

# **IDENTIFICATION OF ECO-INDUSTRIAL NETWORKING OPPORTUNITIES IN GREATER VANCOUVER**

## **DEMAND SIDE MANAGEMENT BENEFITS**

**Submitted to GVRD, Policy & Planning Division**

**By Mark Jeffrey Consultants & Eco-Industrial Solutions Ltd.**

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## **EXECUTIVE SUMMARY**

### **Study Objectives & Methodology**

Like many other municipal and regional agencies, the GVRD has recognized that managing demand for infrastructure, such as energy, transportation, water supply, wastewater treatment, and solid waste disposal, is a more cost-effective alternative to continually increasing infrastructure supply. An Eco-Industrial Networking program is under development to effectively deliver existing pollution prevention and eco-efficiency initiatives, and to identify new opportunities for sustainable modes of production in the region. The GVRD anticipates that eco-industrial networking (EIN) will support its demand side management (DSM) objectives by reducing infrastructure demand and costs, and improving environmental quality. However, research is needed to assess the opportunities for EIN in the region, as well as the extent and potential magnitude of these benefits.

The purpose of this study is to assess the EIN opportunities in the region and their associated DSM benefits to the GVRD and member municipalities.

The study was conducted based on the following methodology:

1. Identify industrial clusters (geographic) within the Region
2. Establish criteria for assessing clusters for EIN potential
3. Evaluate clusters for EIN potential & select case study cluster
4. Assess materials & energy flows in case study cluster
5. Assess DSM benefits
6. Determine potential EIN initiatives in the cluster
7. Determine GVRD rationale & strategies for promoting EIN

### **Case Study Results – Tilbury Industrial Park**

After evaluating industrial clusters in the region, Tilbury Industrial Park was chosen as the case study for which to identify DSM benefits. A detailed review of data available for Tilbury Industrial Park revealed the following characteristics of the cluster:

**Summary of Aggregate Data Gathered for Tilbury Industrial Park**

<b>Description</b>	<b>Result*</b>
Businesses	620
Number of Sectors	16
Total Water Consumption**	2,131,957 m <sup>3</sup> /y
Total Wastewater Discharge (Permittees)	740,915 m <sup>3</sup> /y
Total Stormwater	47.8 % impervious area
Total Solid Waste	unavailable
Total Energy – Natural Gas	1,141,162 GJ/y 9.10 million \$/y 57,058 t/y <sub>e</sub> CO <sub>2</sub> (Associated Emissions)
Total Energy – Electricity	163,670,024 kWh 10.45 million \$/y
Total Transportation	862,420 trucks leaving/y 1,394,380 trucks arriving/y

\*All data is approximate

\*\*Based on a partial data set.

### **Predicted DSM Benefits**

The potential benefits of highly functioning EIN in Tilbury Industrial Park are significant. For the purposes of this study, we assumed that an EIN initiative could match the benefits achieved so far in the EIN case

studies discussed above. It should also be noted that many of these initiatives are themselves in the early stages, with maximum benefits not yet achieved. Based on the benefits achieved in the case studies, we estimated the potential DSM benefits of an EIN initiative in Tilbury Industrial Park. We predict potential substantial savings, as shown in the table below.

**Predicted Savings\* Associated with EIN in Tilbury Industrial Park**

<b>Infrastructure Component</b>	<b>Current Amount</b>	<b>Predicted Savings</b>
Total Annual Wastewater (Generated by Permittees only)	740,915 m <sup>3</sup> /y	185,229 m <sup>3</sup> /y
Total Annual Water Consumption**	2,131,957 m <sup>3</sup> /y	532,989 m <sup>3</sup> /y
Total Annual Gas Consumption	1,144,162 GJ/y	300,223 GJ/y
Total Annual Gas Cost	9,095,418 \$/y	2,386,593 \$/y
Total Annual Electricity Consumption	163,670,024 kWh	61,204,715 kWh
Total Annual Electricity Cost	10,622,185 \$/y	3,972,186 \$/y
Total Annual Number of Truck Trips	862,420 trips/y	211,172 trips/y

\*All data is approximate

\*\*Based on a partial data set.

### **Recommendations**

The GVRD is well and uniquely positioned to promote EIN in Greater Vancouver. The GVRD has regulatory authority over a significant number of businesses; has adopted cooperative strategies for engaging those businesses not regulated; provides policy direction to member municipalities; and has a strong relationship with TransLink. In short, the GVRD could play a significant role in facilitating EIN through its extensive government and business relationships.

It is important to note that the encompassing nature of EIN makes it an excellent mechanism for achieving sustainability in the region. As such, EIN can assist the GVRD meet the goals of the Sustainable Region Initiative and can assist the GVRD meet the objectives of the Livable Region Strategy. Finally, as utility and service provider to member municipalities, the GVRD could use EIN as a cost effective mechanism to lower infrastructure costs to member municipalities.

We recommend that the GVRD focus on the following strategies for promoting EIN in Greater Vancouver: There are five key strategies upon which the GVRD can focus:

- Providing Leadership
- Building capacity and educating stakeholders
- Building relationships and developing partnerships
- Using policy levers, and
- Leveraging GVRD funds.

We also recommend that the GVRD pursue EIN in Tilbury Industrial Park. The data gathered and predicted savings calculated in this study could be used to market an EIN initiative and engage partners. The next step would be meeting with Delta to explore their needs, then partnering with Delta to support a multi-stakeholder workshop. A workshop can serve the following purposes:

- more fully explain the EIN concept and process,
- encourage dialogue and build or enhance relationships between businesses, government and the community, and
- help identify business, municipal and community leaders.

A summary of the recommendations is provided on the following page.

**Identification of EIN Opportunities in Greater Vancouver  
DSM Benefits**

**Executive Summary – Overview of Recommendations**

Provide Leadership	Building Capacity and Educating Stakeholders	Building Relationships & Developing Partnerships	Using Policy Levers	Leverage funds
<p>Be proactive with member municipalities by providing expertise and EIN tools</p> <p>Be proactive with member municipalities by providing expertise and EIN tools</p> <p>Provide technical support and “one-stop” shopping for member municipalities</p> <p>Lead by example, by endorsing EIN as a strategy for meeting SRI objectives and managing infrastructure demand, then encouraging member municipalities to do the same</p> <p>Provide policy direction for municipalities, such as offering EIN as a means of municipalities meeting SRI objectives</p> <p>Create an interdepartmental EIN team in the GVRD and meet regularly to exchange information</p> <p>Connect to the national and international EIN community that is emerging through the Federation of Canadian Municipalities, Canadian Eco-Industrial Network, International Society of Industrial Ecology, and the North American Eco-Industrial Development Council</p>	<p><b>Within the GVRD</b></p> <p>Create an interdepartmental EIN team</p> <p>Deliver EIN workshop to the interdepartmental EIN team</p> <p>Encourage EIN team members to review of EIN case studies and relevant reading material</p> <p>Encourage staff to attend and present at EIN-related conferences</p> <p>Encourage team members to become involved in an EIN project</p> <p>Champion an EIN in Tilbury Industrial Park</p> <p><b>With Member Municipalities</b></p> <p>Conduct “how to” EIN workshop for member municipalities</p> <p>Provide EIN services to member municipalities</p> <p>Provide EIN tools, such as guide for database design to facilitate data collection / analysis</p> <p>Work with member municipalities to develop EIN language Official Community Plans and other strategies.</p> <p>Develop and provide to municipalities an overview of the EIN development process</p> <p><b>Educating Stakeholders</b></p> <p>Act as a clearinghouse for EIN information and for conducting EIN workshops for potential stakeholders.</p>	<p><b>Building/Enhancing Relationships with Business</b></p> <p>Promote EIN to permittees through various DSM mechanisms including permit officers, and Business Services group contacts and newsletters</p> <p>Use existing business relationship with permittees to identify potential EIN Champions</p> <p><b>Developing partnerships</b></p> <p>Identify and approach potential partners for EIN developments.</p>	<p><b>GVRD Plans and Initiatives</b></p> <p>Adopt EIN when amending Liquid / Solid Waste &amp; Air Quality Management Plans, Livable Region Strategic Plan and Sustainable Region Initiative.</p> <p>Consider Landfill bans; EIN as an economic development strategy; EIN as a densification and green space strategy</p> <p><b>GVRD Permits and Permittees</b></p> <p>Encourage permittees to examine EIN strategies when permit is amended or issued.</p> <p>Investigate umbrella / alternative permitting mechanisms</p> <p><b>Member Municipalities</b></p> <p>Recommend member municipalities adopt EIN as a strategy in the Official Community Plans, strategies; and development standards.</p> <p><b>Economic Instruments</b></p> <p>Examine the possibility of raising emission permit fees and lowering property taxes; supporting municipal efforts to increase Development Cost Charges for Industrial Development; Encouraging developers to examine EIN as a condition of re-zoning-Property tax shift</p>	<p>Provide a portion of the initial funds required to start an EIN, based on the return from the DSM benefits.</p> <p>Leverage the funds to attract support from business, other levels of government and other interested parties.</p>

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## **1. INTRODUCTION**

### **1.1. Objective**

Like many other municipal and regional agencies, the GVRD has recognized that managing demand for infrastructure, such as energy, transportation, water supply, wastewater treatment, and solid waste disposal, is a more cost-effective alternative to continually increasing infrastructure supply. An Eco-industrial Networking program is under development to effectively deliver existing pollution prevention and eco-efficiency initiatives, and to identify new opportunities for sustainable modes of production in the region. The GVRD anticipates that eco-industrial networking (EIN) will support its demand side management (DSM) objectives by reducing infrastructure demand and costs, and improving environmental quality. However, research is needed to assess the opportunities for eco-industrial networking in the region, as well as the extent and potential magnitude of these benefits.

The purpose of this study is to assess the EIN opportunities in the region and their associated DSM benefits to the GVRD and member municipalities.

Specifically, the objectives of the assessment are as follows:

- a) identify areas within the GVRD that have the highest potential for establishing eco-industrial networks;
- b) assess demand side management benefits that could be derived from establishing eco-industrial networks in the highest potential areas in terms of waste reduction, wastewater recycling/reuse, water conservation, greenhouse gas emissions reduction, air quality improvements, energy efficiency and stormwater management improvements;
- c) determine context-specific opportunities for GVRD to support the development of eco-industrial networks within these high potential areas.

### **1.2. Eco-Industrial Networking**

Eco-industrial networking (EIN) involves creating collaborative and cooperative relationships between and among businesses, governments and community stakeholders to reduce demand for services such as heating, cooling and transportation and use of resources such as energy, water, air and land. There is a growing interest in EIN across Canada, provincially and locally. Governments and business are using Eco-Industrial Networks as a way to enhance the financial performance and reduce the environmental impact of participating companies, and as an economic development tool for participating communities. For example, there are a number of EIN projects underway in Canada including: Burnside in Halifax, Nova Scotia; Alberta Industrial Heartland near Edmonton, Alberta; Hinton, Alberta; and Regina, Saskatchewan.

At a Federal level, EIN facilitates the development of green infrastructure, described by the Federation of Canadian Municipalities (FCM) as: Distributed, Clustered, Interconnected, Integrated, Service Oriented, Responsive, Renewable, Appropriate, Multi-Purpose, and Adaptable. Further, the Green Municipal Enabling Fund, designed to promote green infrastructure and administered by the FCM, is funding EIN projects in North Vancouver and Hinton, underscoring their support for an EIN approach.

Provincially, 20 communities submitted a formal expression of interest to participate in the Scoping Study to Identify BC Communities for Pilot Eco-Industrial Projects.

Within the GVRD, Richmond, one of the top communities identified in the Scoping Study, is currently in the early stages of pursuing an eco-industrial park project. The District of North Vancouver is undertaking the Maplewood Community Eco-Industrial Partnership Project. The GVRD is also working with a graduate student from Dalhousie University to explore EIN opportunities in the Regional Town Centres.

