Sustainable Solid Waste Management Study

Prepared for

King County Department of Natural Resources and Parks,

Solid Waste Division

July 2014

Sustainable Solid Waste Management Study

Prepared for
King County Department of Natural Resources and Parks, Solid Waste Division
by the Leidos consultant team which includes Brown and Caldwell,
Integrated Waste Management Consulting, Sound Resource Management Group,
Alternative Resources, Inc., and A Goldsmith Resources, LLC.

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Executive Summary

Consistent with the King County 2013 Comprehensive Solid Waste Management Plan the King County Solid Waste Division (SWD) commissioned this Sustainable Solid Waste System Study (Study) to evaluate operational and strategic planning options and to develop an implementation approach to expand these efforts. King County identified five areas in which this Study should focus, including:

1. Resource recovery at division facilities (expanding on work done to date, including the Optimized Transfer Station Recycling Feasibility Study)
2. Construction and demolition (C&D) debris management
3. Organics processing
4. Disposal alternatives and technologies
5. Sustainable system financing

The Study was carried out by a team of subject matter experts led by Leidos Engineering. The team worked closely with SWD staff at each step in the Study.

The Study commenced with the Leidos team's preparation of a broad list of best practices in the five study areas drawing upon knowledge of practices in use across the country and internationally. This long list included a total of 54 best practices distributed across the five study areas as follows:

C&D Debris Management	Resource Recovery at County Facilities	Organics Processing	Disposal Alternatives & Technologies	Sustainable System Financing
13	3	8	11	19

In consultation with the SWD staff and then with the Metropolitan Solid Waste Management Advisory Committee (MSWMAC) and Solid Waste Advisory Committee (SWAC) the long list was reduced to a short list of 20 best practices to be evaluated in detail. The short list was distributed across the five study areas as follows:

C&D Debris Management	Resource Recovery at County Facilities	Organics Processing	Disposal Alternatives and Technologies	Sustainable System Financing
4	3	3	7	3

The team, again working closely with the SWD staff and in consultation with the MSWMAC and the SWAC, generated a list of 59 evaluation considerations distributed across four evaluation categories (fiscal; environmental; operational; and policy and equity and social justice) and 14 subcategories (impact on rates; economic risks; impact on waste prevention; impact on resource consumption; impact on environmental resources; consistency with Climate Action Plan; complexity of implementing; complexity of system and facility operation; level of service to customers; operational risks; flexibility and adaptability; compatibility with equity and social justice ordinance; public and political understanding and acceptance; and, impact on employees).

The study team evaluated the 20 short listed best practices using a standard narrative template that incorporates the 59 evaluation criteria considerations. The narrative evaluations, located in Appendix A, include detailed discussion of how the best practices perform with respect to the evaluation considerations, a summary and recommendation. Based on the results of the evaluations the study team worked closely with the SWD staff to score each of the best practices and rank them using the following six ranking categories in descending order of priority:

1. Implement in the near term
2. Implement in the long term
3. Promising, but needs more in-depth study by the County before implementing
4. Promising, but needs input from private industry before implementation
5. Riskier, would need more in-depth study by the County before implementation
6. Not recommended, no further action

After receiving input from the MSWMAC and SWAC, the study team worked closely with the SWD staff to develop a comprehensive implementation plan for the top 15 best practices. The comprehensive implementation plan reflects the interrelated nature of a number of the best practices as well as the limitation in County resources. The implementation plan focuses on near term implementation action on three of the higher ranked best practices:

- **Best Practice No. 7.** Implement anaerobic digestion of source separated organic waste, with beneficial use of the biogas and composting/marketing of the digestate.
- **Best Practice No. 16.** Issue solicitation to private industry to manage a specified fraction of the County-controlled mixed waste stream leaving the technology up to the proposers (within specified constraints) to allow for demonstration of technologies and possible full commercial operation at large scale. This could include a County-provided location(s) (for waste processing), or leave it up to the proposers to locate the processing facility or facilities.
- **Best Practice No. 17.** Shift solid waste system revenue collection from almost exclusively tipping fees on waste tonnage collected at the gate of County transfer stations and landfill to a combination of non-weight based fees on collection of different commodities and weight-based tipping fees at the gate in a manner that is revenue neutral.

The implementation plan recognizes that the County is already pursuing the following two best practices:

- **Best Practice No. 4:** Institute policies, staff training, and staffing level revisions to support greater diversion of recyclable materials at transfer stations where space and facilities are suitable for enhanced diversion
- **Best Practice No. 18:** Secure revenues from materials derived from waste stream, including carbon credits

The implementation plan recognizes that Best Practice Nos. 1, 3, 6 and 9 would not be implemented until the results of Best Practice No. 4 are known, and that Best Practice Nos. 10, 11, 12 and 14 would not be implemented until the results of Best Practice No. 16 are known.

Finally, the implementation plan recognizes that Best Practice No. 20, Require or incentivize builders to recover/recycle a specified percentage of C&D material, is an activity that the County's suburban city partners would implement outside the unincorporated County according to their priorities, and that the County would assist the cities with information and resources as they become available.

Section 1

Study Background

1.1 Purpose of Study

King County's 2013 Comprehensive Solid Waste Management Plan (Comp Plan) articulates six waste prevention and recycling policies. One of these, WPR-1, reads as follows:

"Achieve Zero Waste of Resources – to eliminate the disposal of resources with economic value - by 2030 through a combination of efforts in the following order of priority:

- *Waste prevention and reuse*
- *Product stewardship, recycling, and composting*
- *Beneficial use"*

Together, the King County Solid Waste Division (the Division), the 37 cities with which the County has interlocal solid waste management agreements, the private collectors and processors, and the businesses and residents in the County have made significant progress on this policy. To continue this progress, the Division retained Leidos Engineering LLC (Leidos) to conduct a Sustainable Solid Waste System Study (Study) to evaluate operational and strategic planning options and to develop an implementation approach to expand these efforts. King County identified five areas in which this Study should focus, including:

1. Resource recovery at division facilities (expanding on work done to date, including the Optimized Transfer Station Recycling Feasibility Study)
2. Construction and demolition (C&D) debris management
3. Organics processing
4. Disposal alternatives and technologies
5. Sustainable system financing

1.2 Study Approach

To begin this Study, the Leidos team and Division staff met to discuss the Division's expectations for the study. As a starting point for selecting best practices that should be considered, Leidos identified a long list of best practices that represent practices in use across the country and in some cases internationally in each of the five study areas. A total of 54 best practices, listed in Table 1-1, were included. These best practices were distributed among the five study areas as indicated below:

C&D Debris Management	Resource Recovery at County Facilities	Organics Processing	Disposal Alternatives & Technologies	Sustainable System Financing
13	3	8	11	19

In addition, with input from Division staff, Leidos also prepared a suggested list of criteria by which the final short list of best practices would be evaluated. Division staff and the Leidos team met to review and finalize the suggested criteria to be used for evaluating the short list of best practices. These criteria are divided into four categories: fiscal; environmental; operational; and policy and equity and social justice. However, there are 14 subcategories and 59 specific considerations within each of these 4 overarching categories. It is important to note that given the diversity of best practices, not all of the criteria apply to each of the best practices under consideration. For example, promoting on-site processing of organics at generator sites has no significant impact on management of construction and demolition debris. Thus, in the evaluations of the best practices covered in Section 2, we took note when a best practice has little to no relevance to a specific evaluation criterion and focused only on those criteria which are applicable to each best practice.

In a meeting on January 30, 2014, King County and the Leidos team narrowed down the long list of best practices to the nineteen most promising practices, and refined the list of evaluation criteria. In early February, the Division then requested input from the Metropolitan Solid Waste Management Advisory Committee (MSWMAC) and Solid Waste Advisory Committee (SWAC) to provide guidance for the study, including input on the short list of best practices and on the evaluation criteria. Specifically, the Division asked the MSWMAC and the SWAC to provide input on the following questions:

1. Which practices are you most interested in knowing more about?
2. Which criteria do you think are most important?
3. Is anything critical missing from either list?

Input received from the MSWMAC and the SWAC, including the addition of one best practice (No. 20), and several additional evaluation criteria, were incorporated into the final best practice short list, Table 1-2, and the refined list of evaluation criteria, Table 1-3. The 20 best practices were distributed among the five study areas as indicated below:

C&D Debris Management	Resource Recovery at County Facilities	Organics Processing	Disposal Alternatives & Technologies	Sustainable System Financing
4	3	3	7	3

Once the short list of best practices and the criteria were finalized, the Leidos team evaluated each of the best practices, applying criteria that were relevant to each best practice. The results of the evaluation are presented in Section 2.

Table 1-1. Long List of Best Practices

	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
1	Construct and operate, or contract operation of, C&D sorting systems or facilities (small scale) at one or more Division transfer stations.	X	X			
2	Construct and operate, or contract operation of, one or more stand-alone C&D material recovery facilities (MRF / large scale) at Cedar Hills Regional Landfill and / or other sites including possible repurposing of an existing transfer station such as the Renton station.	X	X			
3	Assess lower fees for loads that are directed to County owned and operated C&D material sorting facilities.	X	X			X
4	Certify C&D processors that demonstrate ability to meet specified criteria and require that all C&D material collected within the County be delivered to certified processors.		X			
5	Require, or incentivize, builders to recover / recycle a specified percentage of C&D material.		X			

Table 1-1. Long List of Best Practices						
	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
6	Contract with private industry for processing of all C&D material at a private facility generated within the County prior to delivery of residual material to County facilities.		X			
7	Prohibit self-haul C&D material at County facilities, direct loads to certified or specified C&D processing facilities.		X			
8	Prohibit commercially generated C&D material at County facilities and direct loads to certified or specified C&D processing facilities.		X			
9	Offer drop off locations at Division facilities for selected C&D materials such as wood, concrete, gypsum wallboard, etc. in conjunction with ban on comingling of these materials with other materials delivered for disposal, or by incentivizing customer separation by offering reduced fee for loads not containing target materials.	X	X			
10	Institute policies, staff training, and staffing level revisions to support greater diversion of recyclable materials at transfer stations where space and facilities are suitable for enhanced diversion.	X	X	X		
11	Issue new contracts to privately owned and operated C&D disposal facilities.		X			
12	Extend existing contracts for privately owned and operated C&D disposal facilities.		X			
13	Allow free market system to determine how and where C&D waste is disposed.		X			
14	Designate C&D processors that are approved to handle C&D material and require that all C&D material collected within the County be delivered to these processors. Different than #4 in that there would be no certification process.		X			
15	Contract with private industry to operate diversion program at transfer stations where space and facilities are suitable for enhanced diversion.	X	X	X		
16	Incorporation of new and / or revised facilities at transfer stations to accommodate recyclable material diversion.	X	X	X		
17	Implement Anaerobic Digestion of Source Separated Organics (food waste and / or yard waste and other digestible components, from residents, multi-family, restaurants, institutions, and / or other generators, voluntarily or mandatorily separated); compost digestate from AD to market as a product; multiple options for use of biogas.			X		
18	Implement policy requiring source separation of organics from trash.			X		
19	Implement policy requiring large commercial / institutional generators to source-separate / divert food scraps subject to availability of infrastructure to receive for processing.			X		
20	Promote on-site processing using a rate structure and / or grants, matching grants, low interest loans and discounts.			X		
21	Offer and / or expand outreach and education for the public and business for organics management that increases diversion from the waste stream going to landfill disposal. Could include programmatic support for diversion of edible food to people in need.			X		
22	Implement Aerobic Composting of Source Separated Organics - AC of SSO (food waste and / or yard waste and other digestible components, from residents, multi-family, restaurants, institutions, and / or other generators, voluntarily or mandatorily separated); compost to market as a product.			X		

Table 1-1. Long List of Best Practices

	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
23	Implement Recycling and Anaerobic Digestion of Mixed Waste - MWP to recover recyclables with separation of the non-recyclable organic fraction for processing by AD; landfill remaining fraction of waste; compost digestate from AD to market as a product or dispose digestate in landfill; multiple options for use of biogas (e.g., electricity, pipeline quality gas, CNG).			X	X	
24	Implement Recycling and Thermal Processing of Mixed Waste - MWP to recover recyclables with thermal processing of non-recyclable components (e.g., gasification, plasma gasification, pyrolysis, conventional mass burn or advanced thermal recycling) to produce a syngas and other products; multiple options for use of syngas (electricity, diesel, gasoline, ethanol, etc.).				X	
25	Implement Fully Integrated Facility Processing Mixed Waste - MWP to recover recyclables with separation of the non-recyclable organic fraction for processing by AD; additional processing for the remaining fraction as applicable (e.g., thermal processing or plastic-to-oil); compost digestate from AD to market as a product, dispose digestate in landfill, or thermally process as applicable; multiple options for use of biogas (e.g., electricity, pipeline quality gas, CNG) and syngas (as applicable).			X	X	
26	Implement Large-Scale Thermal Processing of Mixed Waste with Conversion Technology – Thermal processing (e.g., gasification, plasma gasification, or pyrolysis) of mixed waste with pre-processing limited to the specific needs of the technology (i.e., without a full-scale MWP facility). Implement on a large-scale, long-term (20-year) basis.				X	
27	Implement Large-Scale Thermal Processing of Mixed Waste with Conventional Mass Burn or Advanced Thermal Recycling – Conventional thermal processing (e.g., mass burn or advanced thermal recycling) of mixed waste with pre-processing limited to the specific needs of the technology (i.e., without a full-scale MWP facility). Implement on a large-scale, long-term basis.				X	
28	Implement Small-Scale Thermal Processing of Mixed Waste with Conversion Technology – Thermal processing (e.g., gasification, plasma gasification, modular combustors or pyrolysis) of mixed waste with pre-processing limited to the specific needs of the technology (i.e., without a full-scale MWP facility). Implement on a small-scale, modular basis, possibly for a short-term period with potential for expansion in capacity and longer-term operation (e.g., a demonstration facility).				X	
29	Implement Emerging Conversion Technology: Plastic to Oil – In combination with one or more of the options listed above or as a stand-alone measure, process non-recyclable and low-value plastics separated or recovered from the waste stream into oil using an emerging plastic-to-oil technology. As appropriate, could implement on a small-scale, modular basis, possibly for a short-term period with potential for expansion in capacity and longer-term operation (e.g., a demonstration facility).				X	
30	Implement Emerging Conversion Technology: Hydrolysis – In combination with one or more of the options listed above or as a stand-alone measure, process the organic fraction separated from the waste stream into ethanol using a hydrolysis process. As appropriate, and subject to economic viability, could implement on a small-scale, modular basis, possibly for a short-term period with potential for expansion in capacity and longer-term operation (e.g., a demonstration facility).				X	
31	Implement Mixed Waste Processing + Aerobic Composting + Landfill compost or Beneficial Use.			X	X	
32	Issue solicitation to private industry to handle a specified fraction of the County controlled mixed waste stream leaving the technology up to the proposers (within any specified constraints) to allow for demonstration of technologies. Could include County provided location or proposers to locate.				X	

Table 1-1. Long List of Best Practices						
	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
33	Contract with private industry to handle a specified fraction of the County controlled mixed waste stream through waste export to a regional waste disposal facility such as one of the regional landfills. Listed separately from 31 since this is a well proven disposal technology for the region and is more likely to result in a contracted solution than 31 which has a higher level of uncertainty regarding outcome. Also time needed to implement 32 could be much shorter (years shorter) than 31.				X	
34	Continue to dispose of some or all County mixed waste at Cedar Hills Regional Landfill for an extended period, possibly combined with one or more of the other disposal practices.				X	
35	Unbundle rates. Possible areas where separate charges could be identified include: (a) planning services (e.g. comprehensive plan); (b) moderate risk waste planning and/or management costs to manage recyclable materials; (c) offer reduced tipping fee for pure organics loads assuming processing capacity (County or private) exists within a reasonable hauling distance; (d) an assessment to generators that covers some or all of the costs for managing recyclables, waste reduction, education outreach, system/program planning, administrative and other system costs; (e) surcharge for mixed waste loads that included X% of organic material; (f) place a surcharge on loads delivered to Division facilities that contain more than a certain percentage of listed recoverable materials, or alternatively assess lower fee for loads that meet specified recovery levels (e.g. if X% OCC). Materials would get on list when convenient market is identified.					X
36	Commercial Source Reduction and Recycling Fee. This fee currently exists. Revise rate structure to change this fee to something greater than $0.00.					X
37	Change the rate structure the County charges haulers, to be one that is at least partially based on their retail customers' container sizes and types. This can be done in a revenue-neutral manner by concurrent reduction of MSW tip fees paid by haulers at Division facilities. The effect is more stable revenues if disposal tonnage decrease.					X
38	Secure revenues from materials derived from waste stream including carbon credits.					X
39	Modify Inter Local Agreements (ILAs) to include shift risk to Cities with put or pay provisions or by having fixed and variable charges.					X
40	Ensure community support for sustainable fees and fee structure.					X
41	Link Capital Improvement Plan to tonnage trends, particularly if revenue projections are based on decreasing tonnage projections.					X
42	Evaluate service levels to match services with revenues and diversion objectives					X
43	Franchise Fees and/or County Franchise Fee surcharge in incorporated areas, if allowable.					X
44	C&D Diversion Deposit. Fees paid at the time of application for a building permit in unincorporated areas. Would require ILA modification for incorporated areas. Deposits returned when documentation is provided that at least 50% of waste was diverted from landfill disposal.					X
45	Automatic inflationary increases in revenues without separate ILA modification or council action.					X
46	Charge a base fee for all vehicles arriving at Division facilities regardless of whether they are carrying MSW, C&D, organics or recyclables. Base fee could be different for customer types.					X
47	Lease County-owned property (for recovery purposes) to raise revenue (more ongoing sources of funds than selling property).					X

Table 1-1. Long List of Best Practices

	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
48	Develop a fee supported by manufacturers, brand owners, retailers to manage waste/recyclables based on their contribution. (Extended Producer Responsibility) Best if created in collaboration with surrounding communities to maximize effectiveness and consistency.					X
49	Charge an annual per vehicle fee for any collection vehicle entering Division facilities.					X
50	Prohibit drop-off of selected materials (e.g. OCC, wood, scrap metals, carpet, etc.) as part of mixed waste loads destined for disposal at Division facilities.					X
51	Implement every-other-week collection of refuse, enhance collection of recyclables and organics and charge surcharge to those residents wanting every week collection.			X		X
52	Utilize property tax and/or CX (General Fund) Funding.					X
53	Have haulers charge a fee to each account per account or by volume collected that would be remitted to the SWD.					X
54	Ban disposal of organics at transfer stations.			X		

Focus Areas of Study: RRDF = Resource Recovery at Division Facilities, C&D = Construction and Demolition Debris Management, ORG=Organics Processing and Management, DA&T = Disposal Alternatives and Technologies, SSF= Sustainable System Financing

Table 1-2. Short List of Best Practices

	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
1	Construct and operate, or contract operation of, a small scale construction and demolition (C&D) debris sorting system or facility at one or more of the County's transfer stations	X	X			
2	Construct and operate, or contract operation of, one or more stand-alone large scale C&D material recovery facilities (MRFs) at Cedar Hills Regional Landfill (CHRL) and/or other sites, including possible repurposing of an existing transfer station such as the Renton station	X	X			
3	Assess lower fee for C&D loads at County-operated C&D material sorting facilities	X	X			X
4	Institute policies, staff training, and staffing level revisions to support greater diversion of recyclable materials at transfer stations where space and facilities are suitable for enhanced diversion	X	X	X		
5	Contract with private industry to operate a diversion program at the transfer stations where space and facilities are suitable for enhanced diversion	X	X	X		
6	Incorporate new and/or revised County-operated facilities at transfer stations to accommodate recyclable material diversion (e.g., mini-MRFs)	X	X	X		
7	Implement anaerobic digestion of source separated organic waste, with beneficial use of the biogas and composting/marketing of the digestate			X		
8	Promote on-site processing of organics (e.g., composting, digesting, dehydration, other hybrid technology) at the generator using a rate structure and/or grants, matching grants, low interest loans and discounts			X		
9	Ban disposal of organics in mixed waste at transfer stations where recycling options exist Ban disposal of organics, in mixed waste, at transfer stations where recycling options exist			X		
10	Implement recycling (using mixed waste processing) and anaerobic digestion of the organic fraction of mixed waste, with beneficial use of the biogas and composting/marketing of the digestate			X	X	

Table 1-2. Short List of Best Practices

	Description of Best Practice	RRDF	C&D	ORG	DA&T	SSF
11	Implement recycling (using mixed waste processing) and thermal processing (with energy generation) of the non-recyclable fraction of mixed waste				X	
12	Implement fully integrated processing of residual municipal solid waste combining recycling (using mixed waste processing) with anaerobic digestion and thermal processing			X	X	
13	Implement small-scale thermal processing with front-end recycling				X	
14	Implement emerging conversion technology plastic-to-oil along with other options or as stand alone				X	
15	Implement mixed waste processing of residual municipal solid waste to recover additional recyclables, with separation of the non-recyclable organic fraction for processing by aerobic composting; landfill remaining fraction of waste; compost to market as a product or dispose in landfill			X	X	
16	Issue solicitation to private industry to manage a specified fraction of the County-controlled mixed waste stream leaving the technology up to the proposers (within specified constraints) to allow for demonstration of technologies and possible full commercial operation at large scale. This could include a County-provided location(s) (for waste processing), or leave it up to the proposers to locate the processing facility or facilities				X	
17	Shift solid waste system revenue collection from almost exclusively tipping fees on waste tonnage collected at the gate of County transfer stations and landfill to a combination of non-weight based fees on collection of different commodities and weight-based tipping fees at the gate in a manner that is revenue neutral.					X
18	Secure revenues from materials derived from waste stream, including carbon credits					X
19	Ensure community support for sustainable fees and fee structure					X
20	Require or incentivize builders to recover/recycle a specified percentage of C&D material		X			

Focus Areas of Study: RRDF = Resource Recovery at Division Facilities, C&D = Construction and Demolition Debris Management, ORG=Organics Processing and Management, DA&T = Disposal Alternatives and Technologies, SSF= Sustainable System Financing

Table 1-3. Evaluation Criteria

Fiscal

1. Impact on rates, including:

- Capital Costs
- O&M Costs
- System Costs
- System Revenue

2. Economic risks, including:

- Financial effect of listed operational risks
- Sustainability of funding sources
- Certainty of costs
- Certainty of revenues, including consideration of market availability for materials/products including energy produced
- Opportunities for regional risk sharing

Environmental

Table 1-3. Evaluation Criteria

3. Impact on waste prevention, recycling and diversion, including:
- Effect on landfill operations
- Effect on waste prevention, recycling and diversion

4. Impact on resource consumption, including:
- Land
- Water
- Energy (amount and type)
- Material resources

5. Impact on environmental resources, including:
- Human health
- Ecosystems health
- Air
- Earth
- Water

6. Consistency with Climate Action Plan

Operational

7. Complexity of implementing, including:
- Program changes
- Time required to implement
- Facility siting, design, permitting and construction challenges
- Contracting for services
- Compatibility with other elements of the system
- Opportunities for regional partnerships
- Compatibility with other regional approaches to solid waste management
- Compatibility with the current role of the solid waste division
- Compatibility with existing private industry role and resources
- Public education requirements

8. Complexity of system and facility operation, including:
- Potential facility downtime
- Residue disposal
- Compatibility with labor agreements

9. Level of service to customers, including:
- Service offerings
- Location of service delivery
- Hours of service offering
- Time required by customers to utilize service

10. Operational risks, including:
- Proven performance of technology
- Market availability for materials/products
- Contract risks and risk sharing
- Ability to respond to external emergencies
- Ability to respond to internal system emergencies and outages
- Operating life (durability of practice)
- Potential energy production
- Impacts from feedstock contamination

Table 1-3. Evaluation Criteria
11. Flexibility and adaptability, including: • Ability to scale up and add or reduce capacity • Adaptability to system changes and demands • Changes in feedstock quantity and composition (includes ability to add, divert or subtract materials) • Impact on landfill life and operation
Policy and Equity & Social Justice
12. Compatibility with Equity and Social Justice Ordinance, including: • Equity of fees • Siting of facilities
13. Public and political understanding and acceptance, including: • Effects on livability and character of communities (includes negative effects of traffic, noise, odor and aesthetics) • Job creation • Impacts on cities • Susceptibility to impacts from action of cities • Public education requirements
14. Impact on employees , including: • Health and safety • Job security • Job satisfaction

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Section 2

Best Practice Evaluations

Each of the 20 short listed best practices were evaluated by the Leidos team using a standard narrative template that is organized to closely follow the four primary evaluation criteria categories, 14 subcategories and 59 considerations presented in Table 1-3. Leidos team members with special expertise in the five study areas took the lead in preparing the evaluation of best practices in each area with support from one or more of the other team members as appropriate. Team member Jeff Morris of Sound Resource Management Group provided overall quality control review of the 20 evaluations as well as providing input for the criteria in the environmental category. The 20 evaluation narratives, which conclude with a summary and recommendations are located in Appendix A.

After completing the evaluation narratives, the Leidos team worked closely with County staff to develop the best practice evaluation summary matrix in Table 2-1 and a table of best practice rankings, Table 2-2. The summary matrix lists each best practice by number and summary description, provides a color coded score or ranking against each of the 14 evaluation criteria subcategories, and repeats the evaluation summary and recommendation given in the evaluation narrative. The ranking table groups the 20 short best practices in six categories of descending priority starting with those practices that are recommended for implementation in the short term down to those that are not recommended for further implementation or study action. The evaluation narratives, summary matrix and ranking table were reviewed and refined by the Division staff and the Leidos team.

The summary results of the evaluation and ranking recommendations were submitted to the MSWMAC and to the SWAC for review and comment. Specifically, the Division asked the MSWMAC and the SWAC to provide input on the following questions:

1. Is there anything that really surprises you?
2. Is there any recommendation that you disagree with? If so, why?
3. The recommendations will inform an implementation plan that we will discuss in May. To help develop that plan, what would you like to see the division work on first and what is least important?

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Table 2-1. Best Practice Evaluation Summary Matrix

Best Practice Number	Best Practice	Fiscal: Impact on rates	Fiscal: Economic risks	Environmental: Impact on waste prevention, recycling and diversion	Environmental: Impact on resource consumption	Environmental: Impact on environmental resources	Environmental: Consistency with Climate Action Plan	Operational: Complexity of implementing	Operational: Complexity of system and facility operation	Operational: Level of service to customers	Operational: Operational risks	Operational: Flexibility and adaptability	Policy and Equity & Social Justice: Compatibility with Equity and Social Justice Ordinance	Policy and Equity & Social Justice: Public and political understanding and acceptance	Policy and Equity & Social Justice: Impact on employees	Recommendation Summary
1	Construct and operate, or contract operation of, a small scale construction and demolition (C&D) debris sorting system or facility at one or more of the County's transfer stations	Empty	Red	Light green	Light gray	Empty	Dark green	Yellow	Light green	Empty	Light green	Light green	Empty	Light gray	Yellow	**3a. Promising, but needs more in-depth study by County before implementing** This best practice would be relatively inexpensive and simple to implement at transfer stations, such as Bow Lake, where space exists and customers deliver large amounts of C&D type material. The system would have flexibility to adapt to day-to-day changes in the composition and quantity of the material being received. Depending on size and technology, costs could exceed revenue significantly. Constructing/operating a stand-alone facility is not recommended. Could be implemented as part of mixed waste processing in conjunction with other practices.
2	Construct and operate, or contract operation of, one or more stand-alone large scale C&D material recovery facilities (MRFs) at Cedar Hills Regional Landfill (CHRL) and/or other sites, including possible repurposing of an existing transfer station such as the Renton station	Empty	Red	Dark green	Light gray	Light gray	Dark green	Yellow	Light green	Light gray	Light green	Light green	Empty	Yellow	Empty	**4. Riskier, would need more in-depth study by County before implementation** This best practice would have a more positive affect on diversion from disposal than practice 1; however, costs would likely be higher because it would not be integrated into an existing facility. Could be implemented as part of mixed waste processing in conjunction with other practices.
3	Assess lower fee for C&D loads at County-operated C&D material sorting facilities	Empty	Empty	Dark green	Light gray	Light gray	Dark green	Empty	Empty	Empty	Empty	Empty	Light green	Light green	Empty	**2. Implement over the long term** This best practice could provide an incentive for diversion. It could be implemented at County-operated facilities that can accept source-separated materials.
4	Institute policies, staff training, and staffing level revisions to support greater diversion of recyclable materials at transfer stations where space and facilities are suitable for enhanced diversion	Yellow	Empty	Light green	Light green	Light green	Dark green	Light gray	Yellow	Light green	Light gray	Light green	Empty	Light gray	Empty	**1. Implement in the near term** This best practice incorporates specific strategies and tactics that were considered in the *Optimized Transfer Station Recycling Feasibility Study*. It would provide moderately favorable impacts in many areas. This best practice would be expected to increase cost and complexity of facility and system operation.
5	Contract with private industry to operate a diversion program at the transfer stations where space and facilities are suitable for enhanced diversion	Empty	Red	Light green	Light gray	Empty	Dark green	Red	Red	Empty	Light green	Light green	Empty	Light gray	Orange	**5. Not Recommended, no further action** The complexity of implementing and operating this best practice would be very challenging and would likely have significant adverse impacts on County employees. The complexity along with significant costs would outweigh positive aspects.
6	Incorporate new and/or revised County-operated facilities at transfer stations to accommodate recyclable material diversion (e.g., mini-MRFs)	Empty	Red	Light green	Light gray	Empty	Dark green	Yellow	Light green	Empty	Light green	Light green	Empty	Light gray	Yellow	**3a. Promising, but needs more in-depth study by County before implementing** This best practice would be relatively inexpensive and simple to implement on a small scale at transfer stations, such as Bow Lake, where space exists and customers deliver large amounts of recyclable material. Note that smaller scale systems would have a lesser impact on diversion from disposal. The system would have flexibility to adapt to day-to-day changes in the composition and quantity of the material being received. Depending on size and technology, costs could exceed revenue. Could be implemented as part of mixed waste processing in conjunction with other practices.
7	Implement anaerobic digestion of source separated organic waste, with beneficial use of the biogas and composting/marketing of the digestate	Orange	Orange	Light green	Light gray	Light gray	Dark green	Yellow	Light green	Empty	Empty	Light gray	Empty	Light gray	Empty	**3a. Promising, but needs more in-depth study by County before implementation** This best practice would provide an alternative to the current organics management being used in King County, with the potential to divert additional organics materials, and provide energy or fuel. There are economic risks associated with this practice related to the uncertainty of costs as well as uncertainty regarding the amount of energy that would be produced and the future value of that energy. Economics would be more favorable for small-scale

Table 2-1. Best Practice Evaluation Summary Matrix

Best Practice Number	Best Practice	Fiscal		Environmental				Operational					Policy and Equity & Social Justice			Recommendation Summary
		Impact on rates	Economic risks	Impact on waste prevention, recycling and diversion	Impact on resource consumption	Impact on environmental resources	Consistency with Climate Action Plan	Complexity of implementing	Complexity of system and facility operation	Level of service to customers	Operational risks	Flexibility and adaptability	Compatibility with Equity and Social Justice Ordinance	Public and political understanding and acceptance	Impact on employees	
																application, such as at one of the County's existing transfer stations.
8	Promote on-site processing of organics (e.g., composting, digesting, dehydration, other hybrid technology) at the generator using a rate structure and/or grants, matching grants, low interest loans and discounts	Yellow	Yellow	Light gray	Light gray	Light gray	Light gray	Yellow	Light green	Light gray	White	Light green	White	White	White	**1. Implement in the near term** This best practice has some environmental benefits at a small scale considering the size of the County's waste stream. If the County's role is to support and facilitate, such as assist participants in obtaining grants and loans from other sources, the recommendation is to implement. However, the benefits would not warrant the financial impact of direct funding.
9	Ban disposal of organics, in mixed waste, at transfer stations where recycling options exist	White	White	Light gray	Light gray	White	Light gray	Light green	Dark green	White	White	Dark green	White	White	White	**1. Implement in the near term** This best practice would have positive impacts on diversion and the environment with no significant negative impacts.
10	Implement recycling (using mixed waste processing) and anaerobic digestion of the organic fraction of mixed waste, with beneficial use of the biogas and composting/marketing of the digestate	Orange	Orange	Light green	Light green	White	Dark green	Orange	Light gray	White	White	Light green	Yellow	Light gray	White	**3b. Promising, but needs input from private industry before implementation** This best practice would have a positive impact on diversion and resource consumption, and is highly consistent with and supportive of the County's Strategic Climate Action Plan. It is compatible with the County's transfer system, and would not require any changes to collection practices or transfer station operations. However, there are economic risks associated with the uncertainty of costs and revenues. Based on estimates, the capital and O&M costs may not be offset by revenues and avoided disposal cost, except perhaps under the most favorable cost and revenue conditions. This best practice appears to be better suited for private operation, due to the complexity and risk involved. Consideration of this best practice together with Best Practice 16 (Solicitation of Private Industry Handling of Waste) would provide industry input needed to address economic risk and other uncertainties.
11	Implement recycling (using mixed waste processing) and thermal processing (with energy generation) of the non-recyclable fraction of mixed waste	Orange	Orange	Dark green	Light green	Light gray	White	Orange	White	White	White	Light green	Yellow	Orange	White	**3b. Promising, but needs input from private industry before implementation** This best practice would have a positive impact on diversion and resource consumption. It is compatible with the County's transfer system, and would not require any changes to collection practices or transfer station operations. However, there are economic risks associated with development costs and uncertainty of revenue. The facility would require a large capital investment, both in terms of building space and equipment, and would likely need 15 to 25 acres or more for development. Except under the most favorable cost and revenue conditions, which could include the production of fuel in place of electricity, this best practice may not reach a financial break-even point in King County. Thermal processing is not well understood by the public, so outreach and education would be required to inform the public about the associated risks and benefits. This best practice appears to be better suited for private operation, due to the complexity and risk involved. Consideration of this best practice together with Best Practice 16 (Solicitation of Private Industry Handling of Waste) would provide industry input needed to address economic risk and other uncertainties.
12	Implement fully integrated processing of residual municipal solid waste combining recycling (using mixed waste processing) with anaerobic digestion and thermal processing	Orange	Orange	Dark green	Dark green	Light gray	White	Orange	White	White	White	Light green	Yellow	Orange	White	**3b. Promising, but needs input from private industry before implementation** This best practice provides for high diversion and a positive impact on resource consumption, while limiting the thermal footprint through the prioritization of recycling and biological processing. It is compatible with the County's transfer system, and would not require any changes to collection practices or transfer station operations. However, there are economic risks associated with

Table 2-1. Best Practice Evaluation Summary Matrix

Best Practice Number	Best Practice	Fiscal		Environmental				Operational					Policy and Equity & Social Justice			Recommendation Summary
		Impact on rates	Economic risks	Impact on waste prevention, recycling and diversion	Impact on resource consumption	Impact on environmental resources	Consistency with Climate Action Plan	Complexity of implementing	Complexity of system and facility operation	Level of service to customers	Operational risks	Flexibility and adaptability	Compatibility with Equity and Social Justice Ordinance	Public and political understanding and acceptance	Impact on employees	
																development costs and uncertainty of revenue. The facility would require a large amount of capital investment, both in terms of building space and equipment, and would need 15 to 30 acres or more for overall site development. It would require 100 or more staff, and would be costly to operate and maintain. Except under the most favorable cost and revenue conditions, which could include the production of fuel in place of electricity, this best practice may not reach a financial break-even point in King County. Thermal processing is not well understood by the public, so outreach and education would be required to inform the public about the associated risks and benefits. This best practice appears to be better suited for private operation, due to the complexity and risk involved. Consideration of this best practice together with Best Practice 16 (Solicitation of Private Industry Handling of Waste) would provide industry input needed to address economic risk and other uncertainties.
13	Implement small-scale thermal processing with front-end recycling															**5. Not Recommended, no further action** This best practice would be consistent with current waste collection and handling practices. It could be installed at an existing transfer station, and could be operated by the County with training and perhaps technical support from the system provider. However, based on estimated costs and revenues this best practice would not be expected to reach a financial break-even point, except perhaps for limited applications where unique cost savings may be achievable (i.e., off-setting high transportation costs). This best practice would provide only a very small diversion benefit, and would have negligible impacts on resource consumption. It would have high performance risk, since small-scale gasification systems have not been substantially demonstrated for municipal solid waste on a commercial basis. Performance risk may increase if the system is operated by the County rather than by the system provider.
14	Implement emerging conversion technology plastic-to-oil along with other options or as stand-alone															**4. Riskier, would need more in-depth study by County before implementation** This best practice would provide a small but positive impact on diversion and resource consumption. Plastic-to-oil is an untapped market, which would provide opportunity for expansion and regional collaboration if proven viable. Future expansion would further increase benefits associated with diversion and resource consumption. Product markets exist in Washington state, including a refinery in Tacoma. Based on estimated costs and revenues, it is expected that this best practice would reach or exceed a financial break-even point. However, this best practice would have high performance risk, since the technology is not yet commercially demonstrated. Performance risk may increase if the system is operated by the County rather than by the system provider. Implementation of this best practice would require acquisition of a steady stream of non-recyclable plastic feedstock, which could be challenging. Curbside recyclables are not delivered to the County system, and there is not currently a collection network for source-separated non-recyclable plastic. Implementation would require outreach and education, particularly due to the thermal nature of the process and the lack of public knowledge and familiarity with such systems.
15	Implement mixed waste processing of residual municipal solid waste to recover additional recyclables, with separation of the non-recyclable organic fraction for processing by aerobic composting; landfill remaining fraction of waste; compost to market as a product or dispose in landfill															**5. Not Recommended, no further action** The primary benefit of this best practice is the favorable impact on materials diversion from disposal. However, considering the significant economic risks and the higher value potential for reuse of diverted material under other, similar best

Table 2-1. Best Practice Evaluation Summary Matrix

Best Practice Number	Best Practice	Fiscal: Impact on rates	Fiscal: Economic risks	Environmental: Impact on waste prevention, recycling and diversion	Environmental: Impact on resource consumption	Environmental: Impact on environmental resources	Environmental: Consistency with Climate Action Plan	Operational: Complexity of implementing	Operational: Complexity of system and facility operation	Operational: Level of service to customers	Operational: Operational risks	Operational: Flexibility and adaptability	Policy and Equity & Social Justice: Compatibility with Equity and Social Justice Ordinance	Policy and Equity & Social Justice: Public and political understanding and acceptance	Policy and Equity & Social Justice: Impact on employees	Recommendation Summary
																practices, this best practice is not recommended.
16	Issue solicitation to private industry to manage a specified fraction of the County-controlled mixed waste stream leaving the technology up to the proposers (within specified constraints) to allow for demonstration of technologies and possible full commercial operation at large scale. This could include a County-provided location(s) (for waste processing), or leave it up to the proposers to locate the processing facility or facilities	light green	light green	dark green	light green	pale	dark green	orange	pale	pale	light green	pale	white	pale	orange	**1. Implement in the near term** This best practice is seen as a key next step for several other recommended best practices including Best Practices 10, 11, and 12.
17	Shift solid waste system revenue collection from almost exclusively tipping fees on waste tonnage collected at the gate of County transfer stations and landfill to a combination of non-weight based fees on collection of different commodities and weight-based tipping fees at the gate in a manner that is revenue neutral.	white	dark green	yellow	pale	pale	pale	yellow	white	white	white	white	light green	light green	white	**3a. Promising, but needs more in-depth study by County before implementing** This could lead to a rate structure that is more cost-based. Revenues would be more stable and not as dependent on solid waste refuse tonnage. Implementation would require significant work with cities and haulers.
18	Secure revenues from materials derived from waste stream, including carbon credits	light green	white	white	white	white	white	yellow	white	white	white	white	light green	light green	white	**1. Implement in the near term** This is a continuation of the County's current practice, which should be considered when evaluating and/or implementing other recommended best practices.
19	Ensure community support for sustainable fees and fee structure	light green	light green	light green	pale	pale	pale	light green	white	white	white	white	light green	light green	pale	**1. Implement in the near term** This is a continuation of the County's current practice, which should be considered when evaluating and/or implementing other recommended best practices. The County should work with cities and other stakeholders to incorporate this practice.
20	Require or incentivize builders to recover/recycle a specified percentage of C&D material	yellow	white	pale	pale	pale	light green	yellow	pale	white	white	white	white	white	white	**1. Implement in the near term** Implementation of this best practice would require significant participation from cities. It would have a mild adverse impact on rates and be relatively complex to implement since it relies on participation by builders throughout the County.

Legend

- (red) Likely to have a significant adverse effect or be significantly challenging to implement
- (orange) Likely to have a moderately adverse effect or be moderately challenging to implement
- (yellow) Likely to have a modest or mild adverse effect or be mildly challenging to implement
- (white) Not applicable or of no recognized beneficial or adverse effect (neutral)
- (pale) Likely to have a small beneficial effect or be modestly easy to implement
- (light green) Likely to have a moderately beneficial effect or be moderately easy to implement
- (dark green) Likely to have a very significant beneficial effect or be very easy to implement

Table 2-2. Best Practice Evaluation Rankings		
BP No.	Best Practice Description	Recommendation
4	Institute policies, staff training, and staffing level revisions to support greater diversion of recyclable materials at transfer stations where space and facilities are suitable for enhanced diversion	1. Implement in the near term
8	Promote on-site processing of organics (e.g., composting, digesting, dehydration, other hybrid technology) at the generator using a rate structure and/or grants, matching grants, low interest loans and discounts	1. Implement in the near term
9	Ban disposal of organics, in mixed waste, at transfer stations where recycling options exist	1. Implement in the near term
16	Issue solicitation to private industry to manage a specified fraction of the County-controlled mixed waste stream leaving the technology up to the proposers (within specified constraints) to allow for demonstration of technologies and possible full commercial operation at large scale. This could include a County-provided location(s) (for waste processing), or leave it up to the proposers to locate the processing facility or facilities	1. Implement in the near term
18	Secure revenues from materials derived from waste stream, including carbon credits	1. Implement in the near term
19	Ensure community support for sustainable fees and fee structure	1. Implement in the near term
20	Require or incentivize builders to recover/recycle a specified percentage of C&D material	1. Implement in the near term
3	Assess lower fee for C&D loads at County-operated C&D material sorting facilities	2. Implement over the long term
1	Construct and operate, or contract operation of, a small scale construction and demolition (C&D) debris sorting system or facility at one or more of the County's transfer stations	3a. Promising, but needs more in-depth study by County before implementing
6	Incorporate new and/or revised County-operated facilities at transfer stations to accommodate recyclable material diversion (e.g., mini-MRFs)	3a. Promising, but needs more in-depth study by County before implementing
7	Implement anaerobic digestion of source separated organic waste, with beneficial use of the biogas and composting/marketing of the digestate	3a. Promising, but needs more in-depth study by County before implementing
17	Shift solid waste system revenue collection from almost exclusively tipping fees on waste tonnage collected at the gate of County transfer stations and landfill to a combination of non-weight based fees on collection of different commodities and weight-based tipping fees at the gate in a manner that is revenue neutral	3a. Promising, but needs more in-depth study by County before implementing
10	Implement recycling (using mixed waste processing) and anaerobic digestion of the organic fraction of mixed waste, with beneficial use of the biogas and composting/marketing of the digestate	3b. Promising, but needs input from private industry before implementation
11	Implement recycling (using mixed waste processing) and thermal processing (with energy generation) of the non-recyclable fraction of mixed waste	3b. Promising, but needs input from private industry before implementation
12	Implement fully integrated processing of residual municipal solid waste combining recycling (using mixed waste processing) with anaerobic digestion and thermal processing	3b. Promising, but needs input from private industry before implementation
2	Construct and operate, or contract operation of, one or more stand-alone large scale C&D material recovery facilities (MRFs) at Cedar Hills Regional Landfill (CHRL) and/or other sites, including possible repurposing of an existing transfer station such as the Renton station	4. Riskier, would need more in-depth study by County before implementation
14	Implement emerging conversion technology plastic-to-oil along with other options or as stand-alone	4. Riskier, would need more in-depth study by County before implementation
5	Contract with private industry to operate a diversion program at the transfer stations where space and facilities are suitable for enhanced diversion	5. Not recommended, no further action
13	Implement small-scale thermal processing with front-end recycling	5. Not recommended, no further action
15	Implement mixed waste processing of residual municipal solid waste to recover additional recyclables, with separation of the non-recyclable organic fraction for processing by aerobic composting; landfill remaining fraction of waste; compost to market as a product or dispose in landfill	5. Not recommended, no further action

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Section 3

Best Practice Implementation Plan

Division staff and the Leidos team met to consider feedback received on the results of the best practice evaluations and to initiate implementation planning for those best practices recommended for implementation or further study. It was concluded that the five best practices (Best Practice Nos. 2, 5, 13, 14 and 15) that fell in the two lowest priority categories would be eliminated from implementation consideration. However, this would not preclude one or more of these best practices being proposed as a response when Best Practice No. 16 is implemented.

Division staff and Leidos team members collaborated on development of the overall implementation plan for the 15 remaining best practices. The resulting plan is illustrated in Figure 3-1. The plan shows the sequencing of implementation efforts for those best practices for which further action is recommended during the next several years (Best Practice Nos. 4, 7, 8, 16, 17, 18 and 20). The plan also shows possible future implementation action on Best Practice Nos. 1, 3, 6, 9, 10, 11, 12 and 14. It was recognized that action on these eight best practices is dependent on the results of the implementation of Best Practice Nos. 4 and 16.

In developing the overall implementation plan it is recognized that Best Practice No. 4, material diversion at transfer stations, and Best Practice No. 18, securing revenue from resources in the waste stream, are activities that the Division has been pursuing for some time. Best Practice No. 19 is also ongoing and is not shown on the implementation plan.

Regarding Best Practice No. 8, promoting on-site organics processing at the generator, it is recognized that action on this practice will be undertaken as resources become available and that the County's support will most likely be limited to directing businesses and institutions to technologies and other sources of information that would be useful to them.

Regarding Best Practice No. 20, which was identified and added to the best practice short list by the MSWMAC, the implementation plan recognizes that this is a practice that interested cities would undertake when and how they see fit.

As a final step, the Leidos team developed individual implementation plans for Best Practices Nos. 7, 16 and 17. These implementation plans are included in Appendix B.

