



**Santa Cruz County**  
**Fatal Flaw Analysis**  
**for**  
**Conceptual Alternative Facilities**

Prepared for:

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# 1 INTRODUCTION AND OBJECTIVES

## INTRODUCTION

SCS Engineers (SCS) was retained by Santa Cruz County to provide an overview and analysis of disposal alternatives for the County. This report summarizes the work completed by SCS, and provides additional information to assist the County Board of Supervisors in the strategic planning process.

In April of 2007, SCS prepared for the County, a presentation in which data were presented indicated a much higher than anticipated population growth rates for the County. Based upon this new information, it is SCS understanding that the County has determined that in approximately six years (2013), the Rio Rico Landfill will begin closure activities, unless cost-effective environmentally sound disposal alternatives are implemented before the year 2013.

The Rio Rico Landfill serves the residential and commercial disposal needs of Nogales, Arizona and the unincorporated areas of Santa Cruz County, including the Rio Rico, Tubac, Sonoita, Elgin, and sometimes the Patagonia communities. The Rio Rico Landfill occupies approximately 60 acres of land within a small canyon, and is classified as a canyon-fill type solid waste facility reflecting the site's topography.

An additional landfill owned and operated by the County is the Sonoita-Elgin Landfill, which is located in Sonoita. This facility, which occupies approximately 40 acres of land, currently receives only demolition debris and some municipal waste, which is temporarily stored in bins, and then transported to the Rio Rico Landfill.

Based upon review of several conventional and innovative/conversion technologies available for disposal of municipal solid waste, and discussions with the County, SCS selected nine disposal alternatives for evaluation. Section 3 presents a summary of the conceptual alternatives technologies, including, descriptions, technical information, and capital costs. Section 4 presents comparative aspects of the alternatives and Tables A-1 and A-2 present economic and non-economic comparisons of the conceptual alternative facilities, respectively. Section 5 presents conclusions and recommendations of the study.

## OBJECTIVES

The main objective of this study is to identify several solid waste management disposal alternatives for the County, and perform a preliminary analysis of the selected alternatives. In addition, this study will determine whether there are technical, environmental or economic issues that would preclude them from further consideration. The ultimate objective of this part of the study is to select the three most technically and/or economically feasible alternatives for a more detailed analysis that will be performed in a future study. This is the purpose of the fatal flaw analysis.

## 2 WASTE PROJECTIONS

The first step in performing this study is to analyze the current waste accepted at the Rio Rico Landfill and project the expected waste to be processed in the future. For this study, we have used 2006 as the starting period and have projected 30 years into the future (year 2036) for the planning horizon. The reason for selecting the 30 year maximum period is that the life of constructed infrastructures, including buildings and mechanical processes, is typically 30 years.

According to recent records provided by the County, approximately 55,523 tons of waste was disposed of at the Rio Rico Landfill during the County's fiscal year 2004, 54,372 tons was disposed of during fiscal year 2005, and 61,579 tons was disposed of during fiscal year 2006.

Following review of various waste projections (using different rate increases per year), and analysis of the potential growth in the County, SCS and the County selected for the 30 year study period a 6% waste increase for the first five years and a 3% increase thereafter. The waste projections using the above rate increases are presented in Table 1. As shown on this table, the amount of waste projected for the year 2036 is 172,541 tons per year. The daily rate for the year 2036 (using an average of 302 days of operation a year) is 571 tons per day. The cumulative amount of waste projected from the year 2014 (after the expected closure of the Rio Rico Landfill) to 2036 is 2,922,316 tons. In other words, any new replacement landfill to Rio Rico, would need to have a minimum design capacity of approximately 3.0 million tons.