### 1.3. Methodology

The work completed for each task, as well as the results, are discussed in the following sections. The methodology for this study is summarized as follows:

1. Identify Industrial Clusters (Geographic) Within the Region: Lists of air emission, sewer use discharge, and solid waste permittees were sorted by postal code to identify areas of concentrated industrial activity; permittees and industrially zoned lands were mapped to provide a spatial representation.
2. Establish Criteria for Assessing Clusters for EIN Potential: Based on case studies and documented success factors, we developed several criteria against which the EIN potential of industrial clusters could be evaluated.
3. Evaluate Clusters for EIN Potential & Select Case Study Cluster: Based on information provided via reports, interviews, and two meetings with GVRD staff, we evaluated the clusters against the criteria. Tilbury Industrial Park was selected as the case study cluster.
4. Assess Materials & Energy Flows in Case Study Cluster: Based on information contained in the GVRD permits; data provided by the Corporation of Delta, BC Gas, and BC Hydro; and knowledge of the sectors in Tilbury Industrial Park, we quantitatively estimated water, wastewater, energy, and transportation generation / use. We completed a qualitative assessment of stormwater, solid waste, and other materials generation / use.
5. Assess DSM Benefits: Working from the baseline information gathered in the previous stage, and based on the achievements of other EIN projects, we estimated the quantitative benefits of an EIN initiative on water consumption, wastewater generation, energy use (and greenhouse gas generation), solid waste generation, and transportation infrastructure.
6. Determine Potential EIN Initiatives in the Cluster: Based on the sectors in Tilbury Industrial Park and using examples from other EIN projects, we created a list of potential EIN initiatives.
7. Determine GVRD Rationale & Strategies for Promoting EIN: Based on the case studies, our experiences, and the results of the above stages, we developed several strategies for promoting EIN in Greater Vancouver.

## 2. IDENTIFICATION OF GEOGRAPHIC CLUSTERS

### 2.1. Identifying Clusters of Permittees

The GVRD provided a list of permittees for each medium (air, wastewater, and solid waste), including business name, site address, site postal code, permit number, owner address, owner postal code, and North American Industrial Classification System (NAICS) code. The permittee lists were merged into one file, then sorted by postal code to quickly identify clusters of permittees (see Appendix A). Table 1, shows the top six clusters (based on total number of permittees).

**TABLE 1: Top Six Industrial Clusters (by Number of Permittees) in Greater Vancouver**

Cluster	Municipality	Description
<b>Annacis Island</b>	Corporation of Delta	Located in Fraser River South Arm. Access via bridges from Richmond, New Westminster and Surrey. Highways 91 and 91A converge at this site; CN Rail line provides freight transportation.
<b>Kennedy Heights</b>	City of Surrey	Bounded by 88 Avenue to the north, 72 Avenue to the south, from Scott Road east to King George Highway. Approx. 1049 hectares. Close to major highways; a CP Rail line transects the area
<b>Mitchell Island</b>	City of Richmond	Mitchell Island (~ 145 ha) is located in the North Arm of the Fraser River, between Vancouver and Richmond. The island is accessed near the Knight St. Bridge.
<b>Port Kells</b>	City of Surrey & City of Langley	Area between Hwy 1 and Fraser River, and between 184th and 204th St (a distance of ~4 km). Cluster lies in Cities of Surrey and Langley. The cluster employs approximately 20,000 people.
<b>Tilbury Industrial Park</b>	Corporation of Delta	Comprises Tilbury Island (in Fraser River South) and industrial area along River Road East. Majority of industrial activity on mainland. Bounded by agricultural land, Burns Bog, and the Fraser River. Located between Highway 99 and Highway 91. Rail and marine access as well.
<b>Clarke Dr./ Burrard Waterfront</b>	City of Vancouver	Area north of Hastings, roughly centred on Clark Dr, and from 6th Ave north to Hastings, between Main and approx. 2 blocks east of Clarke. The total north-south distance is ~ 2 km.

## **2.2. Identifying Industrial Areas**

The sorted permittee data was provided to the GVRD GIS department. The GIS department then created a map showing all zoning patterns (commercial, and industrial, watershed, parks, and agricultural); sewer use, air emission, and solid waste permittees; and major transportation routes. This map provided a useful visual reference indicating clusters of permittees and the location of industrial parks/ zones in the region. A copy of this map is shown in Figure 2 (see insert).

## **2.3. Technical Challenges**

### *Databases*

The GVRD is moving towards combining its air, sewer use, and solid waste permitting databases as part of its new, multimedia approach. There were some difficulties associated with merging the lists generated by each of the existing databases. This should become easier once all permits are entered in the same database. For the purposes of this study, accurate NAICS codes facilitated permit data use.

### *Mapping*

Initially, we did not know whether the GVRD's Geographic Information Systems (GIS) staff could provide maps showing industrial lands in the region. The consultants had located a hard copy of a map, created by the now defunct Greater Vancouver Economic Partnership, identifying commercial and industrial Business Investment Zones in the region, but a GIS- or AutoCAD compatible electronic version of the map could not be found. Based on our experience in obtaining information from municipalities, we determined that a survey of the 21 municipal planning departments to identify industrial areas in their municipalities was beyond the scope of this study. Instead, we proposed to obtain a listing of industrial land from real estate databases and sort these by postal code to identify industrial clusters. This data was obtained at the start of the study. For confidentiality reasons, a full table cannot be published.

After obtaining the real estate data, we determined that the GVRD's GIS department had access to industrial zoning patterns, and could easily place these on a map. The GIS department was also able to map the industrial real estate data. The industrial zoning patterns, industrial lands identified in the real estate data base, and industrial investment zones on the GVEP map were similar, so it was decided that the industrial zoning patterns mapped by the GVRD GIS department would be sufficient in identifying industrial areas in the region.

## **3. CLUSTER EVALUATION CRITERIA**

We developed criteria to evaluate the industrial clusters and to choose one cluster for a theoretical case study. The criteria were developed based on characteristics required to support a potentially successful EIN initiative, while taking into account the availability of qualitative and quantitative information that would facilitate comparison of clusters and evaluation of DSM benefits.

We reviewed EIN literature and case studies, as well as other studies related to sustainable business sites, to determine appropriate criteria. This review considered the following information:

- EIN in Kalundborg, Denmark - the proximity of businesses and close relationships between plant workers and management have been cited as a critical component in the creation of the industrial symbiosis in Kalundborg, Denmark;
- EIN in Regina, Saskatchewan - communities like Regina have prioritized industrial clusters with significant environmental issues
- EIN in Burnside Industrial Park - chosen for an initiative because of its size and the diversity of businesses.
- criteria developed to evaluate Regional Town Centres (LeBreton, 2002);

- criteria used to evaluate proposed projects in ten BC communities (Eco-Industrial Solutions Ltd., 2002); factors for success cited in a survey of 43 sustainable business sites in the Netherlands (Pellenbarg, 2002); and
- strategies proposed for eco-industrial development in Asia (Lowe, 2001).

We also relied on our own experience in establishing EIN projects, eco-efficiency initiatives, green buildings, and personal knowledge of other projects in North America.

Based on the above information, and taking into account the scope of the study and availability of information, a draft list of criteria was created and reviewed by the GVRD. The final 32 criteria, their relevance to EIN, and a potential indicator for this study, were tabulated and may be found in Appendix B.

## **4. EVALUATION OF CLUSTERS & SELECTION OF CASE STUDY CLUSTER**

### **4.1. Evaluations of Clusters Against Criteria**

Two meetings were held with GVRD staff to obtain as much information as possible regarding the clusters. Permitting and enforcement officers attended the first meeting, while Policy and Planning staff attended the second meeting.

After a description of the project goals and data gathered to date, the criteria were reviewed one-by-one, with staff providing anecdotal information or reference to additional studies. The focus was on the Tilbury Industrial Park, Port Kells, Annacis Island, Mitchell Island, Kennedy Heights, and Vancouver Harbour / Clark Drive clusters, although information regarding all clusters was obtained.

In addition, GVRD staff provided information via e-mail in response to our information requests made before and after the cluster evaluation meeting. This information covered green buildings, infrastructure concerns, energy and green space issues. In addition, a draft of the evaluation of Regional Town Centres (LeBreton, 2002) was reviewed for information pertaining to specific municipalities.

All of the evaluation information for each of the top six clusters (by number of permittees) has been summarized in Appendix C.

### **4.2. Selection of Case Study Cluster**

We received both quantitative and qualitative information regarding the clusters. Therefore, the overall assessment was somewhat subjective. Annacis Island, Tilbury Industrial Park, Mitchell Island, and Kennedy Heights were considered the best candidates. Port Kells ranked lower, given the challenges of dealing with two jurisdictions (City of Langley and City of Surrey). With respect to the Vancouver Harbour / Clark Drive area, the unique nature of the businesses compared with the make-up of businesses in other areas, combined with the fact that the GVRD has only an indirect relationship with sewer use permittees in the City of Vancouver, led us to rank this area lower as well.

The relevant municipalities for the remaining four clusters were queried to ensure that they would be able to provide the business list needed to evaluate the potential materials and energy flows. Each municipality responded promptly provided a list of businesses, and expressed interest in the study.

Finally, for each criteria, the top three clusters were identified. Tilbury Industrial Park was ranked first as it rated first against more criteria than other clusters. Given that the Corporation of Delta appeared able and willing to provide the information needed for the rest of the study, Tilbury Industrial Park was chosen as the case study cluster.

## 5. EVALUATION OF MATERIALS AND ENERGY FLOWS IN TILBURY INDUSTRIAL PARK

### 5.1. Sectoral Assessment – Data Gathering

The Corporation of Delta provided a list of all businesses in the Tilbury Industrial Park. Delta does not track NAICS codes, but was able to provide a business description for each company. This list was then merged with the list of permittees. The list was then roughly sorted into the following categories: Agriculture, Chemicals, Transportation, Other Equipment, Services, Asphalt and Concrete, Construction, Electronics, Energy, Food, Other Manufacturing, Metal Works, Paper, Plastics, and Rubber, Printing, and Other Warehousing and Distribution.

This list of businesses was then sent to BC Gas, BC Hydro, and Delta to obtain aggregate natural gas, electricity, and water consumption data per sector. BC Gas was able to supply this data the most quickly, but returned the data as aggregate consumption per sector, according to NAICS codes classifications. Further investigation revealed that the BC Gas billing system (carried over from the BC Hydro billing system once the billing systems were separated in 2001) contained a NAICS code entry for each customer. We asked if BC Gas could generate a list of businesses in Tilbury Industrial Park, including the relevant NAICS code.

BC Gas provided such a list, and it was merged with the original master list of businesses in Tilbury Industrial Park. There were some inconsistencies in classification between codes assigned by the GVRD and those assigned by BC Gas. There were also at least 80 businesses listed by BC Gas not listed by Delta, and vice versa. We made educated guesses regarding the NAICS code for these businesses. The merged list was resorted according to the NAICS categories used by BC Gas.

### 5.2. Sectoral Assessment – Results

#### 5.2.1. Summary of Aggregate Data

Table 2 provides a summary of the aggregate data gathered for Tilbury Industrial Park.

**TABLE 2: Summary of Aggregate Data Gathered for Tilbury Industrial Park**

Description	Result*
Businesses	620
Number of Sectors	16
Total Water Consumption**	2,131,957 m <sup>3</sup> /y
Total Wastewater Discharge (Permittees)	740,915 m <sup>3</sup> /y
Total Stormwater	47.8 % impervious area
Total Solid Waste	unavailable
Total Energy – Natural Gas	1,141,162 GJ/y 9.10 million \$/y 57,058 t/y eCO <sub>2</sub> (Associated Emissions)
Total Energy – Electricity	163,670,024 kWh 10.45 million \$/y
Total Transportation	862,420 trucks leaving/y 1,394,380 trucks arriving/y

\*All data is approximate

\*\*Based on a partial data set

The results of the sectoral assessment are described in more detail in the following sections.

### 5.2.2. Classification of Businesses by Sector

Once the above information was gathered, a revised list of businesses organized by sector was prepared. This list is shown in Appendix D.

The GVRD GIS Department created a map of the Tilbury Industrial Park area, and mapped these businesses as well to provide a spatial representation of the sectors in the park (see Figure 3, insert).

According to Delta, there are 620 businesses in Tilbury Industrial Park. The breakdown of companies by sector is shown in Table 3.

