


Report
Solid Waste Management 2030
Tasks 3 and 4

Prepared for:
Region 2000 Services Authority

May 24, 2017

The Guiding Principles

Open-Minded: to options and diverse perspectives.
Responsible: to our regional community, to our environment, and to our future
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Nelson County Virginia 1807

Appomattox County 1845 The Heart of Virginia

The City of Lynchburg

Region 2000 Services Authority

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1.0 EXECUTIVE SUMMARY

Region 2000 Services Authority (Authority) owns and operates a landfill (Permit 610) located in Rustburg Virginia which serves Appomattox County, Campbell County, Nelson County and the City of Lynchburg. In addition, the Authority owns the closed Concord Turnpike Landfill (Permit 558) which received Regional waste from 2008 through 2012 and which has now entered its permitted 30-year post closure care period.

The four localities officially became the Authority on December 28, 2007 and entered into a Member Use Agreement in 2008. The Permit 610 – Livestock Road Regional Landfill facility is anticipated to reach capacity in 2030. Given the nature of solid waste planning and the required time frame for implementation, the Authority determined that it was appropriate to initiate strategic planning activities in 2016 relative to considering the options available for solid waste management after 2030.

The effort has been divided into multiple tasks that work to develop technical evaluations with a numerical benefits analysis in parallel. The first phase (Tasks 1 and 2) presented to the Board at their January 25, 2017 meeting included the development of a public involvement program, definition of the goals, criteria and measurement for ranking the benefits of options, and identification of potential options. The potential options were divided into two categories; the first was disposal options and the second was enhancements e.g. recycling and organic diversion.

The second phase (Tasks 3 and 4) continued the exercise with more detailed technical analysis by Burns and McDonnell supported by Coker Composting relative to the option evaluation and continued effort by Draper Aden Associates and Renaissance Planning on the benefit analysis.

The following summary relative to the Tasks 3 and 4 work is based on the information provided in the Appendices to this report which include the following:

- Appendix 1 – Benefits Analysis prepared by Draper Aden Associations
- Appendix 2 – Options Analysis prepared by Burns and McDonnell
- Appendix 3 – Organics Diversion prepared by Coker Composting and Consulting

2.0 BENEFIT ANALYSIS - SUMMARY

Draper Aden Associates with input from Renaissance Planning completed the benefits analysis and outlined their results in their report entitled, *"Solid Waste Management 2030 – Benefits Analysis,"* dated May 11, 2017. (Appendix 1) For the benefits analysis, Draper Aden Associates worked with the goals, objectives and measurements as outlined in the report presented to the Region 2000 Services Authority Board at their January 25, 2017 meeting. The goals, objectives and measurements were developed by the Working Group in conjunction with their consultants. This report can be accessed at the site below:

http://www.solidwastemanagement2030.org/uploads/4/4/7/9/44790795/rpt_draft__-_17_0125_-_region_2000_-_swp2030_-_tasks_1_and_2_-_submittal.pdf

The Working Group determined that Draper Aden Associates should focus their evaluation on the primary disposal options for the benefit analysis. The enhancements of recycling and composting were not scored as part of this benefit analysis. The disposal options included waste to energy, transfer station at Livestock Road, and a landfill expansion at Livestock Road. The analysis "scores" each option as described below.

The development of the score begins with the criteria. Each criterion has a set of measurements that are the basis for how many points an option can obtain within that criterion. These points are multiplied against the weighting of the criterion to create a point total for the corresponding goal. That point total is then multiplied by the weighting of the goal, which is how the score for each goal is assigned. The score for each goal is then summed to create the overall 0 to 100 score. Further description on the methodology can be found in the Appendix 1 report as can the scoring sheets for each option.

Using this methodology and applying it to the three chosen disposal options provides a ranking of the three options as summarized in the table below (Note that the higher the total the more "beneficial" the option.):

TABLE 1 – SUMMARY OF BENEFIT SCORES

GOAL AND CRITERIA	Maximum Points	Waste to Energy	Transfer Station	Landfill Expansion
REDUCE WASTE (35%)				
Reduce amount of waste disposed of in landfills	17.5	17.5	0.0	0.0
Increase recycling and reuse	17.5	4.4	13.1	0.0
FLEXIBILITY (25%)				
Ability of option to adjust to changes in industry	11.3	0.0	5.6	11.3
Ability of option to adjust to waste types or tonnages	8.8	0.0	4.4	8.8
Simplicity of option for operations and administration	5.0	0.0	3.0	5.0
RESPONSIBLE TO REGION (25%)				
Reduce impact on natural resources	11.3	3.9	8.4	2.9
Reduce financial risk to authority and communities	8.8	4.4	6.1	6.1
Commitment by local governments to option	5.0	3.0	5.0	5.0
MINIMIZE LOCAL IMPACTS (15%)				
Protect community resources	6.0	0.0	3.0	0.0
Minimize infrastructure impacts	6.0	0.0	3.3	3.3
Compatible with local land use policy	3.0	0.0	0.0	0.0
BENEFIT TOTAL	**100.0**	**33.2**	**52.0**	**42.3**

Based on this ranking, the transfer station option would appear to be the "most beneficial" without consideration of cost. See Section 4.0 of the Appendix 1 report for further detail on the key factors that entered into this scoring.

In summary, the Working Group, working with its consultants, developed a methodology for quantifying the benefits of each option. Table 1 indicates that based on the established goals, criteria and measurements, the transfer option has the highest benefit score. It's higher score is a function of its potential to promote recycling, traditional technology, minimal risk to the Authority and minimal impact to the community. This evaluation does not consider impacts from the landfill (presumed to be outside of the region) on the resources or the community in which the landfill is located. It also does not consider costs. Costs have been evaluated independently by Burns and McDonnell (See the Appendix 2 report).

With the preparation of the Appendix 1 report, the benefit analysis is completed. Next steps include the following:

- Presentation to the Region 2000 Services Authority Board on May 24, 2017.

- Provision of additional information as may be requested by the Board.

3.0 COST ANALYSIS – SUMMARY

Burns and McDonnell evaluated the disposal and enhancement options in their report entitled, *"Evaluation of Disposal Options and Recycling Enhancements,"* dated May 4, 2017. (Appendix 2) Their work was also informed by the information provided by Coker Composting in Appendix 3 relative to organic diversion. Key assumptions cited in their report include the following:

- Cost information includes direct capital and operating costs, management and oversight, support from Region 2000 staff and other costs as specifically described. Other indirect costs or overhead that the Authority may choose to include in future budget years, e.g. community enhancements, host fees etc. are not included.
- All cost estimates are high level planning estimates and will require further analysis and evaluation once the Authority provides further direction.
- No growth was applied to tonnage projections based on trends relative to landfill tonnage at the current facility and population projections.
- All costs are shown in 2017 dollars, even though expenses incurred in the future are expected to be higher due to inflationary factors. Showing the costs in current dollars allows for easier comparisons to the current costs of the existing landfill operation.
- While the planning is based on a 25-year period, the costs shown in the Appendix 2 report are based on one year of capital and operating costs. Since tonnage is kept constant and all costs are shown in 2017 dollars, there are minimal differences in the annual costs over the 25 year period.
- All options require some form of local government approval (e.g. rezoning, special use permitting and site plan approval). All options require some form of VDEQ permitting.

The following table identifies the disposal options and enhancements (e.g. recycling and organic diversion) and level of detail being provided in the evaluation:

TABLE 2
INITIAL LIST OF DISPOSAL OPTIONS AND RECYCLING ENHANCEMENTS

OPTION/ENHANCEMENT	SCENARIO	LEVEL OF DETAIL
Landfill	Continue at existing landfill site	More in-depth analysis
	Expansion of another permitted landfill in the region	The Appomattox County landfill is not a suitable location for the regional landfill so this option was not evaluated further.

OPTION/ENHANCEMENT	SCENARIO	LEVEL OF DETAIL
Transfer Station (TS)	Transfer Station at current landfill site	More in-depth analysis
	Transfer Station at another location in region	Review focused on additional costs to locate a transfer station in another location.
Waste to Energy (WTE)	WTE facility in the region	High-level review based on prior WTE feasibility studies
Regional recycling collection	Develop a regional recycling program	Review focused on potential increase in recycling tonnage collected from member communities.
Material recovery facility (MRF)	MRF at current landfill site	High-level review based on Burns and McDonnell's experience with other small-scale MRFs.
	MRF at another location in region	Review focused on other recycling options available locally and regionally
Mixed Waste Processing (MWP)	MWP at current landfill site	High-level review based on prior MWP feasibility studies
	MWP at another location in region	This scenario not evaluated since location has minimal financial impact on this scenario.
Composting	Source separated organics (SSO)	High-level review included in Appendix 3.

The following table summarizes the Burns and McDonnell cost evaluation for the disposal options as discussed in the Appendix 2 report:

TABLE 3
ESTIMATED COST PER TON
DISPOSAL OPTIONS

Option	Annual Tons	Estimated Cost per Ton
Waste-to-Energy	202,850	$100 – $135
Landfill Expansion at Livestock Road	202,850	$30.71
Landfill at Closed Appomattox Landfill	Not evaluated	Not evaluated
Transfer Station at Livestock Road Landfill	133,615	$61.76
Transfer Station in Lynchburg	133,615	$62.16 – $62.76

The following table summarizes the Burns and McDonnell cost evaluation for the recycling enhancements as discussed in the Appendix 2 report and the impact of an enhancement on either the landfill or transfer option.

TABLE 4
ESTIMATED COST PER TON
DISPOSAL AND ENHANCEMENT OPTIONS

Enhancement	Estimated Cost per Ton[4]	Services Included [1]
Enhancements		
Mixed Waste Processing	$47.40 – $61.80	Recycling, Composting and Disposal
Utilize Existing Recycling Facility – Local	$35	Recycling
Utilize Existing Recycling Facility – Regional	($20) – $20 [2]	Recycling
New Material Recovery Facility	$20 – $70 [3]	Recycling
Disposal with Enhancements		
Landfill with Local Recycling	$31.17	Recycling and Disposal
Transfer Station with Regional Recycling	$58.84	Recycling and Disposal
Transfer Station with Local Recycling	$58.56	Recycling and Disposal

1. Services are recycling processing, composting at a third-party and transfer/disposal. No member collection costs are included.
2. The range shown is a net revenue of $20 per ton to an expense of $20 per ton.
3. Assumes additional private hauler tonnage is hauled to the MRF.
4. Does not reflect additional costs that may be incurred by the localities in implementing the various programs.

Key findings for the disposal options and recycling enhancements may be summarized as follows.

1. Expanding the existing Livestock Road Landfill is the most financially feasible option at $30.71 per ton since the Authority already owns the land (adjacent to the current landfill) necessary for the expansion, and has previously constructed the basic infrastructure (e.g. office, scales, maintenance facility, leachate handling facilities), which reduce the capital expenses associated with this option. It should be noted that this analysis is based on a much smaller landfill footprint (compared to the special use permit application from 2014) with increased buffer areas between the active landfill and the neighboring properties.
2. The cost of the transfer station option is approximately twice the cost of the landfill option (approximately $62 per ton for a transfer station versus approximately $31 per ton for the landfill option) which is a function of hauling.

3. Waste to energy (WTE) is not financially feasible for the Authority given the high up-front capital and ongoing operating costs (approximately $100 - $135 per ton).
4. Mixed waste processing (MWP) has high up-front capital costs and ongoing operating costs. The estimated cost of $47 - $62 per ton is higher than the landfill option and about the same as the transfer station. However, it also introduces additional operating risks based on the fluctuation of commodity prices and risk of acceptance of recyclables, particularly fiber, recovered from the MWP facility that could be contaminated.
5. A stand-alone MRF may be financially viable, if additional private tonnage can be sourced and when commodity markets are strong. However, the Authority would have to assume the risk of fluctuating commodity markets. Utilizing a transfer station to haul recyclables to a regional MRF or utilizing a local recycling facility may be financially comparable to a stand-along Authority MRF based on current commodity markets, without as much additional risk.
6. Utilizing a local recycling facility with the landfill option results in slightly higher per ton costs, on a weighted average basis, when compared to a landfill-only option (less than $1 increase per ton). This analysis excludes additional collection costs for the member communities.
7. Incorporating recycling, whether local or regional, with a transfer station will slightly reduce the costs of the transfer station option. Burns & McDonnell estimated approximately a $3 per ton cost reduction on a weighted average basis. This would reduce the transfer station cost from approximately $62 per ton to approximately $59 per ton. This analysis excludes additional collection costs for the member communities.

With the preparation of the Appendix 2 report, the options evaluation is completed. Once the Region 2000 Services Authority Board provided further direction, the Authority's staff will develop a timeline for conducting a more detailed technical and financial evaluation.

4.0 BENEFIT TO COST RATIO

After completion of the benefit analysis and option evaluation reports, the next step in the process was to merge the information from these reports together. To develop the benefit to cost ratio, the numerical benefit scores (Appendix 1) are merged with the cost of service for the options (Appendix 2) in a simple calculation (benefit score/cost of service). This is a method that allows the Authority Board to consider the technical costs of a project relative to the benefits. Using the information included in the reports referenced above the benefit to cost ratio for the options was calculated as follows:

TABLE 5
BENEFIT TO COST RATIO CALCULATION

ITEM	OPTIONS		
	Waste to Energy	**Transfer Station**	**Landfill Expansion**
Benefit Score	33.2	52.0	42.3
Cost of Service	$100.00	$61.76	$30.71
Benefit to Cost Ratio	0.33	0.84	1.38

Under the benefits analysis, the higher the score the more beneficial. Under the technical evaluation the lower the cost the more cost effective. When merged, the higher the benefit to cost ratio, the more effective the option. For this evaluation, the landfill expansion obtained the higher score and would be considered the more effective option.

5.0 SUMMARY

In summary, the Working Group in conjunction with the consultants developed a methodology for quantifying the benefits of each option and comparing those benefits with the estimated cost of service for the options. This allowed the Working Group to rank the options including both benefits and costs. Based on this evaluation, the expansion of the existing landfill would appear to be the preferred option based on the work completed to date. Waste to energy is not an option under further consideration due to its low benefit score and its high cost relative to the other options.

6.0 NEXT STEPS

The benefit and option analyses under Tasks 3 and 4 have been completed as has the benefit to cost scoring. Next steps include the following:

- Presentation to the Region 2000 Services Authority Board on May 24, 2017.
- Provision of additional information as may be requested by the Board.

APPENDIX 1

Draper Aden Associates – Benefit Analysis




Report
Solid Waste Management 2030 Benefits Analysis

Prepared for:
Region 2000 Services Authority

May 24, 2017

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EXECUTIVE SUMMARY

The Region 2000 Services Authority (Authority) estimates that its operating landfill, identified as Permit 610 - Livestock Road Regional Facility, will reach capacity by 2030. Given the complexity of regional solid waste planning and time frames associated with implementation, the Authority's Board determined that a strategic planning process should be initiated in FY 2017 to evaluate future disposal options with the ultimate goal of identifying the most effective option to be implemented. For purposes of this evaluation, the "Region", is defined as the member localities (the City of Lynchburg and the Counties of Appomattox, Campbell and Nelson).

The process is divided into distinct tasks that are being initiated sequentially, building off of the work of the previous tasks. The purpose of this report is to summarize the information prepared by Draper Aden Associates relative to the benefits analysis under Tasks 3 and 4.

This work was based on the goals, criteria, and measurements previously presented to the Board at their January 25, 2017 meeting. The goals and goal weighting as established by the Working Group for the project are described below:

Table 1: Goals and Goal Weighting

GOAL	DESCRIPTION	WEIGHT
Reduce Waste	Minimize the amount of waste that is sent to landfills or other disposal facilities through source reduction, education, and responsible waste management by all generators (residential, businesses, institutions, and industries).	35%
Flexibility	Develop a flexible waste management program that is efficient, balanced and sustainable to meet changing needs and technologies.	25%
Responsible to Region	Minimize the impacts to communities including fiscal and environmental resources throughout the Region.	25%
Minimize Local Impacts	Minimize the impacts on property owners and the community within the vicinity of any solid waste management facility.	15%
Total		100%

Each goal has a set of criteria that defines the goal. The criteria and weighting as established by the Working Group in response to public input are summarized below:

Table 2: Criteria and Criteria Weighting

GOALS	CRITERIA	WEIGHT
Reduce Waste	1. Reduce amount of waste disposed of in landfills	50%
	2. Increase recycling and reuse	50%
	Total	100%
Flexibility	1. Ability of option to adjust to changes in the solid waste management industry	45%
	2. Ability of option to adjust to waste types or tonnages	35%
	3. Simplicity of option for operations and administration	20%
	Total	100%
Responsible to Region	1. Reduce impact of option on natural resources	45%
	2. Reduce financial risk to Authority and communities	35%
	3. Commitment by local governments to option	20%
	Total	100%
Minimize Local Impacts	1. Protect community resources	40%
	2. Minimize infrastructure impacts	40%
	3. Compatible with local land use policy	20%
	Total	100%

For the benefits analysis, the Working Group determined that Draper Aden Associates should evaluate the primary disposal options for the evaluation. The enhancements of recycling and composting were not scored at this time. The disposal options evaluated are identified in the table below (See the report by Burns and McDonnell for further discussion on the determination of the final options for consideration under the benefits analysis).

