\$869,100	19	\$1,126,000	
Wasco County	29	\$869,100	16	\$1,006,600	
Riverbend	263	\$7,662,400	36	\$2,121,900	

Table 13. Summary of employment and income impacts

Source. Calculated by ECONorthwest. See text for full explanation.

4.5 Electricity

A by-product of a landfill is landfill gas, which contains methane. The landfill gas can be captured and combusted for energy. RLC has developed a facility to generate electricity from captured landfill gas and works with McMinnville Water and Light to deliver the electricity to utility customers. This section describes the impacts associated with generating electricity from captured landfill gas.¹⁵

The facility has a generating capacity of 4.8 megawatts (MW). The 4.8 MW of capacity can generate about 36,500 megawatt- hours (mWh) of electricity per year.¹⁶ This is enough electricity to power roughly 2,500 Oregon homes.¹⁷

Extending the life of Riverbend Landfill will allow the facility to continue to generate this electricity.

Developing electricity-generating capacity has other environmental benefits. By expanding the capacity, other new generation facilities may not be needed to meet growing demand for electricity. The landfill gas facility is most likely to displace electricity generated from natural gas. Natural gas-fired turbines generate additional greenhouse gas emissions and other air pollutants. This analysis does not quantify those impacts.

4.6 Air Emissions from Hauling Waste

Hauling waste to alternative landfills will generate increased emissions of air pollutants as heavy trucks travel the greater distance. This section quantifies emissions generated by hauling waste to alternative disposal sites and estimates economic values for some of those emissions.

The US Environmental Protection Agency (EPA) has developed a computer model (MOVES) to estimate total emissions of pollutants generated by highway vehicles in various geographic areas.¹⁸ The model's inputs include ambient temperature, fuel type, vehicle age, vehicle condition, and other factors that affect emissions. Using the MOVES model, the EPA estimated emissions for a variety of highway vehicle types, including heavy-duty trucks.

For the estimate of average in-use emissions for heavy-duty trucks, the EPA assumed an average, properly maintained heavy-duty truck, running on diesel fuel, operating on the road on a warm summer day in July 2008. Actual emissions for any individual truck will vary. For example, a newer truck will generally have lower emissions and an older truck will have higher emissions.

The EPA calculated emission rates for atmospheric carbon dioxide (CO2), carbon monoxide (CO), nitrogen oxides (NOx), particulate matter under 10 microns diameter (PM10), and particulate matter under 2.5 microns diameter (PM2.5), sometimes referred to as 'fine

¹⁵ Generating electricity from landfill gas converts methane, a powerful greenhouse gas, to carbon dioxide. The burning of the landfill gas greatly reduces the greenhouse gas emissions generated by a landfill. This analysis does not calculate the value of those emissions because RLC is required to flare the landfill gas.

¹⁶ Personal communication with Frank Willmann, RLI engineer, July 29, 2013.

¹⁷ As reported by Waste Management.

¹⁸ Information about the MOVES highway vehicle emission factor model is available at http://www.epa.gov/otaq/moves.htm.

particulate.' Table 14 shows the average in-use emission rates for class VIIIa trucks, the weight class that would most likely be used to haul waste to the three alternative landfills.¹⁹ The table only shows emissions for CO2, NOx, and PM2.5, as those are the emissions for which we calculate the economic value.

Table 14. Average in-use emission rates for Class VIIIa heavy-duty trucks, per mile

	CO2 NOx		PM2.5
	(lbs)	(grams)	(grams)
Emissions per mile	4.26	9.191	0.215

Source: US EPA, Office of Transportation and Air Quality, Air Quality and Modeling Center. Per-mile carbon dioxide missions rate provided by Ted Maciag, Programmer, US EPA, using the MOVES model. Personal communication, July 31, 2013.

Table 15 shows the estimated annual emissions that would be generated by hauling waste to the three alternative landfills. To calculate the total emissions, ECONorthwest assumed that Yamhill County would generate about 126,500 tons of waste per year, and assumed that the trucks identified in Table 3 (on page 12) would be used to haul the waste.

