APPENDIX

E Recycling Potential Assessment Model and Environmental Benefits Analysis

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Appendix E Recycling Potential Assessment Model and Environmental Benefits Analysis

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This appendix describes the two economic models Seattle Public Utilities (SPU) used to develop scenarios for and analyze the benefits of some of the waste prevention and recycling actions, or alternatives, recommended in the *2022 Solid Waste Plan Update* (*2022 Plan Update*). The first model, the Recycling Potential Assessment (RPA) Model, forecasts tonnages and financial costs and benefits of the alternative actions. The Measuring the Environmental Benefits Calculator (MEBCalc) calculates the environmental benefits from the same set of alternatives.

This table shows the 39 recommendations in the *2022 Plan Update* and indicates whether SPU modeled the benefits and costs in the RPA and MEBCalc models. Note that SPU and its consultant could not model all recommendations either due to lack of available, quantifiable data.

Table E.1 2022 Plan Update Recommendations

Recommendation	Modeled in RPA and MEBCalc	Chapter
Overarching		
Lead with race and incorporate racial justice in solid waste programs, education, and outreach in support of SPU's commitment to providing racially equitable, inclusive, and culturally competent services.	✗	1
Maximizing and Measuring Impact		
Keep developing overarching goals consistent with waste prevention and reduction activities instead of continuing to emphasize recycling rate goals focused on diversion.	✗	2
Expand solid waste data analytics, metrics, and evaluation to improve assessment of services and operations.	✗	2
Waste Prevention and Reuse		
Prioritize and support waste prevention with research, data analysis, and metrics.	✗	4
Increase community awareness of waste prevention through coordinated outreach.	✓	4
Expand food waste prevention to reduce the amount of wasted food.	✓	4
Expand efforts to rescue safe, edible food from the waste stream by getting it to those that need it most.	✗	4
Reduce single-use items and promote durable or reusable alternatives.	✓	4
Expand support for community organizations working to prevent waste.	✗	4
Expand support of the City's sustainable and green purchasing policies	✗	4
Explore and expand market opportunities for reused material and repair services	✗	4
Promote and support waste prevention for textiles and monitor emerging textiles recycling technologies	✓	4
Recycling and Composting Policy and Markets		
Advocate for responsible recycling policies recommended by the Responsible Recycling Task Force	✗	5
Continue and expand efforts to reduce the amount of contamination, or non-recyclable material, in the recycling and food and yard waste	✗	5
Support market and infrastructure development for recycling	✗	5
Continue to explore and implement product stewardship policies and programs that require producers, manufacturers, and/or retailers to take back and recycle the products they sell	✓	5
Continue to support and expand industry-led take-back of plastic wrap and bags	✓	5

Recommendation	Modeled in RPA and MEBCalc	Chapter
Require all single-use food service packaging to be compostable and harmonize acceptance standards for compostable products	✓	5
Continue to refine and develop strategies to keep more food waste and compostable paper out of the garbage	✓	5
Continue to support market development for compost products	✗	5
Assess options for diaper and pet waste recovery	✓	5
Solid Waste Handling, Collection, and Removal		
Conduct research to inform future collection, processing, and disposal contracts	✗	6
Adopt collection infrastructure requirements in new multifamily construction to ensure tenants have sufficient solid waste services and convenient access to solid waste containers	✓	6
Explore collection infrastructure requirements for new construction of townhomes and live-work units	✗	6
Improve alley and public right-of-way access for collection vehicles	✗	6
Expand the Clean City education campaign to increase awareness of the City's litter and cleanup programs	✗	6
Solid Waste Transfer, Processing, Disposal, and Emergency Management		
Continue to explore opportunities for adaptive reuse of historic landfills, including opportunities to control costs at closed landfills and to bring the land into productive use	✗	7
Construction and Demolition Debris		
Expand construction and demolition debris industry outreach and education	✓	8
Improve enforcement of and incentives for compliance with C&D system rules	✓	8
Promote salvage and deconstruction for reusable building materials	✓	8
Require deconstruction (instead of demolition) for select project sizes and/or project types to increase C&D debris recovery	✓	8
Expand recycling market development for C&D debris to support diversion of these materials from landfill	✓	8
Enhance diversion of construction and demolition debris at transfer stations	✓	8

Recommendation	Modeled in RPA and MEBCalc	Chapter
Outreach, Education, Code Enforcement, and Compliance Support		
Continue and expand use of large, color-coordinated, multilingual, and icon-based container decals to encourage proper sorting of waste	✗	9
Continue and expand use of available metrics to inform outreach strategy and measure outcomes	✓	9
Continue participating in the regional Communication Consortium to unify solid waste messaging between Seattle and King County municipalities	✗	9
Expand waste prevention and diversion outreach and education in schools	✓	9
Expand efforts to increase compliance with solid waste code and requirements across customer sectors	✓	9
Administration and Financing of the Solid Waste System		
Continue to regularly review rates to ensure they provide incentives for program success, are set equitably, and balance affordability and program costs	✗	10

Recycling Potential Assessment Model

Seattle Public Utilities uses the Recycling Potential Assessment (RPA) Model to:

- Forecast waste generation
- Calculate estimates of tonnages that the City can divert from landfill due to recycling, waste reduction and composting
- Provide financial cost and benefit estimates for each of the scenarios analyzed in the model

> **Terminology: MSW**
>
> This appendix uses the term MSW to mean waste typically generated by the commercial, residential, and self-haul sectors.

The RPA Model consists of two separate RPA components: one model for the municipal solid waste (MSW) stream and one model for the construction and demolition debris (C&D) waste stream. The MSW and C&D RPA models are structured very similarly, so this overview generally applies to both models. Unlike the MSW model, the C&D model includes beneficial uses of the materials as well as recycling. Beneficial use includes energy production or landfill cover. This appendix will point out other differences out as it describes the models.

SPU defines the waste streams, not so much by the materials that are included in them but in the method and location of disposal. SPU considers waste collected from within Seattle, delivered to transfer stations and placed into containers for transportation to the municipal solid waste landfill in Arlington, Oregon, to be MSW garbage. SPU considers waste collected separately under the C&D collection contract, which is destined for disposal in a C&D landfill, to be C&D waste.

On the other hand, SPU credits recycling tonnages to either the C&D sector or the MSW sector depending on the recycled material. For example, SPU counts any recycled wood waste towards the C&D recycling rate. SPU counts plastic film towards the MSW recycling rate, even though plastic film occurs in both the C&D and MSW waste streams. SPU handles the material accounting in this fashion because, in many cases, the recycling reports SPU uses to track recycled materials are not specific enough to tell whether collectors would have disposed the material in a C&D or MSW landfill had it not been recycled.

The next sections describe the four modules that comprise the RPA model: waste generation, recycling tonnages, cost module and reporting module.

Waste Generation Module

The first step in the RPA model involves forecasting the amount of waste generation in Seattle, broken down into three sectors for the MSW model (residential single-family and multifamily, commercial, and self-haul). The C&D model has just one overall sector. The forecast estimate equations use econometric techniques and include a variety of economic, demographic, price, and weather variables.

SPU breaks down each forecasted waste stream down into 20 material types, based on the waste stream composition data Seattle regularly collects. The model forecasts waste generation, by sector by material, for the next 20 years.

Recycling Tonnages Module

The next step in building the RPA Model involves completing the recycling module, which contains data about existing programs and assumptions about alternatives proposed for the *2022 Plan Update*.

SPU models existing recycling and composting programs based on how much they are currently diverting (the existing recovery rate). SPU collects detailed recycling data on a regular basis for programs such as the Seattle's curbside residential and self-haul recycling programs. For city-contracted services, daily "truck level" data are available for total tons collected for each sector, and SPU uses periodic recycling composition data to analyze the tons collected by material type. For other customer sectors, such as most of the commercial recycling, SPU obtains tons recycled from an annual report all recyclers in Seattle submit as required for their business license renewal. These reports include data on annual tons collected by material.

SPU models new alternative recycling programs proposed by staff using judgment about what ultimate recovery rate an alternative program will achieve how quickly the program will reach that steady recovery rate. The model is set up to run “scenarios,” which are groups of programs that SPU staff assemble according to some overall themes or scenario descriptions. A base scenario typically models existing recycling programs without any alternative programs. Other scenarios then layer on top of the base existing programs.

For each alternative program, SPU develops parameters that include what sector and material the program will address, the year the program starts and how quickly the alternative program takes full effect. When SPU includes an alternative program in a scenario that targets the same material as an existing program, SPU attributes only the new tonnages to the alternative program. For example, SPU has a curbside organics program that diverts food waste, and if SPU then wants to model an alternative program that makes the food waste mandatory, the tons attributed to the new mandatory program are the additional tons diverted after SPU calculates the existing program tons.

Financial Costs and Benefits Module

The next step in the model is to calculate program costs and financial benefits. The calculations use the factors in the waste generation and recycling tonnages modules just described.

For program costs, SPU can model each program using a variety or types of costs. The intention is to model program costs at a detailed enough level so that as program recovery rates are varied, costs will vary in a meaningful way. Programs can have fixed and/or variable cost components. The variable components can vary by household, employee, or tons. Programs can also have capital costs, and the life of the capital can be set to reflect what makes sense for that program’s capital types. Examples of typical program costs are costs of collection, bin or cart costs, and education and processing costs.

The financial benefits of recycling include costs SPU does not have to incur—which is the cost to have recyclable material handled as garbage and disposed in a landfill. When Seattle recycles, the City diverts tons of material from garbage, so these tons no longer need collecting, transferring, hauling to the rail head, and landfilling. Savings occur at each step of the way and are the direct financial benefits to recycling. These savings are often referred to as “avoided costs.”

To calculate these benefits, the model includes the variable costs to collect, transfer, transport and dispose of the MSW or C&D as inputs. Note that the City does not gain savings from all the costs of collecting a ton of garbage when the ton is diverted to recycling. Only the part of the costs that vary with tons is saved. For example, SPU calculates the variable part of the residential collection cost based on SPU's collector contracts. SPU reimburses contractors for collection based on a formula that has fixed and variable components. When tonnages vary, SPU can estimate the effect on the contractor payment using the formula in the collection contract. SPU developed the formulas in the contracts to try to reflect how collection costs accrue. There are large fixed costs associated with collection, including the cost of the collection trucks and the costs to pick up waste at each household weekly, for example. The variable portion of the costs is small for collection since the truck must pass by the household each week, regardless of the amount of waste that customers put out for disposal.

Similarly, SPU uses transfer station and self-haul cost models to determine the variable portion of these two functions. Finally, SPU considers disposal costs to be 100% variable with tons. This is because for MSW Seattle has a long-term contract where SPU pays a per-ton fee for rail haul and disposal, and the fee does not depend on how many tons are delivered.

The cost model uses the above information in the calculation of the financial benefits of recycling**.** The result of the cost model is the additional costs of adding the recycling program (which include education, collection, any capital costs, processing, etc.), and the benefits (or avoided costs) of not having to collect the material for disposal in a landfill.

Reporting Module

SPU uses the final module in the RPA model to develop reports so SPU can present detailed results of each model run as needed. Results reported include displaying the tons recycled by year by material and by program. Reports also show the recovery rate for each material by sector, and an overall recycling rate. The C&D model also shows a beneficial use rate for materials diverted from disposal but not recycled. The report tables following this write-up are examples of the reports generated by the reporting module.

Environmental Benefits of Recycling

Since the 2004 Plan Amendment, *On the Path to Sustainability*, SPU has estimated both environmental and economic benefits of recycling. This section describes the steps used to model the environmental benefits. It provides background on the methodology and the MEBCalc model, including detail on how SPU quantifies environmental benefits. The results of applying the methodology appear in Results of Seattle's Solid Waste Recycling, Composting, and Beneficial Use on page E.25.

Life Cycle Environmental Impacts Assessment and MEBCalc

Handling and disposal of municipal solid waste (MSW) and construction and demolition (C&D) discards causes external environmental costs and benefits. Externalities are impacts on the environment that are not reflected in the financial price (cost) of the activity.

For example, using recycled materials instead of virgin raw material resources to manufacture paper, aluminum cans, or tin cans creates measurable environmental benefits. Many of these benefits are from reduced energy use in the production process of creating these products and the associated avoided emissions. There are also measurable benefits of diverting organics from landfills. Landfilled organics produce methane, a powerful greenhouse gas. The MEBCalc model both quantifies and monetizes these benefits.

Over the past 20 or more years, economists and LCA researchers have made strides in estimating the costs of pollution on human health and other environmental receptors. Sources of new data and research have included:

- Regulatory impact analyses (RIAs) mandated by federal law and executive order
- Research on potential impacts of climate change
- Human, other-than-human species, and ecosystem health analyses of the impacts and costs of pollution and other environmental dis-amenities (for example, noise and odor)
- Life cycle analysis of pollution and energy embodied in materials and products, as well as emitted during resource extraction, refining, and manufacturing of those materials and products
- Economic analysis on the value of additional years of life and the costs of increased morbidity

Collection and public availability of data sets on pollutant releases and pollution profiles of resource extraction and refining, as well as on material and product manufacturing, product use, and end-of-useful-life management of product and packaging discards has also improved. Some of these data are maintained in publicly available data bases, including:

- EPA's National Emissions Inventory (NEI)
- EPA's Greenhouse Gas Inventory (GHGI)
- EPA's Toxics Release Inventory (TRI)

- EPA's Compilation of Air Pollutant Emissions Factors (AP-42) for more than 200 industrial air pollution source categories (where a category is a specific industry sector or group of similar emitting sources)
- Data gathered, codified, and maintained by state environmental protection agencies
- Data gathered and maintained by state and local clean air and clean water management, control, and permitting agencies

Researchers have also made progress connecting pollution to environmental and public heath damages. In particular, the United Nations Intergovernmental Panel on Climate Change IPCC developed and helped popularize an index that uses a single number to define the quantity of climate-forcing emissions released into Earth's atmosphere each year. IPCC updates these results periodic assessment reports and codifies them in global warming potentials (GWPs) for each atmospheric pollutant that contributes to trapping of incoming solar heat energy.

Examples of GWPs important for MSW management from the *IPCC 2014 Fifth Assessment Report* range from 1 for carbon dioxide (CO_2) to 28 for methane (CH_4) and 265 for nitrous oxide (N_2O). The *IPCC 2014 Fifth Assessment Report* GWPs top out at 23,500 for sulfur hexafluoride (SF_6). These GWPs are averages over the 100 years following a pollutant's release. GWPs over a shorter period are different, except for CO_2, and are also available from IPCC assessment reports. For example, for the 20 years following release methane's average GWP is 84. The difference between average GWPs for methane over 100 versus 20 years is mostly because once in the atmosphere methane begins to oxidize to carbon dioxide and water vapor. Methane's lifetime in the atmosphere is over after about 12 years.

GWPs express the global warming potential of any greenhouse gas (GHG) relative to the global warming potential of carbon dioxide. Using GWP weights, then, SPU can sum up in terms of carbon dioxide equivalents (eCO_2 or CO_2e) the relative global warming potential of a profile of greenhouse gas releases from an activity or pollution source. SPU may then compare that activity's total GWP to any other activity's total GWP, provided SPU has a GHG emissions profile for both. GWPs allow comparison of the climate impact among alternative methods for producing the same product or material or carrying out the same activity, such as burying or burning MSW discards.

Along with climate change, SPU also considered human health and environmental impacts, some of which SPU assessed in the quantitative results for MSW and C&D diversion in this section. The impacts assessed, with their summary substance impact potential indicator shown in parentheses, are:

- Climate change (carbon dioxide equivalents, eCO_2)
- Human health respiratory (particulate matter 2.5 microns in diameter or less equivalents, $ePM_{2.5}$)
- Human toxicity (toluene equivalents, eT)
- Human carcinogenicity (benzene equivalents, eB)
- Waterways eutrophication (nitrogen equivalents, eN)
- Atmospheric acidification (sulfur dioxide equivalents, eSO_2)
- Ecosystems toxicity (2,4-Dichlorophenoxyacetic acid equivalents, e2,4-D)
- Ozone depletion (trichlorofluoromethane equivalents, eCFC-11)
- Ground level smog formation (ozone equivalents, eO_3)

SPU used the EPA's Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI) to assess these impacts. As of version 2.1, this tool provides characterization factors for the public health and environmental impacts of 3,944 chemicals and other substances, with a characterization factor for each substance for each of the 9 impact categories just listed. Many chemicals and substances have characterization factors of zero for some impacts. For example, for climate change, only 91 of the 3,944 have characterization factors greater than zero.

For climate change, the characterization factors are GWPs. For the other eight impact categories, TRACI's characterization factors also are based on consensus among researchers and scientists on the relative effects of each pollutant in comparison to the impact category's impact potential indicator substance.

Given an emissions profile for the life cycle of a product, material, MSW activity or other pollution emitter of interest, TRACI 2.1 provides impact potentials for 9 human health and environmental impacts. This makes possible, for example, comparison of recycled-content versus virgin-content production impacts for an MSW material diverted from garbage and its associated virgin-content production life cycle, to recycling and its associated recycled-content production life cycle. Life cycle impacts for some materials are available from life cycle supply chain analysis conducted by inquiries of:

- Virgin- and recycled-content manufacturers regarding their outputs and associated inputs of materials, energy, and chemicals
- Suppliers of these input materials, energy, and chemicals
- Suppliers of suppliers, and so on

Such inquiries require many judgements about which inputs require follow-up with suppliers of those inputs, and how far up the supply chain to proceed with the investigation. For life cycle impacts of materials and products that have not been investigated by such process-oriented life cycle assessments (LCAs), economic input-output life cycle assessments (EIO-LCAs) are available from several sources, for example, Carnegie Mellon University Green Design Institute's models at www.eiolca.net.

SPU uses the MEBCalc from Sound Resource Management Group, Inc. (SRMG) to estimate environmental benefits and costs from Seattle's diversion of MSW and C&D discards to recycling, composting, and in the case of C&D wood wastes, beneficial use as an industrial fuel. The MEBCalc tool bases its LCA results on TRACI's characterization factors and life cycle inventory and activity data from well-recognized and well-regarded sources, such as:

- EPA's Waste Reduction Model (WARM)
- Research Triangle Institute's MSW Decision Support Tool's *Life-Cycle Data Sets for Material Production of Aluminum, Glass, Paper, Plastic and Steel in North America*[1]
- The Environmental Paper Network's Paper Calculator
- The Sustainable Packaging Coalition's Comparative Packaging Assessment tool (COMPASS, now available through Trayak at https://trayak.com/company)
- California Air Resources Board's *Method for Estimating Greenhouse Gas Emissions Reductions from Recycling*
- Oregon Department of Environmental Quality's *Life Cycle Inventory of Packaging Options for Shipment of Retail Mail-Order Soft Goods, Final Peer-Reviewed Report*
- Carnegie Mellon University Green Design Institute's EIO-LCA models (available at www.eiolca.net)
- California Department of Resources Recovery and Recycling's (CalRecycle) study on used oil recycling – R. Geyer *et al*, *Life Cycle Assessment of Used Oil Management in California*
- Association of Plastic Recyclers' report by Franklin Associates, *Life Cycle Impacts for Postconsumer Recycled Resins: PET, HDPE, and PP*

[1] The U.S.EPA funded this decision support tool; SPU used this tool in earlier efforts to evaluate the environmental benefits of recycling and composting.

- Numerous peer-reviewed journal articles, such as:
  - For wood wastes: Jeffrey Morris, "Recycle, bury or burn wood waste biomass? LCA answer depends on carbon accounting, emissions controls, displaced fuels, & impact costs," *Journal of Industrial Ecology*, 21 (4) 844-856, 2017.
  - For organic wastes: Sally Brown and Ned Beecher, "Carbon accounting for compost use in urban areas," *Compost Science*, submitted and now in peer review, 2019.

When using MEBCalc tool, the last step involves estimating environmental costs and benefits to monetize each public health and environmental impact using estimated damage costs for releases of the nine indicator pollutant substances. At the time SPU evaluated the proposed alternatives in 2019, the nine damage estimates (2018 dollars) for emissions of one ton of each impact indicator substance were:

1. $68 per ton of CO_2 equivalent climate warming potential
2. $524,418 per ton of $PM_{2.5}$ equivalent potential damages to human respiratory health
3. $152 per ton of toluene equivalent potential human toxicity
4. $4,301 per ton of benzene equivalent potential human carcinogenicity
5. $16,793 per ton of nitrogen equivalent potential waterways eutrophication
6. $221 per ton of SO_2 equivalent potential atmospheric acidification
7. $4,217 per ton of 2,4-D equivalent potential ecosystem toxicity
8. $69,833 per ton of CFC-11 equivalent potential ozone depletion
9. $60 per ton of ozone ($O_3$) equivalent potential smog formation

When available, analysis of environmental costs and benefits during 2007 through 2018, and projections of those damage costs for 2019 through 2030, account for changes over time in damage cost estimates. For example, the federal government's Interagency Working Group on the Social Cost of Carbon estimates climate change costs for a carbon dioxide release in 2010 or 2015 or 2020 and so on for every fifth year through 2050.

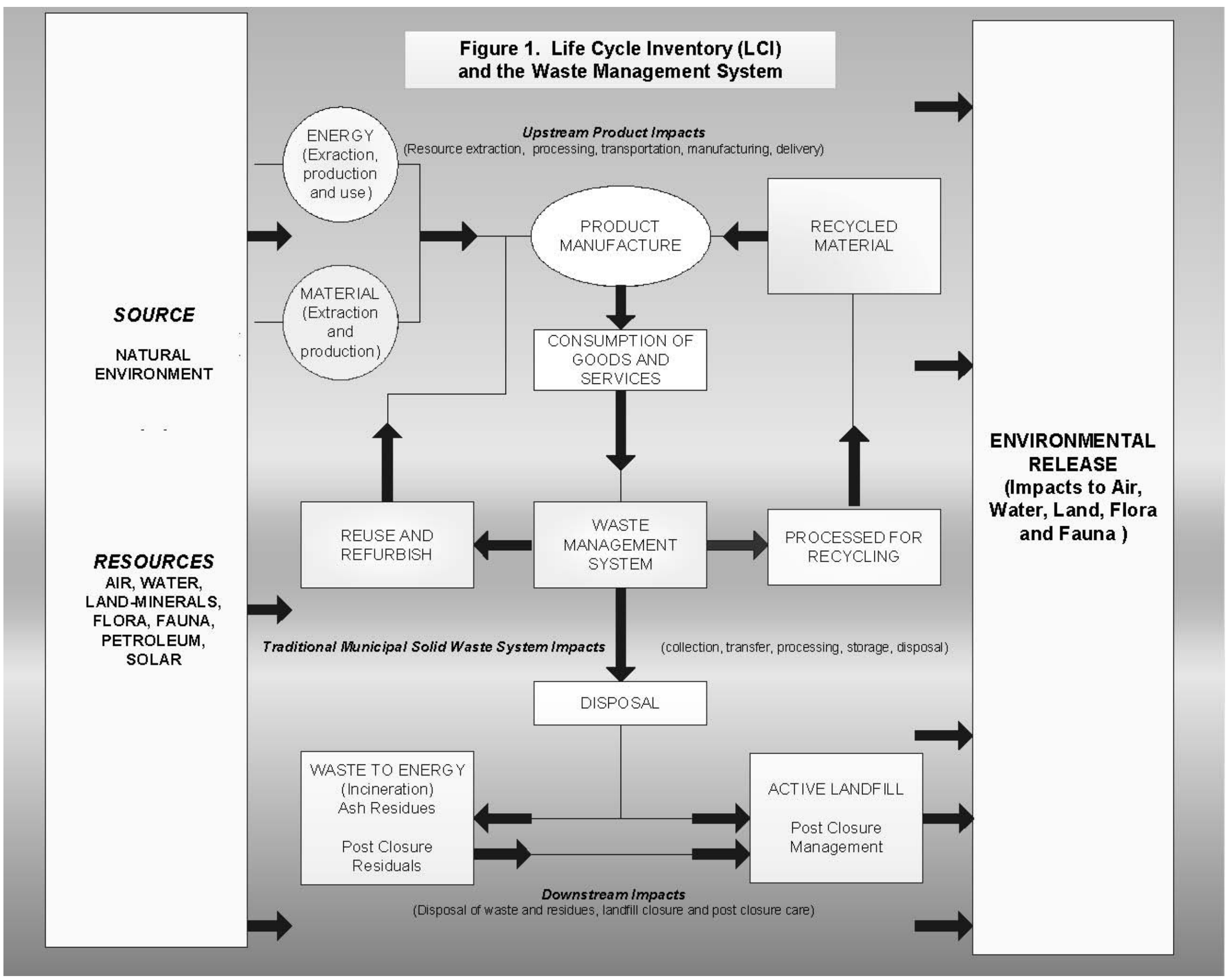
Acidification damage costs vary over time, partially due to the spot allowance clearing price at each year's EPA auction of sulfur dioxide (SO_2) emission allowances under the Clean Air Act's Acid Rain Program. For example, recent decreases in clearing prices at EPA's annual auction are likely in part caused by closure of coal-fired power plants, reducing the demand for sulfur dioxide emission allowances.

In addition, the 2007–2008 financial crisis, resultant economic contraction, and very slow economic recovery also substantially reduced energy demand. This meant that the caps under EPA's Acid Rain Program no longer served to constrain sulfur dioxide emissions by energy producers such as coal-fired power plants. Lower energy demand means that energy producers are less likely to bump up against their SO_2 emissions limits and thus have less need to buy additional emissions permits during the annual auctions.

Human health damage costs for respiratory diseases caused by particulate emissions increase over time, all else being the same. Increased economic activity and population growth put more human receptors in the emission pathways for the increases in particulates emitted into the atmosphere that are generated by economic growth.

Figure E.1 illustrates material flow and the types of externalities associated with the life cycle of materials.

Figure E.1 Flow of Materials and Life Cycle Environmental Impacts



Source: Seattle Public Utilities

Quantifying and Monetizing External Benefits

SPU used the MEBCalc tool to estimate and quantify the environmental value of recycling and composting programs from 2007 through 2018, and to evaluate the environmental benefits of MSW recycling and composting plans for 2019 through 2030, and to assess environmental benefits and costs for construction and demolition (C&D) recycling and beneficial uses. This tool accounts for the environmental costs of collection, processing and hauling activities of recycling, as well as the environmental costs of collection, hauling (by truck and rail), and landfill disposal of these materials in the garbage that are avoided by recycling. These environmental costs are deducted from the environmental benefits of producing products using recycled rather than virgin feedstocks to provide an estimate of the net environmental benefits (or costs, in some cases) of diverting discards to recycling, composting or beneficial use.

SPU takes a series of steps to go from estimating tons of a variety of recycled materials to estimating a dollar value of the environmental benefit of recycling. First, SPU obtains estimated recycled and composted tons, by material, from the outputs of the RPA Model. Then a variety of tools and databases (some of which were listed above) provide information on quantities of pollutants that are not produced when material is recycled or composted instead of being thrown away. For example, research shows that manufacturing a new aluminum can from a recycled aluminum can uses much less energy, which results in the release of fewer pollutants due to the lower energy requirement. Less pollution means lower public health and other environmental impacts from producing the aluminum can. Based on the costs that pollution causes for public health and the environment, SPU can then calculate the environmental and public health cost savings from making a new aluminum can out of a recycled can rather than newly mined bauxite and other virgin raw materials.

Large numbers of pollutants are reduced for each of the life cycle environmental impacts for all the recycled and composted materials. To estimate these reductions, SPU uses one pollutant as an index for each of the life cycle environmental impacts. The most familiar example is CO_2 (carbon dioxide). SPU converts reductions of all other pollutants, such as methane, to units of CO_2 equivalents to add them together. The aggregated quantity is called carbon dioxide equivalents, denoted as eCO_2. In the next step in the analysis, SPU monetizes, meaning places a dollar value on, the reduction in CO_2. This step of monetization allows all the life cycle impacts to be summarized in dollars and added onto the financial costs and benefits of recycling calculated in the RPA model.

The current analysis quantifies external environmental benefits and provides monetary values for nine different types of environmental impacts. This allows SPU to represent some of the upstream savings when material is recycled instead of disposed. The next section describes the nine damages (impacts) SPU has valued, followed by a discussion of other impact categories and benefits not quantified.

Life Cycle Impact Categories

There are many challenges to estimating the cost of pollution externalities, which typically involves two major steps. First, economists quantify pollutant emissions in terms of one or more of their public health, ecosystem health, and other environmental impacts. Second, economists "monetize" these impacts, or calculate an estimated economic cost.

