

Economic Impacts of Expanding Riverbend Landfill

Prepared for

Riverbend Landfill, Inc.

by

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Executive Summary

The Riverbend Landfill and Recycling Center (Riverbend) in McMinnville is approaching its capacity. Riverbend Landfill, Inc. (RLI), the owner of Riverbend, is applying to Yamhill County to allow an expansion of the footprint and capacity of Riverbend.

As a municipal solid waste landfill, Riverbend accepts solid waste collected by households and businesses, construction and demolition debris, and non-hazardous special waste. At current disposal rates, RLI estimates that Riverbend will accept waste for another seven years, through 2014. RLI has filed a land use application to expand the landfill by 87 acres, extending its operating life by 20 to 30 years.

RLI asked ECONorthwest (ECO) to analyze the economic impacts of expanding Riverbend to Yamhill County. This report summarizes ECO's analysis of the impacts of expanding Riverbend and compares those impacts to alternative disposal options.

- **Expand Riverbend.** The proposed expansion of Riverbend is expected to cost about \$66 million (in 2007 dollars) and would take place over the life of the landfill, as new cells are developed and full cells are closed.

The analysis compares three alternative disposal sites to expanding Riverbend. The three alternative sites are:

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

The alternative disposal sites would use a new transfer station in Yamhill County. This analysis assumes the new transfer station would be in McMinnville and would cost about \$2 million (in 2007 dollars) to construct.

Table 1 summarizes the economic impacts for the alternatives. The table shows that expanding Riverbend generates significant and clear benefits to Yamhill County and its residents. The table lists the types of impact, and shows the impact for expanding Riverbend and the impact of hauling waste to alternative sites.

Table 1. Summary of economic impacts, 2007 dollars

Type of Impact	Expand Riverbend	Alternative Disposal Options
Cost of Disposal Per ton cost	\$30.40 per ton	Coffin Butte: \$59.04 Columbia Ridge: \$59.41 Wasco County: \$58.30
Annual cost for Yamhill County service area	\$5.6 million	Coffin Butte: \$8.9 million Columbia Ridge: \$9.0 million Wasco County: \$8.8 million
Annual cost of solid waste service in Yamhill County	No change	Increase by 12%
Licensing and host fees generated to Yamhill County	\$740,00 per year	Coffin Butte: \$59,000 Columbia Ridge: \$59,000 Wasco County: \$58,000
Construction impacts- Employment	600 total jobs (24 jobs per year)	35 total jobs
Personal income	\$23.5 million total (\$940,000 per year)	\$1.4 million total
Operation impacts Employment per year	23.5 FTE	Coffin Butte: 5.7 FTE Columbia Ridge: 11.5 FTE Wasco County: 9.0 FTE
Personal income per year	\$1.1 million	Coffin Butte: \$310,000 Columbia Ridge: \$650,000 Wasco County: \$510,000
Local and regional expenditures by RLI	\$5.3 million per year	\$700,000 per year
Electricity generation	8 MW capacity 63,000 MW-hours per year Powers 5,240 homes	4 MW capacity 32,000 MW-hours per year Powers 2,620 homes
Air emissions from hauling waste (tons per year) Carbon	None	Coffin Butte: 194 Columbia Ridge: 842 Wasco County: 566
Nitrogen Oxides (NOx)		Coffin Butte: 5 Columbia Ridge: 23 Wasco County: 16
Air emissions from hauling waste (value per year of avoided emissions)	None	Coffin Butte: \$8,000 Columbia Ridge: \$35,000 Wasco County: \$9,000
Property tax revenue to Yamhill County	\$4,700 per year	\$2,850 per year

Expanding Riverbend Landfill has large economic benefits to Yamhill County and its residents. Costs of hauling waste are lower, many more local jobs and

associated income are generated, and the County generates more revenue from property taxes and fees. 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 for the entire County would increase by \$3.2 to \$3.4 million (depending on the alternative site). The increased costs are caused by the additional cost of processing waste at a transfer station and hauling the waste to the alternative sites.
- **Fees to Yamhill County.** If Riverbend expands, RLI will continue to pay approximately \$740,000 per year in licensing and host fees to Yamhill County. That revenue supports about half 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 many other programs. If Riverbend closes, the County would only collect license fees from a new transfer station, about \$59,000 per year.
- **Employment and income from construction.** Expanding Riverbend Landfill creates 565 more jobs and generates over \$22 million more personal income in Yamhill County than the alternatives. RLI will spend \$66 million over a 25-year period to continually expand Riverbend. The construction activity will generate 600 jobs over the 25-year period (24 jobs per year) and \$23.5 million in associated income (\$940,000 per year). If the landfill is not expanded, a \$2 million transfer would be built. Constructing the transfer station would generate 35 jobs and \$1.4 million in associated income.
- **Employment and income from operations.** Operating Riverbend requires 23.5 full-time equivalent jobs, generating \$1.1 million in associated personal income. Hauling waste to alternative sites would create less than half as many jobs—operating the transfer station and driving the waste to alternative sites would generate between about six and 12 jobs, and between about \$310,000 and \$650,000 in personal income (depending on the alternative site).
- **Local and regional expenditures.** RLI purchases about \$5.3 million in goods and services from local and regional vendors to operate the landfill. About \$1.3 million is spent with local vendors. Operating a transfer station would require significantly lower expenditures, about \$700,000 per year.
- **Electricity generation.** RLI is working with McMinnville Water and Light to bring electricity to the service area generated by combusting landfill gas. Expanding Riverbend would increase the electricity generation capacity from four to eight megawatts. The additional capacity would generate about 32,000 megawatt-hours of electricity per year, enough electricity to power 2,620 Oregon homes. Developing the

electricity-generating capacity will displace new electrical turbines powered by natural gas, which generate additional greenhouse gas emissions and other air pollutants.

- **Air emissions from trucking waste.** Hauling solid waste from Yamhill County to any of the three alternative disposal sites generates carbon, nitrogen oxides, carbon monoxide, and particulate matter. Expanding Riverbend avoids the generation of greenhouse gases and pollutants that decrease air quality. The economic value of the avoided carbon is between \$5,000 and \$21,000; the value of the avoided nitrogen oxides is between \$3,000 and \$14,000.
- **Property tax revenue.** Expanding Riverbend would generate about \$4,300 per year in property tax revenue to Yamhill County, about \$1,500 more year than a transfer station would generate.

The Riverbend Landfill and Recycling Center (Riverbend) in McMinnville is approaching its capacity. Riverbend Landfill, Inc. (RLI), the owner of Riverbend, is applying to Yamhill County to allow an expansion of the footprint and capacity of Riverbend.