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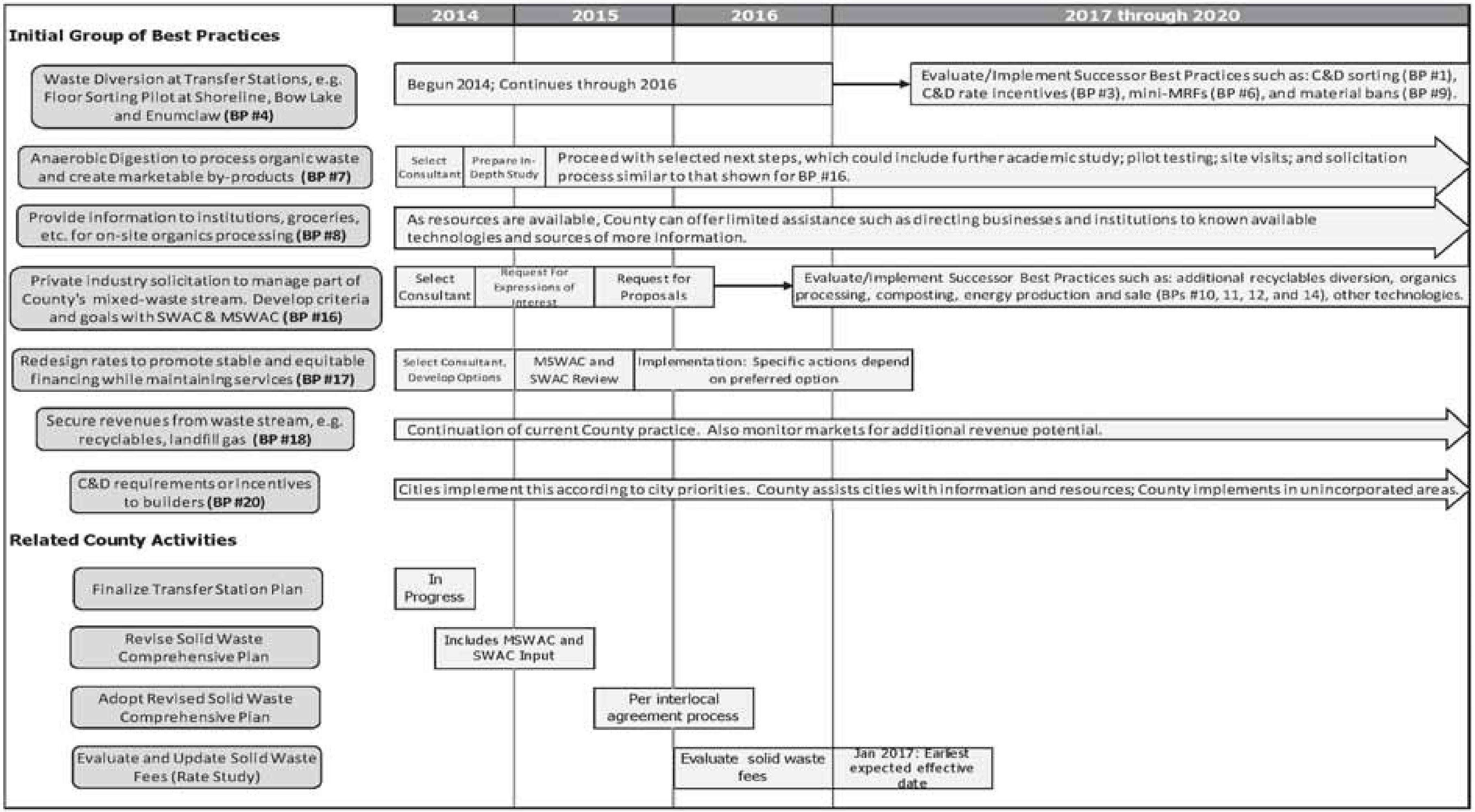

Figure 3-1. Master Implementation Plan

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Appendix A: Best Practice Evaluations

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Best Practice No. 1

Construct and operate, or contract operation of, a small scale construction and demolition (C&D) debris sorting system or facility at one or more of the County's transfer stations

Best Practice Description

This best practice would involve constructing and operating a small scale sorting system for construction and demolition debris at one or more of the Division's transfer stations. These facilities could be considered a type of "mini-MRF" tailored for C&D material. A typical small scale system suitable for the type of self-haul and commercially hauled C&D material seen at the County's stations could have a throughput capacity of between 10 and 20 tons per hour and might include the following pieces of equipment:

- An infeed hopper
- An 60" wide infeed conveyor (horizontal and inclined sections)
- A single deck screen such as a debris roll screen to remove 2" and smaller material
- A cross-belt magnet to remove ferrous metal
- An elevated 6 to 8 station, 4 to 6 bunker manual recovery platform with or without a climate control cabin and bunkers sized for roll-off box collection of recovered materials

The system would use positive manual sorting to pick out materials targeted for recovery such as wood, mixed metals, aggregates, gypsum wallboard, roofing shingles, large plastics, cardboard and paper. The overall footprint of such a system would be on the order of 40 feet wide by 125 feet long (5,000 square feet) not including a dedicated tipping floor area. The tipping floor area would likely be at least 5,000 square feet and include armor-plated concrete push walls and bunker area in which incoming C&D material could be temporarily stored before running through the system on a batch basis. The system would have multiple electrical motors with a combined horsepower rating of from 50 to 75 HP. The capital cost of the sorting system including installation and startup might be on the order of $750,000 to $900,000, not including the cost of surrounding building construction/modifications or the electrical power feed from the station electrical distribution equipment. The cost of the additional construction could range from $250,000 to $500,000 or more depending on the complications of retrofitting the system to the existing facility and site. If a separate building was required that could add as much as $500,000 to the overall capital cost. Design and procurement support costs could add between 40% to 60% to the cost of the equipment and other construction. Operating labor would be between 8 to 10 people. The system would be expected to run intermittently (batch operation) managing accumulated C&D debris.

Assuming the sorting system was operated one 8 hour shift per day, five days per week, at an average throughput rate of 15 tons per hour, and with a 90% availability (10% down time), each system would process around 28,000 tons of material per year, or about 3.5% of the County's current total of 800,000 tons of mixed waste.

This best practice is different from Best Practice No. 6 in that the feedstock for the C&D sorting system would be select loads that are predominantly C&D type material where as the feedstock for Best Practice No. 6 would be a broader range of material that includes some commercially hauled “dry” mixed municipal waste, that has promising amounts of recyclable material. The processing system for Best Practice No. 6 might include additional sorting equipment for recovering other recyclables such as non-ferrous metals, plastics (1, 2 and 3-7 grades), and paper if operating experience showed that these materials were present in sufficient quantity to justify the investment and if space allowed. Finally, Best Practice No. 1 includes the option for contracted operation whereas Best Practice No. 6 is based on County operation. Best Practice No. 5 introduces the option of contracted operation of the small scale sorting system defined in Best Practice No. 6.

Best Practice Evaluation

A. <u>Fiscal</u>

1. Impact on Rates:

   a. **Capital Costs:** A small scale C&D sorting system of the type and size described above could be expected to have a total capital cost ranging between $1.4 million and $3.0 million, not including the County’s administrative costs associated with procurement of design, construction and equipment, or training workers.

   b. **O&M Costs:** Sorting system operation and maintenance costs would depend on the hours of operation and tons of C&D material processed. Assuming the system processed 15 tons per hour using 8 laborers at a full labor cost of $64/hour, and labor represents around 70% of the total O&M cost of the system, the O&M cost might range from $45 to $55 per ton of debris processed.

   c. **System Revenue:** A sorting system with a 50% recovery rate and an average value of recovered material of between $20 and $40 per ton recovered would yield revenue of around $10 to $20 per ton of debris processed. If the County’s currently estimated avoided disposal cost of $10 to $11 is included, the effective revenue per ton of material processed with 50% recovery would increase by approximately $5 to $6 per ton, to around $15 to $26 per ton.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Based on very approximate estimated O&M costs, revenue, avoided disposal cost, and the cost of capital, a small scale C&D sorting system might be expected to be far below a break even point financially, even under the most favorable market conditions.

   b. **Certainty of costs:** Capital and O&M costs for small scale C&D sorting can be expected to be fairly well defined and not subject to a high level of uncertainty.

c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Revenues generated from the recovered material should be expected to vary widely over time, although the types of materials recovered (wood, aggregates, metals, and some types of fibers) should be less volatile than materials recovered from mixed waste processing (fibers and plastics). The materials recovered would be expected to find multiple buyers and consumers in local markets, although some materials might yield higher revenue if shipped out of the local area to more distant end users.

d. **Opportunities for regional risk sharing:** Small scale C&D sorting and recovery would not appear to offer an opportunity for a regional sharing of the risks or benefits.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Would add a modest amount of recycling and diversion.

b. **Effect on landfill operations:** Small scale C&D sorting at one or more of the County's transfer stations would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

2. Impact on resource consumption

a. **Land:** Small scale C&D sorting would have very little effect on land consumption if it is assumed that other waste material will ultimately be landfilled in the space the recovered C&D material would have occupied.

b. **Water:** Small scale C&D sorting would have very little direct effect on water consumption. No water is used in the sorting process and it is estimated that downstream reuse of the recovered materials would not typically require water consumption. However, there could be upstream water use that might be displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are consumed during the C&D sorting process. Transportation energy consumption of material recovered would likely off set the savings in transportation energy from hauling to a disposal site. There could be some adverse differential if recovered material is handled in smaller size vehicles than are used to haul compacted waste from transfer stations to the disposal site. As with overall water consumption, there likely would be upstream energy use displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

d. **Material resources:** Small scale C&D sorting would have a modest effect on the consumption of material resources by displacing raw, virgin materials such as trees and aggregates with recovered material.

3. Impact on environmental resources

   a. **Human health:** Small scale C&D sorting would have very little effect on human health assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. Due to the likely displacement of virgin-content product manufacturing with recycled-content manufacturing using the recovered C&D materials, and the associated savings in combustion energy in manufacturing, there could be a positive human health benefit. The magnitude of human health benefits would depend on type materials recovered, the environmental footprint of the displaced virgin-content products, and the environmental footprint of the recycled-content production operations.

   b. **Ecosystems health:** Small scale C&D sorting would have very little effect on ecosystems health in the neighborhood of the actual C&D sorting operations. However, as with human health, there could be positive ecosystem health impacts due to the offset of virgin-content manufacturing activities.

   c. **Air:** Small scale C&D sorting would have very little effect on resources assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. More importantly, there could be reductions in air emissions from the displacement of virgin-content production by recycled-content production using the recovered C&D materials. Such upstream resource extraction and virgin-content manufacturing displacements are typically an order of magnitude, or more, larger than any increase in transportation emissions associated with hauling recovered materials to recycled-content manufacturing end users.

   d. **Earth:** Small scale C&D sorting would have very little effect on earth resources other than through the displacement of raw or virgin quarried and mined resources by recovered aggregates and metals.

   e. **Water:** Small scale C&D sorting would have very little effect on water resources, other than the water consumption reductions mentioned above. In addition, as with air emissions, the upstream displacements of virgin-content manufacturing could achieve reductions in emissions to water.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

    a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. Operational

1. Complexity of Implementing

    a. **Program changes:** This best practice would require several modest program changes including:

        i. Increasing staff levels

        ii. Special staff training

        iii. Contracting with down stream processors and/or end users for sale of collected materials

        iv. Increasing facility maintenance work load

    b. **Time required to implement:** 24 to 36 months per location. Longer if a new building is required.

    c. **Facility siting, design, permitting and construction challenges:** The primary challenge is finding space within the County's existing facilities and sites for the C&D recovery operation and avoiding interference with the primary function of the transfer stations which is transfer of mixed municipal waste. It is assumed that these facilities would not attract new customers to the facilities, but rather would divert existing customers with C&D type material loads. Therefore permitting is seen as primarily related to building type permits and a modification of the stations' solid waste operating permit.

    d. **Contracting for services:** Contracting the operation of the C&D sorting system with a private operator could be challenged by the County's unionized labor force, particularly since the work areas and responsibilities would overlap. Private operation would therefore seem to be highly problematic. In addition, given the relatively small scale and likely intermittent nature of the operation, it might prove difficult to find a private operator willing to take on this work.

    e. **Compatibility with other elements of the system:** Adding small scale C&D sorting seems highly compatible with other elements of the County's system.

    f. **Opportunities for regional partnerships:** Small scale C&D sorting and recovery would not appear to offer an opportunity for regional partnerships due to the small size of the operations. If preferential tipping rates were given to customers with C&D

loads, the facilities might attract customers who currently drop off this type of material in other jurisdictions.

g. **Compatibility with other regional approaches to solid waste management:** Other jurisdictions such as Seattle, Snohomish County, Tacoma, Thurston County, etc. have considered or are considering this practice.

h. **Compatibility with the current role of the solid waste division:** Small scale C&D sorting and recovery would appear to be highly compatible with the Division's role and would fill a void that currently exists in the C&D management system in the County.

i. **Compatible with existing private industry role and resources:** While the feedstock waste stream for these facilities is currently handled by the County as mixed municipal waste, directing selected customer loads to the C&D sorting would in some respects place the County in competition with private industry which handles much of the C&D material generated in the County. However, the private industry facilities are not likely to have much interest in the C&D type material delivered to the County facilities since much of it is delivered by small self-haul and commercial vehicles which are slow unloading and tie up valuable tipping floor space.

2. Complexity of system and facility operation

   a. **Potential facility downtime**: C&D sorting system downtime for planned and unplanned maintenance and repair could be expected. However since the systems would likely not run on a continuous basis, there would appear to be significant flexibility to continue to manage the C&D debris even with downtime impacts.

   b. **Residue disposal:** Residue disposal would be very simple since the C&D sorting system would be located within or nearby to the transfer building.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain the C&D sorting system (i.e. waste handling) seems highly compatible with the County's current labor agreements.

3. Level of service to customers

   a. **Service offerings:** Adding C&D sorting at County facilities would not significantly improve the service offerings since the C&D material is already being conveniently received at the facilities. However, it could provide an opportunity to offer lower cost service to the customers if C&D loads were priced at a lower tipping fee than MSW loads.

   b. **Location of service delivery:** Same as current system for the C&D type loads.

   c. **Hours of service offering:** Same as current system for the C&D type loads.

d. **Time required by customers to utilize service:** Same as current system for the C&D type loads. However, customers with C&D loads might be given a priority access opportunity after the scale facility if the facility configuration would allow.

4. Operational risks

a. **Proven performance of technology:** Small scale C&D recovery facilities are used in many locations throughout the United States and utilize robust, highly proven, "low-tech" equipment.

b. **Market availability for materials/products:** There are well established local and regional markets for the main types of materials that would be recovered by the C&D sorting operation: wood, ferrous metal, mineral aggregates, gypsum wallboard, large rigid plastics, large film plastic, cardboard and paper.

c. **Contract risks and risk sharing:** Given the low volumes and widely-fluctuating market value of the recovered material, it is not likely that the County would find much opportunity to share market price risk with the material purchasers.

d. **Ability to respond to external emergencies:** Depending on the number of installations, having small scale C&D processing could provide some buffer in the event of an external emergency such as a seismic event or flooding that added significant amounts of residential C&D material to the waste stream.

e. **Operating life:** The C&D sorting equipment would have an estimated service life with good maintenance of between 10 to 15 years before major overhaul and/or replacement would be required.

f. **Potential energy production:** Wood would be a significant portion of the recovered C&D material and could be directed to hog fuel boilers for energy production, assuming the sorting operation effectively separated treated and painted wood from clean wood when processing incoming C&D loads.

g. **Impacts from feedstock contamination:** Feedstock contamination is an inherent condition that is readily accommodated by the processing system.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity:** Since the facility would likely operate intermittently, there would be good opportunity to increase throughput capacity by operating longer hours. However, there could be upfront feedstock storage limitations, and hours of operation constraints that might constrain storing material for processing and/or separated materials after processing.

b. **Changes in feedstock quantity and composition:** Since the system is based on manual sorting of targeted material (positive sorting), it is very adaptable to changes in the composition of the C&D stream. In fact the C&D stream is by its very nature highly variable from load to load. Since the system would be operated on a batch or intermittent basis, it would use an upfront holding area for the feedstock which provides a buffer for variations in the quantity of feedstock material received.

c. **Impact on landfill life and operation:** Small scale C&D sorting at one or more of the County's transfer stations would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

a. **Equity of fees:** It seems likely that facilities with separate C&D processing capability would offer a lower tipping fee for C&D type loads. This could produce a sense of inequity for County customers located a far distance from the facilities that have C&D processing.

b. **Siting of facilities:** Since C&D processing would be added at existing facilities and would be handling materials already delivered to these facilities as MSW, there would not appear to be any facility siting challenges involved.

2. Public and political understanding and acceptance

a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served.

b. **Job creation:** Would create new, relatively low wage or entry level job opportunities (8 to 10 per site). These positions might not be full time depending on the hours of operation of the sorting systems.

c. **Impacts on cities**: No impacts apparent.

d. **Susceptibility to impacts from action of cities:** No susceptibility apparent.

e. **Public education requirements:** Minimal public education requirements needed, but would benefit from some public outreach to explain the purpose and benefits of the program and what customers can do to increase the efficiency by tailoring their loads.

3. Impact on Employees

a. **Health and safety:** C&D handling and processing, particularly hand sorting as would be used in the small scale operations envisioned, creates health and safety hazards for the operating staff. These hazards include puncture wounds, repetitive motion injuries, strains and sprains, impact injuries, crushing injuries, dust inhalation/respiratory risks, hearing damage, slips and falls, and vehicle/human impact injuries. In short, the work is hazardous and therefore requires extensive training and refresher training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

b. **Job security:** Adding C&D sorting could provide additional job security and opportunities for staff.

c. **Job satisfaction:** C&D sorting is physically demanding and monotonous, and not generally considered very satisfying as a long term occupation. However, some people do enjoy the fast pace, teamwork approach that the work demands.

Summary

This best practice would be relatively inexpensive and simple to implement at stations, such as Bow Lake, where space exists and customer deliver large amounts of C&D type material. The system would have flexibility to adapt to day-to-day changes in the composition and quantity of the material being received. Depending on size and technology, costs could exceed revenue significantly. Constructing/operating a standalone facility is not recommended. Could be implemented as part of mixed waste processing in conjunction with other practices.

Recommendation

Promising, but needs more in-depth study by County before implementing.

Best Practice No. 2

Construct and operate, or contract operation of, one or more stand-alone large scale construction and demolition (C&D) material recovery facilities (MRFs) at Cedar Hills Regional Landfill (CHRLF) and/or other sites, including possible repurposing of an existing transfer station such as the Renton station

Best Practice Description

This best practice would involve constructing and operating a large scale C&D material recovery facility (MRF) at CHRLF or another site, including possibly at an existing transfer station site that would be repurposed to C&D recovery. Operation of the MRF could be by County staff or could be contracted out to private industry. A typical large scale facility suitable for the type of self-haul seen at the County's stations and commercially hauled C&D material could have a throughput capacity of between 20 and 40 tons per hour (160 to 320 tons per 8-hour shift) of mixed C&D material, and might include the following elements and pieces of equipment:

- Scale facility
- Administration and worker support facility (1,500 to 2,000 square feet)
- Site roads, parking and vehicle maneuvering areas
- Site utilities (water, sewer, stormwater, electrical)
- MRF building (fully enclosed)
- Processing System (components depend on composition of C&D stream):
  - Infeed hopper
  - 60" wide infeed conveyor (horizontal and inclined sections)
  - Shaker screen (separates unders from overs material)
  - Cross-belt magnet to remove ferrous metal from the unders fraction
  - Overs (>12" material) feed conveyor
  - Overs sort line platform (positive manual sorting of targeted recyclables)
  - Fines screen feed conveyor
  - Fine screen (trommel, separates 6" to 12" fraction from <6" fraction)
  - Unders (6" to 12" fraction) sort line platform (positive manual sorting of targeted recyclables)
  - Air classifier for unders residue (lights to residue/heavies to aggregate bunker)
  - Recovered material bunkers (5 or 6)
  - Residue transfer conveyors (residue to open top rolloff boxes or trailers)

The system would primarily use positive manual sorting to pick out materials targeted for recovery such as wood, mixed metals, gypsum wallboard, large rigid plastics, large film plastic, cardboard and paper. The air classifier would mechanically separate heavy aggregate type material from a light fraction residue at the end of the unders line. The overall footprint of such a system would be on the order of 50 feet wide by 260 feet long (12,500 square feet) if the system was arranged in a continuous linear fashion. This would not include the tipping floor area. The tipping floor area would likely be at least 10,000 square feet, large enough to allow several customer vehicles to dump simultaneously and to provide ample storage area for material to be held prior to processing. The tipping floor would include 12 to 15 foot high armor-plated concrete push walls to facilitate material storage. A building size of between 23,000 and 27,000 square feet (0.5 to 0.6 acres) would be required for the facility. An overall site size of at least 5 acres would be the minimum size needed considering the other site facilities, while allowing for reasonable buffer distances on all four side of the site.

Assuming the sorting system was operated one 10 hour shift per day, five days per week, at an average throughput rate of 30 tons per hour, and with a 90% availability (10% down time), each facility would process around 70,000 tons of C&D material per year.

The processing system would have multiple electrical motors with a combined horsepower rating of around 250 HP. The capital cost of the sorting system including installation and startup might be on the order of $4.2 million to $4.5 million. The cost of the processing building and the balance of the site facilities and site development could be expected to add between $4.0 million and $4.6 million. Design and procurement support costs could add between 40% to 60% to the cost of the equipment and other construction. Site management and operating labor would be between 14 and 18 people. The system would be expected to run steadily (as opposed to an intermittent batch operation).

This best practice is seen as complimenting, rather than conflicting with Best Practice 1. It is expected that for the most part the customers for the large scale C&D MRF would be large commercial and contractor vehicles as well as self-haul C&D vehicles. The latter would be expected to use the large scale MRF if it is closer and more convenient then the small scale C&D sorting systems at transfer stations, assuming both are developed.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

    a. **Capital Costs:** A large scale C&D MRF of the type and size described above could be expected to have a total capital cost ranging between $8.2 million and $9.1 million, not including the cost of land, design, the County's administrative costs associated with procurement of design services, construction and equipment, training of county staff, or procuring an operating contractor if operation were contracted out. These costs could range from around $3.2 million to $5.4 million for a facility of the size indicated assuming land cost was zero.

b. **O&M Costs:** Sorting system operation and maintenance costs would depend on the hours of operation and tons of C&D material processed. Assuming the system processed 30 tons per hour using 15 total staff (10 sort line staff) at an average full labor cost of $64/hour, and that labor represents around 70% of the total O&M cost of the system, the O&M cost might range from $40 to $50 per ton of debris processed.

c. **System Revenue:** A sorting system with a 60% recovery rate and an average value of recovered material of between $20 and $40 per ton recovered would yield revenue of around $12 to $24 per ton of debris processed. If the County's currently estimated avoided disposal cost of $10 to $11 is included, the effective revenue per ton of material processed with 50% recovery would increase by approximately $5 to $6 per ton, to around $17 to $30 per ton.

2. Economic Risks:

a. **Financial effect of listed operational risks:** Based on very approximate estimated O&M costs, revenue, avoided disposal cost, and the cost of capital, a large scale C&D MRF might be expected to fall far below a breakeven point financially, even under the most favorable market conditions.

b. **Certainty of costs:** Capital and O&M costs for a large scale C&D MRF can be expected to be fairly well defined and not subject to a high level of uncertainty.

c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues generated from the recovered material should be expected to vary widely over time, although the types of materials recovered (wood, aggregates, metals, large plastics and some types of fibers) should be less volatile than materials recovered from mixed waste processing (fibers and small plastics). The materials recovered would be expected to have multiple buyers and consumers in local markets, although some materials might yield higher revenue if shipped out of the local area to more distant end users.

d. **Opportunities for regional risk sharing:** Large scale C&D sorting and recovery would appear to offer some limited opportunity for a regional sharing of the risks or benefits, particularly if the facility was run in multiple shifts and more than 5 days per week.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Would add only a modest amount of recycling and material diversion. Large scale C&D MRFs already are in operation in the area.

b. **Effect on landfill operations:** A large scale C&D MRF that accepted C&D debris from self-haul customers would be expected to have a relatively modest positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

2. Impact on resource consumption

   a. **Land:** A large scale C&D MRF of at least 5 acres in size would have a modest adverse effect on land consumption if it is sited at a location other than the CHRLF.

   b. **Water:** A large scale C&D MRF should have a very minimal direct effect on water consumption. No water is used in the sorting process and it is estimated that downstream reuse of the recovered materials would not typically require water consumption. However, there could be upstream use that might be displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products. Water consumption by the facility workers is assumed to occur whether they are working at the MRF or elsewhere.

   c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are consumed during the C&D sorting process. Transportation energy consumption of material recovered would likely off set the savings in transportation energy from hauling to a disposal site. There could be some adverse differential if recovered material is handled in smaller size vehicles than are used to haul compacted waste from transfer stations to the disposal site. As with overall water consumption, there likely would be upstream energy use displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

   d. **Material resources:** A large scale C&D MRF would have a modest effect on the consumption of material resources by displacing raw, virgin materials such as trees and aggregates with recovered material.

3. Impact on environmental resources

   a. **Human health:** A large scale C&D MRF would have very little effect on human health assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. Due to the likely displacement of virgin-content product manufacturing with recycled-content manufacturing using the recovered C&D materials, and the associated savings in combustion energy in manufacturing, there could be a positive human health benefit. The magnitude of the human health benefits would depend on the type of materials recovered, the environmental footprint of the displaced virgin-content products, and the environmental footprint of the recycle-content production operations.

b. **Ecosystems health:** A large scale C&D MRF would have very little effect on ecosystems health if sited at the CHRLF. It could have some adverse effect if site at another undisturbed site, but it is assumed that an environmental review, with mitigation of impacts if necessary, would address any serious negative effects. However, globally, as with human health, there could be positive ecosystem health benefits due to the displacement of virgin-content manufacturing activities by recycle-content manufacturing.

c. **Air:** A large scale C&D MRF would have very little effect on resources assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. More importantly, there could be reductions in air emissions from the displacement of virgin-content manufacturing activities by recycle-content production using the recovered C&D materials. Such upstream resource extraction and virgin-content manufacturing displacements are typically an order of magnitude or more larger than any increase in transportation emissions associated with hauling recovered materials to the recycled-content manufacturing end users.

d. **Earth:** A large scale C&D material recovery facility would have very little effect on earth resources other than through the displacement of raw or virgin quarried and mined resources by recovered aggregates and metals.

e. **Water:** A large scale C&D material recovery facility would have very little effect on water resources, other than the water consumption reductions mentioned above. In addition, as with air emissions, the upstream displacements of virgin-content manufacturing could achieve reductions in emissions to water.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** This best practice could require several modest program changes if it is County operated including:

i. Increasing overall staff levels

ii. Special staff training

iii. Contracting with downstream processors and/or end users for sale of collected materials

iv. Increasing facility maintenance work load

b. **Time required to implement:** 36 to 48 months assuming it is developed under a conventional design-bid-build approach at CHRLF or another existing County transfer station site. Probably 12 to 18 additional months if it is sited at a new site.

c. **Facility siting, design, permitting and construction challenges:** If the C&D MRF is sited at CHRLF or another County transfer station site, the primary challenge would probably be finding sufficient room to place the facility on the site (i.e. site planning). If the C&D MRF is sited at a new site, the primary challenge would be finding a site that is acceptable to the local community, meets all land use and zoning requirements and does not have any serious, unmitigatable environmental impacts

d. **Contracting for services:** There would not appear to be any significant barriers to contracting operation of the C&D MRF if that option was preferred. However, just as for Best Practice 1, there could be serious objections from the County's unionized labor that would likely see the service contractor as usurping their work. Contracting for a private operator could therefore be highly problematic.

e. **Compatibility with other elements of the system:** Adding a large scale C&D MRF seems highly compatible with other elements of the County's system.

f. **Opportunities for regional partnerships:** A large scale C&D MRF would not appear to offer any significant opportunity for regional partnerships due to the relatively small size of the operations compared to the quantity of C&D debris generated in the County and in the larger region. However, if preferential tipping rates were given to customers with C&D loads, the facilities might attract customers who currently drop off this type of material in other jurisdictions.

g. **Compatibility with other regional approaches to solid waste management:** This would be a departure from the regional approach to large scale C&D management which relies on private industry to own and operate these facilities.

h. **Compatibility with the current role of the solid waste division:** A large scale C&D MRF would appear to be highly compatible with the Division's role.

i. **Compatible with existing private industry role and resources:** A large scale C&D MRF would appear to be in direct competition with a number of privately owned and operated C&D MRFs in the County and the region, even if the operation of the County's MRF were contracted to private industry. Developing such a facility would likely be seen as an unwelcomed deviation from the long standing division of responsibility for processing waste and debris in the County and a commercial challenge to private industry.

2. Complexity of system and facility operation

    a. **Potential facility downtime:** C&D sorting system downtime for planned and unplanned maintenance and repair could be expected. However since the systems would likely not run on a 24/7 basis, there would appear to be significant flexibility to continue to manage the C&D debris even with downtime impacts.

    b. **Residue disposal:** Residual disposal would require compaction, loading and transport to the final disposal site. A C&D MRF at the CHRLF would have the advantage of a short haul to the landfill face while that facility remains in operation.

    c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain the C&D MRF (i.e. waste handling) seems highly compatible with the County's current labor agreements if the MRF is County operated.

3. Level of service to customers

    a. **Service offerings:** Adding one or more large scale C&D MRFs might not significantly improve the service offerings since privately operated C&D MRFs already exist in the County. However, the competition created could result in lower cost service to customers, particularly if the County set the tipping fee lower than for MSW loads at its transfer stations.

    b. **Location of service delivery:** Depending on the location of the C&D MRF(s), customers might find the location more convenient than what is available currently at the County's transfer stations and the private C&D MRFs.

    c. **Hours of service offering:** Would need to be determined.

    d. **Time required by customers to utilize service:** Would depend on how customer convenience is addressed during facility design.

4. Operational risks

    a. **Proven performance of technology:** Large scale C&D MRFs are used in many locations throughout the United States and utilize robust, highly proven, "low-tech" equipment.

    b. **Market availability for materials/products:** There are well established local and regional markets for the main types of materials that would be recovered by the C&D sorting operation: wood, ferrous metal, mineral aggregates, gypsum wallboard, large plastics, cardboard and paper.

    c. **Contract risks and risk sharing:** Given the relatively low volumes and widely-fluctuation market value of the recovered material, it is not likely that the County would find much opportunity to share market price risk with the material purchasers.

d. **Ability to respond to external emergencies:** Depending on the number of installations, having one or more additional large scale C&D MRFs could provide some buffer in the event of an external emergency such as a seismic event or flooding that added significant amounts of residential C&D material to the waste stream.

e. **Ability to respond to internal system emergencies and outages:** A large scale C&D MRF is a unique type of facility that normally would not be permitted to manage MSW waste, nor would it be constructed to efficiently handle MSW. A C&D MRF would not be expected to provide system redundancy for the County's transfer stations. On the other hand, the transfer stations could provide an emergency backup to the MRF if it is out of service.

f. **Operating life:** The C&D sorting equipment would have an estimated service life with good maintenance of between 8 to 12 years before major overhaul and/or replacement would be required.

g. **Potential energy production:** Wood would be a significant portion of the recovered C&D material and could be directed to hog fuel boilers for energy production, assuming the sorting operation effectively separated treated and painted wood from clean wood when processing incoming C&D loads.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity**: Since the large scale C&D MRF would likely operate 8 to 12 hour shifts 5 to 6 days per week, there would be good opportunity to increase throughput capacity by operating more or longer shifts. However, there could be upfront feedstock storage limitations, and hours of operation constraints that might restrict having enough material available for processing during second and third shift operations.

b. **Changes in feedstock quantity and composition**: Since C&D sorting systems are designed to process a feedstock with a high variability in composition and with positive sorting used for targeted material, C&D MRFs are very adaptable to changes in the composition of the C&D stream.

c. **Impact on landfill life and operation**: Since large scale C&D MRF capacity already exists in the County, adding one or more new large scale facilities might not have much effect on landfill operations (i.e. no reduction in the total tons of materials needing to be landfilled and extending the life of the landfill), unless the new facilities attracted C&D debris that is currently not served by the existing C&D MRF system. Conversely, if the new C&D MRF attracted incoming materials that would otherwise have been handled by facilities not using the Cedar Hills Regional Landfill for their disposal needs, thee could be an adverse effect on landfill life, and at the same time, a beneficial effect on near tipping fee revenue.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** It seems likely that adding one or more new large scale C&D MRFs to the current C&D MRF system would either lower tipping fee for C&D type loads or put containment pressure on C&D debris tipping rates across the County. It would seem that the pubic everywhere would benefit equally from this competition.

   b. **Siting of facilities:** Siting one or more new large scale C&D MRFs at any location would likely give rise to questions of fairness in hosting what are typically considered unwanted facilities.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** A large scale C&D MRF at any location would likely be seen as having a negative effect on the livability and character of the host community due to the traffic generated as well as noise and possibly dust created.

   b. **Job creation:** Would create new, relatively low wage or entry level job opportunities for 9 to 13 people and 4 to 5 higher paying positions for managerial and maintenance staff, assuming the facility paid wages and provided benefits lower than wages and benefits of current County employees.

   c. **Impacts on cities:** No impacts apparent.

   d. **Susceptibility to impacts from action of cities:** No susceptibility apparent.

   e. **Public education requirements:** This practice would benefit from significant public and private outreach to ensure how a publicly owned large scale C&D facility is intended to supplement the existing large scale C&D management system in the County.

3. Impact on employees

   a. **Health and safety:** C&D handling and processing, particularly hand sorting as would be used in the small scale operations envisioned, creates health and safety hazards for the operating staff. These hazards include puncture wounds, repetitive motion injuries, strains and sprains, impact injuries, crushing injuries, dust inhalation/respiratory risks, hearing damage, slips and falls, and vehicle/human impact injuries. In short, the work is hazardous and therefore requires extensive training and refresher training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

b. **Job security:** Adding C&D sorting could provide additional job security and opportunities for staff if County operated.

c. **Job satisfaction:** C&D sorting is physically demanding and monotonous, and not generally considered very satisfying as a long term occupation. However, some people do enjoy the fast pace, teamwork approach that the work demands.

Summary

This best practice would have a more positive affect on diversion from disposal than Best Practice 1; however, costs would likely be higher because it would not be integrated into an existing facility. It could be implemented as part of mixed waste processing in conjunction with other practices.

Recommendation

Riskier, would need more in-depth study by County before implementation.

Best Practice No. 3

Assess lower fee for C&D loads at County-operated C&D material sorting facilities

Best Practice Description

The intent of this best practice is to incentivize self-haul customers to separate C&D from other refuse by offering a reduced charge for C&D, thereby saving the self-haul customers money while creating an improved feedstock stream for the County's C&D sorting facilities.

This practice would be applicable only if the County implements one or more separate C&D material sorting facilities at a County-owned transfer stations or builds a separate C&D sorting facility that it would own and operate. Therefore, this practice could only be implemented in conjunction with other best practices, specifically Best Practice No. 1 and/or 2.

Amount of Reduced Charge:

The cost to process separated C&D at a transfer station, in a facility that is not yet built, is obviously not available. Best Practice Nos. 1 and 2 include estimates of processing costs. There are several components of the County's Basic Fee structure (applicable to refuse delivered to transfer stations) that would not be applicable to C&D disposed of separately from landfilling[1]. Conversely, there are other costs that would be appropriate to consider.

Components of current Basic Fee potentially excludable from a cost-based C&D fee

Disposal Operations	$15.58 / ton
Transfer & Transport Operations	part of $31.30 / ton
Rent – Cedar Hills	$7.61 / ton
Landfill Reserve Fund	$12.22 / ton
Total	$35.41 - $66.71 / ton

Costs that could be included in a cost-based fee

- Added Transfer Operations required to handle C&D
- C&D disposal/recycling/processing
- Amortized costs of facilities at transfer stations required to handle C&D

As a comparison, the current Base Fee currently applicable to self-haulers is $129.40 per ton.

The range in the total is because transfer costs would continue to be applicable but transport costs would not. The additional costs that would be included in a cost-based fee are not yet knowable.

[1] Sources of data: Executive Proposed Solid Waste Disposal Fees for 2013 and 2014, published July 2012. Transfer operations would still be applicable to CDL waste, but transport operations would not. In this data, the transfer and transport costs are not disaggregated.

As a separate consideration, the current cost to dispose of C&D at a facility operated by the County's current contractor is $80.16 plus inflationary adjustments since 2004[2]. The County likely does not want to charge a C&D fee at its own facilities that is less than that charged by the County's contractor(s), to avoid creating an incentive for customers to use the County's facilities (which are not intended to be the primary means of C&D handling/processing/disposal) instead of contractor-owned facilities.

<u>Complexity of Transfer Station Fee Structure:</u>

Refuse delivered to the County's transfer stations by self-haulers is assessed a per-ton fee of $129.40 with a minimum charge of $22 that covers up to 320 pounds. Separate fee schedules already exist for charitable organizations, special wastes, appliances, electronics, fluorescent bulbs/tubes, clean wood, and yard waste. While adding an additional fee category for C&D Waste would increase the complexity of the fee structure, the County should be easily able to accommodate an extra fee category.

Best Practice Evaluation

A. <u>Fiscal</u>

1. Impact on Rates:

    a. **Capital Costs:** None

    b. **O&M Costs:** Small. The added fee category would create one-time costs associated with changing signage at transfer stations and in the County's accounting and billing systems. Some additional training of transfer station personnel would be required. Overall the increase in O&M costs is not expected to be significant.

    c. **System Revenue:** A reduced fee would decrease the amount of Division revenue from refuse disposal fees, but the effect is expected to be small. This is primarily because the tonnage affected is expected to be small compared with the total tonnage of transfer station refuse. For illustrative purposes, a C&D fee that is $20/ton lower than the Basic Fee would reduce Division revenues by $1.6 million per year assuming it is applied to 80,000 tons per year of C&D. This represents approximately 1.6 percent of the Division's total revenue of approximately $103 million[3].

2. Economic Risks:

    a. **Financial effect of listed operational risks:** Small, given the small amount of O&M costs – a large uncertainty in a small number is still a small number.

[2] Source: http://your.kingcounty.gov/solidwaste/facilities/cdl-contracts.asp
[3] Source of total Division revenue: Solid Waste Disposal Fees for 2013 and 2014, published by the Division July 2012.

b. **Certainty of costs:** Not certain at all. The amount of a reduced fee has not yet been defined. The County would have to decide if strictly charging a cost-based fee is appropriate or if other considerations (such as incentivizing behavior) are also applicable.

c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Not applicable.

d. **Opportunities for regional risk sharing:** None.

B. Environmental

1. Impact on waste prevention, recycling and diversion

   a. **Effect on waste prevention, recycling and diversion programs:** The fee structure could incentivize self-haul customers to more completely separate CDL waste. The amount would be small compared with other possible activities. The results would be a slight amplification of effects associated with small scale C&D sorting itself.

   b. **Effect on landfill operations:** A slight amplification of effects associated with small scale C&D sorting itself.

2. Impact on resource consumption

   a. **Land:** A slight amplification of effects associated with small scale C&D sorting itself.

   b. **Water:** A slight amplification of effects associated with small scale C&D sorting itself.

   c. **Energy:** A slight amplification of effects associated with small scale C&D sorting itself.

   d. **Material resources:** A slight amplification of effects associated with small scale C&D sorting itself.

3. Impact on environmental resources

   a. **Human health:** A slight amplification of effects associated with small scale C&D sorting itself.

   b. **Ecosystems health:** Very little, if any, direct effect on local ecosystems health. At the same time, this practice would provide a slight amplification of global effects associated with small scale C&D sorting itself.

   c. **Air:** A slight amplification of effects associated with small scale C&D sorting itself.

   d. **Earth:** A slight amplification of effects associated with small scale C&D sorting itself.

   e. **Water:** Very little effect on local water resources, but a slight amplification of global effects associated with small scale C&D sorting itself.

4. Consistency with Climate Action Plan

   a. This best practice is consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations since it entails diverting more materials from disposal at County facilities..

C. Operational

1. Complexity of Implementing

   a. **Program changes:** The County currently has contracts with Regional Disposal Company and Waste Management for Construction, Demolition and Land-Clearing Waste[4] Handling Services. The contract is dated September 14, 2004 and has a 10-year term ("2004 Contract"). The 2004 Contract does not appear to give the County the authority to process or recycle C&D waste on its own, rather:

      "The Contractor shall help provide for the continuous, uninterrupted disposal and related handling of all CDL Waste generated within the County's Jurisdiction"

      This Study assumes that future contracts will authorize the County to also handle and/or dispose of C&D

   b. **Time required to implement:** The timeline to implement a revised fee schedule is shorter than the 24 to 36 month timeline to implement a small-scale C&D recovering station at a facility.

   c. **Facility siting, design, permitting and construction challenges:** Not applicable.

   d. **Compatibility with other elements of the system:** Not applicable.

   e. **Opportunities for regional partnerships:** Not applicable.

   f. **Compatibility with the current role of the solid waste division:** Compatible.

   g. **Compatible with existing private industry role and resources:** Compatible, provided a C&D fee for County-owned facilities is not less than the fee for privately-owned facilities.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** Not applicable.

   b. **Residue disposal:** Not applicable.

[4] CDL = construction, demolition, and land-clearing, and is the term used in the contracts. For the purposes of this evaluation C&D is assumed to be a subset of CDL.

c. **Compatibility with labor agreements:** Not applicable.

3. Level of service to customers

    a. **Service offerings:** No change in the level of service.

    b. **Location of service delivery:** No change.

    c. **Hours of service offering:** No change.

    d. **Time required by customers to utilize service:** No change.

4. Operational risks

    a. **Proven performance of technology:** Not applicable.

    b. **Market availability for materials/products:** Not applicable.

    c. **Contract risks and risk sharing:** Requires future CDL contracts to be written differently from current contracts to allow County the ability to dispose of CDL at its own facilities.

    d. **Ability to respond to external emergencies:** No change.

    e. **Operating life:** No change.

    f. **Potential energy production:** A slight amplification of effects associated with small scale C&D sorting itself.

5. Flexibility and adaptability

    a. **Ability to scale up and add or reduce capacity:** A slight amplification of effects associated with small scale C&D sorting itself.

    b. **Changes in feedstock quantity and composition:** A slight amplification of effects associated with small scale C&D sorting itself.

    c. **Impact on landfill life and operation:** A slight amplification of effects associated with small scale C&D sorting itself.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

    a. **Equity of fees:** If a reduced C&D fee is cost-based, the resulting fee structure will be cost-based. Customers are likely to perceive a cost-based fee structure as more equitable.

    b. **Siting of facilities:** No effect.

2. Public and political understanding and acceptance

    a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served.

    b. **Job creation:** A slight amplification of effects associated with small scale C&D sorting itself.

    c. **Impacts on cities:** No impacts apparent.

    d. **Susceptibility to impacts from action of cities:** No susceptibility apparent

3. Impact on Employees

    a. **Health and safety:** A slight amplification of effects associated with small scale C&D sorting itself.

    b. **Job security:** A slight amplification of effects associated with small scale C&D sorting itself.

    c. **Job satisfaction:** A slight amplification of effects associated with small scale C&D sorting itself.

Summary

This best practice could provide an incentive for diversion. It could be implemented at County-operated facilities that can accept source-separated materials.

Recommendation

Implement over the long term.

Best Practice No. 4

Institute policies, staff training, and staffing level revisions to support greater diversion of recyclable materials at transfer stations where space and facilities are suitable for enhanced diversion.

Best Practice Description

This best practice entails making adjustments in staffing and policies at existing transfer stations to increase diversion of recyclable materials. Unlike best practices such as #1 and #6, this best practice assumes no new facilities and no substantial changes to the design of existing facilities. Instead, this best practice includes adding or reassigning staff, as needed, to divert more material at existing transfer stations, training staff to ensure that this additional diversion is performed in a way that is both effective and safe, and instituting new policies, as needed, to support this additional diversion.

Many of the specific strategies and tactics to accomplish this were considered and prioritized in a report prepared for King County in July 2013 titled *Optimized Transfer Station Recycling Feasibility Study*, *Task 6: Strategy Evaluation and Recommendations*. Some of the strategies recommended in that report that are relevant to this Best Practice are listed below.

- At retrofitted or new stations, develop, install and staff flexible material receiving/processing capability for reusable and recyclable Self-Haul materials, including:
  - Dedicate bulky Item Drop-Off Area using staging areas, bunkers, bins, drop-boxes, or trailers (i.e., furniture, carpet, tires, other bulky items);
  - Include a retail thrift store, building materials yard, and reuse and recycling center at transfer stations;
  - Create a ‘reuse zone’ and employ staff to help the public unload items in the appropriate location;
  - Host an appliance exchange for working items;
  - Co-locate Salvage Lumber Warehouse at Transfer Station;
  - Place on-site trailers for collection of reusable furniture and mattresses for off-site processing;
  - Establish carpet collection in drop-off area at County facilities for transfer to off- site processor only if, after ongoing market development efforts, private facilities prove unable to provide comparable convenience to public facilities;
  - Set up area to receive source-separated loads of clean wood;
  - Dedicate roll-off container for source-separated asphalt shingles; and

- Dedicate roll-off container for source-separated gypsum wallboard from new construction waste.

- Configure operations at retrofitted and new stations to support maximum customer exposure to on-site reuse and recycling opportunities, including:
  - Arrange for private salvage or reuse companies to train transfer station staff on how to identify materials for reuse;
  - Direct loads to specific areas based on load quality and processing requirements; and
  - Direct vehicles to sorting area for recyclables as the default, rather than disposal area.
- Institute selected material-specific actions to increase diversion at updated/retrofitted or new King County solid waste facilities:
  - Provide compactor for paper, cardboard, plastic film, textiles;
  - Establish mattress collection in drop-off area at County facilities for transfer to off-site processor only if, after ongoing market development efforts, private facilities prove unable to provide comparable convenience to public facilities;
  - Set aside area where haulers may deliver wood waste at a reduced tipping fee; and
  - Consolidate curbside organics at Transfer Station and transfer to offsite processing.
- Develop and operate flexible material receiving/processing capability for all reusable and recyclable materials
  - Conduct floor sorts for bulky reusable and recyclable Items;
  - Hire additional staff for floor-sorts and/or pick-line; and
  - Co-locate operations with a salvage retailer or processor to minimize transportation costs and increase visibility of salvage.
- Formalize and foster an internal staff culture that places a high value on reuse and recycling
  - Incorporate recycling responsibilities into all staff job descriptions;
  - Link increased diversion to job security;
  - Hold an All Staff meeting with customer service unit staff, transfer station operators (TSOs), scale operators and managers to recalibrate everyone to the mission of increased diversion;
  - Design and implement a robust and targeted training series;

- Institute or reinforce county-wide policies that support increased focus on reuse and recycling at King County solid waste facilities
  - Ban specific materials from disposal;
  - Identify additional target materials and retail outlet candidates who could participate in a Product Stewardship program initiated or jointly supported by the County; and
  - Adjust fees to further incentivize reuse and recycling, including; and
  - Review and update the 'no salvage policy' to allow TSOs to assist in diverting recyclables.
- Enhance or re-direct staff activities to actively facilitate material diversion to reuse and recycling
  - Enhance scale-house screening of received loads and identification of materials including suspect lead-based paint and suspect ACM, proper fee application, and to provide direction to recycling opportunities inside or outside of the transfers station; utilize visual inspection, camera, XRF, asbestos survey reports completed by accredited AHERA building inspectors to inform staff
  - Direct existing staff to provide active instruction to direct vehicles to proper location
  - Use magnetic color coded cones on vehicles at scale-house to enable staff direction inside Transfer Station to proper recycling or disposal areas Color coding
  - Coordinate with local jurisdictions to offer recycling collection events at Transfer Stations, focusing on hard-to-recycle or other targeted materials;
  - Direct existing staff to provide active unloading and sorting assistance to
  - Hire additional staff (different job classifications) to provide more direct customer assistance with active unloading, sorting of all materials, directing material placement, and answering questions (Personal Sorters);
- Institute selected material-specific actions to increase diversion at all King County solid waste facilities
  - Focus significant effort on C&D diversion at the scale-house, carefully screening incoming loads and educating customers about on-site and off-site options

Best Practice Evaluation

This evaluation considers how adjusting policies, staffing and staff training at King County's facilities to divert more materials performs against fiscal, environmental, operational, and policy, equity and social justice criteria. Although the evaluation of this best practice assumes it is implemented without any new or reconfigured facilities, some of the other best practices that entail increasing diversion at existing County facilities (such as #1 and #6) with facility modifications would benefit, and even necessitate changes in policy, staffing, and staff training.

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** No (or very minimal) direct capital costs are anticipated for this best practice.

   b. **O&M Costs:** Additional staff will likely be required to direct appropriate self-haul and commercial vehicles to diversion areas, to inspect and sort the diverted material, and to direct the diverted materials to processing or end use. Additional training for new staff functions may be required. Some of the added O&M costs associated with staff and training could be offset by savings in transfer, haul, and disposal of these same materials. Until the exact on-site diversion activities are defined, it is not possible to quantify the net increase in O&M cost. However, it is likely that compared to the development of new infrastructure of facilities, the cost will be comparatively low.

   c. **System Revenue:** The County could receive revenue from the additional materials diverted, depending on the type and amount of material diverted. However, much of the additional material anticipated (bulky items, wood, carpet, furniture, shingles, mattresses) is not likely to be high value material.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Operational risks, and thus the financial effect associated with them, are likely to be negligible.

   b. **Certainty of costs:** Costs depend on which activities are implemented. Once the activities are defined, it is likely that the cost could be projected with relative certainty.

   c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues, too, could be projected with relative certainty once the materials to be diverted are defined.

   d. **Opportunities for regional risk sharing:** Since these costs would be incurred at County facilities, there is little opportunity to share risks across the region. However, as stated, the financial risk is minimal.

