

## AN ABSTRACT OF THE DISSERTATION OF

Amireh G. Saberiyan for the degree of Doctor of Philosophy in Civil Engineering

Presented on December 29, 2015.

Title: Owner's Role in Brownfield Remediation: The Brownfield Experts' Perspective

Abstract approved:

---

David N. Sillars

Former industrial or commercial sites that have been left unused are typically referred to as brownfield sites, or simply, brownfields. Many communities have such properties that are abandoned, idle or underused. Despite public efforts to facilitate brownfields revitalization projects, the rate of remediation remains unexpectedly slow. Efforts to resolve this nationwide problem have included legislative liability relief, federal grants and loans to facilitate revitalization, and state and local government initiatives for economic development assistance, among others.

The slow process of brownfields revitalization suppresses economic growth for entire communities, and poses a substantial threat to human health and the environment. This research provides insight into the root causes of the slow rate of remediation.

This research looks into the overall understanding of the three different stakeholder groups (private, public, regulatory) as experts regarding the impact of costs and benefits associated with brownfield remediation projects when considering property owners as the fourth stakeholder group. The expert panel

validates the notion that brownfield property owners are the primary decision-makers and it is their cost/benefit analyses that define and directly contribute to the rate of brownfield remediation projects.

This dissertation offers a conceptual model of a brownfield property owner's decision-making process when deciding whether to remediate or not and identifies factors and sources of information influencing the property owners' decision, including the importance and reliability of each.

An objective analysis of the data collected in this research suggests that property owners perceive zero net benefits exist to remediate, if their analysis focuses solely on the remediation—and not on the cost of the status quo of the existing contaminated property. It is also apparent that property owners use the least reliable sources of information when facing factors that have the most impact on their cost/benefit analyses. When decisions are made based on poor information, property owners may conclude that remediation is not beneficial and they may not take action to remediate.

©Copyright by Amireh G. Saberiyan  
December 29, 2015  
All Rights Reserved

Owner's Role in Brownfield Remediation: The Brownfield Experts'  
Perspective

By:

Amireh G. Saberiyan

A DISSERTATION

submitted to:

Oregon State University

in partial fulfillment of  
the requirements for the  
degree of  
Doctor of Philosophy

Presented December 29, 2015

Commencement June 2016

Doctor of Philosophy dissertation of Amireh G. Saberiyan presented on  
December 29, 2015

APPROVED

---

Major Professor, Representing Civil Engineering

---

Head of the School of Civil and Construction Engineering

---

Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

---

Amireh G. Saberiyan, Author

## ACKNOWLEDGMENTS

The inspiration for this dissertation came from my personal experiences as a consultant working with brownfield property owners. Over the course of the time that I spent working with them and hearing their stories, I was able to understand their agony towards dealing with an unknown and unwanted liability that made them live their lives in stress and indefinite fear. I sincerely hope that this study helps to replace fear with hope and prosperity for those whom their health and lives jeopardized by brownfields.

I would like to thank my advisor, Dr. Sillars, for his patience and willingness to help me find the right path through the maze of unknowns that make brownfields the number one environmental problem in the United States. His knowledge and guidance were instrumental in conducting this research and I cannot thank him enough for helping me fulfill my dream of concluding this dissertation.

I would also like to thank my committee members, whose encouragement and acceptance to take a part in this research has been the ultimate support to complete my work.

Sincere appreciation to all of the members in my expert panel for their time commitment. It was not possible to reach meaningful results without their contribution.

Many thanks to Sarah Mason for helping me to edit and wrap up this work in a timely manner. Sarah is an amazing editor regardless of her young age.

Dr. Ken Williamson was my first research advisor and mentor at Oregon State University. He believed in my abilities and recognized my entrepreneurial spirit very early on. Dr. Williamson has played a significant role in both my academic

life and my career, and has helped me become a successful consultant and an active member within brownfield associations.

Kim Marcus and Doug McCourt have been my mentors over the years, helping me learn how to manage and find solutions towards making a difference in revitalizing brownfields.

Words will never be sufficient when it comes to describing both my mother, who seeded ambition in my heart, and my father, who lived a life filled with goodwill. His wish for me to finish this program before his passing has been a driving force for me to finish.

My deepest gratitude to my brothers, whose assurance in my abilities has played a major role in all aspects of my life, as well as my friends, who have always been there for me with their unconditional love and support, helping me reach my goals.

Many thanks to my sons, Seena and Kian, they give me purpose in life. Their belief in me and their words of encouragement have always been a major force driving me to stay on board with the program to the very end.

An extra special thanks to Homayoon Haddad, my husband, my best friend, my visionary partner in life whom always pushed me forward. He has made my life exceptionally exciting, fulfilling, and meaningful!

## TABLE OF CONTENTS

Title	Page
1 Chapter One – Introduction.....	1
1.1 Preface .....	1
1.2 Brownfields Introduction .....	1
1.3 General Problem Statement .....	3
1.4 Originality and Significance of this Study .....	5
1.5 Dissertation Structure.....	7
1.6 Research Results .....	9
2 Chapter Two - Understanding Brownfields .....	11
2.1 Preface .....	11
2.2 Introduction .....	11
2.3 Brownfields Technical Background.....	11
2.3.1 History of Brownfields Regulation .....	13
2.3.1.1 Resource Conservation and Recovery Act (RCRA) .....	13
2.3.1.2 Community Reinvestment Act (CRA) .....	14
2.3.1.3 The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or the Superfund .....	15
2.3.1.4 The Superfund Amendments and Reauthorization Act (SARA) .....	16
2.3.1.5 The Small Business Liability Relief and Brownfields Revitalization Act of 2002 – Brownfield Law .....	17
2.3.2 Brownfields Initiatives .....	19
2.3.2.1 Federal Initiatives.....	19



## TABLE OF CONTENTS (Continued)

2.3.2.2	Oregon’s Brownfields Initiatives .....	20
2.3.3	Current Practices for Brownfields Revitalization .....	24
2.3.3.1	Pre-development .....	25
2.3.3.2	Property Transaction and Liability Management .....	27
2.3.3.3	Concurrent Cleanup and Redevelopment .....	31
2.3.3.4	Project Completion and Closure Pathway .....	32
2.3.4	Conclusion.....	33
2.4	Parties Involved in Brownfields Revitalization.....	34
2.4.1	Public Sector .....	34
2.4.2	Private Sector .....	35
2.4.3	Federal and States Regulatory Agencies.....	36
2.4.4	Property Owners.....	36
2.5	Conclusion.....	37
2.6	Chapter Summary .....	39
2.7	Problem Statement and Hypothesis.....	41
2.7.1	Research Goals and Objectives.....	41
3	Chapter Three – Decision Making and Perception of Risk .....	43
3.1	Preface .....	43
3.2	Decision Making.....	43
3.2.1	Decision-Making as an Identifiable Process .....	44
3.2.2	Risk and Decision-Making .....	45
3.2.3	Risk in Everyday Decision-Making .....	45
3.2.4	Decision-Making Based on Cost-Benefit Analysis.....	46
3.3	Perception of Risk .....	47
3.3.1	Important Risk Perception Factors .....	49

## TABLE OF CONTENTS (Continued)

3.3.1.1	Real Risk .....	49
3.3.1.2	Risk Target.....	50
3.3.1.3	Heuristics.....	50
3.3.1.4	Trust .....	51
3.3.1.5	Antagonism .....	51
3.3.1.6	Risk Sensitivity.....	51
3.3.1.7	Attitude .....	52
3.3.1.8	Voluntary vs. Involuntary Risk .....	52
3.3.1.9	News Media .....	52
3.3.1.10	Expert vs. Public Perception of Risk.....	53
3.3.1.11	Anchoring.....	53
3.3.2	Risk Perception Theories.....	54
3.3.2.1	Psychological Theory - Heuristics and Cognitive .....	55
3.3.2.2	Cultural Theory .....	56
3.3.2.3	Interdisciplinary Approaches .....	56
3.4	Chapter Summary .....	57
3.5	Research Hypothesis and Model Expansion .....	58
4	Chapter Four – Factors and Risk Perception in Brownfields Remediation...	60
4.1	Perceptions of Risk as Related to Human Health .....	62
4.2	Perceptions of Risk as Related to Financial Risk.....	63
4.3	Cost/Benefit of Redevelopment .....	64
4.4	Chapter Summary .....	68
4.5	Research Hypotheses and Amended Model.....	69
5	Chapter Five – Research Methodology.....	71
5.1	Preface .....	71

## TABLE OF CONTENTS (Continued)

5.2	Introduction .....	71
5.3	Research Framework and Methodology .....	72
5.4	Research Techniques .....	75
5.4.1	Survey Methods – Literature Review.....	76
5.4.1.1	Establish Project Goals and Scope of Work .....	76
5.4.1.2	Understand and Avoid Survey Errors.....	77
5.4.1.3	Choose the Survey Method .....	78
5.4.1.4	Select Samples .....	80
5.4.1.5	Write the Questionnaire .....	81
5.4.1.6	Pilot Test .....	82
5.4.1.7	Conclusion.....	82
5.4.2	Opinion Based Research Techniques - Literature Review .....	83
5.4.2.1	Staticized Group Techniques .....	83
5.4.2.2	Nominal Group Techniques .....	84
5.4.2.3	Focus Groups.....	85
5.4.2.4	Delphi Technique .....	86
5.4.3	Selection of the Proper Opinion-Based Technique for this Research 87	
5.5	Conclusion.....	90
5.6	Chapter Summary .....	92
6	Chapter Six – Delphi Methods Considerations .....	93
6.1	Testing Causal Factors Utilizing the Delphi Method.....	93
6.2	Structure of Delphi Method.....	94
6.2.1	Develop Questionnaire .....	95
6.2.1.1	Mechanism for Administering the Questionnaires in this..... Research.....	97 97

## TABLE OF CONTENTS (Continued)

6.2.2	Delphi Panel Requirements .....	100
6.2.2.1	Delphi Method Population .....	100
6.2.2.2	Number of Participants.....	103
6.2.2.3	Anonymity of the Participants .....	104
6.2.2.4	Delphi Panel Selection Criteria .....	104
6.2.3	Number of Rounds.....	105
6.2.4	Feedback Process.....	105
6.2.5	Bias Control.....	106
6.2.6	Measure of Consensus.....	107
6.2.7	Generalization.....	107
6.3	Chapter Summary .....	107
7	Chapter Seven – Establishing the Delphi Panel .....	109
7.1	Preface .....	109
7.2	Phases of the Delphi Panel Survey.....	109
7.3	Implementation of the Delphi Method .....	110
7.3.1	Independent Review Board (IRB) Approval .....	110
7.3.2	Delphi Panel Selection Process .....	110
7.3.2.1	Delphi Panel Selection -Primary Step .....	112
7.3.2.2	Delphi Panel Selection – Second Step.....	112
7.3.2.3	Delphi Panel Selection – Final Step.....	114
7.4	Chapter Summary .....	118
8	Chapter Eight – Validation of Owner’s Role .....	120
8.1	Presenting the Problem Statement .....	120
8.1.1	First Hypothesis Validation – Owners’ Role.....	121
8.1.2	Second Hypothesis Validation - Owner’s Decision Process.....	121

## TABLE OF CONTENTS (Continued)

8.1.3	Results.....	122
8.2	Chapter Summary .....	124
9	Chapter Nine – Remediation Decision Factors and Sources of Information 126	
9.1	Third Hypothesis Verification - Important Factors that Affect a Brownfield Property Owner’s Decision to Remediate.....	127
9.2	Fourth Hypothesis Verification – Important Sources of Information Used by a Brownfield Property Owner. ....	128
9.3	Results.....	130
9.3.1	Content Analysis .....	130
9.3.1.1	Content Analysis - Factors.....	130
9.3.2	Content Analysis – Sources of Information .....	135
9.3.2.1	Content Analysis Verification.....	138
9.4	Chapter Summary .....	142
10	Chapter 10 – Perceptions of Factors and Sources within the Cost/Benefit Context.....	144
10.1	Introduction .....	144
10.2	Cost/Benefit analysis .....	144
10.2.1	Survey Structure .....	146
10.2.2	Distribution and Data Collection.....	147
10.2.3	Results and Data Analysis .....	147
10.2.3.1	Condition A – Do Not Remediate.....	148
10.2.3.2	Condition B – Remediate .....	154
10.2.3.3	Cost/Benefit Analysis Results.....	164
10.2.3.4	Sources of Information Reliability .....	167

## TABLE OF CONTENTS (Continued)

10.2.3.5	Impact of Factors vs. Reliability of Sources of Information on Property Owners' Decision-Making Processes .....	171
10.3	Chapter Summary .....	177
11	Chapter Eleven - Conclusion and Future Research.....	179
11.1	Introduction .....	179
11.2	Research Focus .....	179
11.3	Research Originality .....	180
11.4	Contribution of this Research .....	180
11.5	Recommendations and Future Studies.....	183

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
Figure 1 - The Integrated Brownfields Remediation/Redevelopment Process....	25
Figure 2 – Decision Makers’ Role in Remediation Flow Process .....	38
Figure 3. Property Owner’s Role as the Primary Decision Maker in Remediation Flow Process. ....	39
Figure 4 – Owner’s Cost-Benefit (C/B) Analysis Gross Model .....	58
Figure 5 - Causal Model Expansion .....	69
Figure 6 – Research Framework Utilizing Opinion Based Methodology .....	75
Figure 7 – Research Framework Utilizing Delphi Methodology .....	91
Figure 8 - Delphi Method Flow Chart.....	94
Figure 9 – Oregon Regions divided based on their counties .....	114
Figure 10 – Delphi Panel Validation and Amendment of Brownfield Property Owners’ Cost-Benefit Causal Model. ....	142
Figure 11 – Diagram of Cost-Benefit Analysis to Remediate or not .....	145
Figure 12- Condition A – Do Not Remediate - Cost Factors Histograms .....	150
Figure 13 – Condition A – Do not Remediate - Cost Factors Histograms – Comparing Three Stakeholder Groups .....	153
Figure 14– Condition B – Remediate – Cost Factors Histograms .....	156
Figure 15 – Condition B – Remediate – Cost Factors Histograms .....	157
Figure 16 – Condition B – Cost Factors Histograms – Comparing Three Stakeholder Groups .....	159
Figure 17 – Condition B - Remediate – Benefit Factors Histograms .....	161
Figure 18 – Condition B – Benefit Factors Histograms - Comparing Three Stakeholder Groups .....	163

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
Table 1 - Summary of Brownfields Program Accomplishment.....	4
Table 2 – Delphi Panel Members .....	116
Table 3 – Factors Influencing Property Owners’ Cost/Benefit Analyses. ....	128
Table 4 –Source of Information Available to Property Owners.....	129
Table 5 – Content Analysis – Factors .....	132
Table 6 – Content Analysis – Sources of Information.....	136
Table 7 – Content Analysis – Factors Verification .....	139
Table 8 - Content Analysis – Sources of Information Verification.....	140
Table 9 – Cost/Benefit Factors Allocation. ....	146
Table 10 – Condition A – Do not Remediate - Cost Factors Data Set.....	149
Table 11 – Condition A – Cost Factors Data Set – Comparing Three Stakeholder Groups.....	151
Table 12- Condition B – Remediate - Cost Factors Data Set.....	155
Table 13 – Condition B- Cost Factors Data Set – Comparing Three Stakeholder Groups.....	158
Table 14 - Condition B – Remediate - Benefit Factors Data Set .....	160
Table 15 - Condition B - Benefit Factors Data Set – Comparing Three Stakeholder Groups.....	162
Table 16 – Cost/Benefit Analyses for Condition A and B Utilizing Mean Values – All Stakeholders .....	165
Table 17 - Cost/Benefit Analyses for Condition A and B utilizing Mean Values – Stakeholders by Group .....	167
Table 18- Sources of Information – Delphi Panel Data Set.....	169
Table 19 – Sources of Information – Comparing Among Stakeholder Groups ..	170



LIST OF TABLES (Continued)

Table 20 – Factors vs. Sources of information – Collective Responses of the Delphi Panel members.....	173
Table 21- Ranking Impact of Factor vs. Reliability of Sources of Information – Median Quadrant.....	174
Table 22- Impact vs. Reliability Quadrant.....	176

## LIST OF APPENDICES

<u>Appendix</u>	<u>Page</u>
Appendix A- Demographic Survey .....	206
Appendix B – Causal Model .....	224
Appendix C- Factors and Sources of Information .....	244
Appendix D – Impact of Factors and Reliability of Sources of Information.....	271
Appendix E – Glossary of Terms .....	286

## **1 Chapter One – Introduction**

### **1.1 Preface**

This chapter introduces brownfields as the topic of interest for this research. This research briefly introduces brownfield properties, the general problem statement, the significance and originality of this research and discusses anticipated results and the benefit of this research.

### **1.2 Brownfields Introduction**

Former industrial or commercial sites that are left unused are typically referred to as brownfield sites, or more simply, brownfields. Many communities have such properties that are left abandoned, sitting idle and often underused. Brownfield properties have a direct negative impact on local economies and can pose a serious threat to both human and the environmental health ([Schadler, Morio, Bartke, Rohr-Zanker, & Finkel, 2011](#)). Brownfields are not limited to large industrial or commercial properties. These sites are everywhere and can come in all shapes and sizes. A brownfield property can be as small as a gas station on a corner or an old dry cleaner in a neighborhood ([Haslam, 2009](#)), or as large as an industrial site in a rural area ([McCarthy, 2002](#)). Most brownfield properties are located in excellent business locations. For example, the properties have access to existing infrastructure and transportation ([Yount, 2003a](#)). Due to possible environmental liabilities and the fear of uncertainties associated with such properties, buyers, lenders and developers are hesitant to commit to redevelopment projects to turn the property around. Instead, buyers, lenders and developers look for sites with less financial risk and overlook the great potential associated with revitalized brownfield sites ([Graziano, 2004](#)). Owners

typically refuse to move forward with property transactions or even the idea of property reuse for the fear of being held responsible for cleanup costs and for creating a bad reputation in their community ([USDA, 2010](#)).

The sustainable redevelopment of brownfields can offer many economic, social and environmental benefits ([Bleicher & Gross, 2010](#)). Brownfields redevelopment can benefit human health and protect the environment once cleanup has been completed at such properties ([Benson, 1998](#)). Redevelopment projects can also have positive economic impacts on the communities adjacent to brownfield sites ([Ellerbusch, 2006](#)) and enhance local and regional municipal tax bases ([Chang, Sigman, & National Bureau of Economic Research., 2010](#)). Advocates for brownfields redevelopment believe site reuse can create and retain local jobs ([BenDor, Metcalf, & Paich, 2011](#)). Redeveloping underused brownfield properties can also help eliminate eyesores in communities and reduce crime rates, for example graffiti ("[Establishing Indicators to Evaluate Brownfield Redevelopment](#)," 2006; [Wedding & Crawford-Brown, 2007](#)). The redevelopment and reuse of abandoned and underutilized properties can help reduce the demand for building on undeveloped clean properties, thus preserving land. In addition, redevelopment allows new businesses the opportunity to expand on already existing sites with existing customer bases.

A neighborhood that is no longer exposed to potential contamination will reduce public concern regarding health risks and improve the overall perception of a property's environmental risk ([BenDor et al., 2011](#)). According to the Northeast Midwest Institute, if low-impact, sustainable, urban development practices are used for redeveloping brownfield sites, then water quality in adjacent rivers can be improved, runoff to groundwater can be recharged and energy efficiency can be increased. This will ultimately reduce air pollution and greenhouse effects ([NORTHEAST MIDWEST INSTITUTE, 2008](#)). Brownfields remediation and

redevelopment improves environmental quality and public health, creates new opportunities that benefit the environment and the public and can increase the local tax base ([Joel, 1999](#)).

### **1.3 General Problem Statement**

In 2012, the U.S. Environmental Protection Agency (EPA) identified brownfields as the number one environmental issue in the nation ([EPA, 2012](#)). The federal government's General Accounting Office estimates that there are more than 450,000 brownfield sites nationwide ([U. S. EPA, 2012](#)). The passage of the Small Business Liability Relief and Brownfields Revitalization Act of 2002, or the "Brownfields Law," has served as the foundation for the EPA's Brownfields Program. The legislation supports land revitalization efforts through funding environmental site assessment, cleanup and related job-training activities once a site has been remediated ([Bartsch, 2003](#)). The EPA's Brownfields Program continually measures progress and reports results in order to track the program's performance. The EPA's status report as of April 2013 is presented in Table 1.

Performance Measures	FY 2013 Targets	FY 2013 Accomplishments	Cumulative Accomplishments
Properties Assessed	1,200	1,174	20,327
Cleanups Completed	120	80	854
Jobs Leveraged*	5,000	6,880	87,095
Acres Made Ready for Reuse	3,000	2,956	38,976
Dollars Leveraged**	\$1.2B	\$0.5B	\$19.3B

Table 1 - Summary of Brownfields Program Accomplishment (EPA web site, April 2013)

The EPA status report suggests that since the program got its start in 2002, only 854 of the 20,327 brownfield sites that have been identified and assessed have completed the cleanup process. That means only 4.2 percent of the properties were cleaned. The data indicates that of the 1,174 brownfield sites assessed in 2013, only 80 sites completed cleanup. The large number of untreated sites and the slow progress of brownfield site poses a substantial threat to human health and the environment due to the existence of harmful substances at such sites. In addition, untreated properties can lose economic value over time and the potential to develop neighboring properties is threatened. Untreated properties can therefore suppress economic growth for entire communities ([EPA, 2012](#)).

Based on a study performed by the EPA to evaluate the agency's Brownfields Program, it was concluded that brownfield sites tend to have greater location efficiency because the property is typically located in an already-developed area

surrounded by established, residential and commercial properties. This is in comparison to a new location in an undeveloped area. Therefore, brownfields redevelopment can reduce vehicular miles traveled by 32-57 percent, thus reducing pollution and greenhouse gas emissions. The same site comparisons show an estimated 47-62 percent reduction for storm water runoff ([EPA, 2012](#)).

This research evaluates current processes for remedial action and brownfields revitalization to establish a set of factors that either inhibit or encourage brownfield property owners from redeveloping. One such factor that slows the rate of remediation is a brownfields property owners' perception of risk. This research study suggests strategies to relieve such factors to encourage brownfields revitalization.

This research focuses on brownfields in the state of Oregon as a case study for a problem that exists nationwide. Oregon is burdened by thousands of brownfield sites. According to a study performed by Metro, there are thousands of brownfield sites around the state ranging from large industrial sites to small former gas stations. ([Metro, 2015](#)).

#### **1.4 Originality and Significance of this Study**

The remediation process and key brownfields stakeholders with various roles in the revitalization process are studied and well known. However, the role of property owners and their perception of risk and the factors that affect property their remediation decisions are poorly presented and not very well understood. This research seeks to fill the gap. This research hypothesizes that brownfields property owners are primary decision makers in moving forward with remediation. Property owners perform an analysis, here conceptualized as a cost/benefit analysis, that makes for the foundation of the decision-making process to remediate a property or not. The originality of this research is that

property owners are included as the primary decision makers who directly influence the rate of remediation and ultimately decide whether remediation will occur or not. In addition, this research hypothesizes that 1) property owners' decision-making is an important factor of the rate of remediation; 2) there is a set of identifiable factors that influence a property owner's decision-making process, and 3) there are sources of identifiable information that property owners rely on to help them make their decision. A goal of this research is to determine the factors and sources of information that influence a brownfield property owner's decision-making process.

This research utilizes an expert panel, using a Delphi process, for an in-depth investigation and confirmation of the proposed hypotheses. Findings are analyzed and validated to suggest guidelines for more effective future practices. In addition, this research suggests alternative approaches to optimize brownfields revitalization.

The benefits obtained through expedited cleaning and reinvestment in these properties include:

- 1) Protecting human health and the environment.
- 2) Protecting the existence and enhancing the unique characteristics of communities by investing in sustainable, livable neighborhoods – rural, urban or suburban.
- 3) Providing economic benefits such as: increased local tax bases; facilitated job growth; existing infrastructure utilization, takes developmental pressures off of undeveloped open land (EPA publication, 2008); and
- 4) Providing social benefits to the community.



The Obama administration and Small Business Administration's (SBA) Office of Advocacy call small businesses the heart of the American economy ([SBA, 2013](#)). It is estimated that 22.9 million small businesses in the United States are located in virtually every kind of neighborhood-rural, urban and suburban. Small businesses also make up more than 99.7 percent of all employers and are responsible for creating 75 percent of the total new jobs in the economy ([Longley, 2014](#)). The General Accounting Office of the federal government estimates that there are more than 450,000 brownfields nationwide. In some reports, as many as one million brownfield sites are estimated to be in existence. Every single brownfield site has the potential to create an average of 10-20 jobs, both directly and indirectly. This translates to between 4 and 9 million jobs nationally.

There is a need to study and analyze the causal effects for low rates of brownfields remediation, and to provide suggested guidelines in order to expedite brownfields revitalization. The potential economic benefits of this effort are enormous.

## **1.5 Dissertation Structure**

This section outlines the structure of this dissertation on and describes the progression of this research project. The following is a brief summary of each chapter outlining the main objectives and outcomes.

Chapter 1 – provides an introduction to brownfields, the general problem statement for this research project, the originality of this research, the significance of this study and the expected results.

Chapter 2 – provides a literature review involving brownfields in order to gain a better understanding of the environmental regulations that pertain to brownfields, the current state of practice for brownfields remediation projects

and identify brownfields stakeholders and the role they play in brownfields remediation projects. The findings from this chapter contribute to the researcher's first hypothesis, which is that brownfield property owners are the primary decision makers in brownfields remediation projects.

Chapter 3 – provides a literature review on the topics of the “decision-making” process, cost/benefit analyses and perceptions of risk, with a focus on brownfield property owners' cost/benefit analyses and the factors that may affect the decision-making process. The findings from this chapter contribute to the second hypothesis of this dissertation.

Chapter 4 – utilizes the findings from Chapters 2 and 3 in order to examine brownfield property owners' perceptions of risk related to human health and financial liabilities. This chapter focuses on the factors influencing brownfield property owners' decision-making processes and looks into the possible sources of information that property owners consult when making a decision to remediate their property or not. The findings from this chapter contribute to two additional hypotheses in this dissertation.

Chapter 5 – provides a literature review on survey methodologies in general, and examines opinion-based surveys specifically. The researcher looks into the advantages and disadvantages of opinion-based survey methodologies and selects the most appropriate methodology for the purpose of this research based on the findings in the literature review.

Chapter 6 – provides a comprehensive understanding of the Delphi methodology through a focused literature review. In addition, this chapter outlines the research structure for this dissertation using the Delphi technique.

Chapter 7 – provides a detailed step-by-step implementation of the Delphi technique. The researcher provides detailed information regarding the

demographic survey that will help select the Delphi panel members for this research project.

Chapter 8 – provides information related to testing the first and second hypotheses of this dissertation, which utilizes the opinions of the Delphi panel.

Chapter 9 – provides information on the implementation of the third survey in order to verify the third and fourth hypotheses proposed in Chapter 4. The main objective in this chapter is to develop a comprehensive list that contains the factors and sources of information that influence a brownfield property owners' cost/benefit analysis.

Chapter 10 – provides information on the implementation of the fourth survey that indicates the Delphi panel members' opinions regarding the level of impact each factor and source of information has on the a property owners cost/benefit analysis. The results obtained from this survey will be analyzed statistically in order to obtain objective results that indicate the possible causes for the slow rate of brownfield remediation projects.

Chapter 11 – concludes the various findings from this research, the originality and contribution of this research, as well as provides suggestions and recommendations for brownfield remediation projects based on findings from this research. In addition, this chapter provides recommendations for future studies pertaining to the field of brownfields.

## **1.6 Research Results**

The research results include a better understanding of a brownfield property owner's decision-making process. This better understanding will shed light onto the perceptions of risk associated with brownfields and the causal effects of the slow rate of property transaction and revitalization. Findings from this research

reveal opportunities to help regulators, professionals, and property owners make better decisions regarding brownfields revitalization and property transactions.

## **2 Chapter Two - Understanding Brownfields**

### **2.1 Preface**

The purpose of this chapter is to provide a summary of the literature review and to provide the reader with enough information to understand brownfields, issues related to brownfields, key stakeholders and the key factors affecting brownfields revitalization projects.

### **2.2 Introduction**

It is important to first understand the causal effects of a slow cleanup and the slow rate of revitalization pertaining to brownfield properties. This section focuses on a literature review that will help define, provide an understanding of and introduce a model of the current state of brownfields revitalization projects. The first part of the literature review focuses on the environmental and technical background of brownfields redevelopment, the environmental regulations that have advanced since inception and the effects of brownfields revitalization processes and responsible parties. This section will present steps in the brownfields revitalization process, identify federal and state programs and initiative in place that promote cleanup and redevelopment and pinpoint key stakeholders and their roles in the revitalization process. This section will conclude with a flow chart model of the revitalization process.

### **2.3 Brownfields Technical Background**

Section 101 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) define a brownfield site as "a real property; the expansion, redevelopment or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant or contaminant" ([EPA, 2007](#)).

Adequate information is needed to identify brownfield properties within a community and in order to determine if such sites are of environmental concern. An appropriate environmental site assessment can be performed to identify potential risks to human health and the environment ([Buonicore & Crocker, 2004](#)). In many cases, assessments demonstrate that human health risks are low or non-existent at a given site. Once the environmental issues are identified and measured, communities can begin to address other problems associated with these properties ([Graziano, 2004](#)).

According to Schadler, stakeholders who are considering brownfields redevelopment must face the fear of how to address perceived or real risks associated with such properties ([Schadler et al., 2011](#)). Identifying the degree of risk associated with contamination and proposing reasonable solutions that are acceptable by regulatory agencies often require technical skills related to environmental assessment and cleanup. In most cases, property owners or potential buyers cannot afford the high cost of hiring a consultant to assess risk, estimate the cleanup costs and the potential extent of financial liability ([Aker, 2009](#)). Because of this, these sites often remain undeveloped, underutilized and in some cases, vacant ([Addlestone, 2004](#)).

Regardless of the potential benefits brownfields redevelopment projects offer to communities and the local economy, the real challenge of brownfields revitalization is the cleanup which must occur in accordance to redevelopment goals. Such goals may include cost-effectiveness, timeliness of remediation, as well as construction and avoidance of adverse effects to site structures and neighboring communities ([McCarthy, 2002](#)).

The increased awareness about the existence of many brownfield sites can be attributed to strict federal liability provisions that were enacted to stop the irresponsible discharge of pollutants to the environment. These provisions hold

entities to very strict liability standards, which affect all properties not just brownfields. These standards hold the owners of properties liable, even those property owners who were not responsible for the pollution ([Mayors, 2006](#)).

The following sections provide a chronological summary of brownfields-related environmental regulations.

### *2.3.1 History of Brownfields Regulation*

Through federal legislation such as the Superfund Act, the EPA has been the leading environmental regulator at sites contaminated with hazardous materials ([Germannano, 2011](#)). However, recent changes in regulations have decentralized this power from the federal to the state and local agency level. Development of environmental policies over the past four decades have favored brownfields revitalization ([Addlestone, 2004](#); [Collin, 2006](#)). One of the major accomplishments in the encouragement of brownfields reuse is the development of voluntary cleanup programs within the majority of the states. Such cleanup programs engage the private sector with regulators as partners, rather than adversaries ([ODEQ, 2005b](#)). It is important to understand the role of federal and state legislation in the success and failure of brownfields cleanup and redevelopment projects. This section presents a timeline and summary of the environmental regulations relevant to brownfields.

#### *2.3.1.1 Resource Conservation and Recovery Act (RCRA)*

The Resource Conservation and Recovery Act (RCRA) is the principal federal law governing the handling, treatment and disposal of hazardous waste at active sites to protect human health and the environment from potential hazardous waste releases. The law was enacted in 1976 and has been evolving since then ([Addlestone, 2004](#)). The RCRA regulates the management of solid waste (for

example, garbage), hazardous waste and underground storage tanks containing petroleum products and other chemicals ([EPA, 2004](#)).

The RCRA contains provisions (40 CFR Part 264 Subpart S and Part 264.10) ([EPA, 2004](#)) which are related to conducting corrective actions that govern the cleanup of hazardous wastes released at RCRA-regulated facilities. The provisions are important, as they keep property owners liable for cleaning up any release that may occur as a result of improper operation. Initially, the RCRA applied only to active hazardous waste sites and did not require any remedial action for hazardous releases that occurred prior to the passage of the RCRA. This deficiency was addressed a few years later with the initiation of the Superfund Law ([Collin, 2006](#)).

Although the RCRA is a federal statute, many states implement the RCRA program. Currently, the EPA has delegated its authority to implement various RCRA provisions in 46 states ([Addlestone, 2004](#)).

Additional laws have since come into effect to address important issues such as financing brownfields redevelopment projects.

### *2.3.1.2 Community Reinvestment Act (CRA)*

The Community Reinvestment Act (CRA) was passed in 1977 ([EPA, 1997](#)). The legislative intent behind the CRA was to provide incentives for brownfields redevelopment. This act was intended to force lenders to provide capital to low- and middle-income borrowers who live on or adjacent to brownfield properties. However, many borrowers took the “easy” money and invested in less expensive, more convenient suburban and rural properties. A lack of proper provisions in the CRA law did not address the pressing need to redevelop brownfields in urban areas until further amendments were enacted ([Cleveland, 2003](#)).



### *2.3.1.3 The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or the Superfund*

The CERCLA regulations were initiated in 1980 as a response to the environmental catastrophe of Love Canal ([EPA, 2011](#)). The CERCLA, also known as the Superfund Act, sought to address existing contaminated properties that previous regulations failed to address, which included brownfield properties. As stated in Section 2.1, the CERCLA defines a brownfield site as "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant" ([EPA, 2007](#)).

Instead of creating a standard regulatory program, the CERCLA imposed a system of strict liability for contaminated properties and focused on forcing the polluters to pay ([BenDor et al., 2011](#)). The law created a tax on the chemical and petroleum industries as a funding source to clean up abandoned and uncontrolled hazardous waste sites. Individual states also responded to concerns about contaminated sites by passing individual versions of the CERCLA. Congress actively supported these states in taking a more defined role in CERCLA-type cleanups ([Buonicore & Crocker, 2004](#)).

Currently, both federal and state agencies oversee the assessment and cleanup of contaminated sites. Related federal regulations are administered by the EPA and governed by the CERCLA statute. Additionally, states have followed the EPA model to establish their own CERCLA-type regulations. The CERCLA in theory could apply to every contaminated site in the country with excessive contaminants, according to federal or state standards. However, in practice, the CERCLA addresses only the most contaminated and complex sites, for which the cost of cleanup is high ([EPA, 2011](#)).

The potential financial and legal liability imposed by the CERCLA caused brownfield property owners and potential investors to be reluctant about the idea of redeveloping a site that may have contamination problems ([Joel, 1999](#)). As a result, many of the sites with uncertain environmental pollution statuses became underutilized or were abandoned. In response to this underutilization issue, the majority of states created some form of voluntary cleanup program that created a more collaborative and less legally-combative environment for responsible parties and regulatory agencies to work together to address environmental liabilities ([ODEQ, 2005b](#)). Typically, voluntary cleanup programs deal with low-impact properties. In exchange for voluntary remediation of a brownfield site, the state virtually eliminates any potential threat of liability for an interested party under the CERCLA ([United States. Environmental Protection Agency. Office of Brownfields Cleanup and Redevelopment., 2005](#)).

While the creation of state voluntary cleanup programs addressed some properties that the CERCLA would otherwise not consider, many contaminated properties were still being ignored due to a lack of resources from federal and local government agencies ([EPA, 2007](#)).

#### *2.3.1.4 The Superfund Amendments and Reauthorization Act (SARA)*

The CERCLA was amended in October 1986 to reflect the EPA's experience administering the Superfund program during the prior six years. The new amendment made several important changes to the CERCLA, including the community's "right-to-know" protocol, which applies to industrial waste management practices and encourages citizens to participate in the decision-making processes concerning how sites should be cleaned up. This provision, known as the Superfund Amendment and Reauthorization Act (SARA) Title III, or the Toxics Release Inventory, required a biennial report from the industry concerning the emissions and management of regulated chemicals ([Yount,](#)

[2003b](#)). The SARA also increased the budget available for federal cleanup and brownfields redevelopment projects([NORTHEAST MIDWEST INSTITUTE, 2008](#)).

The development of environmental regulations from 1976 up until the enactment of SARA in 1986, has established the foundation for brownfields regulation. The passage of an important piece of legislation in 2002 opened the door for a new era of brownfields revitalization.

#### *2.3.1.5 The Small Business Liability Relief and Brownfields Revitalization Act of 2002 – Brownfield Law*

The Small Business Liability Relief and Brownfields Revitalization Act, or the Brownfield Law, was in response to the Superfund Act, which forced industries to pay for toxic spills and pollution. On January 11, 2002, President George W. Bush cited in his address that "American cities have many such eyesores; anywhere from 500,000 to a million brownfields are across our nation." ([Bartsch, 2003](#)).

Under the CERCLA, both current and past owners and operators of contaminated properties were held strictly liable for cleaning up hazardous substances. Strict liability under the CERCLA means that liability for environmental contamination may be assigned based solely on property ownership.

Alternatively, the Brownfield Law was created to put an end to the excess regulations and litigations many developers and property owners were experiencing during the revitalization process for rundown commercial and industrial properties. The Brownfield Law is designed to encourage states, communities and other stakeholders to work together in a timely manner to prevent, assess, safely clean up and sustainably reuse contaminated or formerly contaminated properties ([Pennsylvania Bar Institute., 2002](#)).

The Brownfield Law provides financial assistance to brownfields revitalization through the acceptance of smaller payment amounts and alternative payment methods that would otherwise not be allowed. In addition, the Brownfield Law alleviates parties with properties adjacent to brownfield sites that may contain hazardous wastes from the liability for which they would have previously been held accountable. Additionally, a property owner whose groundwater has been contaminated by the migration of chemicals from an adjacent brownfield site is exempt from the requirement of installing a remediation system and further inspection under the Brownfield Law. Innocent landowners are protected from liability as long as they fully cooperate with regulatory agencies and necessary cleanup efforts ([Wiegard, 2003](#)).

Upon the passage of the Small Business Liability Relief and Brownfield Revitalization Act, landowners became responsible for proceeding with "all appropriate inquiry," which includes inquiring with previous land owners about the nature of the property and its former uses ([Graziano, 2004](#)). In order to carry out an all-appropriate inquiry, the current landowner must take the necessary steps toward protecting human exposure to contaminated areas on the property and salvaging any natural resources impacted by the contamination. Finally, the Brownfield Law requires that an EPA administrator make any information regarding contamination on the property publicly available within two years of discovery ([Buonicore & Crocker, 2004](#)).

The Brownfield Law is the latest piece of legislation that has been established regarding brownfields redevelopment and has been practiced by virtually all stakeholders since 2002. The purpose of the next section is to assess the programs that the EPA and the state of Oregon have established in order to support brownfields revitalization projects.

### *2.3.2 Brownfields Initiatives*

Early federal regulatory approaches discouraged property owners and private parties from becoming involved with brownfields remediation and redevelopment. The fear of liability and expensive cleanup costs are often the main reasons so many brownfield sites are left unused ([Kris Wernstedt, 2004](#)). Brownfield sites often pose risks to public health and the environment and suppress the local economy. As a result of the widespread national problem that these properties create, federal and state agencies have put initiatives in place to facilitate redevelopment for contaminated properties. Among these initiatives are the EPA's grant funding and revolving loans for the assessment and cleanups of brownfields. State programs, such as voluntary cleanup programs and risk-based closure initiatives, help facilitate brownfield revitalization ([K. Wernstedt, Blackman, Lyon, & Novak, 2013](#)). The following sections will provide a summary of existing programs.

#### *2.3.2.1 Federal Initiatives*

The EPA Brownfields Initiative Program began in the mid-1990s. The program is typically a partnership that promotes redevelopment and involves federal, state and local agencies and developers/property owners. Considering the economic, social and environmental benefits brownfields revitalization projects reap, a need to develop tools that expedite revitalization arises ([Lange & McNeil, 2004](#)). Since the passage of the Brownfields Law in 2002, the EPA has awarded millions of dollars in assessment grants to allow developers to capitalize on revolving loan funds and cleanup grants. In turn there are potential widespread environmental and economic benefits from these federal initiatives ([EPA, 2012](#)). The EPA's brownfields initiatives are focused on four goals: 1) to provide grants for assessment and pilot projects; 2) to clarify liability and cleanup issues; 3) to

build partnerships and outreach among federal agencies, states, tribes and other entities and 4) to foster local job development and training initiatives. The EPA plays an administrative role in overseeing the treatment and financial distribution of funds among states and local government agencies associated with brownfields revitalization ([Dorsey, 2009](#)).

### *2.3.2.2 Oregon's Brownfields Initiatives*

The state of Oregon has been a pioneer in environmental regulation advancement since 1951, when the first piece of environmental legislation was enacted to regulate air pollution. The Oregon Department of Environmental Quality (ODEQ) has been on the forefront for providing guidance, facilitating regulatory processes and expediting revitalization through incentives to property owners and potential buyers and developers. The most important incentives are voluntary cleanup programs, prospective purchaser agreements and site closures based on human health risk assessment ([Landman, 2005](#); [ODEQ, 2005a, 2005b](#)).

#### *2.3.2.2.1 Voluntary Cleanup Program*

The ODEQ's Voluntary Cleanup Program is a state program that promotes a partnership between liable parties and the DEQ. The program offers two options for contaminated property owners and operators to voluntarily investigate and, if necessary, clean up the contaminated site. The first option is a standard Voluntary Cleanup Pathway (VCP) and the second option is an Independent Cleanup Pathway (ICP).

Both options offer flexibility and allow for a more efficient investigation and cleanup that will ultimately facilitate contaminated property reuse, sales, refinancing and redevelopment, all while protecting human health and the environment ([ODEQ, 2005b](#)).

#### 2.3.2.2.2 Prospective Purchaser Agreement (PPA)

A Prospective Purchase Agreement (PPA) is a legal agreement that protects a prospective buyer of a hazardous waste site from the liabilities associated with pre-existing contamination at such sites. In return for liability protection, the buyer must agree to support environmental and/or community interests. This entails performing cleanup activities, reimbursing the state or federal regulatory agency for a portion of the cleanup costs, creating jobs, revitalizing the property and participating in community revitalization projects ([Landman, 2005](#)). PPAs often integrate redevelopment plans into the cleanup activities at the site and ensure the long-term maintenance and operation of the cleanup. The PPA program also helps the purchaser manage liabilities associated with existing site contamination; however, it does not provide protection from the liabilities associated with new contaminant releases after the purchaser or lessee acquires the property. A PPA is only put into effect if it is negotiated with the DEQ before the purchaser or lessee signs a legal agreement with the property owner ([ODEQ, 2005a](#)). The PPA agreement is a means of liability management for prospective buyers and is an important tool to help secure financing for the redevelopment of brownfield sites ([Germano, 2011](#)).

#### 2.3.2.2.3 Human Health Risk-Based Closure

The original cleanup regulations required that groundwater cleanup goals be equal to that of drinking water standards. For example, the chemical levels in groundwater should not exceed that of the drinking water Maximum Contaminant Level (MCL) ([Larence J., 1993](#)). This strict cleanup goal was deemed unachievable due to the difficulty in attaining an accurate measurement for some contaminants and a lack of available treatment technologies. In some

cases the cost of treatment outweighed the public health benefits ([Hackney & Massachusetts Continuing Legal Education Inc. \(1982- \), 2008](#)).

If it can be demonstrated that the groundwater in question will never be used for drinking water purposes, the DEQ permits the use of an alternative test. Rather than MCLs, the DEQ allows for Risk-Based Cleanup (RBC) goals for groundwater during brownfields remediation. RBCs, whether for soil, groundwater or air, use information about human and ecological receptors and determine whether receptors are actually exposed to a contaminated media at a particular site ([Whelan, Wessex Institute of Technology, & Università di Siena, 2004](#)). To further explain the use of regulatory human health risk-based decisions in regards to contaminated groundwater, it should be noted that although site groundwater may be contaminated, if human and ecological receptors never come into contact with the chemicals in that groundwater, then no exposure occurs and the human health and ecological risks are zero. This situation can occur if contaminated groundwater is not currently used for drinking purposes nor is it expected to be in the future. This could be due to the presence of a regional water supply - making for human health risks due to groundwater exposure zero. Also, if groundwater does not flow into a surface body of water then the ecological risks are zero ([Karachaliou & Kaliampakos, 2008](#)).

The ODEQ published, Risk-Based Decision Making for the Remediation of Petroleum-Contaminated Sites in 2003 ([DEQ, 2003](#)), along with a table of the RBCs used to screen potential human receptor risks. The RBC table is updated every one or two years and has since been expanded to include additional chemicals and a number of other DEQ guidance documents related to risk-based decision making that need to be considered. Some of these documents include



those that address ecological risk, human health risk, beneficial land and water use and hotspot concentrations of contaminants ([Bogen, 2006](#)).

In risk assessment terms, an exposure pathway consists of a point of release of the contaminant, transport of that contaminant to a medium which can be directly encountered by a human or ecological receptor. When an actual contact of that medium by a receptor happens, it is called an exposure route (such as ingestion or inhalation) by which the receptor absorbs the chemicals present in the contaminated medium. If all of these exposure pathway steps are present, then the pathway is considered complete, and unacceptable risks are likely to occur to the receptor. If any portion of an exposure pathway is incomplete, then direct uptake of a chemical by a receptor will never occur, and no unacceptable risk will be present ([DEQ, 2003](#)).

Risk assessment and risk-based closure of a site play extremely important roles in identifying and minimizing the amount of effort and money required to remediate a brownfield site ([Collin, 2006](#); [Joel, 1999](#)). It is important to engage an experienced risk assessor who will be able to recognize complete and incomplete exposure pathways and utilize this information to demonstrate and quantify the degree of health risk present at a site, and assist the owner or developer in identifying ways to minimize or avoid any current or potential future health risks to human or ecological receptors ([Donati, Rossi, & Brebbia, 2004](#)).

Utilizing the human health risk-based decision-making process will expedite the redevelopment of brownfield sites by providing a way to quantify potential risks to human receptors from existing site contamination. This will in turn allow focused choices to be made in regards to cleanup options due to the fact the contamination that causes unacceptable risk is a critical part of redevelopment ([Frantzen, 2002](#)).

Federal and state regulations are the primary driving force behind the cleanup of contaminated properties. The EPA and state of Oregon offer initiatives that facilitate redevelopment and manage environmental and financial liabilities associated with brownfields. However, there are many other factors that influence the brownfields revitalization process. The next section will introduce the current state of the practice and stakeholders who are involved and the proper chronological steps that need to be taken in order to redevelop a contaminated property.

### *2.3.3 Current Practices for Brownfields Revitalization*

Past businesses' improper disposal and handling of hazardous materials have resulted in soil, water and air contamination for tens of thousands of sites across the nation. Some of the more common categories of contaminants include industrial solvents, petroleum products, metals, pesticides, bacteria and radiological materials. Exposure to these contaminants can threaten human health as well as the environment. In addition, both real and perceived liabilities have resulted in the hindering of economic growth and the vitality of local communities adjacent to contaminated sites. Since the 1980s, a set of guidelines and general practices have been developed by federal and state agencies that help brownfields decision makers with the assessment, treatment technology selection and environmental risk evaluation of contaminated sites ([Wiegard, 2003](#)). The brownfields redevelopment process can be accomplished simultaneously with construction activities. The redevelopment process generally occurs in four major steps: 1) pre-development; 2) property transaction and liability management; 3) cleanup and redevelopment and 4) business development and property management. These steps and the sequence of implementation are presented in Figure 1 and further details are presented in the following sections.

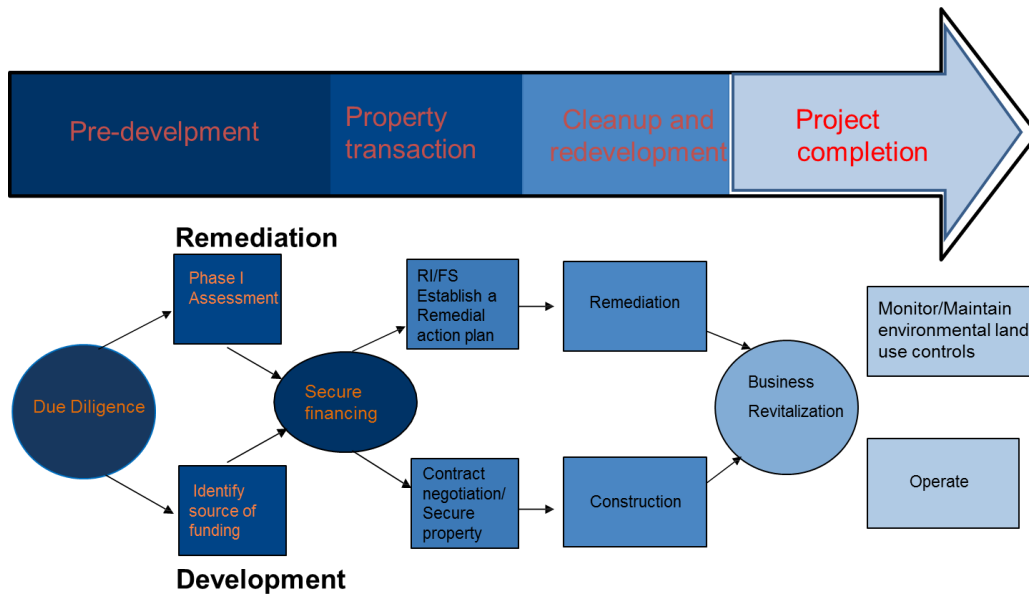


Figure 1 - The Integrated Brownfields Remediation/Redevelopment Process.

### 2.3.3.1 Pre-development

Prior to purchasing a former commercial or industrial site for development, a diligent effort is necessary to learn about the past practices and the potential reuse options for a given site ([Graziano, 2004](#)). Pre-development planning and investigation is an important phase of brownfields redevelopment. This step can reveal the presence of any environmental concerns and possible financial risks associated with a property. Investigation can also provide insight about the potential financing and funding resources available ([Buonicore & Crocker, 2004](#)).

#### 2.3.3.1.1 Phase I Site Assessment

A Phase I Site Assessment includes researching land uses and building titles for a property. Phase I Site Assessment also involves communication with key stakeholders to understand previous and potential future uses of a property. The best use from a developer's perspective may differ from what the community

considers to be the best use of a particular property. Potential contamination on the property may present obstacles to the developer's preferred and best use of the property ([Buonicore & Crocker, 2004](#)). Phase I Assessments will identify the presence, type of and possible extent of contamination on a given property. This is essential for evaluating risk, managing liability and determining appropriate reuses for the property. A Phase II Assessment will also provide the framework for developing a remedial action plan ([BenDor et al., 2011](#)).

A market analysis is also essential for evaluating local and regional economic and real estate conditions. The analysis can characterize the market demand for various real estate products. A proforma analysis may also be done to determine the economic viability of a redevelopment project ([Whitman, 2006](#)).

#### 2.3.3.1.2 *Identify Sources of Financing*

A combination of private- and public-sector funding may be used to finance site assessments, purchase sites, remediate sites and redevelop sites ([Steeler & Hayes, 2009](#)). There are federal and state government programs available for interested parties that offer site assessment and cleanup assistance. In addition, federal and state tax credit and tax abatement programs are available ([BenDor et al., 2011](#)).

Municipal economic development agencies and/or state brownfields programs are likely sources of information for brownfields redevelopment finance.

Due diligence information collected during the pre-assessment phase is essential for proper decision-making in regards to financing during the property transaction process and overall risk management ([Aker, 2009](#)).

### *2.3.3.2 Property Transaction and Liability Management*

Once a decision is made to continue with the project and pre-development activities have been completed, the steps related to securing the deal and managing possible environmental liabilities associated with a brownfields site can begin. These steps are described briefly below:

#### *2.3.3.2.1 Contract Negotiation Between Buyer, Seller and Regulatory Agency - Liability Management*

The first step in purchasing a brownfield site is to enroll in a PPA with the state's regulatory agency. PPAs serve to protect the prospective buyer from liabilities associated with past contamination/releases at a property. These agreements open the door for the next steps, which include managing environmental liability and contract negotiation with the property owner and an involved regulatory agency that acts as an overseer ([Landman, 2005](#)).

A "term sheet" is often used during contract negotiations to identify the responsibilities that the buyer and seller will each agree to during the property transfer. If the property has existing buildings that will be reused, for example, then repairs become a negotiation term documented in the term sheet. Other negotiations included in a term sheet include determining whether the buyer or seller will be responsible for remediation, deciding who will manage the liability once the redevelopment is completed, establishing who is liable for specific pieces of the cleanup and agreeing on long-term responsibility for the upkeep of remediation and/or institutional controls ([BenDor et al., 2011](#)).

This agreement provides a liability cap for the amount of financial responsibility that is associated with a brownfield site for the new owner and any future owners. This eases the difficulty of the next step, which is financing redevelopment.

#### 2.3.3.2.2 Secure Financing for Redevelopment

Typically, it is difficult to secure financing for brownfields projects through conventional banking. Because of this, developers are faced with the challenge of securing financing for property redevelopment through other means. All private and public funding sources identified in the pre-development phase should be secured. For example, loans and grants (Steeler and Hayes, 2009). In many cases, debt financing is utilized, which involves securing loans through a conventional financial institution. Private investors can also be used for portions of redevelopment. For larger developments, the money can be secured through private or public funding sources ([BenDor et al., 2011](#)). For smaller sites, the challenge is significant, as the cost of environmental remediation may exceed the value of the property. As stated earlier, since the inception of the Brownfields Law, federal and state governments have developed programs and allocated funding sources for brownfields ([Ackerman, 2001](#)). Unfortunately, the majority of the budget has been used primarily to locate and identify brownfield sites. Only a fraction of the budget has been spent on the remediation and redevelopment of brownfields ([Alexander, 2012](#)).

Once the money is available, it is important to hire a knowledgeable consultant to start a plan of action for site cleanup and contaminant removal.

#### 2.3.3.2.3 Establish a Remedial Action Plan

The remediation costs related to redevelopment must be quantified as completely as possible in order to expedite the property transfer from buyer to seller. Therefore, it is typical for a property to be completely assessed and characterized so a remedial action plan can be put into place by either the buyer or the seller ([Schaedler, Morio, Bartke, & Finkel, 2012](#)).

In most cases, the cleanup is expected to be done by Potential Responsible Parties (PRPs). However, when the PRP is unable to meet financial obligations, then the EPA, other federal agencies, states or municipalities can step in to assess impact and implement a corrective action to minimize environmental threat ([Chang et al., 2010](#)).

The feasibility of using one remediation technology over another for a given site is based on the site's characteristics and how efficient and cost-effective a particular technology is in addressing the risks associated with contamination. Current practices for remediation are subject to the decision-maker's judgment/point of view and the various stakeholders who have diverse ways of managing liability and may have different roles in respects to remediation and the end goals. Therefore, the final decision is subject to the differences of opinion among stakeholders. For example, a banker, a developer and a regulator will have points of view that are different from those of a property owner or potential buyer ([Lange & McNeil, 2004](#)).

Remedial action plans typically include feasibility studies. The main purpose of a feasibility study is to provide guidelines in which the best remedy is selected for the purpose of managing risk. This remedial selection process will ensure that statutory and administrative rules and requirements are met, provide the public with an opportunity to offer comments on proposed remedies and allow the decision makers to select and approve the most appropriate remedy for contaminated sites. State and federal guidelines for conducting feasibility studies are available ([Lange & McNeil, 2004](#)).

