# Ghost Ecologies: Storytelling and futures in the Athabasca oil sands

by

Jonathan E Knight

MRCP, Kansas State University, 2012

A REPORT

submitted in partial fulfillment of the requirements for the degree

MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture/Regional and Community Planning
College of Architecture, Planning, and Design

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2017

Approved by:

Major Professor
Jessica Canfield

# Copyright

# Abstract

The contemporary globalized world is full of wicked problems. A wicked problem is difficult to resolve, complex, and solving one aspect of a problem may create other problems. Wicked problems are shaped by invisible forces and flows. Landscape architects are uniquely poised to address wicked problems with their skills and capacity to think across systems and scales in spatio-temporal, ecological, and cultural dimensions. Landscape architects also communicate through visually-accessible methods which tell a story. Storytelling in landscape architecture seeks to reveal, connect, and tie together relationships and processes of the past and present to inform future possibilities of a place. Methods of storytelling can be used to address wicked problems because of their utility in inquiry and ideation.

Developed through an original methodology using maps, diagrams, photomontage, and photographs, this project creates a storytelling framework which iteratively uses inquiry and representation to identify dilemmas, pose questions, and address issues as a means to reveal the impacts of forces on a wicked problem.

The site selected to test this proposed methodology is the Athabasca oil sands in northern Alberta, Canada. Visible from space, the potential minable area of the oil sands spans an area the size of New York State. The world's quest for oil has placed this landscape and its people on center stage. Billions of dollars' worth of industry investment has put the landscape and people under siege through ever-shifting visible and invisible forces and flows. Dilemmas created by the region's mining industry not only directly impact local people and landscape, but the greater world as well. Hampered with environmental, social, political, and economic issues, the future of this region is largely unknown, as there are few formal plans and regulations to ensure landscape reclamation and guide urban development.

To tell the story of the oil sands, four themes—oil, infrastructure, environment, and people were analyzed. These themes—referred to as "ghost ecologies" because of their inconspicuous nature—when considered together, reveal key regional dilemmas and highlight new opportunities for future directions. Analysis inspired thinking toward future scenarios that imagine a series of new, highly productive and programmatically-integrated futures for the oil sands and its people.

The unique process of inquiry and discovery led to a final project framework that identified methods for landscape architects to use in addressing wicked problems. A variety of audiences can consume this work to address the challenges of the Athabasca oil sands and other wicked problems in the world. To the public, the work serves as an evocative display of critical dilemmas worthy of future consideration. For professional and student landscape architects, the work reveals methods of inquiry to address wicked problems through the discipline.

# Ghost Ecologies

## Storytelling and futures in the Athabasca oil sands

Jonathan E Knight

# Ghost Ecologies:
## Storytelling and futures in the Athabasca oil sands

*by*

**Jonathan E Knight**
*MRCP, Kansas State University, 2012*

A REPORT

*submitted in partial fulfillment of the requirements for the degree*

MASTER OF LANDSCAPE ARCHITECTURE

*Department of Landscape Architecture/Regional and Community Planning*
*College of Architecture, Planning, and Design*

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2017

Approved by

Major Professor
Jessica Canfield



## ABSTRACT

The contemporary globalized world is full of wicked problems. A wicked problem is difficult to resolve, complex, and solving one aspect of a problem may create other problems. Wicked problems are shaped by invisible forces and flows. Landscape architects are uniquely poised to address wicked problems with their skills and capacity to think across systems and scales in spatio-temporal, ecological, and cultural dimensions. Landscape architects also communicate through visually-accessible methods which tell a story. Storytelling in landscape architecture seeks to reveal, connect, and tie together relationships and processes of the past and present to inform future possibilities of a place. Methods of storytelling can be used to address wicked problems because of their utility in inquiry and ideation.

Developed through an original methodology using maps, diagrams, photomontage, and photographs, this project creates a storytelling framework which iteratively uses inquiry and representation to identify dilemmas, pose questions, and address issues as a means to reveal the impacts of forces on a wicked problem.

The site selected to test this proposed methodology is the Athabasca oil sands in northern Alberta, Canada. Visible from space, the potential minable area of the oil sands spans an area the size of New York State. The world's quest for oil has placed this landscape and its people on center stage. Billions of dollars' worth of industry investment has put the landscape and people under siege through ever-shifting visible and invisible forces and flows. Dilemmas created by the region's mining industry not only directly impact local people and landscape, but the greater world as well. Hampered with environmental, social, political, and economic issues, the future of this region is largely unknown, as there are few formal plans and regulations to ensure landscape reclamation and guide urban development.

To tell the story of the oil sands, four themes—oil, infrastructure, environment, and people were analyzed. These themes—referred to as "ghost ecologies" because of their inconspicuous nature—when considered together, reveal key regional dilemmas and highlight new opportunities for future directions. Analysis inspired thinking toward future scenarios that imagine a series of new, highly productive and programmatically-integrated futures for the oil sands and its people.

The unique process of inquiry and discovery led to a final project framework that identified methods for landscape architects to use in addressing wicked problems. A variety of audiences can consume this work to address the challenges of the Athabasca oil sands and other wicked problems in the world. To the public, the work serves as an evocative display of critical dilemmas worthy of future consideration. For professional and student landscape architects, the work reveals methods of inquiry to address wicked problems through the discipline.


Figure i. River designation sign - Tar River. [Author 2016]

# CONTENTS

Preface xvi
introduction 001

SECTION ONE Grounding Ghost Ecologies
Chapter 01: Landscapes of Extraction 023
Chapter 02: Supply, Demand, Oil sand: An introduction 033
Chapter 03: Landscape Architecture as Storytelling 059
Chapter 04: Ghost Ecologies: A Visual Diary 079

SECTION TWO Assembling Ghost Ecologies
Chapter 05: Storytelling in the Athabasca oil sands 113

SECTION THREE Unveiling Ghost Ecologies
Chapter 06: Unveiling Oil 129
Chapter 07: Unveiling Infrastructure 165
Chapter 08: Unveiling Environment 193
Chapter 09: Unveiling People 233

SECTION FOUR Projecting Ghost Ecologies
Chapter 10: Futures in the Athabasca oil sands 267
Chapter 11: Projections 275
Oil sands as Home . . . 283
Oil sands as Food . . . 287
Oil sands as Exploration . . . 291
Oil sands as Destination . . . 295
Oil sands as National Defense . . . 299
Oil sands as Education . . . 303
Oil sands as Industry . . . 307
Chapter 12: Conclusions 311

Appendix A: References 325
Appendix B: Literature map 330
Appendix C: Glossary of terms 332

# LIST OF FIGURES


Figure i. River designation sign - Tar River. [Author 2016] vi
Figure ii. Author in the Athabasca oil sands, near Fort McMurray, Alberta, Canada, 2016. [Author 2016] xvii
Figure iii. Evening commute in the oil sands. [Author 2016] xviii
Figure iv. Location map of Athabasca oil sands and Fort McMurray. [Author 2016] 002
Figure v. Oil sands production metrics. [Author 2017] 003
Figure vi. Driving forces of the oil sands [Author 2017] 005
Figure vii. Oil sands relationships and ghost ecology themes and theme definitions. [Author 2016] 011
Figure viii. Project Sections and Chapters. [Author 2017] 012
Figure ix. Project path. [Author 2016] 013
Figure 1.1. Syncrude refinery plant at dusk. [Author 2016] 022
Figure 1.2. Resource Extraction Models. [Author 2016] 025
Figure 1.3. Exterior of abandoned home in Kitsault. [Graham 2014] 026
Figure 1.4. Abandoned home in Kitsault. [Graham 2014] 026
Figure 1.5. Exterior of abandoned home in Kitsault. [Graham 2014] 027
Figure 1.6. Abandoned community pool in Kitsault. [Graham 2014] 027
Figure 1.7. Interior of Kitsault library. Stevenson 2016/Flickr. Used under Creative Commons.] 027
Figure 1.8. Single-family housing. Stevenson 2016/Flickr. Used under Creative Commons.] 027
Figure 2.1. Small mineral, large machines. [Author 2016] 032
Figure 2.2. Fort McMurray wildfire evacuation via Highway 63. [Darren RD/Wikimedia Commons. 2016. Used under Creative Commons.] 035
Figure 2.3. Fort McMurray nieighborhood wildfire damage. [PremierofAlberta/Flickr. 2016. Used under Creative Commons.] 035
Figure 2.4. Cold Lake Area, Peace River Area, and Athabasca Area. [Author 2017, adapted from Wikipedia] 037
Figure 2.5. Bitumen composition. [Author 2017] 037
Figure 2.6. Oil sands deposit location and geologic formation . [Author 2017; adapted from Oil Sands Magazine 2017] 038
Figure 2.7. Animals of the boreal forest. [Author 2017; data from Government of Alberta 2015] 040
Figure 2.8. Oil sands mining process. [Author 2016] 042
Figure 2.9. Oil sands landscape change: Mine workers as land sculptors. (See page 40) [Author 2016] 042
Figure 2.10. Overburden removal. [Outside Magazine 2014] 046
Figure 2.11. Excavation. [Green Peace 2010] 046
Figure 2.12. Tailings pond creation. [Toronto Star 2015] 046
Figure 2.15. Byproducts. [Desmog Canada 2014] 047
Figure 2.13. Drying area. [Photosat 2015] 047
Figure 2.14. Water ponds. 047
Figure 2.16. Gateway Hill monoculture tree planting [Author 2016] 051
Figure 2.17. Gateway Hill lake. [Author 2016] 051
Figure 2.18. Gateway Hill hiking path. [Author 2016] 051
Figure 3.1. Syncrude refinery plant at dusk. [Author 2016] 058
Figure 3.2. Simplified and abstract suitability analysis. [Author 2017] 060
Figure 3.3. Mapping as Agency [Author 2017] 062
Figure 3.4 (left). Critical Mapping Example [Knight in Hahn and Belanger, 2014] 067
Figure 3.5 (above). Solution driven by critical map [Knight in Hahn and Belanger, 2014] 067
Figure 3.6. Flow map example [Used with permission ©2009 OPSYS] 068
Figure 3.7. Cartogram example [Author 2009] 071
Figure 3.8. Photo-realistic photomontage. First Christian Church. [Author 2014] 071
Figure 3.9. Eidetic photomontage. First Christian Church. [Author 2014] 071
Figure 3.10. The View. [Belanger 2014]. Used with permission. 075
Figure 4.1. East Mine. [Author 2016] 078
Figure 4.2. Moonescapes. [Author 2016] 080
Figure 4.3. Money. [Author 2016] 081
Figure 4.4. A city of lakes (Eight photo panoramic). [Author 2016] 082
Figure 4.5. Boreal forest. [Author 2016] 084
Figure 4.6. Oil sand forest. [Author 2016] 085
Figure 4.7. Tar River I. [Author 2016] 086
Figure 4.8. Reclamation in Progress?. [Author 2016] 087
Figure 4.9. Evening commute. [Author 2016] 088
Figure 4.10. Welcome to Syncrude. [Author 2016] 089
Figure 4.11. Economy and Energy. [Author 2016] 090

Figure 4.12. Pipelines to United States. [Author 2016] 091
Figure 4.13. Plumes of black gold. [Author 2016] 092
Figure 4.14. Gateway Hill reclamation project monoculture. [Author 2016] 093
Figure 4.15. Tar River II. [Author 2016] 094
Figure 4.16. Tar River III. [Author 2016] 095
Figure 4.17. Fort McMurray's McMansion (Triptych). [Author 2016] 096
Figure 4.18. Supply/Demand. [Author 2016] 097
Figure 4.19. Multi-million dollar stadium for 50,000 people. [Author 2016] 098
Figure 4.20. Multi-million dollar recreation facility for 50,000 people. [Author 2016] 099
Figure 4.21. Home away from home. [Author 2016] 100
Figure 4.22. #YMMSTRONG. [Author 2016] 101
Figure 5.1. New condominiums in downtown Fort McMurray. [Author 2016] 112
Figure 5.2. Dilemmas and Themes. [Author 2016] 114
Figure 5.3.Analytical Framework. [Author 2017] 116
Figure 5.4. Exploration Stage: Tools and Techniques. [Author 2017] 118
Figure 6.1. Syncrude refinery and offices near Highway 63. [Author 2016] 128
Figure 6.2. Athabasca oil sands visible from space [Author 2017] 131
Figure 6.3. Oil sands located in the middle of oil consumption [Author 2017] 134
Figure 6.4. Bloated U.S. marks significant oil consumption rate [Author 2017] 135
Figure 6.5. Largest oil reserves in countries with political conflicts [Author 2016] 136
Figure 6.6. Major oil chokepoints and oil routes near politically unstable countries [Author 2016] 138
Figure 6.7. Oil routes connect to areas with high rates of hunger [Author 2016] 138
Figure 6.8. The consequences of oil [Author 2017] 139
Figure 6.9. Refugee crisis interacts with oil industry [Author 2016] 144
Figure 6.10. Production by major operators planned for years to come [Author 2017] 146
Figure 6.11. Thousands of square kilometers planned but untouched [Author 2017] 147
Figure 6.12. Oil sands footprints grows [Author 2017] 148
Figure 6.13. Oil sands spreading rapidly [Author 2017] 148
Figure 6.14. Code Blue: Oil Sands virus detected [Author 2017] 149
Figure 6.15. Oil sands potential area larger than states and major U.S. cities [Author 2017] 154
Figure 6.16. Current oil sands development as large as major US cities [Author 2016] 156
Figure 6.17. Numerous global firms control oil sands leases [Author 2017] 158
Figure 7.1. Pipeline and oil sands extraction equipment. [Author 2016] 164
Figure 7.2. Controversial Keystone XL Expansion connects to oil sands [Author 2017] 166
Figure 7.3. Athabasca oil sands support U.S. urbanization [Author 2017] 168
Figure 7.4. Oil sands infrastructure stretches across the country [Author 2017] 170
Figure 7.5. Oil sands shipped to Gulf of Mexico [Author 2016] 172
Figure 7.6. Fort McMurray relies on Highway 63 for transportation [Author 2017] 173
Figure 7.7. On the edge of nowhere [Author 2017] 173
Figure 7.8. Oil fields have airstrips to service nearly every mining area [Author 2017] 176
Figure 7.9. Highway 63 has killed many people [Author 2017] 178
Figure 7.10. Highway 63 and 881 are deadly arteries [Author 2017] 179
Figure 7.11. Infrastructure snakes throughout oil sands region [Author 2017] 182
Figure 7.12. Energy infrastructure extended from Fort McMurray to oil sands [Author 2017] 184
Figure 7.13. Workcamps house temporary workers in the middle of the oil sands [Author 2017] 186
Figure 7.14. Fort McMurray land-use dominated by suburban-style housing developments [Author 2017] 188
Figure 8.1. From forest to fire wood. [Author 2016] 192
Figure 8.2. Oil sands expected to be 2.1 - 2.5 degrees warmer by 2050 [Author 2017] 195
Figure 8.3. Oil sands situated in global carbon sink [Author 2017] 195
Figure 8.4. Oil sands region within Northern Lights oval [Author 2017] 200
Figure 8.5. Moderate solar photovoltaic electricity output in oil sands [Author 2017] 202
Figure 8.6. Caribou habitat and wildlife and biodiversity zones in oil sands area [Author 2017] 204
Figure 8.7. Oil sands reduces sustainability of animal habitats [Author 2017] 204
Figure 8.8. Caribou are species most impacted by oil sands [Author 2017] 205
Figure 8.9. Oil sands has led to significant loss of forested lands [Author 2017] 210
Figure 8.10. Caribou and bird species most effected [Author 2017] 212
Figure 8.11. New landscape typologies created from oil sands [Author 2017] 213
Figure 8.12. Landscape mutilation and the oil sands [Author 2017] 218
Figure 8.13. Oil sands shape new landscape typologies [Author 2017] 219
Figure 8.14. Tailings 'ponds' notable landscape impact [Author 2017] 219
Figure 8.15. Disturbed and cleared land dominates land cover [Author 2017] 224

Figure 8.16. Visualizing 0.2%. [Author 2017] 226
Figure 8.17. Oil sands reclamation lagging production [Author 2017] 227
Figure 9.1. #YMMSTRONG bumper sticker, referencing wildfire. [Author 2016] 232
Figure 9.2. Oil sands have been occupied with various populations through history [Author 2016] 236
Figure 9.3. A convegence of people in the oil sands. [Author 2016] 238
Figure 9.4. East Asian countries dominate international immigration to Alberta in last five years [Author 2017] 240
Figure 9.5. Alberta in the Top 3 destinations for interprovencial migrants [Author 2017] 242
Figure 9.6. Many residents work non-standard and long work shifts [Author 2017] 244
Figure 9.7. Aboriginal populations and the oil sands [Author 2017] 246
Figure 9.8. Aboriginal populations living amongst oil sands [Author 2017] 246
Figure 9.9. Housing prices are astronomically high in Fort McMurray [Author 2017] 248
Figure 9.10. High-income, diverse families reside in Fort McMurray [Author 2017] 250
Figure 9.11. Oil sands dominate employment [Author 2017] 252
Figure 9.12. Males dominate Fort McMurray demographics [Author 2017] 254
Figure 10.1. Reclamation in progress with refinery backdrop. [Author 2016] 266
Figure 10.2. Future Scenario #1: The End is Near [Author 2017] 268
Figure 10.3. Future Scenario #2: The Boom is in the Past [Author 2017] 269
Figure 10.4. Future Scenario #3: Mine, baby, mine! [Author 2017] 269
Figure 11.1. Projecting New Endings. [Author 2017] 274
Figure 11.2. Projection Purpose [Author 2016] 276
Figure 11.3. Projections (see next page) [Author 2017] 278
Figure 11.4. Oil Sands as Home: Proposed systems and relationships [Author 2017] 282
Figure 11.5. Oil Sands as Home [Author 2017] 284
Figure 11.6. Oil Sands as Food: Proposed systems and relationships [Author 2017] 286
Figure 11.7. Oil Sands as Food [Author 2017] 289
Figure 11.8. Oil Sands as Exploration: Proposed systems and relationships [Author 2017] 290
Figure 11.9. Oil Sands as Exploration [Author 2017] 292
Figure 11.10. Oil Sands as Destination: Proposed systems and relationships [Author 2017] 294
Figure 11.11. Topography shapes future activities [Author 2017] 295
Figure 11.12. Oil Sands as Destination [Author 2017] 297



Figure 11.13. Oil Sands as National Defense: Proposed systems and relationships [Author 2017] 298
Figure 11.14. Oil Sands as National Defense [Author 2017] 301
Figure 11.15. Oil Sands as Education: Proposed systems and relationships [Author 2017] 302
Figure 11.16. Oil Sands as Education [Author 2017] 304
Figure 11.17. Oil Sands as Industry: Proposed systems and relationships [Author 2017] 306
Figure 11.18. Oil Sands as Industry [Author 2017] 308
Figure 12.1. Boreal forest near Edmonton, Alberta, Canada. [Author 2016] 310
Figure 12.2. Unveiling ghost ecologies visualization selections. [Author 2016] 314

## LIST OF TABLES

Table 3.1. Traditional Map Techniques [adapted from Desimini and Waldheim 2016. Text excerpts by Desimini and Waldheim 2016.] 064
Table 3.2. Diagram Techniques for landscape architecture [adapted from Wikipedia 2017] 070
Table 3.3. Photomontage Techniques [adapted from Belanger and Urton, 2014. Text by Belanger and Urton, 2014] 074
Table 10.1. Future Plans and Proposals [Author 2016] 270
Table 11.1. Projection List [Author 2017] 278

# ACKNOWLEDGEMENTS

I am grateful for the guidance and support of my Master's Report committee. I would like to especially thank my major professor, Associate Professor Jessica Canfield for her support of this crazy project which never seemed to stop shifting. Her ability to push me to see this project in new ways allowed me to produce a truly unique and memorable project. Jessica's feedback always instigated progress at difficult and confusing junctures. I would also be remiss to not thank both Associate Professor Blake Belanger (Landscape Architecture/ Regional & Community Planning) and Associate Professor Kendra McLauchlan (Geography) for their expertise in the methods portion of this project and being supportive of a unique, non-traditional report style and format.

In Fort McMurray I would to thank Frank Creasey, CEO of Fort McMurray Tourism for his hospitality and open and honest conversation. I would also like to thank Ashlee Bevis, Planner III, at the Regional Municipality of Wood Buffalo. To Gajanan Balasubramaniam, Caroline Bampfylde, Muhammad JamalArif, Orlando Rodriguez, Shantel Wagg, and Remington Wang with Alberta Government and Regional Municipality of Wood Buffalo for their data and time. Finally thank you to Ray for a great Airbnb in Fort McMurray!

I am thankful for a tremendous education as a student in the Department of Landscape Architecture/Regional and Community Planning at Kansas State University including my time as a Regional and Community Planning student and Landscape Architecture student. Each (and every!) professor and class shaped this project in one way or another over eight years and their lessons will carry me forward into professional practice. I regret that there are too many to mention here by name, but they know who they are!

Finally, I would like to thank all of my classmates. It has been a wonderful three years working alongside of you. Your thoughts and enthusiasm for this project were often the only thing keeping me seeing this project through to the end. I can't wait to see where your careers and lives take you.



# DEDICATION

This is dedicated to my loving and supportive family: Mom and Dad, Allyson, Jay, Patrick, Sam, and Collin (even if he doesn't know who I am yet).

To my parents for their unending love through this crazy eight-year educational journey. Thank you for instilling in me the importance of never having regrets, to always go after what you want and what you believe in, and for supporting me as you watch me chase my professional dreams.

To Patrick for showing me the true meaning of the words strength and courage.

To Allyson for always having a place to crash for your poor brother and Santiago's breakfast burritos on the menu!

To Jay for always having beer in the fridge and good tunes for the ears.

To Sam and Collin for showing me the future (in many different ways).

# PREFACE

Stories are my life's passion. Prior to returning to school to pursue my Master of Landscape Architecture degree, I made a living as an award-winning photojournalist before—and during—my first master's degree in regional and community planning. Photography—with intention—is a way of thinking, reflecting, and knowing; a way to reveal for others the processes shaping people, their community, and the context of landscapes they existing within. Photography is a tool to document and express the voices of people and landscapes in front of the camera.

My photographic work has been featured in national publications including *USA Today* as well as *The Associated Press* and viewed in aggregate by millions of people. In this day and age, smartphones may allow people to snap dozens of photos daily, but I know they do not see what I see. I often use photography as an "excuse" to explore new or old places. I do this not only out of a desire to make great photos but out of curiosity, to tell stories, and to reveal to myself things I have not seen before.

In confounding urban landscapes of St. Louis's vacant neighborhoods I reflected on housing policy and social justice. In remote landscape like the Canadian oil sands, I reflected on environmental degradation, global warming, the Anthropocene, and our reliance on exploiting nature for human benefit. In National Parks like Yellowstone or the Tetons, I reflect on environmental policy, landscape ecology, and the beauty of our world. My photography is more than recording 'I was here' and placing a "hashtag" in a Flickr or Facebook description. I intend for it to have an impact on viewers and myself. My own photography is not only a part of my voice, but it shapes who and what I am. I make photos to tell my own story, stories of others, and to make me really see the world I am in—to be conscious and alive.

In landscape architecture I see value in thinking as a photographer: to tell stories. Landscape architecture is storytelling, a way of seeing the world which links together human and natural; art and science; people and place. We are storytellers of ideas, whom reflect public opinion and desires, encapsulate hope and change, and tell the story of a future not full of problems, but of resilient, beautiful places. We envisage how people can/should/will live in their future world using visual and oral storytelling skills—of future places, ecologies, economies—for all people, animals, and natural systems. While photography may not be central to this effort, visual communication certainly is. My personal explorations of mapping and diagramming have been central to my development as a designer and planner. This story of the Athabasca oil sands continues these efforts.

My background in photography and planning forms the basis for how I think about my role in landscape architecture. I am an advocate, leader, researcher, and storyteller. The stories we tell matter. And innovative design, research, and advocacy impacts places where we live and work.

It has taken me years to understand what it is about the planning and design professions that has brought me to this point, but embarking on this journey in remote Alberta, Canada has been a culminating and transcendent effort. It represents years of thoughts and feelings about design, planning, people, place, and stories.

The Athabasca oil sands are a fascinating place to me. It represents nearly everything that brought me to landscape architecture. They embody the systems-based thinking landscape architects must possess to be successful. It is a place full of systems that cannot easily be distilled into only numbers or words. The oil sands exist within a set of complex systems which constantly ping and shape each other.

It was only until I went on this journey did so many of these thoughts convalesce. Upon reflection, *Ghost Ecologies* is not just about the oil sands, but the revelatory impact the oil sands has had on my personal development. *Ghost Ecologies* is a concluding effort for me—literally finishing my planning and design education. But its truer intent is to communicate this place to others—to tell the story of the Athabasca oil sands through landscape architecture's voice and my voice as a designer, planner, and storyteller.

Jonathan Knight

Figure ii. Author in the Athabasca oil sands, near Fort McMurray, Alberta, Canada, 2016. [Author 2016]

Figure iii. Evening commute in the oil sands. [Author 2016]

# INTRODUCTION

The contemporary globalized world is full of wicked problems. A “wicked problem” is characterized by being difficult to resolve, complex, and interrelated. Trying to solve one aspect of a problem may reveal or create other problems. Examples of contemporary wicked problems include climate change, natural hazards, United States healthcare reform, nuclear energy policy, waste procurement, and social injustice. Each of these examples demonstrate the characteristics of wicked problems:

1. The solution depends on how the problem is framed and vice versa (i.e., the problem definition depends on the solution)

2. Stakeholders have radically different world views and different frames for understanding the problem.

3. The constraints that the problem is subject to and the resources needed to solve it change over time.

4. The problem is never solved definitively. (Rittel and Webber 1973)

To illustrate these characteristics, consider climate change. Climate change is a contemporary global issue often described as a wicked problem. Different professions will consider climate change differently. Economists will generally think about trade-offs between carbon taxes or cap-and-trade policy. Ecologists will talk about how we’re driving towards the edge of a cliff, with no way to reverse course once we fall off; they will talk of carbon dioxide, soil, and extinction patterns. Oil and gas companies will argue that consumer demand continues for fossil fuel production. An environmental attorney will understand laws and regulations, but not necessarily the science of how and why climate change exists.

1. Each of these disciplines will frame the problem differently—the ecologists will know the science of climate change well. The economists will understand the supply/demand and numbers behind different alternatives and taxes and policy implications.

2. These same stakeholders have different ways to view, measure, and see the issue.

3. Climate change is not paused. It is always changing as stakeholders across the globe harm or improve our chances of solving the problem of climate change.

4. There is no single-way to answer the issue of climate change; there is no right or wrong policy to provide corrective measures to avoid climate change and the problem will continue to be in flux forever.

Wicked problems exist across the globe. Another example of a wicked problem—and the focus of this research—are the Athabasca oil sands in Alberta, Canada.

## THE ATHABASCA OIL SANDS AS A WICKED PROBLEM

The Athabasca oil sands in Northern Alberta, Canada are a wicked problem. The oil sands are a deposit of sand and clay mixed with petroleum-rich bitumen mined for its capability to supply fossil fuel to the world. Current mining operations are located a 30-minute drive north of Fort McMurray, Alberta amidst a potential minable area the size of New York State (Figure iv). Bitumen is a sticky, heavy oil substance which can be processed into synthetic crude, for use in gasoline, kerosene, or other oil-based products. Synthetic crude does not occur naturally but is produced by refining the by-products of petroleum. Between 1999 and 2013, nearly $201 billion has been invested in mining bitumen in the Athabasca oil sands region alone and is expected to contribute $4 trillion to the economy in the next 20 years (Figure v). The Athabasca oil sands contain between 1.75 and 2.5 trillion barrels of oil and is the third largest oil reserve in the world, lagging behind only Venezuela and Saudi Arabia (Chastko 2004; Government of Alberta 2016). Oil sands make up 95% of Canada's total oil reserves (Government of Alberta 2016).

But obtaining oil from the oil sands is not easy. The consistency of bitumen is thick like molasses so it cannot be pumped from out of the earth like conventional petroleum. Instead, it must be mined like mineral ore or it is heated underground and turned into a liquid. Either approach is costly, uses tremendous energy, and has numerous environmental risks (Klare 2012). Because of the effort required to extract bitumen and convert it to a usable petrol it is far more costly than conventional oil extraction. For this reason, major energy firms ignored the region for decades until the 1970s. Production increased dramatically when oil prices rose and


Figure iv. Location map of Athabasca oil sands and Fort McMurray. [Author 2016]

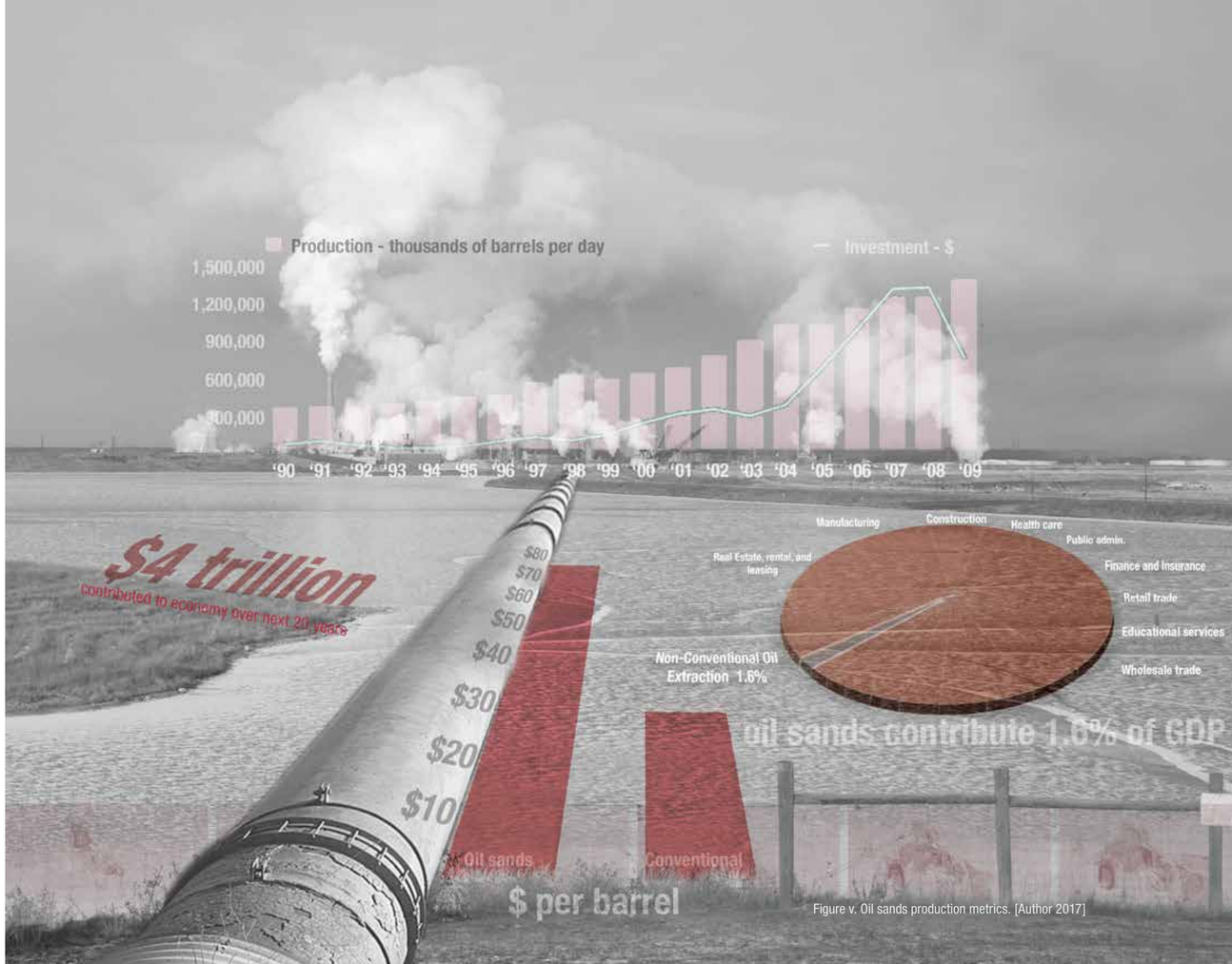



Figure v. Oil sands production metrics. [Author 2017]

traditional oil supply shrank—influenced after the invasion of Iraq (Lustgarten 2005; Mostafavi and Gareth 2010). But even still, rates of extraction are tied tightly to the market and when oil prices drop, mining expansion slows (Levi 2009).

The oil sands are highly complex and constantly changing. They concern issues across scales and disciplines that are inextricably tied (sociology, anthropology, history, design, planning, and ecology amongst others). A quick Google search will pull up news articles from the last two years (paraphrasing): "*The oil sands are over …. The oil sands are ready for a recovery … Thousands moving to the oil sands …. Thousands leaving the oil sands*." There are very few constant threads of thought in the oil sands. This is life and business in a one-industry region which relies so heavily on invisible and visible global forces (including oil prices).

Today the oil sands make international headlines due to their environmental effects and controversial nature in Canadian culture and politics. Environmentalists have long pointed to the oil sands as an environmentally-disastrous place which must be stopped immediately. Others view the oil sands as an economic boom for Alberta and Canada, giving Canada's national economy future hope. Politicians are divided on whether the oil sands should be continued or stopped. Recently, Canada signed a treaty which aims to reduce carbon emission levels 30% below 2005 levels by 2030 (D'Amato 2016). It will be impossible to meet the goals of that treaty if oil sands production continue at current trajectories.

But the oil sands have also propelled Canada's GDP. Extraction has shifted global markets. In fact, Canada has overtaken Saudi Arabia as the United States' leading supplier of oil (Government of Alberta 2016); 99% of oil exported from the oil sands is moved to the United States.

Could oil production in this previously ignored region signal an end of the fossil fuel era? The last drop of fossil fuel will come from the oil sands in 2155 (Yang 2010). And at current rates of global fossil fuel depletion, the oil sands of Canada will be one of—if not the—last remaining fossil fuel source on Earth. This once too-costly resource may now be the world's last place for oil.

Since the 1970s, Fort McMurray has experienced an influx of workers from around the world to support the extraction industry and its population has increased exponentially, following closely with oil prices (Figure vi). The development of oil sands has also brought creation of world-class public facilities (often sponsored and supported by oil sands companies). But due to political and cultural opposition of oil sands, Fort McMurray is at a crossroads. In a very real sense, Fort McMurray is at a collision of culture, society, and the environment with an undetermined long-term future—it may be a "ghost town" in waiting. It is yet unknown what becomes of ecological, cultural, and social landscapes of the Athabasca oil sands and whether the region can avoid a "ghost town" result. Places like the oil sands typically disappear—there are hundreds of thousands of sites in the US which are now "ghost towns" as a result of resource extraction being the only industry in the region. But there is little understanding of what forces, relationships, and flows exist within the oil sands. What are the




Figure vi. Driving forces of the oil sands [Author 2017]

real issues? Are the pictorial and cultural images of the oil sands and Fort McMurray seen in newspapers and news reality? What is the spatial and cultural relationship between the landscape, Fort McMurray, and the oil sands? What is life like in present-day Fort McMurray and what can it be in the future? These are questions of landscape and of landscape architecture.

## LANDSCAPE ARCHITECTURE AND WICKED PROBLEMS

Landscape architecture is not often considered as being within the purview of "wicked" problems. However, as projects grow increasingly complex landscape architecture is shifting focus towards significant issues facing the world. Contemporary landscape architecture is now called upon regularly to address wicked problems through systems-based thinking. Large-scale, complex projects are increasingly common and the discipline has begun to shift away from simple sites with limited users and has gained a position as a discipline which can effectively address wicked problems facing the world. Landscape architects are now often the project lead on large-scale, multi-disciplinary projects. As posited by Richard Weller:

> *"The discipline of landscape architecture realizes that through its ability to deal with large-scale dynamic systems it may be best equipped to deal with many of the problems planners and architects have unsuccessfully struggled with in designing [places]" (Weller 2006, 80).*

In 2016, the Landscape Architecture Foundation (LAF) published "The New Landscape Declaration," updating the Declaration written in 1966 by a small group of landscape architects. Within the New Declaration are charges of landscape architecture's ability and skillset to address wicked problems:

> *"Across borders and beyond walls, from city centers to the last wilderness, humanity's common ground is the landscape itself. Food, water, oxygen – everything that sustains us comes from and returns to the landscape. What we do to our landscapes we ultimately do to ourselves. The profession charged with designing this common ground is landscape architecture.*
>
> *After centuries of mistakenly believing we could exploit nature without consequence, we have now entered an age of extreme climate change marked by rising seas, resource depletion, desertification and unprecedented rates of species extinction. Set against the global phenomena of accelerating consumption, urbanization and inequity, these influences disproportionately affect the poor and will impact everyone, everywhere.*
>
> *Simultaneously, there is profound hope for the future. As we begin to understand the true complexity and holistic nature of the earth system and as we begin to appreciate humanity's role as integral to its stability and productivity, we can build a new identity for society as a constructive part of nature.*
>
> *The urgent challenge before us is to redesign our communities in the context of their bioregional landscapes enabling them to adapt to climate change and mitigate its root causes. As designers versed in both environmental and cultural systems, landscape architects are uniquely positioned to bring related professions together into new alliances to address complex social and ecological problems. Landscape architects bring different and often competing interests together so as to give artistic physical form and integrated function to the ideals of equity, sustainability, resiliency and democracy"* (Landscape Architecture Foundation 2016).

Embedded within this section of the declaration is the ethos of wicked problems, ability to think across systems and scales, and to address problems such as climate change, resource depletion, and social landscapes impacted by these physical landscape changes. Landscape architects are able to address wicked problems because of their unique skills and capacity to think across systems and scales in spatio-temporal, ecological, and cultural dimensions.

## LANDSCAPE ARCHITECTURE'S ROLE IN THE ATHABASCA OIL SANDS

The Athabasca oil sands embody the systems-based thinking central to landscape architecture. The oil sands are a place full of systems that cannot easily be distilled into only numbers or words. The oil sands exist within a set of complex systems which constantly ping and shape each other including human systems, environmental systems, and political systems. The oil sands exemplify many of the systems and problems expressed in the LAF Declaration including climate change, habitat disruption, and cultural and physical landscapes.

### Why should landscape architecture examine the oil sands?

Wicked problems are characterized as being non-linear, dynamic, fluid, and rapidly changing. Landscape architects, through an ability to think across systems and scales, can address wicked problems like the oil sands through their disciplinary skillset. "Natural processes, as well as cultural activities, have always shaped the landscape" (Czechowski 2014). Ever-shifting visible and invisible forces shape the oil sands, putting pressure on people, city infrastructure, and the environment. "Globally, the standard approach to mining has been to create a temporary settlement, extract the resource, and move on, leaving behind an environmental and societal mess" (Nostrand 2014). Other precedence for this type of development is reflected in historic "ghost towns." The Regional Municipality of Wood Buffallo (RMWB) itself worries about life in a one-industry town:

> *"History has shown that resource-based economies can experience boom and bust cycles, or rapid growth followed by periods of relative stability, as has been the case in Wood Buffalo. The region first thrived in the fur trade, then salt mines, and today oil sands development. Dependence on a single economic driver can make a seemingly strong economy vulnerable to changes in market demand, technology, competition, industry and government policies, and other conditions that shape an economy over time."*

The future of the oil sands is unknown in the face of rapidly changing political, economic, and environmental ideologies. An understanding is needed of what forces—both visible and invisible—are at play here and their consequences to the infrastructure, environment, and people. By understanding these forces, the oil sands can be reimagined to address this challenging future by revealing latent future possibilities in the oil sands, revealed through the new ethos embracing complexity and the dynamism of our

world's regions. These new possibilities can help address a region in flux with no determined future. They can be deployed across scales and across time to better address the needs of the people and the land as necessary. These latent possibilities can come to the surface through disciplinary methods and techniques.

### How should landscape architects examine the oil sands?

A basic argument of this project is that landscape architects are storytellers. The act of envisioning future scenarios for cultural, ecological, and social value means landscape architects are telling a story—a story of the future. Landscape architects can examine the oil sands through disciplinary techniques and bring their knowledge and skills to the region for a more hopeful future. Plans, sections, perspectives are pragmatic tools to help tell a story the designer hopes to convey. These drawings can also be abstract, emotive, and poetic. This project argues that visual representation is an element of storytelling. Communication of spatial and non-spatial information helps to relate complex and dynamic processes easier than writing about such processes. Visual communication is storytelling and as visual artists, landscape architects tell stories through their mappings, diagrams, intentional photographs, and digital renderings. Storytelling in landscape architecture seeks to reveal, connect, and tie together relationships and processes across landscape. It also seeks to tell a story of the future, by projecting forward stories of new relationships and new processes.

In recent years, the use of mapping, diagramming, and photomontage have gained theoretical and practical significance as methods to address and reveal the *invisible* processes, flows, and relationships of wicked problems. Photography has been used in landscape architecture for many years and helps to reveal *visible* processes, flows, and relationships. Mapping, diagramming, photomontage, and photography can be used to reveal visible and invisible processes, flows, and relationships in the Athabasca oil sands—to tell a story—and help create a convergence of novel, creative ideas to address the wickedness of the oil sands and address its unknown future. Through the act of storytelling—through mapping, diagramming, photomontage, and photography—this project identifies some of the region's most significant dilemmas and then reimagines a series of new, more productive and programmatically integrated futures for the oil sands and its people.

Instead of ignoring the wickedness of problems like the Athabasca oil sands, attentive and purposeful mapping and data analysis can be used to reveal interrelated social, political, and economic dynamics and these dynamics can be projected forward for new endings in the oil sands region. This understanding of the role and value of landscape architecture in the Athabasca oil sands leads to the primary research question.



## PRIMARY RESEARCH QUESTION

**What are the ephemeral, spatial, and non-spatial forces acting upon the Athabasca oil sands region and how can revealing those forces inform the future?**

*Sub-Research Questions*

Why do industrial-scale landscapes of extraction exist?

How has a need for oil impacted the region and what processes are reshaping the landscape?

What flows and forces are influencing systems of oil, infrastructure, environment, and people?

Why do mapping, diagramming, photomontage, and photography have agency in landscape architecture?

How can these methods be used to imagine new futures for the Athabasca oil sands region?

Each of the sub-questions is repeated within the text before the section or chapters answering the sub-question. The primary question and sub-questions help to shape project goals.

## PROJECT GOALS

1. Tell the story of how the oil sands have impacted the region through visual communication.

2. Reveal unseen forces or reveal new questions, relationships, opportunities, and issues in the Athabasca oil sands through mapping, diagramming, photomontage, and photography.

3. Build a framework for how landscape architecture can address wicked problems through disciplinary tools.

4. Speculate on high-level, long-term strategies for the oil sands which can be deployed across scales and time as necessary to better address the future.

5. Demonstrate author's personal mastery of landscape architectural mapping, diagramming, and visual representation.

## GHOST ECOLOGIES: STORYTELLING AND FUTURES IN THE ATHABASCA OIL SANDS

The purpose of this project is to reveal hidden or seemingly unrelated relationships and processes which shaped/shape/will shape the oil sands. Seemingly unrelated activities or unrelated people are inextricably linked, shaping Fort McMurray culturally and physically. Hidden relationships reveal what this place was before oil sands, how oil sands currently shape this place, land, and people, and what will shape them in the future. As a way to tell the story of the Athabasca oil sands, four themes referred to as “ghost ecologies” were defined to structure the findings of this report: oil, infrastructure, environment, and people. These four themes were identified because of landscape architecture’s ability to most directly address landscapes of infrastructure, environment, and people and as a strategy to better organize project findings.

Titling the project *Ghost Ecologies* seeks to define several themes. First, the oil industry itself is the root cause of the challenges facing the region’s infrastructure, environment, and people. The industry responds to outside forces such as oil prices and oil demand which impact the other “ghost ecologies.” Conversely, the oil industry supplies jobs and economic benefit to the region and is a significant source for oil in the world. So the oil sands themselves influence outside forces, drawing attention, people, and money into the region, impacting infrastructure, environment, and people’s quality of life.

A second theme represents the natural cycle that resource extraction operations typically follow. As resource extraction operations take place, a physical, social and economic landscape emerges. The urban morphology of a one-resource industry is directly related to the development of the industry. In other words, the region is designed and built in a way to address the short-term needs of getting people living and working in the region, often done haphazardly and with little long-term vision. As a mined resource is depleted, economic and social landscapes follow in a path of diminution, causing externalized costs such as population loss, physical neglect, and abandonment of buildings and roads. This pattern traditionally leads to the creation of a physical “ghost town” following terminal production. “Ghost towns” are a physical legacy artifact of North America’s consumption-oriented approach to energy and natural resource consumption. The ghost ecology theme "infrastructure" is used to organize these relationships.

A third theme is that the destruction of our natural landscapes for resource extraction often removes healthy environmental ecosystems. These operations decimate the landscape by removing vegetation, healthy topsoil, and polluting surrounding waterways and groundwater. Ghost ecologies in this regard is a reminder of legacy ecologies displaced and no longer visible. "Environment" is used to organize these relationships.

Finally, the title also represents how people have been impacted by this industry. This includes the embedded historical and cultural meaning of these locations for aboriginal populations who first settled these lands. Many of these populations have been displaced or have a tenuous relationship with existing resource extraction developments. Additionally, the current population of workers and residents must address their needs of living in a harsh, remote region tied to a single-industry. Work is difficult, with long hours affecting mental and physical well-being.



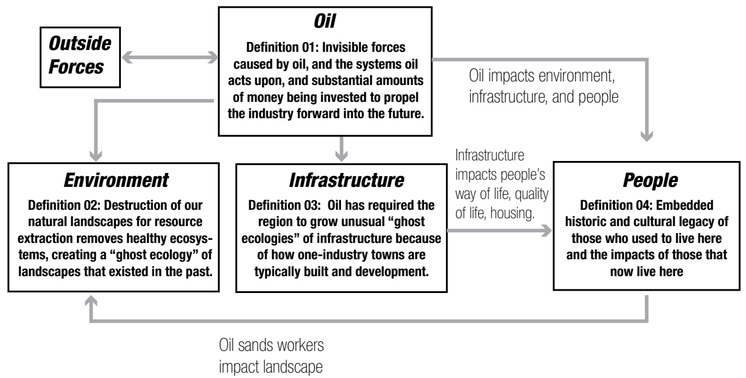



Figure vii. Oil sands relationships and ghost ecology themes and theme definitions. [Author 2016]

Figure vii summarizes the definitions and relationships established in this project.

### Telling the story of the oil sands

Section One “Grounding Ghost Ecologies,” discusses the broader scope of energy extraction in the world and the negative externalities of extraction. This sets up an introduction to the Athabasca oil sands project site where the Athabasca oil sands and Fort McMurray are briefly discussed. Additionally, literature is reviewed on the use of storytelling methods in landscape architecture. Specific modes and techniques for storytelling are introduced including mapping, diagramming, photomontage, and photography. Their agency helps to unveil the Athabasca oil sands ghost ecologies in Section Three. Section One concludes with a visual diary of the Athabasca oil sands from a November 2016 site visit to further ground literature and theory discussed in this section.

Section Two “Assembling Ghost Ecologies,” presents the project structure and how the four storytelling methods—mapping, diagramming, photomontage, and photography—are used in the project. An analytical framework is presented to structure the remaining report. This section links together previously discussed landscape architecture storytelling literature and the Athabasca oil

sands site introduction to describe mechanics of analysis and how the research was completed.

Section Three “Unveiling Ghost Ecologies” offers maps, diagrams, and photomontages to reveal the processes and relationships of the oil sands. This unveiling is focused on the four "ghost ecology" themes described earlier: Oil, Infrastructure, Environment, and People. Specific questions are explored and summarized to reveal dilemmas and opportunities for the future of the oil sands.

Section Four “Projecting Ghost Ecologies” literally projects Section Three forward to speculate on future actions in the Athabasca oil sands. These projections are emotive, poetic, and radical departures from existing ways in which the future of the oil sands have been imagined to this point.

Taken together, these sections intend to provoke thought, contemplation, make connections, and reveal unseen ghost ecologies of the Athabasca oil sands (Figure viii, ix). In some ways, this project seeks to find answers, but not in a traditional sense of “this is what we should do here” so often a goal of landscape architectural work. It does seek to find answers on what is going on here and how this place can avoid becoming a “ghost town” like so many single-industry resource extraction sites before. *Ghost Ecologies* tells the story of the oil sands and projects forward new endings through the voice of landscape architecture. The oil sands story, presented here, sets the stage for future actors to move across it. These actors—that live near the oil sands, work there, love them, or hate them—will forever change the landscape and people of Fort McMurray and the oil sands operations themselves.

A tertiary argument threaded through this project is that by understanding the oil sands a reader can better understand the complexity and dynamism of the 21st century environment. The oil sands are a microcosm of the forces shaping modern politics, economics, land-use, transportation, and lifestyle. Revealing the relationships and processes which have shaped the development of the oil sands, and the relationships and processes which are shaped by the oil sands, is an act which helps readers better understand the complex world around them. This revelatory story exposes select forces, processes, and systems which constantly ping all around our cities, regions, states, and countries.

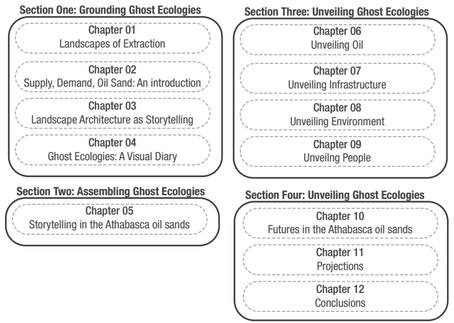



Figure viii. Project Sections and Chapters. [Author 2017]

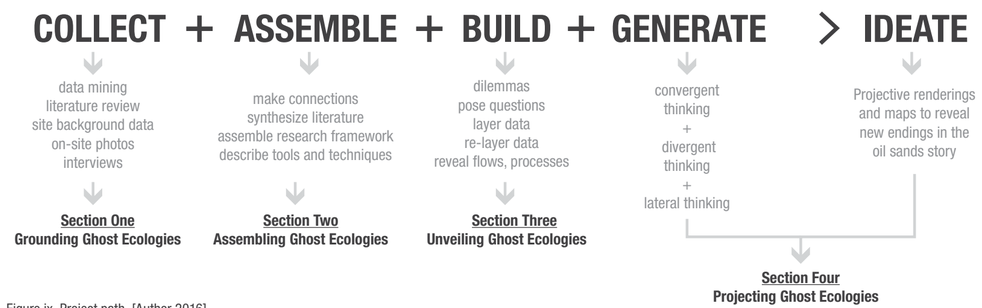



Figure ix. Project path. [Author 2016]

**What are the ephemeral, spatial, and non-spatial forces acting upon the Athabasca oil sands region and how can revealing those forces inform the future?**

## INTRODUCTION: SUMMARY

01. There are 175 billion barrels of proven oil reserves here. That's second to Saudi Arabia's 260 billion..."We know there's much, much more there. The total estimates could be two trillion or even higher," says Clive Mather, Shell's Canada chief. 'This is a very, very big resource.'" -CBS News, 2006

02. Fort McMurray has seen over $200 billion of investment and yet only 60,000 permanent residents live there.

03. Most single-industry economies are vulnerable to external forces, leaving the economy unable to cope with shocks.

04. Ghost ecologies are the invisible, ephemeral, and spatio-temporal forces acting upon this place. They are both internal and external to the oil sands.

05. Infrastructure, environment, and people are affected by oil sands development. Industry growth or decline directly affects what happens to the people, animals, and city relying upon this economic engine.

# SECTION ONE

## Grounding Ghost Ecologies

This section explores why large-scale resource extraction sites exist and how the forces shaping resource extraction sites have shaped the development of the oil sands region. Mapping, diagramming, photography, and photomontage are explored as storytelling devices within landscape architecture. These discussions form the theoretical and practical basis for the remaining project.

# Why do industrial-scale landscapes of extraction exist?

Figure 1.1. Syncrude refinery plant at dusk. [Author 2016]

# CHAPTER 01: LANDSCAPES OF EXTRACTION

## THE ANTHROPOCENE AND FOSSIL FUEL

As more people move to cities, there has been greater exploitation of our limited natural resources. Since the industrial revolution of the last one and a half centuries, there has been an invisible (and visible) link between nature, humans, and our economy. “Massive increases in fossil-fuel use spurred dramatic growth of the human population and the economy and widespread environmental degradation” (Day et al. 2009).

Natural resource extraction for fossil fuels dominates North American energy supply systems. This has resulted in ecological impacts such as deforestation, groundwater pollution, air pollution, and topsoil stripping across the continent. Economically these resource sites are mined with a “speed-at-all-cost” approach without considerations for long-term economic potential outside the specific resource itself. Additionally, energy production is viewed as an externality to a city; off-site natural resource depletion is thought a necessity for urbanized living. It makes the city vulnerable and less resilient because a cities’ energy systems and energy sources are not necessarily located within the city itself. Natural resources like fossil fuels are a fundamental part of our current industrialized way of life. Human civilization relies heavily on natural resource extraction, peripheral to regions in which they live, to receive basic needs like fuel, heat, and electricity. This relationship between natural resources and human settlement are acknowledged widely in science and culture by defining a new geological epoch called The Anthropocene (Edward 2015; Waters et al. 2016; Borenstein 2014).

The Anthropocene age proposes human activities are now the dominant shapers of our landscape (The Encyclopedia of Earth 2016). “The Anthropocene defines Earth's most recent geologic time period as being human-influenced, or anthropogenic, based on overwhelming global evidence that atmospheric, geologic, hydrologic, biospheric and other earth system processes are now altered by humans” (The Encyclopedia of Earth 2016). This has created significant global impacts on Earth’s geology and ecosystems. International news stories show its effects—from deforestation and water pollution to climate change and species extinction. The way we live in the 21st century has profound effects on our environment. But while this is a problem for ecological systems, changes we place on the environment also affect humans. Famine, flooding, and earthquakes cause millions of dollars of damage each year and not infrequently cost human life across urban areas. Nature systems shape human settlement and human settlement shapes natural systems (Alberti, 2009; Mostafavi & Gareth, 2010, and others). In other words, there is a reciprocal relationship between human settlements and environments. By shaping our natural environments, there are side-effects for human environments. Urbanist and planner Nina Marie-Lister summarizes: “The Anthropocene age is upon us. We—humans—are its defining species” (Lister 2016). We have defined, divided, and scratched rural and suburban landscapes, often negatively, through resource extraction and landscape defragmentation to support an increasingly urban lifestyle.

In 2014, the United Nations published a landmark report detailing population growth around the globe. In it they established that for the first time ever more people were living in urbanized areas rather than rural areas (see United Nations, 2014; also mentioned in Reed and Lister 2016 and Mostafavi 2010). Mohsen Mostafavi, Dean of Harvard's Graduate School of Design asks: "Every year, more cities are feeling the devastating impacts of this situation. What are we to do? What means do we have as designers to address this challenging reality" (Mostafavi and Gareth 2010)? While Mostafavi is more directly asking about urban settlement and energy systems within the city, this book recognizes Mostafavi's question as one which also relates to the challenging reality of what we have left behind to make urban settlement.

The venture of human civilization has gone through many periods of development. But we now face a time with rapid change across scales. Population growth and urban migration have shaped our planet in profound ways and have done so in unprecedented short time. With more than 7 billion people on Earth and only growing, designers and planners must find improved ways for humans to interact with each other and their environment. Significant shifts in human settlement reveal challenges we face as we continue to shape our environment. In this new age, people are the heart of both problems and solutions. Mostafavi and Gareth (2010, 17) propose "we need to view the fragility of the planet and its resources as an opportunity for speculative design innovations rather than as a form of technical legitimation for promoting conventional solutions."

The Athabasca oil sands exemplify community-level social and environmental challenges which result from resource extraction in the Anthropocene Age. It is one example of a landscape which results from increased pressure in the Anthropocene age, growing world populations, and growing urban populations. North American oil consumption, economic trends, and political changes have all made the Athabasca oil sands a reality. It has also potentially set up the oil sands for a tumultuous tumble.

There are two traditional models for resource extraction shown in abstract to reveal the general trends of community vitality through time (Figure 1.2). The first is a bell-curve of population and resource extraction production following closely in cadence. The second is a 'roller coaster' with steep gains and losses of population. In either case, as more of a minable resource is discovered, the more people move into an area. As minable resource deplete, people begin to leave. The North American landscape, particularly the Mountain West region along the Rocky Mountains, contains many examples of this type of resource extraction. Over 200,000 "ghost towns" dot the rugged, mineral rich landscapes of the western United States (Berger 2002). Thousands more exist in Canada and Mexico. The city of Kitsault, British, Columbia, Canada exemplifies the traditional resource extraction community and the common effect the instability of resource extraction can have on a place and its people.

## KITSAULT, BRITISH COLUMBIA, CANADA: A BRIEF STUDY IN THE TRADITIONAL RESOURCE-EXTRACTION MODEL

The story of Kitsault, British Columbia exemplifies the model of single-industry towns across North America settled solely for resource extraction. It is the most famous example in western Canada's mineral-rich lands.