B. Environmental

1. Impact on waste prevention, recycling and diversion

   a. **Effect on waste prevention, recycling and diversion programs:** This best practice will have no effect on current waste prevention, recycling, and diversion programs as the material that is anticipated to be diverted is material that is current disposed. Depending on the particular materials and initiatives implemented as part of this best practice, the increase in diversion could range from minimal to moderate.

b. **Effect on landfill operations:** The effect on landfill operations is likely to be positive in two ways. There is likely to be a small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and thus extending the life of the landfill. More importantly, this best practice could be designed to divert materials that are a challenge to transfer and landfill operations such as concrete, mattresses and other bulky items.

2. Impact on resource consumption

   a. **Land:** Increasing recovery at existing County sites by instituting policies and training and dedicating staff to divert more materials on-site would consume little to no additional land. The diversion that is likely to result from this best practice may reduce the impacts on land that would result from extracting virgin materials that this recovered material may supplant.

   b. **Water:** Increased materials recovery that is projected to result from this best practice is not expected to impact local water consumption in any significant way. However, there could be upstream water use that might be displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

   c. **Energy:** Sorting, processing, and shipping additional materials diverted is projected to modestly increase the use of hydrocarbon fuel and electrical energy. Energy required to transport recovered material is likely to be offset by the savings in energy to transport the same material to a disposal site depending on the relative location of the processing and disposal facilities. As with overall water consumption, there likely would be upstream energy use displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

   d. **Material resources:** Additional diversion that would result from this best practice would have a modest effect on the consumption of material resources by displacing raw, virgin materials such as trees and aggregates with recovered material.

3. Impact on environmental resources

   a. **Human health:** This best practice may result in additional traffic and increased materials handling at County transfer stations that could pose potential health and safety issues for customers. However, as long as the sorting areas are designed and operated with customer safety in mind, these effects can be mitigated. Displacement of virgin-content product manufacturing with recycled-content manufacturing using the recovered materials, and the associated savings in combustion energy in manufacturing could result in a positive human health benefit. The magnitude of human health benefits would depend on type materials recovered, the environmental footprint of the displaced virgin-content products, and the environmental footprint of the recycled-content production operations.

b. **Ecosystems health:** Diverting more material at County facilities can be done in a way that has little effect on health of local ecosystems. However, there could be positive global ecosystem health impacts as a result of offsetting virgin-content manufacturing activities.

c. **Air:** Diverting additional materials at County facilities will have little effect on local air resources. The impact on air resources resulting from transporting recovered materials to market instead of to a disposal site will depend on the relative distance to the processor or end user of the recovered material versus the disposal facility. Furthermore, there could be reductions in overall net global air emissions from replacing virgin-content production with recycled-content production using the recovered materials.

d. **Earth:** Diverting additional materials at County facilities would likely result in the displacement of raw or virgin quarried and mined resources.

e. **Water:** This best practice will have minimal impact on local water resources if runoff is appropriately managed. In addition, as with air emissions, the upstream displacements of virgin-content manufacturing could achieve net overall reductions in emissions to water.

4. Consistency with Climate Action Plan

a. This best practice is consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations since it entails diverting more materials from disposal at County facilities..

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** This best practice would require operational changes at the facilities where implemented. Until the locations and specific activities are identified, the degree of program changes cannot be quantified.

b. **Time required to implement:** The time required to hire or assign and train employees would also depend on the activities to be implemented. However, generally, since this best practice does not entail the time-consuming task of development of new facilities, it should not require more than 12 months to implement.

c. **Facility siting, design, permitting and construction challenges:** A new facility is not required in this best practice. However, this best practice would be enhanced when implemented with other best practices (i.e., 1 and 6) that do require expanded processing infrastructure.

d. **Contracting for services:** Some of the activities that may fall under this best practice may require a contract for transporting, receiving, processing, or marketing diverted materials. The County may even choose to consider contracting for recovery operations for some materials at some County transfer stations.

e. **Compatibility with other elements of the system:** Increasing diversion of materials delivered to County facilities complements other elements of the County's system. It addresses materials that are not recovered through the County's other programs and it could increase efficiencies of transferring and hauling waste.

f. **Opportunities for regional partnerships:** This best practice does not offer direct opportunities for regional partnerships although it may offer more convenient locations for handling materials collected by municipalities.

g. **Compatibility with the current role of the solid waste division:** Recovering additional materials at County facilities is compatible with the current role of the solid waste division.

h. **Compatible with existing private industry role and resources:** This best practice is aimed at diverting materials that are currently disposed and, in many cases, diverting them to private processors and/or end users. Thus, it is compatible with existing private industry roles and resources.

i. **Public education requirements:** A moderate level of public education would be required directed to customers at County facilities.

2. Complexity of system and facility operation

a. **Potential facility downtime:** Recovery of additional materials at County transfer stations could be designed to minimize or eliminate potential facility downtime.

b. **Residue disposal:** Residue disposal is not a consideration in this best practice as the only residue associated with this best practice are materials that are currently being disposed..

c. **Compatibility with labor agreements:** Depending on the role of transfer station staff in implementing this best practice, the County may have to revisit labor classifications in current labor agreements to determine whether these functions are consistent.

3. Level of service to customers

    a. **Service offerings:** The County and municipalities would be offering additional services to facility customers as part of this best practice.

    b. **Location of service delivery:** This best practice would be implemented where customers are already delivering material.

    c. **Hours of service offering:** It is anticipated that the service would be offered whenever transfer stations are open and thus, there is no change in the hours of services offered to customers.

    d. **Time required by customers to utilize service:** Whether it takes more or less time for transfer station customers to deliver all or a portion of a load to a recovery location on-site rather than to the tipping floor for disposal will depend on the current wait time at the transfer stations where this is implemented, the location for delivering recovered material, and how the material must be sorted or delivered for recovery.

4. Operational risks

    a. **Proven performance of technology:** The technology for this best practice is assumed to be low-tech and well-proven, primarily sorting by hand or heavy equipment.

    b. **Market availability for materials/products:** Only materials for which markets are well-demonstrated should be added to the items recovered at the transfer stations in this best practice.

    c. **Contract risks and risk sharing:** There is always a possibility that anticipated markets for materials diverted through this best practice dissipate. However, the County could then redirect the materials to disposal until new markets are identified.

    d. **Ability to respond to external emergencies:** This best practice offers one more way to manage materials generated in an external emergency.

    e. **Ability to respond to internal system emergencies and outages:** The County could redirect materials to disposal if needed due to an internal system emergency or outage.

    f. **Operating life:** The operating life of recovery operations at a transfer station likely would be tied to the operating life of the transfer station.

    g. **Potential energy production:** This best practice alone would not impact energy production. However, if it resulted in additional diversion of wood or other potential fuel product, this material could be directed to energy production. For wood and paper/paperboard materials diverted to energy production there would be a reduction in methane generated at Cedar Hills Landfill and a corresponding reduction in energy production from methane recovered at the landfill. There also could be upstream energy conservation benefits as a result of using recovered materials in recycled-content manufacturing which displaces virgin-content manufacturing.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** The ability to scale up this best practice is only limited by the availability of space and trained personnel at the transfer station.

   b. **Adaptability to system changes and demands:** Since minimal technology is anticipated, recovery operations at the transfer stations should be able to adapt to system changes and demands as long as space and trained personnel are available to accommodate them.

   c. **Changes in feedstock quantity and composition:** For this criterion too, a gradual change in the quantity and composition of materials available for diversion through this best practice could be accommodated. Given that the technology in this best practice is relatively low-tech, the difficulty in adding or removing materials from those managed is minimal.

   d. **Impact on landfill life and operation:** Increasing diversion at the County transfer stations would have a positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** Additional fees or rebates could be charged or accrued in an equitable manner.

   b. **Siting of facilities:** This best practice would take place at existing County facilities.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served.

   b. **Job creation:** This best practice would create new County jobs, the exact number depending on the location and type of recovery operations.

   c. **Impacts on cities:** No impact on cities anticipated.

   d. **Susceptibility to impacts from action of cities:** None.

3. Impact on Employees

   a. **Health and safety:** Increased traffic and increased sorting and handling of materials on transfer station sites could present health and safety issues for employees. This could be mitigated with training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

   b. **Job security:** The added responsibilities for staff at the County transfer stations could provide additional job security and opportunities for staff.

   c. **Job satisfaction:** The added responsibilities for staff at the County transfer stations could decrease satisfaction, if added to already overburdened staff, or increase satisfaction by diversifying job responsibilities.

Summary

This best practice incorporates specific strategies and tactics that were considered in the Optimized Transfer Station Recycling Feasibility Study. It would provide moderately favorable impacts in many areas. This best practice would be expected to increase cost and complexity of facility and system operation.

Recommendation

Implement in the near term.

Best Practice No. 5

Contract with private industry to operate a diversion program at the transfer stations where space and facilities are suitable for enhanced diversion.

Best Practice Description

This best practice is essentially identical to Best Practice No. 6, but with the operation of the small scale sorting system contracted to private industry. However, unlike Best Practice No. 6, this best practice might also include some sort of floor sorting operation in which recyclable materials such as cardboard, wood, scrap metal, film plastic, carpet, large rigid plastic and/or gypsum wallboard are sorted on the tipping floor using manual and/or motorized equipment. Private industry might be more motivated and capable in undertaking this type of sorting operation. It seems unlikely that the County would choose to use this type of operation. The recovered material would be loaded into trailers and/or roll off boxes and transported to processors and end users. See Best Practice No. 6 for a more detailed description of the sorting system and facilities. The following evaluation is identical to the evaluation for Best Practice No. 6 except where private operation gives rise to differences.

Best Practice Evaluation

A. <u>Fiscal</u>

1. Impact on Rates:

   a. **Capital Costs:** A small scale sorting system of the type and size described above could be expected to have a total capital cost ranging between $1.3 million and $2.6 million, not including the County's administrative costs associated with procurement of design, construction and equipment, or training workers.

   b. **O&M Costs:** Sorting system operation and maintenance costs would depend on the hours of operation and tons of C&D and/or other recyclable material processed. Assuming the system processed 12 tons per hour using 8 laborers at a full labor cost of $64/hour, and labor represents around 70% of the total O&M cost of the system, the O&M cost might range from $60 to $65 per ton of debris processed. It is assumed that any floor sorting would be undertaken by the laborers who also operate the sorting system. If the number of promising MSW loads is small, then the O&M cost would likely approach that estimated in Best Practice No. 1 for C&D material (i.e. $33 to $43 per ton).

   c. **System Revenue:** A sorting system with a 50% recovery rate and an average value of recovered material of between $20 and $80 per ton recovered would yield revenue of around $10 to $20 per ton of debris processed. If the County's currently estimated avoided disposal cost of $10 to $11 is included, the effective revenue per ton of material processed with 50% recovery would increase by approximately $5 to $6 per ton, to around $15 to $26 per ton.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Based on very approximate estimated O&M costs, revenue, avoided disposal cost, and the cost of capital, a small scale sorting system might be expected to be far below a breakeven point financially, even under the most favorable market conditions.

   b. **Certainty of costs:** Capital and O&M costs for small scale sorting can be expected to be fairly well defined and not subject to a high level of uncertainty.

   c. Certainty of revenues, including consideration of market availability for materials/products including energy produced: Revenues generated from the recovered material should be expected to vary widely over time, although the types of materials recovered from C&D type loads (wood, aggregates, metals, and some types of fibers) should be less volatile than materials recovered from MSW type loads (metals, fibers and plastics). The materials recovered would be expected to find multiple buyers and consumers in local and regional markets, although some materials such as paper and paperboard might yield higher revenue if shipped out of the region to more distant end users.

   d. **Opportunities for regional risk sharing:** Small scale sorting and recovery would not appear to offer an opportunity for a regional sharing of the risks or benefits.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

   a. **Effect on waste prevention, recycling and diversion programs:** Would add a modest amount of recycling and diversion.

   b. **Effect on landfill operations:** Small scale sorting at one or more of the County's transfer stations would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

2. Impact on resource consumption

   a. **Land:** Small scale sorting would have very little effect on land consumption if it is assumed that other waste material will ultimately be landfilled in the space the recovered material would have occupied.

   b. **Water:** Small scale sorting would have very little direct effect on local water consumption. No water is used in the sorting process and it is estimated that downstream reuse of the recovered materials would not typically require water consumption. However, there could be upstream water use that might be displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are consumed during the sorting process. Transportation energy consumption of material recovered would likely off set the savings in transportation energy from hauling to a disposal site. There could be some adverse differential if recovered material is handled in smaller size vehicles than are used to haul compacted waste from transfer stations to the disposal site. However, as with overall water consumption, there likely would be upstream energy use displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

d. **Material resources:** Small scale sorting would have a modest effect on the consumption of material resources by displacing raw, virgin materials such as trees and aggregates with recovered material.

3. Impact on environmental resources

a. **Human health:** Small scale sorting would have very little effect on local human health assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. Due to the likely displacement of virgin-content product manufacturing with recycled-content manufacturing using the recovered C&D materials, and the associated savings in combustion energy in manufacturing, there could be a positive global human health benefit. The magnitude of human health benefits would depend on the type of materials recovered, the environmental footprint of the displaced virgin-content products, and the environmental footprint of the recycled-content production operations.

b. **Ecosystems health:** Small scale sorting would have very little effect on ecosystems health for ecosystems in the neighborhood of the actual sorting operations. However, as with human health, there could be positive global ecosystem health impacts due to the displacement of virgin-content manufacturing activities by recycled-content manufacturing.

c. **Air:** Small scale sorting would have very little effect on local atmospheric resources assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. More importantly, there could be reductions in global air emissions from the displacement of virgin-content production by recycled-content production using the recovered C&D materials. Such upstream resource extraction and virgin-content manufacturing displacements are typically an order of magnitude or larger than any increase in transportation emissions associated with hauling recovered materials to recycled-content manufacturing end users.

d. **Earth:** Small scale sorting would have very little effect on earth resources other than through the displacement of raw or virgin quarried and mined resources by recovered aggregates and metals, and the displacement of virgin biogenic and fossil resources by recovered materials such as paper and plastic.

e. **Water:** Small scale sorting would have very little effect on water resources, other than the global water consumption reductions mentioned above. In addition, as with air emissions, the upstream displacements of virgin-content manufacturing could achieve reductions in pollutant emissions to water.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

   a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

   a. **Program changes:** This best practice would require several modest program changes including:

      i. Increasing staff levels if sorting equipment maintenance was retained by the County.

      ii. Special staff training if sorting equipment maintenance was retained by the County.

      iii. Contracting with downstream processors and/or end users for sale of collected materials if this function was retained by the County.

      iv. Increasing facility maintenance work load if maintenance was retained by the County.

   b. **Time required to implement:** 24 to 36 months per location. Longer if a new building is required.

   c. **Facility siting, design, permitting and construction challenges:** The primary challenge is finding space within the County's existing facilities and sites for the recovery operation and avoiding interference with the primary function of the transfer stations which is transfer of mixed municipal waste. It is assumed that these facilities would not attract new customers to the facilities, but rather would divert existing customer loads. Therefore permitting is seen as primarily related to building type permits and a modification of the stations' solid waste operating permit.

   d. **Contracting for services:** Contracting the operation of the sorting operation with a private operator could be challenged by the County's unionized labor force, particularly since the work areas and responsibilities would overlap. Private operation would therefore seem to be highly problematic thus making this entire best practice highly questionable.

e. **Compatibility with other elements of the system:** Adding small scale sorting seems highly compatible with other elements of the County's system.

f. **Opportunities for regional partnerships:** Small scale sorting and recovery would not appear to offer an opportunity for regional partnerships due to the small size of the operations. If preferential tipping rates were given to customers with loads suitable for sorting, the facilities might attract customers who currently drop off this type of material in other jurisdictions.

g. **Compatibility with other regional approaches to solid waste management:** Other public owned and operated transfer stations in the region, notably Seattle and Snohomish County, do not use this best practice. However, the practice would not be incompatible with the regional approach.

h. **Compatibility with the current role of the solid waste division:** Small scale sorting and recovery would appear to be highly compatible with the Division's role and would fill a void that currently exists in the waste management system in the County.

i. **Compatible with existing private industry role and resources:** Since the feedstock waste stream for these facilities is currently handled by the County as mixed municipal waste, contracting with private industry to operate material diversion facilities on the County's site(s) seems to be a significant deviation from private industry's current role in the waste management system. It does seem that private industry would be very capable in providing the resources needed for this operation and would likely have much more flexibility than the County in adjusting staffing levels to meet the expected frequent variations in the sorting operation.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** Sorting system downtime for planned and unplanned maintenance and repair could be expected. However since the systems would likely not run on a continuous basis, there would appear to be significant flexibility to continue to manage the feedstock loads even with downtime impacts.

   b. **Residue disposal:** Residual disposal would be very simple since the sorting system would be located within or nearby to the transfer building.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain the sorting system (i.e. waste handling) seems highly compatible with the County's current labor agreements, therefore contracting with private industry to perform some or all of these duties seem highly likely to provoke strong objections from the County's unionized labor forces.

3. Level of service to customers

    a. **Service offerings:** Adding sorting at County facilities would not significantly improve the service offerings since the feedstock material is already being conveniently received at the facilities. However, it could provide an opportunity to offer lower cost service to the customers if the loads diverted to the sorting system were priced at a lower tipping fee than MSW loads.

    b. **Location of service delivery:** Same as current system.

    c. **Hours of service offering:** Same as current system.

    d. **Time required by customers to utilize service:** Same as current system. However, customers with loads suitable for diverting to the sorting operation might be given a priority access opportunity after the scale facility if the facility configuration would allow.

4. Operational risks

    a. **Proven performance of technology:** Small scale recovery facilities are used in many locations throughout the United States and utilize robust, highly proven, "low-tech" equipment.

    b. **Market availability for materials/products:** There are well established local and regional markets for the main types of materials that would be recovered by the sorting operation: wood, ferrous metal, mineral aggregates, gypsum wallboard, large rigid plastics, large film plastics, cardboard and paper.

    c. **Contract risks and risk sharing:** Given the low volumes and widely-fluctuating market value of the recovered material, it is not likely that the County would find much opportunity to share market price risk with the material purchasers, at least not on terms favorable to long-run average County revenues from marketing the recovered materials.

    d. **Ability to respond to external emergencies:** Depending on the number of installations, having small scale processing could provide some buffer in the event of an external emergency such as a seismic event or flooding that added significant amounts of residential C&D material to the waste stream.

    e. **Operating life:** The sorting equipment would have an estimated service life with good maintenance of between 10 to 15 years before major overhaul and/or replacement would be required.

    f. **Potential energy production:** Wood would be a significant portion of the recovered material and could be directed to hog fuel boilers for energy production, assuming the sorting operation effectively separated treated and painted wood from clean wood when processing incoming C&D loads.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** Since the facility would likely operate intermittently, there would be good opportunity to increase throughput capacity by operating longer hours or additional shifts. However, there could be upfront feedstock storage limitations, and hours of operation constraints that might limit storing material for processing and/or separated materials after processing.

   b. **Changes in feedstock quantity and composition:** Since the system is based on manual sorting of targeted material (positive sorting), it is very adaptable to changes in the composition of the feedstock stream. In fact the feedstock stream is by its very nature highly variable from load to load. Since the system would be operated on a batch or intermittent basis, it would use an upfront holding area for the feedstock which provides a buffer for variations in the quantity of feedstock material received.

   c. **Impact on landfill life and operation:** Small scale sorting at one or more of the County's transfer stations would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** It seems likely that facilities with separate processing capability would offer a lower tipping fee for C&D type loads or loads from other targeted customer types. This could produce a sense of inequity for County customers located a far distance from the facilities that have processing.

   b. **Siting of facilities:** Since processing would be added at existing facilities and would be handling materials already delivered to these facilities as MSW, there would not appear to be any facility siting challenges involved.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served.

   b. Job creation: Would create new, relatively low wage or entry level job opportunities (8 to 10 per site). These positions might not be full time depending on the hours of operation of the sorting systems.

   c. **Impacts on cities:** No impacts apparent.

   d. **Susceptibility to impacts from action of cities:** No susceptibility apparent

   e. **Public education requirements:** Minimal public education requirements needed, but would benefit from some public outreach to explain the purpose and benefits of the program and what customers can do to increase the efficiency by tailoring their loads.

3. Impact on Employees or Contracted Workers

   a. **Health and safety:** Waste handling and processing, particularly hand sorting as would be used in the small scale operations envisioned, creates health and safety hazards for the operating staff. These hazards include puncture wounds, repetitive motion injuries, strains and sprains, impact injuries, crushing injuries, dust inhalation/respiratory risks, hearing damage, slips and falls, and vehicle/human impact injuries. In short, the work is hazardous and therefore requires extensive training and refresher training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

   b. **Job security:** Contracting the operation of the sorting system would not provide any job security for County staff and could be viewed as very threatening to their job security.

   c. **Job satisfaction:** Sorting is physically demanding and monotonous, and not generally considered very satisfying as a long term occupation. However, some people do enjoy the fast pace, teamwork approach that the work demands.

Summary

The complexity of implementing and operating this best practice would be very challenging and it would likely have significant adverse impacts on County employees. The complexity along with significant costs would outweigh positive aspects.

Recommendation

Not recommended. No further action

Best Practice No. 6

Incorporate new and/or revised County-operated facilities at transfer stations to accommodate recyclable material diversion (e.g., mini-MRFs).

Best Practice Description

This best practice is very similar to Best Practice No. 1 but with a broader range of different feedstock that would include construction and demolition type material as well as commercially hauled, mostly “dry” mixed municipal waste loads which contain promising amount of recoverable material. Unlike Best Practice No. 1, this best practice is envisioned only as a County operated undertaking. It would involve constructing and operating a small scale sorting system for recyclables (including construction and demolition debris) at one or more of the Division’s transfer stations. These facilities could be considered a type of “mini-MRF”. A typical small scale system suitable for the type of self-haul and commercially hauled mixed municipal waste material seen at the County’s stations could have a throughput capacity of between 5 and 15 tons per hour and might include the following pieces of equipment:

- An infeed hopper
- An 60” wide infeed conveyor (horizontal and inclined sections)
- A single deck screen such as a debris roll screen to remove 2” and smaller material
- A cross-belt magnet to remove ferrous metal
- An elevated 6 to 8 station, 4 to 5 bunker manual recovery platform with or without a climate control cabin and bunkers sized for roll-off box collection
- Space for future addition of mechanical sorting equipment for non-ferrous metals, and for sorting plastic grades and paper

The system would use positive manual sorting to pick out materials targeted for recovery such as wood, mixed metals, aggregates, gypsum wallboard, large plastics, small mixed plastics, cardboard and paper. The overall footprint of such a system would be on the order of 40 feet wide by 125 feet long (5,000 square feet) not including a dedicated tipping floor area. The tipping floor area would likely be at least 5,000 square feet and include armor-plated concrete push walls and bunker area in which C&D material targeted MSW loads could be temporarily stored before running through the system on a batch basis. The system would have multiple electrical motors with a combined horsepower rating of from 50 to 75 HP. The capital cost of the sorting system including installation and startup might be on the order of $750,000 to $900,000, not including the cost of surrounding building construction/modifications or the electrical power feed from the station electrical distribution equipment. The cost of the additional construction could range from $250,000 to $500,000 or more depending on the complications of retrofitting the system to the existing facility and site. If a separate building was required that could add as much as $500,000 to the overall capital cost. Design and procurement support costs could add between 40% to 60% to the cost of the equipment and other construction.   Operating labor would be between 8 to 10 people. The system would be expected to run intermittently (batch operation) managing accumulated C&D debris.

Assuming the sorting system was operated one 8 hour shift per day, five days per week, at an average throughput rate of 12 tons per hour, and with a 90% availability (10% down time), each system would process around 22,500 tons of material per year, or about 2.8.5% of the County's current total of 800,000 tons of mixed waste.

Best Practice Evaluation

A. <u>Fiscal</u>

1. Impact on Rates:

    a. **Capital Costs:** A small scale sorting system of the type and size described above could be expected to have a total capital cost ranging between $1.4 million and $3.0 million, not including design and the County's administrative costs associated with procurement of design, construction and equipment, or training workers.

    b. **O&M Costs:** Sorting system operation and maintenance costs would depend on the hours of operation and tons of C&D and/or other recyclable material processed. Assuming the system processed 12 tons per hour using 8 laborers at a full labor cost of $64/hour, and labor represents around 70% of the total O&M cost of the system, the O&M cost might range from $60 to $65 per ton of debris processed.   If the number of promising MSW loads is small, then the O&M cost would likely approach that estimated in Best Practice No. 1 for C&D material (i.e. $45 to $55 per ton).

    c. **System Revenue:** A sorting system with a 50% recovery rate and an average value of recovered material of between $20 and $80 per ton recovered would yield revenue of around $10 to $20 per ton of debris processed. If the County's currently estimated avoided disposal cost of $10 to $11 is included, the effective revenue per ton of material processed with 50% recovery would increase by approximately $5 to $6 per ton, to around $15 to $26 per ton.

2. Economic Risks:

    a. **Financial effect of listed operational risks:** Based on very approximate estimated O&M costs, revenue, avoided disposal cost, and the cost of capital, a small scale sorting system might be expected to be well below a breakeven point financially, even under the most favorable market conditions.

    b. **Certainty of costs:** Capital and O&M costs for small scale sorting can be expected to be fairly well defined and not subject to a high level of uncertainty.

    c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Revenues generated from the recovered material should be expected to vary widely over time, although the types of materials recovered from C&D type loads (wood, aggregates, metals, and some types of fibers) should be less volatile than materials recovered from MSW type loads (metals, fibers and plastics). The materials recovered would be expected to find multiple buyers and consumers in local and regional markets, although some materials such as paper and paperboard might yield higher revenue if shipped out of the region to more distant end users.

d. **Opportunities for regional risk sharing:** Small scale sorting and recovery would not appear to offer an opportunity for a regional sharing of the risks or benefits.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Would add a modest amount of material recycling and diversion.

b. **Effect on landfill operations:** Small scale sorting at one or more of the County's transfer stations would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

2. Impact on resource consumption

a. **Land:** Small scale sorting would have very little effect on land consumption if it is assumed that other waste material will eventually be landfilled in the space the recovered material would have occupied.

b. **Water:** Small scale sorting would have very little direct effect on local water consumption. No water is used in the sorting process and it is estimated that downstream reuse of the recovered materials would not typically require water consumption. However, there could be upstream water use that might be displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are consumed during the sorting process. Transportation energy consumption of material recovered would likely off set the savings in transportation energy from hauling to a disposal site. There could be some adverse differential if recovered material is handled in smaller size vehicles than are used to haul compacted waste from transfer stations to the disposal site. However, as with overall water consumption, there likely would be upstream energy use displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

d. **Material resources:** Small scale sorting would have a modest effect on the consumption of material resources by displacing raw, virgin materials such as trees and aggregates with recovered material.

3. Impact on environmental resources

a. **Human health:** Small scale sorting would have very little effect on local human health assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. Due to the likely displacement of virgin-content product manufacturing with recycled-content manufacturing using the recovered C&D materials, and the associated savings in combustion energy in manufacturing, there could be a positive global human health benefit. The magnitude of human health benefits would depend on the type of materials recovered, the environmental footprint of the displaced virgin-content products, and the environmental footprint of the recycled-content production operations.

b. **Ecosystems health:** Small scale sorting would have very little effect on ecosystems health for ecosystems in the neighborhood of the actual sorting operations. However, as with human health, there could be positive global ecosystem health impacts due to the displacement of virgin-content manufacturing activities by recycled-content manufacturing.

c. **Air:** Small scale sorting would have very little effect on local atmospheric resources assuming effective dust control was employed in the sorting system operation. Air emissions from hauling equipment are assumed to be similar for recovered material versus disposal as waste. More importantly, there could be reductions in global air emissions from the displacement of virgin-content production by recycled-content production using the recovered C&D materials. Such upstream resource extraction and virgin-content manufacturing displacements are typically an order of magnitude or larger than any increase in transportation emissions associated with hauling recovered materials to recycled-content manufacturing end users.

d. **Earth:** Small scale sorting would have very little effect on earth resources other than through the displacement of raw or virgin quarried and mined resources by recovered aggregates and metals, and the displacement of virgin biogenic and fossil resources by recovered materials such as paper and plastic.

e. **Water:** Small scale sorting would have very little effect on water resources, other than the global water consumption reductions mentioned above. In addition, as with air emissions, the upstream displacements of virgin-content manufacturing could achieve reductions in pollutant emissions to water.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

    a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. Operational

1. Complexity of Implementing

    a. **Program changes:** This best practice would require several modest program changes including:

        i. Increasing staff levels

        ii. Special staff training

        iii. Contracting with down stream processors and/or end users for sale of collected materials

        iv. Increasing facility maintenance work load

    b. **Time required to implement:** 24 to 36 months per location. Longer if a new building is required.

    c. **Facility siting, design, permitting and construction challenges:** The primary challenge is finding space within the County's existing facilities and sites for the recovery operation and avoiding interference with the primary function of the transfer stations which is transfer of mixed municipal waste. It is assumed that these facilities would not attract new customers to the facilities, but rather would divert existing customer loads. Therefore permitting is seen as primarily related to building type permits and a modification of the stations' solid waste operating permit.

    d. **Contracting for services:** In this best practice there are no privately contracted services contemplated.

    e. **Compatibility with other elements of the system:** Adding small scale sorting seems highly compatible with other elements of the County's system.

    f. **Opportunities for regional partnerships:** Small scale sorting and recovery do not appear to offer an opportunity for regional partnerships due to the small size of the operations. If preferential tipping rates were given to customers with loads suitable for sorting, the facilities might attract customers who currently drop off this type of material in other jurisdictions.

    g. **Compatibility with other regional approaches to solid waste managemen**t: Other jurisdictions such as Seattle, Snohomish County, Tacoma, Thurston County, etc. have considered or are considering this practice.

h. **Compatibility with the current role of the solid waste division:** Small scale sorting and recovery would appear to be highly compatible with the Division's role and would fill a void that currently exists in the waste management system in the County.

i. **Compatible with existing private industry role and resources:** While the feedstock waste stream for these facilities is currently handled by the County as mixed municipal waste, directing selected customer loads that are predominantly C&D or other recyclable type material to the sorting operation could be viewed as placing the County in competition with private industry which handles much of the C&D and source-separated recyclable material generated in the County. However, the private C&D management industry facilities are not likely to have much interest in the C&D type material delivered to the County facilities since much of it is delivered by small self-haul and commercial vehicles which are slow unloading and tie up valuable tipping floor space.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** Sorting system downtime for planned and unplanned maintenance and repair could be expected. However since the systems would likely not run on a continuous basis, there would appear to be significant flexibility to continue to manage the targeted feedstock loads even with downtime impacts.

   b. **Residue disposal:** Residue disposal would be very simple since the sorting system would be located within or nearby to the transfer building.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain the sorting system (i.e. waste handling) seems highly compatible with the County's current labor agreements.

3. Level of service to customers

   a. **Service offerings:** Adding sorting at County facilities would not significantly improve the service offerings since the feedstock material is already being conveniently received at the facilities. However, it could provide an opportunity to offer lower cost service to the customers if the loads diverted to the sorting system were priced at a lower tipping fee than MSW loads.

   b. **Location of service delivery:** Same as current system.

   c. **Hours of service offering:** Same as current system.

   d. **Time required by customers to utilize service:** Same as current system. However, customers with loads suitable for diverting to the sorting operation might be given a priority access opportunity after the scale facility if the facility configuration would allow.

4. Operational risks

    a. **Proven performance of technology:** Small scale recovery facilities are used in many locations throughout the United States and utilize robust, highly proven, "low-tech" equipment.

    b. **Market availability for materials/products:** There are well established local and regional markets for the main types of materials that would be recovered by the sorting operation: wood, ferrous metal, mineral aggregates, gypsum wallboard, large rigid plastics, large film plastic, cardboard and paper.

    c. **Contract risks and risk sharing:** Given the low volumes and widely fluctuating market value of the recovered material, it is not likely that the County would find much opportunity to share market price risk with the material purchasers, at least not on terms favorable to long-run average County revenues from marketing the recovered materials.

    d. **Ability to respond to external emergencies:** Depending on the number of installations, having small scale processing could provide some buffer in the event of an external emergency such as a seismic event or flooding that added significant amounts of residential C&D material to the waste stream.

    e. **Operating life:** The C&D sorting equipment would have an estimated service life with good maintenance of between 10 to 15 years before major overhaul and/or replacement would be required.

    f. **Potential energy production:** Wood would be a significant portion of the recovered material and could be directed to hog fuel boilers for energy production, assuming the sorting operation effectively separated treated and painted wood from clean wood when processing incoming C&D loads.

5. Flexibility and adaptability

    a. **Ability to scale up and add or reduce capacity:** Since the facility would likely operate intermittently, there would be good opportunity to increase throughput capacity by operating longer hours or additional shifts. However, there could be upfront feedstock storage limitations, and hours of operation constraints that might constrain having material for processing.

    b. **Changes in feedstock quantity and composition:** Since the system is based on manual sorting of targeted material (positive sorting), it is very adaptable to changes in the composition of the feedstock stream. In fact the feedstock stream is by its very nature highly variable from load to load. Since the system would be operated on a batch or intermittent basis, it would use an upfront holding area for the feedstock which provides a buffer for variations in the quantity of feedstock material received.

c. **Impact on landfill life and operation:** Small scale sorting at one or more of the County's transfer stations would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** It seems likely that facilities with separate processing capability would offer a lower tipping fee for selected recyclable-rich loads. This could produce a sense of inequity for County customers located a far distance from the facilities that have processing.

   b. **Siting of facilities:** Since processing would be added at existing facilities and would be handling materials already delivered to these facilities as MSW, there would not appear to be any facility siting challenges involved.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served.

   b. **Job creation:** Would create new, relatively low wage or entry level job opportunities (8 to 10 per site). These positions might not be full time depending on the hours of operation of the sorting systems.

   c. **Impacts on cities:** No impacts apparent.

   d. **Susceptibility to impacts from action of cities:** No susceptibility apparent.

   e. **Public education requirements:** Minimal public education requirements needed, but would benefit from some public outreach to explain the purpose and benefits of the program and what customers can do to increase the efficiency by tailoring their loads.

3. Impact on Employees

   a. **Health and safety:** Waste handling and processing, particularly hand sorting as would be used in the small scale operations envisioned, creates health and safety hazards for the operating staff. These hazards include puncture wounds, repetitive motion injuries, strains and sprains, impact injuries, crushing injuries, dust inhalation/respiratory risks, hearing damage, slips and falls, and vehicle/human impact injuries. In short, the work is hazardous and therefore requires extensive training and refresher training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

b. **Job security:** Adding sorting could provide additional job security and opportunities for staff.

c. **Job satisfaction:** Sorting is physically demanding and monotonous, and not generally considered very satisfying as a long term occupation. However, some people do enjoy the fast pace, teamwork approach that the work demands.

Summary

This best practice would be relatively inexpensive and simple to implement on a small scale at stations such as Bow Lake where space exists and customers deliver large amounts of recyclable material. Note that smaller scale systems would have a lesser impact on diversion from disposal. The system would have good flexibility to adapt to day-to-day changes in the composition and quantity of the material being received. Depending on size and technology, costs could exceed revenue. It could be implemented as part of mixed waste processing in conjunction with other practices.

Recommendation

Promising, but needs more in-depth study by County before implementing.

Best Practice No. 7

Implement anaerobic digestion of source separated organic waste, with beneficial use of the biogas and composting/marketing of the digestate.

Best Practice Description

This best practice involves implementing anaerobic digestion of source separated organic waste, including food waste, yard waste, and possibly other digestable materials such as certain types of non-recyclable paper. The process generates biogas consisting primarily of methane and carbon dioxide. The biogas could be upgraded to pipeline-quality gas (biomethane) or other types of fuel such as compressed natural gas (CNG) or it could be used to generate electricity. The remaining material not converted to biogas, called digestate, would be composted and marketed as a fertilizer or soil amendment. Anaerobic digestion of source separated organic waste would require changes to collection practices to provide for collection of food waste and other suitable organic feedstock separately from recyclables and non-digestable materials. Since source separation and collection of yard waste is already a wide-spread practice across the County, the existing collection network could likely be modified to incorporate food waste and other organics.

The Waste Characterization and Customer Survey Report (October 2012) shows the amount of digestable organics present in the King County waste stream ranges from approximately 21% (unpackaged food waste and yard waste) up to approximately 39% (packaged and unpackaged food waste, yard waste, compostable paper and low-grade recyclable paper). Based on the total quantity of waste disposed in 2011 at the Cedar Hills Regional Landfill (over 800,000 tons per year) and assuming an overall participation and capture rate of approximately 50%, an anaerobic digestion system implemented for King County could be on the order of 80,000 tons per year to 160,000 tons per year. Anaerobic digestion has been developed and demonstrated at capacities ranging from 1,000 tons per year for small modular units up to approximately 100,000 tons per year. Considering the availability of organic waste in King County and the extent to which the technology has been demonstrated, for initial planning purposes it would be reasonable to consider a large-scale facility designed to manage up to approximately 100,000 tons per year of source separated organic waste (approximately 12% of the waste currently disposed at the Cedar Hills Regional Landfill). A small modular unit (1,000 tons per year) could also be considered for locational-specific application.

There are many variations of anaerobic digestion technology including wet and dry systems, continuous and batch processing, and single stage or multi-stage processing. In all cases, anaerobic digestion operates within an enclosed tank, vessel, or bunker, under controlled conditions and without the addition of air or oxygen. The system variations offer differing advantages and disadvantages relating to feedstock suitability, retention times to complete the process, biogas yields, energy needs, space requirements, building requirements, and other infrastructure needs. Highly-automated systems, particularly those that upgrade the biogas to pipeline-quality gas or other fuels, can be capital-intensive. Batch processes and those that convert the biogas to electricity may have less capital requirements. A typical anaerobic digestion system would include the following components:

- Pre-processing equipment to remove contaminants (such as packaging material and metals) and to prepare the feedstock to meet technology-specific requirements (e.g., size reduction, moisture control, blending);
- Digestion tanks, vessels, or bunkers, with pumps, mixers, and other integrated components to handle and digest the prepared feedstock;
- A digestate management system, including handling equipment, composting facilities, and storage facilities;
- A biogas storage and utilization system, including biogas cleaning and conditioning as well as electricity generating equipment (e.g., engines, fuel cells) or equipment to upgrade the biogas to pipe-line quality gas or other fuels; and,
- Support systems, such as wastewater treatment, odor control, and air emission control equipment.

The building footprint for a large-scale anaerobic digestion facility could be highly variable due to technology-specific design aspects, and could be expected to range from 50,000 square feet to 200,000 square feet. Site size would be dictated by building size and layout requirements for other equipment and structures (e.g., digestion tanks), roadways and requirements for large truck queuing and movements, digestate management activities (composting, curing and storage), storm water management, and landscaping and green buffer zones. A large-scale facility processing source separated organic waste could be expected to require 15 acres or more. The footprint for a small modular unit could be as little as 2,000 square feet.

Operation and maintenance requirements for an anaerobic digestion facility would include building and site maintenance, equipment repair and replacement, utilities (power, water, sewer, and possibly natural gas), chemicals and other expendables for process operations, and disposal of residue. Staffing needs would vary based on the design elements of the system (e.g., throughput capacity, batch or continuous operation, generation of electricity or fuel). Anaerobic digestion facilities are typically operated five or six days per week, one or two shifts per day, although the digestion process would occur on a continuous basis (unstaffed or minimal staffing during a second and/or third shift). Considering these variables, staffing requirements for a large-scale facility processing source separated organic waste could be expected to range from 10 to 25 staff. Staffing requirements for a small-scale modular unit could be expected to range from 1.5 to 2 full time equivalents.

This best practice is different from Best Practice 10 in that this best practice receives and digests source separated organic waste, while Best Practice 10 receives mixed waste, sorts that waste to separate recyclables and generate an organic-rich fraction, and then digests the recovered organic fraction. In comparison, Best Practice 7 would require less processing and lower capital and operating investments.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** A large-scale anaerobic digestion system of the size and types described above could be expected to have a total capital cost ranging from $30 million to $60 million. A small-scale modular system could be expected to have a total capital cost ranging from $2.5 million to $4.0 million.

   b. **O&M Costs:** A large-scale anaerobic digestion system could be expected to have operating and maintenance costs ranging from $35 to $75 per ton of source separated organic waste processed. A small-scale modular system could be expected to have much higher operating and maintenance costs on a per-ton basis, perhaps at or above $200 per ton of source separated organic waste processed.

   c. **System Revenue:** Revenues would primarily be generated from the sale of fuel or electricity produced from the biogas. The amount of energy that could be produced is highly dependent on the characteristics of the feedstock as well as the type of technology used. If producing biomethane, output could be expected to range from 1,200 to 2,400 cubic feet per ton of organic waste. If producing electricity, net output could be expected to range from 100 to 250 kilowatt hours (kWh) per ton of organic waste. Assuming a biomethane sale price of approximately $5 per thousand cubic feet or a power sale price of approximately $0.055 per kWh, revenues could range from approximately $5 to $14 per ton of organic waste processed. Project-specific circumstances would need to be considered to optimize net revenue from energy sales, including determination of whether the product should be fuel or electricity. Additional revenue may be generated from the sale of compost, but without an established market compost is often considered to be neutral as a revenue stream or perhaps could carry a cost associated with transportation or, in some cases, for disposal if a market doesn't exist. In addition to system revenues, there would be an avoided disposal cost for the organic feedstock, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost. In addition to the incremental avoided disposal cost, King County has estimated that landfill air space at the Cedar Hills Regional Landfill is valued at approximately $7.00 per ton.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Based on very approximate estimated revenue, avoided disposal cost, the value of landfill air space, O&M costs, and the cost of capital, and considering the costs that may be incurred to modify current collection practices, a large-scale anaerobic digestion project processing source separated organic waste is not expected to be above a break-even point financially except perhaps under the most favorable cost and revenue conditions. A small-scale modular system might be at or above the break-even point under the right circumstances, such as if a small-scale project resulted in significant cost savings associated with transportation. Vashon Island is an example of an area where a small-scale modular system could possibly make economic sense given the higher cost of transportation of organic waste from this island community.

b. **Certainty of costs:** There is limited and only recent development of anaerobic digestion of the source separated organic fraction of municipal solid waste in the United States. Systems are generally comprised of numerous components that must be uniquely designed for project- and site-specific application, and that are not typically procured as "off-the-shelf" systems. Capital and O&M costs vary widely based on the diverse range of technology available. Therefore, costs can be expected to be subject to a high level of uncertainty.

c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Energy revenues generated from the sale of biomethane or electricity are subject to uncertainty associated with the amount of energy that would be produced for sale. Industry values are variable and highly dependent on the characteristics of the feedstock. Energy revenues are also subject to market uncertainties. There is expected to be a stable market for the energy products, but market prices are uncertain. Energy forecasts by the Northwest Power and Conservation Council show wholesale electricity rates on the order of $0.055/kWh for certain current and future conditions, which could be indicative of a future rate that may be available to a project in King County. However, forecasting is uncertain and prices could easily vary by ± 25% or more. Also, prices would be subject to the ability to enter into a long-term purchase agreement and the terms and conditions of such an agreement. Biomethane prices are also subject to price uncertainty. Biomethane prices could be expected to track similar to natural gas pricing, perhaps with some benefits associated with renewable and environmental attributes. The market for compost is uncertain, and could be neutral or a cost to the project rather than a revenue source unless there are multiple buyers and consumers in the local market.

d. **Opportunities for regional risk sharing:** Anaerobic digestion of source separated organic waste would not appear to offer an opportunity for a regional sharing of the risks or benefits. Development of a regional facility (expanding beyond King County and its municipal participants) would require a capacity larger than what has previously been demonstrated elsewhere.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Assuming the development of a large-scale anaerobic digestion facility processing 100,000 tons per year of source separated organic waste and generating an estimated 15,000 tons per year of residue requiring disposal, the facility would divert approximately 85,000 tons per year of waste from landfill disposal. This is about 10% of the waste currently disposed at the Cedar Hills Landfill. A small-scale modular system of 1,000 tons per year would have a very small but positive effect on diversion.

b. **Effect on landfill operations:** Implementation of anaerobic digestion would reduce the total tons of materials needing to be landfilled and would extend the life of the landfill. It would also reduce the amount of landfill gas produced at the landfill.

2. Impact on resource consumption

a. **Land:** A large-scale anaerobic digestion facility would require an estimated 15 acres or more for process operations. A small-scale modular system would require well under an acre for process operations.

b. **Water:** Water requirements vary based on the type of digestion process used (i.e., wet or dry). Some technologies have at least an initial water requirement, with closed-loop systems for sustaining operations and with the use of water recovered from the moisture content of the feedstock. Most facilities will require water for housekeeping and perhaps for system operations such as humidifying a biofilter for odor control.

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are required to support operation of an anaerobic digestion facility, including for operation of pumps, motors, pre-processing equipment, air pollution control equipment, and mobile equipment. Transportation energy consumption for collection and delivery of source separated organic material is expected to be the same as current practices. Transportation energy consumption for delivery of compost to markets could be a small but adverse differential, depending on the distance to the markets.

d. **Material resources:** Anaerobic digestion of source separated organic waste would have a small but positive effect on the consumption of material resources. The upstream displacement of synthetic soil and lawn amendments and pesticides by composted digestate could result in conservation of virgin material resources.

3. Impact on environmental resources

a. **Human health:** Anaerobic digestion of source separated organic waste would have very little effect on human health assuming suitable control measures for air emissions associated with feedstock handling and biogas use.

b. **Ecosystems health:** Anaerobic digestion of source separated organic waste would have very little effect on ecosystems health.

c. **Air:** Anaerobic digestion of source separated organic waste could have air emissions associated with feedstock handling and biogas use, but it is expected that measures would be used to control these emissions to meet State and local requirements.

d. **Earth:** Anaerobic digestion of source separated organic waste would have a small but positive effect on earth resources associated with the beneficial use of compost as a fertilizer or soil amendment.

e. **Water:** Anaerobic digestion of source separated organic waste would have very little effect on water resources.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

   a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

   a. **Program changes:** Anaerobic digestion of source separated organic waste would require changes to set-out practices, to accommodate the collection of food waste and other suitable organic feedstock as part of the current collection network for yard waste. These new practices would need to be implemented by many or all of the participating jurisdictions to ensure program success. Additional program changes would be required if the facility is operated by the County. In addition to changes at a jurisdictional level, changes specific to the County could include:

      i. Increasing staff levels

      ii. Special staff training

      iii. Public outreach and education

      iv. Additional handling equipment at transfer stations

      v. Contracting with end users for sale of energy and compost

      vi. Increasing facility maintenance work load

   b. **Time required to implement:** This practice could take 36 to 48 months to implement, which would include soliciting and receiving proposals from system vendors and project developers, facility design and permitting, construction, and commissioning and start-up. Changes to set-out and collection practices are assumed to be pursued simultaneously with development of the anaerobic digestion facility.

c. **Facility siting, design, permitting and construction challenges:** Assuming a large-scale facility is sited at the Cedar Hills Regional Landfill, a primary challenge would be finding sufficient room to place the facility on the site (i.e., site planning). A small scale modular system would likely find suitable siting space at a number of the County's transfer stations including Enumclaw, Vashon Island, Bow Lake, Shoreline and possibly at Factoria.

d. **Contracting for services:** Contracting the operation of a large-scale anaerobic digestion facility with a private operator is recommended, due to design and operational risk associated with the early development status of this technology in the United States. In addition, some individual anaerobic digestion technologies have proprietary features, which require specific consideration for operation. However, private operation could be challenged by the County's unionized labor force, particularly since the work areas and responsibilities would overlap. Operation of a small-scale modular system might be a reasonable risk undertaking for the County to consider particularly with some vendor operating support in the first year or two of the operation.

e. **Compatibility with other elements of the system:** Adding anaerobic digestion of source separated organic waste seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal.

f. **Opportunities for regional partnerships:** Anaerobic digestion of source separated organic waste would not appear to offer an opportunity for regional partnerships. Development of a regional facility (expanding beyond King County and its municipal participants) would require a capacity larger than what has previously been demonstrated.

g. **Compatibility with other regional approaches to solid waste management:** Anaerobic digestion of source separated organic waste would be compatible with current collection practices, assuming food waste and other suitable organic feedstock would be co-mingled with yard waste and collected as part of the current collection network. Source-separated yard waste is already being delivered to Cedar Grove Composting (located next to the Cedar Hills Regional Landfill) or to a more distant facility in Everett.

h. **Compatibility with the current role of the solid waste division:** Anaerobic digestion of source separated organic waste would appear to be highly compatible with the Division's role.

i. **Compatible with existing private industry role and resources:** Yard waste is already separately collected and processed, while source separated food waste and other organic waste is currently handled by the County as mixed municipal waste. Developing an anaerobic digestion facility for source separated organic waste (inclusive of yard waste) could place the County in competition with segments of private industry that currently provide organic waste management services.

j. **Public education requirements:** Implementing anaerobic digestion of source separated organic waste would require changes to set-out practices. These changes would require public education to provide the expected level of participation and reduce the amount of contaminants included with the organic waste stream.