The state of Oregon requires that a feasibility study be conducted by a PRP when a baseline risk assessment of a contaminated site determines an unacceptable risk to human health or the environment. The main goal of a feasibility study is to develop and evaluate a range of remedial action alternatives from the most

passive (inexpensive) to the most aggressive (expensive) option. Typically, this range includes a no-action alternative, which evaluates baseline conditions, an alternative action utilizing engineering and institutional controls, a treatment-based alternative, an aggressive alternative action utilizing excavation and offsite disposal. A combination of these options is often utilized for further evaluation and selection of the most appropriate one for a given site ([DEQ, 1998](#)).

Usually a consultant with extensive knowledge of the state and/or federal regulations and requirements is hired by the PRP, typically the owner or operator of the contaminated site, to perform the feasibility study after the remedial investigation is completed. In most cases, federal oversight is not required unless the contamination is hazardous waste or the site is a Superfund site listed on the National Priority List (NPL) as CERCLA sites ([Reisch & Bearden, 2003](#)).

Oregon's Environmental Cleanup Law requires the feasibility of the remedial action alternatives to be assessed based on a balance of five remedy selection factors which include: effectiveness; long-term reliability; the ability to implement; implementation risk and cost reasonability ([DEQ, 1998](#)).

#### 2.3.3.2.4 *Secure the Property*

If the property is not owned by the entity performing the cleanup and redevelopment, it can be obtained through a sales agreement or through a process like a foreclosure. During the formal commitment process, contracts and documents are signed and exchanged. Once this commitment is obtained, any zoning changes or variances that may be required should be pursued as soon as possible. For example, changing the property zone from industrial to commercial ([Simons & Urban Land Institute., 1998](#)).



### *2.3.3.3 Concurrent Cleanup and Redevelopment*

It is anticipated that remediation and cleanup of a contaminated property have to be completed before the redevelopment of a site occurs. In most cases, remedial and construction activities can be integrated by project engineers in order to move the redevelopment process forward efficiently. The success of this approach will depend on the owner of the brownfield site's ability to understand and plan for necessary assessment activities, cleanup actions and stakeholder input. The ability to streamline this process is based on ensuring that all issues are resolved up front, so that redevelopment activities can run smoothly.

Resolution of outstanding issues is an important consideration as construction delays may cause significant increases in redevelopment costs ([Sarni, 2010](#); [Schaedler et al., 2012](#)). The risk associated with potentially unacceptable exposure to human receptors can be controlled through the use of appropriate new remediation technologies and state-of-the-art monitoring systems. For many brownfields projects, cleanup and redevelopment can occur simultaneously, saving time and money ([Donati et al., 2004](#); [Gerrard, Foster, & American Bar Association. Section of Environment Energy and Resources., 2008](#)).

#### *2.3.3.3.1 Engaging the Community to Explore a Property's Reuse Potential*

The entity responsible for property redevelopment can choose to engage with the local community about exploring different ways in which the property can be reused ([Gallagher & Jackson, 2008](#)). Encouraging this kind of collaboration may facilitate buy-in and support from the local community during the redevelopment process. Community engagement can be initiated through approaches such as door-to-door visits, passing out informational documents or holding community meetings. The owner of a brownfield site should have a fairly accurate idea of how the community will respond to redevelopment plans before engaging the community directly. This knowledge will help the entity

responsible for redevelopment with providing concerned community members with the most appropriate and relevant ([Deborah A. Lange, 2004](#)).

#### *2.3.3.4 Project Completion and Closure Pathway*

A brownfields project may be considered ""successful" once: 1) construction is complete, 2) ownership and leasing transactions are finalized and 3) the site is occupied and operating under planned reuse activities. It may be beneficial to publicly celebrate the formal opening of the redeveloped site by inviting neighbors, project brokers and elected officials to view the property once construction is completed ([Wedding & Crawford-Brown, 2007](#)).

##### *2.3.3.4.1 Sale, Lease or Business Development*

Typically, leasing occurs once the construction schedule is determined. That is, after construction is complete, the property may or may not be sold. A property redeveloped for commercial use may be leased on a long-term basis, or the property owner may decide to change the use of the property to a more community-based business.

##### *2.3.3.4.2 Long-Term Property Management after Remediation*

Some remedial actions require long-term operation and maintenance. For example, the operation of pump-and-treat systems for the treatment of contaminated groundwater. In these cases, the property owner may also be responsible for submitting periodic monitoring reports to the regulatory agency overseeing the project ([Maltby, 2009](#)). In addition, engineering and institutional controls are commonly used on brownfield sites to restrict property access or use. Examples of engineering controls include the placement of asphalt caps to prevent contact with underlying soil or fencing that restricts the access to impacted media ([Hula, Reese, & Jackson-Elmoore, 2012](#)). These types of

controls, however, will need to be inspected on a regular basis over time to ensure they remain protective of human health and the environment. Examples of institutional controls include deed restrictions or property easements ([Edwards & American Bar Association. Section of Environment Energy and Resources., 2012](#)). These types of controls require continued attention from the property owner and will need to be transferred to a new owner if the property is sold.

#### 2.3.4 *Conclusion*

The process of brownfields redevelopment is certainly more involved than regular site development, which typically takes place on uncontaminated properties. There are a larger number of stakeholders who need to work closely as a team to make a brownfields redevelopment project successful. Each of the steps in brownfields revitalization is well defined, and assumes that decisions are made when all stakeholders come to a consensus to move the process forward, thus enabling successful redevelopment. There are multiple guidelines provided by federal and state regulatory agencies that help owners and stakeholders make technical decisions throughout the process - from initial site assessment to the selection of remediation technologies. Despite the fact these tools are readily available to involved parties, the slow rate of brownfields redevelopment is still an issue and needs to be investigated. The purpose of the next section is to provide a better understanding of the stakeholders who are involved in brownfields remediation projects and their role in the decision-making process concerning brownfields redevelopment projects.

## 2.4 Parties Involved in Brownfields Revitalization

Brownfields revitalization usually relies on the collaboration among stakeholders. There are multiple stakeholders who are involved with brownfields revitalization, and their level of risk acceptance plays a major role in moving ahead with property transactions, funding, cleanup and redevelopment projects. Successful development of brownfields can be accelerated when stakeholders share a common goal ([EPA, 2006](#); [Lange & McNeil, 2004](#)). Stakeholders who want to be a part of the real estate development process can be categorized into four major groups, based on certain roles and interests. The four major groups include: public sector; private sector and supporting parties; federal and states regulatory agencies and property owners ([EPA, 2006](#); "[EPA issues status reports on brownfield projects](#)," 2006).

### 2.4.1 *Public Sector*

Local governments, community groups, EPA grant recipients and nonprofit organizations are the most common public-sector entities ([EPA, 2006](#)). This sector is concerned with brownfields redevelopment from a community and economic development perspective. The public sector is also concerned with how local governments and communities can play a critical leadership role in the revitalization process ([McCarthy, 2002](#)). Local governments and community leaders generally want to return abandoned or idle sites to productive states in order to increase tax revenues, stimulate the local economy, prevent or reduce urban blight, improve the quality of life and conserve valuable unused properties ([Bogen, 2006](#)). In many cases, local governments and communities may serve as project catalysts by acting as intermediaries to the state government. In other instances, local governments and communities simply make sure that proposed

site reuse plans meet the local government and community's current and future economic, social and ecological needs ([Hynes & Lopez, 2009](#)).

Community leaders bring local residents to the table during the planning process for the revitalization of potentially contaminated sites ([Cleveland, 2003](#)). Doing so benefits the project in several ways:

- Integrating neighborhood interests and concerns into the revitalization process helps the community develop a sense of ownership and pride. This can ensure a successful revitalization effort and community support ([United States. Environmental Protection Agency. Region I., 2002](#)).
- Familiarizing local residents with community development and public administration issues facing the community enables them to participate more freely with local government officials and private sector partners ([Gallagher & Jackson, 2008](#)).
- Knowing the community's needs and wants can help the stakeholder team shape the revitalization approach accordingly and prevent future disagreements ([Gallagher & Jackson, 2008](#)).

#### 2.4.2 Private Sector

The private sector is composed of resources that help develop brownfields. These resources include investors, lenders and developers tasked with the purpose of generating economic growth and earning an appropriate return on investment ("[Establishing Indicators to Evaluate Brownfield Redevelopment, 2006](#)"). The private sector also includes the service companies that are responsible for providing the necessary expertise to plan, design and implement remediation and redevelopment projects, as well as lawyers and insurers who

manage the liability and risks associated with brownfields ([Guevara & Deveau, 2013](#); [Neuman, 2007](#)).

### *2.4.3 Federal and States Regulatory Agencies*

The EPA plays an important role in providing funds, technical assistance and resources to state and local government agencies for the purpose of coordinating efforts to move brownfields redevelopment efforts forward. One of the EPA's most important leadership roles is to ensure that information is shared among all stakeholders. The EPA serves as a catalyst at the regional level through programs such as the Technical Assistance to Brownfields Communities (TAB), which is responsible for tasks that range from identifying a candidate site to working with communities on public education and outreach ([Collin, 2006](#)).

States are often the lead regulatory agency for most brownfield property cleanups through the delegation of the U.S. EPA's role / state environmental laws and regulations. Many states offer programs such as voluntary cleanup programs ([ODEQ, 2005b](#)) and PPAs ([Landman, 2005](#)) to help property owners/private stakeholders manage and control environmental liability. Early involvement and communication with local regulatory agencies can avoid regulatory issues later down the line.

### *2.4.4 Property Owners*

Property owners include sellers, corporations, privately held companies, institutional investors and government agencies, as well as municipal governments that own, manage and transfer properties ([Hamin, Silka, & Geigis, 2007](#)). Property owners are considered responsible parties whether they cause the environmental contamination or not. The property owner's interest is to be released from environmental liabilities, in order to set the property value to a

fair market price. These stakeholders are often the most difficult to collaborate with, as their fear of liability keeps them from open communication with other stakeholders ([Hollander, 2010](#)).

## **2.5 Conclusion**

The CERCLA defines brownfield sites as properties where redevelopment may be complicated due to the presence or potential presence of contamination. The roadmap toward the remediation of properties contaminated with environmental hazards is well defined by state and federal regulatory agencies. In the case of brownfields, the real or perceived risks of environmental liability have the same effect on and create the same level of difficulty during the redevelopment process. It is important to understand how the fear of liability and perception of risk associated with brownfield sites can influence the decision process in general, and property owners as key stakeholders specifically.

This section has explored the remediation steps commonly understood once a decision has been made to remediate a property as shown below in Figure 2

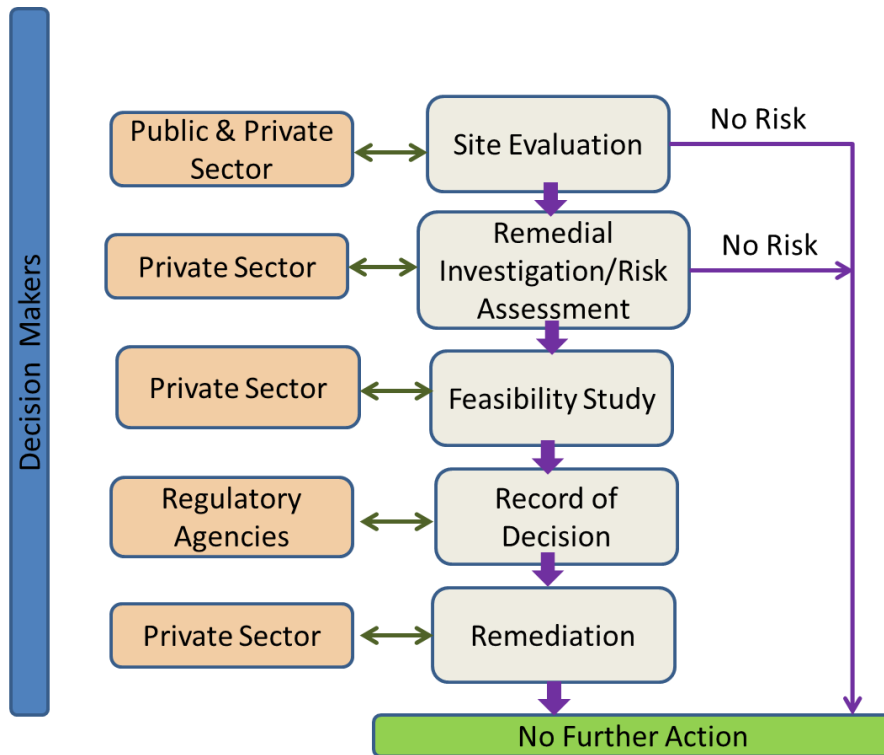


Figure 2 – Decision Makers’ Role in Remediation Flow Process

Importantly however, is the realization that this commonly described process does not include the important first step of the property owner’s decision to remediate a property. An expansion to Figure 2, proposed by this dissertation, adds the important first step of the property owner. The resulting model is presented below as Figure 3. This figure presents the key stakeholders’ decision points throughout the process - from due diligence to obtaining a No Further Action (NFA) determination from regulators. In addition, this dissertation contributes a revised model for the process of remediation that includes the important first step, which is the brownfield property owner’s decision-making process. It is this first step that is hypothesized by this research to be a key factor influencing the slow rate of brownfields remediation.



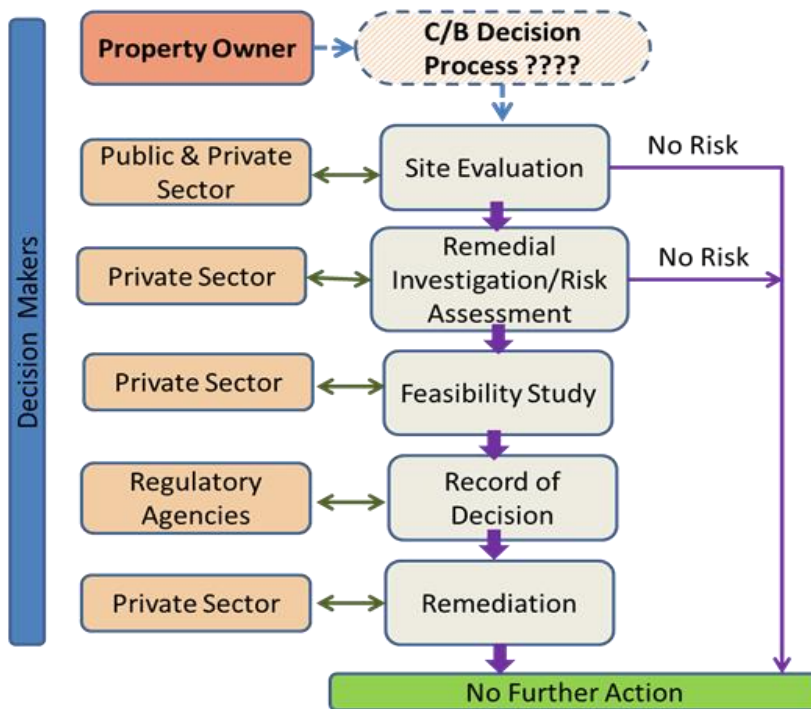


Figure 3. Property Owner’s Role as the Primary Decision Maker in Remediation Flow Process.

## 2.6 Chapter Summary

This chapter provided a comprehensive literature review to better define brownfield properties and the environmental regulations that affect the remediation process. Brownfields can be defined as “real properties that their expansion, redevelopment or reuse is complicated by the presence or potential presence of contamination.” The increased awareness surrounding the existence of many undeveloped brownfield sites in the nation can be attributed to strict federal liability provisions that were enacted in order to stop polluters. These provisions have previously held property owners primarily responsible for any contamination on a site, whether as a result of negligence and bad practice or simply as a result of the release of an underground contaminant without the

property owner knowing. In order to mitigate the nationwide brownfield problem, federal and state regulatory agencies have provided funding and incentives to encourage property owners to remediate and revitalize brownfield properties. There are multiple guidelines provided by federal and state regulatory agencies that help owners and stakeholders make technical decisions throughout the remediation process. These guidelines range from initial site assessment to the selection of remediation technologies. Despite the fact these tools are readily available to involved parties, the slow rate of brownfields redevelopment is still an issue that needs to be investigated.

This chapter reviewed the current state of practice for brownfields remediation and identified the primary stakeholders known to make decisions in each phase of the remediation process. See Figure 2 for the various roles. Most importantly however, this chapter describes the realization that this commonly described process does not include the important first step of the process, which is that a property owner is the primary decision-maker in the remediation process of a brownfield. This research proposes to add property owners as the primary and key decision-makers in the existing process. The modified process is presented in Figure 3.

It is important to understand how the fear of liability and perceptions of risk associated with brownfield sites can influence a property owner's decision-making process, especially considering property owners are the key stakeholders.

The next two chapters of this dissertation will offer a literature review on the subject of decision-making, human perceptions of risk and the factors influencing a brownfield property owner's decision to remediate.

## **2.7 Problem Statement and Hypothesis**

This research proposes that an initial stage of the decision-making process is performed by property owners and is crucial for successful redevelopment, as indicated in Figure 3. The problem to be resolved through this research is that this initial stage, the property owner's decision, is often ignored as confirmed by the above literature review. Yet, it is hypothesized that this initial step is an important element in the remediation process.

**Hypothesis 1 – The property owners are primary decision makers in the remediation process, as indicated in Figure 3.**

### **2.7.1 Research Goals and Objectives**

A goal of this research is to identify the influence that key factors and sources of information have on a brownfield property owner's decision to remediate. The objectives of this research are to:

- Evaluate the current processes for remedial action and revitalization of brownfield properties.
- Identify key brownfields stakeholders of varying roles in the revitalization process and their interaction with brownfield property owners.
- Establish a set of causes that both inhibit and encourage brownfields redevelopment projects.
- Introduce and research the hypothesis that a brownfield property owner's decision is an important element that affects the rate of remediation.
- Assemble an expert panel including stakeholders from major interest groups for more in-depth investigation and confirmation of the factors

and sources of information influencing property owners cost/benefit analysis

- Utilize expert opinion to define the degree of impact that both cost and benefit factors have on a property owner's decision-making process.
- Utilize expert opinion to investigate the reliability of the sources of information
- Suggest strategies to improve the owner's decision-making processes and thus potentially enable revitalization based on expert-panel findings.
- Recommend effective practices and alternative approaches to optimize brownfields revitalization and recommend future studies.

### **3 Chapter Three – Decision Making and Perception of Risk**

#### **3.1 Preface**

The purpose of this chapter is to provide an understanding of overall decision-making processes and perceptions of risk. It is anticipated that brownfields property owners have to make a difficult decision when the perceptions of risk associated with brownfields sites may affect the approach a property owner takes concerning property redevelopment projects/property transactions. This chapter provides a literature review on the subject of human decision-making processes, perceptions of risk and their influences on the brownfields redevelopment process. This research provides a conceptual model of the causal effects of a property owner's perception of risk on the rate of brownfields redevelopment.

#### **3.2 Decision Making**

Decision-making research typically has addressed how individuals go about selecting from a number of choices or alternatives to essentially make the "right" decision. Three assumptions exist and help characterize rational decision makers (Lee, 1971). The first assumption of a rational decision maker is that the individual making the decision is completely informed, meaning they are aware of all the possible choices and what the outcome of every selection will be. The second assumption is that a rational decision-maker is infinitely sensitive. This means the decision-maker can identify even the slightest difference between choices and can use this in determining the most beneficial option. The third assumption is that the decision-maker is rational. This assumes that choices can be organized so that choices are made to maximize a situation.

### 3.2.1 Decision-Making as an Identifiable Process

Researching the decision-making process originated in the early history of thinking possibly beginning with the development of logic. As a result of rational reasoning, an individual can arrive at a decision. The rationalist school of thinking, which goes back to Plato, believes human knowledge can be derived solely on the basis of reason, using self-evident propositions and logical deduction. Rational thinking requires that a decision must be consistent and logical, meaning it is understandable according to some set of rules or criteria. A decision that is not consistent and logical or understandable from a set of rules or criteria is called an irrational decision. Decision-making does not describe an identifiable event, but rather it represents an activity in which specific points can be identified where a choice must have been made because events could have gone one way rather than the other ([Hollnagel, 1984](#)). At the same time, this does not necessarily mean that the people who were involved made an explicit decision at the time, even though in hindsight they may come to accept that they did. Decision-making does not just involve the making of decision among alternatives. Before a decision can be made, an individual requires information about the situation, the demands and the possibilities of a specific action. It is possible that the quality and quantity of that information may indirectly favor one outcome rather than another, and even worse, a lack of information about something may severely restrict the choices that can be made. In most scenarios, a decision requires some sort of action to ensure that the expected outcome is obtained. It is important for a decision-maker to consider the short- and long-term outcomes of a particular choice. Decision-making is not typically a distinct event that takes place at a specific point in time, but rather a continuous human process that demands a decision-maker to contemplate a complex process ([Hollnagel & Woods, 2005](#)).

### 3.2.2 *Risk and Decision-Making*

The ability to identify and avoid harmful situations is vital to the survival of all organisms. Humans have come to dominate this planet, the reason being their exceptional capacity to make decisions. Our ancestors engaged in activities that demanded effective decisions in order to survive. As a result of our ancestors' decisions, some genes were passed on and some were phased-out. Risk, or the perception of risk, plays an important role in the decision-making process. That is, the making of a decision requires the assessment of the risk associated with choosing one potential choice over another. Individuals who do not make risk assessments often make ineffective decisions. It is apparent that an individual's assessment of risk has implications for decision-making. Additionally, there are numerous barriers to achieving an effective assessment of risk ([Hastie & Dawes, 2001](#)).

### 3.2.3 *Risk in Everyday Decision-Making*

An important feature of any decision is the degree of uncertainty associated with future outcomes. A lack of or incomplete knowledge of information can lead to uncertainty. When uncertain outcomes are costly, it is typical to talk about risk during the decision-making process. Risk is an inherent part of everyday life and is a fundamental consideration for a variety of decisions in life ([Bernstein & Federgruen, 2005](#)).

An example of everyday risk assessment is grocery shopping. An individual's choice must be made based on various sources of information: value for money; nutritional value of choices that are available; personal experience and recommendations from health experts. When an individual is provided with this information, much of the uncertainty is removed, enabling an individual to make an informed decision. A low-risk decision means any negative consequences

would not, in most cases, be immediate and could be rectified or reversed. On the other hand, a high-risk decision means there is a greater degree of uncertainty associated with the outcomes. For instance, the decision to take a journey in uncertain, bad weather would be considered high-risk because it is difficult to predict the impact of the weather even with reports from meteorologists. The outcomes become even more complicated when, for example, considering the possible modes of transportation that can cause variations in the degree of perceived risk. Some may perceive flying as higher risk than taking the car in such conditions. This illustrates that risk is context-specific and implies that it cannot be fully understood by simply applying information from one situation to another. Any consideration of risk usually arouses negative connotations, such as the possibility of loss of life, money, time and so on. However, in many uncertain situations, risky decisions have resulted in positive consequences. For instance, had the founders not taken risky decisions, many of the enterprises of our time (Apple, Microsoft, BAE Systems, Coca-Cola) might never have come to fruition. Hence, risky decisions can yield outcomes much better or much worse than those of less risky options can. In essence, risk is an inherent part of the decision-making process, as individuals constantly balance risks in order to make decisions. The over-arching factor is the effectiveness of the risk assessment for which decisions are based ([Baron, 2000](#)).

#### ***3.2.4 Decision-Making Based on Cost-Benefit Analysis***

A cost/benefit analysis is a technique used for deciding whether an action should be taken by comparing its benefits and costs ([vessey, August 1994](#)). Whenever individuals decide whether the advantages of a particular action are likely to outweigh its drawbacks, the individual is engaging in a form of cost/benefit analysis.



Cost/benefit analyses are a systematic approach to estimating the strengths and weaknesses of alternatives. In the case of brownfields, it is the approach to estimating the strengths and weaknesses associated with property remediation and helps a property owner arrive at a satisfying decision to remediate or not. A cost/benefit analysis is a technique that is used to determine the option that provides the best approach for the adoption and practice in terms of financial and human health concerns. There are two steps in a cost/benefit analysis:

1. To determine if it is a sound investment/decision (justification/feasibility).
2. To provide a basis for comparing alternatives. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and if so, by how much.

### **3.3 Perception of Risk**

Risk has been defined in a number of ways and appears to mean different things to different people. It has often been described as the likelihood of experiencing the effect of danger, and as the probability of an adverse event and the magnitude of its consequences ([Rayner & Cantor, 1987](#)). Risk is assumed to be objectively quantified, although social scientists reject this notion and argue that risk assessment is a subjective analysis. In the case of brownfields, the health dangers can be real, but the evaluation of the degree of danger is not independent of our minds and cultures. Human beings innately experience risk to help them understand and cope with the dangers and uncertainties of life. Risk assessment is inherently subjective and represents a blending of science and judgment with important psychological, social, cultural and political factors ([Slovic, 1997](#)).

All risk concepts commonly agree on the distinction between reality and possibility. Rosa ([Rosa, 2003](#)) defines risk as “a situation or an event where something of human value, including humans themselves, is at stake and where the outcome is uncertain.” It can be concluded that uncertainty is the psychological state of the mind in response to situations with unknown outcomes. Uncertainty “...exists only in the mind; if a person’s knowledge was complete, that person would have no uncertainty” ([Slovic, 1997](#)).

Sometimes the implications of uncertainty are threats in the sense of adverse effects. Alternatively, sometimes uncertainty implies opportunities in the sense of potential desirable effects. Humans perceive risk fundamentally in two ways: risk as feelings and risk as analysis ([Lennart Sjöberg, 2004](#); [Paul Slovic, 2006](#)). Risk as feelings occurs when an individual’s reaction to danger is based on instinct and intuition. Risk as analysis occurs when an individual uses logic and reason to manage risk.

The subject of perceived risk has been of great interest to policymakers and researchers since the 1960s, when the subject of nuclear energy became a topic of public concern. Currently, risk perception is being studied and data is being collected because of its importance to policy makers. The larger the risk, the higher the public demand for risk mitigation from politicians is ([Sjöberg, 2003](#)). In an effort to understand why different people make different estimates about the dangers of risk, scientists have looked into factors affecting human behavior ([Paul Slovic, 2006](#)). Risk perception is not only related to technical estimates of risk and benefits, but it also has a subjective dimension related to how people make judgments about the characteristics and severity of a risk. The phrase “risk perception” is most commonly used in reference to natural hazards and threats to the environment or human health ([Addlestone, 2004](#)). Public perceptions of risk have been found to determine the priorities and legislative agendas of

regulatory bodies such as the EPA ([Collin, 2006](#)). Since the public believes that the contamination of Superfund sites is the most serious environmental threat in the nation right now, much of the EPA's budget in recent years has gone to hazardous waste cleanup. On the other hand, indoor air pollution is considered to be a more serious health risk based on some expert reports ([Vermont. Waste Management Division. & Vermont. Agency of Natural Resources., 2007](#)).

Scientists have proposed several factors that may influence human perceptions of risk and have studied these factors using various theoretical models.

### *3.3.1 Important Risk Perception Factors*

Studies conducted as early as 1982 suggest that fear of risk and unknown risks are the two most dominant factors affecting the public's risk of perception ([Slovic, Fischhoff, & Lichtenstein, 1982](#)). Also, risk perception is hypothesized to differ as an effect of cultural, environmental and governmental influences.

Several factors are important to consider when explaining perceived risk ([Paul Slovic, 2006](#); [Sjöberg, 2000](#)). The following sections describe the most commonly acknowledged factors found in the literature review.

#### *3.3.1.1 Real Risk*

The primary factor in risk perception is the concept of "real risk." That is, where the risk itself has a wide range of effects on the way risk is being perceived. For example, risks related to the negative or positive impacts of nuclear technology on the environment and human health are perceived differently from the commonly understood risks related to alcohol consumption. The risks that people have direct or indirect experiences with, such as alcohol consumption, are perceived more realistically and thus as less dangerous than risks related to topics that people have little knowledge or understanding about - such as nuclear waste ([Thompson, 1991](#)).

### *3.3.1.2 Risk Target*

The recipients of a particular risk, or risk targets, make different estimates when rating the degree of risk to themselves, to their family or to the general public. Individuals most often underestimate personal risk compared to how much risk others may experience. This phenomena refers to unrealistic-optimism, or a risk-denial mechanism. An example of a risk target is a person who chooses to smoke or drink despite the risks he/she is aware of that are related to these activities. Generally, it is the perceived risks to the public at large, rather than the known risks to the individual themselves that encourages people to favor policies, which control or prohibit the use of such things like cigarettes and alcohol ([Sjöberg, 2000](#)).

### *3.3.1.3 Heuristics*

Intuitive feelings, which are a form of heuristics, are the most predominant method by which humans evaluate risk in daily life. Heuristics refer to experience-based behaviors when faced with risk - though heuristics are not guaranteed to be accurate. Intuitive feelings are usually used in order to speed up the process of finding a solution (a mental shortcut) when a lengthy and exhaustive cognitive process of risk analysis is impractical. Examples of this method include using a "rule of thumb," an educated guess, an intuitive judgment, stereotyping or the use of common sense ([Lerner, 2000](#)).

Emotions, such as fear and anger, have different effects on how risk is perceived. Fear arises from a perception of uncertainty and loss of control, and can have a negative effect when the recipient feels the risk is high. Anger arises from a perception of certainty and control, and has a positive effect in cases where the individual has a high tolerance for risk ([Lerner, 2000](#)).

#### *3.3.1.4 Trust*

Studies by Slovic ([Slovic, 1993](#)) suggest that trust is another determinant of risk perception. There are strong correlations between trust and perceived risk ([Siegrist & Cvetkovich, 2000](#)). Research on trust and risk perception continues to be dominated by social trust ([Poortinga & Pidgeon, 2003](#)). According to Bakir ([Bakir, 2006](#)), "trust shapes public risk perception." Research suggests negative correlations between perceived risk and social trust: the lower the social trust, the higher the perceived risks are. Researchers have found that the trust-risk relationship is statistically significant and it was concluded that trust contributes significantly to the variance of perceived risk ([Siegrist & Cvetkovich, 2000](#)).

#### *3.3.1.5 Antagonism*

Antagonism is hostility that results in active resistance and opposition. It is demonstrated that antagonism can cause a variance in degree of perceived risk ([Sjöberg, 2008](#)). An example of antagonism is documented in the cases of perceived risk regarding nuclear waste and terrorism. Feelings of resentment result from assuming that higher risks are associated with potential exposure to nuclear waste compared to other hazards like exposure to harmful household cleaning agents ([Engelberg & Sjöberg, 2005](#)).

#### *3.3.1.6 Risk Sensitivity*

Individuals differ in their risk sensitivities. Often times, one individual will interpret the level of risk in a different way than another individual. Some individuals are more risk-tolerant by nature and others are more risk-averse. Some individuals rate risk as low throughout while others rate risk as high throughout. Despite the psychological reasoning for such variation among individuals, the concept of risk is likely to be an important factor when accounting for the level of hazard in a situation ([Sjöberg, 2004](#)).

### *3.3.1.7 Attitude*

Attitude refers to an individual's evaluation or judgment of an object or a concept as good or bad ([Albarracín, Zanna, Johnson, & Kumkale, 2005](#)). Usually risk is assumed to be something negative, and the psychological effects of perceiving a risk are assumed to be based on negative emotions as well. Yet, the reason people engage in risky behavior is because they are interested and feel positive about doing so. For example, there is a positive attitude and hopeful feeling that something will mitigate risk when engaging in high-risk activities like skydiving or gambling ([Sjöberg, 2007](#)).

### *3.3.1.8 Voluntary vs. Involuntary Risk*

Early studies by Starr suggest that people have a higher tolerance for risks that are voluntarily chosen. For example smoking and alcohol consumption ([Starr, 1969](#)). On the other hand, in cases of potential exposure to hazardous waste, an individual often interprets perceived risk as involuntary and has a subsequently low tolerance for risk. For example, an individual may feel they have no choice in being exposed, and have little understanding of what acceptable and unacceptable exposure means ([Sjöberg, 2000](#)).

### *3.3.1.9 News Media*

News media have been known to have a strong effect on the public's perception of risk ([Wahlberg & Sjöberg, 2000](#)). As the media continues to change, the public obtains knowledge from an increasing number of sources. Amidst the information age, the majority of people can be reached through the internet and social media. There is a widespread belief in the risk research community that media is a very important source for informing individuals' risk perceptions. However, studies that support this assumption are limited. Although many studies have been conducted in the general area of media and risk perception, those directly addressing the question of the media's influence on risk

perception are few and far between. The findings are therefore not conclusive. The media attempts to express itself in a manner that is understandable to a widespread audience. As Konheim (([Konheim, 1988](#)) observed, individuals do not understand or listen to quantitative discussions as often as qualitative statements. One opinion from the mass media researcher camp explains that it is not necessarily the content of the media that influence people's opinion, but rather the sheer amount of media coverage ([Mazur & Lee, 1993](#)).

#### *3.3.1.10 Expert vs. Public Perception of Risk*

There is a difference in risk perception between experts and the public. Expert perceptions of risk are typically characterized as objective, analytic, wise and rational. The public's perception of risk is typically characterized as subjective, often hypothetical, emotional, foolish and irrational. An example is the perception of risk associated with the exposure to hazardous waste. Experts rely on collected data to quantify the degree of negative impact resulting from potential exposure to contamination. On the other hand, the public is often ignorant or overly concerned about the degree of negative impact and do not consult such reliable sources before making up their mind about risk ([Siöberg, 1998](#)).

#### *3.3.1.11 Anchoring*

Anchoring is a common human tendency. This tendency is described as an impulse to rely too heavily on the first implicit piece of information available for making a decision, including those related to risk perception. Once an anchor is set, other information is used to make incremental adjustments away from that anchor. Often there is a bias toward interpreting other information around the anchor. For example, an individual is more likely to accept information that agrees with the anchor they established and reject any information that

contradicts the anchor. Various studies have shown that anchoring is very difficult for individuals to avoid ([Furnham, 2011](#)).

Three major groups of theories have been suggested for the purpose of understanding the ways and extent to which each of the above-mentioned factors can affect perceptions of risk. The next section introduces each of the major groups of risk perception theory and the related methodology. Further literature review is necessary for a better understanding about the strengths and weaknesses of each theory and its application.

### *3.3.2 Risk Perception Theories*

Chauncey Starr (1969) was the first researcher to present the concept of a risk model. He assumed that society had reached equilibrium in its judgment of risks, and therefore whatever risk levels actually exist in society are deemed acceptable. This early approach assumed that individuals behave in a rational manner. What is meant by this is that individuals weigh information out before making a decision and that additional information can help individuals understand true risk and ultimately lessen unrealistic perceptions of danger. Later studies rejected the belief that additional information alone can shift perceptions ([Ng & Rayner, 2010](#)). Other factors that are believed to influence an individual's perception of risk and the ability to make decisions include intuition and instinct, belief and the degree of risk acceptance and individual/societal/cultural settings ([Steg & Sievers, 2000](#)).

Researchers have proposed three major theories to explain why individuals make different estimates of risk danger. These theories are: 1) psychological approaches (heuristics and cognitive); 2) anthropological/sociological approaches (cultural theory) and 3) interdisciplinary approaches (social



amplification of risk framework) ([Lennart Sjöberg, 2004](#); [Ng & Rayner, 2010](#); [Steg & Sievers, 2000](#)). These theories are explained briefly in the following sections.

### *3.3.2.1 Psychological Theory - Heuristics and Cognitive*

Psychological theory, as related to risk, was first formed during the 1960s with the rapid rise of nuclear technologies. With nuclear technology, came public concern involving immediate threat of exposure, potential creation of wastelands and long-term dangers to the environment. The public's perception was negative toward nuclear technology despite the availability of evidence championing the massive benefits of the technology if used safely. Because of this discrepancy, policy makers and researchers started to examine why risk perception among different stakeholders varied ([Thompson, 1991](#)). Although psychology-based approaches provide solid results in understanding risk perception among the public, it fails to explain clear results among individuals ([Lennart Sjöberg, 2004](#)).

Resulting behaviors and thoughts related to risk according to the psychological theory are related to the severity of the consequences of a hazard, rather than of the risk itself. This is a weakness of the psychometric model because it focuses on the risk itself rather than the outcome ([Rundmo, 2004](#)).

The psychology-based approach began with research conducted to understand how individuals process information. Humans perceive and act on risk in two ways, as mentioned either through risk as feeling or through risk as analysis. Risk as feeling (a heuristic approach) is based on individual instincts and intuition. Risk as analysis is based on logic, reasoning and scientific support that individuals then use to help perceive and react to risk ([Paul Slovic, 2006](#)). Individuals use cognitive heuristics for sorting and simplifying information, which can lead to biases in comprehension.

Later research built on this foundation and became the psychometric paradigm. This approach identifies numerous factors responsible for influencing an individual's perceptions of risk, including dread, newness, stigma and other factors.

Another belief arising from earlier research is the valence theory approach. The valence theory approach indicates that emotions are grouped as either positive (happiness and hope) or negative (fear and anger). According to the valence theory, optimistic risk perceptions are connected to positive emotions, while negative risk perceptions are connected to pessimistic views of risk ([Ng & Rayner, 2010](#)).

### *3.3.2.2 Cultural Theory*

The concept of cultural theory was first presented in the 1980s to address the shortcomings of the psychometric model. Cultural theory took into consideration the effect of culture and the degree to which people are constrained in their social roles ([Steg & Sievers, 2000](#)).

Both the cultural theory and the psychometric theory have shortcomings regarding the evaluation and measurement of risk perception. In recent years, an interdisciplinary approach which combines research in psychology with sociology and anthropology has been used in an attempt to explain the process involving perceptions of risk to be amplified depending on public attention ([Ng & Rayner, 2010](#)).

### *3.3.2.3 Interdisciplinary Approaches*

The psychometric model and cultural theory were integrated to formulate an alternative for risk perception measurement. The interdisciplinary approach is used to outline how communication of risk passes from a sender through intermediate stations to a receiver. In the process, perceptions of risk are either

amplified or weakened. The interdisciplinary approach studies how risk events interact with individual psychological, social and cultural factors in ways that either increase or decrease public perceptions of risk. A study performed by Ng and Rayner concluded that attitude, - as a psychometric factor - demographics and past experiences collectively influence cultural biases, which in turn exert an effect on risk perception ([Ng & Rayner, 2010](#)).

### **3.4 Chapter Summary**

This chapter provides theoretical background that is proposed to apply toward the owner decision-making process, and indicates that a typical form of decision-making is a cost/benefit analysis, which balances various factors that are evaluated from a variety of information resources. Further, the information received may have differing degrees of reliability that lead to a risk-laden cost/benefit analysis.

This chapter also provides a better understanding of the social aspects of risk, and the perception of risk by individuals and society as a whole. In addition, factors that can affect an individual's perception of risk like news media, culture and intuition were introduced. The theories that measure risk perception and its influence on decision-makers were studied.

Brownfield properties are typically associated with the potential for economic and environmental risks. This may be due to the governing regulations and environmental policies related to site cleanup, which emphasize the threat of liability and the responsibility of the owner to address site contamination. The effects of environmental regulation on brownfields redevelopment and the related fear of liability exhibited by brownfields property owners are important subjects to study. These topics will be evaluated by the research proposed in this dissertation.

### 3.5 Research Hypothesis and Model Expansion

As a result of the information of this Chapter, a gross causal model of the owner's decision-making process is hypothesized to be a major factor influencing the slow rate of brownfields revitalization and is proposed in **Figure 4**. This model assumes that the property owner's rational decision process uses a cost/benefit analysis to determine whether to remediate, leading to an additional hypothesis.

- **Hypothesis 2 - The decision process is as it is presented in the causal model in Figure 4.**

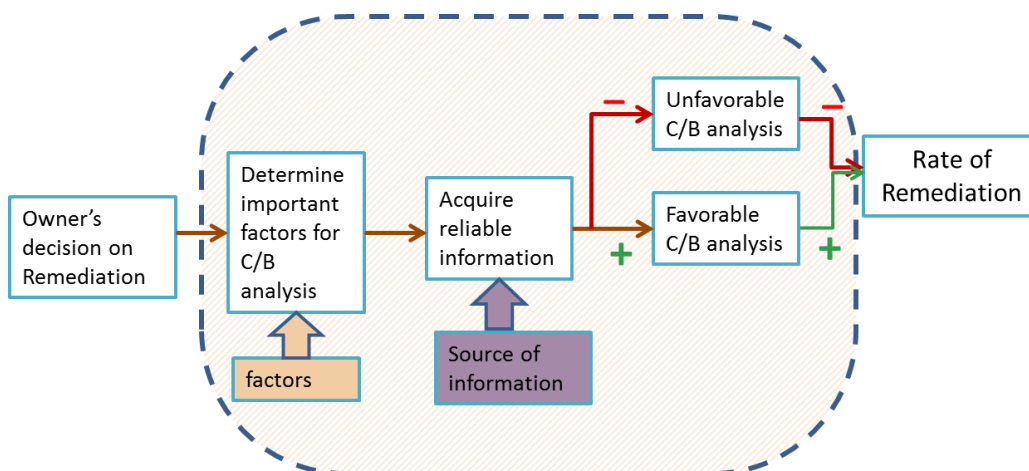


Figure 4 – Owner's Cost-Benefit (C/B) Analysis Gross Model

This model assumes that a brownfield property owner's decision to move forward with remediation is based on a cost/benefit analysis. The factors influencing a brownfield property owner's decision to remediate or not must be identified and weighed. In addition, the sources a brownfield property owner consults to obtain appropriate information regarding remediation projects need to be identified and a determination made regarding their reliability—a measure

of risk. What remains unknown, however, is what are the major factors that are considered, and what sources of information are used when measuring the effects of those factors.

The next chapter provides a more in-depth understanding of the factors that may influence property owner's decision-making processes and the sources of information sought in the decision-making process.

#### **4 Chapter Four – Factors and Risk Perception in Brownfields Remediation**

The purpose of this chapter is to discover the cost and or benefits involved with remediation of brownfields properties, with a special focus on the related perceptions of risk. The risks perceived to be associated with brownfield sites include both the negative impacts of hazardous materials on human health and the environment, as well as the financial burdens associated with remediation ([Richardeiser, Stafford, Henneberry, & Catney, 2007](#)). These projected risks have negative connotations for property owners and potential buyers of such sites ([Graziano, 2004](#)). In some cases, local citizens living and working near the brownfield sites may be concerned with the possibility of exposure to contaminants. This generally results in the creation of dislike and can have a negative impact on the property owners' decision to move forward with changes to the status of their property ([Ellerbusch, 2006](#)). The uncertainty related to the assessment and cleanup of a site, paired with the financial necessity to manage this uncertainty are inherent problems in brownfields revitalization projects ([Collin, 2006](#)).

When considering the risks associated with brownfields revitalization projects, a series of questions may arise:

- 1) Has the site been previously assessed for presence of contamination by previous owners? Are there any formal documents or reports concerning site contaminants from regulatory agencies?
- 2) Who caused the contamination? If it was the fault of my tenant or the previous owner, who is responsible? Is the site owner held responsible even though it might not have been them who caused the problem?

- 3) Are there unacceptable health risks present at the site? Who is exposed to them? How dangerous is the situation? May this jeopardize the site owner's health or anyone else who is or has been working at the site?
- 4) Will evidence of site contamination cause a negative opinion or bad reputation among the site's neighbors?
- 5) Is there a chance of a third party liability law suit if contamination is found on my site?
- 6) Is there a financial burden? And if so, how much of one?
- 7) Are there any affordable technologies available to aid in the reduction of risks or the prevention of contaminant exposure? Can the risks be managed properly?
- 8) What if the regulatory agencies enforce cleanup and results in significant increases in costs? What resources can be used to help manage the financial risks and possible litigations?

Because the answers to these questions contain many uncertainties, it is possible these questions create a perception of risk and may prevent property owners from moving forward with redevelopment or a property transaction because of a desire to protect assets and their reputation within the community.

This research uses qualitative and quantitative methodologies to compile and analyze factors that include both obstacles and opportunities that may assist property owners with the decision-making process and consequently expedite brownfields remediation projects.

There are two types of risks associated with brownfields properties. The following sections discuss the perception of risk from these two angles: 1) the adverse human health perception of risk associated with the release of hazardous wastes on brownfields properties and 2) the financial perception of risk associated with brownfields remediation and revitalization.

#### 4.1 Perceptions of Risk as Related to Human Health

The protection of human health and the environment is the primary goal of environmental regulations at any contaminated site ([Frantzen, 2002](#); [Graziano, 2004](#)). The purpose of this section is to discuss the current state of knowledge and practices for protecting human health and the environment in relation to brownfield properties.

As it is discussed earlier, the general public and members of a community can have a direct influence on a property owner's decision-making process to remediate or not. It is then important to understand how the general public reacts and what their perceptions of risk are concerning contaminated properties. The environmental scientific community and the general public typically have very different ideas about possible human health risks associated with particular chemicals or a particular site that has been impacted by hazardous chemicals ([Sjöberg, 1998](#)). For example, benzene is recognized as a carcinogenic compound, and by policy and statute, benzene is not allowed to be present at concentrations that will cause greater than a single additional occurrence of cancer among one million people. Acceptable carcinogenic risk for a chemical is thus presented as equal to or lower than  $1 \times 10^{-6}$  ([DEQ, 2003](#)). This is a very low degree of risk when compared to the likelihood of contracting cancer from exposure to sunlight (approximately one in three), or to cigarette smoking (approximately one in 10). However, when an audience at a public meeting hears that a  $1 \times 10^{-6}$  risk is associated with "acceptable" levels of benzene, the audience nonetheless tends to interpret this as an individual (or multiple individuals) in the local population will get cancer due to benzene exposure present in the soil at the site undergoing redevelopment. The general public often makes assumptions such as this due to a lack of experience or lack



of access to the same information as experts ([DEQ, 2003](#); [Engelberg & Sjöberg, 2005](#)).

Neighboring property owners to brownfield properties and members of the community fear being exposed to harmful chemicals during remediation or construction activities. This can have negative impacts on redevelopment ([Ellerbusch, 2006](#)). Helping community members understand the ways in which the community might be exposed to harmful chemicals facilitates a more accurate perception of risk within a community ([Haslam, 2009](#); [Whitman, 2006](#)).

It is just as important, if not more so, for the brownfields property seller and buyer to recognize which chemicals are present on site, the degree of contamination (how high are chemical concentrations in the soil, groundwater or indoor air), the extent of contamination (is the contamination confined to one small part of the site, or is it present site-wide?) and how the chemicals might cause health hazard not just to nearby residents or workers, but also to on-site workers conducting cleanup activities ([DEQ, 1998](#); [Engelberg & Sjöberg, 2005](#)).

The better educated property owners and potential buyers are with the types of chemicals, possible exposure pathways and available technologies for remediation and contamination control, then the easier and less expensive it is to incorporate remediation with the redevelopment cost effectively. Individuals can make efficient decisions about the remediation technology whether it is an aggressive treatment such as contaminant removal or a passive remediation such as contamination containment ([Gallagher & Jackson, 2008](#)).

#### **4.2 Perceptions of Risk as Related to Financial Risk**

Brownfield property owners and other stakeholders interested in brownfields redevelopment are often afraid of potential financial liabilities associated with contaminated sites ([BenDor et al., 2011](#)). The U.S. law distinguishes between

highly contaminated sites, those with lower impacts and those with non-hazardous waste. In the past, both federal and state agencies have strictly held property owners and site operators/future developers responsible for any possible contamination on site, and therefore liable for cleanup costs ([EPA, 2004, 2007](#)). Although regulation polices have relaxed a great deal and there are incentives and guidelines in place to encourage brownfields redevelopment, the fear of being held liable by regulators and the high costs of remediation are recognized as potential reasons why brownfields are undeveloped and underutilized ([Bartsch, 2003](#)). Liability concerns prevent many owners of old commercial properties from placing their property on the market or applying for financing to renovate for the fear of discovering contamination ([Collin, 2006](#)). Literature related to the value of the real estate clearly indicates that real and perceived risks of environmental contamination on a property negatively impact the property's value ([Roddewig & Appraisal Institute \(U.S.\), 2002](#)). Diminished property values can result even when there is no property transaction. A diminished income stream and the loss of the full use of a property can hinder an owner's ability to access equity within a property.

### **4.3 Cost/Benefit of Redevelopment**

Throughout the process of any brownfields redevelopment project, many desirable and undesirable occurrences transpire for the property owner. Deciding whether the desirable effects outweigh the undesirable effects is a necessary step a brownfield property owner must take in order to logically make a decision about how to move forward with a brownfield redevelopment project ([Whitman, 2006](#)).

Brownfields redevelopment generate positive benefits including job creation, local tax base increases, utilization of existing infrastructures, public health

benefits, the revitalization of inner city neighborhoods, the reduction of illegal dumping areas and illegal drug activity, the reduced loss of green space from new developments, the attraction of private sector investments, the reduction of public costs for building and maintaining infrastructure in outlying areas to support greenfield growth and the reduction of air pollution from the redevelopment of inner cities as opposed to green spaces ([Kris Wernstedt, 2004](#)). These benefits can apply to many different types of redevelopment. The fact that, by definition, brownfields have been previously developed makes them more likely to be located in areas where infrastructure and population already exist; and because the properties are vacant or abandoned as opposed to undeveloped, the properties are more likely to attract crime and undesirable activities from trespassers.

Studies performed among the EPA's grant recipients and an annual survey conducted by the U.S. Conference of Mayors in 2006 suggests that up to \$2.2 billion in additional annual tax revenues could be generated if brownfield sites were redeveloped.

The EPA claims that since the beginning of the brownfields grant program, in the fiscal year 2012, an average of \$17.79 is leveraged for each EPA brownfields dollar expended, and an average of 7.3 jobs are leveraged per \$100,000 of the EPA's brownfields funding expended by the Assessment, Cleanup and Revolving Loan Fund ([BenDor et al., 2011](#); [EPA, 2012](#)). In 2004, the White House Council on Environmental Quality claimed that for each acre of redeveloped brownfields 4.5 acres of green space were preserved ([Kris Wernstedt, 2004](#)).

The National Governors Association (2000) claims:

“Brownfields redevelopment has successfully rejuvenated impoverished urban centers, created hundreds of thousands of

new jobs, generated millions of dollars in tax revenue and preserved millions of acres of Greenfields.”

The National Governors Association has also reported that for every public dollar spent on brownfields, states recoup from as much as 10-100 times that amount in economic benefits. Studies on the benefits of brownfields reuse have generally used census data, interviews and surveys from local government officials to arrive at conclusions (Greenstone, 2006; Greenberg 2000).

Seller and buyer's perceptions of the high cost of cleanup results in a discounted sale price for brownfield sites. Although the cost of investigation and remediation is high, the potential opportunity to create successful business at these sites is higher. This is especially true considering redeveloped brownfields are usually located on prime real estate properties ([R. H. a. K. Wernstedt, 2003](#)).

The EPA's Brownfield Program empowers states and communities to work together to prevent exposure to hazardous waste, assess the level of contamination, safely clean up the brownfield sites and help establish sustainable reuse. Brownfield sites tend to have greater location efficiency than alternative development scenarios, resulting in a 32-57 percent reduction in vehicle miles traveled, thus reducing pollution emissions, including greenhouse gases. These same site comparisons show an estimated 47-62 percent reduction of storm water runoff ([EPA, 2012](#)).

The property owner and potential buyer of a property must also weigh the costs of cleanup and construction against future projections of profit after eventual sale or reuse of redeveloped sites. The more certainty there is in regards to the amount of cleanup required, the higher likelihood there is for an accurate prediction of cost/benefit ratios associated with redevelopment activities. Factors that play into more cleanup certainty include the possibility of an

overseeing agency demanding more cleanup, the types and timing of construction/repair needed and the attitude of the local community. There are many benefits to revitalizing underutilized properties. The benefits include:

- 1) Protecting the existence and enhancement of a community's unique characteristics by investing in sustainable, livable neighborhoods.
- 2) Providing economic benefits, such as increasing the local tax base, utilizing existing infrastructure and taking developmental pressures off of undeveloped open land (EPA, 2012b).
- 3) Providing economic benefits to the community including the creation of local jobs and increasing property values.

Potential negative aspects of brownfields redevelopment also exist. These include:

- 1) The creation of jobs not available to local residents.
- 2) Increased traffic in the neighborhood.
- 3) Inappropriate use of the property for practices that are not appropriate or the best reuse of land within the neighborhood.
- 4) Inadequate remediation can result in additional costs ([Dasgupta & Tam, 2009](#)).

Communicating the level of risks associated with brownfield sites to property owners and the community is an important factor that can affect the likelihood of a property transaction, remediation or site redevelopment ([Breggin & Environmental Law Institute., 1999](#)).

The literature related to the valuation of real estate clearly indicates that the real and perceived risks of environmental contamination on a site negatively impact the property value ([Roddewig & Appraisal Institute \(U.S.\), 2002](#)). Diminished property values can result even when there is not a property transaction.

Instead, diminished property values can be due to diminished income streams and the loss of the full use of a property, which can hinder an owner's ability to access equity within the property.

Since the early 1990s, many state and federal agencies have made attempts to mitigate redevelopment barriers. Stringent cleanup regulations have been replaced by brownfield programs with voluntary agreements supported by grants and tax credits ([K. Wernstedt et al., 2013](#)). More recent and cost-effective technologies have become readily available, with new additional resources and community outreach programs. With that being said, the rate of brownfields remediation and revitalization has remained slow moving —the cause of which is not well understood.

#### **4.4 Chapter Summary**

This chapter is a literature review summary of the costs and benefits associated with the remediation of brownfield properties. Brownfield property owners and other stakeholders interested in brownfields redevelopment are often afraid of potential regulatory and financial liabilities associated with contaminated sites, whereas there are many benefits associated with the remediation and redevelopment of these sites. Brownfield redevelopment results in benefits such as the protection of both public health and the environment, the creation of jobs, increasing tax revenues, and the preservation of Greenfields.

Both the property owner and the potential buyer of a brownfield property must weigh the cost of cleanup and construction against future projections of profit after the eventual sale or reuse of the redeveloped sites. It has been previously hypothesized that the perception of both positive and negative factors by brownfield property owners plays a role in that owners' decision-making using a cost/benefit analysis. The influence on the owner's perception of various

factors, including the uncertainty or risk surrounding said factors, is an important element that contributes to the slow rate of brownfields remediation and revitalization. Findings from the literature review in this chapter are used to amend the owner's cost/benefit gross model as proposed in Figure 4 by including suggested factors and sources of information that influence property owners decision-making process.

#### 4.5 Research Hypotheses and Amended Model

This section explored the potential factors, and sources of information that may influence a brownfield property owner's decision to remediate. Accordingly, a set of factors and sources of information is proposed by this research, leading to an expansion of the causal model as presented below in Figure 5.

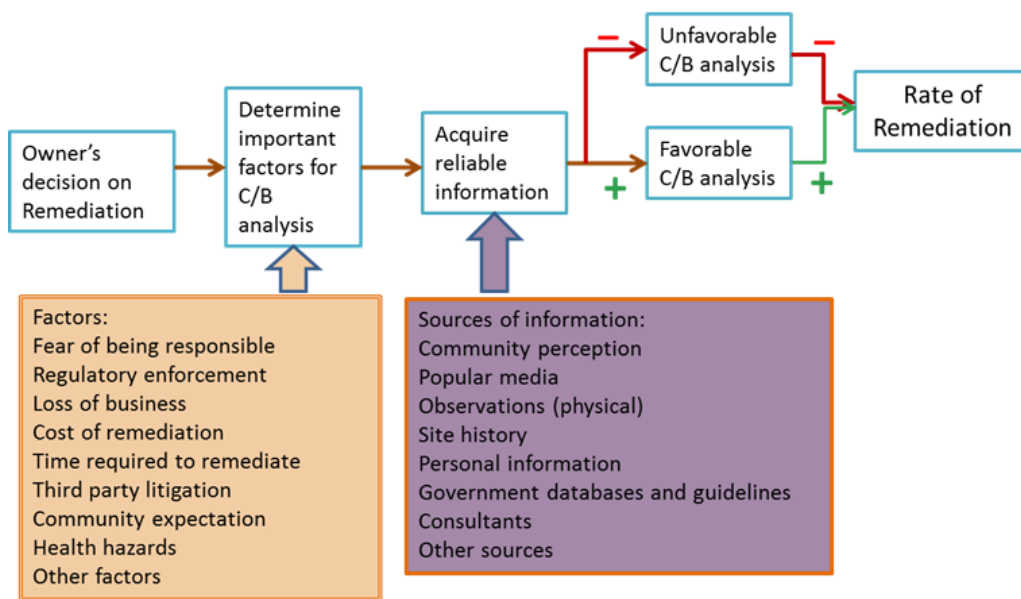


Figure 5 - Causal Model Expansion

This chapter, then adds additional hypotheses to this research:

- **Hypothesis 3: Important factors affect a brownfield property owner's decision to remediate, and are as presented** in Figure 5.
- **Hypothesis 4: Important sources of information are used by a brownfield property owner in measuring the effect of the important factors noted in Hypothesis 3, and those are as presented** in Figure 5.