RLI asked ECONorthwest (ECO) to analyze the economic impacts of expanding Riverbend. This report summarizes ECO's analysis. This introductory chapter has three sections:

- **Background** provides more explanation of the reasons for this evaluation.
- **Evaluation Methods and Data** describes how ECO conducted the evaluation.
- **Organization of this Report** describes how the remaining chapters and appendix fit together.

BACKGROUND

Riverbend is located on Highway 18, about three miles southwest of McMinnville. As a municipal solid waste landfill, Riverbend accepts solid waste collected by households and businesses, construction and demolition debris, and non-hazardous special waste.

Riverbend opened in 1982. In addition to providing disposal service to Yamhill County, it services communities on the coast and portions of Multnomah, Clackamas, and Washington Counties.

At current disposal rates, RLI estimates that Riverbend will accept waste for another seven years, through 2014. RLI will file a land use application to expand the landfill by 87 acres, extending its operating life by 20 to 30 years.

This analysis estimates the impacts of expanding Riverbend and compares those impacts to alternative disposal options. This report examines only a subset of the potential impacts of an expanded landfill: it focuses on describing and, as possible, quantifying economic impacts.

EVALUATION METHODS AND DATA

The evaluation used the following sources of information:

- Local economic and planning data. ECO used standard sources for data on land use, employment, and other economic variables.
- Interviews with waste haulers that dispose waste at Riverbend. ECO interviewed key staff to understand the amount of waste delivered to

Riverbend and the expected cost of delivering the waste to alternative disposal sites.

- Interviews with County staff. ECO interviewed staff at Yamhill County to understand the fiscal impacts of the landfill to the County.
- Landfill operations data from RLI. ECO worked with staff at RLI to understand landfill operations.
- National data sources. ECO relied on federal agencies for electricity and air emissions data.
- Professional literature and experience of ECONorthwest with project evaluation.

ORGANIZATION OF THE REPORT

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

- **Chapter 2, Evaluation Framework** presents a framework for evaluating the impacts associated with expanding the landfill. This chapter describes some basic principles of analysis, and the alternatives analyzed.
- **Chapter 3, Economic Impacts** compares the economic impacts of expanding Riverbend to hauling waste to alternative disposal facilities.
- **Appendix A, Overview of Economic Multiplier Models** describes measuring economic impacts using input/output models.
- **Appendix B, Property Tax Revenue** explains the methods used to estimate property tax revenue to Yamhill County.

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.

KEY ISSUES AFFECTING THIS ANALYSIS

This section discusses assumptions that affect the analysis of the economic impacts of expanding the Riverbend landfill.

- **Identify the base case.** To estimate the net benefits of expanding the landfill, one must compare the benefits and costs of one possible future (with an increased capacity at the landfill) 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 RLI expands Riverbend.
- **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 of doing so only once (i.e., avoiding double counts), is essential to an evaluation of net impacts.
- **Separate direct and indirect impacts.** The issue here relates to causality. Some impacts are direct (sometimes called ‘primary’) and others are indirect (sometimes called ‘secondary’). In this evaluation we estimate the indirect economic effects of direct spending on construction, using an economic input-output model (see Appendix A for details). We do not estimate other indirect 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 2007, is based on 2007 data. This evaluation estimates jobs, income, tax revenue, and other factors based on 2007

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 2007 dollars, and notes that the impacts would continue on an annual basis into the future.

ALTERNATIVES

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

EXPAND RIVERBEND

RLI is currently contractually committed to Yamhill County to accept waste until 2014. RLI proposes an expansion of Riverbend to include an adjacent 87 acres, increasing the life of the landfill by 20 to 30 years.

To expand Riverbend onto adjacent property, that property must be rezoned. As part of the zone change application, RLI is applying to rezone the adjacent property from EF-80 (an exclusive farm use zone) and RC (recreational commercial) to PWS (public works safety), the zone that allows landfill activity. As part of the land use application, approximately 91 acres currently zoned PWS next to the South Yamhill River would be rezoned EF-80.

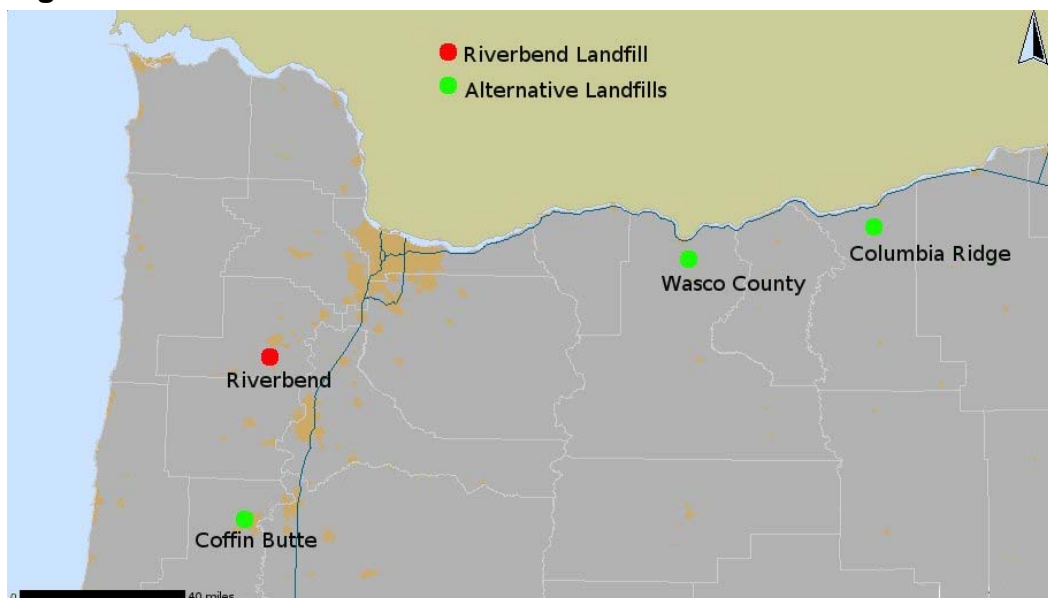
The expansion of Riverbend is expected to cost about \$66 million (in 2007 dollars). The expansion would take place over the life of the landfill, as new cells are developed and full cells are closed.

RLI plans to develop a system to capture methane gas generated in the landfill by decomposing waste and is planning to convert it to usable electricity. The expansion would increase the amount of electricity generated by the landfill.

HAUL WASTE TO OTHER LANDFILLS

If Riverbend does not expand, it is expected to cease accepting waste in 2014. The area currently served by Riverbend would need to find alternative disposal options. This analysis considers three alternative locations, described below. Figure 1 shows the location of Riverbend and the three alternative landfills.

Figure 1. Location of Riverbend and alternative landfill sites



Source: <http://oregonexplorer.info/mappingtools>.