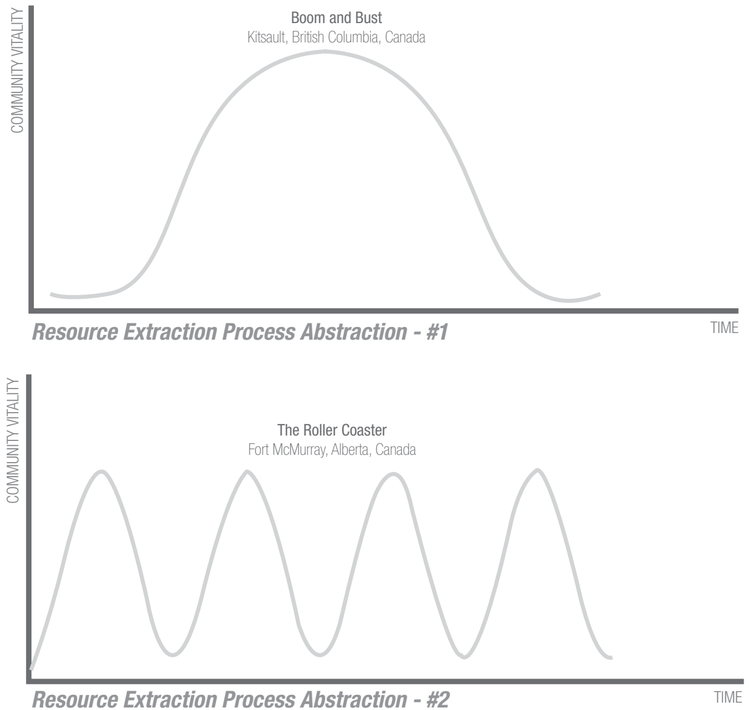



Figure 1.2. Resource Extraction Models. [Author 2016]

Mining first came to this remote fiord valley located in west British Columbia, Canada in 1918. However, Dolly Varden mine was only operated for three years before it was closed. Then U.S.-based Phelps Dodge mining company found 109 million tons of molybdenum metal underneath the forest in the 1970s (Kitsault.com 2016). However, there were no workers within hundreds of miles. Architects and engineers were brought in to create a “complete social economic environment for their families” (Kitsault.com 2016). More than 100 single-family homes and duplexes and seven apartments with 202 units were built. A ho spital, shopping center, restaurants, banks, a theater and a post office were also created. The first families moved to Kitsault in 1980. They would stay only two years.

Mineral prices collapsed in wake of the 1982 recession. Additionally, molybdenum was found to be a by-product from the production of copper mines. These shifts in molybdenum supply and demand sent prices soaring and the industry crashed. Just eighteen months after it opened, Kitsault was abandoned (Figure 1.3-1.8). “The brand new shiny town where people had just moved in full of hope and excitement was a ghost town and the big gates at the entrance to the town were padlocked” (Kitsault.com 2016). This model of discovery, extraction, and decline is seen throughout hundreds of thousands of North American energy extraction sites leading to ghost towns.

Figure 1.3. Exterior of abandoned home in Kitsault. [Graham 2014]

Figure 1.4. Abandoned home in Kitsault. [Graham 2014]

Figure 1.5. Exterior of abandoned home in Kitsault. [Graham 2014]

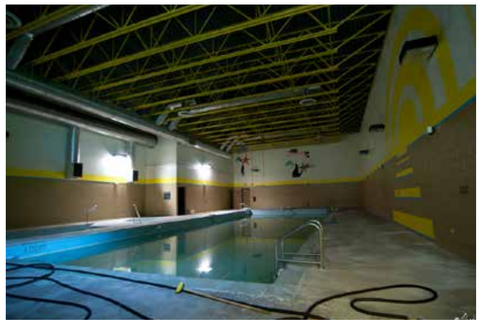


Figure 1.6. Abandoned community pool in Kitsault. [Graham 2014]

Figure 1.7. Interior of Kitsault library. Stevenson 2016/Flickr. Used under Creative Commons.]

Figure 1.8. Single-family housing. Stevenson 2016/Flickr. Used under Creative Commons.]

## LANDSCAPES OF EXTRACTION: CHAPTER SUMMARY

01. As more people move to cities, there has been greater exploitation of our limited natural resources.

02. Energy production is an externality of the city. Energy is rarely produced within the city, but is shipped via powerline, pipeline, rail, and truck into cities.

03. Energy extraction sites often take two forms: Boom and Bust and The Roller Coaster.

04. Boom and Bust places have a bell-shaped curve where production increases, then decreases. The Roller Coaster cycles through periods of highs and lows.

05. Kitsault, British Columbia exemplifies a Boom and Bust resource extraction model and is a famous Canadian example of one-industry resource extraction.

# How has the need for extraction landscapes impacted the region and what processes shape the oil sands landscape?

Figure 2.1. Small mineral, large machines. [Author 2016]

# CHAPTER 02: SUPPLY, DEMAND, OIL SAND: AN INTRODUCTION

The Athabasca oil sands exemplify community-level social and environmental challenges that result from resource extraction in the Anthropocene Age. The oil sands are one example of a landscape resulting from increased pressure in this age represented by growing world populations, and growing urban populations. North American oil consumption, economic trends, and political changes have all made the Athabasca oil sands a needed reality.

This research operates across multiple scales–from global to local. However, the main focus is on two places: The active Athabasca oil sands surface mining site and Fort McMurray, Alberta, Canada, a short distance away.

## AN INTRODUCTION TO FORT MCMURRAY

Fort McMurray is an urban service area in northern Alberta, Canada located approximately 250 miles from Edmonton, Alberta and 400 miles from Calgary, Alberta. Despite its designation as an urban service area, many people, politicians, locals, and media still refer to Fort McMurray as a city. The history of Fort McMurray and its development is inextricably related to oil sands.

### First Nations and European Settlement

The Cree tribe were the major First Nations (aboriginal) people in the Fort McMurray area. They were a semi-nomadic population utilizing surrounding boreal forests to hunt moose, caribou, smaller game, geese, ducks and fish (Preston 2016). Cree traveled by canoe and snowshoes and toboggan in winter living in small bands or hunting groups and would gather into larger groups in summer for socializing and ceremonies (Preston 2016). Metis are of mixed First Nation-European heritage and began to develop after European settlement in the late-1800s.

Peter Pond, a fur trader and a founding member of Northwest Trading Company (later combined with the Hudson's Bay Company) became the first European to enter the Fort McMurray region in 1776 (Alberta Energy and Utilities Board, 2005). Pond was credited with first writing about the oil sands in 1778. Several other Europeans explored the area and Sir John Richardson is credited with the first geological assessment of the oil sands in 1848 and found the principal component was quartz (Preston 2016).

In 1870, a fur trading post was setup at the confluence of the Clearwater and Athabasca rivers. The Hudson's Bay Company post only had river access to Fort McMurray until 1921 and it was the gateway to Arctic regions north of Fort McMurray. River transportation shipped goods on the Athabasca River north to Lake Athabasca, then on to the Mackenzie River towards the Arctic. The trading post, with help of new roads and access points, shifted to more local resources including fishing, logging, lumbering, salt, and eventually oil sands resources.

## Fort McMurray Today

*Population*

Fort McMurray's permanent population in 2015 was 78,382 based on the 2015 municipal census. Included in census numbers was a "shadow" population of 4,342 non-permanent residents living in oil sands work camps for a combined population of 82,724 (Government of Alberta 2015). This has fluctuated dramatically over the years. In the 2010 regional plan, it was stated 23,000 work camp residents were in the region (Regional Municipality of Wood Buffalo 2011). The population increased 23.4% from 2001 making it characteristic of a "boomtown." It is a multicultural community, where people have migrated to from all over the world for the oil sands industry. Housing prices and rents in Fort McMurray are far higher than a remote city would traditionally have. In fact, in 2006, Fort McMurray had the highest housing prices in all of Alberta and second only to Vancouver for the highest cost in all of Canada.

*Economy*

Oil sands are the "engine for growth in the region," requiring construction and operations labor related to oil sands operations (Regional Municipality of Wood Buffalo 2011). In total, oil sands and related industries account for 66% of total employment within the region (Regional Municipality of Wood Buffalo 2011).

*2016 Wildfire*

The Fort McMurray region is also home to Canada's costliest natural disaster in history—nearly $10B including direct and indirect costs. On May 1, 2016, a wildfire began southwest of Fort McMurray, eventually forcing the largest wildfire evacuation in Alberta history (Figure 2.2 and 2.3). The wildfire destroyed 2,400 homes and buildings and forced the evacuation of all residents in the Fort McMurray area. The fire spread across more than 1,500,000 acres and is still burning, although it is under control. It may not be extinguished until spring 2017.

The town's power grid sustained damage. Almost the entire region was under a boil-water advisory during the fire. Several neighborhoods were declared unsafe for reoccupation and still do not have water service.

The wildfire also halted oil sands operators Shell, Suncor, and Syncrude. Some even accommodated evacuees at their work camps. The impact of halting oil sands operations had spillover effects into the rest of Canada—many gas stations ran out of gas in Western Canada (Warnica 2016).

The wildfire shows the tenuous relationship between the community, the oil sands, and ecology of this region. It also shows how the oil sands are interlinked with the rest of Canada.

# AN INTRODUCTION TO THE OIL SANDS

The history, geology, and ecology of the oil sands have shaped its formation and development over time. The expensive mining process is a direct result of these historic forces.

## History of oil sands development

The Cree knew of the oil sands and used it to waterproof their canoes (Preston 2016). After European settlement, there was 200 years of exploration and investment in the oil sands. In 1888, Dr. Robert Bell of the Geological and Natural History Survey of Canada declared to a Senate Committee: "The evidence…points to the existence in the Athabasca and Mackenzie valleys of the most extensive petroleum field in America, if not in the world… it is probable this great petroleum field will assume an enormous value in the near future and will rank among [Canada's] chief assets" (Alberta Energy and Utilities Board 2005). However, initial efforts in the 1880s and early 1900s assumed the deposits were the consistency of previous oil exploration efforts and trapped in large pools underneath the ground like conventional oil. In comparison to other deposits at that time, it was simply too costly to invest in ways to extract the bitumen and convert it to a usable liquid.

It was not until the 1930s that Abasands Oil successfully extracted bitumen from the oil sands via hot water extraction methods. However, production was quite low. Shell Oil Company of Canada began drilling experiments in 1957 and in 1962 Shell applied to the Alberta Oil and Gas Conservation Board to produce 130,000 barrels per day (Alberta Energy and Utilities Board 2005).

Throughout its history, Fort McMurray's population remained small until the oil sands were discovered and experimentations began in the 1800s. By 1966, the town's population grew to 2,000. In 1967, Great Canadian Oil Sands (now Suncor) plant opened and Fort McMurray's growth accelerated.

In 1978, Shell Canada also applied for a mining operation of 100,000 barrels per day. More oil sands plants were opened when, in the 1970s, political tensions and conflicts in the Middle East triggered oil price spikes (Klare 2012). The population

Figure 2.2. Fort McMurray wildfire evacuation via Highway 63. [Darren RD/Wikimedia Commons. 2016. Used under Creative Commons.]

Figure 2.3. Fort McMurray nieighborhood wildfire damage. [PremierofAlberta/Flickr. 2016. Used under Creative Commons.]

reached 6,847 in 1971 and climbed to 31,000 in 1981 after it was incorporated. Population has since traced closely with exploration and production of oil.

## Geology of the oil sands

The Athabasca oil sands is part of a larger series of geologic oil deposits including the Cold Lake Area and Peace River Area (Figure 2.4.). Like any oil deposit, the oil sands were created through a complex geologic process. Initial research efforts on the oil sands were often sponsored by the government but as time passed industry individuals or individual companies like Abasands Oil were also involved in determining how the oil sands developed, its composition, and formation within the Earth.

### *Composition*

Oil sand is composed of quartz sand enveloped within bitumen (Figure 2.5). Bitumen is the heaviest form of petroleum. Each grain of sand is surrounded by a film of water which in turn is covered by bitumen. During the summer, oil sand is soft as molasses but during the winter it will freeze due to its water content. Bitumen is a hydrocarbon, which is why it is valuable as an energy resource. Bitumen content can vary from 18% to 1%, but anything less than 6% is not worth mining (Government of Alberta 2017).

### *Formation*

Oil sands are locked within a 120-million-year-old seashore buried below wetlands and virgin boreal forest (Government of Alberta 2016). Each deposit is covered by a layer of “overburden” (soil) consisting of muskeg, glacial tills, sandstone, and shale (Government of Alberta 2017). In some areas, the oil sands are close enough to the surface they can be surface mined. In the remaining region, the bitumen must be extracted through other methods. Both of these methods are described in detail later.

Oil sand are found throughout the world with significant deposits in Venezuela and Canada. Canada’s oil sands are almost exclusively in northern Alberta in three deposits formed by a layer of shale, sandstone, and oil sands, formed during the Cretaceous period. Ancient organic matter died, covered by layers of sediment that—with enough pressure and heat—transformed these dead organisms into petroleum.

The oil of the oil sands formed by marine organisms falling to the bottom of the sea once covering ancient Alberta. It became trapped in quartz sand left behind by the rivers that drained into the sea. Lighter hydrocarbons evaporated or were consumed by bacteria. This left behind the thick, viscous bitumen. As glaciers moved, debris obscured the oil sands in layers of rock, clay, and muskeg (Figure 2.6).

## Ecology of the oil sands

The oil sands are nestled in boreal forest at the confluence of the Athabasca River and Clearwater River in a mix of coniferous trees (60%) and wetlands (40%). They sit 1,210 feet above sea level. White spruce, trembling aspen, balsam poplar and white birch are the most prominent native trees in and around town. Black spruce and tamarack occur in poorly drained areas and jack pine may be seen on the driest sites. European aspen, blue spruce and sand cherry are among the exotic trees occasionally seen.

The surrounding boreal forest is a mosaic of wetlands and forests, lakes and rivers. Upland forest and wetlands are the two dominant


Figure 2.4. Cold Lake Area, Peace River Area, and Athabasca Area. [Author 2017, adapted from Wikipedia]

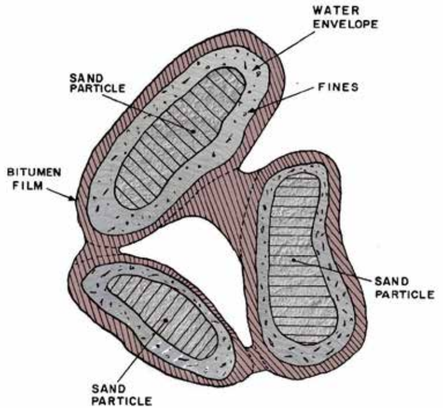



Figure 2.5. Bitumen composition. [Author 2017]

ecologies in this area and including trembling aspen, white spruce, and pine forests.

The boreal forest is an important habitat for a number of wildlife and birds and is also an important carbon storage ecology. The forest and peatlands store an estimated 67 billion tons of carbon in Canada, almost eight times the carbon produced worldwide in year 2000 (Mongabay 2006). The Canadian boreal forest sequesters and absorbs on average an amount of carbon worth $1.8B. The boreal forest is home to:

- 600 vascular species,
- 17 ferns,

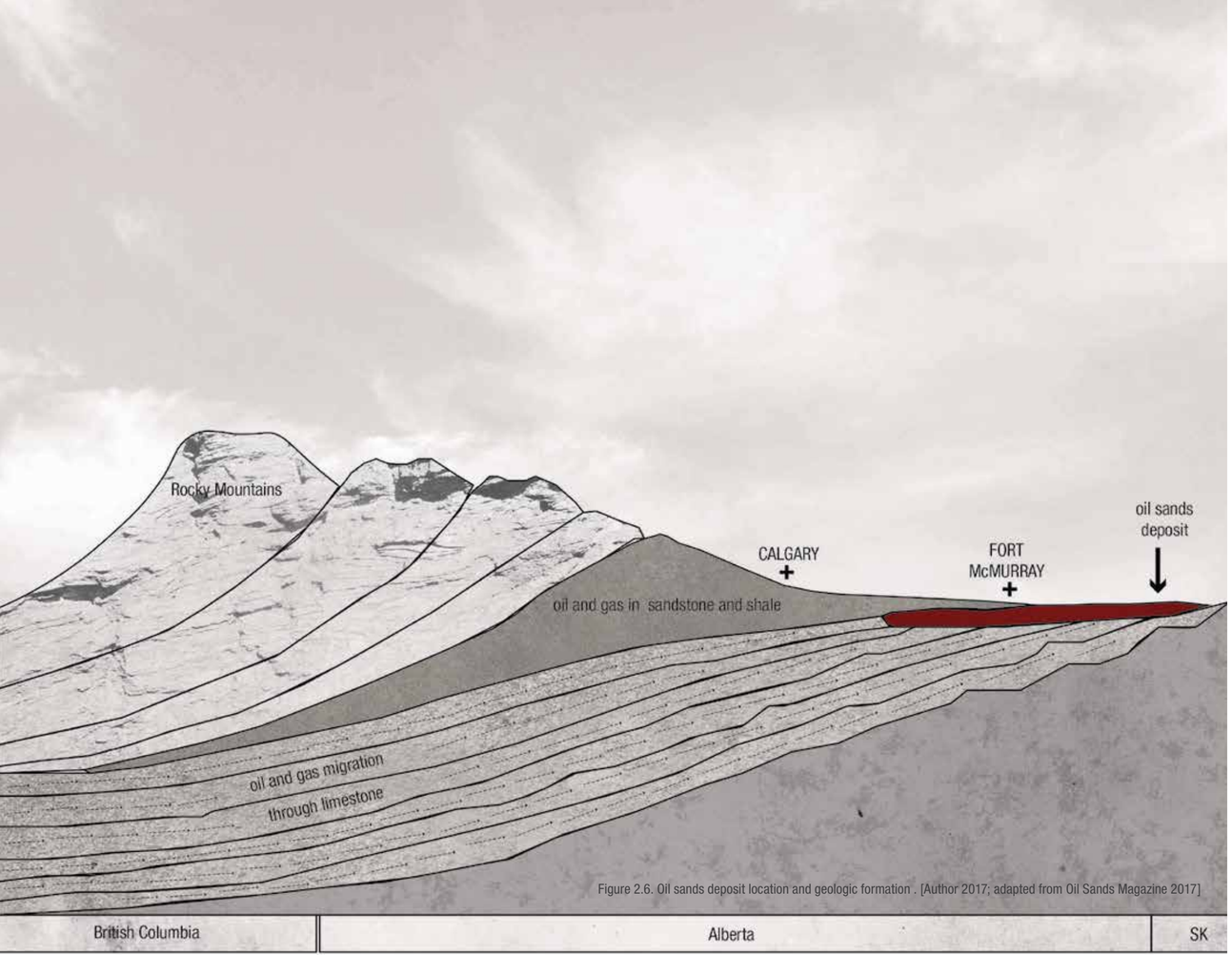



Figure 2.6. Oil sands deposit location and geologic formation . [Author 2017; adapted from Oil Sands Magazine 2017]

- 104 mosses,
- 13 liverworts; and
- 118 lichens.
- The 327 animal species include:
- 40 fish
- 5 amphibians
- 1 reptile
- 236 birds
- 45 mammals including snowshoe hare, southern red-backed voles, black bears, moose, and ermine (Canadian Forest Congress, 2006; Grant, Dyer, & Woynillowicz, 2008).

Key species of the boreal forest ecosystem within the oil sands are highlighted in Figure 2.7.

## MINING PROCESS

Because the oil sands bitumen is in solid form, it does not resemble traditional oil exploration with drilling rigs and periodic “gushers” of petroleum spewing from the Earth. Instead, the most common form of extraction is open-pit surface mining, a method more commonly used with other minerals such as coal or iron. Another method is called ‘in-situ’ mining. Figure 2.8 briefly illustrates each method.

### Surface Mining

*Step 1: Cut down Boreal Forest*

Rivers and streams are diverted and forests are clear cut, with merchantable timber harvested and the remainder piled and burned (Grant, Dyer, and Woynillowicz 2008). An average of four tons of sand and peat are removed for every barrel of oil produced. Forest and wetlands are drained and overburden is excavated up to 10 meters exposing the oil sands ore which is another 40-60 meters thick (Doran 2009). Overburden is removed and stockpiled before the oil sands can be mined. “Nowhere on Earth is more earth being moved these days than in the Athabasca Valley” (Klare 2012). In theory, this stockpiled overburden can then be reinstated and areas can be re-vegetated (Grant, Dyer, and Woynillowicz 2008). However, as described later, this reuse is challenging. Depending on quality and type, overburden may also be used to create mine roads, walls, and other infrastructural uses.

*Step 2: Mining*

Once a pit is opened, giant power shovels—some six stories tall—dig out the bitumen-rich mixture and it is then loaded onto the world’s largest dump trucks. These dump trucks, at $5.5M each, weigh as much as a 747 airplane (40,000 pounds) with tires 12’ tall. Rather than hauling, some companies are piping watered-down bitumen directly from the mine to refining plant. Because bitumen only composes 10-12% of the total “sands,” oil sands are sent to a cleaning facility where it is mixed with heated fresh water to separate bitumen from clay (Globe and Mail 2016).

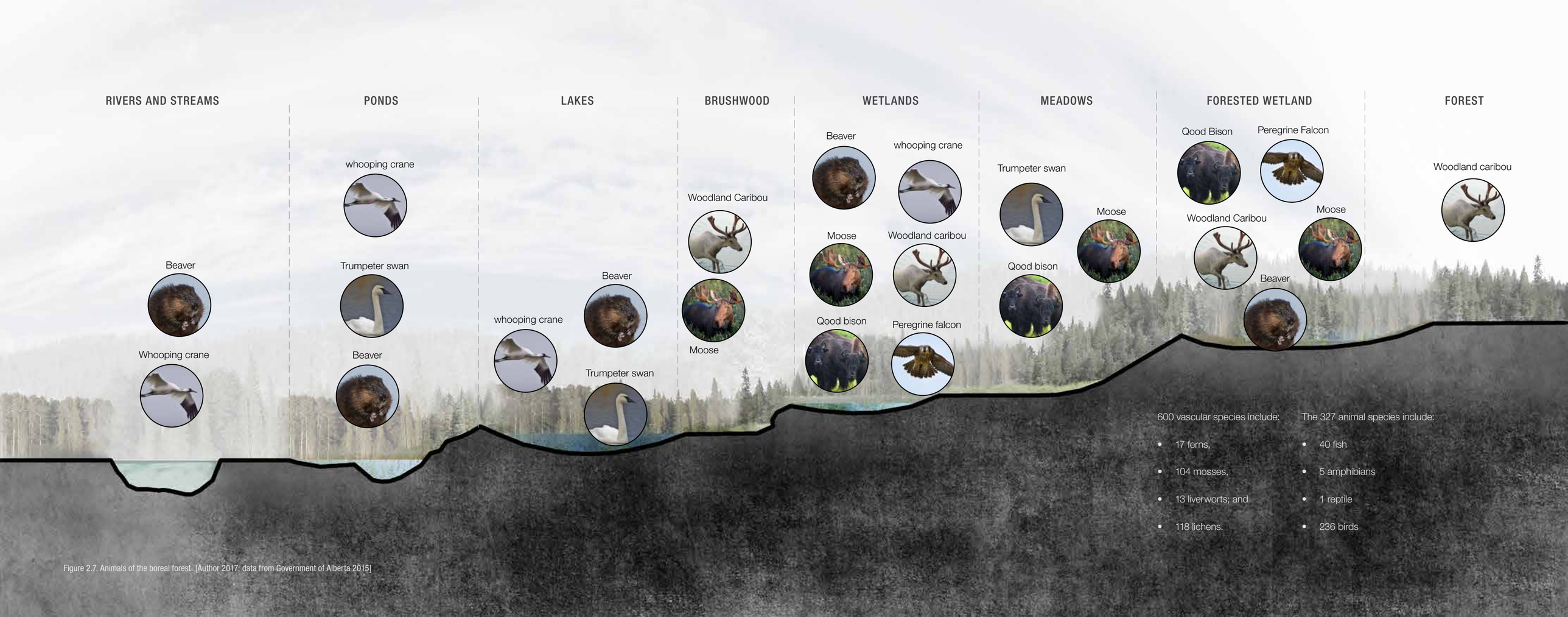



Figure 2.7. Animals of the boreal forest. [Author 2017; data from Government of Alberta 2015]

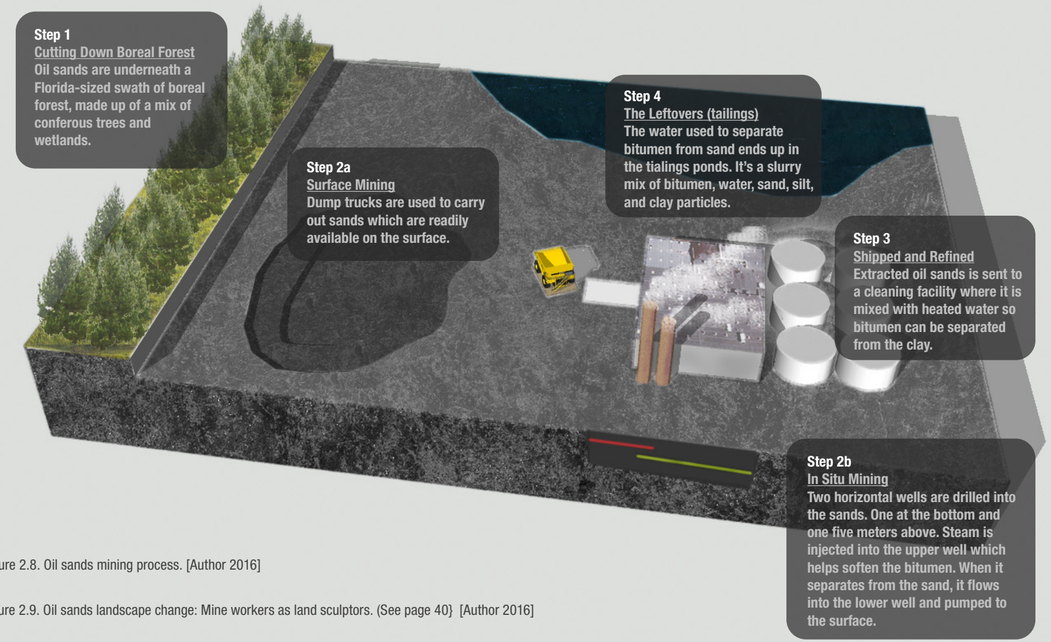



Figure 2.8. Oil sands mining process. [Author 2016]

Figure 2.9. Oil sands landscape change: Mine workers as land sculptors. (See page 40} [Author 2016]



*Step 3: Ship and Refine*

After the bitumen has been separated from the clay and other minerals, an upgrader processes bitumen into synthetic crude. Synthetic crude is an intermediate product produced when oil sands are upgraded into a liquid. The crude is piped to a refinery to be made into petroleum products. It takes two tons of oil sands to make one barrel of synthetic oil through this process (Globe and Mail 2016). This oil is then moved through a combination of pipelines, marine, and rail infrastructure.

*Step 4: The Leftovers*

Water used to separate bitumen from sand ends up in tailings ponds. The leftovers placed in tailings ponds are a slurry of water, sand, silt, clay particles, and small quantities of bitumen all leftover or used in the refining and shipping process. This slurry of remains is contaminated by unrecovered hydrocarbons.

Figure 2.9-2.15 show resulting landscapes from this process.

### In-Situ Mining

As much as 80% of oil lies deeper; inaccessible to traditional surface mining operations (Lustgarten 2005). This deeper bitumen is mined using a process called in-situ mining where two horizontal wells are drilled into the sands. One is placed at the bottom of the formation and one is placed 5 meters above. They can extend for miles in all directions. Steam is injected into the upper horizontal well. Sometimes this steam-injection process lasts for months. This helps soften the bitumen and separates it from the sands where it flows into the lower well, then pumped to the surface. Currently, about 35,000 square kilometers of wilderness is leased for mining using the in-situ process (Anderssen 2008).

Although it does not impact the surface as visibly as surface mining, the construction of roads, pipelines, and other facilities still slice up forests and impacting wildlife habitat and migration.

## OIL SANDS RIGHTS

The term tenure is the system through which Crown-owned (government-owned) mineral rights, including the oil sands, are leased and administered. In Alberta, the Crown owns 81% of the province's mineral rights (Government of Alberta 2007). The remainder is owned by the Crown on behalf of First Nations or in National Parks (Government of Alberta 2009). The Government of Alberta outlines the rights of oil sands exploration (2009):

- Permits are issued for a term of 5 years;
- Leases are issued for a term of 15 years.
- If a lease is proven productive, it will continue indefinitely beyond the end of the term. The tenure ends when an agreement holder can no longer prove his agreement is capable of producing oil or gas in paying quantities or is lost through rental or royalty payment default or by voluntary surrender.
- Owners of freehold mineral rights, except the federal government, pay at tax to the Crown based on the production of oil or gas from their holdings. The tax ensures the owners contribute to Alberta's infrastructure and regulatory costs.

Upon completion of mining, reclamation of the landscape is required by the federal government.


# Oil sands landscape change: Mine workers as land sculptors

### 1. Impact of overburden remova

Storage of overburden results in the development of artificial hills in the landscape
Open pits are developed due to excavation, resulting in a fragmented landscape

### 2. Impacts of excavation

The excavation of the oil sands leads to big open pits
Excavation requires a lot of machines, a dense network of roads, pipes and extraction/upgrading plants and thus disturbs a large surface area

### 3. Impacts of water extraction of the river

Extraction of water impacts aquatic life

Perched lakes, wetlands, and waterways are also sensitive to small changes in the level of the Athabasca River

Once water from river is used in the process, it is too polluted to discharge and thus stored in tailings ponds

### 4. Impacts of tailings ponds

Storage of tailings leads to large contaminated lakes with containment dykes

Tailings ponds may seep, polluting surface and groundwater

### 5. Impacts of drying areas

Drying areas requires a large landscape leading to the disruption of even more space

### 6. Impacts of water ponds

Tailings ponds have similar form and size of tailings ponds but store water instead.
They have containment dykes similar to tailings pond.

### 7. Impacts of generated by-products

The generated by-products in the process results into huge piles of Coke and Sulphur.


Figure 2.10. Overburden removal. [Outside Magazine 2014]

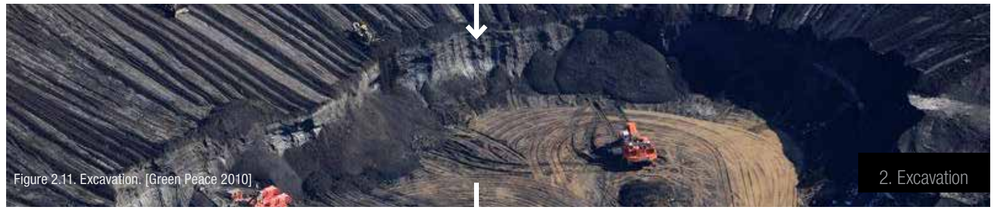



Figure 2.11. Excavation. [Green Peace 2010]


Figure 2.12. Tailings pond creation. [Toronto Star 2015]

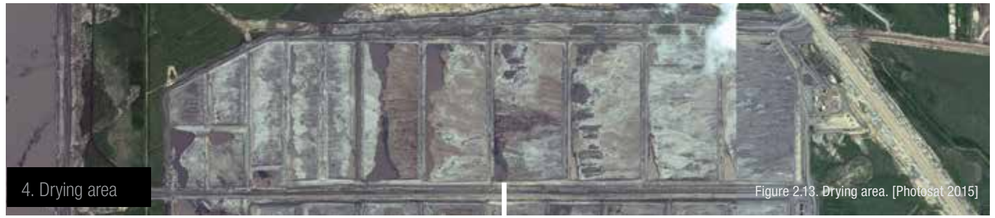



Figure 2.13. Drying area. [Photosat 2015]


Figure 2.14. Water ponds.

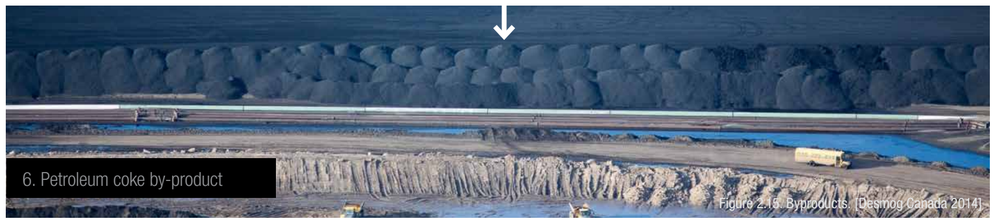



Figure 2.15. Byproducts. [Desmog Canada 2014]

## LANDSCAPE RECLAMATION

The act of landscape reclamation can mean different things to different people, especially in different disciplines. Therefore, distinctions in meanings are important to clarify. Reclamation, restoration, and remediation are not synonymous terms:

- *Reclamation* is the act of recovery and conversion; of taking something that was rendered unusable or uninhabitable and projecting it to a usable state.

- *Restoration* repairs a site or structure to its original state. For example, replacing an exact building structure after a fire.

- *Remediation* reduces or eliminates potential harms to the environment or humans. One such is example is removing mold from a toxic site.

The main distinction between restoration and reclamation is that reclamation is interested in projecting something forward in a new usable state, rather than returning something to its original state.

Landscape reclamation, in context of post-mine sites, means several things as outlined by landscape architect Alan Berger: "Reclamation captures at once the temporal and ethereal issues of designing with altered landscapes: one must think backward in time in order to project forward in time; one must change old trajectories in order to assemble new solutions" (Berger 2008). When we project into the future "we are choosing to reclaim, rather than restore…which is why the topic of reclamation is so vital in today's and tomorrow's design discourse" (Berger 2008). Landscape reclamation embraces historical and existing processes and dynamic change on a site and uses these embedded products as a way to project productive uses into the future. Reclaiming the Athabasca oil sands landscape under reclamation means designers are interested in how impacted landscapes can once again be productive, rather than wiping the slate clean towards a restoration landscape typology which attempts to return a landscape to the way it was.

Berger has spent much of his academic career studying the mining sites of the American Mountain West. In his 2008 book *Designing the Reclaimed Landscape*, Berger argues: "Reclamation, as a unique form of landscape production, offers designers a substantial opportunity to expand their intellectual concerns and scholarship in the areas of landscape disturbance, renewal, design, and of reoccupation of synthetic space and ecology (xxi)." Theorist and leading-edge landscape architect James Corner also argues the re-creation of a "naturalistic" landscape aesthetic leaves little room for cultural, social, and programmatic innovation (Corner 1997 in Reed and Lister 2016, 51). "What is important and significant is how ecology and landscape architectural design might invent alternative forms or relationship between people, place, and cosmos. Thus, the landscape architectural process become more about the invention of new forms and programs than merely corrective measures of restoration" (Corner 1997 in Reed and Lister 2016, 51). Landscape architects can reconsider tradtional reclamation goals and instead ideate new ways of using the previously disturbed, mined site.

### Reclamation of the oil sands

As Gosselin et al 2010 writes of the oil sands, "there appears to be more opportunity to implement progressive reclamation than past practices have demonstrated and the need to do better is compelling." Currently, public policy states land is to be returned to its pre-extraction use—boreal forest. But, only 0.2% of mined land has been certified as reclaimed which presents an opportunity for landscape architecture to interact with these reclamation efforts. Landscape architects can understand ecologically-degraded sites such as the oil sands as opportunities to innovate and transform sites ecologically and socially; looking forward, not backward (Berger 2002; Berger 2008; Corner 1997).

In the Athabasca oil sands, reclamation is the final step oil companies are required to submit in official documentation before they are allowed to begin bitumen extraction operation (Government of Alberta 2016; Testa 2016). This leaves oil sands companies responsible with spending money on reclaiming open-pit mines once thriving wetlands and forests. They are facing what has never been done –the task of rebuilding the most complex, diverse, and delicate ecosystems in the world—boreal forest. The Government of Alberta in their AEP, Land Policy, 2015, no. 7 states:

> *"[T]he aim of reclamation under the Environmental Protection and Enhancement Act is to obtain equivalent land capability. 'Equivalent land capability' is defined in the Conservation and Reclamation Regulation as 'the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical'" (Government of Alberta 2016).*

In a January 2008 survey cited in Grant (2008), "over 90% of respondents considered the current requirements for reclamation in northeastern Alberta inadequate." Problems include the fact that binding reclamation timelines are not present in approvals and companies are not legally required to meet reclamation timelines and milestones identified in Conservation and Reclamation plans (Grant, Dyer, and Woynillowicz 2008). Currently, reclamation is not keeping pace with rates of land disturbance (Gosselin et al. 2010; Lustgarten 2005; Weber 2012). Only 0.2% of oil sands land has been certified reclaimed. Based on industry standards, another 13.6% has been reclaimed but this has not been verified by the government (Grant, Dyer, and Woynillowicz 2008).

Two types of landscapes need reclamation: wetlands and upland habitats. In Alberta, there are five types of wetlands: bogs, fens, swamps, marshes, and ponds, and all occur in the oil sands region (Grant, Dyer, and Woynillowicz 2008). Initial oil company-led wetland reclamation efforts have yielded some results, but often contain problems. "They're starting with essentially contaminated materials which might be completely devoid of organic matter… So it is probably unrealistic to expect that a healthy wetland could be created from essentially contaminated material surrounded by, say open pit mines and tailings ponds and waste water ponds and things like that" (Timoney in CBC News, 2015). One of the problems with the existing reclamation efforts are that the wetlands look suitable, but are not. Ecologist Kevin Timoney explains, "…so they do contain some populations of animals, but these animals are then subjected to contaminants in the wetlands and they're also subjected to contaminants if they leave the wetlands and go visit a nearby tailings pond or some other industrial site (Timoney in CBC News, 2015). Others suggest we can't replace nature and the previous ecosystems, so we should just move on (Weber 2012). "Fens are always going to be too expensive and difficult for large-scale restoration…The money spent...might better spent on

other problems." A report by the Government of Alberta seems to agree and states that it is almost impossible to fully replicate the complexity of a natural wetland (Grant, Dyer, and Woynillowicz 2008).

Industry claims to have the ability to reclaim disturbed lands, and uses this pitch as a PR point (CBC News 2015). In the words of one ad which promises to restore land to: "where you'd never know there'd been a mine in the first place" (Weber 2012). Yet ecologists and scientists have claimed oil sands reclamation is a failure (Weber 2012; Weber 2016; CBC News 2015). Researchers believe at least half of the region's wetlands will be permanently lost and it may take centuries for them to develop into anything resembling what they once were (Grant, Dyer, and Woynillowicz 2008; Weber 2012). Vegetation/plant mix is not what it was, soil and water chemistry has changed, and biodiversity has shrunk. Reclamation is also expensive and the University of Alberta's Lee Foote suggests resources would be better used elsewhere: "It's useful for scientists, but I don't think it's cost-effective over large areas" (Foote in Weber, 2016). A researcher at the University of Waterloo states: "It's probably going to be centuries before these systems become indistinguishable from natural systems" (Weber 2016).

New techniques and technologies are constantly being tried.  Yet there is debate as to whether technology will be the answer for reclamation. In a 2008 article from the *Globe and Mail* newspaper, Suncor's vice-president of sustainable development predicts technology will solve most of the problems (Anderssen 2008). But Gosselin et al. 2010 does not believe this is the case: "Technology cannot reduce the environmental impacts/footprint to zero in the oil sands industry any more than it can in any other heavy industry."

*Gateway Hill Reclamation Project*

The Gateway Hill reclamation project by Syncrude Oil is the only "certified" reclaimed area and represents the 0.2% reclaimed area as stated in many sources (Figure 2.16-2.18) (see Government of Alberta, 2016; Grant et al., 2008; Weber, 2016 among others). But it is 40 years in the making and still does not represent the type of reclamation many expected or want in the future (Grant, Dyer, and Woynillowicz 2008). In a region surrounded by healthy boreal forest, the re-creation of upland forests on what was healthy wetland ecosystems seems unnecessary and not worth the trouble. Spending millions of dollars for stick trees and lakes in the middle of the boreal forest does little to address future needs.

In order to reclaim the area, a thick layer of soil was placed on the surface. It was composed of clay, sand, and water with naturally high sodium sulfate. Next, a "forest layer" mix was placed which included soil, peat, and forest floor material that did not contain any living matter. The reclamation project did not have tailings ponds present. The result of the project is a hilly forested upland with a lake on what used to be a "rich wetland-dominant low-lying landscape" (Grant, Dyer, and Woynillowicz 2008).

Gateway Hill demonstrates the challenging reality of oil sands reclamation. The amount of money compared to the results and the reality that this process would have to be repeated thousands of more times makes one realize the significant challenges ahead for the oil sands.

Figure 2.16. Gateway Hill monoculture tree planting [Author 2016]

Figure 2.17. Gateway Hill lake. [Author 2016]

Figure 2.18. Gateway Hill hiking path. [Author 2016]

## SUPPLY, DEMAND, OIL SAND: CHAPTER SUMMARY

01. The oil sands are inextricably linked to the history of the area and the people.

02. Fort McMurray's history and economy is entirely reliant upon the oil sands and its development.

03. Because the oil sands bitumen is in solid form, it does not resemble traditional oil exploration with drilling rigs and periodic “gushers” of petroleum spewing from the Earth.

04. Oil sands are mined used two processes: surface mining and in-situ mining.

05. Oil sands are locked within a 120-million-year-old seashore buried below wetlands and virgin boreal forest (Government of Alberta 2016).

06. The oil sands mining process is complex, arduous, and requires significant amounts of capitol, labor, and infrastructure.

07. Reclamation is the act of recovery and conversion; of taking something that was rendered unusable or uninhabitable and projecting it to a usable state.

08. Oil sands companies have had very limited success in reclaiming oil sands sites.

09. Only 0.2% of oil sands have been certified as reclaimed.

10. Gateway Hill is the only site which has been certified as reclaimed, but the site was reclaimed as upland forest even though the original ecology was a wetland. Most of the forest is replanted as a monoculture of a single tree species.

# Why do mapping, diagramming, photomontage, and photography have agency in landscape architecture?


Figure 3.1. Syncrude refinery plant at dusk. [Author 2016]

# CHAPTER 03: LANDSCAPE ARCHITECTURE AS STORYTELLING

Landscape architects tell stories. Landscape architects, through mapping, diagramming, photomontage, and photography can tell stories of the past, present, and future and do so through accessible visual media. Storytelling is used as a method to approach the identification of issues embedded within wicked problems. These methods–mapping, diagramming, photomontage, and photograph–have been used throughout the landscape architecture discipline and have agency for designers and those viewing the work.

## MAPPING IN LANDSCAPE ARCHITECTURE

Mapping is storytelling (Mostafavi in Desimini and Waldheim 2016; Czechowski 2014). Maps allow designers to describe characteristics of land, process, change, and transformation. The late landscape architect and professor Ian McHarg pioneered use of mapping in the 1960s at the University of Pennsylvania under the term “suitability analysis.” This method allowed for quantification of various spatial ecological components that make up an ecosystem; it measures the impact for various scenarios; and recommends appropriate action. A series of factors are mapped and then the entire overlay of factors is weighted. Factors included were such layers as soil type, slope, views, surface permeability, and water flow direction. Individually these factors are important, but are difficult to consider together. The systematic and rational framework allows these factors to be considered together with their weighting applied (Figure 3.2).

Although his method was built with good intentions, and suitability analysis remains a staple in landscape architecture schools around the country, the suitability mapping approach used by McHarg and other ecologists reduces processes and life forms involved in the suitability analysis to “objectified factors of utility” (Corner 1997 in Reed and Lister 2016, 50). James Corner (whom studied under McHarg at the University of Pennsylvania) and others now see McHarg’s suitability mapping process to be reductionist and not at all subjective. Objectivity suggests no outside influence, but a designer must subjectively assign value to each factor mapped.

Regardless, McHarg’s suitability mapping process continues to be routinely discussed and admired within landscape architecture discourse. While it may reveal functionalistic opportunities and constraints for proposed solutions, it does little to reveal time or space other than what is already physically on the ground. The importance of McHarg’s contribution may be in the idea that mapping is not a simple site analysis tool where a landscape architect inventories and analyzes ground features for inclusion or exclusion of the final design. Rather, the use of mapping for McHarg was instrumental to the *process* of landscape architecture and design. An ability to map conditions was a revelatory process for a designer, it helped find relationships and processes among a range of complex factors.

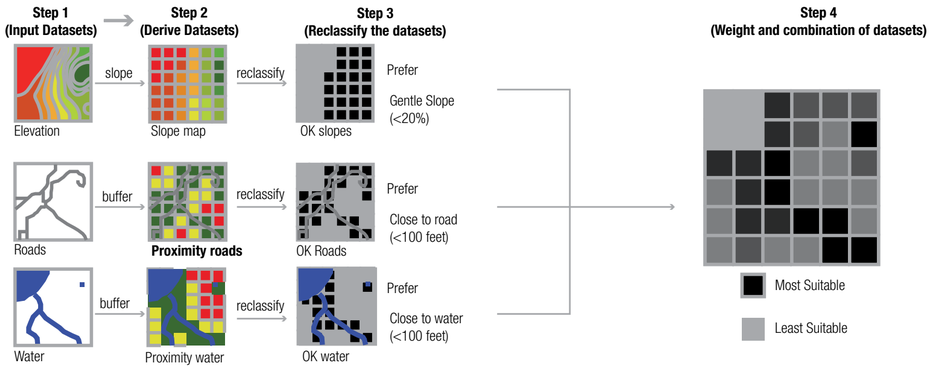



Figure 3.2. Simplified and abstract suitability analysis. [Author 2017]

Use of mapping and data visualization has ascended design culture in recent decades, and in particular landscape architecture, made popular by professional offices such as James Corner Field Operations, MVRDVR, West 8, and GROSS.MAX. In a new book, *Cartographic Grounds* authors Jill Desimini and Charles Waldheim posit that mapping has changed the way designers communicate about buildings and landscapes and the translation of data into visual communication devices is now a ubiquitous aspect of design process (Desimini and Waldheim 2016). Most every design now uses cartographic representation to display physical aspects of the ground. And while the physical aspects of place and culture are important, "the trajectory of representation…has moved from the material and physical description of the ground toward the depiction of unseen and often immaterial fields, forces, and flows" (Desimini and Waldheim 2016, 9). Mapping allows designers to reveal information that is often hidden and can do so in "a poetically striking way" (Amoroso 2012; Amoroso 2010). In this way, mapping has value as a creative, design activity which brings value to the design process. The act of mapping serves as both a representation of data and spatial forces but also as an exploration of design and design process.



## Mapping as agent

The act of mapping is a tool for designers; it has agency and helps tell stories (Corner 1999b; Desimini and Waldheim 2016; Amoroso 2012). In James Corner's seminal article "The Agency of Mapping: Speculation, Critique, and Invention," Corner describes mapping as "a collective enabling enterprise, a project that both reveals and realizes hidden potential…its agency lies in neither reproduction nor imposition but rather in uncovering realities previously unseen or unimagined…Thus, mapping unfolds potential" (Corner 1999b, 213). Corner is less interested in what maps mean and more interested in what maps do. In other words, a beautiful map may show something interesting, may be visually interesting and informative, but it is the process of mapping, the activity of mapping that is more important (Figure 3.3) (Cantrell and Michaels 2010; Amoroso 2012). "It is in this participatory sense that I believe new and speculative techniques of mapping may generate new practices of creativity…by showing the world in new ways, unexpected solutions and effects may emerge" (Corner 1999b, 217). Mohsen Mostafavi agrees that:

> *"[T]he minutiae of cartographic conventions have the capacity to help us imagine fragments of new landscapes, cities, and houses…The interrelationship between depiction and actualization, a key component of the cartographic imagination, is then inseparable from the interrelationship between what is given—topography—and what is yet to come—design" (Mostafavi in Desimini and Waldheim 2016, 7).*

Mapmaking is a creative activity (Corner 1999b; Amoroso 2012; Czechowski 2014). Use of mapping as an activity, and as a creative activity is key to its potential as a source for projective solutions. "Mapping is perhaps the most formative and creative act of any design process, first disclosing and then staging the conditions for the emergence of new realities" (Corner 1999, 216). These "moments of discovery" using active mapping inform projective opportunities for the future. "In order to understand a landscape it helps to analyze its layers. By not only tracing information, but by also assessing and interpreting it, mapping helps in the formation of ideas about how a landscape can be further developed" (Czechowski 2014).

The use of mapping for Amoroso, Corner and others is similar to McHarg—it is a middle ground between understanding what is there and what can be there in the future. It is a part of design process—of revelation, opportunity, relationships—an initial step in uncovering creativity or novelty in landscape architecture (Czechowski 2014). But unlike McHarg these mappings are not objective, rational objects. They are creative and active acts of a designer, embedded within design process (Corner 1999b). "Herein lies the projective potential of cartographic practices that afford greater connection with the ground itself, making present and vivid the landscape, as it exists and as it could be, both to the eye and to the mind…" (Desimini and Waldheim 2016, 10). Designers can imagine—and visualize through mapping—alternative futures.

While using maps as a design tool has been expressed by many landscape architecture scholars and practitioners (see Corner 1999; Waldheim 2016; Reed and Lister 2015), these same authors have identified current representation and analysis methods in landscape architecture as too limiting to represent the complexity of this century (Corner 2006). There is a gap in the literature and landscape architecture practice for how to represent complex

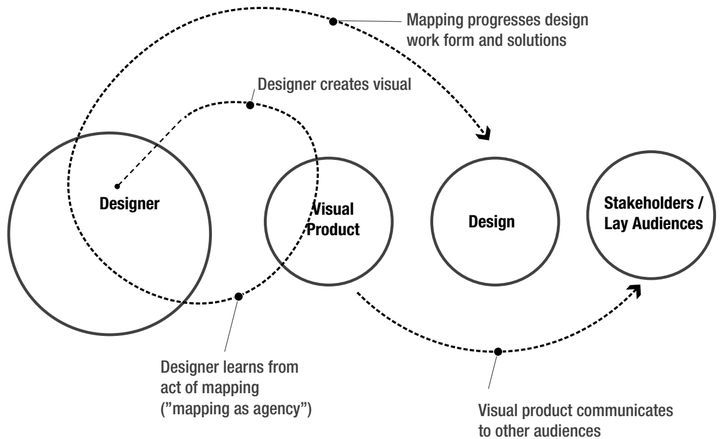



Figure 3.3. Mapping as Agency [Author 2017]

systems. “The techniques to address the sheer scope of [complex, dynamic] issues [presented in the 21st century] are desperately lacking—and this area alone, it would seem to me, is deserving of our utmost attention and research” (Corner 2006 in Waldheim 2006, 32). Landscape architecture needs new means and methods for studying and explaining systems.

*Cartographic Mapping Techniques*

Many techniques exist for cartographic representation—from the traditional to experimental. Desimini and Waldheim (2016) identify ten traditional cartographic types used in landscape architecture through history. These types, description, and conventions are discussed in Table 3.1. Traditional cartographic techniques identified by Desimini and Waldheim (2016) can also be enhanced through the use of novel and emerging techniques such as critical mapping, animated maps, flow maps, and cartograms.

Critical mapping seeks to classify, correlate, and compare site information across a broad spectrum of topics for identifying dilemmas/opportunities and design strategies (Brody, Belanger, and Canfield 2011). Critical maps synthesize complex phenomena to begin leading toward practical design solutions. These maps help ground knowledge and begin to formulate planning and design solutions. By layering together sometimes-incongruent factors, critical maps reveal opportunities and dilemmas a traditional map could not.

Kansas State University’s Department of Landscape Architecture/ Regional & Community Planning has been a leader in the use of critical mapping as a tool in design studio. An example of a critical map is Figure 3.4 completed for a graduate-level landscape architecture studio at Kansas State University (Hahn and Belanger ed. 2014). In this example, by simultaneously layering employment origin-destination information atop vacant parcels, this map reveals a relationship between these two incongruent datasets. In this case, it shows that those living in areas with high levels of vacancy are more likely to commute longer distances and outside the area they are living for employment. For a studio dealing with the complexity of 13,000 vacant lots across the city, this critical mapping process helped to “discover various physical (visible) and non-physical (invisible) site relationships” (Amoroso 2012). In this instance the prevalence of vacancy is a visible phenomena while movements across the region for employment is an invisible force. By spatializing this invisible force (employment) and mapping atop the visible phenomena (vacancy), new and novel relationships were discovered, directly leading to one solution for the project (Figure 3.5): catalyzing employment by utilizing vacant lots as a hybrid clean energy and hiking trail.

Flow maps show movement of objects between different areas such as goods, people, migration patterns, or traffic. These maps are beneficial because they allow cartographers (or, in this case, landscape architects) to easily see differences in magnitude across space with minimal map clutter (Phan et al. n.d.). Different widths are often used to differing levels of frequency—a thicker line representing more movement from one location to another location. Flow maps begin to spatialize both time and movement as seen in Figure 3.6. Figure 3.6 depicts waste flows, backflows, and reflows in the Maas-Rhine River Delta in Rotterdam, the Netherlands drawn by OPSYS/Pierre Belanger. More advanced techniques using animation can also aid in spatializing time and movement relationships.

Animated maps use of a non-static representation helps to reveal forces or flows not as readily available to a designer by creating a series of static snapshots which must be viewed individually and then are considered as a set. By using simple animation techniques, a single mapping can be created which reveals time and space collectively.

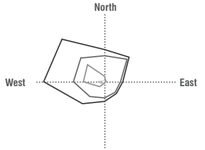
Cartograms are a novel technique with a surprisingly long history in cartography, dating back to the 1800s. Unlike traditional cartographic techniques which attempt to closely replicate area and scale of location, cartograms use thematic mapping variables such as population, Gross National Product (GNP), or travel time to substitute land area or distance. The physical geometry is distorted

Table 3.1. Traditional Map Techniques [adapted from Desimini and Waldheim 2016. Text excerpts by Desimini and Waldheim 2016.]

| MAP TECHNIQUE | DESCRIPTION | CONVENTIONS |
|---|---|---|
| **Sounding/Spot Elevation** | Soundings mark the depth of water measured at a point with a pole or line weighted by lead and noted by a number on a nautical chart at that point. A spot elevation is a number on a map that shows the position and the altitude of a point above a given datum. | • The physical point of measurement correlates to a representational mark -- a number, a cross, a dot, or a circle on a drawing.<br>• Often used in concert with other representational means |
| **Isobath/Contour** | Lines joining points of equal vertical distance above or below a datum. It is an abstraction of altitude. | • A contour line connects points of equal elevation.<br>• Contours are spaced at a given vertical interval<br>• Tight offsets and densely packed lines describe steep slopes, while wide gaps between lines indicate flatness. |
| **Hachure/Hatch** | Lines, often short, following the direction of maximum slope, which in a series indicate shadow, relief, and texture. | • Perpendicularly fill space between contours<br>• Used to depict terrain and shadow |
| **Shaded Relief** | A continuous tone that represents changes in elevation and landform by simulating a cast shadow thrown upon a raised relief map or model. | • Color and tonal gradients blend elevations<br>• Fluid gradation of tonal variation |
| **Land Classification** | The taxonomic method of describing the spatial distribution of the various forms of vegetation and occupation of the land. | • Based on indices, involving the placing of a symbol, letter, color, or pattern to represent soil, vegetation, or human activity.<br>• Generalized and best at larger scales (regional, national, global) |
| **Figure-Ground** | A representation of space, often urban, that uses a fill or poche to show the relationship between built structure and fabric. | • Devoid of lines<br>• Fills and voids represent shapes<br>• Fill the figure, leave the ground (background) as blank |
| **Stratigraphic Column** | A simplified columnar diagram relating a succession of named lithostratigraphic units from a particular area to the subdivisions of geologic time. | • Color is fundamental to coding of a stratigraphic column |
| **Cross Section** | A drawing cut along a predetermined line perpendicular to the plan view to reveal elevation, depth, and structural and material composition. An orthographic view of an object taken from the position of a cutting plane to describe internal organization. | • Vertical cut through landscape showing 3D view of ground plane<br>• Elevation information often included to reference conditions beyond cut line |
| **Line Symbol** | Any elongated continuous mark or discontinuous series of marks (as a line of dots) on a map that serves as a sign for some geographical phenomenon or concept. | • Connect features or represent physical features<br>• Thickness of line often indicates quantity (more = thicker) |
| **Conventional Sign** | AA symbol used to represent information on the face of a map or chart. A cartographic symbol may be a letter; character, or other graphic device. Cartographic symbols fall into two broad categories: pictographic and ideographic. | • Characterizing signs, symbols that denote classes of things |

## ORIGIN/DESTINATION OF CITY OF ST. LOUIS [ALL WORKERS]

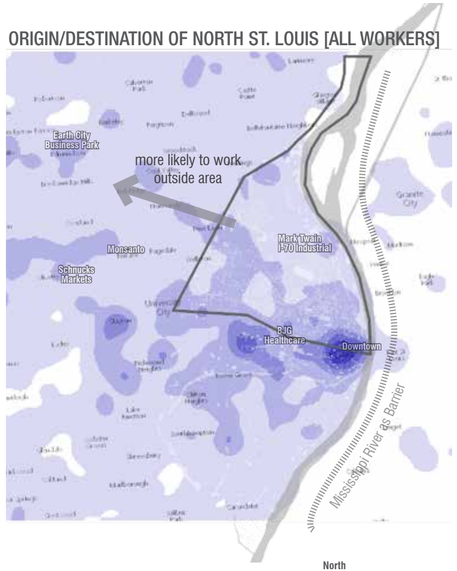




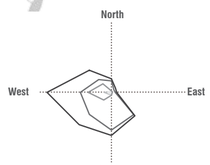

56% of all City of St. Louis workers leave the city for employment.

| | | |
|---|---|---|
| | 121,579 total | 100% |
| Less than 10 miles | 84,645 | 69.6% |
| 10 to 24 miles | 28,053 | 23.1% |
| 25 to 50 miles | 2,278 | 1.9% |
| Greater than 50 miles | 6,603 | 5.4% |

## ORIGIN/DESTINATION OF NORTH ST. LOUIS [ALL WORKERS]





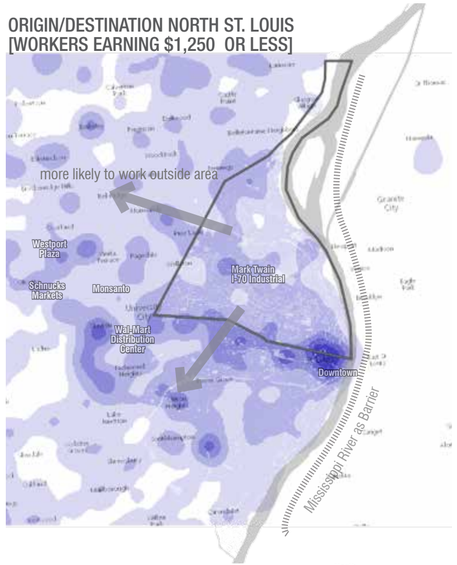



90% of North St. Louis workers leave the area for employment.