This research will evaluate the degree of influence each factor and source of information has on a brownfield property owner's decision-making process.

Findings from this research will be used to suggest which factors are most likely to affect a brownfield property owner in making a decision, as well as provide suggestions to expedite the process of property remediation and redevelopment.

Chapter 5 offers a research framework and examines various opinion-based research methodologies for this research.



## **5 Chapter Five – Research Methodology**

### **5.1 Preface**

The purpose of this chapter is to describe a research methodology to identify and quantify the causal factors that affect the rate of brownfields revitalization using opinion-based research methods. This research uses an expert panel in order to test the proposed research hypotheses. A quantitative analysis of the data obtained from the expert panel provides objective results that suggest amendments to the hypothesized models. The opinions collected in this research are limited to those experts living and working in Oregon; however, the results may be helpful for brownfields revitalization nationwide.

### **5.2 Introduction**

Chapter 2 offered a review of the brownfields remediation process and proposed that adding a property owner's decision as a first step in the existing, well-known remediation process flow is necessary in order to achieve a holistic model. Further, Chapter 3 expands the "owner's decision" step to include a cost/benefit decision process that includes factors and sources of information that may influence the owner's cost/benefit analysis, which has not been addressed in past research.

Hypothesized factors and sources of information were presented in Chapter 4 as the amended causal model, Figure 5 in Chapter 4. Each expert was asked to rank the importance of each factor from the expert's perception of a property owner's interests, as well as indicate the expert's perception of the sources and reliability of information a property owner likely considers while performing a cost/benefit analysis.

The results of the expert panel survey were analyzed quantitatively and findings are provided to suggest strategies to improve the rate of brownfields revitalization.

### **5.3 Research Framework and Methodology**

The following four hypotheses are studied in this research:

- Hypothesis 1 – The property owners are primary decision makers in the remediation process.
- Hypothesis 2 – The decision process is as it is presented in the causal model in Figure 4, Chapter 3.
- Hypothesis 3 – Important factors affect a brownfield property owner's decision to remediate, and are as presented in Figure 5, Chapter 4.
- Hypothesis 4 – Important sources of information are used by a brownfield property owner in measuring the effect of the important factors noted in Hypothesis 3, and those are as presented in Figure 5, Chapter 4.

A literature review was performed to gain a better understanding of the existing remedial action and revitalization processes for brownfield redevelopment projects. In addition, this research identified the various factors and sources of information that ultimately affect owners' decisions in remediation and redevelopment projects.

The validity and importance of these factors were assessed using an expert panel. Experts from various key stakeholder groups with varying roles in the brownfields revitalization process were selected to serve on the panel. The following steps were taken in order to conduct this research:

- Phase I – Literature review

Task 1 – Investigate and model the current processes used for remedial action and brownfields revitalization. Conduct a literature review on the known barriers and enablers involved in brownfields revitalization projects, such as perceptions of risk related to brownfield properties. Develop a gross causal model for brownfield property owners' decision-making processes.

Task 2 – Test and amend the causal model by performing an additional literature review in order to determine the factors influencing a brownfield property owner's cost/benefit analysis. Expand the model.

Task 3 – Perform a literature review on opinion-based research methodologies and select the technique most suitable for this research. Assemble an expert panel to assess the proposed factors.

Phase II – Validate the first two hypotheses of this research using the expert panel's opinions.

Task 1 – Ask the expert panel to validate Hypothesis 1, regarding the importance of the owner's role in the remediation process.

Task 2 – Ask the expert panel to validate Hypothesis 2, that the cost/benefit process is a reasonable model for the owners' decision processes.

- Phase III – Validate the second two hypotheses of this research, and expand the understanding of the importance of the factors and sources of information to the owner's decision process.

Task 1 – Test and amend the list of factors and the list of sources of information presented in Hypotheses 3 and 4.

Task 2 – Perform a quantitative analysis to evaluate the degree of consensus among experts in regards to the degree of influence each factor has on a brownfield property owner's decision-making process and the sources and reliability of information sought by the owners.

- Phase IV – Conclude and suggest strategies necessary to reduce the influence of the factors inhibiting brownfields remediation.

Task 1 – Suggest strategies for effective revitalization practices and alternative approaches for brownfields property optimization remediation based on the findings gathered from the expert panel.

Task 2– Suggest future studies in order to validate the results obtained in this research. The general framework for this dissertation is presented in Figure 6.

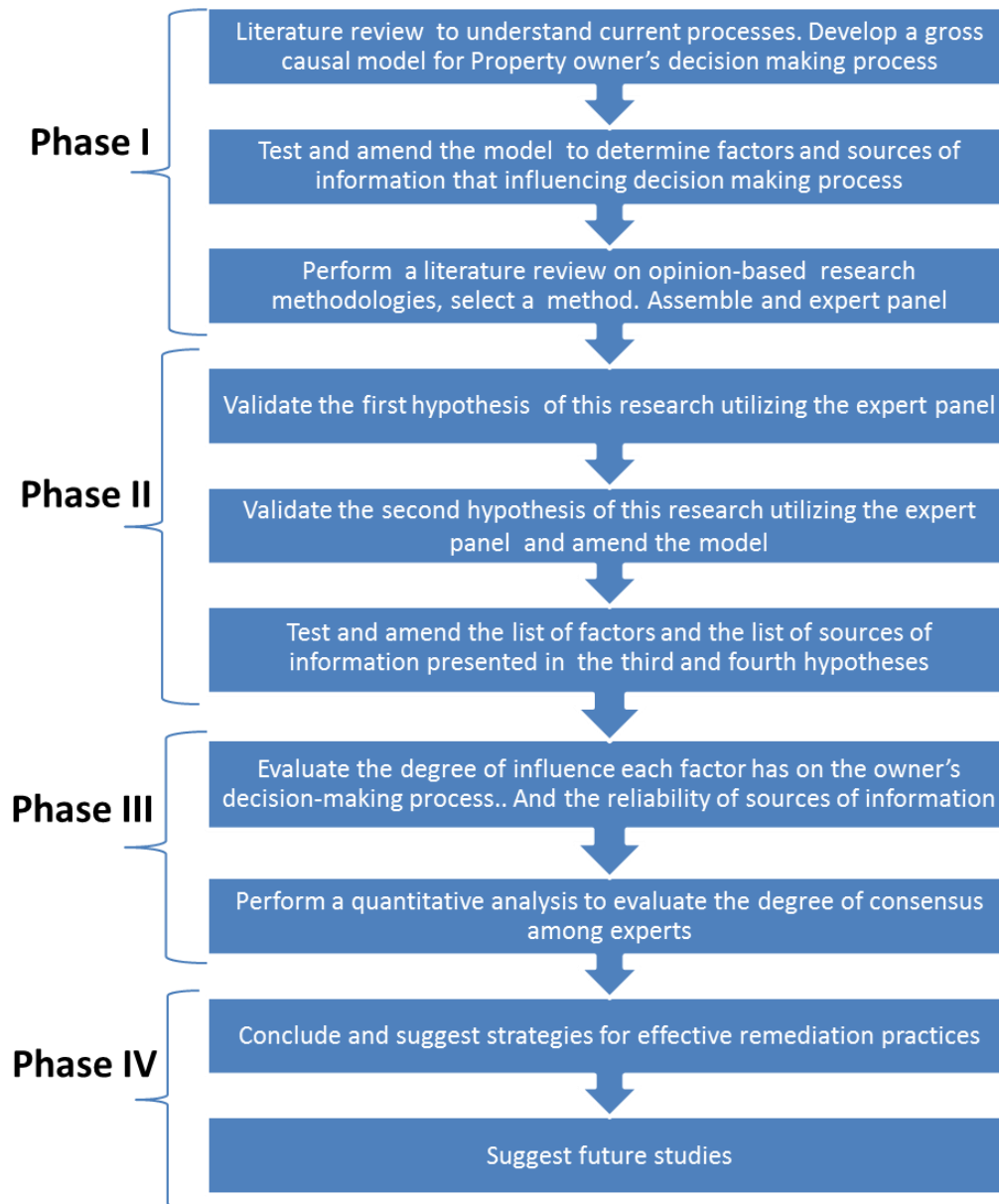


Figure 6 – Research Framework Utilizing Opinion Based Methodology

#### 5.4 Research Techniques

The next sections provide a literature review on general surveying methods and identify the advantages and disadvantages to opinion-based research techniques. The literature review helped this research to understand the critical

steps necessary for designing an effective survey in general and to select the most appropriate opinion-based survey technique specific to this research.

#### 5.4.1 *Survey Methods – Literature Review*

One of the most important steps to conducting a survey is selecting the method. A project's budget, the type of information that is being sought, the characteristics of the sample population and time considerations will all influence the selection of an appropriate survey method ([De Leeuw, Mellenbergh, & Hox, 1996](#); [Groves et al., 2013](#)).

In situations where experimental, empirical or observational data are not available, this research must rely on opinion-based research to collect the necessary data for analysis ([Sillars & Hallowell, 2009](#)). Due to the nature of this research, using opinions from both expert and non-expert groups associated with brownfield property owners seemed appropriate to this research.

The following sections review the necessary steps in conducting a general survey and the ways to conduct and evaluate an opinion-based research project specifically. The following section also compares and selects the various methodologies that were used for collecting and analyzing data in this study. The following is a brief summary of the steps necessary to conduct a survey.

##### 5.4.1.1 *Establish Project Goals and Scope of Work*

In order to collect meaningful data, it is important to establish specific project goals and identify the scope of the work. This can be achieved through a focused survey that addresses the problems and questions at hand. The scope of work must be practical and achievable in order to yield measurable results ([Babbie, 1973](#); [Rea & Parker, 2012](#)).

#### *5.4.1.2 Understand and Avoid Survey Errors*

There are four common types of error that should be considered simultaneously throughout the surveying process ([Alwin, 2013](#); [Biemer, Groves, Lyberg, Mathiowetz, & Sudman, 2011](#)).

The four common types of error are explained below:

Sampling Error: Sampling error is the most common error and is essentially the degree to which a survey statistic differs from its “true” value. Sampling error can occur when a survey is conducted among only one of many possible sample populations. Sampling error describes the degree of uncertainty a researcher is willing to accept ([Alwin, 2013](#)).

Measurement Error: Measurement error is the second most frequent type of error. Measurement error describes the degree to which a survey statistic differs from its “true” value due to imperfections in the way data is collected. Examples of common measurement errors poorly phrased questions, faulty assumptions and imperfect measurement scales ([Biemer et al., 2011](#)).

Coverage Error: Coverage error accounts for an important source of variability in survey statistics. Coverage error refers to the degree to which statistics are “off” due to the fact a limited research sample will not properly represent the entire population being measured.

In recent years, coverage error has been rectified due to the fact that online surveys make it possible to conveniently reach out to a broad population in a limited amount of time ([Groves et al., 2013](#))

Non-response Error: Non-response errors occur when part of a sample group refuses to respond to the survey ([Biemer et al., 2011](#)).

Additional error occurs when false data is collected, which can occur when an interviewer administers a survey over the phone or face-to-face. An interviewer can cause error, often without even knowing, by leading a respondent to answer in a particular way. This can occur when an interviewer's intonation changes a participant's view or when the interviewer does not accurately record the participant's responses. It is also possible that a respondent who is not motivated to provide correct answers can cause some sort of error in the results ([Johnson & Wislar, 2012](#)).

#### *5.4.1.3 Choose the Survey Method*

Choosing the best data collection method is one of the most important and complex steps in conducting a survey. The survey method depends on various parameters such as the size of the sample group, the information a researcher is seeking, the amount of time that is needed, the project's budget and available facilities ([De Leeuw et al., 1996](#)).

The most common approaches to collecting data include personal interviews, telephone surveys, mailed surveys and online surveys.

Below is a detailed description of each survey method:

##### *5.4.1.3.1 Telephone Survey:*

Researchers often use telephone surveys to reach out to specific sample groups. The advantages to this method are: 1) telephone surveys yield lower non-response error and 2) results from telephone surveys can be gathered in a short amount of time.

The disadvantages to this method are: 1) participant refusals are common; 2) the phone number databases that a researcher may refer to are often incomplete



and 3) respondents are often not willing to answer long and complicated questions over the telephone ([De Leeuw et al., 1996](#); [Lavrakas, 1993](#)).

#### 5.4.1.3.2 *Face-to-Face Interviews:*

Face-to face-surveys are known to be one of the best options for conducting a survey ([Fenig, Levav, Kohn, & Yelin, 1993](#)).

The advantages to this method are: 1) face-to-face interviews yield a high response rate; 2) results can be gathered in a short amount of time and 3) face-to-face interviews can be very effective for complicated subjects and situations where more detailed explanations are needed ([Fenig et al., 1993](#); [Tiene, 2000](#)).

The disadvantages to this method are: 1) face-to-face interviews are a very expensive and time consuming; 2) experienced and well-trained interviewers are required; 3) respondents may be influenced by the interviewer's bias and 4) usually this research is not able to reach out to a broad group of people, which can result in a small data set ([Heerwegh & Loosveldt, 2008](#); [Suchman & Jordan, 1990](#)).

#### 5.4.1.3.3 *Mail Questionnaire:*

Mailed questionnaires used to be one of the most common surveying methods. In this method, a sample group first receives a questionnaire followed by a reminder to complete the survey and mail it back to this research within a certain time frame. In some cases the respondent might be contacted again if the questionnaire is not filled out properly ([Dillman, 1978](#)).

The advantages to a mailed questionnaire include: 1) the method is not labor intensive and requires few staff; 2) this method yields fewer sampling errors; 3) respondents often feel more comfortable answering personal questions about their income, health, political attitude, etc. and 4) respondents are less

influenced by the interviewer's bias in a mailed questionnaire ([Allen, Liptak, Guo, & Worasinchai, 2015](#); [De Leeuw et al., 1996](#)).

The disadvantages to this method are: 1) there is a high non-response error; 2) there is a high non-coverage error; 3) this research cannot be sure the questionnaire was filled out completely or by the person who claims to have filled it out and 4) this method may take longer than other surveying methods ([Mentzer & Lambert, 2015](#)).

#### 5.4.1.3.4 *Email or Web Survey*

Email surveys are a convenient method for collecting feedback and data. Sending email surveys is an inexpensive method, and can achieve results faster than surveys sent by mail or conducted over the telephone. When creating an email survey it is important to use a software or website that offers surveying software ([Heerwegh & Loosveldt, 2008](#); [Sauermann & Roach, 2013](#)).

The advantages to this method include: 1) it is time efficient; 2) it yields few sampling errors; 3) the survey is easily accessible to respondents and the respondents may feel more comfortable answering personal questions through this method and 4) results are immediately available to researchers and easy to download into statistical software programs.

The disadvantages to this method are: 1) there is a high non-response error due to changes in email addresses and 2) it is possible that the survey could be blocked by the recipients spam filters.

#### 5.4.1.4 *Select Samples*

A reliable sample is one that is selected randomly and represents the goals of the survey. Random selection does not mean; however, that the sample is arbitrary or that every individual qualifies to participate in the survey. Random selection

uses a scientific approach to select individuals who will produce valid data ([Rea & Parker, 2012](#)).

The first step in sampling is deciding on a target population. The population must first be defined and then the qualifications that make individuals eligible to participate in the survey must be identified

The second step involves determining the database from which the sample population will be selected. Examples of databases that researchers use include those from professional societies, conference attendances and government agency databases ([Groves et al., 2013](#)).

#### *5.4.1.5 Write the Questionnaire*

Preparing the questionnaire is a critical step in survey design because the design can directly affect the quality of the data collected and ultimately the results ([Sanchez, 1992](#)). In the early phases, it might be useful for this research to look at existing questionnaires to assist with the development of their own survey questions. Similar surveys can provide ideas about the length, format and phrasing for a questionnaire. Quality questions should be understood by everyone in the sample population and be written in a consistent way that motivates respondents to answer. In addition, each respondent should have equal access to any information needed to provide an appropriate answer — unless the purpose of the survey is to measure the knowledge of the sample population ([Rubin et al., 2014](#)).

There are some general principles that should be considered when designing a survey and writing its questions:

- Use caution when asking hypothetical questions.
- Do not combine two questions into one.
- Do not ask questions that lead individuals to make assumptions.

- Do not use questions that prompt particular responses from a respondent.
- When dealing with a complex subject matter, avoid open-ended questions and instead provide multiple-choice questions.
- In open-ended questions, make sure to clearly identify what an adequate response looks like. When dealing with sensitive subjects, use a method that makes the individual feel comfortable and able to provide appropriate answers.
- Keep the questionnaire as simple as possible.
- When working with a specific target group, avoid jargon and use language and vocabulary appropriate to the group.
- If questions include technical terminology, clear definitions should be available to respondents before introducing the question.
- The questionnaire should fit the survey method. The survey method should first be selected, and then the questions should be designed around the selected method.

#### *5.4.1.6 Pilot Test*

A pilot test is a pre-test that a researcher performs prior to the main survey to ensure the questions are not deficient and that the delivery method is effective. Sometimes pilot tests lead this research to revise the questions. Pilot tests can help this research avoid error and unnecessary costs related to improper delivery to participants. It is important to conduct the pilot test with actual respondents, and to make sure the pilot test is in accordance with the project needs and expectations ([Rea & Parker, 2012](#))

#### *5.4.1.7 Conclusion*

This research utilized expert opinions to amend the list of factors that influence a brownfield property owner's cost/benefit analysis. Data collected from the

expert panel will help amend the conceptual model that was proposed based on the literature review. The next section provides a literature review on opinion-based techniques to compare and contrast the advantages and disadvantages associated with each method. This will help this research select the most desirable technique for each of the research phases.

#### 5.4.2 *Opinion Based Research Techniques - Literature Review*

Social interaction is essential for producing quality group decisions. However, it is also argued, that social interaction may actually inhibit the quality of a group decision. Consequently, several group decision-making techniques have been developed to control factors that negatively influence the validity of opinions within a group setting. Among these are the staticized group technique, nominal group technique, focus group technique and Delphi panel technique. The purpose of this section is to review these methods in more detail and suggest the most appropriate method for this particular research project.

##### *5.4.2.1 Staticized Group Techniques*

Staticized surveys are a systematic way of collecting information from a particular knowledgeable group regarding a specific topic of interest. This type of survey typically involves one round of information collection from the participants. There should be zero interaction among participants and minimal interaction between the participants and the survey facilitator. This technique can be performed using either a survey or structured interviews. Surveys are typically used when the research objectives are clear. Interviews are typically performed when the research objectives are complex and more detailed information is required (Sillars & Hallowell, 2009). The staticized group survey method is in nature quantitative and has a wide range of applications. Some of the most popular applications include forecasting, marketing, elections and

public policies ([Babbie & Halley, 1995](#)). In a staticized group survey, a group of experts are asked to answer a set of questions. The aggregate responses are then used to make conclusions about the research.

#### *5.4.2.2 Nominal Group Techniques*

The nominal group technique is a group process that involves problem identification, solution generation and decision making ([Sillars & Hallowell, 2009](#)). The nominal group technique can be used for groups of varying sizes that want to make a decision quickly by means of voting. This technique is important because it allows for every participant's opinion to be considered. This is in contrast to traditional voting in which only the largest majority vote is considered.

In the nominal group technique, the facilitator states and clarifies the subject of brainstorming. Each team member anonymously writes down as many ideas as possible in a set period of time, and then the facilitator then records the ideas. In this process, zero discussion is allowed unless individuals are clarifying the terms. Each participant is given an equal opportunity to provide their thoughts. Duplicate ideas will be eliminated and final ideas will be prioritized by the group, one-by-one ([Harvey & Holmes, 2012](#)). The idea with the highest (most favorable) total ranking is selected as the final decision ([Boddy, 2012](#))

In the nominal group technique, often times the facilitator will encourage the group to share and discuss their reasoning behind each response. This helps with identifying a common ground as well as it identifies a variety of ideas and approaches. The diversity in responses allows for the creation of a hybrid idea, which occurs when two or more ideas are combined. Hybrid ideas are often decided to be better than the ideas initially considered ([Boddy, 2012](#)).

An advantage to this technique is that each member is free to present his or her ideas during an anonymous brainstorming session. Because of this, respondents are less likely to feel reluctant about responding for fear of being criticized or challenged by other participants ([Harvey & Holmes, 2012](#)). The nominal group technique has the clear advantage in ensuring relatively equal participation among participants. Additional advantages to the nominal group technique is that it produces a large number of ideas and provides a sense of closure not often found in less structured group surveying methods.

A major disadvantage to the nominal group technique is that this method lacks the flexibility to deal with only one problem at a time. In addition, there must be a certain amount of conformity among the group members. Each member must feel comfortable with the subject and the amount of structure that is involved with the process. Another disadvantage to the nominal group technique is the amount of time it takes to reach a conclusion due to the long process involved with this method ([Hutchings, Rapport, Wright, & Doel, 2013](#)).

#### *5.4.2.3 Focus Groups*

A focus group occurs when a group of individuals is asked about their perceptions and opinions toward a question or idea. Questions are asked in an interactive group setting where participants are free to talk with other group members.

The purpose of using a focus group in research is to acquire as much information as possible from a group of experts on a given topic. This is accomplished by prompting the group with pre-specified topics and open-ended questions. This allows for a group discussion to evolve and also facilitates interaction among participants. Focus groups allow participants to interject with their own observations and understandings while also feeding off the ideas of other participants. Focus groups are particularly useful when access to data is limited

and when this research is addressing a new idea or an emerging innovation ([Sutton & Arnold, 2013](#)). An advantage to focus groups is the fairly-low cost compared to other surveying methods. This is due to the fact this research can obtain results relatively quickly and can increase the sample size by talking with several individuals at once.

A disadvantage to focus groups is that they are often held in a setting where a moderator may dominate and possibly influence the group. This can lead participants to feel reluctant to respond or answer in a way that is consistent with what they think the moderator wants to hear ([Sillars & Hallowell, 2009](#)). Another issue with focus groups is the lack of anonymity. This may cause participants to feel reluctant about sharing their ideas in the presence of their peers and for fear of being rejected.

#### *5.4.2.4 Delphi Technique*

The Delphi method originated in a series of studies used by the RAND Corporation in the 1950s. The goal was to develop a technique to obtain the most reliable consensus among a group of experts.

While researchers have developed variations of this method since its introduction, Linstone and Turoff ([Linstone & Turoff, 1975](#)) have captured common characteristics in the following description:

“Delphi may be characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem. To accomplish this “structured communication” there is provided: some feedback of individual contributions of information and knowledge; some assessment of the group judgment or view; some opportunity for individuals to revise



views; and some degree of anonymity for the individual responses.”

The Delphi method is an interactive research technique used to capture the opinions of a panel of independent experts on a specific topic (Sillars & Hallowell, 2009). Researchers have applied the Delphi method to a wide variety of situations as a tool for expert problem-solving. Variations to this method have also been tailored to specific problem types and outcome goals. One variation that has received widespread use is the “ranking– type” Delphi, which is used to develop a group consensus about the relative importance of various issues ([Okoli & Pawlowski, 2004](#)). The majority of Delphi efforts were originally used purely for forecasting, both long- and short- term. The validity and long–range accuracy of the Delphi method is presented by Schmidt (1997). In later publication, Schmidt provides a detailed description of how to conduct the Delphi survey, including guidelines for data collection, data analysis based on non-parametric statistical techniques and reporting results ([C. O. Schmidt & Kohlmann, 2008](#); [R. C. Schmidt, 1997](#)). A key advantage to this approach is that it avoids direct confrontation among experts ([Sillars & Hallowell, 2009](#)). This technique also provides the flexibility of sharing information among panel members without letting any member dominate or control the opinions of other experts.

#### 5.4.3 *Selection of the Proper Opinion-Based Technique for this Research*

The purpose of this section is to compare and contrast the techniques and suggest the most appropriate opinion-based technique to study the proposed hypotheses. Sillars and Hallowell compared the quality of these opinion-based techniques with respect to complex, multistage tasks ([Sillars & Hallowell, 2009](#)). It was suggested that maintaining anonymity among respondents who are

making a group decision is important to avoid biased decision-making. The open exchange of information, opinions and criticism in a focus group may interfere with the optimal decision-making process of complex tasks. It was suggested that better decisions are made when opinions are shared without the direct influence of others who dominate and overpower the process. Experts in the Delphi method condition would produce better individual decisions than those in the focus group or nominal group settings. The Delphi method was selected by this research for this project because it demonstrates anonymity among respondents and emphasizes a group decision, both of which contribute to the avoidance of biased decision-making.

A comparison of the Delphi approach with other methodologies suggests that the Delphi methodology is the most favorable method for this research project considering the proposed scope, time limitation, geographic location and availability and willingness of resources. A summary of the Delphi method's advantages compared to other methods is presented below:

- 1) In the Delphi method, an appropriate group of experts who are qualified to answer the questions were selected. The goal was to reach a consensus among the group members after a number of iterations. This research administered the survey and analyzed the responses. In the second stage, this research compiled and shared the responses from the first survey with the Delphi panel members. The respondents were then asked to revise their original responses by considering other panel members feedbacks. The facilitator reiterated this process until the respondents reached a satisfactory degree of consensus. The panel members were kept anonymous (though not to the facilitator) throughout the entire process ([Sillars & Hallowell, 2009](#)).

- 2) The questions that a Delphi study investigates are those of high uncertainty and speculation. Thus a general population, or even a narrow subset of a general

population, might not be sufficiently knowledgeable in order to answer the questions accurately. A Delphi study utilizes a group of experts to find solutions to difficult problems where empirical data is not present ([Linstone & Turoff, 1975](#)).

3) The Delphi group size does not depend on statistical power, but rather on group dynamics for arriving at a consensus among experts ([Okoli & Pawlowski, 2004](#)).

4) Studies have consistently shown that for questions requiring expert judgment, the average of individual responses is inferior to the average produced by group decision-making processes. Research has explicitly shown that the Delphi method bears this out. Pretesting is also an important reliability assurance for the Delphi method. However, test-retest reliability is not relevant since researchers expect respondents to revise their responses ([Graefe & Armstrong, 2011](#)).

5) In addition to what is required of a survey, the Delphi method can employ further construct validation by asking experts to validate the facilitator's interpretations and categorization of the variables. The fact that the Delphi panel is not anonymous to the facilitator permits this validation step, unlike other surveys. Respondents are always anonymous to each other, but never anonymous to the facilitator. This gives the facilitator an opportunity to follow up for clarifications and further qualitative data with the respondent ([Linstone & Turoff, 1975](#)).

6) Non-responses are typically very low in Delphi surveys since most researchers have personally obtained participation assurance from each of the respondents prior to beginning the process. Delphi studies inherently provide richer data because of the multiple iterations they allow for and because experts have an

opportunity to revise their answers once they have the chance to see the other experts' point of views. Moreover, Delphi participants tend to be open to any follow-up interviews - should this research need further information ([Ono & Wedemeyer, 1994](#)).

## **5.5 Conclusion**

This research proposes to utilize a Delphi technique in order to find the level of consensus among a focused group of experts. The Delphi technique will allow this research to evaluate, validate the causal model and amend the model to include expert opinions. Once the model is expanded then the second phase will be to rank the level of influence each factor has on a brownfield property owner's decision-making process. The data collected from the surveys will be analyzed quantitatively and will be used to suggest recommendations for effective practices and alternative approaches to optimize brownfields revitalization. The findings will also provide suggestions for further assessment and research.

Figure 7 presents the application of the Delphi method throughout the phases of this research. The following chapters will describe detailed application of these methods and step-by-step planning, data collection and data analysis utilizing SPSS for each phase.

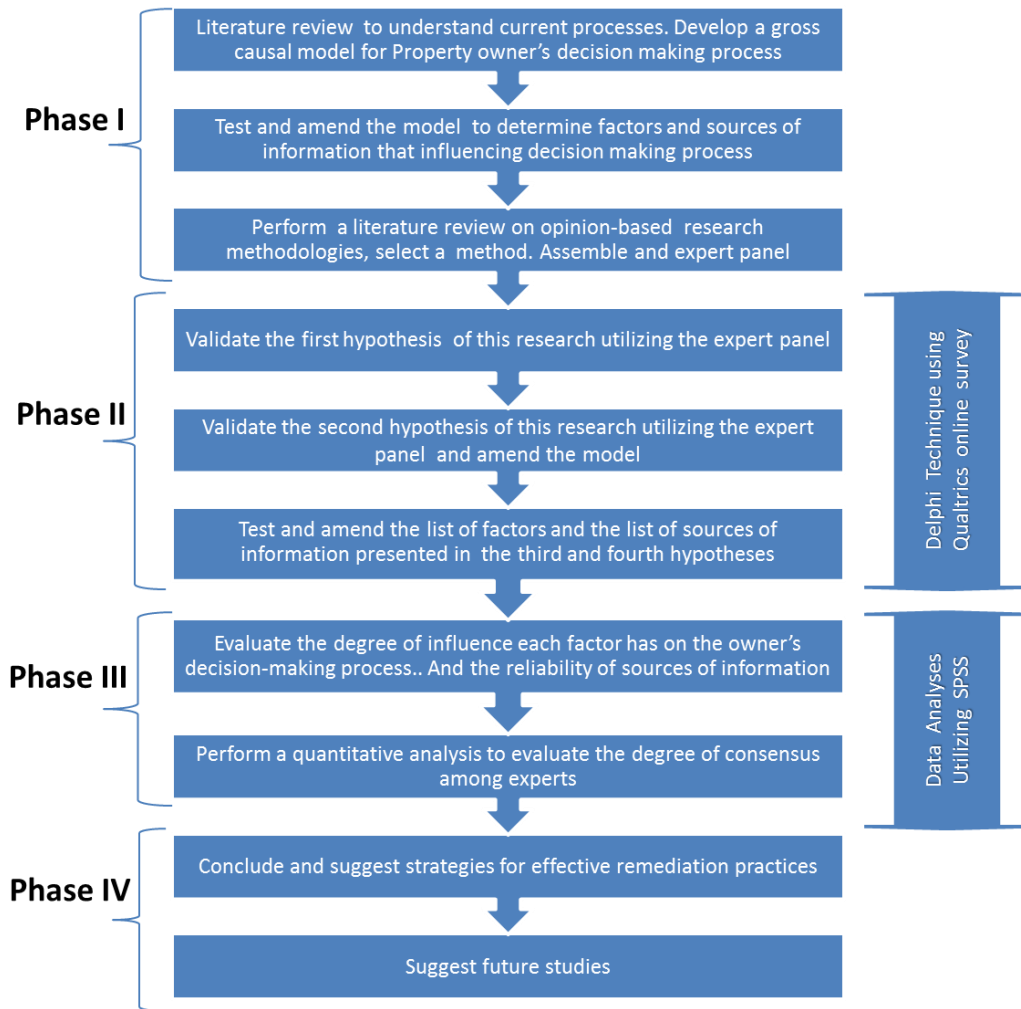


Figure 7 – Research Framework Utilizing Delphi Methodology

## **5.6 Chapter Summary**

This research proposed and utilized a two-tier data collection and analysis process. The first phase used the literature review to compile existing information and proposed a set of hypotheses along with a model to illustrate brownfield property owners' decision-making processes. The second phase of the research used expert opinions to amend the list of factors that influence a property owner's cost/benefit analysis. The responses from the expert panel helped this research validate and amend the conceptual model that was proposed by this research. The panel's responses also helped this research make suggestions about strategies to help improve the rate of brownfield remediation projects.

## **6 Chapter Six – Delphi Methods Considerations**

The increasing complexity of the socioeconomic aspect of the brownfield property issue makes it much more difficult for a single decision maker to consider all of the relevant factors that may affect a brownfield property owner's decision-making process ([Donati et al., 2004](#)).

Delphi technique was used in this research In order to seek expert opinion concerning brownfield property owners' decision-making processes. The Delphi technique allowed this research to easily test and evaluate the proposed causal model and amend the model to include each expert's opinions. This chapter describes the Delphi method that was used for Phase II of this research.

### **6.1 Testing Causal Factors Utilizing the Delphi Method**

In the causal model in Figure 5, it was hypothesized that major, complex factors influence a brownfield property owner's cost/benefit analysis. These factors are important to understand because they ultimately affect a property owner's decision to remediate the property or not, which relates to the rate at which brownfield properties are resolved nation-wide.

Each of the experts on the panel were asked to help amend the model by validation or suggesting additional factors and sources of information that influence a property owner's decision to remediate. The experts were asked to respond based on personal experiences and knowledge about the topic. In addition, this research asked experts to define the level of influence each factor and source of information has on a property owner's decision-making process. This research proposes that through a better understanding of a brownfield property owner's decision-making process, it may be possible to offer solutions for an improved revitalization process - beginning with possibilities for a more effective cost/benefit analysis. A few important steps must be considered when

using the Delphi method. The following sections will describe each step and the process that was used for this research.

### 6.2 Structure of Delphi Method

The common steps for the Delphi method are summarized in Figure 8. The flow chart shows the order of events and the role each round played in achieving a consensus among the panel members.

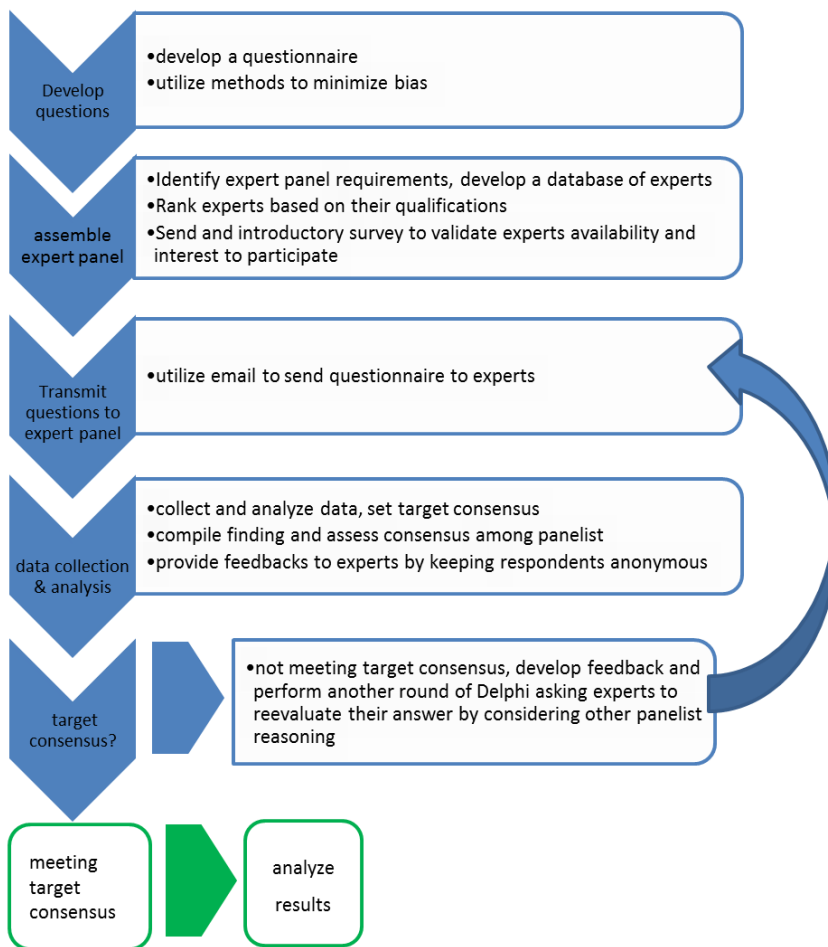


Figure 8 - Delphi Method Flow Chart.



### 6.2.1 *Develop Questionnaire*

Preparing a questionnaire is one of the most critical steps in the Delphi method. The survey can directly affect the quality of the data collected and ultimately the quality of the results ([Sanchez, 1992](#)). Good survey questions should be understood by all those in the sample population and should consistently motivate participants to respond to each of the questions. Each respondent should have equal access to the any information necessary to provide an appropriate answer unless the purpose of the research is to measure the sample population's knowledge about a given topic ([Rubin et al., 2014](#)).

There are some general principles that should be followed when designing a questionnaire for a Delphi research study. Close attention should be paid to the initial broad question, which acts as the focus of the Delphi survey. If respondents do not understand the initial broad question, it is possible the respondent will grow frustrated and provide inadequate responses. Generally, the purpose of the first round of the Delphi questionnaire is to brainstorm the feasibility of the research hypothesis ([R. C. Schmidt, 1997](#)). During the first round of surveys, the questionnaire is distributed to each of the Delphi participants, who then complete and return the survey to this research. It is important to provide a short summary of the literature review and the proposed research objectives as an introduction at the beginning of the questionnaire. If any of the questions use technical terminology, a clear definition for each term should be provided prior to introducing the question. This should be done regardless of the respondent's perceived knowledge about a subject matter. The responses from the first round serve as the foundation for developing questions for the second round of the questionnaire.

Depending on the research goals, this research may choose to direct the focus of the research or choose to be directed by the responses of the participants. If the purpose of the first round of surveys is to generate a list or verify a hypothesis, then it is common to consolidate the list during the second round of surveys ([R. C. Schmidt, 1997](#)).

In the second round of surveys for this research, the respondents had the opportunity to verify that all of the responses in the first round accurately reflect their opinion. The respondents were given an opportunity to change or expand on their previous responses after seeing what fellow panelists had to say. Requesting that the participants rank or rate the output from the first round of surveys is a common practice during the second round of surveys ([Holsapple & Joshi, 2002](#)). Continuous verification throughout the Delphi process is critical for improving the reliability of the results (Adler & Ziglio, 1996)

The second round of responses were used to develop questionnaires for additional rounds. The purpose of each subsequent round was to verify the results and better understand the boundaries of the research. As the survey rounds progressed, the questions became more focused on the specifics of the research ([Rowe, Wright, & Bolger, 1991](#)).

The initial round of questions is typically broad and open-ended in nature. The broader the question, the more data yielded, and ultimately less time consuming the analysis will be. On the other hand, survey questions that are more focused or structured can guide the Delphi participants toward a more specific goal. Deciding whether to include focused questions or broad questions is a significant decision that needs to be made early in the research design phase ([R. C. Schmidt, 1997](#)).

After selecting the Delphi Panel members for this research a set of questionnaires were forwarded to the panel for validation. For the first set of questionnaires, the panelists were asked about the first two hypotheses. The first two hypotheses include: 1) a property owner's decision-making process plays an important role that affects the slow rate of remediation and 2) A property owner performs a cost/benefit analysis to make a decision to remediate or not as proposed in causal model in Figure 4.

Once experts validated the first two hypotheses then this research sent the second survey to the panel requesting that each participant validate and amend the causal model. The respondents were then asked about two additional hypotheses. The second set of hypotheses includes: 3) verify the proposed factors and suggest additional factors that affect a brownfield property owner's decision-making process 4) validate the proposed sources of information provided by this research and suggest additional sources of information that a brownfield property owner may use during a cost/benefit analysis. The factors and sources of information suggested by this research are presented in Figure 5.

The results collected from the second questionnaire were compiled and shared with the panel members during the next round of surveys. The panel members were then asked to rank the factors and sources of information based on their perceived level of influence on a property owner's cost/benefit analysis.

Once the questionnaires were designed, several mechanisms to administer the research were studied including an online survey. Next sections provides information on how these questionnaires were distributed to Delphi Panel and how information were collected for this research.

#### *6.2.1.1 Mechanism for Administering the Questionnaires in this Research*

Several Delphi questionnaires were administered for this research through email using online survey software called Qualtrics. The advantage to this method is that it speed up the turnaround time between each of the questionnaires. This was important, as the Delphi method typically experiences problems related to the amount of time data-collection requires ([Powell, 2003](#)). This research estimated that it would take about a month to distribute and receive the completed questionnaires before analysis could be completed and the next survey was sent out. The following steps occurred during the distribution of the questionnaire. The first stage of the Delphi process was to verify the decision-making process proposed by this research in the causal model. The next stage was to present the factors that were hypothesized to have an influence on a brownfield property owner's cost/benefit analysis and decision-making process. The panelists were then asked to validate the factors, and if possible, were encouraged to add more factors to the existing list. The second stage involved first presenting the list of factors that were agreed on by the panelists in the earlier stage and then asking the panel members to rank the factors based on the perceived level of influence. The questionnaire and possible responses are presented below:

Questionnaire 1 – A demographic survey was sent to help this research select participants for the study. This research invited potential panel members to participate in the research and inquired about each individual's qualifications.

Feedback 1 – Select the Delphi panel members based on each individual's qualifications. Notify each panel member of their selection to participate on the Delphi panel and familiarized each panel member with the research problem statement, methodology and time commitment.

Questionnaire 2 – Ask the selected participants to validate this research's first two hypotheses. The first step involved asking the participants to verify that a

property owner's decision-making process does in fact play a key role in influencing the slow rate of remediation. The second step involved presenting a causal model that illustrates a property owner's decision-making process, as presented in Figure 4. The panel was then be asked to verify whether the proposed process is logical and accurate and if any changes should be made to the model.

Feedback 2– Collect responses, amend the proposed model when necessary and then present the amended model to the panel again for final discussion and further amendments.

Questionnaire 3 – Amend the causal model when necessary. Present the factors and sources of information that were indicated by the literature review, presented in Figure 5. The panel members were then asked to confirm the list of factors and sources of information, which included appropriate definitions. Participants were then asked to confirm the list and add any relevant factors or sources of information that may have been missing from the list and that they believe have an influence on a brownfield property owner's decision-making process.

Feedback 3– Consolidate the factors and sources of information provided by the respondents and eliminate redundancies. Share the findings with the panel members and asked for comments. If a consensus was not reached, repeat the survey an additional time.

Questionnaire 4 – Provide a list of the factors and sources of information suggested by the literature review that were validated and amended by the Delphi panel. Ask experts to rank each of the items based on their perceived level of influence on a brownfield property owner's cost/benefit analysis.

Feedback 4 – Collect the rankings for factors and sources of information provided by each of the panel members. Consolidate all results and analyze data utilizing descriptive statistical analysis.

### **6.2.2 Delphi Panel Requirements**

This section focuses on the requirements that were developed in order to select an expert panel that would evaluate and validate the research hypotheses, help amend the proposed model and provide data, which was later used to reveal disablers and enablers that affect brownfields remediation and revitalization. In order to facilitate this research and provide results within a reasonable amount of time, the panel members were selected from pre-existing rosters containing key brownfield stakeholders in the state of Oregon. The selected expert panel reviewed the decision-making process model hypothesized by this research and helped expand the causal model through suggestions to this research. The following sections elaborate further on the important parameters that were considered when selecting members for the Delphi panel.

#### ***6.2.2.1 Delphi Method Population***

For the purpose of determining the Delphi panel for this research, a database containing the key brownfield stakeholders in Oregon was compiled. This database included those involved with the Oregon Brownfields Coalition, board members from the National Brownfield Association in Oregon, active policy makers in Oregon's House of Representatives, the 2014 Brownfields Conference presenters and session-chairs, brownfields coordinators who work for local government agencies, policy makers and enforcers who have brownfields-related publications and members of local environmental groups and associations.

Three major brownfields stakeholder groups were selected from databases to include experts from the public sectors, private sectors and federal and state regulatory agencies. Below are explanations for each of the three major stakeholder groups that made up the Delphi panel.

The public sector consists of local governments, community groups, EPA grant recipients and nonprofit organizations ([EPA, 2006](#)). This sector is involved with brownfields remediation from a community and economic development standpoint. The public sector is primarily concerned with how local governments and communities can play a critical leadership role in the revitalization process ([McCarthy, 2002](#)). Local governments and community leaders generally want to return abandoned or idle sites to productive states in order to increase tax revenues, stimulate the local economy, prevent and reduce urban eyesores, improve the quality of life for those living around the property and the environment and conserve valuable unused properties ([Bogen, 2006](#)). In many cases, local governments and communities can serve as a catalyst for remediation projects. They do so by acting as intermediaries between the state government and property owners. In other instances, local governments and communities simply approve proposed property reuse plans to ensure the community and local government's current and future economic, social and ecological needs are being met ([Hynes & Lopez, 2009](#)).

The private sector is comprised of resources to assist brownfields remediation and revitalization projects. These resources include investors and lenders who are tasked with the responsibility of generating economic growth and earning appropriate returns on investments. The private sector also includes service companies that provide the necessary expertise to plan, design and implement remediation and redevelopment. Lawyers and insurers also fall under the private sector category and are responsible for managing the liability and risks

associated with brownfield properties ([Guevara & Deveau, 2013](#); [Neuman, 2007](#)).

Federal and state regulatory agencies play an important role in providing funds, technical assistance and resources to state and local government agencies. The purpose of these federal and state regulatory agencies is to help coordinate redevelopment projects and move brownfield projects forward. One of the EPA's most important roles is to ensure that information is shared among all stakeholders. The EPA serves as a catalyst at the regional level through efforts, like the Technical Assistance to Brownfields (TAB) program (Collin, 2006). Through the TAB program, the EPA's tasks range from identifying candidate sites to working with communities on public education and outreach involving brownfield projects.

State environmental quality organizations often act as the lead regulatory agency for most brownfield property cleanups unless the polluted site is listed under the national priority list or known as a superfund site in which the U.S. EPA has an overseeing role. In the state of Oregon, the Oregon Department of Environmental Quality (ODEQ) has the overseeing role for the majority of the state's 13,000 brownfield sites. The ODEQ offers incentives such as the Voluntary Cleanup Programs (VCP) ([ODEQ, 2005b](#)) and Prospective Purchaser Agreements (PPA) ([Landman, 2005](#)) in order to help property owners and private stakeholders manage environmental liability. Early involvement and communication with local regulatory agencies can help property owners avoid regulation issues later down the line.

A roster of more than 60 potential candidates from the three major stakeholder groups was compiled. A short biography for each of the candidates was constructed using the Business Oregon Brownfields Program roster. Each of the



experts, their biographical information and qualifications are presented in Appendix A.

The preliminary survey that validates each of the experts' qualifications, explains the research problem, outlines the procedures for the Delphi method and the time commitment is presented in Appendix A, as well. For this study this research requested that each panelist spend up to 30 minutes for each of the four sessions in order to respond to the surveys appropriately and entirely. After completing each of the questionnaires, the panelists were asked to return the questionnaire within one week. In all, each participant was asked to spend up to two hours over a one-to-three month time period. The preliminary questionnaire was sent to selected stakeholders from the expert database to confirm availability and willingness to participate as a Delphi panelist.

#### *6.2.2.2 Number of Participants*

The specific number of participants for a survey is related to the nature of the study, availability of the participants, demographic representation of each stakeholder group and also the capabilities of the facilitator ([Okoli & Pawlowski, 2004](#)). Most studies that have utilized the Delphi methodology suggest between eight and 16 panelists ([Rowe et al., 1991](#)). The literature review suggested that the number of panelists and the quality of the results do not directly correlate ([Powell, 2003](#)). For the purpose of managing bias in this research, an equal number of panelists (at least four) from each major stakeholder group were selected to form the Delphi panel. Assuming that some participants would not complete the entire survey process, the literature review suggested that a sufficient number of participants be selected at the beginning of the study to ensure that a qualified panel still exists at the end of the study (Hallowell, 2010)

### *6.2.2.3 Anonymity of the Participants*

Typically, each of the participants is to remain anonymous. It is important to keep each of the identities private, even after completing the final report. Anonymity prevents bias that could result from the possibility of a participant's authority, personality or reputation from dominating others during the process ([Yang, 2012](#)). Anonymity also eliminates personal biases among participants and allows for each participant to comfortably and freely express their opinions. Free expression of opinions can encourage open critique, and facilitate admission of errors when revising earlier personal judgments ([Geist, 2010](#)). In this research, participant identities were kept anonymous between panel members throughout the entire process. This was especially important considering the panel for the study was comprised only of Oregonian stakeholders and the small nature of the brownfields community in Oregon.

### *6.2.2.4 Delphi Panel Selection Criteria*

The selection process for the expert panel was systematic in order to avoid bias ([Sillars & Hallowell, 2009](#)). Based on the literature review, the following criteria were used for selecting the expert panel ([Hallowell & Gambatese, 2009](#); [Rogers & Lopez, 2002](#)). Below are the pre-defined guidelines that were developed and used as a screening method to select qualified experts:

- Accept the time commitment for the entire study.
- Have at least five years of experience related to brownfields site assessment and remediation.
- Have a college degree in one of the following fields:  
environmental law; environmental science; environmental engineering; financing, insurance; urban renewal; community planning or development.
- Belong to an active brownfields association in Oregon.

- Be a member of academia, research or a hands-on industry related to commercial site remediation and redevelopment.
- Be a brownfields conference presenter or member/chair of a committee related to a brownfields conference in Oregon.
- Be familiar with the EPA grants and revolving loan programs in Oregon.

### 6.2.3 Number of Rounds

In order to improve precision and reduce variance among expert opinions, multiple rounds of the questionnaire were solicited. The literature review indicated that multiple rounds of a Delphi method can yield more cohesive results among the experts. Several studies suggest that the number of rounds for a Delphi study should be between two and six rounds (Gupta and Clarke, 1996). The majority of these studies suggest that Delphi results are most accurate when the questionnaire is completed in less than three rounds. Few studies suggest that multiple iterations do not necessarily provide more accurate results (Dalkey et al., 1970). The actual number of rounds needed to complete the study is directly related to the answers provided at the end of each round and the degree of consensus among participants.

### 6.2.4 Feedback Process

Following each solicitation of the questionnaire, this research collected the responses and compiled them into an email that anonymously presented each of the responses to all of the experts. It was anticipated that reasoning and justification for each of the responses would be necessary for each of the repeated rounds. Research suggests that feedback, including reasons and justification, from respondents yield significantly more accurate results

compared to Delphi methods that only use feedback with statistical data (Row, 1999).

#### 6.2.5 *Bias Control*

Bias is defined as any factor that distorts the true nature of an opinion or observation. Bias in judgment is important to consider for this project because the effects from a cognitive decision can lead to inaccurate results (Tindale et al. 1994). Bias typically refers to the distortion of a statistical analysis and results from a method of collecting samples when the conclusion of the study is not based on an accurate judgment ([Mentzer & Lambert, 2015](#)). Because the Delphi method is a judgment-based research method, it was important to develop strategies that minimize any form of judgment-based bias. In this study, the structure of the Delphi process was designed in such a way that the influence of the decision-making biases were reduced and eliminated through the following considerations:

1. Members of the Delphi panel were to stay anonymous throughout the study.
2. Members of the Delphi panel were selected from diverse field of studies and practices related to brownfields.
3. Member of the Delphi panel were randomly selected from three major stakeholder groups and different subgroups within each group.
4. Members of the Delphi panel were selected based on widespread knowledge/involvement with brownfields projects across the state.
5. Raw data was shared among the members of the Delphi panel during each phase of survey and without any interpretation.
6. Questions were designed to be clear and free of ambiguity to the best of this research's ability.

### 6.2.6 Measure of Consensus

Variance is a common measurement of consensus. This is true in most cases; however, the level of variance that defines consensus is not the same for all studies. Data collected for different research projects is unique to each project. The level of acceptable variance for this study was defined based on the results collected from experts.

### 6.2.7 Generalization

The extent of statistical generalization of findings in the qualitative research are not well studied and understood ([Onwuegbuzie, 2010](#)). The purpose of this research was not to make statistical generalizations, but rather, the goal of this research was qualitative and sought to obtain expert insight into brownfield property owner's decision-making processes. The focus of this research was to look at the brownfields property owner's cost/benefit analyses from the expert's point of view. It has been hypothesized that a property owner's decision outcome is the main reason behind the slow rate of remediation. This research utilized an expert panel comprised of brownfields stakeholders from all three major brownfields group to better understand a brownfield property owner's decision-making process without false generalizations.

## 6.3 Chapter Summary

This research sought to collect and analyze expert opinions regarding the existing factors and sources of information that can have an effect on a brownfield property owner's decision-making process. This chapter provided detailed information regarding the Delphi research methodology. This chapter suggests strategies to develop an effective questionnaire, to select the Delphi panel members based on certain qualifications and to suggest a method to

distribute and collect data. An online survey software called Qualtrics was used to administer the study.

Since the Delphi method is a judgment-based research method, the importance of bias control was studied and strategies were developed to minimize bias. A few of the important parameters included keeping the Delphi panel members anonymous and selecting members of Delphi panel from diverse fields of study and practices related to brownfields.

The next chapter will provide a detailed description of this research's implementation of the Delphi methodology to examine validity of each proposed hypothesis, and to collect expert opinion data to perform descriptive statistical analyses.

## **7 Chapter Seven – Establishing the Delphi Panel**

### **7.1 Preface**

This chapter is devoted to the implementation of the Delphi method, which consists of an expert panel with individuals from each of the three key stakeholder groups – public, private and regulatory. Brownfield property owners were not included in this phase of the research. The next sections will provide a detailed systematic description of all the phases of the Delphi panel surveys.

### **7.2 Phases of the Delphi Panel Survey**

This research required several rounds of surveying to verify the proposed hypotheses in each stage with an acceptable level of consensus among panel members. The number of surveys and purpose of each survey in this research are presented below:

First Survey - Demographic survey - Members of the Delphi panel were selected based on certain qualifiers established by this research.

Second Survey – Participants were asked to verify the following two hypotheses:

Hypothesis 1 – The property owners are primary decision makers in the remediation process, Figure 3 in Chapter 2.

Hypothesis 2 – The decision process is as it is presented in the causal model in Figure 4 in Chapter 3.

Third Survey – Amend the model with the factors and sources of information that may influence a property owner's decision-making process suggested in the literature review. This research shared findings with the Delphi panel members and asked them to add additional factors and sources of information based on their personal experiences and knowledge.

Hypothesis 3 - Important factors affect a brownfield property owner's decision to remediate, and are as presented in Figure 5 in Chapter 4.

Hypothesis 4 - Important sources of information are used by a brownfield property owner in measuring the effect of the important factors noted in Hypothesis 3, and those are as presented in Figure 5 in Chapter 4.

Fourth Survey – The panel was asked to rank each of the factor's influence on a brownfield property owner's decision-making process and rank the reliability of the sources of information. The panelists were asked to identify what source(s) of information are most likely used by property owners for each given factor. In addition, they were asked to provide an explanation to support their selection.

### **7.3 Implementation of the Delphi Method**

This section presents detailed information regarding the Delphi method application for this research following findings from the literature search in Chapter 6.

#### ***7.3.1 Independent Review Board (IRB) Approval***

The first step in implementing the Delphi method was to gain approval from Oregon State University's Independent Review Board (IRB). The required information was gathered and presented to the IRB office, and the application was approved in July of 2015.

#### ***7.3.2 Delphi Panel Selection Process***

For the purpose of selecting the Delphi panel members, a database containing brownfield stakeholders' information was compiled using multiple organizations and networking groups that maintain active roles in brownfield programs in Oregon. Below is a summarized description for each brownfields organizations:



**Oregon Brownfields Coalition** – Key organizational coalition members include the Association of Oregon Counties, the League of Oregon Cities, Oregon Metro, Business Oregon, the Department of Environmental Quality, the U.S. Environmental Protection Agency and other local public, private and nonprofit agencies that collectively play important roles in reshaping brownfields remediation and revitalization processes. Such roles range from policy-making to the recapitalization of Oregon's brownfields redevelopment fund.