Landfill	CO2	Nox	PM2.5				
Coffin Butte	688	3.3	0.1				
Columbia Ridge	2,631	12.5	0.3				
Wasco County	1,769	8.4	0.2				

 Table 15. Estimated annual metric tons of emissions from

 hauling waste to alternative landfills

Note: A metric ton is 2,204.6 pounds.

Source: ECONorthwest with data from the US EPA, Office of Transportation and Air Quality, Air Quality and Modeling Center.

This section estimates the economic value of CO2, NOx, and PM2.5 emissions that would be generated by hauling waste to the three alternative landfills.

4.6.1 Carbon Dioxide Emissions

The International Panel on Climate Change (IPCC) has identified anthropogenic greenhouse gas emissions as the main contributor to global warming and climate change. CO2 emissions have received the most attention as they account for the majority of these emissions – 77% in 2004.²⁰ Expected impacts of climate change include decreased ecosystem resilience, increased extinction rates, fluctuations in cropland productivity, increased erosion and flooding in coastal areas, and decreased availability of clean drinking water. These impacts could result in the displacement of hundreds of millions of people, increased morbidity, and irreversible damages to critical life-support systems within the environment.

¹⁹ Class VIIIa trucks are long-haul semi tractor-trailer rigs, weighing between 17 and 30 tons.

²⁰ IPCC. 2007. Synthesis Report. Retrieved August 5, 2013, http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf.

There are a variety of methods that can be used to estimate the economic value of reducing CO2 emissions. One data source comes from market transactions. Functioning carbon markets exist in parts of the world that have ratified the Kyoto protocols, and in some U.S. states (e.g., California) where local regulatory response to curbing carbon emissions has been stronger than at the federal level.²¹ Another way to estimate the value of reducing CO2 emissions is quantify the cost of the damage that increasing atmospheric concentrations of CO2 and resulting climate changes are likely to cause over time. This measure, known as the social cost of carbon represents "the full global cost today of emitting an incremental unit of carbon at some point of time in the future, and it includes the sum of the global cost of the damage it imposes on the entire time it is in the atmosphere."²²

The U.S. EPA established a range of values, from \$12 to \$113 per metric ton of CO₂ to account for the social cost of carbon emissions in regulatory analyses. The models and scenarios used to generate this range take into account different discount rates and a variety of climate change effects, such as net agricultural productivity, human health risk, property damage from increased flood risk, and the value of ecosystem changes.²³ For this analysis, the values selected represent a 3% discount rate and range from \$40 to \$113 per metric ton (in 2013 dollars). This discount rate reflects greater emphasis on the complete, long-term effects of carbon dioxide emissions today, and therefore yields a greater social cost of carbon than a higher (short-term focused) discount rate. There is a 95% chance that the actual value is at or below the high value. The lower end reflects the average value across all models and scenarios.

4.6.2 Other Emissions

Air pollutants emitted by diesel trucks can negatively impact human health and the environment. This analysis focuses on the value of two pollutants: Nitrogen oxide (NOx) and particulate matter (PM2.5).

Particulate matter (PM) adversely affects human health by increasing the incidence of asthma, respiratory diseases, cardiovascular disease, lung cancer, pre-term and low-birth weights, and premature death. Because of the well-documented risks associated with PM in diesel exhaust, the U.S. EPA has initiated new regulations to curb fine particulates and their precursors. Research supporting these regulations suggests that the national average monetizable benefit of reducing PM2.5 from air emissions from on-road mobile sources (such as diesel trucks) is \$367,000-\$826,000 per ton (2013 dollars).²⁴ This range was used for this analysis. It should be noted that this value is derived from national averages for health effects, population, and

²¹ Point Carbon. 2013. Carbon Market Overview. Retrieved August 5, 2013, from http://www.pointcarbon.com/1.266920

²² Shaw, R. Et al. 2009. The Impact of Climate Change on California's Ecosystem Services. August.

²³ Interagency Working Group on the Social Cost of Carbon, United States Government. 2013. *Technical Support Document: -Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis - Under Executive Order* 12866. May.

²⁴ CRC FEIS, 2011. Page 3-276; Environmental Protection Agency. 2011. "Regulations and Standards." Available Online: http://www.epa.gov/otaq/highway-diesel/regs.htm. June 29.

ambient air quality. It may over or underestimate the actual value of reducing PM2.5 emissions in the areas this project would affect.