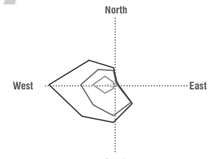
| | | |
|---|---|---|
| | 24,456 total | 100% |
| Less than 10 miles | 16,988 | 69.5% |
| 10 to 24 miles | 5,385 | 22.0% |
| 25 to 50 miles | 472 | 1.9% |
| Greater than 50 miles | 1,611 | 6.6% |



## ORIGIN/DESTINATION NORTH ST. LOUIS [WORKERS EARNING $1,250 OR LESS]








90% of low-income North St. Louis workers leave the area for employment.

| | | |
|---|---|---|
| | 8,609 total | 100% |
| Less than 10 miles | 5,883 | 68.3% |
| 10 to 24 miles | 1,937 | 22.5% |
| 25 to 50 miles | 253 | 2.9% |
| Greater than 50 miles | 536 | 6.2% |

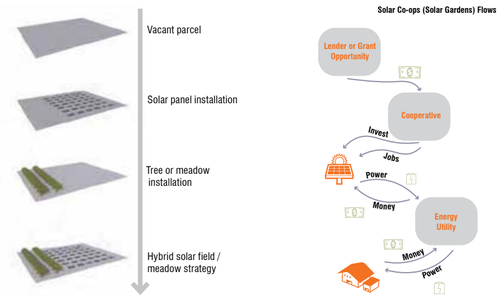




Figure 3.4 (left). Critical Mapping Example [Knight in Hahn and Belanger, 2014]
Figure 3.5 (above). Solution driven by critical map [Knight in Hahn and Belanger, 2014]

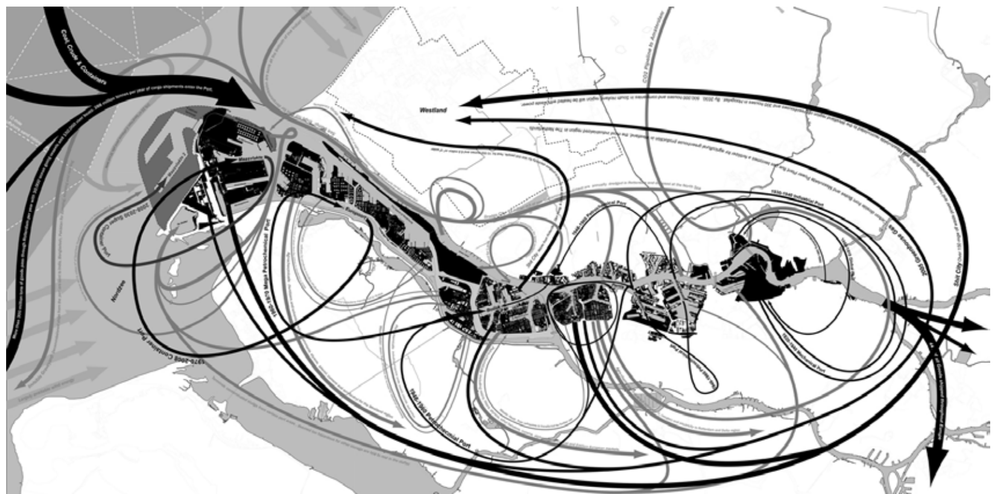



Figure 3.6. Flow map example [Used with permission ©2009 OPSYS]

in order to convey information of the variable of study. Figure 3.7 demonstrates a value-by-area cartogram where county boundaries in Kansas are warped to show unequal population density across Kansas (Knight 2009).

*Mapping for Resource Extraction Sites*

Use of mapping is specifically related to reimagining resource extraction sites such as the oil sands. Alan Berger writes in relation to post-extraction sites: "Cartographies, mappings, and images expose the agents of [landscape] reclamation by promoting speculation and discovery of qualitative and temporal dimensions of landscapes that other modes of representation tend to escape" (Berger 2002). For this reason, maps are a central component of telling the story of the oil sands.

## DIAGRAMS IN DESIGN

The term diagram is a broad term used by many industries and is in many forms, formats, and with various intentions. Diagrams attempt to compress and reduce information into a clear visual. A diagram is "an abstract illustrative figure used to describe a scheme, a statement, a definition, a process, or an action, free from representational and typological bounds" (Desimini and Waldheim 2016, 13). Although it can take many forms closely related to maps or plan drawings, the diagram is separated through its visual accessibility and its lack of convention (Cantrell and Michaels 2010). Whereas maps have legends, scale bars, and north arrows, diagrams take many forms to express ideas or process.

### Diagrams as agent

Just like maps, diagrams "embrace speculation, explanation, and autonomy at the cost of detail, exactitude, and completeness (Desimini and Waldheim 2016, 14). In their industry-standard textbook, Bradley Cantrell and Wes Michaels identify that diagrams begin "to create information through a process…[involving] the active transformation of information in order to elicit or tease out new relationships and/or hierarchies" (Cantrell and Michaels 2010, 87). They can be structured, measured, or methodological (Cantrell and Michaels 2010). "…[I]n active diagramming, the process often holds more weight than the result" (Cantrell and Michaels 2010, 87). This is similar to Corner's and Amoroso's view that mapping is an activity where the process is more important than the result, that it is a revelatory act for a designer.

### Diagram techniques

Diagrams can take many forms and so it is difficult to describe specific techniques employed by diagram-makers. Traditional techniques which may be considered are the use of bar, line, pie charts, and flowcharts. Other diagrams include Activity, Comparison, Decision, Explanatory, Flow, Phase, Process, State, and Timing. Table 3.2 briefly describes these diagrams and provides an example of each.

## PHOTOMONTAGE IN LANDSCAPE ARCHITECTURE

Representing design ideas and landscapes through photomontage is an established technique within landscape architecture history. Landscape architects from across the globe were experimenting with photomontage in the 1980s and 1990s using hand techniques (Waldheim and Hansen 2013). By the mid-1990s, the use of photomontage had been used in a range of practices and by the turn of the century, digital photomontage triggered by the ubiquity of computers and digital editing software had emerged as "a dominant mode of landscape representation internationally" (Waldheim and Hansen 2013). Widespread use of Adobe Photoshop and digital photography propelled photomontage into the mainstream of contemporary landscape architecture representation.

Table 3.2. Diagram Techniques for landscape architecture [adapted from Wikipedia 2017]

| DIAGRAM TYPE | DESCRIPTION |
|---|---|
| **Activity diagram** | Activity diagrams show a sequence of activities. |
| **Comparison diagram** | Comparison diagrams compare objects between themselves, for example to show the largest planes or buildings. |
| **Decision diagram** | A decision diagram or a decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. |
| **Explanatory diagram** | A continuous tone that represents changes in elevation and landform by simulating a cast shadow thrown upon a raised relief map or model. |
| **Flow diagram** | A flow diagram is a general type of diagram that shows a sequence of activities and/or decisions. |
| **Process diagram** | A diagram that represents a process |

Photomontage can be either photo-realistic (Figure 3.8) or eidetic (Figure 3.9). A photo-realistic montage represents a given reality in both space and time. It depicts a specific space in a specific point in time and provides a potential future scene within a landscape architecture design. They often depict details such as materials, textures, tree species, and spatial relationships. A photorealistic photomontage could be confused for a photograph. Eidetic photomontage in comparison is not photo-realistic or pictorial in technique. It is more conceptual creative, experiential, and evocative (Belanger and Urton 2014).

## Eidetic Photomontage as Agent

Eidetic photomontage moves beyond realism and design explication to be generative, nonlinear, and evocative. James Corner describes eidetic as “that which pertains to the visual formation of ideas, or to the reciprocity between image and idea. That drawing is fundamentally about making images suggests that it might actually generate and transform ideas for the percipient rather than simply representing them” (Corner 1992, 244).

Eidetic photomontage’s value to landscape architects is similar to that of mapping and diagramming. It has agency. Photomontage can be generative (Belanger and Urton 2014; Waldheim and Hansen 2013; Corner 2014). Photomontages are “instruments of imagination in their own right, occasioning new relationships, and new landscapes” (Waldheim and Hansen 2013). “Photomontage has come to occupy a privileged position in the depiction of found landscapes, yet the role of photomontage in imagining future landscapes has been an equally potent one” (Waldheim and Hansen 2013). The act of making reveals, synthesizes, and generates new alternatives for a future landscape. The generative

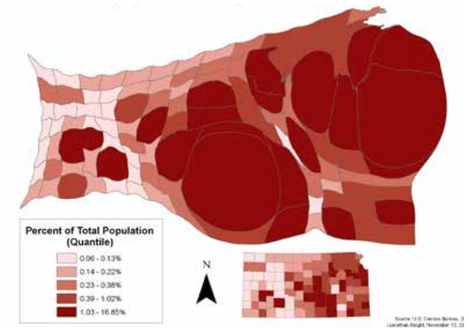



Figure 3.7. Cartogram example [Knight 2009]

nature of photomontage catalyzes new ideas and relationships not previously found by the author of the photomontage work.

Not only is eidetic photomontage valuable in revealing unforeseen forces or relationships or revealing opportunities for combining previously assumed incongruent relationships, eidetic photomontage can be evocative (Belanger and Urton 2014). It can be used as a cultural critique or evoke moods, feelings, or incongruent future relationships. This ability of eidetic photomontage has its roots in the Dada artist movement of the early twentieth-century. Work of Superstudio in the sixties and seventies were “never intended to be built… [but] were intended as provocation and critique” (Waldheim and

Figure 3.8. Photo-realistic photomontage. First Christian Church. [Author 2014]

Figure 3.9. Eidetic photomontage. First Christian Church. [Author 2014]

Hansen 2013). They can be evocative or disruptive and critique existing relationships, laws, or rules of order. While valuable as an artist endeavor, this same type of provocation and evocation can be applied within landscape architecture.

### Photomontage Techniques

Eidetic photomontages often employ photographic elements, but can also include other media as well such as hand drawing, painting, or watercolor. In a 2014 Landscape Journal article, Belanger and Urton (2014) studied hundreds of photomontages by students and professionals to determine eight techniques employed to generate an effective photomontage composition. Technique findings are discussed in Table 3.3 and illustrated in Figure 3.10.

## PHOTOGRAPHY IN LANDSCAPE ARCHITECTURE

Photography is a tool deeply rooted in the landscape architecture profession. It was used by Frederick Law Olmsted to document pre- and post-conditions of many of his designed landscapes. William Whyte used it as an investigative medium for his research into how people interacted with urban landscapes (Ruggeri 2015). Photography—with intention—is a way of thinking, reflecting, and knowing; revealing for others processes shaping people, their community, and the context of landscapes they existing within. Photography is a tool to document and express voices in front of the camera—both voices of people and ecology. Storytelling methods in landscape architecture such as mapping and diagramming are often abstract. The use of photography helps to literally and figuratively "ground" the abstract qualities into past and present-day representations of visible landscape qualities.

In her influential work *The Eye Is a Door*, landscape architect Anne Whiston Spirn writes:

> *"To photograph mindfully is to look and think, to open a door between what can be seen directly and what is hidden and can only be imagined. Beyond my own eye's door are landscapes, the stories they tell, and the ideas they embody. I pass through that door and see: that the natural and the human are one, continuous not separate, landscape a mutual shaping of people and place and a form of language born out of living, a language which to tell new stories and to envision how to adapt human settlements in life-sustaining ways" (Spirn 2014).*

*The Eye is a Door* argues for a visual approach to understanding landscape (Ruggeri 2015). Spirn uses pictures to enlighten, encourage, and activate landscape architects to understand more deeply ecological, socio-cultural, and economic processes and their effect on the landscape. Photography reveals relationships. It also allows a photographer looking through the camera with the lens of landscape architecture to make a photograph that reveals to themselves and others new stories of the place they are photographing.

### Photography for Resource Extraction Sites

The use of photography is a useful tool for documenting sites for viewers and as an investigative tool for a viewer and designer. As documentation, photographs serve as evidence for the vast scale of extraction undertaking many site, including the oil sands. "As investigative tools they require the reader to studiously 'look into' their glossy surfaces in order to reveal a story about altered landscapes" (Berger 2002, 132). Designers studying photographs can begin to understand site conditions or previous and existing landscape changes. Of course, the act of photography itself is a representation and choices are made to reveal or hide certain elements. A designer making photographs absorbs a tremendous amount of information in selecting and framing a photograph. As Spirn (2014) suggests, this is a revelatory tool for a designer. In this way, the image forms a simulacrum, representing a piece of a more complete landscape.

No medium is perfect for revealing a site's story. "Even when one thinks he has achieved a complete understanding of the visual, surficial appearance of reclamation, one discovers the images do not tell the landscape's entire story" (Berger 2002, 132). As Berger astutely observes, no medium can fully represent the complexity of a site solely through photography. Additionally, invisible forces such as toxic plumes or subsurface pollution cannot be represented completely in a single or series of photographs. Other means are necessary to begin telling the complete story, which is why other means of communication such as mapping, diagramming, and photomontage are used in this project.

## STORYTELLING THROUGH MAPPING, DIAGRAMMING, PHOTOMONTAGE, AND PHOTOGRAPHY

These four methods taken together can be a powerful tool to identify dilemmas, answer questions, ask new questions, and suggest answers and/or programmatic possibilities of a place. Some methods help to reveal hidden forces and flows and others help to reveal visible forces and flows. Through their agency, designers can tell the story of a place to lay audiences and consider for themselves appropriate design and planning responses.

Table 3.3. Photomontage Techniques [adapted from Belanger and Urton, 2014. Text by Belanger and Urton, 2014]

| PHOTOMONTAGE TECHNIQUE | | VISUAL CUE | APPLICATION |
|---|---|---|---|
| **Compositional and Affective Strategies in an Original Eidetic Photomontage** | | | |
| **Compositional** | 1 | Ambiguous frame | Elements emerge from the primary frame, creating a secondary implied frame. |
| | 2 | Scale and perspective distortion | Realistic scale and perspective is employed, with attention to foreground, middle ground, and background |
| | 3 | Extracted image fragments | Rough extraction around the perimeter of the foreground figures signals the image fragments originate from another source. As an experiential extract, a willow leaf is collaged onto the image foreground, suggestive of a potential place experience. |
| | 4 | Presentation of abstract surfaces | Part of the pathway is left unrendered, leaving surface materiality open to interpretation. Shadow casting implies a level plane. |
| **Affective** | 5 | Generalized depiction of place | The assembly is not tied to a specific geographic location, and is thus interpretable as an idea. |
| | 6 | Emotive figures and devices | Laughing figures in the foreground set a light-hearted tone. A dusky sky with a crescent moon rising alongside Venus presents a memorable context. |
| | 7 | Simultaneity and temporal distortion | The woman's face is translucently replicated, suggesting movement. |
| | 8 | Imaginative use of cultural references | Middle-ground figures retrieved from a mid-nineteenth century periodical suggest historical considerations to place narrative. |


Figure 3.10. The View. [Belanger 2014]. Used with permission.

## LANDSCAPE ARCHITECTURE AS STORYTELLING: CHAPTER SUMMARY

01. Landscape architects are storytellers.

02. Mapping, diagramming, photomontage, and photography are four methods which landscape architects have a long history of utilizing in the discipline.

03. Mapping and diagramming reveal invisible forces acting on a place.

04. Mapping has a long history of use in landscape architecture.

05. Photomontage illustrates invisible and visible forces and flows.

06. Photography documents visible forces and flows.

07. Mapping, diagramming, and photography are mentioned within landscape architecture literature and their usefulness for dealing with post-industrial sites.

Figure 4.1. East Mine. [Author 2016]

# CHAPTER 04: GHOST ECOLOGIES: A VISUAL DIARY

This chapter grounds the literature on the oil sands and background information discussed in Chapters 01-03. These photographs reveal the visible forces and flows in the oil sands to help link the visible to the invisible maps, diagrams, and photomontage presented later. These photographs demonstrate the agency of photography as described previously by Anne Whiston Spirn and Alan Berger.

Each photograph is accompanied by a short description which helps to reveal or describe what the photograph is intended to present, evoke, or question. Various aspects of the oil sands are presented across multiple scales—from dramatic large-scale views to intimate details.

Figure 4.2. Moonscapes. [Author 2016]

The most dramatic configuration of the oil sands landscape is a combination of vast open space and large refinery plumes reaching into the big sky of Northern Alberta. The vast expanses are reminiscent of moonscapes. Moreover, it is a stunningly visual reminder of what we do to this Earth for our modernized civilization.

Figure 4.3. Money. [Author 2016]

Figure 4.4. A city of lakes (Eight photo panoramic). [Author 2016]

Vast tailings "ponds" are more like lakes. When viewed in aerial view, your mind does not readily grasp the extent of earth-moving and engineering required to create these new geographic features. Viewed on the ground, tailings ponds stretch from foreground to horizon. The ground-level view emphasizes and reminds the viewer of the intense landscape transmutation required to create these new lakes.

Figure 4.5. Boreal forest. [Author 2016]

Boreal forest is an endless sight between Edmonton and Fort McMurray. Not dissimilar to the American Mountain West or Midwest in its vastness and scale, the ecosystem context of the oil sands stretches seemingly forever in every direction.



Figure 4.6. Oil sand forest. [Author 2016]

The first memorable site of the oil sands from Fort McMurray is a logging field operation. Its stark locational contrast—with a boreal forest backdrop—is an ironic introduction to the activities of the oil sands because boreal forest removal is the first step of the oil sands mining process.

Figure 4.7. Tar River I. [Author 2016]

This image of a pipeline running through polluted river runoff in the midst of fresh snow is a stark reminder of environmental ramifications in the oil sands. Media and public relations from the Government of Alberta and oil sands companies highlight reclamation efforts and try and paint a different story about environmental risks. But it is images such as the one above that paint the oil sands in poor light.




Figure 4.8. Reclamation in Progress?. [Author 2016]

It is hard not to laugh at the dichotomy of the sign against the backdrop of refinery plumes. The moonscape, plumes, and reclamation sign are seemingly incongruent, yet this type of marketing effort is constant in the oil sands. Whether or not this vast landscape is ever returned to anything useful remains to be seen.

Figure 4.9. Evening commute. [Author 2016]

Plumes of smoke against a winter late-afternoon grey sky dominate this image. A stream of cars leave their shift in the bottom left of the image. The end of a shift in the oil sands resembles rush-hour in any other part of the world, but against a more visceral backdrop compared to skyscrapers or office towers.




Figure 4.10. Welcome to Syncrude. [Author 2016]

Syncrude is the second-largest oil sands producer but the most visible along Highway 63 which loops around the plant's main offices and refinery plant. Road and refining infrastructure is behind a series of infrastructures: roads, fences, and powerlines.

Figure 4.11. Economy and Energy. [Author 2016]

Offices and refineries intersect at the Syncrude refinery plant adjacent to Highway 63. It is a reminder of the economy of this place, supplying thousands of jobs to Canadians.



Figure 4.12. Pipelines to United States. [Author 2016]

Pipelines snake across the oil sands and underneath roads like Highway 63. Driving along Highway 63 to Fort McMurray are several signs warning "Pipeline crossing ahead." It is hard to imagine the magnitude of scale, with a span clear to the Gulf of Mexico.

Figure 4.13. Plumes of black gold. [Author 2016]

The "No Trespassing fence" serves as a solitary reminder of the private ownership of the oil sands and the destructive activities taking place on "public" Crown-owned land.



Figure 4.14. Gateway Hill reclamation project monoculture. [Author 2016]

In stark contrast to the refinery plumes is the Gateway Hill reclamation project, only a short distance away from active extraction sites.

Figure 4.15. Tar River II. [Author 2016]

The Tar River is deep in the heart of the oil sands. It is frighteningly beautiful. Beautiful because of the abstract swirls of color coarsing through its channel and frightening knowing (or not knowing) what was making the colors in this polluted waterway.



Figure 4.16. Tar River III. [Author 2016]

Figure 4.17. Fort McMurray's McMansion (Triptych). [Author 2016]

The oil sands are full of ironies. One irony is the housing typologies of single-family, split-level, and ranch houses built with traditionally low-cost materials. Luxury brand vehicles are often parked in front of these very average looking houses. It is a also shocking to realize that many of these houses sell for more than $750,000 but look no more than your standard suburban house. A house this size and style would sell for $200,000 or less in hundreds of cities in the U.S. and Canada.




Figure 4.18. Supply/Demand. [Author 2016]

Another aspect of the housing market is the over-abundance of housing in some areas, such as this relatively new subdivision conveniently located in between Fort McMurray and the oil sands.


Figure 4.19. Multi-million dollar stadium for 50,000 people. [Author 2016]

Oil has supported the development of world-class public recreation facilities for residents and visitors as seen in these images of a soccer stadium and leisure center. In total, the region has over $1B of recreation assets.


Figure 4.20. Multi-million dollar recreation facility for 50,000 people. [Author 2016]

Figure 4.21. Home away from home. [Author 2016]

Work camps house a shadow population reaching nearly 40,000 when demand is needed. These sparse and simple metal buildings are cheap housing for workers entering and leaving the oil sands industry in quick succession.




Figure 4.22. #YMMSTRONG. [Author 2016]

There is evidence of a supportive community made visible after the 2016 wildfire, highlighted by the use of #ymmstrong on signs, cars, and businesses. YMM is the Fort McMurray airport code. Airport codes are often used to "brand" regions and become cultural references (i.e., ATL stands for Atlanta, GA; MHK stands for Manhattan, KS; SLC stands for Salt Lake City, UT; DFW stands for Dallas/Fort Worth, TX).

## VISUAL DIARY: CHAPTER SUMMARY

01. The Visual Diary helps to “ground truth” the mapping and visuals explored in Section II.

02. The most prominent visual quality of the oil sands are the endless array of refinery smokestacks billowing into the clouds. It is not uncommon to see more than 7 or 8 on the horizon.

03. Housing is functional in appearance with cheap construction materials yet is the second-most expensive housing in all of Canada.

04. Water systems are dramatically dirty.

05. The juxtaposition of mining amidst the boreal forest is a strike reminder of what was once here and the amount of land which has been altered because of industry.

06. World-class facilities have been sponsored by industry to try and help support the region and be good stewards.

07. Oil sands infrastructure is extensive and haphazardly planned. Workcamps sprout up in fields with nothing but industry surrounding them. No social, cultural, or daily goods are located nearby. They are as isolated as the oil sands themselves.

## GROUNDING GHOST ECOLOGIES: SECTION SUMMARY

**01.** The Anthropocene Age suggests humans are now the dominant shapers of our landscape. The Athabasca oil sands is one example of how our need for natural resources has shaped the landscape and the relationship between humans and nature.

**02.** As more people move to cities, greater exploitation of limited resources has followed. The Athabasca oil sands have developed in response to an increased need for fossil fuels.

**03.** Discovery, development, and protection of fossil fuel economies worsen global problems of political instability, hunger, and refugees as groups fight over control of natural resources.

**04.** In a politically unstable Middle East, the development of the oil sands has become an increasingly stable source of fossil fuel for the United States. The future development of the oil sands is imminent despite speculation of peak oil and renewable sources.

**05.** Many places with single-source economies become “ghost towns” after the resource has been depleted. There is no long-term commitment to regions. This threatens social, economic, and environmental systems.

**06.** The Athabasca oil sands is following the exact model of other previous “ghost towns” and the future of the area is threatened because of this.

**07.** Reclamation can reach into the past, acknowledge the present, and assemble the future in a deeply meaningful way for the resilience of the region and address problems emerging from global fossil fuel development.

**08.** The region has a richly embedded history pre-European arrival. History and its context is imperative to the region’s identity and culture. This should not be forgotten.

**09.** Existing reclamation policy is unclear, poorly administered, and does not discuss limitations of existing reclamation technology for habitat creation.

**10.** Industries and governments operating in the oil sands are too limited in their thinking about what reclamation can mean for the region and the sites.

**11.** The only successful reclamation project in oil sands history did not reclaim the ecologies which existed prior to development. Even though it is a “certified reclaimed” site, it shows the limited capability of matching reclamation policy with the reality of reclaiming boreal forest, an incredibly complex ecosystem.

**12.** Landscape architects should embrace alteration and embedded history on a site when reclaiming the oil sands. Ignoring the present and trying to return to the past (boreal forest) leaves little room for programmatic innovation or creativity.

**13.** The region is reliant upon the oil sands for much of the economic development in the region. This is a dangerous position to be given the oil sands’ political and cultural opposition. Future economies should be considered for the economic resilience of the region.

**14.** Landscape architects can create a new ending to the Athabasca oil sands story. We can design a region which is resilient to shocks through a diversified economy, embraces landscape alteration in its culture, and speculates on the oil sands’ relationship to global problems caused by oil speculation. The oil sands can transition from a politically-controversial and infamously environmentally-damaging industry to a place of pride for Canadians. The Athabasca oil sands can become a new model for regions around the world battling their own ghost ecologies.

# SECTION TWO

## Assembling Ghost Ecologies

Landscape architecture can address 'wicked' nature of the oil sands through the four methods discussed in the last section. The specific theories and techniques of mapping, diagramming, photomontage, and photography are deployed to tell the story of the Athabasca oil sands. Because of their agency, these techniques are also beneficial to a designer considering future plans of the oil sands and to explore alternatives of its unknown future.

This section describes the specific methods, techniques, and tools used to illuminate the dilemmas and challenges of the region.


Figure 5.1. New condominiums in downtown Fort McMurray. [Author 2016]

# CHAPTER 05: STORYTELLING IN THE ATHABASCA OIL SANDS

The project's primary research question is: What are the ephemeral, spatial, and non-spatial forces acting upon the Athabasca oil sands region and how can revealing those forces inform the future?

The project began by defining four "ghost ecologies"—the forces and flows within the region that are most impacted by the oil industry, including the industry itself. Four ghost ecologies were defined: Oil, Infrastructure, Environment, and People. These were defined through initial literature including newspaper articles, periodicals, and journal articles. The four ghost ecologies also help structure the overall project and help to "tell the story" through landscape architecture. They were also selected because landscape architecture has the capacity to address these four systems.

## ANALYTICAL FRAMEWORK

An iterative framework was developed to explore the Athabasca oil sands' "ghost ecologies." The iterative nature of the framework was necessary because of the "wicked" nature of the problem and to allow for a flexible research process. This involved posing questions, exploring answers, creating visuals, questioning the questions, finding new answers, modifying visuals, making new ones, and developing a narrative to support these questions, answers, and visuals. Sometimes data analysis would inform literature to seek, sometimes literature would help to consider a needed data source. Each stage of the project—Grounding, Inquiry, Exploration, Storytelling, and Futures—had specific deliverables and methods. The iterative nature of the project meant the author was moving across these stages in loops and cycles, rather than linearly. Each of the stages is described below:

1. Grounding - Initial information was explored using newspaper articles, periodicals, scientific journals, and government websites to discover basic information and themes related to the oil sands. Early data mining efforts also helped to decide what possible methods could be utilized in the project and to determine information related to industry size, mining process, ghost towns, and wicked problems.

2. Inquiry – The grounding stage helped to define specific dilemmas and questions. The dilemmas focused on surprising or important relationships, forces, or flows of each ghost ecology. After dilemmas were identified, a series of questions were asked to help explore the dilemmas and reveal the ephemeral, spatial, and non-spatial aspects of the oil sands. Dilemmas were organized through a set of categories and themes, shown in Figure 5.2.

3. Exploration – Mapping, diagramming, photomontage, and photography form the basis for the methods used in this stage. Informed by literature, dilemmas, and questions, this stage explores the forces, flows, and relationships in the oil sands using data and visuals. The iterative process of identifying dilemmas and questions and exploring them using

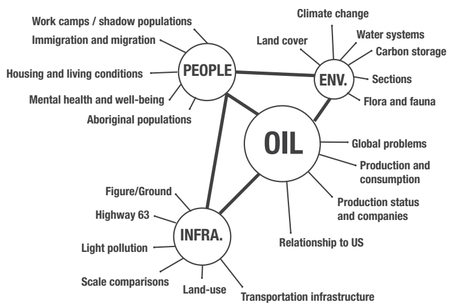



Figure 5.2. Dilemmas and Themes. [Author 2016]

data analysis and visual creation in this stage was useful in beginning the process of imagining new futures for the oil sands. The results of this process helped to tell the story of the oil sands. The Exploration stage is complex in both depth and breadth of analysis and the specific methods and tools used here is explained in more detail later.

4. Storytelling – The exploration of literature, data, dilemmas, questions—and translation of that data through mapping, diagramming, photomontage, and photography—tells the story of the ghost ecologies of the Athabasca oil sands through a series of visualizations. These visualizations are created alongside a summary and set of ideas. The ideas, born directly out of these visualizations, help to reveal new possibilities for the oil sands through the act of creation.

5. Futures – Grounding, Inquiry, Exploration, and Storytelling converge in the final stage of the framework. This project uses the term "projections" to reimagine a series of new, more productive and programmatically integrated futures for the oil sands and its people.

Figure 5.3 summarizes this framework.

## STORYTELLING IN THE ATHABASCA OIL SANDS

### Exploration Methods for Unveiling Ghost Ecologies

Mapping, diagramming, photomontage, and photography form the basis of the findings of this project from the Exploration stage of the analytical framework. The tools and techniques employed are shown in Figure 5.4. Taken together, they tell the story of the oil sands. They also incite creative thinking for new, alternative futures in the oil sands called "projections." These projections embrace the need for landscape reclamation, but do so in contrast to the unsuccessful rules and laws previously discussed in Chapter 02.

### Mapping

*Goals of Mapping:*

» Reveal unseen forces acting upon the oil sands

» Reveal unseen forces the oil sands are acting upon

» Explore cartographic and diagramming techniques and methods to create numerous visual outcomes

» Insight divergent thinking to begin projections

*Mapping Process*

Initial data mining collected spatial information to be mapped. This data helped reveal visible aspects of the oil sands like infrastructure, project site locations, and work camps. Other information was collected to reveal invisible aspects such as how the oil sands fit into global oil flows and immigration flows. The scale, time period of data, and technique are related to the type of data found. Revelations from each individual map can be used to think about new opportunities in the oil sands. It is often easy to read into maps or diagrams what the reader wants to see—they can be subjective—so maps are directly related to a list of divergent brainstorming ideas to minimize this possibility. In other words, there is a direct relationship between the map and the brainstorming ideas. To help tie project components together, each map in Section Three includes the inquiry/question, conclusion, and brainstorming list derived from the revelation shown in the map. Conclusions are drawn from each mapped system at the end of the chapters exploring each ghost ecology (oil, infrastructure, environment, people).

### Diagramming

*Goals of Diagrams:*

» Describe relationships and processes in a non-spatial way

» Reveal significant, salient facts and data in simple visuals

*Diagram Process*

Diagrams supplement the maps and are sometimes included in the same graphic as the map, layering two pieces of information together. Diagrams help reveal surprising facts and statistics related to the map or topic of the map.

### Photomontage

*Goals of Photomontage:*

» Explore relationships revealed in maps and diagrams

» Insight convergent and divergent thinking to begin projections

*Photomontage Process*

Images were extracted using copyright-free internet images. They began often with a photograph from the author forming the background or basis of the montage with the internet images supplementing and adding to the composition of the author's photograph.

Photomontage presented in Section Three is used in tandem with the maps and diagrams to display evocative visuals to synthesize and summarize a series of maps and diagrams. Following the literature on eidetic photomontage, these photomontages were a generative and revelatory tool for the author, beginning to lead towards projections of futures in the oil sands. Additional montages are seen in Section Four: Projections to evoke new relationships and possibilities.

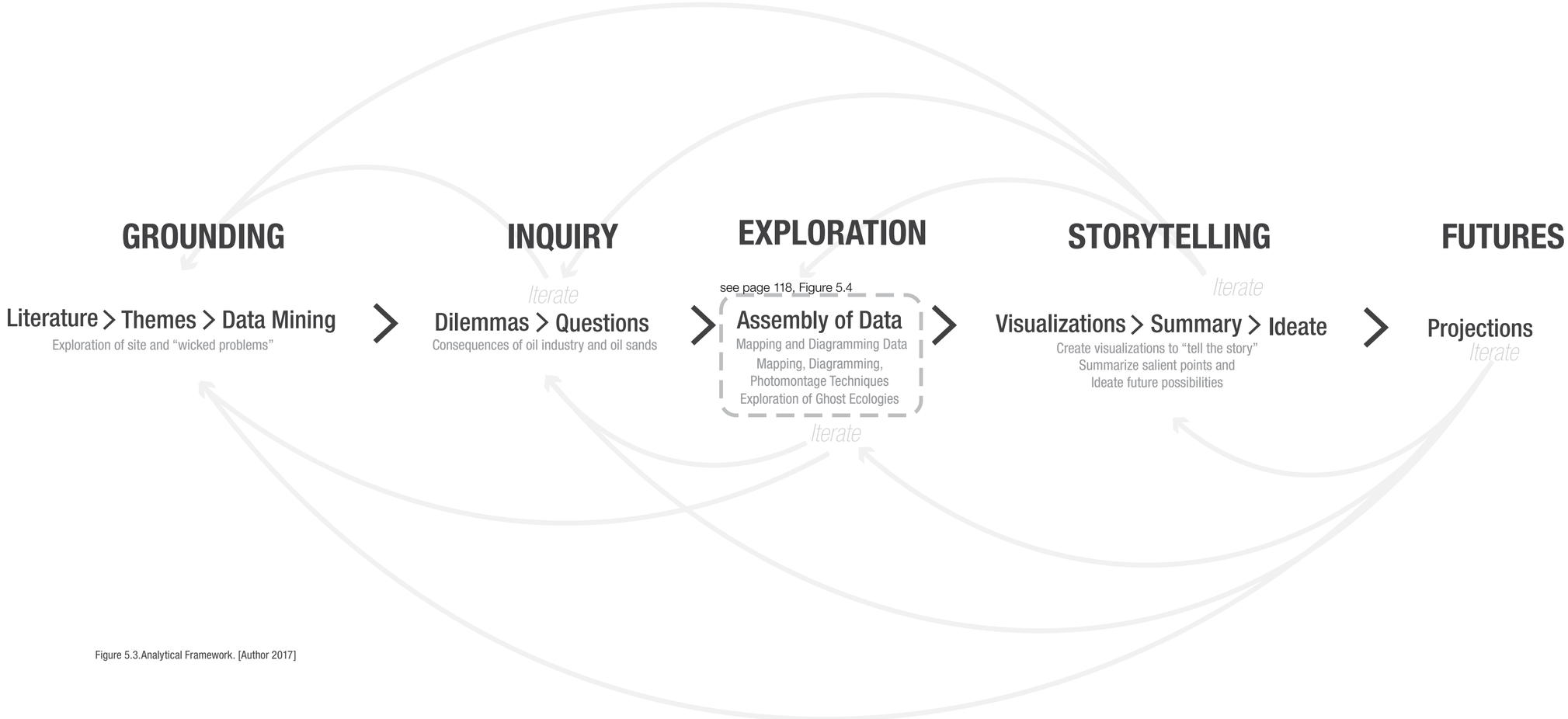



Figure 5.3.Analytical Framework. [Author 2017]

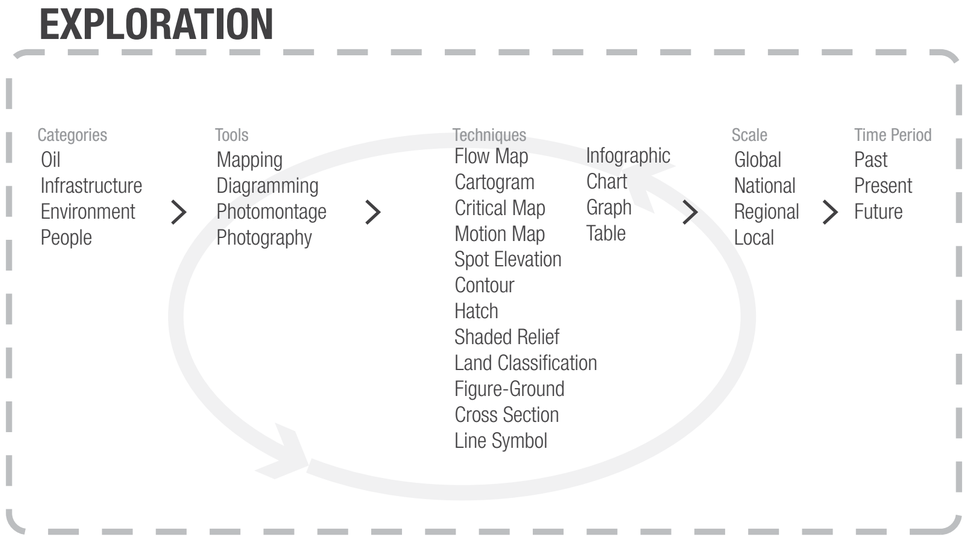



Figure 5.4. Exploration Stage: Tools and Techniques. [Author 2017]

### Photography

*Goals of Photography:*

- Communicate the current reality of the oil sands region to others reading this project
- Ground the literature and background information presented in Section I.
- Provide the author with initial understanding of landscape changes and cultural qualities of the oil sands and region.
- Provide an initial foray into divergent thinking of new futures in the oil sands

*Photography Process*

A three-day site visit was used to make hundreds of photographs of the oil sands and Fort McMurray community. A select few were chosen for publication in this project to reveal the most salient relationships and qualities of the oil sands in the Visual Diary in Section Two and are also used in the photomontages in Section Three. The photographs were made on public property as the author did not have access to private property in the oil sands.

Maps and diagrams are abstractions. They can be visually striking, yet confusing to certain audiences. While the audience for this project is landscape architects attuned to reading, analyzing, and interpreting such abstract two-dimensional graphics, photography was also useful in the oil sands. On-site photography presented in Section Two grounded abstract qualities of the mappings, diagrams, and datascapes presented in Section Three. It was a way of seeing the oil sands for what they really are, not in the abstract, but in its on-the-ground reality. It was a tool to think about the oil sands as a place amongst spatio-temporal dimensions. It revealed to the author a new scale of the oil sands and revealed the physical, social, and economic realities of the location. It also began to reveal future new stories in the oil sands.

## PROJECTING GHOST ECOLOGIES

*Goals of Projections:*

- Tell new story of “ghost ecologies” to set new directions
- Clarify future planning and design dilemmas and opportunities
- Show creative alternatives and novel ideas as an antagonist to current policy and practices
- Demonstrate agency of mapping and diagramming

An alternative to a standard “design proposal” these highly imaginative and speculative images begin to illustrate and reveal new and unique opportunities. Through use of maps, diagrams, photomontage, and photography the oil sands can become better understood. Projections composite situations together—spatial, and non-spatial, large-scale and small. Projections help provide answers to the questions “what, when, and where?” The goal is to provide, in the famous words of Edward Tufte, “beautiful evidence” (Tufte 2013). Telling the story through visuals and text fills current gaps in knowledge, synthesis,

and understanding of the oil sands. It reveals unseen or new questions, relationships, opportunities, and issues. These revelations can help inform new endings to the oil sands story. Through a combination of photo-realistic photomontages and eidetic photomontages, new programmatic opportunities in the oil sands were imagined. They converge the four systems analyzed to project forward new spatial relationship and new reclamation opportunities in the oil sands.

## ASSEMBLING GHOST ECOLOGIES: SECTION SUMMARY

**01.** An analytical framework was used to tell the story of the oil sands; revealing unforeseen forces, flows, and relationships across the themes of oil, industry, environ. people.

**02.** Literature, news articles, and the site visit helped to collect salient information in the beginning stages of this project.

**03.** An iterative process of data mining, mapping and re-mapping, diagramming and re-diagramming is used to reveal forces and flows.

**04.** Projections are based on the mappings, diagramming, photomontage, and photography to reveal new endings in the oil sands.

# SECTION THREE

## Unveiling Ghost Ecologies

The development of the oil sands has created significant environmental, social, and infrastructural costs. It has created environmental side effects including impacts on migration routes and animal habitat, water degradation and groundwater pollution, topsoil removal, amongst other effects. Oil sands have created a significant wage gap, affordable housing issues for people, and development pressures for the region and Fort McMurray. While these dilemmas can be understood individually, the complexity and wicked nature of the oil sands may prevent stakeholders from fully understanding the complex relationships and processes shaping the oil sands and those relationships and processes the oil sands shape. Therefore, the goal of this section is to unveil those forces.

# What flows, forces, and processes are acting upon the oil sands' systems of: oil, infrastructure, environment, and people?

Following the analytical framework discussed in the previous chapter, this section asks specific questions (inquiry), provides brief answers to the questions (conclusion), and considers new opportunities for the oil sands region through divergent thinking (projections). Divergent thinking allows the exploration of many possible solutions within a set of information. Four main themes called "ghost ecologies" were explored, as outlined in the analytical framework and Introduction.

- Oil: The oil industry is impacted by outside forces which shape the oil sands. The oil sands also shape outside forces. Substantial amounts of money invested propel the industry forward into the future.
- Infrastructure: Oil has required the region to grow in unusual ways because of how one-industry towns are typically built and developed.
- Environment: Destruction of our natural landscapes for resource extraction removes healthy ecosystems.
- People: Embedded historic and cultural legacy of people that used to live here and the impacts of people that now live here.

Key dilemmas and questions were identified to explore each of these "ghost ecologies" using the structure below. The structure explains a map or diagram. Bold text is used to highlight the most salient, significant points the visualization demonstrates. Each visualization includes each of these headings:

1. **Inquiry** asks a question of data based on the dilemmas identified through literature review.
2. **Visual Strategy** describes the process for how the visualization was created.
3. **Conclusion** summarizes the map or diagram.
4. **Projections** suggest creative ideas for future oil sands programming based on the visualization.

Figure 6.1- Syncrude refinery and offices near Highway 63. [Author 2016]

# CHAPTER 06: UNVEILING OIL

## DILEMMA

**Negative externalities of the oil industry contribute to global warming, energy insecurity, war and terror, human rights violations, and pollution.**

Search for and extraction of oil resources has produced a series of negative externalities, showing the true consequences of oil. These externalities include global warming, energy insecurity, war and terror, human rights violations, and pollution. Coupled with the strategic location of the oil sands in a politically-neutral and safe country, development of the oil sands is likely to continue into the future, placing Canada and its natural resources in the midst of some of the world's most challenging problems.

Fossil fuels are driving climate change. According to researchers, to have a decent shot at limiting global warming to even 2°C, 80% of the fossil fuels we already have access to must stay in the ground (McKibben 2012). The unconventional and large expanse of oil sands in Canada represent one of the biggest sources of fossil fuel in the ground.

Dependence on oil brings multiple threats to global security. Economies are left vulnerable by relying on production or whether it is a country relying on consumption to fuel their economy, cars, and industry. The United States has doubled production of oil since 2008 yet still imports 40% of its total petroleum (Oil Change International 2017). Net import reliance is 25%.

Oil has been connected to war and violence throughout history including World War I, World War II. "One-quarter and one-half of all interstate wars since 1973 have been linked to oil and that oil-producing countries are 50% more likely to have civil wars" (Oil Change International 2017). Militarization of the Middle East has been linked to oil reserves which account for more than half of all oil reserves. United States military presence—at an estimated cost of over $8 trillion since 1976—has exacerbated regional tensions and instability (Oil Change International 2017).

Connections between oil production and human rights abuses have been documented in Nigera, Myanmar, Ecuador and the Middle East. But the problem is not just in the Middle East. Recent examples in the United States and Canada raise human rights concerns in communities near fracking, Keystone XL pipeline, and the oil sands.

The oil sands exist within a web of negative externalities described above. The oil sands are a site linked to the United States through pipelines and oil refineries and the rest of the world due to its insatiable need for oil. Because of this, the Athabasca oil sands are an important political and economic engine in North America. The ability to get oil from outside the volatile Middle East paves the way for continued development of the oil sands. Due to their size, it is feasible the oil sands become the sole source of U.S. oil. This is particularly true if the US begins to tackle climate change and reduce its dependence on oil. It can be assumed development of the oil sands will continue despite volatility of the oil markets

because demand for oil in the U.S. continues. The location and size of the oil sands in a politically-neutral country near the United States offers a compelling question to consider:

## QUESTION

How will the oil sands become a primary source of fossil fuel in the future amidst the global scene of resource extraction?

## CONCLUSIONS

- Oil sands light emittance as large as major U.S. and Canadian cities
- Six countries responsible for 50% of oil consumption
- Oil sands located to feed oil-hungry U.S.
- Oil sands located in politically stable country with third largest reserves in world
- Oil producing countries are 50% more likely to have civil wars
- Oil routes interact with countries experiencing hunger
- Refugees flee oil-producing countries for oil-consuming countries
- Between 1999 and 2013, approximately $201 billion was invested in the oil sands industry.
- Land leasing continues miles away from Fort McMurray
- Oil sands production increases as footprint grows
- Oil industry spreads like virus through landscape
- Scale of potential oil sands area is difficult to comprehend
- Scale of existing oil sands larger than US cities
- Fifty-five companies own lease rights, many from outside of Canada
- Controversial Keystone xl pipeline expansion set to send more oil sands to US markets
- Recently completed and proposed pipelines cost over $38 billion dollars



see page 130

# OIL SANDS LIGHT EMITTANCE AS LARGE AS MAJOR U.S. AND CANADIAN CITIES

**Figure 6.2. Athabasca oil sands visible from space [Author 2017]**

*Data Source: Night Earth 2016*

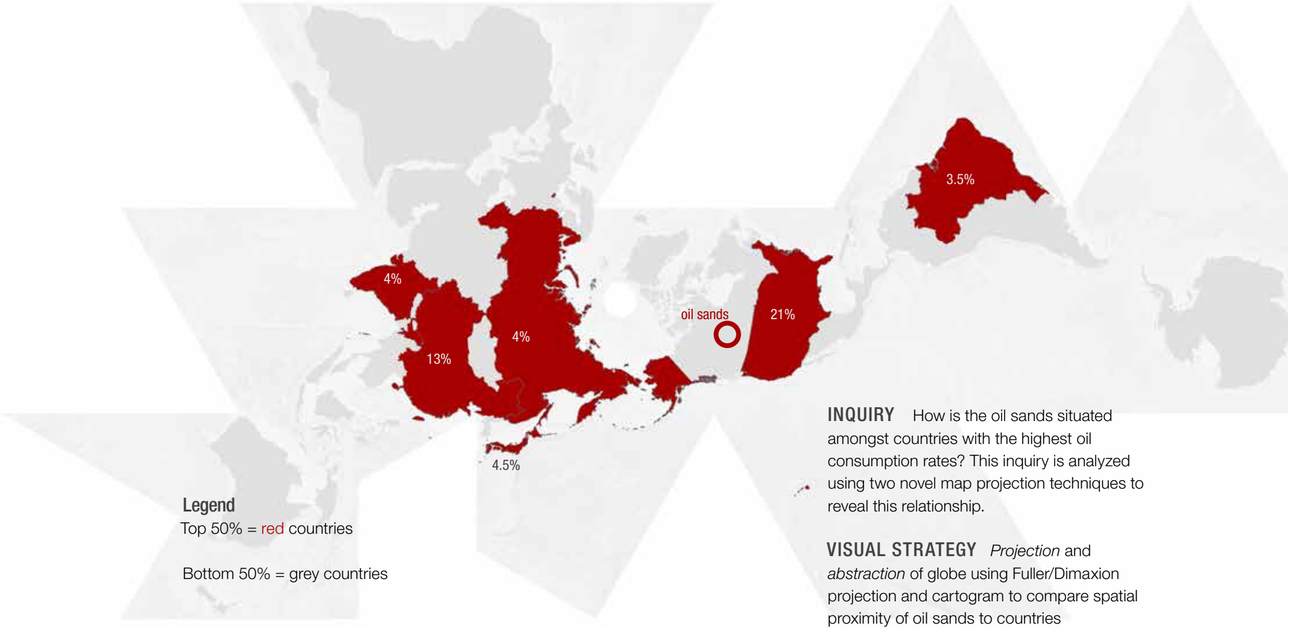
**INQUIRY** How does the existing oil sands development footprint compare to other large developments in the U.S.?

**VISUAL STRATEGY** *Selection* of key cities for comparison to oil sands light emittance displayed through aerial photograph

**CONCLUSION** The oil sands development can be seen from space and its development is comparable to other large metro areas in Canada and the United States.


ATHABASCA OIL SANDS REGION
Northern Alberta, Canada
Population: 61,374
Vancouver, British Columbia, Canada
Population: 603,500
Minneapolis, Minnesota, United States
Population: 3,500,000
Denver Metro region, Colorado, United States
Population: 3,000,000

## SIX COUNTRIES RESPONSIBLE FOR 50% OF OIL CONSUMPTION




**Legend**
Top 50% = red countries

Bottom 50% = grey countries

**Figure 6.3. Oil sands located in the middle of oil consumption [Author 2017]**
Countries with largest oil consumption are located close to oil sands

*Data Source: US Energy Information Administration 2014*

**INQUIRY** How is the oil sands situated amongst countries with the highest oil consumption rates? This inquiry is analyzed using two novel map projection techniques to reveal this relationship.

**VISUAL STRATEGY** *Projection* and *abstraction* of globe using Fuller/Dimaxion projection and cartogram to compare spatial proximity of oil sands to countries

**CONCLUSION** Oil sands in Canada, as viewed using a Dimaxion projection, is located in close proximity to China, Russia, and the United States.

## OIL SANDS LOCATED TO FEED OIL-HUNGRY U.S.

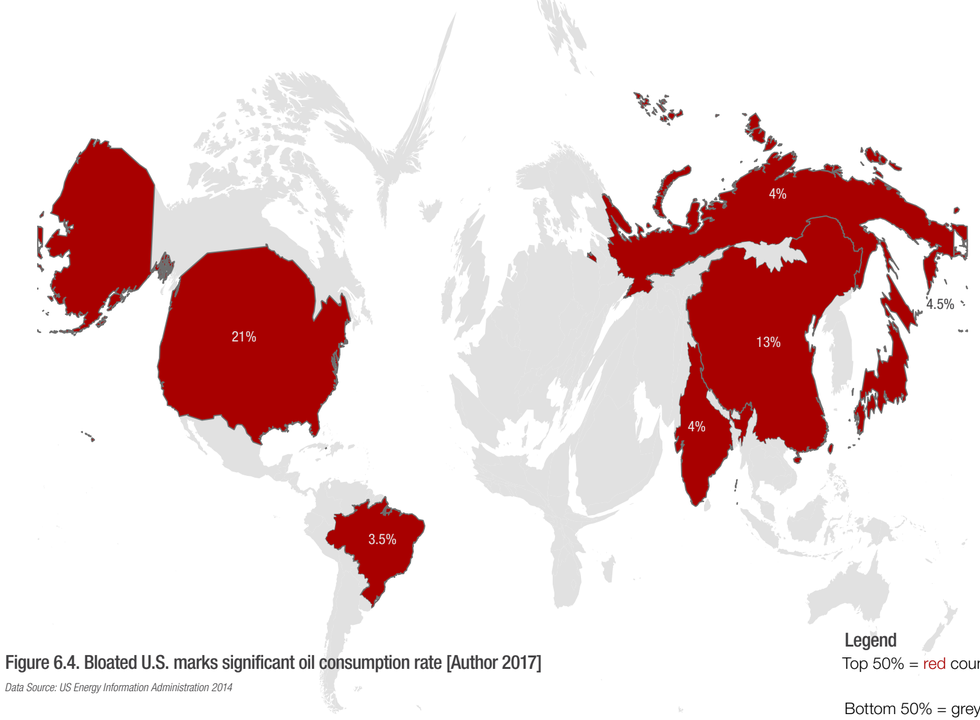
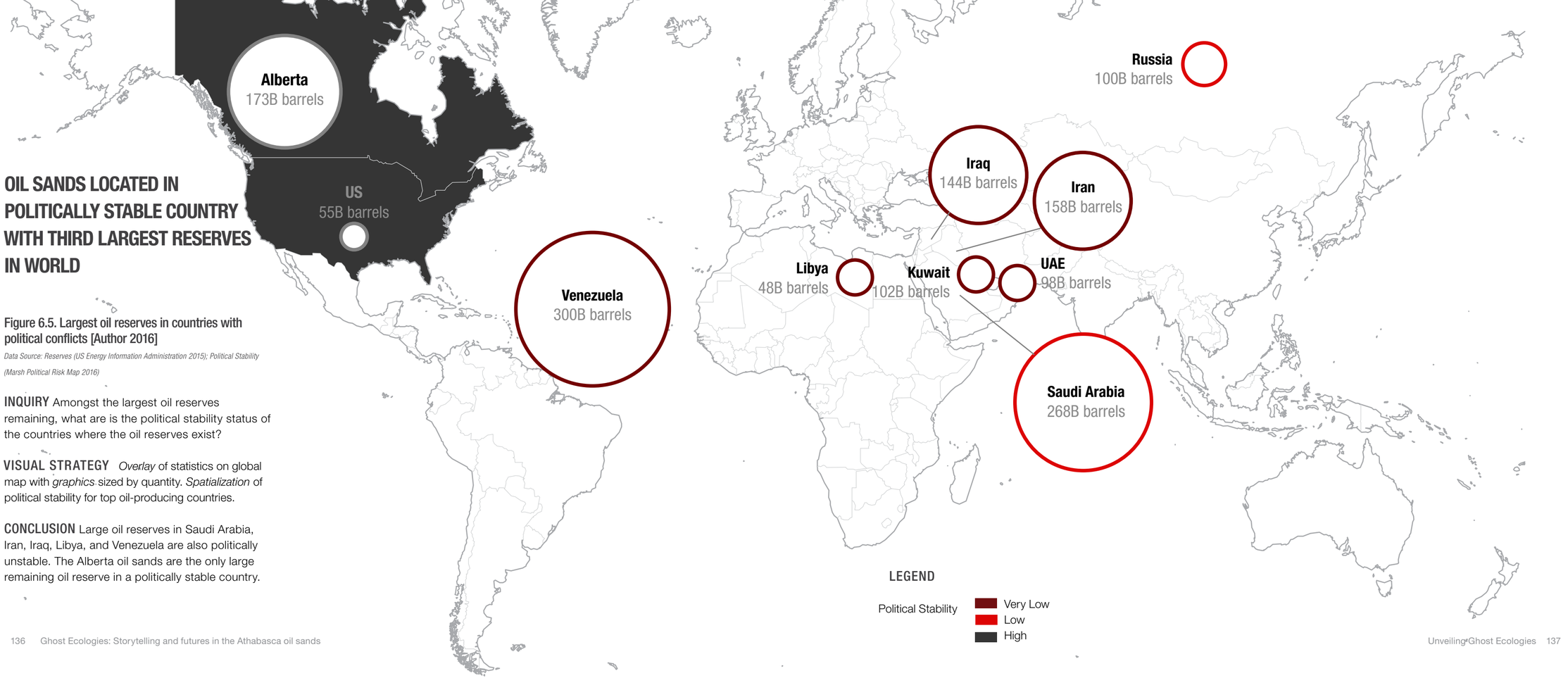



**Figure 6.4. Bloated U.S. marks significant oil consumption rate [Author 2017]**

*Data Source: US Energy Information Administration 2014*

**Legend**
Top 50% = red countries

Bottom 50% = grey countries




## OIL SANDS LOCATED IN POLITICALLY STABLE COUNTRY WITH THIRD LARGEST RESERVES IN WORLD

**Figure 6.5. Largest oil reserves in countries with political conflicts [Author 2016]**

*Data Source: Reserves (US Energy Information Administration 2015); Political Stability (Marsh Political Risk Map 2016)*

**INQUIRY** Amongst the largest oil reserves remaining, what are is the political stability status of the countries where the oil reserves exist?

