



Impacts of Channel Deepening on the Columbia River

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The Ports of Longview, Kalama, St. Helens, Portland, and Vancouver

Export Grain Terminal

Temco LLC

Kalama Export Grain

Global – Columbia Pacific Bio-Refinery

United Grain Corporation

West Vancouver Freight Rail Access

Vancouver Energy

Tidewater Barge Lines

Columbia Grain

Kinder Morgan Bulk Terminal

International Raw Material

LD Commodities

Vigor Industrial

Rivergate Road and Rail Improvements

Canpotex – Portland Bulk Terminal

Shaver Transportation Company

Millennium Bulk Terminal

NW Innovations Works

Pembina

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SUMMARY

Three developments in the shipping industry are driving the push to deepen shipping channels around the world. The first is the increasing size and capacity of trade vessels.¹ The size of vessels continues growing as shippers strive for increasing efficiency gains that reduce costs. The second is the widening and deepening of the Panama Canal. When completed in 2016, the canal will accommodate ships with draft of up to 50 feet, and that can carry up to twice the cargo capacity of the ships that currently pass through the canal.² The third is the increasing competition among ports and terminals to attract and accommodate the larger trade vessels.³ The U.S. Army Corps of Engineers oversees the federal channel-deepening work in the U.S. The Columbia River channel deepening was coordinated by the Corps, with a mix of funding from the Federal government and the States of Oregon and Washington.

Completion of the deepening of the Columbia River shipping channel in 2010 opened a floodgate of investments at terminals and ports along the river. According to a port representative, the deepening and the investments that followed provides shipping and commodity firms with certainty—certainty that ports, terminals and vessels can manage the mix of commodities and tonnage that today's global economy requires. Firms have confidence that shipments won't face backlogs at ports due to capacity constraints. Shipments move efficiently. Firms also spend less time monitoring, planning, and developing contingency shipping plans.⁴

Figure 1: Columbia River Ports



Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

¹Ryan, Timothy P. The Economic Impact of Deepening the Mississippi River to 50 Feet. Big River Coalition, August 22, 2013.

²Panama Canal Authority. 2006. *Proposal for the Expansion of the Panama Canal*. Third Set of Locks Project. April 24.

³Ryan, 2013.

⁴Interview with Katy Brooks, Port of Vancouver, March 5, 2015.

Table 1 lists the investments in our study. Private and public entities invested \$370 million in the Portland Harbor, and \$1 billion at terminals and ports along the Columbia River, since 2010. Additional investments planned along the river amount to \$5.15 billion. Investments completed to date include:

- The first new grain terminal built in the U.S. in 25 years
- Expansion of the largest export grain terminal on the West Coast of the U.S.
- The first new grain barge on the Columbia River since 2011
- The largest drydock in the U.S.

Maintaining the shipping channel to 43 feet will help ensure the continued growth in cargo movement and related economic activity that has occurred since the deepening. Firms made investments and built capacity assuming a level of commerce supported by a 43-foot shipping channel. A channel less than this depth would strand investments, reduce economic activity, and impact jobs.

Table 1. Current and Planned Port Investments Along the Columbia River since 2010

Port	Project	Investment Amount	Description
Longview	Export Grain Terminal (2012)	\$230 million	New grain terminal
Kalama	Temco LLC (2015)	\$100 million	Increase capacity (grain)
	Port of Kalama (2014-15)	\$7 million	Rail upgrades at the Port
	Kalama Export Grain (2011)	\$36 million	Increase storage capacity
Vancouver	United Grain Corporation (2012)	\$80 million	Enlarge storage and handling capacity
	West Vancouver Freight Rail Access (2015)	\$228 million	Rail expansion, new loop track, and road improvement
	Tidewater Barge Lines (2015)	\$30 million	Three new tugboats
Portland	Columbia Grain (2015)	\$44 million	Upgraded grain storage and handling
	Kinder Morgan Bulk Terminal (2013)	\$10 million	New ship loading facilities
	International Raw Materials (2014)	\$2 million	Improvements to rail and storage tanks
	LD Commodities (2014)	\$21 million	Expanded grain storage and moving facilities
	Vigor Industrial (2014)	\$50 million	Largest drydock in the US
	Rivergate Road and Rail Improvements (2012)	\$82 million	Improve road and rail access and capacity
	Canpotex – Portland Bulk Terminal (2013)	\$140 million	Increase efficiency of shiploading
Shaver Transportation (2014)	\$21 million	New barge, new tug and new engines	
Sub Total		\$1.08 Billion	
Proposed Investments			
Longview	Millennium Bulk Terminal (2018)	\$600 million	New coal terminal
	Millennium Bulk Terminal (2018)	\$25 million	Smelter removal and environmental cleanup for new bulk terminal
Kalama	NW Works (2017-18)	\$1.8 billion	New methanol plant
St. Helens Port Westward	Global – Columbia Pacific Bio-Refinery (2018)	\$80 million	Increased storage and rail improvements
	NW Works (2017-18)	\$1.8 billion	New methanol plant
	Ambre Energy (2018)	\$242 million	Coal transport
Vancouver	Vancouver Energy (2018)	\$100 million	Rail improvements and loading facilities
Portland	Pembina (2018)	\$500 million	Propane export terminal
Total Proposed		\$5.15 Billion	