Nitrogen oxide (NOx) is a precursor to PM2.5 formation. In the same way PM2.5 causes health problems in the population, NOx can also be problematic. Using similar techniques to estimate the value of reducing PM2.5, the U.S. EPA estimates that the human-health benefits of reducing NOx range from about \$7,000 to \$16,000 per metric ton (2013 dollars). This range was used for this analysis.

NOx also contributes to the formation of ozone, which also has human health, ecological, and quality of life benefits. The U.S. EPA indicates that these values are not reflected in the value above, but that "the ozone benefits associated with reducing NOx could be substantial."

In 2003, the U.S. EPA developed a market-based 'cap-and-trade' program, the NOx Budget Trading Program (NBP) to reduce NOx emissions in the eastern U.S. In 2010, this program was replaced by the cap-and-trade structure set forth by the EPA's Clean Air Interstate Rule (CAIR), then in 2012 by the Cross-State Air Pollution Rule (CSAPR). The trading program affects large stationary sources, such as electricity generators and industrial facilities.²⁵ The program does not include Oregon, but prices for emissions allowance provide a reasonable proxy for the value of NOx emissions. The CAIR traded 885,025 tons of NOx allowances in 2010.²⁶ The price for a NOx allowance in 2011 has dropped considerably from recent years, with allowances trading near \$16 per ton.²⁷

4.6.3 Cost Of Emissions

Table 16 shows the estimated annual economic cost of emissions that would be generated if Yamhill County must haul its waste to any of the three alternative landfills. The cost of emissions increases as the distance of the alternative landfill increases.

	CC	02	Nox		PM2.5	
Landfill	Low	High	Low	High	Low	High
Coffin Butte	\$28,000	\$78,000	\$23,000	\$52,000	\$28,000	\$63,000
Columbia Ridge	\$105,000	\$297,000	\$88,000	\$200,000	\$107,000	\$242,000
Wasco County	\$71,000	\$200,000	\$59,000	\$135,000	\$72,000	\$163,000

Table 16. Estimated annual cost of emissions from hauling waste to alternative landfills

Source: ECONorthwest. See text for explanation.

²⁵ US Environmental Protection Agency "Cross-State Air Pollution Rule (CSAPR)" (http://www.epa.gov/crossstaterule/basic.html). The CSAPR program is based on a region-wide cap is the sum of the state emission budgets the EPA established to help states meet their air quality goals. Authorizations to emit, known as allowances, are allocated to affected sources based on state trading budgets. The NOx allowance market enables allowance trading throughout the year. To accurately monitor and report emissions, emitting sources use continuous emissions monitoring systems.

²⁶ US Environmental Protection Agency "Clean Air Interstate Rule, Acid Rain Program, and Former NOx Budget Trading Program 2010 Progress Report." (http://www.epa.gov/airmarkets/progress/ARPCAIR10_01.html)

²⁷ US Energy Information Administration "Emissions allowance princes for SO₂ and NOx remained low in 2011." *Today in Energy*. Feb. 2, 2012. Web. Accessed Jul. 8, 2013.

4.7 Tourism Impacts

Yamhill County is the leading production area for Oregon's wine industry, and several studies have identified wine-related tourism as the main driver of tourism activities in Yamhill County.²⁸ A review of studies on tourism in Yamhill County by ECONorthwest yielded no evidence suggesting that Riverbend Landfill negatively impacts tourism in Yamhill County. Analyses by Full Glass Research (2011) and Barney & Worth, Inc. (2009) both recognize several key factors that could affect the growth of wine-related tourism in Yamhill County, but neither points to Riverbend Landfill nor other waste disposal operations as deterrents of tourism growth.

Figure 1 shows the total amount of spending by visitors in Yamhill County from 2000 to 2012 (in current, or nominal, dollars). The County has experienced relatively steady positive spending growth in most years. Total tourism spending declined in 2009, during the severe recession, and in 2012. Overall, visitor spending in Yamhill County outpaced overall spending in the US. Visitor spending grew 75% from 2000 to 2012, compared to total personal consumption expenditures in the US, which grew 64%.²⁹

²⁸ Barney & Worth, Inc. Yamhill County Agri-Business Economic and Community Development Plan. McMinnville: Yamhill County, 2009. 1-42. Print.; Full Glass Research. The Economic Impact of the Wine and Wine Grape Industries on the Oregon Economy. McMinnville: Oregon Wine Board, 2011. 3-60. Print.