**Table 1. Waste Projections - Santa Cruz County**

<b>Year</b>	<b>Projected Waste (tons)</b>	<b>Waste Increase Rate</b>
2006	61,579 <sup>1</sup>	
2007	65,274	6%
2008	69,190	6%
2009	73,342	6%
2010	77,742	6%
2011	82,407	6%
2012	84,879	3%
2013	87,425	3%
2014	90,048	3%
2015	92,749	3%
2016	95,532	3%
2017	98,398	3%
2018	101,350	3%
2019	104,390	3%
2020	107,522	3%
2021	110,748	3%
2022	114,070	3%
2023	117,492	3%
2024	121,017	3%
2025	124,647	3%
2026	128,387	3%
2027	132,238	3%
2028	136,206	3%
2029	140,292	3%
2030	144,500	3%
2031	148,835	3%
2032	153,301	3%
2033	157,900	3%
2034	162,637	3%
2035	167,516	3%
2036	172,541	3%

<sup>1</sup> Actual Tonnage Received at the Rio Rico Landfill

### 3 CONCEPTUAL ALTERNATIVE TECHNOLOGIES

#### SUMMARY OF TECHNOLOGIES

There are currently several existing landfill technologies and alternatives to landfilling available to the County for disposal and/or reuse of municipal solid waste. One example of an existing disposal technology in Santa Cruz County is the Rio Rico Sanitary Landfill. Sonoita Elgin and Patagonia are the two other sanitary landfills located in the County. Landfill disposal has been used extensively in the past, and is still being used today by many communities nationwide. Landfill disposal, although not considered by some to be the most environmentally acceptable alternative, sanitary landfill design is considered a proven well known technology, and in some cases it can also prove to be the most economical option for a community. Alternatives to direct disposal to landfill are process sorting and transfer technologies as in Material Recovery Facilities (MRF) and transfer stations. These technologies, more commonly used to process or consolidate waste from multiple collection vehicles into larger, high volume transfer vehicles for more economical shipment to distant disposal sites, are transfer stations, but can be used in combination with MRF.

Conversion technologies that appear to be suitable for converting organic materials into energy and other commercial development include waste to energy, anaerobic digestion, gasification, pyrolysis and hydrolysis. Conversion technologies include an array of technologies that are capable of converting post-recycling residual solid waste into useful products and chemicals, including clean renewable energy, ethanol and biodiesel. Some of these technologies have been used successfully in Europe and Asia; however, commercial development in the United States is still what could be considered as emerging technologies.

In selecting the conceptual alternative technologies to be considered for evaluation, the following criteria were used:

- Evaluation of existing disposal facilities within the County (landfills).
- Characteristics of the existing facilities for potential future use (location, feasibility for expansion, etc.).
- Applicability of innovative/conversion technologies to the local environment/conditions.
- Waste projections.
- Previous studies performed on recycling and composting alternatives.
- Estimated Capital and operation and maintenance (O&M) Costs of the alternative technologies.

Based on the above discussion and discussions with the County regarding potential disposal alternatives, SCS selected the following disposal alternatives for evaluation:

- Landfill Expansion at the Rio Rico Landfill.

- Retrofitting the Patagonia and/or the Sonoita-Elgin Landfill (SELF).
- A New Landfill.
- Transfer Station at the Rio Rico Landfill.
- MRF.
- MRF and Transfer Station.
- Waste to Energy.
- Composting.
- Anaerobic Digestion.

The following sections describe each of the above alternatives and provide a general comparative overview of the technologies. Costs associated with the various alternative technologies are based on 2007 dollars, and are given in cost per acre, cost per tons per year or other similar units. The ultimate capital and O&M costs of any alternative technologies evaluated can be calculated based on the projected waste for the year 2036. The disposal facilities in the study are conceptually designed for the ultimate projected waste; however, they are constructed in phases.

It should also be mentioned that the analysis performed under this study does not include the residential collection of the waste within the County, which will be the same for all disposal alternatives. Also, in the case of the transfer station and MRF, the costs do not include any tipping fees or the transportation of the waste from these facilities to the final disposal site.

### **Landfill Expansion at the Rio Rico Landfill**

As previously stated, the Rio Rico Landfill, which occupies approximately 60 acres of land and is classified as a canyon-filled type of solid waste facility, will be closing in 2013. By this date, the canyon will be completely filled to the height currently permitted by the Arizona Department of Environmental Quality (ADEQ).

In evaluating the expansion of the Rio Rico Landfill as an alternative to continue to receive wastes past 2013, the following issues need to be addressed:

- Will the expansion be adequate to handle the projected waste?
- How can the landfill be expanded (laterally, vertically, combination of both)?
- Will ADEQ approve any proposed expansion modification?