All three alternatives would include a new transfer station in Yamhill County. This analysis assumes the new transfer station would be on property currently owned by Western Oregon Waste (WOW), located at 1850 NE Lafayette Avenue, in McMinnville. The transfer station would likely be owned and operated by WOW. It is expected to cost about \$2 million (in 2007 dollars) to construct.

- **Coffin Butte Landfill.** Coffin Butte is 38 miles from the assumed McMinnville transfer station site, near Corvallis. It is owned by Valley Landfills, Inc., a subsidiary of Allied Waste Disposal Systems, Inc.¹
- **Columbia Ridge Landfill and Recycling Center.** Columbia Ridge is 183 miles from the transfer station site, in Gilliam County. It is owned by Waste Management Disposal Service of Oregon, Inc.
- **Wasco County Landfill.** This landfill is 123 miles from the transfer station site, near The Dalles in Wasco County. It is owned by Wasco County Landfill, Inc., a subsidiary of Waste Connections, Inc.

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

¹ Ownership information from the Oregon Department of Environmental Quality (<http://www.deq.state.or.us/lq/sw/disposal/permittedfacilities.htm>) and RLI staff.

Table 2. Distance and time from McMinnville transfer station and tipping fees for alternative sites, 2007

Landfill	Miles from WOW Transfer Station	Travel Time from McMinnville Transfer Station	Per Ton Tipping Fee
Coffin Butte	38	0:59	\$42.00
Columbia Ridge	183	3:29	\$27.24
Wasco County	123	2:28	\$32.47
Riverbend	na	na	\$30.40

Source: Mileage from www.mapquest.com, tipping fees obtained through interviews with landfill operators.

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

- Cost of Disposal
- Yamhill County fees
- Employment and income-construction
- Employment and income-operations
- Electricity generation
- Air emissions from hauling waste
- Property tax revenue

This chapter ends with a summary discussion of conclusions.

COST OF DISPOSAL

The households and businesses currently served by Riverbend would see their disposal costs rise. The primary driver of increased costs is the cost of hauling the waste to the alternative disposal sites. The waste will likely be hauled by truck to the alternative landfills. To estimate the cost of disposal, ECO calculated the per-ton hauling costs and added the tipping fee. Table 3 summarizes the calculations, which were based on the following assumptions.

- **Travel time.** ECO used travel times estimated by Mapquest.com (shown in Table 2) and rounded up the travel times to half-hour increments.²
- **Travel cost.** ECO multiplied the travel time by \$95 per hour.³ The costs include the time to bring the empty truck back to McMinnville.
- **Tons per trailer.** RLI reported that 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 or Wasco Landfill would likely be compacted and carried in closed containers with an average load weight of about 30 tons.⁴

² The analysis covers travel times to half-hour increments to show realistic travel costs. Actual travel times are within two minutes of half-hour increments.

³ Travel costs provided by Dan Walsh of Walsh Trucking (personal communication, September 11, 2007). The figure is a rough estimate of hourly costs to haul solid waste. The cost includes the cost of the truck and the driver.

⁴ Personal communication with George Duvendack, RLI, May 24, 2007.

- **Transfer Station processing fee.** Processing the waste at the McMinnville Transfer Station will cost about \$10 per ton.
- **Tipping fee.** ECO interviewed staff at the three alternative landfills to determine the public tipping fee.

Table 3. Estimated per-ton cost of disposing waste, 2007 dollars

Landfill	Travel Time from McMinnville Transfer Station (rounded minutes)		Tons per Trailer	Cost per Ton (1)	Per Ton Tipping Fee	Total Cost per Ton
	Travel Cost					
Coffin Butte	60	\$190	27	\$17.04	\$42.00	\$59.04
Columbia Ridge	210	\$665	30	\$32.17	\$27.24	\$59.41
Wasco County	150	\$475	30	\$25.83	\$32.47	\$58.30
Riverbend	na	na	na	na	\$30.40	\$30.40

1. Per ton cost includes \$10 per-ton processing fee at the transfer station.

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

Although tipping fees at the alternative disposal sites vary widely, estimated cost per ton is about \$59 per ton for all three disposal sites, about \$29 per ton higher than Riverbend.

From May 2006 to May 2007, residents and businesses in Yamhill County generated about 151,000 tons of waste, all of which was disposed at Riverbend Landfill.⁵ Table 4 shows the total cost of disposing waste generated in Yamhill County for Riverbend Landfill and the three alternative disposal sites.⁶ The total cost of disposal increases by \$3.3 million for Coffin Butte, \$3.4 million for Columbia Ridge, and \$3.2 million for Wasco County.

Table 4. Total annual disposal cost for waste generated in Yamhill County, by disposal option, 2007 dollars

Landfill	Total Annual Disposal Cost	Cost Difference from Riverbend
Coffin Butte	\$8,914,593	\$3,297,549
Columbia Ridge	\$8,970,407	\$3,353,363
Wasco County	\$8,803,803	\$3,186,759
Riverbend	\$5,617,044	\$0

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. To estimate the impacts to Yamhill County residents, ECO relied on current fees charged by Western Oregon Waste (WOW) in Yamhill County.

⁵ Personal communication with George Duvendack, RLI, May 24, 2007. The Yamhill County Solid Waste Management Plan (prepared by URS, April 2004) reports the County disposed about 134,000 tons in 2002. The average annual growth rate between the two dates is 3%. Newberg Garbage Service collects two-thirds of the County's waste and Western Oregon Waste collects one-third.

⁶ To calculate the cost of disposing at Riverbend, ECO assumes that Western Oregon Waste pays \$30.40 per ton for disposal, and the Newberg Garbage Services pays \$40.40 per ton (the \$30.40 tipping fee plus \$10 processing fee for the transfer station).

ECO estimated that residential customers would see a 12% increase in costs.⁷ Commercial customers that generate large volumes of waste are likely to see a greater increase in costs. Individual accounts would see varied increases in rates, depending on the cost structure of collection.

YAMHILL COUNTY FEES

This section describes how the alternatives affect the revenue generated to Yamhill County from fees. It has three parts:

- **Solid waste fees** describes the license, restricted host, and unrestricted host fees in Yamhill County. It also briefly describes what the fees support at the County.
- **Expand Riverbend** discusses the fee revenue impacts to Yamhill County of expanding Riverbend Landfill.
- **Haul waste to other landfills** discusses the impacts of hauling waste outside of Yamhill County. The revenue implications for Yamhill County do not vary for each of the different landfill alternatives.

SOLID WASTE FEES

Yamhill County charges four types of fees that would be affected by the changes to Riverbend.