**Northwest Environmental Business Council (NEBC)** – A nonprofit trade association that represents the interests of its members, while promoting the health of the industry and the environment as a whole. The NEBC was formed as a regional organization in 1996. It now acts as the recognized voice of the industry and advocates for science-based regulations, supportive policies and tax structures, the diffusion of knowledge from experts to communities and the adoption of best practices. NEBC members cover a wide spectrum of private sectors, including engineers, consultants, contractors, scientists, lawyers, technology and product providers, insurers, project developers, financiers, architects, business-support professionals and a host of other disciplines and organizations.

**Oregon Brownfields Conference** – The 2014 Oregon Brownfields Conference roster was also used to establish the major brownfields stakeholder groups, with the exception of brownfield property owners. The roster includes conference presenters and session chairs.

In compiling this database, a few key factors were considered. The potential Delphi members were selected from the three major stakeholder groups (private, public and regulatory). The focus of this research is to understand the perceptions of brownfields experts regarding owners' decision processes whether to remediate their properties; therefore the fourth major stakeholder

group, property owners, was eliminated from the database. The result was a list of experts in the non-owner stakeholder groups (private, public or regulatory).

Bias control is important in this research and precautions were taken in order to control bias, as addressed in Chapter 6, Section 6.2.5. Because judgment-based research techniques were used in this research, it was vital to control bias through the use of the Delphi technique. The following sections provide a detailed description of the steps that were taken in order to objectively select the Delphi Panel members for this research project.

#### *7.3.2.1 Delphi Panel Selection -Primary Step*

A database with more than 90 brownfields stakeholders was compiled to include a short biography for each stakeholder, as well as each stakeholder's contact information (phone number and email address). The first screening process removed stakeholders who reside outside of Oregon and brownfields property owners. As a result of the first screening, the number of stakeholders was reduced from 90 to 69 individuals. The database was then used to send an email notifying stakeholders about an Oregon State University research project in which their participation was requested. An indication of the time commitment for each phase of the research was also included. A total of 31 stakeholders were eliminated from the database after this step either due to a lack of interest or an invalid email address.

#### *7.3.2.2 Delphi Panel Selection – Second Step*

In the second stage of the Delphi panel selection, an online survey software, called Qualtrics, was used to communicate and collect data from potential Delphi panel members. Qualtrics allowed this research to obtain data in a timely manner through effective distribution of the questionnaire and allowed panel members eased access to detailed information concerning the research project. The software also enabled this research to interact, share results with and

distribute the panel's anonymous comments among panel members in later phases of the research.

The purpose of the next phase of the survey was to screen for the qualifications of those who accepted the invitation to participate. A predefined, systematic and unbiased approach, adapted from the literature review was used to develop a screening method ([Sillars & Hallowell, 2009](#)). Qualified experts were selected based on the following criteria:

1. Personal Criteria
  - a. Years of education
  - b. Educational degree/field
  - c. Years of professionally related experience in environmental regulations, site assessment, feasibility studies and remediation of contaminated sites
  - d. Years of experience involving brownfields projects in Oregon
  - e. Academia membership or involvement in research related to brownfields
  - f. Familiarity with EPA grants and revolving loan programs
  - g. Affiliation
2. Publications and Conference Participation
  - a. Publication in peer-reviewed journals
  - b. Conference presentations
  - c. Author/co-author of books
  - d. DEQ or EPA publications
3. Brownfields Stakeholder Group Involvement
  - a. Public, private or regulatory – the group that currently reflects the individual's principal activity
4. Geographical Based Research

- a. Assuming Oregon is divided into four regions, Figure 9
- b. the number of brownfields projects the individual has been involved within each region



Figure 9 – Oregon Regions divided based on their counties

A Qualtrics online survey was designed based on the predefined guidelines set by the Independent Review Board (IRB). The Qualtrics survey included summaries of the research goals and objectives, the problem statement, an explanation of the Delphi research technique and an estimation of the time commitment each participant could expect.

**7.3.2.3 Delphi Panel Selection – Final Step**

From the 33 people who responded to the demographic survey, a total of 22 experts were selected to serve on the Delphi panel. This research decided to limit the expert panel to those living in the state of Oregon. The criteria for selecting panel members was based on personal credentials, level of involvement in brownfields related projects, active participation in brownfields associations and project experience, as outlined below:

1. At least a four-year college degree in environmental remediation or revitalization-related field of study.
2. Experience in brownfields remediation and revitalization in the various geographical regions around Oregon.
3. Affiliation with brownfields associations – Oregon-based organizations were preferred.
4. Belonging to a public, private and/or regulatory stakeholder group.
5. Experience working with brownfields projects in the various geographical regions around Oregon, as presented in Figure 9.

The three stakeholder groups were then divided into subgroups based on each of the panelist's roles involving brownfields projects. A complete demographic of the selected stakeholder groups and their subgroups are presented in Appendix A and Table 2 shows a summary of the number of Delphi panel members selected from each stakeholder group.

Stakeholder Group	Stakeholder Role	Delphi Panel Member
Private	Lawyer	3
Private	Planning	2
Private	Remediation	3
Private	Revitalization	3
Public	Assessment	3
Public	Economic Development	2
Public	Policy Maker	1
Regulatory	Community Outreach	2
Regulatory	policy enforcer	2
Regulatory	Policy Maker	1

Table 2 – Delphi Panel Members

Below is a definition for each of the stakeholder subgroup members based on their roles in brownfields remediation and revitalization projects:

#### Private Sector

- **Lawyer** – Environmental lawyers who primarily consult property owners to help manage environmental liabilities, respond to regulatory agencies regarding enforcement and manage third party litigation. Lawyers can also help buyers, or future brownfields owners, and developers with Prospective Purchaser Agreements and regulatory negotiations.
- **Planning** – Environmental consultants who help property owners with cost estimates and planning for property remediation and revitalization. Any individuals with experience in financing, liability insurance, zoning, property end use and risk management will qualify as a member in this

area. The main qualifier for this subgroup is extensive experience in a multi-functional role with numerous brownfields revitalization projects in the state of Oregon.

- Remediation – Experts with degrees in environmental engineering/geology that have extensive project experience with implementing remediation technologies and brownfields cleanups in any of the four regions in Oregon.
- Revitalization – Experts with extensive financing experience or experience with the construction and redevelopment of brownfields properties in any of the four Oregon regions. The priority was given to those with experience in rural areas in Oregon – preferably in the northeast, southwest and southeast regions in Oregon.

#### Public Sector

- Assessment – A state or local public agency employee who has been the recipient of an EPA assessment grant. This also includes program managers who have studied the extent of the brownfields problem in Oregon.
- Economic Development – Program managers who have received federal or state funding to assist brownfield property owners with the financial needs associated with bringing brownfield properties to full-economic potential, and in turn bringing entire communities and properties surrounding brownfields to full-economic potential.

#### Regulatory Sector

- Community Outreach – State or federal agents who reach out to property owners and communities to educate, raise awareness, provide technical

assistance to and direct those who are at risk, including property owners, about the proper steps for cleaning up contaminated properties.

- Policy Enforcer – Regulatory agency project managers and program managers who work with ODEQ or EPA region 10 (overseeing EPA's interest in Oregon). The primary role of these individuals is to protect the environment and human health through the enactment and enforcement of regulations, issuance of program guidance and providing technical assistance.
- Policy Maker – Experts who are actively involved with state legislators and enact brownfields regulations in Oregon.

In order to control bias and avoid generalizations, at least two members from each subgroup were selected. A total of 22 experts were selected to participate as Delphi panel members for this research. The selections were made with a focus on current job positions and primary roles regarding brownfields matters in Oregon. Panel member identities were kept anonymous throughout the study.

## **7.4 Chapter Summary**

This chapter presented all the phases of the Delphi panel surveys. It focused primarily on the first step of implementing this methodology and the Delphi panel selection process. Databases for multiple organizations with members who have active roles in brownfields programs in Oregon were used to compile a list of qualified experts for the panel. The experts were selected based on experience and individual roles pertaining to brownfields remediation and revitalization projects. A total of 69 experts were selected and contacted via email inviting them to participate in this research project. A demographic survey was sent to those who had agreed to participate in the research. The demographic survey was designed based on a predefined, systematic and



unbiased approach, adapted from the literature review. The demographic survey assisted the researcher with selecting the most qualified experts for this project. A total of 22 experts were selected based on their level of experience and involvement with brownfields remediation and revitalization projects in the four proposed regions in Oregon. In addition to the fact the experts were selected from the three primary stakeholder groups, the researcher was concerned with each individuals' expertise in multiple disciplines including environmental law, planning, remediation, revitalization, assessment, economic development, policy making, community outreach and policy enforcement. In order to control bias, at least two members from each discipline were selected and all panel members remained anonymous throughout the study.

The focus of the next few chapters is to seek experts opinions regarding the proposed hypotheses in this research, which utilized Qualtrics, an online survey tool.

## **8 Chapter Eight – Validation of Owner's Role**

After selecting the Delphi panel, the next phase of the research was to seek expert opinions on the first two proposed hypotheses. An online survey was presented to Delphi panel members that included sections to familiarize the Delphi panel members with the problem statement, research objectives and this research's first two hypotheses.

### **8.1 Presenting the Problem Statement**

Respondents were provided with a definition of the brownfields problem statement, the research objectives, goals and benefits of this research, which include improving the rate of remediation in the state of Oregon. A copy of this survey can be found in Appendix B.

This dissertation sought to provide insight into the decision-making processes of brownfield property owners who often face funding uncertainties, legal liability questions, potential property-use doubts, clean-up technology options, costs, potential public health effects and other considerations. This research hypothesized that the remediation process begins with a property owner's decision to remediate. The property owner's decision is inherently based on balancing the perceived benefits and disadvantages (costs) associated with remediation. This research sought to: 1) identify the major factors in the cost/benefit analysis and the degree of importance those factors play in a property owner's decision-making process and 2) identify the major sources of information and their reliability to brownfield property owners.

The sections below will introduce the first two hypotheses of this research:

### 8.1.1 First Hypothesis Validation – Owners' Role

This research explored the commonly understood remediation process that unfolds once a decision is made to remediate a property. It is important however, to understand that the process does not emphasize the important first step, which is that a brownfield property owner must first make a decision to move forward with a revitalization project. This dissertation proposed to add this important first step to the model. The resulting model is presented in Figure 3, Page 39. The first hypothesis of this dissertation proposes that the property owners are primary decision makers in the remediation process.

### 8.1.2 Second Hypothesis Validation - Owner's Decision Process

This research proposed that a property owner's decision to move forward with brownfield remediation is based on a semi-qualitative cost/benefit analysis. The factors influencing a property owner's decision to remediate need to be identified, prioritized and evaluated. In order to do this, this research must obtain information regarding these factors. It is important to understand to what degree the information available to property owners is reliable and to what extent this information influences a property owner's decision to move forward with brownfield remediation. The second hypothesis of this dissertation proposes that the decision process is as it is presented in the causal model in Figure 4 on Page 25. The survey sought verification from experts concerning whether the proposed conceptual model of the property owner's decision-making process was a reasonable representation of the chain of events that occur.

### 8.1.3 Results

A total of 20 experts responded to the second Delphi panel survey. Two participants dropped out of the research project during this phase.

All 20 respondents agreed with the first hypothesis. The panelists confirmed that adding brownfield property owners as the primary decision-maker in the remediation process is an acceptable and necessary addition to the remediation flow process. The panelists' general discussion and comments pertaining to this hypothesis are presented in Appendix B. Highlights from the panelists who generally agreed with the proposed hypothesis, but had additional comments to be considered include:

- Potential buyers can assume liability of clean up through PPA agreements with the DEQ.
- Properties with contamination prior to 1985 are eligible for insurance coverage under pollution provisions, which will pay for environmental cleanup cost.
- If there is a regulatory enforcement, then the property owners have no choice but to decide to remediate."

Comments provided by the panel members in this phase of the study were taken into consideration as factors that influence a property owners' decision-making process. These comments are considered during future phases of this research.

A total of 15 panel members verified the second hypothesis of this dissertation. They agreed that the decision process as it is presented in the gross model in Figure 4, Chapter 3. This model assumes that a property owner's cost/benefit analysis is the basis for a decision whether to remediate and affects the rate of remediation. Five panel members disagreed with the proposed model for the following reasons:

- Two respondents commented that a brownfield property owner's decision to remediate goes beyond economic reasons.
- Additional step needs to be added to the model. The initial step needs to capture the concept that property owner before contemplating cost/benefit analysis must be convinced that they are willing to take a risk
- Not sure that owners acquire reliable information before making a cost/benefit analysis. The cost of reliable information may be prohibitive in itself."
- The model presents a brownfield property owner's decision as a single decision. A cost/benefit analysis is very different depending on why the remediation is being considered to begin with. For example, a decision to remediate is different if a regulatory enforcement or third party litigation is in place

It was apparent from the comments of those panelists who disagreed with the model that the term "cost/benefit analysis" was assumed to only imply monetary values. This assumption is wrong and it was deemed necessary by the researcher to clarify this term prior to collecting expert's opinion for future surveys. The researcher did so by providing a better explanation of the term "cost/benefit analysis." In this research, the term "cost/benefit analysis" is not restricted to calculating and comparing monetary values. Instead, this dissertation uses the term more broadly to account for a property owner's estimated strengths (positive) and weaknesses (negative) of alternatives to brownfields revitalization. The "cost/benefit" term is similar to the concept of a pro/con decision-making process used by property owners to determine whether to remediate a property or not.

In addition, and for the remainder of this research, the proposed causal model was modified and a better description of the cost/benefit component of the model provided in response to panel members that were not clear on the proposed model. As part of the introduction to the next phase of this research, it was explained that the first box in the causal model in Figure 4 on Page 58 represents the owner entering into a decision-making process. The area within the dotted line represents the property owner's decision-making process in which important factors and sources of information were considered. If the owner's cost/benefit analysis presents a negative outcome, then the property owner's decision is to remain inactive. Therefore, the owner's decision has a negative impact on the rate of remediation. If the analysis presents a positive outcome, then the property owner is likely more motivated to move forward with remediation, thus increasing the rate of brownfields remediation.

All of the raw data collected in this phase of the study is presented in Appendix B.

## **8.2 Chapter Summary**

This chapter presented the Delphi panel responses to the first two hypotheses of this research. There was a collective agreement on the first hypothesis among the panel members and a high level of agreement among the panelists for the second hypothesis.

In regards to the first hypothesis, all 20 brownfields experts of this survey confirmed that adding the brownfield property owner as the primary decision-makers in the remediation process was an acceptable and necessary addition to the remediation flow process.

The second hypothesis proposed that a property owner's cost/benefit analysis affects the rate of remediation. A causal model of the property owner's decision-

making process was presented showing that a property owner's cost/benefit analysis is influenced by a set of factors and the sources of information obtained property owner obtains during the process. From the 20 panelists, 15 agreed with the proposed model. Five panelists disagreed with the hypothesis and provided suggestions that were taken into consideration for the next phase of the study. Before the next round of questions, this research provided the panelists with a more comprehensive definition of the term "cost/benefit analysis" in order to clarify the true meaning for this particular research project.

During the next phase of this research, the Delphi panel members were asked to validate and amend the proposed model by suggesting factors and sources of information that are believed to influence a property owner's decision-making process.

## **9 Chapter Nine – Remediation Decision Factors and Sources of Information**

Brownfield property owners must conduct an analysis, herein envisioned as a cost/benefit analysis, in order to make a decision to remediate, redevelop or sell a property. The cost/benefit analysis can be difficult to assess considering there are many factors that could introduce uncertainty and high levels of perceived risk for property owners. It is proposed that a property owner's perception of both positive and negative factors play a role in the decision-making process to ultimately remediate or not. It is possible for a property owner to conclude that property remediation/a property transaction will not be beneficial if these perceptions are based on poor information or a poor evaluation of information. Therefore, an owner's perception of the factors, including the uncertainty or risk surrounding the factors, is an important element that contributes to the slow rate of brownfields remediation and revitalization.

This dissertation proposes the model introduced in Chapter Four. A set of factors and sources of information that influence a property owner's decision-making process, suggested by the literature review, were added. The amended model is presented in Figure 5, on Page 69. This next phase of the Delphi panel survey focused on further development of the proposed model by testing the factors and sources of information, refining definitions for each factor and source of information and removing factors and sources of information deemed unnecessary by the Delphi panelists. This chapter will describe the next two hypotheses that were presented to panel members, the panelists' feedback, and a detailed analysis of the collected information.



### **9.1 Third Hypothesis Verification - Important Factors that Affect a Brownfield Property Owner's Decision to Remediate**

This research hypothesized that a set of factors influences a brownfield property owner's cost/benefit analysis regarding property remediation as presented in Figure 5. This phase of the research explored potential factors that may influence property owners. Using Qualtrics software, a third online survey was prepared and sent to Delphi panel members. A copy of this survey is provided in Appendix C. In this survey, this research provided a set of factors known to influence a property owner's decision to remediate or not. These factors were discovered in both the literature review related to brownfields revitalization and the human decision-making process theory presented in Chapters 2 and 3 of this dissertation. The Delphi panel members were asked to review and verify these factors. A summarized definition for each factor is provided in Table 3. In addition, the panel members were asked to use personal experiences to add no more than five additional factors to the list, along with the reasoning as to why these factors are important for a property owner's cost/benefit analysis.

Factors	Definition
Responsible Party	Responsible parties are individuals, companies or any other party that is potentially liable for causing the release of hazardous materials into the environment.
Regulatory Enforcement	State and federal agencies hold responsible parties financially responsible for reversing environmental pollution.
Loss of Business	Property owners may fear losing their existing business if their site has been tagged with real or perceived environmental concerns.
Cost of Remediation	Remediation is expensive and there are many unknowns that result in a perceived risk of high costs associated with remediation. Brownfields revitalization has to bear the added costs of remediation.
Time Required to Remediate	The time required to fully remediate a brownfield site may delay the revitalization process, which may result in a loss of revenue.
Third Party Litigation	The release of chemicals to groundwater may result in impacting soil and groundwater to adjacent properties, which could embark third party litigation.
Community Expectations	Brownfields are usually eyesores in communities, which can have a negative effect on economic growth of neighboring properties.
Health Hazard	The possible release of hazardous chemicals may cause human health hazards by different exposure pathways including vapor intrusion into buildings on or near brownfield properties.

Table 3 – Factors Influencing Property Owners' Cost/Benefit Analyses.

## 9.2 Fourth Hypothesis Verification – Important Sources of Information Used by a Brownfield Property Owner.

Brownfield property owners rely heavily on any available resources in order to make a decision to remediate a property or not. Based on the literature review, this research proposed a set of informational sources that may have an influence on property owners' remediation decisions. These sources are presented in the

amended causal model in Figure 5, and Page 25. This list and a definition for each was provided to the Delphi panel and is presented below in Table 4.

Source of Information	Definition
Popular Media	News media have been known to have a strong effect on the public's perception of risk. Stories available on news media about liabilities associated with contaminated properties and legal consequences may effect decision process
Personal observation	Physical appearance of a site might create false perception of risk in individuals
Community perception	Threat of creating a bad reputation amongst the members of the community influence decision process
Site history	Historical usage of a commercial site can provide key information on possible environmental concern.
Personal information	Intuitive feelings based on past experiences are usually being used to make decision. Emotions such as fear has a negative effect when the recipient feels the risk is high
DEQ data base	ESCI has a public on line database that offers real information on environmentally challenged sites registered with DEQ. Also DEQ has guidelines for how to remediate a site
EPA data base	EPA has sources of information and guidelines to help property owners with brownfields remediation
Consultant	Professional environmental consultants can help a property owner to find solution to their brownfield's problem

Table 4 –Source of Information Available to Property Owners

Panel members were asked to verify the suggested sources and add no more than three additional sources based on personal experiences. The panel was also asked to provide an explanation as to why the sources of information are important to consider. A copy of the Qualtrics survey is provided in Appendix C.

## 9.3 Results

A total of 20 experts responded to the second Delphi panel survey. Experts were asked to review the list of factors and sources of information provided by this research. This research then asked the panel to provide additional factors and sources of information based on personal experiences pertaining to brownfields.

The data was reviewed, summarized, and compiled into a series of tables including influencing factors, sources of information and Delphi panel members' comments for each item. A content analysis was performed in order to categorize and extract the key factors and sources of information as suggested by the panel members. The next section describes the methodology and steps that were taken in order to make conclusions from this phase of the survey.

### 9.3.1 Content Analysis

Content analyses are typically used when qualitative content is present. A qualitative content analysis begins with categorizing and classifying terms for easier evaluation. To make a valid inference from the text, it is important that the classification procedures be reliable in the sense that they are consistent ([Stemler, 2001](#)). Categorization and classification should be done in a way to avoid bias and to obtain objectivity. It is very important to clearly define keywords so that two or more people are able to obtain the same results from the same dataset ([Neuendorf, 2002](#)).

#### 9.3.1.1 *Content Analysis - Factors*

A content analysis was performed to look for trends and to systematically analyze the content from the Delphi panel's comments in response to Hypothesis 3. An analysis was conducted through the classification, tabulation and evaluation of keywords to determine various themes shared by the panel

members. The assumption of a content analysis is that words and phrases mentioned in the dataset are reflective of important key factors.

Raw data collected during this phase of the study was studied carefully in order to first extract keywords from the experts' comments. This research determined word families based on other words used by the panelists that had similar meanings. The keywords with the same purpose and meaning were then tabulated under the same categories. Each category was then assigned to a key factor, either one suggested by this research or one of the additional key factors suggested by the panel members. A summary table of this categorization and classification process is presented in Table 5.

Responsible Party	fear of being recorded in public data bases as a liable person	Fear of site being added to government database		
Regulatory enforcement	Driver to clean up and sale	How cooperative and creative regulatory agencies are		
Third party litigation	third party involvement			
Funding	Availability of funds	public loan - government cleanup revolving loan	Federal and state funding	ease of private funding
Incentives	Public- private investment	land banking	Tax abatement	grants
Risk mitigation	insurance	liability protection	share liability	Perspective Purchaser agreement
Trusting resources	ability to trust other stakeholders for info.	regulatory agency cooperation		
Property Location	Market Driven	status of surrounding properties	Overall development in the area	
Health hazard	health and environment hazard			
Cost	Uncertainty of cost	risk of change in regulation resulting in higher cost	future challenges	
Time	uncertainty of time	agency review time	loss of market opportunity	
Loss of existing business	Asset to property owner	Partially or fully dependent on revenue generated by business		
Future financial gain	Return on investment	Marketable/usable after remediation/prospect of sale	Progress through process	Development opportunity
Stigma	Community not comfortable to rent or lease	Community perception of hazard		
Community acceptance	community acceptance			
Civic stewardship	Reputation reward	Personal desire	Marketing tool as being sustainable	
Personal life situation	personal issues with negative impact	health and financial issues	Inertia - no desire to change	

Table 5 – Content Analysis – Factors

A summary definition for each key factor is presented below:

**Factors:**

**Listing as a Responsible Party** – The risk that the discovery of hazardous materials in the environment could result in a government listing on a public database.

**Regulatory Enforcement** – The risk that regulatory agencies will hold the owner financially accountable for reversing any environmental pollution to the environment.

**Third Party Litigation** – The risk that the release of hazardous chemicals may result in contamination to the soil and groundwater on adjacent properties, which may embark third party litigation.

**Available Funding** – The chance of eased access to available public or private funding to facilitate remediation.

**Incentives** – The availability of incentives through government assessment grants, land banking, tax abatement and private/public partnership financing to reduce a brownfield property owner's cost of assessment and remediation.

**Liability Mitigation** – The availability of liability-reducing resources to help manage environmental-related remediation liability through insurance and/or a Prospective Purchaser Agreement.

**Distrust of Resources** – A property owner's perception that regulators and private sector professionals (consultants, lawyers, etc.) are not trusted team members to help make appropriate decisions, increasing the potential for unexpected losses.

**Property Location/Prime** – A property is situated in a prime location where economic viability exists, increasing potential for commercial gain in an expansion of the commercial use of the property post-mitigation.

**Property Location/Distressed** – A property is located in a distressed area where redevelopment does not appear to yield economic rewards, yielding risk of low property

values or low commercial gain.

**Public Health Hazard** – The possible release of hazardous chemicals may pose a threat to public human health and the larger environment, yielding liability from regulatory agency action.

**Cost of Remediation** – An owner's belief that they must bear the expensive costs of remediation, which includes many unknowns and may result in a perception of high cost.

**Time to Remediate** – The time required to fully remediate a brownfield property is highly variable and may delay the revitalization process, resulting in a loss of prospective revenue.

**Loss of Existing Business** – For property owners who are partially or fully dependent on existing business revenue, any activity that negates the perceived value of the current commercial asset will create a significant commercial loss.

**Future Financial Gains** – Once remediated, the improved potential property use causes an increase in real estate value.

**Stigma** – Brownfields usually attract attention and are perceived as eyesores within communities. A property's association as a prior brownfield maintains a negative effect on the economic growth of neighboring properties, reducing the value of the mitigated property.

**Community Acceptance** – The community is supportive of the potential development, increasing the real estate value and commercial potential.

**Civic Stewardship** – A property owner is motivated by a decision to leave a redevelopment legacy that contributes to the livability of a community.

**Personal Life Situation** – A property owner is dealing with health or financial issues.



### 9.3.2 Content Analysis – Sources of Information

Raw data collected in response to Hypothesis 4 of this research was studied carefully to first extract keywords from the panel's comments. Next, this research determined word families used by the panel members that pertain to the same or similar subjects. The keywords with the same purpose and meaning were then tabulated under the same categories. Subsequently each category was assigned to a key source of information, either one suggested by this research or one suggested by the panel members. A summary of this categorization and classification process is presented in Table 6, followed by a summary definition for each key source of information.

Popular Media				
Personal observation	Personal information	Intuitive feeling based on the past experiences	Emotions and excitement to do good	
Community perception	Community survey			
Site history	Site specific data, past & present	Former owner	Former employee or neighbor	History of neighboring sites
Personal information				
DEQ data base				
EPA data base				
Private resources	Environmental consultant	Insurance agent/Broker	Environmental lawyer	Brownfields developers
City and County files	Historic records/sources , Sanborn Maps	police reports for vandalism/ neighborhood health and safety reports	Local land use or zoning/ insurance records	Property transactions
Financial institute				
Local government resources	Planning/redevelopment department	Regulatory agencies project manager, DEQ staff	Economic development personnel/ public funding/ business Oregon staff	Neighborhood

Table 6 – Content Analysis – Sources of Information.

A definition for each source of information is presented below:

**Sources of Information**

**Popular Media** – Stories available on popular news media about liabilities or benefits associated with contaminated properties and legal consequences may affect the decision-making processes.

**Property Physical Appearance** – The physical appearance of a site that is apparent to the owner.

**Community Sources** – Any interaction with community members or community organizations may serve as source of information.

**Historical Site History** – The historical usage of a commercial site can provide key information on possible environmental concerns.

**Personal Information** – The intuitive feelings based on past experiences may be used in making a decision. Emotions, such as fear, have a negative effect when the recipient feels the risk is high or emotions such as excitement, trust, goodwill and the desire to change the world may have a positive effect.

**DEQ Database** – The ESCI and LUST are online databases that offer real information on environmentally challenged sites registered with DEQ. In addition, DEQ has guidelines for how to remediate a site.

**EPA Database** – The EPA has sources of information and guidelines to help property owners with brownfields remediation.

**Private Resources** – Professional consultants including environmental consultants, environmental lawyers, insurance agents, brokers, brownfields developers and private sector stakeholders are hired to help property owners find solutions to their brownfields problems.

**City and County Files** – City and county public information sources such as Sanborn Maps, police reports, neighborhood health and safety reports, local land use and zoning, insurance records and property transaction reports can assist property owners with finding additional information.

**Financial Institution** – Financial institutions that have regulations and requirements for financing possible brownfield properties, such as requiring Phase I environmental site assessment, provides information to property owners.

**Local Government Resources** – A property owner consultation with any of the following resources in local government agencies may provide valuable information in regards to their property: city planner; regulatory agency project

manager; economic development personnel/public funding coordinators and neighborhood outreach volunteers.

### *9.3.2.1 Content Analysis Verification*

The original factors determined by this research in the literature review and those suggested by the Delphi panel members are listed in

Table 7. This research determined the keywords from the panel's comments and then tallied the frequency of each mentioned factor. This analysis verified the validity of factors originally suggested by this research. In addition, it provided a way to simply identify any existing trends among the experts.

The content analysis process was repeated by three additional individuals to confirm that this research's content analysis could be replicated. Each individual was to come up with the key factors and code each of the panel members' comments. Minor differences were found among the individuals who duplicated the content analysis process. The differences were taken into account and either included in the definition of each factor or determined to be a duplicate of existing key factors. The data is presented in

Table 7.

Stakeholder Group & Role	Listing as responsible party	Regulatory enforcement	Third party litigation	Avialbel funding	incentives	Liability mitigation	Distrust of Resources	Property location-Prime	Property location-disstressed	Public Health hazard	Cost to remediate	Time to remediate	Loss of existing business	Civic stewardship	Futur financial gains	Stigma	Community acceptance	Personal life situation
Private - Lawyer				1	1													
Private - Lawyer					1			1							1			
Private - Planning	1					1					1			1		1		
Private - Planning						1						1						
Private - Remediation	1	1	1							1	1	1	1				1	
Private - Remediation											1	1						
Private - Revitalization						1	1								1			
Private - Revitalization		1		1			1										1	
Private - Revitalization				1											1			
Public - Policy Maker		1	1							1	1				1		1	
Public - Economic Development									1				1	1	1	1		1
Public - Economic Development				1	1													
Public - Assessment																		
Public - Assessment															1			
Public - Assessment											1	1						
Regulator - Policy Maker												1			1			
Regulator - Policy enforcer				1	1													
Regulator - policy enforcer	1	1												1				
Regulator - Community Outreach				1	1	1												
Regulator - Community Outreach								1						1	1			
	3	4	2	6	5	4	2	2	1	2	5	5	2	4	8	2	3	1

Table 7 – Content Analysis – Factors Verification

The same process was utilized to validate and amend sources of information.

The results are presented in Table 8.

Stakeholder - Role	popular media	Intuition - personal information	Community sources	Historical site information	DEQ data base	EPA data base	Property physical appearance	Private resources	City and county files	Financial institute	local government resources
Private - Lawyer								1			
Private - Lawyer				1					1		
Private - Planning			1	1			1	1			1
Private - Planning								1			
Private - Remediation	1	1	1	1	1	1					
Private - Remediation											
Private - Revitalization								1			1
Private - Revitalization					1			1			1
Private - Revitalization											
Public - Policy Maker					1	1					
Public - Economic Development							1		1		1
Public - Economic Development											1
Public - Assessment											1
Public - Assessment											
Public - Assessment								1		1	
Regulator - Policy enforcer											1
Regulator - policy enforcer					1						1
Regulator - Policy Maker			1								
Regulator - Community Outreach		1	1								
Regulator - Community Outreach											
	1	2	4	3	4	2	2	6	2	1	8

Table 8 - Content Analysis – Sources of Information Verification.

These findings verify that the factors and sources of information suggested by the literature review were mentioned at least once by our experts. The Delphi panel suggestions for this survey were used to further amend the model proposed in Figure 5. After performing the content analysis, adjustments were made to the keywords originally adapted by the researcher in order to incorporate the Delphi panel suggestions. The original keywords that were used for the important factors proposed in Figure 5 were changed as follows: "The Fear of Being Responsible" changed to "Listing as a Responsible Party;" "Loss of Business" changed to "Loss of Existing Business;" and "Community Expectations" changed to "Community Acceptance." In addition, new factors were added based on the Delphi panel suggestions. These factors are: Available Funding, Incentives, Distrust of Resources, Property Location/Prime and Distressed, Future Financial Gain, Stigma, Civic Stewardship, and Personal Life Situation. A short definition of each factor is provided in section 9.3.1.

The same keyword adjustments and amendments were performed for sources of information based on the Delphi panel comments and a content analysis of their suggestions. The final proposed sources of information are; Popular Media, Intuition, Community Sources, Historical Site Information, Property's Physical Appearance, DEQ and EPA Databases, Private Resources, City and County Files, Financial Institutions, and Local Government Resources. A short definition of each source of information is provided in section 9.3.2. The amended model is presented in Figure 10.

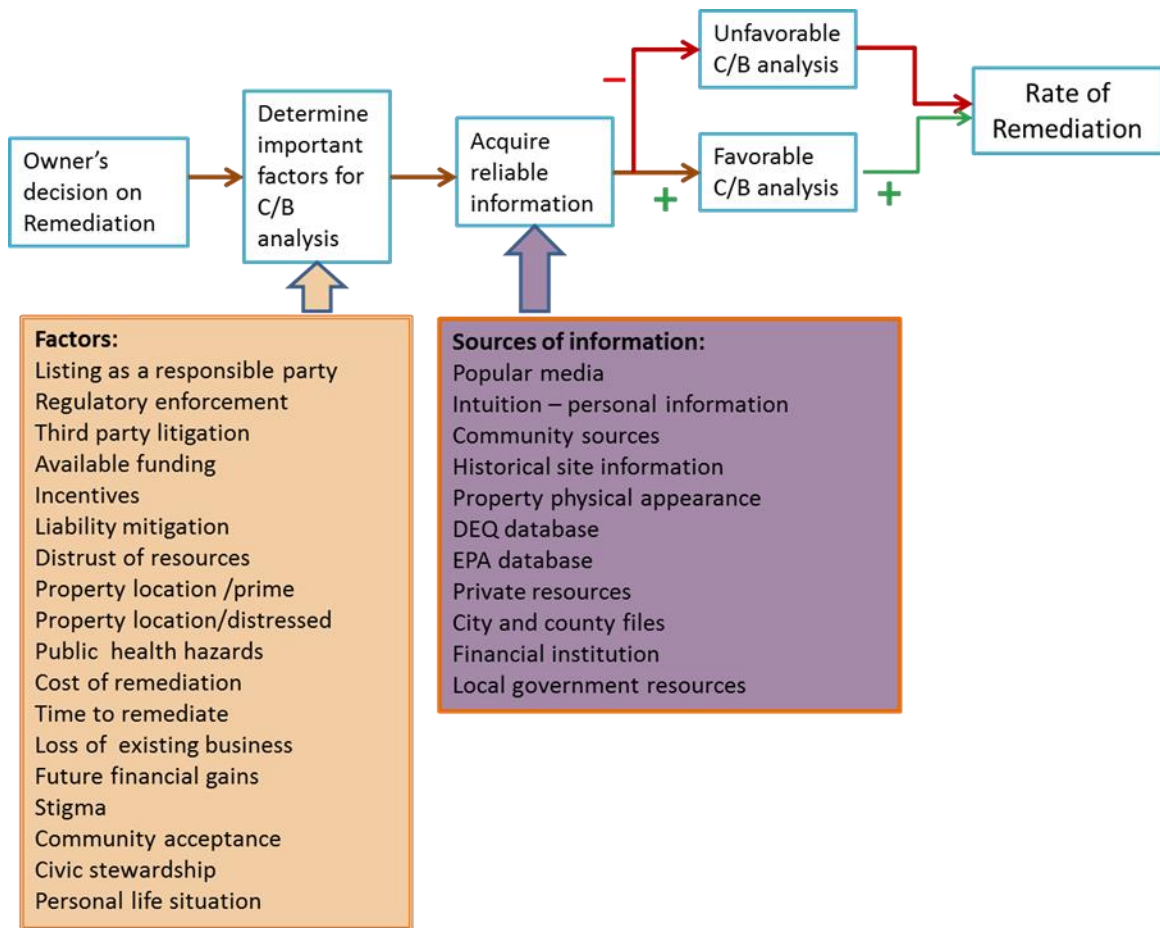


Figure 10 – Delphi Panel Validation and Amendment of Brownfield Property Owners' Cost-Benefit Causal Model.

### 9.4 Chapter Summary

This section provides the results of the third survey where the Delphi panel were asked to verify and amend the list of important factors and sources of information that were proposed as the third and fourth hypotheses of this research. The Delphi panel verified the important factors that affect the property owners decision to remediate as proposed in Figure 5, and suggested additional important factors based on their personal experience. The Delphi panel also verified the important sources of information that are used by a brownfields



property owner in measuring the effect of the important factors as proposed in Figure 5 and suggested additional sources of information based on their personal experience.

Suggestions from the Delphi panel were tabulated and a content analysis was performed to define keywords and trends for important factors and sources of information. Findings from this phase of research were used to amend the causal model as presented in Figure 10.

The next chapter of this dissertation focuses on utilizing the Delphi panel opinions in order to determine the degree of influence each factor has on a brownfields property owner's decision-making process, and to gain additional insights regarding the perceptions of the owners' decision-making processes among the Delphi panel. The next chapter also focuses on the perceived reliability of each of the suggested sources of information.

## **10 Chapter 10 – Perceptions of Factors and Sources within the Cost/Benefit Context**

### **10.1 Introduction**

The purpose of this section is to collect useful data from the Delphi panel in order to perform an objective analysis on the Delphi panel responses. The Delphi panel was asked to define the influence of each factor and the reliability of the sources of information a property owner consults during a cost/benefit analysis. Further, the data was analyzed to discover other tendencies and patterns that may provide insight into perceptions of the factors and sources of information used by Brownfield Owners in their remediation decisions.

### **10.2 Cost/Benefit analysis**

The cost/benefit analysis is a technique used for deciding whether an action should be taken and is done through a comparison of costs and benefits. Decision-makers engage in cost/benefit analyses when assessing whether the advantages of a particular action are likely to outweigh the disadvantages. The cost/benefit analysis involves comparing the total expected cost for each option against the total expected benefits in order to see whether the benefits outweigh the costs, and if so, by how much ([vessey, August 1994](#)).

In this research, a cost/benefit analysis refers to the systematic approach for estimating the benefits and costs of the remediate/don't remediate alternative, in terms of satisfying a brownfield property owner's best interest.

The responses from the final Delphi phase were collected and systematically evaluated through a content and data analysis. Lists of factors and sources of information were identified and modified based on the collective input from the prior surveys and this research's literature review, as indicated in Chapter Nine.

Two alternatives are considered based on the proposed causal model that deal with a property owner's cost/benefit analysis:

- Condition A – Property owners retain the status quo condition and resulting effects of the contaminated Brownfield property.
- Condition B – Property owners consider the factors and resulting effects that would exist in a post-remediation state.

For each condition, there is a set of factors that create either a cost or a benefit to a brownfield property owner. In making a decision, property owners must compare the two conditions in a manner that is outlined below in Figure 11.

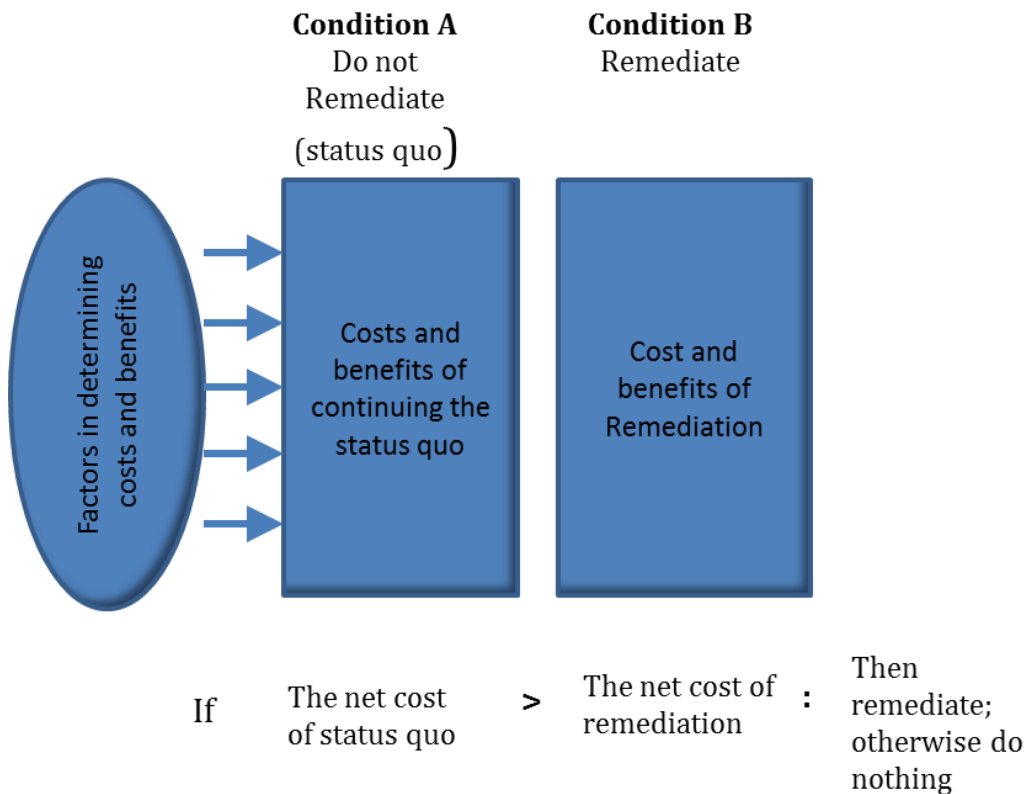


Figure 11 – Diagram of Cost-Benefit Analysis to Remediate or not

10.2.1 Survey Structure

This research categorized the list of factors from the responses compiled in the previous surveys and assigned each factor to either a cost or benefit category for each condition. The cost or benefit allocation for each factor is presented in Table 9.

Factors	Condition A - Do not Remediate		Condition B - Remediate	
	In a cost/benefit analysis -How each factor influence property owner's decision		In a cost/benefit analysis -How each factor influence property owner's decision	
	Cost (Con/Negative Influence)	Benefit (Pro/Positive Influence)	Cost (Con/Negative Influence)	Benefit (Pro/Positive Influence)
listing as Responsible Party				
Regulatory Enforcement				
Third Party Litigation				
Available Funding				
Incentives				
Liability Mitigation				
Distrust of Resources				
Property Location/Prime				
Property Location/Distressed				
Public Health Hazard				
Cost of Remediation				
Time to Remediate				
Loss of existing Business				
Future Financial Gains				
Stigma				
Community Acceptance				
Civic Stewardship				
Personal life Situation				

Table 9 – Cost/Benefit Factors Allocation.

A questionnaire using the Likert scale system was designed to collect the Delphi panel opinions regarding each condition. Experts were asked to rank the level of influence each factor may have on a brownfield property owner’s decision, in terms of the effect on their overall quality of life, and whether it is considered a

cost or benefit for each condition. A copy of the survey questionnaire and results are provided in Appendix D.

Property owners use information sources in order to make an informed decision to remediate or not; these sources and their reliability were tested in the research discussed in Chapter 9. A matrix with a comprehensive list of all the factors and sources of information that were identified based on the literature review and the expert panel's comments was created. Each row in the matrix is dedicated to a key factor and each column is dedicated to a source of information. The Delphi panel members were asked to select the source(s) of information that they believe property owners use when performing a cost/benefit analysis for each factor. In addition, experts were asked to use the Likert scale system to rank each source of information based on its reliability.

### 10.2.2 Distribution and Data Collection

The online survey tool, Qualtrics, was used to distribute the questionnaire to each of the Delphi panel members and to collect their responses in a timely manner. The data collected from this survey was then transferred into Statistical Package for the Social Science (SPSS) software for statistical analysis. The survey was designed to look into the degree of importance of each factor and the level of reliability for each source of information. This survey was distributed to the 20 Delphi panel members; 19 panel members completed the survey. The raw data collected from this survey is presented in Appendix D, and analyzed below.

### 10.2.3 Results and Data Analysis

The data collected from the Delphi panel survey and the statistical analyses performed for each question are presented in following sections. A descriptive statistical analysis was used to analyze data due to the small sample size.

### 10.2.3.1 *Condition A – Do Not Remediate*

It was proposed that in Condition A, property owners only consider a set of status-quo cost factors. The factors identified as having a negative impact on a brownfield property owner's decision to remediate in Condition A include:

- fear of being listed on DEQ/EPA public databases as the person who caused the contamination;
- fear of being held responsible for clean up; fear of getting sued if the site contamination migrates to neighboring properties; not trusting regulators and the private sector to help with remediation;
- redevelopment is not economically sound due to the fact the property is located in a distressed area; fear of causing a health hazard to those who work or live on or near the property;
- and fear of being condemned by the community.

The Delphi panel was asked to respond based on their beliefs regarding the degree to which each factor influences the property owner's decision-making process. The Likert scale, which consists of 1 to 9, was used to determine the degree of influence, with 1 being "no impact" and 9 being "extreme impact." For example, panel members would choose "extreme impact" (9) if they believe a factor would create an extreme loss to the owner. A total of 19 Delphi panel members responded to this questionnaire with only one participant missing one factor to rank.

#### 10.2.3.1.1 Results – Measuring frequency and level of agreement for each factor among Delphi panel members

The frequency of the degree of importance indicated by Delphi panel members for each factor were recorded and the level of agreement or disagreement among the panel members was calculated based on the variance. The statistical

analyses of Delphi panel responses for each cost factor and their relative histograms are presented in Table 10 and Figure 12. A copy of the questionnaire and raw data is presented in Appendix D.

Condition A Cost Factors	Listing as a Responsible Party	Regulatory Enforcement	Third Party Liability	Distrust of Resources	Property Location Distressed	Public Health Hazard	Stigma
<b>Total</b>	19	19	19	18	19	19	19
<b>Missing</b>	0	0	0	1	0	0	0
<b>Mean</b>	5.79	7.26	6.95	5.11	5.68	4.95	4.16
<b>Median</b>	6.00	7.00	7.00	5.00	5.00	5.00	4.00
<b>Variance</b>	5.064	2.538	3.164	2.928	4.339	4.386	3.474
<b>Minimum</b>	2	3	3	3	2	3	2
<b>Maximum</b>	9	9	9	9	9	9	7
<b>Sum</b>	110	138	132	92	108	94	79

Table 10 – Condition A – Do not Remediate - Cost Factors Data Set

#### 10.2.3.1.2 Conclusion

The general high variance value for all the factors suggests that the Delphi panel members are not in agreement when they rank the negative impact of the factors in Condition A. At least 50 percent of the expert panel believed that regulatory enforcement and third party liability factors have the highest negative impact on a brownfield property owner's decision-making process if they choose to not remediate. These factors most highly concern property owners in the do-not remediate alternative regarding being held legally responsible to cleanup. When looking for the influence of outliers, the small difference between the mean and median values suggest that the panel member rankings were not influenced by extreme values in any specific direction.

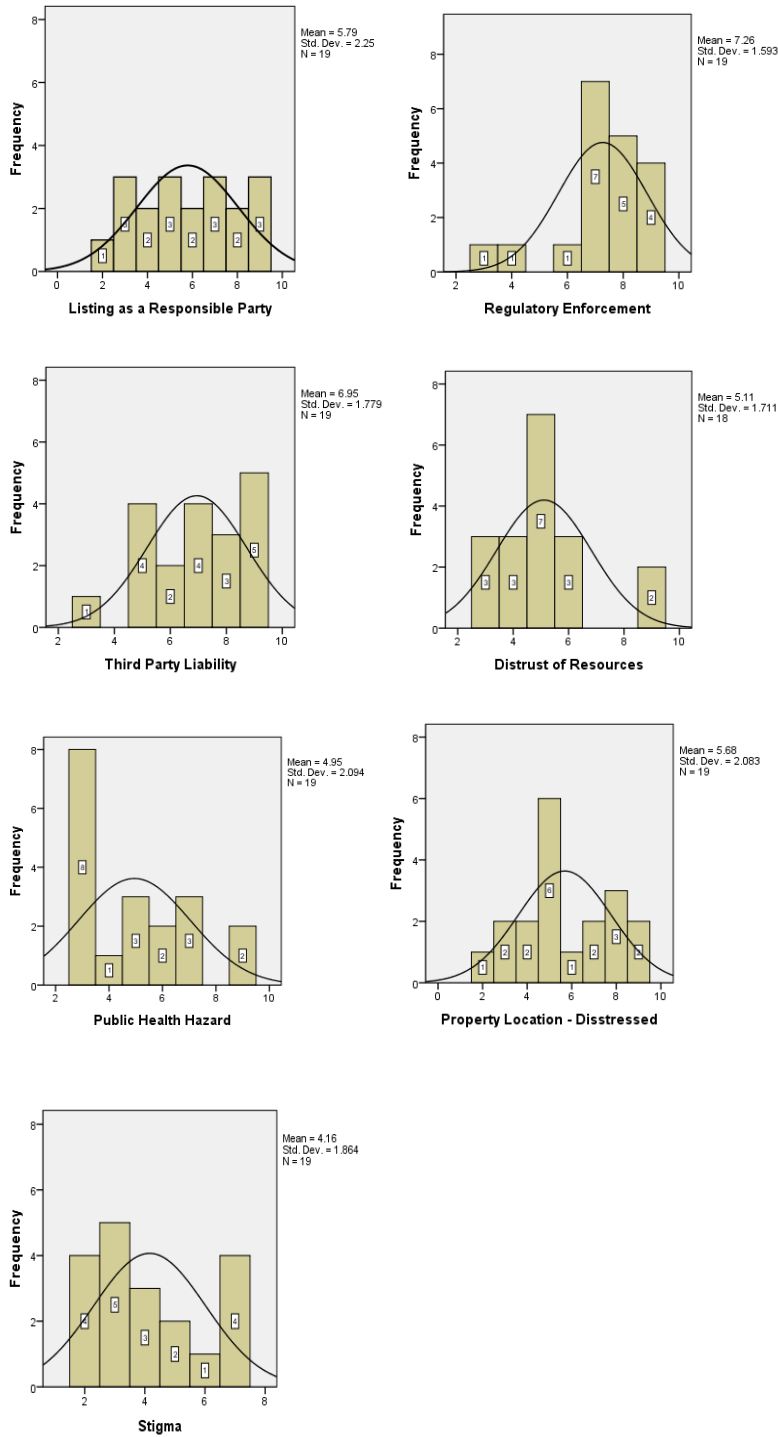


Figure 12- Condition A – Do Not Remediate - Cost Factors Histograms



10.2.3.1.3 Results – Comparing the Level of Agreement Among the Three Stakeholder Groups

The data collected from experts in regards to condition A was further analyzed to compare levels of agreement or disagreement among different stakeholder groups. The median and variance values were used to look for trends, similarities and differences amongst each stakeholder group. The results are presented below in Table 11. The data suggests that the regulatory stakeholder group had the least agreement among group members. This data is limited by the low number of participants and therefore this conclusion might not be representative of the entire stakeholder group’s population. A larger population for each stakeholder group would provide better results.

<b>Condition A Do not Remediate Cost Factors</b>		Listing as a Responsible Party	Regulatory Enforcement	Third Party Liability	Distrust of Resources	Property Location - Distressed	Public Health Hazard	Stigma	
<b>Private Stakeholders</b>	<b>Total</b>	8	8	8	8	8	8	8	
	<b>Missing</b>	0	0	0	0	0	0	0	
	<b>Median</b>	5.50	7.00	7.50	5.00	5.00	6.50	3.00	Mean
	<b>Variance</b>	5.13	0.84	0.79	3.36	4.84	4.41	4.21	3.37
	<b>Minimum</b>	3	7	7	3	2	3	2	
	<b>Maximum</b>	9	9	9	9	9	9	7	
<b>Public Stakeholders</b>	<b>Total</b>	6	6	6	5	6	6	6	
	<b>Missing</b>	0	0	0	1	0	0	0	
	<b>Median</b>	6.00	8.00	5.00	5.00	7.50	3.50	3.50	Mean
	<b>Variance</b>	4.97	4.67	3.37	0.80	2.17	0.97	2.40	2.76
	<b>Minimum</b>	3	3	5	3	5	3	3	
	<b>Maximum</b>	9	9	9	5	9	5	7	
<b>Regulatory Stakeholders</b>	<b>Total</b>	5	5	5	5	5	5	5	
	<b>Missing</b>	0	0	0	0	0	0	0	
	<b>Median</b>	6.00	7.00	6.00	5.00	4.00	3.00	5.00	Mean
	<b>Variance</b>	7.30	3.30	6.30	5.30	2.80	7.20	4.00	5.17
	<b>Minimum</b>	2	4	3	3	3	3	3	
	<b>Maximum</b>	9	9	9	9	7	9	7	

Table 11 – Condition A – Cost Factors Data Set – Comparing Three Stakeholder Groups

After comparing the three-stakeholder group's opinions, it is suggested that the highest disagreement was among the regulatory agencies stakeholder group. This was determined by this research based on the fact that the group had the highest variance for all factors in this condition. The following histograms in Figure 13 show the frequency and distribution of opinion among three different stakeholders group in regards to the ranking of each cost factors under condition A.

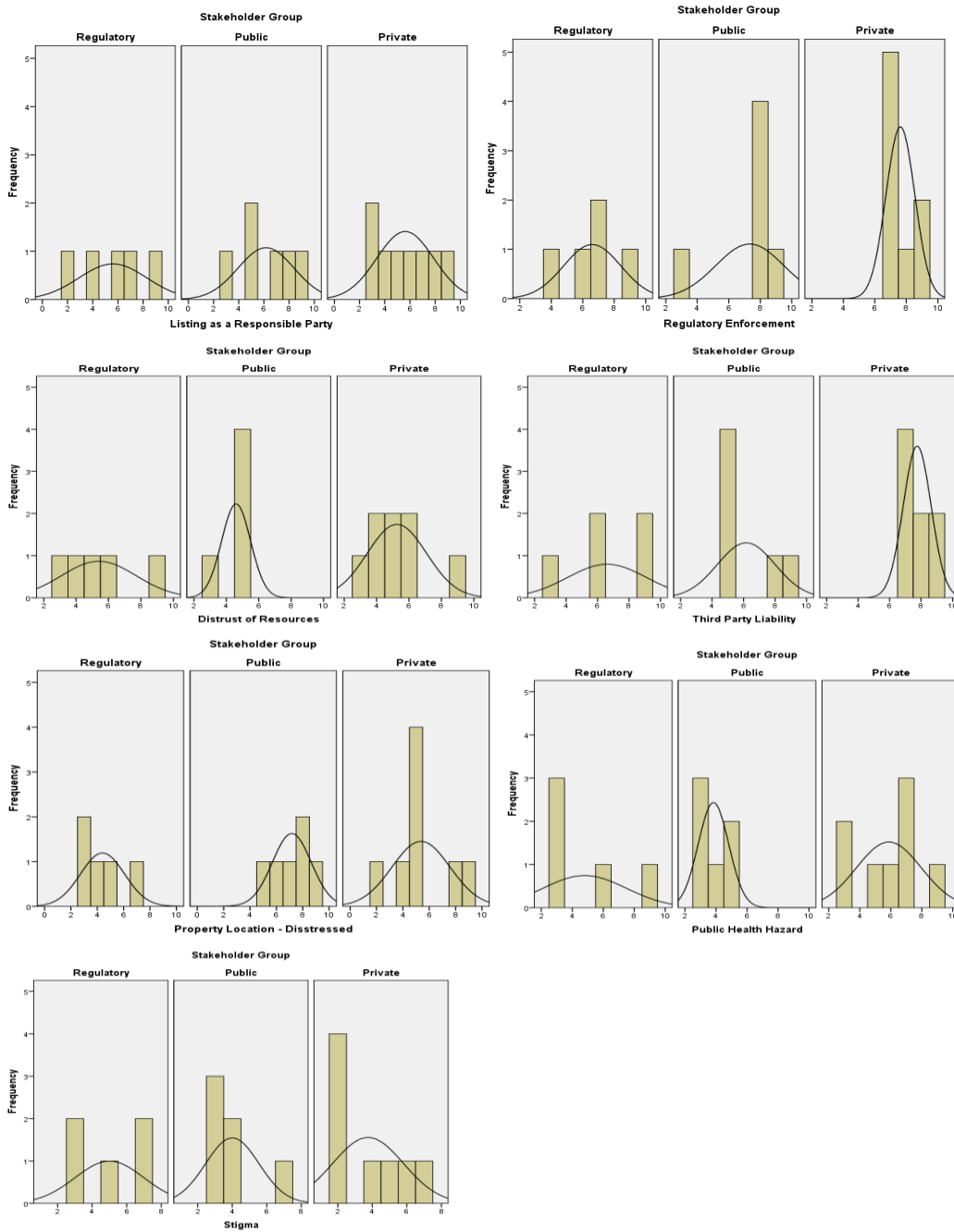


Figure 13 – Condition A – Do not Remediate - Cost Factors Histograms – Comparing Three Stakeholder Groups

### 10.2.3.2 *Condition B – Remediate*

It is assumed that under Condition B, brownfield property owners take both cost and benefit factors into consideration. The factors that have negative impacts on a property owner's decision include:

- the unknowns such as the high cost of remediation;
- the amount of time it takes to remediate a site which may result in loss of revenue; and
- fear of losing business revenue and a personal life situation gets in the way for a property owner -such as their physical health or a financial situation – that keeps them from making a decision to remediate.

