

Identifying Solutions for Brownfield Redevelopment of Former
Landfill Sites in the City of Delta, Metropolitan Vancouver

by

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ABSTRACT

In Canada, planners and policy makers are continuously seeking ways to improve the quality of life in urban areas, including the redevelopment of brownfield sites such as former landfills.

The City of Delta, Metropolitan Vancouver (Delta) is home to 20 former landfill sites and in 2014, created the Landfill Site Economic Investment Zone and Revitalization Tax Exemption Program Bylaw to offset environmental investigations, and remediation and risk management costs associated with redevelopment. Since its inception in 2014, only one property has participated in the tax exemption program to redevelop a former landfill site.

Since Delta has put incentives in place to offset the environmental costs associated with redevelopment, I examined the issues and barriers being faced by developers, even with the existing incentives. Although each landfill redevelopment project has its own unique challenges, this research has identified the most common barriers with possible solutions and recommendations for Delta. The most common barriers identified in this research were costs, liability and regulatory requirements. This thesis provides a number of recommendations for each major barrier for the City of Delta.

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List of Abbreviations

CCME	Canadian Council of Ministers of the Environment
IEDC	International Economic Development Council
MOE	Ministry of Environment
NCP	Neighbourhood Concept Plan
OCP	Official Community Plan
PPP	Public-Private Partnership
NCSR	Canada's National Contaminated Sites Remediation Program
NRTEE	National Round Table on the Environment and the Economy
QEP	Qualified Environmental Professionals

Chapter 1: Introduction

Studies conducted by the National Round Table on the Environment and the Economy (NRTEE) (2003) suggest that brownfields comprise close to 25% of the Canadian urban landscape, with approximately 30,000 brownfield sites across Canada. In the US, the number of brownfields has been estimated to be over 1 million, and an estimated 5 million acres of brownfields exist worldwide (Wernstedt & Hersh, 2006).

Brownfields can be defined as “abandoned, idle or underutilized commercial or industrial properties where past actions have caused known or suspected environmental contamination, but where there is an ‘active potential’ for redevelopment” (NRTEE, 2003). The term “brownfield” originated in the UK to distinguish such lands from “greenfields” which are defined as “plot[s] of land with no buildings, no infrastructure, or contamination risks” such as “clean, agricultural lands located in the periphery of cities” (De Sousa, 2000).

Brownfields vary in size, and can include industrial lands such as former railway corridors or other transportation-based sites, previous landfill and waste disposal areas, and fuel storage and manufacturing facilities (De Sousa, 2006). Contamination varies based on the historical background of the site and can affect all components of the physical environment. Common characteristics of brownfield sites include residual contamination in groundwater and soil, allowing contamination to seep into the local environment, migrating both on and offsite (De Sousa, 2000).

Landfills are a type of brownfield that are of interest to municipalities due to their size and potential for redevelopment. As the population and consumption of goods and services continues to grow, Canadian landfills are quickly reaching their capacity, forcing closures of existing landfill sites and the development of new landfill sites. When the capacity of a landfill is

reached, the site is closed and has little economic value. Instead of leaving the landfill site derelict and underutilized, municipalities have the opportunity to redevelop the sites into a community asset (De Sousa, 2000).

The City of Delta, Metropolitan Vancouver (Delta) is home to 20 former landfill sites throughout the municipality (City of Delta, 2011). These sites were permitted by the provincial government between the 1980s and 1990s, and were poorly regulated as the sites were not capped and did not have landfill gas and leachate management systems in place; they were finally closed in 2010 (City of Delta, 2011). Since their closure, these properties have remained derelict, and besides their ongoing environmental impact, they have contributed to the slow redevelopment of the surrounding area.

In November 2011, Delta created the Landfill Site Economic Investment Zone and Revitalization Tax Exemption Program Bylaw to promote the environmental remediation and development of these former landfill sites (City of Delta, 2011). This bylaw established a revitalization tax exemption for five years, increasing by 20% each year thereafter, until full property taxes are payable in year ten. The bylaw also allows for an exemption of all municipal fees related to the redevelopment of the site. The exemption is to offset investigations, remediation, and risk management costs associated with the redevelopment of these sites. Since its inception, only one property has successfully converted a former landfill site, which was approved in 2014. The site was converted into a truck trailer storage facility and it is estimated to have saved approximately \$375,000 in property taxes over five years.

Significance and Purpose of the Research

The purpose of the proposed research is to explore the barriers and challenges to the reuse of landfill sites in Delta. More specifically, I hope to demonstrate how landfill

redevelopment can be improved in the Delta, with a particular focus on the application of the successful brownfield redevelopment experiences as learned from the case study of the City of Port Moody and through interviews with participants who have worked with the redevelopment of former landfill site in Metro Vancouver.

The National Roundtable on the Environment and the Economy (NRTEE) conducted a preliminary investigation into the economic impacts of brownfield redevelopment activities in Canada and reported that for every \$1 spent in the Canadian economy on brownfield redevelopment, approximately \$3.80 would be generated in total economic output in all industries (2003). The research also showed that for every one-acre of redeveloped brownfields, an estimated 4.5 acres of greenfield development is conserved (NRTEE, 2003). Brownfield redevelopment can be a key foundation for greener and more sustainable municipalities.

Background and History

Remediation and redevelopment of contaminated sites in urban areas has been receiving increasing attention by policy makers and planners since the 1980s (De Sousa, 2001). Canada's approach to contaminated sites is to have the polluter pay for remediation and redevelopment costs. This is the guiding principle behind Canada's National Contaminated Sites Remediation Program (NCSRP), which was initiated in October 1989 by the Canadian Council of Ministers of the Environment (CCME), comprised of federal, provincial, and territorial governments (Therrien, 1995). Property owners and developers have indicated that the policies in Canada can be a barrier to potential redevelopment, where they would rather leave the land derelict than assume the risk of selling the property for redevelopment and being responsible for any liability or future costs (Hayek, Arku & Gilliland, 2010). The NCSRP program was then initiated to

recognize the need for a consistent national approach for classifying and cleaning up contaminated sites in Canada (Therrien, 1995).

In 2003, the National Round Table of the Environment and the Economy (NRTEE) released their National Brownfield Redevelopment Strategy for Canada, which indicated a number of policies, programming, and funding recommendations for all levels of government. After the document was released, all levels of government began taking steps to address the barriers to redevelopment of brownfield sites. Communities also began to realize the damage being caused by the neglected sites to their cities and the benefits that could be had by redeveloping them (Ross, 2002).

As brownfields started to receive more attention in Canada, the policies addressing the issue appeared to have many gaps (De Sousa, 2006). For instance, where the policies in place were at provincial and federal levels, the redevelopment was occurring at the municipal level. Studies revealed that local government efforts were resulting in positive outcomes; however, no standard approach was available to track the outcomes at the municipal level (De Sousa, 2006). A more consistent local approach, with support from provincial and federal levels would result in more successful brownfield redevelopment (De Sousa, 2006).

In 2008, a review of the 2003 NRTEE report was prepared and the report was established for use as a guiding document to address the barriers to brownfield redevelopment in both private and public sectors. The review found that all levels of government would need to work together to coordinate their approaches with regards to brownfield redevelopment and that communication and cooperation between the public and private sectors had played a major role in the development of successful brownfield strategies (OCETA, 2008). Finally, the review found that the public and private sectors had taken significant actions with respect to the

recommendations made by the NRTEE Brownfield Strategy report (OCETA, 2008).

Nevertheless, the federal government had not played a role in addressing many of the recommendations set out in the report. Most of the changes appear to have come from the provincial and territorial levels and the private sector.

The purpose of this study is to investigate whether the City of Delta has implemented significant actions with the recommendations made by the NRTEE by examining brownfield case studies in Delta and offering explanations as to why the redevelopment of former landfill sites has failed to occur, despite Delta having put incentives in place to offset investigation, remediation, and risk management costs associated with redevelopment. The objective of this research is to examine the issues and barriers being faced by developers even though incentives are in place. The research will also provide recommendations on how to overcome the major obstacles and provide future actions for Delta.

Research Questions

- Why have Delta's former landfill sites failed to be redeveloped?
- Why have other brownfields in the BC Lower Mainland, such as the new Administration and Public Works Yard Building in the City of Port Moody, BC (Port Moody) been successfully redeveloped?
- What are the current barriers to brownfield redevelopment in Delta?
- What tools and resources are available to the municipality to encourage brownfield redevelopment?

Chapter 2: Research Methodology

This research used a mixed methods approach with the use of qualitative and quantitative methods of data collection, analysis and comparison (Kuada, 2012). Predominantly qualitative data was analysed with some quantitative information to supplement the findings. Combining the two options provided a better input and insight of the problem formulation and its resolution (Kuada, 2012). Strauss and Corbin (1998) define qualitative research as research that produces findings without the use of any statistical procedures or other possibility of quantification. This was possible through the techniques of semi-structured interviews to obtain qualitative research information from valid and reliable sources and comparison of the case study (Kuada, 2012). Data collected through the semi-structured interviews were formulated into data tables to outline the top five barriers of landfill redevelopment based on the participant's professional opinions in order to supplement the findings. The mixed method approach was appropriate for this research, as it allowed for a more holistic and comprehensive perspective of brownfield redevelopment barriers and opportunities.