Table 3: Disposal Options for Benefits Analysis

DISPOSAL OPTIONS	LOCATION ALTERNATIVES
Landfill	Expansion of Region 2000 Livestock Road Landfill (Campbell County)
Waste to energy facility (Landfill out of Region)	New facility in Region
Transfer Station (Landfill out of Region)	At Region 2000 Livestock Road facility

As indicated above, the enhancements were not considered under the benefits analysis.

The benefits analysis considers each option and assigns it a 0 to 100 score based on how effectively the option achieves the Region 2000 Service Authority's goals. The score is based on the relative weighting of each goal (some goals are considered more important than others, and therefore contribute more to the final score) and the relative weighting of each criterion (some criteria are more important than others as a measure of progress towards the corresponding goal).

The development of the score begins with the criteria. Each criterion has a set of measurements that are the basis for how many points an option can obtain within that criterion. These points are multiplied against the weighting of the criterion to create a point total for the corresponding goal. That point total is then multiplied by the weighting of the goal, which is how the score for each goal is assigned. The score for each goal is then summed to create the overall 0 to 100 score.

Using this methodology and applying it to the three chosen options provides a ranking of the three options as summarized in the table below (Note that the higher the total the more "beneficial" the option.):

Table 4: Benefit Calculation for Chosen Options

GOAL AND CRITERIA	Maximum Points	Waste to Energy	Transfer Station	Landfill Expansion
REDUCE WASTE (35%)				
Reduce amount of waste disposed of in landfills	17.5	17.5	0.0	0.0
Increase recycling and reuse	17.5	4.4	13.1	0.0
FLEXIBILITY (25%)				
Ability of option to adjust to changes in industry	11.3	0.0	5.6	11.3
Ability of option to adjust to waste types or tonnages	8.8	0.0	4.4	8.8
Simplicity of option for operations and administration	5.0	0.0	3.0	5.0
RESPONSIBLE TO REGION (25%)				
Reduce impact on natural resources	11.3	3.9	8.4	2.9
Reduce financial risk to authority and communities	8.8	4.4	6.1	6.1
Commitment by local governments to option	5.0	3.0	5.0	5.0
MINIMIZE LOCAL IMPACTS (15%)				
Protect community resources	6.0	0.0	3.0	0.0
Minimize infrastructure impacts	6.0	0.0	3.3	3.3
Compatible with local land use policy	3.0	0.0	0.0	0.0
BENEFIT TOTAL	**100.0**	**33.2**	**52.0**	**42.3**

The key elements of the ranking for each option are described in further detail in Section 4.0 and measurements discussed in Appendix 1 of this report.

In summary, the Working Group, working with its consultants, developed a method for quantifying the benefits of each option. Table 12 indicates that based on the established goals, criteria and measurements, the transfer option has the highest benefit score. It's higher score is a function of its potential to promote recycling, traditional technology, minimal risk to the Authority and minimal impact to the community. This evaluation does not consider impacts from the landfill (presumed to be outside of the region) on the resources or the community in which the landfill is located. It also does not consider costs. Costs have been evaluated by Burns and McDonnell in a separate report.

NEXT STEPS

The benefit analysis component of Tasks 3 and 4 is completed. Next steps include the following:

- Presentation to the Region 2000 Services Authority Board on May 24, 2017.
- Provision of additional information as may be requested by the Board.

1.0 INTRODUCTION

Region 2000 Services Authority (Authority) owns and operates a landfill (Permit 610) located in Rustburg Virginia which serves Appomattox County, Campbell County, Nelson County and the City of Lynchburg. In addition, the Authority owns the closed Concord Turnpike Landfill (Permit 558) which received Regional waste from 2008 through 2012 and which has now entered its permitted 30-year post closure care period.

The four localities officially became the Authority on December 28, 2007 and entered into a Member Use Agreement in 2008. The Permit 610 – Livestock Road Regional Landfill facility is anticipated to reach capacity in 2030. Given the nature of solid waste planning and the required time frame for implementation, the Authority determined that it was appropriate to initiate strategic planning activities in 2016 relative to considering the options available for solid waste management after 2030.

The effort has been divided into multiple tasks that work to develop technical evaluations with a numerical benefits analysis in parallel. The first phase (Tasks 1 and 2) presented to the Board at their January 25, 2017 meeting included the development of a public involvement program, definition of the goals and criteria for measuring the benefits of the options, and identification of the options. The second phase (Tasks 3 and 4) continued the exercise with more detailed technical analysis by Burns and McDonnell relative to the option evaluation and continued effort by Draper Aden Associates on the benefit analysis with the culmination of this work in ranking the considered options.

1.1 Options Identified

The Working Group, after further discussions, determined that the focus of the benefits analysis should be on the disposal options and not on combinations of disposal and enhancement options at this time. This decision allows the preliminary reporting effort to focus on the critical and primary element of the solid waste program, which is disposal. However this does not preclude further discussions on enhancements as the process moves forward. The options under evaluation include the following:

Table 5: Disposal Options for Benefits Analysis

DISPOSAL OPTIONS	LOCATION ALTERNATIVES
Landfill	Expansion of Region 2000 Livestock Road Landfill (Campbell County)
Waste to energy facility (Landfill out of Region)	New facility in Region
Transfer Station (To landfill out of Region)	At Region 2000 Livestock Road facility

Further information on the disposal options can be obtained from the Burns and McDonnell report, entitled: *"Evaluation of Disposal Options and Recycling Options,* dated May 2017 and from the Coker Composting and Consulting report entitled: *Organics Diversion in the Region 2000 Service Authority Region,"* dated April, 2017.

2.0 ESTABLISHMENT OF CRITERIA AND MEASUREMENTS

2.1 Overview

For the Solid Waste Management 2030 Plan, the Region 2000 Local Government Council, Region 2000 Services Authority and the Working Group determined that development of an evaluation process to compare the solid waste management options would be an important part of the strategic planning process. The evaluation process would consider the benefits of each option and allow for the options to be ranked based on their relative benefits separate from the cost evaluations. Input from the public, through online questionnaires, a focus group meeting, and informational forum, served to inform the Working Group as they worked to develop the project evaluation process.

The strategic planning process and the assessment of potential waste management options includes not only technical and financial evaluations but also consideration of the benefits of each option which may or may not be directly linked to the technical or financial evaluations. Thus, key to Tasks 1 and 2 was the development by the Working Group of an evaluation tool for assessing the benefits of an option, and the extent to which the option aligns with the goals of the Region relative to solid waste management. The tool developed required the identification of broad key goals,

with the goals defined by evaluation criteria (unique to that goal) and measured against a set of indicators unique to the specific criterion.

Ultimately each option is assigned a benefit's score of 0 – 100 points. The goals and criteria are weighted so that they contribute different fractions of the 0 to 100 score as each option is evaluated. The project evaluation process consisted of six steps:

1. Determination of the project goals. (Goals should guide determination of the success or appropriateness of an option.)
2. Relative weighting of these goals. (Are there goals that are strategically more important than others in evaluating an option?)
3. Determination of the evaluation criteria for each goal. (What criteria would be most important in determining whether an options contributes to achieving each goal? The criteria are the basis for evaluating options under each goal.)
4. Weighting the Criteria. (Are there criteria that are strategically more important than others in determining the success of each goal?)
5. Determination of the method for measuring the benefits of an option under each evaluation criteria. (What are important measurements for assessment of each criteria and how will they be measured?)
6. Implementation of the process to rank the options. (Do the assumptions of Steps 1 – 5 lead to a logical and objective conclusion?)

The sections below outline the development of this process by the Working Group; the final recommendations for goals, criteria, and measurements; and the final Benefit Analysis.

2.2 Goals

Goals are the large overarching themes that are important to its member communities, the citizens, and the Region 2000 Services Authority. The goals will direct the future of solid waste management in the Region. After considering input from the public during the informational forum and Focus Group meeting, from the questionnaires and from interviews, the Working Group identified four goals for this project. The weighting was based on input from the public, the experience of the Working Group and recommendations by the consultants. These goals and their weighting are identified as follows:

Table 6: Goals and Goal Weighting

GOAL	DESCRIPTION	WEIGHT
Reduce Waste	Minimize the amount of waste that is sent to landfills or other disposal facilities through source reduction, education, and responsible waste management by all generators (residential, businesses, institutions, and industries).	35%
Flexibility	Develop a flexible waste management program that is efficient, balanced and sustainable to meet changing needs and technologies.	25%
Responsible to Region	Minimize the impacts to communities including fiscal and environmental resources throughout the Region.	25%
Minimize Local Impacts	Minimize the impacts on property owners and the community within the vicinity of any solid waste management facility.	15%
		100%

2.3 Criteria

Each goal has a unique set of criteria which define that goal and are the basis for evaluating options relative to the goal. Based on the input from the public, the knowledge of the Working Group relative to their community's interests, and an understanding of solid waste management, criteria were established for the goals as described below. The weighting was based on input from the public, the experience of the Working Group and recommendations by the consultants. The criteria and their weighting are identified as follows:

Table 7: Criteria and Criteria Weighting

GOALS	CRITERIA	WEIGHT
Reduce Waste	1. Reduce amount of waste disposed of in landfills	50%
	2. Increase recycling and reuse	50%
	Total	100%
Flexibility	1. Ability of option to adjust to changes in the solid waste management industry	45%
	2. Ability of option to adjust to waste types or tonnages	35%
	3. Simplicity of option for operations and administration	20%
	Total	100%
Responsible to Region	1. Reduce impact of option on natural resources	45%
	2. Reduce financial risk to Authority and communities	35%
	3. Commitment by local governments to option	20%
	Total	100%
Minimize Local Impacts	1. Protect community resources	40%
	2. Minimize infrastructure impacts	40%
	3. Compatible with local land use policy	20%
	Total	100%

2.4 Measurements

Each criterion must be measurable for the process to work as an evaluation and ranking mechanism. Objective and quantifiable measurements are preferred. However, many of the measurements for solid waste option evaluations are more subjective and comparative. The solid waste management options were evaluated using the measurements developed under previous tasks. The options received points towards a benefits score based on how well they perform under each measurements described in this section. The measurements are outlined below with more detailed descriptions of the measurements included in Appendix 1. This information was previously included in the January report presented to the Board.

2.4.1 Reduce Waste

The following measurements for the goal of reduction of waste were developed by the Working Group working together with the consultants.

Table 8: Measurements for Reduce Waste and its Criteria

CRITERIA	WEIGHT	MEASUREMENTS	POINTS
1. Reduce amount of waste disposed of in landfills	**50%**	**Reduces amount of waste that must be landfilled (% reduction)**	**100**
		No reduction in tonnage landfilled	0
		Reduction <10% of tonnage landfilled	20
		Reduction 10 - 25%	60
		Reduction > 25%	100
2. Increase recycling and reuse	**50%**	**Enhances recycling and reuse programs (i.e. encourages recycling/reuse; simplifies recycling)**	**100**
		No recycling required for option	0
		Some recycling or reuse required for option	25
		Recycling or reuse required for option	50
		Does not simplify recycling	0
		Simplifies recycling	50
Total	100%		

See Appendix 1 for a further description of these measurements.

2.4.2 Flexibility

The following measurements for flexibility were developed by the Working Group working together with the consultants.

Table 9: Measurements for Flexibility and its Criteria

CRITERIA	WEIGHT	MEASUREMENTS	POINTS
1. Ability of option to adjust to changes in the solid waste management industry	**45%**	**Limits risk of new regulations or obsolescence over next 25 years that will impact operations**	100
		Risk of new regulations or technology high	0
		Risk of new regulations or technology moderate	50
		Risk of new regulations or technology low	100

CRITERIA	WEIGHT	MEASUREMENTS	POINTS
2. Ability of option to adjust to waste types or tonnages	**35%**	**Accommodates wide range of tonnages and waste types.**	100
		Accommodates wide range of tonnages	50
		Capped at specific tonnage for disposal or throughput	0
		Accommodates wide range of waste types.	50
		Certain types of wastes cannot be handled.	0
3. Simplicity of option for operations and administration	**20%**	**Simplifies implementation (i.e. technology, organization, contracts)**	100
		Technology complex requiring special operators; 24-7 operation or similar complexity of operation	0
		Technology traditional - labor readily available; operations well understood	60
		Multiple contracts are required to handle operations	0
		Multiple contracts are not required to handle operations	40
Total	100%		

See Appendix 1 for a further description of these measurements.

2.4.3 Responsible to Region

The following measurements for responsibility to the Region were developed by the Working Group working together with the consultants:

Table 10: Measurements for Responsible to Region and its Criteria

CRITERIA	WEIGHT	MEASUREMENTS	POINTS
1. Reduce impact of option on natural resources	**45%**	**Impact on natural resources (i.e fuel, land, stormwater, post closure use)**	**100**
		> 20% increase in fuel consumption	0
		< 20% increase in fuel consumption	25
		Land requirements > 200 acres	0
		Land requirements 50 - 200 acres	10
		Land requirements < 50 acres	25
		High potential to impact stormwater	0
		Low potential or controllable impact to stormwater	25
		Property cannot be used after facility closes	0
		Property could be used after facility closes	25

CRITERIA	WEIGHT	MEASUREMENTS	POINTS
2. Reduce financial risk to Authority and communities	**35%**	**Impact of liabilities on financial stability (i.e funding source, revenue requirements, market volatility; post closure care expenses)**	**100**
		Lending institution can restrict funding or impose requirements on Authority	0
		Lending institution not likely to restrict funding	20
		Significant revenues from sale of products required to offset operations	0
		Significant revenues from sale of products not required to offset operations	20
		Market volatility makes option vulnerable	0
		Market volatility does not impact operation	30
		Post closure care required for 30 years	0
		Post closure care is not required	30
3. Commitment by local governments to option	**20%**	**Degree that members must adjust their programs and policies to support option (i.e. incentives, collection system modifications, ordinances)**	**100**
		Member must incentivize its citizens to use facility	0
		Member does not need to incentivize citizens to use facility	20
		Member must modify collection system	0
		Member does not need to modify collection system	40
		Member must modify solid waste ordinance	0
		Member does not need to modify solid waste ordinance	40
Total	100%		

See Appendix 1 for a further description of these measurements.

2.4.4 Minimize Local Impacts

The following measurements for minimizing local impacts were developed by the Working Group working together with the consultants.

Table 11: Measurements for Minimize Local Impacts and its Criteria

CRITERIA	WEIGHT	MEASUREMENTS	POINTS
1. Protect community resources	**40%**	**Impact of option on property values**	**100**
		Significant potential impact	0
		Moderate and controllable potential impact	50
		No significant impact anticipated	100
2. Minimize infrastructure impacts	**40%**	**Impact on infrastructure (i.e. roads, entrances, utilities, operation facilities (e.g. offices, scales, maintenance))**	**100**
		> 50% increase in traffic	0
		25% - 50% increase	10
		0 - 25% increase	40
		Additional infrastructure must be constructed	0
		Some infrastructure must be constructed	15
		Additional infrastructure does not need to be constructed	30
		Water and sewer impacted	0
		Water and sewer not impacted	30
3. Compatible with local land use policy	**20%**	**Compatibility of the option with host community's comprehensive plan and land use ordinances.**	**100**
		Comprehensive plan does not address facility	0
		Comprehensive plan addresses facility or option	50
		Significant modifications required in land use ordinances	0
		Significant modifications not required in land use ordinances	50
Total	100%		

See Appendix 1 for a further description of these measurements.

3.0 METHODOLOGY

The benefits evaluation takes each option and assigns it a 0 to 100 score based on how effectively it achieves the Region 2000 Service Authority's goals. The score is based on the relative weighting

of each goal (some goals are considered more important than others, and therefore contribute more to the final score) and the relative weighting of each criterion (some criteria are more important than others as a measure of progress towards the corresponding goal). The development of the score begins with the criteria. Each criterion has a set of measurements that are the basis for how many points an option can obtain within that criterion. These points are multiplied against the weighting of the criterion to create a point total for the corresponding goal. That point total is then multiplied by the weighting of the goal, which is how the score for each goal is assigned. The score for each goal is then summed to create the overall 0 to 100 score.

4.0 BENEFIT SCORING FOR OPTIONS

The Draper Aden Associates in conjunction with input from the Working Group scored the three options using the measurements and the methodology identified above. It should be noted that the scoring is comparative between options and, for some measurements, the project team had to use its professional judgement. The transfer station and waste to energy facilities both require landfills for disposal of waste or ash/waste residuals respectively. However, as it is most probable that the landfills for these options would be outside of the Region at one of the private landfills in Virginia, the landfills were not included in the scoring, as the analysis was developed to be local/regional and not global.