The factors that encourage property owners to move forward with remediation include:

- ease of access and availability of funds to facilitate remediation;
- the possibility to receive grants and financial help or tax incentives if they decide to remediate;
- being able to manage pollution liability by obtaining insurance or negotiating with regulatory agencies to find an acceptable cap on financial liabilities;
- highly probable future gains when the property is at a prime real estate location;
- a good return on investment;
- the community's support of potential development; and
- a personal motivation to leave a redevelopment legacy that contributes to the livability of a community.

The Delphi panel was asked to respond based on their beliefs regarding the degree to which each factor influences the property owner's decision-making

process, in terms of impact on the project owner's well-being. The Likert scale, which consists of 1 to 9, was used for the degree of impact where 1 is defined as no impact and 9 is defined as extreme impact.

A total of 19 Delphi panel members ranked the degree of impact for both cost and benefit factors in a property owner's decision-making process when considering to remediate, Condition B. The following two sections present results collected based on the Delphi panel opinion of both cost and benefit factors for Condition B where experts rank the impact each factor has on a brownfield property owner's well-being .

**10.2.3.2.1 Results – Measuring the Frequency and Level of Agreement for Each Cost Factor Among Delphi Panel Members**

The frequency of the degree of importance indicated by the Delphi panel members for each cost factor was recorded and the level of agreement or disagreement among the panel members was calculated based on the variance. A descriptive analysis of the Delphi panel responses for each cost factor and its relative histogram is presented in Table 12 and Figure 15. A copy of the questionnaire and raw data are presented in Appendix D.

<b>Condition B Cost Factors</b>	<b>Cost of Remediation</b>	<b>Time to Remediate</b>	<b>Loss of Existing Business</b>	<b>Personal Life Situation</b>
<b>Total</b>	19	19	19	19
<b>Missing</b>	0	0	0	0
<b>Mean</b>	7.79	6.53	5.47	5.68
<b>Median</b>	8.00	7.00	5.00	5.00
<b>Variance</b>	1.287	2.263	4.708	3.006
<b>Minimum</b>	5	3	1	3
<b>Maximum</b>	9	9	9	9
<b>Sum</b>	148	124	104	108

Table 12- Condition B – Remediate - Cost Factors Data Set

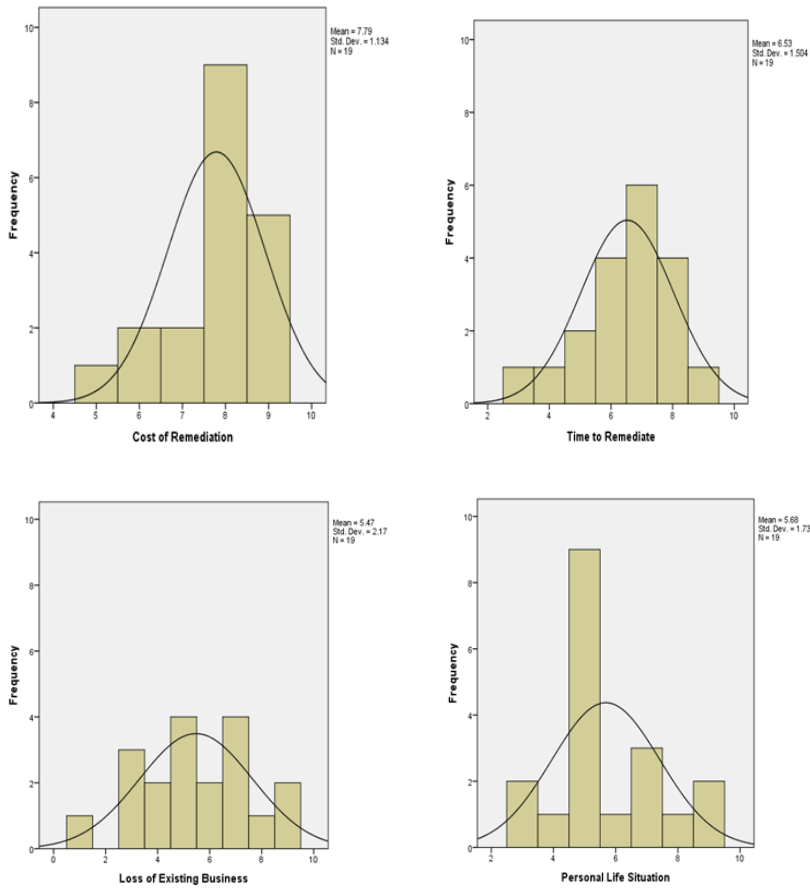


Figure 14– Condition B – Remediate – Cost Factors Histograms

10.2.3.2.2 Conclusion

The ranked data collected for the cost factors in Condition B suggests that the cost of remediation and time to remediate have higher negative impacts on a brownfield property owner’s decision to remediate. The lower variance suggests a higher level of agreement among experts. The loss of existing business was determined to have the highest variance, with a distribution between 1 and 9.

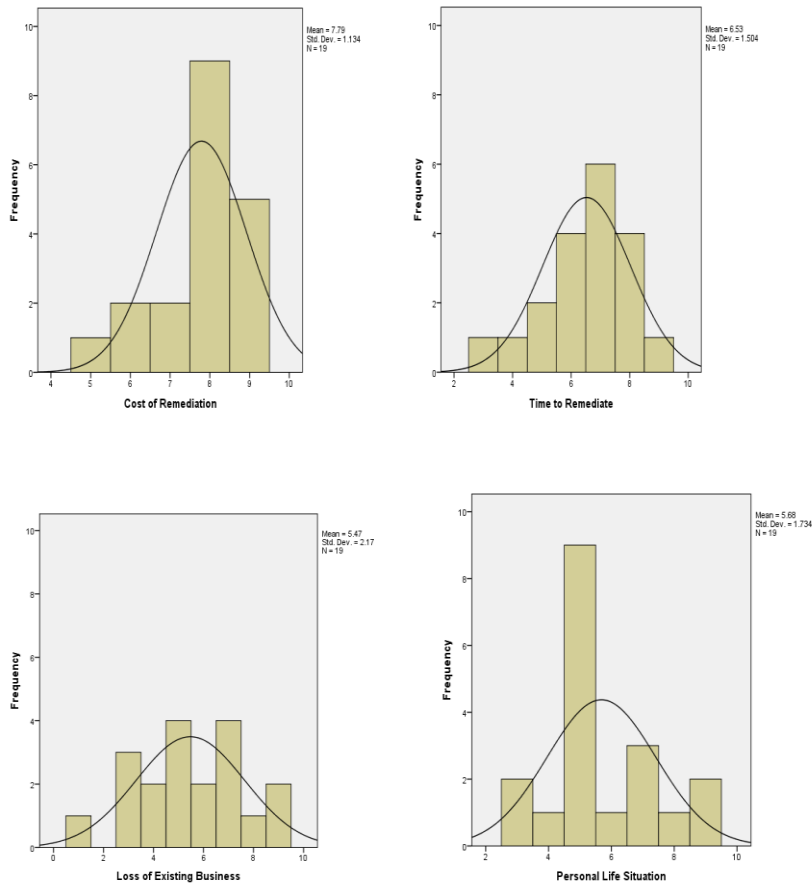


Figure 15 – Condition B – Remediate – Cost Factors Histograms

10.2.3.2.3 Results – Comparing the Level of Agreement among the Three Stakeholder Groups

The data collected from this question was further analyzed to compare levels of agreement or disagreement among different stakeholder’s groups. The median and variance calculation were used to look for trends, similarities and differences amongst each stakeholder group. The results are presented below in Table 13 and Figure 16. The data suggests that the regulatory stakeholder group had the least agreement among their respective group members.

Condition B Remediate Cost Factors		Cost of Remediation	Time to Remediate	Loss of Existing Business	Personal Life Situation	
Private Stakeholders Group	Total	8	8	8	8	
	Missing	0	0	0	0	
	Median	8.00	7.00	5.00	5.00	Mean
	Variance	1.70	3.14	4.13	1.84	2.70
	Minimum	5	3	3	3	
	Maximum	9	8	8	7	
Public Stakeholders Group	Total	6	6	6	6	
	Missing	0	0	0	0	
	Median	8.50	7.00	6.50	7.00	Mean
	Variance	0.30	2.00	2.30	2.57	1.79
	Minimum	8	5	5	5	
	Maximum	9	9	9	9	
Regulatory Stakeholders Group	Total	5	5	5	5	
	Missing	0	0	0	0	
	Median	8.00	6.00	4.00	5.00	Mean
	Variance	1.30	1.50	8.70	3.80	3.83
	Minimum	6	4	1	4	
	Maximum	9	7	9	9	

Table 13 – Condition B- Cost Factors Data Set – Comparing Three Stakeholder Groups

10.2.3.2.4 Conclusion

The mean of variance value suggest that public stakeholders have the highest level of agreement in their ranking and regulatory stakeholders have the least agreement. The data suggests that the all three stakeholder groups in agreement that the cost of remediation has the highest negative impacts on a property owner’s cost/benefit analysis. The public stakeholders group with the median ranking of 7 suggest that the personal life situation of the property owners has a higher negative impact on their decision to remediate compare to median ranking of 5 for the other two stakeholder groups.

This data is limited by the low number of participants and therefore this conclusion might not be representative of the entire stakeholder group’s



population. A larger population for each stakeholder group would provide a better result.

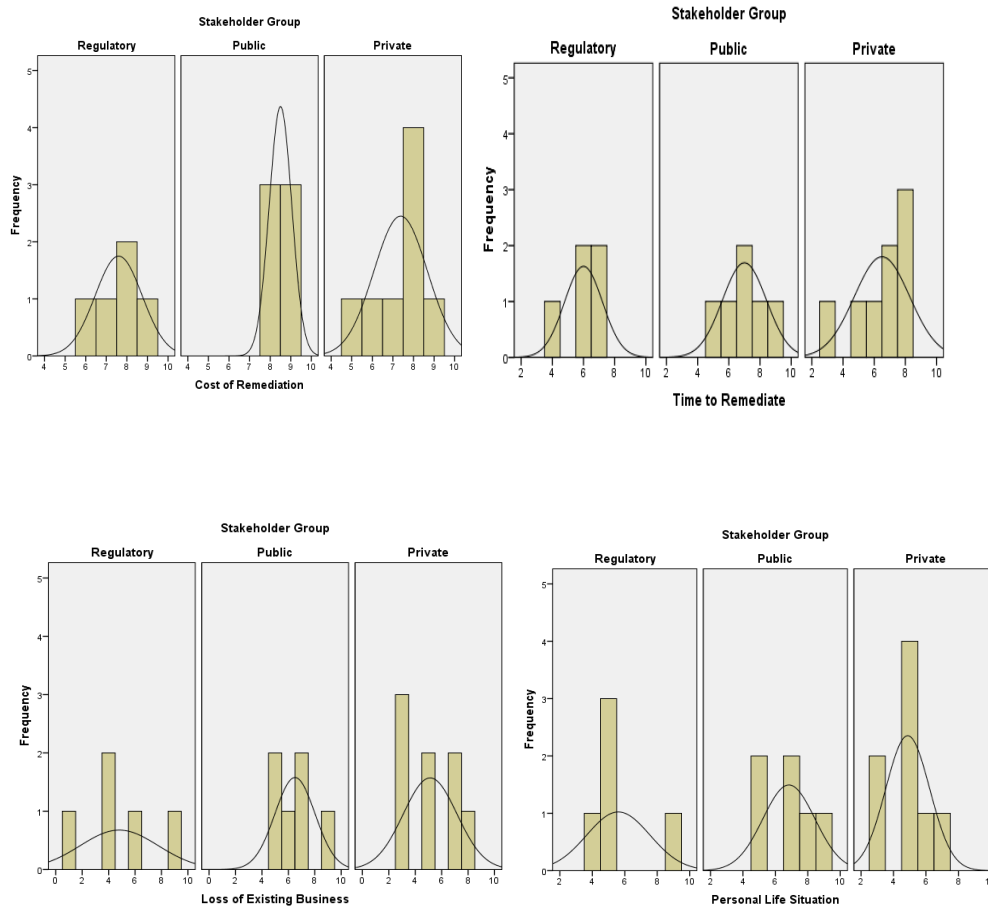


Figure 16 – Condition B – Cost Factors Histograms – Comparing Three Stakeholder Groups

10.2.3.2.5 Results – Measuring the Frequency and Level of Agreement for Each Benefit Factor Among Delphi Panel Members

The frequency of the degree of importance indicated by the Delphi panel members for each cost factor is recorded and the level of agreement and disagreement among the panel members was calculated based on the variance. A descriptive analysis of the Delphi panel responses for each cost factor and its

relative histogram is presented in Table 14 and Figure 17. A copy of the questionnaire and raw data are presented in Appendix D.

Condition B Benefit Factors	Available Funding	Incentives	Liability Mitigation	Property Location - Prime	Future Financial Gains	Community Acceptance	Civic Stewardship
<b>Total</b>	19	19	19	19	19	19	19
<b>Missing</b>	0	0	0	0	0	0	0
<b>Mean</b>	7.05	6.47	6.63	7.42	7.37	4.68	4.95
<b>Median</b>	7.00	7.00	7.00	7.00	8.00	5.00	5.00
<b>Variance</b>	1.830	2.263	2.579	1.146	1.690	3.006	3.830
<b>Minimum</b>	4	4	3	5	5	3	2
<b>Maximum</b>	9	9	9	9	9	9	9
<b>Sum</b>	134	123	126	141	140	89	94

Table 14 - Condition B – Remediate - Benefit Factors Data Set

#### 10.2.3.2.6 Conclusion

Data collected from Delphi panel suggests that:

- Future financial gains with the median value of 8 among experts has the highest perceived positive impact on a property owner's decision to remediate.
- The Delphi panel show a higher level of agreement for factors such as available funding; property location-prime and future financial gains compare to factors such as civic stewardship and community acceptance.
- Community acceptance and civic stewardship do not seem to have a high perceived impact on a property owner's decision to remediate. These two factors also show a high variance value that indicate a high level of disagreement among panel members.

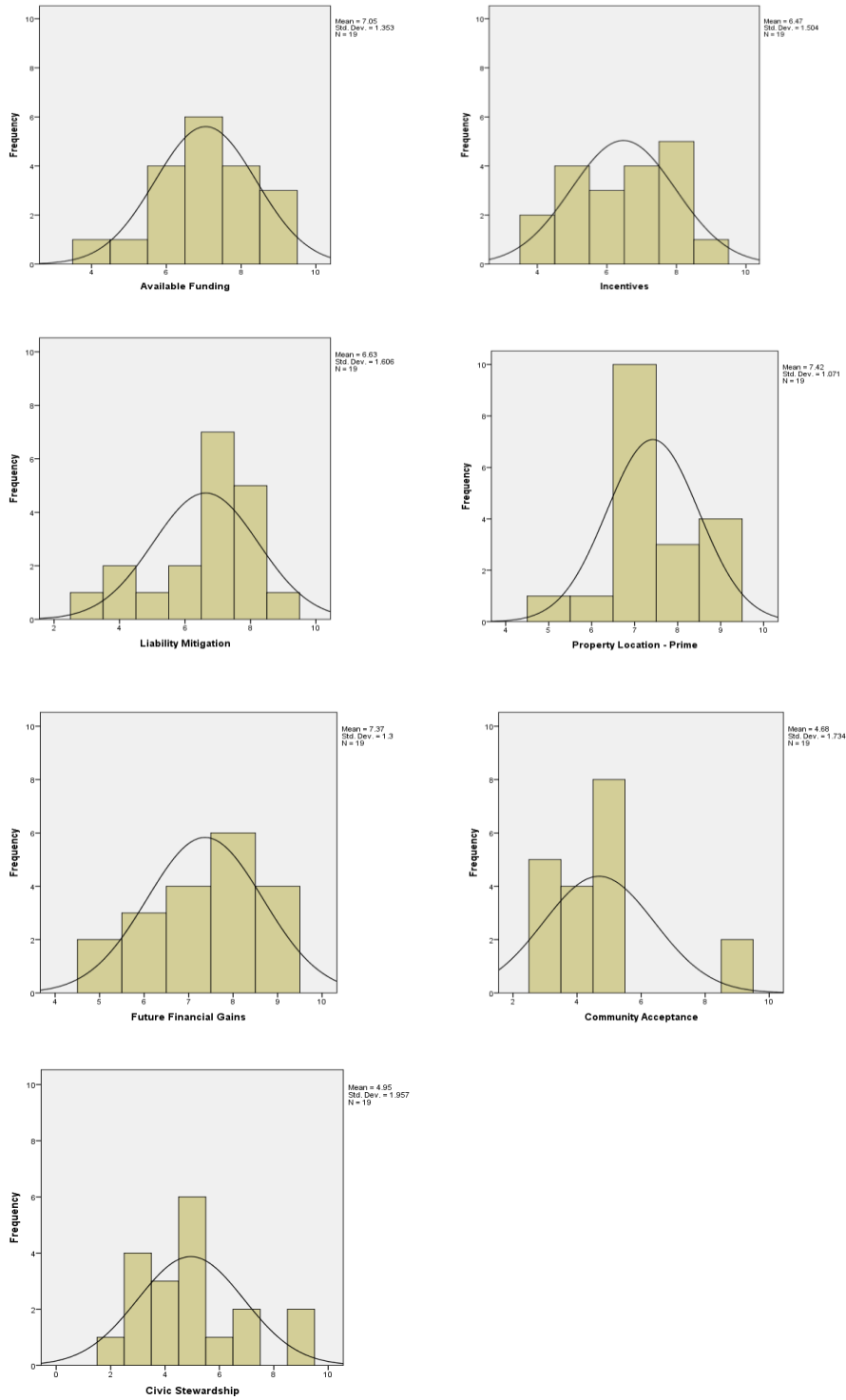


Figure 17 – Condition B - Remediate – Benefit Factors Histograms

10.2.3.2.7 Results – Comparing the Level of Agreement among the Three Stakeholder Groups

The data collected for level of impact of benefit factors in Condition B was further analyzed to compare levels of agreement and disagreement among different stakeholder groups. The median and variance calculations were used to look for trends, similarities and differences amongst each stakeholder group. The results are presented below in Table 15 and Figure 18. The data suggests that the regulatory stakeholder group had the least agreement among group members.

<b>Condition B Remediate Benefit Factors</b>		Available Funding	Incentives	Liability Mitigation	Property Location - Prime	Future Financial Gains	Community Acceptance	Civic Stewardship	
<b>Private Stakeholders</b>	<b>Total</b>	8	8	8	8	8	8	8	
	<b>Missing</b>	0	0	0	0	0	0	0	
	<b>Median</b>	7.00	6.50	7.00	7.00	8.00	4.50	5.00	Mean
	<b>Variance</b>	0.86	1.98	2.13	0.57	2.27	3.27	5.27	2.33
	<b>Minimum</b>	7	5	4	7	5	3	2	
	<b>Maximum</b>	9	9	9	9	9	9	9	
<b>Public Stakeholders</b>	<b>Total</b>	6	6	6	6	6	6	6	
	<b>Missing</b>	0	0	0	0	0	0	0	
	<b>Median</b>	7.00	6.00	6.50	7.00	8.00	5.00	4.50	Mean
	<b>Variance</b>	2.40	2.97	2.17	2.00	0.27	0.70	1.37	1.70
	<b>Minimum</b>	5	4	4	5	7	3	4	
	<b>Maximum</b>	9	8	8	9	8	5	7	
<b>Regulatory Stakeholders</b>	<b>Total</b>	5	5	5	5	5	5	5	
	<b>Missing</b>	0	0	0	0	0	0	0	
	<b>Median</b>	6.00	7.00	7.00	7.00	6.00	3.00	5.00	Mean
	<b>Variance</b>	2.80	2.80	4.30	1.20	2.30	6.80	6.20	3.77
	<b>Minimum</b>	4	4	3	7	5	3	3	
	<b>Maximum</b>	8	8	8	9	9	9	9	

Table 15 - Condition B - Benefit Factors Data Set – Comparing Three Stakeholder Groups

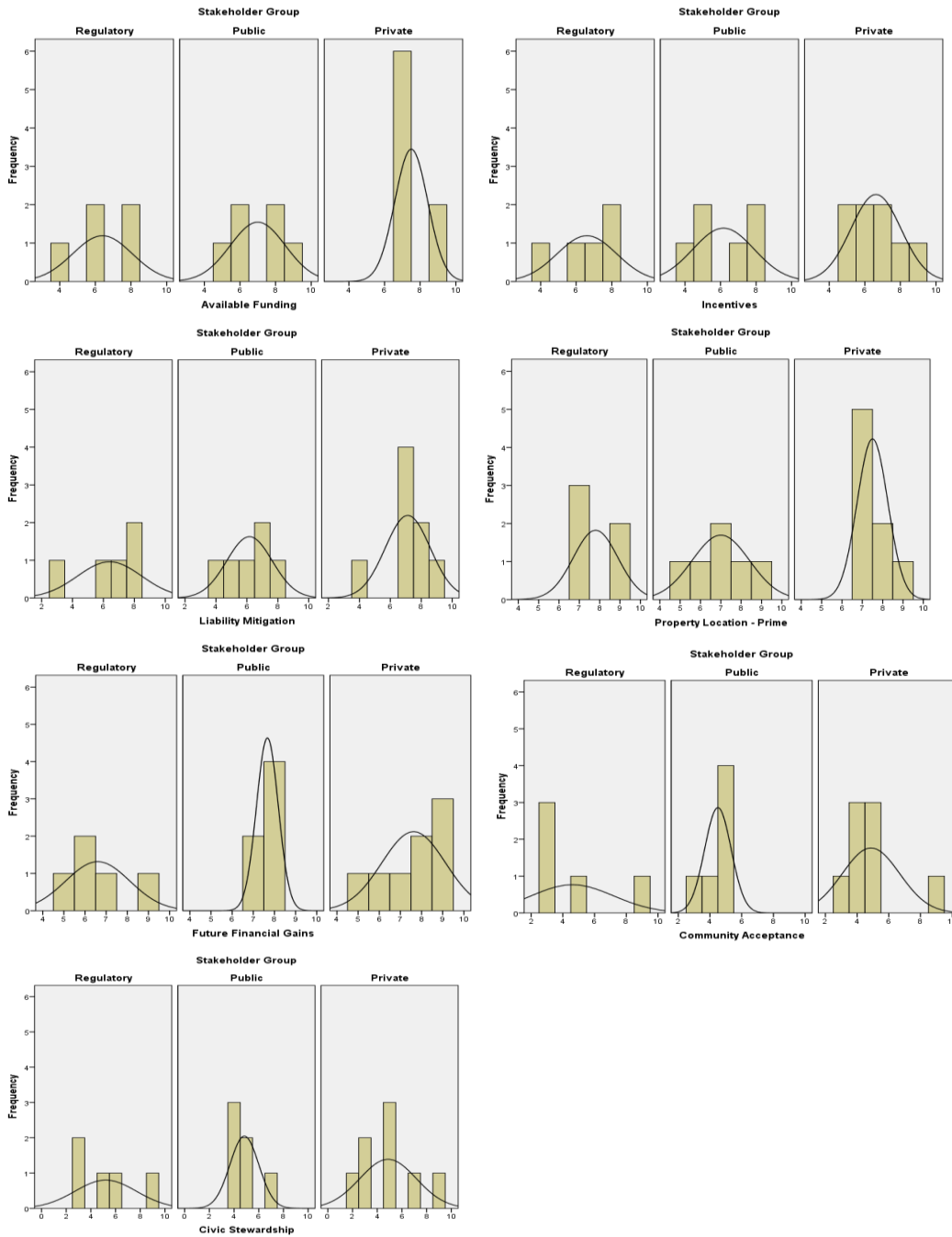


Figure 18 – Condition B – Benefit Factors Histograms - Comparing Three Stakeholder Groups

#### 10.2.3.2.8 Conclusion

Comparing the three different stakeholder groups in the Delphi panel suggests:

- The public stakeholder group has the highest level of agreement in regards to all factors compared to the other two stakeholder groups. The regulatory stakeholder group has the least agreement among the panel members.
- The data collected from the public stakeholder group suggests that the future financial gains factor has the highest positive impact on a brownfield property owner's decision to remediate. This factor also has the lowest degree of variance among all factors indicating the high level of agreement among stakeholders in that group.
- The private stakeholder group indicates a better consensus when giving high rank to available funding and property location- prime factor.
- The regulatory stakeholder group is in a higher level of agreement in giving a high level of importance to the property location-prime factor compared to the rest of the factors.

#### 10.2.3.3 *Cost/Benefit Analysis Results*

As illustrated in Figure 10 and Figure 11 brownfield property owners' cost/benefit analyses for the following conditions were analyzed using the mean value ( $\mu$ ) of data collected from the Delphi panel respondents.

- Condition A – Do Not Remediate – Property owners retain the status quo condition and resulting effects of the contaminated Brownfield properties
- Condition B – Remediate – Property owners consider the factors and resulting effects that would exist in a post-remediation state

The mean value for both the cost and benefit factors in condition A and B are presented below in Table 16.

Stakeholder Groups	Condition A Cost Factors	Condition A Benefit Factors	Condition B Cost Factors	Condition B Benefit Factors	Condition A Cost + Benefit	Condition B Cost + Benefit	Cost/Benefit Mean A - Mean B
private	5.33	0.00	6.75	-6.14	5.33	0.61	4.73
private	6.29	0.00	6.25	-5.29	6.29	0.96	5.32
private	5.43	0.00	6.75	-6.43	5.43	0.32	5.11
private	8.71	0.00	3.50	-9.00	8.71	-5.50	14.21
private	5.86	0.00	5.50	-6.43	5.86	-0.93	6.79
private	5.00	0.00	5.50	-5.86	5.00	-0.36	5.36
private	4.29	0.00	7.25	-7.71	4.29	-0.46	4.75
private	5.29	0.00	6.25	-6.43	5.29	-0.18	5.46
private	6.29	0.00	6.75	-5.57	6.29	1.18	5.11
public	5.71	0.00	7.00	-6.71	5.71	0.29	5.43
public	6.43	0.00	9.00	-6.43	6.43	2.57	3.86
public	6.14	0.00	6.50	-6.29	6.14	0.21	5.93
public	4.57	0.00	7.00	-5.57	4.57	1.43	3.14
public	5.57	0.00	7.00	-6.00	5.57	1.00	4.57
regulatory	4.43	0.00	6.50	-5.29	4.43	1.21	3.21
regulatory	6.14	0.00	7.50	-6.71	6.14	0.79	5.36
regulatory	6.14	0.00	5.00	-6.86	6.14	-1.86	8.00
regulatory	5.57	0.00	5.25	-5.43	5.57	-0.18	5.75
regulatory	5.14	0.00	5.75	-6.86	5.14	-1.11	6.25
<b>Mean</b>	<b>5.70</b>	<b>0.00</b>	<b>6.37</b>	<b>-6.37</b>	<b>5.70</b>	<b>0.00</b>	<b>5.70</b>

Table 16 – Cost/Benefit Analyses for Condition A and B Utilizing Mean Values – All Stakeholders

In performing, the cost benefit analysis to evaluate the costs and benefits for each of the conditions, side-by-side, the following equation was used:

$$[\mu (A \textit{ cost}) + \mu (A \textit{ benefit})] - [\mu (B \textit{ cost}) + \mu (B \textit{ benefit})]$$

From **Table 16**, the result of the above equation is as follows:

$$(5.70+0) - (6.37-6.37) = 5.70 \Rightarrow \text{Positive result, therefore remediate}$$

This analysis suggests that experts believe brownfield property owners will make a decision to remediate as the result of the net costs associated with comparing Condition A to Condition B. As it is positive, it is not to a property owner's advantage to remain at the status quo.

However when analyzing the costs and benefits for condition B only, this equation was used:

$$[\mu (\mathbf{B\ cost}) + \mu (\mathbf{B\ benefit})]$$

From Table 16, the result of the above equation is as follows:

$$(6.37+ (-6.37)) \approx 0 \Rightarrow \text{No net cost or benefit}$$

This analysis suggests that experts believe a property owner would conclude that there is no net benefit for property owners to remediate.

This data suggests that if property owners are comfortable with the costs associated with condition A then they most likely will not take an active role in remediation. Therefore, in performing a cost/benefit analysis in Condition B only, the property owner may not see any benefit to taking an active role in remediating. Thus, a conclusion may be reached that regardless of high cost for Condition A, the property owner most likely will not take any action unless the costs of Condition A become more apparent or higher. A potential situation that may cause this condition is active regulatory enforcement, which can occur either from discovering harmful chemicals that pose health hazards on site or if a property owner gets involved in a third party litigation.

The results collected from the Delphi panel were analyzed by each of the stakeholders groups, as presented in Table 17 to identify whether there are



differences among groups. The results suggest that stakeholders are generally in agreement with no significant difference among different stakeholder groups.

Stakeholder Groups	Condition A Cost Factors	Condition A Benefit Factors	Condition B Cost Factors	Condition B Benefit Factors	Condition A Cost + Benefit	Condition B Cost + Benefit	Cost/Benefit Mean A - Mean B
private	5.33	0.00	6.75	-6.14	5.33	0.61	4.73
private	6.29	0.00	6.25	-5.29	6.29	0.96	5.32
private	5.43	0.00	6.75	-6.43	5.43	0.32	5.11
private	5.86	0.00	5.50	-6.43	5.86	-0.93	6.79
private	5.00	0.00	5.50	-5.86	5.00	-0.36	5.36
private	5.29	0.00	6.25	-6.43	5.29	-0.18	5.46
private	6.29	0.00	6.75	-5.57	6.29	1.18	5.11
<b>Mean</b>	<b>5.64</b>	<b>0.00</b>	<b>6.25</b>	<b>-6.02</b>	<b>5.64</b>	<b>0.23</b>	<b>5.41</b>
public	5.71	0.00	7.00	-6.71	5.71	0.29	5.43
public	6.43	0.00	9.00	-6.43	6.43	2.57	3.86
public	6.14	0.00	6.50	-6.29	6.14	0.21	5.93
public	4.57	0.00	7.00	-5.57	4.57	1.43	3.14
public	5.57	0.00	7.00	-6.00	5.57	1.00	4.57
<b>Mean</b>	<b>5.69</b>	<b>0.00</b>	<b>7.30</b>	<b>-6.20</b>	<b>5.69</b>	<b>1.10</b>	<b>4.59</b>
regulatory	4.43	0.00	6.50	-5.29	4.43	1.21	3.21
regulatory	6.14	0.00	7.50	-6.71	6.14	0.79	5.36
regulatory	6.14	0.00	5.00	-6.86	6.14	-1.86	8.00
regulatory	5.57	0.00	5.25	-5.43	5.57	-0.18	5.75
regulatory	5.14	0.00	5.75	-6.86	5.14	-1.11	6.25
<b>Mean</b>	<b>5.49</b>	<b>0.00</b>	<b>6.00</b>	<b>-6.23</b>	<b>5.49</b>	<b>-0.23</b>	<b>5.71</b>

Table 17 - Cost/Benefit Analyses for Condition A and B utilizing Mean Values – Stakeholders by Group

10.2.3.4 Sources of Information Reliability

Eleven sources of information were identified, based on the literature review and the Delphi panel’s opinions. The sources of information were determined by the Delphi panel to be the primary sources by which property owners obtain

information in order to make a decision to remediate or not. These sources of information include: popular media; intuition; community sources; historical site information; a property's physical appearance, DEQ and EPA databases, private resources, financial institution, city and county public files and resources that are available to local government agencies.

The Delphi panel was asked to respond based on their beliefs regarding the degree of reliability for each source of information that is utilized by property owners during the decision-making process. The Likert scale, which consists of 1 to 9, was used for the level of reliability for each source where 1 is defined as not reliable and 9 is defined as extremely reliable.

A total of 19 Delphi panel members ranked the level of reliability for all 11 sources of information. The results obtained from this questionnaire are presented in the next two sections. This research analyzed the data for the entire Delphi panel and for each of the three stakeholder groups in order to understand the frequency and level of agreement among the groups.

#### 10.2.3.4.1 Results – Measuring the Frequency and Level of Agreement on the Reliability of Each Source of Information Among Delphi Panel Members

The data collected from the Delphi panel members was studied to determine the frequency and level of agreement among the Delphi panel members. Table 18 presents these data. The results suggest that stakeholders are generally in agreement with no significant difference among different stakeholder groups.

Sources of Information	Popular Media	Intuition- Personal Information	Community Sources	Historical Site Information	Property Physical Appearance	DEQ Databases	EPA Databases	Private Resources	City and County Files	Financial Institution	Local Government Resources
<b>Total</b>	19	19	19	19	19	19	19	19	19	19	19
<b>Missing</b>	0	0	0	0	0	0	0	0	0	0	0
<b>Mean</b>	3.89	4.26	4.63	6.47	4.53	6.89	6.58	6.79	6.58	6.74	6.68
<b>Median</b>	4.00	4.00	5.00	6.00	5.00	7.00	7.00	7.00	7.00	7.00	7.00
<b>Variance</b>	1.21	2.32	2.36	2.49	1.37	0.88	1.26	1.18	1.70	1.43	2.01
<b>Minimum</b>	2	2	2	3	2	4	4	5	4	4	3
<b>Maximum</b>	6	7	8	9	7	8	8	8	9	9	8
<b>Sum</b>	74	81	88	123	86	131	125	129	125	128	127

Table 18- Sources of Information – Delphi Panel Data Set

10.2.3.4.2 Results – Comparing the Level of Agreement among the Three Stakeholder Groups

The data collected from each stakeholder group was analyzed individually and the data was compared among the three stakeholder groups in order to study the similarities and differences among the different stakeholder groups. The data collected for each group is presented in Table 19.

Sources of Information		Popular Media	Intuition- Personal Information	Community Sources	Historical Site Information	Property Physical Appearance	DEQ Databases	EPA Databases	Private Resources	City and County Files	Financial Institution	Local Government Resources	
Private Stakeholders	<b>Total</b>	8	8	8	8	8	8	8	8	8	8	8	
	<b>Missing</b>	0	0	0	0	0	0	0	0	0	0	0	
	<b>Median</b>	4.00	5.00	4.50	6.50	4.50	7.00	7.00	7.50	6.50	6.50	7.00	Mean
	<b>Variance</b>	0.98	2.50	1.27	1.71	1.41	1.64	1.70	1.84	1.84	1.64	2.84	1.76
	<b>Minimum</b>	2	3	2	5	3	4	4	5	4	4	3	
	<b>Maximum</b>	5	7	5	9	7	8	8	8	7	8	8	
Public Stakeholders	<b>Total</b>	6	6	6	6	6	6	6	6	6	6	6	
	<b>Missing</b>	0	0	0	0	0	0	0	0	0	0	0	
	<b>Median</b>	4.50	4.00	5.00	6.50	5.00	7.00	7.00	7.00	6.00	7.00	7.50	Mean
	<b>Variance</b>	2.17	0.80	0.57	1.60	0.80	0.40	0.17	0.57	1.77	0.57	0.97	0.94
	<b>Minimum</b>	2	3	4	6	4	6	6	6	6	6	6	
	<b>Maximum</b>	6	5	6	9	6	8	7	8	9	8	8	
Regulatory Stakeholders	<b>Total</b>	5	5	5	5	5	5	5	5	5	5	5	
	<b>Missing</b>	0	0	0	0	0	0	0	0	0	0	0	
	<b>Median</b>	3.00	3.00	4.00	5.00	4.00	7.00	7.00	6.00	7.00	8.00	7.00	Mean
	<b>Variance</b>	0.80	4.20	6.70	5.20	1.70	0.50	2.30	0.70	0.30	1.80	2.30	2.41
	<b>Minimum</b>	3	2	2	3	2	6	4	5	7	6	4	
	<b>Maximum</b>	5	6	8	9	5	8	8	7	8	9	8	

Table 19 – Sources of Information – Comparing Among Stakeholder Groups

10.2.3.4.3 Conclusion

Data collected from the Delphi panel suggests:

- Popular media and intuition are the least reliable sources of information for property owners to rely on.
- The Delphi panel is in general agreement about the reliability of resources – with the highest mean and lowest level of variance indicating that the DEQ Database is the most reliable source of information followed by private resources and financial institutes.
- Considering the median value for each source of information, the Delphi panel suggest that private resources, such as consultants and lawyers, financial institutions and local government agencies, such as city and

county databases and local government resources are the most reliable sources for a brownfield property owner to consult during the decision-making process.

- In general, the Delphi panel members, regardless of their stakeholder group affiliation, are in more agreement when ranking the level of reliability of sources of information compared to ranking the level of impact for either the cost or the benefit factors. This suggests that available sources of information to property owners are well understood among panel members and across stakeholder groups.
- After comparing the results among different stakeholder groups, it is suggested that the public stakeholder group has the lowest level of disagreement (highest agreement) in their responses regarding rankings for the reliability of informational sources. The regulatory stakeholders group has the highest level of disagreement among stakeholder members compared to the other two groups.
- In general, all stakeholder groups suggest that popular media, intuition, community resources and a property's physical appearance cannot be considered as reliable sources of information. They do however indicate that DEQ database, private resources and financial institution are the highest ranked sources of information and considered to be the most reliable sources of information that a property owner consults during a cost/benefit analysis.

#### *10.2.3.5 Impact of Factors vs. Reliability of Sources of Information on Property Owners' Decision-Making Processes*

Property owners use sources of information in order to make an informed decision to remediate or not. Delphi panel members were asked to utilize a matrix with a comprehensive list of all the factors and sources of information

that have been identified based on the literature review and the comments of Delphi panel in the surveys. Each column was dedicated to a key factor and each row was dedicated to a source of information. The panel members were asked to select the source(s) of information that they believed a brownfield property owner uses when performing a subjective assessment of each factor. The raw data collected from this question is presented in Appendix D and the collective responses are summarized below in

Table 20 where all the factors are listed in the columns and the sources of information are listed in the rows.

#### 10.2.3.5.1 Results – Impact of Factors vs. Reliability of Sources of information

The Delphi panel was asked to respond based on their beliefs regarding the degree of reliability for each source of information and the degree of impact each factor has on a property owner's cost/benefit analysis. This research performed a descriptive analysis based on the median and variance data to get a better understanding of the level of importance for each factor and the reliability of each source of information. The median was calculated for each factor and each source of information and was paired with the corresponding factors and sources of the information in

Table 20. All the factors were then arranged in ascending order beginning with the factor with the least level of impact to the factor with the highest level of impact - from left to right. In addition, the sources of information were arranged in descending order from the most reliable source of information to the least reliable source of information, from top to bottom. Using the mean value of medians for the factors and sources of information, the table was divided into four quadrants as shown in Table 21.

Sources of Information	Factors																	
	Listing as responsible party	Regulatory Enforcement	Third Party Litigation	Available Funding	Incentives	Liability Mitigation	Distrust of Resources	Property Location/Prime	Property Location/Distressed	Public Health Hazard	Cost of Remediation	Time to Remediate	Loss of Existing Business	Future Financial Gains	Stigma	Community Acceptance	Civic Stewardship	Personal life situation
Popular Media	4	4	6	4	3	2	10	9	8	10	2	2	3	1	13	12	9	3
Intuition - Personal Information	9	6	10	4	2	2	13	13	14	7	9	10	17	17	12	13	17	19
Community Sources	4	4	5	11	12	2	10	10	8	15	3	0	7	5	14	16	11	4
Historical Site Information	10	4	9	1	0	3	4	6	8	10	7	2	3	2	3	3	3	1
Property Physical Appearance	3	3	1	1	0	1	0	10	13	10	1	1	2	1	11	5	4	2
DEQ Database	13	14	8	6	6	8	4	3	5	11	5	6	2	1	3	0	1	0
EPA Database	10	12	9	4	6	5	3	2	4	10	4	4	1	0	4	0	0	1
Private Resources	11	10	14	12	11	12	6	11	9	10	17	16	7	13	6	2	2	6
City and County Files	6	5	6	1	4	4	3	7	8	12	2	1	2	4	4	2	1	0
Financial Institution	3	4	5	14	12	5	4	12	13	1	10	5	6	13	2	0	1	4
Local Government Resources	8	9	4	15	19	8	7	6	8	11	10	7	3	6	5	9	9	4

Table 20 – Factors vs. Sources of information – Collective Responses of the Delphi Panel members

Sources of Info	Impact	Low Impact										High Impact								
		Stigma	Distrust of Resources	Property Location/Distressed	Public Health Hazard	Loss of Existing Business	Personal life situation	Community Acceptance	Civic Stewardship	Listing as responsible party	Regulatory Enforcement	Third Party Litigation	Time to Remediate	Available Funding	Incentives	Liability Mitigation	Property Location/Prime	Cost of Remediation	Future Financial Gains	
Reliability	Median	4	5	5	5	5	5	5	5	5	6	7	7	7	7	7	7	7	8	8
Reliable	DEQ Database	7	4	6	6	8	11	5	1	0	13	14	8	5	6	2	1	3	3	0
	EPA Database	7	3	4	6	5	10	4	0	1	10	12	9	4	4	1	0	4	2	0
	Private Resources	7	6	12	11	12	10	17	2	6	11	10	14	9	16	7	13	6	11	2
	City and County Files	7	3	1	4	4	12	2	1	0	6	5	6	8	1	2	4	4	7	2
	Financial Institution	7	4	14	12	5	1	10	1	4	3	4	5	13	5	6	13	2	12	0
	Local Government Resources	7	7	15	19	8	11	10	9	4	8	9	4	8	7	3	6	5	6	9
	Historical Site Information	6	4	1	0	3	10	7	3	1	10	4	9	8	2	3	2	3	6	3
Not Reliable	Community Sources	5	10	11	12	2	15	3	11	4	4	4	5	8	0	7	5	14	10	16
	Property Physical Appearance	5	0	1	0	1	10	1	4	2	3	3	1	13	1	2	1	11	10	5
	Popular Media	4	10	4	3	2	10	2	9	3	4	4	6	8	2	3	1	13	9	12
	Intuition - Personal Information	4	13	4	2	2	7	9	17	19	9	6	10	14	10	17	17	12	13	13

Table 21- Ranking Impact of Factor vs. Reliability of Sources of Information – Median Quadrant

A description of each of the quadrant in Table 21 are summarized below:

1. The first quadrant is located in the top right quadrant shown in a dark green color. This quadrant covers the reliable sources of information



(reliability scores 6 and above) that the Delphi panel selected for factors that have a high level of impact (impact scores 7 and above) on brownfields property owner’s cost/benefit analyses.

2. The second quadrant is the top left quadrant shown in a green color. This quadrant covers the reliable sources of information (reliability scores 6 and above) that the Delphi panel selected for factors that have a low level of impact (impact scores below 7) on brownfields property owner’s cost/benefit analyses.
3. The third quadrant is the bottom left quadrant shown in a lighter green color. This quadrant covers the non-reliable sources of information (impact scores below 6) that the Delphi panel selected for factors that have a low level of impact (impact scores below 7) on brownfields property owners’ cost/benefit analysis.
4. The fourth quadrant is the bottom right quadrant shown in the lightest green color. This quadrant covers the non-reliable sources of information (impact scores below 6) that the Delphi panel selected for factors that have a high impact (impact scores 7 and above) on brownfields property owners’ cost/benefit analyses.

The median, mean and sum value for each quadrant of Table 21 was calculated and presented in

Table 22 below:

Median	Mean	Sum							
5	5.746	362	High Impact, Reliable						
6	6.3651	401	Low Impact, Reliable					2	1
4	6.1944	223	Low Impact, Not Reliable						
8	7.9444	286	High Impact, Not Reliable					3	4

#### Table 22- Impact vs. Reliability Quadrant

The first quadrant of the this table with the lowest mean value presents the least probable condition where reliable sources of information are being utilized for factors that have the highest degree of impact on property owners decision. The fourth quadrant with the highest mean value presents the most probable condition where the property owners use the least reliable sources of information to make a decision when faced with factors that have the highest level of impact on their decision.

#### 10.2.3.5.2 Analysis

According to the factor's median ascending arrangements in Table 21, the cost factors that have the highest impact on a brownfield property owner's decision-making process are the cost of remediation and time to remediate, third party litigation and regulatory enforcement are factors. Property owners can find reliable information related to these factors utilizing DEQ and EPA databases as well as private resources, local government databases and resources, financial institution requirements and historical site information.

This table also suggests that the cost factors such as listing as responsible party, public health hazard, a property location in a distressed area, distrust of resources and stigma have low impacts on a property owner's decision-making process. In addition, the benefit factors, such as community acceptance and civic stewardship are among the low impact factors, whereas the benefit factors, such as future financial gains, a property being in a prime location, liability mitigation, incentives and availability of funds are among the factors that have the highest impact on a property owner's decision-making process. This table suggests that stigma has the lowest level of impact and future financial gains have the highest level of impact on a property owner's cost/benefit analysis. The following factors

and their related sources of information were selected as the most frequently chosen among the Delphi panel members.

In the first quadrant, 84 percent of the Delphi panel suggested that the availability of funding can be obtained utilizing private resources, 74 percent of the Delphi panel suggested that for regulatory enforcement, the most appropriate source of information is the DEQ database.

A high percentage of Delphi panel suggested that property owners rely on their own intuition for high impacting factors such as time to remediate (84 percent), incentives (89 percent), and liability mitigation (89 percent). In addition, the Delphi panel responses suggested that community sources with low reliability marks are being utilized by property owners when they look into future financial gains (84 percent) and property prime location (74 percent).

When calculating the mean value for each quadrant, the highest mean value belongs to the fourth quadrant. This finding suggests that based on the Delphi panel opinions, property owners use the least reliable sources such as their own intuition, popular media, community sources and the property's physical appearance as sources of information when considering factors that have the highest level of impact on their decision-making processes to remediate. These findings indicate an important potential explanation for the slow rate of brownfields remediation.

### **10.3 Chapter Summary**

The responses from the last surveys were collected and systematically evaluated through a content analysis. A list of factors was identified based on the collective input from the prior surveys, and this research literature review. Each factor was assigned to be either a cost or a benefit considering two possible options; A) not to remediate and B) remediation.

The members of the Delphi panel were asked to rank the degree of impact each factor may have on the property owner's decision-making process. The general high variance value for the factors in both conditions suggests that the experts did not identify any single factor having a major impact on the property owners' decision-making process. Overall data suggests that public stakeholders generally are more in agreement compare to the other stakeholders. The higher level of variance among regulatory stakeholders suggests a high level of disagreement amongst the members of this group.

The cost/benefit analysis portion of this study suggests that owners may conclude there are almost zero benefits for a property owner to remediate if there is no conscious perception of the costs associated with the status-quo condition of no remediation. Perhaps the no-remediation cost would only be brought to mind in the case of outside actions, such as regulatory or third-party actions. This data suggests that there is a perception that there are not enough motivations for property owners to move forward with remediation.

Data analysis also suggests that brownfields property owners seek the most unreliable sources of information when doing a cost/benefit analysis on the factors that have the most impact on their decisions.

The next chapter provides a comprehensive conclusion of this research and provides a recommendation for areas of focus that may increase the rate of remediation of brownfields properties. In addition, it provides suggestions for future studies.

## **11 Chapter Eleven - Conclusion and Future Research**

### **11.1 Introduction**

The main objective of this chapter is to summarize the findings of this study and to outline the contribution of the research. This section concludes the findings on the subject regarding brownfield property owners' cost/benefit analyses. These findings are based on the expert panel's opinions about the current state of the brownfields remediation process and problems associated with the slow rate of remediation. This section also provides recommendations to increase the rate of remediation and suggests future research studies.

### **11.2 Research Focus**

Brownfield properties are typically associated with the potential for economic and environmental risks. This may be due to the governing regulations and environmental policies related to site cleanups, which emphasize the threat of liability and the responsibility of the owner to address site contamination. The effects of environmental regulation on brownfields redevelopment and the related fear of liability exhibited by brownfields property owners were evaluated by the research proposed in this dissertation.

A comprehensive literature review by researcher evaluated the current processes for remedial action and brownfields revitalization. In doing so, it established a set of causes that both inhibit and encourage brownfields redevelopment projects, including factors such as the perception of risk associated with brownfields remediation. This research hypothesized that a brownfield property owner's cost/benefit analysis is a key factor in determining the rate of remediation.

### **11.3 Research Originality**

The proposed property owner's decision-making model is unique as it presents a different approach to study the root and causes of the slow rate of remediation. This model proposes that brownfield property owners are the primary decision-makers and it is their cost/benefit analyses that are an important step that define and directly contribute to the rate of brownfields remediation.

This research explored expert opinions to gain a better understanding of the perceptions of risk experienced by property owners as individuals, in addition to social aspect of risk and its influence on property owners' decision-making processes. This research also looks into the overall understanding of the three different stakeholder groups as experts regarding the impact of costs and benefits associated with brownfields remediation projects when considering property owners as the fourth stakeholder group. This research sought expert opinion to have a better understanding of the current state of practice for property owners which results in such a diminutive action to remediate.

### **11.4 Contribution of this Research**

This research was performed by utilizing an expert panel comprised of the key decision-makers from the three major brownfields stakeholder groups that include: private; public and regulatory. An online survey technique was used to implement the Delphi methodology by collecting expert opinions to validate the various proposed hypotheses. A total of four surveys were performed, which helped to conclude the followings based on the expert panel's consensus;

1. Brownfield property owners are indeed the primary-decision makers who influence the rate of remediation.
2. The causal model proposed by this research that demonstrates a brownfield property owner's cost/benefit analysis was confirmed to be a

valid model. Per expert panel comments, this research clarified that the term “cost/benefit analysis” in this research does not only refer to monetary values, but rather to the advantages and disadvantages a property owner considers when making a decision to remediate a brownfield property or not.

3. This research's hypotheses were validated and amended by the Delphi panel and include: 1) there are a set of factors that influence property owner's decision process and 2) brownfield property owners rely on noted sources of information to make decisions about remediation. As a result, a comprehensive list of the factors and sources of information that affect brownfield property owners was developed. Each factor was then categorized by this research as either a cost or a benefit factor.
4. Expert opinions were utilized to rank the factors based on their level of impact on a property owner's decision-making process. Experts also ranked the sources of information based on their perceived level of reliability.

An objective analysis was performed to evaluate the impact of each factor as either an enabler (benefit factor) or inhibitor (cost factor) on a property owner's decision-making model. This research findings suggest that experts believe that property owners will make a decision to remediate if the net costs associated with not remediating (condition A) are higher than the net costs associated with remediating— meaning it is not to the brownfield property owner's advantage to remain at the status quo. However when analyzing the costs and benefits for taking an action to remediate (condition B), the data suggested owners may perceive zero net benefits exist for property owners to remediate, if the analysis focuses solely on the remediation—and not on the cost of the status quo of the existing contaminated property.

This research believes this data contributes valuable information regarding a better understanding as to the root of why the rate of brownfield remediation projects stays at such a slow rate regardless of ample efforts to encourage remediation projects.

These research findings also reveal that property owners may use the least reliable sources of information when facing factors that have the most impact on their cost/benefit analyses. When decisions are made based on poor information, property owners may conclude that remediation is not beneficial and they may not take remediation action; if better information is made available, then decisions may more likely be made to remediate. Therefore, an owner's perception of the influence of each factor, including the uncertainty or risk surrounding the factors, is an important element that contributes to the slow rate of brownfields remediation and revitalization.



## 11.5 Recommendations and Future Studies

Based on these research findings, several suggestions are offered that could benefit the rate of remediation of brownfields and the turnaround time for such properties. This research suggests that it is important to encourage property owners to use reliable sources when making cost/benefit analyses for each of the factors.

It is also vital that regulatory agencies provide a better community outreach program that effectively utilizes community resources. It would be especially helpful to brownfield property owners if regulatory agencies provided readily available online cost/benefit analysis tools to help property owners make better-informed decisions. Resources that clearly identify the costs of contaminated properties, and the costs and benefits of remediating brownfield properties in layman terms may also increase the rate of remediation for such properties.

This research determined that the benefit of remediating a property by itself is not the key encourager for a property owner during the decision-making process; coupling understanding of the cost of leaving a brownfield property in status quo (not-remediated) provides a much larger incentive for property owners to decide to take an active role in remediating their property. As many of the brownfields properties are former and potential commercial sites, providing reliable, available sources of information that demonstrate the value of improving the commercial viability of the sites will further improve the incentive to remediate.

This research also suggests that programs, such as the brownfields program in Business Oregon or provision of Small Business Administration (SBA) loans, could be capitalized in order to reduce owners' financing costs for the remediation step, not just the assessment step. The current EPA assessment grant provides

funding to only assess properties and discover contaminated sites; however, the property owners must proceed on their own from there, and they face the difficult-to-assess costs of future financing for remediation projects. Unreliable information regarding remediation costs and lack of information regarding available programs to reduce these costs likely affects owners' decisions whether to consider remediation.

Interagency cooperation among regulatory or incentive-providing entities to proactively provide more available and reliable information to property owners may further improve decisions to pursue remediation.

As for the future of this topic, this research highly recommends a comprehensive survey of brownfields property owners in the state of Oregon to validate the Delphi Panel results.

## REFERENCES

- Ackerman, J. (2001). Finding Your Brownfield of Dreams. *World Wastes*, 32(3), 166. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/14568054?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:envabstractsmodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=World+Wastes&rft.atitle=Finding+Your+Brownfield+of+Dreams&rft.au=Ackerman,+Jerry&rft.aulast=Ackerman&rft.aufirst=Jerry&rft.date=2001-03-01&rft.volume=32&rft.issue=3&rft.spage=166&rft.isbn=&rft.btitle=&rft.title=World+Wastes&rft.issn=10648429](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:envabstractsmodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=World+Wastes&rft.atitle=Finding+Your+Brownfield+of+Dreams&rft.au=Ackerman,+Jerry&rft.aulast=Ackerman&rft.aufirst=Jerry&rft.date=2001-03-01&rft.volume=32&rft.issue=3&rft.spage=166&rft.isbn=&rft.btitle=&rft.title=World+Wastes&rft.issn=10648429)
- Addlestone, S. I. (2004). Looking Ahead: Top Issues in Waste Management in 2004. *Environmental Protection*, 15(1), 36. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/14682936?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:envabstractsmodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Environmental+Protection&rft.atitle=Looking+Ahead:+Top+Issues+in+Waste+Management+in+2004&rft.au=Addlestone,+Steven+I&rft.aulast=Addlestone&rft.aufirst=Steven&rft.date=2004-01-01&rft.volume=15&rft.issue=1&rft.spage=36&rft.isbn=&rft.btitle=&rft.title=Environmental+Protection&rft.issn=10574298](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:envabstractsmodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Environmental+Protection&rft.atitle=Looking+Ahead:+Top+Issues+in+Waste+Management+in+2004&rft.au=Addlestone,+Steven+I&rft.aulast=Addlestone&rft.aufirst=Steven&rft.date=2004-01-01&rft.volume=15&rft.issue=1&rft.spage=36&rft.isbn=&rft.btitle=&rft.title=Environmental+Protection&rft.issn=10574298)
- Aker, J. M. (2009). Brownfield Reclamation is Practical and Cost Effective. *Buildings*, 103(4), 6. Retrieved from

<http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/21486017?accountid=13013>

[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:ssamodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Buildings&rft.title=Brownfield+Reclamation+is+Practical+and+Cost+Effective&rft.au=Aker,+Jenna+M&rft.aulast=Aker&rft.aufirst=Jenna&rft.date=2009-04-01&rft.volume=103&rft.issue=4&rft.spage=6&rft.isbn=&rft.btitle=&rft.title=Buildings&rft.issn=00073725](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:ssamodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Buildings&rft.title=Brownfield+Reclamation+is+Practical+and+Cost+Effective&rft.au=Aker,+Jenna+M&rft.aulast=Aker&rft.aufirst=Jenna&rft.date=2009-04-01&rft.volume=103&rft.issue=4&rft.spage=6&rft.isbn=&rft.btitle=&rft.title=Buildings&rft.issn=00073725)

Albarracín, D., Zanna, M. P., Johnson, B. T., & Kumkale, G. T. (2005). Attitudes: Introduction and Scope.