The research methods used for this thesis consist of three distinct research components: (a) document review, (b) case study of a successful converted brownfield in Metro Vancouver, and (c) semi-structured interviews. All three components play a significant role in identifying the common barriers and benefits to landfill redevelopment in Metro Vancouver, and how they relate to Delta. The primary research tool used in this thesis was the semi-structured interview, which provided this report with fundamental data on the barriers to redeveloping former landfill sites.

Document Review

The method used for researching and evaluating the opportunities and barriers to redevelopment in Delta had several components. A document review of municipal, provincial,

and federal policies, legislations, and tools relevant to brownfields was used in conjunction with a review of academic literature. This information was obtained by researching select Internet websites, planning journals, relevant reports, and technical studies, policies, and legislation. The review of municipal documents was focused primarily on those within Metro Vancouver, and the review of provincial documents was based on those within the province of BC. This research was required to understand the current brownfield and landfill redevelopment strategies and to understand the need for this type of research. The document review was pertinent for gaining insight into the objectives and strategies of professionals in landfill redevelopment, and to gain a better understanding of the planning process for redeveloping contaminated sites in Metro Vancouver.

The literature was used in conjunction with the review of academic literature outlining current brownfield and redevelopment strategies, to determine the need for this type of research and to identify the themes developed in this study. The themes consist of understanding the challenges, benefits, and strategies for overcoming the barriers to landfill redevelopment. The document and literature review familiarized the researcher with an overview of past studies related to brownfield redevelopment, and specifically to common obstacles and benefits for the redevelopment of derelict lands.

Case Study

A case study approach was used for this research as a tool to test the information found in the literature and document review. A case study approach is often used when studying the underlying research, and it focuses mainly on “how” and “why” questions, which can be an effective way of complementing the theoretical research with practical, real life examples (Yin, 2009). The case study strategy explored a successful former landfill site that has been recently

redeveloped in Metro Vancouver. The purpose was to understand why this project was able to overcome the common barriers to redeveloping landfills. The case study was chosen based on specific criteria: history (former/now closed landfill site), location (in a comparable city to Delta), current/future end land use, and whether or not the project successfully achieved its designated goals.

The case study of the new Administration and Public Works Yard building for Port Moody was examined. Port Moody completed a Landfill Closure Plan for the Barnet Landfill site, located at 831 Barnet Highway, in 2014 (City of Port Moody, 2016). The site is 5.8 hectares in area and currently zoned as industrial in Port Moody's zoning bylaw. The surrounding area is zoned general industrial to the west, open space and park areas to the south, and multi-family and detached housing in residential areas to the south and east. This site received municipal waste from 1950 to 2014, and gravel extraction also occurred in some areas of this site from 1950 to 2002 (City of Port Moody, 2016). The funding for the Landfill Closure project was secured through \$1.4 million in federal and provincial grants for site and environmental improvements, with a total project budget of \$2.6 million (City of Port Moody, 2016).

Semi-Structured Interviews

The information gathered from the document review and case study was used to supplement the semi-structured interviews to compare and assess opportunities for Delta. The semi-structured interview method was chosen based on the freedom it provides for both interviewer and respondent. It allows new ideas to surface during the interview based on the answers provided by the interviewee. In such interviews, a set of predetermined questions acts as a guide for the research (Cobetta, 2003). While the researcher works to ensure that certain key questions are asked of every participant interviewed, the semi-structured format allows and

encourages the researcher to interject with additional questions that may arise. Furthermore, the questions merely serve as guides to the session and the flow of the interview is meant to be primarily driven by the respondent. This type of interview method is particularly useful when the researcher wishes to explore a predetermined set of themes, but remains open to additional themes that may emerge during the interview (Cobetta, 2003). Having this flexibility was particularly important given the variation of professional experience and the likelihood that certain themes would only be relevant to some of the respondents.

Participants.

City planners, developers, and environmental consultants were the focus of the interview component of this thesis. A list of potential participants was assembled using online searches to compile a list of public and private sector employees. During the screening process, participants were asked questions regarding their experience and knowledge in the field of landfill redevelopment projects. Based on their answers, professional background, and willingness to participate in the study, interviews were arranged with the participants. The interviewees included environmental consultants from a variety of firms, including Envirowest Consultants, Inc., Phoenix Environmental Services, Ltd., and Enkon Environmental, Ltd.; city planners from both Delta and Port Moody; a representative from the Ministry of the Environment; and developers and project management consultants who have worked with developers on contaminated site projects. The information generated from the interviews contributed the necessary level of understanding to determine the key barriers, benefits, and strategies for brownfield redevelopment on former landfill sites.

The information obtained from the interviews was important to this study for several reasons. First, the professional opinions relating to the barriers and benefits to brownfield

redevelopment on former landfill sites are absent from the literature. Second, the information provided this study with concrete data on the specific barriers to each profession, the severity of the barriers, and a better overall understanding of the obstacles involved with landfill redevelopment. Lastly, the interviewees provided solutions and strategies for overcoming the barriers to improve the efficiency of redevelopment.

Questions and the data collection method.

The interview questions were adapted to each individual profession and to the interviewee's experience in landfill-related projects. For example, city planners answered questions regarding the planning of landfill projects, while environmental consultants were questioned about technical and environmental issues. The questions were designed to identify the key environmental, social, and economic benefits of redeveloping landfills, specific barriers relative to each profession, and strategies for overcoming the barriers.

Although the prepared questions were used to guide the interviews (Appendix 2), the semi-structured nature of the meetings allowed some flexibility for follow-up questions and open discussions. Due to the nature of the semi-structured interviews and the tendency of the participants to discuss alternative topics, the additional information was used as background information throughout this thesis. As part of the interview, the participants were asked to complete a 'barriers' table to develop a clear understanding of the major barriers of landfill redevelopment. Only pertinent information derived from the interview sessions was included in the barrier tables, which constituted the data component of the research.

The questions were formulated in alignment with the main research objectives. The intention of the questions was to help determine the barriers involved in landfill redevelopment and to provide recommendations for alleviating them. In addition, the questions were specifically

designed to identify the barriers faced by the three professions (environmental consultants, city planners, and project developers).

Limitations of the Research Methods

The case study approach had limitations when attempting to discover the best case study and the ideal participants. The case study was chosen based on certain criteria. Even though the Port Moody study met the basic criteria, the project was significantly different in regards to the history of the activities that has previously occurred on the site. The Barnet Landfill received municipal waste from the 1950 to 1982, at which time a partial closure of the site was undertaken, and the site was then used for gravel extraction in some areas between 1950 and 2002 (Morrison Hershfield, 2014). It was also difficult to find a successful case study where redevelopment of a former landfill site had been completed by a developer. The Port Moody case study was selected as it met the criteria for a brownfield redevelopment project on a former landfill site, though the project is being completed by the municipality and it is a public facility project.

Overall, the limitations to this research project posed challenges, but the secondary information (i.e., literature review and grey literature) and the cooperation of key stakeholders allowed the necessary information to be collected and analyzed. The document review, case study, and semi-structured interviews provided the foundation for the study recommendations. The three types of research methods will more accurately identify the specific barriers to landfill redevelopment. Once the obstacles were accurately identified, strategies for overcoming these barriers were provided.

Chapter 3: Literature Review

Introduction

The literature review was an important component of this study because it provided a clear understanding of current barriers to brownfield redevelopment and related definitions. The literature review provided valuable insight into the current issues related to brownfield redevelopment. It also helped identify the research gaps that helped to guide this thesis. Yin (2009) expressed the importance of a literature review for any new research project by stating “a thorough literature review is the first step in establishing a ‘methodological path’.”

Literature on the barriers to brownfield redevelopment, opportunities to brownfield redevelopment, brownfield tools, resources and regulations available in British Columbia were all examined.

Barriers to Brownfield Redevelopment

The review of relevant scholarly literature was conducted to determine the main barriers to brownfield redevelopment that have been identified in previous studies. The review of the literature, focused on Canadian brownfield sites, revealed that the lack of funding, issue of liability, cost of contamination clean up, complex regulatory processes, lack of understanding about the benefits of brownfield redevelopment, lack of experienced developers, stigma, and competition from greenfields are consistently found as barriers to brownfield redevelopment.

Liability and risk.

Liability is a recurring barrier to most types of brownfield redevelopment, often due to the difficulty in determining the original party responsible for the contamination on the site. In some cases, the responsible person may be clearly identified, but in other cases, the party at fault

may be difficult to identify or locate (CCME, 2006). Unpredictability is a major concern with regards to liability for contaminated sites, as it often leads to inaction or inappropriate action in the commercial and industrial sectors because future responsibilities on the site must be ensured (CCME, 2006). Many developers avoid redeveloping contaminated sites due to possible future liabilities and the cleanup and remediation costs associated with those liabilities, making redevelopment economically unfeasible (Alberini, Longo, Tonin, Trombetta & Turvani, 2005).