Based on the waste projections presented in Table 1, the projected waste to be generated by the County from 2014 to 2036 will be approximately 2,922,000 tons. Any proposed alternative must have a minimum capacity to ultimately handle this tonnage.

In comparing the landfill property line with the current permitted limit of waste, there appears to be some small areas where the landfill can be expanded laterally; however, most of the expansion at this landfill would need to occur vertically. Another potential option for lateral expansion is the adjacent properties, to the north and southeast of the landfill.

Without any expansion plans, it is unknown at the present time what additional vertical expansion ADEQ would accept and permit. Preliminary assessment; however, appears to indicate that expansion of the Rio Rico Landfill alone would not accommodate the total projected waste of 2,922,000 tons. A combination of the expansion and an additional disposal facility such as a MRF and/or a transfer station would be a more appropriate alternative.

Capital costs associated with new landfills typically range between \$400,000 to \$800,000 per acre. Since this alternative involves the expansion of an existing landfill, and most of the expansion will occur vertically (minimal excavation), the capital cost would be in the range of \$200,000 to \$400,000 per acre.

### **Retrofitting the Patagonia and/or the Sonoita-Elgin Landfill**

Part of the discussion presented above for the Rio Rico Landfill expansion also applies to retrofitting (expanding) the Patagonia and the Sonoita-Elgin Landfills.

As with the Rio Rico Landfill expansion, the Patagonia Landfill can be expanded laterally or vertically. Based on some preliminary evaluation of the property limits of the Patagonia Landfill, there appears to be adequate area to expand laterally (it is estimated, based on preliminary calculations, that the area needed to accommodate the 2,922,000 tons is approximately 40-45 acres of landfill space).

During a recent conversation with the Town of Patagonia (Patagonia), SCS was informed that Patagonia would be interested in developing a regional solid waste management facility that would handle solid waste generated by Patagonia, and surrounding communities, including Nogales, Sonoita, Elgin, Rio Rico, and others. But in order to accomplish a regional approach, Patagonia would require the financial participation of other communities. Currently, Patagonia has approximately 80 acres, of which 43 acres are available for solid waste disposal at the Patagonia Landfill. The area that is currently permitted by ADEQ for solid waste disposal at the Patagonia Landfill is 23 acres, with an additional 20 acres as potentially available.

The Sonoita-Elgin Landfill, which as stated before, is currently receiving small quantities of construction debris and municipal solid waste (ultimately disposed of at the Rio Rico Landfill) is located within an area of approximately 40 acres. Of these 40 acres, approximately 60-70% has been used for landfilling operation. The remaining area has been designated as undeveloped land and/or unavailable for landfilling operation.

As with the Rio Rico and Patagonia Landfills, the Sonoita-Elgin Landfill could also be expanded laterally and vertically. Based on review of the existing conditions at the landfill, there appears to be a small area of land available for lateral expansion. However, as with the Rio Rico expansion, without any expansion plans, it is unknown at the present time what additional vertical expansion ADEQ would accept and permit.

Based on the above discussion, the Patagonia Landfill expansion alternative appears to have adequate space for the County's projected waste; however, since the landfill is not located adjacent to a major highway, modifications to the existing road, from Highway 82 to the landfill, or a separate new road from Highway 82, will need to be included as part of the expansion plans. Additionally, this alternative will require the design and installation of appropriate infrastructure and utilities, such as water, electricity and telephone.

The Sonoita-Elgin expansion alternative also offers a potential solution to the solid waste needs of the County; however, without knowing the vertical expansion to be approved and permitted by the County, it is unknown whether the expansion alone would satisfy the needs. As previously stated, to accommodate the projected 2,922,000 tons of waste by the year 2036, an area of approximately 40-45 acres of landfill space is required. It is possible that for this alternative, an additional disposal facility such as a MRF and/or a residential transfer station would be a more appropriate alternative.