One challenge is that a pollutant may have more than one environmental impact. For example, SO_2 emissions to the atmosphere can cause human respiratory impacts when SO_2 reacts with other compounds in the atmosphere to form small particles that, when inhaled, cause respiratory illnesses. SO_2 also is a precursor, meaning a chemical that contributes to creating, to acid rain because it combines with water, oxygen, and other chemicals in the atmosphere to form sulfuric acid. Sulfuric acid then deposits on buildings, cars, and trees, as well as in waterways, causing harm to plant and animal life and to buildings, among other impacts. Each of these impacts likely has a different cost per pound or ton of SO_2 emitted from a fossil fuel-fired power plant or other emissions source.

LCA and its impact assessments provide a methodology for converting emissions of numerous pollutants into a manageable number of mutually exclusive environmental impacts. Mutually exclusive impact categories mitigate the double counting problems that could occur with pollutants such as sulfur dioxide that can cause more than one type of environmental impact. EPA's TRACI (Tool for the Reduction and Assessment of Chemical and other environmental Impacts) model is a life cycle impact assessment tool with mutually exclusive impact categories.

TRACI provides indexing weights known as characterization factors for each pollutant that is a potential cause of each environmental impact. These characterization factors allow emissions of disparate pollutants that cause each impact to be aggregated/summed into an equivalent quantity of emissions for a single reference pollutant that also causes the impact. [2] This greatly simplifies reporting and analysis of different levels of pollution. By grouping pollution impacts into a handful of categories, environmental costs and benefits modeling can reduce the

[2] Jane C. Bare, *Developing a Consistent Decision-Making Framework by Using the U.S. EPA's TRACI,* U.S. Environmental Protection Agency, Cincinnati, OH, 2002; Jane C. Bare, Gregory A. Norris, David W. Pennington and Thomas McKone, TRACI: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts. *Journal of Industrial Ecology* 2003, 6(3-4): 49-78; and Jane C. Bare, TRACI 2.0: the tool for the reduction and assessment of chemical and other environmental Impacts 2.0. *Clean Technologies and Environmental Policy*, 2011, 13(5) 687-696, provide expositions on the original and more recent versions of the TRACI model.

complexity of making policy decisions from tracking data on hundreds or thousands of pollutants. This makes environmental impact data far more accessible to policy makers.

As an example of this aggregation technique, all GHG releases are converted and summed into carbon dioxide equivalents, or eCO_2, which serves as a measure for the climate change potential from releases of all GHGs.

Another example illustrates how the TRACI model avoids double counting. Substances that are scored by TRACI 2.1 as having human respiratory impacts greater than zero include filterable and condensable particulate matter, SO_2, nitrogen oxides (NO_x), and total suspended particulates. These substances all have zero characterization factor scores for human health carcinogenic and toxicity impacts. What might seem like another possibility for double counting is thus avoided using the TRACI methodology.

MEBCalc uses TRACI characterization factors for nine environmental impacts. The nine environmental impacts for which TRACI supplies characterization factors are:

1. **Climate change –** The potential increase in greenhouse effects due to anthropogenic emissions. CO_2 from burning fossil fuels is the most common source of greenhouse gases (GHGs). Methane from anaerobic decomposition of organic material is another large source of greenhouse gas. The reference substance for climate change potential is carbon dioxide and the pollutants that have climate impacts are characterized and converted by the TRACI model into eCO_2.
2. **Human respiratory disease and death from particulates –** Potential human health impacts from anthropogenic releases of coarse particles known to aggravate respiratory conditions such as asthma, releases of fine particles that can lead to more serious respiratory symptoms and disease, and releases of particulate precursors, such as nitrogen oxides and sulfur oxides. The reference substance for human respiratory disease potential is particulate matter no larger than 2.5 microns. Pollutants that have respiratory health impacts are converted into reference pollutant equivalences, denoted by $ePM_{2.5}$.
3. **Human disease and death from toxics –** Potential human health impacts (other than respiratory and carcinogenic effects) from releases of chemicals that are toxic to humans. Many chemical and heavy metal pollutants are toxic to humans, including 2,4-D, benzene, DDT, formaldehyde, permethrin, toluene, chromium, copper, lead, mercury, silver, and zinc. The reference substance used for human toxicity potential is toluene and pollutants that have human toxicity impacts are characterized and converted by the TRACI model into toluene equivalents, denoted by eT.
4. **Human disease and death from carcinogens –** Potential human health impacts from releases of chemicals that are carcinogenic to humans. Many chemical and heavy metal pollutants are carcinogenic to humans, including 2,4-D, benzene, DDT, formaldehyde,

kepone, permethrin, chromium, and lead. The reference substance for human carcinogenic potential used herein is benzene and the pollutants that have human carcinogenic impacts are aggregated into benzene equivalents, denoted by eB.

5 **Eutrophication –** Potential environmental impacts from the addition of mineral nutrients to the soil or water resulting from emissions of eutrophying pollutants to air, soil, or water. The addition to soil or water of mineral nutrients, such as nitrogen and phosphorous, can yield generally undesirable shifts in the number of species in ecosystems and a reduction in ecological diversity. In water, nutrient additions tend to increase algae growth, which can lead to reductions in oxygen and death of fish and other species. The reference substance for eutrophication potential is nitrogen and pollutants that have eutrophying impacts are characterized by nitrogen equivalents, eN.

6 **Acidification –** Potential environmental impacts from anthropogenic releases of acidifying compounds, principally from fossil fuel and biomass combustion, which affect trees, soil, buildings, animals, and humans. The main pollutants involved in acidification are sulfur, nitrogen, and hydrogen compounds, such as sulfur oxides, sulfuric acid, nitrogen oxides, hydrochloric acid, and ammonia. The reference substance for acidification potential used in SPU's analysis is sulfur dioxide and the pollutants that have acidifying impacts are characterized by sulfur dioxide equivalents, eSO_2.

7 **Ecosystems toxicity –** The relative potential for chemicals released into the environment to harm terrestrial and aquatic ecosystems, including wildlife. Many chemical and heavy metal pollutants are toxic to ecosystems, including 2,4-D, benzene, DDT, ethyl benzene, formaldehyde, kepone, permethrin, toluene, chromium, copper, lead, silver, and zinc. The reference substance used for ecotoxicity potential is 2,4-D and pollutants that have toxicity impacts to ecosystems are characterized by 2,4-D equivalents, denoted by e2,4-D.

8 **Ozone depletion –** The relative potential for chemical compounds released into the atmosphere to cause degradation of the earth's ozone layer. The reference substance for ozone depletion potential (ODP) is trichlorofluoromethane, CFC-11, where CFC is the acronym for chlorofluorocarbon. CFC-11 is sometimes called R-11.

9 **Ground level smog formation –** The relative potential for chemical compounds released into the atmosphere to react with sunlight, heat, and fine particles to form ozone (O_3). For example, nitrogen oxides (NO_x) and volatile organic compounds (VOCs) can be released when fuels are combusted and are some of the chemical compounds that contribute to ground level smog formation. The reference substance for smog formation is ozone itself.

For each of these nine environmental impacts the reference substance score refers only to the appropriate specific aspect of the reference substance's impact. For example, the TRACI score for human carcinogens is measured in benzene equivalents that are based on the relative strength of each pollutant's carcinogenic effects compared to benzene's carcinogenic effects.

Other effects associated with the same pollutants are expressed relative to the reference substances for other impacts.

Developing reference substance scores from TRACI characterization factors for pollutants is the first step in estimating the environmental costs of externalized pollution. The next step involves developing dollar costs for emissions of the reference substances. Available estimates for these costs for a reference substance may vary widely. The cost of climate impacts for CO_2 emissions provides a good example of the lack of a widespread consensus on environmental costs.

One low-end cost that might be used for CO_2 as the reference substance for climate change is its trading price for voluntary greenhouse gas emission reductions. Operating much as the markets in sulfur dioxide emissions allowances do, except without the Clean Air Act-mandated emissions caps, voluntary markets may be available for trading voluntary greenhouse gas emissions reduction pledges. Over recent years prices on voluntary markets have ranged widely, dropping to near zero and perhaps averaging around $5 per short ton.[3] Values on the European Union Emissions Trading System for emissions permits based on mandatory caps are higher, ranging around $20 per short ton, but fluctuating down to nearly zero and up to $35.[4] Fluctuations in the EU's carbon prices have been due to a variety of factors specific to the EU's carbon cap and trade system. In addition, the financial chaos of 2007-08 and the following recession contributed to that market's instabilities. When demand for goods and services falls, mandatory caps may no longer provide binding constraints that require firms to buy carbon credits to meet their emissions caps.[5] Hence demand to purchase credits from carbon markets falls.

Prices on both voluntary and mandatory markets for GHG emissions tend to be lower than prices derived from direct attempts to estimate the costs of climate change and relate those costs to today's emissions of GHGs. This may reflect the social and political difficulties of imposing costs on today's economic activity that are based on potential future scenarios that are not well understood or universally accepted.

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[3] Richard G. Newell, William A. Pizer, Daniel Raimi, Carbon Markets 15 Years after Kyoto: Lessons Learned, New Challenges. *Journal of Economic Perspectives*, 2013, 27(1), 123-146.
[4] Ibid.
[5] EPA's annual auction of sulfur dioxide emissions allowances under its acid rain program illustrates the price volatility that can be induced in a cap-and-trade system as a result of economic cycles. The spot market auction clearing price was in a steady upward trajectory from $126 in 2000 to $860 in 2006. The financial crisis of 2007–2008 reversed that trend with the 2007 and 2008 clearing prices falling to $433 and $380, respectively. The following Great Recession coincided with a steepening decline to $62 and $36 in 2009 and 2010, respectively. Reflecting the displacement of coal-fired power by other energy sources for generating electricity, clearing prices in the 2011-2019 auctions were, in chronological order, $2, $1 and $0.17, $0.35, $0.11, $0.06, $0.04, $0.06, and $0.04.

One example of a well-respected, relatively recent study is the review of the economic costs of climate change conducted by Nicholas Stern, the former Chief Economist at the World Bank. That review determined that a reasonable estimate for the cost of then-current greenhouse gas emissions was $85 per metric ton of eCO_2. This estimate was based on the risk of catastrophic environmental impacts in the future if substantial reductions in greenhouse gas emissions were not implemented at that time in the mid-2000s.[6]

A 2011 working paper from the U.S. offices of the Stockholm Environment Institute provides a very high estimate near $1,000 per metric ton of carbon dioxide equivalents.[7] Near the other end of the spectrum for climate costs of carbon emissions is a study that estimated GHG emissions costs to be lower than prices for emissions permits under mandatory cap and trade. That estimate is $8 per metric ton, published in an article in a prestigious economics journal.[8]

In 2013, the federal Interagency Working Group on the Social Cost of Carbon issued revised estimates for the social cost of carbon emissions. Table E.2 shows these estimates as a function of the social discount rate and the year in which an additional metric ton of CO_2 is emitted.[9,10] Because climate impact costs are projected to increase as time passes and the amount of CO_2 in the atmosphere increases, the discounted value of future impacts from a current year's emissions rises as years go by and those future events come ever closer. Also, a lower discount rate results in higher discounted present values of those future costs.[11]

[6] Nicholas Stern, *The Economics of Climate Change: The Stern Review*, Cambridge University Press, Cambridge, England and New York, NY, 2007.
[7] Frank Ackerman and Elizabeth A. Stanton, Climate Risks and Carbon Prices: Revising the Social Cost of Carbon. Stockholm Environment Institute – U.S. Center working paper, Somerville, MA, 2011.
[8] Nicholas Z. Muller, Robert Mendelsohn, William Nordhaus, Environmental Accounting for Pollution in the United States Economy. *American Economic Review*, 2011, 101 (August), 1649-1675.
[9] Interagency Working Group on Social Cost of Carbon, U.S. Government (with participation by Council of Economic Advisers, Council on Environmental Quality, Dept. of Agriculture, Dept. of Commerce, Dept. of Energy, Dept. of Transportation, EPA, National Economic Council, OMB, Office of Science and Technology Policy, and Dept. of Treasury), Technical Support Document – Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866, May 2013.
[10] "Avg" in the table refers to the average future damage costs estimated by three different integrated climate impact assessment models for an increase in one metric ton of CO_2 emissions in a given year. 95th refers to the most likely damage cost for the three models, meaning that estimated costs have only a 5% chance of being higher than this level for emissions in the year indicated by table rows.
[11] There is much debate among economists as to what the social discount rate should be, with some suggesting that the discount rate in future years should follow the declining exponential function tending toward zero for more distant years. See, for example, Paul R. Portney and John P. Weyant (eds.), *Discounting and Intergenerational Equity*, Resources for the Future, Washington, DC, 1999.

Table E.2 Revised Social Cost of CO_2, 2010–2050 (in 2007 dollars per metric ton of CO_2)

Discount Rate Year	5.0% Avg	3.0% Avg	2.5% Avg	3.0% 95th
2010	11	33	52	90
2015	12	38	58	109
2020	12	43	65	129
2025	14	48	70	144
2030	16	52	76	159
2035	19	57	81	176
2040	21	62	87	192
2045	24	66	92	206
2050	27	71	98	221

Note: CO2 costs are emissions-year specific.

A further issue that one encounters when developing economic cost estimates for environmental impacts is that some impacts are more global and others more local. CO_2 emissions have global impacts whereas emissions of other pollutants, say chromium or cadmium or lead, likely have effects that are more severe close to the place where they are emitted, or more severe given the type of media to which they are emitted. TRACI 2.1 begins to deal with this issue by providing separate cancer, non-cancer and ecotoxicity characterization factors for emissions to urban versus non-urban air, emissions to fresh versus saltwater, and emissions to agricultural land versus non-agricultural land. Such distinctions are very useful if one knows the point source of the emissions to be characterized. They also can provide an indication of the effect that uncertainty about location of emissions can have on the estimates of environmental impact potentials.

For the estimates of environmental costs and benefits developed in this appendix for Seattle's recycling and composting programs, the following listing shows the 2018 costs in 2018 dollars for each of the nine environmental impacts covered, and the source for each of those nine impact cost estimates:

- **Cost of eCO_2 emissions = $68 per ton.**
  Estimate based on the U.S. Interagency Working Group on the Social Cost of Carbon (with participation by Council of Economic Advisers, Council on Environmental Quality, Dept. of Agriculture, Dept. of Commerce, Dept. of Energy, Dept. of Transportation, EPA, National Economic Council, OMB, Office of Science and Technology Policy, and Dept. of Treasury), *Technical Support Document – Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis – Under Executive Order 12866, May 2013*. $58 is the federal Interagency

Working Group on the Social Cost of Carbon's estimate for future costs of climate change (in 2007 dollars) per metric ton of carbon dioxide emitted in 2015, assuming a 2.5% social discount rate. SPU and its consultant interpolated 2018 emissions cost from the federal Interagency Working Group on the Social Cost of Carbon's estimates for 2015 and 2020. They then converted that estimate from 2007 to 2018 prices using price index data from the U.S. Department of Labor Bureau of Labor Statistics (BLS).

- **Cost of $ePM_{2.5}$ emissions = $524,418 per ton.**
  Estimate based on value of particulate emissions reductions developed in the report: U.S. EPA, *Technical Support Document: Estimating the Benefit Per Ton of Reducing $PM_{2.5}$ Precursors from 17 Sectors*, January 2013, Table 5 Summary of the total dollar value (mortality and morbidity) per ton of directly emitted PM2.5 and PM2.5 precursor reduced by each of 17 sectors in 2016 (2010$, 3% discount rate) and Table 7 Summary of the total dollar value (mortality and morbidity) per ton of directly emitted PM2.5 and PM2.5 precursor reduced by each of 17 sectors in 2020 (2010$, 3% discount rate). Value used in MEBCalc for 2018 estimated by interpolation between 2016 and 2020 weighted averages of reductions in each of the 17 economic/geographic sectors. The 2018 interpolation is converted from 2010$ to 2018$ using BLS price index data.
- **Cost of eT emissions = $152 per ton.**
  This value for toluene is based on health costs of mercury emissions reductions as estimated in Giang and Selin (2015), Benefits of mercury controls for the United States, *Proceedings of the National Academy of Sciences.*
- **Cost of eB emissions = $4,301 per ton.**
  Value for benzene from Eastern Research Group (2006), Draft Report: Cost Benefit Analysis for Six "Pure" Methods for Managing Leftover Latex Paint – Data, Assumptions, and Methods. Prepared for the Paint Product Stewardship Initiative.
- **Cost of eN emissions = $16,793 per ton.**
  Value for nitrogen based on its water eutrophication cost when released to water. See Compton *et al* (2017), Assessing the social and environmental costs of institution nitrogen footprints, *Sustainability* 10 (2) 114-122, Table 1, page117, and Sobota *et al* (2015), *Environmental Research Letters* 10 025006, Table 1, page 4.
- **Cost of eSO_2 emissions = $221 per ton.**
  Cost is based on estimated acid rain damage costs to buildings from acidic air emissions of nitrogen oxides and ammonia. See Compton *et al* (2017), *op. cit.*, Table 1, page 117. Nitrogen oxides and ammonia emissions converted to SO_2 equivalents using TRACI characterization factors for acidification impacts.
- **Cost of e2,4-D emissions = $4,217 per ton.**
  Cost is based on Morris and Bagby (2008), Measuring Environmental Value for Natural Lawn and Garden Care Practices, *International Journal of Life Cycle Assessment*, 13(3) 226-234.

- **Cost of eCFC-11 emissions = $58,949 per ton**
  Cost is based on carbon tetrachloride global warming potential (GWP) of 1400 and ozone depletion potential (ODP) of 0.74.
- **Cost of eO_3 emissions = $60 per ton**
  Cost is based on U.S. EPA Office of Air and Radiation (2016), Allowances Allocation: Final Rule TSD – Technical Support Document (TSD) for the Cross-State Air Pollution Rule (CSAPR) Update for the 2008 Ozone NAAQS, Docket ID No. EPA-HQ-OAR-2015-0500, August 2016, Table 1, Page 4.

Reflections on Impacts Not Quantified, Material Types Not Evaluated, and Externalized Costs Not Well-Estimated

Due to the absence of emissions data for the specific pollutants tracked under some of these categories, the lack of quantitative measures to relate emissions to impacts, and/or the absence of well-researched monetization estimates, SPU and its consultant did not quantify the of benefits the following environmental and resource depletion impacts:

- Fossil fuel depletion potential
- Habitat alteration potential
- Indoor air quality
- Water use
- Land use

Estimates of damage costs may underestimate the actual costs to future generations of current releases of pollutants and depletion of resources. The problem is particularly acute for ecosystem impacts, given the currently limited understanding of long-run impacts from:

- Accelerated species extinctions and decreases in biodiversity
- Associated decreases in various aspects of ecosystems' ability to, among other things, cycle nutrients, clean the air and clean the water

Future costs from cumulative impacts of global warming are also difficult to predict. Estimates of human health costs from toxic and carcinogenic releases do not presently appear to account adequately for impacts (cumulative and interactive) of many of the chemical releases to the environment. There may be as many as 75,000 to 100,000 chemical compounds used in industrial processes and commerce. To put this into perspective, the nine pollution impact categories quantify releases to air and water for less than four thousand substances.

Finally, the RPA model currently tracks discards diversion for about 20 categorical types of materials. One of those is a miscellaneous category. Miscellaneous materials are reported in aggregate by RPA modeling. In the environmental impact analysis using MEBCalc, between 6% and 10% of MSW discards diverted from disposal to recycling or composting are not evaluated for their environmental benefits.

Results of Seattle's Solid Waste Recycling, Composting, and Beneficial Use Analysis

The following charts illustrate the magnitude of the additional benefits from recycling MSW and C&D materials for both past years (2007–2018) and planned future recycling through 2030. For C&D, three charts also illustrate the substantial environmental costs of using discards as industrial fuels to displace natural gas.

Municipal Solid Waste Results

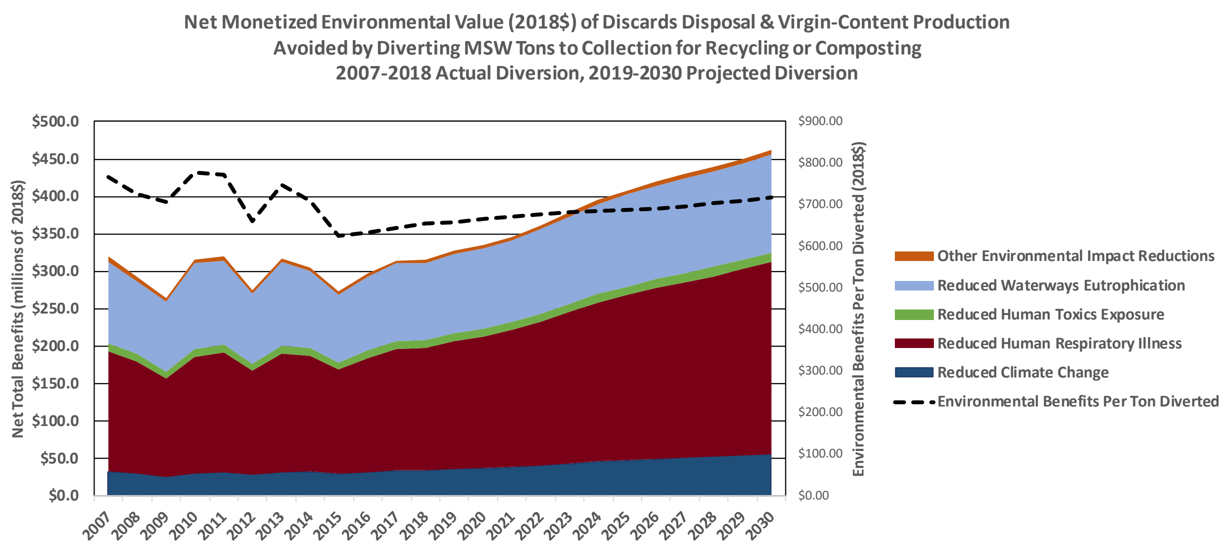
SPU and its consultant calculated benefits for MSW by first starting with the tons recycled or composted from the RPA model for past and current programs and for future recommended scenarios. Then, using the techniques described above and embodied in MEBCalc, they quantified benefits across nine life cycle impact categories using an indexed pollutant for each category. The models place a monetary value on each of the indexed pollutants to allow these different life cycle impact categories to be expressed in dollar terms so they can be added together.

For MSW, Figure E.2 shows estimated environmental benefits for actual recycling and composting from 2007 through 2018 and for RPA-projected recycling and composting during 2019 through 2030. Over the 12 years from 2007 through 2018, the environmental benefits from recycling and composting were worth between $265 million and $320 million (all dollar values in constant 2018$), because Seattle recycled or composted between 368,000 and 456,000 tons of materials. Due to contaminants discarded by households and businesses in their recycling and organics collection containers, this diversion required collection of between 375,000 and 489,000 tons for processing before the collected materials could be sold for recycled-content production or used as compost. The collection, processing, and disposal environmental costs for these contaminants are figured into the net environmental benefits shown in Figure E.2, as are the environmental costs of recycling and organics collection vehicles, processing activities, recycled-content manufacturing, and composting activities.

Increases in net environmental value for the planning period 2019 through 2030 are mainly due to projected increases in diversion from 465,000 tons in 2019 to 604,000 tons by 2030. During this planning period, the net environmental value per ton diverted grows steadily.

During 2007–2018, net environmental value per ton tended to cycle downward due to average contamination in recycling and organics collection containers rising from 1.9% in 2007–2009 to 6.4% by 2016–2018. Composition of collected recyclables can also affect environmental values. For example, environmental impacts would change if Seattle used more aluminum cans, which have a high net environmental value when recycled, and fewer glass containers, which have a lower net recycling environmental value.

Figure E.2 Net Environmental Value ($ millions) of Recycled MSW Tons 2007–2030



Contamination estimates are based on periodic collection stream composition sampling. The approximately 5-year intervals between samplings yields some, perhaps most, of the cycling shown in Figure E.2 when estimated contamination rises based on the most recent study and diverted tonnage then rises during the following years. For projections of net environmental values during the 2019-2030 planning period, MEBCalc estimates assume that contamination rates will remain at 2016-2018 levels.

As shown in Figure E.2 and Table E.3, avoided potential climate change, human health impairments (especially respiratory ailments), and waterways eutrophication account for most of the net environmental value from MSW diversion. These environmental benefits are the result of diverting materials from disposal to recycling or composting, thus avoiding the environmental emissions and associated costs of disposal and of producing products and packaging materials using virgin energy and material resources extracted from the planet's ecosystems.

Table E.3 Net Environmental Value (millions of 2018$) of Diverted MSW Tons 2018*

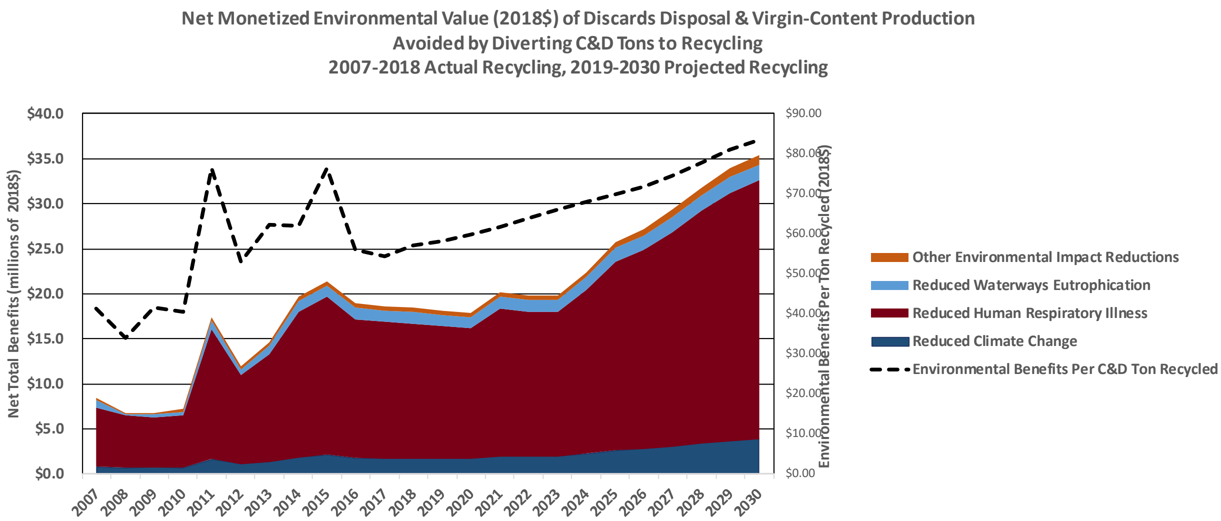
YEAR	CLIMATE CHANGE	HUMAN HEALTH – RESPIRATORY	HUMAN HEALTH – TOXICS	WATERWAYS EUTROPHICATION	OTHER 5 IMPACTS	TOTAL ENVIRONMENTAL VALUE
2010	29.8	155.9	11.0	113.5	5.0	315.3
2020	37.3	175.7	10.5	107.0	4.6	335.2
2030	56.0	256.3	12.8	130.3	6.2	461.6

**Monetized value of specific environmental impacts reductions*

Construction and Demolition Debris Results

Figure E.3 for C&D recycling shows estimated net environmental benefits for actual C&D recycling in 2007–2018 and for RPA-projected C&D debris recycling in 2019–2030. During 2007–2018, the environmental benefits from recycling and composting were worth between $7 million and $21 million (all dollar values in constant 2018$), because Seattle recycled between 163,000 and 343,000 tons of C&D debris. SPU includes the environmental costs of recycling hauling vehicles, processing activities, and recycled-content manufacturing activities when calculating net benefits of avoiding C&D discards disposal and avoiding manufacturing of virgin-content replacement products for recycled C&D debris.

Figure E.3 Net Environmental Value ($ millions) of Recycled C&D Tons 2007–2030



As shown in Figure E.3 and Table E.4, most of the net environmental value of C&D debris recycling comes from avoided potential climate change, human respiratory health impairments, and waterways eutrophication. As indicated in Table E.4, human respiratory impacts avoided by C&D recycling account for most of the environmental benefits of C&D debris recycling. Recycling ferrous metals provided more than half of these environmental benefits. Recycled concrete and asphalt, which typically account for more than half of recycled C&D debris tons, provide relatively low environmental benefits due to their use as replacements for aggregates typically used in construction and road building and repair. Production of construction aggregates is much less material- and energy-intensive than production of metallic construction materials.