**VISUAL STRATEGY** *Overlay* of statistics on global map with *graphics* sized by quantity. *Spatialization* of political stability for top oil-producing countries.

**CONCLUSION** Large oil reserves in Saudi Arabia, Iran, Iraq, Libya, and Venezuela are also politically unstable. The Alberta oil sands are the only large remaining oil reserve in a politically stable country.

See page 138

## OIL PRODUCING COUNTRIES ARE 50% MORE LIKELY TO HAVE CIVIL WARS

**Figure 6.6. Major oil chokepoints and oil routes near politically unstable countries [Author 2016]**

*Data Source: Major Political conflicts (Global Peace Index 2014); Chokepoints (US Energy Information Administration 2015); Routes (Marine Knowledge 2011)*

**INQUIRY** What is the relationship between oil shipping routes and political stability?

**VISUAL STRATEGY** *Flow arrows* of global oil routes on world map *spatialzing* major ongoing conflicts by country.

**CONCLUSION** Oil import routes and chokepoints coincide with countries which are less politically stable. In fact, "one-quarter and one-half of all interstate wars since 1975 have been linked to oil... Oil producing countries are 50% more likely to have civil wars" (Oil Change International 2017). The Canadian oil sands is unique n its position outside the Middle East and with close proximity to the US.

**PROJECTIONS** Addressing global oil issues with site reclamation; refugee camp/sanctuary; reduce oil production to reduce risk of Canada becoming like other oil-producing countries

See page 140

## OIL ROUTES INTERACT WITH COUNTRIES EXPERIENCING HUNGER

**Figure 6.7. Oil routes connect to areas with high rates of hunger [Author 2016]**

*Data Source: Major Hunger areas (Global Hunger Index 2015); Chokepoints (US Energy Information Administration 2015); Routes (Marine Knowledge 2011)*

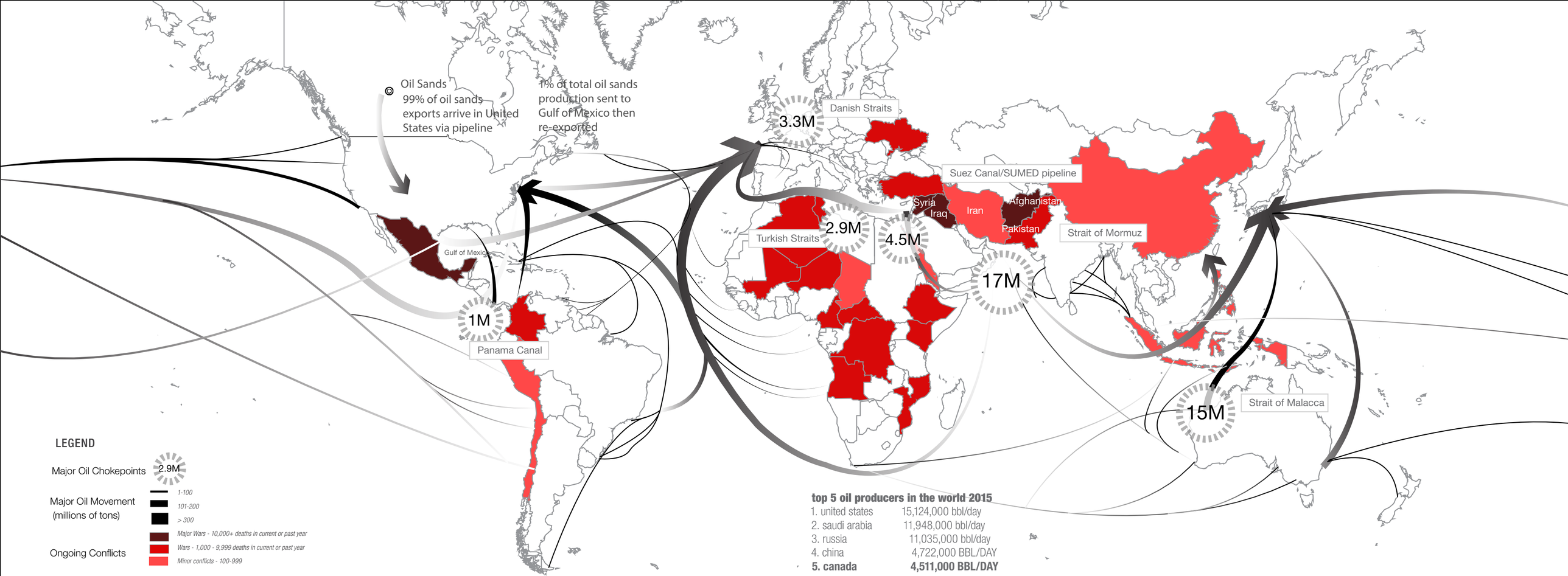
**INQUIRY** How does oil production interact with global problems such as the hunger crisis?

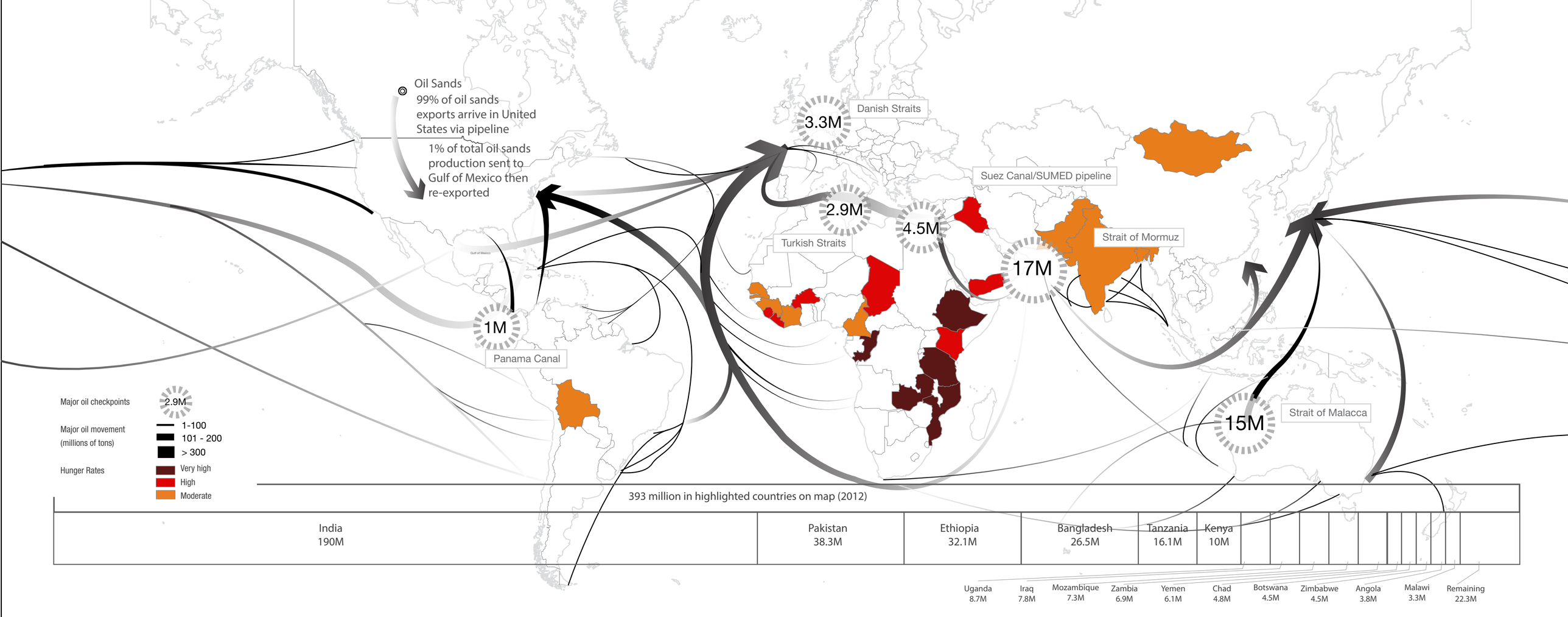
**VISUAL STRATEGY** *Flow arrows* of global oil routes on world map *spatialzing* major hunger areas by country.

**CONCLUSION** Oil routes connect to areas with high rates of hunger particularly in India, Pakistan, and Sub-saharan Africa.

**PROJECTIONS** Oil sands food production; use pipelines to ship new liquid food products to Middle East to support hunger crisis; refugee sanctuary in oil sands; agricultural training facility; school lunch organic agriculture production facility


Figure 6.8. The consequences of oil [Author 2017]


Oil Sands
99% of oil sands exports arrive in United States via pipeline
1% of total oil sands production sent to Gulf of Mexico then re-exported
3.3M
Danish Straits
Suez Canal/SUMED pipeline
Syria
Iraq
Iran
Afghanistan
Pakistan
Strait of Mormuz
2.9M
Turkish Straits
4.5M
17M
Gulf of Mexico
1M
Panama Canal
15M
Strait of Malacca
LEGEND
Major Oil Chokepoints
2.9M
Major Oil Movement (millions of tons)
1-100
101-200
> 300
Ongoing Conflicts
Major Wars - 10,000+ deaths in current or past year
Wars - 1,000 - 9,999 deaths in current or past year
Minor conflicts - 100-999
top 5 oil producers in the world 2015
1. united states 15,124,000 bbl/day
2. saudi arabia 11,948,000 bbl/day
3. russia 11,035,000 bbl/day
4. china 4,722,000 BBL/DAY
5. canada 4,511,000 BBL/DAY


Oil Sands
99% of oil sands exports arrive in United States via pipeline
1% of total oil sands production sent to Gulf of Mexico then re-exported
Gulf of Mexico
3.3M
Danish Straits
2.9M
Turkish Straits
4.5M
Suez Canal/SUMED pipeline
17M
Strait of Mormuz
1M
Panama Canal
15M
Strait of Malacca
Major oil checkpoints
2.9M
Major oil movement (millions of tons)
1-100
101 - 200
> 300
Hunger Rates
Very high
High
Moderate
393 million in highlighted countries on map (2012)
India 190M
Pakistan 38.3M
Ethiopia 32.1M
Bangladesh 26.5M
Tanzania 16.1M
Kenya 10M
Uganda 8.7M
Iraq 7.8M
Mozambique 7.3M
Zambia 6.9M
Yemen 6.1M
Chad 4.8M
Botswana 4.5M
Zimbabwe 4.5M
Angola 3.8M
Malawi 3.3M
Remaining 22.3M

## REFUGEES FLEE OIL-PRODUCING COUNTRIES FOR OIL-CONSUMING COUNTRIES

**Figure 6.9. Refugee crisis interacts with oil industry [Author 2016]**

Oil industry exacerbates increase in refugee populations

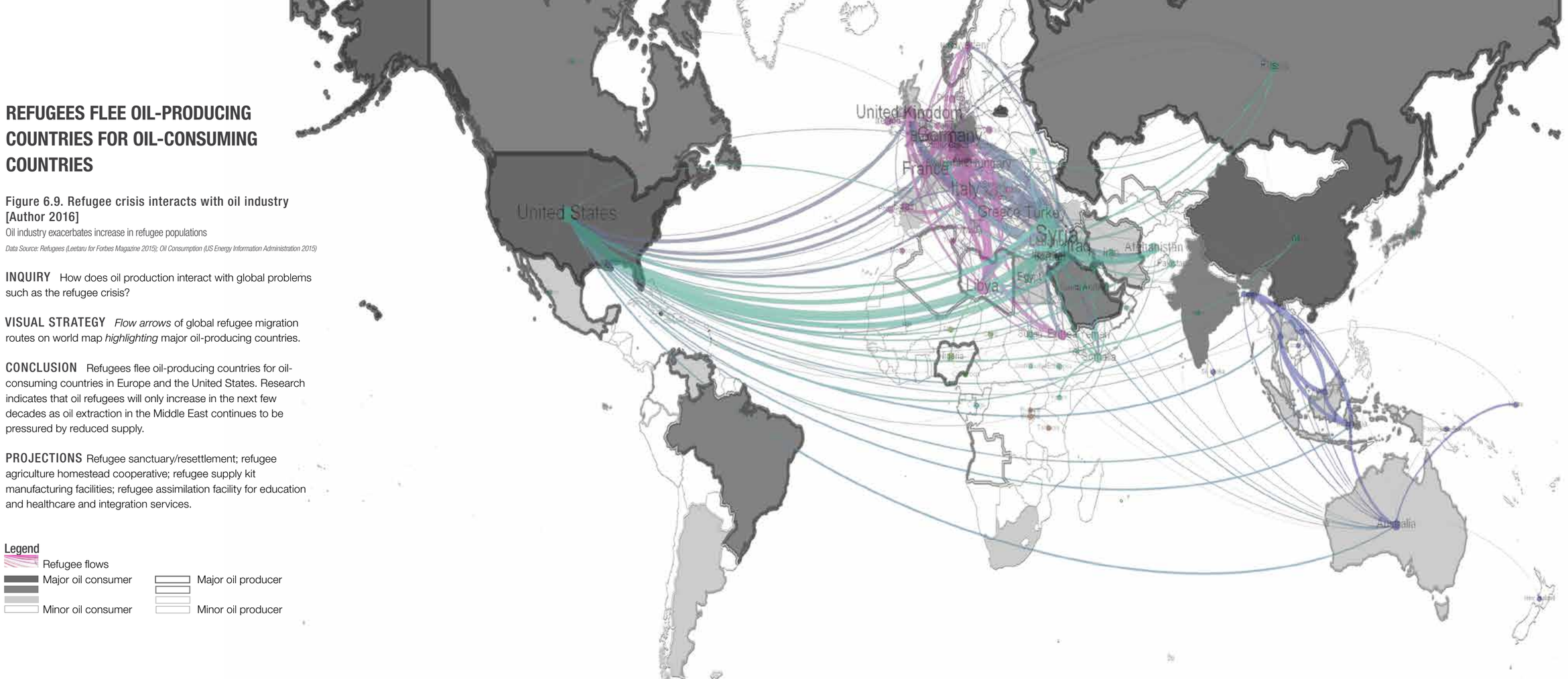
*Data Source: Refugees (Leetaru for Forbes Magazine 2015); Oil Consumption (US Energy Information Administration 2015)*

**INQUIRY** How does oil production interact with global problems such as the refugee crisis?

**VISUAL STRATEGY** *Flow arrows* of global refugee migration routes on world map *highlighting* major oil-producing countries.

**CONCLUSION** Refugees flee oil-producing countries for oil-consuming countries in Europe and the United States. Research indicates that oil refugees will only increase in the next few decades as oil extraction in the Middle East continues to be pressured by reduced supply.

**PROJECTIONS** Refugee sanctuary/resettlement; refugee agriculture homestead cooperative; refugee supply kit manufacturing facilities; refugee assimilation facility for education and healthcare and integration services.



## BETWEEN 1999 AND 2013, APPROXIMATELY $201 BILLION WAS INVESTED IN THE OIL SANDS INDUSTRY.

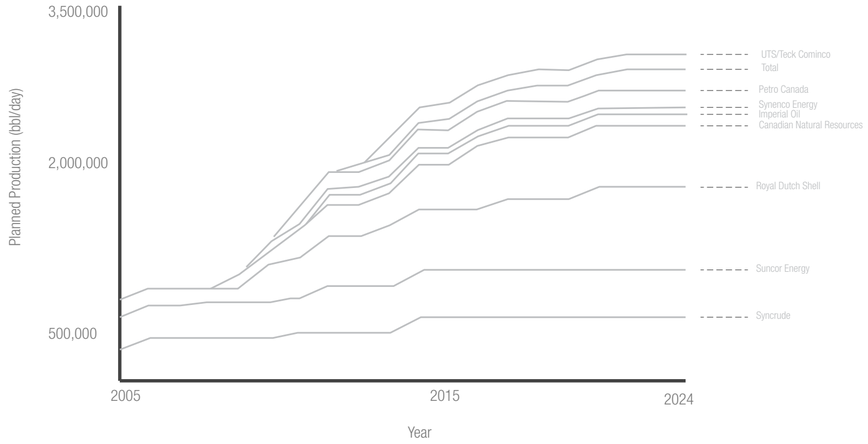



**Figure 6.10. Production by major operators planned for years to come [Author 2017]**

**INQUIRY** How dramatically will the oil sands production increase in the future?

**VISUAL STRATEGY** *Quantification* of past and projected oil production through stacked line chart showing major producers largest-smallest.

**CONCLUSION** Future production is dependent on many variables, but major oil sands operators are predicting steady growth from 2015 through 2024.



## LAND LEASING CONTINUES MILES AWAY FROM FORT MCMURRAY

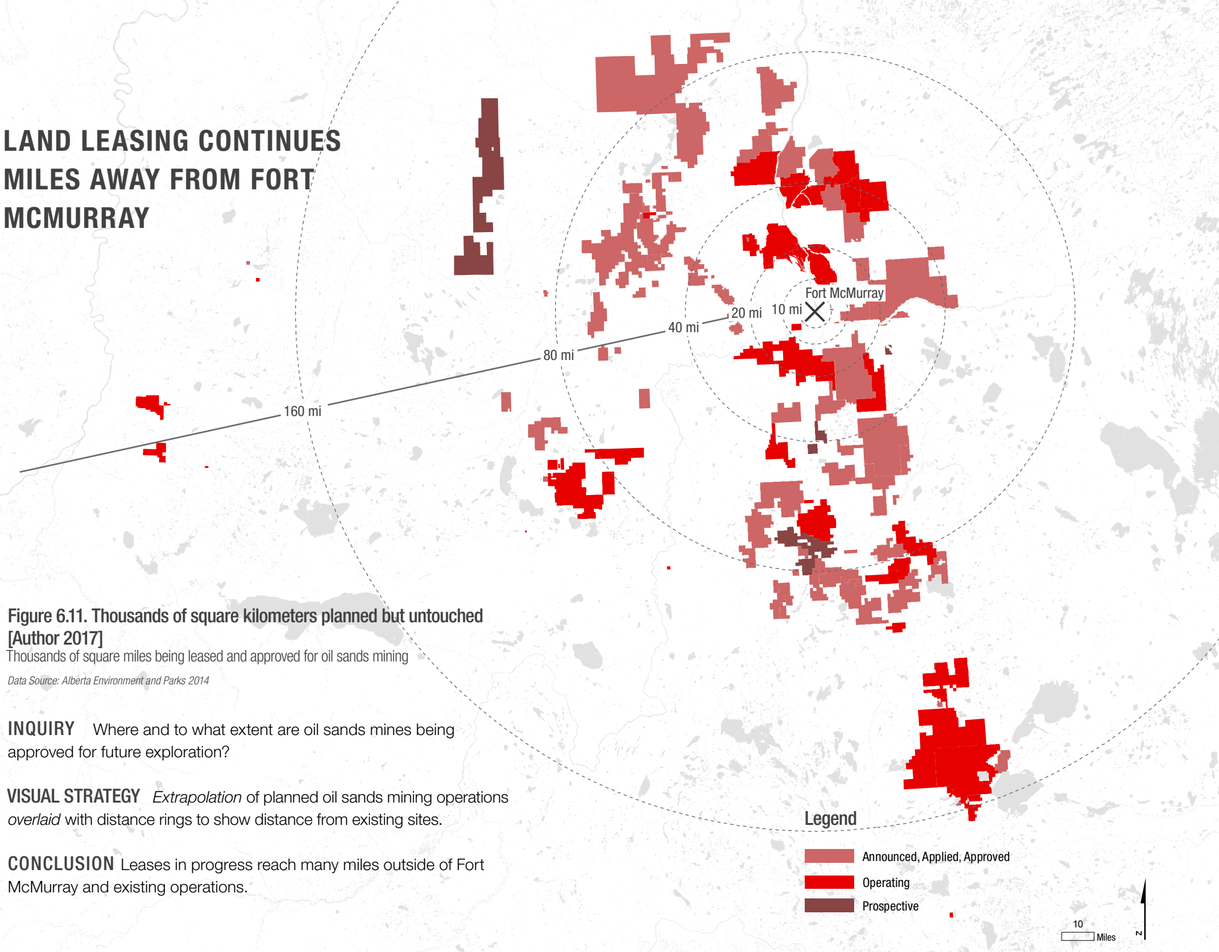



**Figure 6.11. Thousands of square kilometers planned but untouched [Author 2017]**
Thousands of square miles being leased and approved for oil sands mining

*Data Source: Alberta Environment and Parks 2014*

**INQUIRY** Where and to what extent are oil sands mines being approved for future exploration?

**VISUAL STRATEGY** *Extrapolation* of planned oil sands mining operations *overlaid* with distance rings to show distance from existing sites.

**CONCLUSION** Leases in progress reach many miles outside of Fort McMurray and existing operations.

See page 148

## OIL SANDS PRODUCTION INCREASES AS FOOTPRINT GROWS

**Figure 6.12. Oil sands footprints grows [Author 2017]**
Aerial photographs reveal landscape change
*Data Source: Alberta Enviornment and Parks 2014*

**INQUIRY** How has the production capacity increased as the oil sands footprint has changed since the 1980s?

**VISUAL STRATEGY** *Reconstruction* of oil sands development by major years *overlaid* with production statistics.

**CONCLUSION** Oil sands companies have acquired land south, west, and southwest of the original areas and continue to grow rapidly, including major expansion in 2014.

See page 150

## OIL INDUSTRY SPREADS LIKE VIRUS THROUGH LANDSCAPE

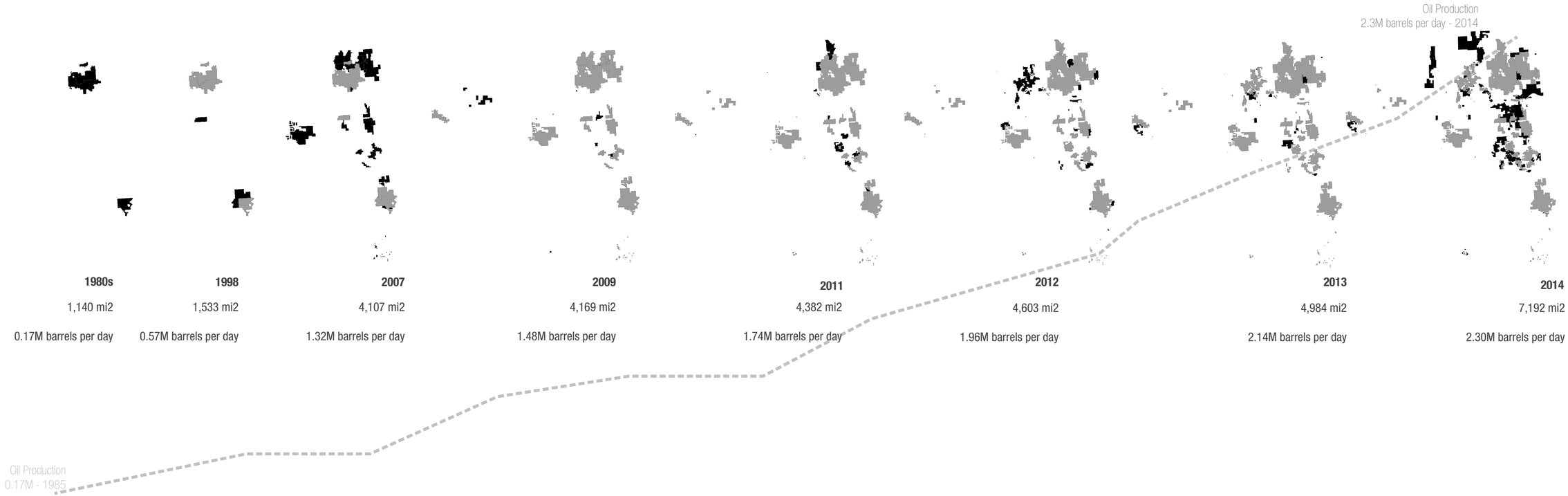
**Figure 6.13. Oil sands spreading rapidly [Author 2017]**
Aerial photographs reveal landscape change
*Data Source: NASA 2010*

**INQUIRY** Where has oil sands development spread and in what direction?

**VISUAL STRATEGY** *Sequence* of oil sands development aerials in 5 year increments showing spread of deforestation and creation of tailings ponds.

**CONCLUSION** The largest extent of oil sands development continues to spread south and southeast through the boreal forest.

Figure 6.14. Code Blue: Oil Sands virus detected [Author 2017]




**1980s**
1,140 mi2
0.17M barrels per day

**1998**
1,533 mi2
0.57M barrels per day

**2007**
4,107 mi2
1.32M barrels per day

**2009**
4,169 mi2
1.48M barrels per day

**2011**
4,382 mi2
1.74M barrels per day

**2012**
4,603 mi2
1.96M barrels per day

**2013**
4,984 mi2
2.14M barrels per day

**2014**
7,192 mi2
2.30M barrels per day

Alberta Energy and Environment, 2013
Barrels Per Day 1985-2011: Hughes GSR Inc.,
Barrels Per Day 2012, 2013: Alberta Energy

1985

1990

1995

2000

2005

2010

# SCALE OF POTENTIAL OIL SANDS AREA IS DIFFICULT TO COMPREHEND

**Figure 6.15. Oil sands potential area larger than states and major U.S. cities [Author 2017]**

Scale comparisons reveal potential extent of oil sands

*Data Source: Athabasca Oil Sands Boundary (ArcGIS Online 2017); States and Cities (US Census TIGER files 2016); National Parks (US National Park Service 2016); Countries (ESRI 2010)*

**INQUIRY** How does the size of the oil sands potential minable area compare to other geographies such as cities, states, and even countries?

**VISUAL STRATEGY** *Isolation* of potential future oil sands development boundary to *compare* against political boundaries of cities, states, and US national parks.

**CONCLUSION** The potential minable area is significantly larger than major US cities such as Boston and Chicago and national parks such as Yellowstone and Yosemite. The most accurate scale comparison is that of South Carolina.

**Legend**

- Oil sands
- Comparable

San Francisco
593X smaller

Grand Teton National Park
58X smaller

Chicago
122X smaller

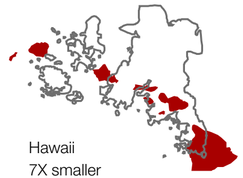
London
46X smaller

Boston
580X smaller

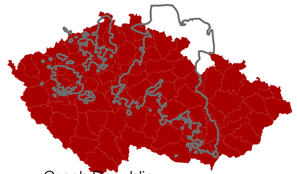
Yellowstone National Park
80X smaller

Yosemite National Park
24X smaller

Rhode Island
23X smaller



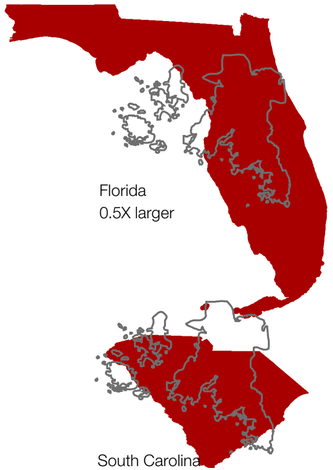
Hawaii
7X smaller



Czech Republic
0.9X larger

Grand Canyon National Park
15X smaller

Lake Huron
1.2X smaller



Florida
0.5X larger

South Carolina
0.8X larger

Delaware
11X smaller

Switzerland
1.7X smaller

# SCALE OF EXISTING OIL SANDS LARGER THAN US CITIES

**Figure 6.16. Current oil sands development as large as major US cities [Author 2016]**

*Data Source: Aerial image (ESRI 2016); Cities (ESRI 2016)*

**INQUIRY** How do current oil sands development areas compare to major US cities?

**VISUAL STRATEGY** *Comparison* of *existing* oil sands development aerial with major US cities political boundaries.

**CONCLUSION** The scale of the oil sands is difficult to comprehend with existing landscape change as large as US cities.

# FIFTY-FIVE COMPANIES OWN LEASE RIGHTS, MANY FROM OUTSIDE OF CANADA

**Figure 6.17. Numerous global firms control oil sands leases [Author 2017]**

*Data Source: Alberta Environment and Parks 2014*

**INQUIRY** What companies own oil sands rights?

**VISUAL STRATEGY** *Extrapolation* of planned oil sands mining operations *overlaid* with distance rings to show distance from existing sites and oil sands companies to show quantity of companies and complexity of ownership.

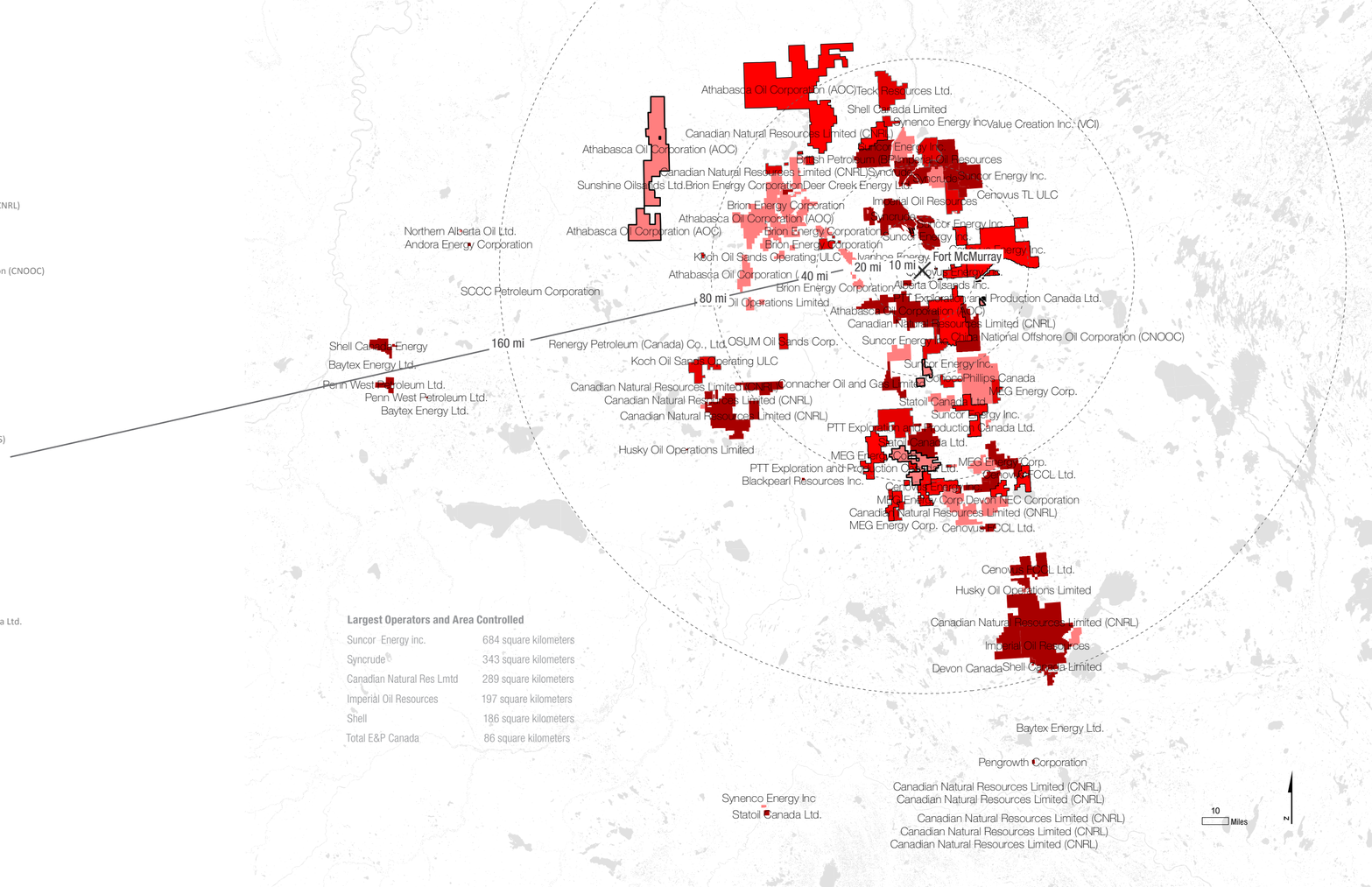
**CONCLUSION** International companies own rights to the oil sands. The complexity of ownership alone reveals the industry's view of the oil sands and the potential of this area's future.

**PROJECTIONS** Opportunities to diversify company portfolio: solar energy; geothermal energy; food; agriculture and crop production; biofuel/ethanol.

**Legend**

- Announced
- Applied
- Approved
- Operating

Alberta Oilsands Inc.
Andora Energy Corporation
Athabasca Oil Corporation (AOC)
Baytex Energy Ltd.
Birchwood Resources Inc.
Blackpearl Resources Inc.
Brion Energy Corporation
British Petroleum (BP)
Canadian Natural Resources Limited (CNRL)
Cavalier Energy Inc.
Cenovus Energy Inc.
Cenovus FCCL Ltd.
Cenovus TL ULC
China National Offshore Oil Corporation (CNOOC)
Connacher Oil and Gas Limited
ConocoPhillips Canada
Deer Creek Energy Ltd.
Devon Canada
Devon Canada Corporation
Devon NEC Corporation
E-T Energy Ltd.
Grizzly Oil Sands ULC
Harvest Operations Corp.
Husky Oil Operations Limited
Imperial Oil Resources
Ivanhoe Energy Inc.
Japan Canada Oil Sands Limited (JACOS)
Koch Oil Sands Operating ULC
Laricina Energy Ltd.
Marathon Oil Canada Corporation
MEG Energy Corp.
Murphy Oil Company Ltd.
Northern Alberta Oil Ltd.
NorthWest Upgrading Inc.
Oak Point Energy Ltd.
OSUM Oil Sands Corp.
Pengrowth Corporation
Penn West Petroleum Ltd.
Petro-Canada
Prosper Petroleum Ltd.
PTT Exploration and Production Canada Ltd.
Renergy Petroleum (Canada) Co., Ltd.
SCCC Petroleum Corporation
Shell Canada Energy
Shell Canada Limited
Southern Pacific Resource Corp.
Statoil Canada Ltd.
Suncor Energy Inc.
Sunshine Oilsands Ltd.
Surmont (Bounty Developments Ltd)
Syncrude
Synenco Energy Inc
Teck Resources Ltd.
Total E&P Canada Ltd.
Value Creation Inc. (VCI)




**Largest Operators and Area Controlled**

| | |
|---|---|
| Suncor Energy inc. | 684 square kilometers |
| Syncrude | 343 square kilometers |
| Canadian Natural Res Lmtd | 289 square kilometers |
| Imperial Oil Resources | 197 square kilometers |
| Shell | 186 square kilometers |
| Total E&P Canada | 86 square kilometers |

## UNVEILING OIL: CHAPTER SUMMARY

01. External forces do and will impact the oil sands in the future. Oil sands are dependent upon global forces and flows of people, politics, and economy.

02. The oil sands is a strategic operation given its relative infancy, stable political context, and ties to United States. The Athabasca oil sands are the only politically stable country with significant oil reserves.

03. Oil exploration and development leads to politically unstable countries.

04. Oil routes stretch across the globe and interface with many countries facing hunger, refugee, and political unsteadiness.

05. Refugees flee Middle East countries for Europe and the United States. Canada has no refugees, but produces amounts of oil comparable to Middle Eastern countries.

06. The infrastructural impact of the oil sands is as large as many US cities, demonstrating the substantial changes to the landscape and environment.

07. Millions of people live in cities of comparable or smaller size than the oil sands.

08. The mining footprint of the oil sands has increased substantially over the years and 2014 saw the largest increase in total oil sands minable area since oil sands inception.

09. Interest in the oil sands has generated significant interest from multinational companies from across the globe, signaling the complexity of business and economic forces in the area.

10. Substantial investment in the oil sands suggests companies and the industry will not leave instantaneously. Companies are likely to operate at a loss for many years in hopes oil prices will rise again.

Figure 7.1. Pipeline and oil sands extraction equipment. [Author 2016]

# CHAPTER 07: UNVEILING INFRASTRUCTURE

**Development of the oil sands has created significant structural impacts on the landscape and the region. Infrastructure systems considered here are energy, housing, land-use, and the context of the site. The oil sands have created a situation where the city has grown so rapidly in response to oil industry, that the oil sands shape the urban morphology.** In other words, the oil industry has led the development of the city and community, and not vice versa. This has impacted the ability of the region to address the short-term and long-term infrastructure needs of the region.

## DILEMMA

Fort McMurray's regional population growth has overwhelmed the municipality's infrastructure and has limited adherence to oil company protocols. Although Fort McMurray has been around for decades, the oil sands and associated growth has been so rapid that all infrastructure such as sewer, water lines, and electrical service is in need of upgrading or needs to be rebuilt (Doran 2009). Infrastructurally, the region is dependent upon Highway 63, "a pipeline right-of-way and the Athabasca River for the transportation of all heavy equipment, construction supplies, hazardous goods and labor to an expanding archipelago of upgraders" (Doran 2009). "The failure of the federal and provincial governments to effectively coordinate their management of the region has permitted a rate of expansion that has exacerbated [all other issues]" (Doran 2009). The region needs to address short-and long-term needs simultaneously. To understand what processes and relationships may need to be addressed leads to the question:

## QUESTION

How have the oil sands impacted the urban morphology and infrastructure of Fort McMurray?

## CONCLUSIONS

- Oil sands infrastructure helps feed oil-hungry U.S. cities
- Snaking pipelines and rail lines connect oil sands to rest of world
- Oil sands production supported by national oil infrastructure
- Approximately 30% of the US' bitumen refining capacity is in nine Gulf of Mexico refineries
- Fort McMurray isolated from urbanized areas
- Forty-seven Airstrips in oil sands mining area
- Highway 63 and Highway 881 responsible for over 100 deaths from 2003 to 2012
- Isolated, haphazard private road infrastructure snakes through oil sands

» Energy sources arrive in the oil sands and energy leaves the oil sands

» Work camps cluster around airstrips and highway 63

» Suburban-style housing dominates and commercial areas lack in Fort mcMurray

## CONTROVERSIAL KEYSTONE XL PIPELINE EXPANSION SET TO SEND MORE OIL SANDS TO US MARKETS

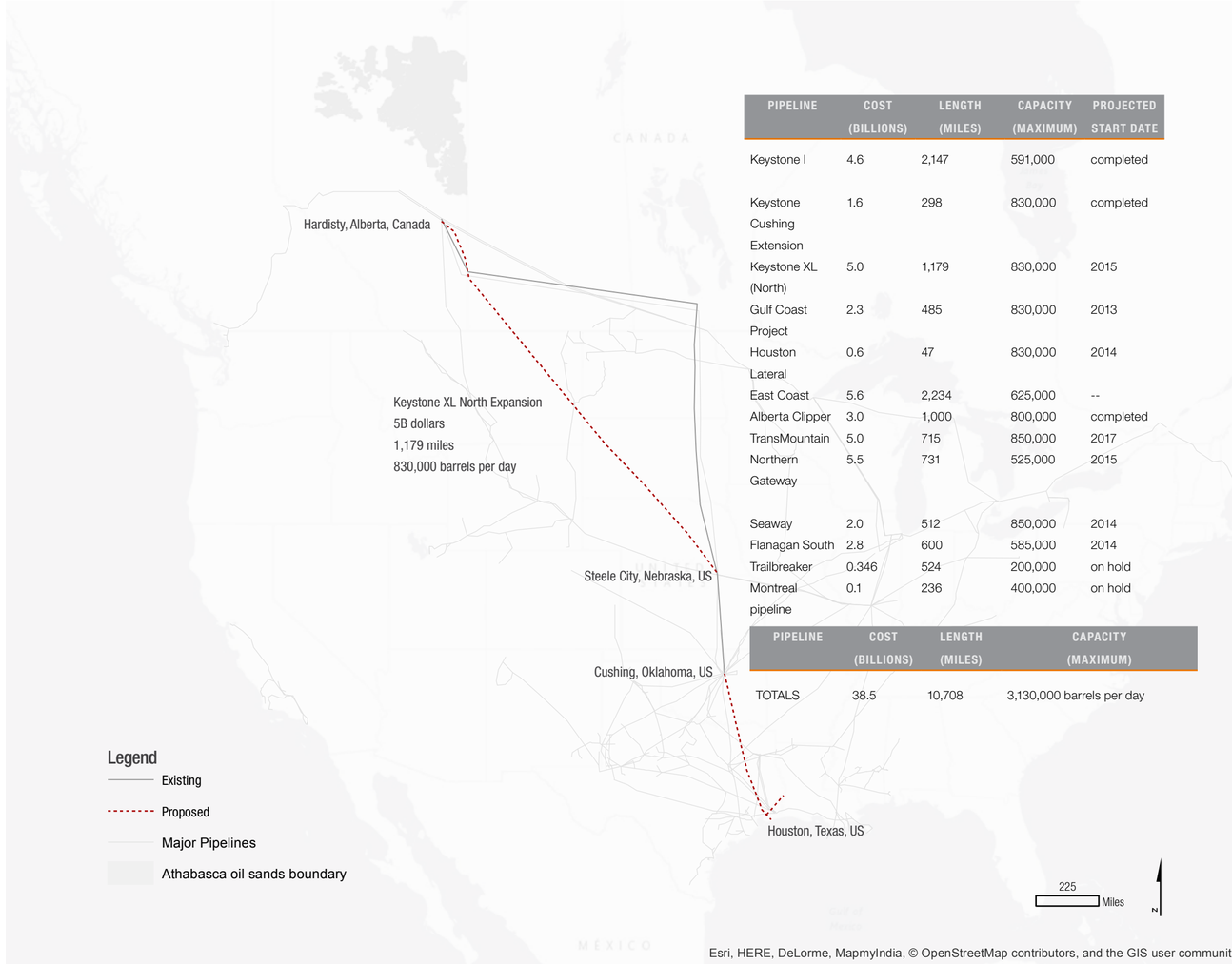
## RECENTLY COMPLETED AND PROPOSED PIPELINES COST OVER $38 BILLION DOLLARS

**Figure 7.2. Controversial Keystone XL Expansion connects to oil sands [Author 2017]**

**INQUIRY** Does the controversial Keystone XL Pipeline expansion relate to the oil sands?

**VISUAL STRATEGY** *Isolation* of planned Keystone XL pipeline and recent pipeline additions *extrapolated* from existing pipelines and *quantified* by tabular data overlaying map.

**CONCLUSION** The proposed expansion of the Keystone XL connects the oil sands with the US and Houston, Texas, US.




| PIPELINE | COST (BILLIONS) | LENGTH (MILES) | CAPACITY (MAXIMUM) | PROJECTED START DATE |
|---|---|---|---|---|
| Keystone I | 4.6 | 2,147 | 591,000 | completed |
| Keystone Cushing Extension | 1.6 | 298 | 830,000 | completed |
| Keystone XL (North) | 5.0 | 1,179 | 830,000 | 2015 |
| Gulf Coast Project | 2.3 | 485 | 830,000 | 2013 |
| Houston Lateral | 0.6 | 47 | 830,000 | 2014 |
| East Coast | 5.6 | 2,234 | 625,000 | -- |
| Alberta Clipper | 3.0 | 1,000 | 800,000 | completed |
| TransMountain | 5.0 | 715 | 850,000 | 2017 |
| Northern Gateway | 5.5 | 731 | 525,000 | 2015 |
| Seaway | 2.0 | 512 | 850,000 | 2014 |
| Flanagan South | 2.8 | 600 | 585,000 | 2014 |
| Trailbreaker | 0.346 | 524 | 200,000 | on hold |
| Montreal pipeline | 0.1 | 236 | 400,000 | on hold |

| PIPELINE | COST (BILLIONS) | LENGTH (MILES) | CAPACITY (MAXIMUM) |
|---|---|---|---|
| TOTALS | 38.5 | 10,708 | 3,130,000 barrels per day |

## OIL SANDS INFRASTRUCTURE HELPS FEED OIL-HUNGRY U.S. CITIES

**Figure 7.3. Athabasca oil sands support U.S. urbanization [Author 2017]**

Complex web of major oil pipelines feed U.S. cities

*Data Source: Major US Oil Pipelines (ESRI 2016); Canada Pipelines (Alberta Environment and Parks 2014); Population (Socioeconomic Data and Applications Center 2010)*

**INQUIRY** How do oil sands pipelines connect to the United States?

**VISUAL STRATEGY** *Comparison* of existing Canada and U.S. pipelines, populated areas, and oil sands location.

**CONCLUSION** Major pipelines connect the oil sands to the United States. These pipelines are connected to major U.S. cities and port areas including Chicago and the Gulf of Mexico.

**PROJECTIONS** Food production; water production and shipping for US drought-stricken areas; Canadian east-west pipeline


United States oil imports
Canada: 40%
OPEC countries (ALL): 31%
Persian Gulf: 16%
Saudi Arabia: 11%
Venezuela: 9%
Mexico: 8%
Colombia: 4%

## SNAKING PIPELINES AND RAIL LINES CONNECT OIL SANDS TO REST OF WORLD

## OIL SANDS PRODUCTION SUPPORTED BY NATIONAL OIL INFRASTRUCTURE

**Figure 7.4. Oil sands infrastructure stretches across the country**

[Author 2017]

**INQUIRY** How does the national rail, pipeline, and refining infrastructure support the oil sands?

**VISUAL STRATEGY** *Overlay* of existing national infrastructures and global shipping routes.

**CONCLUSION** Oil sands infrastructure stretches across the country and connects shipping routes by rail, train, and pipeline with significant concentrations in Alberta and Saskatchewan.

**PROJECTIONS** Food production, alternative goods production

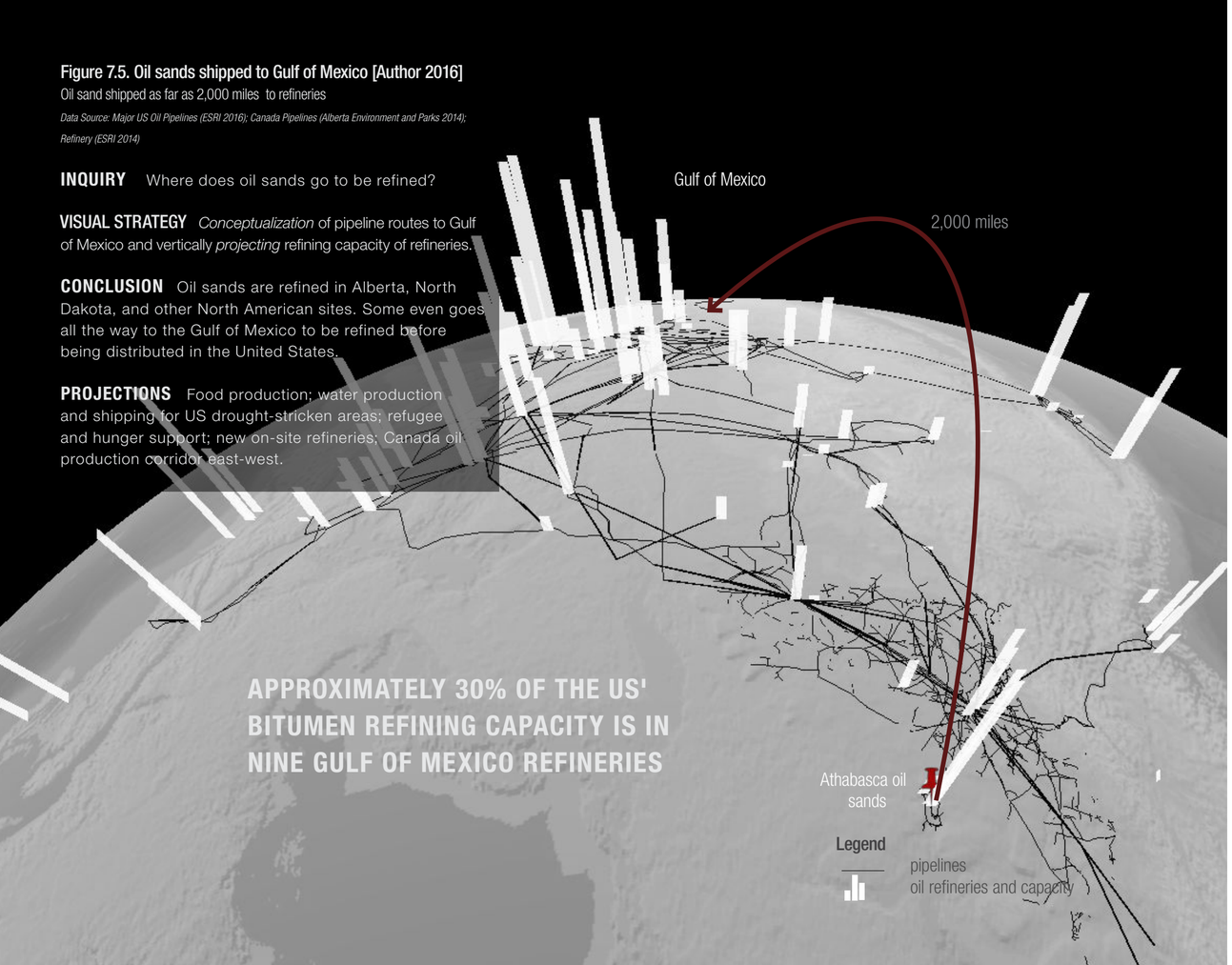
**Figure 7.5. Oil sands shipped to Gulf of Mexico [Author 2016]**
Oil sand shipped as far as 2,000 miles to refineries
*Data Source: Major US Oil Pipelines (ESRI 2016); Canada Pipelines (Alberta Environment and Parks 2014); Refinery (ESRI 2014)*

**INQUIRY** Where does oil sands go to be refined?

**VISUAL STRATEGY** *Conceptualization* of pipeline routes to Gulf of Mexico and vertically *projecting* refining capacity of refineries.

**CONCLUSION** Oil sands are refined in Alberta, North Dakota, and other North American sites. Some even goes all the way to the Gulf of Mexico to be refined before being distributed in the United States.

**PROJECTIONS** Food production; water production and shipping for US drought-stricken areas; refugee and hunger support; new on-site refineries; Canada oil production corridor east-west.




See page 172

# FORT MCMURRAY ISOLATED FROM URBANIZED AREAS

**Figure 7.6. Fort McMurray relies on Highway 63 for transportation [Author 2017]**
*Data Source: Government of Alberta 2015*

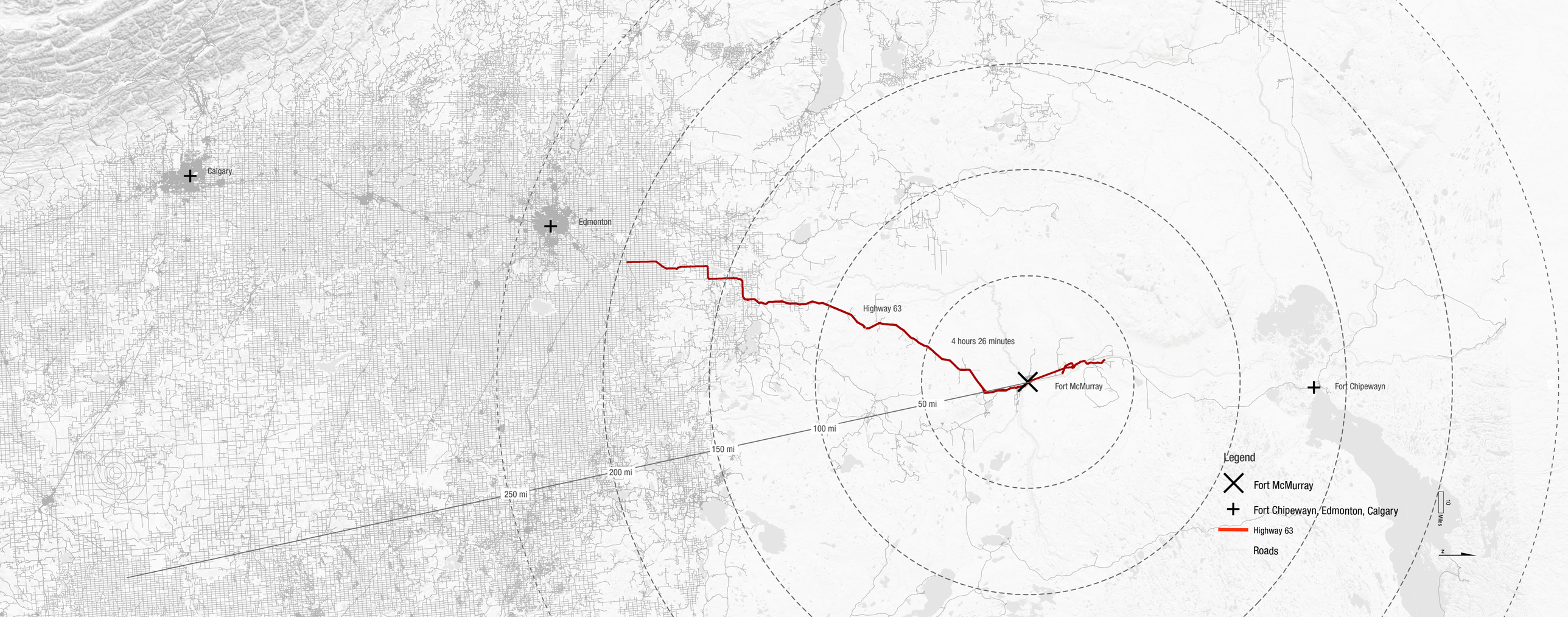
**INQUIRY** What transportation options exist from Edmonton, the closest urbanized area to Fort McMurray?

**VISUAL STRATEGY** *Selection* of Highway 63 within "field" of road infrastructure, *overlaid* with concentric rings *emphasizing* distance and lack of road connectivity closer to Fort McMurray.

**CONCLUSION** Fort McMurray relies on Highway 63 for transportation of goods, people, and oil industry vehicles. This puts pressure on the highway and other related infrastructure. Thousands of people were evacuated via Highway 63 during the 2016 wildfire.

**PROJECTIONS** Northern Lights research cooperative; astronomy cooperative; Canada National Astronomy research station; camping, hiking, astro-photography opportunities; Airline Recycling Facility; Bio-agro defense facility; nuclear waste disposal sites; alcohol and drug rehabilitation center; mental health (ADD and ADHD) hospital or research facilities; UNESCO World Heritage site; National Park; resort development

Figure 7.7. On the edge of nowhere [Author 2017]


Calgary
Edmonton
Highway 63
4 hours 26 minutes
Fort McMurray
Fort Chipewayn
50 mi
100 mi
150 mi
200 mi
250 mi
Legend
Fort McMurray
Fort Chipewayn, Edmonton, Calgary
Highway 63
Roads
10
Miles
N

# FORTY-SEVEN AIRSTRIPS IN OIL SANDS MINING AREA

**Figure 7.8. Oil fields have airstrips to service nearly every mining area [Author 2017]**

*Data Source: Project Boundaries (Alberta Environment and Parks 2014); Airports (RP Erickson & Associates 2012); Fort McMurray Airport Origins/Destinations (Fort McMurray International Airport 2015)*

**INQUIRY** How are the oil sands supported by air transit infrastructure for moving employees and executives?

**VISUAL STRATEGY** *Marking* of airstrips and oil sands project points and boundaries *overlaid* with vectors showing Fort McMurray International Airport routes.

**CONCLUSION** There are 47 airstrips in the oil sands mining area. Some are capable of supporting large jets such as 747-sized aircraft.

**PROJECTIONS** Refugee/immigration agriculture cooperative homestead; airline recycling facility/plane graveyard; nuclear/chemical weapons test site; nuclear waste disposal; manufacturing and shipping; military air force base; improved land-use coordination; new centralized airport;

see page 178

# HIGHWAY 63 AND HIGHWAY 881 RESPONSIBLE FOR OVER 100 DEATHS FROM 2003 TO 2012

**Figure 7.9. Highway 63 has killed many people [Author 2017]**

*Data Source: Conoco-Phillips 2012*

**INQUIRY** Because of the isolated nature of Highway 63 and its link to Edmonton, what impacts has it had on traffic?

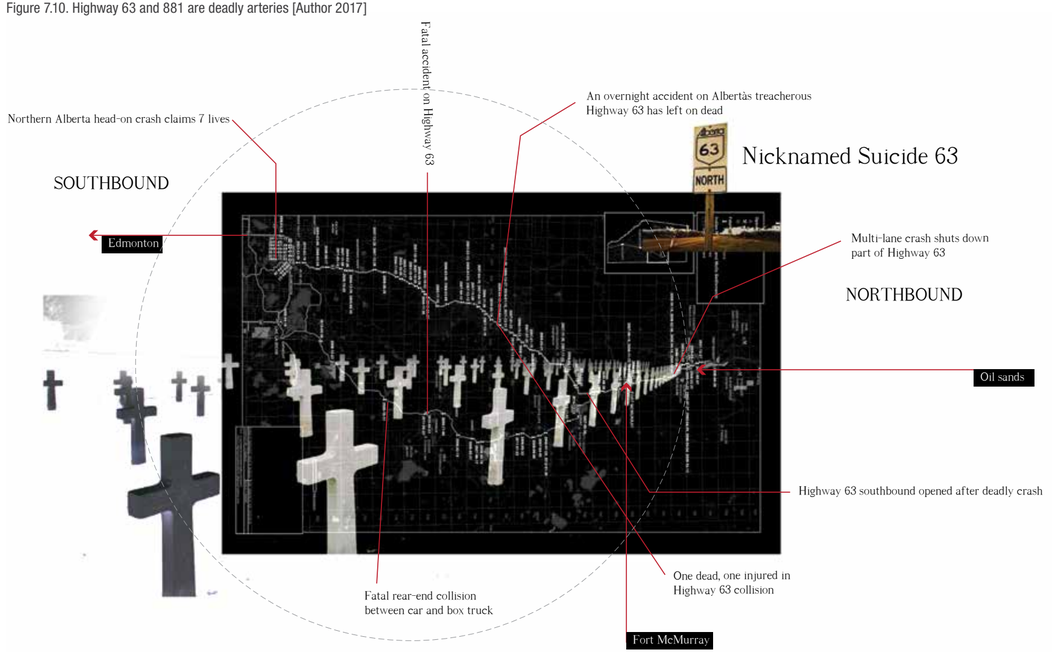
**VISUAL STRATEGY** *Marking* and *grouping* of fatal accidents on Highway 63 and Highwat 883.