**TABLE 3 Sectoral Breakdown in Tilbury Industrial Park**

<b>Category</b>	<b>Number of Companies</b>
Agriculture	10
Cement and Manufacturing	64
Chemical Manufacturing	23
Food and Hospitality	23
Food Manufacturing	12
Institutional	3
Mining, Oil and Gas	3
Miscellaneous	64
Multi-Family (leasors of real estate)	59
Other Manufacturing	52
Retail	93
Services	65
Transportation	27
Warehousing and Distribution	81
Wood and Forest Products	33
Suspected Former Landfills	8
<b>Total</b>	<b>620</b>

### 5.2.3. Water Consumption

The Corporation of Delta provided **partial** water consumption data for Tilbury Industrial Park. The total known water consumption in Tilbury Industrial Park is 2,131,957 m<sup>3</sup>/y.

Unfortunately, it proved more difficult than expected for Delta to pull information from their database. According to staff, the metering utility system is quite old, and so is not easy to query. This number is based on the water consumption at 235 properties. None of the sectors had complete enough data to allow for an estimate of the aggregate water consumption in that sector. Even accounting for multi-tenant facilities, with many businesses at one address, the consumption at many of the 620 businesses in Tilbury is not included in this number. Actual water consumption could be 2-3 times higher than reported.

### 5.2.4. Wastewater & Permitted Discharges

The GVRD provided data related to the average annual discharges of permittees in Tilbury. A summary of this data is shown in Table 4 on the following page. Sixteen (16) companies, or 2.5%, of the businesses in Tilbury hold sewer use discharge permits. As shown in Table 7, these businesses collectively discharge 740,915 m<sup>3</sup>/y of wastewater per year. Annual collective loadings for those substances over 1 kg/y are also shown.

**TABLE 4: Summary of Permitted Wastewater Discharges in Tilbury Industrial Park  
(kg/y except where indicated)**

<b>Parameter</b>	<b>Amount</b>	<b>Parameter</b>	<b>Amount</b>
Avg Flow (m <sup>3</sup> /y)	740,915	Co – T	2.23
Avg. Temp (deg C)	13.72	Cr – T	50.53
BOD	205,491	Cu – T	9.47
COD	459,192	Fe – T	80.88
TSS	238,132	Mn – T	13.92
O&G (hc)	1,695	Mo – T	17.78
O&G –T	7,604	NH4	910.04
Toluene	4.53	Ni – T	11.4
Ag – T	2.59	Pb – T	7.84
Al – T	442.18	SO4	58,644
As – T	20.07	Sulphide	1.15
B – T	221.98	Zn – T	13.59
Cd – T	2.33		

### 5.2.5. Stormwater

Actual stormwater run-off volumes are not measured for Tilbury Industrial Park. According to the GVRD, the Tilbury Island catchment area contains 47.8% impervious surfaces (the GVRD study area is 235 acres). Stormwater run-off is estimated to be 697 mm. According to the River Road East Strategy, Scenario A, the proposed plan for the area, allows for 81 acres of the 280 acres to be open space (29% open space). Of the developed 199 acres under this scenario, the equivalent of 53 acres would have to be permeable just in order to maintain the existing percentage of impervious area, as documented in GVRD studies. It should be noted that these studies were completed for roughly the same geographic area, but each study set slightly different boundaries. Therefore, this data provides only a very general picture of stormwater issues in the area.

### 5.2.6. Solid Waste

Private contractors collect garbage and recyclables from commercial and industrial businesses throughout the Greater Vancouver Region. Therefore, data regarding the amount of solid waste and recyclables generated in Tilbury Industrial Park were not available from either the GVRD or the Corporation of Delta. Given that there are only 2-3 main waste management contractors in the Lower Mainland, the private waste collection contractors servicing Tilbury may be able to estimate the total tonnage of garbage and recycling collected. If an EIN initiative proceeds in Tilbury, the private waste management contractors could be valuable partners, and could provide more insight into the volume, tonnage, and quality of garbage and recyclables generated in Tilbury Industrial Park.

### 5.2.7. Energy

#### Natural Gas

BC Gas provided the total annual natural gas consumption and estimated cost per sector, as shown in Table 5 on the following page. The businesses in Tilbury Industrial Park consume 1,141,162 GJ/y of natural gas, at an estimated cost of \$ 9 million per year.

**TABLE 5: Natural Gas Consumption by Sector in Tilbury Industrial Park**

Rate Class	Industry Group	No. of Customers	Annual Energy (GJ)	Total Annual Cost (\$)³
Commercial¹	Agriculture	6	865.9	\$9,267
	Cement and Metal Manufacturing	63	54,264.60	\$486,765
	Chemical Manufacturing	40	41,768.50	\$376,054
	Food & Hospitality	15	7,260.00	\$68,800
	Food Manufacturing	11	8,345.00	\$76,177
	Institutional	11	7,237.20	\$66,482
	Mining, Oil and Gas	5	6,134.10	\$56,197
	Misc.	93	41,530.40	\$391,112
	Missing	28	16,523.50	\$155,041
	Multi-Family	70	20,751.90	\$201,441
	Other Manufacturing	53	41,240.80	\$372,236
	Retail	88	32,017.50	\$304,147
	Services/Recreational	66	14,337.40	\$144,171
	Transportation	18	10,086.20	\$92,593
	Wholesalers and Distributors	90	40,573.70	\$380,411
	Wood and Forest Products	25	18,502.90	\$168,168
	<b>Total</b>	<b>682</b>	<b>361,439.70</b>	<b>\$3,349,063</b>
Industrial²	Asphalt & Concrete	3	163,302.10	\$1,245,093
	Food	3	46,290.20	\$356,173
	Metal	3	249,286.00	\$1,753,528
	Services	3	85,615.10	\$633,057
	Wood Products/Equipment/Paper	6	238,228.40	\$1,758,504
	<b>Total</b>	<b>18</b>	<b>782,721.80</b>	<b>\$5,746,355</b>
	<b>Total</b>	<b>700</b>	<b>1,144,161.50</b>	<b>\$9,095,418</b>

1. Refers to businesses that are in the commercial rate class. These are generally smaller businesses, but aren't necessarily commercial operations. Many manufacturers and light industrial companies are included in this category. The data is from July 2001 through June 2002.

2. Refers to businesses in the industrial rate class, which are generally larger or more energy intense industrial operations. The data is from October 2001 through September 2002.

3. Estimated total annual gas cost, including the gas commodity cost and all BC Gas delivery charges.

BC Gas's records indicate that there are 700 customers in Tilbury Industrial Park, and not 620 as found in the Corporation of Delta business database. A review of the list of customers provided by BC Gas shows that several customers are listed more than once. It's not known how this affects the gas consumption numbers. The industrial class consumption is double that of the commercial rate class. Only two of the industrial customers were listed twice, so at most, the industrial gas consumption might be off by 10-20%. For the purposes of this study, the numbers are still useful in that they are the right order of magnitude. One other note – it appears that BC Gas queried its database by the name of the industry group, and not by the associated NAICS code. This resulted in 28 businesses falling into a Missing category. This skews the results slightly, but represents less than 5% of the commercial rate class. Therefore, the overall impact on the natural gas consumption numbers is not significant.

The greenhouse gas emissions from the natural gas consumption equal 57,058 t/y eCO<sub>2</sub>. In addition, the GVRD calculated CO<sub>2</sub> emissions for 7 companies in Tilbury Industrial Park. The total emissions for these companies are 1,064,417 t/y CO<sub>2</sub>. The majority of these emissions are generated as a by-product of cement manufacturing, and are not due to natural gas or other fossil fuel consumption. Therefore, reducing natural gas consumption will not reduce these emissions. At this time, we are unable to predict potential greenhouse gas emission reductions from the cement manufacturing process.

Electricity

BC Hydro provided annual electricity consumption data for Tilbury Industrial Park, aggregated by sector. The results are shown in Table 6. The businesses in Tilbury Industrial Park consume 163,670,024 kWh (589,234 GJ/y) of electricity, at an estimated cost of \$10.445 million per year. Although BC Hydro does generate some electricity via the combustion of fossil fuels, for the purposes of these preliminary calculations, it was assumed that the electricity consumed in Tilbury Industrial Park is hydro-generated. Should an EIN initiative proceed in Tilbury Industrial Park, then the GVRD could request that BC Hydro estimate the percentage of non-hydro electricity used in Tilbury Industrial Park. An estimate of greenhouse gas emissions from this electricity could then be estimated.

**TABLE 6: Electricity Consumption by Sector in Tilbury Industrial Park**

Sector	Total Number of Accounts	Total Annual Consumption (kWh/y)	Total Annual Consumption (\$/y)
Agriculture	7	2,727,394	\$177,008
Cement and Metal Manufacturing	70	13,452,834	\$873,089
Chemical Manufacturing	33	23,919,193	\$1,552,356
Food & Hospitality	14	5,646,680	\$366,470
Food Manufacturing	12	10,505,916	\$681,834
Institutional	8	839,993	\$54,516
Mining, Oil and Gas	6	406,992	\$26,414
Miscellaneous	75	8,407,010	\$545,615
Multi-Family	69	3,139,377	\$203,746
Other Manufacturing	56	54,089,314	\$3,510,396
Retail	84	4,319,696	\$280,348
Services	54	6,333,543	\$411,047
Transportation	14	2,620,040	\$170,041
Wholesalers & Distributors	80	8,921,426	\$579,001
Wood and Forest Products	28	17,927,336	\$1,163,484
Municipal Gov	2	413,280	\$26,822
<b>TOTAL</b>	<b>612</b>	<b>163,670,024</b>	<b>\$10,622,185</b>
	<b>TOTAL (GJ/y)</b>	<b>589,165</b>	

\*Costs estimated based on \$0.0649 per kWh. This is a rough estimate only.

**5.2.8. Transportation**

The Delta Survey of River Road East Businesses, completed in 2000 as part of the River Road East Strategy, provided some data with respect to transportation demands in the area. Based on this data, the truck traffic in Tilbury Industrial Park can be very roughly estimated to be 862,420 trucks leaving Tilbury Industrial Park each year, and 1,394,380 trucks visiting Tilbury Industrial Park each year. The data, calculations, and assumptions used to estimate the overall transportation demand may be found in Appendix E.

Other forms of transportation could not be considered at this time.

**5.3. Additional Information About Tilbury Industrial Park**

River Road East Planning Strategy

The Corporation of Delta's website contains information regarding the River Road East Strategy. Delta has been developing a long-term planning process, taking into account the industrial character and

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environmental issues in the area. In July, 2001, council endorsed a master plan (Scenario A) for the area. The plan contained the most green space of the three options presented in the consultants' report. This plan calls for a total of 81 acres of green space, and 199 ha industrial land. Scenario A also provides for increased trails, waterfront parks, view points, and a potential Burns Bog interpretative centre.

The website also contained an electronic copy of the report "River Road East Strategy Phase 1 Report". Information relevant to this study is summarized in point form below.

- The River Road east area is 835 ha, bounded by 72 St. to the west and Highway 91 to the east; Fraser River on north and Burns Bog to the south
- 10,000 people work in the area
- The report lists 558 businesses – 200 Manufacturing, 141 Wholesale, 63 Producer Services, 46 Transportation / Communications / Utility, 45 Domestic Services, 37 Construction, 25 Retail. It's not known how these classifications correspond to NAICS codes
- River Road East area currently has 81 ha of open space (mostly municipal land); 334 ha of established industrial and business parks, 135 ha low intensity industrial; 31 ha major industries like cement plant; and 117 ha of vacant lands / brownfields.
- There are drainage issues in Burns Bog (it is drying out); the local water table is dropping;
- There is significant fish habitat along shoreline and in Tilbury Slough.
- Traffic congestion is a considered a major problem and potential impediment to economic development. The report discusses various road construction options, but makes no mention of managing demand.
- The existing local sanitary sewage collector force main is thought to have sufficient capacity to support development of the area. However, further development will require additional pump stations and gravity collection systems.

The report also outlines strategic objectives for the area. Many of these objectives would support and be enhanced by an eco-industrial initiative. These objectives include the protection of environmentally sensitive areas; development of a comprehensive open space system; and the development of "sustainability guidelines that include tree retention, ecological restoration, materials coop-recycling, and energy conservation". The report also recommends that a master drainage plan be developed that meets the needs of Burns Bog. In addition, the authors suggest that Delta consider the development of a Burns Bog Interpretative Centre, which could involve a coordinated stewardship program with Burns Bog Society and Tilbury Industrial Park industries.

