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"IT'S NOT RAINBOWS AND UNICORNS": REGULATED COMMODITY AND WASTE PRODUCTION IN THE ALBERTA OILSANDS

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DISSERTATION

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
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ABSTRACT OF DISSERTATION

“IT’S NOT RAINBOWS AND UNICORNS”: REGULATED COMMODITY AND WASTE PRODUCTION IN THE ALBERTA OILSANDS

This dissertation examines the regulated oilsands mining industry of Alberta, Canada, widely considered the world’s largest surface mining project. The industrial processes of oilsands mining produce well over one million barrels of petroleum commodities daily, plus even larger quantities of airborne and semisolid waste. The project argues for a critical account of production concretized in the co-constitutional relations of obdurate materiality and labor activity within a framework of regulated petro-capitalism. This pursuit requires multiple methods that combine archives, participant observation, and semi-structured interviews to understand workers’ shift-to-shift relations inside the “black box” of regulated oilsands mining production where materiality co-constitutes the processes and outcomes of resource development and waste-intensive production. Here, the central contradiction pits the industry’s colossal environmental impact and its regulated environmental relations, which – despite chronic exceedances – are held under some control by provincial and federal environmental agents, further attenuated by firms’ selective voluntary compliance with global quality standards as well as whistleblowers and otherwise “troublesome” employees. ‘It’s not rainbows and unicorns,’ explains one informant, distilling workers’ views of the safety and environmental hazards they simultaneously produce and endure as wage laborers despite pervasive regulation. In addition to buttressing geographical conceptualizations of socionatural resource production, contributions arise in the sympathetic engagement with workers, which may hold useful insights for activism against the industry’s environmental outcomes.

KEYWORDS: Oil Sands, Tar Sands, Regulation, Labor, Waste

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INTRODUCTION

Widely considered the world's largest surface mining project, the oilsands[1] mining industry of Alberta, Canada, produces approximately 1.5 million barrels of diluted bitumen and "synthetic crude oil" per day, along with even greater volumes of toxic airborne and sluiced solid waste. Social science involving this industry primarily investigates the political contestation of its ecological outcomes, indigenous resistance to disenfranchisement, and hegemonic reproduction. Indeed, the evidence of postcolonial unevenness is indisputable, as is the extent of ecological impact including the imperative to reduce carbon-intensive capitalism. Meanwhile, in response to increasing activist pressures, provincial and federal governments forestall dramatic reform. This same social science literature, however, offers far less investigation – either theoretical or on the ground – within the geographical tradition of inquiry into the socio-material relations of production workers.

In response to these lacunae, my dissertation argues for a deeper understanding of how oilsands materiality shapes its capitalist extraction and how shift-to-shift workers/consumers navigate inside the "black box"[2] of environmentally regulated commodity and waste production in the oilsands mining industry, which despite its obstacles, contradictions, and outcomes, still manages to "work" on some level. In this vein, one tension becomes immediately clear and serves as a central motivation. This is the contradiction between the industry's colossal environmental degradation and its regulated environmental relations, which – despite chronic exceedances – are held under some control by provincial and federal environmental agents, further attenuated by firms' selective voluntary compliance with global quality standards as well as whistleblowers and otherwise "troublesome" employees. 'It's not rainbows and unicorns,' explains one informant, distilling workers' views of the safety and

[1] Also, variously oil sands, tar sands, tarsands, bituminous sands, or Athabasca sands, located in northeast Alberta, Canada. I use "oilsands" by default in line with my informants; yet nevertheless, adhere to terms various references adopt. The dissertation involves the legacy and still vital *oil mining* segment of the industry, expressed generically as the oilsands industry.

[2] cf. Carter and Zalik 2016, 64; Zalik 2012

environmental hazards they simultaneously produce and endure as wage laborers despite pervasive regulation.

The approach problematizes oilsands materiality critically in terms of social co-constitutionality, and locates oilsands mining within the wider global petroleum industry, particularly vis-à-vis historical anxieties and strategies related to material abundance, limits, and conservation, visible for instance in recent debates over "peak oil" and "unconventional" resources. This prompts my first research question:

> RQ1: How does oilsands materiality contribute to an understanding of "socionatural" resources?

Two additional research questions guide the inquiry into workers' experiences:

> RQ2: How do oilsands production workers' shift-to-shift activities manifest their "socionatural" relations?
>
> RQ3: How do environmental regulation and firms' imperatives mediate workers' "socionatural" relations?

Understanding the tensions on the ground inside the industry's regulated pillage necessitates adaptive iterative multiple methods that put archival sources in conversation with the partial stories of laborers, tradespeople, equipment operators, engineers, managers, and regulators gleaned through multiple seasons of participant observation and building relationships. Archives span libraries, archives, museums, and tradeshows, among others. When interpreted in a theoretical framework drawn from regulation approaches to wage labor production, nature-society, and petroleum geographies, as well as oil historiography, my empirical investigation answers these research questions by cracking open discrete – yet also, co-constitutive – windows into the oilsands mining industry: obdurate materiality, environmental regulation, production imperatives, and workers' activities interplay on the ground in the material outcomes of historically situated, regulated commodity and waste production, and its reproduction.

The dissertation proceeds in six chapters. The literature review of Chapter 1 laces together closely-related geographical criticisms of economism and naturalism that cross paths with the expansive problem of oil, which together contribute to a framework for interpreting my empirical findings. Broadly speaking, these literatures draw from three categories: *régulation* approaches to wage labor production; from the production of nature to co-production of socionature; and geographical petroleum studies. Together, these three lines contribute to what I denote as socionatural régulation approach to production.

Chapter 2 explains my adaptive multiple methods. Repeated encounters across multiple research seasons penetrate what I refer to as the "siege mentality" prevalent among industry workers and a wider cross-section of Fort McMurray, Alberta, inhabitants – indeed, also in federal agencies as my archival findings and border experiences make clear. In short, a combination of participant observation in group living quarters and at public events and venues captures opportunity interview data, serves as my primary tool to recruit semi-structured interviews and cultivate key informants. Despite limited success of a snowball approach, extensive participant observation over successive encounters eventually acquires key informants who, in turn, open some doors. However, I must stress, keen insights also derive from chance interactions, whereas key informants often offer no further leads, due to their colleagues' fears of employer retribution. Additional data are obtained from a wide range of archives described below. Important is that archival and informant data are acquired and analyzed in a process of iterative triangulation in which useful interview data becomes increasingly efficient to collect.

Chapter 3 historicizes the Alberta oilsands mining industry vis-à-vis Canadian petroleum geography and Alberta colonial settlement, which includes an overview of the company town Fort McMurray and contemporary industry dynamics.

Chapters 4, 5, and 6 present the substantive data, largely in narratives that weave together archival research and informants' fragmented anecdotes. Chapter 4 maps oilsands mining production processes and their material relations. This chapter encompasses relations of production in the first two legs of the industry's three-leg mantra: production, safety, environment. Chapter 5 takes on the environment leg in relation to production and safety. While I provide some background on regulation and self-regulation of the wider petroleum industry, the emphasis is the labor practices on the ground, both within the oilsands mining industry and its environmental regulator, that effectively materialize firms' non/compliance with their permitted – copious – pollution limits. Chapter 6 centers on one crucial stream of waste, namely the sluiced solids known as "tailings" produced at a rate of 1.5 barrels for every barrel of finished commodity. In many ways, this chapter is a culmination of my triangulation among and between archival and informant sources. The Conclusion interprets empirical findings within the framework drawn from theoretical and historical literatures. Four appendices supplement these chapters. Appendix I enumerates abbreviations and acronyms used in the dissertation. Appendix II provides maps of Alberta and the oilsands mines. Appendix III diagrams the oilsands mining production process. Appendix IV compiles interview informants, their occupations, my interaction type, and dates of contact.

The dissertation neither disputes the growing documentation of alarming environmental outcomes in the oilsands, nor questions normative democracy and social resistance to capital-state power. Indeed, by shining light on several unmistakable moments when Alberta and the firms sidestep the full implications of oilsands waste tailings, the dissertation offers new empirical evidence of 'willful blindness,' in the words of one informant within the provincial environmental regulator. My chief aim is to animate the particular historical and contemporary relations of materiality, work practices, and the provincial state in oilsands mining production, waste production, and environmental compliance activities.

CHAPTER 1. AMERICAN POLITICAL ECONOMY, SOCIONATURE, AND PETRO-CAPITALISM

To build a framework for interpreting field data, this chapter draws together theoretical foundations and selected empirical findings in political economy, nature-society, and petroleum geography. The breadth of the subject of oil production and its crises necessitates a high-level review. Organized into three broad parts, the first overviews dimensions of political economy relevant to the American experience. The second part presents facets of critical nature-society geography pertinent to oil studies. The third part reviews petroleum geography across a range of concerns, including petroleum space and its production networks; the uneven, violent, environmentally degrading "curses" known to associate with oil producers; fears of limits; and lastly, the relations of oil and hegemonic American consumer culture.

1.1 American Capitalism

1.1.1 Marxian approach to political economy

Marx's 1857 introduction to the *Grundrisse* précises his critique of political economy, an 'unmasking' of the latter's ideological explanations of the Individual and the classical syllogism Production – Distribution – Exchange – Consumption (Hall 1973). This dense analysis of capitalism's pillars provides an historically-situated tonic to classical political economy's findings that, in Marx's words, 'prove the eternity and harmony of existing social relations' (2). To begin, human life under capitalism remains indisputably social. Although the isolated Individual arises in fiction, it utterly fails as the basis of scientific explanation. The independent individual is thus a conceptual product of bourgeois society – not its cause. As Hall (1973) amplifies, 'That the capitalist mode of production depends on social connection assuming the "ideological" form of an individual disconnection is one of the great substantive themes of the *Grundrisse* as a whole' (6). So too, production is a social process across economic epochs. Extraordinary exceptions aside, production by the lone individual, Marx (1971) writes, 'is just as preposterous as the development of speech without individuals who live *together* and talk to one another' (2, original emphasis). The classical framing of production in terms of its natural laws is one in which Marx writes: ‘Bourgeois relations are clandestinely passed off as irrefutable natural laws of society *in abstracto*. This is the more or less conscious purpose of the whole procedure’ (3-4, original italics). While factors such as appropriation of natural materials, labor, and tools are common to production across the ages, Marx insists that the important object of study is capitalism’s distinguishing features, not its timeless similarities to slavery, feudalism. Crucially, production wage labor serves as the wellspring of capitalism’s paramount objective, accumulation of surplus value. Additionally, although one may speak of the totality of production, it proceeds in distinctive branches such as agriculture and manufacturing.

Classical political economy recognizes that production contains within itself the consumption of materials and labor. Marx holds that consumption is also production, discernable in complementary dimensions. Consumption closes the cycle of production; it is not the commodity itself, but rather, the consumption of the commodity that marks this completion. And at the same time, consumption predisposes the producer to produce. This in turn recreates the need for new production. In this way, production and consumption are distinctive but bound together. Production produces both the material as well as the mode of consumption; and also crucially, the desire for consumption. As Marx (1971) encapsulates, ‘Production… produces not only an object for the subject, but also a subject for the object’ (7). These needs and desires to consume are not essential human qualities, but rather, reflect historically produced conditions. For this reason, Hall (1973) summarizes, ‘Production, not consumption, initiates the circuit’ (25).

The primary object of study within classical political economy is the seemingly natural laws of distribution of rent, wages, and profit. Marx demonstrates each of these pertains merely to the distribution of the products of capitalism, the patterns of which were largely determined by the historical distribution of the means of production. Thus, rent depends upon the founding distribution of land; wages presume extensive proletarianization; and, profit is the outcome of capitalization. As such, these originary distributions demand recognition as the opening moments of capitalist production; whereas, distribution in the present day-to-day is a subordinate effect. Notably concurring with the significance of capitalism's formative distribution, Polanyi (1944) dwells upon the fraught emergence of its crucial 'fictional commodities' of wage labor and capitalized nature. Tightly associated with distribution, Marx assigns exchange to a similarly subordinate role as an effect of the mode of capitalist production.

Marx (1971) discerns generalizable implications in the American experience, which illustrate his contention that, 'A nation is at the height of its industrial development so long as, not the gain, but gaining remains its principal aim. In this respect,' he writes, 'the Yankees are superior to the English' (3). Most salient is the pervasiveness of American wage labor: 'Labor, not only as a category but in reality, has become a means to create wealth in general, and has ceased to be tied as an attribute to a particular individual' (15). As such, by the mid-nineteenth century – at the dawn of the petroleum age, coincidentally – Marx deems America the world's most bourgeois society.

1.1.2 Coercion and consent of American labor

Out of early twentieth century America, Henry Ford's two autobiographies are translated into dozens of languages to promote his role in the revolutionary labor management and manufacturing techniques of the day (Ford and Crowther 1926, 1922). Imprisoned socialist Antonio Gramsci possesses both French-language volumes among few possessions (Buttigieg 1992, v1, 468, n6). Indeed, Gramsci (1971) coins the term "Fordism" in his famous prison writings to denote 'an ultra-modern form of production and of working methods' (280-81). Vertical-integration and moving assembly of the behemoth Ford River Rouge Complex commissioned in 1928 is the apotheosis of an age reshaped by advancements in electro-mechanical automation combined with pervasive control of laborers (Allen 1952, 1931, Cochran and Miller 1942). With scant recourse to ravaged disjointed unions, Ford's wage workers experience "coercion" on the job under relentless automation and biased violent foremen, and also at home under the prying gaze of the company Sociology Department (Davis 1986, Gartman 1986).

Yet, at the same time while under this intensive subjugation, some laborers receive a high-wage and credit to entice "consent" to their treatment in return for access to mass consumption. Notwithstanding violent resistances, slowdowns, and turnover, Gramsci perceives a potential historical transformation through the 'biggest collective effort [ever made] to create, with unprecedented speed and a consciousness of purpose unique in history, a new type of worker and of man' (Gramsci 1996, 215). Whether this would indeed come to pass remains uncertain in Gramsci's eyes (Ives 2004). Nevertheless, the inescapable implication is American disruption of Marxian eschatology (Nowell-Smith and Hoare 1971, 277-78). These coercion and consent dynamics play out in social relations known widely as "hegemony," which Williams (1983) distinguishes from ideology for its everyday "normalcy" perceived by subordinated classes, whom thereby consent to their own domination.

On the ground underneath this conceptualization of coercion, consent, and hegemony, it remains to be understood why contemporary American wage laborers work so hard and how do they cope. In the eyes of Burawoy (1979), the key lies in successfully cloaking the mechanisms of surplus value accumulation, accomplished in two complementary dimensions. First is alignment of wage laborers' individually-perceived interests with – not against – the capitalist interest: 'To the degree that workers come to regard their future livelihood as contingent on the survival and expansion of their capitalist employer,' Burawoy contends, 'they will also come to accept theories of profit that reflect the experiences of the capitalist seeking profit through the sale of commodities' (29). Second is working conditions under which wage laborers perceive sufficient retention of agency. So long as coercion is meted out sparingly and specifically, wide consent to work rules can be secured as wage laborers concentrate attention upon the individual challenge of 'making out,' that is balancing personally bearable work activities and wage income. Making out necessitates 'games' such as "banking" production activity presently to claim later for wages, and navigating day-to-day social relations that range from cooperative to confrontational. Any worker who remains in a single workplace, runs the chief argument, will experience production of consent at the plant-level as a result. 'The very activity of playing the game generates consent with respect to its rules,' Burawoy insists. 'One cannot both play the game and at the same time question the rules' (81). These attitudes and activities self-reinforce with the result being the internal production of consent, Burawoy concludes, opposed to its importation from outside social spheres of family, school, church, and so forth.

For Weeks (2011) the central question is Americans' consent to living a 'working life' which is exceedingly favorable for surplus accumulation, yet suppresses pursuits of alternative rewarding activities. Undeniably poor wages, inhospitable conditions, and race and gender bias count among the many inequities in need of resolution. However, Weeks argues, the problem of working life also reaches into middle and upper echelons of wage labor. Alternative paths are explored as a political problem in terms of 'refusal,' not of work, but of working life and its valorization. As tall an order as this may seem, Weeks' feminist analysis underscores the more challenging barriers to this refusal in the realm of unpaid – particularly domestic – work.

1.1.3 Régulation

Marx recognizes capitalism's striking appearance of natural equilibrium, which fosters its idealization in classical political economy. In the eyes of Hall (1973), Marx's 'absolutely crucial pivot is that this equilibrating movement has no eternal, no ethereal *guarantees*.' Nor does Marx accept equilibrium as a gravitational norm, finding rather that it indicates a partial success in the struggle against centrifugal tendencies (25-26 original emphasis). Indeed, the central argument of Polanyi (1944) is that although the precedent conditions for capitalism emerged unplanned, to hold these together for centuries has necessitated capitalists themselves to clamor for state intervention. Returning to these questions more recently, the Parisian régulation[3] school prioritizes

[3] It is important to disambiguate the connotations of English translation, such as Regulation School or Regulation Theory. To be clear, the Parisian word *régulation* denotes *regularization* or *normalization* in English, not the false cognate *regulation*, which translates best into the French *règlementation* (Jessop 1995). The subject in other words is hegemony, where administrative rules and regulations are the state's most obvious, yet non-singular, relation with capital (Gramsci 1971). There is never a lack of social *regularization* within capitalism, rather, only variant manifestations (cf. Boyer 1990, 21). Although régulation shares striking parallels with conceptualizations of governance, clear differences can be drawn. Régulation opposes neoclassical economics whereas governance opposes classical concern with government alone (Jessop 1995). In this dissertation, "régulation" refers to the wider conceptualization of regularization while "regulation" refers to the narrower category of political-juridical rule. "Self-regulation" refers to voluntary actions of firms. Quotations from English-language sources retain the ambiguous "regulation."

how it comes to be that – despite structural crises – capitalist regimes manage to "work" on some levels to survive and reproduce (Lipietz 1987).

A treatise of this school, Michel Aglietta's (1979) *A Theory of Capitalist Regulation: The US Experience* analyzes twentieth century American economic history through the lens of federal policy and automobile production. The central historical claim locates a transformative American regime of intensive accumulation made possible by federal diversion of unaccumulated "excess surplus value" into the supplemental social welfare needed to propel two decades of post-World War II 'consumer society' characterized by rapid expansion of suburban housing economized for the nuclear family (155-61). Together, this new home and the automobile become the two chief – financed – capital acquisitions of households, along with rafts of goods such that in Aglietta's words, 'production of these complex commodities itself became the central process in the development of the mode of consumption' (160). This state-facilitated mass consumerism marks a new stage of capitalism in which, avers Aglietta: 'The accumulation of capital finds its content no longer simply in a transformation of the reproduction of the labour process, but above all in a transformation of the reproduction of labour-power' (80).

Not at all an instrumental outcome, but rather emergent from economic and labor crisis, this new social class détente institutionalizes contestation over American capitalism's contradictions sufficiently to cradle a new "accumulation regime," in a combination denoted Fordism. Paradigmatic here is the 1950 "Treaty of Detroit" between the automakers' union and General Motors that begins to quell nearly two decades of organized resistance to the automobile manufacturing industry's labor practices (Davis 1986, 55-104). Although continued social stratification riddles Fordism with contradictions, the combination of Keynesian state interventions and the postwar Bretton Woods system ameliorate tensions up until its implosion in the 1970s fiscal crises (cf. O'Connor 1973).

As Painter and Goodwin (1995) summarize it, understanding capitalist political economy in terms of a '*mode of regulation* is more concrete than a *mode of production*'

(350, emphasis added). The critical-realist English-language régulation approach seeks to make sense of capitalism's continual contradictions and crises and the nondeterministic, contested – and notably incomplete – social responses to post-Fordism (Amin 1994, Hay and Jessop 1995, Jessop and Sum 2006, Jessop 2005, Jessop 1990). This takes up the challenge of emergent neoliberalism which erupts out of Fordist crises in the 'jungle law' of Thatcher and Reagan, particularly in abrupt acts of privatization and marketization facilitated by the ideological "rollback" of state rules and regulations (Peck and Tickell 1994).

These drastic rollbacks subsequently give way to deepening entrenchment made possible by what Peck and Tickell (2002) later discern as neoliberalism's 'perpetual reanimation of restless terrains of regulatory restructuring' (392), which emerge in the mushrooming rollout of new governing rules and regulations. Earlier notions of the "hollowed out" state oversimplify how the neoliberal state retains – even expands – its regulatory reach in these rollout initiatives (Braithwaite 2005, Bridge 2014). What becomes obvious is that neoliberalism does not rollback and rollout mechanistically, but rather continually: 'it generates a complex reconstitution of state-economy relations' (Brenner and Theodore 2005, 102). Regulatory rollout must be understood, in other words, not as a discrete transition from an antecedent rollback, but rather the relational heart of neoliberalization itself (Peck et al. 2010).

In a typology subsequently influential in the neoliberal environments geography described below, Jessop (2002) delineates a heuristic schema of this emergent capitalist project: At its heart, neoliberalism advances neoconservative ideologies that treat Keynesian social welfare – so crucial in Fordist régulation – as a social cost to justify sweeping programs of deregulation and liberalization of economic transactions. These initiatives feature privatization of state-owned assets and services and the closely-related use of market proxies in the implementation of residual regulation. These tactics unfold in local, national, and transnational networks where state regulations make room for public-private involvements of both supranational and 'flanking' identity-driven nongovernmental organizations. Primary moments of primitive ‘accumulation by dispossession’ remain implicit in this typology (cf. Harvey 2003).

1.2 Socionature and Régulation

> The nature in which Feuerbach lives, it is nature which today no longer exists anywhere (except perhaps on a few Australian coral-islands of recent origin) and which, therefore, does not exist for Feuerbach. (Marx and Engels 1970, 63)

> It’s fair to say, the nature of geography as a subject is intimately linked to the nature that geographers study. (Castree 2005 front matter)

1.2.1 From social construction of nature to socionature

The heart of geographic inquiry beats in the interplay of human and nonhuman realms where the social production of nature is one familiar problem, distilled famously by Erich W. Zimmermann: ‘Resources *are* not, they *become*; they are not static but expand and contract in response to human wants and human actions’ (Zimmermann 1951, 15, original italics). Notwithstanding its uncritical implication of tractable materiality, Zimmermann’s famous expression propels geography’s enduring trajectory. Schmidt (1971) is the first to apply Marxian rigor to the social production of nature, yet does so with nature still passively objectified without explanation of *how* this socialization occurs (Smith 1984, 87, see also, Foster 2000, 45).

In response to this shortfall, Neil Smiths’ (1984) treatise *Uneven Development* argues that the cumulative magnitude of survey, territorialization, and development – pointedly governed by exchange-value rubrics – wholly produces global nature *qua* resource to the specifications of capital logics and its uneven outcomes. Thus, Smith elucidates, more than merely relational, capital and its nature constitute a singular political dialectic. At least four propositions make this insight of the ‘utmost importance’: moving past romantic conceptualizations of primal nature; showing how any specific social project is both ecologically constitutive and constituted; demonstrating the crucial sweeping extent of capitalism’s production of nature in the formation of exchange-value; and, historicizing nature-society, thereby inviting its critique (Castree and Braun 1998, 8).

Yet Smith (1984) leaves space for refinement. Heightened concern with material production understates the cultural transformations necessary for nature to take the commodity form (O'Connor 1994). 'The idea of nature as a social product,' amplifies Harvey (2010, 188), 'has to be paralleled by the recognition that natural resources are cultural, economic and technological appraisals.' Crucially, theoretical fixation with the social production of nature elides the very material consequences of its produced nature. 'In short,' insists Castree (1995, 21), 'we can, indeed we must, recognize the fact that capitalism produces nature, but we must simultaneously recognize the materiality – and consequentiality – of the particular natures capitalism produces.' In other words, production is a crucial material transformation that feeds back into the constitution of economic processes (Bridge 2008a). Moreover, over-valorizing capital instrumentality in the production of nature risks under-theorizing productivity of 'obdurate' materiality and noneconomic social influences (cf. Bakker 2010, 2005, 2003, Bridge 2011). Fully articulated then, longstanding "production of nature" recasts into the 'co-production of socio-nature' (Bakker and Bridge 2006, 19). Resource geography's greatest critical achievement is profoundly destabilizing the apparent *naturalness* of nature in favor of a relational socionatural political economy that gives fuller consideration to the productivity (and disruptiveness) of materiality in capital accumulation (Bridge 2008a).

While this co-constitutional nature-society dialectic animates continued debate, the deftly unhyphenated *socionature* (Swyngedouw 1999) expresses a consensus view of capitalist modes of accumulation and nonhuman nature as mutually constitutive, yet riddled unevenly by contingencies and disparate outcomes. The important questions move from this co-constitutionality to the question of how these socionatural relations work. A key agenda for research becomes how social responses to socionatural contingencies line up with what we claim to manage to achieve (Bakker 2010, 2009). I return below to socionature geography; first however, the next two sections sketch a geographical approach to capitalist political economy.

1.2.2 Socionatural régulation

In a commentary about his famous work, Aglietta (1998) notably recognizes the 1973 Arab oil embargo as a catalyst of Fordism's crisis. As a market event, the embargo rearranges global supply lines with little impact to overall output. Nevertheless, oil companies during this time fan angst over the "environment" and "energy," primarily to justify sharply higher oil prices and new reserve developments (Mitchell 2011, cf. Zalik 2010). These discursive campaigns leverage preexisting social anxiety. Already a decade prior, *Silent Spring* (Carson 1962) inspires environmental sensibilities, while the 1969 Santa Barbara oil spill bolsters these across popular and corporate culture alike (Hoffman 2001, LeMenager 2013, Yergin 1991). Embargo alarmism reinforces not only popular neo-Malthusianism, but also, new environmentalism's concerns over natural limits and energy shortages (Bini et al. 2016, Black 2016, Mitchell 2011).

Caught up in the fervor of these attitudes and policy initiatives, social science begins to view limits of nonrenewable resources and the "sustenance base" as material inevitabilities independent of their social construction (Schnaiberg 1980). New fields organize around this emergent axiom: environmental sociology (Dunlap and Catton 1979), ecological economics (Costanza 1991, 1989), and energy-balance economics (Hall et al. 1981, Odum 1970).

Critical and poststructural geography emerges out of these same historical circumstances. One key object of study is development projects as oil producers' deposit their burgeoning "petro-dollars" into western banks, which subsequently recycle into leveraged development schemes in the global South (Gray 2016), characteristically conservation-minded in their justification (Zimmerer 2006, 1998). Three of these literatures are summarized next. Political ecology aims at development in the global South; environmental régulation and neoliberal environments turn these approaches upon the developed North.

Political Ecology

Influential investigations of development-driven land and forest degradation in the global South put an end to traditional Nature-Society geography that registers human relations with and degradation of the environment, yet fails to consider relations with political economy, ideology, and scientific ecology (e.g., Blaikie 1985, Blaikie and Brookfield 1987, Hecht and Cockburn 1989, Susman et al. 1983, Waddell 1977, Watts

1983; cf. Mitchell 1996). Watts (2001a) explains in retrospect that the impulse behind his groundbreaking *Silent Violence* (1983), is to apply cultural ecology's methodology – historiography, ethnography, and process mapping – in direct rejection of its bourgeoise-leaning models of homeostatic autarky (cf. Rappaport 1967, Vayda and McCay 1975) and cultural maladaptation, whether to environmental hazards (cf. White 1974, White and Haas 1975), or to colonialism (cf. Nietschmann 1979). Crucially, in my mind, *Silent Violence* insists on the indeterminate attraction of capitalism's encroachment: It would be an 'absurdity' to suggest all were impoverished (Watts 1983b, 267). Although this work can veer toward teleology, it marks a key transition from apolitical hazards-type understandings to those of contemporary political ecology, which prioritizes the class aspects of postcolonial environmental outcomes (Giordano and Matzke 2001). Armed with this new critique, geography finally absolves development's marginalized subjects of culpability for their degraded circumstances (cf. Susman et al. 1983, 277-79). Pushing this emergent discipline, contributors to Peet and Watts (1996, see also, Rocheleau et al. 1996) key in on the uneven outcomes of gendered discursive power relations animating postcolonial agriculture and forestry.

Of central relevance is what political ecology has to say about régulation and the processes and outcomes of resource extraction. Concentrating on shifting post-Fordist state-market relations, Peet and Watts (1996) are struck by, 'how political ecology has, from its inception, wrestled with the way management questions – whether in the form of regulatory apparatuses, local knowledge systems, new community or resource-user groups – must occupy an important space in civil society…' (9). The main emphasis is how neoliberalism intensifies indigenous and peasant dispossession of their customary resources under the aegis of the "sustainable development" discourses that supranational and nongovernmental organizations promulgate, crucially in the 1987 Brundtland commission report and subsequent Rio 1992 conference (cf. Escobar 1995, Hajer 1995).

Environmental Régulation

Whereas political ecology generally investigates uneven development in the global South, one controversial issue in recent discussions has been how to leverage the insights of the régulation approach to conceive socionatural political economy in the global North. One the one hand, some argue that the explicit institutional category of Nature sharpens régulation approaches, which emphasize capitalism's endemic crises but with little regard to ecology. Régulation, in this view, is too abstract by itself, pointedly undertheorizing the biophysical co-constitution of political economy (e.g., Bridge 2000, Drummond 1996, Gandy 1997, Jonas and Bridge 2002, Krueger 2002, Robertson 2004). On the other hand, others argue an ecological perspective is better understood as already latent within régulation; and so, to cobble-on ontological fixations often ironically understates the degree to which nonhuman nature always co-constitutes the social institutions studied by Parisian régulation. In the words of one of this latter view's chief proponents, 'rather than positing nature as an unexamined "extra-economic" dimension, the case of oil reveals how ecology can be integrated into a foundational concept of the regulation approach – the wage relation' (Huber 2013a, 171, cf. Watts 1983, 244).

Ad hoc treatments of régulation with thin linkages to the processes of its national modes, argues Huber (2013a), run the risk of merely reporting events while failing to situate evidence within meaningful explanatory frameworks. The most substantive contribution of the environmental régulation approach may be as a political economic framework to understand "sustainability" (Gibbs 2006, 1996), which can be underplayed in "post-political" compromise (e.g., Beck 1992, Blühdorn 2007). Much of this work puts the emphasis on drilling down to the 'messiness' of fragmented institutional responses to socioecological crises, particularly contradictions between "greenwashing" capital/state discourses and inescapably uneven material outcomes (cf. Bridge and McManus 2000).

Neoliberal Environments

Echoing geographical efforts to locate nature in régulation approaches, McCarthy and Prudham (2004) declare, ‘What is largely absent in the neoliberalization literature is a recognition that neoliberalism is also an *environmental* project, and that is *necessarily* so’ (277, original italics). Taking up this challenge, burgeoning literature known widely as *neoliberal environments* investigates socionatural unevenness, typically within the heuristic typology of neoliberalization introduced above (cf. Jessop 2002). Aiming at emergent strategies of resource commodification, representative case study research clarifies implications of *privatization* (including *deregulation and re-regulation*) of municipal water provision (Bakker 2005, Prudham 2007, Swyngedouw 2005, Young and Keil 2007) and wild game (Snijders 2012); *marketization* with *market proxies* in marine fisheries management (Mansfield 2004, St Martin 2005) and in artificial-wetlands for offset credits (Robertson 2006, 2004); *flanking stakeholders* taking the leads in regulatory activities (Holifield 2007); and, *supersedure of sovereignty* through supranational accords that delimit environmental accountability of multinational capital (McCarthy 2004). As a rule, these studies of nature’s neoliberalization rely upon the methodological approaches of political ecology, namely: intensive grounded subject interaction as an alternative to ideological institutional claims; poststructural emphasis on power and discourses; and, untangling the role of techno-science with respect to economy, nature and society (Heynen et al. 2007b).

Castree (2008a, 2008b, see also, 2011, 2010a, 2010b) ambitiously catalogs this proliferating ‘sometimes brilliant’ literature, distinguished by three conceptual strengths; namely, close attention to the agency of biophysical materiality; intense scrutiny of local activities in fluid multi-scale networks; and, sufficient breadth of locations and circumstances to suggest some generalizability is possible.

Four compatible theoretical foundations inspire these studies. Smith (1984) was discussed above in terms of socionature. Benton (1989) underscores how degradation of the ecological sustenance base is a concrete function of the social relations that produce them. Along a similar tack, James O’Connor politicizes material limits to refute the naturalized claims of neo-Malthusianism. On the crucial question of nature and capitalism, O'Connor (1996) famously claims, 'Marx was not so much wrong as he was half-right' (211). Where Marx is half-wrong is that capitalism produces not only social barriers and constraints, but also – crucially – how capitalism produces its own impairments to material factors, thereby hindering and even preventing further production and expansion. This is the 'second contradiction' of capitalism, and examples include 'warming of the atmosphere… acid rain… salinization… toxic wastes… soil erosion' (O'Connor 1996, 207). Like capitalism's better-known social contradictions, these natural limits result in increasing social contradiction, thereby, argues O'Connor, cracking open an opportunity for new social movements to lead to socialist-leaning restructuring and restoration. Last is the influential vision of Karl Polanyi (1944). This begins with the irreducible 'embeddedness' of humans within the natural world, which capitalism nevertheless rends asunder in its ideological 'disembedded' economy, wherein capitalism circumscribes land and wage labor into exploitable 'fictional commodities.' The crisis-riddled challenge of sustaining these patent contradictions arouses capitalists to cry out for stabilizing state regulation. The resulting arrangement in always-regulated socio-economy unfolds in a 'double movement' in the polar tension of laissez faire and socialism.

Using these foundations and informing them in return , neoliberal environments literature prioritizes four firm and state 'fixes' according to Castree (2008b): Market-driven environmentalism, especially assertions that corporate social responsibility will result in normatively sought outcomes; Globally-expanding accumulation through exploitative trade and bio-prospecting agreements; Expansion of rights to degrade the environment, such as the use of NAFTA to undercut efforts to block deleterious pollution (cf. McCarthy 2004); and, Elimination of regulation via streamlining coupled with new social forms such as NGO oversight – with attendant non-prosecutorial powers.

The most salient criticism of these conclusions is the relations of neoliberalism and nature's irreducible non-passivity is 'surprisingly absent' (Bakker (2009).

Surprisingly, because Castree's (1995) review of the production of nature thesis emphasizes how excessive social constructivism can go too far in masking nature's materiality, a basic insight of critical socionature (cf. Bakker and Bridge 2006). However, I suggest, this arises less from a shortcoming of Castree's analysis and rather more from the tendency of neoliberal nature literature to set aside the question of material co-constitutionality; although, see Robertson (2004) aforementioned.

Finally, a brewing tension in this literature demands notice. On the one hand, unsparing definitions of environmental neoliberalization emphasize its non-redemption: 'Instead of resolving the political-economic crisis tendencies of contemporary capitalism, neoliberalism exacerbates them by engendering various forms of market failure, state failure and governance failure' (Brenner and Theodore 2007, following Jessop 1998). On the other hand, there is recognition that neoliberalization projects can result in improved environmental outcomes – notwithstanding implications of privatized public goods (Bakker 2003). Evidence includes the notoriously destructive mining industry where neoliberal environmental interventions yield a modicum of abatement and competitive advantage simultaneously (Emel et al. 1995, Warhurst and Bridge 1996). In other words, the need for some political pragmatism has produced fractures in erstwhile steadfast anti-neoliberalism.

As Castree (2007) explains, 'We [geographers] are, perhaps, still saddled with our own shibboleths – at least at the normative level – and have some way to go before we abandon them for the more supple understandings geographical inquiry can deliver' (283). Or, put another way:

> Admittedly, a focus on critiquing the excesses of neoliberalism may point toward a more reformist politics than a direct critique of necessary features of capitalism (i.e., you can keep your wage labor, just let us have some sort of environmentalism and social safety net and some public spaces), but inasmuch as the latter would be a stunning political victory at the moment, we can live with it for the time being. (Heynen et al. 2007a, 289)

In summary, investigations of post-Fordist and neoliberal environmental regulation pursued by neoliberal environments, environmental régulation, and political ecology literatures share theoretical foundations in what we might designate as a socionatural régulation approach.