Using this methodology and applying it to the three chosen options provides a ranking of the three options as summarized in the table below (Note that the higher the total the more “beneficial” the option.):

Table 12: Benefit Calculation for Chosen Options

GOAL AND CRITERIA	Maximum Points	Waste to Energy	Transfer Station	Landfill Expansion
REDUCE WASTE (35%)				
Reduce amount of waste disposed of in landfills	17.5	17.5	0.0	0.0
Increase recycling and reuse	17.5	4.4	13.1	0.0
FLEXIBILITY (25%)				
Ability of option to adjust to changes in industry	11.3	0.0	5.6	11.3
Ability of option to adjust to waste types or tonnages	8.8	0.0	4.4	8.8
Simplicity of option for operations and administration	5.0	0.0	3.0	5.0
RESPONSIBLE TO REGION (25%)				
Reduce impact on natural resources	11.3	3.9	8.4	2.9
Reduce financial risk to authority and communities	8.8	4.4	6.1	6.1
Commitment by local governments to option	5.0	3.0	5.0	5.0
MINIMIZE LOCAL IMPACTS (15%)				
Protect community resources	6.0	0.0	3.0	0.0
Minimize infrastructure impacts	6.0	0.0	3.3	3.3
Compatible with local land use policy	3.0	0.0	0.0	0.0
BENEFIT TOTAL	**100.0**	**33.2**	**52.0**	**42.3**

The key elements of the ranking for each option are summarized below:

- **Waste to energy:** Waste to energy scoring was impacted by the following:
  - ***Reduce waste:*** It gains points from the fact that the amount of tonnage landfilled is significantly reduced through combustion. It also can encourage recycling of those materials that are not suitable for combustion.
  - ***Flexibility:*** It loses significant points due to the complexity of the technology, high risks to the Authority, need for privatization of the investment and the need for a controlled waste stream.
  - ***Responsible to region:*** It loses points given its potential to increase fuel consumption, cost for decommissioning after closure, vulnerability to market volatility and electric rates, and need for flow control. It gains points as there is no post closure care period and impact to current member collection systems is anticipated to be minimal.
  - ***Minimize local impacts:*** It loses points as it could significantly impact adjacent property values given the perception of air pollution and noise, the potential to increase traffic given the need for additional tonnage and ash haul trucks, the significant amount of infrastructure required, and it water usage. It loses points as a special use permit will be required.

- **Transfer Station:** Transfer station scoring was impacted by the following:
  - ***Reduce waste:*** It loses points as it does not reduce the overall tonnage that must be landfilled. It gains points as transfer operations tend to encourage recycling as there is a direct correlation between tonnage in and tonnage transferred that can promote more recycling or reuse.
  - ***Flexibility:*** It loses some points given its ranking as a moderate risk due to potential impacts from increased fuel costs, the fact that it cannot handle all wastes generated in the region (e.g. sludge, some industrial wastes) and the need for multiple contracts. It gains points as it can handle a wide variety of tonnages and is considered a traditional technology.
  - ***Responsible to region:*** It loses points given the increased fuel consumption of the haul vehicles and vulnerability to fuel increases. It gains points given its reduced land requirements, minimal impacts to storm water, ability to use the site after closure with minimal cost, low risk for funding, no post closure care period and limited impact to current member collection systems.
  - ***Minimize local impacts:*** It loses some points as it could moderately impact adjacent property values given the perception of noise, the potential to increase traffic given the haul vehicles, the moderate amount of infrastructure required. It gains points as the facility would not be anticipated to impact water or sewer utilities. It loses points as a special use permit will be required.

- **Landfill Expansion:** Landfill expansion scoring was impacted by the following:
  - ***Reduce waste:*** It loses points as it does not reduce the overall tonnage that must be landfilled or promote recycling directly or indirectly.
  - ***Flexibility:*** It gains points given its ranking as a low risk as a traditional technology, the fact that it can handle a wide variety of tonnages and waste types, and the minimal contracts needed for the operation.
  - ***Responsible to region:*** It gains points given that it will not increase fuel consumption (compared to current rates), is a low risk for funding, does not need revenues from the sale of products, is not subject to market volatility and does not require the members to modify their collection systems or ordinances. It loses points given its land requirements, potential impacts to storm water and inability to use the site after closure.
  - ***Minimize local impacts:*** It loses points as it could significantly impact adjacent property values given the perception of noise, odor, vectors, dust etc, and has the potential to impact sewer capacity. It gain points as it will not increase traffic over current rates, and only requires a moderate amount of infrastructure for construction. It loses points as a special use permit will be required.

5.0 SUMMARY

In summary, the Working Group, working with its consultants, developed a method for quantifying the benefits of each option. Table 12 indicates that based on the established goals, criteria and measurements, the transfer option has the highest benefit score. It's higher score is a function of its potential to promote recycling, traditional technology, minimal risk to the Authority and minimal impact to the community. This evaluation does not consider impacts from the landfill (presumed to be outside of the region) on the resources or the community in which the landfill is located. It also does not consider costs. Costs are being evaluated by Burns and McDonnell.

6.0 NEXT STEPS

The benefit analysis is completed. Next steps include the following:

- Presentation to the Region 2000 Services Authority Board on May 24, 2017.
- Provision of additional information as may be requested by the Board.

APPENDIX 1

DESCRIPTION OF MEASURMENTS

From January 25, 2017 report

Reduce Waste (35%)

Criteria: Reduce amount of waste disposed of in landfills (50%)

Measurement: Percent reduction (from current tonnage landfilled)

COMPONENT	DEFINITION	POINTS
No reduction in tonnage landfilled	Option does not change quantity of material landfilled when compared to the current landfill operations.	0
Reduction < 10%	Option reduces tonnage landfilled (regardless of location of landfill facility) by less than 10% when compared to the current landfill operations. Reduction could be accomplished by promotion of reuse, recycling, composting, or other waste reduction programs. This does not include consideration of a change in membership whereby an existing member choses to transfer waste directly to a different landfill.	20
Reduction 10 – 25%	Option reduces tonnage landfilled (regardless of location of landfill facility) by 10 - 25% when compared to the current landfill operations.	60
Reduction > 25%	Option reduces tonnage landfilled (regardless of location of landfill facility) by more than 25% when compared to the current landfill operations.	100

Relevance: Waste reduction, in particular reduction in the tonnage landfilled, was identified as a key theme from the community input received from a variety of sources. Waste reduction is compared to the current landfill operations. It is assumed that with the reduction in tonnage, there is a corresponding benefit whether that benefit increases the life of an existing facility, reduces the size of a new landfill, or decreases tonnage transferred.

Data Source: Data for this evaluation will be developed by the consultants when considering the various options.

Outcome: The outcome is to preserve resources and reduce community impacts with the reduction in waste to be handled.

Reduce Waste (35%)

Criteria: Increase recycling and reuse (50%).

Measurement: Enhancement of recycling and reuse programs.

COMPONENT	DEFINITION	POINTS
No recycling required for option	The option does not require or encourage recycling.	0
Some recycling or reuse required	Some monor recycling or reuse included or encouraged	25
Recycling or reuse required for option	The option either requires the segregation of certain waste materials prior to disposal (which can be recycled or reused) or encourages recycling.	50
Does not simplify recycling	This option does not simplify existing recycling collection systems or promote simplification of future collection systems.	0
Simplifies recycling	This option either simplifies existing recycling collection systems or promotes simplification of future collection systems.	50

Relevance: One method to reduce the amount of waste landfilled is through recycling. Not all options require recycling or encourage recycling. An example of encouragement of recycling might be a transfer station where cost is a direct relationship to tonnage delivered to and hauled away from for disposal. An example of an option that might discourage recycling is the operation of a traditional landfill where the cost per ton is related to economies of scale frequently promoting higher tonnages.
Relative to simplification, it is well documented that there is a direct relationship between participation in a recycling program and the ease with which an individual can recycle. Not all options will simplify recycling. This measurement relates more to the hybrid options which include a recycling or composting element. An example of an option that might simplify recycling would be a hybrid solid waste management system which includes a material recovery system that processes materials collected in a single stream/co-mingled program.

Data Source: This measurement is subjective and comparative between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to preserve resources and reduce community impacts with increased recycling which will reduce the waste to be landfilled.

Flexibility (25%)

Criteria: Ability of option to adjust to changes in the solid waste management industry (45%).

Measurement: Limits risk of new regulations or obsolescence over the next 25 years that will impact operations.

COMPONENT	DEFINITION	POINTS
Risk of new regulations or technology is high.	Option is highly technical, including technology subject to change. In addition, option is vulnerable to significant regulatory changes.	0
Risk of new regulations or technology is moderate.	Option is moderately technical, including technology which is mature. Because of the maturity of this option, the option's vulnerability to new regulations is reduced.	50
Risk of new regulations or technology is low.	Option has limited technology, relies on well understood operations, and has been significantly regulated for a long period of time. There is a low probability of significant changes in operations or to the regulations that would create a vulnerability to the implementation of this option.	100

Relevance: A solid waste management program should be flexible and able to adjust to changes in the community and limit the risks to the community of implementing the program. Investment in newer or complicated technologies could leave a community vulnerable to future costs associated with equipment modification or repairs in response to regulations or infrastructure upgrades. An option which is flexible and of a lower risk, is judged under this measurement to be better for the community.

Data Source: This measurement is subjective and comparative between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that does not put the Authority at a risk greater than it is willing to accept or which could jeopardize future funding.

Flexibility (25%)

Criteria: Ability of option to adjust to waste types or tonnages (35%).

Measurement: Accommodates a wide range of tonnages and waste types.

COMPONENT	DEFINITION	POINTS
Accommodates a wide range of tonnages	The current landfill can accommodate a wide range of tonnages and adjust. The options will be evaluated with this as a benchmark.	50
Capped at specific tonnage for disposal or throughput	The option is capped at tonnage or unable to handle wide fluctuations.	0
Accommodates a wide range of waste types	The current landfill can accommodate a wide range of waste types and adjust. The options will be evaluated with this as a benchmark.	50
Certain types of wastes cannot be handled.	This option cannot receive certain types of wastes now accepted at the operating landfill.	0

Relevance: A solid waste management program should be flexible and able to adjust to changes in the community over time. This includes the ability to adjust to fluctuations in tonnages that may require handling and the ability to adjust to a variety of waste materials. Some options will not be able to handle a wide range of tonnages such as may be delivered after a natural disaster or by a new industry in the Region. Some options will not be able to handle a wide range of waste materials such as sludge or large quantities of construction debris or dead animals. This evaluation identifies flexibility in handling a wide range of tonnages and/or waste types to be a benefit to the Region is subjective and comparative between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Data Source: This measurement is subjective and comparative between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to react to fluctuations in tonnages or waste types as may best suit the Region economically, environmentally or socially.

Flexibility (25%)

Criteria: Simplicity of option for operations and administration (20%).

Measurement: Simplifies implementation (i.e. technology, organization, contracts).

COMPONENT	DEFINITION	POINTS
Technology complex	Option relies on complex technology which requires special operators, 24-7 operations or similar complexity of operation. Technology may require privatization.	0
Technology traditional	Option relies on well understood operations with readily available labor. Privatization not required.	60
Multiple contracts required	Option requires multiple private contracts to be coordinated and held by the Authority. Administration significantly more complicated.	0
Multiple contracts not required	Option does not require contracts or limits number of contracts to one. (Exclusive of member use agreement.)	40

Relevance: A solid waste management program should be flexible and able to adjust to changes in the community over time. Complex technology requiring a specialized labor force or privatization reduces the flexibility of the Region to react to changing needs. Complex contractual requirements put a burden on the Authority to assure proper procurement and coordination, and can make the Authority vulnerable to contract requirements (e.g. fuel escalator charges; put or pay requirements).

Data Source: This measurement is subjective and comparative between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to adjust to changing Regional needs as rapidly as may be required while limiting its risks.

Responsible to Region (25%)

Criteria: Reduce impact of option on natural resources (45%).

Measurement: Impact on natural resources (i.e. fuel, land, stormwater, post closure use).

COMPONENT	DEFINITION	POINTS
>20% increase in fuel consumption.	Fuel consumption will be compared to the existing landfill operations. This addresses only activities directly related to the landfill operations and does not address any changes in the collection systems' fuel usage.	0
<20% increase in fuel consumption.	Fuel consumption will be compared to the existing landfill operations. This addresses only activities directly related to the landfill operations and does not address any changes in the collection systems' fuel usage.	25
Land requirements > 200 acres.	Based on facility boundary definition by VDEQ. Includes all infrastructure including roads, buffer, stockpile and borrow areas, leachate storage, and stormwater management structures. Could be theoretical or based on actual parcel.	0
Land requirements 50 – 200 acres.	As above.	10
Land requirements < 50 acres.	As above.	25
High potential to impact stormwater.	Option has potential to significantly impact stormwater through contact of rainfall with waste materials, erosion of operational areas, and on-going construction activities.	0
Low potential to impact stormwater.	Option has limited potential to impact stormwater as operations are either mostly or fully enclosed.	25
Property cannot be used after facility closes.	Based on regulatory requirements or configuration of site after operations are completed, property cannot be used.	0
Property could be used after facility closes.	Property can be used after closure. Usage may require decommissioning of structures or stabilization of operational areas.	25

Relevance: Development of an integrated solid waste management program in addition to reducing waste and being flexible should be responsible to the Region considering natural resources, financial risks, and commitment by the members. This measurement assesses potential impact to the natural resources of the Region considering fuel consumption, land requirements, impact to storm water and usage of the site when usage ends. It is assumed that less fuel, less land usage, reduced impacts to storm water and the ability to use the property after solid waste operations cease are benefits to the Region.

Data Source: This measurement is both objective and measurable, and subjective. The measurement relies less on the comparison between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that minimizes impacts to natural resources.

Responsible to Region (25%)

Criteria: Reduce financial risk to Authority and communities (35%).

Measurement: Impact of liabilities on financial stability (i.e. funding source; revenue requirements; market volatility; post closure care requirements).

COMPONENT	DEFINITION	POINTS
Lending institution can restrict funding or impose requirements on Authority.	Option is potentially perceived as a new, unproven technology with inherent risks that would be scrutinized closely by a lending institution; or option has a long payback period; or option appears vulnerable and additional reserve funds or flow control required by lending institution. Public private partnership may be required that could complicate lending.	0
Lending institutions not likely to restrict funding.	Option is well understood by any potential lending institutions and not subject to severe restrictions or significant reserve funding.	20
Significant revenues from sale of products required to offset operations.	Option requires that the revenues for a product (compost), electricity (WTE) or recyclable materials (MRF) off set a significant portion of the expenses.	0
Significant revenues from sale of products not required to offset operations.	Option does not either produce a product, electricity or recyclable materials that require sale to offset expenses or assumes that operations can be fully funded by tipping fees.	20
Market volatility makes option vulnerable.	Option vulnerable to market volatility that could reduce revenues needed to offset expenses thereby potentially increasing tipping or usage fees thatcould impact the incoming wastestream.	0
Market volatility does not impact operation.	Option not vulnerable to market volatility.	30
Post closure care required for 30 years.	Landfill option must include consideration of the expenses associated with the 30 year post closure care period.	0
Post closure care is not required.	All options will require landfill disposal. This assumes that private landfill post closure expenses are addressed in the tipping fee with no future obligations; or that post closure expenses and obligations are significantly less and/or short term/one-time expenses.	30

Relevance: Development of an integrated solid waste management program in addition to reducing waste and being flexible should be responsible to the Region considering natural resources, financial risks, and commitment by the members. This measurement assesses the potential financial risk to the Authority in the implementation of an option and assumes that the lower the financial risk the greater the benefit. Risks are assessed relative to the availability of funding, the need for revenues, market volatility and the extended responsibility of post closure care unique to the landfill option.

Data Source: This measurement is both objective and measurable, and subjective. The measurement relies less on the comparison between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to implement options while limiting the financial risks to the Authority and its member communities.

Responsible to Region (25%)

Criteria: Committment by local governments to option (20%)

Measurement: Degree that members must adjust their programs and policies to support option (i.e. incentives, collection system modifications, ordinances.)

COMPONENT	DEFINITION	POINTS
Member must incentivize its citizens to use facility.	Option requires specific tonnage or types of materials to be successful. Participation rates critical to financial success of program. Members responsible for encouraging participation.	0
Member does not need to incentivize citizens to use facility.	Option does not rely on unique requirements for operations. Participation rates not critical to program.	20
Member must modify collection system.	Option requires that the member modify collection system to provide materials to the option in a specific form or by a specific method (e.g. single stream versus dual stream recycling); option may have strict requirements for contamination that requires additional vigilance by member. Delivery schedule of waste materials may require control.	0
Member does not need to modify collection system.	Option does not require member to change anything with current collection system.	40
Member must modify solid waste ordinance.	Option requires specific exclusions in the waste materials accepted, or requires that the materials be segregated for collection.	0
Member does not need to modify ordinance.	Option does not require any changes.	40

Relevance: Development of an integrated solid waste management program in addition to reducing waste and being flexible should be responsible to the Region considering natural resources, financial risks, and commitment by the members. This measurement assesses the required commitment by the members and assumes that the fewer changes in existing systems or ordinances the greater the benefit to the Region and its members. Options may require predictable waste or recyclable material streams for the optimum operation of the facility. In addition, an option may require that certain materials be banned from disposal thereby creating a need for an additional system. A change in the solid waste ordinance may be required to assure participation or to provide control of materials.