The report builds a foundation for ecological design, protection, and integration opportunities. EIN initiatives such as coordinated green roof retrofits and stormwater management pilot projects could reduce the need for traditional stormwater infrastructure required for additional development and redevelopment. The GVRD could also work with businesses and TransLink to improve transit, and work with businesses to manage transportation demand by improving transportation and logistics efficiency. Similarly, EIN initiatives that increase material and energy use efficiency would support sustainability objectives.

### Burns Bog Conservation Society 1999 Letter to BC Environmental Assessment Office re: Sustainable Development Strategy

This letter indicates that the Burns Bog Conservation Society has considered and supports eco-industrial projects in Tilbury Industrial Park. Portions of this letter are available on the Burns Bog Conservation Society website, and form the basis of the Society's Sustainable Development Strategy. It is important to note that many local businesses are listed as supporters of the Society.

An especially relevant paragraph from this letter has been extracted below:

Three core development concepts are presented that are intended to provide a platform for environmentally responsible practices, processes, and technologies. The realization of these

proposals relies upon a sustainable development paradigm; that is, their design and construction should incorporate ecologically responsible methods as well as waste management, resource cycling and alternative energy technologies. Each tier has multiple components that together represent an opportunity for Delta to become an international attraction for investment, science, and travel while providing a national nucleus for environmental technologies, industrial ecology, and sustainable practices. To prevent further disturbance of the Bog's ecological integrity, existing industrially zoned sites on the Bog's periphery are proposed as locations for the developments

- RESEARCH AND EDUCATION FACILITY - to initiate: further scientific study of peatlands' ecological processes, environmental technology innovation, and facilitate educational initiatives
- ECO-TOURISM FACILITY - to capitalize on the trend in global tourism markets towards natural experiences and low-impact behaviours while offering exposure to the latest technologies and practices in the environmental industry
- ECO-INDUSTRIAL PARK - attracting industry leaders and investment from across Canada and around the world by providing an arena to showcase environmental technologies and sustainable practices

## **5.4. Technical Challenges**

### *Data Gathering*

Merging and sorting data from the Corporation of Delta was a time-consuming procedure, as a decision had to be made regarding the classification of each business. Further, it was difficult to class each business, as some companies fit in several sectors i.e. Canadian Autoparts Toyota could be classed in Equipment, Transportation, Metal-Related, General Manufacturing. However, we deemed it less time consuming than looking up NAICS codes for each of the 600 plus businesses.

## **6. SUMMARY OF RELEVANT CASE STUDIES**

EIN and related case studies were reviewed to determine how benefits might be transferred to an initiative in Tilbury Industrial Park. The case study review will also help to estimate realistic materials and energy reduction targets, and to illustrate how EIN opportunities might affect the GVRD's DSM programs.

There are dozens of EIN initiatives in North America, Europe, and Asia. Despite the number of initiatives, it can be challenging to find quantitative case study information. Many projects are in the early stages, data is not being disseminated, or, most commonly, the participants have not been systematic or rigorous in quantitatively documenting the results. The case study review focused on the following examples where benefits have been quantified:

- Town of Kalundborg, Denmark
- Riverside EcoPark, Burlington, Vermont, USA
- Phillips Eco-Enterprise Centre, Minneapolis, Minnesota, USA
- Ora EcoPark, Frederikstad, Norway
- Port of Rotterdam, Netherlands
- Vreten Industrial Park, Solna, Sweden
- Burnside Industrial Park as Ecosystem Project, Halifax Regional Municipality, Nova Scotia, Canada

A summary of the achievements is presented below.

### **6.1. Kalundborg, Denmark**

- Over one five year period, 120 million USD savings were achieved with a 60 million USD investment
- Linkages involve recovery of wastewater, steam, hot water, sulphur, fly ash and biomass.

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- Businesses involved include coal and oil-fired generating station, oil refinery, enzyme production, drywall manufacturer, cement plant, residential houses, community greenhouses, aquaculture, and farms
- 97,000 m<sup>3</sup> of solid biomass and 280,000 m<sup>3</sup> liquid biomass used to be discharged to ocean. They are now recovered and used as fertilizer for 600 regional farmers, displacing tons of commercial fertilizers
- Power plant has reduced its water consumption 50% and is aiming for more.

### Thoughts for Tilbury Industrial Park

With respect to Tilbury Industrial Park, the recovery of fly ash for use in cement is already occurring, although the fly ash is not generated in Tilbury Industrial Park, but is shipped from power plants in Alberta and elsewhere. There is some research into the recovery of fly ash from biomass-to-energy systems and use in the manufacture of concrete. Should this prove feasible, then there might be an opportunity to build this network in Tilbury Industrial Park. GVRD concerns regarding particulate emissions need to be addressed; biomass power generation equipment needs to be appropriate. A life-cycle analysis accounting for the selection of co-generation versus thermal energy recovery only, and accounting for potential reductions in solid waste disposal and fossil fuel substitution should also be completed.

There are several sectors that produce biomass waste: wood manufacturing, food manufacturing, restaurants, and the microbrewery. In addition, there may be spoilage/ spillage at the many food related wholesalers and distributors. Furthermore, the Corporation of Delta and neighbouring City of Richmond both have significant agricultural activity that could supply the biomass waste and use any new fertilizer type products. It might be worth considering the business case and quality of biosolids produced at a newer, small facility that focuses on recovering food-related solid and liquid biomass from businesses in Tilbury Industrial Park versus the quality of biosolids produced from GVRD WWTPs, which mix inputs from all residential, commercial, and industrial sectors. The City of Richmond's OCP notes that there is a perception that agricultural lands are poorly used and not contributing their share to the local economy. Agriculture Canada notes that value-added initiatives such as biomass-to-energy or the creation of new products from biomass wastes supports farming activity.

## **6.2. Riverside Eco-Park, Burlington, Vermont (also called Intervale)**

- Planned 10 acre eco-park with a greenhouse complex, using waste heat from the generating plant, other agri- and aquaculture activities and a "Living Machine" (solar aquatics) facility to treat wastewater and support some of the aquaculture activity.
- Green buildings, bicycle and pedestrian friendly.
- Plans to utilize alternative fuel shuttle bus from the parking area
- Plans to coordinate trucking system to reduce transportation needs and impacts.

### Thoughts for Tilbury Industrial Park

Tilbury Industrial Park is bounded by the Fraser River and Burns Bog. Not only are these systems ecologically important, but this location also means that Tilbury Industrial Park would probably be a good location for Living Machine and constructed wetland technology. The Burns Bog Conservation Society's Sustainable Development Strategy and the Corporation of Delta's River Road East strategy each mention the establishment of interpretative centres as one of their objectives. The construction of a wetland or Living Machine could support such a centre. Tilbury Industrial Park contains a number of food-related businesses that could provide inputs for a Living Machine system.

## **6.3. Phillips Eco Enterprise Centre**

- 65,000 ft<sup>2</sup> multi-tenant light industrial and commercial facility.
- Uses about 55% less energy than a similarly sized building
- Includes features such as a green roof and recycled materials.

- businesses include a re-used building supply centre and digital control systems company, which uses the PEEC as a live demonstration of its technology.

#### Thoughts for Tilbury Industrial Park

There are 21 multi-tenant facilities in Tilbury Industrial Park. Additional multi-tenant facilities are likely, given Delta's endorsement of a plan that calls for redevelopment of some lands to accommodate business park and lighter industry.

The GVRD and Delta could encourage the development and retrofit of eco-industrial complexes, which function like small scale eco-industrial parks. These buildings would use fewer resources (water, energy) than conventional buildings, and would also result in savings for the tenants, for whom it becomes easier to share resources, from lunch room space, to training, even materials. Industry Canada has sponsored the creation of an Eco-Industrial Complex Development Protocol; there might be support and funding available for such a pilot project.

### **6.4. Ora EcoPark, Frederikstad, Norway**

- Businesses have established a common fire and safety system and limited, common procurement.
- Mix of industries and sizes, like Tilbury Industrial Park
- So far, businesses have seen an average energy efficiency improvement of 10-12%.
- Materials and energy benefits so far: Fuel oil reduction - 16,500 t/y; CO<sub>2</sub> reductions - 52,800 t/y; Steam transfers - 199,800 t/y; Hot water recycling - 170,000 m<sup>3</sup>/y; Iron sulphate recycling - 32,000 t/y; Dilute H<sub>2</sub>SO<sub>4</sub> recycling - 210,000 t/y
- businesses are also working on water efficiency and solid waste reduction strategies.

#### Thoughts for Tilbury Industrial Park

In cooperation with the local and regional government, and a local university, the Ora initiative brings together seemingly dissimilar companies and identifies common needs. By working together to share energy audit costs and find ways to share energy, the businesses have saved an average of 10-12% in energy so far. Additional energy savings are expected. Given the wide variety of industries in Tilbury Industrial Park and the presence of likely business champions, an eco-industrial initiative in Tilbury Industrial Park should be able to achieve similar results.

### **6.5. Port of Rotterdam, Netherlands**

- 15 different eco-industrial projects have been identified - two of these have been completed
  - water exchanges and improved efficiency reduced the total water consumption by 10%
  - joint compressed air supply (new business opportunity) reduced energy used for air compression by 20%, with a corresponding CO<sub>2</sub> reduction of 4,150 tonnes /y.

#### Thoughts for Tilbury Industrial Park

In terms of direct adaptability, a survey of compressed air users in Tilbury Industrial Park might find the demand for a similar joint supply system. In general, the Rotterdam example shows that cooperative and targeted efforts towards identifying and implementing EIN can result in average water and energy savings of at least 10%, with higher savings possible for some specific initiatives.

### **6.6. Vreten, Solna, Sweden**

- Companies have established business circles to investigate and implement eco-industrial initiatives.
- Significantly reduced solid waste (no figures are available).
- Coordinated planning has reduced freight transport; largest business saw 50% reduction.
- Increased frequency of service for the local commuter train

- Joint initiative reduced energy consumption for heating by 10%.
- Reduced water consumption by an average of 20% per participating company.

#### Thoughts for Tilbury Industrial Park

In general, the Vretna example also shows that cooperative and targeted efforts towards identifying and implementing EIN can result in average water and energy savings of at least 10%, with higher savings possible for some specific initiatives. Furthermore, the Vretna example illustrates that coordinated effort of businesses can result in the identification and implementation of non-material and energy networking, such as coordinated transportation and commuting.

### **6.7. Burnside Industrial Park, Halifax Regional Municipality, Nova Scotia**

- Partners include Halifax Regional Municipality, Dalhousie University, Atlantic Canada Opportunities Agency, Environment Canada, and Nova Scotia Power
- Implemented landscaping standards that require native vegetation;
- established an engineered wetland pilot project to treat landfill leachate;
- increased and improved trails and recreational areas
- establishment of an Eco-Efficiency Centre and eco-business program to provide education and technical assistance to businesses
- establishment and expansion of companies that manufacture and distribute environmentally-friendly cleaning products
- Many companies in recycling / repair / reuse / remanufacturing have increased business.
- Many companies have reduced toxicity, improved efficiency, and formed partnerships with other local businesses
  - *Wartsila Canada, Inc.* saved 30-35% on lighting energy; minimized solvent and paint use; substituted less toxic solvent in its parts washer; found a local company to pick up its scrap metal and metal filings.
  - *Imagerite Ltd.* switched to automated cartridge testing system, reducing paper consumption by 24,000 sheets per month; reuses cardboard boxes for shipping; convinced some of their suppliers to take back polystyrene packing peanuts; found local recyclers for their pallet wrap and plastic toner bottles (thousands per month), substituted used crumpled, compacted recycled paper for foam packaging, resulting in \$15-\$20k savings per year and no longer requiring landfill disposal of tons of foam packaging
  - *Farnell Packaging Ltd.* replaced older water-based cooling system with a closed loop glycol-based cooling system, reducing water consumption by 85%, or about 10,800 m<sup>3</sup>/y. Reduction so dramatic, that Halifax Regional Municipality thought meter malfunctioned. Implemented a solvent management program with VOC reduction targets.
  - *Metrographic Printing Services Ltd.* Recycles 9,900 Lb/y paper; recycles aluminium, corrugated paper, film and aluminium printing plates, printer and toner cartridges, ink containers, paper cups and milk cartons; reuse about 500 corrugated cardboard boxes per year; reuse excess brown paper packaging, diverting 130 bags/y of garbage.
  - *Canadian Maritime Engineering Ltd.* Used in-house expertise to build equipment from scrap parts (one project cost \$8k, and generates \$26k/y revenue; another project cost \$35k, compared \$200k for a new machine); constructed new, more efficient system to pressure test cylinder heads - cost analysis hasn't been completed yet, but staff report that after using the tank on a Friday, and leaving it at 190 F, they returned to work on Monday to find the temperature was still 130 F, versus room temperature in the old system; company now strongly encourages customers to consider using recycled / refurbished material and equipment in their projects.
  - *Agro Protective Coatings Inc.* Purchased in-house methyl ethyl ketone solvent recycler for \$6,000, reducing costs by \$20k per year; reduced water consumption by 650 m<sup>3</sup>/y (~\$600/y) simply by improving housekeeping practices; found local salvager to recycle zinc ash and waste metal containers; reuses 300-600 plastic barrels and 300-600 waste wood pallets in-house.