As previously stated, the capital costs associated with new landfills typically range between \$400,000 to \$800,000 per acre. Since the Patagonia Landfill will involve excavation and potentially major modifications to the existing access to the landfill, and design and installation of infrastructure and utilities, the capital cost for this alternative is estimated to be in the middle to the upper range (\$600,000 to \$800,000 per acre). For the Sonoita-Elgin Landfill expansion alternative, which will also include some excavation (less than at Patagonia), the capital cost is estimated to be in the \$300,000 to \$500,000 per acre. This estimated cost is slightly higher than the expansion at Rio Rico due to the possibility of improvements to the existing landfill access.

### **A New Landfill**

This alternative involves the siting, permitting, design, and construction of a new landfill somewhere within the County. The first step in the process of developing a new landfill is to identify available parcels of land (sites) within the County that will meet the criteria required to construct a landfill. These criteria include among other items, the required acreage, appropriate hydrogeologic settings, acceptance of the locations by the nearby communities, and the cost of the land.

Following the selection of the potential landfill location (from the siting study), the site will be required to be permitted by ADEQ, as a new landfill facility. This new landfill facility will be required to be designed and constructed in accordance with RCRA subtitle D requirements, and will include the design and installation of geosynthetic materials at the bottom of the landfill, provision to collect and treat/dispose of the leachate generated by the landfill, etc.

Capital costs associated with new landfills typically range between \$400,000 to \$800,000 per acre. Since this alternative involves a new landfill, it is estimated that the capital cost for this alternative will be in the upper range of the \$400,000 to \$800,000 per acre (\$600,000 to \$800,000 per acre).

## Transfer Station at the Rio Rico Landfill



The type of transfer station feasible for a certain community depends on various design variables such as: the required capacity and amount of waste storage desired, types of waste, processes required to recover materials, types of collection vehicles, and site characteristics and access. Transfer stations are also typically described as small capacity (less than 100 tons/day), medium capacity (100 to 500 tons/day) and large capacity (more than 500 tons per day).

Transfer stations can also be classified as direct dump stations (where waste is dumped directly from collection vehicles into waiting transfer trailers), pit or platform noncompaction stations (where waste is dumped into a pit or onto a platform and then loaded into trailers), hopper compaction stations (where waste is unloaded from the collection truck, through a hopper, and loaded into an enclosed trailer through a compactor), and push-pit compaction station (where waste is unloaded from the collection truck into a push pit, and then loaded into an enclosed trailer through a compactor).

Each of the transfer stations described above has advantages and disadvantages. For example, direct dump transfer advantages include: minimum hydraulic equipment, relatively inexpensive construction costs, easy provision of drive-through arrangement of transfer vehicles and higher payloads than compactor trailers. Disadvantages of direct dump transfer station include: the requirement of larger trailers than compaction stations, the dropping of bulky items directly into trailers can damage the trailers and the number and availability of stalls may not be adequate to allow direct dumping during peak periods.

Based on the waste projections presented in Section 2, in the year 2036 Santa Cruz County will need a transfer facility with a capacity of 571 tons per day; however, transfer stations are typically designed 5-10 years into the future and upgraded before the existing facilities reach their capacity. Thus, if a transfer facility is to be constructed in approximately 5-10 years, the facility's capacity would be approximately 275 to 315 tons per day (year 2020).

Typical capital costs for transfer stations range from \$1,000,000 to \$2,000,000 for each 100 tons per day. Selecting a 300 tons per day transfer station facility, the estimated capital cost would be approximately \$3,000,000 to \$6,000,000, and the ultimate facility to handle 571 tons per day would be approximately \$5,710,000 to \$11,400,000.

## Material Recovery Facility (MRF)



In October of 1992, SCS conducted an engineering feasibility study for a solid waste MRF to receive and process municipal solid waste from the City of Nogales and the surrounding County. As part of the feasibility study, SCS performed a waste sort at the Rio Rico Landfill, selected the most appropriate site for locating the MRF, prepared site facility drawings and provided financial analysis of the project.

The results of the analysis showed that a MRF could be anticipated to reduce the amount of waste landfilled by approximately 23 percent, and if a composting program were initiated for the compostable fraction of the waste, the amount of material disposed at the landfill could potentially be reduced by approximately 47 percent.

