would have moved through the Canal. Shifting production areas in Asia may also have an impact in the future as manufacturers look for cheaper labor in southeastern and southern Asia. Changes in production areas could lead to a shift in favor of U.S. East Coast ports (a container from Singapore to New York takes 23 days all-water via Suez and 30 days via a West Coast port and rail minibridge). Currently, however, the volume of containerized traffic passing through the Canal has continued to grow. It is apparent that competition among ports for containerized cargo will be increasingly fierce in the future, and the ultimate role of the Panama Canal in this trade remains dynamic.

Future Research

Further analysis of transportation costs could provide an indication of the sensitivity of alternative routings for containers, including the Asia to U.S. East Coast routing via the Panama Canal and via minibridge through West Coast ports. A series of cost curves can be developed based on a variety of assumptions regarding the degree of utilization of container ships, the provision of backhaul for the double-stack rail movement, various port costs and inventory costs for different valued commodities. These curves should help ascertain the level of sensitivity of routings for various commodities and foreign areas.

A recent paper by John L. Eyre, published in International Trade and Transport, April 1988, indicated a cost of 0.3 cents per ton-mile to operate a new 4,200 twenty-foot equivalent ECON container vessel, which compares to the cost of 0.5 cents for the 3,000 TEU containership, 1.0 cents for the 1,800 TEU containership and 4.0 cents for the conventional freighter. For rail, the double-stack express train costs 2.0 to 4.0 cents per ton-mile to operate compared to 4.0 to 15.0 cents or an average of 8.0 cents per ton-mile for conventional rail. For trucks, the jumbo super twin costs 3.0 to 6.0 cents per ton-mile to operate which is about 1/2 of that of a conventional long-haul truck movement.

NAVIGATION ON THE COLUMBIA-SNAKE RIVER SYSTEM

BY
PEGGY BIRD
Pacific Northwest Waterways Association

The Pacific Northwest Waterways Association (PNWA) is a 54-year old non-profit organization. The Association represents the interests of a broad base of members who are committed to the economic development of the region through the appropriate use of the region's natural resources. The association was formed by a group of farm interests and ports on the Columbia River. They wanted the plans for the Bonneville Dam that was about to be built to include a lock that would allow passage of grain barges.

PNWA's members include firms, organizations and public bodies in the states of Oregon, Idaho and Washington. Members range from ports to engineering firms, public and private utilities to grain growers, financial institutions to river pilots. They come from the Puget Sound, the coasts of Oregon and Washington, the dryland areas east of the Cascade Mountains, the major metropolitan areas

of Boise, Portland, and Seattle, and the Columbia River corridor.

The Columbia begins in the Canadian Rockies, 1,200 miles from the Pacific. It drains 219,000 square miles of the U.S. The navigation system consists of 365 miles of shallow draft waterway from Portland, Oregon/Vancouver, Washington upstream to Lewiston, Idaho (making Idaho a seaport state). The shallow draft system includes 139 miles of the Snake River. The deep draft portion, from the sea to Portland/Vancouver, is 100 miles.

The Columbia drops 2,650 feet from its headwaters to the Pacific. The river generates one-third of the entire hydro capacity of the United States. The river's volume is second only to the Missouri/Mississippi system.

The river was developed by the Federal government as a multiple use system--navigation, energy generation, flood control, irrigation, recreation, fish. At the height of development in the late 1950's and early 1960's, 10% of the national public works budget was being spent on the Columbia.

Throughout the entire drainage basin of the Columbia-Snake in the U.S., there are 102 dams built and maintained by the Bureau of Reclamation, the Corps of Engineers, private and public utilities and irrigation districts. On the navigation system, the dams are all owned and operated by the Corps of Engineers.

During the 1850's the gold rush spurred a steamboat boom. Steamboats brought grain to ocean going ships that sailed into the lower Columbia. A major bottleneck was the Cascade Falls rapids where all freight was portaged by rail around the falls. The first major navigation project on the Columbia was the Cascade Lock and Canal, built by the Corps of Engineers. It was completed in 1888 and cost $3.8 million.