- *Swedwood Canada* Diverted 16 metric tons of materials from landfill (22% reduction from 1999 to 2000); substituted wood waste / dust in their boilers, reducing annual oil consumption by 70% (from 110,000 L in 1998 to 35,000 L in 1999) and saving \$30k/y; underwent lighting retrofit and found local recycler to handle old bulbs; completely eliminated glue wastewater and sludge from their effluent stream (from 22,964 L in 1998 to 0 L in 2000); eliminated methyl ethyl ketone use; purchased new UV system that reduces VOC emissions and uses less energy; company has also established a by-product exchange with another company in the park.

Thoughts for Tilbury Industrial Park

The Burnside example illustrates that initiatives such as wetland restoration, trail improvements, and landscaping requirements can be retrofit into existing industrial parks, such as Tilbury Industrial Park. Many of the environmental improvements in Burnside are dependent on the presence of local scavenger and decomposer companies. The Eco-Efficiency Centre helps to build relationships between the scavenger and decomposer companies and other businesses in Burnside, facilitating the identification of new recycling opportunities i.e., the recovery of zinc ash and metal pails from Argo Protective Coatings. Small and medium sized businesses, which often do not have environmental staff, benefit from environmental support provided by the Eco-Efficiency Centre. Seventy-five percent (75%) of the businesses in Tilbury Industrial Park have fewer than 15 employees (Corporation of Delta, 2000). These businesses would benefit from the presence of a shared environmental coordinator, information exchange, and resource centre like the Eco-Efficiency Centre.

## 7. ESTIMATED BENEFITS OF EIN IN TILBURY INDUSTRIAL PARK

### 7.1. Potential DSM Benefits

The potential benefits of highly functioning EIN in Tilbury Industrial Park are significant. For the purposes of this study, we assumed that an EIN initiative could match the benefits achieved so far in the EIN case studies discussed above. It should also be noted that many of these initiatives are themselves in the early stages, with maximum benefits not yet achieved. Based on the benefits achieved in the case studies, we estimated the potential DSM benefits of an EIN initiative in Tilbury Industrial Park. We predict potential substantial savings, as shown in Table 7 and described in the following sections.

**TABLE 7: Predicted Savings\* Associated with EIN in Tilbury Industrial Park**

<b>Infrastructure Component</b>	<b>Current Amount</b>	<b>Predicted Savings</b>
Total Annual Wastewater (Generated by Permittees only)	740,915 m <sup>3</sup> /y	185,229 m <sup>3</sup> /y
Total Annual Water Consumption**	2,131,957 m <sup>3</sup> /y	532,989 m <sup>3</sup> /y
Total Annual Gas Consumption	1,144,162 GJ/y	300,223 GJ/y
Total Annual Gas Cost	9,095,418 \$/y	2,386,593 \$/y
Total Annual Electricity Consumption	163,670,024 kWh	61,204,715 kWh
Total Annual Electricity Cost	10,622,185 \$/y	3,972,186 \$/y
Total Annual Number of Truck Trips	862,420 trips/y	211,172 trips/y

\*All data is approximate

\*\*Based on a partial data set.

As described in the following sections, these savings are based on savings estimated from 10-50%, depending on the sector and infrastructure component. Based on the case studies, an extremely conservative estimate would be an across-the-board savings of 10%. The results of this case, shown in Table 8 on the following page, are still significant.

**TABLE 8: Savings\* Associated with 10% Reduction from EIN in Tilbury Industrial Park**

<b>Infrastructure Component</b>	<b>Current Amount</b>	<b>10% Savings</b>
Total Annual Wastewater (Generated by Permittees only)	740,915 m <sup>3</sup> /y	74,092 m <sup>3</sup> /y
Total Annual Water Consumption**	2,131,957 m <sup>3</sup> /y	213,196 m <sup>3</sup> /y
Total Annual Gas Consumption	1,144,162 GJ/y	114,416 GJ/y
Total Annual Gas Cost	9,095,418 \$/y	909,542 \$/y
Total Annual Electricity Consumption	163,670,024 kWh	16,367,002 kWh
Total Annual Electricity Cost	10,622,185 \$/y	1,062,219 \$/y
Total Annual Number of Truck Trips	862,420 trips/y	86,242 trips/y

\*All data is approximate

\*\*Based on a partial data set.

Note that the predicted savings do not account for indirect and associated benefits i.e., in addition to reducing the wear and tear on roads and to possibly reducing the need for new roads, a reduction in truck traffic would also result in reduced fuel consumption, and in reduced greenhouse gas and particulate emissions (most of these trucks are largely diesel).

### **7.1.1. Water Consumption**

Based on the case studies and our experience, we estimate that an EIN initiative would result in a 50% reduction in water consumption for large, water intensive industries such as food processing as well as in packaging / plastics printing (conservative compared to Farnell Packaging example). We estimate that other industries could reduce their water consumption by 20%.

Unfortunately, water data per sector was not available for this study. Furthermore, the aggregate water consumption for Tilbury Industrial Park is based on incomplete data, and is likely on the low side. Nonetheless, we can estimate a reduction in water consumption based on available data. In the absence of sectoral data, we conservatively estimate that an EIN initiative in Tilbury Industrial Park could result in a 25% reduction in water consumption. Therefore, the estimated savings in water consumption are 532,989 m<sup>3</sup>/y, equivalent to the average annual water consumption of 2,433 people.

### **7.1.2. Wastewater Discharge and Permitted Discharges**

Since most of the water consumed is likely discharged to the sanitary sewer, and based on the figures in Section 7.11 Water Consumption above, we can assume a total reduction in wastewater discharge of 532,989 m<sup>3</sup>/y as well.

#### Sewer Use Permittees

A 25% reduction in the amount of wastewater discharged by sewer use permittees corresponds to a reduction of 185,229 m<sup>3</sup>/y. Reductions in quantity and improvements in quality may not necessarily be the same. It is difficult from the case studies to estimate reductions in the loadings of particular contaminants. However, the case studies do indicate that concerted efforts to improve performance usually result in a 10% improvement. Therefore, we estimate that an EIN initiative could improve wastewater quality by decreasing contaminant loadings by 10%. The corresponding savings are shown in Table 9 on the next page.

**TABLE 9: Predicted Reduction in Contaminant Loadings from Wastewater Discharges  
(kg/y except where indicated)**

Parameter	Current	10% Reduction	Parameter	Current	10% Reduction
BOD	205,491	20,549	Cr - T	50.53	5.05
COD	459,192	45,919	Cu - T	9.47	0.95
TSS	238,132	23,813	Fe - T	80.88	8.09
O&G (hc)	1,695	170	Mn - T	13.92	1.39
O&G -T	7,604	760	Mo - T	17.78	1.78
Toluene	4.53	0.45	NH4	910.04	91.00
Ag - T	2.59	0.26	Ni - T	11.4	1.14
Al - T	442.18	44.22	Pb - T	7.84	0.78
As - T	20.07	2.01	SO4	58,644	5,864
B - T	221.98	22.20	Sulphide	1.15	0.12
Cd - T	2.33	0.23	Zn - T	13.59	1.36
Co - T	2.23	0.22			

### 7.1.3. Stormwater Run-off

None of the case studies have quantified stormwater management benefits. In Burnside, trails have been improved; additional greenspace has been created; native landscaping has reduced water usage (and associated run-off); a constructed wetland leachate treatment project is underway; and several businesses are considering green roof and site gardening projects. Therefore, there is evidence that an EIN initiative would raise awareness and promote projects that would improve stormwater management. Furthermore, by working together with supportive external partnerships, businesses would be more inclined and financially able to tackle programs like green roof retrofits or parking surface replacements.

Although the GVRD, Environment Canada, Smart Growth BC, and the Federation of Canadian Municipalities are promoting alternative stormwater management, none of these organizations was able to provide quantitative case studies by the time this study was completed. Smart Growth America does have some case studies that are worth noting. According to the report, *Paving our Way to Water Shortages*, a one-acre parking lot produces 16 times more runoff than an undeveloped meadow. So, increasing the permeability of rooftops, parking areas, and roadway medians in Tilbury Industrial Park would have a significant effect on stormwater management. In an other case cited by the Smart Growth America study, run-off was reduced by 97% at a 2.3 acre site in Seattle, Washington after an open ditch stormwater drain was converted to a bioswale; the width of the street was decreased; and native vegetation was planted. The Oregon Museum of Science and Industry (OMSI) voluntarily redesigned its landscape and parking lots to minimize stormwater runoff. A vegetated swale, planted with native wetland species, drains all stormwater run-off from 14 acres of the parking lot.

### 7.1.4. Solid Waste

#### Biomass / Compostables

Where biomass recovery and composting programs have been initiated, they have been extremely successful. For example, in Kalundborg, essentially all biomass waste from one company are being recovered. It is not known how much process related biosolids are generated in Tilbury Industrial Park. However, given that there are 23 businesses in the Food and Hospitality sector; 12 businesses in the Food Manufacturing sector, and 3 in the Institutional sector; plus personal biomass waste generated by employee lunches, there is probably a significant amount of biomass waste available in Tilbury Industrial Park. The GVRD has already noted that food organics are the largest component (by volume) of solid waste generated by the Industrial, Commercial, and Institutional Sector. Also, it may be possible to

reclaim from wastewater the biomass which contributes to the 205 t/y BOD loading by permittees, and unspecified amounts from non-permittees. We are not able to estimate a potential recovery at this time.

#### General Solid Waste Diversion

Looking to the example of a small printer in Burnside Industrial Park who diverts 130 bags/y of garbage through recycling and composting, we can estimate that the 620 companies in Tilbury Industrial Park could collectively divert 80,600 bags of garbage per year. Assuming that each bag of garbage weighs 28 kg (the weight limit imposed on the same size bags of residential garbage), this corresponds to 2,256,800 kg of garbage. Given that many of the businesses in Tilbury Industrial Park have more complex operations with a far greater number of employees, this is a conservative estimate.

#### **7.1.5. Energy**

Based on the case studies, we predict that an EIN initiative could result in a 50% savings in energy used for building heating and lighting, and a 15% reduction in energy used for process operations. This corresponds to total energy savings of:

- 300,223 GJ/y in annual natural gas consumption
- 61,204,715 kWh in annual electricity consumption
- \$6,475,358 in annual energy costs

This reduction in natural gas consumption corresponds to a greenhouse gas reduction of 15,011 t/y eCO<sub>2</sub>, or 41,697,000 km driven by an SUV! These reductions might be achieved via efficiency and conservation measures, building retrofits, and energy cascading. This estimate doesn't take into account the potential for an EIN initiative to support green energy generation or procurement programs.

#### **7.1.6. Truck Traffic**

Based on the case studies, we estimate that truck traffic from the largest facilities could be reduced by 50%, while other businesses could reduce their truck trips by 20%. Using the numbers for trucks leaving businesses in Tilbury Industrial Park (the smaller, more conservative figure), the savings in truck trips are estimated to be 211,172 trips per year. The associated savings in road construction and maintenance are not known, but would be significant.<sup>1</sup>

## **7.2. Types of Materials & Energy & Potential Outputs Available for Exchange**

Table 10, on the following page, lists the types of materials and energy likely required or generated by each sector. As the case studies illustrate, every sector has the potential to participate in and benefit from an eco-industrial initiative. The opportunities range from shared services, like transportation and training, for small businesses; to improved process efficiency for each manufacturing type facility; to reduced operating costs for all building owners; to protecting and incorporating local ecological features into the design and operation of the industrial park.