Although a number of barriers can hinder the remediation of contaminated properties, the legal liability associated with landfill sites is the primary barrier to redevelopment (Burnham-Howard, 2004). This idea is supported by McCarthy (2002) who emphasized that legal liability of contamination is the greatest impediment to brownfield redevelopment. Ellerbusch (2006) also found that liability affects a lender's willingness to finance projects for fear of being held responsible through their association with property owners who become legally responsible. De Sousa (2001) further stated that the issue of liability is a greater barrier in private redevelopments than in public redevelopment projects and it is perceived to be most severe obstacle to brownfield redevelopment.

Costs and funding.

High remediation costs are another primary barrier to future redevelopment projects. The costs associated with environmental site assessment and clean up can significantly increase the cost of remediation. The costs of remediating a brownfield site outweigh the costs of developing a similar sized greenfield site due to remediation costs, specific design and construction requirements, and mitigation measures required for redevelopment (City of Calgary, 2011). Furthermore, a longer and more complex regulatory process is in place that can further delay permit applications due to the requirement for a thorough review of the application and the

inadequate processes for municipalities who may lack experience in brownfield redevelopment projects. For these reasons, developers are more comfortable with developing greenfield sites, which leads to ongoing urban sprawl in Canadian cities.

When acquiring the capital to redevelop a brownfield site, a complete financing package including the costs associated with site assessment, site remediation plan, and cleanup is required, which is often difficult to complete by the developers due to the cost of acquiring the technical studies prior to knowing the feasibility of the redevelopment (Bartsch, 2002). To emphasize the potential high costs of developing a contaminated site, McQueen (2011) provided a table with scenarios comparing the purchase of a contaminated site to a greenfield site. Table 1 demonstrates that a contaminated site in Hamilton, Ontario that has been purchased for \$1 can still cost significantly more (up to 14.4%) to develop due to the additional remediation costs. The table is based on the assumption that a moderate level of contamination requires approximately \$450,000 in cleanup costs. The table also assumes that the property is already zoned for industrial use, no industrial development charges are present, and parkland dedication is not required (McQueen, 2011). For this scenario, the cost of a greenfield development project would be more economically feasible than a brownfield redevelopment project.

Table 1. Brownfield vs. Greenfield Development Costs.

Item	Brownfield	Greenfield
Land Purchase	\$1	\$160,000
Building Construction	\$1,800,000	\$1,800,000
Building Permit Fee	\$23,600	\$23,600
Site Plan Control Application	\$1,000	\$1,000
Parkland Dedication	\$0	\$3,200
Clean up of Property	\$450,000	\$0
Total	\$2,274,601	\$1,987,800
Increase in Development Costs of BF over GF	\$286,801 (14.4%)	

Source: Brownfield vs. Greenfield (McQueen, 2011)

Lack of funding is another major barrier to brownfield redevelopment projects. De Sousa, Wu and Westphal (2009) noted that lack of funding support is consistently identified in the literature as a key impediment to brownfield redevelopment. De Sousa (2006) wrote that, according to local officials, financial limitations continue to be the key challenge to successful brownfield redevelopment in Canada.

Regulatory process.

The complexity and length of the regulatory process has been recognized as another obstacle to brownfield redevelopment (Wernstedt, Meyer, Alberini, & Heberle, 2006). Complying with federal, provincial, and local regulatory agency processes can involve substantial time costs for developers and investors (McCarthy, 2002). This additional cost can discourage developers and property owners from taking on brownfield redevelopment as opposed to developing a greenfield site where fewer regulatory hoops exist.

Lack of information.

A general lack of knowledge and understanding exists about the economic, social, and environmental benefits of brownfield developments, which is another barrier to redevelopment (McCarthy, 2002). Insufficient information about the location and condition of a brownfield has been identified as a barrier to redevelopment (De Sousa, 2000). Very few cities have an inventory of their known or suspected contaminated sites. While departments of Canada's federal government have developed a consistent classification of contaminated sites, no standard municipal approach is used for brownfield inventories and only a handful of cities have developed their own (Adams, De Sousa & Tiesdell, 2010). Hayek, Arku, and Gilliland (2010) stated that the lack of information on the location of brownfields and their extent within a city is an obstacle to creating effective policies. Planners and policy-makers need to know the extent of

a city's brownfield problem before they can attempt to create effective policies and legislation for redevelopment and before developers and municipalities can make large monetary investments (Hayek, et al., 2010).

Environmental contamination.

Howland (2010) found that most of the literature and policies concerning brownfields emphasize environmental contamination as the main obstacle to industrial redevelopments, which would be a narrow view for policy makers since they can easily overlook other deterrents to redeveloping brownfields. Howland (2010) studied land sales over a 10-year period in an industrial district of Baltimore and identified other obstacles, such as outdated road configurations and infrastructure, inadequate telecommunication linkages, incompatible residential and industrial land uses, obsolete buildings that prove expensive to demolish, and sellers who are unwilling to lower their prices. The study also showed that in some cases it is not solely the environmental issues surrounding a brownfield site that prevented it from being redeveloped, even though that may be the perception (Howland, 2010). A number of other common obstacles to development may be present at or surrounding the site, which can make it unmarketable.

Social stigma.

Stigma or the negative perception of brownfield properties by the public and other stakeholders has also been one of the difficulties (Hayek et al., 2010). Brownfield redevelopments may have a continuing stigma even after cleanup, which can lower the value of potential sales or rentals (Wernstedt et al., 2006). In a study by Hayek et al. (2010), respondents noted that the public may fear that environmental issues are still present even after remediation has been completed. A shortage of developers who are experienced with brownfield

redevelopment or with the technical skills to proceed with a brownfield redevelopment project to remove stigma has also been mentioned as an obstacle to redevelopment (Wernstedt et al., 2006).

Competition.

Competition from greenfields hampers brownfield redevelopment (Hayek et al., 2010). The increased cost associated with cleanup and the perception of a slow regulatory process can make brownfield redevelopments uncompetitive with greenfield developments. The regulatory process for brownfield redevelopment projects due to environmental reviews can lengthen the redevelopment process, in turn, increasing the cost of the project. In a study of the City of London, Ontario, the abundant supply of greenfield land in the city was a major barrier to brownfield redevelopment (Hayek et al., 2010). The report also identified that the considerable supply of greenfields was a major factor that discouraged property owners and developers from redeveloping brownfields, while providing a safer option for development.

This section on the barriers to brownfield redevelopment has provided a general but clear view of why many contaminated sites remain idle and undeveloped. For the redevelopment of brownfields to gain momentum, and for more sustainable cities to exist, the barriers mentioned above must be overcome. The literature review revealed that lack of funding, issue of liability, cost of contamination clean up, complex regulatory processes, lack of understanding about the benefits of brownfield redevelopment, lack of experienced developers, stigma, and competition from greenfields have been consistent barriers to brownfield redevelopment in Canada.

Opportunities from Brownfield Redevelopment

Economic benefits.

The redevelopment of brownfield sites can have a number of economic benefits to their municipalities and residents. Neighborhood revitalization can be measured by the increase in

property value. Brownfield redevelopments can increase property values from 5% to 15% for properties that are up to 3/4 mile from the brownfield site (De Sousa, 2006). In cases where the redevelopment involves a change in the land use designation from industrial to parkland or residential and commercial mixed-use, the result can be a significant increase in property value (De Sousa et al., 2009).

Landfill redevelopment can also create employment opportunities in specialized areas of clean-up technology and development and maintenance, and from new businesses that settle on the remediated site. According to NRTEE (2003), thousands of contaminated sites have been cleaned in Canada and led to the creation of tens of thousands of jobs. The NRTEE (2003) provides an example that emphasizes the creation of job opportunities in Quebec City, where a program called “Quebec’s Revi-Sols” created an estimated 1,075 jobs for people in the area of landfill assessment and clean up since the program started in 2009. Furthermore, a small brownfield property in West Harbourfront, Quebec that was formerly used for rail yards and a gas station was remediated into a 27-unit housing development. The project generated \$720,000 and ten permanent jobs from the on-site remediation and construction (NRTEE, 2003). These two Canadian examples illustrate the short- and long-term job opportunities that can arise from brownfield redevelopment projects, making it a reliable source of employment for Canadians.

Remediated sites can also increase property tax revenues, either directly through the redevelopment of the brownfield sites or indirectly through increases in property value of adjacent properties (NRTEE, 2003). The NRTEE provides an example of the Spencer Creek Village redevelopment project in Dundas, Ontario, involving the production of 500 new housing units and 40,000 square feet of commercial space on a former steel site. The project is estimated to generate approximately \$1.76 million a year in new property tax revenue, \$7.55 million in

provincial sales tax revenue, and \$6.6 million in additional GST revenues (NRTEE, 2003).

In 2001, the International Economic Development Council (IEDC) examined a number of brownfield sites to determine whether or not remediation had affected the property values in the surrounding neighborhoods. Research showed that property values increased more than two-fold as a result of the brownfield redevelopment (Wernstedt et al., 2006). Studies also showed that, due to unappealing and unsafe conditions in neighborhoods with idle landfill properties, residents are likely to move to other neighborhoods that they consider more economically stable, causing a downward spiral of the surrounding neighborhoods (De Sousa, 2006).

Social benefits.

Due to social and environmental stigma attached to existing or former landfill sites, neighboring communities tend to lack a sense of place and social cohesion (Government of Ontario, 2007). Nevertheless, when brownfield sites are remediated and returned to productive use, benefits can extend to the surrounding communities. The removal of contamination can make an area more attractive for investment, which can then remove the negative perception of an area, improve the quality of life, and promote a sense of community in an economically distressed area (Government of Ontario, 2007).