Table E.4 Net Environmental Value ($ millions) of Recycled C&D Tons*

YEAR	CLIMATE CHANGE	HUMAN HEALTH - RESPIRATORY	HUMAN HEALTH-TOXICS	OTHER 6 IMPACTS	TOTAL ENVIRONMENTAL VALUE
2010	0.7	5.8	0.4	0.3	7.2
2020	1.7	14.5	1.2	0.5	17.8
2030	3.8	28.7	1.8	1.0	35.4

**Monetized value of specific environmental impacts reductions*

Figure E.4 is like Figure E.3 except that it focuses on the beneficial use of C&D wood discards rather than on the recycling of other C&D debris materials. Figure E.4 shows the net environmental costs of using C&D wood discards as industrial fuels to replace using natural gas as fuel and landfilling the wood discards. SPU categorizes this use of C&D discards as a beneficial use rather than as recycling because diverting wood to use as an industrial fuel in place of natural gas fuel typically has negative environmental consequences, unlike recycling, which typically has positive environmental benefits. The main reasons are that (1) natural gas burns more cleanly than wood, given similar emissions controls on the combustion facility, and (2) when wood is disposed of in a modern anaerobic landfill, less than 20% of carbon in typical wood discards anaerobically degrades to produce methane and carbon dioxide in oxygen-starved landfill conditions. The small percentage of carbon in wood that biodegrades in a landfill, takes more than 100 years to break down and generate methane and carbon dioxide.

Figure E.4 shows the estimated net environmental costs for actual wood beneficial use in 2007–2018 and for beneficial use of C&D wood projected by the RPA for 2019–2030. During 2007–2018, annual net environmental costs of using wood discards as industrial fuel were between $7 million and $40 million (all dollar values in constant 2018$), because between 9,000 and 49,000 tons of wood discarded through C&D activities was burned. SPU deducts the environmental costs of burning the natural gas displaced by wood fuel and of otherwise landfilling wood discards from the environmental costs of wood burning to yield the net environmental costs shown in Figure E.4.

As shown in Figure E.4 and Table E.5, increases in human respiratory health accounted for most of the net environmental costs from beneficial use of C&D wood discards. Net environmental costs also increased for potential climate change and toxics impairments.

Figure E.4 Net Environmental Cost ($ millions) from Beneficial Use of C&D Wood Discards as Industrial Fuels Displacing Natural Gas 2007-2030

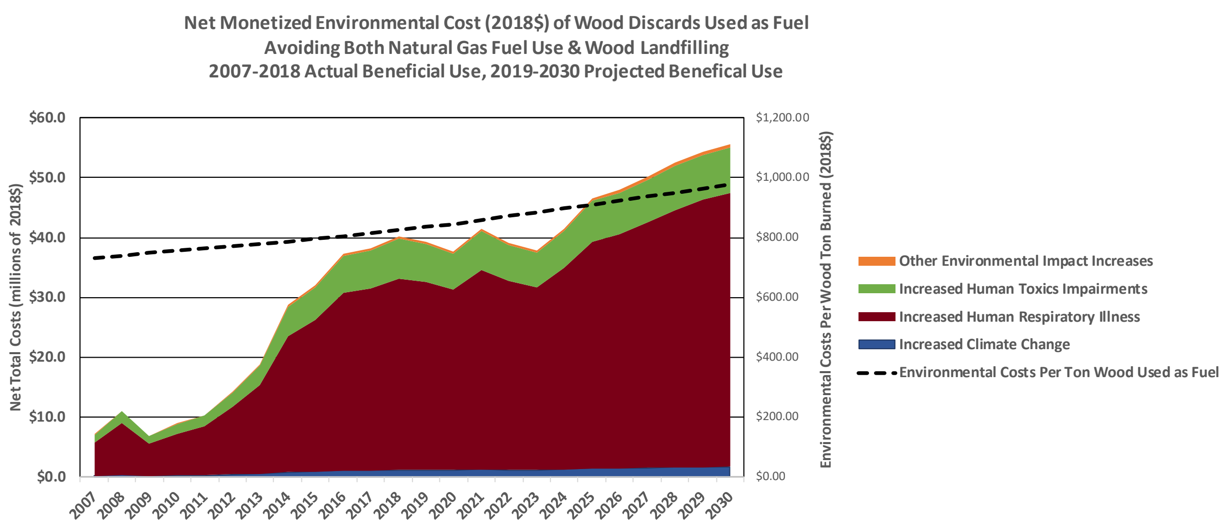


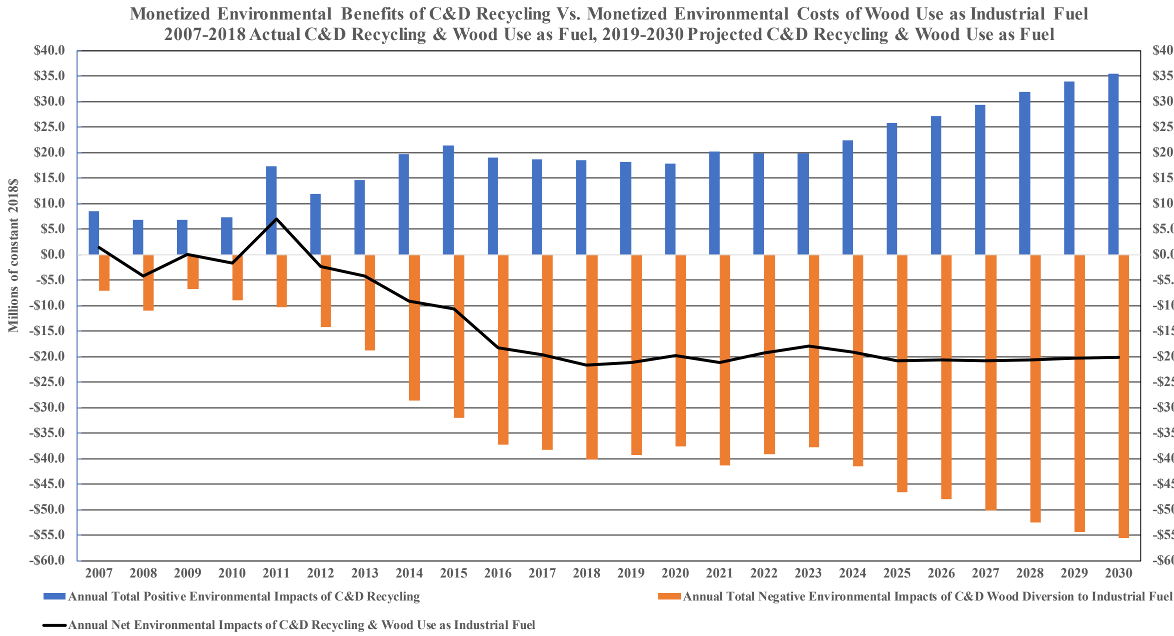
Table E.5 Net Environmental Costs ($ millions) of Burning C&D Wood Discards*

YEAR	CLIMATE CHANGE	HUMAN HEALTH - RESPIRATORY	HUMAN HEALTH-TOXICS	OTHER 6 IMPACTS	TOTAL ENVIRONMENTAL VALUE
2010	0.2	7.0	1.6	0.1	9.0
2020	1.1	30.2	6.0	0.4	37.6
2030	1.7	45.8	7.7	0.5	55.6

Figure E.5 combines the total environmental benefits of C&D recycling shown in Figure E.3 with the total environmental costs of C&D wood diversion to industrial fuel shown in Figure E.4. Figure E.5 illustrates that, in most years, the environmental costs from beneficial use of C&D wood discards as industrial fuel exceeded the environmental benefits of recycling other C&D materials, despite the fact that recycling tonnages were 7 to 21 times greater than the quantity of C&D wood discards diverted to industrial fuel use in 2007–2018.

The few instances when C&D recycling environmental benefits exceed C&D wood burning environmental costs tended to occur when recycled C&D metal recycling surged. C&D metal tons surge either because people discard more metal or because an increase in recycling market prices causes metal recyclers to sell metals they stockpiled and did not report recycling in previous years when metal recycling prices were low. Unlike materials such as paper and cardboard, metals can typically be stockpiled outside at low cost without significant deterioration in value due to weathering.

Figure E.5 Environmental Benefits ($ millions) from C&D Recycling vs. Environmental Costs ($ millions) from C&D Wood Diverted to Use as Industrial Fuel Displacing Natural Gas



Recycling Potential Assessment Model Outputs

The remainder of this appendix presents tables and figures with outputs from the RPA model in two sections:

- Municipal solid waste model
- Construction and demolition debris model

Summary: Municipal Solid Waste Tons Per Year, Status Quo

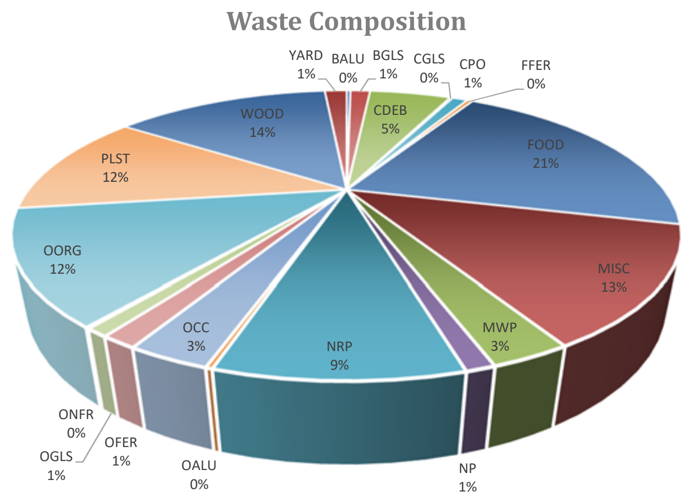
Year	Curb/Apt Rec	Home Organics	Curb/Apt Org	Clean Green	R&R centers	Com Priv Rec
1997	67,509	38,287	43,130	14,137	5,000	194,323
1998	70,279	39,128	40,546	13,034	5,376	194,251
1999	73,478	41,379	39,737	13,692	6,612	199,968
2000	72,864	26,662	34,037	14,032	7,109	162,989
2001	72,382	26,662	36,990	15,034	7,103	149,453
2002	72,543	26,662	34,503	14,353	8,340	149,025
2003	73,780	26,662	33,923	14,156	8,170	126,956
2004	76,860	23,900	38,485	14,907	8,163	159,341
2005	81,139	22,700	42,603	13,925	9,232	179,265
2006	84,531	22,700	51,482	14,277	9,745	215,258
2007	86,621	22,700	54,573	14,247	11,246	219,894
2008	81,888	22,700	56,364	11,893	8,662	213,493
2009	76,584	16,000	74,230	10,149	6,179	184,593
2010	77,110	16,000	79,952	7,682	4,643	203,511
2011	75,778	16,000	78,456	6,794	3,949	215,678
2012	75,916	16,000	82,244	6,593	3,501	213,584
2013	75,909	16,000	80,816	6,290	4,040	224,079
2014	77,970	16,000	81,001	4,199	2,635	229,950
2015	77,193	16,000	87,510	4,167	2,888	230,480
2016	78,991	16,000	89,556	4,390	3,693	247,042
2017	79,775	16,000	89,770	6,127	5,681	259,105
2018	78,102	14,000	88,947	6,127	5,595	257,359
2019	80,283	14,522	92,143	6,155	5,621	264,235
2020	82,555	14,686	93,403	6,127	5,596	264,003
2021	84,001	14,993	95,312	6,106	5,576	266,192
2022	85,371	14,995	95,538	6,153	5,620	270,137
2023	86,667	15,171	96,696	6,232	5,694	275,856
2024	88,428	15,277	97,524	6,292	5,752	280,278
2025	89,102	15,408	98,252	6,296	5,766	282,816
2026	90,002	15,640	99,408	6,334	5,827	285,644
2027	90,771	16,032	100,990	6,390	5,949	288,325
2028	91,399	16,389	101,401	6,524	6,245	290,909
2029	92,704	17,410	103,624	6,693	6,759	294,584
2030	94,254	18,362	103,844	6,988	7,586	298,629
2031	95,522	19,632	105,487	7,298	8,432	300,899
2032	97,117	20,248	105,838	7,507	8,993	303,888
2033	97,192	20,482	105,616	7,585	9,235	304,459
2034	97,828	20,452	105,171	7,625	9,344	304,951
2035	98,512	20,636	105,890	7,641	9,386	306,018
2036	99,068	20,810	106,650	7,661	9,421	306,551
2037	99,010	20,987	107,310	7,642	9,400	305,646
2038	99,366	20,995	107,422	7,637	9,395	305,641
2039	99,184	21,155	108,007	7,628	9,384	304,646
2040	99,930	20,948	107,368	7,633	9,391	304,955

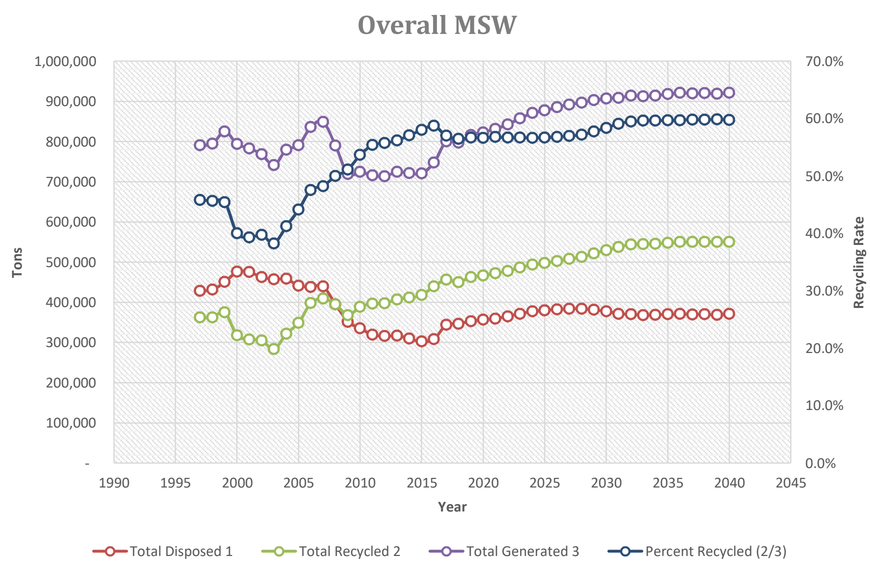
Summary: Municipal Solid Waste, Status Quo
Summary of Recycling Program Impacts (in tons per year)
Modeled waste composition data for 2025 - All Sectors

Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled	Curb/Apt Rec	Home Organics	Curb/Apt Org	Clean Green	R&R centers	Com Priv Rec	Total
Aluminum Beverage	956	1,531	2,486	61.6%	701	-	-	-	5	825	1,531
Beverage Glass	4,896	26,494	31,390	84.4%	11,855	-	-	-	237	14,401	26,494
Construction Debris	20,150	1	20,151	0.0%	-	-	-	-	1	-	1
Container Glass	684	874	1,558	56.1%	874	-	-	-	-	-	874
Computer Office Paper	3,719	14,762	18,481	79.9%	114	-	-	-	-	14,648	14,762
Food Cans	1,420	1,857	3,277	56.7%	1,005	-	-	-	-	852	1,857
Food	78,173	97,090	175,263	55.4%	-	2,694	14,830	-	-	79,567	97,090
Miscellaneous	48,464	42,603	91,067	46.8%	9,417	-	1,085	-	224	31,878	42,603
Mixed Scrap Paper	11,403	52,344	63,747	82.1%	22,048	-	400	-	242	29,654	52,344
Newspaper	4,137	23,743	27,880	85.2%	12,301	-	-	-	78	11,364	23,743
Other Paper	34,053	6,529	40,582	16.1%	596	-	5,933	-	-	-	6,529
Other Aluminum	944	125	1,070	11.7%	125	-	-	-	0	-	125
Corrugated Kraft	11,675	68,998	80,673	85.5%	14,734	-	-	-	793	53,471	68,998
Other Ferrous	5,270	12,652	17,921	70.6%	384	-	-	-	3,083	9,185	12,652
Other Glass	3,435	10,501	13,936	75.3%	10,501	-	-	-	-	0	10,501
Other NonFerrous	525	-	525	0.0%	-	-	-	-	-	-	-
Other Organics	46,803	764	47,567	1.6%	-	-	764	-	-	-	764
Plastics	44,947	10,205	55,153	18.5%	4,448	-	898	-	29	4,830	10,205
Wood	52,787	1,074	53,861	2.0%	-	-	-	-	1,074	-	1,074
Yard	5,500	125,492	130,992	95.8%	-	12,714	74,342	6,296	-	32,140	125,492
Total	**379,942**	**497,639**	**877,581**	**56.7%**	**89,102**	**15,408**	**98,252**	**6,296**	**5,766**	**282,816**	**497,639**

Summary: Municipal Solid Waste, Status Quo
Summary of Recycling Program Impacts (in tons per year)
Modeled waste composition data for 2025 - All Sectors

Year	Total Disposed	Total Recycled	Total Generated	Percent Recycled
1997	428,246	362,386	790,633	45.8%
1998	431,854	362,613	794,467	45.6%
1999	450,489	374,866	825,354	45.4%
2000	476,130	317,693	793,823	40.0%
2001	475,186	307,623	782,809	39.3%
2002	462,759	305,426	768,185	39.8%
2003	457,448	283,646	741,094	38.3%
2004	458,401	321,656	780,057	41.2%
2005	441,595	348,864	790,459	44.1%
2006	438,450	397,993	836,442	47.6%
2007	439,389	409,280	848,669	48.2%
2008	394,830	395,000	789,831	50.0%
2009	351,688	367,735	719,423	51.1%
2010	335,571	388,898	724,469	53.7%
2011	319,342	396,655	715,996	55.4%
2012	315,966	397,837	713,803	55.7%
2013	317,258	407,134	724,391	56.2%
2014	309,512	411,754	721,266	57.1%
2015	302,465	418,237	720,702	58.0%
2016	308,380	439,672	748,052	58.8%
2017	343,924	456,458	800,382	57.0%
2018	346,690	450,130	796,820	56.5%
2019	353,255	462,959	816,214	56.7%
2020	356,685	466,369	823,054	56.7%
2021	359,322	472,180	831,502	56.8%
2022	364,982	477,814	842,796	56.7%
2023	371,325	486,316	857,642	56.7%
2024	377,807	493,551	871,358	56.6%
2025	379,942	497,639	877,581	56.7%
2026	382,565	502,854	885,419	56.8%
2027	383,783	508,458	892,240	57.0%
2028	384,155	512,866	897,021	57.2%
2029	381,265	521,773	903,039	57.8%
2030	377,595	529,664	907,259	58.4%
2031	371,592	537,270	908,862	59.1%
2032	370,615	543,592	914,207	59.5%
2033	368,285	544,569	912,854	59.7%
2034	369,052	545,371	914,423	59.6%
2035	370,010	548,082	918,092	59.7%
2036	370,878	550,161	921,039	59.7%
2037	369,504	549,994	919,498	59.8%
2038	370,035	550,455	920,490	59.8%
2039	368,625	550,004	918,629	59.9%
2040	370,826	550,227	921,053	59.7%





Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Single-family Residential

Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled
Aluminum Beverage	162	434	596	72.9%
Beverage Glass	783	7,967	8,749	91.1%
Construction Debris	982	-	982	0.0%
Container Glass	206	611	817	74.8%
Computer Office Paper	750	56	807	7.0%
Food Cans	351	690	1,041	66.3%
Food	17,993	14,610	32,603	44.8%
Miscellaneous	4,226	6,782	11,008	61.6%
Mixed Scrap Paper	2,457	15,404	17,861	86.2%
Newspaper	1,318	8,475	9,793	86.5%
Other Paper	6,742	5,807	12,549	46.3%
Other Aluminum	237	84	320	26.1%
Corrugated Kraft	924	8,822	9,746	90.5%
Other Ferrous	300	296	596	49.7%
Other Glass	221	7,043	7,264	97.0%
Other NonFerrous	146	-	146	0.0%
Other Organics	16,233	738	16,971	4.3%
Plastics	7,433	3,745	11,178	33.5%
Wood	1,256	-	1,256	0.0%
Yard	626	86,058	86,685	99.3%
Total	**63,345**	**167,622**	**230,966**	**72.6%**

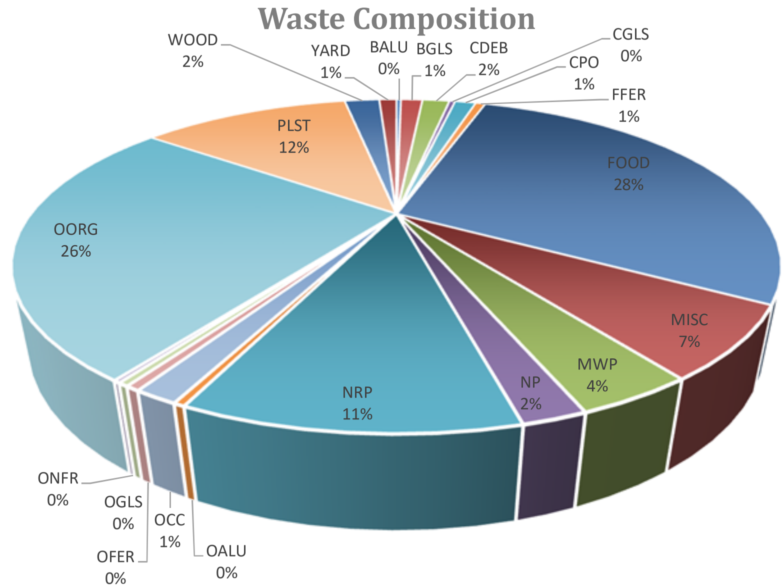
Material MSW	Curb/Apt Rec	Home Organics	Curb/Apt Org	
Aluminum Beverage	434	-	-	434
Beverage Glass	7,967	-	-	7,967
Construction Debris	-	-	-	-
Container Glass	611	-	-	611
Computer Office Paper	56	-	-	56
Food Cans	690	-	-	690
Food	-	2,694	11,916	14,610
Miscellaneous	5,961	-	821	6,782
Mixed Scrap Paper	15,057	-	347	15,404
Newspaper	8,475	-	-	8,475
Other Paper	399	-	5,408	5,807
Other Aluminum	84	-	-	84
Corrugated Kraft	8,822	-	-	8,822
Other Ferrous	296	-	-	296
Other Glass	7,043	-	-	7,043
Other NonFerrous	-	-	-	-
Other Organics	-	-	738	738
Plastics	2,973	-	773	3,745
Wood	-	-	-	-
Yard	-	12,714	73,344	86,058
	58,868	**15,408**	**93,346**	**167,622**

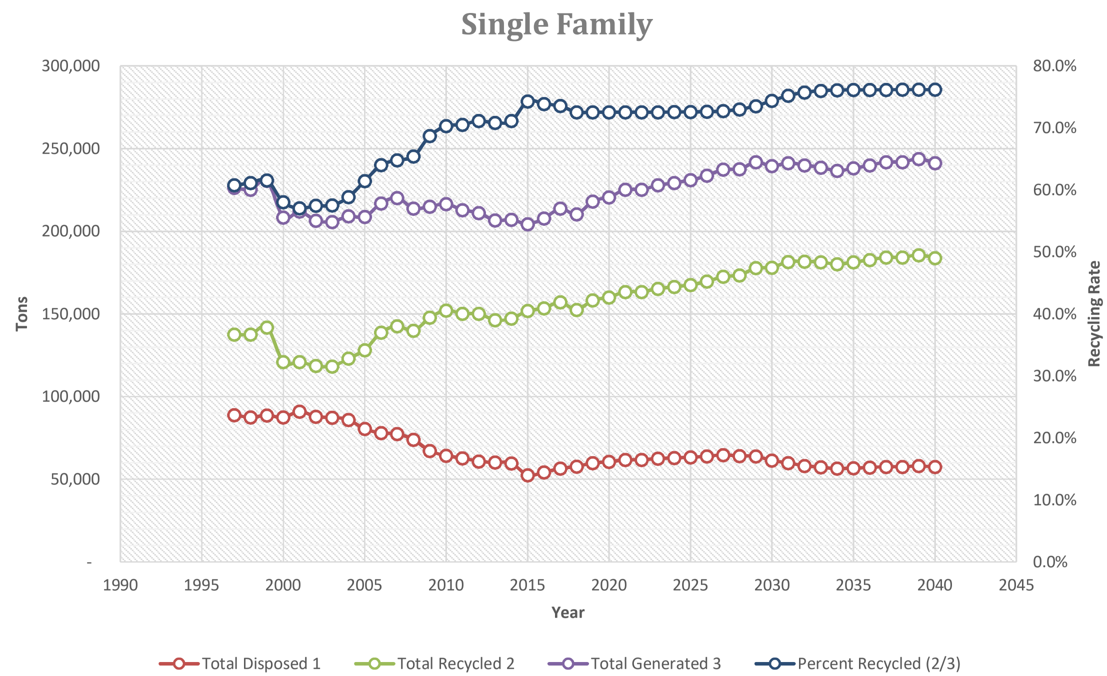
Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Single-family Residential

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	88,783	137,555	226,337	60.8%
1998	87,560	137,686	225,247	61.1%
1999	88,631	141,956	230,586	61.6%
2000	87,499	120,969	208,468	58.0%
2001	91,072	120,910	211,982	57.0%
2002	87,834	118,640	206,474	57.5%
2003	87,426	118,322	205,748	57.5%
2004	86,029	123,103	209,132	58.9%
2005	80,479	128,197	208,676	61.4%
2006	78,078	138,810	216,889	64.0%
2007	77,494	142,634	220,127	64.8%
2008	73,961	139,928	213,889	65.4%
2009	67,229	147,786	215,015	68.7%
2010	64,309	152,175	216,484	70.3%
2011	62,779	150,082	212,861	70.5%
2012	60,906	150,124	211,030	71.1%
2013	60,291	146,301	206,592	70.8%
2014	59,772	147,220	206,992	71.1%
2015	52,529	151,868	204,397	74.3%
2016	54,298	153,506	207,804	73.9%
2017	56,541	157,168	213,709	73.5%
2018	57,725	152,564	210,289	72.5%
2019	59,876	158,248	218,124	72.5%
2020	60,551	160,033	220,584	72.5%
2021	61,817	163,381	225,198	72.5%
2022	61,818	163,391	225,209	72.6%
2023	62,530	165,289	227,819	72.6%
2024	62,923	166,377	229,300	72.6%
2025	63,345	167,622	230,966	72.6%
2026	63,983	169,663	233,645	72.6%
2027	64,752	172,638	237,390	72.7%
2028	64,178	173,397	237,575	73.0%
2029	63,984	177,766	241,750	73.5%
2030	61,365	178,080	239,445	74.4%
2031	59,828	181,469	241,297	75.2%
2032	58,201	181,736	239,937	75.7%
2033	57,265	181,339	238,604	76.0%
2034	56,537	180,070	236,607	76.1%
2035	56,800	181,310	238,111	76.1%
2036	57,188	182,700	239,888	76.2%
2037	57,638	184,193	241,831	76.2%
2038	57,649	184,250	241,899	76.2%
2039	58,083	185,645	243,728	76.2%
2040	57,514	183,829	241,342	76.2%



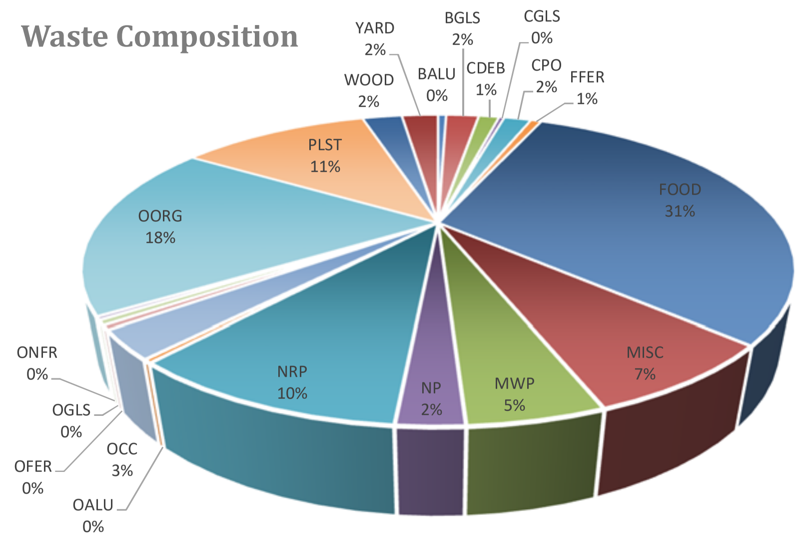


Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled	Total Recycled by Program: Curb/Apt Rec	Curb/Apt Org	
Aluminum Beverage	304	266	571	46.7%	266	-	266
Beverage Glass	1,225	3,888	5,113	76.0%	3,888	-	3,888
Construction Debris	761	-	761	0.0%	-	-	-
Container Glass	194	263	457	57.6%	263	-	263
Computer Office Paper	1,008	57	1,065	5.4%	57	-	57
Food Cans	399	315	714	44.1%	315	-	315
Food	18,844	2,914	21,758	13.4%	-	2,914	2,914
Miscellaneous	4,452	3,720	8,172	45.5%	3,456	264	3,720
Mixed Scrap Paper	2,909	7,044	9,953	70.8%	6,991	53	7,044
Newspaper	1,434	3,826	5,261	72.7%	3,826	-	3,826
Other Paper	6,025	722	6,746	10.7%	197	525	722
Other Aluminum	205	42	246	16.9%	42	-	42
Corrugated Kraft	1,747	5,912	7,659	77.2%	5,912	-	5,912
Other Ferrous	275	88	363	24.3%	88	-	88
Other Glass	288	3,458	3,746	92.3%	3,458	-	3,458
Other NonFerrous	199	-	199	0.0%	-	-	-
Other Organics	11,276	26	11,302	0.2%	-	26	26
Plastics	6,938	1,601	8,538	18.7%	1,475	126	1,601
Wood	1,476	-	1,476	0.0%	-	-	-
Yard	1,360	998	2,358	42.3%	-	998	998
Total	**61,319**	**35,140**	**96,459**	**36.4%**	**30,235**	**4,906**	**35,140**