Based on the case studies, and the preliminary review of materials and energy use in Tilbury Industrial Park, we have brainstormed a list of potential EIN initiatives in Tilbury Industrial Park, summarized in Table 11. The type of infrastructure benefits are also identified, as are potential partners. This list is not comprehensive, and certainly, our experience has shown that a wider range of creative ideas emerge at workshops that bring businesses, government agencies, utility companies, and environmental groups together in one room. These initiatives range from coordinated packaging management strategy, to joint green building retrofits, to establishing an EIN Business Resource Office & Coordinator in Tilbury Industrial Park.

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<sup>1</sup> We contacted Stephen Rees, Mike Lai, and Jim Lang of TransLink, and Eric Bonham of the BC Ministry of Community, Aboriginal, and Women Services for "rules of thumb", and reviewed transportation studies completed as part of the River Road East Strategy. We were unable to find data that would allow us to estimate cost savings associated with the decrease in truck traffic.

**TABLE 10: Potential Inputs and Outputs Available for EIN in Tilbury Industrial Park**

Sector	Inputs	Outputs
Agriculture	plant material, plastic containers and pipe, glass, metal for fabrication, water, pallets, cardboard, natural gas, hydro,	Cardboard, pallets, plastic containers, shrink wrap, organic material (plants, seed, etc.), fertiliser, wastewater
Chemicals*	Organic and inorganic chemicals, alcohols, alkyds, metal pigments, organic pigments, hydrocarbons, ketones and esters, acrylics, vinyl, petroleum thinners, resins, vegetable oils, solvents, caustic, fibreglass, oil, lubricants, degreasers, metal and plastic containers, water, pallets, cardboard, natural gas, hydro	Waste: solvents, caustic, resins, fibreglass, pigments, oil, degreasers, water, pallets, cardboard, xylene, toluene, n-butyl-alcohol, methyl isobutyl ketone, methyl ethyl ketone, methanol, glycol ethers, ethylene glycol, ethylbenzene, barium compounds, zinc compounds
Asphalt & Concrete	water, cement, gravel, sand, limestone, calcium carbonate, oil, grease, lubricants, degreasers, pallets, natural gas, hydro, diesel, used tires, waste oil,	Wastewater, concrete waste, pallets, waste: oil, grease, degreasers, cement dust, waste heat
Construction	Metal for fabrication, resins, fibreglass, lumber, wire, glass, oil, grease, diesel, degreasers, gyprock, concrete, cardboard, pallets, natural gas, hydro,	Metals, resins, fibreglass, lumber, wire, glass, oil, grease, diesel, degreasers, gyprock, concrete, cardboard, pallets,
Electronics	Wire, various metals, packaging material, cardboard, hydro, natural gas	packaging material
Food & Hospitality	Water, plastic containers, shrink wrap, organic material (food), cleaning fluids, degreasers, bleach, paper products, cardboard, syrofoam packaging, salt, pallets, natural gas, hydro,	Wastewater, food waste, pallets, cardboard, paper products
Metal	coal, distillate fuel oil, electricity, fabricated metal products, including forgings, foundry chemicals, metal treating compounds, grinding wheels and other abrasive products, castings, containers, and supplies, steel shapes and forms, nonferrous shapes and forms, other chemicals and allied products, containers, paints, varnishes, lacquers, stains, shellacs, plastics materials and resins, residual fuel oil, liquid propane gas, natural gas, hydro	sulfuric acid, nitric acid, hydrochloric acid, scrap metal, cardboard, packaging, waste heat
Printing	water, soy based ink, recycled paper, rags, photographic film, photographic developer, cardboard cartons, aluminum plates, aluminum plate developer, hydro	Waste paper, ink, solvent, developer,
Plastics and Rubber	Plastics, resins, solvents, release agents, lubricants, grease, degreasers, water, cardboard, pallets, hydro, natural gas,	Waste: plastics, resins, solvents, release agents, lubricants, grease, degreasers, water, cardboard, pallets
Services	Paper products, water, pallets,	Waste: Paper products, water, pallets
Transportation	Oil, grease, degreasers, glycol, metal parts, solvents, paints, thinners, plastic parts, rubber parts, tires, filters, cardboard, pallets, hydro, gas,	Waste: oil, grease, degreasers, glycol, metal parts, solvents, paints, thinners, plastic parts, rubber parts, tires, filters, cardboard, pallets
Warehousing	pallets, cardboard, plastic and metal containers, shrink wrap, natural gas, hydro	pallets, cardboard, plastic and metal containers, shrink wrap, waste heat
Wood	Hardwood lumber, foam, glue, resins, solvent, lubricants, grease, degreasers, fabric, cardboard, syrofoam packaging, hydro, natural gas	Waste wood, wastewater, cardboard, spent solvent
Common to most sectors	Hydro, natural gas, gasoline, diesel, oil, lubricants, grease, degreasers, pallets, cardboard,	oil, grease, degreasers, pallets, cardboard,

\*This sector is more difficult to guess. The most manufactured products are not obvious from the company name or business description

TABLE 11: Potential EIN Initiatives and Infrastructure Impacts in Tilbury Industrial Park

Potential EIN Initiative	Relevant Sectors	Infrastructure Type					Notes
		Water	Stormwater	Wastewater	Solid Waste	Energy	
Material and energy cycling / by-product synergies	All	X	X	X	X	X	Transportation
Green supply chains in park	All	X	X	X	X	X	
Process energy cascades among businesses	All				X		
District energy building heating system in Tilbury	All				X		
Coordinated biomass strategy (composting, energy recovery, etc)	All, especially food and hospitality, food manufacturing, and wood and wood products; Opportunity for new business?				X	X	
Coordinated water management strategy (cascades, metering, conservation)	All, especially permittees	X					
Coordinated packaging management strategy	All can participate; Extra benefit for existing recyclers (i.e. plastic bag mfr, traditional recyclers); New business opportunities?				X	X	
Materials exchange / matching system	All				X	X	
EIN / Systems Approach to Transportation and Logistics	All				X	X	
Capacity Building, Workshops, Outreach	All	X	X	X	X	X	
Biomass to energy generation	All could supply biomass, esp. food & hospitality, food manufacturing, and wood and wood products; New business opportunity for generator; all existing businesses as consumers				X	X	support local farmers
Alternative Energy / Green Energy Retrofits, Support	New business opportunity for generator; all existing businesses as consumers					X	
Recovery of fly ash from biomass to energy projects for use in EcoSmart Concrete	New biomass generator could supply ash (wood and wood products manufacturing may have already); local concrete companies would benefit				X	X	ties to greenhouse industry nearby?
Biomass to value-added biofuels, biolubricants	All could supply biomass, esp. food & hospitality, food manufacturing, and wood and wood products; New business opportunity for generator; all existing businesses as consumers				X	X	ties to farming and greenhouse activity
Coordinated green design push	All	X	X	X	X	X	
Joint green purchase (low flush toilets, lighting, etc)	All	X	X	X	X	X	
Joint recycling collection for items replaced by greener products	All supply "waste"; Existing recyclers benefit; new business opportunities?				X		
Joint green roof retrofits	Most buildings could participate		X				increase local capacity in new, and exportable, technology
Creation of new development standards	Multistakeholder, charrette type process where all sectors can learn, provide input, and participate in greening activities	X	X	X	X	X	increase municipal capacity, transferable to other communities
Native landscaping retrofits / tree planting	Most buildings could participate		X				
Support for wetland construction and treatment	All generate stormwater; might be WWTP option for some sectors		X				relates to hydrological connectivity issues in Burns Bog
EIN Business Resource Office & Coordinator in Tilbury	All businesses would benefit, especially SMEs	X	X	X	X	X	
Targeted Economic Development to Attract Green Leaders & Fill Niches	New businesses could use waste materials and energy from existing businesses; contribute to mentoring of existing businesses in sector	X	X	X	X	X	

## **8. STRATEGIES FOR THE GVRD TO PROMOTE EIN IN GREATER VANCOUVER**

### **8.1. General Rationale**

The GVRD is well and uniquely positioned to promote EIN in Greater Vancouver. The GVRD has regulatory authority over a significant number of businesses; has adopted cooperative strategies for engaging those businesses not regulated; provides policy direction to member municipalities; and has a strong relationship with TransLink. In short, the GVRD could play a significant role in facilitating EIN through its extensive government and business relationships.

It is important to note that the encompassing nature of EIN makes it an excellent mechanism for achieving sustainability in the region. As such, EIN can assist the GVRD meet the goals of the Sustainable Region Initiative, including the following:

- clean water, healthy air, protected watersheds
- efficient patterns of urban development
- resilient, cost-effective infrastructure & systems
- a sustainable region in a better world
- a robust & resilient regional economy
- a region in nature

Further, EIN can assist the GVRD meet the objectives of the Liveable Region Strategy, including:

- protecting the green zone
- building complete communities
- achieving a compact metropolitan region, and
- increasing transportation choices

Finally, as utility and service provider to member municipalities, the GVRD could use EIN as a cost effective mechanism to lower infrastructure costs to member municipalities.

There are five key strategies upon which the GVRD can focus:

- Providing Leadership
- Building capacity and educating stakeholders
- Building relationships and developing partnerships
- Using policy levers, and
- Leveraging GVRD funds.

### **8.2. Providing Leadership**

The GVRD can act as the regional champion, further enabling member municipalities and the business community to pursue EINs. Specifically, the GVRD could build capacity and support municipalities by doing the following:

- Being proactive with member municipalities by providing expertise and EIN tools
- Providing technical support and “one-stop” shopping for member municipalities
- Leading by example, by endorsing EIN as a strategy for meeting SRI objectives and managing infrastructure demand, then encouraging member municipalities to do the same
- Providing policy direction for municipalities, such as offering EIN as a means of municipalities meeting SRI objectives
- Creating an interdepartmental EIN team in the GVRD and meet regularly to exchange information
- Connecting to the national and international EIN community that is emerging through the Federation of Canadian Municipalities, Canadian Eco-Industrial Network, International Society of Industrial Ecology, and the North American Eco-Industrial Development Council

The strategies below fall out of the GVRD taking the leadership role in promoting EINs.

### **8.3. Building Capacity and Educating Stakeholders**

The concept of EIN is relatively simple and easily understood: companies, government and communities create relationships to share resources, and thus realise economic as well as environmental and social gains. Despite this, and as the Maplewood project has illustrated, engaging, educating and building capacity with stakeholders consumes a significant amount of time and resources. The GVRD could take a lead role in building capacity and educating stakeholders regarding EIN and its benefits.

#### Capacity Building within the GVRD

To take on a leadership role, the GVRD must continue to build internal capacity with respect to EIN. This internal capacity would allow the GVRD to provide appropriate guidance to municipalities, businesses and community stakeholders.

The first step would be to create an interdepartmental EIN team. A team would increase networking between staff in different departments within the GVRD. EIN requires a systems approach; staff should have knowledge of potentially related initiatives and resources in other departments. The interdepartmental team could meet regularly to exchange information on EIN projects, permittees, economic development opportunities, GVRD initiatives, and initiatives at other agencies.

There are no courses dedicated to EIN offered in BC. Even if there were, many staff do not have the time or inclination to enrol in a full-time course. Thus, capacity building could begin with a workshop delivered to the interdepartmental EIN team. The workshop could be supplemented by a detailed review of EIN case studies and relevant reading material. The GVRD could also encourage staff to attend and present at, one of the growing numbers of EIN-related conferences. Of course, the best way to build capacity is for team members to become involved in an actual EIN project, as the GVRD has the opportunity to do in Maplewood, and could have the opportunity to champion EIN in Tilbury Industrial Park.

#### Capacity Building with Member Municipalities

The GVRD could help to build capacity within its member municipalities by providing services and tools, including to following:

- Conducting workshop for member municipalities on how to develop an EIN
- Providing EIN services to member municipalities, e.g., a forum for municipal staff to share information, advice on establishing sustainability indicators, or assistance with building stakeholder support
- Providing EIN tools or guides, such as guides for database design to facilitate data collection and analysis (describing which data is important, where to find the data and how to analyse it), and
- Working with member municipalities to develop appropriate EIN language for inclusion in the following documents:
  - Official Community Plans,
  - Industrial and Economic Development Strategies,
  - Community Energy Plans
  - Development standards and guidelines,
  - Building codes, and
  - Covenants.