Alexander, R. (2012). NETWORK STRUCTURES AND THE PERFORMANCE OF BROWNFIELD REDEVELOPMENT PPPs. *PUBLIC PERFORMANCE & MANAGEMENT REVIEW*, 35(4), 753-768. doi:10.2753/PMR1530-9576350409

Allen, J., Liptak, K., Guo, J., & Worasinchai, L. (2015). *Mail Survey Response Rates in Academic Research: A Multi-Disciplinary Trend Analysis*. Paper presented at the Proceedings of the 1999 Academy of Marketing Science (AMS) Annual Conference.

Alwin, D. F. (2013). Investigating Response Errors in Survey Data. *Sociological Methods & Research*, 0049124113507907.

Babbie, E. R. (1973). *Survey research methods*: Wadsworth Belmont, CA.

Babbie, E. R., & Halley, F. (1995). *Adventures in Social Research: Data Analysis Using SPSS for Windows/Book and Disk*: Pine Forge Press.

Bakir, V. (2006). Policy agenda setting and risk communication Greenpeace, Shell, and Issues of Trust. *The Harvard International Journal of Press/Politics*, 11(3), 67-88.

- Baron, J. (2000). *Thinking and deciding*: Cambridge University Press.
- Bartsch, C. (2003). The New Federal Law on Brownfields: the Small Business Liability Relief and Brownfields Revitalization Act. *Environmental Practice*, 5(1), 48. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/14655128?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:envabstractsmodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Environmental+Practice&rft.atitle=The+New+Federal+Law+on+Brownfields:+the+Small+Business+Liability+Relief+and+Brownfields+Revitalization+Act&rft.au=Bartsch,+Charles&rft.aulast=Bartsch&rft.aufirst=Charles&rft.date=2003-03-01&rft.volume=5&rft.issue=1&rft.spage=48&rft.isbn=&rft.btitle=&rft.title=Environmental+Practice&rft.issn=14660466](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:envabstractsmodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Environmental+Practice&rft.atitle=The+New+Federal+Law+on+Brownfields:+the+Small+Business+Liability+Relief+and+Brownfields+Revitalization+Act&rft.au=Bartsch,+Charles&rft.aulast=Bartsch&rft.aufirst=Charles&rft.date=2003-03-01&rft.volume=5&rft.issue=1&rft.spage=48&rft.isbn=&rft.btitle=&rft.title=Environmental+Practice&rft.issn=14660466)
- BenDor, T. K., Metcalf, S. S., & Paich, M. (2011). The Dynamics of Brownfield Redevelopment. *Sustainability*, 3(6), 914-936. doi:10.3390/su3060914
- Benson, C. H. (1998). *Risk-based corrective action and brownfields restorations : proceedings of sessions of geo-congress 98*. Reston, Va.: American Society of Civil Engineers.
- Bernstein, F., & Federgruen, A. (2005). Decentralized supply chains with competing retailers under demand uncertainty. *Management Science*, 51(1), 18-29.
- Biemer, P. P., Groves, R. M., Lyberg, L. E., Mathiowetz, N. A., & Sudman, S. (2011). *Measurement errors in surveys* (Vol. 173): John Wiley & Sons.
- Bleicher, A., & Gross, M. (2010). Sustainability assessment and the revitalization of contaminated sites: operationalizing sustainable development for local problems. *International*

*Journal of Sustainable Development and World Ecology*,  
17(1), 57-66. doi:10.1080/13504500903488263

- Boddy, C. (2012). The Nominal Group Technique: an aid to Brainstorming ideas in research. *Qualitative Market Research: An International Journal*, 15(1), 6-18.
- Bogen, A. (2006). *Brownfields - public involvement*: WIT Press, Southampton, UK.
- Breggin, L., & Environmental Law Institute. (1999). *A guidebook for brownfield property owners*. Washington, DC: Environmental Law Institute.
- Buonicore, A. J., & Crocker, D. P. (2004). Property environmental. Due diligence: AAI vs. ASTM. *Pollution Engineering*, 36(4), 18-24. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/28340902?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:environmentalengabstracts&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Pollution+Engineering&rft.atitle=Property+environmental.+Due+diligence:+AAI+vs.+ASTM.&rft.au=Buonicore,+A+J+Crocker,+D+P&rft.aulast=Buonicore&rft.aufirst=A&rft.date=2004-04-01&rft.volume=36&rft.issue=4&rft.spage=18&rft.isbn=&rft.btitle=&rft.title=Pollution+Engineering&rft.issn=00323640](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:environmentalengabstracts&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Pollution+Engineering&rft.atitle=Property+environmental.+Due+diligence:+AAI+vs.+ASTM.&rft.au=Buonicore,+A+J+Crocker,+D+P&rft.aulast=Buonicore&rft.aufirst=A&rft.date=2004-04-01&rft.volume=36&rft.issue=4&rft.spage=18&rft.isbn=&rft.btitle=&rft.title=Pollution+Engineering&rft.issn=00323640)
- Crocker, D. P., & Buonicore, A. J. (2004). Property environmental. Due diligence: AAI vs. ASTM. *Pollution Engineering*, 36(4), 18-24. Retrieved from [http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:environmentalengabstracts&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Pollution+Engineering&rft.atitle=Property+environmental.+Due+diligence:+AAI+vs.+ASTM.&rft.au=Buonicore,+A+J+Crocker,+D+P&rft.aulast=Buonicore&rft.aufirst=A&rft.date=2004-04-01&rft.volume=36&rft.issue=4&rft.spage=18&rft.isbn=&rft.btitle=&rft.title=Pollution+Engineering&rft.issn=00323640](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:environmentalengabstracts&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Pollution+Engineering&rft.atitle=Property+environmental.+Due+diligence:+AAI+vs.+ASTM.&rft.au=Buonicore,+A+J+Crocker,+D+P&rft.aulast=Buonicore&rft.aufirst=A&rft.date=2004-04-01&rft.volume=36&rft.issue=4&rft.spage=18&rft.isbn=&rft.btitle=&rft.title=Pollution+Engineering&rft.issn=00323640)
- Chang, H. F., Sigman, H., & National Bureau of Economic Research. (2010). *An empirical analysis of cost recovery in superfund cases implications for brownfields and joint and several liability NBER working paper series working paper 16209* Retrieved from <http://www.nber.org/papers/w16209> Retrieved from <http://www.nber.org/papers/w16209>

- Cleveland, F. R. B. o. (2003). The Community Reinvestment Act: A growing tool for brownfield redevelopment.
- Collin, R. W. (2006). *The Environmental Protection Agency : cleaning up America's act*. Westport, Conn.: Greenwood Press.
- Dasgupta, S., & Tam, E. K. L. (2009). ENVIRONMENTAL REVIEW: A Comprehensive Review of Existing Classification Systems of Brownfield Sites. *Environmental Practice*, 11(4), 285-300. doi:<http://dx.doi.org/10.1017/S1466046609990287>
- De Leeuw, E. D., Mellenbergh, G. J., & Hox, J. J. (1996). The Influence of Data Collection Method on Structural Models A Comparison of a Mail, a Telephone, and a Face-to-Face Survey. *Sociological Methods & Research*, 24(4), 443-472.
- Deborah A. Lange, M. A., 1 and Sue McNeil, M.ASCE2. (2004). Brownfield Development: Tools for Stewardship. doi:10.1061//asce/0733-9488/2004/130:2/109
- DEQ, O. (1998). Guidance for Conducting Feasibility Studies. Retrieved from <http://www.deq.state.or.us/lq/pubs/docs/cu/GuidanceConductingFeasibilityStudies.pdf>
- DEQ, O. (2003). Risk Based Decision Making Guidelines. Retrieved from [www.deq.state.or.us/lq/pubs/docs/RBDMGuidance.pdf](http://www.deq.state.or.us/lq/pubs/docs/RBDMGuidance.pdf)
- Dillman, D. A. (1978). *Mail and telephone surveys* (Vol. 3): Wiley Interscience.
- Donati, A., Rossi, C., & Brebbia, C. A. (2004). *Brownfield sites II : assessment, rehabilitation and development*. Southampton ; Boston: WIT Press.
- Dorsey, J. W. (2009). Restorative Environmental Justice: Assessing Brownfield Initiatives, Revitalization, and Community Economic Development in St. Petersburg, Florida. *Environmental Justice*, 2(2), 69. doi:<http://dx.doi.org/10.1089/env.2008.0546>

- Edwards, A. L., & American Bar Association. Section of Environment Energy and Resources. (2012). *Implementing institutional controls at brownfields and other contaminated sites* (2nd ed.). Chicago: American Bar Association, Section of Environment, Energy, and resources.
- Ellerbusch, F. (2006). Brownfields: Risk, Property, and Community Value. *Local Environment*, 11(5), 559. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/14792878?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:envabstractsmodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Local+Environment&rft.atitle=Brownfields:+Risk,+Property,+and+Community+Value&rft.au=Ellerbusch,+Fred&rft.aulast=Ellerbusch&rft.aufirst=Fred&rft.date=2006-10-01&rft.volume=11&rft.issue=5&rft.spage=559&rft.isbn=&rft.btitle=&rft.title=Local+Environment&rft.issn=13549839](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:envabstractsmodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Local+Environment&rft.atitle=Brownfields:+Risk,+Property,+and+Community+Value&rft.au=Ellerbusch,+Fred&rft.aulast=Ellerbusch&rft.aufirst=Fred&rft.date=2006-10-01&rft.volume=11&rft.issue=5&rft.spage=559&rft.isbn=&rft.btitle=&rft.title=Local+Environment&rft.issn=13549839)
- Engelberg, E., & Sjöberg, L. (2005). Perceived reality of visually mediated hazards and beliefs about risk. *Applied Cognitive Psychology*, 19(7), 899-912. Retrieved from [http://oregonstate.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwXZ07DgIxDEQtxAmQ4BZBifNxUiNWHAAO4GTjkvuxOyAkEK0rNzPPduEhinz27s8TppglsI8FhOkDQ7fBCCPkxsHkHWLyff75Y\\_DLgXbzeaTHcr1fbu6TD-AGQxwuZG1tWga1pQunUlvhpKiyHz5q19eVJGaxWtsEh4KYjopGSlrXkcOJ9tix5wY-Tyn0](http://oregonstate.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwXZ07DgIxDEQtxAmQ4BZBifNxUiNWHAAO4GTjkvuxOyAkEK0rNzPPduEhinz27s8TppglsI8FhOkDQ7fBCCPkxsHkHWLyff75Y_DLgXbzeaTHcr1fbu6TD-AGQxwuZG1tWga1pQunUlvhpKiyHz5q19eVJGaxWtsEh4KYjopGSlrXkcOJ9tix5wY-Tyn0)  
[www.summon.com](http://www.summon.com)
- EPA. (1997). Community Reinvestment Act fact sheet. Retrieved from <http://www.epa.gov/brownfields/laws/cra.htm>
- EPA. (2004). What is RCRA. Retrieved from <http://waste.supportportal.com/link/portal/23002/23023/Article/22516/What-is->



[RCRA? \\_utma=172919287.56141135.1386435494.1398639558.1399076902.10& \\_utmb=172919287.29.8.1399077855911& \\_utmc=172919287& \\_utmz=172919287.1398639558.9.6.utmcsr=yahoo|utmccn=\(organic\)|utmcmd=organic|utmctr=\(not%20provided\)& \\_utmv=172919287.1=visitor%20id=56141135=1& \\_utmkt=84623449](http://www.epa.gov/brownfields/RCRA?_utma=172919287.56141135.1386435494.1398639558.1399076902.10&_utmb=172919287.29.8.1399077855911&_utmc=172919287&_utmz=172919287.1398639558.9.6.utmcsr=yahoo|utmccn=(organic)|utmcmd=organic|utmctr=(not%20provided)&_utmv=172919287.1=visitor%20id=56141135=1&_utmkt=84623449)

EPA. (2006). Anatomy of Brownfields Redevelopment. Retrieved from [www.epa.gov/brownfields](http://www.epa.gov/brownfields)

EPA. (2007). CERCLA, BROWNFIELDS, and LENDER LIABILITY. Retrieved from [http://www.epa.gov/brownfields/aai/lenders\\_factsheet.pdf](http://www.epa.gov/brownfields/aai/lenders_factsheet.pdf)

EPA. (2011, 12/12/2011). CERCLA Overview. Retrieved from <http://www.epa.gov/superfund/policy/cercla.htm>

EPA. (2012). Evaluation of Brownfields Program.

EPA issues status reports on brownfield projects. (2006). *HAZARDOUS WASTE CONSULTANT*, 24(2), A8-A12. Retrieved from [http://oregonstate.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwTV27DsIwDIyQkFhYKkFWfqBV0sR5zBUVYu7AaucxViD6\\_yINIBi9WbJ99uC7Y-xEfcgOUaqUBfkUDay6Sr2GmKL11S\\_yp\\_T5h-ZjwzZpPrBpPE\\_Dpf2YAbR38GVofZXViA6CBMTsyADqpMty6yEE6p3IZBVEZVwuRz8ajbLzBMLGilYHeWR7XH\\_G56VyyyIn21wKnPgKurwkwNnu5q-jGJx8h8037J6VANU9Fl4wvVZHC514AY6QORQ](http://oregonstate.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwTV27DsIwDIyQkFhYKkFWfqBV0sR5zBUVYu7AaucxViD6_yINIBi9WbJ99uC7Y-xEfcgOUaqUBfkUDay6Sr2GmKL11S_yp_T5h-ZjwzZpPrBpPE_Dpf2YAbR38GVofZXViA6CBMTsyADqpMty6yEE6p3IZBVEZVwuRz8ajbLzBMLGilYHeWR7XH_G56VyyyIn21wKnPgKurwkwNnu5q-jGJx8h8037J6VANU9Fl4wvVZHC514AY6QORQ)

EPA, U. S. (2012). Basic Information \_ Brownfields and Land Revitalization \_ US EPA. Retrieved from [http://www.epa.gov/brownfields/basic\\_info.htm#plan](http://www.epa.gov/brownfields/basic_info.htm#plan)

Establishing Indicators to Evaluate Brownfield Redevelopment. (2006). *Economic Development Quarterly*, 20(2), 142-161. doi:10.1177/0891242405285749

- Fenig, S., Levav, I., Kohn, R., & Yelin, N. (1993). Telephone vs face-to-face interviewing in a community psychiatric survey. *American Journal of Public Health, 83*(6), 896-898.
- Frantzen, K. A. (2002). *Risk-based analysis for environmental managers*. Boca Raton, Fla.: Lewis Publishers.
- Furnham, A., Boo, H.C. (2011). A literature review of the anchoring effect. *Journal of Socio Economics, 40*(1), 35-42.
- Gallagher, & Jackson, S. E. (2008). Promoting community involvement at brownfields sites in socio-economically disadvantaged neighbourhoods. *Journal of Environmental Planning and Management, 51*(5), 615-630.  
doi:<http://dx.doi.org/10.1080/09640560802210971>
- Geist, M. R. (2010). Using the Delphi method to engage stakeholders: A comparison of two studies. *Evaluation and Program Planning, 33*(2), 147-154.  
doi:<http://dx.doi.org/10.1016/j.evalprogplan.2009.06.006>
- Germannano, B. A. (2011). *Contamination cleanup : Superfund background and issues*. Hauppauge, N.Y.: Nova Science.
- Gerrard, M., Foster, S. R., & American Bar Association. Section of Environment Energy and Resources. (2008). *Law of environmental justice : theories and procedures to address disproportionate risks* (2nd ed.). Chicago, Ill.: American Bar Association, Section of Environment, Energy, and Resources.
- Graefe, A., & Armstrong, J. S. (2011). Comparing face-to-face meetings, nominal groups, Delphi and prediction markets on an estimation task. *International Journal of Forecasting, 27*(1), 183-195.
- Graziano, K. M. (2004). Due Diligence and Environmental Site Assessments: Impact of EPA's Upcoming "All Appropriate Inquiry" Rule. *Environmental Quality Management, 13*(4), 59-69. doi:<http://dx.doi.org/10.1002/tqem.20016>

- Groves, R. M., Fowler Jr, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2013). *Survey methodology*: John Wiley & Sons.
- Guevara, D. L., & Deveau, F. J. (2013). *The bona fide prospective purchaser defense : a guide for lawyers*. Chicago: American Bar Association.
- Hackney, H. H., & Massachusetts Continuing Legal Education Inc. (1982- ). (2008). *Remediation and development of contaminated property*. Boston, MA: MCLE.
- Hallowell, M. R., & Gambatese, J. A. (2009). Qualitative research: Application of the Delphi method to CEM research. *Journal of construction engineering and management*, 136(1), 99-107.
- Hamin, E. M., Silka, L., & Geigis, P. (2007). *Preserving and enhancing communities : a guide for citizens, planners, and policymakers*. Amherst: University of Massachusetts Press.
- Harvey, N., & Holmes, C. A. (2012). Nominal group technique: an effective method for obtaining group consensus. *International journal of nursing practice*, 18(2), 188-194.
- Haslam, C. (2009). RESEARCH ARTICLE: Urban Redevelopment and Contaminated Land: Lessons from Florida's Brownfield Redevelopment Program. *Environmental Practice*, 11(3), 153-163.  
doi:<http://dx.doi.org/10.1017/S1466046609990147>
- Hastie, R., & Dawes, R. (2001). *Rational Decision in an uncertainty world: The psychology of judgment and decision making*: London: Sage Publications.
- Heerwegh, D., & Loosveldt, G. (2008). Face-to-face versus web surveying in a high-internet-coverage population differences in response quality. *Public Opinion Quarterly*, 72(5), 836-846.

- Hollander, J. (2010). Private Property Owners and the Remaking of Brownfields. *Public Works Management & Policy*, 15(1), 32-56. doi:<http://dx.doi.org/10.1177/1087724X10367915>
- Hollnagel, E. (1984). Inductive and deductive approaches to modelling of human decision making. *Psyke & logos*.
- Hollnagel, E., & Woods, D. D. (2005). *Joint cognitive systems: Foundations of cognitive systems engineering*: CRC Press.
- Holsapple, C. W., & Joshi, K. D. (2002). Knowledge manipulation activities: results of a Delphi study. *Information & Management*, 39(6), 477-490.
- Hula, R., Reese, L., & Jackson-Elmoore, C. (2012). *Reclaiming Brownfields a comparative analysis of adaptive reuse of contaminated properties Global Urban Studies* (pp. 1 online resource (407 p.)). Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://orbis.eblib.com/patron/FullRecord.aspx?p=985861>
- <http://library.cocc.edu:2048/login?url=http://orbis.eblib.com/patron/FullRecord.aspx?p=985861> Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://orbis.eblib.com/patron/FullRecord.aspx?p=985861>
- <http://library.cocc.edu:2048/login?url=http://orbis.eblib.com/patron/FullRecord.aspx?p=985861>
- Hutchings, H. A., Rapport, F. L., Wright, S., & Doel, M. A. (2013). Obtaining Consensus from Mixed Groups: An Adapted Nominal Group Technique. *British Journal of Medicine & Medical Research*, 3(3), 491-502.
- Hynes, H. P., & Lopez, R. (2009). *Urban health : readings in the social, built, and physical environments of U.S. cities*. Sudbury, Mass.: Jones and Bartlett.
- Joel, B. E. (1999). BROWNFIELDS POLICIES FOR SUSTAINABLE CITIES. *Duke Environmental Law & Policy Forum U6* - <http://oregonstate.summon.serialssolutions.com/2.0.0/link/0/eLvHCXMwfv09C8lwFAyC4OJS0Kz->

[gZakTfMxlwYRBwcHt0fa5k2IhBf29SFXVxv00N9-6Wu\\_c12RgmW-21MugMMypsklpZ77ZgrSg9Fj-XPr\\_U3CZk5ocVGW19rLbp5yAkuFdWHAzE0ALUw23sYQ-5hMO5hztY4Fr9-UkLJSopEKXrMjdNJ1WDXDgmhBG5Ci7J12TpYqZ8GKfuWUfJHAMBPI2iTMOAlCxOZmdZpfkTjm-YXaeCVHYZafCAiT9pmbEH859KSA](https://doi.org/10.1080/026999300402763)

- Johnson, T. P., & Wislar, J. S. (2012). Response rates and nonresponse errors in surveys. *JAMA*, *307*(17), 1805-1806.
- Karachaliou, T., & Kaliampakos, D. (2008). *Remediation and development of a former landfill and rail yard in Virginia USA*: WIT Press, Ashurst Lodge.
- Konheim, C. S. (1988). Risk communication in the real world. *Risk Analysis*, *8*(3), 367-373.
- Kris Wernstedt, L. H., Anna Alberini, and Peter Meyer. (2004). The Brownfields Phenomenon: Much Ado about Something or the Timing of the Shrewd?
- Landman, C. (2005). Oregon's Prospective Purchaser Agreement.
- Lange, D. A., & McNeil, S. (2004). Brownfield development: Tools for stewardship. *JOURNAL OF URBAN PLANNING AND DEVELOPMENT-ASCE*, *130*(2), 109-116.  
doi:10.1061/(ASCE)0733-9488(2004)130:2(109)
- Larence J., J. (1993). Environmental law handbook, safe drinking water act. 250-257.
- Lavrakas, P. J. (1993). *Telephone survey methods: Sampling, selection, and supervision*: Sage Publications, Inc.
- Lennart Sjöberg, B.-E. M., Torbjørn Rundmo. (2004). Explaining Risk Perception. An evaluation of the psychometric paradigm in risk perception research.
- Lerner, J. S. K. D. (2000). Beyond valence: Toward a model of emotion-specific influences on judgement and choice. *Cognition & Emotion*, *14*(4), 473-493.  
doi:10.1080/026999300402763

- Linstone, H. A., & Turoff, M. (1975). *The Delphi method: Techniques and applications* (Vol. 29): Addison-Wesley Reading, MA.
- Longley, R. (2014). Top 10 Reasons to Love Small Businesses. Retrieved from <http://usgovinfo.about.com/cs/businessfinance/a/sbatopten.htm>
- Maltby, R. A. (2009). *Implementation of the framework agreement, part two : commentaries and actions concerning implementation of the framework agreement : an agreement between the State of Michigan and the Dow Chemical Company*. Midland, Mich.: Richard A. Maltby.
- Mayors, T. U. S. C. o. (2006). Recycling America's Land -A National Report on Brownfields Redevelopment. VI. Retrieved from [http://usmayors.org/74thAnnualMeeting/brownfieldsreport\\_060506.pdf](http://usmayors.org/74thAnnualMeeting/brownfieldsreport_060506.pdf)
- Mazur, A., & Lee, J. (1993). Sounding the global alarm: Environmental issues in the US national news. *Social Studies of Science*, 23(4), 681-720.
- McCarthy, L. (2002). The brownfield dual land-use policy challenge: reducing barriers to private redevelopment while connecting reuse to broader community goals. *Land Use Policy*, 19(4), 287-296.  
doi:[http://dx.doi.org/10.1016/S0264-8377\(02\)00023-6](http://dx.doi.org/10.1016/S0264-8377(02)00023-6)
- Mentzer, J. T., & Lambert, D. M. (2015). Estimating NonResponse Bias in Mail Surveys: A Replication Study *Marketing Horizons: A 1980's Perspective* (pp. 222-224): Springer.
- Metro. (2015, Feb. 18, 2015). Oregon brownfields bill could help get abandoned sites cleaned up, developed. Retrieved from <http://www.oregonmetro.gov/news/oregon-brownfields-bill-could-help-get-abandoned-sites-cleaned-developed>
- Neuendorf, K. A. (2002). *The content analysis guidebook*: Sage.

- Neuman, S. (2007). Tailored Insurance Coverage for Post-Remedial Risks. *Environmental Claims Journal*, 19(1-2), 26-32. doi:<http://dx.doi.org/10.1080/10406020701459171>
- Ng, R., & Rayner, S. (2010). Integrating psychometric and cultural theory approaches to formulate an alternative measure of risk perception. *Innovation: The European Journal of Social Sciences*, 23(2), 85-100. doi:10.1080/13511610.2010.512439
- NORTHEAST MIDWEST INSTITUTE. (2008). <brownfields toolbox for disadvantage communitites.pdf>.
- ODEQ. (2005a). Oregon's Prospective Purchaser Agreement.
- ODEQ. (2005b). Voluntary Cleanup Program
- Okoli, C., & Pawlowski, S. D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, 42(1), 15-29.
- Ono, R., & Wedemeyer, D. J. (1994). Assessing the validity of the Delphi technique. *Futures*, 26(3), 289-304.
- Onwuegbuzie, A. N. L. L. (2010). Generalization practices in qualitative research: a mixed methods case study. *Springer Science and Business Media*, 44, 881-892. doi:10.1007/s11135-009-9241-z
- Paul Slovic, E. P. (2006). Risk Perception and Affect.
- Pennsylvania Bar Institute. (2002). *2002 "Brownfields" legislation*. Mechanicsburg, Pa. (5080 Ritter Rd., Mechanicsburg 17055-6903)Mechanicsburg, Pa.: Pennsylvania Bar Institute.
- Poortinga, W., & Pidgeon, N. F. (2003). Exploring the dimensionality of trust in risk regulation. *Risk Analysis*, 23(5), 961-972.
- Powell, C. (2003). The Delphi technique: myths and realities. *Journal of advanced nursing*, 41(4), 376-382.

- Rayner, S., & Cantor, R. (1987). How Fair Is Safe Enough? The Cultural Approach to Societal Technology Choice. *Risk Analysis*, 7(1), 3-9.
- Rea, L. M., & Parker, R. A. (2012). *Designing and conducting survey research: A comprehensive guide*: John Wiley & Sons.
- Reisch, M. E. A., & Bearden, D. M. (2003). *Superfund and the brownfields issue*. New York: Novinka Publications.
- Richardeiser, J., Stafford, T., Henneberry, J., & Catney, P. (2007). Risk perception and trust in the context of urban brownfields. *Environmental Hazards*, 7(2), 150-156. doi:10.1016/j.envhaz.2007.05.004
- Roddewig, R. J., & Appraisal Institute (U.S.). (2002). *Valuing contaminated properties : an Appraisal Institute anthology*. Chicago , Ill.: Appraisal Institute.
- Rogers, M. R., & Lopez, E. C. (2002). Identifying critical cross-cultural school psychology competencies. *Journal of school psychology*, 40(2), 115-141.
- Rosa, E. A. (2003). The logical structure of the social amplification of risk framework (SARF): Aferatheoretical foundations and policy implications. *The social amplification of risk*, 47.
- Rowe, G., Wright, G., & Bolger, F. (1991). Delphi: a reevaluation of research and theory. *Technological Forecasting and Social Change*, 39(3), 235-251.
- Rubin, G., Bakhshi, S., Amlôt, R., Fear, N., Potts, H., & Michie, S. (2014). The design of a survey questionnaire to measure perceptions and behaviour during an influenza pandemic: the Flu TELEphone Survey Template (FluTEST). *Health Services & Delivery Research*, 2.
- Rundmo, T. (2004). Explaining Risk Perception.
- Sanchez, M. E. (1992). Effects of questionnaire design on the quality of survey data. *Public Opinion Quarterly*, 56(2), 206-217.



- Sarni, W. (2010). *Greening brownfields : remediation through sustainable development*. New York: McGraw-Hill.
- Sauermann, H., & Roach, M. (2013). Increasing web survey response rates in innovation research: An experimental study of static and dynamic contact design features. *Research Policy*, 42(1), 273-286.
- SBA, O. o. A. (Producer). (2013). President Obama calls small businesses the heart of the American economy. Retrieved from [http://www9.buyerpricer.com/Video.aspx?videoid=hiv\\_xQDE404&slk=obama+small+business&cid=3323762670&kwid=20466316108&uq=president+obama+and+small+businesses&nid=2&iscid=2000005&term=obama+small+business&vx=0](http://www9.buyerpricer.com/Video.aspx?videoid=hiv_xQDE404&slk=obama+small+business&cid=3323762670&kwid=20466316108&uq=president+obama+and+small+businesses&nid=2&iscid=2000005&term=obama+small+business&vx=0)
- Schadler, S., Morio, M., Bartke, S., Rohr-Zanker, R., & Finkel, M. (2011). Designing sustainable and economically attractive brownfield revitalization options using an integrated assessment model. *Journal of Environmental Management*, 92(3), 827-837. doi:10.1016/j.jenvman.2010.10.026
- Schaedler, S., Morio, M., Bartke, S., & Finkel, M. (2012). Integrated planning and spatial evaluation of megasite remediation and reuse options. *Journal of Contaminant Hydrology*, 127(1-4), 88-100. doi:<http://dx.doi.org/10.1016/j.jconhyd.2011.03.003>
- Schmidt, C. O., & Kohlmann, T. (2008). When to use the odds ratio or the relative risk? *INTERNATIONAL JOURNAL OF PUBLIC HEALTH*, 53(3), 165-167. doi:10.1007/s00011-007-7068-3
- Schmidt, R. C. (1997). Managing Delphi surveys using nonparametric statistical techniques\*. *Decision Sciences*, 28(3), 763-774.
- Siegrist, M., & Cvetkovich, G. (2000). Perception of hazards: The role of social trust and knowledge. *Risk Analysis*, 20(5), 713-720.

- Sillars, D. N., & Hallowell, M. R. (2009). *Opinion-Based Research: Lessons Learned from Four* (Vol. 339).
- Simons, R., & Urban Land Institute. (1998). *Turning brownfields into greenbacks : developing and financing environmentally contaminated urban real estate*. Washington, D.C.: Urban Land Institute.
- Sjöberg, L. (1998). Risk perception: Experts and the public. *European Psychologist, 3*(1), 1-12. doi:10.1027//1016-9040.3.1.1
- Sjöberg, L. (2000). Factors in Risk Perception.
- Sjöberg, L. (2003). The Different Dynamics of Personal and General Risk. *Risk Management, 5*(3), 19-34. doi:10.2307/3867764
- Sjöberg, L. (2004). Explaining Individual Risk Perception: The Case of Nuclear Waste. *Risk Management, 6*(1), 51-64. doi:10.2307/3867934
- Sjöberg, L. (2007). Emotions and Risk Perception. *Risk Management, 9*(4), 223-237. doi:10.2307/4500403
- Sjöberg, L. (2008). Antagonism, Trust and Perceived Risk. *Risk Management, 10*(1), 32-55. doi:10.2307/27669988
- Slovic, P. (1993). Perceived risk, trust, and democracy. *Risk Analysis, 13*(6), 675-682.
- Slovic, P. (1997). Public perception of risk. *Journal of Environmental Health, 59*(9), 22. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=9705084351&site=ehost-live>
- Slovic, P., Fischhoff, B., & Lichtenstein, S. (1982). Why study risk perception. *Risk Analysis, 2*(2), 83-93.
- Starr, C. (1969). Social Benefits versus technological Risks. *Science, 165*(3899), 1232-1238.

- Steeler, J., & Hayes, C. (2009). Funding Brownfield Redevelopment. *Buildings*, 103(11), 26-27. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/21333269?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:ssamodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Buildings&rft.a\\_title=Funding+Brownfield+Redevelopment&rft.au=Steeler,+I](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:ssamodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=Buildings&rft.a_title=Funding+Brownfield+Redevelopment&rft.au=Steeler,+I)
- Hayes, C. & Steeler, J. (2009). Funding Brownfield Redevelopment. *Buildings*, 103(11), 26-27. doi:10.1177/00139160021972513
- Steg, L., & Sievers, I. (2000). Cultural Theory and Individual Perceptions of Environmental Risks. *Environment and Behavior*, 32(2), 250-269. doi:10.1177/00139160021972513
- Stemler, S. (2001). An overview of content analysis. *Practical assessment, research & evaluation*, 7(17), 137-146.
- Suchman, L., & Jordan, B. (1990). Interactional troubles in face-to-face survey interviews. *Journal of the American Statistical Association*, 85(409), 232-241.
- Sutton, S. G., & Arnold, V. (2013). Focus group methods: Using interactive and nominal groups to explore emerging technology-driven phenomena in accounting and information systems. *International Journal of Accounting Information Systems*, 14(2), 81-88.
- Thompson, C. P. M. D. (1991). Estimating the Frequency of Everyday Events. *Applied Cognitive Psychology*, 5(6), 497-510. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=pbh&AN=12003410&site=ehost-live>

- Tiene, D. (2000). Online discussions: A survey of advantages and disadvantages compared to face-to-face discussions. *Journal of Educational Multimedia and Hypermedia*, 9(4), 369-382.
- United States. Environmental Protection Agency. Office of Brownfields Cleanup and Redevelopment. (2005). *State brownfields and voluntary response programs : an update from the states*. Washington, D.C.: U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Office of Brownfields.
- United States. Environmental Protection Agency. Region I. (2002). *Land & community revitalization : brownfields : program summary & success stories*. Boston, Mass.: EPA New England.
- USDA. (2010). federal resources for sustainable rural communities.
- Vermont. Waste Management Division., & Vermont. Agency of Natural Resources. (2007). *Environmental Contingency Fund status report*. Waterbury, Vt: Agency of Natural Resources, Department of Environmental Conservation, Waste Management Division.
- vessey, I. (August 1994). The effect of information presentation on decision making: A cost-benefit analysis. *Information & Management*, 27(2), 103-119.
- Wahlberg, A. A., & Sjoberg, L. (2000). Risk perception and the media. *Journal of risk research*, 3(1), 31-50.
- Wedding, G. C., & Crawford-Brown, D. (2007). Measuring site-level success in brownfield redevelopments: A focus on sustainability and green building. *Journal of Environmental Management*, 85(2), 483-495.  
doi:10.1016/j.jenvman.2006.10.018
- Wernstedt, K., Blackman, A., Lyon, T. P., & Novak, K. (2013). Revitalizing underperforming and contaminated land through voluntary action: Perspectives from US voluntary cleanup programs. *Land Use Policy*, 31, 545-556.  
doi:10.1016/j.landusepol.2012.08.018

- Wernstedt, R. H. a. K. (2003). *The Brownfield Bargain: Negotiating Site Cleanup Policies in Wisconsin*.
- Whelan, G., Wessex Institute of Technology., & Università di Siena. (2004). *Brownfields : multimedia modelling and assessment*. Southampton ; Boston: WIT Press.
- Whitman, I. L. (2006). *Brownfield redevelopment by the private sector market driven decision making*: WIT Press, Southampton, UK.
- Wiegard, S. M. (2003). The Brownfields Act: Providing Relief for the Innocent or New Hurdles to Avoid CERCLA Liability? *William and Mary Environmental Law and Policy Review*, 28(1), 127. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.proquest.com/docview/14688868?accountid=13013>  
[http://mw8xt6bj7r.search.serialssolutions.com/?ctx\\_ver=Z39.88-2004&ctx\\_enc=info:ofi/enc:UTF-8&rft\\_id=info:sid/ProQ:envabstractsmodule&rft\\_val\\_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=William+and+Mary+Environmental+Law+and+Policy+Review&rft.atitle=The+Brownfields+Act:+Providing+Relief+for+the+Innocent+or+New+Hurdles+to+Avoid+CERCLA+Liability?&rft.au=Wiegard,+Spencer+M&rft.aulast=Wiegard&rft.aufirst=Spencer&rft.date=2003-10-01&rft.volume=28&rft.issue=1&rft.spage=127&rft.isbn=&rft.btitle=&rft.title=William+and+Mary+Environmental+Law+and+Policy+Review&rft.issn=10919724](http://mw8xt6bj7r.search.serialssolutions.com/?ctx_ver=Z39.88-2004&ctx_enc=info:ofi/enc:UTF-8&rft_id=info:sid/ProQ:envabstractsmodule&rft_val_fmt=info:ofi/fmt:kev:mtx:journal&rft.genre=article&rft.jtitle=William+and+Mary+Environmental+Law+and+Policy+Review&rft.atitle=The+Brownfields+Act:+Providing+Relief+for+the+Innocent+or+New+Hurdles+to+Avoid+CERCLA+Liability?&rft.au=Wiegard,+Spencer+M&rft.aulast=Wiegard&rft.aufirst=Spencer&rft.date=2003-10-01&rft.volume=28&rft.issue=1&rft.spage=127&rft.isbn=&rft.btitle=&rft.title=William+and+Mary+Environmental+Law+and+Policy+Review&rft.issn=10919724)
- Yang, X.-J. L. R. (2012). CLOUD DELPHI METHOD. *International Journal of Uncertainty, Fuzziness & Knowledge-Based Systems*, 20(1), 77-97. Retrieved from <http://proxy.library.oregonstate.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cph&AN=71669664&site=ehost-live>

Yount, K. R. (2003a). What Are Brownfields? Finding a Conceptual Definition. *Environmental Practice*, 5(01), 25-33.

doi:doi:10.1017/S1466046603030114

Yount, K. R. (2003b). What Are Brownfields? Finding a Conceptual Definition. *Environmental Practice*, 5(1), 25-33.

doi:10.1605/01.301-0003966211.2008

## **APPENDICES**

## Appendix A- Demographic Survey



## First Survey - Delphi Research Method – Demographic Survey

Q1

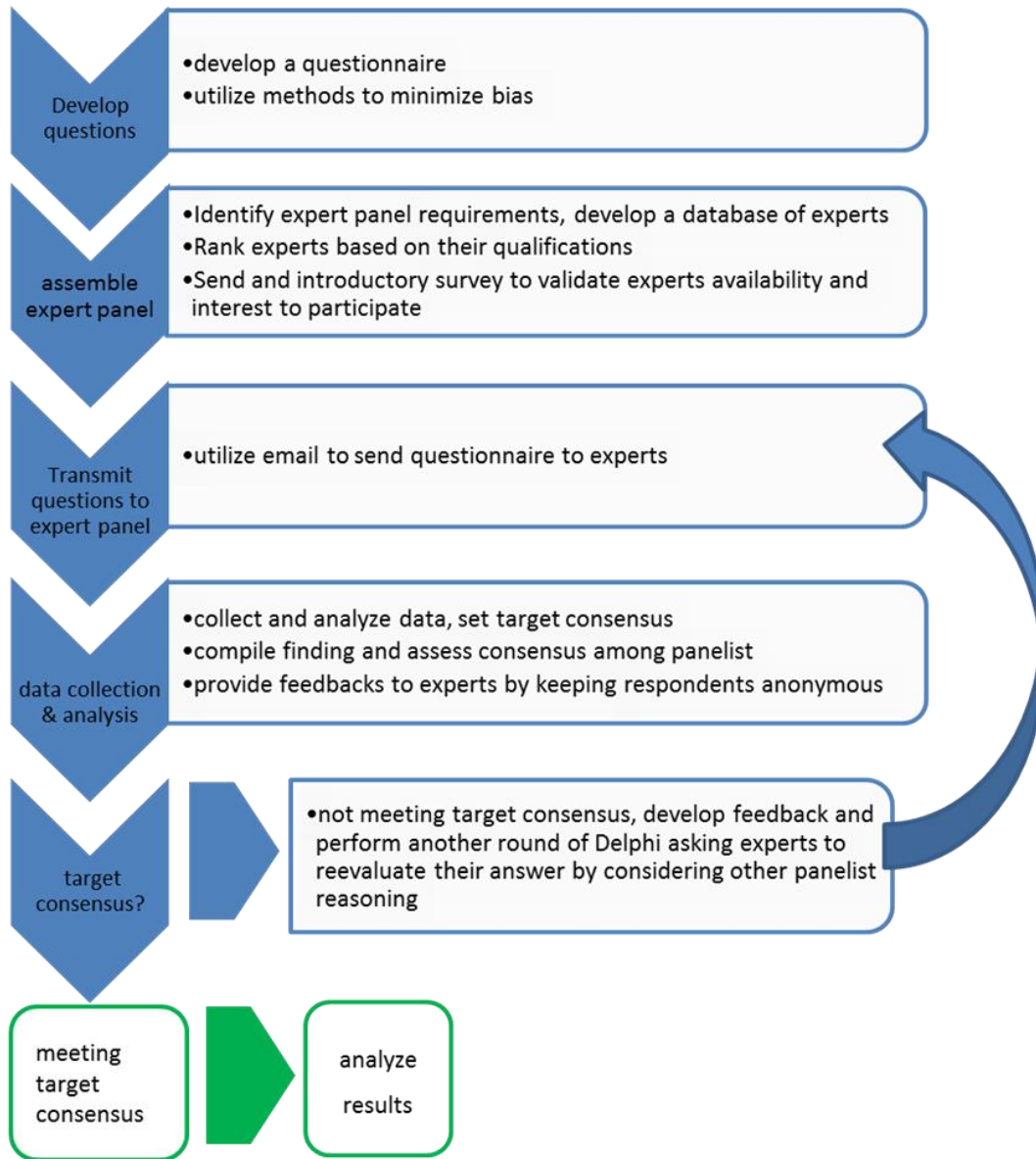


### **Purpose:**

You are being asked to potentially take part in a research study. It is our intent to survey a broad range of Brownfields Owners during our research. Before we contact the Owners, we would like to ensure that we are moving forward with a solid basis for our Owner survey. In order to do so, we will impanel a small group (~14) of brownfields experts to help us. As the first step to this study we would like to confirm your status as an expert in the field of brownfields remediation and revitalization; from this information we will select the panelists that will provide us with a balanced combination of expertise and diversity. In this research your opinion, based on your professional experience, is of the highest interest. The purpose of this research is to study factors that encourage or discourage brownfield's revitalization from the property owner's perspective. This research hypothesizes that through a better understanding of owner's decision-making process, it is possible to offer solutions to improve revitalization by being able to help property owners make informed decisions on their cost/benefit analysis. Please review the attached one page technical summary of the research problem statement and our goal and objectives.

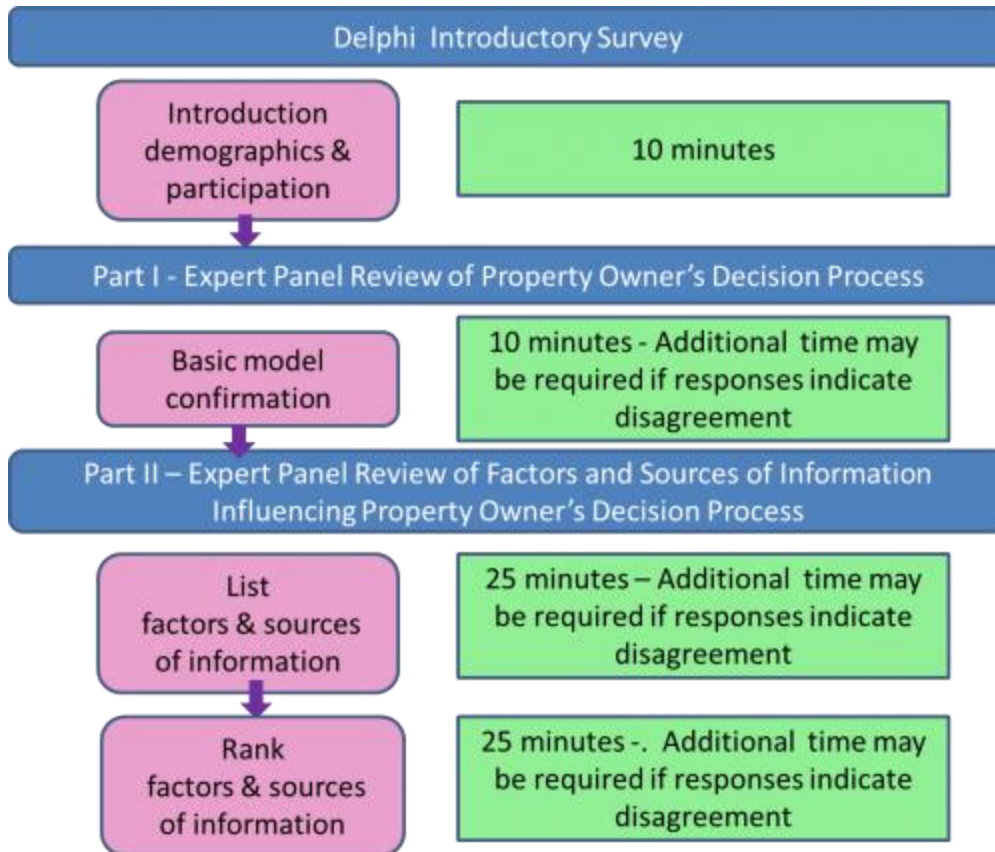
### **Activities:**

The Delphi technique is selected as the most appropriate technique to find consensus among a focused group of experts to test and evaluate the causal model proposed in this research and amend the model to include the expert opinion. There is a set of important steps that have to be considered when utilizing the Delphi Method. Below is the flow diagram of proposed Delphi research method.



**Time Commitment:**

This research will be performed in a series of questionnaires and requires your input and continues participation for duration of this research. It is anticipated that there will be three sets of questionnaires; each might require up to three iterations, with a time commitment of 10 to 25 minutes per iteration. Total estimated time commitment for this research is about 3 hours within the next two months. Below diagram shows the three phases of this research with estimated time commitment for each phase.

**Risk:**

*This research will use the on line survey software known as Qualtrics. The survey information and questionnaire will be sent to you though your email. The security and confidentiality of information collected from you on-line cannot be guaranteed. Confidentiality will be kept to the extent permitted by the technology being used. Information collected on-line can be intercepted, corrupted, lost, destroyed, arrive late or incomplete, or contain viruses. There are no other foreseeable risks to participate in this study.*

**Benefit:**

*This study is not designed to benefit you directly. However, it provides direct and indirect economic benefits to brownfields property owners and their communities. It is estimated that for every \$1 spent on brownfields revitalization there are over \$17 leveraged and every \$100,000 creates 7 direct jobs for local communities.*

**Payment:**

*You will not be paid for participating in this research study.*

**Confidentiality:**

*Your Identity will be known to this research. It is possible that others could learn that you participated in this study but the information you provide will be kept confidential to the extent permitted by law.*

*Your name remains anonymous to other participants during the time period that this survey is in process and thereafter if you wish to keep it confidential. Your answers to this survey should be your own opinion and based on your personal experiences as a brownfield's stakeholder. It is possible information that identifies you will be disclosed to OSU staff and/or presented in dissertation document.*

*It is important that members of the Delphi panel maintain the confidentiality of their comments to other participants during each phase of the study. However, it is likely that your response to questionnaire and comments you make during this research study will be shared (anonymously) with other participants as well as outside interested parties by this research.*

*We will select a random number for you at each round of survey so your response will be presented to others under your assigned number. After each round of iteration that number will be changed to make sure of your anonymity and to reduce bias.*

**Voluntary:**

*Your participation in this study is voluntary. You are free to skip any questions that you would prefer not to answer. However, answering all questions would result in better statistical analysis of collected data.*

*This research utilizes the Delphi group survey methodology which requires multiple iterations of the same questionnaire to reach consensus among participants. If you don't participate in any phase of this study, your access to the survey questionnaire and results may be terminated.*

Q2

**Brownfields - Seeking insights to improve the revitalization effort**

“Contaminated sites may pose health and safety risks to the surrounding community and degrade the quality of Oregon's natural resources. Cleaning up and reusing these properties not only protects people and the environment, but it also increases employment and enhances communities. Furthermore, redeveloping brownfields helps manage growth by making use of the existing infrastructure and lessens the need to build in undeveloped “greenfield” areas, preserving farmland and pristine rural areas.” (White paper: Oregon's Brownfields Programs: An Overview. National Association of Governors' website.)

Despite public efforts to facilitate brownfield revitalization, the rate of remediation remains unexpectedly slow. Oregon's public efforts to resolve this include legislative liability relief, State DEQ initiatives, Oregon Health Authority initiatives, the Business Oregon Brownfields Program, the City of Portland Brownfields program and Economic Development Programs in many other cities across Oregon. Yet, in Oregon as elsewhere these properties are being revitalized at a very slow rate. Nationally, the EPA reports that only 4% of hundreds of thousands such properties have been assessed, and less than 1% have been cleaned up.

The slow process of revitalization of brownfield sites reduces the economic value of these properties, thwarts development of neighboring properties, and poses a substantial danger to human health and the environment—causing suppression of economic growth of entire communities in general.

Both urban and rural regions are affected. While the distinction between the two differs depending on source, strong urban efforts include programs in Portland, Beaverton, and

elsewhere. In Oregon, two-thirds of the population lives in urban areas, yet well over that proportion of the land area is rural. Perhaps due to this imbalance, brownfields revitalization in rural areas has reportedly been neglected the most. Since 2009, EPA allocated only 8% of total grant funding to communities with population less than 10,000 (Rural Revitalization, EPA 2011).

Remediation requires, in most cases, action by a property owner who is faced with a decision based on many factors—funding uncertainty, legal liability questions, potential property use, clean-up technologies and costs, public health effects, and others. This decision is inherently a balancing of the perceived benefits vs. the costs of the remediation. Much work has been done to provide financial incentives and to establish more certainty among other factors to reduce the risk involved with the property revitalization decision. Yet, the rate of clean-up remains slow. So, the question remains: What are the major factors in this cost/benefit discussion that keep the remediation rate low?

Oregon State University is proposing a study to understand the factors that inhibit the remediation decision, including focus on the property owner decision process, answering questions such as—Does the perception of risk and reward match the objective information available? If not, why not? And, importantly, how may such a problem be resolved? As is common in these studies, other important factors may be exposed as well.

The proposed study team involves a faculty committee from the engineering and social sciences communities, and a doctoral candidate who's "been there" and "done that" by actually remediating and revitalizing a well-known and award winning property in Beaverton, Oregon.

EPA estimates that on average \$17.79 are leveraged for each brownfields dollar expended and 7.30 jobs are leveraged per \$100,000 of brownfields funding. Multiplying these amounts by the number of sites currently laying fallow results in a substantial economic boost to our communities in Oregon and nationwide.

### Q3



Please answer all of the following questions to the best of your ability and knowledge. This introductory questionnaire is designed to be completed in less than 10 minutes. It has been broken down into three fields of interest. There is a short description of each field to provide necessary information on how to provide responses to questions.

### Q4



## Personal Information:

The following questions are intended to confirm your knowledge and ability as it would be applied to this research.

First name

Last name

Position

Years of college education

Degree/field of concentration

Years of professionally-related experience in environmental regulations, site assessment, feasibility study and remediation of contaminated sites

Years of experience related to brownfields projects in Oregon

Member of academia or have done research related to brownfields

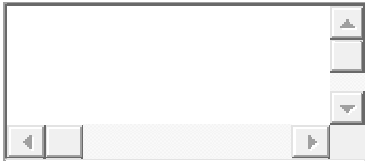
Familiar with EPA grants and revolving loan programs

**Q5**



**Affiliation:**

Please list your membership in any professional association or any community groups related to brownfields remediation and/or revitalization. Please indicate if you serve as a chair or board of director.



**Q6**

**Publications and conference participation:**

Please indicate your publishing and conference activities in the topic related to brownfields remediation and redevelopment, community outreach and risk management. Please provide the number of publications or activities you have had since 2002.

Publications in peer-reviewed journals

Conference presentations

Author or co-author of books

Publications in DEQ or EPA's published material

**Q7**

**Brownfields Stakeholders Group:**

Please select which Brownfields(BFs) stakeholder’s group you belong to and currently reflects your principal activity.

Stakeholder Group	Examples
Public Sector- looks at BFs from community and economic development prospective	Local government, community groups, EPA grant recipients, nonprofit organization, and public sector entities
Private Sector – looks at BFs with the purpose of generating economic growth	investors, lenders, developers, environmental consultants, lawyers,

and return on investment	insurers
Regulatory Agencies – provide BFs with funds, technical assistance to move BFs forward	EPA, Oregon DEQ



**Q9**

**Geographical Regions:**

Assuming Oregon is divided into four regions, please use below map to answer the following question. Please provide approximate number of brownfield projects that you've been involved with in each region.





NW Region

SW Region

NE Region

SE Region

**Q10**

Please indicate any additional information that you feel important to convey to this research.

**1. Personal Information:** The following questions are intended to confirm your knowledge and ability as it would be applied to this research.

First name	Last name	Position	Years of college education	Degree/field of concentration	Years of professionally-related experience in environmental regulations, site assessment, feasibility study and remediation of contaminated sites	Years of experience related to brownfields projects in Oregon	Member of academia or have done research related to brownfields	Familiar with EPA grants and revolving loan programs
			4	Engineering	25	10	no	yes
			4	BS Civil Engineering	30	20	No	Yes
			7	Environmental Law	22	20	no	somewhat
			6	MS Environmental Studies		4	no	Oregon brownfields revolving loan fund
			7	Law	18	8	No	Yes
			6	BA MBA		4	No	No
			6	Land Use Planning	5	5	no	yes
			4	Environmental law	25	6	No	Yes
			4	Economics		2	No	Some
			7	BS Zoology BS Botany BA Economics MA Economics	14	10	No	Yes
			6	Masters of Geology	26	26	No	Yes
			8	Geography and Planning	5	5	No	Yes
			6	MBA Finance	29	16	No	Yes
			4	BA Environmental Sciences	26	15	No to both questions	Very familiar
			6	Masters of Urban and Regional Planning Environmental Planning	4	8	research	yes
			6	MS Geology	41	20	RESEARCH FOR CLIENTS	tES
			4	BA biology Masters Landscape Architecture	8	8	research for my job	very familiar
			5	International Affairs	16	8	Yes	Yes
			5	Environmental Law	2	2	Yes	Yes
			7	law	32	30	yes	yes
			7	Master of Urban and Regional Planning	6	4	Yes	Yes
			10	bs biology ba accounting ms education	29	11	yes	yes

Statistic	Value
Total Responses	22

**2. Affiliation:** Please list your membership in any professional association or any community groups related to brownfields remediation and/or revitalization. Please indicate if you serve as a chair or board of director.

Text Response

View Oregon Brownfields Coalition

ViewNone

ViewNorthwest Environmnetal Business Center Women in Environment Association of Hazardous Materials Professionals - Director at La

ViewOregon Brownfields Coalition Oregon Brownfields Networking Group Member of Steering Committe for last 4 Oregon Brownfield C

ViewEast Portland Action Plan Groundwork Portland

ViewNEBC Brownfield Networking Forum (steering committee), Oregon Brownfields Coalition

ViewAmerican Planning Association, Regional Brownfield Coalition

ViewExecutive Committee member, Environment and Natural Resources Section, Oregon Bar; Member, Metro Brownfield Coalition

ViewAPA, ULI, LEED AP

ViewNone

Viewnebc AND awma

ViewOregon State Bar Environmental and Natural Resources Section.

ViewNorthwest Environmental Business Council, Association of Oregon Industries

ViewI am the lobbyist for Metro, which convened the Brownfields Coalition prior to the 2015 legislative session. I led the effort to pass br  
the advocate on toxics issues at OSPiRG, and in that role served on the DEQ's Central Advisory Committee developing the rules to imple

ViewBrownfield Subcommittee, East Portland Action Plan Hanford Coordinator with Columbia Riverkeeper (part-time position paid throu  
regulations, not brownfield.