1.3 Geographical Petroleum

> At the centre of the analysis of capitalism's relation to nature is its inherent and unavoidable dependence on fossil fuels, and particularly on oil. (Altvater 2007)

> The study of oil removes any doubt that pervasive materiality enables the hydrocarbon-fueled contemporary accumulation regime, which persists despite profound socio-environmental contradictions. (Huber 2013a)

Geographic investigation of petroleum builds on the theoretical foundations of capitalism, socionature, and régulation explained above, albeit implicitly at times. The following subsections describe petroleum geography particularly relevant to the dissertation research. Broadly speaking, these involve the historical spatial relations and processes of global oil production, related violence, consumption, abundance, "peak" oil, and uneven environmental protection**.**

1.3.1 Geographical petroleum: Twentieth century oil

Oil supplants coal as the predominant energy-dense fuel in the twentieth century (Altvater 2007, Huber 2009a, Smil 1994). Resulting oil geography stems from the structural tendency of petroleum *overproduction*, the compulsion behind ongoing competition among global capitalist blocs, including states, and by the extraordinary profitability of the petroleum industry itself. Labban (2008) argues persuasively the main risk to petro-capital is underproduction; which when prolonged, entices marginal producers into the competitive landscape, anathema to oligopoly. These dynamics are at the heart of a century of increasing capital centralization, from the apex of nineteenth century European imperialism and the Great War, through supranational structures that operationalize in the Cold War, and in contemporary neoliberalization. Capital, oil, arms, and state relations – all entwined – intensify throughout this period. At every economic downturn, petro-capital expands spatially through opportunistic state relations and oil reserve acquisitions, a phenomenon that demonstrates investor strategy to acquire productive capacity for control, rather than to expand output. Should there be “resource wars” over oil, the object will be not to control resources, but rather more precisely, to gain inter-capitalist advantage (Labban 2008). Oil is capitalism’s crucial necessity, concurs Moore (2015, 102), not for growth *per se*, but rather for competitive appropriation of natural conditions and labor.

This oil competition plays out in the historical machinations of Euro-American imperialism in the Middle East. Since the early twentieth century, competitive state-capital interests seek always to control supply and – runs the argument (Mitchell 2011) – to constrain democracy in potential large producing regions, particularly in the Middle East. The pattern becomes clear: in the (primarily) Anglo-Parisian carve-up of the Ottoman empire in the 1920s and eventual inclusion of Standard (New Jersey) and Standard (New York) within the Red Line and Achnacarry “As Is” agreements for Middle East oil revenue-sharing; in the Bretton Woods terms, underappreciated as a scheme to govern not only finance capital, but also petroleum flows in a global ‘fuel economy’; in the Cold War birthed in American competitive strategy to exclude the Soviet Union from northern Iran; in the 1970’s ‘energy crisis’; and, in the continuing political and military violence promulgated by the US in the Middle East (Mitchell 2011). Mitchell has company in this prognosis of recent history as the latest invasion of Iraq clearly ‘[had] everything to do with oil’ in the eyes of Harvey (2003, 23; see also Luke 2007).

Without disputing this historical capitalist-state preoccupation with petroleum – indeed, pointing out elite American solicitude towards the oil companies – Smith (2004) emphasizes it remains one facet of the wider imperial enterprise, seen both in Isaiah Bowman’s project to establish ethnic-based postwar borders and the Bush-Cheney “war on terror” (see also, Don Mitchell (2014)). At the same time, it is also important to appreciate the historical messiness of oil contestation. Whereas Mitchell (2011) spells out the 1920s inter-capitalist scramble to secure pipeline, rail, and ship transport for Middle East oil exports to Europe, we can forget how, for a half-decade *after* the 1918 Paris armistice, conflict rages between Turkey and first France, followed by Britain over the question of Syria and Iraq territorialization; and also in that day, how the “natural” alliance of the US and UK simmers in a “war” of position to corner world supply (Mohr 1926).

1.3.2 Geographical petroleum: Contemporary oil space

In the aftermath of World War II, United States hegemony expands together with Middle East crude production to ensure oil supplies for recovering Europe and Japan, a relatively stable arrangement that alters only after high prices in the 1970s impel non-OPEC development in the North Sea, US, and Russia, as well as Alberta. Contemporary petroleum producer and consumer patterns reflect Asian automobile demand, Euro-American conservation, and again-resurgent Russian and American production, which combine in geographical diversification away from the Gulf States (Bridge and Le Billon 2013).

Oil development enlists surprising relations. In some conflict regions, territorial control supersedes state claims as multinational oil companies contract directly with militarized non-state actors (Le Billon 2001). The Turkish state and Kurdish Regional Government jointly partner in a northern Iraq development (Paasche and Mansurbeg 2014). Rural northwest Kenya inhabitants, long marginalized by Nairobi, bypass ill-trusted state channels to directly petition multinational oil firms for abatement and remediation guarantees prior to development (Enns and Bersaglio 2015); and, western environmental NGOs collaborate with Putin’s Russian Federation, which revokes Shell’s environmental approval for the giant Sakhalin II project, and subsequently spurns the NGOs in order to place the majority stake with Gazprom (Bradshaw 2007).

Additional contradictions arise in the relative spatial fixity of nonrenewable petro-resources while borders of state territoriality remain contested (Bridge 2008b, Bunker 1992). For instance, enticements of petroleum threaten to undermine a trans-border ecological zone established jointly by Nicaragua and Costa Rica in an initiative to deescalate their tensions (Barquet 2015). Postcolonial maneuvers over oil in Africa pit the US against China (Ferguson 2005, Pannell 2008, Thomson and Horii 2009, Watts 2008).

Neoliberalization unleashes particularly intensive foreign direct investment as petro-capital presses globally into states weakened by structural adjustments, essentialized in neocolonial 'resource triumphalism' narratives of the new millennium (Bridge 2004, 2002, 2001). Take one small $5 billion oil play in this trend: formerly low-income Equatorial Guinea transforms into a petro-state in a single decade (Frynas 2004). Commonly in these developments, agents of capital such as the World Bank invoke the red herring of risk to cajole resource-licensing states into accepting low-royalty contracts to balance risk/reward calculations (Emel and Huber 2008). Spatial displacement of communities and livelihoods runs part-and-parcel with these new petro-developments, seen recently in Peru and Ghana where agricultural land is lost to oil development (Slack 2014). Indeed, more widely, intensification of petroleum and other natural resource development runs roughshod over traditional water access in state planning in the Andes (Cuba et al. 2014). Fishermen in Nigeria and Mexico are excluded from offshore facilities and the fish attracted to their artificial reefs (Quist and Nygren 2015, Zalik 2009). Economic vulnerability in the US shale region predicts household collocation with "fracking clusters" (Ogneva-Himmelberger and Huang 2015), which local elites endorse (Sica 2015).

Historically, petroleum development operates out of enclaves and their attendant limited integration with local economies (Watts 2004b); however, these enclaves depopulate in the technologically-enabled spatial consolidation of the industry, for instance by outsourcing activities to the Houston, Texas, 'super-node' of industry knowledge and remote control. While of course the local terrain of extraction never can fully eliminate labor, decision power increasingly resides in far-flung networks (Bridge and Wood 2005).

1.3.3 Geographical petroleum: Production networks

Let us turn to the narrower issue of raw crude oil production. Michael Watts's (2005, 2004a) 'oil complex' illuminates two interconnected frames: the postcolonial national organization of the Nigerian petro-state and the globalized multinational oil company, with additional linkages to weapons and security apparatuses as well as OPEC. The petro-state controls legal structures including title over the resource and provides security to enable its exploitation via the multinational firm in return for a portion of production output and taxes. This reinforces the crucial role of the state in the facilitation of extraction (Bridge 2014, 2002). The absorption and distribution of oil rents in Nigeria (including theft of ten percent of output) and provision of military and security to sustain the cycle become the overriding concerns of this rentier state. These institutions just as quickly become overwhelmed by patronage and corruption which de-legitimate the federal petro-state and fracture social cohesion into possibly irreversible anomic petro-violence (Watts 2005, 2004a, 2004b, 2004c, 2001b, 1994, 1984). These conclusions reverse the cautious optimism of *Silent Violence* (1983), wherein petroleum rents enable fragile post-Independence institutions to rapidly centralize national authority.

Gavin Bridge's Global Production Network (GPN) approach to petroleum visualizes global material flows and related social relations across the complete inter-firm process of exploration, reserve development and extraction; to transportation and refining of crude and its distribution; to consumption as feedstock or combustible fuel; and finally, to emerging carbon capture via technical sequestration or securitized schemes (2008b, see also, Dicken 2011, 243-69). Additionally, every step of this broad process co-constitutes environmental, financial, and governmental relations. In comparison with the GPNs of assembly industries, petro-extraction is differentiated by crucial state activities in territorialization of the petro-resource, regulation of its development, and management of royalty and tax income. Additionally, national oil companies have emerged among the leading global integrated firms.

One key interest is, 'the influence of the materiality of oil on the structure of the production network' (Bridge 2008b, 394). This extensive network begins with the geological reserve structure and potential, territorial stability, market proximity, and resource heterogeneity—light (high-gravity, low-viscosity) sweet (low-sulfur) out-values heavy sour, etc.—and the implications of these for marketable production, and continues to the far end of the GPN where combustion often finalizes the emission-intensive process of consumption and production.

The GPN incorporates imperatives of petroleum futures markets with daily trade volumes in excess of material consumption, which not only shape global pricing but also set in motion very material activities including oil production and storage capacity development (Labban 2010, Zalik 2010).

Especially notable with respect to the oilsands, the GPN and wider critical economic geography tend to frame industrial waste as the inadvertent outcome of production (Bridge 2008b, Bridge and Le Billon 2013, Dicken 2011, Smith 1984).

1.3.4 Geographical petroleum: Violence

The GPN has less to say about violence borne by indigenous inhabitants associated with petroleum territorialization and production. Closer inspection reveals that the process of localized violence runs hand-in-hand with petro-development, which remains decoupled from oil prices and scarcity (Le Billon and Cervantes 2009). Indeed, determines Le Billon (2001), sustained low-level local conflict in oil-producing regions generates profit for its perpetrators. Gendered violence of oil development is not merely a side-effect, but rather a constitutive condition (Turcotte 2011). In Nigeria, initial optimism over the potential of oil income to congeal a new national identity (Watts 1983), soon gives way to an oil complex of enclaves and state corruption to produce authoritarianism, environmental devastation, and destruction of traditional economies that results in violent social fragmentation (Watts 2004a, 2004b, 2004c, 2001b, 1996, 1984). Violence besets oil development across the African continent (Basedau and Pierskalla 2014), in Ecuador (Sawyer 2004), US-occupied Iraq (Le Billon 2005), and – further discussed below – Canada (e.g., Simpson 2019).

1.3.5 Geographical petroleum: Consumption

When geography theorizes the petro-consumer, it is typically as the tailpipe of petro-capital's production networks. As Bridge and Le Billon (2013) summarize, consumers are 'hooked on lifestyles and locked into infrastructures that demand a strong will and some sacrifices to opt out of' (138). In this conceptualization, 'addicted' languorous consumers usefully reproduce demand and pose little resistance to the $3 trillion industry (Bridge and Le Billon 2013, 155; see also Suranovic 2013). Indeed, American consumers see access to cheap gasoline as an entitlement (Huber 2009b). Reinforced by design and advertising, what Bourdieu (1984) later calls ‘distinction,’ becomes a secondary motive force of political economy, although still subordinate in the Fordist structures of production/consumption (Aglietta 1979, 155-161).

Selected petroleum histories take pains to contextualize automobility. In California, oil and automobile interests emerge hand-in-hand to transform political, physical, and aesthetic landscapes (Sabin 2005). The lure of mobility and triumph of internal combustion over electric and steam fundamentally alter American culture (Black 2014, Wells 2012). Moreover, while it is difficult to overstate the impact of the gasoline-powered automobile and petro-fueled transportation more widely, they also provide new wedges for oil to penetrate American family life (Johnson 2014). We see articulations of capital accumulation and mundane consumption of fossil fuel foodstuffs (Pfeiffer 2013, Pimentel and Pimentel 2007, Romero 2016), “toxic love” of plastic (Freinkel 2011) and wanton broadcast of household petro-toxins (Robbins 2012, Robbins and Sharp 2003).

Meanwhile, notable studies of the automobile touch lightly, if at all, upon relations with petroleum (Batchelor 1994, Featherstone 2004, Flink 1975, Paterson 2007, Seiler 2009). In this group also, Aglietta’s (1979) study of American Fordism details the automobile manufacturing industry and consumerism, yet brackets petroleum. Sustained Marxian engagement of both oil and petroleum thus distinguishes Matthew Huber’s *Lifeblood* (2013b) in which the ‘American way of life’ sediments in the twentieth century as petroleum, automobiles and suburban households become inseparable. Opposed to consumption as a default, Huber’s monograph injects material and ideological consumer pull into the calculus of political economy. This is an essential understanding, given that automobile consumption in Muncie, Indiana, displaces both household expenditures and labor activism by the 1920s, that is prior to Sloan’s introduction of automobile fashion (Lynd and Lynd 1929; see also, Ise 1926, 164-72).[4] The essential challenge in understanding the contemporary work-home-automobile petro-triad insists Huber (2013b), is to comprehend its spatial materiality, and then pointedly distinguish the political attitudes that derive therefrom. So powerful are the latter, ‘the biggest barrier to energy change is not the technical but the cultural and political structures of feelings that have been produced through regimes of energy consumption’ (169 added italics; see also 187 n. 106). No longer is this sort of lifestyle strictly American. Sprawling urbanized petro-capitals manifest the continuing allure of automobile-centric intensive consumerism in Venezuela (Coronil 1997), China (Gallagher 2006) and Nigeria (Gandy 2006).

1.3.6 Geographical petroleum: Abundance

Under neoclassical theory, marginal supply equilibrates with market demand. American petroleum supply, however, operates under a different set of logics. The historical allure of petro-riches and relatively low start-up costs, argues Lucier (2008), combine to entice market entry by petit capitalists, such as engineers and shop-owners, who thereby democratize oil discovery. Three hundred thousand dry oil wells across the US by the 1959 centenary of the Pennsylvania Drake well testify to the wildcat compulsion to discover new oil, independent of market conditions (Knowles 1959). The result is a persistent condition known as “over-production,” that is production of supply in excess of market demand. Indeed, since the industry’s modern roots, observes Harvard-degreed economist John Ise (1926), ‘Over-production has been chronic. There has hardly been a time since 1860 when too much oil was not being produced…’ (123).

Even with today’s directional drilling technology, dry holes continue to confound oil exploration (Valdivia 2015). Across the industry overall, nevertheless, the challenge of petroleum extraction lies less in new strikes, and rather more in economic development of any particular reserve (Bridge and Wood 2005, Zimmermann 1957).

[4] One observation of many: ‘“The Ford car has done an awful lot of harm to the unions here and everywhere else,” growled one man prominent in [Muncie] labor circles. “As long as men have enough money to buy a second-hand Ford and tires and gasoline, they'll be out on the road and paying no attention to union meetings”’ (Lynd and Lynd 1929, 254 n. 6).

Regardless of these challenges, reserves expand. Labban (2008, 2) puts it bluntly: ‘The problem of oil is not its scarcity but its abundance;’ and thus, since the early twentieth century runs the central argument, the containment of supply – not its expansion – has been a crucial engine in capitalism’s globalizing competition. Especially the postcolonial geographies of Iran and the Gulf States reflect imperial-capital initiatives to delimit production of oil bounty (Mitchell 2011).

These counterintuitive understandings of petroleum supply distinguish critical geography from neoclassical interpretations (cf. McNally 2017), and substantiate Harvey’s (1974) observation that only via ‘carefully managed’ scarcity does capitalism cling to the tenuous ‘self-regulating aspect’ of its price mechanism. Indeed, postwar wage consumerism, the ‘American way of life,’ utterly depends upon state-regulated oil infrastructure and markets (Huber 2013b). Instrumental literature notably concurs that the industry enjoys matchless historical success at inducing government intervention to supplement its porous cartels (Blair 1976).

1.3.7 Geographical petroleum: Peak oil

‘The end of cheap oil,’ blares the *Scientific American* cover March 1998, ‘It’s coming fast.’ Backed up by proprietary datasets and decades of petroleum industry experience, authors Colin Campbell and Jean Laherrère conclude, ‘world oil production of conventional oil will peak during the first decade of the 21st century’ (1998, 81). Global reserve estimates are notoriously inflated, particularly OPEC’s, the authors argue, such that reserve depletion stubbornly outstrips replacement. Published during an extended period of declining oil prices, this starkly contrarian argument proves prescient – at least in terms of market prices. Within eight months of publication, petroleum benchmarks hit a cyclical market bottom and then begin a decade-long run-up to the July 2008 all-time nominal high of $147 per barrel. In signs of the times, multinational Shell pushes peak oil discourses to fan this oil price frenzy and thereby hastens the decoupling of material supply and futures markets (Zalik 2010). Peak oil anxiety prompts community-wide anti-consumption initiatives to dramatically reduce oil dependency; although, these stop far short of autarky, which arguably forestalls more transformational interventions (Bailey et al. 2010, Bettini and Karaliotas 2013, North 2010).

The concept of peak oil has undergone increasing critical scrutiny. Bridge (2010) stresses that this decontextualized notion only gains traction in the first place through historical erasures. The material argument of Campbell and Laherrère (1998) falls short, beginning with its alarm over excess depletion attributable more soberly to an historical ebb of exploration and development as multinational petro-capital adjusts to a new global regime of largely-nationalized reserves (Bridge and Le Billon 2013, Bridge and Wood 2010). Estimates of petroleum reserves in the Gulf States rely on outdated techniques. Were new surveys to be conducted there – the first in generations – they likely would *increase* the total reserve (Labban 2010). Perhaps the greatest recent disruption is the rapid emergence of US fracking, which reasserts national dominance as the world's top producer. This depresses global prices and deeply impacts Saudi fortunes (Kilian 2017). Overall, worldwide oil reserves increase from 1.1 trillion barrels in 1995 to 1.7 trillion barrels in 2014 (BP Statistical Review 2016). Not peak supply, but rather peak access to profit due to increasingly nationalized global petro-territory troubles multinational oil companies, which forces smaller participations, capital/technology-heavy projects globally, and aforementioned upstream development in North America. In addition, the issue of potential supply limits will become increasingly moot as peak consumption shrinks in response to increasing carbon taxation and rising alternatives to private internal combustion (Bridge and Wood 2010).

Critical geography is not immune to the seduction of peak oil. The engrained idea is hard to shake. Peck and Tickell (1994) express certainty, '…the end is in sight for oil (the commodity which both literally and metaphorically fuelled Fordism)' (307). 'Oil is slowly becoming increasingly scarce,' declares Harvey (2003, 23), an inadvertent concession to the logic behind American neo-imperialism. Similarly, in the eyes of Mitchell (2013), '…it appears we are about to enter an era of declining supplies' (6). Arguments put forth by Colin Campbell's Association for the Study of Peak Oil compel Altvater (2007) to the 'inescapable material fact' of the imminent end of low-cost petroleum outside the Gulf States, which would thus soon reclaim dominance – decidedly, not the outcome as explained just above. And although Bridge and Le Billon (2013) project that "unconventional" petroleum supplies will make up any slack in the market, they too agree, 'the end of cheap oil' has arrived (82, see also 182-3). "Unconventional" sources include heavy oil, shale oil, and the Alberta oilsands, all of which demand higher energy inputs in production compared to "conventional" liquid crude, leading scholars, journalists, and NGOs to characterize them – in Ricardian terms – as "scraping the bottom of the barrel" of remaining oil resources (Bordetsky et al. 2007, Brandt and Farrell 2007, Strahan 2009, Zalik 2015). In the same vein, Harvey (2010) classifies the Alberta oilsands as a marginal resource only enticed into production by the high prices of socially constructed oil scarcity; nevertheless, he invokes the oil engineer Hubbert in associating oil's inescapable limits as a contributing factor in the 2008 crisis (see also Zalik 2010).

1.3.8 Geographical petroleum: Uneven environmental protection

When it comes to contemporary environmental regulation of petroleum projects, ceaseless urgency for new development rams fast approvals through review processes with mere fig leaves of compromise in Canada (Zalik 2015) and Norway (Kristoffersen and Young 2010, Cumbers 2012). That said, gross disparities in environmental abatement exist project to project within individual firms, weighed in favor of the global North compared to South (Maiangwa and Agbiboa 2013). For example, only in the 1990s does Nigeria begin to require oil developments to submit environmental impact assessments in connection with new oil developments (Anifowose et al. 2014). Foundational research of Michael Watts (2004b, 2004c, 2001) bares environmental impacts of Nigerian oil production: Shell spills 1.6 million gallons in the decade between 1982 and 1992, an improvement over the 200 million gallons it spills in the 1970s. Hydrocarbon pollution of streams in oil-producing districts exceed European standards by factors of 300 to over 600 times allowable limits. Natural gas flaring constitutes a source of carbon dioxide emissions significant at global scale. Life expectancy in these locales is merely fifty years.

1.3.9 Geographic petroleum: Worker-consumer attitudes

These attitudes of Alberta oilsands workers share some commonality with oil workers studied by researchers around the world. Azerbaijanis retain optimism that the oil industry's benefits outweigh undeniable costs (O'Lear 2007). Similar attitudes have been observed in South American populaces. Indigenous and labor identity politics in Bolivia and Ecuador, respectively, resist oil and gas privatization; yet crucially, this is to maintain or enhance labor opportunities and distribution of rents, not to curtail production (Perreault and Valdivia 2010, Valdivia 2015, 2008). Long beleaguered residents of Nigerian oil producing regions concede the industry's embeddedness, so primarily seek mere participation in the prosperity (Zalik 2010). This is despite the disparity of ecological protection compared to the affluent global North (Maiangwa and Agbiboa 2013). Similarly, wage interests dominate social concern in the 'ruined environments' of Veracruz where most inhabitants are inured to risk and associate the landscape with consequent consumerism. In this case nuisance odors dominate political activism, which the industry abates marginally to defuse protest (Landa 2016).

CHAPTER 2: METHODOLOGICAL APPROACH

This dissertation relies on data gleaned from production workers during nonwork hours to penetrate inside the "black box" of oilsands production by detailing moments the production strategy is shaped in the relations of shift-to-shift work activities, provincial environmental regulation, and co-constitutional obdurate materiality; and, to interpret these findings within the socionatural régulation framework assembled in the Chapter 1 literature review.

2.1 Research Questions

RQ1: How does oilsands materiality contribute to an understanding of socionatural resources?

RQ2: How do oilsands production workers' shift-to-shift activities manifest their socionatural relations?

RQ3: How do environmental regulation and firms' imperatives mediate workers' socionatural relations?

2.2 Multiple Methods

To answer these questions in the geographical tradition of grounded study, the dissertation revolves around fieldwork in Fort McMurray, Alberta, Canada, ("Fort Mac"), the urban center of the oilsands mining industry.[5] Exorbitant living costs during the production boom underway at the time constrain fieldwork to the summer months 2010, 2011, and 2012. Activities in 2010 are limited to preliminary research without interviews. A fourth sojourn to Edmonton in 2017 concentrates on archival sources. With oil prices firmly above $90/barrel, the Canadian "Loony" exchanges above the US dollar during most of the fieldwork, while in 2021 the same Loony exchanges for 79 US cents.

Archive locations include: Alberta Environment public reading room, Alberta Government Library, Barr Colony Heritage Cultural Centre, Energy Resources Conservation Board public reading room, Fort McMurray Heritage Village, Fort McMurray historical and memorial markers, Glenbow Archive and Library, Keyano

[5] The government entity, the Regional Municipality of Wood Buffalo, incorporates Fort McMurray, as well as smaller Anzac, Conklin, Fort Chipewyan, Fort McKay, and Janvier, among other communities and settlements, and also the mineable area of the oilsands.

College Library, Oil Sands Discovery Centre, Provincial Archives of Alberta, University of Alberta Library, University of Kentucky Library, and Wood Buffalo Regional Library.

In petroleum studies, 'If you announce your presence to the oil companies, you'll be routed to corporate PR,' explains feminist resource geographer Anna Zalik.[6] This observation informs my methodological strategy not to approach the companies directly, but rather rely upon individual contacts. The stories I seek to bring to light exist only within the community of workers who live them. They cannot be gleaned from institutional voices and are disclosed only after establishing trust over a period of time in casual settings. 'That's a wise design,' agrees senior municipal employee Buddy Mac, who concurs direct approaches to the firms would yield little new information.

The multiple methods research combines semi-structured interviews, participant observation, and archival investigations, which together enroll a range of informants: industry managers, engineers, tradespeople, equipment operators, and laborers, as well as politicians and municipal employees, environmental regulators, and community members. Most live and work in Fort Mac, although several are in Edmonton and Calgary. The dissertation triangulates patterns within the data to identify moments of clarity in otherwise obscure oilsands processes (cf. Dixon and Jones III 1998, 249). The strength of my qualitative methods shines brightest when holding institutional claims about production activities up to individual experiences and archival disclosures (cf. Ellis et al. 2008, 276).

As detailed below, the majority of potential informants are skittish about participating, which fortunately, I partially accommodated with an exemption to the interviewee signature requirement of the Institutional Review Board. More than one of my semi-structured interviewees stated if I had required their signature, they would have not participated in the study. Even with this exemption, a few informants decline to speak their names to mark the start of recorded interviews. My broader effort to maintain confidentiality masks genders of individual informants and in most instances their specific firms. Thus, all informants have been anonymized as "Buddy" plus an

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[6] Feminist Extraction panel of the Association of American Geographers 2013 Annual Meeting

appellation to keep track of different characters. For instance, B. Chicken, B. Rabbit, and B. Bang count among key informants. Anyone who has spent time in the oilsands will appreciate this convention as a tip-of-the-hat to the influence of workers with roots in the Maritime Provinces, whose distinctive idiom peppers quotidian discourse by using "Buddy" to refer to friends, coworkers, and strangers, alike: "Buddy and me were at Show-G's"; "So, then Buddy comes on the radio"; "Buddy boy, that's cold!". Appendix IV catalogs these informants, together with primary occupation, type(s) of interaction, and date(s) of interaction.

The remainder of this chapter details my process of obtaining informants. In the final tally, fifty-seven named informants participated in the study, including eighteen who consented to semi-structured interviews. Demographically, five percent of these informants were First Nations members. Nearly one-quarter (23%) were females, who filled positions in trades, equipment operation, engineering, and management, among others. Although I made no effort to record informants' origins, the subject arose in conversation. Canadians hailed from nearly every province, but with the majority from Alberta, British Columbia, the Maritimes, and Newfoundland. At least one was a foreign national.

2.3 Position as a Researcher

The subjectivity of the researcher shapes the process of understanding across multiple dimensions (Dixon and Jones III 1998). I am an American Midwesterner of Ashkenazi, Bavarian, and Scandinavian descent. A full beard and pattern baldness mark me as male. I am raised "white," yet as a young adult begin to learn others distinguish my olive skin and brown eyes. In Fort McMurray my appearance is distinctive from ruddier Newfoundlanders and Anglo Canadians. I am uncertain how these dynamics shaped my fieldwork encounters. What seems most important to my informants is that I present as a "college boy," whose life experience and archival research make me familiar with the concerns and lexicons of the oilsands firms' engineers and managers.

Numerous interactions in Alberta are deeply shaded by what I characterize as a siege mentality common among people who identify with the oilsands companies and government alike. I experience this first in 2010, stopping into the then-Heavy Oil

Museum in Lloydminster, Canada, where in response to disclosing I am in transit to Fort Mac to study the oilsands industry, the docent blurts defensibly out of the blue, 'They didn't tell the other side of the story about those ducks,' which I later learn refers to the 1,601 misfortunate ducks that perished in an oilsands company tailings pond two years prior – the focus of Chapter 6 below. At the Canada border crossing on my drive to 2011 fieldwork, as the section below details, my car is emptied of its contents by agents acting under federal intelligence directives to intercept anti-oilsands activists arriving from the United States.

I run into more prickliness during my first scouting visit to the public reading room of the chief environmental regulator at that time, Alberta Environment. After a clerk summarizes the types of documents available, I ask to review files containing "incidence reports" which seem like an obvious place to begin to understand production and its variances. I am provided with several boxes containing just a portion of what becomes clear are blizzards of filings. My request also prompts the appearance of a senior regulator who has been alerted to my presence. The subsequent opportunity interview (B. Reg) proves to be the greater prize. The agency is on edge about researchers, Buddy explains, as scholars recently had been pressing demands for comprehensive access. Only two years later did I appreciate that my foray had occurred in the midst of the research of Timoney and Lee (2013), an ambitious study that catalogs a 17-year record of the industry's incident reports submitted to Alberta Environment at a rate well over 500 annually (detailed in Chapter 5). In a notable exception to the challenge of snowball sampling – discussed below – B. Reg opens doors to B. Reg2 and B. Reg3, who with B. Reg allow me peer into perspectives of provincial environmental officials who work within the compliance division of Alberta Environment.

2.4 Border Crossing into Canada in 2011

Driving from Kentucky to Fort McMurray for my first full summer of fieldwork, I reach the border crossing at Portal, North Dakota/North Portal, Saskatchewan, around 3:15 pm Thursday, 16 June 2011, where on the Canada side I pull up and stop at the guardhouse protruding from the single-story office wall, much like a drive-up bank teller window. Through my rolled-down window I hand over my US passport, confident I will be passed through straightaway as there are no visa requirements between the US and Canada.

‘Hello,’ says a uniformed officer from the booth.

‘Good afternoon.’

‘What brings you to Canada?’

‘I’m driving up to Fort Mac where I’m spending the summer doing research for my PhD.’

‘I see. Where are you from?’

‘Kentucky, the University of Kentucky.’

‘Your car says Minnesota.’

‘I grew up in Minnesota. Dad loaned me his car for the trip.’

‘Got it. Okay.’

I am instructed to park and go to the immigration desk inside. There, I tell the officer that I should be familiar to their agency as I traveled through the same port of entry the previous summer in July for my preliminary fieldwork. It is apparent they have little interest in this background. Inside a private interview booth, I am told the yellow record indicates I never was in Canada.

After an hour or so of waiting, the agent informs me that they and another agent will search my car and I overhear this Agent #1 relate to Agent #2 that my face flushes when I hear their plan. (I recall a flash of annoyance at being delayed from my goal of finding food, a motel, and ATM with Canadian currency.) I am directed to drive my car to Garage 8 and pull in. It is big enough to hold a bus and they roll down the door after I pull in. The floor is clean polished concrete, appearing unstained by oil and fluids. At the side, there are enough large round tables and folding chairs to accommodate a bus full of passengers, but in my case I sit alone. My parked car sits approximately 30 feet away, all doors and the trunk open with two gloved agents beginning to look through it. They speak with their backs to me and although I try to eavesdrop on their conversation, I cannot hear a word they say due to amplified white noise filling the room. At one point Agent #1 apologizes to me for its volume and incessance, explaining that they do not know its origin or how to disable it. I do not share my personal experience with the use of white noise on subjects, gained in a research lab with rhesus macaques. The thought crosses my mind they must have other sensors in this enclosed chamber, filming and more.

The agents empty most of the contents of my car onto long tables where they pick through each box and bag, overlooking few individual objects. For instance, at one point Agent #2 approaches me close enough to converse. In an outstretched forefinger and thumb is a miniature glass jar that had at one time contained a single-serving of jelly for breakfast toast, yet is now filled with white powder. This had been buried deep within a stuff sack in my backpack. Without speaking a word, it is apparent they wish to know the nature of the contents.

'Salt,' I say.

'That's what I thought,' turning on heel to continue the search.

Agent #1 approaches me to explain my guitar has been removed (my banjo, but I offer no correction) and placed carefully on the table, but without opening it because they recognize that people are 'sensitive' about their instruments. After a while, they motion me to join them beside my car, which was three-fourths unpacked.

'You have a lot of organic food,' says Agent #1.

'I told you I'm living in the Keyano College dorms and you have to supply your own kitchen,' which also explains my pots and pans. Later, I snicker to myself when I notice a crumpled empty bag of Old Dutch potato chips on the passenger side floor – some health food nut!

It is the turn of Agent #2, 'What's with the camping gear?'

'I'm going to be in Canada all summer and I like to be prepared. I might meet a friend in the Rockies my last week up here, so want to be ready.'

Similar to the salt, one of the agents pulls from a milk crate in the trunk an unmarked glass jar filled with brown liquid. I explain it is tamari. In neither case do they unscrew the jar lids. Agent #2 reaches into a milk crate in the back seat and pulls out a ream of paper typed double spaced on one side. It is scrap paper to use with a printer in the trunk. Producing it with a one-handed flourish like a magician pulling a rabbit from a hat, the agent asks:

'Is this your *dissertation*?' The word is drawn out as if to mean the more menacing *manifesto*.

Even if it were, how could that possibly be incriminating, I think. 'No, it's just scrap paper for printing. I told you, I haven't even done my field research yet.' To be fair, the scrap paper is an extra copy of the dissertation of a colleague, whom I had assisted in the final administrative steps of formal submission.

In the end, the two agents require little deliberation to reach a decision. Agent #1 tells me I am free to repack my car, the second agent will assist, and then I must return to the immigration counter inside. After Agent #1 leaves, Agent #2 confides that I meet a lot of the criteria they are looking for: traveling alone, a car full of stuff, and peculiarity in the mismatch between state tags and driver license.

I tell the agent, 'My beard, I suppose. I've always worn one.'

'There's that too.'

As it happens, I am told I am crossing the border during a period of high alert: 'Intelligence' warns of protesters bent on crossing the border for a "political summer" in the tar sands. Having shared this clarifying background, the agent feels the need to distinguish personal and official attitude, stressing the legitimacy of 'peaceful' protest and condemning violence, the latter of which it is implied, environmental activists threaten.

Later, I view myself as the perfect plant from the head office in Ottawa to test its systems in the field, replete with all the trappings. Funny that neither agent asks about my crate of books in the backseat – set there to keep the weight low between the car's wheels – with Marx's *Capital* prominently displayed on top.

Back inside the office after more waiting, I receive an elaborate folded visa stapled into my passport. Two and a half hours after arriving, I am allowed to enter Canada. (In the end I am glad Agent #1 gives me until August 15, which is after my original departure plan yet lets me fit in one last interview in Calgary before I return to the States.) This deadline stands in stark contrast with the typical restrictions on visiting Americans, who are allowed to enter Canada without a visa and stay for up to six months.

Agent #1 informs me there will be no record of our episode together; however, in 2012 the Canadian border agent (at a Montana crossing) lets me know they do have me in their records, which combined with my Canadian Studies grant, facilitates my entry and obviates any need for a visa.

A few years later, activists obtain and publicize a January 2014 Critical Infrastructure Intelligence Assessment of the Royal Canadian Mounted Police titled “Criminal Threats to the Canadian Petroleum Industry.” Spurred by then recent anti-shale gas demonstrations in New Brunswick province, which see numerous police vehicles set ablaze, the investigation devotes substantial attention to oilsands activists such as Bill McKibben, Greenpeace, and the Tar Sands Solutions Network, which it deems part of ‘…a growing, highly organized and well-financed, anti-Canadian petroleum movement, that consists of peaceful activists, militants and violent extremists, who are opposed to society’s reliance on fossil fuels,’ from whose ranks the most violent ‘pose a realistic criminal threat to Canada’s petroleum industry, its workers and assets, and to first responders.’ Notably buried within these inflammatory paragraphs, the assessment concedes: ‘Criminal actions mounted by environmental activists are often planned and executed with the intention of NOT inflicting casualties. Activists are focused on delivering a message, while not inflicting physical harm to living entities, or the natural environment’ (original emphasis).

2.5 Rolling Ball Gathers Little Snow

Whereas snowball sampling is a well-established approach to acquiring interview data in human geography (e.g., Parker et al. 2019), this proves challenging when the subject of interest is the oilsands industry in Fort McMurray. During my first day of 2011 fieldwork, B. Circle cautions, ‘Fort McMurray is a culture of silence in which to speak is to risk one’s job.’ I took little note of this insight at the time as my 2010 fieldwork had already established several snowball sample “seeds” Fieldwork in Fort Mac during 2011 begins with surprising revelations of the prospective difficulty of obtaining interview data when the I have known since 2010 are hesitant to speak with me on record without their boss’s advance approval. These are people who gave me tours of operations, candidly shared insights into the daily tradeoffs they make, and whose initial openness helped to establish my fieldwork strategy – even let me stay in their home for several days and introduced me to several friends in the oilsands industry. Nevertheless, the specter of a formal interview threatens them. Although these informants finally agree to unconditional semi-structured interviews, and their introductions lead to one additional semi-structured and one opportunity interview, the experience portends the challenges I face over the next two seasons of fieldwork.