²⁹ Personal consumption expenditure data from FRED Economic Data database, Federal Reserve Bank of St. Louis (http://research.stlouisfed.org/fred2/series/PCE).





ECONorthwest compared the tourism industry in Yamhill County to that of other comparable counties in Oregon, Washington, and California. These counties are either similar in size to Yamhill County, or are also known for their wine-related tourism and wine production.

Figure 2 shows the average annual growth rate of tourism-related spending in Yamhill and comparable counties in Oregon and California, from 2000 to 2011. The data show that since 2000, Yamhill County's tourism-related expenditures have outpaced comparable counties in Oregon and California.

Data for counties in Washington state are only available through 2009. From 2000 to 2009, the average annual growth rate for tourism-related spending in four counties in Washington (Benton, Franklin, Klickitat, and Walla Walla) exceeded the growth rate for the same period in Yamhill County.

Source: Oregon Travel Impacts, 1991-2012p. Dean Runyan, April 2013.. http://www.deanrunyan.com/doc_library/ORImp.pdf.





Source: California Travel Impacts by County, 1991-2011. Dean Runyan, May 2013. http://www.deanrunyan.com/doc_library/CAImp.pdf; and Oregon Travel Impacts, 1991-2012p. Dean Runyan, April 2013.. http://www.deanrunyan.com/doc_library/ORImp.pdf.

4.8 Green Tech

RLC is aggressively pursuing opportunities to develop a new green tech facility at Riverbend. Such a facility could create a marketable energy product, reduce residual waste disposal volumes and maximize the life of the landfill.

Waste Management has developed a system to create a fuel from waste that is currently disposed at the Riverbend Landfill. Waste Management has constructed similar facilities at other landfills, and plans to site such facility at Riverbend Landfill if the expansion proceeds. The facility takes the non-recyclable waste and sorts it, so that about one-third (170,000 tons per year) can be converted to fuel pellets. The remainder would be disposed in the Riverbend

Landfill. For the purposes of this study, we assume the Green Tech facility at Riverbend Landfill will consist of this or similar technology.

The Green Tech facility would take waste that is currently delivered to Riverbend Landfill and first sort it before disposal. The portion of the waste stream that is diverted from the Riverbend Landfill would be processed into fuel pellets, which can be used to generate energy. The primary market for the fuel pellets is expected to be facilities that require fuel to create a commodity, such as a cement kiln.

In this section, we describe the economic impacts associated with the Green Tech facility, including construction, operation, and emissions.

4.8.1 Construction Impacts

Waste Management reports that it would cost \$31 million to construct the Green Tech facility and that about 75% of this figure would purchase the processing equipment and 25% would purchase the building. ECONorthwest estimated the employment and income impacts associated with constructing the industrial building. We estimate the building would cost \$7.75 million.

Table 17 shows the construction of the Green Tech facility would create 89 jobs directly involved in the construction process, and an overall total of 110 jobs would be created in Yamhill County as a result of the construction. The construction of the Green Tech facility would generate \$2.8 million in personal income for the workers directly involved in the construction process and a total of \$3.4 million in income across the County. The jobs and income associated with the Green Tech facility would occur once and would end when construction is complete.

	Construction of Green Tech Facility			
Type of Impact	Total Jobs	Total Income		
Primary	89.0	\$2,826,600		
Secondary	21.0	\$541,200		
Total	110.0	\$3,367,800		

Table 17. Jobs and income (one-time) in Yamhill County from construction
activities-Green Tech facility (2013 Dollars)

Source. Calculated by ECONorthwest using IMPLAN software. See text for full explanation.

4.8.2 Operations Impacts

During the operations period, the Green Tech facility would generate jobs and income in two ways: it would employ individuals in the processing facility and it would employ truck drivers to haul the product to its market.