Based on the waste projections developed for the MRF study and the assumption that approximately 23 percent of the total waste could potentially be recyclable, a processing facility designed to handle approximately 75 tons per day was selected. Also, based on a review of the Rio Rico Landfill area, a site located across the service road from the landfill was selected as a suitable potential site for a MRF. Using 1992 costs, the capital cost of the 75 tons per day facility was estimated at \$1,147,000.

One of the conclusions from the study was that a MRF appeared to be a reasonable solid waste management option for Santa Cruz County.

Since the waste projections developed in the 1992 study have been updated (Table 1), it is appropriate to revisit some of the analysis results and design assumptions used in the 1992 SCS study. The results of the 1992 SCS study showed that a MRF could potentially reduce the amount of waste being landfilled by approximately 23 percent. Based on review of current literature and available data, it appears that for a community with a MRF facility and no residential recyclable program, the 23 percent appears to be high. A more reasonable percent reduction of waste currently being landfilled could be in the 10-15 percent range. It is possible that if the County could develop some sort of a residential recyclable program in cooperation with the private sector, this rate could increase to 20-25 percent. Regarding the projected waste, in the 1992 study, 45,412 tons per year were projected for the year 2030; however, as shown on Table 1, the projected waste for the year 2030 is now 144,500 tons per year.

Based on the waste projections presented on Table 1, in the year 2036, 172,541 tons of waste will be generated by the County. The annual tonnage is equivalent to 571 tons per day. Applying a 20 percent recyclable factor, the County would ultimately require a recycling facility that would be capable of diverting approximately 114 tons per day. With this alternative, the remaining 80 percent (138,000 tons per year or 460 tons of recyclables per day) of waste would be disposed of at a County landfill or transported to a non-County landfill.

Capital costs for a MRF range from \$5,000,000 to \$10,000,000, depending on size and features of the facility. Expected revenues from a MRF for recyclable materials are in the range of \$20.00 to \$80.00 per ton of waste. Selecting a 75 to 100 tons per day facility, the estimated capital cost would be in the \$5,000,000 to \$8,000,000 range.

### **Material Recovery Facility (MRF) and Transfer Station**



This combined alternative offers the option of recycling a portion of the waste received at the facility, with the remaining portion to be handled by the transfer station, and ultimately hauled to a County or non-County landfill. Under this alternative, it is assumed that the combined facility will be installed at the same time.

A typical MRF/transfer station facility consists of the following features:

- Self haul and commercial scales.
- MRF.
- Self haul and commercial tipping areas.
- Transfer truck parking and tarping.
- Recycling area.
- Maintenance area.
- Administration building.

Capital costs for a MRF/transfer station range from \$6,000,000 to \$12,000,000, and expected revenues for recyclable materials is in the range of \$20 to \$80 per ton of waste.

### **Waste-to-Energy**



The waste-to-energy process consists of the burning of municipal solid waste, production of electricity, and the recovery of recyclable materials. Typically, waste-to-energy facilities include the following technologies: mass burn waste-to-energy plants, refused-derived fuel waste-to-energy plants and modular waste-to-energy plants. The mass burn waste-to-energy

plants generate electricity and/or steam from solid waste introduced into large furnaces dedicated solely to burning solid waste and producing power. Refused derived fuel waste-to-energy plants remove recyclable or unburnable materials and shred or process the remaining waste into a uniform fuel. Modular waste-to-energy plants are similar to mass burn facilities, but the modular units typically are smaller.

The steps involved in waste-to-energy plants are as follows:

- The solid waste is deposited onto the floor or into a large concrete pit of the receiving building (in some cases the recyclables have already been removed by some sort of recycling program).
- From this area the solid waste is loaded into the furnaces where high temperature combustion completely destroys viruses, bacteria, rotting of food and other organic compounds found in household wastes.
- The heat from the burning waste boils water flowing inside the boiler tubes and turns the water into steam. The steam is generally used to turn a turbine-generator to make electricity or can be used directly in a heating system or a factory.
- The final products from the waste-to-energy plants are non-combustible residue (ash) and metals that can be removed and recycled and/or disposed of in a landfill.

As with other conversion technologies, waste-to-energy plants preserves valuable space at landfills (the left over ash is approximately 10 percent of the original volume of waste) and avoid the consumption of natural minerals by using the ash for different application such as road base, landfill cover, and other construction applications.