Brownfield redevelopment can also reduce urban sprawl and help in meeting the increasing demand for urban living in municipalities, ultimately helping to preserve greenfields for other uses like productive farmland, environmentally significant areas, or parkland. It can also recover desirable locations to allow for smarter growth planning through urban intensification. Furthermore, mixed-use development from brownfield sites can create vibrant, diverse communities and address the housing problems in places that previously suffered from shortages of affordable or market-rate housing (De Sousa, 2006).

Communities with concentrated and untended brownfields can face public health threats due to exposure to harmful chemicals, poor air quality, lack of green space or recreation areas, and asthma prevalence (Government of Ontario, 2007). Cleanup of contaminated brownfield sites ensures better health for those in the surrounding communities. Public health benefits from brownfield cleanup and redevelopment can be significant when done at a community-wide or regional level, as it ultimately creates more resilient communities (De Sousa, 2006).

Environmental benefits.

Brownfield redevelopment offers many environmental benefits such as removing or reducing the threat to public health by removing actual and potential sources of land, water, and air contaminants from the site (Strother, 2000). Redevelopment of brownfield sites can also help slow the development of greenfields, which can decrease the loss of farmland and open space. Brownfield redevelopment offers responsible growth and saves land from destructive sprawl development. Urban sprawl tends to worsen traffic congestion, adding 20 to 40% of vehicle miles traveled, leading to further environmental concerns such as air pollution (De Sousa, 2000). Reusing brownfields can make it possible for developers to use existing infrastructure, facilities, and ultimately improve the opportunities for using public transit.

In summary, all levels of government have developed policies or programs to encourage and support brownfield redevelopment projects. They recognize the economic, environmental, and social benefits of transforming sites that are no-longer operational into prosperous and more prolific uses (Howland, 2004). Brownfields of all type offer opportunities for urban revitalization that can achieve important social and environmental goals, at the same time producing potentially significant returns on private investments. Brownfield redevelopment can help create

environmentally, socially, and economically sustainable communities and urban areas for current and future generations (McCarthy, 2006).

British Columbia Brownfield Regulations, Resources and Tools

The research process for this thesis also includes collecting and analyzing various grey literature, and a specific document review of brownfield regulations, resources, and tools. These resources have proved to be the most accurate and informative, and are pertinent to gaining insight into the objectives and strategies of professionals in landfill redevelopment. The grey literature was used in conjunction with the review of academic literature to provide a better understanding of the planning process for redeveloping landfills, and the resources and tools available to municipalities in Metro Vancouver. This idea is also addressed in the case study section of the thesis, to determine whether or not Delta's staff and residents are using all resources available to ensure they have an efficient brownfield redevelopment process in their city.

Site Profile

The site profile system is a legally defined, uniform process that provides a mechanism to screen potentially contaminated sites in BC (MOE, 2014). Site profiles are required to be completed when making an application to local government for rezoning, subdivision, OCP amendment, development permit, soil removal, or demolition on a property. They are also required when decommissioning a site; taking over a property as a trustee, receiver, or liquidator; selling a property that has or had a contaminated activity on it; and for an application for a Certificate of Restoration (MOE, 2014). Furthermore, if any commercial or industrial activities and uses that can cause contamination, have occurred on the site, then a site profile would also be required (MOE, 2014). Site profiles are submitted to different parties including local

governments, prospective purchasers or a Director of Waste Management. Once a site profile is received, local governments have 15 days to determine whether or not a site investigation is required (MOE, 2014).

Environmental site assessment.

If a site profile identifies that a site investigation is required, the site must be assessed to determine the type, concentration, location, and extent of contamination through an environmental site assessment (ESA). The ESA is comprised of three parts; Phase I, Phase II, and if required, a risk assessment (MOE, 2014). The Phase I ESA is a preliminary assessment evaluating current and historical land uses or activities on the property and within the surrounding area using various methods, including investigation of past uses, interviews, mapping, and site visits (MOE, 2014). If the Phase I ESA determines that contaminants have a likelihood of affecting the property, a Phase II ESA will be required (MOE, 2014). The Phase II ESA is a more intensive study that characterizes the location and concentration of the contaminants using methods such as soil, groundwater, surface water, and sediment sampling (MOE, 2014). The concentrations of compounds found by the study are compared to the levels established by the Ministry of Environment to determine whether or not they exceed the acceptable standards (Reynolds, 2012).

Site specific risk assessment.

In cases where contaminants at a brownfield site may be present with higher than generic levels as set out by BC regulations, the property owner can hire a qualified environmental professional, with specific education and experience requirements, to conduct a detailed risk assessment to develop site-specific or risk-based remediation objectives. The risk assessment scientifically examines the risk posed to humans, plants, wildlife, and the natural environmental

features to be exposed to a contaminant. Approvals can be achieved if the property meets alternative standards that have been specified in a risk assessment accepted by the Ministry of Environment (MOE, 2014).

British Columbia Brownfield Resources

Brownfield strategy.

BC developed and implemented a provincial Brownfield Strategy in 2008, which outlined solutions to revitalize abandoned and underutilized lands in BC. The strategy provided \$10 million remediation funding over five years for municipalities. The funding would match provincial or private sector investments in the early stages of investigations on sites where market forces had not achieved redevelopment (MOE, 2007). The strategy also created a streamlined process in which developments waiting for provincial environmental approval would be fast-tracked. The strategy also provided brownfield tools for local governments such as providing municipal staff with direct expert assistance, enhanced flexibility in liability allocation so that brownfield owners would be encouraged to sell or redevelop idle properties, and create virtual brownfield offices with the Ministry of Agriculture and Ministry of Environment staff to assist local governments and provide information and guidance (MOE, 2007). The brownfield strategy was concluded in 2014, and the province is currently building on the successes of the strategy and working to identify options to further promote and facilitate brownfield remediation and redevelopment in BC (MOE, 2007).

Canadian brownfield network.

One of the recommendations that was developed from the National Roundtable on the Environment and the Economy was to establish a national brownfields network (NRTEE, 2003). In 2004, an outreach organization called the Canadian Urban Institute (CUI) founded the

‘Canadian Brownfield Network’ (CBN) as an information exchange and communication forum between public, government, developers, and other parties involved in brownfield redevelopment to discuss and seek partnerships to make redevelopment projects successful (Lomas-Jylha, 2005). The vision of the CBN is to promote brownfield property reuse as the preferred solution by developers, and it seeks to accomplish this by providing research, advocacy, and clarity on issues related to brownfields (Network for Brownfielders, 2004). The network offers services such as assisting in removing Crown Liens and Tax Arrears, establishing the Canadian Brownfield Conferences, and assisting with the development of the Green Municipal Fund (Lomas-Jylha, 2005).

Official community plans.

British Columbia’s Local Government Act requires each municipality to develop official community plans (OCPs) that provide objectives and policies to guide decisions on planning and land use management within the area covered by the plan. Municipalities are then required to create bylaws that would be consistent with the approved official community plan, including the policies on brownfield redevelopment. Delta has an official community plan, as required, though the document does not contain any policies or objectives for the revitalization of brownfields in the municipality.

British Columbia Brownfield Tools

Green municipal fund.

The Government of Canada endowed the Federation of Canadian Municipalities (FCM), with money to establish the Green Municipal Fund (GMF) to support municipal initiatives that reach high standards of environmental protection (FCM, 2012). Funding support is available to all Canadian municipal governments and their partners in eligible projects, and funding is

allocated in various sectors of municipal activity: brownfield, energy, greenhouse gas emissions, climate change, transportation, waste, and water. The funding is available within annual limits, which allows the GMF to fund numerous projects. Through this program, the FCM provides 50% of the eligible project costs to a maximum of \$175,000, and it can also be further combined with federal and provincial funding (FCM, 2012).

Originally, the GMF was used for infrastructure projects and it did not specifically deal with brownfields. In 2005, however, the federal government granted \$150 million to GMF funding to be used for financing brownfield remediation and redevelopment projects, plans, and studies (Lomas-Jylha, 2005). This was likely a response to Recommendation 1.4 of the NRTEE National Brownfield Redevelopment Strategy for Canada, which was to provide revolving loans for qualifying brownfield sites that was listed as a responsibility of the federal government.

Three types of municipal environmental initiatives are funded through the program: plans, feasibility studies, and capital projects. Plans that are eligible for grants include sustainable neighborhood actions plans, community brownfield action plans, and greenhouse gas reduction plans. A community brownfield action plan identifies priority redevelopment zones and opportunities, including incentive programs and municipal actions to promote the remediation, rehabilitation, and adaptive reuse of underused properties in a community (such as community brownfield strategies, community improvement plans, and revitalization plans) (FCM, 2012).

A feasibility study typically includes an assessment of the requirements and outcomes of a specific project leading to a recommended course of action. For initiatives in the brownfields sector, Phase 2 ESAs and site-specific risk management plans are considered as feasibility studies. Field tests of a new system, technique, or technology may also be eligible for funding

under the feasibility study category, as long as eligible projects contribute to cleaner air, water, or soil, or reduce greenhouse gas emissions (FCM, 2012).