- Waste Management estimates that the Green Tech facility would directly employ 35 employees. The total value of their wages and benefits is \$3.29 million per year.
- Waste Management estimates that the Green Tech facility would generate 170,000 tons per year of outbound, marketable materials. The material would be hauled to an

outbound market; in this analysis we assume it is hauled to the Port in Astoria, Oregon, which is 109 miles from Riverbend Landfill (drive time two hours and 22 minutes).³⁰ To estimate the number of full-time equivalent jobs, ECONorthwest calculated the number of truck trips required to haul 171,000 tons of waste to Astoria, using the same assumptions regarding the costs to haul waste that we used in Section 4.4, Employment and Income-Operations.³¹ We calculated the total hours to haul the waste (including an hour to unload the material), and divided the total by 2,080 working hours per year per job. ECONorthwest multiplied the total FTE by \$55,454, the median value of salary and benefits for a heavy-truck driver in Yamhill County.³²

Table 18 shows the estimated employment and income impacts in Yamhill County stemming from operating the Green Tech facility and hauling the outbound, marketable material to Astoria. The table shows the number of jobs and their income in two categories: primary and secondary.

- **Primary effects** are those directly generated by operating the facility and hauling the product. These comprise the workers employed at the Green Tech facility and by a trucking company.
- Secondary effects are those indirectly generated by operating the Green Tech facility. They include the jobs and income earned by workers in industries supplying the facility (including vendors that provide goods and services) and jobs and income earned by workers servicing the direct and indirect workers, such as clothing retailers and grocery stores.

	Operation of Green Tech Facility		Haul Outbound Material to Port		ch Haul Outbound Material t Port		"	ſotal
Type of Impact	Jobs	Income	Jobs	Income	Jobs	Income		
Primary	35	\$3,290,000	8	\$465,800	43	\$3,755,800		
Secondary	40	\$1,078,600	5	\$124,300	45	\$1,202,900		
Total	75	\$4,368,600	13	\$590,100	88	\$4,958,700		

Table 18. Jobs and income (annual) in Yamhill County from operations activities-Green Tech facility (2013 Dollars)

Source. Calculated by ECONorthwest. See text for full explanation.

The table shows that operating the Green Tech facility and hauling the marketable material to Astoria would bring 88 total jobs to Yamhill County and 43 of those jobs are directly employed in Green Tech's operations and hauling the waste. All of these jobs are considered permanent jobs.

³⁰ Mileage and travel time from www.maps.google.com.

³¹ We assume that the trucks can carry 34 tons of material.

³² Salary and benefits data provided by www.salary.com. Accessed July 2013.

4.8.3 Air Emissions from Hauling Marketable Material

Hauling the outbound, marketable product from Riverbend Landfill to Astoria would generate emissions of air pollutants as the heavy trucks travel to and from the Port. This section quantifies those emissions.

We use the same methodology as described in Section 4.6, Air Emissions from Hauling Waste. Please refer to that section for our methods to estimate the total emissions and their economic value.

Table 15 shows the estimated annual emissions that would be generated by hauling the outbound material to Astoria. To calculate the total emissions, ECONorthwest assumed that Riverbend Landfill would generate 170,000 tons per year of marketable product, and a truck would haul a 34-ton trailer.

Table 19. Estimated annual metric tons of emissions fromhauling Green Tech material to Astoria

CO2	Nox	PM2.5
2,106	10.0	0.2

Note: A metric ton is 2,204.6 pounds.

Source: ECONorthwest with data from the US EPA, Office of Transportation and Air Quality, Air Quality and Modeling Center.

Table 16 shows the estimated annual economic value of emissions that would be generated if the Green Tech facility produces 170,000 tons per year of marketable materials.

Table 20. Estimated annual values of emissions from haulingGreen Tech product to Astoria

CO2		N	ох	PM2.5	
Low	High	Low	High	Low	High
\$84,000	\$238,000	\$70,000	\$160,000	\$86,000	\$194,000

Source: ECONorthwest. See text for explanation.

4.8.4 Air Emissions from Utilizing Marketable Material

The Green Tech facility would produce a fuel that can be used in place of coal. In this section, we compare the CO2 emissions from using the Green Tech product as a fuel to using coal as a fuel.