2. Complexity of system and facility operation

   a. **Potential facility downtime**: System downtime for planned and unplanned maintenance and repair could be expected. Due to the putrescible nature of the feedstock, the facility must consistently process incoming feedstock and cannot allow it to be stored for lengthy periods of time. Most large-scale anaerobic digestion facilities would be constructed with multiple digesters, and most digesters have some flexibility in throughput capacity to meet short-term fluctuations in feedstock quantity. Pre-processing systems would also have redundant features for key components. Further, since pre-processing would likely not run on a continuous basis, routine maintenance and repair could be performed on off-schedule hours. It is expected that biogas storage and flaring capability would be built into the design to provide a means to handle biogas if energy systems are experiencing malfunctions or undergoing maintenance or repair. Overall, there would appear to be flexibility to continue to manage the source separated organic waste even with downtime impacts. A small-scale modular system constructed at one of the County's transfer stations could quite easily divert incoming feedstock material to the transfer station during downtime periods.

   b. **Residue disposal:** Anaerobic digestion of source separated waste can be expected to produce residue consisting of contaminants that are mixed in with the organic material (e.g., food packing materials). Limiting residue requires strong educational outreach to provide for effective source-separation. Residue quantities can be estimated to range from 10% to 20% of the material received for processing. Assuming a large scale anaerobic digestion facility is located at the Cedar Hills Regional Landfill, residue could be disposed at the landfill with minimal logistical issues. A similar situation would exist for small-scale modular systems located a one or more of the County's transfer stations.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain any size anaerobic digestion facility seems like it could be integrated into the County's current labor agreements. However, as noted above, there are valid reasons to consider private operation.

3. Level of service to customers

   a. **Service offerings:** Adding anaerobic digestion of source separated organic waste would not significantly change the service offerings since the material is already being conveniently collected and received at the facilities. However, it could provide an opportunity to offer customers finished compost for beneficial use.

b. **Location of service delivery:** Customers that currently have curbside collection would be expected to continue to receive this service, but would be required to source-separate organic waste from other waste types prior to collection. It is expected that this organic waste could be co-mingled and collected with yard waste that is already being sorted by customers. Customers that self-haul waste may be required to deliver source-separated organic waste to the anaerobic digestion facility, if there is not a system in place to receive this material at the transfer stations.

c. **Hours of service offering:** This practice is not expected to change hours of service offerings.

d. **Time required by customers to utilize service:** Customers would be expected to spend additional time sorting their waste.

4. Operational risks

   a. **Proven performance of technology:** Anaerobic digestion of source separated organic waste is well-established overseas, particularly in Europe, generally at capacities of less than 50,000 tons per year. There are a small number of facilities in Europe that process closer to 100,000 tons per year. Many facilities have operated for five to ten years, with some that have operating histories approaching 20 years. There are recent developments in the United States and Canada for anaerobic digestion of source separated organic waste, but there is not yet an established operating history in the U.S. for this specific feedstock.

   b. **Market availability for materials/products**: Markets are expected to be available locally and regionally for energy products, but project-specific considerations would need to be assessed to determine the most cost-effective use of the biogas. The market for compost is uncertain.

   c. **Contract risks and risk sharing:** Given the low volumes and market value of the recovered material, it is not likely that the County would find much opportunity to share market price risk with the material purchasers.

   d. **Ability to respond to external emergencies:** An anaerobic digestion facility is not expected to have any measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding.

   e. **Ability to respond to internal system emergencies and outages:** An anaerobic digestion facility is not expected to have any measurable effect on the County's ability to respond to internal system emergencies and outages.

f. **Operating life:** An anaerobic digestion facility would have an estimated service life with good maintenance of at least 20 years, with planned overhaul and/or replacement of system components as required.

g. **Potential energy production:** An anaerobic digestion facility would produce fuel (biomethane) and/or electricity. The determination of which type of energy to produce would be dependent on project-specific considerations regarding potential net energy output and potential net energy revenue based on site, technology, and market considerations.

h. **Impacts from feedstock contamination:** The system would be adaptable to changes in the composition of the organic feedstock, but changes could impact biogas and energy production as well as compost and residue quality and production. Therefore, changes in feedstock composition could have an impact on project economics.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity:** An anaerobic digestion facility would have the ability to scale up, but would require planning during design and construction to ensure sufficient capacity exists or can be added for additional waste receiving, storage and handling, and to provide space for future expansion of digestion capacity and support systems.

b. **Adaptability to system changes and demands:** The facility would be designed and implemented to handle source separated organic waste, and would not likely be impacted by other system changes and demands (such as changes to recycling programs). An exception would be if the facility is located at the landfill and the landfill ceases operation, which would result in longer haul distance for residuals requiring disposal.

c. **Changes in feedstock quantity and composition:** The system would be adaptable to changes in the composition of the organic feedstock. However, changes in composition could impact biogas and energy production, as well as compost and residue quality and production. Therefore, changes in feedstock composition could have an impact on project economics.

d. **Impact on landfill life and operation:** Anaerobic digestion of source separated organic waste with beneficial use of the compost product would be expected to have a positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill. The removal of organic waste from the material being disposed would reduce the quantity of landfill gas produced.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

    a. **Equity of fees:** Assuming a facility is located at the Cedar Hills Regional Landfill and receives source separated organic waste generated County-wide, any impact on fees would be expected to be equitable for all participating jurisdictions.

    b. **Siting of facilities:** Assuming a facility is located at the Cedar Hills Regional Landfill, there would not appear to be any significant facility siting challenges involved. A small-scale system installed at one of the County's existing transfer stations would need to accommodate a site layout that would not interfere with existing transfer station operations.

2. Public and political understanding and acceptance

    a. **Effects on livability and character of communities:** Assuming a facility is located at the Cedar Hills Regional Landfill (or at another County facility for small-scale application), this practice could have a positive effect on the livability and character of the surrounding community, associated with improved handling of organic waste (e.g., improved odor management practices).

    b. **Job creation:** This practice would create 10-25 new positions for operation of a large-scale facility or 1.5 to 2 new positions for a small-scale modular facility, primarily consisting of lower-skilled tipping floor operators and general laborers, with a small number of more highly skilled staff.

    c. **Impacts on cities:** This practice would have a moderate impact on the cities, which would have to implement revised set-out practices for collection of source separated organic waste and conduct associated educational outreach.

    d. **Susceptibility to impacts from action of cities:** If the cities are not able to effectively implement and sustain modified collection of source separated organic waste, or are unable to engage customers to participate in the program to the level expected, the facility may not receive the expected quantity of organic waste for processing.

    e. **Public education requirements:** Implementing anaerobic digestion of source separated organic waste would require changes to set-out practices, including additional sorting and handling by customers. These changes would require public education to provide the expected level of participation and reduce the amount of contaminants included with the organic waste stream.

3. Impact on Employees

    a. **Health and safety**: Organic waste handling and biogas management may create some operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.

b. **Job security:** Adding anaerobic digestion of source separated organic waste could provide additional job security and opportunities for staff, if the facility is publicly operated.

c. **Job satisfaction:** For many of the lower skilled laborer positions, staff employed at an anaerobic digestion facility would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation.

Summary

This best practice would provide an alternative to the current organics management being used in King County, with the potential to divert additional organic materials and provide energy or fuel. There are economic risks associated with this practice related to the uncertainty of costs as well as uncertainty regarding the amount of energy that would be produced and the future value of that energy. Economics would be more favorable for small-scale application, such as at one of the County's existing transfer stations.

Recommendation

This practice is promising, but needs more in-depth study by the County before implementation.

Best Practice No. 8

Promote on-site processing of organics (e.g., composting, digesting, dehydration, other hybrid technology) at the generator using a rate structure and/or grants, matching grants, low interest loans and discounts.

Best Practice Description

This best practice would involve development of a County program to promote on-site processing of organics to reduce the need for material collection, transport, and off-site processing. The program would target the institutional, commercial, and industrial sector generators that produce organic material in sufficient quantity to effectively utilize available small scale processing technologies, such as composting, digesting, dehydration, or other hybrid technology. The processing technology specific to each location would be installed on-site and operated by the generator.

The type and size of a processing technology implemented at different facilities would be heavily dependent on the consistent quantity and quality of organics to be processed, and the generator's technical capacity.

Some available technologies could include the following.

Composting: There are numerous commercially-available, on-site composting technologies that have been implemented at transfer stations, universities, residence facilities (i.e., nursing homes, hospice, etc.), breweries, prisons, and other large generators of organic materials. On-site composting systems can be as simple as a "three-bin" composter to more sophisticated in-vessel units. On-site composting units can range from 100 pounds per day to well over multiple tons per day. The systems can target food waste and other organics. Equipment costs for individual units can range from $1,000 into the millions. Residual product could be used on-site or transported to off-site uses. On-site composting is well demonstrated and proven in the Unite States. These systems can handle a wide variety of organics.

Anaerobic Digestion: This system is expected to be a prefabricated, unitized type facility, much more technically complex than the other options, typically suitable for larger volume generators (grocery store distribution centers, universities, large food production facilities, etc.) because of the high capital cost. Food waste and organic material would typically be pre-processed and fed into a digester with outputs of both liquid and solid digestate and biogas. Solid digestate may require additional composting prior to application. Liquid digestate can be made into a liquid fertilizer product. Biogas can be cleaned up, and used for electricity or transportation fuel. System capacity can range from 1,000 tons per year to over 5,000 tons per year with costs from $1 million to $5 million or more. Footprint requirements can range from 2,000 square feet to over 15,000 square feet or more.

Biodigestion: These systems typically use proprietary equipment, and are typically installed near wastewater drainage (i.e., sewer) connection. Typical systems add water and other additives to break down the organics, both mechanically and biologically, and discharge the end slurry to the wastewater system. Systems can range between 200 pounds per day to over a ton per day. Systems are limited to food waste and have specific limitations on feedstock (size and composition). These systems are more appropriate for specific waste streams, and are limited in the range of organics they can process. Equipment costs for individual units are expected to be thousands to tens of thousands of dollars.

Dehydration: Mechanical dehydrators are proprietary equipment, similar to biodigestors, but rely on mechanical size reduction and heat to dry food waste. The system can pulp/separate and dry the organic material inputs, reducing both volume and weight. Systems can range between 100 pounds per day to over a ton per day. The systems target food waste and other organics, but generally are not suitable for yard waste type material. Equipment costs for individual units are expected to be thousands to tens of thousands of dollars. Experience is limited, but vendors report residual product may be used on-site. Recent research shows the byproduct of dehydrators could require additional processing to stabilize the material (digestion or composting).

Hybrid Technology: Utilizes a combination of the biodigestion and dehydration technologies to breakdown organic material into a pelletized byproduct with reduced volume and weight. System capacities are expected to be similar to biodigestion and dehydration technologies. The process utilizes indoor equipment, essentially an industrial type appliance. Equipment costs for individual units are expected to be thousands to tens of thousands of dollars. Residual product may be able to be used on-site, but could require additional composting.

Animal Feed Production: Separating organics for animal feed has occurred for many years, though typically with food production residuals. This technology typically includes a cleaning step followed by mixing, heating, and extrusion into a pelletized form. Not all food waste is suitable for animal feed, and there is limited experience with this technology applied to urban food streams. However, this may be an option for some generators.

Note that the systems above are based on manufacture performance claims and should be thoroughly vetted prior to making a commitment to a specific product. Additional costs include modifications to the on-site facility to accommodate processing systems and equipment. This may be as simple as dedicating available space to the process, or may be more extensive and include developing a localized area and provision of water, drainage, and power utilities. Some of these systems are complete systems (i.e., take a raw waste product and create a saleable product). Other systems are designed to be pieces of a larger system.

The County program could provide financial incentives to potential participants through rate structure and/or grants, matching grants, low interest loans, and discounts. The program could be tiered to provide grants sized to account for the scale of the on-site processing being incorporated, and may include low interest loans for larger, more technical systems. Most of these options require a substantial amount of technical assistance and education.

Though there are opportunities to reduce the need for collection and processing of organics generated by the single-family residential sector through on-site composting, Best Practice No.

8 is focused on larger generators that can provide a more significant, individual impact on the organic waste stream. Larger generators can also access a wider variety of on-site processing technologies and may be able to better justify the initial capital costs and administration expenses associated with such a program.

As an example scenario, if this program was implemented and ten new participants began on-site processing each year, by year five there would be 50 participants. Assuming that the average participant was able to process 200 pounds per day, or 36.5 tons per year, the resulting diversion would be approximately 1,825 tons per year. This value would increase as new participants are added each year or is a large facility developed a significantly sized compost or anaerobic digestion operation, but considering the limited number of available large organics generators, the quantity is still expected to be relatively small compared to the 808,000 tons per year disposal stream.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

    a. **Capital Costs**: Not applicable.

    b. **O&M Costs**: Not applicable.

    c. **System Costs**: Cost would be dependent on the how extensively an on-site processing incentive program was approached, and what amount of funding and technical assistance would be made available to participants. The amount of funding available (and the availability to avoid collection and disposal costs) will directly impact the success of this best practice at diverting material. There would also be administrative costs to manage the program. In addition, if in-system management of organic material, source separated and/or mixed with refuse, is a net revenue generator, there will be a loss of revenue to the system associated with the reduced volume of material.

    d. **System Revenue**: If in-system management of organic material is an expense to the system, requiring subsidized funding from other sources, there will be a gain of revenue to the system associated with the reduced volume of material.

2. Economic Risks:

    a. **Financial effect of listed operational risks**: Risks are primarily borne by the participating generators.

    b. **Sustainability of funding sources**: Sustainability will depend on where funding is derived. The amount of funding available will directly impact the success of this best practice at diverting material.

c. **Certainty of costs**: Available funding would be established by the County.

d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: NA

e. **Opportunities for regional risk sharing**: Grants, financing, and/or matching funds could additionally be provided from sources outside of the County.

B. Environmental

1. Impact on waste prevention, recycling and diversion

a. **Effect on prevention, recycling and diversion programs**: The impact on prevention, recycling, and diversion programs will depend on the scale of the generators participating in the program. Larger generators have the potential to make a significant impact on the collection and processing system if they implement a comprehensive program. Smaller generators are less likely to make a significant impact on collection and processing infrastructure. Initial diversion will not be significant in quantity, but if program participation is adopted more densely throughout the region, quantities could become substantial.

b. **Effect on landfill operations**: Impact would depend on current destination of organic material. If material is currently composted there will be no impact on landfill operations. If material is currently destined for the landfill, initial diverted quantities would be small. Even if program participation is adopted extensively throughout the region, landfill operational impact will likely not be significant.

2. Impact on resource consumption

a. **Land**: Minimal to none, assuming the adoption of on-site organics processing does not require additions of non-permeable structures for processing.

b. **Water**: Impacts on water consumption will depend on the type of on-site technology for organics processing, and the displacement of virgin-resource-content products and energy by products and energy produced through the on-site facilities. Some forms of on-site biodigestion that depend on slurrying organics via additions of water could result in increases in water consumption.

c. **Energy (amount and type)**: There will be a cumulative reduction on energy required for collection and transport. There is the potential for energy generation, if on-site processing is performed through anaerobic digestion. There is also potential for energy generation from biodigestion, provided that the capability is available at the downstream wastewater treatment. Upstream reductions in energy use for virgin-content products, such as synthetic fertilizers, are possible if such products are displaced by outputs produced through on-site organics processing.

d. **Material resources**: If organic material was previously landfilled, compost material now generated would be a new material resource, potentially reducing material resource use for production of synthetic fertilizers, pesticides and other lawn, garden and agriculture soil supplements. Impacts on energy production from previously landfilled organics would depend on effects on landfill biogas generation, landfill gas collection systems, landfill gas capture efficiency, and energy generated through on-site organics processing.

3. Impact on environmental resources

   a. **Human health**: Processing impact would be minimal, provided that the on-site processing facility meets regulatory standards typical for large scale, off-site organics processing facilities. In addition, for utilizations of compost type outputs the water, energy and resource conservation, and reduced virgin production benefits of compost utilization on soils and lawns would yield associated reductions in emissions to air, water and land pollutants that are harmful to human health. Similar benefits could accrue to energy outputs, depending on the type of energy displaced. For example, the climate impact benefits would range from minimal for displacement of renewable energy sources, such as solar and wind, to substantial, for displacement of coal-powered energy.

   b. **Ecosystems health**: Considerations for human health impacts described above would also apply to ecosystem impacts.

   c. **Air**: Processing impact would be minimal, provided that the on-site processing facilities meet regulatory standards typical for large-scale, off-site organics processing and management facilities. Vehicle emissions from collection and transport would be reduced, especially if the beneficial and material outputs are used on-site and the residual outputs are handled via collection systems that would have been used for the organic material in the absence of on-site processing. Upstream air emissions impacts would depend on the same considerations described above for human health.

   d. **Earth**: Processing impact would be minimal, provided the on-site processing facility meets regulatory standards typical for large scale, off-site organics processing and management. Upstream earth resource impacts would depend on the output energy and product from on-site processing, the displacement of virgin-content products and extraction of energy resources, and the net change in use for transport of on-site product and energy outputs compared with displaced use of transport methods for virgin-content product and energy resources.

   e. **Water**: Processing impact would be minimal, provided the use of water for on-site processing is no greater than water consumption for large-scale, off-site organics processing and management. Considerations listed above for upstream earth resource impacts would also apply for upstream water consumption impacts.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

    a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. Operational

1. Complexity of Implementing

    a. **Program changes**: The program would need to be developed, establishing the funding source and allocation criteria. Implementation would include outreach to perspective participants and vetting of proposed processing systems to determine which ones will be acceptable to the program.

    b. **Time required to implement**: Time required will be heavily dependent on the level of motivation towards development of the program and the level of resource allocation to implement.

    c. **Facility siting, design, permitting and construction challenges**: It's expected that the participants will demonstrate that these items are sufficiently addressed for as part of their funding application.

    d. **Contracting for services**: If the selection of processing system is program participant dependent, the County would not have a role in vender or operator contracting.

    e. **Compatibility with other elements of the system**: This program would be compatible.

    f. **Opportunities for regional partnerships**: Opportunities may exist and will need to be investigated as part of program development.

    g. **Compatibility with other regional approaches to solid waste management:** This practice would be participant site specific and not expected to greatly impact other regional approaches to solid waste management. However, there could be a regional impact related to the quantity of organic material that would no longer be available to large scale private sector compost facilities, potentially affecting financing and capacity.

    h. **Compatibility with the current role of the solid waste division**: This program would be compatible.

    i. **Compatible with existing private industry role and resources**: This program would be compatible and help develop the market for these evolving technologies.

    j. **Public Education Requirements:** A significant amount of outreach is expected to be necessary to educate potential participants on the program and encourage participation. Outreach could be general, but may be more effective if resources are utilized to target specific generators. Some general outreach would still be necessary to inform the public about the practice and its benefits.

2. Complexity of system and facility operation

    a. **Potential facility downtime**: Downtime will be system dependent. Since most systems are standalone, prefabricated equipment, downtime is not anticipated to be significant. The risk of downtime would increase with system complexity.

    b. **Residue disposal**: Disposal requirements will be system dependent and at the discretion of program participants.

    c. **Compatibility with labor agreements**: NA

3. Level of service to customers

    a. **Service offerings**: The program would be a new available service.

    b. **Location of service delivery**: Program administration is expected to be from current County offices.

    c. **Hours of service offering**: Normal business hours.

    d. **Time required by customers to utilize service**: Newly proposed processing systems and venders may take variable amounts of time to vet, depending on the technology, active history, and cost of system. As more systems and venders are vetted, the process time for new participant proposals will decrease.

4. Operational risks

    a. **Proven performance of technology**: Technology exists, but specific processes and vender products need to be thoroughly vetted. Some technologies discussed in this section are more proven and reliable than others. One challenge for this best practice is that it will be difficult to quantify diversion performance results.

    b. **Market availability for materials/products**: Materials/products are expected to be utilized by the program participants, themselves.

    c. **Contract risks and risk sharing**: Risk will be shared by program participants. Risk can be mitigated by thoroughly investigating potential participants and proposed technologies to better ensure program success.

    d. **Ability to respond to external emergencies**: Not applicable.

    e. **Ability to respond to internal system emergencies and outages**: Due to the volumes being limited to the program participant, any outages are expected to be handled by short term storage of material or temporary provision of an alternative disposal method.

f. **Operating life (durability of practice)**: Processing system and vender specific. Operating life of systems would need evaluation during the vetting process to ensure dedicated funds make economic sense.

g. **Potential energy production**: There is the potential for energy generation, if on-site processing is performed through anaerobic digestion. There is also potential for energy generation from biodigestion, provided that the capability is available at the downstream wastewater treatment plant.

h. **Impacts from feedstock contamination:** The impact of feedstock contamination will depend on the contamination and the technology being utilized. Specific systems discussed above have different sensitivities to feedstock composition. However, at this scale and considering that the feedstock will be owner/operator generated, feedstock composition is expected to be well controlled.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity**: Most technologies are unit based and can be operated in series if quantities are available and the site can support the additional equipment and space requirements.

b. **Adaptability to system changes and demands**: NA

c. **Changes in feedstock quantity and composition**: Technologies at this scale are generally limited to specific feedstock quantities and composition.

d. **Impact on landfill life and operation**: Minimal, but could be more substantial if, and as, on-site processing becomes more widespread.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

a. **Equity of fees**: There could be a feeling of inequality of County funds allocation by providing funds to program participants.

b. **Siting of facilities**: The small, dispersed nature of on-site processing at existing businesses is not expected to have significant siting issues.

2. Public and political understanding and acceptance

a. **Effects on livability and character of communities**: The small, dispersed nature of on-site processing through a community is not expected to have a large effect on community livability and character.

b. **Job creation**: Minimal. Only a significantly sized compost or anaerobic digestion facility would have the potential to add one or two jobs.

c. **Impacts on cities**: Not applicable.

d. **Susceptibility to impacts from action of cities**: Not applicable.

e. **Public education requirements:** A significant amount of outreach is expected to be necessary to educate potential participants on the program and encourage participation. Outreach could be general, but may be more effective if resources are utilized to target specific generators. Some general outreach would still be necessary to inform the public about the practice and its benefits.

3. Impact on Employees

   a. **Health and safety**: Provided the proper training is administered, heath and safety should not be an issue.

   b. **Job security**: Not applicable.

   c. **Job satisfaction**: Increasing sustainability may improve job satisfaction.

Summary

This best practice has some environmental benefits at a small scale considering the size of the County's waste stream. The benefits would not warrant the financial impact of direct funding of program participation, which would result in this best practice not being recommended. However, if the County's role is to support and facilitate, a role that only commits administrative resources to assist participants in obtaining grants and loans from other sources, the recommendation is to implement.

Recommendation

Implement in the near term.

Best Practice No. 9

Ban disposal of organics, in mixed waste, at transfer stations where recycling options exist.

Best Practice Description

This best practice would be specific to residential and commercial self-haulers utilizing County recycling and transfer stations. A ban would be imposed such that any self-hauler would have to divert organic materials to available organics material recycling locations, including yard waste or clean wood drop off areas. Mixed loads would have to be sorted by the hauler to offload organic material in a designated location prior to being allowed to dispose of the remaining material as waste to be landfilled.

According to the 2011 King County Waste Characterization and Customer Survey Report, self-hauled organic material disposed at the ten County facilities includes 96,585 tons of organic material (yard waste, wood, paper, food, and other organics) annually. Much of this material will be contaminated, dispersed through a mixed load such that identification and separation may not be realistic, or may be incompatible with the downstream processing (i.e. fabrics, rubber, diapers, etc.). The disposal ban should be limited to yard waste, clean wood, and paper type materials that would be reasonable to divert. These materials account for approximately 62,100 tons of material annually.

The total quantity potentially available is further reduced by the fact that some County facilities don't currently have organics recycling infrastructure. The primary facilities with available wood and yard waste recycling include Bow Lake, Shoreline, Enumclaw, and Factoria (once construction is complete). These facilities receive approximately 54% of the County's transferred waste. Assuming this percentage can be applied directly to the organic material discussed, above, approximately 33,500 tons of organic material is potentially available for diversion.

Consideration should also be made for the mixed nature of self-haul loads and the challenge of enforcing such a ban. A capture rate should be applied to the total available quantity to estimate a realistic volume that might be captured by such a program. For discussion purposes, a 20% to 40% capture rate would result in approximately 6,700 tons to 13,400 tons of diverted organic material per year from these four facilities.

Implementation of an organics disposal ban would need to go through the County administrative approval process. There would be a number of administrative activities to establish the ban and educate the public and train facilities operations staff. Some changes to facilities could include additional signage and localized organic material bins for user convenience, and possibly considerations for impacts to previous traffic patterns, whether vehicular or pedestrian.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs**: Some costs associated with signage and additional organics bins.

   b. **O&M Costs**: Some costs may be associated with inspecting loads and enforcing the ban. This may be able to be added to the duties of existing staff without recognized cost. Management of remote organics bins, potentially on the tipping floors, may also incur cost.

   c. **System Costs**: There would be administrative costs to initially establish the ban and train staff. If organic material is an expense to the system, requiring subsidized funding from other sources, there will be a loss of revenue to the system associated with the transfer of material from the disposal stream.

   d. **System Revenue**: If organic material is a net revenue generator exceeding disposal revenues, there will be a gain of revenue to the system associated with the increased volume of diverted organic material.

2. Economic Risks:

   a. **Financial effect of listed operational risks**: Minimal since the material will be managed in accordance with current County practices.

   b. **Sustainability of funding sources**: Expected to be the same funding source as the County's existing system.

   c. **Certainty of costs**: Unit costs would match the County's existing system costs.

   d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Unit revenues would match the County's existing system revenues.

   e. **Opportunities for regional risk sharing**: No more opportunities than currently exist.

B. Environmental

1. Impact on waste prevention, recycling and diversion

   a. **Effect on prevention, recycling and diversion programs**: The assumed capture quantity of 6,700 tons to 13,400 tons per year may not be large in consideration of the County's entire disposal stream; however it is progress towards the desired goal. Progress that doesn't require a large investment at existing stations with available recycling. The quantity will increase as recycling becomes available at more locations and as customers start to plan their loads to account for the ban.

b. **Effect on landfill operations**: Diverted quantities are not expected to have a significant impact on landfill operations.

2. Impact on resource consumption

a. **Land**: It is assumed that the current facilities have adequate existing space to process the limited amount of estimated material. Assuming land footprint of any composting facility accepting the banned organic material does not need to be expanded to accommodate this additional input organics, no additional land will be consumed.

b. **Water**: There may be reduced upstream water consumption if the composted organics are marketed to purchasers who then reduce their purchase and use of synthetic fertilizers, pesticides and/or other synthetic soil and/or lawn supplements. The use of compost may also reduce irrigation requirements by the compost product purchasers.

c. **Energy (amount and type)**: Compost products may provide upstream virgin energy resource conservation, synthetic soil and lawn amendment production reductions, pesticide reductions and irrigation water reductions that accrue energy conservation benefits for the organics ban on self-hauled loads arriving at County transfer facilities. There may be initial losses in energy generated from captured landfill gas due to the loss of methane generation potential from the diverted organics; however, diverted material quantities will be made up for throughout the life of the landfill.

d. **Material resources**: Previously landfilled organic material would now become a new compost resource, potentially reducing material resource use for production of synthetic fertilizers, pesticides and other lawn, garden and agriculture soil supplements.

3. Impact on environmental resources

a. **Human health**: Water, energy and resource conservation, and reduced virgin production benefits of compost utilization on soils and lawns would yield associated reductions in emissions to air, water and land of pollutants that are harmful to human health. These reductions would typically outweigh, by an order of magnitude, increases in emissions due to hauling organic materials to compost sites and shipping compost products to markets.

b. **Ecosystems health**: The water, energy and resource conservation, and reduced virgin production, benefits of compost utilization on soils and lawns would yield associated reductions in emissions to air, water and land of pollutants that are harmful to ecosystem health. These reductions would typically outweigh, by an order of magnitude, increases in emissions due to hauling organic materials to compost sites and shipping compost products to markets.

c. **Air**: Air emissions associated with virgin energy and material resources used in synthetic soil supplements and pesticides manufacturing are reduced and displaced by compost products.

d. **Earth**: Composting of banned organics would have a beneficial effect on earth resources to the extent that compost products are substituted for fertilizers, pesticides and other synthetic soil, lawn and garden supplements.

e. **Water**: Composting of banned organic waste would have some effect on water use due to water usage for the composting process. This direct water use likely would be offset by reductions in water usage for extraction and refining of virgin energy and material resources that could be displaced by compost products, as well as by reduced irrigation water demand for soils and lawn amended with compost.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

   a. This best practice is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

   a. **Program changes**: Some initial complexity to educate customers and train staff.

   b. **Time required to implement**: The primary time constraint will be to initiate the ban.

   c. **Facility siting, design, permitting and construction challenges**: Since the ban is only at transfer facilities with available recycling of organic material, significant modifications to facilities are not expected.

   d. **Contracting for services**: Not applicable.

   e. **Compatibility with other elements of the system**: This best practice would be highly compatible.

   f. **Opportunities for regional partnerships**: No more opportunities than currently exist.

   g. **Compatibility with other regional approaches to solid waste management:** This practice would be highly compatible with other regional approaches.

   h. **Compatibility with the current role of the solid waste division**: This practice would be highly compatible.

   i. **Compatible with existing private industry role and resources**: This best practice would be highly compatible.

j. **Public education requirements:** Self-haulers will need to be educated about the new ban and modified procedures for separation of loads at the transfer facilities. Some education could also be provided to self-haulers on how best to prepare a mixed load. There should be some general outreach to inform the public about the practice and its benefits.

2. Complexity of system and facility operation

   a. **Potential facility downtime**: Not applicable.

   b. **Residue disposal**: Not applicable.

   c. **Compatibility with labor agreements**: This best practice would be highly compatible.

3. Level of service to customers

   a. **Service offerings**: Consistent with current offerings.

   b. **Location of service delivery**: Consistent with current locations.

   c. **Hours of service offering**: Consistent with current hours of service.

   d. **Time required by customers to utilize service**: Time will be increased for those customers with mixed loads not already planning on utilizing two offload areas.

4. Operational risks

   a. **Proven performance of technology**: Technology consistent with current County system.

   b. **Market availability for materials/products**: Market consistent with current County system.

   c. **Contract risks and risk sharing**: Risk sharing consistent with current County system.

   d. **Ability to respond to external emergencies**: Not applicable.

   e. **Ability to respond to internal system emergencies and outages**: Consistent with current County system.

   f. **Operating life (durability of practice)**: Not applicable.

   g. **Potential energy production**: Not applicable.

   h. **Impacts from feedstock contamination:** This practice should generate a feedstock resembling a source separated organics feedstock, and should not greatly contribute to additional contamination of material provided for compost processing.

5. Flexibility and adaptability

    a. **Ability to scale up and add or reduce capacity**: Operational efforts will be related to volumes generated.

    b. **Adaptability to system changes and demands**: Highly adaptable.

    c. **Changes in feedstock quantity and composition**: Highly adaptable.

    d. **Impact on landfill life and operation**: Minimal.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

    a. **Equity of fees**: Not applicable.

    b. **Siting of facilities**: Not applicable.

2. Public and political understanding and acceptance

    a. **Effects on livability and character of communities**: Not applicable.

    b. **Job creation**: Not anticipated.

    c. **Impacts on cities**: Not applicable.

    d. **Susceptibility to impacts from action of cities**: Not applicable.

    e. **Public education requirements:** Self-haulers will need to be educated about the new ban and modified procedures for separation of loads at the transfer facilities. Some education could also be provided to self-haulers on how best to prepare a mixed load. There should be some general outreach to inform the public about the practice and its benefits.

3. Impact on Employees

    a. **Health and safety**: Not applicable.

    b. **Job security**: Not applicable.

    c. **Job satisfaction**: Increasing sustainability may improve job satisfaction; however, job satisfaction may decrease as a result of new responsibilities that require potentially negative interactions with customers when inspecting/rejecting loads.

Summary

This best practice would have positive impacts on diversion and the environment with no significant negative impacts.

Recommendation

Implement in the near term.

Best Practice No. 10

Implement recycling (using mixed waste processing) and anaerobic digestion of the organic fraction of mixed waste, with beneficial use of the biogas and composting/marketing of the digestate.

Best Practice Description

This best practice is similar to Best Practice No. 7, in which organic waste is processed using anaerobic digestion. However, it does not require source-separation of the organic fraction of the waste. Instead, Best Practice No. 10 processes mixed waste (commonly referred to as trash) to recover recyclable materials for sale and to separate organic materials for use as feedstock in an anaerobic digestion process.

The mixed waste processing system (sometimes referred to as a “Dirty MRF”, or more recently as an advanced MRF – AMRF, or mixed waste MRF – MWMRF) and the anaerobic digestion system could be located together at one site as an integrated facility, or the systems could be separate facilities at different locations. A mixed waste processing system would primarily recover recyclable fibers (paper, newspaper and cardboard) and containers (plastic, metal and glass) that were not source-separated, and could also recover other materials subject to technical and economic feasibility. Materials not recovered as recyclables and not separated as an organic feedstock would be residue requiring landfill disposal.

An anaerobic digestion system would be paired with the recycling system to process the organic feedstock separated during mixed waste processing. As previously described for Best Practice No. 7, anaerobic digestion would generate biogas and digestate. The biogas could be upgraded to pipeline-quality gas (biomethane) or other types of fuel such as compressed natural gas (CNG), or it could be used to generate electricity. The digestate would be composted and marketed as a fertilizer or soil amendment. From a collection perspective, no changes would be required. The County and the municipalities could continue to use the collection and transfer systems that are currently in place. A more detailed description of anaerobic digestion, including identification of key system components, is provided in the description for Best Practice No. 7.

Mixed waste processing facilities consist of a highly integrated system that combines robust mechanical processing with manual labor. Often there is a manual pre-sort to remove oversized materials, followed by mechanical operations to open bags, reduce material size, and meter materials into the sorting process. The sorting process separates materials by size, density and type, using manual sorting labor as well as conveyors, screens, magnets, optical sorting, and other specialized equipment. The sorting process also includes manual labor and mechanical processing to clean and consolidated recovered recyclables to prepare them for sale to markets (e.g., glass clean-up systems, balers, manual quality control). Mixed waste processing facilities that are designed to separate an organic fraction for subsequent processing will typically include additional mechanical screening and sorting, such as incorporation of a de-stoner to remove inerts and produce an organic fraction with fewer contaminants.

Mixed waste processing systems typically range in size from small systems that process 20 tons per hour to large systems that process over 75 tons per hour. As a point of reference for facility size, the low end of system size would handle approximately 75,000 tons per year of mixed waste when operating two, eight-hour shifts per day, five days per week and 90% plant availability (10% downtime for maintenance and/or repairs). Under the same operating conditions, the large systems would handle approximately 280,000 tons per year of mixed waste. Assuming average recovery of about 30% by weight of the mixed waste as an organic fraction, the capacity of the downstream anaerobic digestion process would range from about 23,000 tons per year to 84,000 tons per year, which is within a reasonable capacity range for anaerobic digestion. For King County, Best Practice No. 10 would likely consist of a large mixed waste processing system paired with a large anaerobic digestion system, handling approximately 280,000 tons per year of mixed waste (about 35% of the waste currently disposed at the Cedar Hills Regional Landfill) with about 80,000 tons per year of organic material recovered from the mixed waste for anaerobic digestion. Although the total quantity of mixed waste currently disposed at the Cedar Hills Regional Landfill is more than 800,000 tons per year, facility size is assumed to be limited to the reasonable and demonstrated capacity for both mixed waste processing and anaerobic digestion.

The building footprint for a large mixed waste processing facility is dependent on technology-specific design aspects as well as the amount of floor space reserved for temporary storage of incoming material and processed material, and could be expected to range from 100,000 square feet to 150,000 square feet or larger. The building footprint for a large anaerobic digestion facility could be highly variable due to technology-specific design aspects, and could be expected to range from 50,000 square feet to 200,000 square feet. Site size would be dictated by building size and layout requirements for other equipment and structures (e.g., digestion tanks), roadways and requirements for large truck queuing and movements, digestate management activities (composting, curing and storage), recyclable storage and load-out activities, storm water management, and landscaping and green buffer zones. A 280,000 ton per year mixed waste processing facility paired with an 80,000 ton per year anaerobic digestion facility could be expected to require 15 to 30 acres or more.

Operation and maintenance requirements for a mixed waste processing facility paired with an anaerobic digestion facility would include labor, utilities, chemicals and other consumables, routine equipment maintenance and repair, capital repair and replacement, and other costs (including disposal of residue). Staffing needs for a large facility operating two shifts, five days per week, could be expected to range from 75 to 100 or more staff for mixed waste processing operations, and 10 to 25 staff for anaerobic digestion operations.

Best Practice No. 10 is a large-scale undertaking and would not be implemented at any of the County’s existing transfer station sites. It might be possible to implement this practice at the Cedar Hills Regional Landfill if sufficient space is available.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** A large mixed waste processing facility of the size and type described above could be expected to have a total capital cost ranging from $30 million to $40 million. A large anaerobic digestion system could be expected to have a total capital cost ranging from $30 million to $60 million. Integration of the two systems into a common facility could result in cost savings due to shared resources (e.g., site roadways, utilities, office space, scale, and possibly other elements).

   b. **O&M Costs:** A large mixed waste processing facility of the size and type described above could be expected to have operating and maintenance costs ranging from $30 to $45 per ton of mixed waste received for processing. A large anaerobic digestion system could be expected to have operating and maintenance costs ranging from $35 to $75 per ton of organic waste processed, which is approximately $10 to $25 per ton of mixed waste received for processing (assuming about 30% of the mixed waste is recovered as an organic fraction and digested). In combination, overall O&M costs could range from $40 to $70 per ton of mixed waste received for processing.

   c. **System Revenue:** A facility of the size and type described above could be expected to have revenue ranging from $18 to $36 per ton of mixed waste received for processing, generated from the sale of recyclables and from the sale of fuel or electricity produced from the biogas. In addition to system revenues, there would be an avoided disposal cost, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost. Also, King County estimates that landfill air space at the Cedar Hills Regional Landfill is valued at approximately $7.00 per ton. Recyclables recovered from mixed waste processing would include fiber, plastic, glass, aluminum and ferrous metal. Recovery rates would be expected to vary by material type, generally ranging from 70% recovery for fibers to 95% recovery for aluminum and ferrous cans. Based on the quantity of recyclables in the waste stream as tabulated in the County's Waste Characterization and Customer Survey Report (October 2012), the estimated amount of recyclables that could be recovered is about 20% of the mixed waste received for processing. The value of these recyclables may vary significantly, subject to market values for individual materials and the mix of materials recovered, and could be expected to have an average value ranging from about $80 per ton to $160 per ton at any point in time. Therefore, recycling revenues could range from approximately $16 to $32 per ton of mixed waste received for processing. The amount of energy that could be produced from anaerobic digestion is highly dependent on the characteristics of the feedstock as well as the type of technology used. If producing biomethane, output could be expected to range from 1,200 to 2,400 cubic feet per ton of organic waste. If producing electricity, net output could be expected to range from 100 to 250 kilowatt hours (kWh) per ton of organic waste. Assuming a biomethane sale price of $5 per thousand cubic feet or a power sale price of $0.055 per kWh, energy revenues from the anaerobic digestion process could range from $5 to $14 per ton of organic waste processed (about $2 to $4 per ton of mixed waste processed). Project-specific circumstances would need to be considered to optimize net revenue from energy sales, including determination of whether the product should be fuel or electricity. Additional revenue may be generated from the sale of compost, but for feasibility purposes compost is often considered to be neutral as a revenue stream. Compost generated from mixed waste can be a lower-value product than compost generated from source-separated organics, and may carry a cost associated with transportation or, in some cases, for disposal if a market doesn't exist.

2. Economic Risks:

    a. **Financial effect of listed operational risks:** Based on very approximate estimated revenue, avoided disposal cost, the value of landfill air space, O&M costs, and the cost of capital, a large mixed waste processing system paired with a large anaerobic digestion system might not be able to reach a financial break-even point, except perhaps under the most favorable cost and revenue conditions (i.e., low capital and O&M costs, and high revenue associated with high product recovery and value).

    b. **Sustainability of funding sources:** Costs associated with the facility would be offset to some extent by revenues associated with sale of recyclables, energy, and possibly compost, which are subject to variability as discussed below. Otherwise, as for other system components such as landfill disposal, the cost of the facility would need to be covered by the established rate structure imposed on system users, amended as necessary.

    c. **Certainty of costs:** Capital and O&M costs can be expected to be fairly well defined for mixed waste processing. However, there is limited and only recent development of large-scale anaerobic digestion facilities processing the organic fraction recovered from mixed waste. Such systems are generally comprised of numerous components that must be uniquely designed for project- and site-specific application, with highly variable capital and O&M costs across the diverse range of technology available. Therefore, costs for a large anaerobic digestion project can be expected to be subject to a high level of uncertainty.

    d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Revenues for recyclables are subject to market fluctuations, which can vary widely over time. In addition, revenues for recyclables are subject to the quantity of recyclables in the mixed waste and the quality of the material recovered, both of which are subject to uncertainty. Energy revenues generated from the sale of biomethane or electricity are subject to uncertainty associated with the amount of energy that would be produced for sale.

Industry values are variable and highly dependent on the characteristics of the feedstock. Energy revenues are also subject to market uncertainties. There is expected to be a stable market for the energy products, but as discussed for Best Practice No. 7 market prices are uncertain and subject to forecasting and the ability to enter into a long-term purchase agreement with favorable terms and conditions. The market for compost is uncertain, particularly since the compost is generated from an organic stream recovered from mixed waste and it could contain, or be perceived as containing, increased contaminants. It is possible that compost could be a cost to the project (i.e., for transportation and possibly disposal) rather than a revenue stream.

e. **Opportunities for regional risk sharing:** Mixed waste processing paired with anaerobic digestion would not appear to offer a significant opportunity for a regional sharing of the risks or benefits. Since it is not expected that a facility would have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships for purpose of risk sharing would take away from capacity that could be used by the County. However, despite this capacity limitation, it is possible that the facility could be designed to receive some amount of source-separated organic waste from outside partners as feedstock to the digestion process, since this supplemental feedstock could beneficially enhance the production of biogas and energy.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Assuming the development of a large mixed waste processing facility paired with a large anaerobic digestion facility, it could be expected that up to approximately 136,000 tons per year of material could be diverted from landfill disposal. This is about 17% of the waste currently disposed at the Cedar Hills Regional Landfill. If the compost cannot be beneficially used and requires landfill disposal, the diversion potential would be reduced.

b. **Effect on landfill operations:** Implementation of mixed waste processing with anaerobic digestion would reduce the total tons of materials needing to be landfilled and would extend the life of the landfill. It would also reduce the amount of landfill gas produced.

2. Impact on resource consumption

a. **Land:** A large mixed waste processing facility paired with a large anaerobic digestion facility would require an estimated 15 to 30 acres or more for process operations.

b. **Water:** Except for cleaning and sanitary uses, mixed waste processing would have minimal water requirements. Water requirements for anaerobic digestion vary based on the type of digestion process used (i.e., wet or dry). Some technologies have at least an initial water requirement, with closed-loop systems for sustaining operations and with the use of water recovered from the moisture content of the feedstock. Most facilities will require water for housekeeping and perhaps for system operations such as humidifying a biofilter for odor control. There may also be water requirements for cooling and for heat energy production, depending on the use of generated biogas. Depending on the type of energy that might be displaced by energy or fuel generated from biogas, there may be some upstream water conservation due to reduced energy resource exploration, refining and combustion. There may also be reduced water consumption if the digestate is processed so as to be marketable to buyers who then reduce their purchase and use of synthetic fertilizers, pesticides and other synthetic soil and/or lawn supplements. The use of composted digestate may also reduce irrigation requirements by the compost product purchasers.

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are required to support operation of mixed waste processing and anaerobic digestion, including for operation of pumps, motors, conveyors, sorting equipment, pre-processing equipment, air pollution control equipment, and on-site mobile equipment. If the facility is located at the Cedar Hills Landfill, transportation energy would be nearly neutral, since the facility would receive and process material already being delivered to the landfill. However, transportation energy would be used to deliver recyclables and compost to markets. The recovered recyclables, energy products, and composted digestate products may provide upstream virgin energy resource conservation, synthetic soil and lawn amendment production reductions, pesticide reductions and irrigation water reductions that accrue energy conservation benefits to the mixed waste processing and anaerobic digestion systems.

d. **Material resources:** The recovery of recyclables (glass, plastic, metals, and fiber) would have a positive effect on the consumption of material resources. The anaerobic digestion process would have very little effect on the consumption of material resources. However, the upstream displacements of synthetic soil and lawn amendments and pesticides by composted digestate could result in conservation of virgin material resources.