Providing the noted services and tools will encourage efficient use of scarce municipal resources by helping member municipalities avoid reinventing the EIN development process.

Another tool the GVRD could develop and provide is an overview of the process by which a municipality could develop an EIN project. An EIN development process could be loosely based on the following set of actions, many of which were undertaken in the Tilbury Industrial Park Case Study:

- List all businesses in an identified cluster, including address, NAICS codes, and business descriptions
- Sort the businesses by sector (Using NAICS Codes)
- Map the businesses
- Obtain aggregate data by sector (water, wastewater, air, solid waste, natural gas, electricity, building area / roof area)
- Use aggregated data as a “teaser” to obtain business interest, and attract potential partners
- Prepare invitation to participate in workshop (use EIN expertise to facilitate workshop)
- Hold workshop – intro to EIN, specific opportunities for area, brainstorm and networking
- Identify champions
- Draft TOR for additional studies (energy, water, all materials, facilitation, green buildings retrofit, landscaping, planning and development, shared training, etc).
- Complete planning, feasibility studies, and implementation of EIN initiatives

### Educating Stakeholders

There is a need for potential stakeholders to understand the economic development, environmental and social benefits of EINs. Businesses may be interested in how EIN can help them to meet greenhouse gas reduction targets, increase operational efficiency, and perhaps eliminate their need for GVRD permits. Community groups would benefit from information that highlighted how EIN can make businesses a better neighbour, and can improve community liveability.

Building on the GVRD’s green building program, the GVRD could lead in overall education by gathering relevant EIN information and latest development in the field, and then act as a central clearinghouse for that information.

## **8.4. Building Relationships and Developing Partnerships**

Successful EIN initiatives always depend on multi-stakeholder, partnership approaches. EIN projects can help various stakeholders to work together, allowing financial and technical resources go further than they would if each group were operating in isolation. In fact, one of the advantages of an EIN approach is that it allows multiple objectives to be met simultaneously. Depending on the initiative, different partners may be required / interested.

### Building/Enhancing Relationships with Business

The GVRD issues sewer use discharge, air emission, and solid waste permits to various businesses across the region<sup>2</sup>. As a result, permitted businesses have direct contact with GVRD Permitting and Enforcement staff. Personal relationships are an important factor for successful EIN projects, helping to “shorten the mental distance”, as notable industrial ecologist Prof. Ray Côté calls it, between stakeholders. Therefore, the existing relationship between the GVRD and its permittees could be leveraged in future EIN projects. Furthermore, GVRD Permitting & Enforcement staff are familiar with these companies and should be able to provide anecdotal information that can be used to develop an EIN.

For example, during the evaluation processing this study, three permitted businesses in Tilbury Industrial Park were regarded as progressive companies and potential champions: Tilbury (Lehigh) Cement, Canadian Autoparts Toyota, and Delta Recycling Society. Tilbury Cement and Delta Recycling have worked together on community environmental initiatives. In addition, based on our experience, other

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<sup>2</sup> The exception is the City of Vancouver, which issues sewer use discharge permits to businesses operating within its boundaries. Air emission permits in the City of Vancouver are issued by the GVRD.

## ***Identification of EIN Opportunities in Greater Vancouver DSM Benefits***

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companies such as BC Gas, Taylor Munro Systems (solar heating), Nature's Path Foods / Vita Mills (organic foods), and Weyerhaeuser Canada may be potential champions.

Also, the GVRD can build relationships within the broader business community through the relationships being established by the Business Services Group.

### Developing Partnerships

A range of groups / agencies could be considered as potential partners for GVRD EINs, each providing either funds, expertise, connections to other partners, in-kind contributions, etc. For example, in addition to the Corporation of Delta and the businesses themselves, an EIN initiative in Tilbury Industrial Park might interest the following groups:

Agriculture Canada	Industrial Research Assistance Program
BC Gas	Industry Associations
BC Hydro	Industry Canada
Canadian Agriculture New Uses Council	Local First Nations
Burns Bog Conservation Society	Natural Resources Canada
EcoSmart Concrete	Simon Fraser University
Environment Canada	Smart Growth BC
Fraser Basin Council	TransLink
Fraser Port Authority	University of British Columbia
Fraser River Port Authority	US Green Buildings Council – Cascadia Section
Georgia Basin Ecosystem Initiative	Western Economic Diversification
Green Municipal Enabling Fund	

Also, should a group of businesses and the Corporation of Delta express support for a district energy system in Tilbury Industrial Park, the Canadian District Energy Association might be an interested partner.

It should be noted that many of the groups listed above would be potential partners in EIN initiatives throughout Greater Vancouver.

## **8.5. Using Policy Levers**

### GVRD Plans and Initiatives

As noted, EIN strategies are a good mechanism for achieving sustainability. As such, the GVRD could adopt EIN as a central strategy when amending the Liquid Waste Management Plan, Solid Waste Management Plan, Air Quality Management Plan, Livable Region Strategic Plan and Sustainable Region Initiative.

Also, the GVRD could use the following mechanisms:

- Landfill bans (i.e., electronics, D&C waste) forcing businesses to be creative with their processes and business relationships
- EIN as a economic development strategy, and
- EIN as a densification and green space strategy

### GVRD Permits and Permittees

The GVRD could encourage or require industrial permittees examine the possibility of adopting EIN strategies (working cooperatively with neighbouring companies/organisations) when a permit is being amended or when a new permit is being issued.

The GVRD could also investigate umbrella / alternative permitting mechanisms. Alternative permitting, might be required for the following scenario: a cluster of four businesses are cascading wastewater

between facilities thereby reducing significantly the amount of fresh water consumed and waste water discharged. Where there may have been four discharges to the environment, with four corresponding permits, there would now be only one discharge and one permit required. The question becomes: how does the GVRD promote innovation that reduces infrastructure demand as described above, reduce regulatory burden and still retain regulatory control?

### Member Municipalities

The GVRD could recommend member municipalities adopt EIN as a strategy in the following:

- Official Community Plans,
- Industrial and Economic Development Strategies,
- Community Energy Plans
- Development standards and guidelines, building codes and covenants.

### Economic Instruments

While the scope of influence for local government is smaller than senior levels of government, local governments do have some control over the following:

- Property taxes
- User fees and development charges
- Emission permit fees
- Tradable emission permits
- Fines and penalties

While simply raising fees or taxes may result in achieving the desired behaviour change, it is also likely to have undesired consequences such as businesses leaving the region for example. Therefore, a *tax shifting* approach is probably the most fruitful, where raising one tax or fee is balanced with the lowering of another. In this way total revenues remain neutral but the balance of incentives and disincentives is altered.

There are a number of economic instruments that the GVRD might consider in conjunction with member municipalities to encourage an EIN approach. In some cases, co-operation from the Province will also be required.

#### *Raise Emission Permit Fees and Lower Property Taxes*

The GVRD might raise emission permit and solid-waste fees to create a greater economic incentive for companies to look for EIN opportunities. However, the GVRD should work with member municipalities to lower other taxes or fees so that the overall tax burden remains the same. During this study, we discovered that companies with excellent environmental performance may operate outside the GVRD “radar.” These companies have avoided permit fees (and associated monitoring and reporting costs) by eliminating discharges. The GVRD could work to document these cases, letting businesses know how to avoid discharge fees altogether.

#### *Increase Development Cost Charges for Industrial Development*

The GVRD could support municipalities in efforts to set Development Cost Charges (DCCs) that reflect the true cost of infrastructure, providing incentive to use EIN to identify cheaper, greener infrastructure alternatives.

#### *Encourage EIN be Examined by Developers as a Condition of Re-Zoning*

The GVRD could work with municipalities to encourage developers examine the possibility for an EIN as a condition of the re-zoning process when re-zoning for industrial development.

*Property Tax Shift*

The GVRD could help member municipalities examine shifting property taxes away from buildings and improvements and onto the land value. This would encourage more efficient land use, and require developers and business owners to consider more efficient, value-added development strategies.

## **8.6. Leveraging Funds**

As noted above, there are a large number of potential partnerships from which to leverage financial support. Also, EIN projects meet criteria for many different funding programs.

The conceptual and preliminary feasibility studies, planning, capacity and partnership building, and material and energy studies needed to start an EIN project can cost between \$200,000 and \$300,000. However, if we use Tilbury Industrial Park as an example, an EIN initiative could identify ways to collectively realise the following:

- save businesses \$6 million dollars a year in energy costs, and help the GVRD and member municipalities reduce their CO<sub>2</sub> emissions by at least 15,000 t/y;
- reduce water consumption by 532,989 m<sup>3</sup>/y, saving companies money while reducing infrastructure demand;
- reduce truck transport, there by saving business in vehicle O&M and shipping costs, while reducing impact on infrastructure and reducing overall vehicle emissions
- promote public transportation,
- encourage green buildings in the industrial sector, and
- generate new business opportunities in the region.

The GVRD would be justified in providing a portion of the initial funds required to start an EIN, based on the return from the DSM benefits, as well as on economic development opportunities. With those funds the GVRD could attract support from business, other levels of government and other interested parties. Note there are more than 10 funding sources at this point for Maplewood EIN project; the \$20,000 GVRD and DNV funds have been used to leverage more than \$150,000 from funding programs, local businesses, and other public partners. The Halifax Regional Municipality has leveraged its funds with those of Nova Scotia Power, the Atlantic Canada Opportunities Agency, Environment Canada, and Dalhousie University to fund the Burnside Eco-Efficiency Centre.

## **8.7. Next Steps to Start an EIN in Tilbury Industrial Park**

Should the GVRD decide to pursue an EIN in Tilbury Industrial Park, the next step would be to meet with Delta to explore their needs, and partnering with Delta to support a multi-stakeholder workshop. A workshop can serve the following purposes:

- more fully explain the EIN concept and process,
- encourage dialogue and build or enhance relationships between businesses, government and the community, and
- help identify business, municipal and community leaders.

The data gathered and predicted savings calculated in this study could be used to market an EIN initiative and engage partners. The GVRD can use its direct contact with permitted businesses to encourage participation, and offer support for resource saving initiatives (such as the Eco-Efficiency Partnership). In Maplewood, businesses that are permitted welcome the opportunity to sit at the table with the GVRD and explore new, and mutually beneficial regulatory options.

## **8.8. Other Important Strategy Notes**

It is easier to gain support from businesses and other partners if an incremental approach is taken, rather than launching immediately into large initiatives. The stages of an EIN project can be described as follow:

- exploratory workshop,

- stakeholder and partner capacity building,
- preliminary conceptual opportunities study (similar to this one),
- focused workshop,
- conceptual feasibility study,
- detailed feasibility studies,
- implementation.

Should more than one EIN be developed at any give time it would service member municipalities if the GVRD monitored each initiative and ensured information was being shared between projects to ensure efficient use of resources and avoid duplication.

The GVRD would be well served, as would stakeholders involved in EINs, to ensure systems are in place to track the performance of businesses, government and the community with respect to financial and economic, environmental and social indicators.

## **9. RECOMMENDATIONS**

We recommend that the GVRD implement the strategies discussed in Section 8. These strategies have been summarised in Table 12 on the following page.