To compare the two fuel sources, we must identify the 'heat value' for both fuel sources. The heat value quantifies the amount of energy contained in a fuel source. Energy analysts use British thermal units (BTUs) to compare energy in different fuel sources.

• Waste Management reports that the Green Tech material would have a heat value of 7,500 to 11,000 BTUs per pound of material. In this analysis, we use the mid-point of the range, 9,250 BTUs per pound.

• The U.S. Energy Information Administration (EIA) reports that exported coal from the U.S. has a heat value of 12,823 BTUs per pound.³³

Waste Management estimates that the Green Tech facility at Riverbend Landfill would generate 170,000 tons of marketable product. This would yield 3.145 trillion BTUs of energy annually.³⁴ We estimated that it would require 122,636 tons of coal per year to produce the same volume of energy.

The EIA reports that the average factor for carbon emission for U.S. coal is 207.6. A carbon emission factor equals the pounds of CO2 emitted per million BTUs.³⁵ By multiplying the emission factor by the 3.145 trillion BTUs, we estimate that coal would emit 652,902,000 pounds per year of CO2, or about 296,000 metric tons.

Waste Management reported that the Green Tech product emits 12% less CO2 than coal. To estimate the metric tons of CO2 emitted by the Green Tech product, we reduce the emissions from coal by 12%, resulting in a reduction of approximately 261,000 metric tons of CO2 by using the Green Tech Facility instead of coal.

Table 21 shows the total metric tons of CO2 that would be emitted from 3.145 trillion BTUs of energy generated by the Green Tech product and coal. The table also shows the estimated economic cost of the CO2 emissions for both products.³⁶ The table shows that the Green Tech product produces fewer CO2 emissions than coal, for the same energy production.

Table 21. Estimated annual CO2 emissions from 3.145 trillion BTUs of energy and its economic cost

	Green Tech Material	Coal	Avoided Emissions
CO2 metric tons	261,000	296,000	35,000
Cost of CO2 emissions-low	\$10,425,000	\$11,840,000	\$1,415,000
Cost of CO2 emissions-high	\$29,493,000	\$33,448,000	\$3,955,000

Source: ECONorthwest. See text for explanation.

It is important to note that the volume of avoided emissions from using the Green Tech product exceeds the emissions from hauling the product to Astoria by a factor of 124.

³³ U.S. Energy Information Administration. *Monthly Energy Review*. July 2013. Table A5. "Approximate Heat Content of Coal and Coal Coke". The report shows that coal has a heat value of 25.645 Million BTUs per short ton. We converted the figure to BTUs per pound. Coal consumed in the U.S. has much lower heat value, 9,754 BTUs per pound. We use the figure for exported coal.

³⁴ We converted the 170,000 tons to pounds and then multiplied that figure by the per-pound heat value.

³⁵ U.S. Energy Information Administration. "Carbon Dioxide Emission Factors for Coal" in *Quarterly Coal Report*, January-April 1994, pp. 1-8.

³⁶ Refer to Section 4.6, Air Emissions from Hauling Waste, for a description of methods to estimate the economic cost of CO2 emissions.

4.9 Other Impacts

The expansion area of Riverbend Landfill includes the area that is currently occupied by the Mulkey RV Park. The expansion will eliminate the existing commercial activity at the site.

The operators of the RV Park report that the facility's total annual revenue is \$125,000 per year. It has no paid employees.

If Riverbend Landfill is expanded, the Mulkey RV Park will no longer generate that revenue. It is likely that some of its customers will go to other campsites in Yamhill County. The economic impact of closing the RV Park is likely to be less than \$125,000 per year.

Appendix-Overview of Economic Multiplier Models

One economic modeling framework that captures the direct, indirect, and induced effects of spending on a project is called input-output modeling. Input-output models provide an empirical representation of the economy and its inter-sectoral relationships.

Because input-output models generally are not available for state and regional economies, special data techniques have been developed to estimate the necessary empirical relationships from a combination of national technological relationships and county-level measures of economic activity. This planning framework, called IMPLAN (for IMpact Analysis for PLANning), is the technique that ECONorthwest applied to the estimation of impacts.

The Origins of the IMPLAN Model

IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. U.S. government agencies, other public agencies, and private firms including ECONorthwest have applied the model to a wide variety of public and private sector projects.