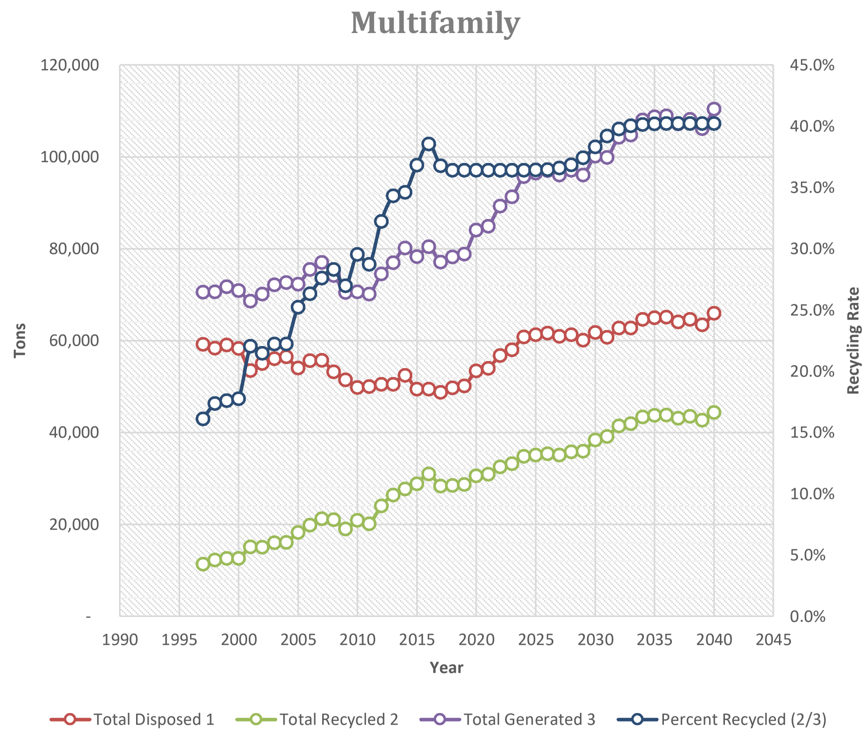


Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

Year	Disposed 1	Recycled 2	Generated 3	Recycled (2/3)
1997	59,189	11,371	70,560	16.1%
1998	58,374	12,266	70,640	17.4%
1999	59,087	12,639	71,726	17.6%
2000	58,333	12,595	70,927	17.8%
2001	53,487	15,124	68,611	22.0%
2002	55,076	15,068	70,144	21.5%
2003	56,106	16,043	72,149	22.2%
2004	56,498	16,142	72,640	22.2%
2005	54,080	18,245	72,325	25.2%
2006	55,643	19,903	75,545	26.3%
2007	55,759	21,261	77,020	27.6%
2008	53,199	21,024	74,223	28.3%
2009	51,497	19,028	70,524	27.0%
2010	49,788	20,887	70,675	29.6%
2011	49,993	20,152	70,145	28.7%
2012	50,497	24,035	74,532	32.2%
2013	50,547	26,423	76,970	34.3%
2014	52,439	27,750	80,189	34.6%
2015	49,443	28,835	78,278	36.8%
2016	49,437	31,041	80,478	38.6%
2017	48,773	28,376	77,150	36.8%
2018	49,760	28,485	78,245	36.4%
2019	50,135	28,700	78,835	36.4%
2020	53,473	30,611	84,084	36.4%
2021	54,020	30,924	84,945	36.4%
2022	56,794	32,513	89,307	36.4%
2023	58,067	33,245	91,312	36.4%
2024	60,857	34,851	95,708	36.4%
2025	61,319	35,140	96,459	36.4%
2026	61,633	35,387	97,020	36.5%
2027	60,932	35,155	96,086	36.6%
2028	61,306	35,792	97,098	36.9%
2029	60,120	35,971	96,091	37.4%
2030	61,782	38,381	100,163	38.3%
2031	60,751	39,172	99,923	39.2%
2032	62,789	41,468	104,257	39.8%
2033	62,799	41,951	104,750	40.0%
2034	64,635	43,380	108,015	40.2%
2035	65,035	43,727	108,762	40.2%
2036	65,141	43,828	108,969	40.2%
2037	64,062	43,113	107,175	40.2%
2038	64,680	43,532	108,212	40.2%
2039	63,442	42,701	106,144	40.2%
2040	65,993	44,418	110,411	40.2%

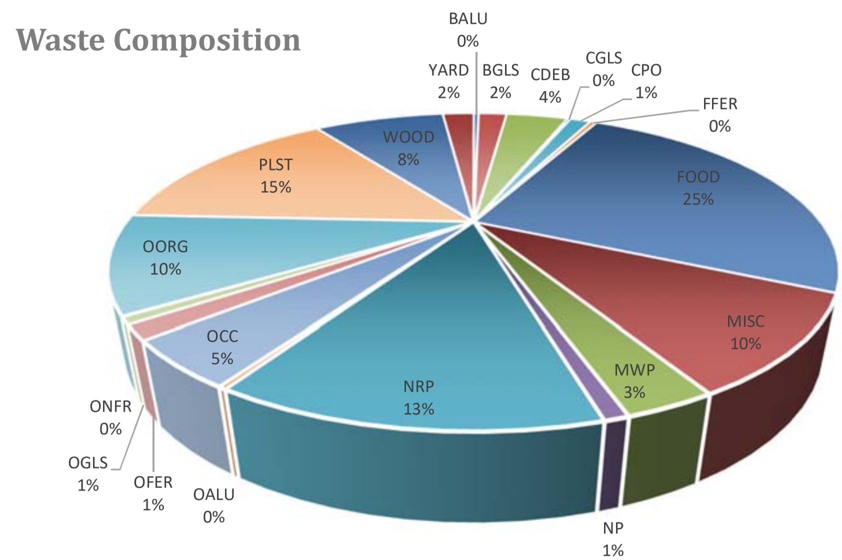


Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

					Recycled by Program	
Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled	Com Priv Rec	
Aluminum Beverage	451	825	1,276	64.7%	825	825
Beverage Glass	2,576	14,401	16,977	84.8%	14,401	14,401
Construction Debris	5,594	-	5,594	0.0%	-	-
Container Glass	285	-	285	0.0%	-	-
Computer Office Paper	1,867	14,648	16,515	88.7%	14,648	14,648
Food Cans	596	852	1,448	58.9%	852	852
Food	37,421	79,567	116,987	68.0%	79,567	79,567
Miscellaneous	14,737	31,878	46,615	68.4%	31,878	31,878
Mixed Scrap Paper	4,762	29,654	34,416	86.2%	29,654	29,654
Newspaper	1,290	11,364	12,654	89.8%	11,364	11,364
Other Paper	19,680	-	19,680	0.0%	-	-
Other Aluminum	417	-	417	0.0%	-	-
Corrugated Kraft	6,919	53,471	60,391	88.5%	53,471	53,471
Other Ferrous	2,225	9,185	11,410	80.5%	9,185	9,185
Other Glass	1,053	0	1,053	0.0%	0	0
Other NonFerrous	89	-	89	0.0%	-	-
Other Organics	15,151	-	15,151	0.0%	-	-
Plastics	22,234	4,830	27,065	17.8%	4,830	4,830
Wood	11,765	-	11,765	0.0%	-	-
Yard	2,843	32,140	34,983	91.9%	32,140	32,140
Total	**151,954**	**282,816**	**434,769**	**65.0%**	**282,816**	**282,816**

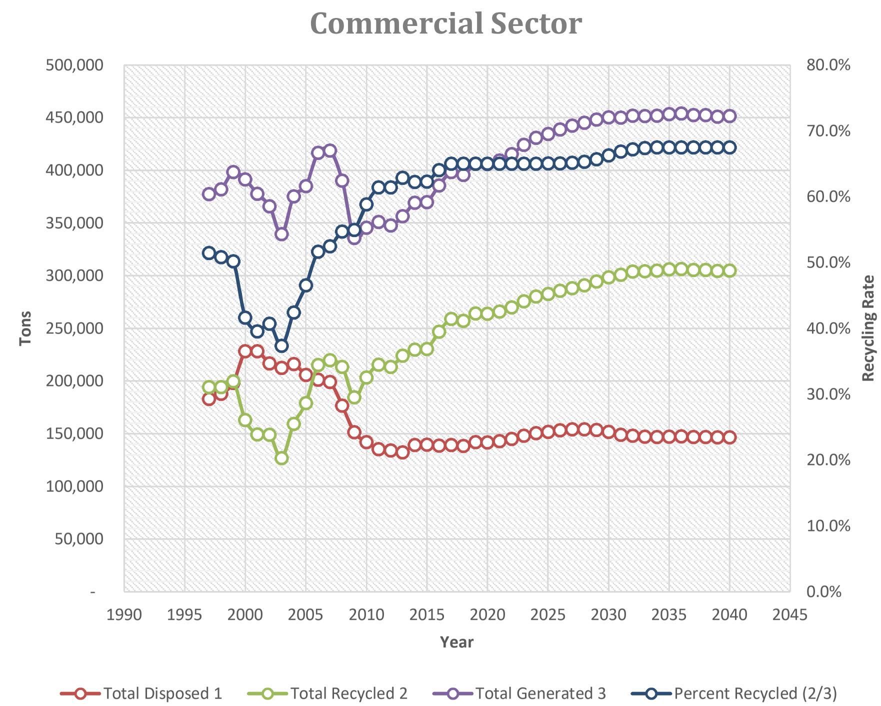


Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	183,130	194,323	377,453	51.5%
1998	187,899	194,251	382,150	50.8%
1999	198,420	199,968	398,388	50.2%
2000	228,417	162,989	391,406	41.6%
2001	228,310	149,453	377,763	39.6%
2002	216,923	149,025	365,948	40.7%
2003	212,647	126,956	339,603	37.4%
2004	216,111	159,341	375,452	42.4%
2005	205,829	179,265	385,094	46.6%
2006	201,306	215,258	416,564	51.7%
2007	199,083	219,894	418,977	52.5%
2008	176,774	213,493	390,267	54.7%
2009	151,399	184,593	335,992	54.9%
2010	142,182	203,511	345,693	58.9%
2011	135,535	215,678	351,213	61.4%
2012	134,090	213,584	347,674	61.4%
2013	132,400	224,079	356,479	62.9%
2014	139,456	229,950	369,406	62.2%
2015	139,556	230,480	370,036	62.3%
2016	138,804	247,042	385,846	64.0%
2017	139,317	259,105	398,422	65.0%
2018	138,378	257,359	395,737	65.0%
2019	142,075	264,235	406,310	65.0%
2020	141,949	264,003	405,952	65.0%
2021	143,125	266,192	409,318	65.0%
2022	145,243	270,137	415,379	65.0%
2023	148,308	275,856	424,164	65.0%
2024	150,660	280,278	430,938	65.0%
2025	151,954	282,816	434,769	65.0%
2026	153,284	285,644	438,928	65.1%
2027	154,225	288,325	442,550	65.2%
2028	154,386	290,909	445,295	65.3%
2029	153,779	294,584	448,363	65.7%
2030	151,948	298,629	450,577	66.3%
2031	149,198	300,899	450,096	66.9%
2032	148,160	303,888	452,048	67.2%
2033	147,238	304,459	451,697	67.4%
2034	146,985	304,951	451,936	67.5%
2035	147,311	306,018	453,328	67.5%
2036	147,497	306,551	454,048	67.5%
2037	147,035	305,646	452,681	67.5%
2038	147,023	305,641	452,664	67.5%
2039	146,541	304,646	451,188	67.5%
2040	146,688	304,955	451,644	67.5%

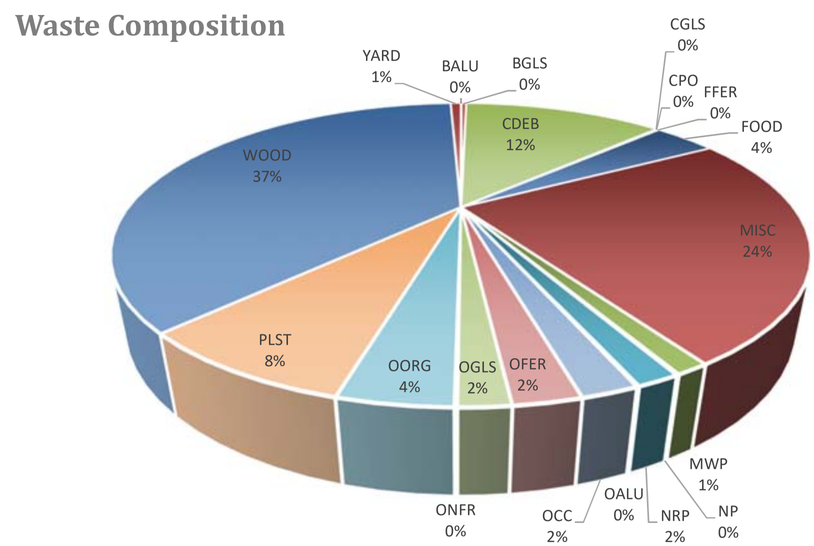


Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Self-haul

Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled	Clean Green	R&R centers	
Aluminum Beverage	39	5	44	11.8%	-	5	5
Beverage Glass	313	237	550	43.1%	-	237	237
Construction Debris	12,814	1	12,815	0.0%	-	1	1
Container Glass	-	-	-	0.0%	-	-	-
Computer Office Paper	94	-	94	0.0%	-	-	-
Food Cans	74	-	74	0.0%	-	-	-
Food	3,915	-	3,915	0.0%	-	-	-
Miscellaneous	25,048	224	25,272	0.9%	-	224	224
Mixed Scrap Paper	1,275	242	1,517	16.0%	-	242	242
Newspaper	95	78	172	45.2%	-	78	78
Other Paper	1,606	-	1,606	0.0%	-	-	-
Other Aluminum	86	0	86	0.2%	-	0	0
Corrugated Kraft	2,085	793	2,878	27.6%	-	793	793
Other Ferrous	2,469	3,083	5,552	55.5%	-	3,083	3,083
Other Glass	1,874	-	1,874	0.0%	-	-	-
Other NonFerrous	91	-	91	0.0%	-	-	-
Other Organics	4,143	-	4,143	0.0%	-	-	-
Plastics	8,343	29	8,371	0.3%	-	29	29
Wood	38,290	1,074	39,364	2.7%	-	1,074	1,074
Yard	670	6,296	6,966	90.4%	6,296	-	6,296
Total	**103,325**	**12,062**	**115,387**	**10.5%**	**6,296**	**5,766**	**12,062**

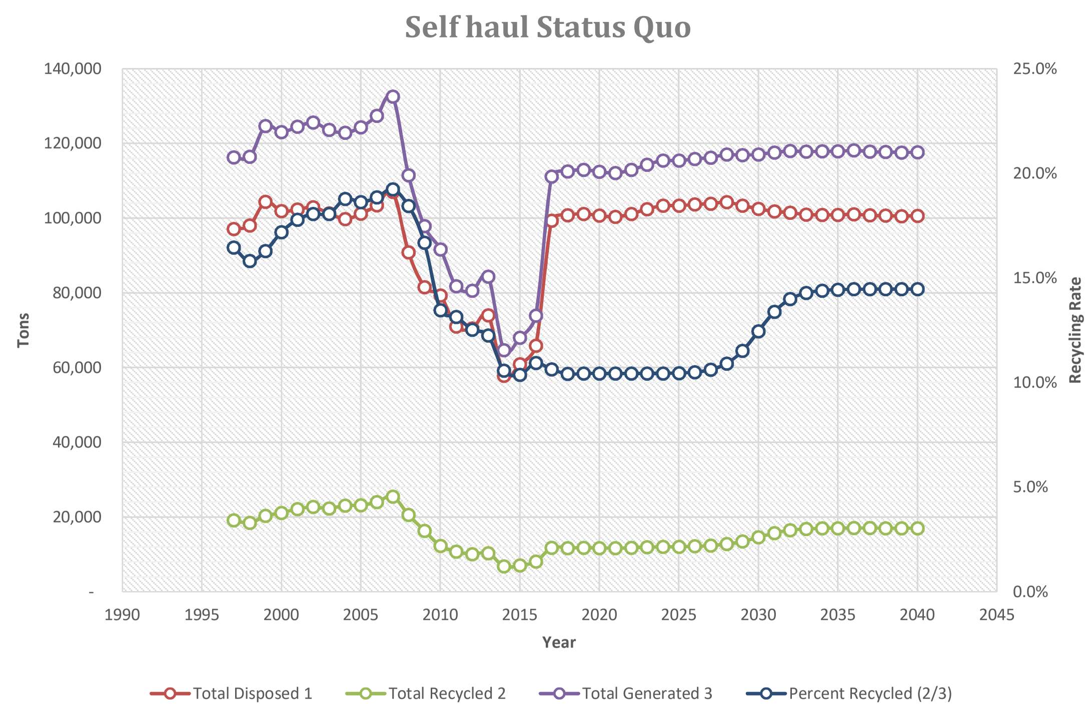


Summary: Municipal Solid Waste, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Self-haul

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	97,145	19,137	116,282	16.5%
1998	98,021	18,410	116,431	15.8%
1999	104,350	20,304	124,654	16.3%
2000	101,881	21,141	123,022	17.2%
2001	102,316	22,137	124,453	17.8%
2002	102,926	22,693	125,619	18.1%
2003	101,269	22,325	123,594	18.1%
2004	99,763	23,070	122,833	18.8%
2005	101,207	23,157	124,364	18.6%
2006	103,422	24,022	127,444	18.8%
2007	107,053	25,492	132,545	19.2%
2008	90,896	20,556	111,452	18.4%
2009	81,564	16,328	97,892	16.7%
2010	79,292	12,325	91,617	13.5%
2011	71,034	10,743	81,777	13.1%
2012	70,473	10,094	80,567	12.5%
2013	74,020	10,330	84,350	12.2%
2014	57,845	6,834	64,679	10.6%
2015	60,936	7,055	67,991	10.4%
2016	65,841	8,083	73,924	10.9%
2017	99,293	11,808	111,101	10.6%
2018	100,827	11,722	112,549	10.4%
2019	101,169	11,776	112,945	10.4%
2020	100,711	11,723	112,434	10.4%
2021	100,359	11,682	112,041	10.4%
2022	101,127	11,773	112,900	10.4%
2023	102,420	11,926	114,347	10.4%
2024	103,367	12,045	115,411	10.4%
2025	103,325	12,062	115,387	10.5%
2026	103,665	12,160	115,825	10.5%
2027	103,874	12,340	116,214	10.6%
2028	104,285	12,769	117,054	10.9%
2029	103,382	13,452	116,834	11.5%
2030	102,501	14,574	117,075	12.4%
2031	101,816	15,731	117,546	13.4%
2032	101,464	16,501	117,965	14.0%
2033	100,983	16,820	117,803	14.3%
2034	100,895	16,969	117,865	14.4%
2035	100,865	17,027	117,891	14.4%
2036	101,051	17,082	118,134	14.5%
2037	100,769	17,043	117,812	14.5%
2038	100,683	17,032	117,715	14.5%
2039	100,558	17,012	117,570	14.5%
2040	100,631	17,024	117,656	14.5%



Summary: Municipal Solid Waste Tons Per Year, Recommended New Programs

Year	Curb/Apt Rec	Home Organics	Curb/Apt Org	Clean Green	R&R centers	Com Priv Rec	Targeted Outreach	Incr MF Enforce	Wast Prev Camp - SH	Mun Codes Update MF	Food Waste Prev - SF
1997	67,509	38,287	43,130	14,137	5,000	194,323	-	-	-	-	-
1998	70,279	39,128	40,546	13,034	5,376	194,251	-	-	-	-	-
1999	73,478	41,379	39,737	13,692	6,612	199,968	-	-	-	-	-
2000	72,864	26,662	34,037	14,032	7,109	162,989	-	-	-	-	-
2001	72,382	26,662	36,990	15,034	7,103	149,453	-	-	-	-	-
2002	72,543	26,662	34,503	14,353	8,340	149,025	-	-	-	-	-
2003	73,780	26,662	33,923	14,156	8,170	126,956	-	-	-	-	-
2004	76,860	23,900	38,485	14,907	8,163	159,341	-	-	-	-	-
2005	81,139	22,700	42,603	13,925	9,232	179,265	-	-	-	-	-
2006	84,531	22,700	51,482	14,277	9,745	215,258	-	-	-	-	-
2007	86,621	22,700	54,573	14,247	11,246	219,894	-	-	-	-	-
2008	81,888	22,700	56,364	11,893	8,662	213,493	-	-	-	-	-
2009	76,584	16,000	74,230	10,149	6,179	184,593	-	-	-	-	-
2010	77,110	16,000	79,952	7,682	4,643	203,511	-	-	-	-	-
2011	75,778	16,000	78,456	6,794	3,949	215,678	-	-	-	-	-
2012	75,916	16,000	82,244	6,593	3,501	213,584	-	-	-	-	-
2013	75,909	16,000	80,816	6,290	4,040	224,079	-	-	-	-	-
2014	77,970	16,000	81,001	4,199	2,635	229,950	-	-	-	-	-
2015	77,193	16,000	87,510	4,167	2,888	230,480	-	-	-	-	-
2016	78,991	16,000	89,556	4,390	3,693	247,042	-	-	-	-	-
2017	79,775	16,000	89,770	6,127	5,681	259,105	-	-	-	-	-
2018	78,102	14,000	88,947	6,127	5,595	257,359	-	-	-	-	-
2019	80,283	14,522	92,143	6,155	5,620	264,235	152	0	-	108	-
2020	82,529	14,686	93,401	6,127	5,593	261,494	407	0	1	287	1,067
2021	83,934	14,993	95,306	6,106	5,570	261,079	928	0	2	640	1,526
2022	85,215	14,995	95,525	6,153	5,604	261,157	1,813	0	5	1,209	1,778
2023	86,360	15,171	96,670	6,232	5,657	262,737	2,710	1	13	1,744	1,865
2024	87,938	15,277	97,478	6,292	5,682	263,993	3,421	2	36	2,150	1,884
2025	88,449	15,406	98,182	6,296	5,663	264,413	3,726	4	97	2,315	1,884
2026	89,193	15,635	99,304	6,332	5,701	265,441	3,859	12	264	2,386	1,882
2027	89,780	16,019	100,820	6,387	5,809	266,168	3,855	29	701	2,377	1,873
2028	90,180	16,357	101,103	6,516	6,089	266,626	3,886	65	1,771	2,390	1,861
2029	91,169	17,332	103,073	6,675	6,580	267,928	3,799	117	4,026	2,329	1,859
2030	92,297	18,209	102,935	6,953	7,370	269,305	3,878	174	7,519	2,369	1,861
2031	93,158	19,391	104,216	7,245	8,177	269,281	3,786	205	11,001	2,307	1,856
2032	94,462	19,948	104,344	7,441	8,710	270,650	3,894	228	13,324	2,369	1,863
2033	94,415	20,153	104,023	7,513	8,939	270,539	3,886	234	14,391	2,363	1,861
2034	94,979	20,112	103,545	7,550	9,043	270,723	3,996	244	14,853	2,429	1,862
2035	95,624	20,290	104,236	7,565	9,082	271,572	4,019	246	15,083	2,443	1,868
2036	96,157	20,460	104,979	7,585	9,115	272,009	4,025	247	15,188	2,446	1,871
2037	96,101	20,632	105,625	7,566	9,096	271,192	3,958	243	15,182	2,406	1,865
2038	96,445	20,641	105,734	7,561	9,090	271,183	3,996	245	15,202	2,429	1,865
2039	96,271	20,798	106,310	7,551	9,080	270,299	3,920	241	15,169	2,382	1,859
2040	96,989	20,595	105,682	7,557	9,087	270,572	4,077	250	15,200	2,478	1,861

Summa Summary: Municipal Solid Waste Tons Per Year, Recommended New Programs

Year	Food & YW Recovery SF	School Education	Incr MF Res Ban Enforce	Take Back Plastic Film	Food Waste Prev - Comm	Comp Food Serv Pack	Container Depo Syst - Com	Electronics Prod Stew	All Pack Prod Stew -	Carpet Prod Stew - Com	South Reuse Center	EPR Bags Film - MF	Serv Ware - Berk	Paint Prod Stew - Com
1997	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1999	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2003	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2004	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2006	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2008	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2009	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2010	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2011	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2012	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2013	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2015	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2017	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2018	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2019	1,373	4	137	59	-	-	-	-	-	-	5	-	-	-
2020	1,790	11	342	86	5	3,830	54	15	5	42	15	8	52	22
2021	2,865	28	769	104	14	8,712	138	38	13	112	38	21	124	59
2022	5,409	68	1,440	113	38	16,435	316	88	36	285	97	54	250	151
2023	10,566	146	2,147	118	103	24,529	598	167	97	656	221	123	413	345
2024	18,514	254	2,645	119	277	29,996	890	249	259	1,236	414	232	554	646
2025	26,348	347	2,874	119	703	32,650	1,080	302	655	1,818	605	340	639	944
2026	31,487	398	2,961	118	1,601	33,812	1,178	329	1,490	2,207	732	409	682	1,142
2027	33,826	417	2,982	117	3,001	34,216	1,223	340	2,787	2,403	794	437	702	1,243
2028	34,521	420	2,976	114	4,415	34,305	1,242	346	4,093	2,493	824	445	713	1,287
2029	34,308	417	2,929	112	5,356	34,419	1,251	349	4,951	2,532	831	448	720	1,309
2030	33,647	410	2,865	109	5,821	34,524	1,257	354	5,370	2,553	836	453	724	1,318
2031	32,655	400	2,789	106	5,994	34,459	1,253	356	5,514	2,559	840	455	724	1,321
2032	32,337	396	2,758	105	6,089	34,598	1,260	361	5,604	2,571	843	461	727	1,326
2033	32,001	393	2,730	104	6,111	34,567	1,257	361	5,616	2,569	842	461	726	1,325
2034	32,053	393	2,729	104	6,123	34,584	1,261	364	5,639	2,570	842	465	727	1,325
2035	32,154	393	2,733	104	6,146	34,690	1,267	366	5,664	2,576	842	468	729	1,329
2036	32,230	394	2,738	104	6,157	34,745	1,271	368	5,679	2,580	844	471	730	1,332
2037	32,100	393	2,728	104	6,139	34,640	1,267	367	5,662	2,573	842	469	728	1,330
2038	32,173	393	2,731	104	6,139	34,639	1,270	369	5,669	2,572	841	471	728	1,330
2039	32,022	391	2,722	104	6,119	34,526	1,266	367	5,648	2,566	840	469	725	1,328
2040	32,272	392	2,734	104	6,125	34,561	1,272	372	5,673	2,568	841	475	726	1,329