- **Annual license fee.** RLI pays the license fee to Yamhill County to operate Riverbend. Yamhill County Ordinance 578 established the annual fee at \$200,000 in 1994. The ordinance indexes the fee to the region's consumer price index (CPI) so the revenue keeps pace with inflation. In 2007 the license fee is about \$245,000.
- **Restricted host fee.** RLI pays the County \$0.75 per ton of 'non-beneficial' waste. 'Non-beneficial' waste is the solid waste generated by residents and businesses that cannot be used in landfill operations, but must be disposed.
- **Unrestricted host fee.** Yamhill County receives 10% of the gross tipping fee paid to RLI for beneficial use waste. Beneficial use waste is waste that can be used as fill or cover.
- **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 from Western Oregon Waste (WOW) and Newberg Garbage and Recycling Service

⁷ WOW reported to ECO that the typical residential customer in McMinnville generates between 28 and 34 pounds of waste per week, and the monthly service fee is \$15.77. To estimate annual waste production per household, ECO assumed the average household generates 1,612 pounds of waste per year (31 pounds per week) and pays \$189 for waste service. 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

(NGS), but those collection franchise agreements are independent of any disposal options within the County.

Table 5 shows the revenue generated by the fees imposed on the landfill in 2006 (calendar year). The landfill generated about \$740,000 in fees.

Table 5. Fees generated from Riverbend landfill, 2006

Fee Type	2006 Revenue
Riverbend License	\$241,048
Restricted Host Fee	\$395,860
Unrestricted Host Fee	\$102,135
Total	\$739,044

Source: Sherri Mathison, Yamhill County Solid Waste Coordinator.

The solid waste fees support the Solid Waste Fund at Yamhill County. The revenue generated by Riverbend accounts for 69% of the budgeted new revenue for the Fund for the 2007-08 fiscal year.⁸ Total budgeted costs for personnel and materials and services in the current fiscal year are about \$1.2 million. The budgeted fees generated by Riverbend cover about half of the Solid Waste Fund 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 landfills. Budget post-closure costs for this fiscal year are \$155,000.
- Planning staff—the Fund supports 0.4 FTE of the County Planning Director and 1.0 FTE of a Code Enforcement Official.
- Household hazardous waste collection program.¹⁰
- Roadside cleanup and cleanup of illegal dumpsites.
- Solid waste and recycling education programs.

EXPAND RIVERBEND

If Riverbend expands, Yamhill County would continue to receive roughly \$740,000 per year in fees. It is possible that the County and RLI would change the fee structure, but for the purposes of this analysis, ECO assumes that the fee structure will not change.

⁸ As reported in the Yamhill County Budgetary Revenue and Expense Worksheet for Fiscal Year ending June 30, 2008 (<http://www.co.yamhill.or.us/>). The total revenue for the Solid Waste Fund is \$3.33 million, but \$2.39 million of that is the beginning balance. Expected *new* revenues equal \$939,000.

⁹ As reported in the Yamhill County Budgetary Revenue and Expense Worksheet for Fiscal Year ending June 30, 2008 (<http://www.co.yamhill.or.us/>).

¹⁰ Personal communication with Sherri Mathison, Yamhill County Solid Waste Coordinator, August 23, 2007.

HAUL WASTE TO OTHER LANDFILLS

If Riverbend 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.

This analysis assumes that the County would continue to receive franchise fees from the Newberg Transfer Station, and this analysis assumes 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, ECO assumed that the waste that is now hauled to Riverbend in route trucks would be hauled to the proposed transfer station, but no other waste from other sources would be routed through that transfer station. The 2% franchise fee would be applied to gross revenue, which ECO estimates to be the cost of disposal (WOW pays a franchise fee for collection services, and the revenues associated with collection are excluded from this calculation).

From May 2006 to May 2007, WOW disposed about 50,000 tons of waste that had been generated in Yamhill County.¹¹ Table 6 shows that the gross revenue generated from that waste stream would generate just under \$50,000 in franchise fees, for all three alternative disposal sites.

Table 6. Estimated franchise fee from new transfer station, 2007 dollars

Landfill	Total Disposal Cost for WOW Transfer Station	Transfer Station Franchise Fee to Yamhill County
Coffin Butte	\$2,951,852	\$59,037
Columbia Ridge	\$2,970,333	\$59,407
Wasco County	\$2,915,167	\$58,303

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

EMPLOYMENT AND INCOME-CONSTRUCTION

This section describes how the alternatives affect the number of jobs and associated personal income in Yamhill County for construction activities. A separate section discusses the job and income impacts for operating the landfill.

Economists measure economic impacts using input-output models.¹² Appendix A provides more information about measuring economic impacts using input-

¹¹ Personal communication with George Duvendack, RLI, May 24, 2007.

¹² ECO 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.

output models. Input-output models track dollars, starting with the initial project being studied, as they move 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.

RLI has estimated the total cost of expanding the landfill to be \$66.2 million (in 2007 dollars).¹³ The expenditures would be made over the life of the landfill.

The total cost is based on these elements:

- Excavation—\$2.7 million
- Perimeter berm—\$9.6 million
- Liner system—\$15 million
- Final cover system—\$11.25 million
- Gas system—\$ 4 million
- Leachate system—\$15 million
- Contingency (15%)—\$8.6 million

To estimate the employment and income impacts associated with these capital costs over the life of the landfill, ECO assumed the expenditures would be evenly spread over a 25-year period.

If Riverbend does not expand, a transfer station would be built in McMinnville. The estimated construction cost of the transfer station is \$2 million.

Table 7 compares the employment and income impacts in Yamhill County stemming from the construction of new landfill space in Yamhill County to the impacts stemming from construction of a transfer station.

To estimate the impacts of constructing the new landfill space, the input-output analysis assumes that excavation and perimeter berm costs are construction costs, and applies the multiplier for the construction sector to those expenditures. The analysis assumes that costs for the liner and final cover systems are evenly divided between materials and installation. Costs for the gas system are evenly divided between construction and gas field extraction machinery. No gas field extraction machinery is manufactured in Yamhill County, so cost allocations to that industrial sector have no local impacts. The leachate system uses a series of pipes and pumps to extract the leachate. The analysis assumes that the pipes and pumps account for 80% of costs, and the installation accounts for the remaining 20%.

The table shows the number of jobs resulting from construction spending in two categories: primary and secondary.¹⁴

¹³ Construction costs provided by RLI.

- **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.

Table 7. Jobs and income in Yamhill County resulting from constructing the expanded landfill and transfer station, 2007 dollars

Type of Impact	Construction of Landfill		Construction of Transfer Station	
	Total Jobs	Total Income	Total Jobs	Total Income
Primary	400	\$16,751,800	26	\$1,121,934
Secondary	200	\$6,758,200	9	\$306,324
Total	600	\$23,510,000	35	\$1,428,258

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

Table 7 shows expanding the landfill will create a total of 400 jobs directly involved in the construction process and an overall total of 600 jobs. On average, the expansion of the landfill would directly create 16 jobs every year, and indirectly create an additional eight jobs every year, a total of 24 jobs every year. The jobs include full-time and part-time jobs.