The GMF usually offers a combination of grants and below-market loans to implement capital projects. Nevertheless, in the case of the brownfield sector, grants are not available. The loan limit for a brownfield capital project is decided on a per-project basis, for up to 80% of eligible project costs. In 2012-2013, the GMF aimed to approve a minimum of \$20 million in loans to 30 brownfield projects (FCM, 2012). For a brownfield capital project to be eligible for GMF support it must bring a contaminated site back into productive use and reduce the need for greenfield development (FCM, 2012).

SDRC innovative technology development funding.

Under the Pan-Canadian Framework on Clean Growth and Climate Change, BC and the Government of Canada provided funding from the province's Innovative Clean Energy Fund, managed through the Sustainable Development Technology Canada (SDTC). The SDTC is a federally funded, not-for-profit foundation that finances and supports the development and demonstration of clean technologies that provide solutions to issues of climate change, clean air, water and soil quality, and deliver economic, environmental and health benefits to Canadians (Government of Canada, 2016). Brownfield redevelopment projects that reduce GHG emissions, improve water and soil quality, or result in economic growth can apply for this funding that, on average, fund 33-50% of the eligible costs per project (Government of Canada, 2016).

Tax exemption programs.

The British Columbia Community Charter allows municipalities to create by-laws that allow them to cancel or defer municipal portions of property tax during the development period of a property to assist with the cost of environmental remediation (MMAH, 2012). Revitalization

tax exemption programs are tools that allow municipalities to encourage various types of environmental, economic, or social objectives. Delta has created a Landfill Site Economic Investment Zone and Revitalization Tax Exemption Program Bylaw to promote the environmental remediation and development of former landfill sites, which allows for a tax exemption for a total of 10 years (City of Delta, 2011).

Development cost charges.

Local governments are authorized to collect development cost charges (DCCs) under the Local Government Act. In 2008, amendments were made to expand local government authority to enable local governments to waive or reduce DCCS for development that would result in low greenhouse gas emissions and low environmental impacts. The requirements that must be met by a development to receive a waiver or reduction must be clearly stated in the DCC bylaw (MMAH, 2012).

Summary

Provincial policies regarding brownfields focus on environmental protection and public health and safety standards that must be met by redevelopment projects. Changes to the Local Government Act, with regards to DCC reductions, and the community charter with tax exemption programs have reduced some of the barriers to brownfield redevelopment, though some issues with federal liens still remain. The British Columbia Climate Action Toolkit encourages brownfield development by encouraging municipalities to provide incentives; however, the responsibility of funding the incentives lies with the municipalities. The current policies seem to reduce some of the barriers to brownfield redevelopment though municipalities are not yet at a stage where they can actively promote redevelopment.

The following list is a summary of the brownfield barriers and the tools and resources available in BC for brownfield redevelopment.

Table 2. Barriers and Tools Comparison Table

Liability	Filing a Site Profile and obtaining a Certificate of Completion can provide regulator protection. Civil liability is still possible.
Lack of Funding	GMF, DCC and Tax Reductions provide a reimbursement or deferment of fees. There is little upfront funding available.
Cost of Clean-up	Programs to aid with studies and remediation costs are available.
Lengthy Regulatory Process	Recent changes have tried to streamline the process.
Stigma	Stricter regulatory process and increased public awareness have lessened stigma surrounding brownfield redevelopment.
Lack of Developer Experience	Developers are pursuing more brownfield development projects in the Lower Mainland.
Competition from Greenfields	Municipalities can utilize the OCP to provide incentives for brownfield redevelopment but not often it is not enough to make it competitive.
Lack of Understanding of Benefits	Increased public awareness and publications and campaigns from the public and private sector have increased understanding
Lack of Information about a Site	Municipalities often do not have brownfield inventory.
Capacity Building	Tools and resources created by the Canadian Brownfield Network, the Canadian Urban Institute, and Federation of Canadian Municipalities.

The province offers a number of capacity building and educational resources to guide municipalities and private sectors in brownfield redevelopment projects in BC. It also provides tools and learning programs for municipalities to encourage them to redevelop their brownfields

and to inform decision makers and planners. Financial tools are available to assist with brownfield redevelopments, but the funding is coming through the municipalities in the form of fee and tax reductions. Grants or upfront capital are not supplied to the developer (MMAH, 2012). In recent years, the GMF has opened up funding for brownfield redevelopment; however, the capital is not sufficiently large to assist with all brownfield projects in the province. The GMF can provide some upfront funding and more financial options to assist with brownfield redevelopment.

Chapter 4: Results

Case Study Selection

Several potential case studies of former landfill sites were reviewed for their similarity in area, policies, and challenges to Delta. Case studies were examined based on their history (type of brownfield, specifically a former landfill site in order to analyse the results and compare it to the City of Delta), location, current/future end land use, and whether or not the case study was successful in achieving its designated goals. There were many examples of privately owned contaminated derelict sites available for review; however, it was difficult to find an example of a private-sector landfill redevelopment project. This was likely due to the potential barriers that make it increasingly difficult for property owners to redevelop their properties. The following case studies were reviewed.

- Paddington Station Project in the City of Langley which transformed a previously contaminated old industrial site into a multi-family residential development in the downtown core;
- Cascade Casino Resort and Coast Hotel & Convention Centre in the City of Langley, which was formerly a fertilizer and bulk fuel operation;
- Southeast False Creek in the City of Vancouver, which were former industrial properties along the southeast shore of False Creek and were remediated to create a model sustainable community for one of the Olympic athlete's villages; and
- Barnett Landfill Redevelopment in the City of Port Moody, which was a former landfill site redeveloping as a Work Yard & Operation Centre for the City of Port Moody's engineering staff.

As outlined in Table 3, the City of Port Moody case study was the closest match. It was difficult to find a case study that met all of the criteria; however, it did meet four out of the five required criteria. Although the other sites were private development, it was imperative that this study included a redevelopment of a former landfill site to be able to compare to the City of Delta.

Table 3. List of Case Studies

Project	Location (Metro Vancouver)	Former Landfill Site	Future End Landuse - Commercial, Industrial or Residential	Project Successfully Completed	Private Development
Paddington Station Project	✓		✓	✓	✓
Cascade Casino Resort	✓		✓	✓	✓
Southeast False Creek	✓		✓	✓	✓
Barnett Landfill	✓	✓	✓	✓	

The redevelopment process of the public sector is not different from the private sector process, as the municipality is still required to carry out the public process as outlined in the Local Government Act. Furthermore, there are lessons that can be learnt from the Port Moody case study in the context of Delta, given it's a municipal sector development. Staff were able to gather substantial provincial and federal funding to fund the landfill redevelopment project in Port Moody. Although, Port Moody did not have any private involvement in the redevelopment, Delta could benefit from a public-private partnership (PPP) to obtain funding for private developers as an incentive for redevelopment.

Public-private partnership in urban study is typically described as a cooperative partnership, which requires a joint investment to prepare an integrated approach and mutually beneficial goals (X Li et al., 2016). PPP creates an institutional framework in which the public

sectors provide strategic profits to the private sectors, while the private entities implement and develop the public sector's plan. One significant benefit of using PPP as an effective method is that the collaborative model can gather funds from both the two sectors and complement the limitation investment for both sectors. Particularly, PPP is necessary when the site faced weak market demand or serious environmental pollution issues that neither public nor private sector can solve alone (X Li et al., 2016). A collaborative vision has characteristics such as taking neighborhood into account, respecting citizens and cooperating among public governments, private investors and non-profit organizations (X Li et al., 2016).

The case study was employed for this research as a tool for testing the information found in the literature review and the semi-structured interviews. The case study approach is an effective way of complementing the theoretical research with practical, real life examples. According to Hartley (2000), case study research consists of a detailed investigation, often with data collected over a period of time, of phenomena, within their context. This research strategy explored a successful landfill redevelopment project in Metro Vancouver, for the purpose of understanding why this project was able to overcome the common barriers to redeveloping landfills. Yin (2009) emphasizes the importance of the 'case study approach', by stating 'case studies are often the chosen approach when studying the underlying research, focusing mainly on "how" and "why" questions. Furthermore, Yin distinguished the 'case study approach' from other research strategies by formulating a definition of the approach. He stated that a case study is defined as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used (Yin, 2009). This is an essential component because it expresses the importance of connecting the literature with real-life examples. The Port

Moody case study provides landfill redevelopment example within the context of Metro Vancouver.

Background of the Barnet Landfill Site.

The Barnet Landfill site is located in the City of Port Moody in Metro Vancouver, and is a former landfill site. The end use for this site is an office building and the redevelopment is nearly complete. Port Moody was chosen for the study and examined in terms of its historical background, intended end use plan, current site operations, benefits, barriers to redevelopment, and how they overcame the barriers. The case study involved limitations, as the redevelopment of the Barnet Landfill is a public project on a property that is owned by Port Moody.

Port Moody is located in Metro Vancouver, enveloping the east end of Burrard Inlet in BC, Canada. Port Moody is the smallest of the tri-cities, bordered by the City of Coquitlam on the east and south, and the City of Burnaby on the west. In 2016, Port Moody had a population of 33, 551 and it covered a total land area of 26 km², with a population density of 1,290 persons per km² (Statistics Canada, 2016).