Numerous additional examples illustrate this challenge of interviewing in the oilsands as even those semi-structured interviews I do manage to arrange lead to little or no snowballing. Manager B. Miner is surprised to be unable to convince their firm's tailings manager to speak with me. Buddy Sharp at first expresses certainty that they can recruit multiple informants, including their supervisor, to speak with me. However, after weeks of my gentle cajoling for updates, B. Sharp finally concedes that none would participate. Semi-structured interviewee Buddy Doggy asks their housemate to contribute to my project, but they decline, explaining, 'I have a mortgage to worry about.' Three additional close friends of B. Doggy also decline. Among key informants, I focus specifically on the industry in ten hours of interactions with B. Cousin, who declines to be recorded. Another potential source, an acquaintance of one of my key informants, contacts me to offer to be interviewed, however after my repeated attempts to schedule a time, declines to meet and talk. Key informant B. Rabbit encourages three close colleagues to provide me with interviews, but they turn me down, 'in good humor, but reverential fear' of their company in B. Rabbit's words.

Despite these experiences with colleagues, B. Rabbit initially scoffs at the notion that I and a second PhD candidate, whose fieldwork in Fort Mac overlaps with mine, face difficulty in securing interview subjects, until a week later when Buddy says 'you were right.' A memorandum has been emailed across their firm warning against infiltration by persons interested in operations and a warning not to disclose proprietary information. Secrets kept at the firm level are not about the processes, but rather about what they're doing wrong, charges B. Boom: 'If it wasn't so important, they wouldn't have so much security,' before adding, 'You're pretty brave,' referring to my choice of research subject. In further confirmation of the challenge, a third PhD candidate reaches out in support of my effort; in two years of fieldwork, they had found continuing difficulty in securing interviews.

2.6 Refining Approaches to Opportunity Interviews

The research plan always calls for participant observation, a method that gains urgency in light of the challenge of snowball sampling. My sensitivity to the concerns of potential informants is a learned approach. Overeager in the first couple weeks of 2011 fieldwork to convert a casual contact into a recorded semi-structured interview, at the community swimming pool I very publicly hand my business card to a prospect who is visibly shaken, glancing over each shoulder to be sure this unwanted exchange is unwitnessed. I also learn quickly, if you tell an oilsands worker you are interested in the relations of workers with the environment, a frequent terse response is: “Fuck Greenpeace!” The challenge of connecting with oilsands workers has been noted by other researchers: ‘Street interviews were particularly difficult in Alberta…’ as prospective informants, ‘would rather keep quiet in order to avoid the negative reactions from employers, colleagues, or offended family members’ (Davidsen 2016, 255).

With these harsh lessons learned, I refine an approach to the point where numerous prospective informants express curiosity rather than reticence. My earliest participant observation with sustained success occurs in the Syncrude Aquatic Centre within the Suncor Community Leisure Centre in Fort McMurray, funded by the two oldest and most venerable oilsands mining firms. Following my daily swim I retreat into the large coed sauna on the pool deck, which easily holds twenty users. It is warm enough to enjoy and yet cool enough to enable extended sessions, which provide numerous opportunities for relaxed interactions. Men and women both readily discuss their work, as well as more personal affairs. This daily swimming routine – several hours sometime between early and late afternoon – crosses paths with other regular patrons, whom once befriended, sustain casual conversations over multiple days, say during a week off before going back to three weeks on. The compilation of informants in Appendix IV names three B. Sauna, B. Sauna2, and B. Sauna3; to be clear however, additional named opportunity interview informants result from this time in the sauna. I seek to duplicate this approach in various settings, but mostly in other parts of the Community Centre, restaurant/bars, community events, and private social gatherings.

The following dialog suggests how seemingly mundane interactions can disarm otherwise potentially defensive informants. It is taken verbatim from field notes recorded shortly following the interaction. This sort of approach was so second nature during fieldwork that – only in retrospect – is it clear to me how unlikely this scene must appear to readers:

‘They’re slightly better over here,’ I say. I'm in the male-designated showers inside the locker room adjacent to the pool where, above I described, I swim daily. My remark is directed to an obvious newcomer, who is struggling with the weak nozzles, which spray water in such a dispersed pattern it is difficult to fully rinse. Thanking me, the stranger takes my advice. (We stand in our swimming suits; the modest decorum of the locker room offers private changing stalls.)

Sensing an opportunity to develop an informant, I continue, ‘What a waste of water.’

‘I'll show you a real waste of water,’ he replies.

‘Oh, yeah? Where's that?’

‘Coker drill.’

‘Ah, you mean at Suncor?’ I confirm.

‘Yes.’

The informant later designated B. Shower continues: Suncor deploys a high-pressure water drill to chip away the hardened carbon-dense bottoms, “coke,” that accumulate inside its refining vessels, known as “delayed cokers.” In the case of Suncor, coke is the waste product from the batch process of super-heating extracted bitumen in order to produce lighter oils and vapors for further "secondary upgrading" into synthetic crude oil. I know that already, but this newest informant floods me with details: the coker drill consumes 800 gallons of water per minute; the discarded coke is so hot and volatile it outgases for a week; the coke dump dimensions are immense – 90 meters high by 1,500 meters wide by 5,000 meters long. Envision a 20-story building, 1 mile wide and 3 miles long. As a result of this interaction, I am able to fit one more piece into the big puzzle.

2.7 Fort McMurray's Laborer-Consumers

Fort McMurray is Canada's highest-income community during the study period, with median household earnings of $228,000 in 2012.[7] Consumerism was a matter of culture and had been for a long time. One key informant (B. Chicken) labored for years driving haul trucks and machinery in the mines and recalls for a period of time keeping track of the conversations around, which with few exceptions consisted of 'I just bought, I'm going to buy, or I'm going to order.' Buddy Bang who has left the industry, says oilsands workers are driven by 'keeping up with the Joneses.' Buddy Dream, a young unskilled laborer, who was in the 4 off days phase of a cycle that begins with 24 days of 12 hours each, bluntly shares aspirations: 'A year from now I'll be driving a huge F350, and people will be saying "that's too big, what a cunt," and I'll be fuck you, it's what I want.' A financial counselor describes acquisitive couples unable to stay afloat on annual incomes exceeding one-half million dollars. To be sure, costs are high. An unremarkable five-bedroom suburban home was just under $1 million. Mortgage payments often rely on extra rent income from itinerant workers boarding in basements. Tight labor in 2011 left the 24-hour McDonalds able to serve only coffee on a Saturday night; new lifeguards at the community center made $21/hour plus a $275/week housing allowance. I obtain opportunity interviews with several female haul truck drivers, at least one divorced, who are financially stable for the first time. Common discussions recorded in my field notes concern purchases or upgrades of gasoline-powered "toys," while for many Las Vegas and Disney vacations are annual affairs.

The prosperity of oilsands workers, coupled with relentless work hours, spurs a vibrant services sector. One successful entrepreneur runs a brokerage placing Filipina housekeepers and nannies. A First Nations investment company prefers the financial returns on Fort McMurray industrial and consumer services over direct participation in oilsands resource production. First Nations member/informant B. Pickup expresses one view: 'I used to be angry. Now I'm worth three million. Not many people can say that.' Advice from an immigrant father to his son encouraging entrepreneurial spirit –

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[7] http://regionaldashboard.alberta.ca/region/wood-buffalo/median-family-income/#/?from=2009&to=2013

overheard in the community coed sauna: 'Albertans don't do anything for themselves, mow their lawns, clean their carpets.'

2.8 This Community has been Good to Us

Loyalty to the industry clearly contributes to workers' hesitancy to discuss their activities and their firms. The words of an early informant capture what I learn is a widely-shared sentiment, 'Fort McMurray has given our family so many opportunities we wouldn't have had.' As one person explains, the pay is extraordinary and due to the lack of competition for jobs the companies willingly retain mediocre performers and allow for substantial on-the-job training. Projects are huge, so it is not unusual to be asked whether you're planning to stay, because if so, "I have a three to five-year task for you." Typical sentiments include a mix of elements, such as: "There are no other jobs in Canada"; "We had to do something and thank goodness for this place"; "We moved here from _____" (Frequently, this is the maritime provinces, but includes most of the country, not to mention foreign workers.); "We only intended to stay here for _____" (Whether the plan was six months or two years, it typically turns out to be a decade or more.); "Our kids would not have had these opportunities had we not moved here".

Notably, similarly positive attitudes prevail across Alberta with respect to the oilsands. During fieldwork, four-of-five Albertans surveyed (and two-thirds of Canadians) believe that the oilsands can expand production without sacrificing environmental protection (Ipsos 2012).

2.9 Local Malcontents

A few discontented voices disrupt the general unanimity. A local chatroom[8] thread titled "Get out" is locked by moderators. The subject is moving away from Fort McMurray started by someone who had just left, which raised the hackles of local boosters. The new (unidentified) place had a weekly farmers' market, bicycle paths, and status conscious drivers in BMWs and Audis with normal exhausts who drove civilly, not F250 and F350 trucks. Fort McMurray in this view was a "shithole" and "blue collar Shangri la" that offers no amenities other than the nice new pool, limited shopping, bad traffic, extraordinary murder rate per capita, expensive housing, geographic isolation, a city

[8] www.mymcmurray.com no longer hosts chatrooms, summary compiled from 2011 field notes

with all the problems of a place much bigger combined with all the limitations of a place much smaller. Boosters pointed to nice weather (better than Edmonton) and a place made enjoyable because ‘we make $300,000 per year,’ our friends are here, and it helps us buy property elsewhere. This thread quickly escalated into personal invective. Complainers were effectively told good riddance, while the defenders were called stupid and worse for denying the reality around them. Another person had recently moved to British Columbia. One critic was asked why they still bother posting after moving away, and it turned out attachments remained as they continued to fly-in for seven and fly-out for seven.

2.10 Final Analysis: Key to Success

In the final analysis, the dissertation’s empirical data derives from archives, fifty-seven designated informants in semi-structured and opportunity interviews, and scores more interactions with oilsands workers and the wider community. Successful acquisition of informants results in no small part from an empathetic stance that keeps in mind informants’ structural positionalities as oilsands wage workers. Community activist Harsha Walia offers a similar, less common, perspective on oilsands workers:

> Many within the mainstream environmental movement simply portray workers as “apathetic” or “greedy,” happy to make money off the destruction their work involves them in, in the tar sands and elsewhere. At the same time, many environmentalists pay little attention to the fact that it is CEOs and other executives, who do not work in the most toxic sites in operations. The failure to understand the intersection of the state, colonialism, labour, capital, and impoverishment contributes to a massive gap in concrete data about the toxic conditions these workers face, and further perpetuates structural divisions between movements and communities. (Walia 2014, 87; see also, Haluza-DeLay and Carter 2016)

Tradespersons, equipment operators, and field technicians in particular navigate the pitfalls and rewards of high wage labor in the oilsands, as B. Curling puts it, between exhausting dangerous jobs, fast food, beer, smokes, and disrupted sleep on the one hand, while on the other, the vehicles and “toys,” second homes, Disney and golf vacations, sporting events, family visits, and opportunities for their children that loyalty to the company lets them buy.

CHAPTER 3. PLACING THE OILSANDS IN THE CANADA RESOURCE ECONOMY

> They took our furs and fish. We missed out on the gold, timber, and uranium. We're not going to miss out on the oil. (2012 fieldnotes summarize an oilsands region chief interviewed on television)

3.1 Resource Colonialism of Fur, Fish, Gold, Timber, and Oil

Harold Innis (1962 [1930]) famously explains that contemporary Canada reflects historical westward colonial settlement revolving around the production of staple commodities of fish, fur, agriculture, timber, and mineral extraction (see also Barnes 1999). The fur trade is well-established in northwest Canada by the mid-eighteenth century followed by nineteenth century settler agriculture across the southern prairies, encouraged in part by the federal government to bolster colonial claims against American encroachment. Outside of its role in the fur trade, the oilsands region of the future-Alberta garners little official interest. As such, aboriginal inhabitants of this region remained outside of the regime of treaties under sway to the south and east.

Then in the late nineteenth century, two particular contingencies force change. Small pox epidemics and the abuses of prospectors in transit to the Klondike gold fields push aboriginal inhabitants of the region into the 1899 Treaty 8, an accord catalyzed by trusted missionaries and to which the state failed to ever fulfill its full obligations (Fumoleau 2004). Notably by this time, as detailed below, the region is known for signs of vast oil resources with several exploratory wells underway.

3.2 Industrial Fuel: Canada's Coal Bust Widens Search for Mineral Fuel

Provision of coal and iron for steelmaking was the *sine qua non* of liberal industrial development in the mid-nineteenth century. British Canada[9] trailed the United States and Europe in developing these strategic resources, and to redress these shortcomings, Parliament authorizes the Geological Survey of Canada ("GSC") in 1842. Already in the 1830s New Brunswick and northern US states Massachusetts, New Jersey, New York, and Pennsylvania among others begin geological surveys, always with the discovery of coal first in mind (Lucier 2008). The US Geological Survey is established in 1879.

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[9] Lower Canada (southern Quebec) and Upper Canada (southern Ontario) united in 1840. New Brunswick and Nova Scotia confederated with Canada under the British North America Act 1867. Rupert's Land, the vast interior north and west was a 17th century crown grant to the Hudson's Bay Company until 1870 when reassigned to the new Dominion of Canada (all imposed over myriad Indigenous claims).

The GSC founding director, physician-turned-geologist William Logan, advances imperial British interest in resource exploitation through scientific classification and territorialization of resources. In so doing, it also maps a fabric of utilitarian nationalist space (Braun 2000, Burr 2006, Zeller 2009). The preoccupation with coal leaves Logan with little initial interest in petroleum. In the Gaspé region of Canada during the 1843 survey for instance, he emphasizes the clear stratigraphy of the local thin oily shale certainly is not Carboniferous coal. A 'petroleum spring' in that region thus raised only desultory interest, without regard to its potential as fusible hydrocarbon (Harrington 1883, 159-60).

Logan is an acolyte of his famous contemporary, Charles Lyell, whose geology of ancient eons he validates persuasively in the description of Canada's pre-Cambrian Laurentian formation, which beginning with the Gaspé region, maps out over the first decade of the GSC. The scientific achievement garners accolades at the 1851 London and 1855 Paris world expositions which leads to knighthood in 1856. Back home, however, this same discovery disappoints as it declares Upper and Lower Canada largely devoid of coal. In quirky misfortune, North American subsurface geology largely corresponds with the (not fully settled) political border, Logan explains; bountiful eastern American coal, if it extends into subsurface Canada, sinks beyond reach.

Logan the messenger endures public and political opprobrium, and in response – an act of institutional self-justification – the GSC broadens surveys for alternative fossil resources and alternative economic minerals. The period 1863-84, for instance, dedicates efforts to coal and petroleum, and also lignite, peat, and shale (Dowling 1900). Geologist Robert Bell of the Survey is particularly keen on the potential of petroleum as an industrial substitute for coal (Zeller 2009).

3.3 Oil in Upper Canada: Boom Fades Quickly

The hunt for oil finally bears fruit in Upper Canada. American chemist Thomas Sterry Hunt had studied under Benjamin Silliman Jr., whom he served as Yale laboratory assistant prior to joining the GSC a few years later in 1847. Hunt's GSC report of 1849-50 contains a study of the Enniskillen petroleum in southwest Ontario. Hunt declares the material described as 'asphaltum or mineral pitch' or 'mineral caoutchouc" suitable as pavement, waterproof, or gasified illuminant (Burr 2006, 62). A follow-up GSC investigation by Alexander Murray in 1850 likely spurs speculators into first attempts to extract the Enniskillen petroleum (Burr 2006, 64; although, Gray 1970 contends first practical efforts at Enniskillen begin in the 1840s). Hunt goes on to serve as a juror in the 1855 *Exposition Universelle* in Paris, from which he dispatches: "The distillation of bituminous shales and mineral bitumens is carried on to a great extent both in England and on the continent" (Hunt 1857, 428). Upon reconsideration of the Enniskillen petroleum, it was better suited for illuminant and lubricant than pavement he decided.

The 1859 Pennsylvania oil rush etches the name "Colonel" Edwin Drake into the historical canon, and eclipses into obscurity Canadian James Miller Williams, who advocates assert is the rightful "father of the North American oil industry." Indeed, a year prior to Drake in August 1858, Williams strikes petroleum in a cribbed excavation about fifty feet deep in the "gum beds" of Enniskillen, Ontario; moreover, Williams already operates a fully-integrated illuminant firm (production, refinery, and sales) about the time of Drake's strike (Gray 1970).

Without adjudicating Williams' claims to fame, the larger point is that by 1861 an "oil mania" grips southwest Ontario, Canada, contemporaneous with the Drake-inspired rush of Pennsylvania (Burr 2006, 66). The J.M. Williams Company likely engages Abraham Gesner to design its refinery relocated to Hamilton in the late 1850s (Burr 2006, Gray 1970, also Lucier 2008 on the broader trend of petroleum consultancy). Although the plant produced at high capacity, lingering sulfurous odor left Williams' Enniskillen illuminant severely disadvantaged against products of Downer and other American firms. Given this defect, the Enniskillen oil production industry grew in the early 1860s, but stagnated compared with Pennsylvania (Burr 2006, 51). Then precipitously in 1863, well pressures failed and flows stopped. Shortly thereafter panic ensued. Nevertheless, exploration soon renewed in Upper Canada at the tail-end of the US Civil War with an injection of American capital and technology. However just as quickly, this Yankee influx retreated after US-based Fenian Raids made Americans *persona non grata* (Taylor 2010). By 1866 the first Enniskillen rush had ended for good

(Burr 2006). George Gesner (1865) took little note of Canadian petroleum beyond its sulfurous disadvantage. 'The petroleum wells of the United States claim from their number and productiveness at the present time'" he wrote, "the chief place in a work devoted to the history and chemical treatment of petroleum and coal oils" (16).

Recalling the geological fates of Canada's paltry reserves of eastern coal compared to the resource bounty of American Appalachia, much the same occurred with petroleum. Production by US firms mushroomed, first in Pennsylvania and quickly Ohio, Indiana, and California, and then on to the giant fields of Oklahoma and Texas which fueled the opening half of the American century. Results in Canada stayed dim by contrast. Despite tantalizing geological evidence — including in the Alberta oilsands— western Canada remained parsimonious until "a century too late" at Le Duc, Alberta in 1947. This crucial "barren" period in Canadian oil development provided an overwhelming advantage to American and Anglo-Dutch petro-capital accumulation (Gray 1970, 280). In 1898 Rockefeller's Standard acquired Imperial Oil, itself the largest wrap-up of Canada's refining industry, while each of Gulf, Texaco, and Royal Dutch Shell gobbled up last scraps of homegrown Canadian integrated oil companies, which were comparable in size to other subsidiaries of their transnational buyers. Not until the twin oil shocks of 1973-74 and 1978-79 did US policymakers begin to reconsider the potential of the western hemisphere to produce a strategically sufficient volume of oil (Randall 2005).

3.4 Alberta's Oilsands Becomes a Resource

> Alberta's dominant ideological outlook is characterized by an upbeat emphasis on change and the future, a pronounced tendency toward intervention in the economy, expanding bureaucracy and budgets, and a fixed belief in the absolute necessity for industrialization. (Pratt 1976, 98)

Cajoled and willed for a century into relevance, the oilsands substantiate Erich Zimmermann's (1951) emphasis on the social fabrication of natural resources. Besides the remote harsh climate, the oilsands are neither liquid crude nor tractable and one-sixth as munificent as solid asphaltenes and cannel coals distilled in the nineteenth century into "coal oil" illuminant. Rather, this materialization of petroleum retains indomitability both in the ground and in the industrial plant, as well as in the waste produced by its commoditization. The oilsands industry's geological survey, extraction, refinery, and markets recapitulate earlier petroleum pioneering in the US and Canada to some degree – yet at a crawl. Nearly a century elapses between the earliest geological survey of the oilsands and the launch of the first industrial plant to survive in commercial markets. Still then, prior to the new millennium the industry remains obscure in narratives of global petroleum.[10]

3.4.1 Geological Survey of Canada: Quantifying the oilsands resource

The GSC territorial mandate expands in 1870 when the newly-unified Dominion of Canada (1867) gains jurisdiction over 2.5 million square miles of the continental interior deeded since the seventeenth century to the Hudson's Bay Company. Echoing its historical flurry in the Enniskillen region, the GSC launches a series of surveys of the Alberta oilsands (Chastko 2004, Ferguson 1986, Gray 1970, Hunt 2012).

John Macoun (1875) begins the campaign with a sweeping sojourn of the interior continent. His description of 'oozing… oil shales' and 'tar sands' in the Alberta region (Ferguson 1986, 14), which repeats the mischaracterization of *flowing* oilsands left by late-eighteenth century Alexander Mackenzie, who records 'bituminous fountains' in the vicinity of today's Suncor Energy plant (Lamb 1970, 129). Macoun's optimism inspires a GSC survey aimed specifically at the oilsands, mounted in 1882 by agency stalwart Robert Bell. Supplementing Macoun's description, Bell widens the lexicon ('asphaltic sands,' 'sandy pitch'), and describes the Alberta oilsands geological formation – accurately in some aspects – as a massive deposit of non-liquid petroleum. Fatefully and erroneously, however, like his predecessors Bell concludes also that an extant resource lay in vast subsurface pools of liquid crude. Robert McConnell of the GSC follows in 1890 to survey the full extent of the resource he knew as 'tar sands,' which becomes standard nomenclature. Based on his recommendation three costly deep wells are bored 1894-98. These produce copious gas and evidence of thick 'tar sands' layers, but no trace of liquid petroleum, which troubles the Bell hypothesis. Interest in further

[10] E.g., unremarked in Yergin (1991)

exploration wanes by the end of the nineteenth century. Alberta and the federal government enter a period of indifference at best, or, obstructive at worst towards oilsands development. For instance, federal government agents appear solicitous toward promoters of the resurgent liquid petroleum industry of the old Enniskillen region who lobby to head-off potential competition from the oilsands (Ferguson 1986, Hunt 2012).

Regardless of the political climate, one conclusion of the early GSC surveys is inescapable; the Alberta oilsands is an immense prospect. Despite lack of clear success in the first three GSC test bores, abundant signposts stoke the passions of wildcatters, and this unquenched optimism contributes to Alberta's 1905 confederation (Chastko 2004, Gray 1970). The ensuing development of the oilsands resource rests on a foundation of dispossessed indigenous inhabitants of the mining region codified under Treaty 8, introduced above (Longley 2020).

3.4.2 Federal Mines Branch: State-sponsored research & development of the oilsands

In the lead-up to the Great War, a mandate to bolster petroleum development within the British realm pushes the oilsands back into federal affairs, encouraged further by local boosters (Chastko 2004, Ferguson 1986).[11] Here enters Sidney C. Ells charged by the new Mines Branch in the Canada Department of Mines to assay potential strategies to develop the oilsands resource. The son of longtime GSC member Robert W. Ells,[12] the young mining engineer throws himself into arduous fieldwork in 1913 and establishes several grounding principles still germane in the contemporary industry. For starters, Ells makes clear in his "preliminary" first report (1914) the bituminous sands are no harbinger of subterranean liquid crude, but rather *the* potential raw resource recoverable by surface mining. Just as salient, Ells identifies the challenge of separating bitumen from sand. He reviews chemical and organic solvent extraction yet favors hydrolytic separation, which remains today's primary industrial chemistry. We can understand the proposed bituminous product of this separation process as analogous –

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[11] Petroleum of Trinidad and Canada intrigue Admiral Lord Fisher, father of the oil-fired British navy (Davenport and Cooke 1924)

[12] Surveys include asphaltic strata of New Brunswick including the Albert mineral in 1876-77 (Dowling 1900)

although super-viscous – to the "crude" oil obtained after the first round of cannel coal refining, from which secondary refining derived coal oil kerosene. However, the extra-heavy Alberta bitumen, reasoned Ells, would be best suited as economical asphalt in road construction and surfacing. Notably, Ells (1926) argues against the nomenclature "tar sand" in favor of "asphaltic sand."

Ells proves a workhorse in rugged Alberta fieldwork. In the course of eight weeks' summer research in 1913 around Fort McMurray, he surveys 175 miles of riverine bitumen outcrops and recovers upwards of 200 hand-augured cores for laboratory analysis (Ells 1914).[13] This headstrong productivity runs Ells into trouble when in a rush to pilot-test road-paving he paves a section of roadway in Edmonton in 1915 without obtaining official approval. City officials take loud umbrage, which leads to Ells being placed under superiors' close scrutiny. In 1917 he submits sprawling volumes of typed observations and analyses to complete his 1913 field study. These demonstrate breadth and insight as noted; however, an internal scientific review deems them scattershot. Although Ells holds only a bachelor degree, he also studies at the Mellon Institute,[14] the center of petroleum research, where in the eyes of those around him he develops a viable extraction technique for the oilsands. Nevertheless, when Ells returns from overseas duty in World War I, he is limited to field research without access to laboratories. Meanwhile the province of Alberta seizes the initiative in research concerned with oilsands processing (Sheppard 1989).

3.4.3 Alberta Research Council: The province seizes the initiative in oilsands development

Development apostle and president of the University of Alberta, Dr. Henry Marshall Tory, establishes the Scientific and Industrial Research Council of Alberta ("Research Council") in 1919 to accelerate exploitation of provincial resources, not least the Alberta oilsands. Well-advanced in appointing S.C. Ells into a lead role the following year, Tory abruptly shies away based in part on discovery of the former's haphazard method but also in rejection of Ottawa's insistence on continued authority. As an alternative, Tory's

[13] Bluffs of the Alberta River and tributaries up to 300' expose mineable oilsands deposits.
[14] Predecessor of Carnegie Mellon University

first research scientist is road-materials chemist Dr. Karl A. Clark of the federal Mines Branch, who had been one of the two internal reviewers who criticized Ells' 1917 volumes. Ells' indignance at being passed over for the Alberta job lasts his lifetime (Sheppard 1989, 81). This perceived sleight personifies one of many obstacles that undermine federal and provincial cooperation in the oilsands through the Second World War (Chastko 2004, 54).

Similar to S.C. Ells, Karl Clark (e.g., 1921, 1922, 1923, 1924) initially prioritizes research into the use of Alberta bitumen as road-surfacing material. These limited horizons later expand exponentially, however, with popularization of a new refinery technology known as "cracking," which fractures heavy long-chain hydrocarbon feedstock into short chain molecular components of gasoline. By 1926 both Clark and Ells recognize the Alberta oilsands bitumen could be cracked into internal combustion motor fuel, by then the most valuable fraction of petroleum, a hypothesis Clark confirms in refinery test-batches. Nevertheless, however readily refiners *might* crack oilsands bitumen, they remain flush with familiar liquid crude petroleum made cheap by new US oilfields opened in the 1910s and 1920s. Contented in this favorable position, refiners utterly dismiss the prospective Alberta product (Chastko 2004, 17; Ferguson 1986, 46). Facing a problem that recalls the oversupply crisis of Samuel Kier, whose combustible illuminant promises to sell higher volumes compared to patent medicine, Karl Clark begins to understand demand for road asphalt in western Canada is miniscule compared to the magnitude of the Alberta reserve. Despite market rejection, Clark increasingly champions oilsands production for gasoline (1929). By comparison, the federal research and development initiative stays stuck on roadbuilding applications (Ells 1929).

3.4.4 Abasand: Failures show the perils of oilsands commercialization

Territorial motives and counterproductive personal ambitions largely undermine initiatives of Ottawa and Alberta to co-develop the Alberta resource from the 1920s past the Second World War (Chastko 2004, Ferguson 1986, Sheppard 1989). One episode illuminates several dimensions of tension: By 1929 the two governments collaborate sufficiently to operate a small pilot project at Waterways on the Clearwater River just south of Fort McMurray. Ells develops the compact surface mine labored by pickaxe; Clark guides his small bitumen separation plant relocated from Edmonton to prove-out his hot water separation process. The bulk of bitumen production is reserved for federal road construction experiments. During this summer work season, Clark hosts a site visit by intrepid American petro-capitalist and former US official Max Ball, whose backers intend to develop a bitumen venture at nearby Horse River. (Ball also shows-off his pilot separation plant in Denver to Ells.) Ball impresses Clark, who looks forward to selling his Waterways plant or at least sharing its experience as a blueprint. Meanwhile by this time, Ottawa ratifies a nominal quitclaim with the Prairie Provinces, including Alberta. This National Resource Transfer Act (1930) transmits legal title over natural resources within Alberta from Ottawa to Edmonton. The Act's quiet codicil, however, retains federal reserve over 2,000 square miles of oilsands prospects. This loophole comes to light post-ratification when the Ottawa government exercises its prerogative to lease the Horse River site to Ball for his Abasand project, excluding Clark from involvement and raising longstanding provincial rancor as a result.

A mere six months of production at Abasand is the reward for a decade of development and start-up activities; in November 1941 it burns to the ground. Ball's syndicate rebuilds in 1942 but operations stall due to thin capital, after which Ball wanders away. The federal government asserts wartime authority the following year and takes over Abasand with a battery of consultants to gauge its and the wider oilsands' strategic utility. Clark has little involvement, yet as consultant to a prospective management contractor he reviews the rebuilt facility and predicts design limitations (Chastko 2004, 21). Days prior to full-capacity operations commence in 1945, the Abasand plant burns to ruin a second time. Clark writes privately to his client in acid condescension: 'Things went just about as we felt they must from our experience and if they had gone differently, it would have meant that we had gone off the beam badly and did not know much for all our work' (Sheppard 1989, 374). Clark attributes this failure to ineptitude; however, those most embittered by the experience accuse the federal government of sabotaging the oilsands prospect (Chastko 2004, 66, Ferguson 1986).

3.4.5 Bitumount: The province acquires an industrial plant

Although shuttered for a decade in the wake of the Great Depression, Clark's Research Council gains a patron during the quarter-century reign of Premier Ernest C. Manning (1943-68) when provincial expenditures on the oilsands substantially increased. Particularly following the Abasand fiasco, the regime recognizes the need for greater proof of concept to attract the multinational petro-capital it sought. Clark returns to his provincial position. Also, to this end in 1944 prior to the second Abasand fire, the province commits funds to promoter Lloyd Champion of Montreal to restart the mothballed venture at an Athabasca River outcrop named Bitumount by Robert C. Fitzsimmons, who had constructed a bitumen separation plant patented in 1931 and later added a refinery. Thin capital and difficult markets most likely shut down the venture; although Fitzsimmons maintains throughout his remaining years that provincial officials colluding with Champion put him out of business (Freeman 1966).

Fitzsimmons' Bitumount facility is deteriorated beyond repair and requires more capital than Champion budget. Inexplicably in the eyes of Karl Clark, the Champion-Alberta venture outsources fabrication of the new separation plant to an Oklahoma firm with no prior experience in the Alberta oilsands. Progress is slow and, once begun, production is sporadic. Champion fails to raise his portion of the capital, so in 1949 the province seizes full control; and thereby, Karl Clark and team gains their high-profile opportunity.

As Chapter 4 details, rudimentary separation of oilsands bitumen is easily accomplished; it is another matter altogether to achieve commercially viable yields. Clark had separated bitumen back in his Ottawa lab and shortly after joining the Research Council he proclaims, 'there is reason to hope a simple commercial process will soon be perfected' (1922, 12). Indeed in 1923, the Research Council's separation plant produces 85 tons of bitumen to pave 450-feet of roadway on the outskirts of Edmonton. Despite this advancement, residual water and clay in the bitumen bedevil further progress. It will take another full quarter-century before the separation process is ready for the Bitumount opportunity. The enigma arises in the confounding materiality of micron-size clay "fines" in the process, which constitute what we might term a "Goldilocks" phenomenon. Too much clay in the ore mix depresses the quantity of recovered bitumen; however, it turns out also that *too little* clay also inhibits isolation of bitumen from oilsands (Clark and Pasternack 1949, Clark 1950; see also, Sheppard 1989, 171). Chapter 6 narrows in on the problem of clay at the heart of the industry's voluminous tailings waste crisis.

Ottawa retreats from the oilsands following the second Abasand disaster. In these same years and ending a long drought, Alberta discoveries of liquid petroleum at Turner Valley in 1936 and Leduc in 1947 divert provincial attention by the time of Clark's Bitumount initiative. Moreover, these Canadian discoveries pale in comparison to massive new developments in the Middle East and Gulf of Mexico. The global economy will remain awash in petroleum for decades to follow with little interest in a costly non-liquid alternative.

3.4.6 Alberta's oilsands promotional event underwhelms

Yet against these tides of indifference, conflict, and incompetence, a small group within the province continues to strain to encourage exploitation of its oilsands. Sidney M. Blair, onetime research associate of Clark at the Research Council and later a thoroughly-rounded petroleum industry consultant,[15] agrees to study the economic case for mining the oilsands. Given the relative success of Bitumount, Blair (1950) calculates a forty cent per barrel profit on oilsands crude piped to Great Lakes terminals and sold at $3.50 per barrel.

A government-sponsored Athabasca Oil Sands Conference (1951) to promote this "Blair Report" mixes technical participants including Blair and Clark, three Alberta Ministers (Industries and Labour, Highways, and Mines and Minerals) who serve as trustees of the government's promotional Oil Sands Project, as well as senior representatives of Gulf Oil, Imperial Oil, Socony-Vacuum, Hanna Mining, etc. Following several days' discussion of technical developments and provincial policy in Edmonton, the entourage sojourns by rail 150 miles north to Fort McMurray, then by riverboat 50 miles downstream on the Alberta River to tour the Bitumount plant. As doting parents

[15] Universal Oil Products (Chicago), founder of Canadian Bechtel Ltd., which constructed Suncor and Syncrude

are blind to their offspring's shortcomings, one can imagine how this rustic curiosity fails to inflame passions of its industry visitors despite high-hopes of its prideful provincial promoters. With regard to the Blair Report budget, the director of research for Anglo-Iranian Oil[16] dismisses its overoptimistic cost and sales projections (Chastko 2004). As he predicts, the learning curve proves costly for eventual early-movers in the oilsands. Similar to failed promotional efforts of the province in the 1920s, the 1951 conference to publicize the Blair Report spurs little action from petroleum companies.

3.4.7 Geopolitics catalyzes oilsands pilot sites of multinational oil companies

Despite this cool reception, fateful strategic shifts lay the groundwork for oilsands development. In May 1951 the liberal nationalist Muhammad Mossadegh nationalized the Anglo-Iranian Oil Co., and quickly thereafter the 1956 Suez crisis imperiled vital Middle East petroleum shipments. By the end of the decade exploratory core sampling in the oilsands rises dramatically (Ferguson 1986). Unlike anytime previously, large multinational petroleum companies begin to accumulate choice leaseholds in the oilsands. Of 2.6 million acres leased to oilsands developers by 1962, three-fourths are owned by US-based petroleum multinationals plus Anglo-Dutch Shell (Freeman 1966, 69-77). Remaining leases are held, Freeman uncovers, by a veiled network of Manning insiders and industrial heirs. This includes former Minister of Mines and Minerals N.E. Tanner, who had been trustee of the Oil Sands Project and then abandons these to become involved in the acquisition of Bitumount upon the provincial liquidation. Going forward oilsands industrial development is the reserve of petroleum multinationals, while the era of Ball, Fitzsimmons, and Champion recedes. Freeman deems the sale of leases to non-Canadian firms 'the biggest sellout.' In concurrence, factions within the government insist the province should develop its resource for public welfare:

> The tar sands offers a unique opportunity to change the historical trend of ever increasing foreign control of non-renewable resource development in Canada. Here is a reserve of the greatest magnitude which does not require highly speculative investment to find and prove. The world wide demand for petroleum will be so compelling within the

[16] Future British Petroleum

> near future that it should be Alberta's objective to increase Canadian equity participation in the resource developments. (CUC 1972, 16)

This strategic statement of the Department of Environment's Conservation and Utilization Committee advocates for measured growth with high royalties, not the intensive capital investment soon directed towards the industry incentivized by low royalties.

3.4.8 Suncor: Longest continually operating oilsands mine

Three risk-tolerant leaseholders begin to pilot-test surface mining and separation technologies in the late-1950s. Satisfactory results motivate early 1960s applications to Alberta for licenses to develop commercial oilsands mines and processors. First is the just-noted collection of Canadian and plutocratic interests led by a controlling investment from Sun Oil of Philadelphia, owned by politically-conservative J. Howard Pew and family, an independent survivor of Rockefeller's Standard Trust. Proposals also are submitted by both Shell Canada and Cities Service-Athabasca, which includes New Jersey Standard's Canadian subsidiary, Imperial Oil.