Table 7 also shows the construction of a transfer station would create 26 jobs directly involved in the construction process, and an overall total of 35 jobs created as a result of the construction.

The landfill expansion would generate \$23.5 million in personal income over the entire construction period, and \$16.8 million of that would be earned by those workers directly involved in the construction process. Personal income includes the value of benefits for Yamhill County residents, and excludes income generated outside Yamhill County.

The construction of the transfer station would generate \$1.4 million in personal income, and \$1.1 million of that would be earned by those workers directly involved in the construction process.

Expanding Riverbend Landfill creates 565 more jobs and generates over \$22 million more personal income in Yamhill County than the alternatives.

EMPLOYMENT AND INCOME-OPERATIONS

If the landfill is expanded, RLI estimates that it would require 23.5 full-time equivalent permanent employees to operate the landfill. Total associated personal income is \$1.1 million (including the value of benefits).

¹⁴ 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.

RLI estimates the transfer station would require three full-time equivalent employees. Total associated personal income is \$157,000. In addition to operating the transfer station, hauling waste to alternative landfills would create truck-driving jobs and associated personal income. To estimate the number of full-time equivalent jobs, ECO calculated the number of truck trips required to haul 151,000 tons of waste to the three alternative disposal sites (based on data reported in Table 3), calculated the total hours to haul the waste, and divided the total by 2,080 working hours per year per job. ECO multiplied the total FTE by \$58,587, the median value of salary and benefits for a heavy-truck driver in Yamhill County.¹⁵ Table 8 summarizes the jobs and personal income associated with operating the landfill and transfer station.

Table 8. Jobs and income in Yamhill County resulting from operating the expanded landfill and transfer station, 2007 dollars

	Operate Facility		Haul Waste to Alternative Facility		Total	
	Jobs	Income	Jobs	Income	Jobs	Income
	Coffin Butte	3.0	\$157,000	2.7	\$157,526	5.7
Columbia Ridge	3.0	\$157,000	8.5	\$496,206	11.5	\$653,206
Wasco County	3.0	\$157,000	6.0	\$354,433	9.0	\$511,433
Riverbend	23.5	\$1,100,000	0	\$0	23.5	\$1,100,000

Operating the landfill or transfer station induces secondary economic impacts. To estimate the secondary impacts of operating the landfill, RLI provided ECO detailed spending records by geography of vendor over an 18-month period. ECO estimated the annual spending, summarized in Table 9.

The table shows the total dollars Riverbend brings to the local and regional economy. The expenditures include all goods and services used to operate the landfill, and include such expenses as engineering, shipping, food service, and donations to organizations. Of the \$5.3 million paid to vendors in the region, \$1.3 million is spent on local vendors in Yamhill County.

Table 9 also shows the estimated expenditures associated with operating a transfer station. To estimate the secondary impacts of operating the landfill, ECO assumed that the local and regional expenses would be comparable to the expenses made by RLI to operate Riverbend. We assume that the vendor spending would be proportional to employment and income figures.¹⁶ Of the \$692,000 paid to vendors in the region to operate the transfer station, about \$169,000 would be spent on local vendors in Yamhill County.

¹⁵ Salary and benefits data provided by www.salary.com.

¹⁶ The transfer station would require about 13% as many employees as would the expanded landfill.

Table 9. Annual local and regional expenditures at Riverbend and transfer station, 2007 dollars

	Estimated Annual Spending		
	Operate Landfill	Operate Transfer Station	Difference
Yamhill County	\$1,296,928	\$168,601	\$1,128,327
Region	\$3,816,551	\$496,152	\$3,320,399
National vendor, local branch	\$105,955	\$13,774	\$92,181
National vendor, regional branch	\$105,031	\$13,654	\$91,377
Total	\$5,324,465	\$692,181	\$4,632,284

Note: "Region" is primarily Salem and Portland vendors.
Source: ECONorthwest with data from RLI.

Expanding and operating Riverbend Landfill generates significantly more jobs and income than building and operating a transfer station. Table 10 shows total jobs, personal income, and expenditures in Yamhill County associated with the alternatives. Expanding the landfill generates 565 more jobs for construction, and between 11 and 17 more jobs for operations. Personal income generated to workers in Yamhill County would be about \$23 million greater if the landfill is expanded. Expanding the landfill would increase spending at businesses in Yamhill County by \$1.1 million.

Table 10. Summary of employment, income, and spending impacts

	Construction		Operations		Expenditures on goods and services in Yamhill County
	Jobs	Income	Jobs	Income	
Coffin Butte	35	\$1,428,258	5.7	\$314,526	\$168,601
Columbia Ridge	35	\$1,428,258	11.5	\$653,206	\$168,601
Wasco County	35	\$1,428,258	9.0	\$511,433	\$168,601
Riverbend	600	\$23,510,000	23.0	\$1,100,000	\$1,296,928

Source: ECONorthwest. See text for full explanation.

ELECTRICITY GENERATION

A by-product of a landfill is landfill gas, which contains methane. The landfill gas can be captured and combusted for energy. RLI intends to develop a facility to generate electricity from captured landfill gas and it is working with McMinnville Water and Light to deliver the electricity to the transmission grid. The expansion of Riverbend Landfill will generate more electricity over a longer period of time. This section describes the impacts associated with generating electricity from captured landfill gas.¹⁷

Engineers have estimated that, in the absence of the landfill expansion, the landfill will create roughly 4 megawatts (MW) of electricity capacity. A detailed analysis of electricity generation capacity with the expansion has not been

¹⁷ 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 RLI is required to flare the landfill gas. The methane emissions will not vary by alternative.

conducted, but RLI engineers estimate that the capacity would double to 8 MW.¹⁸ This analysis estimates the value of the additional 4 MW of capacity.

The 4 MW of additional capacity would generate about 31,536 megawatt-hours (mwh) of electricity per year.¹⁹ This is enough electricity to power 2,620 Oregon homes.²⁰

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 new electrical turbines powered by natural gas. Natural gas turbines generate additional greenhouse gas emissions and other air pollutants.

AIR EMISSIONS FROM HAULING WASTE

Hauling waste to alternative landfills will generate increased emissions of air pollutants as heavy trucks travel the further 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 (MOBILE6.2) to estimate total emissions of pollutants generated by highway vehicles in various geographic areas.²¹ The model's inputs include ambient temperature, fuel type, vehicle age, vehicle condition, and other factors that affect emissions. Using the MOBILE6.2 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 on the road in July 2005, operating on a warm summer day. 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 carbon dioxide (CO₂), carbon monoxide (CO), nitrogen oxides (NO_x), particulate matter under 10 microns diameter (PM₁₀), and particulate matter under 2.5 microns diameter (PM_{2.5}), sometimes referred to as 'fine particulate'. Table 11 shows the average in-use

¹⁸ Personal communication with Mark Reeves, RLI engineer, November 8, 2007.