Typical capital costs associated with waste-to-energy plants range from \$150,000 to \$200,000 per design ton of capacity. Assuming an initial facility for Santa Cruz County of 350 tons per day (year 2020), the capital cost would be in the range of \$52,000,000 to \$70,000,000. For a 571 tons per day facility, the capital cost would be in the range of \$85,000,000 to \$114,200,000. Expected revenues from waste-to-energy plants from the sale of electricity and recyclables, range from \$30 to \$120 per ton of waste processed.

## **Composting**



As part of the 1992 Santa Cruz County Materials Recovery Feasibility Study, SCS performed a brief review of the feasibility and physical arrangements necessary for composting. Several potential composting arrangements were reviewed, including rotary kiln, windrow technologies and/or stacked aerobic systems. The recommendation made in the 1992 study regarding composting was that the County initiates a pilot composting program. Following the recommendations made in the 1992 Materials Recovery Feasibility Study, SCS performed a Compost Facility Feasibility Study in 1997. As part of this study, SCS

evaluated several composting technologies: windrow facilities, aerated pile facilities and in-vessel facilities.

The conclusions from the Compost Facility Feasibility Study indicated among other things that the spoiled produce waste would require a large amount of bulking agents, and that there were no known sources of bulking agents within close proximity of the Rio Rico Landfill. Additionally, it was stated in the report that the spoiled produced would rapidly create odor problems for the major housing subdivision to the south of the parcel identified for potential use as compost site.

The recommendations from the Compost Facility Feasibility Study were that alternatives, other than composting, for disposal of the spoiled produce waste should be investigated by the County, and that a use of easily separable yard waste at the landfill may be for alternative daily cover.

From the 1997 study, by using the total annual compostable waste tonnage of 45,050 tons per year in the year 2030, the land requirement for the windrow, aerated pile and in-vessel facilities were estimated as 8 to 15 acres, 6 to 8 acres and 2 acres, respectively. Using 1997 costs, the capital costs were estimated at \$180,000 to \$380,000 for a windrow facility, \$400,000 to \$700,000 for an aerated pile facility and \$2,400,000 to \$5,000,000 for an in-vessel facility. Updating the 1997 costs (to 2007 dollars), the capital cost for a windrow facility would be \$243,000 to \$515,000, \$540,000 to \$950,000 for an aerated facility, and \$3,242,000 to \$6,750,000 for an in-vessel facility.

### **Anaerobic Digestion**



Anaerobic digestion is the bacterial breakdown of organic materials in the absence of oxygen. This biological process produces a gas, sometimes called biogas, principally composed of methane and carbon dioxide. This gas is produced from feedstock such as biosolids, livestock manure, and wet organic materials.

The anaerobic digestion process occurs in three steps:

1. Decomposition of plant or animal matter by bacteria into molecules such as sugar.
2. Conversion of decomposed matter to organic acids.
3. Organic acid conversion to methane gas.
4. Produces electricity, steam, hot water and compostable “digestate”.

Anaerobic processes can occur naturally or in a controlled environment such as a biogas plant. In controlled environments, organic materials such as biosolids and other relatively wet organic materials, along with various types of bacteria, are put in an airtight container called a digester

where the process occurs. Depending on the waste feedstock and the system design, biogas is typically 55 to 75 percent methane.

The anaerobic digestion process, which requires a MRF is considered a well-developed process in Europe and Asia (with more than 20 years of experience). There are dozens of anaerobic digestion facilities in operation, ranging up to several hundred tons per day, and there are many more in design and construction, some over 1,000 tons per day.

Advantages associated with the anaerobic digestion process include the production of medium-Btu biogas (which can be sold to local electric companies). Potential negative impacts associated with anaerobic digestions facility include noise, odor, and air emissions.

Typical capital costs associated with anaerobic digestion processes range from \$90,000 to \$245,000 per ton and expected revenues from anaerobic digestion (from the sale of recyclables and energy) is in the range of \$30.00-\$120.00 per ton of waste. For a 571 tons per day facility, the capital cost is estimated at \$51,000,000 to \$140,000,000.

