COMMENTS ON THE FINAL DRAFT OF THE INTEGRATED RESOURCE MANAGEMENT (IRM) PHASE 1 STUDY REPORT ENTITLED "RESOURCES FROM WASTE"

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The Technical Advisory Committee (TAC)

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INTRODUCTION

This document summarises the comments of TAC members on the final draft report of the Integrated Resource Management (IRM) Preliminary Study dated November 30, 2007.[1] The draft final report is supported by Ancillary Data provided in a letter to Deborah Rasnick dated December 18, 2007. This additional information was shared with TAC members and is considered here as an integral part of the final draft report.

TAC members provided feedback to the Study Team on two earlier drafts of this report: those dated September 28, 2007 and November 6, 2007. These earlier comments indicated considerable concern with the style of presentation and highlighted significant weaknesses in the analysis. We are pleased to note that the final draft incorporates some of the suggestions made by TAC members on the earlier drafts. For example, significant changes have been made to the revenue estimates based on more cautious assumptions about inflation in energy prices. Also, some cautionary words have been introduced throughout the report. However, not all of the suggestions have been accepted and many of the comments on earlier drafts will be repeated here.

The draft final report and the accompanying Ancillary Data include information not included in earlier drafts (e.g. on the basis for the estimated capital and operating costs of wastewater treatment plants of different sizes). This is useful. The draft final report also includes some changes to specific assumptions and estimates (e.g. some of the revenue estimates) but often without a clear explanation of the rationale for the change. As a result, the reasonableness of these changes is hard to evaluate.

This document is divided into three sections:

- What is meant by IRM – which makes an important distinction between IRM as an approach and particular applications of that approach.
- Overview Comments – summary comments by TAC members on the draft final report.
- Appendices – detailed comments provided by individual TAC members on the draft final report and the Ancillary Data.
- Summary of TAC Conclusions

WHAT IS MEANT BY IRM?

The draft final report uses IRM as short-hand for two very different concepts that need to be clearly distinguished:

[1] The following TAC members providing input to this report: Peter Adams, Randy Alexander, Jack Hull, Bruce Jank and Gary Morrison.

- IRM as a new way of thinking about municipal waste streams and water systems, where resource recovery is maximised – see for example pages two to five of the Executive Summary. We call this the **IRM approach**. The study sometime refers to this as the IRM model.
- IRM as a particular application of the suggested approach in the context of the CRD – see for example pages six to eight of the Executive Summary which illustrates "full" development of the IRM model in the context of CRD. This full development include the use of multiple, small wastewater treatment plants - Note: the study refers to these as Water and Energy Recovery Cells (WERCs) rather than wastewater treatment plants – in order to emphasise the different approach of IRM. We call this the **proposed IRM solution**.

The distinction is very important because the TAC members have very different perspectives on IRM as an approach and the particular application of that approach to CRD that is contained in the study.

The report is also uneven in its use of the word "traditional" when characterizing waste treatment. Sometimes, traditional is meant to imply an **approach** that is not structured around resource recovery. In other situations, traditional seems to imply a particular form of **solution** to liquid waste management i.e. centralised sewage treatment.

OVERVIEW COMMENTS

From the start, the IRM study was an ambitious undertaking. The scope of work laid out in the project's terms of reference was huge given the time and resources available to the study team. Nevertheless, the study team has worked extremely hard to produce a report that covers all of the expected deliverables. However, given these constraints, it is not surprising that the quality of the report is uneven:

- The report is strongest when it speaks to the merits of the **IRM approach** and provides examples of its applications in other countries. While the suggested novelty of the approach in Canada is overstated, the authors are right to emphasize the importance of resource recovery in "waste" management and to promote increased integration of decision-making in areas that have traditionally been isolated. There is general agreement by the TAC members that the **IRM approach** should be supported and implemented.
- The report also lays out well the conceptual benefits and challenges of the IRM approach (see Page 59 to 67) although TAC members do not necessarily agree on all the points made or the relative emphasise of benefits and challenges.
- The report is very useful in drawing attention to the scope of potential revenue and green house gas (GHG) benefits associated with different types of resource recovery. It is also useful in challenging decision makers to consider alternative approaches to liquid waste management that are fully integrated

with resource recovery. While TAC members emphasise the conceptual and preliminary nature of the study's estimates and conclusions, there is general agreement that the study has highlighted some real possibilities for local government to consider.

- The report is helpful in illustrating the possibility of applying different "elements" of IRM in different situations depending on the precise circumstances faced by local government and on the risks and returns associated with each application. This perspective is one that was added in the latest draft and for TAC members has not been as fully developed as it needs to be. For example the report continues to imply that "full" application and optimal application of IRM are one and the same thing. This is not the case. Optimal application of the IRM approach in different circumstances will lead to different IRM solutions that reflect those circumstances.
- The report is weakest in its analysis of and presentation of the **proposed IRM solution** in the CRD.
    - **The analysis**: The proposed technologies and their projected revenues and costs are presented with far more certainty than the authors' analysis can support. Also, the technical and business risks associated with the suggested solutions are understated. Therefore, TAC members cannot endorse the proposed solutions or the estimated business case benefits as presented in the study.[2] In particular, it does not agree with the statement on page 50 that the chosen value estimates "reasonably represent the probable financial picture for an implementation in the Capital Region".
    - **The presentation of revenue**: The authors do not clearly point out that their calculations show that the **majority** (60%) of the estimated net resource revenues and GHG reductions are associated with the recovery of **non-sewage** waste (e.g. organic waste collected from homes) rather than resources recovered from sewage treatment. A further 14% is associated with centralised recovery of sewage sludge. Only 25% of estimated net revenue is obtained by adopting multiple small WERCs. [3]
    - **The presentation of capital costs**: Nor are the authors clear enough in presenting all of the assumptions behind their estimated capital costs. Most importantly, the estimate of the capital cost of the needed infrastructure is based on a system that will serve only the **current** population of the core region. It does not include the cost of adding capacity to serve population increases because the authors assume that this additional capacity will be funded by new development. (Over the next 60 years, the population of the core area is expected to increase by

[2] See Appendices for more detailed comments.