The Barnet Highway Landfill is owned by Port Moody and it is located at 831 Barnet Highway near the entrance to the Reed Point Marina. The landfill property is 11.2 hectares in area, of which approximately 5.8 hectares has been used for landfilling of municipal solid waste. The remainder of the property is relatively undisturbed. The landfill site is designated “industrial” in the official community plan and zoned M3 “general industrial”. Surrounding land uses consists of general industrial lands to the west, open space and parks areas to the south, and multi- and single-family residential areas to the east (Figure 1).



Figure 1. Bird's eye view of Barnett Highway Landfill in the City of Port Moody. Adapted from *Barnett Highway Landfill Closure Plan Final Report* by Morrison Hershfield, February 4, 2014 (used with permission of the copyright holder).

The landfill was formerly a north-south aligned creek valley that was excavated for the extraction of sand and gravel. It formed a large pit in the northern portion of the creek ravine (Morrison Hershfield, 2014), with the north-south creek extending the length of the site along the western boundary of the property.

Previous work identified six distinct and contiguous areas of potential landfilling, which received municipal, industrial, and inert fill materials, likely coinciding with sand and gravel extraction operations (Morrison Hershfield, 2014). The areas surrounding the six landfilled areas consist of steeper slopes that flatten out at the boundary of the six areas. Overall, the six areas consist of a mix of flatter areas, some gentle topography, and some steeper slopes up to 10 m high. In general, the site is heavily vegetated with a mix of grasses, plants, shrubs, small trees, and larger trees (Morrison Hershfield, 2014). These areas are shown in Figure 2.

Port Moody completed a partial land closure in 1982, and the site has not accepted waste since 2002. A landfill closure plan for the landfill was conducted in 2013, and the landfill was officially closed in 2014. A Stage 1 preliminary site investigation and a Stage 2 detailed site investigation was completed in accordance with BC Contaminates Sites Regulations. In 2015, Port Moody applied for a federal/provincial grant to help cover the costs of the landfill closure plans and the Stage 1 and Stage 2 reports, and the city was successful in receiving a \$1.4 million grant from the green municipal fund to help fund the proposed environmental upgrades at the landfill. These included the installation of landfill cover and upgrades to storm water controls to prevent rainwater from flowing down into Burrard Inlet. The remediation project also included site grading and site preparation for future use, to relocate the new works yard on the site once environmental upgrades are complete. The project is anticipated to be complete in 2020.

The case study of the brownfield project in Port Moody was accompanied by interviews with local experts to gain a better understanding of the barriers to brownfield redevelopment in the city in general, and how the municipality dealt with them. During the interviews, cost was outlined as one of the two major barriers to the redevelopment of the Barnett landfill. Although both federal and municipal government funds were acquired by the available brownfield resources and tools, additional funding is needed for monitoring and ongoing maintenance.

Lack of regulatory requirement was considered as the second major barrier for Port Moody. When the landfill was active, regulatory requirements issued by the MOE did not exist; therefore, dumping and dredging occurred without environmental regulations. This created additional challenges of liability and time, due to the often-delayed approval processes, to meet MOE deadlines and garner public involvement. Planning challenges continue to arise due to the

different perspectives of public and private organizations. Each group lobbies for very different end land uses, which results in drawn out council meetings and planning initiatives

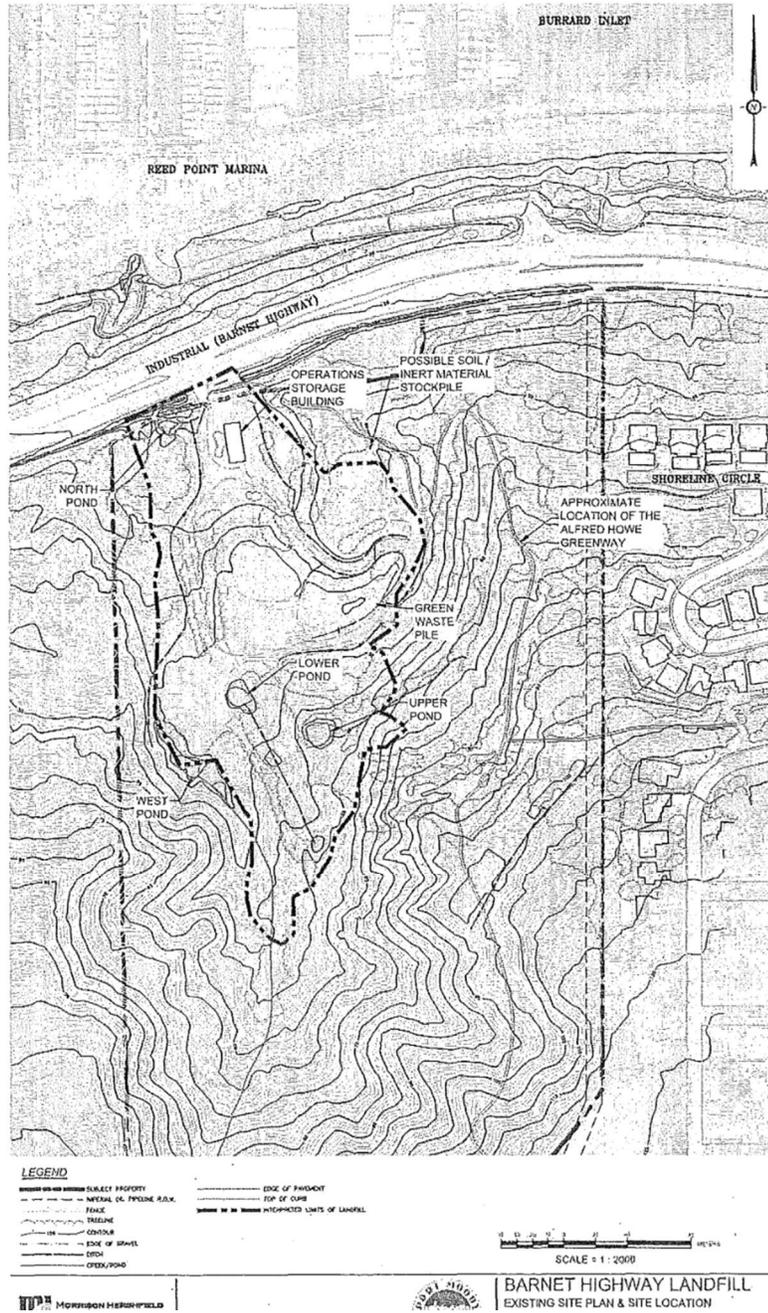


Figure 2: Existing Site Plan and Site Location of Barnett Highway Landfill. Reprinted from *Barnett Highway Landfill Closure Plan Final Report* by Morrison Hershfield, February 4, 2014 (used with permission of the Copyright holder).

An interviewee stated that the most significant barriers to brownfield redevelopment in Port Moody are the cost of competing land. “The potential land values aren’t high enough and there are cheaper sites around town. Developers don’t want to go through this process when there are simpler and cheaper properties available.” This was similar to De Sousa’s (2006) and Hayek et al.’s (2010) findings that suggested that the abundant greenfields depressed the demand for brownfield redevelopment. The interviewee also indicated that the development industry in BC is unfamiliar and uncomfortable with the brownfield redevelopment process. This was also the case in Wernstedt et al. (2006) who found that less experienced developers were not willing to propose brownfield redevelopments that did not offer greater incentives.

The issue of liability was mentioned by a respondent as the most significant barrier to another potential brownfield redevelopment site in Port Moody. The respondent indicated that the proponent was most likely not interested in selling or developing the site because of the high risk in the future liability in any development. Similarly, Hayek et al. (2010) found that liability was a major barrier for brownfield redevelopment in their study of brownfields in London, Ontario. The respondent stated that the cost of cleanup was not a significant barrier: “A lot of redevelopment has been done using site specific risk assessment so it’s not a big risk and not a big cost.” Nevertheless, most of the redevelopment projects in the city have been public projects, such as the redevelopment of the Barnet landfill site. “The public has a different philosophy than the private. The public looks at key properties located near downtown and it’s not just about making a buck.”

Successful redevelopment projects in the city were funded federally or provincially. The successful projects were those that were remediated with relatively low costs and were the most

obviously profitable. This finding is consistent with De Sousa's (2006) study that in Canada the easiest brownfields are getting redeveloped.

Semi-Structured Interviews

This section presents a series of tables that present the data collected in this research. Twelve professionals and stakeholders were interviewed to increase understanding of current barriers to brownfield redevelopment in Delta. The focus was on city planners, developers, and environmental consultants, because of their involvement and experience in brownfield and landfill redevelopment projects. Each participant was asked to state the top five barriers in Delta (Tables 3-6). Brief summaries are also given to identify the key information in each table.

City planners.

City planners are heavily involved in brownfield redevelopment projects. They determine the appropriate land use in a given area, based on the official community plan, neighborhood concept plans, and market trends. In an interview with Delta's Director of Planning, it was emphasized that the planning perspective, and if marketability exists for an alternative use, and it's a private owner, the developer will likely want to get some economic yield from the site.