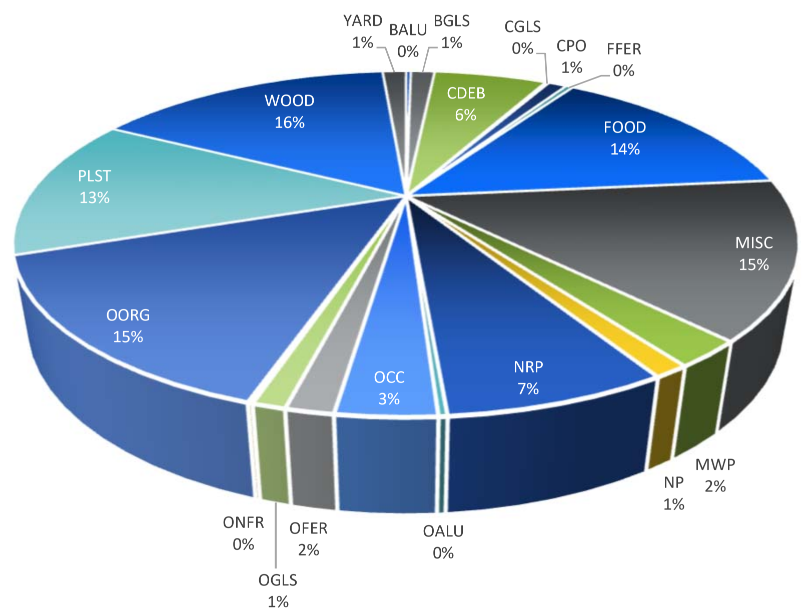
Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - All Sectors

Material MSW		Total Disposed	Total Recycled	Total Generated	Percent Recycled
Aluminum Beverage	BALU	810	1,676	2,486	67.4%
Beverage Glass	BGLS	4,144	27,246	31,390	86.8%
Construction Debris	CDEB	19,479	672	20,151	3.3%
Container Glass	CGLS	584	974	1,558	62.5%
Computer Office Paper	CPO	3,134	15,347	18,481	83.0%
Food Cans	FFER	1,218	2,059	3,277	62.8%
Food	FOOD	45,940	129,323	175,263	73.8%
Miscellaneous	MISC	46,908	44,159	91,067	48.5%
Mixed Scrap Paper	MWP	7,665	56,082	63,747	88.0%
Newspaper	NP	3,786	24,094	27,880	86.4%
Other Paper	NRP	23,113	17,468	40,582	43.0%
Other Aluminum	OALU	902	168	1,070	15.7%
Corrugated Kraft	OCC	10,285	70,389	80,673	87.3%
Other Ferrous	OFER	4,952	12,969	17,921	72.4%
Other Glass	OGLS	3,435	10,501	13,936	75.3%
Other NonFerrous	ONFR	525	-	525	0.0%
Other Organics	OORG	46,803	764	47,567	1.6%
Plastics	PLST	43,049	12,104	55,153	21.9%
Wood	WOOD	50,908	2,953	53,861	5.5%
Yard	YARD	4,080	126,912	130,992	96.9%
Total	**Grand Tota**	**321,722**	**555,859**	**877,581**	**63.3%**

Waste Composition



Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - All Sectors

Material MSW	Curb/Apt Rec	Home Organics	Curb/Apt Org	Clean Green	R&R centers	Com Priv Rec	Targeted Outreach	Incr MF Enforce	Wast Prev Camp - SH	Mun Codes Update MF	Food Waste Prev - SF	Food & YW Recovery SF	School Education
Aluminum Beverage	698	-	-	-	5	822	33	0	1	26	-	68	-
Beverage Glass	11,610	-	-	-	232	14,100	130	0	7	102	-	339	-
Construction Debris	-	-	-	-	1	-	-	-	-	-	-	-	-
Container Glass	873	-	-	-	-	-	21	0	0	16	-	51	-
Computer Office Paper	114	-	-	-	-	14,643	109	0	6	86	-	318	11
Food Cans	1,005	-	-	-	-	852	43	0	1	34	-	101	-
Food	-	2,694	14,830	-	-	63,207	2,728	3	-	1,535	1,884	19,242	133
Miscellaneous	9,190	-	1,057	-	217	30,630	-	-	-	-	-	-	-
Mixed Scrap Paper	22,044	-	400	-	237	29,644	316	0	16	247	-	2,954	23
Newspaper	12,299	-	-	-	78	11,360	156	0	7	122	-	-	-
Other Paper	596	-	5,933	-	-	-	-	-	-	-	-	-	-
Other Aluminum	125	-	-	-	0	-	-	-	0	-	-	33	-
Corrugated Kraft	14,716	-	-	-	776	53,262	189	0	24	148	-	734	44
Other Ferrous	384	-	-	-	3,015	9,182	-	-	4	-	-	177	-
Other Glass	10,501	-	-	-	-	0	-	-	-	-	-	-	-
Other NonFerrous	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Organics	-	-	764	-	-	-	-	-	-	-	-	-	-
Plastics	4,293	-	867	-	29	4,582	-	-	-	-	-	-	136
Wood	-	-	-	-	1,074	-	-	-	7	-	-	936	-
Yard	-	12,712	74,332	6,296	-	32,129	-	-	24	-	-	1,394	-
	88,449	**15,406**	**98,182**	**6,296**	**5,663**	**264,413**	**3,726**	**4**	**97**	**2,315**	**1,884**	**26,348**	**347**

Summary: Municipal Soli

Summary of Recycling Progra

Modeled waste composition dat

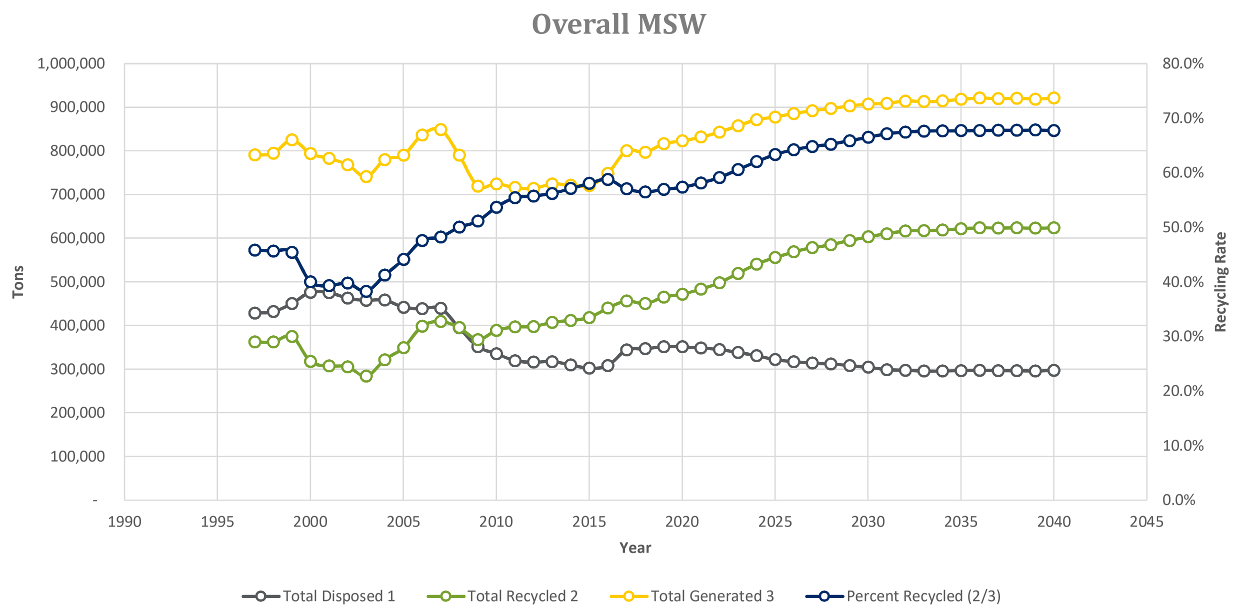
Material MSW	Incr MF Res Ban Enforce	Take Back Plastic Film	Food Waste Prev - Comm	Comp Food Serv Pack	Container Depo Syst - SF	Electronics Prod Stew	All Pack Prod Stew - SF	Carpet Prod Ste - SH	South Reuse Center	Film - SF	Serv Ware - Berk	Paint Prod Stew - SH	
Aluminum Beverage	15	-	-	-	8	-	-	-	-	-	-	-	1,676
Beverage Glass	79	-	-	-	635	-	-	-	12	-	-	-	27,246
Construction Debris	296	-	-	-	-	-	-	-	375	-	-	-	672
Container Glass	11	-	-	-	-	-	-	-	-	-	-	-	974
Computer Office Paper	60	-	-	-	-	-	-	-	-	-	-	-	15,347
Food Cans	23	-	-	-	-	-	-	-	-	-	-	-	2,059
Food	898	-	703	21,467	-	-	-	-	-	-	-	-	129,323
Miscellaneous	-	-	-	-	-	302	-	1,818	-	-	-	944	44,159
Mixed Scrap Paper	168	-	-	-	-	-	-	-	33	-	-	-	56,082
Newspaper	72	-	-	-	-	-	-	-	-	-	-	-	24,094
Other Paper	-	-	-	10,545	-	-	-	-	-	-	394	-	17,468
Other Aluminum	9	-	-	-	-	-	-	-	-	-	-	-	168
Corrugated Kraft	198	-	-	-	-	-	236	-	63	-	-	-	70,389
Other Ferrous	85	-	-	-	-	-	-	-	122	-	-	-	12,969
Other Glass	-	-	-	-	-	-	-	-	-	-	-	-	10,501
Other NonFerrous	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Organics	-	-	-	-	-	-	-	-	-	-	-	-	764
Plastics	-	119	-	638	437	-	419	-	-	340	244	-	12,104
Wood	936	-	-	-	-	-	-	-	-	-	-	-	2,953
Yard	24	-	-	-	-	-	-	-	-	-	-	-	126,912
	2,874	**119**	**703**	**32,650**	**1,080**	**302**	**655**	**1,818**	**605**	**340**	**639**	**944**	**555,859**

Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - All Sectors

Year	Total Disposed	Total Recycled	Total Generated	Percent Recycled
1997	428,246	362,386	790,633	45.8%
1998	431,854	362,613	794,467	45.6%
1999	450,489	374,866	825,354	45.4%
2000	476,130	317,693	793,823	40.0%
2001	475,186	307,623	782,809	39.3%
2002	462,759	305,426	768,185	39.8%
2003	457,448	283,646	741,094	38.3%
2004	458,401	321,656	780,057	41.2%
2005	441,595	348,864	790,459	44.1%
2006	438,450	397,993	836,442	47.6%
2007	439,389	409,280	848,669	48.2%
2008	394,830	395,000	789,831	50.0%
2009	351,688	367,735	719,423	51.1%
2010	335,571	388,898	724,469	53.7%
2011	319,342	396,655	715,996	55.4%
2012	315,966	397,837	713,803	55.7%
2013	317,258	407,134	724,391	56.2%
2014	309,512	411,754	721,266	57.1%
2015	302,465	418,237	720,702	58.0%
2016	308,380	439,672	748,052	58.8%
2017	343,924	456,458	800,382	57.0%
2018	346,690	450,130	796,820	56.5%
2019	351,417	464,797	816,214	56.9%
2020	351,185	471,869	823,054	57.3%
2021	348,382	483,119	831,502	58.1%
2022	344,564	498,232	842,796	59.1%
2023	338,256	519,386	857,642	60.6%
2024	330,921	540,436	871,358	62.0%
2025	321,722	555,859	877,581	63.3%
2026	316,864	568,555	885,419	64.2%
2027	313,934	578,307	892,240	64.8%
2028	311,983	585,039	897,021	65.2%
2029	308,218	594,820	903,039	65.9%
2030	304,148	603,111	907,259	66.5%
2031	298,815	610,047	908,862	67.1%
2032	297,535	616,672	914,207	67.5%
2033	295,474	617,380	912,854	67.6%
2034	295,909	618,515	914,423	67.6%
2035	296,603	621,489	918,092	67.7%
2036	297,314	623,725	921,039	67.7%
2037	296,290	623,208	919,498	67.8%
2038	296,672	623,818	920,490	67.8%
2039	295,657	622,972	918,629	67.8%
2040	297,263	623,791	921,053	67.7%



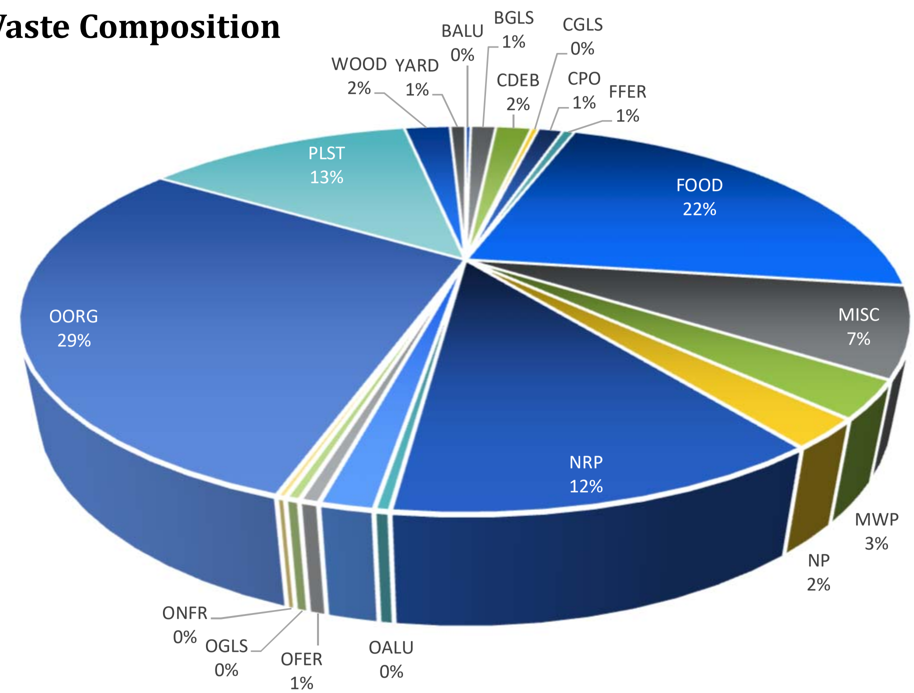
Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Single-family Residential

Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled
Aluminum Beverage	146	450	596	75.6%
Beverage Glass	692	8,057	8,749	92.1%
Construction Debris	982	-	982	0.0%
Container Glass	186	631	817	77.2%
Computer Office Paper	678	129	807	16.0%
Food Cans	318	724	1,041	69.5%
Food	12,208	20,395	32,603	62.6%
Miscellaneous	4,104	6,904	11,008	62.7%
Mixed Scrap Paper	1,667	16,194	17,861	90.7%
Newspaper	1,294	8,499	9,793	86.8%
Other Paper	6,742	5,807	12,549	46.3%
Other Aluminum	237	84	320	26.1%
Corrugated Kraft	834	8,912	9,746	91.4%
Other Ferrous	300	296	596	49.7%
Other Glass	221	7,043	7,264	97.0%
Other NonFerrous	146	-	146	0.0%
Other Organics	16,233	738	16,971	4.3%
Plastics	7,173	4,005	11,178	35.8%
Wood	1,256	0	1,256	0.0%
Yard	425	86,260	86,685	99.5%
Total	**55,840**	**175,126**	**230,966**	**75.8%**

Waste Composition



Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Single-family Residential

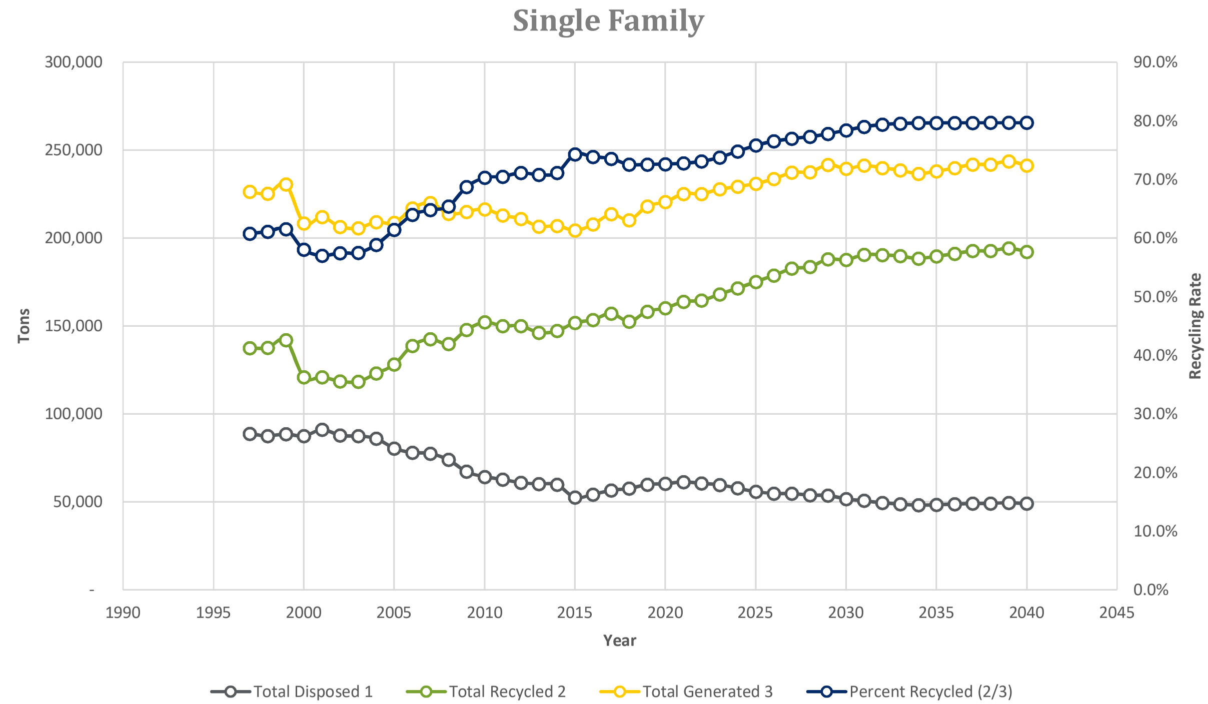
Material MSW	Curb/Apt Rec	Home Organics	Curb/Apt Org	Food & YW Recovery SF	Incr MF Res Ban Enforce	Wast Prev Camp - SH	Paint Prod Stew - SH	Container Depo Syst - SF	Electronics Prod Stew	All Pack Prod Stew - SF	EPR Bags Film - SF	Total
Aluminum Beverage	433	-	-	13	3	0	-	2	-	-	-	450
Beverage Glass	7,802	-	-	61	13	1	-	180	-	-	-	8,057
Construction Debris	-	-	-	-	-	-	-	-	-	-	-	-
Container Glass	611	-	-	16	3	0	-	-	-	-	-	631
Computer Office Paper	56	-	-	60	13	0	-	-	-	-	-	129
Food Cans	690	-	-	28	6	0	-	-	-	-	-	724
Food	-	2,694	11,916	5,558	227	-	-	-	-	-	-	20,395
Miscellaneous	5,789	-	797	-	-	-	145	-	172	-	-	6,904
Mixed Scrap Paper	15,055	-	347	759	31	2	-	-	-	-	-	16,194
Newspaper	8,474	-	-	-	24	1	-	-	-	-	-	8,499
Other Paper	399	-	5,408	-	-	-	-	-	-	-	-	5,807
Other Aluminum	84	-	-	-	-	0	-	-	-	-	-	84
Corrugated Kraft	8,814	-	-	73	16	1	-	-	-	7	-	8,912
Other Ferrous	296	-	-	-	-	0	-	-	-	-	-	296
Other Glass	7,043	-	-	-	-	-	-	-	-	-	-	7,043
Other NonFerrous	-	-	-	-	-	-	-	-	-	-	-	-
Other Organics	-	-	738	-	-	-	-	-	-	-	-	738
Plastics	2,869	-	746	-	-	-	-	106	-	91	193	4,005
Wood	-	-	-	-	-	0	-	-	-	-	-	0
Yard	-	12,712	73,334	193	8	12	-	-	-	-	-	86,260
	58,414	**15,406**	**93,286**	**6,761**	**343**	**19**	**145**	**289**	**172**	**99**	**193**	**175,126**

Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Single-family Residential

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	88,783	137,555	226,337	60.8%
1998	87,560	137,686	225,247	61.1%
1999	88,631	141,956	230,586	61.6%
2000	87,499	120,969	208,468	58.0%
2001	91,072	120,910	211,982	57.0%
2002	87,834	118,640	206,474	57.5%
2003	87,426	118,322	205,748	57.5%
2004	86,029	123,103	209,132	58.9%
2005	80,479	128,197	208,676	61.4%
2006	78,078	138,810	216,889	64.0%
2007	77,494	142,634	220,127	64.8%
2008	73,961	139,928	213,889	65.4%
2009	67,229	147,786	215,015	68.7%
2010	64,309	152,175	216,484	70.3%
2011	62,779	150,082	212,861	70.5%
2012	60,906	150,124	211,030	71.1%
2013	60,291	146,301	206,592	70.8%
2014	59,772	147,220	206,992	71.1%
2015	52,529	151,868	204,397	74.3%
2016	54,298	153,506	207,804	73.9%
2017	56,541	157,168	213,709	73.5%
2018	57,725	152,564	210,289	72.5%
2019	59,813	158,310	218,124	72.6%
2020	60,368	160,216	220,584	72.6%
2021	61,326	163,872	225,198	72.8%
2022	60,591	164,618	225,209	73.1%
2023	59,756	168,063	227,819	73.8%
2024	57,790	171,510	229,300	74.8%
2025	55,840	175,126	230,966	75.8%
2026	54,848	178,797	233,645	76.5%
2027	54,704	182,686	237,390	77.0%
2028	53,893	183,682	237,575	77.3%
2029	53,719	188,032	241,750	77.8%
2030	51,720	187,725	239,445	78.4%
2031	50,683	190,614	241,297	79.0%
2032	49,486	190,451	239,937	79.4%
2033	48,780	189,825	238,604	79.6%
2034	48,196	188,411	236,607	79.6%
2035	48,435	189,675	238,111	79.7%
2036	48,771	191,117	239,888	79.7%
2037	49,157	192,674	241,831	79.7%
2038	49,167	192,732	241,899	79.7%
2039	49,538	194,190	243,728	79.7%
2040	49,052	192,290	241,342	79.7%



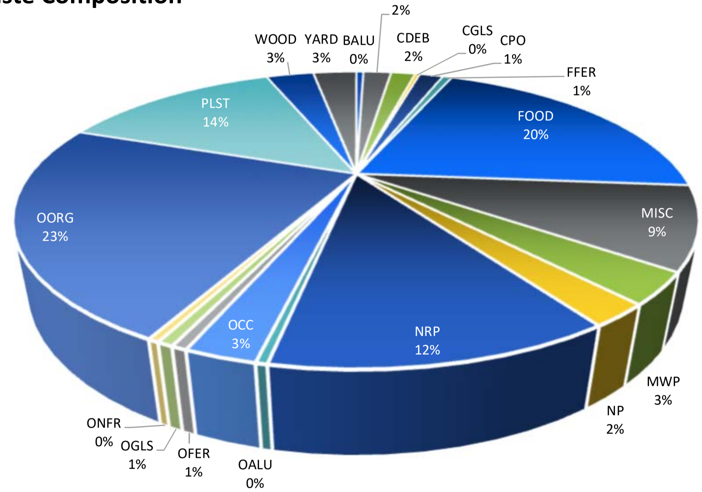
Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

Material MSW		Total Disposed	Total Recycled	Total Generated	Percent Recycled
Aluminum Beverage	BALU	221	350	571	61.3%
Beverage Glass	BGLS	874	4,239	5,113	82.9%
Construction Debris	CDEB	761	-	761	0.0%
Container Glass	CGLS	141	316	457	69.1%
Computer Office Paper	CPO	734	331	1,065	31.1%
Food Cans	FFER	291	424	714	59.3%
Food	FOOD	9,891	11,867	21,758	54.5%
Miscellaneous	MISC	4,353	3,819	8,172	46.7%
Mixed Scrap Paper	MWP	1,591	8,362	9,953	84.0%
Newspaper	NP	1,135	4,126	5,261	78.4%
Other Paper	NRP	6,025	722	6,746	10.7%
Other Aluminum	OALU	205	42	246	16.9%
Corrugated Kraft	OCC	1,270	6,388	7,659	83.4%
Other Ferrous	OFER	275	88	363	24.3%
Other Glass	OGLS	288	3,458	3,746	92.3%
Other NonFerrous	ONFR	199	-	199	0.0%
Other Organics	OORG	11,276	26	11,302	0.2%
Plastics	PLST	6,699	1,840	8,538	21.5%
Wood	WOOD	1,475	0	1,476	0.0%
Yard	YARD	1,360	999	2,358	42.3%
Total	**Grand Total**	**49,064**	**47,395**	**96,459**	**49.1%**

Waste Composition



Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

Material MSW	Curb/Apt Rec	Curb/Apt Org	Food & YW Recovery SF	Incr MF Res Ban Enforce	Targeted Outreach	Incr MF Enforce	Mun Codes Update MF
Aluminum Beverage	266	-	19	4	33	0	26
Beverage Glass	3,808	-	77	16	130	0	102
Construction Debris	-	-	-	-	-	-	-
Container Glass	263	-	12	3	21	0	16
Computer Office Paper	57	-	65	14	109	0	86
Food Cans	315	-	26	5	43	0	34
Food	-	2,914	4,503	184	2,728	3	1,535
Miscellaneous	3,401	260	-	-	-	-	-
Mixed Scrap Paper	6,989	53	724	30	316	0	247
Newspaper	3,825	-	-	21	156	0	122
Other Paper	197	525	-	-	-	-	-
Other Aluminum	42	-	-	-	-	-	-
Corrugated Kraft	5,901	-	112	24	189	0	148
Other Ferrous	88	-	-	-	-	-	-
Other Glass	3,458	-	-	-	-	-	-
Other NonFerrous	-	-	-	-	-	-	-
Other Organics	-	26	-	-	-	-	-
Plastics	1,424	121	-	-	-	-	-
Wood	-	-	-	-	-	-	-
Yard	-	998	-	-	-	-	-
	30,035	**4,897**	**5,538**	**301**	**3,726**	**4**	**2,315**

Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

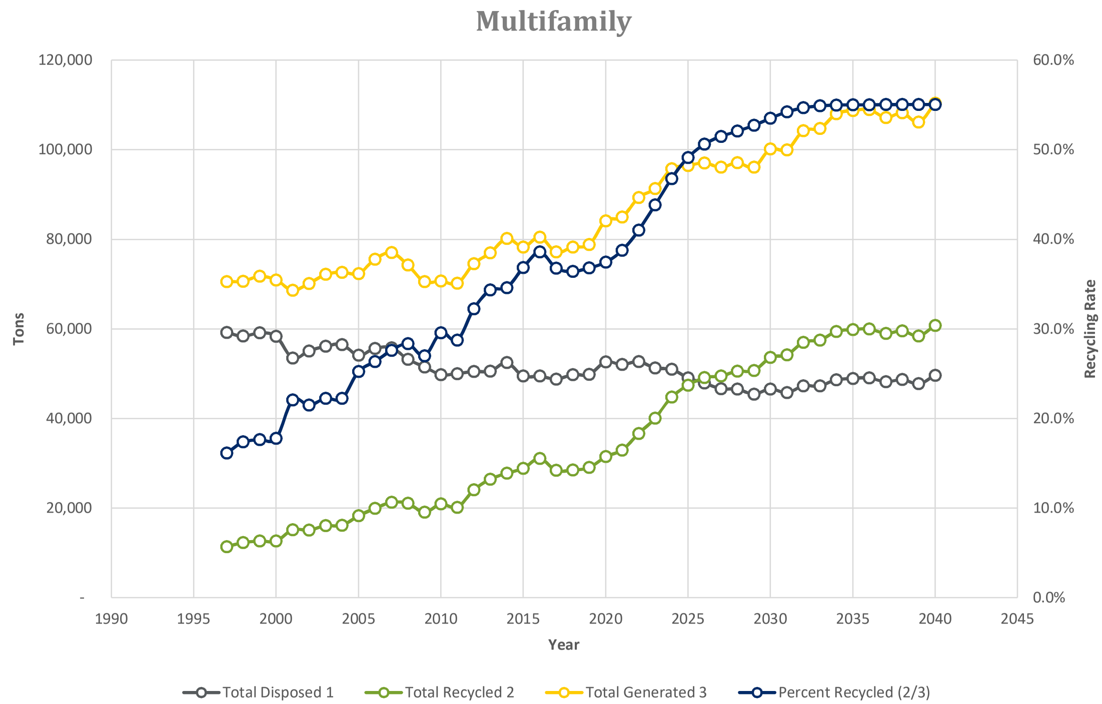
Material MSW	Wast Prev Camp - SH	Paint Prod Stew - SH	Container Depo Syst - SF	Electronics Prod Stew	All Pack Pro	EPR Bags Film - SF	
Aluminum Beverage	0	-	2	-	-	-	350
Beverage Glass	-	-	105	-	-	-	4,239
Construction Debris	-	-	-	-	-	-	-
Container Glass	0	-	-	-	-	-	316
Computer Office Paper	0	-	-	-	-	-	331
Food Cans	0	-	-	-	-	-	424
Food	-	-	-	-	-	-	11,867
Miscellaneous	-	29	-	130	-	-	3,819
Mixed Scrap Paper	2	-	-	-	-	-	8,362
Newspaper	1	-	-	-	-	-	4,126
Other Paper	-	-	-	-	-	-	722
Other Aluminum	0	-	-	-	-	-	42
Corrugated Kraft	2	-	-	-	12	-	6,388
Other Ferrous	0	-	-	-	-	-	88
Other Glass	-	-	-	-	-	-	3,458
Other NonFerrous	-	-	-	-	-	-	-
Other Organics	-	-	-	-	-	-	26
Plastics	-	-	81	-	66	147	1,840
Wood	0	-	-	-	-	-	0
Yard	1	-	-	-	-	-	999
	7	**29**	**188**	**130**	**78**	**147**	**47,395**

Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Multifamily Residential

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	59,189	11,371	70,560	16.1%
1998	58,374	12,266	70,640	17.4%
1999	59,087	12,639	71,726	17.6%
2000	58,333	12,595	70,927	17.8%
2001	53,487	15,124	68,611	22.0%
2002	55,076	15,068	70,144	21.5%
2003	56,106	16,043	72,149	22.2%
2004	56,498	16,142	72,640	22.2%
2005	54,080	18,245	72,325	25.2%
2006	55,643	19,903	75,545	26.3%
2007	55,759	21,261	77,020	27.6%
2008	53,199	21,024	74,223	28.3%
2009	51,497	19,028	70,524	27.0%
2010	49,788	20,887	70,675	29.6%
2011	49,993	20,152	70,145	28.7%
2012	50,497	24,035	74,532	32.2%
2013	50,547	26,423	76,970	34.3%
2014	52,439	27,750	80,189	34.6%
2015	49,443	28,835	78,278	36.8%
2016	49,437	31,041	80,478	38.6%
2017	48,773	28,376	77,150	36.8%
2018	49,760	28,485	78,245	36.4%
2019	49,819	29,016	78,835	36.8%
2020	52,609	31,475	84,084	37.4%
2021	52,017	32,928	84,945	38.8%
2022	52,689	36,619	89,307	41.0%
2023	51,278	40,034	91,312	43.8%
2024	50,960	44,749	95,708	46.8%
2025	49,064	47,395	96,459	49.1%
2026	47,903	49,117	97,020	50.6%
2027	46,629	49,458	96,086	51.5%
2028	46,535	50,563	97,098	52.1%
2029	45,432	50,659	96,091	52.7%
2030	46,573	53,589	100,163	53.5%
2031	45,741	54,182	99,923	54.2%
2032	47,252	57,005	104,257	54.7%
2033	47,251	57,499	104,750	54.9%
2034	48,629	59,386	108,015	55.0%
2035	48,929	59,833	108,762	55.0%
2036	49,009	59,961	108,969	55.0%
2037	48,197	58,979	107,175	55.0%
2038	48,661	59,551	108,212	55.0%
2039	47,730	58,413	106,144	55.0%
2040	49,649	60,762	110,411	55.0%

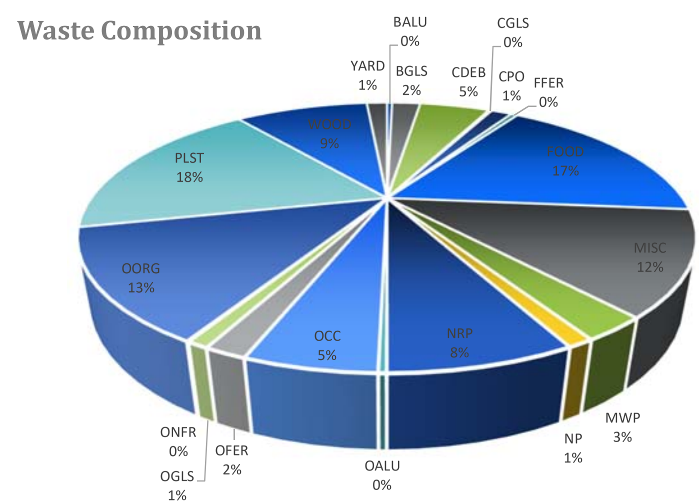


Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Commercial

Material MSW	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)	Recycled by Program: Com Priv Rec 30	Food & YW Recovery SF 108	Incr MF Res Ban Enforce 111	School Education 109	Take Back Plastic Film 114
Aluminum Beverage	405	870	1,276	68.2%	822	36	8	-	-
Beverage Glass	2,277	14,700	16,977	86.6%	14,100	201	44	-	-
Construction Debris	5,594	-	5,594	0.0%	-	-	-	-	-
Container Glass	257	28	285	9.7%	-	23	5	-	-
Computer Office Paper	1,629	14,885	16,515	90.1%	14,643	194	32	11	-
Food Cans	538	910	1,448	62.9%	852	47	10	-	-
Food	19,926	97,061	116,987	83.0%	63,207	9,182	486	133	-
Miscellaneous	14,161	32,454	46,615	69.6%	30,630	-	-	-	-
Mixed Scrap Paper	3,190	31,226	34,416	90.7%	29,644	1,470	78	23	-
Newspaper	1,265	11,389	12,654	90.0%	11,360	-	25	-	-
Other Paper	8,741	10,939	19,680	55.6%	-	-	-	-	-
Other Aluminum	376	41	417	9.7%	-	33	7	-	-
Corrugated Kraft	6,180	54,211	60,391	89.8%	53,262	549	120	44	-
Other Ferrous	2,008	9,402	11,410	82.4%	9,182	177	39	-	-
Other Glass	1,053	0	1,053	0.0%	0	-	-	-	-
Other NonFerrous	89	-	89	0.0%	-	-	-	-	-
Other Organics	15,151	-	15,151	0.0%	-	-	-	-	-
Plastics	20,834	6,231	27,065	23.0%	4,582	-	-	136	119
Wood	10,618	1,146	11,765	9.7%	-	936	206	-	-
Yard	1,641	33,342	34,983	95.3%	32,129	1,201	-	-	-
Total	**115,933**	**318,836**	**434,769**	**73.3%**	**264,413**	**14,048**	**1,060**	**347**	**119**

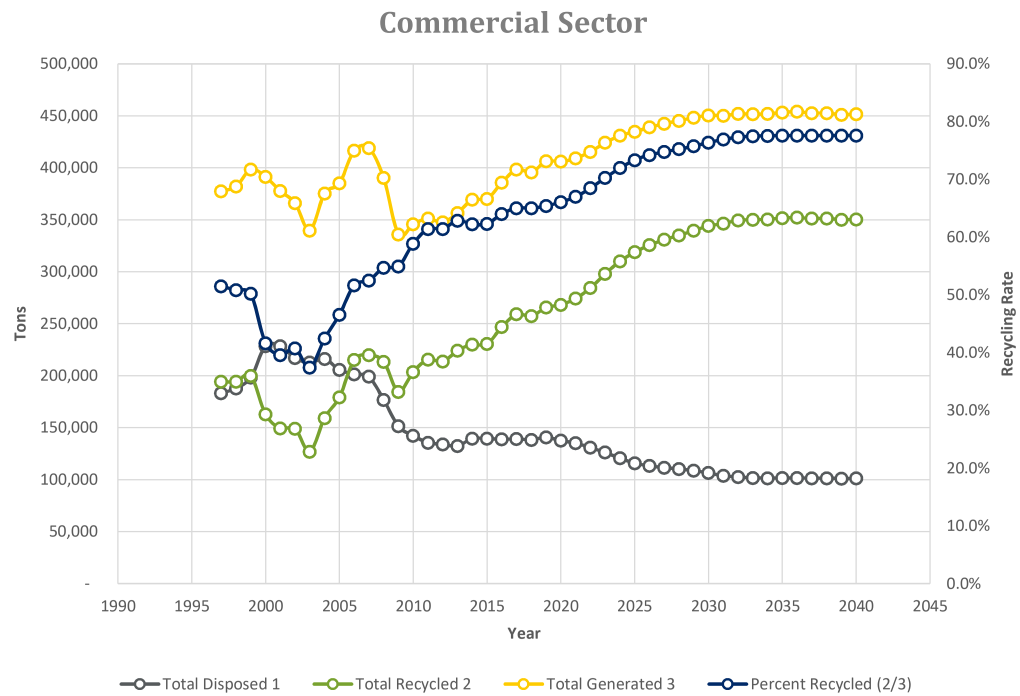


Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Commercial

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	183,130	194,323	377,453	51.5%
1998	187,899	194,251	382,150	50.8%
1999	198,420	199,968	398,388	50.2%
2000	228,417	162,989	391,406	41.6%
2001	228,310	149,453	377,763	39.6%
2002	216,923	149,025	365,948	40.7%
2003	212,647	126,956	339,603	37.4%
2004	216,111	159,341	375,452	42.4%
2005	205,829	179,265	385,094	46.6%
2006	201,306	215,258	416,564	51.7%
2007	199,083	219,894	418,977	52.5%
2008	176,774	213,493	390,267	54.7%
2009	151,399	184,593	335,992	54.9%
2010	142,182	203,511	345,693	58.9%
2011	135,535	215,678	351,213	61.4%
2012	134,090	213,584	347,674	61.4%
2013	132,400	224,079	356,479	62.9%
2014	139,456	229,950	369,406	62.2%
2015	139,556	230,480	370,036	62.3%
2016	138,804	247,042	385,846	64.0%
2017	139,317	259,105	398,422	65.0%
2018	138,378	257,359	395,737	65.0%
2019	140,677	265,632	406,310	65.4%
2020	137,671	268,281	405,952	66.1%
2021	135,085	274,233	409,318	67.0%
2022	130,965	284,414	415,379	68.5%
2023	126,160	298,005	424,164	70.3%
2024	120,759	310,178	430,938	72.0%
2025	115,933	318,836	434,769	73.3%
2026	113,193	325,735	438,928	74.2%
2027	111,627	330,923	442,550	74.8%
2028	110,267	335,027	445,295	75.2%
2029	108,739	339,624	448,363	75.7%
2030	106,481	344,096	450,577	76.4%
2031	103,773	346,323	450,096	76.9%
2032	102,577	349,472	452,048	77.3%
2033	101,716	349,981	451,697	77.5%
2034	101,451	350,485	451,936	77.6%
2035	101,641	351,687	453,328	77.6%
2036	101,757	352,291	454,048	77.6%
2037	101,433	351,247	452,681	77.6%
2038	101,423	351,241	452,664	77.6%
2039	101,090	350,097	451,188	77.6%
2040	101,192	350,452	451,644	77.6%



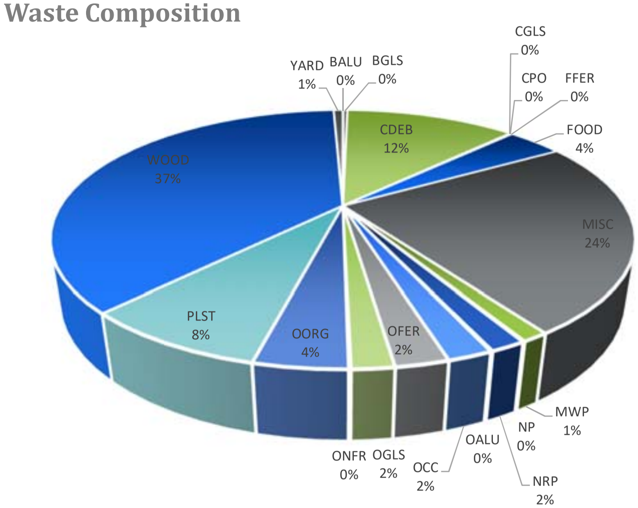
Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Self-haul

					Recycled by Program							
Material MSW	Total Disposed	Total Recycled	Total Generated	Percent Recycled	Clean Green	R&R centers	Incr MF Res Ban Enforce	Wast Prev Camp - SH	Paint Prod Stew - SH	Carpet Prod Ste - SH	South Reuse Center	
Aluminum Beverage	38	6	44	13.5%	-	5	1	0	-	-	-	6
Beverage Glass	300	250	550	45.5%	-	232	6	0	-	-	12	250
Construction Debris	12,143	672	12,815	5.2%	-	1	296	-	-	-	375	672
Container Glass	-	-	-	0.0%	-	-	-	-	-	-	-	-
Computer Office Paper	93	2	94	1.9%	-	-	2	0	-	-	-	2
Food Cans	72	1	74	1.9%	-	-	1	0	-	-	-	1
Food	3,915	-	3,915	0.0%	-	-	-	-	-	-	-	-
Miscellaneous	24,291	982	25,272	3.9%	-	217	-	-	173	591	-	982
Mixed Scrap Paper	1,217	300	1,517	19.8%	-	237	30	0	-	-	33	300
Newspaper	93	80	172	46.2%	-	78	2	0	-	-	-	80
Other Paper	1,606	-	1,606	0.0%	-	-	-	-	-	-	-	-
Other Aluminum	84	2	86	2.1%	-	0	2	0	-	-	-	2
Corrugated Kraft	2,000	878	2,878	30.5%	-	776	39	0	-	-	63	878
Other Ferrous	2,369	3,183	5,552	57.3%	-	3,015	46	0	-	-	122	3,183
Other Glass	1,874	-	1,874	0.0%	-	-	-	-	-	-	-	-
Other NonFerrous	91	-	91	0.0%	-	-	-	-	-	-	-	-
Other Organics	4,143	-	4,143	0.0%	-	-	-	-	-	-	-	-
Plastics	8,343	29	8,371	0.3%	-	29	-	-	-	-	-	29
Wood	37,558	1,806	39,364	4.6%	-	1,074	729	3	-	-	-	1,806
Yard	654	6,312	6,966	90.6%	6,296	-	16	0	-	-	-	6,312
Total	**100,885**	**14,501**	**115,387**	**12.6%**	**6,296**	**5,663**	**1,169**	**4**	**173**	**591**	**605**	**14,501**

Waste Composition

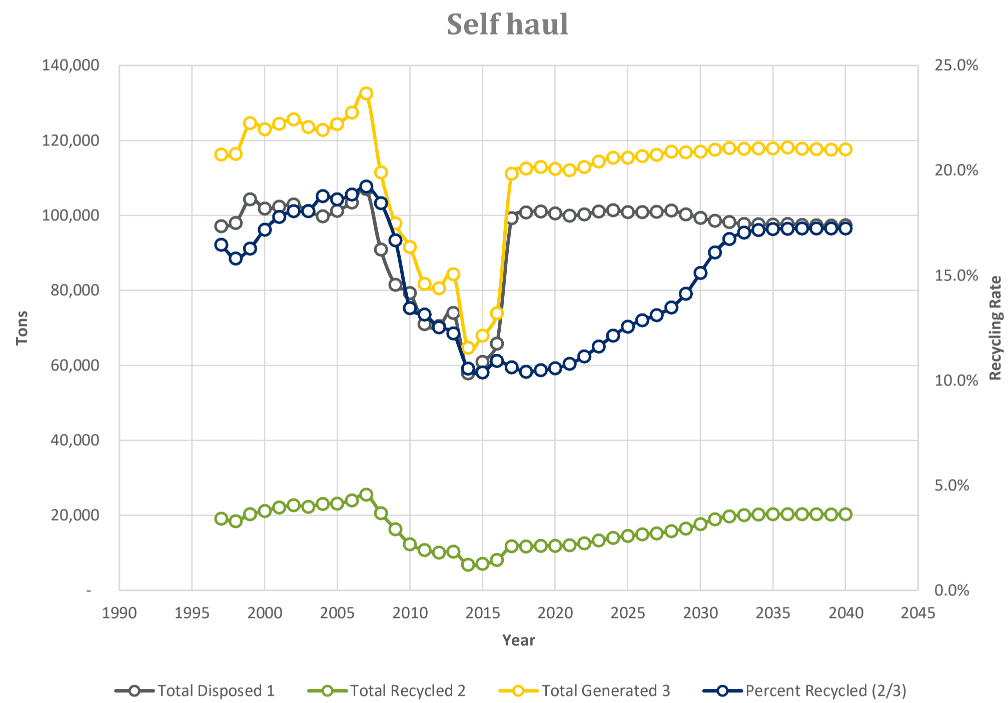


Summary: Municipal Solid Waste, Recommended New Programs

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2025 - Self-haul

Year	Total Disposed 1	Total Recycled 2	Total Generated 3	Percent Recycled (2/3)
1997	97,145	19,137	116,282	16.5%
1998	98,021	18,410	116,431	15.8%
1999	104,350	20,304	124,654	16.3%
2000	101,881	21,141	123,022	17.2%
2001	102,316	22,137	124,453	17.8%
2002	102,926	22,693	125,619	18.1%
2003	101,269	22,325	123,594	18.1%
2004	99,763	23,070	122,833	18.8%
2005	101,207	23,157	124,364	18.6%
2006	103,422	24,022	127,444	18.8%
2007	107,053	25,492	132,545	19.2%
2008	90,896	20,556	111,452	18.4%
2009	81,564	16,328	97,892	16.7%
2010	79,292	12,325	91,617	13.5%
2011	71,034	10,743	81,777	13.1%
2012	70,473	10,094	80,567	12.5%
2013	74,020	10,330	84,350	12.2%
2014	57,845	6,834	64,679	10.6%
2015	60,936	7,055	67,991	10.4%
2016	65,841	8,083	73,924	10.9%
2017	99,293	11,808	111,101	10.6%
2018	100,827	11,722	112,549	10.4%
2019	101,107	11,838	112,945	10.5%
2020	100,537	11,897	112,434	10.6%
2021	99,955	12,086	112,041	10.8%
2022	100,319	12,582	112,900	11.1%
2023	101,062	13,285	114,347	11.6%
2024	101,412	13,999	115,411	12.1%
2025	100,885	14,501	115,387	12.6%
2026	100,920	14,906	115,825	12.9%
2027	100,974	15,240	116,214	13.1%
2028	101,288	15,766	117,054	13.5%
2029	100,329	16,505	116,834	14.1%
2030	99,374	17,700	117,075	15.1%
2031	98,618	18,928	117,546	16.1%
2032	98,220	19,745	117,965	16.7%
2033	97,727	20,075	117,803	17.0%
2034	97,632	20,233	117,865	17.2%
2035	97,598	20,294	117,891	17.2%
2036	97,777	20,356	118,134	17.2%
2037	97,503	20,309	117,812	17.2%
2038	97,420	20,295	117,715	17.2%
2039	97,299	20,271	117,570	17.2%
2040	97,369	20,286	117,656	17.2%



Summary: Municipal Solid Waste, Recommended New Programs
Summary of Recycling Program Benefits and Costs
All costs in 2019 dollars

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$60,238,665	$288,533	$1,031,809	$2,050,907	$3,733,612	$5,851,458	$7,999,570	$9,690,659	$10,823,036	$11,537,866	$12,062,949	$12,503,947	$13,045,591
Program Cost	$27,877,001	$1,931,700	$3,294,850	$3,860,898	$3,354,589	$3,322,968	$3,097,598	$3,183,694	$3,248,783	$3,245,392	$3,222,626	$3,124,652	$3,016,678
Net Benefits	$32,361,664	($1,643,166)	($2,263,041)	($1,809,990)	$379,023	$2,528,490	$4,901,972	$6,506,965	$7,574,253	$8,292,474	$8,840,324	$9,379,295	$10,028,913
Tons avoided through recycling		**1,839**	**8,039**	**16,131**	**29,584**	**46,561**	**63,782**	**77,464**	**86,984**	**93,415**	**98,399**	**102,595**	**107,055**

Program Number and Name: *101 Targeted Outreach*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$2,917,919.33	$ 24,051	$ 55,558	$ 127,421	$ 247,939	$ 368,178	$ 461,224	$ 498,766	$ 512,284	$ 506,928	$ 505,479	$ 487,977	$ 492,643
Program Cost	$2,122,990.31	$ 353,479	$ 353,479	$ 353,479	$ 176,498	$ 176,498	$ 176,498	$ 176,498	$ 176,498	$ 176,498	$ 220,179	$ 220,179	$ 220,179
Net Benefits	$794,929.02	($329,429)	($297,921)	($226,058)	$71,441	$191,679	$284,725	$322,268	$335,785	$330,430	$285,300	$267,798	$272,465
Tons avoided through recycling		**152**	**407**	**928**	**1,813**	**2,710**	**3,420**	**3,725**	**3,857**	**3,848**	**3,868**	**3,760**	**3,803**

Program Number and Name: *102 Incr MF Enforce*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$30,466.58	$ 2	$ 4	$ 11	$ 30	$ 80	$ 220	$ 585	$ 1,530	$ 3,755	$ 8,405	$ 15,056	$ 22,206
Program Cost	$156,431.74	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ 17,649
Net Benefits	($125,965.16)	($17,648)	($17,645)	($17,639)	($17,619)	($17,569)	($17,429)	($17,064)	($16,120)	($13,895)	($9,244)	($2,593)	$4,556
Tons avoided through recycling		**0**	**0**	**0**	**0**	**1**	**2**	**4**	**12**	**29**	**64**	**116**	**171**

Program Number and Name: *103 Wast Prev Camp - Com*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$1,088,205.38	$ -	$ 84	$ 232	$ 638	$ 1,755	$ 4,802	$ 13,010	$ 35,017	$ 92,326	$ 231,452	$ 522,509	$ 974,058
Program Cost	$1,749,517.63	$ -	$ 108,331	$ 440,779	$ 333,688	$ 275,233	$ 180,431	$ 181,804	$ 181,115	$ 179,252	$ 174,357	$ 162,375	$ 137,139
Net Benefits	($661,312.25)	$0	($108,247)	($440,546)	($333,050)	($273,478)	($175,629)	($168,794)	($146,097)	($86,925)	$57,095	$360,134	$836,919
Tons avoided through recycling		**-**	**1**	**2**	**5**	**13**	**36**	**97**	**264**	**701**	**1,771**	**4,026**	**7,519**

Program Number and Name: *104 Mun Codes Update MF*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$1,835,852.27	$ 17,128	$ 39,168	$ 87,921	$ 165,342	$ 237,000	$ 289,959	$ 309,930	$ 316,713	$ 312,584	$ 310,982	$ 299,405	$ 301,484
Program Cost	$62,584.17	$ 17,649	$ 17,649	$ 17,649	$ 17,649	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Benefits	$1,773,268.10	($521)	$21,518	$70,271	$147,693	$237,000	$289,959	$309,930	$316,713	$312,584	$310,982	$299,405	$301,484
Tons avoided through recycling		**108**	**287**	**640**	**1,209**	**1,744**	**2,150**	**2,315**	**2,384**	**2,373**	**2,380**	**2,307**	**2,327**

Program Number and Name: *105 Food Waste Prev - Comm*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$2,047,108.44	$ -	$ 145,658	$ 209,675	$ 243,213	$ 253,712	$ 255,019	$ 254,749	$ 256,873	$ 264,841	$ 288,552	$ 343,567	$ 432,868
Program Cost	$1,432,435.76	$ -	$ 240,735	$ 307,610	$ 284,576	$ 151,560	$ 147,049	$ 145,667	$ 144,600	$ 141,731	$ 134,456	$ 116,126	$ 76,430
Net Benefits	$614,672.68	$0	($95,077)	($97,935)	($41,363)	$102,152	$107,970	$109,082	$112,274	$123,110	$154,097	$227,441	$356,438
Tons avoided through recycling		**-**	**1,067**	**1,527**	**1,778**	**1,867**	**1,891**	**1,903**	**1,934**	**2,010**	**2,208**	**2,647**	**3,341**

Program Number and Name: *108 Food & YW Recover - Com*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$20,326,236.91	$ 217,526	$ 244,341	$ 393,451	$ 739,639	$ 1,435,645	$ 2,496,418	$ 3,527,053	$ 4,181,072	$ 4,451,837	$ 4,500,011	$ 4,428,954	$ 4,315,408
Program Cost	$3,496,014.84	$ 1,012,991	$ 1,012,991	$ 922,715	$ 593,729	$ 417,231	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Benefits	$16,830,222.08	($795,465)	($768,650)	($529,264)	$145,910	$1,018,414	$2,496,418	$3,527,053	$4,181,072	$4,451,837	$4,500,011	$4,428,954	$4,315,408
Tons avoided through recycling		**1,373**	**1,790**	**2,865**	**5,408**	**10,566**	**18,513**	**26,344**	**31,476**	**33,793**	**34,437**	**34,122**	**33,312**

Summary: Municipal Solid Waste, Recommended New Programs
Summary of Recycling Program Benefits and Costs
All costs in 2019 dollars

Program Number and Name: *109 School Education*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$219,535.73	$ 498	$ 1,295	$ 3,326	$ 8,062	$ 17,248	$ 29,780	$ 40,309	$ 45,896	$ 47,680	$ 47,585	$ 46,864	$ 45,947
Program Cost	$1,071,759.71	$ 108,331	$ 138,423	$ 120,367	$ 120,367	$ 120,367	$ 120,367	$ 120,367	$ 120,367	$ 120,367	$ 120,367	$ 120,367	$ 120,367
Net Benefits	($852,223.98)	($107,832)	($137,128)	($117,042)	($112,306)	($103,119)	($90,588)	($80,059)	($74,471)	($72,687)	($72,782)	($73,504)	($74,421)
Tons avoided through recycling		**4**	**11**	**28**	**68**	**146**	**254**	**347**	**398**	**417**	**420**	**417**	**410**

Program Number and Name: *111 Incr SF Res Enforce*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$2,269,799.69	$ 21,727	$ 46,646	$ 105,618	$ 196,896	$ 291,695	$ 356,618	$ 384,721	$ 393,271	$ 392,710	$ 388,550	$ 379,383	$ 369,618
Program Cost	$3,375,409.87	$ 377,070	$ 377,159	$ 377,314	$ 377,705	$ 378,618	$ 380,330	$ 382,618	$ 384,356	$ 385,238	$ 385,537	$ 385,548	$ 385,312
Net Benefits	($1,105,610.18)	($355,343)	($330,513)	($271,696)	($180,809)	($86,924)	($23,713)	$2,103	$8,916	$7,472	$3,013	($6,164)	($15,694)
Tons avoided through recycling		**137**	**342**	**769**	**1,440**	**2,147**	**2,645**	**2,874**	**2,961**	**2,981**	**2,973**	**2,923**	**2,853**

Program Number and Name: *114 Take Back Plastic Film*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$109,185.81	$ 7,222	$ 10,384	$ 12,445	$ 13,462	$ 13,890	$ 13,968	$ 13,851	$ 13,645	$ 13,314	$ 12,919	$ 12,562	$ 12,246
Program Cost	$140,197.41	$ 44,530	$ 44,530	$ 23,668	$ 6,018	$ 6,018	$ 6,018	$ 6,018	$ 6,018	$ 6,018	$ 6,018	$ 6,018	$ 6,018
Net Benefits	($31,011.60)	($37,308)	($34,145)	($11,223)	$7,443	$7,872	$7,949	$7,833	$7,627	$7,295	$6,900	$6,544	$6,228
Tons avoided through recycling		**59**	**86**	**104**	**113**	**118**	**119**	**119**	**118**	**117**	**114**	**112**	**109**

Program Number and Name: *115 Food Waste Prev - Comm*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$1,466,001.32	$ -	$ 604	$ 1,641	$ 4,486	$ 12,225	$ 32,479	$ 81,715	$ 184,541	$ 342,837	$ 499,985	$ 602,100	$ 652,926
Program Cost	($279,369.60)	$ -	$ 90,276	$ 59,932	$ 59,496	$ (1,890)	$ (5,186)	$ (13,892)	$ (35,227)	$ (80,238)	$ (150,405)	$ (221,274)	$ (268,433)
Net Benefits	$1,745,370.92	$0	($89,671)	($58,292)	($55,010)	$14,115	$37,664	$95,607	$219,768	$423,076	$650,390	$823,374	$921,359
Tons avoided through recycling		**-**	**5**	**14**	**38**	**103**	**277**	**703**	**1,601**	**3,001**	**4,415**	**5,356**	**5,821**