Then abruptly, the province contradicts its oilsands promotion. As noted, global oil supply burgeons in the postwar years. In an effort to protect Alberta producers of liquid crude, the Manning administration undermines its own longstanding development policy and caps oilsands production at five percent of total provincial petroleum output. One rationale is economic. In its haste to promote the oilsands, Manning's agencies had slashed royalties by more than half to 30 cents per barrel compared to 68 cents for liquid crude. Overdevelopment of the oilsands would bleed the treasury (Great Plains Research Consultants 1984, 90). Yet, in 1963 Alberta bends this five percent oilsands allotment when it approves the Sun Oil 36,000 barrels per day (b/d)[17] facility. The two deferred applicants, each having proposed 100,000 b/d facilities, were told to prepare to wait *9-15 years* before another oilsands venture was likely to be approved (Great Plains Research Consultants 1984, 91). The single approved licensee launched in 1967 as Great Canadian Oil Sands Ltd. (GCOS; later, Suncor Energy Inc. "Suncor"), suffers start-up troubles across every phase of the enterprise. For years

[17] Amended to 45,000 b/d over howls from the two other bidders

output runs at a fraction of nameplate, akin more to a large pilot than viable industrial facility; yet in 1974, the firm ekes out a milestone with its first quarterly profit, aided largely by high oil prices with the 1973 Arab oil embargo.

3.4.9 Syncrude: Industry's second mine threefold larger than Suncor

The Cities Service group responds to rejection with ambitious laboratory research. Promising results lead to reorganization in 1964 as Syncrude Canada Ltd. ("Syncrude") with accomplished Imperial Oil executives tapped for leadership. In briefs to Premier Manning, Syncrude chief executive Frank Spragins argues that delays in the oilsands give hope to US shale (Bellemare 1990, 18-19). In the wake of the shaky start of the Sun Oil project, the province encourages its two spurned oilsands suitors to resubmit. Shell demurs; however, in 1968 Syncrude proposes to construct an 80,000 b/d facility worth $200 million. Then suddenly again, Alberta proves schizophrenic and postpones Syncrude's approval for at least one year pending developments of the new boom on the Alaska North Slope. Syncrude responds with an 'ultimatum' that insists the firm will liquidate and walk away in the case of any further delay (Bellemare 1990, 26). Subsequently, in 1969 Syncrude gains its approval.

In 1971 the Conservative Peter Lougheed regime (1971-85) commences a Manning-like reign. Building on his predecessor's development initiatives, Premier Lougheed applies renewed provincial urgency to rapidly expand the oilsands industry. At the same time, identifies Larry Pratt (1976), the 1973 Arab embargo resets American oil strategy, led by influential petroleum consultant Walter Levy, whereby a "fortress America" policy reemphasizes North American petroleum resources. With a wary eye toward the competitive threat of US shale, the Lougheed administration retains Levy's services to seize the apparent moment. Measured projections of the day foresee a Syncrude-size plant commissioned every three years; a second oil strategist, arch-conservative Herman Kahn who pushes Levy-like arguments to Ottawa, thinks that too slow (Nikiforuk 2010).

Independent of these unrealistic expansion scenarios, Syncrude retains all the cards on the question of capital construction. Whereas the Alberta oilsands stir singular dreams in its Alberta boosters, to the multinational petroleum companies behind

Syncrude it remains merely *one* play, unchartered with high-ante and risk, albeit with a vast reserve with certain yields. The game plays out with few surprises. Following the abrupt withdrawal of consortium member Atlantic Richfield Co. in 1974, Syncrude calculates millions more dollars are needed to cover rising costs and thirty percent equity shortfall. Gulf Oil Canada joins the mix; however, Shell's lack of interest dashes the last hope of fully-replacing Atlantic Richfield with multinational petro-capital. Chief executives of Syncrude's owners turn to brinksmanship. Despite sunk costs of $250 million, they insist face-to-face with provincial premiers and federal ministers: contribute capital or we will scuttle it all. To continue the playing cards analogy, the governments fold.[18] In the Winnipeg Agreement (Government of Canada et al. 1975) provincial and federal ministers agree to take a thirty percent equity stake in Syncrude in return for an aggregate $600 million capital injection as follows: Canada (15%), Alberta (10%), and Ontario (5%). Critics at the time heap calumny on Alberta for retaining a too little stake in the growing oilsands mining industry (Pratt 1976). By its 1978 launch as just the second oilsands mine, Syncrude costs $2.3 billion, tenfold more than its original budget, and there is no immunity from expensive start-up bugs as the enterprise struggles to reach its revised 125,000 b/d production limit.

3.4.10 Fort McMurray takes contemporary shape

Although Fort McMurray lies at the confluence of the Athabasca and Clearwater Rivers, the latter which serves as trade route to the East, the settlement remains a minor colonial outpost during the eighteenth and nineteenth centuries. Settler activity picks up at the dawn of the twentieth century as the location hosts one of the Treaty 8 signings and Waterways just to the south serves as a point of steamboat embarkation for speculators in the Klondike gold rush. By 1920 a railroad replaces the oxcart path to Edmonton. Still, the population is little more than 5,000 when the initial influx of workers arrives to construct and operate the first permanent oilsands mine, Suncor, nee Great Canadian Oil Sands; it then reaches approximately 30,000 with the completion of Syncrude in 1978 (Fumoleau 2004, Huberman 2001, Hunt 2011, Innis 1962 [1930]).

[18] Cravenly in the eyes of critic Pratt (1976); shrewdly, according to Alberta Premier Lougheed (1976)

Whereas single industry resource towns across Canada have been replaced by fly-in fly-out operations (Barnes, Hayter, Hay 2001, McDonagh 2010) and several large so-called “man camps” are associated with newer mine developments, Fort McMurray lies within commuting distance of Suncor, Syncrude, and Canadian Natural Resources operations. As a result, Fort McMurray appears to have attained greater permanency as a government, services, and retail center in support of the oilsands mining industry. Although the population of Fort McMurray during the dissertation fieldwork is approximately 65,000, this swells by several tens of thousands more workers who rent rooms in homes for months and even years on end. A substantial subset of this workforce hails from the Maritime provinces where they establish in the words of Major and Winters (2013), a ‘community by necessity’ (see also Ferguson 2011). Although the housing stock replicates the bland suburbs across the US and Canada, which municipal agents promote as a bastion of normalcy (Major 2013), this masks a ‘feral’ topology not far removed from the Klondike prospectors of a century prior (Shields 2012).

3.4.11 The oilsands mining long boom

Through much of the 1980s these two pioneers – Suncor and Syncrude – stabilize operations, and hostile labor relations in the case of Suncor (Boychuk 1996). By the 1990s both reach positions to undertake ambitious expansions of their oilsands mines and refining facilities; in addition, they foster a crucial new round of resource boosterism. Like a latter-day version of the Alberta Oil Sands Conference (1951) and Blair Report (1950), a public-private assemblage known as the National Task Force on Oil Sands Strategies is hardly the first of its kind; this combination of industry and provincial decision-makers issues a report that simplifies the royalty regime and corresponds with an inflection in oilsands economic history (National Task Force 1995). Within a decade of the Task Force publication, aggregate oilsands production doubles to outstrip its authors’ most optimistic aspirations (Nikiforuk 2010, Woynillowicz et al. 2005).

After a century of development initiatives, the region finally enters its first sustained resource boom, which corresponds with soon-rising oil prices and political shifts in stalwart exporters Saudi Arabia and Venezuela. With rare setbacks[19] this expansion continues through the years of primary fieldwork (2010, 2011, 2012). Alberta returns to strategic primacy during this time. Echoing Walter Levy and Herman Kahn of the previous generation, contemporary petroleum authority Daniel Yergin locates Alberta as a crucial resource within the US-sphere, and promotes ramped-up oilsands production to exploit their magnitude, proximity, and political stability (Krauss and Rosenthal 2010). In the wake of the Deepwater Horizon disaster in the Gulf of Mexico the oilsands industry promotes itself as the clean alternative (Kirby 2010), a concept argued at length in *Green Oil* (Das 2009). In a similar register, due to regulatory oversight and high wages argues Levant (2011), oilsands exploitation constitutes exceptionally *Ethical Oil*.

Syncrude doubles capacity with its Aurora Mine opened in 2000. Royal Dutch Shell becomes the industry's third entrant with its Muskeg River Mine in 2002 followed by Jackpine Mine in 2010. Alberta-based independent Canadian Natural Resources begins production from its Horizon Oil Sands Mine in 2009. Aggregate annual production of synthetic crude by the oilsands mining industry increases fifteen percent from 2010 to 2012 to reach over 330 million barrels.[20] Production begins in 2013 at Imperial Oil's Kearl mine and separator. In 2018 Suncor's Fort Hills mine opens at the original Bitumount lease. Once any oilsands mine begins operations, the capital plan is to run to exhaustion, typically forty to fifty years. Syncrude has processed about thirty-nine percent of its eight-billion-barrel reserve; Suncor with Fort Hills included has consumed only thirty-four percent of its 6.7-billion-barrel reserve. Altogether by 2035, oilsands mine production is projected to expand to 1.82 million b/d, a nearly fifty percent increase over 2018 levels (Canadian Association of Petroleum Producers 2019).

3.4.12 Post fieldwork conditions

Fieldwork concludes in 2012 with the oilsands development boom in full swing. Subsequent contingencies pepper the oilsands mining industry. In the period January

[19] 1995-2012 production declined only three years: 2000 (0.8%), 2005 (15% due to Suncor fire), 2008 (1%)

[20] Imperial Oil began steam-generated *in situ* production at Cold Lake in the 1960s; a combination of related steam injection techniques have led to a rapid increase in *in situ* production of bitumen, which first surpassed mining output in 2013 and by 2015 was 17 percent greater.

2014–16 world oil prices plunge seventy percent to less than $30/barrel. The primary cause is the upwelling of US petroleum production as the specter of shale finally materializes (from 5.5 to 9.4 million b/d during 2010–15). In 2015 the US government rejects the Keystone XL pipeline, which the owner abandons in 2021. Epic firestorms in the summer of 2015 obliterate residential neighborhoods and force the rapid evacuation of one hundred thousand residents of Fort McMurray and surrounding communities, which temporarily suspends most of the region's bitumen production. In 2016 Suncor gains controlling ownership (nearly 54 percent) of Syncrude while Imperial retains a 25 percent stake and Sinopec (China) holds nine percent. In late-2016 with oil still less than $50 per barrel, the Canadian dollar exchanges for just 75 cents US.

3.4.13 Oilsands mining expansion ending?

In recent decades, the rapidly-growing industrial technique in the oilsands relies upon steam injection into the geological formation too deep for mining, followed by recovery of the resultant liquefied bitumen via conventional wells. Presenting investors with lower costs of entry and wider geographic opportunity, these Steam Assisted Gravity Drainage (SAGD, "sag-dee") and related *in situ* approaches today account for the majority of the region's aggregate output. Readers should find no surprise that Alberta's provincial government is deeply involved in the research and development of this technology. Although various *in situ* approaches have been developed in the oilsands since the 1950s, the most significant advancement is the establishment of the Alberta Oil Sands Technology and Research Authority (AOSTRA), which with a budget of $144 million funded evenly by public and industry proves out in situ methods in four major field pilots (Spragins 1978). *In situ* production in the oilsands reaches 1.56 million barrels per day in 2018 compared to 1.35 million b/d produced by the oilsands mines (Canadian Association of Petroleum Producers 2019).

An inflection point may have been reached in the oilsands mining industry. Development of an oilsands mine reflects capital logic that plays out in incremental stages until the final "go." Costs have always been high. Recently, this inescapable constant combines with plunging global oil prices and uncertain availability of pipeline capacity – the latter a win for activism. This leads a partnership of Suncor and French oil giant Total to cancel the well-advanced Voyageur project in 2013 and then in 2014 to indefinitely mothball their $11 billion Joslyn mining project (Tait 2014). The next year (2015) Shell Canada withdraws its Pierre River Mine application, which proposes to double the firm's oilsands production. Shell's decision is the harbinger of a sharper pivot as in 2017 the company sells out all of its oilsands operations to Canadian Natural Resources Ltd, another oilsands mine operator. In these same years, Suncor publicizes potential interest in a "leave it in the ground" strategy surprisingly compatible with activist calls for an oilsands moratorium (cf. Homer-Dixon 2015). Most recently in 2020, Teck Resources Ltd. terminates its Frontier project.

Beyond these decisions to withhold capital investment from new oilsands mines, shaky reliability of existing operations – especially upgraders – pressures industry profitability. Most notable during my fieldwork, ExxonMobil, the operating partner of Syncrude at the time, postpones billions of dollars in expansions until at least after 2020 in order to divert capital into upgrader maintenance (Healing 2012). Additional capital challenges arise in financial markets under pressure to reduce involvement in atmospheric carbon-intensive industries. To this end, an expanding raft of insurers, pension funds, and investment houses pledge not to invest in the oilsands industry or new pipelines that service it (Flavelle 2020).

Despite this string of halted projects, Suncor provides possible counterevidence to this apparent trend of decline. In 2016 – around the time, as noted, Suncor publicizes potential interest in a mining moratorium – the firm increases its stake in Syncrude to secure a controlling interest. Two years later in 2018 Suncor commences mining production at its formerly mothballed Fort Hills Oil Sands Project jointly owned with Total, which previously had been put on hold around the same time the Voyageur, Joslyn, and Pierre River projects were shelved. Like Imperial Oil's Kearl plant, and the former Shell mines, Fort Hills implements a strategy of producing diluted bitumen as an end commodity – for refinery markets in the US Midwest and Gulf – thereby eliminating the cost and challenge of running upgraders with all the related material, logistical, and cost challenges.

In the midst of the boomtime underway during my fieldwork, B. Miner predicts precisely this sort of behavior in the event of a prolonged downdraft in global oil markets: '[If prices fall too low] they'll put a padlock on the gate and walk away and come back in five years or ten years when we can make money.' In this light, no one should express surprise if, at some future date, any or all of the Voyageur, Joslyn, and Pierre River mine projects remove their "padlocks" to recommence development.

3.5 Alberta Oilsands Literature

3.5.1 Postcolonial violence and unevenness

Although the dissertation takes a narrow view of the socionatural relations of wage labor production in the oilsands mines, it is important to recognize vibrant postcolonial research aimed at this industry. Reaching back to the end of the nineteenth century, Treaty 8 circumscribes aboriginal inhabitants of the oilsands region under the guise of law, resulting in resource expropriation and environmental defilement that has disenfranchised indigenous people by destroying a political economy dependent upon fish, animals, plants, and water (Longley 2020). Beyond these legalistic machinations, Simpson (2019) pinpoints violence as the necessary condition of the dispossession, enclosure, and continuing colonialism that constitutes the Alberta tar sands as national resource. Fundamentally, these are policies of elimination and assimilation (Ray 2017). Exacerbating the violence of oilsands extraction, neoliberal ideologies of occupation and resource extraction normalize and racialize the legacy of settler colonialism in new formulations of non-white wage labor exploitation (Preston 2017).

Pathways out of this ongoing violence are elusive. Bowness and Hudson (2014), for instance, locate no avenues for meaningful democratic input to industry activity. Notably however, activism – frequently in the face of violent state suppression – has achieved marked successes, particularly in quashing new pipeline construction, which effectively bottlenecks the distribution capacity of the oilsands (e.g., Lukacs 2014, McCreary 2014, Simpson and Le Billon 2021, Stendie and Adkin 2016). These actions are complemented by a range of initiatives by artists and activists to raise awareness (Cardinal 2014, Kane 2021, Leclerc and Weyler 2014). Indigenous resistance to colonial development in the oilsands region reaches back decades, even over a century (e.g., Audette-Longo 2018, Fumoleau 2004, Laboucan-Massimo 2014), which fits the pattern in the Americas of radical aboriginal resistance since first contact (Simpson 2017). Despite these successes however, activism is fragmented among conservationists, climate advocates, and Indigenous-led movements observes Coats (2014), who argues that successful counter-hegemony will emerge most effectively under unified leadership of the latter. In concurrence, numerous commentators observe the potency of Indigenous actions in the Canadian courts where treaty rights have been reaffirmed in recent years, thus, leaving open the possibility of profound legal victories against colonial extraction (e.g., Lameman 2014, Parlee 2016, Thomas-Muller 2014). With a vision beyond court action as an endpoint, Arnold (2018) argues delegitimization of extractive capitalism ultimately depends on emergent indigenous cultural politics that seek to create alternative communities altogether independent of capitalism (see also Wickstrom 2014).

3.5.2 Neoliberal hegemony

Studies of the oilsands mining industry detail outcomes of a hegemonic petro-state, legitimated through industry-friendly oversight and discourses that advance capital interests while they simultaneously hide failed state stewardship (Adkin and Miller 2016, Adkin and Stares 2016, Carter 2014, Fluker 2014, Garvin 2016, Grant 2014, Haluza-DeLay 2014, Longley 2015, Parlee 2016, Urquhart 2018, Weis et al. 2014, Zalik 2016). This critical literature chiefly probes the capacity of activism to leverage discursive campaigns into regulatory reform and larger counterhegemonic shifts. Any one activist action, investigators argue, constitutes a tactical blow in a long *war of position*;[21] for instance, cost burdens imposed on the industry by resistance slow new mines and pipelines (Adkin and Courteau 2016, Stendie and Adkin 2016), or perceptions of hundreds of millions of people worldwide reshape through poetry and aerial photography that highlight the industry's environmental impacts (Davidson and Gismondi 2011, Leclerc and Weyler 2014, Weis et al. 2014).

[21] Gramsci (1971) in Haluza-DeLay and Carter (2016, 458).

These activist objectives fall into two sorts. More modest aims with near-term attainability include imposition of higher resource rents, First Nations access to royalty data, increased First Nations enfranchisement, and improved public consultation (Carter 2016, Mills 2017, Zalik 2012). Others' goals are loftier, yet viewed as crucial to rein in the drivers of climate change; namely, a moratorium on industry expansion as the decisive first step toward post-fossil political economy ((D'Arcy 2014, Davidson and Gismondi 2011, Homer-Dixon et al. 2015, LaDuke 2014); in the postcolonial analysis of Simpson (2019), the oilsands objectify the imperative to 'dismantle the category of resources altogether' (11; see also Vasey 2014).

Among this literature, *Challenging Legitimacy at the Precipice of Energy Calamity* (Davidson and Gismondi 2011) remains notable for its combination of historical reach and engagement with key issues (see also, Chastko 2004, Ferguson 1986, Great Plains Research 1984, Hunt 2012, Longley 2021, 2020, 2016, 2015, Urquhart 2018). At its heart, *Challenging Legitimacy* evaluates how both state and industry deploy discursive tactics to legitimate tar sands exploitation, from nineteenth century roots to the present day, and identifies resultant winners and losers – plus a strategy for progressive activism to alter the historical trajectory. This work addresses one popular misconception. To wit, the historical engine of oilsands industrialization is not petro-capital, but rather the state, specifically Alberta province, which after fifty years of state-sponsored research and development finally enticed global petro-capital into the oilsands. Industry expansion over recent decades, Davidson and Gismondi argue, rests on the power of ideological political discourse to bottle-up dissent and diffuse public concern, thereby, to legitimate state-capital hegemony. As they make their case:

> Attempts to engage in a more inclusive type of decision-making, or at least exercises that give the appearance of inclusivity, have been largely unsuccessful, leaving state and industrial interests at the center of this policy-making community and all others making noise outside the closed doors of boardrooms. (Davidson and Gismondi 2011, 201)

Even so, the authors contend activism can eventually catalyze a post-fossil regime. Alternatives are stark and the stakes immense in this framework. With the oilsands conceived as an emblematic global precipice, Davidson and Gismondi conclude, the choice is either: 1) continue reliance on ever-more disastrous hydrocarbons at climactic peril, or, 2) challenge the fault lines of provincial political legitimacy so effectively as to shutter the tar sands completely and potentially catalyze an epochal transition to global post-fossil society. As implied, the wider body of this oilsands literature remains sanguine towards the potential for both incremental improvements and dramatic shifts in the oilsands.

At the same time, several reluctantly acknowledge status quo entrenchment, and the at best distant prospect of uprooting it. Davidson and Gismondi themselves concede this inertia: 'The human exceptionalism paradigm, which prescribes faith in future economic and technological solutions to ecological travesties committed today,' they bemoan, 'is being contested but by no means replaced' (2011, 210). Despite Alberta's 2013 enactment of the most aggressive environmental monitoring obligations of any Canadian province, these still fall short of ecological significance (Olszynski 2014). There are simply no avenues for meaningful democratic input to industry activity (Bowness and Hudson 2014). In a recent sobering check on progressive ambitions, the first left-leaning Alberta premiership in decades quickly cratered to industry imperatives (Adkin 2016). Consumerism in Alberta dulls the social capacity for transformation (Davidsen 2016), while the tenor of "tar sands" environmentalism fails to connect with Albertans, or even with environmental justice activists (Adkin and Miller 2016, Haluza-DeLay and Carter 2016, Vasey 2014).

CHAPTER 4. HOW IT WORKS ON THE GROUND: CONTINGENCY-RIDDLED COMMODITY PRODUCTION AND ITS HAZARDS

> So many people have told me that I'm not alone, that people who have worked in this industry for thirty years, people who are lifers, still don't really understand how it works… It's just so big. (B. Calgary2)

> The buildings don't make money. The people don't make money. Only the product makes money. (B. Cousin)

Whereas Chapter 3 historicizes the oilsands industry in North American petroleum geography, this Chapter 4 investigates the co-constitutional interplay of materiality and work activities on the ground inside the "black box" of oilsands mining production. The inquiry takes off from the point where an oilsands mining venture has already secured applicable approval and licensure by government ministries and agencies, a regulatory process explained in Chapter 5. See Appendix III for a simplified schematic diagram of this oilsands mining production process.

Any one firm is too sprawling and complex for most insiders to grasp fully: 'Guys who work in a place for thirty years still don't know how it works' (B. Millwright). My methodological approach to overcome this fragmented knowledge relies on weaving together a narrative derived from informants in combination with technical literature, reports, and regulatory filings of companies, the province, and nongovernmental organizations. Continuity of production techniques in the oilsands mines makes historical archives still relevant sources of insight into industry fundamentals, which is confirmed in triangulation with the contemporary archive (e.g., Andrews et al. 1968, Camp 1976, Clark 1929, Dor et al. 1967, Masliyah et al. 2011, Masliyah et al. 2004). As should be expected when taken alone, these written sources sketch a deceptively idealized understanding of material and work flows. Despite these limitations, these descriptions still helpfully contextualize informants' explanations of various points along the production process as its complications play out on the ground in practice. And in turn, informants shed light on the archival descriptions. The result provides some depth of understanding into the contingency-riddled reality of commodity and waste production.

This complexity of oilsands mining operations is exacerbated by material challenges arising in the vast volumes processed, sheer physical extent of the facility, boreal climate extremes, and the qualities of bitumen and surrounding geology – as well as the raft of chemical inputs, variability in production processes akin more to cooking than assembly, and voluminous atmospheric and solid wastes produced in tandem with commodities. Moreover, the solution to any one problem in this process of commodity and waste production typically births a wholly-new challenge previously unknown.

Human error and recklessness is unavoidable under these conditions; however, such behaviors are promoted by long shifts lasting over a week with few rest days between and managers from foremen to executives for whom everything but product is cost. Equipment failure is to be expected under the extreme operating conditions; yet, ramifications of such failure are amplified by cutting corners in maintenance and running machinery beyond design limits. An unexpected aspect of this research, but one now understood as a fundamental facet of informants' descriptions, is that their recollections of the production process are often bound with descriptions of equipment failures, accidents, and unsafe practices often pushed by supervisors.

4.1 Oilsands Mining Production: Sprawling 24/7/365 Process

In the construction, maintenance, and operation of billions of dollars in capital under remote boreal extremes and hazardous working conditions employing thousands, each oilsands mining enterprise materializes Promethean feats of engineering and labor that metabolize raw earth into 1.5 million barrels per day of bitumen and synthetic crude oil, along with clouds, mountains, and seas of by-product wastes. Comprised of three basic phases, oilsands mining production begins with open pit mining to recover raw ore. Then, a warm water flotation plant separates bitumen from pulverized ore; and last this extracted bitumen undergoes refinery 'upgrading' to yield a commodity known widely as 'synthetic crude oil'. To achieve this outcome, oilsands mining enterprises combine two historically unrelated industrial logics, those of surface mining and petroleum refining. Although many techniques involved in oilsands ore recovery and extraction long have drawn from the wider mining industry, oilsands mines are distinguished by their size and ceaseless operation. Recovered raw ore is bulky, so to achieve scale economies any one oilsands mine processes volumes comparable with the world's largest surface mines. Crucially, these mines remain subservient to the relentless appetites of their bitumen upgraders, which like oil refineries more broadly, demand a continuous feed of input material to sustain operations. These upgraders are only shut down for maintenance on multiyear cycles. Unplanned shutdowns lose income and entail lengthy costly "restarts." As a result, though rare in the global mining industry, the oilsands bitumen mines and upgraders operate 24 hours per day 365 days per year. This unremitting drive combines with the extensive reserve of bitumen – mine plans run as long as 50 years (B. Mine) – to make the oilsands the world's largest mine and mine waste complex (Camp 1976, Masliyah et al. 2004).

4.2 Mine Preparation: Everything is Waste Except the Ore

After an oilsands mine has obtained government licensing but before ore recovery operations commence, firms undertake extensive geological core sampling to inform a detailed iteration of the mine plan, which remains under constant refinements of near and long-term horizons, according to B. Miner, a senior mining engineer with 25 years of experience. Next is to "grub and clear" several square miles of endemic tamarack and peat fens known as muskeg that overlie the uppermost surface of the eventual pit (Rooney et al. 2012), and subsequently to sink wells to evacuate the saturated subsurface until water levels have been pushed beneath the projected pit-bottom. Over the next 2-3 years the muskeg desiccates to the point that a truck-and-shovel corps can remove it when it is frozen during winter months (Oliver 1975). Although historical efforts to preserve muskeg were abandoned by some firms, others continue to store muskeg with intentions to utilize it in future mine reclamation (B. Miner). Once a mine has been commissioned, these overburden removal operations continue to advance ahead of the working mine face. After muskeg has been removed work begins to dig away and relocate clay and drift overburden to expose bituminous strata for extraction. As in every step of mine development, the technical challenges are substantial. In one instance the misfortune of one regional mine inadvertently solves the dilemma of another. Syncrude's Aurora mine had long struggled with the challenge of sustaining its hydrological depressurization; the solution comes abruptly when a nearby Shell-operated mine punches through a limestone cap over the same aquifer at the bottom of its mine, which instantaneously depressurizes Aurora and creates an artesian well in the Shell mine (B. Supper, B. Union).

The sheer scope of these preparatory activities prompts one senior mine engineer to measure performance by the flow of material, where everything but ore is 'waste'. In this informant's eyes, all of the boreal forest and peatland, subsurface water, and earthen overburden, plus additional "inter-burden" encountered deeper in the mine collectively constitute waste that demands removal and storage in order to expose bituminous layers:

> The waste is in the way of the ore. Without removing the waste, I don't have the ore exposed to take to the plant for processing. So, it's really simple. The way I look at my job quite simply is I gotta get the waste out of the way. The ore will take care of itself. It's there. But you've gotta move the waste. (B. Miner)

A compounding logistical factor is that material released from the pressure of the geological formation swells volumetrically by twenty percent, and thus, material handling requirements increase by an equal amount.

Notably, the technological capacity to remove and relocate overburden has been a historical bottleneck to industrial production. Although the economically practicable limit of overburden is reported as 250 feet thick actual working oilsands mines penetrate less. The first contemporary mine, Suncor (1967), exploited bituminous sands beneath an average of just over 50 feet of overburden, removed with front-end loaders and 150 ton capacity trucks, following disappointing results with scrapers (Camp 1976). One of the newer oilsands mines, Kearl has begun to recover bituminous ore under an average 70 feet of overburden (Eisner 2008). By comparison, during the earlier pioneering decades, smaller equipment capacities made this same overburden quite imposing, which drove early mining ventures to glean from surface outcroppings exposed by fluvial erosion. Particularly in contemporary oilsands mines, much of this overburden is reused. For instance, clay is recovered for placement in the cores of dikes constructed with overburden to contain the post-production “tailings” sludge detailed in Chapter 6 while gravel is reserved for road construction (Oliver 1975).

Overburden removal aside, before mining can commence the development of an oilsands mine necessitates firms to build out expansive engineered facilities including to procure river water, grade for drainage in anticipation of tailings deposition and dike-building, construct roads, and deploy a work camp (B. Calgary2). When mining finally commences it follows a mine plan that aims to open up mineable benches at several depths to recover raw ore simultaneously from richer deeper geological layers and the shallower less-rich uppermost bituminous layer (B. Miner, B. Chicken). The blending of these ore streams is explained below in the discussion of bitumen separation.

4.2.1 Mining oilsands one 100-ton shovelful at a time

It is difficult not to marvel at the magnitude of a contemporary oilsands mining operation. A twelve-hour shift produces one-half million tons of raw bituminous ore, taken in 100-ton chomps by monster shovels that dwarf the dinosaurs whose fossilized bones they periodically chew up in their relentless feast. I observe tourists of Suncor pose for a photograph before an upright haul truck tire 13-feet in diameter, arm-in-arm with a coverall-clad driver whom they’ve decided is a hero. The largest Caterpillar 797F ore hauling trucks (“Fs”) tip the scales at 400 tons gross and carry their equivalent weight in bitumen ore, 400 tons, which becomes 200 barrels of oil, or US $18,000 at the time of my study. Given the thirty percent profit margin of the two most established mines at that time, every truckful pays $6,000 profit to their bottom lines.

The industry’s two pioneers, Suncor followed by Syncrude, commenced production with two different approaches to large scale earth moving – excavation by bucketwheel and dragline, respectively – which both loaded conveyor belts with bituminous ore for delivery to their extraction plants. However, by the 1990s truck-and-shovel technology had attained the capacity ratings necessary for firms to achieve output goals while controlling marginal cost (cf. Camp 1976), and the two firms migrated operations to that strategy. Suncor completed the switch by 1993, while

Syncrude did not retire its third dragline until 2006. Management engineers continually scrutinize truck-and-shovel operations for potential innovations. Frimpong and Hu (2004), for instance, insist that production optimization initiatives must take into account bucket dynamics, uneven seasonality and materiality, and their variable interactions. The motive force powering shovel buckets appears to contribute to hard-to-manage lumps, with hydraulic buckets more likely than electric-powered rope units to generate such unsatisfactory raw material (Tannant and Cyr 2007). Yet, while shovel-type and bucket teeth configurations factor into productivity, variation between laborers who operate the shovels can range as high as fifty percent (Patnayak et al. 2008). Notably, the newest P&H 4800XPC electric-powered rope shovel features a 135 ton bucket capable of filling 400 ton haul trucks in just three passes, rather than four (JoyGlobal 2013). Truck-and-shovel is no sacred cow, although it remains the standard. Suncor invested millions of dollars to field-test technology to crush and slurry at the mine face and thereby do away with haul trucks; however, it determined capital costs were too high to pursue (Energy Resources Conservation Board [ERCB] 2010). In the latest initiative to cut labor costs, oilsands mining firms are pushing ahead with pilot studies of driverless autonomous haul trucks (Moore 2019).

Oil prices are high during my study; the mines run at full tilt. An associate of B. Doggy routinely becomes so engrossed in their repetitive tasks as a mine shovel operator that they forgot to break during 12-hour shifts. (Incidentally, this prospective informant turns down a direct meeting with me: ‘I have a mortgage to pay,’ was the reason for declining.) Buddy Bucky operates a 120-ton mine shovel and recalls their largest load of 482 tons delivered in four passes of the maxed-out bucket onto a Cat 797F haul truck. By comparison, the stalwart Cat 793, a ‘good truck,’ hauls no more than 240 tons (B. Chicken). Each “F” is networked with oilsands operations and Caterpillar’s headquarters in Peoria, Illinois, to monitor that its usage remains within acceptable limits. According to B. Bucky, the typical load per 797F ranges from 395 to 405 tons, because when overloaded as in their record of 482 tons, haul truck drivers are mandated to dump immediately while the firm is subject to contractual fine. Buddy

Driver, a heavy equipment operator and “F” driver who claims to have carried 505-ton ore loads, explains a workaround to detection, which begins by creeping in first gear away from the mine face to evade the threshold of sensors. Then, ‘when you get to the incline to climb out of the mine, pop the gearbox into second to throw the load toward the back of the bed and fool the onboard scale,’ down to 440 tons in this example. The widespread result of this kind of gamesmanship Buddy reports is an epidemic of blown tires, cracked wheel rims, even cracked frames. However, B. Pool drives an “F” in a newer mine carrying only 360-380 tons of oilsands ore, primarily to reduce the occurrence of throwing loads off the back of the haul truck when it hit unavoidable potholes. ‘When the shovel gives us a 400-ton load,’ ran their dictum, ‘we take pride in delivering it all.’ Despite prohibitions, it was common to overload Fs to 110 percent of rated capacity, and then run them in low gear for short distances (beneath the range of detection) to remove overburden (B. Chicken).

The key informant B. Chicken had been a heavy equipment operator in the industry for decades including a long stint as a haul truck driver – ‘meat in the seat,’ in Buddy’s colorful words. The companies insist contradictorily, they explain, that workers ‘slow down,’ but also, ‘You get that last load at any cost.’ At the same time that safety is an undeniable matter of concern, mining supervisors’ bonuses are peer-competitive based upon shift production tracked in terms of distance-adjusted load counts; and the competition works down to individual haul truck drivers who are compensated based upon safe driving and tonnage dumped in the crusher hopper. B. Chicken elaborates:

> You’re getting incentives to race and you’ve got a bunch of competitive kids, you know? Twenty-two years old driving an eight-million-dollar haul truck…with a full load on it…and smoking the tires off it…you see that all the time. I’m surprised there aren’t more incidents just with reckless driving. I’ve seen people going just crazy on roads, sliding and slipping and bouncing. It’s a wonder that more people haven’t been injured.

There is a practical limit to incident reporting in the mine; haul truck wipeouts, minor dings from shovels, and similar events remain uncounted as ‘incidents’ when they neither impair equipment nor interrupt production. ‘Just back ‘er out and go’ is the standard procedure, according to B. Chicken, both to avoid the administrative hassle of incident-reporting and to maximize production. However, incident-reporting can reflect working cliques and vendettas, so some individuals are singled-out (B. Doggy). More on this system-gaming is detailed below.

In addition to the demands of continuous operation, each step of the process is fraught within interplays of climatic and geochemical materiality, technology, and worker's labor. To a substantial degree historical commercial exploitation of the oilsands has depended upon the provision of labor power to advance and operate technological capacity, both facilitated and buffeted by biophysical immutabilities. No phase of oilsands mining can be construed as routine or simple, beginning with the sub-Arctic latitude and idiosyncratic ore which is all at once brutally abrasive, tenaciously sticky, and subject to vertical shearing. The teeth of Syncrude's first generation mining equipment were ground down in matters of days, forcing constant replacement (Syncrude 2010). Throughout the long winter, water in the geological formation immediately freezes in the mine face, necessitating that these faces be worked continuously to prevent the needs for explosives treatment to thaw them (Speight 2000). This frigid ore sticks in haul trucks despite beds heated by rerouted hot exhaust (B. Sailor) and when dumped into the crusher it clogs hopper intakes. At the other extreme, summer-warmed sticky bituminous sand can coat equipment with as much as fifty percent of its weight during a single shift of operations (B. Driver, B. Sailor, B. Chicken, Oliver 1975). Syncrude's blue ribbon geotechnical board registered surprise that the firm avoided a catastrophic pit wall collapse during its opening decades of operations, which relied upon massive draglines perched along the top edges of the readily-shearing walls (Morgenstern and Scott 1997).

Buddy Chicken describes relentless intervention into the condition of roads and ramps in the mine pit, which remain operable due to a campaign of continuous conditioning, grading and repair. Seasonality, weather, and time of day all come into play to shape the impacts on road surfaces due to the unremitting abuse of fleets of 800 net tons of haul truck and oilsands ore. Roads and ramps in the mine degenerate unavoidably into potholes and punched-out ramp landings. Especially in upper layers of the mines which contain more clay, the same road frozen firm overnight can become 'slick as snot' in the afternoon sun, in need of sand to be passable. Overburden removal operations come to a halt during wet weather because the terrain is too soggy while less-experienced haul truck drivers shift to smaller trucks to spread sand (B. Drum). Under harshest conditions, firms deploy seasoned drivers to descend treacherous slippery ramps in order to continue to push the flow of raw ore. 'Cause,' explains B. Chicken, 'you gotta feed the monster, you can't afford to shut down extracting.'