Participants were asked to rank the severity of each barrier based on their personal experience with projects and the costs and risks. Answers were given according to a scale: non-obstacle (1 point), moderate obstacle (3 points) and severe obstacle (5 points). This ranking process was used for all of the interviews. The responses from the six urban planners were analyzed and presented in Table 4. The cost for redevelopment was determined to be the number one barrier to landfill redevelopment, largely because of the high up-front costs of remediation, development, and on-going monitoring and maintenance.

Table 4: Ranking of Obstacles and Barriers to Landfill Redevelopment by Planners

Barrier	Total Votes	Average	Ranking
Costs	6	4.5	1
Liability	5	3.4	4
Regulatory Requirement	3	4.25	2
Public Perception	4	2.25	6
Design	1	4.5	-
Control of Contaminants	2	3.5	-
Political Will	1	5	-
Location	4	3.5	3
Ownership	3	3.25	5
Time	1	3	-

Developers.

In general, private developers avoid brownfield redevelopment opportunities because of a number of key impediments that can easily increase costs (Government of BC,2009). In a report provided by the Government of British Columbia (2009), these challenges include the additional costs of funding required for environmental studies and site cleanup; difficulty obtaining project financing from traditional sources of development capital; demolition and infrastructure costs; additional time; complexities and process uncertainty and limited information of a given project (2009).

Due to a limited involvement in landfill redevelopment projects, developer participants were difficult to locate, therefore, three project managers from planning and engineering consulting firms who had experience in brownfield redevelopment were also interviewed. The responses from the five participants were analyzed and presented in Table 5. Based on this sample, the main barriers for developers consist of cost, liability, regulatory requirements and design. Acquiring sufficient funding for landfill redevelopment projects is challenging for developers, due to the average size of landfills, remediation strategies, and required

infrastructure. Liability concerns arise with every brownfield redevelopment due to risks involved in exposing harmful materials or contaminants to site users. Sites must be properly remediated and implemented with appropriate monitoring infrastructure to ensure their safety.

Table 5: Ranking of Obstacles and Barriers to Landfill Redevelopment by Developers

Barrier	Total Votes	Average	Ranking
Costs	5	5	1
Liability	5	5	1
Regulatory Requirement	4	4	2
Public Perception	5	5	1
Design	2	2	3
Control of Contaminants	2	2	4
Lack of Communication	4	4	3

Environmental consultants.

The preliminary stages of any brownfield redevelopment project starts with a series of environmental assessments. Qualified Environmental Professional's (QEP) are hired as consultants to determine the potential on-site contamination and to recommend solutions for managing the impacts. Four environmental consultants were interviewed for the purpose of this thesis. According to this sample of consultants, the major barriers to redeveloping landfills include the (1) costs, (2) liability concerns, (3) operational design and geotechnical construction of the landfill infrastructure, (4) a lack of communication and understanding between professionals, (5a) meeting regulatory requirements and (5b) public perception and negative stigma about developing landfills. The participants were asked to rank the severity of each barrier. The costs associated with environmental assessments and remediation was emphasized as the primary barrier to redeveloping brownfields and landfills (Table 6).

Table 6: Ranking of Obstacles and Barriers to Landfill Redevelopment by QEPs

Barrier	Total Votes	Average	Ranking
Costs	4	4.5	1
Liability	4	4	2
Regulatory Requirement	3	3.65	3
Location	1	3	4
Public Perception	2	2.5	5
Design	3	4	2
Control of Contaminants	1	2	-
Lack of Communication	1	3	4
Lack of Understanding	1	3	4

Summary of Key Findings

The purpose of this study was to investigate the current barriers of brownfield redevelopment of former landfill sites and to provide recommendations to help alleviate these obstacles for future redevelopment projects in Delta. A number of challenges were identified in the literature, the case study, and the interviews.

Table 7: Comparison of Obstacles and Barriers to Landfill Redevelopment

Barrier	Literature¹	Planners	Qualified Environmental Professionals	Developers /Project Managers	Total
Costs	10	6	4	5	25
Liability	10	5	4	5	24
Regulatory Requirements	8	3	3	4	18
Public Perception	4	4	2	5	15
Location	4	4	2	-	10
Geotechnical / Operational Design	-	3	3	2	8
Lack of Communication	4	-	1	4	9
Uncertain Cleanup Standards	4	-	-	-	4
Availability of Funding	3	-	-	-	3
Lack of Government Involvement	3	-	-	-	3
Control of Contaminants	-	1	1	2	4

Lack of Understanding	-	1	1	-	2
Legal Uncertainty	-	-	-	-	0
Political Will	-	-	-	-	0
Time	-	-	-	-	0
Total:	50	27	21	27	125

¹The Literature column includes the number of times each category was mentioned as a barrier in the literature review.

Table 7 summarizes the results from all participants to provide a current and better understanding of common barriers to brownfield redevelopment in Metro Vancouver, and as well, a better understanding of the barriers for redevelopment in the City of Delta. The cost (related to remediation for contaminated sites, clean up, environmental site assessments, hiring of consultants, design and development of the end use) involved in any redevelopment was outlined as the number one barrier with a total of 25 votes out of 25 surveyed. Bartsch (2002) has identified cost associated with environment site assessment, site remediation and site clean-up as major obstacle to brownfield redevelopment. This is evident in the research, as planners and developers have difficulty acquiring capital to pay for the three activities unique to brownfield redevelopment. When acquiring the capital to redevelop a brownfield site, a complete financing package including the costs associated with site assessment, site remediation plan, and cleanup is required, which is often difficult to complete by the developers due to the cost of acquiring the technical studies prior to knowing the feasibility of the redevelopment (Bartsch, 2002).

Concerns relating to liability (involving meeting environmental regulations, ensuring health and safety of surrounding communities and environment, unpredictability, and risk management initiatives) were voted the second most significant barrier brownfield redevelopment. Liability has been identified as one of the major impediment to brownfield redevelopment in Canada because all parties involved can potentially be exposed to risk of liability for an indefinite amount of time (CIELAP, 2011). Both private and public sectors are

concerned about unforeseen expenditures resulting from increased liability (CCME, 2006). Furthermore, governments want to ensure that taxpayers are not burdened with costs associated with poor environmental practices from the past. Liability concerns arise due to potential migrating contamination and leachate to neighbouring sites or infiltrating into the groundwater (CCME, 2006). With a total of 24 votes out of a potential 25, liability is a major concern for all stakeholders involved in landfill redevelopment projects.

Complicated regulatory requirements and cumbersome approval processes (related to lack of communication between stakeholders regarding regulations for landfill redevelopment projects, obtaining regulatory approvals, land use restrictions for landfills, non-existent regulatory requirements when subject landfills were active, and the lack of availability of data and information on site conditions) were determined as the third most significant barrier to overcome. With 18 out of 25 potential votes identified in Table 7, this challenge has the potential to impact all stakeholders involved in brownfield redevelopment. Stringent environmental regulations outlined by the MOE and EPA, cause this barrier to be a significant challenge to overcome.

With respect to the public, both their involvement and potential negative perceptions can be a significant barrier for landfill redevelopment projects. Although public involvement is important for determining a suitable end land use for a given landfill project, their participation can cause redevelopment delays to occur. Council meetings, aggressive community members and neighboring residents can potentially delay projects from starting. Furthermore, public perception can also be a potential future barrier, as potential buyers may avoid purchasing in the development due to social stigma, even after the site has been remediated and redeveloped. With

any new project, addressing public concerns over health and safety are important details to communicate.

Lack of communication, location and design were all considered significant barriers. Although these barriers ranked fifth in Table 7, consistent communication amongst all stakeholders is a crucial barrier to overcome for any brownfield redevelopment project. These barriers should not be underestimated and should be strongly considered when attempting to redevelop a former landfill site.

Although there was general consensus on the main barriers to brownfield redevelopment, some differences are evident between the literature data and the participant data. Howland (2010) found that most of the literature and policies concerning brownfields emphasize environmental contamination and its uncertain cleanup standards as the main obstacle to industrial redevelopments. Furthermore, the costs associated with environmental site assessment and the lack of available funding and government involvement was also identified as a distinct challenge to brownfield redevelopment (Bartsch, 2002). The participant data did not mention any of these, but instead emphasized the control of contaminants and operational/ geotechnical design as one of the significant barriers, which is an unexpected result because compared to most brownfields, landfills have additional operational challenges when attempting to remediate and redevelop. Due to unstable lands, often large in magnitude, and high degree of environmental social impacts, landfills pose significant challenges for all stakeholders, as geotechnical problems associated with weak (unstable) soil or existing foundations can add extra time and expense (McCarthy, 2012).

The significance of this is that the technologies and strategies for managing landfill contaminants have advanced considerably, to the point where it is no longer a major challenge

(Bartsch, 2002). The collection and conversion of gas to energy has made these types of redevelopment projects profitable, while the advancements in leachate containment and monitoring ensure a site is being properly managed (Barlaz & Ham, 1993). Another interesting and relatable observation is that although the literature review did not mention operational and geotechnical design as a barrier, the planners, environmental professionals and developers all mentioned this as an obstacle during the interviews.