[3] These figures are based on Figure 14 of the report adjusted to allocate GHG credits to the source of GHG reduction and data on the contribution of different waste sources to biofuel production presented in an earlier version of the report. Figure 14 is assumed to represent net revenue not gross revenue because the figures are inconsistent with the gross revenue figures included in the Ancillary Data.

85%.) By failing to highlight this key assumption of the their business case, the authors overstate the potential benefit of their WERC model of sewage treatment in the CRD compared to other treatment options. Financing sewage treatment through development is not unique to their proposed IRM solution.

- TAC members suggest that the study report overstates the potential benefits and understates the potential risks of adopting multiple small waste water treatments plants as the preferred approach to sewage treatment in the CRD. TAC members cannot endorse the business case conclusions presented on page 57 of the report which suggest a compelling case for introducing the study's suggested solution.[4]
- Because of these weaknesses in analysis and presentation, TAC members caution against simplistic comparisons between the figures on costs and benefits of the **proposed IRM solution** and the analysis that has been completed to date for the CRD on sewage treatment, which is summarised in "the Path Forward" document. Indeed, TAC members believe it would be better if Table 2 were completely removed from the Executive Summary of the report.

Clearly, the report's authors are passionate advocates of the concept of IRM. This passion serves them well when they outline the merits of the **IRM approach** and they are to be congratulated for their thorough documentation of the case for IRM. The same passion serves them less well when they apply the IRM approach in the context of the CRD because they try too hard to prove that their **proposed IRM solution** (WERCs) is convincingly supported by the analysis. TAC members agree completely with the value of applying the IRM approach in the CRD but remain sceptical that the study's proposed waste water treatment strategy is the way to proceed.

Nor are TAC members convinced that the IRM approach is at odds with the work completed to date on sewage treatment in the CRD. "The Path Forward" document clearly points out that water reuse and resource recovery are part of the proposed treatment strategy, although more work remains to be done on the specifics. Also, the document notes that the distributed wastewater treatment strategy that is not tied to a specific form of wastewater treatment and the optimal number of decentralised plants has not been determined. The proposed strategy allows for use of WERCs in locations where the business case is sound.

TAC members agree that there may be a number of opportunities in the CRD where this option could be considered. However, unlike the authors of the report, TAC members do not agree that optimal implementation of the IRM approach in the CRD implies "full" implementation as defined by the authors of the report i.e. adopting many small WERCs as the primary form of sewage treatment. The

[4] Apart from the specific estimates, it is not clear that there will be unanimous agreement that net revenues associated with the recovery of resources from non-sewage waste should be included in the business case for a specific approach to sewage treatment. Local governments may wish to consider those revenues in the context of other or all aspects of waste management.

most cost-effective method of implementing IRM does not imply the adoption of a particular technical solution unless the business case clearly demonstrates that such a solution is both feasible and optimal. This has not been done.

SUMMARY OF TAC CONCLUSIONS

We endorse two central features of the **IRM approach** to waste management as laid out in the draft final report:

- the need to recognise waste streams as potential sources of valuable resources and
- the need to maximise the net value of resource recovery in the management of waste streams.

Great care must be taken to distinguish between the I**RM approach** to the management of waste and **particular** waste management **solutions** derived using that approach. Sensible application of the IRM approach in different circumstances will lead to different waste management solutions.

Application of the **IRM approach** is not the same thing as implementation of a technical solution that maximizes resource recovery. Cost-effective implementation of the IRM approach necessitates careful evaluation of the costs and benefits of each element of resource recovery.

We cannot endorse the report's **proposed IRM solution** for the CRD based on the information and analysis provided. We do not agree that the report has adequately, completely and convincingly demonstrated that there is a business case for the proposed solution. We believe the analysis to be uneven and believe the authors make a stronger case for some types of resource recovery than others.

We remain extremely sceptical about the potential value (taking into account revenue, resource recovery, cost, risk and public acceptability) of implementing a sewage treatment system in the CRD based on numerous small water treatment plants. Although we do see considerable opportunity for consideration of such plants in new developments and major redevelopment of existing facilities.

We caution against simplistic comparison of the revenue and cost figures in the report with the cost figures in "the Path Forward" document. The figures do not allow for an 'apples to apples' comparison even on the cost of sewage treatment. Also, we have considerable doubts about the reasonableness of the revenue estimates.

We do not see any inconsistency between the IRM **approach** and the **approach** proposed in "the Path Forward" document prepared for the CRD . We recognise, however, that considerable work still needs to be completed on the CRD's plans for resource recovery and for identifying the optimal number, location and size of distributed plants.

APPENDICES

COMMENTS FROM GARY MORRISON

Comments on Financial Issues in Draft Final Report and Ancillary Data Report

The Ancillary Data report provides better support for the financial section of the main Study Report. It is a high level review using parametric model assumptions which at this stage of the study is a reasonable approach. However the actual key parameter assumptions made in the Study require further review and validation.