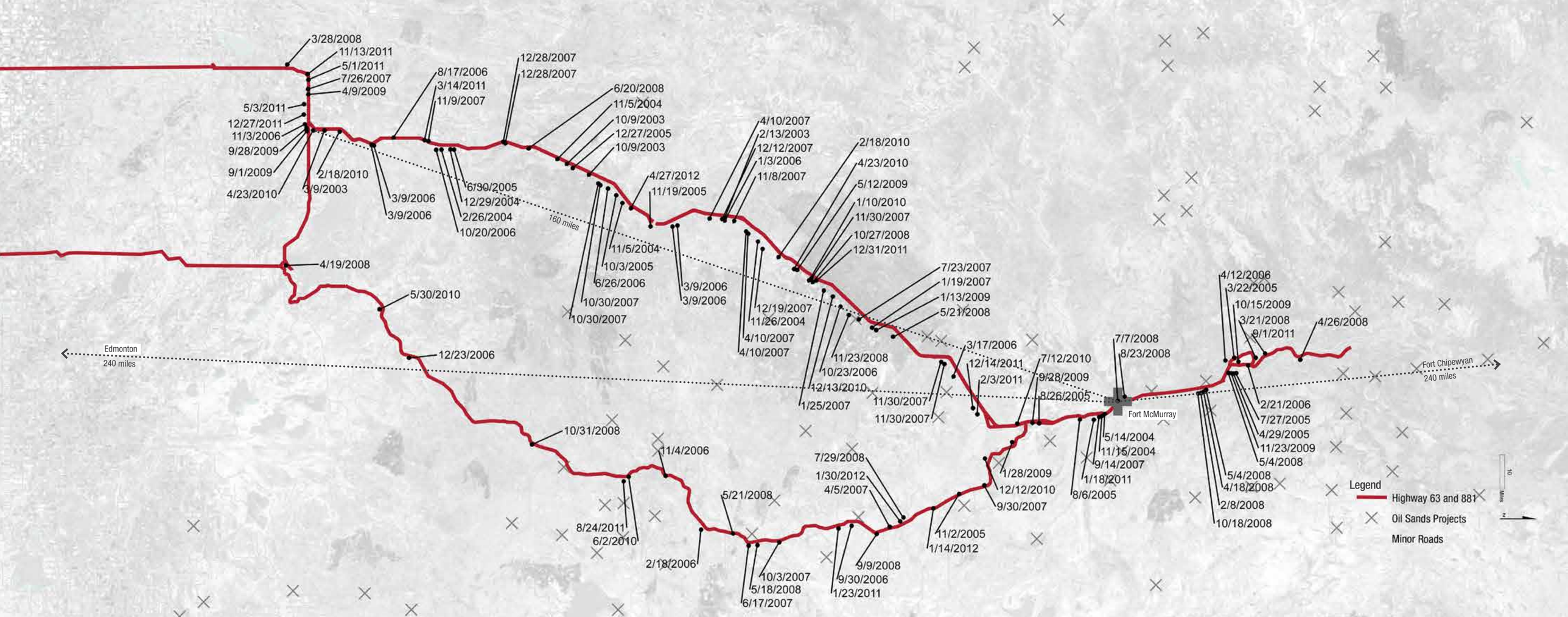
**CONCLUSION** Highway 63 has seen hundreds of deaths as a result of drinking, falling asleep, and the isolated nature of the highway in its rural setting.

**PROJECTIONS** High-speed rail; public bus services from Edmonton; oil industry-sponsored transportation; increase of commercial and night-life opportunities in Fort McMurray; utilization of airfields for receiving goods and shipments.



Figure 7.10. Highway 63 and 881 are deadly arteries [Author 2017]




3/28/2008
11/13/2011
5/1/2011
7/26/2007
4/9/2009
5/3/2011
12/27/2011
11/3/2006
9/28/2009
9/1/2009
4/23/2010
2/18/2010
3/9/2003
8/17/2006
3/14/2011
11/9/2007
3/9/2006
3/9/2006
12/28/2007
12/28/2007
6/30/2005
12/29/2004
2/26/2004
10/20/2006
6/20/2008
11/5/2004
10/9/2003
12/27/2005
10/9/2003
4/27/2012
11/19/2005
10/30/2007
10/30/2007
11/5/2004
10/3/2005
6/26/2006
3/9/2006
3/9/2006
4/10/2007
2/13/2003
12/12/2007
1/3/2006
11/8/2007
12/19/2007
11/26/2004
4/10/2007
4/10/2007
2/18/2010
4/23/2010
5/12/2009
1/10/2010
11/30/2007
10/27/2008
12/31/2011
7/23/2007
1/19/2007
1/13/2009
5/21/2008
11/23/2008
10/23/2006
12/13/2010
1/25/2007
11/30/2007
11/30/2007
3/17/2006
12/14/2011
2/3/2011
8/26/2005
7/12/2010
9/28/2009
7/7/2008
8/23/2008
Fort McMurray
5/14/2004
11/15/2004
9/14/2007
1/18/2011
8/6/2005
4/12/2006
3/22/2005
10/15/2009
3/21/2008
9/1/2011
4/26/2008
2/21/2006
7/27/2005
4/29/2005
11/23/2009
5/4/2008
5/4/2008
4/18/2008
2/8/2008
10/18/2008
4/19/2008
5/30/2010
12/23/2006
10/31/2008
11/4/2006
8/24/2011
6/2/2010
2/18/2006
5/21/2008
10/3/2007
5/18/2008
6/17/2007
7/29/2008
1/30/2012
4/5/2007
9/9/2008
9/30/2006
1/23/2011
11/2/2005
1/14/2012
1/28/2009
12/12/2010
9/30/2007
160 miles
Edmonton
240 miles
Fort Chipewyan
240 miles
Legend
Highway 63 and 881
Oil Sands Projects
Minor Roads
10
Miles
N

# ISOLATED, HAPHAZARD PRIVATE ROAD INFRASTRUCTURE SNAKES THROUGH OIL SANDS

**Figure 7.11. Infrastructure snakes throughout oil sands region [Author 2017]**

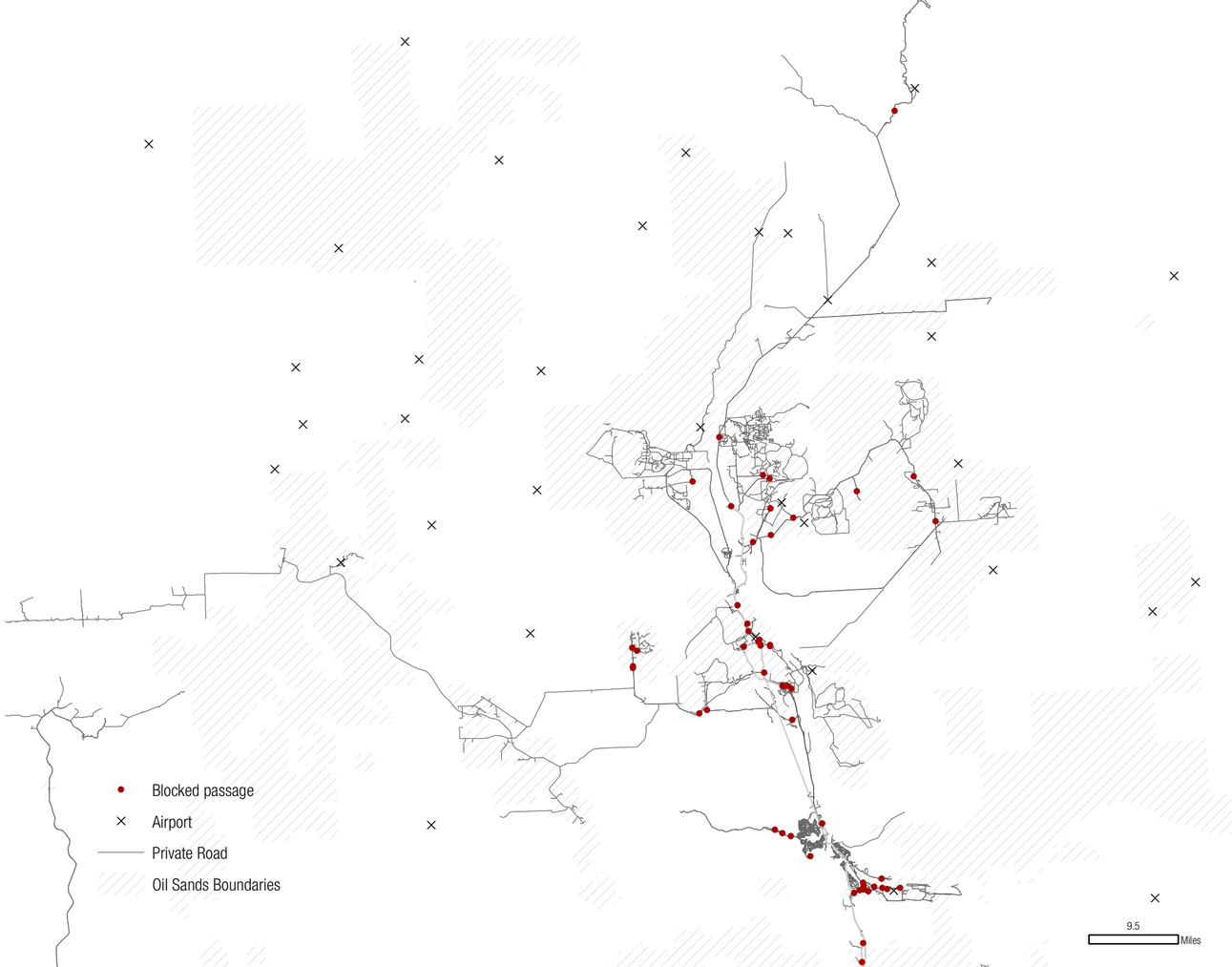
*Data Source: Government of Canada 2016*

**INQUIRY** How well do oil sands companies develop transportation infrastructure and control road access?

**VISUAL STRATEGY** *Overlay* of road infrastructure on top of oil sands boundaries, *emphasizing* blocked passage indicating private road access.

**CONCLUSION** Private roads twist and turn in the oil sands and are protected through checkpoints and blocked passages throughout the oil sands development area.

**PROJECTIONS** trails, hiking, camping opportunities; resort developments; youth outdoors camps; food production; water shipping; refugee resettlement areas; prison; solar field; geothermal production; commercial developments to support work camps; education and university cooperatives; better coordination with land-use and area development.



## ENERGY SOURCES ARRIVE IN THE OIL SANDS AND ENERGY LEAVES THE OIL SANDS

**Figure 7.12. Energy infrastructure extended from Fort McMurray to oil sands [Author 2017]**

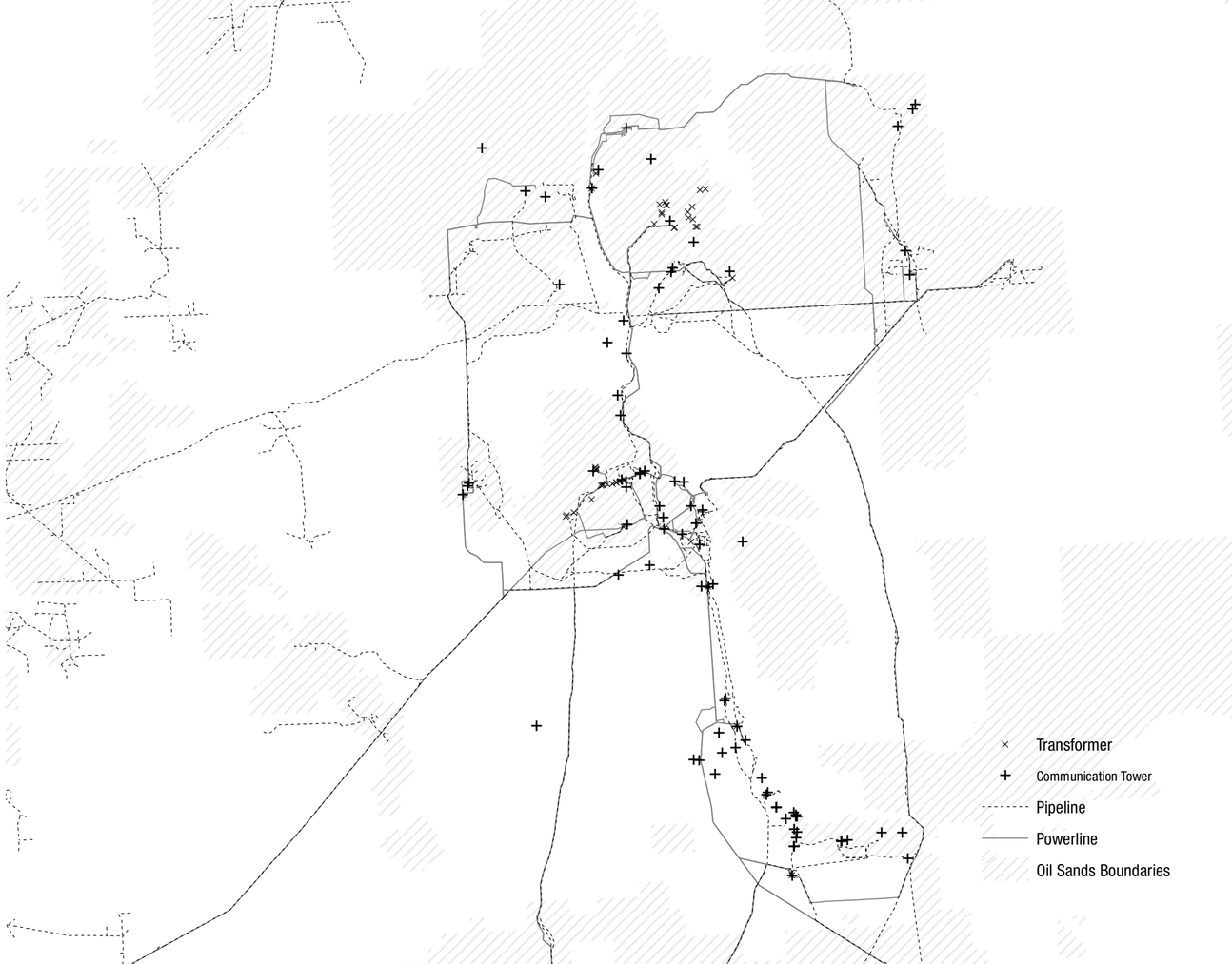
*Data Source: Government of Canada 2016*

**INQUIRY** What energy infrastructure is extended from Fort McMurray to the oil sands?

**VISUAL STRATEGY** *Overlay* of communication/energy infrastructure on top of oil sands boundaries.

**CONCLUSION** Transformers, communication towers, and powerlines are in the oil sands. This is juxtaposed by pipeline infrastructure snaking out of the oil sands.

**PROJECTIONS** camping opportunities; resort developments; youth outdoors camps; refugee resettlement areas; prison; commercial developments to support work camps; education and university cooperatives; better coordination with land-use and area development.



## WORK CAMPS CLUSTER AROUND AIRSTRIPS AND HIGHWAY 63

**Figure 7.13. Workcamps house temporary workers in the middle of the oil sands [Author 2017]**

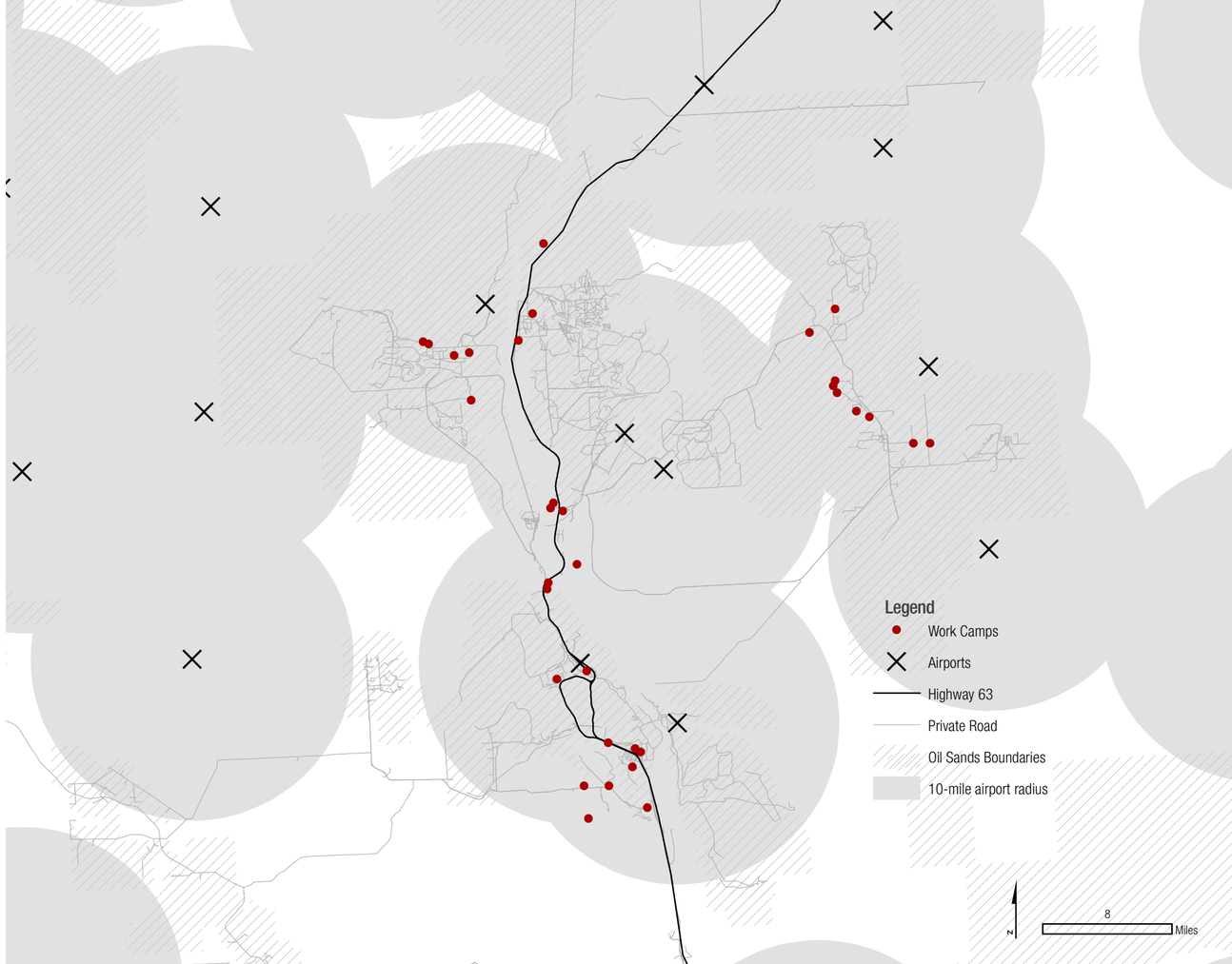
**INQUIRY** How do work camps relate to oil sands roads, boundaries, and other transportation infrastructure?

**VISUAL STRATEGY** *Overlay* of work camp, road, and airport infrastructure with *buffered* rings *emphasizing* proximity of work camps to airports.

**CONCLUSION** Work camps are strategically located near Highway 63 and airstrips typically in private areas in the middle of the oil sands developments.

**PROJECTIONS** camping opportunities; resort developments; youth outdoors camps; refugee resettlement areas; prison; commercial developments to support work camps; education and university cooperatives; better coordination with land-use and area development.





## SUBURBAN-STYLE HOUSING DOMINATES AND COMMERCIAL AREAS LACK IN FORT MCMURRAY

**Figure 7.14. Fort McMurray land-use dominated by suburban-style housing developments [Author 2017]**

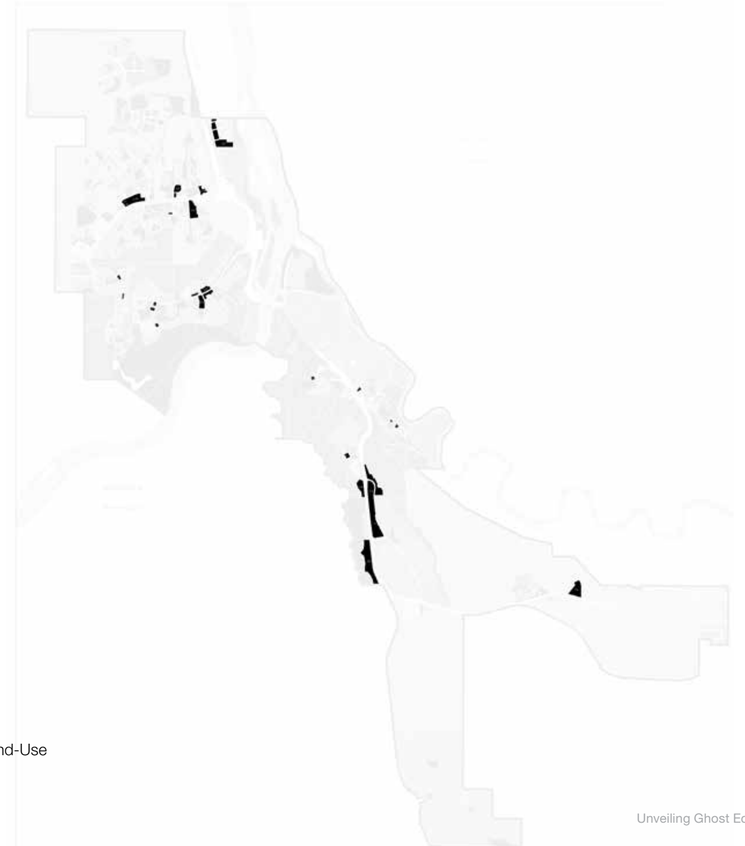
*Data Source: Regional Municipality of Wood Buffalo 2016*

**INQUIRY** How has oil sands development influenced the morphology of housing stock in Fort McMurray?

**VISUAL STRATEGY** *Isolation* of zoning categories to compare quantity of housing and commercial areas.

**CONCLUSION** Fort McMurray land-use leans significantly towards housing and suburban-style housing types identifiable by curvilinear roads sometimes referred to as "loops and lollipops."

Legend
Residential Land-Use



Legend
Commercial Land-Use

## UNVEILING INFRASTRUCTURE: CHAPTER SUMMARY

01. The oil sands are significant in part because of the substantial developments created for mining in the middle of the boreal forest in an isolated region of Canada.

02. Haphazard and poorly planned oil sands mining has created redundant infrastructure systems. It appears little cooperation or collaboration exists. Companies operate autonomously.

03. Pipelines and refining infrastructure connect the oil sands to the United States and the rest of the world.

04. Transportation infrastructure is abundant with many private roads and airports have been built by mining companies.

05. The exponential increase in oil sands production has caused Fort McMurray to respond with short-term strategies that create cities directly supporting the oil sands, but little else. Suburban style housing dominates Fort McMurray land use.

06. Fort McMurray and the oil sands are reliant upon one road—Highway 63—for all movement of people and goods in and out of the region. This was exemplified by the 2016 wildfire where thousands lined the highway to escape.


Figure 8.1. From forest to fire wood. [Author 2016]

# CHAPTER 08: UNVEILING ENVIRONMENT

Environment is a broad term encompassing the physical structure of the landscape and its natural constituents, i.e. elements on the ground or in the air. The development of the oil sands has had direct impacts to boreal forest ecosystems, water systems, and flora and fauna.

## DILEMMA

**The Canadian boreal forest sequesters and absorbs carbon worth $1.8B in ecosystem services. Destruction of this ecology impacts water systems, flora and fauna habitat, and animal migration.**

The boreal forest is an important habitat for a number of wildlife and birds and is also an important carbon storage ecology. The forest and peatlands store an estimated 67 billion tons of carbon in Canada, almost eight times the carbon produced worldwide in year 2000 (Mongabay 2006). The Canadian boreal forest sequesters and absorbs on average an additional amount of carbon worth $1.8B. In total, the ecosystem services of the boreal forest are worth $250B per year (Mongabay 2006) including its carbon capture and storage, water filtration, and waste treatment, biodiversity maintenance, and pest control. This translates to about $160 per hectare or $93 billion per year in Canada.

If these ecosystem services were counted in Canada, they would amount to roughly 9% of GDP. “Ignoring these values would be like leaving out the combined annual contribution to GDP made by Canada’s health and social services sector and half of the public services sector” (Canadian Forest Congress, 2006). Instead, the oil sands development has cleared or degraded almost two million acres—six times larger than New York City (Petersen, Sizer, and Lee 2014). On a larger scale, more than 20% of the boreal forest region is covered by industrial concessions for timber operations, hydrocarbon development, hydroelectrical power reservoirs, and mineral extraction” (Petersen, Sizer, and Lee 2014). Direct forest loss caused by surface and sub-surface tar sands development is projected to exceed 1,150,000 hectares (nearly 3 million acres) over the next few decades (Petersen, Sizer, and Lee 2014).

Oil sands have affected migration routes and habitat for many animals. Endangered woodland caribou populations have seen a 50% decline in ten years (Globe and Mail 2016). An expanding network of pipelines will also confine animals. Tailings ponds are a continuous threat to migratory waterfowl and current protection practices are “seriously inadequate” (Gosselin et al. 2010). "So they do contain some populations of animals, but these animals are then subjected to contaminants in the wetlands and they're also subjected to contaminants if they leave the wetlands and go visit a nearby tailings pond or some other industrial site” (CBC News 2015).

Water degradation is also an important side effect to consider. Six cubic meters of tailings are created for every cubic of bitumen. Tailings pond at Syncrude’s Mildred Lake has enough tailings to fill 160,000 Olympic-sized swimming pools. Overall, these tailings ponds cover an area greater than 50 square kilometers (Anderssen 2008). Many scientists believe tailings pond clay will take 500 to 1,000 years to settle (Anderssen 2008). In addition to

tailings ponds, it takes two to four barrels of fresh water from the nearby Athabasca River. Current allocation represents 4.4% of the mean annual Athabasca River flows (Sauchyn, St-Jacques, and Luckman 2015). A study by Sauchyn (2015) found declining regional flows and “periods of serve and prolonged low flows” (Sauchyn et al, 2015, 12621-12626) and summarized that “At the very least, risk assessment in the oil sands industry should consider the repeated decadal droughts that are a common feature of the regional hydroclimate but have not occurred since the industry was established” (Sauchyn 2015, 12625).

In 2006, researchers at Simon Fraser University found oil sands extraction created five times as many greenhouse-gas emissions compared to conventional wells (Anderssen 2008; Lustgarten 2005). Under current conditions, it takes 750 cubic feet of non-renewable natural gas and about four tons of “overburden” (soil) to extract one barrel. These greenhouse gas emissions are a turning point for broad discussions about the industry. With increasing emissions, it becomes a challenge for Canada to meet its international commitments for greenhouse gas emissions reduction (Chan et al. 2012; Gosselin et al. 2010; Lustgarten 2005). “The provincial and federal governments need to recognize that the tangible commitments evident to date are likely still inadequate for Canada to meet its economy-wide GHG emissions target” (Gosselin et al. 2010). According to the Government of Alberta in 2012, the oil sands industry alone was responsible for 41.9 Mt Co2-e, equivalent to 6.5% of Canada’s total GHG emissions and 0.1% of global greenhouse gas emissions (Percy, Hansen, and Dann 2012).

## QUESTION

How have the oil sands impacted regional ecologies?

## CONCLUSIONS

- Oil sands affected by rising global temperatures
- Oil sands in the midst of largest carbon sink of any global ecosystem
- Oil sands located within northern lights oval
- Moderate solar potential in the oil sands region
- Oil sands impact caribou habitats
- Oil sands create unsustainable habitats
- Various wildlife impacted by oil sands
- Oil sands has cleared or degraded more than 2 million acres of boreal forest[1]
- Oil sands transfigure existing landforms
- Oil sands mutilate existing boreal forest landscapes
- Toxic lakes in span 176 square kilometers and can be seen from space.[1]
- Land cover is mostly cleared and disturbed, not reclaimed
- 0.2% of oil sands is certified reclaimed after decades of mining



See page 194

# OIL SANDS AFFECTED BY RISING GLOBAL TEMPERATURES

**Figure 8.2. Oil sands expected to be 2.1 - 2.5 degrees warmer by 2050 [Author 2017]**

*Data Source: Temperature Change (CCSM SRES, A2 scenario 2000); Climate Change (Institute for Veterinary Public Health, Climatic Research Unit [CRU], Global Precipitation Climatology Centre [GPCC], German Weather Service, University of East Anglia, Tyndall Centre for Climate Change Research, Intergovernmental Panel on Climate Change [IPCC])*

**INQUIRY** How will climate change impact the temperature and ecosystem of the oil sands?

**VISUAL STRATEGY** *Identification* of oil sands boundaries within global temperature change.

**CONCLUSION** Climate change will increase the temperature around 3 degrees Celsius and place the oil sands in a new climate zone.

**PROJECTIONS** recreation opportunities; national park; new crop opportunities; Boreal Forest Climate Change Research Institute; UNESCO World Heritage Site designation.

See page 196

# OIL SANDS IN THE MIDST OF LARGEST CARBON SINK OF ANY GLOBAL ECOSYSTEM

**Figure 8.3. Oil sands situated in global carbon sink [Author 2017]**

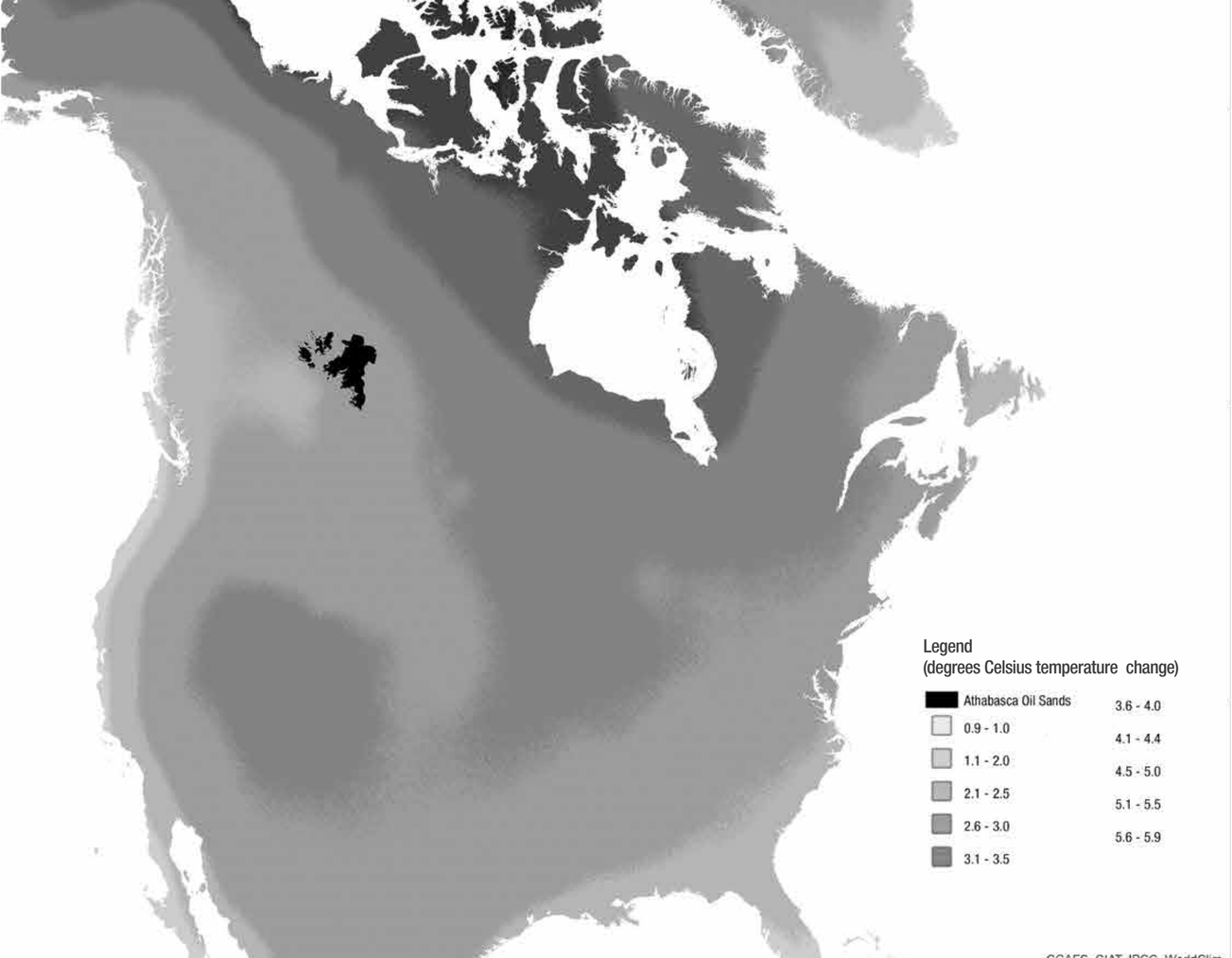
*Data Source: ESRI 2010*

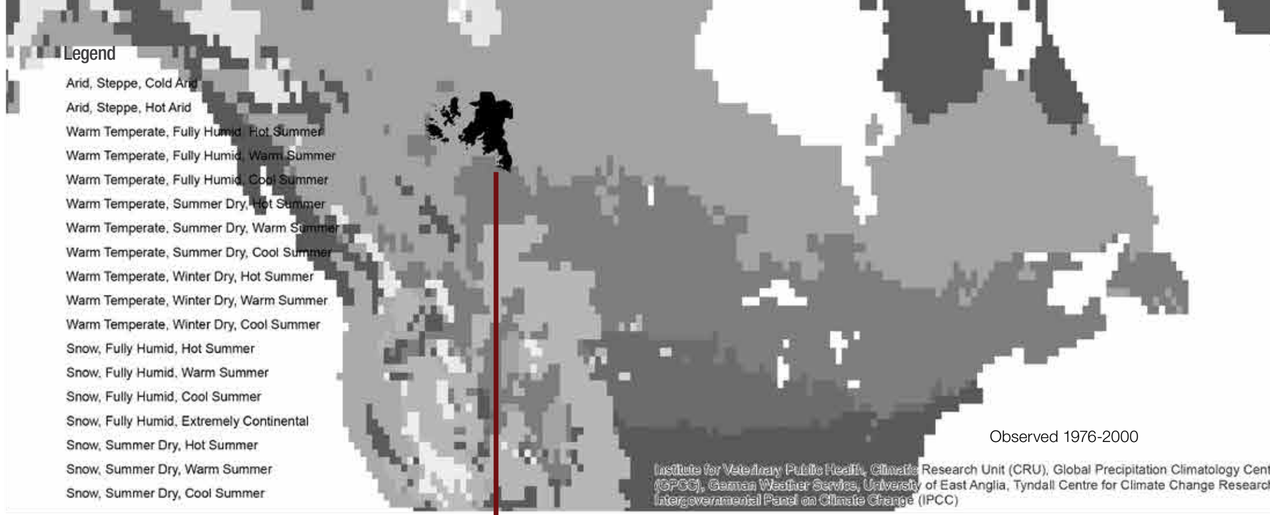
**INQUIRY** Where do the oil sands exist amongst large ecosystem zones?

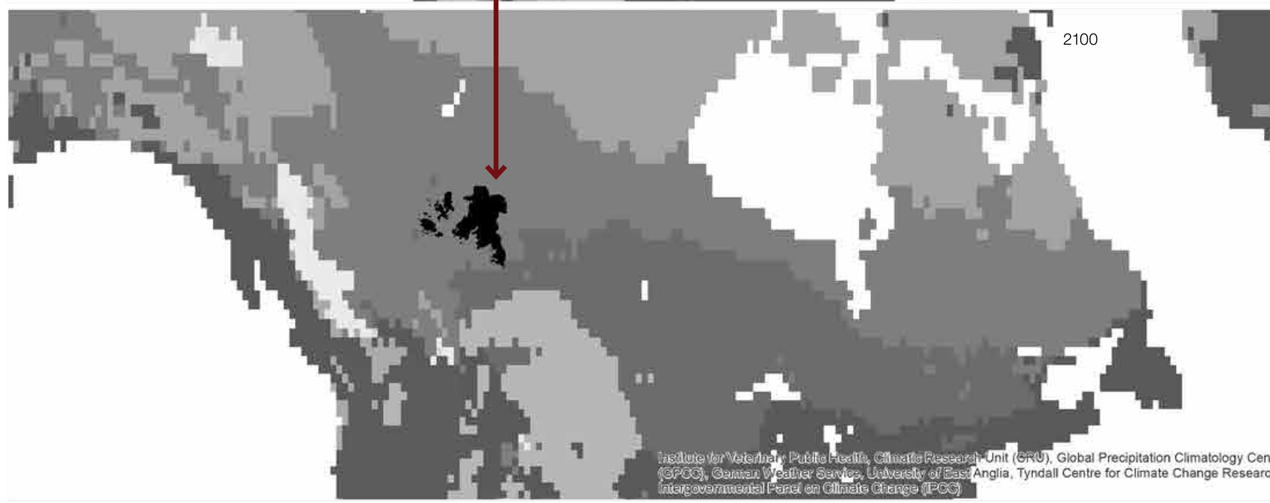
**VISUAL STRATEGY** *Identification and categorization* of global ecosystems.

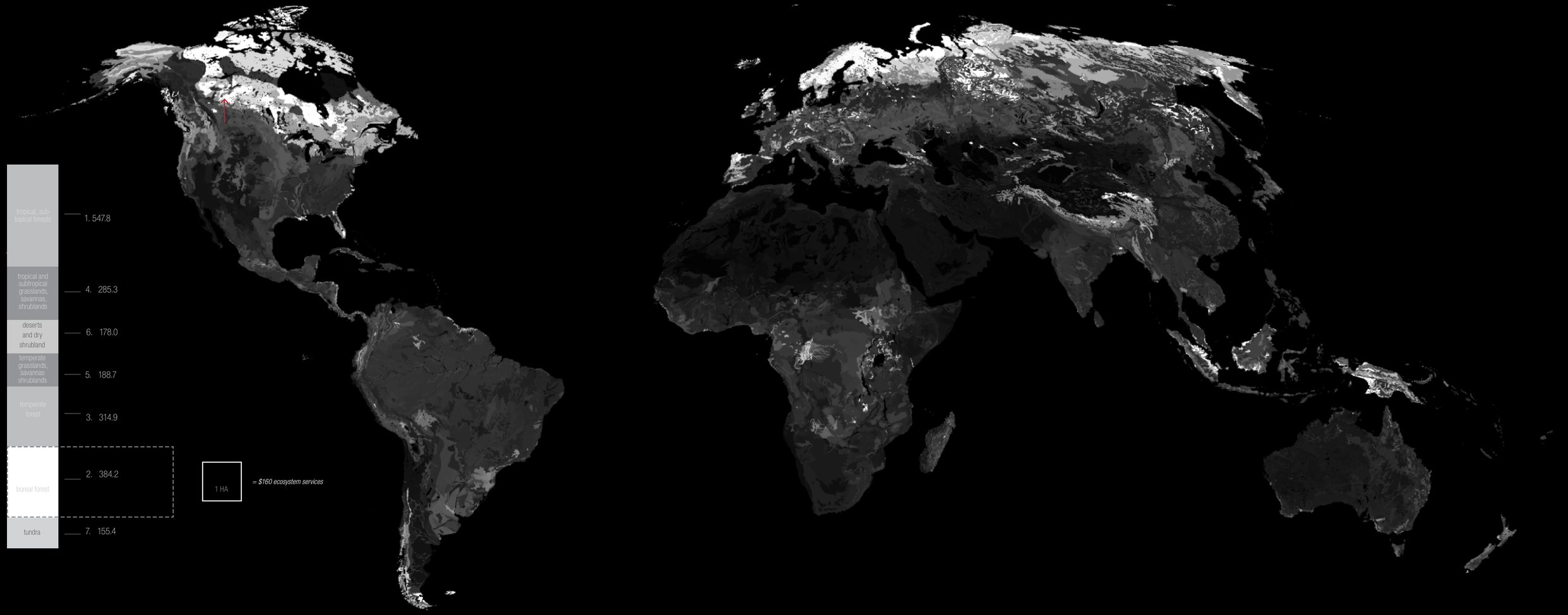
**CONCLUSION** Oil sands are situated in the midst of the boreal forest ecosystem, a substantial global carbon sink which stores carbon. Disrupting this ecosystem releases carbon into the atmosphere.

**PROJECTIONS** new crop opportunities; Boreal Forest Climate Change Research Institute; UNESCO World Heritage Site designation.


Legend
(degrees Celsius temperature change)
Athabasca Oil Sands
0.9 - 1.0
1.1 - 2.0
2.1 - 2.5
2.6 - 3.0
3.1 - 3.5
3.6 - 4.0
4.1 - 4.4
4.5 - 5.0
5.1 - 5.5
5.6 - 5.9


Legend
Arid, Steppe, Cold Arid
Arid, Steppe, Hot Arid
Warm Temperate, Fully Humid, Hot Summer
Warm Temperate, Fully Humid, Warm Summer
Warm Temperate, Fully Humid, Cool Summer
Warm Temperate, Summer Dry, Hot Summer
Warm Temperate, Summer Dry, Warm Summer
Warm Temperate, Summer Dry, Cool Summer
Warm Temperate, Winter Dry, Hot Summer
Warm Temperate, Winter Dry, Warm Summer
Warm Temperate, Winter Dry, Cool Summer
Snow, Fully Humid, Hot Summer
Snow, Fully Humid, Warm Summer
Snow, Fully Humid, Cool Summer
Snow, Fully Humid, Extremely Continental
Snow, Summer Dry, Hot Summer
Snow, Summer Dry, Warm Summer
Snow, Summer Dry, Cool Summer
Observed 1976-2000
Institute for Veterinary Public Health, Climatic Research Unit (CRU), Global Precipitation Climatology Cent
(GPCC), German Weather Service, University of East Anglia, Tyndall Centre for Climate Change Research
Intergovernmental Panel on Climate Change (IPCC)


2100
Institute for Veterinary Public Health, Climatic Research Unit (CRU), Global Precipitation Climatology Cen
(GPCC), German Weather Service, University of East Anglia, Tyndall Centre for Climate Change Research
Intergovernmental Panel on Climate Change (IPCC)


tropical, sub-topical forests
1. 547.8
tropical and subtropical grasslands, savannas, shrublands
4. 285.3
deserts and dry shrubland
6. 178.0
temperate grasslands, savannas shrublands
5. 188.7
temperate forest
3. 314.9
boreal forest
2. 384.2
tundra
7. 155.4
1 HA
= $160 ecosystem services

# OIL SANDS LOCATED WITHIN NORTHERN LIGHTS OVAL

**Figure 8.4. Oil sands region within Northern Lights oval [Author 2017]**

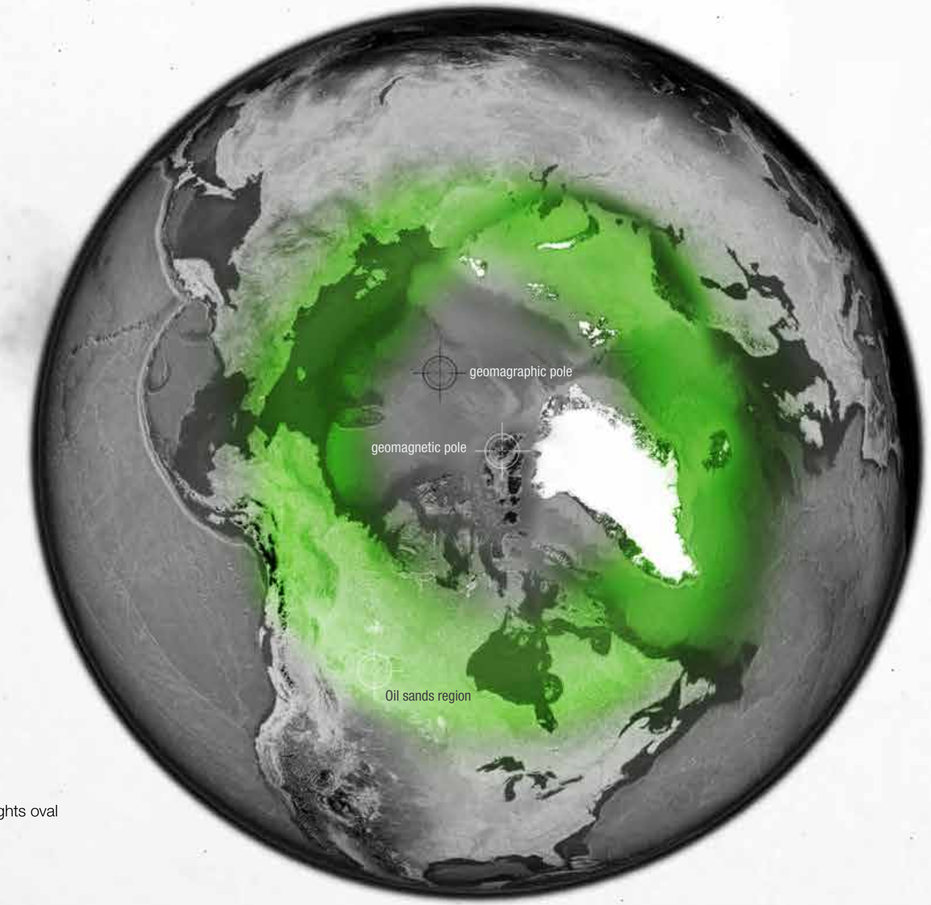
*Data Source: University of Calgary (Northern Lights Oval)*

**INQUIRY** Where do the oil sands exist amongst the Northern Lights?

**VISUAL STRATEGY** *Overlay of* Northern Lights oval with *identification* of poles and oil sands location.

**CONCLUSION** Oil sands are situated within the area with the best opportunity to see the Northern Lights. It is mentioned as a tourist highlight for those traveling to the region on the Fort McMurray tourism website, as well. Clear, cold winters make this one of the best spots to see the northern lights near major Canadian cities.

**PROJECTIONS** Northern lights viewing areas, astrophotography programs, lodges and resorts focused on northern lights



## MODERATE SOLAR POTENTIAL IN THE OIL SANDS REGION

**Figure 8.5. Moderate solar photovoltaic electricity output in oil sands [Author 2017]**

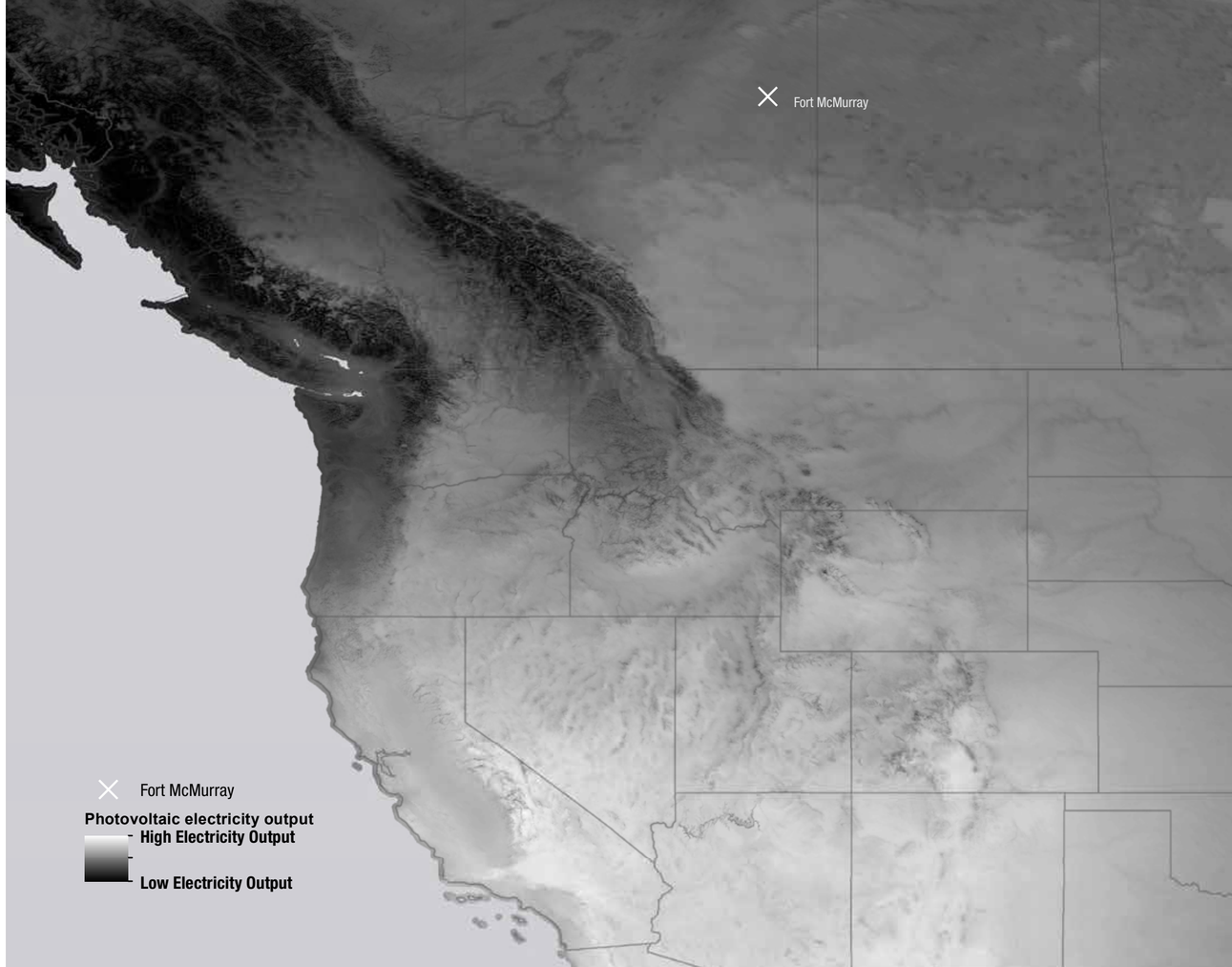
*Data Source: Global Solar Atlas (World Bank Group)*

**INQUIRY** Are there alternative energy opportunities in the oil sands region like solar power?

**VISUAL STRATEGY** *Comparison* of oil sands location with dataset of photovoltaic potential.

**CONCLUSION** The oil sands region and Fort McMurray have moderate potential for solar industries, helped by nearly constant sun in summer months. This is lower than other areas of North America, but it is still one of the highest potentials in Alberta and western Canada.

**PROJECTIONS** Solar fields for alternative energy production for employment and economic diversification.



See page 204 (left)

# OIL SANDS IMPACT CARIBOU HABITATS

**Figure 8.6. Caribou habitat and wildlife and biodiversity zones in oil sands area [Author 2017]**

*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** What animal habitats are impacted?

**VISUAL STRATEGY** *Abstraction* and *overlay* of oil sands boundaries and caribou habitat *highlighting* caribou habitat.

**CONCLUSION** Caribou populations and other species have habitat within the oil sands lease areas which may impact food and shelter and migration routes.

**PROJECTIONS** Synchronize migration season with oil sands development; nature preserve; national park; Northern Alberta Environmental Research Center; Reclamation procedures in coordination with production; wildlife corridor easements.



See page 205 (right)

# OIL SANDS CREATE UNSUSTAINABLE HABITATS

**Figure 8.7. Oil sands reduces sustainability of animal habitats [Author 2017]**

*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** What animal habitats are impacted?

**VISUAL STRATEGY** *Aggregation* and *highlight* of habitats which are not self-sustained *overlayed* with oil sands boundaries.

**CONCLUSION** Oil sands create unsustainable habitats based on this Alberta Parks and Environment dataset, likely from the disruption to habitat, water, and food sources.

**PROJECTIONS** Synchronize migration season with oil sands development; nature preserve; national park; Northern Alberta Environmental Research Center; Reclamation procedures in coordination with production; wildlife corridor easements.

See page 206

# VARIOUS WILDLIFE IMPACTED BY OIL SANDS

**Figure 8.8. Caribou are species most impacted by oil sands [Author 2017]**

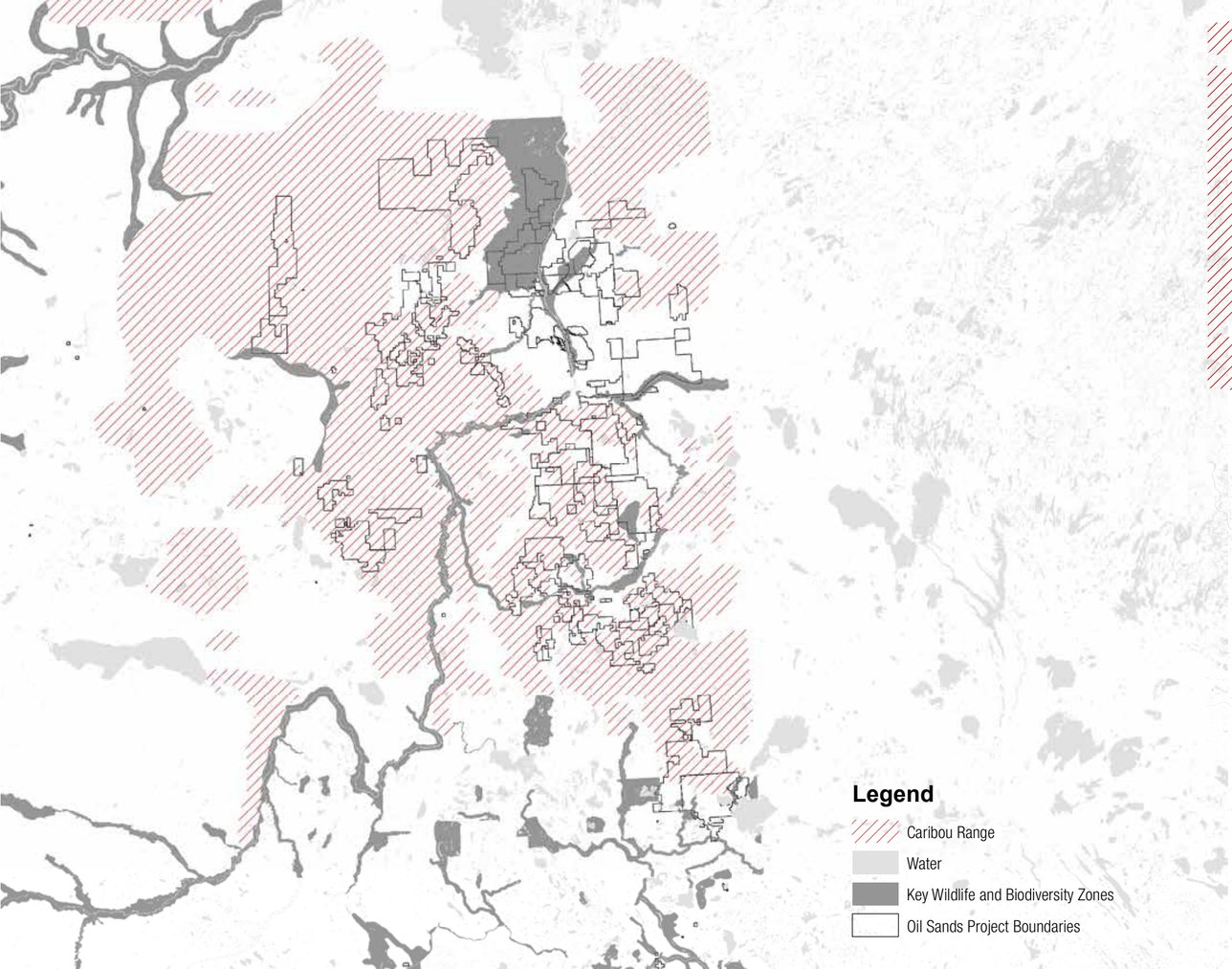
*Data Source: Alberta Environment and Parks 2015*

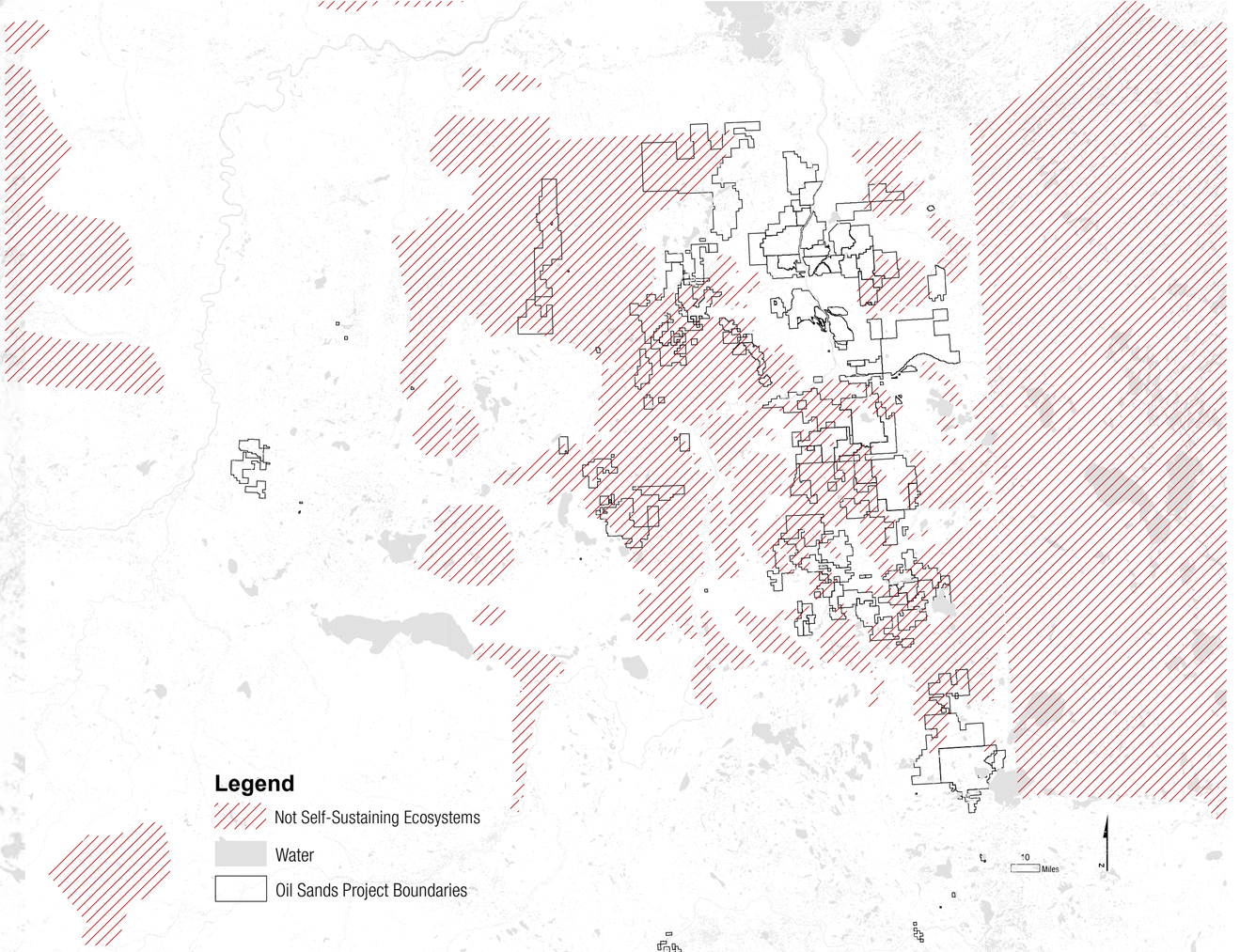
**INQUIRY** What key habitats and species, as defined by the Government of Alberta, are or may be impacted?