TABLE 12: Summary of Recommendations

Provide Leadership	Building Capacity and Educating Stakeholders	Building Relationships & Developing Partnerships	Using Policy Levers	Leverage funds	Other Important Strategy Notes:	Next Steps to Start an EIN in Tilbury Industrial Park
<p>Be proactive with member municipalities by providing expertise and EIN tools</p> <p>Be proactive with member municipalities by providing expertise and EIN tools</p> <p>Provide technical support and “one-stop” shopping for member municipalities</p> <p>Lead by example, by endorsing EIN as a strategy for meeting SRI objectives and managing infrastructure demand, then encouraging member municipalities to do the same</p> <p>Provide policy direction for municipalities, such as offering EIN as a means of municipalities meeting SRI objectives</p> <p>Create an interdepartmental EIN team in the GVRD and meet regularly to exchange information</p> <p>Connect to the national and international EIN community that is emerging through the Federation of Canadian Municipalities, Canadian Eco-Industrial Network, International Society of Industrial Ecology, and the North American Eco-Industrial Development Council</p>	<p><b>Within the GVRD</b></p> <p>Create an interdepartmental EIN team</p> <p>Deliver EIN workshop to the interdepartmental EIN team</p> <p>Encourage EIN team members to review of EIN case studies and relevant reading material</p> <p>Encourage staff to attend and present at EIN-related conferences</p> <p>Encourage team members to become involved in an EIN project</p> <p>Champion an EIN in Tilbury Industrial Park</p> <p><b>With Member Municipalities</b></p> <p>Conduct “how to” EIN workshop for member municipalities</p> <p>Provide EIN services to member municipalities</p> <p>Provide EIN tools, such as guide for database design to facilitate data collection / analysis</p> <p>Work with member municipalities to develop EIN language Official Community Plans and other strategies.</p> <p>Develop and provide to municipalities an overview of the EIN development process</p> <p><b>Educating Stakeholders</b></p> <p>Act as a clearinghouse for EIN information and for conducting EIN workshops for potential stakeholders.</p>	<p><b>Building/Enhancing Relationships with Business</b></p> <p>Promote EIN to permittees through various DSM mechanisms including permit officers, and Business Services group contacts and newsletters</p> <p>Use existing business relationship with permittees to identify potential EIN Champions</p> <p><b>Developing partnerships</b></p> <p>Identify and approach potential partners for EIN developments.</p>	<p><b>GVRD Plans and Initiatives</b></p> <p>Adopt EIN when amending Liquid / Solid Waste &amp; Air Quality Management Plans, Livable Region Strategic Plan and Sustainable Region Initiative.</p> <p>Consider Landfill bans; EIN as an economic development strategy; EIN as a densification and green space strategy</p> <p><b>GVRD Permits and Permittees</b></p> <p>Encourage permittees to examine EIN strategies when permit is amended or issued.</p> <p>Investigate umbrella / alternative permitting mechanisms</p> <p><b>Member Municipalities</b></p> <p>Recommend member municipalities adopt EIN as a strategy in the Official Community Plans, strategies; and development standards.</p> <p><b>Economic Instruments</b></p> <p>Examine the possibility of raising emission permit fees and lowering property taxes; supporting municipal efforts to increase Development Cost Charges for Industrial Development; Encouraging developers to examine EIN as a condition of re-zoning-Property tax shift</p>	<p>Provide a portion of the initial funds required to start an EIN, based on the return from the DSM benefits. Leverage the funds to attract support from business, other levels of government and other interested parties.</p>	<p>Take an incremental approach to developing an EIN as it is much easier to sell to businesses and other partners than a full-blown six-figure project.</p> <p>Should more than one EIN be developed at any give time it would encourage and build municipalities if the GVRD monitored each initiative and ensured information was being shared between projects to ensure efficient use of resources and avoid duplication.</p> <p>Ensure systems are in place to track the performance of businesses, government and the community with respect to financial and economic, environmental and social indicators.</p>	<p>Meet with the Corporation of Delta to explore their needs</p> <p>Partner with Delta to support a multi-stakeholder workshop to do the following:</p> <ul style="list-style-type: none"> <li>more fully explain the EIN concept and process,</li> <li>encourage dialogue and build or enhance relationships between businesses, government and the community, and</li> <li>help identify business, municipal and community leaders.</li> </ul> <p>Use direct contact with permitted businesses to encourage participation in an EIN</p>

## 10. REFERENCES

American Rivers, Natural Resources Defense Council, and Smart Growth America. 2002. Paving Our Way to Water Shortages: How Sprawl Aggravates the Effects of Drought. Smart Growth America. Available online at [www.smartgrowthamerica.com/DroughtSprawlReport09.pdf](http://www.smartgrowthamerica.com/DroughtSprawlReport09.pdf).

LeBreton, W. 2002. Small Community Networks and Eco-Industrial Networking in the Greater Vancouver Regional District (Draft). GVRD, Burnaby, BC.

Henney, K.D. 2001. Industrial Ecology and the Capacity For Implementing Eco-Industrial Parks In Richmond, British Columbia. School of Community and Regional Planning, University of British Columbia, Vancouver, BC.

Pellenburg, P.H. 2002. Sustainable Business Sites in the Netherlands: A Survey of Policies and Experiences. *Journal of Environmental Planning and Management*, vol. 45, no. 1, pp. 59-84.

### Case Studies

#### Burnside Industrial Park

Côté, R.P. 2001. The Evolution of an Industrial Park: The Case of Burnside. Presented at New Strategies for Industrial Development Conference, Manila, Philippines.

Personal communications, Professor Ray Côté, School for Resource and Environmental Studies, Dalhousie University, Halifax, NS

Personal communications, Peggy Crawford, Manager, Burnside Eco-Efficiency Centre, Halifax, NS

Various resources available at <http://www.mgmt.dal.ca/sres/eco-burnside/index.htm> (accessed throughout October, 2002)

#### Kalundborg, Denmark

Data and project descriptions available at <http://www.symbiosis.dk> (accessed throughout October, 2002)

#### Ora EcoPark

Thoresen, J. 2001. Evaluation and Monitoring of Eco Efficiency - Ora Ecopark Example. Presented at the First International Conference of the International Institute of Industrial Ecology, Lieden, Netherlands. Available at <http://www.yale.edu/is4ie/images/Thoresen.pdf>

Thoresen, J. 2000. Development and Testing of a Concept for Ecopark Co-operation. Presented at the Helsinki Symposium on Industrial Ecology and Material Flows, Helsinki, Finland. Available at <http://www.cfe.cornell.edu/wei/thor.pdf>.

#### Phillips Eco-Enterprise Centre, Minneapolis, USA

Personal communication, Tom Osdoba, Principal, e4 partners, inc. Portland, OR.

E4 Partners. 2001. Phillips Eco-Enterprise Center, Minneapolis, Minnesota. Case Studies in Eco-Industrial Development. E4 Partners, Inc., Minneapolis, MN.

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DSM Benefits**

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Port of Rotterdam, Netherlands

Baas, L. 2001. Developing and Industrial Ecosystem in Rotterdam: Learning by... What?. Journal of Industrial Ecology, vol. 4, no. 2, pp.4-6.

Riverside EcoPark, Burlington, USA

Work and Environment Initiative. 1999. The Riverside Eco-Park, Burlington, Vermont: Project Update. Cornell University, Ithaca, NY. Available at <http://cfe.cornell.edu/wei/EIDP/BurlingtonUpdate.htm>.

Ocean Arks International. 2002. The Intervale Aquaponics Bioshelter. Available at <http://www.oceanarks.org/Intervale/Intervale.html>.

Clavelle, Peter. 1997. Burlington's Riverside Eco-Industrial Park: Developing a Real-World Model of Sustainability. Presented at Brownfields '97 (Session – Back to the Future with Eco-Industrial Parks). Mayor's Office, Burlington, VT.

Vreten Industrial Park, Solna, Sweden

United Nations Environment Programme. 2001. Vreten, Solna, Sweden. Case Study Fact Sheet. Environmental Management of Industrial Estates. Available at <http://www.unepie.org/pc/ind-estates/casestudies/Vreten.htm>

**APPENDIX A PERMITTEES IN GREATER VANCOUVER**



**APPENDIX B    EIN EVALUATION CRITERIA FOR GEOGRAPHIC  
CLUSTERS**



## **APPENDIX C    EVALUATION OF TOP 6 CLUSTERS**



**APPENDIX D LIST OF BUSINESSES IN TILBURY, BY SECTOR**



## **APPENDIX E    CALCULATIONS**

### **Transportation Demand Calculations**

The Delta Survey of River Road East Businesses, completed in 2000 as part of the River Road East Strategy, provides the following data with respect to truck traffic in the area:

- 70% of businesses have 5 or fewer commercial vehicles operating from them per day.
- 2% of responding businesses operate more than 40 trucks per day
- 34% of businesses are visited by 5 or fewer commercial vehicles per day.
- 4% of businesses are visited by more than 40 commercial vehicles per day.

We can use this data to conservatively estimate the truck traffic in Tilbury Industrial Park.

Assume 70% of the 620 businesses average 2.5 commercial vehicles leaving their property per day:  
Assume that this traffic occurs 260 days per year.

$$0.70 * 620 * 2.5 * 260 = 282,100 \text{ trucks leaving these businesses in Tilbury per year}$$

Assume 2% of the 620 businesses average 40 commercial vehicles leaving their property per day:  
Assume that this traffic occurs 260 days per year.

$$0.02 * 620 * 40 * 260 = 128,960 \text{ trucks leaving businesses in Tilbury per year}$$

Assume the remaining 28% of businesses average 10 commercial vehicles leaving their property per day:  
Assume that this traffic occurs 260 days per year.

$$0.28 * 620 * 10 * 260 = 451,360 \text{ trucks leaving businesses in Tilbury per year}$$

Assume 34% of the 620 businesses average 2.5 commercial vehicles visiting their property per day:  
Assume that this traffic occurs 260 days per year.

$$0.34 * 620 * 2.5 * 260 = 137,020 \text{ trucks visiting these businesses in Tilbury per year}$$

Assume 4% of the 620 businesses average 40 commercial vehicles visiting their property per day:  
Assume that this traffic occurs 260 days per year.

$$0.04 * 620 * 40 * 260 = 257,920 \text{ trucks visiting these businesses in Tilbury per year}$$

Assume the remaining 62% of the 620 businesses average 10 commercial vehicles visiting their property per day: Assume that this traffic occurs 260 days per year.

$$0.62 * 620 * 10 * 260 = 999,440 \text{ trucks visiting these businesses in Tilbury per year}$$

Based on these assumptions, the truck traffic in Tilbury can be very roughly estimated to be 862,420 trucks leaving Tilbury each year, and 1,394,380 trucks visiting Tilbury each year.

### **Energy Consumption Savings- Assumptions and Calculations**

Based on the electricity intensity (electricity consumed per customer), as well as our knowledge of the sectors in general and of the actual companies within each sector, assume that Transportation; Services; Miscellaneous; Wholesalers & Distributors; Institutional; Mining, Oil & Gas; Retail; and Multi-Family use 90% of their electricity for building heating / lighting and sanitary hot water generation. The remaining 10% is used for other operations i.e., non-HVAC pumps and motors.

## **Identification of EIN Opportunities in Greater Vancouver DSM Benefits**

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Assume that the Other Manufacturing; Food Manufacturing; Chemical Manufacturing; and Wood and Forest Products use 50% of their electricity for building heating and lighting, and the remaining 50% for operations (process equipment, etc).

- ➔ Total Electricity Consumed for Building-Related Heating and Lighting = 104,726,318 kWh
- ➔ Total Electricity Consumed for Process Operations = 58,9437,06 kWh

Assume that 10% of the natural gas consumed by customers in the Industrial rate class is for building related heating, and 90% is for process-related activity, such as steam generation or evaporating water.

Assume that 80% of the natural gas consumed by customers in the Commercial rate class is for building related heating, and 20% is for process-related activity, such as steam generation or evaporating water.

- ➔ Total Natural Gas Consumed for Building-Related Heating and Lighting = 367,424 GJ/y
- ➔ Total Natural Gas Consumed for Process Operations = 776,738 GJ/y

### Predicted Energy Savings

Across the board reduction in energy for building heating and lighting – 50%

183,712 GJ/y reduction in annual natural gas consumption (\$1,626,943 annual savings)  
52,363,159 kWh reduction in annual electricity consumption (\$3,398,369 annual savings)

Across the board process energy reduction 15%

116,511GJ/y reduction in annual natural gas consumption (\$876,229 annual savings)  
8,841,556 kWh reduction in annual electricity consumption (\$573,817 annual savings)

### **Water Savings Assumptions & Calculations**

Per capita consumption in the GVRD = 600 L/d = 0.6 m<sup>3</sup>/d = 219 m<sup>3</sup>/y.

### **Truck Traffic Savings Assumptions and Calculations**

Assume that the 20% traffic reduction applies to the 70% of businesses with an average 2.5 commercial vehicles leaving their property per day, and the 28% of businesses with an average of 10 commercial vehicles leaving their property per day. The number of trips saved is then equal to (282,100 + 451,360) \* 20% = 146,692 trips.

Assume that the 50% traffic reduction applies to the 2% of the businesses that average 40 commercial vehicles leaving their property per day. The number of trips saved is then equal to 128,960 \* 50% = 64,480 trips.