Capital Costs

1. Capital costs for installation of basic piping infrastructure for the heating network (kilometers of piping etc.) appear low and require further review and validation by cost consultants.
2. The capital budget appears to exclude retrofitting costs for district heating/cooling loops and integration of such hardware into existing homes and businesses.
3. Retrofit of homes and businesses for use of reclaimed water is also excluded.
4. Storage for reclaimed water is excluded from capital budget.
5. Land costs are excluded from analysis.
6. Cost of fleet of vehicles to use methane and biogas excluded.

Operating Costs and Maintenance

1. All O&M costs require further review. The Study simply applies high level assumptions of such costs based upon a percentage of capital costs (and as noted above many capital costs appear under-estimated). O&M costs range from 10% of capital costs to 1/40 of capital costs.
2. Costs for management and overall coordination of this integrated plan should also be considered in the analysis. This is a complex endeavour and would add incremental costs for management.

Revenue Issues

IRM have adopted the *Vancouver Valuation Accord* methodology[5] in the analysis which allows substantial flexibility in counting non-cash revenues, or revenue which will not be received by the municipal authority hosting the wastewater treatment (in our case, CRD). IRM revenue assumptions can be broadly grouped as follows:

1. Revenues earned from the sale of energy (e.g. electricity from cogeneration, or recovered heat).
2. Costs avoided (e.g. tipping fee avoided by diverting less waste to landfill and therefore avoiding the CRD tipping fee, or savings as a result of using less electricity for air conditioning).

[5] Details on the VVA can be found at http://www.vancouveraccord.org/overview.html

3. Sale of reusable water.
4. Carbon credits.

It would be very helpful for the IRM Study Team to provide a summary of actual revenues to be earned by CRD in the case study.

Specific Revenue Assumption Issues

1. Tipping fee revenue in the IRM Study requires further review. It appears more feasible to add a credit to the IRM Study for tipping costs avoided by CRD (rather than adding a revenue based upon the tipping fee charged by CRD of $84 per tonne). The tipping costs avoided by CRD as a result of the IRM Study's waste management plan would be significantly less than the amount used by IRM of $10,352,918 per year.
2. Revenues from fuel in buses and cars appear exaggerated. The analysis appears to ignore efficiency factors in (i) the capture rate of methane gas (perhaps +/-30% loss), and (ii) the efficiency of conversion of methane to a usable form of biofuel (possibly another 30% loss). Thus the actual amount of equivalent gasoline may be +/-50% less than the amount assumed in the Study.
3. Revenues from space heating and domestic hot water recovered from sewage appear high. Can 1,791,340 GJ per year be generated from wastewater and sewage? This assumption requires further validation.
4. Displaced Electricity from Cold Water. The approach to valuing "displaced" electricity takes a liberal view of the saving of electricity costs. CRD would not receive this revenue of $4,538,945 per year. Who receives the benefit of this amount?
5. Inclusion of CO2 credits in the analysis also requires further validation. Prices for Certified Emission Reductions (CERs) units are as low as $2.00 per tonne (equivalent) in voluntary markets. The IRM Study uses $30 for tonne (equivalent). This value is heavily dependent upon current discussions for Canada's participation in the extended Kyoto process and the ability of CRD to validate, securitize and sell its credits.
6. For the CRD, will anyone there pay for reused water during the non-summer months when there is an abundance of rainfall? The seasonality of demand for most aspects of the IRM Study Report requires further review.

Other Issues

1. It is not clear if IRM's capital cost budget is sufficient to support all the revenues included in the plan. That is, IRM may have counted revenues for various items (e.g. district heating/cooling) without including the cost of installing the supporting infrastructure to produce and deliver such services to the customer. Clearly revenues should not be included in the plan which are not actually available since no capital is allocated to generate such revenues.
2. For the CRD case study included in the Report, IRM should clearly illustrate which of the above listed specific revenues is to be received by CRD versus

revenues paid to other parties. IRM state they reject the accounting approach of "single entity analysis" and have chosen a valuation approach which counts all revenues received by all levels of government (total impact on taxpayer), however if CRD's project is to be showcased in the Report then IRM should provide more guidance on the specific costs/impacts to CRD.

3. The Report assumes an "incremental approach" to building capacity (per comments on page 3, paragraph 3). The Report assumes wastewater treatment capacity in the CRD is built to match actual demand and capacity is expanded incrementally in future as population grows. It would be very helpful to include cost details on future expansions required over the planning horizon (to 2065) to allow an apples-to-apples comparison of other alternative approaches to CRD's infrastructure. Furthermore, during discussions with the IRM Study Team on November 14, 2007 Chris Corps stated that the Study Team had identified a possible third party real estate developer who would fund future capital costs to build additional treatment capacity. This could potentially make the IRM proposal extremely attractive and any details supporting this plan would significantly enhance the Report.
4. Page 55, paragraph 3 states a nominal allowance for maintenance and no ongoing capital maintenance budget is included. Thus the Report under-estimates the life-cycle cost of the proposed solution. For simplicity it would be reasonable to assume a +/-1% per annum capital maintenance allowance in these early stages of planning (this would allow comparison to CRD's Path Forward plan).
5. Since several parties have suggested a test case plant installation be considered instead of a full network, it would be helpful to review the economics of a single installation of each type of plant. For example, what would be the costs revenues for a small BC community? Since most of the Study Team's financial projections appear to be based upon per capita data (costs, flows and resulting revenues) it should be feasible to include the cost of an installation for a community of 30,000 people. This may be helpful to reviewers of the plan considering expansion throughout BC.
6. How many of the benefits identified by the IRM Study Report could be achieved through centralized treatment (versus aggressively decentralized treatment as proposed)? Many of the benefits identified in the IRM Report could likely be achieved by more centralized approaches to wastewater treatment. The IRM Study Report does not address the incremental benefits and costs of the aggressively distributed plan versus more conservative approaches to integrated resource management.