That monster – the unquenchable upgrader -- opens its maw wide in the mine pit in the form of a gaping crusher hopper into which haul trucks dump their 400-ton loads for initial processing on the way to the extraction plant. Taking advantage of comprehensive instrumentation, Sharma and Cheng (2007) quantify the pounding mechanical stress endured by one such crusher during nonstop operation to screen and roll-crush ore material while hosting two simultaneous 400 ton haul truck dumps, which combine to rattle-free the bolts holding-together this machine comparable in size to a 3-story office building. Screening systems at this stage aim to remove boulders, marcasite nodules, fossilized trees and other rejects. Crusher-jamming lumps of ore arise more frequently in wintertime and more often from the geological formation's shallower deposits; and as noted, hydraulic bucket shovels are more likely than electric-powered rope units to generate problematic lumps.

Crushers play a pivotal role in the relentless effort to blend material recovered throughout the mine into a predictably-graded input of the bitumen extraction plant. Relying upon seismic and core data plus experience in the pit, mine engineers continually re-plan this blending over cycles ranging from the current week to five years to as long as twenty-five or fifty years – modeling each and every haul truck load of variably-graded material from shovel to delivery to the extraction plant (B. Miner, B. Deer). Mine engineers and extraction operations maintain continual communication to smooth inevitable transitions in ore quality from the mine, such as the transition from the typically richest middle seam of the McMurray geological formation to the deepest third seam, a transition that might reduce bitumen content from 12 percent to 8 percent. Efforts to smooth the feed grade also extend into real time operations; haul truck drivers respond to dispatches to pull aside and yield to others hauling ore with a more desired grade at the moment (B. Pool), or to divert activities away from ore-hauling (B. Drum). Some mines have automated these alerts (B. Chicken) while others rely upon dispatchers in need of six years' experience to reach full competence in routing variable haul truck loads (B. Doggy).

4.3 Bitumen Separation: Crucial Economic Step

As Chapter 3 notes, Canadians Gesner, Ells, and Clark are historical innovators in asphaltene and bitumen extraction, which this section explains in terms of the contemporary oilsands industry. The companies' extraction plants house the crucial step of commodity production, an approach to hot water flotation tailored to the oilsands widely-known as the "Clark Process" in honor of Karl Clark's leadership in its development (e.g., Fine Tailings Fundamental Consortium 1995): 'By itself, [the Clark Process] does not have a preponderant effect on the economics – but without it there can be no economics' (Syncrude 1973, 35).

4.3.1 Tabletop demonstration naturalizes bitumen separation

The basics of bitumen separation can be observed in bi-daily demonstrations at the Oil Sands Discovery Centre operated by Alberta Culture and Tourism in Fort McMurray. Simply obtain a fresh softball-sized sample of bituminous ore supplied by the mining firms, explains a staff member, and place it into a Pyrex beaker about five times larger in volume; then using splashes of steaming hot water obtained from an electric tea kettle along with a stout wooden spoon, slowly mash the ore into a thick pulp – a process known as ablation. Add more hot water to fill the beaker while beating vigorously to dissolve lumps and create froth, an activity known as aeration. Set aside to rest. After just a few minutes a discernable black band accumulates at the surface of the otherwise cloudy beaker filled on the bottom with a layer of sand, a step known as flotation. The black substance is extracted bitumen, the petroleum "prize" that drives the oilsands mining industry. The lower two components, the process-contaminated water and heavier solids, staff explain, are known collectively as tailings, which they assure audiences, the industry further treats and impounds.

4.3.2 Challenges of bitumen separation at industrial scale

Complications not apparent in the tabletop demonstration become causes for concern at industrial scales first achieved by Suncor and Syncrude. The sheer scope and complexity of operations in practice must continuously negotiate minefields of contingencies arising in the interplay of fallible human work and technology, geology, and climate that complicate the actual industrial practices in bitumen separation. Despite the contemporary industry's achievements, it continues to wrestle with many of the same challenges encountered a century ago; namely, how to provision sufficient freshwater for the process, increase the bitumen separation yield, purify it this recovered bitumen, and manage the waste produced in the process (Masliyah et al. 2004). To give one example, the same ultra-fine particles in the waste stream that confound Karl Clark at his pilot plant in Waterways in the 1920s (Ferguson 1986) continue to defy resolution by the industry today (Masliyah et al. 2011).

In their initial operations, Suncor and Syncrude ablate ore with steam and caustic soda in rotating drums, 100 feet long and 16 feet in diameter at one plant (B. Cousin), which although common in mining, undergo unique wear-factors in the oilsands. However, in most oilsands mine operations today such drums no longer operate; rather, crushed ore is slurried and piped from distant expansion mines to the primary extraction plant. The reliance upon piped slurry developed initially as the low-cost alternative to either unreliable conveyors or too-long haul truck runs for gathering the output of remote expansion mines such as Syncrude Aurora and Suncor Steepbank and Millennium (B. Prof); yet in an instance of serendipity, piped oilsands slurry subsequently was found to achieve much of the primary bitumen extraction process while reducing reliance on massive tumblers to pulp ore (B. Cousin, Sharma and Cheng 2007). A cost incurred by this strategy is constant maintenance and replacement of slurry pipelines to counteract the abrasive properties of raw oilsands slurry. Firms transport this slurry in expensive hard carbon-steel pipes that laborers periodically rotate, first 90°, then 180°, and finally end-for-end to even-out the wear and tear and thereby extend service lives (B. Retiree).

Aeration and flotation steps of bitumen separation occur in towering primary separation vessels, downwardly-conical structures that in one plant measure 125 feet in height by 75 feet in diameter across the top. Screened for debris again, caustic bituminous slurry is further aerated upon injection into the separation vessel. Much as in the glass beaker demonstration, heavy sand settles into the tapered bottom where it's drawn out; aerated bitumen floats in a bubbly froth to the vessel surface, where guided by rotating rakes it flows to collection drains around the outer rim. Innovations have reduced the temperatures of flotation water from Clark's "hot" 180F to "warm" around 160F. Still, B. Catwalk perches on catwalks in 180F heat over the open tops of primary separation vessels in order to remove debris manually. In addition to the heat, salts and acids produce a highly-corrosive atmosphere, which caused one extraction plant roof to cave in during the industry's early decades (B. Cousin). Firms set ambitious control limits for the ore content of slurry entering primary separation vessels; at least one mine aims to maintain slurry graded to 1/100 percent bitumen and the mine and extraction managers maintain ongoing communication to ensure this consistency (B. Miner).

Rapid variation in this feed can hold disastrous consequences. If the bitumen content spikes too rich, for instance, the separation vessels can well-over and quickly the plant becomes waist-deep in hot bitumen that subsequently cools to the hardness of soft rock; or if caught in time, the plant dumps valuable bitumen into waste ponds. These contingencies plague the industry's infant years (B. Deer, B. Cousin). The froth recovered by this primary separation process consists roughly of 60 percent bitumen and a 40 percent mix of water, bitumen, and solids. Firms add volatile diluent, typically naphtha or paraffinic solvent, to keep this bituminous compound pipeable, and then centrifuge it to reduce solids (Masliyah et al. 2011). Despite these efforts, the output of the centrifuge retains approximately 6 percent water and 2 percent solid particles, which require another round of filtration prior to delivery to the upgrader (B. Cousin).

4.3.3 Maintenance of the separation plant due to sand

In the Clark process extraction plant, substantial labor time continuously maintains and improves the high wear zones of the plant exposed to erosive sand. Indeed, at one firm, whereas the bitumen upgrader sits with production managers, in the extraction plant the maintenance manager calls the shots. The cost of catastrophic equipment failure is high, due less to lost production – as redundant systems can take up the slack – and rather much more, to the time-consuming cleanup cost of overflowing hot bitumen. 'This product, it turns to tar and then it turns to cement,' explains B. Deer, who then describes the challenge of extending usable lives of metal components exposed to the gritty raw material processed by stage one separation:

> Basically, the main focus in extraction is increasing mean time between failure. We have a lot of redundant equipment, so we have the option of taking things down often… because it's a high wear environment. So, the piping – generally we have piping last a year – and if we leave it to two or three years, we've got holes. So, we were trying to improve flow uniformity, flow quality, and mean time between failures. So, we were changing out pump train components regularly. Our casings, the pump casings were four inches thick. The minimum on that is 1.2 inches. And we changed them out every year. So, we were losing 2, 2.5 inches of material every year.

At this point I interject: 'That's very different than run-to-fail. You are doing a tremendous amount of preventative maintenance or replacement.' B. Deer agrees, 'That's right,' and details the search for advanced wear-resistant materials:

> So, we tried many different hard facing components. So, it's basically ultra-high wear material, laser clad, ceramic beads and epoxy, uh, just high strength high hardness, cast materials… so, we substituted all of these things in at one time or another just searching for a quarter extra life, doubling the life. We had some good luck with some of the materials. We doubled the life of our section liners with a laser clad hard liner, and we doubled the life of our breaker screens by adding chromite iron blocks on them instead of a tungsten overlay. And so, we had some excellent success. In terms of changes of design as well as material.

4.3.4 Middlings: Materialization of the industry's challenges

Recall, primary separation recovers only 60 percent of the available bitumen. Suspended inside the tabletop beaker between floating bitumen froth at the top and hydrophobic sand at the bottom, a wide band of turbid "middlings" contains mostly water, but also fine-grained solids and valuable bitumen that failed to rise to the surface in the bubbly froth. In these peculiar middlings, it is no exaggeration to say, the industry comes face-to-face with its two fundamental challenges, which after a century of research and development persist. These are, namely, how to optimize bitumen production and how to cope with its waste. Generations ago, Clark and Pasternack (1949) emphasize the crucial role of fine clay particles contained within oilsands ore. A threshold concentration of clay is necessary, they conclude, for bitumen separation to proceed (Fine Tailings Fundamentals Consortium [FTFC] 1995, Liu 1993); and in addition, they emphasize, post-extraction, these crucial fine clay particles stubbornly refuse to precipitate fully out, leaving intractable "middlings" water. From their initial launches, Suncor and Syncrude subjected middlings to re-frothing in secondary separation cells to increase bitumen yield and capture fine solids, modifying approaches first attempted by Clark in the 1920s to improve the recovery rate at Waterways (Ferguson 1986). Tertiary extraction technologies have added hydro-cyclones followed by yet more frothing and centrifuging all to boost overall marginal recovery of bitumen above 95 percent; and also, to capture as many "fine" (<45 microns) clay particulates from the waste stream as possible in an effort to minimize volumes of the most confounding waste tailings detailed in Chapter 6.

Bitumen scavenged through secondary methods combines with the product of primary separation; and as introduced above, these undergo treatment with diluent to remove water and decrease viscosity so this diluted bitumen ("dilbit") will flow, and then centrifuging to reduce solids as well as additional filtration, hydro cyclone treatment, further frothing etc. to squeeze out bitumen and ultrafine solid particulates (Rao and Liu 2013). Suncor claims 98 percent bitumen recovery in its Millennial mine operations. This purified dilbit travels first to a battery of storage tanks that inventory a buffer supply of diluted bitumen, chief input into the upgrading process discussed in the next section. Before that, however, it bears emphasizing that for nearly a century, water flotation has enabled oilsands bitumen extraction. Yet, only with recent advancements in analytical instrumentation – particularly atomic microscopy – emphasize Masliyah et al. (2004), has the molecular process of bitumen separation begun to come into focus, leading for instance to revisions in Clark's widely-reproduced sketch-theory of the bitumen/sand/water/clay matrix.

4.4 Bitumen Upgrading to Add More Value

As detailed in Chapter 3, Karl Clark (1929) reasons early on that the market for oilsands bitumen for road surfacing was limited, although that application had driven federal and provincial research up to that time. The greater potential lay in transportation fuels, Clark concludes, which necessitates refinement beyond recovery of purified bitumen alone. In furtherance of this objective, the oilsands mining industry has developed an "upgrading" process of thermal and pressurized refining techniques to both extract lighter compounds from heavier bitumen "bottoms" and to remove noxious sulfur and ammonia, thereby yielding a blended liquid hydrocarbon known generically as synthetic crude oil (SCO).

Although each of the first four oilsands mining enterprises (Suncor, Syncrude, Shell, and CNRL) is predicated on the production of fully-upgraded SCO, a market for dilbit has developed among Midwestern and Gulf refineries with facilities to handle heavy feedstock. The industry's two newest mines, the Kearl Oil Sands Project owned by Imperial Oil and the Fort Hills operation run by Suncor, specifically target this dilbit market to avoid capital and operating costs associated with upgraders in northern Alberta. Indeed, while SCO remains a core product, the other firms also market less-complete blends such as dilbit and sulfur-heavy ("sour") SCO.

Informants provided insights into these upgrader sub-activities. Consistent with findings above with respect to mining and separation stages, my research uncovers an upgrading process fraught by interactions of fallible technology, climactic and material contingencies, capital priorities, and human unpredictability that complicate its operation. Upgrading produces synthetic crude oil in a two-stage, thermal/chemical, process. Stage one, known as "coking," draws dilbit from inventory in storage tanks and warms it to about 500F in order to recover the volatile naphtha fraction, which is reused as diluent. Furnace-powered cokers then heat bitumen to 900-1,000F in order to boil off and then re-condense hydrocarbon gases and oils contained within the bitumen, notably naphtha, kerosene and gasoil, leaving behind petroleum coke as waste. Step two of the upgrading process takes in the oil products of first stage coking, and through applications of hydrogen, catalysts, heat, pressure, vacuum, and additional distillation refines these feedstocks further while removing sulfur and nitrogen, which results in synthetic crude (cf. Speight and Moschopedis 1981).

Organized labor pushes for construction of new upgraders in the province, particularly expansion of the existing concentration in "upgrader alley" northeast of Edmonton in the Fort Saskatchewan vicinity, also promoted as the "heartland". Graffiti at the base of a new Fort McMurray overpass shouts, "REFINE IT HERE," in eight-foot-high letters. Notably, the Alberta government is an investor in an Edmonton-area upgrader that processes bitumen obtained in "payment-in-kind" schemes where the province accepts dilbit in lieu of cash royalties, which to date has been a money losing arrangement for the province (Morgan 2021).

4.4.1 Coking to remove the heaviest "bottoms" from the separated bitumen

If the crucial step of commodification is the separation of bitumen from its ore matrix, then the highest marginal value is added in the coking process. For Suncor, Syncrude, and CNRL the firms hosting mine-side upgraders, the coker is the 'very heart' of the enterprise avers B. Calgary, a key informant with wide experience in management initiatives involving batch coking. Sticking with this analogy, the need to sustain a ceaseless coker heartbeat becomes all the more imperative at Syncrude, where reliance on a continuous "fluidized" coking process means that any significant interruption of the bitumen feedstock can result in catastrophic shutdowns, and thus the entire enterprise feels the pressure to sustain the coker (Hyndman 1981, 646). By one internal estimate, if Syncrude's coker loses its bitumen input for one to two hours, the resulting two-month shutdown and restart requires 2,000 additional laborers (Kruger 2008). To avoids such calamity, the company implements ad hoc fixes to keep its coker running. For example, one firm purchases a fleet of [industrial vacuum] ‘sucker trucks’ so a small business can operate nonstop for two years to mitigate a chronic fluid leak, which otherwise would have required a coker shutdown to repair – ‘they made buddy a millionaire’ (B. Cousin).

Tried and True Batch Coking

Standard Oil of Indiana’s Whiting refinery first developed petroleum batch coking in the early 1910s to squeeze recoverable gasoline from the distillation fraction known as gasoil in order to capitalize the surging demand of automobiles (Wilson 1928). This technology, also known as delayed coking, remains widely deployed worldwide to process heavy oil feedstock, and was adaptable to the even heavier oilsands.

In B. Calgary’s thinking, the central issue in batch coking is how industry veterans present it as a straightforward operation with ample margins for error. The functional flow chart *is* simple after all. However, the complexities of material, human operators, and the reaction vessels (‘that’s a lot of valves’) translate into practices of bitumen coking historically fraught with mishaps. Buddy Deer specifies selected causes of failure: cracks, improper sealing, and operator error resulting in valves opened at improper times.

Batch coking works by charging a coker drum with bitumen heated to above 900F in order to draw off volatized lighter hydrocarbon gases and liquids into a distillation column known as a “fractionator” that condenses the volatized compounds into three chief fractions: naphtha (sent to the extraction plant for use as a bitumen diluent), kerosene and gasoil sent to secondary upgrading. Batch coking in particular is a brute thermal approach to ‘cracking’ heavy bitumen explains B. Calgary: ‘basically… we’ve got a really heavy feed so we’re just gonna heat the crap out of it, then the heaviest stuff will turn into coke and then we’ll have something lighter that comes out the back end’ (cf. Berger and Anderson 1981). Heavier constituents of the bitumen left behind bake into coke deposited inside the drum which, once filled, ends the process. High pressure water drills remove annealed coke leftover from the process (Ellis and Paul 1998, B. Shower). Hot waste coke goes to the coke dump. In a breakthrough, Suncor has streamlined its coking process from 13 to 11 hours, thereby enabling one full cycle within each twelve-hour shift (B. Deer). One strategic advantage of delayed coking is that the process starts and stops by design, thereby avoiding the ceaseless bitumen feed demanded by fluidized cokers. On the downside in the view of B. Calgary, the turnaround process of batch coking opens the door to failures and the copious dumping of coke reflects a chemically-clumsy use of the bitumen feedstock.

Although Syncrude and Shell deploy technological advancements over delayed coking described below, CNRL commences production in 2009 using a delayed coker. Suncor expands delayed coking for its remote Millennium mine brought online in 2008. Delayed coking has been the tried-and-true bankable technology according to B. Calgary, who recalls a consultant's presentation that compares new technology adoption cycles by all industry (5-7 years) to the petroleum industry (20 years). As in any business reducing capital risk is a key goal, and to that end, 'It's all in the design phase' instructs B. Rabbit, who illustrates the point with Syncrude's upgrader extension UE-1 as the 'perfect example of poor design.' CNRL's multi-train upgrader design was a clear effort to steer clear of such complexities. Yet, B. Rabbit continues, design alone does not fully predict actual performance. Syncrude pipes product while newer CNRL has been buggy and accident-prone.

Fluidized Coking – innovative technology

The three fluidized bed cokers installed at Syncrude are the world's largest, and by no means simple. The technology license owner is Exxon-Mobil and enables the injection of hydrogen into the coking process and partial desulfurization in a continuous – as opposed to batch – process. One advantage of fluidized coking is that coke dust rendered by the process can be combusted to stoke the coker and its furnace; another waste product, carbon monoxide, is similarly burned as fuel for heat (Spragins 1978). However, as discussed further below, in practice this setup has been a source of unreliability.

Non-Coking

Oilsands mines first developed by Shell maintain an adjacent extraction plant that notably implements an innovative paraffinic process to produce a form of dilbit that travels by pipeline to an upgrader northeast of Edmonton where direct hydrotreating – sans coking – refines it into a synthetic crude blend. The Shell solution is more elegant chemically than the Clark process in the eyes of B. Calgary who, without intending to copy Shell's operation, theorizes a similar strategy through personal research conducted during idle hours. The newer Kearl and Fort Hills mines deploy comparable paraffinic approaches. To be sure, this non-coking technology remains noxious, captured by the catchphrase of an engineer who worked at this Shell upgrader: 'We're not making rainbows and unicorns,' sardonically recalls B. Show.

4.4.2 Secondary upgrading: Wicked challenge of sustaining heat

The output of the coker is a heavy gasoil with high sulfur content not unfamiliar in the spectrum of liquid crude oils recovered in selected global reserves. To this end, the oilsands firms' secondary upgraders are comparable to conventional refineries, which process a continuous supply of feedstock through a series of hydrotreaters and fractionators operating under various conditions of heat and vacuum to produce synthetic crude oil as the highest value output. Maintenance engineer B. Show is involved in seven plants in secondary upgrading, which are involved in several descriptions in the remainder of this chapter.

Wicked Challenge of Sustaining Heat

Electrician B. Scofflaw emphasizes that bitumen upgrading relies upon chemical alterations impelled by a series of "thermal cracking" steps. A lattice of "steam tracings" and insulation envelops miles and miles of pipes and hydrotreaters to maintain heat in the process. One upgrader utility plant distributes steam for year-round use by some plant facilities but only seasonally by others. Whereas the processing plant operators and engineers would prefer 203F steam, the utilities plant strived to stay above a 198F minimum, a goal profoundly complicated by frigid winters. A typical hydrotreater is wrapped by 1,500 to 2,000 steam tracers joined by a manifold to the main steam supply line; at one time constructed of jointed pipe but today largely of tubing, each tracer is 100 to 300 feet long, with the return portion of each tracer circuit collecting condensate into a water recovery manifold. Operational pressures run around 50-100psi, a scalding danger yet not explosive (B. Calgary, B. Rabbit, B. Panel, B. Show).

Numerous informants explain how in the wintertime leaks in steam tracings freeze on contact with frigid air resulting in the buildup of massive "ice castles". I had developed the impression that steam tracing leaks go hand-in-hand with the business. Buddy Calgary heartily dissents: 'I would challenge that mindset. Petrochemical plants that I came from [in cold Alberta], didn't have or accept leaks. So, I mean I don't know, I'm not a materials or inspection engineer, so I don't know the underlying issues of exactly why these plants have a lot more steam leaks than we had,' before conceding that the volumes, pressures, and distances involving steam and oilsands upgrading were all contributing factors. 'They have more steam going all over the place,' was Buddy's shorthand concession. A sub-section below concerned with unresolved maintenance issues, returns to these steam tracings, ice castles, and tragic consequences.

Almost to a person this contingency of frigid conditions is explained in the shorthand expression, "forty below," which happens to be the point where Fahrenheit and Centigrade scales correspond with each other. Early GCOS operations overcame many cold weather obstacles, yet operations ceased when temperature reached 'minus 40' (Great Plains Research Consultants 1984, 115). Oilsands operations must be designed to function at -40C (Speight 2000). During the 1978-79 winter, Syncrude gained invaluable experience with the 'harsh realities' of mining and materials handling 'at forty degrees below zero' (Scott 1981, 43). A short dialog with key informant B. Rabbit conveys the limits imposed by the cold:

B. Rabbit: Forty below is when you start to have problems.

HD: Problems?

B. Rabbit: *Pro....blems*... in the plant. Forty-two below is where you start calling people.

HD: What kind of people?

B. Rabbit: It's like Ghostbusters, who you gonna call?

In B. Rabbit's particular example, the challenge is maintaining heat and fluid operations across the upgrader, especially alarming, 'when flames die' at minus forty-three.

4.4.3 Upgrader operations: Cruise control with high-stakes contingencies

Standing aside the upgrader a single-story blast-resistant building houses the most elite tradespeople of the upgrader, plant operators who labor in its inner sanctum known as the control room. When compared with the facility's conventional outer office space, the new ergonomic control room is all the more striking. Entering through swinging doors gives the impression of passing an air-lock. The resonance of the tiled utilitarian corridor gives way to hushed stillness while stark white walls, floors and ceiling are left behind for a pallet of warm grays rather dimly lit but for directed spotlighting of several dozen operator workstations. Each workstation hosts multiple LCD screens with numerical, graphical, and schematic data that enabled operators to run their individual plants, telephone and radio to coordinate with other plant operators and to communicate with field engineers within the plant itself. Several informants are experienced engineers who rarely—sometimes never—step foot in the plants themselves.

Under the best of conditions, the tasks of these panel operators can be compared to rural driving with cruise control or flying with autopilot, explains B. Rabbit, a key informant knowledgeable in instrumentation and control across the upgrader. While operators must remain vigilant, during halcyon stretches an occasional minor adjustment holds plants well within control limits. However, stresses B. Rabbit, 'The real skill is how to cope with the unpredictable part of the processes we use…. Everything is good when it's good, but how do you handle it when it's bad?' Here is where the challenge of an effective control room becomes clearer. Given that the upgrader contains approximately 90,000 pumps and valves in aggregate, operators require that workstations not bombard them about normal process fluctuations – even those into the 'red' zone. At the same time, they need prompt alarms ahead of emergent failures – especially boiler trips and upsets. Buddy Rabbit role-plays:

> "And if I have to do something, make it simple so I get it done quickly." Cause [the operator's] on the radio telling some guy out there, and it

> could be a safety issue…. What's been recognized is that ultimately the operator, if he misses the clue that's gonna give him the warning to save the day, millions of dollars, lives… or I should say in the right order, lives and…then that's what it's all about.

With so many operating parameters and permutations – for instance flows can change abruptly while temperatures are more stable was B. Rabbit's example – and continues:

> The combination of that could be very confusing. So, when a boiler trips and there's lots of heat and lots of steam, there's a dangerous position, there is danger [of fire]; [the operator] has to eliminate the danger before he identifies the problem.

Thus, a well-designed alarm commands precipitous actions without the need to explain the rationale, the accuracy of which the operator and process engineers later determine in due course.

4.4.4 Continual flaring: Manifestation of upgrader variability

By design, upgraders burn flares continually to vent-off 'overpressures' of short-chain hydrocarbons no heavier than butane, which are too light to be commoditized (B. Deer). "Upsets" in the process are the second chief cause of flaring. When batch cokers shutdown half-way through a cycle (or fluidized cokers shutdown anytime), for instance, a significant volume of partially processed gas would damage the downstream hydrotreaters and no capacity exists to store massive quantities of vaporous hydrocarbon; simply no alternative remains to venting/flaring the material. 'Most of the flares are tied in to our safety valves, which is part of the point of the flare system,' B. Deer explains:

> Because we have a lot of systems that carry material that is really dangerous to people; so, if there's ever an overpressure event in that system you want that to vent out of the plant and to some safe disposal area, which is the flare. So, for us, when we have to dump to flare, there really isn't (sic) a lot of secondary options.

During coker upsets the most prevalent flared substances may be sulfur dioxide (SO_2), dumped nonstop for several days in extreme circumstances. Other common substances produced/used by the process and 'really dangerous to people' include hydrogen sulfide (H_2S) and carbon monoxide (CO).

Sulfur and Nitrate - 'We run a very sour process' (B. Shred)

Oilsands firms fix and remove sulfur from cokers and hydrotreaters, both to prevent production rates from slipping, and damage to other plants in secondary stage upgrading (B. Shred). Thus, sulfur compounds are frequent constituents of sustained heavy flaring (Timoney and Lee 2013, B. Deer). Two ubiquitous sulfur compounds in the upgrader are deadly hydrogen sulfide (H_2S) and sulfur dioxide (SO_2), emissions of which are capped by provisions in operating agreements, yet, frequently exceeded during upsets and restarts. Known as "sour gas" and highly toxic to humans, hydrogen sulfide is heavier than air, so it sinks and pools on the ground and in depressions. Buddy Boom, a safety expert, cautions one must never approach a downed worker in a depression due to the risk of H_2S. Buddy Cousin recalls once walking through the upgrader and glancing down, shocked at the black air below waist level – H_2S levels were 'off the charts'. Sour water strippers in the upgrading process use steam-blast to remove hydrogen sulfide and ammonia from hydrocarbons. The former is purified and pressurized to several hundred pounds, and then burned as a fuel source; the latter is fixed as nitrate for sale to the fertilizer industry.

Sheet metal worker B. Sauna3 is nearing completion of a multiyear long-distance commute to work in construction of the Syncrude SERP (Sulfur Emissions Reduction Plant), which will enable the firm, they explain, to increase production while remaining compliant under existing emissions caps. 'Anyone with a brain knows they're not going to reduce their overall discharge,' they scoff, but then add, 'I'm proud to work on it. It's the first of its kind in the world. Lots of people think they don't do anything up here with the environment.'

4.4.5 Costly fires, upsets, shutdowns, startups, and turnarounds

If we return for a moment to B. Calgary's analogy of coker *qua* heart, then all of the upgraders suffer recurring infarctions which blow up as fires in their cokers and connected systems. Whether firms have deployed batch or continuous processes, catastrophic coker fires have plagued the oilsands industry from the start and continue with regularity. Timoney and Lee's (2013) survey of environmental incidents reported to

Alberta Environment 1996-2012 identifies several coker fires: CNRL (2011, 2012), Suncor (2003, 2008), Syncrude (1996, 2000, 2012). However, they concede the dataset is incomplete, apparently confirmed by press accounts of additional coker fires during their study period: Suncor (2009) and Syncrude (Canadian Press 2007). Shell's Scotford Upgrader does not operate a coker; nevertheless, it has not been immune to fires (Reuters 2007). Moreover, fires erupt in other areas of the upgrader, for instance in 2005 Suncor's fractionator burned out of control in an electrical fire (Ebner 2007). The 20-year ticketed electrician B. Scofflaw marvels how that fire melted #9 chrome into an ingot, 'because we didn't use the proper fireproof shields, because they were ordered wrong but the drive for 'do it now, now, now' overrides the decision,' is the explanation.

4.5 Operations Management: "Production, Safety, Environment" Versus "Production, Production, Production"

Recall from Chapter 1 that ecological modernization theorizes neoliberal rollout can facilitate scientific advancements in industrial efficiency sufficient to achieve breakthroughs in environmental abatement and remediation (Mol 2001, Mol 1995). Also described in Chapter 1, geographical literature concedes some neoliberalization projects apparently achieve a degree of ecological modernization's promises. The oilsands firms call this the "triple bottom line" of "production, safety, environment."

The limits of the safety component of the triple bottom line become clear in the actual practices of labor and management, gleaned from interview data that this section highlights. 'I've seen a lot of people being killed out there,' recounts B. Doggy: People crushed, 'he looked like somebody stepped on a package of ketchup, all they found was his boots'; and people burned fatally when a pipeline under construction fills with gas and then ignites, 'basically turning into a flame thrower, frying them.' Although some of these occurred as long ago as the 1990s, B. Doggy insists, 'Things still happen today that they keep hush-hush. Everything's confidential; we're not allowed to talk about it. They pay you off.' Buddy Chicken confirms one such quiet payout 'to the widow' related to an accident involving an – at the time – newly deploying Cat 797F haul truck.

Two general types of mishaps are most prevalent, those due to human error and those due to equipment failure. B. Cousin, whose career begins in the early days of Syncrude, reflects 'I can't believe I survived,' and marvels how fatal accidents remain limited to at most a few workers at a time, rather than the hundreds who could be involved in any given incident. B. Chicken repeats, 'dodged a bullet' in recalling numerous close calls. Laborers face additional risk exposure due to managers' cavalier adherence to safety guidelines and aversion to maintenance expenditures.

4.5.1 Tacitly promoted recklessness can be fatal

Mundane risks occur daily, such as jumping down ten feet from haul truck cabs suspended in the air when full loads of frozen ore stick in the beds after attempts to dump them (B. Chicken). An undercurrent of thought among my informants insists the firms' abandonment of the master-apprentice process of job training has left numerous workers undertrained and thus at higher risk of incidents. A young worker drops a wrench into the bottom of an apparently empty tank and then, climbing down to retrieve it, collapses. Their work partner descends to assist and they both die, succumbing to poisonous hydrogen sulfide gas (B. Boom). Inexperienced workers attempt to thaw a stuck valve on a vacuum "sucker" truck in the frigid winter. Yet, instead of applying steam, they employ a propane torch, which blows up the gaseous contents of the truck and kills three (B. Cousin). The truck is there in the first place to remediate a chronic leak that would require a coker shutdown to repair, a contingency, as explained above, to be avoided. Asked if machismo gets in the way of proper safety procedures, B. Boom answers with an example from a pipeline, workers using sledgehammers to pound couplings into place – metal on metal – without ear protection. Buddy brings it up to the foreman, and the next day sees the pipeline workers standing in the same position with their fingers in their ears. Thus, Buddy knows they took their advice to heart, but workers don't use free earplugs. Buddy Lighter is working in a trench fitting new pipe when a contractor's 'owner's son in his Hush Puppies' shows initiative by climbing into a vacant excavator to accelerate the work pace. Everything proceeds smoothly for some time, until he tears into a 42-inch oil pipe. 'It looked like Jed Clampett' within minutes as more than an acre floods ankle deep in oil.

Even experienced workers are not immune to life-threatening mistakes. 'I've seen a guy, a welder, inhale some gas from a certain kind of pipe that wasn't supposed to be cut… talking to first aid, next thing you know he's on the floor with red welts all over his face and he couldn't breathe' (B. Doggy). Despite exhaustive safety procedures to conduct scuba maintenance in tailings ponds, a diver drowns because in a faraway control room a person with best intentions turns-on what appears to be a senselessly idle pump, a fatal error made possible by a control panel left unlocked (B. Cousin). With 25 years' experience in trades and carpentry, B. Carpenter is fired after dropping a scaffolding pipe 80 feet to the ground. Although the mishap causes no injuries, the timing is misfortunate as the pipe lands, bounces and rattles at the feet of executives on tour being led by a foreman who all day has been 'bird-dogging' to make a show as the project is behind schedule. Buddy, who is dismissed summarily, concedes sleep deprivation could have played a role. Over the preceding month Buddy had been allowed to push the policy limit of 18 break-free days of work followed by 3 days off; instead logging 16 twelve-hour days on the job, one day off, then 12 more twelve-hour days of work followed by 2 days off.

4.5.2 Deferred/improper maintenance and run-to-fail

Deferred and improper maintenance and run-to-fail is a common hazard embedded throughout operations: contractors running haul truck tires to blowouts (B. Chicken), and valves run until they rupture in a 'firefighting' approach to upgrader maintenance (B. Show, B. Rabbit). Other examples throughout the process include intervening with leak boxes to catch drips rather than replacing leaking valves (B. Show) and employing a fleet of high-volume vacuum ("sucker") trucks to avoid a coker shut down (B. Cousin). Inventoried parts for a coker are cannibalized to hold together other sections of day-to-day operations; these supplies are not replenished, leaving no backup parts (B. Hockey). The corrosive atmosphere of extraction leads to the partial cave-in of a plant roof in the industry's early decades; yet, rather than replace it immediately, a Jerry-rigged stopgap fills the breach for five years before permanent repairs take place. Buddy Cousin recounts the tale to underscore the logic of the firm: 'The buildings don't make money. The people don't make money. Only the product makes money.' A catastrophic electrical fire at Suncor in 2005 stems from the pressure to 'do it now, do it now, do it now,' rather than wait for proper heat shields, which had been improperly ordered (B. Scofflaw).

Given the imperative of mine production, one example of improper maintenance is particularly odd in its seeming counter-productivity. Buddy Hockey describes the challenge of delivering high voltage to power the large mining shovels. Crucially, 13.4 kV switches can fail due to cold and lack of maintenance. Even under normal operating conditions these switch connections heat to almost 400F, but B. Hockey describes an internal review that uncovers some stainless-steel switches melted half-through due to arcing. The melting point of stainless is at least 2500F.[22] No further inquiries seek to resolve the matter. Moreover, the firm's purchasers fail to heed a senior journeyman and instead continue to acquire cheaper aluminum switches, which are not up to the rigors of the climactic conditions and thus fail in a year. These high voltage electrical failures are particularly hazardous, Buddy emphasizes, in the vicinity of petrochemicals under heat and pressure. A seeming contradiction lies in the cost of switch failure, which takes a shovel out of production for at least one full day. Buddy Hockey makes it clear the cost of a stainless switch is a fraction of lost shovel productivity, valued at the time: 10 trucks/hour*24hr*$18k/truck = $4.3 million in revenue.