Data Source: This measurement is both objective and measurable, and subjective. The measurement relies less on the comparison between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to implement options with a full understanding of the commitments that must be made by the members to assure success and financial viability.

Minimize Local Impacts (15%)

Criteria: Protect community resources (40%)

Measurement: Impact of option on property values

COMPONENT	DEFINITION	POINTS
Significant potential impact.	Option creates significant concern relative to potential impact of the operations on community activities and quality of life, and on potential future impacts from unpredictable failures of the system, or from a natural disaster.	0
Moderate and controllable potential impact.	Option creates moderate concern from citizens with recognition that there are controls that can minimize impact.	50
No significant impact anticipated.	Option does not create concern from citizens relative to impact to property values.	100

Relevance: Development of an integrated solid waste management program in addition to reducing waste and being flexible should minimize local impacts where possible. Local impacts can include adjacent property devaluation, impacts to infrastructure and conformance with local land use policies. This measurement assesses the impact to property values immediately adjacent to the option's facility boundary or within a set radius of influence as established by the host community through their local land use policies. Property devaluation considers the ability of a property owner to sell their property at fair market value. It is a function of the buyer's perceived concern about impact from the operating facility whether it is related directly to the operations (e.g. noise or traffic congestion), to quality of life (e.g. odors or vectors (birds, rodents) or to some less tangible concern (e.g. unpredictable failures of the infrastructure in the future.) For this measurement, the less the impact, the greater the benefit of the option.

Data Source: This measurement is subjective and comparative between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to implement options with a full understanding of the potential impacts on property values in the vicinity of the facility. It allows the Authority to assess the need for a property value protection plan.

Minimize Local Impacts (15%)

Criteria: Minimize infrastructure impacts (40%)

Measurement: Impact on infrastructure (i.e. roads, entrances, utilities, operations facilities.)

COMPONENT	DEFINITION	POINTS
>50% increase in traffic.	Option increases traffic to community over existing traffic flow by greater than 50%. Would be measured from VDOT records or subjectively compared to other options if data not available.	0
25% - 50% increase.	Option increases traffic to community over existing traffic flow by greater than 25% but less than 50%. Measured as above.	10
0% - 25% increase.	Option either does not increase traffic or increases traffic to community over existing traffic flow by less than 25%.	40
Additional infrastructure must be constructed.	Option requires significant road work, new buildings, scales, leachate collection system, gas collection system, compliance monitoring system or other infrastructure associated with the option. This would be exclusive of landfill liner or cap systems or buildings for the option itself (e.g. transfer station, WTE facility) which will be addressed in the cost analysis.	0
Some infrastruture must be constructed	Option requires some infrastructure improvements	15
Additional infrastructure does not need to be constructed.	Option either does not require any significant road work or infrastructure improvements or limited work when compared to other options. Exclusions as noted above.	30
Water and sewer utilities impacted.	Option requires significant usage of or upgrades to either existing water utilities and/or sewer utilities or requires significant sewage treatment capacity when compared to existing landfill operations.	0
Water and sewer utilities not impacted.	Utility requirements no greater than those of existing landfill operations.	30

Relevance: : Development of an integrated solid waste management program in addition to reducing waste and being flexible should minimize local impacts where possible. Local impacts can include adjacent property devaluation, impacts to infrastructure and conformance with local land use policies. This measurement assesses the impact to the community from changes in traffic patterns, construction of significant infrastructure (exclusive of the option's direct requirements – e.g. landfill cell construction) and the water and sewer requirements. While a landfill may require significant sewage treatment capacity for handling its leachate, a waste to energy facility may require significant water for its boilers. The fewer the impacts, the greater the benefit of the option.

Data Source: This measurement is both objective and measurable, and subjective. The measurement relies less on the comparison between the options. Some comparison to the existing landfill operations may be necessary for context, however. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to implement options with a full understanding of the capital improvements that may be needed for handling traffic, utilities and infrastructure. This information should also be mirrored in the capital costs of the project.

Minimize Local Impacts (15%)

Criteria: Compatible with local land use policy (20%).

Measurement: Compatibility of the option with host community's comprehensive plan and land use ordinances.

COMPONENT	DEFINITION	POINTS
Comprehensive does not address facility/option.	This assumes that a host community is identified for an option and that this is a relevant question.	0
Comprehensive does address facility/ option.	Option as identified in comprehensive plan in support of community development.	50
Significant modifications required in land use ordinances.	If host community is identified, the option is compared against its land use ordinances for compatibility. If rezoning, special use permit or other major modifications or approvals are required this is considered a risk for development of the option.	0
Significant modifications not required in land use ordinances.	Option as identified is addressed in existing ordinances or would require only minor updates for approval.	50

Relevance: Development of an integrated solid waste management program in addition to reducing waste and being flexible should minimize local impacts where possible. Local impacts can include adjacent property devaluation, impacts to infrastructure and conformance with local land use policies. This measurement assesses the need for a host community to revise their comprehensive plan to address the option or the need to modify land use ordinances (e.g. zoning). It also indirectly assesses the potential issues that may arise if an option requires rezoning or special use permits. Either of these processes could impact the ability of the project to be implemented as envisioned and potentially create some vulnerability to the Authority throughout the process. If an option is addressed in the comprehensive plan and/or in a host community's land use ordinances, the greater the benefit to the Region. A key assumption to this evaluation is that a host community is identified for each option. Preferably a general location is also assigned but this may not be practical.

Data Source: This measurement is objective and measurable. Uncertainty in scoring could arise for options for which a site location has not been chosen. The measurement does not rely on the comparison between the options. Information relative to this measurement will be developed by the consultants when considering the various options.

Outcome: The outcome is to provide an integrated waste management system that allows the Authority to implement options with a full understanding of the future land use requirements within the host community that may impact implementation.

APPENDIX 2

SCORING SHEETS

Appendix 2 - Table 2-1 - DRAFT						
REGION 2000 - SWP 2030 - BENEFITS ANALYSIS						
OPTION	Landfill - at Livestock Road					
	AVAILABLE POINTS	SCORE	CRITERIA FACTOR	GOAL FACTOR	TOTAL	COMMENTS
GOAL	**REDUCE WASTE**			**35%**		
CRITERIA	**Reduce Amount of Waste Disposed of in landfills**					
No reduction in tonnage landfilled	0	0				For this option there is no reduction assumed in landfilled tonnage.
Reduction , 10%	20					
Reduction 10 - 25%	60					
Reduction > 25%	100					
Subtotal	100	0	50%	35%	0.0	
CRITERIA	**Increase Recycling and reuse**					
No recycling required for option	0	0				There is no recycling required or encouraged by this option.
Some recycling or reuse required	25					
Recycling or reuse required	50					
Does not simplify recycling	0	0				This option does nothing to enhance or simplify recycling.
Simplifies recycling	50					
Subtotal	100	0	50%	35%	0.0	
GOAL	**FLEXIBILITY**			**25%**		
CRITERIA	**Ability of option to adjust to changes in industry**					
Risk is high	0					Landfill technology is relatively stable and predictable and major changes in the industry are not anticipated. This is in comparison to WTE facility where the technology is adapting to new technology. Capital expenditures are spread over a longer period of time.
Risk is moderate	50					
Risk is low	100	100				
Subtotal	100	100	45%	25%	11.3	
CRITERIA	**Ability of option to adjust to waste types or tonnage**					
Accommodates wide range of tonnages	50	50				Landfills can readily adapt to a variety of tonnages.
Capped as specific tonnage	0					
Accommodates wide range of waste types	50	50				Landfills can accommodate a wide range of waste types for disposal as outlined in their permit and approved by VDEQ.
Certain types of wastes cannot be handled	0					
Subtotal	100	100	35%	25%	8.8	
CRITERIA	**Simplicity of option for operations and administration**					
Technology complex	0					The landfill is traditional technology well understood by the owner and operators. It does not require specialized operators for the operation. It is similar to earthwork activities on construction sites.
Technology traditional	60	60				
Multiple contracts required	0					Minimal contracting is required when compared to WTE or transfer operations.
Multiple contracts are not required	40	40				
Subtotal	100	100	20%	25%	5.0	
GOAL	**RESPONSIBLE TO REGION**			**25%**		
CRITERIA	**Reduce impact on natural resources**					
> 20% increase in fuel consumption	0					If the operation remains similar to that of today, fuel consumption is not anticipated to increase.
<20% increase in fuel consumption	25	25				
Land requirements > 200 acres	0	0				Land requirements for the landfill, infrastructure and borrow/stockpile areas will exceed 200 acres.
Land requirements 50 - 200 acres	10					
Land requirements < 50 acre acres	25					
High potential to impact stormwater	0	0				Given that the landfill is an open air operation, there is a high potential to impact storm water during construction and operations when compared to the operations of the WTE or transfer facilities when their landfill components are not considered. It is probable that any landfills that would support the WTE or TS facility would be outside the region.
Low potential to impact stormwater	25					

	AVAILABLE POINTS	SCORE	CRITERIA FACTOR	GOAL FACTOR	TOTAL	COMMENTS
Property can not be used after closure	0	0				Given the probable configuration of the landfill after closure and the need to protect it during the 30 year post closure care period, it is not considered to be readily usable space after closure.
Property can be used after closure	25					
Subtotal	100	25	45%	25%	2.8	
CRITERIA	**Reduce financial risk to authority and communities**					
Lending institution can restrict funding	0					Given that the Region has borrowed and repaid multiple loans, there should be no restrictions on funding.
Lending institution not likely to restrict funding	20	20				
Significant revenues from sale of products required	0					Revenues from sale of products is not required for offsetting operational costs.
Significant revenues from sale of products not required	20	20				
Market volatility makes option vulnerable	0					Market volatility is not considered to be a potential and significant rist to the Authority. The primary aspect of the operations that would be vulnerable would be maintaining sufficient tonnage should competition for tonnage increase. The landfill operations however can adjust to reductions in waste with the expansion of its life expectancy.
Market volatility does not impact operation	30	30				
Post closure care for 30 years	0	0				Post closure care is required for 30 years.
Post closure care not required	30					
Subtotal	100	70	35%	25%	6.1	
CRITERIA	**Commitment by local governments to option**					
Member must incentivize citizens to use facility	0					Incentives are not required.
Member does not need to incentivize citizens	20	20				
Member must modify collection system	0					Collection systems do not need to be modified.
Member does not need to modify collection system	40	40				
Member must modify solid waste ordinance	0					The solid waste ordiance does not need to be modified.
Member does not need to modify solid waste ordinance	40	40				
Subtotal	100	100	20%	25%	5.0	
GOAL	**MINIMIZE LOCAL IMPACTS**			**15%**		
CRITERIA	**Protect community resources**					
Significant potential impact to property values	0	0				Given the outdoor operations of the facility, and the potential for vectors, odors and blowing litter, the potential to impact property values is higher for this facility than for a transfer station although the additional traffic of a transfer station may impact some property values.
Moderate or controllable impacts	50					
No significant impact anticipated	100					
Subtotal	100	0	40%	15%	0.0	
CRITERIA	**Minimize infrastructure impacts**					
> 50% increase in traffic	0					If the facility continues to operate in a manner similar to the 2017 operations and should tonnage remain similar, an increase in traffic is not anticipated.
25% - 50% increase	10					
< 25% increase	40	40				
Additional infrastructure must be constructed - significant	0					Some additional infrastructure will be needed.
Some infrastructure must be constructed.	15	15				
Additional infrastructure not needed	30					
Water and sewer impacted	0	0				Water usage is not anticipated to change or to be significant. Leachate collection and transmission to the disposal facility through the CCUSA system will increase with the continued expansion of the landfill. CCUSA could determine at some time in the future that capacity has been reached.
Water and sewer not impacted	30					
Subtotal	100	55	40%	15%	3.3	
CRITERIA	**Compatible with local land use policy**					
Comprehensive plan does not address facility	0	0				Comprehensive plan may need to be changed for the landfill expansion.
Comprehensive plan does address facility	50					
Significant modifications required in land use ordinances	0	0				Rezoning and special use permit is required.
Modifications not required	50					
Subtotal	100	0	20%	15%	0.0	
TOTAL					42.2	

Appendix 2 - Table 2-2 - DRAFT						
REGION 2000 -SWP 2030 - BENEFITS ANALYSIS						
OPTION	**Transfer station at Livestock Road (Does not consider disposal facility out of Region.)**					
	AVAILABLE POINTS	**SCORE**	**CRITERIA FACTOR**	**GOAL FACTOR**	**TOTAL**	**COMMENTS**
GOAL	**REDUCE WASTE**			**35%**		
CRITERIA	**Reduce Amount of Waste Disposed of in landfills**					
No reduction in tonnage landfilled	0	0				No reduction in overall tonnage as all wastes will still require disposal capacity. Sludge and members not using the Region 2000 TS will still need a landfill or alternative disposal option.
Reduction , 10%	20					
Reduction 10 - 25%	60					
Reduction > 25%	100					
Subtotal	100	0	50%	35%	0.0	
CRITERIA	**Increase Recycling and reuse**					
No recycling required for option	0					Recycling is not required for the operation of a transfer station. However transfer stations encourage recycling as reduction in waste is tied directly to the offsite haul and disposal costs. Some points given.
Some recycling or reuse required	25	25				
Recycling or reuse required	50					
Does not simplify recycling	0	0				This option does not in and of itself simplify recycling but can enhance recycling through separation of materials on tipping floor. Points given.
Simplifies recycling	50	50				
Subtotal	100	75	50%	35%	13.1	
GOAL	**FLEXIBILITY**			**25%**		
CRITERIA	**Ability of option to adjust to changes in industry**					
Risk is high	0					Risks identified for transfer include escalating fuel costs, liability during transport, and closure of disposal facility. Given moderate risk for these.
Risk is moderate	50	50				
Risk is low	100					
Subtotal	100	50	45%	25%	5.6	
CRITERIA	**Ability of option to adjust to waste types or tonnage**					
Accommodates wide range of tonnages	50	50				Tranfer stations are permitted around a maximum daily tonnage. Can handle a wide range of tonnage through scheduling of operations.
Capped as specific tonnage	0					
Accommodates wide range of waste types	50					Not all wastes can move through a transfer station. In particular, sludges, dead animals, and some CDD and industrial wastes are incompatible with the operation.
Certain types of wastes cannot be handled	0	0				
Subtotal	100	50	35%	25%	4.4	
CRITERIA	**Simplicity of option for operations and administration**					
Technology complex	0					Technology is traditional and well understood.
Technology traditional	60	60				
Multiple contracts required	0	0				Typically transfer stations are operated by the local government and transport and disposal privatized under contract. Haul contracts typically include fuel escalators. Transfer station operation may be privatized.
Multiple contracts are not required	40					
Subtotal	100	60	20%	25%	3.0	
GOAL	**RESPONSIBLE TO REGION**			**25%**		
CRITERIA	**Reduce impact on natural resources**					
> 20% increase in fuel consumption	0	0				By hauling tonnage out of the region (closest private landfill is 70+ miles one way) fuel consumption increased signigicantly.
<20% increase in fuel consumption	25					
Land requirements > 200 acres	0					Transfer station and trailer storage can be require less than 20 acres. This does not include the acreage of the disposal facility assumed to be outside the region.
Land requirements 50 - 200 acres	10					
Land requirements < 50 acre acres	25	25				
High potential to impact stormwater	0					All operations are under cover so there is limited potential to impact storm water at this facility. This does not include the disposal facility.
Low potential to impact stormwater	25	25				