Attractive Plans, However Validation Required

Overall, the IRM Study Report's financial estimates appear optimistic. Further review and validation is required of the Study Group's claims to be able to transmute CRD's wastewater, sewage and organics into a revenue stream of $114-million per year and net profit of $61-million per year. Capital costs required to achieve the stated biofuel production levels and district heating revenues also require validation (certain capital costs have been excluded which may

significantly increase the overall capital required). Finally, for comparison to the existing CRD LWMP the phasing and capacity planning estimate used by the IRM Study Group should be updated to illustrate how costs will increase with population growth and resulting capacity demands.

Despite these shortcomings, the IRM Study Report clearly demonstrates recent advances in technology have improved the economic viability of resource recovery. While the components of the IRM Study Report plan may not be as profitable as suggested in the Report, they appear to warrant further investigation.

COMMENTS FROM BRUCE JANK

Comments on the Draft Final Report

The major issue that I had with the initial and the second draft of the "IRM Phase I Study Report" was the revenue projections. During both the initial review and the review of the second draft, it was requested that it was essential to verify the original revenue projections using data from operating district heating and biofuels generating facilities. The revenue projections from the electricity and heating energy from the syngas and cogeneration facilities need to be included in this verification.

In the second draft, the revenue projections were reduced substantially from approximately $200 million to $114 million. The district heating revenue percentage had shifted from approximately 73% to 21% while the biofuels had increased from approximately 25% to 62%. Using these revenue generation ratios, the biofuels revenue would be 62% of $114 million, or approximately $70 million. This calculation did not correspond to the estimated fossil fuel displacement of 28.4 million litres/year at $1.10 / litre which would amount to approximately $31 million. There was an additional inconsistency as on page 34 of the second draft, it was stated that 600,000 GJ/year of methane would be produced from the sewage sludge and wet organic solid waste. At the projected price of natural gas of $17.65/GJ which supposedly accounted for efficiencies, the estimated revenue would only be $10.65 million. As a result, there were 3 revenue projections for biofuels: $10.6 million, $31.25 million and $70 million.

In the Final Report the IRM Revenue Projections in Figure 14 have not changed from those presented in the second draft. The biofuels still represents 62% of the revenue and syngas is not included. On page 53 of the Final Report, the annual methane production is revised to 980,000 GJ/year from 600,000 GJ/year. At $17.65/GJ this represents $17.3 million and not $28.4 million as shown in Table 8 of the Final Report. At 62% of the total revenue, the Annual Revenue would be $28 million and not $114 million as presented in Table 8.

The electricity generated from syngas production in the Final Report has been increased from 70 to 117 GWh/year and the heat energy from 240,000 to 390,000 GJ/year. There is no explanation provided for the revised projections in biomethane, syngas electricity and heat energy as a byproduct from the

cogeneration of the syngas. The increases are very significant and thus, it is essential to have an explanation as to why these numbers were modified.

The importance of verification of the revenue projections from the biomethane, the syngas electricity and heating energy, and the heating and cooling from a district heating system can not be ignored. Since these revenue projections have not been verified, the Phase I IRM Report as submitted, represents a conceptual plan for Integrated Resource Management with no confirmation or verification of the revenue projections. The conclusions as presented identify the benefits of the IRM concept and should be identified as benefits of the concept and not conclusions.

If the Study Team were confident in their revenue projections, they would be making a definitive statement such as the following conclusion. “The Study Team has concluded that the annual revenues generated from vehicular fuel from biogas, the electricity from syngas, and the heating and cooling revenues from the district heating system, exceed the annual capital repayment and operating and maintenance costs for CRD’s utility service facilities. Thus, CRD can proceed with the implementation of a design-build-finance-operate contract with the private sector, with no additional charges to CRD’s taxpayers.” The Study Team is obviously not prepared to make this conclusion. However, there are many aspects of the IRM concept that are valid and warrant further evaluation. As a result, the program as presented below in the review of the second draft of the IRM Report, are still valid. It is proposed that CRD should follow this strategy or a revised version of this strategy, as the environmental and economic benefits of this program warrant inclusion in CRD’s development program.

There are many other issues in the report that need additional explanation or correction; however, the extensive list which was provided in the review of the second draft were not addressed so no effort has been made to provide additional documentation of the inconsistencies throughout this version of the report.

The one issue that is significant and needs to be noted is the estimated capital and operating costs of the WERC’s which has been introduced in Appendix H of the Final Report. The capital cost for the capacity identified is in the appropriate range; however, as Gary Morrison has identified, this does not correspond to the capacity which has been provided in the Path Forward. The issue of concern is the operating and maintenance cost projections which I am certain are on the low side for a network of plants which are technically complex and interconnected with heat recovery and special water reuse or effluent disposal options. Nevertheless, as has been stated elsewhere, if the revenue projections are close to being correct, a doubling of the operating costs will have a minimal impact on the profitability of the project.