ViewOregon Brownfields Coalition

ViewIndiana brownfiled assocaition ( founder ), Florida brownfield association ( founder ) National Brownfield Association

ViewNEBC, Groundwork Portland

ViewMember of Oregon Brownfields Coalition, an informal and diverse group of stakeholders in the public, private, and non-profit sectors  
increase cleanup and reuse of brownfields across Oregon.

ViewNone

•

**Text Response**

ViewOregon Brownfields Coalition

ViewNone

ViewNorthwest Environmnetal Business Center Women in Environment Association of Hazardous Materials Professionals - Director at La

ViewOregon Brownfields Coalition Oregon Brownfields Networking Group Member of Steering Committe for last 4 Oregon Brownfield C

ViewEast Portland Action Plan Groundwork Portland

ViewNEBC Brownfield Networking Forum (steering committee), Oregon Brownfields Coalition

ViewAmerican Planning Association, Regional Brownfield Coalition

ViewExecutive Committee member, Environment and Natural Resources Section, Oregon Bar; Member, Metro Brownfield Coalition

ViewAPA, ULI, LEED AP

ViewNone

Viewnebc AND awma

ViewOregon State Bar Environmental and Natural Resources Section.

ViewNorthwest Environmental Business Council, Association of Oregon Industries

ViewI am the lobbyist for Metro, which convened the Brownfields Coalition prior to the 2015 legislative session. I led the effort to pass brownfield legislation, the advocate on toxics issues at OSPIRG, and in that role served on the DEQ’s Central Advisory Committee developing the rules to implement

ViewBrownfield Subcommittee, East Portland Action Plan Hanford Coordinator with Columbia Riverkeeper (part-time position paid through grants, not brownfield.

ViewOregon Brownfields Coalition

ViewIndiana brownfield association ( founder ), Florida brownfield association ( founder ) National Brownfield Association

ViewNEBC, Groundwork Portland

ViewMember of Oregon Brownfields Coalition, an informal and diverse group of stakeholders in the public, private, and non-profit sectors working to increase cleanup and reuse of brownfields across Oregon.

ViewNone

- 

Statistic	Value
Total Responses	20

**3.** Publications and conference participation: Please indicate your publishing and conference activities in the topic related to brownfields remediation and redevelopment, community outreach and risk management. Please provide the number of publications or activities you have had since 2002.

Publications in peer-reviewed journals	Conference presentations	Author or co-author of books	Publications in DEQ or EPA’s published material
2	15		
	4		
	3		
	50		
	2		
	20		
	20		
	2		
	5		
	6		
	1		
	4	4	
	10	1	

	5		
	1		
	6		
	5		2
	3		
	5		5

Statistic	Value
Total Responses	19

5. Brownfields Stakeholders Group: Please select which Brownfields(BFs) stakeholder’s group you belong to and currently reflects your principal activity

Stakeholder Group	Examples
Public Sector- looks at BFs from community and economic development prospective	Local government, community groups, EPA grant recipients, nonprofit organization, and public sector entities
Private Sector – looks at BFs with the purpose of generating economic growth and return on investment	investors, lenders, developers, environmental consultants, lawyers, insurers
Regulatory Agencies – provide BFs with funds, technical assistance to move BFs forward	EPA, Oregon DEQ

Text Response
Private Sector
Regulatory Agency
Private sector
Private Sector
Regulatory Agencies
Public Sector - State financing
Public Sector
Public Sector
Public sector (Lake Oswego Development Review Commission), Private Sector
Public Sector
PRIVATE SECTOR

Public Sector since 2006. Previously in private practice and worked on environmental issues related to property transactions for the private sector

Private sector

Public sector

Public Sector: local government (City of Portland's Brownfield Program) Public Sector: non-profit (Columbia Riverkeeper - empowering citizens to get involved in cleaning up America's most contaminated site, the Hanford Nuclear Reservation)

Private Sector

EPA, Oregon DEQ, consultants: Geo-Engineers, Cole & associates, Kane & associates, various lenders, various developers, insurers of PRP's

Private

Regulatory agency (DEQ)

Public sector

•

Statistic	Value
Total Responses	20

## 5. Geographical Regions:

Assuming Oregon is divided into four regions, please use below map to answer the following question. Please provide approximate number of brownfield projects that you've been involved with in each region.



NW Region	SW Region	NE Region	SE Region
25	1	3	
10	3	1	
101	5	5	5
1			
63	11	18	2
40			
13			
2	1		
4			
6	4	2	
20	1		
20	1	2	
4	1	2	
30			
12			
5	5	5	5
12	1		
30	15	5	5

	5	3
--	---	---

Statistic	Value
Total Responses	19

**6.** Please indicate any additional information that you feel important to convey to this researchs.

**Text Response**

I have managed brownfield assessment and public outreach projects in several Oregon communities (such as Astoria, Eugene, and Salem), including engaging with the public and property owners to identify and eliminate barriers to brownfield redevelopment.

I manage twostate level funding programs available to private and public owners of contaminated properties - funds can assist with assessment through cleanup of sites and, depending on ownership type, can be either a loan or a grant or a mix of grant and loan.

I have been an environmental attorney for a little over 25 years. I spent approximately 12 years with the U.S. EPA as a Superfund enforcement attorney, and dealt with brownfield sites during that time. After leaving EPA and joining the private sector, I have been actively involved in brownfield property issues both in Oregon and in California.

**BROWNFIELD WORK THAT I HAVE DONE HAS FOCUSED ON TWO AREAS GETTING MUNICIPALITIES AND TRIBES TO UNDERSTAND THE PROGRAM, USES, ADVANTAGES, PROCESS, AND AVAILABILITY OF GRANTS AND IMPLIMENTING ONCE THEY HAVE CAPTUREED A GRANT**

I was a consultant to the City of Portland when it implemented its first EPA grant to evaluate Brownfields in ~1995. I have been involved in environmental cleanup issues in Oregon since those first conversations on how to define "brownfield." In private law practice, I specialized in property transactions with environmental issues. If you were wondering, the Brownfield project that I worked on in SE Oregon was the acquisition of the Williamson River Ranch by the Nature Conservancy. For the City of Portland, I provide legal advice to City Bureaus that seek to acquire or redevelop contaminated property. The most visible projects being the South Waterfront Greenway and former industrial land around the Water Bureau Interstate Facility. Currently, I represent the City in the allocation of environmental liabilities for Portland Harbor. In the 2010 legislative session, I helped draft and testified in support of successful Brownfield legislation that expanded the scope of liability protection from the State under prospective purchaser agreements (HB 3325 codified at ORS 465.327). In 2012, I was on the City's review team for the Portland Brownfield Redevelopment Assessment. I have been a participating member of the Brownfields Coalition and was a significant contributor to the drafting of the Land Bank Authority bill (HB2734) which is now awaiting Governor Brown's signature. The City is already considering how to establish and use a land bank for Brownfield redevelopment and I am assisting the Mayor's office in that work.

I have also worked extensively in the other three states in EPA Region 10; Washington, Idaho, and Alaska. Additionally, our firm has completed in-depth analyses for the City of Portland and Metro on brownfield matters, which may be of use to your work. These are available to you, regardless of my involvement in your research.

Zero, because I don't work on projects, I work on policy.

My involvement in brownfields has been anywhere from physically helping to transform the site to managing grants to support Phase I and Phase II environmental site assessments.

I'm involved with some of the largest brownfield redevelopment projects in the State of Oregon including



the Troutdale Reynolds Industrial Park, the former Willamette Industries mill site in Sweet Home and the former Boise Cascade mill site in Salem.

Restorical Research works for various disciplines including State and Cities within a real estate transaction to find and pursue historic insurance that enables brownfield projects to move forward so that development can occur. This includes consultants, lawyers, developers, banks, brokers, economic development organizations, all of whom are dependent on creative dollars being brought to the table to pay for the investigation and clean-up that of sites that often are too expensive. RR has also worked with EPA to demonstrate the importance of leveraging grant dollars with the supplementation of historic insurance recovery.

I'm very familiar with Oregon's statutory scheme for identifying and remediating BF sites, and liabilities associated with contaminated properties, including Prospective Purchaser Agreements. I know the brownfields "grant landscape" in Oregon quite well. I also understand the hesitancy of some property owners to engage with government agencies in identification, much less investigation and cleanup, of their sites.

None

Statistic	Value
Total Responses	12

## Appendix B – Causal Model

## Second Survey – Validating Cost benefit Causal Model

### Causal Model

Q2



#### **Problem Statement**

Former industrial or commercial sites that have been left unused are typically referred to as brownfield sites, or simply, brownfields. Many communities have such properties that are abandoned, idle, or underused.

Despite public efforts to facilitate brownfields revitalization, the rate of remediation remains unexpectedly slow. Efforts to resolve this nationwide problem have included legislative liability relief, federal grants and loans to facilitate revitalization, state and other local government initiatives for economic development assistance, and others. Yet, nationally, the EPA has reported that only 4% of the hundreds of thousands of brownfield properties have been assessed, and less than ¼ of 1% have been cleaned up.

The slow process of revitalization of brownfield sites reduces the economic value of these properties, thwarts development of neighboring properties, and poses a substantial danger to human health and the environment—causing suppression of economic growth of entire communities in general. A review of the brownfields literature provides a picture of the state of discussion of the remediation process. A typical, currently published model of the remediation process is presented in Figure 1, below. We believe that an important step is missing.

This dissertation seeks to provide insight into the decision making process of the property owners at these brownfield sites who are faced with funding uncertainty, legal liability questions, potential property use, clean-up technologies and costs, public health effects, and other considerations. We believe the remediation process begins with a property owner's decision to remediate. Their decision is inherently based on balancing the perceived benefits vs. the costs of the remediation. This research seeks to identify major factors in this cost/benefit consideration and the degree of importance of those factors to property owners. It is important to understand how the fear of liability and perception of risk associated with brownfield sites can influence the decision process in general and property owners (as key stakeholders) specifically.

This research has explored the remediation steps commonly understood once a decision has been made to remediate a property.

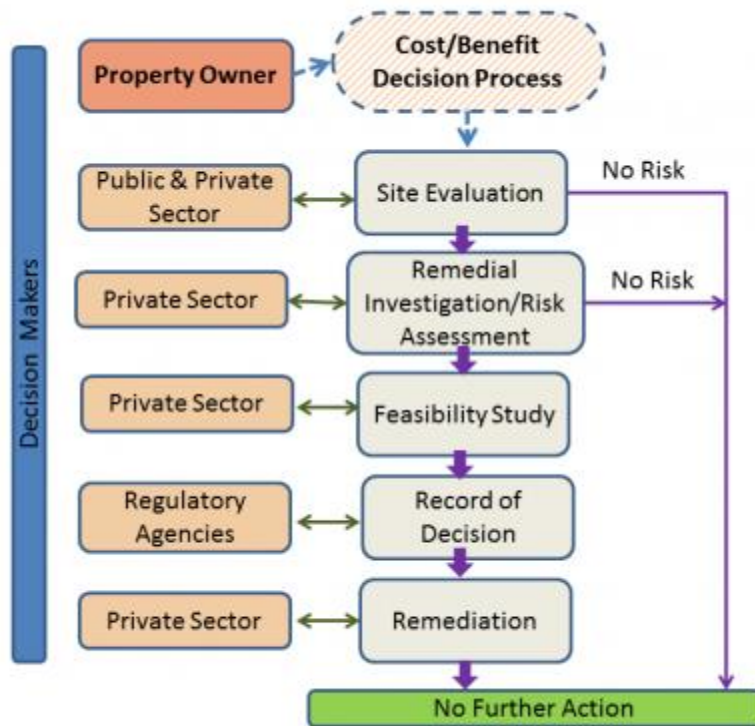


1

**Figure 1 – Remediation Decision Process**

Important however, is the realization that this commonly described process does not emphasize on the important first step of the property owner's decision to move forward. This dissertation proposes to add that important first step. The resulting model is presented here as Figure 2. This figure expands the model to a potentially more holistic process from owner due diligence by Cost/Benefit (C/B) analysis to following the steps in reaching a No Further Action (NFA) determination.

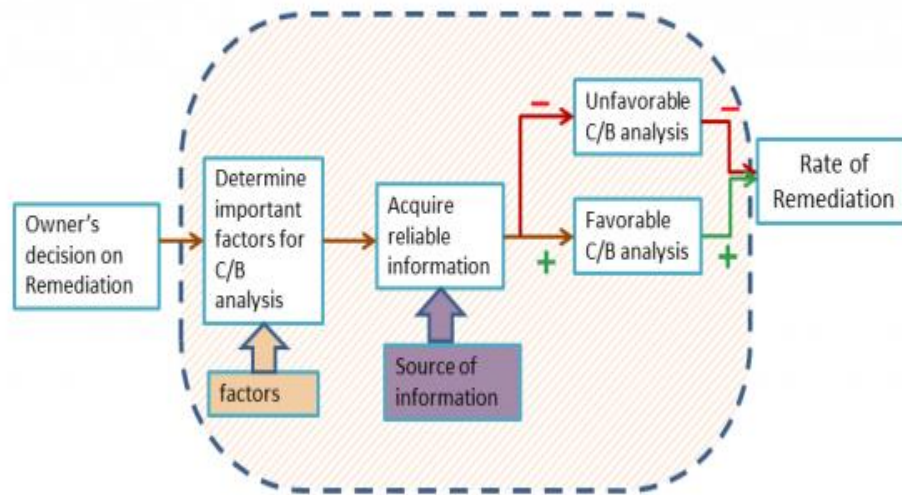
The first hypothesis of this dissertation proposes that the property owner's decision is a key factor influencing slow rate of remediation.



1

**Figure 2 – Proposed Decision Process Including Property Owner’s Decision**

The second hypothesis of this dissertation proposes the following decision process model for brownfields owner’s cost/ benefit (C/B) analysis.



1

### Figure 3 – Gross Model - Property Owner's Cost/Benefit Decision Process

This model assumes that the property owner's decisions on whether or not to move forward with remediation is based on a semi-qualitative cost/benefit analysis as the initial step of remediation process. Factors affecting their decision need to be identified, and prioritized, and evaluated. To do so they must obtain information related to the factors. It is important to understand to what degree the information they obtain is reliable information and to what extent this information influences their decision in moving forward with remediation or against it.

The first step in this Delphi process is to establish these basics. To do so, please respond to the following two simple questions. Your comments are very valuable at this stage, especially if you answer "NO" to either of the two questions.

Q6

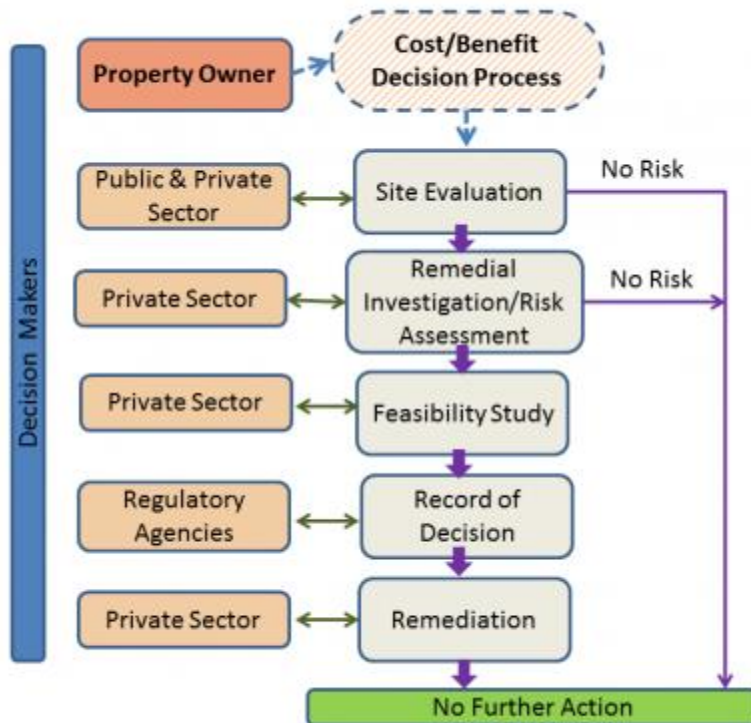
Please provide your first and last name.


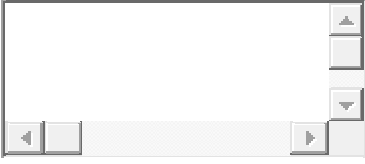
First Name

Last Name

Q3

Is the property owner's decision an important factor influencing rate of remediation (Hypothesis One)? Please make comments in the appropriate cell to indicate your answer and your thoughts.

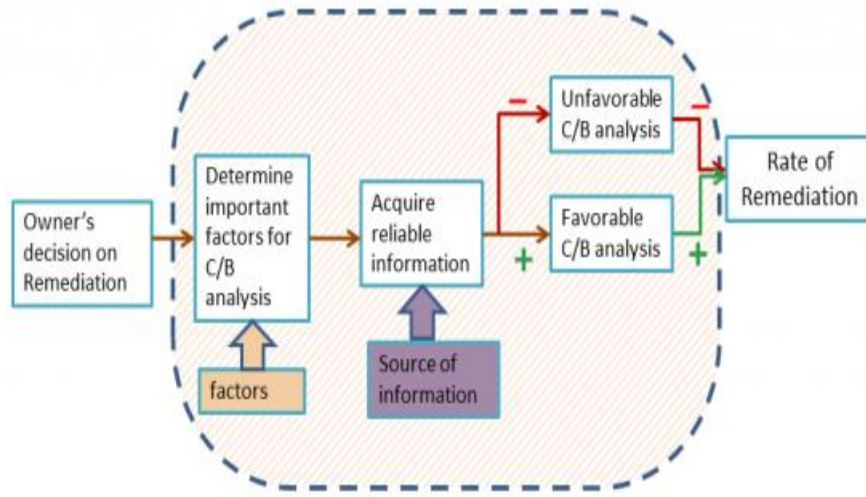


Yes	
No	

**Q4**

Is the proposed conceptual model of the property owner's decision process (Figure 3) a reasonable representation of the chain of events that occurs during the owner's decision-making (Hypothesis Two)? Please make comments in the appropriate cell to indicate your answer and your thoughts.





1

Yes

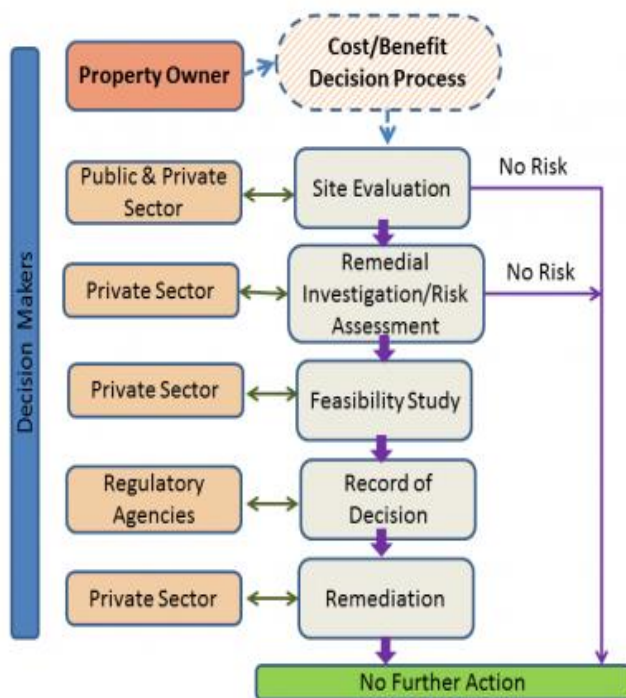
No

Q5

Responses to this survey will be consolidated and any adjustments for the causal model will be made. In the next stage of our research, we will ask you about the



2. Is the property owner's decision an important factor influencing rate of remediation (Hypothesis One)? Please make comments in the appropriate cell to indicate your answer and your thoughts.



Yes	No
<p>You are missing two important points. If the property has been around a long time, in several states before 1985, then there is a "hidden asset" to pursue. This is old "slip and fall" policies , comprehensive general liability policies ( CGL ) that will pay for all investigation and clean-up for most sites. As an insurance archaeologist and an owner of an insurance archaeology firm, we have been successful in 14 states, allowing for over 450 projects to get completed including in Oregon and Washington. In addition, from a liability stand point, the owner and the purchaser/developer can be comforted by this asset and creative trnasactions can take place.</p> <p>Brownfields and other contaminated properties are sometimes "mothballed" by owners to avoid the expenditure of funds for investigation and cleanup. Government agencies lack resources to require cleanup at all but the most hazardous properties.</p>	

<p>It is, particularly when there is little enforcement activity by regulatory agencies.</p>	
<p>Property owners are generally motivated by two factors 1) Is someone requiring me to clean up the property or 2) I want to sell the property so I had better clean it up. The speed of the clean up is dependent on the urgency of the motivation. They often take a measured time if the agencies request the clean up and a shorter time if they are selling the property. Time is money works both ways - go slow and titrate it out because of the agency requirement - go faster when the money will be flowing your way.</p>	
<p>Yes. (On privately owned property) Property owners are not obligated to report, assess or remediate their potentially active/inactive hazardous waste sites (Brownfields) They are also under no obligation to report these sites to regulating agencies. This makes the rate of remediation entirely dependent on the property owner's prerogative to find a new/transitional use for the property and the perceived benefits on their part of such an undertaking.</p>	
<p>Seems obvious that this is the case. In my experience, the comfort of the property owner plays the largest role in how quickly the property moves through the assessment and remediation process. The idea that a property owner has contaminated land is a scary one. They need to feel some level of certainty and security that the investments they make will yield favorable outcomes. Any uncertainty slows down the process.</p>	
<p>Yes. Many sites are driven by this decision, as opposed to those for which actions are compelled by State or Federal regulatory agencies.</p>	
<p>Yes, if it is the property owner assuming all of the risk. However, there are instances where the purchaser is the willing party or remediation becomes the purchaser's responsibility. Also, if a state agency (like OR Department of Environmental Quality) is able to assume all liability for cleanup like through a Prospective Purchaser Agreement then the cost/benefit decision process changes for both the property owner and the purchaser.</p>	
<p>Yes. In many situations, a property owner is not under any pressure from environmental regulatory authorities to remediate a property. As a result, many properties go unremediated until there is an economic reason for the owner to do so - most often when the owner wishes to sell the property to a third party or the owner identifies a use for which the financial benefits will outweigh the cost of remediation.</p>	
<p>Yes, without the property owner's willingness to engage in the remediation process, the only option for getting the remediation moving is regulatory pressure.</p>	
<p>I think so. I suppose a decision to move forward depends on how important a particular property is to the owner's overall financial picture.</p>	
<p>Yes. Many times property owners move forward not considering a cost/benefit analysis because they believe there is endless public resources available for cleanup. Or, the property owner has a fear of liability if further site analysis is conducted and the property sits.</p>	
<p>Yes, even if the cleanup is driven by an enforcement action the owners perceived value of the work influences the scope, quality and pace of work completed.</p>	
<p>This seems obvious to me.</p>	
<p>If the property owner's hand is not being forced by a regulatory requirement, the</p>	

answer is yes. I believe the first decision a property owner has to make is whether or not they want to collect data on the condition of the site. This data must be in-hand in order for a cost/benefit decision process to be completed. Many property owners suspect their property is contaminated, and fear having this suspicion confirmed through data collection. This fear is based upon an expectation, often false, that if contamination is found they will be forced to spend a lot of money on remediation.

Agreed. Unless a property owner is under an order from the state or federal regulatory agency, the decision to clean up a contaminated property is almost always driven by the conditions of the economy and specifically the local real estate market.

Yes, moving forward the benefit may outweigh the costs (even is uncertain) if the owner perceives that there is going to end gain - in other words, is the purpose to sell the property at the appraised (as clean) price; is development planned and the only uncertainty is related to the environmental condition of the property which are perceived by the owner as minimal but may be causing lender adversion. IF there is no market pressure to redevelop the property; or there is no trigger event that changes private ownership of the property (death / divorce etc.) than the costs may continue to be perceived as dominant outweighing taking any action to determine whether or not environmental risk exists.

I can't imagine that the owner's perceptions, and individual circumstances wouldn't play a decisive role.

The property owner's decision process is critically important in whether many brownfields "go public." In my view, the owner's obtaining reliable information and doing a C/B analysis is part of the motivation or lack of motivation to move forward. However, fear of potential costs and liabilities, lack of trust in government and consultants, and independence/unwillingness to seek help are also important factors to consider. And many owners may not have the tools needed even to acquire information about their properties, or to conduct a basic C/B analysis.

Absolutely. It may be the single most important factor. If the property owner decides not to remediate, that is the end of the story - except in very rare cases of regulatory enforcement.

I think the property owner can influence the rate of remediation. It is an important factor, one of many.

•

Statistic	Value
Total Responses	21

3. Is the proposed conceptual model of the property owner's decision process (Figure 3) a reasonable representation of the chain of events that occurs during the owner's decision-making (Hypothesis Two)? Please

make comments in the appropriate cell to indicate your answer and your thoughts.

Yes	No
	<p>The owners decision on remediation goes beyond the economics. Most property owners will not do anything unless the state environmental agency forces them to. So if they were to do initial investigation and discovered a problem they are required to report the "release" to the state, thus getting themselves into trouble. Thus they will not do anything</p>
	<p>Not sure that owners acquire reliable information before making a C/B decision. The cost of reliable information may be prohibitive in itself, even before the appropriate environmental investigation. Lack of reliable information would lead to an incomplete C/B analysis.</p> <p>The model presents the owners decision on remediation as one box which makes it seem like it is a single kind of decision. That is not my experience. The cost/benefit analysis is very different depending on why the remediation is being considered. The rate and scope of remediation and information that will be collected is highly dependent on the reason why the property owner is considering evaluating the environmental condition of the property. The pace of remediation is very different if the owner is making a decision to investigate environmental conditions to facilitate a property transfer, in response to current release that was reported to regulatory agencies, in response to third party claims, to conform to corporate policies or to address suspected but unconfirmed contamination based on historical activities. Even solely within the context of facilitating a property transfer, it depends on whether there is a potential buyer, a specific redevelopment plan or the owner is just trying to establish the value of its property.</p>
	<p>I believe an additional step needs to be added to the front end of the proposal model, but that otherwise, the proposed model is a reasonable representation of the chain of events. This initial step needs to somehow capture the concept that before the property owner even contemplates C/B factors or sources of information, they must be convinced that they even want to look under that rock.</p>
	<p>I would add that the owner usually has information - both reliable and unreliable - going in to the decision process. In other words, there is a variety of misinformation and assumptions that may</p>

	<p>strongly shape the early steps of decision making. Also there are other factors besides the C/B analysis that lower the rate of remediation, even when the C/B analysis is favorable.</p>
	<p>I seems like the owner's decision is not a single point. Owner may commit, then because of slow agency response, them back out.</p>
<p>It is, but again mainly when there is little enforcement activity by the regulatory agencies. The hypothesis has to assume that the owner is not being compelled to perform any action.</p>	
<p>This is generally the correct model - which way is the C/B more favorable</p>	
<p>Yes, this is an appropriate conceptual model. I would volunteer that ACCESS to information and community context/setting would also be fundamental considerations.</p>	
<p>Somewhat reasonable. Not sure that every owner thinks of things in a C/B frame of mind. This, ultimately, may be what they are doing, but I'm not sure it all happens in that linear of a fashion.</p>	
<p>Yes, although note that there are also a significant number of sites that are dormant because of the perceived risks as viewed by potential purchasers. This hypothesis is confined to the present owner's decision-making process (or at least that's how I'm understanding it).</p>	
<p>Yes. See answer above for one explanation. Also, I'm assuming "factors" take into account any brownfield remediation incentive available.</p>	
<p>Yes. If it makes financial sense to remediate, it will get done. If costs exceeded benefits, remediation will not be done absent external pressure.</p>	
<p>This is a likely a reasonable representation of what occurs when a property owner is considering remediation. However, the quality/reliability of "information" they use in the C/B analysis will vary widely from case to case. If a property owner is considering remediation without talking to public agencies about known conditions, cleanup requirements, funding sources, and other resources, they are less likely to move forward due to assumptions about cost and liability.</p>	
<p>I think so, though I am not sure I understand the "rate of remediation" box. The real question is: what are the factors in the brown box.</p>	
<p>If a feasibility analysis is considered in the decision making process, then yes this is true. However, this model is heavily dependent on the scale and depth of</p>	

<p>information in the acquire information stage.</p> <p>But, I think there are more factors or ways to describe the process. I don't think property owners always know what the important factors are, I also don't think they always acquire reliable information. I think there is also a huge fear of the unknown and an assumption that not knowing is better than knowing which affects a property owners willingness to even consider acquiring additional information.</p> <p>What I understand from the model is that positive or negative analyses have the same impact on rate of remediation</p>	
<p>Yes. How would generational and cultural factors be captured - I see these are important determinants influencing owner C/B analysis?</p>	
<p>It seems a reasonable approximation to me, though I also think it is understandably a simplification. As research progresses it may be possible to identify some of the commonly confronted factors.</p> <p>However, as suggested above, I believe there should also be a "beginning" box labeled something like "Owner's attitude, level of knowledge about environmental issues, and willingness to seek outside help."</p>	

Yes	No
	<p>The owners decision on remediation goes beyond the economics. Most property owners will not do anything unless the state environmental agency forces them to. So if they were to do initial investigation and discovered a problem they are required tto report the "release" to the state, thus getting themselves into trouble. Thus they will not do anything</p>
	<p>Not sure that owners acquire reliable information before making a C/B decision. The cost of reliable information may be prohibitive in itself, even before the appropriate environmental investigation. Lack of reliable information would lead to an incomplete C/B analysis.</p>
	<p>The model presents the owners decision on remediation as one box which makes it seem like it is a single kind of decision. That is not my experience. The cost/benefit analysis is very different depending on why the remediation is being considered. The rate and scope of remediation and information that will be collected is highly dependent on the reason why the property owner is considering evaluating the environmental condition of the property. The pace of remediation is very different if the owner is making a decision</p>



	<p>to investigate environmental conditions to facilitate a property transfer, in response to current release that was reported to regulatory agencies, in response to third party claims, to conform to corporate policies or to address suspected but unconfirmed contamination based on historical activities. Even solely within the context of facilitating a property transfer, it depends on whether there is a potential buyer, a specific redevelopment plan or the owner is just trying to establish the value of its property.</p>
	<p>I believe an additional step needs to be added to the front end of the proposal model, but that otherwise, the proposed model is a reasonable representation of the chain of events. This initial step needs to somehow capture the concept that before the property owner even contemplates C/B factors or sources of information, they must be convinced that they even want to look under that rock.</p>
	<p>I would add that the owner usually has information - both reliable and unreliable - going in to the decision process. In other words, there is a variety of misinformation and assumptions that may strongly shape the early steps of decision making. Also there are other factors besides the C/B analysis that lower the rate of remediation, even when the C/B analysis is favorable.</p>
	<p>It seems like the owner's decision is not a single point. Owner may commit, then because of slow agency response, them back out.</p>
<p>It is, but again mainly when there is little enforcement activity by the regulatory agencies. The hypothesis has to assume that the owner is not being compelled to perform any action.</p>	
<p>This is generally the correct model - which way is the C/B more favorable</p>	
<p>Yes, this is an appropriate conceptual model. I would volunteer that ACCESS to information and community context/setting would also be fundamental considerations.</p>	
<p>Somewhat reasonable. Not sure that every owner thinks of things in a C/B frame of mind. This, ultimately, may be what they are doing, but I'm not sure it all happens in that linear of a fashion.</p>	
<p>Yes, although note that there are also a significant number of sites that are dormant because of the perceived risks as viewed by potential purchasers. This hypothesis is confined to the present owner's decision-making process (or at least that's how I'm understanding it).</p>	
<p>Yes. See answer above for one explanation. Also I'm</p>	

<p>assuming "factors" take into account any brownfield remediation incentive available.</p>	
<p>Yes. If it makes financial sense to remediate, it will get done. If costs exceeded benefits, remediation will not be done absent external pressure.</p>	
<p>This is a likely a reasonable representation of what occurs when a property owner is considering remediation. However, the quality/reliability of "information" they use in the C/B analysis will vary widely from case to case. If a property owner is considering remediation without talking to public agencies about known conditions, cleanup requirements, funding sources, and other resources, they are less likely to move forward due to assumptions about cost and liability.</p>	
<p>I think so, though I am not sure I understand the "rate of remediation" box. The real question is: what are the factors in the brown box.</p>	
<p>If a feasibility analysis is considered in the decision making process, then yes this is true. However, this model is heavily dependent on the scale and depth of information in the acquire information stage.</p>	
<p>But, I think there are more factors or ways to describe the process. I don't think property owners always know what the important factors are, I also don't think they always acquire reliable information. I think there is also a huge fear of the unknown and an assumption that not knowing is better than knowing which affects a property owners willingness to even consider acquiring additional information.</p>	
<p>What I understand from the model is that positive or negative analyses have the same impact on rate of remediation</p>	
<p>Yes. How would generational and cultural factors be captured - I see these are important determinants influencing owner C/B analysis?</p>	
<p>It seems a reasonable approximation to me, though I also think it is understandably a simplification. As research progresses it may be possible to identify some of the commonly confronted factors.</p>	
<p>However, as suggested above, I believe there should also be a "beginning" box labeled something like "Owner's attitude, level of knowledge about environmental issues, and willingness to seek outside help."</p>	
<p>•</p>	
<p><b>Yes</b></p>	<p><b>No</b></p>
	<p>The owners decision on remediation goes beyond the economics. Most property owners will not do</p>

	<p>anything unless the state environmental agency forces them to. So if they were to do initial investigation and discovered a problem they are required to report the "release" to the state, thus getting themselves into trouble. Thus they will not do anything</p>
	<p>Not sure that owners acquire reliable information before making a C/B decision. The cost of reliable information may be prohibitive in itself, even before the appropriate environmental investigation. Lack of reliable information would lead to an incomplete C/B analysis.</p>
	<p>The model presents the owners decision on remediation as one box which makes it seem like it is a single kind of decision. That is not my experience. The cost/benefit analysis is very different depending on why the remediation is being considered. The rate and scope of remediation and information that will be collected is highly dependent on the reason why the property owner is considering evaluating the environmental condition of the property. The pace of remediation is very different if the owner is making a decision to investigate environmental conditions to facilitate a property transfer, in response to current release that was reported to regulatory agencies, in response to third party claims, to conform to corporate policies or to address suspected but unconfirmed contamination based on historical activities. Even solely within the context of facilitating a property transfer, it depends on whether there is a potential buyer, a specific redevelopment plan or the owner is just trying to establish the value of its property.</p>
	<p>I believe an additional step needs to be added to the front end of the proposal model, but that otherwise, the proposed model is a reasonable representation of the chain of events. This initial step needs to somehow capture the concept that before the property owner even contemplates C/B factors or sources of information, they must be convinced that they even want to look under that rock.</p>
	<p>I would add that the owner usually has information - both reliable and unreliable - going in to the decision process. In other words, there is a variety of misinformation and assumptions that may strongly shape the early steps of decision making. Also there are other factors besides the C/B analysis that lower the rate of remediation, even when the C/B analysis is favorable.</p>
	<p>It seems like the owner's decision is not a single point. Owner may commit, then because of slow agency response, them back out.</p>

It is, but again mainly when there is little enforcement activity by the regulatory agencies. The hypothesis has to assume that the owner is not being compelled to perform any action.

This is generally the correct model - which way is the C/B more favorable

Yes, this is an appropriate conceptual model. I would volunteer that ACCESS to information and community context/setting would also be fundamental considerations.

Somewhat reasonable. Not sure that every owner thinks of things in a C/B frame of mind. This, ultimately, may be what they are doing, but I'm not sure it all happens in that linear of a fashion.

Yes, although note that there are also a significant number of sites that are dormant because of the perceived risks as viewed by potential purchasers. This hypothesis is confined to the present owner's decision-making process (or at least that's how I'm understanding it).

Yes. See answer above for one explanation. Also, I'm assuming "factors" take into account any brownfield remediation incentive available.

Yes. If it makes financial sense to remediate, it will get done. If costs exceeded benefits, remediation will not be done absent external pressure.

This is a likely a reasonable representation of what occurs when a property owner is considering remediation. However, the quality/reliability of "information" they use in the C/B analysis will vary widely from case to case. If a property owner is considering remediation without talking to public agencies about known conditions, cleanup requirements, funding sources, and other resources, they are less likely to move forward due to assumptions about cost and liability.

I think so, though I am not sure I understand the "rate of remediation" box. The real question is: what are the factors in the brown box.

If a feasibility analysis is considered in the decision making process, then yes this is true. However, this model is heavily dependent on the scale and depth of information in the acquire information stage.

But, I think there are more factors or ways to describe the process. I don't think property owners always know what the important factors are, I also don't think they always acquire reliable information. I think there is also a huge fear of the unknown and an assumption that not knowing is better than knowing which affects a property owners willingness to even

consider acquiring additional information.

What I understand from the model is that positive or negative analyses have the same impact on rate of remediation

Yes. How would generational and cultural factors be captured - I see these are important determinants influencing owner C/B analysis?

It seems a reasonable approximation to me, though I also think it is understandably a simplification. As research progresses it may be possible to identify some of the commonly confronted factors.

However, as suggested above, I believe there should also be a "beginning" box labeled something like "Owner's attitude, level of knowledge about environmental issues, and willingness to seek outside help."

•

Statistic	Value
Total Responses	21

## Appendix C- Factors and Sources of Information

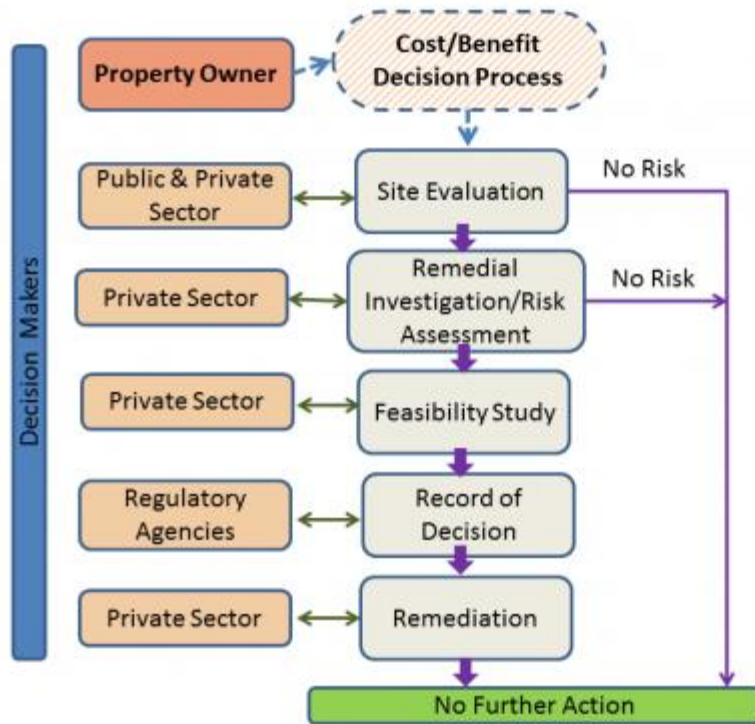
### **Third Survey – Determination of Factors and Sources of Information**

The first set of Delphi Panel responses were collected and reviewed to assess the first two hypotheses. These hypotheses and the experts' responses are provided below for your review. **An amended model, followed by two additional hypotheses now require your attention.** The purpose of this phase of surveying is to get your input to complete a list of a) the factors that you think are affecting a property owner's decision making process and b) the sources that they used to obtain this information. Your contribution to this phase plays an important role in understanding our current state of knowledge of what influences a property owners' decision making process.

Q1



**Hypothesis 1 - The property owner's decision making is an important step to add in to the current flow process for brownfield's revitalization**



1.

**Results:**

Total Respondents	20
Agree with suggested hypothesis	20
Disagree with suggested hypothesis	0

Below is a list of all responses provided by the expert panel as they were collected through Qualtrics - all responses are presented here as they were entered into the system.

- Yes, if it is the property owner assuming all of the risk. However, there are instances where the purchaser is the willing party or remediation becomes the



purchaser's responsibility. Also, if a state agency (like OR Department of Environmental Quality) is able to assume all liability for cleanup like through a Prospective Purchaser Agreement then the cost/benefit decision process changes for both the property owner and the purchaser.

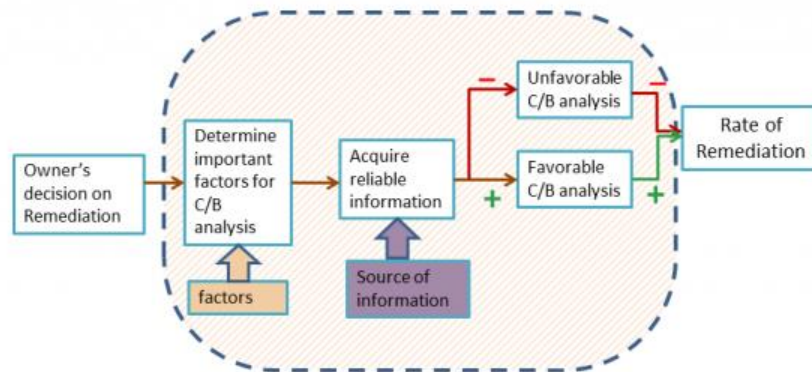
- Seems obvious that this is the case. In my experience, the comfort of the property owner plays the largest role in how quickly the property moves through the assessment and remediation process. The idea that a property owner has contaminated land is a scary one. They need to feel some level of certainty and security that the investments they make will yield favorable outcomes. Any uncertainty slows down the process.
- Yes, without the property owner's willingness to engage in the remediation process, the only option for getting the remediation moving is regulatory pressure.
- You are missing two important points. If the property has been around a long time, in several states before 1985, then there is a "hidden asset" to pursue. This is old "slip and fall" policies, comprehensive general liability policies (CGL) that will pay for all investigation and clean-up for most sites. As an insurance archaeologist and an owner of an insurance archaeology firm, we have been successful in 14 states, allowing for over 450 projects to get completed including in Oregon and Washington. In addition, from a liability stand point, the owner and the purchaser/developer can be comforted by this asset and creative transactions can take place.
- It is, particularly when there is little enforcement activity by regulatory agencies.
- Yes, moving forward the benefit may outweigh the costs (even is uncertain) if the owner perceives that there is going to end gain - in other words, is the purpose to sell the property at the appraised (as clean) price; is development planned and the only uncertainty is related to the environmental condition of the property which are perceived by the owner as minimal but may be causing lender aversion. IF there is no market pressure to redevelop the property; or there is no trigger event that changes private ownership of the property (death / divorce etc.) than the costs may continue to be perceived as dominant outweighing taking any action to determine whether or not environmental risk exists.
- Property owners are generally motivated by two factors 1) Is someone requiring me to clean up the property or 2) I want to sell the property so I had better clean it up. The speed of the clean up is dependent on the urgency of the motivation. They often take a measured time if the agencies request the clean up and a shorter time if they are selling the property. Time is money works both ways - go slow and titrate it out because of the agency requirement - go faster when the money will be flowing your way.
- Yes. (On privately owned property) Property owners are not obligated to report, assess or remediate their potentially active/inactive hazardous waste sites (Brownfields) They are also under no obligation to report these sites to regulating agencies. This makes the rate of remediation entirely dependent on the property owner's prerogative to find a new/transitional use for the property and the perceived benefits on their part of such an undertaking.
- If the property owner's hand is not being forced by a regulatory requirement, the answer is yes. / / I believe the first decision a property owner has to make is whether or not they want to collect data on the condition of the site. This data must be in-hand in order for a cost/benefit decision process to be completed. Many property owners suspect their property is contaminated, and fear having this suspicion confirmed through data collection. This fear is based upon an expectation, often false, that if contamination is found they will be forced to spend a lot of money on remediation.

- This seems obvious to me.
- Brownfields and other contaminated properties are sometimes "mothballed" by owners to avoid the expenditure of funds for investigation and cleanup. Government agencies lack resources to require cleanup at all but the most hazardous properties.
- Yes, even if the cleanup is driven by an enforcement action the owners perceived value of the work influences the scope, quality and pace of work completed.
- Yes. In many situations, a property owner is not under any pressure from environmental regulatory authorities to remediate a property. As a result, many properties go unremediated until there is an economic reason for the owner to do so - most often when the owner wishes to sell the property to a third party or the owner identifies a use for which the financial benefits will outweigh the cost of remediation.
- I think so. I suppose a decision to move forward depends on how important a particular property is to the owner's overall financial picture.
- Agreed. Unless a property owner is under an order from the state or federal regulatory agency, the decision to clean up a contaminated property is almost always driven by the conditions of the economy and specifically the local real estate market.
- Yes. Many sites are driven by this decision, as opposed to those for which actions are compelled by State or Federal regulatory agencies.
- Yes. Many times property owners move forward not considering a cost/benefit analysis because they believe there is endless public resources available for cleanup. Or, the property owner has a fear of liability if further site analysis is conducted and the property sits.

Q2



**Hypothesis 2 - Is this conceptual model of the property owner's decision making process a reasonable representation of the events that occur during an owner's decision making?**



1

**Results:**

Total respondents	20
In agreement with the suggested hypothesis	15
Disagree with the suggested hypothesis	5

Below is a list of all responses provided by the expert panel as they were collected through Qualtrics - all responses are presented here as they were entered into the system. Some panel members did not provide any comments.

Comments of panel members who agree with the suggested hypothesis:

- Yes. See answer above for one explanation. Also, I'm assuming "factors" take into account any brownfield remediation incentive available.
- Somewhat reasonable. Not sure that every owner thinks of things in a C/B frame of mind. This, ultimately, may be what they are doing, but I'm not sure it all happens in that linear of a fashion.
- This is a likely a reasonable representation of what occurs when a property owner is considering remediation. However, the quality/reliability of "information" they use in the C/B analysis will vary widely from case to case. If a property owner is considering remediation without talking to public agencies about known conditions, cleanup requirements, funding sources, and other resources, they are less likely to move forward due to assumptions about cost and liability.

- It is, but again mainly when there is little enforcement activity by the regulatory agencies. The hypothesis has to assume that the owner is not being compelled to perform any action.
- Yes. How would generational and cultural factors be captured - I see these are important determinants influencing owner C/B analysis?
- This is generally the correct model - which way is the C/B more favorable
- Yes, this is an appropriate conceptual model. I would volunteer that ACCESS to information and community context/setting would also be fundamental considerations.
- But, I think there are more factors or ways to describe the process. I don't think property owners always know what the important factors are, I also don't think they always acquire reliable information. I think there is also a huge fear of the unknown and an assumption that not knowing is better than knowing which affects a property owners willingness to even consider acquiring additional information.
- Yes. If it makes financial sense to remediate, it will get done. If costs exceeded benefits, remediation will not be done absent external pressure.
- I think so, though I am not sure I understand the "rate of remediation" box. The real question is: what are the factors in the brown box.
- What I understand from the model is that positive or negative analyses have the same impact on rate of remediation
- Yes, although note that there are also a significant number of sites that are dormant because of the perceived risks as viewed by potential purchasers. This hypothesis is confined to the present owner's decision-making process (or at least that's how I'm understanding it).
- If a feasibility analysis is considered in the decision making process, then yes this is true. However, this model is heavily dependent on the scale and depth of information in the acquire information stage.

Comments of panel members who disagree with the suggested hypothesis:

- The owners decision on remediation goes beyond the economics. Most property owners will not do anything unless the state environmental agency forces them to. So if they were to do initial investigation and discovered a problem they are required to report the "release" to the state, thus getting themselves into trouble. Thus they will not do anything
- I believe an additional step needs to be added to the front end of the proposal model, but that otherwise, the proposed model is a reasonable representation of the chain of events. This initial step needs to somehow capture the concept that before the property owner even contemplates C/B factors or sources of information, they must be convinced that they even want to look under that rock.
- Not sure that owners acquire reliable information before making a C/B decision. The cost of reliable information may be prohibitive in itself, even before the appropriate environmental investigation. Lack of reliable information would lead to an incomplete C/B analysis.
- The model presents the owners decision on remediation as one box which makes it seem like it is a single kind of decision. That is not my experience. The cost/benefit analysis is very different depending on why the remediation is being considered. The rate and scope of remediation and information that will be collected is highly dependent on the reason why the property owner is considering evaluating the environmental condition of the property. The pace of remediation is very different if the owner is making a decision to investigate environmental conditions to facilitate a property transfer, in response to current release that was reported to regulatory agencies, in response to third party claims, to conform to

corporate policies or to address suspected but unconfirmed contamination based on historical activities. Even solely within the context of facilitating a property transfer, it depends on whether there is a potential buyer, a specific redevelopment plan or the owner is just trying to establish the value of its property.

### Q3



## Conclusion

In general all participants agreed with the first hypothesis confirming that adding property owners as the primary decision makers is an acceptable step to add to remediation flow process. The second hypothesis - a simple model of the property owner's decision process and its influence on rate of remediation- was also accepted by majority of the Delphi Panel. There are five disagreements and some valid suggestions which were taken into consideration to amend the model as proposed in the next phase of this survey.

It is important to clarify that the term "cost/benefit analysis" in this dissertation is not restricted to calculating and comparing monetary values. This dissertation uses this term broadly when a property owner is estimating the strengths (positive) and weaknesses (negative) of alternatives, using any measure. This cost/benefit term is similar to the concept of a pro/con decision process that is being used by owners to determine whether to remediate their site or not.

The first box in the causal model is representing the owners when they enter into a decision process. The area within the dotted line presents the property owner's decision making process considering factors that are important to them and also considering the sources of information that owner is relying on to make a decision. If the analysis presents a negative outcome then the rate of remediation slows down and if the analysis presents a positive outcome which motivates property owners to move forward with remediation then rate of remediation would increase.

### Q4



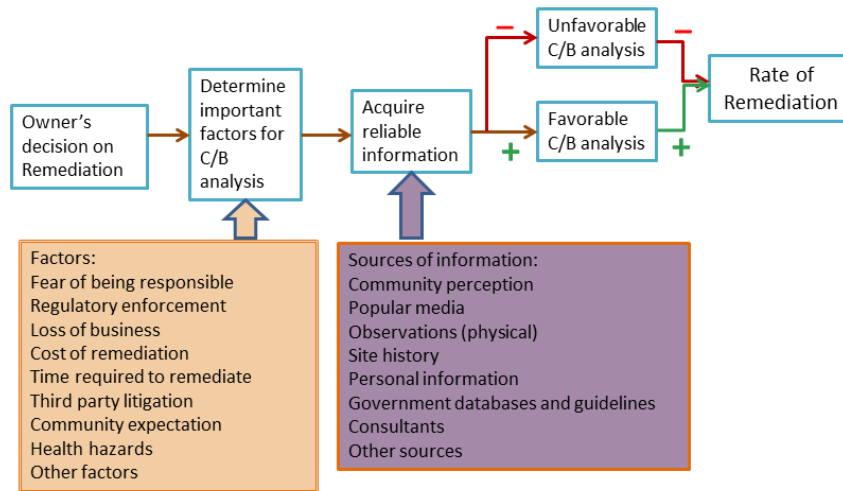
## Next Step: Define the important elements affecting the property owners' cost/benefit analysis

Property owners have to do a cost/benefit analysis in order to make a decision to remediate, redevelop, and/or sell their property. This analysis is difficult to assess when there are many unknown factors that could introduce uncertainty and high levels of perceived risk for property owners. It is not known how property owners perceive risk, and in what ways their perception will affect their cost/benefit analysis.

It is concluded that the perception of both positive and negative factors by property owners play a role in their decision making. If these perceptions are based on poor information or a poor evaluation of information, the owners may conclude that it is not beneficial to remediate or sell their property, even though better information may rationally conclude otherwise. Therefore, an owner's perception of the factors, including the uncertainty or risk surrounding the factors, is an important element that contributes to the slow rate of brownfield remediation and revitalization.

This dissertation proposes the following model which is amended from the previous model by adding a set of factors and sources of information that are suggested by

literature as influencing factors in owners' decision making process. The amended model is presented below.



6

Therefore the following two additional hypothesis are being tested in this research:

**Hypothesis 3: The factors shown in the Amended Model are important factors used by owners to decide whether to remediate**

**Hypothesis 4: Owners typically seek information regarding decision factors through sources as indicated in the Amended Model.**

This questionnaire explores potential factors that may be involved in owners' decisions to remediate. Please review the proposed factors and add any additional factors that you believe owners do or should consider and that will have a direct effect on a property owners cost/benefit analysis.

Q5

**Hypothesis 3: The factors shown in the Amended Model are important factors used by owners to decide whether to remediate**

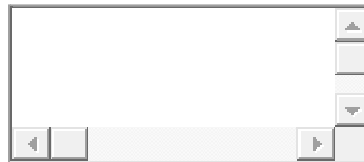
Below are a list of factors that are known to influence a property owners decision.

<b><u>Factors</u></b>	<b><u>Definition</u></b>
Become a responsible Party	Responsible Parties are individuals, companies, or any other parties that are potentially liable for causing release of hazardous material to the environment
Regulatory enforcement	State and federal agencies hold responsible parties financially responsible to reverse the environmental pollution
Loss of business	Property owners may fear losing their existing business if their site being tagged with real or perceived environmental concern
Cost of remediation	Remediation is expensive and there are many unknowns that results in a perceived risk of high cost associated with remediation. Brownfields revitalization has to bear added cost of remediation.
Time required to remediate	The time required to fully remediate a brownfield site may delay the revitalization process which results in loss of revenue
Third party litigation	Release of chemicals to groundwater may result in impacting soil and groundwater of adjacent properties which might embark third party litigation
Community expectations	Brownfields are usually eyesores in communities which has negative effect on economic growth of neighboring properties.
Health hazard	Possible release of hazardous chemicals may cause human health hazards by different exposure pathways including vapor intrusion into the buildings on or near brownfield properties

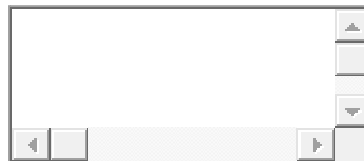
Please provide up to five additional factors that you think has a positive or negative

impact on property owner's decision. Please provide a short definition for each factor and a reason why you think that factor is important in a property owners decision making process. If you have additional comments please use the "General Comments" box.

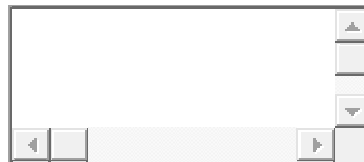
1 - Factor



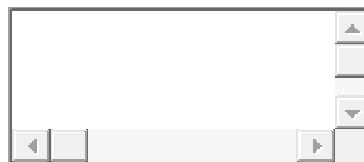
2 - Factor



3 - Factor



4 - Factor



5 - Factor



General comments :



Q6



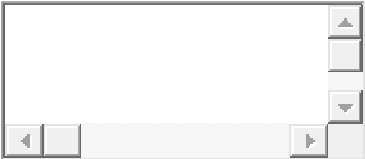


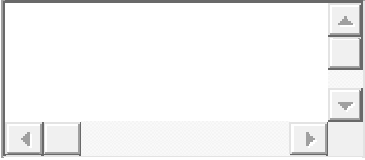
#### **Hypothesis 4: Owners typically seek information regarding decision factors through sources as indicated in the Amended Model**

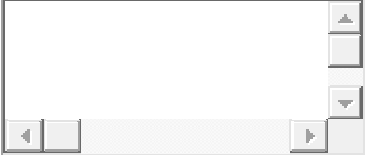
Below is a table with a list of information sources that property owners may rely on to make a decision. Some of these sources are based on this research's opinion and some are from data sources that are available through local and federal overseeing agencies (DEQ and EPA). From your experience, please add to this list, including a definition for each source of information in the fields provided.