¹⁹ Calculated by multiplying each MW by 8760 hours (hours in one year) and by a 90% capacity factor (to account for generator downtime).

²⁰ The average annual residential electricity consumption in Oregon was 12,036 kilowatt-hours (source: US Energy Information Administration, http://tonto.eia.doe.gov/ask/electricity_faqs.asp)

²¹ Information about the MOBILE6.2 highway vehicle emission factor model is available at <http://www.epa.gov/otaq/m6.htm>. Emissions data were provided by Larry Landman at the Air Quality and Modeling Center, US EPA, Office of Transportation and Air Quality.

emission rates for class VIIIa trucks, the weight class that would most likely be used to haul waste to the three alternative landfills.²²

Table 11. Average in-use emission rates for Class VIIIa heavy-duty trucks

	CO2 (lbs)	Nox (grams)	CO (grams)	PM2.5 (grams)	PM10 (grams)
Emission per mile	3.70	12.60	3.21	0.33	0.36

Source: US EPA, Office of Transportation and Air Quality, Air Quality and Modeling Center.

Table 12 show the estimated annual emissions that would be generated by hauling waste to the three alternative landfills. To calculate the total emissions, ECO assumed that Yamhill County would continue to generate about 151,000 tons of waste per year, and the trucks identified in Table 3 would be used to haul the waste.

Table 12. Estimated annual metric tons of emissions from hauling waste to alternative landfills

Landfill	Carbon	NOX	CO	PM2.5	PM10
Coffin Butte	194	5.4	1.4	0.1	0.2
Columbia Ridge	842	23.2	5.9	0.6	0.7
Wasco County	566	15.6	4.0	0.4	0.4

Note: One unit of carbon is equal to 3.67 units of carbon dioxide; 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 carbon and NOx emissions that would be generated by hauling waste the three alternative landfills.

CARBON

There are a variety of methods that can be used to estimate the economic value of carbon. One data source is market data. There is a voluntary market for carbon, and trading volumes have increased in the past two years.²³ Most carbon trading was carried out through the sale of allowances under the European Union’s emissions trading scheme, which covers industries emitting large amounts of carbon. The emissions-trading scheme has been criticized because allowances under the initial phase were too generous, causing a fall in the carbon price. The second phase of the emissions trading scheme has tightened the allocations to resolve the problem, but the new allocations have not been implemented yet.

In the absence of improved market data, this study relies on the economic literature to estimate the value of carbon. Economists use the term “social cost of carbon” as a monetary indicator of the global damage resulting from the emission

²² Class VIIIa trucks are long-haul semi tractor-trailer rigs, weighing between 17 and 30 tons.

²³ See The World Bank, “State and Trends of the Carbon Market 2007”, May 2007 (<http://carbonfinance.org/>).

of one extra ton of carbon today. Estimates of the social cost of carbon have evolved over the past two decades. A recent review of 103 estimates from 28 published studies in the economics literature found the median is \$14 per metric ton of carbon.²⁴

Other work, however, shows there are strong reasons to believe that even those studies that are otherwise methodologically sound underestimate the social cost of carbon because they use incorrect discount rates.²⁵ The studies assumed that the discount rate is constant over time. Several authors have demonstrated both theoretically and empirically, that social discount rates associated with global warming decline with time. A declining discount rate yields a higher present value than a constant discount rate. Several studies have summarized this literature and applied it to adjust the finding of previous estimates of the social cost of carbon.²⁶ The studies find that, all else equal, using a declining discount rate increases an estimate of the social cost of carbon.

Based on this literature, ECO increased the social cost of carbon from \$14 per metric ton by 80%, the median estimate of the effect of using a declining discount rate. The result is \$25 per metric ton of carbon.

NITROGEN OXIDE (NOX)

Nitrogen oxide (NOx) is a prime ingredient in the formation of ground-level ozone, which creates smog. The EPA developed a market-based ‘cap-and-trade’ program, the NOx Budget Trading Program (NBP) to reduce NOx emissions in the eastern US. The trading program affects large stationary sources, such as electricity generators and industrial facilities.²⁷ The program does not include Oregon, but prices for emissions allowance provide a reasonable proxy for the value of NOx emissions.

The NBP traded 491,000 tons of NOx allowances in 2006. The price for a NOx allowance in 2007 has been relatively steady, with allowances trading near \$600 per ton. This analysis uses the \$600 per ton figure.

²⁴ Tol, R.S.J. 2005. “The Marginal Damage Costs of Carbon Dioxide Emissions” An Assessment of the Uncertainties.” In *Energy Policy* 33: 2064-2074.

²⁵ A discount rate is the rate at which future benefits and costs are discounted because of time preference (a dollar is worth more today than a dollar next week) or because of the existence of a positive interest rate.

²⁶ Newell, R.G. and W.A. Pizer. 2003. “Discounting the Distant Future: How Much Do Uncertain Rates Increase Valuations?” in *Journal of Environmental and Economic Management*. 46: 52-72; and Pearce, D.W. 2003. “The Social Cost of Carbon and Its Policy Implications.” In *Oxford Review of Economic Policy*. 19(3): 362-384; and Guo, J., C.J. Hepburn, R.S.J. Tol, and D. Anthoff. 2006. “Discounting and the Social Cost of Carbon: A Closer Look Uncertainty.” In *Environmental Science & Policy* 9:205-216.

²⁷ US Environmental Protection Agency “NOx Budget Program 2006 Progress Report” (www.epa.gov/airmarkets/progress/nbp06.html). The NBP 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.

VALUE OF EMISSIONS

Table 13 shows the estimated annual economic value emissions that would be generated if Yamhill County must haul its waste to any of the three alternative landfills. The values of emissions increases as the distance of the alternative landfill increases.

Table 13. Estimated annual values of emissions from hauling waste to alternative landfills

Landfill	Carbon	NOX
Coffin Butte	\$4,859	\$3,213
Columbia Ridge	\$21,061	\$13,927
Wasco County	\$14,156	\$9,361

Source: ECONorthwest. See text for explanation.

PROPERTY TAX REVENUE

If the Riverbend landfill expands, it would generate about \$4,300 a year in property tax revenue to Yamhill County.²⁸ The proposed transfer station would generate about \$2,850 in annual property tax revenue to the County. The landfill would increase property tax revenue to Yamhill County by about \$1,500 per year.

Appendix B provides a detailed discussion of how the proposed changes to the landfill site would affect property tax revenue.