3. Impact on environmental resources

a. **Human health:** Mixed waste processing combined with anaerobic digestion would have very little effect on human health assuming the use of dust and odor control measures for mixed waste handling and sorting, and suitable control measures for air emissions associated with biogas use. There could be an increase in transportation air emissions associated with delivering recyclables and compost to markets. However, these transportation emissions can be expected to be small in comparison to the water, energy and resource conservation and reduced virgin production benefits of recyclable recovery and reuse and compost utilization on soils and lawns. Reduced virgin production provides significant reductions in air emissions that typically accompany virgin energy and material resource extraction, refining and virgin-content product manufacturing.

b. **Ecosystems health:** Mixed waste processing combined with anaerobic digestion would have very little effect on ecosystems health. However, as with human health, the upstream benefits of recyclables recovery, energy product, and compost product usage could have substantial ecosystems benefits. The upstream benefits of energy products would be a function of the type of energy resource displaced. For example, displacing coal energy resources typically would have greater ecosystem and human health benefits than displacing solar energy.

c. **Air:** Mixed waste processing combined with anaerobic digestion could have air emissions associated with mixed waste handling, downstream organics handling, and biogas use, but it is expected that measures would be used to control these emissions to meet State and local requirements. Potentially harmful emissions to air, water and land from virgin energy and material resource extraction, refining and virgin-content product manufacturing could be significantly reduced if these virgin energy and material resources are displaced by recovered recyclables, energy from biogas, and composted digestate.

d. **Earth:** Mixed waste processing combined with anaerobic digestion would have a small but positive effect on earth resources, associated with the displacement of virgin materials and the beneficial use of compost as a fertilizer or soil amendment.

e. **Water:** Mixed waste processing combined with anaerobic digestion would have very little effect on water resources, other than reduction in water usage for displaced virgin energy and material resources, and reduced irrigation water demand for soils and lawn amended with composted digestate.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

a. Mixed waste processing combined with anaerobic digestion is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** Mixed waste processing combined with anaerobic digestion of the recovered organic fraction is entirely consistent with current collection and transportation practices of the County and the participating jurisdictions, particularly if the facility is located at the Cedar Hills Regional Landfill. If the facility is at another location, it would require some re-routing of transfer vehicles coming from the transfer stations. Additional program changes would be required if the facility is operated by the County, including increasing staff levels and special staff training.

b. **Time required to implement:** Implementation could take 36-48 months or longer, most likely at the higher end of the range. If the facility is located at a new site rather than at the Cedar Hills Regional Landfill, implementation could take an additional 12-18 months. Based on the complexity and certain proprietary elements of a combined mixed waste processing and anaerobic digestion facility, it is assumed that the facility would be developed under an alternative project delivery method (e.g., design-build-operate), which would shift responsibility and risk to the private sector. Implementation would include procurement (soliciting and receiving proposals from system vendors and project developers, negotiating a contract), design and permitting, construction, and commissioning and start-up.

c. **Facility siting, design, permitting and construction challenges:** Assuming the facility is sited at the Cedar Hills Regional Landfill, a primary challenge would be finding sufficient room to place the facility on the site (i.e., site planning). If located at a new site, the primary challenge would be finding a site that is acceptable to the local community, meets all land use and zoning requirements, and does not have any unmitigatable environmental impacts.

d. **Contracting for services:** Contracting the operation with a private operator would be beneficial, due to the complexity of design and operation as well as certain proprietary aspects of mixed waste processing and anaerobic digestion. In addition, large-scale anaerobic digestion is at an early development status in the United States, particularly for feedstock extracted from mixed waste. Contracting with a private operator would shift operating risk to the private entity. However, private operation could be challenged by the County's unionized labor force.

e. **Compatibility with other elements of the system:** Adding mixed waste processing combined with anaerobic digestion seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal.

f. **Opportunities for regional partnerships**: Mixed waste processing combined with anaerobic digestion does not appear to offer significant opportunity for regional partnerships. Since it is not expected that a facility would have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships would take away from capacity that could be used by the County. However, despite this capacity limitation, it is possible that the facility could be designed to receive some amount of source-separated organic waste from outside partners as feedstock to the digestion process, since this supplemental feedstock could beneficially enhance the production of biogas and energy.

g. **Compatibility with other regional approaches to solid waste management:** Mixed waste processing combined with anaerobic digestion is highly compatible with other regional approaches, since it manages waste currently disposed of at the landfill. This practice would not require any changes to recyclable or waste handling at the either the municipal or customer level, and would not be expected to have any impact on existing transfer station operation.

h. **Compatibility with the current role of the solid waste division:** Mixed waste processing combined with anaerobic digestion would appear to be highly compatible with the Division's role.

i. **Compatible with existing private industry role and resources:** Developing a mixed waste processing facility combined with anaerobic digestion would not appear to place the County in competition with private industry. The facility would be handling waste currently managed by the County and disposed at the County's Cedar Hills Regional Landfill. Also, it could be expected that the County would contract with private industry for design, construction and operation of the facility, which is expected to be of interest to private industry.

j. **Public Education Requirements:** Developing a mixed waste processing facility combined with anaerobic digestion would not require any changes to recyclable or waste handling at either the municipal or customer level. Therefore, this practice would not require any significant public education efforts. However, it would be appropriate to conduct outreach and education similar to current practices, for purposes of informing the public about the practice and its benefits. A focus of such outreach may be to ensure that public participants continue to practice source-separation of recyclables, since source-separation can result in higher end values for the recyclables.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** System downtime for planned and unplanned maintenance and repair could be expected. The effects of downtime could be mitigated with redundant design features (e.g., two smaller mixed waste processing lines rather than one larger processing line, and use of multiple digestion vessels). Also, it is expected that waste handling operations would operate two, eight-hour shifts per day, five days per week. Since waste handling would not operate on a 24/7 basis, it would allow for routine maintenance and repair during off-hours and would provide for mitigation of unplanned downtime impacts with operation on a third shift or extra day. For digestion operations, it is expected that biogas storage and flaring capability would be built into the design to provide a means to handle biogas if energy systems are experiencing malfunctions or undergoing maintenance or repair.

   b. **Residue disposal:** The mixed waste processing operation would remove recyclables by a positive sort, and would separate an organic stream that would be feedstock for anaerobic digestion. The remaining material would be residue requiring loading and transport to the final disposal site. Locating the facility at the Cedar Hills Regional Landfill would have the advantage of a short haul to the landfill face while that facility remains in operation.

c. **Compatibility with labor agreements**: The nature of the work required to operate and maintain a mixed waste processing facility combined with anaerobic digestion seems like it could be integrated into the County's current labor agreements if the facility is operated by the County. However, as noted above, private operation of the facility would be beneficial.

3. Level of service to customers

   a. **Service offerings:** Adding mixed waste processing with anaerobic digestion would not impact the service offerings since the material is already being collected and received at the facilities. However, it could provide an opportunity to offer customers finished compost for beneficial use.

   b. **Location of service delivery:** This practice would not require a change to current curbside collection services or to practices associated with self-haul waste.

   c. **Hours of service offering:** This practice would not require any changes to hours of service for curbside collection or self-haul practices.

   d. **Time required by customers to utilize service:** This practice would have no impact on the time required by customers to handle their waste, since it would have no impact on curbside collection or self-haul practices.

4. Operational risks

   a. **Proven performance of technology:** Mixed waste processing facilities have been in use since the 1980s in the United States but are not in widespread operation across the country. Use is most prevalent where there are legislated mandates for high waste diversion, such as in California. Renewed interest and development over the past decade has occurred, due to evolution and improvements in mechanical sorting equipment and increased interest in landfill diversion. Anaerobic digestion is well-established overseas, generally at capacities of less than 50,000 tons per year but with some facilities processing closer to 100,000 tons per year. The technology is best demonstrated for source-separated organic feedstock, but is also in use for the organic fraction of mixed waste. There are recent developments in the United States for anaerobic digestion of the organic fraction of mixed waste (e.g., San Jose, CA), but there is not yet an established operating history in the U.S. for this specific feedstock.

   b. **Market availability for materials/products**: There are well established local and regional markets for recyclables that would be recovered from mixed waste processing operations. However, these materials may have reduced end-use value as compared to source-separated recyclables due to the increased possibility of contaminants or end-user perception of higher contaminants. Markets are expected to be available locally and regionally for energy produced from the biogas, but project-specific considerations would need to be assessed to determine the most cost-effective use of the biogas. The market for compost generated from mixed waste is uncertain, as the compost may be a lower-value material than compost generated from source-separated organics (e.g., with increased possibility of plastic flakes and other contaminants in the compost).

c. **Contract risks and risk sharing:** Assuming the facility is privately operated, there would be opportunity for shifting operating risk to the private sector, with contractual opportunities for revenue sharing tied to operational performance

d. **Ability to respond to external emergencies:** The facility is not expected to have any measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding, since it would be designed to manage mixed municipal waste and not C&D material that could be generated as a result of an emergency event. To the extent an emergency event generated increased amounts of municipal waste, the facility could be operated for extended hours (e.g., for a third shift) to recover recyclables that would otherwise be disposed.

e. **Ability to respond to internal system emergencies and outages:** Since the facility would receive mixed waste for processing, it would be able to receive waste hauled directly from a collection route, should there be an outage at a transfer station. The equipment designed for mixed waste processing would be similar to the equipment and activities used in single stream recycling, and could be used to process single stream materials if needed. Similarly, the anaerobic digestion system could be used to process source separated organics if needed. In both cases, the additional processing capability (i.e., for single stream materials or source separated organics) would be subject to system capacity limits for receiving, storing and processing materials.

f. **Operating life:** The facility would have an estimated service life with good maintenance of at least 20 years, with planned overhaul and/or replacement of system components as required.

g. **Potential energy production:** The anaerobic digestion system would produce fuel (biomethane) and/or electricity. The determination of which type of energy to produce would be dependent on project-specific considerations regarding potential net energy output and potential net energy revenue based on site, technology, and market considerations.

h. **Impacts from feedstock contamination:** The mixed waste processing system is inherently designed to receive and process mixed waste, inclusive of contaminants that are not recyclables or organics. However, the nature of the feedstock can have a negative impact on the value of the recyclables recovered and the value of the compost produced, associated with contamination that carries through to the products.

5. Flexibility and adaptability

    a. **Ability to scale up and add or reduce capacity:** Assuming the mixed waste processing system would be designed to operate two, eight-hour shifts per day, five days per week, there would be opportunity to increase operating capacity by operating longer shifts (or a third shift), or by adding an operating day. However, unless planned for, there could be upfront feedstock receiving and storage limitations that constrain increased operating capacity. The anaerobic digestion facility would have the ability to scale up capacity with the addition of more digesters, but would require planning during design and construction to ensure sufficient space is available and to provide for sufficiently-sized support systems (e.g., biogas storage and handling). Capacity could be reduced by a corresponding reduction in operating hours, but would likely have a negative impact on financial performance.

    b. **Adaptability to system changes and demands:** The facility's ability to adapt to system changes and demands would be dependent on the change. For example, if the facility is located at the Cedar Hills Regional Landfill and the landfill closes, there would be increased cost to transport residue to an alternate landfill for disposal. If system changes result in increased source-separation of recyclables and/or organic materials with management of those materials through alternate means, the facility would be less cost-effective as it would recover fewer recyclables and generate less energy. However, if the County's system was generating an increased amount of source-separated recyclables and organic waste, the facility could possibly be adapted, through operational and other changes, to manage this feedstock along with or in place of mixed waste.

    c. **Changes in feedstock quantity and composition:** Since mixed waste processing systems are designed to process a feedstock with a high variability in composition, and since the system would use positive sorting for recovery of recyclables, it would be adaptable to changes in the composition of the mixed waste. The anaerobic digestion system would have some adaptability to changes in the organic nature of the feedstock, but significant changes (e.g., removal of food waste for other management options) could impact system operations and energy production. Therefore, changes in feedstock composition could have an impact on project economics.

    d. **Impact on landfill life and operation:** Mixed waste processing paired with anaerobic digestion would be expected to have a positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill. The removal of organic waste from the material being disposed would reduce the quantity of landfill gas produced, and would reduce the quantity of fugitive methane emissions from the landfill.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** Assuming the facility is located at the Cedar Hills Regional Landfill and receives mixed waste generated County-wide, any impact on fees would be expected to be equitable for all participating jurisdictions

   b. **Siting of facilities:** Assuming the facility is located at the Cedar Hills Regional Landfill, there would not appear to be any significant facility siting challenges involved since it would be receiving and processing waste that is already going to the landfill.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities**: Assuming the facility is located at the Cedar Hills Regional Landfill, this practice could be seen as not having any effect on the livability and character of the communities served since it would be receiving and processing waste that is already going to the landfill. However, due to the different nature of mixed waste processing and anaerobic digestion as compared to landfill operations, the community may view the facility as having a negative effect, particularly if the landfill continues to operate.

   b. **Job creation:** Mixed waste processing paired with anaerobic digestion would create near to or in excess of 100 new positions for operation of the facility. Although many of these positions would be lower-skilled tipping floor operators, general laborers, and sorters, some positions would be for more highly skilled staff (e.g., management, administrative, supervisory and key maintenance staff).

   c. **Impacts on cities:** This practice would have no apparent impact on the cities, with the exception of shared benefits (e.g., associated with increased recycling and energy production) and shared costs, as applicable, if the facility is financially more costly than current practices.

   d. **Susceptibility to impacts from action of cities:** No susceptibility is apparent, other than the impacts already discussed of changing waste composition, such as if cities ramp up their source separation programs and participation therein.

   e. **Public education requirements:** Developing a mixed waste processing facility with an anaerobic digestion facility would not require any changes to recyclable or waste handling at either the municipal or customer level. Therefore, this practice would not require any significant public education efforts. However, it would be appropriate to conduct outreach and education similar to current practices, for purposes of informing the public about the practice and its benefits. A focus of such outreach may be to ensure that public participants continue to practice source-separation of recyclables, since source-separation can result in higher end values for the recyclables.

3. Impact on Employees

    a. **Health and safety:** Mixed waste handling, particularly hand sorting, and biogas management creates operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.

    b. **Job security:** Adding mixed waste processing with anaerobic digestion is not expected to significantly impact job security and opportunities for County staff. Facility operation could be easily integrated into existing system operations (i.e., without impacting transfer station operations). However, with the diversion of waste from landfill disposal it could potentially have an impact on landfill operating requirements. The facility is not expected to increase job opportunity and security for County staff, since it is likely that the facility would be privately operated.

    c. **Job satisfaction:** For many of the lower skilled laborer positions, staff employed at the anaerobic digestion facility would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation.

Summary

This best practice would have a positive impact on diversion and resource consumption, and is highly consistent with and supportive of the County's Strategic Climate Action Plan. It is compatible with the County's transfer system, and would not require any changes to collection practices or transfer station operations. However, there are economic risks associated with the uncertainty of costs and revenues. Based on estimates, the capital and O&M costs may not be offset by revenues and avoided disposal cost, except perhaps under the most favorable cost and revenue conditions. This best practice appears to be better suited for private operation, due to the complexity and risk involved. Consideration of this best practice together with Best Practice No. 16 (Solicitation of Private Industry Handling of Waste) would provide industry input needed to address economic risk and other uncertainties.

Recommendation

This best practice is promising, but needs input from private industry before implementation.

Best Practice No. 11

Implement recycling (using mixed waste processing) and thermal processing (with energy generation) of the non-recyclable fraction of mixed waste.

Best Practice Description

Best Practice No. 11 integrates mixed waste processing with large-scale thermal processing. Mixed waste (commonly referred to as trash) would be processed to recover recyclable materials for sale and then the non-recyclable fraction would be processed using thermal technology to generate energy. The mixed waste processing system (sometimes referred to as a “Dirty MRF”, or more recently as an advanced MRF – AMRF, or mixed waste MRF - MWMRF) and the thermal processing system could be located together at one site as an integrated facility, or the systems could be separate facilities at different locations. Co-location would result in capital and operational cost savings. For Best Practice No. 11, the mixed waste processing system would primarily recover recyclable fibers (paper, newspaper and cardboard) and containers (plastic, metal and glass) that were not source-separated, and could also recover other recyclable materials subject to technical and economic feasibility. Materials not recovered as recyclables, including any organics that are in the waste and other residual material, would be feedstock for the thermal processing system. For Best Practice No. 11, the AMRF would not be designed to recover organics for separate processing; this is different from the intent for Best Practices No. 10 and No. 12, which do include recovery of organics.

The mixed waste processing system would be very similar to that described for Best Practice No. 10, with the exception that it would not need to include specialized processing steps designed to recover an organic fraction for digestion. As previously described, the system would include robust mechanical processing combined with manual labor to separate materials by size, density and type for purpose of recovering recyclables. The mixed waste processing system may also include supplemental preprocessing equipment, such as shredders or dryers, as needed to meet the specific preprocessing needs of the downstream thermal processing system. For King County, the mixed waste processing system would be designed to handle about 280,000 tons per year of waste (about 35% of the waste currently disposed at the Cedar Hills Regional Landfill), which is considered a large facility. Although the total quantity of mixed waste currently disposed at the Cedar Hills Regional Landfill is more than 800,000 tons per year, the complexity and space requirements for mixed waste processing designed to maximize recovery of recyclables would reasonably limit the facility size to about 280,000 tons per year.

The mixed waste processing facility could be expected to recover about 56,000 tons per year of recyclables, which is about 20% of the waste received for processing. Actual quantities recovered would depend on the amount of recyclables in the waste stream and the recovery rate for specific material types, which could range from about 70% to 95%. The total quantity of recyclables recovered could be higher if the facility is processing recyclable-rich loads from commercial sources. The facility may also remove a small amount of material not suitable for further processing (e.g., oversized bulky and other rejected or inert materials that can be cost-effectively removed). For planning purposes, this could be estimated to be up to about 5% of the waste received (14,000 tons per year). The remaining waste available for thermal processing would average about 210,000 tons per year. A thermal processing facility designed to handle this quantity of feedstock would need to have a design capacity of about 640 tons per day, assuming 90% facility availability (10% downtime for system repair and maintenance). Some thermal technologies could process significantly more waste, including capacities comparable to the amount of waste currently disposed at the Cedar Hills Regional Landfill (over 800,000 tons per year or about 2,200 tons per day). However, for Best Practice No. 11 the facility size is assumed to be limited by the reasonable capacity of a front-end mixed waste processing system.

There are various types of thermal processing systems that could be considered for Best Practice No. 11, including conventional waste to energy, advanced thermal recycling, and emerging conversion technologies (e.g., pyrolysis, gasification, and plasma gasification). Selecting the thermal technology best suited to the quantity and characteristics of the feedstock and the goals and criteria of the County (e.g., type of energy output, amount of diversion, and status of technology development) would be important for successful project outcome. Types of thermal processing systems that could be considered include the following.

- Conventional waste-to-energy technology, including mass-burn and refuse derived fuel combustion applications, are well established in the United States. As reported in The 2014 ERC Directory of Waste-to-Energy Plants, there are 80 plants in the United States that are in operation and four that are currently inactive. Over the past seven years, five of the operating facilities have undergone expansions. In addition, there is one new plant under construction in West Palm Beach, Florida (estimated startup in 2015). Many of these plants have processing capacities near to or above 2,000 tons per day, and several have processing capacities near to or above 3,000 tons per day, which provide for processing approximately 600,000 tons per year to more than one million tons per year at a single facility. These systems combust waste to generate energy, and can incorporate metal recycling before or after combustion. Ash generated from the combustion process typically requires disposal in a landfill.
- Advanced thermal recycling integrates certain design improvements to conventional waste-to-energy combustion, including the addition of pre-processing to recover recyclable materials, ash processing to produce commercially usable products, and advanced air pollution control systems.
- Emerging conversion technologies such as pyrolysis, gasification and plasma gasification (simply called gasification herein) differ from conventional waste-to-energy and advanced thermal recycling by converting the waste into an energy-rich gas (called synthesis gas or syngas) without burning the waste. The syngas is then cleaned and conditioned, as needed, and used to generate electricity, fuels or chemicals. Some gasification technologies produce ash residue in the form of aggregate, which may have beneficial use. There are many variations of gasification technology, with proprietary and patented features for reactor design and related components. Facility design and operation is usually complex and highly automated. Gasification of mixed waste is not yet established within the United States, but there are commercial applications overseas.

For example, facilities with capacities greater than 100 tons per day (or about 36,500 tons per year) that process municipal solid waste are in operation in Japan (Westinghouse plasma gasification, Thermoselect high temperature gasification, and JFE high temperature gasification/direct melting furnace) and in Norway (Energos gasification technology).

As previously presented, the building footprint for a large mixed waste processing facility could be expected to range from 100,000 square feet to 150,000 square feet or larger. The building footprint for a corresponding thermal processing facility would vary significantly based on design elements of the processing system and support systems, and the ability to locate certain equipment and structures outside of the building. A footprint of 200,000 square feet or even larger could be expected. Site size would be dictated by building size and layout requirements for other equipment and structures, roadways and requirements for large truck queuing and movements, recyclable storage and load-out activities, storm water management, and landscaping and green buffer zones. A large mixed waste processing facility paired with a thermal processing facility could be expected to require 15 to 25 acres or more.

Operation and maintenance requirements for a mixed waste processing facility paired with a thermal processing facility would include labor, utilities, chemicals and other consumables, routine equipment maintenance and repair, capital repair and replacement, and other costs (including disposal of residue). Staffing needs could be expected to range from 75 to 100 or more staff.

Best Practice No. 11 is a large-scale undertaking and would not be implemented at any of the County's existing transfer station sites. It might be possible to implement this practice at the Cedar Hills Regional Landfill if sufficient space is available.

Best Practice Evaluation

A. Fiscal
   1. Impact on Rates:
      a. **Capital Costs:** A large mixed waste processing facility of the size and type described above could be expected to have a total capital cost ranging from $30 million to $40 million. A corresponding thermal processing system could be expected to have a total capital cost ranging from $150 million to $250 million. Integration of the two systems into a common facility could result in cost savings due to shared resources (e.g., site roadways, utilities, office space, scale, and possibly other elements).
      b. **O&M Costs:** A large mixed waste processing facility paired with a large thermal processing facility as described above could be expected to have total operating and maintenance costs ranging from $75 to $125 per ton of mixed waste received for processing.
      c. **System Revenue:** A facility of the type and size described above could be expected to have system revenue ranging from $37 to $65 per ton of mixed waste received for processing, generated from the sale of recyclables and from

the sale of energy. In addition to system revenues, there would be an avoided disposal cost, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost. Also, King County estimates that landfill air space at the Cedar Hills Regional Landfill is valued at approximately $7.00 per ton. As described for Best Practice No. 10, revenue from the sale of recyclables could range from approximately $16 to $32 per ton of mixed waste received for processing. Revenue from energy sales would be highly dependent on the characteristics of the feedstock, the type of thermal technology used, the type of energy produced, and market conditions for energy sales. Electricity is currently the most common form of energy output, and is applicable to all of the thermal technologies identified above. Assuming the production of electricity, net output could typically be expected to range from 500 to 800 kilowatt hours (kWh) per ton of waste processed, with a reasonable planning assumption of 700 kWh per ton for a large-scale facility. Higher electrical output may be feasible under certain project-specific configurations, but is not a suggested planning assumption. Assuming a power sale price of $0.055 per kWh, electricity revenues could range from $21 to $33 per ton of waste processed. Production of fuels could potentially produce greater energy revenue but would require further study. Fuel production is not an option for conventional waste-to-energy technology, but could be considered for thermal conversion technologies such as gasification. Revenue may be generated from the sale of ash in the form of aggregate, but for feasibility purposes this material is often considered to be neutral as a revenue stream or a cost to the project for transportation and disposal.

2. Economic Risks:
   a. **Financial effect of listed operational risks:** Based on very approximate estimated revenue, avoided disposal cost, the value of landfill air space, O&M costs, and the cost of capital, a large mixed waste processing system paired with a thermal processing system might not be able to reach a financial break-even point, except perhaps under the most favorable cost and revenue conditions (i.e., low capital and O&M costs, and high revenue primarily associated with high energy output and value), or if economics could be improved by producing fuel instead of electricity.
   b. **Sustainability of funding sources:** Costs associated with the facility could be offset to a significant extent by revenues associated with sale of recyclables and electricity. However, these revenues are subject to variability as discussed below. Unless the facility achieves a financial break-even point, the cost would need to be covered by the established rate structure imposed on system users, amended as necessary.
   c. **Certainty of costs:** Capital and O&M costs can be expected to be fairly well defined for mixed waste processing. Costs are also well defined for conventional waste-to-energy technology. However, there is only limited development, primarily overseas, of advanced thermal processing and gasification technologies, particularly for facilities that produce fuel as an energy product instead of electricity. Such systems are uniquely designed for project-specific

and site-specific application, with highly variable capital and O&M costs across the diverse range of technology available. Therefore, costs can be expected to be subject to a high level of uncertainty.

d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues for recyclables are subject to market fluctuations, which can vary widely over time. In addition, revenues for recyclables are subject to the quantity of recyclables in the mixed waste and the quality of the material recovered, both of which are subject to uncertainty. Electricity is the predominant energy product from existing thermal facilities. Electricity revenues are subject to uncertainty associated with the amount of electricity that would be produced for sale. Industry values are variable and highly dependent on the characteristics of the feedstock and the nature of the technology used. Electricity revenues are also subject to market uncertainties. There is expected to be a stable market for the electricity, but as discussed for Best Practice #7 market prices are uncertain and subject to forecasting and the ability to enter into a long-term purchase agreement with favorable terms and conditions. Project-specific considerations could be given to the ability to produce fuel or other types of energy for sale, instead of electricity, but revenue uncertainties would remain.

e. **Opportunities for regional risk sharing:** Due to capacity limitations imposed by mixed waste processing, this practice would not appear to offer a significant opportunity for a regional sharing of the risks or benefits. Since the facility would not have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships for purpose of risk sharing would take away from capacity that could be used by the County. Thermal processing without mixed waste processing or with less extensive mixed waste processing, particularly conventional waste-to-energy technology, would have less capacity restrictions and would provide greater opportunity for regional partnering.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** This practice would have a positive effect on recycling and diversion programs. It could be expected to result in recovery of up to 56,000 tons of additional recyclables with overall diversion of 235,000 tons or more from landfill disposal. This is about 28% of the waste currently disposed at the Cedar Hills Regional Landfill.

b. **Effect on landfill operations:** Implementation of mixed waste processing with thermal processing would significantly reduce the total tons of materials needing to be landfilled and would extend the life of the landfill. It would also reduce the amount of landfill gas produced.

2. Impact on resource consumption

a. **Land:** A large mixed waste processing facility paired with a thermal processing facility would require an estimated 15 to 25 acres or more for process operations.

b. **Water:** The system would require consumption of water, primarily for thermal process operations. Depending on the type of energy that might be displaced by the electricity generated, there may be some upstream water conservation due to reduced energy resource exploration, refining and combustion. In addition, to the extent that recyclables recovered by sorting incoming mixed waste are marketed to end uses that produce recycled-content products which can substitute for virgin-content products, there would be global upstream water conservation through displacement of virgin material and energy resource extraction, refining and product manufacturing operations.
c. **Energy:** The system would meet its own electrical needs, but modest amounts of hydrocarbon fuel would be required to support operations, such as for start-up of the thermal system and for operation of mobile equipment. This practice may provide upstream virgin energy resource conservation accruing energy conservation benefits to the recycling and thermal processing systems. If the facility is located at the Cedar Hills Regional Landfill, transportation energy would be nearly neutral, since the facility would receive and process material already being delivered to the landfill. However, transportation energy would be used to deliver recyclables to markets.
d. **Material resources:** The recovery of recyclables (glass, plastic, metals, and fiber) would have a positive effect on the consumption of material resources. The thermal process would have very little effect on the consumption of material resources, except for systems that produce an aggregate with beneficial use.

3. Impact on environmental resources
   a. **Human health:** A large mixed waste processing facility incorporating thermal processing likely would have little effect on human health assuming the use of dust and odor control measures for waste handling, and suitable control measures for air emissions associated with thermal processing and/or energy generation. Reduced virgin production associated with recovery of recyclables and generation of energy would provide reductions in upstream global air emissions that typically accompany virgin energy and material resource extraction, refining and virgin-content product manufacturing.
   b. **Ecosystems health:** A large mixed waste processing facility incorporating thermal processing likely would have little effect on nearby ecosystems health, assuming the use of suitable control measures for air emissions associated with thermal processing and/or energy generation. In addition, as with human health, the upstream benefits of recyclables recovery and energy generation could have global ecosystems benefits. The upstream benefits of energy generation would be a function of the amount and type of energy resource displaced. For example, displacing coal energy resources typically would have greater ecosystem and human health benefits than displacing solar energy.
   c. **Air:** A large mixed waste processing facility incorporating thermal processing would have air emissions associated with thermal processing and/or energy generation, but it is expected that measures would be used to control these emissions to meet State and local requirements. Potentially harmful emissions to

air, water and land from virgin energy and material resource extraction, refining and virgin-content product manufacturing could be reduced if these virgin energy and material resources are displaced by recovered recyclables and electricity from the facility.

   d. **Earth:** A large mixed waste processing facility incorporating thermal processing would have a positive effect on earth resources, associated with the displacement of virgin materials and energy resources.
   e. **Water:** The system would have a consumptive water requirement, and could have a negative effect on local water resources. However, there could be global reduction in water usage for displaced virgin energy and material resources.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)
   a. The extent to which, and even whether, this practice would be consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations would depend on the mix of fossil and biogenic carbon in mixed wastes, the emissions of fossil carbon dioxide due to thermal processing and/or energy generation, the emissions of biogenic carbon that would otherwise be stored in landfilled mixed wastes, the displaced emissions of fugitive methane from landfilled mixed wastes, the difference between the amount of energy generated via thermal processing versus via landfill methane combustion and the carbon footprint of energy displaced by energy from mixed wastes, and the upstream carbon footprint of displaced virgin-content product manufacturing displaced by recycled-content manufacturing using the recycled materials recovered from pre-processing incoming mixed wastes.

C. Operational

1. Complexity of Implementing
   a. **Program changes:** A large mixed waste processing facility incorporating thermal processing is entirely consistent with current collection and transportation practices of the County and the participating jurisdictions, particularly if the facility is located at the Cedar Hills Regional Landfill. If the facility is at another location, it would require some re-routing of transfer vehicles coming from the transfer stations. Additional program changes would be required if the facility is operated by the County, including increasing staff levels and special staff training.
   b. **Time required to implement:** Implementation could take 36-48 months or longer, most likely at the higher end of the range. If the facility is located at a new site rather than at the Cedar Hills Regional Landfill, implementation could take an additional 12-18 months or longer. Based on the complexity and certain proprietary elements of a combined mixed waste processing and thermal processing facility, it is assumed that the facility would be developed under an alternative project delivery method (e.g., design-build-operate), which would shift responsibility and risk to the private sector. Implementation would include procurement (soliciting and receiving proposals from system vendors and project developers, negotiating a contract), design and permitting, construction, and commissioning and start-up.

c. **Facility siting, design, permitting and construction challenges:** Assuming the facility is sited at the Cedar Hills Regional Landfill, a primary challenge would be finding sufficient room to place the facility on the site (i.e., site planning). Also, due to the vastly different nature of mixed waste processing and thermal processing as compared to landfill operations, there could be challenges in obtaining public acceptance of the facility at the landfill. If located at a new site, the primary challenge would be finding a site that is acceptable to the local community, meets all land use and zoning requirements, and does not have any unmitigatable environmental impacts.
d. **Contracting for services:** Contracting the operation with a private operator would be beneficial, due to the complexity of design and operation as well as certain proprietary aspects of mixed waste processing and thermal processing. In particular, emerging conversion technology such as gasification is at an early development status in the United States. Contracting with a private operator would beneficially shift operating risk to the private entity. However, private operation could be challenged by the County's unionized labor force.
e. **Compatibility with other elements of the system:** Adding mixed waste processing with integrated thermal processing seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal.
f. **Opportunities for regional partnerships:** Due to capacity limitations imposed by mixed waste processing, this practice would not appear to offer a significant opportunity for regional partnerships. Since the facility would not have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships would take away from capacity that could be used by the County. Thermal processing without mixed waste processing or with less extensive mixed waste processing, particularly conventional waste-to-energy technology, would have less capacity restrictions and would provide greater opportunity for regional partnering.
g. **Compatibility with other regional approaches to solid waste management:** Mixed waste processing with integrated thermal processing is highly compatible with other regional approaches, since it manages waste currently disposed of at the landfill. This practice would not require any changes to recyclable or waste handling at the either the municipal or customer level, and would not be expected to have any impact on existing transfer station operation. However, there could be transfer station impacts if it became desirable to segregate incoming waste by customer types served by incoming collection vehicles loads. This might be beneficial to providing a more recyclables-rich input stream for the mixed waste processing system.
h. **Compatibility with the current role of the solid waste division:** Mixed waste processing with integrated thermal processing would appear to be highly compatible with the Division's role.
i. **Compatible with existing private industry role and resources:** Mixed waste processing with integrated thermal processing would not appear to place the County in competition with private industry. The facility would be handling waste

currently managed by the County and disposed at the County's Cedar Hills Regional Landfill. Also, it could be expected that the County would contract with private industry for design, construction and operation of the facility, which is expected to be of interest to private industry.

   j. **Public Education Requirements:** Developing mixed waste processing with integrated thermal processing would not require any changes to recyclable or waste handling practices at either the municipal or customer level. However, thermal processing is commonly not well understood by the public. Therefore, it would be necessary to conduct outreach and education, for purposes of informing and educating the public about the practice and its risks and benefits.

2. Complexity of system and facility operation
   a. **Potential facility downtime:** System downtime for planned and unplanned maintenance and repair could be expected. The effects of downtime could be mitigated with redundant design features (e.g., two or more smaller processing lines rather than one larger processing line, for both the mixed waste processing system and the thermal processing system).
   b. **Residue disposal:** The system could be expected to generate residue requiring landfill disposal. The quantity of residue is highly dependent on the characteristics of the waste and the design features of the processing systems. Overall, the quantity of residue requiring disposal could be expected to range from 5% to 25% of the waste processed, not including bypass waste that may require disposal during periods of facility downtime. The lower end of the range would be characteristic of technologies that vitrify the ash and inert materials (such as broken glass and stones) producing an aggregate for sale as a product. The higher end of the range would be characteristic of thermal technologies that remove and dispose inert materials prior to processing as well as those that produce a non-vitrified ash residue requiring disposal. Locating the facility at the Cedar Hills Regional Landfill would have the advantage of a short haul to the landfill face while the landfill remains in operation.
   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain a mixed waste processing system seems like it could be integrated into the County's current labor agreements if the facility is operated by the County. However, operation and maintenance of thermal processing systems, particularly for large-scale operation, can require specialized expertise and knowledge of proprietary systems. As noted above, private operation of the facility would be beneficial.
3. Level of service to customers
   a. **Service offerings:** Adding mixed waste processing with integrated thermal processing would not impact service offerings to customers since the material that would be processed is already being collected and received at the County's facilities.
   b. **Location of service delivery:** This practice would not require a change to current curbside collection services or to practices associated with self-haul waste.

c. **Hours of service offering:** This practice would not require any changes to hours of service for curbside collection or self-haul practices.
d. **Time required by customers to utilize service:** This practice would have no impact on the time required by customers to handle their waste, since it would have no impact on curbside collection or self-haul practices.

4. Operational risks
    a. **Proven performance of technology:** Mixed waste processing facilities have been in use since the 1980s in the United States but are not in widespread operation across the country. Use is most prevalent where there are legislated mandates for high waste diversion, such as in California. Renewed interest and development over the past decade has occurred, due to evolution and improvements in mechanical and optical sorting equipment and increased interest in landfill diversion. Conventional waste-to-energy technology is well-established in the United States, with a wide range of facility capacities and with demonstrated operation for over 20 years. Advanced thermal recycling and gasification technologies are in commercial operation overseas for processing mixed waste, but not in the United States. There are recent developments in both the United States and Canada with projects in early operation or under development, but there is not yet an established operating history.
    b. **Market availability for materials/products:** There are well established local and regional markets for recyclables that would be recovered from mixed waste processing operations. However, these materials could potentially have reduced end-use value as compared to source-separated recyclables due to the increased possibility of contaminants or end-user perception of higher contamination. Markets are expected to be available locally and regionally for energy produced from the facility, but project-specific considerations would need to be assessed to determine the most cost-effective combination of thermal technology and energy production.
    c. **Contract risks and risk sharing:** Assuming the facility is privately operated, there would be opportunity for shifting operating risk to the private sector, with contractual opportunities for revenue sharing tied to operational performance.
    d. **Ability to respond to external emergencies:** The facility would be designed to manage mixed municipal waste, which may include some elements of C&D waste. The thermal process would be expected to have some flexibility to handle certain elements of C&D waste such as lumber and other wood waste, but it is not expected that it would be designed to handle large volumes of C&D waste. The use of the facility to handle C&D debris from an emergency event would displace the processing of other waste normally managed by the facility. Therefore, the facility is not expected to have any measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding.
    e. **Ability to respond to internal system emergencies and outages:** Since the facility would receive mixed waste for processing, it would be able to receive waste hauled directly from a collection route, should there be an outage at a

transfer station. Also, the equipment designed for mixed waste processing would be similar to the equipment and activities used in single stream recycling, and could be used to process single stream materials if needed.

f. **Operating life:** The facility would have an estimated service life with good maintenance of at least 20 years, with planned overhaul and/or replacement of system components as required.

g. **Potential energy production:** The thermal processing system would produce energy, which could include electricity or fuel. The determination of which type of energy to produce would be dependent on project-specific considerations regarding potential net energy output and potential net energy revenue based on site, technology, and market considerations.

h. **Impacts from feedstock contamination:** The mixed waste processing system would inherently be designed to receive and process mixed waste inclusive of contaminants typically found in municipal waste. However, the nature of the feedstock can have a negative impact on the value of the recyclables recovered, associated with contamination that carries through to the products. Thermal processing systems have different levels of pre-processing requirements for feedstock consistency, with some technologies being very adaptable to widely varying feedstock characteristics.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity:** Assuming the mixed waste processing system would be designed to operate two, eight-hour shifts per day, five days per week, there would be opportunity to increase operating capacity by operating longer shifts (or a third shift), or by adding an operating day. However, unless planned for, there could be upfront feedstock receiving and storage limitations that constrain increased operating capacity. The thermal processing system would have the ability to increase capacity with the addition of more processing units, but this would require planning during design and construction to ensure space is available and to provide for sufficiently-sized support systems. Capacity could potentially be reduced subject to the turn-down capability of individual thermal systems, but would be expected to have a negative impact on financial performance.

b. **Adaptability to system changes and demands:** The facility's ability to adapt to system changes and demands would be dependent on the change. For example, if the facility is located at the Cedar Hills Regional Landfill and the landfill closes, there would be increased cost to transport residue to an alternate landfill for disposal. If system changes result in increased source-separation of recyclables with management of those materials through alternate means, the facility would be less cost-effective as it would recover fewer recyclables and could generate less energy. As an example of adaptability, the thermal processing system could perhaps be used to handle specific feedstocks other than waste currently managed through the transfer stations, such as industrial waste, wood waste, biosolids, or other biomass, subject to regulatory requirements and the logistical ability to handle additional feedstock.

c. **Changes in feedstock quantity and composition:** Since mixed waste processing systems are designed to process a feedstock with a high variability in composition, and since the system would use positive sorting for recovery of recyclables, it would be adaptable to changes in the composition of the mixed waste. Thermal systems are designed to process feedstock based on an energy balance. If the composition of the feedstock changes, the quantity processed by the system will also have to change to maintain a proper heat input. Under normal operations for municipal waste processing, the system would be designed around an expected range of waste composition, providing some flexibility. If there are significant changes in feedstock composition, there can be an impact on system operation and project economics.

d. **Impact on landfill life and operation:** Mixed waste processing with integrated thermal processing would be expected to have a positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill. The removal of organic waste from the material being disposed would reduce the quantity of landfill gas produced. This could have a small but positive impact on fugitive methane emissions from the landfill.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance
    a. **Equity of fees:** Assuming the facility is located at the Cedar Hills Regional Landfill and receives mixed waste generated County-wide, any impact on fees would be expected to be equitable for all participating jurisdictions.
    b. **Siting of facilities:** Assuming the facility is located at the Cedar Hills Regional Landfill, there would not appear to be any significant facility siting challenges involved since it would be receiving and processing waste that is already going to the landfill.
2. Public and political understanding and acceptance
    a. **Effects on livability and character of communities:** Assuming the facility is located at the Cedar Hills Regional Landfill, this practice could be seen as having only a minimal effect on the livability and character of the communities served since it would be receiving and processing waste that is already going to the landfill. However, due to the vastly different nature of mixed waste processing and thermal processing as compared to landfill operations, the community may view the facility as having a negative effect, particularly if the landfill continues to operate.
    b. **Job creation:** Mixed waste processing with integrated thermal processing would create near to or in excess of 100 new positions for operation of the facility. Although many of these positions would be lower-skilled tipping floor operators, general laborers, and sorters, some positions would be for more highly skilled staff (e.g., management, administrative, supervisory and key maintenance staff).
    c. **Impacts on cities:** This practice would have no apparent impact on the cities, with the exception of shared benefits (e.g., associated with increased recycling and energy production) and shared costs, as applicable, if the facility is financially more costly than current practices.

d. **Susceptibility to impacts from action of cities:** No susceptibility is apparent, other than the impacts already discussed of changing waste composition, such as if cities ramp up their source separation programs and participation therein.
e. **Public education requirements:** Developing mixed waste processing with integrated thermal processing would not require any changes to recyclable or waste handling practices at either the municipal or customer level. However, thermal processing is commonly not well understood by the public. Therefore, it would be necessary to conduct outreach and education, for purposes of informing and educating the public about the practice and its risks and benefits.

3. Impact on Employees
    a. **Health and safety:** Mixed waste handling, particularly hand sorting, and thermal processing create operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.
    b. **Job security:** Adding mixed waste processing with integrated thermal processing is not expected to increase job security and opportunities for County staff, since it is likely that the facility would be privately operated. Transfer station operations are not expected to be impacted, however, diversion of waste from landfill disposal could potentially reduce staffing needs at the landfill.
    c. **Job satisfaction:** Many of the staff employed for system operation would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation. Some of the supervisory and more specialized functions associated with thermal operations may provide satisfying job opportunities.

Summary

This best practice would have a positive impact on diversion and resource consumption. It is compatible with the County's transfer system, and would not require any changes to collection practices or transfer station operations. However, there are economic risks for this best practice. The facility would require a large amount of capital investment, both in terms of building space and equipment, and would likely need 15 to 25 acres or more for development. Except under the most favorable cost and revenue conditions, which could include the production of fuel in place of electricity, this best practice may not reach a financial break-even point in King County. Thermal processing is not well understood by the public, so outreach and education would be required to inform the public about the associated risks and benefits. This best practice appears to be better suited for private operation, due to the complexity and risk involved. Consideration of this best practice together with Best Practice No. 16 (Solicitation of Private Industry Handling of Waste) would provide industry input needed to address economic risk and other uncertainties.

Recommendation

This best practice is promising, but needs input from private industry before implementation.

Best Practice No. 12

Implement fully integrated processing of residual municipal solid waste combining recycling (using mixed waste processing) with anaerobic digestion and thermal processing.

Best Practice Description

This best practice incorporates elements of several other best practices for a fully integrated approach. Specifically, it is similar to Best Practice No. 10, which is mixed waste processing with anaerobic digestion, but it also includes thermal processing for the residual fraction that is not recycled or recovered for digestion (as addressed in Best Practice No. 11). The integrated approach of Best Practice No. 12 provides for high diversion, while limiting the thermal footprint through the prioritization of recycling and biological processing ahead of thermal processing. For capital and operating cost efficiencies, the mixed waste processing system, anaerobic digestion system, and thermal processing system would be co-located together at one site as an integrated facility, such as at the Cedar Hills Regional Landfill. However, as necessary or appropriate, these systems could be separate facilities at different locations.

As previously described for Best Practice No. 10, the mixed waste processing system (sometimes referred to as a "Dirty MRF", or more recently as an advanced MRF – AMRF, or mixed waste MRF – MWMRF) would recover recyclable fibers (paper, newspaper and cardboard) and containers (plastic, metal and glass) that were not source-separated, and could also recover other materials subject to technical and economic feasibility. In addition, the system would separate the organic fraction of the waste for anaerobic digestion. The organic fraction would consist of paper not recovered for recycling, packaged and unpackaged food waste, yard waste, and other miscellaneous organics. For descriptive purposes, this fraction of the waste stream is sometimes called the "wet" organic fraction. Materials not recovered as recyclables and not separated as an organic feedstock (sometimes called the "dry" residual fraction) would be thermally processed to recover additional energy and provide further diversion from landfill disposal.

As described in other practices, the mixed waste processing facility would be designed to handle about 280,000 tons per year of waste (about 35% of the waste currently disposed at the Cedar Hills Regional Landfill). Although the total quantity of waste currently disposed at the Cedar Hills Regional Landfill is more than 800,000 tons per year, the complexity and space requirements for mixed waste processing designed to maximize recovery of recyclables would reasonably limit the facility size to about 280,000 tons per year. The mixed waste processing system could be expected to recover about 56,000 tons per year of recyclables.

An anaerobic digestion system would be paired with the recycling system to process the organic feedstock separated during mixed waste processing. Based on the King County Waste Characterization and Customer Survey Report (October 2012), it is reasonable to assume recovery of about 28% to 30% by weight of the mixed waste as an organic fraction. This would support an anaerobic digestion system with a capacity of about 80,000 tons per year. As previously described for Best Practices No. 7 and No. 10, anaerobic digestion would generate biogas and digestate. The biogas could be upgraded to pipeline-quality gas (biomethane) or other types of fuel such as compressed natural gas (CNG), or it could be used to generate electricity. The digestate would be composted and marketed as a fertilizer or soil amendment.

The integrated facility would also include a thermal processing system to manage the residual fraction of waste. Assuming recovery of 56,000 tons per year of recyclables, diversion of 80,000 tons per year to anaerobic digestion, and removal of about 14,000 tons per year as oversized bulky and other rejected or inert materials not suitable for processing, about 130,000 tons per year of waste would be thermally processed. This would require a thermal design capacity of about 400 tons per day, accounting for approximately 90% system availability. For purposes of this integrated practice, the thermal process is assumed to be gasification or a similar process that would produce energy (fuel or electricity). The thermal process would produce ash residue that would require landfill disposal or a vitrified aggregate that could potentially be marketed as a product. The amount of residue would vary based on the type of system used and the amount of inert material removed ahead of the process, and could range from less than 5% to about 20% (by weight). For planning purposes, and assuming the removal of some unprocessible material during mixed waste processing, the residue generation rate for gasification could be assumed to be about 15% of the feedstock thermally processed.

The building footprint for a large mixed waste processing facility is dependent on technology-specific design aspects as well as the amount of floor space reserved for temporary storage of incoming material and processed material, and could be expected to range from 100,000 square feet to 150,000 square feet or larger. The building footprint for a large anaerobic digestion facility could be highly variable due to technology-specific design aspects, and could be expected to range from 50,000 square feet to 200,000 square feet. The building footprint for a 400 ton per day thermal processing system could also be highly variable, and could be expected to be 100,000 square feet or larger. As an integrated facility, it would be expected that some facility elements would be combined, reducing overall building footprint requirements. Site size would be dictated by building size and layout requirements for other equipment and structures, roadways and requirements for large truck queuing and movements, digestate management activities (composting, curing and storage), recyclable storage and load-out activities, storm water management, and landscaping and green buffer zones. A 280,000 ton per year mixed waste processing facility paired with anaerobic digestion and thermal processing could be expected to require 15 to 30 acres or more.

Operation and maintenance requirements for an integrated facility would include labor, utilities, chemicals and other consumables, routine equipment maintenance and repair, capital repair and replacement, and other costs (including disposal of residue). Waste receiving and mixed waste processing would likely operate two shifts per day, five or six days per day. Anaerobic digestion could be a batch or continuous process. Thermal processing would likely be a continuous process (24/7). Staffing needs could be expected to be more than 100 staff, with the highest staffing needs for mixed waste processing operations and lesser staffing needs for anaerobic digestion and thermal processing operations. Certain supervisory, maintenance, and general laborer positions could be shared for an integrated facility, as compared to three separate processing facilities.

Best Practice No. 12 is a large scale undertaking and would not be implemented at any of the County's existing transfer station sites. It might be possible to implement this practice at the Cedar Hills Regional Landfill if sufficient space is available.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** A large mixed waste processing facility of the size and type described above could be expected to have a total capital cost ranging from $30 million to $40 million. A large anaerobic digestion system could be expected to have a total capital cost ranging from $30 million to $60 million. A 400 ton per day thermal processing system (1 or more units) could be expected to have a total capital cost ranging from $100 to $160 million. In combination, overall capital cost could range from $160 million to $260 million. Integration of the three systems into a common facility could result in cost savings due to shared resources (e.g., site roadways, utilities, office space, scale, and other elements), perhaps narrowing estimated capital costs to the lower half of the range cited.

   b. **O&M Costs:** An integrated facility of the size and type described above could be expected to have operating and maintenance costs ranging from $80 to $150 per ton of mixed waste received for processing. These costs include labor as well as other operating and maintenance costs such as utilities, consumables, and equipment and building maintenance.

   c. **System Revenue:** An integrated facility of the size and type described above could be expected to have revenue ranging from $28 to $54 per ton of mixed waste received for processing. In addition to system revenues, there would be an avoided disposal cost, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost. Also, King County estimates that landfill air space at the Cedar Hills Regional Landfill is valued at approximately $7.00 per ton. Revenue would be generated from the sale of recyclables, from the sale of fuel or electricity produced from the anaerobic digestion and thermal processes, and potentially from the sale of compost and aggregate. As described for Best Practice No. 10, revenue from the sale of recyclables could range from approximately $16 to $32 per ton of mixed waste received for processing. The amount of energy that could be produced and sold is highly dependent on the characteristics of the feed stock as well as the type of technology used, with thermal processing producing more energy than anaerobic digestion. If producing electricity, net output from anaerobic digestion could be expected to range from 100 to 250 kilowatt hours (kWh) per ton of organic waste processed. Net output from gasification (at a scale of 400 tons per day) could be expected to range from 400 to 700 kWh per ton of waste thermally processed. The electricity sale price is uncertain, as described in Best Practice No. 11. However, assuming an average wholesale electricity price of about $0.055 per kWh, revenue for electricity could range from approximately $12 to $22 per ton of waste processed by the integrated facility. The anaerobic digestion and gasification processes would have the ability to produce and sell fuel instead of electricity, which could potentially improve project economics. Production of fuels would require further study. Revenue may also be generated from the sale of compost and aggregate, but for feasibility purposes these materials are considered to be neutral as a revenue stream.