INVESTMENT DETAILS

The Columbia River federal navigation channel runs from the Astoria bar to the Portland Harbor, a distance of 105 miles. Every year millions of tons of cargo worth billions of dollars flow into and out of the region, making this shipping channel a critical connection between the region and the rest of the world. In the fall of 2010, the U.S. Army Corps of Engineers completed deepening the shipping channel from 40 to 43 feet. Since 2010, private and public entities invested more than \$1 billion in facilities and transportation capabilities. Much of this investment can be linked to the channel deepening.

ECONorthwest reviewed news reports, press releases, and other public information on the investments made at terminals and ports along the Columbia River since the 2010 channel deepening. We also interviewed representatives of terminal operators and ports about these investments. Table 1 (on page 2) lists the major investments by port and terminal and those proposed for the near future.

Here we summarize information on each investment and proposed investment, by port. We begin with investments at the Port of Longview, and then move upstream to the Ports of Kalama, St. Helens/Port Westward, Vancouver, and Portland.

THE CHANNEL DEEPENING MAKES THE PHONE RING AT PORTS AND TERMINALS.

Soon after it became clear that the deepening would happen, a “floodgate” of investment opened. The deepening gave private firms the confidence to invest in terminal and transportation infrastructure at ports along the Columbia River. But for the deepening, much of this investment would not have happened, or would not have happened at ports on the Columbia River.

The deepening of the Columbia River shipping channel, and the investments in port, terminal and transportation infrastructure that followed, provides shipping and commodity firms with the

certainty that ports, terminals and vessels can manage the mix of commodities and tonnage that competing in today’s global economy requires. Firms have confidence that shipments won’t face backlogs at ports due to capacity constraints. Shipments move efficiently. Firms also spend less time monitoring, planning, and developing contingency shipping plans.

A representative from one of the Columbia River ports summed up the effect of the deepening as: “The channel deepening makes the phone ring.”⁷

PORT OF LONGVIEW

Export Grain Terminal

The Export Grain Terminal (EGT) at the Port of Longview was the first new grain terminal in the U.S. in 25 years. This efficient, state-of-the-art terminal was the first of a series of investments in grain terminals along the Columbia River. Increasing demand from Pacific Rim countries combined with the greater efficiency of larger ships with deeper drafts facilitated by the deepening of the Columbia shipping channel, gave EGT and other terminal operators the confidence that their investments would pay off. EGT invested approximately \$230 million in their

Longview terminal, which came online in 2012. Prior to the channel deepening, EGT primarily stored and moved wheat. Now, with expanded capacity and facilities, they store and move wheat, corn and soybeans. The increased grain shipments through the EGT terminal after the channel deepening also increased the demand for rail service to the terminal.⁵

Millennium Bulk Terminal

Millennium Bulk Terminal is proposing an investment of \$600 million toward renovating an existing terminal into a coal export terminal and another \$25 million to complete the environmental cleanup to make way for a new bulk terminal.⁶

⁵Interview with Ashley Helenberg, Port of Longview, March 18, 2015; *Port of Longview New Release, Port of Longview Inks Property Lease for Export Grain Terminal*, June 1, 2009; Export Grain Terminal New Release, July 9, 2012, <http://www.egtgrain.com/news/release/egt-facility-creates-new-export-opportunities-for-american-farmers/>.

⁶Interview with Peter Bennett, Millennium Bulk Terminal, March 14, 2015; Information on Millennium Bulk Terminal’s website, www.millenniumbulk.com.