As a result, the business case and development strategy as presented in the “Comments on the Second Draft” are still valid and should be followed by CRD in the incorporation of IRM into the utility services program. The text which follows is a repetition of the final portion of the comments on the Second Draft.

“To establish a business case, the most important financial information in this document is the revenue projection, especially if there is a possibility that revenues could exceed capital costs, and operating and maintenance costs. Because of the inconsistencies in the existing documentation, the present revenue projections cannot be used to develop a business case for implementation of the IRM model. These revenue projections need to be corrected and confirmed based on actual financial data from operating systems.

The most significant component of the IRM model is the solid waste management strategy. The potential benefits from eliminating the MSW landfill are so significant that the project should proceed based on this as the core strategy. Germany has legislation in place to eliminate discharges to landfills. Research institutes such as the Institute for Applied Material Flow Management at Trier University in Birkenfeld, Germany, have been established to support the development and implementation of strategies to achieve their objective of Zero Waste.

Because of the importance of the most significant components of the IRM model, a modified version of the model should be considered for implementation by CRD. It should be possible to immediately integrate the solid waste resource recovery components of the IRM strategy into the solid waste management program.

I do not believe that it will be cost effective or socially acceptable to provide a network of approximately 32 wastewater treatment plants (WWTPs) or water and energy reclamation cells (WERCs) throughout CRD’s existing collection infrastructure. However, plants at the University of Victoria and the Westhills/Langford/Colwood location could be designed and constructed immediately incorporating heat recovery and water reuse through aquifer recharge as applicable in the development area.

The University of Victoria facility would take advantage of existing piping arrangements within existing university buildings.

Westhills would be able to incorporate the district heating systems into their new infrastructure with wastewater pumped to one or more WERCs from Colwood and Langford through existing sewers. The location and number of plants would be based on the need to optimize servicing of the district heating systems. Wetlands enhancement, stream augmentation and aquifer recharge would provide the effluent disposal options and thus, there would be no requirement for a marine discharge. The phasing of plants would provide a just-in-time capacity to respond to future growth in the area. The subsurface disposal of effluent for aquifer recharge is acceptable addressing all technical and environmental concerns; however, it is not a practice which is presently accepted by BC Ministry of the Environment. Developmental demonstration to confirm acceptability of aquifer recharge will have to be integrated into the program.

The University of Victoria and Westhills/Langford/Colwood plants represent two of the plants specified in the accepted option of the “Path Forward”. While these plants are being designed and constructed an in-depth assessment could

be carried out to determine whether there are other locations which could provide district heating and effluent disposal / reuse options. There will definitely be a central WWTP at Macaulay Point and the design capacity of the plant would be based on the treatment of 2ADWF from the flows which could not be processed in the network of WERCs located throughout the existing infrastructure. The provision of just-in-time infrastructure in all new developments or subdivisions, will substantially reduce the volume of wastewater which needs to be processed at the Macaulay Point WWTP.

To accomplish the above, Phase II of the IRM model development and implementation should include three components.

The first is an implementation component involving an RFEI (Request for Expressions of Interest) and an RFP (Request for Proposals) to the private sector for a long term service contract to process wet organic solid waste, collected fat, oil and grease, sewage sludge and septage at a new facility likely to be located at the Hartland Landfill Site. The technology which provides the maximum revenue return to CRD while having the greatest positive impact on the environment will be selected. This should be a 20-year contract with an option to renew for 10-year periods. It is obvious that anaerobic digestion with methane processing/upgrading to vehicular fuel could be an option, but in a competitive bidding process, it may not be the selected option. The RFEI and the RFP could also include the selection of technology for the processing of the dry organic solid wastes. Again gasification and cogeneration may be an option. As with the wet organic fraction, technology selection will be based on maximum revenue return to CRD with the greatest positive impact on the environment.

The second component of Phase II of the IRM model is also an implementation phase. An RFEI and RFP should be issued for the design and construction of a WERC at a Saanich East location involving University of Victoria district heating facilities. This project will also have to address I&I reduction strategies and treated effluent disposal issues.

A separate RFEI and RFP should be issued for the design and construction of one or more WERCs to be located at the Westhills/Langford/Colwood location. This will require considerable creativity and the complete cooperation of the new Westhills Community as the district heating facilities will have to be integrated into the new community as well as other commercial and institutional facilities in the area. The area surrounding the new Westhills Community has considerable potential for wetlands augmentation and aquifer recharge and thus, it may be possible to service a large population base without marine discharge. For the east and west plants, selection criteria will be based on least cost to the CRD and the selection of systems which provide the greatest potential for environmental sustainability, including the effective management of wet weather flows.

The third component of Phase II of the IRM model is the developmental phase of the strategic planning activity. CRD needs to know what percentage of the developed areas can be serviced by a network of WERCs strategically

located throughout the community. The availability of district heating customers and appropriate effluent disposal opportunities will be the primary selection criteria. All flows which can not be handled in the network of WERCs, will have to be processed at a centralized WWTP facility. Obviously Macaulay Point is one of the locations which will be considered because of its existing outfall and the availability of options for district heating.

The components of Phase II of the IRM model identified above should be expanded and included as recommendations within the Phase I report. Since the integrated IRM model incorporates technologies which have already been demonstrated successfully at full scale, the risk in implementing the Integrated Resource Management model will be minimized by carefully selecting competent teams to deliver the critical components of the model."