Program Number and Name: *120 Comp Food Serv Pack*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$22,480,179.76	$ -	$ 461,411	$ 1,041,325	$ 1,955,452	$ 2,898,305	$ 3,514,946	$ 3,796,062	$ 3,897,620	$ 3,909,069	$ 3,885,078	$ 3,869,443	$ 3,872,606
Program Cost	$7,472,788.31	$ -	$ -	$ 292,125	$ 490,641	$ 792,611	$ 1,121,711	$ 1,287,826	$ 1,395,767	$ 1,442,989	$ 1,459,421	$ 1,463,027	$ 1,467,668
Net Benefits	$15,007,391.45	$ -	$ 461,411	$ 749,201	$ 1,464,811	$ 2,105,694	$ 2,393,236	$ 2,508,235	$ 2,501,854	$ 2,466,080	$ 2,425,657	$ 2,406,416	$ 2,404,938
Tons avoided through recycling		**-**	**3,830**	**8,712**	**16,435**	**24,529**	**29,996**	**32,650**	**33,812**	**34,216**	**34,305**	**34,419**	**34,524**

Program Number and Name: *122 Container Depo Syst - Com*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$809,652.60	$ -	$ 7,422	$ 18,978	$ 43,269	$ 81,271	$ 119,973	$ 144,575	$ 156,507	$ 161,051	$ 162,232	$ 162,438	$ 162,818
Program Cost	$76,328.32	$ -	$ 29,430	$ 29,430	$ 29,430	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Benefits	$733,324.27	$0	($22,008)	($10,451)	$13,839	$81,271	$119,973	$144,575	$156,507	$161,051	$162,232	$162,438	$162,818
Tons avoided through recycling		**-**	**54**	**138**	**316**	**598**	**890**	**1,080**	**1,178**	**1,223**	**1,242**	**1,251**	**1,257**

Program Number and Name: *123 Electronics Prod Stew*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$226,225.32	$ -	$ 2,055	$ 5,281	$ 12,099	$ 22,674	$ 33,606	$ 40,404	$ 43,681	$ 44,850	$ 45,206	$ 45,345	$ 45,878
Program Cost	$76,297.11	$ -	$ 29,418	$ 29,418	$ 29,418	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Net Benefits	$149,928.21	$0	($27,363)	($24,137)	($17,318)	$22,674	$33,606	$40,404	$43,681	$44,850	$45,206	$45,345	$45,878
Tons avoided through recycling		**-**	**15**	**38**	**88**	**167**	**249**	**302**	**329**	**340**	**346**	**349**	**354**

Summary: Municipal Solid Waste, Recommended New Programs
Summary of Recycling Program Benefits and Costs
All costs in 2019 dollars

Program Number and Name: *126 All Pack Prod Stew - Com*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$1,566,873.96	$ -	$ 647	$ 1,780	$ 4,858	$ 13,164	$ 34,930	$ 87,693	$ 197,890	$ 367,184	$ 534,898	$ 642,565	$ 695,618
Program Cost	$289,110.60	$ -	$ 78,236	$ 78,236	$ 30,091	$ 30,091	$ 30,091	$ 21,063	$ 21,063	$ 21,063	$ 21,063	$ 21,063	$ 21,063
Net Benefits	$1,277,763.36	$0	($77,590)	($76,456)	($25,233)	($16,927)	$4,840	$66,630	$176,827	$346,121	$513,835	$621,502	$674,555
Tons avoided through recycling		**-**	**5**	**13**	**36**	**97**	**259**	**655**	**1,490**	**2,787**	**4,093**	**4,951**	**5,370**

Program Number and Name: *127 Carpet Prod Stew -Com*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$1,211,672.81	$ -	$ 5,103	$ 13,407	$ 33,962	$ 77,494	$ 144,850	$ 211,372	$ 254,440	$ 274,540	$ 282,394	$ 284,699	$ 286,417
Program Cost	$121,298.73	$ -	$ 29,418	$ 29,418	$ 29,418	$ 29,418	$ 29,418	$ -	$ -	$ -	$ -	$ -	$ -
Net Benefits	$1,090,374.08	$0	($24,315)	($16,011)	$4,544	$48,076	$115,432	$211,372	$254,440	$274,540	$282,394	$284,699	$286,417
Tons avoided through recycling		**-**	**42**	**112**	**285**	**656**	**1,236**	**1,818**	**2,207**	**2,403**	**2,493**	**2,532**	**2,553**

Program Number and Name: *128 South Reuse Center*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$225,594.18	$ 379	$ 999	$ 2,597	$ 6,544	$ 14,812	$ 27,469	$ 39,696	$ 47,437	$ 50,847	$ 52,161	$ 52,071	$ 52,145
Program Cost	$6,100,208.56	$ -	$ 647,155	$ 653,174	$ 653,174	$ 829,672	$ 829,672	$ 829,672	$ 829,672	$ 829,672	$ 829,672	$ 829,672	$ 829,672
Net Benefits	($5,874,614.38)	$379	($646,157)	($650,576)	($646,630)	($814,860)	($802,203)	($789,976)	($782,235)	($778,826)	($777,511)	($777,601)	($777,527)
Tons avoided through recycling		**5**	**15**	**38**	**97**	**221**	**414**	**605**	**732**	**794**	**824**	**831**	**836**

Program Number and Name: *129 EPR Bags Film - MF*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$254,527.09	$ -	$ 1,067	$ 2,875	$ 7,332	$ 16,648	$ 31,316	$ 45,506	$ 54,289	$ 57,568	$ 58,196	$ 58,170	$ 58,721
Program Cost	$265,190.70	$ -	$ 50,554	$ 50,554	$ 50,554	$ 50,554	$ 20,836	$ 20,836	$ 20,836	$ 20,836	$ 20,836	$ 20,836	$ 20,836
Net Benefits	($10,663.61)	$ -	$ (49,487)	$ (47,679)	$ (43,222)	$ (33,906)	$ 10,481	$ 24,670	$ 33,453	$ 36,733	$ 37,361	$ 37,334	$ 37,885
Tons avoided through recycling		**-**	**8**	**21**	**54**	**123**	**232**	**340**	**409**	**437**	**445**	**448**	**453**

Program Number and Name: *131 Serv Ware - Berk*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$429,415.99	$ -	$ 6,311	$ 14,765	$ 29,770	$ 48,809	$ 64,918	$ 74,254	$ 78,590	$ 80,251	$ 80,699	$ 80,903	$ 81,212
Program Cost	$26,507.77	$ -	$ -	$ 27,962	$ 25,069	$ 19,918	$ 13,296	$ 7,566	$ (13,932)	$ (15,684)	$ (16,524)	$ (16,936)	$ (17,224)
Net Benefits	$402,908.22	$0	$6,311	($13,197)	$4,701	$28,891	$51,622	$66,688	$92,521	$95,934	$97,223	$97,838	$98,435
Tons avoided through recycling		**-**	**52**	**124**	**250**	**413**	**554**	**639**	**682**	**702**	**713**	**720**	**724**

Program Number and Name: *142 Paint Prod Stew -Com*

Year	Present Value	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$724,211.86	$ -	$ 3,052	$ 8,157	$ 20,619	$ 46,852	$ 87,075	$ 126,408	$ 151,740	$ 163,694	$ 168,166	$ 169,936	$ 170,772
Program Cost	$121,298.73	$0	$29,418	$29,418	$29,418	$29,418	$29,418	$0	$0	$0	$0	$0	$0
Net Benefits	$602,913.12	$0	($26,365)	($21,261)	($8,799)	$17,434	$57,657	$126,408	$151,740	$163,694	$168,166	$169,936	$170,772
Tons avoided through recycling		**-**	**22**	**59**	**151**	**345**	**646**	**944**	**1,142**	**1,243**	**1,287**	**1,309**	**1,318**

Summary: Construction and Demolition Debris Tons Per Year, Status Quo (All Materials)

Year	Recycle Rate	Total Material -	Total Diposed -	Total Diverted -	Beneficial Uses 90	ABC BAN 92	Facility Certification 94	C&D Priv Rec 99
2007	49.28%	415,801	201,156	214,645	9,738	-	19,996	184,911
2008	50.59%	397,052	181,241	215,811	14,961	-	7,464	193,387
2009	56.40%	288,551	115,446	173,105	10,362	-	9,146	153,596
2010	61.88%	288,957	98,309	190,648	11,854	-	10,235	168,559
2011	63.18%	359,390	118,216	241,174	14,125	-	33,721	193,328
2012	60.24%	371,962	129,383	242,579	18,519	40,168	23,168	160,723
2013	60.84%	386,200	127,040	259,160	24,178	55,548	31,708	147,725
2014	65.40%	485,242	128,024	357,218	39,887	67,756	37,710	211,865
2015	63.99%	437,883	117,343	320,541	40,336	81,860	40,912	157,433
2016	63.80%	532,126	146,139	385,987	46,509	89,182	39,576	210,721
2017	66.57%	514,858	125,074	389,784	47,029	89,216	33,291	220,249
2018	63.90%	504,325	133,332	370,993	48,728	82,708	33,410	206,147
2019	63.90%	487,431	128,862	358,569	47,096	79,938	32,293	199,243
2020	63.90%	462,018	122,134	339,884	44,641	75,771	30,614	188,858
2021	63.91%	501,923	132,656	369,267	48,499	82,317	33,272	205,179
2022	63.92%	469,208	123,940	345,269	45,343	76,956	31,139	191,830
2023	63.96%	449,417	118,532	330,885	43,445	73,722	29,919	183,800
2024	64.06%	487,841	128,144	359,697	47,200	80,058	32,745	199,694
2025	64.31%	540,956	140,595	400,361	52,456	88,872	37,079	221,954
2026	64.93%	547,906	138,745	409,162	53,419	90,252	39,409	226,082
2027	66.17%	559,780	134,186	425,594	55,193	92,711	44,007	233,683
2028	67.98%	569,196	125,176	444,019	57,089	95,043	50,079	241,809
2029	69.66%	571,737	115,133	456,604	58,315	96,224	55,018	247,047
2030	70.69%	571,046	108,500	462,546	58,874	96,587	57,675	249,410

Summary: Construction and Demolition Debris Tons Per Year, Status Quo (Without Concrete)

Year	Recycle Rate w/o Concrete	Total Material -	Total Diposed -	Total Diverted -	Beneficial Uses 90	ABC BAN 92	Facility Certification 94	C&D Priv Rec 99
2007	20.18%	231,093	184,455	46,638	9,738	-	16,414	20,486
2008	19.42%	206,236	166,193	40,043	14,961	-	4,504	20,579
2009	29.92%	151,062	105,861	45,201	10,362	-	5,284	29,554
2010	31.56%	131,709	90,147	41,562	11,854	-	5,748	23,959
2011	40.60%	182,491	108,401	74,089	14,125	-	22,448	37,516
2012	33.65%	178,814	118,641	60,173	18,519	-	14,428	27,226
2013	39.11%	191,307	116,493	74,814	24,178	-	21,551	29,085
2014	44.47%	211,391	117,394	93,996	39,887	-	30,773	23,336
2015	47.75%	205,947	107,600	98,347	40,336	-	35,525	22,487
2016	42.33%	232,356	134,005	98,351	46,509	-	33,670	18,171
2017	44.97%	208,395	114,690	93,705	47,029	-	27,318	19,358
2018	43.83%	220,217	123,705	96,511	48,728	-	27,873	19,911
2019	43.83%	212,840	119,559	93,281	47,096	-	26,941	19,245
2020	43.83%	201,743	113,318	88,425	44,641	-	25,540	18,244
2021	43.84%	219,168	123,085	96,083	48,499	-	27,757	19,827
2022	43.87%	204,883	115,009	89,874	45,343	-	25,976	18,555
2023	43.94%	196,241	110,019	86,222	43,445	-	24,954	17,823
2024	44.13%	213,019	119,024	93,996	47,200	-	27,300	19,495
2025	44.62%	236,212	130,826	105,386	52,456	-	30,884	22,046
2026	45.80%	239,247	129,676	109,571	53,419	-	32,769	23,383
2027	48.22%	244,431	126,573	117,858	55,193	-	36,546	26,119
2028	51.82%	248,543	119,741	128,802	57,089	-	41,702	30,011
2029	55.28%	249,653	111,644	138,008	58,315	-	46,135	33,558
2030	57.45%	249,351	106,111	143,240	58,874	-	48,669	35,697

Summary: Construction and Demolition Debris, Status Quo

Summary of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2023

Material C&D	Total Disposed a	Total Generated d = a + b + c	Total Beneficial Uses b	Total Recycled c	Percent Recycled c/d
Carpet	1,794	2,175	-	381	17.5%
Rock/Concrete/Brick/Ceramic & Porcelain	8,513	253,176	-	244,663	96.6%
Dimension lumber	9,180	57,686	43,445	5,061	8.8%
Sand/Soil/Dirt	6,742	6,747	-	5	0.1%
Glass	612	612	-	-	0.0%
Clean Gypsum Board	4,949	25,781	-	20,832	80.8%
Hazardous & Other	5,850	5,850	-	-	0.0%
Metal	1,186	13,465	-	12,279	91.2%
Corrugated Kraft (OCC)	1,250	1,250	-	-	0.0%
Other C&D	11,351	12,478	-	1,126	9.0%
Other ferrous	3,442	3,446	-	4	0.1%
Other Paper	376	376	-	0	0.1%
Other recyclable wood	15,134	15,150	-	16	0.1%
Other Recyclable Paper	540	540	-	0	0.1%
Painted/Demolition Gypsum	8,427	8,429	-	3	0.0%
Pallets & crates	2,700	2,703	-	3	0.1%
Plastic	1,789	1,790	-	1	0.1%
Roofing (asphalt & comp)	16,239	16,975	-	737	4.3%
Treated and contaminated wood	16,087	18,416	-	2,329	12.6%
Yard waste & other organics	2,370	2,370	-	-	0.0%
Total	**118,532**	**449,417**	**43,445**	**287,440**	**64.0%**

Summary: Construction and Demolition Debris, Status Quo

Summary Of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2023

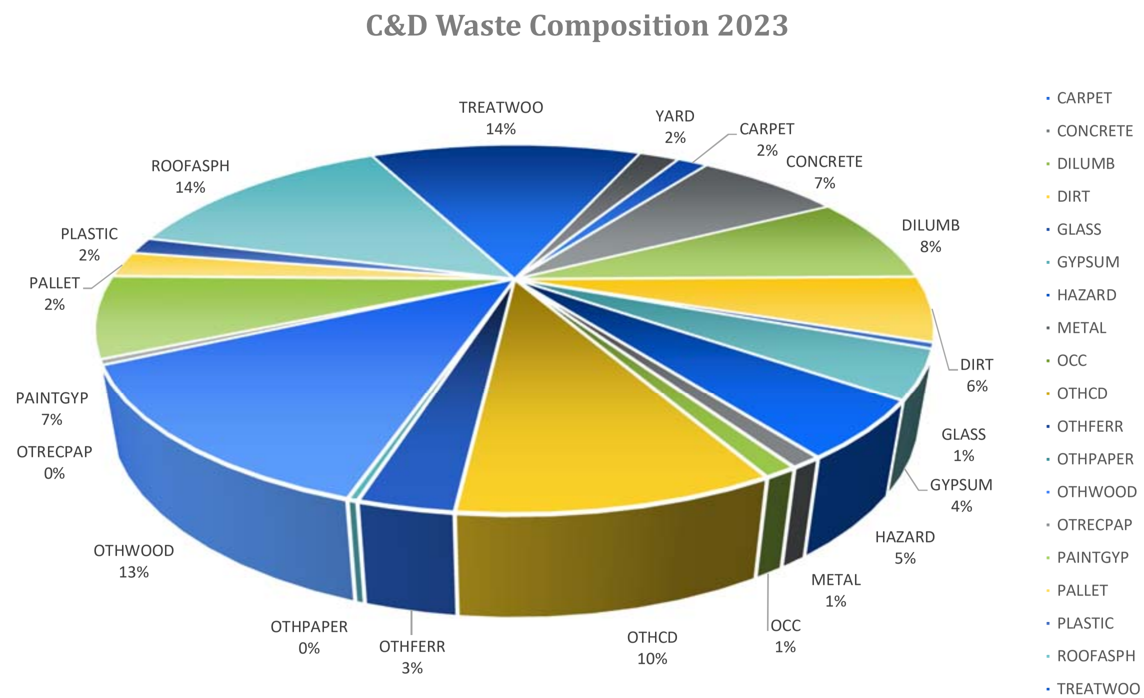
Material C&D	C&D Priv Rec	Facility Certification	Beneficial Uses	ABC BAN	
Carpet	380	1	-	-	381
Rock/Concrete/Brick/Ceramic & Porcelain	165,977	4,965	-	73,722	244,663
Dimension lumber	569	4,492	43,445	-	48,505
Sand/Soil/Dirt	-	5	-	-	5
Glass	-	-	-	-	-
Clean Gypsum Board	7,972	12,861	-	-	20,832
Hazardous & Other	-	-	-	-	-
Metal	4,719	7,560	-	-	12,279
Corrugated Kraft (OCC)	-	-	-	-	-
Other C&D	1,120	6	-	-	1,126
Other ferrous	1	2	-	-	4
Other Paper	-	0	-	-	0
Other recyclable wood	6	10	-	-	16
Other Recyclable Paper	-	0	-	-	0
Painted/Demolition Gypsum	-	3	-	-	3
Pallets & crates	1	2	-	-	3
Plastic	-	1	-	-	1
Roofing (asphalt & comp)	726	11	-	-	737
Treated and contaminated wood	2,329	-	-	-	2,329
Yard waste & other organics	-	-	-	-	-
	183,800	**29,919**	**43,445**	**73,722**	**330,885**

Summary: Construction and Demolition Debris, Status Quo

Summary Of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2023

Year	Total Disposed	Total Generated	Total Beneficial Uses	Total Recycled	Percent Recycled
2007	201,156	415,801	9,738	204,907	49.3%
2008	181,241	397,052	14,961	200,851	50.6%
2009	115,446	288,551	10,362	162,742	56.4%
2010	98,309	288,957	11,854	178,794	61.9%
2011	118,216	359,390	14,125	227,049	63.2%
2012	129,383	371,962	18,519	224,060	60.2%
2013	127,040	386,200	24,178	234,982	60.8%
2014	128,024	485,242	39,887	317,331	65.4%
2015	117,343	437,883	40,336	280,205	64.0%
2016	146,139	532,126	46,509	339,478	63.8%
2017	125,074	514,858	47,029	342,755	66.6%
2018	133,332	504,325	48,728	322,265	63.9%
2019	128,862	487,431	47,096	311,473	63.9%
2020	122,134	462,018	44,641	295,243	63.9%
2021	132,656	501,923	48,499	320,768	63.9%
2022	123,940	469,208	45,343	299,925	63.9%
2023	118,532	449,417	43,445	287,440	64.0%
2024	128,144	487,841	47,200	312,498	64.1%
2025	140,595	540,956	52,456	347,905	64.3%
2026	138,745	547,906	53,419	355,743	64.9%
2027	134,186	559,780	55,193	370,400	66.2%
2028	125,176	569,196	57,089	386,930	68.0%
2029	115,133	571,737	58,315	398,289	69.7%
2030	108,500	571,046	58,874	403,672	70.7%

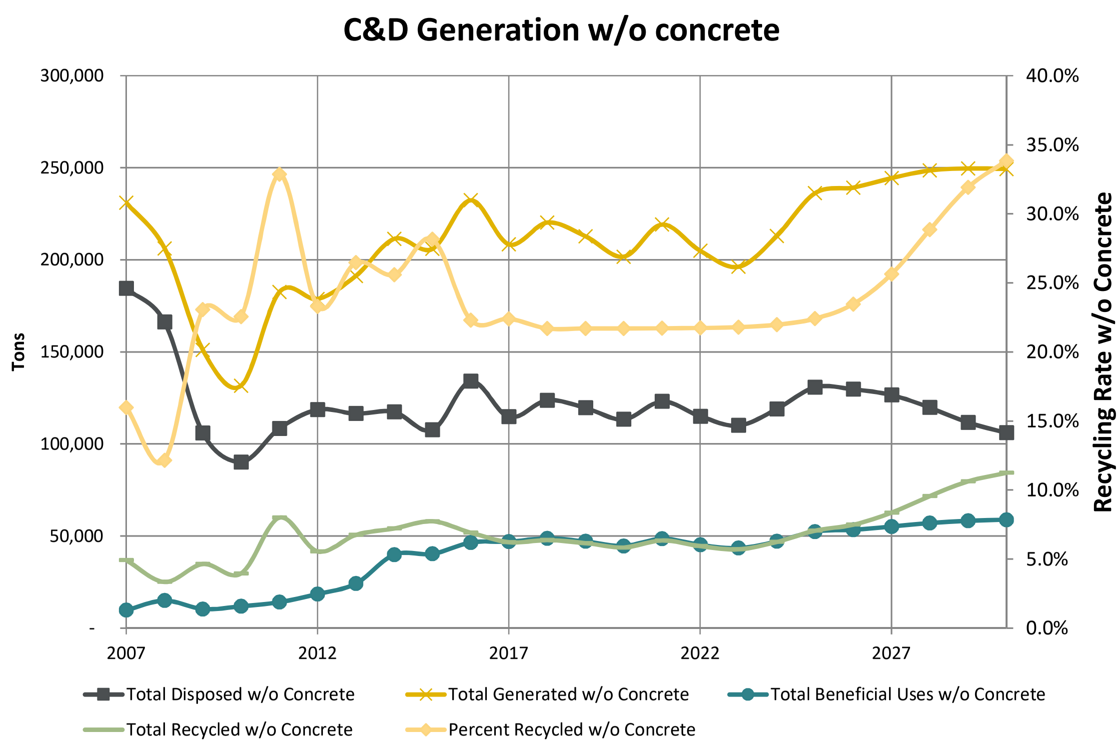


Summary: Construction and Demolition Debris, Status Quo

Summary Of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2023

Year	Total Disposed w/o Concrete	Total Generated w/o Concrete	Total Beneficial Uses w/o Concrete	Total Recycled w/o Concrete	Percent Recycled w/o Concrete
2007	184,455	231,093	9,738	36,900	16.0%
2008	166,193	206,236	14,961	25,082	12.2%
2009	105,861	151,062	10,362	34,838	23.1%
2010	90,147	131,709	11,854	29,708	22.6%
2011	108,401	182,491	14,125	59,964	32.9%
2012	118,641	178,814	18,519	41,654	23.3%
2013	116,493	191,307	24,178	50,636	26.5%
2014	117,394	211,391	39,887	54,109	25.6%
2015	107,600	205,947	40,336	58,012	28.2%
2016	134,005	232,356	46,509	51,842	22.3%
2017	114,690	208,395	47,029	46,676	22.4%
2018	123,705	220,217	48,728	47,783	21.7%
2019	119,559	212,840	47,096	46,185	21.7%
2020	113,318	201,743	44,641	43,784	21.7%
2021	123,085	219,168	48,499	47,584	21.7%
2022	115,009	204,883	45,343	44,531	21.7%
2023	110,019	196,241	43,445	42,777	21.8%
2024	119,024	213,019	47,200	46,796	22.0%
2025	130,826	236,212	52,456	52,931	22.4%
2026	129,676	239,247	53,419	56,152	23.5%
2027	126,573	244,431	55,193	62,665	25.6%
2028	119,741	248,543	57,089	71,713	28.9%
2029	111,644	249,653	58,315	79,693	31.9%
2030	106,111	249,351	58,874	84,366	33.8%



Summary: Construction and Demolition Debris, Status Quo
Summary of Recycling Program Benefits and Costs
All costs in 2019 dollars

Total

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$182,193,712	$12,467,667	$13,753,415	$13,258,666	$13,278,419	$15,022,547	$17,082,551	$17,499,791	$17,948,390	$18,250,445	$18,293,370	$18,224,969
Program Cost	$230,879	$40,000	$25,000	$20,000	$35,000	$20,000	$20,000	$35,000	$20,000	$20,000	$35,000	$20,000
Net Benefits	$181,962,833	$12,427,667	$13,728,415	$13,238,666	$13,243,419	$15,002,547	$17,062,551	$17,464,791	$17,928,390	$18,230,445	$18,258,370	$18,204,969
Tons avoided through recycling		**107,480**	**118,564**	**114,299**	**114,469**	**129,505**	**147,263**	**150,860**	**154,727**	**157,331**	**157,701**	**157,112**

Program Number and Name: *92 ABC BAN*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$112,216,823.09	$ 8,777,258	$ 9,515,549	$ 8,856,805	$ 8,426,637	$ 9,087,265	$ 10,039,340	$ 10,166,345	$ 10,426,798	$ 10,703,128	$ 10,911,547	$ 11,059,642
Program Cost	$55,453.25	$ 10,000	$ 10,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000
Net Benefits	$112,161,369.83	$ 8,767,258	$ 9,505,549	$ 8,851,805	$ 8,421,637	$ 9,082,265	$ 10,034,340	$ 10,161,345	$ 10,421,798	$ 10,698,128	$ 10,906,547	$ 11,054,642
Tons avoided through recycling		**75,666**	**82,031**	**76,352**	**72,643**	**78,338**	**86,546**	**87,641**	**89,886**	**92,268**	**94,065**	**95,342**

Program Number and Name: *94 Facility Certification*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$69,976,888.87	$ 3,690,409	$ 4,237,865	$ 4,401,860	$ 4,851,783	$ 5,935,282	$ 7,043,211	$ 7,333,446	$ 7,521,592	$ 7,547,317	$ 7,381,823	$ 7,165,326
Program Cost	$175,426.04	$ 30,000	$ 15,000	$ 15,000	$ 30,000	$ 15,000	$ 15,000	$ 30,000	$ 15,000	$ 15,000	$ 30,000	$ 15,000
Net Benefits	$69,801,462.82	$ 3,660,409	$ 4,222,865	$ 4,386,860	$ 4,821,783	$ 5,920,282	$ 7,028,211	$ 7,303,446	$ 7,506,592	$ 7,532,317	$ 7,351,823	$ 7,150,326
Tons avoided through recycling		**31,814**	**36,533**	**37,947**	**41,826**	**51,166**	**60,717**	**63,219**	**64,841**	**65,063**	**63,636**	**61,770**

Summary: Construction and Demolition Debris Tons Per Year, Recommended New Programs (All Materials)

Year	Recycle Rate	Total Material	Total Diposed	Total Diverted	Bans beyond ABC	Education & Outreach & WDR	Monitoring & Enforcement	Expand Recycling Market	Salvage Assessment	Deconstruction Requirement Single Family	Beneficial Uses	ABC BAN	Facility Certification	C&D Priv Rec
2007	51.6%	415,801	201,156	214,645	-	-	-	-	-	-	9,738	-	19,996	184,911
2008	54.4%	397,052	181,241	215,811	-	-	-	-	-	-	14,961	-	7,464	193,387
2009	60.0%	288,551	115,446	173,105	-	-	-	-	-	-	10,362	-	9,146	153,596
2010	66.0%	288,957	98,309	190,648	-	-	-	-	-	-	11,854	-	10,235	168,559
2011	67.1%	359,390	118,216	241,174	-	-	-	-	-	-	14,125	-	33,721	193,328
2012	65.2%	371,962	129,383	242,579	-	-	-	-	-	-	18,519	40,168	23,168	160,723
2013	67.1%	386,200	127,040	259,160	-	-	-	-	-	-	24,178	55,548	31,708	147,725
2014	73.6%	485,242	128,024	357,218	-	-	-	-	-	-	39,887	67,756	37,710	211,865
2015	73.2%	437,883	117,343	320,541	-	-	-	-	-	-	40,336	81,860	40,912	157,433
2016	72.5%	532,126	146,139	385,987	-	-	-	-	-	-	46,509	89,182	39,576	210,721
2017	75.71%	514,858	125,074	389,784	-	-	-	-	-	-	47,029	89,216	33,291	220,249
2018	73.56%	504,325	133,332	370,993	-	-	-	-	-	-	48,728	82,709	33,410	206,146
2019	73.56%	487,431	128,862	358,569	-	-	-	-	-	-	47,096	79,939	32,293	199,241
2020	74.17%	462,018	119,336	342,683	36	317	2,247	1	16	908	44,540	75,612	30,552	188,454
2021	74.76%	501,923	126,700	375,223	102	838	4,525	2	46	2,226	48,249	81,929	33,119	204,185
2022	75.50%	469,208	114,972	354,236	238	1,709	6,154	6	114	3,869	44,899	76,291	30,869	190,088
2023	76.25%	449,417	106,713	342,704	532	2,963	7,055	16	273	5,418	42,792	72,824	29,525	181,305
2024	76.97%	487,841	112,308	375,534	1,212	4,610	8,206	46	668	7,086	46,261	79,005	32,191	196,247
2025	77.69%	540,956	120,555	420,401	2,366	6,011	9,220	135	1,377	8,497	51,172	87,986	36,349	217,287
2026	78.55%	547,906	117,170	430,736	3,353	6,280	9,095	348	2,038	8,873	51,908	90,289	38,612	219,940
2027	79.77%	559,780	112,418	447,361	3,895	6,008	8,633	839	2,508	9,169	53,503	94,828	43,287	224,692
2028	81.35%	569,196	104,394	464,801	3,926	5,282	7,753	1,744	2,758	9,363	55,278	100,497	49,707	228,492
2029	82.80%	571,737	95,406	476,331	3,676	4,473	6,792	2,949	2,856	9,419	56,440	105,043	55,198	229,485
2030	83.67%	571,046	89,208	481,838	3,426	3,932	6,142	4,039	2,885	9,413	56,970	107,568	58,306	229,156
2031	84.07%	568,729	85,896	482,833	3,272	3,656	5,806	4,699	2,885	9,377	57,026	108,398	59,521	228,191
2032	84.23%	566,844	84,387	482,457	3,197	3,537	5,657	5,002	2,880	9,347	56,954	108,557	59,906	227,419
2033	84.29%	566,883	83,920	482,963	3,172	3,495	5,607	5,132	2,882	9,348	57,003	108,763	60,132	227,428
2034	84.31%	569,115	84,072	485,043	3,175	3,494	5,610	5,202	2,894	9,385	57,245	109,266	60,451	228,321
2035	84.32%	572,469	84,502	487,967	3,190	3,508	5,636	5,251	2,911	9,440	57,588	109,937	60,838	229,666
2036	84.32%	576,367	85,052	491,315	3,211	3,530	5,672	5,294	2,931	9,504	57,983	110,696	61,264	231,229
2037	84.33%	579,795	85,549	494,246	3,229	3,550	5,705	5,328	2,949	9,561	58,329	111,358	61,633	232,604
2038	84.33%	581,646	85,819	495,827	3,240	3,561	5,723	5,346	2,958	9,591	58,515	111,715	61,831	233,347
2039	84.33%	581,862	85,849	496,013	3,241	3,562	5,725	5,348	2,959	9,595	58,537	111,757	61,855	233,434
2040	84.33%	581,588	85,809	495,780	3,239	3,561	5,722	5,346	2,958	9,590	58,509	111,705	61,826	233,324