⁷Interview with Katy Brooks, Port of Vancouver, March 5, 2015.

PORT OF KALAMA

Temco (CHS/Cargill)

The \$100 million expansion of the Temco LLC grain terminal tripled the terminal's capacity. The project included a new vessel dock and loading equipment, new rail and barge receiving machinery, and upgraded grain cleaners. The terminal can now process up to 200 million bushels of grain per year, comparable to the Temco terminal in Tacoma. As a result of the expansion, employment during grain-shipping season will double to 120.⁸

The Port of Kalama invested \$7 million in rail upgrades at the port to facilitate and support the increased rail traffic.⁹

Kalama Export Company

Kalama Export expanded their grain storage and handling capacity by 25 percent with a \$36 million dollar investment. In addition to expanded storage, they added a new grain cleaning system and loading belt.¹⁰

NW Innovation Works

NW Innovation Works is considering multiple sites in Oregon and Washington to locate two methanol plants. The Port of Kalama is one of those sites. Each plant would be built in two

phases. A phase one \$1 billion investment, with \$800 million invested in phase two. Once operational, the plant would employ 120 full-time workers.¹¹

PORT OF ST. HELENS AND PORT WESTWARD

Global Partners– Columbia Pacific Bio-Refinery

Global Partners is investing approximately \$80 million in improved and expanded rail lines, increased oil storage and unloading capacity, and is working with the Port to expand their dock to support moorages of larger vessels.¹³

NW Innovation Works

NW Innovation Works is also considering the Port Westward location for a methanol plant. This plant would also happen over two phases with a total investment of \$1.8 billion and full-time employment of 120.¹⁴

Ambre Energy

Ambre Energy is pursuing the Morrow Pacific Project where up to 8 million tons of coal would travel by rail to the Port of Morrow and by barge to the Port of St. Helens for export loading. This project has a total investment of \$242 million and would create over 1,000 jobs.

CHANNEL DEEPENING INCREASED THE COMPETITIVENESS OF COLUMBIA RIVER PORTS AND TERMINALS.

The investments spurred by the deepening increased the competitiveness of Columbia River ports. For example, ports on the Columbia River have a cost and time advantage over Gulf Coast ports for corn and soybean shipments to the Pacific Rim. Before the deepening, corn and soybeans produced in the Midwest moved by barge down the Mississippi River to Gulf Coast ports for shipment through the Panama Canal to Pacific Rim destinations.

Terminals at Columbia River ports were not equipped to move these grains, which require different conveyer and storage infrastructure than wheat, the dominant grain moved through Columbia River terminals at the time. Investments made at ports along the Columbia River in the wake of the deepening include upgraded grain elevators designed for corn and soybeans, along with expanded unit train capabilities. The result: a significant shift in grain activity from Gulf ports to Columbia River ports.¹²

⁸Interview with Paul Butters, Temco LLC, March 2, 2015; Luck, M. 2014. "Temco grain terminal expansion nearly complete." TDN.com. November 24; Pittman, J. 2014. "Temco grain terminal expansion on track for fall completion, officials say." TDN.com. July 21; Comments from Pacific Northwest Waterways Association staff, May, 2015.

⁹The Columbian. "Port of Kalama to double Temco site's rail capacity." December 13, 2013.

¹⁰Interview with Steve Oakes, Kalama Export Company, March 19, 2015; Olson, E. 2010. "Kalama port officials say grain export expansion will create 180 jobs." TDN.com. February 17; Siemers, E. 2011. "Vancouver port lands \$72M deal." The Portland Business Journal, <http://www.bizjournals.com/portland/print-edition/2011/01/14/vancouver-port-lands-72m-deal.html?s=print>; ADM. 2014. News Release: Marubeni and ADM Bolster Export Joint Venture in U.S. Pacific Northwest. September 30.

¹¹Interview with Mark Wilson, Port of Kalama, March 9, 2014; Northwest Innovation Works, <http://nwinnovationworks.com/>; Castano, C. 2014. "China-funded methanol plants in Oregon." KOIN6. <http://koin.com/2014/01/22/china-funded-methanol-plants-oregon/>.

¹²Interview with Tony Flagg, United Grain Corporation, March 16, 2015.

¹³Interview with Pat Trapp, Port of St. Helens, March 9, 2014; Toledanes, L. 2013. "Port of St. Helens commissioners approve increase to train traffic." TDN.com. November 13.