CONCLUSION

Expanding Riverbend Landfill has large economic benefits to Yamhill County and its residents. Costs of hauling waste are lower, many more local jobs and associated income are generated, and the County generates more revenue from property taxes and fees. 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 for the entire County would increase by \$3.2 to \$3.4 million (depending on the alternative site). The increased costs are caused by the additional cost of processing waste at a transfer station and hauling the waste to the alternative sites.
- **Fees to Yamhill County.** If Riverbend expands, RLI will continue to pay approximately \$740,000 per years in licensing and host fees to Yamhill County. That revenue supports about half 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 many other programs. If Riverbend closes, the County

²⁸ The landfill generates property tax income to other taxing jurisdictions, but this analysis focuses on Yamhill County.

would only collect license fees from a new transfer station, about \$59,000 per year.

- **Employment and income from construction.** Expanding Riverbend Landfill creates 565 more jobs and generates over \$22 million more personal income in Yamhill County than the alternatives. RLI will spend \$66 million over a 25-year period to continually expand Riverbend. The construction activity will generate 600 jobs over the 25-year period (24 jobs per year) and \$23.5 million in associated income (\$940,000 per year). If the landfill is not expanded, a \$2 million transfer would be built. Constructing the transfer station would generate 35 jobs and \$1.4 million in associated income.
- **Employment and income from operations.** Operating Riverbend will require 23.5 full-time equivalent jobs, generating \$1.1 million in associated personal income. Hauling waste to alternative sites would create less than half as many jobs—operating the transfer station and driving the waste to alternative sites would generate between about six and 12 jobs, and between about \$310,000 and \$650,000 in personal income (depending on the alternative site).
- **Local and regional expenditures.** RLI purchases about \$5.3 million in goods and services from local and regional vendors to operate Riverbend. About \$1.3 million is spent with local vendors in Yamhill County. Operating a transfer station would require significantly lower expenditures, about \$700,000 per year and about \$169,000 of that would be spent with local vendors in Yamhill County.
- **Electricity generation.** RLI is working with McMinnville Water and Light to bring electricity to the service area generated by combusting landfill gas. Expanding Riverbend would increase the electricity generation capacity from four to eight megawatts. The additional capacity would generate about 32,000 megawatt-hours of electricity per year, enough electricity to power 2,620 Oregon homes. Developing the electricity-generating capacity will displace new electrical turbines powered by natural gas, which generate additional greenhouse gas emissions and other air pollutants.
- **Air emissions from trucking waste.** Hauling solid waste from Yamhill County to any of the three alternative disposal sites generates carbon, nitrogen oxides, carbon monoxide, and particulate matter. Expanding Riverbend avoids the generation of greenhouse gas and pollutants that decrease air quality. The annual economic value of the avoided carbon is between \$5,000 and \$21,000; the value of the avoided nitrogen oxides is between \$3,000 and \$14,000.
- **Property tax revenue.** Expanding Riverbend would generate about \$4,300 per year in property tax revenue to Yamhill County, about \$1,500 more year than a transfer station would generate.

Table 14 summarizes the key economic effects of expanding the landfill.

Table 14. Summary of economic impacts, 2007 dollars

Type of Impact	Expand Riverbend	Alternative Disposal Options
Cost of Disposal Per ton cost	\$30.40 per ton	Coffin Butte: \$59.04 Columbia Ridge: \$59.41 Wasco County: \$58.30
Annual cost for Yamhill County service area	\$5.6 million	Coffin Butte: \$8.9 million Columbia Ridge: \$9.0 million Wasco County: \$8.8 million
Annual cost of solid waste service in Yamhill County	No change	Increase by 12%
Licensing and host fees generated to Yamhill County	\$740,00 per year	Coffin Butte: \$59,000 Columbia Ridge: \$59,000 Wasco County: \$58,000
Construction impacts- Employment	600 total jobs (24 jobs per year)	35 total jobs
Personal income	\$23.5 million total (\$940,000 per year)	\$1.4 million total
Operation impacts Employment per year	23.5 FTE	Coffin Butte: 5.7 FTE Columbia Ridge: 11.5 FTE Wasco County: 9.0 FTE
Personal income per year	\$1.1 million	Coffin Butte: \$310,000 Columbia Ridge: \$650,000 Wasco County: \$510,000
Local and regional expenditures by RLI	\$5.3 million per year	\$700,000 per year
Electricity generation	8 MW capacity 63,000 MW-hours per year Powers 5,240 homes	4 MW capacity 32,000 MW-hours per year Powers 2,620 homes
Air emissions from hauling waste (tons per year) Carbon	None	Coffin Butte: 194 Columbia Ridge: 842 Wasco County: 566
Nitrogen Oxides (NOx)		Coffin Butte: 5 Columbia Ridge: 23 Wasco County: 16
Air emissions from hauling waste (value per year of avoided emissions)	None	Coffin Butte: \$8,000 Columbia Ridge: \$35,000 Wasco County: \$9,000
Property tax revenue to Yamhill County	\$4,700 per year	\$2,850 per year

Overview of Economic Multiplier Models

INPUT-OUTPUT MODELING

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.)

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 AREAS

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 IMPLAN COEFFICIENTS

The process of customizing the IMPLAN model does not stop with the development of the Study Area Databases. Part of the expertise of input-output practitioners is in the customization of the model coefficients. In this section, we describe the various steps in the customization process.

CONSTRUCTING 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 ACCOUNTS

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 unaggregated 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.

Property Tax Revenue

This appendix describes how the alternatives affect property tax revenue to Yamhill County. It has two parts: expand Riverbend and haul waste to other landfills.

EXPAND RIVERBEND

To expand Riverbend to the land adjacent to the existing landfill footprint, Yamhill County must approve an amendment to change the zoning of the affected acres. Changes to the zoning and use of property would trigger a change in assessed values, which would in turn, change the property tax revenue paid to Yamhill County. In addition to the zoning changes, capital improvements affect the assessed value of the property. To estimate a property's assessed value, a number of assumptions must be made. If the zone changes are approved, and the landfill is developed, actual property tax revenues would differ. This analysis therefore provides an *estimate* of the property tax revenues.

There are three types of proposed zoning changes for this project:

- **EF-80 to PWS.** About 74 adjacent acres are zoned for Exclusive Farm Use (EF-80). Landfill operations require a Public Works Safety (PWS) zone.
- **RC to PWS.** About 25 acres of the adjacent property is zoned Recreational Commercial (RC) and is used as a recreational vehicle park.
- **PWS to EF-80.** A portion of the existing landfill site is in the floodplain and is unlikely to be used as landfill. The zone change would establish a more accurate representation of how the land would and can be used. Approximately 91 acres would be converted from PWS to EF-80.