Comments on the Ancillary Data

It is acknowledged that this document provides additional information essential to understanding the model. Unfortunately, the information presented as "IRM Study Ancillary Data" does not provide the information required for verification of the revenue projections.

At each of the presentations of the IRM Study Team, it was stated that it was essential to verify revenue projections using data from similar operating systems. Actual design and performance data, and revenues from comparable systems, specifically those in Sweden, have not been provided to verify concepts, system performance and revenue projections. The Study Team has stated on page 2 of the Ancillary Data submission that "The IRM model is a preliminary assessment of the probable costs and revenues of IRM." On page 3, under the heading "Revenue from Biofuels", it is stated that "It should be stressed that the revenues presented are estimates for the purpose of studying feasibility, and should not be relied upon without verification."

As the Study Team have now confirmed that there will be no attempt to verify revenue projections, the following paragraph extracted from my December 16th review, "Comments on the Final Report", represents a realistic assessment of the Phase I Study Report. **"The importance of verification of the revenue projections from the biomethane, the syngas electricity and heating energy, and the heating and cooling from a district heating system can not be ignored. Since these revenue projections have not been verified, the Phase I IRM Report as submitted, represents a conceptual plan for Integrated Resource Management with no confirmation or verification of the revenue projections. The conclusions as presented identify the benefits of the IRM concept and should be identified as benefits of the concept and not conclusions."**

I have issues with many of the statements made throughout the document but will only comment on those which would have a significant impact on the validity of the concept as presented.

- Page 4 – Note # 2: The Study Team needs to provide confirmation that "one m^3 of methane is equivalent to 1.099 litres of gasoline". I don't believe that this conversion is correct. Since the conversion of methane to vehicular fuel, represents a significant portion of the revenue stream, this conversion needs to be verified.
- Page 5 – Heat recovery from sewage for space heating and domestic hot water by means of heat pumps is estimated at 1,791,340 GJ/year with a revenue projection of $26.87 million. The basis for this and similar calculations, has not been presented.
- Page 5 – Who will pay $0.29/litre for treated effluent?
- Page 7 - The annual O&M cost for the anaerobic digesters is estimated at $1.2 million. What is the cost of collecting and preparing the wet organic feedstock for the anaerobic digester? Where is this cost included?
- Page 6 to 8 - Capital and O&M costs for specific components need to be compared to revenue generation potential to determine whether the expenditure is warranted.
- Page 11 - Note # 28 – 105,000 m^3/day is not twice ADWF. From the corrected version of Table 14, 1.25ADWF is 120,000 m^3/day and thus, the present ADWF is 96,000 m^3/day.
- Page 12 - The designs presented are for the present ADWF of 95,000 m^3/day and the remaining capacity for future growth, needs to be provided on a just-in-time basis. Flow equalization will provide capacity for wet weather excursions; however, I'm not certain that flow equalization capacity has been adequately addressed in the design and cost estimates.
- Pages 14 & 15 - Both examples provide an O&M credit for process simplicity and shared operations. These are tertiary treatment system and thus, I would not give a credit for process simplicity.
- Page 15 - Item # ii There is no indication that the flow equalization tank capital costs have been incorporated in the designs and cost estimates provided.
- Page 16 - Item # c Why has this option been considered? There is no process design or performance information that indicates that this technology could be considered.
- Page 16 - Item # d What is the ADWF, peak flow and effluent quality (actual versus permit) for the Central Saanich and Sooke plants? How does performance compare with proposed WERC designs? The lower capacity at Sooke has an increased unit cost, which would be expected. However, the size is comparable to the 28 WERCs specified in the concept plan and this does not appear to have been considered in the design and cost estimates.
- Page 18 – Note # 5 Is the assumption of no electricity displaced by district heating installations valid?
- Page 23 – Items # 2 & 3 (bottom of page) Can these pumping and treatment plant efficiency improvements be verified?

- Page 24 - Reference to a deferred maintenance cost of $100 million should be removed as there is no basis for this number.

I believe that components of the conceptual Integrated Resource Management Plan as submitted by the Study Team have considerable merit and warrant implementation in CRD's environmental management program. However, the revenue projections from the biomethane, the syngas electricity and heating energy, and the heating and cooling from a district heating system must be verified with results from operating systems prior to proceeding with implementation at CRD.

COMMENTS FROM RANDY ALEXANDER

Comments on the Draft Final Report

The study team has provided a strong vision of the need to change how our society views and utilizes solid and liquid wastes. They provide an integrated conceptual framework for a wide range of opportunities that exist to utilize these resources to conserve energy and water and to help meet climate change goals. The aim of the IRM approach is to integrate the management of energy, water, and waste resources to maximize benefit and reduce environmental impacts. Sewage makes up roughly 20 to 25% of the raw materials used in the study's revenue projections (up to 80% originates from solid waste). As a result, the large majority of the resource recovery, green house gas and revenue opportunities could be implemented independent of decisions related to sewage treatment. The main potential advantages of decentralizing sewage facilities identified are increased opportunity to use warm sewage effluent for district heating, and more efficient local distribution of reclaimed water. The majority of revenues, including energy recovery from sewage sludge, can still be achieved with a more centralized sewage treatment system.