**VISUAL STRATEGY** *Overlay* habitats and oil sands boundaries with graphics to *highlight* impacted wildlife species.

**CONCLUSION** The oil sands impact caribou populations, trumpeter swans, other wildlife biodiversity zones (as defined by Alberta Parks and Environment), and colonial nesting birds.

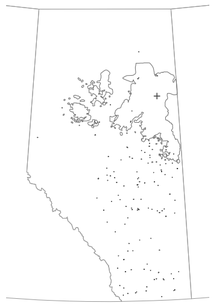
**PROJECTIONS** Synchronize migration season with oil sands development; nature preserve; national park; Northern Alberta Environmental Research Center; Reclamation procedures in coordination with production; wildlife corridor easements.


Legend
Caribou Range
Water
Key Wildlife and Biodiversity Zones
Oil Sands Project Boundaries


Legend
Not Self-Sustaining Ecosystems
Water
Oil Sands Project Boundaries
10
Miles
N

Burrowing Owl

X **Caribou Range**



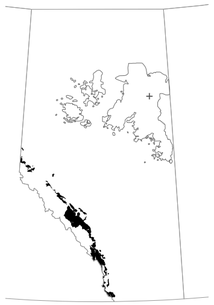
X **Colonial Nesting Bird**

Endangered/Threatened Plants

Greater Sage Grouse

Grizzly Bear

X **Key Wildlife Biodiversity Zones**



Mountain Goats and Sheep

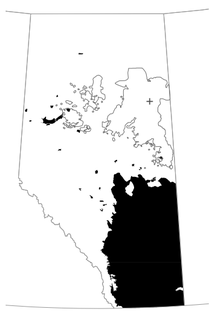
Ords Kangaroo Rat

Piping Plover

Sensitive Amphibian Range

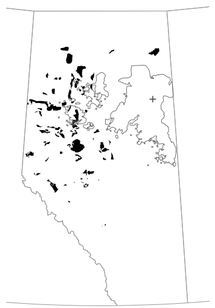
Sensitive Raptor Range

Sensitive Snake Habitat



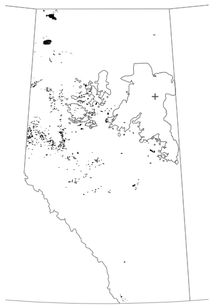
Sharptailed Grose

Short-Horned Lizard



X **Special Access Zone**

Swift Fox



X **Trumpeter Swans**

**Legend**

Species Habitat

Athabasca minable area

# OIL SANDS HAS CLEARED OR DEGRADED MORE THAN 2 MILLION ACRES OF BOREAL FOREST[1]

**Figure 8.9. Oil sands has led to significant loss of forested lands [Author 2017]**

*Data Source: Forest Loss (World Resources Institute 2014); Oil sands projects (Alberta Environment and Parks 2015)*

**INQUIRY** How have the oil sands mining process increased forest tree loss in the region?

**VISUAL STRATEGY** *Overlay* of oil sands projects, forest loss, and forest coverage.

**CONCLUSION** The oil sands process dramatically contributes to loss of surrounding boreal forest and other forest ecosystems.

**PROJECTIONS** Norther lights research and tourism opportunities; biofuel from logging operations; recreational park.

[1] *World Resources Institute 2014*

Figure 8.10. Caribou and bird species most effected [Author 2017]



See page 212

# OIL SANDS TRANSFIGURE EXISTING LANDFORMS

**Figure 8.11. New landscape typologies created from oil sands [Author 2017]**

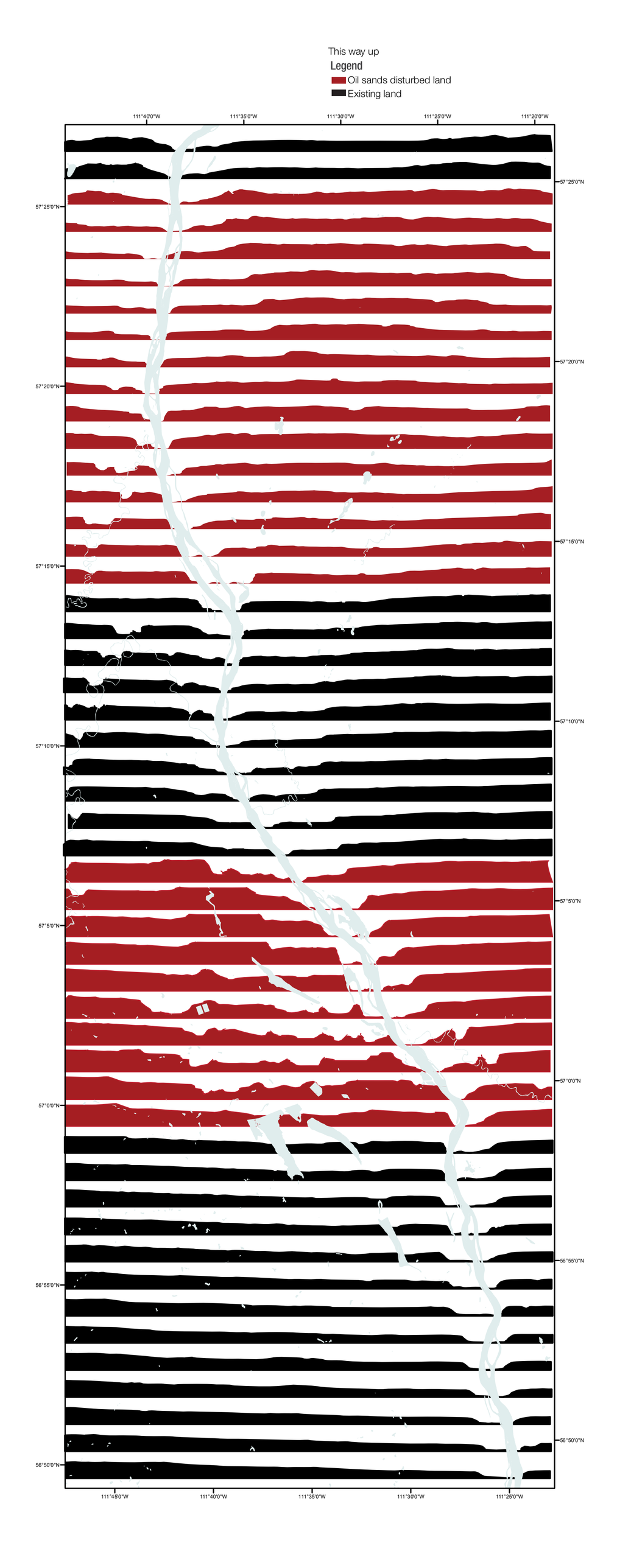
*Data Source: Government of Alberta 2013*

**INQUIRY** How has development of the oil sands impacted physiography?

**VISUAL STRATEGY** *Abstraction* of fifty-one *combined* landscape sections *highlighting* oil sands region in red to emphasize landscape impacts in region.

**CONCLUSION** Oil sands mining has created artificial hills and valleys from the removal and storage of top soil and creation of tailings ponds for wastewater storage.

**PROJECTIONS** Adventure/outdoor recreation park (dune buggy, dirt bikes, skate park. etc.); winter sports parks; cross-country ski resort; nuclear/chemical weapons waste disposal pits; cranberry production farms;


This way up
Legend
Oil sands disturbed land
Existing land
111°40'0"W
111°35'0"W
111°30'0"W
111°25'0"W
111°20'0"W
57°25'0"N
57°20'0"N
57°15'0"N
57°10'0"N
57°5'0"N
57°0'0"N
56°55'0"N
56°50'0"N
111°45'0"W
111°40'0"W
111°35'0"W
111°30'0"W
111°25'0"W

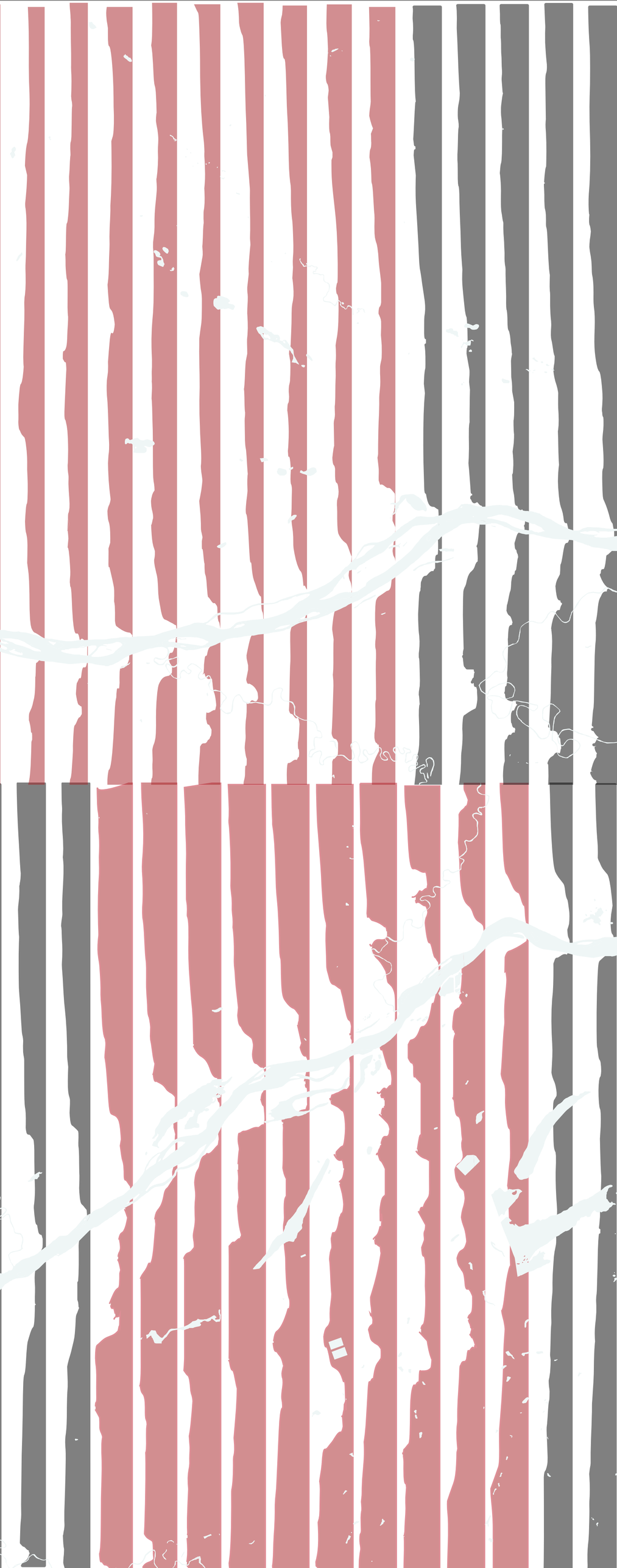


Figure 8.12. Landscape mutilation and the oil sands [Author 2017]


See page 218

## OIL SANDS MUTILATE EXISTING BOREAL FOREST LANDSCAPES

**Figure 8.13. Oil sands shape new landscape typologies [Author 2017]**

*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** How are new landforms created?

**VISUAL STRATEGY** *Contouring* of digital elevation model to reveal new landscape forms *overlayed* with elevation grid and disturbed land to emphasize boundary between disturbed and natural landscapes.

**CONCLUSION** Mining creates significant craters and hills as surface mining operations continue. This differs in comparison to surrounding landscape typologies.

**PROJECTIONS** Adventure/outdoor recreation park (dune buggy, dirt bikes, skate park. etc.); winter sports parks; cross-country ski resort; nuclear/chemical weapons waste disposal pits; cranberry production farms

see page 220

## TOXIC LAKES IN SPAN 176 SQUARE KILOMETERS AND CAN BE SEEN FROM SPACE.[1]

**Figure 8.14. Tailings 'ponds' notable landscape impact [Author 2017]**

*Data Source: Alberta Environment and Parks 2015*

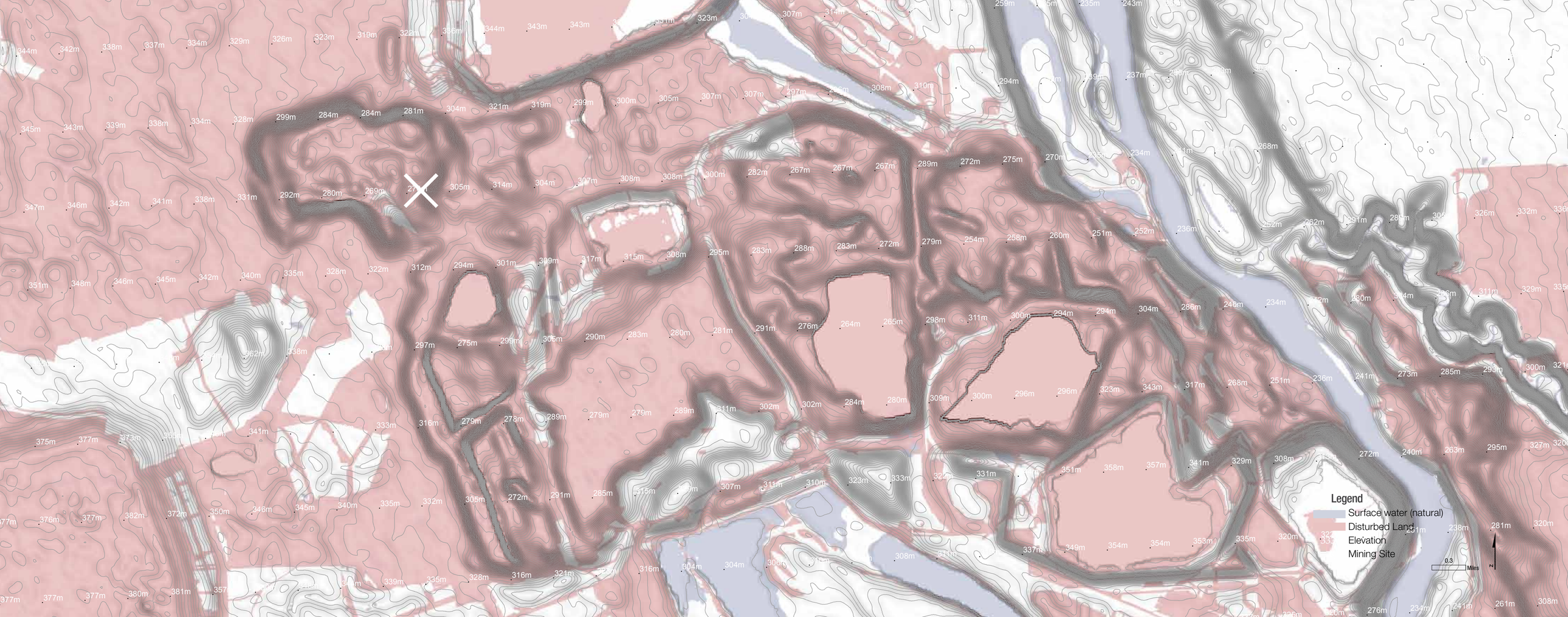
**INQUIRY** How have water systems been impacted?

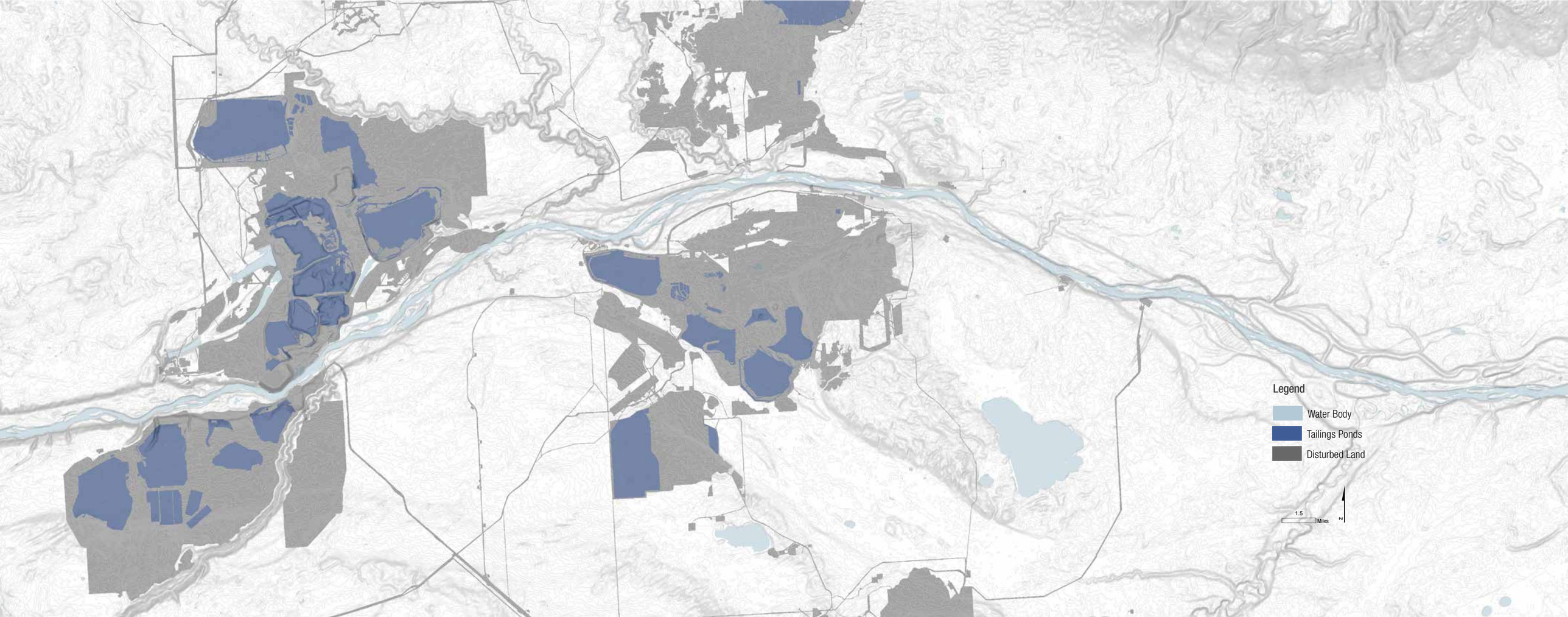
**VISUAL STRATEGY** *Isolation* of tailings ponds against other landscape disruptions.

**CONCLUSION** Oil sands development has created tailings ponds which are the size of lakes.

**PROJECTIONS** Resort and lake district developments; Canadian coast guard training facility; submarine test facility; national park; wildlife habitat; national forest fire training facilities; improved coordination of tailings ponds distribution and location;

[1] *https://www.desmogblog.com/top-10-facts-canada-alberta-oil-sands-information*


Legend
Surface water (natural)
Disturbed Land
Elevation
Mining Site
0.3
Miles
N


Legend
Water Body
Tailings Ponds
Disturbed Land
1.5
Miles
N

# LAND COVER IS MOSTLY CLEARED AND DISTURBED, NOT RECLAIMED

**Figure 8.15. Disturbed and cleared land dominates land cover [Author 2017]**

*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** What are the land uses of the oil sands?

**VISUAL STRATEGY** *Classification* of landscape by land use.

**CONCLUSION** Oil sands development has disturbed land and very little has been reclaimed by industry. Most reclaimed land is not certified as reclaimed, but industry is claiming its status as reclaimed.

**PROJECTIONS** Adventure/outdoor recreation park (dune buggy, dirt bikes, skate park. etc.); winter sports parks; cross-country ski resort; nuclear/chemical weapons waste disposal pits; cranberry production farms;

| LAND COVER | HECTARES | PERCENT |
|---|---|---|
| Natural | 266,093 | 71% |
| Disturbed | 78,287 | 21% |
| Reclaimed | 7,774 | 2% |
| Cleared | 22,515 | 6% |

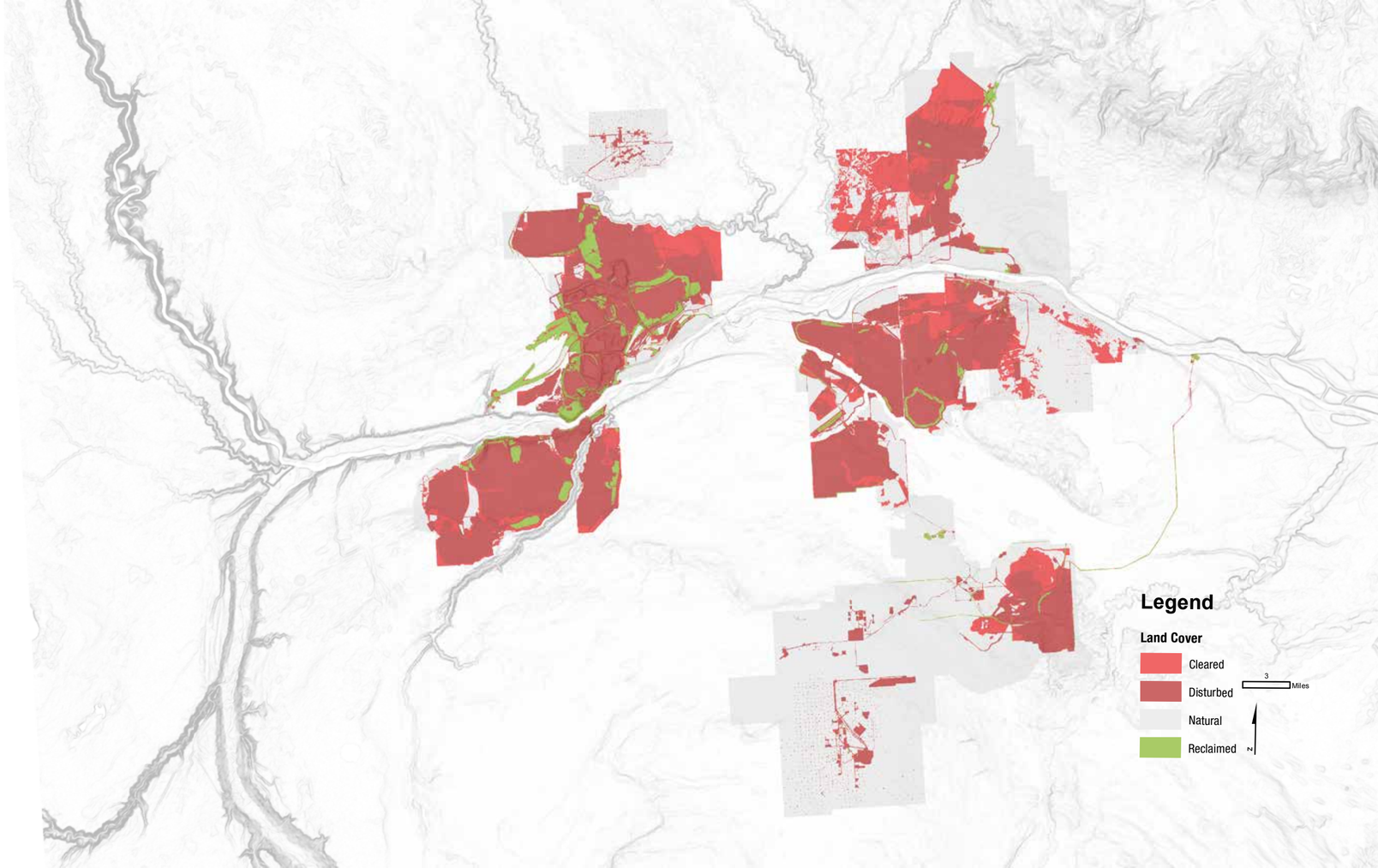


Figure 8.16. Visualizing 0.2%. [Author 2017]

see page 226

## 0.2% OF OIL SANDS IS CERTIFIED RECLAIMED AFTER DECADES OF MINING

**Figure 8.17. Oil sands reclamation lagging production [Author 2017]**

*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** How muchland has been reclaimed to date? What areas?

**VISUAL STRATEGY** *Isolation* of certified reclaimed site against oil sands disturbed lands.

**CONCLUSION** Only 0.2% of the oil sands have been reclaimed so far. Reclamation technology, loosely defined laws and regulations, and cost have all contributed.

**PROJECTIONS** Stop trying to reclaim (e.g. utilize existing landscape for new uses); develop significantly more aggressive reclamation rules; require concurrent and balanced production and reclamation;


Gateway Hill reclamation project
Legend
Tailings ponds
Water
Certified Reclaimed
Cleared
Disturbed
2.5
Miles
N

## UNVEILING ENVIRONMENT: CHAPTER SUMMARY

01. Almost no land has been reclaimed in the last forty years of oil sands mining.

02. Oil sands mining has raped the existing boreal forest.

03. Mining creates new and unusual landscape forms. Oil sands workers are literal architects of the landscape.

04. The oil sands threaten animal habitat and migration. Of particular concern and interest are woodland caribou.

05. Climate change may further worsen changes to the region.

06. Mining transfigures the landscape by creating new water systems and changing existing ecological systems.

07. Boreal forest—a global carbon sink—is being cleared at exponential rates to make way for new surface mining operations. Leases have been issued that will threaten 3000 square kilometers of boreal forest (Sierra Club, 2008).


Figure 9.1. #YMMSTRONG bumper sticker, referencing wildfire. [Author 2016]

# CHAPTER 09: UNVEILING PEOPLE

People operate the oil sands, and the oil sands impact the social and cultural landscapes of people. The development of the oil sands has contributed to negative impacts on people's mental health and well-being and quality of life. Historic considerations inform present and future considerations for the oil sands, positioning the oil sands developments in the context of the lands' historic occupation by various groups of aboriginal people.

## DILEMMA

**"Many indigenous communities in Alberta suffer disproportionately from the adverse socio-economic and ecological implications of resource development and see few socio-economic benefits" (Parlee 2015). Living and working amongst the oil sands—in an industry with long hours and manual labor—has negatively impacted home life and mental health of residents and workers. There are other issues including high housing and cost of living, and substantial income gaps amongst workers. And then there are darker stories of prostitution, sex trading, STDs, drugs, and alcohol.**

Chapters 06-08 showed how the oil sands are intertwined within the energy industry, region, and ecology. But people operating mines shape the landscape, and mining operations shape social and cultural landscapes of people. Because of this relationship with land and dominance of the industry, the oil sands are home to a complex web of socio-economics as conveyed by Alberta journalist Peter Scowen:

> "There's three kinds of people who come to Fort McMurray," says resident Peter Fortna, a historian and consultant, and an active supporter of the provincial NDP. "There's people who come to make a quick dollar and get out. There's other people who come with a five-year plan – 'We're gonna make our money and then we're going to move back.' And then there's people who come here and want to make a community of it" (Scowen 2015a).

And then there are those who did not move to Fort McMurray at all: Aboriginal and First Nation populations whom have called these lands home for thousands of years. Five First Nation populations continue to live in the area today, including about 5,000 people in areas slated to be leased for oil sands development. Cree nations were interviewed for a report about oil sands reclamation and their expectations (Grant, Dyer, and Woynillowicz 2008). There is concern about the utility of the landscape after mining, and that it will become functionally useless if regulation and reclamation is not better (Grant, Dyer, and Woynillowicz 2008). Parlee 2015 found that indigenous communities were disadvantaged by the oil sands in several ways: mismanagement of rents, crowding out of other sectors, weakening of governing institutions, resource rents flowing out of the community and region. Parlee concludes: "A rich endowment of natural resources in the region would suggest that economic growth is guaranteed, yet socio-economic statistics, as well as Aboriginal leaders, tell a much different story. Many

Indigenous communities in Alberta suffer disproportionately from the adverse socio-economic and ecological implications of resource development and see few socio-economic benefits" (Parlee 2015).

For those that are here for the oil sands, there are the obvious issues including high housing and cost of living, a substantial income gap, and a rapid influx of labor from around the world. And then there are darker stories of prostitution, sex trading, STDs, drugs, and alcohol. But the story gets even more complicated if you look at recent news articles. Those darker stories are rapidly being replaced by stories of Fort McMurray becoming a "family town" (Scowen 2015a). Fort McMurray is also home to world-class recreation facilities. "The real tension in a maturing Fort McMurray is between newcomers looking to cash in and move on and residents who want to build something that lasts" (Scowen 2015b). The "boomtown" full of problems in the early 2000s has seemingly dissipated but Fort McMurray is not without serious problems.

Half of households earn more than $200,000 a year with oil sands salaries ranging from $90,000 to $120,000 (Bouw 2014). But this high income comes at other costs. Results of a recent well-being survey point to a potential mental-health crisis. People here work long, grueling shifts while trying to raise a family, and they are feeling the stress. The Canadian Index of Well-being revealed (Scowen 2015b):

- "Only half the working population has a daytime shift, well below the Canadian average of around 70 percent."
- "The other half is working evenings, nights and rotating shifts that routinely last 12 hours (one in five respondents said they work more than 60 hours a week)."
- "Shift work is hard on employees and has been associated with health issues including injury, heart disease and cancer. It makes child care difficult, weakens a person's sense of connection to the community (20 percent of respondents complained of this) and causes people to feel rushed."

There is a growing gap between living conditions of newcomers and lower-income earners and those who own homes or condos in the subdivisions. The median price for a new house is about $800,000 and Fort McMurray boasts the highest per-capita income in Canada but that is equalized by such expensive housing.

A darker vision of Fort McMurray has been seen in the men's restroom at the Oil Can Tavern attached to the Oil Sands Hotel, as described by an American journalist in 2009 (Kemmick 2009):

> "A [poster] bore the headline "Syphilis alert!" and urged patrons to get tested for sexually transmitted infections. "There is an alarming rate of sexually transmitted infections in Fort McMurray," it said. "Some STIs, like syphilis, can seriously affect your health."



But illusion, perception, and reality are a messy combination in Fort McMurray. "The truth is, the lurid 2006 version of Fort McMurray embedded in the Canadian imagination – the wild-west town where transient oil workers with pockets full of cash abuse drugs and alcohol, and prostitutes solicit clients outside the 7-Eleven on Franklin Avenue – is gone. Less than 10 years after being swallowed whole by the social disruptions inherent to boom towns, this city has pulled itself together" (Scowen 2015b). The messy combination of people, living near the oil sands region for a variety of reasons, along with aboriginal populations presents a compelling question:

## QUESTION

How are the people living and working in the region impacted by the oil sands, including mine workers and aboriginal populations?

## CONCLUSIONS

- Aboriginal and Europeans converge in oil sands region
- People come to Alberta from all over the world
- Alberta is a top destination for interprovencial migrants
- Unusual working hours in the oil sands region
- Aboriginal people need to be represented in oil sands future
- The average price of a single-family home is $676,047 and the average monthly rent for a two-bedroom apartment is over $2,200
- Fort McMurray creates high-earning families with diverse backgrounds
- Fort McMurray has four times the level of resource-based employment and two and a half times the level of construction employment compared to the province of alberta as a whole
- Fort McMurray is 55% male compared to 48.9% male for canada.[1]

## ABORIGINAL AND EUROPEANS CONVERGE IN OIL SANDS REGION

**Figure 9.2. Oil sands have been occupied with various populations through history [Author 2016]**

*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** Who has occupied the region near the oil sands?

**VISUAL STRATEGY** *Schematization and abstraction* of land settlement and occupation to show progression of European and outside occupations.

**CONCLUSION** Aboriginal populations have lived in the region for centuries. European settlement in the late 1800s increased populations and began to reproduce with aboriginal populations, creating metis ethnicities. Oil companies are only a recent addition to the oil sands region.

**PROJECTIONS** Aboriginal and metis populations must be represented in oil sands future; job opportunities; land acquisition strategies

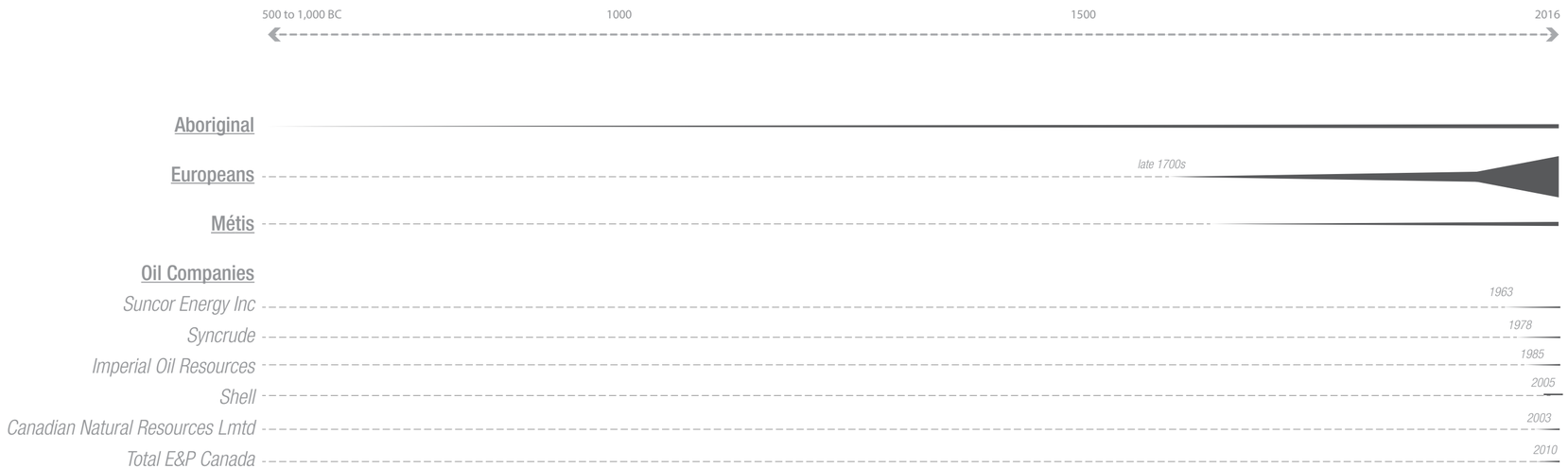


Figure 9.3. A convegence of people in the oil sands. [Author 2016]


## FIRST NATIONS

The dominant First Nations people in the Fort McMurray area were the Cree. The Denesuline and Metis also occupied swaths of land in northern Alberta. The Cree were semi-nomadic, congregating at lakes to fish, hunt game, gather berries and socialize with other Cree bands. Moose and elk were hunted by bow and arrow. They would canoe, snowshoe, and toboggan in the autumn. They knew the oil sands and often used it to protect and waterproof their boats.

## FUR TRADING / TRADING FORT

Europeans arrived in the 18th century. In 1789, the first North West Company established a fur trading post. The arrival of Europeans and treaty negotiations that followed had profound, negative long-term impacts on the Cree, Denesuline and Métis. It acquired a reputation as a boom and bust town early in its history as a result of all the speculative, developing industries. Potential oil reserves were discovered in 1891, but the first oil sands project did not begin until 1964.

## OIL SANDS DEVELOPMENT

Modern Fort McMurray was established in 1964 when Great Canadian Oil Sands (now known as Suncor Energy, Inc.) began to build a plant to separate bitumen from the oil sands. Fort McMurray grew from 2,614 in 1966 to 10,000 by the mid-1970s. By the 1990s the population jumped to nearly 50,000.

## FUTURE

The region and Fort McMurray face an uncertain future from the volatility of the oil market and the "end-date" of resource extraction industry. Importantly, this end date marks the end of the fossil fuel era. The oil sands are a cultural landscape imbued with significance. This alternative embraces the oil sands as a social, cultural, and environments landscape worthy of future alternatives which embrace the past and present landscapes while staging the future.

## PEOPLE COME TO ALBERTA FROM ALL OVER THE WORLD

**Figure 9.4. East Asian countries dominate international immigration to Alberta in last five years [Author 2017]**

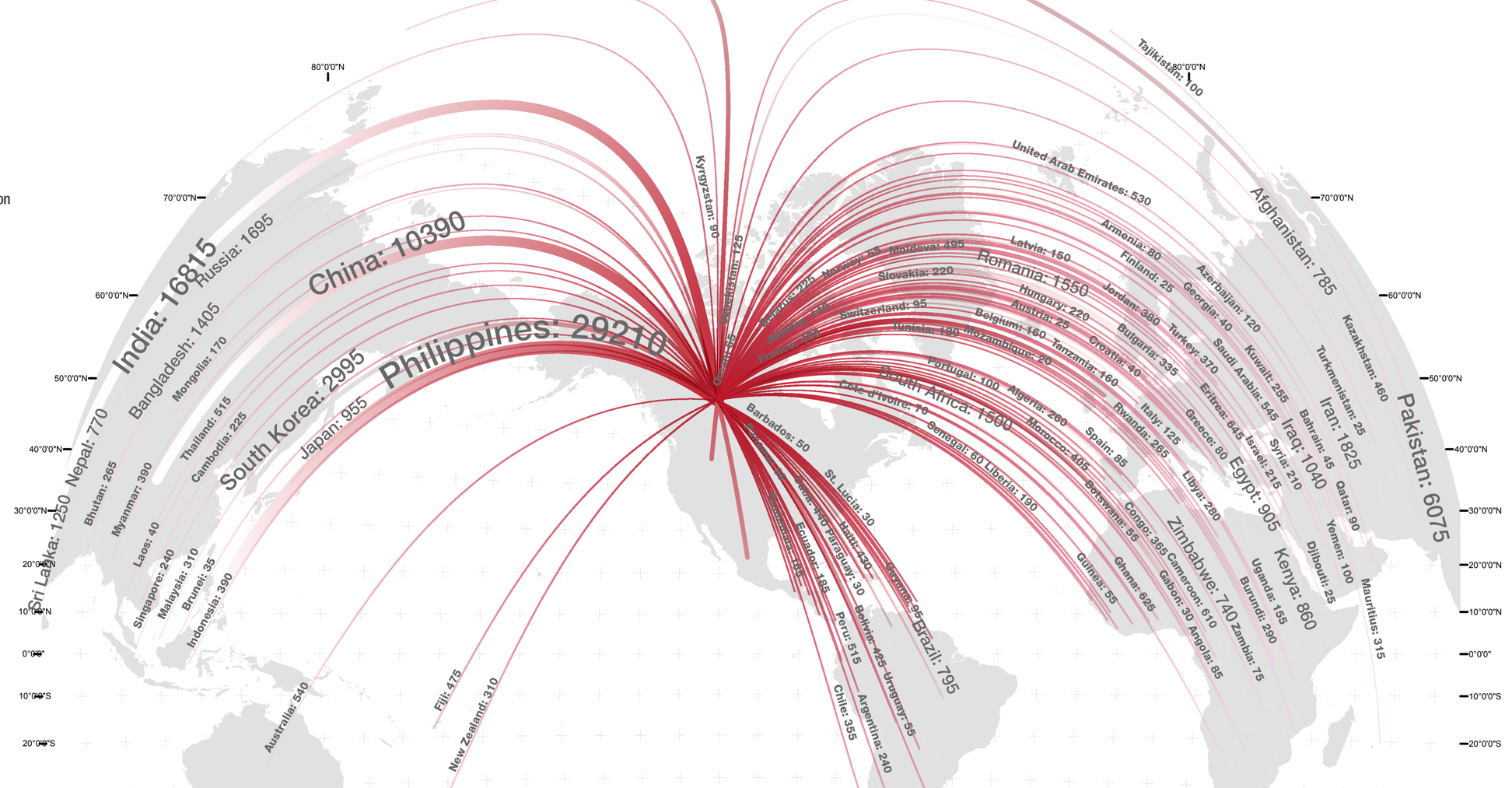
*Data Source: Government of Canada/Statistics Canada 2015*

**INQUIRY** Where have international immigrants arrived from in the last five years since the oil sand developments have increased significantly?

**VISUAL STRATEGY** *Abstraction* of flows *overlaid* with labels and quantifiable data emphasizing flow size and color.

**CONCLUSION** East Asian countries including the Philippines, China, and India dominate immigrant flows.

**PROJECTIONS** Refugee/immigration agriculture cooperative homestead program; Cranberry production farm;



## ALBERTA IS A TOP DESTINATION FOR INTERPROVENCIAL MIGRANTS

**Figure 9.5. Alberta in the Top 3 destinations for interprovencial migrants [Author 2017]**

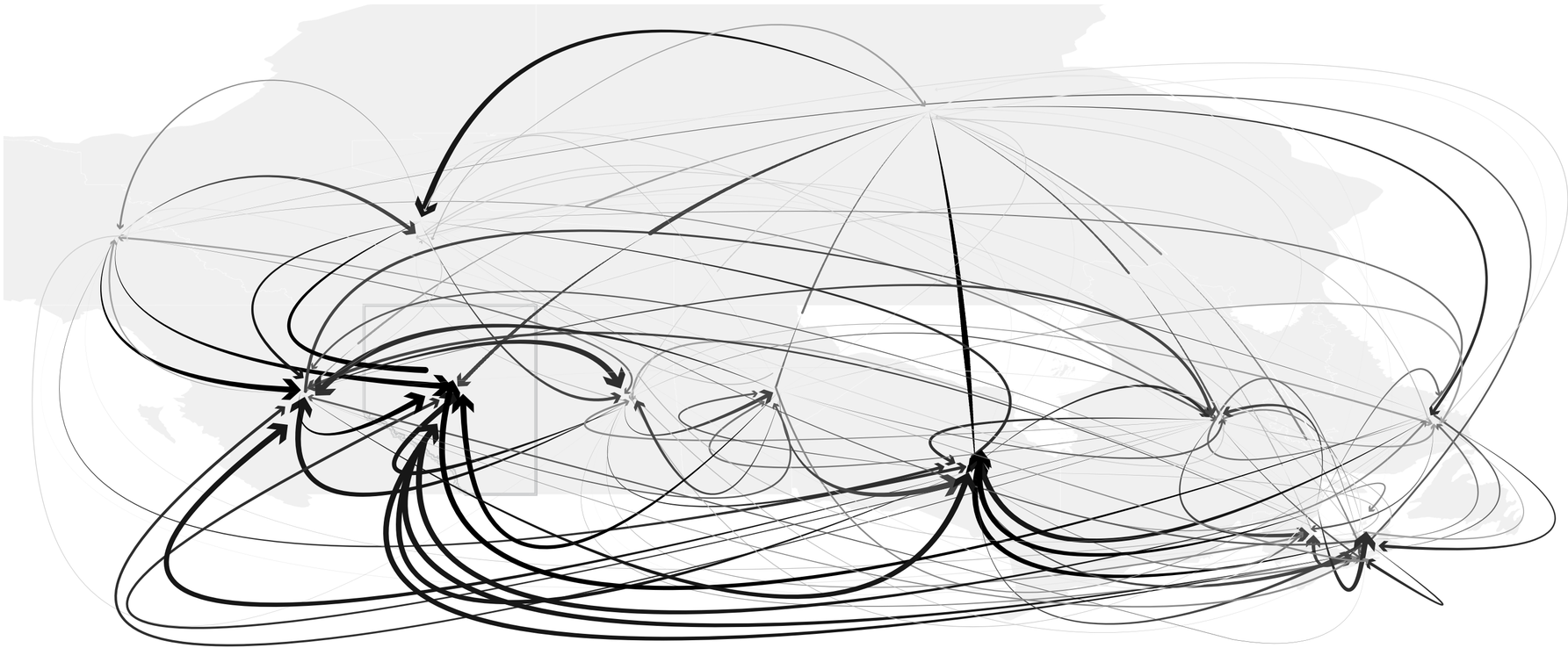
*Data Source: Government of Canada/Statistics Canada 2015*

**INQUIRY** Where have national immigrants arrived from in the in the last decade since the oil sand developments have increased significantly?

**VISUAL STRATEGY** *Abstraction* of flows *overlaid* with labels and quantifiable data emphasizing flow size and color.

**CONCLUSION** All provinces have lost significant numbers of migrants to Alberta.

**PROJECTIONS** Refugee/immigration agriculture cooperative homestead program; Cranberry production farm;



## UNUSUAL WORKING HOURS IN THE OIL SANDS REGION

**Figure 9.6. Many residents work non-standard and long work shifts [Author 2017]**

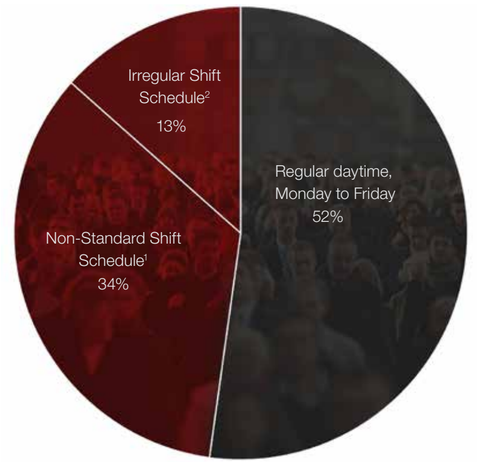
*Data Source: Regional Municipality of Wood Buffalo 2015*

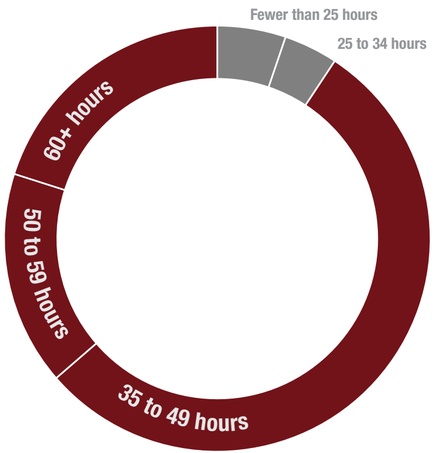
**INQUIRY** What are the work and shifts like in the oil sands?

**VISUAL STRATEGY** *Abstraction* of tabular data and *highlight* of unusual answers.

**CONCLUSION** Many workers in the oil sands region work long hours with unusual shift schedules.

**PROJECTIONS** recreation/adventure parks




*1. Includes evenings, nights, and/or rotating shifts throughout the week*

*2. Includes irregular shifts, on call, compressed work weeks*

Figure 9.7. Aboriginal populations and the oil sands [Author 2017]

## ABORIGINAL PEOPLE NEED TO BE REPRESENTED IN OIL SANDS FUTURE

**Figure 9.8. Aboriginal populations living amongst oil sands [Author 2017]**

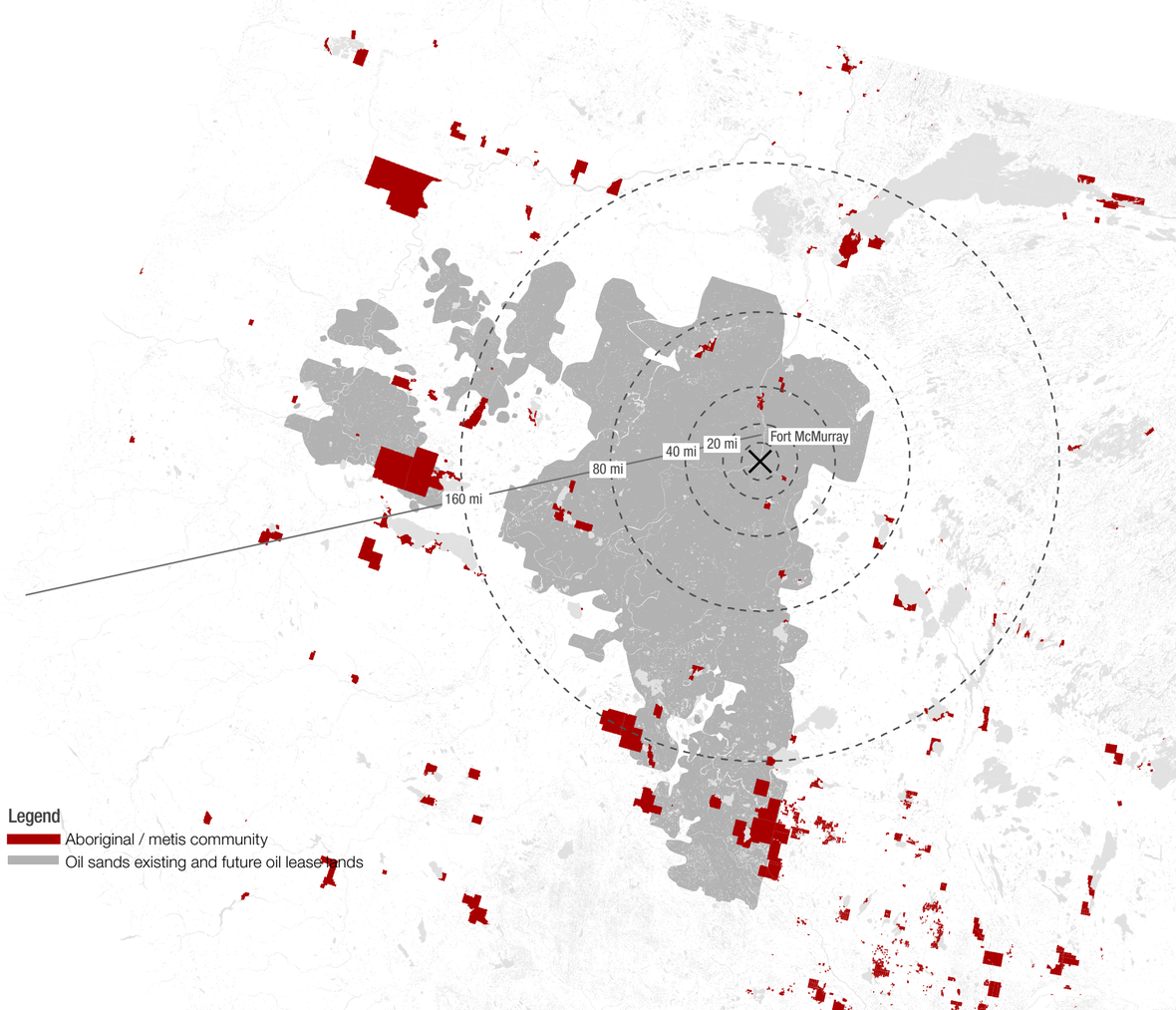
*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** Where do aboriginal and metis reservations exist in relation to existing and future oil sands leases?

**VISUAL STRATEGY** *Highlight* of aboriginal boundaries *overlaid* with concentric rings showing distance of future projects.

**CONCLUSION** The oil sands leases are amidst many aboriginal populations although only a few small reservations exist in the midst of existing lease operations. Indigenous peoples rely on boreal ecosystems for food, water and livelihoods, but the oil sands industry has decimated vast amounts of wildlife habitat and polluted the region's rivers and streams.

**PROJECTIONS** refugee/immigration agriculture cooperative homestead; UNESCO World Heritage site; airline recycling facility; northern Alberta environmental research center; cranberry production farms; improved coordination of future developments; policies and programs for stakeholder engagement; oil sands development buffers from aboriginal communities



## THE AVERAGE PRICE OF A SINGLE-FAMILY HOME IS $676,047 AND THE AVERAGE MONTHLY RENT FOR A TWO-BEDROOM APARTMENT IS OVER $2,200

**Figure 9.9. Housing prices are astronomically high in Fort McMurray [Author 2017]**

**INQUIRY** How have the oil sands impacted housing demand and housing prices?

**VISUAL STRATEGY** *Abstraction* of chart data and *overlaid* with photograph to emphasize chart shape/data.

**CONCLUSION** Housing is one of the most surprising aspects of the oil sands region. Single-family houses in Fort McMurray are the highest average cost other than Vancouver, British Columbia.[1]

**PROJECTIONS** Address affordable housing; low-income housing in oil sands reclamation zones; housing development.


*1. http://www.readersdigest.ca/travel/canada/10-most-expensive-cities-canada/*

## FORT MCMURRAY CREATES HIGH-EARNING FAMILIES WITH DIVERSE BACKGROUNDS

**Figure 9.10. High-income, diverse families reside in Fort McMurray [Author 2017]**

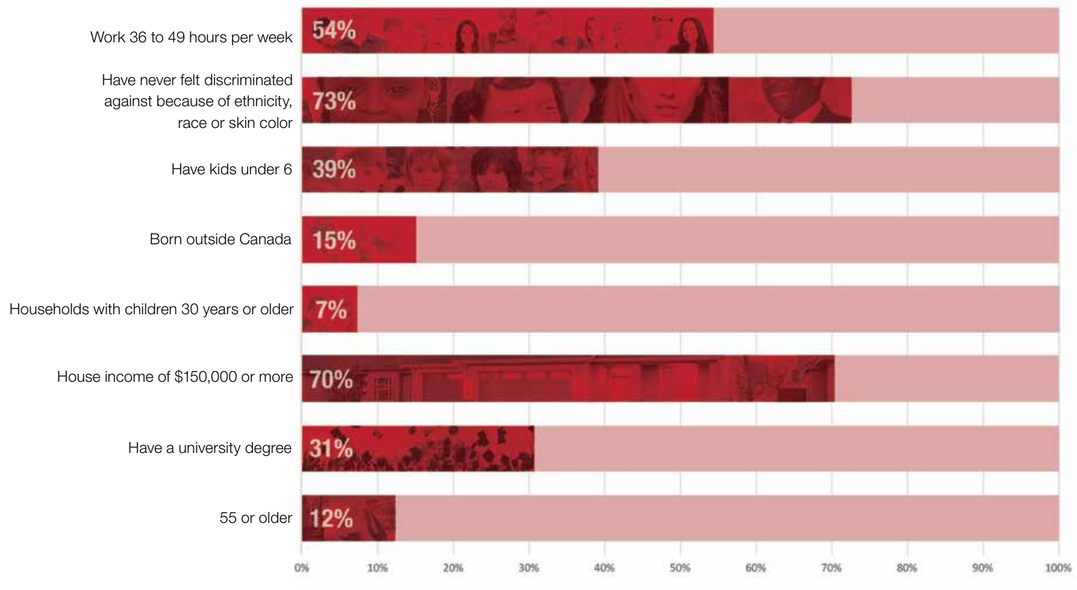
*Data Source: Alberta Environment and Parks 2015*

**INQUIRY** What are the demographics of the region and how have the oil sands impacted earnings, families, and work schedule?