The model is distinguished from typical input-output models in that it is not survey based; survey-based input-output models place significant demands on data, and are uneconomical to apply in most situations. Rather, IMPLAN employs secondary source data, available by state and county, to define a model for any region in the United States.

Two sources of data are particularly central to the IMPLAN models: the National Income and Product Accounts published annually by the Bureau of Economic Analysis (BEA) of the U.S. Commerce Department, and the BEA input-output model for the United States. The IMPLAN modeling process utilizes the national input-output model and county-level economic activity data to derive input-output models for units as small as a county.

The process that develops the county-level input-output model generates coefficients that are internally consistent, in that county data sum to state totals and state data sum to national totals. This generally is not the case with survey- based input-output models, which limits their applicability to large-scale projects that affect a number of interrelated regions. (Arguably, however, an input-output model estimated from survey data has more accurate coefficients, because the survey can be customized to the problem at hand. In contrast, IMPLAN *derives* its coefficients using a combination of the national input-output survey model and local activity data; conceivably, this will produce somewhat different results from a direct, local survey. Given the difficulty and expense of input-output surveys, however, the disadvantages of the IMPLAN approach are slight.)

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Modeling

The process of modeling involves three steps:

- Creation of study area database;
- Customization of IMPLAN coefficients;
- Estimating the impact of an activity on the model of the study area economy.

The IMPLAN model allows substitution and incorporation of primary data at each stage of the model-building process, greatly increasing the model's accuracy and flexibility. In addition to being able to directly modify the IMPLAN database statistics, the user can alter import and export relationships, utilize modified input-output functions, and change industry groupings. IMPLAN allows the creation of aggregate models consisting of industries grouped together for a specific purpose.

Once a regional input-output model has been specified, impact analysis may be performed on that model. New industries or commodities can be introduced to "shock" the regional economy, industries or commodities may be removed or disaggregated, and reports can be generated to show the consequences (on output, employment, and value-added) of various impacts.

The key to input-output analysis is the construction of the input-output or transactions table, which shows the flow of commodities from each of a number of producing industries to all consuming industries and final demand (ultimate consumers). Given that many industries produce more than one commodity, production information is often tabulated on an industry-by-commodity basis into a "Make" matrix, containing the value of commodities produced by different industries, and a "Use" matrix, containing the value of commodities used by each industry in the production process. These matrices are combined to produce the input-output transactions table showing each industry buying and selling from other industries.

From these industry flows, two other structural tables are developed: (1) a table of technical coefficients or direct requirements and (2) a table of direct and indirect coefficients or total requirements. The entries in the former are interpreted as the dollar value of the minimal requirements from each of the contributing industries in order for each producing industry to produce one dollar's worth of output. The entries in the latter table are to be interpreted as the amount of output from the contributing industries required, both directly and indirectly, to deliver one dollar's worth of the producing industry's output to final demand.

Defining the Study Area

The IMPLAN program uses an ordered series of steps to build the model. We describe them here to provide the interested reader with a view of the sequence of steps employed, and the types of data needed to model the impacts.

The first step is the definition of the study area or study areas. Study area Databases are created corresponding to these areas. These databases contain the representation of the behavior of the study area economies, but do not contain any information about the specific project under study.

Customizing the Social Accounting Matrix

From the Study Area Databases, a mathematical concept called the Social Accounting Matrix is constructed, using computer procedures incorporated in the IMPLAN modeling system. The initial study area data in this transformation can be viewed and edited in a spreadsheet-like program. There are 22 IMPLAN data elements appearing in columns and 528 industry/commodity names forming the rows. The database elements are organized into five main groups: Final Demand, Sales, Value Added, Employment, and Total Industry Output. These elements can be further divided into those that are specific to commodities and those that relate to industries.

The user may edit the Regional Purchase Coefficient and the Directly Allocated Exports Coefficient for each commodity. Both of these coefficients are calculated from the Social Accounting Matrix so they may only be modified after that matrix has been constructed. The IMPLAN program contains internal checks, which enforce data integrity and will not allow values outside the specific, valid range for these coefficients to be accepted by the model.