¹⁴Interview with Pat Trapp, Port of St. Helens, March 9, 2014; Northwest Innovation Works, <http://nwinnovationworks.com/>; Castano, C. 2014. "China-funded methanol plants in Oregon." KOIN6. <http://koin.com/2014/01/22/china-funded-methanol-plants-oregon/>; Miller, M. 2014. "Port of St. Helens give OK to methanol plant lease option." Pamplin Media, <http://www.pamplinmedia.com/>; The Clatskanie Chief, 2014. "Port commission signs lease option with methanol company." The Clatskanie Chief. February 20. <http://www.thechiefarchive.com/author/clatskaniechief/page/147/>; Godley, V. 2014. Letter to the Port of St. Helens Community. NW Innovation Works. October.

BECAUSE OF THE DEEPENING, COLUMBIA RIVER PORTS AND TERMINALS ARE WELL POSITIONED TO RESPOND TO GROWING DEMAND FROM THE PACIFIC RIM

Many terminal operators indicated that without the deepening they would not have invested in upgrading their facilities. With growing demand from China and other countries along the Pacific Rim, this would have been a significant lost opportunity for terminal operators and shippers. Now, terminals along the Columbia River are well positioned to take advantage of this growth.¹⁵



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VANCOUVER

United Grain Corporation

With their \$80 million investment to expand their grain terminal, United Grain Corporation now has the largest export grain terminal on the West Coast, and the second tallest grain structure in the world. The development started in 2008-2009, anticipating the channel deepening completion and larger ships with deeper drafts calling on Columbia River ports. Like other grain terminals along the Columbia River, United Grain Corporation's expansion included adding

storage and transport capabilities for grains new to this market—corn and soybeans—along with their traditional wheat product.¹⁶

West Vancouver Freight Rail Access

The Port of Vancouver is investing \$228 million in rail and road improvements to meet the transportation demands of terminal operators such as United Grain Corporation. These investments include expanding rail tracks, adding a loop track, and improved road and rail access to the port and terminals.¹⁷

Vancouver Energy

Vancouver Energy is investing approximately \$100 million in a “crude-by-rail” terminal. The project is projected to start in 2016. The investment includes new rail lines and storage facilities to move crude oil through the terminal. This terminal will be one of those serviced by the new West Vancouver Freight Rail Access investments.¹⁸

¹⁴Interview with Pat Trapp, Port of St. Helens, March 9, 2014; Northwest Innovation Works, <http://nwinnovationworks.com/>; Castano, C. 2014. “China-funded methanol plants in Oregon.” *KOIN6*. <http://koin.com/2014/01/22/china-funded-methanol-plants-oregon/>; Miller, M. 2014. “Port of St. Helens give OK to methanol plant lease option.” Pamplin Media, <http://www.pamplinmedia.com/>; *The Clatskanie Chief*, 2014. “Port commission signs lease option with methanol company.” *The Clatskanie Chief*. February 20. <http://www.thechiefarchive.com/author/clatskaniechief/page/147/>; Godley, V. 2014. Letter to the Port of St. Helens Community. NW Innovation Works. October.

¹⁵Interview with Katy Brooks, Port of Vancouver, March 5, 2015.

¹⁶Interview with Tony Flagg, United Grain Corporation, March 16, 2015; United Grain Corporation, <http://www.ugcpnw.com/>; Siemers, E. 2011. “Vancouver port lands \$72M deal.” *The Portland Business Journal*. January 14. <http://www.bizjournals.com/portland/print-edition/2011/01/14/vancouver-port-lands-72m-deal.html?s=print>; Interview with Katy Brooks, Port of Vancouver, March 5, 2015; Mitsui & Co. “Harvesting opportunities in agriculture.” https://www.mitsui.com/jp/en/business/challenge/1201987_1856.html.

¹⁷Interview with Katy Brooks, Port of Vancouver, March 5, 2015; Port of Vancouver USA Press Release, “Port begins final phase of West Vancouver Freight Access rail projects.” November 12, 2014; Port of Vancouver USA. West Vancouver Freight Access, <http://www.portvanusa.com/wvfa/wvfa-home/>; Guerra, K. 2011. “Port of Vancouver launches key component of multimillion-dollar rail expansion project.” *The Oregonian*. December 7.