	AVAILABLE POINTS	SCORE	CRITERIA FACTOR	GOAL FACTOR	TOTAL	COMMENTS
Property can not be used after closure	0					Property can be used after facility decomissioned.
Property can be used after closure	25	25				
Subtotal	100	75	45%	25%	8.4	
CRITERIA	**Reduce financial risk to authority and communities**					
Lending institution can restrict funding	0					No restrictions on funding anticipated. Capital costs low.
Lending institution not likely to restrict funding	20	20				
Significant revenues from sale of products required	0					Revenues from the sale of products not required to fund operations. User fees will fund operations.
Significant revenues from sale of products not required	20	20				
Market volatility makes option vulnerable	0	0				Operations significantly at risk from increases in fuel costs or outside disposal fees.
Market volatility does not impact operation	30					
Post closure care for 30 years	0					Once decommissioned there is no additional post closure care requirements.
Post closure care not required	30	30				
Subtotal	100	70	35%	25%	6.1	
CRITERIA	**Commitment by local governments to option**					
Member must incentivize citizens to use facility	0					No incentive needed for use of facility.
Member does not need to incentivize citizens	20	20				
Member must modify collection system	0					Collection system does not require modification.
Member does not need to modify collection system	40	40				
Member must modify solid waste ordinance	0					Solid waste ordinance impacting residents or businesses will not need to be modified to use this facility.
Member does not need to modify solid waste ordinance	40	40				
Subtotal	100	100	20%	25%	5.0	
GOAL	**MINIMIZE LOCAL IMPACTS**			**15%**		
CRITERIA	**Protect community resources**					
Significant potential impact to property values	0					There is some potential to impact local property values given the additional traffic of the haul trucks. However operations under roof and noise, dust and odors should be mitigated.
Moderate or controllable impacts	50	50				
No significant impact anticipated	100					
Subtotal	100	50	40%	15%	3.0	
CRITERIA	**Minimize infrastructure impacts**					
> 50% increase in traffic	0					Increase in traffic from haul trucks in and out. Assumed a moderate increase in traffic especially when compared to the WTE facility with its need for additional tonnage.
25% - 50% increase	10	10				
< 25% increase	40					
Additional infrastructure must be constructed - significant	0					Some infrastructure required but not as extensive as the WTE facility.
Some additional infrastructure required	15	15				
Additional infrastructure not needed	30					
Water and sewer impacted	0					Impacted limited to need for washdown water and handling of fluids. Must less than either landfill or WTE options.
Water and sewer not impacted	30	30				
Subtotal	100	55	40%	15%	3.3	
CRITERIA	**Compatible with local land use policy**					
Comprehensive plan does not address facility	0	0				May need to be modified.
Comprehensive plan does address facility	50					
Significant modifications required in land use ordinances	0	0				Rezoning and special use permit probably required.
Modifications not required	50					
Subtotal	100	0	20%	15%	0.0	
TOTAL					52.0	

Appendix 2 - Table 2-3 - DRAFT						
REGION 2000 - SWP 2030 - BENEFITS ANALYSIS						
OPTION	Waste to energy (Does not consider ash/residual landfill which may be out of region.)					
	AVAILABLE POINTS	SCORE	CRITERIA FACTOR	GOAL FACTOR	TOTAL	COMMENTS
GOAL	**REDUCE WASTE**			**35%**		
CRITERIA	**Reduce Amount of Waste Disposed of in landfills**					
No reduction in tonnage landfilled	0					WTE facilities typically reduce the waste going to landfills by 50% or more per EPA information. Ash and other residuals must be landfilled.
Reduction , 10%	20					
Reduction 10 - 25%	60					
Reduction > 25%	100	100				
Subtotal	100	100	50%	35%	17.5	
CRITERIA	**Increase Recycling and reuse**					
No recycling required for option	0					Some materials such as metals are not combustable and are removed and recycled.
Some recycling or reuse required	25	25				
Significant recycling or reuse required	50					
Does not simplify recycling	0	0				This technology does not in and of itself simplify recycling.
Simplifies recycling	50					
Subtotal	100	25	50%	35%	4.4	
GOAL	**FLEXIBILITY**			**25%**		
CRITERIA	**Ability of option to adjust to changes in industry**					
Risk is high	0	0				There is significant technology associated with this option and it is dependent on the sale of energy to offset the extensive capital and operating costs. Needs predicable tonnage for operations.
Risk is moderate	50					
Risk is low	100					
Subtotal	100	0	45%	25%	0.0	
CRITERIA	**Ability of option to adjust to waste types or tonnage**					
Accommodates wide range of tonnages	50					Tonnage would be fixed by requirements of technology chosen. Reduction in the required tonnage can have a significant impact.
Capped as specific tonnage	0	0				
Accommodates wide range of waste types	50					Cannot accept all types of waste materials. Not all materials suitable for incineration. Sludges, some debris materials, and metals are not acceptable.
Certain types of wastes cannot be handled	0	0				
Subtotal	100	0	35%	25%	0.0	
CRITERIA	**Simplicity of option for operations and administration**					
Technology complex	0	0				Technology is very complex and specialized.
Technology traditional	60					
Multiple contracts required	0	0				Facility would be privatized. Region 2000 would need contract with private owner/operator who would in turn have multiple contracts for operations.
Multiple contracts are not required	40					
Subtotal	100	0	20%	25%	0.0	
GOAL	**RESPONSIBLE TO REGION**			**25%**		
CRITERIA	**Reduce impact on natural resources**					
> 20% increase in fuel consumption	0	0				Fuel consumption by Region should not increase significantly. Supplemental energy would be required by private operator. Ash would probably be hauled out of region to private landfill increasing fuel requirements overall. Additonal tonnage would need to be transported to facility from outside the Region.
<20% increase in fuel consumption	25					
Land requirements > 200 acres	0					Land requirements would include the WTE facility and all infrastructure. Landfill not considered.
Land requirements 50 - 200 acres	10	10				
Land requirements < 50 acre acres	25					
High potential to impact stormwater	0					Considering the operation of WTE facility only, the potential impact is moderate when compared to a landfill.
Low potential to impact stormwater	25	25				

	AVAILABLE POINTS	SCORE	CRITERIA FACTOR	GOAL FACTOR	TOTAL	COMMENTS
Property can not be used after closure	0	0				WTE facility once decomissioned at closure could be used after closure. Decommissioning of a WTE facility is very expensive and time consuming and may not be a high priority. No points given.
Property can be used after closure	25					
Subtotal	100	35	45%	25%	3.9	
CRITERIA	**Reduce financial risk to authority and communities**					
Lending institution can restrict funding	0					Not applicable to this option. Facility would be privatized. Private capital may have restrictions. Region 2000 will not be funding except through usage fees.
Lending institution not likely to restrict funding	20	20				
Significant revenues from sale of products required	0	0				Sales of electricity at sufficient rates required to make operations profitable for private owner/operator.
Significant revenues from sale of products not required	20					
Market volatility makes option vulnerable	0	0				Market volatility can impact where tonnage is directed (if WTE much higher than alternatives, tonnage may be hauled to other facility). There may also be some volatility in electric rates and regulations that could impact operations although contracts may mitigate this.
Market volatility does not impact operation	30					
Post closure care for 30 years	0					The WTE facility would not have an extended post closure care period once decomissioned.
Post closure care not required	30	30				
Subtotal	100	50	35%	25%	4.4	
CRITERIA	**Commitment by local governments to option**					
Member must incentivize citizens to use facility	0					Incentive not required. Not anticipated that WTE facility would impact waste collection and disposal by residents or businesses.
Member does not need to incentivize citizens	20	20				
Member must modify collection system	0					Collection systems not required to be modified for MSW. Some changes may be needed for CDD or industrial wastes.
Member does not need to modify collection system	40	40				
Member must modify solid waste ordinance	0	0				Solid waste ordinance will probably need to be changed to address flow control of wastestream to facility.
Member does not need to modify solid waste ordinance	40					
Subtotal	100	60	20%	25%	3.0	
GOAL	**MINIMIZE LOCAL IMPACTS**			**15%**		
CRITERIA	**Protect community resources**					
Significant potential impact to property values	0	0				Given increased traffic, noise from facility and potenial air pollution concerns, there is a significant potential to impact property values at the WTE facility. Ash landfill may impact property values. Dependent on location.
Moderate or controllable impacts	50					
No significant impact anticipated	100					
Subtotal	100	0	40%	15%	0.0	
CRITERIA	**Minimize infrastructure impacts**					
> 50% increase in traffic	0	0				Additional tonnage required for WTE facility operations which would increase traffic. Ash and residuals would need to be hauled to landfill. Significant increase anticipated.
25% - 50% increase	10					
< 25% increase	40					
Additional infrastructure must be constructed - Significant	0	0				Significant infrastructure must be constructed.
Some infrastructure must be constructed.	15					
Limited to no infrastructure required to be constructed.	30					
Water and sewer impacted	0	0				Significant impacts to water consumption and potentially waste water discharges would be anticipated in regards to operations.
Water and sewer not impacted	30					
Subtotal	100	0	40%	15%	0.0	
CRITERIA	**Compatible with local land use policy**					
Comprehensive plan does not address facility	0	0				Comprehensive plan would need to be changed.
Comprehensive plan does address facility	50					
Significant modifications required in land use ordinances	0	0				Rezoning and special use/conditional use permit required.
Modifications not required	50					
Subtotal	100	0	20%	15%	0.0	
TOTAL					33.2	

APPENDIX 2

Burns and McDonnell – Options Evaluation

BURNS McDONNELL

Solid Waste Strategic Plan

Evaluation of Disposal Options and Recycling Enhancements

REGION 2000 SERVICES AUTHORITY

Region 2000 Services Authority

5/15/2017

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1.0 EVALUATION OF DISPOSAL OPTIONS AND RECYCLING ENHANCEMENTS

As a subconsultant to Draper Aden Associates (DAA), the Region 2000 Services Authority (Authority) retained Burns & McDonnell to conduct a high-level, planning level evaluation of multiple disposal options and recycling enhancements that may be considered once the Authority's landfill reaches capacity by approximately 2030. The purpose of this evaluation was to provide an initial, planning level analysis of the options. In collaboration with the Authority's Working Group and DAA, Burns & McDonnell identified those options that would not be cost effective for the region and which, therefore, did not require detailed analysis, and those options which deserved additional detail for the evaluation. For options selected, Burns & McDonnell identified key assumptions for the analysis, developed capital and operating costs and provided discussion on other considerations. The analysis included herein was intended to be utilized as a part of the broader decision-making process. This financial evaluation will ultimately be coupled with the benefits analysis for determination of the most suitable option for the Authority.

1.1 Overview of Disposal Options and Recycling Enhancements

Burns & McDonnell evaluated multiple disposal options and recycling enhancements based on feedback provided by the Working Group and our team's experience in the solid waste industry. In an effort to complete the analysis in a relatively cost-effective manner, Burns & McDonnell leveraged prior experience to guide the level of detail evaluated in this analysis for specific options/enhancements. For example, Burns & McDonnell staff completed planning studies on waste to energy (WTE) and mixed waste processing (MWP) that provided the opportunity to effectively summarize key information needed to determine whether to further evaluate those technologies. Table 1-1 communicates the scenarios and levels of detail evaluated for each disposal option and recycling enhancement.

Table 1-1: Initial List of Disposal Options and Recycling Enhancements

Option/Enhancement	Scenario	Level of Detail
Landfill	Continue at existing landfill site	More in-depth analysis
	Expansion of another permitted landfill in the region	The Appomattox County Landfill is not a suitable location for the regional landfill, so this option was not evaluated in detail
Transfer Station	Transfer station at current landfill site	More in-depth analysis
	Transfer station at another location in the region	Review focused on additional costs to locate a transfer station at another location
Waste to Energy (WTE) Facility	WTE facility in the region	High-level review based on prior WTE feasibility studies
Regional Recycling Collection	Develop a regional recycling program	Review focused on potential increase in recycling collected from member communities
Material Recovery Facility (MRF)	MRF at current landfill site	High-level review based on Burns & McDonnell's experience with other small-scale MRFs
	MRF at another location in the region	Review focused on privately-operated recycling options available locally and regionally
Mixed Waste Processing (MWP)	MWP facility at current landfill site	High-level review based on prior MWP feasibility studies
	MWP facility at another location in the region	This scenario not evaluated since location has minimal financial impact on this scenario
Composting	Source Separated Organics	High-level review included in Appendix 3

1.2 Overall Assumptions

The following list provides several key overall assumptions and notes for this analysis:

- The cost information discussed in this memo includes direct capital and operating costs, management and oversight, support from Region 2000 staff, and other costs as specifically described. Other indirect costs or overhead that the Authority may choose to include in future budget years are not included in this analysis and would increase any annual cost or cost per ton information described in this analysis. These costs could include various forms of payment or enhancements to the local community. Burns & McDonnell focused on costs only and not any revenue from private companies that may be generated in excess of costs.

- All cost estimates are high level planning estimates and will require further analysis and evaluation once the Authority Board provides further direction.
- No growth was applied to tonnage projections based on historical trends at the Authority's current landfill as suggested by Authority staff.
- All costs are shown in 2017 dollars, even though expenses incurred in the future are expected to be higher due to inflationary factors. Showing the costs in current dollars allows for easier comparisons to the current costs of the existing landfill operation.
- While the planning is based on a 25-year period, the costs shown in this analysis are based on one year of capital and operating costs. Since tonnage is kept constant and all costs are shown in 2017 dollars, there are minimal differences in the annual costs over the 25 year period.
- The interest rate for debt-financing was assumed to be four percent. The finance period was assumed to be 25 years although landfill cells will be constructed in phases and financed over the life of that phase.
- All options require some form of local government approval (e.g. rezoning, special use permitting and site plan approval). All options require some form of VDEQ permitting.
- This analysis does not include a greenfield landfill site.

1.3 Current Cost of Service

To provide perspective on the cost of the options and enhancements addressed in this section, Table 1-2 provides the fiscal year (FY) 2018 preliminary budget for the Authority's Livestock Road Landfill.

Table 1-2: FY 2018 Preliminary Landfill Budget

Description	Amount
Operating Costs	
Personnel	$1,473,182
Landfill Operations & Maintenance	$1,391,395
Closure and Post-Closure Reserve	$694,001
Environmental Reserve	$0
Future Disposal Planning Reserve	$65,000
Capital/Debt Service Costs	
Equipment Replacement	$450,000
Debt Service	$2,083,592
Non-Operating Income	($21,000)
Total	**$6,136,170**
Budgeted Tons	202,849
Per Ton Cost of Service Rate	**$30.25**

The cost of service rate of $30.25 per ton is the amount that member communities pay for disposal. Market rate customers pay an additional amount over the cost of service rate.

1.4 Disposal Options

This section evaluates the following disposal options: WTE, landfill and transfer station. Each section provides a description of the option and the cost per ton. The level of detail within each section varies, as discussed in Section 1.1, with more detail on the landfill and transfer station options, and less detail on WTE.

1.4.1 Waste-to-Energy (WTE)

One approach to managing the disposal of municipal solid waste (MSW) is through waste-to-energy (WTE). While there are multiple technologies that can be used to recover energy from the processing of waste, the most common approach in the United States is via a thermal process. The most common thermal WTE process in the United States is mass burn combustion or refuse derived fuel (RDF) combustion. A number of other technologies have been considered for the processing of MSW (such as gasification and pyrolysis), but many of these other technologies are not proven, as they have not processed MSW on a commercial basis in the United States. Table 1-3 summarizes key aspects for mass burn, RDF and gasification technologies.

Table 1-3: Summary of WTE Technologies

Topic	Mass Burn	RDF	Gasification
Description	MSW combusted on grate or hearth	MSW processed into RDF and combusted in suspension or on grate	High temperatures convert hydrocarbons to synthesis gas, which is processed to make other products (chemicals, fuel, energy)
Status of Commercialization	Commercially proven with over 30 years of operations	Commercially proven with over 20 years of operations	Used commercially for decades on non-MSW feedstock (mainly Japan and China)
Environmental Impacts	Recognized by Federal government as a cleaner energy source than coal and oil		Reduces greenhouse gas emissions compared to mass burn
Management of Ash	Typically disposed in a landfill	Reduced compared to mass burn	Needs to be tested and properly managed
Location of Existing Plants	Worldwide including approximately 85 in the U.S.	Worldwide including approximately 10 in the U.S.	No facilities commercially operating with MSW as a feedstock in the U.S.

During the past 5 – 10 years, a number of other governmental entities have evaluated the feasibility of multiple WTE technologies. Since this study for the Authority is being performed at an initial planning level, Burns & McDonnell relied on prior studies completed by members of our project team that evaluated the feasibility of WTE, rather than complete a separate, analysis for the Authority.[1]

Specifically, Burns & McDonnell relied on a WTE feasibility study conducted for another city that evaluated a similar annual disposal quantity. In 2011, SAIC completed a feasibility study for the City of San Antonio.[2] While San Antonio disposes of more MSW than Region 2000, the San Antonio study evaluated the feasibility of a WTE facility that would process approximately 250,000 tons per year, which is relatively similar to the tonnage accepted by the Authority's landfill. The technologies evaluated in that study were mass burn, gasification, and pyrolysis. Based on the analysis for the San Antonio study, key financial results were:

- Approximately $100 – $135 per ton tipping fee, depending on WTE technology (including amortized capital)
- Up-front capital costs of $230 – $500 million, depending on WTE technology

Other considerations for the Authority include:

- Process byproducts will require disposal, either with an Authority landfill or transfer to another landfill. Transfer to another landfill would require a transfer station.
- More material would be diverted from landfills, but for energy recovery rather than recycled into new products.
- Traffic in and out of the facility would be similar to the landfill with the exception of the ash trucks.
- Significant air permitting required.
- Facility may require significant water resources for operation.
- Net cost is dependent on revenues from the sale of electricity.

Landfill tipping fees for San Antonio (less than $25 per ton) are relatively similar to the Authority. The study for San Antonio concluded that WTE would not be economically feasible in the present or foreseeable future. Given that all of the other disposal options evaluated in this analysis for the Authority

[1] This approach was taken in an effort to complete the analysis in a cost-effective manner.
[2] Key members of the Burns & McDonnell project team were previously employed at SAIC, and managed this project for the City of San Antonio. This was a comprehensive feasibility study and was completed with a budget of $150,000.

are substantially less than $100 – $135 per ton, Burns & McDonnell would recommend that WTE be eliminated as a disposal option for the Authority.