Howland (2010) found that most of the literature and policies concerning brownfields emphasize environmental contamination and its uncertain cleanup standards as the main obstacle to industrial redevelopments. However, the interviews result did not consider clean-up standards to be a major barrier. The assumption is that developers and qualified professionals who have considerable experience with the redevelopment of brownfields have knowledge and are informed on the applicable standards for redevelopment. Furthermore, government authorities and the MOE have improved in outlining current landfill standards for all professionals and stakeholders involved in a landfill redevelopment project.

Conclusion

Chapter 4 provided a summary and an analysis of the three major research components in this research – a literature review, successfully redeveloped case studies in Metro Vancouver, and twelve professional interviews. A clear consensus of the top barriers to redeveloping former landfill sites was evident in Table 7. The top five barriers to redevelopment were the associated costs, liability concerns, unclear regulatory requirements, public perception/ involvement, a site's location, and a lack of communication were identified as the primary barriers.

CHAPTER 5: RECOMMENDATIONS

Although each landfill redevelopment project has its own unique challenges, this research has identified the most common barriers with possible solutions and recommendations for Delta. The most common barriers identified in this research were costs, liability and regulatory requirements. This section provides a number of recommendations for each major barrier.

Costs.

The up-front cost associated with landfill redevelopment was indicated as the most significant barrier. This includes various factors such as the cost of hiring professionals, required environmental assessments, developing remediation strategies, construction of preventative and monitoring systems, funding of the ongoing monitoring and maintenance, and staff salaries. These factors often delay or deter landfill projects from being pursued. The following recommendations are put forward.

Government funding is the most often noted method for overcoming the high costs of redeveloping landfills. Local governments are responsible for ensuring that the remediation of former landfill sites are conducted once a landfill reaches its' capacity. Municipalities have available funding for brownfield redevelopment projects or have opportunities to apply for provincial or federal funding's on behalf of the developer or property owner, as part of a public-private partnership. The British Columbia government has empowered municipalities with the ability to offer financial assistance to promote community planning goals, including brownfield redevelopment (Province of BC, 2009).

Municipalities have the lead role for ensuring the success of any brownfield redevelopment with the ability to create redevelopment plans to stimulate investment and funding to offset redevelopment costs through grants, loans and tax assistance (Hayek et. al,

2010). The City of London (Ontario) is a great example in which its municipal council adopted a Community Improvement Plan (CIP) in 2006, identifying key brownfield redevelopment sites and offered financial support for redevelopment (City of London, Department of Planning and Development 2006). The municipality was able to gain \$100,000 in 2006, \$250,000 in 2007, and \$500,000 per year from 2008 to 2010 from provincial and federal government grant programs (City of London, Department of Planning and Development 2006). These financial incentives were included in the CIP to reduce the upfront cost of brownfield redevelopment. The city considered each site's redevelopment on a case-by-case basis to ensure that it is both cost effective and in the public interest.

Financial incentives are intended to provide economic assistance to developers and property owners where the economic feasibility of a site is under question. Adams et al. (2000) found that redevelopment prospects pivot on the availability of up-front financial incentives, and interview results support this view. Adams et. al (2000) studied the effectiveness of financial incentives provided by community improvement plans, which resulted that developers found that CIP specifically geared towards brownfield redevelopment had value, and believed that the financial incentives that provide funding to cover up-front costs (such as environmental impact assessments, remediation, etc.) make brownfield redevelopment more attractive. Respondents of this study also suggested that without those incentives, potential developers would not consider taking on a brownfield redevelopment project (Adams et. al, 2000). Delta does not identify specific policies to redevelop the former landfill sites, however, it is recommended that the City of Delta create CIPs to incorporate "improvement areas" to their existing plans to readily receive funding to cover costs of landfill redevelopment projects, and publicize the financial opportunities to potential developers.

Liability concerns.

Liability was indicated as the second most difficult barrier to overcome, and was a major concern for all professionals, including owners, developers, planners, and environmental consultants due to the retrospective environmental costs and potential for lawsuits if an incident occurs. Ultimately, any brownfield redevelopment project carries with it some degree of liability. With good information and the right team, those risks can often be managed effectively and a strong business case can be made for moving forward on any brownfield project. Ensuring the liability risks associated with landfill redevelopment are mitigated, proper installation of monitoring systems and liners should be installed with redevelopment. The construction of this monitoring infrastructure plays a pivotal role in providing ongoing information on methane levels, on-site water quality and any potential migrating leachate (Burnham-Howard, 2004). Multiple interview respondents emphasized the importance of these monitoring systems and recommended strategies of reducing liability concerns would consist of ‘monthly monitoring of perimeter gas probes, daily monitoring of pressure levels with the gas collection system to prevent odors and gas migration and the appropriate liners during the redevelopment process’. An interview respondent also stated that ‘the demonstration of past monitoring data and compliance can help reduce liability risks associated with landfill redevelopment’. The installation of monitoring systems is not only required for redeveloping landfills, but it ensures the safety of a given site and limits potential negative impacts on end users.

Public involvement is another important strategy for the development of environmental policies. The Canadian Council of Ministers of the Environment (CCME) emphasizes that contaminated site remediation should incorporate openness, accessibility and participation (2006). Furthermore, accessible information and opportunity for public input are considered

fundamental to the development and operation of policy and legislation related to contaminated site liability (CCME, 2006). Interviewees in this study believe that both the regulatory authorities and the surrounding public should be invested in the decisions making process. It is recommended ‘that both regulatory and civil parties should participate in the development of appropriate mechanisms to adequately address liability concerns’ relating to redeveloping landfills. Proper communication and agreement between all stakeholders provides everyone with a better understanding of the risks involved in redeveloping landfills, thus avoiding accidents and potential lawsuits.

Regulatory requirements.

Legislative and regulatory requirements have been put in place to help encourage the cleanup and redevelopment of landfill sites while ensuring that the environment is protected. These requirements establish rules for site assessment and cleanup and ensure that only qualified professionals undertake the works and services (Province of British Columbia, 2009). When developing landfill sites, the research has demonstrated that regulatory requirements are the third most significant barrier for reasons that include a lack of communication between stakeholders regarding regulations, obtaining regulatory approvals in a timely manner, and the lack of available data and information on existing site conditions and historical use. The following regulatory requirements are recommended.

“Brownfield Redevelopment” is only mentioned once in Delta’s Official Community Plan, and aside from the standalone tax exemption program bylaw, the municipality has not identified the former landfill sites in any other plans or policies. Brownfield redevelopment can produce a multitude of benefits, but they will not be realised until the goals of brownfield redevelopment policy are embedded in a broader set of strategically planned agendas (Hayek et.

al, 2010). It is recommended that the City of Delta review its policies and plans to incorporate and comprehensibly embed brownfield redevelopment strategies in their plans and policies.

Interview respondents suggested improvements to the regulatory process, which mostly related to consistency in applying regulations or factors that would improve the economic viability of projects, such as streamlining procedures, changing approach from regulatory to partnership, and relaxing regulations. Regulatory requirements need to move beyond a case-by-case approach and place brownfields in a large-scale undertaking that seeks to revitalise multiple properties across a wider area of their communities (Hayek et. al, 2010). A coordinated redevelopment approach is required to consider how individual brownfield sites relate to the entire urban region (Raco et al, 2006). Brownfield redevelopment is affected by the interplay among various interests, including developers and community, local and regional stakeholders, and various government agencies, and a municipality can overcome barriers to brownfield redevelopment through a multi-disciplinary approach through a balanced and coordinated planning process (Williams et al, 2007).

To improve the regulatory requirement, municipalities' role in brownfield redevelopment is paramount (Hayek et al, 2010). Delta should engage local citizens, entice the local development industry, and communicate the values of brownfield redevelopment, which delta is not currently doing in its municipality to allow developers and property owners to understand the regulatory process. Municipalities can promote support from residents by creating a common vision for an area, and therefore, create demand for redevelopment by helping the public understand the benefits of using brownfield sites (Meyer et al, 2000). When the demand exists for using Delta's former landfill sites for residential or commercial use, the development

community will shift its focus to meet the demand. Delta can then implement redevelopment programmes to help developers and property owners understand the regulatory process.

A cooperative effort among all levels of government is needed to develop and implement integrated strategic redevelopment programmes (Hayek et al, 2010). The easier it is for property owners and developers to receive necessary approvals, the more attractive a brownfield is for redevelopment. To simplify the process, and thereby reduce the time component, prevent complications, and prevent misunderstanding, municipalities can create a task force charged with the purpose of streamlining and standardising the redevelopment application process (Hayek et al, 2010). This task group would receive all brownfield (landfill redevelopment) proposals in Delta and assess the merits of each application relative to the broader community goals and planning principles. With such a task force in place, Delta can eliminate the bureaucratic process of having the application circulated to various departments at city hall that creates a lengthy process.

Summary

This research has identified costs, liability and regulatory requirements as the top three major barriers to brownfield redevelopment. A number of recommendations have been provided in this section. For example, the City of Delta can incorporate brownfield redevelopment strategies in their plans and policies to receive provincial and federal funding to cover upfront costs for developers. Furthermore, public involvement, installing monitoring systems and creating reserve funds could also help alleviate liability concerns. Lastly, to address the barriers of complex regulatory requirements, Delta consider a multi-disciplinary approach and create a task force to eliminate the bureaucratic process to redevelopment.

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