## 4 COMPARATIVE ASPECTS OF THE SELECTED ALTERNATIVES

A comparison of the conceptual alternative facilities is presented in Table A-1. Cost and revenue data reported in this Table are discussed below.

As shown on Table A-1, the most expensive alternatives are waste-to-energy and anaerobic digestion. The waste-to-energy alternative is estimated at \$150,000 to \$200,000 per ton (\$85,650,000 to \$114,200,000 for a 571 tons per day facility), and the anaerobic digestion alternative is estimated at \$90,000 to \$245,000 per ton (\$51,000,000 to \$140,000,000 for a 571 tons per day facility).

For new landfills and landfill expansions, the capital costs range from \$200,000 to \$800,000 per acre. As discussed in previous sections, the lowest capital cost has been estimated for the Rio Rico Landfill expansion, where the majority of the expansion is assumed to be vertically. The expansions at Sonoita-Elgin and Patagonia Landfill will require more effort, and therefore will require more capital costs. The estimated capital cost for a new landfill is estimated at \$400,000 to \$800,000 per acre (approximately \$16,000,000 to \$32,000,000 for a 40 acre facility). It should be further noted that these costs represent cell construction cost and do not consider land purchases in these costs. Furthermore, it is anticipated that approximately 1.0-1.5 million dollars will be needed to fully permit a new landfill. Permitting at other new facilities is estimated to be considerably less than a new landfill. Retrofitting an existing facility will have the lowest permitting cost of any of the three scenarios discussed.

MRF capital costs are estimated at \$5,000,000 to \$10,000,000 and transfer stations are estimated at \$1,000,000 to \$2,000,000 per 100 tons per day facility (approximately \$5,700,000 to \$11,400,000 for a 571 tons per day facility).

Capital cost for a compost facility varied from \$243,000 to \$515,000 for a windrow facility to \$3,242,000 to \$6,750,000 for an in-vessel facility (45,050 tons per year facility). These costs were based on the results of the 1997 Santa Cruz County Compost Facility Feasibility Study and using 2007 dollars.

Table A-1 also presents non-economic aspects of each of the conceptual alternative facilities included in this study. For each alternative, the following factors/aspects have been included: environmental factors, social aspects, drawbacks/disadvantages, process reliability and risk assessment, unresolved questions, and overall assessment. As shown on this table, each alternative offers some beneficial aspects and also some drawbacks and disadvantages.

## 5 OBSERVATIONS AND RECOMMENDATIONS

Each of the disposal and/or reuse alternatives assessed in this study offer certain technical, environmental and economic advantages and disadvantages and are presented in Table A-1. The cost and environmental observations presented in Table A-1 are based on the data gathered during this study. The three ranked alternatives presented below have no known environmental factors that would preclude them from being implemented. The most feasible alternatives are ranked from lowest to next highest cost and are presented as follows:

- It is readily apparent that expansion of the existing landfills within the County offer the most cost effective feasible alternative for the future, and therefore should be included for consideration in the next phase of the study.
- Next lowest cost effective alternatives are the consideration of a MRF and/or transfer station. A stand-alone facility or in combination with an existing landfill indicate that a facility of this type should also be included as an option for detailed analysis in the next phase.
- The last and the most expensive of the three disposal alternatives evaluated is the consideration to site a new landfill somewhere in Santa Cruz County.

The specific recommendations from this conceptual study are as follows:

- The three alternatives to be recommended for further evaluation in the next phase are:
  - 1) Landfill expansion to the Rio Rico Landfill,
  - 2) Retrofitting the Patagonia Landfill, and
  - 3) Siting a new landfill.
- Since the Rio Rico Landfill expansion alone will not accommodate the projected waste of 2036, a MRF (initially) and a transfer station (at later date) will be included in the landfill expansion alternative.
- As part of the next phase, MRF vendors may be informally contacted regarding their potential interest in participating a specific project. This information will be used to evaluate the benefits/drawbacks of a privately versus County owned MRF facility.
- Also, as part of the next phase, conversations and possible meeting (s) with ADEQ will be scheduled to request preliminary response from ADEQ regarding the recommended alternative.
- Regarding the new landfill alternative, a preliminary evaluation of potential sites and review of available geotechnical data and other related information may be performed. The next phase will not include a specific siting study or any design drawings associated with a new landfill.