1.4.2 Landfill at Appomattox County Landfill

Based on discussions with the Working Group at the March 7, 2017 meeting, it was determined Appomattox County Landfill was not suitable for a regional landfill for the following reasons:

- The cells that were previously permitted at the now-closed Appomattox County Landfill would provide approximately four years of disposal capacity.
- Significant improvements would be required on Route 460 and other secondary roads, which are Virginia Department of Transportation maintained roadways.
- The adjacent land owned by Appomattox County does not allow for adequate site infrastructure (stormwater ponds, roads, scale facility, leachate management, etc), buffer areas, or other non-landfill areas required to support a regional landfill for 25 years.
- Purchasing additional private land adjacent to the existing landfill would be similar to developing a new landfill, which is not being addressed in this analysis.
- There would be significant infrastructure upgrades needed at the site, including scales, scalehouse, maintenance facility, leachate holding tank, roads, active landfill gas system, etc.
- Leachate would have to be pumped and hauled to a wastewater treatment plant.
- Having a regional landfill at or adjacent to the Appomattox County Landfill would require longer hauling distances for most landfill customers. Therefore, the Authority would likely require a transfer station located near Lynchburg or the current Livestock Road Landfill, adding significant costs to the disposal operations.

Due to the reasons listed above, no additional analysis was performed for this disposal option.

1.4.3 Landfill Expansion at Livestock Road Landfill

This option, a landfill expansion at the Livestock Road Landfill, was evaluated based on a number of factors, including costs. The factors are identified throughout the remainder of this section.

1.4.3.1 Key Assumptions

The following lists several of the key assumptions for this option:

- Similar staffing and equipment requirements to current landfill

- The Authority would replace the landfill scales and make improvements to the existing scalehouse
- Other landfill improvements[3]: $2,000,000 (over the 25 year period)
- Landfill permitting and design costs: $1,480,000
- Average cost for cell development: $350,000 per acre (spent in phases over the life of the landfill)
- Average cost per acre for closure and post-closure: $233,000 per acre (an annual reserve contribution was included in the budget)
- Net disposal capacity: 7,617,000 cubic yards (net airspace for waste, after taking into account the liner and final cover)

The overall size and capacity of the expansion area was assumed for this analysis to be smaller than the landfill expansion proposed in the 2014 special use permit. Table 1-4 provides a summary comparison.

Table 1-4: Comparison of Current Assumption to 2014 Special Use Permit

Description	2014 Special Use Permit	Current Assumption
Total Expansion Area [1]	213 acres	213 acres
New Disposal Area	123 acres	60 acres
Buffer Width	100 feet	200 feet
Elevation	Taller than current landfill	Similar to current landfill
Estimated Airspace [2]	30,250,000 cubic yards	8,310,000 cubic yards

1. Includes roads, buffer areas, leachate handling, erosion and sediment control, stockpiles, and borrow areas. While the total acreage is the same between the two options, the current assumption has a smaller disposal area and wider buffer.
2. Includes airspace for waste, liner and final cover

Table 1-5 shows the tonnage by customer from the preliminary FY 2018 budget. This was the assumed tonnage for this landfill option.

Table 1-5: Landfill Tons (Preliminary FY 2018 Budget)

Tonnage Source	Annual Tons
City of Lynchburg	33,748
Campbell County	22,222
Nelson County	9,304
Appomattox County	5,280
Market Rate Customers	132,296
Total	**202,850**

[3] Other improvements include roads, leachate management infrastructure and other improvements to ensure the expansion area is capable as serving as regional landfill.

1.4.3.2 Capital and Operating Costs

Table 1-6 shows the projected operating costs of this landfill option. The personnel costs and landfill O&M costs are the same as those shown in Table 1-2. However, Burns & McDonnell divided the personnel costs into the direct operations personnel and the management and administrative personnel, which also includes contributions from staff at the Region 2000 Local Government Council. This same management and administrative cost was used in the transfer station option.

Table 1-6: Annual Landfill Operating Costs

Description	Annual Cost
Personnel	
Management and Admin Salaries/Benefits	$613,548
Operations Salaries/Benefits	$859,634
Landfill O&M	$1,391,395
Miscellaneous Expenses [1]	$150,000
Closure/Post-Closure Contributions	$496,406
Environmental Reserve [2]	$50,000
Total Operating	**$3,560,983**

1. Allowance for any unanticipated operating costs. Estimated at approximately 10 percent of landfill O&M expense and then rounded to $150,000.
2. While this amount was not included in the FY 2018 preliminary budget, the Authority has included it in past budget years and therefore Burns & McDonnell included it in this analysis.

Table 1-7 shows the annualized capital costs based on the assumptions described in Section 1.4.3.1 and a 25 year planning period. The replacement cycle for some items is less than 25 years and therefore Burns & McDonnell accounted for the replacement of the asset during the 25 year period. Each capital category was amortized over the projected useful life.

Table 1-7: Annualized Landfill Capital Costs

Description	Annualized Costs
Site Improvements, Design and Permitting	$436,153
Equipment [1]	$909,000
Cell Development (60 ac)	$1,322,685
Total Capital	**$2,667,839**

1. Based on the current equipment inventory, replacement schedules and replacement cost.

Table 1-8 shows the total projected annual cost and the cost per ton for a landfill expansion at the Livestock Road Landfill. The $30.71 per ton is similar to the cost for the current landfill operations,

which is $30.25. The cost per ton between the current and expanded landfill are similar because both include similar operations and maintenance expenses, and fully-account for capital and closure-post closure costs.

Table 1-8: Total Annual Cost and Cost per Ton

Description	Cost
Operating Costs	$3,560,983
Capital Costs	$2,667,839
Total Annual Costs	**$6,228,822**
Tons	202,850
Cost per Ton	**$30.71**

1.4.3.3 Permitting Considerations

Prior to pursuing any permitting with the Virginia Department of Environmental Quality (VDEQ), the Authority will first need to pursue a special use permit that would allow the Authority to use the adjacent land as a landfill since it currently zoned for agricultural use.[4] As mentioned in the key assumptions for this option, the Authority previously pursued and was denied a special use permit for the land. Changes to the landfill design and development plan, and continued discussion with the surrounding community, may be required prior to the Authority securing the special use permit.

If the Authority receives the special use permit, it can then start the design process and regulatory permitting process in parallel. Section 1.4.3.5 discusses the timeline for regulatory permitting and construction.

1.4.3.4 Market Considerations

Market consideration address the potential for other landfills to reduce the tonnage to the Authority's facility via competition. The current Livestock Road Landfill is the only landfill within Region 2000 that has permitted capacity to serve as a regional landfill for 25 years. Other landfills in nearby regions that have capacity to accept waste from Region 2000 would require the use of a transfer station, an option discussed in Section 1.4.4. The use of a transfer station would increase the disposal cost for the member communities.

[4] The land is already currently owned by the Authority, but not part of the permitted landfill.

1.4.3.5 Implementation Schedule

For this option, the two main considerations for the implementation schedule are permitting and cell construction. There are additional infrastructure improvements that would need to be constructed, but the development of those improvements could align with cell construction.

Permitting and construction of a landfill is a multi-year process. In the case of an expansion of the Livestock Road Landfill, regulatory permitting and construction of the first phase could take three to four years, after approval of the special use permit. Much of the VDEQ permitting could be completed in parallel with design and construction preparation activities.

1.4.3.6 Impact on Member Community Collection Operations

Since this option is a continuation of the current operation, there would no impact to the member community collection operations.

1.4.3.7 Relationship to Other Options

If the Authority were to pursue increased options for recycling, the landfill would still play a key role for disposal in the region. Section 1.5.5 discusses the financial impact to the landfill of increased recycling.

If the Authority were to pursue other disposal options or recycling enhancements such as MWP or WTE, a smaller landfill could still play a key role for disposal in the region. These are both discussed in the relevant sections (Section 1.4.1 and 2.5.1).

1.4.4 Transfer Station at Livestock Road Landfill

This option involves constructing a transfer station at the Livestock Road Landfill, on adjacent land that is currently owned by the Authority but that is not part of the currently permitted landfill.

This option was evaluated based on a number of factors, including costs. The factors are identified throughout the remainder of this section.

1.4.4.1 Key Assumptions

The following lists several of the key assumptions for this option:

- Similar management, administration and Region 2000 support costs as expansion of Livestock Road Landfill
- Hauling from transfer station would be privatized
- Building size: 22,000 square feet and two loading hoppers

- Building cost: $150 per square foot
- Site development size: 8 acres (excluding existing entrance roads and existing site infrastructure)
- New scales and upgrades to existing scalehouse
- Haul distance from transfer station to landfill: 75 miles
- Disposal cost: $25 per ton

Table 1-9 shows the assumed tonnage for this option. Burns & McDonnell assumed the municipal sludge currently hauled to the Livestock Road Landfill would be hauled to another location and that one-third of market rate tonnage would be either diverted through increased recycling effort or hauled to another disposal location. Also, Nelson County, which already utilizes a transfer station, would likely transfer the waste to the landfill contracted by the Authority.

Table 1-9: Transfer Station Tons

Tonnage Source	Annual Tons
City of Lynchburg	17,916
Campbell County	22,222
Nelson County	0
Appomattox County	5,280
Market Rate Customers	88,197
Total	**133,615**

1.4.4.2 Capital and Operating Costs

This section addresses capital and operating costs for the transfer station option at Livestock Road. Table 1-10 shows the direct personnel costs, which excludes management, administration and Region 2000 staff support. Table 1-10 excludes personnel associated with hauling material from the transfer station to the landfill.

Table 1-10: Direct Personnel Costs

Cost Item	Quantity	Unit Cost [1]	Item Cost
Facility Manager	1	$65,000	$65,000
Supervisor/Lead Operator	1	$50,000	$50,000
Scale Operator	2	$35,000	$70,000
Laborer/Spotter	2	$25,000	$50,000
Equipment Operators			
Front-end loader [2]	1	$40,000	$40,000
Material handler	1	$40,000	$40,000
Yard tractor [3]	0	$40,000	$0
Overtime	10%	$315,000	$31,500
Benefits	38%	$315,000	$119,700
Direct Personnel Subtotal			**$466,200**

1. Based on typical costs for these positions.
2. The lead operator will provide additional support for front loader.
3. The yard tractor would be operated by a combination of the other operators.

Table 1-11 shows all projected transfer station operating costs, excluding hauling costs. For personnel, Table 1-11 includes the personnel costs from Table 1-10 and includes costs for management, administration and Region 2000 staff support.

Table 1-11: Annual Transfer Station Operating Costs

Description	Annual Cost
Personnel	
Management and Admin Salaries/Benefits	$613,548
Direct Personnel Salaries/Benefits	$466,200
Equipment Operating and Maintenance	209,000
Utilities	$60,120
Insurance	$16,880
Professional/Engineering/Legal Fees	$25,000
Miscellaneous Supplies & Maintenance	$67,520
Total Operating	**$1,458,268**

Table 1-12 shows projected hauling costs, assuming a private hauling contractor. The costs shown in Table 1-12 are relatively conservative in that it assumes the personnel and transfer vehicles, including back-ups for both, would be dedicated to the Authority. If a private hauler has other operations in the region, it may be able to reduce costs by sharing resources with other hauling contracts. Burns &

McDonnell also contacted several private hauling contractors in the region to confirm hauling costs would be in the range the cost per load shown in Table 1-12.

Table 1-12: Annual Hauling Costs

Description	Cost
Salary and Benefits	$938,400
Insurance Costs	$102,000
Fuel Costs	$417,548
O&M Costs	$387,500
Vehicle Capital	$470,639
Overhead and Profit [1]	$579,022
Total Annual Expenses, Overhead, & Profit	**$2,895,108**
Cost per Ton	$21.67
Cost per Ton-Mile	$0.14
Cost per Load	$433.35

1. Based on 25 percent of operating and capital costs.

Table 1-13 shows the type, number and cost of equipment that would be needed for the transfer station.

Table 1-13: Equipment Capital Costs

Cost Item	Quantity	Unit Cost	Item Cost	Useful Life	Annualized Cost
Skid Steer	1	$60,000	$60,000	7	$9,997
Small Loader	1	$150,000	$150,000	7	$24,991
Large Loader	1	$350,000	$350,000	7	$58,313
Yard Tractor	1	$85,000	$85,000	7	$14,162
Material Handler	2	$200,000	$400,000	7	$66,644
Total			**$1,045,000**		**$174,107**

Table 1-14 shows the annualized transfer station capital costs based on the assumptions for this option.

Table 1-14: Transfer Station Capital Costs

Cost Item	Item Cost	Useful Life	Annualized Cost
Land	$0	25	$0
Scales and Scalehouse Improvements	$400,000	25	$25,605
Mobilization and Site	$475,000	25	$30,406
Building	$3,300,000	25	$211,239
Contingency	$835,000	25	$53,450
Project Development	$1,002,000	25	$64,140
Total	**$6,012,000**		**$384,840**

1. Includes design and permitting costs.

Table 1-15 shows the total projected annual cost and the cost per ton for a transfer station located at the Livestock Road Landfill. This does not include any costs incurred by Nelson County for direct haul from their transfer station to a landfill.

Table 1-15: Total Annual Cost and Cost per Ton

Description	Cost
Transfer Station Operating Cost	$1,458,268
Hauling Cost	$2,895,108
Equipment Capital	$174,107
Transfer Station Capital	$384,840
Disposal Costs	$3,340,375
Total Annual Costs	**$8,252,696**
Tons	133,615
Cost per Ton	**$61.76**

1.4.4.3 Permitting Considerations

Similar to the expanded Livestock Road Landfill option, a transfer station located at the current Livestock Road Landfill would also need a special use permit. Differences to the surrounding community of a transfer station versus the landfill include:

- Less tonnage accepted, but traffic may or may not decrease. There will be few collection vehicles in and out of the transfer station, but there will be additional transfer vehicles into and out of the transfer station.
- No wastewater treatment sludge would be accepted at the transfer station

- Waste accepted at the transfer station would be hauled away on a continuous basis, so no significant amounts of landfill gas would be generated at the transfer station.

These differences may or may not impact the likelihood of the Authority attaining the necessary special use permit as compared to the landfill expansion.

If the Authority receives the special use permit, it can then start the design process and regulatory permitting process in parallel. Section 1.4.4.5 discusses the timeline for regulatory permitting and construction.

1.4.4.4 Market Considerations

Similar to the landfill, there is not currently another transfer station within Region 2000 capable of serving as a regional transfer station. If the Authority were to move forward with a transfer station, other private companies may choose to build their own transfer station rather than utilize the one developed by the Authority.

1.4.4.5 Implementation Schedule

Based on past experience with other transfer stations of similar size, a typical timeframe for design, permitting and construction of a transfer station is 20 – 30 months. This excludes the timeframe required for a special use permit. The regulatory permitting for a transfer station would occur in parallel with the initial design phase of the transfer station.

1.4.4.6 Impact on Member Community Collection Operations

For a transfer station located at the Livestock Road Landfill, there is no impact for those member communities direct hauling to the transfer station. Since Nelson County already utilizes a transfer station, they would haul directly to another landfill instead of hauling to the regional landfill. Their hauling costs may increase due to longer haul distances.

1.4.4.7 Relationship to Other Options

If communities increase their recycling efforts and divert the material from the transfer station, the Authority would see a reduction in the hauling costs to a landfill for that material. There would be minimal change to the transfer station operating and capital costs. Section 1.5.4.2 discusses the scenario of the Authority accepting recyclables at the transfer station for transfer to material recovery facility outside of Region 2000.

If the Authority were to pursue other disposal options or recycling enhancements such as MWP or WTE, a smaller transfer station (or landfill) would still play a key role for disposal in the region. These are both discussed in the relevant sections (Section 1.4.1 and 2.5.1).

1.4.5 Transfer Station in Lynchburg

This disposal option is similar in most respects to a transfer station at the Livestock Road Landfill. Operational costs and hauling costs would be very similar or the same as a transfer station at the Livestock Road Landfill. Key differences are the cost of land (versus using land already owned by the Authority), plus additional site development, roads, scale facility and other infrastructure needed for a regional transfer station. Depending on the cost of land and what site improvements are needed, Burns & McDonnell estimates the cost for these improvements could be in the range of $830,000 to $2.1 million. However, these costs would be amortized over the 25-year planning period and therefore not have a significant impact on the cost per ton. Burns & McDonnell estimates an increase of $0.40 to $1.00 per ton, as compared to the $61.76 per ton for a transfer station at Livestock Road.

A transfer station located in or near the City of Lynchburg would result in shorter haul distances for member communities, on average.

1.4.6 Disposal Options Summary

Table 1-16 summarizes the results of the disposal options evaluated in this section.

Table 1-16: Summary of Disposal Options

Option	Annual Tons	Estimated Cost per Ton
Waste-to-Energy	202,850	$100 – $135
Landfill Expansion at Livestock Road	202,850	$30.71
Landfill at Closed Appomattox Landfill	Not evaluated	Not evaluated
Transfer Station at Livestock Road Landfill	133,615	$61.76
Transfer Station in Lynchburg	133,615	$62.16 – $62.76

1.5 Recycling Enhancements

Section 1.5 addresses the recycling enhancements that were selected for inclusion in this analysis.