Table B-1 shows the approximate acres associated with each zone change. The three changes each have different property tax implications, calculated in this section.

Table B-1. Type of proposed zone change and number of acres

Existing Zone	Proposed Zone	Approximate Acres
EF-80	PWS	74
RC	PWS	25
PWS	EF-80	91

Source: RLI.

Property tax revenue in Oregon is determined by multiplying the property tax for a taxing district by a property's assessed value. In Oregon, "assessed value" is no longer directly tied to a property's appraised real market value. To calculate assessed value, the "changed property ratio" is applied to the appraised value. The

changed property ratio is the average percentage difference of like properties between real market value and assessed value.

Yamhill County's property tax rate is \$2.5757 per \$1,000 of assessed value.²⁹ Other taxing districts have jurisdiction over the affected property, but this analysis focuses only on Yamhill County.

EF-80 TO PWS

Land that is farmed has special tax status in Oregon. It is taxed at 'farm use value', which gives it a low assessed value. It is not the zoning, however, that gives farmland the special tax status, it is the use. For example, land zoned for industrial uses may be farmed, and if the owner applies and demonstrates to the County Assessor that the land is being farmed and meets income requirements, it is valued and taxed at the lower farm use value (estimated between \$50 and \$500 per acre). For this analysis, ECO assumes that the change in zoning is accompanied by a change in use, so the tax status would change. The analysis assumes the EF-80 land would have an assessed value of \$500 per acre.

The estimated real market value of the existing landfill parcel (zoned PWS) is \$5,000 per acre.³⁰ PWS land in Yamhill County has a changed property ratio of 0.554, so the assessed value is approximately \$2,770 per acre.³¹

Annual tax revenue to Yamhill County for the 74 acres would change from \$95 to \$528, a net increase of \$433 (see Table B-2). Oregon law limits assessed value growth to 3% a year, so tax revenue would grow 3% per year.

RC TO PWS

The parcel that is zoned RC has an appraised value of \$43,000 (about \$1,700 per acre). The changed property ratio for RC land in Yamhill County is 0.554, so the assessed value is \$23,800.³² Changing the property to PWS would change the assessed value to \$2,770 per acre, or a total assessed value of about \$69,000.

Tax revenue to Yamhill County for the 25 acres would change from \$61 to \$178, a net increase of \$117 (see Table B-2).

PWS TO EF-80

The 91 acres that are currently zoned PWS should see a decrease in assessed value and tax revenue when it is rezoned to EF-80. During interviews with staff at

²⁹ As reported by the Oregon Department of Revenue in *Oregon Property Tax Statistics, Fiscal Year 2006-07*, Appendix A.

³⁰ Yamhill County conducted a full appraisal of the property in 1992, and used real estate trends to estimate value since that time.

³¹ Appraised values and changed property ratios were provided by Roy Reel at Yamhill County Assessment and Taxation, August 21, 2007.

³² Appraised values and changed property ratios were provided by Roy Reel at Yamhill County Assessment and Taxation, August 21, 2007. Mr. Reel reported that the tax parcel is 29.8 acres. For the purposes of this analysis, ECO used the acreage number provided by RLI.

the Assessment and Taxation Department of Yamhill County, ECO learned that the entire PWS parcel is not being taxed on PWS assessed value. The parcel is currently taxed at farm use value—\$500 per acre. Therefore, the property already generates the lower tax revenue amount and the zone change would not negatively impact revenues to Yamhill County.

CAPITAL IMPROVEMENTS

In addition to the zone change, the expanded landfill would have roughly \$66 million of capital improvements built over a 25-year period. Capital improvements affect the value of a property, and generate additional tax revenue.

A typical method to estimate the assessed value of capital improvement is to use the cost of construction as a proxy for the real market value. To estimate the assessed value, one would apply the changed property ratio for the land use (in this case, PWS) to the market value proxy.

In the case of a landfill, the total cost of construction does not accurately represent the value of the improvements. The construction would take place over a 25-year period, so the method described above would show that the highest assessed value is at the end of the construction period, after the entire \$66 million have been spent. But a landfill's actual value does not increase over time. As a landfill is filled with waste, its ability to generate revenue declines. Its actual value is higher earlier in its operating life, and its value declines as it approaches capacity.

To estimate the assessed value of the capital improvements, ECO used an annual cost approach.³³ The cost approach uses the capital expenditures for active landfill cells. ECO assumed that the \$66 million in total capital expenditures would be evenly divided across a 25-year period, \$2.64 million a year.

ECO applied the changed property ratio for PWS (0.554) to the real market value, yielding an assessed value of \$1.46 million. Yamhill County would generate about \$3,800 in property tax revenue from the capital improvements (see Table B-2).

³³ The Oregon Department of Revenue uses three methodologies to appraise landfill properties: 1) the discounted cash flow method is based on the net present value of expected income; 2) the sales comparable method considers sale values of comparable properties, and 3) the cost approach, which considers capital expenses for current operations. The cost approach takes into account expenses for active cells in a landfill. Source: personal communication with Bill Rodriguez at the Oregon Department of Revenue, September 26, 2007.

Table B-2 Assessed values and annual tax revenue generated to Yamhill County, 2007 dollars

	Existing		Proposed		Net Difference	
	Assessed Value	Tax Revenue	Assessed Value	Tax Revenue	Assessed Value	Tax Revenue
EF-80 to PWS	\$37,000	\$95	\$204,980	\$528	\$167,980	\$433
RC to PWS	\$23,822	\$61	\$69,250	\$178	\$45,428	\$117
PWS to EF-80	\$45,500	\$117	\$45,500	\$117	\$0	\$0
Capital Improvements			\$1,462,560	\$3,767	\$1,462,560	\$3,767
Total	\$106,322	\$274	\$1,782,290	\$4,591	\$1,675,968	\$4,317

Source: ECONorthwest with data from the Yamhill County Assessment and Taxation.

If the Riverbend landfill expands, it would generate about \$4,300 in property tax revenue.

HAUL WASTE TO OTHER LANDFILLS

If Riverbend is not expanded, the property adjacent to the landfill would not be rezoned, and the assessed value would not increase. Yamhill County would see no increase in tax revenue associated with the 92-acre and 25-acre parcels that would be rezoned to PWS.

The new transfer station that would serve the McMinnville area would generate some new property tax revenue. The new facility would be on land owned by Western Oregon Waste (WOW). The value of the land would not change, but the transfer station would be a substantial new capital improvement and the assessed value would increase.

The estimated construction cost of the transfer station is \$2 million. ECO used the cost of construction as a proxy for its real market value. To estimate the assessed value, ECO applied the change property ratio for PWS (0.554) to the real market value, yielding an assessed value of \$1.1 million. Yamhill County would generate about \$2,850 in property tax revenue from the transfer station.