One widely-discussed fatality fits into this category of lack of maintenance due to cost avoidance. On New Year's Eve 2008 a field technician is alone outside in dark frigid conditions on the upgrader catwalks when an overhead "ice castle" weighing up to several tons gives way and crashes upon him, causing death. In 2011 the company is found liable under the Alberta Occupational Health and Safety Act. As a result, it is fined a $11,500 and ordered to pay an additional $365,000 to fund Fort McMurray-based Keyano College to train workers about 'hazard assessments, awareness and control in

[22] https://www.thyssenkrupp-materials.co.uk/stainless-steel-melting-points.html (accessed 26-Aug-21)

relation to winter conditions and the formation of ice,' plus a final $100,000 in student assistance (Gerson 2011). This penalty fails to align with the material circumstances; lack of maintenance – not awareness – is the cause of the fatality. Buddy Show offers a closer account:

> So, we've got the fatality on the books. Of someone killed by ice created by a failed steam tracer. On a line that's falling apart. Two years after that fatality, or one year I think, occupational health and safety arrived on site to conclude their investigation.
>
> This is Alberta occupation. So, this is the police as far as safety is concerned. Came to get the permit to go into the area and was told by the permit writer that they could not enter the area. The occupational health and safety guys are asking why and they said, "there's too much ice overhead, you can't go in there" (laughter).
>
> Needless to say, the next day the guilty verdict was rendered. I was involved in discussions about needing to get that line fixed. I actually never linked it to the fatality. I never understood that had happened at the same place... but multiple, *multiple* discussions about, "no you can't have those contractors right now. Um… we've got too many FTEs employed in maintenance right now." They're working on other priorities. Like should it be a higher priority than what killed someone last year? So, I guess that's one decision: production, or money, totally overrode safety. In the face of the safety police on site.
>
> Exact same situation as far as I'm concerned. Multiple safety observations – you're talking like 100 entered – by the rank-and-file employees over the course of this preceding winter about the worsening conditions in our hydrotreater. And then in April, the senior manager telling us, "No, we're dismissing your steam workforce". And us going, "Hey, did you get out there to look at it?" "No, I didn't make it out there this year."
>
> Failed steam tracers. Creating these huge ice castles. I mean I walked staircases this winter that you couldn't actually see the stairs because the cloud of steam I was walking into was too big. And hanging off the bottom of that grating would have been like an iceberg the size of an elephant. That could let go at any time. No structural integrity. Those are two decisions that I was privy to where production overrode safety.
>
> They're just leaking though, they're not failed. You can still pound steam through them. Especially since that ice castle almost effectively seals it. The steam will shoot past. So, you can probably maintain your temperatures.

I ask: ‘Would it be when the operator says “I can’t maintain my temperatures” that maybe something would get fixed?’

> Yeah, maybe they fix that tracer. And that would be the kind of job that would come as a break-in, right? The hydrotreater is gonna be down if you don’t fix this! We’re literally pulling guys off who are fixing the other failed tracers to go fix this one. “That one’s important? Yeah, of course, it affects production.”’

Other plant failures present undeniably immediate hazards.

B. Shower volunteers an anecdote in which they and two co-workers dodge serious injury: Walking down a corridor inside the naphtha recovery unit, B. Shower comes across a leaking pump with its status light lit. ‘The thing is the guy ahead of me walked right past it, young, say twenty-two. I didn’t say anything because I didn’t want him to lose his job.’ With misfortunate timing, the pump fails catastrophically, instantly soaking B. Shower head-to-toe with super volatile butane and syrupy gasoil. Fearing a phone call might cause a spark that sets them on fire, B. Shower walks to the plant’s control room where they smell B. Shower even before they can open the interior doors, and emphatically direct them to the emergency shower installed there for just such contingencies.

In the meantime, two workers – one a gung-ho veteran and one inexperienced – by some accounts rush directly to the failed pump – and promptly catch fire, yet fortunately their flames are quelled. As B. Rabbit comments after hearing this anecdote, there are three possible responses to industrial crises such as this: 1) calm commonsense response directed by the appropriate operator; 2) recklessness; 3) turning to emergency handbooks ‘written down ten years ago,’ and thus, meaningless to current workers. In practice only the first two approaches are taken, explains B. Rabbit, and seasoned operators usually – but not always – manage to impose the first.

4.5.3 The imperative of production

Despite mine safety rules, supervisors’ bonuses are peer-competitive based upon shift production tracked in terms of distance-adjusted load counts; and the competition worked down to individual haul truck drivers whose incentives are based upon safe driving and tonnage dumped in the crusher hopper. In the mine pit, the company contradictorily insists, workers must ‘slow down,’ and also, ‘You get that last load at any cost’ (B. Chicken). On a related note, road conditioning and maintenance are unavoidable costs in the oilsands mines. This includes spreading sand to improve traction and watering to suppress dust, which are carried out by drivers who could otherwise be engaged hauling oilsands ore. Of course, hauling ore contributes more directly to managers’ shift performance metrics; thus, not surprisingly, some routinely neglect dust in particular (B. Chicken). After fire cripples an extraction plant, access to the area is restricted. ‘We had areas roped off, PCBs, do not enter, and our job was to go around chipping ice, and when we told the supervisor we couldn’t go in the area he walked up to it and rip down all the plastic tape and says “yeah, we’re going in there” – without doing any checks for PCBs’ (B. Bang).

4.5.4 Gaming safety accountability systems

Four types of system-gaming among tradespersons and equipment operators arise repeatedly in the research. These involve punitive drug testing and its avoidance, hiding lost time injuries, falsifying trades certification “tickets,” and shirking work. The Alberta Federation of Labour in Edmonton devotes a 2012 public meeting – which I attend – to the systemic flaw of the oilsands mines and upgraders, namely, safety regulation: Occupational health and safety regulators refund portions of the firms workers’ compensation payments as rewards for low claims. The problem is reliance on company self-reporting; thus, the perverse incentive is to blame workers for accidents or hide them altogether. On the former, everyone knows companies administer drug screening (“piss tests”) after every accident in the hope of justifying termination and displacing liability. A day after B. Boom’s pipeline project shuts down for a safety review there is an accident. An unattended welder’s line has leaked gas, which collects in the 42-inch pipe under construction. When the welder re-ignites his torch, the gas accumulation flares in a fireball that blasts out of the pipe to char a ragged 42-inch black circle on the side of his truck. After such incidents, an immediate “piss test” is routine; however, the welder’s helper refuses and quits. This leaves his record clear of what many presume would have been a positive reading for THC. Quitting after an accident lets him tell his next employer that he had to get away from the clear danger, which was proven by the accident. Lore has it that another strategy of workers is to wear a bag of "clean" urine close to the body in case a sample is required.

An experience of B. Chicken illustrates the game of hiding lost time injuries. B. Chicken recalls how the force of a nearby haul truck tire blowout left them with an eardrum rupture and back injury that made it impossible to drive equipment. Yet, despite the need for clinical treatment and painkillers, Buddy misses zero days of work. Rather, every day for several weeks a taxicab would pick them up at home and take them to an onsite office where they would "work" reading and dozing for eight hours (paid for twelve) before being taxied back home.

Due to a combination of size, turnover, and contracted labor, the firms simply cannot keep track of their workers and their qualifications. False credentialing comes up repeatedly. The International Brotherhood of Electrical Workers launches a program to keep counterfeit "tickets" out of Alberta (B. Scofflaw). On a related note, for $500 per month one can obtain a journeyman carpenter "ticket," resulting in "carpenters" onsite who cannot construct a window (B. Bang). It is possible to collect a paycheck without doing any work – the firms simply cannot keep track. Senior carpenter B. Boston recalls a maintenance job known amongst insiders as 'hide and seek for a thousand a week.' Buddy Bang brags of working for five years as a well-paid lubricator without ever learning where all the relevant grease nipples are located. Some work avoidance is detrimental. Buddy Hockey explains a chief cause of failed pump motors is seized bearings; which an audit confirms is the result of both the failure to follow prescribed lubrication regiments and also rough handling of filters ('banging them with broom handles'), which injects fine debris directly into the heart of motor works in complete contravention to the purpose of the filter.

In conclusion we see that the production process and its hazards are functions of stubborn materiality, capital decisions, engineered design, management strictures, equipment fallibility, as well as human error and negligence that results from sheer chance and also the ceaseless drive for production.

CHAPTER 5. ENVIRONMENTAL REGULATION AND SOCIONATURAL RÉGULATION

> The continuous interventions of the state into capitalism's crises are best understood neither as adjustments to an otherwise stable regime, nor desperate attempts to stave off inevitable collapse; but rather, state juridico-political agency is by its own constrained capacity, doomed *not* to resolve the crises of its creation. (Offe 1984)

> There have been people who have stood up in meetings and said, "the gas falls like anvils and it's killing us." They don't last long. (B. Scofflaw)

Recall our empirical progress to this point. Chapter 3 locates the Alberta oilsands within the North American and global petroleum economy as an obdurate socionatural resource researched and developed by state agents for nearly a century until reaching the threshold of economic viability in the 1960s, when global petro-capital first takes root in the oilsands. Chapter 4 traces the present-day process of commodity and waste production from the oilsands mine, to extraction, to refinery/upgrader, to effluent stacks and tailings ponds. Special attention is paid to contradictions between the production imperative and concerns involving laborers' safety. Chapters 5 investigate that same production process in relation to provincial environmental regulation, which involves state agents, nongovernmental agents (including quasi nongovernmental organizations ("quangos")), firm self-regulation, and whistleblowers. Informed by archival and interview data, the chapter first considers the activities of provincial environmental regulators, before turning to workers' material practices within the regime of environmental regulation and their perceptions of their relations with environment and with environmental activists as well. This culminates with a brief case that examines the fraught weeks leading up to a new mine's[23] commissioning when regulated environmental contingencies interfere with the schedules set by petro-capital's priorities. Looking ahead further, Chapter 6 narrows to the particular case of environmentally regulated tailings waste produced by the oilsands mines.

5.1 Key Regulatory Agencies During Fieldwork

Folded together today into the Alberta Energy Regulator under the 2013 Responsible Energy Development Act (REDA), two previously independent agencies are germane to

[23] The mine in question will remain unnamed to help preserve confidentiality of informants.

my fieldwork. The Energy Resources Conservation Board (ERCB) oversaw the oil and gas industry consistent with the historical priority of petroleum regulation; namely, "conservation" of production to sustain markets through rationalized extraction that limits "waste" (Huber 2011, Ise 1926, Nash 1968, Zimmermann 1957). The ERCB was founded in 1938 (as the Conservation Board) to assert regulatory rationality over producers in the Turner Valley oil and gas field, Canada's first western boom. Although a provincial authority, ERCB economic implications made it, 'one of the most important regulatory bodies in Canada,' prefaces Breen's (1993) political history. Across the liquid crude industry, conservation typically specifies oilwell density, for instance one well per forty acres; whereas, in the oilsands, it sets the lowest quality ore that firms must process to prevent them from "skimming" the richest seams.

The ERCB granted final approvals and licenses to oilsands firms to launch or expand extraction operations and exerted some ongoing environmental oversight, but only after the second agency, Alberta Environment (AENV), had approved applicants' environmental impact assessments and specified permissible pollution limits and abatements in ten-year licenses and approvals. AENV coexisted within the hybrid Alberta Environment and Sustainable Resource Development (AESRD); however, my interactions stayed within the AENV silo, which oversaw approvals and compliance. To reiterate, these AENV approvals legalize the discharge of megatons of poisonous and greenhouse gases and billions of gallons of oily toxic mine tailings generated by the oilsands production process.

AENV regulated under two main environmental laws: The Environmental Protection Enhancement Act 1995 (EPEA) was the standard against which applicants' environmental impact assessments were approved. The 1996 Water Act, although aimed primarily at agricultural industries (Heinmiller 2013), guided oilsands regulators in the issuance of licenses to divert and use water, approvals to alter water, and the specifications of water containment structures. For instance, to divert new water from the Athabasca River, to befoul that new water in the separation plant, and to construct and maintain the dikes that contain tailings ponds. AENV asserted four levels of regulatory enforcement: warning, administrative penalty, order, and prosecution. The 2012 Lower Athabasca Regional Plan carved out a "Green Zone" of provincial land managed by AESRD downstream of the oilsands mineable area.

5.1.1 Practical distinction between ERCB and AENV

Buddy Boots distinguishes the two key agencies' domains of interest. The ERCB regularly required firms to submit actual production results and, on different schedules, forward-looking mine plans – both to project royalties payable to the province. Here, Nikiforuk (2010) exposes the provincial audit process four years in arrears. 'Their main mandate is exploitation of the resource,' explains B. Miner who interacts continually with the agency. 'They want yearly mine plans, they want to know how much bitumen we said we were gonna mine last year, how much did we mine, how much are we gonna mine next year,' Buddy continues, 'ERCB also wants the lease boundary type information. So those are big ones.' AENV, meanwhile, was involved in ongoing air and water monitoring along with wildlife abatements.

Crucially, the operating parameters established under these agencies' regulatory permits structures the work of environmental offices and production activity. Firms' environmental offices remain the sole points of contact when environmental incidents occur onsite regardless of the point in the production process. 'Because communication between a regulating government body is very delicate,' explains B. Deer, '[Environmental incidents] shouldn't be handled by every pipefitter or engineer. Only by the authorized folks. That's the environmental group' (See also, B. Bear).

The crucial material paradox of the regulated oilsands production process – further detailed in Chapter 6 – is driven by the ERCB mission to maximize resource utilization by requiring the industry to mine and process lower grade ore than it would if economics were the sole consideration. Perversely, extracting bitumen from this low-grade ore produces a disproportionate quantity of particularly onerous waste that vexes industry and environmentalists alike.

5.2 Shortcomings of Oilsands Environmental Regulation

5.2.1 Development-first environmental approvals

Environmental regulation of the oilsands falls short, both in terms of meaningful public influence and ecosystem protection. Although the Alberta constitution protects human right to life and self-determination, the bar is high both on the question of causality and establishment of standing (Fluker 2015). For instance, a recent provincial judgment draws the limit on historical suppression of civic involvement in the approval process when it compels the resistant regulator Alberta Environment to admit public commentary from people living in the midst of a proposed oilsands development (Fluker 2013). Still, in neighboring Saskatchewan, oilsands operations need give no prior notice to First Nations inhabitants before commencing exploratory activities (Bankes 2014). When the "duty to consult" does exist, it has devolved into secretive deal-making between First Nations bands and petro-capital on a project-to-project basis resulting in social and ecological fragmentation (Longley 2015, Parlee 2016, Zalik 2016). Regardless of these deals' legality, just downstream from Syncrude and Suncor some among the First Nations Fort McKay band refer to their payments as 'hush money' (B. Chicken).

The latest Responsible Energy Development Act (REDA) has intensified alienation of First Nations and the public – even landowners – from consequential influence in the provincial fast-track approach to petroleum development (Davison et al. 2018). Adopted just after my primary fieldwork was completed, REDA rolls up provincial resource conservation and environmental agencies into a unified entity. Nominally, this new Alberta Energy Regulator enacts the most aggressive environmental monitoring obligations in Canada; unfortunately, however, it ultimately invests pro-development interests with insuperable final say (Olszynski 2014). Pro-industry and toothless by design, REDA fulfills the decades-long effort by the oilsands mining industry to streamline the application process into a "single window"; while it fails utterly to remediate – let alone improve – patchy oversight and poor public influence (Fluker 2014, Vlavianos 2012). This unevenness tracks with the historical sellout of First Nations and environmental interests to the benefit of hegemonic industrialization, laid bare by the 19th century land enclosure and 1970s expansion wave (Longley 2021, 2015). As a point of emphasis, my informants within the provincial environmental regulator refer to development applications submitted by oilsands firms as “approvals” in concession to the foregone outcome of their reviews.

5.2.2 Shoddy records, chronic contraventions, and scant enforcement

Approvals, when finalized, specify their holder’s maximum allowable environmental impacts – daily tons of sulfur dioxide emissions for instance. In practice however, these restrictions appear rarely enforced. In response to their project to catalog oilsands environmental infractions from the ostensibly public provincial Environmental Management System, Timoney and Lee (2013) are directed to route all requests through bureaucratic Freedom of Information and Protection of Privacy (FOIPP) Act applications. This disclosure process turns out to be so onerous and incomplete that the researchers expand their original scope beyond environmental records alone, to include the barriers to public access. Short of this FOIPP hurdle, the public has no way to track the status or outcome of incidents. Yet, even then, over the course of three months of requests, the authors receive ‘erroneous, corrupted output’ (13; see also, 12-30). In the end, they piece-together 9,262 incidents in the oilsands during the 16½ years between 1996 and mid-2012, including 4,063 contraventions, or an average rate of 0.67 contraventions per 24 hours throughout the period. This figure assuredly understates the actual frequency due to redaction, incomplete records, and multiple environmental incidents compiled into single events, the researchers explain. Perhaps not surprising, eighty-eight percent (88%) of these incidents are attributable to Suncor, Syncrude, or both given their long tenure; although, in the last calendar year of fieldwork, Canadian Natural Resources Ltd. – the third oilsands mine with an onsite upgrader – reports incidents at the same rate as Suncor (98 and 95 incidents, respectively). Virtually no data is available from prior to 1996. The authors calculate that less than one percent (0.91%) of contraventions suffer punitive enforcement (2013, 245). Although several informants make it clear the firms are concerned to avoid negative publicity that a major environmental incident would provoke (B. Boots, B. Sharp), this low rate of provincial punishment does little to encourage compliance.

More fundamentally, independent of the enforcement regime, material conditions in the oilsands impose structural limits on operational reliability (Morgenstern and Scott 1997). Informants recount how run-to-fail decisions and safety shortcuts in the mine and upgrader increase both short-term profit and the probability of catastrophic incidents. At the same time, the swap-out of old parts also carries a host of risks due to ill-matched replacement components and lost institutional knowledge. Thus, if not due to neglect, failure arises in sheer complexity. Timoney and Lee (2013) concede as much regarding a 2010 coker fire at Suncor that burned into a third day: 'The incident is a good illustration that the combination of system complexity, interconnectedness, and the processing of hazardous and flammable materials makes environmental incidents and resultant impacts *essentially inevitable*' (p 57, added emphasis). Impactful failures feature prominently in the structure of production.

5.2.3 Discursive obfuscation and regulatory failure

A growing body of ecological science pinpoints the industry's damage to regional air, water, land, flora, and fauna (Finkel 2018, Gosselin et al. 2010, Hebert 2019, Kelly et al. 2010, Kelly et al. 2009, MacDonald 2013, Pilote et al. 2018, Rooney et al. 2012, Timoney and Lee 2009, Thomas et al. 2020, Tolton et al. 2012, Wells et al. 2008). Rather than redress these and other shortcomings, both Alberta and the industry promulgate discursive campaigns to counter the industry's critics and downplay environmental destruction in the oilsands (Adkin and Stares 2016). Arguably most condemnable is suppression of public access to information about resultant environmental outcomes, which in the eyes of Smandych and Kueneman (2010) elevate to criminal culpability. These activities reinforce a half-century process of center-right developmentalism (Adkin 2016, Haluza-DeLay and Carter 2016, Pratt 1976). In point of fact, as Chapter 3 describes, Alberta has been a petro-state devoted to exploiting the oilsands since its 1905 confederation with Canada (Chastko 2004, Davidson and Gismondi 2011), in line with the longer North American petro-economy. More recently on top of this historical agenda to shape consent, provincial and federal governments have securitized the oilsands to thereby justify heavy-handed coercion of activists and opponents (Le Billon and Carter 2010).[24]

The overall picture of the oilsands paints Alberta at the precipice of regulatory failure with open gaps between permitted practice and actual performance, or between regulatory under-enforcement and the capacity of regional ecologies to withstand industrial damage (cf. Drummond 1996). These problems appear to exemplify what Young and Keil (2007) identify in other words as the urgent need for research to specify 'what can and what cannot be regulated successfully in the nature-society relationship' (143). The situation is so dire even staid industry sympathizers have concluded the credibility of provincial and federal environmental oversight has been so damaged, only an independent review board can rebuild its integrity Dowdeswell et al. 2010, Wallace et al. 2012).

5.3 Environmental Regulation in Practice

Without disputing the "regulatory failure" thesis, indeed again as noted, in marshaling evidence that supports it, the remainder of this chapter digs into the details of structured work – of both regulators and firm workers, both blue and white collar – and their minute-to-minute activities that in aggregate *produce* the firm's regulatory non/compliance. Informed by an ethnographic method that combines interview, participant observation, and archival sources, my focus aims always at the moments laborers and government agents are translating the production strategy vis-à-vis the objects of environmental regulation, invariably co-constituted with obdurate materiality. These informants portray environmental and safety regulation as a continuous set of *practices* among firms and the state, inhabitants and laborers, NGOs, as well as material nature. Oilsands work is undeniably structured by environmental rules on the one hand, yet on the other, these are inadequate to prevent the impacts identified by ecological scientists described above.

To be clear, the intersection of labor with environmental regulation runs beyond idealized procedures to include a raft of underreporting, gaming, luck, and

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[24] See the description of my 2011 border crossing in the Methodological Approach section 2.4.

nonregulation. Regardless, most labor unfolds within the structured drive to produce, which engenders associated safety and environmental impacts. Work rules stress adherence to safety and environmental strictures; however, every management level from foremen to executive pushes the envelope of environmental compliance. On top of that, material conditions produce ever-present variations, upsets, and failures, exacerbated by maintenance regimes pushing to the edge of failure. In a study that prompts withering criticism of environmental regulation over the oilsands, Timoney and Lee (2013) concede the structural limits of environmental strictures:

> The bitumen operations are technologically complex, functionally interconnected, and large. The operations are run to maximize production. Large volumes of hazardous materials are used, processed, or released every day. Because the plants run at maximum rates, at high pressure and high volume, any upset, such as a power outage, loss of a seal or gasket, a plugged vent, an overload, ice formation, a leak, a malfunction in a control circuit, or a human error, can have a significant effect. The narrow margin for error in a high throughput system with strong feedbacks means that incidents are inevitable. As a result, there is a high probability of unit upsets that are associated with exceedances and other incidents. (190)

Or said another way, laborers impact and are impacted by the environment in the course of job activities in a production process all at once environmentally catastrophic and, at the same time, scrupulously abated compared with global norms.

5.3.1 Regulators' relations with environmental regulations

Alberta Environment (AENV) functioned through three interrelated branches: Science and Monitoring; Approvals; and, Compliance. Regulators in AENV, noted above, referred to oilsands environmental impact applications as "approvals" in a concession to the foregone outcome of their reviews. Yet, they certainly exerted some influence, particularly at renewal points for the firms' production authorizations, which offer only 10-year terms on top of 50-year land leases. At these decade intervals, AENV approvals engineers required companies to invest in leading-edge abatement technology, effectively mandating some degree of ecological modernization (B. Reg3). At the same time, technological innovations of provincial scientists, firms, and industry consortia inform the standards imposed by regulators (B. Job).

As the Chapter 2 methodology introduces, my initial opportunity interview with an Alberta environmental regulator arises in the public reading room of the AENV Twin Atria records library in Edmonton. I had handed a clerk a request slip to review "notification of incident" call summaries, which companies must submit when they exceed permitted pollution limits or breach standard operating practices. My purpose had been a preliminary data survey; only later did I come to understand my inquiry was fresh on the heels of the exhaustive study of the same documents by Timoney and Lee (2013) described below. Apparently, AENV remained prickly as a senior regulator soon approached me to learn my intentions.

Buddy Reg worries negative publicity prevents fuller explanations of the intensity of environmental oversight in place. Buddy expresses concern my intent is to publicize rules breaches and their embarrassingly light enforcement actions. As an alternative, B. Reg wishes the agency would receive more accolades for its accomplishments, not least for its aggressive standards and enforcement over dike structures around tailings ponds. Indeed, confirms geotechnical surveyor B. Transit, Syncrude monitors dike wall perturbations to tolerances of less than one centimeter. Failure models of these dikes predict inundation of the Athabasca valley *upstream* to flood Fort McMurray.

The agency's approach to environmental regulation is more cooperative than punitive, marked in practice by torrents of reports, phone calls, emails, onsite testing, and retesting that occupies staff to analyze, spot trends, launch initiatives/investigations, and seek recourse. In AENV's Fort McMurray district alone, more than 2,000 such environmental reports were filed monthly, including hundreds of incidents reports, explain Buddies Reg, Reg2, and Reg3. This blizzard of activity, points out Carter (2010), nearly overwhelmed AENV regulators decimated at the time by staff cuts and narrowed key metrics merely to whether firms filed reports on time. On top of this, animal control reports, among other arguably secondary concerns, drew provincial resources away from urgent conditions of air pollution and tailings ponds. The majority of B. Reg's time in Compliance demonstrates these priorities as most was spent – not on penalties, but rather – on granting company requests for variances from their permits, typically justified by unpredictable materiality and human error, not malfeasance (setting aside the question of delayed maintenance regimes).

Of central importance in the AENV-industry relation was how environmental defilement – even beyond permitted limits – was less egregious in legal terms than is its non-disclosure. 'Non-reporting, we take very serious; under reporting, that's what we're worried about,' stresses environmental regulator B. Reg3, who recognizes a significant distinction between one-time anomalies and chronic violators. A "warning letter" begins to set a track record for each "call" or "incident" in the AENV Compliance vernacular. 'I say "investigation" and people here panic,' explains B. Reg3. In the end, the province issues qualified pardons for most infractions. One rarer example is widely discussed – a firm is penalized for failure to report the dumping of diluent into a tailings pond. Consistent with AENV's tiered approach to incidents, the problem is not that the diluent is dumped in the tailings pond, which is not uncommon (B. Boots): 'But we will *investigate* if these [incidents] are not reported' (B. Reg3, Buddy's emphasis). 'The public's concerns are our hammer,' Buddy explains.

Nevertheless, practical compliance enforcement remains limited by the firms' begrudging cooperation. As B. Reg3 puts it, 'If it wasn't voluntary compliance, how would we… (pause) my god… (pause) how would we get out there? It's going to be a nightmare.' If AENV took an adversarial stance, 'These companies would close right up' (B. Reg3). Outside of this degree of firm cooperation with AENV, incidents deemed worthy of deeper investigation do originate from whistleblowers onsite who identify industry violations. The infamous case of "the ducks" spotlighted below in Chapter 6, an informant tells me, begins with complaints filed by disaffected employees.

5.3.2 Quango fig leaves

During fieldwork Alberta environmental regulators had established and partially funded several quasi-nongovernmental organizations ("quangos") to enlist membership representative of firms, government, nongovernmental organizations, and First Nations in an effort to administer “environmental effects monitoring” in a manner positioned to be acceptable to all involved stakeholders. This section discusses two quangos. The Wood Buffalo Environmental Association (WBEA) dedicates activities to measurements of air quality across the region. The Regional Aquatics Monitoring Program (RAMP) collects water quantity and quality, sediment, and fish samples from the Athabasca River, tributaries, and lakes. Participation in these quangos number among the many stipulations set by firms’ operating approvals and licenses (Lott and Jones 2010).

The WBEA grows out of the 1985 Air Quality Task Force established by Alberta and oilsands firms to engage complaints over odors lodged by the First Nations community of Fort McKay just a few miles north – and downwind – of Syncrude and Suncor plants. The portfolio expands to several dozen monitors across the RMWB in population centers and proximate to – however, not directly in the midst of – the firms’ operations. WBEA uploads real time air quality reports, including to digital displays in the hallways of the Fort McMurray community recreation center. It is not until 2009 that the WBEA adopts an institutional commitment to peer-reviewed scientific method. Perhaps this new WBEA strategy is understandable as preemptive avoidance of the travails of RAMP.

Syncrude’s (2009) promotional sustainability report touts the company’s involvement in RAMP, which it calls a ‘science based, multi-stakeholder’ organization (68). Similarly, in a 2008 promotional brochure, the Alberta government promotes the beneficial contributions of RAMP. Outside such assurances, prominent NGOs and First Nations groups abandon RAMP soon thereafter, frustrated over its domination by industry (B. Bear 2012, B. Engo 2012). In response, RAMP commissions an independent review of its research program in an effort to bolster its legitimacy. Among several findings of shoddy science, this review details how RAMP violated basic scientific principles when it placed monitors *only* upstream of potential industrial sources of contamination of the Athabasca River. ‘The standard approach,’ the peer review acidly observes, ‘would be to monitor both upstream and downstream’ (Ayles et al. 2004, 28). A follow-up organizational study includes a review of plans to outsource data collection to third parties. Unfortunately, however, RAMP is found to have made little headway towards scientific relevance (Main 2011).

Despite these profound shortcomings, RAMP's "authority" is repeatedly invoked by the industry and province alike as evidence of effective environmental governance in the region. Besides its invocation by Syncrude mentioned above, the province also cites RAMP as an authority long after that claim had become questionable on its face (e.g., Alberta, Canada 2008). One buddy with intimate knowledge of RAMP believes in retrospect the organization should have been clearer about its limited capacity. The chief problem, in Buddy's excuse, was not the shoddy science but rather outsiders who overstated RAMP's authoritative scope.

5.3.3 Quasi-public information

Senior government librarian B. Books offers reassurance that my difficulty in accessing industry data is structural, no fault of my own. Most required regulatory disclosures related to the oilsands, Buddy explains, are simultaneously published online upon receipt by regulatory agencies, and then without viable indexing, vanish within days or weeks depending on the frequency of other filings. As a result, law firms and the industry are the only actors with sufficient resources to construct their own comprehensive database of filings. Moreover, when the province does offer online access, there is no index of available information while search results are often incomplete (Timoney and Lee 2013); which my own experience confirms.

5.3.4 Red carpet treatment softens some criticism

Media exposés of Fort McMurray irritate local residents. Two specific exposes are denounced repeatedly. In 2006, *Chatelaine* magazine investigated Fort McMurray, including its notorious bars (Preville 2006). In response to my prompt about this, B. Mac scoffs: 'Of course, they found prostitutes and maybe drugs.' Second, the oilsands industry fetes *National Geographic* magazine when it visits in 2009. Nevertheless, the famous magazine's cover story, "Scraping Bottom," featuring its famous photography aimed at the mining devastation (Kunzig 2009). B. Sharp, who describes this experience unprompted, feels betrayed: ‘We showed National Geographic around for three days and they did us wrong.’

Despite these instances, there is no question that oilsands mining personnel, along with Fort McMurray officials, through demonstrations of their dedication to “softening the blow” of operations, achieve some success in charming high-profile critics. Federal Opposition Leader Thomas Mulcair had been committed to using the derogatory term “tar sands” on the campaign trail over the months leading up to a daylong briefing and site tour of the oilsands. At the end of the long day, Mulcair’s tune changes in departing remarks expressing the need for measured approaches to the challenges of the “bituminous sands” (Gerson 2012).

5.4 Workers Relations under Environmental Regulation

5.4.1 Following the law

A senior environmental officer onsite asserts their firm operates scrupulously, always within the letter of the law:

> We have a 75-page Environmental Protection Enhancement Act approval that details what we can do for construction, air monitor, ground water and surface water monitor, how we do reclamation, how to report, what do with waste material, how we treat our potable water, how we dispose of sewage. Everything is wrapped up in this big long approval. So, there are requirements on how we have to do things and why we have to do things…. Those are the law. (B. Bear)

With respect to tailings pond seepage specifically, Buddy emphasizes well-over 100 AENV-approved wells monitor groundwater onsite. Monthly, quarterly, and biannual ‘groundwater response plans’ set change parameters and confidence intervals to track naphthenic acids and chlorides. A five-step process guides response actions – from resampling for confirmation all the way to drilling collection wells to capture and manage process-affected water.

Despite the letter of these protocols, expert hydrogeologist B. Supper expresses skepticism over their implementation. Given what we know about the challenges of contamination management in well-understood settings, it is implausible to believe everything is under control in the very new oilsands. It has been historically easy to comply with Alberta environmental strictures, yet skirt accountability: 'A coal mine could get away for a long time with three or four closely placed wells before Alberta Environment caught up. Slow moving plumes in the tar sands might not yet be at the wells.' Moreover, grievous study results alone do not activate remediation interventions: 'When we find a leak it's not like we rush in to fix the problem; it continues to leak. It's not the movies.' And in very recent confirmation, after decades of indications, the international Commission for Environmental Cooperation (2020) establishes incontrovertibly that the oilsands industry tailings ponds seep beyond containment structures and no one knows how to abate it.

5.4.2 General disdain for environmental activism

The oilsands activist community, conclude Haluza-DeLay and Carter (2016), fails to connect with the hegemonic mindset in Alberta. Fieldwork provides substantial confirmation. 'Fuck Greenpeace,' snaps more than one Newfoundlander in the oilsands, who impugns its principles for fundraising off the traditional Newfoundland seal hunt on the one hand, while on the other, ignoring requests to help save Newfoundland's non-charismatic cod fishery, both of which hastened labor migration to Alberta. A rebuke from an Illinois church sent to one firm castigating its environmental practices flashes into the memory of a regulatory compliance officer at that company. Buddy Stern's jaw clenches and eyes flash disdain at the presumptive interference, quickly sublimated by closed eyes and a practiced deep breath. Subsequently, a legalistic scoff: 'They have no standing,' ends the discussion.

It is not that the industry workforce does not care about the environment, but rather that they are 'sick and tired of hearing about it' in the words of B. Lumber. Much higher priorities for equipment operators in the mine are amount of job hours, safety, inconsistent foremen, sex and drugs, and the next purchase they will make. To a person they bristle at the topic of downstream impacts (B. Chicken). When pushed in social chat at the recreation center, party, or bar, one person counsels old pipelines are riskier than the new one they are currently constructing; quite a few workers argue natural bitumen seeps have impacted the environment for millennia. Itinerant laborers compare the oilsands to previously worked extraction zones, such as the Australian who recalls Victoria's 'far dirtier' lignite mines, or the Canadian who 'moved here eight years ago from Ontario and everybody told me "It's so dirty up there," but I breathe better here than I ever did where I lived northeast of Toronto.'[25] Others locate the region's historical "staples economy" of uranium mining, logging, trapping, pulp mills, and today's oilsands mining as pillars of economic production within global resource extraction networks. Laborers recognize basic industry never operates without impacts – 'it's not rainbows and unicorns,' explains one. However, given their daily efforts both in direct environmental abatement and remediation and in labor compliant with environmental licenses, they feel unfairly singled out by critics.

Greenpeace occupies a Suncor plant

'I was [at Suncor] when Greenpeace came on site,' offers B. Deer (2011), who agrees to elaborate on the September 2009 incident. Buddy explains the firm and industry were on high alert as Greenpeace activists had lodged for a week in a Fort McMurray hotel and already had staged an action in the Shell oilsands mine. The Suncor operation spans both sides of the Athabasca River without shoreline fence. From the bridge, security monitored approaching canoes and notified managers, who assembled shoulder-to-shoulder to block the activists' advance beyond shore. However, top management had ordered strict avoidance of physical engagement with the intruders, who simply squeezed through the human wall and proceeded to the central production facility.

Activists climbed the steep conveyors that run raw crushed ore up into the primary separation plant. Controllers shut down all plant conveyors to forestall injury while tradesmen who had seen the drama unfold blocked the openings where the conveyors entered into the plant itself. (The upgraders are supplied by tanks of bitumen inventory, thus, were not affected):

> They chained themselves, it was about nine in the morning, they chained themselves to the conveyer structure. Apparently, they were fully

[25] Others recorded: Oilsands are cleaner and less corrupt than foreign sources; the industry is simply cleaning up the oil spill left by nature; and, wind turbines and buildings kill countless more birds.

> prepared, they had survival suits on, "Depends" adult diapers, they were ready to stay for a while…. One had a satellite phone on a laptop and he was blogging live about the protest that was occurring and whatnot. (B. Deer)

Local police and Royal Canadian Mounted Police flooded the area. Video was set up to capture the scene. One protestor miscalculated the traverse to a second conveyer, rappelled to the ground, and submitted to arrest. Most striking was the virulent response of laborers in the separation plant:

> I was surprised at the animosity that came out of the trades guys. They were angry. Very angry, that people would come in and disturb their workplace like this. And endanger themselves, endanger their workplace, to do this. It really frustrated them. And there were all sorts of suggestions about, let's offer them some coffee with "ex-lax" in it, why don't we spray the firehose on them about every ten minutes, let them cool off and spray them a little more, there was a real animosity towards these guys. (B. Deer)

Buddy appreciates, but does not share this anger, although Greenpeace's action seems 'sort of dumb' and cheapens its reputation. 'So, my respect for Greenpeace has fallen, let's just say that. I don't agree with their methods and I don't agree with their methodology, so, they're not my kind of not-for-profit charity.'

In reference to Greenpeace more generally, B. Curling, who as a young adult had been involved with the group, applauds the urgent matters it brings to light, yet rejects its one-sided lack of recognition of the industry's ecological modernization. Comparable in sentiment, B. Boots says in one breath that environmental watchdogs are valuable; and in the next, 'I don't have any time for Greenpeace.' Greenpeace has garnered tens of thousands of views of its tar sands actions; the sort of consciousness-raising actions Davidson and Gismondi (2011), among others, urge to build global coalitions to shut down the tar sands. Yet, relations fray with the likes of B. Boots, B. Curling, and B. Deer in line with concerns of Haluza-DeLay and Carter (2016).