1.5.1 Mixed Waste Processing

A mixed waste processing (MWP) facility accepts a commingled stream of all municipal solid waste (i.e., recyclables are not collected separately). The MWP facility would separate the incoming waste stream

into three categories: recyclables, organics, and landfill materials. The recyclables are sorted into various commodities similar to a material recovery facility (MRF).

Some communities have sought to better understand whether MWP could assist local governments with meeting their recycling goals. Recognizing that multiple technical, economic, and environmental questions exist concerning the feasibility of MWP, the American Forest and Paper Association (AF&PA) retained Burns & McDonnell (BMcD) in 2015 to develop an economic and policy study (study) for its members regarding mixed waste processing.[5]

The study completed for the AF&PA included a financial model with various inputs, including incoming tonnage. Burns & McDonnell utilized that financial model to estimate the cost of construction and operating a MWP facility at the Livestock Road Landfill.

Approximately half of the materials that enter the MWP facility will have to be landfilled. Therefore, even if the Authority were to construct a MWP facility, a smaller landfill or transfer station would be needed to dispose of approximately 100,000 tons annually. Based on the disposal options analysis, Burns & McDonnell estimated the costs of operating a smaller-scale landfill or transfer station and incorporated those costs in this analysis.

The following table summarizes both the MWP with landfill and MWP with transfer station options.

[5] The "Mixed Waste Processing Economic and Feasibility Study" is available from AF&PA at: http://www.afandpa.org/docs/default-source/default-document-library/final_mixed-waste-processing-economic-and-policy-study.pdf

Table 1-17: Mixed Waste Processing Costs (Including Disposal)

Option	MWP with Landfill	MWP with Transfer Station
Total Annual Tons	202,850	202,850
Annual Disposal Tons	101,425	101,425
Approximate MWP Building Size (square feet)	100,000	115,000
Total Capital (excluding transfer trailers)	$30.8 million	$36.2 million
Annual Amortized Capital and Operating Costs	$16.0 million	$18.9 million
Revenue from Sale of Recyclables[1]	$7.0 million	$7.0 million
Net Capital and Operating Costs [2]	$9.6 million	$12.5 million
Estimated Cost Per Ton	**$47.40**	**$61.80**

1. The revenue from the sale of recyclables is based on current commodities values and potential recovery rates for the facility. This revenue is subject to changes in the commodity markets and challenges selling recovered paper from a MWP facility, where it has been previously mixed with organic waste.
2. Includes management and administration costs for Authority and Region 2000 staff.

The costs shown in Table 1-17 assume that all tonnage currently hauled to the landfill would be hauled to the MWP facility. However, with higher costs, some customers may seek out increased recycling opportunities or alternative disposal locations. If so, the cost per ton would increase relative to what is shown in Table 1-17.

Although the MWP with a smaller scale transfer station is similar in cost to a larger scale transfer station, it includes multiple risks the Authority would need to consider, including:

- High up-front capital costs
- Fluctuation of commodity values
- Quality of the recyclables recovered from the MWP facility
- Price sensitivity of customers

As an example of how these risks have recently impacted another MWP facility, the facility in Montgomery, Alabama ceased operations and closed after a short period in operation (opened in 2014 and ceased operations in 2015). The owner and operator of the facility filed for bankruptcy in 2016.

1.5.2 Regional Recycling

The level of regional recycling will depend on the extent to which each member community implements individual recycling programs. In evaluating the potential impact regional recycling programs may have on the other regional solid waste management options discussed in this analysis, Burns & McDonnell documented the recycling tons collected through each of the member communities' existing recycling

programs. Burns & McDonnell then evaluated potential increases in recycling for each community. This allowed Burns & McDonnell to assess the potential impact that increased recycling could have on the landfill and transfer station options.

1.5.2.1 Existing Recycling Programs

Currently, each member community has a drop-off recycling program, administered by the local government. There are private recycling options available to residents in some areas of Region 2000; however, the impacts of private recycling options were not considered in this assessment because the communities or the Authority do not have control over these operations or the recovered material.

The drop-off programs consist of multiple sites located throughout each community, where residents may bring their recyclable materials. The material is then hauled to another facility that accepts or processes recyclables. Table 1-18 summarizes the current recycling programs and recovered material for each community.

Table 1-18: Current Recycling Programs

Community	Type of Program[1]	Material Stream[3]	Total Households[2]	2016 Tons Collected[3]	Approximate Pounds per Household per year
Appomattox County	7 Drop-off Locations	Source separated; no glass	7,051	594	168
Campbell County	1 Drop-off Location	Source separated; no glass	25,100	40	3
City of Lynchburg	7 Drop-off Locations	Source separated; no glass	32,252	1,301	81
Nelson County	6 Drop-off Locations	Source separated; no glass	10,017	840	168
Total				**2,775**	

1. This includes only residential drop-off locations that accept recyclable materials. Campbell and Nelson Counties have additional drop-off locations that do not accept recyclables.
2. Household counts are based on U.S. Census housing data.
3. Includes paper, metal and plastics. Does not include household hazardous waste, electronics, tires or other materials that may be diverted from the landfill, but that are not typically processed at a material recovery facility.

1.5.2.2 Recycling Program Options

Based on discussions with the Authority and Working Group and past in-depth studies evaluating recycling options, Burns & McDonnell identified options for recycling programs within the region that have the potential to increase recovery rates of recyclable materials while remaining cost-effective for

member communities. The options considered include enhancements to current drop-off programs and implementation of a single-stream curbside collection program for the City of Lynchburg.

Enhanced Drop-off Program

The option to implement enhancements to the current drop-off programs focuses on building upon existing locations and services. This approach has the potential to increase residential recycling rates, therefore increasing recovered material, without requiring large capital investments by the communities. Descriptions of potential drop-off center enhancement options are presented in Table 1-19.

Table 1-19: Drop-off Program Enhancement Options

Enhancement Option	Explanation	Cost
Increase signage and develop graphic based signage	Ensure that adequate signage is placed near and within the drop-off locations Utilize signage with color and graphics to better describe materials collected and reduce contamination and customer confusion and improve aesthetics (see Figure 1-1)	Low
Improve public education and outreach to collect additional tonnage	Education regarding drop-off locations, recyclable materials accepted and proper participation, and program benefits Communication raising interest in program and awareness of any changes to program Develop tailored approach specific to the needs of each community's residents and program	Low to Moderate – dependent on member community's specific needs and residential base
Offer recycling collection at additional existing drop-off locations	Maximize material recovery potential by adding recycling collection services at existing drop-off locations that currently offer only refuse collection	Low to moderate – dependent on member community's specific hauling and recycling contracts

Enhancements would be focused on public education and maximizing the recycling potential of the existing drop-off locations. These enhancement options are common practices considered for improving drop-off recycling program performance. Implementation of these options would be relatively low-cost, and would not necessitate large capital expenditures, annual budget increases, or operational changes over current program levels in order to realize higher participation and material recovery rates. If the Authority and communities were to consider these options, a more in-depth analysis of each drop-off

Figure 1-1: Example of Graphic Based Signage

program and site would be required to determine the necessary or appropriate enhancements and develop an implementation plan specific to the needs of each community's residents and programs.

Drop-off programs are conducive to a range of community types and needs, and are likely the most appropriate option for the rural, less densely populated areas of Region 2000. As further discussed in the following section, implementation of a residential curbside collection program would be cost-prohibitive for rural areas, but may be cost-effective option in more densely populated areas, such as the City of Lynchburg.

Curbside Collection Program

A curbside collection recycling program offers residents collection of recyclable materials at their home. This type of program is typically most conducive to densely populated areas (e.g. urban, suburban areas, rather than rural areas). The relatively low population densities of Appomattox, Campbell, and Nelson Counties results in a lack of collection route density, and therefore collection costs would be high. Consequently, curbside collection would be cost prohibitive for more rural areas of Region 2000. Burns & McDonnell would not recommend consideration of a curbside recycling program for these member communities. Residents interested in curbside collection would still have the option of contracting with a private hauler. Curbside collection may be a financially feasible program option for the more densely populated City of Lynchburg.

For purposes of this planning analysis and based on industry experience, if the City of Lynchburg were to consider a curbside recycling program, Burns & McDonnell would recommend a single-stream program. Residents would place all of their program recyclable materials into a single large cart, to be collected every week or every other week at their home by semi- or fully automated collection vehicles. Relative to other curbside program collection options, this program structure typically results in the highest resident participation and material diversion rates for a lower per-household collection cost to the City.

A curbside collection program requires a significantly higher level of capital and operational expenditures than a drop-off program. However, a well-developed and successful single stream curbside collection program may yield 300 – 500 pounds of recyclable material per household per year, compared with an average of 60-90 pounds per household per year for a successful recycling drop-off program (in areas where residents have access to a curbside refuse program).

1.5.2.3 Program Option Impacts

To evaluate the impact of increased recycling on future disposal options, Burns & McDonnell estimated potential recycling tons. Below is a discussion of potential material recovery rates and potential program costs.

Potential Material Recovery

Typically, a successful drop-off recycling program in an area that also has a curbside refuse collection program can expect to recover 60 – 90 pounds of material annually per household, and a successful single-stream curbside recycling collection program can expect to recover 300 – 500 pounds of material annually per household.

The drop-off programs for Appomattox County and Nelson County both currently recover approximately 168 pounds per household per year, which is a significantly higher amount of material than a drop-off program where residents also have access to a curbside refuse collection program. A probable contributing factor to the relatively high recovery rates is the absence of curbside refuse collection programs in these communities. Therefore, many residents likely already visit a drop-off collection center on a regular basis to dispose of their household waste, and may choose to take advantage of the recycling opportunities available at the drop-off locations. A special trip to a drop-off location to dispose of recyclable materials is likely not required, leading to higher recycling participation rates.

The current recovery rate per household for the City of Lynchburg is typical of a successful urban drop-off recycling program, at approximately 81 pounds per household per year. This may be partially due to the fact that the City has a curbside refuse collection program in place. Given the City of Lynchburg's population density, the City's greatest potential for material recovery would be with a single-stream curbside collection program.

For Appomattox County and Nelson County, Burns & McDonnell assumed a potential increase of 25 percent above current rates based on increased public education and outreach (which could be coordinated on a regional level). For Campbell County, Burns & McDonnell assumed the recycling rate (on a pounds

per household basis) would match that of Appomattox and Nelson Counties based on an expansion of the recycling drop-off program and increased public education and outreach.

Table 1-20 summarizes potential material recovery, per household and per community.

Table 1-20: Potential Material Recovery

Community	Program Type	Households	Estimated Pounds Per Household	Estimated Total Annual Tons
Appomattox County	Drop-off	7,051	168 – 210	594 – 743
Campbell County	Drop-off	25,100	168 – 210	2,110 – 2,637
City of Lynchburg	Curbside[1]	23,112	300 – 500	3,467 – 5,778
	Drop-off[1]	9,140	60 – 90	274 – 411
Nelson County	Drop-off	10,017	168 – 210	840 – 1,050
Total				**7,285 – 10,619**

1. Burns & McDonnell assumed a curbside program for single-family homes but also included a drop-off program for multi-family homes and small businesses.

The average annual total from Table 1-20 is 8,952 tons. This represents an increase of 6,177 tons from the current programs. For the impact on landfill and transfer station options, Burns & McDonnell assumed a rounded 6,200 annual tons of increased recycling.

Potential Program Costs

Based on curbside collection programs in other communities where Burns & McDonnell has conducted financial and operational projects, the estimated cost for a curbside single-stream recycling program is $3.70 to $4.40 per household per month. In most cases, this includes minimal costs or revenues from recycling processing and, therefore, primarily represents the cost of collection.

Campbell County was the only community that was assumed a significant increase in recycling tonnages from the drop-off program. Since Campbell County already has a number of drop-off locations for refuse, the cost to add recycling at these locations will depend on several factors, including the contract with the County's hauler.

1.5.3 Authority-Owned Material Recovery Facility

The additional recyclables that could potentially be collected from the member communities (Table 1-20) are insufficient to justify an Authority owned and operated material recovery facility (MRF). However, if the Authority were to have commitments from private haulers to process an additional 7,000 to 8,000 tons per year of single-stream recyclables, a single-stream MRF may be more financially viable.

To provide a basis for the costs of a single-stream MRF, Burns & McDonnell utilized financial data from a recent MRF project. Burns & McDonnell recently worked with a county in Minnesota to develop a small, single-stream MRF with a design capacity of 20,000 tons per year, but that currently accepts approximately 15,000 tons per year.

Based on information from that MRF project and the county's current cost of operations, Burns & McDonnell estimates the processing fees for the Authority, before the sale of recyclables, would be in the range of $120 to $140 per ton, inclusive of all amortized capital and operating costs.[6] Based on current commodity values and the relatively small scale of the facility, the revenue from the sale of recyclables would likely be in the range of $70 to $100 per incoming ton. Therefore, the net cost to the Authority could be in the range of $20 to $70 per ton.

1.5.4 Authority Use of Existing Recycling Facility

Burns & McDonnell also evaluated the potential use of an existing recycling facility, both within Region 2000 (Section 1.5.4.1) and outside Region 2000 (Section 1.5.4.2).

1.5.4.1 Local Recycling Facility

Burns & McDonnell contacted a recycling company with operations in Madison Heights (Sonoco Recycling) and also identified several recycling facilities outside Region 2000 (Roanoke, Richmond and Raleigh).

The Sonoco Recycling facility in Madison Heights accepts single-stream recycling materials, but bales the material and hauls the bales to its single-stream MRF in Raleigh. Based on the current commodity values, Sonoco typically charges a processing fee of $35 per ton for single-stream materials at the Madison Heights facility, which is higher than the current member disposal rate at the Livestock Road Landfill.

1.5.4.2 Regional Recycling Facility

If the Authority were to haul the recycling material to a single-stream MRF using transfer trailers (which would require the Authority to construct a transfer station), the Authority could incur a lower processing fee and in some cases, depending on commodity markets, may receive positive net revenue. However, the Authority would incur the cost of hauling the material. Sections 2.5.5 and 2.5.6 communicate the

[6] These costs were adjusted to reflect a new MRF building. In the case of the Minnesota MRF, the community had an existing building that was modified to accommodate the new processing equipment.

impact of hauling additional recyclables material to either a local recycling facility or utilizing a transfer station to haul materials to an existing MRF in the region.

1.5.5 Impact of Increased Recycling on Landfill Options

If member communities were able to divert an additional 6,200 tons per year from the landfill (as described in Section 1.5.2.3), the annual operating budget for the landfill would stay relatively constant, with small decreases to the annual costs for cell development and closure/post-closure contributions. However, the total annual costs, with these small changes, would be allocated over fewer tons. Burns & McDonnell estimates that landfill customers would pay an additional $0.60 to $0.70 per ton for disposal. In addition, any single-stream recycling tons hauled to a local recycling company may be charged approximately $35 per ton, which is higher than the current member community disposal rate. The weighted average disposal and recycling processing cost would be approximately $31.17 per ton (using an average increase of disposal of $0.65 per ton, exclusive of hauling the recyclables).

1.5.6 Impact of Increased Recycling on Transfer Station Options

Burns & McDonnell evaluated the impact on transfer station options in two ways: (1) adding space to the transfer station building to accommodate storage and transfer of recyclables and (2) impact of diverting the recyclables from the transfer station and having the member communities direct haul the materials to a local recycling facility. Table 1-21 summarizes the impact of recycling under both scenarios.

Table 1-21: Impact of Recycling on Transfer Station Options

Option	Transfer Station with Recycling Storage	Transfer Station with Diverted Recycling
Building Size (square feet)	27,000	22,000
Annual refuse and recycling throughput (tons)	133,615	127,415 [1]
Total Capital (excluding transfer trailers)	$7.6 million	$7.0 million
Refuse Cost (per ton)	$61.90	$62.28
Recycling Cost (per ton)	$39.46 [2]	$35.00 [3]
Weighted Average Cost per Ton [4]	$58.84	$58.56

1. 133,615 tons – 6,200 tons = 127,415 tons
2. Includes the incremental building cost (for the additional 5,000 square feet), and a proportional share of the operating and hauling costs. Assumes hauling recyclables to a larger-scale MRF in Roanoke, Richmond, or Raleigh at a net zero processing fee.
3. Based on direct hauling to a facility similar to the Sonoco recycling facility in Madison Heights, which bales the material locally and hauls to it another MRF.
4. Represents a weighted average of the refuse and recycling cost per ton.

In either case, incorporating increased recycling reduces the average cost of the transfer station option by approximately $3 per ton. **However, those costs do not account for any additional recycling collection costs that would be incurred by the member communities.**

1.5.7 Recycling Enhancements Summary

Table 1-22 summarizes the recycling enhancements, but does not include the collection or other program costs of increasing regional recycling quantities since those costs would be incurred directly by the member communities and not the Authority.