2. Economic Risks:

    a. **Financial effect of listed operational risks:** Based on very approximate estimated revenue, avoided disposal cost, the value of landfill air space, O&M costs, and the cost of capital, a large integrated facility (mixed waste processing system paired with anaerobic digestion and thermal processing) is not expected to be able to reach a financial break-even point, except perhaps under the most favorable conditions, including the ability to produce and sell fuel for significantly higher revenue than projected for electricity sales.

    b. **Sustainability of funding sources:** Costs associated with the facility would be offset to some extent by revenues associated with sale of recyclables, energy, and possibly compost and aggregate, which are subject to variability as discussed below. Otherwise, as for other system components such as landfill disposal, the cost of the facility would need to be covered by the established rate structure imposed on system users, amended as necessary.

    c. **Certainty of costs:** Capital and O&M costs can be expected to be fairly well defined for mixed waste processing. However, there is limited and only recent development of large-scale anaerobic digestion facilities processing the organic fraction recovered from mixed waste, and similarly limited development of gasification facilities. Such systems are generally comprised of numerous components that must be uniquely designed for project- and site-specific application, with highly variable capital and O&M costs across the diverse range of technology available. Therefore, costs for a large integrated facility, particularly one that produces fuel instead of electricity, can be expected to be subject to a high level of uncertainty.

    d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues for recyclables are subject to market fluctuations, which can vary widely over time. In addition, revenues for recyclables are subject to the quantity of recyclables in the mixed waste and the quality of the material recovered, both of which are subject to uncertainty. Energy revenues generated from the sale of electricity or fuel are subject to uncertainty associated with the amount of energy that would be produced for sale.

Industry values are variable and highly dependent on the characteristics of the feedstock. There is expected to be a stable market for the energy products, but market prices are uncertain and subject to the ability to enter into a long-term purchase agreement.

e. **Opportunities for regional risk sharing:** An integrated facility designed to process 280,000 tons per year of waste may not offer a significant opportunity for a regional sharing of the risks or benefits. Since the facility would not have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships for purpose of risk sharing would take away from capacity that could be used by the County.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** The development of a large mixed waste processing facility paired with anaerobic digestion and gasification could be expected to divert approximately 246,000 tons per year of material from landfill disposal. This assumes beneficial use of compost from anaerobic digestion but disposal of residue from gasification. This total quantity of waste diverted is about 30% of the amount currently disposed at the Cedar Hills Regional Landfill.

b. **Effect on landfill operations:** Implementation of a large integrated facility would significantly reduce the total tons of material needing to be landfilled, extending the life of the landfill and reducing the amount of landfill gas produced.

2. Impact on resource consumption

a. **Land:** A large integrated facility would require an estimated 15 to 30 acres or more for process operations.

b. **Water:** Except for cleaning and sanitary uses, mixed waste processing would have minimal water requirements. Water requirements for anaerobic digestion would vary based on the type of digestion process used (i.e., wet or dry). Water requirements for thermal processing would also depend on technology requirements as well as project-specific application. Depending on the type of energy that might be displaced by energy or fuel generated from anaerobic digestion and thermal processing, there may be some upstream water conservation due to reduced energy resource exploration, refining and combustion. There may also be reduced water consumption if the digestate is processed so as to be marketable to buyers who then reduce their purchase and use of synthetic fertilizers, pesticides and other synthetic soil and/or lawn supplements. The use of composted digestate may also reduce irrigation requirements by the compost product purchasers.

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy would be required to support operations, including for operation of pumps, motors, conveyors, air pollution control systems, on-site mobile equipment, and other equipment and operations. If the facility is located at the Cedar Hills Regional Landfill, transportation energy would be nearly neutral, since the facility would receive and process material already being delivered to the landfill. However, transportation energy would be used to deliver materials to markets. The recovered recyclables, energy products, and composted digestate may provide upstream virgin energy resource conservation, synthetic soil and lawn amendment production reductions, pesticide reductions and irrigation water reductions that accrue energy conservation benefits to the mixed waste processing and anaerobic digestion systems.

d. **Material resources:** The recovery of recyclables (glass, plastic, metals, and fiber) would have a positive effect on the consumption of material resources. The anaerobic digestion and thermal processes would have very little effect on the consumption of material resources. However, the upstream displacements of synthetic soil and lawn amendments and pesticides by composted digestate could result in conservation of virgin material resources.

3. Impact on environmental resources

a. **Human health:** Integrated processing likely would have little effect on human health assuming the use of dust and odor control measures for mixed waste handling and sorting, and suitable control measures for air emissions associated with anaerobic digestion, gasification, and energy production. There could be an increase in transportation air emissions associated with delivering recyclables and compost to markets. However, these transportation emissions can be expected to be small in comparison to the water, energy and resource conservation and reduced virgin production benefits of recyclable recovery and reuse and compost utilization on soils and lawns. Reduced virgin production provides significant reductions in air emissions that typically accompany virgin energy and material resource extraction, refining and virgin-content product manufacturing.

b. **Ecosystems health:** Integrated processing likely would have little effect on ecosystems health, assuming the use of suitable control measures for air emissions associated with anaerobic digestion, gasification, and energy production. In addition, as with human health, the upstream benefits of recyclables recovery, energy generation, and compost product usage could have global ecosystems benefits. The upstream benefits of energy generation would be a function of the type of energy resource displaced. For example, displacing coal energy resources typically would have greater ecosystem and human health benefits than displacing solar energy.

c. **Air:** A large integrated facility would have air emissions associated with mixed waste handling, downstream organics handling, and energy generation, but it is expected that measures would be used to control these emissions to meet State and local requirements. Potentially harmful emissions to air, water and land from virgin energy and material resource extraction, refining and virgin-content product manufacturing could be reduced if these virgin energy and material resources are displaced by recovered recyclables, energy, and composted digestate.

d. **Earth:** A large integrated facility would have a positive effect on earth resources, associated with the displacement of virgin materials and the beneficial use of compost as a fertilizer or soil amendment.

e. **Water:** A large integrated facility would have a consumptive water requirement, and could have a negative effect on local water resources. However, there could be global reduction in water usage for displaced virgin energy and material resources. .

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

a. The recycling and anaerobic digestion systems of a large integrated facility is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations. The extent to which, and even whether, thermal operations would be consistent with and supportive of the SCAP goal would depend on the mix of fossil and biogenic carbon in mixed wastes, the emissions of fossil carbon dioxide due to thermal processing and/or energy generation, the emissions of biogenic carbon that would otherwise be stored in landfilled mixed wastes, the displaced emissions of fugitive methane from landfilled mixed wastes, the difference between the amount of energy generated via thermal processing versus via landfill methane combustion and the carbon footprint of electricity (or other energy) displaced by energy from mixed wastes, and the upstream carbon footprint of displaced virgin-content product manufacturing displaced by recycled-content manufacturing using the recycled materials recovered from pre-processing incoming mixed wastes.

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** A large integrated facility would be entirely consistent with current collection and transportation practices of the County and the participating jurisdictions, particularly if the facility is located at the Cedar Hills Regional Landfill. If the facility is at another location, it would require some re-routing of transfer vehicles coming from the transfer stations. Additional program changes would be required if the facility is operated by the County, including increasing staff levels and special staff training.

b. **Time required to implement:** Implementation could take 36-48 months or longer, most likely at the higher end of the range. If the facility is located at a new site rather than at the Cedar Hills Regional Landfill, implementation could take an additional 12-18 months or longer. Based on the complexity and certain proprietary elements of an integrated facility, it is assumed that the facility would be developed under an alternative project delivery method (e.g., design-build-operate), which would shift responsibility and risk to the private sector. Implementation would include procurement (soliciting and receiving proposals from system vendors and project developers, negotiating a contract), design and permitting, construction, and commissioning and start-up.

c. **Facility siting, design, permitting and construction challenges:** Assuming the facility is sited at the Cedar Hills Regional Landfill, a primary challenge would be finding sufficient room to place the facility on the site (i.e., site planning). If located at a new site, the primary challenge would be finding a site that is acceptable to the local community, meets all land use and zoning requirements, and does not have any unmitigatable environmental impacts.

d. **Contracting for services:** Contracting the operation with a private operator would be beneficial, due to the complexity of design and operation as well as certain proprietary aspects that would be inherent to the facility. In addition, large-scale anaerobic digestion and gasification are both at early development status in the United States, particularly for processing feedstock from mixed waste. Contracting with a private operator would shift operating risk to the private entity. However, private operation could be challenged by the County's unionized labor force.

e. **Compatibility with other elements of the system:** Adding integrated processing seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal.

f. **Opportunities for regional partnerships:** Integrated processing does not appear to offer significant opportunity for regional partnerships. Since it is not expected that a facility would have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships would take away from capacity that could be used by the County.

g. **Compatibility with other regional approaches to solid waste management:** Integrated processing is highly compatible with other regional approaches, since it manages waste currently disposed of at the landfill. This practice would not require any changes to recyclable or waste handling at the either the municipal or customer level. This practice would not be expected to have an impact on existing transfer station operation, unless it became desirable to segregate incoming waste by customer types to enable diversion of a more recyclables-rich and organics-rich waste stream to the processing facility.

h. **Compatibility with the current role of the solid waste division:** Integrated processing would appear to be highly compatible with the Division's role.

i. **Compatible with existing private industry role and resources:** Integrated processing would not appear to place the County in competition with private industry.

The facility would be handling waste currently managed by the County and disposed at the County's Cedar Hill Regional Landfill. Also, it could be expected that the County would contract with private industry for design, construction and operation of the facility, which is expected to be of interest to private industry.

j. **Public Education Requirements:** Developing an integrated facility would not require any changes to recyclable or waste handling at either the municipal or customer level, which would avoid the need for public education requirements related to waste handling and collection practices. It would be appropriate to conduct outreach and education similar to current practices, for purposes of ensuring that customers continue to practice source-separation of recyclables. Also, thermal processing is commonly not well understood by the public. Therefore, it would be necessary to inform and educate the public about the practice and its risks and benefits.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** System downtime for planned and unplanned maintenance and repair could be expected. The effects of downtime could be mitigated with redundant design features, such as incorporation of two or more smaller processing lines for each element of the facility (mixed waste processing, anaerobic digestion, gasification, and electricity generation or fuel production).

   b. **Residue disposal:** The mixed waste processing operation would remove recyclables by a positive sort, separate an organic stream that would be feedstock for anaerobic digestion, and remove a small amount of bulky and non-processible material requiring landfill disposal. The remaining material would be feedstock for thermal processing. The thermal process would generate an ash residue or an aggregate that could potentially have beneficial use, but is assumed to require disposal. Compost from the anaerobic digestion process is assumed to have beneficial use, but depending on the quality of the material and other market conditions, could potentially require landfill disposal. Locating the integrated processing facility at the Cedar Hills Regional Landfill would have the advantage of a short haul to the landfill face while that facility remains in operation.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain an integrated processing facility seems like it could be integrated into the County's current labor agreements if the facility is operated by the County. However, operation and maintenance would be expected to require specialized expertise and knowledge of proprietary systems. Therefore, as noted above, private operation of the facility would be beneficial.

3. Level of service to customers

   a. **Service offerings:** Integrated processing would not impact the service offerings since the material that would be processed is already being collected and received at the County's facilities. However, it could provide an opportunity to offer customers finished compost for beneficial use.

b. **Location of service delivery:** This practice would not require a change to current curbside collection services or to practices associated with self-haul waste.

c. **Hours of service offering:** This practice would not require any changes to hours of service for curbside collection or self-haul practices.

d. **Time required by customers to utilize service:** This practice would have no impact on the time required by customers to handle their waste, since it would have no impact on curbside collection or self-haul practices.

4. Operational risks

a. **Proven performance of technology:** Mixed waste processing facilities have been in use since the 1980s in the United States but are not in widespread operation across the country. Use is most prevalent where there are legislated mandates for high waste diversion, such as in California. Renewed interest and development over the past decade has occurred, due to evolution and improvements in mechanical sorting equipment and increased interest in landfill diversion. Anaerobic digestion is well-established overseas, generally at capacities of less than 50,000 tons per year but with some facilities processing closer to 100,000 tons per year. The technology is best demonstrated for source-separated organic feedstock, but is also in use for the organic fraction of mixed waste. There are recent developments in the United States for anaerobic digestion of the organic fraction of mixed waste (e.g., San Jose, CA), but there is not yet an established operating history in the U.S. for this specific feedstock. Gasification technologies are in commercial operation overseas for processing mixed waste, but not in the United States. There are recent developments in both the United States and Canada, but there is not yet an established operating history.

b. **Market availability for materials/products:** There are well established local and regional markets for recyclables that would be recovered from mixed waste processing operations. However, these materials could potentially have reduced end-use value as compared to source-separated recyclables due to the increased possibility of contaminants or end-user perception of higher contamination. Markets are expected to be available locally and regionally for energy (fuel and/or electricity) produced from the facility, but project-specific considerations would need to be assessed to determine the most cost-effective combination of technology and energy production. The market for compost generated from mixed waste is uncertain, as the compost may be a lower-value material than compost generated from source-separated organics (e.g., with increased possibility of plastic flakes and other contaminants in the compost).

c. **Contract risks and risk sharing:** Assuming the facility is privately operated, there would be opportunity for shifting operating risk to the private sector, with contractual opportunities for revenue sharing tied to operational performance.

d. **Ability to respond to external emergencies:** The facility is not expected to have a measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding, since it would be designed to manage mixed municipal waste and not C&D material that would be generated as a result of an emergency event. The thermal process would be expected to have some flexibility to handle certain elements of C&D waste such as lumber and other wood waste. However, the use of the facility to handle C&D waste from an emergency event would displace the processing of other waste normally managed by the facility.

e. **Ability to respond to internal system emergencies and outages:** Since the facility would receive mixed waste for processing, it would be able to receive waste hauled directly from a collection route, should there be an outage at a transfer station. The equipment designed for mixed waste processing would be similar to the equipment and activities used in single stream recycling, and could be used to process single stream materials if needed. Similarly, the anaerobic digestion system could be used to process source separated organics if needed. In both cases, the additional processing capability (i.e., for single stream materials or source separated organics) would be subject to system capacity limits for receiving, storing and processing materials.

f. **Operating life:** The facility would have an estimated service life with good maintenance of at least 20 years, with planned overhaul and/or replacement of system components as required.

g. **Potential energy production:** The facility would produce energy, which could include electricity and/or fuel. The determination of which type of energy to produce would be dependent on project-specific considerations regarding potential net energy output and potential net energy revenue based on site, technology and market considerations.

h. **Impacts from feedstock contamination:** The facility would be designed to receive and process mixed waste, inclusive of contaminants that are not recyclables or organics. However, the nature of the feedstock can have a negative impact on the value of the recyclables recovered and the value of the compost produced, associated with contamination that carries through to the products. Thermal processing systems have different levels of pre-processing requirements for feedstock consistency, with some technologies being very adaptable to varying feedstock characteristics.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** Assuming the mixed waste processing system would be designed to operate two, eight-hour shifts per day, five days per week, there would be opportunity to increase operating capacity by operating longer shifts (or a third shift), or by adding an operating day. However, unless planned for, there could be upfront feedstock receiving and storage limitations that constrain increased operating capacity. The anaerobic digestion and thermal processing systems would have the ability to scale up capacity with the addition of more processing units, but this would require planning during design and construction to ensure space is available and to provide for sufficiently-sized support systems. Capacity could potentially be reduced by a corresponding reduction in operating hours and subject to the turn-down capability of the thermal system, but would be expected to have a negative impact on financial performance.

   b. **Adaptability to system changes and demands:** The facility's ability to adapt to system changes and demands would be dependent on the change. For example, if the facility is located at the Cedar Hills Regional Landfill and the landfill closes, there would be increased cost to transport residue to an alternate landfill for disposal. If system changes result in increased source-separation of recyclables and/or organic materials with management of those materials through alternate means, the facility would be less cost-effective as it would recover fewer recyclables and generate less energy.

   c. **Changes in feedstock quantity and composition:** Depending on the circumstances, changes in feedstock quantity and composition could have an impact on project economics. Mixed waste processing systems are inherently designed to process variable feedstock and would be adaptable to certain changes in the composition of the mixed waste. The anaerobic digestion system would have some adaptability to changes in the organic nature of the feedstock, but significant changes (e.g., removal of food waste for other management options) could impact system operations and energy production. Thermal systems are designed to process feedstock based on an energy balance. Although the system would be designed across a range of expected feedstock composition, if the composition materially changes the quantity processed may also have to change to maintain a proper energy balance.

   d. **Impact on landfill life and operation:** A large, integrated facility would be expected to have a positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill. The removal of organic waste from the material being disposed would reduce the quantity of landfill gas produced, and would reduce the quantity of fugitive methane emissions from the landfill.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** Assuming the facility is located at the Cedar Hills Regional Landfill and receives mixed waste generated County-wide, any impact on fees would be expected to be equitable for all participating jurisdictions.

   b. **Siting of facilities:** Assuming the facility is located at the Cedar Hills Regional Landfill, there would not appear to be any significant facility siting challenges involved since it would be receiving and processing waste that is already going to the landfill.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Assuming the facility is located at the Cedar Hills Regional Landfill, this practice could be seen as having a small effect on the livability and character of the communities served. Although it would be receiving and processing waste already going to the landfill, the nature of operations of the integrated facility would be different from that of landfill operations. Therefore, the community may view the facility as having a negative effect, particularly if the landfill continues to operate.

   b. **Job creation:** An integrated facility of the size and type described would be expected to require 100 or more staff for operation of the facility. Although many of these positions would be lower-skilled tipping floor operators, general laborers, and sorters, some positions would be for more highly skilled staff (e.g., management, administrative, supervisory and key maintenance staff).

   c. **Impacts on cities:** This practice would have no apparent impact on the cities, with the exception of shared benefits (e.g., associated with increased recycling and energy production) and shared costs, as applicable, if the facility is financially more costly than current practices.

   d. **Susceptibility to impacts from action of cities:** No susceptibility is apparent, other than the impacts already discussed of changing waste composition, such as if cities ramp up their source separation programs and participation therein.

   e. **Public education requirements:** Developing an integrated facility would not require any changes to recyclable or waste handling at either the municipal or customer level, which would avoid the need for public education requirements related to waste handling and collection practices. It would be appropriate to conduct outreach and education similar to current practices, for purposes of ensuring that customers continue to practice source-separation of recyclables. Also, thermal processing is commonly not well understood by the public. Therefore, it would be necessary to inform and educate the public about the practice and its risks and benefits.

3. Impact on Employees

   a. **Health and safety:** The integrated processing facility, as described, creates operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.

   b. **Job security:** Adding integrated processing is not expected to significantly impact job security and opportunities for County staff, since it is likely that the facility would be privately operated. Transfer station operations are not expected to be impacted; however, diversion of waste from landfill disposal could potentially reduce staffing needs at the landfill.

   c. **Job satisfaction:** Many of the staff employed for system operation would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation. The supervisory and more specialized operation and maintenance functions may provide satisfying job opportunities.

Summary

This best practice provides for high diversion and a positive impact on resource consumption, while limiting the thermal footprint through the prioritization of recycling and biological processing. It is compatible with the County's transfer system, and would not require any changes to collection practices or transfer station operations. However, there are economic risks for this best practice. The facility would require a large amount of capital investment, both in terms of building space and equipment, and would need 15 to 30 acres or more for overall site development. It would require 100 or more staff, and would be costly to operate and maintain. Except under the most favorable cost and revenue conditions, which could include the production of fuel in place of electricity, this best practice may not reach a financial break-even point in King County. Thermal processing is commonly not well understood by the public, so outreach and education would be required to inform the public about the associated risks and benefits. This best practice appears to be better suited for private operation, due to the complexity and risk involved. Consideration of this best practice together with Best Practice No. 16 (Solicitation of Private Industry Handling of Waste) would provide industry input needed to address economic risk and other uncertainties.

Recommendation

This best practice is promising, but needs input from private industry before implementation.

Best Practice No. 13

Implement small-scale thermal processing with front-end recycling.

Best Practice Description

This best practice is similar to Best Practice No. 11 (mixed waste processing with thermal conversion), but at a much smaller scale. Thermal processing is generally considered to be most cost-effective for large-scale applications (near to or in excess of 300,000 tons per year), due to the economies of scale associated with waste processing and energy production. However, there is a class of technology providers offering modular, shop-fabricated thermal processing units with capacities ranging from about 3,000 tons per year to about 20,000 tons per year (approximately 10 tons per day to 50 tons per day), which may be cost-effective for project-specific applications.

For King County, the use of small-scale thermal processing (e.g., pyrolysis, gasification or plasma gasification) with front-end recycling offers the opportunity to potentially locate a system at one or more of the Division's transfer stations. This practice would provide several benefits, including: diverting waste from landfill disposal; reducing transportation costs associated with hauling waste from the transfer station to the landfill; recovering recyclables; and generating electricity, for use at the transfer station and/or for sale to the grid. Modular application of small-scale thermal technology at a transfer station could be for long-term operation or for a shorter-term demonstration project with potential for continuing operations and possibly expanding capacity in the future.

For purposes of evaluation, this best practice is based on installation of a single, 25 ton per day gasifier at an existing transfer station. Assuming the system is operated on a continuous basis and allowing for planned and unplanned downtime (about 85% availability), the system would be able to process about 7,800 tons per year of waste (less than 1% of the waste currently disposed at the Cedar Hills Regional Landfill). Mixed waste received at the transfer station would be pre-processed to recover cardboard, ferrous metal, aluminum, and possibly other materials for recycling. The recycling system would be smaller and less robust than the extensive mixed waste processing systems described for other practices, and could be expected to recover about 400 tons per year of recyclables (about 5% of the waste processed). In addition to recycling, pre-processing may include shredding, grinding, screening, drying, and/or pelletizing, as required by the particular technology for optimum performance. Other system components would include waste handling and conveyance equipment, the gasifier, syngas cleanup and conditioning equipment, power generation equipment, air pollution control systems, ash or aggregate handling and conveyance equipment, and support systems.

System performance can vary widely based on the specific technology used and the characteristics of the feedstock processed. Small-scale thermal processing systems would generate electricity using engines, micro turbines, or fuel cells. Generally, small-scale thermal systems can be expected to generate between 400 and 700 kilowatt hours (kWh) of electricity per ton of feedstock when processing municipal waste, after meeting the system's own electricity needs. Many small-scale providers are exploring fuel applications, but gas-to-liquid technologies for small-scale applications have only been demonstrated on a limited basis. In addition to recovering certain recyclables and generating electricity, the system will produce an ash or aggregate material. The quantity of ash or aggregate generated will depend on the characteristics of the feedstock, and can be expected to range from 5% to 25% by weight when processing waste from the transfer station, with 15% being a reasonable planning level assumption. This material may have beneficial use, or could require landfill disposal.

A small modular system installed at an existing facility could be expected to have an overall footprint on the order of 15,000 to 30,000 square feet to accommodate equipment (pre-processing, gasification and power generation), waste storage and handling activities, and other operational functions. Capital costs could range from $5 million to $10 million (or more, if considering plasma technology). Layout and cost variability are based on technology-specific requirements and the extent to which existing infrastructure could be used. Operations could require 8 to 10 staff, including general laborers for sorting and waste handling, supervisory/operations staff, and maintenance staff. The system could be operated by County staff with training from the technology provider.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

    a. **Capital Costs:** A small thermal processing facility with limited front-end recycling, installed at an existing transfer station and designed to generate electricity for use by the transfer station and/or for sale to the grid, could be expected to have a capital cost ranging from $5 million to $10 million. Costs may be higher for a system designed to produce fuels instead of electricity.

    b. **O&M Costs:** Waste handling (including pre-processing) would generally be performed over a single shift corresponding with transfer station operating hours, with a reduced staff for continued gasifier operation on a second and third shift. Assuming the system requires 8 to 10 employees at an average (burdened) labor cost of approximately $63 per hour (County operation), and accounting for other O&M costs such as utilities, consumables, and non-labor repair costs, the overall O&M cost might range from $160 to $200 per ton of waste processed.

    c. **System Revenue:** The system could be expected to have revenue ranging from $26 to $47 per ton of waste received for processing. In addition to system revenues, there would be an avoided disposal cost, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost. Also, King County estimates that landfill air space at the Cedar Hills Regional Landfill is valued at approximately $7.00 per ton. Revenues would be generated from the sale of recyclables and from the sale of electricity (or other energy). Assuming recovery of approximately 400 tons per year of recyclables, with average market values ranging from $80 to $160 per ton, revenue from recyclables may range from $4 to $8 per ton of waste processed. Assuming electricity production, net electrical output could be expected to range from 400 to 700 kWh per ton of waste processed, depending on the characteristics of the waste and the project configuration. Assuming a power sale price of $0.055 per kWh, electricity revenues could range from $22 to $39 per ton of waste processed. The production of fuels instead of electricity could potentially improve project economics, but would require further study. If the system produces vitrified aggregate with beneficial use, additional revenue may be generated. However, for feasibility and planning purposes this material is often considered to be neutral as a revenue stream or a cost to the project (for transportation and disposal as residue).

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Based on very approximate estimated revenue, avoided disposal cost, the value of landfill air space, O&M costs, and the cost of capital, a small-scale recycling and thermal processing system would not be expected to reach a financial break-even point, expect perhaps for project-specific applications where unique cost savings may be achievable (e.g., where transportation costs may be high and could be offset with on-site processing). Otherwise, costs may need to be offset with grants, revenue associated with additional specialty feedstock, or with collaboration with a technology provider for a demonstration project to showcase the technology.

   b. **Sustainability of funding sources:** Costs associated with the system would be offset to some extent by revenues associated with sale of recyclables and electricity, which are subject to variability as discussed below. Otherwise, as for other County practices such as landfill disposal, the cost of the system would need to be covered by the established rate structure imposed on users, amended as necessary.

   c. **Certainty of costs:** Capital and O&M costs are not well defined for small-scale thermal processing systems, since most systems have been demonstrated to only a limited extent, with no commercial applications in the United States. Costs for systems producing fuel instead of electricity are even less defined. Therefore, costs can be expected to be subject to a high level of uncertainty.

   d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues for recyclables are subject to market fluctuations, which can vary widely over time. In addition, revenues for recyclables are subject to the quantity of recyclables in the mixed waste and the quality of the material recovered, both of which are subject to uncertainty. Energy revenues are subject to uncertainty related to the amount of energy that would be produced for sale. Industry values are variable and highly dependent on the characteristics of the feedstock. As discussed for other best practices, energy revenues are also subject to uncertainty of forecasting market prices and the ability to enter into a long-term energy purchase agreement with favorable terms and conditions.

e. **Opportunities for regional risk sharing:** A small-scale recycling and thermal processing system at one of the County's transfer stations would not appear to offer an opportunity for regional sharing of the risks or benefits.

B. Environmental

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** A small-scale recycling and thermal processing system would add only a small amount of recycling and diversion (1% or less).

b. **Effect on landfill operations:** A small-scale recycling and thermal processing system would have a minimal effect on landfill operations, since it would divert no more than 1% of the waste currently managed at the landfill.

2. Impact on resource consumption

a. **Land:** A small-scale recycling and thermal processing system would require less than an acre of land, and in some cases could be installed at an existing transfer station within a footprint as small as 15,000 square feet.

b. **Water:** The system would require a modest amount of water for process operations. Depending on the type of energy that might be displaced by the electricity generated, there may be some upstream water conservation due to reduced energy resource exploration, refining and combustion.

c. **Energy:** The system would meet its own electrical needs, but modest amounts of hydrocarbon fuel would be required to support operations, such as for start-up of the gasifier and for operation of mobile equipment. The system would reduce the need for hauling waste from the transfer station to the landfill, resulting in savings in transportation energy. It may provide upstream virgin energy resource conservation accruing energy conservation benefits to the recycling and thermal processing systems.

d. **Material resources:** The recovery of recyclables would have a positive effect on the consumption of material resources, but the effect would be small due to the limited amount of recyclables recovered. The thermal process would have very little effect on the consumption of material resources, even for systems that produce an aggregate with beneficial use.

3. Impact on environmental resources

    a. **Human health:** A small-scale recycling and thermal processing system would have little effect on human health assuming the use of dust and odor control measures for waste handling, and suitable control measures for air emissions associated with thermal processing and/or energy generation. Reduced virgin production associated with recovery of recyclables and generation of energy would provide reductions in air emissions that typically accompany virgin energy and material resource extraction, refining and virgin-content product manufacturing. There would be a decrease in transportation air emissions associated with processing waste at the transfer station rather than hauling it to the landfill for disposal.

    b. **Ecosystems health:** A small-scale recycling and thermal processing system installed at an existing transfer station would have very little effect on ecosystems health. However, as with human health, the upstream benefits of recyclables recovery and energy generation could have ecosystems benefits. The upstream benefits of energy generation would be a function of the amount and type of energy resource displaced. For example, displacing coal energy resources typically would have greater ecosystem and human health benefits than displacing solar energy.

    c. **Air:** A small-scale recycling and thermal processing system would have air emissions associated with thermal processing and/or energy generation, but it is expected that measures would be used to control these emissions to meet State and local requirements. Potentially harmful emissions to air, water and land from virgin energy and material resource extraction, refining and virgin-content product manufacturing could be significantly reduced if these virgin energy and material resources are displaced by recovered recyclables and electricity from the facility.

    d. **Earth:** The system would have a small but positive effect on earth resources, associated with the displacement of virgin materials and energy resources.

    e. **Water:** The system would have a modest water usage requirement, and could have a small but negative effect on local water resources. However, there could be global reduction in water usage for displaced virgin energy and material resources.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

    a. This practice is seen as consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

    a. **Program changes:** A small-scale recycling and thermal processing system installed at an existing transfer station is entirely consistent with current collection and transportation practices of the County and the participating jurisdictions. Program changes would be required for County operation, including increasing staff levels, providing for special staff training, and increasing facility maintenance work load.

b. **Time required to implement:** Installation at an existing transfer station could take 24-36 months. Based on the complexity and proprietary elements of thermal processing, it is assumed that a system vendor would provide design, installation, commissioning and start-up, training of County staff in operation and maintenance, and perhaps O&M support for some period of time.

c. **Facility siting, design, permitting and construction challenges:** Assuming the system is installed at an existing transfer station, the primary challenge would be finding space for the operation without interfering with ongoing transfer station operations.

d. **Contracting for services:** Contracting the operation with a private operator could be challenged by the County's unionized labor force, particularly since the work areas and responsibilities would overlap for installation at an existing transfer station. Also, many small-scale thermal providers are equipment suppliers that do not offer operating services. Given the small scale of the system, it might prove difficult to find an independent, qualified, private operator willing to take on the work and assume the risk of operation. Therefore, a small-scale thermal system at an existing County transfer station would most likely be operated by County staff.

e. **Compatibility with other elements of the system:** Adding small-scale recycling and thermal processing at an existing transfer station seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal.

f. **Opportunities for regional partnerships:** Due to the scale of the system and the location at an existing transfer station handling County waste, this practice does not appear to offer opportunity for regional partnerships.

g. **Compatibility with other regional approaches to solid waste management:** Small-scale recycling and thermal processing at an existing transfer station is highly compatible with other regional approaches, since it would manage waste currently received at the transfer station and ultimately disposed of at the landfill. This practice would not require any changes to recyclable or waste handling at the either the municipal or customer level. However, the system would need to be designed, installed and operated to prevent any negative impacts on existing transfer station operation.

h. **Compatibility with the current role of the solid waste division:** This practice would appear to be highly compatible with the Division's role.

i. **Compatible with existing private industry role and resources:** This practice would not appear to place the County in competition with private industry. The facility would be handling waste currently managed by the County at County facilities.

j. **Public Education Requirements:** Installing a small-scale recycling and thermal processing system at an existing transfer station would not require any changes to recyclable or waste handling practices at either the municipal or customer level. However, thermal processing is commonly not well understood by the public. Therefore, it would be necessary to conduct outreach and education, for purposes of informing and educating the public about the practice and its benefits.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** System downtime for planned and unplanned maintenance and repair could be expected. As a small-scale system, there is likely to be little or no redundancy built into the process. Since the system would be located at an existing transfer station, waste would be bypassed to the landfill during periods of downtime, using existing transfer capability.

   b. **Residue disposal:** The system could be expected to generate some residue requiring landfill disposal. The quantity of residue could range from 5% to 15% of the waste processed. Since the system would be located at an existing transfer station, the residue would be managed using existing transfer station capability.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain the system seems like it could be integrated into the County's current labor agreements.

3. Level of service to customers

   a. **Service offerings:** Adding small-scale recycling and thermal processing at an existing transfer station would not impact service offerings to customers since the material is already being collected and received at the County facilities.

   b. **Location of service delivery:** This practice would not require a change to current curbside collection services or to practices associated with self-haul waste.

   c. **Hours of service offering:** This practice would not require any changes to hours of service for curbside collection or self-haul practices.

   d. **Time required by customers to utilize service:** This practice would have no impact on the time required by customers to handle their waste, since it would have no impact on curbside collection or self-haul practices.

4. Operational risks

   a. **Proven performance of technology:** Small-scale thermal processing for municipal waste has been used by some technology providers for commercial applications overseas. Many technology providers have operated their technology only on a demonstration basis, such as under intermittent operating conditions. Overall, there is limited operational data, which presents operational and performance risks. However, there appears to be growing interest in the United States for use of small-scale thermal processing systems, with several vendors reporting sale of equipment to private operators for specialized applications.

b. **Market availability for materials/products:** There are well established local and regional markets for recyclables that would be recovered. Markets are expected to be available locally and regionally for energy (fuel and/or electricity), which could also be used to meet the needs of the transfer station. Project-specific considerations would need to be assessed to determine the most cost-effective combination or technology and energy production.

c. **Contract risks and risk sharing:** Assuming the system is operated by the County, it is expected that the County would take risk for system operation and sale of electricity and recyclables.

d. **Ability to respond to external emergencies:** The system is not expected to have any measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding, primarily because of its small capacity in comparison to overall system waste volumes. It is worth mentioning, however, that some small-scale thermal technology providers offer skid-mounted or transportable systems that could be mobilized for purposes of managing waste from emergencies, subject applicable regulatory requirements.

e. **Ability to respond to internal system emergencies and outages:** The system is not expected to have any measurable effect on the County's ability to respond to internal emergencies, primarily because of its small capacity in comparison to overall system waste volumes.

f. **Operating life:** The system could be designed and fabricated to have a service life of 10 to 20 years, with good maintenance and planned overhaul and/or replacement of system components as required. However, since most small-scale thermal processing systems have not operated for long-term periods under continuous operating conditions, estimated operating life is subject to uncertainty.

g. **Potential energy production:** The system would produce energy (electricity and/or fuel) which could be used to meet system and transfer station needs and/or which could be sold. The determination of type and use of energy would be dependent on project-specific considerations regarding potential net energy output and potential net energy revenue based on site, technology and market considerations.

h. **Impacts from feedstock contamination:** The system would be inherently designed to receive and process mixed waste, inclusive of contaminants that are typically found in municipal waste. However, the characteristics of the feedstock directly impact system operation, including the amount of residue requiring disposal and the amount of energy generated for use or sale. Most small-scale systems incorporate pre-processing to remove inert materials such as rubble and broken glass and to create a more consistent feedstock, and some systems include the addition of some fossil fuel (such as natural gas) or supplemental feedstock (such as industrial plastics or shredded tires) to optimize system performance.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** An increase in capacity would require installation of additional processing units, which would be limited based on space constraints at the existing transfer stations.

   b. **Adaptability to system changes and demands:** As a small-scale system designed to be integrated into the operations of an existing transfer station, the system would appear to offer limited opportunity to adapt to other applications. As an example of adaptability, the system could perhaps be used to handle specific feedstocks other than waste currently managed at the transfer station, such as industrial waste, wood waste, biosolids, or other biomass, subject to regulatory requirements and the logistical ability to handle additional feedstock at the transfer station.

   c. **Changes in feedstock quantity and composition:** Thermal systems are designed to process feedstock based on an energy balance. If the composition of the feedstock changes, the quantity processed by the system will also have to change to maintain a proper heat input. Under normal operations for municipal waste processing, the system would be designed around an expected range of waste composition, providing some flexibility. If there are significant changes in feedstock composition, there can be an impact on system operation and project economics.

   d. **Impact on landfill life and operation:** A small-scale recycling and thermal processing system would be expected to have a small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** A small-scale recycling and thermal processing system would serve only the transfer station at which it was located. Any net financial impact of the system would need to be applied on a system-wide basis to ensure fees remain equitable for all system users.

   b. **Siting of facilities:** The system would not require siting a new facility. It would be located at an existing transfer station and would be handling materials already delivered to that facility. The system could improve siting issues, from the perspective that it would reduce truck traffic currently hauling waste from the transfer station to the landfill. However, thermal processing operations can raise concern with the public regarding air emissions and other perceived environmental issues. Therefore, even though installation would be at an existing facility, there could be some siting challenges regarding public understanding and acceptance.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** As a small-scale system located at an existing transfer station, this practice is not seen as having any effect on the livability and character of the communities served since it would be receiving and processing waste that is already going to the facility.

   b. **Job creation:** A small-scale recycling and thermal processing system located at an existing transfer station would be expected to create 8 to 10 new positions, some of which may be entry level, low-wage opportunities.

   c. **Impacts on cities:** This practice would have limited impact on the cities. It could have a positive impact of reducing truck traffic for the City in which it is located. It could have a negative impact of increased costs, shared across the system, assuming the system would not reach a financial break-even point.

   d. **Susceptibility to impacts from action of cities:** No susceptibility is apparent.

   e. **Public education requirements:** Installation of a small-scale recycling and thermal processing system at an existing transfer station would not require any changes to recyclable or waste handling practices at either the municipal or customer level. However, thermal processing systems are often not well understood by the public and operations can raise concern regarding air emissions and other perceived environmental issues. Therefore, it would be necessary to conduct outreach and education for purposes of informing and educating the public about the practice and its benefits.

3. Impact on Employees

   a. **Health and safety:** Small-scale recycling and thermal processing creates operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.

   b. **Job security:** This practice is not expected to significantly impact job security and opportunities for County staff.

   c. **Job satisfaction:** Many of the staff employed for system operation would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation.

Summary

This best practice would be consistent with current waste collection and handling practices. It could be installed at an existing transfer station, and could be operated by the County with training and perhaps technical support from the system provider. However, based on estimated costs and revenues this best practice would not be expected to reach a financial break-even point, except perhaps for limited applications where unique cost savings may be achievable (i.e., off-setting high transportation costs). This best practice would provide only a very small diversion benefit, and would have negligible impacts on resource consumption. It would have high performance risk, since small-scale gasification systems have not been substantially demonstrated for municipal solid waste on a commercial basis. Performance risk may increase if the system is operated by the County rather than by the system provider.

Recommendation

This best practice is not recommended. No further action is suggested.

Best Practice No. 14

Implement emerging plastic-to-oil conversion technology with other options or as a stand-alone practice.

Best Practice Description

Plastic-to-oil conversion is an emerging technology that can serve as a complement to plastic recycling. This practice converts scrap plastic to a crude oil product. As a waste management practice, plastic-to-oil conversion is intended for non-recyclable and/or low-value plastic material, including plastic items that are made up of multiple resins, materials that are co-mingled by resin and difficult to sort, and plastics that are otherwise too dirty or contaminated to economically recycle. Sources of scrap plastic can include plastics not recycled from municipal solid waste, and other sources such as agricultural plastics, oil bottles, auto shredder residue, scrap carpet, and electronic waste. For consideration as a potential practice for King County, a plastic-to-oil conversion process would need to receive scrap plastic already separated from municipal solid waste (e.g., from a MRF or mixed waste processing facility) or from other sources generating scrap plastic that would otherwise be landfilled. Cost-effectively obtaining a steady supply of feedstock could be a challenging aspect of this best practice.

Plastic-to-oil technology commonly uses pyrolysis, a thermal conversion process. Plastic-to-oil technologies have been developed to a limited extent in Europe and Asia, and one company (Agilyx) has constructed and operates a 10 ton per day (3,500 ton per year) production demonstration facility in Tigard, Oregon. Due to the emerging nature of plastic-to-oil technology, there is limited technical, cost and performance information available, and such information is primarily associated with literature in the public domain.

The Agilyx demonstration facility in Oregon serves as a representative model of a potential system for King County. Pre-processing includes shredding and/or grinding, with batch feeding of the prepared feedstock to the pyrolysis process. The plastic is indirectly heated to a temperature in the range of 750°F to 1,500°F. A natural gas fired burner is used to provide process heat, in the form of hot air circulating around the enclosed pyrolysis chamber. The pyrolysis process converts the solid plastic first to liquid and then to a gas, and leaves behind a solid residue (char). The gases are collected, cooled and condensed into crude oil. Lighter gases (residual hydrocarbons) that do not condense into an oil product are combusted in a thermal oxidizer or could potentially be used to displace the onsite use of natural gas for process energy. The char is residual material that the process is unable to convert to a gas; its characteristics would be directly related to feedstock quality.

Plastic-to-oil conversion has been demonstrated, and is generally proposed for use, at small-scale capacities up to about 10,000 tons per year (about 30 tons per day). In King County, the amount of plastic material remaining in the waste stream is about 12.2%, consisting of #1 through #7 containers and packaging, film plastic, and other plastic packaging and products (Waste Characterization and Customer Survey Report, October 2012). Based on the quantity of waste disposed in 2011 at the Cedar Hills Regional Landfill, approximately 98,000 tons of plastic is landfilled annually in King County. Therefore, there is sufficient plastic waste to support a 10,000 ton per year (30 ton per day) plastic-to-oil system, even if the County implements other practices to increase plastic recycling. However, separating the plastic from the waste stream and directing it to processing could be challenging.

A 10,000 ton per year plastic-to-oil system could be expected to have a capital cost on the order of $10 million, and may require approximately 20,000 to 30,000 square feet of area. Operations would be expected to occur on a continuous basis, and could be operated by County staff with training from the technology provider. Oil production rates would depend on feedstock characteristics. Based on literature values, it could be expected to range from 200 to 240 gallons of oil per ton of plastic feedstock. Assuming the system would produce, on average, approximately 200 gallons of crude oil per ton of plastic processed, annual oil production would be about 2 million gallons (or about 47,000 barrels).

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** A 10,000 ton per year plastic-to-oil system could be expected to have a capital cost of approximately $10 million, not including costs associated with a MRF or mixed waste processing facility, if such additional facility is the source of plastic for the system. Additional costs to acquire plastic feedstock are not yet defined and could potentially be substantial.

   b. **O&M Costs:** The system is not expected to require a large number of operating staff, but it would operate continuously and would require staff for all operating shifts. Staffing requirements would include one or more equipment operators per shift, maintenance personnel, and management staff. In addition to labor costs, O&M costs would include utilities (electricity, natural gas, water and sewer), consumables, and non-labor capital repair and replacement costs. For a 10,000 ton per year system, annual O&M costs are expected to range from $2 to $3 million ($200 to $300 per ton of plastic processed).

   c. **System Revenue:** Revenues would be generated from the sale of crude oil. Assuming production of about 47,000 barrels of crude oil per year at a price of $100 per barrel, annual revenues would be about $4.7 million ($470 per ton of plastic processed). These revenues are subject to uncertainty, as discussed below. In addition to revenues from sale of oil there would be an avoided disposal cost, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost. Also, King County estimates that landfill air space at the Cedar Hills Regional Landfill is valued at approximately $7.00 per ton.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Based on very approximate estimated revenue, avoided disposal cost, the value of landfill air space, O&M costs and the cost of capital, and assuming the plastic feedstock could be cost-effectively acquired, a 10,000 ton per year plastic-to-oil system could be expected to reach a financial break-even point. However, the cost to separate, collect and transport the plastic feedstock has not yet been determined, and could significantly impact project economics.

   b. **Sustainability of funding sources:** Costs associated with the processing system would likely be offset by revenues associated with sale of crude oil, subject to uncertainty as discussed below. Costs to acquire the plastic feedstock would require further study.

   c. **Certainty of costs:** Capital and O&M costs are not well defined for plastic-to-oil conversion systems, since most systems have been demonstrated to only a limited extent, with no commercial applications in the United States. Therefore, costs can be expected to be subject to a high level of uncertainty. Also, if the plastic-to-oil system must be paired with a MRF or mixed waste processing facility, or if new collection infrastructure is required, additional costs would be incurred.

   d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues for sale of crude oil are subject to inherent uncertainties in price forecasting. For feasibility and planning purposes, the price can be estimated at $100 per barrel. NYMEX futures crude oil prices for February 2014 ranged from approximately $98 to $101 per barrel[1]. The Washington State Department of Commerce projects that petroleum prices will likely remain above $100 per barrel, and cites EIA 2013 forecasts of a short-term decline in prices followed by a steady increase of about 1.5% per year over about a 20-year period[2]. Even so, prices have only recently risen above $100 a barrel; if prices drop to more historical values, project economics would be negatively impacted.

   e. **Opportunities for regional risk sharing:** A 10,000 ton per year plastic-to-oil system would not appear to offer an immediate opportunity for regional sharing of the risks or benefits, due to the small-scale capacity of the system compared to the amount of plastics disposed by King County at the Cedar Hills Regional Landfill. However, if the technology is proven viable, future expansion of the system could provide for regional collaboration.

[1] http://www.eia.gov/dnav/pet/pet_pri_fut_s1_d.htm

[2] Petroleum Supply and Use in Washington State, Washington State Department of Commerce, October 2013, (http://www.commerce.wa.gov/Documents/Petroleum-Whitepaper-7-15-2013.pdf)

B. Environmental

1. Impact on waste prevention, recycling and diversion

   a. **Effect on waste prevention, recycling and diversion programs:** A 10,000 ton per year plastic-to-oil system would add only a small amount of diversion (about 1% of current disposal rates). If the system were expanded in the future, it could provide up to 12% diversion based on the quantity of plastic that is currently disposed at the Cedar Hills Regional Landfill.

   b. **Effect on landfill operations:** The system would have a minimal effect on landfill operations, unless expanded to handle most of the plastic present in the waste disposed.

2. Impact on resource consumption

   a. **Land:** The system would require limited space, and could potentially be installed at an existing County facility within a footprint as small as 20,000 square feet.

   b. **Water:** The system would not require a significant amount of water for process operations. With the production of crude oil, there would be some upstream water conservation due to reduced energy resource exploration, refining and combustion.

   c. **Energy:** The system would require electricity and natural gas to support operations, but would produce a net positive amount of energy in the conversion of plastic to crude oil. There is potential opportunity to replace the use of natural gas for process heat to the use of non-condensable gases from the conversion process, further improving energy efficiency.

   d. **Material resources:** The system would have a positive effect on the consumption of material resources, offsetting exploration for and production of crude oil.

3. Impact on environmental resources

   a. **Human health:** A plastic-to-oil system likely would have little effect on human health, assuming the use of suitable control measures for air emissions associated with the use of natural gas and the combustion of non-condensable process gases. Transportation impacts could be minimized by co-locating the system at or near the source of plastic generation/recovery (e.g., at a MRF or mixed waste processing facility) or otherwise at a central location, and by selling the oil to a local refinery. The upstream benefits of synthetic oil production could have benefits associated with the displacement of fossil fuel.

   b. **Ecosystems health:** A plastic-to-oil system likely would have little effect on nearby ecosystems health, assuming the use of suitable control measures for air emissions associated with the use of natural gas and the combustion of non-condensable process gases. In addition, as with human health, the upstream benefits of crude oil production could have global ecosystems benefits.

c. **Air:** A plastic-to-oil system would have air emissions associated with the use of natural gas for process heat and the combustion of non-condensable process gases, but it is expected that measures would be used to control these emissions to meet State and local requirements.

d. **Earth:** The system would have a small but positive effect on earth resources, associated with the displacement of energy resources.

e. **Water:** The system would not require significant amounts of water, and would not be expected to have a significant effect on local water resources. However, there could be global reduction in water usage for displaced virgin energy resources.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

a. This practice could be seen as consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations, assuming the characteristics of the synthetic fuel oil are comparable to or better than petroleum crude oil and assuming the methods for acquiring plastic feedstock do not inhibit plastic recycling.