The study lays out a high level risk/benefit hierarchy of potential IRM applications that can be used to assist communities in determining what components of IRM would be most practical to implement in their particular situation. This could be a roadmap to facilitate adoption of the concepts identified in the study. Unfortunately the study focuses on the differences between IRM and what they call traditional waste management. This may create an incorrect impression that the two approaches and infrastructures are incompatible. This silo approach can create artificial hurdles to adoption and lost opportunities, particularly in communities where there is already a significant investment in waste management infrastructure. Perception of risk and uncertainty can be significant barriers to adoption. An approach that shows how IRM concepts are compatible with, and can be incrementally layered onto, existing plans should break down barriers and speed implementation.

The concept of carrying out IRM pilot projects has merit, and is already a part of CRD planning. The CRD's current plan, "The Path Forward" provides an

excellent base from which to implement resource recovery opportunities. The current CRD plan envisions an infrastructure backbone that addresses high wet weather flow problems and the limitations of the existing sewage handling systems, while retaining the flexibility to support the implementation of innovative resource recovery projects. Dockside Green is one example of an IRM style project that has been integrated into the CRD plan. The CRD plan as laid out in “The Path Forward” commits to implementing two or more water reclamation facilities in the vicinity of potential customers (i.e. UVic, DND etc) as the first step in implementing treatment. These proposed facilities, along with other opportunities, could meet the objectives of pilot projects recommended in the IRM report.

Further assessment of IRM opportunities in the CRD should be integrated into the CRD planning process currently underway, in order to ensure that decisions made are legally supportable. Under legislation, the CRD is mandated to manage waste on behalf of their citizens. This includes the legislated authority to plan and carry out projects that require a financial commitment from taxpayers. In the case of sewage, this authority and responsibility is carried out through the Liquid Waste Management Planning process under the Environmental Management Act. The process includes requirements for ensuring: the environment is protected; public funds are expended prudently; and the public has adequate opportunity for input.

The CRD Liquid Waste Management Planning Process needs to proceed. The current discharge does not meet federal and provincial regulatory standards. There is clear scientific evidence that the discharge is having an unacceptable impact on the environment and does not meet regulatory requirements at both provincial and federal levels. Opportunities identified in the IRM study can be addressed as part of the CRD Liquid Waste Management Planning (LWMP) process. The CRD has committed to undertaking an Integrated Resource Recovery study as the next step in developing their sewage strategy. This IRM study will provide valuable input to the CRD’s work.

Integrated resource recovery opportunities can be most effectively implemented in new developments, but can pose significant challenges in applying to existing urban communities. Several large new developments on Vancouver Island and across British Columbia would be excellent candidates to showcase these opportunities. The model of 30+ sewage treatment plants integrated into existing CRD neighbourhoods is highly conceptual and there is not sufficient evidence provided to conclude that the fully distributed model is practical or would provide a capital cost advantage for the CRD. Challenges include the anticipated high cost and complexity of retrofitting in existing neighborhoods, as well as significant wet weather flows and stormwater infiltration into the system. The operation and maintenance of many small facilities could be a significant challenge with many small widely geographically distributed components requiring maintenance and attention (the study cites the example in Goteborg Sweden where 1000 employees are required to maintain the community's facilities).

The resource recovery concepts described hold significant potential. If efforts to implement them are to be successful, it is critical that the technical challenges and risks (i.e. cost, design, implementation, environmental, and human health) are identified and faced head on. The challenges, and potential costs (both capital and operating) of designing, building and operating distributed treatment facilities within established communities need to be better understood. The proposed designs of small treatment facilities are highly generalized and do not consider site specific limitations. Facilities will need to be individually designed for differing available footprints, feed characteristics, effluent quality required to meet local reuse opportunities, specific uses of recovered water (for example stream augmentation will need to address phosphates), and adequate redundancy and contingency planning for how to deal with off spec effluent when it occurs.

As the CRD considers specific IRM opportunities, they will need to assess the practicality of placing treatment plants in individual neighbourhoods and the capacity in the local receiving environment to accept effluent and reclaimed water. The CRD will need to ensure that all the sewage produced is treated in a manner that protects the environment and meets regulatory standards.

Current regulations are designed primarily to minimize environmental and health risks, rather than to encourage reuse and resource recovery. For example, regulations governing the use of reclaimed water are restrictive in an effort to minimize risk human health and the environment. This achieved by restricting uses that may provide a pathway for human contact. A less restrictive approach that facilitates broad reuse opportunities will need to find alternate means of mitigating the risks.

The study recommends integrating various community resource planning processes to facilitate adoption of IRM concepts. Liquid and Solid Waste Management Plans are already linked to Official Community Plans, and this approach could be expanded to more closely integrate relevant planning processes.

IRM Study Team Response to Comments on Final Draft of the Integrated Resource Management (IRM) Phase 1 Study Report entitled *Resources from Waste* Prepared by the Technical Advisory Committee (TAC) 16 January 2008

Overview

The IRM Study Team appreciates receiving the responses from TAC on its draft Phase 1 report. The TAC has been generous over the entire period of the analysis in providing comments on the draft reports from the Study Team and these comments have improved the quality of the final draft report.

The Study Team has elected to comment on only a few of the points raised by the TAC in order to enable the draft report to be circulated to the Peer Reviewers selected by the Steering Committee as soon as possible. It will carefully examine the technical points suggested by individual members of the TAC in the Appendices to the TAC report and incorporate appropriate changes into the Final Report of the Study Team following receipt of the peer review group comments. The Team hopes that the peer review can be completed expeditiously so that the report can be finalized by the Study Team and then released by the Government to inform the public debate on the advantages of IRM to support the Government's ambitious climate change agenda.