- The next phase of the study will include an in-depth economic analysis of each selected alternative, including detailed costs for engineering, construction and O&M, and where applicable, the SCS pro-forma model will be modified to include the County's costs and revenue structures.

APPENDIX A - Comparison of Conceptual Alternative Facilities

**TABLE A-1. COMPARISON OF CONCEPTUAL ALTERNATIVE FACILITIES**

	<b>Capital Costs</b>	<b>O&amp;M Costs</b>	<b>Engineering Costs</b>	<b>Environmental and Social Factors</b>	<b>Process Reliability and Risk Assessment</b>	<b>Overall Assessment</b>
<b>Landfill Expansion at Rio Rico</b>	\$200,000 to \$400,000 per acre.	\$5 to \$25 per ton.	\$300,000 to \$500,000.	Site already approved as landfill, and has been accepted by the community.	Landfill disposal has been determined to be reliable, when properly designed.	Landfills are typically less expensive, but environmentally unacceptable due to aesthetics, odors, and vectors.
<b>Retrofitting Patagonia and/or SELF</b>	\$300,000 to \$800,000 per acre.	\$5 to \$25 per ton.	\$500,000 to \$1,000,000.	Site already approved as landfill, and has been accepted by the community.	Landfill disposal has been determined to be reliable, when properly designed.	Landfills are typically less expensive, but environmentally unacceptable due to aesthetics, odors, and vectors.
<b>New Landfill</b>	\$600,000 to \$800,000 per acre.	\$5 to \$25 per ton	\$1,000,000 to \$1,500,000.	Location of potential sites could present environmental challenges, but can be permitted. Public may oppose to landfill locations.	Landfill disposal has been determined to be reliable, when properly designed.	Landfills are typically less expensive, but environmentally unacceptable due to aesthetics, odors, and vectors.
<b>Transfer Station at Rio Rico</b>	\$1,000,000 to \$2,000,000 per 100 tons per day.	\$30 to \$40 per ton.	\$500,000 to \$1,000,000.	Increased traffic (potential air pollution). Can be permitted. Jobs created at the transfer station will replace those lost at closed landfills.	Process has been proven to be reliable.	Transfer station offers lower collection costs, reduced fuel and maintenance costs and the opportunity to recover recyclables and compostables at the transfer facility.
<b>Material Recovery Facility</b>	\$5,000,000 to \$10,000,000.	\$30 to \$40 per ton.	\$500,000 to \$1,000,000.	Land conservation (by reducing MSW going to landfills). Can be permitted. Will affect current individual recyclers.	Process has been proven to be reliable and low risk.	Has been implemented commercially for many years, and can be implemented immediately at local level.
<b>Material Recovery Facility/Transfer Station</b>	\$6,000,000 to \$12,000,000.	\$30 to #40 per ton.	\$500,000 to \$1,000,000.	Same as described above, for transfer stations and MRF.	Same as described above, for transfer stations and MRF.	Same as described above, for transfer stations and MRF.
<b>Waste To Energy</b>	\$150,000,000 to \$200,000 per ton.	\$100 to \$150 per ton.	\$2,000,000 to \$3,000,000.	Air permit difficult to obtain. Facility siting very difficult.	Somewhat reliable, based on limited facilities.	Expensive alternative and limited reliability.
<b>Composting</b>	\$243,000 to \$6,750,000.	\$23 to \$54 per ton.	\$500,000 to \$1,000,000.	Runoff may be contaminated. Process creates odor problems.	Proven technology; however, difficult to control odors, and therefore somewhat risky.	Based on 1997 study, not cost feasible for implementation in Santa Cruz County.
<b>Anaerobic Digestion</b>	\$90,000 to \$245,000 per ton.	\$65 to \$75 per ton.	\$2,000,000 to \$3,000,00.	Relatively easy to acquire environmental permits. Generated electricity can be used by the local community.	Facility designs are relatively new. The majority of the existing facilities are outside the United States.	Expensive alternative and unproven for large facilities (greater than 75 tons per day).

Notes: O&M Costs do not include debt service.

## APPENDIX B – References

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