Notably, however, not all laborers agree on these attitudes. Thirty-plus year veteran B. Cousin says we need activists like Greenpeace to offset the ineffective regulation of a government in bed with the industry. Without that pressure, in Buddy's mind, the companies would run out of control.

5.4.3 Environment of work in the mine pit

Removal of overburden and groundwater to establish the mine obliterates labor's relation with the lost boreal habitat. After mining begins, 'There's no difference between day and night. It's all twenty-four-hour a day operation, everything's the same' (B. Doggy). Throughout the mine, berm-lined cantered roads direct runoff into onsite impoundments (B. Chicken, B. Hobby). High-voltage power lines are strung between eighty-foot utility poles, tall enough to give clearance for haul trucks, yet insufficiently tall for electricians working on them to escape truck's trailing dust plumes. Master electrician B. Hockey locates adult-onset allergies to the years engaged on those lines.

On the question of wider environmental concern among site workers, a person familiar with Newfoundlanders in the industry reports, 'I wouldn't be surprised if many of them thought nothing at all of it' (B. Black). However, some do pause to think. Haul truck driver B. Drum confesses, 'Sometimes I feel guilty about it. I'm at the top and look down and think, "What have we done?", but then I think if I didn't do it, someone would.'

Wistful thirty-year veteran B. Doggy bemoans 'little respect for animals' in the mine. For instance, Buddy explains, newly-opened mine faces tear into dens of overwintering bears. If not killed outright, the hibernators are shooed away to fend for themselves. Other workers also share affection toward animals in the mine. Haul truck driver B. Sauna2 recognizes coyotes, but reports more foxes and once being upbraided by a grader operator for stopping on a mine road to let one pass: 'He wanted me to keep going, but I couldn't do that. They're like dogs; I don't feed them, but wouldn't hurt one.' More informants described habituated coyotes, including the prohibition against feeding them, which is ignored enough to encourage canid begging around the shovels where traffic comes to a temporary stop. Coyotes in one den situated in the heart of 24-hour mining operations appear inured to the din, yet also wary enough to disappear when wildlife personnel arrive with rifles to exterminate them (B. Union).

Hyper-mitigation

Fluid spills comprise one of several categories of hyper-mitigation. Spills of any fluids inside the vast mines, previously overlooked, today receive immediate scrutiny, and frequently, demand excavation for relocation into contaminant impoundments (B. Boots, B. Union). One firm outfits its 120-ton capacity Bucyrus mine shovels with 'diapers' in the words of B. Bucky to contain blow-outs of hydraulic lines. 'I think it's a bit extreme,' says Buddy in a clear effort to be polite; however, given the downtime cost of contaminant spills, diapers likely pay off in productivity. Practical limits appear. Consultant B. Iron scrupulously complies with a client's stated procedures; so, when fluid spills during an ore crusher setup, Buddy immediately informs the firm's environmental office. However, after the response team arrives and jumps to remediate an old stain rather than the new smaller mishap, Buddy gains the impression of having wasted their time. This level of concern stands in stark contrast with the once common practice of burying damaged and obsolete heavy equipment in the mine pits (B. Chicken); at the same time, it does little practically to mitigate the industry's ravages.

5.4.4 Environment of work in the separation plant and upgrader

As B. Drum and other informants inside the mine suggest, laborers' decision-making influence on the environment is limited once the choice has been made to participate as a worker. Outside of wildlife encounters and mine road mishaps, relentless structured labor pushes ore towards the unquenchable upgrader. 'You gotta feed the beast,' B. Chicken (2011) puts it.

Refer to the Chapter 4 explanation of the production process that yields synthetic crude oil as well as copious volumes of waste in the form of liquid tailings, solid coke and sulfur, and toxic gases. Laborers who work in the separation and upgrader plants experience continual exposures to these perilous substances: 'Now, if you're inside the plant next to the coker, you're exposed to all sorts of stuff,' emphasizes B. Mouse (2012). Most of this risky material results from highly-structured production activity. Indeed, even manual emergency flaring of partially processed coker gas, for example, reflects rules-based logical controls executed by panel operators. These elite blue-collar workers feel bad about such emergency releases, due both to direct concern for the environment, and also because management initiatives make it a point of emphasis to reduce such events, which often trigger incident reports to provincial environmental authorities (B. Rabbit). Or, in the words of plant engineer B. Show, 'When the smoke from that stack turns black, we have to file an incident.' Beyond emergencies alone, day to day operations flare continually; and in one example of this maintenance, continuous flaring was projected to last over two weeks (Timoney and Lee 2013, 145).

5.5 Unregulated Environmental Hazards

5.5.1 Dangerous gases

Like all frigid lakes every spring, tailings pondwater undergoes a thermal turnover, which in their peculiar case belches massive plumes of poisonous hydrogen sulfide lasting days on end – a million cubic meters released on one site alone (B. Curling). At such times, and throughout the year, the companies host regulators to take spot samples of such tailings ponds emissions (Siddique et al. 2008, Small et al. 2015). This methodology troubles one company insider: 'How can you really quantify what comes off your tailings pond? Okay so you stick this thing floating around on the surface to capture for that particular day at that particular time….' (B. Boots). The necessity of environmental monitors conceded, Buddy suggests pond studies serve institutional goals without repercussions to operations:

> So, it's better than doing nothing, but what is it *really* telling you? I mean, we've done all kinds of tests and studies and things like that, and it tells you something, either tells you you're really bad or not sure (*laughs*). Or, I think we're really great, but, really? I don't know. You have to do it to satisfy people. (B. Boots)

Regardless of vaporization data, in other words, everyone understands the ponds are long-term fixtures.

Other sources of volatilization are tank facilities without vapor recovery units and running vapor recovery units above capacity (B. Deer), as well as the expansive coke dump where for a period of time B. Chicken both drives a haul truck to remove waste from the Suncor batch cokers and water truck to suppress its dust. Syncrude also dumps coke, yet more discreetly (Timoney and Lee 2013, 45). Suncor management urges equipment operators to keep their windows rolled up as the cab climate was maintained by HEPA-filtration and the discarded coke smoldered for a week. Nevertheless, due to poor maintenance, 'Even with the windows rolled up I'd come home at the end of the day covered in black soot.' Presumably, says Buddy, these conditions are what lead Suncor to ban pregnant women from work in the coke dump.

In addition to volatilization, malevolent gases spew from the upgraders. Buddy Sauna keeps an eye on the exhaust of dozens of short stacks, which typically appears white, but turns gray or yellow due to, respectively, excessive arsenic or sulfur in the process. With engineering experience in the chemical industry, both B. Calgary and B. Show decry such leaks, which in their eyes indicates poor process control and plant maintenance. These sorts of toxic gases with associated heavy metals, along with 400 tons of fine particulates 2.5 microns and less ($PM_{2.5}$), were discharged from these short stacks in 2010 at Syncrude and Suncor (MacDonald 2013). 'There have been people who have stood up in meetings and said, "the gas falls like anvils and it's killing us." They don't last long,' deadpans Buddy Scofflaw, who adds it *does* pay to know the upgrader's sheltered locations: 'You learn where to stand.' Buddies Millwright and Boom sustain constant vigilance over wind direction should they need to escape poisonous plumes.

On a related note, B. Bus a senior bus driver who ferries onsite executives in a reserved passenger coach, parks it in a far corner of the leasehold during the workday and opens its windows in order to provide fresh air to patrons on their commute back to Fort McMurray.

The material danger is real in the eyes of B. Mouse who places high probability on sulfur compounds shooting out of short stacks or billowing from flares to become readily acidified by humid atmosphere; and if so, wreak havoc on lung tissue. Former

Suncor executive-turned-consultant Harold Page (1972, 20-1) emphasizes this concern increases in the 'ice fog' of winter months. This question eludes investigation by the Wood Buffalo Environmental Association (WBEA), the nongovernmental organization that serves as the region's *de facto* air quality monitor.

5.5.2 Fine particulates and associated compounds

'There's stuff in that dust,' asserts Alberta regulator B. Reg3 in a personal belief that appears to garner no institutional urgency. To the contrary, B. Curling had participated in a study (that also involved WBEA) in which onsite laborers wore sampling "badges" to capture ambient particulates. Results held nothing of interest. Buddy Mouse classifies road and dike dust in the coarse category, larger than $PM_{2.5}$, thus, less likely to lodge in lung tissue. Sand dust is not a "toxin" and therefore not studied. Environmental impact studies filed by oilsands mine applicants do contain sections dedicated to Human Exposure; however, these fail to include airborne particulates (Alberta Energy and Utilities Board [AEUB] 1997).

More recent research, however, isolates five key sources of $PM_{2.5}$: haul truck road dust, equipment emissions, and the upgrader, as well as soil disturbance and regional forest fire smoke, which combine organic and mineral compounds as well as heavy metals (Phillips-Smith et al. 2017). In concurrence, Landis et al. (2019) also demonstrate these fine particles bind with hazardous polycyclic aromatic hydrocarbons (PAH). A key source of PAHs is coke dust, left over from upgrading and both stored and burned as fuel (Xu 2018, Zhang et al. 2016). Note, these particulate studies are undertaken at already-installed WBEA monitoring towers proximate to – yet, not in the hearts of – the oilsands firms' operations.

Anecdotal evidence of something going on

Chatting in the coed sauna at the community recreation center, B. Sauna says, 'It's good to sweat out Fort McMurray. Now if I could only do the same for my lungs,' and continues: 'I have respiratory problems. Doctors in Edmonton tell me they're surprised by how many young [buddies] they're seeing with emphysema.' Buddy Driver recalls driving a haul truck for years with the window down, 'but one day I finished my shift coughing and having trouble breathing. That lasted for two days. Now, if the air conditioner doesn't work, I don't drive the truck.' Individual experiences, not managerial commands, lead to such decisions. 'I tell my guys to roll up windows and keep their cabs clean,' explains B. Union before conceding, 'Yeah, what can you do?' As a contract laborer specialized in immense outdoor scaffolds, B. Carpenter had been instructed, nevertheless, not to work outside more than four hours a day, 'to cover Suncor's ass,' in Buddy's words.

B. Curling concedes these onsite environmental hazards, and adds they are exacerbated yet adds cigarettes, fast food, and sleeplessness as additional key lifestyle factors. In addition, research shows volatile organic compounds and PAHs measured in gas flare emissions are also present indoors – originating from indoor sources and almost always at higher concentrations than outdoors (Kindzierski 2000).

5.6 Brief Case: Protected Birds Disrupt a New Mine Launch

Legal compliance with environmental regulations is not so straightforward suggests the following brief case, wherein production managers and attorneys scrutinize every path to skirt bird protection rules, so as to avoid disruption to the commissioning schedule of their new mine.

The oilsands industry will, over its lifetime, kill up to 160 million migratory birds, directly and through habitat loss (Wells et al. 2008). Ironically, B. Show winces, 'Birds love our pipes,' as we walk the less-restricted edges of an upgrader. Songbirds flock year-round to miles of bundled pipes in the upgrader for warmth and shelter. Government-protected birds pose a nuisance onsite where environmental departments devote substantial resources towards deterrence. Besides scarecrows, noise canons, and even radar-activated alarms, firms deploy airboats to chase ducks off tailings ponds, scoop out dead ones, 'and if they're still squirming to give their little neck a twist' (B. Doggy; also, B. Boots). Despite these efforts, nevertheless, the birds remain insistent and it is difficult to keep them away. A report produced for AENV quantifies the low performance of the AENV-regulated bird protection regime, and makes recommendations to minimize mortality. The provincial agency stifles this public release until forced by freedom of information rulings (Riley 2021). Nevertheless, regulation shapes activity. This brief case describes how a scheduled multibillion dollar mine start-up runs smack up against protected birds.[26]

During fieldwork, all the firms – and AENV regulators – are on edge in the wake of the 2010 “ducks” disaster, detailed in the next chapter, which sees a $3 million penalty levied on Syncrude for its failure to deploy waterfowl abatement measures consistent with its regulatory permit, and the resultant deaths of 1,601 ducks that mistake a toxic industrial tailings impoundment for a freshwater pond. To be clear, oilsands tailings ponds kill plenty of waterfowl, between 450 and 5,000 annually, calculate Timoney and Ronconi (2010). The Syncrude penalty is not for the deaths *per se*, rather specifically, its failure to exercise preventative due-diligence.

Easy to denounce, oilsands tailings ponds nevertheless incorporate substantive engineered structures to direct seepage flows in predictable channels where they can be intercepted and returned. At the same time, I cannot overemphasize how this engineering has undergirded rationalizations of tailings production. Only very recently has the failure of this mitigation alone become incontrovertible (Commission for Environmental Cooperation 2020). Under construction at the time, the new mine’s tailings pond would extend over 6 square miles upon completion. One day in the intensive closing days of this build-out, an environmental worker discovers a nest with waterfowl eggs protected under provincial and federal law. As a result, the entire area had to be vacated to wait for the eggs to hatch and the birds to fledge. But that is only the beginning. Apparently attracted by the successfully nesting pair, other waterfowl descend on the area to set up a colony. Workers scramble to interrupt avian nature, but with mixed results. Despite best efforts, these waterfowl force a comprehensive recalculation of the critical path of the tailings pond construction and imperil the mine launch.

Buddy has seen careers made and broken based on abilities to meet demanding progress timetables to open the new mine; and at this point, it is only months from its

[26] To anonymize the limited participant pool in these events, this section lumps informants under the catchall, “Buddy.” Even so, details remain murky due to informants’ equivocations.

launch. The firm's executive leadership has not planned for such delays and shows no wherewithal to adjust the timetable. With the mine opening imminent, the countdown remains on track to flood the waterfowl-occupied area with hot toxic tailings – a *prima facia* violation of environmental strictures in the eyes of a few outspoken project leaders. Fully cognizant of the very real risk, senior management resolves, nevertheless, to press on with the launch schedule. Pressure is high to sign-off on benefit-cost analyses that concede the risk of environmental rule violation, yet calculate that is outweighed by the benefit of on-time plant commissioning. Under regulatory scrutiny redoubled by the recent Syncrude "ducks" case, the firm's legal office scours potential pathways forward within the letter of the law. However, none is found. Only at the midnight hour does risk-averse sensibility prevail, and concede to a postponement. In Buddy's words: 'The right thing was done at the end. But we came that close. To violating. Our principles.'

In addition to these unwelcome waterfowl, suddenly it comes to light there are nearly 200 cliff swallow nests on the walls of the separation plant's outdoor treatment cells. Like the nesting ducks, these migratory birds are protected, which means the plant cannot be commissioned so long as their nests obstruct its operations. In urgent response, the firm retains a wildlife biologist who deploys a flexible scope to peer into each nest and monitor its eggs, chicks, and fledglings. Once young birds fledge, nests are scraped off the walls without ceremony. Then, after weeks of progress and to the chagrin of all involved, new eggs are discovered. Capital and management exasperation reaches its breaking point and the plant is commissioned without fully-resolving the situation. A firm employee files a complaint prompting a site visit by a regulatory investigator. Several senior leaders including the general manager are informed they should retain attorneys as any situation with wildlife is potentially fraught with legal jeopardy. In the end, however, regulators agree the firm has pursued adequate due-diligence and the matter is dropped. This close call shapes Buddy's industry view: 'I've put a lot of this stuff out of my mind, but I look back at some of the stuff that happened and… there are unethical people that work in our organization.'

This case demonstrates how environmental regulation, the unpredictable environment, and individual workers' actions and decisions shape company behavior. A vast oilsands mine is about to launch with associated environmental outcomes; at the same time, two small groups of protected birds in separate areas of the mine grind petro-capital's schedules to a temporary halt.

CHAPTER 6. THE FINE CRISIS

> We can, indeed we must, recognize the fact that capitalism produces nature, but we must simultaneously recognize the materiality – and consequentiality – of the particular natures capitalism produces. (Castree 1995, 21)

> You cannot make tailings ponds go away, you go to any mine on the planet and there will be a tailings pond. (B. Miner)

6.1 The Ducks

In Spring 2008, a cold snap and late-season snowfall drove thousands of ducks toward an ice-free pond at the facilities of Syncrude, the largest operator in the Alberta, Canada, oilsands mining industry. Unfortunately, the birds' perceived refuge was not an open lake at all, but rather a two square mile wastewater containment facility kept partially unfrozen by the continuous addition of warm sludgy waste produced by the oilsands extraction process – a tailings pond. The pond appeared as freshwater to the exhausted waterfowl, but in fact the surface was blanketed by a floating mat of unrecovered bitumen, and soon after landing the misfortunate ducks either became engulfed and drowned or died of toxicity and exposure.

In response to this calamity the Province of Alberta and federal government filed an environmental lawsuit against the firm, ultimately prevailing in a 2010 decision. Rather than punish Syncrude for the deaths of 1,601 migratory waterfowl *per se*, this $3 million judgment stemmed from the firm's failure to deploy standard safeguards (i.e., scarecrows, canons, etc.) that discourage – but never prevent – wildlife from falling prey to tailings ponds (R v Syncrude 2010; see also, Timoney and Ronconi (2010) for annual waterfowl mortality in the oilsands tailings ponds).

Despite this guilty verdict, in many eyes the evidence of industry culpability still is not so straightforward. Countless Albertans flare with indignation when prompted, 'tell me about the ducks.' They remain skeptical about the Syncrude verdict, reasoning human error should be excused and herculean attempts were made to save the stricken birds. Others believe the magnitude of avian fatalities was inconsequential compared with mortality caused by windows, wind turbines, and hunters.

The Ducks provide an entry into this chapter's analysis of the tailings ponds of the oilsands mining industry — the crucial feature of the materiality and consequentiality of the particular nature that capitalism produces in the oilsands mines, as well as the particular capitalism that oilsands nature produces. The Syncrude verdict is superficially punitive; more crucially however, it affirms that the industry's production of nearly 30 square miles of open tailings water – 40 square miles today – is not *prima facie* violation of provincial and federal laws that prohibit environmental desecration (Fluker 2011). Using these legalized oilsands tailings ponds as a lens, this chapter locates the relations between the oilsands industry, the state, and the material idiosyncrasies of bituminous sands in constituting a regulated waste-heavy economy by: 1) producing oilsands tailings in the first place; 2) impounding tailings in diked ponds, which produces water crises related to non-settling, water balance, and seepage; 3) attempting to mediate and abate the crisis of impounded recalcitrant "mature fine tailings" (MFT); and, 4) regulating tailings pond remediation, including rollout of "command-and-control" strictures typically claimed to be obsolete in the neoliberal era.

6.2 Waste-Heavy Economy: Producing Tailings

Although raw oilsands ore contains little use value and less in exchange, earlier chapters detail how generations of technological perseverance worked to make it a resource.[27] Chapter 4 sketches the contemporary process of oilsands commoditization, where readers will recall, the first crucial challenge is to separate and isolate bitumen. Most mining firms accomplish this via variants of the Clark flotation process, the basics of which can be appreciated in twice daily tabletop demonstrations in Fort McMurray's Oil Sands Discovery Centre wherein the addition of hot water stirred into pulped ore in a large beaker yields three distinct layers consisting of floating bitumen, sinking sand, and in between, a larger cloudy fraction of "middlings" water. This primary extraction recovers only about two-thirds of the available bitumen. As such, at industrial scale, oilsands firms subject their middlings to secondary and tertiary treatments, which raise total bitumen yields from the raw ore to 95 percent and higher.

[27] Cf. Zimmermann, E. W. 1951. *World resources and industries; a functional appraisal of the availability of agricultural and industrial resources*. New York, London,: Harper & Brothers.

The chief waste byproduct of the Clark process is a siliceous slurry of consisting of added water, raising it from 30 to 50 percent of total volume, plus stony sand to clay fines, naphthenic acid, polyaromatic hydrocarbons, metals, and unrecovered bitumen, collectively known as "fluid tailings." Indeed, the Clark process produces more tailings waste than bitumen – 1.5 barrels of fluid tailings for each barrel of synthetic crude oil (Mikula 2012). Thus, beyond the challenge of bitumen separation, the second basic industry challenge is handling this resultant waste stream of the Clark process, which – due to the combination of nonstop operations and input ore that process-water swells to 40 percent greater waste volume (Camp 1976) – makes the oilsands mines the world's largest producers of mine tailings (Masliyah et al. 2004).

Whereas earlier generations of oilsands entrepreneurs dumped these tailings directly on the ground or into the same rivers they sourced for raw production water, regulation of the sheer volume of the contemporary industry makes that impracticable. Empirical data analyzed within this chapter addresses the vast network of ponds constructed to impound this tailings waste and the attempts to manage this network. Beyond the quantity of tailings and their cocktail of toxic substances, the core challenge of tailings is the confounding property of clay "fines." Smaller than 45 microns, these fines exist throughout the raw oilsands ore and are necessary to some degree in effecting bitumen separation via the Clark process; yet also, problematically they defy efforts to completely eliminate them from the tailings pond water column where they accumulate.

6.3 Waste-Heavy Economy: Impounding Tailings

By the late 1950s, as oil companies seek regulatory approval for larger scale oilsands ventures, a solution needs to be found to the incredible volume of tailings waste produced by the Clark process, which will pose a navigation hazard if dumped into the Athabasca River. In addition, the issue of tailings toxicity lingers. The workaround emerges in the form of the diked impoundments known as tailings ponds to store the firms' postproduction wastewater. After a half century, this "zero discharge" rubric continues to mitigate the release of contaminated tailings water into the ambient environment, shaping both ecological impacts and provincial regulation.

It is important to understand parameters of zero discharge are not fully specified at the outset; rather they emerge over the 1960s and 1970s during the opening decades of the oilsands industry. This coalescence becomes clear through analysis of the earliest approval applications and provincial responses pertaining to the Suncor and Syncrude start-ups. The province's Oil and Gas Conservation Board (1960) retains experts to review Great Canadian Oil Sands' (Suncor's) initial proposal in which the one planned mitigation is a low dike to prevent direct drainage into the river outfitted with a trench to capture clarified tailings drainage, and with ambitious plans to transport dried tailings sand back to mined out areas within three years. The Board expresses repeated misgivings about the firm's plans, which amount to little more than dumping tailings on the delta of an Athabasca tributary just to the south of the extraction plant and upgrader: 'The Board is of the opinion that the problem of initial sand tailings disposal has been given a minimum of study by the applicant' (50). Specific shortcomings include lack of provision for cold weather, lack of understanding the challenge of transporting sluiced tailings, and unrealistic expectations about the stability of stacked dry tailings. Similarly, the Cities Service consortium proposal to the Oil and Gas Conservation Board (1962) offers optimistic expectations of returning clarified postproduction wastewater to the Athabasca River with the vague acknowledgement that excess bitumen and solids will pose difficulties in need of resolution. A few years later, Suncor offers little additional evidence that tailings will settle in ponds as claimed, according to the Oil and Gas Conservation Board (1964). Despite this crucial shortfall, however, its greater attention to dike integrity in the dump area is enough to win provincial approval.

Using the coarsest tailings sand and clay as the primary construction materials, engineers raise dike walls ahead of rising tailings contents to heights of 200-300 feet, which can extend over 10 miles in length to encircle many square miles of surface area, ranking them among the world's largest diked impoundments (Morgenstern and Scott 1997). As observed in Chapter 5, environmental regulator B. Reg is particularly impressed with the agency’s standards and enforcement with respect to dike structures around tailings ponds, which aim to prevent failures that models predict would inundate the Athabasca valley *upstream* to flood Fort McMurray. Suncor’s original tailings pond had been under-engineered from the outset, but subsequently underwent significant interventions to enhance its stability (Morgenstern 1976). Here is one area in which Syncrude does appear to implement the lessons of Suncor. Prior to completing construction of its first mine and upgrader, the firm empanels an outside geotechnical review board with particular emphasis on mine wall and tailings dike integrity (McKenna 1998). Syncrude’s first tailings pond features strategically placed drains that capture seepage at the toe of the dike for return to the pond in addition to sustained attention to the integrity of the dike (List and Lord 1997, McKenna 1998). In this regard, geotechnical surveyor B. Transit confirms that Syncrude monitors dike wall perturbations within tolerances of less than one centimeter.

Contemporary Alberta approvals and licenses have evolved to require that the oilsands companies institute: strict dike-construction practices and monitoring to reduce the possibility of catastrophic dike failure caused by foundation slippage or liquefaction; drains at downstream toes of dikes that capture seepage for return to the tailings pond; monitoring procedures to report quantities and locations of seepage emanating from the tailings ponds, including remedial intervention if indicated; and, wildlife mitigation practices. The latter includes vegetation clearance, booms to prevent the formation of bitumen ‘mats’ on pond surfaces, randomized noise canons, and animated falcon effigies. Some firms are testing the efficacy of radar-triggered wildlife aversions intended to reduce the problem of habituation – activity that picks up after the Ducks verdict, according to B. Radar, a manufacturer’s representative with a display at an oilsands trade conference.

These practices of impounding tailings spawn decades of crises, my research reveals, including the three detailed immediately below, which – even the firms and province concede – remain only partially resolved.

6.3.1 Tailings pond crisis #1: Non-clarifying water

A sprawling problem emerges within a year of Suncor's 1967 launch when it becomes obvious that the tailings impoundment process does not work as planned. Heavier coarse tailings solids do settle rapidly to the bottom of the company's Pond 1; however, the finest clay particles in the tailings remain locked within cloudy middlings and a toxic yogurt-like suspension of approximately thirty percent solids that is extremely resistant to further dewatering. The resistance of oilsands fine tailings to settling stems from molecular scale interactions of bitumen, water, sand, and clay. During the Clark process, more complete dispersion of oil particles away from other constituents of the saturated ore matrix enhances the recovery of economic bitumen; yet also as a direct consequence, this dispersion exacerbates the molecular challenge of forcing the leftover material back into solids that settle out of postproduction water. This confounding challenge is known as dewatering or producing non-segregating tailing. Clay plays the central role in this formula. Some proportion of clay is essential during bitumen separation, as it enhances the conversion of bitumen droplets into surfactants, which enables extraction efficiencies well above 90 percent (Schramm et al. 2000; see also, Clark and Pasternack 1949). But at the same time, higher proportions of clay in the input feed increase volumes of clay particles that remain separated in a cloudy suspension rather than settling out of the tailings waste along with coarser particles (Mikula et al. 1996).

The technical literature largely excuses Suncor for this contingency. Typical is the determination of Morgenstern and Scott (1997) that '[t]he characteristics of segregating tailings… and the resulting large storage requirements were not understood by the initial designers of the Suncor operation' (105). Less charitable criticism points to mid-century discovery of properties of clay fines in oilsands extraction and the peculiarities of associated tailings wastewater that Clark and Pasternack (1949) describe. Comparable to Suncor's initial lackadaisical approach to tailings pond construction, the firm's plan to easily recover clarified water from tailings relies more upon asserted desire rather than experimental evidence. Putting aside culpability, the material challenge is profoundly pressing as within the first year of operation this 'unanticipated' tailings accumulation rapidly fills Suncor Pond 1 at a rate of 20 percent of the volume of material processed in the separation plants (FTFC 1995, Liu 1993). By the early 1970s, Suncor invests millions to dry out its problem 'sludge,' yet a decade later it is no closer to dewatering what has become known widely as "mature fine tailings" (MFT) (Oliver 1977). Researchers later concede that without mitigation it will take '*thousands of years*' for MFT to settle into eighty percent solids, which is the ratio necessary to support the weight of earthmoving equipment and reclamation (Mikula et al. 1996, added emphasis). As an emergency stopgap, Suncor petitions Alberta for regulatory permission to dump Pond 1 overflow into a neighboring lake (Page 1972). This emergency action is narrowly averted only by the construction of several new tailings ponds, and also by increasing the height of the retention dike of Pond 1 faster than anticipated, which in its service life vaults to 320 ft. – over half again higher than the original planned top of 200 ft. (Morgenstern and Scott 1997).

The experience of Suncor's Pond 1 could have served as a valuable lesson in the logistical challenges of impounding industrial volumes of oilsands tailings. It is not clear then why Syncrude so underinvests in its waste facilities, setting up its own tailings crisis. Syncrude plans that 50 percent of its water needs will be met by recycled water drawn from its initial tailings pond. Immediately, however, excessive fine particles in the tailings effluent inhibit settling, and thus prevent the reuse of water for production. At the same time, the residual toxic bitumen found in the pondwater makes it impossible to dump it into the Athabasca watershed without breeching regulations. As Suncor's decade-old MFT crisis continues unabated, Syncrude begins operations in 1978 with an acute shortage of infrastructure to store tailings and MFT. Despite enlisting scientists from the University of Alberta to devise and test potential solutions, resolution of this crisis remains elusive (Caughill, Morgenstern and Scott 1993). Without any other options, Syncrude fills its original tailings pond with MFT decades before its forecasts had projected (List and Lord 1997).

Echoing these early under-investments in tailings facilities uncovered in my archival research, the contemporary oilsands industry's environmental disclosures continue to understate the rate and accumulation of fine tailings production (Houlihan and Mian 2008). In 2016, a few years after primary fieldwork is complete, the total wet surface area of the industry's tailings ponds is almost 40 square miles, within 99 square miles of dedicated tailings management facilities[28] in which the total volume of fine tailings is over 6 billion barrels.[29]

6.3.2 Tailings pond crisis #2: Difficulty of water balance

Most accounts of oilsands production, including this dissertation for the most part, emphasize material flows in terms of the transformation of raw ore into commodities and waste. Yet, a subset of design and operating engineers understand the enterprise as a problem of water flow, which is involved in sluiced transport of raw ore and waste, bitumen separation, steam heating, amine and sulfur recovery, and comprises 70 percent of MFT. Despite the significant challenge of MFT, B. Rabbit explains, tailings ponds long have been key features of the continuously operating industrial operations, as a destination for new waste to be sure, but also as a crucial source of recycled settled water from the surface layer of the ponds. Recycling water requires substantial capital and operational funding as it depends on massive water treatment facilities, engineered to handle high volumes with added redundancy including support and ancillary equipment. In one example, Syncrude currently obtains 85 percent of its water needs via recycling (Syncrude 2009).

Despite this high rate of recycling, however, what is known as "water balance" in the firms' systems exists under increasing stress, due to the accumulation of MFT, bitumen, and ionized calcium from consolidated tailings (CT) technologies explained below. To put it simply, the repeated re-use of tailings ponds water for steam and other operational applications leaves even the clarified water degraded by ionization and contamination. In response, despite the firms' and provincial assurances of zero discharge, Syncrude, Suncor, and provincial regulators for decades have been

[28] http://osip.alberta.ca/library/Dataset/Details/542 (accessed 2-October-21)
[29] http://osip.alberta.ca/library/Dataset/Details/540 (accessed 2-October-21)

investigating the political and material implications of the overt release of postproduction water (Oil Sands Water Release Technical Working Group 1996, Rogers et al. 1996, Rogers et al. 1998). Pushing for some degree of postproduction water discharge to reset the ponds' water balances, Buddy Prof assures me that researchers have sent samples of candidate release water to federal agents for assay, which has determined this water to be less turbid and toxic than routine industrial effluent released into the Great Lakes, an irksome double standard in Buddy's eyes, who sees no achievable alternative to release. This political pressure to allow the release of tailings pond water into the Athabasca has only strengthened, so that current expectations anticipate in 2023 such water releases will commence (French 2020).

6.3.3 Tailings pond crisis #3: Seepage

Oilsands mining firms issue sustainability reports that routinely tout their compliance with zero discharge policies, intended as palliative assurances that toxic waste is fully contained (Suncor 2009, Syncrude 2009). Of crucial importance, however, is that these specious public relations reports pointedly fail to disclose the copious seepage of materials from the unlined bases of the tailings ponds. This long indisputable topic codified in the firms' operating permits (e.g., Hodgson 1978) sanctions the release of significant volumes of tailings pond seepage – currently over 25 million barrels annually for the industry (Price 2008), an equivalent volume to more than 90 Exxon-Valdez spills every year. The companies are required to monitor this seepage and report results to Alberta according to the ten-year terms of their operating permits; however, the results are not made public. After years of provincial rebuffs of NGO requests for seepage data, the federal government has recently snuffed out a comparable petition by the environmental watchdog under the North American Free Trade Agreement (Sutherland 2015). To estimate seepage given this empirical data embargo, Price (2008) uses modeled seepage estimates disclosed in the environmental impact assessments of company's approval applications as stand-ins for minimal seepage in practice. My informants inside firms are emphatic about aiming to comply with the minimal standards set by Alberta-issued licenses and approvals – 'we follow the law' (B. Bear).

Firms' silence on seepage stands in notable contrast to the tendency of the industry's public relations to disclose information selectively to paint the best picture, which makes it reasonable to conclude the situation is not appreciably better, and possibly worse than Price (2008) projects.

Due to the dearth of publicly available data, little more can be concluded for certain about current levels of pond seepage. Archival research into Suncor's first tailings pond during its first decade of operations (Pond 1) reveals actual seepage rates at that time: over 4 million barrels of seepage discharge annually (Bouthillier 1976), a volume that diminishes only marginally two decades later when Pond 1 annual seepage volume remains at 3.7 million barrels (Alberta Energy and Utilities Board 1997). Importantly, these seepage statistics account for only 55–70 percent of total Pond 1 seepage, which also seeps undetectable quantities flowing through the base of the pond (Gallup 1976). This seepage is highly toxic to fish, although the dilution by freshwater of the Athabasca River may attenuate the immediate impacts (Hrudey 1975, Mackay 1976). Regardless, the detrimental effects of long-term sub-lethal exposure continue to be the most pressing health concern for both human and wildlife populations (Greenhill 1976).

6.4 Waste-Heavy Economy: Mitigating, Abating, and Remediating Tailings

Finally acknowledging the volumetric challenges of tailings, in the 1980s state-sponsored research and development pivots away from the generational question of bitumen separation to face up to the industry's ballooning inventory of MFT. The Fine Tailings Fundamentals Consortium organized in 1989 is particularly notable for bringing together government and university researchers and company engineers to encourage development of technology to try to tackle the twin volumetric problems of continuously produced new fine tailings and remediation of stockpiled MFT into trafficable solids. From its start, the FTFC collective dismisses alternatives to the Clark process as mere curiosities, leading it to pursue mitigation at the end-of-pipe tailings stream. During this same period, environmental regulations continued to evolve. The province now demands more exhaustive environmental impact disclosures, seen between the first Syncrude approval application (1973) versus its later submission seeking expansion (1984), although both are primitive by contemporary comparison. During this time also, with increasing provincial encouragement, multilateral nongovernmental organizations raise concerns over Fort McMurray regional air quality, Athabasca River monitoring, and the industry's cumulative impacts on the environment.

The FTFC investigates physical and chemical technologies to subjugate fine tailings, striving to scale-up promising lab technology to handle voluminous everyday oilsands operations. The FTFC's key innovation, known as composite or consolidated tailings (CT), is a technique that mixes gypsum or lime with MFT, which is then injected with carbon dioxide into the fresh tailings stream. This enhances fine particles' ability to settle out from suspension with larger grains and not contribute to future MFT. A marginal but significant advance in MFT remediation, CT reduces the dewatering times of new tailings from a millennium or more to perhaps fewer than 100 years (FTFC 1995, Liu 1993).

Two chief problems of CT stem from the calcium content of gypsum. Calcium rich recycled water scales the insides of extensive steam piping that encircles upgraders to sustain heat, which increases maintenance costs and downtime, and heightens the risk of catastrophic failure. Also, calcium ionized water is unusable in the Clark hot water process, which requires *deionized* conditions achieved by sodium hydroxide treatment. Recall from the discussion of water balance above, the growing concentration of calcium in the system water balance pressures allowance of some level of discharge. The newest hardware technologies such as hydro cyclones and centrifuges offer some degree of relief to these tensions as they enable admirable fines removal without added calcium, thus increasing quantities of clarified postproduction water available to recycle back into the extraction process, and simultaneously lessening reliance on the problematic CT approach.

6.3.4 Second generation MFT remediation: Flocculants

During fieldwork, engineers and laborers, including many informants, were scaling-up a pilot operation at Suncor that promised the first breakthroughs in MFT remediation since the development of CT. By 2010, the company had trademarked this flocculent-based Tailings Reduction Operation (TRO), which it intended to license to competing firms (Bugg 2010). Earlier proving out of the method had contributed in part to remediating the company's notorious Pond 1. To this end Suncor evacuated its MFT to a newer pond complex, in the process converting some via TRO. Rather than dismantling the over 300-foot Pond 1 dike, the removed pond contents were replaced with sandy tailings waste to refill the diked enclosure. This area was then topped with soil, landscaped to mimic dry and wetland features, and planted sporadically with grass. In accordance with the long-term plans in oilsands leases, Suncor returned the area to provincial authority with great fanfare.