The Team appreciates that the TAC recognized that the general approach for applying IRM in the province 'should be supported and implemented'. It was also heartened that the TAC agreed that there were 'real possibilities for local government to consider' when preparing their response to the Premier's targets for reducing greenhouse gas emissions as set out in the Climate Action Charter that has been signed by numerous local governments and the Province.

That said, the Team was disappointed that the TAC did not take a stronger position in support of the potential for IRM application across the province as this was the main focus of the draft report. However the Team noted that, with the exception of one of its members, the TAC is represented by either staff or consultants to the CRD and therefore understands that most of the TAC comments would be applied to the case example for applying the concept of IRM to the CRD.

Comments on the CRD Example

The Study Team is surprised in the TAC conclusions that they 'cannot endorse the proposed solutions or the estimated business case benefits as presented in the study.' The Study Team went to great lengths to point out that the CRD case study was conceptual in nature and required a more detailed analysis before it could be implemented in the CRD or in any other regional district or municipality in BC. The disclaimer on page 1 states 'the report is intended to present a

general preliminary assessment of the potential for IRM and expressly cannot be applied to specific circumstances without adjustment and considerable further analysis.' Further on page 8, the report states that 'IRM has the potential to be implemented in the CRD and should go forward for more detailed and refined planning and assessment as part of the steps to implementation'. Indeed one of the TAC members states on page 15 of the TAC Commentary states that 'components of the conceptual Resource Management Plan as submitted by the Study Team have considerable merit and warrant implementation in the CRD's environmental management program'.

The TAC states that 'we caution against simplistic comparison of revenue and cost figures in the report with the cost figures in the 'Path Forward' document prepared by the CRD'. The Study Team went to great lengths in pages 2 and 3 of its draft report to demonstrate how the IRM and the CRD approaches differed and why there could not be a simplistic 'apples to apples' comparison. Indeed the Team took the approach of avoiding direct comparison with the Path Forward document on the explicit advice of TAC following the review of the first preliminary draft.

While The Study Team agrees that there would be significant benefits to adding resource recovery options to the proposed CRD approach, the Team feels that the TAC did not fully comprehend that this 'add-on' approach produces sub-optimal results, and is significantly different from an IRM approach that maximizes revenues and environmental benefits. The draft report contains a lengthy section beginning on page 53 on the benefits of the IRM approach and how these differ from the so-called 'traditional approach' to waste management. The Team recognizes that the IRM approach is not readily understood by most professionals and that the main way to understand its application is to 'establish some form of collegiate model to support and to inform professional and expert resources and to support municipalities in its implementation'(see page 56 of the draft report). IRM is a new way of thinking that integrates a number of fields in professional resource management which have traditionally been analyzed separately. The Study Team identifies the need for a Board of Expert Practitioners in IRM to be established to assist local government in understanding the power behind the concept and its ability to maximize revenues and reduce taxpayer investment in water and waste management facilities.

An example of the apparent lack of understanding by TAC on the nature of IRM occurs with the comments on page 3 of the TAC Commentary regarding net revenue projections. The TAC states that the Study Team did not clearly identify the distribution of net revenues from various waste streams yet this apportionment is explicitly presented on Figure 14, page 53. In addition, the comment on capital costs for the CRD is also misrepresented. The Study Team pointed out that one of the benefits of the IRM approach was that it could be modularized and that it did not require the entire infrastructure needed to support a population increase to 2060 to be included into the design at the beginning of the planning process. The advantage of IRM is that it could be applied to new development in the same way as the Dockside development has done. Through innovative development cost charges that encourage green buildings and policies that encourage incremental steps for water and energy conservation, both of which have been signaled by the province in its recent policy announcements on climate change and green cities agenda, it is reasonable to project that future development will not require the same per capita use of

resources—water, waste and energy as at present. Furthermore new development should be able to contribute funding for incremental infrastructure through resource recovery. In the draft IRM report in Table 12 on page 140, the Study Team compared differential rates of per capita use of water and waste use over the next 60 years to indicate that even with population growth it is not unreasonable to assume that incremental measures for conservation and reuse of resources will reduce future infrastructure and debt financing costs compared with the so called traditional approach.

The TAC states that the Study Team 'overstates the potential benefits and understates the potential risks of adopting multiple small waste treatment plants' in the CRD. The Study Team went to great lengths to point out that 'the distribution scheme (for waste treatment plants) is just one of many configurations for the CRD and was chosen for modeling purposes only' (page 43). The Team advised that there is a need to evaluate distributed waste treatment plants through pilots—see page 8 and this approach was endorsed by the appendices to the TAC Commentary which states that 'these proposed facilities (for distributed water treatment plants at UVic and DND) along with other opportunities could meet the objectives of pilot projects recommended in the IRM report'.

It is apparent to the Study Team that the Summary points on page 5 of the TAC Commentary are more negative about the application of IRM to the CRD than the comments provided by the individuals in the appendices. Compare the statement '(the TAC) cannot endorse the report's proposed solution for the CRD based on the information and the analysis provided' with the statements ' while components of the IRM Study Report may not be as profitable as suggested, they appear to warrant further investigation' (page 9); 'there are many aspects of the IRM concept that are valid and warrant further investigation (page 10) and finally 'further assessment of the IRM opportunities in the CRD should be integrated into the CRD planning process currently underway'(page 16).

The three appendices attached to the Commentary contain many useful suggestions and the Study Team will carefully consider all these technical points and made appropriate adjustments in its Final Report to be submitted to government following the peer review process.