Summary: Construction and Demolition Debris Tons Per Year, Recommended New Programs (Without Concrete)

Year	Recycle Rate w/o Concrete	Total Material	Total Diposed	Total Diverted	Bans beyond ABC	Education & Outreach & WDR	Monitoring & Enforcement	Expand Recycling Market	Salvage Assessment	Deconstruction Requirement Single Family	Beneficial Uses	ABC BAN	Facility Certification	C&D Priv Rec
2007	16.7%	231,093	184,455	46,638	-	-	-	-	-	-	9,738	-	16,414	20,486
2008	13.1%	206,236	166,193	40,043	-	-	-	-	-	-	14,961	-	4,504	20,579
2009	24.8%	151,062	105,861	45,201	-	-	-	-	-	-	10,362	-	5,284	29,554
2010	24.8%	131,709	90,147	41,562	-	-	-	-	-	-	11,854	-	5,748	23,959
2011	35.6%	182,491	108,401	74,089	-	-	-	-	-	-	14,125	-	22,448	37,516
2012	26.0%	178,814	118,641	60,173	-	-	-	-	-	-	18,519	-	14,428	27,226
2013	30.3%	191,307	116,493	74,814	-	-	-	-	-	-	24,178	-	21,551	29,085
2014	31.5%	211,391	117,394	93,996	-	-	-	-	-	-	39,887	-	30,773	23,336
2015	35.0%	205,947	107,600	98,347	-	-	-	-	-	-	40,336	-	35,525	22,487
2016	27.9%	232,356	134,005	98,351	-	-	-	-	-	-	46,509	-	33,670	18,171
2017	28.9%	208,395	114,690	93,705	-	-	-	-	-	-	47,029	-	27,318	19,358
2018	27.9%	220,217	123,705	96,511	-	-	-	-	-	-	48,728	-	27,873	19,911
2019	27.9%	212,840	119,559	93,281	-	-	-	-	-	-	47,096	-	26,941	19,245
2020	29.4%	201,743	110,946	90,798	36	245	1,912	1	16	348	44,540	-	25,488	18,212
2021	30.9%	219,168	118,039	101,129	102	649	3,850	2	46	853	48,249	-	27,630	19,748
2022	32.9%	204,883	107,419	97,464	238	1,324	5,237	6	114	1,482	44,899	-	25,750	18,413
2023	34.8%	196,241	100,014	96,227	532	2,301	6,006	15	273	2,076	42,792	-	24,620	17,611
2024	36.7%	213,019	105,544	107,475	1,212	3,585	6,992	45	668	2,714	46,261	-	26,816	19,182
2025	38.6%	236,212	113,542	122,670	2,366	4,689	7,874	132	1,377	3,255	51,172	-	30,209	21,597
2026	40.9%	239,247	110,691	128,556	3,353	4,939	7,815	341	2,038	3,399	51,908	-	31,944	22,819
2027	44.0%	244,431	106,861	137,571	3,895	4,815	7,522	822	2,508	3,513	53,503	-	35,566	25,427
2028	48.1%	248,543	100,234	148,309	3,926	4,376	6,918	1,716	2,758	3,587	55,278	-	40,569	29,181
2029	52.1%	249,653	92,580	157,073	3,676	3,854	6,224	2,914	2,856	3,609	56,440	-	44,889	32,612
2030	54.7%	249,351	87,190	162,161	3,426	3,489	5,737	4,001	2,885	3,606	56,970	-	47,362	34,683
2031	56.0%	248,339	84,251	164,088	3,272	3,296	5,475	4,662	2,885	3,592	57,026	-	48,337	35,543
2032	56.5%	247,516	82,894	164,622	3,197	3,209	5,357	4,965	2,880	3,581	56,954	-	48,646	35,833
2033	56.7%	247,533	82,482	165,051	3,172	3,180	5,318	5,096	2,882	3,581	57,003	-	48,828	35,991
2034	56.8%	248,508	82,649	165,859	3,175	3,181	5,324	5,166	2,894	3,595	57,245	-	49,087	36,191
2035	56.8%	249,972	83,078	166,895	3,190	3,196	5,350	5,215	2,911	3,616	57,588	-	49,401	36,426
2036	56.8%	251,674	83,622	168,053	3,211	3,216	5,384	5,257	2,931	3,641	57,983	-	49,747	36,683
2037	56.8%	253,171	84,111	169,060	3,229	3,234	5,416	5,291	2,949	3,663	58,329	-	50,046	36,904
2038	56.8%	253,979	84,376	169,603	3,240	3,245	5,433	5,309	2,958	3,674	58,515	-	50,207	37,023
2039	56.8%	254,074	84,407	169,667	3,241	3,246	5,434	5,311	2,959	3,676	58,537	-	50,226	37,037
2040	56.8%	253,954	84,367	169,588	3,239	3,244	5,432	5,309	2,958	3,674	58,509	-	50,203	37,020

Summary: Construction and Demolition Debris, Recommended New Programs

Summary Of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2028

Material C&D	Total Disposed a 1	Total Generated d = a + b + c 3	Total Beneficial Uses b 2	Total Recycled c	Percent Recycled c/d
Carpet	1,902	2,709	-	808	29.8%
Rock/Concrete/Brick/Ceramic & Porcelain	5,558	315,348	-	309,791	98.2%
Dimension lumber	5,969	71,851	53,503	12,379	17.2%
Sand/Soil/Dirt	7,391	8,404	-	1,013	12.1%
Glass	763	763	-	-	0.0%
Clean Gypsum Board	5,210	32,112	-	26,902	83.8%
Hazardous & Other	7,230	7,287	-	57	0.8%
Metal	820	16,771	-	15,952	95.1%
Corrugated Kraft (OCC)	1,557	1,557	-	-	0.0%
Other C&D	11,141	15,542	-	4,400	28.3%
Other ferrous	3,135	4,292	-	1,157	27.0%
Other Paper	409	469	-	60	12.8%
Other recyclable wood	14,193	18,870	-	4,677	24.8%
Other Recyclable Paper	591	673	-	81	12.1%
Painted/Demolition Gypsum	10,094	10,499	-	405	3.9%
Pallets & crates	2,250	3,367	-	1,117	33.2%
Plastic	1,835	2,230	-	395	17.7%
Roofing (asphalt & comp)	11,728	21,144	-	9,416	44.5%
Treated and contaminated wood	17,691	22,939	-	5,247	22.9%
Yard waste & other organics	2,952	2,952	-	-	0.0%
Total	**112,418**	**559,780**	**53,503**	**393,858**	**70.4%**

Summary: Construction and Demolition Debris, Recommended New Programs

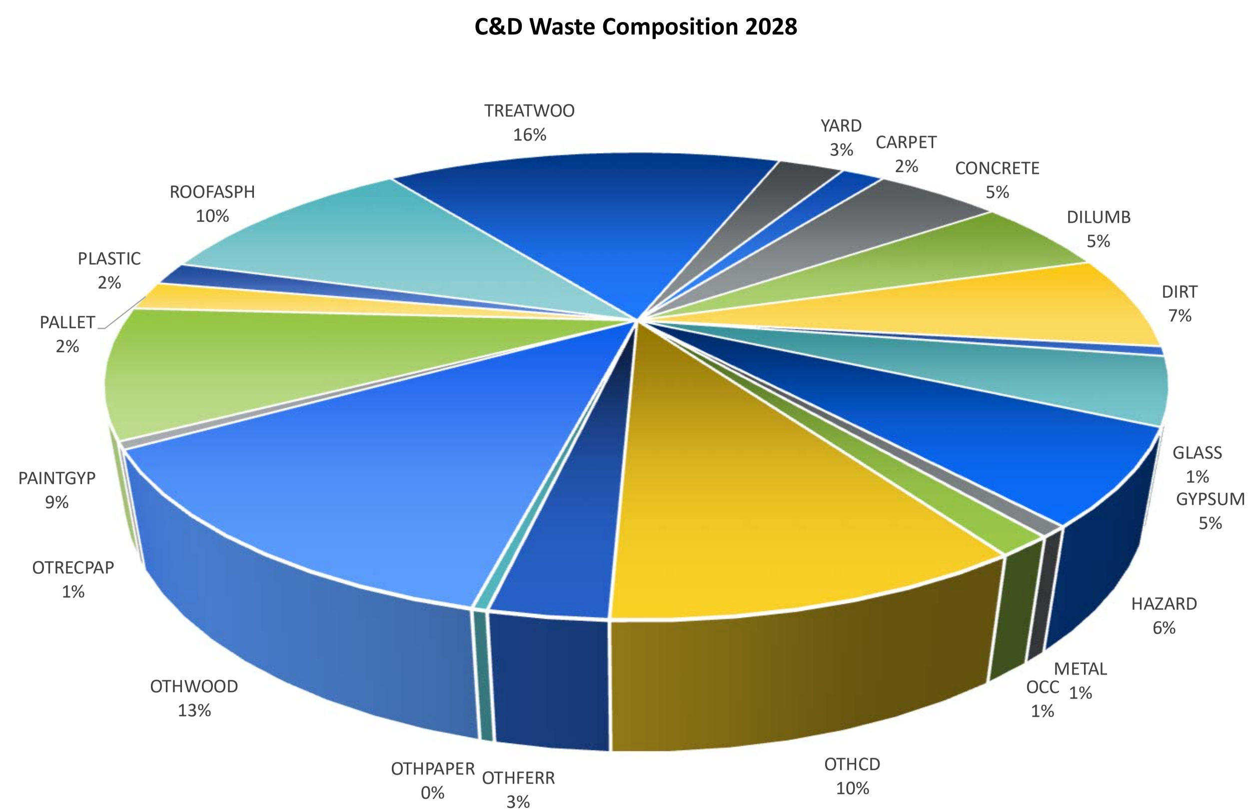
Summary Of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2028

Material C&D	C&D Priv Rec	Facility Certification	Beneficial Uses	ABC BAN	Deconstruction Requirement Single Family	Salvage Assessment	Expand Recycling Market	Monitoring & Enforcement	Education & Outreach & WDR	Bans beyond ABC	
	99	94	90	92	75	74	73	72	71	70	Grand Total
Carpet	622	44	-	-	48	-	-	94	-	-	808
Rock/Concrete/Brick/Ceramic & Porcelain	199,265	7,721	-	94,828	5,656	-	17	1,110	1,193	-	309,791
Dimension lumber	1,164	6,775	53,503	-	1,301	899	157	1,131	951	-	65,882
Sand/Soil/Dirt	-	250	-	-	147	-	-	617	-	-	1,013
Glass	-	-	-	-	-	-	-	-	-	-	-
Clean Gypsum Board	8,056	17,634	-	-	452	-	-	656	104	-	26,902
Hazardous & Other	-	-	-	-	-	57	-	-	-	-	57
Metal	5,642	9,202	-	-	304	517	-	155	131	-	15,952
Corrugated Kraft (OCC)	-	-	-	-	-	-	-	-	-	-	-
Other C&D	3,393	259	-	-	194	-	-	333	221	-	4,400
Other ferrous	54	117	-	-	75	54	-	439	419	-	1,157
Other Paper	-	13	-	-	5	-	-	42	-	-	60
Other recyclable wood	288	461	-	-	330	236	251	1,901	1,210	-	4,677
Other Recyclable Paper	-	21	-	-	11	-	-	49	-	-	81
Painted/Demolition Gypsum	-	134	-	-	133	-	-	139	-	-	405
Pallets & crates	52	87	-	-	61	-	60	436	419	-	1,117
Plastic	-	49	-	-	31	29	-	100	40	146	395
Roofing (asphalt & comp)	1,668	518	-	-	377	-	354	1,430	1,319	3,749	9,416
Treated and contaminated wood	4,487	-	-	-	45	715	-	-	-	-	5,247
Yard waste & other organics	-	-	-	-	-	-	-	-	-	-	-
	224,692	**43,287**	**53,503**	**94,828**	**9,169**	**2,508**	**839**	**8,633**	**6,008**	**3,895**	**447,361**

Summary: Construction and Demolition Debris, Recommended New Programs
Summary Of Recycling Program Impacts (in tons per year)
Modeled waste composition data for 2028

Year	Total Disposed	Total Generated	Total Beneficial Uses	Total Recycled	Percent Recycled
2007	201,156	415,801	9,738	204,907	49.3%
2008	181,241	397,052	14,961	200,851	50.6%
2009	115,446	288,551	10,362	162,742	56.4%
2010	98,309	288,957	11,854	178,794	61.9%
2011	118,216	359,390	14,125	227,049	63.2%
2012	129,383	371,962	18,519	224,060	60.2%
2013	127,040	386,200	24,178	234,982	60.8%
2014	128,024	485,242	39,887	317,331	65.4%
2015	117,343	437,883	40,336	280,205	64.0%
2016	146,139	532,126	46,509	339,478	63.8%
2017	125,074	514,858	47,029	342,755	66.6%
2018	133,332	504,325	48,728	322,265	63.9%
2019	128,862	487,431	47,096	311,473	63.9%
2020	119,336	462,018	44,540	298,143	64.5%
2021	126,700	501,923	48,249	326,974	65.1%
2022	114,972	469,208	44,899	309,337	65.9%
2023	106,713	449,417	42,792	299,912	66.7%
2024	112,308	487,841	46,261	329,272	67.5%
2025	120,555	540,956	51,172	369,229	68.3%
2026	117,170	547,906	51,908	378,828	69.1%
2027	112,418	559,780	53,503	393,858	70.4%
2028	104,394	569,196	55,278	409,523	71.9%
2029	95,406	571,737	56,440	419,891	73.4%
2030	89,208	571,046	56,970	424,868	74.4%
2031	85,896	568,729	57,026	425,807	74.9%
2032	84,387	566,844	56,954	425,502	75.1%
2033	83,920	566,883	57,003	425,960	75.1%
2034	84,072	569,115	57,245	427,798	75.2%
2035	84,502	572,469	57,588	430,379	75.2%
2036	85,052	576,367	57,983	433,332	75.2%
2037	85,549	579,795	58,329	435,917	75.2%
2038	85,819	581,646	58,515	437,312	75.2%
2039	85,849	581,862	58,537	437,476	75.2%
2040	85,809	581,588	58,509	437,270	75.2%

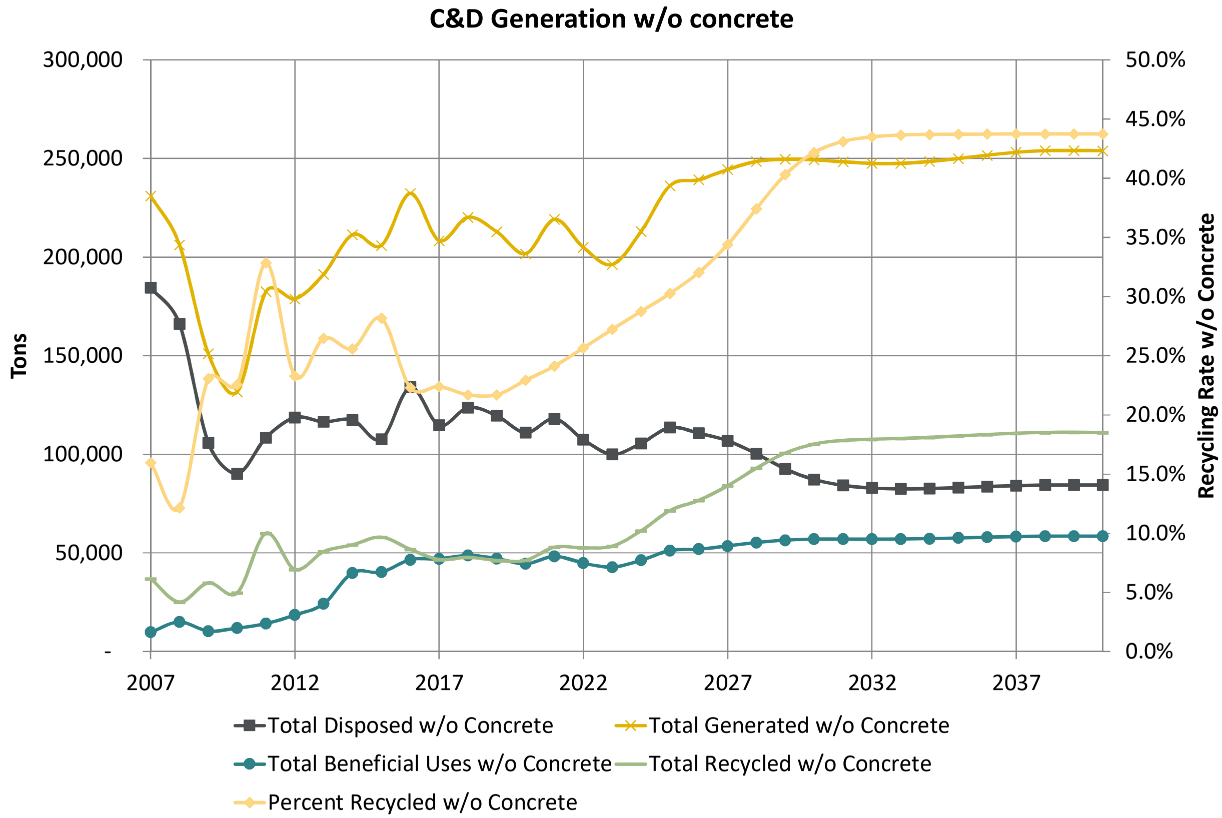


Summary: Construction and Demolition Debris, Recommended New Programs

Summary Of Recycling Program Impacts (in tons per year)

Modeled waste composition data for 2028

Year	Total Disposed w/o Concrete	Total Generated w/o Concrete	Total Beneficial Uses w/o Concrete	Total Recycled w/o Concrete	Percent Recycled w/o Concrete
2007	184,455	231,093	9,738	36,900	16.0%
2008	166,193	206,236	14,961	25,082	12.2%
2009	105,861	151,062	10,362	34,838	23.1%
2010	90,147	131,709	11,854	29,708	22.6%
2011	108,401	182,491	14,125	59,964	32.9%
2012	118,641	178,814	18,519	41,654	23.3%
2013	116,493	191,307	24,178	50,636	26.5%
2014	117,394	211,391	39,887	54,109	25.6%
2015	107,600	205,947	40,336	58,012	28.2%
2016	134,005	232,356	46,509	51,842	22.3%
2017	114,690	208,395	47,029	46,676	22.4%
2018	123,705	220,217	48,728	47,783	21.7%
2019	119,559	212,840	47,096	46,185	21.7%
2020	110,946	201,743	44,540	46,258	22.9%
2021	118,039	219,168	48,249	52,881	24.1%
2022	107,419	204,883	44,899	52,565	25.7%
2023	100,014	196,241	42,792	53,435	27.2%
2024	105,544	213,019	46,261	61,214	28.7%
2025	113,542	236,212	51,172	71,498	30.3%
2026	110,691	239,247	51,908	76,648	32.0%
2027	106,861	244,431	53,503	84,068	34.4%
2028	100,234	248,543	55,278	93,030	37.4%
2029	92,580	249,653	56,440	100,633	40.3%
2030	87,190	249,351	56,970	105,191	42.2%
2031	84,251	248,339	57,026	107,062	43.1%
2032	82,894	247,516	56,954	107,668	43.5%
2033	82,482	247,533	57,003	108,048	43.6%
2034	82,649	248,508	57,245	108,614	43.7%
2035	83,078	249,972	57,588	109,306	43.7%
2036	83,622	251,674	57,983	110,070	43.7%
2037	84,111	253,171	58,329	110,732	43.7%
2038	84,376	253,979	58,515	111,088	43.7%
2039	84,407	254,074	58,537	111,130	43.7%
2040	84,367	253,954	58,509	111,078	43.7%



Summary: Construction and Demolition Debris, Recommended New Programs
Summary of Recycling Program Benefits and Costs
All costs in 2019 dollars

Total

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$22,429,704	$424,676	$925,155	$1,438,398	$1,920,918	$2,557,873	$3,209,535	$3,456,642	$3,547,519	$3,491,070	$3,391,234	$3,346,940
Program Cost	$10,623,534	$246,200	$703,966	$1,165,157	$1,451,262	$1,384,225	$1,434,596	$1,489,596	$1,215,711	$1,215,711	$1,270,711	$1,275,711
Net Benefits	$11,806,170	$178,476	$221,189	$273,242	$469,656	$1,173,648	$1,774,939	$1,967,046	$2,331,808	$2,275,359	$2,120,523	$2,071,229
Tons avoided through recycling	**176,796**	**2,618**	**5,517**	**8,227**	**10,855**	**14,789**	**19,243**	**21,462**	**22,721**	**23,206**	**23,695**	**24,463**
Net Benefits per Ton	**$66.78**											

Program Number and Name: *70 Bans beyond ABC*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$2,041,953.49	$ 4,384	$ 12,239	$ 28,340	$ 62,871	$ 141,983	$ 275,125	$ 386,479	$ 444,944	$ 444,661	$ 413,312	$ 384,336
Program Cost	$2,310,927.54	$ 43,055	$ 129,997	$ 355,084	$ 392,121	$ 361,102	$ 343,047	$ 368,047	$ 184,162	$ 184,162	$ 209,162	$ 184,162
Net Benefits	($268,974.05)	$ (38,671)	$ (117,758)	$ (326,744)	$ (329,249)	$ (219,120)	$ (67,922)	$ 18,432	$ 260,782	$ 260,498	$ 204,150	$ 200,174
Tons avoided through recycling	**22,763**	**36**	**102**	**238**	**532**	**1,212**	**2,366**	**3,353**	**3,895**	**3,926**	**3,676**	**3,426**
Net Benefits per Ton	**($11.82)**											

Program Number and Name: *71 Education & Outreach & WDR*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$3,961,571.51	$ 38,170	$ 100,212	$ 203,295	$ 350,118	$ 540,244	$ 698,817	$ 723,899	$ 686,413	$ 598,188	$ 502,827	$ 441,016
Program Cost	$1,519,019.43	$ 36,018	$ 101,017	$ 71,017	$ 194,995	$ 194,995	$ 224,995	$ 224,995	$ 194,995	$ 194,995	$ 194,995	$ 224,995
Net Benefits	$2,442,552.08	$ 2,152	$ (805)	$ 132,278	$ 155,123	$ 345,248	$ 473,822	$ 498,903	$ 491,418	$ 403,193	$ 307,832	$ 216,021
Tons avoided through recycling	**42,422**	**317**	**838**	**1,709**	**2,963**	**4,610**	**6,011**	**6,280**	**6,008**	**5,282**	**4,473**	**3,932**
Net Benefits per Ton	**$57.58**											

Program Number and Name: *72 Monitoring & Enforcement*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$7,280,430.80	$ 270,697	$ 540,820	$ 732,189	$ 833,596	$ 961,644	$ 1,071,951	$ 1,048,435	$ 986,258	$ 878,050	$ 763,535	$ 689,009
Program Cost	$3,135,982.66	$ 88,980	$ 268,327	$ 291,289	$ 382,768	$ 382,768	$ 412,768	$ 412,768	$ 382,768	$ 382,768	$ 382,768	$ 412,768
Net Benefits	$4,144,448.14	$ 181,716	$ 272,493	$ 440,900	$ 450,827	$ 578,876	$ 659,182	$ 635,666	$ 603,490	$ 495,282	$ 380,767	$ 276,241
Tons avoided through recycling	**75,822**	**2,247**	**4,525**	**6,154**	**7,055**	**8,206**	**9,220**	**9,095**	**8,633**	**7,753**	**6,792**	**6,142**
Net Benefits per Ton	**$54.66**											

Summary: Construction and Demolition Debris, Recommended New Programs
Summary of Recycling Program Benefits and Costs
All costs in 2019 dollars

Program Number and Name: 73 *Expand Recycling Market*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$854,142.13	$ 99	$ 289	$ 726	$ 1,862	$ 5,381	$ 15,667	$ 40,166	$ 95,849	$ 197,487	$ 331,576	$ 453,044
Program Cost	$2,807,179.50	$ 48,055	$ 132,404	$ 351,473	$ 397,121	$ 361,102	$ 343,047	$ 373,047	$ 343,047	$ 343,047	$ 373,047	$ 343,047
Net Benefits	($1,953,037.37)	($47,956)	($132,115)	($350,747)	($395,258)	($355,721)	($327,380)	($332,881)	($247,198)	($145,561)	($41,471)	$109,997
Tons avoided through recycling	**10,125**	**1**	**2**	**6**	**16**	**46**	**135**	**348**	**839**	**1,744**	**2,949**	**4,039**
Net Benefits per Ton	**($192.89)**											

Program Number and Name: 74 *Salvage Assessment*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$1,378,966.91	$ 1,917	$ 5,541	$ 13,555	$ 32,309	$ 78,317	$ 160,038	$ 234,891	$ 286,516	$ 312,316	$ 321,029	$ 323,605
Program Cost	$365,034.29	$ -	$ 24,073	$ 36,110	$ 48,147	$ 48,147	$ 48,147	$ 48,147	$ 48,147	$ 48,147	$ 48,147	$ 48,147
Net Benefits	$1,013,932.62	$ 1,917	$ (18,532)	$ (22,555)	$ (15,838)	$ 30,170	$ 111,891	$ 186,744	$ 238,369	$ 264,169	$ 272,882	$ 275,458
Tons avoided through recycling	**15,538**	**16**	**46**	**114**	**273**	**668**	**1,377**	**2,038**	**2,508**	**2,758**	**2,856**	**2,885**
Net Benefits per Ton	**$65.25**											

Program Number and Name: 75 *Deconstruction Requirement Single Family*

Year	Present Value	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Program Benefits	$6,912,638.78	$ 109,410	$ 266,054	$ 460,294	$ 640,162	$ 830,305	$ 987,937	$ 1,022,772	$ 1,047,537	$ 1,060,369	$ 1,058,954	$ 1,055,929
Program Cost	$485,390.44	$ 30,092	$ 48,147	$ 60,184	$ 36,110	$ 36,110	$ 62,591	$ 62,591	$ 62,591	$ 62,591	$ 62,591	$ 62,591
Net Benefits	$6,427,248.34	$ 79,318	$ 217,907	$ 400,110	$ 604,051	$ 794,195	$ 925,346	$ 960,181	$ 984,946	$ 997,778	$ 996,363	$ 993,338
Tons avoided through recycling	**74,241**	**908**	**2,226**	**3,869**	**5,418**	**7,086**	**8,497**	**8,873**	**9,169**	**9,363**	**9,419**	**9,413**
Net Benefits per Ton	**$86.57**											