¹⁸Interview with Katy Brooks, Port of Vancouver, March 5, 2015; Port of Vancouver USA. Board of Commissioners Workshop Tesoro-Savage Joint Venture Lease Overview. July 22, 2013; Savage. Tesoro and Savage announce joint venture to construct and operate crude-by-rail unloading and marine loading facility at Port of Vancouver USA. <http://www.savageservices.com/pressroom/>; Energy Facility Site Evaluation Council, <http://www.efsec.wa.gov/Tesoro-Savage.shtml>.

DEEPENING-RELATED INVESTMENTS STRETCH BACK TO THE MIDWEST

Most of the investments spurred by the deepening happened or are happening at terminals along the Columbia River. Some investments, however, occurred many miles away. For example, some shippers made investments in rail infrastructure that supports their upgraded and expanded elevators at terminals on the river. These investments include unit-train cars, rail loops, and loading facilities in Montana and North Dakota.²⁰

Tidewater Barge Lines

With the channel deepening came larger ships, with deeper drafts, carrying increased amounts of cargo. Much of this cargo moves up and downriver via tugs and barges. In response to this demand, Tidewater Barge Lines is investing an estimated \$30 million in three new and environmentally friendly tugs, with reduced air emissions and improved fuel efficiency. Vigor Industrial in Portland is fabricating the tugs, which will be delivered by the end of 2015. Fabricating the tugs in the Portland area helps keep more investment dollars in the local economy.¹⁹

PORTLAND

Columbia Grain

Columbia Grain is expanding their grain storage and handling capacity with a \$44 million investment. In addition to more storage capacity, the expansion will allow Columbia Grain to store and move corn and soybeans in addition to wheat, which had been their primary grain product.²¹

Kinder Morgan Bulk Terminal

Kinder Morgan invested \$10 million in a new ship loader. This is the largest investment Kinder Morgan has made in any of their terminals on the Columbia River (Ports of Longview, Vancouver, and Portland).²²

International Raw Materials

International Raw Materials switched their loading operations from loading shallow-water barges to a deep water berth that can service larger ships that use the added depth of the shipping channel. They invested \$1.5 million in the switch. International Raw Materials now has one of the deepest berths on the West Coast of the U.S. Ships carrying liquid fertilizer frequently dock at their facility to offload fertilizer and then head south to terminals with shallower berths that could not accommodate fully-loaded vessels.²³

LD Commodities

Louis Dreyfus Commodities invested \$21 million to remodel and update its grain terminal on the Willamette River. Prior to this investment, their terminal frequently hit capacity due to the increasing volumes of grains traveling down the Columbia River.²⁴

Vigor Industrial

The largest floating drydock in the U.S., the *Vigorous*, arrived at Vigor Industrial's Portland shipyard in August of 2014. Vigor invested \$40 million building the drydock and \$10 million delivering and assembling it. Demand for the new drydock will come from servicing cruise ships, post-Panamax vessels and U.S. Military Sealift Command ships. At the time the *Vigorous* arrived at Vigor Industrial, two large cargo ships operated by the Maritime Administration were waiting for service using the new drydock.²⁵

Rivergate Road and Rail Improvements

The Port of Portland, along with other public and private partners, is investing approximately \$82 million in road and rail improvements in the Rivergate area. These investments include widening roadways and adding rail overpasses, expanding rail yards, deepening berths, and investing in new cranes and wharfs. These investments are necessary to meet the growing demand for

¹⁹Interview with Jennifer Riddle, Tidewater Barge Lines. March 31, 2015; estimates by ECONorthwest.

²⁰Interview with Tony Flagg, United Grain Corporation, March 16, 2015.

²¹Interview with Amer Badawi, Columbia Grain, March 9, 2015; Interview with Patrick Bryan, Pacifcor LLC, February 25, 2015; ADM. "Marubeni and ADM bolster export joint venture in the U.S. Pacific Northwest." *Longshore Shipping News*. October 1, 2014. <http://www.longshoreshippingnews.com/2014/10/adm-marubeni-announce-changes-in-northwest-grain/>.

²²Interview with Neil Maunu, Kinder Morgan Bulk Terminal. March 10, 2015.

²³Interview with Tim Mahoney, International Raw Materials. March 11, 2015; International Raw Materials LTD. <http://www.irmteam.com/our-company/>;

²⁴Culverwell, W. 2012. "Louis Dreyfus plans \$21 M update to Rose Quarter grain elevator." *The Portland Business Journal*. December 27.