As the Cascade Lock and Canal was completed, plans began for eliminating the last barrier to navigation to the interior of Oregon and Washington--Celilo Falls. With support from the region and the Corps, Congress approved the Dalles-Celilo Canal in 1905 and the canal was completed in 1915.

In 1913, new work at the mouth of the Columbia brought a depth of 36 feet over the entrance. In 1918, a navigation channel 30 feet deep and 300 feet wide from Portland to the sea was completed. By 1926, oceangoing cargo using the system had more than tripled. But larger vessels calling the lower Columbia meant that further improvements were needed. In 1933, the channel was deepened by five feet and widened by 200 feet. The bar was deepened in 1957 to allow ships to fully use the deeper channel.

In the 1930's, the Federal government began a program of dam building. The need for navigation, substantial hydro potential, the need for flood control and the national program to create work to offset the Great Depression all coincided to produce the drive to construct the series of dams that now control the river.

Bonneville, the first major Federal dam on the river, was constructed to create power as well as a slackwater pool that would reach 48 miles upriver to the

Dalles. But it was clear that the Snake River could not be navigated with larger loads and deeper draft craft.

Again, the ports, the Corps and business worked together through the Inland Waterways Association (PNWA's predecessor organization) to extend navigation. Those efforts resulted in passage of the "River and Harbor Act of 1945" authorizing McNary Dam on the Columbia and four dams on the Snake: Ice Harbor, Lower Monumental, Little Goose and Lower Granite.

The "River, Harbor and Flood Control act of 1950" authorized The Dalles and John Day dams. Finally, in 1975 slackwater navigation reached Lewiston, Idaho 465 miles from the sea. In the first two years, more cargo moved through the locks at the last dam than had been projected for the year 2000.

A 40-foot channel in the lower Columbia was dedicated in 1976 and a 50-foot bar was dedicated in 1984, completing the current system. These navigational improvements have helped make the Columbia/Snake River System one of the fastest growing waterways in the U.S.

Cargo is loaded on ships for Korea, Japan, China and our other Pacific Rim markets. To give you some idea of how important this trade is, over two-thirds of Washington state's grain is grown for export. And one of every five jobs in Portland depends directly on port activities. Soft white wheat, which is what we grow best, has been marketed to various potential customers in innovative ways. The Oregon and Washington growers, for example, took ovens and bakers and recipes to Japan to teach them to use our wheat. They, in fact, changed the diet of the Japanese.

In addition to grain, the area exports lumber, fruit, beef, wool and other bulks such as soda ash. It imports containers, petroleum, motorcycles, bauxite and cars. The Port of Portland is one of the largest car import ports in the country. One hundred autos a day cross the docks bound for 32 states. What makes it all possible are dams like Bonneville, The Dalles, Little Goose, Lower Granite. And what they make possible is barge traffic. The Columbia is the West Coast's only major navigable river. With 34 allied ports, it is the fastest growing inland system in the country. Total cargo on the system last year was 28 million tons. Most of that moves in international trade. But nearly 10 million tons move on the inland barge system.

Log rafts and lumber move on the system. In movements upriver, the Columbia/Snake is unique. It is the only system in the United States to successfully barge containers. Over 40,000 containers are barged to and from upriver ports each year. In fact, 30% of all container traffic on the river moves on barges.

No overview of the Columbia would be complete without mentioning Mt. St. Helens. Mt. St. Helens erupted in May 1980 sending mud and ash down the Cowlitz and Toutle Rivers and into the lower Columbia. Within a few hours of the eruption,dredges were scooping the mud and ash out of the channel. It only happened once. And we want to keep it that way.

The Corps is at work constructing a sediment retention structure on the mountain. It will keep the remaining sediment on the mountain and out of the river, avoiding the extra $10 million per year it has been costing the Corps to dredge the sediment out of the navigation channel. The sediment retention structure is yet another Japanese import. The concept has long been used there. They call them "sabo dams" and there are 23 on one river alone.

The Bonneville Lock, the oldest on the river, was originally built to accommodate ocean going ships. It was assumed that those ships would go as far as The Dalles. But it was not to be. The Lock is primarily used by barge tows, usually in a 4-5 barge configuration. The narrow lock at Bonneville forces the tow boat to break up the barge tow and lock through in two or three passes. This increases time and expense.