Currently, this site – designated Wapisiw Lookout after the early-eighteenth century Cree who purportedly shared oilsands ore with the Hudson's Bay Company – plays a prominent role in Suncor's choreographed onsite bus tour, which foregrounds environmental stewardship against a backdrop of industrial triumph. Tourists ride on a road that encircles the area, and are directed to observe utility poles stuck into the soft surface to give raptors hunting perches in hopes they will control pesky vole populations. A glass and steel multilevel viewing facility with interpretive signage overlooks this site, which is one of only two locations on the tour where visitors are allowed off the bus and encouraged to appreciate the vista. Although Pond 1 was never a mine site, it is presented as crowning evidence of fulfilled social obligation, even *noblesse oblige*, implies an effusive guide: 'We remove everything from the surface, take away the oil spill that Mother Nature left us, and then we replace everything through reclamation.' This experience takes up approximately one-third of the entire tour.

Newer facilities that implement TRO do not dump tailings into ponds directly, but rather first treat them with flocculent, and then spread them across gently graded expanses of multiple square miles to encourage the settlement of fine particles, as water flows into a central deep pond that holds the resulting clarified water in its uppermost layers. This clear water is subsequently transported to diked ponds to undergo additional clarification and settling of MFT. In a familiar pattern to engineering fixes in the oilsands, Suncor's initial success with TRO has produced brand new sets of problems. With TRO, as B. Calgary2 explains, the surprising problem now is *too much* success. Sand and clay solids drop out of the tailing so copiously with TRO that the firm is overwhelming its sand recovery facilities. Remediation is challenging due to the mass and bulk of sand, which cannot be pumped in pipes.

6.4 Waste-Heavy Economy: Regulating Tailings and MFT

6.4.1 Provincial "conservation" requirements exacerbate MFT crisis

The entanglements of Alberta regulatory policy, oil extraction, and the biophysical properties of the oilsands suggest the MFT crisis has been driven by a vicious set of interactions between the state and raw materiality. In addition to its marginal regulation of environmental impacts, Alberta maintains a financial interest in the oilsands industry's production output, from which it extracts a stream of royalty payments. The contradictions of the state play out in the tailings ponds where provincial regulations to promote environmental protection run into other regulations to promote environmental conservation.

In its efforts to maximize royalties, Alberta insists that firms not skim just the richest ore deposits from the lower depths of mines. Rather, they are compelled to "conserve" the resource, which in practice means to process lower grades of bitumen (containing higher proportions of fine clays) than the firms otherwise would, which are obtained from the mines' upper reaches. The result is production of more obdurate MFT waste. For instance, in issuing the first approval for the Suncor Steepbank mine, the province insists that the firm processes ore with as little as 6 percent bitumen, despite acknowledging that introducing ore with less than 8 percent bitumen will depress recovery efficiency, increase the volume and toxicity of tailings, and drive-up energy usage (AEUB 1997).

6.4.2 Lack of historical hydrogeological research

Stresses on groundwater have intensified across Canada due to population growth, agriculture, and petroleum development, whereas systematic study and planning has lagged. This situation prompts the Council of Canadian Academies to convene an Expert

Panel on Groundwater to research the problem; its final report contains a chapter dedicated to the Alberta oilsands that finds ‘sustainable groundwater management is unsustainable to date’ Council of Canadian Academies 2009, 142). The Expert Panel identifies two conspiring factors in the oilsands. First, the regional hydrogeological model is incomplete due to lack of data. Second, even when firms collect hydrogeological information in the course of meeting regulatory requirements, it is not obtained consistently, and, therefore is of limited use in scientific analysis.

Calls for groundwater research in the oilsands have gone unheeded at least since the original Syncrude development began in the early 1970s. This longstanding gap in knowledge – not least related to the firms’ tailings ponds – is documented in selected boxes[30] of records in the Provincial Archives of Alberta among the several dozen boxes indexed “Albert Environment,” “Great Canadian Oil Sands,” or “Syncrude” that I draw on throughout the dissertation. Overall, these contents show how small budgets, resistant firms, and contradictory provincial agendas weighted towards development all conspire to doom meaningful groundwater research. Specifically, in two separate provincial environmental research initiatives of the early 1970s, the province downplays and sidesteps investigation into the threats to groundwater posed by the Syncrude facility under construction at the time. These apparent episodes of ‘willful blindness,’ to borrow a phrase from environmental regulator B. Reg3, corroborate the argument that Alberta’s 1975 equity investment in Syncrude is inimical to provincial environmental stewardship (cf. Longley 2021).

6.4.3 Newest regulation over tailings and MFT

The most recent major development in the relations of the Alberta government and oilsands tailings is its 2009 issuance of Directive 074 (Energy Resources Conservation Board 2009) (superseded by Directive 085 in 2016) that requires all of the oilsands mining firms to accelerate the implementation of unproven tailings remediation strategies, such as Suncor’s TRO, in seeming defiance of fifty years’ evidence regarding the intransigence of the tailings problem. Put in place abruptly by Alberta’s *conservation*

[30] Provincial Archives of Alberta: Accession number 81.396, Box 32; Accession number 6R 1983.0125, Box 3

regulator, this mandate reflects very little coordination with the provincial *environmental* regulator according to B. Reg. Some aspects of Directive 074 appear tough – draconian even – but cooperative rather than contentious enforcement is always likely based upon the firm-state relationship described in Chapter 5. Notably for instance, the regulator appears unfazed by the paradox of approving noncompliant plans in which each firm determines its own course of action for remediation and the firms are falling far behind of achieving the lower targets they negotiated with provincial regulators (Grant and Flanagan 2013). Problematically, the resulting company filings are incommensurable because each relies on its own terminology (Simieritsch et al. 2009). Moreover, firms estimate they will capture only fifty percent of fine tailings and MFT, resulting in rising MFT inventories. On top of that these projections fail both to fully translate mining plans into waste calculations and make room for contingency and variation (Kalantari et al. 2013).

Thus, technologies and regulations are both being crafted in response to crises. Buddy Job emphasizes that Alberta and the national government look to Suncor and Syncrude for guidance in crafting the technical requirements of regulations, including Directive 074, based on the firms' advanced technological capabilities. Not even the experts fully appreciate the properties and implications of tailings, Buddy explains.

Due to the smallish footprint of its leases, Suncor particularly faces opportunity costs arising in the volume of waste overburden and post-production tailings sand and sludge that must be stored on otherwise "good tar sand." The firm speaks of this problem in terms of resource 'sterilization' (Bugg 2010; cf. Bridge 2000, Zalik 2015). It is crucial to understand this crisis of sterilization is experienced with similar urgency within the provincial government, which stands to lose royalty revenue should good tar sand not be mined. The promulgation of Directives 074 and 085 by the provincial conservation regulator indicates such monetary concerns – not the environment – are the primary motivation. Archival documents indicate this has been a longstanding point of interest. For instance, the Alberta Energy and Utilities Board (1997) provisional approval of Suncor's Steepbank mine observes favorably that overburden and interburden dumps 'will not sterilize recoverable reserves' (6).

This includes Suncor's technology, which is a work in progress. Suncor had envisioned licensing its TRO process to its competitors; however, that opportunity closed in the rapid emergence of oligopolistic cooperation among firms scrambling to respond, seen in the new Canada's Oil Sands Innovation Alliance (COSIA) and the Oil Sands Tailings Consortium (OSTC), which combined with provincial funding of research and development, recall historical FTFC initiatives of the 1990s to optimize consolidated tailings (CT) technologies. Buddy Calgary2 concurs, albeit more colorfully:

> Nobody had to tell us. The government didn't have to legislate anything. You know if these guys want to keep making money and have a good return for their investor, they're going to figure out a way that it's not gonna cost them as much to maintain these ponds and to protect the environment, to make sure the ducks don't land!

Thinking through a decade of technical implementations in the oilsands, B. Calgary2 comes to a realization during our conversation that every single project on which they have worked has involved tailings in one way or another. Many of my informants are wrapped up in this tailings dilemma, whether piloting solutions, constructing tailings pond components, or interacting with provincial regulations.

Directive 074 and developments by individual firms garner favorable press coverage that extolls new breakthroughs as the long-sought technological resolution of the mature fines tailings crisis (e.g., Christian 2010). At least one exuberant executive goes on record to predict in two short decades MFT will be eliminated altogether (Christian 2011). In practice, however, Directive 074 is no panacea. It is yet another episode in the continuing efforts of state and industry to normalize MFT production and its outcome, which will persist long after oilsands mining winds down sometime after 2050. At that time, according to Directive 074 projections, over 7 billion barrels of MFT would be transferred to massive permanent end-pit lakes (ERCB 2013). This volume is the equivalent of 26,000 Exxon-Valdez spills, 1,400 BP Deepwater Horizon catastrophes, or 16 times the volume of toxic wastewater and oil infamously dumped by Texaco/Chevron into the Ecuadoran Amazon basin.

However, even these voluminous projections turn out to be overly optimistic. In late 2014 the regulator announces, abruptly, its intention to redraft Directive 074 performance targets due to the difficulty industry finds in achieving them (McDermott 2014), which anticipates superseding Directive 085. Despite short-lived fanfare, these remain formative mediations in the enduring MFT crisis.

CONCLUSION

The dissertation begins to fill two lacunae in the literature pertaining to Alberta oilsands geography: lack of attention to the co-constitutional relations of materiality in the problem of oilsands mining, and, absent ground-level views inside the "black box" of regulated commodity and waste production. Three research questions guided the inquiry and organize this conclusion: 1) How does oilsands materiality contribute to an understanding of socionatural resources? 2) How do oilsands production workers' shift-to-shift activities manifest their socionatural relations? 3) How do environmental regulation and firms' imperatives mediate workers' socionatural relations? Answering these questions necessitated the use of iterative multiple methods that put geographical literatures and petroleum historiography in conversation with archival sources and the partial stories of laborers, tradespeople, equipment operators, engineers, managers, and regulators gleaned through multiple seasons of participant observation and relationship-building necessary to overcome reticence among prospective study informants.

These answers, I hasten to emphasize, inform each other. Insistent materiality, environmental regulation, production imperatives, and workers' activities interplay on the ground in the theoretical implications of historically situated, regulated commodity and waste production, and its reproduction. These findings unfold in the processes of socionatural régulation wherein federal and provincial environmental regulation is only one facet of the contradictory multifold state – especially apparent in crucial provincial research and development and favorable lease and royalty terms as well as equity investment in the industry. This conclusion closes with a discussion of the dissertation's limitations and suggestions for future research.

Unconventionality and the difficulty of commoditization

My research clearly shows the Alberta oilsands exemplifies Erich Zimmermann's famous dictum that, 'resources *are* not, they *become*' (1951, 15, original italics), as well as newer precepts of socionatural and petroleum geography that focus on capitalism and co-constitutive materiality. The label "unconventional" often applied to the oilsands is more of an historical fluke arising in the challenges of bitumen separation and mining volumes than an intrinsic material distinction. In Alberta specifically, geological exploration commences in oilsands in the nineteenth century after liquid petroleum has already triumphed commercially over the solid raw materials of coal oil. After four decades of investigation, government agents finally conclude that the bituminous sand is *the* potential resource, not a sticky barrier concealing an underlying pool of liquid petroleum. It requires four more decades to develop an economical technique to separate commodifiable yields of bitumen from its obdurate ore matrix, during which time the objective of commoditization shifts from road surfacing to automobile fuel. Yet, despite that proof of concept, it still takes two additional decades until 1967 to launch the first plant remaining in operation today. Undeniably, the oilsands do not easily "become" a petroleum resource, yet the contemporary mining industry achieves acceptable returns. Moreover, compared with fickle liquid petroleum reserves, it is important to appreciate the relative ease with which oilsands mining yields can be calculated over 50-year spans. Had bitumen separation been more readily achieved in the ventures of the 1920-40s and followed by more rapid oilsands mining expansion, today the resource would be called simply "oil."

Natural Limits

Critical geography identifies the structural tendency toward "overproduction" of petroleum worldwide; in North America, strategies and tactics of both petro-capitalists and states strive to constrain this tendency. These dynamics play out in competition over reserves, state conservation initiatives, and even militarized intervention. Contrary to neoclassical theory and popular perception, in other words, oil prices reflect not conditions of material limits, but rather, the conditions of market control. Since the 1859 Drake well, social anxiety episodically flares over perceived natural limits of petroleum resources.

My research shows how these tensions play out in the oilsands, beginning in the 1950s launch of onsite pilot tests by multinational petroleum companies panicked by the Mossadegh-led Iranian revolution and Suez crisis. American oil strategists urge rapid development of the oilsands in the wake of the 1973 oil shock, despite – as critical geography makes clear – its political rather than material impetus. Contrary to these urgent calls for expansion, however, I show how the province drags out the approval for the region's second oilsands mine in order to monitor the market effects of the newly-opened Alaska oilfields. This contradiction echoes a pattern I uncover that pits province-driven oilsands development, on the one hand, against liquid petroleum interests on the other. Historically, the province shelters the latter from competition by stalling oilsands commercialization.

The majority of my fieldwork unfolded during an extended production boom, when contemporaneous proponents of "peak oil" began to conflate oilsands materiality with "scraping the bottom of the barrel" of global petroleum reserves. The oilsands is undeniably challenging to exploit economically; however, in line with the literature, I make clear this cost is a matter of value accumulation independent of natural limits. Comparable to my critique of the oilsands framed as "unconventional," had this bituminous material "become" an economic resource for mining earlier, its immense predictable output would have been a stabilizing bulwark against the notion of "peak oil" as opposed to seeming evidence in its support.

The nature that environmentally regulated oilsands mining produces

My review of the critical literature shows how the theoretical frame of régulation and the environment often narrows in case studies to the mechanisms of regulation on the ground, whether promulgated by the restructuring state or in tandem with supranational initiatives. Turning this narrower case study framework upon the oilsands, I find a central tension is the contradiction between the mining industry's colossal environmental degradation and its thoroughly regulated environmental relations. Despite firm's chronic exceedances, environmental impacts are held under some control by provincial and federal environmental agents, further attenuated by firms' voluntary compliance with global standards, plus alarms raised by whistleblowers.

These regulatory accomplishments are tenuous to say the least. My investigation brings to light occurrences when business pressures nearly provoke deliberate violations of environmental rules. In addition, I confirm previous research findings of provincial regulators' practical collegiality with the firms that curtails aggressive enforcement. The preponderance of environmental violations are forgiven as long as they are reported. This current state of affairs is an outgrowth of historical practices, I show. Both provincial and federal regulators have fostered what one environmental regulator dubs, 'willful blindness.' This approach is perhaps most obvious in the still incomplete fragments of groundwater mapping that result from decades of postponing comprehensive studies, combined with ongoing secrecy about quantities of seepage from tailings ponds into groundwater.

The waste output of the industry in general, and perhaps the tailings most of all, demonstrates the urgency of Castree's (1995) call for understanding the nature that capitalism produces. The raw resource is obdurate – so is the waste. Molecularly, after warm water flotation pries apart the ore matrix to separate bitumen, it proves a wicked challenge to force the post-process and slurry water back out of the remaining solid material. My archival inquiry makes clear that firms and the province deceived themselves and the public in their historic understatement of the challenges of waste mediation. Despite published findings of provincial research scientists, early mine approvals allowed notoriously optimistic claims of tailings settling. In the opening year of the first contemporary oilsands mine, crises emerged due to the resistant tailings; yet, despite this unresolved calamity, the second contemporary oilsands mine was allowed to open with a patently impossible projection of tailings settling in five years. Only decades later do published papers from sources inside the firms concede the real timeframe for untreated tailings to settle is one thousand years or more, while still excusing plant designers for tailings' "surprising" obduracy.

A widely repeated conceptualization holds that waste is an unintended byproduct of production (cf. Benton 1989, Bridge 2008b, Bridge and Le Billon 2013, Dicken 2011, Smith 1984). Quite to the contrary however, my project demonstrates oilsands tailings are the highly engineered outcome of bitumen separation. Not only that, the province exacerbates the waste problem, according to documents I uncover in the archive, by insisting firms process low grade ore with high clay content which produces higher volumes of the most obdurate tailings. Provincial environmental regulators never held authority to insist the tailing conundrum be solved before oilsands mining commenced; and to this day, a range of informants explains, regulators look to the firms to slowly invent their way out of the crises they produce. Unfortunately, I learn that behind glowing press releases celebrating breakthroughs, at industrial scales these breakthroughs repeatedly create new problems. One indication is that despite decades of "zero discharge" fanfare, firms may be close to achieving a decades-long initiative to release tailings water directly into the watershed.

Informants' socionatural relations

Socionatural relations of many informants lie at the intersection of production imperatives, environment, and personal safety. Extended strings of 12-hour shifts with few days off demand hyper-vigilance in the relentless 24/7/365 operations of the world's largest surface mines scorched by boreal summer days and frozen in winter to the point of extinguished flames. Death, disfigurement, and chronic debilitation are continuous threats for thousands of workers each shift due to falls, crushing blows, toxic gases, equipment failures, vehicle collisions, and human error, plus some instances of recklessness. Ever edgy about potential exposure to poisonous gases, veteran workers constantly monitor wind direction and escape routes. Some workers relocate to leave behind the industry and its conditions. Others take pause over the magnitude of environmental disturbance, but continue as a practical matter of wage work: 'If I didn't do it, someone else would.' Still others hold the attitude that they are producing vital materials for contemporary society while at the same time holding up their end of the wage labor bargain. Engineers and technical workers, in particular, widely express confidence that their work contributes to the safest and cleanest production possible of much-needed oil.

Oilsands mine workers are frustrated with being castigated for the environmental impacts of oilsands mining. I confirm previous findings about workers' antipathy toward environmental activism in general – especially Greenpeace actions –

which fosters a siege mentality aligning workers with industry, comparable to the pattern identified by Burawoy (1979). I also show the analytical value in understanding these workers' perspectives. Informants demonstrate normative regard for the environment, including several who express wonderment over wildlife they encounter and some who express grief and remorse for the impacts they produce. Many are itinerant workers in resource extraction and claim the oilsands mines are far cleaner than anywhere else they have worked. Critics may denounce this view as naïve; however, many of these laborers view themselves as realists. They are impressed by their firms' environmental and reclamation commitments and see the impacts as the necessary trade-off for the society we live in. These informants understand that surface mining always entails substantial impacts. Landscape alteration and waste production are inevitable. Several explicitly argue that giving a humane twist of the neck to a stricken duck is certainly no more monstrous than hunting. Damage to habitat, disturbing hibernating bears, and the like are facets of production labor that workers rationalize.

Workers' shift-to-shift activities demand scrupulous adherence to management rules that encompass environmental compliance. Workers operationalize firms' non/compliance with provincial environmental rules. Yet for most informants, environmental rules are invisible as only specialists maintain contact with provincial regulators. That said, everyone understands that environmental incidents must be reported. However, the obsessive drive for production is the basic motive force in the oilsands mines and upgraders. My informants share rafts of examples of shortcuts demanded by supervisors – more to the point – imperatives passed down from their supervisors' managers. While I document extensive gaming of labor systems, my study was not able to establish the degree of gaming in the environmental compliance side of the business. The one extended example I obtained – related to protected birds in the way of facility start-up plans – provides some indication, as does an environmental regulator who explains the importance of whistleblowers in keeping eyes on the firms.

Limitations of the study and avenues for future research

High living costs in Fort McMurray combined with extremely limited access to plant sites, narrow the scope of my research in terms of length of fieldwork and contact with informants. When I was able to interview, who, and where, and what these informants remembered and chose to share, are all constrained by the limitations of participant observation and interviews of a guarded industry. In the final tally I assembled 57 interviewees – including 9 key informants – during seven months of fieldwork largely in the summer. It is likely that a continuous presence over a full calendar year could have raised additional opportunities for developing key informants, and also opened new channels of informants and data collection. Notably, such a continuous presence would have provided the opportunity to conduct fieldwork during the materially distinct winter months.

Degrees in science and business management prepared me to attain some understanding from the background technical literature, which when put in iterative conversation with interview data, helped stitch together a reasonable explanation of workers' material relations across the regulated enterprise from mine to commodity production to waste discharge and impoundment – particularly through the worker-eye view. No doubt, any area specialist might suggest any number of revisions – a prospect I would welcome in line with my method. The project achieves its objective to crack open black box of production, but it is surely a rudimentary beginning rather than the last word. One more crucial limitation is that in an effort to focus on laborers as a group – and to protect confidentiality in an industry I confirm blacklists – I aimed to hide identifiers that mark age, gender, race, ethnicity, and national or provincial origin. Therefore, I did not engage these potentially important avenues for understanding workers' environmental relations.

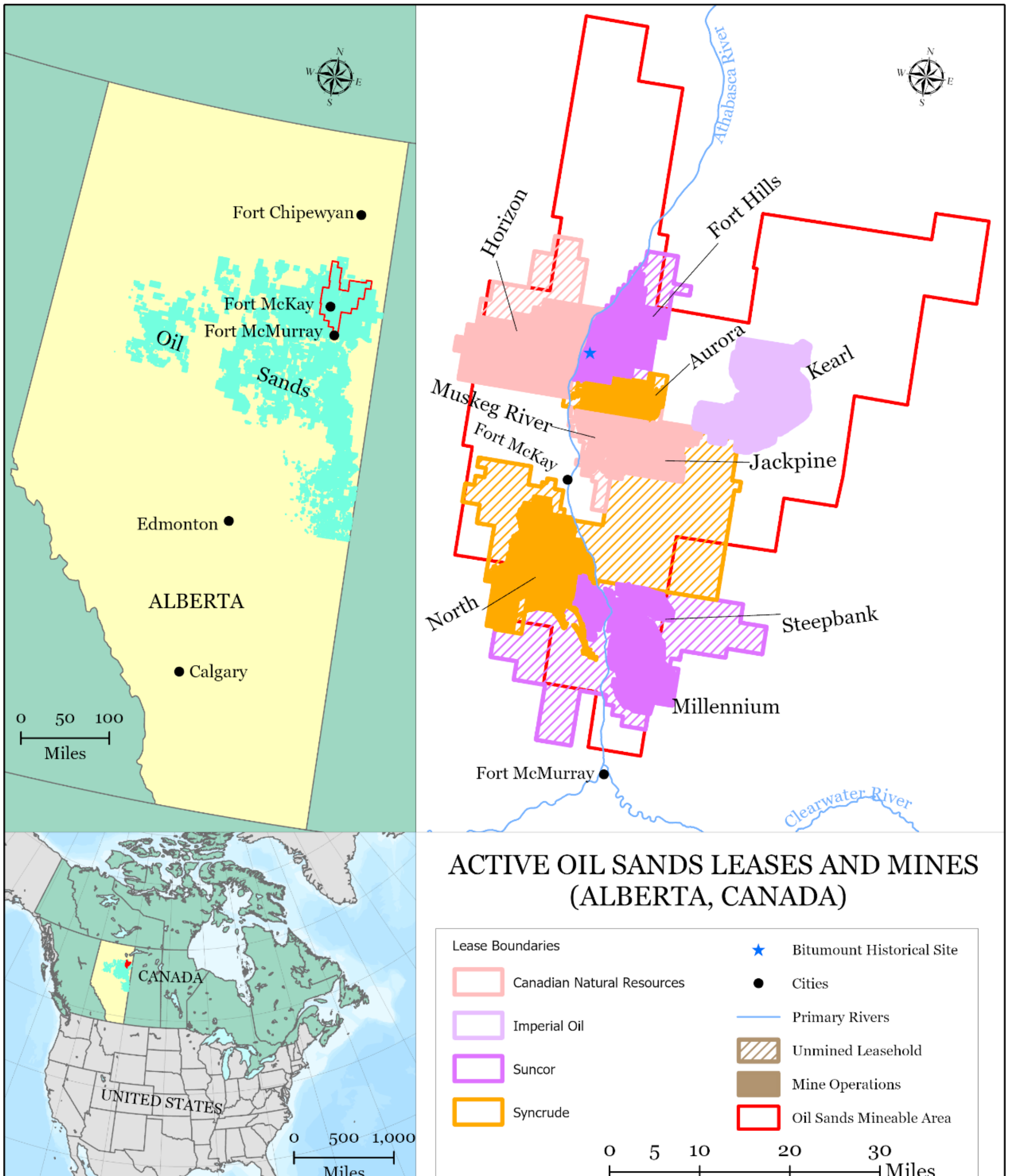
While the present study considers the implication of environmental regulation for workers' environmental relations, it would be interesting if future research along these lines also investigated potentially overlapping implications of labor safety regulation. Given that my findings corroborate the rift between oilsands workers and environmental activism, additional research with oilsands workers about their daily experiences at the intersection of production, environment, and personal safety could be useful, including for instance, what avenues are available for activists to engage with workers in mutual perspective-sharing research. Here, specific consideration of identities that remain hidden in the current study might prove beneficial – if that can be done while securing informants' confidentiality, particularly in the instances of non-cisgender white males. Several of my informants were both First Nations members as well as seasoned oilsands workers, and I believe it would be fruitful to investigate these positionalities explicitly – especially as most of the literature conflates indigeneity with resistance to the industry.

APPENDICES

APPENDIX I. ABBREVIATIONS AND ACRONYMS

AENV	Alberta Environment
AER	Alberta Energy Resources
AESRD	Alberta Environment and Sustainable Resource Development
b/d	Barrels per Day
bbl	Barrel
Barrel	42 US Gallons
CAPP	Canadian Association of Petroleum Producers
CENV	Environment Canada
COSIA	Canada's Oil Sands Innovation Alliance
CT	Composite or Consolidated Tailings
CUC	Alberta Department of Environment Conservation and Utilization Committee
CUC	Conservation and Utilization Committee (Alberta Department of Environment)
Dilbit	Diluted Bitumen
ERCB	Energy Resources Conservation Board
FOIPP	Freedom of Information and Privacy Protection (Act)
Fracking	Hydraulic Fracturing
FTFC	Fine Tailings Fundamentals Consortium
GCOS	Great Canadian Oil Sands (Predecessor to Suncor Energy)
GSC	Geological Survey of Canada
Integ	Intercontinental Engineering
MFT	Mature Fine Tailings
OPEC	Organization of Petroleum Exporting Countries
OSMA	Oil Sands Mineable Area
OSTC	Oil Sands Tailings Consortium
PAH	Polycyclic Aromatic Hydrocarbon
RAMP	Regional Aquatic Monitoring Program
RCA	Research Council of Alberta
REDA	Responsible Energy Development Act
RMWB	Regional Municipality of Wood Buffalo, Alberta
SCO	Synthetic Crude Oil
TRO	Tailings Reduction Operations (Suncor)
WBEA	Wood Buffalo Environmental Association

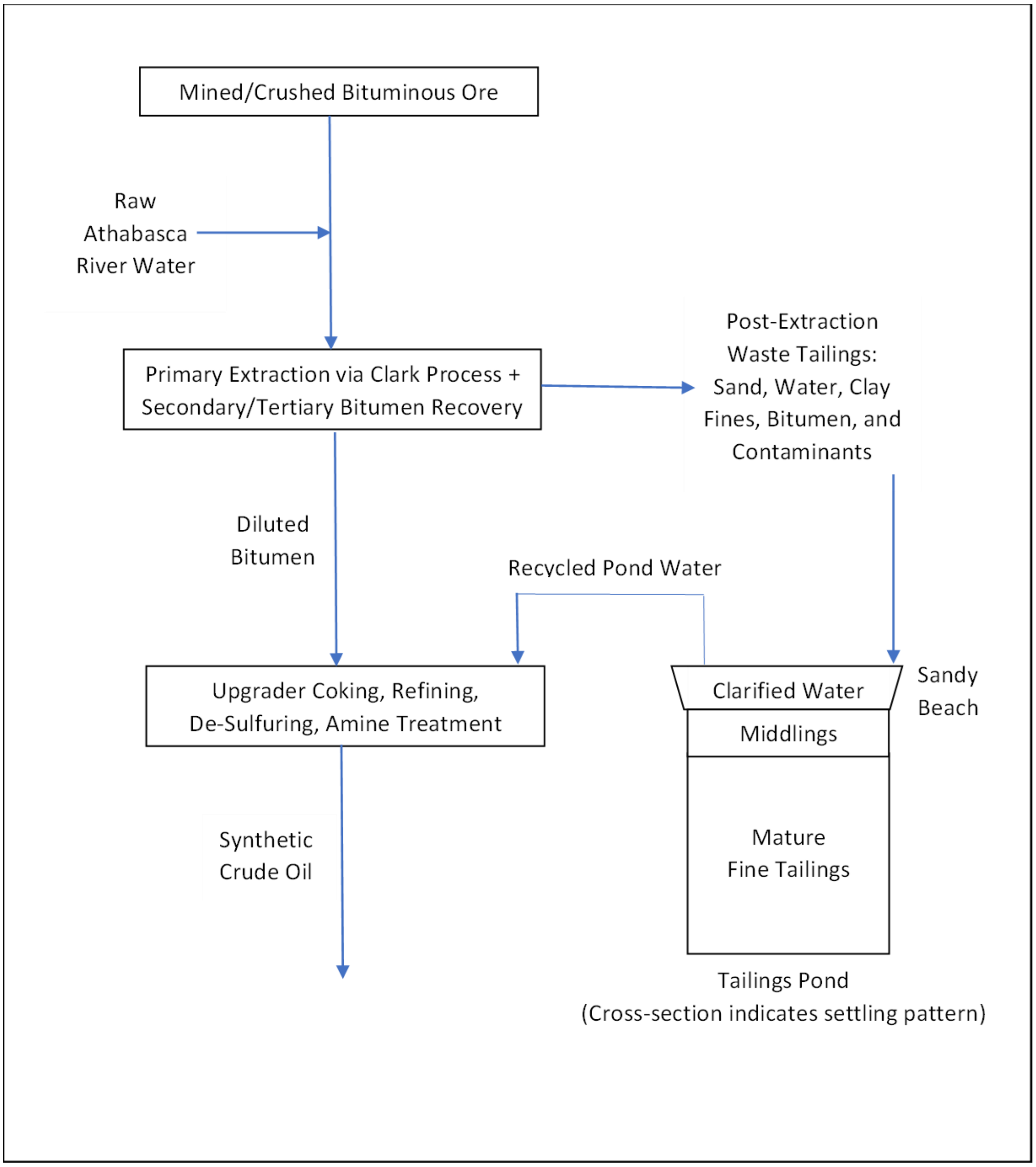
APPENDIX II. ALBERTA OILSANDS MAPS



The Mining area data were acquired from Alberta Energy Regulator, Altalis Ltd, and the Government of Alberta via their websites and portals, whereas the census data were downloaded from Statistics Canada. Additional administrative data were collected from www.naturalearthdata.com. The data were analyzed and mapped in ArcGIS Pro versions 2.8 and 2.9. The map of the Oil Sands Leases, upper right, the inset map of Alberta, upper left, and that of North America, bottom left, are all projected to North America Albers Equal Area Conic.

Credit to: Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, NRCan, Parks Canada, Esri, USGS, Esri, FAO, NOAA, NRCan; By Guetchine Gaspard; November 2021

APPENDIX III. OILSANDS MINING BASIC PRODUCTION PROCESS



APPENDIX IV. INFORMANTS

Buddy	Occupation	Interaction Type	Year(s)
Bang	Equipment Operator	Opportunity Interview	2011-12
Bear	Compliance Officer	Semi-structured Interview	2012
Black	Community Media	Opportunity Interview	2011-12
Books	Librarian	Opportunity Interview	2012
Boom	Equipment Operator	Semi-structured Interview	2011
Boots	Environmental compliance manager	Opportunity & Semi-structured Interview	2012
Boston	Carpenter	Opportunity Interview	2012
Bucky	Shovel Operator	Opportunity Interview	2012
Bus	Passenger Bus Driver	Opportunity Interview	2012
Calgary	Senior Process Engineer	Semi-structured Interview	2011
Calgary2	Senior Instrumentation Engineer	Opportunity & Semi-structured Interview	2012
Carpenter	Carpenter	Opportunity Interview	2012
Catwalk	Laborer	Opportunity Interview	2012
Chicken	Equipment Operator	Opportunity & Semi-structured Interview	2011-12
Children	Librarian	Opportunity Interview	2011
Circle	Educator	Opportunity Interview	2011-12
Cousin	Millwright	Opportunity Interview	2011
Curling	Safety Specialist	Semi-structured Interview	2012
Deer	Engineer	Opportunity & Semi-structured Interview	2010-11
Doggy	Equipment Operator	Semi-structured Interview	2011
Dream	Laborer	Semi-structured Interview	2011
Driver	Equipment Operator	Opportunity Interview	2011
Drum	Haul Truck Driver	Opportunity Interview	2012
Engo	NGO Staff	Opportunity Interview	2012
Hobby	Engineer	Opportunity & Semi-structured Interview	2011
Hockey	Electrician	Semi-structured Interview	2012
Iron	Capital Equipment Vendor	Opportunity Interview	2012
Job	Engineer	Opportunity Interview	2011
Lighter	Boilermaker	Opportunity Interview	2012
Lumber	Laborer/Musician	Opportunity Interview	2012

Mac	Municipal Employee	Opportunity Interview	2011
Millwright	Millwright	Semi-structured Interview	2011
Miner	Senior Mining Engineer	Semi-structured Interview	2011
Mouse	Toxins Researcher	Opportunity Interview	2011-12
Panel	Plant Operator	Opportunity Interview	2012
Pickup	Entrepreneur	Opportunity Interview	2012
Pool	Haul Truck Driver	Opportunity Interview	2012
Prof	Engineering Professor	Opportunity Interview	2010
Rabbit	Senior Process Engineer	Opportunity & Semi-structured Interview	2011-12
Radar	Manufacturer's Representative	Opportunity Interview	2010
Reg	Alberta Regulator	Opportunity Interview	2011
Reg2	Alberta Regulator	Semi-structured Interview	2012
Reg3	Alberta Regulator	Semi-structured Interview	2012
Retiree	Maintenance Engineer	Opportunity Interview	2010
Sailor	Haul Truck Driver	Opportunity Interview	2012
Sauna	Haul Truck Driver	Opportunity Interview	2011
Sauna2	Haul Truck Driver	Opportunity Interview	2012
Sauna3	Sheetmetal Worker	Opportunity Interview	2012
Scofflaw	Electrician	Opportunity Interview	2012
Sharp	Trainer	Opportunity Interview	2011
Show	Engineer	Opportunity & Semi-structured Interview	2010-11
Shower	Engineer	Opportunity Interview	2012
Shred	Engineer	Opportunity Interview	2011
Stern	Environmental Compliance Officer	Opportunity Interview	2011
Supper	Contaminant Hydrogeologist	Opportunity Interview	2012
Transit	Geotechnical Surveyor	Opportunity Interview	2012
Union	Haul Truck Driver	Opportunity Interview	2012

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EDUCATION

1996	MBA	Kenan-Flagler Business School, University of North Carolina (Chapel Hill, NC)
1996	MRP	Department of City and Regional Planning, University of North Carolina (Chapel Hill, NC)
1983	BA	Department of Biology, Grinnell College (Grinnell, IA)

PROFESSIONAL POSITIONS HELD

2016	University of Kentucky College of Arts & Sciences – Bluegrass Down Under, Inaugural Study Abroad Instructor
2009-2016	Teaching Assistant, University of Kentucky Department of Geography
2012	Dean's Fellowship Research Associate, Kentucky Transportation Center, University of Kentucky
2005-2007	Commercial Lending Officer, Self-Help Credit Union (Durham, NC)
1996-2005	Founder, President, Queue Workflow Solutions (Chapel Hill, NC)
1986-1992	Founder, Executive Editor, Federal Filings (Washington, DC)

AWARDS AND FELLOWSHIPS

2014	Certificate for Outstanding Teaching, College of Arts & Sciences, University of Kentucky ($500)
2012	Doctoral Student Research Award, Understanding Canada – Canadian Studies Program, Foreign Ministry of Canada ($10,000)
2011	Barnhart-Withington Summer Research Award, University of Kentucky ($2,500)
2008-2011	Daniel R. Reedy Quality Achievement Award, University of Kentucky Graduate School ($9,000)
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