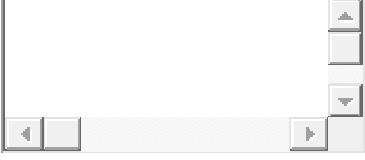
<b><u>Source of Information</u></b>	<b><u>Definition</u></b>
Popular media	News media have been known to have a strong effect on the public's perception of risk. Stories available on news media about liabilities associated with contaminated properties and legal consequences may effect decision process
Personal observation	Physical appearance of a site might create false perception of risk in individuals
Community perception	Threat of creating a bad reputation amongst the members of the community influence decision process
Site history	Historical usage of a commercial site can provide key information on possible environmental concern.
Personal information	Intuitive feelings based on past experiences are usually being used to make decision. Emotions such as fear has a negative effect when the recipient feels the risk is high
DEQ data base	ESCI has a public on line database that offers real information on environmentally challenged sites registered with DEQ. Also DEQ has guidelines for how to remediate a site
EPA data base	EPA has sources of information and guidelines to help property owners with brownfield's remediation
Consultant	Professional environmental consultants can help a property owner to find solution to their brownfield's problem

Please provide up to three additional sources of information in the fields provided below that you think property owners may use to reach a decision. Please provide a short definition for each one and a reason as to why you think property owners may use these sources to obtain the information they need to make their decision. If you have additional comments please use the "General Comments" box.

1 - Source of information 

2 - Source of information 

3 - Source of information 

General comments 

**Q7**

Thank you for your participation. Your comments will be compiled, and the lists of factors and information sources will be amended. In the next and last phase of the Delphi Panel, you will be asked to rank this information based on level of importance. A summary of the input of all panel members from this survey will be provided. Should there be significant differences among the responses, expert opinion and reasoning provided here will be

shared among the panel members to finalize these lists before making a final ranking of the factors and the sources of information.

## Factors and Sources of Information Raw Data

1. Hypothesis 3: The factors shown in the Amended Model are important factors used by owners to decide whether to remediate

Below are a list of factors that are known to influence a property owners decision.

<b><u>Factors</u></b>	<b><u>Definition</u></b>
Become a responsible Party	Responsible Parties are individuals, companies, or any other parties that are potentially liable for causing release of hazardous material to the environment
Regulatory enforcement	State and federal agencies hold responsible parties financially responsible to reverse the environmental pollution
Loss of business	Property owners may fear losing their existing business if their site being tagged with real or perceived environmental concern
Cost of remediation	Remediation is expensive and there are many unknowns that results in a perceived risk of high cost associated with remediation. Brownfields revitalization has to bear added cost of remediation.
Time required to remediate	The time required to fully remediate a brownfield site may delay the revitalization process which results in loss of revenue
Third party litigation	Release of chemicals to groundwater may result in impacting soil and groundwater of adjacent properties which might embark third party litigation
Community expectations	Brownfields are usually eyesores in communities which has negative effect on economic growth of neighboring properties.

Health hazard Possible release of hazardous chemicals may cause human health hazards by different exposure pathways including vapor intrusion into the buildings on or near brownfield properties

Please provide up to five additional factors that you think has a positive or negative impact on property owner's decision. Please provide a short definition for each factor and a reason why you think that factor is important in a property owners decision making process. If you have additional comments please use the "General Comments" box.

1 - Factor	2 - Factor	3 - Factor	4 - Factor	5 - Factor	General comments :
Access to information - property owners are more likely to assume the risk associated with Brownfield remediation with access to relevant information and data that communicates the aforementioned factors.	Market - where the property and commercial markets are responsive to innovation and enterprise, property owners would see the benefit in undertaking the aforementioned factors for the possibility of capital/financial gain through remediation, redevelopment and commercialization of the property				
Status of surrounding properties - are there other brownfields nearby or adjacent	Availability of third-party funding (e.g., grants) to assist in site investigation	how does the brownfield fit within the overall development in the area	upside value - what is the upside value of developing the brownfield compared to the value in its current condition		

<p>Stigma - site is contaminated will the public be comfortable renting/leasing, using the property? If I clean it up will that make it more marketable/usable?</p>	<p>Insurance complications- pollution exclusion but more expensive insurance could help mitigate risks.</p>	<p>Long term or unknown risks or changed regulations - Look at new guidance on Vapor intrusion are there other issues that might not be evident now that will be challenges later.</p>	<p>Reputation rewards - cleaning up and reusing a site is a marketing tool as being more sustainable.</p>	<p>The likelihood of success and the confidence in the cost estimates are critical. Do you believe it is only going to be X not X times 50%.</p>	<p>Availability of loans and grants are also important</p>
<p>Confidence in timeliness and progress through process.</p>					
<p>Uncertainty. This compounds the other factors. At times a property has a low probability of a very high cost remedy or an expensive third party claim. The inability to adequately account for the range of uncertainties influences the decision making process.</p>					
<p>Availability of public funds. This is related to the cost of information and the cost of remediation. The logic model of the</p>					

<p>brownfields program is that public funds will reduce the cost to the property owner, thereby leading to more brownfields cleanup than without public funding.</p>					
<p>Perceived redevelopment opportunity: the potential for redeveloping, expanding the use of, or selling a property after assessment and/or cleanup may influence an owner who has access to information on liability protection, funding and other incentives.</p>	<p>Perception of regulators and others involved as trusted "team members": if a property owner has open/positive communication with regulators, consultants, or trusted sources, they may be positively influenced to begin remediation.</p>				
<p>"Unknowns" or items not well quantified like the agency review time, actual costs for remediation verses estimate costs, and third party involvement that could include late-in-the-process concerns.</p>					
<p>How cooperative and creative is the regulatory agency</p>	<p>Can the end use lead to a site plan that factors in the contaminated area or areas</p>	<p>assuming their is private funding, i.e a bank, what is</p>	<p>Does the potential developer have an experienced and</p>	<p>Is the community on board with the potential developme</p>	<p>Most contaminated sites can be dealt with in a reasonable fashion, with the proper team of professionals and the right end use and site plan. There is no need for delay or loss of</p>

		their willingness to fund the project	expert consultant and counsel to advise regarding the risks	nt	business with the technology and expertise of today.
<p>Funding programs to conduct the analysis and/or potential cleanup can reduce or eliminate financial burden for property owner</p>					
<p>Shared Liability - Options available for dividing or limiting liability, e.g. escrow account for cleanup, insurance, PPA</p>	<p>Market Timing - Development opportunities are usually highly timing-dependent. Cleanup uncertainties generally weigh negatively on timely development needs.</p>				
<p>Brownfield Redevelopment Tools - this could include tax abatement and incentive programs, land banking, private-public partnerships, prospective purchaser agreements, etc</p>	<p>Assessment and Cleanup Grants - federal and state funding available to sellers and purchasers of brownfields, helps define remediation needs and eliminate the unknown.</p>				
<p>Potential return on investment - Is there a strong possibility that investing time, money, and energy in</p>					

<p>environmental investigation right now will be worth it financially?</p>					
<p>Fear of site being added to government database - Owners of sites not on any public database may wish to avoid actions that could result in a government "listing" of their site.</p>	<p>Inertia - Some owners may be happy with their properties as they are, and don't want to remediate, sell, or see new uses on them - unless required to do so by government.</p>				
<p>Environmental hazard - as opposed to only health hazard. For example, possible release to surface water, effect on wildlife, etc. This may be a factor that leads to litigation, may affect community perception, or may be important to the property owner for intrinsic reasons.</p>	<p>Prospect of sale - may or may not be included in "Loss of business" but was mentioned by several people in the last round as a driver, along with regulatory enforcement.</p>	<p>Uncertainty - already mentioned under "Cost of remediation" but might be worth mentioning separately, since additional contamination discovered during cleanup could theoretically result in costs outrunning resources. (I'm not a practitioner so I am speculating.)</p>			
<p>Sources of funding for remediation - i.e., can the remediation be funded by outside</p>					



<p>sources, such as insurance, a prior owner and/or brownfield grants.</p>					
<p>Redevelopment Opportunity - market conditions that are favorable to redevelopment; cleanup is therefore not an obstacle.</p>	<p>Availability of funding / financing - if the cost is subsidized, or if property owner recognizes cost saving</p>				
<p>Civic stewardship - positive impact - property owner is motivated by decision to leave a redevelopment legacy that contributes to the livability of the community.</p>	<p>Intergenerational property transfers - positive impact - desire on part of property owner not to burden family members (children) with contamination impacted property.</p>	<p>Health issues - negative impact - property owner(s) dealing with either their own health issues or family health issues and unwilling or unable to undertake addressing contamination on property even if sale of property is necessary.</p>	<p>Personal financial situation - negative impact - opposite of Civic stewardship which assumes property owner has financial means to be philanthropic - in this case, property owner sees property as an asset in which its financial wellbeing is either fully or partially dependent - any activity that negates the perceived value of the asset will lead to inaction</p>	<p>Investment property - negative or positive impact - dependent on reasons for investment - might be dependent economic /community "health". Decision to sell property / address contamination issues may occur when sufficient return on investment is perceived. Ownership of property is likely not local.</p>	<p>I'm probably not going to say this right but it seems to me that the decision to hold or sell land is a personal one and the list of factors provided strike me as too impersonal - too big picture and still coached in regulatory/planner/economic/community development lingo. In other words, the factors that influence why or why not a property owner would decide to "cleanup" property is going to be driven by those factors that are impacting them or their family directly or by the "legacy" they wish to leave either personally for their family or civically in their community. At the end of the day, it comes down to money - so how does the model get to defining the factors that trigger a financial commitment to address the environmental contamination on the property. What proxies can be used?</p>

			on the part of the property owner.		
					I believe you have captured all important factors.

Table Options	
Statistic	Value
Total Responses	19

**2.** Hypothesis 4: Owners typically seek information regarding decision factors through sources as indicated in the Amended Model

Below is a table with a list of information sources that property owners may rely on to make a decision. Some of these sources are based on this research's opinion and some are from data sources that are available through local and federal overseeing agencies (DEQ and EPA). From your experience, please add to this list, including a definition for each source of information in the fields provided.

<u>Source of Information</u>	<u>Definition</u>
Popular media	News media have been known to have a strong effect on the public’s perception of risk. Stories available on news media about liabilities associated with contaminated properties and legal consequences may effect decision process
Personal observation	Physical appearance of a site might create false perception of risk in individuals
Community perception	Threat of creating a bad reputation amongst the members of the community influence decision process
Site history	Historical usage of a commercial site can provide key information on possible environmental concern.
Personal information	Intuitive feelings based on past experiences are usually being used to make decision. Emotions such as fear has a negative effect when the recipient feels the risk is high

- DEQ data base      ESCI has a public on line database that offers real information on environmentally challenged sites registered with DEQ. Also DEQ has guidelines for how to remediate a site
  
- EPA data base      EPA has sources of information and guidelines to help property owners with brownfield's remediation
  
- Consultant          Professional environmental consultants can help a property owner to find solution to their brownfield's problem

Please provide up to three additional sources of information in the fields provided below that you think property owners may use to reach a decision. Please provide a short definition for each one and a reason as to why you think property owners may use these sources to obtain the information they need to make their decision. If you have additional comments please use the "General Comments" box.



•

1 - Source of information	2 - Source of information	3 - Source of information	General comments
site specific data, both past and present	site specific data concerning adjacent and nearby properties		
Brokers and Insures to help mitigate the risk	Former employees or neighbors - I have been at sites when some one who stopped while driving by said "did you check over in that corner" it used to smell real bad".	Former owners. they may or may not want to deluge issues	Also historic records such as Sanborn maps, city and county files, and other historic sources.
Community survey(s)  Perhaps this is included in the consultant source, but environmental sampling is an important source of information for decision making.	Lawyers. Environmental attorneys are often retained to assess the magnitude of various litigation risks.	Financial institutions. Lenders may have positive or negative influence on decision making.	
Local land use information for zoning, permits, licensing, property transactions, insurance records, Sanborn fire maps. These may be part of the consultant's work.			
Attorney: may apply only to more savvy/motivated	Local government planning/redevelopment		

<p>owners</p>	<p>department: property owner may contact local agencies to assess options for dealing with property</p>		
<p>need an opinion from the regulatory agency, specifically a project manager in the program area that would over see the site and has had experience in other like sites</p>	<p>economic development personnel within the community. Is there incentives, is there tax relief, are there other dollars, i.e grants, etc. available</p>	<p>Other brownfield developers can provide their experience good and bad on taking on a development</p>	<p>The key for this to work is realistic expectations of all parties, the developer and the community/city. The developer when it is all said and done has to make money and arguably a higher return to offset the risk. The City or community has to help in any way it can and has to realize that the end use is based on location and demographics. The environmental issues and legalities is the easy part if you have the right team of experts. the difficulty is meeting expectation</p>
<p>Community development/economic development/DEQ or Business Oregon staff can provide information about programs to assist with costs</p>			
<p>Legal Counsel - Transaction and/or environmental attorneys can help a property owner find solutions to their brownfield's problem</p>			
<p>Community need - listening to what a community may need (community gardens, affordable housing, parks, small-business incubator sites) may influence a property owner to develop a piece of land that might otherwise not be developed (aka brownfield).</p>	<p>Personal information - intuitive feelings based on past experience: emotions such as excitement, trust, goodwill and desire to change the world can have a very positive impact on brownfield redevelopment.</p>		
<p>DEQ personal contact - While DEQ is a regulatory agency, it can also provide a lot of useful information to property owners about their properties and what's needed to get to a clean bill of health</p>	<p>Public funding - Though limited, there may be public grants/loans (or tax incentives) available for site investigation, cleanup, and some redevelopment activities</p>	<p>Environmental lawyer - An experienced attorney can provide a wealth of information to a property owner</p>	

		about risks/liabilities, regulatory hurdles (or lack thereof), costs/sources of funding, and likely outcomes of moving forward.	
<p>What about actual environmental data about the contamination? I suppose that might be found in a DEQ or EPA database or obtained from a consultant.</p> <p>Government Agency other than DEQ/EPA- some local government jurisdictions have brownfield programs that provide technical assistance to property owners</p>			<p>Some of these sources listed above don't seem to fall under the category of RELIABLE information - e.g., popular media, personal observation, community perception, personal information. That is not to suggest that they wouldn't be considered, of course.</p>
<p>Legal counsel - when deciding whether to remediate, property owners often rely on advice from their attorneys regarding, among other items, how their taking the lead in remediation may affect their liability, whether they will be able to recover the cost of remediation from other parties and negotiation with potential purchasers regarding responsibility for remediation.</p>			
<p>Personal health issues or clusters of health issues in the area of the property.</p>	<p>Neighborhood health and safety reports - police reports of vandalism, graffiti, arson..</p>		
•			<p>Again, I don't think you have missed anything.</p>

1 - Source of information	2 - Source of information	3 - Source of information	General comments
site specific data, both past and present	site specific data concerning adjacent and		

	nearby properties		
Brokers and Insures to help mitigate the risk	Former employees or neighbors - I have been at sites when some one who stopped while driving by said "did you check over in that corner" it used to smell real bad".	Former owners. they may or may not want to deluge issues	Also historic records such as Sanborn maps, city and county files, and other historic sources.
Community survey(s)			
Perhaps this is included in the consultant source, but environmental sampling is an important source of information for decision making.	Lawyers. Environmental attorneys are often retained to assess the magnitude of various litigation risks.	Financial institutions. Lenders may have positive or negative influence on decision making.	
Local land use information for zoning, permits, licensing, property transactions, insurance records, Sanborn fire maps. These may be part of the consultant's work.			
Attorney: may apply only to more savvy/motivated owners	Local government planning/redevelopment department: property owner may contact local agencies to assess options for dealing with property		
need an opinion from the regulatory agency, specifically a project manager in the program area that would over see the site and has had experience in other like sites	economic development personnel within the community. Is there incentives, is there tax relief, are there other dollars, i.e grants, etc. available	Other brownfield developers can provide their experience good and bad on taking on a development	The key for this to work is realistic expectations of all parties, the developer and the community/city. The developer when it is all said and done has to make money and arguably a higher return to offset the risk. The City or community has to help in any way it can and has to realize that the end use is based on location and demographics. The environmental issues and legalities is the easy part if you have the right team of experts. the difficulty is meeting expectation
Community			

<p>development/economic development/DEQ or Business Oregon staff can provide information about programs to assist with costs</p>			
<p>Legal Counsel - Transaction and/or environmental attorneys can help a property owner find solutions to their brownfield's problem</p>			
<p>Community need - listening to what a community may need (community gardens, affordable housing, parks, small-business incubator sites) may influence a property owner to develop a piece of land that might otherwise not be developed (aka brownfield).</p>	<p>Personal information - intuitive feelings based on past experience: emotions such as excitement, trust, goodwill and desire to change the world can have a very positive impact on brownfield redevelopment.</p>		
<p>DEQ personal contact - While DEQ is a regulatory agency, it can also provide a lot of useful information to property owners about their properties and what's needed to get to a clean bill of health.</p>	<p>Public funding - Though limited, there may be public grants/loans (or tax incentives) available for site investigation, cleanup, and some redevelopment activities.</p>	<p>Environmental lawyer - An experienced attorney can provide a wealth of information to a property owner about risks/liabilities, regulatory hurdles (or lack thereof), costs/sources of funding, and likely outcomes of moving forward.</p>	
<p>What about actual environmental data about the contamination? I suppose that might be found in a DEQ or EPA database or obtained from a consultant.</p>			<p>Some of these sources listed above don't seem to fall under the category of RELIABLE information - e.g., popular media, personal observation, community perception, personal information. That is not to suggest that they wouldn't be considered, of course.</p>
<p>Government Agency other than DEQ/EPA- some local government jurisdictions have brownfield programs that provide technical assistance to property owners</p>			

<p>Legal counsel - when deciding whether to remediate, property owners often rely on advice from their attorneys regarding, among other items, how their taking the lead in remediation may affect their liability, whether they will be able to recover the cost of remediation from other parties and negotiation with potential purchasers regarding responsibility for remediation.</p>			
<p>Personal health issues or clusters of health issues in the area of the property.</p>	<p>Neighborhood health and safety reports - police reports of vandalism, graffiti, arson..</p>		
			<p>Again, I don't think you have missed anything.</p>

•

Table Options	
Statistic	Value
Total Responses	16



## Appendix D – Impact of Factors and Reliability of Sources of Information

## Fourth Survey – Ranking Impact of Factors and Reliability of Sources of Information

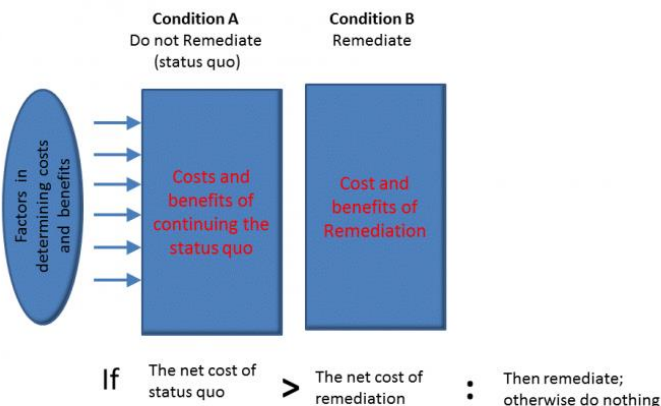
Q1



### Cost - Benefit Analysis

Brownfield property owners have to make a decision on remediation. A set of factors and the sources of information a property owner taps into to obtain information have an influence on the decision-making process to remediate a property. The responses from the last survey were collected and systematically evaluated through a content analysis. A list of factors and sources of information were selected based on the collective input from the prior surveys and this research's literature review.

This portion of the research proposes that, in making their decision, owners compare two conditions for their property in a manner suggested by the figure, below.



Condition A) - The net value of the unremediated state of their property.

VS.

Condition B) - The net value of their property after and including the cost of remediation.

For each condition there is a set of factors related to remediation that are either cost or benefit to a property owner. This researchs categorized the list of factors from the responses compiled from the previous surveys and assigned each factor to either a cost or benefit category for each of the above conditions.

Factors	Condition A - Do not Remediate		Condition B - Remediate	
	In a cost/benefit analysis -How each factor influence property owner's decision		In a cost/benefit analysis -How each factor influence property owner's decision	
	Cost (Con/Negative Influence)	Benefit (Pro/Positive Influence)	Cost (Con/Negative Influence)	Benefit (Pro/Positive Influence)
listing as Responsible Party	■			
Regulatory Enforcement	■			
Third Party Litigation	■			
Available Funding				■
Incentives				■
Liability Mitigation				■
Distrust of Resources	■			
Property Location /Prime				■
Property Location /Distressed	■			
Public Health Hazard	■			
Cost of Remediation			■	
Time to Remediate			■	
Loss of existing Business			■	
Future Financial Gains				■
Stigma	■			
Community Acceptance				■
Civic Stewardship				■
Personal life Situation			■	

In this survey this researchs are asking you to;

- Rank the impact of each factor in presented conditions,
- Suggest what source(s) of information property owners most likely use in respect to specific factors, and
- Rank the reliability of each source of information.

Q2



For ranking the following factors, please respond based on your belief regarding the degree to which the factor influences the property owner’s overall well-being. For example, if a factor, say *regulatory enforcement*, would create an extreme loss to the owner, then choose ‘Extreme impact’. Similarly, where benefits are being considered, an extreme benefit would score as “Extreme impact”. The overall purpose is to compare on one scale each of the factors in relation to the impact on the owner and in comparison to each other.

The definitions of each factor may be obtained by 'hovering' over the impact name. Remember that the terms 'cost' and 'benefit' are generic terms, not necessarily measurable in terms of money.

Hover over the short title of the Factors to obtain the long definition. Please score each factor. A comment box is made available at the end of the next page.

### Condition A - Should I not remediate? What are the cons?

The factors that would be considered a cost to property owners should they choose to not remediate are listed below.

Condition A - Not Remediated - Negative Impact (Degree of Impact from 1 to 9)									
	No Impact 1	2	Minor Impact 3	4	Some Impact 5	6	Strong Impact 7	8	Extreme Impact 9
Listing as a Responsible Party	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Regulatory Enforcement	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Third Party Litigation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Distrust of Resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property Location/Distressed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public Health Hazard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Stigma	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Q3**

### Condition A - Should I Not Remediate? What are the Pros?

No factor is applied for this condition.

**Q4**





**Factors in Rows, Sources of Information in Columns**

	Popu- lar Media	Intuitio- n - Personal Information	Comm- unity Sources	Histori- cal Site Inform- ation	Propert- y Physical Appearance	DEQ Datab- ase	EPA Datab- ase	Privat- e Resou- rces	City and Cou- nty File s	Finan- cial Institu- tion	Local Govern- ment Resour- ces
Incentives	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Liability Mitigation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Distrust of Resources	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Property Location/Pri- me	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Property Location/Dis- tressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Public Health Hazard	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost of Remediation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Time to Remediate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Loss of Existing Business	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Future Financial Gains	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Stigma	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Community Acceptance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Civic Stewardship	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Personal life situation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Q7

**How reliable are the sources of information?**

Property owners rely on information sources in order to make a

decision. Below is a list of informational sources that were suggested either in the literature review or by the panel members. using the scale provided please rank each source of information based on its reliability.

<b>Sources of Information</b> (Degree of Reliability from 1 to 9)									
	Never Reliable 1	2	Rarely Reliable 3	4	Somewhat Reliable. 5	6	Mostly Reliable 7	8	Always Reliable 9
Popular Media	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Intuition - Personal Information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Community Sources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Historical Site Information	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property Physical Appearance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
DEQ Database	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
EPA Database	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Private Resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
City and County Files	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Financial Institution	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local Government Resources	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Q8**

Your comments are important to the success of this research. Please provide your comments, in regards to this survey, below.



**Q10**



The next step for this research is to collect and analyze your responses in order for this research to confirm a valid data set for developing insightful conclusions. The results from this survey will help this research to understand the level of consensus among the experts and to identify the degree of impact each factor may have on a property owner's decision-making process from an expert's point of view. Further, the sources of information will guide understanding regarding how owners assess their situation.

A second stage of this research is contemplated if funding becomes available. That stage proposes that additional data needs to be collected from brownfield property owners in Oregon and will be used to compare against the findings from this current research.

## Ranking Results

**1. Condition A - Not Remediated - Negative Impact (Degree of Impact from 1 to 9)**

#	Question	No Impact 1	2	Minor Impact 3	4	Some Impact 5	6	Strong Impact 7	8	Extreme Impact 9	Total Responses	Mean
1	Listing as a Responsible Party	0	1	3	2	3	2	3	2	3	19	5.79
2	Regulatory Enforcement	0	0	1	1	0	1	7	5	4	19	7.26
3	Third Party Litigation	0	0	1	0	4	2	4	3	5	19	6.95
4	Distrust of Resources	0	0	3	3	7	3	0	0	2	18	5.11
5	Property Location/Distressed	0	1	2	2	6	1	2	3	2	19	5.68
6	Public Health Hazard	0	0	8	1	3	2	3	0	2	19	4.95
7	Stigma	0	4	5	3	2	1	4	0	0	19	4.16

•

Table Options							
Statistic	Listing as a Responsible Party	Regulatory Enforcement	Third Party Litigation	Distrust of Resources	Property Location/Distressed	Public Health Hazard	Stigma
Min Value	2	3	3	3	2	3	2
Max Value	9	9	9	9	9	9	7
Mean	5.79	7.26	6.95	5.11	5.68	4.95	4.16
Variance	5.06	2.54	3.16	2.93	4.34	4.39	3.47
Standard Deviation	2.25	1.59	1.78	1.71	2.08	2.09	1.86
Total Responses	19	19	19	18	19	19	19

**2. Condition B - Remediated - Negative Impact (Degree of Impact from 1 to 9)**

#	Question	No Impact 1	2	Minor Impact 3	4	Some Impact 5	6	Strong Impact 7	8	Extreme Impact 9	Total Responses	Mean
1	Cost of Remediation	0	0	0	0	1	2	2	9	5	19	7.79
2	Time to Remediate	0	0	1	1	2	4	6	4	1	19	6.53
3	Loss of Existing Business	1	0	3	2	4	2	4	1	2	19	5.47
4	Personal life situation	0	0	2	1	9	1	3	1	2	19	5.68

Statistic	Cost of Remediation	Time to Remediate	Loss of Existing Business	Personal life situation
Min Value	5	3	1	3
Max Value	9	9	9	9
Mean	7.79	6.53	5.47	5.68
Variance	1.29	2.26	4.71	3.01
Standard Deviation	1.13	1.50	2.17	1.73
Total Responses	19	19	19	19

**3. Condition B - Remediated - Positive Impact (Degree of Impact from 1 to 9)**

#	Question	No Impact 1	2	Minor Impact 3	4	Some Impact 5	6	Strong Impact 7	8	Extreme Impact 9	Total Responses	Mean
1	Available Funding	0	0	0	1	1	4	6	4	3	19	7.05
2	Incentives	0	0	0	2	4	3	4	5	1	19	6.47
3	Liability Mitigation	0	0	1	2	1	2	7	5	1	19	6.63
4	Property Location/Prime	0	0	0	0	1	1	10	3	4	19	7.42
5	Future Financial Gains	0	0	0	0	2	3	4	6	4	19	7.37
6	Community Acceptance	0	0	5	4	8	0	0	0	2	19	4.68
7	Civic Stewardship	0	1	4	3	6	1	2	0	2	19	4.95

Statistic	Available Funding	Incentives	Liability Mitigation	Property Location/Prime	Future Financial Gains	Community Acceptance	Civic Stewardship
Min Value	4	4	3	5	5	3	2
Max Value	9	9	9	9	9	9	9
Mean	7.05	6.47	6.63	7.42	7.37	4.68	4.95
Variance	1.83	2.26	2.58	1.15	1.69	3.01	3.83
Standard Deviation	1.35	1.50	1.61	1.07	1.30	1.73	1.96
Total Responses	19	19	19	19	19	19	19

#### 4. What sources do property owners use to assess the impact of the factors on their well-being?

Property owners use sources in order to make an informed decision. The below matrix is a comprehensive list of all factors and sources of information that have been identified based on the literature review and the expert panel's comments. Each row is dedicated to a key factor and each column is dedicated to a source of information. Please select the source or sources - you can select as many boxes as it applies - of information that you believe property owners use when performing a subjective assessment of each factor. List all that apply.

Hover over the short title of either Sources of Information or Factors to obtain the long definition. A comment box is made available at the end of this page.

#	Question	Listing as responsible party	Regulatory Enforcement	Third Party Litigation	Available Funding	Incentives	Liability Mitigation	Distrust of Resources	Property Location/Prime	Property Location/Distressed	Public Health Hazard	Cost of Remediation	Time to Remediate	Loss of Existing Business	Future Financial Gains	Stigma	Community Acceptance	Civic Stewardship	Personal life situation	Total Responses
1	Popular Media	4	4	6	4	3	2	10	9	8	10	2	2	3	1	13	12	9	3	105
2	Intuition - Personal Information	9	6	10	4	2	2	13	13	14	7	9	10	17	17	12	13	17	19	194
3	Community Sources	4	4	5	11	12	2	10	10	8	15	3	0	7	5	14	16	11	4	141
4	Historical Site Information	10	4	9	1	0	3	4	6	8	10	7	2	3	2	3	3	3	1	79
5	Property Physical Appearance	3	3	1	1	0	1	0	10	13	10	1	1	2	1	11	5	4	2	69
6	DEQ Database	13	14	8	6	6	8	4	3	5	11	5	6	2	1	3	0	1	0	96
7	EP A Database	10	12	9	4	6	5	3	2	4	10	4	4	1	0	4	0	0	1	79
8	Private Rec	11	10	14	12	11	12	6	11	9	10	17	16	7	13	6	2	2	6	175

9	City and County Files	6	5	6	1	4	4	3	7	8	12	2	1	2	4	4	2	1	0	72
10	Financial Institution	3	4	5	14	12	5	4	12	13	1	10	5	6	13	2	0	1	4	114
11	Local Government Resources	8	9	4	15	19	8	7	6	8	11	10	7	3	6	5	9	9	4	148

**5. Your comments are important to the success of this research. Please provide your comments, in regards to this survey, below.**

**Text Response**

The matrix that was put together was not as clear as it could be. While I can understand the goal of the matrix, I am not sure they "fit" together in the manner presented as you may have hoped.

The uncertainty surrounding contaminated property makes all sources of information a bit suspect, in reality.

These are hard to rank "in general" since on a case-by-case basis items like Personal Life Situation may be the one key factor for a land owner; however, in most cases it is minor factor or not a factor at all.

The matrix in the survey was a little confusing. You won't necessarily find out about incentives or funding from DEQ or EPA databases but DEQ and EPA do provide brownfield incentives and funding.

Information sources accessed by a property owner will vary widely depending on the sophistication of the property owner. Some have access to lawyers, consultants, etc. and understand local, state, and federal government databases. Many have no access to or understanding of these resources, and depend largely on intuition.

I believe this survey is fundamentally flawed in the assumption used to identify what factors go into decision making and in particular the list of potential resources. In my experience, property owners rely most heavily on information from professional service providers like environmental consultants and attorneys. I can't even figure out what you mean by some of your factors or how the sources related to those factors. Consequently, I don't think my responses are very reliable or informative and I will not be able to place any value on the results of your survey or its interpretation.

Two comments: 1. There may be an opportunity cost associated with not remediating, which perhaps is the inverse of "future financial gain" resulting from remediation and subsequent redevelopment. So, you may have it indirectly covered through your "future financial gain" metric. 2. An attorney is the single most significant resource for information and guidance; your questions infer that the owner is making decisions without counsel. In my experience, this is uncommon (granted, my experience comes from consulting for landowners most often with some degree of legal counsel involvement, so my view point may be biased).

I understand that the factors and sources come from previous survey questions; however, the structure of this series of questions speaks to the decision making process of property owners yet the factors and sources (with a couple of exceptions such as intuition/personal information and property physical appearance) are more applicable to buyers of property.

Just a reminder that I am not a brownfield owner or brownfield remediation professional - I operate in the realm of public policy so my opinions are just based on imagining myself in the shoes of the owner of a brownfield.

I would say the biggest cons of not remediating - which weren't choices in the question - are lower property value / inability to sell property, and inability to get loans/investments to redevelop property. Likewise, the biggest risk of remediating - which was not a choice - would be the risk and unknowns. Also, in the question about sources of information, "DEQ Database" and "EPA Database" are listed, but not just DEQ and EPA. People at these agencies are a very different resource than just the database, and are a very valuable and reliable source of information that wasn't listed.

The range of sources of information seems complete and the question of perceived reliability vs actual reliability is a key. Property owners that just do not believe that their past activities or the scope of the past activities on their property could impact human health and the environment are unlikely to even seek out objective sources of information (such as environmental sampling). Then there is human nature in decision making where some one may never admit that media shapes their perception of an issue but in fact the media has influenced the framework that they are using for analysis. Fascinating topics. Good luck figuring out we humans.

Investors and/or property buyer are going to go to agency files first if they don't already have knowledge. They then will go to their attorneys (which I would put under the private resources column), then they will go to a consultant.

Statistic	Value
Total Responses	12

## 6. Sources of Information (Degree of Reliability from 1 to 9)

#	Question	Never Reliable 1	2	Rarely Reliable 3	4	Somewhat Reliable. 5	6	Mostly Reliable 7	8	Always Reliable 9	Total Responses	Mean
1	Popular Media	0	2	5	6	5	1	0	0	0	19	3.89
2	Intuition - Personal Information	0	2	6	2	4	4	1	0	0	19	4.26
3	Community Sources	0	2	2	4	7	2	1	1	0	19	4.63
4	Historical Site Information	0	0	1	0	4	5	5	1	3	19	6.47
5	Property Physical Appearance	0	1	2	6	7	2	1	0	0	19	4.53
6	DEQ Database	0	0	0	1	0	3	11	4	0	19	6.89
7	EPA Database	0	0	0	2	1	2	12	2	0	19	6.58

8	Private Resources	0	0	0	0	3	4	6	6	0	19	6.79
9	City and County Files	0	0	0	2	1	5	7	3	1	19	6.58
10	Financial Institution	0	0	0	1	1	6	6	4	1	19	6.74
11	Local Government Resources	0	0	1	1	1	3	7	6	0	19	6.68

Statistic	Popul ar Media	Intuition - Personal Information	Communit y Sources	Historica l Site Information	Property Physical Appearance	DEQ Databa se	EPA Databa se	Private Resour ces	City and Coun ty Files	Financi al Instituti on	Local Govern ment Resource s
Min Value	2	2	2	3	2	4	4	5	4	4	3
Max Value	6	7	8	9	7	8	8	8	9	9	8
Mean	3.89	4.26	4.63	6.47	4.53	6.89	6.58	6.79	6.58	6.74	6.68
Varian ce	1.21	2.32	2.36	2.49	1.37	0.88	1.26	1.18	1.70	1.43	2.01
Standar d Deviat ion	1.10	1.52	1.54	1.58	1.17	0.94	1.12	1.08	1.30	1.19	1.42
Total Respon ses	19	19	19	19	19	19	19	19	19	19	19

**7. Score**

Statistic	Value
Mean Score	173.74
Score Standard Deviation	13.74
Weighted Mean of Items	6.00
Weighted Standard Deviation of Items	1.89
Items	550.00

## Appendix E – Glossary of Terms



## GLOSSARY OF TERMS

**Active site** – An active site is one at which site assessment, removal, remedial, enforcement, cost recovery or oversight activities are being planned or conducted.

**Anchoring** – A common decision-making tendency in which humans rely too heavily on the first available piece of information when making a decision. Incremental adjustments are made around the anchor.

**Antagonism** – In opposition. Antagonist tendencies are determined to skew risk perception.

**Assessment, Cleanup and Revolving Loan Fund** – All EPA funded grants. Assessment grants provide funding for brownfields inventories, planning, environmental assessments and community outreach. Cleanup grants provide direct funding for cleanup activities at specific sites. Revolving loan provide funding to capitalize a revolving loan fund that provides loans and sub-grants to carry out cleanup activities on brownfield properties.

**Baseline Risk Assessment** – A baseline risk assessment is an analysis of the uncertainties that covers all aspects of risk to human health and environment. Each baseline risk assessment includes an exposure analysis, a toxicity analysis evaluating the inherent toxicity of chemicals, a risk characterization combining the results of the exposure and toxicity analyses.

**Bias** – Prejudice in favor or against something or someone usually considered to be in an unfair way. Bias can affect the decision-making process and lead an individual to choose one alternative over another.

**Brownfields Law** – The name for the Small Business Liability Relief and Brownfields Revitalization Act, both of which were passed in 2002. The

legislation supports land revitalization projects from beginning to end through funding and job training once remediation is complete.

**Brownfields/Brownfield Property** – A real property where expansion, redevelopment or reuse of which is complicated by actual or perceived environmental contamination.

**Business Oregon Brownfields Program** – A state government agency program that provides finances for the environmental activities involved with brownfields redevelopment projects. The Business Oregon Brownfields Program works closely with the Oregon Department of Environmental Quality to ensure that a project's scope and scale of work will achieve environmental compliance and the needs of the redevelopment projects.

**Causal Factors** – The list of factors presented in this study that are determining elements and considered as either enablers or disablers in a property owner's decision-making process to remediate or not.

**Civic Stewardship** – The duties and obligations to conduct, supervise or manage something. In this research, it refers to a possible causal factor that influences a brownfield property owner's decision to remediate or not. Civic stewardship refers to the property owner's desire to leave a redevelopment legacy that contributes to the livability of a community.

**Community "Right to Know" Act** – The Emergency Planning and Community Right-to-Know Act was passed in response to concerns regarding the environmental and safety hazards posed by the storage and handling of toxic chemicals. It calls for planning, reporting and inventory of toxics.

**Community Acceptance** – In this research, it refers to when a community is supportive of the potential development, increasing the real estate value and commercial potential for a brownfield property.

**Community Reinvestment Act (CRA)** – A piece of legislation passed in 1977 that had intentions to provide incentives to redevelop for brownfield property owners. The act forced lenders to provide capital to low- and middle-income borrowers living on or adjacent to brownfield properties.

**Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)** – The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment.

**Content Analysis** – A content analysis is a systematic analysis of the content of a body of communication. This is done through the classification, tabulation and evaluation of key symbols and themes. Content analyses are often helpful in identifying trends.

**Corrective Action Plan** – A remediation plan that proposes a plan of action to remediate contamination on a polluted property.

**Cost of Remediation** – In this research, a property owner's belief that they will endure expenses related to remediation. The perceived costs include the many unknowns and risks related to remediation projects which can affect a property owner's decision to remediate or not.

**Cost/Benefit Analysis** – A systematic approach for estimating the strengths and weaknesses of alternatives and deciding whether to go ahead with a decision.

**Decision-Making Process** – A process of making choices by setting goals, gathering information and assessing alternatives.

**Delphi Panel** – A Delphi panel consists of a group of experts who are surveyed in order to obtain a reliable consensus about a topic.

**Delphi Technique** – A forecasting method that originated in the 1950s and consists of several rounds of questionnaires. The anonymous responses are aggregated and shared with the group after each round. The word “Delphi” refers to the Oracle of Delphi from Greek mythology in which prophecies were passed down. In each round of the survey, panel members are allowed to adjust their responses.

**Demographic Survey** – A survey that helps to define a population by considering factors such as age, race, sex, economic status, level of education, income level and employment. In this research, the demographic survey was used for selecting the panel of experts based on their qualifications.

**Department of Environmental Quality (DEQ)** – A regulatory agency that is responsible for protecting the quality of Oregon's environment. Their mission is to work with Oregonians for a healthy, sustainable environment. They seek to restore, maintain and enhance the quality of Oregon's air, land and water.

**DEQ Database** – Refers to the Environmental Cleanup Site Inventory (ECSI) and Leaking Underground Storage Tank (LUST), which are online databases that offer real information on environmentally challenged sites registered with the DEQ. DEQ databases may offer information to property owners about remediation projects.

**Due Diligence** – Refers to the combination of procedures and investigation that take place before a business transaction (e.g., acquisition of real property or granting a loan in order to assess potential liabilities and problems). In particular, information is gathered to gauge the level of environmental risk associated with the proposed transaction.

**Economic Development** – From a policy perspective, the efforts that seek to improve the economic well-being and quality of life for a community by creating and/or retaining jobs and supporting or growing incomes and the tax base.

**ECSI Database** – The Environmental Cleanup Site Inventory database consists of all the properties in Oregon that are currently undergoing or have undergone the cleanup process.

**Environmental Liabilities** – Obligation based on the principle that a polluting party should pay for any and all damage caused to the environment by its activities. In some countries, this is a strict liability if the damage can be attributed to a specific party.

**Environmental Protection Agency (EPA)** – An agency of the U.S. federal government whose goal is to protect human and environmental health and oversees environmental regulations and property cleanups.

**EPA's Brownfields Initiative Program** - Provides grants and technical assistance to communities, states, tribes and other stakeholders through resources that help prevent, assess, safely clean up and sustainably reuse brownfields. EPA's Land Revitalization program works with communities, states, non-profits and other stakeholders to develop and test sustainable approaches for the reuse of formerly contaminated properties.

**EPA Databases** – In this research, it refers to the U.S. Environmental Protection Agency public databases that provide brownfield property owners with the necessary information and guidelines regarding remediation and environmental regulations.

**Exposure Pathway** – The path that a chemical takes from a source area to an exposed organism. An exposure pathway describes the mechanism by which an individual or population is exposed to a chemical originating from a site. Each

exposure pathway includes a source, a point of exposure and an exposure route. The ways in which a human or the environment can come into contact with a contaminant.

**Feasibility Studies** – A pilot study that assesses the practicality of a proposed plan or a method. It generally refers to the assessment of a set of remediation technologies that helps with selecting the most appropriate technology for a given brownfield site.

**Federal and State Tax Credit** – In this research, it refers to a tax benefit offered by either the IRS or a state/local government for spending money on environmental assessment and cleanup. The benefit comes in the form of a direct reduction in the amount of income taxes one might owe by the amount of the credit one receives.

**Federal Liability Provisions** – Provisions that hold entities accountable for discharging pollutants into the environment. Increased awareness surrounding the existence of brownfield sites can be attributed to strict federal liability provisions that have been enacted in order to stop irresponsible pollution.

**Focus Groups** – An opinion-based methodology in which a group of people are asked about their perceptions and opinions toward a question or an idea. Questions are asked in an interactive group setting where participants are free to talk with other group members.

**Foreclosure** – The process of taking possession of a property as a result of the mortgagor's failure to keep up tax or mortgage payments.

**General Accounting Office** – The arm of Congress that investigates the performances of governmental agencies or programs. They are responsible for evaluating how public funds are spent and whether federal programs are meeting their stated goals.

**Green Spaces** – A plot of undeveloped land separating or surrounding areas of intensive residential or industrial use that is maintained for recreational enjoyment and is free of contamination.

**Greenfield Growth** – Relating to or denoting previously undeveloped sites for commercial development or exploitation.

**Hazardous Substance** – Chemicals that pose a threat on human and environmental health.

**Public Health Hazard** – Refers to when the possible release of hazardous chemicals may pose a threat to public human health and the larger environment, yielding liability from regulatory agency action. In this research, it is proposed that it may have an effect on a property owner's decision-making process.

**Heuristics** – Refers to experience-based behaviors. Making a decision based on a "rule of thumb," educated guess, intuitive judgment, stereotype or common sense.

**Hot Spot** – The location at a contaminated site where the level of contamination is the highest.

**Human/Ecological Receptors** – Receptors, either ecological or human, including any living organisms, habitat which supports such organisms or natural resource that could be adversely affected by environmental contaminations. This can be because of a release at a site or migration from a site.

**Independent Cleanup Pathway (ICP)** – The Department of Environmental Quality (DEQ) created the Independent Cleanup Pathway (ICP) to assist parties wishing to clean up contaminated sites without ongoing DEQ oversight. If a cleanup is completed to a level that is protective of human health and the environment and is consistent with Oregon's cleanup regulations, DEQ will issue

a No Further Action (NFA) letter to the responsible party when the cleanup activities are completed, reviewed and approved.

**Institutional Review Board (IRB)** – A committee established to review and approve research involving human subjects to ensure that all human subject research be conducted in accordance with all federal, institutional and ethical guidelines.

**Innocent Landowners** – Land owners who have not caused contamination on their property or are not aware of existing contamination. The Superfund has categorized such land owners into three categories: purchasers who acquire property without knowledge of contamination on the property; governments acquiring contaminated property involuntarily or through the exercise of eminent domain authority by purchase or condemnation and inheritors of a contaminated property.

**Institutional Controls** – Non-engineering measures intended to affect human activities in such a way as to prevent or reduce exposure to hazardous substances. They are typically used in conjunction with, or as a supplement to, other measures such as waste treatment or containment. There are four categories of institutional controls: governmental controls; proprietary controls; enforcement tools and informational devices.

**Land Revitalization** – Projects focused on restoring land and other natural resources into sustainable community assets that maximize beneficial economic, ecological and social uses to ensure protection of human health and the environment.

**Likert Scale** – A psychometric scale commonly involved in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research. A type of rating scale intended to measure individual attitudes.



Respondents specify their level of agreement or disagreement on a symmetric agree-disagree scale of a series of statement. The range captures the intensity of their feeling toward a given item.

**Low-Impact Properties** – Properties that contain low-levels of contamination.

**Maximum Contaminant Level (MCL)** – The highest level of a contaminant that the EPA allows in drinking water. MCLs ensure that drinking water does not pose short- or long-term health risks. EPA sets MCLs at economically and technologically feasible levels. Some states set MCLs that are stricter than EPA's.

**National Brownfield Association** – The National Brownfield Association is the premier national association dedicated to supporting brownfield professionals. In this research, the Oregon chapter is referred to.

**National Priority List (NPL)** – U.S. Environmental Protection Agency public databases that provides a list of priority Superfund hazardous substance sites for cleanup.

**No Further Action (NFA)** – Determined by regulatory agencies when remediation is complete and no further action is necessary for remediation.

**Nominal Group Technique** – An opinion-based research method used when a decision needs to be made quickly. The technique involves voting and a group process that involves identifying the problem, generating a solution and making a decision.

**Northeast Midwest Institute** – A non-profit organization dedicated to the economy, environment and regional equity for Northeast and Midwest states.

**Northwest Environmental Business Council (NEBC)** – Represents the Northwest's leading service and technology providers working to protect, restore and sustain the natural and built environment.

**ODEQ's Voluntary Cleanup Program (VCP)** – Created to assist parties wishing to clean up contaminated sites without ongoing DEQ oversight. If a cleanup is completed to a level that is protective of human health and the environment and is consistent with Oregon's cleanup regulations, DEQ will issue a No Further Action (NFA) letter to the responsible party when the cleanup activities are completed, reviewed and approved.

**Oregon Brownfields Coalition** – Metro has convened a diverse coalition of public, private and non-profit partners from around Oregon to address this challenge. The Oregon Brownfields Coalition is working together to find strategies that address financial risks, liability and community interests. Through the right combination of incentives, funding and regulatory approaches, more brownfields will be cleaned up and utilized based on community need.

**Oregon Brownfields Conference** – Designed to target the educational needs of brownfield practitioners and the network of brownfields stakeholders in the state of Oregon. Long-time brownfield professionals to those just entering the process of transforming contaminated sites into productive reuse attend and participate in work sessions that dig deep into issues associated with building on brownfield properties, and provide a forum for discussion of “sustainability” in the current economic and real estate climate of record breaking property foreclosure and bankruptcy rates.

**Oregon's Environmental Cleanup Law** – Oregon's law that focuses on the investigation and cleaning up of hazardous substances that have either been released or have the potential to be released. Oregon's Environmental Cleanup law is similar to CERCLA in that it holds owners and operators of facilities liable for cleanup costs where a hazardous substance was released. In contrast to CERCLA, Oregon's Environmental Cleanup law includes oil as a “hazardous substance.”

**Personal Information** – In this research, it describes an individual's intuitive feelings based on past experiences that may be used in making a decision. Emotions, such as fear, have a negative effect when the recipient feels the risk is high or emotions such as excitement, trust, goodwill and the desire to change the world may have a positive effect.

**Phase I Assessment** – A report prepared for a real estate holding that identifies potential or existing environmental contamination liabilities. The analysis, often called an ESA, typically addresses both the underlying land as well as physical improvements to the property. Phase I ESA is generally considered the first step in the process of environmental due diligence. Standards for performing a Phase I site assessment have been promulgated by the US EPA.

**Phase II Site Assessment** – If a site is considered contaminated based on the Phase I assessment, a Phase II environmental site assessment may be conducted to assess the presence or the potential presence of hazardous chemicals or petroleum-based products. Its procedures are based on the scientific method to characterize property conditions in an objective, representative, reproducible and defensible manner.

**Popular Media** – Communication channels through which news, entertainment, education, data and promotional messages are spread. In this research, popular media are proposed to be a source of information in which property owners may be influenced by during the decision-making process. News media have been said to have a strong effect on the public's perception of risk. Stories about liabilities associated with contaminated properties and legal consequences may affect the decision-making process.

**Potential Responsible Parties (PRPs)** – An individual or company (e.g., an owner, operator, transporter, or generator of hazardous waste) who is potentially

responsible for the contamination at a Superfund site. Whenever possible, the EPA requires PRPs to clean up hazardous waste sites that have been contaminated.

**Private Resources** – In this research, it refers to the professional consultants including environmental consultants, environmental lawyers, insurance agents, brokers, brownfields developers and private sector stakeholders that are hired to help brownfield property owners find solutions to their property problems.

**Property Location/Distressed** – In this research, it refers to a factor that affects a property owner's decision. The property is located in a distressed area where redevelopment does not appear to yield economic rewards.

**Property location/Prime** – In this research, it refers to a factor that affects a property owner's decision. The property is situated in a prime location where economic viability exists, increasing the likelihood for potential commercial gains post-mitigation.

**Prospective Purchaser Agreement (PPA)** – A legal agreement that protects prospective buyers from the liabilities associated with pre-existing contamination on a property. In return for liability protection, the buyer must agree to support environmental and/or community interests.

**Qualitative Analysis** – The examination of non-measurable data such as attitudes or feelings about a topic – the qualities about a particular topic.

**Qualtrics** – An online survey software that was used in this research to distribute questionnaire and collect survey data from Delphi panel members.

**Quantitative Analysis** – The examination of measurable data and a substance's constituents – the quantities of a particular topic.

**Raw Data** – Data that has not yet undergone interpretation.

**Real Risk** – The actual existing risk related to a topic.

**Regulatory Agencies** – In this research refers to agencies that oversee and protect environmental and human health by providing guidelines, standards and regulation. Regulatory agencies have the authority to enforce cleanup actions on a property.

**Regulatory Enforcement** – Authorization and supervision, in the sense that a regulator must enforce compliance with rules. Enforcement is as much about investigating, gathering and sharing information as it is about imposing penalties. In this research it describes the legal order to clean up pollution on a property.

**Remedial Action** – Refers specifically to selected remediation technology for a given cleanup on a property.

**Remediation** – The act of removing hazardous chemicals from the environment. In this research, it is used as a decision-making milestone that leads to revitalization of brownfields properties.

**Resource Conservation and Recovery Act (RCRA)** – The principal federal law enacted in 1976 governing the handling, treatment and disposal of hazardous waste at active sites in order to protect human health and the environment from potential hazardous waste releases.

**Risk Assessment** – Determining the level of risk a contaminant may pose on human or environment health.

**Risk Management** – The forecasting and evaluation of financial risks together with the identification of procedures to avoid or minimize their impact and manage liability.

**Risk Mitigation** – Taking the steps to reduce adverse effects. In this research it refers to managing environmental liability risk by purchasing insurance or determining legal agreement that limits the cost of unknowns.

**Risk Perception** – Risk perception is not only related to technical estimates of risk and benefits, but also has a subjective dimension related to how people make judgments about the characteristics and severity of a risk.

**Risk Sensitivity** – Individuals differ in their risk sensitivities. Often times, one individual will interpret the level of risk in a different way than another individual.

**Risk Targets** – The recipients of a particular risk.

**Risk-Based Cleanup (RBC)** – Describes cleanup goals for contaminated sites where residues is not deemed hazardous to human health.

**Site Assessment** – The process of investigating the presence, concentration and extent of contamination at a given site.

**Site Closures** – Determined by regulatory agencies after a proper clean up that follows appropriate standards.

**Site History** – An important part of a Phase I environmental site assessment which provides the historical usage of the site in respect to business and practices that may have trigger any kind of environmental liability to the site's soil or groundwater.

**Small Business Administration's Office of Advocacy** – The U.S. Congress created the Office of Advocacy in 1976 within the U.S. Small Business Administration to inform policymakers about small business contributions and effectively represent the nation's small businesses within the federal government's rule-making processes. The Office of Advocacy's mission is to give visibility to

American small businesses and to encourage policies – especially regulatory policies – that support start-up, development and growth.

**Small Business Liability Relief and Brownfields Revitalization Act of 2002 –**

Passed to provide certain relief for small businesses from liability under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 and to amend such act to promote the cleanup and reuse of brownfields, to provide financial assistance for brownfields revitalization, to enhance State response programs and for other purposes.

**SPSS** – Software for statistical analysis helpful for making predictions with confidence about what will happen next.

**Staticized Surveys** – An opinion-based survey. A systematic way of collecting information from a particular knowledgeable group about a specific subject of interest. This type of survey typically involves one round of information collection from participants.

**Superfund Act** – Responsible for cleaning up some of the nation's most contaminated land and responding to environmental emergencies, oil spills and natural disasters. The Superfund Act seeks to protect public health and the environment, by focusing on making visible and lasting differences in communities, ensuring that people can live and work in healthy, vibrant places.

**Superfund Amendment and Reauthorization Act (SARA)** – Requires a biennial report from the industry indicating the emissions and management of regulated chemicals on contaminated properties. The SARA also increased the budget available for federal cleanup and brownfields redevelopment projects.

**Superfund Site** – Contaminated properties that the Comprehensive Environmental Response, Compensation and Liability Act of 1980 was designed to clean up.

**Tax Abatement** – Subsidies that lower the cost of owning real and personal property by reducing or eliminating the taxes a company pays on it. In this research, it refers to the tax relief for every dollar spent on environmental cleanup projects.

**Technical Assistance to Brownfields Communities (TAB)** – A program offered by the EPA that serves as a catalyst at the regional level. The TAB program is responsible for a wide range of tasks including identifying candidate sites to working with communities on public education and outreach.

**The National Governors Association** – The collective voice of the nation's governors and one of Washington, D.C.'s most respected public policy organizations. Its members are the governors of the 55 states, territories and commonwealths. The NGA provides governors and their senior staff members with services that range from representing states on Capitol Hill and before the Administration on key federal issues to developing and implementing innovative solutions to public policy challenges through the NGA Center for Best Practices.

**The Oregon Department of Environmental Quality** – Responsible for regulating and overseeing the environmentally challenged sites in Oregon and offers incentives such as Voluntary Cleanup Programs (VCP) and Prospective Purchaser Agreements (PPA) to help property owners and private stakeholders manage environmental liabilities.

**Third Party Liability Lawsuit** – Refers to a neighboring property owner who has found contamination on their property due to contaminant migration from the property that has the source of contamination.

**Toxics Release Inventory** – A database of annual toxic releases from certain manufacturers compiled from reports. Manufacturers must report annually to the EPA and the states the amounts of almost 350 toxic chemicals and 22



chemical categories that they release directly to air, water or land, inject underground or transfer to off-site facilities. EPA compiles these reports and makes the information available to the public under the "Community Right-to-Know" portion of the law.

**Treatment Technology** – The active remediation technologies that remove hazardous chemicals from soil, groundwater, surface water and air.

**U.S. Conference of Mayors** – The official non-partisan organization for cities with populations of 30,000 or more.

**Uncertainties** – The lack of certainty. A state of having limited knowledge where it is impossible to describe the exact existing state, a future outcome or more than one possible outcome.

**Voluntary Cleanup Programs (VCP)** – One of several options for cleaning up a hazardous waste site under the state's cleanup law.

**White House Council on Environmental Quality** – Coordinates federal environmental efforts and works closely with agencies and other White House offices in the development of environmental policies and initiatives. Established within the Executive Office of the President by Congress as part of the National Environmental Policy Act of 1969 (NEPA).