The Corps of Engineers is now replacing that bottleneck on the river with a new lock. It will be completed in 1993 and will cost about $200 million dollars.

At Ice Harbor there is a different problem. The gate on the lock is a lift gate, not the miter gates found on most of the other locks. The gate is not wearing well. The Corps has slowed down the speed with which the gate is raised and lowered and has limited recreational use of the locks to twice a day each way. In this way, they hope to reduce the strain on the gears and other pieces of machinery which is causing problems. The Corps is also trying to find out why the wear has occurred, and they are looking at how to deal with replacing worn machinery without totally disrupting commerce on the Snake. We also have some interesting navigation hazards on the river. The mid-Columbia has become the sailboard capital of the U.S., some say the world. In the summer with strong currents running west and winds blowing to the east, there are hundreds of "board heads" on the river everyday.

Now, technically, the board sailors are correct when they say that sail has precedence over powered tow boats. However, it has been pointed out to them that a barge tow takes about a quarter of a mile to stop. And the operator has a large blind spot which can be dangerous for the board sailor.

The Pacific Northwest has always been dependent on its natural resources and agricultural commodities. That has brought boom and bust cycles that have played havoc with the economy. The climate of deregulation in the railroad industry, airline industry and the trucking industry has resulted in the rail abandonments, shipping lines moving from port to port, and independent trucking companies springing up everywhere.

There has been some predatory pricing by the railroads on segments on the Columbia in order to drive barges off the river. Integrated transportation companies have been created that own truck, rail and barge and have the potential of eliminating the leverage many Pacific Northwest businesses have enjoyed with a competitive, multimodal transportation system. Planning is difficult, to say the least.

On the other hand, the region is now beginning to enjoy the fruits from completion of the Columbia/Snake River system. The Port of Lewiston, Idaho

shipped more cargo in its second year of operation after slackwater was achieved than had been projected for the end of the century.

At Kalama there is a computerized grain elevator where feed corn is loaded at breathtaking speed. The largest load of grain ever shipped on the river was shipped out of this facility. A ship drawing 42 feet moved out in a 40-foot channel. What made that possible is the new river level forecasting system now in place. It has been the plan for some time to eventually deepen the channel. However, because of the cost and the climate of fiscal constraint, better use of the existing resources have been achieved. The river level forecasting system gives ship captains accurate, to the hour, information on the river level.

PNWA is also working with the Corps and Coast Guard to establish new safe anchorages for ships waiting to take advantage of the system. We continue to pursue the concept of extending navigation to Northcentral Washington, on the Hanford reach of the Columbia, through an innovative barge lift system. Explorers once hoped that the Columbia would turn out to be the Northwest Passage. Now we know that it's the Northwest network to the world--and it works.

VESSEL OPERATIONS ON THE COLUMBIA RIVER

BY
PETER J. BRIX
Knappton Corporation

From an operation standpoint, the significant thing about the locks on the Columbia River is that most are 86 feet wide and 675 feet long. Bonneville Lock is 76 feet wide and 500 feet long. This requires breaking up tows at Bonneville, and doubles the number of lockages.

The tows on the shallow-draft portion of the Columbia River are very small compared to those on the Mississippi River. Tows of 10,000-12,000 tons of cargo in 4-5 barges are the most common. The standard locking configuration is two barges side by side and two barges long, and sometimes there is a fifth barge alongside the towboat.

The grain barges have capacities of 3,000-3,500 tons. There are also a number of other barges that are not standard. This causes inefficiencies, and the odd sized barges are being phased out.

The towboats on the Columbia range in size from 2,000 to 4,000 horsepower. These are more comparable to the types of towboats operating on the Upper Mississippi than the larger boats operating on the Lower Mississippi.

The boats have crews of four or five people. This is the result of the short river system and the relatively small number of barges in a tow. Since our barges are twice the size of those operating on the Mississippi, there is less breaking up and making up of barge tows.

The main commodities moving on the Columbia River are grain, oil, logs, other forest products such as pulp, paper and woodchips, and containers. As