Table 1-22: Summary of Recycling Enhancements

Enhancement	Estimated Cost per Ton	Services Included [1]
Enhancements		
Mixed Waste Processing	$47.40 – $61.80	Recycling, Composting and Disposal
Utilize Existing Recycling Facility – Local	$35	Recycling
Utilize Existing Recycling Facility – Regional	($20) – $20 [2]	Recycling
New Material Recovery Facility	$20 – $70 [3]	Recycling
Disposal with Enhancements		
Landfill with Local Recycling	$31.17	Recycling and Disposal
Transfer Station with Regional Recycling	$58.84	Recycling and Disposal
Transfer Station with Local Recycling	$58.56	Recycling and Disposal

1. Services are recycling processing, composting at a third-party and transfer/disposal. No collection costs are included.
2. The range shown is a net revenue of $20 per ton to an expense of $20 per ton.
3. Assumes additional private hauler tonnage is hauled to the MRF.

1.6 Key Findings

This section of the analysis presents the key findings for the disposal options and recycling enhancements.

1. Expanding the existing Livestock Road Landfill is the most financially feasible option at $30.71 per ton since the Authority already owns the land (adjacent to the current landfill) necessary for the expansion, and has previously constructed the basic infrastructure (e.g. office, scales, maintenance facility, leachate handling facilities), which reduces the capital expenses associated with this option. This option also has the most impact on the surrounding community, but this analysis is based on a much smaller landfill footprint (compared to the special use permit application from 2014) with increased buffer areas between the active landfill and the neighboring properties.

2. The cost of the transfer station option is approximately twice the cost of the landfill option (approximately $62 per ton for a transfer station versus approximately $31 per ton for the landfill option).
3. Waste to energy (WTE) is not financially feasible for the Authority given the high up-front capital and ongoing operating costs (approximately $100 - $135 per ton).
4. Mixed waste processing (MWP) has high up-front capital costs and ongoing operating costs. The estimated cost of $47 - $62 per ton is higher than the landfill option and about the same as the transfer station. However, it also introduces additional operating risks based on the fluctuation of commodity prices and risk of acceptance of recyclables, particularly fiber, recovered from the MWP facility.
5. A stand-alone MRF may be financially viable, if additional private tonnage can be sourced and when commodity markets are strong. However, the Authority would have to assume the risk of fluctuating commodity markets. Utilizing a transfer station to haul recyclables to a regional MRF or utilizing a local recycling facility may be financially comparable to a stand-along Authority MRF based on current commodity markets, without as much additional risk.
6. Utilizing a local recycling facility with the landfill option results in slightly higher per ton costs, on a weighted average basis, when compared to a landfill-only option (less than $1 increase per ton). This analysis excludes additional collection costs for the member communities.
7. Incorporating recycling, whether local or regional, with a transfer station will slightly reduce the costs of the transfer station option. Burns & McDonnell estimated approximately a $3 per ton cost reduction on a weighted average basis. This would reduce the transfer station cost from approximately $62 per ton to approximately $59 per ton). This analysis excludes additional collection costs for the member communities.

1.7 Next Steps

DAA will use the information from the benefits analysis it completed and this financial analysis to develop a cost-benefits analysis. Once the Region 2000 Services Authority Board provided further direction, the Authority's staff will develop a timeline for conducting a more detailed technical and financial evaluation.

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APPENDIX 3

Coker Composting and Consulting – Organic Diversion

APPENDIX 3

Organics Diversion in the Region 2000 Service Authority

Integrated Solid Waste Management Planning

Prepared For

Region 2000 Services Authority
Rustburg, VA

Prepared By:

Coker Composting and Consulting
Troutville, VA

April 2017

Introduction

The Region 2000 Service Authority ("Region 2000") is engaged in a planning effort to determine which type of solid waste management infrastructure to pursue to replace the current municipal solid waste (MSW) landfill at Livestock Rd. in Rustburg, which is expected to reach capacity in Year 2030. The Working Group guiding the 2030 Solid Waste Management Plan has adopted the following goals to guide the planning effort:

GOAL	DESCRIPTION
Reduce Waste	Minimize the amount of waste that is sent to landfills or other disposal facilities through source reduction, education, and responsible waste management by all generators (residential, businesses, institutions, and industries).
Flexibility	Develop a flexible waste management program that is efficient, balanced and sustainable to meet changing needs and technologies.
Responsible to Region	Minimize the impacts to communities including fiscal and environmental resources throughout the Region.
Minimize Local Impacts	Minimize the impacts on property owners and the community within the vicinity of any solid waste management facility.

The planning study is currently in the "fatal flaw" analysis-stage, assessing various options for solid waste management from "the 30,000-foot view" in order to simplify options moving forward. This report addresses the potential for organics diversion as part of a future integrated solid waste management (ISWM) strategy that includes source reduction, recycling, and disposal. ISWM strategies are gaining acceptance among municipal solid waste managers as they offer potential to extend the lives of solid waste management facilities, and by doing so, potentially delay or defer the often challenging aspects of siting and building new solid waste management facilities. ISWM strategies also offer the potential for cost savings for MSW transfer operations, particularly where transport charges and/or tipping fees are high.

The purpose of this white paper is to assist the Working Group in understanding how source-separated organics diversion, as part of an ISWM strategy, might factor into its decisions about long-term solid waste infrastructure.

Source-Separated Organics (SSO)

For the purposes of this paper, SSO is defined as pre- and post-consumer food wastes and yard trimmings (grass, brush and leaves) from residential, institutional (schools, prisons, hospitals) and small commercial (grocery, restaurants, convenience stores) sources. The food waste stream also includes food-soiled paper, which is difficult to recycle through normal paper recycling channels. SSO does not include any solid wastes containing human waste materials (i.e. soiled diapers).

Region 2000 does not have specific waste characterization data on the percentage of SSO in the MSW stream, but using USEPA data from 2014[1], approximately 14.9% of MSW is food wastes, 13.3% is yard wastes (where there is no pre-existing ban on landfilling yard wastes), and 26.6% is paper. As the Region 2000 service area is largely rural, it is reasonable to assume that perhaps 18-20% of the MSW sent to Livestock Rd. is potentially divertable as SSO (potentially up to 44,000 tons/year), and much of this is likely to be food wastes. These diversion potentials are normally reduced by estimates of SSO-diversion program participation rates and actual weekly setout rates. Using conservative estimates of participation (20% of households and businesses in Region 2000 curbside collection zones) and a setout rate of 75%, actual SSO diversion tonnages will likely be less than 10,000 tons/year. Co-collection with MSW offers a potential for a higher diversion rate (see below).

Collection of Organics

SSO diversion works most efficiently where there are sufficient numbers of curbside MSW collection customers to make separate collection routes cost-efficient, and, for private haulers, profitable. It requires a minimum of 300-400 collection stops/route to be cost-efficient. Efforts underway in the U.S. to make these SSO routes more cost-efficient include establishing fee-based collection systems[2], or co-collecting the SSO with the MSW and separating the two out at a transfer station, materials recovery facility, or other suitable infrastructure[3]. Many of the private haulers working in the Region 2000 service area use a fee-based system for MSW collection.

SSO collection would have to be a fee above and beyond MSW collection fees. There are areas in Virginia where residents and businesses are paying extra fees for SSO collection for diversion (i.e. Falls Church, Alexandria, Richmond, Charlottesville, and several Tidewater-area jurisdictions). It is not known if any of the residents or businesses in Region 2000 would be willing to pay an extra fee for SSO collection and diversion. As an alternative to, or in conjunction with, curbside collection, some municipalities (Falls Church, Alexandria, Charlottesville) are using dedicated drop-off collection stations, often in concert with local farmer's markets to collect SSO.

As only 30% of the Region 2000 collection infrastructure is municipally-based and subject to flow control while 70% is private and not subject to flow control, there is significant risk that any SSO diversion programs enacted by Region 2000 members will cause SSO to "leak" out of the Region 2000 system to organics processing facilities not controlled by Region 2000, thus reducing Region 2000 revenues. For example, Liberty University has been exploring ways to divert about 500 tons per year of food waste to composting off-campus. Co-collection of SSO with MSW may offer some opportunity to offset this potential leakage.

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1 Vance, R. "2014 Facts and Figures Report and Recycling Economic Information Report", Dec. 2016

2 Denver, CO collects weekly from 80,000 households at a fee of $29.25/HH/quarter; Boise, ID is launching their SSO diversion program this year for a fee of $25.20/HH/quarter.

3 http://www.waste360.com/organics/minnesota-evaluate-co-collection-organics-program

Processing of Organics

Composting

Composting is the primary method used to process SSO. It is the controlled aerobic (with oxygen) decomposition of SSO, or feedstocks, such as food scraps, sewage sludges, yard trimmings, water treatment residuals, animal manures and mortalities and certain industrial solid wastes. Composting is a well-proven approach to recycling organic materials; there are thousands of operating composting facilities around the world. It is a self-heating process that destroys pathogens and weed seeds and produces a material similar to soil humus. Heat is produced by biological activity of decomposition and temperatures rise to thermophilic levels (45º C. – 70º C.). This heating kills pathogenic microbes like fecal coliform and *Salmonella sp.* Well-stabilized (and mature) compost can be stored indefinitely and has a wide variety of product markets in residential and commercial landscaping, sediment and erosion control, agriculture, non-point source water quality management systems, disturbed lands remediation, and commercial horticultural applications.

Composting, at any scale, is a biological manufacturing process, where the inputs to the process are feedstocks, air and water, and the outputs are compost, heat, water vapor and carbon dioxide (biogenic). Compost production requires a medium dry enough to provide pore spaces with free air, but wet enough to sustain biological activity (around 50% to 65% moisture). Porosity (around 35% to 50%) typically is provided by mixing organic wastes with a bulking agent or amendment, such as wood chips. The addition of woody materials as amendments also serves to raise the carbon:nitrogen ratio of the organic waste materials into the preferred range of 25% to 30%. One drawback to composting in central Virginia is a lack of woody material. This is due to the presence of wood chip-based industries (Grief Bros. paper mill in Amherst, Dominion power plant at Hurt, etc.) and to the lack of yard waste collection efforts in a largely rural area.

Composting is a relatively simple process that can be performed outdoors in most climates. Because of a desire to operate the process more efficiently, control odors, and minimize the effects of weather, some facilities are constructed under structures, in fully enclosed buildings, or in entirely mechanized facilities (and combinations thereto). Composting capital costs can vary from $75/ton of installed capacity for open-air turned windrows to $150-$200/ton for fully-enclosed facilities with sophisticated exhaust air treatment systems. Operating costs will run $15-$25/ton of material processed. Revenues can be derived from compost sales, but more often from compost-amended soils sales.

There is already an operating composting infrastructure in the Region 2000 Service Area. Royal Oak Farm LLC (DEQ Permit No. SWP-601) is located 14.4 miles west of the Livestock Rd. landfill and is permitted to accept 150,000 tons/year of various solid wastes, including all of the types of SSO potentially divertible. Royal Oak Farm processes primarily industrial residuals but takes in the food wastes from Virginia Tech (77 miles) and from JMU (115 miles). The facility only processes about 35,000 tons/year at present so has adequate capacity to absorb all of the SSO that could reasonably be diverted from the Region 2000 service areas. This would result in leakage of revenues away from Region 2000, as noted above, unless Region 2000 were to contract with Royal Oak Farm to process the SSO collected and transported to Livestock Rd. (either collected separately or co-collected with MSW).

A second composting facility, owned and operated by McGill Environmental Systems, is operating in Waverly, VA, 136 miles from Livestock Rd. While primarily a biosolids composting facility, it also takes in food wastes. McGill is currently accepting food wastes from UVA, 119 miles away, as well as from residents and businesses in the Richmond and Tidewater metropolitan areas.

Anaerobic Digestion

The other method commercially-proven for processing SSO is anaerobic digestion (AD), or biogas production. This is a sealed-tank system that produces a gaseous fuel similar to the biogas now captured and flared at the Livestock Rd. landfill. AD is a biological treatment process, but the lack of oxygen results in organic materials decomposition and stabilization by a different group of microorganisms that produce a usable energy source in the form of biogas. The products of anaerobic digestion are methane, carbon dioxide, trace gases and stabilized solids. Biogas production is approximately 4,200 cubic feet per ton of incoming feedstock. The biogas has an average methane content of 55-65%, but pretreatment would be needed to remove impurities before it can be used for energy production[4].

AD systems can be configured to handle liquid wastes or solid wastes. Liquid waste digesters can be either low-solids (less than 10% total solids) or high-solids (25%-50% total solids). Solid waste digesters are known as dry fermentation reactors and normally handle feedstocks with more than 50-70% total solids. The majority of AD systems operating in the U.S. today are low-solids liquid systems, which are used at wastewater treatment plants for sewage sludges and on farms handling liquid animal manures, both of which are suitable locations for co-digestion of some SSO (notably food wastes) with the main substrate. High-solids liquid digesters are used in Europe and Asia to handle food scraps and similar feedstocks that can be moved by high-solids piston pumps; none are operational in the U.S. at present. Dry fermentation reactors are an emerging AD technology in the U.S. The first dry fermentation system came on-line in Wisconsin in 2011, followed by two in California in 2014 and numerous others are in various stages of planning, design, or construction.

The only nearby AD infrastructure to Region 2000 is the dairy manure digester at Vanderheyden Farms in Chatham, VA. It is not known if they would be interested in co-digestion. The Prince William County, VA Dept. of Solid Waste has entered into a 20-year public-private partnership for their contractor, Free State Farms, to digest 45,000 tons/year of SSO collected from residential and commercial sources. The contractor has hired *quasar* Energy Co. (Columbus, OH) to build their liquids AD technology at the County's Balls Ford Rd. composting facility.

If Region 2000 decides to capture the Livestock Rd. landfill gas and use it to make renewable energy, then the idea of building a dedicated SSO AD system to supplement that landfill gas could be evaluated.

[4] Van Opstal, B. "Evaluating AD System Performance for MSW Organics," *Biocycle*, Vol. 45, No. 11, November 2006, p. 35-39, and "Managing AD System Logistics for MSW Organics," *Biocycle*, Vol. 45, No. 12, December 2006, p. 39-43.

Recycled Organics Product Markets

One unique characteristic about organics recycling that differentiates it from conventional recycling is that the processing technologies make products that have to be sold as retail/wholesale distribution items or as captive product off-takes.

Compost Products

Compost-based organics recycling facilities can derive a significant revenue from product sales, either on the retail or wholesale level. Most compost producers are now making soil blends with compost, sand, and sandy loam soils to meet particular project specifications for "engineered soils" (i.e. bioretention pond media, athletic turfgrass media, green roof media, etc.), in addition to selling different composts screened to different sizes (½" for garden soil amendment, ¼" for turfgrass topdressing). This process of making and selling products can be a foreign concept to traditional municipal solid waste service providers, so many look to public-private partnerships to move the products to market.

The major drawback to Region 2000 distributing compost products for sale is the proximity of a major producer, Royal Oak Farm, in its service area. Royal Oak Farm distributes over 50,000 cubic yards of compost and soil products annually in the greater Lynchburg area.

AD Products

The two products from AD are biogas and digestate. Biogas can be combusted to make electricity, or cleaned up to make biomethane (vehicle fuel and/or pipeline gas additive). The sale of the electricity or biomethane made from biogas is usually done under the contractual terms of an off-take agreement with a particular power or natural gas utility. The AD system at Vanderheyden Dairy sells power to Dominion Power, but only receives the wholesale electric rate of 3.4¢ per kWh. Some AD-based producers of electricity provide the power to a high-demand dedicated end user, such as Liberty University or Lynchburg Airport, who can use the power "behind the meter".

Digestate is often spread on farm fields as a fertilizer supplement, much like biosolids. Similar to biosolids, digestate can be used more widely if it has been produced in a high-temperature thermophilic reactor. There are likely adequate farm demands for digestate in the service area, which has a typical N-P-K value of 125 lbs/acre nitrogen, 20 lbs/acre phosphorus, and 44 lbs/acre potassium[5]. Digestate can also be composted to make soil products for market.

Conclusions and Recommendations

Due to the proximity of Royal Oak Farm, with its available capacity, there is no reason for Region 2000 to pursue its own composting facility. There is potential advantage in opening a dialogue with member municipalities about developing SSO programs in suitable areas, where that SSO could be brought to Livestock Rd. and transferred to Royal Oak Farm.

If the Working Group selects a transfer station as the preferred Year 2030 alternative, then a costs evaluation is warranted to see if diversion of SSO to Royal Oak Farm, or to an AD system at Livestock

[5] Gissen, C., et.al., "Comparing energy crops for biogas production – yields, energy input and costs in cultivation using digestate and mineral fertilization", *Biomass and Bioenergy*, 64 (2014), 199-210

Rd. in conjunction with a landfill gas-to-energy project would save money in hauling and tip fee costs. If the Working Group selects landfilling as the preferred alternative, this same type of analysis could be used to evaluate potential capacity life extensions to the new landfill with SSO diversion in place.