**VISUAL STRATEGY** *Abstraction* of tablular data and *overlaid* with photograph to emphasize chart shape and topics.

**CONCLUSION** The oil sands have attracted those without university degrees, young children, and many from outside of Canada, and they earn more than $150,000 per year.

**PROJECTIONS** recreation and adventure areas; educational advancement opportunities; cultural convergence programs; stress reduction programming.



## FORT MCMURRAY HAS FOUR TIMES THE LEVEL OF RESOURCE-BASED EMPLOYMENT AND TWO AND A HALF TIMES THE LEVEL OF CONSTRUCTION EMPLOYMENT COMPARED TO THE PROVINCE OF ALBERTA AS A WHOLE

**Figure 9.11. Oil sands dominate employment [Author 2017]**
Oil sands cause one-resource region and make it vulnerable to collapse

*Data Source: Regional Municipality of Wood Buffalo*

**INQUIRY** How are local employment opportunities impacted by the oil sands?

**VISUAL STRATEGY** *Abstraction* of tabular data, *overlaid* with photograph to emphasize chart shape and data, and *highlighting* similar industries for comparison.

**CONCLUSION** The oil sands have a significant impact on local employment opportunities, comprising 2/3 of all employment in the region. This puts pressure on the region and industry. If the oil sands fail, the region fails.

**PROJECTIONS** alternative energy job growth and training programs, food and agriculture production, education programs through Kayano College.

## FORT MCMURRAY IS 55% MALE COMPARED TO 48.9% MALE FOR CANADA.[1]

Figure 9.12. Males dominate Fort McMurray demographics [Author 2017]

**INQUIRY** How has the heavy industry of the oil sands impacted the population ratio of males to females in Fort McMurray and how does that compare to Canada?

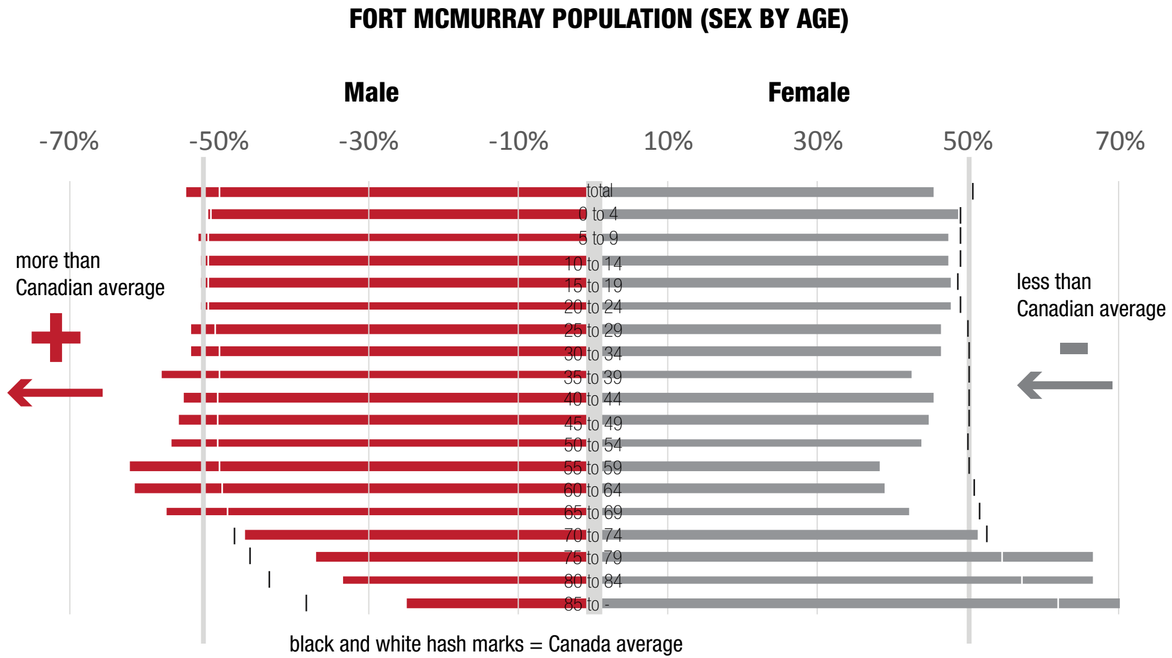
**VISUAL STRATEGY** *Abstraction* of tablular data and *overlaid* with Canada statistics for comparison.

**CONCLUSION** Fort McMurray has a dramatically higher rate of males than females compared to the average in Canada.

**PROJECTIONS** Outdoor sports areas for hunting, shooting, fishing; extreme sports recreation;

*Statistics Canada 2014*





## UNVEILING PEOPLE: CHAPTER SUMMARY

01. The oil sands have attracted people from all over the world to work in Alberta.

02. Aboriginal populations are an important cultural asset to the region and need to be addressed in future planning and design.

03. Other than recreation spaces, the region is devoid of many cultural needs.

04. Population fluctuates with the rise and fall of oil prices. Work camps house tens of thousands of workers.

05. Long hours and blue collar work has mental health side effects.

06. Employment opportunities are dominated by the oil sands. Without the oil sands, most would not be here and many would not have opportunities to move away and look for work elsewhere. Many are here for the oil sands only.

## UNVEILING GHOST ECOLOGIES: SECTION SUMMARY

01. This section has demonstrated the agency of mapping and photomontage as tools of landscape architecture.

02. Mapping, diagramming, and photomontage have helped to generate novel relationships and reveal forces and flows in the oil sands.

03. The region and its development is difficult to understand without cartographically and visually laying out forces, flows, and relationships. This section has revealed selected forces in hopes to tell the story of the oil sands.

04. Oil sands mining is linked to the rest of the world through its infrastructure and through the industry itself. This is both an asset and a liability for the region's future.

05. The oil sands are spatially isolated from the rest of Canada. As it exists, this region will never support the types of development and growth patterns of larger regions with more people, closer to the border, and closer to traditional shipping routes of highways and waterways.

06. The oil sands scale is difficult to imagine but suggests many new uses can coexist with the oil sands.

07. Future production is likely to continue, with thousands of acres still leased for oil exploration.

08. Oil sands have transformed the ecologies of the region negatively—including deforestation, water quality, and flora and fauna.

09. Infrastructure has been haphazardly created with pipelines and roads snaking through the region and airports operating throughout the landscape. There appears to be little coordination between mining operators.

10. People living in the oil sands region impact development of the oil sands. The oil sands mining operations impact the social and cultural landscapes of people.

11. Historical and embedded cultural significance should be included in considerations of the future. The oil sands are not a tabula rasa landscape.

12. The future of the oil sands is unknown amidst a complex web of forces and flows.

# SECTION FOUR

## Projecting Ghost Ecologies

This section investigates future opportunities of oil sands reclamation through photomontage—both eidetic and photorealistic. The purpose of these projections is to reconsider the possibilities of oil sands reclamation to avoid becoming a ghost town. All mining activity in the United States and Canada is required to be reclaimed (Berger 2002). This creates a technological, legal, and public-health challenge (Berger 2008), as demonstrated in the lack of success the industry has had in reclaiming surface mining landscapes. These projections consider new programming opportunities for the land and region of the oil sands, often utilizing existing landscape changes, industry infrastructure, and leveraging political and industry trends of alternative energy production. In so doing, the story of the Athabasca oil sands is projected forward with a new ending, a new future where the oil sands do not leave the region a ghost town. These projections can be used to incite inter-disciplinary dialogue of stakeholders, landscape architects, and the public.

# How can the agency of mapping, diagramming, photomontage, and photography be used to think creatively for new future scenarios in the Athabasca oil sands region?


Figure 10.1. Reclamation in progress with refinery backdrop [Author 2016]

# CHAPTER 10: FUTURES IN THE ATHABASCA OIL SANDS

Three factors shape viability of the Athabasca oil sands:

1. Global oil prices and supply;
2. Alternative fuel sources; and
3. Climate policy.

The fate of future production of oil sands is complicated. An analysis by Chan et al. (2012) described scenarios of future production based on global liquid fuel supply, crude oil prices, carbon prices, carbon dioxide policy, and others. As global oil supply decreases, the oil sands have become more viable (Chan et al. 2012). However, need for oil sands is reduced as more countries take part in climate policy. Likewise, for alternatives to petroleum-based diesel and gasoline transportation. There is a niche based on price and consumption which makes oil sands profitable. Existing oil sands projects will continue if world oil prices exceed $35 - $40 per barrel (Levi 2009). In 2012, US crude was well under $90. So while the magnitude and potential of the industry is staggering, the economics must make sense for large, multi-national companies spending billions each year to continue development of the oil sands. Up until the last two decades, oil sands were too expensive both financially and environmentally to consider exploration. Only when oil prices rose and traditional source supply shrank did oil sands become viable (Lustgarten 2005) but, even still, price drops slow expansion as Levi (2009) found.

"With potential CO2 control looming in Canada, the economic viability of the industry and the value of these large reserves may be at risk" (Chan et al., 2012, 241). Just recently Prime Minister Stephen Harper signed a declaration which committed G7 nations to decarbonize the global economy by 2100. Harper later qualified the goal as "aspirational" but "that doesn't change the fact that the world has basically put an expiration date on Fort McMurray" (Scowen 2015b).

These factors leave the industry, region, and government in flux with an undetermined future. What if production costs continue to soar? What if alternative fuels are developed, as anticipated, dramatically reducing need for fossil fuels? What becomes of the landscapes left behind by industry?

The future of the Athabasca oil sands and Fort McMurray are at "a critical juncture" (Globe and Mail 2014). There is "significant moral opposition to the oil sand." Production and profitability rely heavily on global markets and "business-as-usual" global oil production markets and supply. If moral opposition and carbon policies aim to reduce oil sands production, the once unsustainable and infeasible oil sands will return to being infeasible and production will stop. A Canadian national government official summarized it best: "What is our plan long-term, going forward? Is industry going to work with us to create a sustainable community? Are we going to be able to achieve that? Or are we going to continue these boom-and-bust cycles that never really address the core issues of housing, stability, and livability?" (Scowen 2015a). Landscape architecture's purpose

lies within these cultural and social questions. Table 10.1 shows a summary of existing and previous plans for the region.

## THREE SCENARIOS FOR THE OIL SANDS

Section Three explored dilemmas and questions to help reveal processes, relationships, and actions being taken in the oil sands. These maps, diagrams, and photomontages have value for design. They have agency. As Jill Desmini and Charles Waldheim argue, "the projective potential of cartographic practices…afford[s] greater connection with the ground itself, making present and vivid the landscape, as it exists and as it could be, both to the eye and to the mind" (Desimini and Waldheim 2016). This section projects forward these relationships and connections made in the previous section through this agency. Landscape reclamation is the driving force for these projections, acknowledging three likely directions the oil sands may take in the future.

Outside forces are likely to impact the future of the oil sands. Recently the Canadian government has taken aggressive measures to reduce national carbon emissions. If the oil sands continues its current production trend, Canada cannot successfully meet these carbon emission goals. The environmental impact of the oil sands is still being researched. Environmental groups have already aggressively tried to stop the oil sands. But new efforts by scientists are likewise calling for a moratorium on the oil sands (Homer-Dixon, Jaccard, and Lertzman, n.d.). Alternative energy growth in the US may also impact the oil sands. Renewable energy was 16.9% of US electricity generation in the first half of 2016 (Fleischmann 2016). Regardless of any outside sources, the simple fact is the oil sands will not last fewer. While the projected end date of the oil sands is still more than 100 years off, Fort McMurray and the industry must recognize that outside forces are much more likely to end exploration before that date. Amidst these outside forces, three imagined scenarios are likely for the oil sands.

### Possible Scenario 1: The End is Near

Aggressive political and environmental policies significantly reduce or entirely stop production in the oil sands (Figure 10.2). Industries diminish production and employment significantly; thousands of people are left without jobs. Left behind is a landscape 99.8% un-reclaimed punctuated by abandoned industry infrastructure including roads, refineries, pipelines, etc. Fort McMurray will become a ghost town, left behind because of its inability to reach beyond its single-industry economy. Fort McMurray residents who are unable to leave will ride one final wave to the bottom.

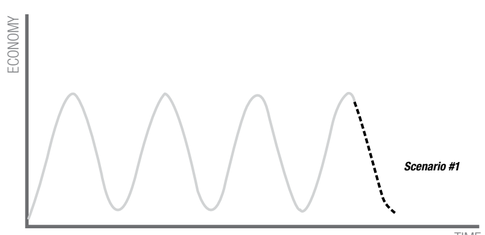



Figure 10.2. Future Scenario #1: The End is Near [Author 2017]

### Possible Scenario 2: The Boom is in the Past

The oil sands continue production but at a slower pace (Figure 10.3). Low oil prices compared to historical trends reduces industry pressure to mine at a "no end in sight" pace. Pressure from the government, environmental groups, and social groups will force the oil sands to better plan its production and reduce its output levels. Alternative energy will continue growing in North America and Europe, reducing global need for fossil fuels in the oil sands and elsewhere.

This scenario allows for better coordination of reclamation and for more productive land uses. New uses can be introduced, operated concurrently alongside a reduced oil sands production. These new uses offer hybrid landscapes where recreation, government, and private oil sands industry uses can coalesce in the same landscape.

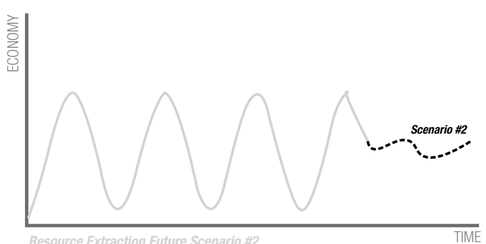



Figure 10.3. Future Scenario #2: The Boom is in the Past [Author 2017]

### Possible Scenario 3: Mine, baby, mine!

Minimal changes are made in the oil sands (Figure 10.4). Production continues nearly unchanged until the last drop leaves the oil sands in 2155. The region continues to cycle through boom-bust cycles with large changes in temporary worker populations and immigrants. City infrastructure is simultaneously overbuilt and under serving, depending on whether it is a boom or a bust cycle. The landscape is detrimentally altered across tens of thousands of square miles. The Athabasca River is polluted and water shortages are common. Canada must aggressively fend off foreign attacks and terrorists to defend the last precious drops of fossil fuel on the planet. Fort McMurray is a boomtown but has grown so haphazardly it more closely resembles an informal refugee settlement than a city. It's an industry town operated by industry, for industry.

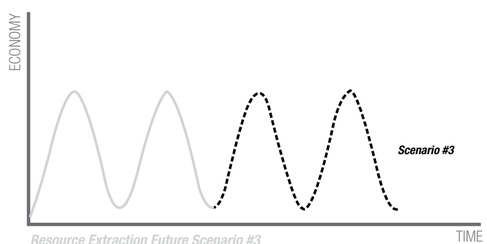



Figure 10.4. Future Scenario #3: Mine, baby, mine! [Author 2017]

Table 10.1. Future Plans and Proposals [Author 2016]

| Government / Official | | | |
|---|---|---|---|
| **Organization** | **Plan / Proposal** | **Summary** | **Year** |
| Government of Alberta | Coal and Oil Sands Exploration Reclamation Requirements | The aim of reclamation under the Environmental Protection and Enhancement Act is to obtain equivalent land capability. "Equivalent land capability" is defined in the Conservation and Reclamation Regulation as "the ability of the land to support various land uses after conservation and reclamation is similar to the ability that existed prior to an activity being conducted on the land, but that the individual land uses will not necessarily be identical." | 2010 |
| Government of Alberta (Energy) | Comprehensive Regional Infrastructure Sustainability Plan (CRISP) | The Comprehensive Regional Infrastructure Sustainability Plan (CRISP) is a guideline for long-term infrastructure development in the Athabasca Oil Sands Area (AOSA) and supports Responsible Actions, the Alberta government's strategic plan for development of its oil sands resource. -Population growth will be managed through natural growth in existing communities, a possible new community north of Fort McMurray and planned work camp communities in the Conklin and Wabasca areas. -Multi-modal transportation system that -Upgrades to existing roads, the creation of new roads, coordinated air transportation infrastructure, as well as new bus transit and commuter rail systems that provide quick access between communities and project sites, as well as locations outside of the AOSA. - Coordination will include integration with regional planning under the Landuse Framework, as well as exploration of alternative financing mechanisms, partnerships and innovative project delivery. | 2011 |
| Regional Municipality of Wood Buffalo | Municipal Development Plan | Therefore, it can be said that this Plan is a plan for sustainability with a desire to have Wood Buffalo emerge as a global model for sustainable living in the north. "Still, prosperity in a single industry can put stress on the service sector and make us vulnerable to the many local and global factors that influence the oil economy. We can establish a more resilient economy through diversification, supporting local businesses, and promoting a culture of innovation, education and training." Wood Buffalo is a region rich in natural resources including minerals, aggregates, timber, and the bitumen deposits that have given rise to the oil sands industry. However, history has shown that resource-based economies can experience boom and bust cycles, or rapid growth followed by periods of relative stability, as has been the case in Wood Buffalo. The region first thrived in the fur trade, then salt mines, and today oil sands development. Dependence on a single economic driver can make a seemingly strong economy vulnerable to changes in market demand, technology, competition, industry and government policies, and other conditions that shape an economy over time. | 2011 |
| Government of Alberta (Energy) | Responsible Actions: A Plan for Alberta's Oil Sands | The Provincial Energy Strategy outlines the plan for Alberta's energy future. It builds on Alberta's strengths, addresses challenges, and charts a strategic path to ensure clean energy production, wise energy use, and sustained economic prosperity. -provides a platform to balance development with environmental protection, social responsibility, and economic success. It outlines a strategic approach to responsible development of the oil sands resource. Six strategies are proposed: (1) Develop oil sands in an environmentally responsible way; (2) Promote healthy communities and quality of life that attracts and retains individuals, families, and businesses; (3) Maximize long-term value through ecnomic growth, stability, and resource optimization; (4) Strengthen proactive approach to Aboriginal consultation to reconcile interests; (5) Maximize research and innovation to support sustainable development; (6) Increase available information, develop measurement systems, and enhance accountability | 2009 |

| Unofficial / Academic | | | |
|---|---|---|---|
| **Organization / Individual** | **Plan / Proposal** | **Summary** | **Year** |
| Kelly Doran, Professor and Architect | Operational Alternatives: (Re-) Configuring the Landscape of Alberta's Athabasca Oil Sands | A short paper/study on creating post-oil economies on the Kearl Lake lease. Turning the oil companies into biofuel, biomass, and bio-energy companies. Addresses volatility of market forces and ongoing legal requirements. | n.d. |
| Fionne Byrne, Professor and landscape architect | Reclamation in Progress - the potential of wate: form and function of sand without oil | Reclamation is the final step mining companies are required to complete before mine closure. Defined in Alberta as the "stabilization, contouring, maintenance, conditioning or reconstruction of the surface of land," reclamation is an essential component of responsible oil sands development. How will this new reclaimed landscape be designed? What habitats, ecologies and species will be prioritized? | 2015 |
| Kyle Zuekun Yang | Last Grain: Revising the End of the Fossil Fuel Era and Canada's Oil Sands Legacy | Canada's oil sands are called the "dirtiest oil on earth", which come with a deleterious environmental impact. This thesis uses landscape ecology to reorganize the oil sands' surface mining operations and reclamation processes. It aims to redeem Canada's damaged environmental reputation while searching for a place for landscape architecture within this contemporary industrial process. | 2010 |
| John van Nostrand | If We Build It, They Will Stay | Instead of extracting resources and leaving, we could populate the mid-Canada corridor—and create a bigger, better country. The Far North, though largely unpopulated, has always been part of our national identity, and under Stephen Harper, who is keenly aware of threats to our northern sovereignty, it has become a strategic asset and an increasingly important site of natural-resource interests. But the millions of square kilometres in between these two areas have represented something of a forgotten zone, even though mid-Canada is quickly becoming the most productive part of the economy, defines our country internationally as a vast reservoir of natural resources, and is home to the majority of First Peoples in Canada. Globally, the standard approach to mining has been to create a temporary settlement, extract the resource, and move on, leaving behind an environmental and societal mess. As an architect and planner with a special interest in mining regions and towns, I've seen the damage first-hand. For the companies doing the extraction, developing countries are ideal: labour is cheap, the enforcement of environmental restrictions lax, and legal recourse for aggrieved locals minimal. This explains why these countries often end up poorer as a result of such projects. Nigeria is an example. While it has made hundreds of billions of dollars from oil, close to two-thirds of Nigeria's 170 million people live in extreme poverty. The country exports millions of barrels of oil every day, but thanks to government corruption and anemic public institutions it lacks a reliable electrical grid to light workers' homes. | 2014 |

## FUTURES IN THE ATHABASCA OIL SANDS: CHAPTER SUMMARY

01. Futures in the Athabasca oil sands are unknown and ambiguous because the oil sands are the single industry responsible for most of the regional economy.

02. Existing plans from private and public entities have considered the oil sands, but none consider alternative futures for oil sands reclamation.

03. Three scenarios within the oil sands are likely: The End is Near, The Boom is in the Past, and Mine, baby, Mine!

04. Each scenario was considered and The Boom is in the Past was identified as the most likely scenario for the oil sands future.

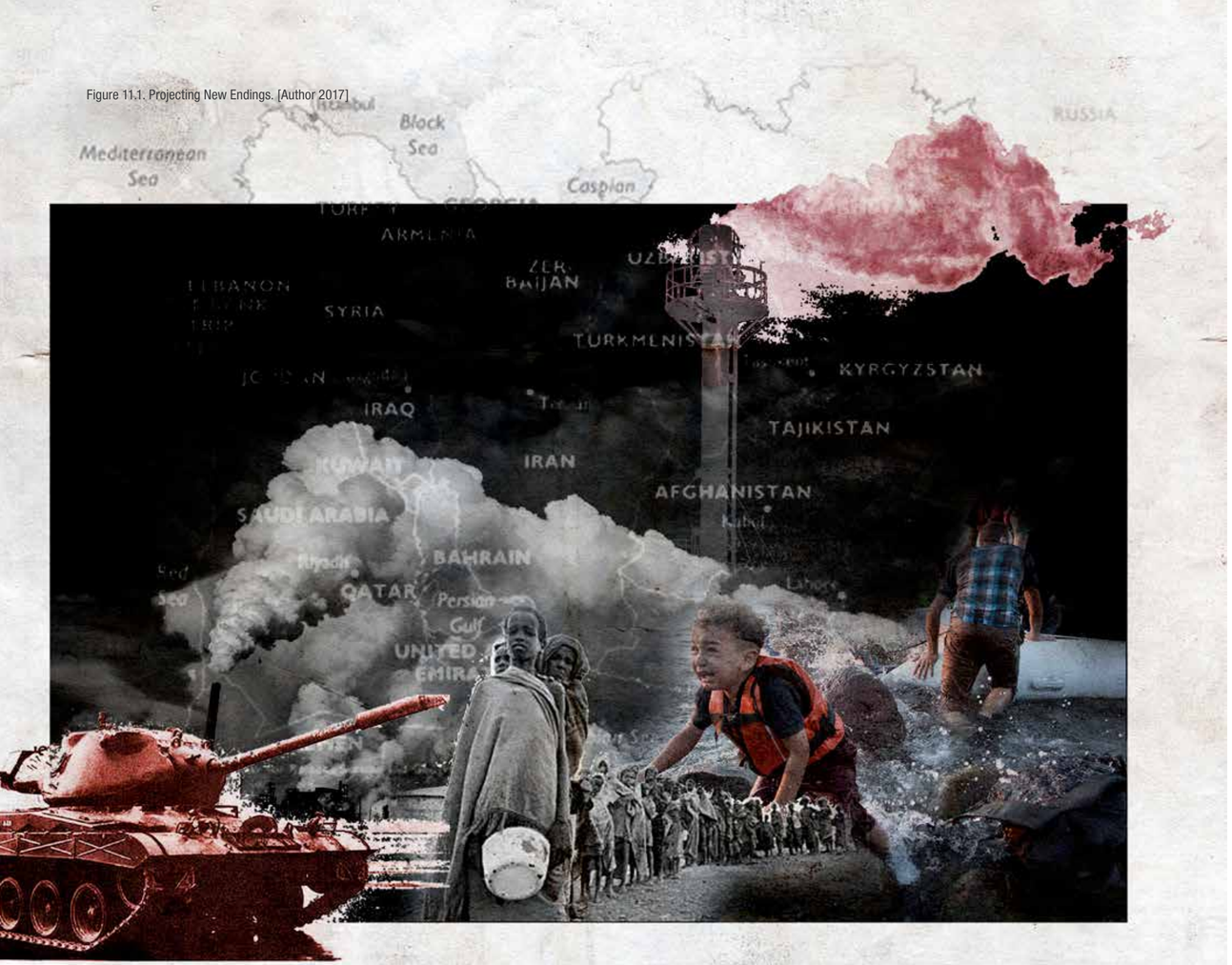



Figure 11.1. Projecting New Endings. [Author 2017]

# CHAPTER 11: PROJECTIONS

The story of the Athabasca oil sands is ambiguous, and the future is yet to be written. Existing reclamation strategies are limited in their potential. The story of the Athabasca oil sands reveals new opportunities to reconsider reclamation strategies and policies. Landscape architects need to integrate the "…reclamation of natural-resource-extraction sites into the ongoing needs of local and regional communities" (Berger 2008). Designers can project new meanings, new forms, new relationships for Fort McMurray and the oil sands.

Presented in this chapter are a series of strategies to reclaim the oil sands in new and novel ways. The goals of these projections are to better address Scenario 02 discussed in Chapter 10, where the oil sands production continues but new industries and new social and environmental opportunities converge spatially and non-spatially to address future regional needs (Figure 11.2).

Table 11.1 and Figure 11.3 show eight themes to illustrate reclamation alternatives used in the projections, illustrated below in Figure 11.4-11.18. Table 11.1 presents the future oil sands region as an alternative industry using the phrase "oil sands as..." to suggest how the oil sands could be re-appropriated as more than just an oil production operation. Figure 11.3 demonstrates the relationships between each of these new systems and proposed sub-systems. Each projection shows how the oil sands could be changed to better address the social and economic ambiguity of the region's future. Figure 11.3 presents new systems and how these new systems also relate to each other spatially and conceptually.

These new strategies reclaim the oil sands and use reclamation funds to better address an unknown future and help the region avoid becoming a ghost town like so many other resource extraction sites. Rather than replace existing ecologies with less-than-healthy trees and grasslands, these strategies better address site reclamation by addressing cultural, social, and economic needs. In many examples, existing infrastructure like airports, roads, workcamps, and landscape changes are re-used. Many other examples speculate on federal- or provincial-level initiatives to create new jobs to diversify the employment sector.

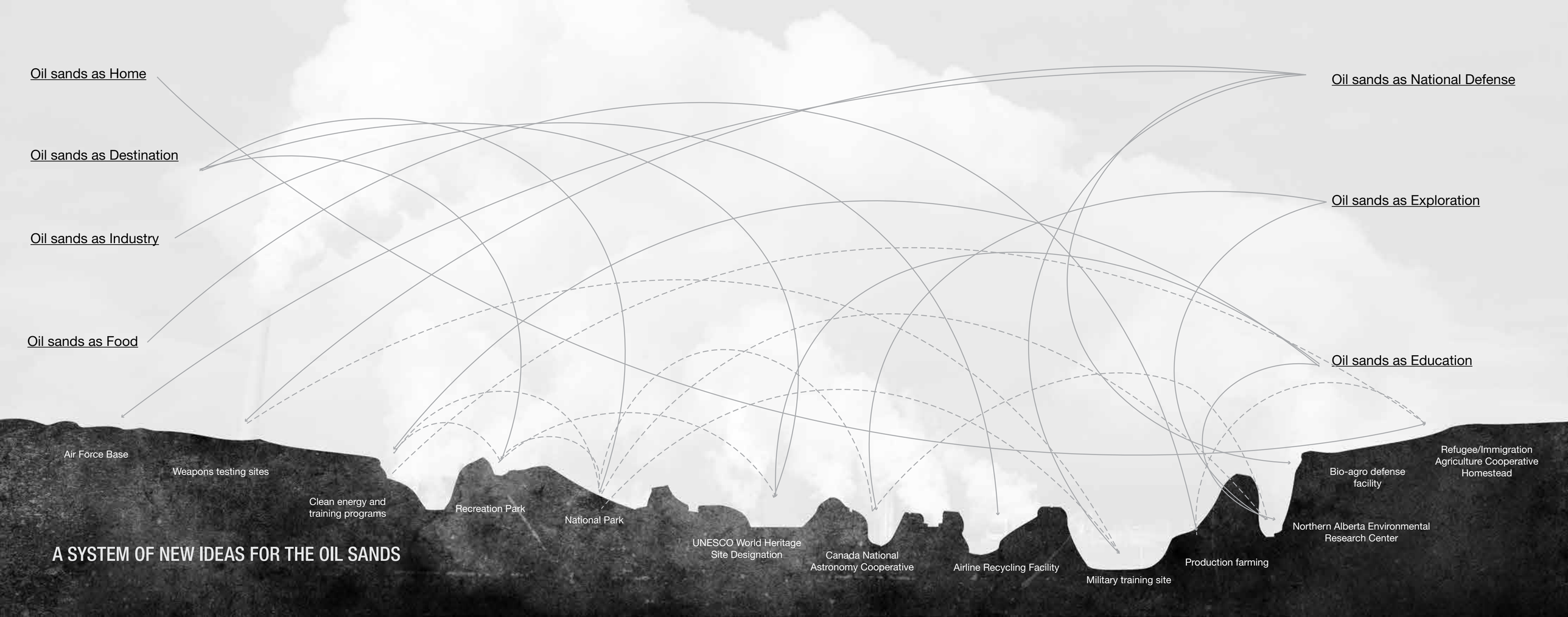
All strategies recognize an adjustment to the existing reclamation policies. Currently, all reclamation must be returned to a "pre-existing state." These proposals disrupt this status quo and allow new entities, new industries, and new uses to occupy the landscape. This theoretical adjustment allows for novelty, creativity, and discussion to emerge. The goal of this adjustment is to incite discussion, debate, and new ways of viewing oil sands reclamation. Oil sands reclamation can address the future, address current and futures needs of people, and leverage existing industry development.


Figure 11.2. Projection Purpose [Author 2016]

Table 11.1. Projection List [Author 2017]

Figure 11.3. Projections (see next page) [Author 2017]

| THEME | PROJECTION | PROJECTION DESCRIPTION |
|---|---|---|
| OIL SANDS AS HOME | Refugee/Immigration Agriculture Cooperative Homestead | Given world problems and accessibility by plane to the oil sands, and Canada's progressive immigration policies, refugees can be given a home in the oil sands to assimilate to Canada and learn a trade. |
| OIL SANDS AS DESTINATION | Recreation/National Park | Landscape changes and the "middle of nowhere" context allow for novel recreation uses like dune buggies, dirt bikes, but also winter sports like sledding and cross-country skiing. |
| | UNESCO World Heritage Site Designation | Designation helps preserve the cultural legacy of the largest remaining oil reserve on the planet for future generations to reflect on our generation's insatiable need for oil exploration and natural destruction for oil production. |
| OIL SANDS AS INDUSTRY | Airline Recycling Facility / Plane "graveyard" | Due to its isolated location, large expanses of open space, and existing infrastructure, the oil sands can become a recycling facility for large machinery such as airplanes. |
| OIL SANDS AS FOOD | Production farming | The infrastructure and pipelines of the oil sands can be reversed to supply food and energy across the globe. |
| OIL SANDS AS EDUCATION | Clean energy training programs | Oil sands companies are transformed from "dirty oil" producers to a wider range of energy including wind and solar. Training programs can prepare oil sands workers for new jobs in an emerging industry. |
| OIL SANDS AS NATIONAL DEFENSE | Weapons testing site | Isolated like the American West desert, the oil sands becomes a site for strategic military and national defense uses particularly in light of Canada having the last remaining fossil fuel source on the planet. It is conceivable other nations will threaten the neutrality and safety of its borders. |
| | Bio-agro defense facility | Located in the heart of Canada's agricultural region, but isolated in case of contamination leaks, the Oil Sands Bio-Agro Defense Facility tests and researches new ways to protect Canada's agricultural systems. |
| | Air Force Base and Military Training Facility | Strategic operations and training can be held in the remote oil sands. |
| OIL SANDS AS EXPLORATION | Canada National Astronomy Cooperative | Accessibility to Northern Lights and its isolated location allow the oil sands to become a national research cooperative location for astronomy and a recreational star-gazing hotspot. |
| | Northern Alberta Environmental Research Center | The University of Alberta and other environmental research initiatives converge on the oil sands to research and test the impacts of the oil sands and to test reclamation efforts. Results can be used globally on other surface mining sites. |
| OIL SANDS AS EDUCATION | UNESCO World Heritage Site Designation | Visitors reflect and respond to one of the largest human-engineered landscape projects on Earth and the last source of fossil fuel on the planet. |


Oil sands as Home
Oil sands as Destination
Oil sands as Industry
Oil sands as Food
Oil sands as National Defense
Oil sands as Exploration
Oil sands as Education
Air Force Base
Weapons testing sites
Clean energy and training programs
Recreation Park
National Park
UNESCO World Heritage Site Designation
Canada National Astronomy Cooperative
Airline Recycling Facility
Military training site
Production farming
Northern Alberta Environmental Research Center
Bio-agro defense facility
Refugee/Immigration Agriculture Cooperative Homestead
A SYSTEM OF NEW IDEAS FOR THE OIL SANDS

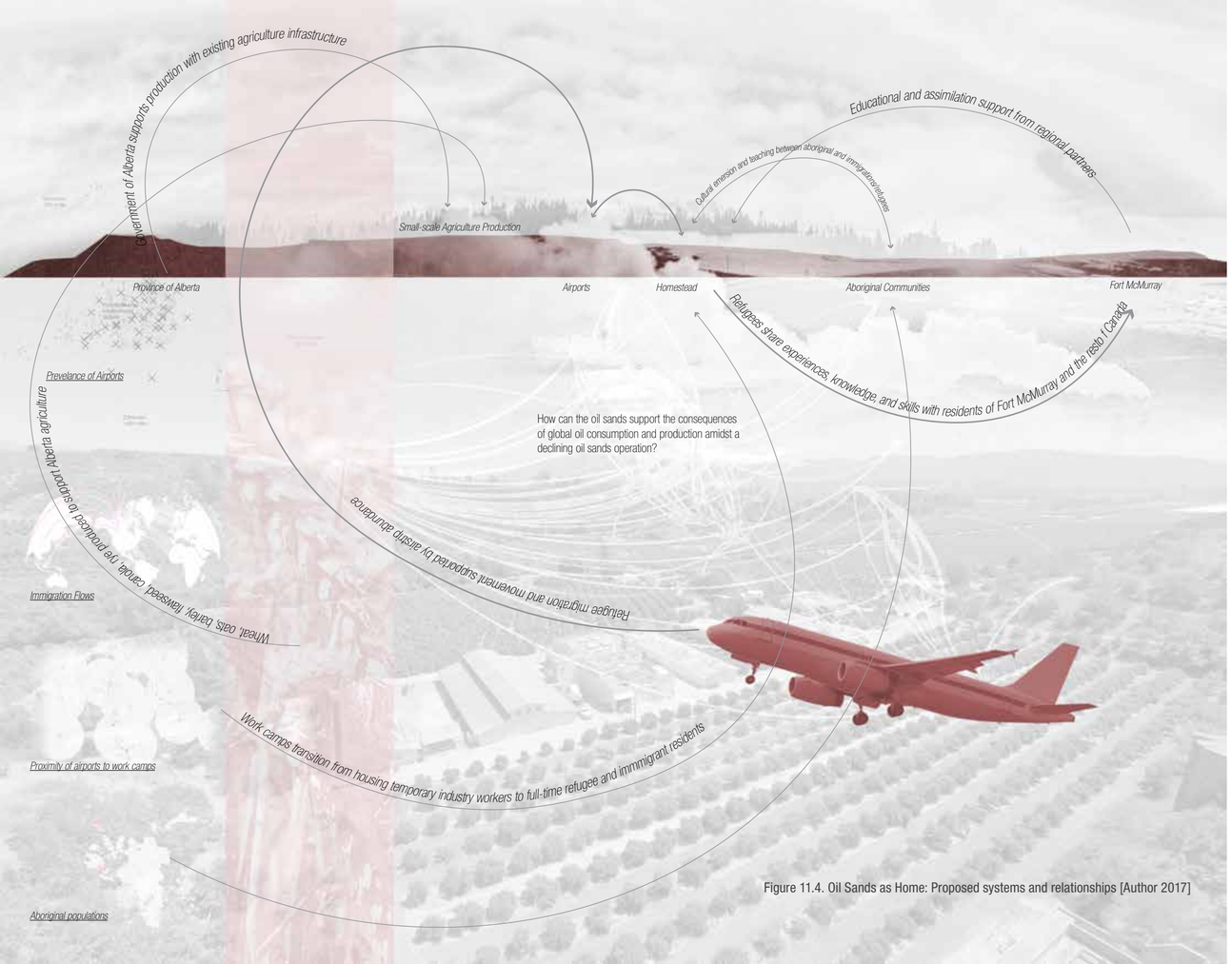



Figure 11.4. Oil Sands as Home: Proposed systems and relationships [Author 2017]

# Oil sands as Home

## DILEMMA

Globally, the oil industry has exacerbated global problems such as hunger, war, and refugee populations.

## GOAL

Address the global consequences of oil and support the Canadian government's open borders for refugees and immigrants.

## PROPOSED SYSTEM

The oil sands can become home to the world's most marginalized populations by creating Refugee/Immigration Agriculture Cooperative Homesteads. Small-scale agriculture clustered around re-purposed work camps and re-activated airports produces agriculture crops for the immediate region including wheat, oats, barley, and other major existing crops in Alberta. As the homesteads grow, these crops can be embedded within existing agriculture infrastructure in the province, shipped nationally and internationally. Buses which currently transport oil sands workers to and from Fort McMurray become public transportation for those homesteading in the oil sands. Education programs through Keyano College support ESL classes and cultural immersion to give support to these new Canadian residents.

In the wake of global oil flows which have exacerbated the refugee crisis in the Middle East (Figure 6.9), airports which can fly refugees and immigrants into the oil sands from around the world (Figure 7.8), and proximity of those airports to work camps (Figure 7.13), the oil sands are transformed into a new form of living and production. Aboriginal populations, immigrants, and refugees converge in a single space for cultural exchange and the richening of Canadian culture, known for its diversity. Each population can teach and learn from each other, deepening and enriching the cultural dynamics of the region. Prime Minister Justin Trudeau recently said, "To those fleeing persecution, terror, and war, Canadians will welcome you, regardless of your faith…Diversity is our strength."

The oil sands as home transforms existing mining operations to support negative consequences of wicked problems in other parts of the world. Canada will become an example of how developed countries can support and house the most marginalized people of our generation. The existing oil sands infrastructure transforms from single-function oil production to an operation which supports the very populations being marginalized by oil in other parts of the world. Rather than exacerbating these global consequences, the oil sands support those most harmed by global oil consumption and production.

The Refugee/Immigration Agriculture Cooperative Homesteads can be spatially adjacent to other forms of new oil sands uses including large-scale production farming (see page 286) and clean energy training and production (see page 302).

This proposal relates to:

» Oil sands as Food

» Oil sands as Education

Figure 11.5. Oil Sands as Home [Author 2017]

# Oil sands as home

"To those fleeing persecution, terror and war, Canadians will welcome you, regardless of your faith...Diversity is our strength."

- Justin Trudeau, Canadian Prime Minister

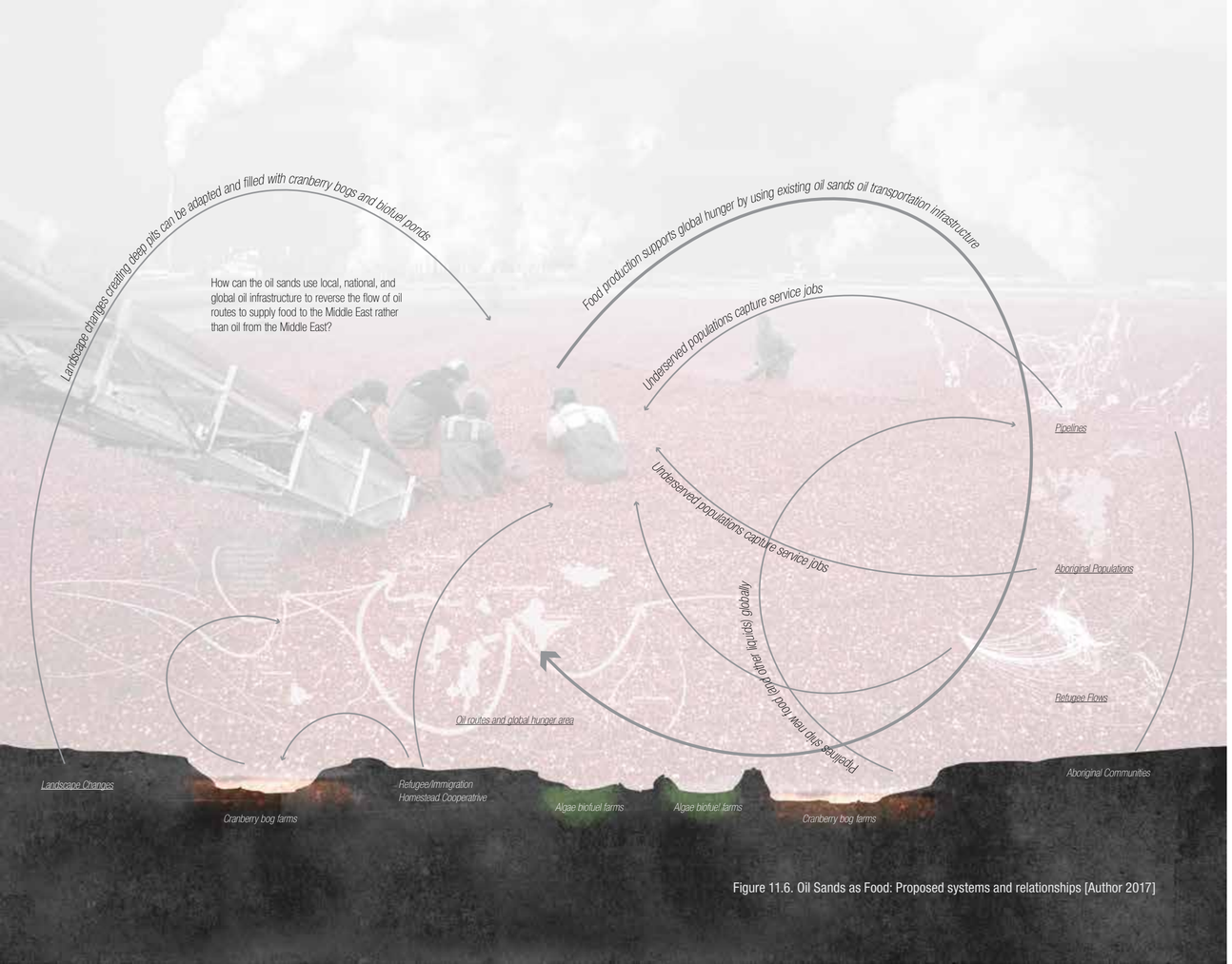



Figure 11.6. Oil Sands as Food: Proposed systems and relationships [Author 2017]

# Oil sands as Food

## DILEMMA

Globally, the oil industry has exacerbated global problems such as hunger, war, and refugee populations.

## GOAL

Diversify the region's economy for the workforce and oil sands companies.

## PROPOSED SYSTEM

Oil sands infrastructure of pipelines and ponds links to bigger infrastructural flows. Food production in the oil sands can reverse the flow of oil routes that supply oil to North America from the Middle East to instead supply food to the Middle East from North America (Figure 6.7). The oil sands as food transforms global oil routes from Middle East - North America to North America – Middle East, capable of supplying food to the areas of the world—in the Middle East—most impacted by hunger. Impoverished populations will be supported by the very industry which currently threatens it.

The transmutation of landscape changes (Figure 8.11) in the oil sands provides an opportunity to pool new resources in these impacted landscapes. Algae biofuel farms and cranberry bogs are the new forms of production in the oil sands placed in holdings ponds and eventually tailings ponds—both cleaned through phytoremediation. As energy reliance shifts away from the oil sands, oil companies will become biofuel and biomass producers. The existing finite oil sands will be designed to suit infinite production capacities in a renewable industry: Food production.

The spatial realities of oil—its destruction of landscape and water systems, its extensive pipeline infrastructure (Figure 7.12), and proximity to marginalized aboriginal populations (Figure 9.8) supports the region's economy and people. Existing pipeline infrastructures and landscape changes are transformed to transport and hold new fluids to support the region's existing agricultural base. New industry production also supports new refugees and immigrants and provides jobs and jobs training for these new provincial residents. Oil sands as food simultaneously demonstrates the oil sands' effect of our peak oil demands and the possibility without it.

This proposal relates to:

- Oil sands as Home
- Oil sands as Education
- Oil sands as Industry


Figure 11.7. Oil Sands as Food [Author 2017]

# Oil sands as food

"Alberta is the third largest producer and exporter of agri-food products in Canada."

- Province of Alberta

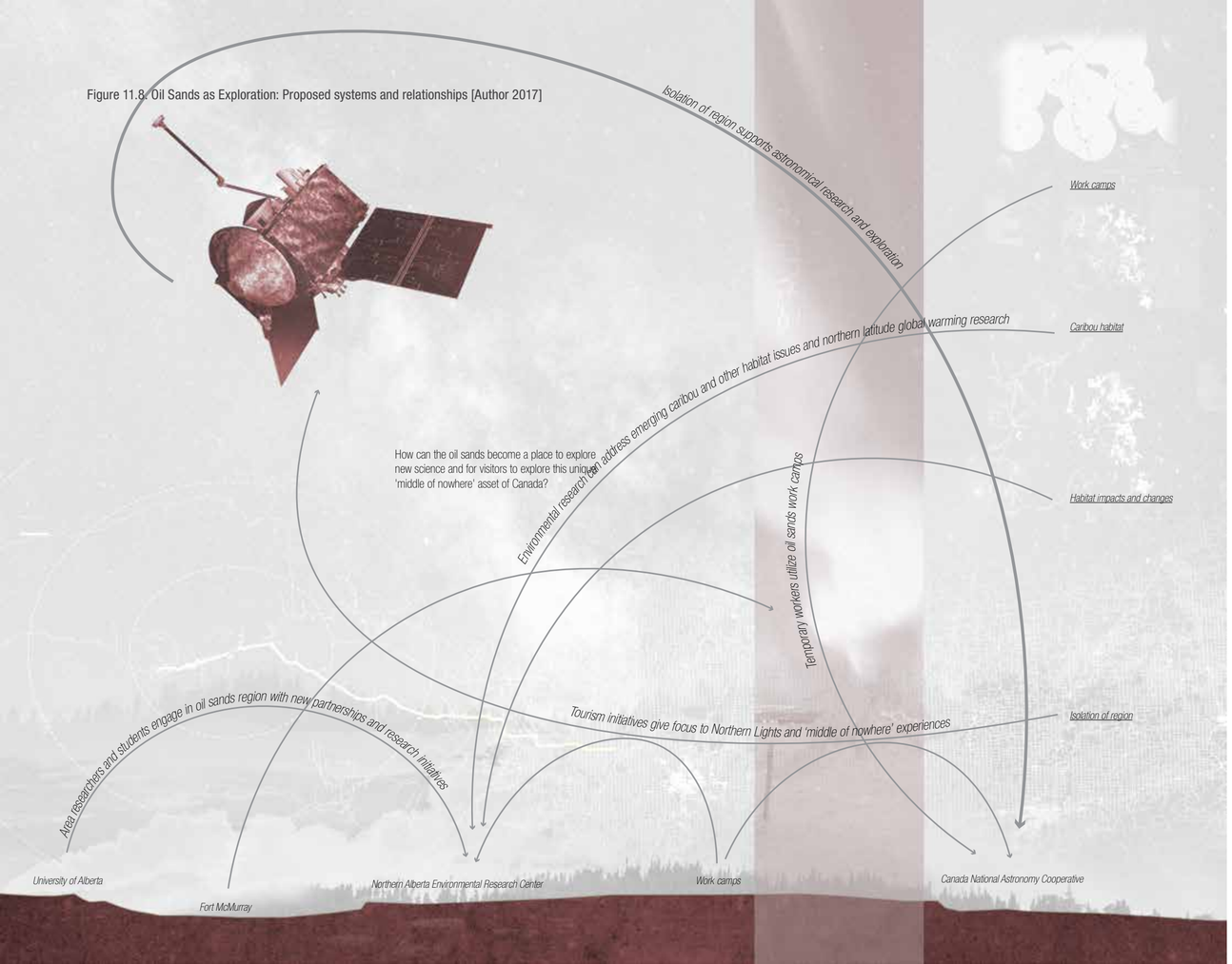



Figure 11.8: Oil Sands as Exploration: Proposed systems and relationships [Author 2017]

# Oil sands as Exploration

## DILEMMA

The isolation of the region can be perceived as an asset or a liability.

## GOAL

Diversify the region's economy for the workforce and oil sands companies by positioning the region as a location for expanded economic sectors like tourism and research.

## PROPOSED SYSTEM

In Canada, 80% of people live within 100 miles of the United States border. The Athabasca oil sands are more than 500 miles from that border. Fort McMurray and oil sands are spatially isolated from much of Canada and this could be perceived as either an asset or a liability (Figure 7.6). The oil sands as exploration recognizes its spatial isolation and oil sands infrastructure as an asset for boreal forest climate change research, astronomy cooperatives, and those public users looking for unique 'middle of nowhere' experiences like the Northern Lights, night sky photography, or amateur astronomy.

Research initiatives in the oil sands can utilize existing work camp infrastructure (Figure 7.13) to house temporary researchers to study caribou habitat change, boreal forest ecosystems in a changing climate (Figure 8.2, 8.3), Northern Lights (Figure 8.4), and the oil sands reclamation themselves. The Northern Lights and dramatically dark night sky offer opportunities to create Canada's first National Astronomy Cooperative for use by federal, provincial, and University of Alberta researchers to study the universe.

The oil sands are uniquely positioned to capture those looking to escape in the age of digital over-abundance. Hiking the boreal forest, camping and canoeing along the Athabasca River, and viewing Northern Lights at night make this a viable tourism and recreation region. The region is "a really interesting experience for some folks. It literally feels like you are in the 'middle of nowhere'" (Creasey 2016). Instead of ignoring this reality, the region can embrace it and do so through the oil sands.

Public uses can coincide with institutional uses to create a convergence of interesting experiences. Institutional uses can share their research and draw interested parties to the region. Public users can be educated through these institutional uses as a part of their time in the region.

This proposal relates to:

» Oil sands as Destination

Figure 11.9. Oil Sands as Exploration [Author 2017]

# Oil sands as exploration

"This is a really interesting experience for some folks. It literally feels like you are in the 'middle of nowhere.'"

- Frank Creasy, Fort McMurray Tourism

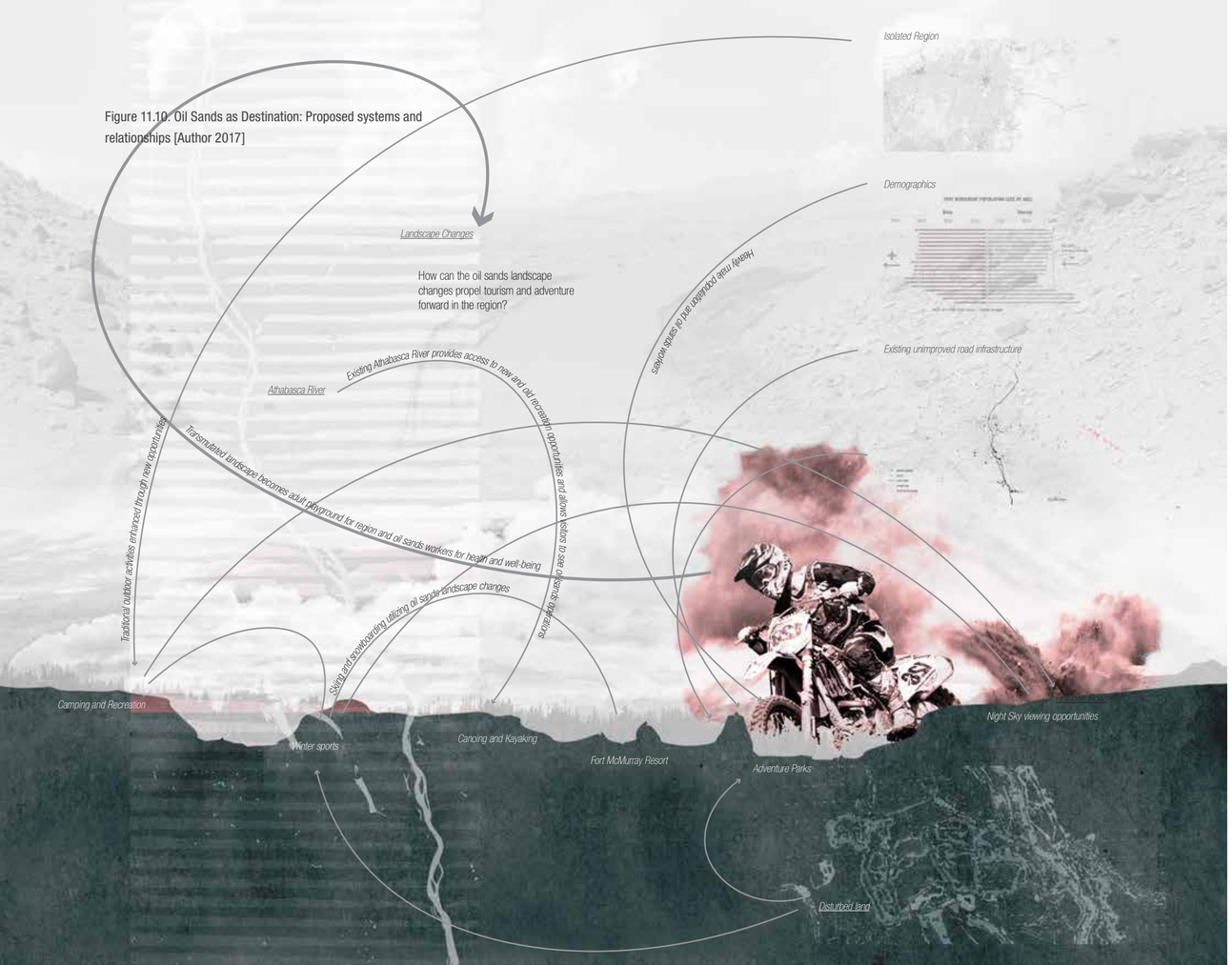



Figure 11.10. Oil Sands as Destination: Proposed systems and relationships [Author 2017]

# Oil sands as Destination

## DILEMMA

The region has livability and mental health and well-being issues because of the oil sands.

## GOAL

Address cultural and social needs of the region and to strengthen existing tourism industry in the region.

## PROPOSED SYSTEM

Oil sands as destination works closely in hand with Oil sands as Exploration (see page 290) to imagine the oil sands as a destination for oil sand workers, visitors to Fort McMurray, and visitors to all of Canada. How can the oil sands support tourism and recreation and support the workers struggling with the harsh working conditions of the oil sands? The oil sands will become a world-class “adult playground” with spaces for dirt bikes, dune buggies, hang gliders, cross country skiing in the winter, and Northern Lights experiences.

Oil sands workers, battling mental and physical stress from oil sands work are given a space to unwind. Landscape changes (Figure 8.11) and existing road infrastructure (Figure 7.11) are re-used for dirt tracks and adventure sports. Disturbed lands (Figure 8.13) are given up to the public. Resorts can be established with specific resorts having primary functions depending on surrounding landscape forms. For example, flatter oil sands areas near boreal forests can be used for dog sledding or cross-country skiing. Adventure park resorts can be adjacent to areas with more severe topographic changes. Clean energy production or industry can be immediately adjacent to these louder oil sands reclamation or along the interface with areas being environmentally reclaimed.