²⁵Interview with Alan Sprott, Vigor Industrial, March 19, 2015. Vigor Industrial. "The Vigorous: investing in the future," "Country's largest floating drydock coming to Portland." vigorindustrial.com/vigorous/; Graves, M. 2014. "North America's largest drydock floats first ship at Swan Island's Vigor Industrial." *The Oregonian*. November 23. http://blog.oregonlive.com/business_impact/print.html?entry=/2014/11/north_americas_largest_drydock_1.html.

²⁶Interview with Phil Healy, Port of Portland. February 17, 2015; Linstrom, A. 2012. "South Rivergate Rail Yard Expansion boosts flow of export." *PortDispatch*. Port of Portland. August, 7. <http://www.portofportland.com/publications/PortDispatch/post/South-Rivergate-Rail-Yard-Expansion-Boosts-Flow-of-Exports.asp>

transportation services from expanded terminals that service larger ships with deeper berths that use the added depth in the shipping channel.²⁶

Canpotex – Portland Bulk Terminal

Canpotex is investing \$140 million in new facilities and equipment to increase the efficiency of their potash shiploading facility. The investment includes a new shiploader, improved operations and management capabilities, and an upgraded conveyance system. The increased efficiency will shorten turnaround times for Canpotex trains and ships at their Portland terminal.²⁷

Shaver Transportation Company

Shaver Transportation Company has been on a steady program of upgrade and construction since the channel deepening. The company responded to the increased demands from larger vessels with a repowering and new construction program kicked off in 2011. Shaver invested \$9.5 million in a new tug, the SUMMER S, which is being fabricated in Portland at Diversified Marine. They also invested \$4.9 million in new engines and repowering some of their existing tugs. They also invested \$7 million in two new grain barges, the first new grain barges on the Columbia River since 2011.²⁸

Pembina

Pembina proposes building a \$500 million propane export terminal. The City of Portland's Planning and Sustainability Commission recently voted to amend a zoning code to allow the terminal to be built. The



By Sarah McD from Portland, OR, USA (Tidewater Barge - Columbia River) [CC BY 2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons

proposal now goes to the Portland City Council for a vote. If the Council approves the project, it may come online by 2018.²⁹

CONCLUSION

According to terminal operators, if not for the deepening of the Columbia River shipping channel to 43 feet, many of the investments listed in this report either would not have happened, or would not have happened at ports or terminals along the Columbia River. The deepening occurred at a time of increasing demand from Pacific Rim countries, especially China, for U.S. grain exports. Columbia River ports and terminals capitalized on this demand in large part because of the enhanced shipping capacity that the deepening offered. Operators

upgraded and expanded grain terminals. Transportation investments facilitated moving increasing amounts of Midwest grain to ports on the Columbia River—grain that otherwise would have moved down the Mississippi River to Gulf Coast ports. In addition to grain terminal and transportation infrastructure investments, terminal operators expanded or proposed new facilities for energy and bulk commodities.

Maintaining the shipping channel to 43 feet will help ensure the continued growth in cargo movement and related economic activity seen since the deepening. Firms made investments and built capacity assuming a level of commerce supported by a 43-foot shipping channel. A channel less than this depth would strand investments, reduce economic activity, and impact jobs.

²⁷Port of Portland. 2014. Press Release. "Canpotex to Invest at Port of Portland Terminal." October 8. <http://www.portofportland.com/NewsRelease>; Canpotex. Logistics. <http://www.canpotex.com/what-we-do/logistics>; Siemers, E. 2013. "Canpotex planning new potash storage facility at Port of Portland." *The Portland Business Journal*. February 20. <http://www.bizjournals.com/portland/news/2013/02/20/canpotex-planning-new-potash-storage.html?s=print>; George-Cosh, D. 2014. "Canpotex expanding Portland, Ore., marine terminal." *The Wall Street Journal*. October 8. <http://www.wsj.com/articles/canpotex-expanding-portland-ore-marine-terminal-1412796970>.

²⁸Interview with Rob Rich, Shaver Transportation Company, March 31, 2015.

²⁹Interview with Teresa Carr, Port of Portland, April 3, 2015; Holmstrom, C. 2015. "Propane pipeline one step closer to Portland." *KOIN6*. April 7. <http://koin.com/2015/04/07/pembina-propane-plan-draws-port-protesters/>.