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** A plastic-to-oil system would require program changes to divert plastic in the waste stream to the system for processing. This could include pairing the system with a new mixed waste processing facility, implementing changes to collection practices for non-recyclable plastic, and/or implementing other programmatic changes to divert plastic to the system for processing. Program changes would also be required for County operation, including increasing staff levels, providing for special staff training, and increasing facility maintenance work load.

b. **Time required to implement:** Implementation could be expected to take 24 to 36 months to procure and install a system, train County staff, and secure an off-take agreement for crude oil. Implementation time could be longer if a new building is required to house equipment and operations, or if other program changes are required to secure the plastic feedstock. There is also uncertainty regarding permitting requirements for a plastic-to-oil facility, including how it would be permitted and how long it would take.

c. **Facility siting, design, permitting and construction challenges:** If the system is installed at an existing transfer station, the primary challenge would be finding space for the operation without interfering with ongoing transfer station operations.

d. **Contracting for services:** Contracting the operation with a private operator could be challenged by the County's unionized labor force, particularly since the work areas and responsibilities would overlap for installation at an existing transfer station. Also, the technology providers may prefer to serve as equipment suppliers and may not offer operating services. Given the small scale of the system, it might prove difficult to find an independent, qualified, private operator willing to take on the work and assume the risk of operation. Therefore, a plastic-to-oil system installed at an existing County facility would most likely be operated by County staff with training by the system provider.

e. **Compatibility with other elements of the system:** Adding a plastic-to-oil system seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal, but will require consideration of the means by which the plastic feedstock will be diverted to the system for processing.

f. **Opportunities for regional partnerships:** Due to the scale of the system, this practice does not appear to offer opportunity for immediate regional partnerships. If the technology is demonstrated to be technically and financially viable, future expansion could provide for regional collaboration.

g. **Compatibility with other regional approaches to solid waste management:** A plastic-to-oil system located at an existing facility handling County waste would be highly compatible with other regional approaches, since it would manage waste currently disposed of at the landfill. However, unless paired with a mixed waste processing facility or implemented with other means to acquire the plastic feedstock, this practice would be expected to require changes to recyclable and waste handling at the municipal and customer level. It would also need to be designed, installed and operated to prevent any negative impacts on transfer station operations.

h. **Compatibility with the current role of the solid waste division:** This practice would appear to be highly compatible with the Division's role.

i. **Compatible with existing private industry role and resources:** This practice would not appear to place the County in competition with the private waste management industry. The facility would be handling waste currently managed by the County at County facilities.

j. **Public Education Requirements:** If changes are required at a municipal and/or customer level to divert waste plastic for processing, it would be necessary to conduct significant public outreach and education regarding such changes. It would also be necessary to inform and educate the public about the practice and its risks and benefits, due to the lack of public knowledge and familiarity with such systems.

2. Complexity of system and facility operation

    a. **Potential facility downtime:** System downtime for planned and unplanned maintenance and repair could be expected. Although individual system configurations could vary significantly, the Agilyx demonstration facility and commercial development model is constructed as a continuously-operated batch process with multiple processing lines. This type of configuration is beneficial, since it minimizes the possibility of total facility downtime and the need for bypassing of feedstock to disposal.

    b. **Residue disposal:** The system will generate residue (char) that could potentially have beneficial use applications, but for planning purposes is assumed to require landfill disposal. The quantity and characteristics of the char will depend on the type and level of contaminants in the plastic feedstock. Literature values for char production range from less than 10% to as much as 25% by weight of the material processed, with a value ranging from 10% to 15% commonly cited. For the system described above, this would be about 1,000 to 1,500 tons per year of char requiring disposal.

    c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain the system seems like it could be integrated into the County's current labor agreements.

3. Level of service to customers

    a. **Service offerings:** Adding a plastic-to-oil system would increase service offering to customers, since it would provide a means for customers to divert additional material currently collected as waste.

    b. **Location of service delivery:** This practice could require a change to current curbside collection services or to practices associated with self-haul waste, if customers are required to separate additional types of plastic from the waste stream.

    c. **Hours of service offering:** This practice would not require any changes to hours of service for curbside collection or self-haul practices.

    d. **Time required by customers to utilize service:** This practice would have little or no impact on the time required by customers to utilize services, expect perhaps a small amount of additional time sorting additional plastic from the waste if required to do so for implementation purposes.

4. Operational risks

    a. **Proven performance of technology:** Plastic-to-oil technologies have been developed to a limited extent in Europe and Asia, and one company (Agilyx) has constructed and operates a 10 ton per day (3,500 ton per year) production demonstration facility in Tigard, Oregon. As an emerging technology there is a limited data, which presents operational and performance risks.

b. **Market availability for materials/products:** The Agilyx demonstration facility in Tigard, Oregon has produced in excess of 350,000 gallons of crude oil and has an off-take agreement with U.S. Oil & Refining in Tacoma, Washington for purchase of the crude oil. It could be reasonably expected that a plastic-to-oil facility in King County could also negotiate an off-take agreement with U.S. Oil & Refining or with one of the other four refineries in WA (two in Ferndale and two in Anacortes).

c. **Contract risks and risk sharing:** Assuming the system is operated by the County, it is expected that the County would take risk for system operation and sale of crude oil.

d. **Ability to respond to external emergencies:** The system is not expected to have any measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding, primarily because of its small capacity in comparison to overall system waste volumes and its specific purpose of processing plastic waste.

e. **Ability to respond to internal system emergencies and outages:** The system is not expected to have any measurable effect on the County's ability to respond to internal emergencies, primarily because of its small capacity in comparison to overall system waste volumes and its specific purpose of processing plastic waste.

f. **Operating life:** Operating life is uncertain, due to the emerging nature of the technology and the limited operating history at other installations. Agilyx has represented that its technology has about a five year payback period, for a 10,000 ton per year system selling crude oil at $100 a barrel. The Agilyx demonstration facility in Oregon has operated for about 4 years.

g. **Potential energy production:** The system would produce crude oil for sale to a refinery. Literature values indicate the potential to produce 200 to 240 gallons of crude oil per ton of plastic, with actual output depending on the characteristics (resin types) of the feedstock.

h. **Impacts from feedstock contamination:** Individual systems will have different abilities to handle various plastic resins and contaminants. For example, some systems can handle higher levels of PVC, while others cannot due to the production of hydrochloric acid and its corrosive impact on the system. Most systems will be able to handle contaminants such as metal, glass, food, paper and water, but crude oil yield will go down with the presence of these contaminants and project economics may be affected.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** An increase in capacity would require installation of additional processing units, which could be limited based on space constraints if located within an existing building. If the system proves successful, capacity could be increased by installation of additional systems at other locations.

   b. **Adaptability to system changes and demands:** The system would be adaptable to processing plastic feedstock from a variety of sources and of varying composition. For example, it could possibly be implemented to process plastic waste from industrial or agricultural sources, if more readily available, and could be transitioned to manage plastic from municipal waste at a later date. The system would provide flexibility to process plastic typically intended for recycling markets, should markets change in the future.

   c. **Changes in feedstock quantity and composition:** A 10,000 ton per year plastic-to-oil system would be small compared to the overall quantity of waste handled by King County and the quantity of plastic waste ultimately disposed. It would be adaptable to processing plastic from alternate sources to maintain necessary quantity and composition, as needed.

   d. **Impact on landfill life and operation:** Due to the small scale of the system, it would be expected to have a small but positive effect on landfill operations by reducing the total tons of materials needing to be disposed. If expanded to handle all or most of the plastics disposed at the landfill, it would have an increased positive effect on the landfill.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** The system would not provide sufficient capacity to meet the needs of all customers served by King County. However, any net financial impact of the system could be applied on a system-wide basis to ensure fees remain equitable for all system users.

   b. **Siting of facilities:** Due to the small capacity and system footprint, it is assumed that the plastic-to-oil system would be located at an existing transfer station, at the landfill, or co-located with a new facility the County may implement such as a mixed waste processing facility. However, plastic-to-oil systems are an emerging technology of a thermal nature. This could raise concern with the public regarding air emissions and other perceived environmental issues. Therefore, even if installation is a small system at an existing facility, there could be some siting challenges regarding public understanding and acceptance.

2. Public and political understanding and acceptance

    a. **Effects on livability and character of communities:** As a small-scale system most likely located at an existing transfer station or at the landfill, this practice is not seen as having any effect on the livability and character of the communities served.

    b. **Job creation:** A 30 small-scale system would be expected to create only a small number of new positions (perhaps 8 to 10).

    c. **Impacts on cities:** This practice would have limited impact on the cities, unless it results in a change in curbside collection programs in order to divert plastic waste to the system for processing. It could have a positive financial impact associated with potentially high revenues from sale of crude oil, which could be shared across the system to the benefit of all users.

    d. **Susceptibility to impacts from action of cities:** No susceptibility is apparent, unless the practice requires source separation of waste plastic by customers and this new practice is not successfully implemented by the cities.

    e. **Public education requirements:** If changes are required at a municipal and/or customer level to divert waste plastic for processing, it would be necessary to conduct public outreach and education regarding such changes. It would also be necessary to inform and educate the public about the practice and its risks and benefits, due to the lack of public knowledge and familiarity with such systems.

3. Impact on Employees

    a. **Health and safety:** Processing activities could create operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.

    b. **Job security:** This practice is not expected to significantly impact job security and opportunities for County staff.

    c. **Job satisfaction:** Staff employed for system operation would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation. However, the emerging nature of the technology and the possibility of future expansion may be of interest to staff.

Summary

This best practice would provide a small but positive impact on diversion and resource consumption. Plastic-to-oil is an untapped market, which would provide opportunity for expansion and regional collaboration if proven viable. Future expansion would further increase benefits associated with diversion and resource consumption. Product markets exist in Washington State, including a refinery in Tacoma. Based on estimated costs and revenues, it is expected that this best practice would reach or exceed a financial break-even point. However, this best practice would have high performance risk, since the technology is not yet commercially demonstrated. Performance risk may increase if the system is operated by the County rather than by the system provider. Implementation of this best practice will require acquisition of a steady stream of non-recyclable plastic feedstock, which could be challenging. Curbside recyclables are not delivered to the County system, and there is not currently a collection network for source-separated non-recyclable plastic. Implementation would also require outreach and education, particularly due to the thermal nature of the process and the lack of public knowledge and familiarity with such systems.

Recommendation

This best practice is riskier, and would need more in-depth study by the County before implementation.

Best Practice No. 15

Implement mixed waste processing of residual municipal solid waste to recover additional recyclables, with separation of the non-recyclable organic fraction for processing by aerobic composting; landfill remaining fraction of waste; compost to market as a product or dispose in landfill.

Best Practice Description

This best practice is initially consistent with the upfront mixed waste processing (MWP) and recovery of recyclables discussed in Best Practice No. 10. The difference is in the processing of the non-recyclable organics component of the waste stream. Rather than processing through anaerobic digestion, the remaining suitable organic material will be processed through aerobic composting, as is currently performed for source separated organics collected within the County's system.

Best Practice No. 15 processes mixed waste (commonly referred to as trash) to recover recyclable materials for sale and to separate organic materials for use as feedstock in an aerobic composting process. The MWP system (sometimes referred to as a "Dirty MRF", or more recently as an advanced MRF – AMRF, or mixed waste MRF - MWMRF) and the aerobic composting system could be located together at one site as an integrated facility, or the systems could be separate facilities at different locations. The County has historically relied on the private sector to provide composting capacity, it is assumed that any additional quantities of organic feedstock will be processed by the private sector at a different location, unless the MWP facility is privately operated and partnered with a new private sector composting facility to increase regional composting capacity and minimize organics transfer requirements.

A MWP system would primarily recover recyclable fibers (paper, newspaper and cardboard) and containers (plastic, metal and glass) that were not source-separated, and could also recover other materials subject to technical and economic feasibility. Materials not recovered as recyclables, and not separated as an organic feedstock, would be residue requiring landfill disposal or other processing.

Typical MWP facilities consist of a highly integrated system that combines robust mechanical processing with manual labor. Often there is a manual pre-sort to remove oversized materials, followed by mechanical operations to open bags, reduce material size, and meter materials into the sorting system. The sorting process separates materials by size, density and type, using manual sorting labor as well as conveyors, screens, magnets, optical sorting, and other specialized sorting equipment. Other processing steps are typically used to clean and consolidate recovered recyclables to prepare them for sale to markets (e.g., glass clean-up systems, balers, manual quality control). MWP facilities that are designed to separate an organic fraction for subsequent processing will typically include additional mechanical screening and sorting, such as incorporation of a de-stoner to remove inerts and produce an organic fraction with fewer contaminants.

MWP systems typically range in size from relatively small systems that process 20 tons per hour to larger systems that process over 75 tons per hour. As a point of reference for facility size, the low end of system size would handle approximately 75,000 tons per year of mixed waste when operating two, eight-hour shifts per day, five days per week and 90% plant availability (10% downtime for maintenance and/or repairs). Under the same operating conditions, the larger systems could handle approximately 280,000 tons per year of mixed waste. Assuming average recovery of about 30% by weight of the mixed waste as an organic fraction, the capacity of the downstream aerobic composting process would range from about 23,000 tons per year to 84,000 tons per year.

For King County, Best Practice No. 15 would likely consist of one large MWP system and an offsite, private sector composting facility, handling on the order of 280,000 tons per year of mixed waste. The compost facility required to process the 80,000 tons of new organic feedstock would need approximately half the capacity of the Cedar Grove Composting, Inc. facility in Everett, which processes approximately 170,000 tons per year.

The building footprint for a large MWP facility is dependent on technology-specific design aspects as well as the amount of floor space reserved for temporary storage of incoming material and processed material, and could be expected to range from 100,000 square feet to 150,000 square feet or larger. Site size would be dictated by building size and layout requirements for other equipment and structures, roadways and requirements for large truck queuing and movements, organic feedstock management activities, recyclable storage and load-out activities, stormwater management, and landscaping and green buffer zones. A 280,000 ton per year MWP facility could be expected to require 10 to 20 acres or more.

Operation and maintenance requirements for a MWP facility would include labor, utilities, chemicals and other consumables, routine equipment maintenance and repair, capital repair and replacement, and other costs (including disposal of residue). Staffing needs for a large facility operating two shifts, five days per week, could be expected to range from 75 to 100 or more staff for MWP operations.

The aerobic composting system would be located offsite, requiring transport of material, and is expected to be provided by the County's private sector processor of source separated yard waste and clean wood. The organic feedstock would be processed through controlled biological decomposition and marketed as a fertilizer or soil amendment. Due to the quantity of organic feedstock material being generated, it is expected that the regional processing capacity will be exceeded, requiring construction of a new private sector facility (or facilities).

As should be evident with the foregoing discussion, Best Practice No. 15 is a large scale undertaking and would not be implemented at any of the County's existing transfer station sites. It might be possible to implement this practice at the Cedar Hills Regional Landfill, if sufficient space is available.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

    a. **Capital Costs:** A large MWP facility of the size and type described above could be expected to have a total capital cost ranging from $30 million to $40 million. Though a new, aerobic composting facility would likely be required, the capital cost is expected to be borne by the private sector. A large aerobic compost facility could be expected to have a total capital cost ranging from $15 million to $25 million.

    b. **O&M Costs:** A large MWP facility of the size and type described above could be expected to have operating and maintenance costs ranging from $30 to $45 per ton of mixed waste received for processing. The costs for handling, transport, and contracted processing of separated organic feedstock through aerobic composting is expected to be similar to the current yard waste and clean wood fees ranging from $75 to $85 per ton, which is approximately $22 to $26 per ton of mixed waste received for processing (assuming about 30% of the mixed waste is recovered as an organic fraction). These costs include labor as well as other operating and maintenance costs such as utilities, consumables, and equipment and building maintenance.

    c. **System Revenue:** Revenues would be generated from the sale of recyclables. The value of the recyclables will depend on market conditions. Recyclables recovered from mixed waste may have low-end uses due to the increased likelihood of the presence of contaminants in the materials sent to market. Assuming a weighted sale price ranging from $100 to $200 per ton and assuming a recyclables recovery rate of 20% of the mixed waste received for processing, revenues would be about $20 to $40 per ton of mixed waste received for processing. Revenues generated from the sale of compost are expected to remain in the private sector, with no impact on the County. The diversion of recyclables and organics would result in avoided disposal cost, which for King County currently ranges from $10.50 to $11.00 per ton not including transportation cost.

2. Economic Risks:

    a. **Financial effect of listed operational risks:** Based on very approximate estimated O&M costs, revenue, avoided disposal cost, and the cost of capital, a large MWP system paired with contracted aerobic composting is not likely to be able to reach a financial break-even point, except perhaps under the most favorable cost and revenue conditions (i.e., low capital and O&M costs, and high revenue associated with high product recovery and value).

    b. **Sustainability of funding sources:** Costs associated with the facility would be offset to some extent by revenues associated with sale of recyclables, which are subject to variability as discussed below. Otherwise, as for other system components such as landfill disposal, the cost to compost, and the cost of the facility would need to be covered by the established rate structure imposed on system users, amended as necessary.

c. **Certainty of costs:** Capital and O&M costs can be expected to be fairly well defined for MWP and aerobic composting.

d. **Certainty of revenues, including consideration of market availability for materials/products including energy produced**: Revenues for recyclables are subject to market fluctuations, which can vary widely over time. In addition, revenues for recyclables are subject to the quantity of recyclables in the mixed waste and the quality of the material recovered, both of which are subject to uncertainty.

e. **Opportunities for regional risk sharing:** Mixed waste processing would not appear to offer a significant opportunity for a regional sharing of the risks or benefits. Since it is not expected that a facility would have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships for purpose of risk sharing would take away from capacity that could be used by the County. However, the compost facility component could be regionally shared depending on regional capacities available or developed.

B. Environmental

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Assuming the development of a large MWP facility paired with aerobic composting, it could be expected that approximately 140,000 tons of material could be diverted from landfill disposal. This is about 17% of the waste currently disposed at the Cedar Hills Regional Landfill. If the compost cannot be beneficially used and requires landfill disposal, the diversion potential would be reduced.

b. **Effect on landfill operations:** Implementation of MWP with aerobic composting would reduce the total tons of materials needing to be landfilled and would extend the life of the landfill. It would also impact the generation of landfill gas, perhaps substantially reducing the generation rate per ton disposed, based on the changed rate and characteristics of disposal material.

2. Impact on resource consumption

a. **Land:** A large MWP facility would require an estimated 15 to 20 acres or more for process operations and does not include land for aerobic composting since it is dependent on available regional organics composting capacity.

b. **Water:** Except for cleaning and sanitary uses, MWP would have minimal water requirements. Water requirements for aerobic composting are also expected to be minimal. Though there is a water requirement for organics processing, water can often times be reused as it is recovered or collected on-site. Most facilities will require water for housekeeping and perhaps for system operations. There may also be reduced water consumption if the compost is processed so as to be marketable to buyers who then reduce their purchase and use of synthetic fertilizers, pesticides and other synthetic soil and/or lawn supplements. The use of compost may also reduce irrigation requirements by the compost product purchasers. In addition, to the extent that recyclables recovered by MWP are marketed to end uses that produce recycled-content products which can substitute for virgin-content products, there would be global upstream water conservation through displacement of virgin material and energy resource extraction, refining and product manufacturing operations.

c. **Energy:** Modest amounts of hydrocarbon fuel and electrical energy are required to support operation of MWP and aerobic composting, including for operation of pumps, motors, conveyors, sorting equipment, pre-processing equipment, air pollution control equipment, and on-site mobile equipment. If the facility is located at the Cedar Hills Regional Landfill, transportation energy would be nearly neutral, since the facility would receive and process material already being delivered to the landfill. However, transportation energy would be used to deliver recyclables and organic feedstock. The recovered recyclables, and compost products may provide upstream virgin energy resource conservation, synthetic soil and lawn amendment production reductions, pesticide reductions and irrigation water reductions that accrue energy conservation benefits to the MWP and aerobic composting systems.

d. **Material resources:** The recovery of recyclables (glass, plastic, metals, and fiber) would have a positive effect on the consumption of material resources. The upstream displacements of synthetic soil and lawn amendments and pesticides by production of compost would also result in conservation of virgin material resources.

3. Impact on environmental resources

   a. **Human health:** When properly engineered, MWP combined with aerobic composting would have very little effect on local human health. There could be an increase in transportation air emissions associated with delivering recyclables and compost to markets. However, these transportation emissions can be expected to be small in comparison to the water, energy and resource conservation and reduced virgin production benefits of recyclable recovery and reuse and compost utilization on soils and lawns. Reduced virgin production provides significant reductions in air emissions that typically accompany virgin energy and material resource extraction, refining and virgin-content product manufacturing.

   b. **Ecosystems health:** When properly engineered, MWP combined with aerobic composting would have very little effect on health of local ecosystems. However, as with human health, the upstream benefits of recyclables recovery and compost product usage could have substantial global ecosystems benefits.

c. **Air:** MWP combined with aerobic composting could have air emissions associated with mixed waste handling and downstream organics handling, but it is expected that measures would be used to control these emissions to meet State and local requirements. Potentially harmful emissions to air, water and land from virgin energy and material resource extraction, refining and virgin-content product manufacturing could be significantly reduced if these virgin energy and material resources are displaced by recovered recyclables and compost.

d. **Earth:** MWP combined with aerobic composting would have positive effect on earth resources, associated with the displacement of virgin materials and the beneficial use of compost as a fertilizer or soil amendment.

e. **Water:** MWP combined with aerobic composting would have very little direct effect on local water resources. However there could be global reduction in water usage for displaced virgin energy and material resources, and reduced irrigation water demand for soils and lawn amended with compost.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

a. MWP combined with aerobic composting is seen as entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** MWP combined with aerobic composting of the recovered organic fraction is entirely consistent with current collection and transportation practices of the County and the participating jurisdictions, particularly if the facility is located at the Cedar Hills Regional Landfill, though there would be additional transportation required for recovered recyclables and organic feedstock. If the facility is at another location, it would require some re-routing of transfer vehicles coming from the transfer stations. Additional program changes would be required if the MWP facility is operated by the County, including increasing staff levels and special staff training. Composting is expected to be in parity with the current source separated organics composting by the private sector.

b. **Time required to implement:** Implementation could take 36-48 months or longer, most likely at the higher end of the range. If the facility is located at a new site rather than at the Cedar Hills Regional Landfill, implementation could take an additional 12-18 months. Based on the complexity and certain proprietary elements of a MWP facility, it is assumed that the facility would be developed under an alternative project delivery method (e.g., design-build-operate), which would shift responsibility and risk to the private sector. Implementation would include procurement (soliciting and receiving proposals from system vendors and project developers, negotiating a contract), design and permitting, construction, and commissioning and start-up. Any additional composting capacity required by the private sector is expected to be achievable within the time required to implement the MWP facility.

c. **Facility siting, design, permitting and construction challenges:** Assuming the facility is sited at the Cedar Hills Regional Landfill, a primary challenge would be finding sufficient room to place the facility on the site (i.e., site planning). If located at a new site, the primary challenge would be finding a site that is acceptable to the local community, meets all land use and zoning requirements, and does not have any unmitigatable environmental impacts. The private sector organics processor would have similar challenges if new capacity were required.

d. **Contracting for services:** Contracting the MWP operation with a private operator would be beneficial, due to the complexity of design and operation as well as certain proprietary aspects of MWP. Contracting of the organics component is expected to be similar to the current contracting for source separated organics processing. Contracting with a private operator would shift operating risk to the private entities. However, private operation of the MWP facility could be challenged by the County's unionized labor force.

e. **Compatibility with other elements of the system:** Adding MWP combined with aerobic composting seems highly compatible with the County's focus on resource recovery and diversion from landfill disposal.

f. **Opportunities for regional partnerships:** MWP does not appear to offer significant opportunity for regional partnerships. Since it is not expected that a facility would have sufficient capacity to handle all of the waste currently disposed at the Cedar Hills Regional Landfill, any capacity allocated to regional partnerships would take away from capacity that could be used by the County. Since the current approach to organics processing is regional, there are expected to be partnership opportunities.

g. **Compatibility with other regional approaches to solid waste management:** MWP combined with aerobic composting is highly compatible with other regional approaches, since it manages waste currently disposed of at the landfill. This practice would not require any changes to recyclable or waste handling at either the municipal or customer level, and would not be expected to have any impact on existing transfer station operation. However, there could be transfer station impacts if it became desirable to segregate incoming waste by customer types served, or by incoming collection vehicles loads. This might be beneficial to providing a more recyclables and/or organics rich input stream for the MWP system.

h. **Compatibility with the current role of the solid waste division:** MWP combined with aerobic composting would appear to be highly compatible with the County's role.

i. **Compatible with existing private industry role and resources:** Developing a MWP facility would not appear to place the County in competition with private industry. The facility would be handling waste currently managed by the County and disposed at the County's Cedar Hill Regional Landfill. Also, it could be expected that the County would contract with private industry for design, construction and operation of the facility, which is expected to be of interest to private industry. Maintaining composting operations within the private sector is consistent with current practice.

j. **Public Education Requirements:** Developing a MWP facility with aerobic composting of the organics component would not require any changes to recyclable or waste handling at either the municipal or customer level. Therefore, this practice would not require any significant public education efforts. However, it would be appropriate to conduct outreach and education similar to current practices, for purposes of informing the public about the practice and its benefits. A focus of such outreach may be to ensure that public participants continue to practice source-separation of recyclables and organics, since source-separation can result in higher end values.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** MWP system downtime for planned and unplanned maintenance and repair could be expected. The effects of downtime could be mitigated with redundant design features (e.g., two smaller MWP lines rather than one larger processing line). Also, it is expected that waste handling operations would operate two, eight-hour shifts per day, five days per week. Since waste handling would not operate on a 24/7 basis, it would allow for routine maintenance and repair during off-hours and would provide for mitigation of unplanned downtime impacts with operation on a third shift or extra day. For compost operations, it is expected facilities will have extra storage capacity, or that excess organic material can be diverted to a different composting location.

   b. **Residue disposal:** The MWP operation would remove recyclables by a positive sort, and would separate an organic stream that would be feedstock for aerobic composting. The remaining material would be residue requiring loading and transport to the final disposal site. Locating the facility at the Cedar Hills Regional Landfill would have the advantage of a short haul to the landfill face while that facility remains in operation.

   c. **Compatibility with labor agreements:** The nature of the work required to operate and maintain a MWP facility seems like it could be integrated into the County's current labor agreements if the facility is operated by the County. However, as noted above, private operation of the facility would be beneficial. Composting by the private sector is consistent with current practice.

3. Level of service to customers

    a. **Service offerings:** Adding MWP with aerobic composting would not impact the service offerings since the material is already being collected and received at the facilities. However, it could provide an opportunity to offer customers finished compost for beneficial use.

    b. **Location of service delivery:** This practice would not require a change to current curbside collection services or to practices associated with self-haul waste.

    c. **Hours of service offering:** This practice would not require any changes to hours of service for curbside collection or self-haul practices.

    d. **Time required by customers to utilize service:** This practice would have no impact on the time required by customers to handle their waste, since it would have no impact on curbside collection or self-haul practices.

4. Operational risks

    a. **Proven performance of technology:** MWP facilities have been in use since the 1980s in the United States but are not in widespread operation across the country. Use is most prevalent where there are legislated mandates for high waste diversion, such as in California. Renewed interest and development over the past decade has occurred, due to evolution and improvements in mechanical and optical sorting equipment and increased interest in landfill diversion. Though not without its challenges, composting is the most common approach to organics processing in the region. The process and technology can be engineered as required for the feedstock.

    b. **Market availability for materials/products:** There are well established local and regional markets for recyclables that would be recovered from MWP operations. However, these materials may have reduced end-use value as compared to source-separated recyclables due to the increased possibility of contaminants or end-user perception of higher contamination. The market for compost generated from mixed waste is uncertain, as the compost may be a lower-value material than compost generated from source-separated organics (e.g., with increased possibility of glass, plastic, and other contaminants in the compost).

    c. **Contract risks and risk sharing:** Assuming the facilities are privately operated, there would be opportunity for shifting operating risk to the private sector, with contractual opportunities for revenue sharing tied to MWP operational performance.

    d. **Ability to respond to external emergencies:** The facility is not expected to have any measurable effect on the County's ability to respond to external emergencies such as a seismic event or flooding, since it would be designed to manage mixed municipal waste and not C&D material that could be generated as a result of an emergency event. To the extent an emergency event generated increased amounts of municipal waste, the facility could be operated for extended hours (e.g., for a third shift) to recover recyclables that would otherwise be disposed. The compost facility may experience capacity limitations if an emergency generated an excessive amount of vegetative debris.

e. **Ability to respond to internal system emergencies and outages:** Since the MWP facility would receive mixed waste for processing, it would be able to receive waste hauled directly from a collection route, should there be an outage at a transfer station. Also, the equipment designed for MWP would be similar to the equipment and activities used in single stream recycling, and could be used to process single stream materials if needed.

f. **Operating life:** The MWP facility would have an estimated service life with good maintenance of at least 20 years, with planned overhaul and/or replacement of system components as required.

g. **Potential energy production:** NA

h. **Impacts from feedstock contamination:** The MWP system is inherently designed to receive and process mixed waste, inclusive of contaminants that are not recyclables or organics. However, the nature of the feedstock can have a negative impact on the value of the recyclables recovered and the value of the compost produced, associated with contamination that carries through to the products.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity:** Assuming the MWP system would be designed to operate two, eight-hour shifts per day, five days per week, there would be opportunity to increase operating capacity by operating longer shifts (or a third shift), or by adding an operating day. However, unless planned for, there could be upfront feedstock receiving and storage limitations that constrain increased operating capacity. Capacity could be reduced by a corresponding reduction in operating hours, but would likely have a negative impact on financial performance. Composting would be approached more on a regional capacity.

b. **Adaptability to system changes and demands:** The MWP facility's ability to adapt to system changes and demands would be dependent on the change. For example, if the facility is located at the Cedar Hills Regional Landfill and the landfill closes, there would be increased cost to transport residue to an alternate landfill for disposal. If system changes result in increased source-separation of recyclables and/or organic materials with management of those materials through alternate means, the facility would be less cost-effective as it would recover fewer recyclables and generate less compostables. However, if the County's system was generating an increased amount of source-separated recyclables and organic waste, the facility could possibly be adapted, through operational and other changes, to manage this feedstock along with or in place of mixed waste.

c. **Changes in feedstock quantity and composition:** Since MWP systems are designed to process a feedstock with a high variability in composition, and since the system would use positive sorting for recovery of recyclables, it would be adaptable to changes in the composition of the mixed waste. The aerobic composting system would have some adaptability to changes in the organic nature of the feedstock, but significant changes (e.g., removal of food waste for other management options) could impact system operations requiring some reengineering and reduced capacity due to increased processing time. Therefore, changes in feedstock composition could have an impact on project economics.

d. **Impact on landfill life and operation:** MWP paired with aerobic composting would be expected to have a positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill. Modifying the characteristics and annual quantity of the disposal stream will impact landfill gas produced.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

a. **Equity of fees:** Assuming the facility is located at the Cedar Hills Regional Landfill and receives mixed waste generated County-wide, any impact on fees would be expected to be equitable for all participating jurisdictions

b. **Siting of facilities:** Assuming the MWP facility is located at the Cedar Hills Regional Landfill, there would not appear to be any significant facility siting challenges involved since it would be receiving and processing waste that is already going to the landfill. There may be some local concern regarding the extended landfill life and the long term presence of a MWP facility. If a new compost facility is required to increase regional capacity, facility siting could have challenges.

2. Public and political understanding and acceptance

a. **Effects on livability and character of communities:** Assuming the MWP facility is located at the Cedar Hills Regional Landfill, this practice is not seen as having any effect on the livability and character of the communities served since it would be receiving and processing waste that is already going to the landfill. The community may have expectations of landfill closure and reduced industrial activity in the area. Extending the landfill life and constructing a MWP facility may be objectionable to local residents. If a new compost facility is required to increase regional capacity, siting may find local public opposition.

b. **Job creation:** MWP paired with aerobic composting would create near to or in excess of 100 new positions for operation of the facilities. Although many of these positions would be lower-skilled tipping floor operators, general laborers, and sorters, some positions would be for more highly skilled staff (e.g., management, administrative, supervisory and key maintenance staff).

c. **Impacts on cities:** This practice would have no apparent impact on the cities, with the exception of shared benefits (e.g., associated with increased recycling and compost production) and shared costs, as applicable, if the facility is financially more costly than current practices.

d. **Susceptibility to impacts from action of cities:** No susceptibility is apparent, other than the impacts already discussed of reduced recyclable and organic material in mixed wastes if, and as, cities ramp up their source separation programs and participation therein.

e. **Public education requirements:** Developing a MWP facility with aerobic composting would not require any changes to recyclable or waste handling at either the municipal or customer level. Therefore, this practice would not require any significant public education efforts. However, it would be appropriate to conduct outreach and education similar to current practices, for purposes of informing the public about the practice and its benefits. A focus of such outreach may be to ensure that public participants continue to practice source separation of recyclables and organics, since source separation can result in higher end values.

3. Impact on Employees

a. **Health and safety:** Mixed waste handling, particularly hand sorting, creates operational health and safety hazards for the operating staff. Staff will require training and refresher training, consistent use of personal protective equipment as appropriate, and supervision by staff with hazard awareness skills and the authority and responsibility to take action.

b. **Job security:** Adding MWP with aerobic composting is not expected to significantly impact job security and opportunities for County staff. Facility operation could be easily integrated into existing system operations (i.e., without impacting transfer station operations). However, with the diversion of waste from landfill disposal it could potentially have an impact on landfill operating requirements. The facilities are not expected to increase job opportunity and security for County staff, since it is likely that the facilities would be privately operated.

c. **Job satisfaction:** For many of the lower skilled laborer positions, staff would incur physically demanding and/or monotonous work, which may not generally be considered satisfying as a long term occupation.

Summary

The primary benefit of this best practice is the favorable impact on materials diversion from disposal. However, considering the significant economic risks and the higher value potential for reuse of diverted material under other, similar best practices, this best practice is not recommended.

Recommendation

Not recommended. No further action.

Best Practice No. 16

Issue solicitation to private industry to manage a specified fraction of the County-controlled mixed waste stream leaving the technology up to the proposers (within specified constraints) to allow for demonstration of technologies and possible full commercial operation at large scale. This could include a County-provided location(s) (for waste processing), or leave it up to the proposers to locate the processing facility or facilities.

Best Practice Description

This best practice is intended to explore private industry's interest and ideas for managing some portion of the mixed waste stream controlled by King County through public-private partnerships. The goal of this best practice would be to understand what options may exist for private industry to process portions of the mixed waste stream in ways that would contribute to the County's objectives for increased material diversion and reduced waste disposal. Assuming that an initial solicitation demonstrated that there are commercially viable options that can achieve the County's goals and objectives, the County would then consider entering into one or more contracted arrangements to manage portions of the waste stream that could range from small scale pilot or demonstration level, with a relatively short development and operating term (up to a few years), to a larger scale, full commercial operation with a much longer development and operating term.

It is envisioned that the solicitation process would involve two primary sequential steps:

1. Issuance of a Request for an Expression of Interest (RFEI) from potential proposers. The responses would provide an initial understanding of the types of waste, waste quantities, waste processing options (technologies), and general business parameters that potential proposers would see as a viable basis for a successful public-private partnership. The information gained from the responses would be used to develop the RFP second step of the solicitation process. The duration of this first step is envisioned to be from 6 to 8 months.

2. Issuance of a Request for Proposals (RFP), from potential proposers. Proposals would include detailed technical information and commercial terms and conditions or comments on the County's offered terms and conditions. Assuming one or more proposals proved of interest to the County, this step would also include contract formation. The duration of this step is envisioned to be from 10 to 14 months.

The overall duration of the solicitation through contract formation process would be from 16 to 22 months. Implementation of selected private industry management solutions could then require a number of more years to fully implement.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** This best practice is not seen as involving any significant capital investment by the County, although it could lead to a decision in which the County would fund the construction of one or more County-owned and contractor-operated facilities.

   b. **O&M Costs:** This best practice is not seen as involving any direct County responsibility for operation and maintenance of processing facilities. The County would be expected to pay for O&M costs and contractor profit through a service fee.

   c. **System Revenue:** This best practice is seen as having the potential to lower the overall cost of the system waste management practices (through privatization), and thus would have a positive effect on overall system revenue requirements.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** To be determined based on the public-private partnership(s) created. Generally, operational risks are likely to be born primarily by the operating party (i.e. the private contractors) but some of the cost allocated to that risk could be expected to be reflected in the service fees.

   b. **Certainty of costs:** Capital and O&M costs, including cost escalation over time, would be well defined through a competitive procurement process.

   c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Responsibility for uncertainty in revenues would appear to reside with the private contracting partners. Some this revenue risk would be reflected in the service pricing submitted by the proposers. As discussed under 1.c above, predicted lower overall system cost should add stability to the County's tipping revenue since lower costs would reduce the likelihood of customers reducing disposal tonnage in the County's system.

   d. **Opportunities for regional risk sharing:** This practice is seen as having the potential for significant long term regional risk sharing by creating what could be the startup stimulus for a new and more beneficial alternative to the current regional reliance on landfill disposal. A successful King County-private contractor partnership could spur a large scale regional shift to more local waste management solutions that would gain economies of scale for all regional entities who choose to get on board a new approach.

B. Environmental

1. Impact on waste prevention, recycling and diversion

    a. **Effect on waste prevention, recycling and diversion programs:** Would be expected to make a significant improvement in the amount of recycling and diversion provided the County's procurement documents placed a priority on this goal.

    b. **Effect on landfill operations:** Would be expected to have a significant positive effect on landfill operations, including extending the life of the CHRLF, if the contracted waste management services were focused on maximizing material recycling and diversion.

2. Impact on resource consumption

    a. **Land:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    b. **Water:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    c. **Energy:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    d. **Material resources:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

3. Impact on environmental resources

    a. **Human health:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    b. **Ecosystems health:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    c. **Air:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    d. **Earth:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

    e. **Water:** To be determined based on the public-private partnerships created. Low impact could be an evaluation criteria for proposals.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

    a. An evaluation criteria for this best practice could be that it be entirely consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

   a. **Program changes:** This best practice is likely to result in fundamental changes in the County's solid waste and resource management program as it would herald a shift to a public-private partnership approach and away from a much more public-centric program. It therefore is likely to have significant policy, operational, labor agreement, interlocal agreement, and external stakeholder considerations that will need to be considered.

   b. **Time required to implement:** 16 to 22 months to award of private industry service contract(s) followed by as much as several more years for implementation by the private industry partner(s).

   c. **Facility siting, design, permitting and construction challenges:** These challenges would be the responsibility of the County's private industry service provider(s), unless County-owned, contractor-operated facilities were involved.

   d. **Contracting for services:** Contracting for private industry services is the essence of this best practice. The development solicitation documents and evaluation of proposals will be a complex undertaking.

   e. **Compatibility with other elements of the system:** in general this best practice would be compatible with other existing elements of the County's system.

   f. **Opportunities for regional partnerships:** Refer to discussion under A.2.d above.

   g. **Compatibility with other regional approaches to solid waste management:** This best practice would be similar to the public-private partnership approach to solid waste management taken in Pierce County, Kitsap County, Snohomish County (disposal), Seattle (disposal), Spokane (waste incineration and disposal), Grays Harbor County, Clark County, Portland Metro, and other jurisdictions in the Northwest.

   h. **Compatibility with the current role of the solid waste division:** This best practice would be compatible with the current role of the solid waste division, but as indicated in C.1.a above would mark a shift away from the division's role as the sole entity responsible for operating the County waste disposal facility.

   i. **Compatible with existing private industry role and resources:** This best practice would be compatible with private industry's role and resources in many other geographic areas of the Country and in large areas of the Northwest.

2. Complexity of system and facility operation

    a. **Potential facility downtime:** The potential for facility downtime would be a consideration in the procurement process and proposers would be required to identify backup facilities and/or contingency plans to deal with facility outages

    b. **Residue disposal:** Residue disposal would be a continuing requirement with private industry facilities and would most likely involve short haul of residue to the County's transfer station system where the residue would be combined with other non-processible waste for transport to a final disposal site.

    c. **Compatibility with labor agreements:** This best practice has significant potential impacts on the County's labor agreements in that it could significantly reduce the amount of waste materials flowing through the County's transfer station and disposal site and move management of portions of the solid waste stream to private industry.

3. Level of service to customers

    a. **Service offerings:** To be determined based on the public-private partnerships created. Presumably this would not reduce current service offerings.

    b. **Location of service delivery:** To be determined based on the public-private partnerships created. Could expand the number of locations for service delivery.

    c. **Hours of service offering:** To be determined based on the public-private partnerships created.

    d. **Time required by customers to utilize service:** To be determined based on the public-private partnerships created.

4. Operational risks

    a. **Proven performance of technology:** The solicitation process would likely include requirements for proposing technologies that have demonstrated performance and exclude those that do not.

    b. **Market availability for materials/products:** To be determined based on the public-private partnerships created, the technologies employed, and the materials/products generated.

    c. **Contract risks and risk sharing:** To be determined based on the public-private partnerships created. Typically risk sharing is addressed in the procurement documents and then refined during contract negotiation.

    d. **Ability to respond to external emergencies:** To be determined based on the public-private partnerships created. Presumably the private industry partners' roles during external emergency situations would be spelled out in the procurement and resulting contract documents.

e. **Operating life:** To be determined based on the public-private partnerships created.

f. **Potential energy production:** To be determined based on the public-private partnerships created. It would be expected that energy from waste processes would be among the potential proposed processes that the County would specifically invite proposers to consider.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

b. **Changes in feedstock quantity and composition:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

c. **Impact on landfill life and operation:** The central purpose of this best practice is to divert material from landfilling, so the impact would be expected to be large if full scale or large scale diversion processes result from solicitation process.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

a. **Equity of fees:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

b. **Siting of facilities:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

2. Public and political understanding and acceptance

a. **Effects on livability and character of communities:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

b. **Job creation:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process. Would likely create a number of new, relatively low wage or entry level job opportunities within the County.

c. **Impacts on cities:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

d. **Susceptibility to impacts from action of cities:** To be determined based on the public-private partnerships created. Another factor that is very likely to be addressed in the procurement process.

e. **Public education requirements:** To be determined based on the public-private partnerships created.

3. Impact on private industry employees and County employees

a. **Health and safety:** Waste handling and processing, particularly hand sorting as would be used in the small scale operations envisioned, creates health and safety hazards for the operating staff. These hazards include puncture wounds, repetitive motion injuries, strains and sprains, impact injuries, crushing injuries, dust inhalation/respiratory risks, hearing damage, slips and falls, and vehicle/human impact injuries. In short, the work is hazardous and therefore requires extensive training and refresher training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

b. **Job security:** This best practice would likely be viewed by current County employees as threatening their job security since it could divert significant quantities of material from the County's system.

c. **Job satisfaction:** Certain types of material recovery, particularly mixed waste processing can be physically demanding and monotonous, and not generally considered very satisfying as a long term occupation. However, some people do enjoy the fast pace, hands-on, teamwork approach that the work demands.

Summary

This best practice is seen as a key next step for several other recommended best practices including Best Practices 10, 11, and 12.

Recommendation

Implement in the near term.

Best Practice No. 17

Shift solid waste system revenue collection from almost exclusively tipping fees on waste tonnage collected at the gate of County transfer stations and landfill to a combination of non-weight based fees on collection of different commodities and weight—based tipping fees at the gate in a manner that is revenue neutral.

Best Practice Description

Currently, approximately 97 percent of Division revenues are from tipping fees associated with solid waste delivered to County-owned transfer stations.

However, the Division's services extend beyond solid waste transfer and disposal to other types of services. Other expenses are related to transfer and/or disposal but are not entirely proportional to the tonnage. Some examples include:

Type of Cost	Per Ton Cost[1]	Comments
Not Related or Only Partially Related to Solid Waste Transfer or Disposal		
Waste Prevention & Recycling Programs	$7.30	
Grants to Cities	$1.24	
Public Health Transfer	$1.09	
Moderate Waste Surcharge	$4.73	
Subtotal	$14.36	11.1 percent of per-ton fee
Transfer & Disposal Related but Not Entirely Proportional to Tonnage		
Administrative Costs		
Finance & IT	$7.73	
Engineering	$6.92	
SWD Administration	$7.04	
Overhead	$4.12	
Planning & Communications	$1.82	
Legal Services	$0.36	
Subtotal	$27.99	21.6 percent of per-ton fee

As a result, the Division is vulnerable in the event solid waste tonnage decreases, because expenses don't decrease proportionately. A greater emphasis on diversion may require additional expenses and result in a reduced revenue stream from which to pay them.

[1] Source: Executive Proposed Solid Waste Disposal Fees for 2013 and 2014. Published by Division, July 2012. Costs shown are average of 2013 and 2014 costs per ton.

The County might consider looking to these services for ways to unbundle their rates. Unbundling the rates could result in separate fees, not based on tonnage, for certain services. There are certain ways that the County already unbundles its fees:

- The moderate risk waste surcharge. Although applied per ton of solid waste, the County does separately identify a portion of the per-ton fee for activities related to moderate risk waste.
- Special wastes and recycling fees. The County has separate fee schedules for special wastes and several types of recyclable materials. Examples of recyclable materials with separate fee schedules are clean wood, yard waste, refrigerant-type appliances, other appliances, certain types of electronics, and fluorescent bulbs.
- The minimum charge at transfer stations. This minimum charge is currently $22 and covers the first 320 pounds of solid waste. This minimum charge can be thought of as helping to defray some fixed costs that aren't related to tonnage.

The ability of the County to further unbundle its rates is uncertain. Because the County does not provide retail solid waste, recyclable, or green waste collection services, the County has fewer ways to charge for its services. Contractual considerations include:

- Amended and Restated Solid Waste Interlocal Agreement. The County currently has ___ of these agreements with local jurisdictions, which will remain in effect through 2040. These agreements were recently (in 2013) renegotiated and are collectively referred to in this document as the "New Agreements". Relevant terms of the New Agreements include:
  - Preamble Section C includes: "the Parties continue to support the established goals of Waste Prevention and Recycling as incorporated in the Comprehensive Solid Waste Management Plan…"
  - Definition: "Disposal Rates" means the fee charged by the County to System Users to cover all costs of the System consistent with this Agreement."
  - Definition: "System Users" means Cities and any person utilizing the County's system for Solid Waste handling, Recycling or Disposal.
  - Section 7.1, regarding Disposal Rates: In establishing Disposal Rates for System Users, the County shall consult with MSWAC[2].
  - Section 7.1, regarding Disposal Rates: The County shall establish classes of customers for Solid Waste management services and by ordinance shall establish rates for classes of customers.
- Solid Waste Interlocal Agreement. The predecessor agreement to the New Agreements, there are ___ agreements in effect which are collectively referred to in this Study as the

[2] MSWAC is the Metropolitan Solid Waste Advisory Committee, the advisory committee composed of city representatives.

“Old Agreements”. The Old Agreements are similar to the New Agreements, except the cooperation language in the preamble is different, neither Disposal Rates nor System Users are defined terms, and specific language about the MSWAC does not exist. The sentence noted as item 5 in the above list is included in the Old Agreements.

When considering unbundling of rates, it is important to distinguish between:

- The services funded by the unbundled fee structure (that is, *what* the fee pays for), and
- The unbundled fee structure (that is, *how* to collect revenue)

The Division could choose any of its services to be funded using an unbundled fee structure, though those services with costs that are not directly proportional to tonnage are most reasonable. Examples of services funded by an unbundled fee structure could include all or portions of the cost of:

- Waste prevention and recycling programs
- Grants to Cities
- Transfer to King County Public Health Department
- Moderate Risk Waste programs
- Planning services
- Debt service

Regarding how to collect revenue, the Division’s unbundling choices can be put into two broad categories[3]:

- Charging Cities directly for certain services provided instead of charging haulers
- Revising the fee structure for haulers to include a component that is not based on tonnage

Charging Cities Directly

It does not appear that either the New Agreements or the Old Agreements prohibit a fee structure that is based on something other than tonnage. Further, the New Agreements appear to allow the County to consider the Cities a separate customer class and charge the Cities directly instead of charging the haulers who deliver to the County’s transfer stations.