This proposal relates to:

» Oil sands as Exploration

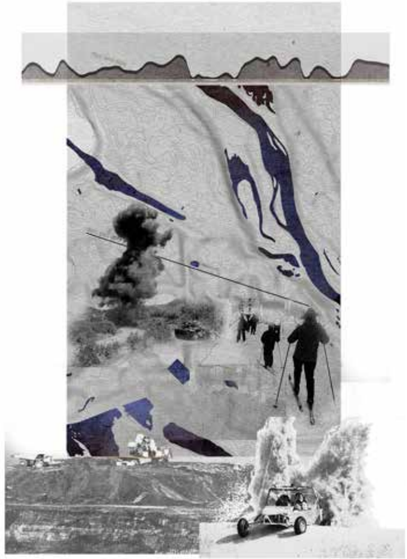


Figure 11.11. Topography shapes future activities [Author 2017]


Figure 11.12. Oil Sands as Destination [Author 2017]

# Oil sands as destination

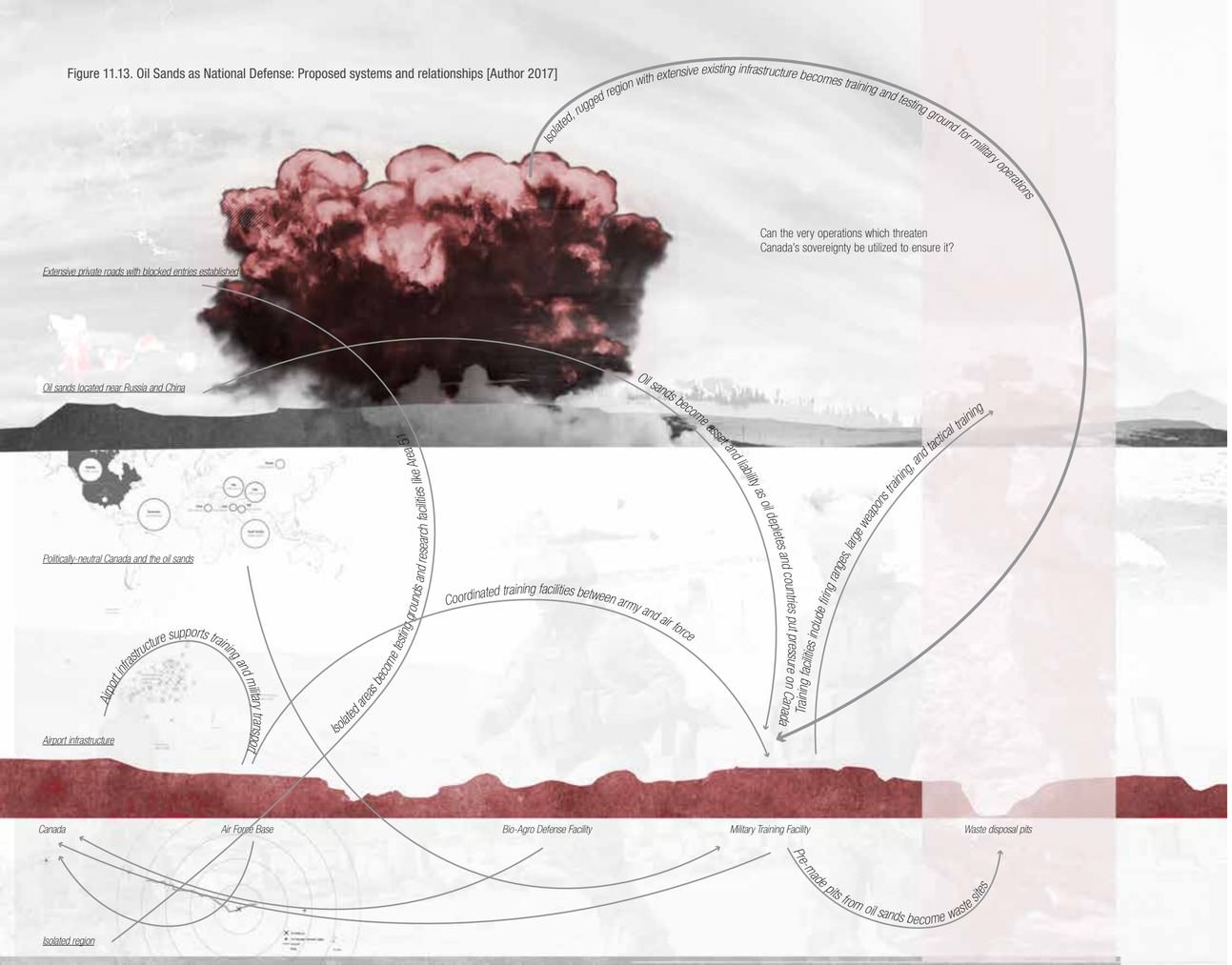



Figure 11.13. Oil Sands as National Defense: Proposed systems and relationships [Author 2017]

# Oil sands as National Defense

## DILEMMA

The oil sands threaten the sovereignty of Canada and the region because it may be the last source of fossil fuel on Earth.

## GOAL

Create a world-class military training facility to protect Canada and the oil sands because this region and Canada may be the last place on Earth fossil fuel production will occur, possibly threatening the country's sovereignty.

## PROPOSED SYSTEM

Canada has the third largest oil reserves in the world but is one of the only politically-stable countries with significant oil reserves (Figure 6.5). In a globalized world which functions off depleting oil, Canada and the oil sands may be threatened by nearby countries seeking these last few precious drops. Can the very operations which threaten Canada's sovereignty be utilized to ensure it?

Extensive private road infrastructure (Figure 7.11), landscape changes (Figure 8.11), global oil considerations (Figure 6.6 and 6.7), and airport infrastructure situated in an isolated region (Figure 7.8 and Figure 7.6, respectively) makes the oil sands an ideal location for strategic military training and operations—coincidentally in the same location that most threatens Canada's political stability. Existing airports and helipads can be used to train Canada Air Force, work camps can house trainees, recruits, and temporary military installations. Shooting ranges and training facilities utilize existing oil sands buildings and deserted landscape. The desolation of boreal forest landscapes is not a liability, but an asset for weapons testing and military waste disposal pits including nuclear waste.

Area 51 in the United States in the Nevada desert is a world-famous military operation known for its secret military testing and operations. Fort McMurray and the oil sands are equally as isolated. In a diminished oil sands region with fewer full-time residents, the region can further isolate itself with military operations intended to protect it in an increasingly global and violent world full of wicked problems with military implications.

This proposal relates to:

- Oil sands as Industry
- Oil sands as Exploration


Figure 11.14. Oil Sands as National Defense [Author 2017]

# Oil sands as national defense

"Vigilamus pro te" / "We stand on guard for thee."

- Canadian Army motto

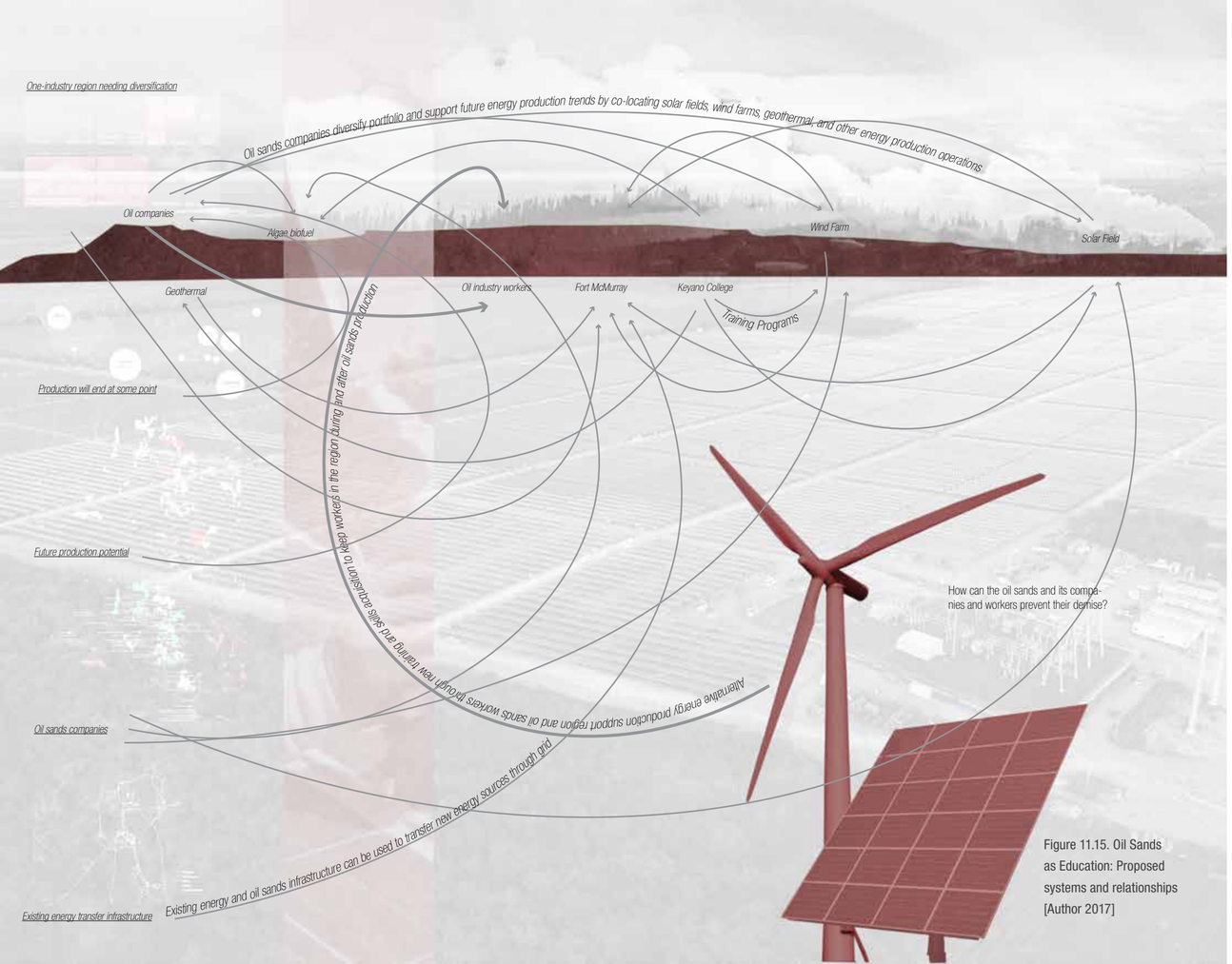



Figure 11.15. Oil Sands as Education: Proposed systems and relationships [Author 2017]

# Oil sands as Education

## DILEMMA

Oil sands workers and oil sands companies have done very little to address the inevitability of the finite supply of oil in the region.

## GOAL

Create clean-energy alternatives for oil sands worker training and diversification for oil sands companies.

## PROPOSED SYSTEM

Oil sands workers and oil companies will face declining production given their focus on mining the finite oil sands resource. How can oil sands workers and oil sands companies prevent their own built-in demise? How can oil sands companies continue to be economically-productive in the face of declining oil sands and what will Alberta oil and gas workers do after the oil sands are depleted? In coordination with food production (Oil sands as Food; see page 286), oil sands operators can diversify their business portfolio by incorporating clean energy production amidst declining oil sands operations. New operations can be used to educate workers for new jobs in the energy sector, even allowing them to stay with the same oil sands company after the oil sands production stops.

Iron & Earth is an organization started in 2015 calls for training in renewable energy for oil sands workers. They indicate that most tradespeople would need only minor extra training to switch to these renewable sectors. Courses at Kayano College could support such efforts.

Solar field, geothermal, and wind power harnesses northern Canada's existing climate and geology for renewable energy production (Figure 8.5). Nearly constant sun in the winter months produces solar energy for use in the region. Energy is shipped to Fort McMurray via existing energy grid infrastructure (Figure 7.12). Geothermal and wind developments further diversify renewable energy sources. Adjacent these solar fields, geothermal, and wind farms can be hiking trails for public education of these emerging uses. The oil sands become a visible and accessible example of Canada's commitments. Aboriginal/Immigration Homesteads (see page 282) can work in these industries and live adjacent to them.

The oil sands as Education shows a shift away from the "dirty" oil sands and supports Canada's recent commitment to cleaner energy and reduced carbon emissions by 2025. Workers and operators facing decline will face an uncertain future amidst declining oil sands operations. A focus on educating those workers, through existing industry, will leave the region more prosperous and stable in the future. The Athabasca oil sands become the operations for which arise new modes and models of energy production in Canada and globally in the wake of peak oil and the needs of landscape reclamation. Public accessibility educates the public about the industry and they can visually see the changing oil sands landscape—from dirty to clean. From liability to oil sands companies and workers to an asset.

This proposal relates to:

» Oil sands as Industry

Figure 11.16. Oil Sands as Education [Author 2017]

# Oil sands as education

"Oil and gas workers are ready to build the future that Canada needs, but we need support."

- Lliam Hilderbrand, Iron & Earth executive director

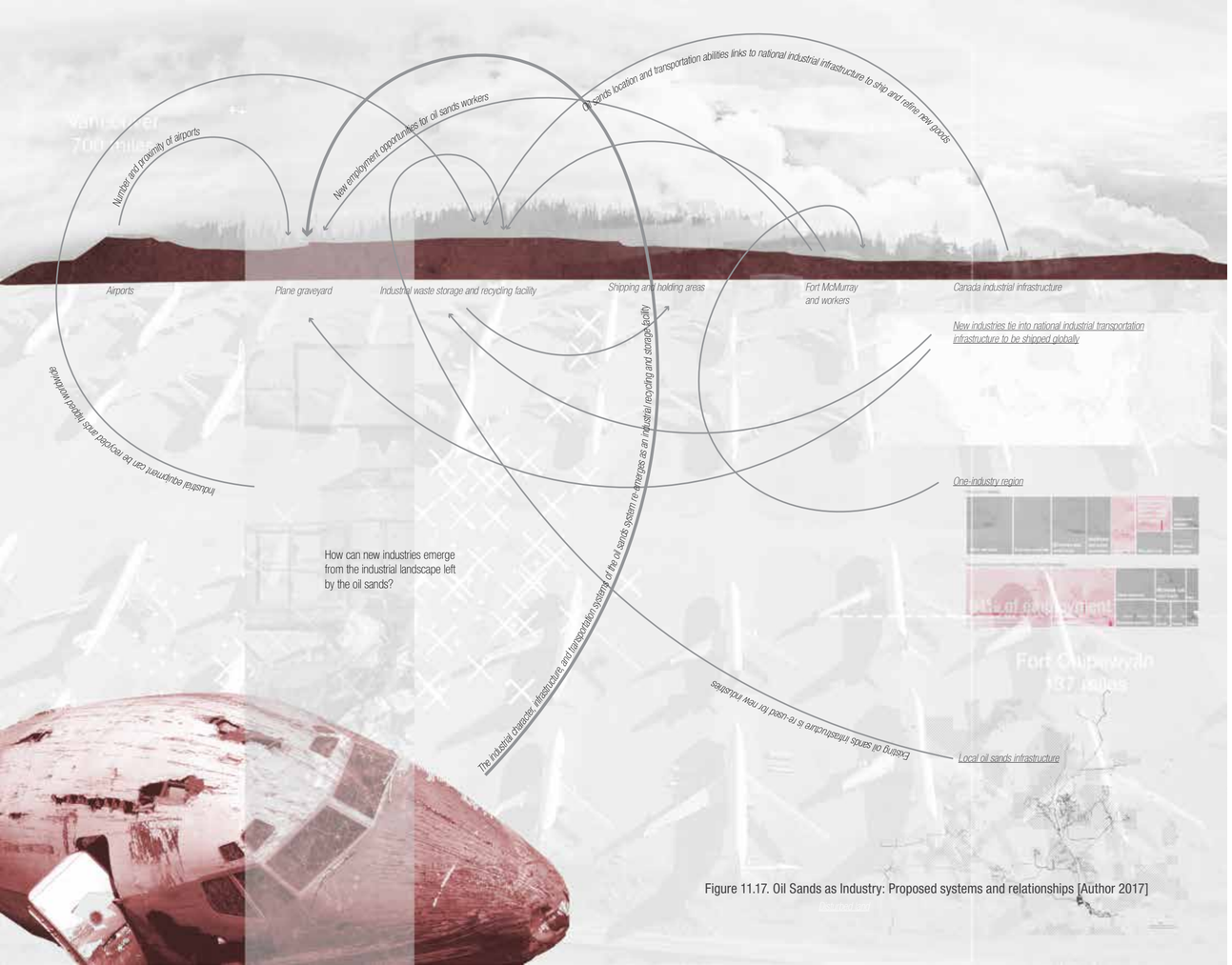



Figure 11.17. Oil Sands as Industry: Proposed systems and relationships [Author 2017]

# Oil sands as Industry

## DILEMMA

$200 billion worth of oil sands industry investment has left an industrial landscape, but that landscape and investment does not guarantee a successful future.

## GOAL

Diversify the economy and re-use the industrial landscape left behind by the oil sands.

## PROPOSED SYSTEM

The industrial nature of the oil sands, existing industrial infrastructure, and industrial transportation systems are re-configured for new industry to diversify the region's economy (Figure 9.11). The abundance of airports and helipads (Figure 7.8) can receive decommissioned aircraft to be stored and eventually recycled. The desolated oil sands landscape supports the storage of other post-industrial manufacturing equipment no longer used in the midst of a post-industrial economy. Oil sands equipment itself can be decommissioned and recycled. These recycled parts or new products emerge from the oil sands connected to the industrial transportation infrastructure of railroads and roads of the region and country (Figures 7.3 and Figure 7.11).

This proposal relates to:

» Oil sands as Education

» Oil sands as National Defense

Figure 11.18. Oil Sands as Industry [Author 2017]

# Oil sands as industry

Figure 12.1. Boreal forest near Edmonton, Alberta, Canada. [Author 2016]

# CHAPTER 12: CONCLUSIONS

The future of the Athabasca oil sands is unknown. In 1999, Fort McMurray had 37,000 residents and five years later it had nearly doubled to 61,000. While plans at the regional and local scale are being created, the fact of the matter is no one knows what will become of this place in 10 years, let alone 50 years. The central objective of this project was to use landscape architecture storytelling mediums—mapping, diagramming, photomontage, and photography—to reveal the dilemmas and challenges of this region and incite future scenarios. It explored the potential for these storytelling mediums to incite creative future scenarios for landscape reclamation—to incite discussion, disruption, and alternative thinking.

Reclamation of post-industrial, resource-extraction sites has emerged in recent decades as a topic of importance to the landscape architecture profession. Amidst peak oil and the increased use of alternative energies in developed worlds, more of these sites will be closed or activity reduced. Landscape architecture can consider the methods employed in this project when addressing the complex nature of these sites.

## REFLECTIONS OF RESEARCH PROCESS AND METHODS

The methods employed in this project helped to identify key dilemmas, incite creative solutions, and reveal unseen and interconnected forces and flows. This helps to substantiate claims that the processes of mapping, diagramming, photomontage, and photography can help to reveal the story of a place.

### Mapping

On more than one occasion, the author had eye-opening moments, or general thoughts of disbelief amidst map creation helping to spurn creative ideas for landscape reclamation. Outside viewers of in-progress work had similar visceral responses. Global forces and flows of maps in the "Unveiling Oil" section helped to expand possibilities by thinking about reclamation of the oil sands in a larger context and pushed the projections to address larger systems of which the oil sands are a part. Infrastructure and ecology formed the basis of the projection ideas because of the tangibility of the data. Mapping infrastructure across national, regional, and local scales helped to connect global forces and flows to these infrastructures. Ecological maps were mostly small-scale, helping to connect larger forces and flows of oil and infrastructure to the actual alterations of the landscape from mining operations. The act of data mining, mapping, re-mapping, and making alterations to maps allows a designer to reveal for themselves numerous relationships even if one final visual is created. Making a handful of maps typically yielded new questions and new directions to map.

The process of exploring data is a revelatory process itself. Most maps were not created using highly complex ArcGIS analytical tools but were created using basic cartographic methods. Designers do not have to know advanced cartography to be able to produce a similar analysis.

Figure 12.2 shows all diagrams and maps that were created for the Unveiling Ghost Ecologies section. Analysis of this diagram reveals that many representation techniques were used but critical maps, present time maps, and regional maps were most used by the author. The intuitive process used by the author, summarized in Figure 12.12, may help others as a starting place for their own work.

### Diagrams

Diagrams mostly supplemented the maps either adjacent to or on top of a map showing related information. Unlike the mappings, the process of diagram creation was less useful to the final projections. But the final diagram was useful as a communication tool. Charts, tables, and other diagram techniques are less flexible than maps because the designer is using a finite set of data, rather than having many possible map layers to combine. But the numbers and information contained within the diagrams is certainly valuable. Revealing the large extent to which the oil sands is a single-industry region helped to spur projections which related to increasing employment opportunities. There were fewer diagrams made than originally planned and the visualizations which combine diagrams and maps seem to have a deeper richness to them than other static maps without diagrams included.

### Photomontage

The process of creating photomontages for “Unveiling Ghost Ecologies” summarized a series of maps in evocative and emotive ways. They were beneficial to the projections because they helped to summarize a set of maps and/or diagrams together to clarify and converge salient issues. Rather than getting stuck in focusing on individual maps, the photomontages helped to make mappings and diagrams more clear, communicative, and evocative. They were generative through their capacity to ideate directions to explore in the projections and future maps.

The three photomontages in “Projecting Ghost Ecologies” helped to combine maps and ideas from the projections to start the process of envisioning the three projections those photomontages were used for. Although not used for every projection, the creation of those photomontages helped to spur several of the projections.

### Photography

Photographs from the 2016 site visit helped to “ground” the abstract nature of the maps, diagrams, and photomontage. The act of creating the photographs through a three-day site visit revealed the visible forces and flows in the oil sands, revealing the real, physical, tangible reality of the oil sands in opposition of the abstract nature of the data used for maps and diagrams. The act of editing to create the final visuals helped the author to think about what aspects of the image should be emphasized. Editing, therefore, was a revelatory process and allowed the author to think about what the photograph is revealing and how new reclamation processes could be placed on the landscape in the photograph.

The act of photographing also helped conjure questions to research in the mappings and diagrams. They helped the author to think about questions or dilemmas the photograph is not revealing but may be hinting towards. For example, the scale of the tailings ponds and the scarecrows and air cannons made the author explore data on tailings water quality and toxin levels.



## LIMITATIONS

Wicked problems are just that—wicked. They are complex, operate at multiple scales, are ever-changing, and nearly impossible to predict. The report is surely not exhaustive of all relationships or forces at play and only the most salient information was presented within these pages to bring to the surface the most interesting of the ghost ecologies analyzed, but this process is not without its limitations.

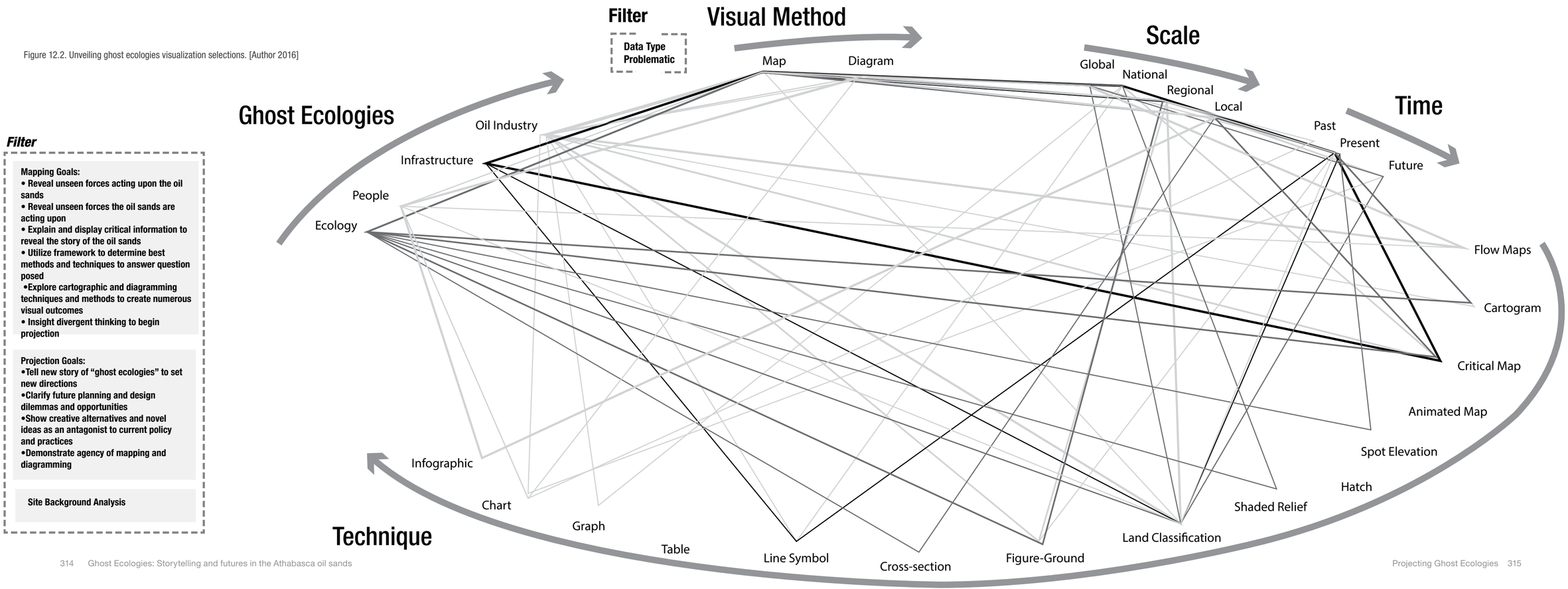
This project is highly theoretical, taking significant liberties in the realities of the oil sands. Section II: Grounding helped to describe real-world conditions including the use of a visual diary to show actual conditions of the oil sands and Fort McMurray. However, the basic assumption of this research dealt with reclamation of the oil sands in new, novel ways which would not be possible given existing laws and regulations. The purpose, of course, was to acknowledge that these new ideas could be implemented given changes to these laws and regulations. But it must be noted that these laws and regulations will not be easily changed.

The world is also now full of data. The challenge in “solving” wicked problems in a world full data, is that it is impossible to know exactly what you have, but more importantly, what you don’t have. The term “big data” has gained widespread acknowledgement in a wide range of industries. But the challenge of solving and analyzing a wicked problem can be thought of by asking two extreme questions: “Where do you start?” But more importantly, “When do you end?” Many datasets are now publicly accessible or easily consumable. This report has exclusively used public datasets or translated private datasets now posted online. But it is difficult to assess whether the story of the Athabasca oil sands would have been more or less clear and compelling with other data.

It is likewise difficult to assess accuracy of the information used. On several occasions, similar data would yield drastically different results. For example, the dataset showing 47 airstrips in the region was not brought to the author’s attention until a conversation in Fort McMurray. The original assumption was that there were nine airstrips in the region. Without additional knowledge, the author would have assumed the correct number of airstrips were nine. It is impossible to know if all of the data represents the most accurate and relevant information without spending months to verify, which could lead to analysis paralysis.

Analysis paralysis can result when tackling such a complex problem, largely brought on by exhaustive data mining and a process of checking, double-checking, and re-checking to ensure the most relevant, complete, and up-to-date dataset is being used. A designer can map and diagram for hours and hours and hours amidst this world full of data. But time was limited in this study. This project was a nine-month exploration of this topic, but many central components of this project were not clearly defined until well into the process. The simple act of mapping, data mining, and creating visuals is time-consuming and with limited time only so many maps, diagrams, photographs, and photomontages could be created. The Section III: Unveiling could have benefited from more time spent on diagramming to supplement the maps.

Figure 12.2. Unveiling ghost ecologies visualization selections. [Author 2016]




***Filter***

**Mapping Goals:**
- **Reveal unseen forces acting upon the oil sands**
- **Reveal unseen forces the oil sands are acting upon**
- **Explain and display critical information to reveal the story of the oil sands**
- **Utilize framework to determine best methods and techniques to answer question posed**
- **Explore cartographic and diagramming techniques and methods to create numerous visual outcomes**
- **Insight divergent thinking to begin projection**

**Projection Goals:**
- **Tell new story of "ghost ecologies" to set new directions**
- **Clarify future planning and design dilemmas and opportunities**
- **Show creative alternatives and novel ideas as an antagonist to current policy and practices**
- **Demonstrate agency of mapping and diagramming**

**Site Background Analysis**

## APPLICABILITY TO PROFESSIONAL PRACTICE

This was an academic nine-month process without constraints for time or energy used. In a professional office, deadlines and project costs are a significant driver of both design process depth and breadth, but is less true of an academic project. In order to adapt and apply this framework for use in professional practice, five changes are suggested:

1. **Define scope of project as narrowly as possible.** Several months were spent on simply determining what to focus on and the particular opportunities of the project site. Pre-planning and narrowly defining the goals and scope of the analysis would help to simplify data collection and the number of products produced.

2. **Ask specific questions.** There are hundreds of datasets for most project sites. Consider what questions and data analysis will yield the most beneficial results for the scope, scale, and project client. Know what you are looking for; know what you are not looking for.

3. **Spend the most time researching dilemmas.** Literature, stakeholder and client interviews, newspaper articles, etc. can reveal a significant amount of information about forces and flows at play in a given place. From there, it's a matter of finding data to illustrate the identified flows and forces. The research process helps to narrow the scope of the project and ask the most salient questions.

4. **Spend the least amount of time on cartography and stylizing visual products.** Develop a style and color scheme and stick with it. In professional practice, the final visual is less important than the information it reveals. Given the fact that visualization can take up significant amounts of time, focus on the value of the product, and less on the aesthetic quality of the final visual. Clarify of message is most important, and visuals should beest support whatever message that may be.

5. **Be bold, but not too bold.** The benefit of an academic project is its ability to detach itself from the reality of budgets and clients. It can be disruptive, question preconceived notions, and be bold without worry of upsetting relationships with the public or clients. Many of the projections proposed in this project were imagined specifically to be bold and disruptive, and question norms. Professionals typically do not have as much creative freedom to suggest disruptive or controversial proposals due to the reality of budgets, client needs, and public opinion.

## FUTURE RESEARCH

Other landscape architects can view this work as an example of how to use these methods for their own work in dealing with complex sites and scales. As landscape architects continue to lead complex projects involving wicked problems, these methods can allow for clear visual communication to stakeholders and revelations for their own benefit. The emergence of mapping and the ability to use maps and diagrams to reveal forces and flows will continue to be an effective medium for future landscape architecture projects. As written in Chapter 03:

> *"'The techniques to address the sheer scope of [complex, dynamic] issues [presented in the 21st century] are desperately lacking—and this area alone, it would seem to me, is deserving of our utmost attention and research' (Corner 2006). Landscape architecture needs new means and methods for studying and explaining systems."*

The use of mapping, diagramming, photomontage, and photography have been embedded within landscape architecture for quite some time. While new ways of using these tools are being developed, this project did not delve deeply into addressing the issue raised above by Corner. Future research should continue to explore new and novel ways of representing systems. This project was limited in time and scope and could not cover the use of both 2D and 3D representation methods. "The trajectory of representation…has moved from the material and physical description of the ground toward the depiction of unseen and often immaterial fields, forces, and flows" (Desimini and Waldheim 2016), but it is still difficult to represent these immaterial fields, forces, and flows using 2D maps and diagrams. Three-dimensional or moving imagery may better represent forces and flows and should be explored in more depth in the future.

Future research can also focus on bringing reality to the projections included here. How many jobs would these create? How much space would be necessary for these proposals? More detail and refinment of ideas presented in this project could be better substantiated.

The process itself should be replicated in both academic and professional settings to clarify its value in inquiry and ideation. The applicability of this process has not been tested across project scales and project types. Valuable information could be gathered about the methodology proposed here and whether it is applicable to other types of situations.

## SUMMARY

This region has significant environmental, infrastructural, and livability challenges, as revealed through Section II: Grounding and Section III: Unveiling. To be sure, the oil sands region will emerge as the poster child of what human civilization has necessitated by our modern lifestyle. The site was once thought too infeasible and expensive to mine. But amidst our insatiable need for energy and raw materials, it will likely now be one of the last sites on Earth mined for fossil fuel. How the region and country responds to this pressure and global attention will set the course of what happens here for decades to come. With these challenges, comes an unknown future.

Spending millions on landscape reclamation to return this place to boreal forests does little to recognize the inevitable economic and social downfall this region will face when the bitumen stops being mined. Perhaps the region turning into a ghost town is perfectly acceptable but one would suspect Canada and the region will want better.

Landscape architecture was needed to tell the story of the region for lay and professional audience alike and set a vision of the future, one that has not been discussed nearly enough. The future is left open for interpretation with this project—rather than assumption of a downfall as evident by ghost towns. New industries emerge alongside mining, where social needs are better met, and where environmental concerns are still considered. This project incited disruptive visions for the future specifically to incite discussion, debate, and to reveal the how/why/where/when of the oil sands.

Perhaps the future looks something like Section V: Projections or perhaps the region can come up with other ideas for the future. This project sought to reveal opportunities and directions, but the future is ultimately up to those who live/work, love/hate the Athabasca oil sands. There is little doubt the oil sands will continue and Canada's economy will benefit. But at what cost and for how long? And what will become of the ghost ecologies of the Athabasca oil sands?

## PROJECTING GHOST ECOLOGIES: SECTION SUMMARY

**01.** Existing policies do not effectively address the high likelihood of the oil sands becoming a ghost town.

**02.** Few are fully considering futures in the oil sands, in part because of the wickedness of the oil sands and the political, economic, and cultural divisions.

**03.** Three scenarios are likely in the oil sands. Research suggests Scenario 2, where oil sands production continues but is at a slower pace than the last decade is the most likely.

**04.** Projections use novel, creative, emotive, and evocative diagrams and perspectives to imagine new ways to use the oil sands in the future.

**05.** Projections seek to reimagine landscape reclamation policies to address the needs of infrastructure, environment, and people.

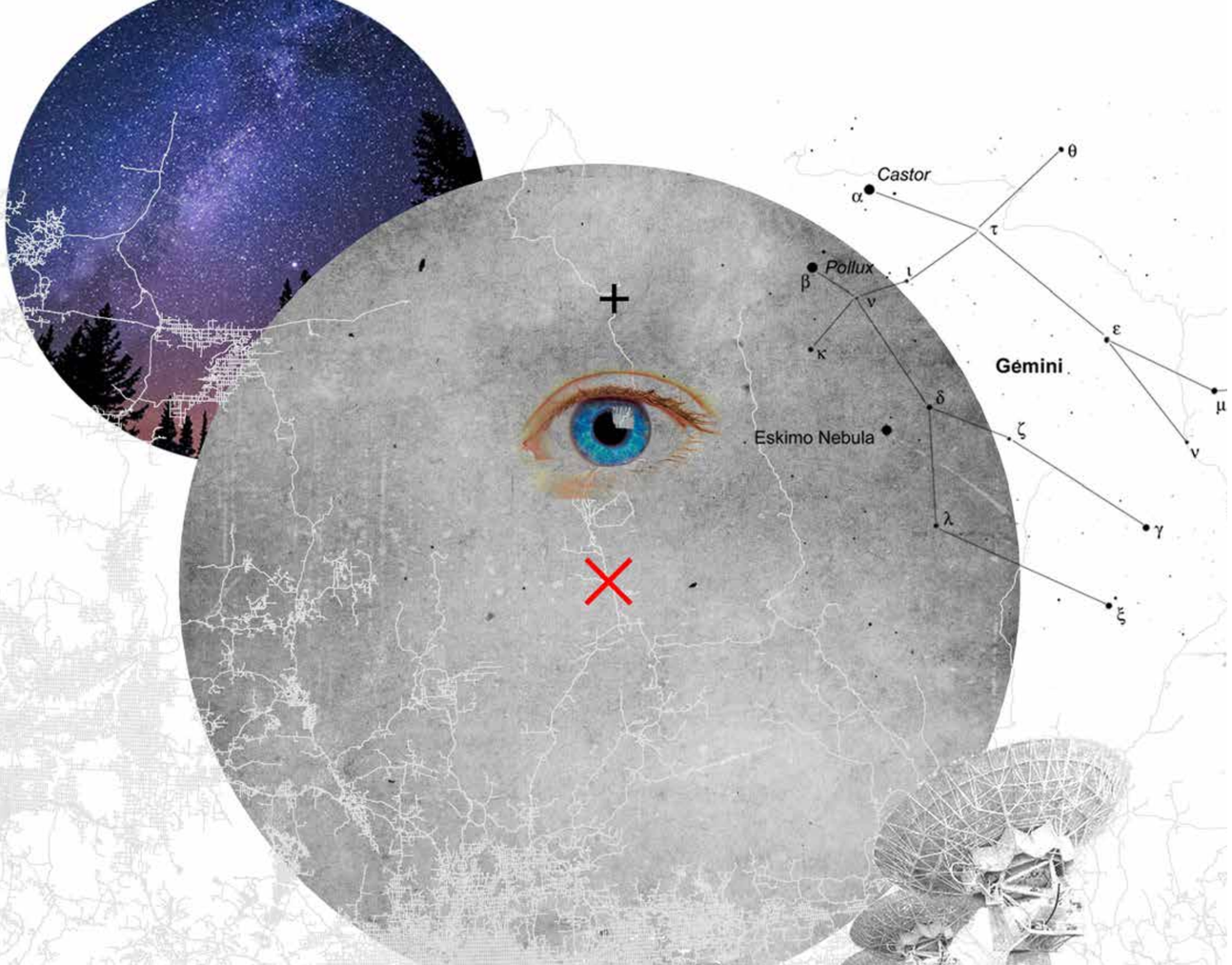
**06.** Each projection can be used independently or in tandem with one or more other projections across the oil sands operation.

**07.** Diagrams help to connect the analysis to the projections and propose new systems of forces, flows, and relationships.

**08.** Stakeholders and interested parties can engage projections for discussion and debate.

**09.** The wicked nature of the oil sands is a challenge to address but the use of mapping, diagramming, photomontage, and photography has been useful to this effort.

**10.** Landscape architecture should continue rethinking landscape reclamation as simply returning to what the land was used previously. Novel landscape reclamation can better address future needs.




# APPENDIX A: REFERENCES


Alberta Energy and Utilities Board. 2005. “Historical Overview of the Fort McMurray Area and the Oil Sands Industry in Northeast Alberta.” Earth Sciences Report. Alberta Energy and Utilities Board.

Alberti, Marina. 2009. *Advances in Urban Ecology.* Springer Science+Business Media, LLC.

Amoroso, Nadia. 2010. *The Exposed City: Mapping the Urban Invisibles*. New York: Routledge.

———. 2012. “Creative Mapping.” Canadian Architect, March 1. https://www.canadianarchitect.com/features/creative-mapping/.

Anderssen, Erin. 2008. “The Climatic Costs of Rapid Growth.” The Globe and Mail, February 1, sec. Shifting Sands. http://v1.theglobeandmail.com/servlet/story/RTGAM.20080131.w-OS-main-01/BNStory/oilsands/feature-topic.

Belanger, Blake and Howard Hahn, eds. 2014. *Parcels and Peppers: Savory Ideas for Addressing Vacancy in St. Louis*. Self-published.

Belanger, Blake, and Ellen Urton. 2014. “Situating Eidetic Photomontage in Contemporary Landscape Architecture.” Landscape Journal 33 (2): 109–26.

Berger, Alan. 2002. *Reclaiming the American West*. New York, New York: Princeton Architectural Press.

———. 2008. *Designing the Reclaimed Landscape*. New York, New York: Taylor & Francis Group.

Borenstein, Seth. 2014. “Excite News - With Their Mark on Earth, Humans May Name Era, Too.” Excite News, October 14, sec. Science. http://apnews.excite.com/article/20141014/us-sci-age-of-humans-961f501908.html.

Bouw, Brenda. 2014. “I Want to Work in the Oil Sands. What Will My Salary Be?” The Globe and Mail. March 12. http://www.theglobeandmail.com/report-on-business/careers/career-advice/life-at-work/i-want-to-work-in-the-oil-sands-what-will-my-salary-be/article17438086/.

Brody, Jason, Blake Belanger, and Jessica Canfield. 2011. “Critical Mapping: Practical Inquiry for Complexity-Driven Praxis.” In *Association of American Geographers 2011 Annual Conference*.

Canadian Forest Congress. 2016. “Carbon Capture, Water Filtration, Other Boreal Forest Ecoservices Worth Estimated $250 Billion/Year.” EurekAlert! Accessed October 27. http://www.eurekalert.org/pub_releases/2006-09/cfc-ccw091806.php.

Cantrell, Bradley, and Wes Michaels. 2010. *Digital Drawing for Landscape Architecture*. Hoboken, New Jersey: John Wiley & Sons, Inc.

CBC News. 2015. “Man-Made Wetlands Destructive, Says Ecologist on Oilsands Reclamation.” CBC News. July 17. http://www.cbc.ca/news/canada/calgary/oilsands-reclamation-a-failure-says-ecologist-1.3156500.

Chan, Gabriel, John M. Reilly, Sergey Paltsev, and Y. -H. Henry Chen. 2012. “The Canadian Oil Sands Industry under Carbon Constraints.” Energy Policy, Special Section: Past and Prospective Energy Transitions - Insights from History, 50 (November): 540–50. doi:10.1016/j.enpol.2012.07.056.

Corner, James. 1997. “Ecology and Landscape as Agents of Creativity.” In Projective Ecologies, 40–63. New York: Actar.

———. 1999. “The Agency of Mapping: Speculation, Critique, and Invention.” Edited by Denis Cosgrove. Mappings, 213–52.

———. 2014. “Eidetic Operations and New Landscapes.” In The Landsscape Imagination: The Collected Essays of James Corner, 320. New York: Princeton Architectural Press.

Creasey, Frank. 2016. Tourism Office. Audio Recording.

Czechowski, Daniel. 2014. “A Map Is Worth a Thousands Words.” Topos, The Narrative of Landscape, 88: 26–31.

D’Amato, Ilario. 2016. “Canada Sets National Climate Plan to Meet Paris Agreement, Showing Leading Role of Sub-National Governments.” *The Climate Group*. December 11. https://www.theclimategroup.org/news/canada-sets-national-climate-plan-meet-paris-agreement-showing-leading-role-sub-national.

Desimini, Jill, and Charles Waldheim. 2016. *Cartographic Grounds*. New York: Princeton Architectural Press.

Doran, Kelly. 2009. “Scraping For Oil.” Canadian Architect, January 1. https://www.canadianarchitect.com/features/scraping-for-oil/.

Edward, Lucy E. 2015. “What Is the Anthropocene?” Earth & Space Science News. November 30. https://eos.org/opinions/what-is-the-anthropocene.

Fleischmann, Daniel. 2016. “Renewable Energy Was 16.9 Percent of US Electric Generation in the First Half of 2016.” August 25. http://www.renewableenergyworld.com/articles/2016/08/renewable-energy-was-16-9-percent-of-u-s-electric-generation-in-the-first-half-of-2016.html.

Globe and Mail. 2014. “Efficient Management Crucial to Future Operations.” The Globe and Mail, May 27, sec. Oil Sands Special Report. http://www.theglobeandmail.com/partners/advoilsands0514/efficient-management-crucial-to-future-operations/article18812004/.

———. 2016. “Globeandmail.com Special Report: Shifting Sands.” http://v1.theglobeandmail.com/v5/content/features/oilsands/.

Gosselin, Dr. Pierre, Dr. Steve E. Hrudey, Dr. M. Anne Naeth, Dr. Andre Plourde, Dr. Rene Therrien, Dr. Glen Van Der Kraak, and Dr. Zhenghe Xu. 2010. “Environmental and Health Impacts of Canada’s Oil Sands Industry.” The Royal Society of Canada Expert Panel, 1–23.

Government of Alberta. 2007. “What Is Tenure.” Text. What Is Tenure. June 21. http://www.energy.alberta.ca/Tenure/867.asp.

———. 2009. “About Oil Sands Tenure.” Text. http://www.energy.alberta.ca/OilSands/1705.asp.

———. 2015. “2015 Municipal Affairs Population List.” Municipal Affairs Population. Edmonton. Alberta: Alberta Government.

———. 2016. “Industry Facts and Statistics (Alberta Energy).” Text. Facts and Statistics. http://www.energy.alberta.ca/oilsands/791.asp.

———. 2017. “The Composition of Oil Sands - Oil Sands - Alberta’s Energy Heritage.” http://history.alberta.ca/energyheritage/sands/origins/the-geology-of-the-oil-sands/the-composition-of-oil-sands.aspx.

———. 2016. “Reclamation Policy.” Accessed October 26. http://aep.alberta.ca/forms-maps-services/directives/documents/CoalOilSandsReclamationReqs-Dec02-2015.pdf.

Grant, Jennifer, Simon Dyer, and Dan Woynillowicz. 2008. “Fact or Fiction: Oil Sands Reclamation.” The Pembina Institue. http://www.pembina.org/reports/Fact_or_Fiction-report.pdf.

Homer-Dixon, Thomas, Mark Jaccard, and Ken Lertzman. n.d. “Scientists Call for Moratorium on Oil Sands Development.”

Kemmick, Ed. 2009. “Portrait of a Boomtown.” The Gazeette Staff, September 24. http://oilsandstruth.org/portrait-a-boomtown.

Kitsault.com. 2016. “About Kitsault - History.” About Kitsault. http://www.kitsault.com/about_hist.html.

Klare, Michael T. 2012. *The Race for What’s Left*. New York: Picador.

Knight, Jonathan. 2009. “No One Lives in Western Kansas.” Cartogram.

Landscape Architecture Foundation. 2016. “The New Landscape Declaration | Landscape Architecture Foundation.” https://lafoundation.org/news-events/2016-summit/new-landscape-declaration/.

Levi, M.A. 2009. “The Canadian Oil Sands: Energy Security vs. Climate Change.” Special Report. NewYork: Council on Foreign Relations.

Lister, Nina-Marie. 2016. "Of Wilderness, Wild-Ness and Wild Things." Online video. Summit on Landscape Architecture. Philadelphia: Landscape Architecture Foundation.

Lustgarten, Abrahm. 2005. “The Dark Magic of Oil Sands - October 3, 2005.” Fortune, October 3.

McKibben, Bill. 2012. “Global Warming’s Terrifying New Math.” Rolling Stone. July 19. http://www.rollingstone.com/politics/news/global-warmings-terrifying-new-math-20120719.

Mongabay. 2006. “Boreal Forests Worth $250 Billion per Year Worldwide.” Conservation News. September 25. https://news.mongabay.com/2006/09/boreal-forests-worth-250-billion-per-year-worldwide/.

Mostafavi, Mohsen, and Doherty Gareth, eds. 2010. *Ecological Urbanism: Alternative and Sustainable Cities of the Future*. Zurich, Germany: Lars Muller Publishers.

Nostrand, John Van. 2014. “If We Build It, They Will Stay.” Thewalrus.ca. http://thewalrus.ca/if-we-build-it-they-will-stay/.

Oil Change International. 2017. “The Price of Oil: Energy Insecurity.” Oil Change International. Accessed February 3. http://priceofoil.org/thepriceofoil/energy-insecurity/.

Parlee, Brenda L. 2015. “Avoiding the Resource Curse: Indigenous Communities and Canada’s Oil Sands.” World Development 74 (October): 425–36. doi:10.1016/j.worlddev.2015.03.004.

Percy, Kevin E, M.C. Hansen, and T. Dann. 2012. “Air Quality in the Athabasca Oil Sands Region 2011.” In Alberta Oil Sands: Energy, Industry and the Environment, 1st ed. New York: Elsevier.

Petersen, Rachael, Nigel Sizer, and Peter Lee. 2014. “Tar Sands Threaten World’s Largest Boreal Forest.” World Resources Institute. July 15. http://www.wri.org/blog/2014/07/tar-sands-threaten-world%E2%80%99s-largest-boreal-forest.

Phan, Doantam, Ling Xiao, Ron Yeh, Pat Hanrahan, and Terry Winograd. n.d. “Flow Map Layout.” Stanford Universeity.

Preston, Richard J. 2016. “Cree.” The Canadian Encyclopedia. Accessed November 5. http://www.thecanadianencyclopedia.ca/en/article/cree/.

Reed, Chris, and Nina-Marie Lister, eds. 2015. *Projective Ecologies*. New York: Actar.

Regional Municipality of Wood Buffalo. 2011. “Municipal Development Plan: Regional Municipality of Wood Buffalo.” Regional Municipality of Wood Buffalo.

Rittel, Horst W. J., and Melvin M. Webber. 1973. “Dilemmas in a General Theory of Planning.” Policy Sciences 4 (2): 155–69. doi:10.1007/BF01405730.

Ruggeri, Deni. 2015. “The Eye Is A Door: Landscape, Photography, and the Art of Discovery by Anne Whiston Spirn (Review).” Landscape Journal: Design, Planning, and Management of the Land 34 (1): 101–4.



Sauchyn, David J., Jeannine-Marie St-Jacques, and Brian H. Luckman. 2015. “Long-Term Reliability of the Athabasca River (Alberta, Canada) as the Water Source for Oil Sands Mining.” Proceedings of the National Academy of Sciences 112 (41): 12621–26. doi:10.1073/pnas.1509726112.

Scowen, Peter. 2015a. “From Boom Town to Family Town: Meet the Real Fort McMurray.” The Globe and Mail, June 12, sec. News. http://www.theglobeandmail.com/news/alberta/meet-the-real-fort-mcmurray/article24915022/.

Spirn, Anne Whiston. 2014. *The Eye Is a Door*. http://www.theeyeisadoor.com/.

Testa, Bridget. 2016. “Reclaiming Alberta’s Oil Sands Mines | EARTH Magazine.” Accessed October 26. http://www.earthmagazine.org/article/reclaiming-albertas-oil-sands-mines.

The Encyclopedia of Earth. 2016. “The Anthropocene | Welcome.” http://www.anthropocene.info/.

Tufte, Edward. 2013. *Beautiful Evidence*. Fourth. Graphics Press LLC.

Waldheim, Charles, and Andrea Hansen, eds. 2013. *Composite Landscapes: Photomontage and Landscape Architecture*. Germany: Hatje Cantz Verlag.

Warnica, Marion. 2016. “Flames Reach Oilsands Facilities North of Fort McMurray.” CBC News, May 17, sec. Canada. http://www.cbc.ca/news/canada/edmonton/fort-mcmurray-oilsands-sites-fire-1.3585921.

Waters, Colin N., Jan Zalasiewicz, Colin Summerhayes, Anthony D. Barnosky, Clément Poirier, Agnieszka Gałuszka, Alejandro Cearreta, et al. 2016. “The Anthropocene Is Functionally and Stratigraphically Distinct from the Holocene.” Science 351 (6269): aad2622. doi:10.1126/science.aad2622.

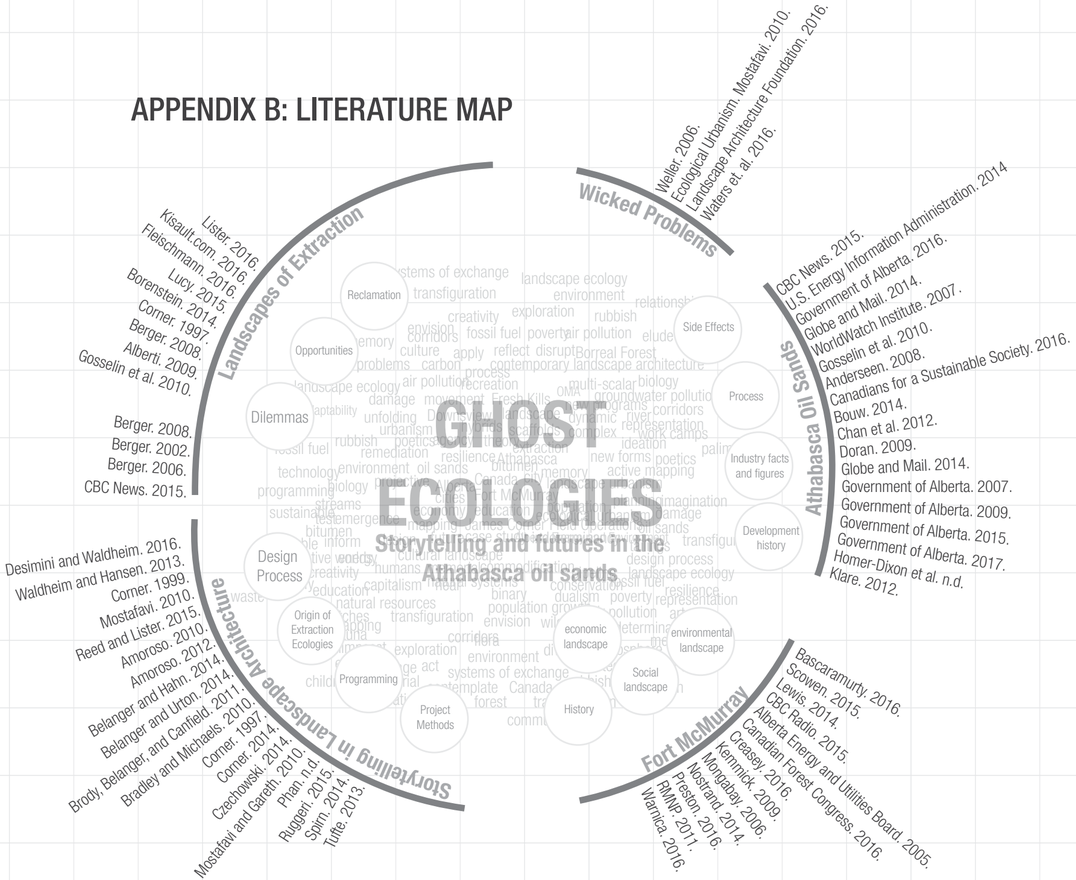
Weber, Bob. 2012. “Rebuilding Land Destroyed by Oil-Sands May Not Restore It, Researchers Say.” The Globe and Mail, March 11, sec. National. http://www.theglobeandmail.com/news/national/rebuilding-land-destroyed-by-oil-sands-may-not-restore-it-researchers-say/article552879/.

———. 2016. “Oilsands Wetland Reclamation a Mixed Success.” Fort McMurray Today. September 12. http://www.fortmcmurraytoday.com/2016/09/12/we-cant-replace-nature-oilsands-wetland-reclamation-a-mixed-success.

Weller, Richard. 2006. “An Art of Instrumentality: Thinking Through Landscape Urbanism.” In The Landscape Urbanism Reader, 069–085. New York, New York: Princeton Architectural Press.

Yang, Kyle Xuekun. 2010. “Last Grain: Revising the End of the Fossil Fuel Era and Canada’s Oil Sands Legacy.” University of Toronto.

# APPENDIX B: LITERATURE MAP



# APPENDIX C: GLOSSARY OF TERMS

## BARREL
An oil barrel (abbreviated as bbl) is a unit of volume whose definition has not been universally standardized. In the United States, an oil barrel is defined as 42 US gallons, which is about 159 litres or 35 imperial gallons. In Canada, oil companies measure oil in cubic metres but convert to barrels on export, since most of Canada's oil production is exported to the US. The nominal conversion factor is 1 cubic metre = 6.2898 oil barrels, but conversion is generally done by custody transfer meters on the border since the exact conversion factor depends on oil density and temperature.

## BITUMEN
Bitumen is an oil based substance. It is a semi-solid hydrocarbon product produced by removing the lighter fractions from heavy crude oil during the refining process.

## BOREAL FOREST
The surrounding boreal forest is a mosaic of wetlands and forests, lakes and rivers. Upland forest and wetlands are the two dominant ecologies in this area and including trembling aspen, white spruce, and pine forests.

## CONVENTIONAL FOSSIL FUEL
Conventional oil is a category that includes crude oil - and natural gas and its condensates. Crude oil production in 2011 stood at approximately 70 million barrels per day.

## DATASCAPING
Visual representations of measurable forces that may influence, steer, regulate or reveal latent site opportunities to an architect.

## DIAGRAM
A diagram is "an abstract illustrative figure used to describe a scheme, a statement, a definition, a process, or an action, free from representational and typological bounds" (Desimini and Waldheim 2016).

## GHOST ECOLOGIES
Four themes (oil, infrastructure, environment, people) identified to describe the ephemeral, hidden, and visible forces of the oil sands and oil industry.

## IN SITU
A mining process used to recover oil sands through boreholes drilled into a deposit.

## MAP
A graphic representation of features occurring the earth's surface with conventions included such as legend, north arrow, and scale bar.

## MONTAGE
The process of producing a composite picture by combining several different pictures so that they blend into one another, or a picture made by this method.

## OIL SANDS
Oil sands are a mixture of sand, water, clay and bitumen. Bitumen is oil that is too heavy or thick to flow or be pumped without being diluted or heated.

## OVERBURDEN
In mining, overburden (also called waste or spoil) is the material that lies above an area that lends itself to economical exploitation, such as the rock, soil, and ecosystem that lies above a coal seam or ore body.

## PHOTOMONTAGE
A montage that makes use of photographic images and techniques, or a picture made by this method.

## RECLAMATION
Reclamation is the act of recovery and conversion; of taking something that was rendered unusable or uninhabitable and projecting it to a useable state.

## REMEDIATION
Remediation reduces or eliminates potential harms to the environment or humans. One such is example is removing mold from a toxic site.

## RESTORATION
Restoration repairs a site or structure to its original state. For example, replacing the exact structure after a fire.

## SURFACE MINING
Surface mining, including strip mining, open-pit mining and mountaintop removal mining, is a broad category of mining in which soil and rock overlying the mineral deposit (the overburden) are removed.

## TAILINGS PONDS
It's a slurry of bitumen, water, sand, silt, and clay particles. It is contaminated by unrecovered hydrocarbons.

## TENURE
Permits are issued for a term of 5 years; Leases are issued for a term of 15 years. If a lease is proven productive, it will continue indefinitely beyond the end of the term.

## UNCONVENTIONAL FOSSIL FUEL
Unconventional oil consists of a wider variety of liquid sources including oil sands, extra heavy oil, gas to liquids and other liquids.

## WICKED PROBLEM
Characterized by being difficult to resolve, complex, and often interrelated whereas attempting to solve one aspect of the problem may reveal or create other problems.