Building the Input-Output Coefficients

After creating the social accounting matrix, the input-output accounts for the model are constructed. The input-output accounts are formed by transforming parts of the social accounts from an "industry-by-commodity" format to an "industry-by-industry" format; it combines submatrices into a single "transactions" submatrix, as described in general above. The input-output accounts may be constructed with either aggregated or disaggregated industry data. The former will reduce the size of the industry matrix (and processing time) by creating aggregate industries from individual industries.

Estimating Multipliers

The last step in building the model is to estimate the multipliers. Five different sets of multipliers are estimated by IMPLAN corresponding to five measures of regional economic activity: Total Industry Output, Personal Income, Total Income, Value Added, and Employment. Multiplier analysis is used to estimate the regional economic impacts resulting from a change in final demand. Impacts can be in terms of direct and indirect effects (commonly known as Type I multipliers), or in terms of direct, indirect, and induced effects (Type II and Type III multipliers). More specifically, direct effects are production changes associated with the immediate effects of final demand changes. Indirect effects are production changes in backward-linked industries caused by the changing input needs of directly affected industries. Induced effects are the changes in regional household spending patterns caused by changes in household income-- generated from the direct and indirect effects.

IMPLAN calculates two types of multipliers for each of the five impact measures. The first output multiplier represents the value of production, from indirect and direct effects, required from all sectors by a particular sector in order to deliver one dollar's worth of output. The second output multiplier adds in the induced requirements. The size of the multiplier is not a measure of the amount of activity or the importance of a given industry for the economy. It is an estimation of what would happen if that industry's sales to final demand increased or decreased. In other words, output multipliers can be used to gauge the interdependence of sectors; the larger the output multiplier, the greater the interdependence of the sector on the rest of the regional economy.

Performing Impact Analysis

Once the model is complete, impact analysis can be performed on the model. Impact analysis involves posing a change in the demand for commodities and using the multiplier model to examine the effects that producing and delivering the commodities may have on a region's employment, income, and population. Several types of economic impact analyses can be carried out simply by varying structural, technological, and/or trade factors within the model. For instance, the user may add or remove sectors from the model, or change the size of an industry, or the user may change production functions, or make changes in commodity imports and exports. To perform a full economic impact analysis with IMPLAN, all of the relevant structural, technological, and trade related adjustments must already be incorporated in the regional model.

In order to keep track of and organize all of the information needed to describe a change in the final demand for commodities, IMPLAN uses the general concept of a "scenario" to capture all of the information about the change(s) in commodity demand for which impacts are being estimated. Scenarios are made up of several building blocks.

At the lowest level is a transaction; this is the actual expenditure that represents the final demand for a commodity. Descriptive information about this transaction, such as what commodity is involved, when it occurred, and how it was measured, are collectively referred to as an event. A collection of events, which have descriptive information in common, occurring together, are referred to as an activity. For instance, the group of events that make up an activity may be related to each other by who caused them to take place or why they took place.

A scenario is a collection of one or more activities (which includes, in turn, events with transactions), specifying where the activity(s) occurred and at what level(s). A scenario may be viewed as equivalent to a management, planning, or policy alternative. Units of measure are assigned to each activity and can be in physical terms, monetary terms, household consumption, or any other terms appropriate for the problem under study. The unit price represents the transaction rate--the total amount of purchases necessary to participate in one unit of an activity.

In order to run an economic impact analysis, the user must build a datafile of changes in final demand. All activities to be included in the analysis must be defined, providing information about who initiated the demand change, the base year of the activity, the transaction basis (commodity purchase or an industry's output), conversion rate (which gives a scale of the transactions occurring in the activity), and measurement units. There is a finite list of causal agents to choose from when describing the activity, comprised of the following choices: households, federal government, state/local government, enterprises (investment), and industry. Once the activity is defined, the next step is to define events that occur in the activity, in much the same way as for the activity itself.

Model Outputs

The IMPLAN model provides estimates of impacts of the expenditures on income, and employment that follow from direct, indirect, and induced expenditures. By writing special fiscal impact modules, the model also can be used to estimate impacts on the tax revenue collected through property taxes, sales taxes, corporate income taxes, and other fiscal devices. In addition, IMPLAN can provide estimates of stimulus to population growth that will result from project expenditures.