Although it may be consistent with the Contract to do so, the County will have to assess whether charging cities directly is viable, given that this would change ultimate responsibility for payment from the retail customer to the cities. Nonetheless, since ultimately the retail customers are a

[3] Charging generators directly is a potential option but was not considered for this evaluation because of implementation constraints.

source of revenue for cities in the form of taxes or other fees, the County may choose to discuss this with the MSWAC.

Transfer Station Fee Structure Revision

Compared with other agencies, the Division has fewer fee structure alternatives available because it does not provide retail collection services. From a revenue perspective, its only source of direct customer contact is at its transfer stations.

One potential option is a fee that is based on the customer and/or revenue data of each hauler. Haulers (who by contracts with Cities, are responsible for retail collection of solid waste, recycling, and yard waste) collect their revenues by billing their customers. As a result, they have customer data that totals the number of customers, number of bins, and size of bins. The Division could implement a fee structure based on this customer data, and charge each hauler a monthly charge based on this customer data. If implemented on a revenue-neutral basis, it would be accompanied by a concurrent decrease in the per-ton refuse disposal fee.

If applied to the solid waste refuse customer data, revenues could be linked to costs the Division incurs to provide solid waste refuse transfer and disposal capacity. This is because the customer data on refuse collection services represents the capacity to deliver solid waste refuse services. Debt service and planning associated with facilities that provide capacity may be appropriate for this type of fee.

If applied to recycling customer data, revenues could be linked to the cost of providing recycling services. Hennepin County, Minnesota charges a Solid Waste Management Fee that is a percentage of a hauler's gross revenue. Separate percentages are established for residential (9%) and non-residential (14.5%) revenues. If investigated further, a follow-up action would be to contact Hennepin County to understand what Management Fee revenues pay for.

The implementation feasibility of this option has not yet been evaluated and contractual constraints with the haulers, if any, have not been assessed.

Another potential option is to impose surcharges for mixed waste loads that do not meet a minimum percentage of recoverable materials. With the County's current system of transfer stations, the amount of recoverable materials is not measured. However, it could be done if, in the future, the County were to build a materials recovery facility. The City of Elk Grove, California is an example of a jurisdiction that charges a "Commercial Refuse Hauler Fee", which is a percentage of a hauler's gross receipts. The percentage is inversely proportional to the % of diverted materials.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** None, presuming contract modifications are either not proposed or not considered capital costs.

   b. **O&M Costs:** Could lead to an increase in O&M costs as it would require additional effort to administer a more complicated rate structure. The amount of additional O&M costs would depend on the specific rates being proposed. Could result in further increases in costs to retail customers if haulers incur additional administrative costs adapting to the County's changed fee structure.

   c. **System Revenue:** Unbundling rates could be done in a way that is revenue-neutral. If a revenue-neutral policy is chosen, then system revenues wouldn't change, but revenue stability would improve.

2. Economic Risks:

   a. **Financial effect of listed operational risks:** Not applicable.

   b. **Certainty of costs:** Cost impacts are not certain because they cannot be developed until specific proposals are identified.

   c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Certainty of revenues would be improved.

   d. **Opportunities for regional risk sharing:** Possible, depending on which unbundling alternatives are chosen.

B. Environmental

1. Impact on waste prevention, recycling and diversion

   a. **Effect on waste prevention, recycling and diversion programs:** Depends on what is implemented. Charging for recycling programs in some form may discourage participation.

   b. **Effect on landfill operations:** Depends on what is implemented and how haulers would pass through any transfer station rate structure changes to their customers.

2. Impact on resource consumption – all impacts in this category depend on changes to diversion and disposal quantities that may be induced by the rate unbundling option(s) implemented.

    a. **Land:** Difficult to quantify induced impacts.

    b. **Water:** Difficult to quantify induced impacts.

    c. **Energy:** Difficult to quantify induced impacts.

    d. **Material resources:** Difficult to quantify induced impacts.

3. Impact on environmental resources– all impacts in this category depend on changes to diversion and disposal quantities that may be induced by the rate unbundling option(s) implemented.

    a. **Human health:** Difficult to quantify induced impacts.

    b. **Ecosystems health:** Difficult to quantify induced impacts.

    c. **Air:** Difficult to quantify induced impacts.

    d. **Earth:** Difficult to quantify induced impacts.

    e. **Water:** Difficult to quantify induced impacts.

4. Consistency with Climate Action Plan

    a. Consistency of this best practice with the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations depends on changes to diversion and disposal quantities that may be induced by the rate unbundling option(s) implemented.

C. <u>Operational</u>

1. Complexity of Implementing

    a. **Program changes:** Depends on what is implemented. Could require billing system changes, signage changes, training. Would require public outreach.

    b. **Time required to implement:** Depends on what is implemented and length of public involvement/education that is required.

    c. Facility siting, design, permitting and construction challenges: Not applicable

    d. **Compatibility with other elements of the system:** Compatible.

    e. **Opportunities for regional partnerships:** Depends on what is implemented.

f. **Compatibility with the current role of the solid waste division:** Enhances current role because of greater certainty of revenues.

g. **Compatible with existing private industry role and resources:** Compatible.

2. Complexity of system and facility operation

   a. **Potential facility downtime:** Not applicable.

   b. **Residue disposal**: Not applicable.

   c. **Compatibility with labor agreements:** Not applicable.

3. Level of service to customers

   a. **Service offerings:** Could provide more certainty on the levels and types of service offered if revenues are not considered at risk.

   b. **Location of service delivery:** Not applicable.

   c. **Hours of service offering:** Not applicable.

   d. **Time required by customers to utilize service:** No change.

4. Operational risks

   a. **Proven performance of technology:** Not applicable related to technology. Some unbundling alternatives may not be common in other agencies.

   b. **Market availability for materials/products:** Not applicable.

   c. **Contract risks and risk sharing:** Shifts risk away from County. Unclear whether other contract parties are willing to accept additional risk.

   d. **Ability to respond to external emergencies:** Unchanged.

   e. **Operating life:** Not applicable.

   f. **Potential energy production:** Not applicable.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** Not applicable.

   b. **Changes in feedstock quantity and composition:** Not applicable.

   c. **Impact on landfill life and operation:** Depends on changes to diversion and disposal quantities that may be induced by the rate unbundling option(s) implemented.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** Depends on what is implemented. There is the opportunity to create a stronger link between the services provided and the cost of services. Expected that fee structure changes would increase costs to some customers and reduce costs to others – a shift away from solid waste tonnage-based fees could shift costs to those who generate recyclables. If unbundling of fees is cost-based, then customers may perceive the overall fee structure as more equitable.

   b. **Siting of facilities:** Not applicable.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Depends on what is implemented. Cost-based fee structures, specifically one that decouples costs for programs not related to solid waste refuse tonnage and fees that are solely related to solid waste refuse tonnage, may result in increased public and political understanding and acceptance.

   b. **Job creation:** Not applicable.

   c. **Impacts on cities:** Depends on what is implemented. Cities are likely to object to direct charges.

   d. **Susceptibility to impacts from action of cities:** None, other than potentially requiring the approval of cities to implement depending on what is proposed.

3. Impact on Employees

   a. **Health and safety:** Not applicable.

   b. **Job security:** Not applicable.

   c. **Job satisfaction:** Not applicable.

Summary

This could lead to a rate structure that is more cost-based. Also, revenues could be more stable and not as dependent on solid waste refuse tonnage. Implementation would require working with Cities and haulers.

Recommendation

Promising, but needs more in-depth study by County before implementing.

Best Practice No. 18

Secure revenues from materials derived from waste stream, including carbon credits

Best Practice Description

Increasingly, solid waste is being thought of as a resource, because the materials it contains have value, both as commodities on recycling markets and as resources that embody lower environmental burdens than the virgin raw materials and products they potentially displace. Ongoing challenges are the ability to extract the valuable resources from the waste stream, and the ability to sell these materials at prices that covers the costs of extracting them.

The County currently does extract valuable resources from its waste stream and is able to sell them. County records[1] show 2012 projected revenues of:

- About $1.1 million for the sale of landfill gas
- About $300,000 associated with recycling, projected to increase to almost $1.0 million in 2014
- About $900,000 of rental income from facilities on Harbor Island

Some of the other best practices evaluated in this Study, if implemented, would extract additional resources from the waste stream that provide opportunities for sales. These resources include:

- Construction and demolition materials
- Recyclables
- Organics
- Biogas
- Electricity
- Oil derived from a plastics to oil facility

In addition, there may be future opportunities for carbon credits. Additional information on carbon credits follows:

What it is: A carbon credit (also known as offset credit, verified carbon unit) is a financial term that represents one ton of CO_2 (carbon dioxide) or CO_2e (carbon dioxide equivalent gases) that has been removed from the environment. Once you have a carbon credit, you have the right to emit the one ton of CO_2 or sell it on the international carbon market.

How it started: The Kyoto Protocol of 1997 was an international treaty that took effect in 2005 with intentions to reduce emissions of greenhouse gases. There are approximately 182

[1] Source: Executive Proposed Solid Waste Disposal Fees for 2013 and 2014, published by the Solid Waste Division in July 2012.

countries involved. The United States signed the protocol in 1998 but was not bound by it because of lack of Senate ratification. However, the U.S. has three regional initiatives – the Regional Greenhouse Gas Initiative (RGGI[2]), the Midwest Greenhouse Gas Reduction Accord (MGGA[3]), and the Western Climate Initiative (WCI) – that are providing a structure for a possible federal system. Washington is not a participating jurisdiction of the WCI; current participating jurisdictions are California, British Columbia, and Quebec.

Who can get them: Credits are awarded to countries and/or groups that have reduced their greenhouse gases below their emission quota. A solid waste utility could potentially collect carbon credits through a Waste to Energy (WTE) facility. In 2013, Hillsborough County, FL began selling carbon credits they produced through their Resource Recovery Facility. The County's credits were approved by the Verified Carbon Standard (VCS), a global standard for the approval of carbon credits.

The other option for a company, industry or government to obtain carbon credits is by purchasing them through a carbon credit commodities exchange (for example, the Chicago Climate Exchange, when it was still in operation) or through a "cap and trade" auction.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

    a. **Capital Costs:** No effect on capital costs other than the cost of the specific facility that would generate the revenue-producing materials.

    b. **O&M Costs:** Some small increase in O&M costs to facilitate the sale of materials. Any increased O&M costs would be offset by the added revenues.

    c. **System Revenue:** Increases system revenues.

2. Economic Risks:

    a. **Financial effect of listed operational risks:** None associated with the selling of revenue-producing materials derived from the waste stream. Risks associated with the facilities themselves are discussed elsewhere.

    b. **Certainty of costs:** Implementation costs will depend on the specific materials derived and the facilities built to obtain them.

    c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** There is considerable uncertainty

[2] The RGGI is a cooperative effort among nine northeast and mid-Atlantic states to cap and reduce carbon dioxide emissions from the power sector.
[3] The MGGA is a commitment of six Midwestern states and one Canadian province to reduce greenhouse gas emissions through a regional cap-and-trade program and other complimentary policy measures.

in the amount and uniformity of revenues. Revenues will depend on the specific materials derived from the waste stream, variability in the quantity of these materials, and the volatility of market price for these materials. There also may be some risk due to the evolving nature of, and debate regarding, exactly what constitutes a reduction in emissions that have the potential to cause climate impacts.

d. **Opportunities for regional risk sharing:** This could exist provided that other generators produce similar materials, or through the existence of a pool of potential customers. This could smooth out potential variations in supply or demand of the materials derived from the waste stream.

B. Environmental

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** Could improve the stability of funding sources for these programs.

b. **Effect on landfill operations:** If obtaining these revenues makes the business case for the facilities itself favorable, then the revenues are a way to increase diversion. In turn, this extends the landfill life.

2. Impact on resource consumption

a. **Land:** None, other than that associated with the facility itself.

b. **Water:** None, other than that associated with the facility itself.

c. **Energy:** None, other than that associated with the facility itself.

d. **Material resources:** None, other than that associated with the facility itself.

3. Impact on environmental resources

a. **Human health:** None, other than that associated with the facility itself.

b. **Ecosystems health:** None, other than that associated with the facility itself.

c. **Air:** None, other than that associated with the facility itself.

d. **Earth:** None, other than that associated with the facility itself.

4. Consistency with the King County Climate Action Plan (SCAP)

a. This best practice would be consistent with, and supportive of, the County's SCAP to the extent that increased revenues from recovered material and/or energy sales, whether through acquiring and selling carbon credits or other means, induced higher levels of waste diversion, so long as the additional diversion has a beneficial climate impact that exceeds the loss of biogas production and carbon storage at CHRL.

C. <u>Operational</u>

1. Complexity of Implementing

    a. **Program changes:** Program changes are required to implement: must be able to quantify/characterize materials, find customers, and develop contractual arrangements to sell materials. On an ongoing basis, program changes are expected to include: monitoring material production to ensure it meets the buyer's specifications, monitoring market changes that could affect demand or price, and monitoring both material quantity and revenue.

    b. **Time required to implement:** Depends on materials produced and availability of markets. Carbon credit sales not yet feasible.

    c. **Facility siting, design, permitting and construction challenges:** None.

    d. **Compatibility with other elements of the system:** Compatible with other system elements.

    e. **Opportunities for regional partnerships:** Potentially, depending on the material.

    f. **Compatibility with the current role of the solid waste division:** Compatible – viewing solid waste as a resource is compatible.

    g. **Compatible with existing private industry role and resources:** Compatible.

2. Complexity of system and facility operation

    a. **Potential facility downtime:** Not applicable.

    b. **Residue disposal:** Not applicable.

    c. **Compatibility with labor agreements:** Not applicable.

3. Level of service to customers

    a. **Service offerings:** Increases service offerings, by providing revenues for recovered material sales that are not currently available.

    b. **Location of service delivery:** For existing services, this is unchanged.

    c. **Hours of service offering:** Depends on material produced.

    d. *Time required by customers to utilize service:* Depends on contractual arrangements, in this case customers means buyers of materials.

4. Operational risks

    a. **Proven performance of technology:** Not applicable.

b. **Market availability for materials/products:** Depends on material.

c. **Contract risks and risk sharing:** Depends on materials and the terms of contracts negotiated for sale of materials. Contract risk sharing depends on market considerations for the material(s).

d. **Ability to respond to external emergencies:** Not applicable.

e. **Operating life:** Not applicable.

f. **Potential energy production:** Not applicable.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** Not applicable.

   b. **Changes in feedstock quantity and composition:** Ability to sell materials depends on availability of materials. Changes in feedstock quantity and composition could have adverse or beneficial changes in the ability to sell materials, depending on the change.

   c. **Impact on landfill life and operation:** Selling materials provides a way to divert them from the waste stream, thereby extending the landfill life.

D. <u>Policy and Equity & Social Justice</u>

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** In itself, revenues from materials, won't change the equity of fees. If the revenues are applied in a revenue-neutral way, they would offset expenses and reduce the required per-ton fee for disposal of solid waste at transfer stations. This wouldn't necessarily change the equity of fees, but it would make the fees less than they otherwise would be.

   b. **Siting of facilities:** The marketability of materials derived from the waste stream depends in part on the location of both the materials and the customers. Market considerations regarding the sale of materials could influence the siting of facilities (in other words, it may provide an incentive to locate facilities closer to where the customers for materials are).

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served. However, public and political understanding and acceptance of the County's overall solid waste management strategy should be enhanced with the public's knowledge that the County is maximizing the value of its resources.

b. **Job creation:** Not expected to directly create jobs.

c. **Impacts on cities:** No impacts apparent.

d. **Susceptibility to impacts from action of cities:** No susceptibility apparent.

3. Impact on Employees

a. **Health and safety:** Not anticipated.

b. **Job security:** Not anticipated.

c. **Job satisfaction:** No anticipated effects.

Summary

This is a continuation of the County's current practice, which should be considered when evaluating and/or implementing other recommended best practices.

Recommendation

Implement in the near term.

Best Practice No. 19

Ensure Community Support for Sustainable Fees and Fee Structure

Best Practice Description

Community support is essential for the County in order to provide services on an ongoing basis. Ultimately, the community provides the revenues needed for solid waste services – though for the Solid Waste Division, this revenue from the community is indirect. The community pays others for solid waste, recycling, and yard waste collection, and the County collects revenues as solid waste is brought to transfer stations.

The County already has mechanisms related to public outreach, public education, and obtaining community support. Inclusion of this as a best practice is not intended to imply the County doesn't seek input or support from the community. Rather, it is included to underscore the importance of community support.

Community support can be linked to the equity of the fee structure (that is, *how the Division's costs are recovered* from customers) and it can also be linked to the overall amount of fees (that is, *the total cost to customers*). Sometimes, the community has different ideas and preferences on how much to spend (and the concurrent level of service provided) than the governmental agency providing the service. Community support should be sought in both areas.

Best Practice Evaluation

A. Fiscal

1. Impact on Rates:

   a. **Capital Costs:** No direct impact because there are no capital costs associated with this best practice. However, this can possibly substantially reduce the risks of other best practices that are implemented because community support may reduce delays in siting, design, or construction resulting from community-generated opposition.

   b. **O&M Costs:** Ensuring community support does require effort. It takes time and money to complete activities associated with public outreach and education, and seeking community input. Specific costs are not evaluated in this Study and will depend on the nature of the other best practices the County chooses to pursue further.

   c. **System Revenue:** No effect on system revenue

2. Economic Risks:

   a. **Financial effect of listed operational risks:** No direct effect.

   b. **Certainty of costs:** Not applicable, as specific actions have not yet been identified.

c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Not applicable.

d. **Opportunities for regional risk sharing:** Obtaining community support fosters trust in the County's actions, and may lead to increased opportunities for regional risk sharing.

B. Environmental

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** No direct effect, but increased community involvement is an opportunity to concurrently provide education on available programs. This education could lead to increased participation in waste prevention, recycling, and diversion programs.

b. **Effect on landfill operations:** No readily quantifiable.

2. Impact on resource consumption

a. **Land:** No readily quantifiable effect.

b. **Water:** No readily quantifiable effect.

c. **Energy:** No readily quantifiable effect.

d. **Material resources:** No effect.

3. Impact on environmental resources

a. **Human health:** No readily quantifiable effect.

b. **Ecosystems health:** No readily quantifiable effect.

c. **Air:** No readily quantifiable effect.

d. **Earth:** No readily quantifiable effect.

e. **Water:** No readily quantifiable effect.

4. Consistency with King County Strategic Climate Action Plan (SCAP)

a. No readily quantifiable effect on the County's SCAP.

C. Operational

1. Complexity of Implementing

a. **Program changes:** Program changes would depend on several factors: (1) the extent that the County feels that the community does not support existing fees or fee schedules and that additional work is needed; (2) the nature of proposed changes to facilities and/or fee schedules; and (3) the types of additional activities, if any, the County feels are necessary to obtain community support for these proposed changes.

b. **Time required to implement:** Not applicable. Engaging the community is done on an ongoing basis.

c. **Facility siting, design, permitting and construction challenges:** Potential to mitigate these challenges. Obtaining community support for fee structures and changes is an opportunity to engage the community in overall Division plans. This may be an opportunity to concurrently involve the community in other facility considerations.

d. **Compatibility with other elements of the system:** Compatible.

e. **Opportunities for regional partnerships:** Can encourage regional partnerships by fostering regional relationships and trust.

f. **Compatibility with the current role of the solid waste division:** Compatible.

g. **Compatible with existing private industry role and resources:** Compatible.

2. Complexity of system and facility operation

    a. **Potential facility downtime:** No effect.

    b. **Residue disposal:** No effect.

    c. **Compatibility with labor agreements:** No effect.

3. Level of service to customers

    a. **Service offerings:** No effect, though it could improve the customer's understanding of service offerings.

    b. **Location of service delivery:** No effect.

    c. **Hours of service offering:** No effect.

    d. **Time required by customers to utilize service:** No effect.

4. Operational risks

    a. **Proven performance of technology:** Not applicable.

    b. **Market availability for materials/products:** Not applicable.

    c. **Contract risks and risk sharing:** Not applicable.

d. **Ability to respond to external emergencies:** Not applicable.

e. **Operating life:** Not applicable.

f. **Potential energy production:** Not applicable.

5. Flexibility and adaptability

a. **Ability to scale up and add or reduce capacity:** Not applicable.

b. **Changes in feedstock quantity and composition:** Not applicable.

c. **Impact on landfill life and operation:** Not applicable.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

a. **Equity of fees:** In itself, seeking community input and support wouldn't change the equity of fees. It is possible that community input and support influences the County's decisions related to its fee structure. In this case, there could be an increase in the equity of fees and/or the customers' perception of the equity of fees.

b. **Siting of facilities:** None expected.

2. Public and political understanding and acceptance

a. **Effects on livability and character of communities:** None expected.

b. **Job creation:** No effect.

c. **Impacts on cities**: No impacts apparent.

d. **Susceptibility to impacts from action of cities:** No susceptibility apparent.

3. Impact on Employees

a. **Health and safety:** No effect.

b. **Job security:** No effect.

c. **Job satisfaction:** No effect.

Summary

This is a continuation of the County's current practice, which should be considered when evaluating and/or implementing other recommended best practices. The division should work with cities and other stakeholders to incorporate this practice in all programs.

Recommendation

Implement in the near term.

Best Practice No. 20

Require or incentivize builders to recover/recycle a specified percentage of C&D material.

Best Practice Description

In this best practice, King County and participating municipalities would either require or incentivize builders (or developers, contractors, or other responsible parties) to divert construction and demolition debris (C&D) generated at a particular site or project from disposal. This requirement or incentive is typically implemented as part of a building permit process. Such a diversion requirement or incentive could specify a *percentage* of total construction and demolition debris to be diverted or the *materials* to be diverted.

It is likely that any requirement imposed on builders would need to be implemented through a building permit process, which in the incorporated areas of King County, would be the purview of municipal governments. The County would administer the program within the unincorporated area but also could work with its member municipalities to develop consistent requirements or incentives for implementation county-wide. In that way, builders would know what diversion requirements or incentives to expect no matter where in the County a site is located.

Some approaches to implementing this best practice are listed below.

- A local government could require the submittal of a waste diversion plan prior to the issuance of a building permit. The plan would establish diversion goals consistent with the requirement or incentive offered and would identify how the goals will be achieved. Adherence to the plan could be confirmed during a permit inspection process.
- As a condition of issuing an occupancy permit, local governments could require builders to submit receipts documenting the tons of C&D material disposed and recycled.
- As an incentive, local governments could accelerate the permit process for builders that achieve certain diversion goals.
- As an incentive, local governments could rebate a portion of permit fees (or release a security deposit) if permittee can demonstrate that certain diversion goals are achieved.

If King County and the municipalities pursue this best practice, then the following questions would need to be addressed in program design.

- What type of projects would be included?
  - Residential, commercial, industrial
  - Construction, demolition, reconstruction
  - Projects of a certain size
- Who would be responsible for compliance? (property owners, developers, contractors, builders, etc.)

- What collection, processing, end use infrastructure would need to be in place before requiring diversion and penalizing builders for non-compliance?

Best Practice Evaluation

This evaluation considers how requiring or offering incentives to builders for diversion of C&D performs against fiscal, environmental, operational, and policy, equity and social justice criteria, per se. For many criteria, requiring diversion or offering incentives has minimal impact. However, this best practice will only be successful if one or more of the other alternatives that involve developing infrastructure for collecting, processing, and end use of C&D are implemented. Thus, the results of the evaluation of some of the other best practices, such as 1, 2, and 6, should be considered when evaluating how this policy, paired with the necessary infrastructure, meets the established criteria.

A. Fiscal

1. Impact on Rates:

    a. **Capital Costs:** No direct capital costs are anticipated from offering incentives or requiring that builders meet diversion goals.

    b. **O&M Costs:** Depending on how this requirement or incentive is structured, King County and municipal permitting agencies may need to dedicate additional staff time to implement, and in the case of a requirement, to enforce. In 2012, King County issued 477 residential permits, 13 new construction permits, and 38 commercial improvement permits[1]. If this added requirement/incentive required two additional hours per permit, the requirement/incentive applied to all of these projects (which is probably unlikely as a subset of projects, such as new construction, may offer the most likely target for diversion) then the equivalent of .5 FTE may be required to administer this program in the unincorporated county. Assuming an average salary (plus benefit) of $70,000 per year, an estimated $36,000 per year of administrative cost is estimated for King County alone. If this cost was extrapolated county-wide to include all municipalities with Interlocal Agreements for solid waste services, then the estimated total cost across King County and municipal governments would be about $175,000 per year.

    c. **System Revenue:** The County and municipalities could structure the program so that any additional administrative costs would be covered by permitting fees.

2. Economic Risks:

    a. **Financial effect of listed operational risks:** The overall financial effect is minimal as no significant investment and no new facility is anticipated.

[1] http://www.kingcounty.gov/property/permits/about/YearlyStats.aspx

b. **Certainty of costs:** Costs depend on how a requirement or incentive is implemented. In the case of a requirement, the county and municipalities can estimate the number of building permits applied for in a given year and confirm the projected added cost associated with each permit attributable to reviewing and enforcing diversion at each site. In the case of an incentive, costs to implement are less certain because the number of sites choosing to participate is unknown. However, because the costs are relatively small compared to other best practices being considered, any uncertainty in the projected costs is, by default, minor.

c. **Certainty of revenues, including consideration of market availability for materials/products including energy produced:** Assuming revenues are generated from building permit fees, the fees can be structured in a way that is relatively assured.

d. **Opportunities for regional risk sharing:** Because each municipality would be responsible for the costs and revenues associated with the permitted building activities within their borders (and the county responsible for the building activity in the unincorporated area), the risk is automatically distributed throughout the region.

B. <u>Environmental</u>

1. Impact on waste prevention, recycling and diversion

a. **Effect on waste prevention, recycling and diversion programs:** The additional C&D recovery that is likely to result from requiring builders to divert a certain percentage of the material generated (or to incentivize them to do so) would depend, in part, on the strength of the incentive or requirement and most importantly, in implementing this alternative in conjunction with other best practices that ensure builders have access to collection, processing, and end use capacity. In isolation, this policy may have minimal effect on waste prevention, recycling, and diversion. However, in conjunction with development of sufficient and cost-effective infrastructure to divert C&D, an estimated 50 percent of the C&D could be diverted.

b. **Effect on landfill operations:** The additional C&D recovery that is likely to result from requiring builders to divert a certain percentage of the material generated (or to incentivize them to do so) would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

2. Impact on resource consumption

a. **Land:** Increased recovery of C&D on building sites and/or at centralized sites would require a relatively small amount of land. Diversion is projected to have minimal effect on land consumption assuming that other waste material will ultimately be landfilled in the space the recovered C&D material would have occupied.

b. **Water:** Increased C&D recovery that is projected to result from requiring or incentivizing builders to divert more material is not expected to impact water consumption in any significant way. However, there could be upstream water use that might be displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

c. **Energy:** Although implementing the diversion requirement or incentive for builders alone is unlikely to impact energy use, the increase in processing C&D that is likely to result from this best practice is projected to modestly increase the use of hydrocarbon fuel and electrical energy. Energy required to transport recovered material is likely to be offset by the savings in energy to transport the same material to a disposal site depending on the relative location of the processing and disposal facilities. As with overall water consumption, there likely would be upstream energy use displaced in manufacturing virgin-content products from virgin raw materials due to use of the recovered materials in manufacturing recycled-content products.

d. **Material resources:** Additional C&D diversion that is expected to result from the incentives or requirements on builders would have a modest effect on the consumption of material resources by displacing raw, virgin materials such as trees and aggregates with recovered material. To the extent that cardboard and paper are recovered and recycled into recycled-content products, and to the extent that clean wood is recycled into engineered wood products or perhaps even papermaking pulp, there likely would be more substantial benefits in terms of conservation of material resources.

3. Impact on environmental resources

a. **Human health:** If requirements and/or incentives encourage builders to process materials on construction sites where materials are not currently processed (i.e. such as crushing and grinding aggregate for use on site), then steps will need to be taken to ensure this is done in a manner that does not impact human health (i.e. effective dust control measures are taken when crushing aggregate). Processing additional C&D at centralized facilities will have minimal impact on human health assuming appropriate protective measures are taken. Due to the likely displacement of virgin-content product manufacturing with recycled-content manufacturing using the recovered C&D materials, and the associated savings in combustion energy in manufacturing, there could be a positive human health benefit. The magnitude of human health benefits would depend on type materials recovered, the environmental footprint of the displaced virgin-content products, and the environmental footprint of the recycled-content production operations.

b. **Ecosystems health:** If requirements and/or incentives on builders encourage processing of additional C&D, either on-site or at centralized locations, measures can be taken to process materials in a way that has little effect on ecosystems health. However, as with human health, there could be positive ecosystem health impacts due to the offset of virgin-content manufacturing activities.

c. **Air:** If requirements and/or incentives on builders encourage processing of additional C&D, either on site or at centralized locations, measures will need to be in place to process materials in a way that has little effect on air resources. Furthermore, there could be reductions in air emissions from the displacement of virgin-content production by recycled-content production using the recovered C&D materials. Such upstream resource extraction and virgin-content manufacturing displacements are typically an order of magnitude larger, or more, than any increase in transportation emissions associated with hauling recovered materials to recycled-content manufacturing end users.

d. **Earth:** If requirements and/or incentives on builders encourage processing of additional C&D, a minor impact would result from the displacement of raw or virgin quarried and mined resources by recovered aggregates and metals.

e. **Water:** If requirements and/or incentives on builders encourage processing of additional C&D, either on site or at centralized locations, this will have minimal impact on water resources if runoff is appropriately managed. In addition, as with air emissions, the upstream displacements of virgin-content manufacturing could achieve reductions in emissions to water.

4. Consistency with the King County Strategic Climate Action Plan (SCAP)

a. Especially if the County places this diversion requirement on all buildings owned, occupied, or funded by the County, then this best practice is consistent with and supportive of the SCAP goal of minimizing the life cycle impacts of consumption and materials in the areas of County services and County operations.

C. <u>Operational</u>

1. Complexity of Implementing

a. **Program changes:** This best practice would require several modest program changes including:

i. Evaluating options and developing model ordinance/incentive programs in collaboration with participating municipalities

ii. Educating the entities (builders, contractors, property owners, etc.) about the requirements/incentives

iii. Dedicating staff time to review permits for appropriate diversion plans

iv. Dedicating staff time to ensure diversion plans are implemented

v. Special staff training

b. **Time required to implement:** 12 months to evaluate options and implement ordinance/incentive program.

c. **Facility siting, design, permitting and construction challenges:** A new facility is not required in this best practice. However, this best practice would be enhanced when implemented with other best practices (i.e., Best Practices Nos. 1, 2, and 6) that do require expanded processing infrastructure.

d. **Contracting for services:** No need to contract for services, except perhaps consulting services to evaluate and propose an ordinance/incentive.

e. **Compatibility with other elements of the system:** Requiring or incentivizing builders to divert a certain percentage of C&D and/or certain materials is compatible with other elements of the County's system.

f. **Opportunities for regional partnerships:** For this best practice to have maximum impact, all local governments in the region would implement a similar policy.

g. **Compatibility with the current role of the solid waste division:** Agencies other than the solid waste division would primarily be responsible for implementing permit requirements on builders. However, developing the policy and reviewing diversion plans is compatible with the current role of the solid waste division.

h. **Compatible with existing private industry role and resources:** Developing and implementing diversion plans on construction sites is likely to be a new role for many builders in King County and some are likely to express concern over the challenges (space, staff training, cost) associated with meeting required diversion goals.

2. Complexity of system and facility operation

a. **Potential facility downtime:** No facility is required as part of this best practice but increasing the C&D diverted to existing facilities may increase system downtime. With existing or new capacity, if facilities are shut down for any length of time, it will be a challenge for builders to meet diversion requirements.

b. **Residue disposal:** Residue disposal is not a consideration in this best practice but is considered in the evaluation of C&D facilities that should be paired with this best practice for maximum effect.

c. **Compatibility with labor agreements:** Although this best practice is not likely to have any effect on local government labor agreements, it may cause builders to require construction workers to perform activities (i.e., sorting materials) that may not be compatible with existing agreements.

3. Level of service to customers

    a. **Service offerings:** The County and municipalities would not be offering additional services to customers as part of this best practice (except evaluating diversion plans for building permit applicants).

    b. **Location of service delivery:** There is no specific location anticipated as part of this best practice but C&D processing location(s) will influence the feasibility of this best practice.

    c. **Hours *of* service offering:** There is no specific location anticipated as part of this best practice but C&D processing location(s) will influence the feasibility of this best practice.

    d. **Time required by customers to utilize service:** This would be a new policy for most permit applicants in the County and most of its municipalities. Thus, it may require additional time for permit applicants to develop and implement diversion plans for their sites.

4. Operational risks

    a. **Proven performance of technology:** No technology required for this best practice but see assessment of technology for Best Practices Nos. 1, 2, and 6 that could be implemented concurrently.

    b. **Market availability for materials/products**: There are well established local and regional markets for the main types of materials that would be recovered by increasing C&D diversion as a result of this best practices, specifically wood, ferrous metal, mineral aggregates, gypsum wallboard, large plastics, cardboard and paper.

    c. **Contract risks and risk sharing:** It is anticipated that any risks associated with additional material diverted as a result of policies implemented in this best practice would be assumed by the builders.

    d. **Ability to respond to external emergencies:** This best practice does not affect the ability to respond the external emergencies.

    e. **Ability to respond to internal system emergencies and outages:** This criterion is not applicable to this best practice.

    f. Operating life: Since no facility is involved in this best practice per se, there is no evaluation of operating life.

    g. **Potential energy production:** This best practice alone would not impact energy production. However, if it resulted in diversion of additional wood, this material could be directed to hog fuel boilers for energy production. There also could be upstream energy conservation benefits as a result of using recovered materials in recycled-content manufacturing which displaces virgin-content manufacturing.

5. Flexibility and adaptability

   a. **Ability to scale up and add or reduce capacity:** Since no facility is directly anticipated as part of this best practice, this criterion is not relevant.

   b. **Adaptability to system changes and demands:** Since no facility is directly anticipated as part of this best practice, this criterion is not relevant.

   c. **Changes in feedstock quantity and composition:** Since no facility is directly anticipated as part of this best practice, this criterion is not relevant.

   d. **Impact on landfill life and operation:** Encouraging diversion of C&D by builders through requirements or incentives would be expected to have a relatively small but positive effect on landfill operations by reducing the total tons of materials needing to be landfilled and extending the life of the landfill.

D. Policy and Equity & Social Justice

1. Compatibility with Equity and Social Justice Ordinance

   a. **Equity of fees:** Any requirements or incentives would need to be structured in a way that treats all builders equally.

   b. **Siting of facilities:** No facilities would be sited directly as part of this best practice although more sorting and possible processing may occur on construction sites.

2. Public and political understanding and acceptance

   a. **Effects on livability and character of communities:** Not seen as having any effect on the livability and character of the communities served.

   b. **Job creation:** This best practice would not create a significant number, if any, new jobs, however, the resulting additional processing of C&D materials that may result could produce additional relatively low wage or entry level job opportunities at C&D processing facilities.

   c. **Impacts on cities:** Cities would need to adopt, implement, and administer the requirements/incentives for this best practice to be effective given that they are responsible for building permit requirements within their jurisdiction.

   d. **Susceptibility to impacts from action of cities:** If only some of the cities pass and implement the ordinance, the impact of the requirement/incentive will not be as substantial.

3. Impact on Employees

    a. **Health and safety:** Although there are no particular health and safety issues associated with implementing a requirement or incentive per se, the increased sorting and handling of C&D on building sites could present health and safety issues. These could include puncture wounds, strains and sprains, impact injuries, crushing injuries, dust inhalation/respiratory risks, slips and falls, and vehicle/human impact injuries. In short, the work is hazardous and therefore requires extensive training and refresher training, consistent use of personal protective equipment, and supervision by staff with strong hazard awareness skills and the authority and responsibility to take action.

    b. **Job security:** The added responsibilities for permitting staff at the County and municipalities could provide additional job security and opportunities for staff.

    c. **Job satisfaction:** The added responsibilities for permitting staff at the County and municipalities could decrease satisfaction, if added to already overburdened staff or increase satisfaction by diversifying job responsibilities.

Summary

Implementation of this best practice would require participation of the cities. It would have a mild adverse impact on rates and be relatively complex to implement since this best practice relies on participation by builders throughout the County.

Recommendation

Implement in the near term.

Appendix B: Best Practice Implementation Plans

Best Practice No. 7

Best Practice No. 16

Best Practice No. 17

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Implementation Plan for Best Practice No. 7

Best Practice Summary: Implement anaerobic digestion (AD) of source separated organic waste, with beneficial use of the biogas and composting/marketing of the digestate.

Reason for Early Implementation: Implementation of Best Practice No. 7 is a high priority since there is a lack of adequate capacity in the region for processing source separated organic waste. Anaerobic digestion has been successfully demonstrated at capacities as low as 1,000 tons per year and appears to have promising potential for co-digestion of wastewater treatment plant sludge. There appear to be a number of potential AD opportunities to develop small scale projects at County solid waste and wastewater facilities, interested potential public and private partners who control the source separated organic waste, and technology developers/operators who are interested in partnering with pubilc agencies.

Implementation Plan:

Step 1: Select Consultant to Assist with In-Depth Study of the Best Practice

Activity	Primary Responsible Party	Duration, Months	Start	Comments
Develop/Issue RFP	Division	1.5	July 2014	
Prepare Proposal	Consultants	1	August 2014	
Select Consultant	Division	1.5	September 2014	

Total Duration: 4 months

Step 2: Prepare In-Depth Study

Activity	Primary Responsible Party	Supporting Party	Duration Months	Start	Comments
Conduct Initial Study Phase to identify: • potential sources of source separated organic waste and other feedstock material; • potential locations for AD facilities; • possible size(s) of AD facilities to be considered; • potential private industry developer/operator interest;	Consultant	Division	4	October 2014	

Activity	Primary Responsible Party	Supporting Party	Duration Months	Start	Comments
• visits to reference facilities; • best use plant biogas and digestate; and, • preliminary business plan, economics and risk assessment					
Review initial study phase results with stakeholders and determine next steps (if any) for further study and development	Division	Consultant	2	February 2015	
Proceed with selected next step(s). This could include: • further in-depth academic study; • pilot facility development and operation; • additional reference facility site visits; • solicitation (RFP) to private industry for development proposals at one or more sites (would require siting and environmental review); and, • integration of further development effort into the implementation plan for Best Practice No. 16.	Division	Consultant	TBD	April 2015	

Total Duration: TBD

Implementation Plan for Best Practice No. 16

Best Practice Summary: Issue solicitation to private industry to manage a specified fraction of the County-controlled mixed waste stream leaving the technology up to the proposers (within specified constraints) to allow for demonstration of technologies and possible full commercial operation at large scale. This could include a County-provided location(s) (for waste processing), or leave it up to the proposers to locate the processing facility or facilities.

Reason for Early Implementation: Implementation of Best Practice No. 16 is a high priority since it is a precursor step to possible implementation of technologies covered under Best Practices 10, 11, 12 and possibly 14, each of which requires detailed input from private industry in order for the County to understand the viability of these technologies and private industry's interest and requirements for partnering with the County to develop and operate them.

Implementation Plan:

Step 1: Select Consultant to Assist with Solicitation Process

Activity	Primary Responsible Party	Duration, Months	Start	Comments
Develop/Issue RFP	Division	1.5	July 2014	
Prepare Proposal	Consultants	1	August 2014	
Select Consultant	Division	1.5	September 2014	

Total Duration: 4 months

Step 2: Request for Expressions of Interest (RFEI)

Activity	Primary Responsible Party	Supporting Party	Duration, Months	Start	Comments
Develop RFEI	Consultant	Division	2	October 2014	
Prepare/Issue Advertisement	Division	--	1	December 2014	
Prepare Response to RFEI	Private Industry	–	2	January 2015	
Review Responses & Develop Recommended Course of Action	Division	Consultant	1	March 2015	

Activity	Primary Responsible Party	Supporting Party	Duration, Months	Start	Comments
Review Recommendations with Stakeholders and Obtain Consensus on Course of Action	Division	Consultant	3	April 2015	
Visit Reference Facilities to Complete Staff's Understanding of Technologies Offered	Division	Consultant	-	April 2015	Would be undertaken as part of RFEI response review

Total Duration: 9 months

Step 3: Request for Proposals (RFP)

Activity	Primary Responsible Party	Supporting Party	Duration, Months	Start	Comments
Develop RFP	Consultant	Division	3	July 2015	
Obtain Stakeholder Input on RFP Boundary Conditions and Evaluation Criteria	Division	Consultant	1	October 2015	
Prepare/Issue Advertisement	Division	-	1	November 2015	
Prepare Response to RFP	Private Industry	-	3	December 2015	
Evaluate Responses, Clarify Proposals & Develop Recommendations	Division	Consultant	4	March 2016	
Review Recommendations with Stakeholders and Obtain Consensus on Course of Action and Authorization to Award	Division	Consultant	3	July 2016	
Award Contract(s)	Division	-	1	October 2016	

Total Duration: 16 months

Step 4: Private Industry Partner(s) Implement Service Solution(s)

Implementation Plan for Best Practice No. 17

Best Practice Summary: Shift solid waste system revenue collection from almost exclusively tipping fees on waste tonnage collected at the gate of County transfer stations and landfill to a combination of non-weight based fees on collection of different commodities and weight-based tipping fees at the gate in a manner that is revenue neutral.

Reason for Early Implementation: Many of the Best Practices evaluated in this Sustainable Solid Waste Study lead to greater diversion and a reduction of weight-based tipping fee revenues. This will exacerbate the current situation where the Division's services extend beyond solid waste transfer and disposal, but the revenues are nearly entirely linked to waste disposal.

There are several potential solutions associated with this Best Practice, and implementation of any of them may be complex. Shifting revenue collection will provide a more stable Division revenue source which could facilitate implementation of other Best Practices as well. Accordingly, early implementation is recommended.

Implementation Plan:

<u>Step 1: Illustrate alternatives.</u> Implementation of any changes to the fee structure will require community, MSWAC, and SWAC involvement, along with the approval of the County's elected officials. As a first step, the County will need to develop specific alternatives and illustrate the impact of each alternative on customers. The objective of these illustrations is to help the County decide which, if any, fee changes to bring to the MSWAC, SWAC, community, and elected officials for further discussion. This step in itself isn't particularly time consuming, but given other competing priorities for County resources, it is expected to require about six months to complete. If started in 3Q 2014, it would be complete in 1Q 2015.

<u>Step 2: Evaluate Alternatives</u>

Step 2a: Evaluate "Board of Health Alternative"

Currently, the King County Board of Health is authorized to collect revenues directly from County retail solid waste ratepayers to fund its Local Hazardous Waste Management Program ("LHWMP"). King County Code Section 11.04.060 authorizes these fees, and it specifically requires, for example, each private and public entity which bills for solid waste collection services to pay the County an amount equal to $1.09 per month per residential customer. A similar fee exists for each commercial solid waste account. Also, there are similar fees for each private vehicle at a transfer station or landfill, commercial vehicle at a transfer station or landfill (paid by the ton), and for sewer customers[1].

The County may choose to pursue increasing this fee amount to fund additional projects or adopt a similar type of fee that is chargeable to the entities that bill for solid waste collection. Specific evaluation and/or implementation actions for Step 2a would be:

- Define the type of expenses that could be funded under such a fee, expected to be an internal discussion involving the Solid Waste Division and its legal counsel. The County intends, at a minimum, to evaluate whether recovering the existing Division payment to the King County Board of Health (currently $1.09/ton) can be done on a per customer basis. The effect of this change would be comparatively small, as the Division's payments to the Board of Health are approximately $1 million per year, or just under 1 percent of its revenues.
- Develop a specific alternative and obtain County consensus on a proposal. Concurrent MSWAC and SWAC input would also occur
- Prepare a draft ordinance
- Additional public involvement
- If acceptable to the County Council, adopt revised ordinance

This work would be expected to begin in 4Q 2014 and continue into 3Q 2015.

Step 2b: Evaluate formation of a Solid Waste Collection District

Solid Waste Collection Districts are authorized by RCW Chapter 36.58A. Specifically, the County Council is authorized to create a solid waste collection district for the mandatory collection of solid waste, provided that it cannot include any area within the corporate limits of a city or town without consent of the legislative authority of the city or town. Formation of a Solid Waste Collection District might give the County additional flexibility to implement a fee schedule that helps implement this best practice.

Specific implementation actions for Step 2b would include:

- Internal feasibility evaluation. The RCW contains provisions that place boundary conditions on this alternative. One of these provisions is the reference to mandatory collection. The County Council must make a determination that mandatory solid waste collection is in the public interest and necessary for the preservation of public health. As part of this determination, the utilities and transportation commission must make a finding as to the ability and willingness of existing garbage and refuse collection companies to provide the required service.

[1] The program website, www.lhwmp.org, also describes proposed changes to this rate schedule for commercial solid waste accounts intended to make its rates fairer.

The RCW's requirements also mean that in order to implement a county-wide district, the consent of every city and town in King County is required. Given these requirements, County staff will have to define whether pursuing this alternative is desired.

- Formation of a proposal for a District, which would include specifying purpose, mission, and governance.
- Outreach to MSWAC and SWAC
- Obtaining Consent from Cities and Towns
- Public Hearing
- Adoption by County Council
- Implementation of District

A specific timeframe for this alternative is not possible to define at this time. The primary reason is because of uncertainty in (1) to internally develop the proposal for a District, (2) the amount and length outreach to MSWAC and SWAC, and (3) the length of time to obtain consent from cities and towns.

Step 2c: Evaluate fee structure changes in absence of Solid Waste Collection District formation.

Implementation actions for Step 2c would include:

Activity	Primary Responsible Party	Supporting Party	Duration Months	Start	Comments
1. Develop and Illustrate Alternatives and Select Consultant	Division	Consultant	5	August 2014	
2. Review with MSWAC and SWAC	Division	Consultant	6	December 2014	Partially concurrent with Activity 1
3. Make Decision to Pursue this Alternative Further	Division	Consultant	2	June 2015	
4. Revise Solid Waste Comprehensive Plan	Division	Consultant	Ongoing	Ongoing. Earliest expected completion date August 2015	• Parallel to Activities 1 and 2 • Comp Plan would need to include rate structure proposal
4. Adopt Revised Solid Waste Comp Plan	Division	Consultant	12	August 2015	• Adoption of revised Comp Plan, which would require approval by Cities, would compel cities to make necessary contract changes with their haulers
5. County Council adopt revised rate structure	Division	Consultant	1	August 2016	• Would address SF and MF collection rates in unincorporated areas • Effective date 1/1/17
6. Cities make changes to respective contracts with haulers	Cities		5	August 2016	Q for Division: Is a 4-month duration reasonable? It would have to be in order to have a 1/1/17 effective date.
7. Haulers work with Utilities and Trade Commission to implement rate structure	Haulers		5	August 2016	Q for Division: is a five month duration reasonable?

Total Duration: 2.5 years

Appendix C: Study Team Information

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Appendix C

Study Team Information

Team Member	Company Affiliation	Area of Expertise
Matthew Cotton	Integrated Waste Management Consulting LLC	Organics management
Abby Goldsmith	A Goldsmith Resources, LLC	Integrated solid waste management planning
Arthur Griffith	Leidos Engineering, Inc.	Utility system financing and economics
Susan Higgins, PE	Alternative Resources Inc.	Conversion technologies, landfilling, resource recovery and composting
Karl Hufnagel, PE	Brown and Caldwell	Solid waste facility design and operation, alternative technology assessment
Jeffrey Morris, Ph.D.	Sound Resource Management Group	Economic cost/benefit valuation, life cycle analysis and environmental impact assessment
Ian Sutton, PE	Brown and Caldwell	Organics processing and management